Research Centre_
Prague College

Bulletin of the Prague College Research Centre

issue 2010/1

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Preface

The Prague College Research Centre (PCRC) was founded with the idea of developing interdisciplinary research crossing several fields and subject areas underlying the academic curricula at Prague College, its main purposes are:

- To promote a medium of participation and discussions by means of regular interdisciplinary workshops and seminars.
- To promote and to encourage the collaboration among different Schools and programs in the design and creation of multidisciplinary courses in the College.
- To provide a means of publishing research work for both students and staff as part of a quarterly academic bulletin and e-journal.
- To cooperate with other education institutions and organizations in the development of common projects of interest.

The Centre was developed from projects initiated by Stefano Cavagnetto in the context of his role as Head of the School of Business and the School of Computing, by Bruce Gahir, Principal Lecturer in the School of Business and Computing, and by Pascal Silondi, Director of Libat and Principal Lecturer in Interactive Media. Beginning in 2009 research in the following areas has been initiated:

1. Game theory and its application to economics, business, philosophy and international relations.
2. The history of programming languages and history of computers.
3. Experimental media (Prague College and the PCRC is an associate partner for Underground City XXI, an international interdisciplinary EU project).
4. The history of cryptology and the science of enciphering.
5. Art and mathematics: a profitable relationship in history-from classical geometry to fractals and topology.

By combining academic study with practical training the PCRC aims to create an environment where personal achievement goes hand-in-hand with social responsibility. Strategically, this offers students the chance to actively collaborate in several research areas with the support of faculty members and lecturers of the College.

Beginning in March 2010, a quarterly Bulletin will be published detailing progress in relevant research activities of lecturers and students. This bulletin forms an integral part of the PCRC and provides a medium whereby the research activities of the centre can be documented. Faculty members, Lecturers and students belonging to every School of the College are welcome to submit their work for publication. Deadlines for submission for next issues in 2010 are:

- 30/06/2010
- 28/09/2010
- 31/12/2010

To submit your work, please contact the project coordinator of the PCRC:
Venera Muftakhova <venera@praguecollege.cz>

Education and Culture DG

Culture Programme

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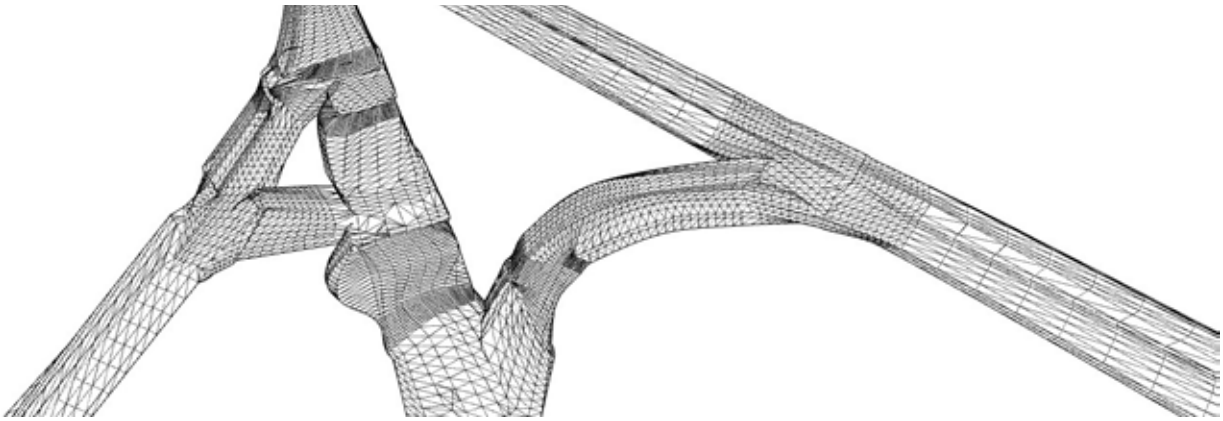
european cultural foundation

Part I:

Underground City Project
(EU Project)



The European Interdisciplinary Platform Underground City (XXI) originates from a long-term project "Underground City XXI". The aims of this project include the protection of an ex-coal mine in Labin and Rasa, in the Region of Istria, Croatia and and the conservation of its industrial and architectural heritage. This project was initiated in 1998 by the cultural and art association Labin Art Express (L.A.E.) and the Region of Istria. The goal of the project is the transformation of an ex-coal mine into a modern, underground town, with streets, bars, galleries, a swimming pool, shops, restaurants, children play-grounds, Museum of Coal Mining, and other components of a modern town including Government, Statute, Mayor, police, laws and regulations, following the historical tradition of the Republic of Labin in 1921. The main idea of the project was to provide an ample and true testimony of the nearly 400 year old tradition of mining, transforming an ex-coal mine's heritage into an avant-garde cultural and art project with a strong economic and social impact and potentially to become one of the leading Croatian cultural and tourist attractions, and a generator of future local/ regional development. Construction of the first underground town in the world in the 8th "horizon" (level) of the ex-coal mine (10 km long, app. 50.000 m2 of space, 160 meters below ground surface), would demonstrate how space exploitation can be treated as environmental preservation.

In the summer of 2007 the cultural & art association L.A.E.(Croatia) in cooperation with art association LIBAT (France), NOMAD theatre (Austria) and Prague College (Czech Republic), established the project "Interdisciplinary Internet Platform Underground City XXI (UC XXI)" – the creation of a virtual, 3D futuristic underground town and establishment of a specific European cultural and interdisciplinary community.

Internet platform UC XXI, a 3D multi-user environment shared and distributed on Internet, will consist of: an interactive tour through highly developed spatial/urban plans and experimental architectural models of fundamental city buildings including the Museum of Industry and Mining, a City Hall, an exhibition gallery, a movie theatre, a cultural centre, public spaces, public institutions and executive bodies (in the form of specific avatars). The Underground City community with citizens and residents, Statutes, regulations and laws, moral and ethical codes will form permanent communication and social networks. Mixed media art works and hybrid performances will be created by the residents and guests of the virtual underground town.

In 1993 Podlabin (Labin Downtown) pit was officially recognized as a national monument of culture. In September 1998 Cultural Centre "Lamparna" (future entrance of the "Underground City") was opened in one of the abandoned mine buildings. In December 1998 the Assembly of the Region of Istria proclaimed Underground City XXI "millennium regional project". In the year 2000 the Faculty of Mining, Geology and Oil in Zagreb provided technical expertise, which proved the technical feasibility of the project in the areas of security, ventilation, water and electricity supplies as well as lifts and other means of transport. The entire project development is divided into six different phases from conceptual work on the definition of the interdisciplinary platform to the dissemination of the project's eventual results.

Phase 1. Definition of the Interdisciplinary platform (artistic, social and technological)

The virtual community's statutes, regulations, moral and ethical codes, terms for citizenship, beneficiary's rights and obligations, technical and other requirements, as well as different tools, services and facilities to be offered on the platform, will be discussed internationally and interdisciplinary by inviting European artists, scientists, programmers, other experts and officials to propose the first model for the future platform. This will be accomplished with a regard to artistic, social,

political, legal, economical and technological issues. Available tools, technologies and already existing communities such as blaxxun, Second Life, or Active Worlds will be studied and evaluated to enable the definition of a strategy that meets the requirements of the UCXXI community relating to collaborative work, art production and implementation of mixed media content within interactive 3D real time environments on the Internet, in particular:

- Various tools will be presented relating to 3D modeling techniques as well as open source, gnu, or other well known software. These tools will be evaluated from the perspective of usability.
- Various languages and applications like VRML/X3D, Java, 3D games engines, OpenGL, DirectX, will be presented and evaluated for quality and network usability.
- Various communication technologies will be evaluated to meet the requirements of the UCXXI network, regarding interactivity, collaborative work and virtual Internet communities. Functionalities being explored include real time content manipulation, audio/video streaming, chatting and shared database management.

Phase 2. Definition of architectural and spatial/urban model of the future 3D environment

The basic virtual city infrastructure will be defined, synthesizing various already realized studies from the Faculty of Mining in Zagreb and using existing digital data provided by laser measurments of the coal mine provided by VIAS in Vienna. An interdisciplinary European expert team will be established to develop proposals for some spatial/urban units with streets, squares, parks, buildings, to design fundamental ' public' buildings like museums, theatres, City Hall, galleries, cultural centres, to propose and integrate various means of transport such as lifts, railways, cycle and walking tracks, as well as some other infrastructure, in preparation for the 3D model construction Phase.

Phase 3. Creation of the 3D Model

3D artists and programmers in a close relationship with architects and designers will create the first 3D model of the Underground City XXI based on the real dimensions and situation of the ex-coal mine, using advanced CAD techniques and the results of the previous mine studies and measuring. They will collaborate in experimentation and integration of architectural studies, installations and utopian architecture projects as well as in adaptation of gained proposals and ideas to be optimally integrated into the future 3D virtual environment.

Phase 4. Development and implementation of the real-time multi-user platform for delivery of shared interactive 3D content on the Internet

Programmers will directly collaborate with an expert team to enhance the potential of virtual 3D environments and provide an advanced multi-user server platform. A server for computer aided architectural design within real-time multi-user 3D platform will be provided, enabling users and community members to visualize and communicate their proposals. The UCC XXI platform will provide community communication tools such as chatting, forums, message boards and clubs as well as extensive multi-user functions with membership members and profile management and will integrate web 3D formats such as 3D, 2D, audio, video and streaming media. Regarding technology, UC XXI platform will utilize networked 3D rendering engines, with performance comparable to 3D game engines, which support character animation(avatars), which will enhance social experiences as well as web 3D content visualization. Programmers directly co-operating with expert groups and artists will integrate 3D models developed during Phase 3 into multi-user environment shared and distributed on the Internet.

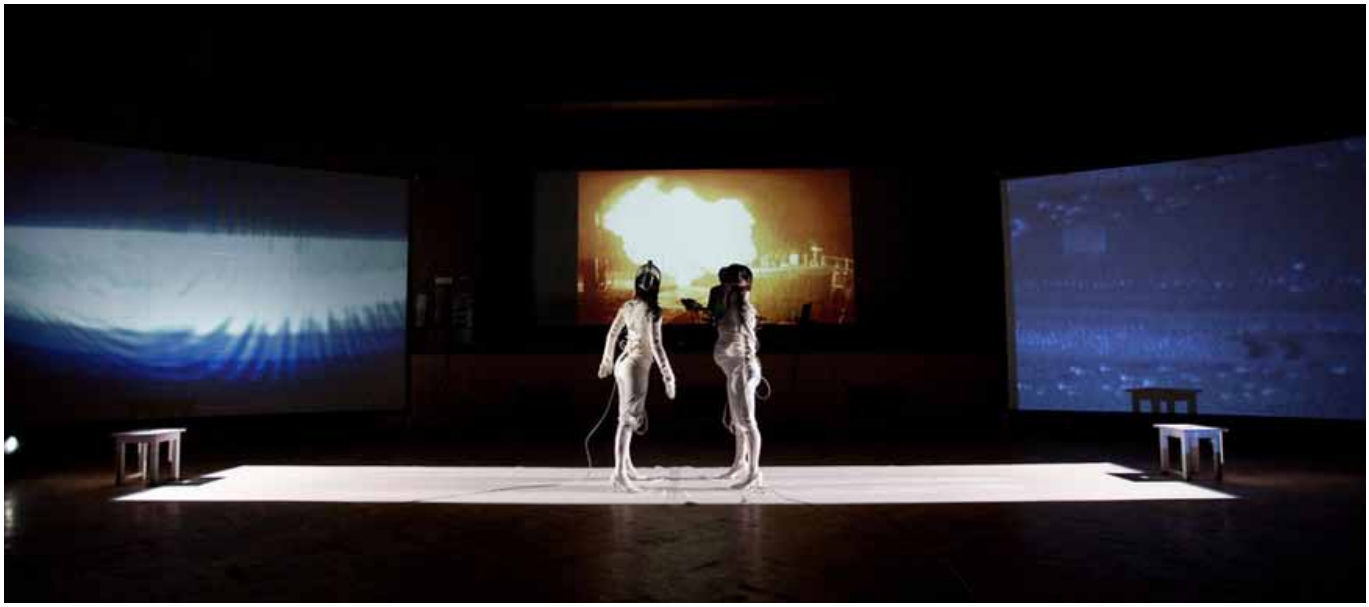
Phase 5. Dissemination (a): Creation and public presentation of mixed media art works and performances, in between real and virtual spaces

Artists will experiment and create mixed media works in sound, video, 3D volumes, 3D architecture, texts, images, 2D and 3D animations, for example, that will be implemented in the UCXXI platform, in order to stimulate and promote the artistic and cultural dimension of the project. Artists will thus also initiate inter-connection with other artistic forms, based on real-time experimentation with image processing, contemporary poetry, performance, contemporary music events, broadcasting of independent radio programs, robotic installations and other experimental media. This inter-connectivity will help to modify existing creative strategies and make the revolutionary step into the age of mixed reality.

Phase 6. Dissemination (b): Communication/Promotion

The communication strategy is based on the establishment of a trademark "Underground City XXI" and use of different promotional tools. The organisation of seminars, festivals, internationally announced conferences; website (such as www.undergroundcityxxi.com, www.artservis.org, www.artfactories.net, and other European cultural websites) and banners on some internationally popular websites, announcements and press releases for each project's activity in regional, national, and European printed and electronic media, production and public presentations of multimedia art works and performances, digital and printed brochures for UCXXI, flyers and posters, T-shirts, caps, stickers, badges and similar products with UC XXI logo. Endorsements from UCXXI supporters such as well known artists, musicians, actors, models, sportsmen and other popular public figures, and public presentations of the initial and finalized platform will take place in Zagreb, Prague, Venice, Ljubljana, Belgrade, Vienna, at new media/electronic art festivals and events in Europe as part of a public communication strategy.

Game Engine experimentation, Unity and the UC3D Platform



Multimedia Triangular propaganda, city festival of Lednica (Poland)

Introduction

In this report we discuss and outline some of the work that has been done during the development of Phase 1, the evaluation phase of the project. In this respect a careful investigation of several existing technologies relating to cyber worlds, collaborative experimentations and 2D/3D multimedia creation in mixed 3D multiuser environments shared on the internet was carried out. We did not exclusively work on one system but we tested, interconnected and evaluated different technologies that could be used to build the future UCXXI multi-layered Platform.

The first months of investigation were designed as a concrete continuous work session where artists, interdisciplinary researchers, IT experts and students were invited to present and exchange ideas about the UCXXI project. During this time participants investigated and worked collaboratively in order to build bridges between social network concepts, the art and technology.

The main aim was to customize specific technologies for artistic creation and interdisciplinary research, as to develop new collaborative and educational models, and to identify which software, hardware or programming languages could be used to create the multiuser 3D platform.

Special attention was devoted to the creation of 3D multimedia worlds which can be shared and distributed on the Internet, and to the realization of alternative interfaces to interact within the content of digital worlds using a range of sensors, motion tracking techniques and different programming languages.

Various systems (3D Rad[1], Unity3D, Unreal Tournament) and languages (Lite-C Atari, Virtual Reality Modeling Language) were explored. The first result of this research was the performance in the "Army House of Culture" in Legnica (PL) September 2009. The title of the performance was Multimedia Triangular Propaganda. A second important outcome of the research was the creation of the installation titled Underground Landscape which was presented in the Gamerz # 5 festival in Aix en Provence (FR) in December 2009[2].

The First Phase of experimentation resulted in organizing the first Workshop in Prague, in December 2009. Thus workshop proposed to all UCXXI participants a synthesis of the investigations carried out in the last trimester of 2009. An essential research session has been suggested to interconnect analogical and digital systems, and to discuss and test their capabilities and limits.

The principal aim of the workshop was to identify the needs and wishes of all participants correctly in order to identify the technologies which will be used for developing the Underground city XXI platform during the next phases.

The main aim of this report is to summarize in detail the activities which were done during this first phase. They can be outlined as follows:

1. Creation of Interactive 3D environments
1.1 3D modeling and animation for UCXXI
1.2 The VRML/X3D language and cyberspaces
2. Experimentations using 3D game engines
2.1 Advantages of Unity 3D
2.2 Experimentation with Unity 3D

1 http://www.3drad.com

2 See http://www.festival-gamerz.com/

Creation of Interactive 3D environments

This part deals with creation of 3D environments that might be useful for the final platform.

3D Modeling and animation for UCXXI.

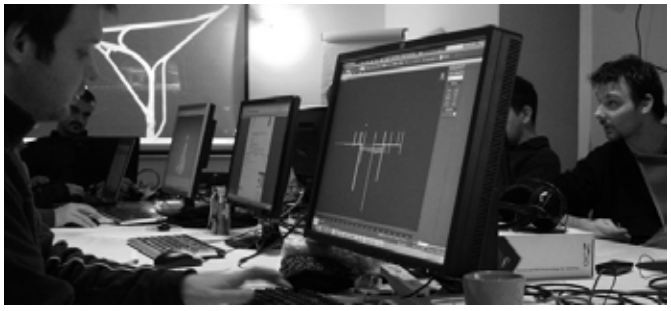
The architecture of 3D tunnels is based on the actual dimensions of the ex-coal mines located in Labin, Croatia, and was created using Laser measurement and data processing carried out by VIAS, Vienna Institute for Archaeological Science and Vienna University of Technology.

These initial 3D models were drafts and had to be rebuilt. This data was interesting as a reference and helped us to understand the complexity and organic nature of the mine. However it was not suitable to be a part of the future 3D environment without a serious reconstruction.

The first task was to properly rebuild the 3D volumes and surfaces. We refined and reconstructed the 3D meshes, welding the different shapes and their vertices, re-connecting edges, re-triangulating faces and optimizing the geometry. We tried to make the best artistic choices and not lose the precision of the Laser measurements and the organic nature of the mine.

The first part the "Labin entry" was reconstructed by Inge Schiller and Pascal Silondi and was used as the foundation of the "Underground Landscape" immersive installation (see 1.2 for more details).

Reconstructions of the 3D geometry as well as 3D models



Underground City XXI first Prague workshop

were necessary before they could be used in the 3D game engine. It was also an essential task for the next steps of the 3D environment creation to apply visual materials to geometry (2D graphics, videos), in order to create and to render light solutions and to prepare the physics, the dynamics and the animation principles of the future Cyber world.

```
#VRML V2.0 utf8

WorldInfo {info [ "Underground Landscape by P. and M. Silondi" ]}

DEF Camera10 Viewpoint {
  position -258.966 -4.22235 228.244
  orientation 0.0176876 0.999789 0.0104696 -1.06908
  fieldOfView 1.10752
  description "Camera10"
}
NavigationInfo {
    avatarSize [1, 1.6, 0.75]
    speed    1
}
DEF Tunnels_05 Transform {
  translation 0 0 0
  rotation 0 0 1 0
  scale 1 1 1
  children [
    Shape {
      appearance DEF MAT-tunnels Appearance {
          material Material {
              diffuseColor .35 .16 .12
              specularColor .21 .11 0
              ambientIntensity .0533
              shininess .05}

              texture DEF _T-t_05completemap ImageTexture {url "maps/t_0

              geometry DEF T_05-FACES IndexedFaceSet {
        creaseAngle 3.14
        solid FALSE
        coord DEF T_05-COORD Coordinate { point [
          135.904 -7.35477 92.0235,135.773 -6.1057 92.0929,135.664 -4.97
          135.789 -3.87303 92.3398,135.477 -2.09602 93.1516,135.336 -1.3
          135.164 -0.519989 94.3594,136.461 1.11327 94.3337,136.992 1.34
          137.484 1.56763 95.5884,138.883 1.84396 96.2509,140.234 1.8777
          141.086 1.87901 97.1061,142.898 1.38968 98.3652,143.898 0.8605
          144.414 0.582611 100.927,144.414 -1.13708 101.245,144.453 -2.6
          144.266 -4.41243 101.839,144.203 -6.57948 100.839,142.695 -7.6
          141.211 -7.66805 100.065,139.055 -7.68723 99.5144,136.32 -7.65
          134.617 -7.72644 98.4303,133.734 -7.77103 98.1891,135.383 -7.2
          135.219 -6.04189 94.948,135.125 -4.93307 94.844,135.109 -3.888
          134.992 -2.08437 95.1028,134.938 -1.32986 95.5005,134.797 -0.4
          135.904 1.00583 96.0363,136.594 1.24048 96.6355,137.086 1.4477
          138.438 1.75806 97.8575,139.742 1.80598 98.3481,140.648 1.8244
          142.406 1.34958 99.7594,143.430 0.838043 101.259,144.070 0.535
          144.078 -1.07704 102.424,144.109 -2.57005 103.016,144.063 -3.3
          143.969 -4.31355 103.034,143.803 -5.79512 99.355,143.013 -6.15
```

VRML/X3D language example

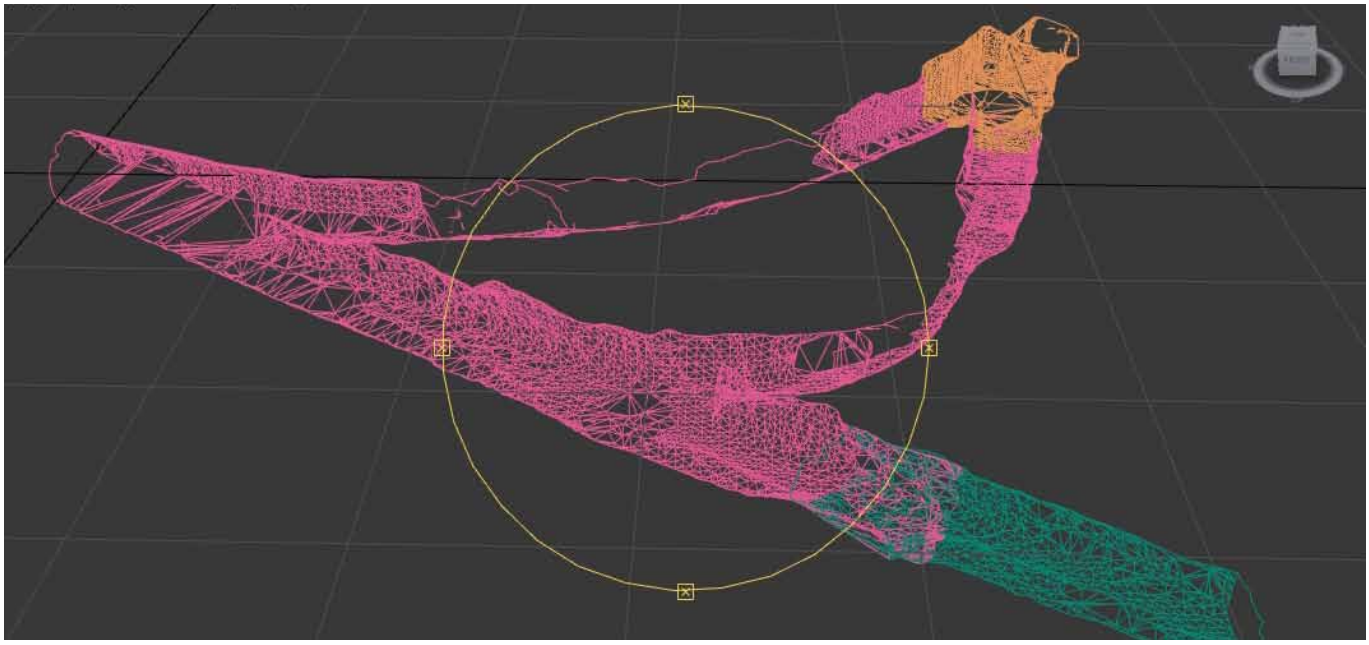
The VRML/X3D language, working with Virtual Reality Modeling Language and cyberspaces.

The VRML, Virtual Reality Modeling Language was first presented in 1994 during the World Wide Web Conference and is used to describe 3D scenes for the Internet or for stand alone applications. It is a text file format that defines the 3D geometry, (position, orientation, scale of the objects and XYZ coordinates of the vertices that compose the shapes), the appearance of the 3D objects, (colors, UVW mapped textures, transparency, and URLs of the textures be they static pictures or movies), the animation keys, the physical principles (collisions, gravity), hyperlinks, sounds, lights and cameras.

The VRML is not exactly a programming language, it is more a descriptive language. To program advanced functionalities, programmers will add to their VRML files, JAVA or JavaScript code. The 3D scenes can be created and described directly in text editors like those for HTML. However, most 3D modeling software can be used to create the 3D scenes and then to export it as a VRML file (.wrl). VRML/X3D files can be read using players such as are used for flash files or plug-ins integrated into web browsers.

Another choice was the BS Contact player developed by Bitmanagement[1]. This option allowed for advanced functionalities

1 See http://www.bitmanagement.com



Model under-reconstruction of the coal-mine

proposed by they visualization platform such as shaders, multi-texturing support, advanced Physics, flash playback, audio-video streaming integration and more, as put of the development platform.

VRML/X3D was the main technology used to develop and present "Underground Landscape". It was created by Pascal and Marie Silondi and it is an interactive audiovisual installation where users are immersed simultaneously in multiple 3D cyber underground worlds projected in parallel in a gallery prey to erosion. This is an enclosed and partitioned space in which the subject is immersed in sound dissonance as part of the contemporary digital exhibition.

The new twenty-first century miner equipped with hammers extended with motion sensors may initiate his descent into the abyss. There the miner can explore a network of multimedia tunnels lined of pixilated shadows, virtual characters glued to frantic loops, mechanical rhythms and over-cadenced sounds, all inspired by the past industrial revolution.

The Underground Landscape offers the user the chance to multiply his influence, an opportunity offered by the use of a computer network, to interact simultaneously with the contents of several interconnected cyber tunnels. It is a schizophrenic installation-system, an organism sensitive to stimuli that react, at times contradictory to their translation.

The Underground Landscape proposes a non-linear immersive and chaotic storytelling architecture that uses 3D gaming technologies (VRML/X3D, 3Drad) to integrate and manipulate videos, sounds or 3D objects, and to allow the "free" exploration of the virtual "triptyque" while multiplying viewpoints and interactive principles. The Underground Landscape is the first installation proposed by Libat as part of the platform Underground City XXI project. The architecture of 3D tunnels is based on the actual dimensions of the ex-coal mines located in Labin, Croatia, and was created using Laser measurement and data processing carried by VIAS, Vienna Institute for Archaeological Science and Vienna University of Technology.

The "Underground Landscape" 3D environment is based on the central part of the mine (the "Labin entry").The geometry was reconstructed and prepared by Pascal Silondi using 3D modeling software. The 3D meshes were unwrapped to create proper UV mapping coordinates for textures and to make possible the design

Electro-magnetical motion capture system (eGaLab)

of the objects' appearances. Thus the aesthetic ground was ready for the next step: the light mapping process.

The light solution was set up to create an abyssal immersive feeling and was rendered to texture and print the lights and shadows directly on the objects' surfaces optimizing the future display of the 3D space. Various 3D objects were integrated in the 3D tunnels with the ability to receive a moving image texture. Video streaming in real time was controlled by users the acceleration parameters were provided by controllers built from mining hammers. Sound nodes were also implanted in the 3D tunnels as "Audio clips/ samples" designing the sound scape to function as audio geography

in the Cyber space. Sound in 3D environments can be spacialized. It has a location, an orientation, intensity and fall off parameters that can be fixed, animated or manipulated by the users.

Hammers served as an interface to navigate in the 3D space, to interact with the 3D objects and to control the audio and video streaming. They were augmented by analogical sensors, such as accelerometers and gyroscopes. The analogical information generated by the sensors was converted into MIDI messages that were then sent to the 6 computers that compose the installation network and control the 3 parallel cyber spaces: the video manipulation and streaming, the sound manipulation, and the video tracking.

The VRML/X3D is a polyvalent format. It is very flexible and adaptable for installations, performances or internet purposes. If it is possible to prepare objects and spaces visually using 3D modeling software and to export worlds to VRML, the next steps will be to work fully in the code in order to finalize the scene and to program the interactive principles of the 3D environment. There is not yet an advanced enough graphical editor that can help with the final stage, therefore the creation process of those VRML environments stays remains an area reserved for specialists. That is one of the main reasons why we chose to test other technologies like 3Drad, Unity3D, Unreal Tournament, Lite-C Atari. These are all interesting 3D game engines in that they utilize graphical game editors that help to assemble the 3D scenes in order to design and to program the interactive principles.

Experimentations using 3D Game Engines for the UCXXI platform

Advantages of Unity 3D

As mentioned before we tested different existing technologies and tools, 3D engines and editors, e.g. Unreal Tournament, Lite-C Atari, and Unity3D[1]; Unity3D most closely met our artistic and pedagogical needs and can be used to develop the UCXXI 3D multiuser environment that will be shared and distributed on the Internet.

Unity3D is multi platform compatible. It is possible to compile for PC, MAC, IPhones, IPod and Wii, and should be available for Linux, Xbox, PlayStation and androids in the next versions.

Unity3D is compatible with most of the 2D/3D editing tools and most of the web2D/3D media and file formats present on the Internet. It is possible to import 3D scenes and objects including textures and animations from most of the 3D modeling tools, not only professional software like 3Dsmax or Maya but also open source like Blender. This accomplished through the use of the FBX format. The creation process of the 3D scene will be pretty much the same as the one used for the creation of VRML worlds.

The Game Editor in our investigation is an advanced visual tool used to set up the 3D environment properties and assemble the different assets that can be used in the Cyber world, (3D space composition, real-time lightning, texturing, FX). It allows us to use and program game principles in the Underground City platform. It must be noticed that such a tool is definitively missing for the creation of VRML/X3D environments and in this case most of the work was done mainly by coding in a text editor. Thus Unity, in its full functionality, represents a great advantage in the construction of the final work.

Unity3D is optimized for both DirectX and OpenGL graphics. We can create and use animated 3D objects that can be avatars, digital organisms, artificial life forms etc. Artificial intelligence principles, physics realized using the Ageia PhysX™Physics Engine, particle systems, advanced lighting and shadows are implemented as well. This allow for not only a great visual quality, but alsp a really dynamic 3D environment that is constantly changing. This represents an element missing from all existing on-line 3D multi-user environments as Second life.

In terms of programmability, Unity supports three scripting languages: JavaScript, C#, and a dialect of Python called Boo; all three are equally fast and compatible. All three can use the underlying.NET libraries which support databases, regular expressions, XML, file access and networking[2].

Photo of real coal mine

Such support can be useful in the implementation into the platform of advanced functionalities for the multi-user 3D walkthrough. Examples of such functionalities include chat, collaborative object manipulation tools, and advanced shared events. Thus, development could include artificial intelligence principles, avatars' gallery, audio-video endless streaming, 2D web content access, interactive html/flash, inputs like physical devices, digital messaging and media , for instance.

1 See http://unity3d.com

2 Idem.

Real coal mine's wall texture

Experimentation within Unity 3D (modeling and animation)

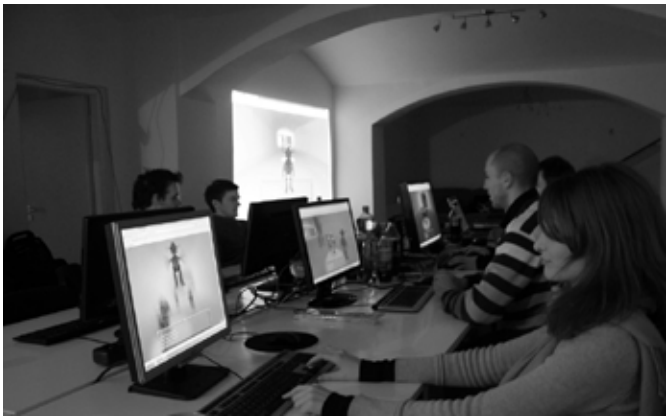
The first step was to identify how to create, model and prepare the 3D objects and then how to import them into the Unity Game Editor. The workflow has been established and the techniques and principles which were used to set up the VRML scenes are similar for Unity.

The geometry was well reconstructed to be recognized and used for physicsal properties and interactions (collision, mass, etc). The 3D meshes have to be unwrapped to create the proper UV mapping coordinates that will be used for the Diffuse, bump textures (main appearance) and the Light maps. Unity is only able to import two independent UV map channels, but this is enough to create the materials needed. It is important to maintain precision in terms of the units (1 unit =1 meter) when preparing a 3D scene in a 3D modeling software.

For example, we can create and import animations and then set up the animation cycles such as walk/run/jump. We imported the models of the 3D tunnels used for "Underground Landscape" in the Unity editor and used them as the test scene for our experimentations. First we created a 3D walkthrough, as a first or third person view and we added step by step new functionalities and new graphical qualities. Futher, we made tests using some realistic textures extracted from the real coal mine photos. Finally, we set up different visual atmospheres, and we experimented with the physical principles of the engine. Properties such as gravity, collisions to control other objects, sound playback on collision detection and other functionalities were explored.

Two students of the school of IT and Computing, Marko Puskaric and Rajmond Berisha, created a way of transforming the 3D tunnels into online multiuser environment using Unity server classes. The resulting work was a double version of the environment; in both versions a chat successfully implemented. The first version might be integrated in a web browser with the limitation that plugins are not supported, while the second one with more advanced functionalities may be compiled as a standalone application, and can be downloaded from the Web.

An important requirement for us was the possibility to display videos and sounds into the Cyber world. We would like to use videos as textures mapped on 3D volumes to compose or present artworks,



Experimenting with multi-user aspects

Video integration and realistic 3D tunnels in Unity 3D

archives or learning materials and to place sound sources in the 3D geography. We imported and successfully used video samples that were applied to the surfaces of the landscape. The videos can be exported as.avi,.mov or.mpg but they are finally converted into .ogg format when imported into the Editor. The videos can be imported, compressed, and looped directly in the editor. When they are used in the 3D scene, they are compiled with the other assets and stored in the final package. The videos and sounds can be also linked to a URL stream. In that case the stream must be an .ogg file and it is not stored in the original package but it is stored on a server. A serious issue is that endless video streaming types are not supported natively. If we can use a webcam as source, for example, we cannot at the moment, stream from a live camera to the Internet and use that live audiovisual stream in the 3D space. One of the important plug-ins we will have to develop during the next phases of the project which must enable endless audiovideo streaming, allowing for example , live audio visual performances, concerts, discussions, lectures, and presentations between users directly inside Cyberspace and connected from their respective countries.

We investigated and found possible ways how to interact collaboratively with the objects and scene parameters. Two plug-ins were partly used to connect Wiiremote and MIDI sensors to the 3D environment and to manipulate the scene content. We were then able to manipulate the 3D objects, to sculpt the mesh, pushing/pulling vertices and painting volumes on the fly. We created or tested different graphical user interfaces (GUI) to prepare the future menus that could be created and proposed to the user to interact within the UCXXI environment. We developed some "radar systems" and layers to recognize the position of the other users and special objects present in the scene, and we created some triggers and buttons to control some of the animations' parameters. We also created or adapted the first scripts to be able to write, to draw and paint directly on the object surfaces and are currently in discussion regarding improvement of those functionalities next months.

A major point of interest is to integrate html, desktop and Flash as textures in the 3D environment with full interactive functionalities. That would not only enable web navigation principles, but also make possible the creation and the use of advanced white boards and collaborative writing tools directly accessible into the 3D environment. This feature was already implemented in VRML and Second Life. It remains for us to find a way how to implement it in Unity3D. Thus, the bridge between web content and 3D environments could become the key functionality to be implemented in the proposition of new models for cyberspaces.

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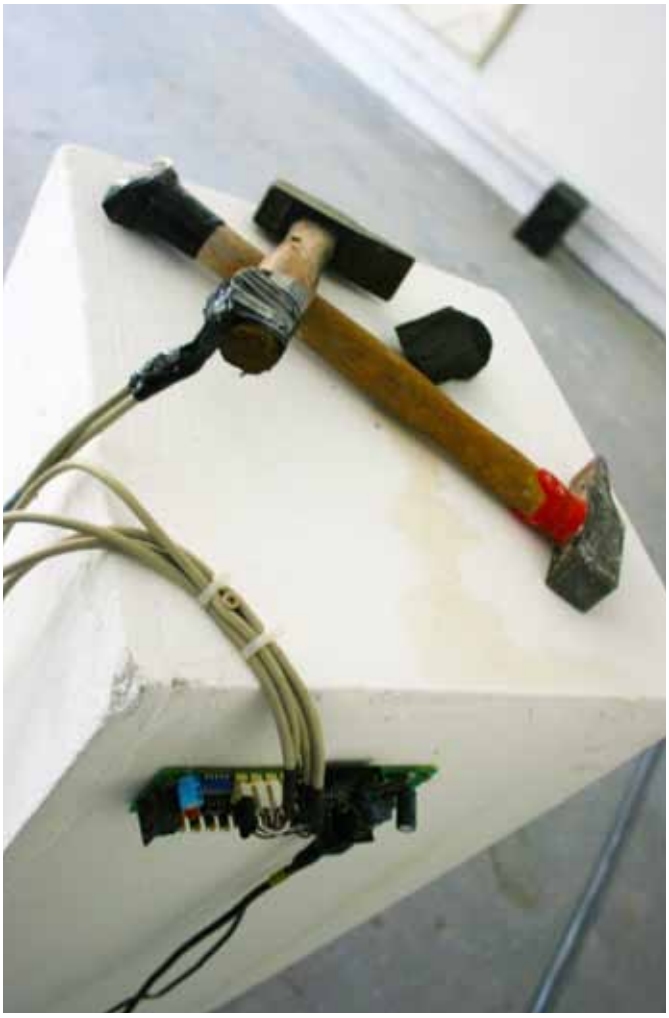


User interface for Underground landscape

Underground landscape

The Conception of the Self in Multiple Cyber Worlds

Introduction

Questions relating to multiple selves and personal identity in multiple cyber worlds are a complex subject. It raises many difficult philosophical interrogatives. We call these questions, questions of the first type. What is a Person? Is it identical to my body? Is it my soul? How can there be continuity in time, and yet, a consistent identity? Is Personal Identity uniform? Moreover, how can we even know?

These questions become even more challenging and interesting when we consider multiple worlds, outside of our world. In particular, once a clear approach to personal identity has been defined, what happens to identity when we consider many coexisting worlds at the same time? Does the approach remain consistent and are its consequences still acceptable? When questions of the first type are considered in a multiple worlds, we call them questions of the second type.

In this introductory paper we will investigate the concept of the self and its relation to personal identity in multiple cyber worlds. This investigation has its own justification the fact that several questions concerning personal identity are answered by constructing examples of thought experiments involving fictional worlds. Thus it seems legitimate to us to discuss the problem in the framework of concrete alternative worlds which we call cyber worlds. At the moment we consider just question of the first type. Section 2 deals with a brief history of the problem of personal identity in philosophy and introduces the concept of the self . In Section 3 we introduce important conceptual frameworks that illustrate the idea of the self as composed of information in multiple cyber worlds and as a result pose some important questions to be investigated further, we finally conclude with section 4 and we consider how some concepts from anthropology may be applied to the study of the Cyberspace. Some authors tend to confuse, or overlap the concept of virtual communities or reality with the concept of Cyberspace because this is a rather vague concept. In this paper we consider virtual communities and virtual reality in a broader sense just one portion of the Cyberspace. Nevertheless at the moment we are not going to try to answer fundamental ontological questions such as: what' s a Cyberspace? Is it or does it have a dimension? We assume that there exists a Cyberspace, a sort of electromagnetic space, where a virtual interaction might be created.

Some classical theories

A tree and rock, may be distinguished from one another in terms of their different properties. We might then go further and insist that this also forms the basis for ascribing individuality to them. This forms the basis of the so-called ' bundle' view of individuality, according to which an individual is nothing but a bundle or properties. We could formulate this as follows:

$$I(O_1) = (p_{1,\ldots\ldots\ldots\ldots,}p_n),$$

Where the identity of an object O_1 is denoted by $I(O1)$ and it is given by the list of properties $p_1 \ldots p_n$: which are the properties that individuate this object. On this view, no two individuals can be absolutely indistinguishable, or indiscernible, in the sense of possessing exactly the same set of properties. This last claim has been expressed as the Principle of Identity of Indiscernibles[1].

A more thorough-going criticism of this property-based approach to individuality insists that it conflates epistemological issues concerning how we distinguish objects, with ontological issues concerning the metaphysical basis of individuality. Thus, it is argued, to talk of distinguishability requires at least two objects. Yet, we can imagine a universe in which there exists only one. In such a situation, it is claimed, it would be inappropriate to say that the object is distinguishable but not that it is an individual. Although we do not actually find ourselves in such situations, of course, it is still insisted, distinguishability and individuality should be kept conceptually distinct.

If this line of argument is accepted, then the principle of individuality must be sought in something over and above the properties of an object. One candidate for such a representation of substance, in which properties are taken to inhere in some way, was put forth by the English philosopher John Locke (1632 – 1704), one of the great pioneers in this area of research in the modern ages. In his fundamental work "An Essay Concerning Human Understanding" Locke[2] claims that personal identity is founded on consciousness, and not on the substance of either the body or the soul. We are the same person in the sense of continuous consciousness between past and present in our thoughts and memories. Thus personal identity is fundamentally based on the repeated act of consciousness. In this respect personal identity is the identity of consciousness and

1 Leibniz, W. J. 1969, "Discourse on Metaphysics", Section 9, Loemker.

2 Locke, J. 1689, An Essay on Human Understanding, online version at <http://enlightenment.supersaturated.com/johnlocke/>

not the identity of some substance. The body may change, but the person remains the same, argues Locke.

We can also draw a distinction between two sorts of question about identity. First, we can ask what makes it true that an individual that we encounter at one time is the same individual that we have encountered at some earlier time. This is a metaphysical question – a question about being. It can be distinguished from a second question: how can we tell that an item encountered at one time is the same individual as that encountered at another? This is an epistemological question – a question about knowing.

The difference between the epistemological and the metaphysical question needs to be kept in mind. What "criterion" we can use to tell the difference between one thing and another is an epistemological consideration; a metaphysical consideration is one that determines whether one item is identical with another. The problem of identity over time is first and foremost a problem about change. How much can an individual change and yet remain the same individual? Are there particular kinds of change that an individual cannot undergo without ceasing to exist as the same individual? Certainly there are innocuous changes and everyday changes that individual items undergo without any threat to their identity. You can repaint your chair, yet the chair remains the same chair.

There are limits, however: there are changes that you could make to your chair that would mean that the chair no longer existed. If you were to dismantle the chair and use the pieces to make a sled, we could not say that the sledge was the same thing as the chair. But suppose that you dismantle the chair and immediately put the pieces back together in exactly the same way. In this case, many people would say that you have the same chair. But this raises some puzzles. Did the chair still exist while it was dismantled? Or did it go out of existence for a time, and then come back into existence? In the next section the areas that have been discussed will be examined further in relation to the idea of "identity" in MUD's.

Self and Cyberspace

Gilbert Ryle[1] in "The Concept of Mind" provided a description of René Descartes' Mind-Body Dualism, where a categorical (ontological) distinction between mental activity and physical activity is presented which introduced the expression "the doctrine of the ghost in the machine". Personal identity is conceived with a psycho-logistic conception based on the doctrine of the Ghost in the Machine, and with a materialistic characteristic. In this "Cartesian Theater", using terminology developed by Daniel Dennett[2], the Self is not attached to the physical body, but rather is comprised of a collection of mental states. This vision of personal identity has a deep relationship with contemporary information theories. We may here look to Daniel Dennett's "Multiple Drafts Model of Consciousness" which is a theory of consciousness based upon cognitivism and views the mind in terms of information processing.

According to this model, there are a variety of sensory inputs from a given event and also a variety of interpretations of these inputs. The sensory inputs arrive in the brain and are interpreted at different times, so a given event can give rise to a succession of discriminations, constituting the equivalent of multiple drafts of a story. Each discrimination, as soon as is accomplished, becomes available for eliciting a behavior; it does not have to wait to be presented in the theatre. In the next section we will look to this conceptual model for an explanation of the evolution of the real self when it interacts with the virtual environment.

To paraphrase Norbert Weiner[3], the father of cybernetics, we may say that a person is something which can be sent in a telegraph. This indicates that the self can be considered as a body of information. The main point is that if a person is consists of nothing more than thoughts and memories, in other words, is composed of information then this information can be reduced to a collection of bits. "The conception of Self as a body of information is realized in a rather interesting fashion in life on-line, for example, Second Life. In the process of constructing an identity on the internet, (homepage, nickname, and behaviour-text-based information) a person runs more and more of his/her life on-line, so that the manner in which he/she presents him/herself on-line constitutes a more central component of his/her identity"[4]. We also might go further with our analogy of thoughts and memories to bits and say that people are simply programs, and that these programs act not only in the real world but also in virtual worlds, and in general, in cyberspace.

Figure 1 below is one way such a representation can be viewed. Let the "real" world be symbolized by W, this is the world where the individual exists and performs the daily duties concerning survival. The self in this world can therefore be symbolized by S(w) and according to what has been discussed above we could say that S(w) is composed of information from the real world, W. This can be partly formalized as:

$$S(w) = I_{r1,} I_{r2,} \dots \dots, I_{rn}$$

1 Ryle, G.1949, "The Concept of Mind", London Hutchinson and Company

2 Dennett, D.C. 1991, "Consciousness Explained", Back Bay Books.

3 Weiner, N. 1954, "The Human Use of Human Beings", Erving Goffman in "The Presentation of Self in Electronic Life", Goffman on the Internet/e-mail and the world wide web (1995).

4 Shay, R. 2006. http://total.eclipse.co.il/2006/10/01/personal-identity-in-the-information-age-dotperson-dotcommunity/

Now, in the cyber world C_1 the "self" can be $S(C_1)$. The process of composition of this "new self" in the cyber world may utilize part of the information content I_{rx} from the real world W. Via such an interaction with the cyber world C_1, a "new self" $S(C_1)$ is created, composed of specific information from the cyber world C_1 and the real world W.

$$S(C_1) = I_{c11}, I_{c12}, \dots, \boldsymbol{I_{rx}} \dots, I_{rc1n}$$

An important point to note here is that $S(C_1)$ is a relation of S (W), we could represent this as follows:

$$S(C_1) = \boldsymbol{R}(S(W))$$

"R" takes on the role of a "psychological continuous" relation to be detailed later on. For example, part of what characterizes the self in the real world, labeled here as S(W), could be represented by certain information content that the individual has experienced in the real world, such as being a generous person in general and in particular under certain circumstances being generous for self interested reasons. Experience related to this particular virtuous character could be symbolized by I_{rx}. When this individual interacts with the cyber world, C_1, under a different character, I_{rx} is utilized to one's advantage with experiences encountered in the cyber world C_1, and as a result of this interaction a new "self" $S(C_1)$ is formed in this Cyber World. Therefore, a relationship between the real world is and the cyber world formed by such an interaction. We could assume that there are two series of thoughts governed by their respective information content, and that they are both mine, one in the cyber world and the other in the real world. Although these thought processes take place in distinct spatio-temporal locations one could consider the feedback and the formation of the "new self" $S(C_1)$ associated with the formation of memories, with information content relating to events in the cyber world and the real world.

Here we can look to Taylor[5] who discusses how social life is created online and how attendant communication occurs, in particular, he says that avatars are particularly powerful artifacts to consider. Avatars prove to be the material out of which relationships and interactions are embodied: much as in offline life with its corporeal bodies, digital bodies are used in a variety of ways- to greet, to play, to signal group affiliation, to convey opinion or feelings, and to create closeness. At a very basic level, Taylor says that bodies root us and make us present to ourselves and to others. Avatars form one of the central points at which users intersect with technological objects and embody themselves, making the virtual environment and the variety of phenomenon it fosters real.

In the above example the notion of presence in virtual worlds is invoked to relate information content Irx from my real self to the "creation" of the virtual self in the cyber world (see Fig. 1). Taylor continues to say that "presence" is one of the most elusive and evocative aspects of virtual systems- and yet it forms the very foundation on which immersion is built. It goes to the heart of what feels "real" and creates the quality of experience that signals to us "I am here". There is ample evidence to indicate (for example Warburton[6]) that users do not simply roam through the space as "mind", but find themselves grounded in the practice of the body and the world. This grounding of presence in the virtual world not only consists of embodied practice, but of embodied social practice. The bodies themselves thus act as agents of engagement and in the virtual world users have learned to delegate their agency to body-representatives of other individuals.

The feedback to the real self could be formed of memories due to a combination of experiences and social interactions with characters in the cyber world. One could consider this as two sets of memories or information content in one mind: one of them being due to my experiences in the real world, and the other belonging to the character in the cyber world. There is evidence that this feedback to the real self can be strong. Taylor discusses the case of "Meg" where the level of immersion into the virtual world had created a strong dependency and a connection with the real self, her digital body had come to be tied to her identity. Taylor also discovered that this was the case with most users. There are several questions that arise concerning identity of the self in virtual worlds in relation to what we have just discussed and elaborated upon in the previous section. For example, how is the identity of the real person related to their identity in the virtual world? What does the relation "R" that we have invoked consist of?

We may here look to Bernard Williams[7] who presents similar arguments in relation to several puzzles about divided minds in the arena of personal identity. Williams presents arguments that cast doubt on the widely held view that people are essentially minds, or that mental or psychological considerations are decisive in issues of personal identity. He suggests that bodily continuity plays a critical role in establishing who the person is.

Williams begins by proposing that a memory belief will count as a genuine memory of an event only if that memory belief has been caused by that event; he also suggests that it may be important that the causal chain linking the event to the memory belief should not run outside the person's body. The question how can we distinguish between apparent and genuine memories is an old one, and has generated literature of its own. So, if I were to originate an avatar in Second Life and experience certain situations as my avatar then Williams would say that these memories are not "memory beliefs" as the causal link runs outside my body. However, as discussed earlier, if there is relational feedback of experiences from the virtual world to the real world we could say that such memories could be memory beliefs of the type Williams is indicating. How do these memory beliefs relate to my being psychologically continuous with my avatar?

5 Taylor, T.L. 2002, "Living Digitally: Embodiment in Virtual Worlds", Springer-Verlag.

6 Warburton, S. 2006, http://warburton.typepad.com/about.html.

7 Williams, B.1973, "The problems of the Self", Philosophical papers 1956-1972, CUP, pp. 46 - 63.

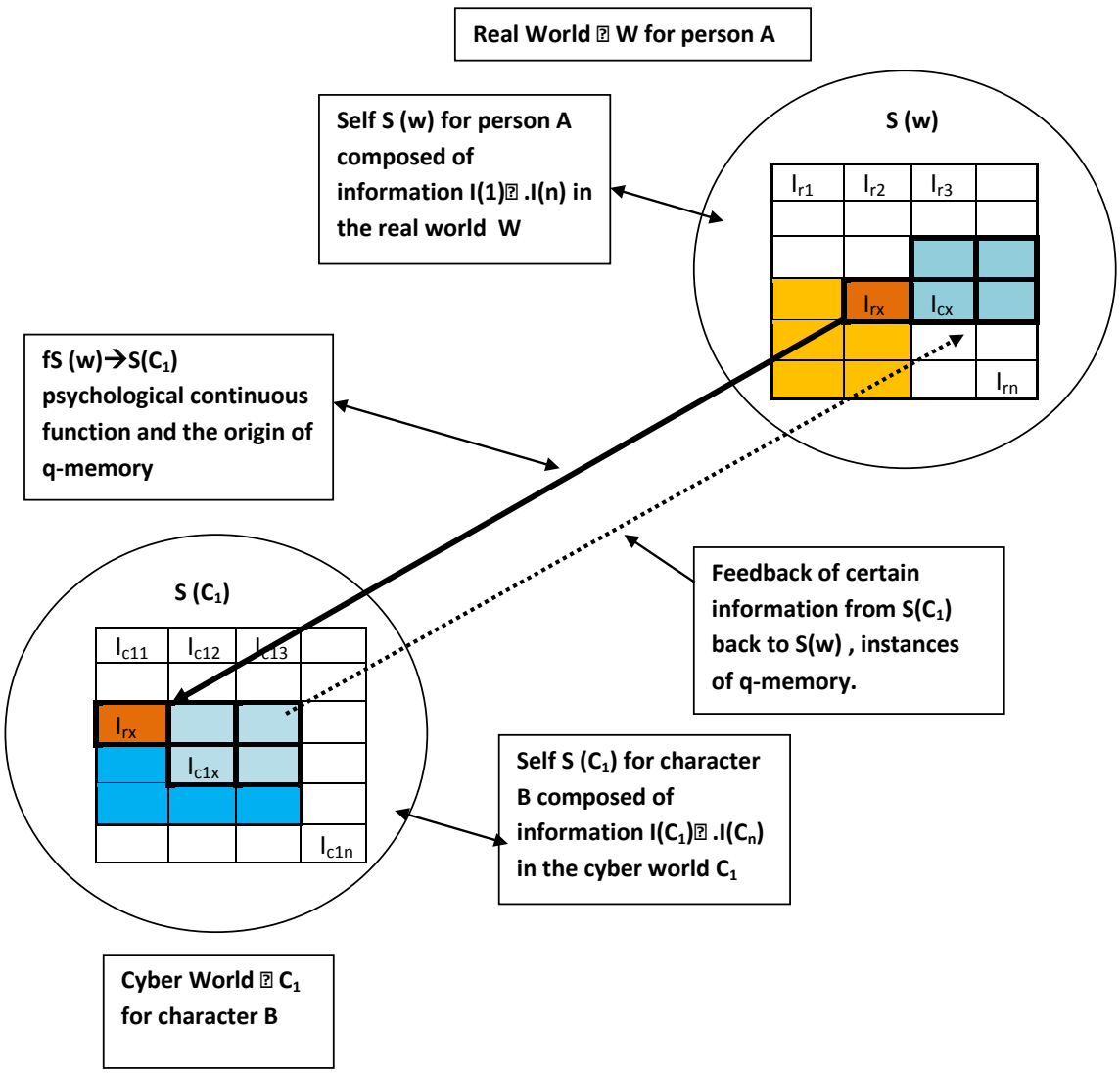
Parfit[8] in his book "Reasons and Persons" insists that there is a gradual unfolding and development of a particular psychology1. With reference to Fig 1, consider what it means to say that B's psychological states are continuous with those of A? According to Parfit we could say that a set of psychological states S1 can be described as continuous with a later set of psychological states S2 if S2 is "developed" from S1, either directly or through a series of intervening steps. Such a development process could be described by our "psychological continuous" relation. Although this process of development may involve change, any changes must be gradual. There are ways in which it is natural or appropriate for a line of psychological states to develop; for example, my belief that a friend is in danger naturally gives rise to a feeling of anxiety and a desire to help. In this sense, a continuous line of psychological states will develop in a way that is both gradual and natural.

Why does Parfit suppose that it is psychological continuity that we care about, and not bodily continuity? He seems to be assuming that the pattern of our lives depends to a much greater extent on our psychological features than our physical qualities. Parfit introduces the idea of q- memory to get around the problem that continuity of memory presupposes identity. He presents a clear definition of q-remembering in his paper and bases psychological continuity on the notion of q-relations. The basic notion underlying q-relations, such as q-memory and q-intentions, is that they do not presuppose identity of the person. Paraphrasing Parfit' s definition of one such q- relation, q-memory must consist in: (1) a relation with a past experience that seems like a memory, (2) the actual happening of such a past experience to some person, and (3) the acquisition of the relation with the past experience in the normal fashion in which memories are acquired.

Thus, q-relations are a subset of relations (i.e., all memories, both real and apparent, are q- memories) and they avoid the problem of circularity, by not presupposing the identity of the one bearing a memory. Parfit bases psychological continuity on the continuity of q-relations, such as q- memory, q-intentions and q-anticipation, rather than on a one-to-one relation of psychological connectedness, of real memories, as does the memory theory of

8 Parfit, D. 1984, "Reasons and Persons", Oxford University Press.

Figure 1: Representation of Real World Selves and their Interaction with the Cyber Worlds



personal identity. Utilizing Parfit's idea we can develop our model and provide some substance to the relation "R", the "psychological continuous" relation mentioned earlier. "R" can be related to the idea of q-memory, such a relation will therefore be a relational mapping between S(W) and S(C) as shown in Fig. 1. "R" would thus be invoked whenever an individual forms an avatar and interacts in the virtual world.

We can extend this model and consider the interaction of several cyber worlds C_1, C_2,... this is shown below in Figure 2 below .

Considering the interaction of several such multiple cyber worlds where multiple cyber world selves are composed. Several questions arise: How are these "layers of information" formed when the individual experiences these different cyber worlds? Do selves in different cyber worlds have the same kind of moral responsibility as they do in the real world, W? How can we characterize a "virtual moral experience" in such multiple cyber worlds?

Questions relating to identities in cyber worlds having moral status can be considered as reasonable because we started from our assumption that thoughts and memories are collection of bits or simply programs. If this is plausible then the following question might be reasonable and well-founded as well: do programs have a moral status?

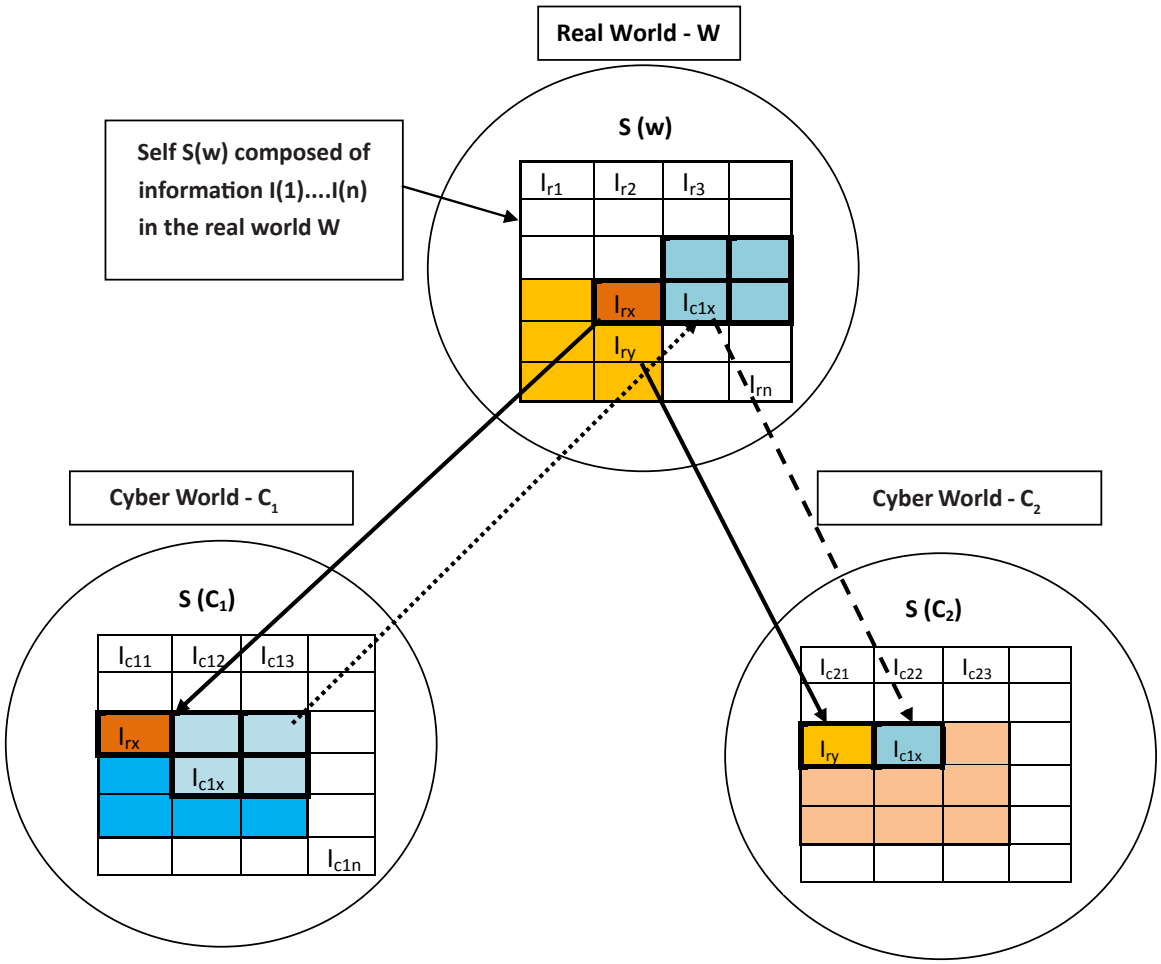
As pointed out by David Cole[9] in "AI and personal identity" (1991), a conception of self as a body of information allows the possibility of several persons to exist in a single body as show in the above model where S(W), $S(C_1)$, $S(C_2)$,....., $S(C_n)$ would all exist in a single individual. Advocates of these ideas tend to see unity of body as a motivation to accept a unified self, however since this conception of unity of body has been under attack since the late 20th century[10], and in light of the contradicting empirical evidence, this position is maintained by a minority of thinkers today[11]. Another consequence of the conception of the self as body of information is that a person might be seen as something decentralized, and less consistent and uniform.

9 Cole, D.1991, "A.I. & Personal Identity". Synthese, 399 – 417.

10 Dawkins, R. 1990, "The Selfish Gene", Oxford University Press.

11 Shay, R. 2006. http://total.eclipse.co.il/2006/10/01/personal-identity-in-the-information-age-dotperson-dotcommunity/

Figure 2: Representation of Several Cyber Worlds



Information Iry from the world W with self S(w) is employed in C_2 to create another new self $S(C_2)$. However we could have a situation where information, I_{c1x} that had been "transferred" back from $S(C_1)$ to S(w) is also now used to form a new self in $S(C_2)$ as shown above.

Anthropology of Cyberspace

As it has been widely noticed the internet life emphasizes this embedding of personhood in the concept of information. "Life in virtual worlds enables these sorts of divisions, which are nothing more than projections of what exists internally. Several windows open simultaneously and multiple examples of the Self are replicated and projected into the Virtual space"[1]. Shay referes to this as the complementary approach. Cyberspace is the arena where divisions of the Self are possible. The space itself has a normative side which encourages this splitting and maintains a complementary role. Sherry Turkle[2] in her "Construction and Reconstruction of Self in Virtual Reality: Playing in the MUD's"[3] interprets the cyberspace in this manner and it sees it as a realization of these ideas. She is influenced in this by Foucault[4] and Derrida[5], who assert that we live in a society that demands a coherent Self. Their work also emphasizes the fact that beyond the normative aspect this kind of society gives an intrinsic positive value to the self who is monolithic and uniform. This depends on the cultural context, in fact in other communities the lack of consistency and uniformity is not only legitimate, but also welcome. Tribal examples are classic examples of situations where a decentralized or divided Self (which can occur, for instance, in a state of trance) is normative[6].

Technically these divided states are called "liminal states", border-states where the Self is "neither here nor there". To the traveler in a rite of passage, personal characteristics become indistinct. She/he is not as she/he was before, but is still not what she/he will become. The liminal state is characterized by bizarre elements. Through abnormal strangeness, the traveler goes through a deconstruction and reconstruction of subject. Thus the liminal state is infused with creative force and its space is an "anthropological arena", hidden and magical[7]. In this manner it configures itself in opposition to the familiar space where work and the normal life takes place. "Liminal entities are neither here nor there; they are betwixt and between the positions assigned and arrayed by law, custom, convention, and ceremony"[8].

In the modern society appears the liminoid state and the difference between liminoid states and liminal states assumes great relevance when we examine the distinction between play and work. Liminoid phenomena emerge in feudal, but predominantly capitalistic societies with a complex social and economic division of labor. With stress on individuality and open ended processes, they are seen to occur within leisure settings apart from work, are experimental and exploratory, forming social critique and providing the potential for the subversion of the status quo. The essence of liminoid is characterized by the permanent change and the role-playing aspect which confers to the player a greater freedom and flexibility. Thus the main dissimilarity among liminal and liminoid states consists in the fact that the former are characterized by transitions towards some defined end where the change becomes permanent and stable. In this way, liminal cultural phenomena are perceived to be collective, integrated, and obligatory ritual action of pre-modernity, such as found in tribal and early agrarian cultures, enforced by necessity but containing the potentiality to create new symbols, models and ideas. They can be seen as collective representations, symbols having common intellectual and emotional meaning for all the members of the group. We can interpret liminal as part of the society, an aspect of social or religious ritual, while the liminoid is a break from the actual society[9].

Cyberspace exhibits some liminoid characteristics, for example, anyone can join in a cyber community and be somebody else for a few hours as depicted by the model explained in Figs. 1 and 2 and

1 Shay, R. 2006. http://total.eclipse.co.il/2006/10/01/personal-identity-in-theinformation-age-dotperson-dotcommunity/.

2 Turkle, S. 1997, "Construction and Reconstruction of Self in Virtual Reality : Playing in the MUDS". See also "Virtuality and Its Discontents: Searching for Community in Cyberspace" available at http://www.hermeneia.net/sala_de_lectura/s_turkle_virtuality_and_its_discontents.htm

3 Multi User Dungeon/Dimension. A MOO is an Object-Oriented MUD.

4 Foucault, M. 1975, "Surveiller et punir: Naissance de la prison". Gallimard.

5 Derrida, J. 1966, Writing and Difference. Routledge. Online version of the chapter "Structure, Sign, and Play in the Discourse of the Human Sciences" at <http://hydra.humanities.uci.edu/derrida/sign-play.html>.

6 Gennep, Van A. (2004). "The Rites of Passage". Routledge Edition.

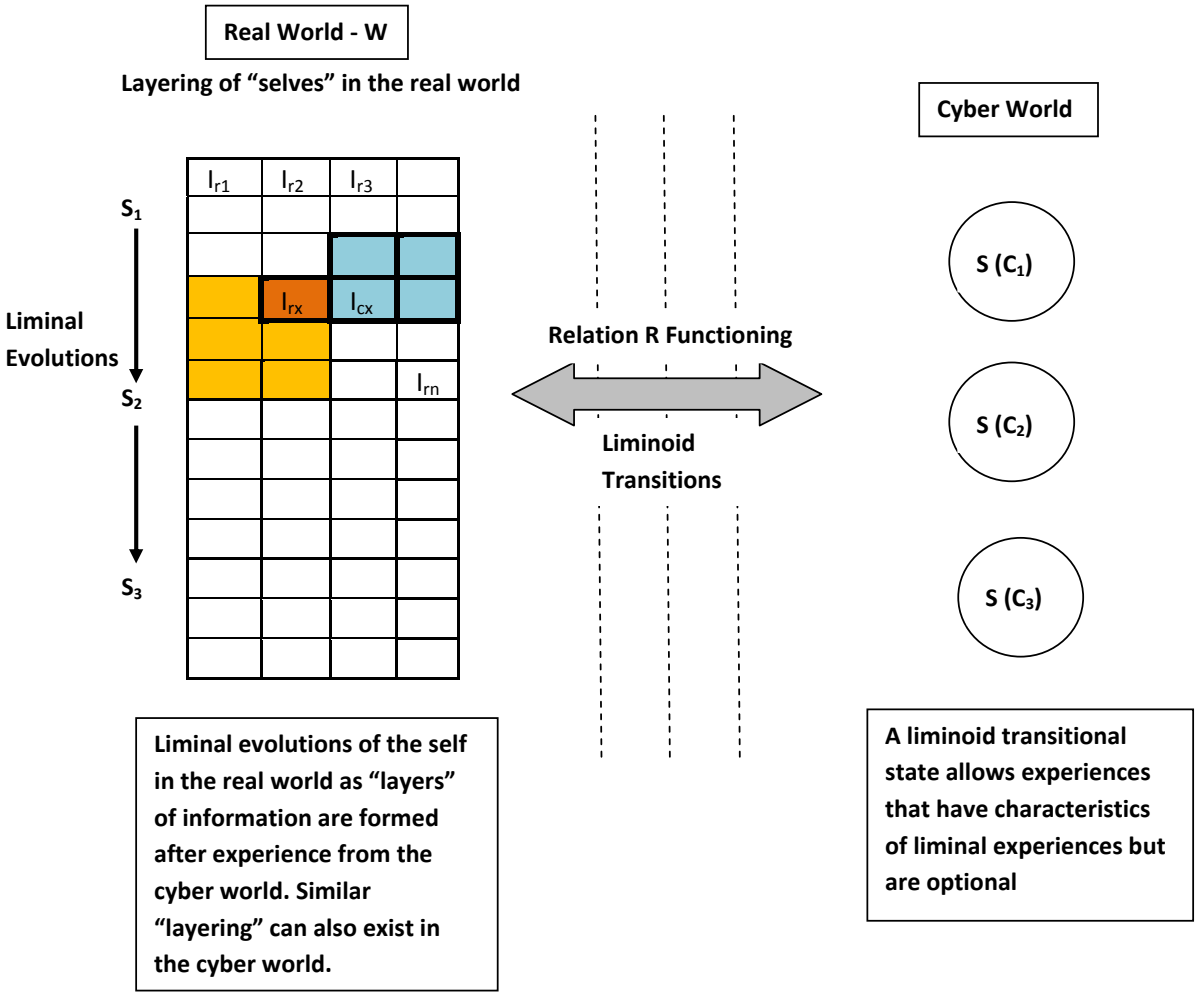
7 Geertz, C. 1973, "Deep Play: Notes on the Balinese Cockfight", The Interpretation of Cultures.

8 Turner, V. 1964, "Betwixt and Between: The Liminal Period in Rites de Passage," in The Forest of Symbols, Cornell University Press.

9 Floridi, L. 2005, "Semantic Conception of Information," The Stanford Encyclopedia of Philosophy (Edward N. Zalta (ed.)).

detailed further in Fig. 3 below. Movement of the individual from the real world, W into the cyber world C1 in order to experience the cyber world and as a result allows for a composition of S(C1), and can therefore be considered as a liminoid transitional state. Such a state would allow the individual to have experiences that have characteristics of liminal experiences but are optional for the individual as such an individual can decide to engage or not engage with C1. The subject moves between leisure and seriousness, work and play, enters the virtual world and exits it, essentially a two way relational process once a virtual identity is formed. The liminal evolution of the self can be viewed as the composition of memory layers of information forming the self after experiences from the virtual world as shown in Figs. 3 and 4. Essentially a one way process is taking place between the real and virtual worlds. Every social interaction in cyberspace contains a dominant component of playfulness which weakens the normative side of work and the cyberspace game becomes a social simulation for the outside world in which the main actor is a hybrid social player that moves in a different dimension and explores a different interaction.

Figure 3: Liminoid and liminal state analogies with the suggested model

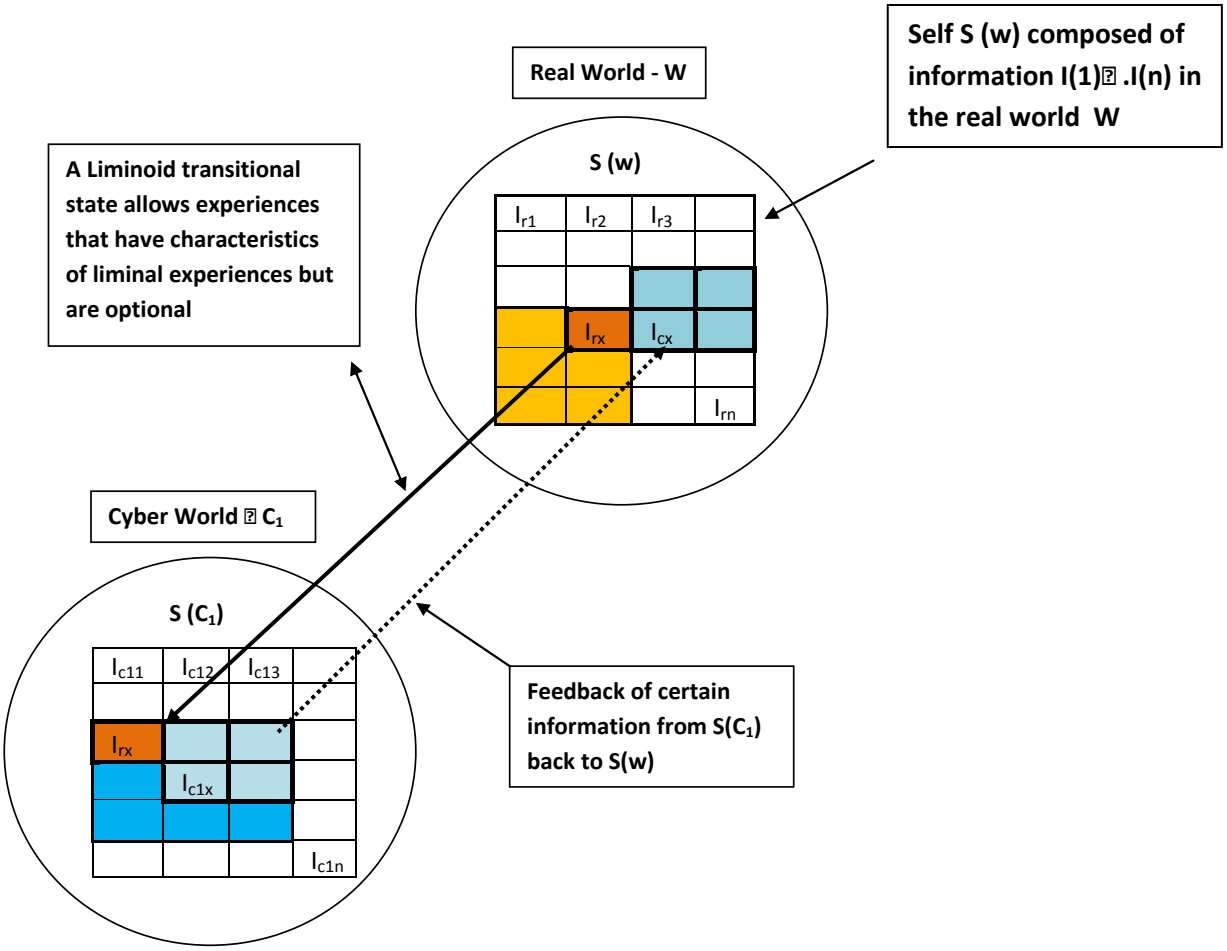


Conclusion

In this introductory paper it has been our intention to produce a framework for assisting in the formulation and development of the concept of identity in virtual worlds. A two way psychological continuous relation anchored in Parfit's q-memory was put forward as a mode that connects the real self with the virtual self (the avatar). From an anthropological point of view a liminoid state was related to the two way interaction that mediates the real self and the virtual self. The liminal state was related to the evolution of layers of information that defines the self in both the real and virtual worlds after the initial relationship relation has been initiated. Several questions have been raised as a result of these elaborations and it is our intention is to explore these theses further in future papers.

Stefano Cavagnetto (Schools of Business and Computing)
Bruce Gahir (Schools of Business and Computing)

Figure 4: Representation of Real World Selves and their Interaction with the Cyber Worlds as Liminoid States



Cellular Automata and the Game of Life

A short History

In the 1940s John von Neumann (1903 – 1957), one of the greatest mathematicians in modern history was working on the non trivial problem of self-replication in logical systems. Initially he founded his project on the idea of one robot R building another robot Q[1]. After some work von Neumann came to the conclusion that it was extremely difficult and expensive to provide robot R with a "sea of parts" from which to build its replicant Q and also that the idea of a self-replicating robot was itself different to implement.

The Jewish Polish-American mathematician Stanislaw Ulam (1909 – 1984), while working at the Los Alamos National Laboratory in the 1940s as von Neumann's collegue on the Manhattan Project, investigated the growth of crystals, using a simple lattice network as his model[2]. Thus it seems that Ulam suggested to von Neumann to develop his project around a mathematical abstraction, such as the one Ulam used to study crystal growth[3].

These suggestions led to the first examples of cellular automata (CA). Von Neumann's cellular automata are two-dimensional, like Ulam's lattice network, with his self-replicator implemented through a finite set of local rules. The resulting CA can be described as large collections of simple objects (cells) locally interacting with each other. A cell is always in one state from a finite state set. The cells change their states synchronously in discrete time steps according to a local rule. The rule gives the new state of each cell as a function of the old states of some finitely many nearby cells, its neighbours. The automaton is homogeneous so that all its cells operate under the same local rule. The local rule of the CA induces a global function that tells how each configuration is changed in a one time step. The neighborhood considered in von Neumann's work is determined by only those cells that are orthogonals to the given cell (see below, in the next section): the so called von neumann neighborhood. Also in the 1940s, the father of cybernetics the American mathematician Norbert Wiener (1894 – 1964) in collaboration with the Mexican physician and physiologist Arturo Rosenblueth (1900 – 1970) developed a cellular automaton model in order to provide a mathematical description of impulse conduction in cardiac systems[4]. It is worth to noting that despite the long time that has passed, their original work continues to be cited in modern medical research publications[5].

The study and research around these mathematical structures continued in the 1960s and culminated in 1969 with two oustanding works. The first was by the American mathematician Gustav A. Hedlund (1935 -) who made the first connection between dynamical systems, topological dynamics and CA. Hedlung's paper compiles many results following this point of view in what is still considered to be seminal paper for the mathematical study of cellular automata. One of the most fundamental results is the characterization of the set of global rules of cellular automata in a rigorous manner (as the set of continuous endomorphisms of shift spaces)[6]. In the same year the German computer pioneer Konrad Zuse (1910 – 1995) published a book Rechnender Raum[7] in which he proposed an interpretation of the physical laws of the universe as discrete by nature, and that the entire universe is the output of a deterministic computation of a giant cellular automaton. This might be considered the first publication on what nowdays is called Digital Physics.

Perhaps the most famous Cellular automata, The Game of Life, made it's appearence in the computing community in the 1970s. The English mathematician John Conway (1937 -) invented this 2-D CA and it was subsequently it was popularized by Martin Gardner (1914 -) in a Scientific American article (see section 3 for more details). As we will see later on despite its simplicity, this CA achieves an impressive diversity of behavior, fluctuating between apparent randomness and order. To conclude this short survey it is important to mention that in 2002 the British physicist, software developer and mathematician, Stephen Wolfram (1959 -) published

1 Today in Cybernetics this model is known as the kinematic model.

2 Stanisław Ulam, Analogies Between Analogies: The Mathematical Reports of S.M. Ulam and his Los Alamos Collaborators. Berkeley: University of California Press, 1990.

3 Idem.

4 N. Wiener and A. Rosenblueth, The mathematical formulation of the problem of conduction of impulses in a network of connected excitable elements, specifically in cardiac muscle. Arch. Inst. cardiol. México 16, p. 205 (1946).

5 J. M. Davidenko, A. V. Pertsov, R. Salomonsz, W. Baxter, and J. Jalife, Stationary and drifting spiral waves of excitation in isolated cardiac muscle, Nature, 355, pp. 349-351 (1992).

6 G. A. Hedlund: Endomorphisms and Automorphisms of the Shift Dynamical Systems. Mathematical Systems Theory 3(4), pp. 320-375 (1969)

7 Konrad Zuse, 1969. Rechnender Raum. Braunschweig: Friedrich Vieweg & Sohn. 70 pp. English translation: Calculating Space, MIT Technical Translation AZT-70-164-GEMIT, Massachusetts Institute of Technology (Project MAC), Cambridge, 1970.

a major text titled A New Kind of Science, which extensively argues that the discoveries about cellular automata are not isolated facts but are robust and have significance for all disciplines of science. In general CA are of interest to physicists as a model of simple local physics, to biologists as settings for models in theoretical biology, to computer scientists and mathematicians as a setting for massive parallel processing in future computers and for other applications concerning tessellation. In the next section we define some of the most important neighborhoods in the literature; section 3 deals with the Game of Life, and section 4 has some concluding remarks.

Definition of Cellular Automata and some neighborhoods

CA are by definition dynamical systems which are discrete in space and time, and operate on a uniform, regular lattice, and are characterized by "local" interactions. In more recent times there has been some interest in similar cellular systems which are aperiodic, or are spatially non-uniform.

One possibility is that the term "cellular automata" could be broadened to include these new systems. Another is that a new category be proposed that includes these dynamical systems. The word "cellular" does not immediately suggest a system of cells where all the cells are necessarily identical - and consequently its current technical use is misleading and counter-intuitive.

The term "cellular automata" was created before there was any significant understanding of the importance of non-uniform cellular automata - and before aperiodic tilings were well-known. If the term had been assigned in more modern times, it seems likely that aperiodic tilings would not have been neglected in the definition. The current usage does not "carve nature at the joints". The non-uniform and aperiodic systems under discussion share so much with cellular automata that it makes little sense to place them in a separate category. Those involved in working with discrete non-uniform cellular systems generally call them "non-uniform cellular automata". Similarly those developing discrete aperiodic cellular systems call give them names like "cellular automata on a quasi-crystal" and "cellular automata on Penrose tiles". They do this despite the fact that these are oxymorons under the current definition. In fact non-uniform cellular systems are all cellular automata under today's definition anyway. Every non-uniform cellular automaton is, for example, isomorphic to some uniform cellular automaton with multiple states per cell, and is part of its state in a fixed, static configuration. Seen in this light the restriction of uniformity seems useless and superflous[1].

Despite any possible discussion about the type of systems one might allow under the label CA, the characterization of the neighborhood is fundamental to the theory and offers substantially different behaviours. The two most common neighborhoods are the von Neumann neighborhood and the Moore neighborood. The von Neumann neighborhood comprises the four cells orthogonally surrounding a central cell on a two-dimensional grid. The central cell often being omitted. Often the set of cells (sometimes the central cell is omitted) on 2-D grid are usually described by directions on the compass N = {N,W,C,E,S}; (see Figure 1). The Moore neighborhood comprises the eight cells surrounding a central cell on a two-dimensional grid (see Figure 2).

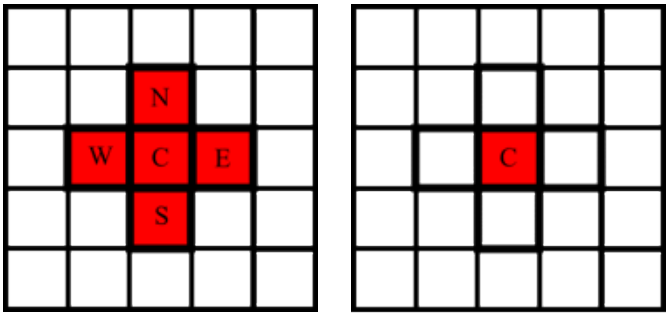


Figure 1

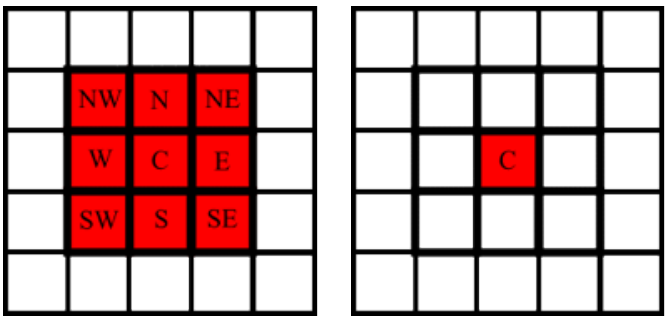


Figure 2

A less common but very interesting is the definition of neighborhoods, is made using a grid made of hexagons instead of squares as in the two previous cases. In this case perhaps the simplest neighborhood is the so called Honeycomb neighborhood which comprises the six hexagons surrounding the given hexagonal cell (see Figure 3).

Using the same grid, it is possible to have a different neighborhood defined, the Tripod neighborhood (see Figure 4).

Finally another interesting neighborhood which may be characterized on the same type of grid is the Hexagonal star neighborhood (Figure 5).

The neighborhoods presented above are conceived on a 2-D grid with cells having different forms (squares and hexagons here,

1 See http://cell-auto.com/.

but in literature is also possible to find cells with different shapes)[2]. Also, in these case we considered only 2-D grid, but the same type of neighborhoods can be defined in a 3-D environment. Below we give the case of the von Neumann and the Moore neighborhood considering a 3-D space (Figure 6, Figure 7).

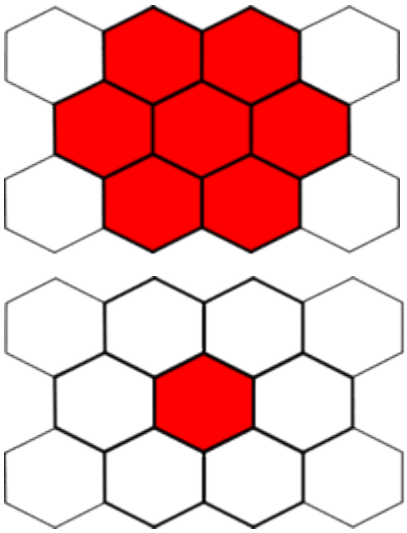


Figure 3

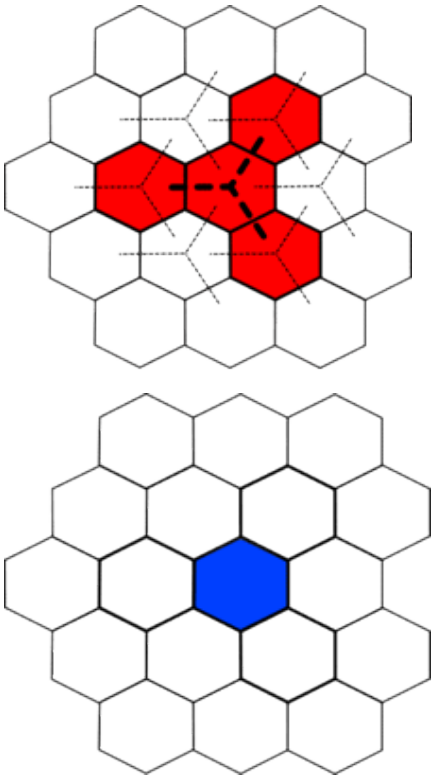


Figure 4

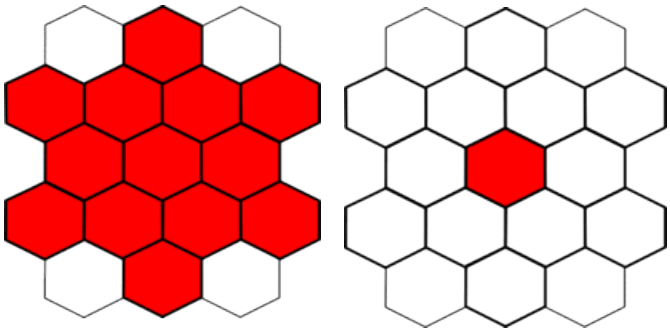


Figure 5

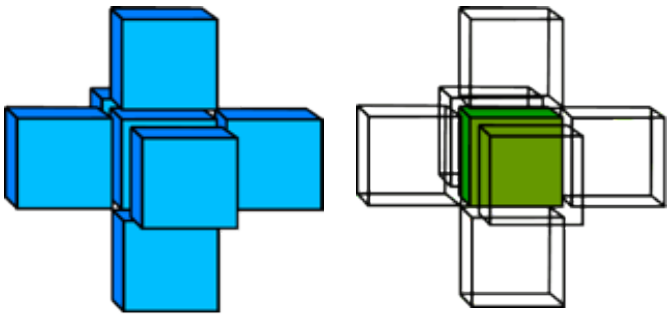


Figure 6

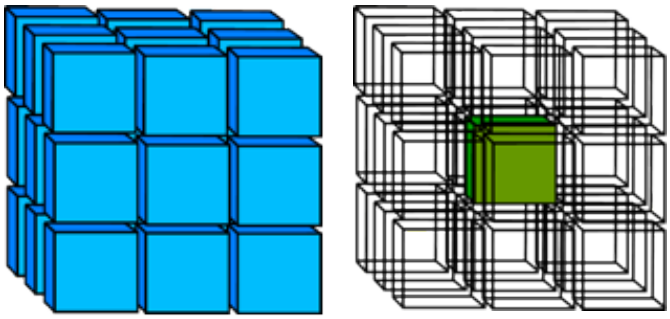


Figure 7

2 See for example a survey of neighborhood at http://cell-auto.com/neighbourhood/.

The Game of Life

Conway was interested in the problem presented in the 1940s by John von Neumann, when he found a mathematical model for such a machine with very complicated rules on a rectangular grid. The English mathematician tried to simplify von Neumann original models and ideas and came up with the Game of Life[1]. The game made its first public appearance in the October 1970 issue of Scientific American, in Martin Gardner's Mathematical Games column[2]. From a theoretical point of view, it is interesting because it has the power of a universal Turing machine: that is, anything that can be computed algorithmically can be computed within Conway's Game of Life.

For this cellular automaton, one takes a two-dimensional grid of cells and a Moore neighborhood.

There are two states: alive and not alive (dead). The transition function for the local automaton is as follows at each step in time:

1. Any live cell with fewer than two live neighbours dies, as if caused by underpopulation.
2. Any live cell with more than three live neighbours dies, as if by overcrowding.
3. Any live cell with two or three live neighbours lives on to the next generation.
4. Any dead cell with exactly three live neighbours becomes a live cell.

With these simple rules on an infinite 2D grid, it is possible to construct a machine capable of universal computation, that is, of emulating the computing power of any Turing machine or existing digital computer.

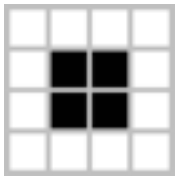
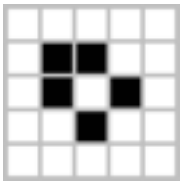
Let's have a closer look to this interesting CA. The initial pattern is the seed of the system. The first generation is created by applying the above rules simultaneously to every cell in the seed–births and deaths happen simultaneously, and the discrete moment at which this happens is called a tick, each generation being a pure function of the one before. The rules continue to be applied repeatedly to create further generations. Conway's rules satisfy the following criteria:

1. There should be no initial pattern for which there is a simple proof that the population can grow without limit.
2. There should be initial patterns that apparently do grow without limit.
3. There should be simple initial patterns that grow and change for a considerable period of time before coming to an end in the following possible ways: (a) Fading away completely (from overcrowding or from becoming too sparse), or (b) Settling into a stable configuration that remains unchanged thereafter, or (c) Entering an oscillating phase in which they endlessly repeat a cycle of two or more periods.

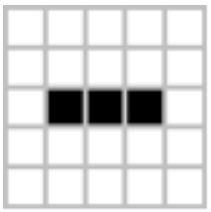
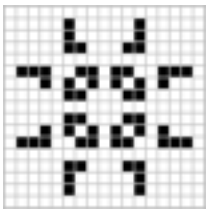
This CA, sometimes referred to simply as Life, provides an example of emergence and self-organization and it shows clearly how very complex patterns can emerge from the implementation of very simple set of rules. The study of patterns in the last twenty years has produced interesting results that we will summarize briefly in the remaing part of this section.

The simplest static patterns, called still lives, and repeating patterns called oscillators in the Game of Life were discovered without the use of computers but with only graph paper, blackboards and physical game boards. Many different types of patterns occur in the Game of Life, including still lives, oscillators, and patterns that translate themselves across the board, called spaceships. Some frequently occurring examples of these three classes are shown below, with live cells shown in black, and dead cells shown in white.

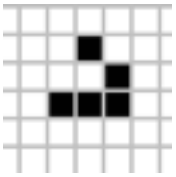
Below examples of static patterns still lives, (a) BLOCK and (b) BOAT.

a   b

Then as an example of oscillators, the (c) BLINKER and the (d) PULSAR.

c   d

and an example of spaceship, a pattern which travel across the grid, the (e) GLIDER.

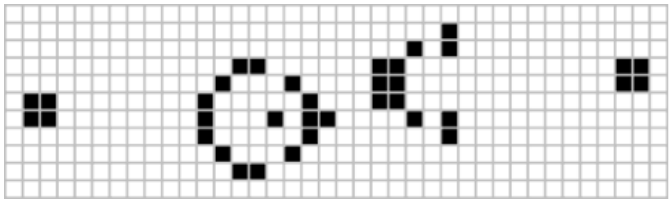
e 

1 Berlekamp, E. R. Conway, John Horton Guy, R.K. Winning Ways for your Mathematical Plays, (2nd ed.), A K Peters Ltd, 2004

2 Paul Chapman (November 11, 2002) Life Universal Computer, available at http://www.igblan.free-online.co.uk/igblan/ca/ accessed 21 march 2010.

The amount of "digital creatures" populating Life and Life-like automata is extremely vast and the interested reader can find a taxonomic table available at the http://www.conwaylife.com/soup/. It is a collaborative on-line project called "Online Life-Like CA Soup Search" the main aim is to discover new interesting patterns in Life and Life-like cellular automata by watching the evolution of random initial configurations (known as soups). In particular, random soups are evolved until they stabilize, and all the resulting stable patterns are uploaded to the server and catalogued.

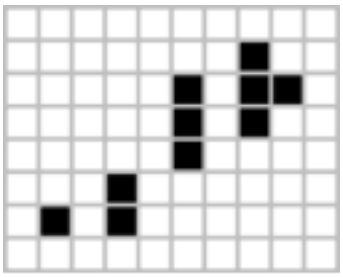
When Life became public there was a conjecture about its patterns. The conjecture was fomulated by Conway himself and can be stated as follows: no pattern can grow indefinitely. This means that for any initial configuration with a finite number of living cells, the population cannot grow beyond some finite upper bound. One way to disprove Conway's conjecture would be to discover patterns that keep adding counters to the field: a "gun", which would be a configuration that repeatedly shoots out moving objects such as the "glider" as seen above (e). A team from the Massachusetts Institute of Technology led by the American mathematician Ralph W. Gosper[3] solved the problem. The "Gosper glider gun" which produces its first glider on the 15th generation, and another glider every 30th generation from then on[4]. Below we show the Gosper glider gun figure (f).



f

Later, on three smaller patterns which exhibit infinite growth were found. The first has only 10 live cells and which has been proven to be minimal (see figure g). The second fits in a 5 × 5 square, as seen in figure (h). The third is only one cell high, and can be seen below in figure (i)[5].

g



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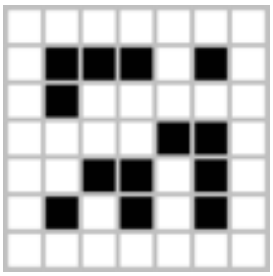
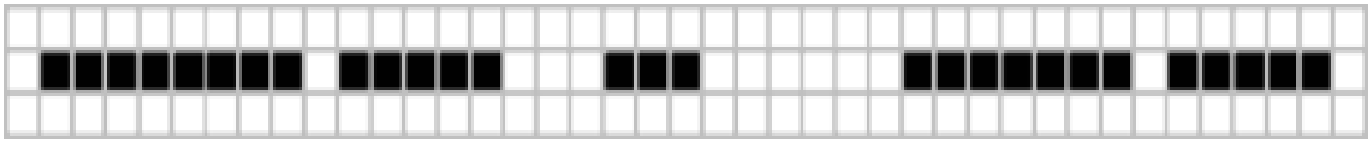


In recent years other types of creatures have been found. Perhaps the most interesting are the so called puffer trains. A puffer train is a finite pattern that moves itself across the entire grid-universe, leaving debris behind. Thus a pattern consisting of only a puffer will grow arbitrarily large over time. They have the same charcteristic with respect to spaceships when movement is taken into account, nevertheless they differ from the latter in that they do not leave debris behind. Thus, the puffers can be conceived as special spaceships which leave a trace behind[6].



i

3 Ralph W. Gosper along with Richard Greenblatt founded the hacker community and is one of the prominent figures in the development of LISP.

4 This first glider gun is still the smallest one known, see www.argentum.freeserve.co.uk/lex_g.htm#gosperglidergun. The Life lexicon by Stephen A. Silver.

5 See http://www.ericweisstein.com/encyclopedias/life/InfiniteGrowth.html

6 See http://www.radicaleye.com/lifepage/glossary.html, http://www.ibiblio.org/lifepatterns/, and http://entropymine.com/jason/life/status.html.

Artificial Life

We conclude this article with some remarks about possible links between a philosophical analysis of the CA Game of Life and the field of Artificial Life (ALife), which examines systems related to life, its processes, and its evolution through simulations using various tools. ALife has broad intellectual roots, and shares many of its central concepts with other disciplines: computer science, cybernetics, biology, biochemistry, complex system theory and artificial intelligence. The most primitive phenomenon investigated by some ALife models is self-organization. Roughly, these models study how structure can emerge from unstructured ensembles of initial conditions. An interesting fact, from a philosophical point of view, is that many ALife models are designed not to represent known biological systems but to generate wholly new and extremely simple instances of life-like phenomena[1].

The Game of Life presented above is a system of this type. It can be thought of as a model at the physical or chemical level, embodying an extremely simple and unique form of "chemical" interactions. However the self-organization exhibited in the Life is not a representation of a chemical self-organization in the real world[2]. In the CA the time advances in discrete time steps and the state S (alive or dead) of a cell at any time is determined by the states of the cells belonging to the Moore neighborhood and by the rules given above. Nothing can be predicted by checking the basic rules governing the automaton. It is not possible to predict how the whole system will behave. But when the CA is run a rich variety of complicated dynamics can be observed and a complex zoo of creatures can be identified and classified as we have seen in the previous section (gliders, guns, puffer train, ...)[3]. Self-organization is emerging as a consequence of the self-reproducing environment. It is interesting to note that before biologists determined the nature of inheritence via DNA encoding of protein synthesis (and other relevant resent discoveries), John von Neumann showed how systems can be constructed that can self-reproduce using the cellular automata. The original idea and project from von Neumann, subsequently displayed, for example, in Conway's work, was based on a mechanism which distinguished data as having two aspects: (i) material that can be copied, and (ii) material that can be used as instructions.

In the 1980s, Cristopher Langton showed that in fact much smaller automata can in fact self-reproduce. Although these cellular automata self-reproduce in a non-trivial manner using the two-fold nature of data, the generated copies are exactly the same as the parent, and the growth is like that of a crystal rather than of biological life which involves heredity, variability and differing fitness, necessary for real evolution by means of natural selection.[4] In this respect their work is closer to Ulam's aim of understanding growth of crystals using lattice networks.

Game of Life provides interesting dynamics and the emerging creatures may suggest and address philosophical insights. The Game of Life has been employed as a didactic analogy, used to convey the somewhat counterintuitive notion that "design" and "organization" can spontaneously emerge in the absence of a designer. The American philosopher and cognitive scientist Daniel Dennett (1942-) has used an analog of Conway's Life in order to illustrate the possible evolution of complex philosophical constructs, such as consciousness and free will, from the relatively simple set of deterministic physical laws governing our own universe[5]. Thus the interesting aspect of both living systems and artificial-life models is that they exhibit emergent phenomena. However, there are difficulties because the idea of emergence remains a problematic notion.

In general, emergent phenomena share two broad hallmarks: (i) they are constituted by and generated from underlying phenomena; (ii) they are also autonomous from those underlying phenomena. This is not the right place where to deal with a deep investigation of these philosophical issues, nevertheless it is important to point out that most of the examples of apparent emergent phenomena involve mind or life. However the two hallmarks seems to be inconsistent or methaphisically illegitimate. At least at first sight it appears counter-intuitive that something can be autonomous from underlying phenomena and at the same time constituted and generated by those phenomena. This is, in short, the problem of emergence. On the other hand a solution would both dissolve the appearance of inconsistency and illegitimate methaphysics we are facing now. It would enfold emergence in constructive scientifc explanations of phenomena involving life and mind[6]. The approach to modelling in ALife considerably differs from the classical approach in modelling; the latter mostly studying "life-as-we-know-it", while the former studying "life-as-it-might-be". The intriguing idea at this point could be to exploit these differences in the hope that this sense of possibility (life-as-it-might-be) will help us to bring some light into the shadowy of mystery surrounding the concept the concept of emergence.

Stefano Cavagnetto (Schools of Business and Computing)
Bruce Gahir (Schools of Business and Computing)
Pascal Silondi (School of Art and Design)

1 Cristopher Langton, Artificial Life. Addison-Wesley. 1991, section 1.

2 Mark Bedau, Artificial Life, in Philosophy of Computing and Information, edited by Luciano Floridi, Blackwell, 2004, p 199.

3 Mark Bedau, Artificial Life, in Philosophy of Computing and Information, edited by Luciano Floridi, Blackwell, 2004, p 200.

4 Cristopher Nehaniv, http://homepages.stca.herts.ac.uk/~comqcln//CM/ca.html, 1996.

5 Daniel Dennett, Darwin's Dangerous Idea, Penguin Books, London, 1995.

6 Mark Bedau, Artificial Life, in Philosophy of Computing and Information, edited by Luciano Floridi, Blackwell, 2004, p 201.

Morality and Artificial Agents in Cyberspace

Introduction

Artificial agents, particularly those in cyberspace, extend the class of entities that can be involved in moral situations. In this paper it is our intention to present arguments that show that such artificial agents can be conceived as moral agents.

In section 1 we analyse the concept of an artificial agent (AA), from a broad point of view, without any particular emphasis in relation to avatars in Multiuser Dungeons (MUD's). In section 2 we introduce the fundamental principle of a "level of abstraction" (LoA) as defined by Floridi [1]. The reader is invited to pay particular attention to this section as it is essential for the current development of ideas and its application in any ontological analysis is crucial. We then continue to expand upon the idea of an artificial agent as an information object that has intrinsic value and hence moral worth. Finally we review the consequences of the above approach for artificial agents in cyberspace and conclude that the framework provided by Floridi is a pluralistic approach that is essential to the development of a global information and computing ethic at the cross-cultural level.

1 Floridi, Luciano. Information ethics: A reappraisal. In "Ethics and Information Technology", 10(2-3), 2008, pages 189-204.

Characterization of Artificial Agents

Complex biochemical compounds and abstruse mathematical concepts have at least one thing in common: they may be unintuitive, but once understood they can all be defined with total precision, by listing a finite number of necessary and sufficient properties. Mundane entities like intelligent beings or living systems share the opposite property: one naively knows what they are and perhaps could be, and yet there seems to be no way to encase them within the usual planks of necessary and sufficient conditions.

The term "Artificial Agent (AA)"is a similar entity that is difficult to define. AA's are often described as entities with attributes considered useful in a particular domain or what Floridi would refer to as a level of abstraction. Several researchers [1] have attempted to provide a meaningful classification for the attributes that AA might have, some common ones can be listed as follows:

Adaptivity–the ability to learn and improve with experience.

Autonomy–goal-directedness, proactive and self-starting behavior.

Collaborative behavior–the ability to work with other agents to achieve a common goal.

Inferential capacity–the ability to act on abstract task specifications.

"Knowledge-level" communication ability–the ability to communicate with other agents with language more resembling human-like "speech acts" than typical symbol-level program-to-program protocols.

Mobility–the ability to migrate in a self-directed way from one host platform to another.

Personality–the ability to manifest attributes of a "believable" human character.

Reactivity–the ability to selectively sense and act.

Temporal continuity–persistence of identity and state over long periods of time.

According to these attributes, AA's could be classified as showing weak or strong notions of agent-hood [2]. The weak notion of agent-hood, which comes from Distributed Computing (DC) and Distributed Artificial Intelligence (DAI), sees AA's as a paradigm of network based cooperative automation. The strong notion of agent-hood, from Artificial Intelligence (AI), leads towards an anthropomorphic view where AA's are seen as conscious, cognitive entities that have feelings, perceptions and emotions just like humans [3].

Classifying the above attributes as:

$$a_1, a_2, a_3, \ldots\ldots, a_n$$

we could formulate a set-theoretic framework for agent hood (A_{gh}) as:

$$A_{gh} = \{ a_1, a_2, a_3, \ldots\ldots, a_n \}$$

1 Bradshaw, J.M. An Introduction to Software Agents. In "Software Agents", J.M. Bradshaw (Ed.), Menlo Park, Calif., AAAI Press, 1997, pages 3-46.

2 Jennings, N.R. and Wooldridge, M. Intelligent Agents: Theory and Practice. In "Knowledge Engineering Review", Volume 10, No. 2, 1995, pages 115-152.

3 Mamdani, A. The Social Impact of Software Agents. In "Proceedings of the Workshop on The Impact of Agents on Communications and Ethics: What do and don't we know?", Program presentation, Foundation for Intelligent Physical Agents (FIPA),Dublin, July 15, 1998.

In other words, agent-hood can be formalised as a set of attributes that define a minimal level at which one could consider interaction as being an important attribute of AA's, from the point of view of developing an agent-relative framework of morality, since AA's recurrently interact to share information and to perform tasks to achieve their goals. In this case if we let,

$$a_1 = \textit{Interaction}$$

then

$$A_{gh}^* = \{a_3\}$$

where

$$A_{gh}^* \acute{I} A_{gh}$$

We could further define each attribute $a_1, a_2, a_3, \ldots\ldots, a_n$ in terms of a set of elements, hence:

$$a_1 = \{e_1, e_2, e_3, \ldots\ldots e_n\}$$

where $e_1, e_2, e_3, \ldots\ldots e_n$ would define the key elements of the attribute a_1, e.g. if $a_1 = \textit{Interaction}$ then the key elements of interaction could be defined as:

e_1 = ***A common agent communication language and protocol.***

e_2 = ***A common format for content of communication.***

e_3 = ***A shared ontology.***

Researchers investigating agent communication languages mention these three key elements as essential components of multi-agent interaction[4], Floridi defines his guidelines for "agent hood" as:

1. interactivity (response to stimulus by change of state).
2. autonomy (ability to change state without stimulus) and
3. adaptability (ability to change "the transition rules" by which state is changed).

Floridi also takes the view that an effective characterization of AA's depends on the specific level of abstraction (LoA) at which one chooses to analyse and discuss a particular entity and its context[5], therefore the proposal put forward by Floridi, consistent with recent literature [6], indicates that the right LoA is probably one which includes the above three criteria, namely:

1. Interactivity - means that the agent and its environment (can) act upon each other. Typical examples include input or output of a value, or simultaneous engagement of an action - for example gravitational force between bodies.
2. Autonomy - means that the agent is able to change state without direct response to interaction: it can perform internal transitions to change its state. So an agent must have at least two states. This property ascribes an agent with a certain degree of complexity and decoupled-ness from its environment.
3. Adaptability - means that the agent's interactions (can) change the transition rules by which it changes state. This property ensures that an agent might be viewed, at the given LoA, as learning its own mode of operation in a way which depends critically on its experience, a kind of self-learning entity. Note that if an agent's transition rules are stored as part of its internal state then adaptability follows from the other two conditions.

We therefore note that Floridi's definition of agent hood utilizes what we have referred to as attributes, a1, a2, a3,... ... ., an, in fact, Floridi's set of attributes is a subset of { a1, a2, a3,... ... ., an}. Form the point of view of this paper we are interested in systems that change, which means that some of those attributes defining "agent hood" evolve over time, thus, such entities can be thought of as having states, determined by the value of the properties which hold at any instant of thier evolution. The kind of evolution that we have in mind is that often experienced by avatars of MUD participants. From this viewpoint the entity becomes a transition system that moves from state to state by execution of actions or transition rules depicting the character development that is evolving in time, the definition of agent hood Agh(t) for such time-dependent AA's could therefore be defined by a set of time dependent attributes:

$$A_{gh}(t) = \{ a_{t1}, a_{t2}, a_{t3}, \ldots\ldots, a_{tn}\}$$

In the following sections we assume the characterization of AA's that has been provided in this section and continue to explore the role that morality has to play in environments such as the cyberspace, however before this, it is important for the reader to understand the principle of levels of abstraction as presented by Floridi.

4 Finin, T., Labrou, Y. and Mayfield, J. KQML as an Agent Communication Language, In: "Soft Agents", J.M. Bradshaw (Ed.), Menlo Park, Calif., AAAI Press, 1997, pages 291-316.

5 Levels of Abstraction (LoA) are discussed in detail in the next section.

6 Allen,C., Varne, G., and J. Zinser, Prolegomena to any future artificial moral agent. In "Journal of Experimental and Theoretical Artificial Intelligence", 12: pages 251-61, 2000.

The Principle of Levels of Abstraction (LoA)

The idea of a ' level of abstraction' plays an absolutely crucial role in our account of artificial agents. The concept comes from modeling in science where the variables in the model correspond to observables in reality, all others being abstracted. The terminology we use has been influenced by an area of Computer Science, called Formal Methods, in which discrete mathematics is used to specify and analyse the behavior of information systems. Despite that heritage, the idea is not at all technical.

The fact is that in the exact discipline of mathematics, for example, definitions are ' parameterised' by generic sets. In section 1 we formulated a set-theoretic approach to define agent hood for AA's in terms of a set of attributes which were in turn defined by a set of elements, we could view this as providing a technique for regulating a level of abstraction (LoA). Indeed abstraction acts as a ' hidden parameter' behind exact set-theoretic definitions. An x is never defined as y absolutely (i.e. LoA-independently), as a Kantian ' thing-in-itself', but always contextually, as a function of a given LoA or following a set-theoretic approach, as a set of attributes. When a LoA is sufficiently common, important, dominating or in fact is the very frame that constructs the definiendum, it becomes ' transparent', and one has the pleasant impression that x can be subject to an adequate definition in a sort of conceptual vacuum. So for example glass is not a solid but a liquid, tomatoes are not vegetables but berries and whales are mammals not fish, such views are all accepted without further complaint because one silently bows to the uncontroversial predominance of the corresponding LoA.

When no LoA is predominant or constitutive, things get messy. In this case the trick lies in deciding on an adequate LoA, before embarking on the task of understanding the nature of the definiendum. The example of intelligence or ' thinking' behavior is enlightening. One might define ' intelligence' in a myriad of ways; many LoA are all equally convincing and no single, absolute, definition is adequate in every context. Turing solved the problem of ' defining' intelligence by first fixing a LoA–in this case a dialogue conducted by a computer interface–and then establishing the necessary and sufficient conditions for a computing system to count as intelligent at that LoA: the communication game. The LoA is crucial and changing it invalidates the test, as Searle was able to show by adopting a new LoA represented by the Chinese room game.

Floridi [1] provides the following interesting example. Suppose we join Anne, Benand and Carole in the middle of a conversation. Anne is a collector and potential buyer; Ben tinkers in his spare time; and Carole is an economist. We do not know what they are talking about, but we are able to hear this much:

A) Anne observes that it has an anti-theft device installed, is kept garaged when not in use and has had only a single owner.

B) Ben observes that its engine is not the original one, that its body has been recently re-painted but that all leather parts are much worn.

C) Carole observes that the old engine consumed too much, that it has a stable market value but that its spare parts are expensive.

The participants view the object under discussion according to their own interests, at their own LoA. We may guess that they are probably talking about a car, or perhaps a motorcycle or even a plane. Whatever the reference is, it provides the source of information and is called the system. A LoA consists of a collection of observables, each with a well-defined possible set of values or outcomes. For the sake of simplicity let's say that Anne's LoA matches that of a buyer, Ben's that of a mechanic and Carole's that of an insurer. Each LoA makes possible an analysis of the system, the result of which is called a model of the system. Evidently an entity may be described at a range of LoA's and so can have a range of models.

We are now ready for a definition as provided by Floridi[2]:

Given a well-defined set X of values, an observable of type X is a variable whose value ranges over X. A LoA consists of a collection of observables of given types.

Thus, in the example above, Anne's LoA might consist of observables for security, method of storage and owner history; Ben's might consist of observables for engine condition, external body condition and internal condition; and Carole's might consist of observables for running cost, market value and maintenance cost. In this case, the LoA's happen to be disjoint but in general they need not be. A particularly important case is one in which one LoA, D, includes another, E. Suppose Emily analyses the system using a LoA that contains only a subset of the observables constituting the LoA used by Daniel. For Emily the system is a vehicle, where as for Daniel it is a motor vehicle. In this case, LoA^E is said to be more abstract or higher and LoA^D more concrete or lower, for E abstracts some observables apparent at D.

A LoA is therefore formalized in the concept of "interface", which consists of a set of features, the observables (or attributes). The LoA is determined by the way in which one chooses to describe, analyse and discuss a system and its context. It must be stressed that a clear indication of the LoA at which a system is being analysed allows ethical pluralism without endorsing relativism. It is a mistake to think that ' anything goes' as long as one makes explicit the LoA, because LoA's are mutually comparable and assessable. Introducing an explicit reference to the LoA clarifies that the model of a system is a function of the available observables, and that (i) different

1 Floridi, L., Information ethics: A reappraisal. In "Ethics and Information Technology", 10(2-3), 2008, pages 189-204.

2 Ibid.

interfaces may be fairly ranked depending on how well they satisfy modeling specifications (e.g. informativeness, coherence, elegance, explanatory power, consistency with the data etc.) and (ii) different analyses can be fairly compared provided that they share the same LoA.

For the analysis of AA's an adaptable LoA at the informational level would be an appropriate framework to explore. Donald Michie's [3] concept of a mechanism's adaptability can provide a good introduction to the concept of machine learning, from the field of Computer Science to explain the underpinnings of adaptability. The subtlety revealed by this example is that if a transition rule is observed to be a consequence of a program state then the program is not adaptive. Floridi points out that this distinction is vital for current software. Early software used to lie open to the system user who, if interested, could read the code and see the entire system state. For such software, a LoA in which the entire system state is observed, is appropriate. However the user of contemporary software is explicitly barred from interrogating the code in nearly all cases. This has been possible because of the advance in user interfaces; use of icons means that the user need not know where an applications package is stored, let alone be concerned with its content. Similarly applets are downloaded from the internet and executed locally via a click of an icon, without the user having any access to their code. For such software a LoA in which the code is entirely concealed is appropriate, such an informational level of abstraction, call it LoA^i would be appropriate for the analysis of AA. We now progress to examine how an LoA^i could be defined as a minimal state for AA's to be conceived as moral agents.

3 Michie, D., Trial and error. In "A. Garrett (editor), Penguin Science Surveys", Harmondsworth, Penguin, pages 120-145, 1961.

Levels of Abstraction, Artificial Agents and Morality

Suppose we are analyzing the behavior of a population of AA's in a cyberworld (let us for this argument suppose that these AA's are represented by entities capable of learning* and intentionality* - the asterisks signify that the learning and intentionality of such artificial agents may not be perfectly identical to those of human beings) through a system that gives us complete access to all the observables available at a LoA provided by informational analysis, call this LoAi (a kind of "gods eye view)[1], we observe that the AA's are able to:

1. Respond to environmental stimuli, this presupposes that AA's are informed about the environment through some data-entry devices, for example some preceptors or sensors.
2. Change their states according to their own transition rules and in a self-governed way, independently of environmental stimuli (autonomy),e.g. by taking flexible decisions based on past and new information, which modify the environment, and
3. Change, according to the environment, the transition rules by which their states are changed (adaptability), e.g. by modifying past procedures to take into account successful and unsuccessful actions.

In such a dynamic system any action to be classified as a "moral action" we must have the logical structure of a variably interactive process relating one or more sources (depending if one is working within a multi-agent context): The agent, a, with one or more of its destinations, the patient p.

More generally, the agent initiates the process and the patient reacts more or less interactively to it[2]. Once a and p are interpreted, their analysis depends on the LoA and the corresponding set of observables. If we consider a = AA_1 and p = AA_2 where AA_1 and AA_2 are artificial agents characterized by the framework explored in section 1 then at the LoA provided by an informational analysis, say LoAi, both AA_1 and AA_2 are informational objects. This means that AA_1 is analysed as an informational object that interacts and shares a number of attributes with other objects, like a high level programming code. This does not mean that AA_1 and AA_2 are necessarily only information objects.

For a LoAi to be defined as a minimal state, Floridi [3] takes the conceptual approach of modeling information systems by using the Object Orientated Programming (OOP) methodology. This provides a very flexible and powerful methodology with which to clarify and make precise the concept of "information object" as an entity constituted by a bundle of properties[4], to use the Humean

1 Such a system providing an observation 'view-point' and acting as an LoAi has been developed as part of the Underground City XXI project.

2 The terms "agent" and "patient" are standard in Ethics and therefore will be maintained in this paper, however it is essential to stress the interactive nature of the process and hence the fact that the patient is hardly ever a passive receiver of an action. The unidirectional, bivalent, causal model is often far too simplistic. A better way to qualify the patient in connection with the agent would be to refer to it as the "reagent".

3 Rambaug, On the conceptual modeling of informational systems, see also Flynn and Diaz Fragoso, 1996, Veryard 1992 and Boman et al. 1997.

4 Cavagnetto, S and Gahir, B. "The conception of the self in multiple cyberworlds" Paper presented at the 7th International Cyberspace Conference,, Brno, Czech Republic 20-21 November 2009.

expression. When AA_1 and AA_2 are analysed as information objects at LoAi this means that they are considered and treated as discrete, self-contained, encapsulated[5] packages containing:

1. The appropriate data structures, which constitute the nature of the entity in question, state of the object, its unique identity, and attributes.
2. A collection of operations, functions or procedures (methods) which are activated by various interactions or stimuli, namely messages received from other objects or changes within itself, and correspondingly define how the object behaves or reacts to them.

At LoA^i a moral action can now be modelled as an information process, i.e. a series of messages (M) invoked by AA_1, that brings about a transformation of states directly affecting AA_2. Following Floridi[6] we can define the following information components for AA_1 and AA_2 that could be considered as the minimal components for a moral action to be modelled as an information process. The first three are AA_1, AA_2 and M, the fourth component is the personal or subjective frame of information within which the AA_1 operates. This shell, which is really an integral part of AA_1's nature, is the information frame that encapsulates the subjective world of information of AA_1 (or in general the agent). It can be considered as being constituted by internally dynamic and interactive records (modules) of AA_1's moral values, prejudices, past patterns of behavior, attitudes, likes and dislikes, phobias, emotional inclinations and so forth. In short this could represent the ethical and epistemic conceptualizing interface between AA_1 and the environment. This shell, although it embodies aspects of AA_1's "life", is constantly evolving through time, may contain shared or imported attributes from other AA shells.

The factual information concerning the moral situation represents the fifth dynamic component of the system, according to Floridi, it is the only element in the model that remains unmodified when the LoA changes. We can still speak of factual information even at the lower LoA, where there are sufficient observables to analyse both AA_1 and AA_2 not just as two information objects but also as two software entities. The majority of ethical theories are ready to recognize factual information as playing an instrumental role in any moral action, for example, Socratic positions explain the existence of evil in terms of ignorance and according to Warnock[7] lack of information is one of the main factors that cause "things to go badly".

We can now introduce the sixth component. At LoA^i being considered, Floridi[8] describes this as the informational environment, the infosphere, it is a context constituted by the whole system of information objects, including all agents and patients, messages, their attributes and mutual relations. The specific region of the infosphere in space and time within which the moral action takes place represents the last component of the system, namely the moral situation, Floridi terms this the envelope, borrowing a term from robotics. To summarise here is a complete list of the information components attributed to our information entities AA_1 and AA_2:

1. a = moral agent (AA_1).
2. p = moral patient (AA_2).
3. M = moral action, constructed as an interactive information process, the message.
4. Shell = a's personal world of information.
5. Factual information = information about the moral situation.
6. Infosphere = the general environment.
7. Envelope = the moral situation.

In the model being considered, we could say that from the observation of group dynamic behaviour at LoAi, the function M could act like a vector, with given direction and a discrete force. Once the message has been released, its direct and indirect effects almost immediately cease to be under the control of its source a, while their life extends in time and space, in the form of a gradually decreasing continuum. Following Floridi we may use another concept from OOP and speak of the propagation of an operation, which starts at some initial OBJECT and flows from OBJECT to OBJECT through association links in the system and according to possible specifiable rules during the propagation, the vector may change both in direction and in force.

We now observe that such a model of "information ethics", where AA's are considered as information entities[9] at LoA^i, and modelled according to the principles of OOP, allow us to model a moral action as an information process. This leads us to Floridi's claim that all entities, even when interpreted as only clusters of information, still have a minimal moral worth qua information objects and so may deserve to be respected. It is worth elaborating upon the different ways and degrees in which an entity may have some instrumental value. When the value in question is neither instrumental nor only emotional, one can first distinguish between extrinsic and intrinsic value and correspondingly, between two

5 Encapsulation or information hiding is the technique of keeping together data structures and the methods (class-implemented operations), which act on them in such a way that the package's internal structure can only be accessed by approved package routines. External aspects of the object, which are accessible to other objects, are thus separated from the internal implementation details of the object itself, which remain hidden from other objects.

6 Floridi, L., On the intrinsic value of information objects and the infosphere, Computer Ethics, In "Philosophical Enquiry (CEPE 1998)", 2008.

7 Warnock, G.J., The Object of Morality, London, Methuen, 1971

8 Floridi, L., Information Ethics, On the Philosophical Foundations of Computer Ethics, In "Ethics and Information Technology", 1, (1), 2009, pages 37-56.

9 From the point of view of a set of attributes defining agent hood for AA's as detailed in section 1, one could consider the set of elements defining each attribute as information entities.

types of respect, therefore an entity x has extrinsic value when it is respected as y. For example, a piece of cloth may be respected as a flag, a person may be respected as a police officer, or a practice may be respected as a cult. This sense of relative respect is associated with a sense of value that is no longer instrumental or emotional and may be called symbolic. Symbolic value is still utterly contingent, maybe acquired or lost, and can be increased as well as relaxed, in brief it is utterly extrinsic.

In order to capture in full the fact that x has moral value in itself, a value that necessarily belongs to x in all circumstances, not just under certain conditions, and is not subject to modification unless x ceases to exist as x, one needs to consider the case in which x deserves to be respected not just symbolically, as something else, but qua x. Floridi introduces a second distinction: the moral value of an entity is based on its ontology, what the entity is determines the degree of moral value it enjoys. Minimalist theories of intrinsic worth have tried to identify in various ways the inherited attributes, i.e. the minimal condition of possibility of the lowest possible degree of intrinsic worth, without which an entity becomes intrinsically worthless, and hence deserves no moral respect. Investigations have led researchers to move from more restricted to more elusive, anthropocentric criteria and then further on towards biocentric criteria. At the most recent stage in this dialectical development, Information Ethics (IE) maintains that even biocentric analyses of the inherited attributes are still biased and too restricted in scope. As Deep Ecologists argue, inanimate things too can have an intrinsic value. Today there are geologists' codes of ethics stating, for example, "Don't disfigure rock surfaces with brightly painted numbers, symbols or clusters of core-holes"[10] for apparently no other reason than a basic sense of respect for the environment in all its forms.

Indeed, even ideal, intangible or intellectual objects can have a minimal degree of moral value, no matter how humble, and so be entitled to some respect. UNESCO recognizes this in its protection of "masterpieces of the oral and intangible heritage of humanity"[11]. What lies behind these examples is the view that:

if x can be p, then x's nature can be taken into consideration by a, and contribute to shaping a's action, no matter how minimally

Floridi[12] argues that such a minimal guiding criterion for qualifying an object is more general than any biocentric reference to the object's attributes as a biological or living entity.

What, then, is the most general possible common set of attributes which characterizes something as intrinsically valuable and an object of respect, and without which something would rightly be considered intrinsically worthless (not just instrumentally useless or emotionally insignificant) or even positively unworthy and therefore rightly to be disrespected in itself? The least biased and most fundamental solution is to identify the minimal condition of possibility for an entity's least intrinsic worth with its nature as an information object. The information nature of an entity x that may, in principle, act as a patient p of moral action is the lowest threshold of inherited attributes that constitutes its minimal intrinsic worth, which in turn may deserve to be respected by the agent. Alternatively, to put it more concisely, being an information object qua information object is the minimal condition of possibility of moral worth and hence of normative respect. This is the central axiological thesis of any future Information Ethics that will emerge as a Macroethics according to Floridi, and for the purposes of the present paper we are inclined to agree with this thesis.

10 http://www.bbc.co.uk/education/rocks/code.shtml

11 http://www.unesco.org/culture/heritage/intangible/

12 Floridi, L., On the intrinsic value of information objects and the infosphere, In "Computer Ethics: Philosophical Enquiry (CEPE 1998)", 2008.

A Cross-Cultural Approach to Cyber Ethics

Following on from the previous section, we further note that Floridi takes "information" as the primary ontological category. In this way, "to be is to be an information entity"[1]. That is, Floridi's philosophy of information (PI) is motivated from the outset by the observation that other metaphysical frameworks are ill-suited to take on and help resolve the multiple ethical issues and challenges evoked in the emergence of ICT's. His PI seeks to offset these deficits by starting all over metaphysically and redefining our understanding of reality in terms of information. At the same time, Alison Adam[2] and Soraj Hongladarom[3] point out that this ontology resonates with feminist and environmental views as well as with the views of Spinoza and Kant in a number of ways.

The ethical consequences of this ontological emphasis on relationship are immediate and crucial. To begin with, this relational ontology represents a foundational shift from the modern Western emphasis on the (human) moral agent – i.e. the individual who, as a moral autonomy, is primarily responsible for his or her actions – to the recognition that "moral actions are a result of complex interactions amongst distributed systems integrated on a scale larger that the single human being"[4]. Whether in terms of our interactions with one another from different cultures via distributed networks in cyberspace models such as the Underground City XXI project, or, in Floridi's example, within the processes of globalization as such, we are in need of developing notions of distributed responsibility in an ethics of distributed morality. Alison Adam[5] points out that such a viewpoint can be reinforced further with insights drawn from actor-network theory, as well as Daniel Dennet's account of "as-if" intentionality[6] and Lorenzo Magnani's description of "moral mediators"[7]. Our evaluation of the relative worth or value of diverse entities in the infosphere therefore depends entirely on the level of abstraction that we take up to make such an evaluation, one that would endorse a wide but not unlimited number of LoA's – each one of which is defined by a specific goal.

According to Charles Ess [8] such an IE thereby makes available a plurality of frameworks that will work especially well in relation to a particular culture, ethical tradition, etc. However, the further implicaties of these ideas are crucial to our development of an ethical framework for AA's in a cyberworld such as that being developed in the Underground City XXI project, as such an environment allows the interaction of individuals from different cultural backgrounds. What is important here is Floridi's notion of flourishing as the final norm and the telos defining our actions in relation to interaction within such environments. This is similar to the works of Norbert Wiener who takes up flourishing as an overarching goal and value of IE, for Wiener, "flourishing" includes advancing and defending human values. This convergence between Floridi and Wiener is crucial not only as it identifies the ethical norm towards which all actions should aim, but also because it stands as an example of ethical pluralism within cyberworld environments, and such an ethical pluralism will be an important factor in the characterization of interaction at the multicultural level within cyberworld environments.

Any analysis at this level will tend to reflect irreducible differences that define individuals across cultures and will further influence moral action and behavior in cyber communities not only involving AA's but also in general. Charles Ess has stressed that preserving cultural plurality while developing an ethical framework at this global level is therefore an important goal and one of the conditions of developing such a framework is that the ethics must emerge from cross-cultural dialogues, marked by a fundamental respect precisely for irreducible differences that define our cultures and our identities. Here we can look to the notion of resonance that governs our ethical framework, and consider how far we are prepared to engage "the other" as Other, i.e., in ways that recognize, respect, indeed foster our irreducible cultural differences when engaging in cyber communities via AA's such as avatars.

One could introduce here, what I believe is a central model for encountering "the Other"- namely, the Japanese Buddhist and comparative philosopher Kitaro Nishida's understanding of resonance. This notion of resonance is of interest because it represents a notion that is shared between such Western philosophers as Plato and Aristotle, and such Eastern philosophers as Confucius – as it is found in Taoist and Buddhist traditions. As well, if our goal in the intercultural engagements made possible by internet communication technologies in the electronic global metropolis is to take up relationships with "the Other" that seek

1 Floridi, L. "Information ethics: A reappraisal. Ethics and Information Technology 10(2-3), p. 199.

2 Adam, A. "Ethics for things", Ethics and Information Technology 10(2-3), P 149-154.

3 Hongladarom, S. "Floridi and Spinoza on global information ethics", Ethics and Information Technology 10(2-3), P175-187.

4 Floridi, L. "On the intrinsic value of information objects and the infosphere", Computer Ethics: Philosophical Enquiry (CEPE 1998).

5 Adams, A. "Ethics for things", Ethics and Information Technology 10, (2-3), P149-154.

6 Dennet, D. "The myth of original intentionality", Thinking computers and virtual persons: Essays on the intentionality of machines, Ed. E.Dietrich, pp.91-107, San Diago, CA: Academic Press, 1994.

7 Magnani, L. "Distributed morality and technological artifacts", Paper presented at the 4th international conference on Human being in Contemporary Philosophy' Volvograd, 2007.

8 Ess, C. "Cybernatic pluralism in an emerging global information and computing ethics", paper originally presented at the Centre of Information Policy Research (CIPR), University of Wisconsin, Nov 13th 2006.

to foster the irreducible differences that makes these resonances possible, then such a framework would be beneficial towards the development of a global ethics. Nishida emphasizes that our relationships with one another always takes place across the difference of "absolute opposites" if we are to preserve our identities as irreducibly distinct from one another. However if only sheer differences define our relationship – then there will be no connection or unity. To describe human relationships as a structure that holds together both irreducible differences and relationships, Nishida turns to the term and concept of resonance. How do we know the Other as absolute Other? In part... .

"Through the resonance of my personal behavior (with you) I can know you, and you can know me through the resonance of your personal behavior (with me)."[9]

This resonance clearly entails a relationship that sustains the irreducible differences required to keep our identities and awareness separate. What emerges, then, is the conjunction of what appears to be contradictory – i.e., connection alongside irreducible differences. A framework for ethics that allows interaction at different cultural levels will require such resonance and complimentarity for our engagements with "the other", a kind of harmony within pluralism. In particular these conditions may emerge as necessary conditions for a global cyberworld ethics. One must be reminded that the difficulty of developing an ethics that works across diverse cultures and traditions is an ancient problem – we should not be surprised to note that the ancients in both Eastern and Western traditions have developed often highly sophisticated ways of resolving the apparently conflicting demands between agreement and difference.

Both Plato and Aristotle – and subsequently, Aquinas – responded to this complex requirement in at least two key ways. To begin with, Plato develops a view that Ess characterizes as "interpretative pluralism"[10]. On this view, as elaborated especially in The Republic, we may conjoin shared ethical norms with irreducible differences by recognizing that diverse ethical practices may represent distinctive interpretations or applications of those shared norms. Such differences do not necessarily mean, as ethical relativists would argue, that there is no universally legitimate ethical norms or values: rather, such differences may mean only that a given norm or value is applied or understood in distinctive ways – precisely as required by the details of a given context as shaped by a particular traditions, cultural norms, or practices.

Aristotle builds on Plato's teaching in several ways building his notion of pros hen or "focal" equivocal. Such equivocals stand as a linguistic middle ground between a homogeneous univocation (which requires that a term have one and only one meaning) and a pure equivocation (as a single term may have multiple but entirely unrelated meanings – for example, "bat" can refer both to a winged mammal and a wooden stick used in cricket). Pros hen or focal equivocal, by contrast, are terms with clearly different meanings that simultaneously relate or cohere with one another as both point towards a shared or focal notion that anchors the meaning of each. Aristotle uses the example of "healthy" to illustrate his point: "... ..the term "healthy" always relates to health (either as preserving it or as producing it or as indicating it or as receptive of it... "[11]. In his later elaboration on Aristotle's understanding of such equivocal, Aquinas illustrates the point more fully:

"... .there is the case of one word being used of two things because each of them has some order or relation to a third thing. Thus we use the word "healthy" of both diet and passing water, because each of these has some relation to health in a man, former as a cause, the later as a symptom of it"[12].

So we could say, for example, that a particular diet is healthy(1) – and good kidney function may also be said to be healthy(2): but the two terms are not univocals – that is they do not have precisely the same meaning. On the contrary: with healthy(1) we mean that the diet contributes to the state of being healthy – while healthy(2) means s good kidney function is a reflection of the state of being healthy. At the same time, however, precisely because healthy(1) and healthy(2) refer to the same "state of being healthy" that, as a shared focal point, thus grounds their meanings - their differences in meaning are thus conjoined with a coherence or connection alongside these differences.

For Aristotle (as well as for Aquinas) this linguistic analysis is significant because language is assumed to reflect the structure of reality itself. In particular, Aristotle says rather famously that being itself is such a focal or pros hen equivocal "... there are many senses in which a thing is said to "be", but all that "is" is related to one central point, one definite kind of thing, and is not said to "be" by a mere ambiguity"[13]. That is, all things are – in ways that are both irreducibly different and yet at the same time inextricably connected with one another by way of reference to a single focal point. For Aristotle, our ability to negotiate the complex ambiguities of pros hen equivocal is affiliated with a particular kind of practical judgment – what Aristotle calls phronesis. Just as we can recognize and appropriately utilize terms that hold different but related meanings – so phronesis allows us to discern what and how general ethical principles apply to diverse contexts, thereby making ethical decisions and actions possible. As Aquinas puts it:

9 Kitaro, N. "Nishida Kitaro Zenshu", 1988ff, Vol. 6, 391f, cited in Elberfeld 2002, 138f.

10 Ess, C. "Ethical Pluralism and Global Information Ethics", In Luciano Floridi and Julian Savulescu (eds.) "Information Ethics: Agents, Artifacts and New Cultural Prespectives", a special issue of Ethics and Information Technology 8, 2006, p215-226.

11 Metaphysics, 1003b2-4.

12 Aquinas, T. "Summa Theologiea 1A.13, 5. 208"

13 Mataphysivs, 1003a33, Burrell's Translation, 1973, 84.

"Practical reason... is connected with contingent matters, about which human actions are concerned, and consequently, although there is necessity in general principles, the more we descend to matters of detail, the more frequently we encounter deviations... . Accordingly, in matters of action, truth or practical rectitude is not the same for all in respect of detail but only as to the general principles, and where there is the same rectitude in matters of detail, it is not equally known to all"[14].

This is to say: phronesis allows us to make a general principle and discern how it may be interpreted or applied in different ways in different context. It thereby makes possible an ethical pluralism that recognizes precisely that shared ethical principles and norms will necessarily issue in diverse ethical judgments and interpretations, as required by irreducibly different contexts defined by an extensive range of fine-grained detail. Such ethical pluralism, finally, as engaging such structures of connection alongside irreducible differences, and as rooted in a phronesis that is precisely the cultivated, experientially-informed ability to judge as to how to interpret and apply shared principles to diverse contexts, thereby carries us beyond Hinman's notion of "potential compatibility" and even the notion of "overlapping consensus" put forwad by Rawls. In fact, Aristotle's understanding of phronesis and thus of ethical pluralism is intimately connected with a central component of computation – namely, cybernetics. Of course, most of us are familiar with the term – as originally developed by Norbert Wiener – as referring to the ability of computer systems to self-regulate and self-correct their processes through various forms of feedback mechanisms. What is apparently forgotten or unacknowledged is that "cybernetics" is derived from Plato's use of cybernetes. The cybernetes is a steersman, helmsman, or pilot, and Plato uses the cybernetes as a primary model of ethical judgment – specifically, our ability to discern and aim towards the ethically-justified path in the face of a wide range of possible choices. So Plato has Socrates observe in The Republic:

"... a first-rate pilot [cybernetes] or physician, for example, feels the difference between the impossibilities and possibilities in his art and attempts the one and lets the other go; and then, too, if he does happen to trip, he is equal to correcting his error"[15].

"Cybernetics" means more originally the capability of making ethical judgments in the face of specific and diverse contexts, complete with the ability to self-correct in the face of error and/or new information. This is to say, the cybernetes, as a model of ethical self-direction, thereby embodies and exemplifies the sort of ethical judgment that Aristotle subsequently identifies in terms of phronesis – i.e., precisely the ability to discern what general principles may apply in a particular context – and how they are to be interpreted to apply within that context as defined by a near-infinite range of fine-grained, ethically relevant details.

Given this conjunction between the cybernetes and phronesis, where phronesis is the ethical judgment capable of discerning what general principles may apply and how they apply in diverse ways as required by diverse contexts – we can then meaningfully speak of a "cybernetic pluralism" in Information and Computer Ethics. Indeed, there are at least two examples of such pluralism operating in contemporary theoretical work, beginning with Terrell Ward Bynum's[16] synthesis of the work of Norbert Wiener and Luciano Floridi in what Bynum calls "flourishing ethics". Briefly, Bynum argues that the ethics of both Wiener and Floridi converge towards the central values of: contributing to human flourishing; advancing and defending human values (life, health, freedom, knowledge, happiness); and fulfilling the great principles of justice drawn from Western philosophical traditions. In fact, Bynum further points out agreement on these central values in the ethics of such computer ethics pioneers as Deborah Johnson, Philip Brey, James Moor, Helen Nissenbaum.

Similarly, Luciano Floridi has developed more recently a conception of what he calls a "lite" information ontology developing a view towards avoiding a cultural imperialism that would thereby remain fragmented and isolated from other cultures and frameworks. Such a "lite" ontology can serve as a shared framework that allows precisely for a pluralistic diversity of understandings and applications of a shared notion of information ethics, as, in effect, the focal, pros hen notion, Floridi makes explicit that his notion of "lite" ontology is intended precisely to avoid the cultural imperialism of imposing a single norm, language or culture across cyberspace: rather, his vision is of a pluralistic structure of a shared framework – in this case, information ontology as something of a shared language.

These various structures of pluralism require the interpretation or application of a shared focal norm or value within the diverse contexts established by distinctive cultural values, traditions, practices, etc. such a conception of multi-cultural ethical pluralism extends globally and includes states and regimes that are clearly not liberal or democratic. Despite these radical cultural and political differences, however, the sort of focal, pros hen pluralism that has been articulated above makes possible ethical alignments – indeed, resonances and harmonies – between diverse cultural traditions and ethical systems. As a minimal requirement, it is therefore possible to begin our encounters with one another in cyberspace environments with a reasonable and understandable search for commonalities, including a set of minimal rights and obligations towards one another. More broadly, our emerging and global interaction in cyberspace also depends very much on

14 Aquinas, T. "Summa Theologiea 1- 2 q.94, a4"

15 Republic, 360e-361a, Blooms trans., Republic I, 332e-c;VI, 489c

16 Bynum, Terrell W., "A very short history of computer ethics", Newsletter of the American Philosophical Association on Philosophy of Computing, 2002.

how far we want/will/need/ought to go in meeting "the Other" in such environments. Presuming that we seek to meet with and engage "the Other" in a more robust way – i.e., one defined by our willingness to acknowledge not only commonalities but also the irreducible differences that define our individual and cultural identities – we are required to move to a more complex mode of thinking and behaving, one shaped precisely by the structures of pluralism and harmony, as these hold together both similarity and irreducible differences.

In addition, two of the most important factors of successful general cross-cultural communication that sustain the irreducible differences defining individual and cultural identities are trust and the ability to recognize and effectively respond to the linguistic ambiguity that thereby allows for a pluralistic understanding of basic terms and norms holding different interpretations or applications in diverse cultures[17]. Moreover, these elements of human communication finally require the now familiar work of judgment – beginning with judgments as to how far or close one's meaning is understood by "the Other", and in turn how far one understand the meaning of the Other. Even though we may use the same word or term, their differences in our diverse cultural settings require careful attention and judgment to determine whether or not we are sliding into equivocation and misunderstanding. However, earning and sustaining trust, successfully recognizing and comfortably negotiating linguistic ambiguities, and utilizing the needed judgment in establishing and sustaining resonant relationships that preserve our irreducible differences are capacities are not easily captured in set-theoretic analytical frameworks as such those detailed in earlier sections, much less taught in any formal way.

Such compassionate attributes, after all, are essential to healing the ruptures that follow upon the first mistakes we inevitably make, especially in our first efforts to understand "the Other" – and most especially as we venture out into new linguistic and cultural settings offered by cyberworld communities. Finally, attributes such as compassion and care are essential to building and sustaining the trust, essential to all human interactions. One could not agree more with the views of Floridi, Hongladarom and Ess who echo the point of shared norms expressed in diverse ways and diverse traditions, i.e., as respectful care or compassion. Nor could we agree more with their shared call to a sort of pluralistic virtue ethics that has to attend to our feelings and requires us to cultivate a compassion that will deeply challenge those modern Western ethicists who take a more purely conceptual approach, which, rests, we suspect, on Cartesian dualism.

17 Ess, C. and Thorset, M. "Neither relativism nor imperialism", Theories and practices for a global information ethics, Ethics and Informatiion Technology 8 (3), p109-119

Conclusion

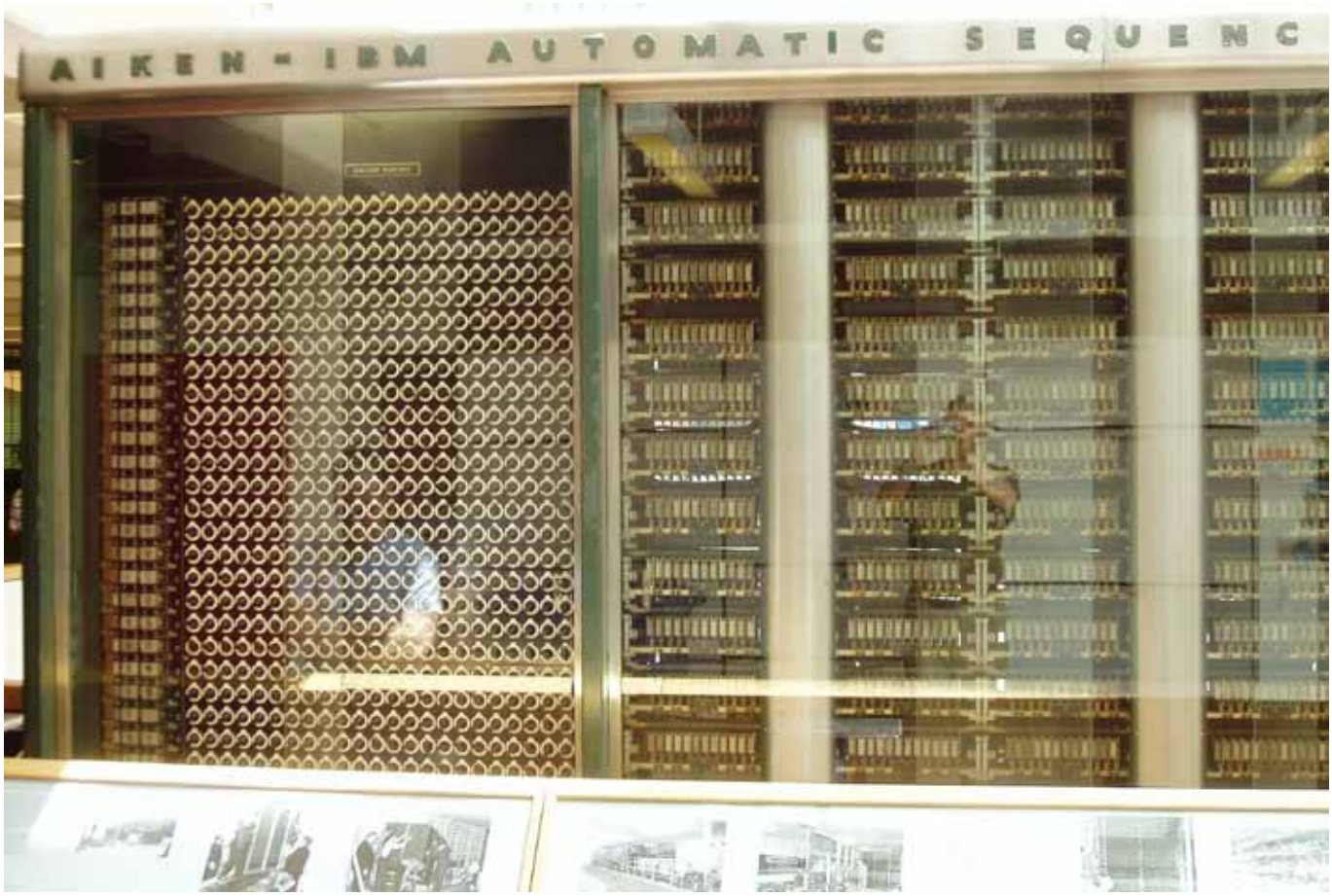
It has been our intention to provide a set-theoretic model that defines AA's from the point of view of their attributes and to relate this model to the levels of abstraction (LoA) approach provided by Floridi. In adopting the LoA approach we developed the most general possible common set of attributes which characterized an AA as intrinsically valuable and identified the minimal condition of possibility of such an entity's least intrinsic worth with its nature as an information object. In other words, being an information object qua information object is the minimal condition of possibility of moral worth and hence of normative respect for AA's. This was seen as the central axiological thesis of any future Information Ethics that will emerge as a Macroethics according to Floridi.

The ethical consequences of such an ontological relationship for a cross-cultural cyber-ethics were developed to include pluralism and resonance that tends to reflect irreducible differences that define individuals across cultures and further influence moral action and behavior in cyber communities not only involving AA's but also in general.

Stefano Cavagnetto (Schools of Business and Computing)
Bruce Gahir (Schools of Business and Computing)

Part II:

The history of programming languages, and of computers



Harvard-IBM Mark I Computer, left side of the computer.

The main aim of the project the history of programming languages and of computers is to explore the historical development of programming languages and computing devices as a means of human expression and creation.

This project is entirely devoted to programming languages and their features, people who designed them and what influenced them to design programming languages the way they did.

During last year students of the School of Computing actively took part in the project and explored such languages as: COBOL, FORTRAN, ALGOL, LISP, APL, SIMULA, PL/I. In the current issue of the bulletin COBOL and P/I (Programming Language One) will be considered.

COBOL

Pre COBOL era

Computing in the 1940's was quite different from the technology we have today. For example, the Atanasoff–Berry Computer from the US in 1942 was the world's first electronic digital computer, but it was not programmable and was used only for a single purpose[1]. Other machines as Colossus Mark I (UK, February 1944) did not last a long time. The Colossus machine was an electronic computing device used by British code breakers to read encrypted German messages during World War II. The machine was programmed using patch cables and switches. This was the world's first programmable, digital, electronic, computing device[2].

With the available hardware, it was logical to use a low level language which falls into machine code category, like "Assembler" language.

Harvard Mark I of IBM ASCC (US, May 1944) was the first large-scale automatic digital computer in the USA. It is considered by some to be the first universal calculator. It was almost 3 meters high and 3 meters wide. This miracle of modern science was built from relays, switches and vacuum tubes, program-controlled by 24-channel punched paper tape. One of the first three programmers on the Harvard Mark I was Grace Hooper, who later created FlOW-MATIC compiler for UNIVAC computer (1949, Eckert-Mauchly Computer Corporation) in 1955. The FLOW-MATIC language influenced the developments of a new programming language – COBOL[3].

AUTHOR/S

In 1959, an industry-wide team was assembled to formulate a common business programming language. The Conference on Data System Languages (CODASYL) led by Joe Wegstein of National Bureau of Standards (now National Institute of Standards and Technology) developed a new language, and created the first standardized business computer programming language[4].

A specification of COBOL was initially created during the second half of 1959 by Grace Hopper. The CODASYL committee, which originated the development of COBOL, extended Hopper's FLOW-MATIC language with some ideas from the IBM equivalent, the COMTRAN, and the FACT language from Honeywell.

It was Grace Hooper's innovation that programs could be written in a language that was close to English rather than in machine code or languages close to machine code (such as assembly language), which is how it was normally done at that time. It is fair to say that COBOL was based very much on her philosophy.

CODASYL's members were individuals from industry and government (US Air Force, the David Taylor Model Basin, the National Bureau of Standards).The six individuals were William Selden and Gertrude Tierney of IBM, Howard Bromberg and Howard Discount of RCA, Vernon Reeves and Jean E. Sammet of Sylvania Electric Products. This sub-committee completed the specifications for COBOL in December 1959.

PURPOSE OF THE LANGUAGE

COBOL (Common Business Oriented Language) was developed under the auspices of the U.S. Department of Defense in cooperation with computer manufactures, users and universities. The initial specifications for COBOL were presented in a report of the executive committee of CODASYL committee in April of 1960. The main larger goal of COBOL was to promote more effective data systems analysis, design, and implementation as a business problem oriented language.

ON WHAT HARDWARE IT WAS RUN?

The compilers subsequently implemented ARITH-MATIC, MATH-MATIC and FLOW-MATIC for COBOL during the year 1960. Essentially the same COBOL program was run on two different types of computers, an RCA 501 computer and a Remington-Rand Univac II computer. This provided the proof that demonstrating that compatibility between the two could be achieved.

ABOUT THE LANGUAGE

COBOL appeared in 1959. COBOL (Common Business Oriented Language) is the high-level computer programming language designed for general commercial use. It was typically a file-oriented application and is not designed for writing systems programs.

COBOL applications can be very large, with typically more than 1,000,000 lines of code. The applications are also very long-lived, because of the huge investment in building COBOL applications of a million lines. That is why business applications between 10 and 30 years old are common and the language is still in use.

According to a report from Gartner group in 1999 over 50% of all new mission-critical applications are still coded in COBOL. Their recent estimates indicate that through 2004-2005 15% of all

1 Ralston, Anthony; Meek, Christopher, eds. (1976), Encyclopedia of Computer Science (second ed.), New York: Petrocelli/Charter, pp. 488–489, ISBN 0-88405-321-0

2 Sale, Tony, Colossus, the revolution in code breaking, viewed 5 June 2009, <http://www.codesandciphers.org.uk/virtualbp/fish/colossus.htm>.

3 Dickason, Elizabeth. "Remembering Grace Murray Hopper: A Legend in Her Own Time." Chips, 12 no. 2 (April 1992): 4-8.

4 A Brief History, LegacyJ Corp., viewed 24 May 2009, <http://www.legacyj.com/cobol/cobol_history.html>.

new applications (5 billion lines) will be developed in COBOL, while 80% of all deployed applications will include extensions to existing legacy (usually COBOL) programs.

STRUCTURE/EXAMPLES

COBOL programs are hierarchical in structure. Each element of the hierarchy consists of one or more subordinate elements. The levels of hierarchy are Divisions, Sections, Paragraphs, Sentences and Statements. There are 4 main divisions and each division provides an essential part of the information required by the compiler.

At the top of the COBOL hierarchy there are the four divisions. The sequence in which they are specified is fixed, and must follow the order:

- IDENTIFICATION DIVISION supplies information about the program to the programmer and the compiler.
- ENVIRONMENT DIVISION is used to describe the environment in which the program will run.
- DATA DIVISION provides descriptions of the data-items processed by the program.
- PROCEDURE DIVISION contains the code used to manipulate the data described in the DATA DIVISION. Here the programmer describes his algorithm.

Some COBOL compilers require that all the divisions are present in a program while others only require the IDENTIFICATION DIVISION and the PROCEDURE DIVISION.

COBOL is not a strongly typed language and there are only three data types: numeric, alphanumeric (text/string), alphabetic. The data types are declared using: a level number, a data-name or identifier, a picture clause (e.g. 01 STUDENT-IN PIC X(43).).

The group items are the COBOL equivalent of structures and the items with a group item must be elementary items or other group items. Ultimately every group item should be defined in terms of elementary items. The hierarchy in a group item is represented by different level numbers, e.g.:

01 DateOfBirth.
02 DayOfBirth PIC 99.
02 MonthOfBirth PIC 99.
02 YearOfBirth PIC 9(2).

Basic Commands in COBOL:

```
ADD a TO b.
ADD a TO b GIVING c.
SUBTRACT a FROM b.
SUBTRACT a FROM b GIVING c.
MULTIPLY a BY b.
MULTIPLY a BY b GIVING c.
DIVIDE a INTO b.
DIVIDE a INTO b GIVING c.
COMPUTE x = a + b * c.
MOVE a TO b c.
SORT sort-file
ON ASCENDING KEY k
USING inventory-file
GIVING sorted-inventory-file.
MERGE merge-work-file
DISPLAY total-cost.
ACCEPT identifier.
PERFORM paragraphname1 THROUGH paragraphname2
```

A detailed example in COBOL:

```
000010 IDENTIFICATION DIVISION.
000020 PROGRAM-ID. SAMPLE.
000030 AUTHOR. J.P.E. HODGSON.
000040 DATE-WRITTEN. 4 February 2000
000041
000042* A sample program just to show the form.
000043* The program copies its input to the out-
put,
000044* and counts the number of records.
000045* At the end this number is printed.
000046
000050 ENVIRONMENT DIVISION.
000060 INPUT-OUTPUT SECTION.
000070 FILE-CONTROL.
000080 SELECT STUDENT-FILE ASSIGN TO SYSIN
000090 ORGANIZATION IS LINE SEQUENTIAL.
000100 SELECT PRINT-FILE ASSIGN TO SYSOUT
000110 ORGANIZATION IS LINE SEQUENTIAL.
000120
000130 DATA DIVISION.
000140 FILE SECTION.
000150 FD STUDENT-FILE
000160 RECORD CONTAINS 43 CHARACTERS
000170 DATA RECORD IS STUDENT-IN.
000180 01 STUDENT-IN PIC X(43).
000190
000200 FD PRINT-FILE
000210 RECORD CONTAINS 80 CHARACTERS
```

```
000220 DATA RECORD IS PRINT-LINE.
000230 01 PRINT-LINE PIC X(80).
000240
000250 WORKING-STORAGE SECTION.
000260  01  DATA-REMAINS-SWITCH  PIC  X(2)  VALUE
SPACES.
000261 01 RECORDS-WRITTEN PIC 99.
000270
000280 01 DETAIL-LINE.
000290 05 FILLER PIC X(7) VALUE SPACES.
000300 05 RECORD-IMAGE PIC X(43).
000310 05 FILLER PIC X(30) VALUE SPACES.
000311
000312 01 SUMMARY-LINE.
000313 05 FILLER PIC X(7) VALUE SPACES.
000314 05 TOTAL-READ PIC 99.
000315 05 FILLER PIC X VALUE SPACE.
000316 05 FILLER PIC X(17)
000317 VALUE 'Records were read'.
000318 05 FILLER PIC X(53) VALUE SPACES.
000319
000320 PROCEDURE DIVISION.
000321
000330 PREPARE-SENIOR-REPORT.
000340 OPEN INPUT STUDENT-FILE
000350 OUTPUT PRINT-FILE.
000351 MOVE ZERO TO RECORDS-WRITTEN.
000360 READ STUDENT-FILE
000370 AT END MOVE 'NO' TO DATA-REMAINS-SWITCH
000380 END-READ.
000390 PERFORM PROCESS-RECORDS
000410 UNTIL DATA-REMAINS-SWITCH = 'NO'.
000411 PERFORM PRINT-SUMMARY.
000420 CLOSE STUDENT-FILE
000430 PRINT-FILE.
000440 STOP RUN.
000450
000460 PROCESS-RECORDS.
000470 MOVE STUDENT-IN TO RECORD-IMAGE.
000480 MOVE DETAIL-LINE TO PRINT-LINE.
000490 WRITE PRINT-LINE.
000500 ADD 1 TO RECORDS-WRITTEN.
000510 READ STUDENT-FILE
000520 AT END MOVE 'NO' TO DATA-REMAINS-SWITCH
000530 END-READ.
000540
```

Hello World in COBOL

This program demonstrates the text output function of the COBOL programming language by displaying the message "Hello world!"[5].

```
IDENTIFICATION DIVISION.
PROGRAM-ID. HELLO-WORLD.
PROCEDURE DIVISION.
MAIN.
DISPLAY 'Hello, world.'.
STOP RUN.
```

5 COBOL, viewed 15 June 2009, <http://www.csee.umbc.edu/courses/graduate/631/Fall2002/COBOL.pdf>.

ABOUT GRACE HOOPER

The CODASYL committee with several companies completed the specifications for COBOL in 1959.

The first steps for realization of this project were made by Grace Hooper who developed the FLOW-MATIC compiler which was extended by the CODASYL committee. It was her great idea that programs could be written in a language that was close to English rather than in machine code or in languages close to machine code, such as the assemblers of the time.

Grace Brewster Murray Hopper was born in New York City on December 9, 1906, to Walter Fletcher Murray and Mary Campbell Horne Murray. Being the oldest of three children, she was intensely curious at an early age. Even though only aged seven, she showed a particular love for gadgets, disassembling seven alarm clocks in the attempt to determine how they worked.

Hopper's parents provided a strong foundation for her inquisitiveness. She shared her love for math with her mother, who studied geometry by special arrangement, at a time when women where not to study mathematics.

She graduated Phi Beta Kappa from Vassar College in 1928, with a Bachelor's Degree in Mathematics and Physics. In 1930, at age 23, she received her Master's Degree in Mathematics from Yale University. The same year, she married Vincent Foster Hopper, an English instructor at New York School of Commerce.

A year later, Vassar hired her as a mathematics instructor and she taught at Vassar from 1931 until 1943. During that time, she earned a Ph.D. from Yale in 1934 (with a thesis on "New Types of Irreducibility Criteria"), and was promoted from instructor to associate professor. In 1936 she published a paper on "The ungenerated seven as an index to Pythagorean number theory" in the American Mathematical Monthly.

When the Japanese attacked Pearl Harbor [1], at the outbreak of World Ware II, Hopper made a life-altering decision to serve her country by joining the U.S. Navy. The process was not an easy one. At age 34, weighing 105 pounds, she was considered overage and underweight for military enlistment. Futhermore, her position as a mathematics professor was declared crucial to the war effort. Navy officials asked her to remain a civilian. These obstacles did not stop Grace Hopper. She obtained a waiver for the weight requirement, special government permission, and a leave of absence from Vassar College. In December 1943, she was sworn into the U.S. Naval Reserve. She went on to train at Midshipman's School for Women, graduating first in her class[2].

Hopper's first assignment was under Commander Howard Aiken at the Bureau of Ordinance Computation at Harvard University. She was the third person to join the research team of Professor (and Naval Reserve lieutenant) Howard H. Aiken, who had requested her months earlier and greeted her with the words, "Where the hell have you been?" Then he pointed to the Mark I electromechanical computing machine: "There's the machine. Compute the coefficients of the arc tangent series by next Thursday." Hopper plunged in and learned what the machine could do with a clever mathematician at the helm.

The Mark I was the world's first large-scale automatically sequenced digital computer. The computer was used to calculate aiming angles for Naval guns in varying weather conditions. Because the numbers were so pertinent, Hopper and her assistants were often required to run and monitor the system twenty-four hours a day. They spent countless hours transcribing and inputting codes for Mark I and its successors, Mark II and Mark III. Hopper received the Naval Ordinance Development Award in 1946 for her work on the Mark series.

During her work with Mark II, Hopper was credited with coining the term "bug" in reference to a glitch in the machinery. This story is apparently a bit of computer folk-lore, however, as the term had already been used by Harvard personnel for several years to describe problems with their computers.

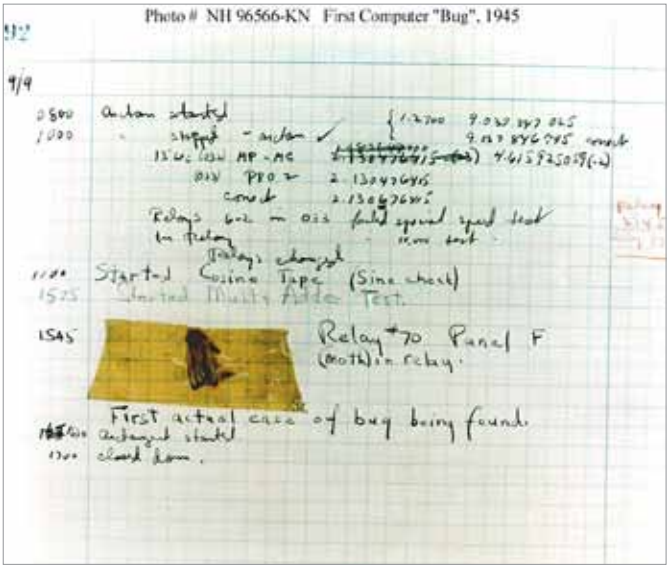
It is, in fact true, however that she and her team of programmers found a moth which had flown a through an open window and into one of the Mark II's relays, temporarily shutting down the system. The moth was removed and pasted into a logbook. At that time the use of the word "bug" referred to problems with the hardware. In the mid 1950's, Hopper extended the meaning of the term "debug" to include removing programming errors[3].

In 1946 Hopper was told that she was too old to remain in active service. By that time, she was divorced with no children. Turning down a renewed position at Vassar, Hopper chose to remain at Harvard as a civilian research fellow in Engineering Sciences and Applied Physics until 1949. Then, Hopper made a risky business move. She left Harvard to join Eckert-Mauchley Computer Corporation as a senior mathematician. The gamble paid off when the company introduced the BINAC, Binary Automatic Computer, which was programmed using C-10 code instead of the punched

1 Biographies of Women Mathematicians, viewed 20 May 2009, <http://www.agnesscott.edu/LRIDDLE/WOMEN/hopper.htm>.

2 Maisel, Merry, About Grace Hooper, viewed 21 May 2009, <http://grace-hopper.org/2009/about/about-grace-hopper/>.

3 Maisel, Merry, About Grace Hooper, viewed 21 May 2009, <http://grace-hopper.org/2009/about/about-grace-hopper/>.



The First "Computer Bug"
Source: Dickason, Elizabeth. "Remembering Grace Murray Hopper: A Legend in Her Own Time." Chips, 12 no. 2 (April 1992): 4-7.]
Removed caption read: Photo # NH 96566-KB First Computer "Bug", 1945
Date : September 1945
Source : U.S. Naval Historical Center Online Library Photograph NH 96566-KN
Author : Courtesy of the Naval Surface Warfare Center, Dahlgren, VA., 1988

cards utilized by the Mark series. This paved the way for production of the first commercial computers, UNIVAC I and II. Although great improvement had been made, programming the BINAC still proved difficult. Hopper taught herself how to add, subtract, multiply, and divide in octal, a number system with base eight that uses digits 0 through 7, in order to facilitate the process. Unfortunately, her checkbook suffered, as she occasionally subtracted an octal instead of a decimal from her balance.

Hopper remained with the company when Remington Rand bought it in 1950, and later when it merged with Sperry Corporation. During this time, she developed the first compiler, A-0, which translated symbolic mathematical code into machine code.

Using call numbers, the computer could retrieve subroutines stored on tape and then perform them. The A-2 became the first extensively used compiler, laying the foundations for programming languages. In 1952, she published her first paper on compilers. Hopper's next move was radical. She suggested that UNIVAC could be programmed to recognize English commands. Despite ridicule from her peers, Hopper succeeded in developing the B-0 compiler, later know as FLOW-MATIC, which could be used for typical business tasks such as payroll calculation and automated billing.

It soon became apparent that a standardized, universal computer language was necessary. In 1959, the first specifications for the programming language COBOL appeared. Members of Hopper's staff helped to frame the basic language design using FLOW-MATIC as their foundation. Hopper then helped to create standard manuals and tools for COBOL.

In 1966, Hopper's age forced her to retire from the Naval Reserves. However, in less than seven months, the Navy, unable to develop a working payroll plan after 823 attempts, recalled Hopper from retirement in order to help standardize the high-level Naval computer languages. Hopper returned to active duty with the Navy in 1967, charged with leading the effort to combine various versions of COBOL into USA Standard COBOL. She retired in 1986 with the rank of Rear Admiral.

Rear Admiral Grace Brewster Murray Hopper died January 1, 1992. She was buried with full military honors at Arlington National Cemetery[4].

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4 Maisel, Merry, About Grace Hooper, viewed 21 May 2009, <http://grace-hopper.org/2009/about/about-grace-hopper/>.

PL/1 (Programming Language One)

Abstract

This work examines important factors which supported the development of computer technology. The paper investigates history of appearance and developing of the Programming Language One (PL/1). The main points of the language and its structure were examined.

This project also shows the importance and the interconnection of PL/1 with the history of spacecraft technology and engineering.

History

PL/1 (Programming Language One) was the result of an attempt to come up with a new programming language which included the best features of the main languages in the 1960's. They wanted to bring FORTRAN up-to-date and be compatible with existing programs at the same time. Therefore, a decision to incorporate the best features of FORTRAN, COBOL and Algol was made.

PL/1 was introduced in 1966 and came with features which were innovations at the time. It included interrupt handling, array operations, list processing and a macro preprocessor. IBM originally intended to call this language NPL ("New Programming Language") but that abbreviation was already taken by the National Physical Laboratory in England.

Although lacking overwhelming popularity, it did receive significant use in isolated areas within business data processing, and some general use, especially authoring operating systems.

A PL/1 compiler was typically between two and four times as large as a similar COBOL or FORTRAN compiler, and about two to four times slower. In the days if 156Kb mainframes, this was a significant drawback that was only offset by programmer productivity.

PL/1 has a wide variety of subsets, such as PL/M, which was used to write the CP/M operating system, or CORC, developed by Cornell University, which had the interesting capability of never failing to compile any program due to extensive automatic syntax correction, and in addition it could convert any syntax errors it couldn't fix into output statements. Another variant developed for the Navy's signal processing was called SPL/1. PL/8, named as such because it was a simplified version of PL/1 containing approximately 80% of the functionality, had fewer data types and much more limited input/output.

Although it was used primarily for mainframes, there are versions of PL/1 for DOS, Windows, AIX, Unix and OpenVMS.

Author / IBM

IBM was originally called CTR (Computing Tabulating Recording) Corporation, formed in 1911. CTR was a merger between three different companies, called Tabulating Machine Company, International time Recording and the Computing Scale Corporation. This company manufactured a wide range of products from weighing scales, to coffee grinders, to punched card equipment (vital for the development of the computer). Although their products were incredibly varied, Flint (the noted financier responsible for the merger) believed that since they all focused on equipment and technology that made businesses more efficient, there were synergies and cross selling opportunities to be had.

When the incredibly diversified products being manufactured became difficult to manage, Flint turned to Thomas Watson Sr, former executive at the Natonal Cash Register Company for help. Watson then proceeded to enforce a wide variety of changes (such as employing the company's first disabled worker, starting an employee education department, generous sales incentives, etc). The most lasting reform occurred when an article from a Canadian CTR publication caught his attention, and on Feb. 14, 1924 the company was officially renamed International Business Machines, or IBM.

During the great depression of the 1930s, rather than reduce spending or attempting to save money in some way, Watson decided to continue to invest in more people, manufacturing and technological innovation. After the factories had been in operation for 6 years of running with virtually no market to sell to the social security act of 1935 ("the biggest accounting operation of all time", according to the IBM archives) presented IBM with a highly favorable economic position, as they were the only bidder in the market who could provide the necessary equipment. The successful performance of IBM lead to other governmental orders, and by the end of the great depression IBM had risen to the forefront of the industry.

After the passing of Thomas J. Watson Sr. 1956,, Thomas J. Watson Jr. became CEO in the midst of a period of rapid technological change and innovation, with nascent computer technologies rapidly being developed. After drastic restructuring of the company and the codification of the "unwritten rules" of IBM (such as the Open Door policy, and Speak Up!) as well as creating an equal opportunity policy (11 years before the civil rights act of 1964), he began pushing the company more and more towards modern computers as opposed to punch cards and tube circuitry. A combination of pioneering computer technology and governmental

partnerships, primarily for military technology, allowed IBM to emerge from the 1950s as the world's leading technology firm.

By the 1960s the industry would jokingly talk of "IBM and the seven dwarfs", as IBM produced 70% of all computers in 1964, and the much smaller size and scope of competitors.

From that point on, IBM has been the industry leader, inventing and pioneering all sorts of products. Some of these include first PC (personal computer, not seen as a "proper computer" when first invented) magnetic stripe technology used on credit cards, organic photoconductors used in office copiers, and fractal geometry, which is used in biology, engineering, metallurgy, art, health sciences, and computer graphics and animation.

Purpose of the Language

PL/1 was intended to be one universal language for both business and scientific programmers. This did not work out as IBM had intended, due in no small part to the deeply entrenched enmity between the two camps. A scientific programmer would look at PL/1 and see COBOL syntax, and a business programmer would look at PL/1 and see FORTRAN syntax.

To compound this issue, it also had pseudosimilarities to the languages they were used to, statements that look very similar to FORTRAN and COBOL, but subtly different, which left many experienced programmers with a negative view of the language, and often with an active dislike for it.

PL/1 was indeed a leap forward compared to the languages available at the time. Although it had full support for pointers to all data types, including structures, recursion, coprocessing, built-in functions, and a host of other interesting features. and a combination of the previously mentioned programmer bias, a lot of strange choices made the development of in language syntax caused difficulties for programmers. Some of these, such as having to scan down a few lines to find out if a statement was a declaration or executable, keywords not being reserved lending to further problems with autocorrection, for example meant that PL/1 never really gained a foothold in the market.

The major impediment for IBM's language, however, was the fact that competitors were not enthusiastic about spending money on an IBM designed language. As such they delayed or ignored implementation until their customers specifically asked for it, at which point they would attempt to convince them to stay with "tried and true" COBOL or FORTRAN.

Hardware / Systems supporting PL/I

PL/I is available on the following systems:

- IBM PC (80x86)
- IBM PL/I for z/OS and Windows
- IBM VisualAge PL/I
- Microfocus Open PL/I for Intel (Windows XP, 2000, Me/98)
- Microfocus Open PL/I for Redhat Linux (Intel)
- Solaris ix (Intel)
- HP 9000 HPUX
- UNIX
- SPARC Solaris 2.x
- Many other platforms and systems[1].

About the language

Character set:

There are 60 characters in the PL/1 language. They include the extended alphabet of 29 characters: A-Z,

@, #, and $: 10 decimal digits; 21 special character including " " blank, "="equal or assignment symbol, "+ "plus sign, "- "minus sign, "* "asterisk or multiplication symbol, " / "slash or divide symbol, "("parenthesis, ") "right parenthesis, ", "comma, ". "point or period, " ' "single quotation mark or apostrophe, '%" percent symbol, " ; " semicolon, " : "colon, " ^ " NOT symbol, " < "less than symbol, "_" underscore, and " ? "question mark.

Special characters may be combined to create other symbols. For example, "<=" means less than or equal to, and "**" denotes exponentiation. Blanks are not permitted in such character combinations.

Statements:

PL/1 is said to be free form, that is, a statement may contain blanks as needed to improve readability and it may span several lines. The end of a PL/1 statement is signified by a semicolon. As such, one line may contain several PL/1 statements each of which is terminated by a semicolon.

Because PL/1 is freeform, no special coding sheets are required. However, the first position (column) on a line cannot be used. In general, it is desirable to have no more than one statement per line. In many cases, it is appropriate to break a statement into smaller parts and code them on separate lines using indentation to highlight logical grouping of program code.

Structure/Examples

Brief overview of the structure in PL/1

There is a program which outputs the smallest value, the largest value, and the average value for a series of numbers input to the program. The number of values to be input is itself an input to the program and will be supplied first.

```
PRGRM1: PROCEDURE OPTIONS(MAIN);
DECLARE COUNT DECIMAL FIXED;
```

1 Internet FAQ Archives (2009) PL/I Frequently Asked Questions (FAQ), viewed 8 December 2009, <http://www.faqs.org/faqs/computerlang/plifaq/>.

```
PUT LIST('How many value will be input?');
GET LIST(COUNT);

IF COUNT >= 1THEN
BEGIN;
RUNNING_TOTAL = O;

PUT SKIP LIST('Enter the first value');
GET LIST(FIRST_VALUE);
SMALLEST = FIRST_VALUE; LARGEST = FIRST_VALUE;
RUNNING_TOTAL = RUNNING_TOTAL + FIRST_VALUE;

DO I = 2 TO COUNT;
PUT SKIP LIST('Enter the next value');
GET LIST(VALUE);
RUNNING_TOTAL = RUNNING_TOTAL + VALUE;
IF VALUE > LARGEST

THEN LARGEST = VALUE;

ELSE IF VALUE <SMALLEST THEN SMALLEST = VALUE;
END;/*DO*/

PUT SKIP LIST('The smallest value: ', SMALLEST);
PUT SKIP LIST('The largest value: ', LARGEST);
PUT SKIP LIST('The average: ', RUNNING_TOTAL/
COUNT);

END;/*BEGIN*/

END PRGRM1;
```

The program structures of PL/1 are basically those of ALGOL: block structure, conditional statement, and loops. A subroutine may be invoked as a separate task. One feature not usually found in high level languages is the ability to have compiletime macros. These permit, among other things, the calculation of indices or constants at compile time to permit greater execution efficiency without writing an excessive number of statements.

A distinguishing feature of most PL/1 implementations is their size. The complexity of the language makes a compiler and support packages for the full language quite large. Because the language was initially designed in the early 1960s, before conversational processing was well developed, its features are not particularly suited to interactive usage. However, some derivatives of the language have been specially designed for interactive use. Because of its size and heritage (originating with IBM and some of their major users), the language has been available primary on IBM mainframes, although PL/1 compilers have been developed. Subset PL/1 compilers have also been developed for educational use by Comell University and for microcomputer development by Microsoft Corporation.

Arrays of structures:

It is also possible to construct arrays in which each is a structure. To start below we re-declare CUSTOMER as a structure whose element ADDRESS is an array of two structures representing respectively the home and the business address of the customer.

```
DECLARE 1 CUSTOMER,
2 NAME CHARACTER(25),
2 ADDRESS (2),
3 LINE(2)  CHARACTER(20),
3 CITY            CHARACTER(15)
3 STATE           CHARACTER(2),
3 ZIP             FIXED DECIMAL(5),
2 BALANCE         FIXED DECIMAL(7,2);
```

As it can be seen, to declare an array of structures, a structure identifier – either major or minor – can be assigned the dimension attribute. The program segment below sorts an array of 1000 customers by their business address zip code value.

```
DECLARE CUSTOMERS(1000) LIKE CUSTOMER;
DECLARE TEMP LIKE CUSTOMER;
DO I = 1 TO 999;
DO J = I+1 TO 1000;
IF CUSTOMERS(I).ADDERSS(2).ZIP>
CUSTOMERS(J).ADDRESS(2).ZIP
THEN DO;
TEMP = CUSTOMER(I); CUSTOMER(I) =
CUSTOMER(J); CUSTOMER(J) = TEMP;
END;
END;
END;
```

Hello World in PL/1

This program demonstrates the text output function of the PL/I programming language by displaying the message "Hello world!"[2].

```
HELLO: PROCEDURE OPTIONS (MAIN);
/* A PROGRAM TO OUTPUT HELLO WORLD */
FLAG = 0;

LOOP: DO WHILE (FLAG = 0);
PUT SKIP DATA(' HELLO WORLD!');
END LOOP;
END HELLO;
```

2 University of MichiganDearborn – College of Engeneering & Computer Science (1996) The PL/1 Programming Language: Hello World!, viewed 20 November 2009, <http://www.engin.umd.umich.edu/CIS/course.des/cis400/pl1/pl1helloworld.html>.

Figure 1: The display and keyboard (DSKY) interface of the Apollo Guidance Computer mounted on the control panel of the Command Module, with the Flight Director Attitude Indicator (FDAI)

PL/I and Spacecrafts

"When NASA attempted to launch the first space shuttle, they rolled the spacecraft out to the pad, put the astronauts on board, and started the countdown. Then the computer reported a selfcheck failure"[1].

NASA's space program had a huge impact on the development of computer software and hardware. The prestigious Apollo project had to compete with the Russians, who had already launched their first human into space. This supported the development of computer technology and results in the standards we are used to nowadays.

IBM was closely related to the process of integrating adequate computer systems into spacecrafts. Today, IBM computers are used in the space shuttles[2].

Years ago, the most difficult task was to have a computer which would fit into a spacecraft and whose weight would not interfere with the launch. This was a change from the first computer called ENIAC to the Apollo Guidance Computer (AGC). As an example, this is a change in weight from 27t in the year 1946 (ENIAC) to 31.8kg (AGC) in the year 1966.

"The improvements in digital computer hardware made possible equally important improvements in the capability of the software that embodies the control laws of the aircraft. Whereas with an analog computer the "software" is essentially hardwired into the machine, a digital computer can be adapted to many different uses by changing its programming.

A limitation on soft-ware for real-time systems in aero spacecraft is the size of a computer word.

It not only affects the scale at which the computer can do computations; it affects the flexibility of its instruction set and the application software built for it. Engineers programmed early digital systems exclusively in low-level machine languages that are very difficult to inspect and understand and thus prone to human error. Early recognition of the inherently complex nature of these machine-based languages inspired the development of machine-independent languages such as FORTRAN, which express mathematical formula in terms more recognizable by the average engineer. However, the use of such high-level languages requires special translation software such as interpreters and compilers that recast the language statements into machine code"[3].

The AGC was divided into two systems called Block I and Block II. One of the great innovations in computer history was the so-

1 Qualline, S (2003) How Not to Program in C++: 111 Broken Programs and 3 Working Ones, or Why Does 2 + 2 = 5986?, No Starch Press, Incorporated

2 NASA (2009) Computers in Spaceflight: The NASA Experience Chapter Four – Computers in the Space Shuttle Avionics System, viewed 31 November 2009, <http://www.hq.nasa.gov/office/pao/History/computers/Ch43.html>.

3 Tomayk, J.E (2000) Computers Take Flight: A History of NASA's Pioneering Digital Fly by Wire Project, The NASA History Series, National Aeronautics and Space Administration, Washington D.C.

called timesharing. This system allowed multiple users using the same computer[4].

AGC software was written in AGC assembly language and stored on rope memory. Evidence can be found that also BASIC was used as a high-level language[5].

What is of more importance in regard to PL/I, is the mentioning of a dialect called XPL, which was especially engineered for HAL/S. HAL/S is the language used on space shuttles. Languages such PL/M, Pascal and Processor related Assembler languages are used today in commercial "Fly-by-wire" airliners. Here we see the importance and the interconnection of PL/I with the history of spacecraft technology and engineering.

HAL/S is a high-level programming language commissioned by NASA in the late 1960s to meet the real-time programming needs of the Agency. At the time, programs used on board spacecraft were either written in assembly languages or in interpreted languages. The former make programs difficult to write and maintain, and the latter are insufficiently robust and slow.

Also, future systems were expected to be much larger and more complex and cost would be moderated by the use of a high-level language.

Since NASA directed the development of the language from the start, it influenced the final form it took and specifically how it handled the special needs of real-time processing.

Statements common to other high-level languages such as FORTRAN and PL/1 were put into HAL. These included decision statements such as IF and looping statements such as FOR, DO, and WHILE. NASA added to the list of statements several specifically designed to create real-time processes, such as WAIT, SCHEDULE, PRIORITY, and TERMINATE. The objective was to make HAL quickly understandable to any programmer who had worked in other languages.

In addition to new statements, HAL provided for new types of program blocks. Two of these which are specific to realtime processing are COMPOOL and TASK. "Compools" are declarations of data to be kept in a common data area, thus making the data accessible to more than one process at a time. It was expected that several processes would be active at once and that many data items would need to he dynamically shared.

In late 1985, NASA announced that the language of choice for the upcoming Space Station project would be Ada. Commissioned by the Department of Defense in the late 1970s to serve as a standard for all contractor software development, Ada includes real-time constructs pioneered by HAL such as task blocks, scheduling, and common data. The announcement made NASA the first nonmilitary agency to use Ada. Ada was adopted because commercial compilers were available and because the DoD's insistence on its use meant that it would be around for a long time. It appears that HAL will be phased out, destined to join the hundreds of other dead computer languages"[6].

Reliability, "Fly-by-wire", Analog vs. Digital

While electronic analog computers were powerful and small enough to work in flight-control systems as early as 1940, no one seriously considered using digital computers for that purpose until the late 1950s. The reason was simple: digital computers were still giants. They used vacuum tubes, they had large power and refrigeration support systems, and their circuitry was neither densely packed nor reliable. As far as aircraft designers were concerned, they were cargo. At that time, the chief cause of computer failure was not software defects, as it is today, but hardware faults. A particular logic circuit could easily malfunction due to a vacuum tube and the resulting loss of a bit would result in an error in output. Early computer experts were quite concerned by this, of course, because widespread computer use meant that they would eventually be operated by nonexperts who would be much less likely to detect subtle hardware failures.

John von Neumann, one of the true geniuses of the twentieth century, spent much of the last decade of his life thinking about how digital computers are similar to the human brain and how exploiting the similarities could result in more sensible and reliable machine designs. In January 1952, he gave five lectures at the California Institute of Technology entitled "Probabilistic Logics and the Synthesis of Reliable Organisms from Unreliable Components" in which he suggested a way of increasing the reliability of computer systems. He proposed a component called a "majority organ." This would be used to vote the inputs from redundant strings of logic circuits. He chose as an example a triple logic design. Von Neumann showed that a positive value e exists for all components that represent their probability of failure. Exploring the mathematics, he noted that eventually all systems still fail, but increasing the number of input bundles to the majority organ allows a designer to fine-tune the desired reliability.

At first glance, this seemed to ensure that digital computers would never find their way into flight control systems. Objections to redundant digital computers centered on size, power, and weight. Tripling the logic circuitry and adding majority organs meant a penalty in all three areas. However, within a few years, transistors matured enough to replace vacuum tubes, core memories became more reliable and rugged (though still not very dense), and physical miniaturization together with lower power requirements all became

4 NASA (2004) Apollo operations handbook, 21 December 2004, viewed 30 November 2009,<http://history.nasa.gov/afj/aohindex.htm) >.

5 Mindell, D.A (2008) Digital Apollo : Human, Machine, and Spaceflight, MIT Press.

6 NASA (2009) Computers in Spaceflight: The NASA Experience [393397] Appendix II: HAL/S, A RealTime Language for Spaceflight, viewed 31 November 2009, <http://www.hq.nasa.gov/office/pao/History/computers/AppendixII.html>.

common. Therefore, interest in using digital computers in control systems increased, and von Neumann's elegant proofs became of interest to designers.

Deets and Szalai experienced difficult problems while building the software specification for these companies, in pryicls : 1) the use of a digital system in a previously all-analog world, and 2) the encapsulation of the computer behind an analog interface to the airplane. At the input end of the computer there was an analog-to-digital converter; at the output end, a digital-to-analog converter. When the pilot moved the stick, displacement translated to voltage. For instance, in the pitch axis, the limit of physical movement was 5.9 inches (nose up) toward the pilot and 4.35 inches (nose down) away from the pilot. The transformers were designed to generate a signal of plus or minus three volts. Therefore, the input to the analog-to-digital converter was scaled to the longer aft movement, so the forward movement had a maximum value of about 2.4 volts, while the aft movement topped out at 3.0 volts. The voltage from the transformers would be converted into bits and then serve as input to the software control laws".

"Draper Lab prepared the specification of the software from it. The variable names were cryptic and at first incomprehensible to an outsider. The following equation is an example:

DEC1=(KGE1)DEP1+DET1

DE meant "delta" or "change," C is "command," K is "constant," GE is "gearing," P is "pilot," and T is "trim." The equation can be loosely translated as: "The command change equals the gearing gain times the pilot stick position plus the change in trim"[7].

Despite the expectation that the software was correct and the hardware robust, the switch over to the analog backup flight system was carefully designed. Draper Lab used computer restarts as a solution to what were hopefully transient problems. Various logic errors could cause a restart: a parity failure in a data transfer (the bit used for parity checking was a 0 instead of 1, or vice versa), an infinite loop in the computations, an attempt to access unused memory, or silence from a running program. The most famous and disconcerting restarts happened for a different cause on the first lunar landing. The computation cycle was shared by multiple programs, each getting a few milliseconds to do one cycle. The total time of the cycle exceeded 20 milliseconds, which was the limit. The computer did a restart, but the problem persisted[8].

There were many different issues and problems in regard to the implementation of computer systems into NASA's spacecrafts. Some citations shall illustrate the delicacy of the problematic:

1) NASA News Release 66205, "Apollo Complex to Be Converted in IBM Contract," Aug. 3, 1966:[9]

NASA modified its contract with IBM to provide for work to be performed under a multiple-incentive arrangement covering cost, performance, schedule and equipment management. It also ordered the Real Time Computer Complex (RTCC) at MSC to be converted to IBM System computers, which would increase the operational capability for Apollo. The contract with IBM's Federal Systems Division, Gaithersburg, Md., provided the computing capability required for mission monitoring, in-flight mission planning and simulation activities.

2) Memorandum, William A. Lee, MSC, to Assistant Director for Flight Operations, "LEM UpData Link," May 6, 1965[10]:

"ASPO overruled a recommendation by the Flight Operations Directorate for an up-data link in the LEM. Although an automated means of inserting data into the spacecraft's computer was deemed "highly desirable," there were prohibitive consequences:

- Weight - 7.25 kg (16 lbs) in the ascent stage
- Cost - $1.7 million
- Schedule delay – five months

3) Memo, Phillips to Mueller, "Cost problems on AC Electronics Contract NAS 9497 for G&N Systems," March 28, 1966[11]:

Apollo Program Director Samuel C. Phillips discussed cost problems of the contract with General Motors' AC Electronics Division, in a memo to NASA Associate Administrator for Manned Space Flight George E. Mueller. One of the problems was late design releases from Massachusetts Institute of Technology to AC Electronics, resulting in an increase of $2.7 million.

Phillips also pointed out that computer problems at Raytheon Corp. had increased the program cost by $6.7 million, added that many of these problems had their origins in the MIT design, and listed seven of the most significant technical problems.

7 Tomayk, J.E (2000) Computers Take Flight: A History of NASA's Pioneering Digital FlyByWire Project, The NASA History Series, National Aeronautics and Space Administration, Washington D.C.

8 Tomayk, J.E (2000) Computers Take Flight: A History of NASA's Pioneering Digital Fly by Wire Project, The NASA History Series, National Aeronautics and Space Administration, Washington D.C.

9 NASA (2009) Part 1 (C) – Preparation for the Flight, the Accident and Investigation, viewed 30 November 2009, <http://www.hq.nasa.gov/office/pao/History/SP4009/v4p1c.htm>.

10 NASA (2009) Advanced Design, Fabrication and Testing, viewed 30 November 2009, <http://history.nasa.gov/SP4009/v3h.htm>.

11 NASA (2009) Part 1 (A) – Preparation for the Flight, the Accident and Investigation, viewed 30 November 2009, <http://www.hq.nasa.gov/office/pao/History/SP4009/v4p1a.htm>.

4) Memo from Bellcom, 29 July 1966[12]:

1. MSC had not had the opportunity to review an approved version of the final test method for the Block II/LM computer and as a result there was no official acceptance test for computers at that point, although the first of the flight-worthy computers had left the factory and the second was its final test at the factory.
2. The Design Review Report classified the timing margin of the Block II computer as indeterminate, since the team was unable to make a detailed timing analysis in the allotted time.
3. Both Block I and Block II Apollo guidance computer programs had experienced serious problems with parts qualification and with obtaining semiconductor devices which could pass the flight processing specifications.
4. The lack of adequate documentation to support the Block II computer and its design was cited "as perhaps the most significant fault uncovered" by the design review team.

12 Encyclopedia Astronautica (2008) Apollo CSM, viewed 1 December 2009, <http://www.astronautix.com/craft/apolocsm.htm>.

5) TWX, MSFC to addressees, Explosion of SIVB503 Stage, Jan. 23, 1967[13]:

The Saturn 503 SIVB stage exploded and was destroyed at the Douglas Sacramento, Calif., Test Facility at 4:25 pm. PST during a countdown. The exercise had progressed to 10 seconds before simulated launch (about 8 minutes before SIVB ignition) when the explosion occurred. Earlier that day the countdown had progressed to about 6 minutes past simulated launch when a problem with the GSE computer tape carrier head required a hold and a recycling in the countdown. No one was injured.

Patrick Scherer (Student, School of Computing)
Azamatjon Sharapov (Student, School of Computing)

13 NASA (2009) Part 1 (E) – Preparation for the Flight, the Accident and Investigation, viewed 30 November 2009, <http://www.hq.nasa.gov/office/pao/History/SP4009/v4p1e.htm>.

Part III:

Business Ethics

A major area of research in the research center concerns Ethics and Applied Ethics. In the current issue of the Bulletin a pluralistic view of virtue ethics is considered and a sample chapter of a book on Business Ethics to be published in the next year is presented.

ARISTOTELIS DE
MORIBVS AD NICOMACHVM
LIBRI DECEM.

Græcis Latina eregionè respondent, interprete DIONYSIO LAMBINO: cum eiusdem Annotationibus, & THEOD. ZVINGGERI Scholijs.

LIBER PRIMVS.

CAPVT PRIMVM.

Tria ueluti prolegomena declarat: Subiectum scilicet philosophiæ Ethicæ: Modum siue rationem eius tractandæ & explicandæ: & Qualem auditorem esse oporteat.

OMNIS ars, omnisq; docendi uia, atq; institutio, itēq; actio, & consilium, bonū aliquod appetere uidet. Iccirco pulchrè ueteres id esse bonum pronunciarūt, quod omnia appetūt. Sed uidētur fines inter se discrepare. Alij enim sunt muneris functiōes: alij, præter eas, opera quædam. Quarū aūt rerū, præter actiones, aliqui sunt fines, in his operasunt actionib. meliora natura. Cùm uerò multę sint actiōes, artes & scientię: tū multi quoq; fines extiterūt. Nā medicinę finis est, bona ualetudo: artis ædificādarū nauiū, nauis: artis imperatoriæ, uictoria: rationis eius, quæ in re familiari tuēda uersat, diuitiæ. Quæcunq; aūt artes huius generis uni alicui facultati subiectę sunt, (ut equestri ea, quę in frenis cōficiēdis occupata est, cæteræq; oēs ad instrumēta equestria cōparatæ: atque hęc ipsa equestris, omnisq; actio militaris, arti imperatoriæ: itēq; aliæ alijs:) in ijs omnibus fines earū, quę principē locū obtinent, earū quę eis subiectæ sunt, finibus

Aristotle's Nicomachean Ethics (Aristotelis De Moribus ad Nicomachum).
Source: http://www.ub.unibas.ch/kadmos/gg/pic/gg0127_007_txt.htm

Pluralistic Virtue Ethics and the Corporate Community

Abstract

In this paper we first present a brief historical introduction of virtue ethics and then continue to explore the "pluralistic view" of virtue ethics as presented by Swanton[1]. We then argue for a pluralistic virtue ethics framework as a foundation for business ethics within a corporate community and attempt to answer some of the problems posed by skeptics who are of the view that there is no sound conceptual foundation for the application of virtue ethics within the business arena.

1 Swanton, C., Virtue Ethics A Pluralistic View. Oxford University Press, 2005

Introduction

Virtue Ethics was one of the prevailing approaches in Western moral philosophy until at least the eighteenth century but during the nineteenth century it suffered a momentary eclipse. In January 1958 Anscombe's famous article "Modern Moral Philosophy"[1] brought it back in to the discussion of normative ethics. In her article she emphasized an increasing dissatisfaction with the forms of deontology and utilitarianism. Anscombe's article has also generated virtue ethical readings of philosophers other than Aristotle, such as Hume and Nietzsche[2]; as a consequence of this, many different forms of virtue ethics have been developed. Although modern virtue ethics does not have to take the form known as "neo-Aristotelian", almost any modern version still shows that its roots are in ancient Greek philosophy by the employment of three concepts derived from it. These concepts are arête (excellence or virtue) phronesis (practical or moral wisdom) and eudaimonia (happiness or flourishing).[3]

All standard versions of virtue ethics agree that living a life in accordance with virtue is necessary for eudaimonia. This supreme good is not conceived of as an independently defined state or life which possession and exercise of the virtues might be thought to promote. It is, within virtue ethics, already conceived of as something of which virtue is at least partially constitutive. Thereby virtue ethicists claim that a human life devoted only to physical pleasure or the acquisition of wealth is not eudaimon, but a wasted life, and also accept that they cannot produce a good argument for this claim proceeding from premises that the happy hedonist would also acknowledge. But although all standard versions of virtue ethics insist on that conceptual link between virtue and eudaimonia, further links are matters of dispute and generate different versions[4].

For instance, in Aristotle, is philosophy, virtue is necessary but not sufficient. Following the Aristotelian perspective what is also needed are external goods. Meanwhile for the Stoics it is sufficient and necessary[5]. Thus, if we follow Swanton account of the eudaimonism, the good life is the eudaimon life, and the virtues are what enable a human being to be eudaimon because the virtues are just those character traits that benefit their possessor in that way. So there is a link between eudaimonia and what confers virtue status on a character trait. According to pluralism, there is no such tight link. In the end the good life is the morally meritorious life, the morally meritorious life is one that is responsive to the demands of the world on a suitably moralized understanding of "the demands of the world". It therefore becomes the virtuous life because the virtues just are those character traits in virtue of which their possessor is thus responsive. We now examine how such a suitably moralized understanding of "the demands of the world" can be incorporated in a pluralistic view of virtue ethics[6].

1 The article is available at http://www.philosophy.uncc.edu/mleldrid/cmt/mmp.html.

2 Swanton, C., Virtue Ethics A Pluralistic View. Oxford University Press, 2005.

3 See Hursthouse R., at http://plato.stanford.edu/entries/ethics-virtue/ on possible problems with the translation of eudaimonia with happiness and or flourishing.)

4 See Hursthouse, R., at http://plato.stanford.edu/entries/ethics-virtue/

5 Annas, J., The Morality of Happiness, New York: Oxford University Press, 1993

6 Swanton, C., Virtue Ethics A Pluralistic View. Oxford University Press, 2005

Pluralistic Virtue Ethics

Swanton's pluralism is an important contribution to pluralism. Her account is complex and provocative, surely to be probed by the philosophical community. According to Swanton, the most fundamental normative moral concepts are the concepts of virtue and the associated concept of character. Here the concept of good character-trait-profiles is central to understanding the kind of pluralistic virtue-ethics that Swanton recommends.

The definition of virtue put forward by Swanton is as follows:

"A virtue is a good quality of character, more specifically a disposition to respond to, or acknowledge, items within its fields or fields in an excellent or good enough way"[1].

We need to know what kinds of response to items in a virtue's field constitute virtuous responses and what are the standards for a response, in order to count as good enough to be virtuous. In order to answer these questions we first explore the following key ideas put forward by Swanton:

1) The field of a virtue.
2) Modes and bases of moral responsiveness.
3) Profiles of the virtues.
4) Bases of moral responsiveness.

The notion of a virtue's field consists of those items which are the sphere(s) of concern of the virtue and to which the agent should respond. In agreement with the virtue's demands, these items may be situations such as business virtues associated with excellence in business deals that may be the concern of an investor responding to investment decisions. Items in a virtues field therefore make demands upon us. Swanton says that a virtue is a disposition to respond well to the "demands of the world" which in a broad sense include those of oneself. Kant's view, for example, there is a moral duty of self-perfection arising from the treatment of oneself as a moral end. The Kantian view is reflected in those virtues which are at least in part self-regarding, for example, those of self-love, temperance, and the creative virtues necessary for developing one's talents. Figure 1 represents a pictorial view of the field of a virtue.

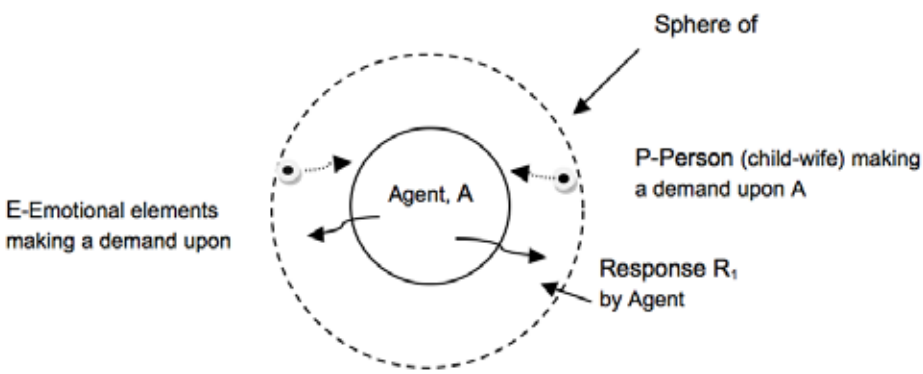

Fig. 1 – Illustrating the Sphere of Concern

Swanton explains the modes and bases of moral responsiveness as "kinds of responsiveness" in the virtue's field. Responding well to items in the field of a virtue may take several forms; these are called "modes of moral responsiveness" or "modes of moral acknowledgement". They include not only promoting or bringing about benefit or value but also honoring value[2]. According to Swanton these modes of moral responsiveness are richly displayed in the virtues. Is it possible to provide some kind of unifying account of the plurality of modes?

In Fig. 1, the response $\boldsymbol{R_1}$ to the "demands of the world" may take several forms, this represents the plurality of modes of response, and how are these integrated within the virtues. What are the standards for a response to count as good enough to be virtuous? Swanton describes the "profile" of a virtue as that constellation, or set of modes of moral response which comprises the virtuous disposition; $\boldsymbol{R_1}$ is therefore a response that comprises the virtuous disposition. If we denote the profile of a virtue as $\boldsymbol{P(v)}$, then

$$\boldsymbol{P(v) = \{R_1,\ldots,R_n\}}$$

So, for example, the profile of the virtue of friendship requires that we acknowledge items in its field through several modes of responsiveness that comprises virtuous dispositions. The important aspect of virtue-ethical pluralism is that the modes of moral responsiveness to items in the fields of the virtues are plural. This conception of virtue acknowledges the complexity of human responsiveness to the world. The virtues, with their complex profiles, recognize that we are beings who are not only agents of change in the attempt to promote good, but also agents of change in the attempt to produce and create.

The other reason for the variety of response acknowledged in the virtues lies not in the nature of the responder but in the nature of the items responded to. Different types of response are warranted by the different types of morally significant features in the items constituting the fields of the virtues. Swanton calls such features a "basis" of moral acknowledgement and observes four such bases: value, status, good (benefit), and bonds. For example various virtues will call for the value of objects to be promoted or honored. Bonds between an agent and items within the field of a virtue may call for such items to be loved in ways appropriate to those bonds, as exhibited in virtues such as compassion, parental love, and friendship.

Virtues therefore have profiles containing a plurality of functions, a plurality of modes of moral acknowledgement, and a plurality of targets (objects of moral concern).

1 Idem, p. 19.

2 Ibid. 2.1

A virtue's function-profile includes its integrative functions, its expressive functions, and its creative functions by way of its multiple modes of moral acknowledgment. In addition to the promotion of value, a virtue's acknowledgment-profile contains universal love and self-love, respect for persons and proper authority, and various modes of creativity. A virtue's target-profile includes the many objects that can be integrated and expressed by various modes of moral acknowledgment.

To have the virtues implies one has set of good character traits that embed a complete and pluralistic set of good forms of moral acknowledgment: promotion of value, the bonding and attachments that go with universal love and self-love, the distancing that comes with respect for persons and respect for proper authority, and the various modes of creative expression. This aspect of virtue has the function of connecting us to the world and providing us with many objects of concern to be integrated into a good life.

The plural modes of moral acknowledgment that are expressed in good character-trait-profiles. This require that good character-trait-profiles have integrative functions that bring unity to this plurality and expressive functions that allow the virtuous person to coherently express a life that honors all these modes of acknowledgment in an integrated way. This explains why moral concern is pluralistic and not unitary, nevertheless a substantially integrated whole. What is central is that the view we are being asked to accept by Swanton is one in which no one mode of moral acknowledgment dominates all other forms of moral acknowledgment. Each operates as a constraint on the expression and integration of the others to achieve a coherent whole. This means that we should reject any monistic view that either acknowledges only one form of moral concern or gives lexical priority of place to a single form of moral concern across all moral contexts.

Another part of the view that we are being asked to accept is that possessing the virtues raises the question of right action in a certain way and provides the grounds for answering it. Possessing the plural acknowledgment-profiles of good character traits gives us reasons to care about the targets of the virtues "as the demands of the world" and about how these demands can be reconciled and integrated in a coherent way in terms of action. Indeed, the issue of right action just is how to integrate, reconcile, and express the demands of the world as they press upon a person of good character. The positive view that we are being asked to accept is the view that the right action is action that satisfactorily meets the demands of the world, that is, the demands of honoring the targets of the virtues as objects of plural modes of moral acknowledgment. Among other things, this means that we should reject views that reduce the demands of the world to the demands of what contributes to our flourishing.

Finally, to possess the virtues requires the capacity to integrate and reconcile a plurality of concerns and demands of the world. The achievement of this requires a moral epistemology that involves a context dependent procedures, carefully specifying the contexts in which conflicts arise. Successful integration is often achieved by seeing how the conflicts are resolved by a proper understanding of the particular features of the contexts in which they arise. Possessing the virtues means possessing the virtues or practice, which include the virtues of inquiry and wisdom about how to specify ends in their various contexts. It also means being open to the views of others and the kind of searching dialogue required to properly respond to the demands of the world. What role does Swanton's pluralistic virtue ethics play in the arena of business?

Pluralistic Virtue Ethics and the Business Arena

The problem with business ethics is no longer vulgar ignorance, but a far more sophisticated confusion concerning exactly what the subject is supposed to do and how. The theory applies to the practice of business. Indeed a large part of the problem is that it is unclear what a theory in business ethics is supposed to look like or whether there is, any such theoretical enterprise. Business ethics is too often conceived as a set of impositions and constraints, obstacles to business behavior rather than the motivating force behind the behavior. So conceived, it is no surprise that many people in business look upon ethics with suspicion, as antagonistic if not antithetical to their enterprise. However, properly understood ethics does not and should not consist of a set of prohibitive principles or rules. In our view Swanton's pluralism has an important role to play in the domain of business ethics. We begin by detailing Swanton's idea of the role of love and respect in profiles of the virtues and then extend this to the arena of business ethics.

As detailed in the previous section the concept of good character-trait-profiles is central to understanding the kind of pluralistic virtue ethics being recommended by Swanton. The shape of the virtues, for Swanton, is determined by the specification of standards for responsiveness to items in the virtues field. What we mean by this is that inasmuch as virtue demands that we transcend various personal desires, attachments, feelings and emotions in our responses to the demands of the world, we want to know just what is the nature and extent of such a demand. A central distinguishing feature of a pluralist virtue-ethical account of virtue lies in its conception of what counts as acknowledgement of an item which is good enough to count as manifesting a state of virtue. Such acknowledgement must express inner states that are sufficiently fine.

For Swanton, expressing inner states is an aspect of the profiles of the virtues, for each mode of moral acknowledgement comprising

the profile, be it providing value or respecting individuals, must express those states. A fundamental characteristic of pluralistic virtue ethics that has to be incorporated into any framework of business ethics is that for an action to be from a state of virtue, that is for an action to be expressive of virtue, it must be expressive of fine inner states, and amongst those states will be the background motivation of acting from virtue. According to Swanton the features that make traits virtues are exactly the same features that determine the virtuousness of response to items in the field of a virtue. This yields the following principle of virtue status:

"What makes a trait a virtue is that it is a disposition to respond in an excellent way (or a good enough) way (through the modes of respecting, appreciative creating, loving, promoting and so on) to items in the fields of virtue"[1].

Swanton calls this principle (T). The essential difference between (T) and neo-Aristotelian virtue ethics is that the later is characterized by an attempt to combine eudemonism and naturalism through the unifying idea of the perfection of our (rational) nature. Perfection of our nature certainly requires not merely that we flourish but that we respond excellently to the demands of the world. A pivotal integrating role is played by love and respect in the profiles of the virtues. According to Swanton[2], Kant is correct in his claim that love and respect (including self-love and self-respect) are the two great moral forces and they must come into equilibrium if they are to constitute aspects of profiles of all the virtues. That love features in all the virtues is a prima facie counterintuitive claim. For example, perseverance as a virtue requires self-love if a healthy bonding with ones' projects is to be worthwhile in a virtuous manner.

For example, laboratory technicians and other specialists are less likely to concentrate on the examination of cervical smears if they fail to have the attitude "there is a woman behind every smear" and an attitude of concern for those women. There may be research abuses if there is inadequate respect.

If love and respect are aspects of the profiles of all virtue, we might ask, how do these feature in the different kinds of virtue? A virtue ethics recognizes that love and respect as "two great moral forces" have to be interpreted through the various virtues. According to Swanton[3] their nature as displayed in the virtues will be appropriately contoured by the following sources of variation:

(a) The various types of objects which constitute the fields of the virtues.
(b) The different aims of the virtues in relation to those fields.
(c) The different bases of moral response which are appropriate to the kinds of items in the virtue's field, and to the aims of that virtue.
(d) The way the virtue is manifested in the narrative structure of the agent's life.

Consider the example of a business manager in an organization that is involved in multicultural trade. This business manager is under pressure to meet strict deadlines relating to sales targets. The sales team he manages has to work over-time during the weekend and one of the members of the sales team cannot meet this requirement as she is also under pressure to look after her disabled child at home, and no one else can do this for her during the weekend. Her work is important, as this is the only source of income, and working overtime may bring her a much needed bonus payment. To make things more complicated, the business manager is also emotionally attached to this member of staff of his sales team; he is married but has been having an elusive relationship with this sales team member for a few years. What does Swanton say concerning the modes of moral response of this manager?

According to Swanton if we are to assess whether loving attention is required in virtue we need to first consider what role wisdom plays in loving attention. The business manager has all the required knowledge of his staff member in order to decide what ought to be done in this case; however we need to ask the question, is this all that is required? Swanton identifies two important issues, namely:

(i) What is the relation between attention and love?
(j) Can (loving) attention be distorting, and inaccurate to the facts?

In the above example, what is required to formulate a complete analysis of the situation and therefore a pluralistic virtuous response is not further knowledge of the team member that the business manager is having an affair with, but what psychological and historical traits of the relationship are distorting his emotional perceptions. So, the requirement is not further knowledge of the team member, but self-knowledge. As Murdoch claims, "The world is aimless, chancy and huge and we are blinded by self"[4]. The point made here is that because perception that the world is "chancy and huge" is necessarily highly selective, but the selection must be free of psychological distortions. The difficulty is to keep the attention field upon the real situation and to prevent it from returning surreptitiously to the self with consolations of self-pity, resentment, fantasy and despair. Receptivity is also inhibited by anxiety, according to Murdoch:

"By opening our eyes we do not necessarily see what confronts us. We are anxiety ridden animals. Our minds are continuously active, fabricating an anxious, usually self-preoccupied, often falsifying veil which, partially conceals the world"[5].

Attention, required to gain an increased perception of detail in a huge, complex world, and a sense of relevance of detail to problems cannot therefore be blinded by self and the obscure devices of the psyche. In the example detailed earlier, unless the distorting elements within attention are identified and the relevant

1 Ibid. 93
2 Ibid.100
3 Ibid. 101
4 "The Sovereignty of Good over Other Concepts", The Sovereignty of the Good, London: Routledge, 1970, 77-104, at 100.
5 Ibid. 84

action taken, the insecure manager whose attention is "emotionally inclined" as a consequence of his own emotional attachment will most probably fail to recognize the goal of the sales team clearly, let alone utilize their strengths in ways optimally beneficial to the organization.

We now turn to answer the critique made by Dobson[6]. In his paper Dobson states that "A detailed understanding of virtue concepts reveals that it is fundamentally anti-ethical to conventional business activity". Dobson addresses two questions:

(a) Why is virtue finding such a powerful voice within the business ethics discourse?

(b) What are the implications for the discipline of business ethics if it is viewed increasingly through the lens of virtue-ethics theory?

In answering the first question, Dobson suggest that business ethics is turning to virtue ethics because attempts to apply other moral philosophies have failed and commenting on the second question Dobson says that by "admitting" virtue ethics into " the walls of business ethics theory, will force the later to question the very tenets of competitive business enterprise"[7]. We agree with Dobson when he says that the crucial factor here is not observable action, but rather the underlying motivation. It is the motivation for the action that determines whether the act is fundamentally ethical or economic. Dobson comments that business ethicists often seem to forget this; they confuse strategic cooperation with moral cooperation. Commenting on the work of Richard T. De George, Dobson[8] continues to say that the reasons why firms and individuals within firms act with integrity is because they wish to be successful: " success is the aim of integrity ", the motivation is economic not moral.

We agree with Dobson that "economic rationales" cannot be used to "sell" ethics in business. However substantive concepts from pluralistic virtue ethics can aid us here. We must be careful not to confuse business or corporate success with the ethical behavior of individuals within the corporate arena. Individuals running and governing business organizations within a competitive business environment are bound by the framework of pluralistic virtue ethics discussed earlier. Our argument is that such ethical frameworks can be successfully implemented at the individual managerial level as will be detailed later on in this paper.

Dobson quotes the review of Robert Black[9] and says that there is "confusion between motivation and action". The action appears moral, but the motivation is clearly material when businesses honor contracts in order to foster ongoing customer relations. However following what was discussed earlier concerning pluralistic virtue ethics, such action is not compatible with behavior at the individual level. Modes of moral acknowledgement would require the implementation of business virtues that an individual sales manager would aim to develop. The end goal of such actions may be economic profit, however the motivation behind the actions would be to develop and exercise pluralistic business virtues.

Dobson asks the following questions, " what exactly precludes individuals within a corporation from exercising the virtues? Why can we not have a virtuous corporation?"[10].

Dobson is in fact asking two different questions, the first relates to an individual within an organization and the exercise of business virtues, the second question relates to a virtuous corporation. As stated earlier, a pluralistic virtue ethics framework can be applied to formulate an understanding of ethical behavior and motivation of an individual here, the manager within a corporation. Such a pluralistic ethical framework can incorporate agents within the corporation to carry out "competitive economic activity" that is congruent to the economic goals of the corporation and at the same time the actions of such agents will be grounded within the domain of pluralistic virtue ethics.

Dobson utilizes MacIntyre's work who concluded that, " the tradition of the virtues is at variance with central features of the modern economic order "[11]. Dobson utilizes MacIntyre's conclusion, which is based on three key ideas, that of a "practice", "external good" and an "internal good", to show that virtue ethics excludes competitive economic activity. Before we continue to show that a pluralistic virtue ethics framework can indeed incorporate competitive economic activity, contrary to Dobson's view point, it is worth elaborating on the three key ideas of Macintyre mentioned above. According to MacIntyre external goods are characteristically objects of competition in which there must be losers as well as winners. Internal goods are indeed the outcome of competition to excel, but it is characteristic of them that their outcome is a good for the whole community who participate in the practice, so according to Macintyre a tentative definition of virtue could be:

"A virtue is an acquired human quality the possession of which and the exercise of which tends to enable us to achieve these goods which are internal to practices and the lack of which effectively prevents us from achieving any such goods"[12].

When Aristotle speaks of excellence in human activity, he sometimes though not always, refers to some well-defined type of human activity. MacIntyre suggests that this notion of a particular type of practice as providing the arena in which the virtues are exhibited, and in terms of which they are to receive their primary definition, is crucial. Let us, for a moment, elaborate on what

6 Dobson, J. "Virtue Ethics as a Foundation for Business Ethics: A "MacIntyre-Based" Critique", Paper available at www.stthomas.edu/cathstudies/cst/conferences/antwerp/.../Dobson.pdf

7 Ibid. 1

8 De George, R. T., Business Ethics, 4th Edition, Prentice Hall, New York, 1995.

9 Black, R., "John Commons on Customer Goodwill and Economic Value of Business Ethics: Response to Professor Sen, Business Ethics Quarterly 4, No.3, 359-366, 1994.

10 See Dobson page 5.

11 MacIntyre, A., After Virtue, University of Notre Dame Press, 2nd Edition, Notre Dame, p.254, 1984.

12 Ibid. 191.

"practice" could mean. MacIntyre suggests that this could mean any coherent and complex form of socially established cooperative human activity through which goods internal to that form of activity are realized in the course of trying to achieve these standards of excellence which are appropriate to, and in particular definitive of that form of activity, with the result that human powers to achieve excellence, and human conceptions of the ends and goods involved are systematically extended.

Every practice requires some kind of relationship between those who participate in it, the virtues are those goods by reference to which, whether we like it or not, we define our relationship to those other people with whom we share the kind of purpose and standards which inform practices. MacIntyre is always clear about the difference between practices and institutions. Institutions are characteristically concerned with external goods. They are involved in acquiring money and other material goods, they are structured in terms of power and status and they distribute money, power and status as rewards. Institutions and practices characteristically form a single causal order in which the ideals and the creativity of the practice are always vulnerable to the acquisitiveness of the institution, in which the corporate goods of practice are venerable to the competitiveness of the institution. In this context the essential function of the virtues is clear. Without them, without justice, courage and the truthfulness, practices could not resist the corrupting power of institutions. We could therefore formulate MacIntyre's relationship between external and internal goods as follows, if we denote internal goods as IG and external goods as EG then,

$$IG=f(,1\text{-}EG.)$$

As MacIntyre says, "possession of the virtues may perfectly well hinder us in achieving external goods "[13]. In other words, pursuit of external goods is inversely related to the acquisition of internal goods. In an example detailed by MacIntyre and used by Dobson, two fishing communities are compared:

"A fishing crew may be organised as a purely technical and economic means to a productive end, whose aim is only overridingly to satisfy as profitably as possible some market demand for fish. Just as those managing its organization aim at high level of profits, so also the individual crew members aim at a high level of reward. When however the level of reward is insufficiently high then the individual whose motivations and values are of this kind have for her or his own point of view the best reasons for leaving this particular crew or even taking another trade. Management will from its point of view have no good reason, and owners will have no good reason not to invest their money elsewhere"[14].

According to MacIntyre such an organization is clearly one that is pursuing external goods in a competitive market economy. MacIntyre goes on to describe another fishing community.

"Consider by contrast a crew whose members may well have initially joined for the sake of their wage or other share of the catch, but who have acquired from the rest of the crew an understanding of and devotion to excellence in fishing and to excellence in playing ones part as a member of such a crew... .so the interdependence of the members of a fishing crew in respect of skills, the achievement of goods and the acquisition of virtues will extend to and interdependence of the families of the crew members and perhaps beyond them to the whole society of the fishing village"[15].

MacIntyre comments that the later fishing crew clearly pursues internal goods of practice, and such an organization is powerless against the rigors of market competition. Dobson comments and says, "Indeed it seems likely that the later crew would rapidly fall victim to the former if these two crews were in competition for the same fishing grounds. A truly virtuous corporation qua virtue-ethics theory therefore is an entity that is very poorly suited to competitive economic activity"[16].

Our view is that there is a key component missing from the above argument. In addition to the cultivation of the virtues mentioned in the later fishing community, there is also the duty of the crew members to work towards the survival of their fishing industry in the competitive fishing market. Their duty is not only to themselves, but it extends to the fishing community of which they are a part. We would therefore argue that the later fishing community will be motivated by this desire to "excel" in such a competitive market. As a consequence the crew members that form such a community will cultivate and exercise such pluralistic virtues of "survival", one could argue further and say that such virtues may compel the flourishing of the competitive economic market, since the existence of such a vibrant competitive economic market is a pre-requisite for the existence of any fishing community that is to aim for profit maximization as their key strategic objective.

In order to understand this point, it is important to make a much neglected distinction between a corporation and a corporate community. Some business ethicists note that a corporation is a type of community, for example Solomon[17] states that, "corporations are real communities". Following Solomon we could therefore say that a corporation, C_1 is defined by its members (individual managers) $m_1, m_2, ..., m_n$, so:

$$C_1 = (m_1, m_2, ..., m_n)$$

For example, for a hedge fund management corporation, m_1, m_2,..., m_n could be the hedge fund managers, directors etc. In a similar manner C_1, C_2,..., C_n could form the different hedge fund corporations that form the market for hedge funds. The survival of these corporations within the market would depend on several variables; key amongst these, could be the attainment of external

13 Ibid. 196.

14 Ibid. 285.

15 Ibid. 285.

16 See Dobson, p.9.

17 Solomon, Robert C., "Corporate Roles, Personal Virtues, An Aristotelian Approach to Business Ethics", Business Ethics Quarterly, 2, p.325, 1992.

goods, for example, the attainment of profits, as defined by MacIntyre. We could therefore define the degree of survival of the corporation within the market as D_s, where D_s would be a function of several variables such as profits, P, market share, M_s... so,

$$D_s = f(P, M_s, ...)$$

The managers that form the corporation would formulate strategies and work to achieve goals congruent with corporate strategy in the pursuit of external goods. Considering our example of hedge fund managers, let us define the ethical business virtues of a hedge fund manager, m_1 as BV_{m1}, following Swanton, we could formulate the profiles of such business virtues for a hedge fund manager, these would include, amongst others, Trust, T, justice, J and honesty, H so:

$$BV_{m1} = f(T, J, H, ...).$$

Following the ideas developed earlier concerning pluralistic virtue ethics, it would be reasonable to consider such business virtues as dispositions of the hedge fund manager. This is a reasonable claim; if someone is generous, for example, that she has a character of a certain sort, that mates her dispositionally, that is, habitually and reliably generous. So, such managers would have dispositions to act for reasons. The exercise of the managers practical reasoning is thus essential to the way such virtues would be built up and exercised, they would be dispositions to do the right thing for the right reasons, in the appropriate way – honestly, courageously, and so on. This would involve two aspects, the affective and the intellectual. What would be the affective part of virtue in this case? Managers may do the right thing and have a variety of feelings and reactions to such actions. They may discover that doing the right thing may be contrary to their desires, so they may do the right thing but with conflicted feelings or with difficulty; do the right thing effortlessly and with no internal opposition, virtue requires doing the right thing for the right reasons, without serious internal opposition as a matter of character – the manager understands that this is the right thing to do.

It is therefore essential that to develop such pluralistic business virtues the manager goes through appropriate training programs incorporating the development of character that allows the manager to think for himself about reasons on which he acts. Following Swanton[18] the notion of virtues as prototypes could be incorporated within such a training framework. Swanton suggests thinking of virtues as a framework of broad constraints (the prototype) which is then "contoured" (made more specific) so that such prototypes are applicable to concrete situations.

Ideally, the manager will begin to reflect for himself on what he has accepted, will detect and deal with inconsistencies, and will try to make his judgments and practice coherent in terms of a wider understanding that enables him to unify, explain and justify the particular decisions he makes. This is a process that requires the agent at every stage to use his mind, to think about what he is doing and to try to achieve understanding[19].

The development of such ethical understanding, leading the manager to develop dispositions that are virtues is like the acquisition of practical skills or experience. As Aristotle says, becoming just is like becoming a builder: one is not born with such character traits. In the case of the hedge fund manager progressive training and learning of business virtues will be an essential component of a management training program. With a practical skill, there is something to learn, something conveyable by teaching, and there is progress from the mechanical rule, or model-following of the learner to greater understanding of the expert, whose responses are sensitive to the particularities of situations, expressing learning and general reflection. Corporate business ethics training incorporating such conveyable skills has been shown to be successful and productive for management decision making[20]. Following such a coordinated training program the set of managers forming the corporate community would develop pluralistic virtue ethics skills as part of their character. With appropriate coaching at the individual level such training could be focused to attend to the lack of virtue ethical traits in management decision making. We could therefore define the ethical character, ECc of the corporate community as the sum of the ethical business virtues of the individual members forming that community:

$$ECc = \sum_{m=1}^{k} BV_{m_n}$$

Contrary to what was discussed earlier concerning the work of MacIntyre and Dobson, the ethical character of a business community, as defined above, would offer us a framework to incorporate a pluralistic virtue ethics framework at the level of a corporate community, this would allow us to re-define our notion of degree of survival of a corporation in a competitive market as:

$$D_s = f(P, M_s, EC_c .....)$$

Acting virtuously is not therefore an alternative to making money, as described by MacIntyre and Dobson, but rather, making money is one of the things you have to do, as the degree of survival, D_s for a corporation is a function of profitability. P. Managers can therefore make money virtuously or not. Which of the two options chosen makes all difference to the significance of the corporation in the market. Consumer behavior is increasingly determining market structures and responses; one of the key determinants of such consumer led demand is the corporation's response to ethical

18 See Swanton, p. 279.

19 Annas, J., "My Station and Its Duties, Ideal and the Social Embeddedness of Virtue", Proceedings of the Aristotelian Society n.s., 102, 109-123, 2002.

20 Gahir, B., "An Evaluation of Business Ethics Training though DIT and Content Analysis", CASA Conference, June 2007

objectives. There is ample evidence to indicate[21] that corporations integrating ethical principles within their strategic objectives outperform, in the long-run, those that do not follow such actions.

The much neglected importance of incorporating business ethics training at all levels of management has taken on importance recently. There is recent evidence[22] indicating that the brain has two systems for making judgments about money and a whole array of other decisions that allow us to navigate our everyday lives, one system is intuitive, the other rational. The intuitive system sometimes produces errors in thinking, "cognitive biases", which lead us to trouble when dealing with financial matters. Neuroeconomics in a close relation of behavioral economics has determined how such biases have led us to formulate decisions based on the use of money. Pinpointing the irrational psychological factors that lead to bubbles and severe market disequilibrium conditions, behavioral psychologists have addressed the "money illusion" and other irrational psychological foibles as the key underlying features for financial bubbles and severe downturns that follow. Schiller[23], leader in the field, cites "animal spirits" – a phrase originally used by John Maynard Keynes as the predominant cause of such irrational behaviour. In the business cycle, the normal ebbs and peaks of economic activity depends on a basic sense of trust, an ethical principle forming one of the business ethics virtues defined earlier for both business and consumers to engage one another every day in routine economic dealings. This basis for trust, however is not always built on rational assessments. Animal spirits – the gut feeling that, yes, this is the time to buy that house or that stock – drive people to overconfidence and rash decision making during a boom. Emotion-driven decision making complement cognitive biases that lead to poor investment logic. Such "animal spirit" reactions are ample evidence to indicate the paramount need for business ethics training at all levels of management when coupled with a framework of governance to ensure that pluralistic virtue ethics principles are embedded within management decision making. Without a governance framework such pluralistic virtue ethics principles would only be an optional choice for the corporate community and would therefore be adopted for non-ethical motivational reasons. Behavioral economics has gone beyond just trying to provide explanations for why investors behave as they do. It actually supplies a framework incorporating key pluralistic virtue ethical principles for investing and policy making to help people avoid succumbing to emotion-based or ill-conceived investments. Sustein[24] has come up with the term "libertarian paternalism" to describe how government regulation can nudge people away from an inclination towards poor decision making based on self interested profit motives coupled with irrationalism (MacIntyre's external goods). It relies on a heuristic called anchoring – a suggestion of how to begin thinking about something in the hope that thought carries over to behavior. Decision making can be more complex for a business or hedge fund manager faced with conflicting desires, in such circumstances, a "choice architecture" incorporating a pluralistic virtue ethics framework would assist to formulate decisions amongst various options, various examples incorporating such strategies have been detailed by Thaler, the founder of behavioral economics[25].

We would therefore argue that it is part of the business processes of a corporate community to integrate the training of pluralistic virtue ethical principles that can be governed by an appropriate framework. What is important, however, is that such virtue ethical training frameworks cannot be developed into a theory telling people what it is right and wrong to do in a way that pays no attention to the fact that they are aspiring to ideals from within different contexts and at very different stages of their own ethical development. As has been forcefully pointed out by Hursthouse[26], this is a completely unrealistic view of ethical thinking.

Conclusion

In this paper our intention has been to provide an understanding of pluralistic virtue ethics as detailed by Swanton and to apply such a framework to a corporate community. A tentative definition of a corporate community was provided with a view to make a distinction between a corporation and a corporate community. The importance of business ethics training with an appropriate governance framework was stressed as a key component for the successful implementation of any kind of pluralistic virtue ethics framework at the managerial level forming a business community.

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Ethics in the Marketplace

The following forms chapter 4 of a textbook "Business Ethics-Concepts and Scenarios" due to be published shortly by Bruce Gahir and Stefano Cavagnetto. This textbook is an integral part of business ethics studies at HND, B.A. and Masters levels at the college.

Introduction

This chapter moves the consideration of business ethics from the morality of the economic system in general to the morality of specific practices within our system. Given that our system generally follows the free market model, which is based on competition, it may be surprising to note that there are so many examples of anticompetitive practices in the world today. A report on New York Stock Exchange companies showed that 10 percent of the companies had been involved in antitrust suits during the previous five years. A survey of major corporate executives indicated that 60 percent of those sampled believed that many businesses engage in price fixing[1]. One study found that in a period of two years alone over sixty major firms were prosecuted by federal agencies for anticompetitive practices[2]. Actually, it is more than surprising. The morality of the free market system itself is based on the idea of competition creating a just allocation of resources and maximizing the utility of society's members. To the extent that the market is not competitive, it loses its moral justification for existing.

To understand the nature of market competition and the ethics of anticompetitive practices, it is helpful to examine three abstract models of the different degrees of competition in a market: perfect competition, pure monopoly, and oligopoly.

1 Sharen, D.K., Concerned Investors Guide, NYSE Volume 1983, Arlington, VA, Resource Publishing Group, Inc., 1983, pp 24-25.

2 Nader, R. and Green, M.J., Crime in the Suites, New Republic, 1972, pp17-21.

Ethics and Perfect Competition

In a perfectly free competitive market, no buyer or seller has the power to significantly affect the price of a good[1]. Seven features characterize such markets:

1. There are numerous buyers and sellers, none of whom has a substantial share of the market.
2. All buyers and sellers can freely and immediately enter or leave the market.
3. Every buyer and seller has full and perfect knowledge of what every other buyer and seller is doing, including knowledge of the prices, quantities, and quality of all goods being bought and sold.
4. The goods being sold in the market are so similar to each other that no one cares from whom each buys or sells.
5. The costs and benefits of producing or using the goods being exchanged are borne entirely by those buying or selling the goods and not by any other external parties.
6. All buyers and sellers are utility maximizers: Each tries to get as much as possible for as little as possible.
7. No external parties (such as the government) regulate the price, quantity, or quality of any of the goods being bought and sold in the market.

In addition, free competitive markets require an enforceable private property system and a system of contracts and production. In such markets, prices rise when supply falls, inducing greater production. Thus, prices and quantities move towards the equilibrium point, where the amount produced exactly equals the amount buyers want to purchase. Thus, perfectly free markets satisfy three of the moral criteria: justice, utility, and rights. That is, perfectly competitive free markets achieve a certain kind of justice, they satisfy a certain version of utilitarianism, and they respect certain kinds of moral rights.

The movement towards the equilibrium point can be explained in terms of two principles: the principle of diminishing marginal utility and the principle of increasing marginal costs. When a buyer purchases a good, each additional item of a certain type is less satisfying than the earlier ones. Therefore, the more goods a consumer purchases, the less he will be willing to pay for them. The more one buys, the less one is willing to pay. On the supply side, the more units of a good a producer makes, the higher the average costs of making each unit. This is because a producer will use the

1 The account that follows can be found in any standard economics textbook, for instance, Samuelson, P.A., Economics, 11th Edition, New York, McGraw Hill Book Company, 1980, p 52-62.

most productive resources to make his or her first few goods. After this point, the producer must turn to less productive resources, which means that his costs will rise. Since sellers and buyers meet in the same market, their respective supply and demand curves will meet and cross at the equilibrium point.

Though some agricultural markets approximate the model of the perfectly competitive free market, in actuality there is no real example of such a market. Markets that do not have all seven features of the perfectly free market are, therefore, correspondingly less moral.

In the capitalist sense of the word, it is just is when the benefits and burdens of society are distributed such that a person receives the value of the contribution he or she makes to an enterprise. Perfectly competitive free markets embody this sense of justice, since the equilibrium point is the only point at which both the buyer and seller receive the just price for a product. Such markets also maximize the utility of buyers and sellers by leading them to use and distribute goods with maximum efficiency.

Efficiency comes about in perfectly competitive free markets in three main ways:

1. They motivate firms to invest resources in industries with a high consumer demand and move away from industries where demand is low.
2. They encourage firms to minimize the resources they consume to produce a commodity and to use the most efficient technologies.
3. They distribute commodities among buyers so that they receive the most satisfying commodities they can purchase, given what is available to them and the amount they have to spend.

First, in a perfectly competitive market, buyers and sellers are free (by definition) to enter or leave the market as they choose. That is, individuals are neither forced into nor prevented from engaging in a certain business, provided they have the expertise and the financial resources required.

Second, in the perfectly competitive free market, all exchanges are fully voluntary. That is, participants are not forced to buy or sell anything other than what they freely and knowingly consent to buy or sell.

Third, no single seller or buyer dominates the market that he is able to force the others to accept certain terms or go without the product in question. In this market, industrial power is decentralized among numerous firms so that prices and quantities are not dependent on the whim of one or a few businesses. In short, perfectly competitive free markets embody the negative right of freedom from coercion. Thus, they are perfectly moral in three important respects: (a) Each continuously establishes a capitalist form of justice; (b) together they maximize utility in the form of market efficiency; and (c) each respects certain important negative rights of buyers and sellers. No single seller or buyer can dominate the market and force others to accept his terms. Thus, freedom of opportunity, consent, and freedom from coercion are all preserved under this system.

Several cautions are in order, however, when interpreting these moral features of perfectly competitive free markets. First, perfectly competitive free markets do not establish other forms of justice. Because they do not respond to the needs of those outside the market or those who have little to exchange, for example, they cannot establish a justice based on needs. Second, competitive markets maximize the utility of those who can participate in the market given the constraints of each participant's budget. However, this does not mean that society's total utility is necessarily maximized. Third, although free competitive markets establish certain negative rights for those within the market, they may actually diminish the positive rights of those outside those whose participation is minimal. Fourth, free competitive markets ignore and even conflict with the demands of caring. As we have seen, an ethic of care implies that people exist in a web of interdependent relationships and should care for those who are closely related to them. A free market system, however, operates as if individuals are completely independent of each other and takes no account of the human relationships that may exist among them. Fifth, free competitive markets may have a pernicious effect on people's moral character. The competitive pressures that are present in perfectly competitive markets can lead people to attend constantly to economic efficiency. Producers are constantly pressured to reduce their costs and increase their profit margins. Finally, and most important, we should note that the three values of capitalist justice, utility, and negative rights are produced by free markets only if they embody the seven conditions that define perfect competition. If one or more of these conditions are not present in a given real market, then the claim can no longer be made that these three values are present[2].

Of course, the three values of capitalist justice are only produced if the market embodies the seven conditions that define perfect competition. If even one of the conditions is not present, then the market cannot claim to promote those values. This, in fact, is the most important limitation of free market morality: because free markets are not perfectly competitive, they do not achieve the moral values.

2 One of the major criticisms levelled at the capitalist conception of justice is that it says people should be paid the exact value of the things they contribute, yet it gives no criterion for determining the "value" of a thing. Because different people place different values on things, this indeterminacy seems to make the capitalist conception of justice hopelessly vague. A price that is "just" in terms of the value one person places on a thing may be "unjust" in terms of the value another places on the same thing. However, the values given to things by perfect competitive markets are just from every participant's point of view because at the point of equilibrium all participants (both buyers and sellers) place the same value on commodities and prices converge on this uniquely just value.

Ethics and Monopolistic Competition

In a monopoly, two of the seven conditions are absent: there is only one seller, and other sellers cannot enter the market. As the case of Alcoa exemplifies, such markets are far from the perfectly competitive model[1]. Although Alcoa's patents on the manufacturing of aluminum ran out in 1909, it remained the sole producer of virgin aluminum for another thirty years. No competitor could enter the market because their startup costs would have been too great, and they lacked Alcoa's experience. Alcoa and other monopolies like Western Electric, Standard Oil, and the American Tobacco Company were thus able to fix output at a quantity less than equilibrium, making demand so high that they reaped excess profits. (Had entry into these markets been open, the excess profits would have drawn others into producing these goods until prices dropped, but this does not happen in a monopoly.)

Monopolistic markets and their high prices and profits violate capitalist justice because the seller charges more than the goods are worth[2]. Thus, the prices the buyer must pay are unjust. In addition, the monopoly market results in a decline in the efficiency of the system.

First, the monopoly market allows resources to be used in ways that will produce shortages of those things buyers want and cause them to be sold at higher prices than necessary. Second, monopoly markets do not encourage suppliers to use resources in ways that will minimize the resources consumed to produce a certain amount of a commodity. A monopoly firm is not encouraged to reduce its costs and is therefore not motivated to find less costly methods of production. Third, a monopoly market allows the seller to introduce price differentials that block consumers from putting together the most satisfying bundle of commodities they can purchase given the commodities available and the money they can spend. Because everyone must buy from the monopoly firm, the firm can set its prices so that some buyers are forced to pay a higher price for the same goods than others.

In effect, those who have a greater desire for an item will buy less, and those who desire an item less will buy more, which is a great inefficiency, and means that consumers are no longer able to purchase the most satisfying bundle of goods they can.

1 Douglas F.G., Industrial Organization and Public Policy, N.Y., Macmillan, Inc., 1984, pp189-91.

2 Of course, it is conceivable that the managers of a monopoly firm may be motivated by altruism to forgo potentialprofits and fix their prices at a low equilibrium level- that is, the level that just covers their costs. But we assume that, in the absence of any regulatory agencies 9such as the government), monopolists are utility maximisers like everyone else in the market and therefore, work to maximise their profits

Oligopolistic Competition

Most industries are not entirely monopolistic; in fact, most are dominated by a few large firms. These markets lie somewhere in between the monopoly and the perfectly competitive free market; the most important type of these imperfectly competitive markets is the oligopoly.

In an oligopoly, two of the seven conditions are not present. Instead of many sellers, there are only a few significant ones. The share each firm holds may be somewhere between 25 percent and 90 percent of the market, and the firms controlling this share may range from 2 to 50 depending on the industry. Second, as with the monopoly, other sellers are not free to enter the market. Markets like this, which are dominated by four to eight firms, are highly concentrated markets. A list of firms in oligopoly markets in the most highly concentrated American industries reads like a who's who of American corporate power.

The most common cause of oligopolistic market structure is the horizontal merger or unification of two companies that formerly competed in the same line of business. Because such markets are comprised of a small number of firms, it is easy for their managers to join forces to set prices and restrict their output, acting, in effect, like one large monopolistic firm. Therefore, like monopolies, they can fail to set just profits, respect basic economic freedoms, and protect social utility.

Oligopolies can set high prices through explicit agreements to restrain competition. The more highly concentrated the oligopoly, the easier it is to collude against the interests of society, economic freedom, and justice. The following list identifies practices that are clearly considered to be unethical:

1. Price Fixing - when companies agree to set prices artificially high.
2. Manipulation of Supply - when a company agrees to limit production.
3. Exclusive Dealing Arrangements - when a company sells to a retailer only on condition that the retailer will not purchase products from other companies and/or will not sell outside a certain geographical area.

4. Tying Arrangements - when a company sells a buyer certain goods only on condition that the buyer also purchases other goods from the firm.
5. Retail Price Maintenance Agreements - when a company sells to a retailer only on condition that they agree to charge the same set retail prices.
6. Price Discrimination - when a company charges different prices to different buyers for the same goods or services.

Several industrial and organizational factors lead companies to engage in these practices:

1. Crowded and Mature Market - When large numbers of new entrants or declining demand create overcapacity in a market, the resulting decline in revenues and profits creates pressures on middle-level managers. They may respond by allowing, encouraging, and even ordering their sales teams to engage in price fixing.
2. Job-Order Nature of Business - If orders are priced individually so that pricing decisions are made frequently and at low levels of the organization, collusion among low-level salespeople is more likely.
3. Undifferentiated Products - When the product offered by each company in an industry is so similar to those of other companies that they must compete on price alone, continually reducing prices, salespeople come to feel that the only way to keep prices from collapsing is by organized price fixing.
4. Culture of the Business - When an organization's salespeople feel that price fixing is a common practice and is desired, condoned, accepted, rationalized, and even encouraged by the organization, price fixing is more likely.
5. Personnel Practices - When managers are evaluated and rewarded solely or primarily on the basis of profits and volume so that bonuses, commissions, advancement, and other rewards are dependent on these objectives, they will come to believe that the company wants them to achieve these objectives regardless of the means.
6. Pricing Decisions - When organizations are decentralized so that pricing decisions are pushed down into the hands of a lower part of the organization, price fixing is more likely to happen. Price decisions should be made at higher organizational levels.
7. Trade Associations - Allowing salespeople to meet with competitors in trade association meetings will encourage them to talk about pricing and to begin to engage in price setting arrangements with their counterparts in competing firms.
8. Corporate Legal Staff - When legal departments fail to provide guidance to sales staff until after a problem has occurred, price-fixing problems are more likely.

It is difficult to legislate against many common oligopolistic price-setting practices, however, because they are accomplished by tacit agreement. Firms may, without ever discussing it explicitly, realize that competition is not in their collective best interests. Therefore, they may recognize one firm as the "price leader," raising their prices in reaction when the leader decides to do so. No matter how prices are set, however, clearly social utility declines when prices are artificially raised.

Firms also occasionally resort to bribery, which also results in a decline in market competition. Bribes serve as a barrier to others entering the market; the briber becomes, in effect, a monopoly seller. To determine whether a payment is ethical, there are three relevant points to consider:

1. Is the offer of a payment initiated by the payer (the one who pays the money), or does the payee (the one who receives the money) demand the payment by threatening injury to the payer's interests? In the latter case, the payment is not a bribe but a form of extortion. If the threatened injury is large enough, the payer may not be morally responsible for his or her act, or the moral responsibility may at least be diminished.
2. Is the payment made to induce the payee to act in a manner that violates his or her official sworn duty to act in the best interests of the public? Is the payment made to induce the payee to perform what is already his or her official duty? If the payee is being induced to violate his or her official duty, then the payer is cooperating in an immoral act because the payee has entered an agreement to fulfill these duties.
3. Are the nature and purpose of the payment considered ethically unobjectionable in the local culture? If a form of payment is a locally accepted public custom and there is a proportionately serious reason for making the payment, then it would appear to be ethically permissible on utilitarian grounds.

Oligopolies and Public Policy

What should society do in the face of the high degree of market concentration in oligopolistic industries? There are three main points of view:

First, the "Do-Nothing" view claims that the power of oligopolies is not as large as it appears. Though competition within industries has declined, they maintain that competition between industries with substitutable products has replaced it. In addition, there are "countervailing powers" of other large corporate groups, the government, and unions that keep corporations in check. Finally, they argue that bigger is better, especially in the current age of global competition. Economies of scale, produced by high concentration, actually lower prices for consumers.

Second, the Antitrust view argues that prices and profits in highly concentrated industries are higher than they should be[1]. By breaking up large corporations into smaller units, they claim, higher levels of competition will emerge in those industries. The result will be a decrease in collusion, greater innovation, and lower prices. Clearly, the antitrust view is based on a number of assumptions. J. Fred Weston has summarized the basic propositions on which this traditional view is based:

1. If an industry is not atomistic with many small competitors, there is likely to be administrative discretion over prices.
2. Concentration results in recognized interdependence among companies, with no price competition in concentrated industries.
3. Concentration is due mostly to mergers because the most efficient scale of operation is not more than 3 to 5 percent of the industry. A high degree of concentration is unnecessary.
4. There is a positive correlation between concentration and profitability that gives evidence of monopoly power in concentrated industries–the ability to elevate prices and the persistence of high profits. Entry does not take place to eliminate excessive profits.
5. Concentration is aggravated by product differentiation and advertising. Advertising is correlated with higher profits.
6. There is oligopolistic coordination by signaling through press releases or other means.

The third view is the Regulation view, which can be seen as a middle ground between the other two. Those who advocate regulation do not wish to lose the economies of scale offered by large corporations, but they also wish to ensure that large firms do not harm the consumers. Therefore, they suggest setting up regulatory agencies and legislation to control the activities of large corporations. Some even suggest that the government should take over the operation of firms where only public ownership can guarantee that they operate in the public interest[2].

Whichever view we take, clearly the social benefits of free markets cannot be guaranteed, and the markets themselves cannot be morally justified, unless firms remain competitive[3].

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1 The numerous studies confirming this relationship are surveyed in Douglas F. Greer, Industrial Organizations and Public Policy, 2nd Edition, N.Y., Macmillian, Inc., 1984, pp407-14.

2 Mises, V.L., Planned Chaos, NY, Foundations for Economic Education, 1947

3 It has been argued, however that a company in which caring flourishes will have a competitive economic advantage over a company in which such caring does not obtain. See Jeanne M. liedtka, Feminist Morality and Competitive Reality: A Role for an Ethics of Care?, Business Ethics Quarterly, vol. 6, no.2, April 1996, pp179-200.

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