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EDITOR IN CHIEF

Stefano Cavagnetto
<stefano@praguecollege.cz>

COMPUTING AND BUSINESS EDITORIAL BOARD

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<bruce.g@praguecollege.cz>

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<leah.a@praguecollege.cz>

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<dave@praguecollege.cz>

Anna Boguszak
<anna@praguecollege.cz>

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<veronika.d@praguecollege.cz>

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<pascal.s@praguecollege.cz>

Simon Gray
<simon.g@praguecollege.cz>

George Allen
<george.a@praguecollege.cz>

Jorge Boehringer
<jorge.b@praguecollege.cz>

PRODUCTION DEPARTMENT

Silvia Weinzettelova
<silvia.weinzettelova@praguecollege.cz>

Gavin Bird
<gavin.b@praguecollege.cz>

To submit your work, please contact one
of the project coordinator of the PCRC:
Masa Hilcisin <masa@praguecollege.cz>

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Clips is a so-called production system or rule based language if you will, so we will start with simple explanation of all terms connected to clips, which could be unknown for classical C programmer.

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.

Since 2010 a quarterly Bulletin has been 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.

You can find the published Bulletins of PCRC in Prague college library and in six Prague's libraries (Národní knihovně, Knihovně Národního muzea v Praze, Ministerstvu kultury ČR, Parlamentní knihovně, Městské knihovně v Praze, Knihovně a tiskárně pro nevidomé K. E. Macana) and digital version in the electronic library "Ebrary".

Deadline for the next issue is 30th December 2011.



PART I **HUMANITIES IN TODAY'S WORLD**

DOCUMENTARY ACTIVISM IN POST-CONFLICT AND POST-COMMUNIST SOCIETIES

A CASE IN THE SEE REGION

MAŠA HILČIŠIN

Questioning identities, nationalistic ideologies, reconstruction of the historical past and its effects on people's lives, brutal corruption, limited access to human rights, the process of reconciliation, nationalism, war crimes, ethnic cleansing, mass rape, religious fundamentalism, economical and political agonies and regressions of societies in transition – these are just some of the topics articulated in SEE documentary films within the last two decades. One of the reasons of empowering documentary film in this region was a lack of enough visibility of important social and political issues in the public space. Documentary filmmakers from this region have a tendency to take a stand and to have an ideological commitment. Political expression is very common for most of the documentary film works as a reflection on a current state. Tectonic changes in this region have transformed public space into the new historical, political, social, and cultural environment which is articulated through the 'newly' born ideologies and values. The space poses questions of political and cultural re-definition within the post-socialist and post-conflict realities along with difficulties and justifications of political and ideological struggles.

What appears as an important issue when it comes about documentary filmmaking is ethical dimension, which is mainly related to the relationship with a social subject (social subjects = people in the film). What do we do with subjects in the film? How far are we allowed to go into someone's life? How do we present a certain group of people or reality? What is the real effect of documentary film on society? Should documentary filmmakers act as an active agents in society? These questions become even more important and provocative when we discuss documentary filmmakers from fragile and politically conscientious regions such as SEE, where most of their works are an extended activity of social and human rights activism.

Another important dimension for the documentary filmmakers in the SEE region is the level of responsibility; on the one side they share information in the public and protect the subjects in the film, and on the other side, they have a responsible role towards society, to speak loudly about issues which are usually hidden or unspoken enough in a public space. There are different levels of responsibilities when it comes to documentary and video making, especially those dealing with social and political issues. Some of these levels touch ethical issues, which are mainly related to the relationship built between the filmmaker and the social subject, rather than a statement and stand posed by the documentary filmmaker. In addition, there is the desire not to harm others, which includes people in the film, and not to use any language which might cause hate speech or any other discrimination against certain individuals or groups of people. Some of the additional principles to those 'do not harm' are protection of the vulnerable and respect of audience trust.

This paper explores video and documentary cinema in SEE during the last two decades emphasizing the major changes, political and social involvement, documentary activism, as well as an ethical approach to the subjects and levels of responsibility. It is divided into the most popular subjects in SEE documentary cinema in recent history: identity, reconstruction of the past, and activism and social issues which will be discussed through a presentation of the significant filmmakers and their works. This paper just intends to research some of the already on-going discussions in documentary films and their real involvement in society by showing it through the example of the SEE cinema landscape.

IDENTITY

A valuable film contribution in the search and examination of the Balkan's identity is the documentary film 'Whose is this Song?' (2003) done by Bulgarian filmmaker Adela Peeva. In this film, Peeva is trying to find out the origin of a Balkan song which took her on a journey through different Balkans countries. In an almost 'naive' search for the origin of one song, the author detects and exposes powerful politics, and still a very conflicted Balkan reality, harshly determined by consequences of nationalism, hatred, and ethnic-wars. Various interpretations of this song (hymn, military march, love ballade) in each of the Balkans countries shows sensitivity of the people in the film when it comes to cultural heritage and war wounds that are still open. Peeva creates forceful documentary images on complexity and importance of historical memory, collective and individual memory, and demands for self-definition within the certain historical and cultural context. The documentary has a form of traveling through the cultural Balkan's landscape nowadays, stressing also the complexity in defining the Balkans.

The re-examination of identities, questioning the importance of belonging or not-belonging, identifying or not-identifying with particular historical and cultural codes, the collapse of totalitarian regimes, the rise of nationalism, and recent war are all important themes. It comes from the re-writing of histories, languages, and national identities modified in most of the SEE countries according to the dominant political forces; therefore the idea of SEE cinema should be also perceived within the complexity of building new identities and their ambiguity. Peeva is showing a politically fragile Balkan post-war landscape. Unlike observational documentarists, she is very interactive with social subjects in the film, and sometimes she is a presence in

front of the camera as well, questioning and communicating with the subjects. The film is led by music, a nice melodic song, yet through the music it shows how these elements of culture powerfully create national identities. During her journey, Peeva also shows everyday life of the Balkan people, cultural and other habits, sensitivity, mentality, and colloquial languages. The film even shows, at the beginning, a certain easiness, and the more it progresses, the more it reveals an earnest perception of historical and cultural space. The level of responsibility is paramount in this film as Peeva is approaching subjects spontaneously most of the time, without previous arrangement or scheduled interview. As she touches cultural heritage she never knows what is going to happen, what kind of reaction she will encounter, and how to escape a possible uncertain situation where subjects can get emotionally hurt, and maybe even aggressive. This journey was especially sensitive during her stay in former Yugoslavia, especially in communication with war veterans who are still dealing with hard war traumas and ethnic based animosity. Besides significant anthropological documentary work produced with this film, a powerful dimension of Peeva's approach is humor, which helps her to communicate with others despite war damages. It also helps to devictimise the image of the Balkans by showing optimism; people are still singing despite all historical quakes.

A similar journey was done by Slovenian filmmaker, Maja Weiss, in the documentary 'The Road Of Fraternity And Unity' (1999), that explores post-Yugoslav national identities. She took the road through different countries, this time post-Yugoslav countries showing a wide spectrum of emotions of different subjects – from harsh nationalism towards other ethnic groups, to struggles with trauma and loss of beloved ones, to the still strong belief in Yugoslav identity and 'unity.' Symbolically, Weiss shot interviews on the road that was at one time called The Road of Fraternity and Unity, which was the highway built between Ljubljana and Zagreb, and Belgrade and Skopje. The film was based on a number of interviews which Weiss was doing on the road with accidental passer-bys, local people, and some famous people from cultural and political life, who were trying to deal with war and nationalism through their works, and who gave significant articulations of such issues: *'For me, the phrase fraternity and unity was not empty, though it had lost its import in the political vocabulary. It was mentioned often enough, particularly as the peg upon which to hang lies... War in Yugoslavia, the army that we'd been building and richly financing for years on end in order to have protection from enemies from without... that this same army that we'd funded with enormous resources should be used on the territory of Yugoslavia, to my mind, was contrary to any sane logic'* (from the interview with Bosilja Pušić, ('The Road Of Fraternity And Unity', 1999), 48:41 – 49:45). Responsibility in taking statements and sharing people's experiences in the film, Weiss respectively sometimes has a more observational role, especially with subjects who are dealing with animosity towards other ethnic groups.

The film was built between the private and public space as well as confrontations which are conceived through several layers:

- 'unity' and 'brotherhood' vs. an ethnically divided society
- collective conscious or 'guilty' vs. individual grief and pain
- nostalgic past vs. disillusioned present
- political vs. personal experience.

The film was shot in 1999 when most of the post-Yugoslav countries were still cut off from the rest of the Europe and under complicated administrative visa's regimes. Space in the film is very personal and it can be said it overtakes, yet at the same time it brings up wider political issues while depicting post-war society. Weiss concluded the film with her own statement: '*Why the slogan 'brotherhood and fraternity'? Why the road of fraternity and unity? One must have a reason in order to make a documentary. Also, I was one of those who lived more than half their lives in a country that was cemented by this slogan, forcibly, as we know now and as some people have known from the very beginning. When we were younger, some of us realized it when we entered high school and the punk movement began to spread. This trip was probably my search for a time gone by, for some...for some...*' ('The Road Of Fraternity And Unity', 1999, 101:23 – 102:22).

Another, not less important dimension in re-defining identity, is imposing it within the European cultural space. Even knowing they – SEE - belong to Europe, very often they feel left outside alone. Most of the cinematographies are, at first place, recognized as national cinemas through their specific historical, cultural, and political context, and then, at the second place, as a part of a wider European space. Additionally, for most of the SEE countries, they still consider themselves as 'others' within the context of Europe which also reflects subjects dealt in documentary cinema. Serbian filmmaker Željimir Žilnik dedicated several of his documentaries dealing with physical and mental borders, questioning Europe and 'others', in films like 'Europe Next Door' (2005), 'Fortress Europe' (2000). In 'Europe Next Door' (2005) Žilnik shows the effects of borders with the *Schengen* border on domestic trade. An ordinary farm family were cut off from their financial source because they were not able to sell their products to Hungary after Hungary was accessed into the *Schengen* zone. Anica, whose brother is running the farm, decided to get married in order to get papers and a work permit in Hungary. Žilnik was following the whole story and her attempt to find a false groom, with the elements of sarcasm and irony showing still the very strong isolation of some of the countries from the rest of the Europe, and the physical and mental borders among people. With sarcasm and irony, he questions belonging to the particular space and sole existence. Which kind of space we belong to? Is it space defined stronger mentally than geographically? What is the effect of space on people lives? What is the effect of space on identity? How to define 'others' within the European space if those 'others' are feeling isolated and left 'outside'? In a documentary search of these issues, Žilnik is using his very well known method of recreating the real scenes in documentary film, adding feature elements, where subjects 'play' their own roles from their life and their own experiences. Space is transformed again, but now with even more intensity.

The categorization of 'other' and 'otherness' and the complexity of the individual and a collective identification with particular geographical, cultural, and historical spaces was widely discussed by Maria Todorova. In her book 'Imagining the Balkans' Todorova (1997, p.14) posed, for example, the term *Balkanism*, which presents stereotypes of the Balkans usually perceived from the outside, with Balkans signified as 'others', stating 'a specter is haunting Western culture – the specter of the Balkans'. Todorova discussed *Balkanism* through the 'outside' seeing a vision which is sometimes interpreted through the culture of tribalism and other negative connotations. Torsten Källemark in his research on cultural heritage and its influence on peace and reconciliation, stresses Todorova's theoretical impact and contribution in examination of problems of manipulation of memory and identity in Balkan conflicts. Todorova (Todorova, 2011, cited in Källemark, http://www.chwb.org/dokument/pdf/CHwB_evaluation.pdf) stresses effects of intense history where 'unedifying stereotype portrays the Balkans as a region cursed with too much history per square mile with an excess of historical memory, protracted hatreds, and a proliferation of obstinate and incompatible ethnic and religious identities.' Identity, and the need for self-definition within the certain space, deals a lot with searching and the reconstruction of the past, which is a very large subject presence in SEE documentary cinema – the composing of lost pieces or trying to search for historical truths.

'RECONSTRUCTION(S)'

Thematically, most of the subjects which are dealing with the reconstruction of the historical past or certain events, such as Romanian, Albanian, or Bulgarian cinematographies, are dealing with the period of the totalitarian regimes and their effects on people's lives. Other cinematographies, such as those of former Yugoslavia, deal with more the recent war which took place during the 90's. In documentaries where the focus is on reconstructing historical events, it is very common for filmmakers to combine archive footage with interviews which brings together historical TV reportage, collecting stories, facts, and memories from survivors of certain events. This method and approach can be grouped within the expository mode, introduced by Bill Nichols (2001, p.105) which connects to the viewer directly with 'titles, or voices that propose a perspective, advance an argument, or recount history'. Voice-over is present in most of the cases. Interviews are usually done with people, survivors or victims of totalitarian regimes. Reconstruction is also a way to build or to empower collective memory. As history is a memory, it can be a very powerful and dangerous tool when modified and manipulated by official ruled politics. Reconstruction of history is very common for the SEE region, and documentary is usually made according to the following framework:

Presentation of the main problem + introduction to historical past using archive video and photos + interviews with social subjects [survivors/victims] + interviews with social subjects [survivors/perpetrators] + director's main statement and political stand of the film.

A reconstruction of a totalitarian past was shown in the documentary 'Divorce Albanian Style' (2007) by Bulgarian filmmaker Adela Peeva. It is a film in a surreal world and its political regime is in Albania during the 1960's and Enver Hodža's dictatorship (1908-1985). Peeva reconstructs the lives of people who were suffering while living under the regime of the longest-serving dictator of the 20th century in Europe, who, among other things, applied different brutal mechanisms in the separation of families. The director uses the method of historical overview in the period illustrating with TV archive footage and the narrator, combining interviews with families who were survivors of that period. There is plenty of evidence in the film which shows the ugly face of the totalitarian regime and its consequences. Most of the audience cannot be indifferent to such images. Additionally, the documentary exposes the fact that one in every three Albanians was either in prison or in a labor camp or was at least interrogated by security offices, where Peeva stresses that it is hardly known the exact number of the people killed with or without trial or sentence. She is opening the film with archive footage of Albania during the 1960's when the Communist party was ruling the country. Albania became the most absurd state in Europe. Enver Hodža, who was ruling the country, was the most fanatic pupil of the Soviet leader Stalin. There were thousands of victims of his regime. Footage also contains the killing of people including civilians who did not support his regime. Peeva does not show direct violence, except in a couple of archive images, but she rather shows it more spontaneously through the people who share their life stories and their recollection of events which affected and changed their whole life. Hodža's administration in that time was identifying foreign women as the enemy of the state or spies. Dozens of people were deported outside of the country, including imprisonment, and forced separation of mothers from their children. Some of the families never get back together again. Those who refused to leave were kept in labour camps in terrifying human conditions: total isolation, with no normal beds, water, or electricity, and surrounded by barbed-wire.

The film reconstructs these historical events through the story of three couples - only three of many couples of Albanian men married to foreign women. The last people who were released from prison were released only in 1987. Film is an interesting critical and ethical discussion in approaching the 'other' side. Confronting the other side was powerfully shown in this film, especially when doing an interview with a for-



Divorce Albanian Style (2007)

mer state prosecutor. The filmmaker in this case avoided ethical procedure when announcing the interview. It is clear from the film that the prosecutor did not know what was the film about shooting. At the beginning of the interview, Peeva showed the former prosecutor documents which show names of the people who were in prison along with their statements. The prosecutor expresses his discomfort and anger: *'Who gave you access to these verdicts? I cannot understand this. How did you obtain these verdicts? Who gave them to you? Tell me... Because such documents can't be given just anyone. If I had known you would ask me about them, I wouldn't have come. I came only because I learned you were making a film. What kind of film is it – about politics? You can make a political film only about Enver Hodža, because he was the great leader of the Party and the Albanian people'*, (from the interview with former prosecutor, (*'Divorce Albanian Style'*, 2007), 38:38 – 39:24). According to the surviving victims, he committed many crimes. In this case, when the filmmaker is 'catching' the subject in order to get more information from the 'other' side, critical discourse follows another dimension to justify viewers trust and to reveal the facts as much as possible.

In the *'Children of the Decree'* (2004), done by Florin Iepan and Razvan Georgescu, a similar brutality was shown of another totalitarian ruler, Nicolae Ceaușescu. This reconstruction follows Nicolae Ceaușescu and his issuing of the Decree 770 in 1966 in which he banned abortion and birth control for all women in Romania, except for women over 40 years old or who already had four children. Ceaușescu had a vision to build a 'new nation' with his followers, with no identity, no history, who will be created according to his political agenda. This huge demographic boom was caused by more than a million babies born in the next

two years after the issuing of the Decree. At the same time, the death rate among pregnant women was the highest in Europe. The film contains a lot of unseen archive footage, revisiting the period of oppression, interviews with famous people and testimonies of survivors of such a regime, uncovering one of the darkest and the most brutal periods of the Communist regime. Interviews are done nowadays to show the agony of people, especially women, who experienced back-alley abortions. In that time, all gynecologist practices were watched and monitored by militia. Because of the huge children boom, the nation was endeavoring to build thousands of kindergartens and schools in an effort to build the future of the state. On the other hand, children who were born with disabilities were kept in horrible human conditions in children houses where they were dying of hypothermia and starvation or even eaten by rats. Reconstructing the history as any other subject in documentary goes along with the trust which appears as an important element for the documentary in general. Therefore, for the SEE region the element of the truth is crucial, and documentary film serves as a platform for the construction of this value, either through an examination of history or present social contexts, the element of truth is very important in building the story and relationship with the subjects, especially when presenting someone else's discourse. Dealing with someone else's discourse means we share opinions, thinking, attitudes, and values with the outside world, creating a forum for further discussions of such issues. This is where documentary social involvement as an active agent in society comes into play. There are various levels of trust; 'between filmmaker and social subject, filmmaker and viewers, and filmmaker and his artistic vision'. (Center for Social Media, 2011).

The region of former Yugoslavia shows different examples as it deals more with recent history, conflict and the latest ethnic war. Most of the documentary films deal with the recent war in way by researching past events, consequences on society, and possibilities for reconciliation. All of these elements were shown in the film 'Statement 710399' (2006) by Refik Hodžić. It deals with a particular case of war crime committed in Bosnia during the war 1992 – 1995. This documentary film is a story of a father who is trying to find his son who disappeared during the genocide in Srebrenica (July 11 – 22, 1995). Shot eleven years after the war, the film outlines and questions 'justice' and deals with war crimes by emphasizing the inability of society to deal with such kind of issues, which leaves society on one side the destroyed lives of survivors of war, and on the other side perpetrators of war crimes. One item of proof that the boy was alive during and after executions is in his statement taken under the number 710399 by Serb military police. The filmmaker is covering the reconstruction parts with feature elements, reconstructing the events when they were happening during the Srebrenica genocide. Hodžić uses the method of recreating the scenes when the boy was missing, including the arrest from the Serbs police. He created the scenario according to the documents and statements of the people he had. Ethically, this is very sensitive in order to show true and real facts. Another level of responsibility here is to protect the families and their feelings when showing and exposing this kind of material in the public.

Hodžić uses the testimonies of people and families who are looking for their relatives who disappeared during the Srebrenica genocide, stressing also the importance of the dealing with war crimes in one society naming a legacy of war crimes as a 'malign tumour' of society, adding in his personal statement to the film that '*most of our political and economic problems have their roots in the atrocities committed during the war and our inability to deal with them. So, we create brands for sadness like the Srebrenica anniversary, which allows us to feel compassion for the victims of war crimes once a year while we tolerate further victimisation of those people throughout the rest of the year and their lives. We watch them go hungry, live in squalid conditions as returnees, we watch mothers die waiting for any DNA identification for their murdered children, we make them think that what happened to them is normal, we tolerate the state employing those who took their children into the death. We don't see them as people, equal members of this society but as faceless, burdening mass of people whose problems are too great for the society to deal with, excellent material for political manipulation who can be wheeled out in front of world public once a year to remind everybody how much we suffered...*' (XY Films, 2006).



Statement 710399 (2006)

The documentary 'Scorpions - a Home Movie' (2007) by Lazar Stojanović was made from home video, and it is one of the examples of documentary films and the way how the same material can be used in the court procedures. In this case that was used in the charging for committed war crimes in Bosnia (1992 – 1995). The film depicts the life of the Scorpions, a unit of the Serbian Ministry of the Interior. The same unit committed a number of crimes during the war in Bosnia including the brutal murders of six Srebrenica Bosniaks in July 1995, and other killings committed in Kosovo in 1999. 'The film includes the infamous footage of the execution of the six Bosniaks, shot by the unit's cameraman, and footage of the trial conducted before the War Crimes Trial Chamber of the Belgrade District Court, as well as interviews with former members of the Scorpions themselves' ('Scorpions - a Home Movie', 2007). 'Scorpions - a Home Movie' (2007) was released on the day (April 2007) that the verdict was pronounced at the War Crimes Council of the Regional Court of Belgrade for the war crimes committed in Bosnia. In this case, home video was used as the material during the court procedure and later produced into documentary film form. It was stressed in the film statement that 'by using the statements of former members and the materials recorded by the unit itself in course of its campaigns, this film demonstrates the functioning of a typical combat unit organized by the security service to do dirty jobs in the Balkan wars. This is an example of the practice mushrooming in a half of the world for decades. This film is also an attempt to cast light on the personal, intimate aspect of crime'. (Humanitarian Law Center, 2007). The film was produced by the Humanitarian Law Center, which released a video tape found in a home archive, recorded by Scorpion's former members. This tape showed and revealed Serbia's involvement in war crimes in Bosnia. It is again the responsibility to protect the families whose families were murdered in front of the camera. How does one deal with this kind of material which was important enough to be part of the media, yet it contains a very personal moment and pain?

*Invisible (2005)*

SOCIAL

As a result of political turmoils and wars, there were a number of activists movements, organizations and groups who have been growing during the 90's (Women in Black, Networks for Human Rights Education...). Along with organizing activists of movements and groups many documentary filmmakers have been dealing with various political, social, and cultural issues, trying to use video and documentary form as an instrument for advocacy and social changes. These issues are mainly dealt through the enormous corruption, and high rate of unemployed as it was shown in Željimir Žilnik latest film 'The Old School of Capitalism' (2009), or the desperate condition of society and lives of young people who ended up abusing heroin, observed in the documentary 'Invisible' (2005) by Konstantin Bojanov. Željimir Žilnik is one of the most important filmmakers in the region of SEE. His presentation of political and social reality in documentary form contain a lot of feature elements and it is used sometimes as even grotesque. Still his films strongly communicate with today's reality showing political non-conformism and confronting ruling political regimes. Žilnik's newest film 'The Old School of Capitalism' (2009) traces new-born capitalism in Serbia. As a background for his story, Žilnik uses a number of strikes that took place in Belgrade in recent years and introduces us to several people involved who are allowed to 'play' themselves. That leads to explosive situations. The main focus of the film is the strike of the workers from the cities Sremska Mitrovica and Zrenjanin who lost their jobs caused by post-war corruption. In his method, Žilnik, uses real subjects 'transforming' them into the actors; they are playing their own roles from their own life, just the scenes are played again, or reconstructed for the documentary form. Žilnik also involves the other side, with 'actors' by transforming the whole scene from real life into the documentary film. It is very adeptly 'playing' with reality but at the same time with elements of game showing its real, revealed face. With feature elements and in a grotesque way, he constructs reality where new born managers stand against their workers, and communicates a very real political reality in Serbia. Workers entered the factory by force. The film was opened with the protest in Niš with slogans – Niš – City of Humiliated. Žilnik is very well known for his social and political activism.

Using the observational method, Bulgarian filmmaker, Konstantin Bojanov, made 'Invisible' (2005), a documentary about six heroin addicts who live on the streets of Sofia. Bojanov does not intervene, he is letting the subjects speak for themselves, and there are almost no questions or interviews. He follows them on the streets and to rehab clinics, and their attempt to recover from drug abuse. The subjects in the film are aged 17 – 39. They live in basements and abrasive flats, in the shadow of society. In the film they are not afraid to show their faces. There are also explicit scenes of the preparation and injection of heroin, and the shock and look right after the dose was taken, with pale faces and barely opened eyes. Bojanov reflects on one example of an SEE country. Similar examples can be seen in most of the SEE, as by the end of the 90's, drug abuse for the whole region became a kind of plague. Most of the countries failed to provide proper help for drug addicts due to a bad economic situation, a lack of rehab clinics, and a lack of education on how to act. The filmmaker was showing his subjects as an 'invisible' part of society who were dying from overdosing and nobody knows about them and their lives. As one of the subjects describes in the film: *'We wander the streets, shoot up in basements, places like this...We are cast away by society, in a way. To get high is as easy as drinking a glass of water...In reality we don't have a choice. When I get up, I have no other place to go except for the Spot. And If one grew up being high all the time, than what else is left?'* (from the interview with Kamen, ('Invisible' , 2005), 15:03 – 16:15).

Bojanov observed his subjects for three years. Since he was a drug abuser himself, he could approach them more friendly, and in the film the viewer can easily see that they are comfortable to talk in front of the camera, not only to talk but to take drugs, and expose their fears and weaknesses. The filmmaker is transforming his personal space and personal experience through the film and its subjects. He is also taking a more observational role, letting subjects talk for themselves. That is a characteristic of most of the observational documentaries, especially those where the filmmaker uses the long-term method of following a person or group of people during a certain period of time. A characteristic for observational documentary in general is its specific approach to social issues where it applies techniques such as synchronized speech, a 16mm camera that could move freely about the scene, no voice-over commentary, no music or additional sound effects, sometimes not even interviews. Observational mode of representation was introduced by Nichols (2001, p.109) who defined observational documentary as the mode which 'observing what happens in front of the camera without overt intervention'. The film 'Invisible' (2005) represents one of the most significant documentaries in the SEE which address the subject of drug abuse.

'Invisible' (2005) also opens various ethical questions. What influence can this kind of film have on society? When showing the explicit scenes of drug abuse, how does it affect a young audience? Does it make it better or worse for people in the film? Their faces are exposed. What if they are recognized on the street, how does it affect their lives? These questions can be posed in most of the films which are dealing with similar issues; they are almost generic questions. But what is specific for this film is when it comes to its ethical approach is actually at the end of the film when one of the subjects almost overdoses in front of the camera, and for more than a couple of minutes the film crew does not react, but just continues with filming. This is especially related to the social subject. When and how to make this border between film making, filmmaker, and a subject in the film? In her analysis of documentary film and filmmakers role, Vanessa Roth stresses that "many documentary filmmakers passionately believe that their role in a subject's life is to be an inconspicuous observer no matter how difficult their subject's life become". (Public Broadcasting Service, 2005). But really, how far are we allowed to go with someones life?

Analysing ethics in the film, and levels of responsibility is still part of many theoretical debates. Theoreticians are making efforts in order to define 'tools' which can be used in documentary film. At the same time it shows the complexity in using such tools when doing documentary film as every documentary is a different experience and brings up new questions depending on the story and subject. The more documentary has social and political involvement, the more complex is the apparatus for a 'clear ethical' approach and responsibility. And if we pose question 'why film' as an action for social change, the only relevant answer

can be given through the powerful effects we can get from the visual. Dina Iordanova (2001, p.5) stresses the significance of these effects explaining from the one side the role of visual which has a 'crucial role in discourse formation at any level and because the informative power of transmitted images is at least as influential as the exchange that takes place in spoken and written language'. From the other side, she emphasizes the dimension of electronic media which reach much more and wider audience than writing expression ...[...] Nowadays it is the moving image rather than the printed word that carries more persuasive weight.' It is the visual which is powerful and which transforms cultural and political public space and brings important debates into its form. Most of the documentaries produced in the SEE region are also an attempt to examine and discuss question on what kind of society have we become. ■

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REPUTATION BUILDING IN ORGANIZATIONS FROM THE VIEWPOINT OF INDIRECT RECIPROCITY

STEFANO CAVAGNETTO
BRUCE GAHIR

ABSTRACT

A corporate reputation can be considered as a set of attributes ascribed to a firm, inferred to a firm's past actions. While the intuition behind reputation-building is hardly new our aim in this paper is to present a formalized model of reputation building in organizations from the point of view of reputation dynamics in indirect reciprocity.

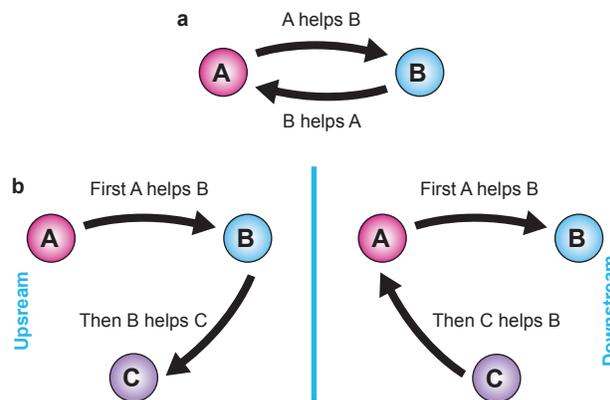
A model is proposed based on indirect reciprocity from the point of view of multi-agent systems (MAS). This model is then developed to define the notion of agent reputation and organizational reputation within the framework of individual and organizational norms.

EVOLUTION OF INDIRECT RECIPROCITY

Humans are the champions of reciprocity. Experiments and everyday experience alike show that what Adam Smith called ‘our instinct to trade, barter and truck’ relies to a considerable extent on the widespread tendency to return helpful and harmful acts in kind. We do so even if these acts have been directed not to us but to others. This has been analysed under the headings of ‘third party altruism’¹ or ‘indirect reciprocity’², and has led to a considerable amount of experimental and theoretical investigation over the past few years.

Several reputation models have been proposed with the aim to make available the reputation of agents interacting in multi-agent systems (MAS) and it is observed that the notion of indirect reciprocity is prevalent in such models. Generally there are two types of reciprocity that can be considered, direct and indirect.

Direct reciprocity is captured in the principle: ‘You scratch my back, and I’ll scratch yours’. But it is harder to make sense of the principle ‘You scratch my back and I’ll scratch someone else’s’³ or ‘I scratch your back and someone else will scratch mine’ (Fig. 1). Why should this work? Presumably, I will not get my back scratched if it becomes known that I never scratch anybody else’s. Indirect reciprocity, in this view, is based on reputation. But why should anyone care about what I did to a third party?



Figures 1 (a) and (b): Direct and Indirect Reciprocity.

In Figure 1(a), direct reciprocity means that A helps B and B helps A. Figure 1(b) shows that indirect reciprocity comes in two flavours. ‘Upstream reciprocity’ (left) is based on a recent positive experience. A person who has been at the receiving end of a donation may feel motivated to donate in turn. Individual B, who has just received help from A, goes on to help C. ‘Downstream reciprocity’ (right) is built on reputation. Individual A has helped B and therefore receives help from C. Mathematical investigations of indirect reciprocity have shown that natural selection can favour strategies that help others based on their reputation. Upstream reciprocity is harder to understand⁴ but is observed in economic experiments. In both cases, the decision to help can be interpreted as a misdirected act of gratitude. In one case recipients are thanked for what another did; in the other case they are thanked by someone who did not profit by what they did.

¹ Program for Evolutionary Dynamics, Department of Organismic and Evolutionary Biology, Department of Mathematics, Harvard University, Cambridge, Massachusetts 02138, USA.

² Faculty for Mathematics, University of Vienna, A-1090 Vienna, Austria

³ IIASA, A-2631, Laxenburg, Austria

⁴ Alexander, R. D. *The Biology of Moral Systems* (Aldine de Gruyter, New York, 1987).

The main reason why economists and social scientists are interested in indirect reciprocity is that one-shot interactions between anonymous partners in a global market become increasingly frequent and tend to replace the traditional long-lasting associations and exchanges based on repeated give and take between relatives, neighbours, or members of the same village. A substantial part of our life is spent in the company of strangers, and many transactions are no longer face-to-face. The growth of web-based auctions and other forms of e-commerce is built, to a considerable degree, on reputation and trust. The possibility to exploit such trust raises what economists call moral hazards. We can therefore ask, how effective is reputation, especially if information is only partial?

In contrast, evolutionary biologists are interested in the emergence of human societies, which constitutes the last (up to now) of the major transitions in evolution. Unlike other species, such as bees, ants or termites, humans display a large amount of cooperation between non-relatives. A considerable part of human cooperation is based on moralistic emotions—for instance, anger directed towards cheats, or the proverbial ‘warm inner glow’ felt after performing an altruistic action. Neuro-economic experiments relate these emotions to physiological processes.

Intriguingly, humans not only feel strongly about interactions that involve them directly, they also judge the actions between third parties, as demonstrated by the contents of gossip. Indirect reciprocity is therefore likely to be connected with the origins of moral norms. Such norms are evidently to a large extent culture-specific, but the capacity for moral norms seems to be a human universal for which there is little evidence in other species.

Because the recent rapid advance of experimental investigations of indirect reciprocity was in large part driven by theory, we shall discuss the modelling approaches before suggesting a formal model for indirect reciprocity in organizations. But first we note, in a wider context, that indirect reciprocity seems to require a ‘theory of mind’. Whereas altruism directed towards kin works because similar genomes reside in different organisms, reciprocal altruism recognizes that similar minds emerge from different brains. It is easy to conceive that an organism experiences as ‘good’ or ‘bad’ anything that affects the organism’s own reproductive fitness in a positive or negative sense. The step from there to judging, as ‘good’ or ‘bad’, actions between third parties, is not obvious. The same terms ‘good’ and ‘bad’ that are applied to pleasure and pain are also used for moral judgments: this linguistic quirk reveals an astonishing degree of empathy, and reflects highly developed faculties for cognition and abstraction.

Any review of theoretical and empirical studies of indirect reciprocity tends to stress the importance of monitoring not only partners in continuing interactions but also all individuals within the social network. Indirect reciprocity requires information storage and transfer as well as strategic thinking and has a pivotal role in the evolution of collaboration and communication. The possibilities for games of manipulation, coalition-building and betrayal are limitless.

DIRECT VERSUS INDIRECT RECIPROCITY

In the terminology based on Hamilton, Trivers and Wilson (3-5), an act is said to be altruistic if it is costly to perform but confers a benefit on another individual. In evolutionary biology, costs and benefits are measured in Darwinian fitness, which means reproductive success. In other contexts, other utility scales such as monetary rewards may be more appropriate. Reciprocal altruism in its original, ‘direct’ sense is defined as an exchange of altruistic acts between the same two individuals so that, in total, both obtain a net benefit. In the simplest model, the altruistic act consists in conferring a benefit b on the recipient at a cost c to the donor.

We shall always assume that the cost is smaller than the benefit, so that if the act is returned, both individuals experience a gain. The payoff structure yields an instance of the familiar Prisoner's Dilemma game. If both players cooperate, each receives $(b - c)$, which is better than what they would obtain by both defecting, namely 0. But a unilateral defector would earn b , which is the highest payoff, and the exploited cooperator would pay the cost c without receiving any benefit. The payoff-maximizing move is defecting.

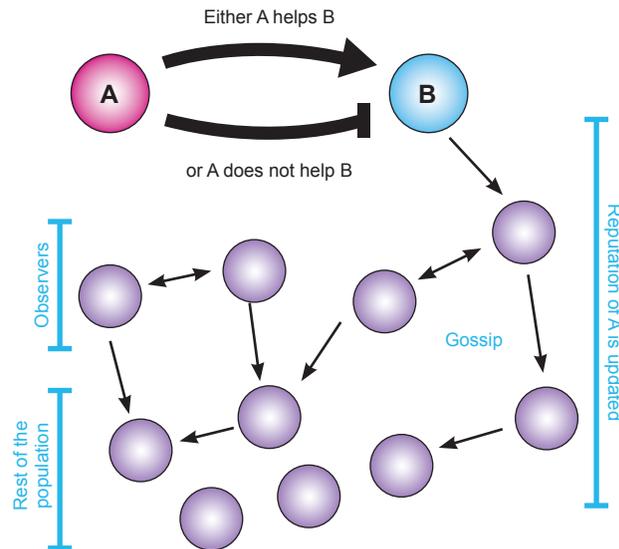


Figure 2: Building a Reputation

In a natural extension of the basic model of indirect reciprocity, an action between donor A and recipient B is observed by a subset of the population, see figure 2. The observers, the donor and the recipient can inform others. People could pass on what has happened (the action) or their assessment of the action. There are many possibilities of error: the action or the intention of the donor can be interpreted differently by different people; some individuals may receive conflicting information from different sources; some individuals may not receive any information at all; people can have different assessment modules. The reputation of a person is therefore not simply a label that is visible to all others, but instead each person has a private list of the reputation of others. Although language could help to synchronize these lists, ultimately reputation is in the eyes of the beholder.

In this paper, we distinguish between two different dimensions of reputation:

- a) **Reputation as a service provider.** This value represents the degree of satisfaction an agent has obtained after performing an interaction. This reputation reflects the fulfillment and violations of *organizational norms* (*ON*) in an interaction playing a specific role.
- b) **Reputation as a reputation source.** This kind of reputation is related to the degree of satisfaction that an agent obtains after requesting opinions about others to a third party. The reputation of an agent as a reputation source evaluates the behavior of such agent while providing information about the reputation of others. If an agent has a bad reputation as a reputation source, the opinions it has provided about other agents should not be trustworthy. The reputation of an agent as a reputation source is related to the role reputation provider and to a unique norm that prohibits the agent from lying when informing others about a counterpart's reputation.

It is fundamental to distinguish these two different dimensions of reputation since, on the one hand, the former deals with the quality, competence, availability, etc. of the agent which is requested for some kind of interaction to provide a service. On the other hand, the second reputation is calculated in order to measure how popular and accurate is another agent providing reputation information about third parties. Both values are important depending on the information the agent needs in each moment. In particular we shall focus on (b) – reputation as a reputation source, since the notion of indirect reciprocity plays a central role in this kind of reputation.

A MODEL OF INDIRECT RECIPROCITY IN ORGANIZATIONS

Organizational approaches are more and more used in order to build Multi-Agent Systems (MAS) since they allow facing complex problems using simple abstractions. Assuming that organizations can be modelled as MAS, we can reasonably say that those abstractions can be concepts that structure relationships among organization members with notions of indirect reciprocity playing a key functional role, concepts such as *roles* that agents can play and *interactions* that agents can use to communicate to each other, and also *constraints*, such as *norms* that establish undesirable agents' behavior.

In developing our formal model the notion of indirect reciprocity will play a central role from the viewpoint of organizations storing reputation values of agents and providing this information to third parties- reputation as a reputation source.

The main characteristics of our approach are:

- a) Agents are able to evaluate the behavior of other agents, store such information, and provide to the organizations (they are not forced to do this) the reputations evaluated and the reasons for such evaluations (violated and fulfilled norms and the facts that have violated or fulfilled the norms).
- b) Organizations implement centralized mechanisms and, therefore, are able to store and to provide the reputation values and related information, and also the identification of the agents that have provided the information.
- c) Together with the reputation values, agents store and send information about norms violated and fulfilled and about the facts that contributed to such behavior and in addition.
- d) The model allows considering two different dimensions for reputation: agents' reputation as service providers and agents' reputation as reputation sources. While the reputation as service provider represents the degree of satisfaction an agent has obtained after performing an interaction, the reputation as reputation source is related to the degree of satisfaction an agent obtains after requesting reputation about other agents to a third party, it evaluates the behavior of an agent while providing information about the reputation of others.

We define an organization specified by the following definition:

Definition 1: Let $O \equiv (R, I, ON)$ be an organization formed by the following essential elements:

1. A set R of roles that are involved in these interactions and can be played by agents in O .
2. A set I of interactions available for agents within O .
3. A set ON of organizational norms that regulate the behavior of the agents playing roles in O .

A typical organization establishes a set R of *roles* as positions that agents have to put themselves in order to achieve some specific goals while interacting with other agents. Therefore, organizations have to be capable of providing a set I of *interactions* that can be used by agents to interact with each other. In addition, organizations can define a set ON of *organization norms* that regulate agents behavior by establishing how agents are expected to fulfill their roles in the organizations in terms of *rights* and *duties*.

Although our model assumes that norms can sometimes be violated. Those norms describe actions that agents are prohibited, permitted or obligated to do and the sanctions to be applied in the case of violations and rewards to be provided in the case of fulfillment. Reputation mechanisms are well-known techniques to fight against unexpected behavior (i.e. norm violations) since they provide agents with relevant information about the trustworthiness of others.

Reputation of agents is usually associated with the behavior of an agent while playing a role in a given interaction. Therefore we have defined the concept of a *situation*, S in order to relate agents, interactions and roles, three essential elements of organizations.

Definition 2: Let $S \equiv (A_i, R_j, I_k, t)$ be a situation where $A_i \in A$ is an agent among organization members, $R_j \in R$ represents a role enacted by A_i and $I_k \in I$ represents an interaction performed by A_i playing the role R_j , at instant t .

A situation can be related to the violation or to the fulfillment of a norm. Both violations and fulfillments are associated with actions that were executed or with actions that should have been executed. In order to state such type of situations we have defined the concept of *(il)legal situation (ILS)*.

Definition 3: Let $(ILS) \equiv (hS_i, N_m, F_n)$ be a illegal situation *ILS* if the situation $SI - (A_i, R_j, I_k)$ - entails a violation of a norm N_m broken by A_i due to some actions represented by F_n or a legal situation *LS* if the situation S_i entails a fulfillment of a norm N_m by A_i due to the actions represented by F_n .

Most of the reputation systems use quantitative values (opinions) to indicate the reputation of agents. However, such information is not sufficient to understand the behavior of the agents since such values are subjective, i.e. the same norm violation or fulfillment can be differently evaluated by two different agents.

The subjective opinion of each agent about the same third party behavior could entail the problem of interpreting the meaning of the agent reputation. In order to tackle this, we propose a reputation model that not only takes into account a numerical value as the opinion an agent provides about a third party behavior, but also the set of norms that the latter has violated or fulfilled and the facts associated with them as a justification of the former's evaluation. This could be viewed as a single-step argumentation about how an agent evaluates the opinion about others.

Definition 4: Let $RI \equiv (P_q, (ILS)_r, Rep)$ be a reputation information provided by the agent provider $P_q \in A$ about an *(il)legal situation (ILS)* $r \in (ILS)$ associated with the reputation value Rep .

The reputation Rep of an agent can vary from $[-1, +1]$. Norm violations are described by illegal situations and are represented by negative reputation values $[-1, 0]$. Norm fulfillments are described by legal situations and are represented by positive reputation values $[0, +1]$. In order to illustrate the need for stating the norm violated and the actions associated with such violation while informing the reputation of an agent, consider the following example.

Alice is looking for a seller to purchase a new guitar. In order to choose the most trustworthy one, she decides to ask other agents for opinions about sellers that have sold guitars (or musical instruments) to them. Note that she is searching for opinions about similar situations such as:

$$S_i = (\text{Bob}, \text{Seller}, \text{SellInstruments})$$

where *Bob* is one of the available *sellers* with whom *Alice* is interested to interact using a *SellInstruments* interaction. In the case of seller *Bob* three agents have sent the following reputation values:

$$(-0.4, -0.1, -0.5)$$

By analyzing such reputations she can only conclude that Bob has violated norms while interacting with those agents but she cannot understand why there exist different reputation values. She has received three different reputation values about the same agent in similar situations and she does not know what has happened when those agents have interacted with Bob. If Alice had received not only the reputation values but also the information about the norms violated and the facts that have violated the norms, Alice would be able to understand the different agents' opinions. She would be able to understand that similar violations can be evaluated in different ways and diverse punishments can, thus, be applied by different reputation sources.

At the beginning of this section we have defined an organization as an entity which is formed, among others, by a set of organizational norms (*ON*) that regulate the behavior of agents in different situations.

Definition 5: Let $ON(R_j, I_k)$ be an organizational norm applied to the agents playing the role $R_j \in R$ in the interaction $I_k \in I$. If R_j is not specified, the norms are applied to all agents playing any role in the interaction I_k . If I_k is not defined, the norms are applied to all agents playing the role R_j in any interaction. If neither R_j nor I_k are specified, the norms are applied to all members of the organization.

Note that when describing a situation where the norm being mentioned is not fulfilled in the situation must be a valid norm, i.e., must be a norm that is defined for the role being mentioned and for the interaction being described. From a social point of view - macro level - *ON* are global norms commonly accepted by all organization members. They are imposed by the organization and are publicly advertised. On the other hand, from an individual point of view - micro level - agents may define their own norms by specializing the organization norms and making them more restrict. Such norms, called individual norms, reflect the relevance the global norms represent to the agents and cannot be used as a mechanism to modify or delete organization norms. In contrast to organizational norms, individual norms are not public but can be shared with anyone according to the agent decision. While evaluating the behavior of agents, an agent may consider both the organizational and individual norms. An individual norm that specializes an organizational norm ON_x is also related to the same (R_j, I_k) tuple defined by ON_x , that is, the individual norm is applied to the same interaction and role as the organizational norm that it specializes.

Definition 6: Let $IN_{A_i}(R_j, I_k)$ be an individual norm applied by agent A_i to the agents playing the role $R_j \in R$ in the interaction $I_k \in I$.

We then define agent reputation $Rep_{A_i \rightarrow A_j}$ resulting from applying agent A_i 's assessment about other agent A_j regarding to violations and fulfillment of norms is as follows:

- a) If A_j has fulfilled the organizational norm (here the organizational norm refers to that from which the individual norm is specialized), then $Rep_{A_i \rightarrow A_j} \in [0, +1]$. The specific value will be generated by the agent according to the fulfillments of the individual norms. If no individual norm has been fulfilled then $Rep_{A_i \rightarrow A_j} = 0$.
- b) If the organizational norm has been fulfilled and so have the individual ones, then $Rep_{A_i \rightarrow A_j} = +1$.
- c) On the other hand, the violation of the organizational norm entails that $Rep_{A_i \rightarrow A_j} \in [-1, 0]$. The adjustment of the specific value calculated in this range will result from checking individual norms.
- d) If the organizational norm and the individual norms have been violated, then $Rep_{A_i \rightarrow A_j} = -1$.

We can assume that the behavior of agents while providing information about the reputation of other agents is regulated by only one organizational norm. Such norm states that the agent playing role *ReputationSource* in the interaction *reputationInformationExchange* cannot lie while providing that information. The norm that regulates such behavior is described by $ON(ReputationSource, ReputationInformationExchange)$:

ON(ReputationSource,ReputationInformationExchange) :
PROHIBITION (ReputationSource EXECUTE sendingWrongInformation)

In contrast with other organizational norms, this is the unique norm that is domain-independent since it neither depends on the roles nor interactions defined in the organization. The reputation of the agent as a reputation source can only be evaluated after the agent that is receiving the information has interacted with the desired agent (the third party it requested for). After the interaction, the agent that has received the information is able to evaluate if the reputation value it has received is consistent with the counterpart's behavior (from agent's individual view). This evaluation will form the reputation value for the agent that played the role *ReputationSource*.

Let us illustrate this with the following example:

Let's suppose that *Alice* playing role *Flight Customer* has made a reservation of a flight ticket and that *Bob* is playing the role as *Flight Provider*, let's also suppose *Alice* has never interacted with *Bob* before; then she asks *Carol* about how "good" is *Bob* playing role as *Flight Provider*. After interacting with *Bob*, *Alice* evaluates his behavior and compares it with the information she has received from *Carol*. In the case the reputation values are similar, the reputation of *Carol* as a reputation source will be good, i.e., will be in the range $[0, +1]$.

In the other case, *Carol*'s reputation as reputation source will be bad from *Alice*'s point of view, i.e., will be in the range $[-1, 0]$. The specific reputation value will depend on how different the reputation being informed is from the reputation being evaluated by the agent herself.

The notion of indirect reciprocity is therefore playing a key functional role in the origin of agent reputation from the point of view of reputation source.

AGENT REPUTATION AND ORGANIZATIONAL REPUTATION BUILDING

Every time an agent evaluates the behavior of another one, it may send such evaluation as *reputation information (RI)* as defined in definition 4, to the organization. The organization is able to put together all reputations and provide them to any other agent. As a passive entity, the organization aggregates *RI* tuples and makes rankings using such information. Therefore, agents cannot call the organization as an entity capable of lying, since it only acts as a means for publicizing information.

In order to illustrate that idea we show some examples of reputation information provided by the organization using the format of the tuple *RI*:

$$(P_q, ((A_i, R_j, I_k, t), N_m, F_n), Rep_{P_q \rightarrow A_i})$$

Where:

Provider (P_q): the agent providing the evaluation about another agent's behavior.

(II)legal Situation: a legal or illegal situation evaluated according to a norm:

Situation, S : the situation being evaluated:

- Client (A_i): the agent whose behavior is being evaluated.
- Client role (R_j): the role that the client was playing and that is related to the behavior being evaluated.
- Interaction (I_k): the relation between the provider and the client associated with the evaluation.
- Time (t): the time where the situation has occurred.

Norm (N_m): the organizational or individual norm that is being considered.

It can be a violated or fulfilled norm;

Fact (F_n): the action(s) that was(were) executed (that is fulfilling the norm, in the case of an obligation, or violating the norm, in the case of a prohibition) or the action(s) that was(were) not executed (that is fulfilling the norm, in the case of an prohibition, or violating the norm, in the case of an obligation) during the interaction.

Reputation ($Rep_{P_q \rightarrow A_i}$): a value that represents the evaluation about the agent's behavior.

A reputation value should be generated for each (R_j, I_k) tuple by separately considering each norm that regulates such interaction and/or role. An agent should start its evaluation by checking if the organizational norms have been fulfilled. The agent must check if the other agent has fulfilled the obligations and has not violated the prohibitions defined by the organization. The organizational norms are public to all agents executing in the organization. Every time an agent enters in the organization, it is informed about

- a) The norms to be fulfilled related to the role to be played, and
- b) Other norms applied to all agents in the organization regardless of the role they play.

Agents must request for both types of norms to the organization before starting any interaction. After verifying if the organizational norms have been fulfilled or violated, the agent may verify if its individual norms were fulfilled, in the case they have been defined. The individual norms to be analyzed are those applied to the same (R_j, I_k) tuple and also those that do not depend on the role or interaction being analyzed.

We can therefore define the reputation of the organization Rep_{ON} based upon organizational and individual norms, N_m that are being satisfied as the sum of all the RI -tuples, hence:

Definition 7: Let $Rep_{ON} = \sum_{(i,j=1)}^n (R_j, I_k)$ playing the role $R_j \in R$ in the interaction $I_k \in I$ based on N_m as defined above.

Based upon this model the overall reputation of an organization as a service provider from the agent P_q point of view is simply the aggregated opinions provided by P_q about the agents A_i in all situations in which it has participated concerning the norms it has violated or fulfilled within the organization.

CONCLUSION

It has been our intention in this brief paper to formulate a model of organizational reputation based on indirect reciprocity from the point of view of multi-agent systems (MAS). This model was then developed to define the notion of agent reputation and organizational reputation within the framework of individual and organizational norms.

There are several areas that have been covered briefly and it is our intention to develop these areas in forthcoming papers. ■

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AN INTRODUCTION TO 'SHARED-VALUE LEARNING SUSTAINABLE UNITS' STRATEGIC APPROACH

ANALYSING AND CRITICALLY EVALUATING THE STRATEGY OF GOOGLE

OLDŘICH DUTÝ, JR.

This paper will comment on the overall strategy concept used by Google. In particular, the author will examine the generic strategic approach used by Google, a CSR as a part of strategy, as well as define evaluation criteria (suitability, feasibility, acceptability). In addition to this, the author will also comment on the future strategy that Google should use and introduce a newly created model of 'Shared-value learning sustainable units.'

The basic background on Google will be provided first.

2. COMPANY - BACKGROUND INFORMATION

According to Google (2011), Google Inc. is an American company founded in 1998 as a private company that eventually transformed into a public corporation in 2004. The main source of revenue for the company is from advertising related to its search engine Google and other services provided by the company such as Google videos, Google books, Google maps, Gmail, etc. Google is also the owner of Youtube.com.

Google (2011) claims that the business culture is very informal, relaxed, open and yet professional. In spite of the fact that Google is not a small company anymore, the spirit of a friendly small business environment is kept. In the other words, they claim that Google is a Learning Organization according to Senge (1990).

Following is some other data provided by Google (2011):

Mission: To organize the world's information and make it universally accessible and useful

Founders: Larry Page and Sergey Brin

Incorporation: September 4, 1998

Headquarters: 1600 Amphitheatre Parkway, Mountain View, CA 94043

Offices: 68 (Figure 1)



Figure 1: Google Locations (Google, 2011)

3. EVALUATION OF STRATEGY USED BY GOOGLE

3.1 GENERIC STRATEGIES FOR A COMPETITIVE ADVANTAGE

Business strategy can be defined many ways as written in John and Gillies (1996, pp. 176-7). For instance, Quinn (1980) says a business strategy is "the pattern or plan that integrates major goals of an organization, policies, and action sequences into a cohesive whole," while Johnson and Scholes (1993) state it is "the direction and scope of an organization over the long-term," and finally Porter (1985, 1986) says it is the "definition of strategy in terms of achievement competitive advantage by scope of operation."

Competitive advantage is described by Hoskisson et al. (2008, p.7) as being better in creating value than competitors. According to Porter1 (1998, p. 12), the competitive advantage is at the heart of any strategy and the company needs to make a choice on the overall generic type of the competitive advantage. Porter1 (1998, pp. 11-7) describes three types of generic strategies in order to gain a sustainable competitive advantage:

- a) Cost leadership (lower price)
- b) Differentiation (different products/services from competitors)
- c) Focus (differentiation or cost leadership in a particular segment within the market)

According to Lin (2005), among the top success factors are customer service/knowledge, product quality, operating efficiency and innovation. So it is possible to say that these areas are where the competitive advantage could be created.

3.1.1 ASSESSMENT OF GENERIC STRATEGY IN GOOGLE

As of Google (2011), the company claims that the company adapted a learning organization approach that is regarded to be the latest development in management thinking as of Carr (1997, p. 229). From this and a number of innovations provided by Google and from the number of locations, it is clear that differentiation is a generic strategy that is adapted. One of the latest innovations developed by Google (2011) is the so-called 'Google Instant' that speeds up the searching.

The following section will describe corporate social responsibility from a strategic perspective in general and apply it to Google.

3.2 CORPORATE SOCIAL RESPONSIBILITY AS A PART OF THE STRATEGIC CONCEPT

According to Friedman (1970, p. 122), to serve means to sell the product and service to bring profit to the shareholders; however, to serve can be also explained as to 'assist to/promote interest of.' The second part is talking about a modern approach to CSR that is according to Yeldar (2004) and Kotler and Lee (2005, p. 4) a part of every good strategy.

As of Zadek (2004, p. 6) there are five stages of organizational learning towards corporate social responsibility showed in Figure 2.

| Stage | What the organization does | Why |
|------------|---|--|
| Defensive | Deny CSR | Defend against attacks |
| Compliance | Policy based, CSR considered as costs | Protect reputation |
| Managerial | Embedding CSR into managerial practices | Medium term gains |
| Strategic | Integrating CSR into strategies | Long term gains, first mover advantage |
| Civil | Promote broad perspective of CSR | Gains from collective actions |

Figure 2: CSR Approaches from Zadek (2004, p. 6)

How can the approach that Zadek (2004) proposes be viewed for Google will be examined in the next part.

3.2.1 ASSESSMENT OF CSR IN GOOGLE

Google focuses on CSR in the areas of innovation by supporting a so-called innovation cup, many educational institutions, and they also sent a significant amount to help Japan recover from Earthquake. They also have their own foundation. The categories of managerial and strategic approaches are the most frequently used in Google, and they even do some civil approaches as well.

The modern theory talks about 'Creating Shared Value' (CSV) that is similar to civil CSR. Therefore, it is recommended to change the approach from CSR to CSV. The differences are displayed in Figure 3 as of Porter and Kramer (2011, p. 76).

| CSR | CSV |
|--|---|
| Value: doing good | Value: economic and social benefits relative to costs |
| Citizenship, philanthropy, sustainability | Joint company and community value creation |
| Discretionary or in response to external pressure | Integral to competing |
| Separate from profit maximization | Integral to profit maximization |
| Agenda is determinate by external reporting and personal preferences | Agenda is company specific and internally generated |
| Impact limited by corporate footprint and CSR budget | Realigns the entire company budget |
| Example: Fair trade purchasing | Example: Transforming procurement to increase quality and yield |

Figure 3: The Differences between CSR and CSV as of Porter and Kramer (2011, p. 76)

3.3 CRITERIA FOR STRATEGY EVALUATION

In order for the author to analyze and critically evaluate the chosen strategy, clear criteria needs to be set against the strategy that will be evaluated.

In Johnson et al. (2008, pp. 364-9) there are three evaluation criteria:

- **Suitability** – is the strategy addressing key issues relating to strategic positioning?
- **Feasibility** – is the strategy on capabilities acceptable?
- **Acceptability** – is the strategy addressing and meeting the expectations of the stakeholders?

The author will now explain in detail each of the evaluation criteria in regards to Google.

3.3.1 ASSESSMENT OF STRATEGY SUITABILITY FOR GOOGLE

As of Kotler (2010), it is an age of turbulence and constant changes in the business environment requires constant learning. On the other hand, Karamchandani et al. (2011, p. 107) consider the growing population and unequal distribution of wealth as one of the major ethical issues and challenges for every company, and rather than a learning organization focus, there is a suggestion on strategy focused on caring about people 'at the bottom of the pyramid.'

3.3.2 ASSESSMENT OF STRATEGY FEASIBILITY FOR GOOGLE

According to Senge (1990), in order for an organization to claim a learning organization status, they should have the following characteristics:

- **Personal Mastery** – realizing one's own vision;
- **Mental Models** – explicit communication of what we really think;
- **Shared Vision Building** – creating commitment and enthusiasm about the shared objective;
- **Team Learning** – developing others and learning from them;
- **System Thinking** – thinking about the impact of one's own decision in a context of the organization as a whole.

A key factor for feasibility to become a learning organization and maximize effectiveness and efficiency is an organizational **structure and culture**. Bower (1970, p. 287) stresses that the importance of choosing an appropriate organizational structure because it not only affects the current operations, but it creates a framework and channels for information flow. Burns and Stalker (1994, p.100-25) divide organizational structures into two groups; 'organic,' also called 'organismic,' (corresponds to task culture) and 'mechanistic,' also called 'bureaucratic' (corresponds to role culture). They claim that organic structures are more effective and efficient when responding to changes (1994, p. 121). From the roles like CEO and CFO it is clear that there is a role culture (Harrison, 1972, in Handy, 1976, pp. 181-186) that according to Senge (1990) limits learning by departmentalization described also by Piercy (2002, p. 234-6).

Clearly the company has the capabilities of becoming a good learning organization; however, as it was discovered through a detailed look, all learning organizational characteristics are being employed on so-called 'Casual Fridays' (name as of Google, 2011), when employees work on the projects of their interest (personal mastery/task culture/shared vision). As of the feasibility of adapting a strategy for people 'at the bottom of the pyramid,' Google is also half way to success. According to Porter and Kramer (2011, p. 65), the Google company has begun to consider the importance of so-called shared value, but this is just the very beginning.

3.3.3 ASSESSMENT OF STRATEGY ACCEPTABILITY FOR GOOGLE

While the learning organizational concept is well accepted by stakeholders as it is ensuring generating profit (the only CSR that must be done by business is to generate profit as of Friedman (1970, p. 122) by constant learning about the constantly changing expectations of the customers, the concept of shared value refers to connections of economic as well as social progress. In the opinion of the author, the concept of a shared value has a higher profit potential in the long term because it builds a sustainable customers base, so the long term perspective on profit = strategic perspective. Therefore, there is an expectation of even better acceptability of strategy at the 'bottom of the pyramid' (shared values), and then the learning organization should generate a sustainable profit while constantly increasing the customers base.

4. STRATEGY FOR THE FUTURE AND ITS IMPLEMENTATION

4.1 STRATEGY FOR THE FUTURE

Regardless of the fact that Google is a very progressive company and adapting current trends in managerial thinking, it is strongly recommended by the author to turn from a learning organization into a 'shared-value learning sustainable units organization' that would combine the characteristics of Senge's learning organization (Personal Mastery; Mental Models; Shared Vision Building; Team Learning; System Thinking)

and ethical principles regarding the redistribution of wealth (based on CSV concept proposed by Porter and Kramer (2011, p. 76). The implementation will not be an easy matter; however, the author believes that adopting the 'shared-value learning sustainable units' approach will become a norm in future years (due to the need of redistribution of wealth), and if so, the adaption of just learning organizational characteristics without shared value elements will not be enough as the competitive nature of the industries will be ridiculously high and companies will go out of business. The one that survives will be bigger and stronger and more ethical as they will be forced to compete for the customer base 'at the bottom of the pyramid.'

As every implementation of a new strategy, change management needs to be employed. The process of implementation as well as a new model application is explained in the next section.

4.2 IMPLEMENTATION

According to Wickham (2004, pp. 123-7) based on Kotter (1996), the following is an eight- stage process of change management:

1. Sense of urgency establishment: the ethical problem of re-distribution of wealth – the majority people represent 'the bottom of the pyramid,' and they are not served so it is a potential opportunity for profit.
2. Powerful coalition creation: the consultant must involve internal human resources with the right positions, nationalities, leadership skills, credibility etc. Suggested by Diamond (2007), it is also necessary to make sure that all of the levels of the organization are involved in the change and it is critically important that the organization agrees on the values and desired cultural changes.
3. Vision development: a desirable, imaginable, communicable picture of the future position.
4. Vision communicating: leadership by examples, constant two-way communication which adapt to the level of communication with the audience.
5. Empowering employees: let the audience think that it was their own vision, equipping people affected by the change with needed skills, delegate. According to Diamond (2007), change should be promoted by workshops, and learning and training needs to be involved.
6. Short-term success celebration: a process of change takes time, a long way must be divided into stages and meeting the requirements of each stage should be celebrated and rewarded. According to Diamond (2007), well motivated and rewarded employees are essential for a successful change in management process, and managers should encourage and coach employees rather than use punishment and negative motivation strategies.
7. Improvement consolidation and more change adding: people should not feel that the job is almost finished.
8. Anchoring changes in the culture of the organization: the new approaches created by the change should be an incorporated part of the culture of the organization, and this must be ensured.

According to Porter and Kramer (2011, p. 65), shared value should be created by:

1. Understanding products and markets
2. Redefining productivity in the value chain
3. Local cluster development

The author suggests to combine these ways with an adapting learning organizational value chain created by Cousins (2010, pp. 54-60), and the diagram summarizing the value creation concept of this kind is shown in Figure 4.

| | | | | |
|------------------------------|-----------------|------------------|-----------------|------------------|
| Infrastructure | | | | |
| HRM | | | | |
| Procurement | | | | |
| Technical Development | | | | |
| Inputs | Creation | Promotion | Delivery | Knowledge |

Figure 4: Value Creation Model (summarized from Cousins, 2010, pp. 54-60)

The following section deals with the implementation of a new model for Google.

4.2.1 IMPLEMENTATION OF THE NEW MODEL FOR GOOGLE

While the learning organizational concept is well accepted by stakeholders as it ensures that Google would provide inputs into newly created clusters by out-sourcing creation of services (countries with the biggest proportion 'people at the bottom of the pyramid'), of course this will require huge initial investment in a country's infrastructure, training people, etc. By this Google would create sustainable cluster units that would promote themselves by training others and also helping create other clusters and this knowledge of how to build self-sustainable clusters would be used cyclically. It is clear Google would turn the Corporate social responsibility into Creating Shared Value according to Porter and Kramer (2011, p. 76).

In exchange for the huge investment, the company value would ensure sustainability by building a loyal and significant customer base as well as gain a sustainable cash flow from the shares of the profit generated by the clusters. The social status of the company would increase significantly as well.

This approach respects one of the favorite Chinese proverbs "if you give a fish to a hungry man, you will peace him for a day. If you teach him how to catch the fish, you will peace him for the rest of his life."

As the learning organization is just 'giving a fish to a hungry man' as it is about satisfying constantly changing needs of the customers, then a new concept of 'shared-value learning sustainable units' would 'peace the shareholders constantly' not only by generating an increased profit, but also respecting ethical norms and making the world a better place.

Moreover, the new concept respects all of the characteristics of a learning organization in a broader perspective than just a company one.

- **Personal Mastery** – shareholders will get increased profit, the people 'at the bottom of the pyramid' will gain sustainability;
- **Mental Models** – mental models will be shifted from an old paradigm thinking about competitive advantage arising just from product differentiation and cost leadership, and Corporate social responsibility that is regarded as pure cost will be transformed in a profit generating 'creating social value;' the profit potential will no longer be assessed just by recent possession of money but the near future profit potential will be accessed instead. This is real strategic thinking in the opinion of the author;
- **Shared Vision Building** – creating commitment and enthusiasm about the shared objective not only within the company but also globally shared vision by 'all' stakeholders;

- **Team Learning** – developing others and learning from them again not just within the company but utilizing a global team work systems and clusters;
- **System Thinking** – thinking about the impact of one's own decision in the context of the WOLD as a whole.

CONCLUSION

This paper was designed to evaluate and critically analyze the generic strategy adopted by Google. Its intention was NOT to focus on the external environment.

The paper was divided into two sections. The first section was about current strategy where brief background information on the company was presented. This was followed by an explanation of a differentiation generic competitive strategy adopted by Google (constant innovation). Further, the CSR approach was explained as managerial/strategic approaches with civil elements. It was recommended to turn it into 'Creating Shared Value.' Next the strategy was evaluated against the criteria of: Suitability: the current strategy of a Learning organization (LO) is suitable but employed just on the 'Casual Fridays.' The Bottom of the Pyramid (BP) strategy is based on the concepts of CSV would be more suitable and Google is at the beginning of the adaption of it. Feasibility: the company has capabilities to adapt both strategies LO and BP strategy). Acceptability: both strategies should be well accepted by stakeholders).

The second section was about the future strategy and its implementation. It starts with proposing a new concept of 'Shared-value learning sustainable units organization' – a combination of LO and BP strategy concept. This is followed by suggested steps in the management change as well as value creation combining the Value Creation concept and Creating Shared Value concept. The fundamental idea is to build self-sustainable clusters that will bring sustainable future profit as well as from the sustainable and loyal customer base.

The recommended concept is to keep in mind and in practice the following proverb: "if you give a fish to a hungry man, you will peace him for a day. If you teach him how to catch the fish, you will peace him for the rest of his life." In addition to this aspect the learning organization is a global, not only an organizational, concept. ■

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— PART II

TOPICS FROM

COMPUTING



DATA MINING TECHNIQUES

JANA JAROLÍMOVÁ

Data mining is the process of analysing [very large amounts of] data by finding and extracting patterns and correlations, and also modeling the data to enable an easier grasp of the information. It deals with ratios and influences, and can predict and discover relationships (amongst factors such as price, product positioning, competition and customer demographics) and effects (within sales, customer satisfaction and corporate profits).

Data mining allows organisations to learn more about their customers and make profitable decisions. Its applications include market segmentation, which allows you to find common behavioural patterns amongst your customers; and customer churn, which allows you to estimate which customers you are likely to lose to competitors. This article explains various techniques of data mining, including linear regression, clustering, classification and associative learning rule.

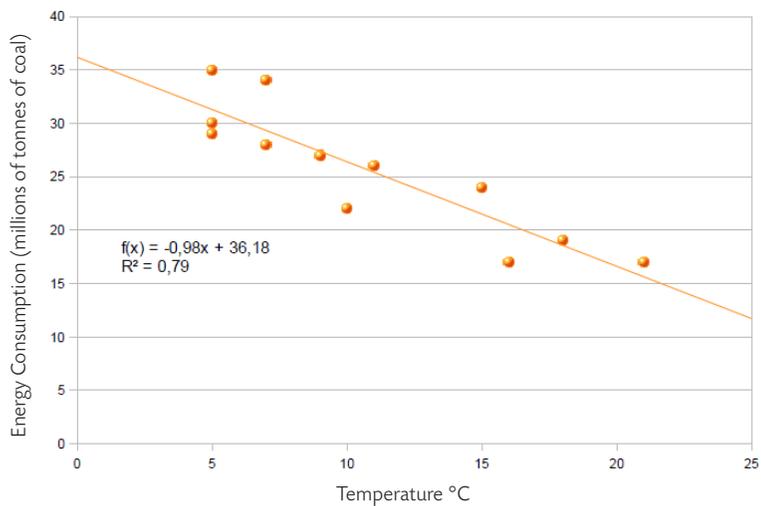
LINEAR REGRESSION

Linear regression is a technique which analyses the relationship between a dependent and an explanatory variable, which helps to anticipate behavioural patterns and trends. The data is plotted onto a scatter diagram, the shape of which reveals the correlation between the two, or lack thereof. Before plotting the scatter diagram of the variables, one must determine which is dependent on the other. For instance, if comparing the sales of a store with its advertising expenses; the sales would be dependent on the advertising, which in turn would explain the sales. It could not be the other way around; the sales would never explain the advertisement expenditures. The dependent variable is plotted along the y-axis, whilst the explanatory variable is plotted along the x-axis.

The following data shows temperature (°C) and energy consumption (EC) in millions of tonnes of coal. In this example, the energy consumption is dependent upon the temperature. Figure 1 then shows the plotted diagram from the table's data.

| | x | y |
|-----------|----|----|
| Month | °C | EC |
| January | 5 | 29 |
| February | 5 | 30 |
| March | 7 | 34 |
| April | 9 | 27 |
| May | 10 | 22 |
| June | 15 | 24 |
| July | 18 | 19 |
| August | 21 | 17 |
| September | 16 | 17 |
| October | 11 | 26 |
| November | 7 | 28 |
| December | 5 | 35 |

Figure 1: Temperature and Energy Consumption



The previous diagram was plotted using spreadsheet software, which automatically calculates the regression line. The equation to find the regression line is

$$y = bx \pm a$$

where b is the slope of the line, and is calculated as

$$b = \frac{n\sum xy - (\sum x)(\sum y)}{n\sum x^2 - (\sum x)^2}$$

and a is the y-intercept (it is equal to y when $x = 0$), and is calculated with the following equation:

$$a = \frac{\sum y - b\sum x}{n}$$

where n = the number of rows in the table.

With these formulae, we can easily make a new table, calculating the values needed to find the regression line.

| Month | x °C | y EC | xy °C*EC | x ² °C ² |
|-----------|------------|------------|-------------|-----------------------------------|
| January | 5 | 29 | 145 | 25 |
| February | 5 | 30 | 150 | 25 |
| March | 7 | 34 | 238 | 49 |
| April | 9 | 27 | 243 | 81 |
| May | 10 | 22 | 220 | 100 |
| June | 15 | 24 | 360 | 225 |
| July | 18 | 19 | 342 | 324 |
| August | 21 | 17 | 357 | 441 |
| September | 16 | 17 | 272 | 256 |
| October | 11 | 26 | 286 | 121 |
| November | 7 | 28 | 196 | 49 |
| December | 5 | 35 | 175 | 25 |
| Σ | 129 | 308 | 2984 | 1721 |

$$b = \frac{12(2984) - (129)(308)}{12(1721) - (129)^2} = -0.9783$$

$$a = \frac{308 - (-0.9783)(129)}{12} = 36.1835$$

Once we have the values for a and b , we can calculate 2 points on y with 2 different values for x , one for each end of the diagram.

$$y = (-0.9783)(0) + 36.1835 = 36.1835$$

$$y = (-0.9783)(20) + 36.1835 = 16.6175$$

The regression line is then drawn, connecting the 2 points.

How well the regression line fits with the points on the diagram is measured by the correlation coefficient (r). It can be seen with the naked eye whether it fits at all, by how close the points follow the line. If the points are not in correlation whatsoever with the regression line, then there exists no relationship between the 2 variables. The correlation coefficient is a number between -1 and 1. The closer the number is to 1 or -1, the better the relationship is, in either a positive or negative direction (if positive the regression line goes upwards, if negative then downwards).

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{(n\sum x^2 - (\sum x)^2)(n\sum y^2 - (\sum y)^2)}}$$

By plugging in the appropriate values, we find that the correlation coefficient is 0,89. This is the square root of r^2 , which is the determination coefficient, which was calculated on the spreadsheet with the regression line equation.

The determination coefficient is a percentage which tells us how much of the variation of the dependent variable is actually explained by the explanatory one. In this example, 79% of the variation in energy consumed is explained by the temperature, whilst the remaining 21% is influenced by other causes. Accuracy of forecasts is also diminished by extrapolation, which is when the value of x falls outside of the range given. When forecasting for x within the range it is called interpolation.

Being able to identify what factors affect various goals or downfalls of a business, and to what degree, can help make invaluable decisions. But, what happens when you want to see the relationship between 2 variables who hold no values, only places? For instance, if you wanted to see the correlation between different people's ranking of the same person or object. This can be discovered by finding the value of b from the equation given earlier. A simpler way, though, is to calculate Spearman's rank correlation coefficient

$$r_s = 1 - \frac{6\sum d^2}{n(n^2 - 1)}$$

This method is also more efficient when the values are known, but irrelevant, as when comparing evaluations, or influences of rankings.

CLUSTERING

Clustering is a way of grouping unlabeled data based on a selected criterion. The criterion chosen for each specific case determines what similarity is observed. Clustering is a form of unsupervised learning, as you are in the dark as to how the data should be clustered, and into how many clusters they should be partitioned. Similarities within a cluster should always be high, whilst similarities between clusters should be low. There are different techniques for grouping data in this natural method, the two which will be discussed here are hierarchical and k -means clustering. A common criterion in grouping clusters is by distance, which will be the criterion by which the following cluster examples will be shaped.

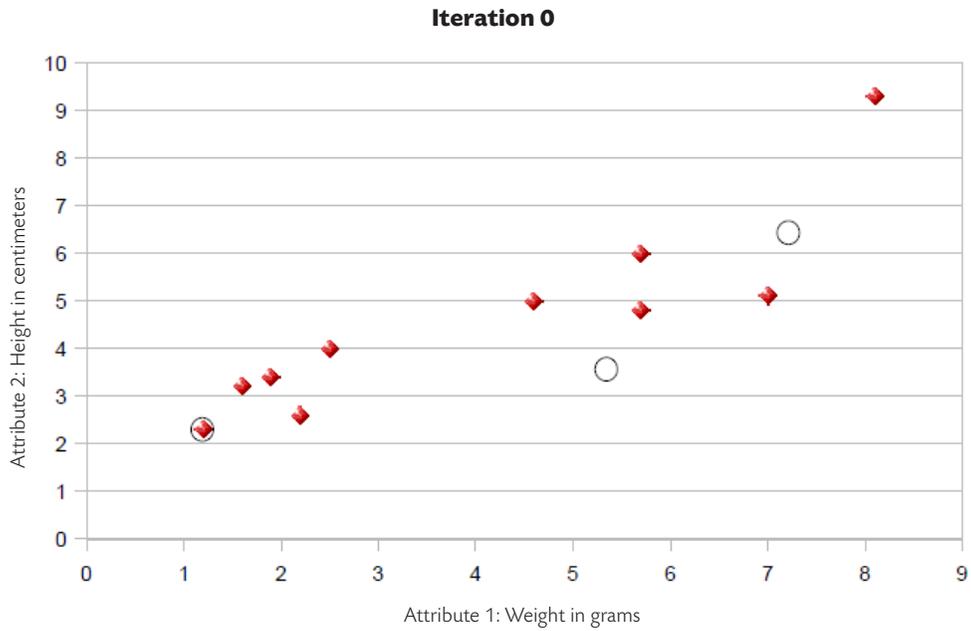
K-MEANS

K -means is a method of clustering in which you randomly select k clusters by defining k means. Items then become part of the cluster to whose mean they are closest. After the initial 'clusterisation', all k -means are then repositioned to the newly-formed centroid. Then, the distance between each item and centroid is recalculated so as to minimise the sum of squares. These steps are done recursively until movement no longer occurs and clusters are stabilised. An obvious drawback in this method is that the end result depends entirely on the initial selection of centroids, their quantity and position. For this reason, the process should be done several times with different starting points, so a comparison can be made.

To illustrate by example, the table below shows n -objects with their attributes (x,y) .

| | x | y |
|--------|----------------|----------------------|
| Object | Weight (grams) | Height (centimeters) |
| A | 1.2 | 2.3 |
| B | 5.7 | 4.8 |
| C | 7 | 5.1 |
| D | 2.5 | 4 |
| E | 1.9 | 3.4 |
| F | 1.6 | 3.2 |
| G | 4.6 | 5 |
| H | 2.2 | 2.6 |
| I | 5.7 | 6 |
| J | 8.1 | 9.3 |

With the given data, we then decide how many k -means we would like to classify the features into. For this example, we will divide them into 3-means and place them arbitrarily, as illustrated in the following diagram.



The coordinates of the centroids are

$$c_1 = (1.2, 2.3)$$

$$c_2 = (5.2, 3.7)$$

$$c_3 = (7.1, 6.5)$$

$$D(c, i) = \sqrt{\sum_{i=1}^n (c_n - i_n)^2}$$

$$D(c, i) = \sqrt{(c_1 - i_1)^2 + (c_2 - i_2)^2}$$

$$D(c_2, B) = \sqrt{(5.2 - 5.7)^2 + (3.7 - 4.8)^2} = 1.21$$

| | A | B | C | D | E | F | G | H | I | J | |
|---------|------|------|------|------|------|------|------|------|------|------|-------|
| $D^0 =$ | 0 | 5.15 | 6.44 | 2.14 | 1.3 | 0.98 | 4.34 | 1.04 | 5.83 | 9.83 | c_1 |
| | 4.24 | 1.21 | 2.28 | 2.72 | 3.31 | 3.63 | 1.43 | 3.2 | 2.35 | 6.31 | c_2 |
| | 7.24 | 2.2 | 1.4 | 5.24 | 6.05 | 6.41 | 2.92 | 6.26 | 1.49 | 2.97 | c_3 |

We now adjust the centroids to the means of their items. To find the mean we simply add the x coordinates and y coordinates of the items belonging to each centroid and divide them by the total number of items included in the group.

So

$$c_1 = \left(\frac{1.2 + 2.5 + 1.9 + 1.6 + 2.2}{5}, \frac{2.3 + 4 + 3.4 + 3.2 + 2.6}{5} \right)$$

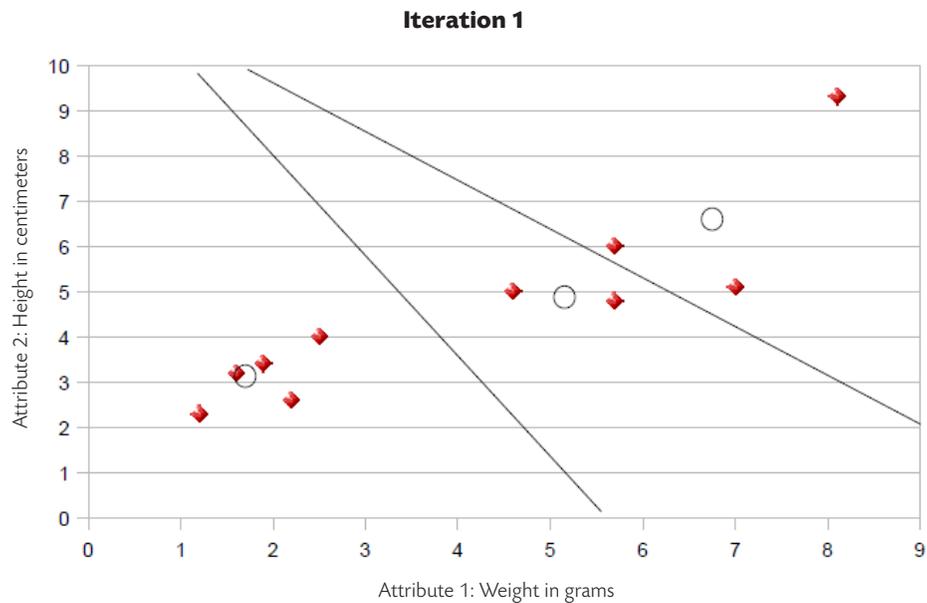
$$c_1 = \left(\frac{9.4}{5}, \frac{15.5}{5} \right) = (1.88, 3.1)$$

and

$$c_2 = (5.15, 4.9)$$

$$c_3 = (6.93, 6.8)$$

We can now plot the next iteration. The following diagram illustrates the newly positioned means, along with the division of the 3 groups, showing which items belong with which centroid.

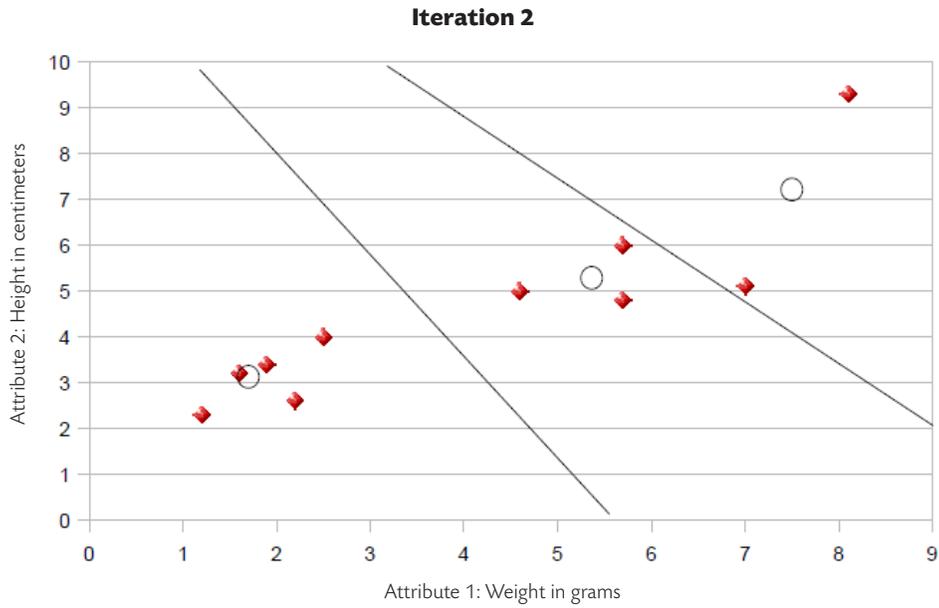


We now compute the new distance between all items and centroids.

$$D^2 = \begin{bmatrix} A & B & C & D & E & F & G & H & I & J \\ \begin{bmatrix} 1.05 & 4.18 & 5.5 & 1.09 & 0.3 & 0.3 & 3.32 & 0.59 & 4.8 & 8.78 \\ 5.09 & 0.6 & 1.68 & 3.1 & 3.91 & 4.27 & 0.78 & 4.11 & 0.82 & 4.89 \\ 8.02 & 3.03 & 2.17 & 5.98 & 6.81 & 7.17 & 3.68 & 7.06 & 1.47 & 2.17 \end{bmatrix} & \begin{matrix} c_1 \\ c_2 \\ c_3 \end{matrix} \end{bmatrix}$$

Only one item has changed groups in this iteration, being *I*, from centroid 3 to 2. Since centroid 1 has the same members, its mean will remain unchanged, but we must recalculate the new mean for c_2 and c_3 .

The following groups are then formed, with their new means.



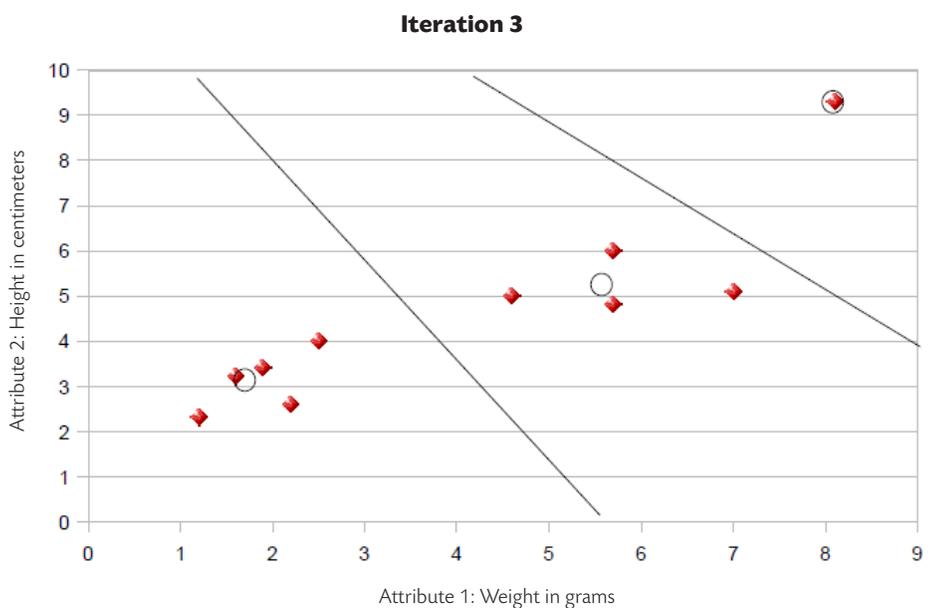
Once again, the distances are calculated and items are regrouped.

$$D^2 = \begin{bmatrix} A & B & C & D & E & F & G & H & I & J \\ \left[\begin{array}{c} 1.05 & 4.18 & 5.5 & 1.09 & 0.3 & 0.3 & 3.32 & 0.59 & 4.8 & 8.78 \\ 5.09 & 0.6 & 1.68 & 3.1 & 3.91 & 4.27 & 0.78 & 4.11 & 0.82 & 4.89 \\ 8.02 & 3.03 & 2.17 & 5.98 & 6.81 & 7.17 & 3.68 & 7.06 & 1.47 & 2.17 \end{array} \right] \begin{array}{l} c_1 \\ c_2 \\ c_3 \end{array} \end{bmatrix}$$

Groups 2 and 3 have changed members, so their centroids are recalculated.

$$c_2 = \left(\frac{23}{4}, \frac{20.9}{4} \right) = (5.75, 5.23)$$

$$c_3 = (8.1, 9.3)$$



$$D^3 = \begin{bmatrix} A & B & C & D & E & F & G & H & I & J \\ 1.05 & 4.18 & 5.5 & 1.09 & 0.3 & 0.3 & 3.32 & 0.59 & 4.8 & 8.78 \\ 5.41 & 0.43 & 1.26 & 3.47 & 4.26 & 4.62 & 1.17 & 4.42 & 0.77 & 4.7 \\ 9.83 & 5.1 & 4.34 & 7.71 & 8.56 & 8.91 & 5.54 & 8.93 & 4.08 & 0 \end{bmatrix} \begin{matrix} c_1 \\ c_2 \\ c_3 \end{matrix}$$

We are left with our final groupings: $c_1 = (A, D, E, F, H)$, $c_2 = (B, C, G, I)$ and $c_3 = (J)$.

HIERARCHICAL

Hierarchical clustering can be done from the bottom-up (agglomerative) or from the top-down (divisive), though bottom-up is much more common. In agglomerative clustering, each item starts out as its own cluster, whereas with the divisive method you start out with all items in one cluster, and you form new clusters by joining or disjoining them, respectively, until you have formed one whole cluster of all the items, or each item has become its own cluster. Using the agglomerative method, and merging clusters, is done by joining the closest/most similar pairs. After a cluster is joined with another, the distances are recalculated to find the next closest pair. Distances can be measured in different ways, either taking the shortest (single-link), greatest (complete-link), or average distance (or similarity) between clusters. Distance is measured between two items who each belong in a different cluster, but represent the entire cluster. Figure 2, below, illustrates the difference between single-link and complete-link measuring, where the distance between c and y would represent the distance between clusters using single-linkage, and the distance between a and z would equal the distance between clusters if applying complete-linkage.

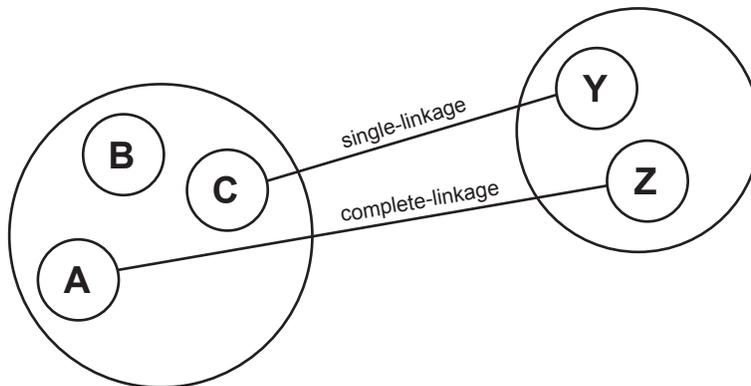


Figure 2

To illustrate how the technique is performed, we will apply single-linkage (also called nearest neighbour) agglomerative clustering to the following table of data, which represents 8 objects that each have 2 measured attributes.

| Object | X | Y |
|--------|-----|-----|
| A | 4 | 1 |
| B | 5.1 | 4.2 |
| C | 1.7 | 5 |
| D | 2 | 4.8 |
| E | 1.2 | 3.4 |
| F | 1.9 | 1.2 |
| G | 3.9 | 2.2 |
| H | 3 | 2.6 |

From this data we then create a distance matrix by calculating the distance between each object using the Euclidean distance formula

$$D(c,i) = \sqrt{\sum_{i=1}^n (c_n - i_n)^2}$$

ITERATION 0:

| | | | | | | | | |
|---|------|------|------|------|------|------|------|------|
| | A | B | C | D | E | F | G | H |
| A | 0 | 3.38 | 4.61 | 4.29 | 3.69 | 2.11 | 1.2 | 1.89 |
| B | 3.38 | 0 | 3.49 | 3.16 | 3.98 | 4.39 | 2.33 | 2.64 |
| C | 4.61 | 3.49 | 0 | 0.36 | 1.68 | 3.81 | 3.56 | 2.73 |
| D | 4.29 | 3.16 | 0.36 | 0 | 1.61 | 3.6 | 3.22 | 2.42 |
| E | 3.69 | 3.98 | 1.68 | 1.61 | 0 | 2.31 | 2.95 | 1.97 |
| F | 2.11 | 4.39 | 3.81 | 3.6 | 2.31 | 0 | 2.24 | 1.78 |
| G | 1.2 | 2.33 | 3.56 | 3.22 | 2.95 | 2.24 | 0 | 0.98 |
| H | 1.89 | 2.64 | 2.73 | 2.42 | 1.97 | 1.78 | 0.98 | 0 |

The first step in the iteration is to find the 2 items which have the smallest distance between them. In our example, C and D have the smallest distance, with 0.36, so they are the first cluster we create. Now that we have formed our first cluster which consists of more than 1 item, we will apply the single-linkage rule to measure the difference between cluster (C, D) and every other cluster. For instance, to measure the distance between A and (C, D) we take whichever distance is smallest, either (A, C) or (A, D).

$$d_{(C,D)-A} = \min(d_{CA}, d_{DA}) = \min(4.61, 4.29) = 4.29$$

4.29 is the shortest distance, therefore that is the distance between A and (C, D). After calculating all the distances for (C, D), we then restart the iteration by once again finding the pair which has the shortest distance between them.

ITERATION 1:

| | | | | | | | |
|------|------|------|------|------|------|------|------|
| | A | B | C, D | E | F | G | H |
| A | 0 | 3.38 | 4.29 | 3.69 | 2.11 | 1.2 | 1.89 |
| B | 3.38 | 0 | 3.16 | 3.98 | 4.39 | 2.33 | 2.64 |
| C, D | 4.29 | 3.16 | 0 | 1.61 | 3.6 | 3.22 | 2.42 |
| E | 3.69 | 3.98 | 1.61 | 0 | 2.31 | 2.95 | 1.97 |
| F | 2.11 | 4.39 | 3.6 | 2.31 | 0 | 2.24 | 1.78 |
| G | 1.2 | 2.33 | 3.22 | 2.95 | 2.24 | 0 | 0.98 |
| H | 1.89 | 2.64 | 2.42 | 1.97 | 1.78 | 0.98 | 0 |

The smallest difference is now between clusters *G* and *H*, so we group those together and again recalculate the distance matrix.

ITERATION 2:

| | | | | | | |
|------|------|------|------|------|------|------|
| | A | B | C, D | E | F | G, H |
| A | 0 | 3.38 | 4.29 | 3.69 | 2.11 | 1.2 |
| B | 3.38 | 0 | 3.16 | 3.98 | 4.39 | 2.33 |
| C, D | 4.29 | 3.16 | 0 | 1.61 | 3.6 | 2.42 |
| E | 3.69 | 3.98 | 1.61 | 0 | 2.31 | 1.97 |
| F | 2.11 | 4.39 | 3.6 | 2.31 | 0 | 1.78 |
| G, H | 1.2 | 2.33 | 2.42 | 1.97 | 1.78 | 0 |

The next shortest distance is between *A* and (*G, H*), so the next matrix clusters them together.

ITERATION 3:

| | | | | | |
|---------|---------|------|------|------|------|
| | A, G, H | B | C, D | E | F |
| A, G, H | 0 | 2.33 | 2.42 | 1.97 | 1.78 |
| B | 2.33 | 0 | 3.16 | 3.98 | 4.39 |
| C, D | 2.42 | 3.16 | 0 | 1.61 | 3.6 |
| E | 1.97 | 3.98 | 1.61 | 0 | 2.31 |
| F | 1.78 | 4.39 | 3.6 | 2.31 | 0 |

This goes on until all items are in one cluster.

ITERATION 4:

| | | | | |
|---------|---------|------|---------|------|
| | A, G, H | B | C, D, E | F |
| A, G, H | 0 | 2.33 | 1.97 | 1.78 |
| B | 2.33 | 0 | 3.16 | 4.39 |
| C, D, E | 1.97 | 3.16 | 0 | 2.31 |
| F | 1.78 | 4.39 | 2.31 | 0 |

ITERATION 5:

| | | | |
|------------|------------|------|---------|
| | A, G, H, F | B | C, D, E |
| A, G, H, F | 0 | 2.33 | 1.97 |
| B | 2.33 | 0 | 3.16 |
| C, D, E | 1.97 | 3.16 | 0 |

ITERATION 6:

| | | |
|---------------------|---------------------|------|
| | A, G, H, F, C, D, E | B |
| A, G, H, F, C, D, E | 0 | 2.33 |
| B | 2.33 | 0 |

Once we have made one cluster of all the items we can then create a dendrogram. A dendrogram illustrates the ordering of items and shows us where smaller clusters were formed, whilst also displaying the distance at which the clusters were merged (Figure 3).

Hierarchical clustering is disadvantageous in that you cannot undo anything you have done, and it does not scale well, with a time complexity of at least $O(n^2)$. Also, since there are different ways of measuring the distance between clusters, you can easily end up with varying results.

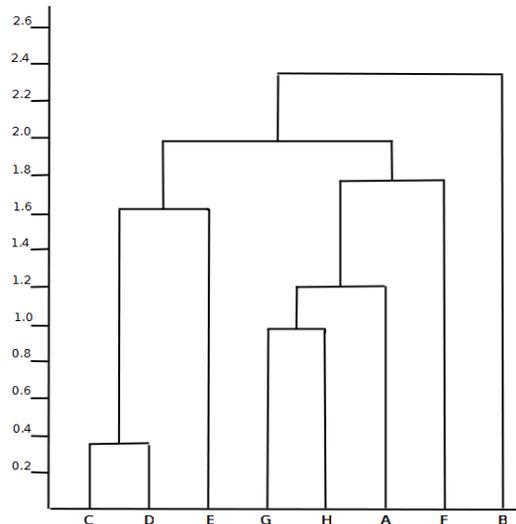


Figure 3

CLASSIFICATION

Classification is similar to clustering in that it also segments items, but where clustering is an exploratory analysis of unlabeled data, the process of classification classifies pre-labeled data with a purpose. A popular method of classification is that of the decision tree, whose applications include credit approval, fraud detection, and direct marketing.

A decision tree works in such a way, that, starting from the top, you are faced with a finite list of options of the *if* variety, or 2 booleans. After selecting one, you *then* follow its path to the next condition. The *if/then* scheme continues until you reach the bottom and are given your final choice/response which the tree directed you in making. Figure 4 shows a simple modeling of a decision tree.

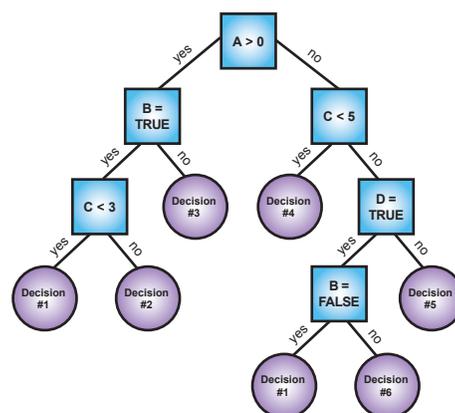


Figure 4

ASSOCIATION RULE

Association rule learning is a way of discovering relations between items in a large data set, based on their (recurring) associations with other items or sets of items. An association rule is an implication, and is probabilistic by nature; the sets of items (or itemsets) X and Y , from the complete set of items I , are known as the antecedent and consequent, respectively, and do not have any items in common:

$$X \Rightarrow Y \text{ where } X, Y \subseteq I \text{ and } X \cap Y = \emptyset$$

The support number of a rule ($\text{supp}(X)$) indicates how many times the rule is satisfied in all the transactions, and is often shown as a percentage. A rule's confidence number is the ratio of ($\text{supp}X$) to the number of transactions which include all items in the antecedent.

| Transaction ID | chewing gum | chocolate | condoms | wine |
|----------------|-------------|-----------|---------|------|
| 1 | 0 | 0 | 0 | 1 |
| 2 | 0 | 0 | 1 | 1 |
| 3 | 1 | 1 | 1 | 0 |
| 4 | 1 | 1 | 0 | 1 |
| 5 | 1 | 0 | 0 | 0 |
| 6 | 1 | 0 | 1 | 1 |

Association rule learning is widely used in market basket analysis, which analyses customer's purchasing behaviour. This is very beneficial for businesses, as this information can be used in many ways to increase sales by strategically placing products known to influence one another's sales, or to motivate purchase of promotional items through loyalty programs. ■

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JAVA (PROGRAMMING LANGUAGE)

MICHAL HLÁSNY

1. DEVELOPMENT AT THE BEGINNING

Work on Java originally began with the goal of creating a platform-independent language and operating system for consumer electronics. The original intent was to use C++, but as work progressed in this direction, the Java developers realized that they would be better served by creating their own language rather than extending C++. The effort toward consumer electronics led the Java team, then known as FirstPerson, Inc., toward developing hardware and software for the delivery of video-on-demand with Time-Warner (creators of Java – Patrick Naughton, James Gosling).

Unfortunately (or perhaps fortunately, depending on your perspective), Time-Warner selected Silicon Graphics as the vendor for its video-on-demand project. This setback left the FirstPerson team with an interesting piece of software (Java) but no market in which to place it. Eventually, the needs of the Java language and the World Wide Web (WWW) were noticed, and Java found a market. This task was easy because on the Internet were many users running on different platforms with several browsers and they demanded and asked for these applications being made available on the Internet. This was the point where platform-independent programming became very desired and important.

Prior to creating Java, five basic goals have been set as a starting point or criteria that should be covered by this new artificial language.

1. Java should incorporate object-oriented methods because other products at that time were proven useful and popular by using this approach.
2. It should make it possible to run programs on multiple platforms .
3. The support for using computer networks should already be included.*
4. It was supposed to be designed to execute code form remote sources securely.
5. The interface was supposed to be 'easy' to use by taking over the popular and efficient parts of object oriented languages.

It was originally called OAK (apparently because James Gosling used to like the view from his window overlooking big oak), but the people from Sun realized that the Oak was a name of an already existing computer language, and changed it to Java in 1995, but work started in 1991.

"In 1992, the Green project (it was named like that at the beginning when it was support small consumer devices like switch-boxes) delivered its first product, called '7.' It was an extremely intelligent remote control (It had the power of SPARCstation in a box that was 6"by 4"by 4".)" (Horseman and Cornell, 1999).

The Green project spent 1993 and half of 1994 looking for companies interested in this technology but had no luck. As the Internet was growing, Sun developers thought it would be a good idea to build an architecture neutral browser. The browser was build by Patrick Naught and Jonathan Payne, and it demonstrated the power of Java (WebRunner (named after the movie Blade Runner), later renamed HotJava). After that, Netscape released its new Netscape 2.0 Java enabled browser and others followed.

2. WHAT IS JAVA AND HOW DOES IT WORK

Java is an object oriented language, similar to C++, but its creators tried to remove and simplify features that had caused programming errors in the past (most namely API – application programming interface).

Java source code files (files with Java extensions) are compiled into a format called byte code (files with a class extension) and then executed by an interpreter. Compiled Java code can run on most computers because Java interpreters and runtime environments (Java Virtual Machine), exist for most operating systems (UNIX, Macintosh OS, Windows). Byte-code has the ability to be converted directly into a machine instruction thanks to just in time compiler (JIT). The dynamic JIT compilation is faster than the virtual machine interpretation.

Java was meant to be a general programming language. Small Java applications called Java applets can be downloaded from a web server and run on a number of Java compatible web browsers (Netscape Navigator, Microsoft Explorer, Google Chrome, Opera), and that is what makes users directly interact with a web page.

It was designed to have the "look and feel" of the C++ language, but it is simpler to use than C++ and enforces an object-oriented programming model. Java can be used to create complete applications that may run on a single computer or be distributed among servers and clients in a network.

* To achieve the goals of networking support and remote code execution, Java programmers sometimes find it necessary to use extensions such as CORBA, Internet Communications Engine, or OSGi.

3. THE MAJOR CHARACTERISTICS OF JAVA

- The programs you create are portable in a network. Your source program is compiled into what Java calls byte code, which can be run anywhere in a network on a server or client that has a Java virtual machine. The Java virtual machine interprets the byte-code into code that will run on the real computer hardware. This means that individual computer platform differences such as instruction lengths can be recognized and accommodated locally just as the program is being executed. Platform-specific versions of your program are no longer needed.
- The code is robust, here meaning that, unlike programs written in C++ and perhaps some other languages, the Java objects can contain no references to data external to themselves or other known objects. This ensures that an instruction cannot contain the address of data storage in another application or in the operating system itself, either of which would cause the program and perhaps the operating system itself to terminate. The Java virtual machine makes a number of checks on each object to ensure integrity.
- Java is object-oriented, which means that, among other characteristics, an object can take advantage of being part of a class of objects and inherit code that is common to the class. Objects are thought of as "nouns" that a user might relate to rather than the traditional procedural "verbs."

In addition to being executed at the client rather than the server, a Java applet has other characteristics designed to make it run fast. Relative to C++, Java is easier to learn.

4. JAVA RELATED TERMS

JavaScript should not be confused with Java. JavaScript, which originated at Netscape, is interpreted at a higher level, is easier to learn than Java, but lacks some of the portability of Java and the speed of byte code. Java applets will run on almost any operating system without requiring recompilation, and also Java has no operating system-unique extensions or variations.

Byte code is a computer object code that is processed by a program, usually referred to as a virtual machine, rather than by the "real" computer machine, the hardware processor. The virtual machine converts each generalized machine instruction into a specific machine instruction or instructions that this computer's processor will understand.

Byte code is the result of compiling a source code written in a language that supports this approach. Most computer languages, such as C and C++, require a separate compiler for each computer platform that is for each computer operating system and the hardware set of instructions that it is built on. Windows and the Intel line of microprocessor architectures are one platform; Apple and the PowerPC processors are another. Using a language that comes with a virtual machine for each platform, your source language statements need to be compiled only once and will then run on any platform.

The well-known language today that uses the byte code and virtual machine approach is Java. The LISP language, used in artificial intelligence applications, is an earlier language that compiled byte code. Other languages that use byte code or a similar approach include Icon and Prolog.

Rather than being interpreted one instruction at a time, Java byte code can be recompiled at each particular system platform by a just-in-time compiler. Usually this will enable the Java program to run faster. In Java, byte code is contained in a binary file with a .CLASS suffix.

5. JAVA FEATURES

Java is considered to be a simple programming language. Starting as C++, Java has removed some of the complicated features. For example, the infamous GOTO statement has been removed. Also the syntax is easier than C++. Programmers already experienced with working in C++ or C should have no problems with transition to this language.

Significant improvement or change is the complete removal of pointers from the Java language. C++ and C were based on these features, but Java manipulates the memory directly so the so-called hustle with pointers causing trouble has been removed. In C++ you could use pointers to store allocated memory, so if a programmer forgot to release this memory afterwards it would eventually run out of memory.

“One of the most important is automatic memory management, usually known as *garbage collection*. Garbage collection is really just a blue-collar term that means that you don't need to free memory that you allocate—the Java Virtual Machine takes care of this for you”(Java, 2007).

5.1. OBJECT ORIENTED

Unlike C++ where you can freely mix functions and classes, in Java everything except a few basic data types is an object and all functions are invoked through an object.

Class is like a template from which objects are created. They are stored as separate files and are loaded into the Java interpreter only when needed. This means that the application itself decides and dynamically expands as it needs to. “When you write programs in the Java language, all program data is wrapped in a class, whether it is a class you write or a class you use from the Java platform API libraries” *Object-oriented programming* (Oracle, 2010).

An object usually stores or encapsulates* related data and provides operations which the data is subjected to.

6. PERFORMANCE

Because Java works with byte codes, it is faster than other purely interpreted languages, but it is a bit slower than C or C++ programs compiled to a native machine language. It is important to mention that not all Java platforms are implemented with interpreted byte codes. If the computation is too intensive, e.g. string manipulation methods, programs are implemented using machine native code.

* Encapsulation is a technique where data is hidden within a class. This method hides the code which is written to perform the operation for which the class is written. This will help the programmers to easily modify the code of the class without worrying about the existing code details.

Creators of Java tried to eliminate the mistakes while using for example C++, so they tried to remove the most common bugs. Examples:

- They introduced true arrays and eliminated pointers arithmetic, which is basically removing the possibility of overwriting critical area of memory while working with pointers.
- “Embedded computers had to be robust. Consumers should not have to reboot their television or toaster because its control software has crashed. These appliances must be as reliable as their non computerized predecessors” *Java Development Environment* (OOPJ, 2008).
- A large amount of platforms are needed to provide their browser with additional plug-ins in order to function. These need to be downloaded, and this approach is potentially dangerous and may do damage to the local machine either intentionally or accidentally. Therefore, a framework was needed that would provide a safer environment in which the code could run.

The Java runtime relies on garbage collection to identify and reclaim objects no longer in use automatically. But the efficiency of garbage collection algorithms depends on several factors: One factor is the hardware of the targeted platform, its CPU type, the amount of memory available, and the availability of memory management hardware support. Another factor is the type of runtime system (compiled or interpreted) and the level of support it provides for memory allocation (supervised or unsupervised). Finally, there are factors depending on the application itself, especially its memory usage patterns (memory cells connectivity, relative size, and life span of allocated objects).

7. CURRENT TRENDS

Today Java continues to support and create new ways to become entwined in our life. One popular technology that has taken over the market is the blue ray and this relies on Java, more specifically Java ME.*

Other technologies that use Java are visible and around us all the time, without us even realizing it. For example, mobile phones have to deal with problems supporting several services providers, many applications and channels. One of the tools used to deal with this situation is the Mobile Enterprise Application platform.**

There are also other ways how Java offers its possibilities, not only to end users but also to developers with their latest packages, SE, ME and EE.***

* Java ME platform is a collection of technologies and specifications that can be combined to construct a complete Java runtime environment specifically to fit the requirements of a particular device or market. This offers a flexibility and co-existence for all the players in the eco-system to seamlessly cooperate to offer the most appealing experience for the end-user. About Java ME (ORACLE, 2011)

** Oracle ADF Mobile enables enterprises to meet ever-changing mobile requirements by allowing developers to rapidly and visually develop applications once, and deploy to multiple devices and channels. Oracle Berkeley Database helps to extend the reach of existing applications to mobile devices by supporting unparalleled performance and a robust data store on the mobile device. Oracle Lite Mobile Server delivers critical bi-directional data synchronization capability to mobile devices, while providing a centralized backend interface for managing mobile deployments. Mobile Enterprise (ORACLE, 2011)

*** Java Platform, Standard Edition (Java SE) is the best platform for development of desktop, server and high-end embedded devices, and it is the most versatile runtime for Java as well as many other languages. Enterprise Edition (Java EE) is the standard for delivering secure, robust, scalable, multi-platform applications and services across the enterprise, from server and desktop applications to wireless and wireline applications. Java Technology (ORACLE, 2011)

Java not only creates environment and applications, but also works with other products hand in hand. Just one example is Microsoft and its Windows Server System, .NET, and Microsoft Office helping with Strengthen security enterprise wide through Oracle's support of Windows native security and Active Directory or boost end-user productivity by enabling employees to work seamlessly between Microsoft Office and Oracle applications. The interesting sidebar about this cooperation is for example Microsoft's lobbying against Java with Safety Scanner proving how insecure Java can be and pointing out the bugs in the code. Another is that today most Internet browsers try to keep up to date and incorporate Java plug-ins; Microsoft and its Internet Explorer does not and you have to additionally install it (the installation process can be found at Microsoft's home page, however is not part of this report and will not be further dealt with).

As one of the large supporters of open-source software, ORACLE with its statement commits itself to offer choice, flexibility and the lowering the costs of computing for end users by spending significant resources into development and support of open source (MySQL, OpenOffice.org, GlassFish, Linux, PHP, Apache, Eclipse, Berkeley DB, NetBeans, VirtualBox, Xen, and InnoDB). One way how to achieve this goal was to involve more people from around the world to participate on Java development and Oracle is doing it by supporting JCP.*

The JCP consists of over 1,200 individual, corporate and user group members who together define Java standards and drive the direction of the Java language and platforms through Expert Groups. *ORACLE Press Release* (ORACLE, 2011)

8. SUMMARY

Java has changed since its inception, and for a while dominated programming languages while trying to become the new universal programming language that unifies technologies. After twenty years is still trying to prove its worth by dodging bullets from its opponents and influencing more areas of the market. Even if it did not become the new gold standard, Java has left its mark on the market and is expected to grow and continue to evolve based on the presented evidence.

Creators of Java understand that involving the private sector and individuals into the process of enhancing and improving Java and its products is a good strategy. Thanks to the JCP program, they make the system sort of transparent by allowing JSRs to be published as an Early Draft, Public Draft, Proposed Final Draft and Final Release. As a response this is a way how to distribute a faulty product for suggestions so that the community can look at this early release subject to discussion, compare different versions and post their recommendations. On the other hand, reviewers will be aware how the experts have been influenced by their participation. This program helps programmers write a better code, eliminate bugs and demonstrate the effectiveness of JSR. ■

* The JCP is the mechanism for developing standard technical specifications for Java technology. Anyone can register for the site and participate in reviewing and providing feedback for the Java Specification Requests (JSRs), and anyone can sign up to become a JCP Member and then participate on the Expert Group of a JSR or even submit their own JSR Proposals.

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CLIPS (PROGRAMMING LANGUAGE)

TOMÁŠ LAUBE

In this report we will briefly talk about the basic features of Clips with some examples. The next topic, the History of Clips, is a little bit about authors and areas of usage. We presume that the reader has experiences with programming in general. This report is part of assignment 2 for the Personal Skills Development class at Prague College, and the next part of the assignment is a report about Java. For this assignment we worked in group that included me and Michal Hlasny.

1. INTRODUCTION TO CLIPS

The first thing before we start with a discussion on Clips is terminology, because Clips is a so-called production system or rule based language if you will, so we will start with a simple explanation of all terms connected to Clips, which could be unknown for a classical C programmer.

1.1 EXPERT SYSTEM

This term is synonymous to the other terms as knowledge-based system or knowledge-based expert system. This name's origin is in the past where a given system should work with the knowledge of experts and return expertise in return, but nowadays when we use AI very often, we use the term expert system mainly because of nostalgia.

Classical structured programming languages are processing data in a machine way, which means that they are fast, but not very readable for humans. This is caused by the fact that people use a quite high level of abstraction. To make our life more easier, we developed objective oriented languages that are more human readable, but they still have a lot in common with procedural languages.

The next step in abstraction was made because of research in the area of artificial intelligence, which has developed techniques that allow us to work with in-formations on the high level of abstraction as humans use and transform it into a machine readable format. This programs that emulate the human view are called expert systems.

By a high level of abstraction we, for example, mean rules; as if Jane likes blue color, then James likes Jane. The next step is to give facts that we can image as classical input from user; for example Jane likes blue. Our output would be that James likes Jane. By intertwining these rules we can easily describe relations between objects and get nice outcomes for different situations according to the facts. To to sum up, the expert system is a computer program that emulates the decision-making ability of humans.

We can list the following as the main advantages of the expert system:

- Reduced Cost
- Reduced Danger
- Fast Response
- Intelligent Database

1.2 RULE-BASED PROGRAMMING

Rule based programming is one of the techniques for developing expert systems. All expert systems include a so-called inference engine that works with specified rules and facts and makes different kinds of observations from the information.

A rule consists of a given pattern that describes how it can be used; for example, if an animal is a duck then the sound that it makes is a quack. This approach makes our life so easy when we are dealing with a huge amount of data because we can interlace them to get a result very easily.

Some expert systems allow users to learn rules by examples, then systems creates tables of rules. Creating rules isn't easy because of the continuity of rules, so we have to take care of all the inconsistencies and duplication, and to find these bugs we usually have to try, which makes debugging very difficult.

So now when we know what experts system we can move on, Clips is a tool mainly used for creating expert systems. There are three programming paradigms connected to the Clips: objected-oriented, rule-based and procedural. We will mainly focus on the rule-based part of Clips. So in the next part we will go over the basic features of Clips as adding, modifying and removing facts and rules. We will also explain how the rules work with facts.

2. BASIC FEATURES

So let's get started with Clips. We suggest that you already know how to turn it on, if you don't, try to write Clips into the terminal. If you are using something that doesn't have a terminal, you are on your own. To exit Clips just insert (exit).

2.1 FIELDS

All input data from the keyboard or file are grouped into tokens; for example, an open bracket is a token. A group of tokens is called a field, and there are seven types of fields: integer, float, symbol, string, external address, instance name and instance address.

The first types are numbers, and this field always consists of sign, number and exponent. The next data type is a symbol, a type that starts with ASCII character and it's followed by zero or more characters. The big difference between a string is the absence of double quote marks at the start and end. The end of the symbol is given by a delimiter, which is a symbol as space, tabs and special characters. So, for example space-station is a symbol, but space station without a dash has to be in double quotes or it will be taken as a string.

In this paper we won't use the last three types much. External address is address of a external data structure returned by a user-defined function in other programming languages, for example C. Instance name and address are used when we work with objects in Clips.

2.2 FACTS

To solve problems we have to get some sort of input from the user; in rule-based programming we do so via facts. As fact we call simple a chunk of information, that includes relation name (something as a variable name) followed by zero or more slots of associative values. Let's take a look at a simple fact:

```
(person (name "July")
        (age 21)
        (eye-color blue))
```

The whole fact is closed into brackets, as we can see, the relation name is person and the fact contains 3 slots: name, age, eye-color. The order of these slots is irrelevant for Clips, so feel free to order them as you wish.

Sometimes we want to insert facts that are practically the same, for example multiple persons, to make our life easier we can create a so-called template for a person and easily fill it in to save time. Templates are practically the same as structures in C or record in Pascal. To define a template we will use following syntax:

```
(deftemplate <relation-name>[<optional-comment >]
  (slot definition))
```

As we can see, using a template is very easy. In slot definition we can define slot name, type, or even range and default value. So now we can create our person template:

```
(deftemplate person "just trying"
  (slot name
    (type STRING)
    (default "unknown"))
  (slot age
    (type INTEGER)
    (range 25 100))
  (slot eye-color
    (type STRING)
    (default "brown")))
```

To insert the fact now we can use this simple definition:

```
(person (name "July") (age 23) (eye-color blue))
```

Maybe it doesn't seem like that big of a deal, but I can catch a lot of problems connected to bad input. In this case, we can face a little problem because every slot has just one field, which can be problem because if you insert a name without semicolons, you can have more than one field. To define this kind of so-called multi-slot value, we have to use a multi-slot in the place of a slot. Facts that are created over a template are so called deftemplate facts. But we can also create facts without a template, and these facts are called ordered facts. Ordered facts have only a relation name and one big multi-slot field that contains all of the values like in the following example:

```
(number-list 3 4 5 6 7)
```

Generally, we are trying to use templates as much as possible because they are much more readable and easier to use. Although sometimes it is worth it to use ordered facts; as for example to list things, or as ag, which works the same way as boolean. In fact when you insert an ordered fact, Clips make a so-called implied deftemplate for the fact.

2.2.1 ADDING AND REMOVING FACTS

Now when we know how the facts look like, we can start using them. Facts are stored in a facts list, and we can add new facts to the list by:

```
(assert <fact >)
```

Now we can try to add a person with the template that we created in the previous part:

```
(assert (person (name "Izzi")
  (age 21)
  (eye-color emerald)))
```

You should notice that assert gives a return value as <Fact-0 >, and there will be a discussion on how to use these values later in pattern matching, ut for now all we need to know is that every fact has this unique identifier. Normally Clips does not accept duplicated input of facts, and if you try it, assert will have no result. To print out all the facts use the (facts) command. Sometimes when we deal with a lot of facts, but we

want to print out just some of them. To do so, we will add a few arguments to the facts as <start>, <end> and <maximum>, which are all positive integers, and as you already suspect these numbers are indexes of facts.

Removing facts is done by the command `retract`, which takes `fact-index` as an attribute to delete all of the facts use the command `reset` that will remove all of the facts from memory.

2.2.2 MODIFYING AND DUPLICATING FACTS

Because most of programmers are lazy, we are always trying to find ways to get rid of boring work such as duplicating facts and because we don't want to delete a whole fact and make it all over again we can modify them. To modify we will use the command `modify` with this syntax (`modify <fact-index><slot-modifier>`), where the `slot-modifier` is `slot-name` and `slot-value`. So if we can use the easy example of some person that we created earlier:

```
(modify 0 (age 20))
```

By this simple command we made Isabel younger by a year. Now to duplicate we will use the command with the following syntax: (`duplicate <fact-index><slot-modifier>`). As we know, we can have two facts with the same attributes with a default setup of Clips that we are using, so we always have to modify some attribute. So now we can create a nice twin for Izzi:

```
(duplicate 0 (name "Becky"))
```

2.3 RULES

After creating facts we need rules that will work with them. From the first part we already know what a rule is, so let us start with simple examples. If you kick a duck she will quack. Let us start with simple pseudo code:

```
If you kick a duck
Then the duck does quack.
```

In Clips syntax this looks like this:

```
(defrule duck
  (action-is kick-duck)
=>
  (printout t"QUACK"))
```

To make it work we have to insert a fact to do so write (`assert (action-is kick-duck)`), then just run the program with (`run`) and you should get the output QUACK. In this very simple example we can describe parts of every rule: the first part is the unique name of the rule (`duck`), the second part is the If part, and the last part is the THEN part. We can simply create more complicated rules as following:

```
(defrule hurts
  (action-is kick)
  (boots-are none)
=>
  (assert (leg-is broken))
  (printout t"Ouch"))
```

When we define a rule this way Clips will give AND between two (action-is kick) and (boots-are none) and the same for the THEN part of the condition. Sometimes we want to use the OR in our If statement, which we can see in the following example:

```
(defrule hurts
  (or (action-is kick)
      (boots-are none))
=>
  (assert (leg-is broken))
  (printout t"Ouch"))
```

2.4 FUNCTIONS

One of the paradigms that we can relate to the Clips is procedural programming, which means that we can create functions to have a nice structure. To define a user-function we use the command `deffunction`, which consists of 5 parts: name, optional comment, a list of arguments (single field variable), wildcard parameter (this means just a multi-field variables) and a sequence of action of what we will do with them.

```
(deffunction <name>[<comment>]
  (<regular-parameter>[<wildcard-parameter>])
  <actions >)
```

The name of the function is the unique identifier, `deffunction` cannot overload the system functions. As you can see, when the number of parameters is dynamic, we just use the wildcard parameter. Let's try an easy example with some return value.

```
(deffunction card-value
  (?card-name)
  (switch ?card-name
    (case ace then (bind ?return-value 1))
    (case two then (bind ?return-value 2))
    (default (bind ?return-value 0))
  )
  (return ?return-value))
```

Next to `deffunction` we can use two other types of functions - `defgeneric` and `defmethod`. `Defgeneric` is much more powerful than `deffunction` mainly because it can take objects as arguments. Generic function contains multiple methods that works with different data types, and if the generic function has more than one method we can call it overloaded. In most cases, methods are not called directly, but with Clips data types of arguments can be recognized and then decided by the user himself which method to use.

2.5 CLASSES

Now we will focus more on object oriented programming aka COOL – CLIPS Object-Oriented Language. When we want to work with objects we have to create classes, which are templates for objects. Let's skip all of the talking about the benefits of OO, because everyone has heard them many times and let's start with a few examples.

To create a class we use the `defclass` command with the following syntax: name, list of superclasses (father class from which our class will inherit slots and message-handler), specifying kind of class (abstract

or concrete), specifying if instances of this class can match objects patterns of LHS rules and a list of slots of class. So lets start with some general syntax:

```
(defclass <name>[<comment>]
  (is-a <super-class name>
    [<role>]
    [<pattern-match-role>]
    <slots>
    <handler-documentation>)
```

2.6 DEBUGGING TOOLS

Clips include some classical debugging tools called watchers. Watch command can be used on facts, rules, compilations, statistics, focus or all. By default watch is Clips watching compilations, if for example we use watch on facts, Clips will print a message every time when fact is deleted, modified or added, as for example:

```
(facts)
f-0 (person (name "Izzi")
      (age 21)
      (eye-color emerald))
(watch facts)
(modify 0 (age 20))
<== f-0 (person (name "Izzi")
      (age 21)
      (eye-color emerald))
==> f-0 (person (name "Izzi")
      (age 20)
      (eye-color emerald))
```

The string <== stands for retraction of fact and ==> is there for assertion of fact. To remove the watch command (unwatch <watch-item>).

3. HISTORY OF CLIPS

C Language Integrated Production System dates back to 1984 at the Johnson Space Center of NASA. During the 1980's NASA developed many prototypes of expert systems because they knew about the big potential of expert systems. All of these prototype systems were made via Lips, which was one of the main reasons why they failed. Using Lips had a few big disadvantages, such as the low availability of Lips on all platforms, the high cost of development in Lips and a very bad integration of Lips with other languages.

After these disappointments, the artificial intelligence section of NASA came up with the idea of a conventional language which would lower the cost and improve compatibility, so they decided to use C. The first idea was to buy such a system, but there were no satisfactory tools that would fulfill all of the requirements that NASA had, and after this it was obvious that NASA have to develop their own C based expert system.

The first prototype of Clips was developed in 1985. One of the main criteria was the compatibility with other projects that were under development. It is for this reason that Clips is so similar with the ART expert system tool developed by Inference Corporation. In this time Clips was just an alternative to the ART and originally it was called NASA's AI Language.

Originally Clips were made just as more of an exercise to gain information about experts systems for the construction replacement tool for the commercial tools that were being used. After a few months of development NASA realized that Clips is a low cost and efficient tool for creating expert systems. After the first version of Clips, developers focused very hard on performance and documentation. In 1986 Clips 3.0 was released to the public.

After other upgrades, Clips has become not just a great practice tool, but also a great tool for creating expert systems as well. In version 4.0 and 4.1 developers focused on overall performance and compatibility with other languages. The next version, 4.2, was a complete rewrite of Clips for code modularity, and they also added utility programs for better verification and validation of rule-based programs.

Clips was originally made as a forward rule-based language using the Rete algorithm, and in version 5.0 NASA added two paradigms: procedural programming (as in C) and object-oriented programming (as in C++ or Java). The object oriented language is called CLIPS Object-Oriented Language aka COOL. Version 5.1 added support for multiple platforms, and next version, 6.0, was released in 1993 and added a fully integrated tool for object/rule matching and support features for rule-base software engineering.

Another two versions added support for C++ compilers and addition tools for compatibility with C++. For the future Clips team plans to upgrade support of other languages like Java and C#.

4. ABOUT THE AUTHORS

Clips was a NASA project that was made by many people, so we will just briefly go through them. As primary contributors we can list: Robert Savely, who led the whole project, Chris Culbert, who wrote the CLIPS Reference Manual, Gary Riley, who created the rule-base part of Clips, co-authored Clips Reference Manual and created the MAC interface.

Others to be included were: Brian Dantes, who designed and developed COOL and co-authored Clips Reference Manual, Bebe Ly, who created X interface for CLIPS, Chris Ortiz, who developed Windows interface and Frank Lopez who designed and developed Clips 1.0 and wrote the user's manual for it. Many others contributed to this project and since it is an open source project there is a huge support from the community as well.

5. AREAS OF APPLICATION

In the previous parts, we mentioned that Clips is used to create expert systems, but the area of usage is much wider, especially in the field of artificial intelligence. In the last few years this field has gone through big changes mainly because the theoretical basics from previous years are starting to have usage in everyday life.

I'm sure that all of you have read about IBM Watson, the gigantic mainframe named after founder of IBM. This supercomputer is nothing different than an expert system that is able to decode questions from the way that we people are using it to the computer language. This computer is just the first swallow, in the future artificial intelligence like this should be in every hospital to help doctors diagnose diseases.

For the future the whole IT field counts with integration of artificial intelligence in our everyday life to simplify it. Clips is a widely used tool for creating expert systems with great performance, and it will play a big role in this development. ■

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PRAGUE COLLEGE

Polská 10
120 00 – Prague 2, Vinohrady
Czech Republic

Tel.: (+420) 222 101 020
(+420) 222 722 544
Fax: (+420) 222 718 813

www.praguecollege.cz
info@praguecollege.cz

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