The Power of Social Machines

Adriana Anri Georgieva,Technical University of Sofia, Bulgaria
Bozhidar Georgiev, Technical University of Sofia, Bulgaria

The Asian Conference on the Social Sciences 2015
Official Conference Proceedings

Abstract
The main issue of this paper concerns the future of social machines, analyzed as united system of computers and people. Starting from existing social networks as Facebook, Twitter, Wikipedia etc., which have an enormous impact on every aspect of our lives, and thanks to an explosion of modern technologies, the opportunity for creation of new generation social machines is becoming a reality. Here proposed analysis presents the social machine as a class of relationships between individual and social behavior on one hand, and between hardware and software of computer systems on the other hand. The emergence of social machines can be expected to fundamentally change the way in which such properties and functions of the social systems are built. In this context, here presented concept about social machines appears as a contemporary model for unifying both computational and social processes. In this article are explained the characteristics that describe and differentiate current social machines when viewed as a collective enterprise. The paper also focuses on some basic hardware and software tools, which can be included as components of social machines. Here are discussed the trends towards optimal configurations of software and hardware architectures, needed for right social machines functioning. Finally, authors present their future work researches, offering plans to engage with the broader Web community of professionals and volunteers.

Keywords: Social machine (SM), Internet of Things (IoT), Social intelligence, Crowdsourcing, Software engineering, Web languages, Semantic Web, Web Services.

Introduction

Nowadays is reached out the moment as yet the accruals in WWW quantities lead to new changings and transformations about the qualities of social networks toward social machines.

The definition of a social network according to Oxford English dictionary asserts that "social network is a network of social interactions and personal relationships." Some authors consider first emerged social networks (Facebook, Twitter, Wikipedia, Galaxy Zoo etc.) as early pioneers, covering the social machine concept. But as is well seen from Oxford English dictionary this SM definition is devoid of technical nuance as priority. This definition is based mainly on two kind of interaction:

- interaction among people with one another - here is included every interaction in which human been is engaged throughout his life comprising friends, families, colleagues, and those he randomly encounter.
- interaction between members and groups of society through contemporary modern interfaces as computers, internet, phones and mobile smartphones, notebooks, I Pads, crowd sourced social media, robots etc., which turns our world into intelligent sociotechnical system.

With the advent of the information age and the ubiquitous use of the Internet, there is an unprecedented development of computer technologies in the last few decades. In the early 1990s, computers used to be programmed by programmers and used by business consumers. The Web, and the enormous human participation in it, changed this boundary. The distance between today's social networks and a world in which humans can be empowered to use these promising technologies (social machines) may seem so great that bridging the gap is almost unimaginable. But we remember that twenty years ago the notion of an interlinked Web of documents that spanned the world seemed like an unrealizable dream, and a decade ago the Semantic Web vision seemed like science fiction. Instead of dividing process between the human and computer parts of the collaboration, modern researchers of the information era draw a line around them and explore each such assembly as a united system of digital and human components, named social machine. Therefore, there is a need of models and theoretical perspectives to start the understanding of this new phenomenon, named social machine.

In looking to the future, our focus is not primarily in terms of the cyber-infrastructure of high-speed supercomputers and their networked interconnections, but the even more powerful human interactions enabled by the next generation of social machines. Exploring this new generation of social machines can take artificial intelligence and computer science researchers into the design of new algorithms and interfaces, into new approaches to distributed inferences, and into developing new declarative languages and programming tools. By adding social filters and parameters to social networks, there raise some possibilities to provide needed context to filter, analyze, and qualify transmitted data. Recently, the efforts of scientists in this area are turned to design the interaction between all elements of social machines: between machine and human, between humans mediated by machines, and between machines, humans and the data they use and generate. In order to pin down what constitutes a social machine, and establish the boundaries of this emerging field of research, there is a need to explore the relationships between social machines and related topics such as social networking, software engineering, web engineering, crowdsourcing etc. In the next generation social machines one of the most interesting issues is the Internet of Things (IoT). When we talk about the early internet in the 1990s, we mean about a billion users to the internet, primarily via their desktops. In the 2000s, we had the second wave, which connected about two billion people to the Internet through their mobile devices. In the course of the next ten years with the Internet of Things will be connect from 20 to 50 billion or more things. While all these possibilities, that IoT offer are very exciting, we certainly can't lose track of the challenges here. Now, these have obviously been significant challenges in the internet as we know it. But we look at IoT from the overall perspective of our society as a whole, we appreciate that there's going to be significant benefits to human existence, to our health, and to the environment. The power of the social machines comes from the notion that a machine is not just a computer which has some users, but rather it is a purposefully designed sociotechnical system comprising machines, different devices and connecting geographically dispersed people.

In this article, the remaining sections are organised as follows. Next part emphasizes on a unified point of view with the main purpose to define, describe and implement a SM. Here is proposed mathematical model (formula), which attempts to reveal the complex functionality of SM. Section “Internet of Things (IoT) - the next mega-trend technology” explains the characteristics of a new transformational trend over the next five to ten years, which will change our world, creating the foundation for more powerful business models - Internet of Things (IoT), named also Internet of Everything. Here are discussed the trends towards optimal configurations of software and hardware architectures, needed for right functioning of social machines. In the next section the Social machine paradigm is characterized as a result of the convergence of six different visions: Hardware & Software, Social intelligence, Crowdsourcing, Social network as WS, Social computing, and Social machine Observatory. The challenges regarding Social machine as sociotechnical system, lie in finding appropriate ways to not only describe the data, but also describe what it means to be a Web Observatory projects, which may also include the methodologies, tools that underpin the projects. Last section focuses on some basic hardware and software tools, which can be included as components of social machines. Here are discussed the trends towards optimal configurations of software and hardware architectures, needed for right functioning of social machines. The paper concludes with proposed future work researches, offering plans to engage with the broader web community of professionals and volunteers.

Mathematically over social machines

In order to build theoretical model of social machines, it is necessary to describe and formulate their existence. So, most of researchers in this area accept following definition, which mathematically presents a SM as a n-tuple:

$$SM = \langle Rel, WI, Req, Resp, S, Const, I, P, O \rangle \quad (1)$$

SM comprises a specific abstract entity containing an internal processing unit (P) and a wrapper interface (WI) that waits for requests (Req) from and replies with responses (Resp) to other social machines. The processing unit receives inputs (I), produces outputs (O) and has states (S). Social machine connections define temporary or permanent relationships (Rel) with other SMs. These relationships are established under specific sets of constraints (Const). Actually, social machines are defined as tuples of input, output, processes, constraints, states, requests and responses. This supposes the need for modern types of hardware and software tools to manage these new challenges.

Internet of Things (IoT) - the next mega-trend technology

The Internet of Things (IoT), named also Internet of Everything, will be a new transformational trend over the next five to ten years, which will change our world, creating the foundation for more powerful business models. In the very near future, as a part of SM architecture, IoT uses different interfaces to gather valuable data from a growing collection of connected devices – cars, hospital beds, bicycles, home appliances, vending machines, mobile devices etc. IoT is the platform, contributing to the transformation of government, businesses and society through the next big thing - internet of things adoption. M2M is also considered as integral part of the Internet of Things, bringing more benefits to industry and business.
Contradictory to the case "Are superior artificial intellects sitting on higher stage compared to human beings brains or not?", discussed by Nick Bostrom, in this paper is taken notice mainly of the problem about collective (collaborative) interactions among people, machines and data as a core of social machine unified paradigm. On Fig. 1 are shown those transformations (quantitative and qualitative), that present social machines into the top right quadrant. This fourth quadrant marks the epistemological and ontological boundaries and limitations of both the quantitative and qualitative paradigm, which define SM. The open questions and highlights, connected with socio-technical framework development of the Internet of Things (IoT) are following:

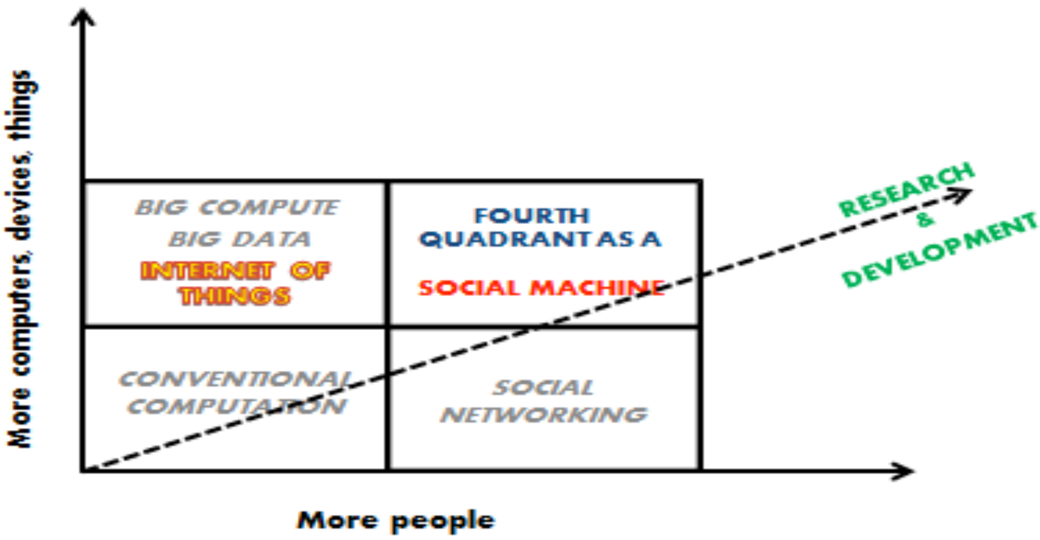

Fig. 1 Fourth Quadrant Diagram

- complex investigation of mutual interaction between social and technical aspects of the IoT, by highlighting the co-evolution, interaction, and interface, which constitute the next generation network environment.
- challenges in prediction, assess, designing, deploying, and sustaining the diverse components of the IoT, and the providing snapshot of modern approach to meeting this challenge.
- creation of concept how the IoT can be designed and situated within human-centered contexts.

Unified components of social machine

According to author's concept the Social machine paradigm is characterized as a result of the convergence of six different visions: *Hardware & Software, Social intelligence, Crowdsourcing*, *Social network as WS, Social computing, and Social machine Observatory*. To visualize this convergence, below is used a appropriate diagram that illustrates author's approach. In this way, it is possible to clearly highlight and classify the main concepts, technologies and standards with reference to the various visions of social machines.

Social intelligence

Social intelligence (human and computational intelligence) helps web connections between people, computers and data to create systems much more powerful than the component parts. Collective intelligence provides possibilities for social context that turns internet information into knowledge. The new generation social machines will have at their disposal a web of *linked data.* They will be able to find things in the easiest way, leading to the rapid emergence of new ideas, products and services, disrupting existing business models. Big linked data describes a method of publishing structured data so that it can be interlinked and become more useful.

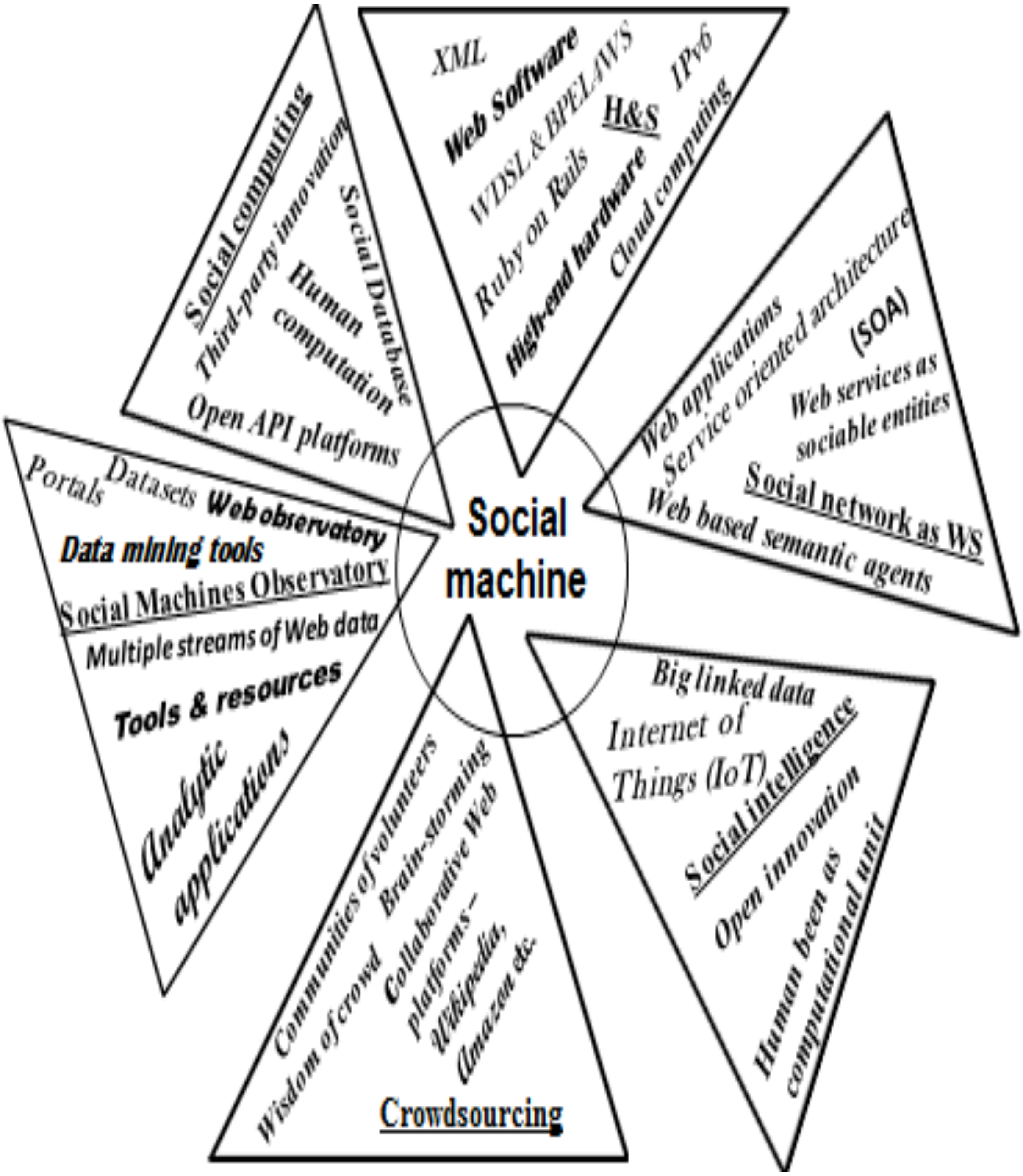

Fig. 1. Social machine unified paradigm as a convergence of appropriate components

On the fig.1 is shown an abstraction model of SM that could be used for specifying new applications and services. Here are depicted the different sides of this process of convergence. *Open innovation* is a part of social intelligence and human activities. It allows everyone to participate and contribute to the generation of new insights, content and knowledge. It also challenges those who have a vested interest in closed data and methods, restricted markets and knowledge. Abstracting the physical product into a series of services available on a network opens the door to further innovation by others. More than this, removing the barriers to others' imagination may add a feature that entices it. The vision of *human been as computational unit* refers to research efforts that integrate people, in the form of human-based computing, and software in one composite system. This vision relies on systems that make use of human abilities for computation to solve problems that are trivial for humans, but complex for machines.

Social network as WS

Web based semantic agents are a research effort and represent an approach in which semantic web technologies are used to improve the meaning of Web Services descriptions and to facilitate the interactions of loosely-coupled Web Services. The involved Web Services interact with each other to decide who will be responsible for treating a specific request. Under this SM perspective, these Web Services represent *services as sociable entities* that are related in communities. Despite wide acceptance of Web services (or *SOA*) in distributed business applications, the absence of human interactions is a significant gap for many real-world business processes. The authorized institutions have introduced specifications that consider human interaction in the compositions of services in *Service oriented Architecture (SOA)* environments. Web applications could be run in just about any contemporary language you choose such as PHP, Ruby on Rails, C#, and others. *Web based semantic agents* are a research effort and represent an approach in which semantic web technologies are used to improve the meaning of Web Services descriptions and to facilitate the interactions of loosely-coupled Web Services. The involved Web Services interact with each other to decide who will be responsible for treating a specific request.

Social Machines Observatory and Social computing

A Web Observatory portal brings together Web communities to contribute or engage with *datasets* (Big data) and visualization applications. It also provides links to dataset and resources, hosted in remote locations. The architecture of *Social Machine Observatories* could include linking support to remote datasets in other locations, hosted in other Web observatories. The new organization of W3C, the Web Science Trust (www.webscience.org) proposes to create a global "Web Observatory“, called *Social Machine Observatory*. Web observatory engage Web communities with *Big linked datasets* and analytic researches via dedicated *portals*. Web observatories include following parts of resources: *portals, datasets, applications, tools.* The growth of the Web Observatory as a social-technical activity is something that requires both bottom up involvement, as well as the help and support of a top-down framework that can help support and guide the community with standards and best practices. Reflecting on the current progress of the Web Observatory community, the W3C community group, the commitment of the various academic institutions and ongoing work of the individuals exhibit the characteristics of a translating Web activity, driven by common goals and incentives. The different casestudies in a Social Machines Observatory need to be based on: interacting and competing with others; being designed, born and co-evolving; variable in size, purpose and intent; reflecting the trends towards cyber-physical and

machine-to-machine systems. There has been much effort invested in developing the necessary infrastructure to support storing, accessing, and querying large-scale Web streams, which an increasing emphasis on offering streaming access and *analytics* across multiple streams of Web data. In this paper are analyzed tools such as the Web Observatory to gather, analyse and arrange web data individually but also forming part of a growing global collective network of social machine Web observatories through which new insights and new approaches to analytics are being developed.

Social computing is a new technology, which consists of social data bases, based on XML or Web API platforms, social networking websites, video sharing, etc. These technologies have allowed users to interact and collaborate with each other by storing and sharing various types of content, including messages, photos and videos. *The open API Platforms* allow developers to handle with social-networking sites, access information and media, posted by their users. API Platforms also create other applications and services, on top of the platform, that aggregate, process, and generate content based on users interests. The combination of social information from multiple sources has enabled the creation of a novel breed of applications and service based on social data. Such *social data bases* can provide social knowledge to support other applications in their decision making processes. Many portals for *third-party innovation* let the imagination of the *communities of volunteers* run in unpredictable directions. *Human computation* is an other component of the social machine and lets organizations outsource tasks, traditionally performed by specific individuals or experts teams to an undefined group of remote workers over the internet. This vision refers to research methods that integrate the whole internet society, in the form of human computation, and software into one united system.

Crowdsourcing

Crowdsourcing is a relatively new launched feature, where people with common area of interests and expertize gather together to solve problems by collective thinking and create a virtual *community of professionals and volunteers*. Here exists the necessity to manage and moderate the online community and do quality control. The typical example of crowdsourcing is OS Linux, based on sharing resources and outputs among widely distributed, loosely connected contributors, who cooperate with each other without relying on either market indications or chef's commands. Wikipedia, a multilingual encyclopedia, being created by about fifty thousand and more volunteers, is other particularly effective example of the power of crowdsourcing. According to this idea of crowdsourcing everyone individual on the planet has the rights to vote for everything - from the choice of parliament in his country to solutions of the problem about tiger's population. Giving an opportunity customer to create an ongoing dialog generates a better product built on the basis of *brain-storming*. The way to help the development of modern innovations is realized by empowering more people to create social machines in increasingly sophisticated directions through *wisdom of crowd (WoC)*.

Hardware and Software Tools for Social Machines

One of the most important components of the SM is the *hardware* environment, which is used to send/receive, write, save and execute the applications. The main problem in these heterogeneous networks is the finite number of IP addresses, which are available. As an exercise of mind, IPv4 has about 4.3 billion IP addresses. The set of IP addresses has been exhausted. The good news is a creation of a new addressing scheme, named *IPv6* that practically allows 4.8x10^{28} IP addresses. Running an application on the hardware device implies that the CPU, RAM, I/O and the other resources, involved in computing process, have sufficient speed and processing power. If there is a lack of processing power and memory, a good option is to use the resources of cloud computing technology. Web applications are generally deployed in textual form, using representations such as HTML, XML, CSS and JavaScript source code. The shift to dynamic representations and languages has a significant impact on development process, integration testing and deployment practices of social machines. The trend towards web-based software will continue and even strengthen in the future. Conventional binary software simply cannot compete with a *web software* in which worldwide software distribution is effectively free and the new software versions can be completed and released – without compilation, linking, installation and/or rebooting. All this happens in a matter of seconds or minutes rather than months or years. The *WDSL/BPEL* languages specify the description and behavior of business processes as long as the activities of these processes are connected with corresponding Web services. The behavioral aspect describes the dynamics of a service type, for example using states, control flow, conditions, and exceptions. BPEL4People extends BPEL from orchestration of Web services alone to orchestration of role-based human activities. High level languages such as Java, Python, and C++ are very sophisticated and promising for use in social machines. For example, Apple iPhones run only applications written in Objective C. Samsung Galaxy and HTC mobile phones support applications under Android operating system. Actually, software engineering researchers have paid little attention to the evolution of XML and web technologies in general. The second version of XML – XML 1.1 provides syntax for the resource description framework (RDF), a language to express data in a relational way aiming for a "semantic web". The whole set of web software tools (WSDL, BPEL, UDDI, WS-CDL etc.) mandatory work with metalanguage XML. Nowadays exists a new technology, which offers modern prospective for application development – *cloud computing.* A cloud based application model has at least the most important advantage- it opens the world of social machine application development to a much larger audience of users.

The road ahead

In this paper is introduced a model, meant to conceptualize the formation and structure of social machines (SM). The authors explore several pioneering methods of supporting purposeful human interaction on the World Wide Web, leading to new phenomena SM. This article sets up a researcher to be involved in this modern scientific and practical area. The authors of this paper have already proposed nontraditional approach for fast XML navigation using algebraic tools. It contributes to advanced efforts in the making of an easier user-friendly API for XML transformations in future standards of XML that will be used in social machines. This way, the user can avoid the difficulties about the complicated language constructions of XSL, XSLT and XPath languages, which is the main purpose to make easy data transfer in social networks and especially in social machines. The authors suggest a different point of view about the creation of advanced XML parser to avoid the bottleneck that characterizes the languages XSLT/XPath for XML transformations. The implementation of so proposed method in the area of SM could accelerate the various types of XML message-based communications concerned WSDL, UDDI, BPEL, REST, SOAP etc. The proposed approach is different and faster in comparison to other query and transformational languages in respect of their definition, expressiveness and search techniques. When algebraic XML parser is used, it accelerates the whole process with approximately 30% against traditional SAX parser. The next steps in this science area will require a set of minimum standards of what it is supposed to be a Web Observatory. These standards will help almost all aspects of SM such as the big linked data, SM analytic applications, SM tools, Internet of Things (IoT), and many other topics. The future work in Technical University of Sofia is going towards to solve the problem about the necessity for using a common SM language to describe the entities that will be shared across different Web Observatories and to provide common vocabulary to describe datasets, projects and appropriate tools for SM.

References

Hendler J., & Berners-Lee T. (2009). From the Semantic Web to social machines: A research challenge for AI on the World Wide Web. *Artificial Intelligence*, doi:10.1016/j.artint. 2009.11.010.

Shadbolt, N. (2013). Knowledge acquisition and the rise of social machines, *Int. Journal of Human-Computer Studies*, vol. 71, no. 2, pp. 200–205, Feb.

Shadbolt N., & al. (2013). Towards a Classification Framework for Social Machines, *The Theory and Practice of Social Machines*.

Nascimento M., Garcia V., Meira S. (2012). SMADL: The Social Machines Architecture Description Language, *Recife, Information Center- University of Pernambuco* (UFPE), Brazil.

Georgieva A., & Georgiev B. (2009). A Navigation over XML Documents through Linear Algebra Tools, The Fourth International Conference on Internet and Web Applications and Services - ICIW 09, Venice/Mestre, Italy, 24-29 May, Published by IEEE Computer Society, ISBN: 978-0-7695-3613-2/09.

Bostrom, N. (2009). How long before super intelligence? , Oxfrord Future of Humanity Institute, University of Oxford, printed in *Linguistic and Philosophical Investigations Vol. 5, No. 1, pp. 11-30*.

Contact email: adig@tu-sofia.bg
Contact email:bgeorgiev@tu-sofia.bg