Social Machines

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INTRODUCTION

A key trend in the recent technological evolution of the Web has been the development of applications and services that support greater levels of user participation in the generation and management of online content. The Web has now emerged as a platform in which user communities play a key role in terms of what appears online, and the sole purpose of many sites on the Web is to support users in generating, editing and organizing online content. With the transition to greater levels of user participation, we have witnessed the rise of what has been referred to as the 'Social Web': a suite of applications, services, technologies, formats, protocols and other resources, all united in their attempt to both foster and support social interaction. Social media sites (e.g., YouTube), social networking systems (e.g., Facebook), and microblogging services (e.g., Twitter) all form part of this Social Web, and they have arguably transformed our traditional notions of what the Web can be used for. Far from being a mechanism to simply support the online publication and dissemination of information content, there is a growing sense that the Web can play an important role in a broad range of social processes. These range from simple forms of social interaction through to the coordination of large-scale collaborative efforts. They include various forms of socially-distributed problem-solving, various aspects of social relationship management (including the formation, maintenance and dissolution of both professional and personal relationships), and various aspects of social cognition or social sensemaking (for example, person perception). To an ever-greater extent, the Web is serving as a platform on which a variety of social process are implemented. Some of these are familiar processes; others are not. All of them, however, are shaped by the properties of the Web.

In response to the growth of the Social Web, a panoply of new terms has arisen to refer to various parts of the emerging conceptual landscape. We thus have terms such as crowdsourcing (Doan, Ramakrishnan, & Halevy, 2011), human computation (Quinn & Bederson, 2011), collective intelligence (Malone, Laubacher, & Dellarocas, 2010), social computing (Parameswaran & Whinston, 2007), the social operating system (Rainie & Wellman, 2012), and social machines (Hendler & Berners-Lee, 2010). This latter term, which is the focus of the current article, was first used in a Web context by Berners-Lee and Fischetti (1999), and it has since grown in popularity to the point where it is now the focus of large-scale research programs, such as the EPSRC's SOCIAM initiative1, and the subject of a multitude of academic publications (e.g., Hendler & Berners-Lee, 2010; Shadbolt et al., 2013; Smart, Simperl, & Shadbolt, in press). The term is typically used in relation to systems such as Wikipedia, Facebook and Twitter, which are among some of the most popular sites on the Web today. In addition, the Web itself has been presented as a social machine (Hall & Tiropanis, 2012). This highlights the potential significance of the term to the Web and Internet Science community. By identifying a set of mechanisms and processes that are at the core of the Social Web, the notion of social machines serves as a conceptual anchor for research efforts associated with the nascent discipline of Web Science (Berners-Lee et al., 2006). In addition, by focusing attention on Web-based systems that are involved in the mediation or material realization of social processes, the notion of social machines serves to emphasize the *socio-technical* nature of the Web, and it provides the basis for multidisciplinary collaboration with the social scientific community. Such collaboration is of vital importance given the increasingly significant role the Web plays in the functioning of contemporary society.

DOI: 10.4018/978-1-4666-5888-2.ch675

The current article aims to provide a brief overview of social machines and associated research efforts. We start by focusing on what is meant by the term 'social machines'. Although social machines are the focus of current research, there is no consensus, at the present time, as to what the term 'social machine' actually means. This is unfortunate because without an ability to say what social machines are it becomes difficult to know where to focus research and development efforts. In addition, an understanding of the social machine concept is crucial if we are to answer questions concerning the relationship between social machines and ostensibly similar concepts, such as those associated with social computing, crowdsourcing, human computation and collective intelligence systems. One of the main aims of this article, therefore, is to critically evaluate the initial characterization of social machines, as made by Berners-Lee and Fischetti (1999), and propose a working definition of the social machine concept. A second aim of this article is to examine the variety of social machines that are available. Thirdly, we will look at some of the issues that form the basis for future research efforts into social machines.

BACKGROUND

What are Social Machines?

The topic of social machines has been the focus of increasing interest within the Web and Internet Science community in recent years. A multitude of research papers attests to this growing interest, as does the funding of large-scale research programs designed to investigate the capabilities and characteristics of social machines. In spite of this interest, however, there is still considerable confusion as to what the term 'social machine' actually means. The term is clearly used to draw attention to Web-based systems that feature some degree of active human participation, and it is this notion of active human participation that seems to be critically important to what makes something a social machine – systems in which humans merely browse or consume content without contributing anything in return do not seem to be regarded as social machines. But beyond this rather vague notion of active human participation there does not seem to be any consensus on what it is that makes something a genuine member of the class of social machines. This is not to say that people have been reticent in terms of pointing out specific examples of social machines. FaceBook, mySpace, Twitter, Ushahidi, Galaxy Zoo, reCAPTCHA, and Wikipedia have all been cited as examples of social machines. It thus seems relatively easy for people to point to specific examples of social machines, but it seems far less easy to identify what it is that enables us to treat these exemplars as a conceptually unified bunch. It is possible, of course, that the extension of the concept 'social machine' is something that can only be fixed by ostension. However, even in this case, it seems important to understand what it is that actually underlies the ostension: what are the features of certain kinds of Web-based system that appeal to our intuitions as to when we confront a genuine member of the class of social machines?

Perhaps the most popular characterization of what constitutes a social machine is provided by Berners-Lee and Fischetti (1999) in their book 'Weaving the Web: The Original Design and Ultimate Destiny of the World Wide Web': "Real life is and must be full of all kinds of social constraint – the very processes from which society arises. Computers can help if we use them to create abstract social machines on the Web: *processes in which the people do the creative work and the machine does the administration*" [our emphasis] (p. 172).

According to this characterization, we confront a social machine whenever we encounter a process in which there is a division of labor between the human users of a Web-based system and the technological elements that actually realize the processes implemented by the system. In particular, the contributions of the human end users should consist in some form of creative work, while the contributions of the machine components should consist in some form of administrative activity. Setting aside the (not unproblematic) notion that social machines should be equated with some form of process, the key features of this kind of characterization are 1) that multiple individuals are engaged in a process, 2) that the processes engaged in by the individuals are actually part of a larger joint process that is (perhaps essentially) bio-technologically hybrid in nature (i.e., it requires the contribution of both human and machine elements), and 3) there is a commitment to the idea of human and technological elements fulfilling particular kinds of roles, roles that are (perhaps broadly) construed as either creative or administrative in nature.