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Norm-aware socio-technical systems

Bastin Tony Roy Savarimuthu and Aditya Ghose

Systems under development in several domains consider awareness of normative behaviour as a core element of their design and operation.

Social norms play an important role in shaping human behaviour. They guide people on how to behave under certain circumstances by prescribing what is permitted and what is prohibited. The growth of socio-technical systems enabling interaction between humans and technical systems calls for endowing systems with the ability to understand and facilitate socially acceptable behaviour as governed by norms.[1]

Awareness of socially acceptable (normative) behaviour becomes particularly important when social interactions between humans are facilitated through software systems. For example, researchers working on teleconferencing systems have realized the importance of aligning eye contact between different participants (the length-of-gaze norm).[2] Also, cultural differences in length-of-eye contact should be taken into consideration to facilitate engaging interactions.[3] The same applies to the norm of interpersonal distance between participants in both human societies and artificial agent societies such as Second Life.[4] When a human user interacts with an avatar, for example, the interaction becomes realistic for the user if the agent follows a gaze model that mimics the human's gaze model, instead of the avatar constantly staring at the human.[5] The systems in question should detect the normative activity, and inform associated parties to take appropriate remedial action if there are violations. To do otherwise would reduce the presence and the engagement of the users in such virtual environments. Such a norm-aware system is one that can identify norms from a variety of information sources, and recommend those norms to the involved parties (see Figure 1). Norm-aware systems broadly sit under the larger umbrella of socially adaptive systems which take into account other norm-related concepts such as conventions, rules, policies and laws and also other social concepts such as values, trust and reputation.[6]

There are several advantages to developing norm-aware systems. A system that is norm-aware can warn humans about norms they are violating and can offer remedial actions to perform. These systems thus decrease the amount of resources

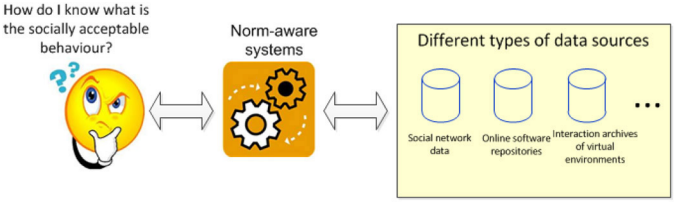

Figure 1. *An agent employs a norm-aware system to identify socially acceptable behaviour.*

used (e.g. by recommending the 'green norm' of duplex printing) and decrease the amount of time spent on analysing social context (e.g. by recommending whether an action is allowed in a virtual environment). Additionally, norm-aware systems are more attractive for humans because they are natural and intuitive to work with, easy to understand and learn, and dynamic. They flexibly respond to changes in the environment (as opposed to systems with hard-wired norms).

Norm-aware systems can be useful in many domains. In our recent work, we investigated mechanisms for inferring norms from sequences of recorded agent interactions. For example, agents' actions and interactions in virtual environments such as Second Life and multi-player online games recorded in various chat and action logs can be used to extract norms. We have proposed algorithms that can identify prohibition[7] and obligation[8] norms from action logs. Upon norm identification, an agent can inform other agents about the existing norms. Other projects have focused on identifying norms in workplaces and making them explicit to the involved parties.[9]

A second domain that has the potential to offer the most for norm awareness is big data. With huge volumes of data available online, software systems can mine appropriate behavioural data and present information to users. For example, analysis of tweets suggests the convention on sending re-tweets.[10] A software entity can recommend, for instance, that one use the 'RT' option (i.e. re-tweet norm of using RT) instead of all the other possible options since the RT option is most widely used. An emerging research area focuses on mining the rich and large quantities of data available in software repositories to uncover useful and

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important patterns and information about software systems and projects.[11] Such information assists developers, managers and testers by offering insights into the nature of open-source software development.

A third domain where norm-aware systems are of help are systems that facilitate sustainable practices. In recent work, we proposed a system that can recommend green norms based on data extracted in an organizational setting. In a case study conducted at the University of Otago we investigated how much voluntary duplex printing was done (i.e. without any explicit norm governing this behaviour). We showed that about 70% of the users of the Department of Information Science printed in the duplex mode. Based on this result, appropriate interventions can be designed to encourage people who do not follow the convention to follow it through social comparison approaches such as nudges or pledge schemes. The next stage in this direction is to automatically identify commonly observed behaviours and spread them through appropriate channels such as e-mails and social media. For example, a norm-aware printing system can find the duplex printing norm and recommend this to members that do not follow the norm.

Though research work has begun on developing norm-aware systems in different domains, the research challenges are far from trivial. A norm-aware system should have the ability to learn from a variety of data sources and also employ a variety of techniques such as data mining, information retrieval and natural language processing. We have proposed an agent-based framework that integrates different open-source repositories, and the development of such a system is currently in progress.[12] Implementing an integrated framework to extract different types of norms (obligations, prohibitions and permissions) from different data sources is likely to be a challenge. Other future challenges to address include integrating different norm-aware systems in order to provide a holistic experience to the user (currently different norm-aware systems are developed for different purposes), and integrating contexts between norm-aware systems.

Author Information

Bastin Tony Roy Savarimuthu
University of Otago
Dunedin, New Zealand
http://infosci.otago.ac.nz/tony-bastin-roy-savarimuthu/

Bastin Tony Roy Savarimuthu is a senior lecturer. His main area of research interest is normative multi-agent systems.

Aditya Ghose
University of Wollongong
Wollongong, Australia
http://www.uow.edu.au/∼aditya/

Aditya Ghose is professor of computer science. His research interests are in the areas of artificial intelligence, business process management, services computing, software engineering and constraint programming.

References

1. M. P. Singh and K. Tadanki, *Norms as a basis for governing sociotechnical systems*, **ACM TIST**, pp. 1–21, 2013.
2. A. Jones, M. Lang, G. Fyffe, X. Yu, J. Busch, I. McDowall, M. Bolas, and P. Debevec, *Achieving eye contact in a one-to-many 3d video teleconferencing system*, **ACM TOG 28** (3), p. 64, 2009.
3. M. Obaid, I. Damian, F. Kistler, B. Endrass, J. Wagner, and E. André, *Cultural behaviors of virtual agents in an augmented reality environment*, **Lect. Notes Artif. Intell.**, pp. 412–418, 2012.
4. N. Yee, J. Bailenson, M. Urbanek, F. Chang, and D. Merget, *The unbearable likeness of being digital: the persistence of nonverbal social norms in online virtual environments*, **CyberPsychol. Behav. 10** (1), pp. 115–121, 2007.
5. A. Fukayama, T. Ohno, N. Mukawa, M. Sawaki, and N. Hagita, *Messages embedded in gaze of interface agents—impression management with agent's gaze*, **Proc. CHI**, pp. 41–48, 2002. doi:10.1145/503376.503385
6. M. B. van Riemsdijk, *Socially adaptive software*, **Awareness**, February 2013. doi:10.2417/3201302.004666
7. B. T. R. Savarimuthu, S. Cranefield, M. A. Purvis, and M. K. Purvis, *Identifying prohibition norms in agent societies*, **Artif. Intell. Law**, pp. 1–46, 2012. doi:10.1007/s10506-012-9126-7
8. B. T. R. Savarimuthu, S. Cranefield, M. A. Purvis, and M. K. Purvis, *Obligation norm identification in agent societies*, **J. Artif. Societies Soc. Sim. 13** (4), p. 3, 2010. http://jasss.soc.surrey.ac.uk/13/4/3.html
9. M. S. Santos and J. Pitt, *MACS—Affective Conditioning System for Shared Working Environments*, **Proc. IEEE/WIC/ACM Int'l Conf. Web Intell. Intell. Agent Technol. 3**, pp. 57–60, 2011.
10. F. Kooti, H. Yang, M. Cha, K. P. Gummadi, and W. A. Mason, *The emergence of conventions in online social networks*, **Proc. ICWSM-12**, p. 194, 2012.
11. A. Hassan, *The road ahead for mining software repositories*, **Proc. IEEE ICSM**, pp. 48–57, 2008. doi:10.1109/FOSM.2008.4659248
12. B. Savarimuthu and H. Dam, *Towards mining norms in open source software repositories*, **Proc. ADMI**, in press.

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