# Guest Editorial:
# Special Issue on Hybrid Human–Artificial Intelligence for Social Computing

THE unprecedented development of the Internet of Things (IoT), artificial intelligence (AI), and Big Data has stimulated a boom of social networks such as Twitter, WeChat, Facebook, etc., generating a huge amount of social data that are worth further analysis. Social computing has an important focus on mining the deep relationships between social organizations, networks, and media. The increasing volumes and complexities make big social data mining more and more difficult. Hybrid Human–Artificial Intelligence (H-AI) is an approach combining both human intelligence and AI, so as to handle demanding problems in a harmonious way. By adopting H-AI in social computing, it would provide more possibilities for social data analysis, relationship discovery, outlier detection, and prediction, and is proving to be an emerging and promising direction for AI and big data research.

Along with the overwhelming advances of information technologies, particularly the rapid improvements of computer networks and social complexities, social computing emerges as a novel computing paradigm that concentrates on the interrelationships among humans, organizations, and social systems [items 1) and 2) in the Appendix]. Broadly speaking, social computing refers to computing theories and techniques oriented to social sciences, which is coupled with various social behaviors, organizations, and media. Due to unprecedented developments of Internet and web technologies, social computing is expanded tremendously to a cross-disciplinary area with wide applications in online communities, interactive entertainments, business, and public sectors [items 3) and 4) in the Appendix]. A large number of new social applications and services facilitating data collection and generation are emerging, where users become data consumers and producers at the same time.

There is an increasing accumulation of massive social data from blogs, wikis, multiplayer games, video streaming communities, and other social media tools. This becomes very challenging due to the volumes and complexities of these social big data. Although artificial intelligence (AI) can play very important roles in processing large-scale data, it is far inferior to humans in terms of cognition, understanding, and reasoning, particularly when dealing with human-centric social data. In order to meet the challenges of mining the complex social big data, especially hidden information such as social sense behind the social data, combining human intelligence and AI together [item 5) in the Appendix] becomes a natural choice.

Hybrid human–artificial intelligence (H-AI) is an approach combining both advantages of human intelligence and AI, so as to achieve collaborations in a harmonious way. The shortcomings of standalone AI in social computing will be mitigated by H-AI as humans can be helpers by interacting and collaborating with AI systems or machines. With the introduction of human intervention, H-AI paves a new way for processing incomplete, inaccurate, and unstructured data, which assist a lot in improving the performance of social data mining and analysis, such as behavior recognition, intention prediction, and so on, so as to avoid potential mistakes that AI may make when working alone. It could not only realize the efficient analysis for large-scale social data with AI algorithms but also make the most reasonable decisions referring to human wisdom of cognition, intuition, and inference. The H-AI for social computing would be an interesting topic and is worth further study.

Coupling H-AI in social computing is still in its infancy, and it is significant to explore more about fundamental theories, underpinning techniques, potential applications, etc. In addition, issues regarding the combination of humans and AI in social computing such as the collaboration mechanisms, the appropriate optimization as well as the security and privacy also need to be further discussed. Important research directions include the following:

1) H-AI for social computing theories, models, and architectures;
2) H-AI for social network analysis/mining, behavior modeling;
3) H-AI in information diffusion, social contagion, and opinion formation;
4) coexistence and coevolution of H-AI and social computing;
5) H-AI social network analysis and modeling;
6) security and privacy issues in H-AI social computing systems;
7) novel applications of H-AI for social computing.

## WHAT DO WE COVER IN THIS SPECIAL ISSUE?

In this special issue, 12 articles have been accepted which represent the most recent research of H-AI for social computing. There are six articles concentrating on social data analysis and mining, particularly in events or outlier detection and prediction. Two articles are related to public opinion and topic representation in social networks, which focus on the social opinion transmitting and evolution via different networks. Another two articles propose some relative privacy

preservation mechanisms so as to guarantee the safety of social networks. In addition, there is one article emphasizing the protocol innovation in H-AI systems with the case of competitive crowdsourcing, and one providing a big data platform that could achieve functions like social data collection, saturation, visualization, and analysis.

The social data, generated by various organizations, networks, and media, are full of information and knowledge that need to be discovered and analyzed, thus innovative techniques are being developed for applications such as trend prediction, state monitoring, behavior discovery, and outlier detection. Raj *et al.*, in their article "Information granulation-based community detection for social networks," design an algorithm of granular-based community detection (GBCD) to detect communities in online social networks. Yu *et al.* have an interesting work on "Detecting outlier patterns with query-based artificially generated searching conditions," which aims at detecting the outlier behaviors in social networks, equipped with intelligent users' queries. Another article by Jiang *et al.*, "Computational experimental study on social organization behavior prediction problems," provides a detailed comparison between four typical cost-sensitive learning methods in organizational behavior prediction. Zhang *et al.*, in their article "A bisubmodular approach to event detection and prediction in multivariate social graphs," propose a framework of multivariate anomalous subgraph scanning for detecting and predicting anomalous in multivariate social graphs. The article "Deep correlation mining based on hierarchical hybrid networks for heterogeneous big data recommendations," by Zhou *et al.*, focuses on deep correlation mining and detection in hierarchical hybrid networks and was evaluated with recommending related papers and researchers. The article by Zhu *et al.* "ArvaNET: Deep recurrent architecture for PPG-based negative mental-state monitoring" proposes an attentive deep recurrent architecture so as to monitor social mental states, which can complement existing emotional and mental states recognition.

Analyzing and mining social opinions and public topics are significant in social media and social networks, which would have influential impacts on decision making. For example, decision makers need to investigate and analyze different opinions on existing products, services, promotion, etc., so as to make the most appropriate strategies. Han *et al.*, in their article "A topic representation model for online social networks based on hybrid human–artificial intelligence," design a model for topic representation on the basis of H-AI in which humans would help modify the representation words with their cognition. Liu *et al.* propose an innovative cellular automata in their article "POCA4SD: A public opinion cellular automata for situation deduction," which could simulate the life cycle of opinions in social networks, ranging from its generation, evolution, to final stage. "Suicidal ideation detection: A review of machine learning methods and applications" by Ji *et al.* gives a comprehensive research on how to tackle the tricky problem of suicidal ideation detection using AI techniques.

Since social network provides a mode of extensive connection, information can be shared and transmitted with each other, which leads to security and privacy issues such as sensitive information disclosure. Lin *et al.*, in their article "Location-aware service recommendations with privacy-preservation in the Internet of Things," design a location-aware recommendation approach with privacy-preservation. Gati *et al.*, in the article "Differentially private tensor deep computation for cyber–physical–social systems," introduce a deep private tensor autoencoder for cyber–physical–social systems with strong security and privacy capabilities. In addition, the article "Extortion and cooperation in rating protocol design for competitive crowdsourcing," by Lu *et al.*, pays attention to the dilemma of free-ride and attack in competitive crowdsourcing, one of the popular aspect in H-AI, and develops an efficient rating protocol with binary ratings and differential pricing. The article titled "A scalable platform to collect, store, visualize, and analyze data in real time" by Mendhe *et al.* demonstrates a social platform which supports social data collection, saturation, visualization, and analysis, and is proved to be compatible and scalable with any topics.

Social computing provides the possibilities to mine and analyze more information from existing social networks, organizations, and media, while H-AI complements a lot in social computing by combining advantages of humans intelligence and AI. We do firmly believe H-AI is worth further studies.

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APPENDIX

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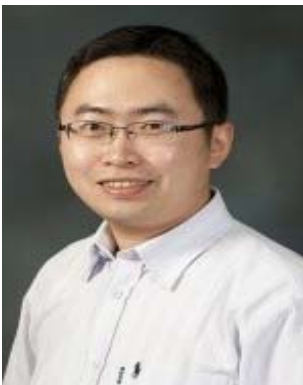


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