Artificial intelligence in health – the three big challenges

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EDITORIAL

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The last twelve months have seen the already constrained Australian health space become an even more complex one. Faced by increasing demand for services, reduced funding and staffing, and pressures imposed by state and federal government health reform agendas, hospital based services are under increasing pressure to become more efficient in how they offer their services. There is a growing need for novel technologies that understand the complexities of hospital operations and offer much needed productivity gains in resource usage and patient service delivery.

The last twelve months have also seen Artificial Intelligence (AI) research pushed beyond its boundaries. Google is dabbling in deep learning to build the Google Brain and teach machines to think and learn like humans. Semantic technologies are working harder than ever to take on the challenge of enhancing big data analytics. Translating research from labs to everyday use in hospitals and medical practice still remains one of the greatest challenges for AI in the health research community. The Artificial Intelligence in Health research workshop series was started in 2011 as a National initiative to bring together scholars and practitioners in the field of AI driven health informatics to present and discuss their research, share their knowledge and experiences, define key research challenges and explore collaborations to advance e-health development nationally and internationally.

This special issue reports on the latest developments in AI inspired research in health. The issue arose from the proceedings of the Second Australian Workshop on Artificial Intelligence in Health (AIH 2012). This was held in conjunction with the 25th Australasian Joint Conference on Artificial Intelligence (AI 2012) in Sydney, Australia, on the 4th of December, 2012.

AIH 2012 received an excellent community response this year. All submitted papers went through a rigorous review process. Of these, six full papers and three short papers were accepted for presentation at the workshop. The workshop also featured three keynote addresses and a panel discussion.

The first keynote address "Technology in Healthcare: Myths and Realities" was delivered by Dr. Jia-Yee Lee from National ICT Australia (NICTA). Dr. Lee provided an excellent setting for the day's talk by introducing the current challenges facing healthcare in Australia. She discussed the myth of a paperless e-hospital, the buzz behind big data in health and the true cost of destructive technologies in healthcare. Dr Lee then gave an overview of the AI based e-health research efforts at NICTA.

The second keynote address "Driving Digital Productivity in Australian Health Services" was delivered by Dr. Sankalp Khanna from the CSIRO Australian e-Health Research Centre (AEHRC). Sankalp discussed the current and forecasted states of the Australian health landscape and how CSIRO's Digital Productivity and Services Flagship and Health Services research were working towards addressing the challenges in health. He provided an overview of the AEHRC's programs in biomedical imaging, forecasting and scheduling, health informatics, and telehealth and mobile health.

The third keynote address "Smart Analytics in Health" was delivered by Dr. Christian Guttman from IBM Research Australia. Dr. Guttman focussed on IBM research's Smarter Planet Initiatives and health care research programs. He also shared his experiences from working with British Telecom on healthcare projects in the United Arab Emirates. Dr Guttman discussed opportunities for AI in health, identifying big data and heavy computation, and predictive analytics as key research challenges, and discussing the potential of collaboration with IBM research.

The workshop concluded with a panel discussion on the

topic "AI in Health: Defining the 3 Big Challenges". This was chaired by Prof Abdul Sattar from Griffith University, and joined by our keynote speakers Dr. Jia-Yee Lee and Dr. Christian Guttman, along with Prof. Wayne Wobcke from the University of New South Wales and Prof. Sadananda Ramakoti from NICTA. An enthusiastic discussion followed which engaged audience participation as researchers from both the health informatics and AI research areas outlined the challenges they faced in this domain. The community largely agreed on the following key challenges:

- The challenge of Big Data: discussions ranged from whether big data was a big and complete distraction to the need for new and efficient techniques to handle the large volume, variety and velocity of this data. Taking all the information generated in the right context, and the use of the evidence generated were also seen as significant challenges.

- The health cottage industry paradigm: The community agreed that the health domain functioned largely like a cottage industry where various silos followed autonomously governed norms and practices and called for a world without walls to solve the healthcare delivery problem.

- Solutions for tomorrow: The health community discussed need for the AI researchers to better understand the most urgent current needs of the health system and design technologies to address them. It was suggested that solutions be developed to assist current workflows and to provide an evidence base to drive reform. The AI community discussed the need for current systems to use more sophisticated AI technologies wherein humans could interact better with the data and communication could be integrated with the flow of information.

The panel and audience also acknowledged the key role this workshop is playing in driving collaborative research efforts between the AI and health informatics research communities.

All accepted papers were also invited to revise and submit their manuscripts for inclusion in this special issue of the Australasian Medical Journal (AMJ). Seven papers have been accepted for publication in the journal.

The first paper, by Zarita Zainuddin, Kee Huong Lai and Pauline Ong, entitled "Reliable epileptic seizure detection using an improved wavelet neural network",[1] employs a wavelet neural network based classifier to classify Electroencephalogram (EEG) signals for automated identification of seizures. Their model achieves very high sensitivity and specificity, and an overall classification accuracy of 98.87%. This paper was awarded the best paper award at the AIH 2012 workshop.

The second paper, by Mani Abedini, Michael Kirley and Raymond Chiong, entitled "Incorporating feature ranking and evolutionary methods for the classification of high-dimensional DNA microarray gene expression data",[2] evaluates two evolutionary machine learning models to improve microarray gene expression classification tasks.

Their analysis reveals that employing feature selection to highlight informative features and using these to guide rule discovery outperforms conventional feature reduction approaches.

The third paper, by Qing Zhang, Yang Xie, Pengjie Ye and Chaoyi Pang, entitled "Acute Ischemic Stroke Prediction from Physiological Time Series Patterns",[3] employed psychological parameters from stroke patients to predict stroke outcomes after three months. They found that using psychological trend pattern features in the prediction model helped improve prediction accuracy from just over 70% to 90%.

The fourth paper, by Amol Wagholikar, Guido Zuccon, Anthony Nguyen, Kevin Chu, Shane Martin, Kim Lai and Jaimi Greenslade, entitled "Automated Classification of Limb Fractures from Free-Text Radiology Reports using a Clinician-Informed Gazetteer Methodology",[4] presents initial experimental evaluation of an automated clinician-informed system for classification of limb fractures. The authors identify avenues for future development using advanced machine learning and natural language processing methods.

The fifth paper, by Zahra Shahabi Kargar, Sankalp Khanna and Abdul Sattar, entitled "Using Prediction to Improve Elective Surgery Scheduling",[5] discusses current research challenges in the area of elective surgery scheduling and presents a two stage methodology to improve the process through improved estimation of surgery duration, dynamic sharing of theatres between elective and emergency surgery and schedule optimisation based on better compliance to national surgery targets.

The sixth paper, by Luke Butt, Guido Zuccon, Anthony Nguyen, Anton Bergheim and Narelle Grayson, entitled "Classification of Cancer-related Death Certificates using Machine Learning",[6] evaluates multiple feature extraction and machine learning approaches for automatic detection of cancer as the cause of death from death certificates. Their analysis reveals that the best performance is obtained using a token stem feature set with a support vector machine classifier.

The seventh paper, by Colin Curtain, Ivan Bindoff, Juanita Westbury and Gregory Peterson, entitled "An investigation into the types of drug related problems that can and cannot be identified by commercial medication review software",[7] evaluated the efficacy of a commercial expert system that employs multiple classification ripple down rules in identifying drug related problems from home medicine reviews. The analysis revealed that the system identified significantly more potential drug related problems than pharmacists.

We hope that the breadth and diversity of the papers presented at the workshop and published in this special issue will foster further collaboration between health informatics and AI researchers and improve the state of AI driven research in health.

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PEER REVIEW

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CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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