

# Research Newsletter

## School of Computer Science

Issue 4 – Spring 2015



The School of Computer Science - Kilburn Building Quad

### In this issue

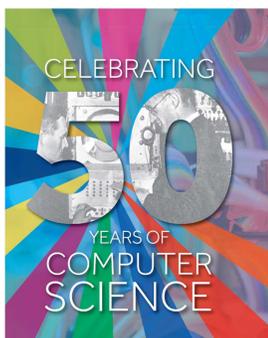
- p.2 Head of School Editorial and Research News
- p.5 Feature – VADA Programme Grant
- p.6 Spotlight – Inaccurate reporting jeopardising IBS clinical trials
- p.6 Recent Appointments
- p.7 Grants and Awards

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### About us

At The University of Manchester, we have one of the longest established schools of computer science in the UK and one of the largest. We are constantly building on our strong research history with research groups operating across the spectrum of computer science, from fundamental theory and innovative technology, through novel hardware and software systems design, to leading-edge applications.

The School is consistently ranked highly; top 5% in the UK (REF2014, GPA); assessed as *the best environment* in the UK for computer science and informatics research (REF2014); 7th in the UK by ARWU 2014 and the expertise and achievements of our staff are well-recognised internationally.

# Editorial by the Head of School

This is an important year for computer science, with it being 30 years since the first ARM processor was switched on, the 50th anniversary of Moore's Law, 50 years of Computer Science at Manchester and 200 years since the birth of the world's first computer programmer Ada Lovelace.



Professor Jim Miles

As well as recognising the past, I am pleased to say that we have a lot to look forward to in Computer Science. This edition of the newsletter showcases some of the key contributions to the research of the School from our PhD students, in addition to recent research and discoveries from staff.

## News

### Professor Steve Furber's Lovelace lecture

As the winner of the BCS Lovelace medal in 2014, Professor Steve Furber delivered the Lovelace lecture in March at the Royal Society in London.

The evening event featured contributions from Prof. Furber's colleagues past and present, including Simon Segars, CEO of ARM, Andy Hopper CBE FRS FREng FIET, Professor of Computer Technology at the University of Cambridge, Prof. Mike Wooldridge FBCS, Head of Computer Science at the University of Oxford and Carole Goble CBE FREng FBCS CITP, Professor of Computer Science at Manchester.



Prof. Furber talked about his personal take on '**Computers and Brains**' and work on the SpiNNaker project for brain modelling applications, including the EU Human Brain Project.

It has been 200 years since the birth of Ada Lovelace who, even then, foresaw brain modelling:

*'I have my hopes... of one day getting a cerebral phenomena such that I can put them in mathematical equations – in short, a law or laws for the mutual actions of the molecules in the brain...'*

A hundred and fifty years later Turing asked "Can machines think?" and created "The Imitation Game" or "The Turing

Test" for machine intelligence. Despite Turing's expectation that increasing memory would solve the problem by the end of the 20<sup>th</sup> century, and spectacular progress in the performance and efficiency of machines, we have yet to see any convincing demonstration of a machine that can pass his test.

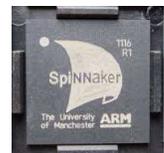
*'the problems with true artificial intelligence are that we still really haven't worked out what natural intelligence is... we need to return to the source of natural intelligence, the human brain.'*

Prof. Furber

Although cognitive systems are beginning to display impressive environmental awareness, they do not come close to the sort of "thinking" that Turing had in mind.

The SpiNNaker project has been 15 years in conception and 8 years in construction, but is now ready to contribute to the growing global community that is aiming to deploy the vast computing resources now available to us to accelerate our understanding of the brain, with the ultimate goal of understanding the information processing principles at work in natural intelligence.

The full article is available at <http://academy.bcs.org/content/lovelace-lecture>



- In February Prof. Furber gave a talk for **The Manchester Literary and Philosophical Society** entitled '**Brains and Chips**' about bio-inspired massively-parallel computing at the Royal Northern College of Music.
- Prof. Furber is joining Prof. Goodacre as a speaker at the **first Manchester IPEXPO** on IT Infrastructure and Cloud in May [www.ipexpomanchester.com/Seminars/Speakers](http://www.ipexpomanchester.com/Seminars/Speakers)
- He is also a speaker in the **Low-power & Energy Efficient Computing session** at the upcoming **EMIT** (Emerging Technology) Conference 2015 <http://emit.manchester.ac.uk/> (30 June-1 July 2015)

## Why publish and be so damned hard to find?

Times Higher Education (THE) publish a report on Professor Goble's talk to the Jisc Digital Festival.



In March the Times Higher Education published a report by Chris Parr on Professor Carole Goble's keynote talk to the 2015 Jisc Digital Festival (Digifest) conference in Birmingham.

The way in which academic papers are published makes much research “unfindable”, while scholars’ lack of transparency about their research methods renders many of their conclusions highly questionable. She cited research by the Software Sustainability Institute ([www.software.ac.uk](http://www.software.ac.uk)) that suggested that one-fifth of academics who develop their own software for use in research have had no training in programming. “If we have broken software, we have broken science,” she said.

The full article and accompanying podcast is available through:

[www.timeshighereducation.co.uk/news/why-publish-and-be-so-damned-hard-to-find/2019144.article](http://www.timeshighereducation.co.uk/news/why-publish-and-be-so-damned-hard-to-find/2019144.article)

**Prof. Goble** ([www.manchester.ac.uk/research/Carole.goble](http://www.manchester.ac.uk/research/Carole.goble)) also spoke at the *Reproducibility in Science and Policy* event in an Open Data Manchester January Special at Manchester Science Park

<https://opendatamanchester.org.uk/2014/12/08/reproducibility-in-science-and-policy-an-open-data-manchester-january-special/>



### ARMOR – a solution to prevent Row-Hammer data corruption in DRAMs

PhD student Mohsen Ghasempour has devised a solution to a problem that has been exercising industry specialists over the last couple of years.

Mohsen's research (supervised by Dr Mikel Lujan and Dr Jim Garside): “ARMOR: A Run-time

Memory hot-row detector to prevent Row-Hammer data corruption in DRAMs” is now the subject of a patent application filed on behalf of the University by UMIP, the University's commercialisation arm. UMIP is also seeking partners to develop the technology into a full commercial offering.

#### What is ARMOR?

ARMOR is a hardware-solution to prevent Row Hammer Errors in DRAMs, designed and developed in the School of Computer Science.

Row hammering can occur when a specific wordline of a DRAM cell is activated repeatedly within a refresh interval (Row-Aggressor). In this situation the neighboring cells leak charge at a faster rate than expected. Thus, the retention time of such cells becomes less than refresh cycle (e.g. 64 ms) which means that these cells may lose their data (charge) before the refresh happens (Row-Victims). Therefore, during refreshing process the corrupted data will be read and written back again to the DRAM cell.

The row hammering phenomenon is an unintended side effect in dynamic random-access memory (DRAM) that causes memory cells to leak their charges and interact electrically between themselves, possibly altering the content of nearby memory rows that actually were not addressed in the original memory access. This effect can be used for security exploitation.

The main challenge to mitigate the Row-Hammer effect is to monitor the number of activations for each row in the DRAM, which imposes a significant storage overhead to the memory system. ARMOR monitors the activation stream at the memory interface level and detects which specific rows (i.e. hot rows) are at risk of being “hammered” at run-time. ARMOR is capable of detecting all the possible hot-rows in a system with a minimal storage overhead (e.g. 800 Bytes to protect 4 GB of DRAM).

#### Why ARMOR is a Promising Solution?

- capable of detecting all the possible Row Hammer errors with a high level of confidence
- provides precise information about the hammered rows (addresses) and the number of activations with a high level of accuracy (e.g. 99.99%)
- it does not need to know about the logical to physical mapping of DRAMs in order to mitigate Row Hammer error (ARMOR Cache Solution)
- scalable according to the size of memory
- technology independent and can easily support future device technologies.

For more information see: <http://apt.cs.manchester.ac.uk/projects/ARMOR/RowHammer/index.html>

## PhD student Farideh Jalalinajafabadi: 3MT People's Choice award winner

The Three Minute Thesis®(3MT) competition challenges PhD students to present a compelling spoken presentation of their research topic and its significance in just three minutes.

From 61 applicants, 46 presenters and 12 finalists, final year Computer Science PhD student, Farideh Jalalinajafabadi (supervised by Dr Barry Cheetham and Dr Mikel Lujan) was awarded the People's Choice prize for her presentation, entitled '**3MT: Computerised measurement of voice quality conforming to the GRBAS scale,**' as the People's Choice and a £100 prize.



You can see the finalist's performances here:

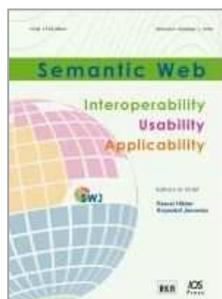
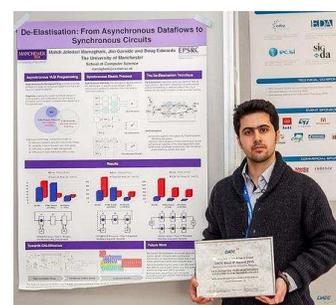
[http://www.engagement.manchester.ac.uk/highlights/3\\_minute\\_thesis/index.html](http://www.engagement.manchester.ac.uk/highlights/3_minute_thesis/index.html)

With thanks to Manchester Doctoral College, Faculty Researcher Development Teams, Business Engagement Support Team and the University of Manchester Alumni Association for their kind sponsorship.

## DATE Best Paper Award for PhD student

Mahdi Jelodari Mamaghani, a third year EPSRC-funded PhD student in the Advanced Processor Technologies group (supervised by Dr Jim Garside and Dr Doug Edwards) received the DATE Best Paper Award 2015 in March at Grenoble with his paper titled "**De-Elastisation: From Asynchronous Dataflows to Synchronous Circuits**" ACM/IEEE; 2015. p. 273-276.

Design, Automation and Test in Europe (DATE) is among the top three conferences in the EDA and CAD area with 915 submissions this year.



## Semantic Web Journal top paper for Sean Bechhofer

Back in March 2014 we reported that Senior Lecturer Sean Bechhofer was the author of the [most cited paper in 2013](#) in the Semantic Web Journal (SWJ).

[The OWL API: A Java API for OWL ontologies](#) paper continues to make an impact and is now listed as *the top most cited paper of all time in SWJ*.

For more information see the SWJ news pages: [www.semantic-web-journal.net/blog/swj-5-years-most-cited-papers](http://www.semantic-web-journal.net/blog/swj-5-years-most-cited-papers)

## Robot Scientist in the News

Professor Ross King's robot scientist, Eve, featured in Voice of America, [Google News](#), [BBC News](#), [Sky News](#) and [Yahoo! News](#) this in February following an [article in the Royal Society Interface](#): **Cheaper faster drug development validated by the repositioning of drugs against neglected tropical diseases** (DOI: 10.1098/rsif.2014.1289).

Eve is designed to automate early-stage drug design and has already discovered that a compound shown to have anti-



cancer properties might also be used in the fight against malaria. You can see Eve in action in the Voice of America article: [www.voanews.com/content/robot-scientist-helps-design-new-drugs/2629358.html](http://www.voanews.com/content/robot-scientist-helps-design-new-drugs/2629358.html)

## Newsround feature

Dr Gavin Brown featured on CBBC's Newsround in February explaining how Google built a deep neural network that can learn to play Atari video games like Breakout, Pacman and Pong.... and won!



**Hold that thought: Learning, Memory & AI** - Dr Gavin Brown is speaking at the Pint of Science Festival in May. The sold out event sees Gavin explain Machine Learning with the promise that '**The Robots are NOT Coming to Kill Us!**' <http://pintofscience.co.uk/event/hold-that-thought/>

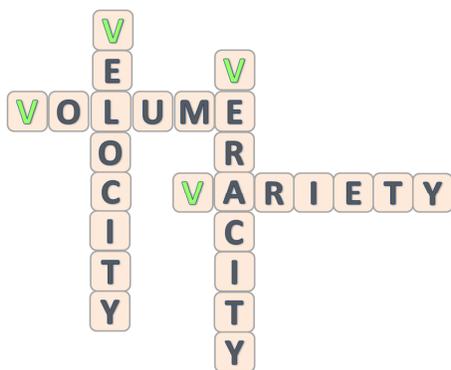


# VADA Programme Grant: Value Added Data Systems – Principles & Architecture

The School of Computer Science is a partner on a major 5-year EPSRC Programme Grant worth £5.7M.

The VADA programme brings together university researchers from Manchester (**Prof. Norman Paton, Prof. John Keane (MIB), Dr Alvaro Fernandes**), Oxford and Edinburgh with commercial partners who are in desperate need of a new generation of data management tools.

*Data is everywhere, generated by increasing numbers of applications, devices and users, with few or no guarantees on the format, semantics, and quality. The economic potential of data-driven innovation is enormous, estimated to reach as much as £40B in 2017, by the Centre for Economics and Business Research.*

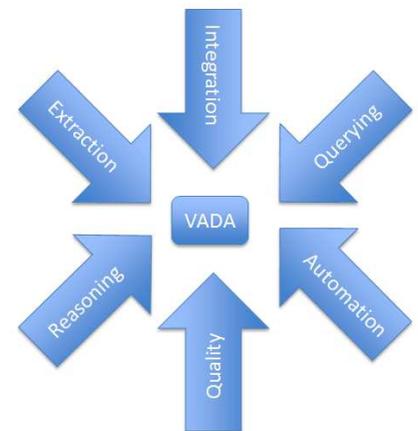


To realise this potential, and to provide meaningful data analyses, data scientists must first spend a significant portion of their time (estimated as 50% to 80%) on "data wrangling" - the process of collection, reorganising, and cleaning data. This heavy toll is due to what is referred to as the **four Vs of big data**: **Volume** - the scale of the data, **Velocity** - speed of change, **Variety** - different forms of data, and **Veracity** - uncertainty of data.

There is an urgent need to provide data scientists with a new generation of tools that will unlock the potential of data assets and significantly reduce the data wrangling component. As many traditional tools are no longer applicable in the 4 V's environment, a radical paradigm shift is required. The VADA Programme Grant aims to add value to data by:

- carrying out data management tasks in an environment that takes full account of data and user contexts, and
- integrating and automating key data management tasks in a way not yet attempted, but desperately needed by many innovative companies in today's data-driven economy.

The VADA research programme will define principles and solutions for Value Added Data Systems, which support users in discovering, extracting, integrating, accessing and interpreting the data of relevance to their questions. In so doing, it uses the context of the user, e.g., requirements in terms of the trade-off between completeness and correctness, and the data context, e.g., its cost, provenance and quality. The user context characterises not only what data is relevant, but also the properties it must exhibit to be fit for purpose.



Partners include:

This revolutionary approach to data management relies on interlinking research in the areas shown.



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**Prof. Keane** is also working with colleagues across the University to establish an extensible and self-sustaining Hadoop cluster to enhance new and existing activity in Big Data. Big data processing requires innovative algorithmic approaches and distributed execution platforms (that process in a different way to traditional HPC). Hadoop enables distributed processing of datasets across potentially thousands of nodes, with some as masters and others as workers.

**£20k from the Faculty Strategic Fund has been awarded to the team for Hadoop Cluster for "Big Data"**

# Spotlight: Inaccurate reporting jeopardising IBS clinical trials

**Researchers at The University of Manchester say better method reporting in animal experiments could save hundreds of thousands of pounds and stop clinical trials being commissioned that have no hope of a successful result.**

A team led by **Dr Sheena Cruickshank of the Faculty of Life Sciences** and **Professor Andy Brass from the School of Computer Science** analysed 58 papers on research into inflammatory bowel disease published between 2000 and 2014. They found a wide variety in how methods were reported and that vital information about experiments were missing, meaning they couldn't be accurately reproduced in animal or human models.



In several instances the gender of the animal used wasn't recorded which can have a bearing on the result as female mice have a stronger immune response to males. How the animals were housed will also impact on the results in experiments about the gut.

The problem first became clear to the researchers when they were looking at building a knowledge base to help pull together research on inflammatory bowel disease (colitis). Working with computer scientists it became clear to the biologists that the data couldn't be understood by colleagues from different disciplines.

**“So much research is now being carried out across disciplines so it's vital that experiments can be understood by as many scientists as possible. Relying on the reader to make assumptions based on their own experience will only lead to errors, but this is what many papers are asking people to do when they come to replicate the research.”**

Prof. Andy Brass

To address the issue the team have developed a critical checklist of what information should be included. It covers nine areas ranging from information about the animals, their housing condition, genetics, how colitis is induced, experiment design and monitoring. The checklist is included in their paper ***Quality of Methods Reporting in Animal Models of Colitis*** due to be published in the journal *Inflammatory Bowel Diseases*.

**“Our work has been focused on identifying the field-specific factors that have a significant impact on experimental results. These factors are included in what we have named miniMECH (minimal MEthods CHecklist), a flexible spreadsheet format for scoring new submissions to scientific journals and published scientific literature.”**

Michael Bramhall and Oscar Florez-Vargas

The Manchester team is recommending the adoption of their checklist as a requirement for publication to improve the quality, comparability and standardisation of studies into inflammatory bowel disease. They believe it will make the interpretation and translation of data to human disease more reliable and ultimately contribute to making clinical trials more successful.

For more information see the blog at: [www.cs.manchester.ac.uk/bhig/areas-and-projects](http://www.cs.manchester.ac.uk/bhig/areas-and-projects)

**Michael Bramhall** and **Oscar Florez-Vargas** are PhD students in Computer Science in their third year. Michael is funded by an EPSRC CASE studentship with Biotechnology Company Epistem. Oscar is funded through the "Francisco Jose de Caldas" scholarship from Colciencias (Colombia).

## Recent appointments

**Dr Markel Vigo** has been appointed Lecturer in Health Informatics/ HCI and he is a new member of the Bio-Health Informatics Group. He investigates innovative empirical methods to analyse how individuals interact with complex information artefacts. This is of utmost importance in order to provide engineering solutions to make such interfaces more



understandable, operable and effective. He is currently collaborating with the HeRC in order to apply such techniques in the health domain with an ongoing study on medical dashboards. He is also involved in the "How is Britain Breathing" initiative where he investigates the most effective ways to collect allergy symptoms from individuals who engage in citizen science activities. Before coming to Manchester he was a research consultant

working on national and international projects. He has also been a visiting research scholar at the University of California, Irvine and the Italian National Research Council. Currently, he is a track chair at the ACM Hypertext and Social Media Conference, the Int. Conference on Web Engineering and ACM ASSETS. His latest paper, "Constructing Conceptual

Knowledge Artefacts: Activity Patterns in the Ontology Authoring Process" has recently been presented at the prestigious ACM CHI conference in Seoul (Korea).  
[www.markelvigo.info](http://www.markelvigo.info)



**Dr Christoforos Moutafis** is a lecturer in the Nano Engineering and Storage Technology (NEST) research group. His research interests lie at the intersection of spintronics and nanomagnetism with a particular focus on the exciting dynamical properties of topological objects like the magnetic skyrmion and with a view to novel magnetoelectronic devices with enhanced functionalities.

His core expertise includes ultrafast magnetisation dynamics, Synchrotron-based experiments and micromagnetic simulations. He received his PhD in Physics at the Cavendish Laboratory, Cambridge and he has served as a fellow of the Japanese Society for the Promotion of Science at the Institute for Materials Research at Tohoku University, Japan. Dr Moutafis has come from post-doctoral research work at the University of

Konstanz, EPFL and the Paul Scherrer Institute where he ran large collaborative projects in the Swiss Light Source, CH, the Advanced Light Source, USA and BESSY, DE.

## Grants and awards

**The School of Computer Science has been awarded over £16 million external funding for research over the last two years. Much of the research involves working in collaboration with others across the University and all over the world.**

**Here are just some examples of recent research funding awarded in the School.**

### Open Mining Infrastructure for Text and Data (OpenMinTeD)

**Prof. Sophia Ananiadou**, Jock McNaught

**Funding body:** EC H2020

**Award amount:** €514k

A 3-year project funded by H2020 on managing, preserving and computing big research data.

The development of an interoperability framework and service-oriented platform for the integration of text mining services, content and language resources. NaCTeM will develop an

interoperable text mining infrastructure, align text mining platforms to support use cases in the Life Sciences i.e. the curation of the EMBL-EBI chemical databases and the curation of the KnowledgeSpace developed by



the Human Brain Project.

For more information contact Prof. Ananiadou:  
[www.nactem.ac.uk/staff/sophia.ananiadou](http://www.nactem.ac.uk/staff/sophia.ananiadou)

### Generating and using "Big Data" to identify hearing aid patterns of usage in order to optimise and personalise fitting.

**Prof. John Keane** with Dr Michael Stone (SPS and Central Manchester University Hospitals NHS Foundation Trust).

**Funding body:** MRC/ EPSRC

**Award amount:** £103k

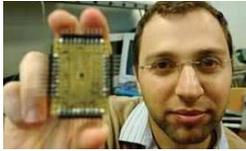
Modern hearing aids have the capacity to "log" data to characterise the soundfields and the settings with which the aid is used. These data can be used to check usage patterns, but little other use is currently made of them. This logging is but one component of the dataset gathered during the process of hearing aid prescription and fitting, operation and user interaction. This proposal will co-ordinate collection of these disparate data to build complex Big Data sets that

characterise the use of, or failure to use, hearing prostheses. Identifying interaction between user, aid and resulting lifestyle should verify existing practices, but, more long term, should generate inferences to enhance understanding of what improves outcomes for users both as a group with better performing devices and as an individual, with more personalised fitting.

[www.manchester.ac.uk/research/john.keane/personaldetails](http://www.manchester.ac.uk/research/john.keane/personaldetails)



## Exploration of 3-D Monolithic Memory Design



**Dr Vasilis Pavlidis** with Dr Volkan Kurzun (The Hong Kong University of Science and Technology)

**Funding body: Royal Society Kan Tong Po Visiting Fellowship**

**Award amount: £23.5k**

The Visiting Fellowship establishes a link between Drs Pavlidis and Kurzun, for collaboration in memory design research starting with a two-week visit to Hong Kong.

The density of electronic memories has traditionally been improved by scaling down the physical dimensions of the devices in the memory cell. For specific types of memory, such as SRAM and DRAM, the scaling of dimensions faces increasing difficulties that hinder an increase in density and pose cost increase threats.

3-D monolithic integration is a highly potent technology to overcome this bottleneck, as it allows the stacking of the devices comprising the cell rather than the scaling of the dimensions of the devices.

## COPIOUS: Conserving Philippine Biodiversity by Understanding Big Data

**Prof. Sophia Ananiadou** and Dr Riza Batista-Navarro

**Funding body: British council Newton Fund**

**Institutional Links**

**Award amount: £115k**



results and software will be open to the wider community working in biodiversity For more information contact Prof. Ananiadou:

[www.nactem.ac.uk/staff/sophia.ananiadou](http://www.nactem.ac.uk/staff/sophia.ananiadou)

NACTEM is teaming up with several Biodiversity teams in the Philippines for 2 years to produce an interoperable infrastructure based on Argo and a knowledge repository based on text mining the literature related with biodiversity in the Philippines. The

## Research Programmes in Computer Science

By choosing to study at Manchester you will be joining one of the most innovative and successful schools of computer science in the world. Manchester saw the birth of computer science, with the creation of the world's first stored-program computer. We continue to work on pioneering research including cutting-edge image processing software, new technologies to exploit the power of the web, medical imaging software and low-power chip design. The School incorporates ten research groups operating across the spectrum, from fundamental theory and innovative technology, through novel hardware and software systems design, to leading edge applications.

Although a research degree is traditionally the route to an academic post, and is often an essential qualification for a research career, it is now frequently sought by industry. Research graduates are a step ahead in the race for jobs: the communication and analysis skills integral to a research degree make them highly employable individuals.

For more information, please contact [pgr-admissions@cs.man.ac.uk](mailto:pgr-admissions@cs.man.ac.uk) or visit [www.cs.manchester.ac.uk/study/postgraduate-research](http://www.cs.manchester.ac.uk/study/postgraduate-research)

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