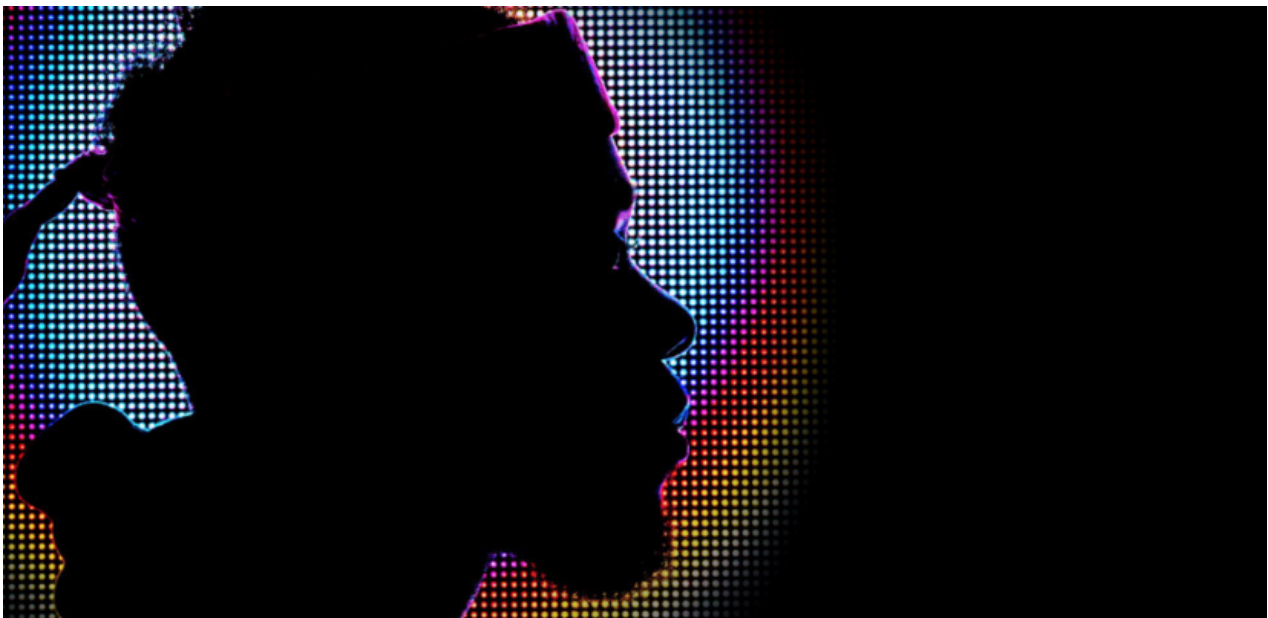


Decoding big data

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Experts say a re-imagining of data could see societies move away from one-size-fits-all approaches and towards more tailored solutions for education, finance, sustainability and more.



Data is about more than just numbers. Photo by Drew Graham

Data is about more than just numbers. It's about people. That's why we're breaking through the binary code, scrutinising the hype and revealing six different ways our researchers are using data to change society for the better.

You scan your rewards card at the supermarket. Ping! Walk down the street listening to your favourite tunes. Ping! Google 'top tropical holiday destinations'. Ping! Ping! Ping!

Today, we're all being watched; our movements and interactions stored as data on our own devices and in the cloud. It sounds scary, but Director of the Advanced Analytics Institute (AAI) Bogdan Gabrys says we don't have to be afraid, because "Humans have been surrounded by data since the beginning of history."

Data can be created by people, art, computers, social media platforms, smart home devices, scientific installations (such as particle accelerators and radio telescopes), genome sequencing devices. The list goes on.

“We should never divorce data from its provenance – from the people who produce it or the people it impacts.”

Bogdan Gabrys


Director of the Advanced Analytics Institute (AAi)

What’s different today, Bogdan says, is that “the rate at which data is now being created and stored is exponential. The biggest game-changers in recent years have been the availability of data, computational power, storage and sensory devices.”

Much of our suspicion, suggests Bogdan, stems from a fear of the unknown. He says, “The vast majority of us are not used to handling, dealing or even comprehending these amounts of data.”

And that, says Associate Dean (Engagement and Innovation) in the Faculty of Arts and Social Sciences Professor Deb Verhoeven is really what makes big data ‘big’. “Big data is data which readily available tools and methods can’t quite grapple with. It forces you to address your own limitations and work beyond them and outside them.”

While it seems ‘new’, Bogdan says it’s really not. “Some of the algorithms that help us make sense of all this data have been around for a very long time, but the hardware wasn’t actually there for them to react quickly enough to be useful.”

 Deb Verhoven. Image supplied

Both Bogdan and Deb agree that universities should be the ‘safe space’ where ideas and issues surrounding data are debated from all angles.

For example, says Bogdan, “How do we educate people in terms of what data can do? How do we find our place in the world? And how can we control it or drive it or define our co-existence?”

Such a re-imagining of data could see societies move away from one-size-fits-all approaches and towards more tailored solutions for education, finance, sustainability and more. But the biggest gains, says Bogdan, are set to come from areas like the social sciences, which haven't traditionally been driven by data.

Already UTS is leading the charge with Deb overseeing a new national virtual laboratory for the humanities and social sciences – the Humanities Network Infrastructure (HuNI).

“It’s a new way of thinking about how we organise and engage with complex data,” explains Deb. “HuNI enables people to navigate vast sets of data from different places. Humanities data tends to be very heterogeneous and typically, to work across different types of data, we have built ways to standardise it. But there is a loss with that. HuNI is designed to preserve the complexity of cultural data by allowing researchers to propose in their own words the ways the data should be connected.”

And that’s important, Deb says, because “the reason data gets used in the way it does is not because of data, it’s because of people.

“We need to think about why it is that data is traded and exchanged in the way it is by people.


“We should never divorce data from its provenance – from the people who produce it or the people it impacts.”

Improving customer service

If you’re worried robots may one day replace you at work, fear not. AAI researchers are working to make AI your friend, not foe.

AAI Associate Professor Guandong Xu is leading a team investigating how client behaviour modelling, data mining, natural language processing and social and predictive analytics can be used to assist customer service staff in the insurance industry.

“Since 2016, we’ve been working with ANZ Wealth to develop an intelligent underwriting model that harnesses machine learning and gives insurers the opportunity to develop more efficient and reliable assessment,” explains Guandong.

 Guandong Xu. Photo by Shane Lo

For example, instead of time-intensive manual underwriting, the ‘virtual’ computerised underwriter will determine if a loading or exclusion needs to be applied and only processes the applications most likely to be accepted. Not only does it mean better

customer service, fewer errors and improved quality assurance, but it can reduce workload demands for on-the-ground staff too.

It's not the first time AAI have teamed up with the business sector. Researchers at the institute are also working with [Colonial First State](#), Credit Suisse, AMP and HCF to uncover new ways these companies can use their data to improve their business too.

Guandong says, "We're very experienced in predictive analytics which uses big data, machine learning and artificial intelligence to find underlying correlations between different customer attributes and outcomes.

"Our aim is to be the leading research group in applying data analytics and AI across the finance sector."


Health services and government spending

"In NSW emergency departments (ED), there's this four-hour rule where they're expected to get a target per cent of their patients out of ED within four hours. And since introducing this target, the general understanding is patient outcomes have improved." But Industry Professor in the Faculty of Engineering and Information Technology Barry Drake wants evidence.

That's why he's heading up this project as part of the Digital Intelligent Systems for Health (DISH) initiative. It's a new network of UTS academics, led by Barry and co-convened by Distinguished Professor of Public Health Elizabeth Sullivan. They're who are committed to transforming health systems through the application of smart algorithms, data science and systems-wide thinking.

DISH aims to improve patient outcomes, increase evidence-based decision-making in our healthcare system and boost cost efficiency.

Alongside the NSW Health ED project, DISH is showcasing a range of big data projects including ones that seek to tailor treatments for childhood leukaemia, prevent cyberbullying, and improve accident recovery trajectories.

 Barry Drake. Image supplied

The aim of the showcase is to ignite the imagination of industry partners to the possibilities of combining their data with cutting-edge technology and UTS expertise.

"Many people in health, including my customers, are very interested in being able to anticipate negative outcomes for patients, things like unexpected hospital admissions

or deteriorating health.”

Barry hopes to use the data to develop systems that identify which patients may be at risk of an adverse outcome and help healthcare workers intervene before it's too late. Often, he says, “these interventions are quite cheap and easy, so the patient gets a better outcome and the resources that would have been taken up are actually freed up for someone who really needs them.”

For Barry, “This is one of the good things about UTS – it has a real emphasis on the impact of your work, social justice and engaging with people outside of the university. Peer review is very important, of course, but to have a real impact, your research needs to be translated into practice.”

Visualising climate change

“Data is something you can sculpt when you manipulate it, play with it. And the different forms can tell you different things.” So says Head of the School of Design Dr Kate Sweetapple.

Right now, Kate is playing with plankton – specifically data about how these microscopic marine algae (the first link in the aquatic food webs) are affected by changes in open ocean conditions.

To do this, Kate's teamed up with the School of Design's Dr Jacquie Lorber-Kasunic, the Faculty of Science's Professor Martina Doblin and Professor Nancy Longnecker from the University of Otago in New Zealand for a Department of Industry, Innovation and Science funded project called ‘Increasing participation in ocean science through data visualisation’.

“What we are looking at is ways to visualise the morphological change of plankton – so changes to the size, shape and structure of microbes – in order to understand how they are impacted by climate change,” says Kate.

 Ferris Wheel Diatom (microscopic plant). Photo by Martina Doblin

At the moment, they're putting the finishing touches on a website, called MarMic, which will launch in August as part of National Science Week. The site will be open to citizen scientists so they can create, collect and view data they're producing.

Kate says the data they collect and the visualisations they produce will help them “track through and see where the greatest morphological changes happen, and potentially

identify where planktonic populations will need to evolve most to deal with contemporary changes in ocean conditions.”

At the same time, Kate and Jacquie will be seeking to answer specific questions about the visual representation of data. Jacquie says, “In data visualisation, there's a tendency to value quantification, which leaves out the qualities in data sets that may be better represented in expressive visual and material forms.”

Student feedback and learning


In the Connected Intelligence Centre (CIC) “We’re using a range of techniques from artificial intelligence and data science to analyse new kinds of digital data,” explains CIC Director Professor Simon Buckingham Shum.

One example is student writing. “Of course, students writing is as old as the hills and students using word processors for writing is hardly new. But now with cloud computing, the students can submit drafts of their writing and get instantaneous feedback on that using the AI technique of natural language processing.”

According to Simon, it’s a world-first for UTS to provide instant feedback on reflective writing. So, how does it work? Students simply copy and paste their written work into the AcaWriter (that’s short for academic writer) website and the site’s software instantly analyses the text.

“It's not that the machine understands a piece of writing in the way that a human does,” explains Simon, “but it can spot interesting patterns that correspond to good academic ‘rhetorical moves’ and draws your attention to areas for you to reflect on.

“We're going way beyond spelling, grammar and plagiarism here,” he adds.

 Simon Buckingham Shum. Photo by Jamie Williams

AcaWriter, which will be available to students 24/7, is set to be rolled out university-wide. Simon says, it’s been developed with “early adopter academics and the experts in IML, the Institute for Interactive Multimedia and Learning, who are the specialists here in the teaching of writing.”

It’s set to be a boon for undergraduates, postgraduates and academics who will have more time to help students understand the content of their degrees.

“This isn't grading them,” clarifies Simon. “Students don't have to worry that they've made mistakes or the academics are going to see their very early drafts or anything like

that. It's about improving the quality of what they end up submitting.”

And, hopefully, give them greater confidence in their ability to write analytically and reflectively, whether they embark on an academic career or something else.

Find out more about AcaWriter at utscic.edu.au/tools/awa

Cultural capital

“In the humanities, we actually take a slightly different approach to data,” says Deb.

For her, the most interesting thing about data is the values attached to it. “We don’t just deal with numbers; we actually try to unpack them in terms of the cultural values they rest on and reiterate,” she explains.

Most recently, Deb’s been working with a data set that details every film screening, in every cinema, in every country in the world over two-and-a-half years. “It’s about 350 million records,” she admits.

One of the exercises generated by the [Kinomatics](#) project, as it’s known, ranks every city in the world in terms of its ‘cinemability’. “It’s a terrible word,” confesses Deb, “but it’s about measuring how great a city is in terms of going to the cinema.”

The world-first project led to the development of an online tool where users can scroll through a range of factors (like the relative importance of big cinemas or film festivals) and then rate them on a scale of importance from one to 10. The site then gives you a personalised list of which cities are best suited to your cinema-going needs.

 Cinema data visualised. Image supplied

For the researchers, the exercise also generated information about what people using the site most valued about their experience of cinemagoing.

Currently, Deb and her team, which includes humanities scholars, network scientists, data scientists, geospatial scientists, cultural economists and cultural policy experts, are using the same data set to uncover film trade relationships that aren’t always evident in a world dominated by Hollywood cinema. It’s a move that has implications for cultural policy planning.

For Deb, “Big data is interesting not because it’s big; it’s interesting because it’s incredibly detailed.

“We’ve found all these amazing relationships between countries like Australia and Germany, which exchange films quite equitably. Or between India and Switzerland,” explains Deb.

“And these become really interesting relationships to examine, because they start to tell us things about potential trade relationships that we might be unable to see, or lead us to consider carefully how we’ve set up co-production agreements.”

Find out more at [kinomatics.com](https://www.kinomatics.com)

Household economics and infrastructure spending

“Sometimes the small pieces of data can actually make the biggest difference,” affirms Director of Business Intelligence and Data Analytics in the UTS Business School Professor John Rose.

His primary research focus, thanks to an Australian Research Council grant, is understanding if and how people make household budgets, how changes in the economy influence peoples’ spending habits and what the repercussions of these changes might be. For example, if interest rates rise and your rent or mortgage repayments increase are you more likely to make up the shortfall by cutting back on your healthcare, entertainment or something else?

“If you are more likely to substitute mortgage payments with healthcare,” says John, “then that may have an impact on your health and wellbeing. Whereas households that are more likely to substitute mortgage payments with entertainment, that may have a different impact. So, I’m trying to understand what the flow-through effects are and how that has an impact on other non-traditional economic measures.”

 John Rose. Photo by Max Halden

To begin with though, John says, “I’m starting to go back and have a look at the first principles of a lot of microeconomic theory and finding the holes – the differences between what the theory says and how we’re actually using it.

“In many cases, the way we study demand for goods and services appears to be in violation of basic microeconomic theory.”

And that’s a concern because that’s how governments and large companies run cost-benefit analyses for large-scale infrastructure projects. “We’ve seen toll roads fail, go bankrupt, billions of dollars’ worth of infrastructure just going to waste,” says John.

“To be able to come up with a better cost-benefit is the ultimate goal.”

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