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Shaping algorithms for uncertain futures: A summary of the Algorithmic Futures Policy Lab Workshop Series Elizabeth T. Williams, Natasha Harvey, Joseph Guillaume, and Katherine Daniell



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The principal objective of the Algorithmic Futures Policy Lab project is to catalyse the work needed to successfully design policy and technology for an uncertain future, with a specific focus on upcoming governance challenges and opportunities in this space of relevance to the EU and Australia. The academic workshop series considered algorithmic design and policy development for uncertain futures through a social responsibility lens, an exploration of human-machine collaboration, and an exploration of water operations in places where climate change is already influencing algorithmic system design.

The following is a report on the <u>Algorithmic Futures Policy Lab workshops</u>. These workshops aimed to bring diverse participants together to shape transdisciplinary perspectives and research on policy and technology design for systems undergoing rapid change.

#### Introduction

In the locations our workshops were set in, algorithmic systems are everywhere we look, from the banking app at our fingertips to the quiet zoom of a CCTV camera on busy city streets. These systems hum away in the background, subtly – or not so subtly – shaping our lives.

In late 2019, Australia began to burn. Too much fuel, too little water, and far too much heat combined to transform more than 24 million hectares to ash, killing 33 people, destroying over 3000 homes, cutting communications and power, and smothering the land with smoke (Richards et al. 2020; May et al. 2021). The summer laid bare the brittleness of the algorithmic systems designed to provide information about emergent threats, as communities rigged up makeshift air quality monitors, navigated between fire warning apps distributed by different regional authorities, and taped their houses shut to keep out the worst of the smoke. It was during this period that the proposal for this workshop series was written. In the background, another change agent – Covid-19 – quietly spread across the world. We began our proposal for this workshop series with the thought that we would look at algorithmic system design for uncertain climate futures, but our definition of uncertain futures expanded as we experienced the realities of lockdowns and border closures and controversy over Covid tracking apps.

Algorithmic systems – which we define broadly as systems involving some form of computation – are often designed based on the experiences of their designers and tested on the world as it is now. Our considerations around the resilience of such systems are naturally shaped by what we know. But what happens to these algorithmic systems once deployed in the face of rapid environmental, social, economic, or cultural change? With climate change, extreme weather and greater variability inject considerable uncertainty into the environments we are designing for. With Covid-19, the social, cultural, and economic fabric of our world underwent severe disruption, leading to another kind of uncertainty around what societies were willing to do for the sake of health.

This workshop series explored algorithmic design for uncertain futures in three ways: (1) through the lens of social responsibility – as informed by the diversity of perspectives the EU, Australia and US apply to this concept when actualised (or neglected) through algorithmic systems; (2) through human-machine systems, which offer a simultaneous opportunity and challenge to explore human-machine assistance, collaboration or teaming as a possible path towards resilience; and (3) through a deep exploration of one domain – water operations – for which Australia is already taking the lead, given it is already experiencing more of those uncertain (climate) futures.

A cybernetic lens was deliberately encouraged in all three workshops. Cybernetics defies a single succinct definition by design (plurality being a cornerstone in some flavours of the field) but can loosely be described as the art and science of steering complex goal-seeking systems (Wiener, 2013). A cybernetic lens in this context involves looking at algorithmic systems as *systems*, with boundaries drawn such that their interconnections – marked by information flows, or other signs of relationships – with humans (and other life forms) and the environment are made explicit. Throughout the workshops, the system was presented as an important unit of analysis, the tracing of information flows and relationships shaping outcomes were encouraged, feedback loops connecting sensory input and actualised output were explored, and algorithmic systems were treated as far more than lines of computer code. Instead, we teased out a tentative ensemble of useful (transdisciplinary) boundaries, pursuing a teleological exploration of each complex goal-seeking algorithmic system in its full messy and sometimes hopelessly intertwined glory. There are humans and other living things, organisational cultures and structures, and ecological systems connecting to these systems,

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too. And those lines of code, those engineered sensors and actuators? They may capture our interest, but they are only part of the story.

We wanted to encourage participants to contribute freely, without needing to worry about their contributions being made publicly available following the event. This choice was deliberately made to help foster early transdisciplinary collaborations between communities that are working on these issues from different perspectives. We will therefore offer only high-level reflections on the three events. Following these, we provide some suggestions for formulating effective policy approaches for algorithmic system design in the face of likely uncertainty.

# Social Responsibility of Algorithms in a changing world 2022 – Online (June 2022)

This <u>workshop</u> was held virtually due to uncertainties around travel restrictions introduced by Covid-19. It was therefore an experiment in virtual participatory workshop design. With this in mind, we used a combination of media, accessible both offline and during the workshop, to bring richness to the event and help participants explore case studies relevant to the workshop theme from a range of different sectors and settings.

We also invited a series of keynote speakers to explore their work on algorithmic systems and social responsibility from a range of disciplinary and cultural perspectives. The keynote speakers included:

- <u>Doaa Abu-Elyounes</u> (UNESCO, Harvard, Ecole Normale Superieure) –
  The Role of Technology Assessment Tools in Ensuring that AI Benefits All
- Benedetta Brevini (University of Sydney)
  AI And the Climate Crisis: Rethinking the Relationship Between Artificial Intelligence and the Planet
- <u>Solon Barocas</u> (Cornell, Microsoft Research)
  <u>Unavoidable Tensions in Explaining Algorithmic Decisions</u>
- <u>David Ríos Insua</u> (ICMAT, Spanish Royal Academy of Sciences, Complutense University)
   <u>Views on the Security of Machine Learning Algorithms</u>
- Sihem Amer-Yahia (CNRS, Grenoble) Fairness on Online Labour Markets

Our keynote talks (accessible from our <u>program page</u>) provided a cross-disciplinary exploration of social responsibility in relationship to algorithmic systems from US, EU and Australian perspectives.

#### Pandemics and their (algorithmic) consequences

This case study session was created by Amir Asadi, Ned Cooper, Memunat Ibrahim, Lorenn Ruster, and Elizabeth Williams from the ANU School of Cybernetics. The <u>podcast episode</u> created for this session discussed the use of facial recognition systems in home quarantine applications, focusing on the South Australia home quarantine app. A diverse line-up of podcast guests shared their perspectives on how such systems – introduced in times of crisis – could lead to rapid change in how societies chose to use certain high-risk technologies.

In the workshop sessions, participants were encouraged to experiment with the Multi-Level Perspective – a framework designed to analyse historical cases of technology development – to explore future the challenges and opportunities events like Covid-19 could pose for technology development, use, and regulation.

#### The Great Barrier Reef

This case study was set in the Great Barrier Reef, and explored how technology use was shaping how the Australian Institute of Marine Science (AIMS) carried out its responsibilities for reef monitoring and management. The <u>podcast episode</u> made to accompany this session, featuring Lyndon Llewellyn from AIMS, explored the ways the organisation was trialling the use of machine learning and autonomous underwater technologies to improve its ability to monitor the Reef at scale. The challenges they were facing around the quality of the data they were collecting – how to maintain it, how to validate it, how to connect it to the decades of observational data they had already collected – were documented, as were the opportunities autonomous technologies were simultaneously presenting to them. Trust – human trust in data collected and processed using autonomous systems – was therefore a strong theme throughout the podcast episode and workshop.

In the workshop session, designed by Lyndon Llewellyn (AIMS), Melanie Olsen (AIMS), Scott Bainbridge (AIMS), Hannah Feldman (ANU), and Elizabeth Williams (ANU), <u>Instant</u> <u>Archetypes: Tarot for a New Normal</u> by SuperFlux was used to help participants consider the future of the Reef and the algorithmic systems used to document and shape it in light of climate change.

#### Bushfires and disaster management

In this session, created by Felicity Millman (ANU), Zena Assaad (ANU), Jean-Baptiste Filippi (Université de Corse Pascal Paoli), workshop participants were presented with a series of realistic emergent scenarios inspired by events that had happened during the 2019/2020 Australian bushfires. They used the 'Millman Map' – a tool designed and developed by workshop facilitator Felicity Millman – to explore threats and opportunities emerging from interactions between various actors (broadly defined) involved in the emergent scenarios.

#### Digital agriculture

For this session, designed by Joseph Guillaume (ANU), Hannah Feldman (ANU), Nicolas Paget (CIRAD), and Katherine Daniell (ANU), participants began their exploration of digital agriculture with a <u>podcast episode</u> focusing on the future of water irrigation at scale, through the eyes of Sam Yenamandra from Murrumbidgee Irrigation Ltd. In many respects, Australia has been having to design for considerable uncertainty in its water management systems for some time, and therefore represents a glimpse at what that future could look like, and how the choices we make in technology design can shape water and land use at scale. In the workshop session accompanying this episode, participants contributed their own expertise and individual experience to a map of future possibilities and challenges for digital agriculture. They were encouraged to identify how their own work could help shape digital agriculture futures.

#### Financial wellbeing

This session, created by Anna Leontjeva (CBA), Luiz Pizzato (CBA), Ben Grauer (CBA), Erika Ly (ANU), Elizabeth Williams (ANU), Ben Swift (ANU), Hannah Simpson (ANU), Adrian Schmidt (ANU), Vikas Sharma (ANU), Kim Blackmore (ANU), and Brenda Martin (ANU), started with a <u>podcast episode</u> exploring how algorithmic systems had shaped financial systems in the past, and how they are currently shaping our futures through a conversation with Dan Jermyn from Commonwealth Bank. We explored the responsibilities banks have in assisting customers and providing support in times of crisis, and looked at some of the ways CommBank was using algorithmic systems to scale their support to

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customers in regions experiencing crises. In the workshop session, participants came together to collaboratively propose ways to create more resilient banking systems, with safety, responsibility and sustainability in mind.

#### Other media and presentations

In addition to the case study sessions and keynotes, we produced four additional podcast episodes supporting the workshop, including:

- An <u>episode</u> on the history of the Social Responsibility of Algorithms workshop series with series creators and co-organisers Alexis Tsoukiás (CNRS LAMSADE) and Fred Roberts (DIMACS, Rutgers University), exploring what social responsibility means in relation to algorithmic systems and why transdisciplinary or cross-disciplinary work is so important for shaping our algorithmic futures.
- An <u>episode</u> exploring public trust and accountability in algorithmic systems, featuring Pia Andrews.
- An <u>episode</u> exploring artificial intelligence policy approaches in Australia and the European Union.
- An <u>episode</u> recapping the SRA22 workshop, discussing lessons learned and possible futures.

We also had an early career researcher track during the workshop, which provided opportunities for researchers around the world to share work relating to the workshop theme. All presentations we have permission to make public are available from the <u>workshop</u> webpage.

**Human-Machine Collaboration in a changing world 2022** – Paris, France and online (December 2022)

This <u>workshop</u> was designed to explore human-machine collaboration (broadly defined), with a focus on designing for safety, responsibility and sustainability at scale. We deliberately brought together cross-disciplinary researchers interested in (1) fairness, accountability, transparency and ethics in algorithmic systems, and (2) human-robot interaction for this workshop as a means of connecting two communities exploring some of the same challenges and opportunities from different angles. We also chose to incorporate an artistic theme – and two interactive art demo sessions curated by Samuel Bianchini (École des Arts Décoratifs – PSL University) and Damith Herath (University of Canberra) – to the workshop as a means of injecting a creative approach to designing for uncertain futures into the proceedings. Artists and artworks featured included:

- James Auger Real Prediction Machines
- Fabien Zocco Spider and I
- Raphaëlle Kerbrat Bug Antenna
- Melanie Lane and Damith Herath Judy
- Patrick Tresset RNP-S Sketching study
- Sarah Fdili Alaoui and Léa Paymal Physicalizing Loops Scores
- Hugo Scurto The Co-Explorer
- Yosra Mojtahedi L'érosarbénus and Sexus Fleurus

In-person participants were invited to interact with the artists and the artwork and were encouraged to ask questions about how artistic works like this could be used to explore the challenges and opportunities human-machine collaboration could present in uncertain environments and futures.

Keynote talks were given by:

- Alex Zafiroglu (ANU School of Cybernetics) Hard Yards and Malleable Motions: realising cobotics
- Anna Ma-Wyatt (University of Adelaide, IRL CROSSING) Human machine collaboration: new challenges and new opportunities
- Primavera De Fillipi (CNRS, Harvard, European University Institute) Plantoid, a new blockchain-based lifeform
- Guy Hoffman (Cornell University) From Human-Robot Collaboration to Human-Robot Conflict
- Ken Goldberg and Ryan Hoque (University of California, Berkeley) Robots and the Return to Collaborative Intelligence

Together, they explored the workshop themes from a range of Australian, European Union, and US perspectives.

There was a <u>panel discussing responsibility</u> in human-machine collaboration, chaired by Lorenn Ruster (ANU School of Cybernetics) and featuring panellists Caitlin Bentley (Kings College London), Keoni Mahelona (Te Hiku Media, New Zealand), Dylan Cawthorne (U Southern Denmark), and Jurriaan van Diggelen (TNO). There was also a panel investigating safety in human-machine collaboration, chaired by Elizabeth Williams (ANU School of Cybernetics) and featuring Myriam Merad (CNRS LAMSADE), Nicolas Paget (CIRAD), Zena Assaad (ANU School of Engineering), Simon McKenzie (Griffith University), and William Lawless (Paine College).

<u>Additional contributions</u> – documented on our workshop program page – were given by researchers from around the world, and came in the form of panels, short talks, and lightning talks.

The workshop ended with a <u>session</u> exploring the role of human-machine collaboration in climate adaptation, led by Delia Pembrey (International Society for the Systems Sciences), Alexis Tsoukiás (CNRS LAMSADE), and Fred Roberts (DIMACS).

All presentations we have permission to make public are available from the <u>workshop</u> webpage.

Water Operations for Uncertain Futures 2023, Canberra, Australia (June 2023)

The final workshop in the Algorithmic Futures Policy Lab series was an interdisciplinary, futures-focused workshop designed to bring together researchers, government employees, and industry professionals for three days of discussion and networking. Participants from Australia and overseas attended.

The first day consisted of a panel comprised of domestic and international members who pondered the question, "What water operations future could we build together?" The panel was moderated by Katherine Daniell (ANU) and included David Kennewell (Hydrata), Karen Hutchinson (Murrumbidgee Irrigation LTD), Nícola Ulibarrí (UC Irvine), Julie Quinn (U Virginia) and Jazmin Zatarain Salazar (Delft U). This was followed by an evening networking event. The main workshop day centred around several concept pitches that were explored using the Open Space Workshop concept. Developed concepts were tested for practicality in a simulation session facilitated by an international guest. The workshop concluded with a debrief, ensuring that every participant left with knowledge about all the pitches. Many great points were raised by the groups including either change legislation or work-around legislation to enable innovation, changing policy after a crisis, the need to account for different water literacy between involved groups and the importance of monitoring, allowing for adaption.



**WOUF23 Day 1 Panel:** From left, Katherine Daniell (ANU), Karen Hutchinson (Murrumbidgee Irrigation LTD), David Kennewell (Hydrata), Jazmin Zatarain Salazar (Delft U), Nícola Ulibarrí (UC Irvine), Julie Quinn (U Virginia)

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WOUF23 Day 2: Participants discussing concept pitches

On the final day of the workshop, participants visited the Snowy Hydro headquarters in Cooma. The morning was spent at the Discovery Centre, followed by a guided tour of the control room and a talk by a Snowy Hydro water operations employee. Participants asked a broad range of questions on topics including water resources, the electricity market, cyber security, and more.

#### **Reflections on the workshop series**

The workshop series explored algorithmic system design for uncertain futures from transdisciplinary perspectives and was in itself an evolution of changing times and uncertain circumstances. What began with bushfires and smoke evolved with pandemics, border closures, and the consequential shift in our collective willingness to travel. Through necessity, we learned how to hold international workshops involving <u>participatory</u> <u>collaboration</u> across many time zones and using a range of different interactive media. We also learned how to bring diverse communities together and foster interaction and collaboration using art, and explored how to apply a cybernetic systems lens to considerations around safety, responsibility and sustainability in an incredibly diverse range of algorithmic systems.

We leave you with three key policy recommendations stemming from our experience running these three workshops:

- Policy must be shaped through effective collaboration between technology designers, regulators / policy makers, transdisciplinary scholars working on algorithmic systems, and communities that will directly or indirectly be impacted by the technologies in question;
- Policy applicable to algorithmic systems must be designed to account for increasing uncertainty and interconnections between environmental, social, and technological systems that shape our world; and
- Creating opportunities to carefully facilitate conversations and collaborations between experts with diverse perspectives, world views, experiences, and cultures on these matters is crucial for fostering resilience in the algorithmic systems we design – not just for now, but for our future.

# **Further reading**

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### Acknowledgements

We would like to acknowledge all the organisers and institutions that provided support for this workshop series.

SRA22 was a collaboration between <u>ANU Centre for European Studies</u>, <u>ANU School of</u> <u>Cybernetics</u>, <u>ANU Fenner School of Environment and Society</u>, <u>DIMACS at Rutgers</u> <u>University</u>, and <u>CNRS LAMSADE</u>. It was organised by Katherine Daniell (ANU), Joseph Guillaume (ANU), Fred Roberts (DIMACS, Rutgers University), Alexis Tsoukiás (CNRS LAMSADE), Elizabeth Williams (ANU), and Kathy Reid (ANU).

HMC22 was a collaboration between organised by <u>ANU Centre for European Studies</u>, <u>ANU</u> <u>School of Cybernetics</u>, <u>ANU Fenner School of Environment and Society</u>, <u>DIMACS at</u> <u>Rutgers University</u>, <u>CNRS LAMSADE</u>, <u>University of Canberra</u>, and <u>École Nationale</u> <u>Supérieure des Arts Décoratifs</u>. Katherine Daniell (ANU), Joseph Guillaume (ANU), Damith Herath (University of Canberra), Fred Roberts (DIMACS, Rutgers), Alexis Tsoukiás (CNRS LAMSADE), Elizabeth Williams (ANU), Xuanying Zhu (ANU), Sarra Tajouri (Université Paris Dauphine-PSL, CNRS LAMSADE), Nicolas Fayard (Université Paris Dauphine-PSL, CNRS LAMSADE), Lorenn Ruster (ANU), Myrna Kennedy (ANU), Kathy Reid (ANU), and Samuel Bianchini (EnsADLab).

WOUF23 was co-organized by the <u>Institute for Water Futures</u> at The Australian National University as part of the Water on the Horizon series and by <u>One Basin CRC</u>, in support of productive, resilient, and sustainable irrigation regions. Workshop organisers included Joseph Guillaume (ANU), Natasha Harvey (ANU), Emma Richardson (ANU), and Katherine Daniell (ANU). Support from Kasia Williams and Anne McNaughton of the <u>ANU Centre for European</u> <u>Studies</u> for the Algorithmic Futures Policy Lab project is gratefully acknowledged.

Finally, we would like to acknowledge all the workshop participants, who generously shared their time and expertise during the workshop events.

This workshop series was made possible with the support of the Erasmus+ Programme of the European Union.

# **Disclaimers:**

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With the support of the Erasmus+ Programme of the European Union



# Algorithmic Futures Policy Lab

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