

2025 Royal Society of New South Wales and Learned Academies Forum: “AI: The Hope and the Hype”

Thursday, 6 November 2025
Government House, Sydney

Her Excellency the Honourable Margaret Beazley AC KC, Governor of New South Wales

Emeritus Professor Christina Slade FRSA FRSN, President, Royal Society of NSW

The Honourable Victor Dominello, Director of the UNSW–UTS Trustworthy Digital Society Hub,
Future Government Institute

Professor Sally Cripps, UTS, Forum Program Chair

Professor Pascal Van Hentenryck, A. Russell Chandler III Chair, Georgia Institute of Technology

Opening Addresses

Her Excellency the Honourable Margaret Beazley AC KC

Bujari gamarruwa

Diyn Babana Gamarada Gadigal Ngura

Good morning, distinguished guests, Fellows of the Royal Society of New South Wales, representatives of Australia’s Learned Academies, leaders from government, industry and research, and all joining us in person and by livestream.

I pay my respects to the Traditional Owners of the lands on which we meet — the Gadigal of the Eora Nation — and to Elders past, present, and emerging. I extend that respect to all Aboriginal and Torres Strait Islander peoples with us and acknowledge the particular relevance of the topic of today’s discussions to First Nations peoples, their culture and intellectual property.¹

It is my great pleasure to welcome you to the 2025 Royal Society of New South Wales and the Learned Academies Forum and its topical subject: “AI: The Hope and the Hype.”

May I begin by acknowledging:

- Emeritus Professor Christina Slade, President of the Royal Society of New South Wales and Chair of this Forum.
- The Honourable Victor Dominello, Director of the UNSW–UTS Trustworthy Digital Society Hub, and former NSW Minister for Customer Service and Digital Government.
- Professor Pascal Van Hentenryck, A. Russell Chandler III Chair and Professor at the Georgia Institute of Technology; and
- Professor Hugh Durrant-Whyte, Chief Scientist and Engineer of New South Wales.

Each of these distinguished leaders — representing the fields of philosophy, civic leadership, science and engineering — presents a vital dimension to today’s discussion. I also acknowledge the generous support of the many bodies that have contributed to this Forum.

¹ <https://www.abc.net.au/news/2025-08-23/calls-to-protect-indigenous-intellectual-property-from-ai-culture/105680182>

How does one define AI?

As AI evolves at an unprecedented pace, the definition itself continues to evolve. Indeed, in recent years, the Organisation for Economic Co-operation and Development (OECD) has struggled to reach consensus on a definition, acknowledging that “There is no clear red line but a continuum of features characterising what we think of artificial intelligence and where the ‘magic’ happens.”²

Its current (2023) definition, a definition which the Australian Government’s Digital Transformation Agency also employs,³ is that it is “a machine-based system that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments. (It notes that) different AI systems vary in their levels of autonomy and adaptiveness after deployment.”⁴

AI’s applicability and transformative potential in a seemingly endless range of environments — from governance to science and engineering, medical research,

law, education, health and the public and community sectors — is matched by extraordinary commercial investment. McKinsey forecasts an astonishing \$7 trillion US in global AI investment over the next 5 years.⁵ It has fuelled expectations of governments, with the Australian Government’s Productivity Commission forecasting growth of \$116 billion in gains over the next decade and a 4.3 percentage-point boost in labour productivity.⁶ It has also fuelled an industry of new AI scholarship with an incredible 403,897 books, journals and papers published worldwide in 2023.⁷

A quick old-school Google search of the range of recent media articles about AI — noting that AI relies on patterns, and thus historical rather than current data,⁸ “threw up” some arresting headlines:

- Australia’s culture of AI-powered innovation⁹
- How AI falsely named an innocent journalist as a notorious child murderer¹⁰
- The Sydney hospital using AI to improve diagnoses under pressure¹¹

² <https://oecd.ai/en/wonk/definition>

³ <https://architecture.digital.gov.au/domain/ai>

⁴ <https://oecd.ai/en/wonk/definition>

⁵ Forum summary: <https://www.royalsoc.org.au/events/rsnsw-and-learned-academies-forum-2025/>

⁶ *ibid*

⁷ <https://ourworldindata.org/grapher/annual-scholarly-publications-on-artificial-intelligence?tab=discrete-bar&time=latest>

⁸ “Artificial intelligence is often hailed as the technology of the future. Yet it primarily relies on historical data, reproducing old patterns instead of fostering progress” — Alexander von Humboldt: Institut für Internet und Gesellschaft: <https://www.hiig.de/en/why-ai-is-currently-mainly-predicting-the-past/>

⁹ <https://www.afr.com/technology/australia-s-culture-of-ai-powered-innovation-20251015-p5n20l>

¹⁰ <https://www.smh.com.au/national/how-google-ai-falsely-named-an-innocent-journalist-as-a-notorious-child-murderer-20251024-p5n52d.html>

¹¹ <https://www.smh.com.au/national/nsw/the-sydney-hospital-using-ai-to-improve-diagnoses-under-pressure-20251010-p5n1jp.html>

- Big Tech deploys Orwellian doublespeak to mask its democratic corrosion¹²
 - AI can help the environment, even though it uses tremendous energy¹³
 - Tech billionaires seem to be doom prepping. Should we all be worried?¹⁴
- And this last:

- “Over 50 Percent of the Internet Is Now AI Slop, New Data Finds” ... with the intriguing subtitle: “Humans aren’t finished ... (pause) yet.”¹⁵

All of which led another editorial to lead with a lament:

- Can we just have one day when no one mentions AI?¹⁶

It then went on to quote a recent Gallup poll in the US which showed that 49% of people think AI is just another tech advance that will improve our lives and 49% think it will harm humans and society.¹⁷

Australians are less inclined to sit on the digital fence: a snap Roy Morgan SMS survey of 18000 Australians in early October revealed that 65% of us believe that “artificial intelligence (AI) creates more problems

than it solves” compared to 35% who believe it “solves more problems than it creates.”¹⁸

On any measure, Artificial Intelligence can be a polarising topic. It has entered our public discourse not only as a technological innovation, but as a social force — one that promises to reshape the way we learn, work, govern, create and even imagine what it means to be human. Indeed, we should remember Alan Turing who, way back in 1950, pressed the question: “Can machines think?”¹⁹

On one hand, we hear of AI’s capacity to help solve some of our greatest challenges — climate change, diseases and medical conditions, resource scarcity. On the other, we are reminded that technology has often outpaced regulation, and that many promises may remain — at least in the near term — unfulfilled.

This duality — the hope and the hype — underscores the tension that societies around the world now grapple with how to harness AI’s enormous potential while guarding against its risks. The question arises: who is leading whom in intelligence? Who imagines the future?

12 <https://www.theguardian.com/commentisfree/2025/oct/15/big-tech-deploys-orwellian-doublespeak-ai-deployment>

13 <https://abcnews.go.com/Technology/wireStory/ai-environment-tremendous-energy-5-ways-126751869>

14 <https://www.bbc.com/news/articles/cly178345240>

15 <https://futurism.com/artificial-intelligence/over-50-percent-internet-ai-slop>

16 <https://www.afr.com/technology/can-we-just-have-one-day-when-no-one-mentions-ai-20250811-p5mlvs>

17 *ibid*; Drilling down into that Gallup poll result: <https://news.gallup.com/poll/692435/major-threat-next-tech-thing.aspx>

18 <https://www.roymorgan.com/findings/10048-ai-press-release-october-2025>

19 CSIRO: *Artificial Intelligence for Science, Adoption Trends and future development pathways*: November 2022: <https://www.csiro.au/en/research/technology-space/ai/Artificial-Intelligence-for-Science-report>

“One of the pivotal papers in AI was written by Alan Turing and published in October 1950. This paper opens with the words ‘I propose to consider the question, can machines think?’. It lays out the future challenges for AI to solve. Turing’s question is still being asked but remains unanswered.” — Turing A (1950) *Computing machinery and intelligence in Mind — A quarterly review of psychology and philosophy* 59(236): 433–460.

Even more importantly: who has the power and where is the equity? noting that: “AI algorithms need big datasets to learn from, but several cultures and groups of the human population are absent or misrepresented in existing datasets.”

As a paper published by the now insecurely-funded US National Library of Medicine has pointed out: “AI is thus prone to reinforcing bias which can lead to poor or fatal outcomes”²⁰ — or entrenching disadvantage.²¹ All of this has led the European Union to legislate the EU AI Act — the first comprehensive regulation on AI by a major regulator anywhere.²²

Over the course of today’s sessions — AI and the Law; in Communities; in Health; AI in Practice and AI Research & Future Directions — we will probe precisely these tensions. Let us hold in mind a few guiding principles:

- Use evidence over assertion. Let claims about AI’s power be backed by data, by peer review, by real-world trials and critical evaluation.
- Prioritise ethics, justice, and human rights. Technological possibility must be tethered to human values: fairness, transparency, accountability, inclusivity.
- Factor in governance and oversight. Institutions — governmental, academic,

civil society — must evolve to keep pace, balancing innovation with precaution.

- Reflect on interdisciplinarity and humility. No discipline has all the answers alone. We need collaboration across law, technology, the social sciences, medicine, and beyond.
- The need for continuous assessment and adaptation of our legal, regulatory, educational frameworks.

AI is a shared responsibility and Forums such as this are essential. They bring together the broad spectrum of expertise needed to ensure that our collective intelligence keeps pace with our artificial one. As more than one academic has pointed out: “We are still in the early stages of this history, and much of what will become possible is yet to come.”²³

The Royal Society of New South Wales — the oldest learned society in the Southern Hemisphere — has always stood for rigorous, open, cross-disciplinary dialogue. That tradition is alive today in this gathering of scientists, policymakers, ethicists, and industry leaders.

It is, therefore, with great pleasure that I declare open the 2025 Forum of the Royal Society of New South Wales and the Learned Academies’ “AI: The Hope and the Hype.” Thank you.

20 Natalia Norori et al: ‘Addressing bias in big data and AI for health care: A call for open science: National Library of Medicine (USA)’; <https://pmc.ncbi.nlm.nih.gov/articles/PMC8515002/>

21 “Artificial intelligence is often hailed as the technology of the future. Yet it primarily relies on historical data, reproducing old patterns instead of fostering progress”: Alexander von Humboldt: Institut für Internet und Gesellschaft: <https://www.hiig.de/en/why-ai-is-currently-mainly-predicting-the-past/>

22 (2023) <https://artificialintelligenceact.eu/>

23 <https://ourworldindata.org/brief-history-of-ai>. Also, the view of the University of Sydney’s Dr Rob Nicholls: “Dr Nicholls still believes the industry is 20 or 30 years off truly mimicking humans, and that AI as it currently stands is immense data systems that are very good at predicting trends and patterns.” <https://www.abc.net.au/news/2025-09-22/is-ai-the-fourth-industrial-revolution/105790912>

Christina Slade, President, Royal Society of NSW

Thank you, Your Excellency. A characteristically broad ranging and wise talk. I should say that I have now heard Her Excellency talk on many, many different issues, and she brings scholarship and wisdom to us. And I think those principles are ones that are really worth our while thinking about more seriously.

It's my great honour to be the president of the Royal Society of New South Wales. I acknowledge the traditional owners of the land on which we meet: the Gadigal people of the Eora nation. I welcome you all to the Royal Society of New South Wales and Learned Academies' Forum, which is yet again being held most generously at the residence of our patron, Her Excellency. I thank the office of the Chief Scientist of New South Wales for supporting the Forum this year, not only financially, but actually personally.

So it's a great joy for me. This is the eleventh in the series which draws together the Royal Society, the Learned Academies, and members of civil society to debate issues of pressing importance. I should tell you that the last seven of these have been recorded and are available on our YouTube channel.²⁴

The forums are designed to cross disciplinary boundaries to allow a broadly based, informed and civil discussion on a theme. Our fellows and members come from across the academy, but from beyond the academy as well: government, business, professional startups. Last year, our topic was "Threats to Democracy," which was held in the very week of Trump's election to the presidency. And no doubt, many of us have noted an

election in the United States this week or yesterday.

This year we're equally topical: AI, the hope and the hype. It has been convened by the redoubtable Professor Sally Cripps, who not only brings her own enormous expertise, but her extended network of colleagues who are going to be speaking with us today. In fact, when we had this idea of artificial intelligence, we put together a committee to organise the event. And it was about two months in and a great deal of debate. And Sally said, "This is my area of expertise. Just leave it to me."

Now, I suspect she has regretted that very much, but it has been amazing. So I want to welcome you, the speakers, the Fellows and Members of the Royal Society of New South Wales and of the Learned Academies, Fellows of the Royal Society of Arts of London, and also some newcomers. We've worked very hard to have a new group here. I do hope that those of you who are new to the Society will consider becoming a Fellow or a Member.

I'm now turning to Sally Cripps, who's the convenor of today's forum. You'll see in your booklet the list of enormously long and impressive list of Sally's achievements. I wanted to say that one of the things that I think is most exciting about Sally's work is that she's working in a very highly technical area, enormously specialised, and yet she has managed to work across a whole range of issues looking for global impact. Her concerns and her interests are about global impact. So I'm delighted to introduce her as the chair of the forum.

²⁴ See <https://www.youtube.com/watch?v=HutO4CpRKaY?t=26> [Ed.]

Sally Cripps, Forum Program Chair

Thank you for those very kind words. It's really a pleasure to be here with you. As we've heard today from the Governor and from the President, we really are at a crossroads of grand hopes and rampant hype. We heard the Governor (who has also stolen some of my statistics, I was going to say) talk about the extraordinary investments that we have going on in AI. McKinsey, as was mentioned, forecasting a seven trillion in global investment. And in the last two months, NVIDIA has announced a hundred billion dollar investment in OpenAI. And also Google announced a \$15 billion investment in India in setting up an AI data centre. There is a huge amount of optimism. Australia has moved in line with this optimism. We have gone from being quite cautious about AI, to looking at it as a game changer for productivity.

And the UK has also shifted in this narrative, but I would like to offer a really cautionary note about this productivity gains: a recent article looked at 59 countries, and where those gains in productivity go.²⁵ And the more developed the country, the more likely those gains go to profits and not to wages. What that means is that income inequality — or just in general wealth inequality — is exacerbated or can be exacerbated by new technology such as AI. This is a real challenge for politicians to recognise and stop talking about it as if everybody is naturally going to share in it. Everybody could naturally share in it, but only with deliberate action on our part will that happen.

Economists have sounded a further warning: this may be less transformation than hype, with one arguing that's only about 1% of increase to global GP over the next decade.

Markets are wobbling and what we seek to do today is to explore this tension between the boundless excitement of hype and hope, which is, to my way of thinking, grounded optimism shaped by governance, ethics, and fairness. So as you see, I'm in front of you, but the AI panic is here. I don't think it's a panic, and I'm hoping today we'll draw that out by having a look at various aspects of AI. The first one is the Law, the second is Communities, the third is Medicine, then in Practice, and finally wrapping it up will be what the Future of Research is in AI. So these are the five things that we're going to be looking at today. And Christina said, I said, "Leave it to me." And actually what I did was ask some really remarkable people and left it to them.

The people you're going to hear talking today — the people who are on the panels — have all come together to do this. And I'm so forever grateful for all they're doing. I actually just picked up the phone and said, "Hey, what do you think?" And they ran with it. So I'm really grateful.

I did want to say just a couple of minutes about AI, because there's so much confusion. Today, we are going to be hearing about all sorts of AI. I'm not going to define AI, but I will give a taxonomy. So: first, Generative AI, I think of as that's what you'll all be familiar

25 Xiao A et al. (2024) Bridging the digital divide: the impact of technological innovation on income inequality and human interactions. *Humanit Soc Sci Commun* 11: 809. <https://doi.org/10.1057/s41599-024-03307-8>

with ChatGPT.²⁶ Fantastic at prediction so much so that it can write essays.

Generative AI — Prediction & Automation:

- Produces text, images, summaries;
- Useful for drafting, triage, translation;
- Risk: errors, hallucinations, misinformation;
- Policy relevance: needs transparency, human oversight.²⁷

And then, second, Probabilistic or Causal or inferential AI, which is really about understanding the world.²⁸

*Probabilistic & Causal AI —
Understanding Systems:*

- Models uncertainty;
- Causal AI identifies true drivers of outcomes;
- Supports targeted, equitable education, health, justice policy;
- Policy relevance: strengthens evidence-based decisions.

And the third type I would call: Adaptive AI, which is that which engages in systems and adaptively learns and changes as it goes along.²⁹

Adaptive AI — Continuous Learning:

- Continuously updates as new data arrives;
- Supports adaptive trials and real-time policy learning;
- Helps governments refine interventions safely;
- Policy relevance: enables responsive, iterative governance.

So they're just my framing. There are many others, but that's what we're going to hear about today.

I'm going to introduce our introductory speaker, Victor Dominello. Victor is a globally recognised leader in public transformation and digitalisation. He's listed as in the top 25 innovative government innovative leaders. Most of you here will remember Victor as NSW Minister for Customer Service. And most of you, I presume — at least the statistics tell me — 85% of us have done it. We have all got our driver's licence on our phones. This was all led by the wonderful Victor Dominello. So he's a superstar. And so without any further ado, I'll ask Victor to give the Introductory Talk.

²⁶ Examples of Generative AI apps include chatbots such as ChatGPT, Claude, CoPilot, DeepSeek, Google Gemini and Grok; text-to-image models such as Stable Diffusion, Flux, Midjourney, and DALL-E; and text-to-video models such as Veo, LTX and Sora. [Ed.]

²⁷ How dangerous is Gen AI? See Chayka K (2026) A.I. has a message problem of its own making. *New Yorker*, April 15, <https://www.newyorker.com/culture/infinite-scroll/ai-has-a-message-problem-of-its-own-making> [Ed.]

²⁸ GenAI is deterministic but Causal AI is probabilistic. GenAI looks probabilistic because it samples from probability distributions. But those distributions are hard-coded correlations in past data. Given the same prompt and weights, GenAI's behaviour is fully deterministic. Causal AI, on the other hand, starts with the admission that the world itself is uncertain. In a nutshell, GenAI predicts words; Causal AI predicts worlds. [Ed.]

²⁹ Adaptive AI is a form of AI that learns, adapts, and improves as it encounters changes, both in data and the environment. It lets organisations become more flexible, resilient, and effective when faced with complex challenges in daily operation. [Ed.]

The Honourable Victor Dominello, Director, UNSW–UTS Trustworthy Digital Society Hub;
Future Government Institute

Thank you very much, Sally. It's actually 87% with a 93.6% satisfaction score. Lost a couple of points between friends. Thank you, Excellency for that amazing introduction. Today, I'm glad you put the "and" — not the "or" — between the hope and the hype, but everyone talks about AI. I've been fortunate enough since leaving politics and government two and a half years ago to be all around the world, from the White House to Mongolia — even in places like Mongolia, they're talking about some of the things that we've done here in New South Wales, particularly through the Service NSW app, because what we did here in New South Wales through that service transformation was really Government 3.0. Now, I'll just walk you back. Everyone talks in every boardroom I go to, in every government department I talk to, they're all talking about AI. Everyone's talking about AI and the evolution of AI.

Where is it going? You got Grok 2, Chat 3, Claude 4, Gemini 5. And as Sally's identified, that's just one stream of AI. Everyone's talking about the various stages, as you do. We talk about the evolution of connectivity. Last decade was 2G and then 3G, now we're in 4 and 5G. Next decade it'll be 6G. There are stages, there are gates. No one is talking about the evolution of government because if you don't talk about the evolution of government, then government stays this rock type figure that becomes reactive rather than proactive. And in the age of AI, that's moving so fast, that is like oil and water. It's not going to mix. Governments have to evolve. They have to become more agile and have to move a bit faster, just a bit faster would help. If I could walk you

through the stages of government evolution and then maybe address where I think the hope and the hype is, and then sit down.

The stages of government: think about if you were to distil government, ultimately what's its interface with people, with the citizens, the customers it serves. Now, I say customers because it also provides services to refugees who are not citizens, to tourists who are not citizens, to businesses who are not citizens, to visa holders. So when it's dealing with or providing services to organisations, people, communities, how does it interface? It doesn't get a Ouija board out and say, "Hmm, I wonder what our client's wanting to do today." It normally interfaces through a form, right? If you want to receive a grant, if you want to receive a grant, you're going to have to fill out a form. Even if you have to pay money to tax, you've got to fill out a form. If you want a driver's licence, fill out a form. That's the interface. Up until 1990, we're Government 0.0. That's the paper form. That was the interface for many, many years before that.

In 1990, a big meteor hit the planet. It was called the Internet and it hit every government around the world. We went from paper form, Government 0.0, to web form, Government 1.0. So we're still communicating via forms, but now we also had a web form that we could do 24/7 when we're at the beach, but still in very siloed structures and still pretty much one-way traffic — the government basically requesting information. There wasn't much engagement. 15 years later, about 2005, another big meteor hit the planet. It was called the smartphone, social media. We went to the platform era, Government 2.0, and that means we've got

mobile apps and we're starting to have a bit more engagement with the customer. And now we're starting to hear a bit more noise around social media.

Well, they like these services, or they don't like those services, but still very siloed. Health does its piece, education does its piece, transport, police — they all do their thing. 15 years later, another big meteor hit the planet. It was called COVID, and then you bring in AI. COVID forced governments all around the world to go to "uniform." Think about it: in New South Wales alone, if we said to you, "We'll get you through COVID, but you're going to have to download a transport app for the border pass, you're going to have to download a police app for QR check-ins, you're going to have to download a health app for the vaccine certificate, you're going to have to download a finance app for your Dine and Discover vouchers, and then you're going to have to call each department if there's a problem on different numbers."

There is no way we would have got through it. "Uniform" doesn't mean it's one, but it means it's a unified experience. One major dominant app — the Service NSW app, one major website ... we started looking through that lens. That's Government 3.0, and that's what service is. It's the beginning of what that could look like. In another 15 years' time, 2035, another big meteor was going to hit the planet, and it's called AGI — however that's framed. It will be 6G. That's definitely going to come next decade. We are going to have a lot more robotics, humanoid robotics. It's going to be an augmented world. As Her Excellency said now, I can't even tell now who's real

and who's not. The level of augmentation in the next decade is going to be almost impossible to discern, but it's going to be a fundamentally different world.

We might even have the beginnings of quantum in some enterprise level. That is, that's going to be intelligent government. There's no such thing as intelligent government now. We might have smart departments, but there's no such thing as intelligent government because the left hand doesn't know what the right's doing. What we are finding is that with the private sector, they are moving rapidly into that G3, G4 environment. Governments have gone from G3, which was forced upon them by COVID, and most governments have now gone back to G2, which is siloed, because the Empire Strikes Back.

Ultimately, the source of power in government is around authority — the premier or the prime minister — and money, the treasurer. And things revolve around those two suns. There's no real third sun that represents the human, to make sure that we get that horizontal seamless experience rather than the silos. What the challenge for us is, particularly as we are talking about the hope and the hype of AI, is how do we get governments to evolve? Because I can guarantee you this: government is the elephant in the room. In every discussion you have, government is the elephant in that room. It could either be a good elephant and remove roadblocks, get rid of regulation and red tape, and let us move faster. Or it could be a slow elephant as most governments are, and just sit there and just slow things down. Or it could be a rampaging bad elephant such

as the Robodebt scheme³⁰ and like that it tramples all over us.

So how do we get government to move from bad to slow to good so that we can capture the hope of AI? I'll end on this note. There are so many things that we can unpack, and I'm sure a lot of the great speakers after me will go through that. But this is the reality. This is the hype. I had my brain MRI'd recently, my beloved mum's got dementia. As a result, I've now taken on a role of trying to promote brain health. So I thought I'd go and get an MRI. Spoke to the neurosurgeon, and he's using AI now to slice my brain into a thousand pieces and find dots that probably wouldn't have been seen before. Good bill of health so far, so that's great. But it's just extraordinary listening to these doctors and researchers about how powerful this will be.

This will literally be a tool to profoundly reduce suffering. We will have modern tech miracles. The blind will see. The deaf will hear. The lame will walk with brain-computer interfaces and everything else that's coming on board. I went to a neu-

rotech conference the other day and they were talking about neural dust. Forget brain computer interfaces, neural dust. The world is going to change so fast. But this is the hype. What happens if all that power, all that control becomes centralised, then all of a sudden we're in a bad, bad place? Her Excellency was referencing a book about autocracies. We could have corporate autocracies, because autocracies are just about power. And power in the 21st century, as it has always been really, is about data who controls your data. So that's another lens that we should probably think about in the Hope and Hype era.

There is so much hope and it will be realised hope. But equally, there's a lot of hype in terms of: it may not go where we'd like it to be, but hype in a negative sense. If we don't get it right, it will be very, very bad.

Thank you. Your Excellency: it's been so wonderful to see you again. And thank you for the invitation and to another superstar. Sally, you're amazing. Thank you very much. Cheers.

Sally Cripps, Forum Program Chair

Thanks, Victor. We need to work that superstar bit out so that we can sort of tag. I was going to call another superstar, but before I call him a superstar, I just need to tell you a bit about him. Our next speaker is Professor Pascal Van Hentenryck. Pascal is the real deal when it comes to AI. He runs the NSF-funded AI Research Institute for Advances

in Optimization. And they're looking at such a range of problems, from energy, the environment, and health, to supply chains. He really is across it all. And I know he's going to give us a lovely talk about what he believes AI is and what he has done in that area. I don't want to take up any more time and welcome another superstar.

³⁰ See https://en.wikipedia.org/wiki/Robodebt_scheme [Ed.]

Keynote

AI: The Hype and the Hope

Pascal Van Hentenryck

Director, NSF AI Institute for Advances in Optimization
Georgia Institute of Technology

Thank you, Sally. And good morning, everyone. I still feel like a little kid from Belgium. That's where I come from. It's going to be very difficult to follow Her Excellency and Victor and Sally, but I'll try to do it as best I can. I'm the director of one of the national AI institutes in the United States.³¹ We do use Inspire research. And a lot of the things that I will tell you in the second part of the presentation is going to be about what we do in the institute for actually trying to make a difference using AI. First, I'd like to thank you for the invitation. It's very humbling and I'm deeply honoured to be here today and trying to talk to you.

When I talk about AI, I like to give some context. In 1966, Joseph Weizenbaum, a professor at MIT, wrote the first chatbot, Eliza,³² a chatbot mimicking a therapist.³³ It was so compelling that people using the chatbot actually revealed deep secrets about their private lives. He wrote an entire book that I was forced to read when I was

an undergraduate in part of a philosophy class.³⁴ But it actually got me interested in AI. But this is telling you that this is not a new area. We actually have been looking at AI for more than 60 years. I was part of the first AI summer when expert systems were really the hot topic, and that was a big bubble that burst. And then we entered a very, very long winter. But typically in the winter, you do a lot of good works.

So that's where we invented most of the technologies which are the foundation of AI these days. And that's where people at AT&T Labs — Bell Labs at the time — invented convolutional neural networks, which are the core of what is basically used in computer vision.³⁵ Statistical natural-language processing — you can think of it as the core of ChatGPT these days — was invented at the time.³⁶ This was a very big move from grammar-based natural-language processing to statistical natural-language processing. The core of robotics was invented at that

31 The AI Institute for Advances in Optimization (AI4OPT) <https://www.ai4opt.org/about/about-ai4opt> [Ed.]

32 Named after Eliza Doolittle in Shaw's "Pygmalion." [Ed.]

33 Weizenbaum J (1966) ELIZA — a computer program for the study of natural language communication between man and machine. *Com. of the ACM* 9: 36–45 <https://doi.org/10.1145/365153.365168>.

34 Weizenbaum J (1976) *Computer Power and Human Reason: From Judgment To Calculation*. San Francisco: WH Freeman.

35 See Hubel DH and Wiesel TN (1968) Receptive fields and functional architecture of monkey striate cortex. *The Journal of Physiology* 195(1): 215–243. DOI: 10.1113/jphysiol.1968.sp008455 [Ed.]

36 See Charniak E (1993) *Statistical Language Learning*. Camb.: MIT Press.

time here in Australia. And other technologies like constraint programming³⁷ as well, which are very trendy now in manufacturing, were also invented at that time. So we are in the middle of a very hot summer for AI right now. And I want to tell you what actually changed because there are three things that were really important in actually bringing AI where it is today.

The first one is data. It's the web, the point that we have access to a very, very large amount, a massive amount of the data that have been produced by humans for many, many years. This was not the case before.

The second thing that I'm sure you are all aware about is our GPUs. Now, I heard about GPUs in 1995 because they were used in computer graphics for actually doing video games and so on. But in a sense, the mathematics behind computer graphics and the mathematics behind AI is actually the same. They are the same concept. And this is why GPUs now are so useful for AI technologies.

The third thing that people typically forget is the democratisation of the tools. Big tech — Meta, Google, and so on — were actually very, very good at releasing software that made the technology accessible to a very wide range of the public, a large number of scientists. They were able to build the new machine-learning models and the new tools that AI is relying upon these days. This has made a huge difference for the field.

This is an example of what happened in 2010. People at Stanford started building

this massive amount of data, concerning images. It's called ImageNet.³⁸ It was at the time a very, very large data set of images. What happened is the computer vision system got better and better. In 2015, they started beating humans in actually classifying images.³⁹ So this progress in having this data set, and then the GPUs, made the big difference in computer vision, and they started to be used for actually diagnosing cancer,⁴⁰ for recognising the faces of people when you board a plane and things like this.

At the same time, researchers on recurrent neural networks made a lot of progress as well. This is what was at the core of Apple's Siri and Amazon's Alexa. It's all about recognising speech, recognising language. Bloomberg said that this was the main commercial outcome of AI technology up to that point. This is natural-language processing. This is the technology at the core of ChatGPT these days. It relies on predicting the next word when you see a sentence, and so the next set of words. Google made a big, big contribution to that in around 2018 when they introduced the transformers technologies. This is what is used in ChatGPT. It's all about predicting the next word. It's a statistical machine, and I'll come back to that when I talk about hallucinations and so on. And, of course, we got Waymo. If you go to San Francisco, you can take a trip on Waymo. If you go to Atlanta or Phoenix, you can get trips to move from one point to another using this technology, which once

37 See Rossi F, van Beek P and Walsh T (2006) *Handbook of Constraint Programming*. Elsevier.

38 See <https://www.image-net.org/index.php> [Ed.]

39 See Markoff J (2015) A learning advance in artificial intelligence rivals human abilities. *New York Times*, 10 December. [Ed.]

40 O'Connor M (2019) AI may help radiologists reduce missed breast cancer cases, June 18, *Radiology Business*. <https://radiologybusiness.com/topics/artificial-intelligence/ai-radiologists-reduce-missed-breast-cancer-cases>

again was invented in the late '80s and beginning of the '90s.

Obviously, when people talk about AI these days, they talk about generative AI, the large language models (LLMs).⁴¹ I won't talk too much about them, but I have already mentioned some other things. I'll tell you what they are good at in a moment. The big thing happened when OpenAI actually released ChatGPT, which changed the perception of AI and made AI come to public awareness. Obviously, we knew about that technology. I don't think any academic would have released that technology. I didn't think big corporations would have released that technology, but somehow it got released. One of the things that people have been building now — and this is going to be the future in a sense — is chatbots based on large language models. And one of the things that they try to do is understand the intention of the speaker.

That's the difference between using a search engine and using a chatbot these days. They try to understand what you are trying to do. And they act — this is not a single tool, this is something they're trying to see, "Oh, you are trying to do this. I'm going to use that tool." They can do content generation, as I mentioned before. They can do summarisation, they can do query answering. They also try to maintain conversations such that they understand what you are trying to achieve. And so this is kind of what the state of the art is in some of these technologies.

2025 is supposed to be the year of agentic AI.⁴² Victor actually talked about AI for government. This is one of the promises of

agentic AI. What agentic AI is, if I summarise it, is automated workflows. When we look at big corporations, including universities, we are really working at a very low level. Where is the data? How do I access this database? The promise of agentic AI is that we are actually looking at what people are trying to achieve, and are trying to build tools so that that process is automated. People are supported who are actually implementing these workflows. So this is one of the big, big promises. It's not yet realised. A lot of companies are trying to make it happen, but it's not as easy as people believed because we humans know a lot about the processes that we have automated and we need to bring that knowledge inside the AI system.

So this is some of the hype that you see. We won't need any programmers in the next 10 years. I did something really bold this year. I told my students they have projects that they have to implement using programming languages and so on. I told them, "You can use any tool that you want." This was forbidden the previous year. And you know what? The grades didn't change. They are the same because the fundamentals are not going to change. You still need to understand what you are doing when you are actually using AI.

What about doctors? Are we going to need doctors? My daughter is a pediatrician in intensive care. She came to me about six months ago saying she never wanted to know about computer science. She thought I was working too hard. And six months ago, she called me and said, "Daddy, I want to learn about AI because I need to diagnose these kids and the doctors don't have

41 See <https://www.esafety.gov.au/industry/tech-trends-and-challenges/generative-ai>.

42 See <https://www.ibm.com/think/topics/agentic-ai> [Ed.]

enough information.” I’ll talk about some of the tools later on, but we still need doctors, but we need better tools for them. It was predicted 10 years ago that they would not be a radiologist and that we would have autonomous diagnoses everywhere. As far as I know, all the radiologists are still commuting to work and looking at X-rays and MRIs at this point. They will replace lawyers. We’ll talk about the law. I can tell you that I don’t think they’re going to disappear, but they are going to be much more productive.

And then teachers will replace teachers. Again, I think education is going to change fundamentally, but we’ll still need teachers. So the role of generative AI is going to be a productivity tool. It’s going to improve productivities.

“AI won’t replace humans, but humans using AI will.” This is a quote I like, and I’ll come back at the end of this talk to tell you what I think the future is going to be, but this is part of the future. The people using AI are going to be much better than the people not using AI. This is going to be a tool that essentially everybody should use. When you talk about generative AI, it is a hallucination machine. Hallucination is not necessarily bad. As a scientist, I have to hallucinate. That’s part of my job. But the public has to understand about the concept of hallucination, what these technologies are actually doing such that they can use them properly.

So AI at the edge is going to make a big difference. It’s going to change the way we educate. It’s going to change education. It’s going to change the way we learn. It’s going to change the way we access knowledge. Some people expressed doubts earlier about

knowledge, and I think this is a big concern, but our relationship with knowledge is going to change. It’s going to change the way we communicate. This is also something that we need to take care of. And it’s also going to change the way every profession is going to operate.

It’s also going to change the way we think about us being humans compared to machines. We can talk about that a lot. This is where I think there are a lot of dangers. A lot of people anthropomorphise AI based what the technology can do now. But I can tell you that the technology is very, very far from actually being human. I think these conversations sometimes are somewhat dangerous because we are much more than an electrical system. We are also biological machines, chemical machines and so on. It’s very interesting when you look at popular books like science fiction books.⁴³ They all talk about consciousness and things like this. So if you read this book, this is actually pretty interesting.

I’m also doing the national AI strategy for the country of Panama. And I want to touch upon some of the issues that you mentioned because of all these dangers: how the technology is going to affect knowledge, understanding how we communicate. I think you need regulation. What we do for the country of Panama is telling them how they can actually boost their economy, where they have to invest in AI. But we also want to give them a governance framework: how to make the government much more responsive, how to make sure that you have the sandboxes that you can experiment in, and so on. So governance and equity are super important. In Panama,

⁴³ Such as Dan Brown’s *The Secret of Secrets*.

you have a very modern city and very rural areas. We have to make sure that whatever we propose to them will boost equity. We are going to boost every segment of the population.

Let me talk about the hope now. This is going to be very different from what you hear about AI. This is what we are doing in the AI Institute that I'm leading. In a sense, this is the road less travelled. This is what people don't talk about in the press, but this is where I believe AI is going to make a huge difference.

Science is going to be completely revolutionised. You probably have heard about what Google did with AlphaFold.⁴⁴ It's actually completely changing the way you can do a structure prediction for proteins. I worked on that topic. I had papers in that topic 20 years ago. What they did is remarkable: it shortened the time to discovery by about six months. They got a Nobel Prize in chemistry for this.⁴⁵ They deserve it tremendously. So science is going to change completely.

Engineering is going to be completely revolutionised. I'll touch upon some of these topics later on again, but I want to talk about engineering as well. What I'm going to do now is tell you a couple of stories, stories that we have in my institute. There are some stories that exist, but there are many others, but these are stories that I know very well.

What I want to convince you is that AI is actually ready to be deployed in critical infrastructure. Not only is it ready, it's going to be the critical component. If you don't have it, you won't be able to manage this infrastructure correctly. And it all comes

from the fact that the infrastructures that we are building are getting bigger and bigger, and humans have a lot more difficulty in controlling them. We have to control them in real time, and I'm going to show you examples of that. But the reality in the field is that this big infrastructure doesn't change very fast. When you think about a power grid, you don't build a transmission line every day. You don't put a new key gantry in Port Botany every day. You don't change your assembly lines very quickly.

Those things are very stable. So you end up running into the same problems over and over and over again with a lot of data, because through digitisation you have accumulated a lot of data. And we are also very good these days at forecasting the future. Therefore, we have a lot of forecast data that we can use. As I told you, data is the new electricity and I'm going to show you how we can leverage it. And I'm going to talk about power systems. This is one of the areas which are personalised. And this is, I think, a fundamental area for the future. This is how you run a power system in the United States. It's very much the same in Australia or in Europe. You try to decide who is going to generate power for every hour of the next day. That's the commitment of the generators.

Then in real time, you have to choose how much they are going to produce. Because, to keep the lights on, you have to make sure that at any point in time, the generation and the consumption are equal. And so what you're going to see in the next slide is from the French system, but this is like if the US would take over France. I'm not saying this

⁴⁴ Jumper J et al. (2021) Highly accurate protein structure prediction with AlphaFold. *Nature* 596: 583–589. <https://doi.org/10.1038/s41586-021-03819-2>.

⁴⁵ See <https://www.nobelprize.org/prizes/chemistry/2024/press-release/>.

is a good idea, but this is how they would run the system. On the left, you see the energy that is being produced. The big circles are the nuclear generators. They're not at the right place intentionally. You see also renewable energy there in the Southwest. On the right, you see the reserves. The reserves are there if something happens, if you lose a generator, if the lines are down.

And so these things work. Why am I talking about this? I'm talking about this because there is increased volatility and increased complexity these days, because of renewable energy, because of batteries, because of the data centres that were mentioned before, because everything is being electrified, and also because you have a lot of things that the system doesn't see, with solar panels on the roof. There are cars that are being charged and you don't want a blackout to happen.

This happened in Spain about three months ago, they had a blackout for about 24 hours. What people would like to have now, what the operators of this system want, is a real-time assessment platform. They want to run a lot of scenarios very quickly to actually see if there is a risk in this system. But one of these scenarios is 15 minutes. So you have to run your system in like two minutes.

What are you going to do? We need two things. We need a crystal ball for predicting the future, that's predicting what the load is going to be, what the renewables are going to be. We have made a lot of progress in actually forecasting technologies in the last couple of years. And then you need speed. This is where we take these optimisation problems that we have to solve. We use the massive amount of data and we use machine learning, because machine learning can approximate any function. Then in

real time, you have tuned your machine-learning model and you can run it on a CPU and take milliseconds. Essentially what I'm telling you is that what we are doing is we are taking what we used to do in real time and moving it offline. We are training the machine learning model.

The analogy that I can give you is when you do sports, you train your body such that you build this muscle memory. That's what we are doing here. We are basically building the muscle memory of the critical system, such that in real time it goes really, really fast. But we have to keep the lights on. So machine learning on its own is not sufficient. You have to have this integration between machine learning and symbolic reasoning, between optimisation and mathematics, essentially. And so this combination is what you're going to see in the future, these combinations of generative AI of prediction methods and the symbolic part of AI that people have been working on for many years as well. When you do that, you solve the problems, near-optimal solution in milliseconds, and you can train this algorithm in about 30 minutes. What happens to your system when you do that?

Instead of taking 15 minutes, you replace every one of the optimisation models by these machine-learning models, this AI system, and now you are going to take five seconds. It's a game changer. We have a tool that could not be done five years ago, and it can be used for operating your system. 15 minutes, five seconds. Roughly speaking, this was the same thing for actually more complex models. We can do that for hydro, and batteries, which is going to be very important. You improve the efficiency of the system by 7%, these are billions of dollars,

and you can do that again in milliseconds, very, very fast.⁴⁶

I'm going to talk a little bit about logistics and supply chains now. This is a project that we had with one of the largest packet delivery services in the United States.⁴⁷ They run thousands of terminals. They send millions of packages every year. One of the things that they have to do is load consolidation. They have to choose the path that these packages are going to follow, such that they minimise the number of trailers, the number of trains, the number of planes. There are many routes that the packages can take from Atlanta to Chicago. The key point there, again, we use this new AI system that I talked about to move from what took about an hour into three seconds. Now we can start automating this and the planners can actually look at this and say, yes, this is a good plan. No, I need to change this because I know something that the system doesn't know.

There are always planners in the loops. This is probably the most compelling application that we have built. So this is based on a very large supply chain you're going to see in the moment. But they start from the bill of materials, the suppliers, the way you build the products. It can be chips, for instance, chip design, the way that the customer demands, and you do that from a very large number of SKUs for an horizon

which is about three years. The problems are massive. They're massively scaled. I have never seen problems that large. They have very large numbers, which is very difficult for machine learning in general. This is a problem in the pharmaceutical industry supply chain.⁴⁸ Again, we move from 40 minutes to three seconds. For a planner, it makes a huge difference because now they can actually look at different scenarios in real time.

Consider the semiconductor industry. It's one of the largest semiconductor factories in the world. This is two million variables. Half of them are integers. And at this particular point, again, we move from 40 minutes to about a couple of seconds.

Fashion is being affected by AI. This is with a company that we work with in Colombia. Typically, what is happening in the fashion industry is every six months you decide what you're going to produce for the next six months, what kind of things we want. I mean, this is boring, but what young people want to wear in the next six months. And so typically they send people all over the world to actually look at what is happening in Barcelona, in Milan, in Paris, Tokyo, in Sydney, and so on. And then they decide what to manufacture.

But currently they don't do that anymore. They scrape the web. They actually look at the fashion shows. They are looking at what

46 Zhang H et al. (2025) Weather-informed probabilistic forecasting and scenario generation in power systems. *Applied Energy* 384, 15 April 2025, 125369. <https://doi.org/10.1016/j.apenergy.2025.125369>; Tuo M et al. (2025) F. Inertia-constrained generation scheduling: sample selection, learning-embedded optimization modeling, and computational enhancement. *IEEE Transactions on Power Systems*. <https://doi.org/10.1109/TPWRS.2025.3639407>; Tuo M, Li X and van Hentenryck P (2026) Machine learning-assisted dynamics-constrained day-ahead energy scheduling. *Electric Power Systems Research* 252: 112449. <https://doi.org/10.1016/j.epsr.2025.112449>.

47 Ojha R et al. (2025) Outbound load planning in parcel delivery service networks using machine learning and optimization. *Transportation Science* 59. <https://doi.org/10.1287/trsc.2024.0672>.

48 Akhlaghi VE, Zandehshahvar R and Van Hentenryck P (2025) PROPEL: Supervised and reinforcement learning for large-scale supply chain planning. arXiv. <https://arxiv.org/abs/2504.07383>.

the images of people in Paris, in Barcelona, and so on. And then they do price optimisation, but not only their own data, but they can look on the web what the competitors are doing. It's a completely different game. And this requires multimodal learning using images and text and so on.

I want to talk about healthcare because I think, as Victor said, healthcare is going to change dramatically. Let me share a quote from a TV documentary.

Right now, the pathway through a healthcare system for somebody with dementia is a journey. It's a nightmare just like it is for anybody with any complicated chronic disease. It's really tragic because most people still get delayed diagnosis, no diagnosis, rural America, underrepresented minorities, there is such poor access to healthcare that that's number one.

— PBS Video, Allan Levey (head of the Emory Goizueta Brain Health Institute⁴⁹)

This was from a PBS documentary in the US. I'm proud of that at the end of the day, but I'm going to talk about what is happening. Victor talked about brain health before. In the United States, if you want to have an appointment with a neurologist in the state of Georgia, it takes about 10 months. It's predicted to actually get to two years in the next five years. Delayed care in brain health is brain loss, so you really need to change the healthcare system. We are trying to look at the workflows and changing them completely. You could do the same for government, for business scope, the way you run business systems as well. It's thinking differently about how you organise care or government. What we are doing with Dr.

Allan Levey, who's a very famous neurologist for Alzheimer's disease and so on, is building a brain health centre.

What that means is that we are using AI technology to do better triage, to do better diagnosis, to do better treatments. AI is used in every one of the steps, but there are obviously doctors in the loop all the time. This is how you do diagnosis triage. This is a chatbot for triage, but it's very different from what you would be using with an LLM. You are actually being driven by what is called the test, a CDR test, which is actually looking at various symptoms and trying to diagnose them. But this is still a conversation. We still use natural language processing for doing this, but we are driven by the medical knowledge. And what we sent — and this is very interesting — is something like this. What you see is essentially the summary of the conversation that the chatbot has with the doctor. What is very important is when we make a recommendation, we actually tell the doctor, "This is why we are making this recommendation." So the provenance of the recommendation is there.

I was very lucky to go to Tasmania a few years back and I was very stunned because in Tasmania, you know where a particular animal is being grown, what grass is being fed. And when you see that particular piece of meat in the US, we know exactly where that particular animal came from. This is the same here. We have the provenance of the data. We know exactly why we are making this decision, and this is going to be super important.

I told you stories. There are many more stories. I think one of the things that's going to happen is that we are going to use AI for

⁴⁹ See <https://goizuetabrainhealth.emory.edu/about/index.html> [Ed.]

creativity, designing new products, designing new molecules. This is a project that we have inside the Institute: how do you build new enzymes? It's called combination. It's very interesting, combination of generative AI and Bayesian optimisation. We design better aircraft. This is again, using design now and AI for actually generating new ways of thinking about this that were not possible before.

We are building new plants by not using the soil, but directly giving nutrients to the roots of the plant, monitoring how they grow, monitoring using computer vision, and then using reinforcement learning to actually control the way they look, the way they taste, and the way they grow.

Finally, I have one more. Manufacturing is going to change completely as well, detecting defects much more quickly and integrating with supply chains.

A last thing: I love Sydney. Sydney has a very big financial industry. The financial industry is changing very quickly, but there is also massive risk. Fraud detection has to be taken care of. When I work with Panama, this is one of the big recommendations that we are telling them. You need to be on top of this. There is massive data. The transactions are going so fast that you need to contact the malicious agents using AI as well.

The future of X is the future of AI plus X. I think the future of X, where X is any discipline, is going to be the future of AI plus X. You do not ask an engineer if they are using mathematics these days. In five years' time, you won't ask them if they are using AI. It's going to be obvious and it's going to be the same for every profession. I believe the future of X is the future of AI for X. Thank you very much.

Questions and Closing

Sally Cripps: What a fantastic talk. We've got about five minutes for questions, so I'm going to throw to the audience and see if there are any questions.

Qr: My question is related to the usage of water in generating electricity. Jeff Bezos said that to solve it, you have to go into space and use the very low temperatures there and 24 hours of sunlight. What do you think?

Pascal Van Hentenryck: I agree that, and this was mentioned by Her Excellency before, that AI is consuming a massive amount of electricity, a massive amount of water, and water is getting really a scarce resource at this point for the Earth. I think that AI can help in actually managing these processes much better. One of the things that you

need to think about is how we manage these very large data centres in a much better fashion, how you combine them with renewable energy, how you combine them with batteries and so on. People have to start thinking about this, and how you are actually using the data centre itself. This is a big issue, but again, AI can actually help AI there.

To reassure you, I believe that at the level of the large language models, we are going to converge at some point. The progress is going to slow down tremendously there because we have already trained them at massive scale. So don't worry so much about that. I agree that we have to start looking at how we use water, but we also have a lot of other options, which are actually optimising the way you use these very big machines,

and they are very big. But at some point, I think there is not much more that you can train them on compared to what they have already been trained on.

Q2: Thank you. One of the stress points that seem to be happening are deepfakes, particularly in finance. And I'm wondering, what do you see as the future of the solution of this. A huge number of people, a very smart deepfake that can simulate people, simulate voices, simulate everything.

Pascal Van Hentenryck: I was very happy that Her Excellency actually mentioned that. And this is why I talked about Tasmania. This is why I showed you the example in healthcare. I think provenance is the real issue. For everything that's going to be produced, we have to understand what data has been used. It's also what has been used in the process of creating something, and you need to be able to validate that. If there is no provenance, you should not allow the system to actually publish these things. Now this is an academic answer. We need a regulatory framework to actually do this, but the technology is there to do that. We have to be able to say, this is where and how this has been produced. This is the data that

has been used. This is why you believe this is truthful and trustworthy. And this is kind of like, you have a publication where you have essentially the sources that have been used. And if there are points where you don't know, you're not sure, they should be highlighted. Obviously, you need the regulatory framework to do that. I hope people are going to do this.

Sally Cripps: Watermarks and images?

Pascal Van Hentenryck: Yes, absolutely. Absolutely. And to see this image, this has been created using this, this and this and so on. And the technology, you can't do things like this. It's possible to do this from a technology standpoint. So it's a great question. I'm glad that I could answer it because it gives you a sense that the technology is there, but you need the regulatory framework to do that.

Sally Cripps: Thank you, Pascal. I know there are so many more burning questions, but in the interest of time, I'm going to have to shut them off. You will be getting a chance with Pascal in the very last session today. So hold those thoughts and you can ask him those questions then. Thank you.

