

Role of Artificial Intelligence in Empowering Future Cross-Disciplinary Research

Keynote Address by Prof Damminda Alahakoon

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Distinguished guests, fellow academics and friends, it's a great pleasure to have this opportunity to talk to you at the 2023 University of Colombo Annual Research Symposium. I spent four of the happiest years of my life at the University of Colombo and have such beautiful memories of that time. I would like to thank the University of Colombo's Vice Chancellor Prof. H. D. Karunaratne, and the Chairperson of this event, Prof. Tharusha Gunarathne, for this opportunity.

My talk today is focused on Artificial Intelligence (AI), and how AI can enable and also facilitate cross-disciplinary research. I'm going to talk about artificial intelligence and how artificial intelligence plays a role as the enabling and facilitating technology for cross-disciplinary research. Now, before I get into the actual cross-disciplinary part, or the AI aspects, and how the two come together, it's important to give some context and background. It's said that we live in an Information Age and I'm sure that you are familiar with the term "Big Data" - it's been around for some time. And Artificial Intelligence in such an environment plays a very different role from what AI used to be. Artificial Intelligence in the past was mainly a computing-based technology that was trained on a particular data set, and then that was used as a tool to achieve a particular need and a goal. But, in this Information Age, in everything we do – the work we do, the socializing we do, the smart houses we live in, our transport to travel, to everything we do – there is digital data being generated and captured in various forms. And that's what the Information Age is about. Of course, we do it for various purposes: to make life easier and make ourselves do things more efficiently and effectively and so on. This is also called "Big Data".

Big Data is not just about large volumes of data. It's the digitalization of everything that we do, and the generation and capturing of such information in various forms. Now, in this environment, the traditional practices of AI have changed, where we don't pick a particular set of data and carefully select samples, pre-process these and then build AI models for well-defined purposes. AI now has a different role and a lot more autonomy, where it can basically be exposed to and absorb this information, the large volumes of data in various different sources. We call it multiple dimensions. Dimensions could be text, social media, images, videos and so on, and we process them so that they can do things in a much more autonomous manner and generate value to us humans.

So, what we say is that the role of AI from the past (being just a tool) has changed to artificial intelligence that exists and coexists with us as humans, as another artificial being in a society of humans. Now the term "AI" was coined

in 1956, but thoughts about AI have been around for a while. So, it's important to understand how this term evolved. For hundreds and even thousands of years, people have thought about artificial beings. Mostly, more robotic types of beings. But it was in 1956 that the term AI was coined, as I said. And from then onwards, the advent of computing and various computing technologies such as cloud computing, mobiles, and specifically the internet. Especially with the internet with social media coming in, and humans starting to live almost in a partly virtual environment (for example, we socialize a lot on the internet, we work from home, and so on) we leave what we call "digital footprints" in many different processes and knowledge-gathering aspects. So in this environment, humans and the new type of AI will have to co-exist and help each other. When you say "help", this means the humans create a new type of AI, and the AI in turn works with, communicates, and so on with humans. In such an environment, compared to previous times, it is not possible for AI to only interact with very skilled humans, or computer science- or technology-savvy humans. This change has been called the democratization of AI. The democratization of AI, or "AI for everybody", is basically just like what happened in the past to technology. A few decades ago, technology had to be operated and managed by highly skilled technicians or computer scientists or engineers compared to the present day. Now everybody, and in many cases we in our households, use technology. So the same thing is happening to AI and that's called the democratization of AI.

I'll give you some examples from Australia. The Australian government has a digital economic strategy and Australia's artificial intelligence action plan is a core aspect of that. I'm not going to go into detail, but just want to give you an idea that this democratization of AI or AI being used for almost every aspect, even in the economy and society, is now the key direction. For example, AI is supposed to transform Australian businesses and attract the world's best AI talent to Australia and provide cutting-edge technologies to solve Australia's national challenges, but also to conduct world-class research in what we call responsible and inclusive AI. Now, the last point, is something that has come up when AI is used in diverse situations, especially in day-to-day routine tasks and used by people who are not specialists, or who use it for harmful, criminal purposes or even for mischief. That's where the responsible and ethical use of AI has become a very important core factor.

Now how does all this impact cross-disciplinary research? A metaphor, but an oversimplified way of looking at cross-disciplinary research: we all know about the story of the blind men or women trying to explore or understand an elephant. The key issue here is that instead, there is a change or shift in research as well. Research carried out in a specific discipline will look at expanding, extending and advancing that particular discipline. But if you look at real-life problems or building solutions to real-life problems, then it has multiple angles. It's complex, interconnected, and of course needs to be urgently done. That's where cross-disciplinary research is really

important, because real-life problems are inherently cross-disciplinary. Therefore, researchers from across multiple disciplines have to work together to address such problems. In such a case, the researchers from different disciplines need to be able to understand each other, and work with each other. This is where technology and AI are playing a really important role.

So how does this happen? Again, I'm trying to connect what I mentioned about this Information Age. In the Information Age, as you can see the outer layer of the circle represents many different types of data that are created and captured in our day-to-day activities, from social media to various other activities: videos, sensors, Internet of Things and all kinds of processes. I have just mentioned a few of the key artificial intelligence aspects or technologies or algorithms, programs, however you look at them, which help to transform this raw data into a form that can then be consumed or used by various different researchers. The Inner Circle consists of cross-disciplinary research teams working on real-life problems and the Outer Circle is made up of the digital information or the digital footprints that are generated and captured from various real-life activities. So, AI plays the role of translating the digital footprints into suitable forms as well as capturing patterns and behaviors in such footprints into forms suitable for multi-disciplinary researchers.

This is a very broad and abstract representation of real-life situations. But I can point out a few things that many of you as academics and researchers would be quite familiar with. One of the key things in cross-disciplinary research is the ability to synthesize different types of information. So, knowledge synthesis and collaboration is essential in cross-disciplinary research and AI plays a key aspect there. There's data fusion, or what we call multimodal data integration techniques. Also, one of the main things that we have used, and one that I'm sure many of you are already quite familiar with, is conducting literature surveys. As researchers, we carry out literature surveys to understand the state of the art in our discipline. And that itself, especially with the amount of research that is being carried out, is itself a massive task. Just imagine having to work with multidisciplinary and cross-disciplinary research! It's impossible to find time to even look for, and definitely read through and understand all the research in related disciplines. Artificial intelligence and Natural Language Processing (NLP) play a key role here. For example, instead of 50, 100, or even 200 research papers, AI and NLP can go through thousands of research papers and bring it all together and carry out information extraction and pattern capture from the extracted text.

Bridging the communication gap is another important key factor. I will very briefly say what I mean by "communication gap". Communication gap does not mean using all kinds of technologies, mobile apps and so on only. That is one core part of it, but there is another deeper meaning. One last point before I go on to that is that generative AI can identify potential interesting areas that will not be thought

of as possible by human beings. So, in the communication part of it, this is a point that I thought is very important to make. We have the digital data we call the digital footprints and then through using the AI models this digital data is transformed into various modules, or what I have called “domain agnostic research building blocks”. So, what I am trying to say here is, you have this cross-disciplinary research team working together on a real-life problem, and you have the source data in raw form. But that raw data as it is may not be meaningful. Perhaps for a computer scientist, a data scientist or a database researcher, it would be meaningful. But a psychologist, for example, would be looking at emotions, and would be used to actually interacting directly with a human being face-to-face and identifying emotions. So, what AI models can do is, based on elements or traces of emotions – with facial expressions, with audio, with social media interactions – they can derive the emotions that are embedded in those traces of digital information and produce this emotion model which can then be consumed or worked on by a psychologist. That is what I meant by “domain agnostic research building blocks” which are then understandable and usable by various different researchers who will not have that opportunity of working directly with the raw data. I will not go into the last column, but these are actually real outcomes that my team and myself, working with multiple researchers from across domains, have come up with, from traffic predictions to customer profiling, identifying and quantifying emotion changes over time, etc.

Now considering this I would like to present how the La Trobe University Research Organization Structure has acknowledged these and restructured to accommodate these in the last couple of years. The shapes on top [in the slide] are called the research themes of La Trobe and you can see that these are not discipline-specific. These are multi- and cross-disciplinary areas that cover real-life problems, which relate to key national problems in Australia. At the bottom [of the slide] you can see the research centers. Research centers are discipline-specific. There can be research centers on agriculture, different types of health, speech therapy for autism, and so on and so forth. You can see the horizontal bar, which is where the AI and digital technologies lie which enable and facilitate the discipline-specific research centers to work together and connect so that they can work on the research themes of the university. I will go into a couple of examples. This project is based on a national health and medical research council government-funded grant that is currently being conducted, in which my team and I play the role of technologists and AI and data analytics expertise providers, with a large group of health-care researchers in Australia as well as around the world. The terms “technology-enabled”, “rehabilitation”, “support” and “self-management programs” for people are important. This technology is already built and is currently being trialed, but the important thing that I wanted to point out in this project are the diverse researchers who work on this project. The key element that enables them to work together is

the cross-disciplinary technology platform, which I am proud to say that my team built. So, we are AI data and computer scientists, software engineers and mobile app developers. Some of these have been actually outsourced to groups in Sri Lanka as well. On the right side of the figure [in the slide], there are accountants, risk analysts, social scientists and demographers working on this as well.

Again, just another example, is one of the PhD students from Sri Lanka working on another such project. This is another key point that I wanted to make. He is a computer scientist from Sri Lanka with some industry experience as well. He is using AI-powered computer vision technology. Certain therapies and certain treatments for post-stroke patients on their recovery journey were to be given where the patient has to come to a clinic and sit face-to-face with a clinician or a therapist. With the innovations that came out of his research, the patient can, most of the time, 70% or 80% of the time, work on a computer virtually and receive the therapy. But the most important factor is that, with the technology that we have come up with, and the artificial intelligence, the therapists can now define and create new types of activities and tasks as part of the therapy for the patients. You can see that with the different types of researchers, the health researchers, psychologists and neuroscientists working together, we have opened doors for them to invent and create different types of treatments and therapies for, in this case the stroke patients, but obviously for others as well.

I thought it was important for me not just to talk about AI and cross-disciplinary research, but to provide a few real examples from La Trobe and my research center itself to show you that it is not just something theoretical or conceptual. I am talking about something that we actually do, and I am sure many of you are involved in this as well. La Trobe is involved in this large project: it is a future smart city project, a 10-year plan that our research center is also involved in. The target is for La Trobe University to be Net Zero by 2029. We built this La Trobe energy analytics platform – we call it LEAP – which is currently in operation. The key information about the project is listed in the figure, but it is important to note that researchers, experts and technologists from diverse areas such as engineers, computer scientists, and social scientists, work together to achieve this successful outcome. Sustainability researchers, accountants and a number of supply chain researchers also work together in using this platform for their connectivity and collaboration to achieve a common goal.

Where are we heading with regards to these endeavors? There are AI trends and hypes, and it is important to be aware of this. I am sure you are familiar with Chat-GPT, and that most of you have started using Chat-GPT which is a major advancement in Natural Language Processing (NLP) and text analytics which covers social media analytics as well. Generative AI is artificial intelligence that can basically come up with possibilities, potentialities and so on. Artificial general

intelligence is another key area where AI would show the ability of generalizing from information extracted and processed from multiple and related specific examples. This is again really tied to the Information Age which I described at the beginning of the presentation, because the AI that had to be built on very specific tasks on selected data sets is called ‘artificial narrow intelligence’ and is becoming obsolete when considering the needs of this Information Age. AI for such an environment is being called ‘artificial general intelligence’ which needs to be a much more autonomous AI that can work mostly on its own by feeding on digital data that is freely available. It does not require human handholding – that is where the world and humanity is heading towards. But with all this, it is very important that we look at responsible AI and ethical use of AI. Those are key issues but of course these are topics for another day.

I would like to finish on a philosophical note. Many of you would have heard of Plato’s allegory of the cave. A group of prisoners are tied near the wall, so they see only what’s in front of them. It is a cave, so there is a wall that they can see and there is a fire behind them and there are all kinds of people who are carrying certain objects behind them. So, the shadows of the people and objects they carry are not the wall in front of them, but the shadows of the objects falling on that because of the fire. Now what the prisoners see, because they have actually grown up and lived all their lives in the cave, are those shadows. Whether it is a chair or a pot or whatever, they do not see that. For them, it is that gray or black two-dimensional shadow. For them, this is reality. Now why am I talking about this? Why did I relate Plato’s story of the cave? It is very important to understand what AI sees or understands. It is based on one certain aspect of a real situation, because we feed it, or it is only exposed to, certain aspects which are represented by particular data. It could be social media, it could be video, it could even be multiple things, but still it is only seeing certain aspects. It is important to understand this factor, and this really applies to large language models such as Chat-GPT. What it learns and tells us is only based on what it has seen or been trained upon. So, it is only the shadows of human experiences that AI experiences.

Plato obviously was not talking about AI. He was referring to human beings. The really important factor is, when you make interpretations or take decisions based on what AI tells you, to have this in mind. What is the shadow? The really deeper thought is that, according to Plato, what we see, our perceptions of reality, are our shadows as well.

Thank you very much. I hope that gave you some idea of the current usage of AI, cross-disciplinary research and some very interesting facts about AI. Thank you.

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