AI 4 Science Discovery Network+

AI4SD Interview with Jules Tilly
29/11/2021
Online Interview

Michelle Pauli
Michelle Pauli Ltd

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Humans-of-AI4SD:Interview-34

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Principal Investigator: *Professor Jeremy Frey*
Co-Investigator: *Professor Mahesan Niranjan*
Network+ Coordinator: *Dr Samantha Kanza*

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Interviewer	MP: Michelle Pauli - MichellePauli Ltd
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Figure 1: Jules Tilly

Jules Tilly: 'It's important to control the hype around quantum computing - we need to make sure we don't get too excited too quickly'

Jules Tilly specialises in developing quantum machine learning methods for drug discovery with a focus on optimising algorithm implementation on current / NISQ Quantum Computers. He is a Quantum Research Scientist at Rahko, and is currently completing his PhD at UCL. Prior to this, Jules worked for 6+ years in financial services acting as regulatory and strategic advisor for top global investment banks. He holds degrees in Mathematics, Quantum Physics, Law, Economics, Finance and Public Policy. Rahko was acquired by Odyssey Therapeutics, a biotech company pioneering next generation precision immunomodulators and oncology medicines. Read more about Odyssey's mission here [https://odysseytx.com/]

In this Humans of AI4SD interview he discusses his varied career, life as a PhD researcher in a startup, the challenges of working with quantum systems and his advice for early career researchers.

3 Interview

MP: What's been your path to where you are today?

JT: I initially studied law, because that's what I was interested in when I finished high school, but I later realised it wasn't really my calling. I was missing mathematics and numerical reasoning, so I started studying economics on the side too. Then I moved to London, where I ended up working as a financial regulator at the Bank of England, and then working in consulting. It was around then that I realised I had never studied anything that I truly enjoyed simply for the sake of it. That's when I decided to start studying mathematics on the side, and got passionate about it. I then decided to go back into academia to study quantum technologies.

I wanted to work in a field that was a research frontier, so I explored a range of fields, including machine learning. The one that excited me the most was quantum computing, because of how challenging, new and forward-looking it is. When I was doing my MSc at UCL, I met some PhD students who were starting up a professional company called Rahko, which did quantum computing research. We got along very well and I decided to start working with them on the startup. We agreed that I would do a PhD, which they partially funded, and I would work on the PhD and for them in parallel. My work with Rahko is probably 90% research and 10% bringing some of my experience in consulting and large-scale project management to the startup. I'm mostly quite free to research what I want; most of it is related to how to use quantum computing for computational chemistry.

MP: What's it been like working at a startup while completing a PhD?

JT: It's very nice to be working with people who are excited about changing things and testing new scientific grounds. That's not the case for all startups, but it's the case at Rahko. I'm able to look at an industry and see how new technologies and ideas can help improve it. I think that's quite an exciting prospect when you compare it with big organisations or research entities — it's more enticing. Working in a small team is also great because you get to be close to everyone you work with, you learn how they function, you see different aspects of the work. That creates a very nice vibe.

MP: What kind of research are you involved in?

JT: There's a famous quote by Richard Freeman, from 1982 I believe, where he said that if you want to simulate a quantum system, the best way to do it would be to use a quantum system itself. This is one of the first conceptualisations of quantum computing, but obviously it dates from a time when we were nowhere near the technological capabilities we have now to build quantum computers. Forty years later, the technology has advanced enormously.

We're now able to build machines that can manipulate quantum systems directly: quantum computers. So we have the prototypes, and we'll have quantum computers which work very well in a decade or so, but the question is "What can we do with them?" The first thing that comes to mind is the simulation of quantum systems, and any molecule is essentially a quantum system. This is why quantum computing lends itself very naturally to problems involving molecules: it is the most direct way we can model the quantum properties of atomic and molecular systems..

MP: What kinds of challenges have you found in this research?

JT: The first challenge is typical of any new-frontier technology: all the research communities are interdependent on each other's work. Because I do more research on software and algorithms, for example, I am dependent on the research of those who work on the hardware. One of the challenges we have is that we work with certain assumptions about what the quantum computer is capable of doing, and what it will be capable of doing in the future. So it's an enormous challenge trying to modify algorithms that will work specifically for the machine that'll be there in five years, in ten years, and so on.

Another challenge comes from the hype around quantum computing. People go around saying, "It's going to change everything in the next few years." It's important to control the hype, because it could take much longer than that. Basically, we need to make sure we don't get too excited too quickly. We don't know what it takes to build the machine we want to build. We might have all the theories, but at some point in the hardware development, we might encounter something we didn't know about, which creates delay while we figure out that problem. A great example is nuclear fusion, which has been in development now for nearly 70 years. Often they will say that it'll be reading in the next ten years, but it keeps getting postponed. Hopefully quantum computers aren't like this, but it could be one of these cases in which the "when" is very uncertain.

MP: What has surprised you in your research?

JT: I had always heard that there's a large amount of politics involved in academia, but I've found that there's surprisingly little, at least in my field. I was pleasantly surprised that people are very willing to help one another and to discuss ideas. It's quite a friendly community.

I'm also always surprised by the amount of interest people have in quantum technologies. Of course, a lot of people get excited by the words, but many are also very willing to spend their time learning about the science behind the hype.

MP: Your background is very interdisciplinary: how has this contributed to your research?

JT: It's difficult for me to assess how my background has influenced my work, because I'm limited by my own perspective. Where my experience has been helpful is working in the context of the startup where I'm able to have conversations with people who are more business-minded. That certainly helps when making decisions around which research is most relevant, and which should be prioritised. Diversity of perspective is also extremely important but, again, it's difficult to measure.

MP: What advice would you give to postgraduate and early career researchers?

JT: The first thing I would advise anyone that wants to do a PhD is to take a bit of time before they do it. If you're not sure that you want to go into research when you are just out of undergraduate study, just go work for a couple of years. When you're working, you learn about what you want to do on a daily basis, which is not something you typically get when you're at university. When I decided to start my research, I had no doubts about what I had chosen. Work also helps you to accept some of the frustrations that research can present for people who have not worked outside of academia. If you work for a consulting firm for 80

hours a week, for example, you learn how to organise your work, you learn how to get things done in a way that's ordered and efficient.

When you're a researcher, one thing that I have found very helpful is not to hesitate to talk with people. When you start your career, people often don't feel like it's appropriate to reach out to people out of the blue. The important thing to remember is that most people are very friendly and happy to have a chat. It's important to build these connections, to know what ideas others' have, and to know what they're working on.