

Pīkau Name: Computational Thinking: the International Perspective

Video Name: What is Computer Science

Presenter: Professor Tim Bell

One of the definitions of computational thinking is “thinking like a computer scientist”. So I thought it would be interesting to explore this by looking at a product of computer science, and in-fact this is the most popular website in the world at the moment – it is, of course, the Google search engine, which uses lots of elements of computer science. When you look at it, it’s really simple: it’s one text box and one button that people press. There is actually another button, but hardly anyone ever uses that and so we just click in the text box and we start typing. Let’s search for the word computational thinking, what you notice is that it’s starting to make predictions about what I am interested in and by the time I have typed a few letters its top prediction is that I am looking for something about computational thinking. Maybe because that’s the kind of thing that I tend to search for? Maybe because that’s what lots of people are searching for when they’ve typed those few letters?

We’ll keep going a wee bit more, and again it’s already predicting it quite well. Also, see that I’ve typed it incorrectly, and it’s going ‘well I think you probably meant to type thinking instead of ‘thining’ or whatever that spells’, and so there is a whole lot of stuff going on here, let’s just choose the first one. Computational thinking, let’s do it ‘in New Zealand’ – who knows what will come up? If you look up here, it says how long it took, 0.39 seconds; let’s not worry too much about the results, although they are probably quite interesting to explore, but let’s look at what actually happened there in computational terms. When I was typing things in it was predicting what I was going to do and that’s actually touching on artificial intelligence. It’s building a model of what I am doing and it’s got models of what everyone else has been doing and what they are interested in, and it’s making predictions that help me in my job.

It’s also very fast – it took 0.39 seconds for that particular search, less than half a second, and that requires really good algorithms, because it just searched billions of web pages and it actually found over one million results. That happened in a very short amount of time; we can’t afford to use the wrong algorithm if that’s going to happen. It’s also very reliable: I expected it to work, it basically is working all the time and yet things go wrong with digital devices and things probably go wrong on the Google software or with the Google hardware, but somehow they have made it very resilient. They’ve thought about how to have back-ups and spare versions and multiple things happening at the same time so that it will be as reliable as possible.

It’s also very secure – I just searched for something there and I don’t mind too much if other people find out what I was searching for then, but in general people don’t really want everyone else to know what they have been searching for and so it’s important that although all of your queries have been kept to help inform future ones, they don’t accidentally reveal those to other people; so there has to be some digital security going on there. It also has to be very easy to use. Now in some ways that not hard – there’s one textbox and one button, but, you know, it’s got a microphone input, and it’s got all sorts of options and things, and someone has had to really think about the person using it to make sure that it’s easy for them to use. One of the really important parts of usability is that it took a fraction of a second to get back to us. If Google always took 20 seconds to get back to us it would not be a popular site.

It’s also very scalable – when Google started off it probably had thousands of users, maybe even millions of users, but now of course they get billions of queries every day, and whatever system they came up with it has to cope easily with a thousand times the demand. Overnight if something goes viral and it really needs to answer lots of queries, again, whoever designs it has to think about ‘how will we cope if things suddenly require twice the computing power or a hundred times?’ Will the system scale up ok?

There are all these different things going on with security, and AI, and scalability, and efficiency, and interface design, and thinking about the human. These are all the things that computer scientist thinks about. So another definition of computational thinking would be understanding why Google has been built how it is – why the Google website search engine functions like that.

Another definition of computational thinking is essentially to understand how to build software that has all of those properties. But in the end, how to build software that people will love to use.