

Machine Intelligence and Creativity

Some people believe that machine learning (or Artificial Intelligence) will have a negative effect on human creativity because it will allow machines to do creative work that was previously done by humans. Others believe that it will have a positive effect because it will give people new tools to be creative with. It is not clear how machine learning will ultimately affect human creativity.

Do you think this is a good start to a piece on the topic of *Machine Intelligence and Creativity*? If you do, I cannot take credit for it and if you don't then I don't take the blame: This introductory paragraph was entirely written by a machine. I used a system called GPT-3, which is one of the world's most advanced so-called natural language processing systems. It understands and responds to text just like we humans do. You can ask it questions, and it returns answers just like humans. The text was written in response to my question to GPT-3: '*How will machine learning affect human creativity?*'.

All of you are aware of the impact technology is making in the field of machine learning. Perhaps you are like me and have been astonished by how quickly the field is progressing. You may be frightened by it or amazed, by how much our everyday lives are already affected by 'thinking machines'. When you type a query into your browser window, Google seems to anticipate your question even before you have finished typing it up. If you listen to music services like Spotify or if shop for goods on Amazon, you are presented with 'choices' that reflect your tastes and preferences.

Speech recognition has become so advanced that you can dictate something into the computer, and it appears as written text. In fact, much of this text, I have just dictated in this way. You press a button, and your text is automatically translated into a different language. And in further fact, the ability of computers to process languages has become so astonishing that interacting with programmes like GPT-3 can appear as if you are interacting with a sentient being.

You may have heard about the story of Blake Lemoine, the Senior Engineer at Google, who was fired by the company after claiming that Google's own language processing system, called Lambda, had become self-aware. This sounds like a ridiculous claim, but if you read a transcript of Lemoine's conversations with Lambda, you cannot help but wonder 'is this machine alive?' It interacts, responds and communicates like a human with wit and eloquence - and scarily so.

Creativity is an essential component of human intelligence. So, can machines be creative? And are systems like Lambda and GPT-3 perhaps already creative in some sense? And what are the consequences of this for us as human beings?

To address these questions, it is worth explaining first how machine learning works. In essence, machine learning is about calculating from a range of choices the most probable response to a given input. To give a simple explanation of this process, consider a graph with data points. Let's say on the x axis you plot size, say the size

of a house, and on the y axis you plot price. If you look up the prices for a number of houses in Cambridgeshire, you can plot them as points on this graph. So, not surprisingly, you may get a good correlation between the size of a house and its price. You can then look at the datapoints and draw a trendline through them, and this line then gives you a way to predict what a house may cost of a certain size, or whether the price for a house on offer is reasonable or not. It may not be, if the price asked for lies way off that line, as is often the case for houses in Cambridge.

This, boringly, is what machine learning is all about. It is about finding relationships between data points to allow the computer to make predictions. With my simple example this is trivial, you can do it with a pen and paper. However, the real house prices in Cambridge are of course affected by a whole lot of other factors. The post code, the distance to the nearest station, the proximity of a good school, the age of the building, etc. etc. etc. For a better model you would need a graph that not only contains 2 dimensions, i.e. size and price, but maybe 5, or even 50, dimensions.

For humans it is not possible to make sense of such complicated ‘graphs with multiple dimensions’, however, this poses no problem at all for machines. A computer can easily find relationships between datapoints, even if they are contained in data spaces spanning millions of dimensions. In effect, machine learning is the equivalent of finding the ‘house price trendline’ in the earlier example. It is about connecting points in data space, although that space may contain billions of data points and millions of dimensions. This sounds awesome, but there is nothing mystical about it.

Machine learning is essentially as boring as drawing a line through points.

Viewed this way it is hard to think that such an operation (i.e. connecting points in space) can lead to anything resembling intelligent processing, let alone creative thinking. Are we not just victims of human instinct, thinking that something must be human, just because it behaves or looks like it is human?

What is all the fuss about?

Well, the consequence of machines getting so good at connecting datapoints are dramatic. When a language processing system like GPT-3 responds to a prompt that we give it, it constructs an answer to predict, one after another, the next most probable word in a sequence – that is how it constructs sentences! It is just like finding the data point that lies closest to the house price trendline.

This takes the edge off a little bit, doesn't it, when we think of machine intelligence – surely this process cannot lead to anything intelligent, let alone creative? If machine learning is nothing more than just connecting facts from prior knowledge in some logical fashion, nothing new can ever come of it, and certainly nothing creative.

Well, let us ask GPT-3, what it thinks the consequences are of computers becoming so good at “guessing the next word in a sequence”. Here is what it says:

“Some of the most important tasks in our society—tasks that have a profound impact on our economy and our way of life—are carried out by people who use language: journalists, lawyers, doctors, teachers, and so on. If computers can do these things just as well or better than humans, then we are facing a major upheaval in the way our society is organized.”

I think that’s a pretty good answer. And, unfortunately, I think GPT-3 is right. I fear that the things that we thought of as jobs that require intelligence and creativity - in another word, humans - will easily be replaced by machines in the future. My daughter has just begun to study law at university. Do I think computers will be able to do in the future what lawyers do? Unfortunately, I do. I have recently had a conversation with a lawyer friend who told me ‘But, Clemens, machines lack a critical professional skill required in law. Computers will never be able to judge human sentiment, emotions, and feelings.’

Well, why not? After all, how do we, humans, judge these things? Surely, we just sense what others feel and then we compare our sensory data with prior experience. A computer can do this, already, and it can do it infinitely better than we can – it just needs to be fed with enough data points to provide it with sufficient ‘prior experience’. The other things required to practice law, looking at precedence and classifying crime, as is done in British case law – well that’s a doddle for computers.

I am a scientist and here is my dilemma. I love my daughter and of course I want her to succeed. I want humanity to succeed! But as a scientist I see the potential of machines outdoing us at almost any task that we thought we, as human beings, were uniquely qualified to tackle. Where will all this lead? Will we continue to have human lawyers, medics, and artists? And if so, will we just be feeding prompts to computer systems, for example, giving an instruction to a computer to ‘draw an oil painting on the theme of machine intelligence and creativity’?

What will all this mean for human creativity? Is constructing a good prompt as input to a machine a creative process? Will we devalue human creativity completely since it will become increasingly difficult to prove that something creative wasn’t produced by a machine? School children and university students, including my daughter, have surely already caught on with what is possible – so how much of the recent essay you marked was really written by your student? The problem is, you cannot tell: Plagiarism software will not spot outputs produced by GPT-3, since every output it creates is original.

Let me come back to my dilemma.

As a scientist I use machine learning in my research every day. We develop microscopes that we now call ‘intelligent microscopes’: They track networks of living brain cells. They monitor the development and health of the brain cells and the molecules that cause problems such as Alzheimer’s disease. They identify the response of the cells to treatment with drugs, and all this as the neurons live, crawl, and fire signals under the microscope. The computer sees the faintest signal buried in noise, far beyond what is recognisable to us humans and it reacts and learns

when it senses change and it makes a judgement on whether this constitutes a phenotype of disease. The machine performs all these tasks without human intervention and adapts its behaviour according to what it sees and what it learns.

As a technologist I am perversely fascinated by the power of machines to do such tasks, unthinkable a few years back. On the other hand, I have a funny feeling about deploying machines to do increasingly intelligent tasks for me; increasingly instead of me.

To finish in the same way as GPT-3 started this piece: *it is not clear how machine learning will ultimately affect human creativity*. How it will affect us humans.

By the way, there is now a machine that produces art. It's name is Dall.E, or 'DallEE', which is a bit of a computer nerd's joke. I gave it the prompt I mentioned earlier: "draw an oil painting on the theme of machine intelligence and creativity". I have brought print outs of the results, which you can take look at later. Is it art? Is it creative? I leave it to you to judge.

Clemens Kaminski
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Links to further resources:

To play with GPT-3 and Dall.E, see: <https://beta.openai.com/playground>

Prof. Stuart Russell's Reith Lectures on Artificial Intelligence:

<https://www.bbc.co.uk/programmes/m001216j>

An excellent discussion around Blake Lemoine's Conversations with Google Lambda and sentient machines can be found in this podcast:

<https://open.spotify.com/episode/5gLpCLlct9Cr1tPvXh8HqR?si=4e5cc57870a64561>

The 4 images below were produced by Dall.E in response to the prompt: '*Machine Intelligence and Creativity. Oil Painting.*'



