Turing, AI and immortality

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Imagine going back almost a century. To the year 1926. Imagine how the world looked and felt back then. Written communication was through letters. No e-mail. Having a telephone in your house was something for the important or rich people. No mobile phone. There were computers, but they were humans calculating everything by hand on paper, with a pencil. The devices we now call computers simply didn't exist at that time.

Imagine a boy, aged 14 going to a Public School in England. The boy is clumsy and untidy. He is non-conventional or even awkward in his social interaction. People used to call him dreamer. He already has got the resilience and talent to attack intricate problems in a unique way. Four years earlier at age 10 he received a gift for his birthday. The gift was a book called Natural Wonders Every Child should know. It is a book explaining several wonders of nature in a language, understandable for children. The book told about how the brain basically worked, how embryos grew and that plants had some kind of organization in how the developed into an actual plant. It is laced with informative images.

The boy's name? Alan Mathison Turing

This boy became one of the greatest scientists of the 20th century. In the next 20 or so minutes I will explain to you why he became one of the greatest scientists. I will also explain how his influence is still felt in our society of today and tomorrow.

In the first phase I focus on Alan Turing as scientist and his sexual identity. In the second phase I will use the basis provided in the first phase, to put forward some thoughts and questions with the hope they will kick start the panel discussion.

Turing the scientist

The boy went through Public School and was admitted at Cambridge University in 1931 to study the Mathematical Tripos, one of the most renowned mathematical studies of the world at that time. He developed a talent for tackling complex, open problems. Often, he developed profound mathematical theories, showing a deep understanding of the problems at hand.

in 1936, he independently answered an important question in Mathematics, posed by the godfather of Mathematics at that time, David Hilbert. The question boiled down to the following: *Is there an algorithm to say whether a statement in First Order Logic is true or false.* First Order Logic is a system of reasoning, think of it as a language specifically for mathematics. It was believed by Hilbert and his disciples that you could capture all mathematics in First Order Logic. Hence this algorithm would be quite handy. There was one problem. The notion of algorithm wasn't yet mathematically defined. Alan defined just that and came up with the concept of an A-machine. Later this theoretical machine would be called a turing-machine and form the basis of what now call a computer. With this precise notion of an algorithm he lay the foundation of Computing Science. Furthermore, he sparked into existence hitherto unknown nuances in the realm of Mathematical Logic.

Oh yes, that question of Hilbert? Turing answered it negatively. After Gödel's Incompleteness theorems, he put the last nail on the coffin of Hilbert's program. Which in a philosophical way is good news? Gödel and Turing provided work for humans on mathematics into eternity.

One important property of a turingmachine, is that it is capable interpreting or mimicking itself. It is the equivalent of the Eval-function in any hip programming language. A machine having this self-interpreting capability is, what Alan called, a *Universal machine*. This has the consequence that you don't need a new machine for every new task you can come up with. You just have to write a new program for the universal machine and it will perform that task for you. Without having to build a new machine.

Before the existence of digital computers, logicians already could reason about what could and could not be computed. Let that sink in.

Think of your mobile phone, tablet or computer. Even if it is almost 20 years old, it is a universal machine. Even modern washing machines are universal. Well, up to the odd exception.

During the second world war Alan Turing played a vital role in breaking the German codes. In order to actually help breaking these codes, he learned how to design electronic machines, that could check the huge amount of possible codes at breakneck speed. In typical Turing-style: in order to bring down the number of possible codes to check he developed a part of the theory of Bayesian statistics on-the-go. Due to the secrecy and hush-hush, he didn't publish this theory. Today: In bigdata, Bayesian statistics are an important tool of analysis.

As diversion: in his spare time during the war, he wrote a program to play chess together with his friend David Champernowne. They called it TuroChamp. Lacking an electronic digital computer, they used pen and paper to calculate the moves. In chess-terms it was a very unsophisticated program, but nonetheless. The first rays of light of Artificial Intelligence started shining.

He had discussions about the philosophy of mind. He contemplated the idea that a future electronic brain could be considered the same as a human brain if it would operate the same or show similar behavior. This is a forebode for the Turing Test.

After the second world war, his experience in mathematical theory and in designing electronic machines put him in the ideal position to start working on England's first computer at a government funded laboratory. At that time, he saw that it would possible to, as he put it, '*Build a brain*'.

Alan wrote that this brain, essentially a binary neural network, was very much like the brain of an infant. Unorganized. For the brain and the infant to actually acquire knowledge, they, in his eyes, needed to be trained. The basis of Artificial Intelligence is formed.

In 1948, he started work at the University of Manchester. In his Manchester period delivered an oration and subsequently an interview.

His words are worth quoting:

> *Not until a machine can write a sonnet or compose a concerto because of thoughts and emotions felt, and not by the chance fall of symbols, could we agree that machine equals brain – that is, not only write it but know that it had written it. No machine could feel pleasure at its success, grief when its valves fuse, be warmed by flattery, be made miserable by its mistakes, be charmed by sex, be angry or*

miserable when it cannot get what it wants.

This is only a foretaste of what is to come, and only the shadow of what is going to be. We have to have some experience with the machine before we really know its capabilities. It may take years before we settle down to the new possibilities, but I do not see why it should not enter any of the fields normally covered by the human intellect and eventually compete on equal terms.

We already entered the year 1950. The number of digital computers on the world was still below 20. The interaction with these beasts was through small, fading dots on a screen, big switches and slow teleprinters.
Again, as in his wartime philosophical diversions, he started pondering the question: how can we tell whether the electronic brain is equal to a human brain?
Since the interaction with an electronic brain is different from the interaction with a human brain, he needed to 'to level the playfield'. He adapted a 19th century parlor game called 'The imitation game'.

The basic idea of the imitation game is to place a man and a woman behind a curtain. A third person is sitting at the other side of the curtain. By asking questions to the persons behind the curtain the player needs to find out which one of the hidden persons is a man and which one a woman. Communication takes place via typed messages. In order to make the game more attractive, one of the hidden players is obliged to lie and the other to tell the truth.
Turing adapted this game by replacing the lying player with an electronic brain. Interaction takes place through terminals or as we now call it a chat window. This game is what's called the *Turing Test*. It aims to reveal the computer amongst the hidden players. He introduced his test in his seminal article Computing Machinery and Intelligence
In his book Turing's Tango, mr Bennie Mols, one of the panel members, wrote an excellent chapter on the Turing Test and how it faired in the past 67 years. Even today the Turing Test is relevant.
Now for the last chapter in his scientific work
For the outsider a radical change, for Alan a logical next step: In 1951, he published an article on morphogenesis. The mathematical basis of how and why plants grow in the form they grow. This step in his career can partly be explained by looking back at the book he received as a 10-year old. In Natural Wonders the author describes how plants grow from seed to full plant. In typical Turing-style he, again, addressed a vague, or at its best, an ill-defined problem. He lay the mathematical basis of what is now called non-linear dynamical theory.
Now let's focus on Turing and his sexual identity
Back in Public School he fell in love with a fellow pupil, who was one year older than Alan. Christopher Morcom. Although he wouldn't call it 'in love' he actually wrote to his mother about the sheer adoration he had for him and his work (!) and felt a better person being in his presence. Unfortunately, Christopher died in 1930, leaving Alan mourning for several years.
While studying at King's College he shyly became more open about his sexuality. But beware! It was dangerous to be open about homosexuality in England at that period of time. It was punishable by law. Therefore, discreetness was of paramount importance. After the war Alan became more outspoken about his sexual orientation.
In the period when Alan started working in Manchester he had a relationship with a young Manchester man. When police in 1952 learned of this relationship, he was charged and convicted for acts of gross

indecency. Instead of going to prison he agreed, for a period of a year, on injections with the female hormone estrogen to neutralize his libido. The hormone treatment did lower his libido, but did not take away his sexual identity. Because police were actively surveilling him, he could not form relationships in his own country. He found his desired contacts in Norway.

Unknowing to his surroundings he had continued working for the British government on cryptography. This put him in a situation where he was in possession of state secrets. That's one of the reasons why police where continually surveilling him. It is not difficult to imagine the nervousness of the secret service when he went to Norway! This dark cage of surveillance and his undeniable sexual identity were very incompatible. This irreconcilable tension most probably led him to eating the cyanide-poisoned apple. He died in his home in June 1954.

Phase 2

We step in our time machine and zoom back to our present. What's the current state of affairs in Artificial Intelligence?

It's big and big business. And some remarkable milestones have been reached.

6 years ago, a computer from IBM, called Watson, beat all human players in the hardest tv-quiz of the US, Jeopardy. Remember it is still basically a turingmachine on steroids. Its unique ability to lookup information and reason faster and deeper than the human players were the factors that contributed to its victory.

In 1996 world champion Gary Kasparov lost to IBM's DeepBlue.

But if you think chess is a hard game for a computer to play, the game of Go is even harder to play. Last May, Google's AlphaGo beat the world champion Ke Jie. Most remarkable is that Google went further. They created AlphaGo Zero. Treating it like an unorganized machine, they only gave it the rules of the game Go and let it play against AlphaGo. Within 40 days of learning, AlphaGo Zero was capable of beating AlphaGo. There are two things important about the AlphaGo family.

First: In the process of training for the match, the first AlphaGo was taking steps in the game, humans could not explain. Basically, becoming smarter at the game then humans. Second: AlphaGo Zero learned from its predecessor and not from a database of human-played games.

The Jeopardy-computer? After its victory, it went on to learn how to help doctors in suggesting possible diagnoses based on a pathology.

Likewise, in designing new cars, computers, phones, bridges, the computer plays an important role in tackling the complexity and size of the design process. Artificial Intelligence is here and it is basically extending our intelligence and capabilities.

What's left for us?

There are opinions that creativity is a domain, exclusive to humans. In a way, Alan Turing addressed these opinions in his article, where he introduced the Turing Test as Lady Lovelace's objection. Turing did not exclude computers to be able to show creativity.

And now IBM's research center even has a whole department devoted to Computational Creativity.

Some examples from my own discipline, music. It is already known for quite a few years that computers are able to compose music in certain styles. In 2012 a composer-in-a-computer Iamus was commissioned to write a piece for the London Symphony Orchestra. Iamus had developed its own style and was capable of writing moving music for a full classical orchestra.

The year 2012 was not a random year. The composition was commissioned to honor the fact that Turing was born a century ago.

Being recorded by a renowned classical orchestra is a validation.
But that's only composed music. My personal interest lies with improvised music. Say, instantly composed music, where the musician (human or not) reacts in the moment with musical expressions. For a computer to be able to improvise it not only needs to be able to adapt and develop its own style in a relative slow learning process. It needs to be able to react instantaneously to its musical surroundings.
Lo and behold. There are computer systems capable of co-improvising with a single musician.
So, using a N=1-argument, it's safe to say, that creativity is not a domain exclusive for humans. We, however, can use computers to help us create. Even create art. It's happening already. Let's call it Computer Augmented Art.
Again: what's left for us?
The experts tend to agree: emotions.
In his TED-talk Mr Mols questioned the need for machines with emotions. We don't need a machine that's suddenly outraged or depressed.
It reminds me Marvin the paranoid android from the Hitchhiker's Guide to the Galaxy. It's a robot that's utterly depressed and subsequently is too funny. Think of why that is funny.
So, when I perceive a piece of art it will or will not evoke emotions with me. Posing it more general: We can create new art in its broadest sense, with the help of artificial intelligence. but it's the judgment on that art that is for humans.
Let me give you an example. Imagine the London Symphony Orchestra performing the composition by the computer composer. Now imagine a person in the audience. Let's call him Alonzo.
Alonzo is a frequent visitor to performances by this orchestra. He grew up in a family, where a broad taste in classical music was considered essential to life. Orchestral music makes him feel comfortable and reminds him of the Friday evenings when his father used to play recordings conducted by the great Herbert von Karajan.
This short story of his emotions, evoked by a computer composer is exactly the small core of emotion a computer is not able to reproduce. It is even very unique to Alonzo. Even more so, this argument applies to every individual in the audience.
I talked about human emotions being a bastion that AI currently does not reach. Like a small core inside the complex structure of human intelligence. A small core currently incompatible with computers. I see a poetic parallel between this concept and the life of Turing. During the course of his life, Turing's emotions became incompatible with the system he lived in.
I would say let's not bite that apple and continue our discussion and search for the essence of that small core and embrace the current incompatibility.

I thank you for your attention.