

Imagine/project how A.I. will improve people's lives by 2035.

Propose the role of Natural Scientists in making this happen.

Imagine waking up in 2035. AI is able to predict useful chemicals for every area of science, and scientists have used this to personalise all of our medicine, make every industrial process faster, and help break down our plastic waste – quite unlike the wars that science fiction depicted with AI. Without it, scientists wouldn't have time to run through huge databases of molecules to find every exact structural formula and stereoisomer that could bind to every specific receptor- but without the scientists to synthesise the chemicals and carry out the physical research into their chemical interactions, this vital knowledge would be wasted.

For years, science fiction writers were captivated with the idea of artificial intelligence, long before it became a tangible prospect for society. Currently, A.I. shows promise of losing the fiction element from science fiction, and becoming an inherent part of our daily lives. Over the last few years AI has improved exponentially, machines becoming able to make their own scientific discovery and use techniques like deep learning to beat humans in both games like chess and in predicting the tertiary structure of a protein. If AI continues to develop at this rate, by 2035 it is likely AI will be making many more scientific discoveries that change our lives in many different subtle ways.

One particular area that AI is set to have a huge impact in is genomics. The human genome project had sequenced the entire human genome by 2002, giving us a list of the billions of base pairs that encodes everything about us as individuals. An impressive feat, but of no use to scientists until we know what the genes represent. AI can sort through the sequence in a fraction of the time humans can, to compare the genes of individuals and predict the functions of genes from known data. This development could have potentially massive impact in the field of personalised medicine. Although bespoke medicine has long been an ideal for medical professionals due to its increased efficacy in treatment, the large cost involved and the time it would require has been a barrier. AI offers a way to overcome this – it can rapidly sequence DNA in a cell, look at all of the patients' alleles and suggest the most effective treatment based on the proteins that the genes show have been made in their body.

This technology isn't a fantasy- it exists today, albeit in a very primitive form. In 2007 humans lost their monopoly on scientific discovery when a robot hypothesised the function of 19 yeast genes and 18 of these turned out to be correct after the scientists tested them in the lab. This showed us the exact DNA code that generates the enzymes for catalysing specific reactions in this yeast species. By 2035, computer scientists may have developed 'general AI' for science, able to perform many different complicated functions. They could not only identify known genes but also predict the genes that lead to genetic diseases, and which base pairs are responsible for these mutations. This could make screening for these diseases more accurate and allow scientists to develop treatments using CRISPR technology to target the genes responsible. It would also allow scientists to know which genes they would need to edit to give particular characteristics, which would have applications in farming especially, enabling the growth of more durable and nutritious crops by increasing drought resistance or editing vitamins they contain.

Another interesting application of AI that could aid science in every area would be literature reviewing. As Isaac Newton famously said, doing your own research is 'standing on the shoulders of giants' – using other researchers' previous discoveries and adding our own to complete the whole picture. However, it can be hard to scour the millions of papers out there when you're working on a scientific project. It is estimated a new scientific paper is

published every thirty seconds, so it's more than likely that you will miss something along the way. This can be detrimental to a research project; you could find you've missed some vital information about an anomalous chemical bond for example, or even that someone has already investigated your hypothesis and disproved it. If AI could thoroughly search through all the scientific literature relating to your project and pick out any relevant information, scientists could save years of their time, and it could lead to making more informed theories and accurate discoveries. These AI 'speed-readers' have been suggested in the past, but they have yet to be developed enough to make a significant impact. However, by 2035 I believe this is an entirely realistic prospect for AI which could make an unprecedented impact on the rate of scientific discovery by aiding scientists in all disciplines.

Potentially the way AI could most significantly transform our lives would be to predict the progress and mechanism of chemical reactions. Although our understanding of chemistry has progressed significantly over the last decade, we still can't always accurately predict exactly how chemical reactions are going to play out. Molecules often behave in completely unexpected ways; we try to predict how they'll behave but there are always anomalies in the data that can have an important effect. AI will hopefully improve this – perhaps by studying all our collated data on chemical reactions it may be able to more accurately predict the behaviour of particular molecules, or even sub-atomic particles. This could have applications in industry, predicting which catalysts may work for any given reaction and how; pharmacology, predicting how different drugs could be synthesised and how they would work; in biochemistry, projecting how different biochemical reactions vital to our bodies take place; and in technology, predicting the movement of electrons in different elements. This may even lead us to be able to develop quantum computers, thousands of times faster than 2019's silicon semi-conductors. If AI can predict the movements of sub-atomic particles we may be able to harness this and use it in technology, one of the most important tasks quantum physicists are working towards presently.

Already Google's DeepMind has recently shown it is able to predict the ways proteins fold more accurately than any humans, one of the hardest challenges in biochemistry. As AI develops, it is likely that by 2035 we will have systems capable of predicting the shapes of thousands of proteins accurately, as well as uses for these proteins. AI could suggest particular sequences of amino acids that could fold into the protein structure most useful to catalyse a reaction or bind to an antigen on a pathogen, making it easy for us to synthesise these proteins from the suggested chemical formula. This would have thousands of applications, such as developing catalysts to break down toxic waste or non-decomposable plastics to reduce pollution.

An important use for this technology would be in drug development. Currently just 0.1% of potential clinical drugs make it to market, one of the most frustrating facts of science today. Despite most ideas for drugs being solidly based on research by lots of qualified scientists, the vast majority of drugs are found to be either completely ineffective or have an insignificant effect in the body. We think we have a good understanding of how most biochemical reactions in the body take place, yet when we send in chemicals we think will catalyse or inhibit certain reactions, more often than not they work completely differently to how we expect. Yet every new drug that is synthesised can cost up to £1.5 billion to bring to market, and takes an average of 12 years, a massive waste of resources and time. By 2035, AI may be able to improve the odds of a drug being successful, by having the ability to develop algorithms which are far more accurate than humans at predicting which chemicals will successfully alter biochemical reactions in the body. This could significantly improve people's lives – more effective drugs would mean more diseases can be treated, and people can have more effective relief from symptoms. It would also mean scientists spend less time

working on drugs that will be scrapped, and so are able to devote more time to other important projects.

Overall, AI has the potential to dramatically transform and improve many areas of science. Despite its uncertain reputation, AI improving our quality of life is far more likely than a robot apocalypse, and we should focus our efforts on developing AI that can work side-by-side with scientists to improve the scientific process. It has been suggested that AI may become intelligent enough to win a Nobel prize; by 1935, I truly believe that this is possible. AI is a catalyst for science- it speeds up the rate that science is developed and improved, but it is nothing without the scientists in the first place. Just as a catalyst can't replace the reactants, there's no either/or with scientists and AI – but together the process is much faster, richer, and more effective.

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