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A HUMAN AND COMPUTER PARTNERSHIP: THE MACHINE LEARNING OF THE FUTURE

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A Human and Computer Partnership: The Machine Learning of the Future

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Photo: Hemera Technologies, Getty Images.

Repetitive drudgery is a problem in many professions. In a radiology, for example, radiologists spend the majority of their time manually checking through images with no problems or relatively simple defects, which are easy to classify with an expert eye. However, radiologists should be able to spend more time considering images with harder to spot and more complex defects. What if Artificial Intelligence could solve this problem?

If we plug an AI into the diagnostic process of radiologists, we can make everything more efficient. While the AI handles the easy-to-spot defects in images, the radiologist's time is freed up, allowing him to spend longer looking at the more complex defects. And through active learning, the AI will become better and better at spotting defects the more examples it is given. So, if an AI and a radiologist work together to spot defects in images, the diagnostic process is greatly

improved, ultimately making the outcome for the patient better. Through active learning, we can take the radiologist's expertise and feed it into the algorithm, training it to spot defects with greater accuracy. Eventually, the AI will be able to operate with greater accuracy than a human expert, which has interesting implications for the future of healthcare.

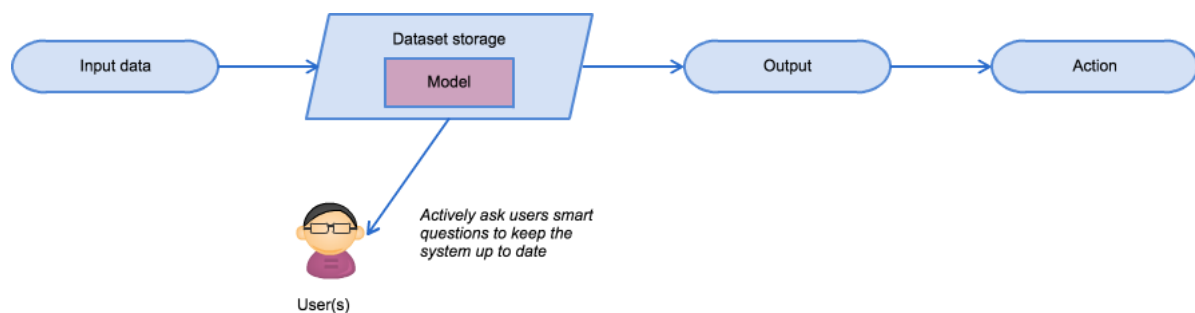
With this in mind, the future possibilities for active learning and AI are endless. We could take the expertise of the top five radiologist experts in the world, and, through machine learning, make their knowledge available anywhere. This will be hugely beneficial in fields with a scarcity of such expertise.

II *We could take the expertise of the top five radiologist experts in the world, and, through machine learning, make their knowledge available anywhere.*

This doesn't just apply to AI in the medical field, either. We could take the expertise of the top five experts of just about anything and make their knowledge widely available everywhere. The future of artificial intelligence will be democratised: everyone will be able to train their own AI to improve their lives.

What is active learning?

Active learning, also called human-in-the-loop learning, is a form of semi-supervised learning which involves allowing the computer algorithm to interactively query the human user when it is unsure about something. Ordinarily, an AI will take a given data set and through machine learning, produce an output. The difference when active learning is used is that the algorithm interacts with the human user to produce the output.



Human in the loop AI

The user is actively part of the production process as it gives the algorithm feedback when it makes a mistake. The model is able to explain why it has made a certain decision. Overall, the human judgment interacts with the AI in the same way that a teacher interacts with a pupil; the AI can ask the teacher questions and when it is corrected by the human it will learn from its error.

II *Overall, the human judgment interacts with the AI in the same way that a teacher interacts with a pupil*

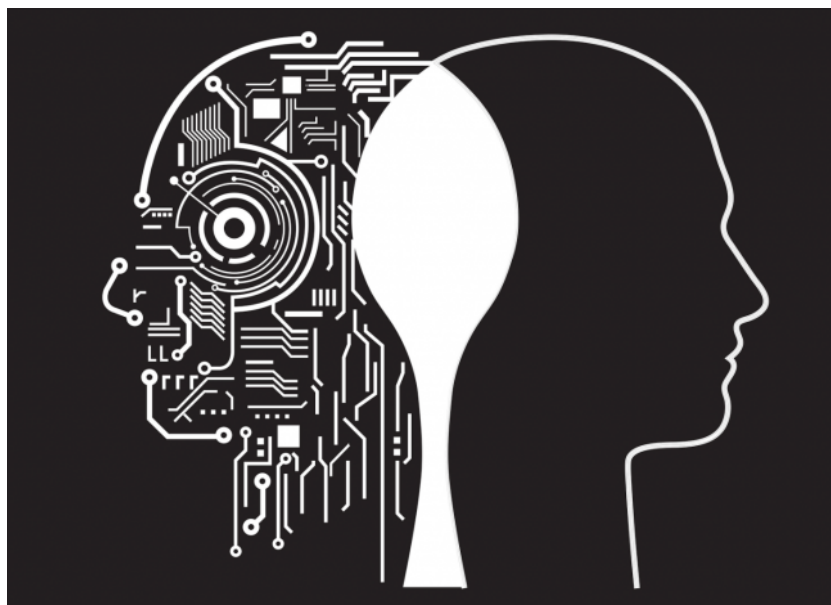
Why are humans an important element?

The most successful machine learning occurs when there is an element of human judgement, creativity and imagination involved in the process. There are also some things that humans just do better than machines, such as evaluating content (<https://www.forbes.com/sites/adrianbridgwater/2016/03/07/machine-learning-needs-a-human-in-the-loop/2/#15443003fce4>) suitable for certain platforms. Additionally, a human element to the machine learning process is important for building a good relationship with a client, using empathy and human understanding.

Also, without human interaction, a machine cannot adapt when its environment changes, which can lead to diminished results. For example, the software in a car will struggle to deal with unexpected changes in the weather, like snow. This is because the AI has been trained on a specific data set and so will look strictly at the variables it has been given. So when something changes, like the weather, it becomes outdated. However, with active learning, the AI is able to ask the human to give it input to help it improve, which enables it to better adapt to a changed environment. This has many real-world applications, since there is no such thing as a static environment in which no variables ever change.

Interacting with a human user also allows the machine to learn from its mistakes, as the human can nudge it in the right direction. The AI will ultimately become smarter the more it makes mistakes and learns from them. Therefore, in the same way that we humans learn best when we are able to ask questions and learn from our mistakes, so do machines. Active learning takes the principle of "practice makes perfect" and applies it to machine learning, making AI's smarter and more accurate.

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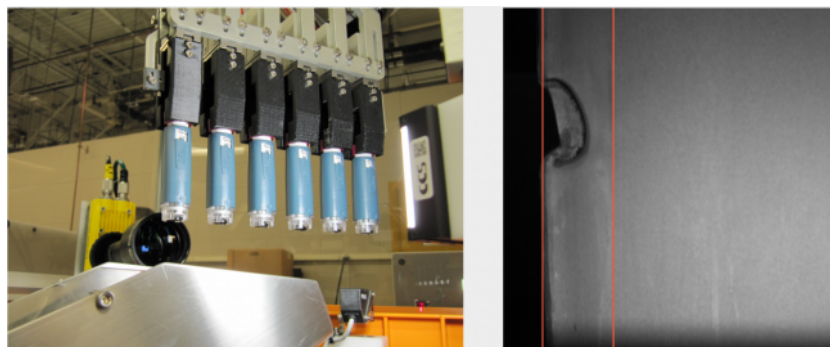
Fusion of human head with artificial intelligence, from Shutterstock

A good rule of thumb for AI and human collaboration utilises the principle of 80:20. While it's often easy to get an algorithm to achieve a rate of 80 percent accuracy, it is practically impossible to get it up to 99 percent. This is where active learning comes in: humans can handle that remaining 20 percent, as journalist Eden Shochat proposes. So, if we apply the 80:20 rule to machine learning, a collaboration between human intelligence and leads to greater levels of accuracy.

Therefore, not only does active learning solve a problem which is prevalent within many professions, that of repetitive tasks, but it also makes AI software smarter, more accurate and more adaptable to changes in the environment. Machine learning solutions are ultimately faster and better when humans are involved in the loop. The overall benefits of active learning are:

- Human creativity, imagination and empathy is infused in the process.
- Smarter algorithm that learns from making mistakes.
- Greater levels of accuracy – better solutions for a client.
- Less data needed.
- Can adapt to changing environment.
- Happy human user and happy client.

Active learning in action: Tata steel project



As an artificial intelligence company, we see the benefits of active learning in action every day. Our Tata steel project, for example, shows the capabilities that human-in-the-loop learning has. We were tasked with improving Tata steel's surface inspection process through machine learning. The stakes were high: the surface inspection is a crucial step in their quality control process and any errors made can lead to disastrous consequences. Their existing system had to classify millions of images a day and could identify common defects, but wasn't always effective at detecting visually complex defects. It was a challenge as the data sets were not always representative and the environment was often changing; the use of a different steel, for example, meant that the algorithm could quickly become outdated.

Therefore, active learning was an integral part of providing our client with a viable machine learning solution. Scyfer's plan was to first properly understand how the expert's eye works in detecting the complex defects and how they deal with them. We then built a customised machine learning platform that uses computer vision to detect the defects. The images are produced daily, which helps to train and test the model. And the more examples we give the software, the better it gets. So, the more images of visually complex defects in the steel that it sees, the better it becomes at identifying these defects. The machine is also able to adapt to changing environments, such as changes in lighting or steel, since it learns through interacting with a human user. Therefore, our approach combines human expertise with a software capacity able to handle massive amounts of data every day.

You can find out more about how we used active learning in our Tata steel project here.
(<http://scyfer.nl/portfolio/quality-inspection/>)

Machine learning in the future

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AI removes the problem of repetitive tedious work from many jobs, allowing professionals to focus on the things that matter, while the AI handles the tedious stuff.

We believe that in the future, active learning will be an integral part of machine learning and everyone will have access to AI which interactively involves a human user. AI removes the problem of repetitive tedious work from many jobs, allowing professionals to focus on the things that matter, while the AI handles the tedious stuff. Therefore, making sure the human and computer work well together is crucial, as it is a partnership between man and machine that will ultimately yield the best results.

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