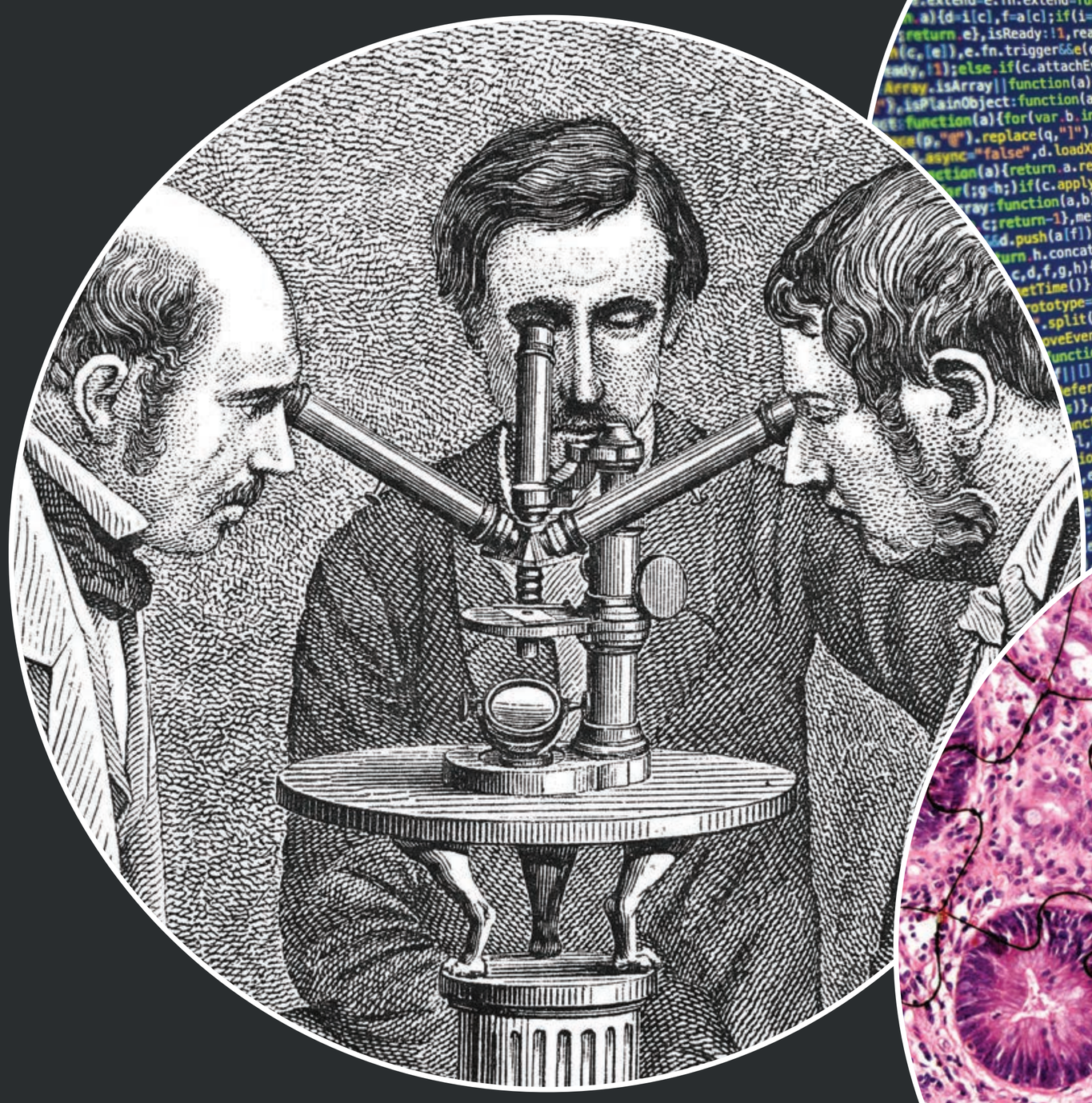
Digitising Disease

Artificial intelligence under the microscope.



Artificial intelligence (AI) is playing an increasingly important role in the way diseases are diagnosed. But what is meant by AI and what do patients need to know about its use in healthcare? This exhibition puts AI under the microscope, raising a series of questions posed by patients and the public concerning the use of AI when diagnosing disease.

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What is Artificial Intelligence?

Artificial intelligence, or AI, is predicted to change our world in many ways. From driverless cars and advanced robots to facial recognition systems and smart home devices, we are beginning to see that change all around us.

But what is meant by AI?

There is no agreed upon definition of AI. When medical researchers use the term, however, they usually refer to a field of computer science and engineering, one concerned with programming computers to perform "intelligent" or complex tasks.

But some tasks are too complicated to program "by hand," and in these cases computers can learn to write their own instructions for how to complete a task. "Machine learning" is the name given to this type of AI program.

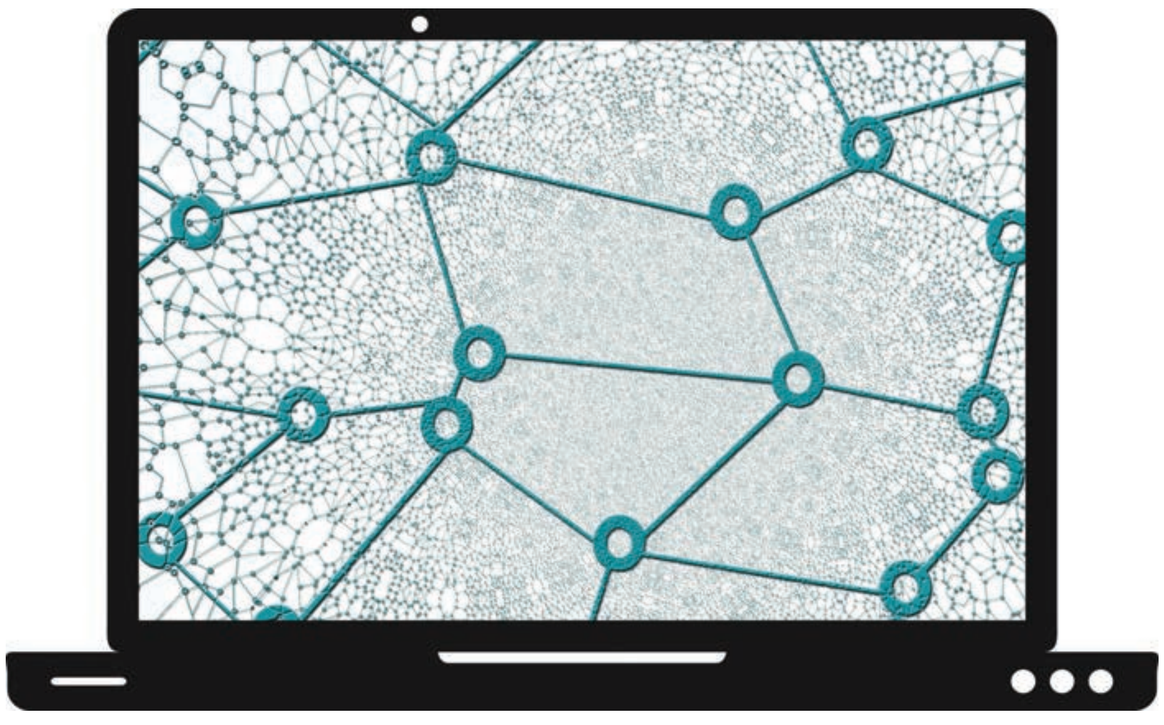
COMPUTERS LEARNING COMPLEX TASKS BY ANALYSING LARGE AMOUNTS OF DATA

How does AI "learn"?

"Deep learning" is a new AI process by which computers learn how to perform tasks. In deep learning, the computer is fed large amounts of data and looks for patterns which it uses to make predictions regarding new data.

Deep learning techniques are modelled on how we understand the brain to work. The brain learns from repeated experience, which strengthens the connections between "neurons" or brain cells. With deep learning, the computer learns from data. And the more data it has, the better it gets at learning and performing the task.

The technology is already used in everyday life, for instance, when using online image searches. The question is whether that same technology can be used in medical research to recognise images of diseased tissue.



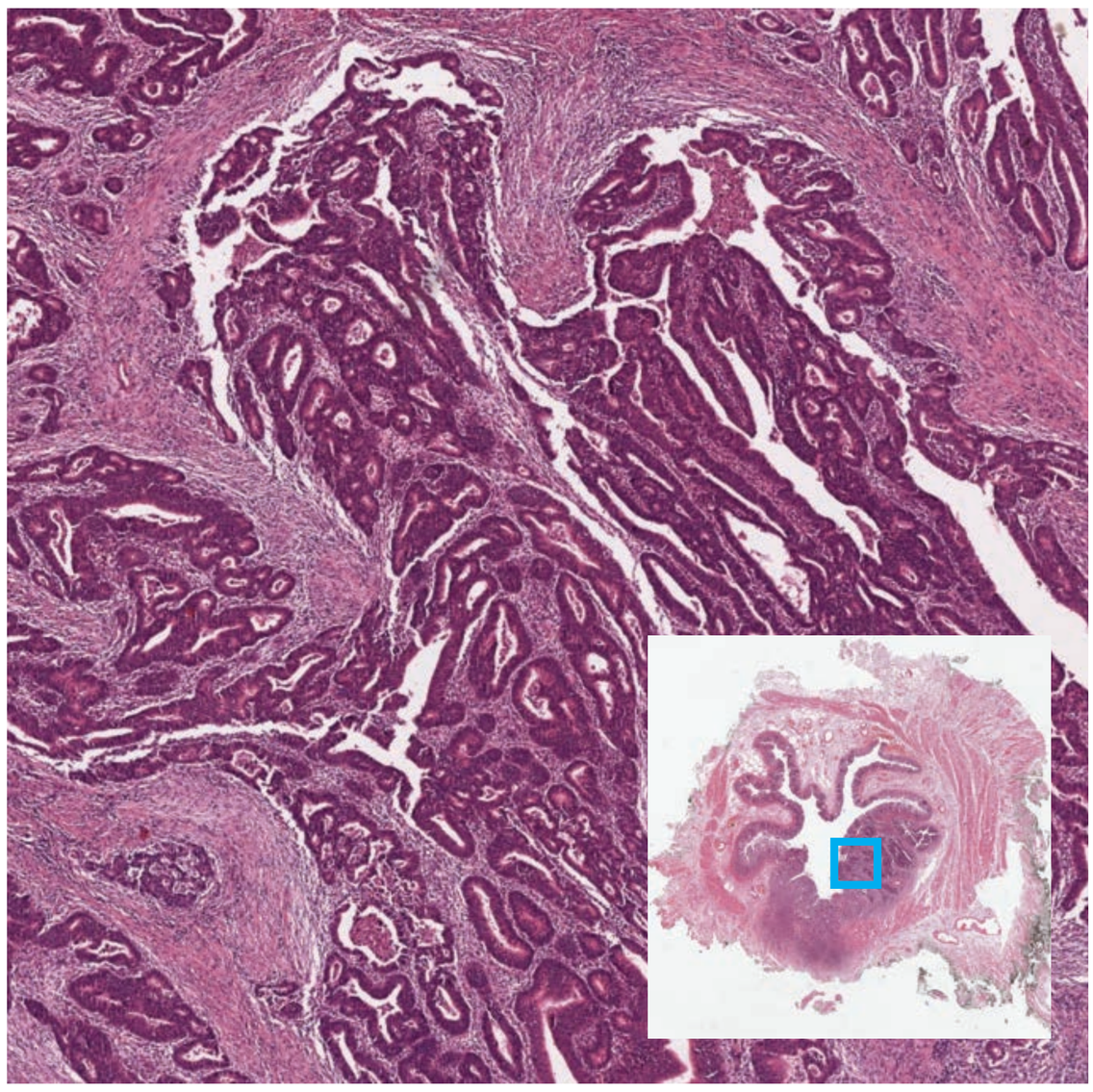
How could AI help diagnose disease?

If a patient has symptoms of a disease, a "biopsy" (a sample of their tissue) may be taken. A specialist doctor, called a pathologist, then uses a microscope to view thin slices of the biopsy to see if they can identify patterns of disease. They also write a report explaining the diagnosis, how serious or advanced the disease is, and what treatments may work.

Some hospitals now use "digital" methods instead of microscopes, scanning the tissue slide so it can be viewed on a computer screen. These digital images can also be saved in a database, which can be used for training AI to find patterns in the data using deep learning techniques. Those deep learning technologies could, in the future, assist pathologists with various tasks, including:

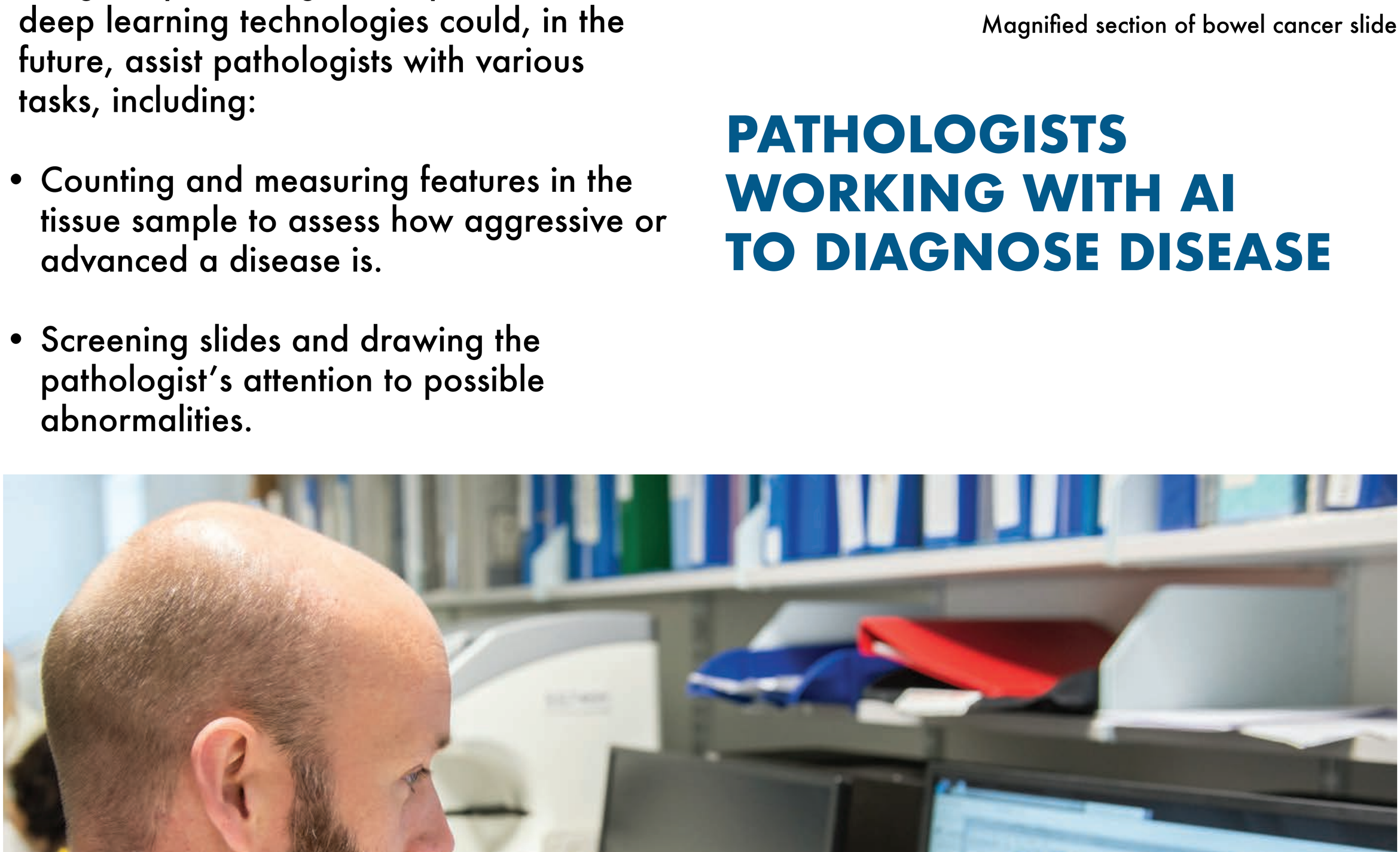
- Counting and measuring features in the tissue sample to assess how aggressive or advanced a disease is.

- Screening slides and drawing the pathologist's attention to possible abnormalities.



Magnified section of bowel cancer slide

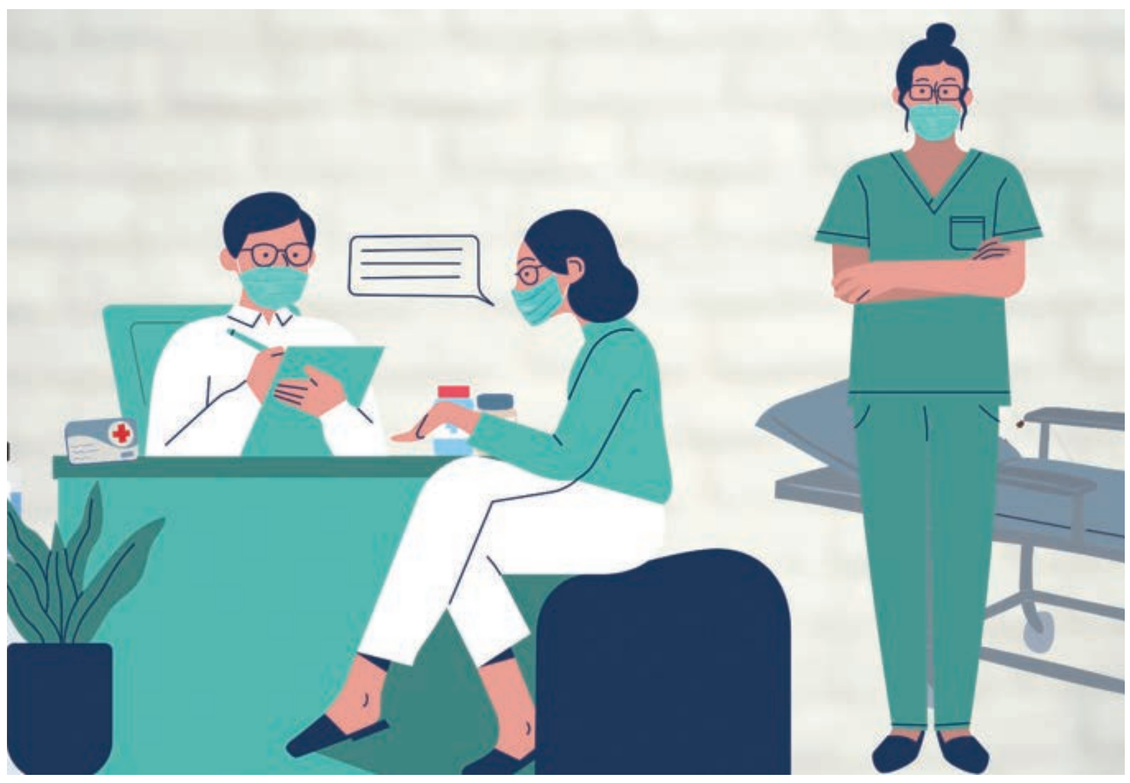
PATHOLOGISTS WORKING WITH AI TO DIAGNOSE DISEASE



What are the benefits of using AI?

Research is revealing multiple potential benefits for both patients and the healthcare system when using AI for diagnosis.

01 More Efficient



AI could improve the efficiency of diagnosis, allowing the NHS to examine slides more quickly and cheaply. This could lead to faster diagnoses and treatment. And by replacing some of the simple, repetitive tasks of diagnosis, AI would allow doctors to concentrate on the most urgent or complex cases.

02 More Accurate

AI could produce more accurate and repeatable measurements. If it is presented with the same slide again, for instance, a computer will always reach the same answer, whereas human pathologists can sometimes form different opinions when there is uncertainty.

03 More Patients Diagnosed

Improving efficiency of diagnosis means more patients can be seen. In addition, some diseases are rare, requiring specialist knowledge to diagnose. In those instances, AI could compare images with a library of millions of different diseases to suggest possible diagnoses so that rare cases can be identified and treated more quickly.

04 New Discoveries

AI could help us gain new insights into disease and spot diagnostic clues that humans cannot perceive. This could open up new areas of medical research and help doctors to develop targeted treatments for individual patients.

What are the risks and risk protections?

Patients understandably have many questions and concerns about the adoption of new medical technologies in the NHS.

"What happens if AI is commercialised?"

Putting public health first

Many people are concerned about commercial involvement in the NHS and how it could affect healthcare's commitment to patient care. As with many tools developed for medicine, the NHS will likely need to involve commercial partners to develop, install, and support AI's use in the hospital. Research and development of those tools, however, should be driven by public benefit, rather than profits.

"Can computers make mistakes?"

Keeping doctors "In the loop"

Before AI can be used to support diagnosis, it will undergo many checks to make sure it is safe and reliable. But computers, like humans, can make mistakes. That is why rather than fully automate the process of diagnosis, computers should be used to only make recommendations that the pathologist oversees. Keeping a human in the loop would help mitigate the risk of automated errors.

"Will my data be protected when shared with researchers?"

Anonymising patient data

AI needs patient data to work. Hospitals have multiple layers of data protection that prevent unlawful sharing of patient data. When sharing data for research, this includes de-identifying patient data, i.e., removing or obscuring details such as names, NHS numbers, exact dates of birth, etc. so that patients cannot be identified from the data that is shared.

"Will everyone benefit equally?"

Ensuring diversity & equality

It is important that algorithms work the same for everyone. By digitalising pathology slides across the UK, and training AI systems on datasets that contain every type of cancer, future AI can be used for the benefit of all.

Have your say!

How AI should be brought into medicine is a question that concerns not just doctors and computer scientists, but all of us. As a consequence, it is up to all of us to decide how it should be used. The best way to shape the future medical use of AI is to be part of the discussion. We have **3 ways** you can be involved:

1. You can complete our survey to let us know what you think about the use of AI for diagnosis. You can access the survey using the QR code on the left.

2. You can apply to take part in our upcoming online citizen's panel, during which members of the public will debate the pros and cons of AI in diagnoses to determine its future development. For more information on how to apply, and to show your interest, please email francis.mckay@ethox.ox.ac.uk

3. If you have specific questions that come up from reading the exhibit, please contact Bethany Williams at NPIC@leeds.ac.uk or visit us at www.npic.ac.uk for more information.

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Contributors:

The exhibition was co-curated by: Francis McKay, Nina Hallowell, Milly Farrell, Nick Pitt, Bethany Williams, Graham Prestwich, Eloise Pearson, Alex Wright, Darren Treanor, Derek Maee, and the members of NPIC's Patient and Public Advisory Group. Additional advice was provided by Kelly Richards (Oxford University Museum of Natural History) and Michael Fulton (Leeds Teaching Hospital Trust). Panels were designed by Francis McKay and Gemma Hattersley Pitt.