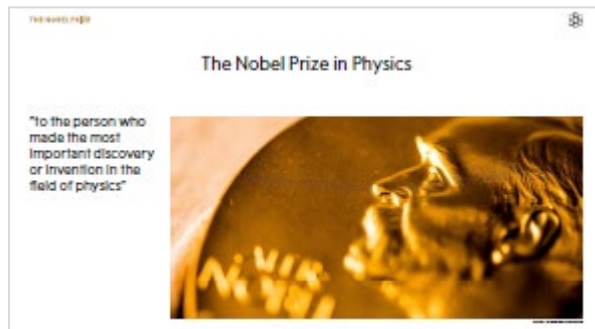


THE NOBEL PRIZE

Speaker's manuscript – Physics prize 2024 Inventions behind AI

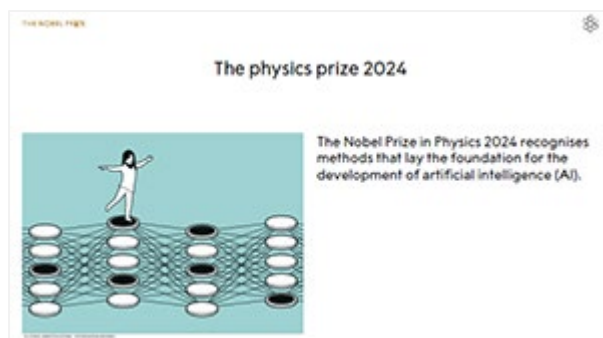
The Nobel Prize in Physics

- The Nobel Prize in Physics is one of the five prizes founded by the Swedish inventor Alfred Nobel and awarded on 10 December every year.
- Before Alfred Nobel died on 10 December, 1896, he wrote in his will that the largest part of his fortune should be placed in a fund. The yearly interest on this fund would pay for a prize given to “those who, during the preceding year, shall have conferred the greatest benefit to humankind.”
- The interest would be divided into five equal parts, with one part awarded to those who “shall have made the most important discovery or invention within the field of physics”.



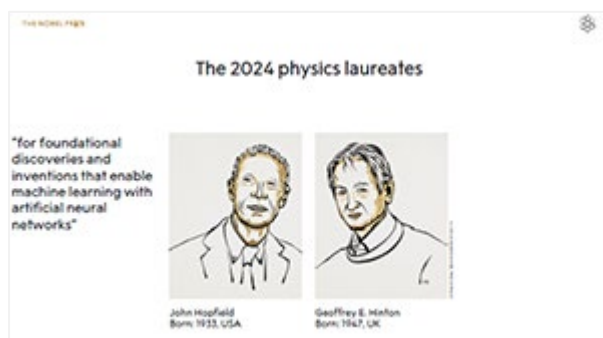
The physics prize 2024

- In recent years, artificial intelligence, or AI, has become a common topic of discussion in our society. And we encounter new applications for AI in everyday life with increasing frequency.
- The Nobel Prize in Physics 2024 recognises methods that provide an important basis for the development of AI.



The 2024 physics laureates

- AI is usually based on what is called "machine learning with artificial neural networks." Machine learning means training a computer to be able to chat, for example, or to drive a car or interpret images of faces and plants.

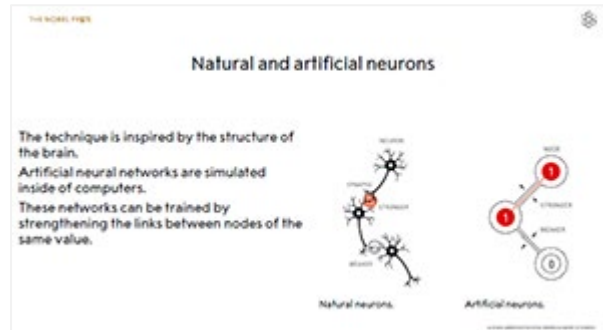


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- John Hopfield is a professor at Princeton University in the United States. Geoffrey Hinton is a professor at the University of Toronto in Canada.

Natural and artificial neurons

- The technique was initially inspired by the structure of the brain. The brain is made up of neurons (or cells) that are interconnected with one another.
- Artificial neural networks are constructed as simulations inside computers. In an artificial neural network, the brain's cells are represented by nodes (or points) that are connected together with one another. The nodes can have different values, like 0 or 1, or other types of values. The nodes influence one another by making the links between them stronger or weaker.
- Training the network makes the links between nodes which are active at the same time stronger and links between nodes that are not active at the same time weaker.



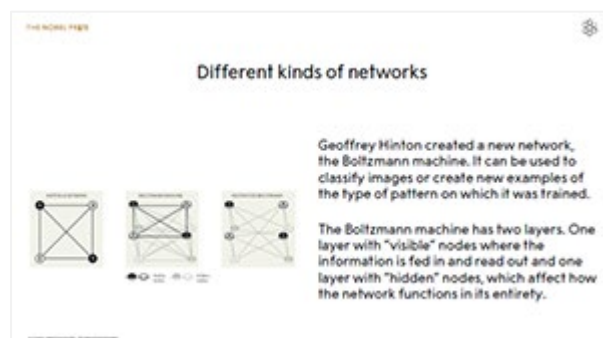
Memories are stored in a landscape

- John Hopfield found inspiration in physics' descriptions of the way the many small parts of a system influence the system as a whole. Hopfield invented a network that can save and recreate patterns. We can think of the nodes in a network as pixels in an image.
- Information is stored in a way that is comparable to the formation of a landscape. When the network is being trained, each pattern that is stored forms a valley of low energy in the landscape. When a distorted or incomplete image is fed into the network, it passes through the nodes and updates their values so that the network's energy falls. The network thus works stepwise to find the saved image that is most like the imperfect one that was fed into it.



Different kinds of networks

- Geoffrey Hinton created a new network based on the Hopfield network, and he called it the Boltzmann machine. Hinton used tools from statistical physics, the science of systems built from many similar components, such as atoms in a gas.



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- In the Boltzmann machine, there are two layers, one with "visible" nodes on which information is fed in and interpreted and another with "hidden" nodes that impact how the network functions as a whole. The Boltzmann machine can learn to distinguish characteristic attributes from a data set. The machine can be trained by feeding it examples that are very likely to arise when the machine is run.
- The Boltzmann machine can be used to classify images or create new examples of the type of pattern on which it was trained. For example, it can be used to recommend movies or television shows based on the viewer's own personal preferences.

Machine learning today and tomorrow

- Machine learning is used in many different fields today.
- In physics, for example, machine learning is used to search for planets in other solar systems, known as exoplanets.
- Many researchers today are working to develop different areas of use for



machine learning. It remains to be seen which applications will turn out to be most useful. Meanwhile, there is an ongoing discussion of ethical questions surrounding how the technology should be developed and utilised. In addition to providing us with valuable new tools, could AI also pose a threat to human values?

"I am someone who doesn't really know what field he's in but would like to understand how the brain works."

- In an interview given in conjunction with the announcement of the 2024 Nobel Prize in Physics, Geoffrey Hinton discussed his research and how he sees the development of AI.
- When asked whether he saw himself as a data scientist or a physicist when he invented his method, he said his foremost motivation had been to understand how the brain works.
- Hinton also described the anxiety he feels about the development of AI and how important it is for the big technology companies to take responsibility for and invest resources in research on security and control.

