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Report about Neural Networks as paradigm to simulate human intelligence

a) What led Geoffrey Hinton to believe in neural networks as the right path to understanding and simulating human intelligence?

Geoffrey Hinton believed neural networks were the right way to understand and create human-like intelligence because he was not satisfied with other traditional explanations. When he was studying the brain through physiology at Cambridge, he thought he would learn how the brain actually works. However, all they focused on was how neurons send signals (called action potentials), which he found very interesting but not helpful in understanding actual learning and thought processes.

Because of this disappointment, Hinton switched his focus toward philosophy and artificial intelligence. He discovered the idea of learning through strengthening connections between neurons, which comes from Donald Hebb's hypothesis. Hebb suggested that learning happens when neurons work together, and their connections become stronger over time. This idea felt more realistic to Hinton because it matched how learning happens in real life—through experience and interaction, not by following logical or pre-programmed instructions.

Hinton was also inspired by John von Neumann and Alan Turing's exploration of how the brain works differently from computers. They showed that the brain's way of computing is unique and not based on strict logic alone. These influences made Hinton believe that artificial neural networks, which try to mimic how neurons interact, could help scientists better understand how learning and intelligence work. This is what led him to focus his research on neural networks as a way to explore how intelligence might emerge from networks that act like the brain

b) How physics fundamentals help Geoffrey Hinton to obtain the necessary insights to develop his research and discoveries related with Neural Nets?

Geoffrey Hinton learned a lot about neural networks by using ideas from physics, particularly from a branch called statistical physics. Statistical physics studies how groups of small things (like gas molecules) interact and behave together as a group, even though it would be impossible to study each molecule individually. This idea helped Hinton build his first neural networks by focusing on how a group of connected nodes (or neurons) could interact with each

other to solve problems and recognize patterns. His first model, called the *Boltzmann machine*, was based on these principles. The Boltzmann machine uses probabilities and energy to learn patterns, much like how physical systems behave by finding their lowest energy state.

Hinton also took inspiration from the study of magnetic materials. In physics, these materials can form patterns because the magnetic fields of neighboring atoms influence each other, creating regions with the same magnetic direction. Hinton used this idea to create a model of how neural networks might work. The idea was that networks of artificial neurons could adjust their connections in similar ways to find stable patterns, just like how physical systems find balance or "low energy states" to maintain stability.

This connection between physics and neural networks gave Hinton a new way of thinking about how these networks process and store information. His understanding of these physical interactions led to the development of key techniques in machine learning, including deep learning. These deep learning models rely on training neural networks with data to learn patterns, just as Hinton learned by connecting statistical physics ideas with artificial intelligence. His ability to borrow and apply physics concepts to artificial intelligence research has been a key part of why modern machine learning works as well as it does today.