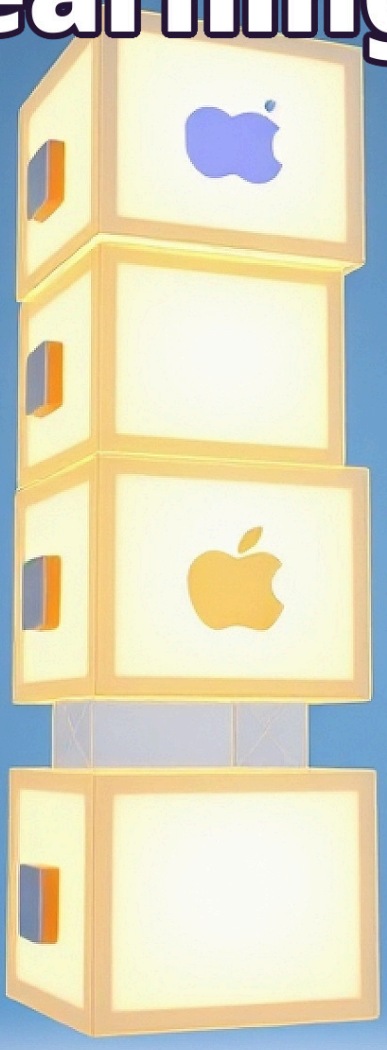
What is deep learning?



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You ask: what is deep learning? The short answer is that it is a machine learning approach that uses multi-layer artificial neural networks. That one sentence is your anchor: machine learning, neural networks, and many layers. Everything else in this book simply explains those words in order, so you can understand the whole idea from zero.



Machine learning means a computer learns from examples instead of being given fixed rules. You show it many examples, and it adjusts itself to give good answers. Deep learning is one way of doing this, so it sits inside the bigger idea of machine learning. Think of machine learning as the large box, and deep learning as one method inside that box.



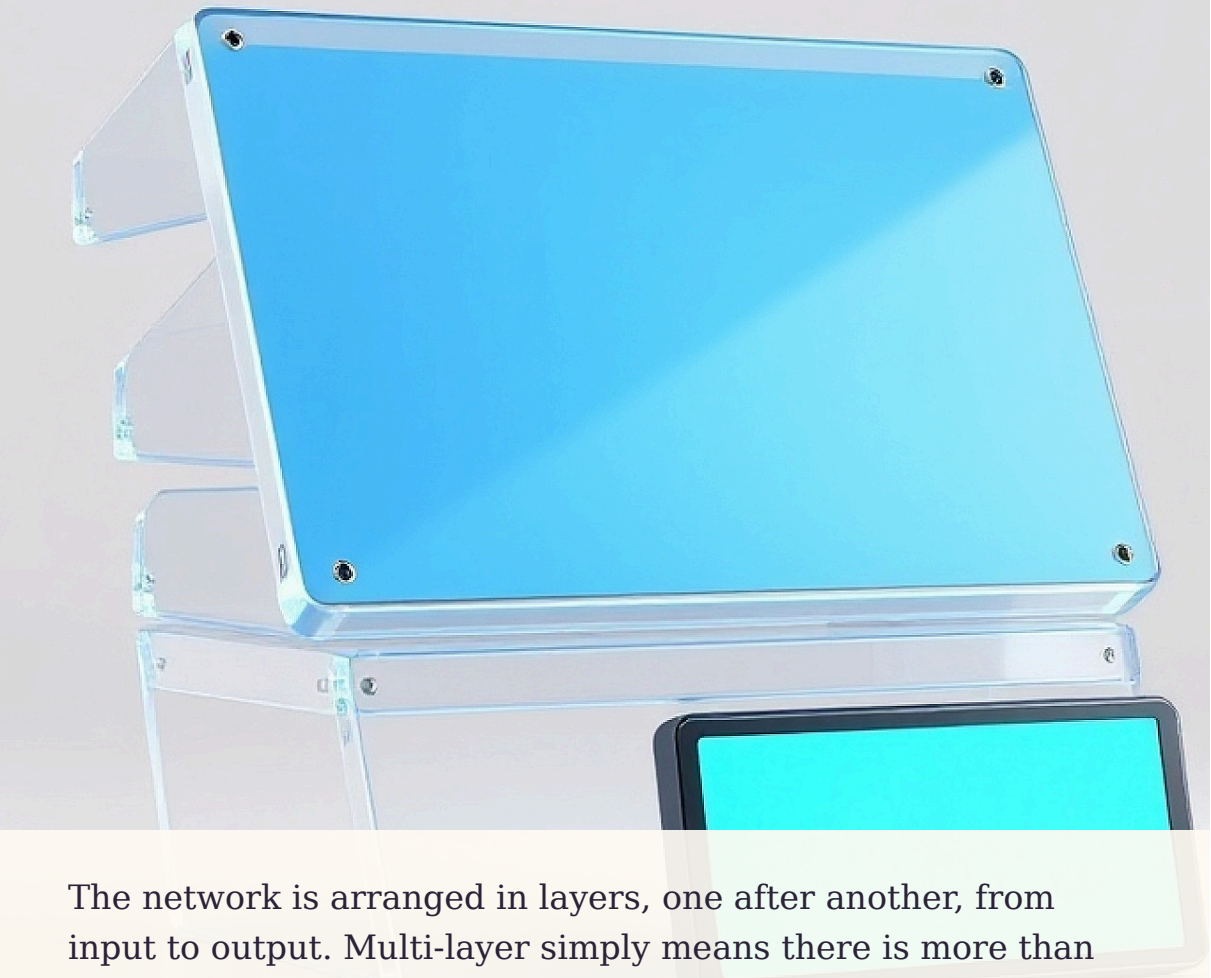
Learning from examples works like this: show the system many examples, and it adjusts itself to give good answers. You do not tell it every rule in advance. For instance, show a system thousands of photos labelled cat or dog, and it learns to tell them apart. This makes clear that the system improves by seeing data, not by being told every rule.



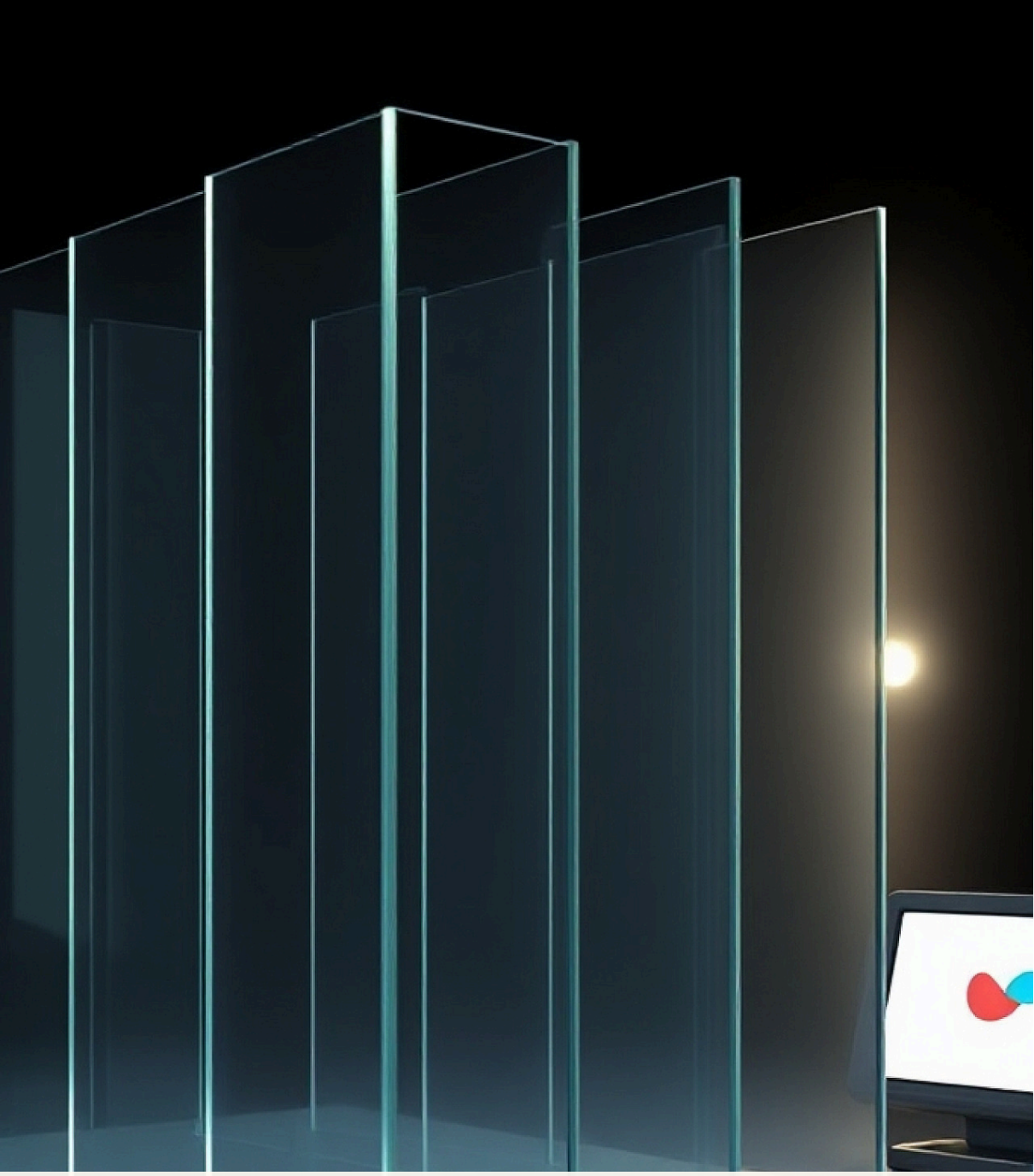
An artificial neuron is a tiny unit that takes in numbers and produces an output number. It is the smallest building block of the network. For example, it might take in several numbers, weigh them, add them up, and pass on one result. Many of these small units together form the building blocks of a neural network.



A neural network is a set of artificial neurons connected together. The outputs of some neurons become the inputs of others, so signals pass along the connections. This connected set of units is what we call an artificial neural network. You can picture it as a group of small units linked in a chain, each passing numbers to the next.



The network is arranged in layers, one after another, from input to output. Multi-layer simply means there is more than one such layer in the chain. For example, a network might have an input layer, two middle layers, and an output layer. The word multi-layer describes this arrangement, nothing more complicated than that.



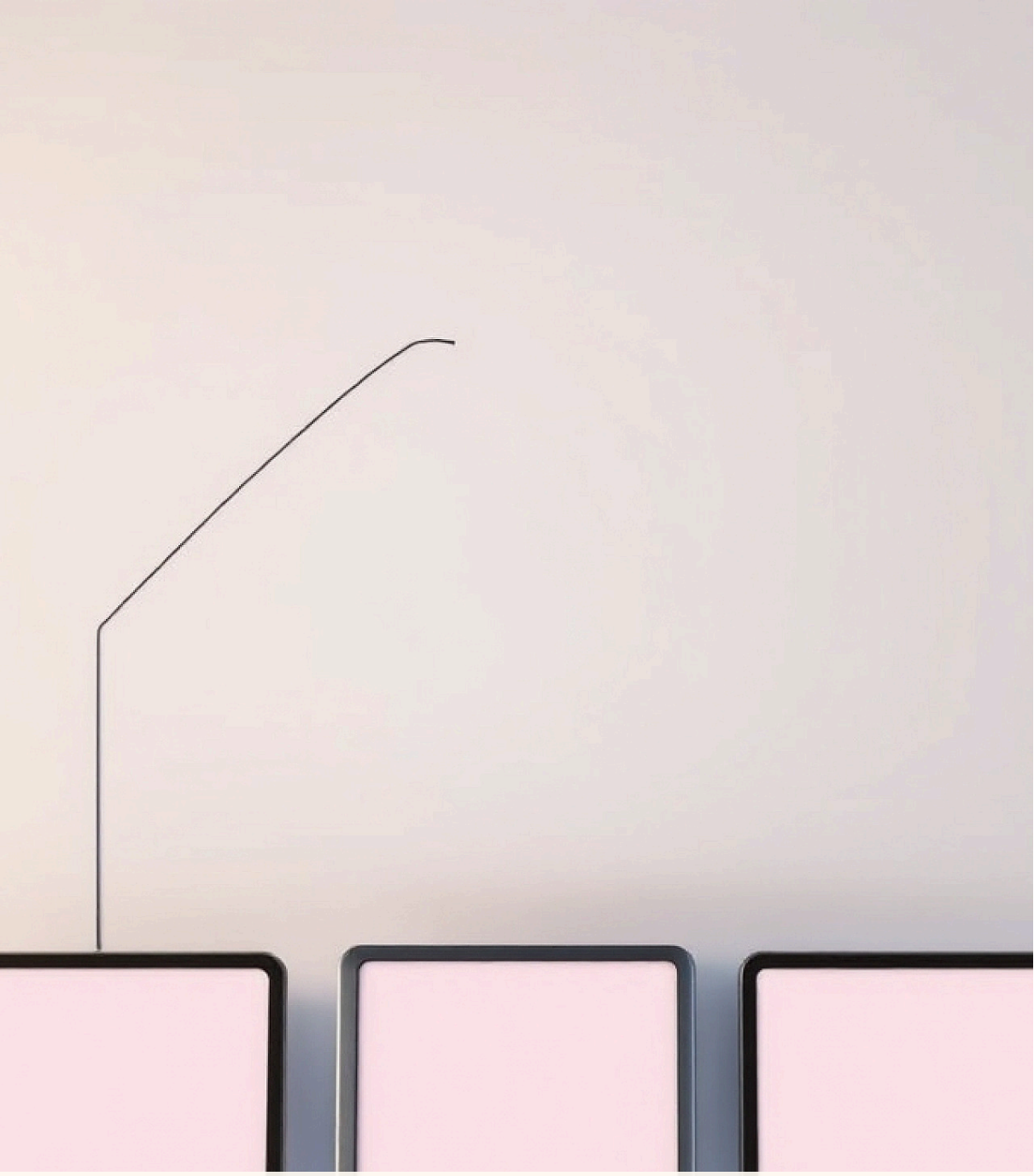
Data enters the first layer and passes through each layer in turn. Each layer hands its result to the next one, so processing happens in stages. For example, a photo goes in at the start, and numbers move forward layer by layer until an answer comes out at the end. This staged flow is the core of how the network works.



Each layer learns relationships in the data that are useful for the task. The layers are not told these relationships; they are learned from examples. For instance, during training the network adjusts its internal numbers so its answers get better. Over many examples, each layer finds patterns that help the whole network produce good results.



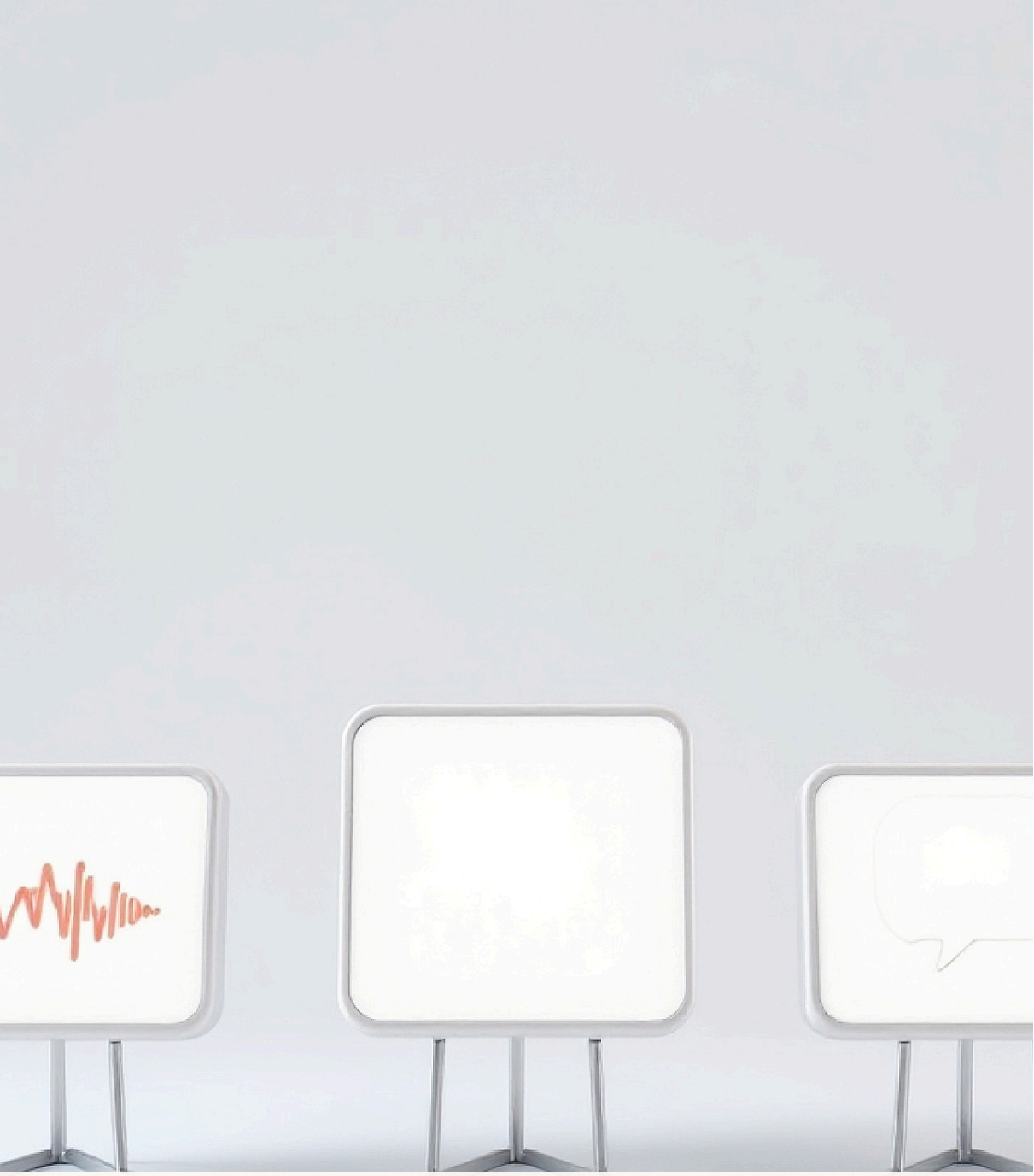
In an image system, early layers are linked to simple things like lines and patterns. These simple features are the first things the network picks out. For example, one early layer may respond to short edges, and another to small patches of colour or texture. Starting with simple lines and patterns gives the network a basic vocabulary for looking at pictures.



Later layers combine the simple lines and patterns into more complex combinations. Step by step, simple pieces build into richer features. For example, lines may join into corners, and corners into shapes like circles or rectangles. Each later layer takes what earlier layers found and builds something a little more meaningful from it.



Follow the chain from simple lines to complex combinations that can describe an object in the image. Early layers find lines, middle layers find shapes, and later layers combine shapes into something like a face or a car. This shows why processing in stages helps with a whole picture: small pieces add up to a complete description.



The same layered approach is used in image, sound and language processing. The examples change, but the idea of layers learning in stages stays the same. In sound, early layers may pick out simple tones; in language, they may pick out simple word patterns. In every case, simple features come first and complex ones come later.



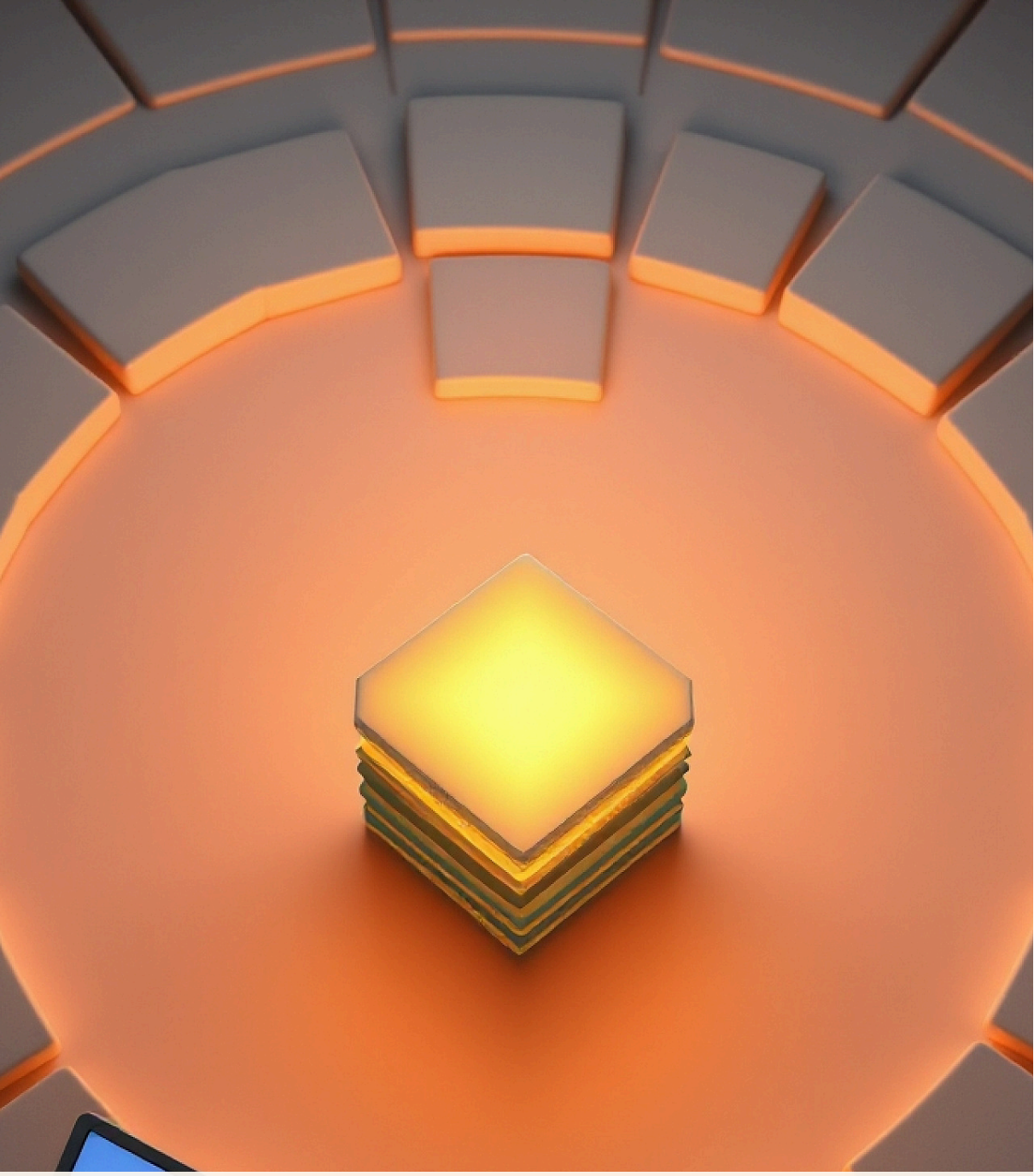
The word deep describes the layered structure of the network, not depth of thought. It is just a name for having many layers in a row. For example, a network with ten layers in sequence is called deep simply because the chain is long. Nothing about the word deep suggests that the system thinks or understands.



A common mistake is to think deep learning copies a human brain or thinks like a person. It does not. It is a layered network that learns from examples, nothing more. It adjusts numbers to give good answers, but it has no feelings, no understanding, and no awareness. Keep this clear to avoid confusion.



Another common mistake is to think deep means the system is thoughtful or especially intelligent. It only refers to the number of layers in the network. A deep network with many layers is not wiser than a shallow one; it simply has more stages. The name describes structure, not smartness, so do not read more into it.



To sum up: deep learning is machine learning with multi-layer neural networks that process data in stages and learn useful relationships. Remember that deep means the layered structure, not depth of thought. Keep the short answer in mind: machine learning, neural networks, many layers. With these three ideas, you can explain deep learning to anyone.