EdSutra

Teaching guide

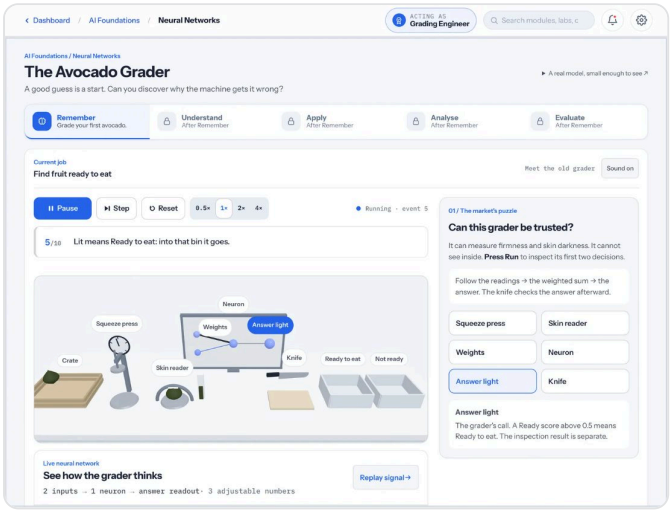
Module 01 · AI Foundations · Unit 04 · Stage 1, Foundations

Neural Networks

The Avocado Grader

Grades 7–10 | **30 minutes** | Role: **Grading Engineer** | **Free**, no account needed

Grade 7: About age 12–13 · Year 8 in the UK · Class 7 in India



The big idea

A neuron multiplies each reading by a weight, adds a bias, and lights up when the total is high enough. One neuron makes one straight cut, so it cannot pick out avocados that are ready to eat, between rock-hard and mushy. Two neurons together can. Training is the computer nudging every weight to make fewer mistakes.

The learner's job

Learners are the **Grading Engineer** at Halden Market · Packhouse. This grader reads two numbers per avocado. Right now it can't tell ready from mushy. Their task: teach the grader to spot ready-to-eat. Then explain what each neuron learned.

By the end, learners can say

- I can name the parts of a neural network (inputs, weights, bias, neuron, output)
- I can work out by hand whether a neuron lights up from its readings, weights and bias
- I can train a network and choose how many neurons it needs
- I can explain what each trained neuron learned, and choose between networks on evidence

Before class

- One computer or tablet for each learner or pair, with EdSutra open. Module 1 is free and needs no account.
- Open the studio once on each device before class, so the Unit still runs if the internet drops.
- Play the first two steps yourself, so you know where learners will click and how the dials feel.
- Draw a squeeze line on the board from 0 (mushy) to 1 (rock-hard). You will use it in Apply to show one cut against two.
- Pairs work well: one learner drives, the other is the Grading Engineer who records each run's settings and score.
- Best after AI Alphabet and What is AI? and How Machines Learn.
- Units open in order: a learner new to EdSutra starts at AI Alphabet. With the full studio, Open every Unit in Settings → Teachers & parents lets a class start here.

Words to introduce

Input: A reading the network gets, here squeeze and skin darkness, from 0 to 1.

Weight: A number that sets how much one reading counts in the sum.

Bias: A number added to the sum. Here it does not mean unfairness.

Neuron: Adds weighted readings and a bias into a signal from 0 to 1.

Hidden neuron: A neuron between the inputs and the output; nobody tells it its job.

Output: The final neuron that makes the call: Ready to eat or Not ready.

Training round: One pass through all 24 labeled practice avocados, nudging every weight.

Running the lesson 39 minutes

Open 5 min

"A machine can only squeeze an avocado and check its skin color. Could it ever tell you which avocados are ready to eat?"

Before anyone clicks, ask: is a ready avocado hard, soft, or in between? Then: could one rule, like "softer than this line", pick out only the ready ones? Note the votes and come back to them in Apply.

Step	What learners do	Ask the class	Listen for
1. Remember 5 min	Learners press Run and follow two avocados through the shop's old one-neuron grader. They predict the second, softer one before the knife shows the truth, then answer: what does a weight do?	• Which two readings does the grader use, and what can it not see? • What did the knife show about the second avocado?	The grader only sees squeeze and skin; it called a mushy one ready. A weight sets how much a reading counts.
2. Understand 8 min	Learners predict whether the old neuron lights up for a rock-hard avocado. Then they turn three dials (firmness weight, skin weight, bias) until it lights for rock-hard ones only, and run the practice crate.	• What happens to the sum when you make the firmness weight bigger? • What does the bias do, if it is not about fairness?	A bigger firmness weight lifts the sum for hard avocados. The bias is added every time, shifting where it lights.
3. Apply 9 min	Learners choose 1 to 3 hidden neurons and 50 to 2,000 rounds, predict how many of 12 new avocados it gets right, and train. Then they compare one neuron with more at the same rounds.	• One neuron trained for 2,000 rounds: did it get there? Where did the mushy avocados go? • Look at our squeeze line. Can one cut keep only the ready avocados on one side?	Ready avocados sit between rock-hard and mushy. One straight cut cannot fence in the middle; two neurons can.
4. Analyze 6 min	Learners probe each neuron of their trained network: the practice crate runs through, and each avocado lands in Lit or Dark by that neuron alone. They name each neuron's job.	• Nobody told the neurons their jobs. What job did each one find? • Why did one hidden neuron miss the middle group?	One lights for any avocado that is not rock-hard, one for mushy ones. The output combines them to find ready-to-eat.
5. Evaluate 6 min	Learners run graders A, B and C on the stall's crate of 12, pick one to send, and back it with one fact from the runs. They also choose what the market should check next.	• B and C both got 12 of 12. Which would you send, and why? • Grader C has the most neurons. Why is that not evidence on its own?	A choice backed by results on the stall's crate, such as B matching C with fewer numbers, not by size.

Steps follow Bloom's revised taxonomy, in the order the Unit presents them.

Deepen the thinking

Critical thinking	A grader got 12 of 12 on one crate. What would you still want to know before trusting it with every delivery?
AI thinking	Face unlock uses a far bigger network than our grader. What stays the same inside it, and what gets harder to explain?
Ethics and fairness	If a grader decided loans or school places instead of avocados, who should be able to open the black box and ask what each part does?
Connect to life	Think of a choice you make by weighing two things, like whether to bike or take the bus. What would your weights be?

Misconceptions to listen for

"A weight is how heavy something is."

The Remember question shows it: a weight sets how much one reading counts in the sum. A weight of 0 ignores that reading.

"Train it longer and it will get there."

One neuron trained for 2,000 rounds still sends every mushy avocado to Ready to eat. Training can only move the one line it has.

"More neurons is always better."

Grader C's three neurons scored no better than grader B's two, and C has more numbers to check. Evaluate refuses "more neurons" as evidence.

In real life the card learners see at the end of the Unit

- Face unlock on many phones uses a neural network that learned which patterns match your face.
- Speech-to-text turns your voice into numbers, passes them through layers, and outputs its best guess at the words.
- At the post office, machines read handwritten addresses. Reading handwriting is a classic neural-network job.

Try it this week. At a shop, gently squeeze a few avocados or peaches. Sort them: rock-hard, just right, mushy. You're checking two things at once, like the grader's two neurons.

Watch out for. A network doesn't understand avocados or faces. It adds up readings times weights. A high score on one crate isn't proof it will work on the next.

Talk about it. Brains inspired neural networks. How is a network like your brain, and how is it different?

Exit ticket

1. What does a weight do in a neuron?

2. Why can one neuron not pick out the ready-to-eat avocados?

3. Which grader would you send to the stall, and what fact backs it?

Going further

In the full studio, the Neural Playground Lab lets learners draw their own digits, train a real network on them, and take it apart neuron by neuron. For homework, use the "Try it this week" activity from the In real life card.