

Weight Pond

Tune the frog's weights. Find out why one neuron isn't enough.

OBJECTIVE

A frog decides whether to jump with one sum: weight x left-right + weight x up-down + bias. If the total is above zero, it jumps. Drag the sliders until it jumps on every lily pad with a fly and none of the stones. Six ponds. The last two can't be done with one frog.

PLAY FREE AT [HIBOT.SPACE/GAMES/WEIGHT-POND/PLAY](https://hibot.space/games/weight-pond/play)

- 1 Each dot is a lily pad. Amber pads have a fly. Grey ones are stones.
- 2 The line is where the frog's sum is exactly zero. On the shaded side the sum is above zero, so the frog jumps.
- 3 Drag weight 1 and weight 2 to turn the line. Drag the bias to slide it. Get every dot right to clear the pond.
- 4 Stuck? Press Let it learn. The frog finds one dot it got wrong and nudges its numbers toward fixing it. Press again to watch it learn.

WHAT THE FROG TEACHES

- 1 A neuron is a weighted sum plus a threshold. Nothing more mysterious than that.
- 2 Weights are what a neural network learns. Training means nudging them after every mistake.
- 3 Some patterns can't be split by one line. Ponds 5 and 6 need two neurons working together: a layer.
- 4 Bigger networks are the same idea stacked up: millions of weights, all nudged by mistakes.

THE SIX PONDS

- 1 Left or right: The weight decides which way the line faces; the bias slides it. One number per idea.
- 2 Up or down: A different weight, the same trick. The frog doesn't know what up means. It just multiplies.
- 3 On a slant: Two weights together set the angle. Mixing inputs is what a neuron is for.
- 4 Off to one side: Bias moves the line without turning it. Try the Let it learn button: the frog fixes itself one mistake at a time.
- 5 The stripe: No single line can cut out a stripe. Two neurons and a rule for combining them can. That's a layer.
- 6 Opposite corners: This is the famous XOR problem. In 1969 it showed that one neuron can't learn everything, and it's one reason today's networks stack many layers.

NO SCREENS? PLAY IT UNPLUGGED

- 1 No screens? Draw 10 dots on graph paper, some circled. Students take turns drawing one straight line that separates circled from plain.
- 2 Then draw a stripe of circled dots across the middle. Can one line do it? How many lines does it take?
- 3 Ask: if a computer only had straight lines, how would it learn a curvy pattern? (Answer: lots of lines, combined.)