McCulloch-Pitts Network

Firing threshold $\Gamma = 2$

Heat receptor

Cold receptor

A active $\rightarrow$ heat felt
B active $\rightarrow$ cold felt

When happens when...

1) Present heat (activate heat receptor) for 1+ time steps? Heat felt
2) Present cold (activate cold receptor) for 2+ time steps? Cold felt
3) Present cold (activate cold receptor) for 1 time step, then release? Heat felt at $t=3$
   (like when you hold snow for a long time and feel warmth when you let go)
Exercise

Neuron 1 fires when exposed to light.

Fill in connections to have Neuron 2 fire after light is on for 3 or more time steps.

Only use excitatory feedforward connections (no feedback).

Firing threshold $\Gamma = 3$ (all units)
Reichardt (1961)

**Motion detection in fly visual system**

**Goal:** Have signals from A and B arrive at a single place (M) at the same time to detect the ladybug’s rightward movement.

Can this exact circuit detect the motion?
Reichardt (1961)
Motion detection in fly visual system

Want:
Signals arrive in the same place, at the same time.

Suggested modification?
Delay $d$
Preview of CS343/443: Motion-based decision making

What’s the direction of motion in the global pattern?

Cells in 1st layer of model (A and B)

Motion cells in the model (M)
Preview of CS343/443: Motion-based decision making

What’s the direction of motion in the global pattern?

Model cells accumulating evidence for right (blue) vs. left (red)
Single layer supervised learning neural networks

- Key limitation of McCulloch & Pitts nets: structure of network connections fixed. They cannot learn/adapt/change.

- **Single layer networks**: Simplest form of neural networks that learn to classify inputs via supervised learning — give it training feature data and associated classes.