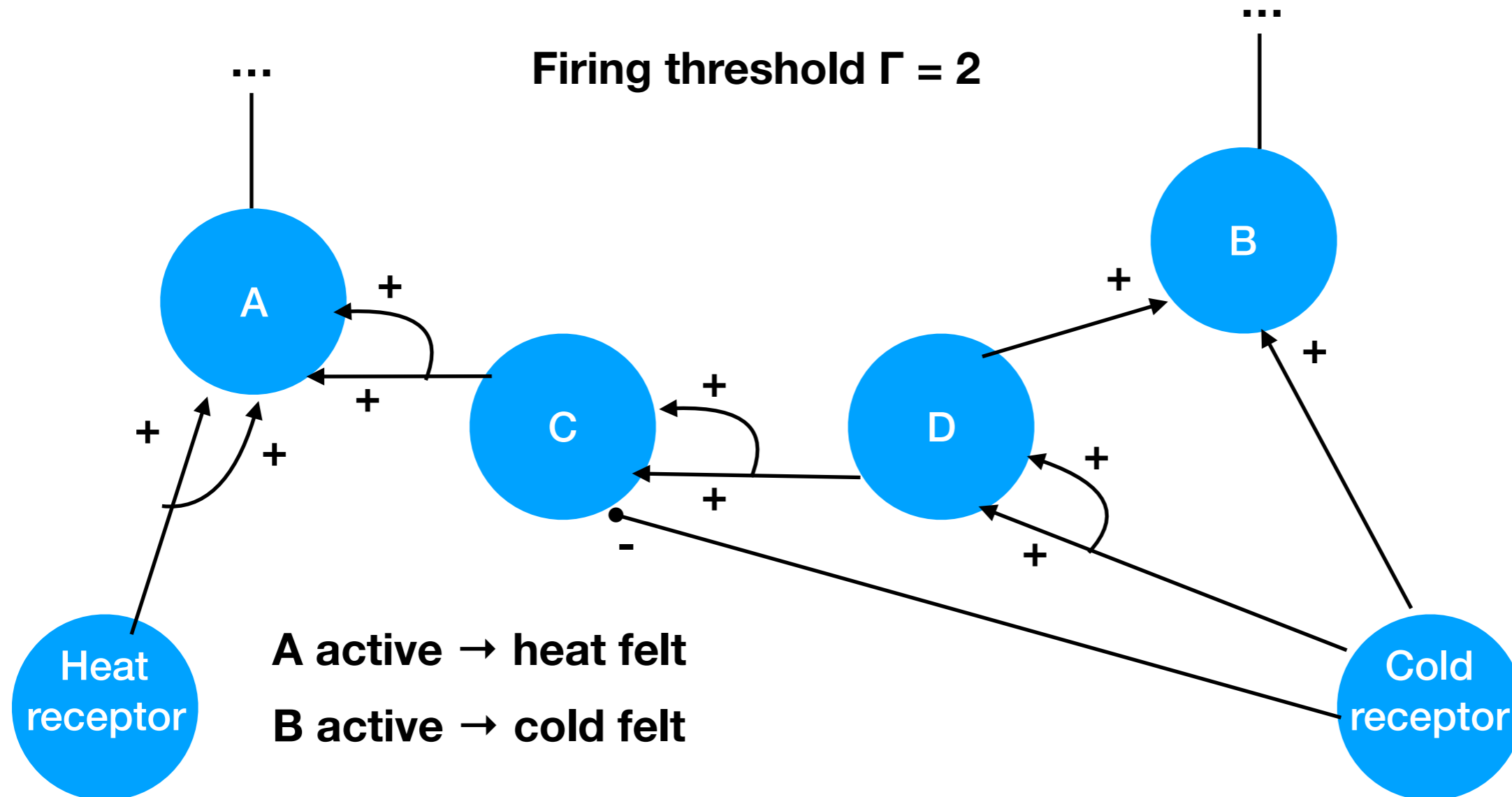


# McCulloch-Pitts Network



When happens when...

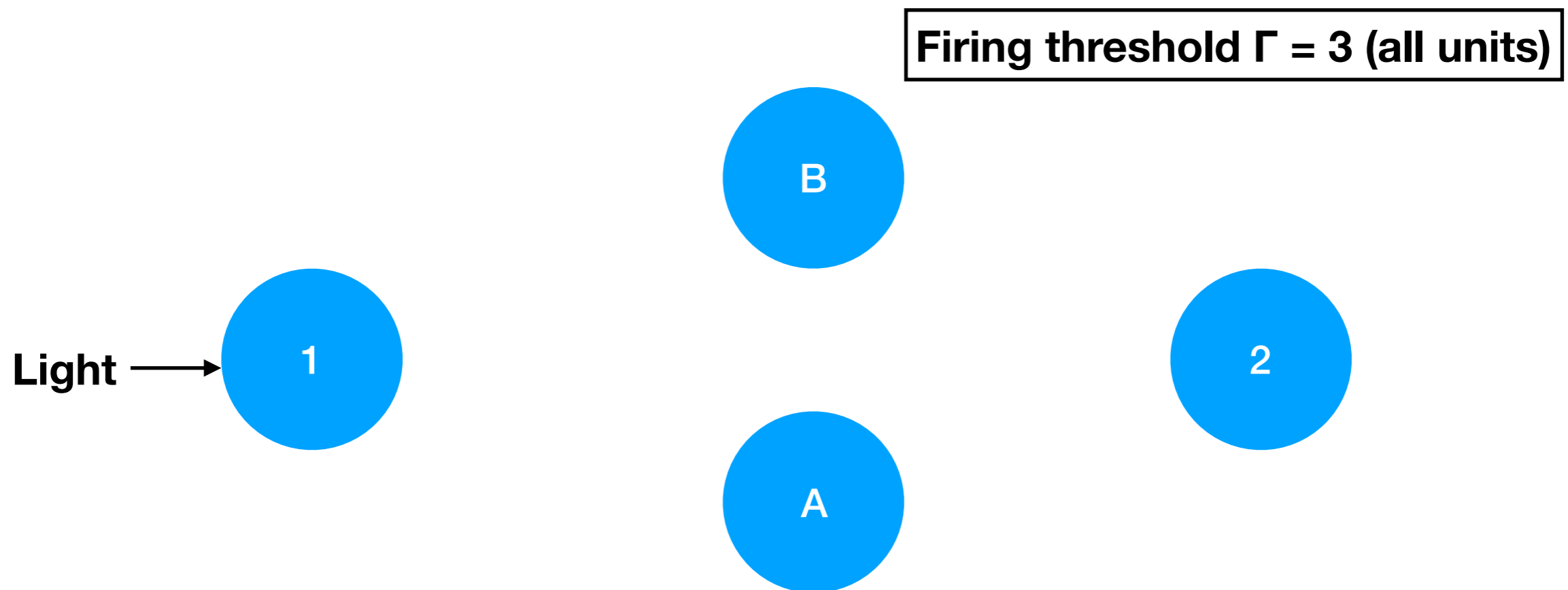
- 1) Present heat (activate heat receptor) for 1+ time steps? Heat felt
- 2) Present cold (activate cold receptor) for 2+ time steps? Cold felt
- 3) Present cold (activate cold receptor) for 1 time step, then release? Heat felt at  $t=3$   
(like when you hold snow for a long time and feel warmth when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

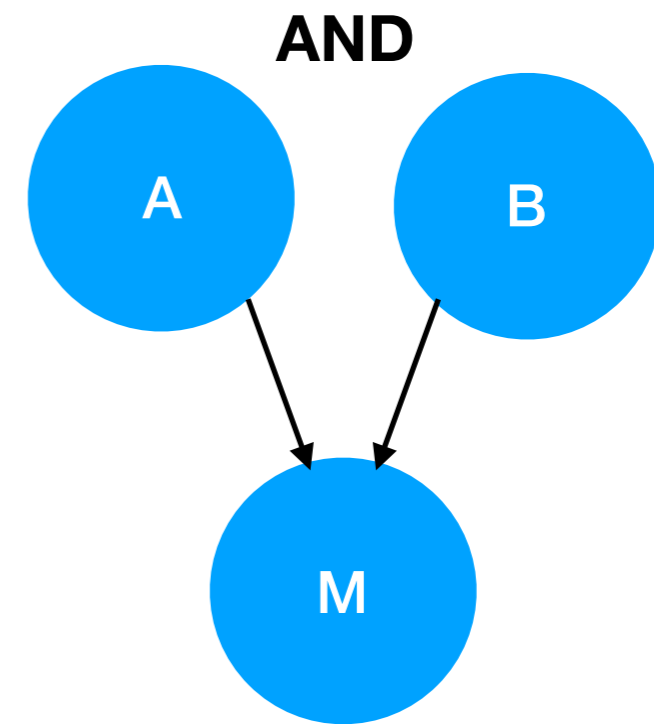
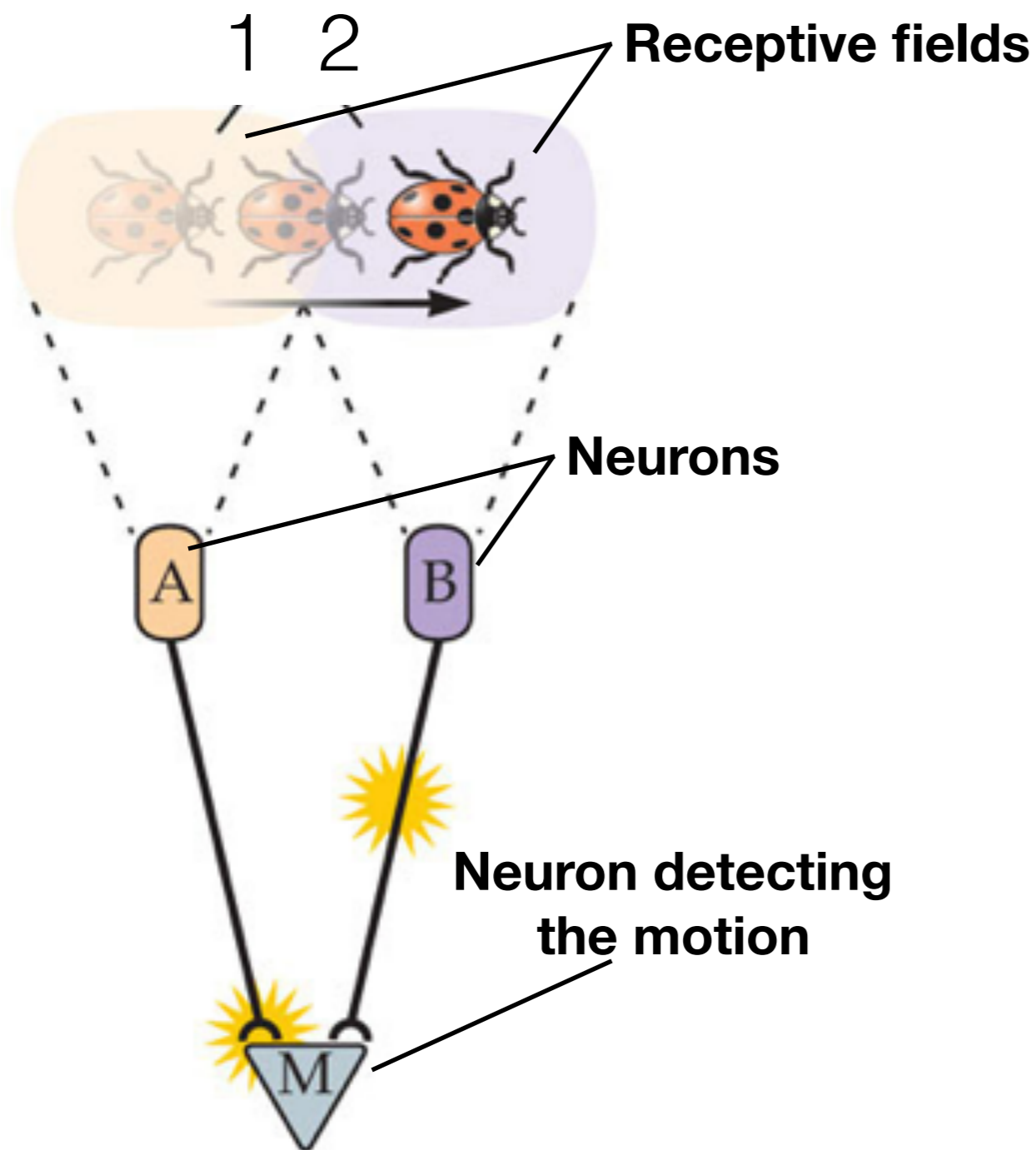
Only use excitatory feedforward connections (no feedback).



# 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.



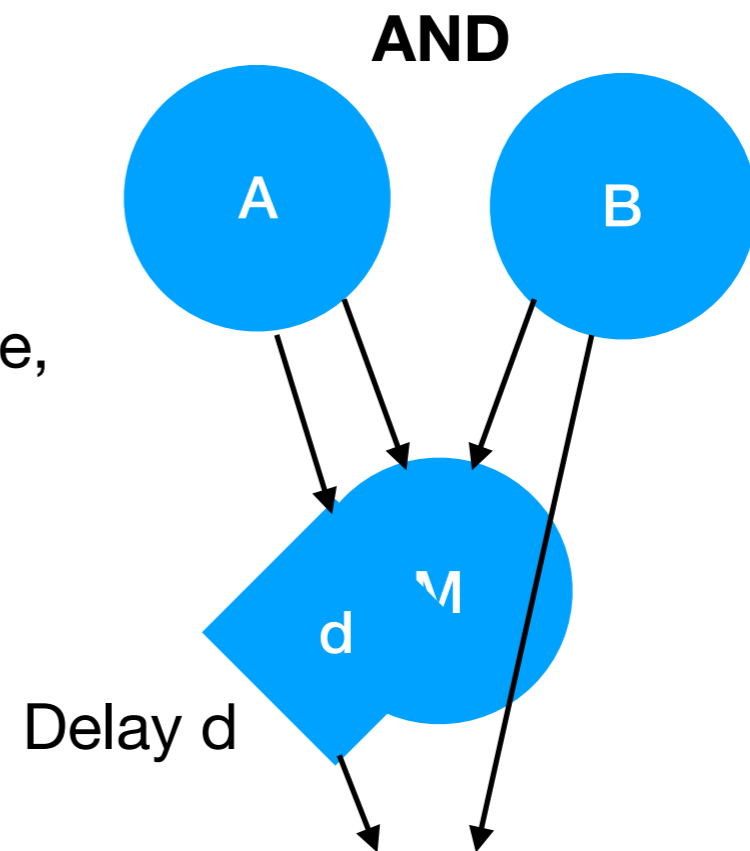
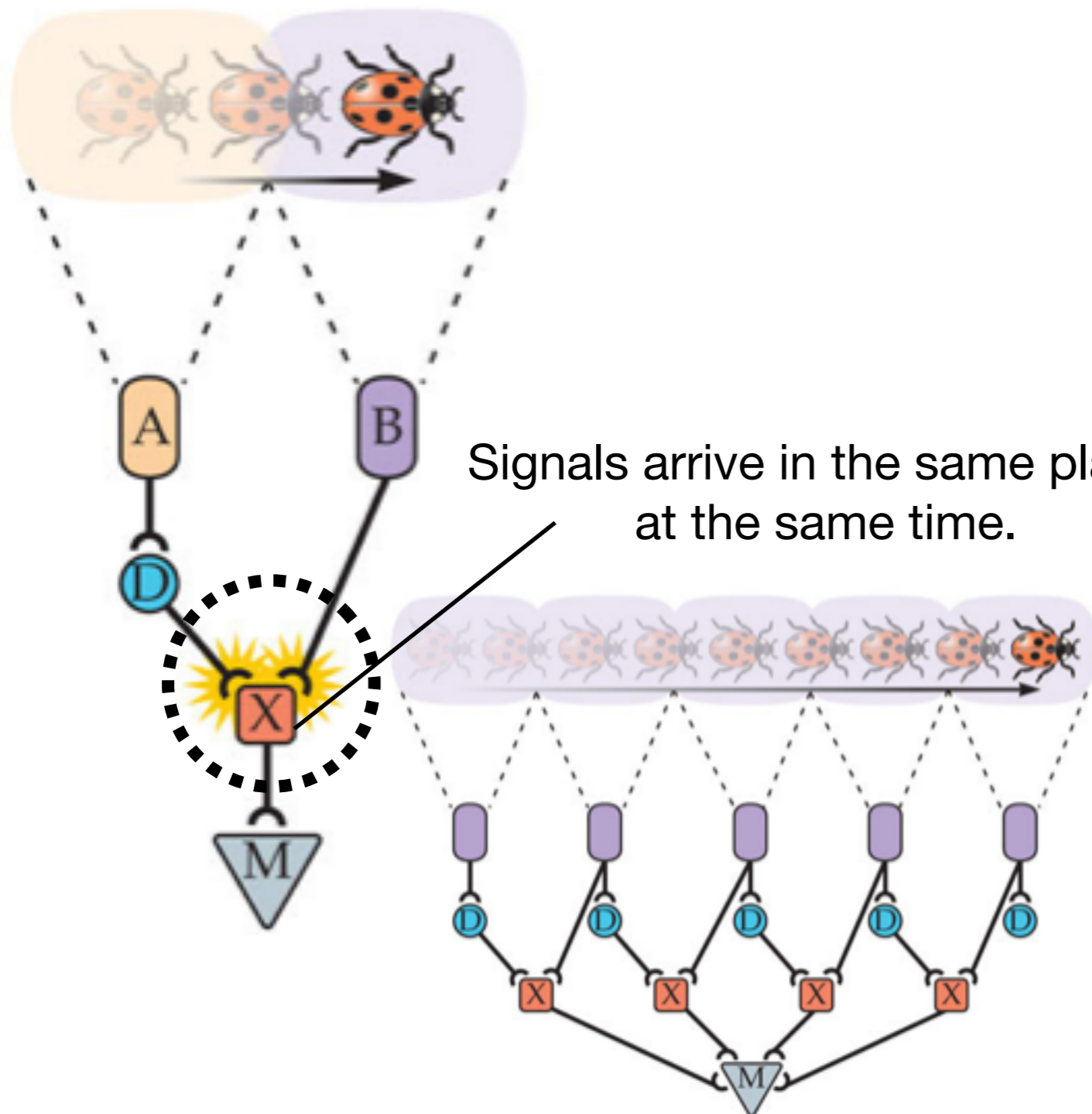
Can this exact circuit detect the motion?

# Reichardt (1961)

## Motion detection in fly visual system

Want:

Suggested modification?

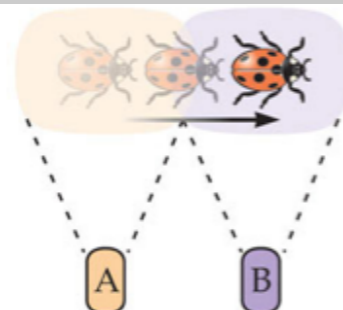
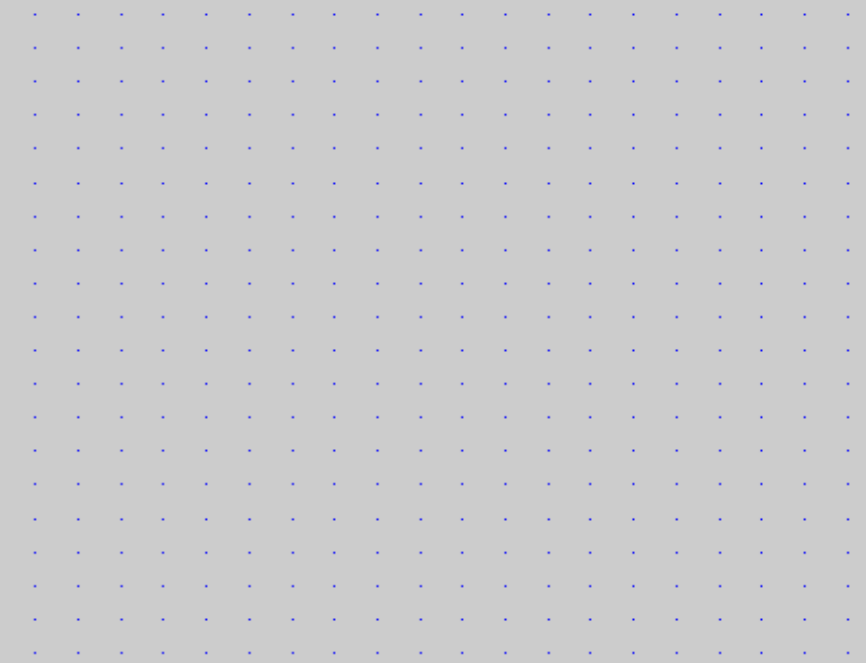
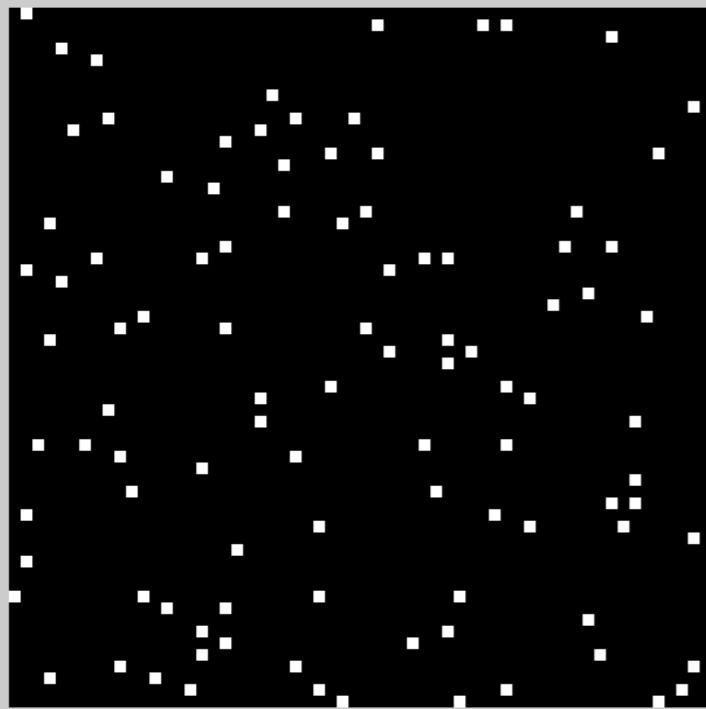


# Preview of CS343/443: Motion-based decision making

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

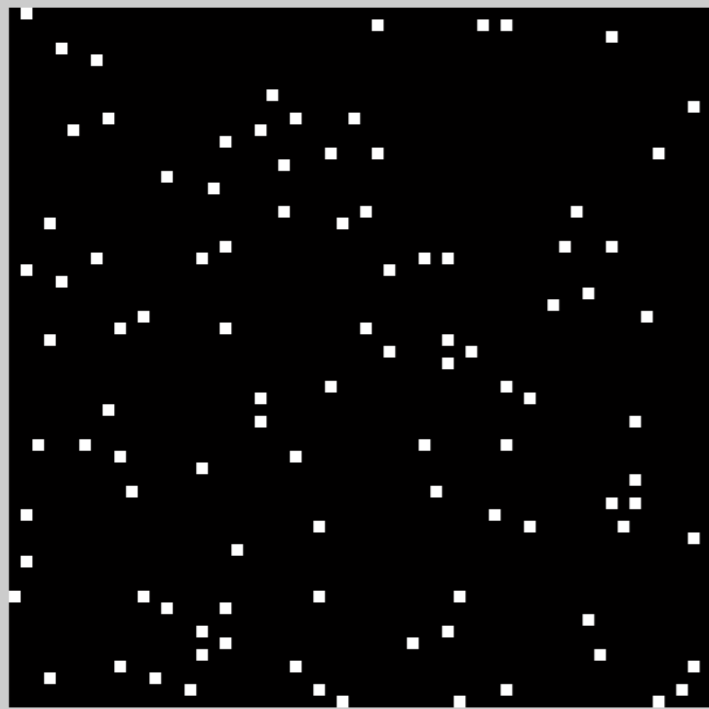
Cells in 1st layer of model  
(A and B)

Motion cells in  
the model (M)

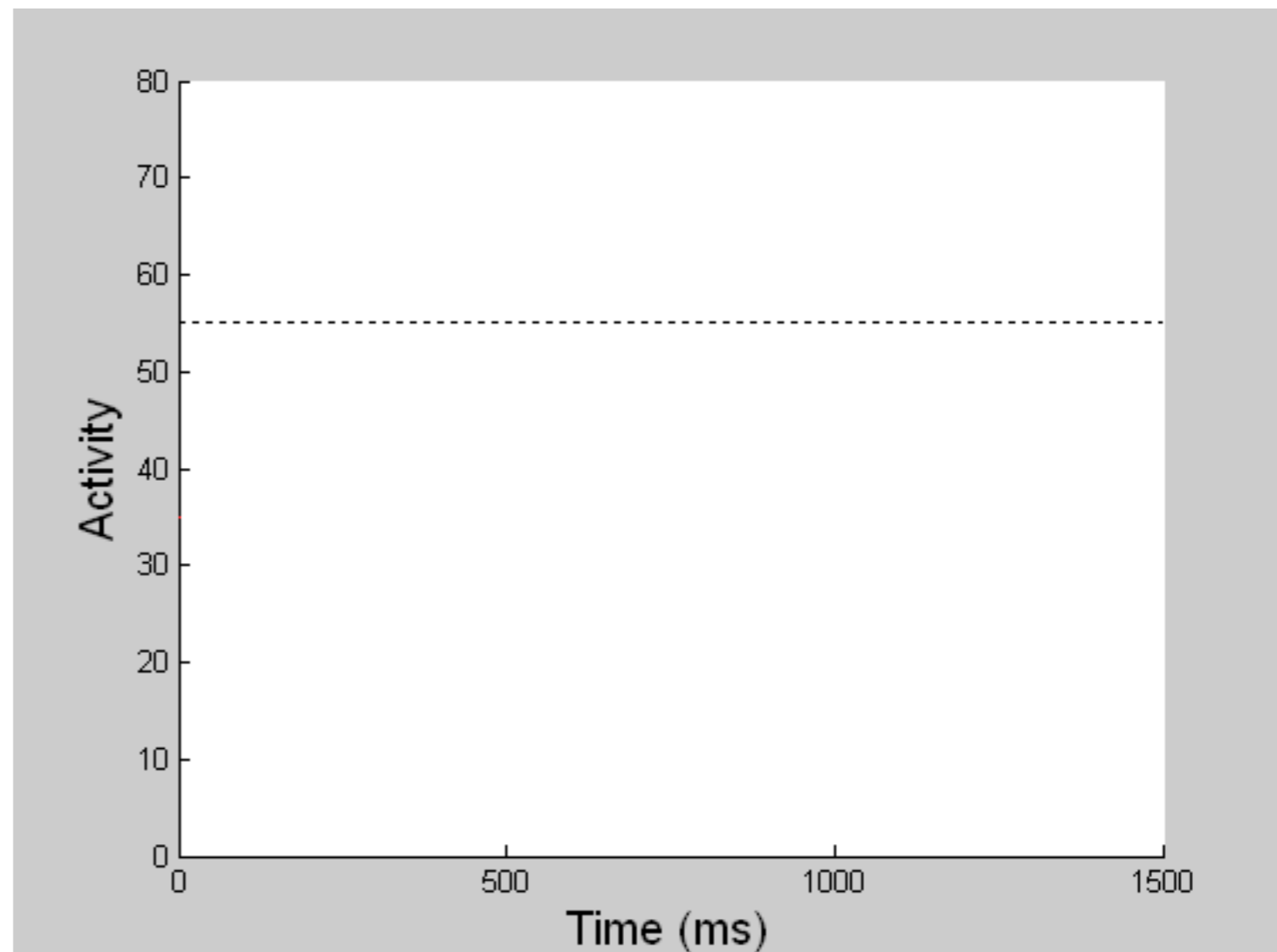


# Preview of CS343/443: Motion-based decision making

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.