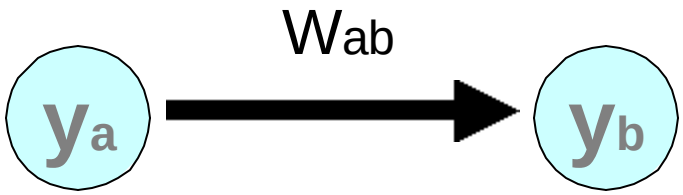
Hebb's learning postulate:

Whenever neuron A fires,

and neuron B fires soon afterwards ...

the synaptic efficacy, W_{ab}, increases.

A Hebbian learning rule:



$$W_{ab} = W_{ab} + \eta y_a y_b$$

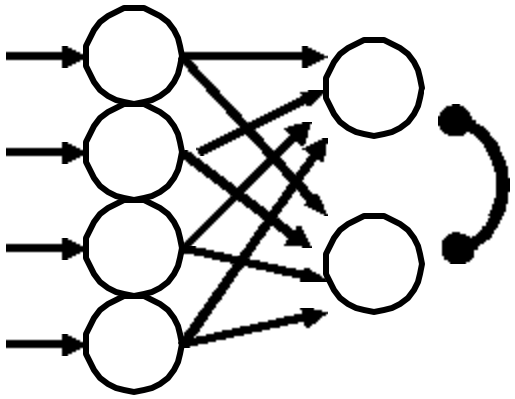
“Self-organizing” models based on Hebbian learning

I. Competitive learning

Input patterns:

A_2	A_1
0	1
0	0
0	1
1	0

Output:



- Lateral inhibition
- Units compete to respond to pattern
- Winning unit does Hebbian learning

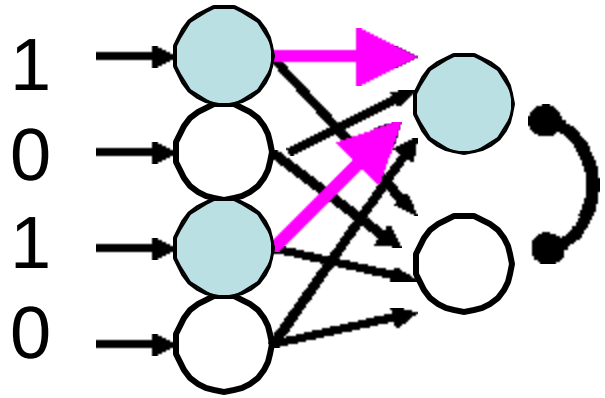
“Self-organizing” models based on Hebbian learning

I. Competitive learning

Input patterns:

A_1

Output:



First learn pattern A1:

- The first output unit wins the competition
- Its connections to active inputs are strengthened

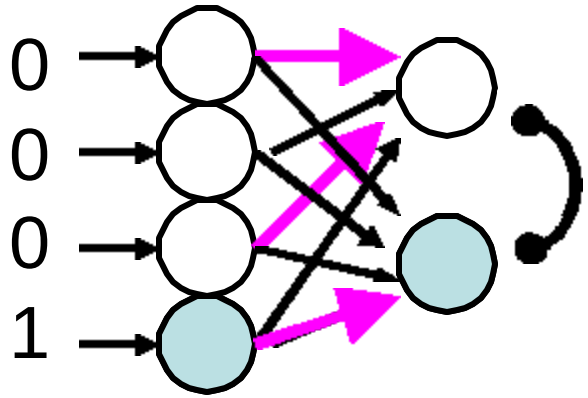
“Self-organizing” models based on Hebbian learning

I. Competitive learning

Input patterns:

A_2

Output:



Then learn pattern A2:

- Second output unit wins the competition
- Its connections to active inputs are strengthened

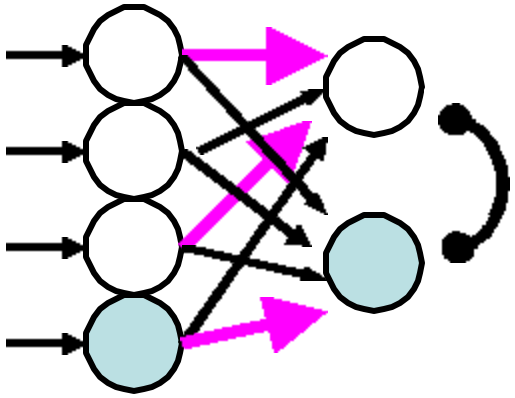
“Self-organizing” models based on Hebbian learning

I. Competitive learning

Input patterns:

A_2	A_1
0	1
0	0
0	1
1	0

Output:

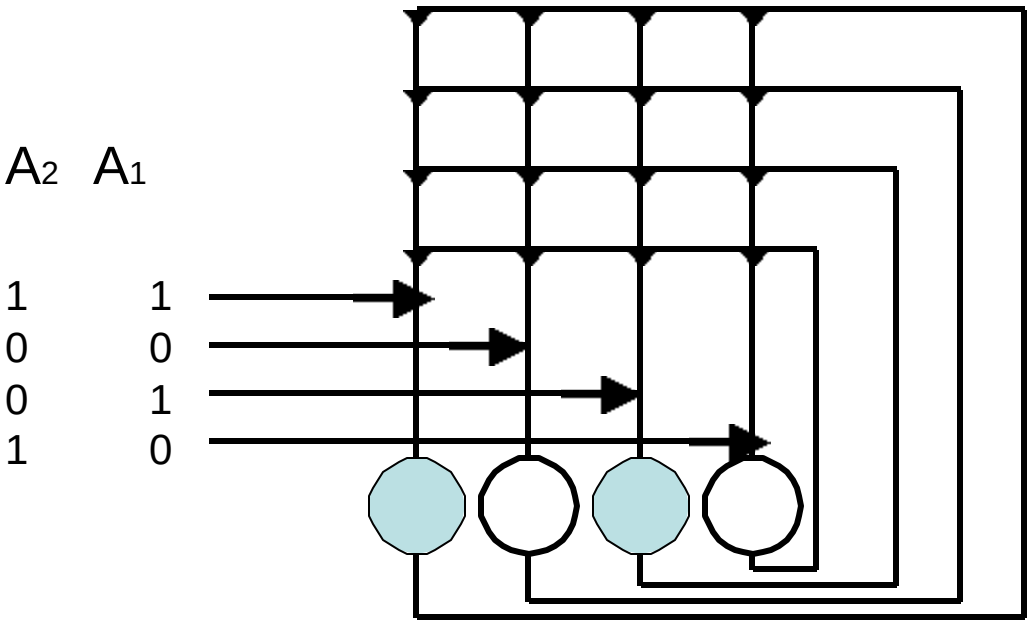


After learning:

- Each output unit responds to a different pattern (or subset of patterns)

“Self-organizing” models based on Hebbian learning

II. Auto-associator

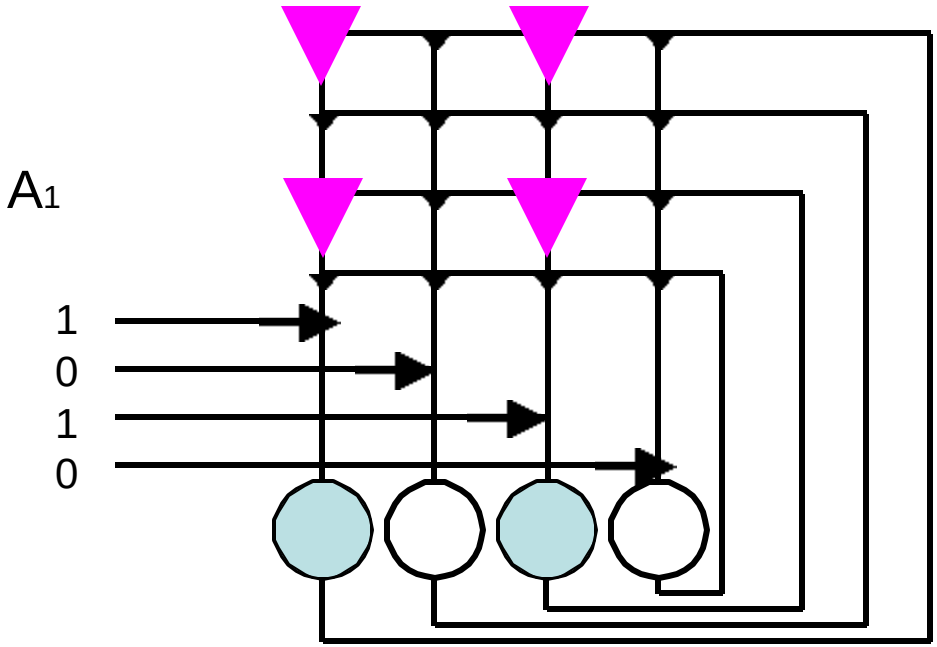


During learning:

- patterns A1 … An are memorized via Hebbian learning

“Self-organizing” models based on Hebbian learning

II. Auto-associator



First present pattern A_1

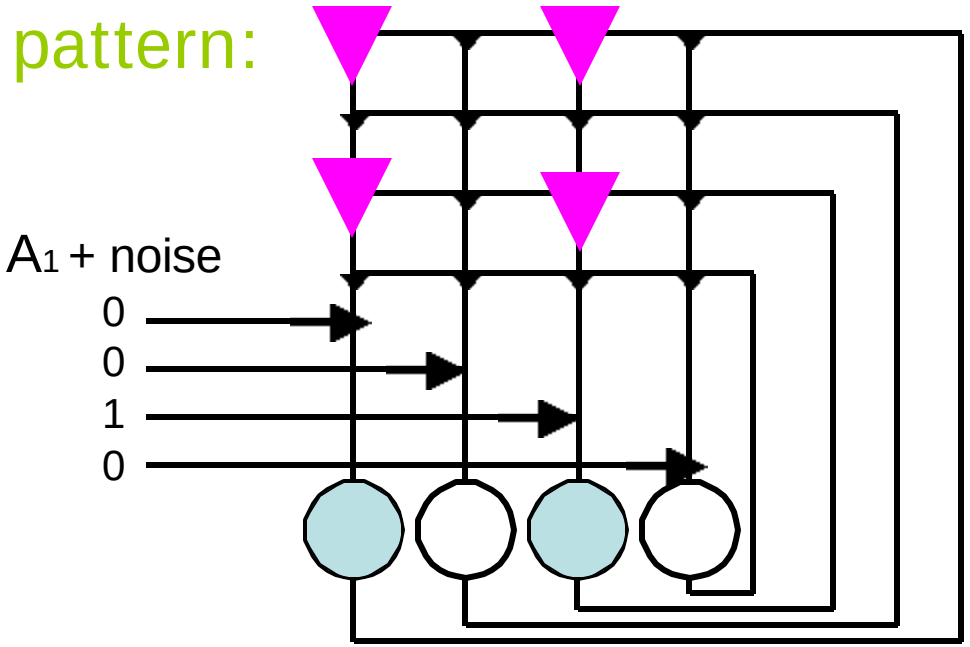
After learning pattern A_1:

- Some synapses have been strengthened
- Elements of pattern have been associated together

“Self-organizing” models based on Hebbian learning

II. Auto-associator

Test pattern:

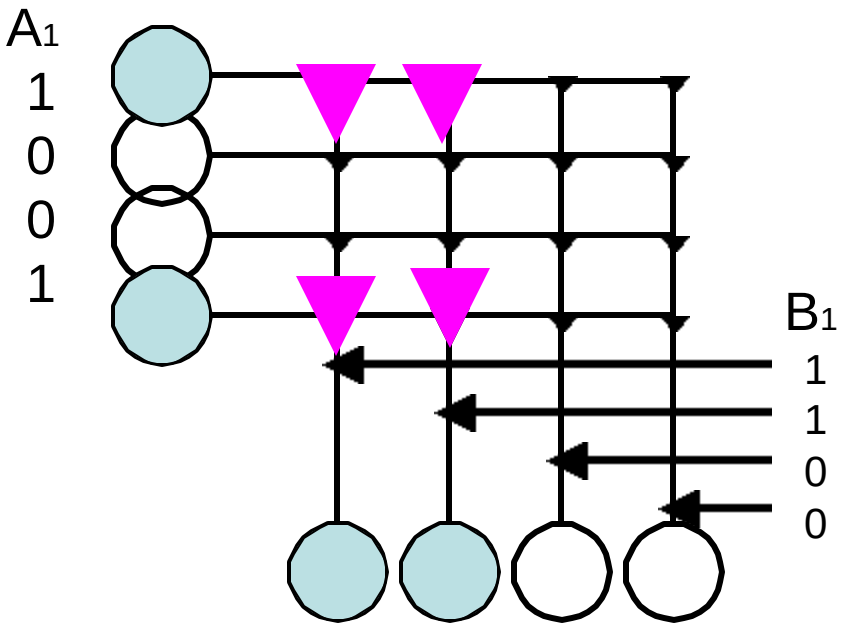


Activate units via recurrent connections:

- Correct recognition of A_1
- Pattern completion

“Self-organizing” models based on Hebbian learning

III. Hetero-associator



During learning:

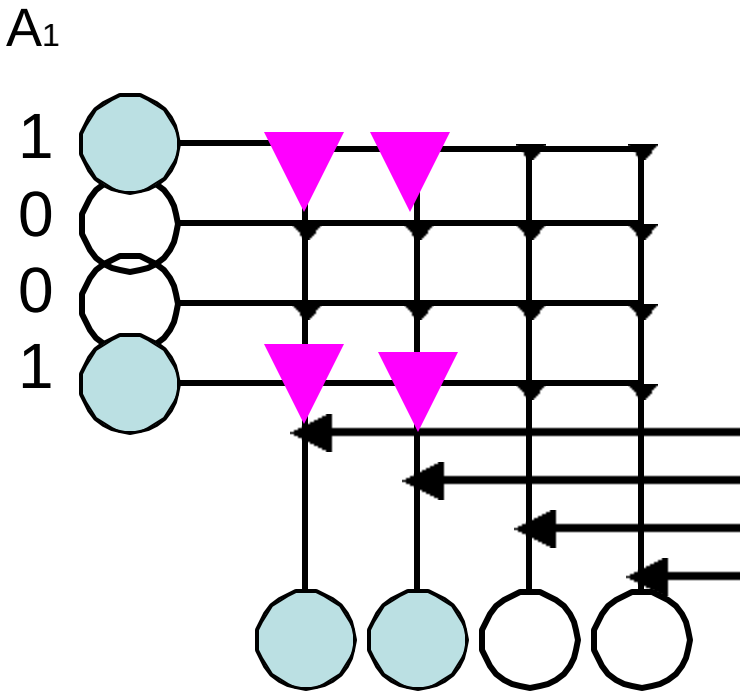
- Present pairs of input, output patterns A,B
- Apply Hebbian learning

After learning:

- elements of the patterns A,B have been associated together

“Self-organizing” models based on Hebbian learning

III. Hetero-associator

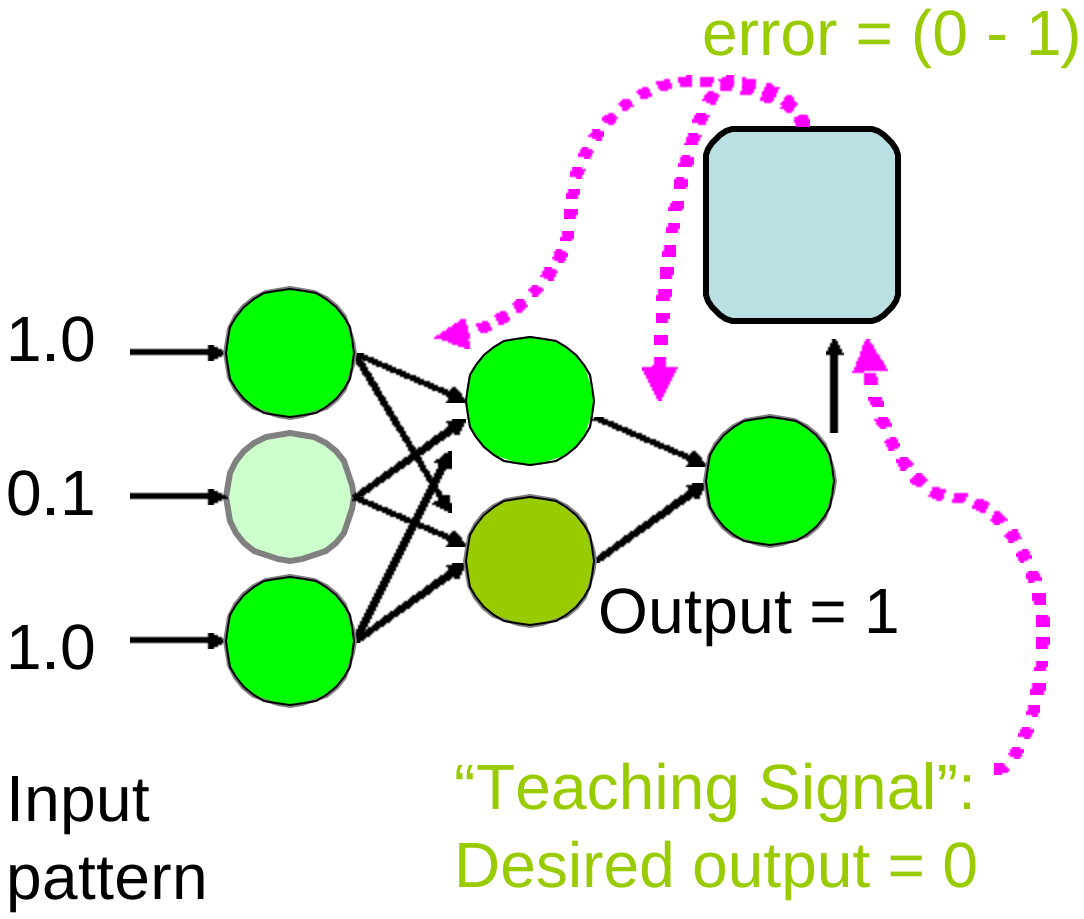


After learning, test with A1 alone

Then activate B units by propagating activity through syapses

- correct recall of B1

“Supervised” learning based on error back-propagation



- very powerful learning procedure
- biologically implausible

Reinforcement learning