Transistor models of neurons and synapses

esp. with applications to learning

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UIUC
Why use neuromorphic circuits?

- complex problems with many variables
- uncertain and noisy data
- rapidly changing environment requires quick decision making

Needs of industrial neuromorphic engineering:

- small size
- low power
- flexibility

Hence transistors.
Transistors

MOSFET - Metal Oxide Semiconductor Field Effect Transistor - a semiconductor device commonly used to

- amplify,
- switch,
- modulate electronic signals.

Start with a resistor and add a 3rd terminal (gate) that somehow allows to control resistance between the other two terminals (source and drain).
Treat either as variable resistor, or switch

Figure 1: Gate voltage controls current passing through the device.
Figure 2: Gate voltage can "open" the current on the device in a threshold manner.
MOSFET learning circuit

Figure 3: With coincidence detection mechanism and postsynaptic feedback.
Coincidence detection mechanism

Figure 4: Learning in-silico – p.7/8

(a)

gate to plasticity mechanism
Figure 5: