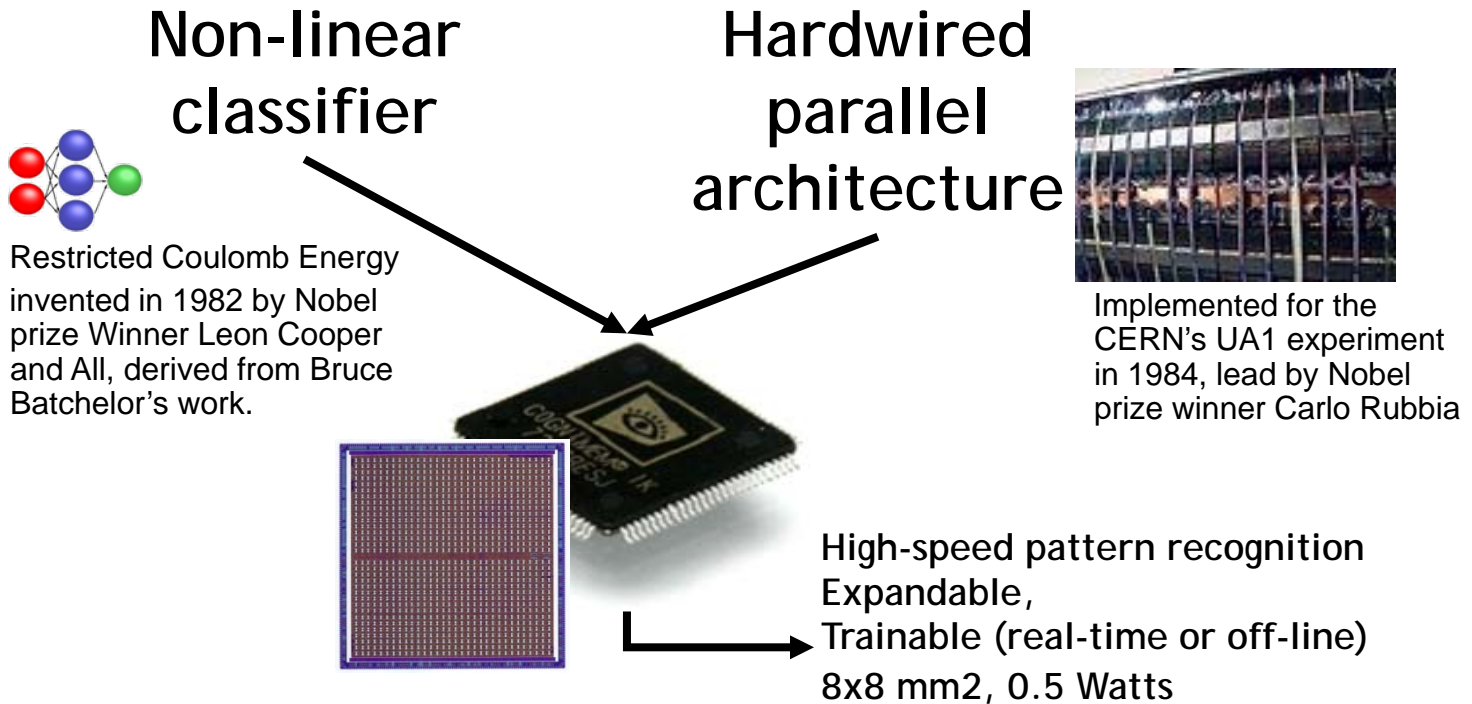
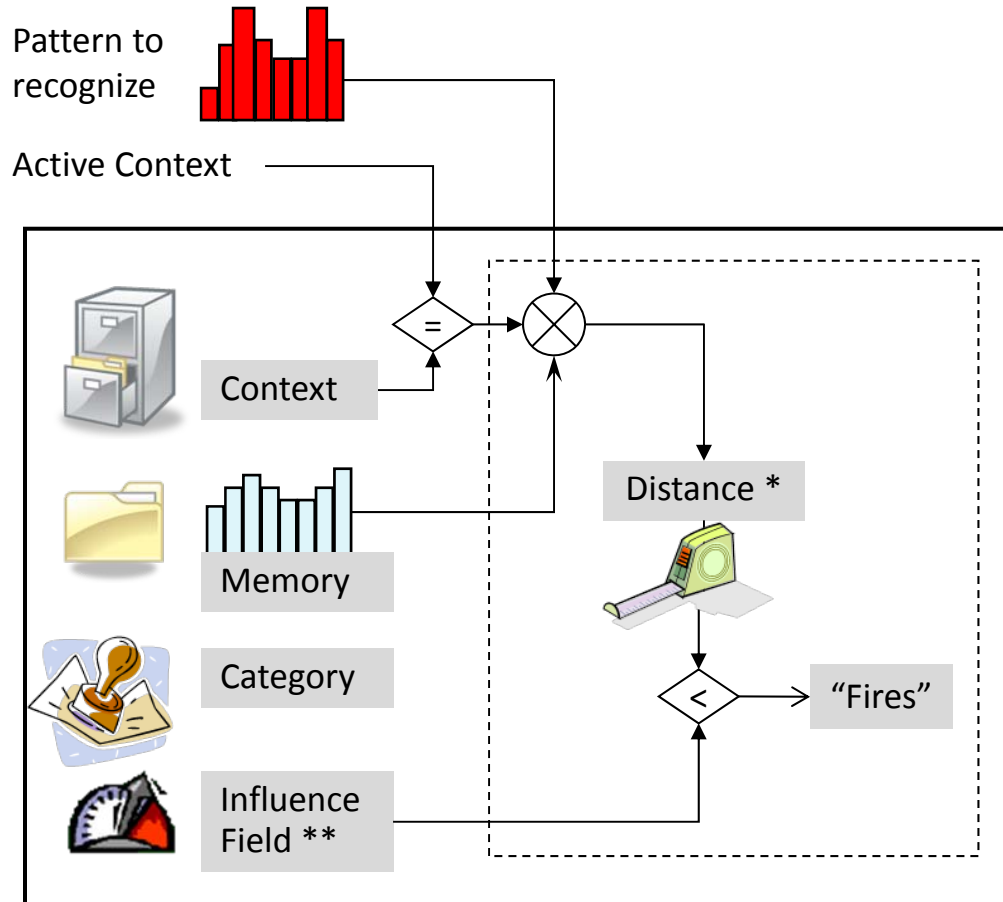


CM1K, the merger of 2 concepts



What is a neuron?

A neuron is a reactive memory which can autonomously evaluate the distance between an incoming vector and a reference vector stored in its memory. If this distance falls within its current influence field, it returns a positive classification.



- Calculated by the neuron during the broadcast of the input vector
- ** Updated during the learning, if applicable

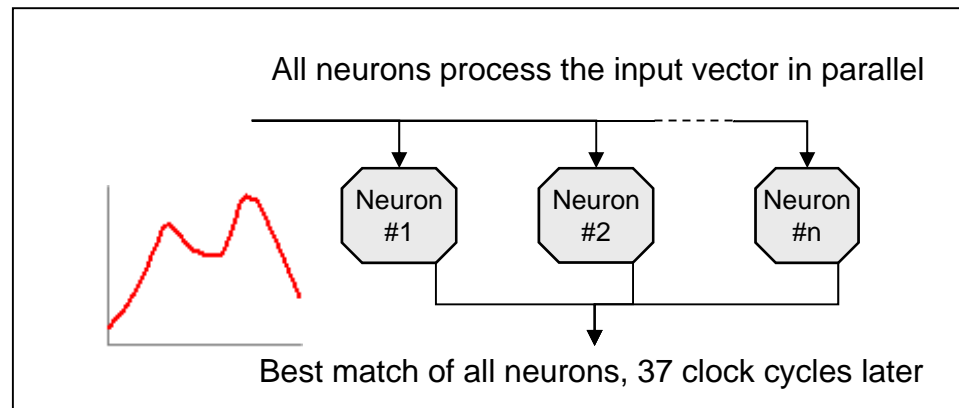
What is a neural network?

The true significance of a neuron is its arrangement into a parallel network and ability to Search-And-Sort for best match without sequential access.

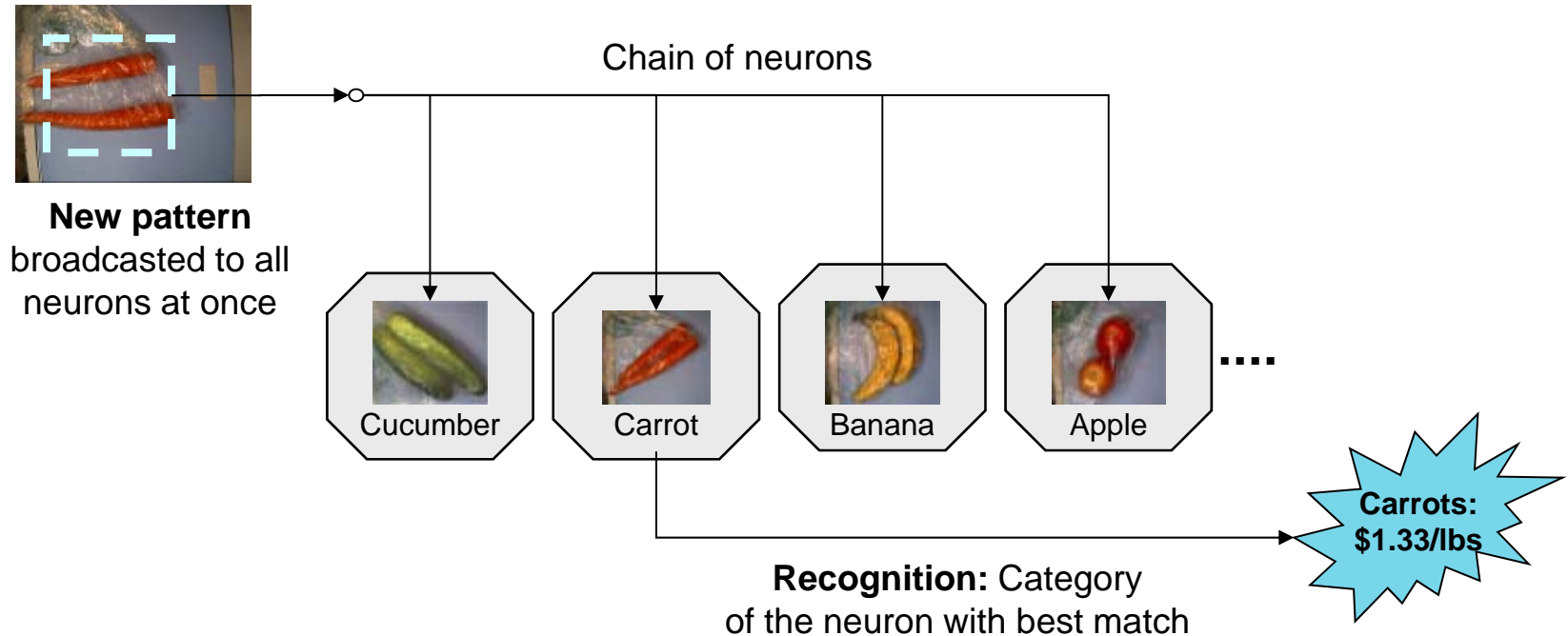
The Winner takes All

→ Learn and recognize a vector in a constant amount of time independent from the number of neurons

→ Network can be expanded at will



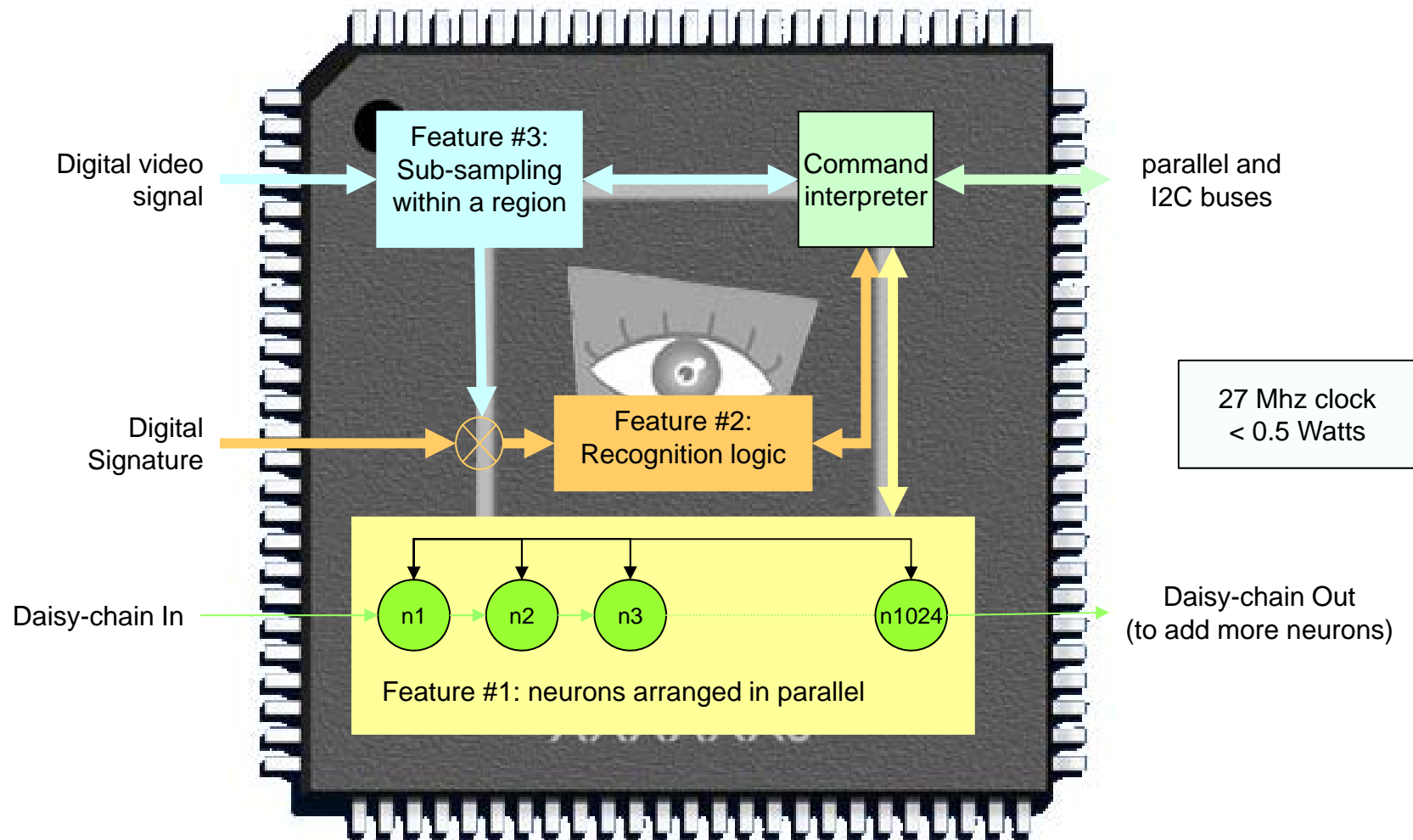
Neurons = Cognitive Memories



Neurons = A component with memory storage and reactive logic to learn and recognize

Neural network = A bank of neurons operating together

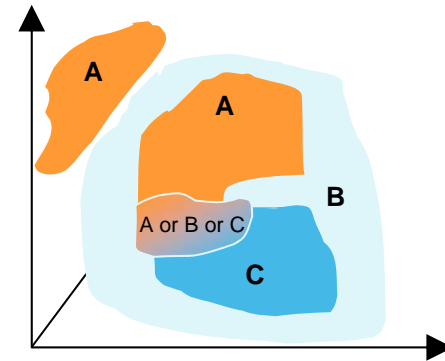
A network of neurons in parallel



An adaptive model generator

- Learn by examples (supervised or unsupervised)
- Map decision spaces by aggregates instead of hyper planes
- Cope with non-linear, convex, disjoints and embedded categories
- Possible modulation between conservative and liberal decision spaces with zones of uncertainties
- Save and restore the contents of the neurons
- Can append more training at any time

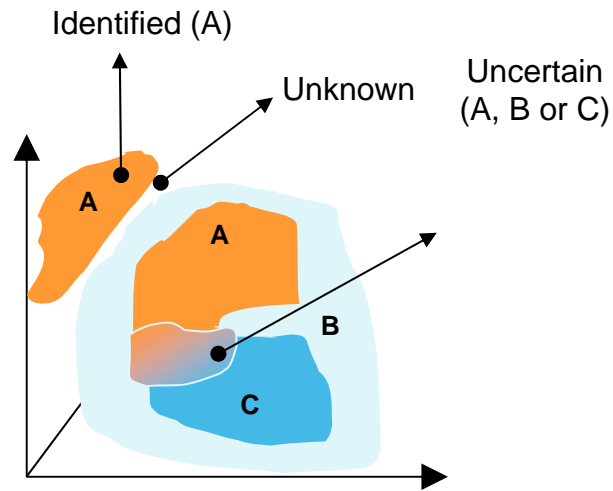
Learning = Building a “**decision space**” by teaching examples



A high-performance classifier

- Global response readout:
 - positively identified
 - identified with uncertainty
 - unknown
- Detailed response of all the firing neurons
 - category and confidence level (or distance)
 - retrieved per decreasing confidence

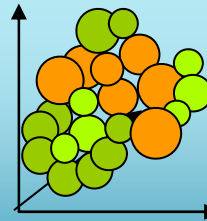
Recognition = where does the sample fall in the decision space?



CM1K Benefits

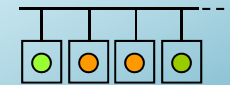
Easy to use

- Trained by examples
- Automatic model generator
- Adaptive non-linear classifier
- Knowledge traceability and portability



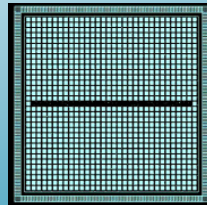
High-Speed

- Recognition time independent from number of neurons
- Expandable parallel neural network
- Equivalent to >90 DSP @300Mhz



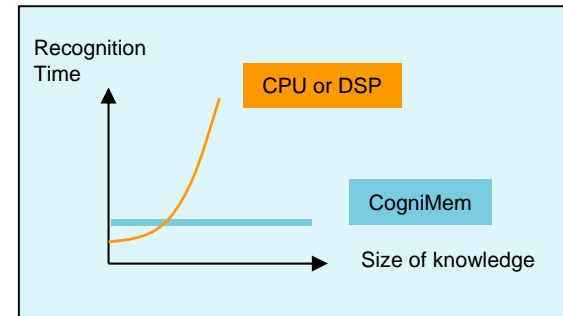
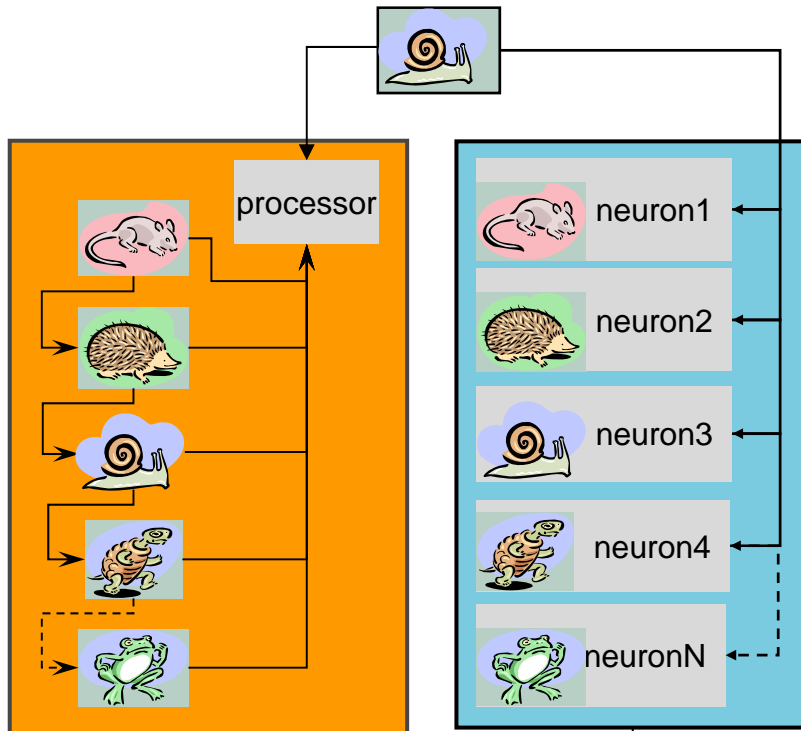
Easy to integrate

- Low clock frequency
- Low power
- Low pin count connectivity
- Cascadability



High speed, Low-power

Find the snail...



Peak power consumption

→ Pentium IV @ 2.4GHz → 59W

→ CM1K @ 27Mhz → 0.5 W

→ N CM1K in parallel = $N \cdot 0.5$ W

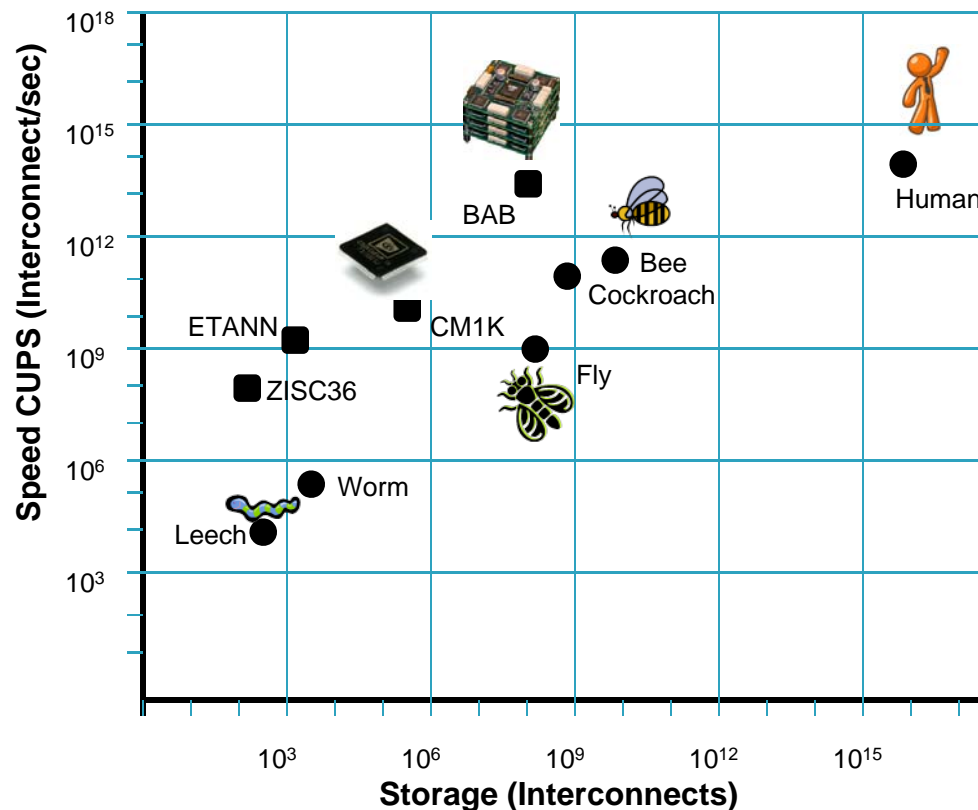
CM1K @ 27Mhz

→ - 9.47 usec to broadcast a pattern of 256 bytes

- 1.3 μ sec to find o the best match among N

Enabler for new architectures

@27 Mhz, the recognition of a 256–bytes vector takes 10.9 μ sec., equivalent to 91,617 recognition /sec.



Legend:
Interconnects:
CM1K= 256 * 1024,
BAB= 1000 CM1K
CUPS= Connection Update Per Second

Endless possibilities from Sensors to Servers

Neurons directly connected to a sensor output for real-time recognition at low-cost and low power

Thousands of neurons assembled in parallel for high-speed data mining

