

CogniMem 1K



- Network of 1024 trainable neurons arranged in parallel and capable of classifying one input vector in 10 microseconds regardless of the number of neurons in use
- Its parallel architecture achieves two technological breakthroughs:
 - a recognition time independent of the number of neurons in use
 - the ability to cascade multiple chips to size the network at will.
- Digital input bus interfaced to built-in recognition logic

Applications



Image recognition

- Face recognition
- Fingerprint identification
- Target tracking
- Target identification
- Factory inspection
- Person monitoring
- OCR
- Gaze tracking
- Human System interface
- Biological imaging (microarrays)
- Wild intelligence sensor
- Kinematics monitoring
- Smart airbag
- Much more...

Signal recognition

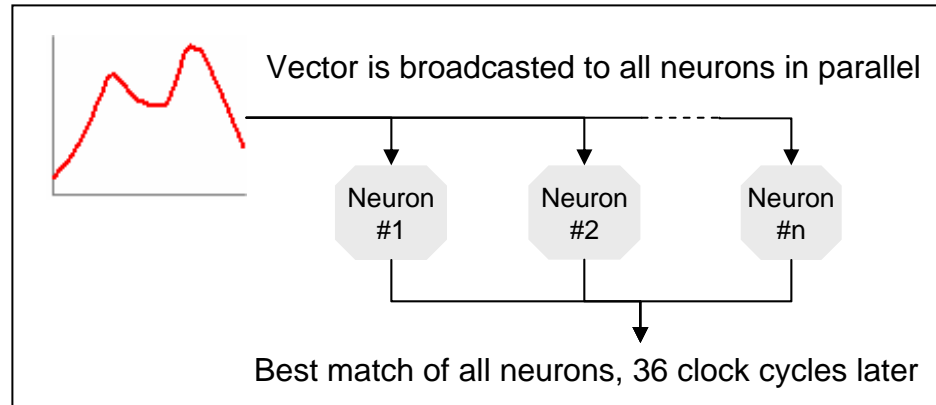
- Speech recognition
- Voice identification
- Radar identification
- EKG monitoring
- EEG monitoring
- Sonar identification
- Spectrum recognition
- Flight analysis
- Vibration monitoring
- more...

Pattern search

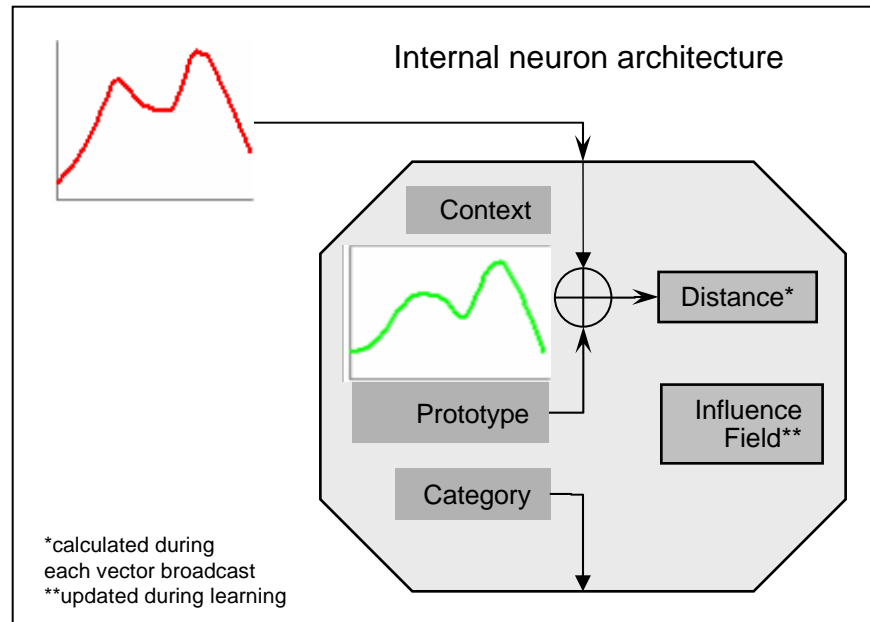
- Cryptography
- Genomics
- Bioinformatics
- Unstructured data mining
- CRC more...

A parallel neural network

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.



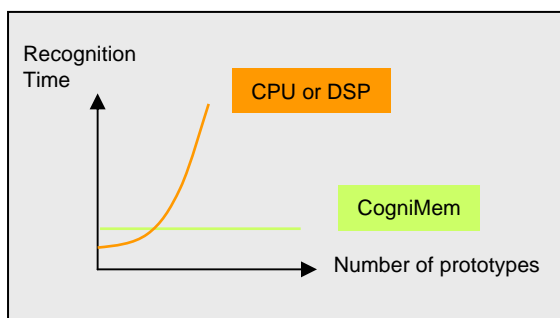
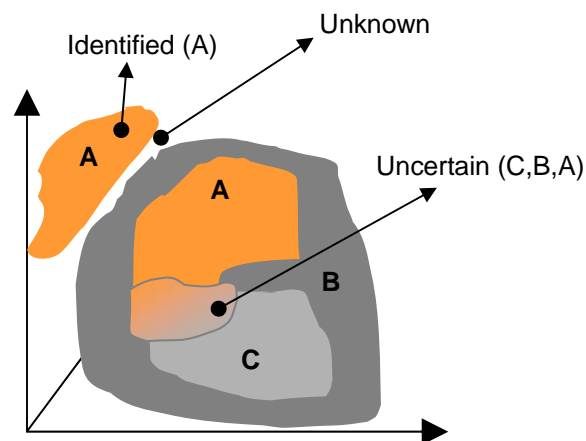
The true significance of a neuron is its arrangement into a parallel network which allows to decode the collective response of all the neurons in a constant amount of time. This response can be a list of categories and distances automatically sorted per decreasing confidence level. An empty list means that the vector is not recognized.



More details...
Prototype=256 bytes
Contexts= 127
Distance norm= L1 or Lsup
Category= 32768
Neurons= 1024

Unique recognition capabilities

- Constant recognition time after vector broadcast to the neurons, independent from the number of neurons in use
- Global response status: Positively identified, Identified with uncertainty or Unknown
- Detailed response of the firing neurons: Distance value between input and prototype, Category value of the prototype. This data is retrieved per firing neuron per increasing distance value (i.e. decreasing confidence level)
- Recognition under multiple independent contexts for data fusion and hypothesis generation
- Anomaly detection and predictive maintenance through the detection of an Unknown classification status



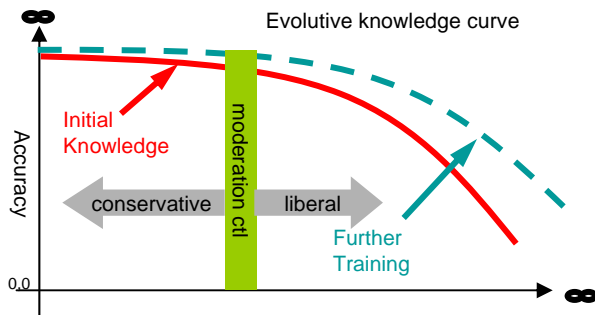
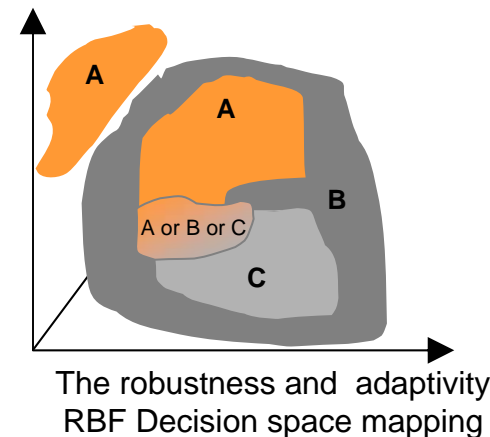
More details...

Classification status after 1 clock cycle
Category and distance inquiry = 36 clock cycles
Distance inquiry = 16 clock cycles
Contexts=127
Recognition cycle= 10 usec for 1 256-byte vector

Automatic model generator and adaptive learning

Transfer human expertise by teaching examples of vector data. The neural network builds the corresponding knowledge on its own. Add more training at any time to expand or complete a knowledge base. The neural network will adapt to fit any example adding novelty to an existing knowledge. The throughput and accuracy of the knowledge can be tuned to produce a recognition engine with conservative or moderate behavior.

- Learn by examples (supervised or unsupervised)
- Automatic model generator
- Map decision spaces by aggregate instead of hyper planes
- Cope with non-linear, convex, disjoints and embedded categories
- Modulation of throughput versus accuracy
- Multiple space generation using different context for data fusion and hypothesis generation
- Novelty detection
- Save and restore the contents of the neurons.



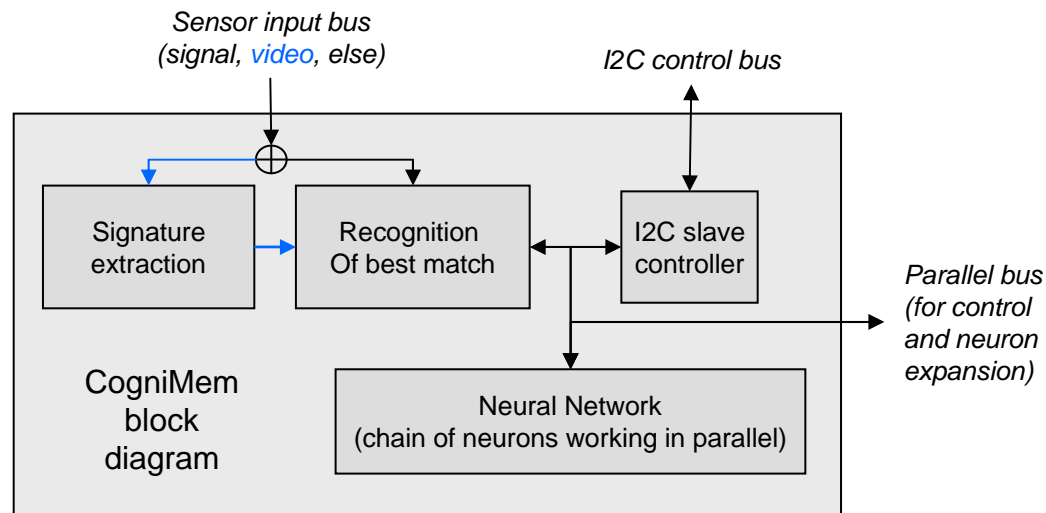
More details...

K Nearest neighbor model
Compound Classifier
Space dimension=256
Number of spaces or contexts= 127
Basic shape entity= Square or Diamond

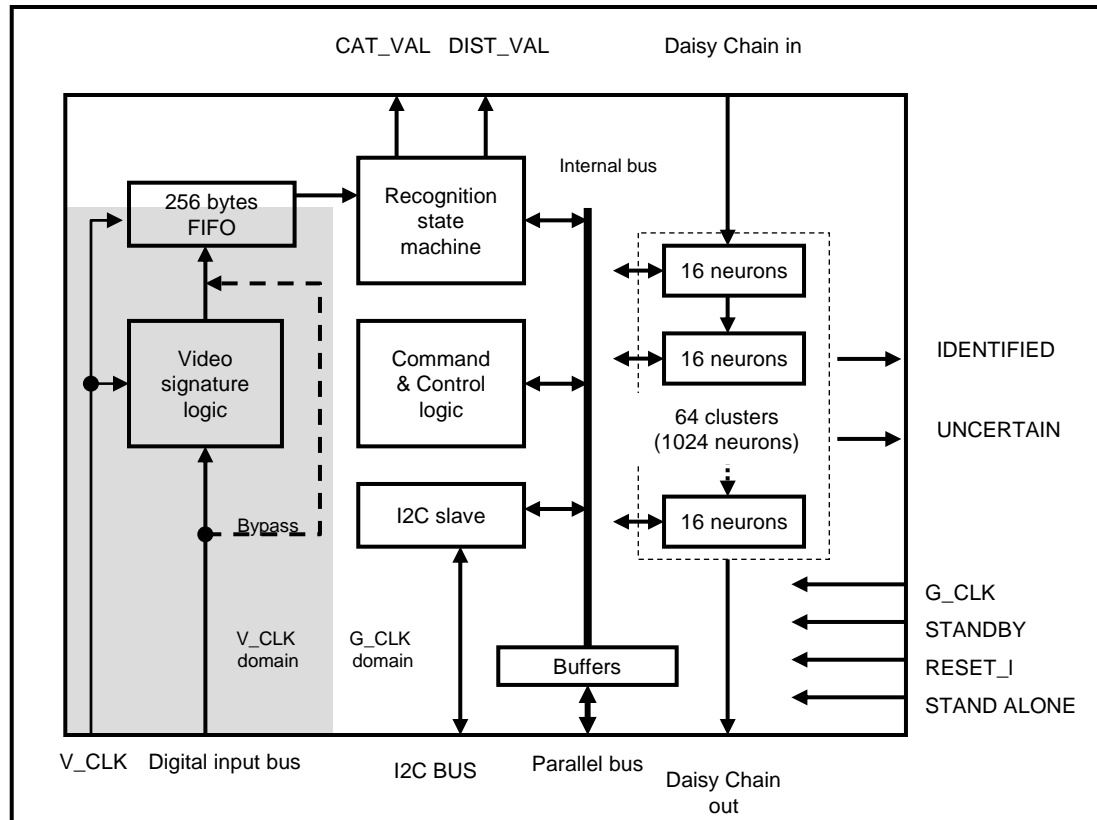
Optional high-speed recognition

In addition to its parallel neural network, CogniMem integrates a built-in recognition engine which can receive vector data directly from a sensor and broadcast it to the neurons in real-time. Upon receipt of the complete vector, the category of the firing neuron with the closest match is transmitted to the output bus. In the case of a monochrome video sensor, CogniMem offers a proprietary signature extraction from 2D video to 1D vector.

The recognition engine can operate at sensor speed (up to 27 Mhz). The usage of the high-speed recognition engine requires that a knowledge be previously loaded into the neurons.



Block diagram



Electrical and mechanical specs

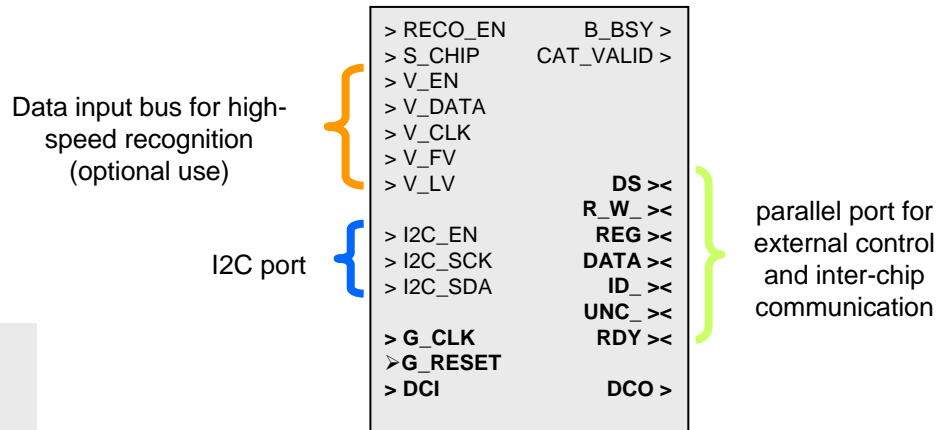
Communication

Parallel control bus (23 pins)
I2C slave control bus (2 pins)

Mechanical/Electrical

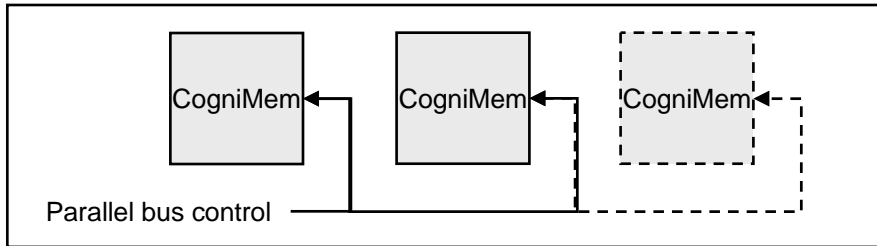
- 30-pins connectivity
- Up to 27 Mhz clock in single chip
- Up to 27 Mhz for multiple chips
- Up to 27 Mhz sensor clock
- 1.2v for the core; 3.3v for the I/O
- TQFP 100 package, 16 x16 mm

CogniMem pin out



Single and multi-chip configurations

A sizable neural network



N CogniMem chips connected together make a network of $N \times 1024$ neurons. A knowledge built on smaller network size can be loaded as is and expand by learning new examples.

A sizable image or signal recognition system

