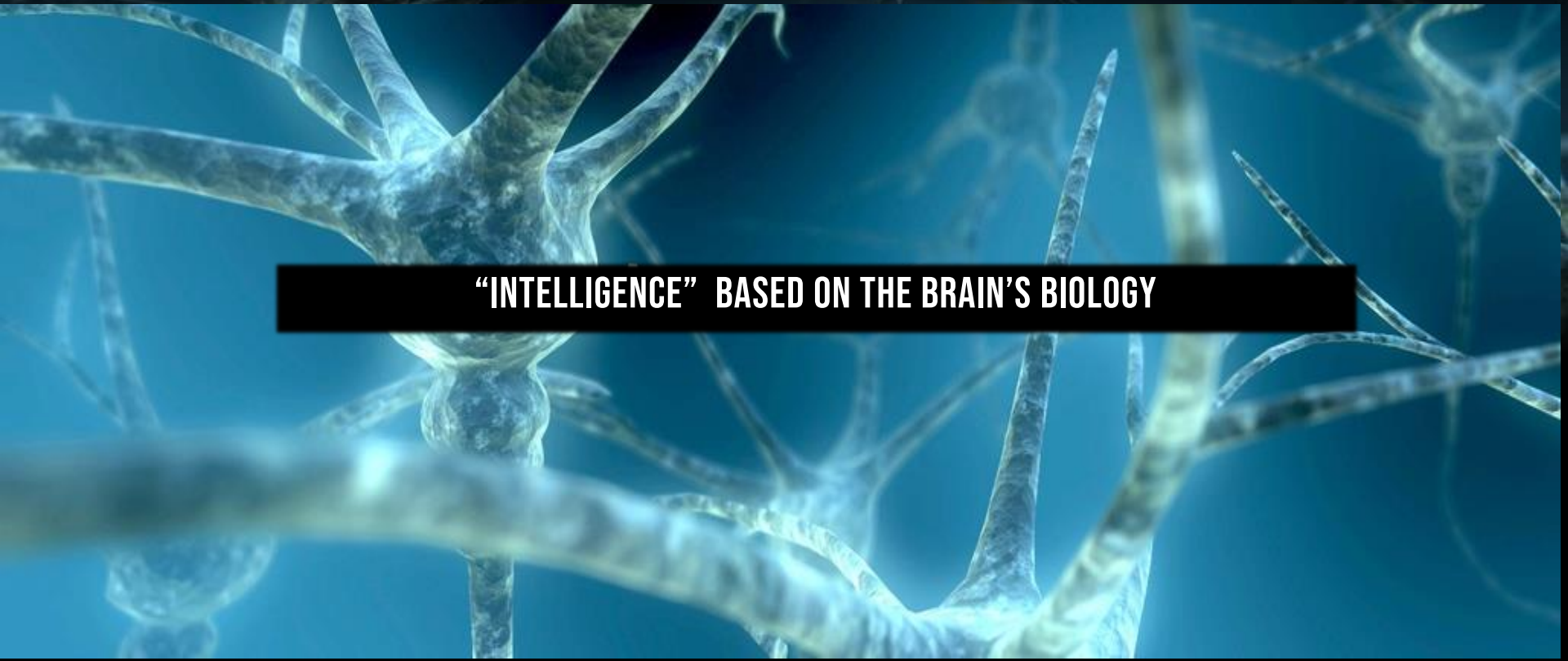
neuraMATIX

breaking new ground in
intelligent software and devices



Neuramatix Sdn Bhd (2022)

FOUNDER

Robert Hercus
Founder, Director

BSc (Hons) Information Science, Monash

50 years experience, Australia and Malaysia, starting his career at Weapons Research in Adelaide, Australia

Specialises in large-scale computing infrastructure and computationally intensive projects

Developed and deployed world's first contactless smartcard system for tolls and highways – Touch 'n Go

Developed large scale genetic analysis and bioinformatics tools - first to sequence, assemble and annotate the palm oil genome

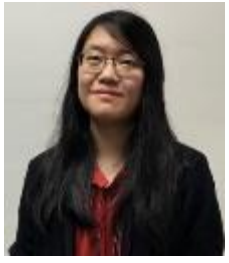
NEURAMATIX TEAM

Munirah Abdul Hamid
Managing Director

- LLB (Hons) from University of London.
- Over 40 years' experience in running various businesses. Executive Director of Neuramatix Sdn Bhd and its subsidiary companies. Co-founder and former Executive Director of Malaysian Genomics Resource Centre Bhd (MGRC).
- Responsible for setting up the Neuramatix Group of Companies' operations procedures and management protocols.

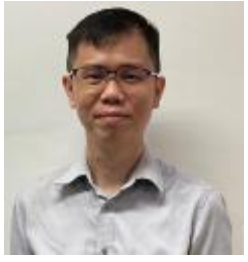
Radzif Shamsudin
Investor

- Master of Management Sciences, Saint Louis University, USA, Dec 1985.
- Radzif started his career in banking in 1986 and moved to stockbroking in 1989. In 2004 he formed Inertia Sdn Bhd to invest in technology companies. He invested in Neuramatix group and sits on the board of its related companies.
- CEO of Synamatix Sdn Bhd



Wong Kit Yee
Senior AI Engineer

- B.E. in Mechatronic Engineering from Monash University, Malaysia.
- 9 years with Neuramatix.
- Involved in NeuraBASE research and development as well as mechanical design and prototyping of robotic control systems.
- Current research interests include intelligent control systems and Natural Language Processing.



Kong Hong Shim
Senior AI Engineer

- BSc in Computer Science (Software Engineering) from Universiti Putra Malaysia (UPM), Malaysia. MSc from UPM, where his research focused on developing a neural-fuzzy network system.
- 11 years with Neuramatix.
- Research interests include autonomous agents, vision system, drone pursuit and evasion.

THE FUTURE FOR AI – WHAT IS NEEDED - GOOGLE

October 12, 2021 – George Anadiotis

DeepMind is developing one algorithm to rule them all.

“Images can be seen as graphs of pixels connected by proximity. Text can be seen as a sequence of objects linked together.” “**We need a slightly more universal algorithm** executor to use as the basis for better methods for Machine Learning.”

October 28, 2021 – Abner Li

Google announces next-gen ‘Pathways’ AI architecture to allow for more general, multimodal & efficient models.

“Pathways ‘**could enable multimodal models that encompass vision, auditory, and language understanding simultaneously**’ again like a human using multiple senses to perceive the world. At the moment, AI models choose one corpus to analyze at a time: text, images, or speech.”

November 2021 – Market Research Telecast

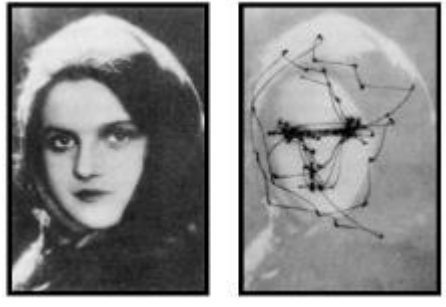
Google: AI architecture will soon be more like “the mammalian brain”.

“**Current AI models simply do not do justice to the great potential of technology**. Under the name **Pathways**, several teams from the internal research department are working on the ‘next generation of AI’ announced Google AI Lead, Jeff Dean.”

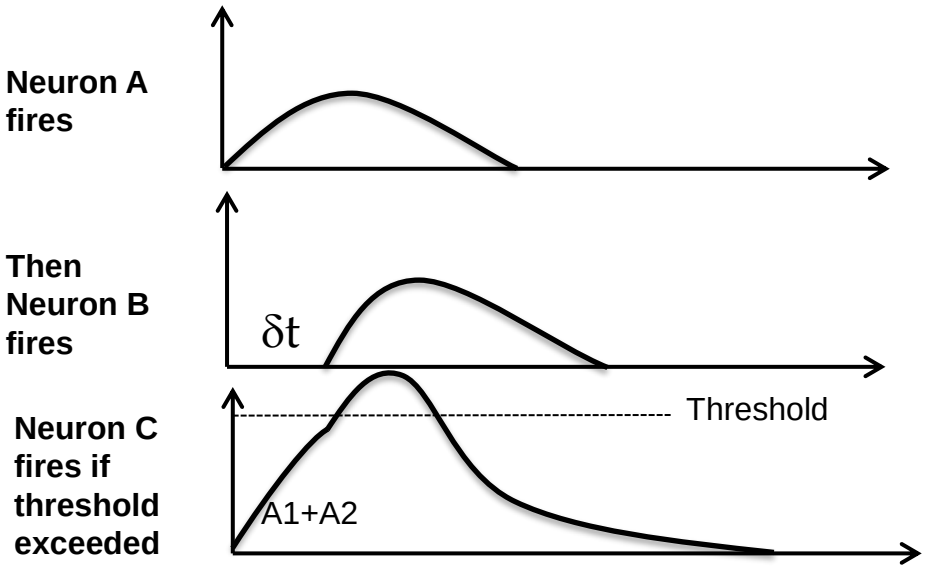
WHAT IS THE BASIS OF INTELLIGENCE?

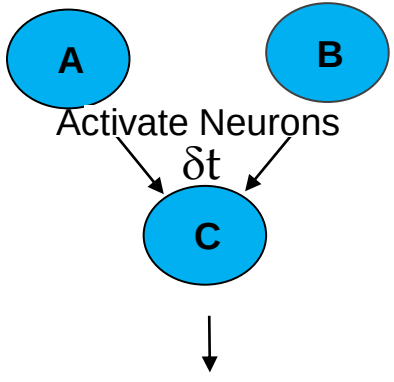
Intelligent beings are able to perceive and interact with their surroundings

- Hearing - a sequence of sounds (speech, music, etc)
- Speech - a sequence of articulatory muscles (vocal cords, tongue and mouth)
- Touch - a sequence/pattern of feelings (hot, soft, etc)
- Action/Motion - a sequence of muscular movements (talking, walking, eating, etc)
- Vision - a sequence of saccadic eye movements



NEURON ASSOCIATION - BIOLOGICAL





At an appropriate threshold neuron C will fire – Neuron Plasticity

NEURABASE – A NEW AI MODEL

NeuraBASE is the only neural network that can express exactly what it has learnt - natural intelligence

Fundamental and broad patent

- US approved all 104 claims, and Australia recognised 11 unique inventions within the patent

- Granted in China, Japan, Hong Kong, Malaysia, USA, Europe, and India
  Granted: EU

- Pending: Hong Kong and India

Plan to submit two continuation patents

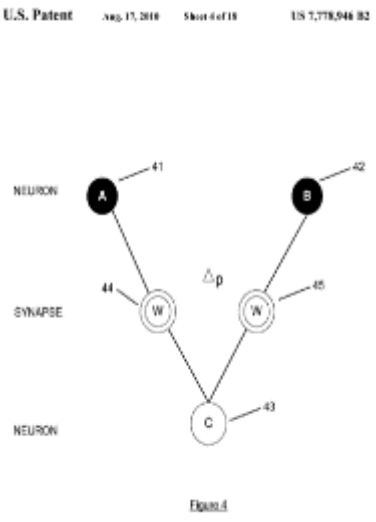
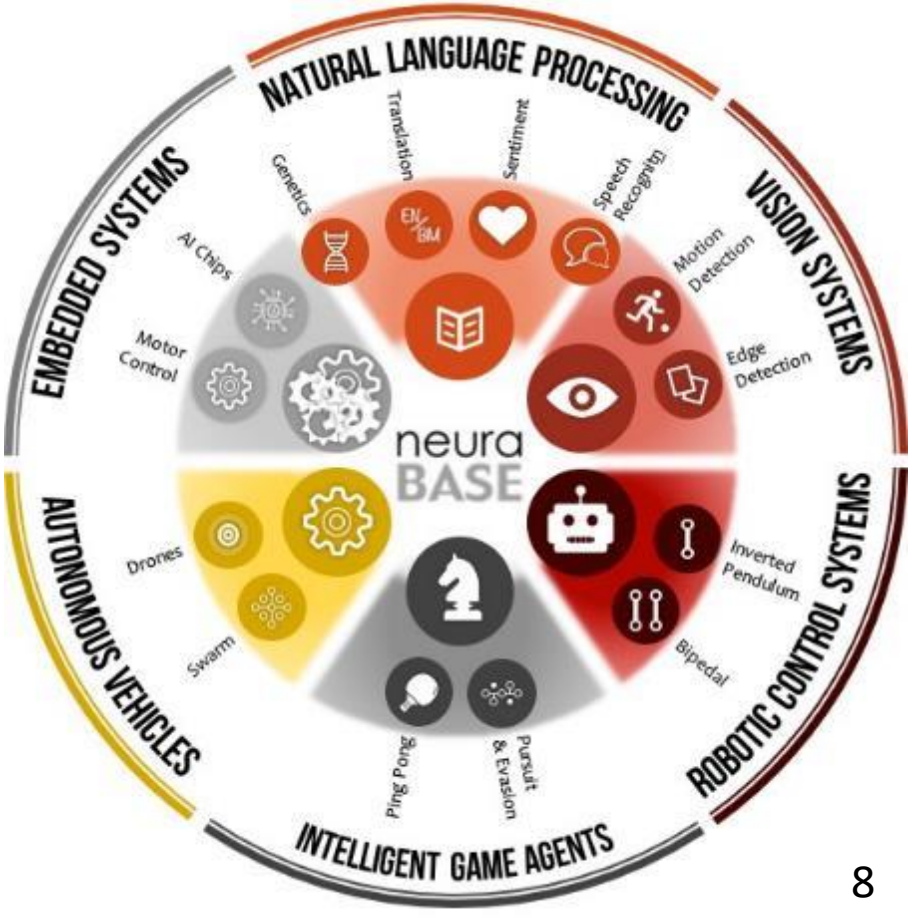


Figure 4

NEURABASE – A NOVEL AI ENGINE FOR MULTIPLE APPLICATIONS

- One Algorithm

- Enables extreme performance for:
  - Big data analytics/vision & speech analytics
  - Natural language processing
  - Reinforcement learning/control systems
  - Inherently compresses & encrypts data
  - A sparse Neural Network



THE NEURABASE STRUCTURE

The NeuraBASE model is biologically inspired.

The same neurons used to create a memory are used to recall the memory.

Learns continuously in real-time – never forgets.

Neurons don't store data – they only store pointers for recall.

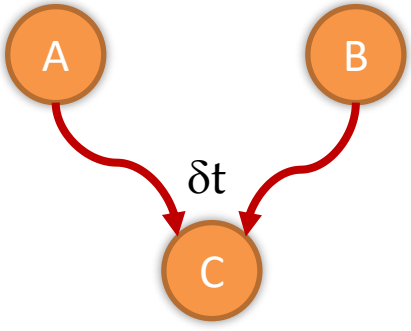
Each neuron contains a single weight (frequency of pattern occurrence - strength of synapses).

Each neuron can participate in thousands of associations.

NeuraBASE inherently compresses & encrypts data.

NeuraBASE

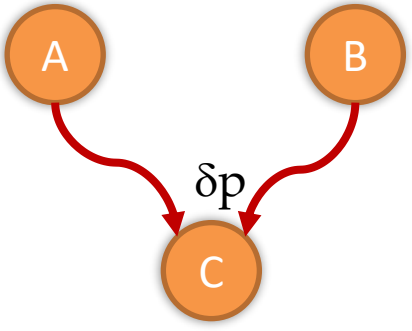
"Neurons that fire consecutively are associated"



Bi-directional

Temporal - Sequences

"Neurons that fire in proximity are associated"

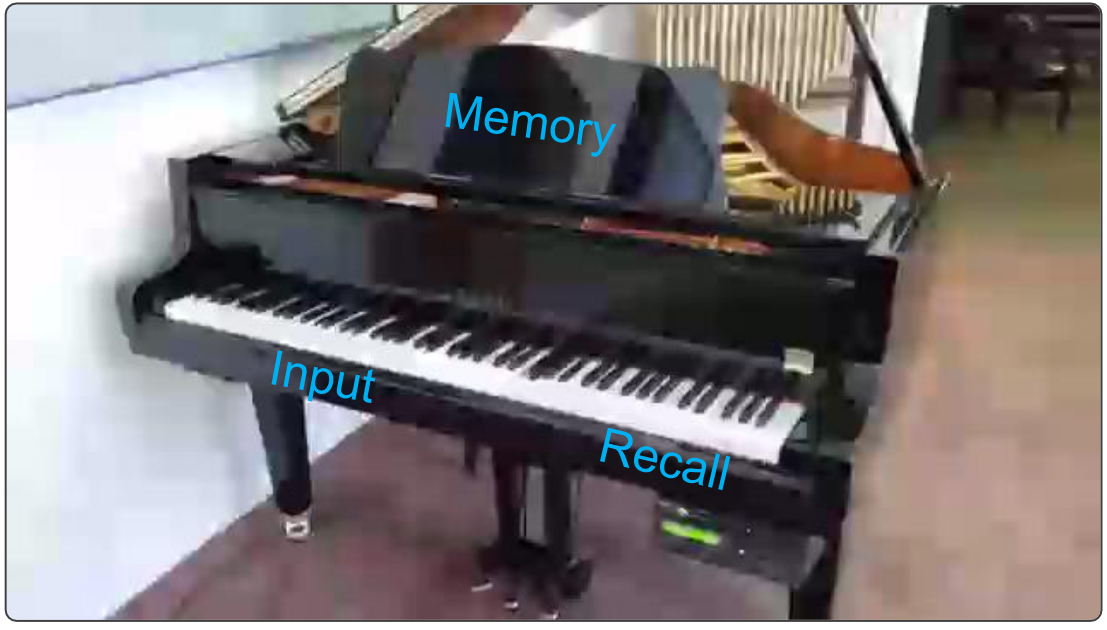


Bi-directional

Spatial Proximity - Patterns

(Vision)

A NEW PARADIGM – NO ENCODING

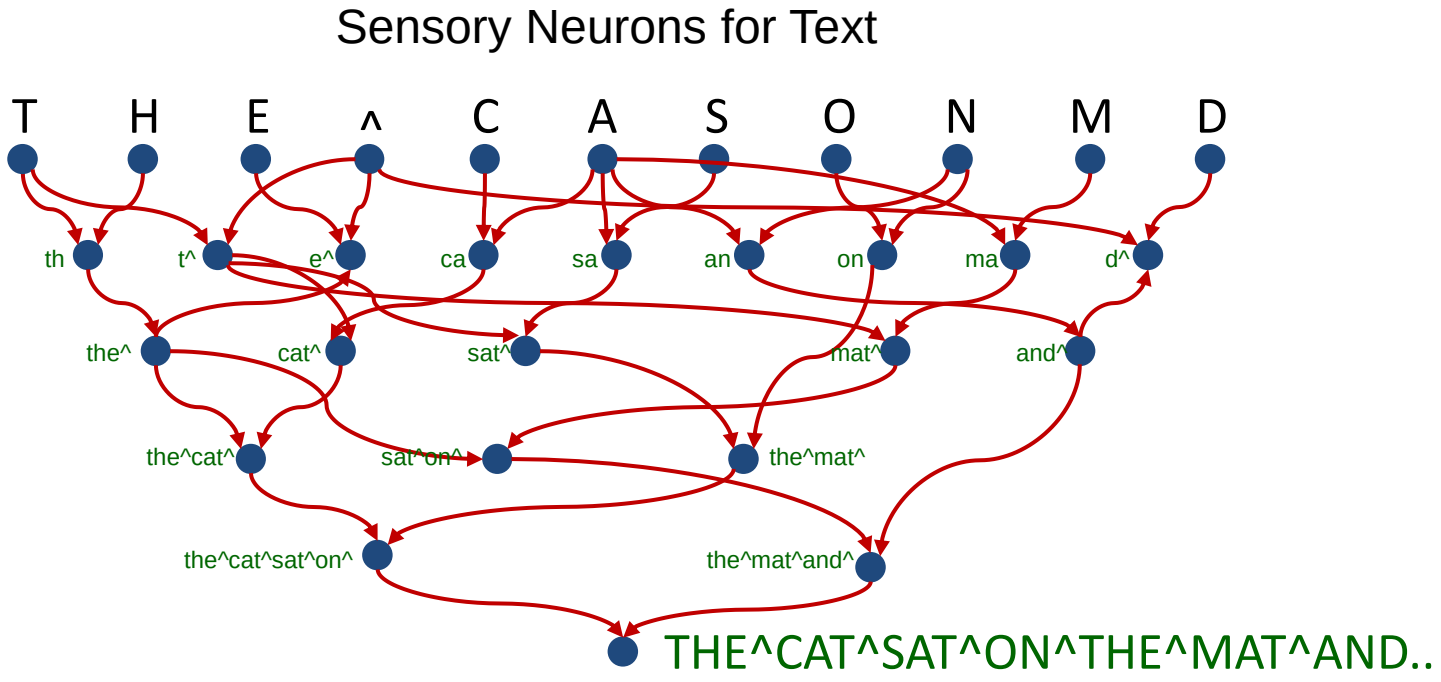


Sensory Neurons ⟷ **Input / Recall** ⟷ NeuraBASE

Memories are recalled by reactivating the same neurons
that created them – there is no need for encoding and decoding.

NEURABASE LEARNING PATTERNS IN LANGUAGE

Level	Characters
0	1
1	2
2	4
3	8
4	16
5	32
.	
.	
10	1,024 characters
.	
.	
20	1,048,576 characters



22 characters

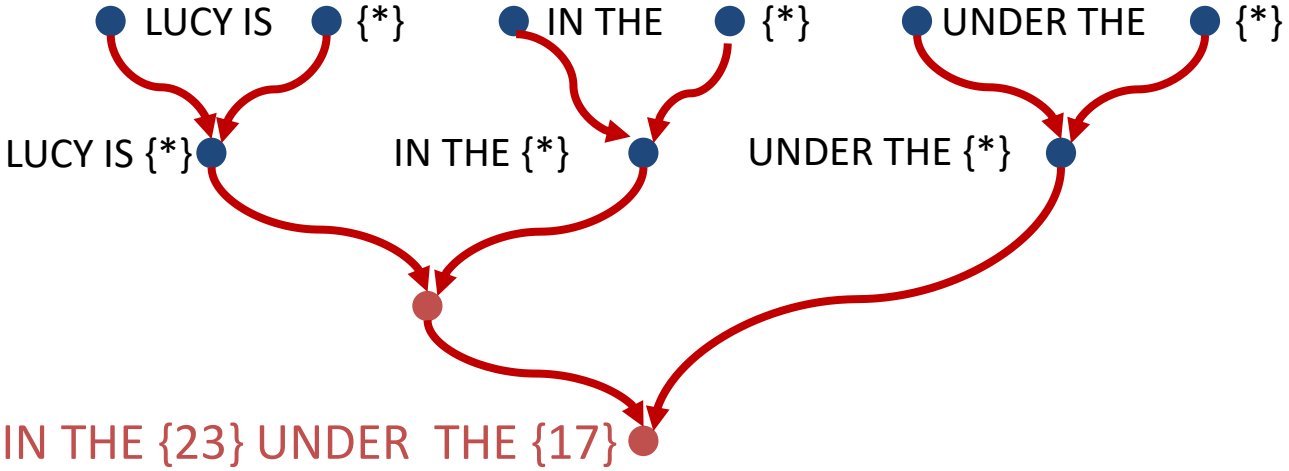
Unique feature:

as data volume increases ↑

incremental storage decreases ↓

NEURABASE LEARNING PATTERNS IN LANGUAGE

Multiple-choice provides many alternatives for expression

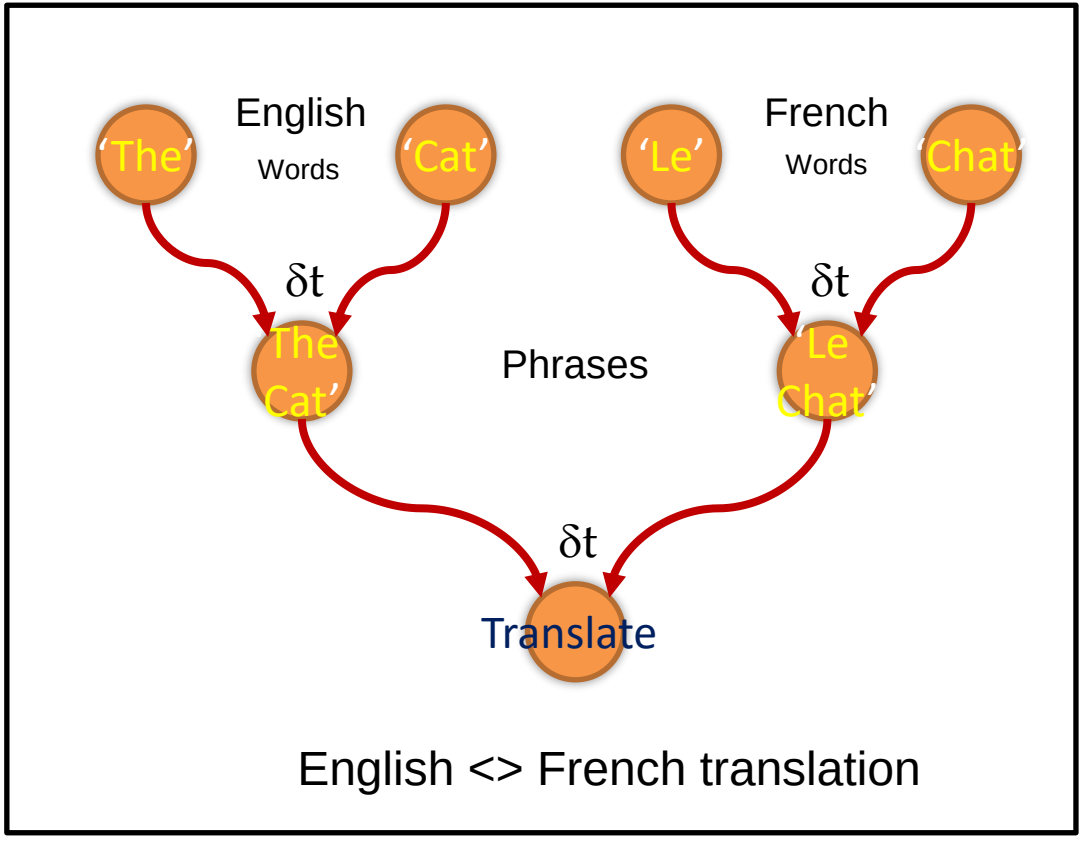


Having learned {15} + {23} + {17} = **55 common expressions**,

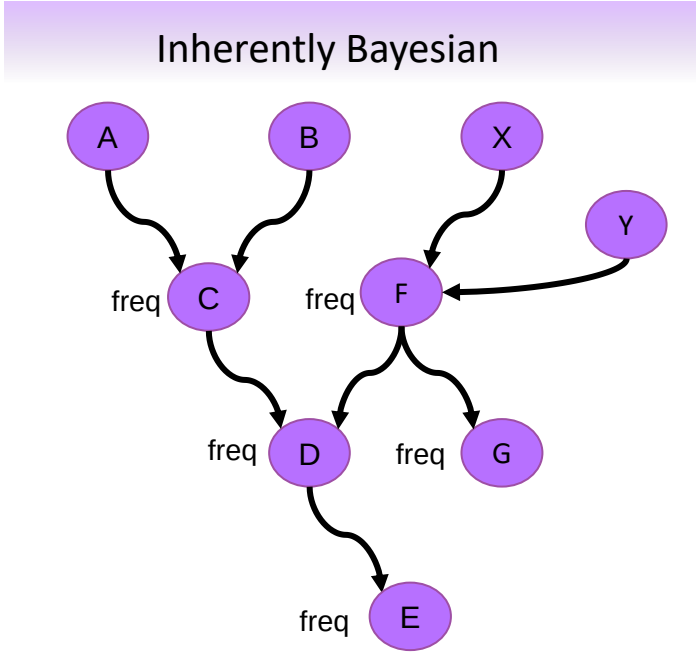
the model can express a total of {15} * {23} * {17} = **5,865 different sentences**, all with correct syntax. That is expression creativity.

NEURABASE IN TRANSLATION

- TRANSLATION
- SPEECH RECOGNITION
- BIG DATA
- CHAT BOTS
- ETC…



TWO TYPES OF NEURAL NETWORKS, IN DETAIL



Can recall

Computationally simple

Parallel processing of different levels

Maintains frequency of each pattern

Multi-level network structure

Learning is simple

Inherently Bayesian

P(A|B) = freq(C)/freq(B)

P(B|A) = freq(C)/freq(A)

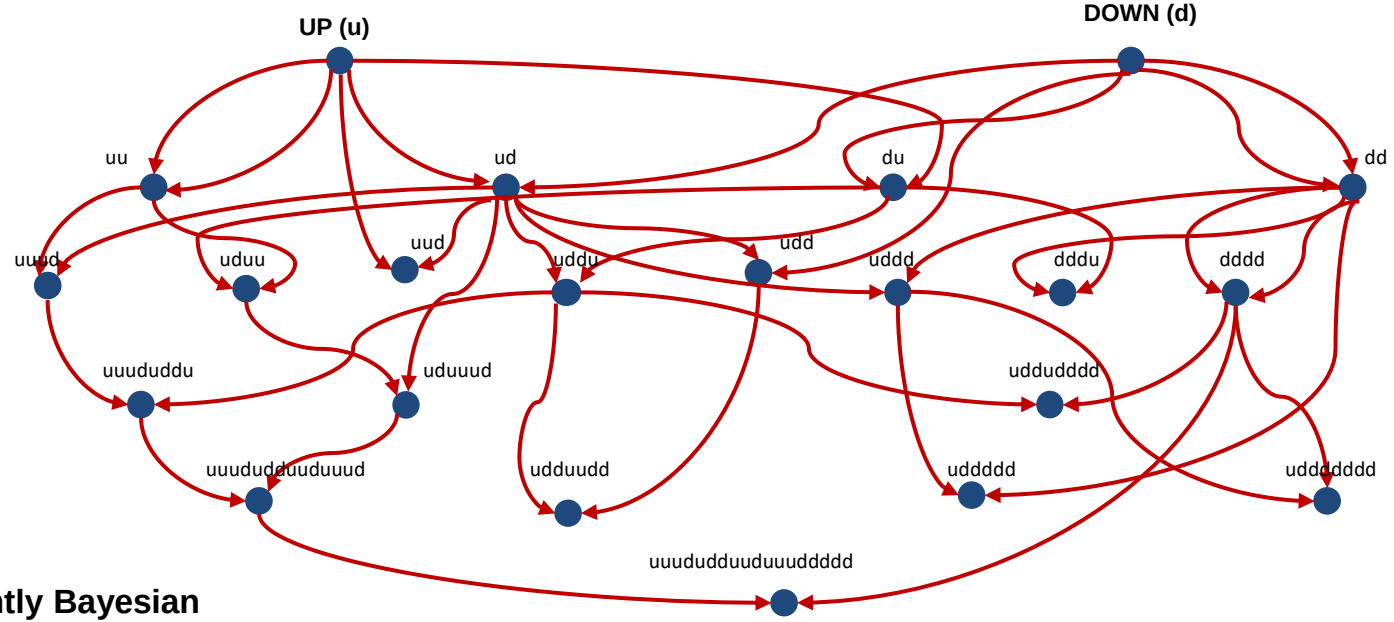
Etc…

corresponding to Synaptic strength of A>C and B>C connections.

Algorithmic Trading

NeuraBASE for Trading

Two Sensory Neurons



Inherently Bayesian

P(udddd|uddd) = freq(udddd)/freq(uddd)

Etc…

corresponding to Synaptic strength of neuron connections.

Prediction of next Stock Movements

Gold\OANDA,

SEARCH

PATTERN? **uddudddddddddd**

Predictions

Length	Current History	Freq	P(u)	P(d)	P(uu)	P(ud)	P(dd)	P(du)
13	uddudddddddddd	6	0.333	0.667	0.333	0	0.667	0
12	ddudddddddddd	27	0.222	0.778	0.222	0	0.741	0.037
11	dudddddddddd	32	0.250	0.750	0.250	0	0.719	0.031
10	uddddddddd	167	0.156	0.844	0.126	0.030	0.713	0.132
9	ddddddddd	1126	0.148	0.852	0.123	0.026	0.726	0.125
8	dddddddd	1342	0.161	0.839	0.134	0.027	0.715	0.124
7	ddddddd	1597	0.160	0.840	0.134	0.026	0.705	0.135
6	dddddd	1898	0.159	0.841	0.132	0.026	0.707	0.134
5	ddddd	2285	0.169	0.831	0.137	0.032	0.699	0.132
4	dddd	2767	0.174	0.826	0.142	0.032	0.686	0.140
3	ddd	3386	0.183	0.817	0.149	0.034	0.675	0.142
2	dd	4170	0.188	0.812	0.153	0.035	0.664	0.148

NATURAL LANGUAGE PROCESSING BIG DATA ANALYTICS

Machine Language Translation

- English <-> Malay translation and English <-> Chinese translation
  - 20,000 words per second on a desktop PC
  - 100M neurons

Genetic Data

- Searches a target pattern in 3GB human genome data in 12 msec
- 700M neurons

Intel Neuromorphic Chip (2021)	IBM True North	NeuraBASE
64 CPU	1 Chip	1 CPU
8 million neurons	16 million neurons	4 billion neurons

FIRST IN THE WORLD TO OFFER MALAY ONLINE TRANSLATION (2007)

FASTEST TEXT-TO-TEXT MACHINE TRANSLATION

Offered free access to Malaysians to seamlessly search and surf the English internet in Bahasa Malaysia or Chinese

REAL-TIME SPEECH TRANSLATION

Bi-directional app offered on mobile devices running on Android.

LARGEST ONLINE RESOURCE OF WIKIPEDIA CONTENT IN MALAY

The disparity between encyclopedia-quality content available in English as compared to other languages is today's digital divide.

FIRST IN THE WORLD TO USE AI FOR GENETIC ANALYSIS (2004)

Big Data Analytics

USD Impact by Market Segment per Annum

LUNG CANCER
Worked with Harvard affiliate to identify novel drug targets.

OIL PALM
Sequenced, assembled, annotated oil palm genome for yield improvement.

NUTRITION
Identified nutraceutical micro RNAs in domestic plants and herbs.

INFECTIOUS DISEASES
Therapeutic candidates for respiratory diseases.

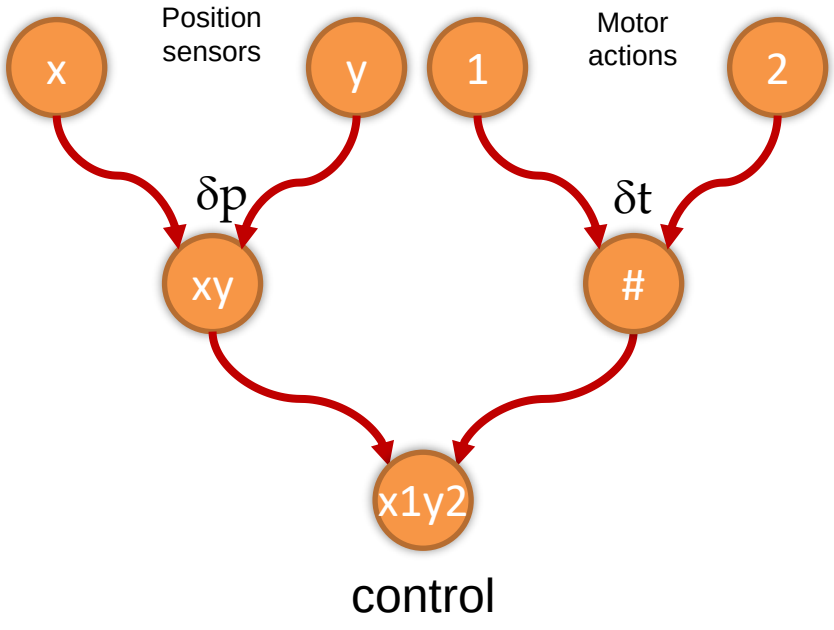
NEURABASE IN CONTROL SYSTEMS

-CONTROL SYSTEMS

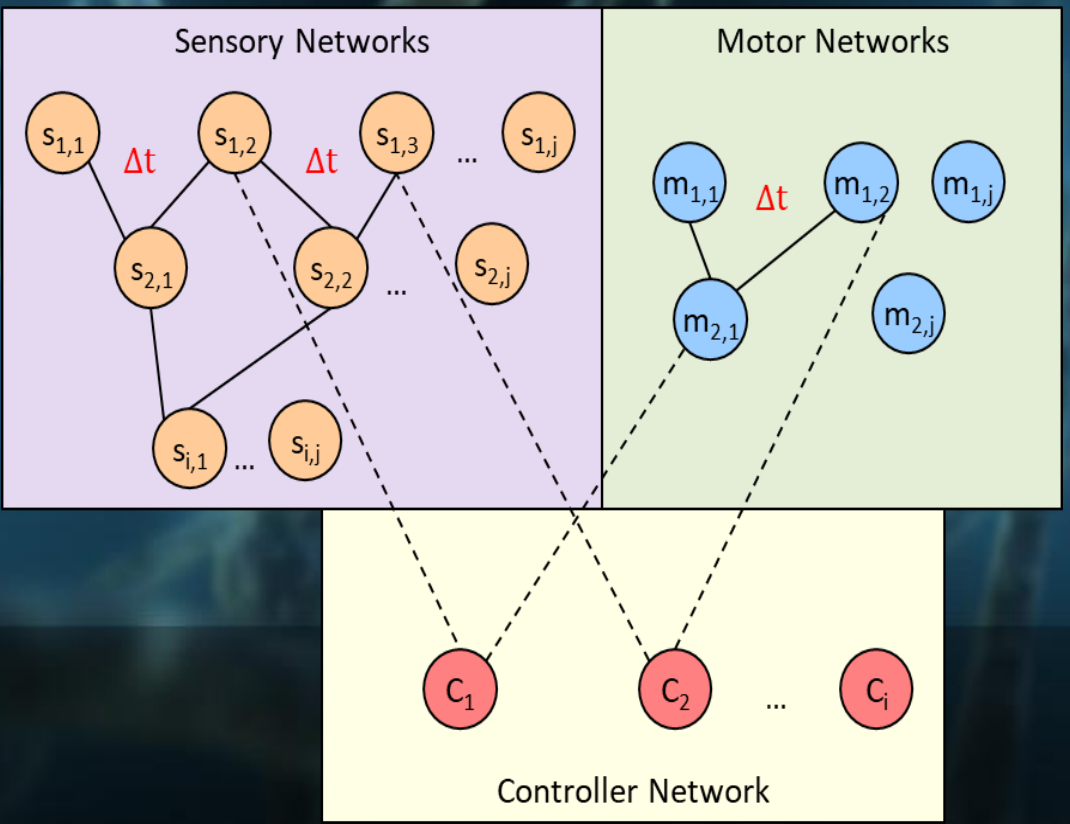
-PURSUIT AND EVASION

-ROBOTICS

-REINFORCEMENT LEARNING



REINFORCEMENT LEARNING



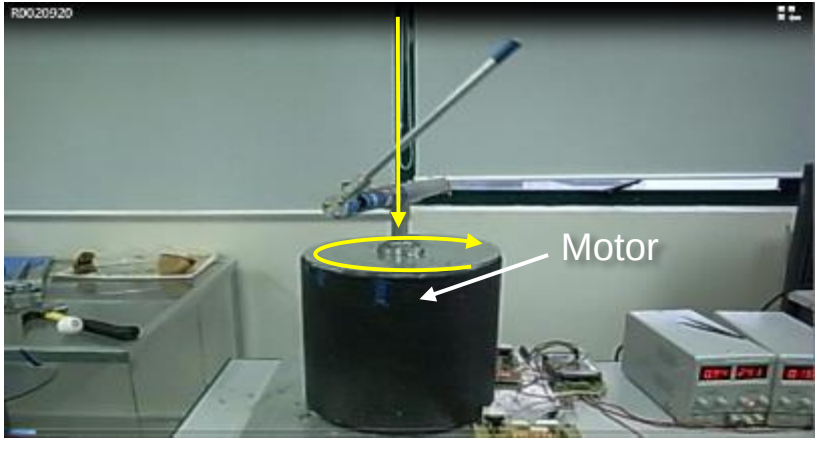
breaking new ground in

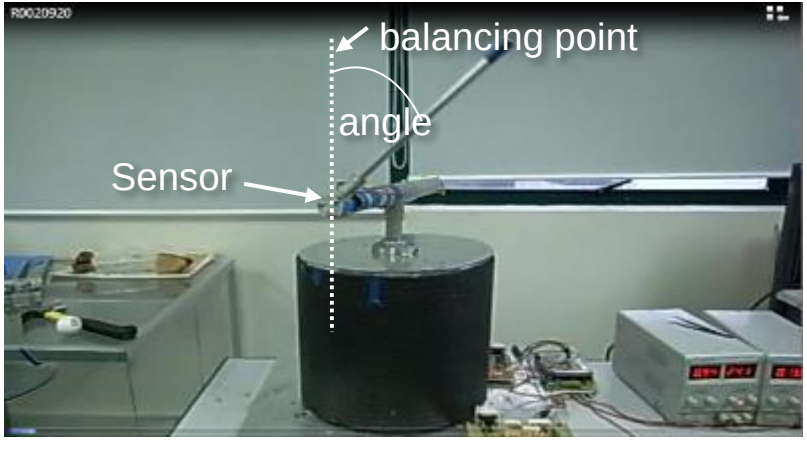
intelligent software and devices

NeuraBASE enables machine learning using user-defined sensor neurons and motor neurons

ROTARY INVERTED PENDULUM

Position and Control Reinforcement Learning



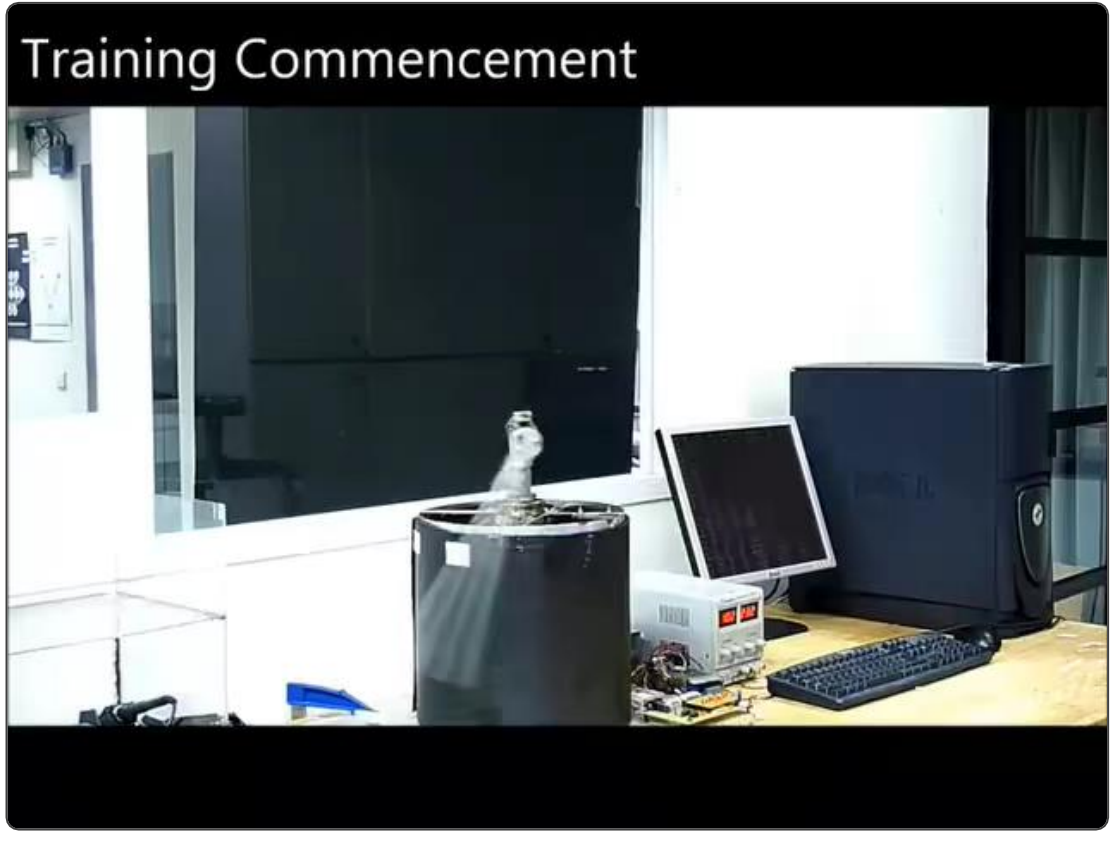


71 sensor neurons (9,000 sensory network neurons)

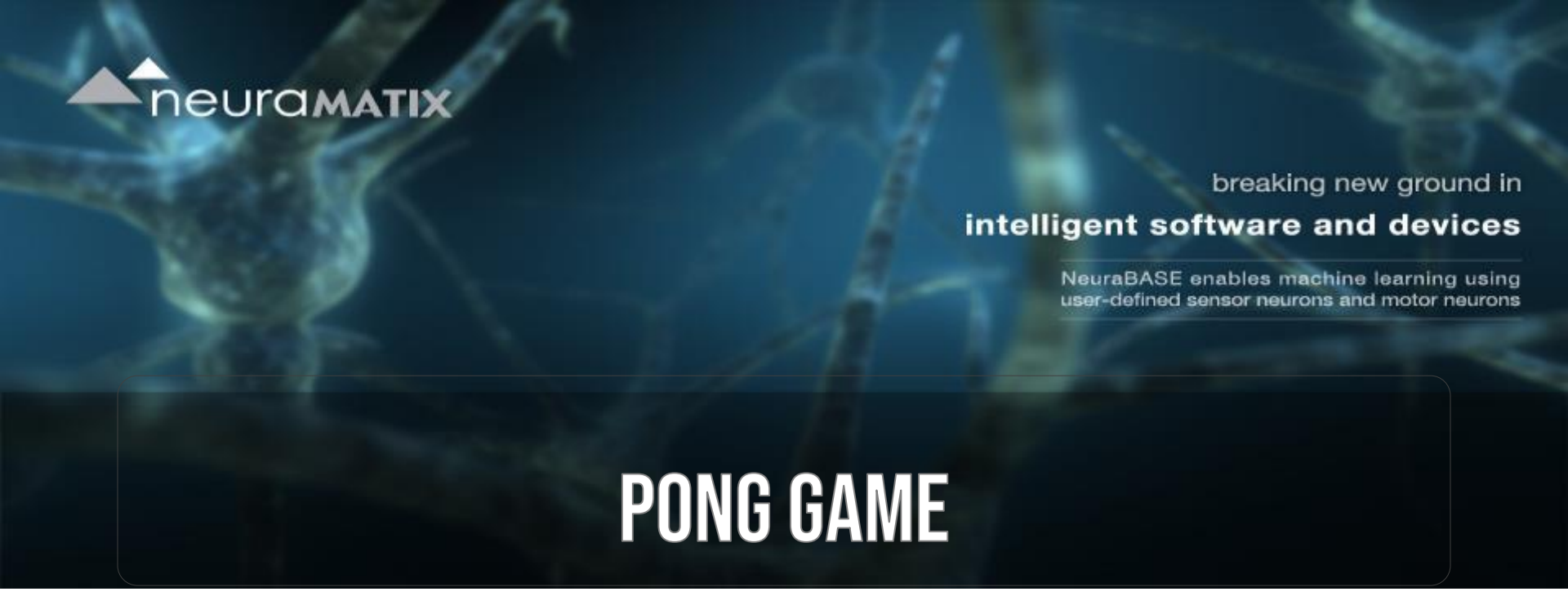
101 motor neurons

25,000 controller network neurons

ROTARY INVERTED PENDULUM



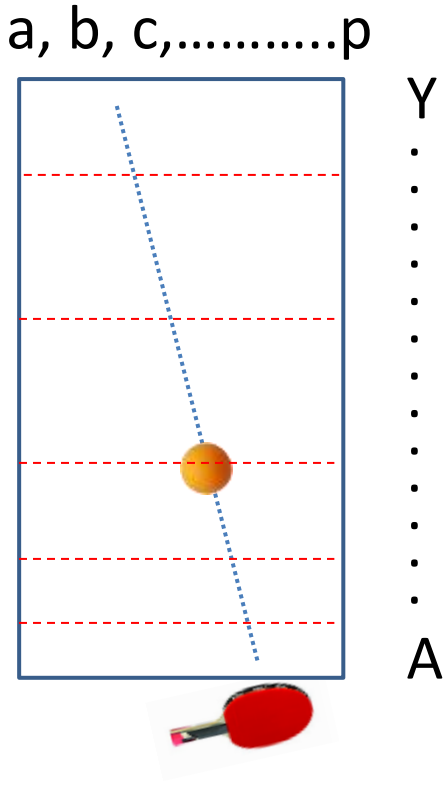
- Knowledge of system dynamics not required
- Adaptive to changes in environment (e.g. blowing fan, changes in pendulum mass)

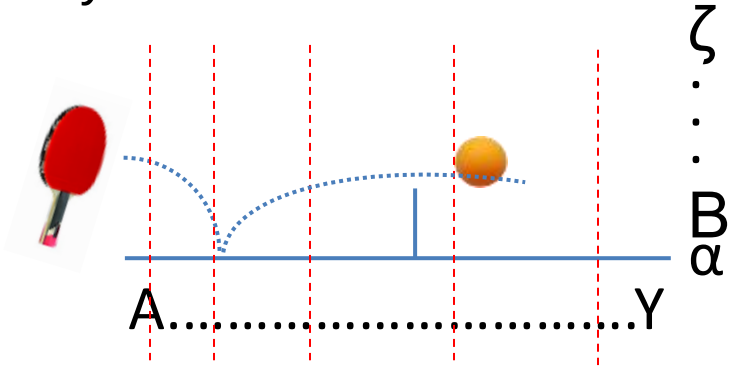


Control of Paddles using
the NeuraBASE Network Model

PONG GAME

Sequence of five ball positions to track trajectory





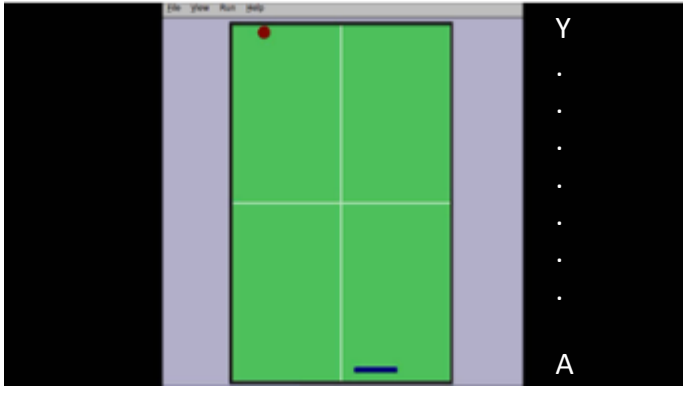
Only 5 or 6 positions are necessary for each trajectory

PONG GAME

TWO INDEPENDENT NEURABASES

Step 1: Learn <u>horizontal</u> motions to hit ball = NeuraBASE A

a, b, c,….p

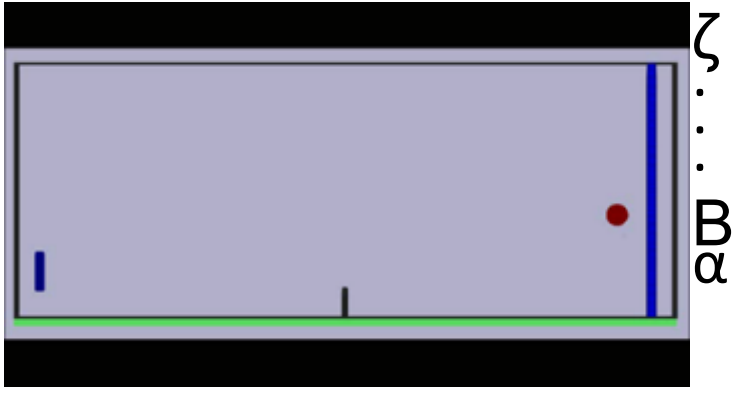


16 sensor neurons

15 motor neurons

30,000 network neurons

Step 2: Learn <u>vertical</u> motions to hit ball = NeuraBASE B

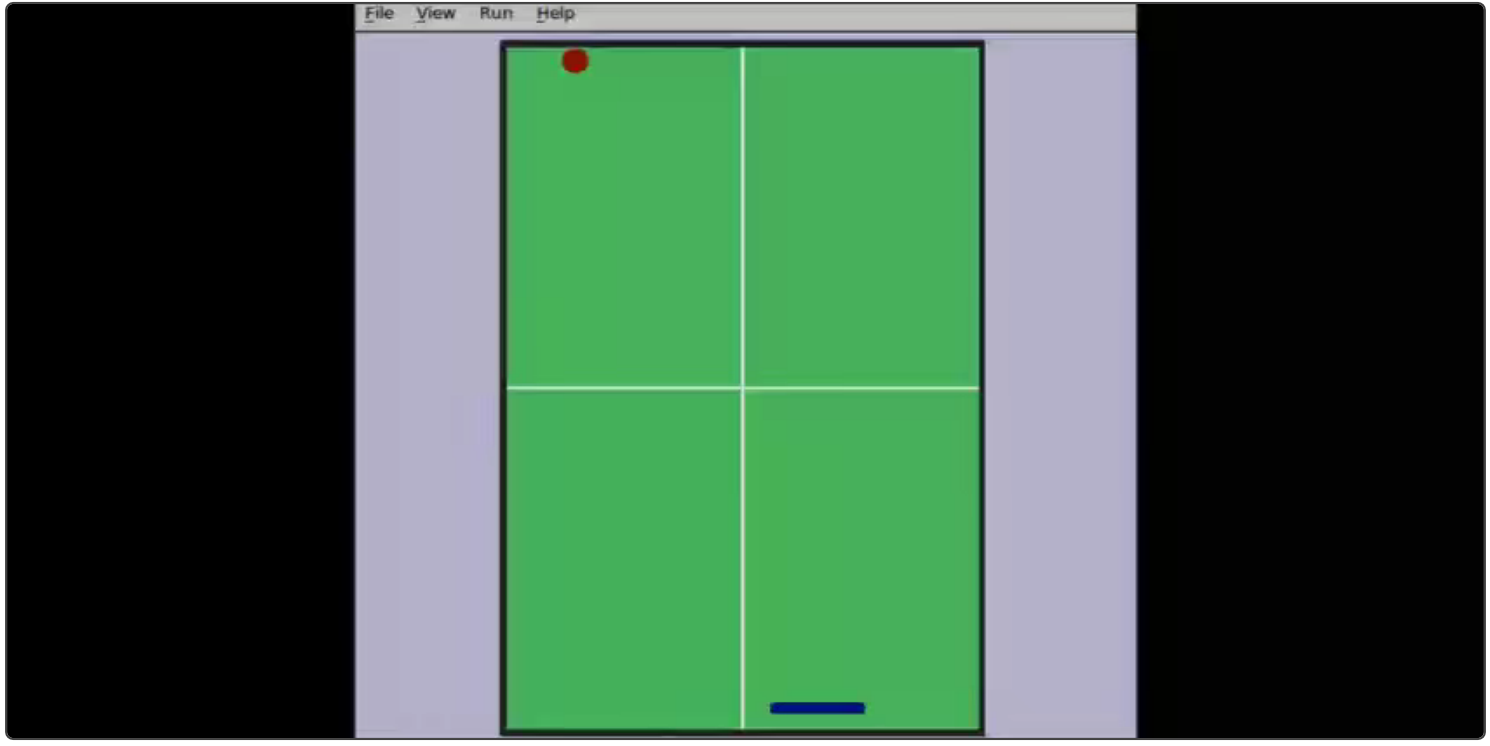


25 sensor neurons

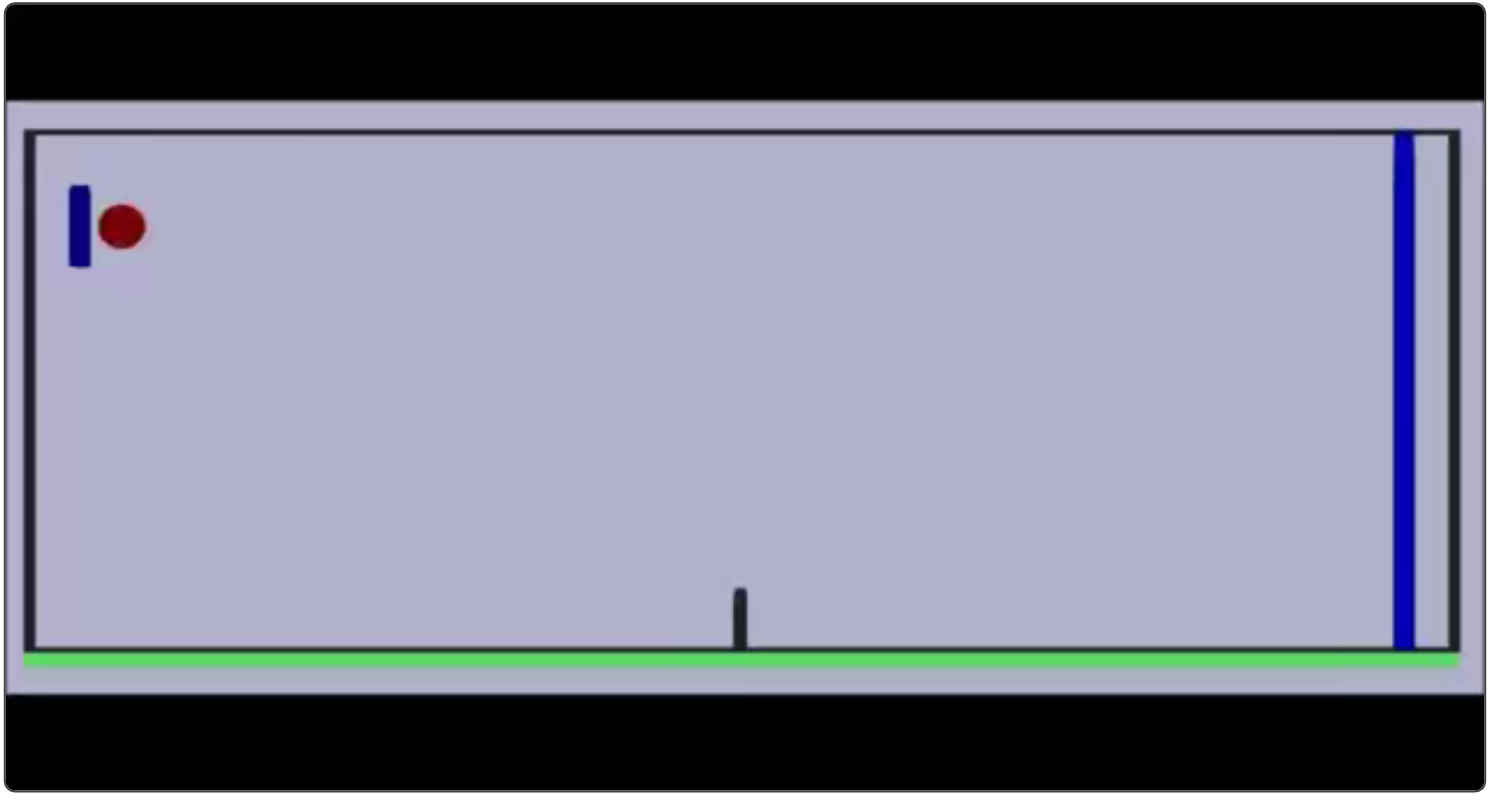
20 motor neurons

15,000controller neurons

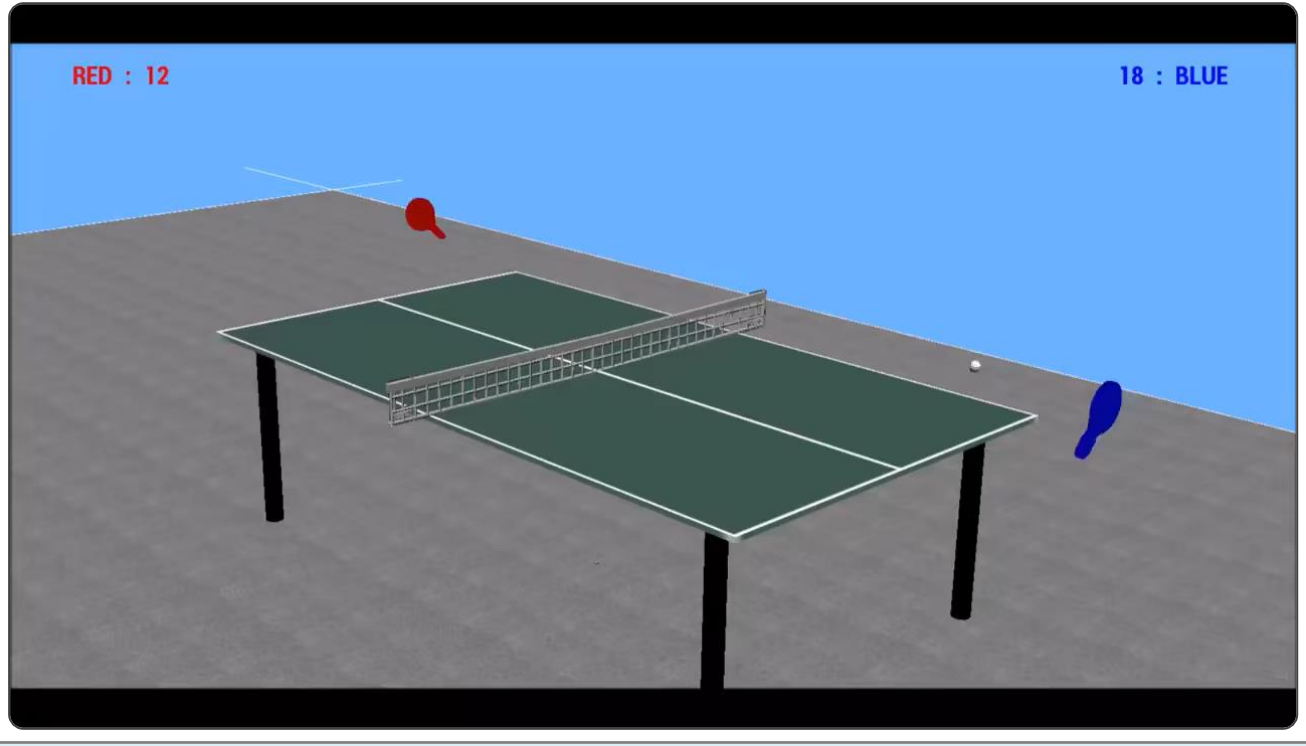
PONG GAME – HORIZONTAL MOVEMENT



PONG GAME – VERTICAL MOVEMENT



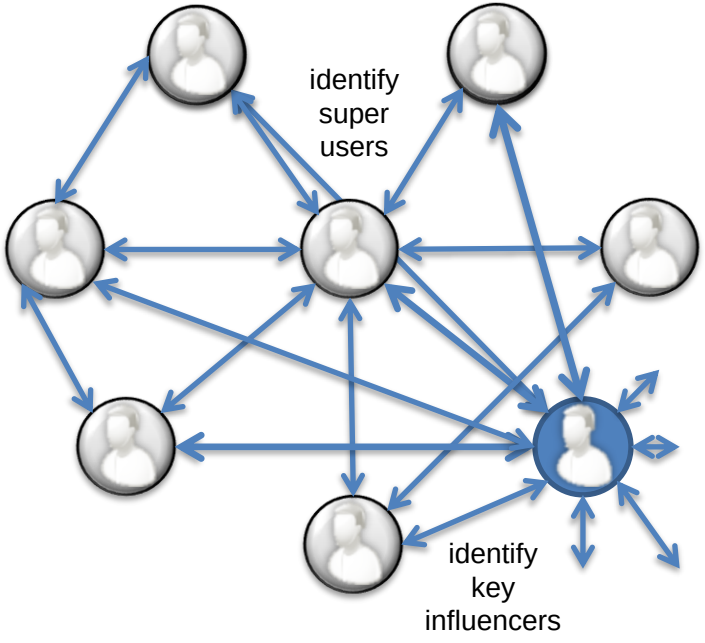
PONG GAME – RUN IN PARALLEL



Advantage

Multiple NeuraBASEs can operate independently in parallel to achieve control of a complex system, similar to how a human operates in parallel, e.g. a human can walk while eating or talking, etc.

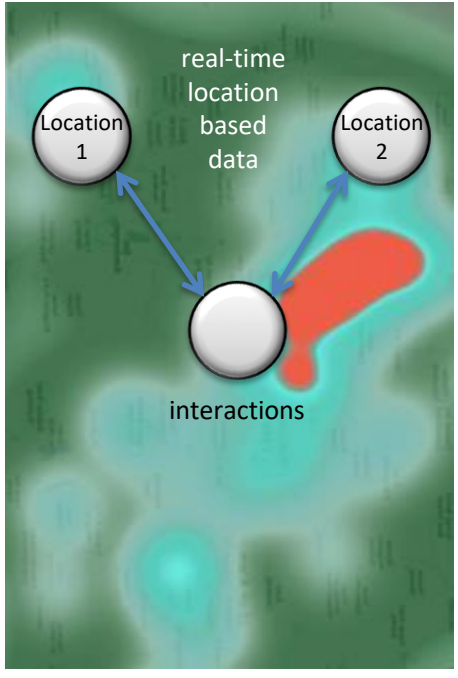
NEURABASE STRUCTURES/NETWORKS



MAPPING SOCIAL RELATIONSHIPS OR ONLINE PURCHASES

- Some people have more contacts/purchases than others
- Can identify super users as valuable referral points
- Can identify key influencers for channel marketers
- Can have millions of sensory neurons (millions of identities/items)
- Realtime continuous learning

LEARN GEOSPATIAL PATTERNS



- Are users receiving or making calls to/from overseas or do they travel frequently?
- Mapping of commercial establishments to user location for location-based ad targeting
- Mapping of users to cell tower locations by time
- Visualising patterns of geo-data over time

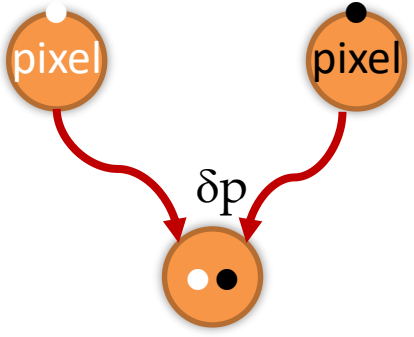
Interactive Speech Systems

Interactive Speech System running on a stand-alone Android processor

NEURABASE IN VISION – USING PROXIMITY

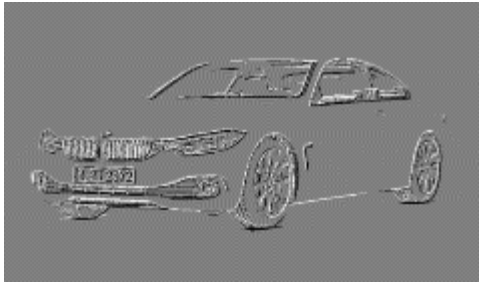
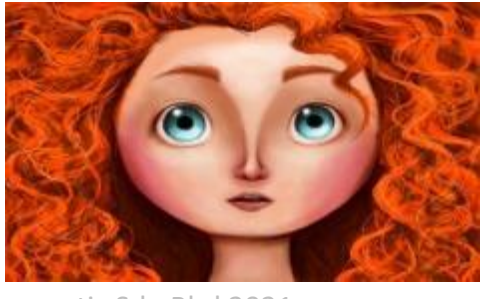
- VIDEO ANALYSIS
- IMAGE RECOGNITION
- EDGE DETECTION
- DISTANCE COMPUTATION
- MOVEMENT DETECTION

Image



Edges

EDGE DETECTION

Original Image	Google Edge Detection	NeuraBASE Edge Detection
		
		
		

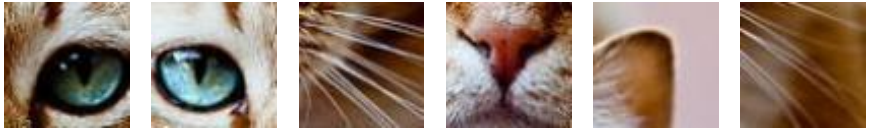
FACE DETECTION








SALIENCY + FEATURES EXTRACTION



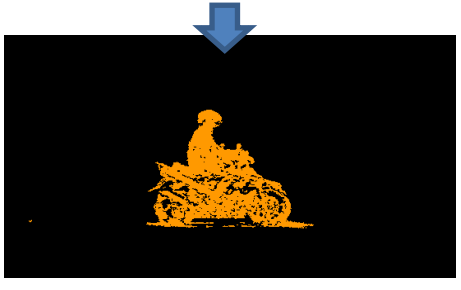
Extracted salient points for feature detection

NEURABASE MOVING OBJECT DETECTION

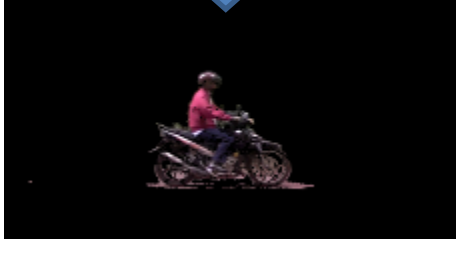
Frame -1

Frame 0

Frame +1



Movement Detection

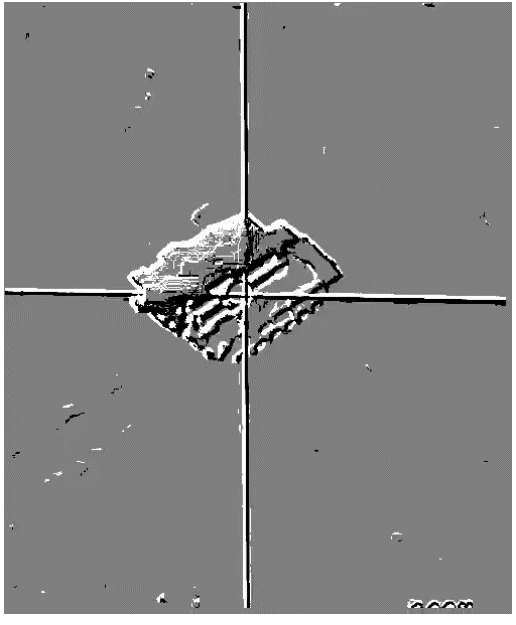


Object Selection

NEURABASE MOVING OBJECT DETECTION

Surveillance

- Video frames from a camera can be transformed into edge-frames by NeuraBASE edge detection
- By using edges, subsequent image processings such as object detection/ recognition, are faster as there is less information to be processed. Less bandwidth is required for data transmission to a control centre



Surveillance

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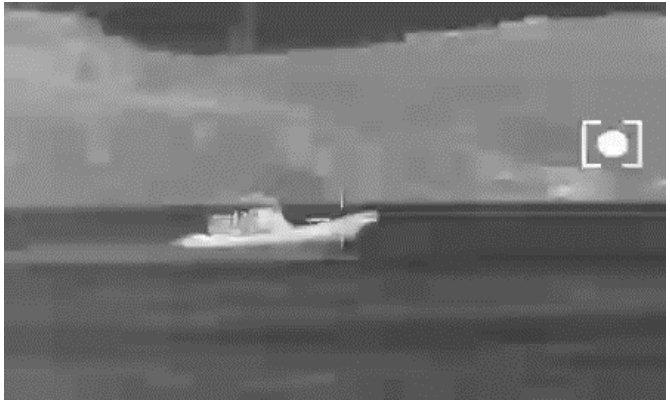
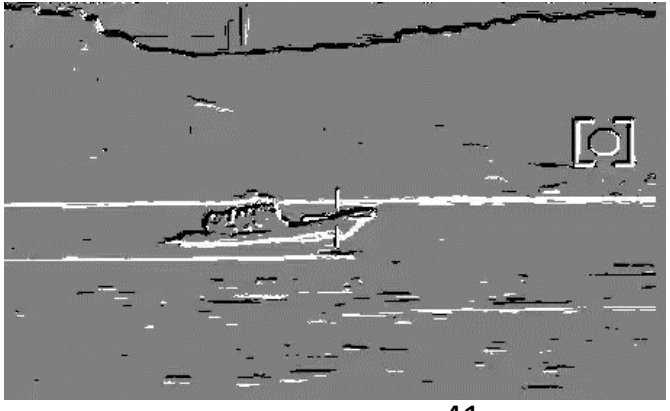
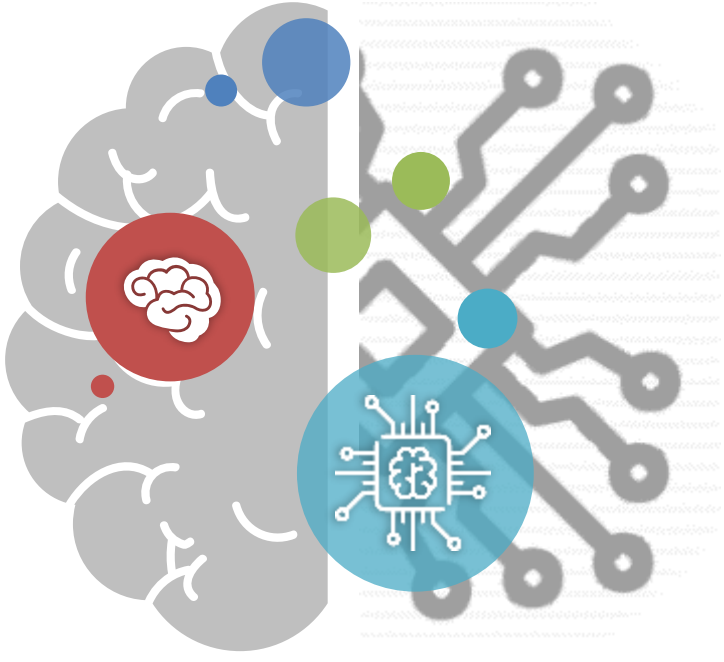




THE END GAME FOR MATURE TECHNOLOGY RESIDES IN SILICON



INTELLIGENT MOTOR CONTROL IN FIRMWARE

TO CONTROL JOINTS INDEPENDENTLY WITH SENSORY FEEDBACK OF POSITION DATA.

VISION SENSORY SYSTEMS IN FIRMWARE

FOR OBJECT DETECTION, DISTANCE COMPUTATION AND MOVEMENT DETECTION.

NEURAL CHIP FOR INTELLIGENT DEVICES

Neural chip bundled together with memory and communication on a chip for large-scale, low-cost deployment in a number of IOT-enabled application areas.

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Only ONE Algorithm

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