Deep Learning

Insights

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HUMAN BRAIN VS CONSCIOUSNESS

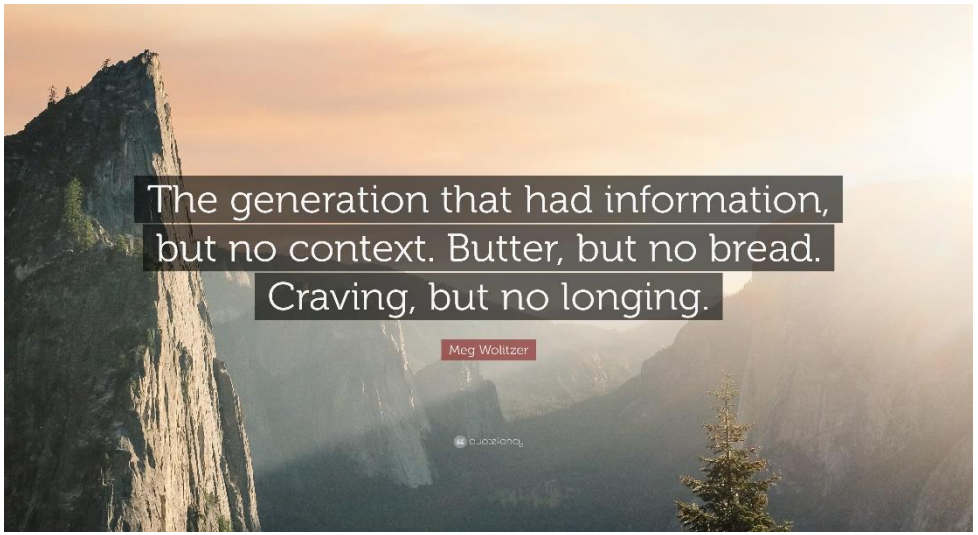
An High Dimensional and Complex Neural Network

- **The lack of a formal li nk between neural ne twork structure and it s emergent function h as hampered our und erstanding of how the brain processes infor mation.**

Scientists find evidence of a Multidimensional Universe within the Brain

Reimann, M. W., Nolte, M., Scolamier o, M., Turner, K., Perin, R., Chindemi, G., ... & Markram, H. (2017). Cliques o f neurons bound into cavities provide a missing link between structure and function. Frontiers in computational neuroscience, 11, 48.

MACHINE LEARNING VS CONSCIOUSNESS



Is this a Glass or a Pot?

Where is the Human-Like Thoughts Flow?

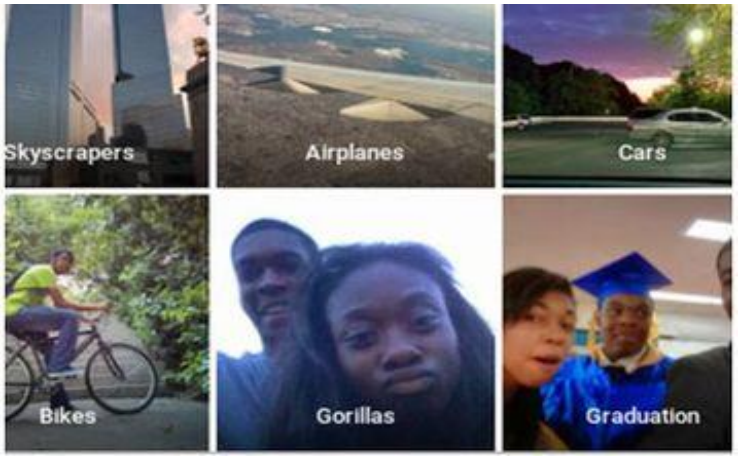
Why and How Lea Seadol beats Alpha Go Zero once?

Even though all metrics say it is impossible.

MACHINE LEARNING LIMITS

Will ever Self Driving Car cope with Mumbai Traffic?

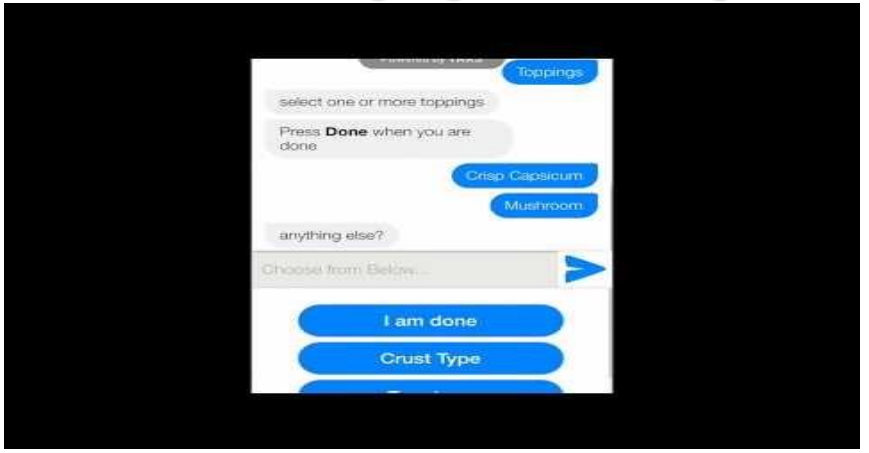
Will ever AI have context information ?



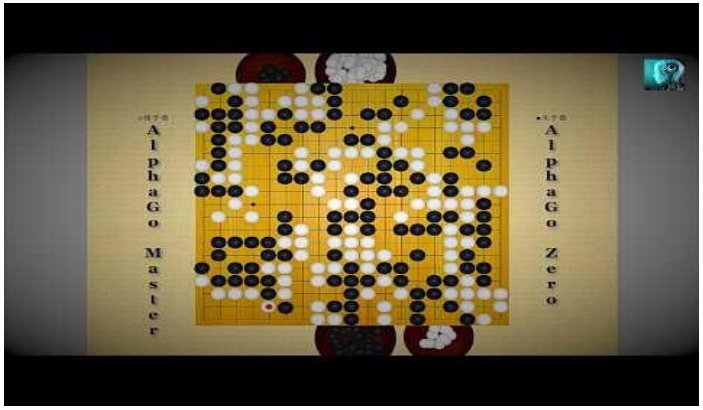
MACHINE LEARNING BREAKTHROUGHTS

Computer Vision

Natural Language Processing

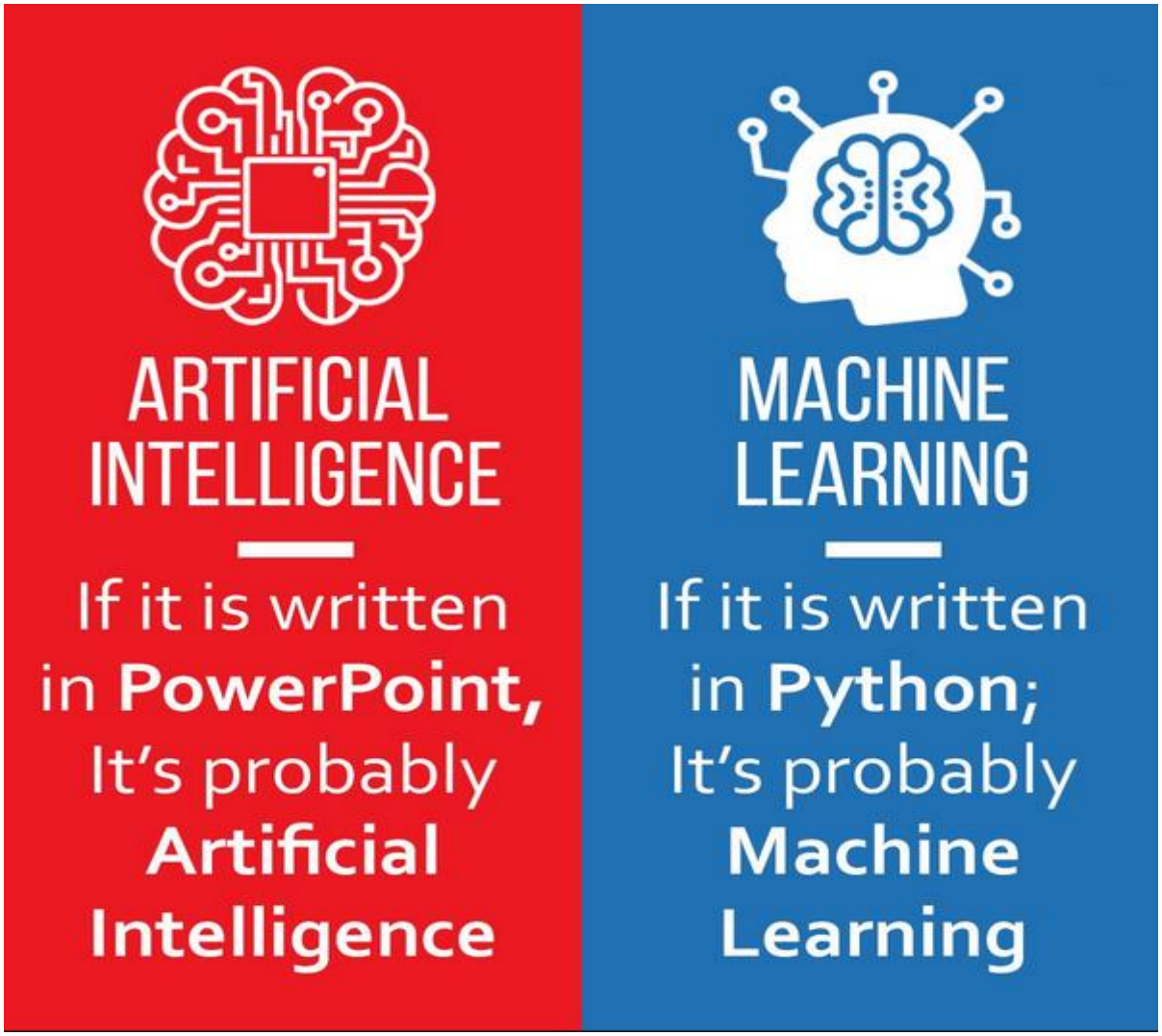


A truly general Artificial Intelligence



A Generative Artificial Intelligence

Difference between AI and ML



MACHINE LEARNING ENGINEER

What My Parent Think I do

What My Friend Think I do

What Society Think I do

What Media Think I do

What I Think I do

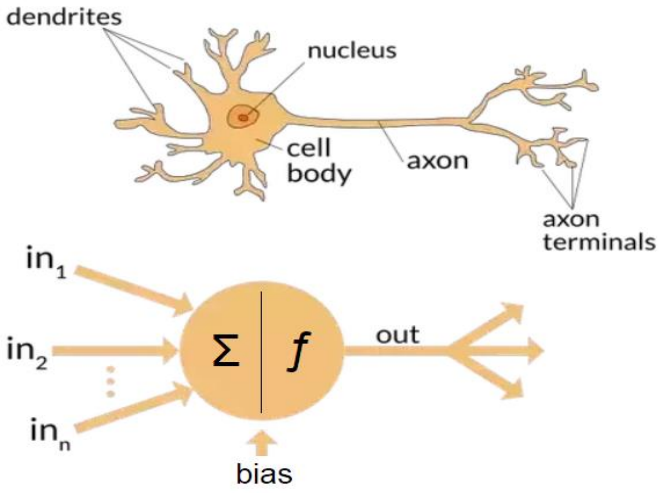
```
1   import tensorflow as tf
2   import torch
3
```

What I really do

ARTIFICIAL NEURAL NETWORKS

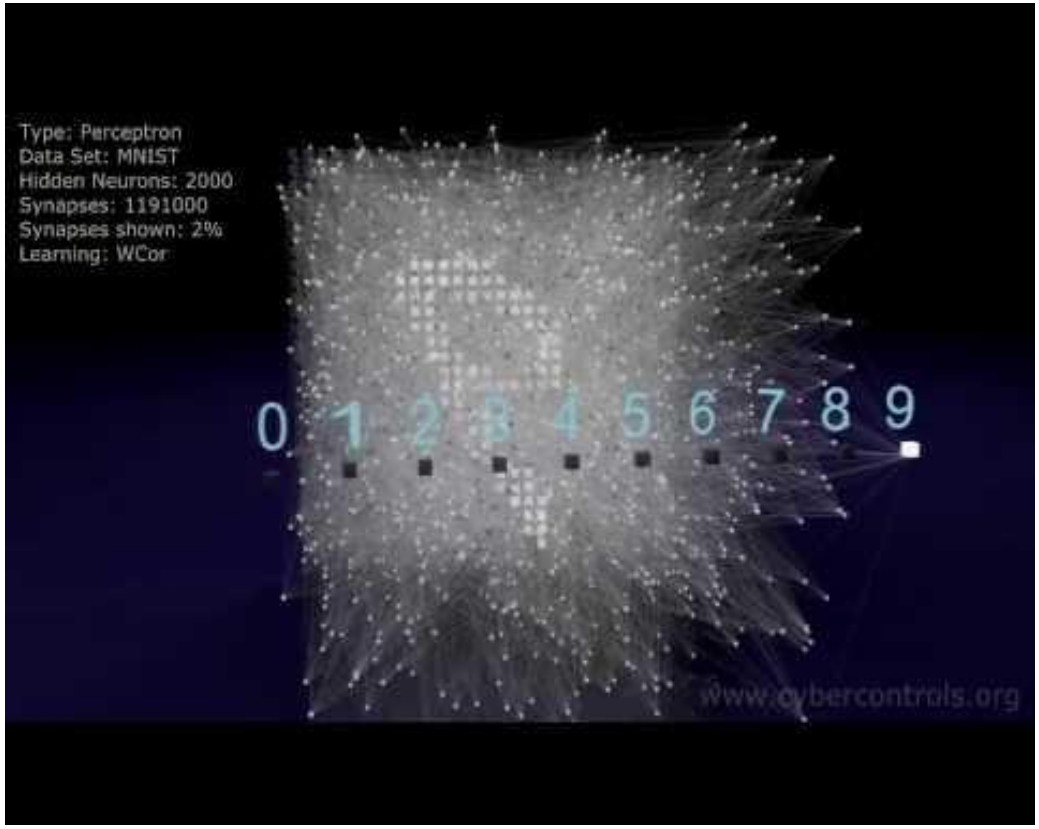
- **Artificial neural networks (ANN) or Connectionist Systems are computing systems vaguely inspired by the biological neural networks that constitute animal brains (van Gerven & Bohte, 2018)**

Biological Neuron Vs Artificial Neuron



Neuron Activation

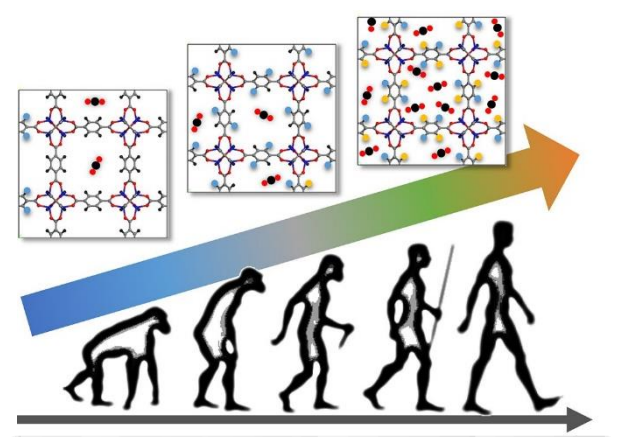
$$y_j = \Phi\left(\sum_{i=1}^{N} w_{ij} X_i - \theta_i\right)$$



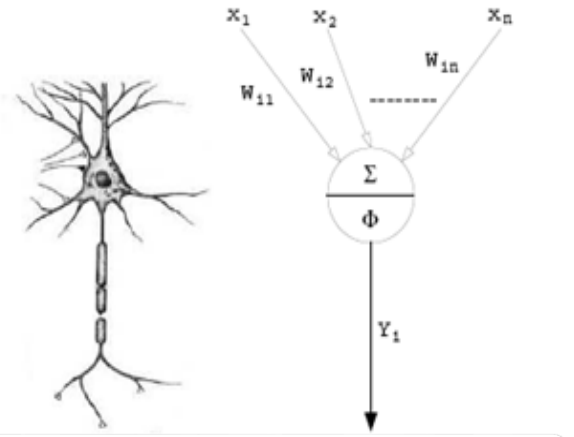
One traditional application ANN: Evolutionary robotics

In order to overcome the problems associated with the robotic system decomposition of traditional approaches (i.e. behavior-based robotics), evolutionary robotics can be used, where the robotic system is able to self-organize

[*Nolfi, S., Floreano, D ., 2000*].



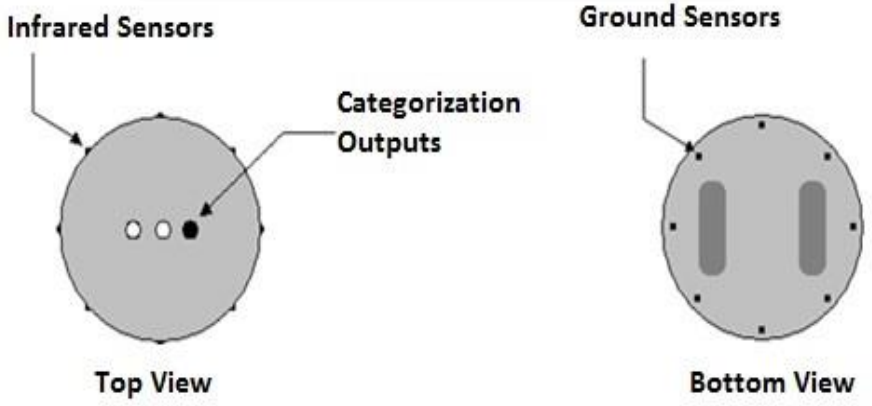
NeuroGenetic Algorithm



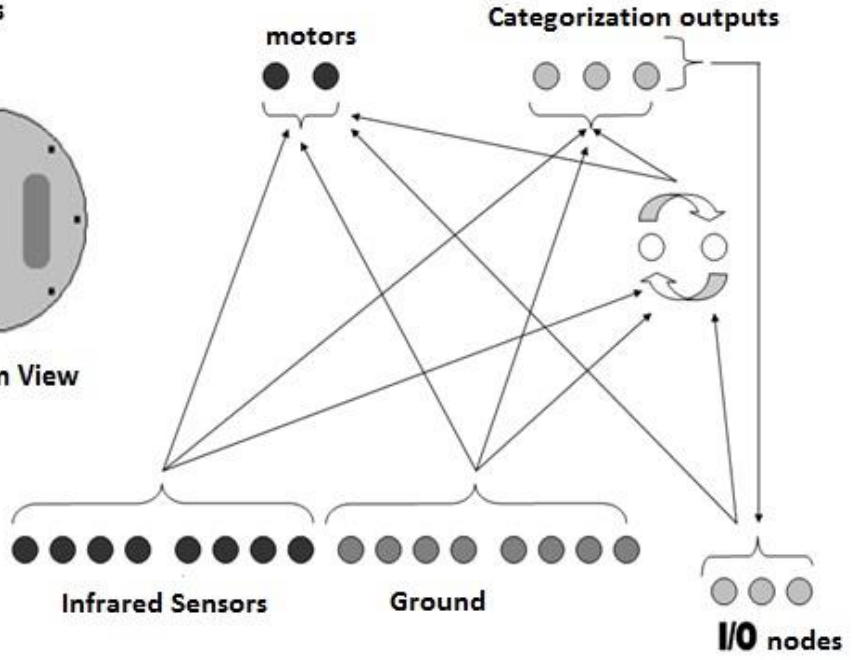
Control Neural Network

EXPERIMENTAL SETUP

ROBOT'S CHASSIS



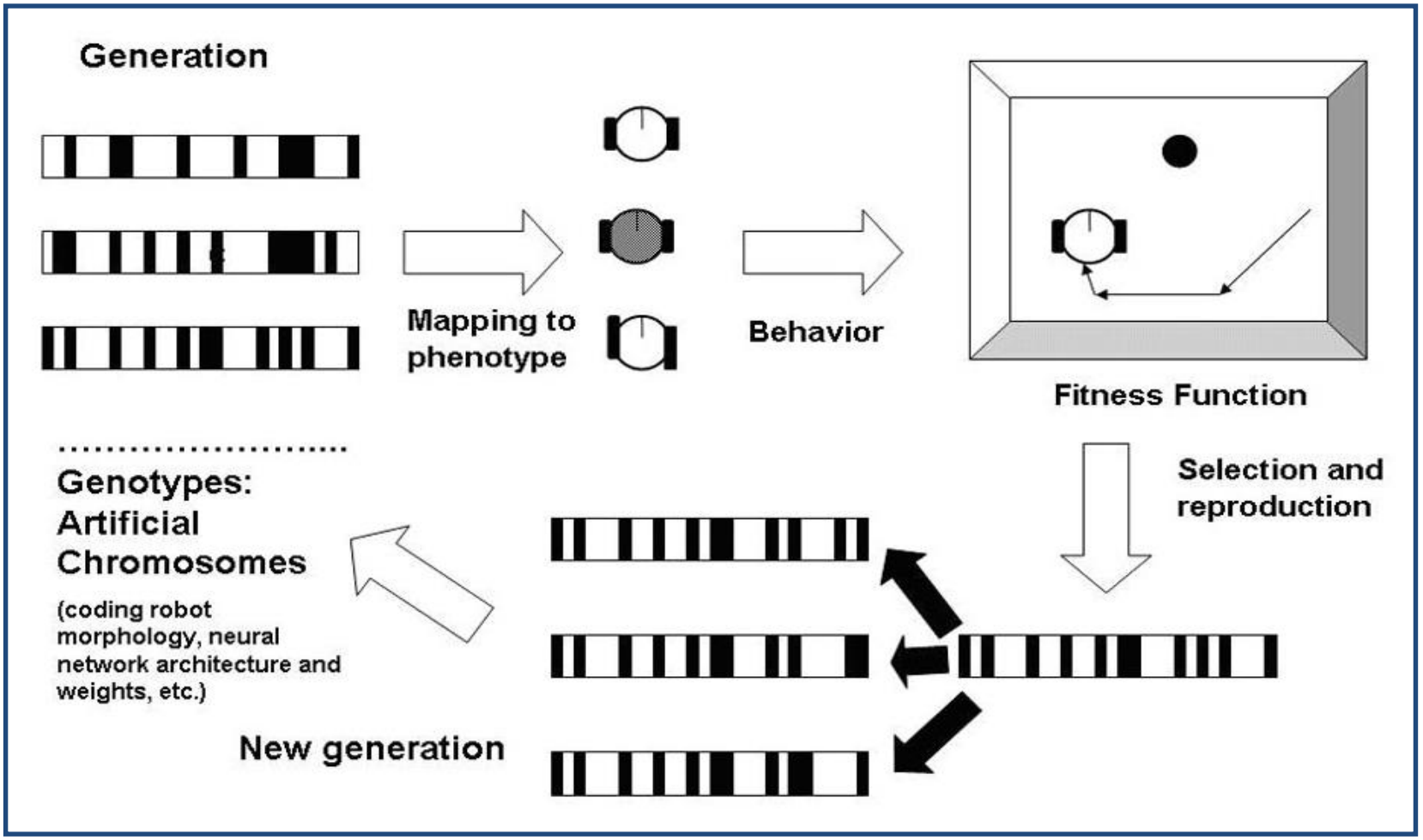
NEURAL NETWORK



LEAKY Activation

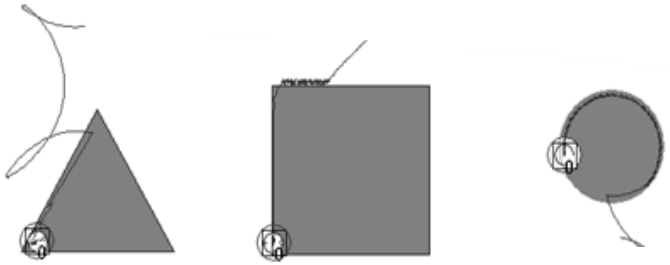
$$A_j = t_j + \sum w_{ij} O_i \;,\; O_j = \delta_j O^{t-1} + (1 - \delta_j)\left(1 + \frac{1}{e^{A_j}}\right), 0 \le \delta_j \le 1$$

Evolutionary Robotics



EXPERIMENTAL SETUP N.1

RESULTS



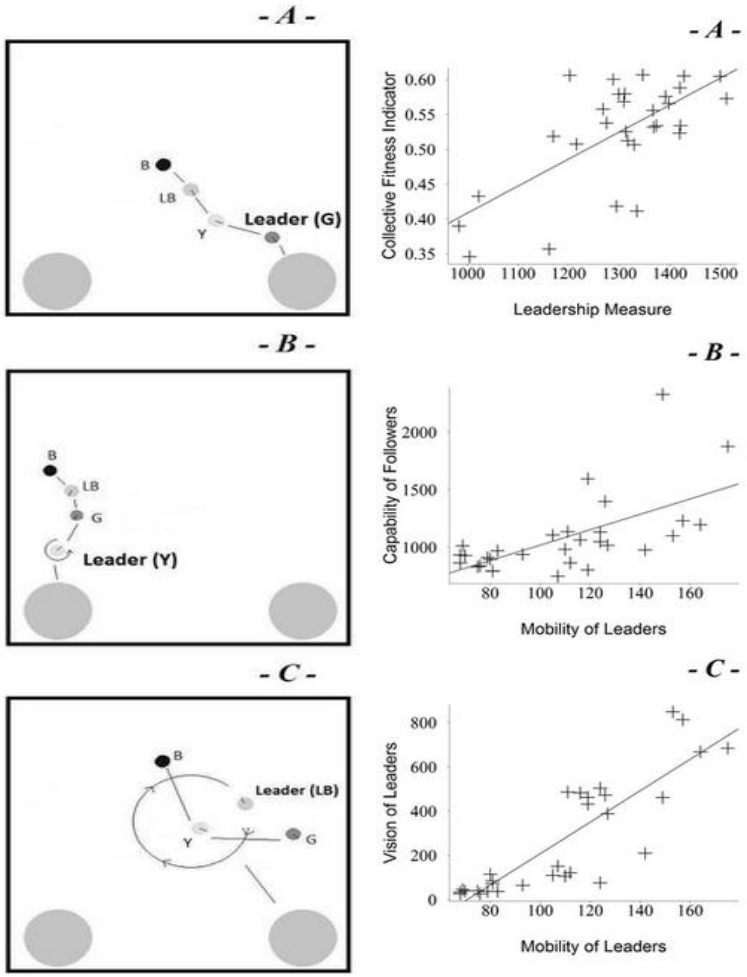
FITNESS CURVE

Emergence of Leadership in Robots

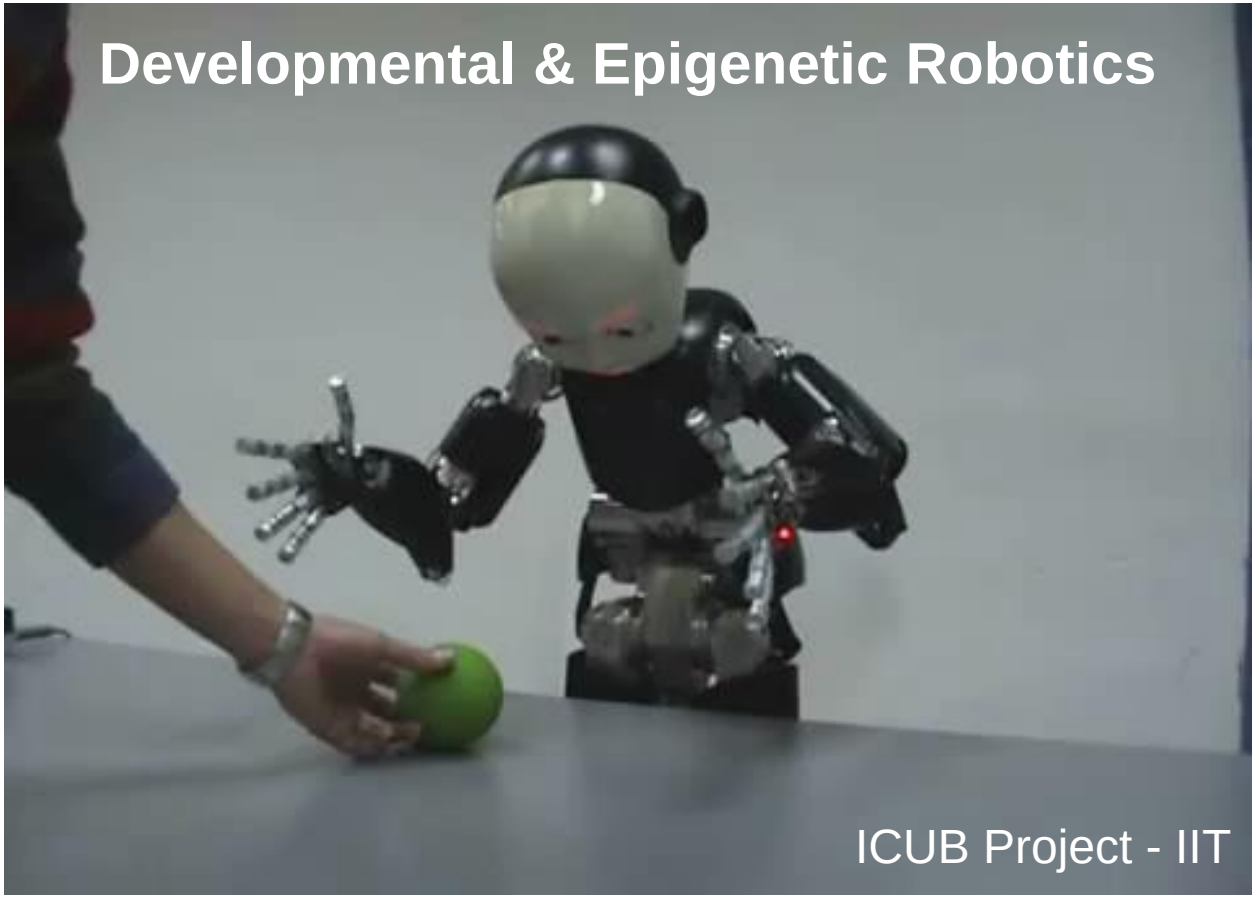
- Behavioural and quantitative analysis indicate that a form of leadership emerges
- Groups with a leader are more effective than groups without.
- The most skilled individuals in a group tend to be the leaders.
- Further analysis reveals the emergence of different “styles” of leadership (active and passive).

- A - Passive Leadership. - B - Weak Active Leadership.
- C - Strong Active Leadership.

- (Pugliese, et. Al., 2015)



MAY Robotics help to understand social and psychological problems?



DEEP LEARNING: Neural Networks become more effective

In recent years **Deep Neural Networks** have achieved noticeably breakthroughs in research (*Bengio, 2009*). This new methodology dealing with deep neural networks and their training algorithms is called *"Deep Learning"*. **So far, in all the experiments, the resulting performances were many magnitudes better than other machine learning techniques available.**

GOOGLE DATACENTER

1,000 CPU Servers 2,000 CPUs • 16,000 cores	600 kWatts $5,000,000

STANFORD AI LAB

3 GPU-Accelerated Servers 12 GPUs • 18,432 cores	4 kWatts $33,000

DEEP LEARNING: a cutting-edge approach to Computer Vision and NLP

GPU

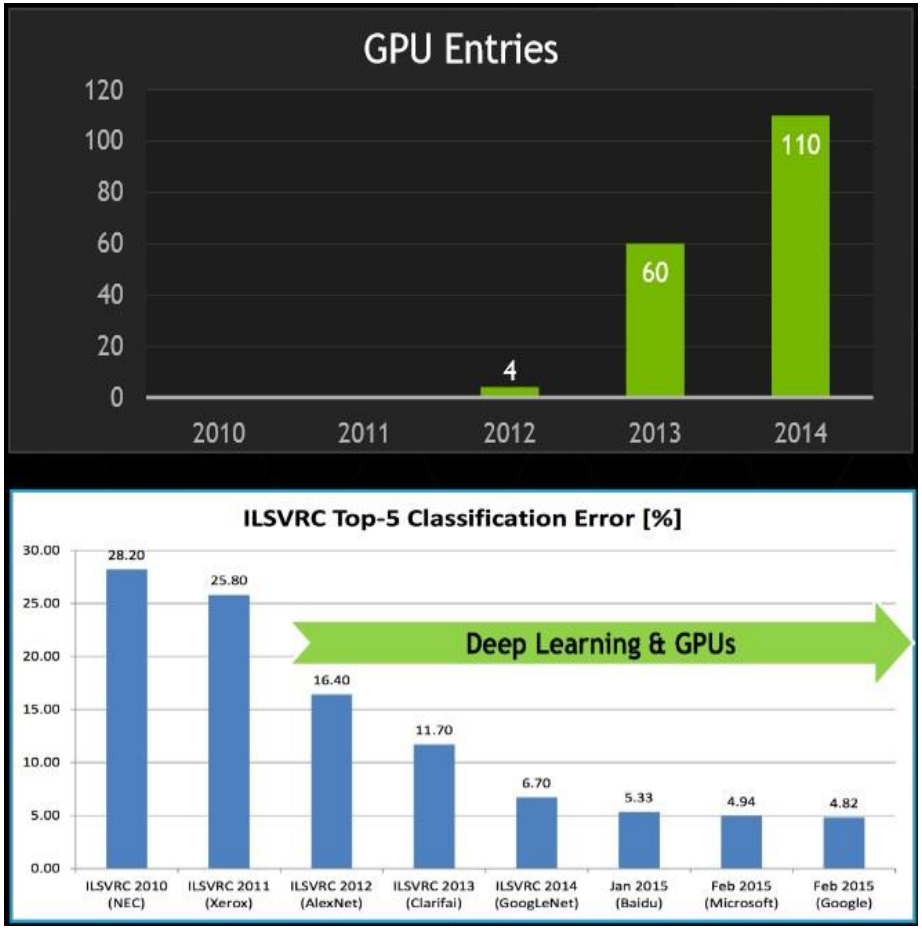
- **The advent of GPUs makes possible the training of very large neural networks with even more than 150 millions of parameters.**

BIG DATA

- **A new generation of larger training and test sets.**

DROPOUT

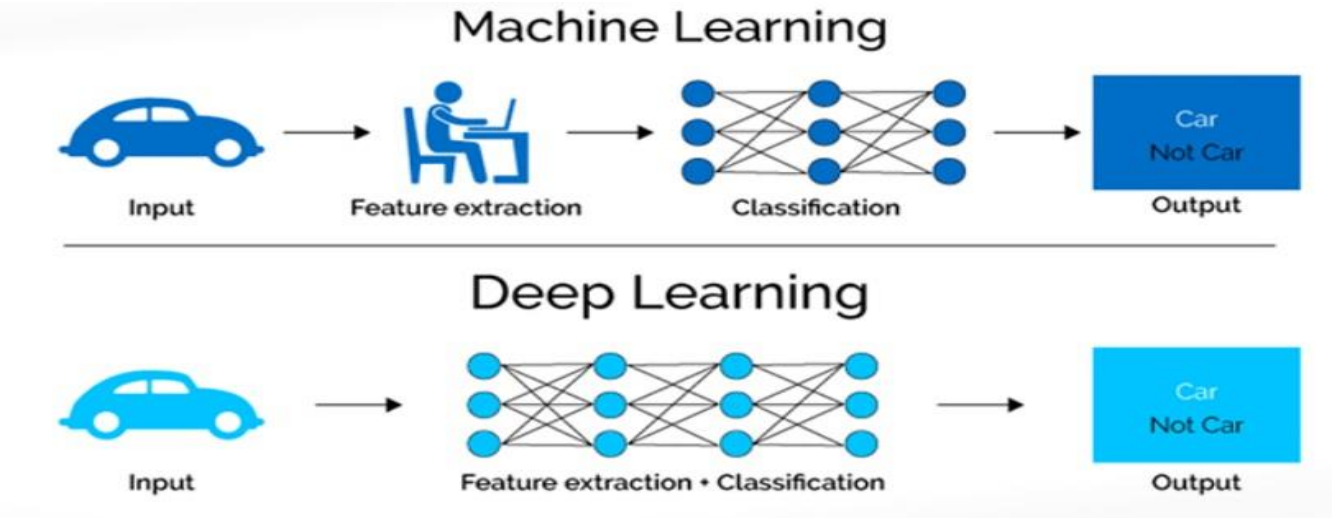
- **Better model regularization techniques have been discovered such as *"Dropout"* or *"Data Augmentation"***



Deep Learning is Machine Learning

Deep Learning refers to algorithms that automatically ‘model’ high-level abstractions in data

i. here ‘model’ means: define, find, recognize and exploit
ii. here ‘automatically’ means: directly from data, without hinging upon handcrafted, task-specific features.



Acknowledgements

THANK YOU FOR YOUR ATTENTION

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