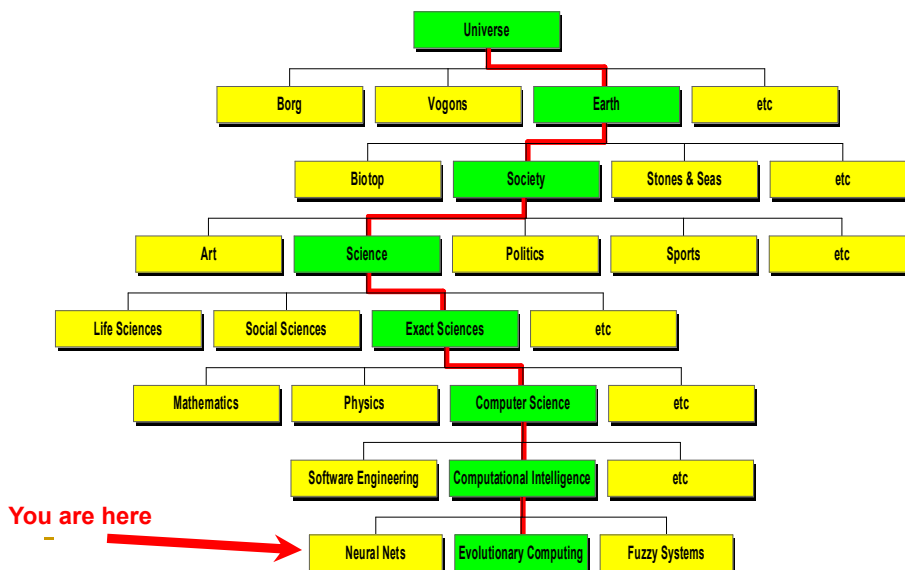


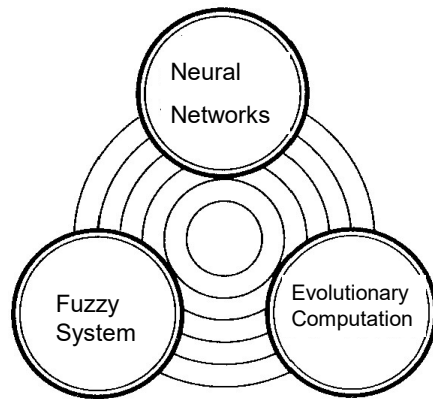
Where are Neural Networks?

Where Are the NNs ?



Technologies Learned from Living Thing

- Computational Intelligence
- Neurocomputing
- Softcomputing
- Intelligent computing

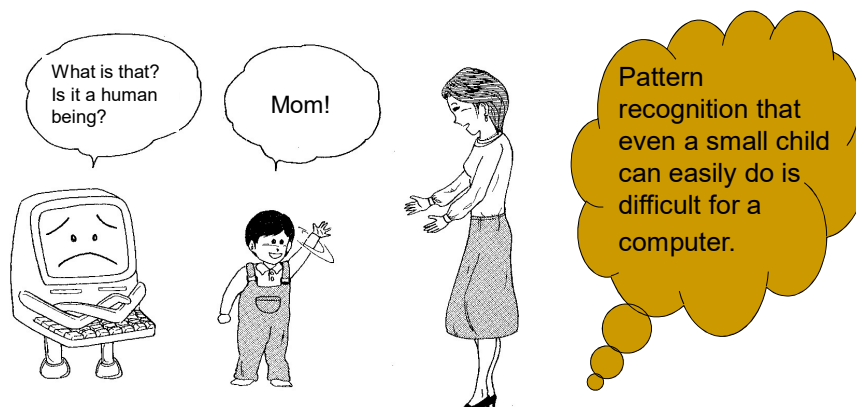


Neural network imitates the brain; *Fuzzy system* imitates human's subjective information processing method; *Evolutionary Computation* imitates the evolution mechanism of living thing. A common feature is that all of these are technologies learned from living thing.

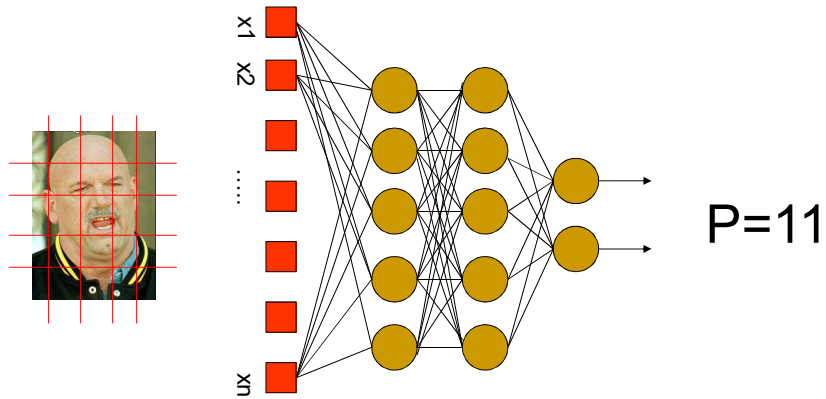
- Particle swarm optimization (PSO)
- Ant colony optimization (ACO)

Why Neural Network ?

■ Human and Computer



- Face Detection Using Neural Network

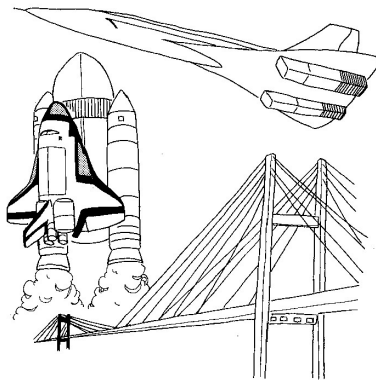


Why Fuzzy ?

- Expression by mathematic formula

Description with math formula

$$F = ma \quad F(\omega) = \frac{1}{2\pi} \int_{-\infty}^{\infty} f(t) e^{-j\omega t} dt$$

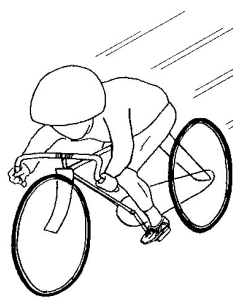


In current science and technology, we usually "describe a plant by mathematic formula, then control it based on the description"

$$y = f(x)$$

$$x = f^{-1}(y)$$

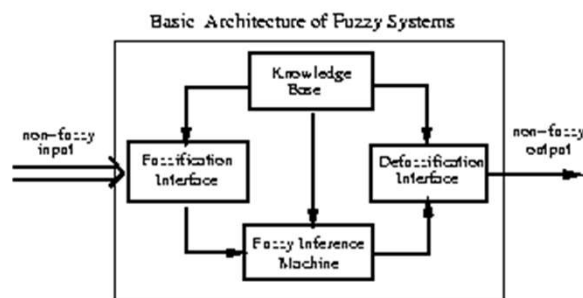
■ Problem that cannot be described mathematically



Radius of wheel,
ratio of the gear,
the speed,
the slope,
⋮
?

In order to describe the movement of a bicycle, it is necessary to consider the radius of the wheel, ratio of the gear, the speed, the inclination, and hands and feet's position of the rider at every movement, etc. It becomes impossible. However, one doesn't actually use a math model to control the bicycle.

• Fuzzy Expert System

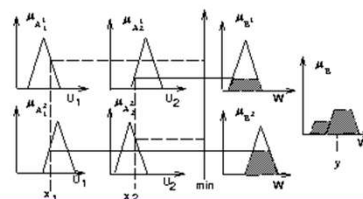


Fuzzy rules:

if x_1 is A_1^1 and x_2 is A_2^1 then y is B^1

if x_1 is A_1^2 and x_2 is A_2^2 then y is B^2

where A_i^j and B^j are fuzzy sets whose membership functions are $\mu_{A_i^j}$ and μ_{B^j} , respectively.



A fuzzy-based control system

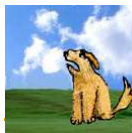
Why Genetic Algorithm ?

- Gradient descent method

■ Darwin's Theory of Evolution

Natural selection

- Natural selection acts to preserve and accumulate minor advantageous genetic mutations.
- The inferior (disadvantaged) members of the same species would gradually die out, leaving only the superior (advantaged) members of the species.

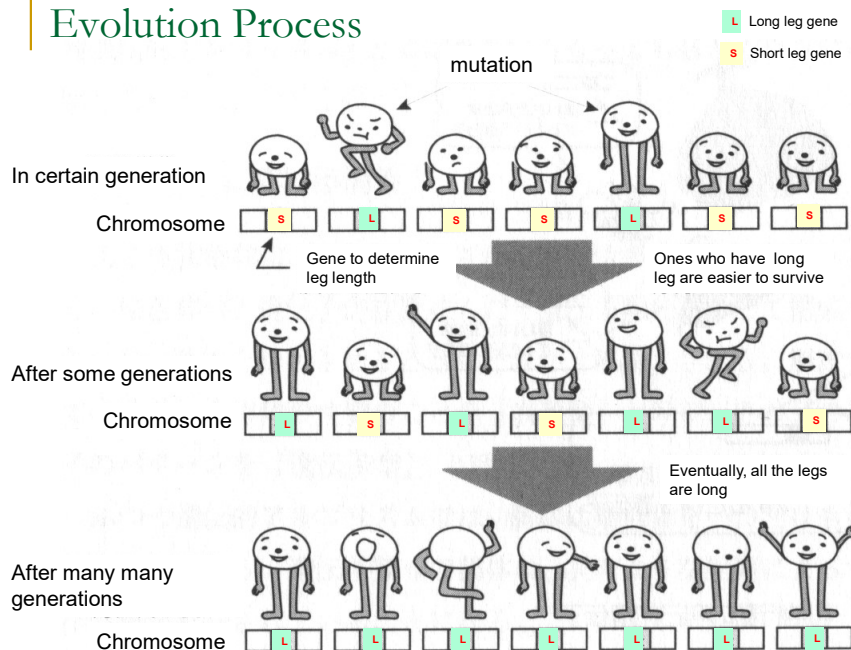


Superior one



Inferior one

Evolution Process



■ Genetic Algorithm

An optimization algorithm imitates the genetics and the evolution mechanism of living thing.

