

FROM AI to ALIFE  
Hugues Bersini  
IRIDIA - ULB

# AI Pantheon



# PLAN

The human side of IA

Good old fashioned AI

How computer think, resolve, play or discuss of restaurants.

The animal side of AI

New fashioned AI

How computers drive, refuse a credit or control a process

# The human side

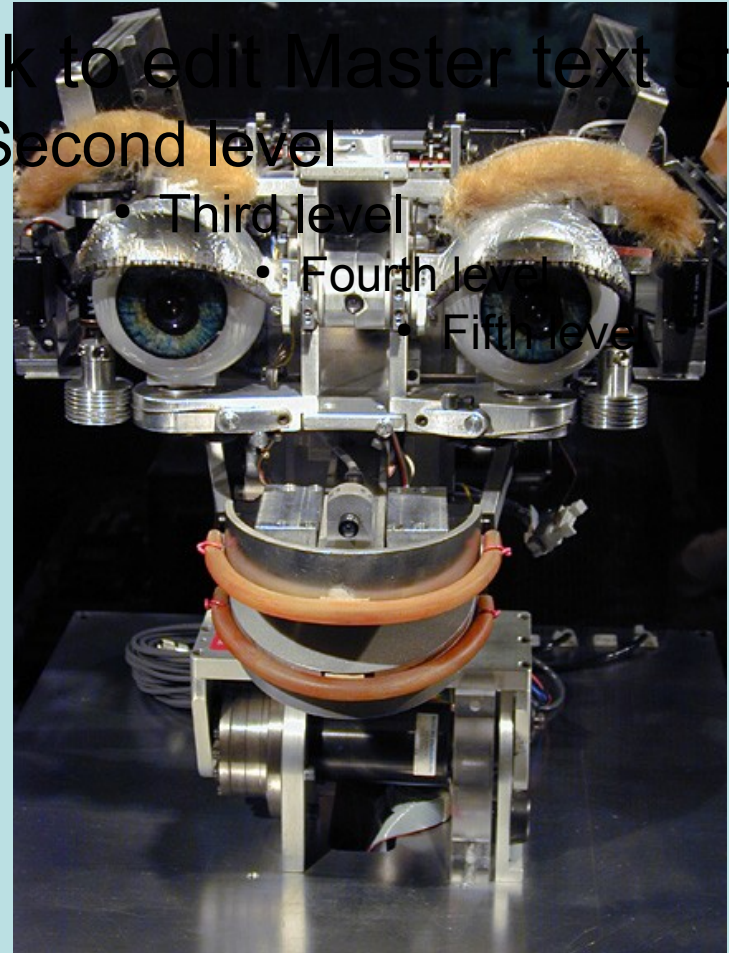
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Second level



Third level

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Intelligence = Mental inferences

Deductions, planning, mental simulations,  
reasoning, logics

Rational intelligence to distinguish from fake  
intelligences:

*Emotional intelligence*

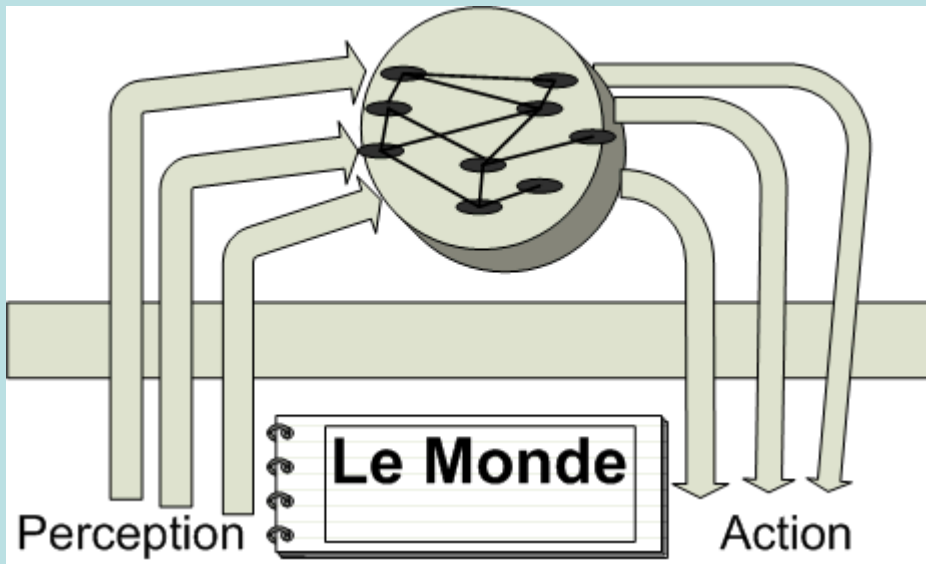
*Animal intelligence*

*Embodied intelligence*

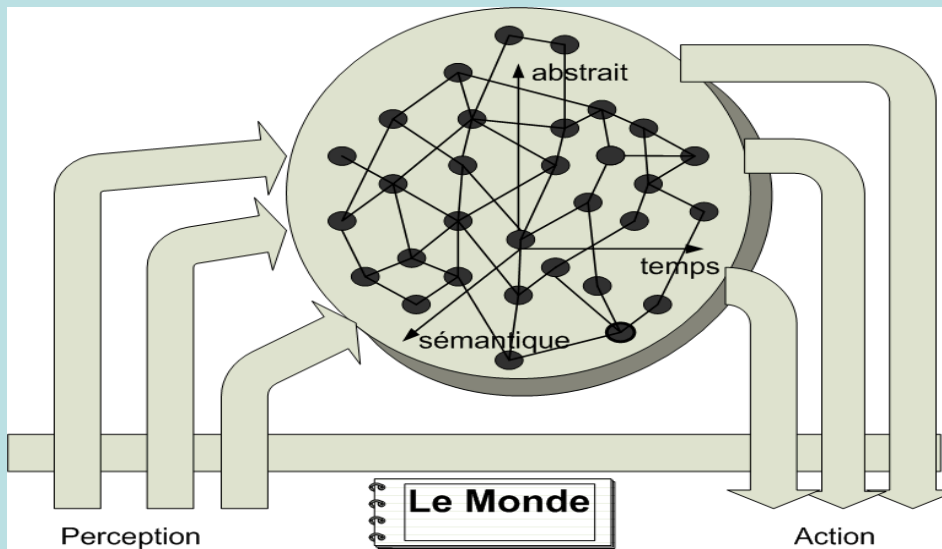
*Collective intelligence*

Intelligence = IQ, chess, math, logical solving  
all the rest is just skills

# The inferential brain



ANIMAL



Human

Good old fashioned AI

# The problem of the water jugs





# Definition of the problem

The state of the world:  $(x,y)$

The initial state :  $(0,0)$

The final state:  $(2, n)$

Then a set of operators allowing to evolve the world:

# The set of operators

$(x < 4, y) \square (4, y)$  fill up the first

$(x, y < 3) \square (x, 3)$  fill up the second

$(x > 0, y) \square (0, y)$  empty the first

$(x, y > 0) \square (x, 0)$  empty the second

$(x + y > 4, x < 4) \square (4, y - (4 - x))$  fill x with part of y

$(x + y > 3, y < 3) \square (x - (3 - y), 3)$  fill y with part of x

$(x + y < 4, y > 0) \square (x + y, 0)$  empty y in x

$(x + y < 3, x > 0) \square (0, x + y)$  empty x in y

# The inferential engine

Find the operators that can be applied: their pre-conditions need to match the current state of the world

Select one □ the control strategy:

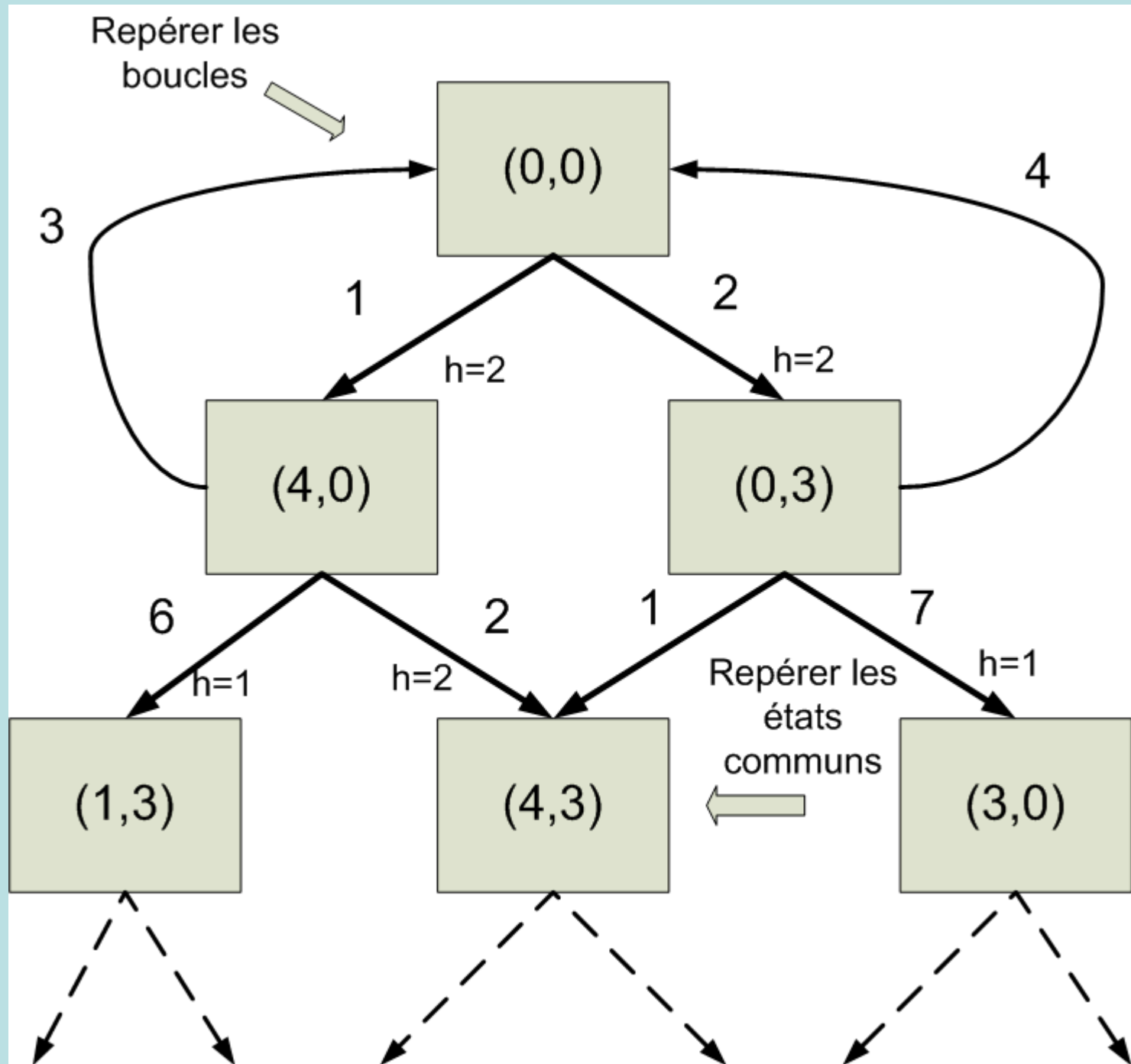
In depth or in width, with heuristics or not

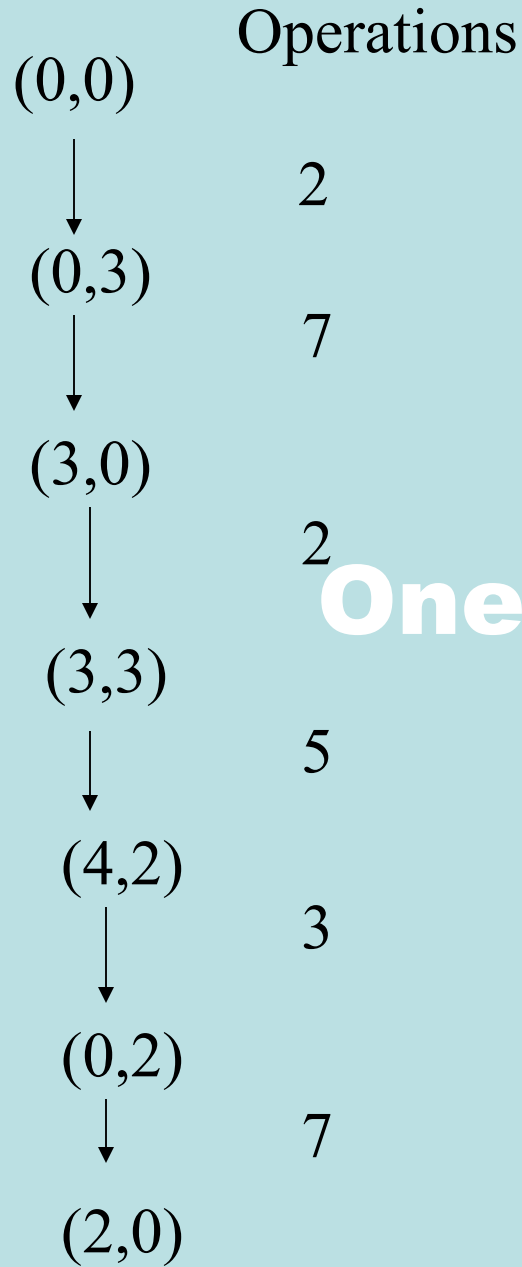
Avoid looping

Be able to backtrack

Do that iteratively until to find the final state

The solution of a planning problem is the sequence of operators. Often the shortest if you find several solutions.





**One possible solution**

# Society games

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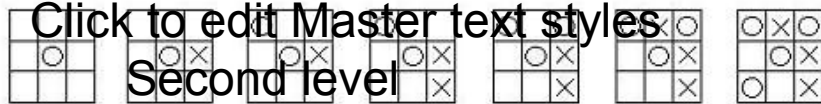
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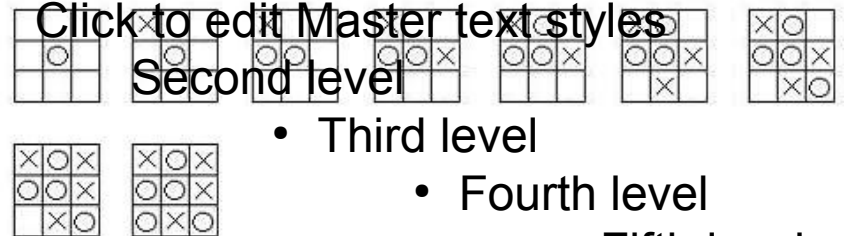
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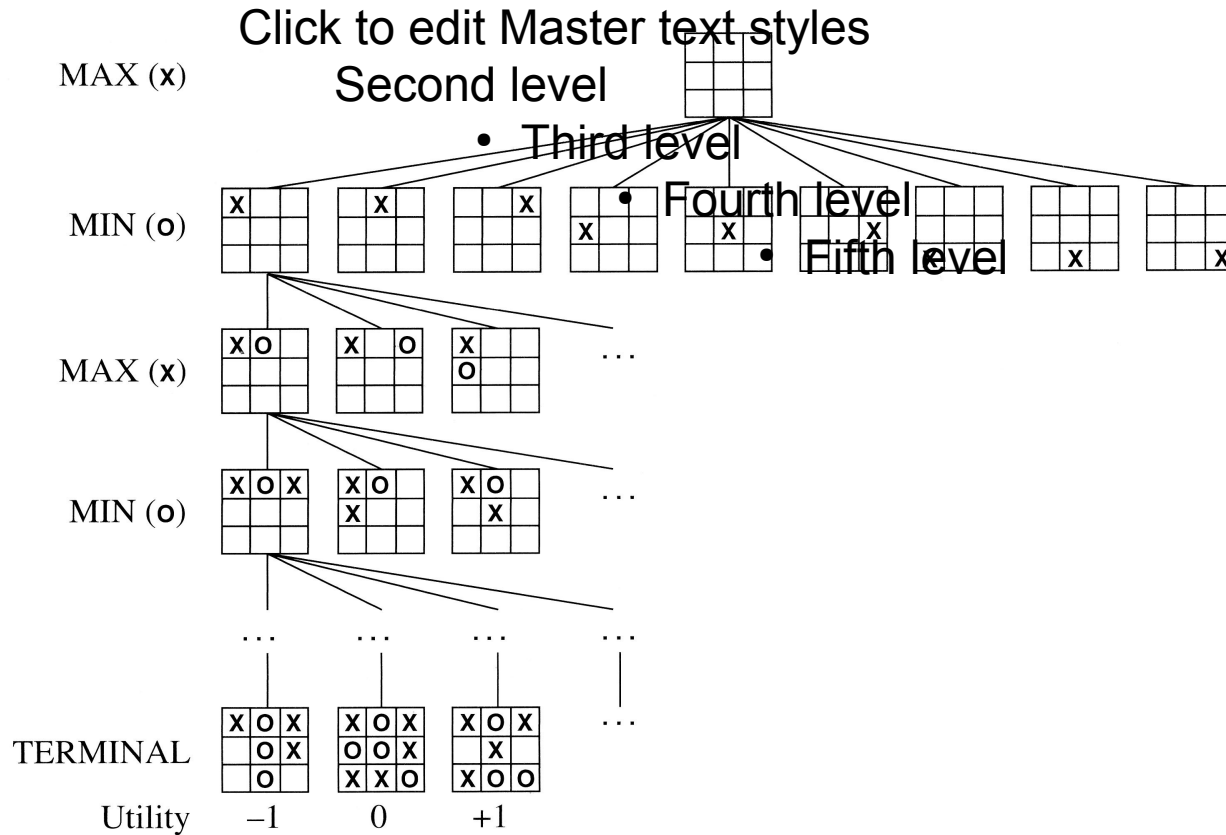
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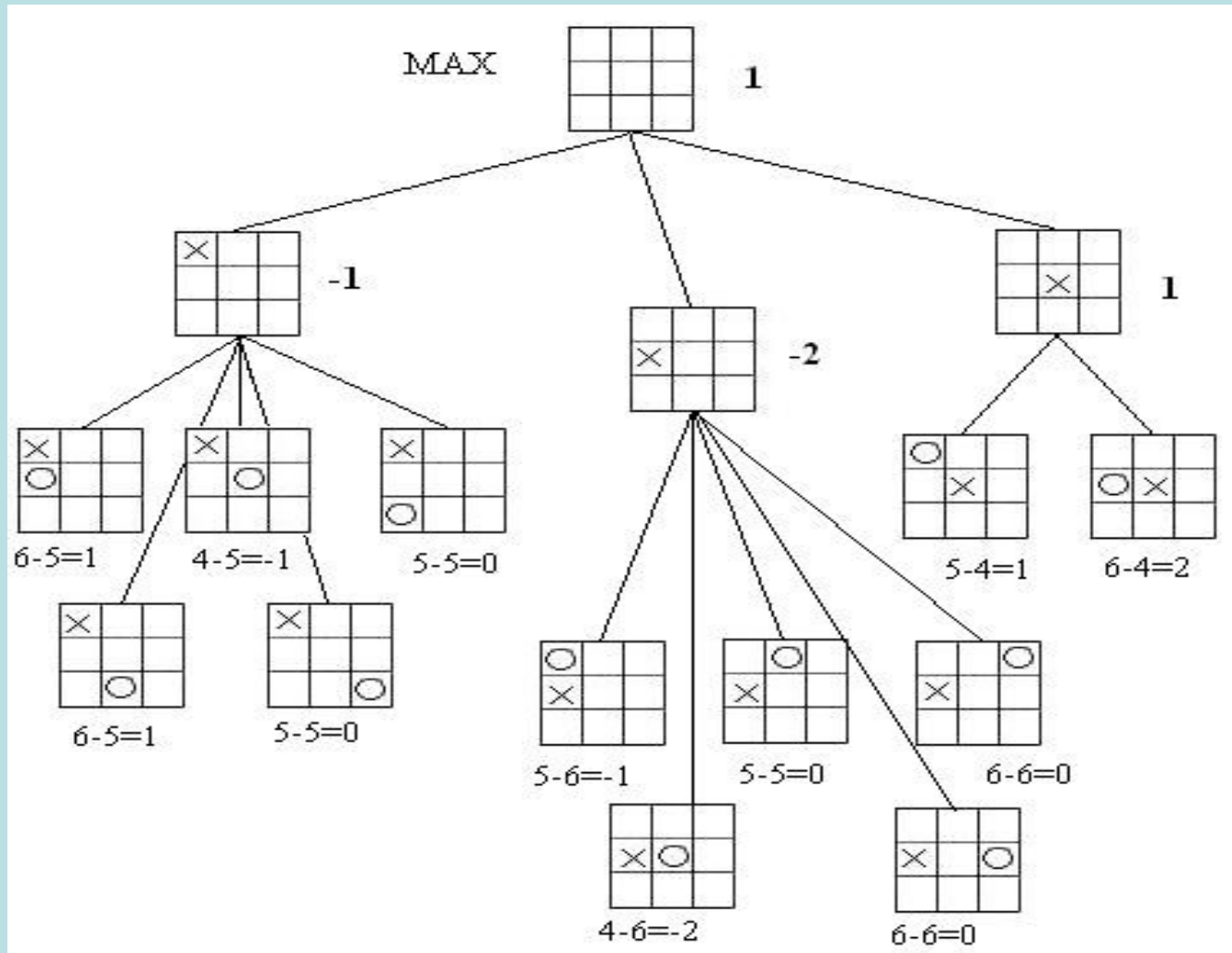
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# The Min-Max Strategy

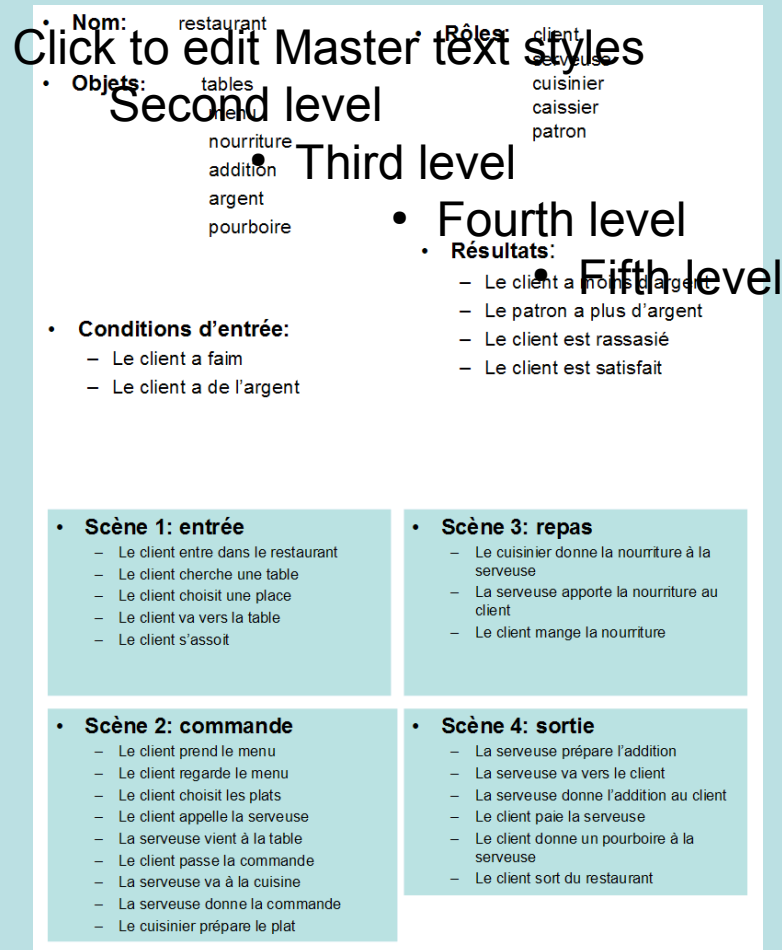


# With heuristics





# What a software knows about a restaurant



# Diagnosis of a car problem

Car Problem

Where is the problem

engine trouble

transmission

brakes

engine starts

engine won't start

engine turn's over

engine won't turn over

lights come on

lights don't come on

# The AI failures

- Man is embodied in his environment
  - à Man is a sophisticated sensori-motor process much before any cognitive process takes on.
    - à His perception is intrinsically and materially parallel
  - à The sensori-motor processes essentially depend on their biological grounding: parallel and adaptable
  - à World outside is complex and requires an interface of a similar complexity.
  - à But this complexity can be achieved by learning and experience rather than being handcrafted
    - à Based on learning and an iterative simplicity. Complex processes emerge from iterating simple mechanisms

Man possess 2 cognitive systems

1) Parallel, automatic, unconscious, reflex, adaptable, and very efficient

Based on neuronal hardware

For playing tennis, piano, becoming an expert ....

2) Sequential, rigid, conscious and very laborious

Based on neuronal software

For playing chess, for testing IQ

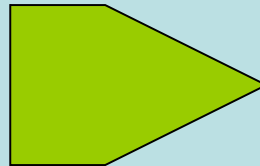
Man goes from one to the other in the cases of breakdowns in his automatisms

Machine intelligence and human intelligence can be of different nature

For the machines today, recognizing a face is much more difficult than playing chess

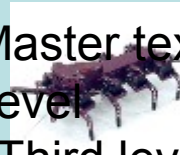
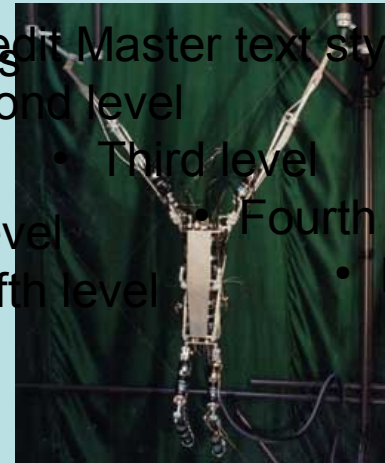
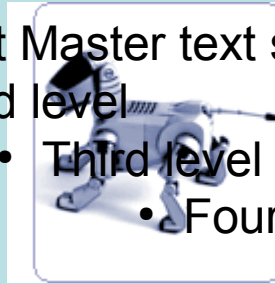
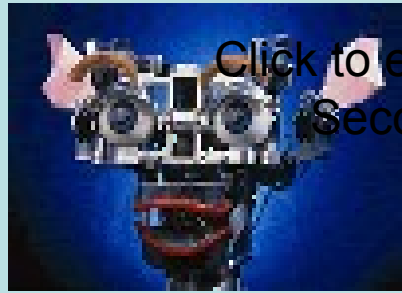
But doesn't Kasparov in part play chess like indeed we recognize a face ?

# The animal side



AI  
Software  
Cognitive Science

ALife  
Hardware  
Biology



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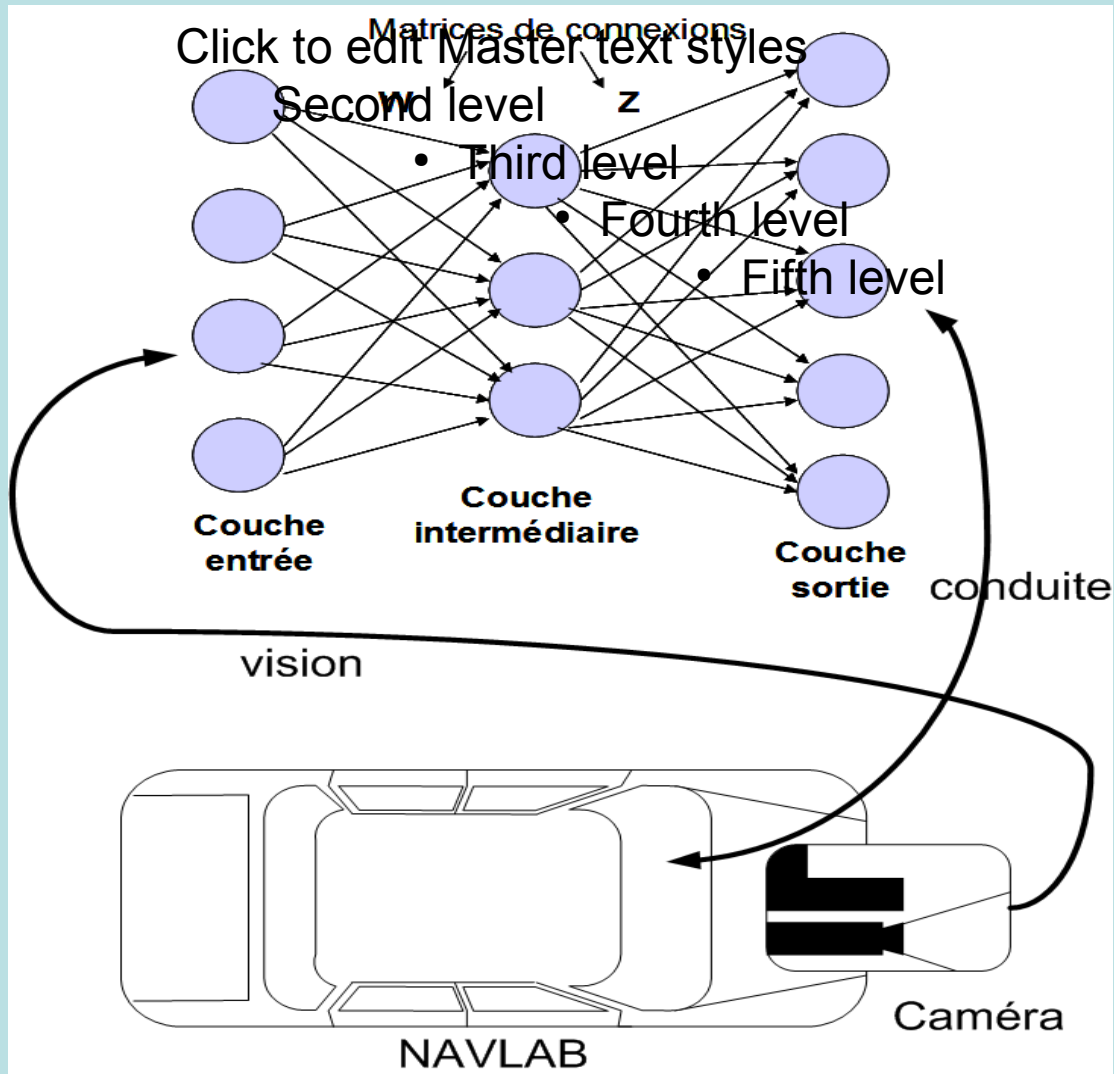
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- The animal hidden in each of us might be unavoidable on the road to intelligence
- Our intellectual skill are embodied in our automatism. They depart from there.
- Don't ever try to fully understand what a chair is without having ever sat in it.
- A turn back is needed towards our biological interface with the outside world.
- Can we as engineer bypass this biology ?
- Do we have to get rid with good old fashioned AI ? NO

Today AI

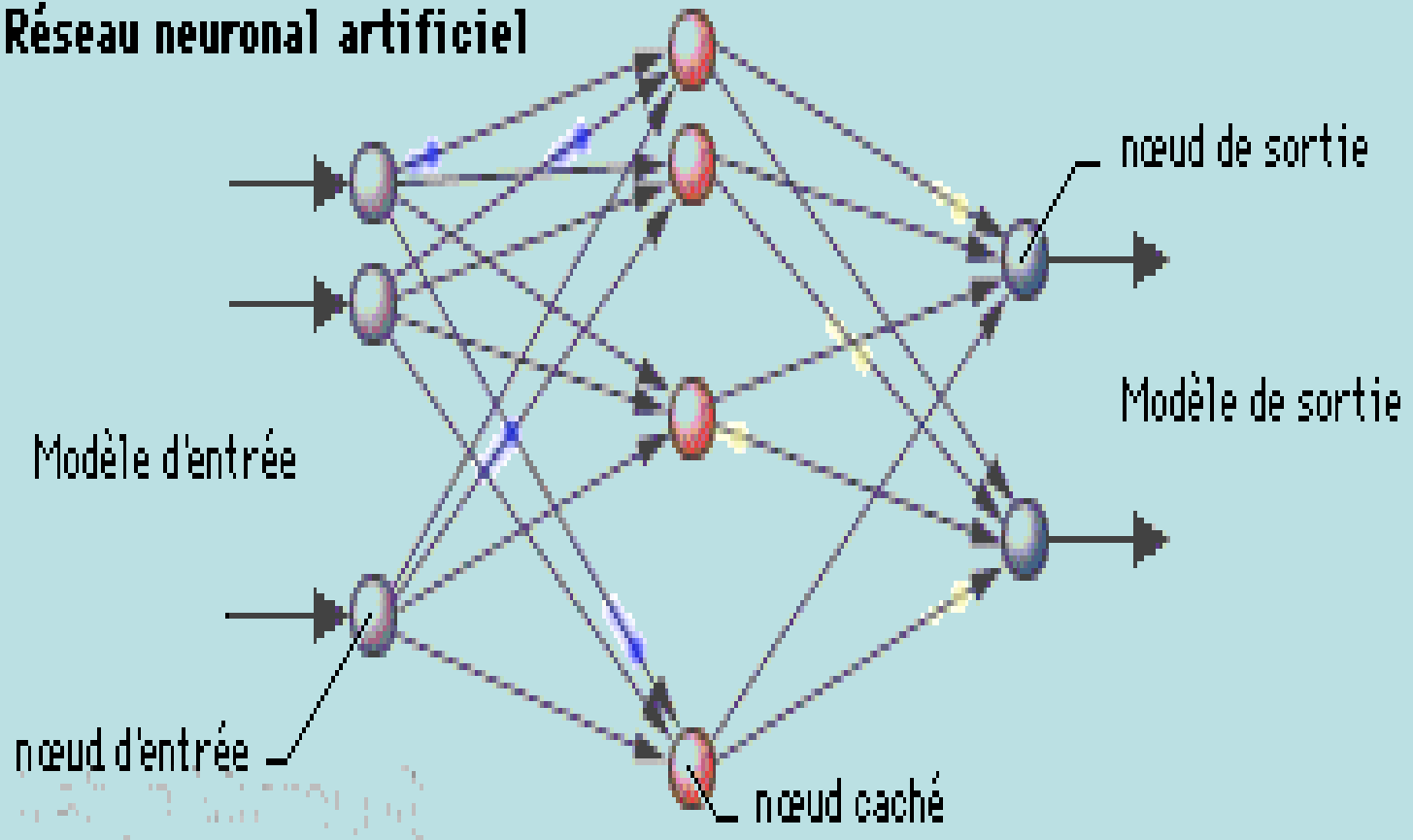
# How does the computer drive





# Neural networks

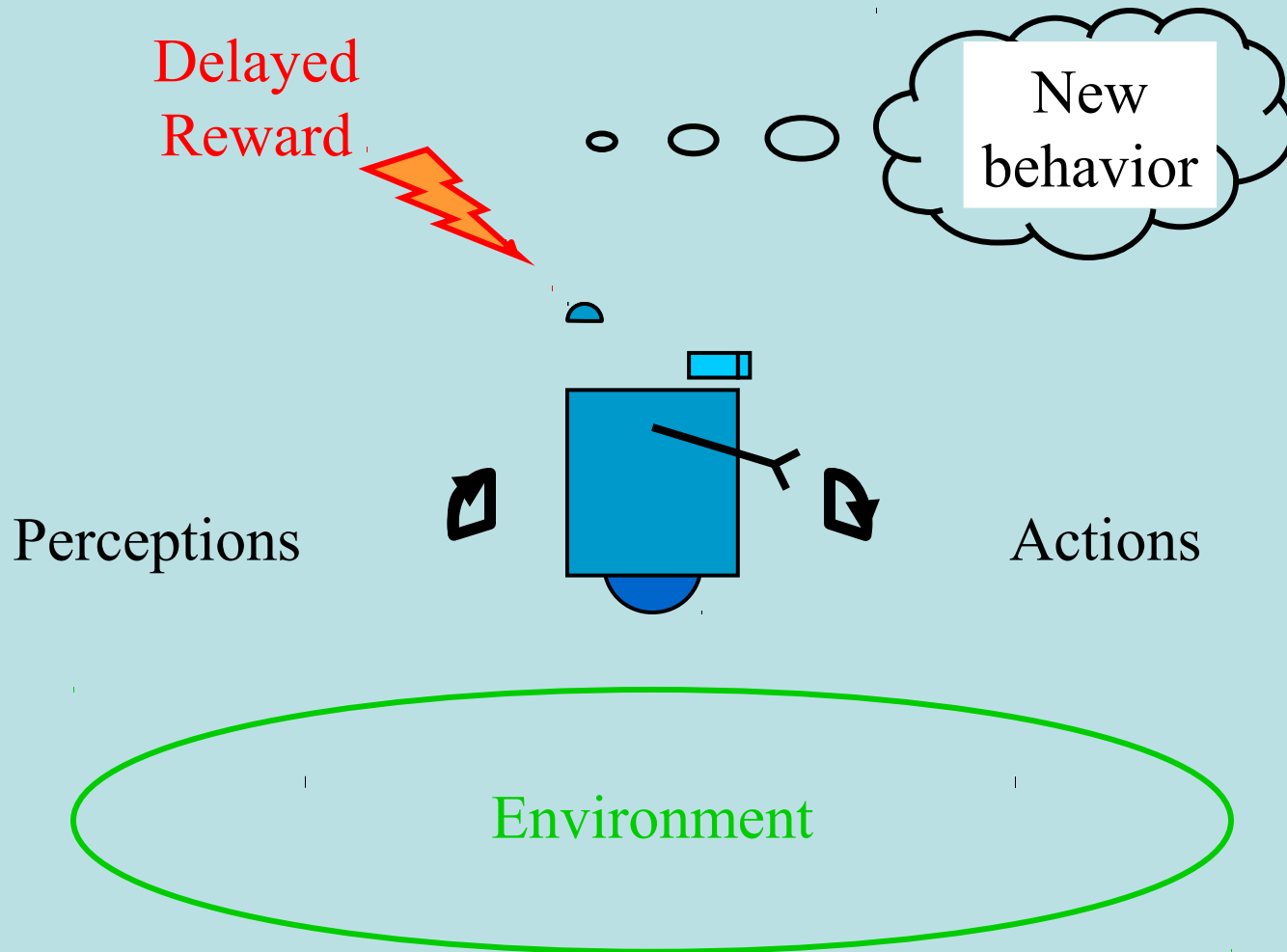
## Réseau neuronal artificiel



# The Darpa Challenge



# Learning Autonomous Agent

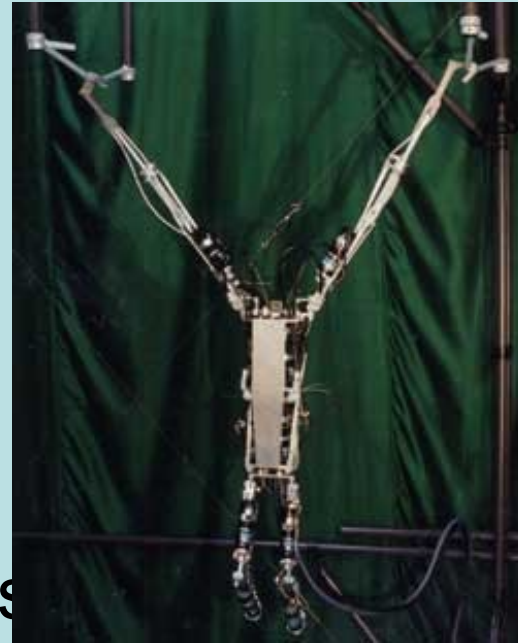


# Robotic applications

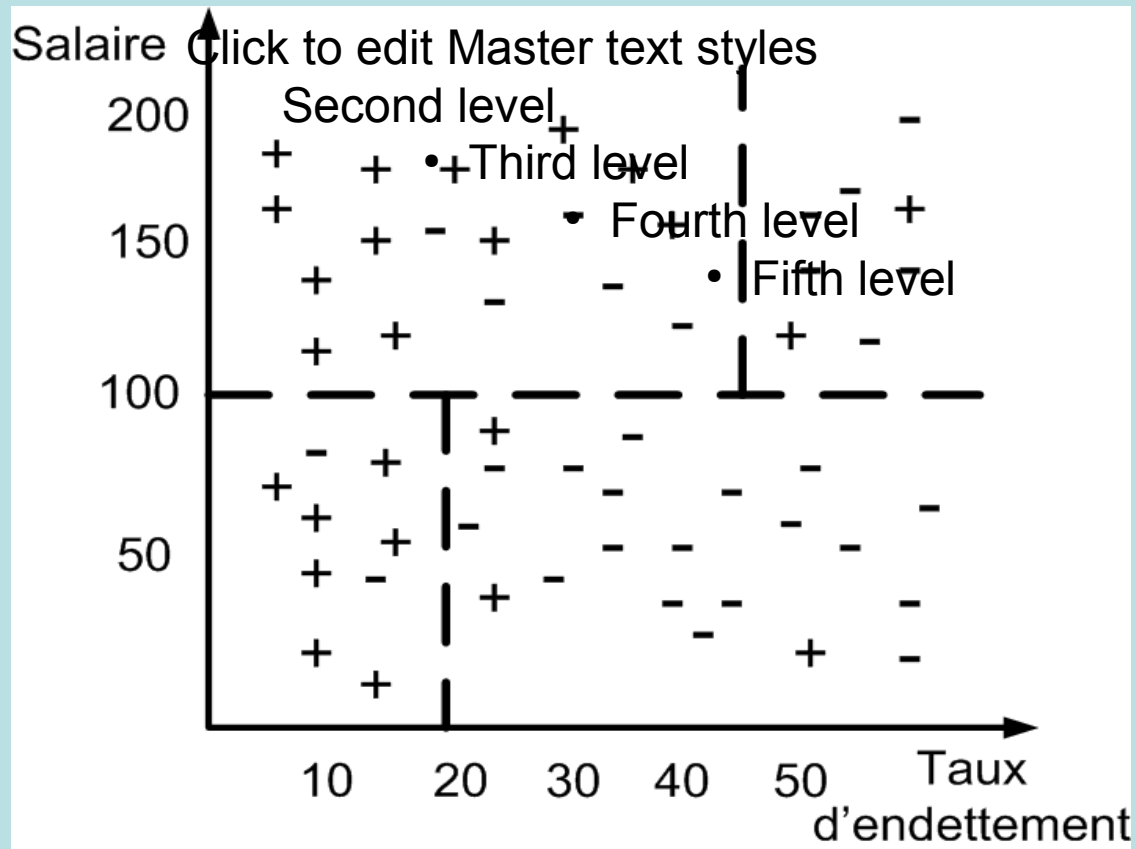
Autonomous robots:

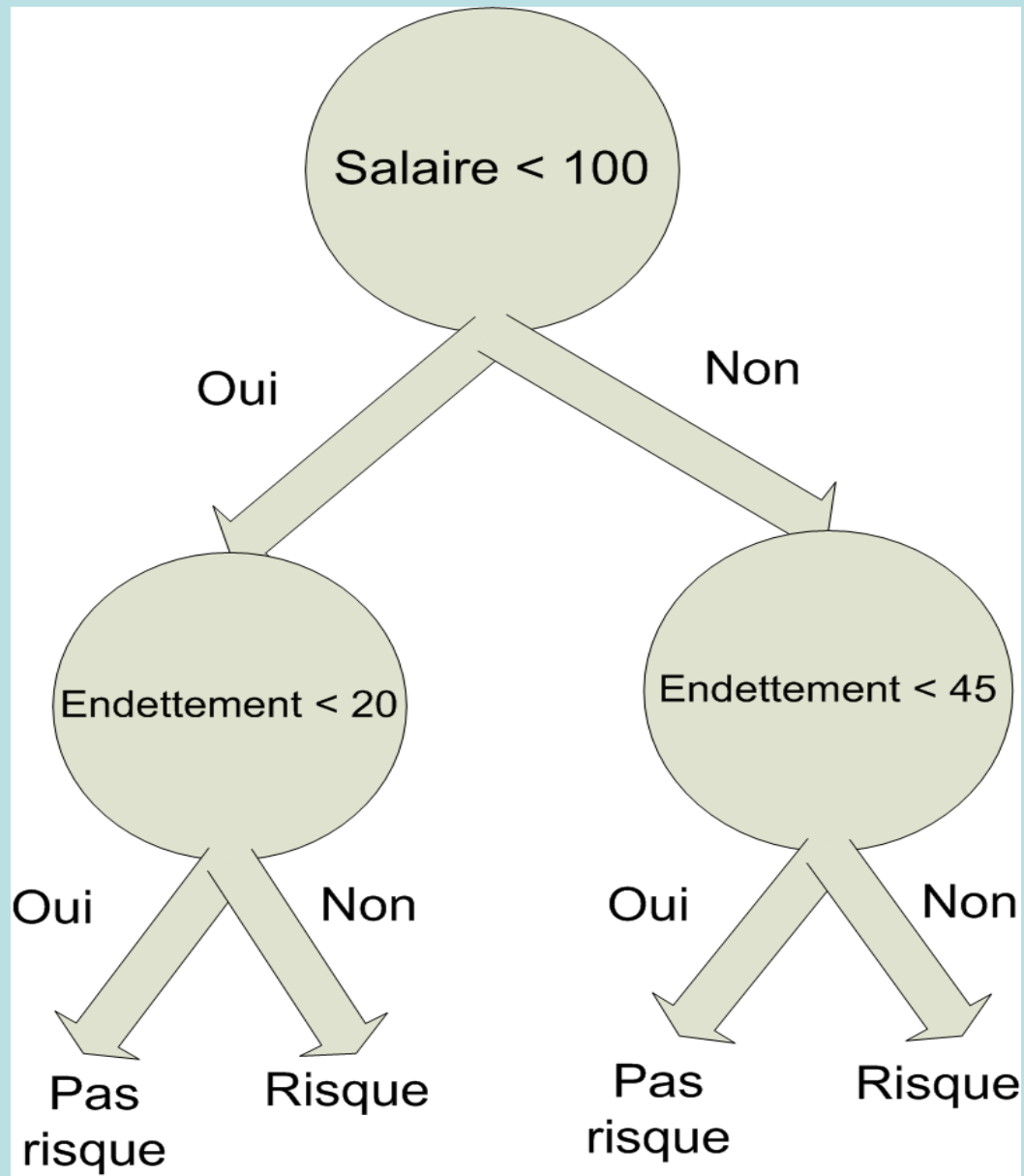


Softbots: autonomous agents that can interact with the environment and help the users.

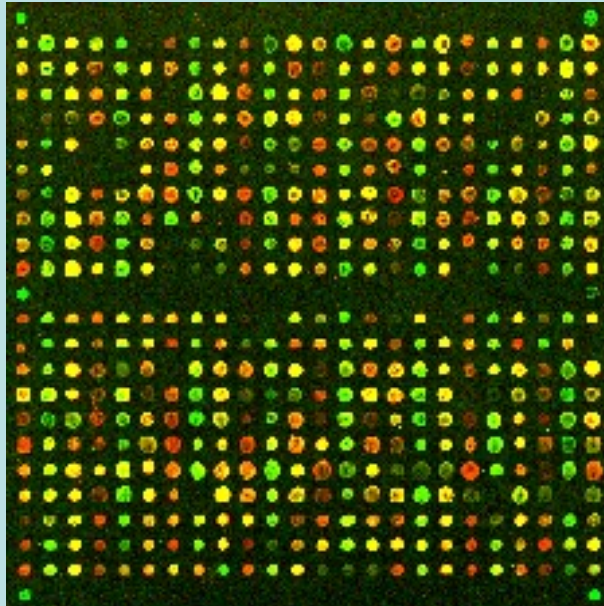


# How does the computer score a credit



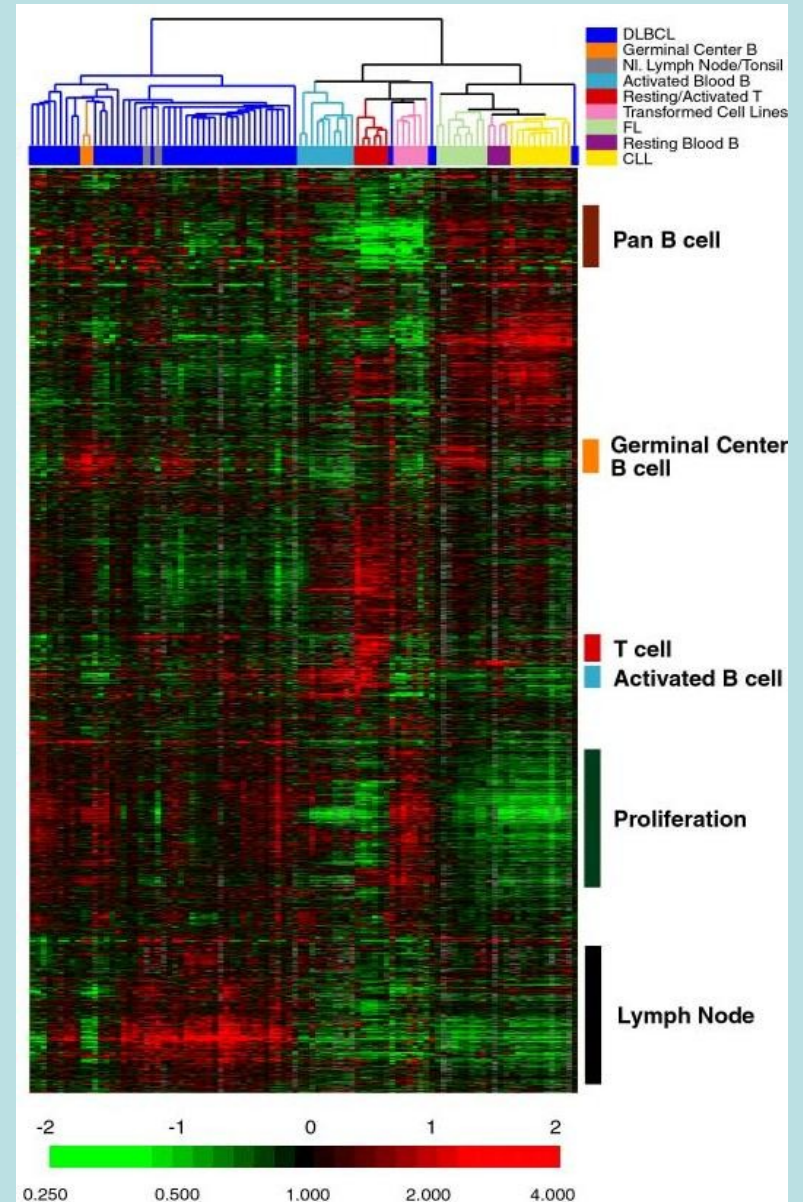


# PUCE ADN

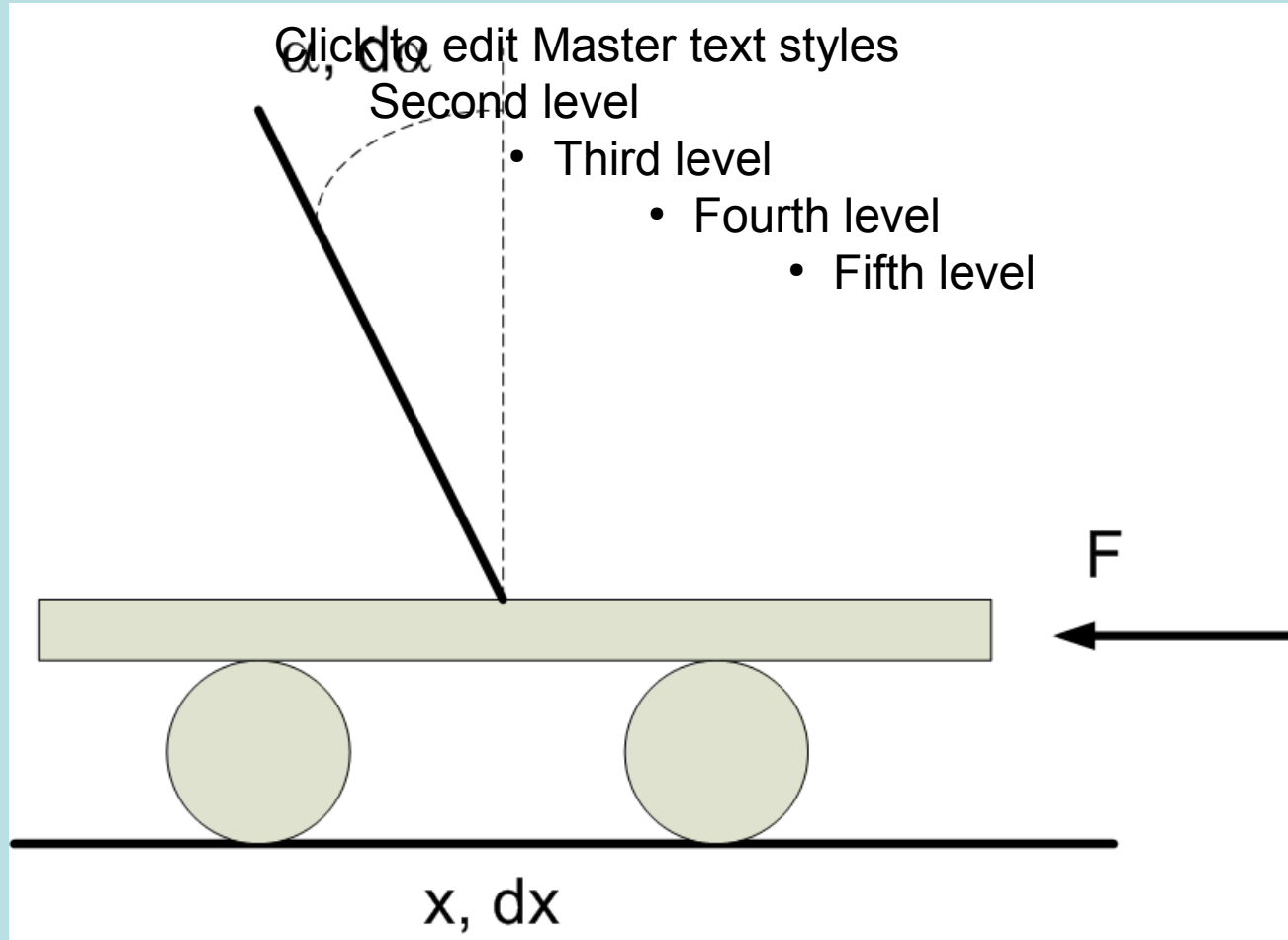


Microarray chip

Spin off: Enlightenment



# How does the computer control





*Si «  $-5 \leq \alpha \leq 5$  » ET «  $-20 \leq x \leq 20$  » ET «  $+2 \leq d\alpha \leq +3$  » ET «  $-1 \leq dx \leq +1$  »*

*Alors «  $f = +10$  »*

*Si «  $-5 \leq \alpha \leq 5$  » ET «  $-20 \leq x \leq 20$  » ET «  $-5 \leq d\alpha \leq -3$  » ET «  $-1 \leq dx \leq +1$  »*

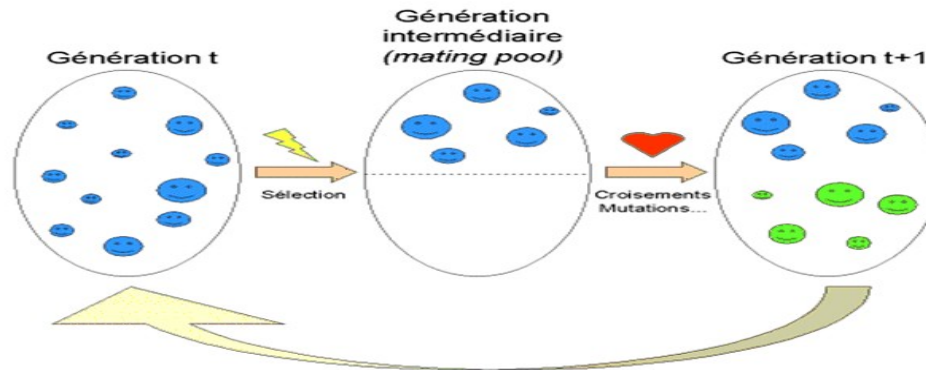
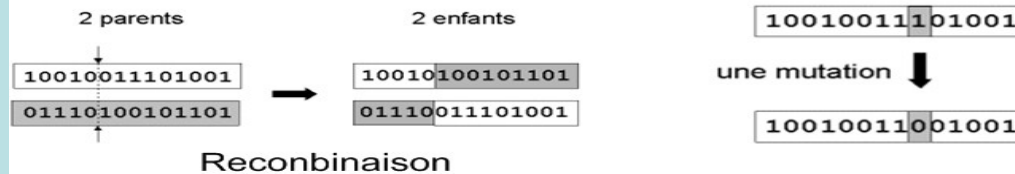
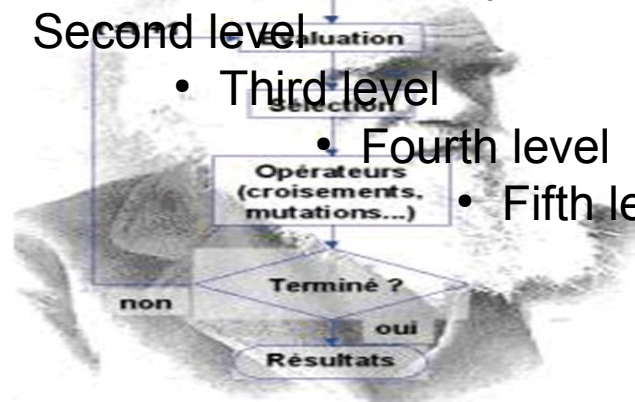
*Alors «  $f = -10$  »*

# Genetic algorithms

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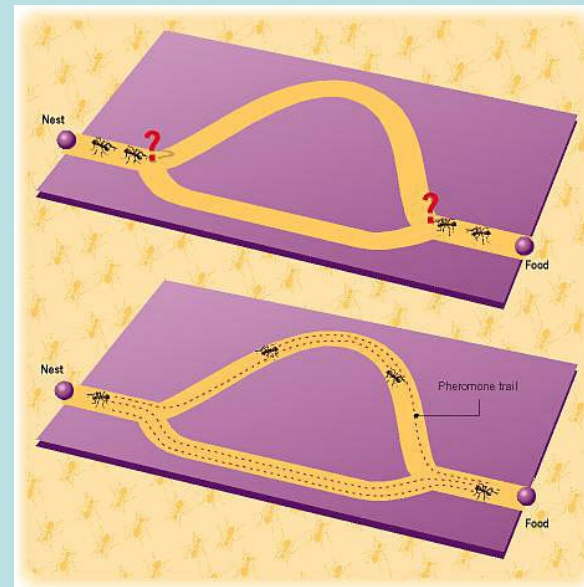
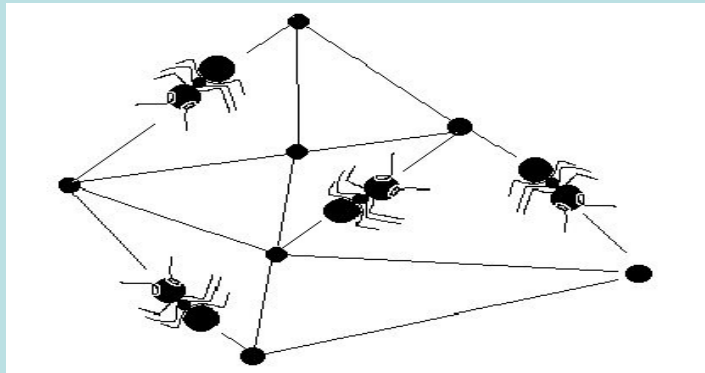
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# Ant Colony Optimisation

Emergence: How new processes (often complex) appear at a higher level from simple underlying rules but iterated infinitely in space and time at a lower level.  
Insect societies are striking examples.  
ACO an excellent optimisation strategy



# Conclusions

The best chess player is AI based:

Deep Blue

But the best backgammon player is

ALife based: TD-Gammon learning  
by reinforcement learning

Jeopardy Watson is just brute force  
search engine.

So ? It is possible that at a certain  
level of complexity, even for an  
engineer, learning and adaptation is  
the only way out.

To the expense of a “lost of control”.  
The engineer guides but does not  
find out.

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