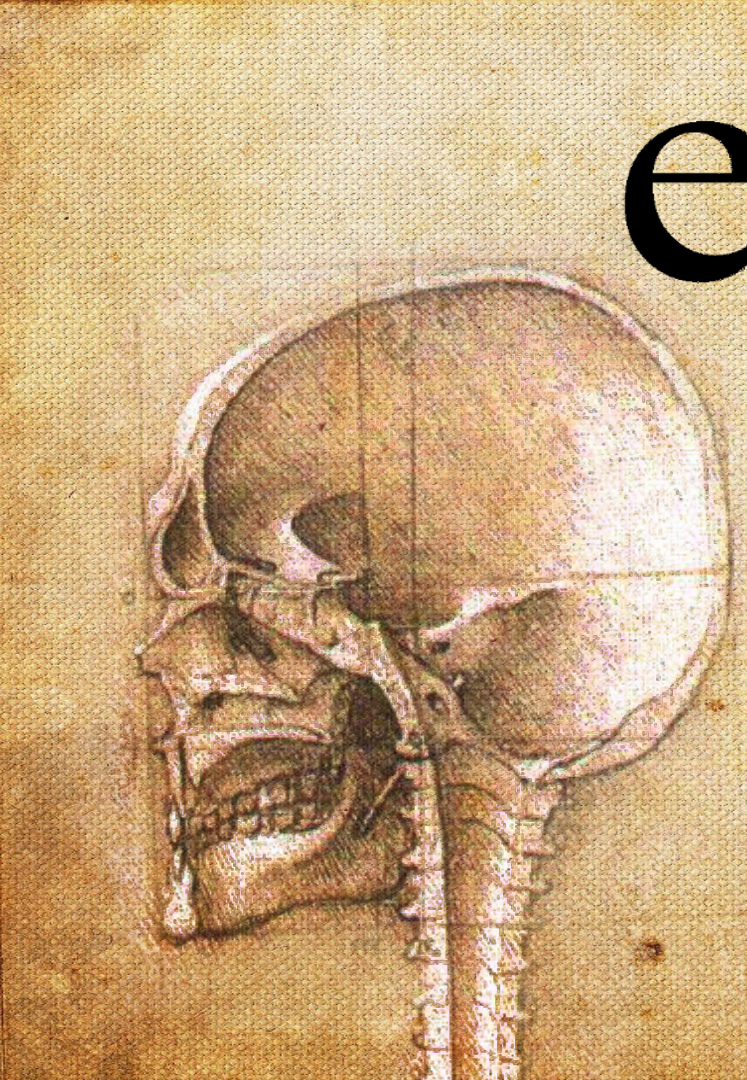

entropiCAI

Emotional Intelligence for Video Games

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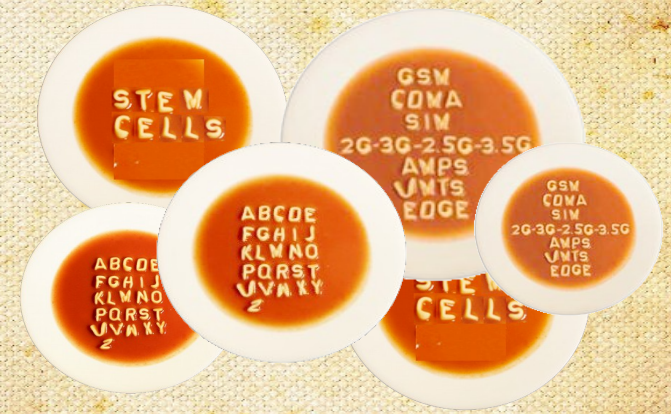
Classic Entropy

Entropy measure how many “micro-states” are possible for a given system “macro-estado”.

= 500



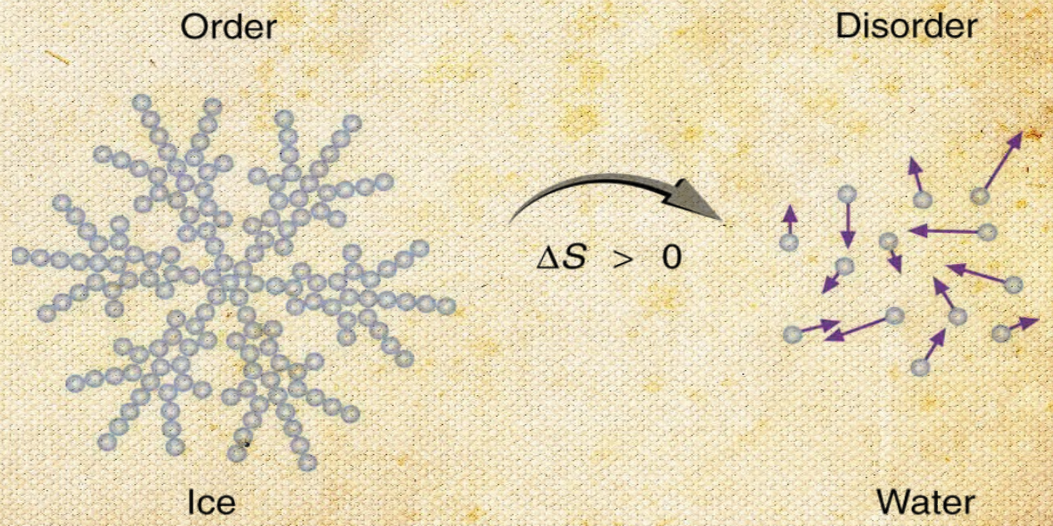
Macro-Estado:
A full soup plate

Micro-Estado:
Each possible soup plate

Entropy and classic physics

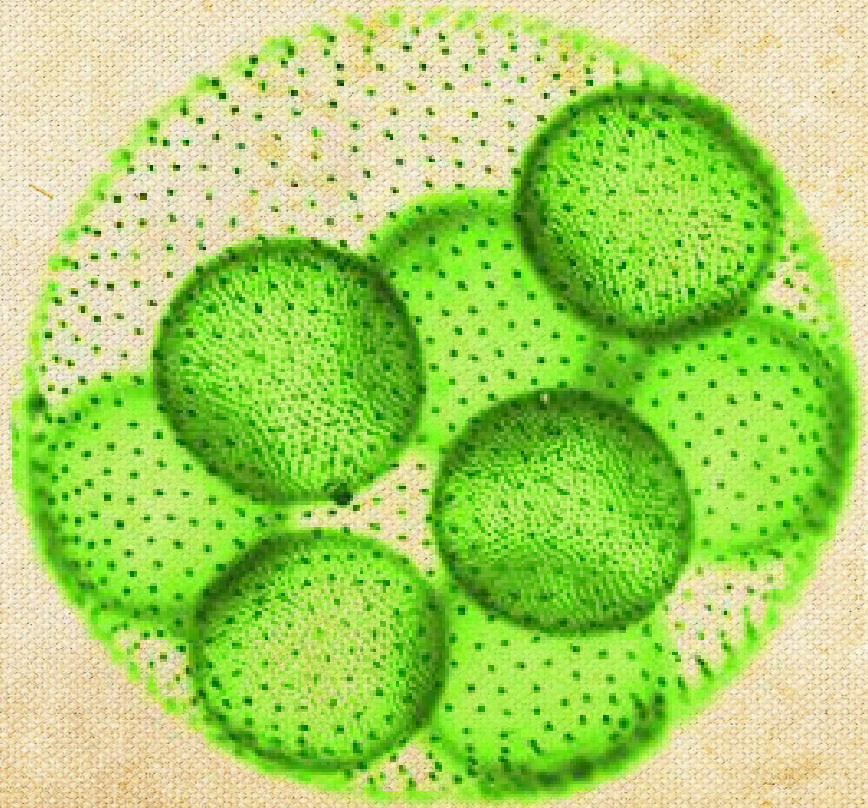
Second law of thermodynamics

Physic systems always evolve in the way the instantaneus or “classic” entropy grows the most.



Entropy and life

A living being is, among other things, a physical system capable of keeping its internal entropy low, at the cost of external entropy growth.



Entrópy and intelligecne

Alexander Wissner-Gross y C.E. Freer published in 2013 a paper about **Causal Entropic Forces** about "*a possible deep conexión between intelligence and entropy maximization*" using the concept of "future entropy".

$$F = T\nabla S_\tau$$

"A force that maximizes the future freedom of action"

We can then define the causal path entropy S_c of a macrostate $\mathbf{X}$ with associated present system state $\mathbf{x}(0)$ as the path integral

$$S_c(\mathbf{X}, \tau) = -k_B \int_{\mathbf{x}(t)} \Pr(\mathbf{x}(t)|\mathbf{x}(0)) \ln \Pr(\mathbf{x}(t)|\mathbf{x}(0)) \mathcal{D}\mathbf{x}(t), \tag{2}$$

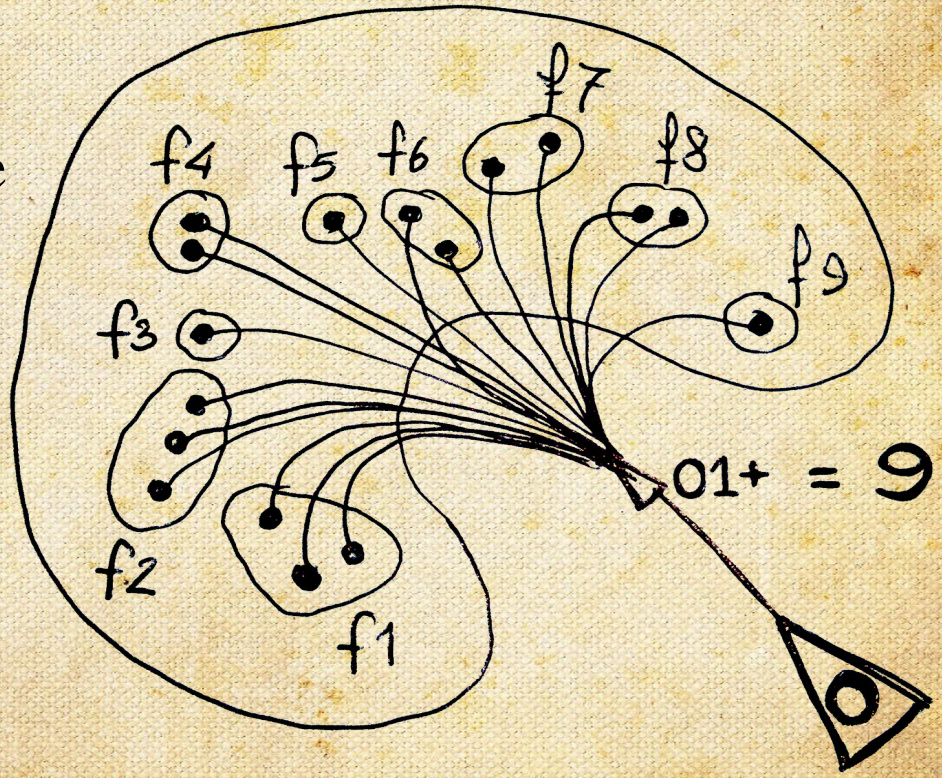
where $\Pr(\mathbf{x}(t)|\mathbf{x}(0))$ denotes the conditional probability of the system evolving through the path $\mathbf{x}(t)$ assuming the initial system state $\mathbf{x}(0)$, integrating over all possible paths $\mathbf{x}^*(t)$ taken by the open system's environment during the same interval:

$$\Pr(\mathbf{x}(t)|\mathbf{x}(0)) = \int_{\mathbf{x}^*(t)} \Pr(\mathbf{x}(t), \mathbf{x}^*(t)|\mathbf{x}(0)) \mathcal{D}\mathbf{x}^*(t). \tag{3}$$

Future entropy

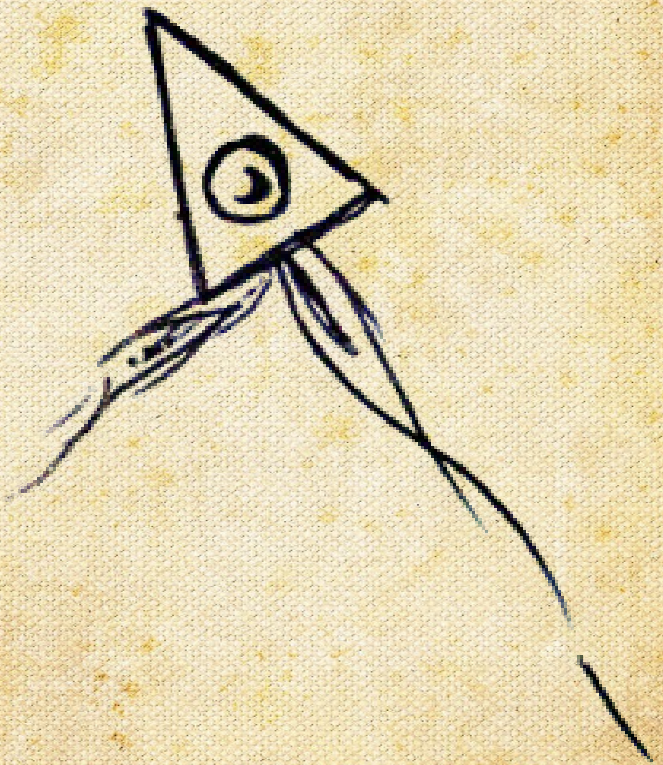
Micro state is changed into “Each future state reacheable in a time horizon”.

This is the classical entropy definition but applied to the state space of all possible future states.



Pre-Algorithm 1: The State

An “state” of our system is a real vector containing fixed params (like size), calculated ones (speed), positional (X and Y) and free params (driving wheel angle).



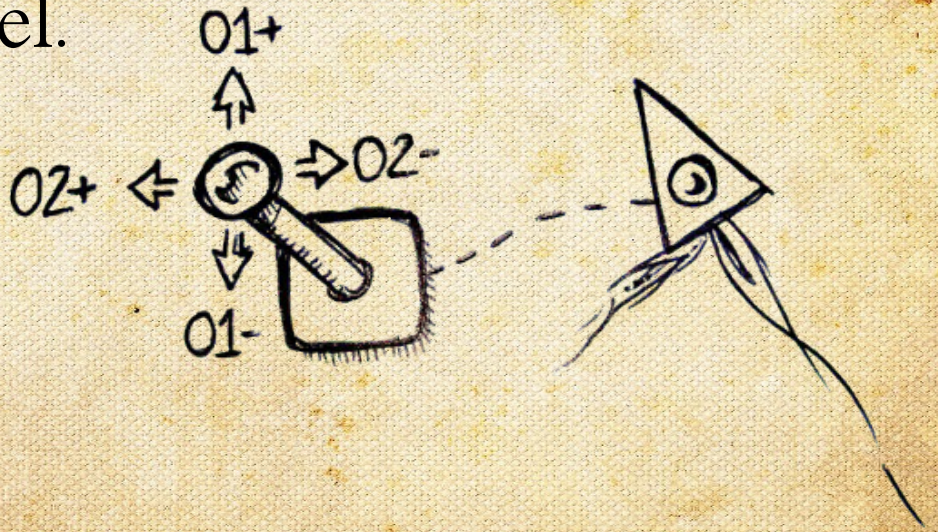
Pre-Algorithm 2: Simulation

E_1 = Simulation(E_0, dt)

From an initial state E_0 we obtain E1, the aproximate state the system will be in after a dt passed.

Algorithm 1: Options

Easch degree of freedom correspond to a "Joystick" with two options, for instance, turn -5° or +5° the driving wheel.

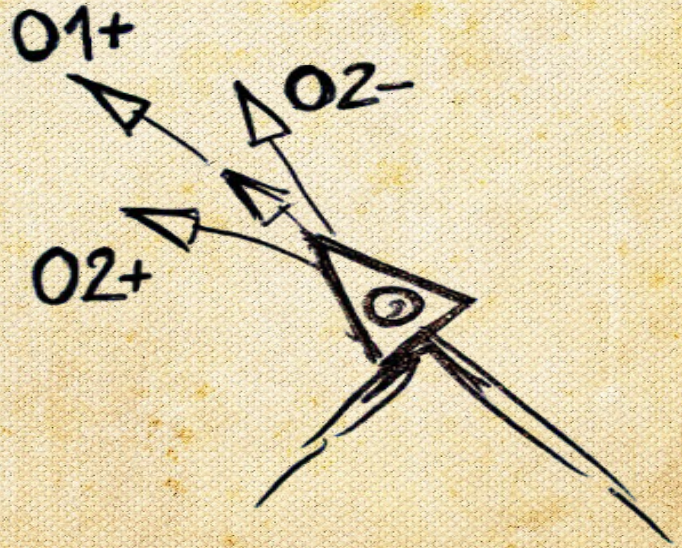


We basically need to compare our options before deciding.

Algorithmo 2: Initials

Each option correspons to an initial position: where will it be after taking this option.

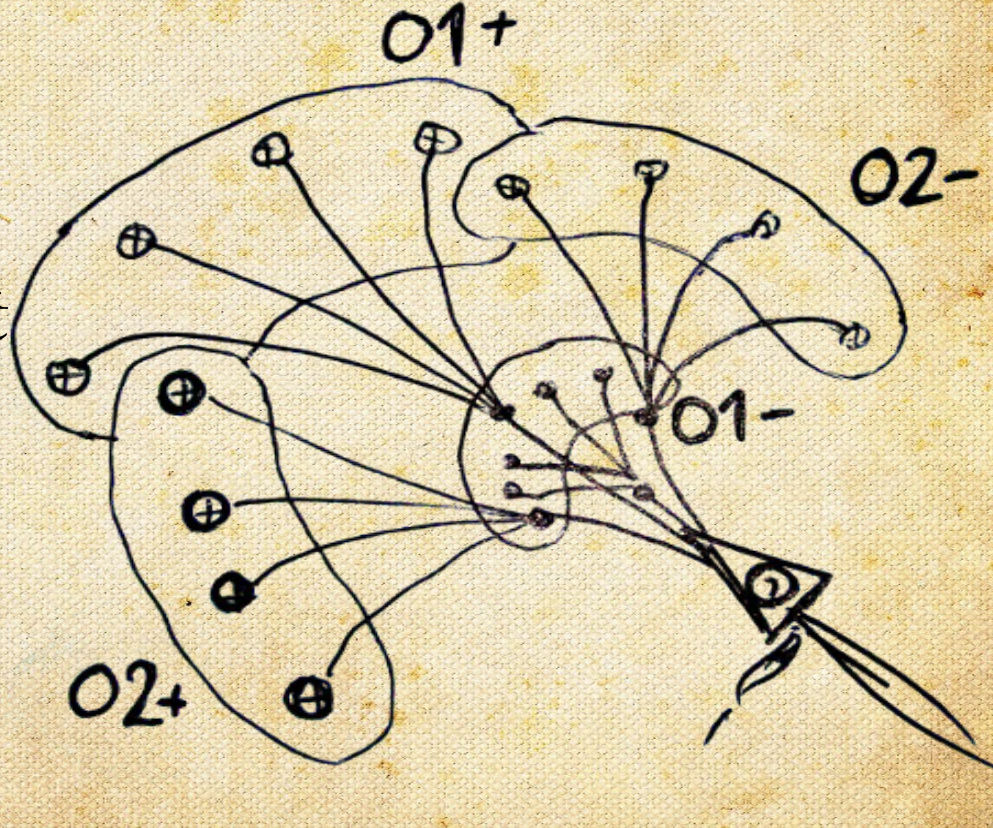
Note we will need to use Simulation(E, dt) and that environment is also simulated.



Algorithm 3: Futures

For each option we will “imagine” some N futures. (N is about 100).

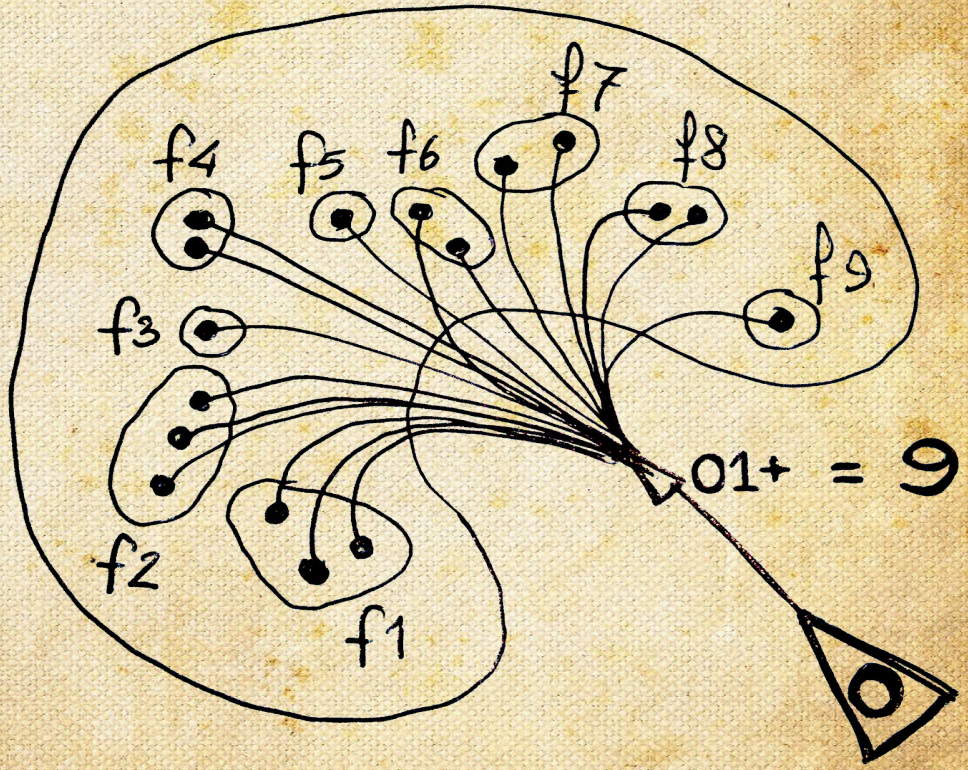
We keep using only Simulation(E, dt).



Algorithmo 4: Repeated futures

Similar futures are now discarded.

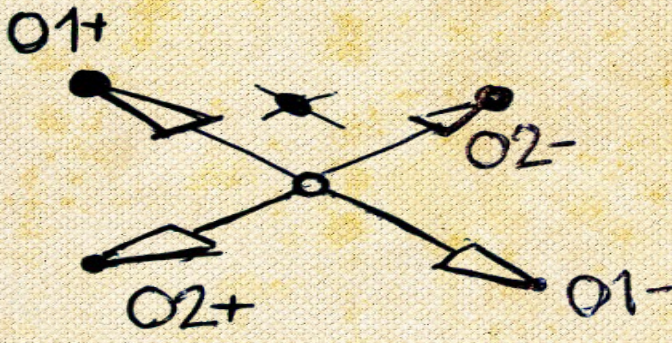
Position params snap to a grid so detecting similar futures is easy.

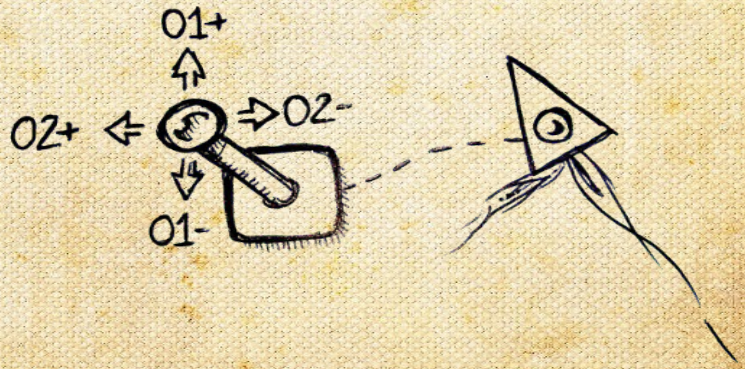


Algorithm 5: Entropies decide

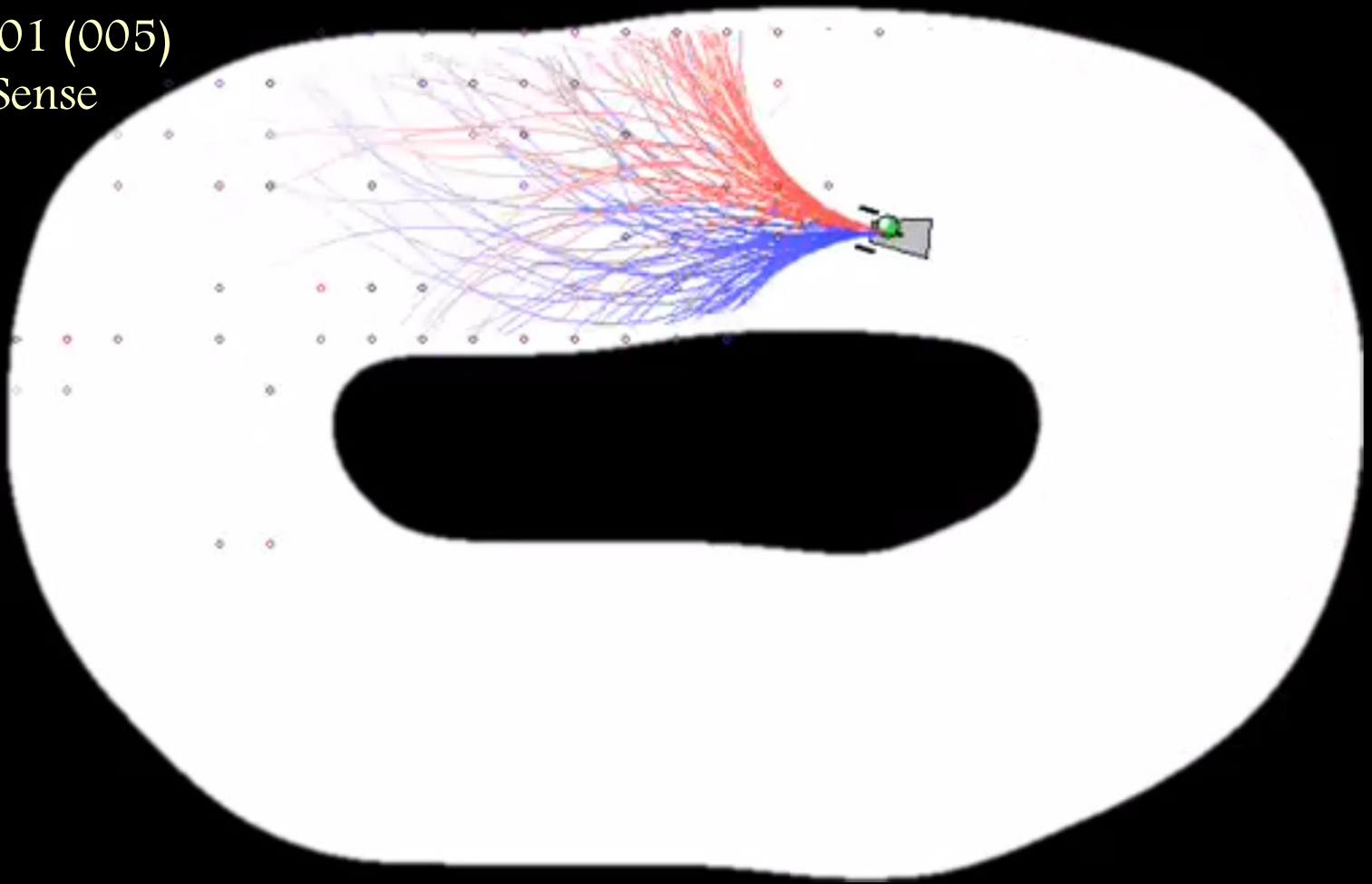
Finally, you do push joystick as if future entropies were forces or masses:

Σ(Option x Entropy)





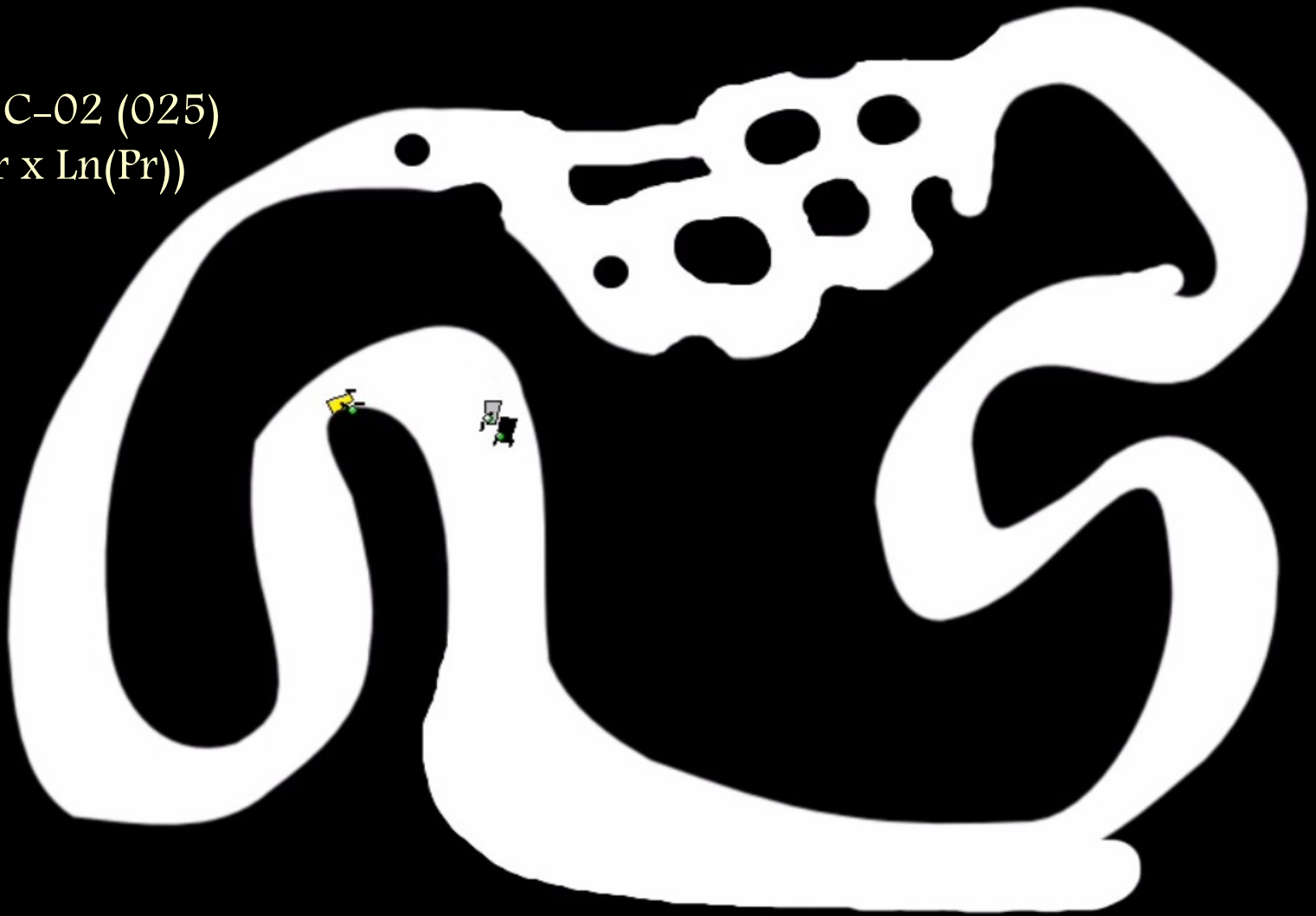
VIDEO C-01 (005)
Common Sense



Result: Common Sense

"Common sense" emerging intelligence is goal-less: it has a null psycology.

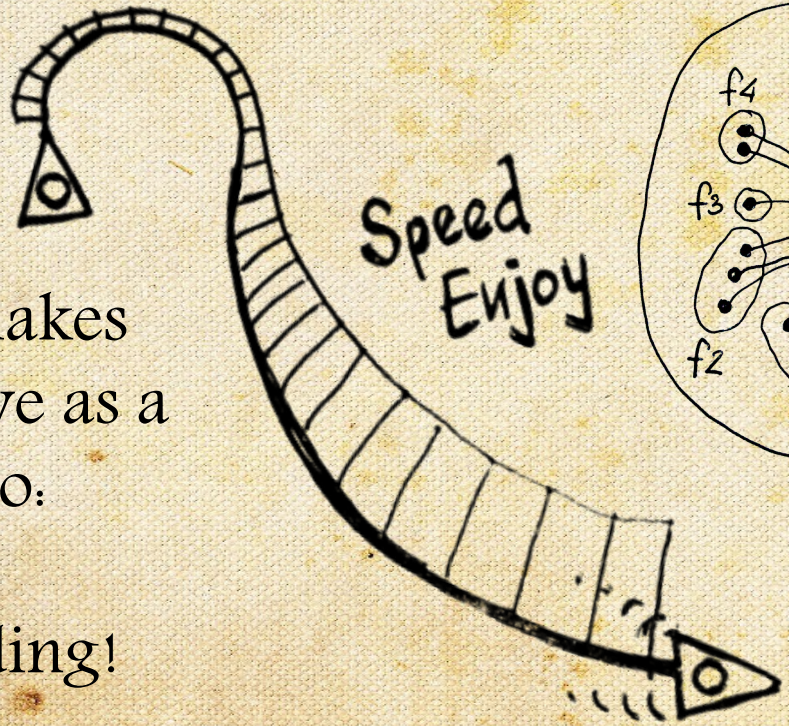
VIDEO C-02 (025)
N vs (Pr x Ln(Pr))

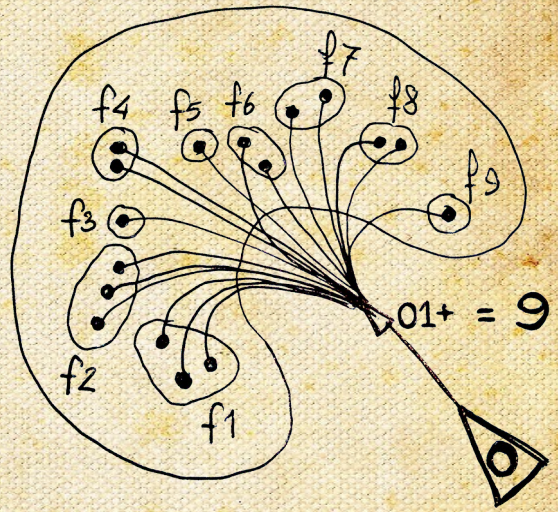


Enhacement 1: Pilots

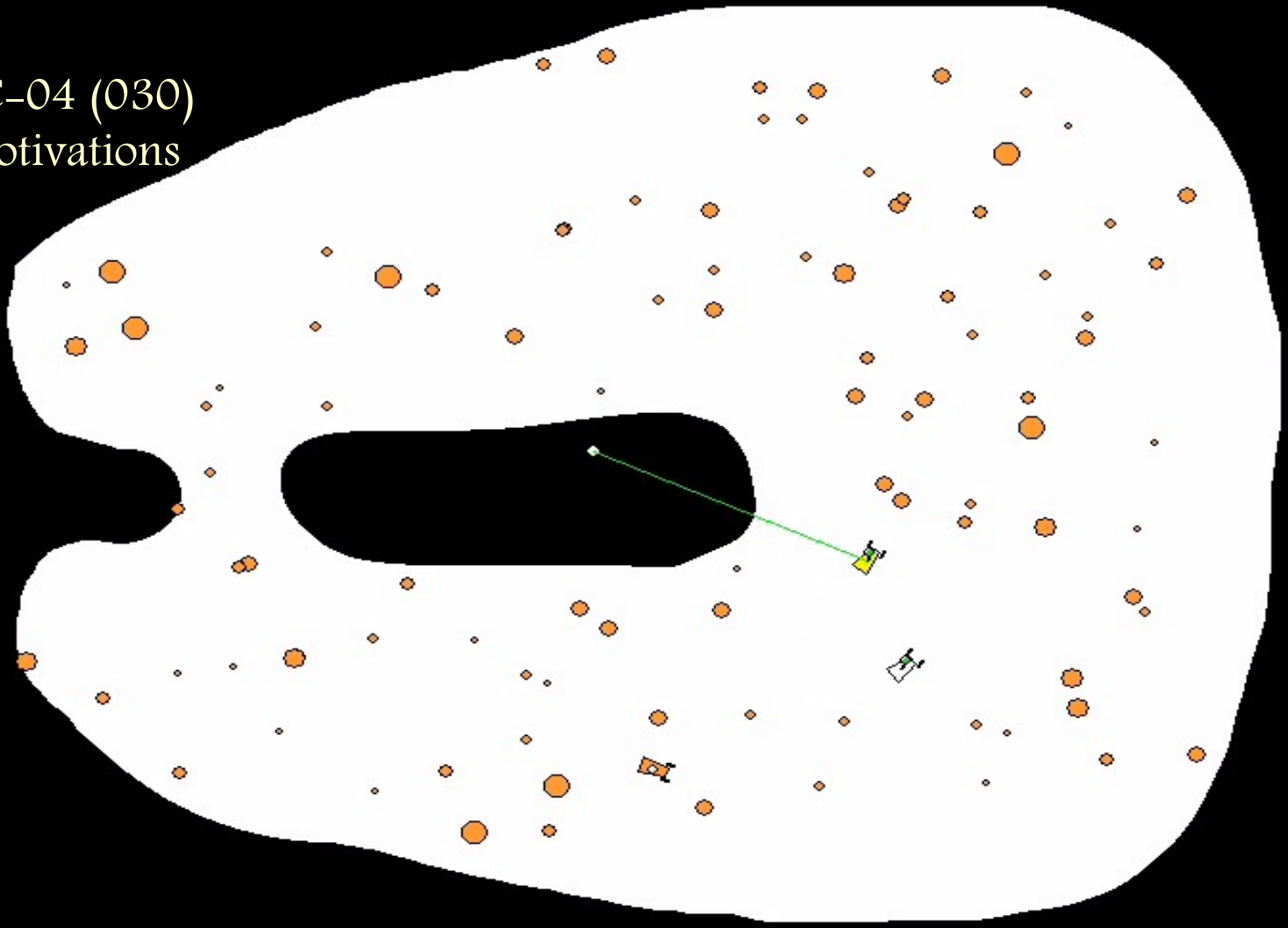
Scoring each future with the distance raced (instead of one) makes the agent to behave as a real pilot would do:

It will enjoy speeding!



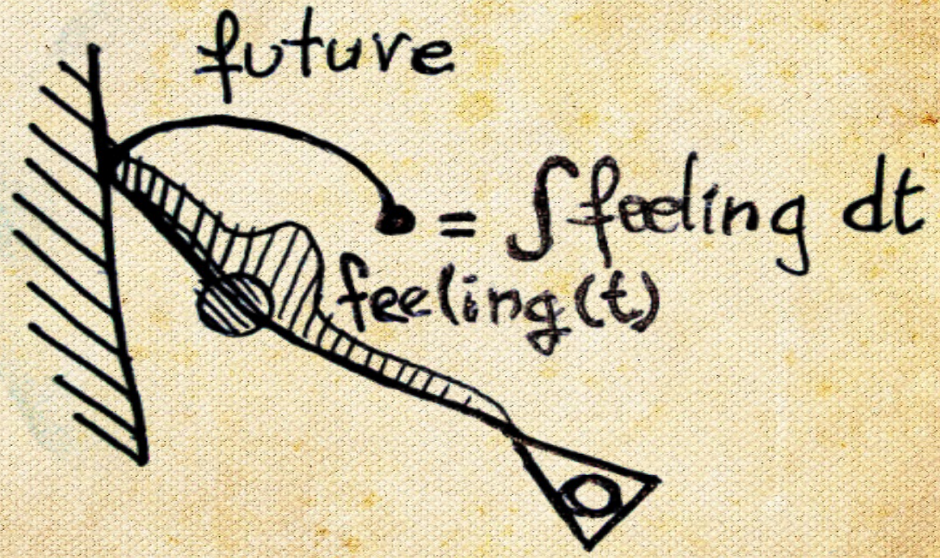


VIDEO C-04 (030)
Sweet Motivations

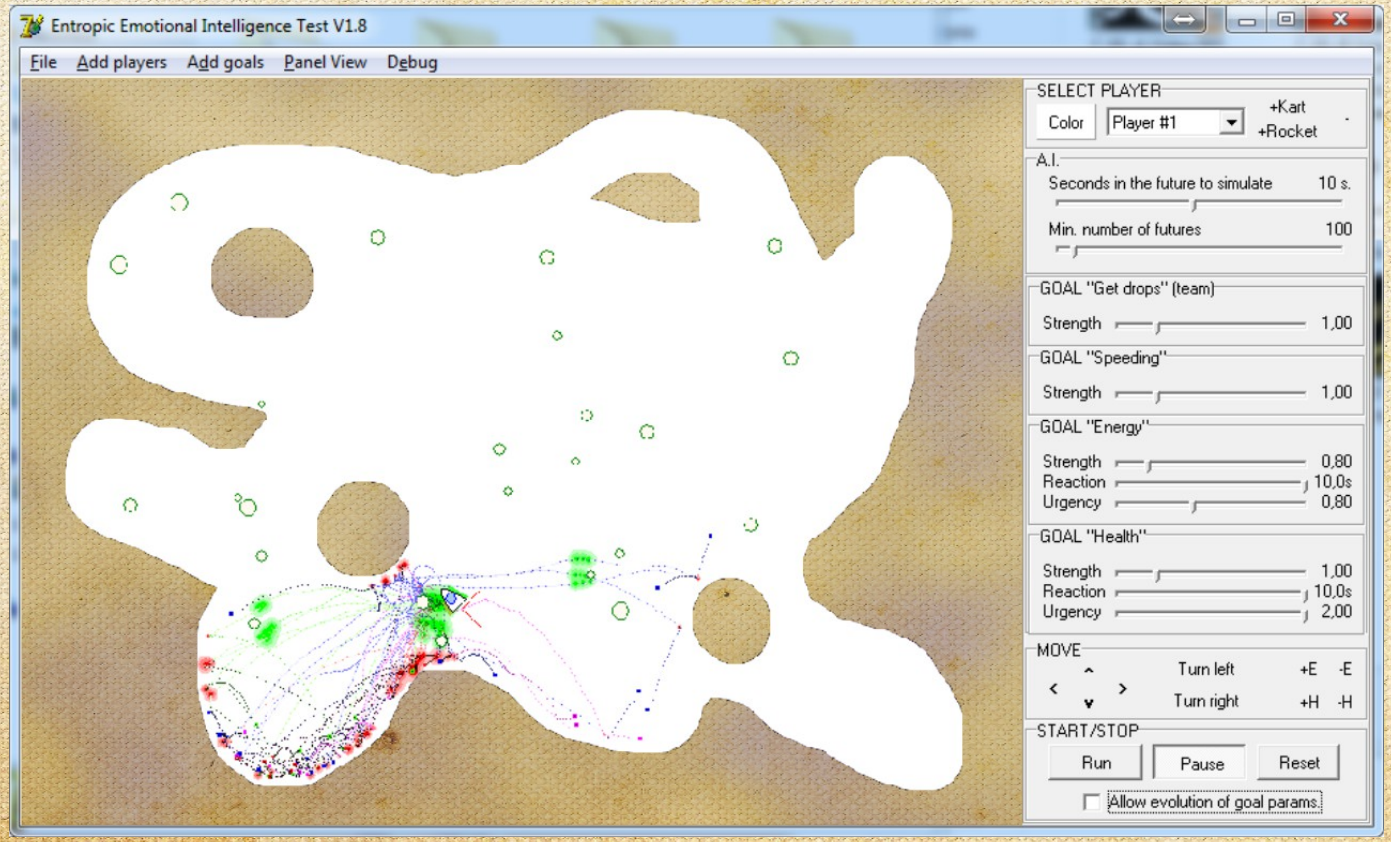


Enhacement 2: Feelings

As in the pilot case, more “enjoyable” goals can be added and, if done correctly, it will cope with “conflicting goals” nicely.

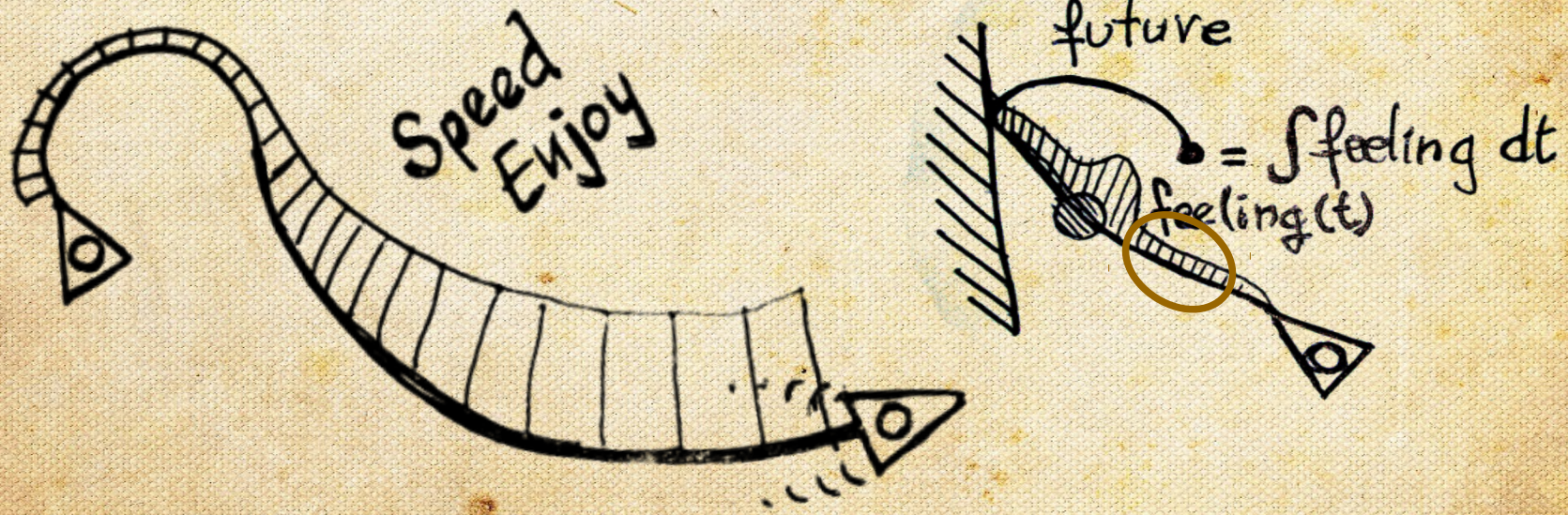


Emotional Intelligence App



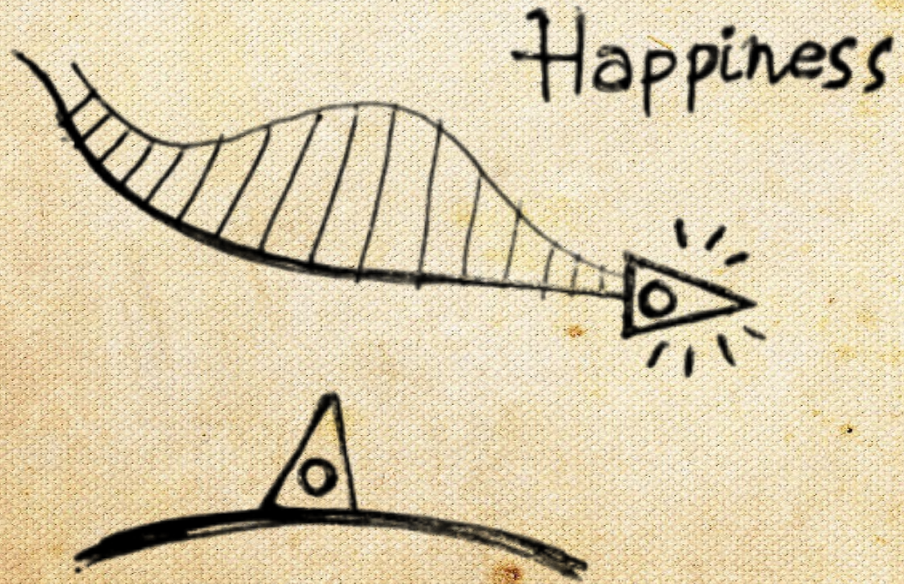
Feeling # 1: Enjoy

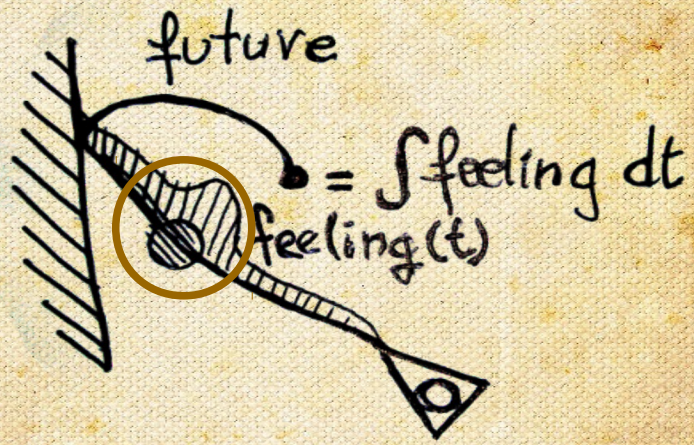
Enjoy is what you feel on each “present moment”.



Sentimiento 2. Felicidad

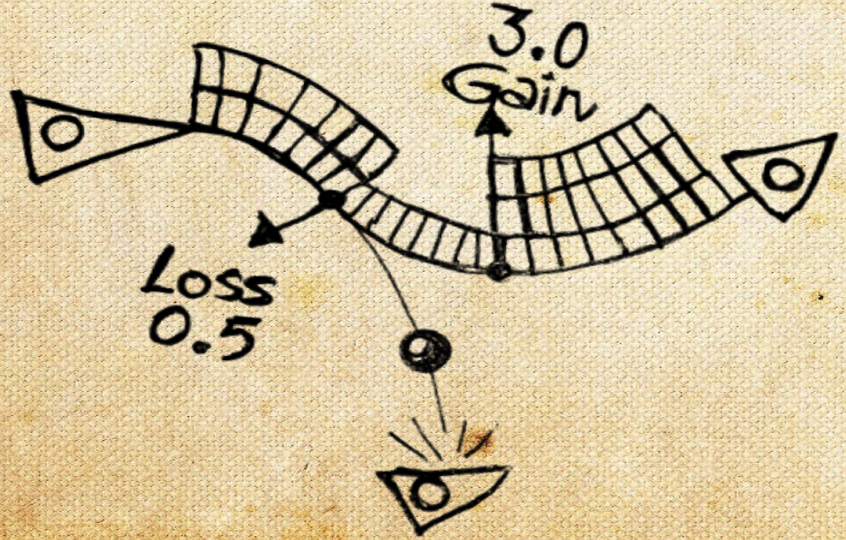
Enjoy scores higher as your mood is higher.

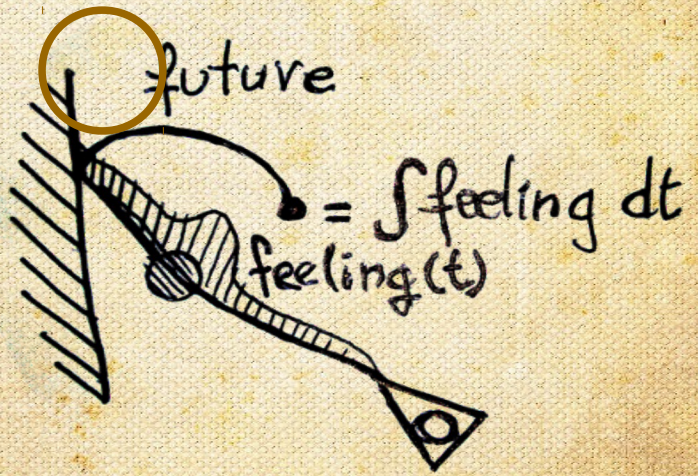




Sentimiento 3: Ganacia-Pérdida

If you loose your leg while dancing, all the enjoy felt on this future was not so funny after all.



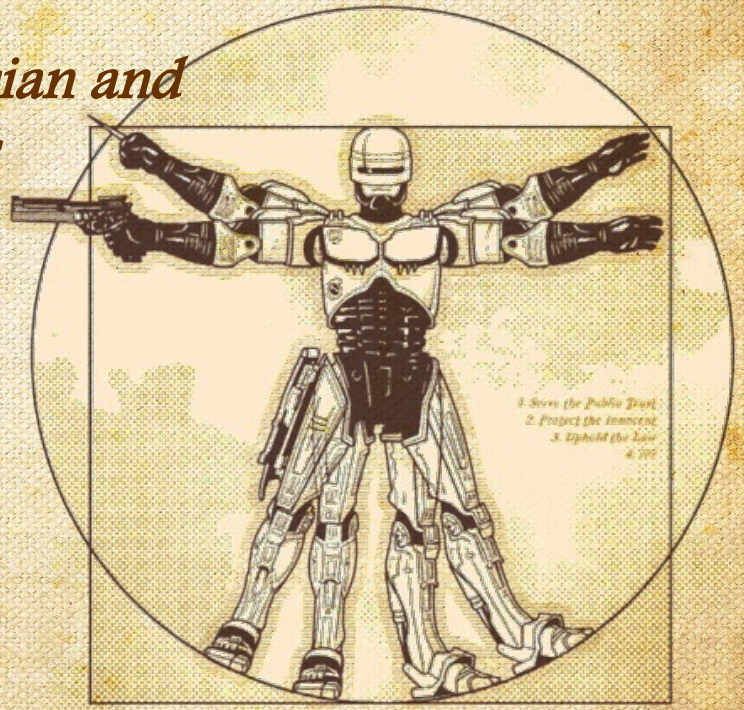


Psicologías patológicas

Some goal mixes makes you not so nice...

SkyNet: List of guilties

"A physicist, a psicologist, a mathematician and a programmer talk in a bar about theirs problems... "



- **"Phycisit"** complains about uncertantly.
- **"Phycologist"** shows negative feelings.
- **"Mathematician"** use imaginary numbers.
- **"Programmer"** uses neuronal networks.

Some Improvements

1.- Foccused Intelligence
A new joystick to cope with risky situations.

2.- Cooperation
Working and living for a common goal.

3.- Transcendence
Cooperating at the longest term.

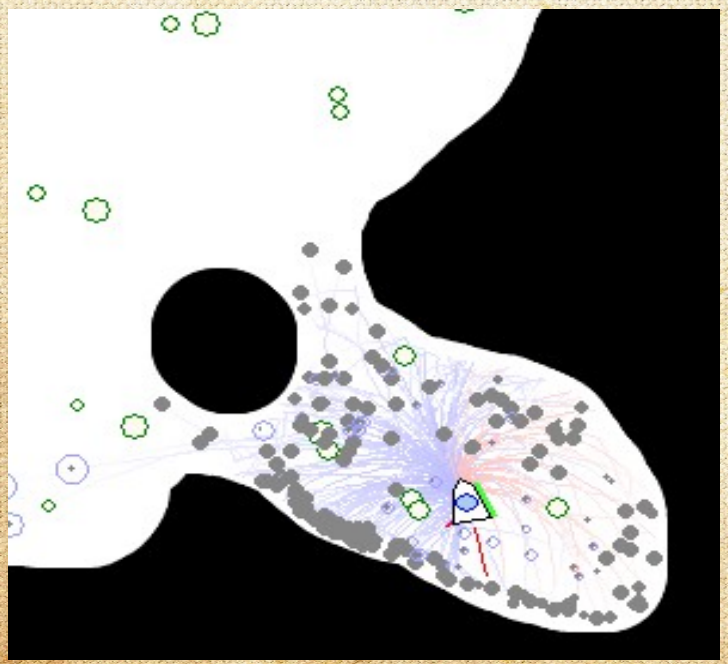
4.- Neuronal Networks
Learning to predict the future by your own.

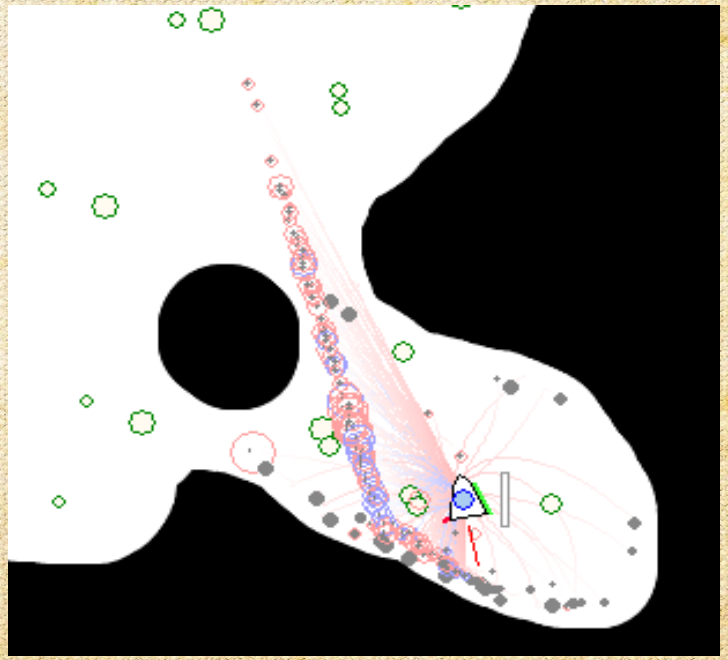
5.- Multi-Layer
Adjusting feelings to be optimal on the actual conditions.

6.- Auto-Multi-Layer
The power of recursivity.

Foccused Intelligence

Blocking your degrees of freedom to avoid risks.






Questions?