

The Predator

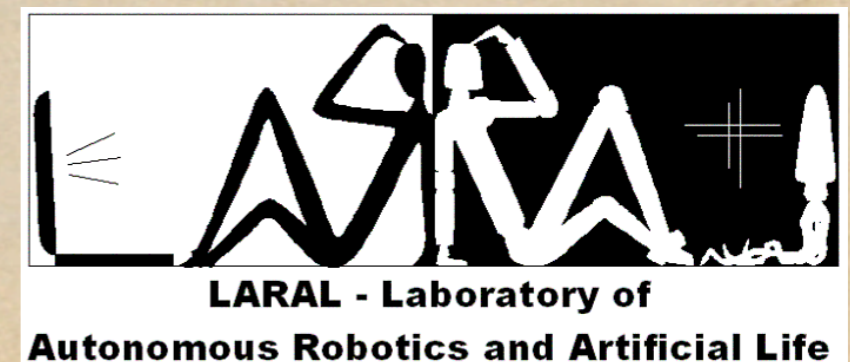
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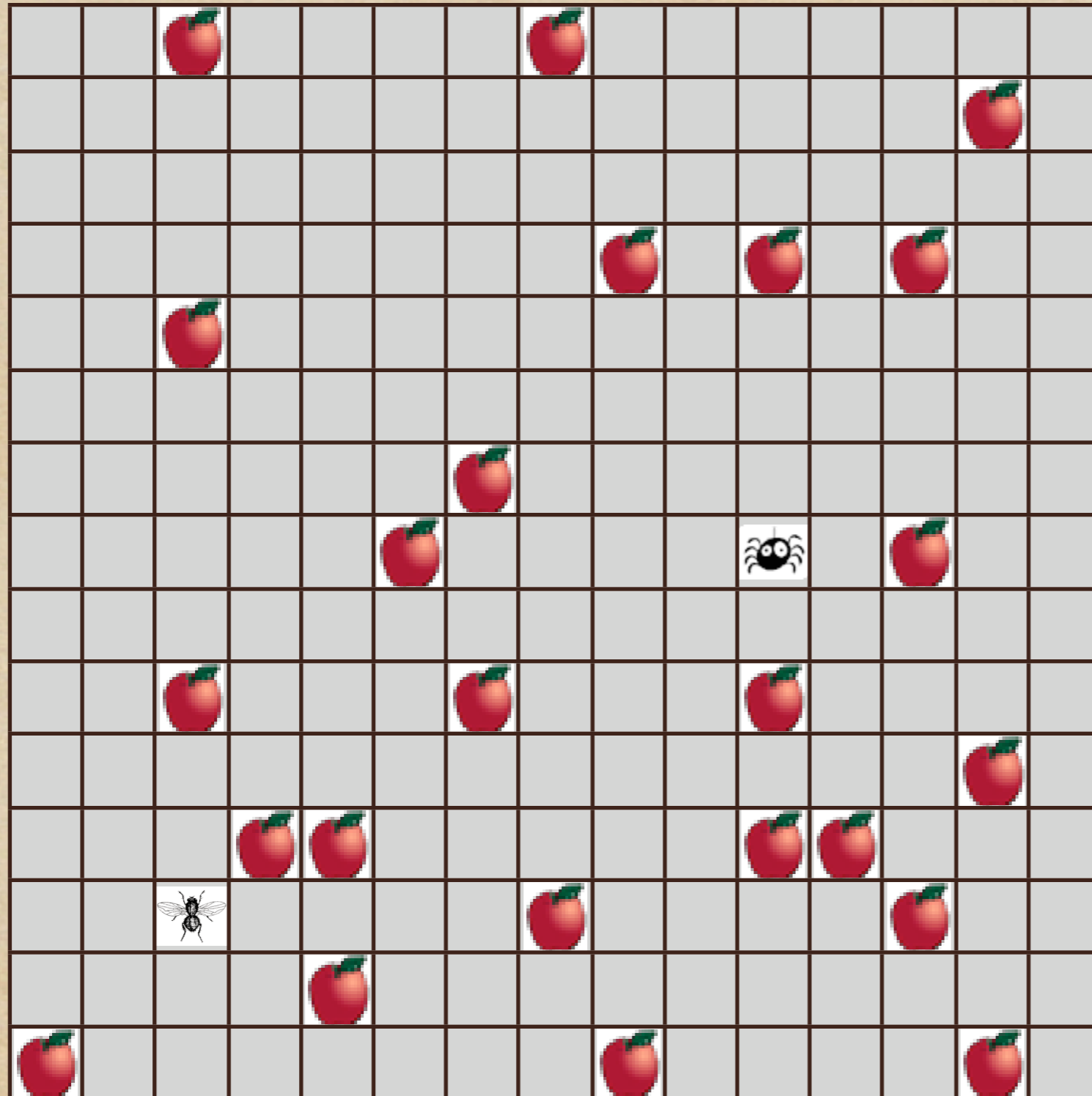


A quick introduction

In the next slides, we will show a simple model relative to the emergence of selective attention mechanisms in populations of neural networks.

This model is the first step (a “baseline”) of a more specific effort toward the creation of a future simulation model that could reproduce some animal’s pathologic condition like the depression.

The world



Bi-dimensional
discrete world
(dimension: 15x15)

Legend:



Empty cell



Food



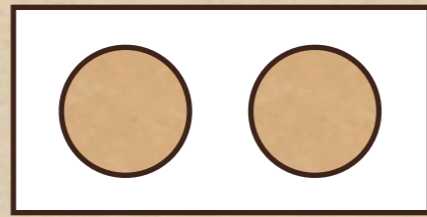
The organism



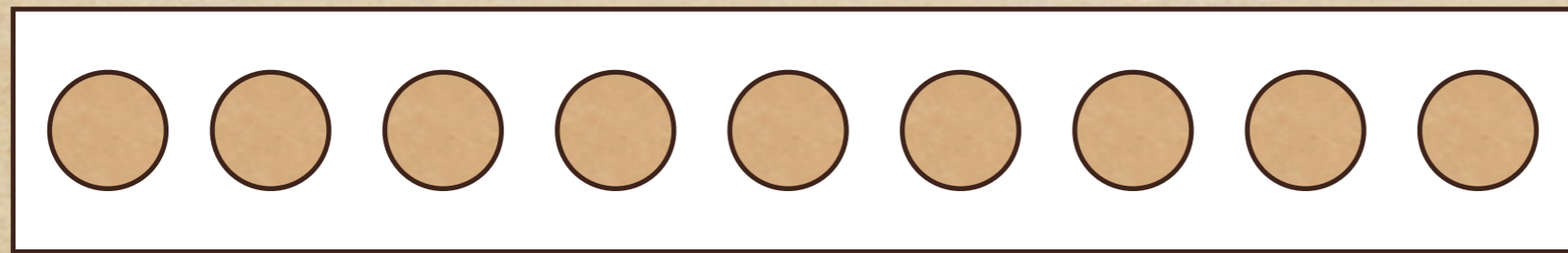
The predator

The neural network

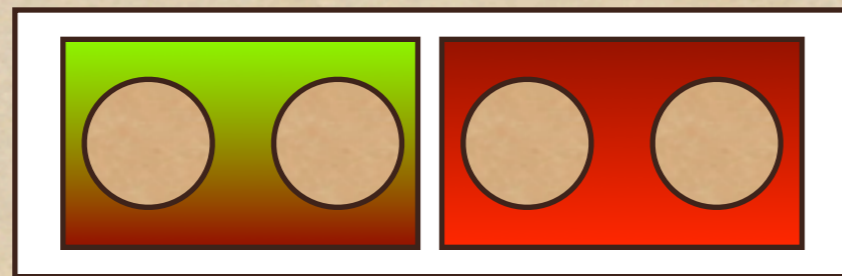
The organisms are modeled by a neural network with this architecture.



Output layer
(2 boolean neurons)



Hidden layer
(9 continuous neurons with sigmoidal activation function)



Input layer
(4 continuous neurons)

Food units

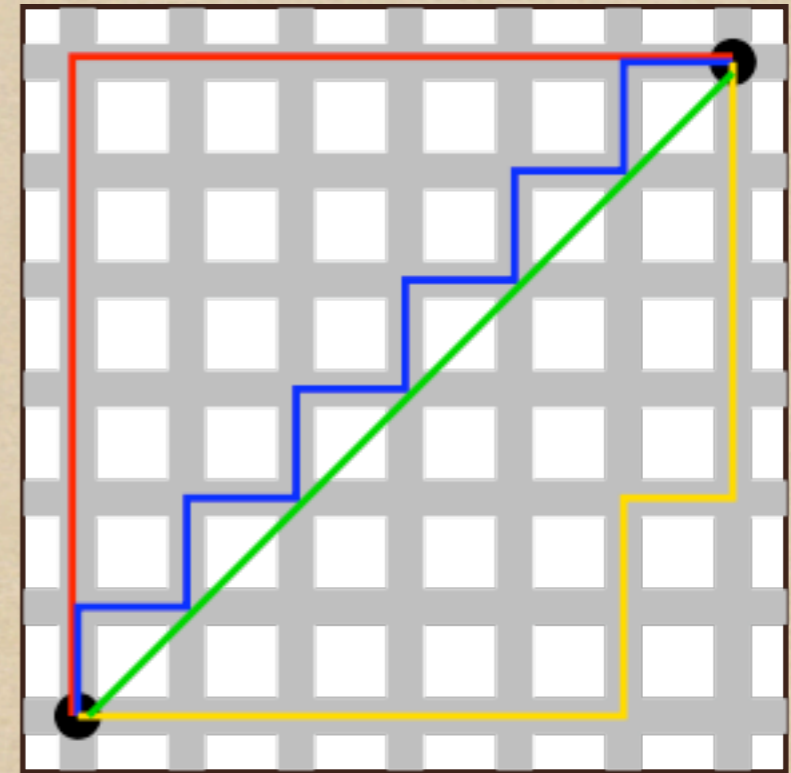
Predator units

Sensorial input management: distance to predator/nearest food unit

Manhattan Distance:

$$|x_1 - x_2| + |y_1 - y_2|$$

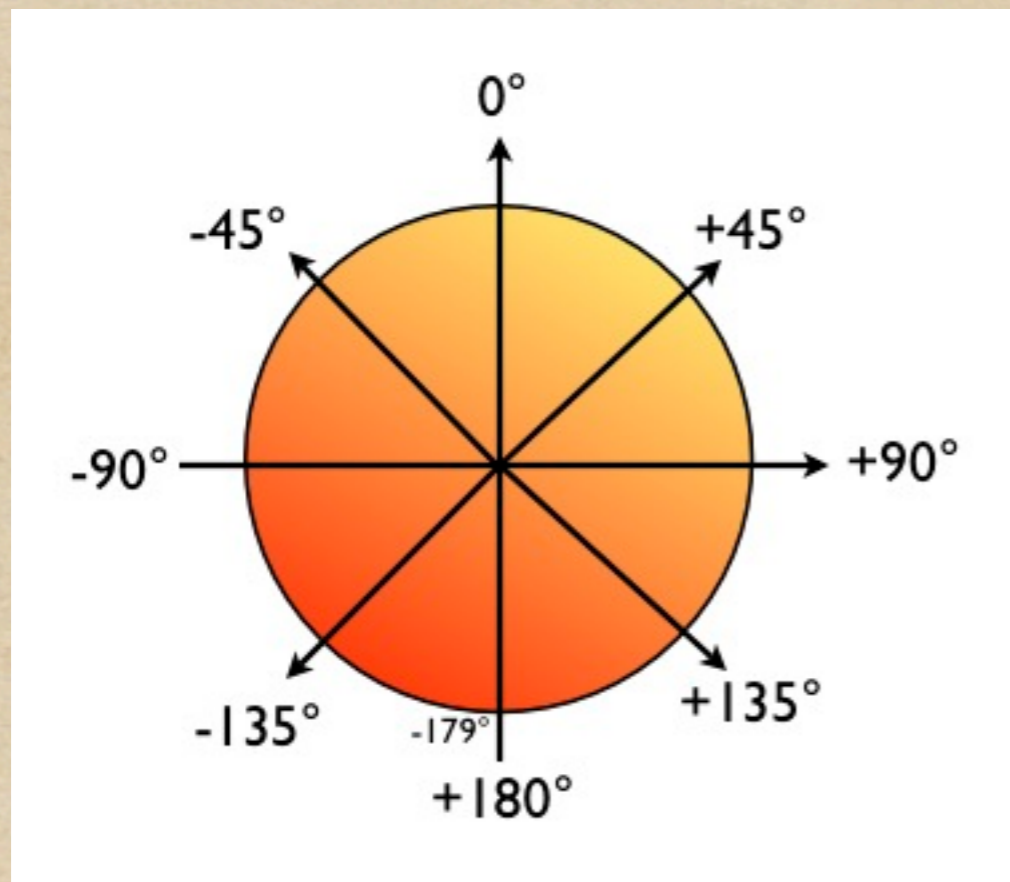
where (x_1, y_1) are the coordinates of the first point and (x_2, y_2) are the second point's coordinates.



(example of Manhattan Distance: the red, blue and yellow lines have the same length)

The value of the Manhattan Distance is calculated and then normalized in the range $[0,1]$

Sensorial input management:
angle between the organism and the predator/
nearest food unit



According to the organism's direction, the algorithm calculate the angle between itself and the predator/nearest food unit.

This value, calculated as shown in the figure, is then normalized in the range $[0,1]$

The NN's output

Basing on the current sensorial inputs, the two boolean neurons of the output layer encode one of four possible organism's motor actions, which are binarily encoded:

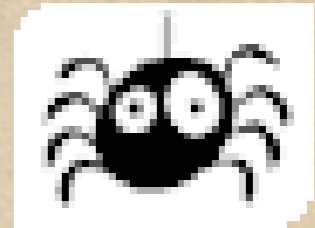
11: one step forward in the facing direction;

01: turn 90 degrees clockwise;

10: turn 90 degrees counter-clockwise;

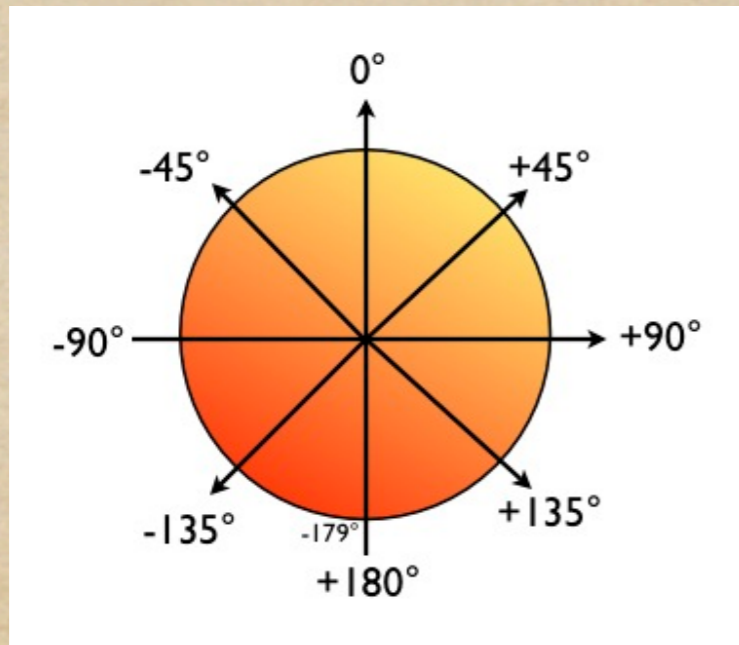
00: do nothing.

The predator: an overview



- One time for each epoch, the predator appears in the world (at a step randomly chosen);
- In a single step, the predator can move itself to any adjacent cell (not diagonally), without "orientation problems";
- His goal is to reach the organism;
- Each time the predator reach the prey, the "captured" organism loose 10 food units;
- After 25 movements (or at the end of the epoch, if appeared after the 75th step), the predator leave the world.

The predator in a nutshell



The predator's behaviour is "hardwired".

According to the angle that separate it from the organism, the algorithm elaborate where to move the predator:

Angle between -135° and -45° : move with direction NORTH;
Angle between -45° and $+45^\circ$: move with direction EAST;
Angle between 45° and 135° : move with direction SOUTH;
else: move with direction NORTH;

To make the predator's behaviour less efficient, a random quantity (noise, included between 0 and 80) is added (or subtracted) to the angle calculated by the algorithm.

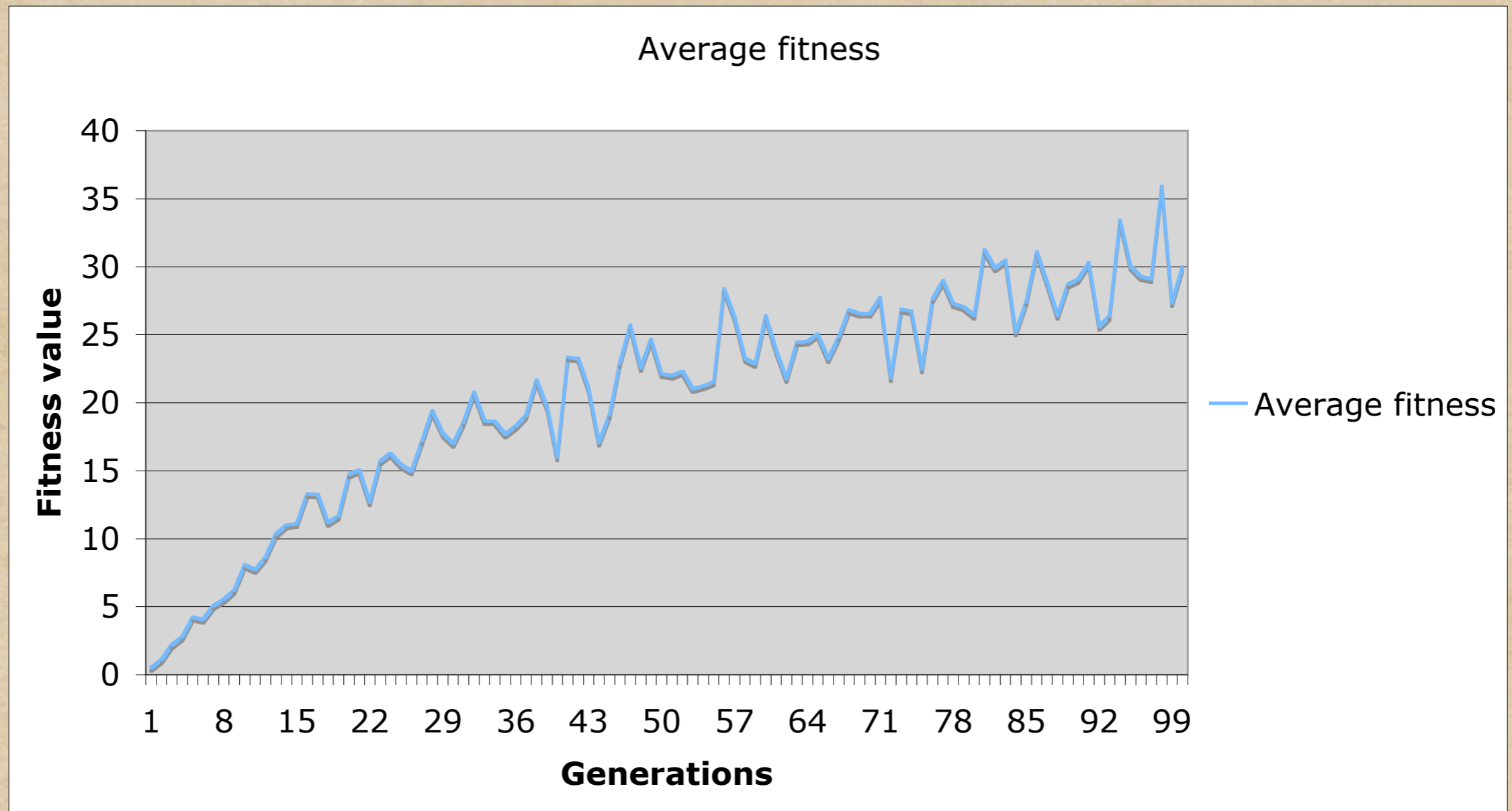
Various parameters

The population is made by 100 organisms and evolve for 100 generations.

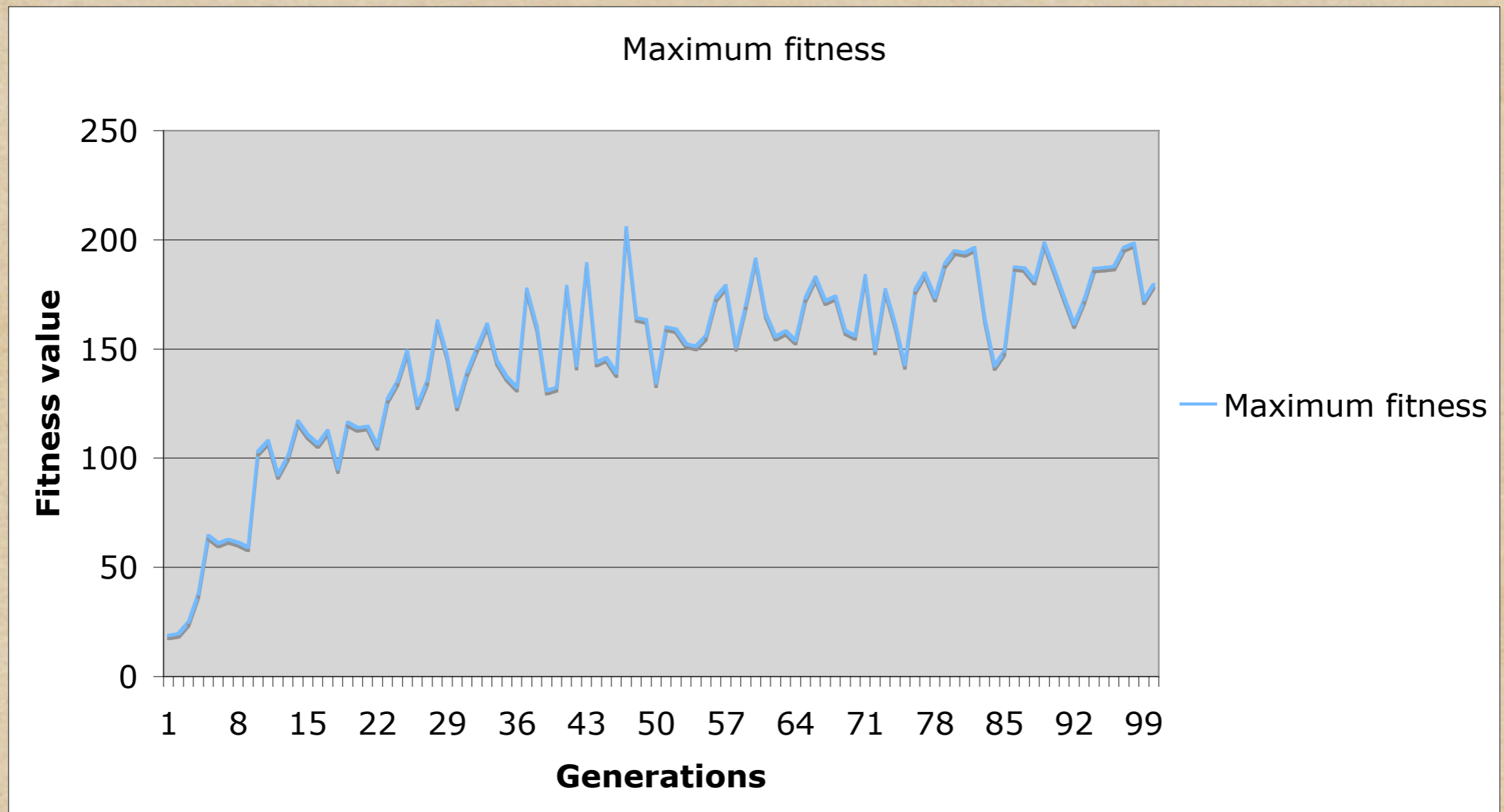
During each generation, all the 100 individuals of the current population are "tested" for 5 epochs (each of 100 steps), in 5 different environments.

The fitness simply correspond to the amount of food "saved" by an organism (i.e. the quantity of food captured in the environment and not "stolen" by the predator) multiplied for two.

Preliminary results (I)

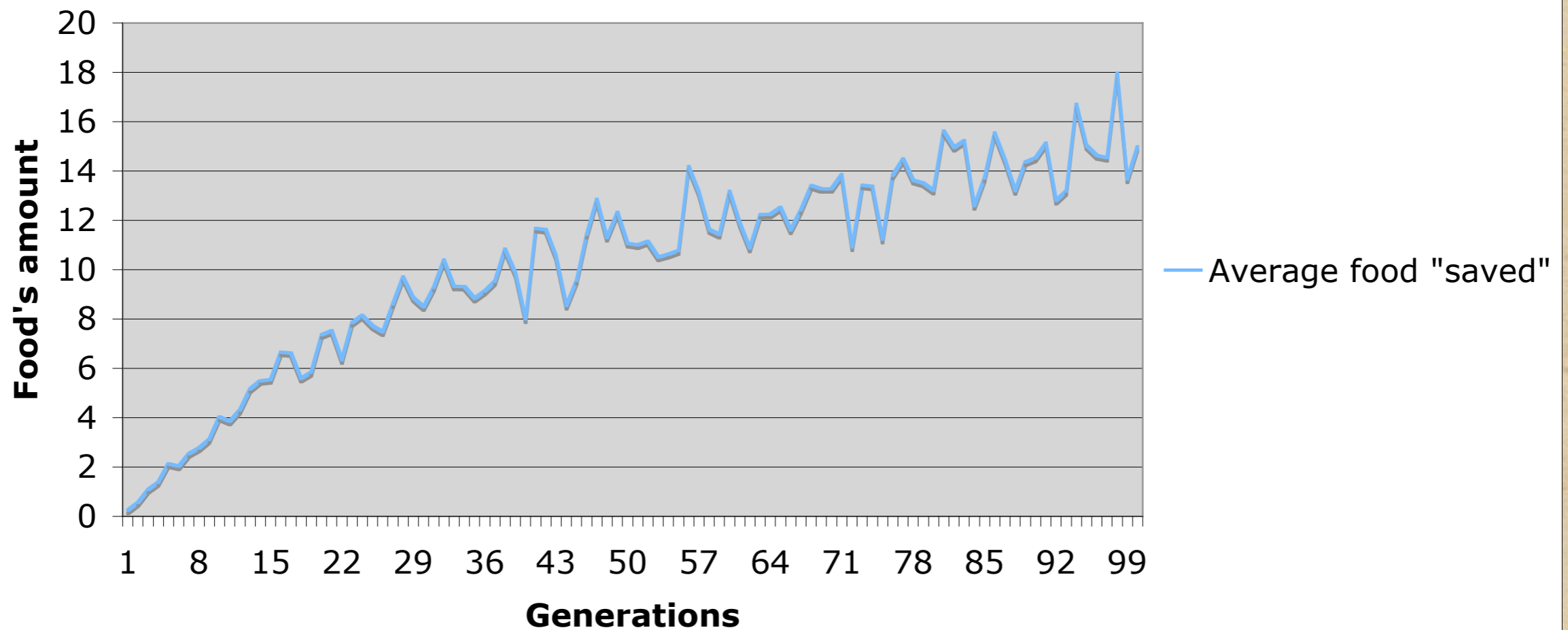


Preliminary results (II)



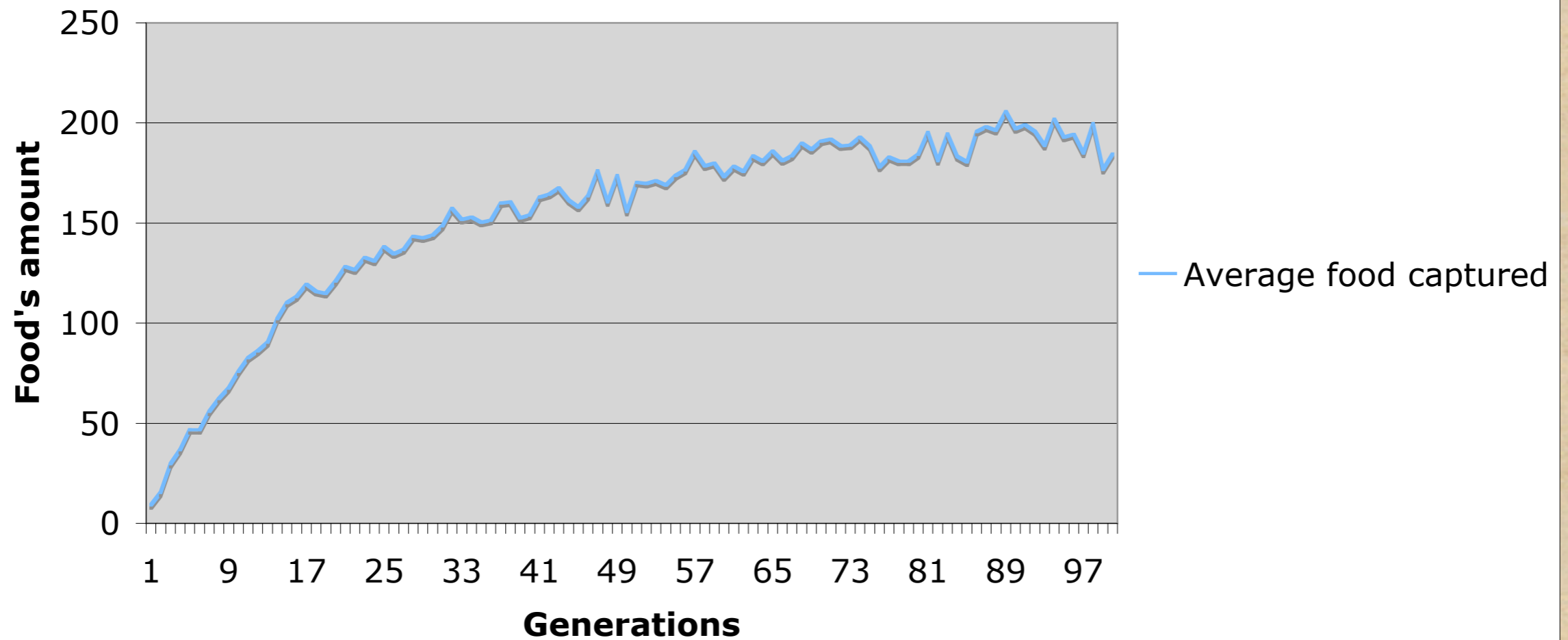
Preliminary results (III)

Average amount of food "saved" by an organisms at the end of his total lifespan



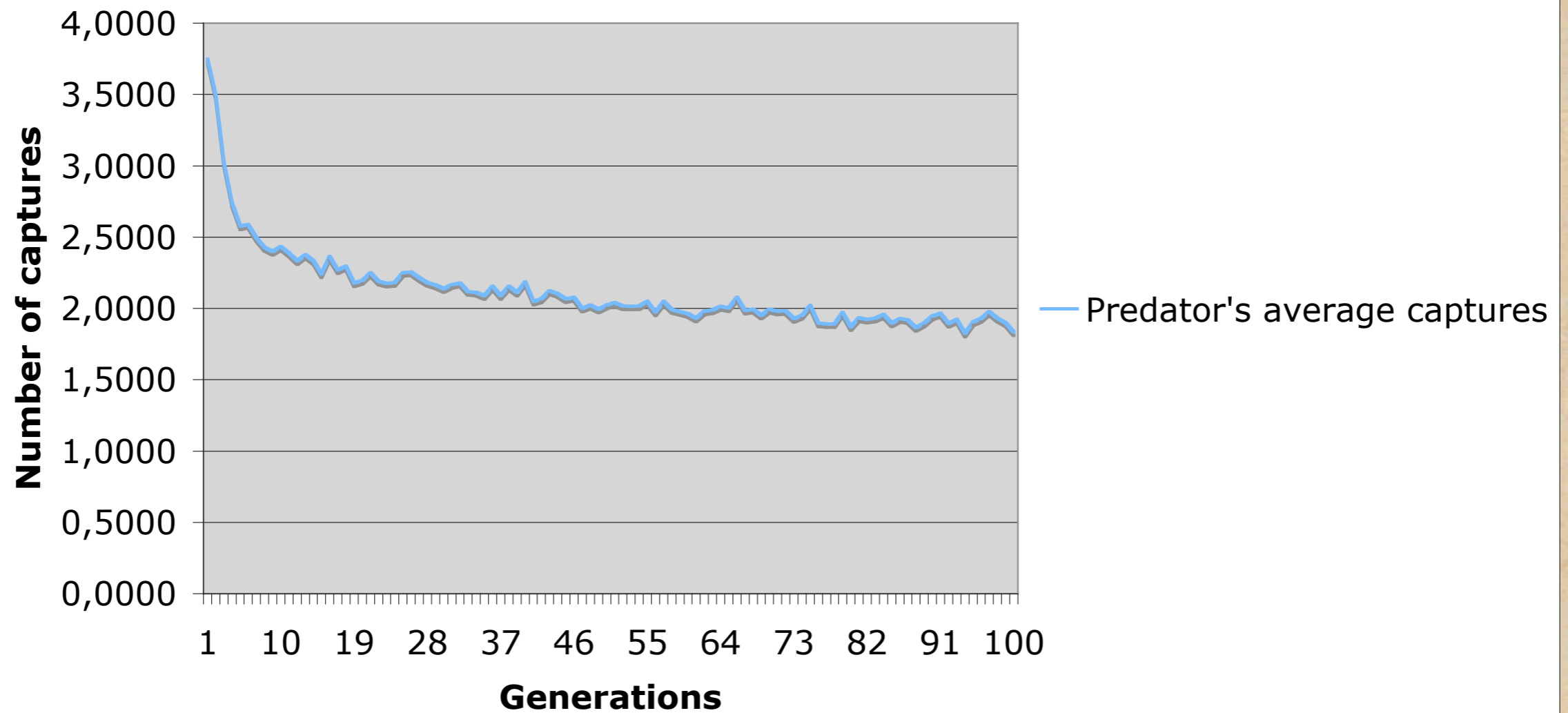
Preliminary results (IV)

Average amount of food captured by an organism during his total lifespan



Preliminary results (V)

Average number of "captures", made by a predator during an epoch



Preliminary results (VI)

Average percentage of successful escaping moves made by an organism during his lifespan, when the predator is present

