# Final report

The presented parameter represent our best configuration to solve the problem.

• Control (e.g. drawing of ANN, exact number of nodes, type of neurons)

- 12 + 4 input nodes (sensors + hidden layer recursion), one hidden layer with 4 neurons that are recursively fed back to the network as input using a delay interval of 8 robot steps, tanh as activation function in both hidden and output layers, two nodes as output that are multiplied with the maximum velocity and represent the velocity of left/right motor.
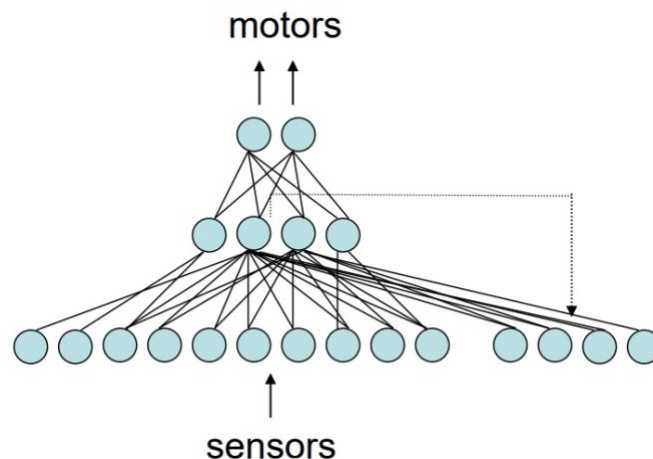
• Morphology (here simulation, state which simulator you are using)

- Our own simulation made for assignment 2.

• Genetic representation -> exact genome

- Bit string of length 4608, 64 bit for each weight of the neural network.

• Population size -> exact number

- 100.

• Initialization (how do you initialize genomes?) -> exact distributions

- Initialize bit to 0 or 1 with prob 0.5.

• Exact fitness function

- Fitness = $\sum((2a + b + c) / 4) / n + 5d$

a = punishment by the normalized number of sensors that detect the wall with a distance smaller than 10.

b = fitness is punished when the two motors' velocities have different signs, resulting in the robot spinning. The amount of punishment depends on the absolute value of the difference of velocities normalized with the maximum speed.

c = punishment when both motors have negative velocity. The amount of punishment depends on the absolute value of the difference of velocities normalized with the maximum speed.

n = number of steps that the agent performed.

d = calculation of explored ground using 'virtual dust' (i.e. grid with the same dimensionality as the robot world is set to a fixed value (255), successively all cells that the robot body touches when traversing the world are set to a different value(100))

• Selection and reproduction

   o   Truncated rank based selection of 1/5 best performing individuals.
   o   Phenotypes are equally reproduced and generational replacement is applied.

• Crossover & mutation

   o   One point crossover with splitting at random index.
   o   Each bit is flipped with a probability of 0.01.

• Stop criterion

   o   600 time steps in simulation.