Autonomous Intelligent Systems,
Institute for Computer Science VI, University of Bonn

Dr. N. Goerke
Friedrich-Ebert-Allee 144, 53113 Bonn, Tel: (0228) 73-4167
E-Mail: goerke@ais.uni-bonn.de
www.ais.uni-bonn.de

Exercises for Artificial Life (MA-INF 4201), SS15

Exercises sheet 10, till: Mon 29.6.2015

22.6.2015

Group	Name	63	8^2	65	66	67	68	69	$\sum$

Assignment 63 (2 Points)

Explain the idea and all main parts of the SMPA architecture (one sentence each) and draw a diagram to depict the SMPA structure.

Assignment 2^6 (1 Point)

Check the assignments you have done, sum up the points achieved so far, and calculate the difference to the 50% threshold that normally would have been necessary for beeing admitted to the exam.

Assignment 65 (2 Points)

Derive, and write down, the closed-loop transfer function G(s) of the complete control loop with controller, actuator, additive noise, plant, sensor (feedback).

Assignment 66 (3 Points)

A Braitenberg type vehicle (two sensors and two motors, type 2 or 3) shall have the behavior to position itself directly in front of an object in the working distance d_w.
The working distance shall be maintained even in the two cases, that the object is moving away and that the object moves towards the vehicle.
Describe the necessary structure of the vehicle including the Sensor-Motor mapping characteristics in brief words and by using a sketch and a diagram.

Assignment 67 (2 Points)

Describe a situation where a vehicle with a type 3-a Braitenberg behavior is more favorable than a 2-b behavior.

Assignment 68 (2 Points)

Braitenberg type 3-b vehicles tend to have problems in corners.
Explain what the problems are, and describe in detail at least 2 stategies to circumvent this unwanted effect.

Assignment 69 (3 Points)

The inner control structure of a robot has been designed as a table $\mathbf{T}$, mapping from a set of $N = 8$ discrete sensory distance values $\mathbf{S} = (s_1, ..., s_8)$, to a set of 2 discrete motor values denoted with $\mathbf{M} = (m_l, m_r)$.
The set of discrete sensor values is $s_n = \{0.0, 2.0, 8.0, 64.0\}$, and the set of discrete motor values is $m_i = \{-0.5, -0.2, -0.1, 0.0, +0.1, +0.2, +0.5, +0.75, +1.0\}$.

Design and describe a genome and a fitness function for an EA to optimize the table $\mathbf{T}$ with respect to the task of obstacle avoiding movements.
Don't forget to define the objective and/or fitness function.

Programming Assignment PA-F (10 Points, due date 29.6.15)

Write a small robot simulator in C, C++, Java or Python.
The world of the robot is a rectangular world of 50x50 grid-cells. Each grid-cell is either 0 =*free space*, or 1 =*wall*. The grid-world shall be read in from an ASCII-file where the positions of all occupied cells can be found as one (X, Y)-position per line `SS15_4201_PA-F.grid`; the first line of this file contains a comment and can be omitted.

You can visualize the world with the following command within *gnuplot*:
```
plot 'SS15_4201_PA-F.grid'  using 1:2 with points
```

The robot has a size of 1 cell, it has a position (X, Y) within the world and an orientation a pointing to one of the eight surrounding cells. The robot can sense the situation of the eight surrounding cells, and in one simulation step can move one cell into the heading a .

Implement either a wall following or a Braitenberg type 3b behaviour.
Start your robot at position $(48, 17)$ heading south, and calculate the resulting movements for at least 200 steps.

It is not intended to programm a visual output.
To document the movement of the robot it is sufficient to print out the pose (X, Y, a) of the robot in every timestep into a file named `PA-F_robot.path`.
gnuplot readable format; one pose per line, values separated by blanks, in the order $X\ Y\ a$

The following *gnuplot* command should then visualize the world and the journey of the robot:
```
plot 'SS15_4201_PA-F.grid'  u 1:2 w p, 'PA-F_robot.path'  u 1:2 w p
```