FFR125, FIM760
Autonomous agents

LP III-IV, 2008

Course information

Lecturer:
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Course web page:
http://www.am.chalmers.se/~wolff/AA/AutonomousAgents.html

Course contents:

The fundamentals of behavior-based robotics and evolutionary robotics.
The basics of robot hardware: sensors, actuators, and microcontrollers.
The basics of rational decision-making.
The basics of animal behavior and its relevance for autonomous agents.
The basics of learning and adaptive behavior for autonomous robots.
Elementary robot construction and programming.

Teaching hours and locations:

3rd quarter (January 21 - March 7):
Tuesday 10.00 - 11.45, MC
Friday 13.15 - 15.00, MC
(Entrance to the MC lecture hall is from Hörsalsvägen 5.)

4th quarter (March 31 - May 23):
Tuesday 08.00-11.45, F7105A (ET-lab).

Literature:

For the first part of the course: Theory and simulations:

1. **Wahde, M.:** *An introduction to autonomous robots,* lecture notes (**MW**).
Will be made available for download shortly.

2. **Xie, M.** -- *Fundamentals of robotics - linking perception to action* (**MX**).
Available at Cremona bookstore, and at various web bookstores.

3. Various scientific papers (web links or printouts will be made available during the course).

For the second part of the course, robotics construction project:

4. Lindsay, A.: *Robotics with the BoeBot - Student guide v2.2*, (**AL**).
Available for download at www.parallax.com.

5. The BasicX Manual: *BX-24 Documents* (**BX**).
Available for download at www.basicx.com.

6. Various additional materials, which will be announced in the beginning of Lp IV.

Home problems

There will be two sets of home problems with a maximum score of 25p (10p and 15p, respectively). A *minimum* score of 4p (set 1) and 6p (set 2), on the home problems is required in order to pass.
Incorrectly solved problems will *not* be returned for correction, so make sure to check your solutions and programs carefully before you submit!

Preliminary deadlines for the home problems are 2008.02.12 and 2008.03.04, respectively.

Mid-course exam

After the 3rd quarter, there will be a written exam. Maximum score is 25 points. A minimum of 10p is required in order to pass.

Robotics project

The students will work in groups of 4-6 students. It is mandatory to carry out the robot construction project. There will be an opportunity to receive *two extra points* on the robot construction, for creativity[1]. There will be two major robotics assignments to carry out for the students, and each project group *must* participate, with their robot, in the robotics project demonstration events:

Preliminary dates for the robotics project demonstration events are 2008.04.22 and 2008.05.20.

Note: It is *mandatory* for *each* student to participate in the project demonstration events (and in the construction/programming work!), in order to pass.

Each project group is also *required* to hand in a brief report, by the end of the 4th quarter, regarding their robot construction and programming activities.

Examination and grading:

The examination will consist of two sets of home problems (maximum score: 10p and 15p, respectively), and a written exam by the end of the third quarter (maximum score: 25p).
The robotics construction project is mandatory to carry out. Two points *may* be received for creative robot construction.

The requirements for the various grades are as follows:

ECTS:
A: Total score in [45, 50]
B: Total score in [41, 44.5]
C: Total score in [36, 40.5]
D: Total score in [30, 35.5]
E: Total score in [20, 29.5]

Chalmers:
5: Total score in [43, 50]
4: Total score in [36, 42.5]
3: Total score in [20, 35.5]

GU:
VG: Total score in [42, 50]
G: Total score in [20, 41.5]

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1 The criteria for receiving two extra points will be described at the beginning of Lp IV.

Preliminary course program (quarter.week):

Theory and simulations will be covered in the 3rd quarter. Robot construction and programming will be the topics of the 4th quarter.

Week 3.1:

Lecture 1: Course introduction, introduction to autonomous robots:
MW: p. 1-2
MX: p. 1-26

Lecture 2:Kinematics, dynamics, and sensors of autonomous robots:
MW: p. 2-19
MX: p. 115-143

Week 3.2:

Lecture 3: Simulation of autonomous robots:
MW: p. 19-27, 109-114
Handout of home problems, set 1.

Lecture 4: Reserve lecture:
Work on home problems, if nothing else is announced.

Week 3.3:

Lecture 5: Decision-making system of robots:
MX: p. 573-600,
and an example of path-planning for mobile robots, i.e. the A*-algorithm.

Lecture 6: Animal behavior: Lessons for robotics:
MW: p. 29-38
Shi, W. and Zusman, D.R. Fatal attraction, Nature, 366, 414-415, 1993.

Week 3.4:

Lecture 7.a: Behavior-based robotics: Generating robot behaviors:
MW: p. 39-52

Lecture 7.b: Evolutionary robotics: Evolving basic behaviors:
MW: p. 53-74

Lecture 8: Utility theory and rational decision-making:
MW: p. 75-84.

Week 3.5:

Lecture 9: Behavior organization in autonomous robots:
MW: p. 85-108.
Handout of home problems, set 2.

Lecture 10: Reserve lecture:
Work on home problems, if nothing else is annonced.

Week 3.6:

Lecture 11: Control system of robots I:
MX: 199-239:

Lecture 12: Control system of robots II.
MX: 239-283:

Week 3.7:

Lecture 13: Information system of robots:
MX: 303-374:

Lecture 14a: Learning and adaptive behavior in animals and robots:
Scherffig, L. Reinforcement learning in motor control.

Lecture 14b: Multi-robot applications:
Labella T.H., Dorigo M., Deneubourg J.-L. (2006): Division of Labour in a Group of Robots Inspired by Ants' Foraging Behaviour.

Week 4.1-8:

Robotics construction project will be the topic of the 4th quarter. Detailed information regarding these activities will be announced on the course homepage.
