Advanced AI Techniques

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Exercise Sheet 11

Due: Tuesday, 30. Januar 2007

Exercise 11.1 (Strategic Games)

Formalize the game "Rock, Paper, Scissors" as a strategic game, i.e. define the number of players, actions, and utility function (in a matrix).

Hint: The rules of the game can be found under `http://en.wikipedia.org/wiki/Rock_Paper_Scissors`.

Exercise 11.2 (Iterative Elimination)

The *project game* is a game for three persons: The *doer*, the *opportunist*, and the *grumbler*. Each player decides (secretly), if he supports the project (S) or not (–).

- The *doer* receives one point for each player supporting the project.
- The *opportunist* receives one point for each player *having the same opinion* as himself.
- The *grumbler* receives one point for each player *having a different opinion* as himself.

Since the project has public benefit, each player receives *an additional point*, if the project can be accomplished, i. e. it can be accomplished if it has a *majority* of the players.

Each player wants to maximize his points (but for example not to have more points than another player).

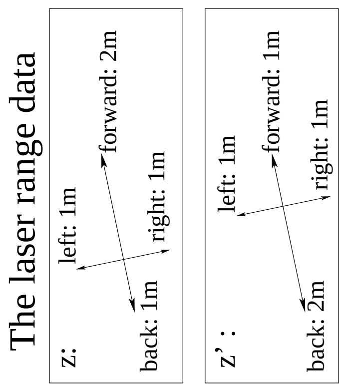
(a) Formalize the project game.

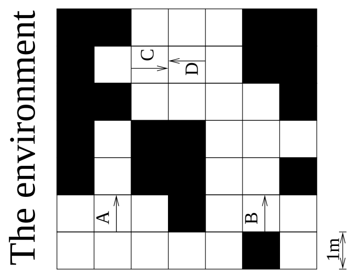
(b) Each play has only one rational strategy. Determine this strategy by using iterative elimination.

Exercise 11.3 (Position estimation)

Consider the environment shown in the picture below. A robot of size $1m \times 1m$, that exactly fits into a field of the grid, is with equal probability in each of the poses (grid-cell and orientation) A, B, C, and D.
To estimate its position, the robot first receives the laser-range data z shown in the picture below. Then it performs the action of moving $2m$ forwards (on average, in 1 of 26 cases, its energy is low and therefore it moves $1m$ instead of $2m$), and finally it receives the laser-range data z'.
The robot knows that its sensors are inaccurate. In $\frac{2}{3}$ of all cases, the odometry is correct, otherwise it counts half of the distance actually moved. For each of the four directions, the laser range is correct with probability $p = 0.6$, but

with $p = 0.2$ it overestimates the actual distance by $1m$, and with $p = 0.2$, it underestimates the distance (if possible) by $1m$.[1] The measurements for different directions are stochastically independent.
Estimate the final position of the robot with its intermediate steps (observing z, moving forward, and observing z'). Keep in mind that the robot may have actually moved $1m$ instead of $2m$.





Please hand in a joint solution of three students and write all names on the sheet.

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[1]For example, in position B, the distance to the left would be measured as $1m$ with probability $p = 0.6$ and $2m$ or $0m$ with $p = 0.2$ each. The distance forward would be measured as $3m$ with $p = 0.6$ and $4m$ or $2m$ with $p = 0.2$ each. The distance backwards would be measured as $0m$ with $p = 0.8$ and $1m$ with $p = 0.2$.