

GWV – Grundlagen der Wissensverarbeitung

Tutorial 4 : Searching

Exercise 1.1 : (Scotland yard again)

In Scotland Yard, you can take taxis, busses, and subways to move around. Each time you use one of these, you have to pay one ticket that fits. Suppose you are Mister X. You have tickets for taxi, bus, and subway as well as a well as black tickets which can be used for all three modes of transportation. The tickets differ in value (black > subway > bus > taxi).

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1. Again, Mister X takes some steps and then the detectives do. Find a way to escape the detectives and keep the best tickets. What kind of search would you use?
2. Suppose you had a fixed set of tickets and were tasked to go as far as possible from a given location (measured in centimeters on the board). How would you compute the best moves?

Exercise 1.2: (Heuristic Search)

```

XXXXXXXXXXXXXXXXXXXXX
X                    X
X          xxx      X
X        X xxxxxx   X
X      s      X     X
X        X X  xxxxxx X
X   xx xxxxxx X     X
X        X      g    X
X        X          X
XXXXXXXXXXXXXXXXXXXXX

```

Figure 1 shows the known environment for a robot in an ASCII-Art representation. Again the robot starts in the field S (start) and wants to get to the field G (goal). The robot can move one field at a time in any of the four directions (up, down, left, right). The fields with an X denote a blocked field that the robot can not enter. *Hint: Again you will find the text files specifying the environments in the nats wiki.*

1. Implement the heuristic search strategy “A*” to find a path for the robot. Make sure you choose a suitable heuristic function and motivate your choice. (4 Pt.)

```

XXXXXXXXXXXXXXXXXXXXX
X                    X
X          xxx      X
X        X xxxxxx   X
X      s      X     X
X        X X  xxxxxx X
X   xx xxxxxx X     X
X        X      xg   X
X        X          X
XXXXXXXXXXXXXXXXXXXXX

```

2. Figure 2 shows a slightly modified version of the environment. How does your search react in this case? Can you ensure termination? (2 Pt.)

```

XXXXXXXXXXXXXXXXXXXXX
X2                    X
X          xxx      X
X        1 X xxxxxx   X
X      s      X     X
X        X X  xxxxxx X
X   xx xxxxxx X     X
X        X      g    X
X        X          X
X   1  x  2          X
XXXXXXXXXXXXXXXXXXXXX

```

3. Figure 3 shows yet another modified environment. This time there are mysterious portals that transport the robot from one field to a pre determined field far away. They are denoted with numbers, that is if the robot enters a field with a 1, it is teleported to the other field with a 1 and so on. Modify your program accordingly and also modify your heuristic function accordingly. (3 Pt.)
4. For each of the three environments (and the search strategies used so far) document the time and memory resources used by the algorithm in terms of expansion operations performed on the frontier of the search and the number of nodes in the frontier. (3 Pt.)