Intelligent Agents

Exercise Sheet #1

In addition to the PDF version of this exercise sheet, we also offer a matching online version. We hope to integrate the aggregated results or exemplary (and anonymous) excerpts to make our online exercise more fruitful for you. Therefore, we kindly ask you to indicate your answers in this survey (as well). Of course, all answers remain anonymously at all time.

To access the online version, please scan the QR code or use the following URL:

https://forms.gle/Qw1Fb7epB93LviDS6

Exercise 1.1: *Agent Types*

After watching our exciting lecture on intelligent agents, you decide to take a short break and go for a walk with your best mate. After discussing numerous fascinating topics (such as today's weather, GPT-3, and your latest binge-watching on Netflix), your friend wants to know more about what you have learned today about AI—especially about the different kinds of intelligent agents that you just mentioned. Instantly, your friend raises the following questions that you try to address as a newly self-proclaimed AI expert:

a. "Intelligent agent", you say? Can you please give some examples for such "intelligent agents" besides your vacuum robot? What would be fitting *performance measures*, *parts of environment*, *actuators*, and *sensors* for these examples?

b. You just said that an agent's environment can have different characteristics, including:
   - i. *fully* vs. *partially* observable
   - ii. *single agent* vs. *multiagent*
   - iii. *deterministic* vs. *stochastic*
   - iv. *episodic* vs. *sequential*
   - v. *static* vs. *dynamic*
   - vi. *discrete* vs. *continuous*
   - vii. *known* vs. *unknown*

   However, I am unsure whether I understood this correctly. Can you please explain which of the two different forms of each characteristic applies to the following examples respectively? Why?

   1. ***Chess***
   2. ***Poker***
   3. ***Taxi driving***
   4. ***Internet book-shopping agent:*** The agent tries to find the cheapest offer for a certain book. If it finds a book, it decides by itself whether it wants to buy the book or not. To do so, it tries to gather as much information as possible from the internet by crawling internet bookstores. It can be assumed that neither the internet nor the sellers' inventory changes significantly during the action of the agent.
   5. ***Robot soccer player:*** The robot has sensors (cameras, etc.) which allow it to see the location of the soccer field from its perspective. With this information it has to determine the ball, has to get out of the way of other robot players and must try to shoot a goal.

Exercise 1.2: "*Agent Function*" *vs.* "*Agent Program*"

An "agent function" and "agent program" of an intelligent agent—same but different? Please answer the following questions to further explore how they relate to one another:

a. Can there be more than one *agent program* that implements a given *agent function*? Please either provide an example or show why giving one is not possible.

b. Are there *agent functions* that cannot be implemented by any *agent program*?

c. Given a fixed machine architecture, does each *agent program* implement exactly one *agent function*?

Exercise 1.3: *Rationality*

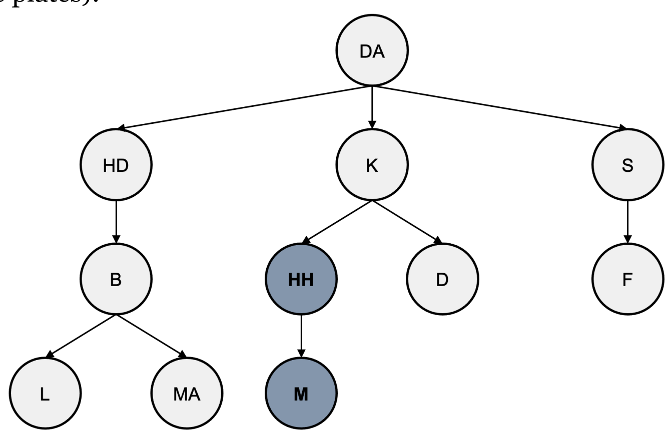
One underlying objective of creating an intelligent agent is to design its behavior to be rational. But what does it actually mean to act "rationally"? Let's explore it together in more detail:

a. The so-called "omniscience" and "rationality" are two similar concepts. How can we define each of the two concepts and how do they differ?

b. Assume that your vacuum robot starts cleaning your apartment. After six hours of vacuuming, you finally realize that your robot did not stop vacuuming although your floor is perfectly clean by now: the dirt sensor stopped working, leading to the robot continuously sensing dirt everywhere. Did the robot act irrational?

Exercise 1.4: *Solving Problems by Searching (*BFS *vs.* DFS*)*

Looking back at how bored you were at home during last summer, you decide to do a road trip through Germany this year if this is possible again. Based on various criteria, you created the following tree of potential paths you can combine for this trip (the letters in the nodes represent abbreviations for German cities as found on license plates):



You decide that your road trip should start in Darmstadt (DA) and either end in Hamburg (HH) or Munich (M). As you want to minimize costs, you want to reduce the number of visited nodes. As an AI expert, you decide to look at this problem from the perspective of search algorithms. Considering breath-first search (BFS) and depth-first search (DFS):*

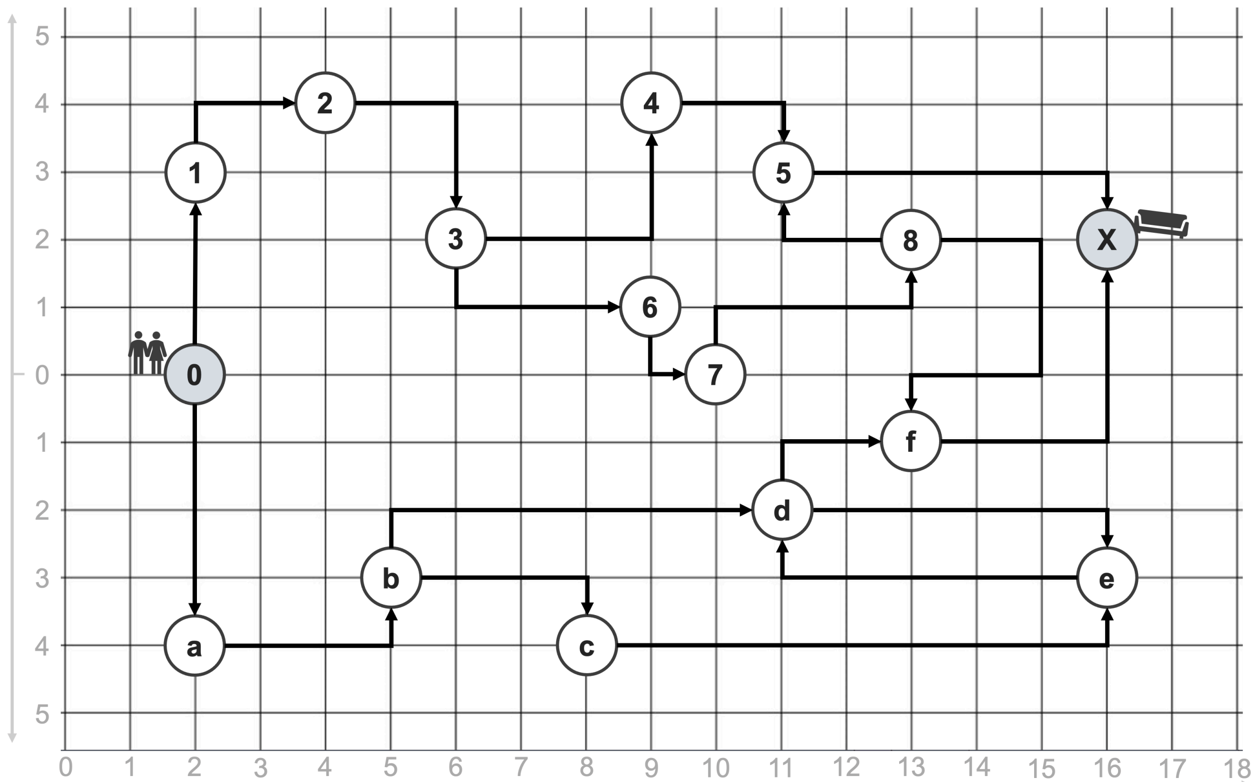
a. Indicate the order of nodes for both search algorithms until they reach:
   1. Hamburg (HH)
   2. Munich (M)

b. For each of the two goals, which algorithm covers less nodes until it reaches Hamburg (HH) or Munich (M) respectively?

* Please assume that the algorithms always choose the left-most node if they can choose between multiple nodes.

Exercise 1.5: *Solving Problems by Searching* (Greedy Best First *vs.* A*)

Having developed a devastating back pain from laying on your old sofa, your significant other decided that the time has come for you to buy a new - comfortable - sofa. When you arrive at your favorite furniture store "Okea", you check out the floor plan (see image below) to locate the sofa section. On the floor plan, you see that each section is indicated by a number or letter and that certain sections are connected with one another. Moreover, you notice that you are currently in section "0" (which is specialized on much-too-dim lamps) and that your desired sofas are located in section "X". To avoid passing too many compelling offerings, you want to take the shortest path possible. Unfortunately, "Okea" does not indicate exact route lengths on their floor plans. Therefore, you decide that the most reasonable choice for a helpful heuristic might be the *Euclidian distance* between a section and the sofa section ("X").



a. Based on your considerations above, you decide to use "greedy best first" search to find the shortest path from 0 to X. Which path will you use?

b. Your significant other challenges you that (s)he will reach the sofa section faster than you. To achieve this, (s)he develops a path using A* search instead. Which path will (s)he use? Is this path shorter than your path (from the previous task)?

c. If you have to choose between using greedy best first or A* search, in which situations would you use either one?

d. Right before you start your journey towards the sofa section, you notice the loop between section "d" and "e". Is this a problem for you (or your significant other)?