
Übung 1: Search Space Design

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1. Exercise 2.3

1.1. In the game Scotland Yard, Mister X has to evade several detectives using different means of transportation (and spending tickets). We use the board and the transportation rules but discard everything else from the game: Suppose (against the rules of the game) you as Mister X has a fixed amount of steps A before the detectives may move a fixed amount of steps B each (and that is all nor more steps afterwards!). Mister X and the detectives start at different but known positions on the board. How would you find a place to go where the detectives can't reach you? Formalize your answer!

- The tree root node would be a vector containing the initial positions of Mister X and the detectives.
- A "valid" node is a node where the position of Mister X is different to the position of each detective.
- The goal node is a valid node with a deepness of Q steps (Q is the maximum between A and B).
- Each arc going from one node to another represents one step made for every character in the game, just by Mister X (in case $A > B$) or just by the detectives (in case $B > A$).
- After that, we should use depth-first search with a variation: for every possible position reachable by Mister X, we must expand all the nodes contemplating all the possible combination of movements for every detective, and if any of them is "invalid" then we must delete all the nodes in that level and come back to the parent node.
- If we reach the maximum between Q steps to a valid node, and no other node in the same deepness level (in which Mister X has the same position) is invalid, then we have found a path and the position we should go as Mister X so the detectives can't reach us.

2. Exercise 2.4

Define the search space, the goal, properties for the search space and an appropriate search strategy for the following problems:

2.1. Placing furniture in a flat. There are different kinds of furniture you can put in a set of places. Try to find an optimal placement, e.g. no door should be obstructed and the chairs should be near the table.

- The search space is the collection of the different positions where the furnitures can be placed.
- The goal is to place the furnitures in the “optimal” placement. For example, we could give the furnitures a value in function of how “good” they are placed (give the chairs more value if they are close to a table, give 0 or -1 if a furniture is positioned in front of a door, etc).
- The property for the search space are that every node represent the positions of the house and their value depends on if there is or not a furniture on that position.
- An appropriate search strategy would be to start expanding the nodes where the “more difficult to place” furnitures are placed and they have a low value.

2.2. Construction Site planning. When building a house, you can e.g. only paint the walls after the walls have been built and so on. In addition, several people may work on site at the same time on different parts of the house. We need a plan on who is doing what when to build the house as fast as possible.

- The search space is a collection where in every node you add an activity to the planning in a given time and a given part of the house, so in the final nodes you have the complete planning for building the house.
- The goal is to have a planning with the shortest possible time and where two different activities are never happening at the same time in the same place.
- An appropriate search strategy would be to start expanding the nodes where the longer activities are included in the planning in a good way and the the shorter ones.

2.3. An elevator has to transport people in a sensible way. Suppose you have an elevator and several people want to use it, standing in different doors. What should the elevator do?

- The search space is a collection of nodes where every node represent a sorted list of the doors that the elevator have to go to.
- The goal is that the difference between the doors is the less possible (i.e. that the elevator has to travel as little distance as possible)

- An appropriate search strategy would be to start expanding the nodes where the next door to visit is the closest door to the actual one.