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# Übung 1: Search Space Design

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## Exercise 1.1

A core capability a student of computer science should obtain is to characterise and to model an environment for applying an algorithm or in our case a knowledge-based method. For each distinction give a reason why the difference might be important when designing AI applications for the given environment. Environments can be characterized by the following concepts:

- Fully observable  $\Leftrightarrow$  partially observable
- Discrete  $\Leftrightarrow$  continuous
- Deterministic  $\Leftrightarrow$  stochastic

Try to identify problems that exists in environments of one type but not in the other. You can use simple examples of environments and tasks to explain these problems.

- Fully observable: Too much space reserved in memory
- Partially observable: The agent has to recompute the path each step it does and discovers new environment.
- Discrete: No problem found
- Continuous: Does not have a finite number of states.
- Deterministic: Everything is structured, we can not take random actions
- Stochastic: There is no chance to predict the nex state

## Exercise 1.2

1. Imagine you have to design a route planning application for public transport (German: Öffentlicher Nahverkehr). What would be the state-space in this application? And what would be the semantic of nodes and edges in the graphs representing the state-space for this application?

States space is form by different bus stops and where the buses are (Environment state) and in which bus or stop is the person (Agent state) The nodes of this space are the bus stops and the arcs are the paths between two bus stops.

2. **You are given two jugs, a 4-liter jug and a 3-liter jug. Neither has any measuring markers on it. There is a pump that can be used to fill the jugs with water. How can you get exactly 2 liters of water into the 4-liter jug? Solve this riddle using your knowledge about searching gained so far.**

**a) Develop a formal model of the problem and select appropriate methods to solve it.**

- States
  - 3-liter jug fill
  - 3-liter jug empty
  - 3-liter jug with 1 liter
  - 3-liter jug with 2 liters
  - 4-liter jug fill
  - 4-liter jug empty
  - 4-liter jug with 1 liter
  - 4-liter jug with 2 liters
  - 4-liter jug with 3 liters
- Start: Both jugs are empty  
Goal: 2 liter in 4-liter jug
- Transitions between states
  - Fill 4-liter jug
  - Fill 3-liter jug
  - Empty 4-liter jug
  - Empty 3-liter jug
  - Fill 4-liter jug with 3-liter jug
  - Fill 3-liter jug with 4-liter jug

**b) Imagine instead of water you would have to measure 2 liters of expensive wine, so wasting any liquid is not an option. Is the riddle still solvable? Why/Why not?**

No, because there is no solution if you delete the empty actions from the transitions between states.