
Exercise sheet 3

CommonKADS, Problem-Solving Methods & Planning

1 CommonKADS

Note: This is an individual task, you should answer it with your own words.

Exercise 1.1 - CommonKADS Model Set (6 points)

Provide a summary of the **CommonKADS Model Set** and **its application** (i.e., for what is it used). Design the summary in a way that you are able to use it for a presentation in the pro-seminar (powerpoint or well-structured text document). Use examples to clarify the differences.

Exercise 1.2 - Stages in Knowledge-Model Construction (6 points)

Provide a summary of the stages involved in **Knowledge-Model Construction** and **its application** (i.e., for what is it used). Design the summary in a way that you are able to use it for a presentation in the pro-seminar (powerpoint or well-structured text document). Use examples to clarify the differences.

2 Problem Solving Methods

Note: This is an individual task, you should answer it with your own words.

Exercise 2.1 - Generate & Test (6 points)

Explain the **generate & test approach** and the **steps** involved. How do these steps relate to the aspects of the problem to be solved?

Exercise 2.2 - Problem Solving Methods (6 points)

Provide a summary of **Problem Solving Methods (PSM)** and **its application**.

- In what sense do they extend the generate & test paradigm?
- Explain the different proof obligations and for what they are needed?

3 Planning

Note: This is an individual task, you should answer it with your own words.

The following exercises have been adopted from the book "Artificial Intelligence: A Modern Approach" ¹

Exercise 3.1 (7 points)

Figure 3.1: A STRIPS Problem

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Init(At(C1, SFO) ∧ At(C2, JFK) ∧ At(P1, SFO) ∧ At(P2, JFK)
    ∧ Cargo(C1) ∧ Cargo(C2) ∧ Plane(P1) ∧ Plane(P2)
    ∧ Airport(JFK) ∧ Airport(SFO))
Goal(At(C1, JFK) ∧ At(C2, SFO))
Action(Load(c, p, a),
    PRECOND: At(c, a) ∧ At(p, a) ∧ Cargo(c) ∧ Plane(p) ∧ Airport(a)
    EFFECT: ¬At(c, a) ∧ In(c, p))
Action(Unload(c, p, a),
    PRECOND: In(c, p) ∧ At(p, a) ∧ Cargo(c) ∧ Plane(p) ∧ Airport(a)
    EFFECT: At(c, a) ∧ ¬In(c, p))
Action(Fly(p, from, to),
    PRECOND: At(p, from) ∧ Plane(p) ∧ Airport(from) ∧ Airport(to)
    EFFECT: ¬At(p, from) ∧ At(p, to))

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Given the axioms from Figure 3.1, find all applicable concrete **instances** of **Fly(p,from,to)** in the state described by:

$At(P_1, JFK) \wedge At(P_2, SFO) \wedge Plane(P_1) \wedge Plane(P_2) \wedge Airport(JFK) \wedge Airport(SFO)?$

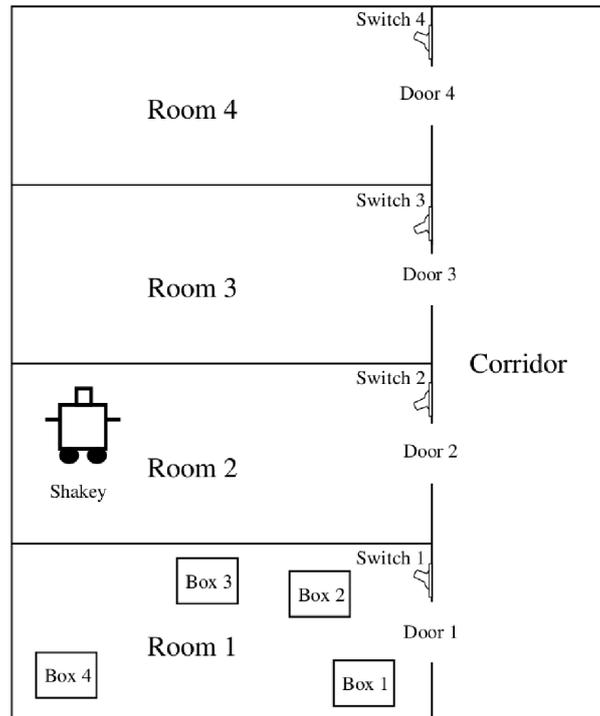
Exercise 3.2 (14 points)

The original STRIPS program was designed to control Shakey the robot. Figure 3.2 shows a version of Shakey's world consisting of four rooms lined up along a corridor, where each room has a door and a light switch.

The actions in Shakey's world include moving from place to place, pushing moveable objects (such as boxes), climbing onto and down from rigid objects (such as boxes), and turning light switches on and off. The robot itself was never

¹Chapter 11 (Planning), Stuart Russell and Peter Norvig, 1995

Figure 3.2: A Shakey's World



dexterous enough to climb on a box or toggle a switch, but the STRIPS planner was capable of finding and printing out plans that were beyond the robot's abilities. Shakey's six actions are the following:

1. **Go(x,y)**, which requires that Shakey be at x and that x and y are locations in the same room. By convention a door between two rooms is in both of them.
2. Push a box b from location x to location y within the same room: **Push(b,x,y)**. We will need the predicate **Box** and constants for the box.
3. Climb onto a box: **ClimbUp(b)**; climb down from a box: **ClimbDown(b)**. We will need the predicate **On** and the constant **Floor**.
4. Turn a light switch on: **TurnOn(s)**; turn it off: **TurnOff(s)**. To turn a light on or off, Shakey must be on top of a box at the light switch's location.

Describe Shakey's six **actions** and the **initial state** from Figure 3.2 in STRIPS notation. Construct a **plan** for Shakey to get **Box-3** into **Room-3**. You have to include the complete map of the world in the initial state.