Artificial Intelligence: Solution to Exercise 7

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1. In Fig. 1 you find a schematic sketch of a flat. An elderly person, who needs support, lives in the flat. The robot (smiley) should support the person. The robot needs to move around the flat.

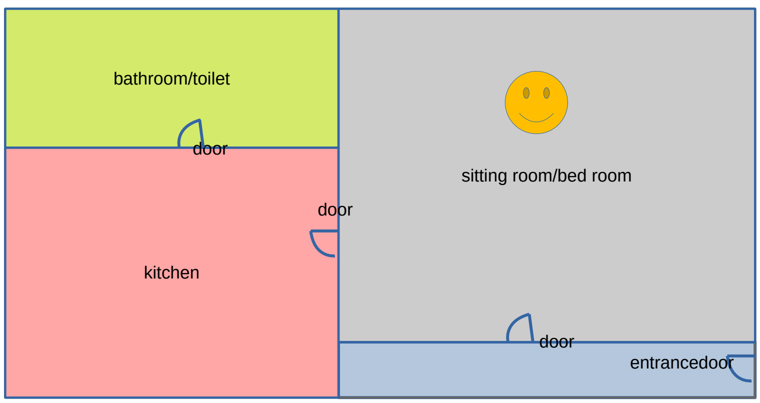

Figure 1: A flat of an elderly person needing support. The robot (smiley) should support the person in the different rooms. The robot needs to move around the flat, a process that can be described by first order predicate logic (PL1).

   (a) Describe the different possible positions of the robot using first order predicate logic (PL1). Try to find a simple description. Use a predicate "Door" to indicate rooms that are connected by a door.

   (b) Describe the possible movements of the robot by one or more actions.

   (c) Solve the planning task to move from the sitting room to the bathroom.

   Solution.
   There might be different possible solutions.

   (a) We use four constants corresponding to the four different rooms and one predicate called "Here" indicating the location of the robot. In addition, we use the predicate "Door" for neighbouring rooms which are connected by a door. The situation on the picture can be described as

$$\begin{aligned}
&Door(floor, bedroom)\\
&Door(bedroom, kitchen)\\
&Door(kitchen, bathroom)\\
&Here(bedroom)
\end{aligned} \tag{1}$$

The fact that a door can be transversed in both directions can be desribed by

$$\forall Room_1 \forall Room_2 \; Door(Room_1, Room_2) \Leftrightarrow Door(Room_2, Room_1).$$

(b) We describe the action of moving through a door from one room to the other as follows

$Changeroom(Room_1, Room_2)$

Constraint:	$Door(Room_1, Room_2)$	
	$Here(Room_1)$	
Action:		
	delete:	$Here(Room_1)$
	add:	$Here(Room_2)$

(c) Starting from the initial state (1) in the picture the robot needs to go to the bathroom. This target state is described as

$$\begin{aligned}
&Door(floor, bedroom)\\
&Door(bedroom, kitchen)\\
&Door(kitchen, bathroom)\\
&Here(bathroom)
\end{aligned}$$

First, the robot moves to the kitchen

$Changeroom(bedroom, kitchen)$

Constraint:	$Door(bedroom, kitchen)$	
	$Here(bedroom)$	
Action:		
	delete:	$Here(bedroom)$
	add:	$Here(kitchen)$

We need to check, whether the current state $\mathcal{S}$ described in (1) entails the conditions

$$Door(bedroom, kitchen) \wedge Here(bedroom)$$

of the previous action. To check this, we negate the constraint

$$\neg Door(bedroom, kitchen) \vee \neg Here(bedroom)$$

in the last action and combine it with (1).

$$\begin{aligned}
&\neg Door(bedroom, kitchen) \vee \neg Here(bedroom)\\
&Door(floor, bedroom)\\
&Door(bedroom, kitchen)\\
&Door(kitchen, bathroom)\\
&Here(bedroom)
\end{aligned}$$

Here, the derivation of the empty clause is very simple. The new position in the kitchen is obtained by adding and deleting the clause, as describe in the action

$$\begin{aligned}
&Door(floor, bedroom)\\
&Door(bedroom, kitchen)\\
&Door(kitchen, bathroom)\\
&Here(kitchen)
\end{aligned} \tag{2}$$

Now, the robot moves to the bathroom by the action

$Changeroom(kitchen, bathroom)$

Constraint:	$Door(kitchen, bathroom)$	
	$Here(kitchen)$	
Action:		
	delete:	$Here(kitchen)$
	add:	$Here(bathroom)$

Again, checking the constraints

$$\begin{aligned}
&\neg Door(kitchen, bathroom) \vee \neg Here(kitchen)\\
&Door(floor, bedroom)\\
&Door(bedroom, kitchen)\\
&Door(kitchen, bathroom)\\
&Here(kitchen)
\end{aligned}$$

is easy and the above action yields the final state in the bathroom.

2. It is an accepted scientific base that physical characteristics of life are genetically transferred. Do you believe that information and knowledge are also genetically transferred? Justify for yes/no?
Solution:
This is a discussion exercise. One interesting phenomenon is linked to animals. Take, for example, horses. They are able to walk or even run quite

shortly after birth. This means, that the ability to walk must be already be an inherited trait, encoded somehow in the genes or possibly also epigenes. It is unknown, how this information and procedural knowledge of how to walk is encoded. But what about human babies?´