T-93.4400 Principles of Artificial Intelligence
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Exam
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No aiding devices allowed.

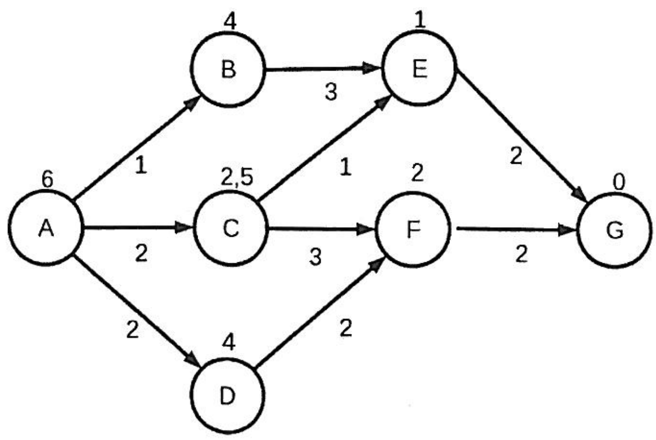
Task 1.

Describe the behaviour of depth-first, breadth-first and uniform-cost search, and compare their relative advantages and disadvantages. (3 points)

How does "informed search" try to improve on "uninformed search"? (3 points)

Task 2.

Apply A* - search procedure to a problem with the state transitions shown in the figure.



The aim is to find a path from state A to state G , when the values of function h are as shown in the figure on top of the states and the state transition costs are presented in connection to the arrows representing the transitions in the figure.

(a) Present the progression of the search using the fringe (i.e. frontier) so that in connection to the nodes in the fringe the estimate of the total cost is shown (3 p)

(b) What would happen if instead of the estimate $h(C) = 2.5$ an estimate $h(C) = 7$ were given to us? What is wrong with this estimate? What is required of estimates?

Task 3.

Solve using resolution:

Jouko, Maija, and Tauno are studying in the Theater Academy.

There each student, who is not a performance addict, is a body-building addict.

Those who are body-building addicts, dislike audience, and all those who dislike publicity, are not performance addicts.

Maija dislikes things, which Tauno likes, and likes things, which Tauno dislikes.

Tauno likes audience and publicity.

Is there in the Theater Academy a student, who is a body-building addict, but who is not a performance addict?

Use e.g. the predicates:

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in-Theater-Academy( <person> )
likes( <person>, <thing> )
is-performance-addict( <person> )
is-body-building-addict( <person> )
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Task 4.

In constraint problem the objective is to set 4 chess queen on a 4X4 board so that they do not threathen each other. The constraints are represented with variables $X_1, ..., X_4$ so that they represent from left to right the positions (the row) of the queens on the columns. Rows are numbered from top to bottom. The constraints are represented in the following way:

$$\forall i, j : X_i \neq X_j$$
$$\forall i, j : X_i - X_j \neq i - j$$
$$\forall i, j : X_i - X_j \neq j - i$$

Represent the variable assignments in the solution to the following problems as a set of *variable=value* pairs, for instance $\{X_2 = 4, X_4 = 1\}$.

(a) Describe how the backtracking-algorithm progresses by showing the recursive calls and the variable assignments they pass, phase by phase along with the selection of the value alternatives in different phases. The order in which variables are selected is 1,...,4 and similarly 1,...,4 for values.

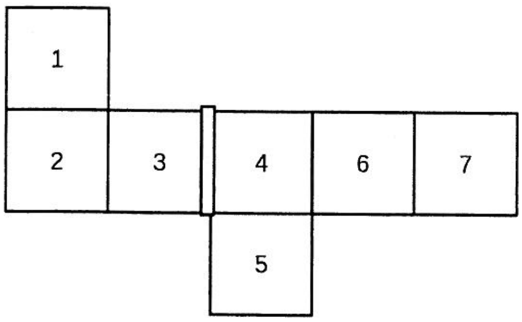
(2p)

(b) Describe how a more evolved backtracking-algorithm that uses *minimum remaining values* (MRV) heuristic for variable selection and *least-constraining-value* heuristic for value selection progresses in a similar way as in part (a) above. As a tie-break for both the equally good variables and equally good values use the same ordering as the selection order in (a).

(4p)

Task 5.

Agent, who can not make observations, has to find a plan that gets it to goal state, one in which the agent is in room nro 7., using a technique based on belief-states. The agent does not know its starting position, action U takes it up, D down, R to right and L to left. If there is now room in the direction agent is moving it holds it position but notices nothing. Agent knows the map of the appartment. There is a door between rooms 3 and 4 that opens when the agent is in either of these rooms by action O. The action O has no effect in other rooms. Agent knows additionally that in the initial state the door is closed.



Form the relevant belief-states and state transitions between them. Present a plan as a list of actions that is sure to take the agent to goal state with the least number of actions.