CS 188 Spring 1996 — Introduction to AI — Stuart Russell

Midterm Solutions

1. (18 pts.) True/False

(a) True. BFS finds the "nearest" solution, where distance measures the number of operations.

(b) True.

(c) False. Forward chaining can't do resolution.

(d) False (unless the domain consists of only one object).

(e) False. Alpha-beta is just a more efficient version of minimax.

(f) False.

2. (14 pts.) Search

(a) (4) We will create a graph, in which the nodes represent countries, and there is an edge between two nodes if their corresponding countries are neighbors. A state specifies the color of each node. This can be represented as a vector, $< c_1, c_2, \ldots, c_n >$, $c_i \in \mathcal{C} \cup \{u\}$, where n is the number of nodes, $\mathcal{C}$ is the set of colors, and u represents uncolored. The initial state is $< u, u, \ldots, u >$, and the goal state is a vector $< c_1, c_2, \ldots, c_n >$ such that (1) no node is uncolored, and (2) if (i, j) is an edge in the graph, then $c_i \neq c_j$. The operators are to assign a color to a vertex.

(b) (4) Adding a constant to the heuristic function h_1 does not affect the relative desirability of different moves, so the decision about which move to make will be unchanged.

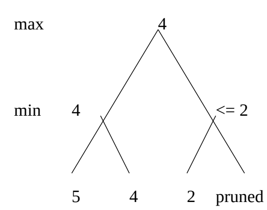
(c) (6)

i. Timisoara. Greedy expands the node with the lowest h score.

ii. Zerind. Uniform-cost expands the node with the lowest g score.

iii. Arad. A* expands the node with the lowest f score.

3. (8 pts.) Game-playing



4. (12 pts.) Simple knowledge representation

(a) (3) $\neg \exists p . StudentAt(p, UCB) \wedge ListensTo(p, KBLX)$

(b) (3) $\neg \exists p . StudentAt(p, UCB) \wedge StudentAt(p, Stanford)$

(c) (3) $[\exists p . Knows(Joe, p) \wedge StudentAt(p, Stanford)] \Rightarrow [\exists p' . Knows(Joe, p') \wedge \neg StudentAt(p, UCB)]$

(d) (3) $\exists r_1, \ldots, r_n . \forall p . StudentAt(p, Stanford) \Rightarrow ListensTo(p, r_1) \wedge ListensTo(p, r_2) \wedge \ldots \wedge ListensTo(p, r_n)$

5. (13 pts.) Logical Inference

(a) i. $\{y/1, x/F(1)\}$.

ii. None.

iii. None (occurs check).

(b) $1 + c = 1$, where c is a new Skolem constant.

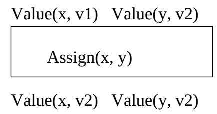
(c) $1 + c' = 1$, where c' is a new Skolem constant.

(d) The interpretation maps both c and c' to the same element in the domain, namely 0.

(e) $\neg At(Father(x), Stanford) \vee Owns(x, BMW) \vee \neg Happy(x)$, which can be interpreted as "Stanford students who don't own BMWs are not happy".

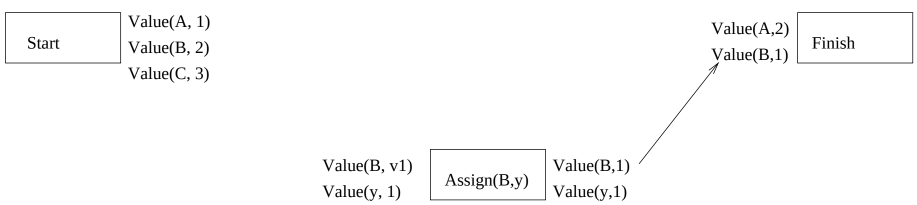
6. (15 pts.) Planning

See figures.

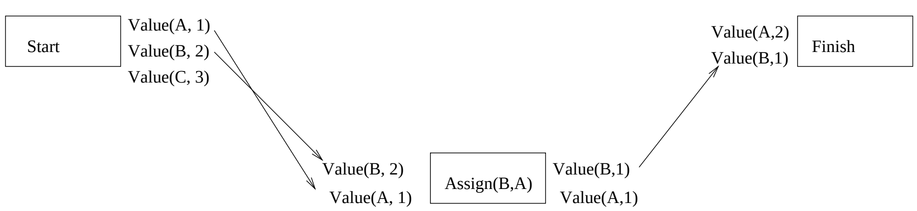


(a) The Assign operator

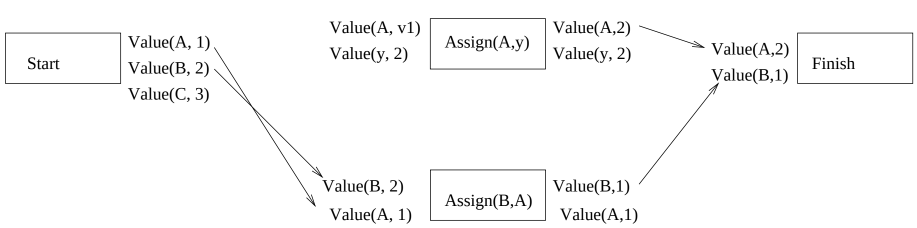
(b) Here is the initial plan



(c) One of the postconditions gets bound.



(d) Both of the preconditions get bound.



(e) The new Assign(A,y) step threatens the causal link Start $\xrightarrow{Value(A,1)}$ Assign(B,A), so it demotes the new step, i.e., it adds the ordering constraint Assign(B,A) $<$ Assign(A,y).