1. [10%] General AI Knowledge.

46E29D64-128E-43C1-845E-0768FD1E7AC4
561-F14-midterm1
#92   2 of 8

For each of the statements below,
write T if the statement is always and unconditionally true,
or write F if it is always false, sometimes false, or just does not make sense:

-1 a. [1%] T Uniform-cost search is a special case of Breadth-first search.

b. [1%] F A simple reflex agent does not use perception.

c. [1%] T DFS has lower asymptotic space complexity than BFS

d. [1%] F Poker is fully accessible.

-1 e. [1%] T A rational agent is one which always selects and then executes the optimal solution to a problem.

f. [1%] F The $\alpha - \beta$ cuts in minimax improve efficiency but can cause the loss of some solutions.

g. [1%] T In genetic algorithms a successor state is generally computed on the basis of two parent states (and not only one, as it happens in other local search algorithms).

h. [1%] T Let D(*i*,*j*) be the straight-line distance between any two cities *i* and *j* in a map. D(i,j)/2 is an admissible heuristic.

i. [1%] F An agent that senses only partial information about the state cannot be perfectly rational.

j. [1%] F An optimal search algorithm finds all solutions.

2. [30%] Search

Consider the search space on the following page, where S is the start state and G1, G2, and G3 satisfy the goal test. Arcs are labeled with the cost of traversing them and the estimated cost to a goal is reported inside nodes.

For each of the following search strategies (next page), indicate which goal state is reached (if any) and list, in order, all the states of the nodes popped off of the OPEN queue. When all else is equal, nodes should be removed from OPEN in alphabetical order.

You should not expand nodes with states that have already been visited (where *"State X has been visited"* here means: some node was previously created and enqueued with state X). Note how the arcs in the figure are oriented, which means that you can only go from one state to another if the arrow points from the first to the second. For example, you can go from S to A (i.e., A is a successor of S) but not from A to S (i.e., S is not a successor of A).

Q2 Score: **22.0**

21

D7689243-4595-4E9F-A5CA-0A80FBC18E9B

561-F14-midterm1

#92 3 of 8

a) [10%] Depth-first search

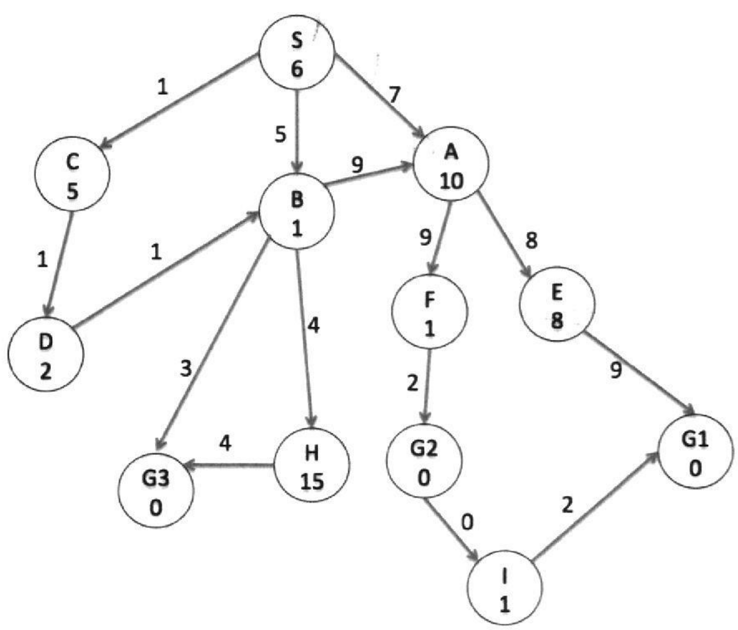
Goal state reached: G1 States popped off OPEN: S A E G1 10

b) [10%] Uniform cost Search

Goal state reached: G3 States popped off OPEN: S C D B G3 10

c) [10%] A* Search 2

Goal state reached: G3 States popped off OPEN: S B G3



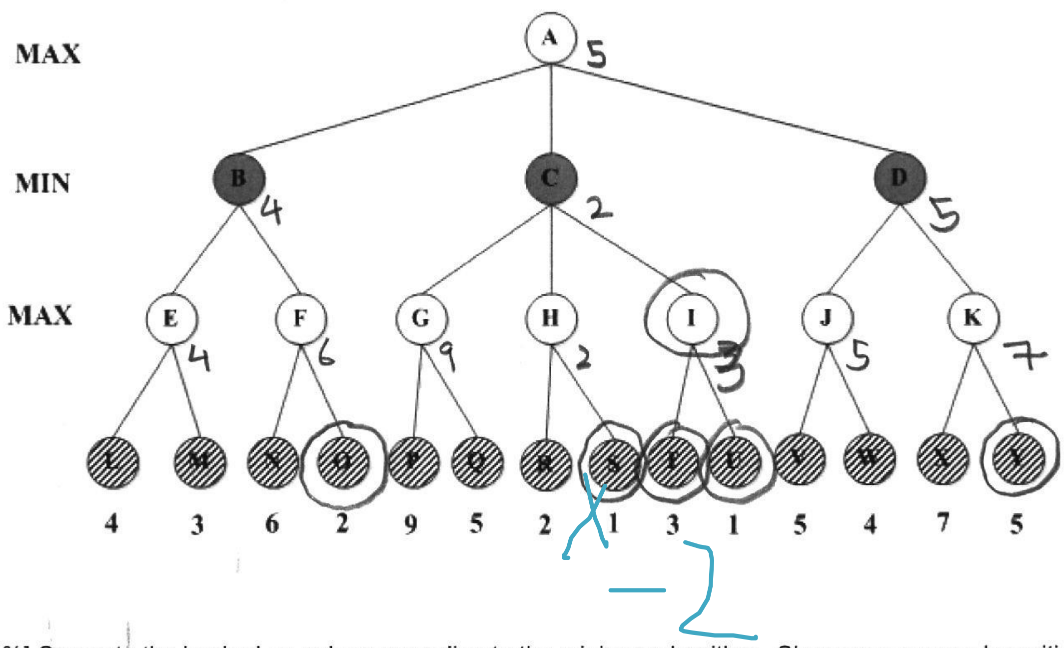
3. [10%] GamePlaying

873C6A36-751E-435E-BA6A-BE8AF6CF7B97

561-F14-midterm1

#92 4 of 8

Consider the following game tree in which the evaluation function values are shown below each leaf node.
The root node is the maximizing player.
Assume that the search always visits children left-to-right.



a) [4%] Compute the backed-up values according to the minimax algorithm. Show your answer by writing values next to the appropriate nodes in the above tree.

4

b) [6%] Which nodes will not be examined by the alpha-beta pruning algorithm? Circle them on the above tree.

I, O, S, T, U, Y are not examined by α-β pruning

4

Q4 Score: **6.0**

16

4. [20%] Constraint Satisfaction

You are an IT manager in charge of customer support. You have **five important customers** that need maintenance once each week during specific time slots on **Friday, Saturday, and Sunday**.

Your job is to assign your **three engineers** to these companies on the three days for regular maintenance. The engineers have to stay there until the task is done. The engineers have different skills, so not all of them can maintain all companies. Also, each engineer can only serve one company in the assigned period.

The schedules of the customers are:

- Company 1: Webflix: 8:00-9:00am
- Company 2: Anazon: 8:30-9:30am
- Company 3: Pied Piper: 9:00-10:00am
- Company 4: Hooli: 9:00-10:00am
- Company 5: Gulu: 9:30-10:30am

The profiles of your engineers are:

- Albacore can maintain Pied Piper and Hooli.
- Bosam can maintain all companies, except Webflix.
- Coleslaw can maintain all companies.

a) [3%] Using Company as variable, formulate this problem as a CSP problem with variables, domains, and constraints. Constraints should be specified formally and precisely, but may be implicit rather than explicit.

3

Let 5 companies be represented as W, A, P, H and G and let E be the set of engineers, E = {Albacore, Bosam, Coleslaw}.

Variables = {W, A, P, H, G}

Domain for W = {Coleslaw}.

Domain for A = {Bosam, Coleslaw}

Domain for P = E

Domain for H = E

Domain for G = {Bosam, Coleslaw}.

Constraints:
Let worksFor() be a function which returns ~~value~~ engineer ~~for which an engineer is~~ working for a company ~~at time~~ at time t, so, for ~~no two~~ AllDiff[worksFor(W,t), worksFor(A,t), worksFor(P,t), worksFor(H,t), worksFor(G,t)]

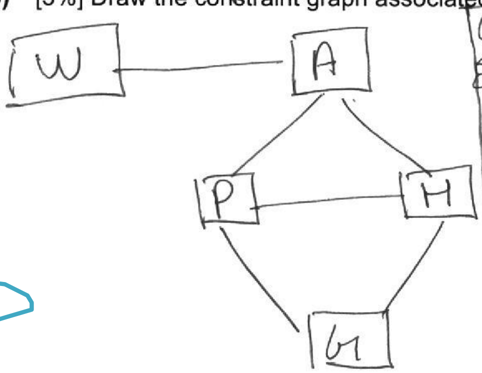
~~Let~~ Constraint:
Let works() be a function which tells which eng. is working for the company at time t. Constraint: AllDiff[works(W,t), works(A,t), works(P,t), works(H,t), works(G,t)]

Goal test: Each company is assigned an engineer

Path cost: Assigning an engineer costs 1 to a company.

b) [3%] Draw the constraint graph associated with your CSP.

(b)



3