Quiz Submissions - MidTerm 1- Requires Respondus LockDown Browser

Attempt 1

Written: Sep 28, 2022 17:00 - Sep 28, 2022 18:50

Submission View

Your quiz has been submitted successfully.

Answering format for the exam [This is for all the questions in the exam]

Only final answers will be asked in the exam, so no marks for intermediate steps. Please note the following when answering questions during the exam.

1. **Floating type answers:**

For any type of calculation being done, please **DO NOT round** the numbers during the intermediate steps. Keep at least 4 decimal places in the intermediate steps when calculating till you get the final answer. Once you get the final answer, truncate your answer at 3 decimal points, **DO NOT round your answer at all.**

For example:

0.23345... => 0.233

0.99999... => 0.999

0.55901 => 0.559

0.54999 => 0.549

0.3333333... => 0.333

In case you are getting less than 3 decimal places, please follow the below format:

For example:

0.29 => 0.290

0.2 => 0.200

Any other answers will be treated as 0 marks.

Let's say, we need to do 3.4256/2.3456. As stated above we will keep at least 4 decimal places and get the result as 1.4604. If this is the final answer then we truncate it at 3 decimal places to get the final answer as

1.460. If this is not the final answer then we carry the 1.4604 to the next step of the calculation. Remember to carry at least 4 decimal places to the next step. **ONLY truncate the final answer.**

2. **Integer type answers:**

If you are getting an integer answer, please follow the below format.

Let's assume you are getting 2 as the final answer, then the following answers are acceptable:

2 that's all!

Any other answers will be treated as 0 marks.

[20%] General AI Knowledge

For each of the statements below, select **True** if the statement is always and unconditionally true, or **False** if it is always false, sometimes false, or just does not make sense:

Question 1 — 2 / 2 points

[2%] It is not a good heuristic to choose the variable that is most constrained instead of choosing the value that is least constraining in a CSP search.

- ( ) True
- (✓) False

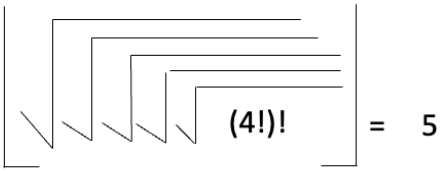
Question 2 — 2 / 2 points

[2%] It is possible for a given agent to be perfectly rational in two distinct task environments.

- (✓) True
- ( ) False

Question 3 — 0 / 2 points

1. [2%] Knuth conjectured that starting with the number 4, a sequence of factorial, square root, and floor operations will reach any desired positive integer. For example, we can reach 5 from 4 as follows:



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The above problem has a finite number of states.

- ✗ (●) True
- ➡ ( ) False

Question 4 **0 / 2 points**

[2%] Breadth-first search is a special case of uniform-cost search.

- ➡ ( ) True
- ✗ (●) False

Question 5 **2 / 2 points**

[2%] A purely random walk - that is, moving to a successor chosen uniformly at random from the set of successors is complete.

- ✓ (●) True
- ( ) False

Question 6 **0 / 2 points**

[2%] An agent that senses only partial information about the environmental state cannot be perfectly rational.

- ✗ (●) True
- ➡ ( ) False

Question 7 **2 / 2 points**

[2%] The map coloring problem discussed in the class can be solved by arc consistency using colors red and blue.

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- ( ) True

✔ ◉ False

Question 8 **0 / 2 points**

[2%] Both the learning element and performance element in a learning agent receive feedback from the critic.

✖ ◉ True

➡ ○ False

Question 9 **2 / 2 points**

[2%] Policy Iteration has been empirically observed to converge more slowly than Value Iteration.

○ True

✔ ◉ False

Question 10 **2 / 2 points**

[2%] It is not possible for an agent to get stuck at a local extreme while following the Hill Climbing Algorithm.

○ True

✔ ◉ False

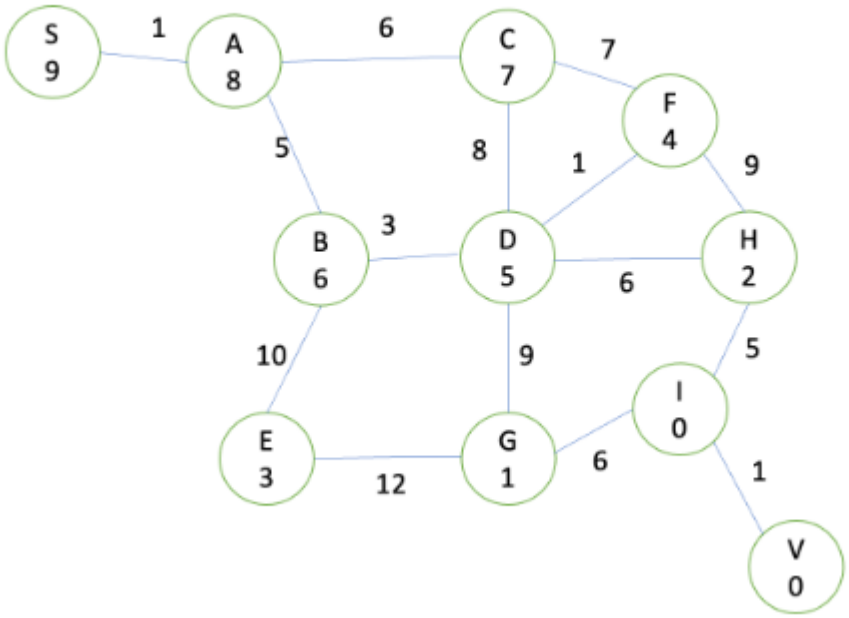
[30%] Search Algorithm Concepts

USC campus has been invaded by aliens, who think that the **Student Union (S)** contacted their mothership. Despite their realization that it did not, they went ahead with their invasion plan anyway. Advanced alien technology has disabled the use of phones and the internet, so you and your friends decide to go to the **Viterbi School of Engineering (V)** to get help and to tell everyone what's going on. You decide to use the secret underground network of tunnels underneath the campus to get from your **starting location at S, to the destination at V**.

You have the following graph of the underground tunnels. The edges are labeled with distances, and the nodes are labeled with a heuristically estimated to your destination at V.

When performing the search, ties are broken by choosing the node that is **alphabetically** first.

Please note that for DFS, you are supposed to run the **recursive** version of the algorithm.
For algorithms BFS and DFS, take the cost of each edge to be 1.



<< Contact your proctor in case you don't see the above graph >>

The sequence of Nodes Explored, Solution Path by Algorithm, Solution Cost of the Path by Algorithm.

Each answer below should be a sequence of states, e.g., "S-A-B-C-D-E-V". Please follow this format only i.e. use '-' between any two nodes.

Please follow the instructions given on the first page to enter numerical answers.

Question 11 **6 / 6 points**

[6%] BFS

[2.4%] Exploration Sequence:

___S-A-B-C-D-E-F-G-H-I-V___ ✔(40 %)

[2.4%] Path

___S-A-B-D-G-I-V___ ✔(40 %)

[1.2%] Cost

___6___ ✔(20 %)

Question 12 **0 / 6 points**

[6%] DFS (Recursive)

[2.4%] Exploration Sequence:

___S-A-B-D-F-C-H-I-V___ ✘ **(S-A-B-D-C-F-H-I-G-E-V)**

[2.4%] Path

___S-A-B-D-F-H-I-V___ ✖ **(S-A-B-D-C-F-H-I-V)**

[1.2%] Cost

___7___ ✖ **(8)**

Question 13 **3.6 / 6 points**

[6%] UCS

[2.4%] Exploration Sequence:

___S-A-B-D-F-C-H-I-V___ ✖ **(S-A-B-C-D-F-H-E-G-I-V)**

[2.4%] Path

___S-A-B-D-H-I-V___ ✔(40 %)

[1.2%] Cost

___21___ ✔(20 %)

Question 14 **3.6 / 6 points**

[6%] A*

[2.4%] Exploration Sequence:

___S-A-B-C-D-F-H-E-I-V___ ✖ **(S-A-B-C-D-F-H-E-G-I-V)**

[2.4%] Path

___S-A-B-D-H-I-V___ ✔(40 %)

[1.2%] Cost

___21___ ✔(20 %)

Question 15 **6 / 6 points**

[6%] Greedy Best-First

[2.4%] Exploration Sequence:

___S-A-B-E-G-I-V___ ✔(40 %)

[2.4%] Path

___S-A-B-E-G-I-V___ ✔(40 %)

[1.2%] Cost

___35___ ✔(20 %)

[10%] CSP

In a primary school, 5th grade is divided into 2 sections and there are 4 teachers who teach different subjects. On a particular day, both the sections have 4 lectures (1 hr each) from 9 AM to 1 PM.

The teachers are:

[T] Tom Cruise teaches Math

[J] Johnny Depp teaches English

[D] Dwayne Johnson teaches Science

[R] Ryan Reynolds teaches History

There are some constraints,

1. History cannot be taught as the first lecture for the 5th graders as the school does not want students to be sleepy during the first lecture, even though Ryan is teaching.
2. Math requires a lot of mental strength, so Tom does not want to teach this as the last lecture of the day
3. All the teachers give only one lecture for each section
4. A teacher needs 1 hr of break after every lecture he gives
5. Johnny Depp only wants to teach a section while Tom Cruise teaches the other section.
6. Dwayne Johnson has a morning workout routine so he cannot give the first lecture for any class

You have to design a timetable satisfying all the constraints.

Time Table is denoted in the format: T[i,j] where i is the section {1, 2} and j is the lecture number {1,2,3,4}.

1. Lecture (9 AM - 10 AM)
2. Lecture (10 AM - 11 AM)
3. Lecture (11 AM - 12 Noon)
4. Lecture (12 Noon - 1 PM)

So for example, the 3rd lecture of the 2nd section is denoted as T[2,3].

Time table is the variable matrix and the domains are the teachers {T, J, D, R}

Answer the following questions:

Question 16 — 0 / 1 point

[1%] How many unary constraints are there in this CSP? ___3___ ✖ **(6)**

[4%] Question 17

[4%] After resolving all the unary constraints, you assign Tom to take the first lecture for section 1 (i.e., T[1,1]=T)

What is the final configuration after you run AC-3 (Arc consistency algorithm)

Note <answer format>:

If for example, your answer for T[1,2] = J,D,R then your answer should be D-J-R (alphabetical order and hyphen separated)

Question 17 — 2 / 4 points

T[1,1]

___T___ ✔(12.5 %)

T[1,2]

___D-J-R___ ✖ **(D-R)**

T[1,3]

___D-J-R___ ✔(12.5 %)

T[1,4]

___D-J-R___ ✖ **(D-R)**

T[2,1]

___J___ ✔(12.5 %)

T[2,2]

___D-R-T___ ✖ **(D-R)**

T[2,3]

___D-R-T___ ✔(12.5 %)

T[2,4]

___D-R-T___ ✖ **(D-R)**

Question 18 **0 / 1 point**

[1%] The timetable configuration obtained after performing Q17, which is the most constrained variable? If there are multiple answers give any one of them.

Note <Answer Format>:

If your answer is T[1,2] then write T[1,2]

Make note of the brackets, comma :)

___T[1,1],T[2,1]___ ✖ **(T[2,1])**

[4%] Question 19

In the timetable configuration obtained from Q17, let's say you assign [D] Dwayne Johnson to give lecture 2 for section 2 (i.e. T[2,2] = D). After this assignment, perform AC-3 algorithm again. What is the configuration?

Note <answer format>:

If for example, your answer for T[1,2] = J,D,R then your answer should be D-J-R (alphabetical order and hyphen separated)

Question 19 **0.5 / 4 points**

T[1,1]

___J-T___ ✖ **(T)**

T[1,2]

___J-R-T___ ✖ **(R)**

T[1,3]

___D-J-R-T___ ✖ **(J)**

T[1,4]

___J-R-T___ ✖ **(D)**

T[2,1]

___J-T___ ✖ **(J)**

T[2,2]

___D___ ✔(12.5 %)

T[2,3]

___J-R-T___ ✖ **(T)**

T[2,4]

___J-R___ ✖ **(R)**

[10%] Game Playing

Consider the following game tree:

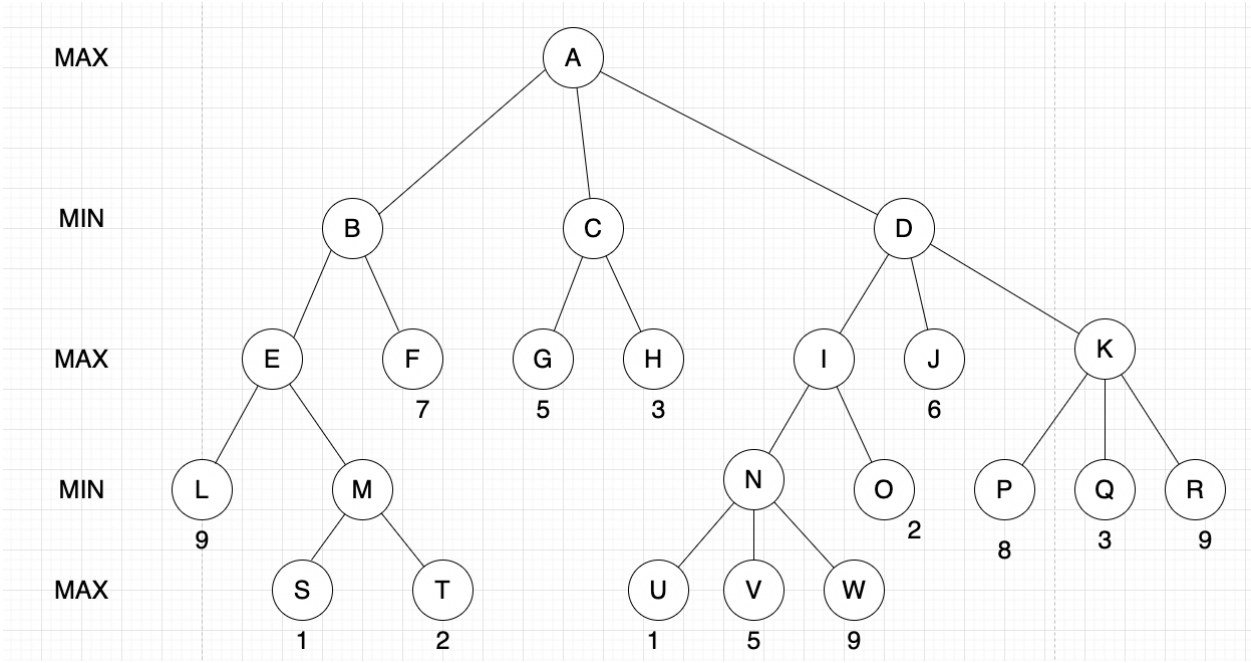


Figure 1

The values at the leaves of the tree are the utilities for each outcome of the game. The node names are labeled within each MIN/MAX node.Assume that the search always visits children left-to-right.

Please follow the instructions given on the first page to enter numerical answers.

Question 20 **3 / 3 points**

[3%] Perform the MiniMax algorithm on the above tree. What will be the values at nodes **B, I, and D in this order**? Write the answer hyphen separated. (For eg if B=1, I=3 and D=2 then write : 1-3-2) ___7-2-2___ ✔

Question 21 **0 / 3 points**

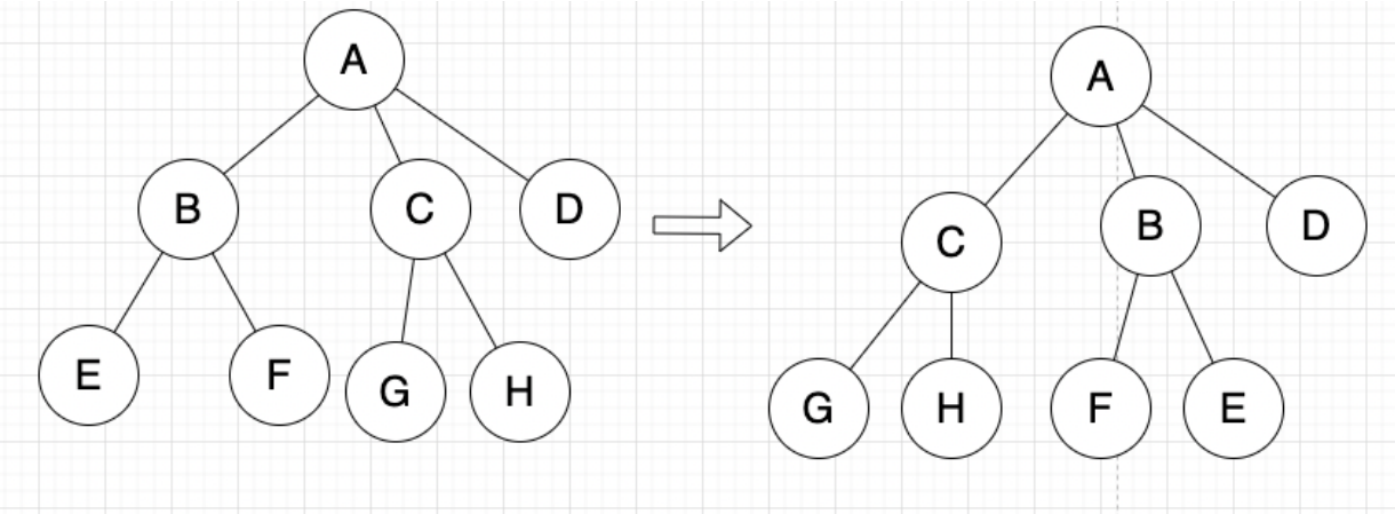
[3%] Perform the alpha-beta pruning algorithm on this game tree. After running

alpha-beta pruning on the given game tree, which nodes(including leaves) will **NOT** be visited during the search? The answer should be sorted in **alphabetical** order (Example : **A-B-C** Please follow this format only i.e. use '-' between any two nodes.). If all nodes will still be visited then answer NONE.

___F-H-J-K-O-T-V-W___ ✖ **(H-J-K-P-Q-R-T-U-V-W)**

Question 22 **0 / 4 points**

[4%] You are given the ability to swap the position of children for any number of nodes. Below is an example of such transitions.



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Perform such transitions in figure1. Give the minimum number of nodes that you must have to evaluate for calculating the value at A in the original tree. (Enter a number)

(Hint: For each node, think which subtree will give the results with minimum computations)

___3___ ✖ **(9)**

[20%] MDP

The following figures describe a bee nest your agent is exploring:

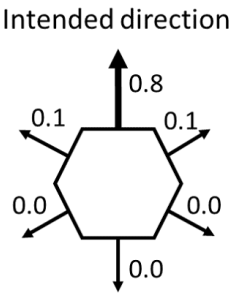

Figure 1: Probabilities of transitions at states

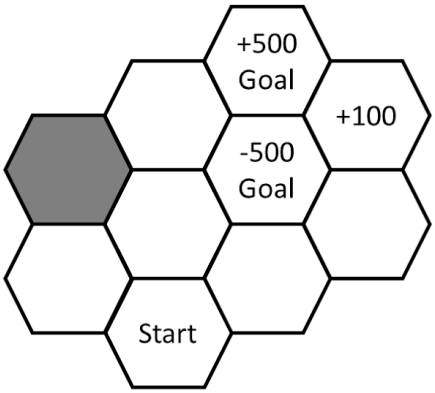

Figure 2: Rewards for grids

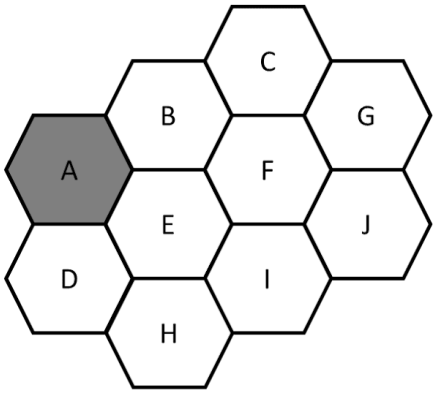

Figure 3: Letters that identify grids

Termination and rewards: The agent always starts in H. There are two terminal goal states, C with reward +500 and F with reward -500. Rewards are 0 in non-terminal states except +100 for G. (The reward for a state is received as the agent moves into the state.) A is not available for exploring.

Transitions: Figure 1 explains how the transition function works. The intended direction, which is the bolded edge, has a success probability of **0.8**. If a transition to an unavailable grid happens, the agent stays in the same grid. The transition discount is **γ = 0.9.** The cost for each transition is **c(a) = -10**.

Iteration:

$$Q_{t+1}(a,s) = R(s) + c(a) + \gamma \sum\nolimits_{s' \in S} P(s'|a,s) max_{a \in A} \gamma Q_t(a', s')$$

Please follow the instructions given on the first page to enter your numerical answers.

Question 23 **20 / 20 points**

[2%] The utility value of B after the **first** utility value iteration

___350___ ✔(10 %)

[2%] The utility value of D after the **first** utility value iteration

___0___ ✔(10 %)

[2%] The utility value of E after the **first** utility value iteration

___0___ ✔(10 %)

[2%] The utility value of G after the **first** utility value iteration

___405___ ✖ **(450)**

[2%] The utility value of I after the **first** utility value iteration

___0___ ✔(10 %)

[2%] The utility value of J after the **first** utility value iteration

___0___ ✔(10 %)

[2%] The utility value of E after the **second** utility value iteration

___197___ ✗ **(242)**

[2%] The utility value of J after the **second** utility value iteration

___236.6___ ✗ **(314)**

[2%] The utility value of I after the **third** utility value iteration

___115.352___ ✗ **(226.080, 226.08)**

[2%] The path to C with the highest utility value (answer with a pure sequence of letters, e.g. "ABCDE")

___HIJGC___ ✗ **(HEBC)**

[10%] Multiple choice from discussions

Question 24 **1.2 / 2 points**

[2%] Which of the following search algorithms are NOT complete? Select all that apply:

- ✓ ☐ Breadth-First Search
- ➡ ✓ ☑ Depth-First Search
- ✓ ☐ Uniform Cost Search
- ➡ ✗ ☐ Depth-limited Search
- ✓ ☐ None of the Above

Question 25 **0 / 2 points**

[2%] Which of the following are non-deterministic games? Select all that apply:

- ➡ ✗ ☐ Backgammon
- ✗ ☑ Go
- ✓ ☐ Chess
- ✓ ☐ Checkers

Question 26 **0 / 2 points**

[2%] Which of the following is true about Monte Carlo RL (model-free)? Select all that apply:

- ➡ ✗ ☐ Works only in episodic problems
- ➡ ✗ ☐ Wastes information as it figures out state values in isolation from other states
- ✓ ☐ None of the above
- ➡ ✓ ☑ Takes a very long time to converge as learning is from complete sample returns
- ✗ ☑ The utility value of states U(s) is not fixed

Question 27 **1 / 2 points**

Select all statements that are true about game-playing strategies:

- ✓ ☐ None of the above
- ✗ ☑ Minimax uses a breadth-first technique
- ➡ ✓ ☑ Good move ordering improves the effectiveness of pruning
- ➡ ✓ ☑ α-β pruning can be used as a speed-up strategy in the Minimax algorithm

Question 28 **2 / 2 points**

During the discussion, we discussed the situations when it is suitable to use CSP (Constraint Satisfaction Problem) Techniques. Please select the options that are true:

- ✓ ☐ None of the Above
- ✓ ☑ When the problem can be expressed by a set of variables with constraints on their values
- ✓ ☑ When constraints are relatively simple (e.g., binary)
- ✗ ☐ Local Search: when the solutions are "densely" distributed in the space of possible assignments (change densely to sparsely)
- ✓ ☑ When constraints propagate well (AC3 eliminates many values)

Attempt Score: 60.9 / 100 - 60.9 %

Overall Grade (highest attempt): 60.9 / 100 - 60.9 %

Done