19UCS181 – VAIBHAV

LNMIIT
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Department: Computer Science and Engineering

Artificial Intelligence (CSE 328)

End Term Examination

Time: 3 Hours **Date: 07.12.2021** **Max. Marks: 70**

Instructions:
1. There are 07 questions. All the questions are mandatory.
2. Write all the sub-parts of a question at one place.
3. Make and state assumptions precisely, as and when required.
4. All the notations have their usual meanings.

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1. (a) Mention the condition under which Uniform Cost Search (UCS) will not produce correct results on cyclic graph. Justify your answer. [2]

   (b) Consider a graph in which some of the edges are having negative costs. As an alternative solution one may add a large positive constant to each action cost to make them all non-negative, and subsequently solve the problem using UCS. Will this strategy lead to correct solution? Explain. [2]

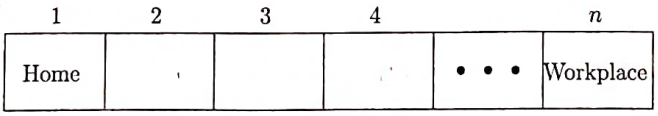
   (c) Find out the correctness of the given statement(s) with proper justification. [2×2=4]
   i. Fuzzy set F can be completely characterized by the membership function μ_F.
   ii. In fuzzy logic, membership function can have continuous or discrete membership values.

2. Prove that, " A STRIPS planning problem $\mathcal{P} = (\sum, s_i, g)$ (and a statement of such a problem $P = (O, s_i, g)$) has a solution iff $S_g \cap \Gamma^{>}(s_i) \neq \{\}$". [6]

3. (a) Compare and contrast between Model-based Monte Carlo and Model-free Monte Carlo Methods? [4]

   (b) What do you mean by "On-policy" and "Off-policy" algorithms? Is SARSA off-policy or on-policy? Justify your answer? [2+2]

4. Lee wants to go from his home (located at 1) to his workplace (located at n). At each location s, he can either (i) deterministically walk forward to the next location $s+1$ (takes 1 unit of time) or (ii) wait for the bus. The bus comes with probability ϵ, in which case, he will reach the workplace in $1 + \alpha(n - s)$ units of time, where α is some parameter. If the bus does not come, well, he stays put, and that takes 1 unit of time.



The problem is formalized as an MDP given below:

$$State: s \in 1, 2, ..., n$$

$$Actions(s) = walk, bus$$

$$Reward(s, walk, s') = \begin{cases} -1 & if\ s' = s+1 \\ -\infty & otherwise \end{cases}$$

$$Reward(s, bus, s') = \begin{cases} -1 - \alpha(n-s) & if\ s' = n \\ -1 & if\ s' = s \\ -\infty & otherwise \end{cases}$$

$$T(s'|s, walk) = \begin{cases} 1 & if\ s' = s+1 \\ 0 & otherwise \end{cases}$$

$$T(s'|s, bus) = \begin{cases} \epsilon & if\ s' = s+1 \\ 1-\epsilon & if s' = s \\ 0 & otherwise \end{cases}$$

$$IsEnd(s) = 1\ [s = n]$$

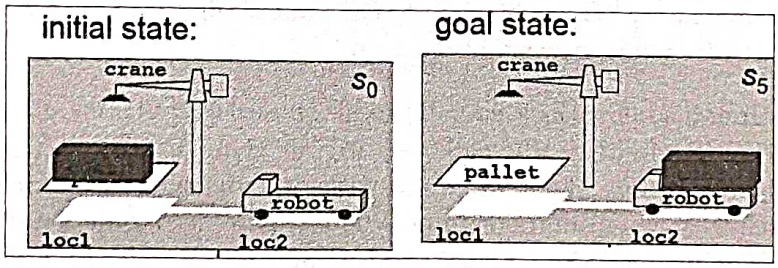
(a) Compute a closed form expression for the value of the "*always walk*" ($V_{walk}(s)$) policy and the "*always wait for the bus*" ($V_{bus}(s)$) policy (using some or all of the variables ϵ, α, n). Assume a discount rate of $\gamma = 1$. [10]

(b) For what values of ϵ (as a function of α and n) is it advantageous to walk rather than take the bus? [6]

5. (a) What is the difference between State-space Search and Plan-space Search? [2]

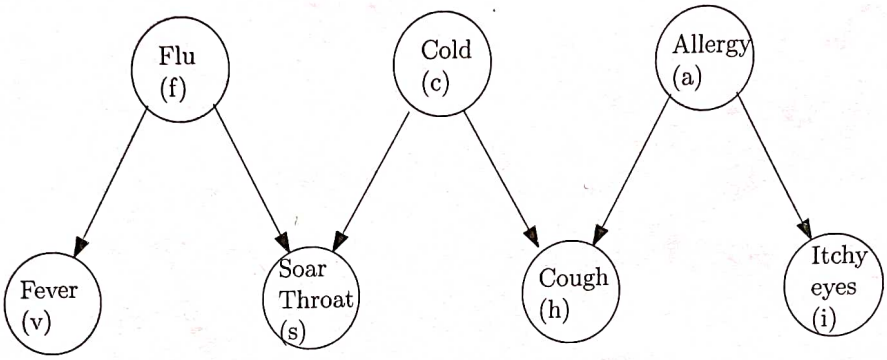
(b) Which is more efficient among Data-driven search and Goal-driven search in State-space Search? Justify your answer. [2]

(c) In a port-city beside Han river, a harbour is having several locations (docks), dock ships, storage areas for containers, and parking areas. In each location, there is a crane to load and unload the containers and there is robot cart to move containers around. Given a scenario, as shown in figure, design a code for STRIPS planner using PDDL which helps the dock-manager to move container from one place to another with less human intervention. [8]



6. Consider a scenario of busy road, where two cars $[x_1, x_2]$ are running in opposite directions. Given the positions of the cars, define an Artificial Neural Network to decide whether the two cars will collide or not. The position of the cars is assumed to be taken in euclidean space.
Note: You must formulate the final predictor also. [10]
Hint: Use vector notations to formulate the problem.

7. The data regarding the symptoms of a patient's medical diagnosis is given to a expert system which is shown as a Bayesian Network given below. Use probabilistic inference algorithm (using factor graph) to compute the probability of the patient is suffering from Flu, given he/she has soar throat $\mathbf{P}(F = 1|S = 1)$? [10]
Note: Each letter in parenthesis (e.g.: (v) against Fever) is the random variable(s) of the Bayes Net. You are instructed not to change the variable name(s) on your own. Keep α and β as variable parameters.



f	p(f)
0	1-α
1	α

c	p(c)
0	1-β
1	β

s	f	c	p(s|f,c)
0	0	0	1.00
1	0	0	0.00
0	1	0	0.30
1	1	0	0.70
0	0	1	0.25
1	0	1	0.75
0	1	1	0.10
1	1	1	0.90