

AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

Department of Computer and Systems Engineering
4th Year, Electrical Engineering - Computer and Systems



Spring Semester, 2019/2020

Course Code: CSE 481

Time allowed: 2 Hrs.

Artificial Intelligence Exam

The Exam Consists of 5 Questions in Two Pages.

Maximum Marks: 90 Marks

1 / 2

تعليمات هامة

- حيازة التليفون المحمول مفتوحا خلال الامتحان يعتبر حالة غش تستوجب العقاب.
- لا يسمح بدخول أي كتب أو ملازم أو أوراق داخل اللجنة والمخالفة تعتبر حالة غش.
- يجب ترتيب الإجابات في كراسة الإجابة حسب ورودها في ورقة الأسئلة والا لن يلتفت إليها

Question (1): Logic (22 marks)

- Convert the following two sentences to Conjunctive Normal Form. (6 marks)
 $(p \vee q) \rightarrow (q \wedge \neg r)$. $P \Leftrightarrow Q$.
- Consider the following knowledge base:
 $b \wedge c \wedge f \rightarrow a$; $c \wedge f \rightarrow d$; $e \wedge c \rightarrow b$; $d \wedge g \rightarrow e$; $d \wedge c \rightarrow b$; $e \wedge c \rightarrow g$; c ; f
Prove using resolution refutation that a is true. (6 marks)
- For each sentence below write "Yes" or "No" depending on whether the first order logic sentence correctly expresses the English sentence. (10 marks)
 - "All cats are mammals." $\forall x (Cat(x) \wedge Mammal(x))$.
 - "Spot has a sister who is a cat." $\exists x (Sister(x, spot) \wedge Cat(x))$.
 - "Every person has someone that they like." $\exists x \forall y Likes(x, y)$.
 - "There is someone who likes everyone." $\forall x \exists y Likes(x, y)$.
 - "Everyone likes ice cream." $\neg \exists x (\neg Likes(x, IceCream))$.

Question (2): Prolog (20 marks, 2 per item)

For each, of the following Prolog queries, say whether or not the unification would succeed. If it does, what values the variables in the terms would take on? If it does not, explain why.

- $eats(fred, mangoes) = eats(fred, what)$.
- $ancestor(X, Y, Z) = ancestor(john, mary)$.
- $loves(john, mary) = loves(mary, john)$.
- $husband(john, mary) = wife(mary, john)$.
- $spouse(john, mary) = spouse(father(bill), mother(bill))$.
- $father(mother(bill)) = father(jane)$.
- $child(mary, mother(bill)) = child(child(bill), mary)$.
- $child(child(sally), mother(bill)) = child(child(john), sally)$.
- $times(Z, times(Y, 7)) = times(4, W)$.
- $and(father(P1, P2), brother(P1, P3)) = and(father(X, john), brother(john, john))$

Question (3): State Space (8 marks)

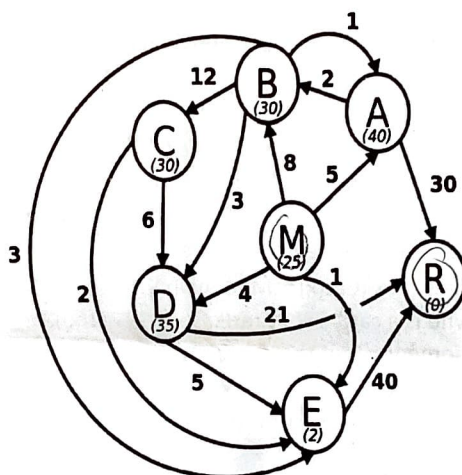
You are solving a puzzle where the object is to build up a 6-letter word starting with a single letter "O" adding or subtracting one letter each turn. Each intermediate step along the way must also be a word, and all the words are limited to those in this list (ON, OW, ONE, THROW, TON, TONE, TONES, TONS, TOW, TOWN, TOWNS, TOWS, TROW, TROWS, and THROWS).

- Give a state space representation of the problem. (3 marks)
- Draw the state space of the puzzle. (5 marks)

Question (4): Search (24 marks, 4 per item)

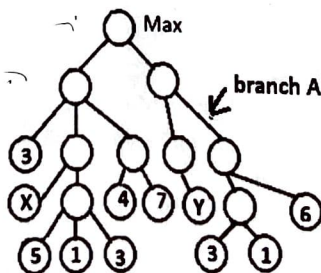
In the figure below let M be the start node and R the goal node. Branch costs are given beside each link, and heuristic values inside each node.

- Of all the blind search techniques (DF, BF, ID, Random, Bidirectional) which one should you apply to the graph in order to find a path from M to R with least search time that has the minimum number of nodes from M to R? Justify your answer.
- Draw the search tree for the graph. PS: use alphabetical order to break ties when deciding the priority to use for node exploration.
- Apply depth first search to the problem. Give the path from M to R together with a list of all explored nodes.
- Try beam search on the tree with $w=2$. Give the resulting path to the goal if any as well as the explored nodes.
- If Branch and Bound is applied instead of beam search would it yield the same path? Why?
- Name other algorithm(s) that guarantee(s) the same answer as Branch and Bound for the given graph. Under what conditions?



Question (5): Games (16 marks, 4 marks per item)

- For the game tree below calculate the minimax value of the tree given that $X=4$ and $Y=2$.
- If $Y=0$, for which values of X will the minimax value of the topmost node be X ?
- If $X=0$, for which values of Y will the minimax value of the topmost node be Y ?
- What condition must X, Y satisfy so that minimax with α - β pruning prune branch A in the given figure?



END of Exam, Good Luck

Examination Committee

Prof. Dr. Hani Mahdi, Dr. Manal Mourad

Exam. Date : 25/7/2020