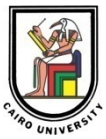
Cairo University
Faculty of science
Mathematics Department
120 minutes.



Final Exam (Sum. 2019)
Artificial Intelligence
Comp 408

Answer the following questions. The total credit is 60. **The Exam is in <u>eight</u> Pages**

Question (1) (20 points)

A. **(5 points)** Definitions

a. Define AI as *Acting rationally.*

b. Define the state space search.

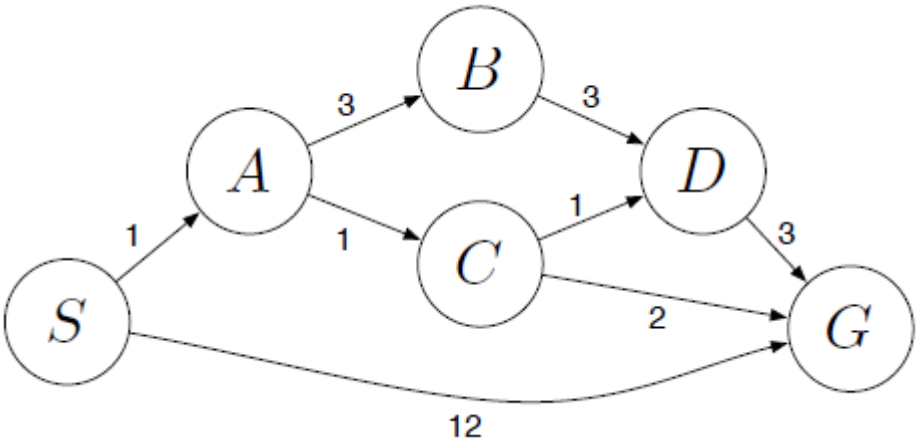
c. What is the difference between omniscient and rational agents?

d. What does it mean for an inference rule to be sound? Does soundness imply completeness?

e. What does it mean for a sentence to be satisfiable? Does Satisfiability imply validity?

B. **(8 points)** Develop a PEAS description of the automated taxi-driver.

C. (7 points) Consider the following search space where S is the start state and G is the goal state:



- Each edge is labeled by the cost to traverse that edge.
- An estimate to the goal is given by

Node	S	A	B	C	D	G
h	4	2	6	1	3	0

- For nodes on the same level assume <u>alphabetical</u> order in blind search.
- Show the order of the states visited (include the repeated) and the path to the goad by:

a. The Breadth First algorithm.
Visited states:
Path to Goal:

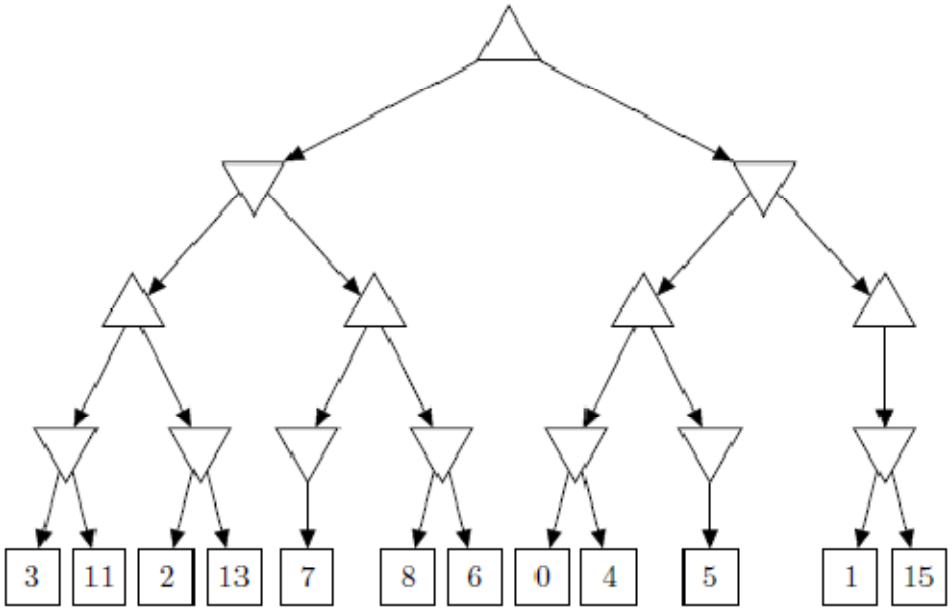
b. The Depth First algorithm.
Visited states:
Path to Goal:

c. A*
Visited states:
Path to Goal:

d. Is the *h* used above admissible or not? Why?

Question (2) (15 points)

A. **(5 points)** On the minimax game tree below, assuming its max's turn to play. Cross out the branches removed by alpha-beta pruning assuming left to right traversal.



B. **(4 points)** Both Local beam search, genetic algorithms combine an uphill tendency with random exploration and exchange of information among parallel search threads.

a. Explain how this is done in both.
b. What advantage the genetic algorithm has over the local beam search?

C. **(6 points)** Consider the following fitness function:

$$fitness = 5a + 3bc - d + 2e$$

where *a-e* are all Boolean-valued parameters. Consider the following initial population

a	*b*	*c*	*d*	*e*
1	1	0	1	1
0	1	1	0	1
1	1	0	0	0
1	1	1	1	0
1	0	0	0	0

a. Compute the fitness of each of the members of the initial population above.

b. Assuming the best two (with greater fitness values) of members of the population are selected for reproduction, and the *cross-over* point is that between the *b* and the *c*, show the resulting children:

Question (3) (25 points)

A. (3 points) What does it mean that FOL is semidecidable, how does that affect the resolution inference rule.

B. (5 points) Put in the CNF Form

i. $A \leftrightarrow (B \vee C)$

ii. $\forall x \, \exists y \; course(x) \wedge std(y) \rightarrow takes(y,x)$

C. (12 points) Represent the following sentences in FOL

i. All watches contain at least two buttons.

ii. Only doctors use watches

iii. Ali has a blue watch

iv. There is exactly one pink watch.

v. All watches must show 12 hours.

vi. Apple and Samsung watches have the same price.

D. **(5 points)** From the sentence: "Cats are animals" we can deduce the goal "The tail of a cat is the tail of an animal"

a. Translate the above (the sentence and the goal) into first-order logic using the three predicates
   - tail_of(x,y): x is the tail of y
   - Cat(x): x is a cat
   - Animal(x): x is an animal

b. Negate the goal and put all sentences in CNF.

c. Use Resolution to prove the goal.

Best Wishes
Areeg Abdalla