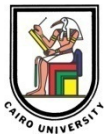
Cairo University
Faculty of science
Mathematics Department
120 minutes.



Final Exam (Spring 2015)
Artificial Intelligence
Comp 408

Answer the following questions. The total credit is 60.

Question (1) (16 points)

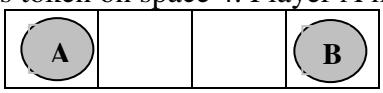
A. **(2 points)** How can you define Artificial Intelligence as "acting humanly"?

B. **(2 points)** What is a rational agent? And what is bounded rational agent?

C. **(4 points)** Define the PEAS (Performance Measure, Environment, Actuators, Sensors) of an internet shopping agent.

P.T.O.

D. **(8 points)** Consider a two-player game; a board with four locations, from 1 to 4, in a line. Each player has a single token. Player A starts with his token on space 1, and player B starts with his token on space 4. Player A moves first.



initial state: State (1,4)

The two players take turns moving. Each player can move his token to an open adjacent space in either direction, left or right; or jump over the opponent to the next space if any. (For example, if A is on 3 and B is on 2, then A may move back to 1.) The game ends when one player reaches the opposite end of the board. If player A reaches space 4 first, then the value of the game is +1; if player B reaches space 1 first, then the value of the game is -1.

a. Draw the complete game tree, using the following conversions:
- Write each state as (S_A, S_B) where S_A and S_B denote the token locations.
- Put the terminal states in square boxes, and write its game value.
- Put loop states (states that already appear on the path to the root) in circles. Since it is not clear how to assign values to loop states, give them a question mark "?"

b. Evaluate the value of each node propagating upward from the leaves to the root. Explain in wards how you can handle the "?" value, and why.

c. Explain why the standard minimax algorithm would fail on this game tree and explain how you might fix it.

P.T.O.

Question (2) (16 points)

A. **(3 points)** What is the need for Skolem function in First Order Predicate Calculus?

B. **(7 points)** Explain how does the Genetic Algorithm work? Why is it considered as Local Search Algorithm?

P.T.O.

C. **(6 points)** Consider the following 8-puzzel states:

1	2	3
8		4
7	6	5

1	2	3
8	6	
7	5	4

Given a puzzle state like the one on the right, where the numbers are in the wrong places, we want to search for a series of moves which ends in the solution on the left. A path cost could be calculated as the number of moves required.

a. Write down a heuristic function, h, for this game (remember that this estimates the path cost from a particular state to the solution).

b. What is the value of h for the above board state?

c. In a greedy search, what move would be chosen next? (i.e., move the 3, the 4 or the 6 into the gap?) Is this heuristic admissible?

d. Can you suggest a better heuristic measure?

P.T.O.

Question (3) (16 points)

A. (8 points) Suppose there are two friends living in different cities on a map. On every turn, we can move each friend simultaneously to a neighboring city on the map. The amount of time needed to move from city i to neighbor j is equal to the road distance d(i; j) between the cities, but on each turn the friend that arrives first must wait until the other one arrives (and calls the first on his phone) before the next turn can begin. We want the two friends to meet as quickly as possible.

a. What is the state space? Write a formal description of the state to use it in the rest of the question?

b. What is the successor function?

c. What is the goal state?

d. What is the cost function?

e. Let SLD(i; j) be the straight-line distance between any two cities i and j. Which, if any, of the following heuristic functions are admissible? Explain the reason of your choice?

(i) SLD(i; j) (ii) 2*SLD(i; j) (iii) SLD(i; j)/2 (iv) None

P.T.O.

B. **(8 points)** Just write True/False:

i. (……..) The omniscience of an intelligent agent requires the agent to have infinite knowledge.
ii. (……..) Depth-first search always expands at least as many nodes as A* search with an admissible heuristic.
iii. (……..) True ⊨ False.
iv. (……..) Percept based intelligent agent collects information from its Actuators.
v. (……..) $(A \leftrightarrow B) \wedge (\neg A \vee B)$ is satisfiable
vi. (……..) Forward Chaining with the Generalized Modus Ponens is complete in First order predicate Calculus.
vii. (……..) A Unifier is a substitution for variables in atomic sentences that makes them identical
viii. (……..) An existentially quantified sentence with one variable can be instantiated several times as long as the Skolem constants used are all distinct.

Question (4) (16 points)

A. **(4 points)** Which of the following pairs can be unified and which can not. For those which can be unified, find a suitable substitution; For those which can not , explain why they cannot be unified.

(First pair)

likes(homer, dinner(x)) $\wedge$ (today(a) $\rightarrow$ dinner(x)).

likes(homer, dinner(cooked_by(y))) $\wedge$ (today(z) $\rightarrow$ dinner(cooked_by(Sally))).

(Second pair)

$p(x) \vee (q(f(x)) \wedge r(y))$.

$p(x) \vee (q(x) \wedge r(M))$.

B. **(6 points)** Translate the following sentences into first-order logic, using a function to represent mother:

All dogs are mammals

Fido is a dog

Fido's mother is a mammal

All mammals have a mother who is a mammal

P.T.O.

C. **(6 point)** Consider the following Knowledge Base
Jack owns a dog. Every dog owner is an animal lover. No animal lover kills an animal. Either Jack or Curiosity killed the cat, whose name is Tuna.
Did Curiosity kill the cat?

a. Write this KB and your goal in First Order predicate calculus sentences

b. Put them CNF Form

c. Use Resolution-Refutation to answer the question

Best Wishes
Areeg Abdalla