**Artificial Intelligence Comprehensive Exam** [14 question, 33 points]

*YOU MAY WORK FOR COMPUTATIONS ON BALNK PAGES HERE BUT, THE RESULTS MUST BE ON THIS TABLE, AND ALL ROUGH WORKS MUST BE NUMBERED FOR ME IN CASE I WANT TO VERIFY.*

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| ***Questions*** | ***Write your answers here*** |
| **Q1.** The canonical Decision tree learning algorithm for choosing “next” attribute is by looking at \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the attribute with respect to all available attributes at that stage, and this quantity is computed based on \_\_\_\_\_\_\_\_\_\_ calculation. Fill in these two blanks.  | **ANS a.** **ANS b.**   [2] |
| **Q2.** With *five* binary attributes making a target decision (e.g. going to a restaurant or not) how many total number of decision trees may exist (a combinatorics formula will do, you need not compute the actual number)? | **Ans:**  [2] |
| **Q3.** A machine learning algorithm is so much biased toward the training set that it often fails in test sets. What is this problem called?How is it avoided in the decision tree-learning? You need not explain. | **ANS a.**  **ANS b.**   [2] |
| **Q4.** What type of learning problem is the following one?Given a training set learn to predict the classification of a unknown data. | **ANS.**  [1] |
| **Q5.** What type of learning problem is the following one?Given a set of data cluster them into different groups. | **Ans.**  [1] |
| **Q6.**  Your goal is to navigate a robot out of a maze. The coordinate system is defined so that the center of the maze is at (0, 0), and the maze itself is a square from (−1,−1) to (1, 1). The robot can turn to North, South, East, or West. Initial state: robot at coordinate (0, 0), facing North. Goal test: either |x| > 1 or |y| > 1 where (x, y) is the current location in real number. Successor function: move forwards any distance d; change direction of robot it is facing.Cost function: total distance moved.How large is the state space? | **Ans.**  [2] |
| **Q7.**  In above question, assume now that the maze consists of 3x3 (9) rooms and the robot navigates from room to room (i.e., x and y are integers between -1 and 1).**a.** How many doors are possible in the maze to go from one room to another?**b.** If there are 4 doors (the robot now moves straight if it sees through doors, i.e. state changes only when robot turns its face), then how large is the search space? | **Ans a.** **Ans b.**  [2] |
| **Q8.** Search: If f(s), g(s) and h(s) are admissible heuristics, then will the followings be also guaranteed to be admissible heuristics? Answer with True/False.**a**. f(s) + g(s) + h(s) **b.** max(f(s), g(s), h(s))  | **ANS a.** **ANS b.**   [2] |
| **Q9.** Suppose anAC iteration makes a node empty. Instead of stopping if it is allowed to run to the end (until nothing changes any more) what will happen?  | **ANS.** [2] |
| **Q10.** Consider a vocabulary with the following symbols and express the English statement in First Order logic:*O(p, c):* Predicate. Person *p* has occupation *t.**C(p1, p2)*: Predicate. Person *p1* is a customer of person *p2*.Constants denoting occupations: *Doctor (D), Surgeon (S), Lawyer (L)*.**a.** There exists a lawyer all of whose customers are doctors. (Do not skolemize from Q10-11) | **ANS.**  [2] |
| **Q10 b.** Every surgeon has a lawyer.[Clients are customers] | **ANS.**  [2] |
| **Q11.** Using a constant *Wumpus*, and a location variable *s*, create a first order logical statement that saysthe *Wumpus* is not at two different locations. Predicate: In(x, y) means agent x is at location y | **ANS.**  [2] |
| **Q12.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | toothache | toothache | ~toothache | ~toothache |
|  | catch | ~catch | catch | ~catch |
| cavity | .108 | .012 | .072 | .008 |
| ~cavity | .016 | .064 | .144 | .576 |

Calculate the followings:(Note upper case for vector)**a. P**(Cavity) | **ANS a.** [2] |
| **Q12 b. P**(Toothache | Cavity=true) | **ANS b**.[2]  |
| **Q13.** A bag of 3 biased coins a, b, and c (for head: 80%, 60%, 20% respectively). A coin is drawn randomly from the bag and flipped 3 times: X1, X2, X3.Calculate the probabilityP(2heads, 1tail | coin = a) | **ANS.** [2] |
| **Q14.**  Write a few lines on the class project you did in any AI course you have taken. If you have not done any AI related project, then write a few lines on any project you did. | **ANS.** [5] |