**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 says  the *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 probability  P(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] |