# Midterm Examination

***COEN 166 Artificial Intelligence***
***Department of Computer Engineering***
***Santa Clara University***


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Tuesday & Thursday 7:00-7:30pm


1. [30 points] True or false (yes or no, 1 or 0) problems with wrong-answer penalties:
   a) Neural networks are supervised learning.
   b) Agent-based systems are supervised learning.
   c) Genetic programming are supervised learning.
   d) The scientific methods are supervised learning.
   e) Perceptron can classify AND relation, also can classify OR relation.
   f) Among the 3 basic database operations (selection, projection, and join), only selection can reduce duplicate entries.
2. [30 points] What is total count of integers between 1,000 to 1,000,000 which are multiple of 2 or 5, or perfect square of integers?
3. [20 points] A doctor says that an infant who predominantly turns the head to the right while lying on the back will be right-handed, and one who turns to the left will be left-handed. Isabella predominantly turned her head to the left. Given that 90% of the population is right-handed, what is Isabella's probability of being right-handed if the test is 80% accurate?
4. [20 points] For each of atomic sentences, give the most general unifier if it exists:
   a) P(a, b, b), P(x, y, z)
   b) Q(y, G(a, b)), Q(G(x, x), y)
   c) Older(Father(y), y), Older(Father(x), John)
   d) Knows(Father(y), y), Knows(x, x)
5. [20 points] Perform a left-to-right alpha-beta prune on the tree below. Perform a right-to-left prune on the same tree.


6. [20 points] A new operator *exclusive-or* may be defined by the following truth table:

| P | Q | P exor Q |
|---|---|---|
| T | T | F |
| T | F | T |
| F | T | T |
| F | F | F |

   Create a propositional calculus expression using only $\wedge$, $\vee$ and $\neg$ that is equivalent to P exor Q. Prove their equivalence using truth tables.
7. [30 points] What is the probability of being dealt the following hands in a five card poker game (from the normal deck of fifty-two cards)?
   (a) A "flush" or all cards from the same suit.
   (b) A "full house" or two cards of the same value and three cards of another value.
   (c) A "royal flush" or the ten, jack, queen, king, and ace all of the same suit.
8. [20 points] Does a finite state space always lead to a finite search tree? How about a finite state space that is a tree? Can you be more precise about what types of state spaces always lead to a finite search tree?
9. [30 points] Given the TSP problem with following non-negative weighted undirected complete graph (A, B, 14), (A, C, 4), (A, D, 10), (A, E, 20), (B, C, 7), (B, D, 8), (B, E, 7), (C, D, 7), (C, E, 16), and (D, E, 2), where (X, Y, Z) means from node X to node Y has cost or weight Z. Please give the state space tree by using branch-and-bound algorithm, and show the optimal solution.
10. [30 points] The following training data and desired output, d, are used to train a perceptron with two input ($x_1$ and $x_2$), and a constant bias of value 1. The perceptron computes f(net) = f($x_1$ * $w_1$ + $x_2$ * $w_2$ + $w_3$ * 1), where f(x) is the sign of x. Please find the weights after the training assume the training rate is 0.2 and the initial weights for $w_1$, $w_2$ and $w_{bias}$ (or $w_3$) are 0.75, 0.5, and -0.6, respectively.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| $x_1$ | 1.0 | 9.4 | 2.5 | 8.0 | 0.5 | 7.9 | 7.0 | 2.8 | 1.2 | 7.8 |
| $x_2$ | 1.0 | 6.4 | 2.1 | 7.8 | 2.2 | 8.4 | 7.0 | 0.8 | 3.0 | 6.1 |
| output | 1 | -1 | 1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 |

***Name:***
***ID:***
***Score:***
1. [30 points]
2. [30 points]
3. [20 points]
4. [20 points]
5. [20 points]
6. [20 points]
7. [30 points]
8. [20 points]
9. [30 points]
10. [20 points]

***Total:***