Final Examination

COEN 367 & 368 Artificial Intelligence I & II
Department of Computer Engineering
Santa Clara University

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1. Which of the following situations is a case of learning? Explain why or why not in each case.
   a) A pigeon walking on the ground spots a piece of bread. Knowing where the bread is, it picks it up in its beak and eats it.
   b) A weight lifter who was ill is now recovering. Each day, before practise, it is becoming easier to lift 300 lbs.
   c) A computer program evaluate a function F on some arguments over and over again. The evaluation is initially slow because memory is almost full and the garbage collector runs frequently. Between some of these evaluations, the program frees a large area of memory, and then the successive evaluations of the function proceed more quickly.
   d) A program that solves problems is fed a lots of facts that have nothing to do with the problems it has to solve, and as a result, the time it takes to solve an average problem is lenghthened.

2. In a grammar for a subset of English, is it necessary to provide a separate production rule for each (terminal) word? Suggest a way to which production rules for words could be represented efficiently.

3. What is the difference between the radiance and the irradiance? Describe a situation in which some light plays both roles at the same time.

4. Plot a histogram for the 8 by 8 image below. Choose a threshold using the "valley" method. Show the result of thresholding with this value and also with the values 0.5 and 5.5.

```
6 2 5 0 0 5 2 6
2 6 0 4 4 0 6 2
5 0 6 1 1 6 0 5
0 4 1 6 6 1 4 0
0 4 1 6 6 1 4 0
5 0 6 1 1 6 0 5
2 6 0 4 4 0 6 2
6 2 5 0 0 5 2 6
```

5. For the binary images *A* and *B* shown below, apply dilation (by *B*) to *A* 3 times followed by erosion 3 times. What is the result?

```
A                   B
0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
0 0 0 1 0 1 0 0     1 1 1
0 0 1 1 0 0 1 0     1 1 1
0 0 0 1 0 0 1 0     1 1 1
0 0 0 0 1 0 0 0
0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
```

6. In an *N* by *N* binary image, what is the maximum number of connected components possible for the foreground and for the background if
   - 4-connected components are counted for each of the foreground and background?
   - 8-connected components are counted for each of the foreground and background?
   - 8-connected components are counted for the foreground and 4-connected components are counted for the foreground?

7. Write a program that computes the horizontal and vertical integral projections of a 32 by 32 binary image and detects and counts the peaks in these projections.
   - Study and describe the resulting features for images of the capital letters A, E, I, O, and U.
   - Study and describe the features for all the capital letters
   - Write a program that attempts to recognize the capital letters by using these features.
   - Improve the performance of your recognizer by adding additional features to it, of your own design.

8. One of the difficulties of vision is that a 3-dimensional scene, when digitized as an image, is represented in a 2-dimensional array. What are some ways in which the depth information in the scene can be inferred?

Name:

ID:

Score:

1. [40 points]
2. [40 points]
3. [30 points]
4. [30 points]
5. [20 points]
6. [30 points]
7. [80 points]
8. [30 points]

Total: