CS365: Artificial Intelligence

Mid-semester Examination

Total Marks = 50, Time = 1 hour

Question 1. *(Stereo Vision):* Consider a robot with left and a right cameras separated by the baseline distance "b". Imagine it has to thread a needle. [5 + 5 + 5]

a) Draw a diagram and derive its stereo vision geometry, and indicate the optimal distance it should hold the needle to make it least susceptible to motor control errors. What constrains the upper and lower bounds on this distance?

b) If b=6cm and the task requires a resolution of 0.04 mm, indicate what angular resolution would the robot need at your chosen distance.

c) Compare these three modes of 3D dimension estimation for executing this task: Shading, Texture, and Stereo.

Question 2: A system for recognizing faces at Delhi Airport has been trained on 10 million face images, and uses 100 eigenfaces for detecting faces. If f(n) is the number of operations needed in Singular Value Decomposition, indicate the computation needed in training the system and in running the system to identify new faces. [5 + 5 + 5]

b) Comment in the light of the above: The main benefit of the eigenface algorithm is dimensionality reduction?

c) As a child, you learned at some point, to recognize toothbrushes. How many sample images did you have? Consider other sensory modalities that may have gone into this task. Comment, in two paragraphs or so, on the role of function in recognition and how a machine learning system might encode this information.

Question 3: [3+3+3+5+6]

1. Name the two authors of the book *Perceptrons*, which showed that simple Neural Nets could not model an XOR function (determine if the two inputs are different).
2. Under the trihedral assumption, how many line junctions are possible of the "Y" type? Sketch them.
3. Starting in 1952, Arthur Samuels worte a series of programs for which game? How did Samuel's system eventually learn to play this game at the tournament level?
4. Who is the psychologist who proposed the idea of "Affordances" to recover 3D information from images presented in the usual perspective. He also emphasized how optical flow can be critical in evaluating environmental variables such as surface slant. Can you show how this may be possible using the pinhole camera model ?
5. Comment, in a sentence or two, if each of the following are true: Modern AI proposes:
   (a) More continuum models instead of discrete.
   (b) Modular systems that determine the sensory interpretation before proceeding to solve the task.
   (c) Systems that throw away large chunks of input images because there is too much data.