CS365: Artificial Intelligence

Mid-semester exam. Mar 2012 Total Marks = 100, Time = 2 hours

Question 1. **(General):** [5×4 = 20]

(a) Your grandfather would have considered a machine playing chess at the grandmaster level as a wonder of AI. Today a chess-playing program does not seem like a very good candidate for AI. What does this tell us about how AI differs from Physics as a scientific activity?

(b) Name the author of the book *Perceptrons*. What was its effect on the field of Machine Learning?

(c) Give an example of an alpha cutoff in a game tree search.

(d) Consider a set of images with a disk shown at random positions on a circle. If we attempt to project these to a lower dimension d using isomap projection, what value of d can we expect? What might the lower dimensional parameters $q_1, ...q_d$ correlate with?

Question 2. **(Vision):** [5×4 = 20]

A stereoscopic system is to be used for a tank navigation. It will have two CCD cameras, each with 512 × 512 pixels on a 10 cm × 10 cm square sensor. The lenses to be used have a focal length of 16 cm, with the focus fixed at infinity. The optical axes of the two cameras are parallel. The baseline between the cameras is 1 meter.

(a) If the nearest range to be measured is 16 meters, what is the largest disparity that will occur (in pixels)?

(b) What is the range resolution at 16 meters, due to the pixel spacing?

(c) What range corresponds to a disparity of one pixel?

(d) (Human vision.) Draw a sketch of the human eye. Indicate the "blind spot".

Question 3. **(Robotics):** [5×4=20]

A robot with d degrees of freedom has joint parameters $\mathbf{q} = q_1, ...q_d$. The set of points $\mathbf{x}$ in the workspace occupied by the robot at configuration $\mathbf{q}$ is given by $\mathbf{V}(\mathbf{q})$. An obstacle is defined as $O = \{\mathbf{x}|f_O(\mathbf{x})\}$.

(a) Define the configuration space mapping of the obstacle O.

(b) For a convex translational robot, show that Minkowski sum gives this obstacle map if O is also convex.

(c) Consider a 2-armed robot, base at origin and L1=5, L2=3, sketch the configuration space (approximately) for the point obstacles (6,1), and (-2,2). Show that it follows the definition you gave in (a).

(d) Consider a robot which is L-shaped: 0,0, 5,0, 5,1, 1,1 2,1, 2,0. Consider a line obstacle at 5,2 to 3,-2. Sketch the C-space map for this obstacle, assuming the robot is purely translational.

Question 4. **(Search):** [5+5+10 = 20]

(a) Say the L-robot above wished to reach the pose where it's bottom-left point was at (8,1). Shade the area that would be explored if you were to use an A* algorithm with an euclidean distance heuristic.

(b) An A-algorithm uses a h(n) which understimates the true cost from node n to the goal. What are the assumptions under which it is guaranteed to result in an optimal path?

(c) If h1() is less than h2() and both are admissible heuristics, show that an A-algorithm using h1() will expand at least as many nodes as one using h2().

Question 5. **(Machine Learning):** [10x2 = 20]

(a) If your power supply has a problem (P), your laptop will stop working (L) 98supply problem, in 3failure probability is 0.8

You know your laptop has stopped working. Which hypothesis is more likely - that the power supply has failed, or that it has not failed?

(b) You are given two points xi, yi = (-1,3.1) and (5.9,2). You expect these points to lie on a circle with center at (2,-1). Assuming zero-mean Gaussian error, formulate the problem as a maximum likelihood model.
(No marks for speculations.)