Student Name: _____ Student ID # _____

OU Academic Integrity Pledge

On my honor I affirm that I have neither given nor received inappropriate aid in the completion of this exercise.

Signature: _____ Date: _____

Notes Regarding this Examination

Open Book(s) You may consult any printed textbooks in your immediate possession during the course of this examination.

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No Electronic Devices Permitted You may not use any electronic devices during the course of this examination, including but not limited to calculators, computers, and cellular phones. All electronic devices in the student's possession must be turned off and placed out of sight (for example, in the student's own pocket or backpack) for the duration of the examination.

Violations Copying another's work, or possession of electronic computing or communication devices in the testing area, is cheating and grounds for penalties in accordance with school policies.

Question 1: Sensing, Modeling, and Planning (30 points)

Consider Jeeves, the robot used by Thrun's team in the Clean Up a Tennis Court competition.

A. *Explain* two ways in which Jeeves used sensing to improve (build) its model.

B. *Explain* one way in which Jeeves used its model to improve its sensing.

C. *Explain* whether it would be better for Jeeves to plan paths using A* or D*.

Question 2: Modeling, Planning, and Navigation (25 points)

Consider Turnip 1, the robot used by Mowforth and Grant to navigate in an office environment.

A. List (name or briefly describe) the maps used by Turnip 1.

B. For each map you listed in Part A, *explain* whether it is topological, metric, both, or neither.

C. *Explain* how Turnip 1 uses its map(s) for planning and navigation.

Question 3: Models and Robot Software Architectures (20 points)

Consider the following two statements:

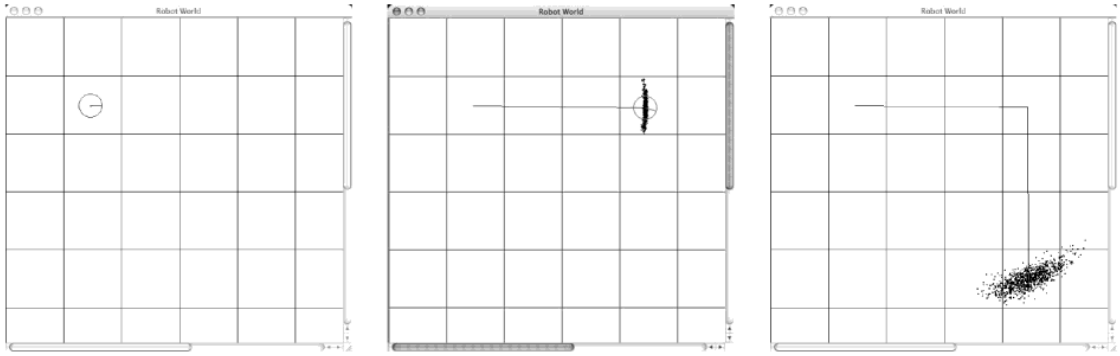
1. "The world is its own best model."
2. "Undoubtedly, the environment is its most accurate model ... unfortunately, the environment is often not its own most accessible model."

A. If statement 1 is taken to be true, can it reasonably be used to argue for or against reactive, deliberative, and/or hybrid approaches to robot software architectures? *Explain* your answer.

B. If statement 2 is taken to be true, can it reasonably be used to argue for or against reactive, deliberative, and/or hybrid approaches to robot software architectures? *Explain* your answer.

Question 4: Sensing and Localization (10 points)

Consider the figure below, taken from page 117 of your textbook.



(a) (b) (c)

Figure 4.20. Three snapshots of a particle filter implementation for a differential drive robot. The robot moves forward 3 m, turns right 90°, and then moves forward another 3 m. The distribution of particles represents the pdf for the robot's pose.

A. *Explain* what it means for a set of particles to represent the probability distribution function of the robot's pose.

B. *Explain* why the particle cloud spreads out from subfigure (a) to subfigure (c).

Question 5: Vision-Based Sensing (15 points)

Explain three ways in which one can get distance information from camera data.

A. One.

B. Two.

C. Three.