

Student Name: \_\_\_\_\_ Student ID # \_\_\_\_\_

**UOSA Statement of Academic Integrity**

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

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

**Question 1:** The Deliberative Paradigm (10 points)

Consider the common robotic industrial application of assembly. Now imagine a robotic assembly plant in which a computer is provided with a computer-aided design (CAD) model of the product to be assembled. From the model, a planner determines an appropriate assembly sequence, which is then carried out by the robot. The robot senses components and their locations. As long as the components are recognized and are in their expected locations (within some tolerance), the robot proceeds to assemble them. If there are unrecognized objects in the workspace, or if recognized components are away from their expected locations (beyond the tolerance), the robot stops and requests help.

A. List and **explain** one *similarity* between the software architecture of this system and a typical deliberative software architecture as described in your textbook and in class.

B. List and **explain** one *difference* between the software architecture of this system and a typical deliberative software architecture as described in your textbook and in class.

**Question 2:** The Reactive Paradigm (5 points)

Schema theory is presented by Murphy as a good way to capture the elements of the reactive paradigm in a formal structure.

List and **explain** one advantage of a schema-theory-based approach to reactive robotics, as compared to other approaches to reactive robotics, such as Brooks's subsumption architecture.

**Question 3:** The Reactive Paradigm Redux (5 points)

Schema theory separates perception from action by dividing each behavior into a perceptual schema and a motor schema. This requires that the two halves of each behavior be connected through some representation of the world (which serves as the output of perceptual schema and the input to the motor schema). Because of this intermediate representation, it might be argued that schema theory has put models between sensing and action. After all, what is a model but a representation of the world? Then, if schema theory is model-based, doesn't it really belong in the deliberative paradigm, rather than the reactive paradigm?

List and **explain** one way in which, despite the intermediate representations, schema theory differs from the deliberative paradigm in its use of models.

**Question 4:** The Hybrid Deliberative/Reactive Paradigm (20 points)

I have argued that recent versions of RCS, such as RCS-4, might well be considered examples of the hybrid paradigm, rather than the deliberative paradigm.

List and **explain** the parts of RCS-4 that correspond to the common components of hybrid architectures (as given by Murphy).

1. Sequencer.

2. Resource Manager.

3. Cartographer.

4. Mission Planner.

5. Performance Monitoring and Problem Solving Agent.

**Question 5:** Sensing (20 points)

Choose any of the robots described in any of the additional readings assigned for this course.

A. State which robot you have chosen and in which paper it is described. (For students in 5023, please give a complete citation. If you do not have complete citation information handy, please give the partial citation information that you do have and list the elements of a complete citation that you are missing.)

B. For the robot you chose in part A, give an example of sensor fusion in which multiple readings from the same sensor are fused. **Explain** why it is beneficial for this robot to fuse sensor data this way.

C. For the robot you chose in part A, give an example of sensor fusion in which multiple readings from different sensors of the same type are fused. **Explain** why it is beneficial for this robot to fuse sensor data this way.

D. For the robot you chose in part A, give an example of sensor fusion in which multiple readings from different sensors of different types are fused. **Explain** why it is beneficial for this robot to fuse sensor data this way.

**Question 6:** Metric and Topological Path Planning (20 points)

The following directions come (with slight editing) from the website of the Robert M. Bird Health Sciences Library of the University of Oklahoma Health Sciences Center:

Traveling East on I-40 (Coming from Yukon)

Go east on I-40. Approximately 1 mile after the Western Avenue exit is an exit indicating the Oklahoma Health Center. Exit here and turn right at the stop sign. You will be on Lincoln Boulevard after you cross Reno (past the stop light and railroad tracks). Continue north and turn right onto NE 10th Street, which dead-ends at Stonewall. The Library is on the left, the State Health Department on the right.

From the directions above, list one example of each of the following item types and **explain** why each example you give is an instance of the type.

A. Artificial Landmark

B. Natural Landmark



C. Gateway

D. Metric Information

E. Local Control Strategy