

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: \_\_\_\_\_

**Notes Regarding this Examination**

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

**Open Notes** You may consult any printed notes in your immediate possession during the course of this examination.

**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:** Robotics Paradigms (30 points)

Jill wants to use robots to help her with her pizza business. Some of the activities that she imagines the robots potentially doing include answering phones and taking orders, making pizzas according to the orders, delivering pizzas to people's residences or workplaces, ordering supplies when they begin to run low, restocking shelves when the supply truck arrives, and making the work schedule for the other employees for the coming week.

A. Select one of the activities from the list above that you believe could be handled best using a purely *deliberative* software architecture as described in your textbook and in class. **Explain** why you believe a purely *deliberative* software architecture could handle this activity best.

B. Select a different activity from the list above that you believe could be handled best using a purely *reactive* software architecture as described in your textbook and in class. **Explain** why you believe a purely *reactive* software architecture could handle this activity best.

C. Select yet a different activity from the list above that you believe could be handled best using a *hybrid deliberative/reactive* software architecture as described in your textbook and in class. **Explain** why you believe a *hybrid deliberative/reactive* software architecture could handle this activity best.

**Question 2:** The Hybrid Deliberative/Reactive Paradigm (25 points)

While Brook's Subsumption architecture is often held up as the classic example of a reactive robotic architecture, one could strongly argue, based on his original paper ("A Robust Layered Control System for a Mobile Robot." MIT AI Lab Memo No. 864, September 1985), that he was really proposing a hybrid deliberative/reactive architecture.

To make that argument, relate the proposed parts of the Subsumption architecture to the five common components of hybrid architectures. *Explain* your answers

A. Component One.

B. Component Two.

C. Component Three.

D. Component Four.

E. Component Five.

**Question 3:** Models, Reaction, and Deliberation (20 points)

When sensor data is stored in a model for later use, it can either be used *deliberatively* (as input for a planner, for example) or *reactively* (as a “virtual sensor” supplying input to a reactive behavior).

A. Choose one of the robots described in any of the additional readings assigned for this course that stores sensory data in models for later use and then uses it *deliberatively*. 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 a task for which this robot stores data in a model for later *deliberative* use. **Explain** how you concluded that the data was being used *deliberatively*.

C. Choose one of the robots described in any of the additional readings assigned for this course that stores sensory data in models for later use and then uses it *reactively*. This could be the same robot you chose in part A or it could be a different robot. 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.)

D. For the robot you chose in part C, give an example of a task for which this robot stores data in a model for later *reactive* use. **Explain** how you concluded that the data was being used *reactively*.

**Question 4:** Sensing & Navigation (15 points)

A. Describe a sensor that is good for navigation using a *metric* representation but poor for navigation using a *topological* representation. *Explain* your answer.

B. Describe a sensor that is good for navigation using a *topological* representation but poor for navigation using a *metric* representation. *Explain* your answer.

C. Describe a sensor that is good for navigation using either a *topological* representation or a *metric* representation. *Explain* your answer.



**Question 5:** Sensing (10 points)

Does the code of Jones, et al., show sensor fusion or sensor fission? *Explain* your answer.