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.

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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: Robotics Paradigms (36 points)

For the Sooner Lunar Schooner (SLS) mission, Mori argues in favor of the following set up:

1. Using existing lunar maps, plan the best course for the sprint rover to follow from the likely landing site to the last known position of the Lunakhod 2 rover. The course will be given to the rover as a series of about 15 waypoints in relatively open areas that are each about 10 meters apart.
2. As the sprint rover moves, have it use a star tracker to localize itself relative to the next waypoint (starting with the first waypoint) and attempt to move in a straight line from its current position to the next waypoint.
3. As the sprint rover moves, have it use a laser rangefinder to detect obstacles in front of it. Based on what it senses, have the rover either continue forward, move in an arc to the left or right, or halt. Moving in an arc or halting based on obstacles takes precedence over moving to the next waypoint.
4. If at any time the rover halts due to obstacles, finds itself more than 15 meters from it next waypoint, or finds itself in a location it has visited before, it will plan a new course from its current position to the last known position of the Lunakhod 2 rover. The course will be a series of waypoints in relatively open areas that are each about 10 meters apart.

A. List and **explain** one *similarity*, if any, between the software architecture of this system and a typical *deliberative* software architecture as described in your textbook and in class. (If there is no such similarity, say so.)

B. List and **explain** one *difference*, if any, between the software architecture of this system and a typical *deliberative* software architecture as described in your textbook and in class. (If there is no such difference, say so.)

C. List and **explain** one *similarity*, if any, between the software architecture of this system and a typical *reactive* software architecture as described in your textbook and in class. (If there is no such similarity, say so.)

D. List and **explain** one *difference*, if any, between the software architecture of this system and a typical *reactive* software architecture as described in your textbook and in class. (If there is no such difference, say so.)

E. List and **explain** one *similarity*, if any, between the software architecture of this system and a typical *hybrid deliberative/reactive* software architecture as described in your textbook and in class. (If there is no such similarity, say so.)

F. List and **explain** one *difference*, if any, between the software architecture of this system and a typical *hybrid deliberative/reactive* software architecture as described in your textbook and in class. (If there is no such difference, say so.)

Question 2: The Hybrid Deliberative/Reactive Paradigm (10 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** which style of hybrid architecture (as given by Murphy), RCS-4 most closely corresponds to.

Question 3: Sensing and Modeling (30 points)

Sometimes robots use sensory data immediately in reactive ways, as Brooks suggests that they should. Sometimes they store sensory data in models and make use of their models later, as Thrun suggests that they should. Sometimes they do both.

Choose one of the robots described in any of the additional readings assigned for this course that uses sensory data immediately in reactive ways and also stores sensory data in models for later use.

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 a task for which this robot *uses sensory information immediately in a reactive way.* **Explain** whether or not you think this is an effective use of sensor data. (That is, does this seem to work well? Why or why not?)

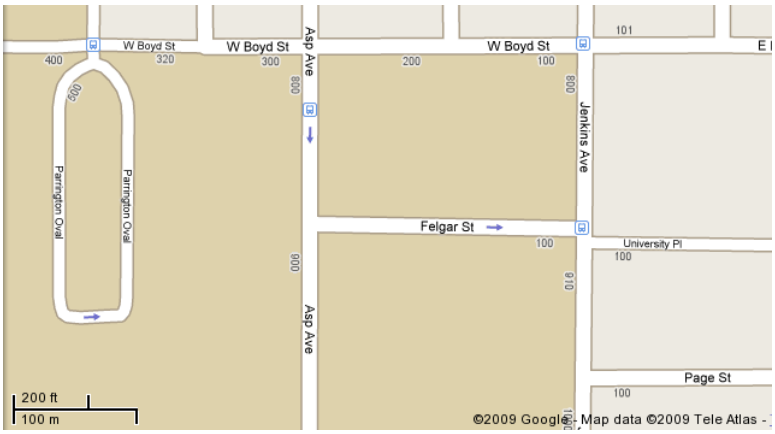
C. For the task example you gave in part B, **explain** whether you think *storing this data in a model and using it later* would have more effective, less effective, or equally as effective as using it immediately and reactively.

D. For the robot you chose in part A, give an example of a task for which this robot *stores sensory data in models and makes use of that model later*. **Explain** whether or not you think this is an effective use of sensor data. (That is, does this seem to work well? Why or why not?)

E. For the task example you gave in part D, **explain** whether you think *using this data immediately and reactively* would have more effective, less effective, or equally as effective as using it immediately and reactively.

Question 4: Metric and Topological Path Planning (24 points)

Consider the task of getting from the intersection of Felgar Street and Jenkins Avenue to the south end of Parrington Oval.



A. Describe a route using purely metric information for accomplishing this task. (Values given, if any, may be approximate.)

B. Describe a route using purely topological information for accomplishing this task. (Values given, if any, may be approximate.)