

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 & Navigation (25 points)

Consider the following activities related to navigation: Goal determination, path planning, mapping, localization, and route following. For each one, **explain** whether you think the activity is best done deliberately, reactively, or with a combination of deliberation and reaction.

A. Goal determination.

B. Path planning.

C. Mapping.

D. Localization.

E. Route following.

Question 2: Sensing & The Hybrid Deliberative/Reactive Paradigm (30 points)

In robotic sensing, it is often beneficial to combine multiple readings from the same sensor, readings from multiple sensors of the same type, and/or readings from sensors of multiple types. Indeed, Albus's Real-time Control System Four (RCS-4) provides mechanisms for all of these combination options.

A. List an RCS-4 module type in which *multiple readings from the same sensor* are combined, describe one way in which these readings are combined, and give Albus's reason for using this combination in this module.

B. List an RCS-4 module type in which *readings from multiple sensors of the same type* are combined, describe one way in which these readings are combined, and give Albus's reason for using this combination in this module.

C. List an RCS-4 module type in which *readings from sensors of multiple types* are combined, describe one way in which these readings are combined, and give Albus's reason for using this combination in this module.

Question 3: Sensing & Robotics Paradigms (15 points)

A. Is sensor fission together with behavior fusion applicable to *deliberative* robots? **Justify** your answer.

B. Is sensor fission together with behavior fusion applicable to *reactive* robots? **Justify** your answer.

C. Is sensor fission together with behavior fusion applicable to *hybrid deliberative/reactive* robots? **Justify** your answer.

Question 4: Metric Mapping & Navigation (15 points)

Some types of metric maps (e.g., regular/uniform grids and quadtrees) use some form of square grid to represent the robot's environment. This can work well for many buildings in which most or all walls are perpendicular or parallel to one another, since the walls may be aligned well with the lines of the grid. However, if the grid lines are shifted or rotated with respect to the primary walls of the building, performance may degrade significantly.

A. Describe and **explain** one way in which metric mapping and/or navigation performance could degrade due to map/building misalignment.

B. Describe and **explain** a second way in which metric mapping and/or navigation performance could degrade due to map/building misalignment.

C. List a metric map representation that is not subject to this misalignment problem. **Justify** your answer.

Question 5: Topological Navigation (15 points)

List and **explain** three different local control strategies (LCSs) that could be useful for navigating from the lectern in Devon 270 to the CS reception desk in Devon 150. For each LCS, give an example of where on that route the LCS would be likely to work well and where it would be likely to work poorly.

A. LCS 1.

B. LCS 2.

C. LCS 3.