

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: Navigation & Hybrid Architectures (40 points)

Imagine a robot capable of sensing and moving while avoiding collisions with static obstacles at a speed of approximately 5 km/h (which is approximately average human walking speed) using Albus's Real-time Control System Four (RCS-4). Imagine further that this robot is given the task of going from Devon 270 to Devon 150 in order to pick up a package from the CS reception desk and bringing it back to Devon 270.

A. Which level(s) of task decomposition would you expect to be involved in the path planning for this task? (Refer to Figure 5 of Albus.) *Justify* your answer.

B. If, during route following, this robot encountered an obstacle *on the path between two waypoints*, which module(s) would it use to deal with this obstacle in such a way that it could complete its navigation task? *Justify* your answer.

C. If, during route following, this robot encountered an obstacle *blocking a waypoint*, which module(s) would it use to deal with this obstacle in such a way that it could complete its navigation task? *Justify* your answer.

D. If, during route following, this robot encountered *a person carrying the package in question*, which module(s) would it use to deal with this encounter in such a way as to take advantage of it and more quickly complete its package pickup and delivery task? *Justify* your answer.

Question 2: Topological Navigation & Hybrid Architectures (25 points)

Explain how each of the five common components of hybrid architectures would function, given a distinctive places representation as proposed by Kuipers and Byun.

A. Component One.

B. Component Two.

C. Component Three.

D. Component Four.

E. Component Five.

Question 3: Sensing & The Reactive Paradigm (15 points)

List three *different* benefits that can be derived in reactive robots by combining readings from multiple sensors of the same type. *Justify* each answer.

A. Benefit One.

B. Benefit Two.

C. Benefit Three.

Question 4: Metric & Topological Navigation (10 points)

Murphy (pp. 367–369) describes “subgoal obsession” as a problem that can occur with metric navigation. Do you believe that a similar problem could occur with topological navigation? *Justify* your answer.

Question 5: Sensing & Robotics Paradigms (10 points)

A. *Explain* one typical way in which contact sensors are used in *reactive* robots.

B. *Explain* one typical way in which contact sensors are used in *deliberative* robots.