

Final Exam

16-311: Introduction to Robotics

Last Updated: 9 May 2017

Name: _____

Andrew ID: _____

Team Number: _____

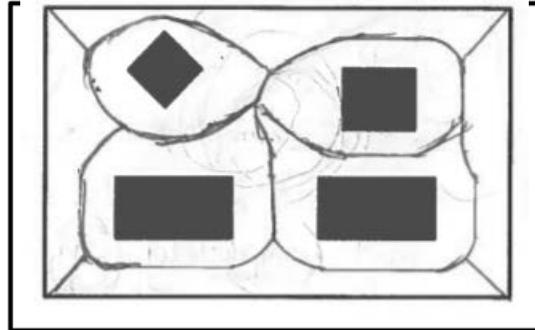
- You will have 1 hour and 15 minutes to complete this exam
- There are 6 sections on 20 pages. Make sure you have all of the pages. Write your Andrew ID on all the sections and keep your work in that section (they will be graded individually). There is a blank page after every section.
- When making drawings - be precise. Rounded edges should look rounded, sharp edges should look sharp, sizes should be close to scale. Neatness counts.
- Show your work. Partial credit may apply. Likewise, justify algebraically your work to ensure full credit, where applicable.
- It should be very clear what your final answer is, circle it if necessary.
- You may need to make certain assumptions to answer a problem. State them (e.g. what is optimal).
- You are allowed one handwritten two-sided reference sheet for the exam. No cell phones, laptops, neighbors, etc. allowed.
- Good luck and you can do it.

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6. Draw the Voronoi Diagram for this space with respect to the L2 metric:



3 points

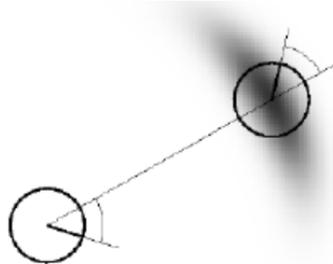
Figure 13: Mobile robot workspace with unmodified obstacles.

7. What is a benefit of using a Voronoi diagram to plan a path? (What is good about a path produced from this algorithm?)

2 points

Stay as far away from the obstacles as possible.

8. We run a two-motor LEGO robot 1000 times with the same motor speed and duration. We mark the place where the robot ends (shown below). Explain why these dots are not completely on top of each other?



slip, battery power, dust, etc.

2 points

Figure 14: Results of running robot at given theta for constant duration and motor power.

9. Name at least two ways to improve our results so that these 1000 iterations result in a tighter resulting bunch.

PID, add another sensor, use a more accurate encoder, etc.

2 points

10. Choose one of the following to answer:

- Dr. Jodi Forlizzi came in to discuss her research on Human Robot Interaction. What type of relationship (cooperative, augmentation, none) do you think humans SHOULD have with autonomous cars? Explain your reasoning. **any thoughtful response**
- Dr. Khalid Jawed came in to discuss his research on rod mechanics. What is one application of this research? Explain how basic science research can influence fields like robotics. **video games**

11. Which of these robots is optimal?

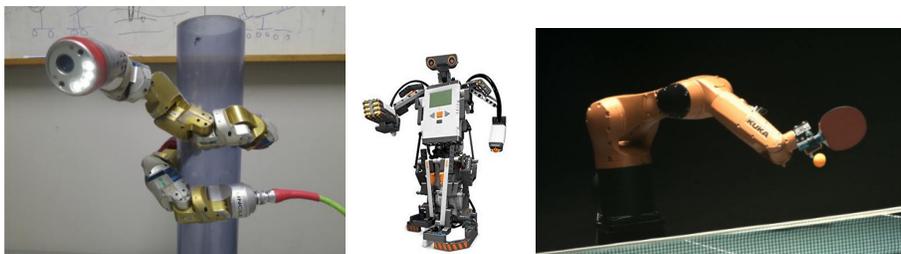


Figure 15: Candidate optimal robots.

Optimal with respect to what?

2 points

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This is the end of the test.