ME/CS 132: Preliminary Final Project Guidelines
(Winter Quarter, 2017)

1 Final Project

Students will have the option of a conventional final exam or a final project. The final project should be considered as an extended homework where students can integrate the course concepts in a practical implementation.

The final projects can take many forms: (1) theoretical projects (e.g., proposing a new motion planning algorithm and proving its completeness); (2) simulation studies of an algorithm (e.g., implementing a voronoi graph planner in 2-D, and demonstrating the planner on some different environments); or (3) an experimental project on the lab robots(e.g., implementing a sensor-based motion planner, or joining together SLAM and a sensor-based motion planning scheme). Below are some abbreviated project descriptions to give you some ideas for your project. You need not be constrained by this list of projects–students can propose their own projects, subject to my approval. It is perfectly permissible for students to join together in teams for the final project. Of course, the final project output should be commensurate with the number of team members, and the same grade will be assigned to all team members.

2 Final Project Suggestions

Simulation/Algorithm Projects:

- Implement and demonsrate a *sample based* (or *probabilistic*) planner for a disc-like robot operating in planar polygonal environment. The algorithm should be able to take an arbitrary list of polygon obstacles and an arbitrary start-goal pair to produce a motion plan.
- Develop a system to take a description of a closed polygonal room with polygonal obstacles in its interior and generate the voronoi graph. A more advanced version will also generate a path from an arbitrary initial to final goal.
- Develop or implement a *coverage algorithm.* that will systematically sweep a bounded area (such as a room). Think of the robot trying to vacuum the room, or systematically sweeping for land mines.
- Develop a motion planner for a point robot operating in an environment of 3-D polygons.

Experimental Projects:

- Implement a "D-star" algorithm on the lab robots (a sensor-based way to implement an approximate cellular decomposition) and negotiate at least 2 obstacles on the way to a goal.
- Implement and demonstrate on the lab robots one of the "bug" algorithms.
- Develop a visual odometry system.
- Implement a SLAM system using a Kalman filter or Bayesian filter. You might want to use stereo vision as the front end, or and RGB-D sensor (such as the "Kinect" sensor from microsoft, or the "Xtion" sensor from Asus). Map a single room with your SLAM algorithm. A very ambitious experiment would map multiple rooms.

3 Final Project Schedule

Preproposal: All students (or student teams) should prepare a 1-2 page "preproposal" by Friday, March 3 (5:00 pm). This preproposal will contain:

- A brief description of the proposed project.
- A summary of the likely approach that will be taken by the project investigator(s).
- A listing of the "project deliverables." That is, a description of how you propose to demonstrate and document the outcome of your project.

Due date: The final project is due at 5:00 p.m. on the last day of the finals period. Your final project submission will consist of a project report that will include *at least* the following items:

- a short introduction that reviews the project's subject area and its goals.
- a description of the technical approaches taken to solve the project problems.
- A demonstration of the project's function (e.g., snapshots of graphical simulations, or plots of data taken from the robot).
- A "debriefing," which is a brief summary of what you would do differently if you had more time, or started all over again.

In creating your final report, you should aim for a document that could be read and understood by another student in the ME/CS 132 class.