

# **CSC 397/595: Topics in Computer Science**

## **Robotic Motion Planning**

### **Winter 2019-20**

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**Office Hours:** Thursday 5:00-5:30 PM & 9:00-10:00 PM (Godage)  
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**Course Website:** <https://d2l.depaul.edu/>

## **Course Description**

This course will cover the basics of robotic motion planning, including fundamental concepts of the robot's anatomy, kinematics, and control. Students will be introduced to different aspects of the robot's environment (boundaries, obstacles, etc.), and will devise suitable planning mechanisms for such environments that respect the environments' constraints. The course will entail hands-on problems and projects, whose aim is to reinforce the concepts covered in the course.

## **Prerequisites**

CSC 321 (for CSC 397) OR CSC 421 (for CSC 595) OR consent of the instructors.

## **Textbooks**

Selected chapters from the following textbooks will be covered. (Both textbooks are available online.)

- STEVEN M. LAVALLE, Planning Algorithms, Cambridge University Press, NY, USA, ISBN 978-0-521-86205-9, (2006). Available for free download at <http://lavalle.pl/planning/> for personnel use.

- MORDECHAI BEN-ARI AND FRANCESCO MONDADA, Elements of Robotics, Springer, ISBN 978-3-319-62533-1, (2018). Available for free download at <https://link.springer.com/book/10.1007/978-3-319-62533-1>.

## Attendance

Attendance is mandatory. Class participation constitutes 15% of the course grade (refer to the “Grading” section below), and missing a lecture can significantly harm your participation grade.

## Grading

**Note:** Students enrolled in CSC 595 will be given extra work to do, as part of their homework assignments and course project. Moreover, CSC 595 students will be assigned to read research papers and present them at the end of the course.

- *Class Participation— 15%*

Students are required to attend all lectures, actively participate in the class discussions (e.g., answer questions), and work on any assigned class activities. Except for extenuating circumstances (e.g., medical emergencies), missing a lecture will result in a 5% reduction in your class participation grade, for a maximum of 15% reduction in the class participation grade (i.e., the overall reduction over all absences does not exceed the 15% class participation grade).

- *Homework Assignments — 35%*

Assignments are due on the specified due date and time. The homework may include hands-on implementations of planning tasks on robotic platforms. Late submissions are not accepted. Please double check your homework submission after uploading it on D2L. It is your responsibility to submit the correct and complete file. Please upload all your submission files on D2L as a single zipped file.

- *Project — 50%*

There will be a course project in which the students will develop a planner and test it on a robotic platform. The project will be a group project. The groups will be assigned by the instructors. The students will be expected to demonstrate their projects at the end of the course.

## Topics

1. Introduction: Planning (examples, applications, formulation) & Robots.
2. Review: Geometric Transformations and Basic Graph Searching Algorithms.
3. The Configuration Space.
4. Sampling-Based Planning.
5. Localization and Obstacle Avoidance.
6. Mapping and Mapping-Based Navigation (if time permits).

## Learning Outcomes

- The students will be able to represent and model the robot and its environment mathematically.
- The students will be able to devise suitable planning mechanisms for robots that respect the environments' constraints.
- The students will be able to integrate robot localization and sensing into motion planning.
- The students will be able to develop and implement simple robot motion planners and test them on real-world robotic platforms.

## Plagiarism

Apart from the group project, all assignments must be done on **YOUR OWN**. You are strictly prohibited from using any source other than the text and the lecture notes when working on the homework problems. In particular, you are strictly forbidden from acquiring hints and/or solutions from the internet or from any other external resource or person (besides the instructor). Copying is strictly forbidden. Scholastic dishonesty includes acquiring answers from any unauthorized source, working with another person except when permitted by the instructor, observing the work of other students during any exam, providing answers when not specifically authorized to do so, and informing any person of the contents of an exam prior to the exam. Disciplinary actions range from grade penalty to expulsion. Please refer to the school policy on plagiarism for more specific details.

## **Students with Disabilities**

Students who feel they may need an accommodation based on the impact of a disability should contact the instructor privately to discuss their specific needs. All discussions will remain confidential. To ensure that you receive the most appropriate accommodation based on your needs, contact the instructor as early as possible in the quarter (preferably within the first week of class), and make sure that you have contacted the Center for Students with Disabilities (CSD) at: [csd@depaul.edu](mailto:csd@depaul.edu)

Lewis Center 1420, 25 East Jackson Blvd.  
Phone number: (312)362-8002  
Fax: (312)362-6544

## **Course Evaluation: School Policy**

Course and instructor evaluations are critical for maintaining and improving course quality. Please complete the evaluations at the end of the quarter.