California State University Stanislaus
Department of Computer Science
Syllabus

Instructor: Dr. Xuejun Liang
My Office: DBH 282
Office Hours: M 2:00PM-3:00PM & WF 10:00AM-11:00AM (ZOOM Meeting ID 4438930033)
Phone: (209) 667-3169, Email : xliang@csustan.edu

Class Information:
Classroom: DBH 101 / Online
Class Days & Times: TR 12:30PM-1:45PM
Class Website: https://www.cs.csustan.edu/~xliang/Courses2/CS4710-24S

Hybrid Online - Synchronous. In-person class meetings will be on campus at the room, day, and time listed. Online class meetings will be at the day and time listed. Students must be available at the class times listed in the Class Schedule and must attend in person on days indicated as such by the instructor. Students do not have the option to choose in-person or virtual, nor opt for asynchronous participation.

Course Description:
CS4710 Mobile Robotics. (3 Units) Pre-requisites: CS 3100 and MATH 2300. This course will introduce robotics and the key artificial intelligence issues involved in the development of intelligent robots. The course will examine algorithms forthe control of autonomous mobile robots and explore issues that include software control architectures, localization, navigation, sensing, planning, and uncertainty. Provides a variety of hands-on robot programming and simulation projects.

Required Textbook:
1. Introduction to AI Robotics, Second Edition, by Robin R. Murphy, The MIT Press, 2019

Reference Books:
1. Introduction to Autonomous Mobile Robots, Second Edition, by Roland Siegwart, IIIah Reza Nourbakhsh, and Davide Scaramuzza, The MIT Press, 2011
2. Probabilistic Robotics, by Sebastian Thrun, Wolfram Burgard, and Dieter Fox, The MIT Press, August 2005, ISBN: 9780262201629.

Course Outcomes
Students who successfully complete the course must be able to
1. Understand issues and concepts in autonomous mobile robotics, problem statements, and typical applications.
2. Understand and apply mobile robot locomotion with legs and wheels and motion control, and compute with and apply mobile robot kinematic models and constrains, maneuverability, and workspace.
3. Understand and apply robotic sensing and perception, and master sensor performance, sensor classification, uncertainty representation, and feature extraction.
4. Understand and apply algorithms and methodologies in the robot path planning, localization, and map making.
5. Write software programs to control or simulate mobile robots on selected platforms.

Course Outline* (Major Topics and Weekly Schedule)

Dates	Topics Covered	Chapters
Week 1: 01/30, 02/01	Course Introduction and Syllabus. Overview of intelligent mobile robots, definition, components, motivations, modalities, AI areas. Automation and autonomy: the differences and the impacts, Bounded rationality, Open-world and Closed-world.	CH01 CH03
Week 2: 02/06, 02/08	Overview of software organization of autonomy, three type of software architectures, Canonical AI robotics operational architecture. Five subsystems in systems architectures, Systems architecture paradigms and examples: Hierarchical, Reactive, Hybrid.	CH04: S1-3, 5-6
Week 3: 02/13, 02/15	Telesystems: Taskable Agency versus Remote Presence, The Seven Components of a Telesystem, Human Supervisory Control, Human Factors, Teleoperation Applications. Mechanical Locomotion, Biological Locomotion, Legged Locomotion, Action Selection.	CH05 CH09
Week 4: 02/20, 02/22	Sensors and Sensing: Sensors, Sensor Model, Computer Vision, Choosing Sensors and Sensing. Range Sensing: Stereo, Depth from X, Sonar, Sonar Model and Occupancy Grid, Light Stripers, Lidar, RGB-D Cameras, Point Cloud.	CH10 CH11: S1-5
Week 5: 02/27, 02/29	Deliberation: STRIPS, Symbol Grounding Problem and Anchoring, The Nested Hierarchical Controller (NHC) Navigation: the four questions of navigation, spatial memory, topological navigation and metric navigation Landmarks and Gateways, Relational Methods, Associative Methods	CH12: S1-3, 5 CH13: S1-7
Week 6: 03/05, 03/07	Metric Path Planning and Motion Planning: Configuration Space, A* and Graph-Based Planners, Wavefront-Based Planners, Executing a Planned Path. Motion Planning, Criteria for Evaluating Path and Motion Planners.	CH14: S1-7
Week 7: 03/12, 03/14	Localization: Position Tracking, Global localization, Feature-based vs Iconic, Probabilistic, Map-Based Localization, Markov versus Kalman localization, SLAM, Exploration: Frontier-based, Generalized Voronoi graph. Terrain Mapping, Terrain Identification, Stereophotogrammetry, Scale and Traversability.	CH15: S1-9
Week 8:	Review for midterm examination	

03/19, 03/21	Exam #1	
Week 9: 03/26, 03/28	Programming Project #1: 2D Markov Localization.	
	Spring break	
Week 10: 04/09, 04/11	Programming Project #2: 4D Kalman Localization.	
Week 11: 04/16, 04/18	Programming Project #3: Particle Filter	
Week 12: 04/23, 04/25	Programming Project #4: Path Planning	
Week 13: 04/30, 05/02	Programming Project #5: PID Control	
Week 14: 05/07, 05/09	Programming Project #6: SLAM	
Week 15: 05/14, 05/16	Programming Project #6: SLAM (Cont.) Exam #2	
Week 16:	Final Examination Schedule https://www.csustan.edu/class-schedule/finals-schedule/	

* It is subject to change.

Grading Scale

Grading Scale will be assigned on a standard scale as below. Clustering of grades may cause the grading scale to be lowered (to your benefit), but it will not be raised.

A	B	C	D	F
90-100	75-89	60-74	45-59	<45

Evaluation:

The overall course grade will be the weighted sum of the points earned in the following categories:

Homework	Two Exams	Programming Assignments	Programming Projects
20%	40%	20%	20%

Other Polices:

1. I will accept the late assignments for maximum three days (including holidays) with the point deduction 20% per day.
2. There will be no makeup exams except in a verified emergency with immediate notification.

Academic Honesty:

The work you do for this course will be your own, unless otherwise specified. You are not to submit other people's or machine's work and represent it as your own. I consider academic honesty to be at the core of the University's activities in education and research. Academic honesty is always expected in this course.

Accommodations for Students with Disabilities

Students with disabilities seeking academic accommodations must first register with the Disability Resource Services (DRS) program, located in MSR 210, ph. (209) 667-3159. Students are encouraged to talk with the instructor regarding their accommodation needs after registering with DRS.