

CS 4023/5023 : Introduction to Intelligent Robotics

Instructor: Ali Reza Pedram
University of Oklahoma, Spring 2026

Class Hours: Tuesday and Thursday 12 - 13:15 CST

Course Material: <https://canvas.ou.edu/courses/472724>

Office Hours: Monday and Friday 12:00 - 13:30 CST

Class Room: CEC 0441

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Instructor Office: SEC 1174

Course Description

This course introduces students to the state of the art in Intelligent Robotics and the principles involved. Topics include the historical development of intelligent robotics; deliberative and reactive robot architectures; behavior-based and ethologically inspired approaches; sensing; and robot software architectures and implementation methodologies. The course also covers hybrid deliberative/reactive systems and multi-robot systems. Additional topics include navigation, localization and mapping, and topological and metric path planning.

Required Materials

Each student is required to have their own copy of the following textbook(s).

- **Required for both 4023 and 5023:** [Springer Handbook of Robotics, Second Edition, Bruno Siciliano and Oussama Khatib \(editors\), 2016, Springer. \(ISBN 978-3-319-32550-7; e-ISBN: 978-3-319-32552-1; DOI: 10.1007/978-3-319-32552-1\)](#)
- **Required for 5023 only:** [Writing for Computer Science, Third Edition, Justin Zobel, 2014, Springer. \(ISBN 978-1-4471-6638-2\)](#)

Students are expected to read assigned chapters and materials prior to class meetings (see the course schedule [here](#)). Students should bring their textbooks to class for lectures, discussions, group work sessions, and examinations.

Additional Reading Materials

The following papers and readings will be covered in class.

1. P.H. Mowforth and P. Grant. "From Task Level Planning To Analogical Navigation." *The Autonomous Mobile Robots and Its Applications – IEEE/RSJ International Workshop on Intelligent Robots and Systems (IROS '89)*, pp. 142–146, 1989. **Access:** You can access an electronic copy of this paper through the OU library under the databases (choose "IEEE Xplore").
2. T.J. Pennings. "Do Dogs Know Calculus?" *The College Mathematics Journal*, 34(3):178–182, 2003. **Access:** You can access an electronic copy of this paper through the OU library under the databases (choose "JSTOR").

3. R.A. Brooks. "A Robust Layered Control System for a Mobile Robot." *MIT AI Lab Memo No. 864*, September 1985. **Access:** you can access an electronic copy of this paper from Prof. Brooks' website at [its new location](#).
4. R.A. Brooks. "Planning is Just a Way of Avoiding Figuring Out What To Do Next." *MIT AI Lab Working Paper No. 303*, September 1987. **Access:** MIT DSpace PDF: You can access an electronic copy of this paper from MIT at [this link](#).
5. S. Thrun. "To Know or Not to Know: On the Utility of Models in Mobile Robotics." *AI Magazine*, 18(1):47–54, 1997. **Access:** You can access an electronic copy of this paper from AAAI Press at [its new location](#).
6. R.G. Simmons, R. Goodwin, K.Z. Haigh, S. Koenig, J. O'Sullivan, and M.M. Veloso. "Xavier: Experience with a Layered Robot Architecture." *SIGART Bulletin*, pp. 22–33, Fall 1997. **Access:** A draft version of this paper is available from the group's [website](#).
7. J.S. Albus. "A Reference Model Architecture for Intelligent Systems Design." **Access:** You can access an electronic copy of this paper from CiteSeer at [this location](#).

Course Prerequisites

The prerequisites for this course are CS 2413 (Data Structures) and CS 2813 (Discrete Structures) or Math 2513 (Discrete Math) or instructor permission. You are expected to have a sufficient background in Computer Science to be able to support team projects involving robots. You are expected to have a working knowledge of a high-level object-oriented or imperative language, including a familiarity with its basic data types and control structures. A background in AI such as that provided by CS 4013 (Artificial Intelligence) may be useful but is not a requirement.

Computer Accounts and Software

All students in this class should have an account on the Computer Science Network (CSN). This will be used for writing and testing programs and sending and receiving materials electronically. Source code written for the projects **MUST** run on these machines. You may do your development work on whatever system you choose but it is your responsibility to ensure that your code runs on the CSN machines.

Communication

The primary means of transmitting class information to the students will be through announcements and discussions during class time and posts to Canvas. You are responsible for announcements made through either or both of these means.

The best way for students to communicate with the instructor is to come to scheduled office hours. If you cannot attend office hours in person, email can also be used but a quick or detailed personal response is unlikely as we get a **lot** of email and responding to email can be very time consuming. If you have not heard back within five working days, please resend your message, if it is still relevant. Students present in the classroom will get priority over emailed questions.

Students should use the email addresses listed above.

Students may communicate with one another using the discussion forums in Canvas or by other means outside of class as mutually agreed to by the students involved.

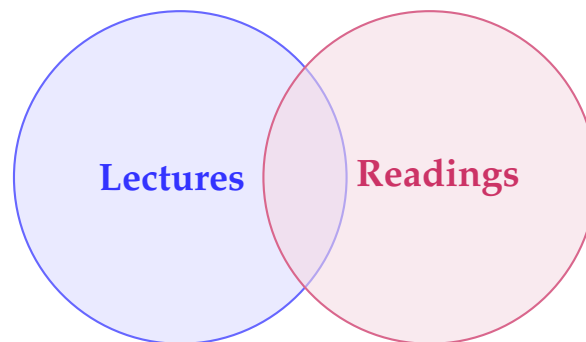
Course Evaluation and Policy

The graded assignments and their contribution to a student's grade are given in the table below. (Subject to change.)

Item	4023	5023
Exam (1)	20%	15%
Homework (6, drop lowest)	10%	5%
Group Project 1 (Simulation)	10%	5%
Group Project 2 (Real Robots)	10%	5%
Major Group Project	50%	50%
<i>Technical Paper Reviews, Presentation, and Feedback</i>	–	20%

All homework, exams, and technical paper projects in this course are to be done **ALONE**; the work submitted by a student **MUST** be the student's own. Group work is **REQUIRED** for the projects; students will select their own groups and each group will give specific roles and tasks to its group members.

You are responsible for the material covered during the lecture sessions, whether or not it is also found in your textbooks or other assigned reading materials. Similarly, you are responsible for the material found in your textbooks and other assigned reading materials, whether or not it is also covered during the lecture sessions. In other words, you are responsible for the **UNION** of these sources of knowledge, as depicted by the entire shaded region of the Venn diagram below, not merely their intersection.



You may write your programs from scratch or may start from programs for which the source code is freely available on the web or through other sources (such as friends or student organizations). If you do not start from scratch, you must give a complete and accurate accounting of where all of your code came from and indicate which parts are original, which are changed, and which you got from which other source. Failure to give credit where credit is due is academic

fraud and will be dealt with accordingly.

All work **must** properly cite sources. For example, if you quote a source in one of your technical paper reviews, you must include the quotation in quotation marks and clearly indicate the source of the quotation.

Late assignments will be penalized 20% per day late. (All parts of days will be rounded up.) After five days, you will not be able to turn in that assignment for credit. If you are worried about turning in the assignment late and losing points, turn in the assignment ahead of time. You will be turning in electronic copies of all projects and homeworks. (For projects, because they are to be done in groups, only one electronic copy needs be submitted per group regardless of the group size.)

Course Grade Scaling

Score	Final Letter Grade
[90, 100]	A
[80, 90)	B
[70, 80)	C
[60, 70)	D
(0, 60)	F

Academic Integrity and Honesty

All exams will be open book/open notes. **NO** electronic devices will be permitted in the testing area. (Note that we may be transitioning to electronic testing this semester. If that happens, then you will only be able to use a computing device running the approved software.)

Copying another's work, or possession of unauthorized electronic computing or communication devices in the testing area, is cheating and grounds for penalties in accordance with school policies. Please see [OU's academic integrity website](#).

Academic honesty is incredibly important within this course. Cheating is strictly prohibited at the University of Oklahoma, because it devalues the degree you are working hard to get. As a member of the OU community, it is your responsibility to protect your educational investment by knowing and following the rules. For specific definitions on what constitutes cheating, review [the Student's Guide to Academic Integrity](#).

Accommodations

Any student with a disability should contact the instructor so that reasonable accommodations may be made for that student.

The Accessibility and Disability Resource Center is committed to supporting students with disabilities to ensure that they are able to enjoy equal access to all components of their education. This includes your academics, housing, and community events. If you are experiencing a disability, a mental/medical health condition that has a significant impact on one or more life functions,

you can receive accommodations to provide equal access. Possible disabilities include, but are not limited to, learning disabilities, AD(H)D, mental health, and chronic health. Additionally, we support students with temporary medical conditions (broken wrist, shoulder surgery, etc.) and pregnancy. To discuss potential accommodations, please contact the ADRC at 730 College Avenue, by phone at 405.325.3852, or by email at adrc@ou.edu.

Adjustments for Pregnancy/Childbirth Related Issues

Should you need modifications or adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact your professor or the Accessibility and Disability Resource Center at 405/325-3852 as soon as possible. Also, see the Institutional Equity Office <http://www.ou.edu/eoo/faqs/pregnancy-faqs.html> for answers to commonly asked questions.

Mental Health Support Services

If you are experiencing any mental health issues that are impacting your academic performance, counseling is available at the University Counseling Center (UCC). The Center is located on the second floor of the Goddard Health Center, at 620 Elm Rm. 201, Norman, OK 73019. To schedule an appointment call (405) 325-2911. For more information, please visit [University Counseling Center](#).

Title IX Resources and Reporting Requirement

For any concerns regarding gender-based discrimination, sexual harassment, sexual misconduct, stalking, or intimate partner violence, the University offers a variety of resources, including advocates on-call 24.7, counseling services, mutual no contact orders, scheduling adjustments and disciplinary sanctions against the perpetrator. Please contact the Sexual Misconduct Office 405-325-2215 (8-5) or the Sexual Assault Response Team 405-615-0013 (24.7) to learn more or to report an incident.

Drop Policy

Any student who fails to attend the first week of class may be dropped from the class.

Religious Observance

It is the policy of the University to excuse the absences of students that result from religious observances and to provide without penalty for the rescheduling of examinations and additional required class work that may fall on religious holidays.

Emergency Protocol

During an emergency, there are official university [procedures](#) that will maximize your safety.

- **Severe Weather:** If you receive an OU Alert to seek refuge or hear a tornado siren that signals severe weather.
 1. Look for severe weather refuge location maps located inside most OU buildings near the entrances

2. Seek refuge inside a building. Do not leave one building to seek shelter in another building that you deem safer. If outside, get into the nearest building.
3. Go to the building's severe weather refuge location. If you do not know where that is, go to the lowest level possible and seek refuge in an innermost room. Avoid outside doors and windows.
4. Get in, Get Down, Cover Up
5. Wait for official notice to resume normal activities.

Additional [Weather Safety Information](#) is available through the Department of Campus Safety.

- **Armed Subject/Campus Intruder** If you receive an OU Alert to shelter-in-place due to an active shooter or armed intruder situation or you hear what you perceive to be gunshots:
 1. Avoid: If you believe you can get out of the area WITHOUT encountering the armed individual, move quickly towards the nearest building exit, move away from the building, and call 911.
 2. Deny: If you cannot flee, move to an area that can be locked or barricaded, turn off lights, silence devices, spread out, and formulate a plan of attack if the shooter enters the room.
 3. Defend: As a last resort fight to defend yourself. For more information, visit [OU's Active Shooter page](#) and [Shots Fired on Campus Procedure-video](#).
- **Fire Alarm/General Emergency:** If you receive an OU Alert that there is danger inside or near the building, or the fire alarm inside the building activates: 1. LEAVE the building. Do not use the elevators 2. KNOW at least two building exits 3. ASSIST those that may need help 4. PROCEED to the emergency assembly area 5. ONCE safely outside, NOTIFY first responders of anyone that may still be inside building due to mobility issues. 6. WAIT for official notice before attempting to re-enter the building. For more information, visit [OU Fire Safety on Campus](#).

Generative AI Policy

Generative AI can be very useful as you plan your strategy for how to approach an assignment in this class and begin to gather the information you'll need to be successful. Here is how you can use Generative AI in this class:

- **Planning:** [Goblin.tools](#) has a "Magic ToDo", which can help you break down more complicated tasks into smaller action items. This can help you in the planning stage of any assignment.
- **Brainstorming and Outlining:** You may use Generative AI to help you in the initial stages of your assignments, but you must ensure that your work goes beyond the Generative AI output. This starts with effective prompts. For example, brainstorming means thinking with Generative AI, rather than having Generative AI think for you. Instead of a prompt that says: "I have to do an assignment on a topic. What topic should I do?", you should provide more context in your prompt, share your interests, your ideas, what questions you have, and ask it to help you make a decision or to learn about topics you might be interested in given what you shared. Similarly with outlining, you should include in a prompt your initial ideas based

on what you are learning in the course and can then use AI to help you order those ideas effectively.

- **AI Research tools:** We will explore ResearchRabbit, SemanticScholar, AI research assistants in e-books, and other appropriate AI research tools to explore how AI can help you find additional sources that you can use in your exploration of our course topics.

To ensure everyone has access to the same resources, you may only use free Generative AI tools, or those that are provided to you through the university such as [Copilot](#) and AI tools with [Adobe Creative Cloud](#) (available in campus computer labs).

To implement this policy, we will have ongoing discussions in class about effective use of Generative AI and how you are using it. You'll be asked to reflect frequently about AI usage both in-class and as part of your assignment submission (see assignment instructions for specifics), where you'll also be asked to share your prompts, screenshots of your chats with Generative AI tools, and how you ensure your ideas and voice remain central in your assignment. In this class, it is important that you take the time to fully develop your own ideas and, therefore, you should not use AI to draft or revise your writing.

It is important to follow the guidelines for each assignment carefully. There may be times, such as in-class quizzes, midterms, or finals, where Generative AI usage is prohibited. I will clearly state this on any relevant assignment. Any use of Generative AI in those cases will be considered a violation of the academic integrity policy.

If you have any questions about this policy, please talk with me.

Consequences for Violating the Generative AI Usage Policy: Per our usage policy, you will be responsible for the accuracy of anything you submit, including appropriately citing and summarizing any articles you find through AI research tools, and thus must read the material you are citing. Submitting data or research that is not real (a risk when overly relying on Generative AI) may result in an academic integrity violation for falsifying information.

My Use of Generative AI: I will model appropriate Generative AI usage by clearly disclosing when I use it and why. Expected use cases include: using my notes and previous PowerPoints to improve the structure of my lectures so that they are clearer to you all as students and using AI research tools to find current articles to update our course readings. I will never use Generative AI to grade your work or to communicate with you.

Course Structure and Tentative Schedule (Subject to Change)

Week	Date	Topic	Handbook	Readings (5023)	Out	Due (5023)
1	Jan 20	Course Intro/Overview	1	ROS 2 Documentation	Tech Paper	-
	Jan 22	Deliberative Paradigm	14	Mowforth & Grant	HW1	-

Week	Date	Topic	Handbook	Readings (5023)	Out	Due (5023)
2	Jan 27	Deliberative Paradigm; Introduction to Reactive Robotics	14, 13	Pennings	HW2	Topic
	Jan 29	Reactive Paradigm	13	Brooks1; Brooks2 Zobel Ch 1, 10-11	-	HW1
3	Feb 5	Hybrid Deliberative/Reactive Paradigm	12	Thrun; Simmons Zobel Ch 12-13	HW3	HW2
	Feb 5	Hybrid Paradigm	12	Albus Zobel Ch 9	-	References
4	Feb 10	Wheeled Robots	24	- Zobel Ch 2	HW4	HW3
	Feb 12	Sensing and Estimation, Inertial Sensing, GPS, and Odometry	5, 29	- Zobel Ch 3	PR1	-
5	Feb 17	Sonar Sensing, Range Sensing	30, 31	- Zobel Ch 4	-	HW4
	Feb 19	3-D Vision for Navigation Multisensor Data Fusion	32, 35	- Zobel Ch 4	HW5	Draft Tech Review 1
6	Feb 24	World Modeling	45	- Zobel Ch 5-7	-	-
	Feb 26	Simultaneous Localization and Mapping (SLAM)	46	- Zobel Ch 14	PR2	PR1 Draft Tech Slides
7	Mar 3	Motion Planning and Obstacle Avoidance	47	-	HW6	HW5
	Mar 5	Project Two (PR2) Work	-	-	-	Review 1 Feedback
8	Mar 10	Project Two (PR2) Work	-	-	-	HW6 Tech Slides Feedback
	Mar 12	Major Project (MP) Work	-	-	MP	PR2

Week	Date	Topic	Handbook	Readings (5023)	Out	Due (5023)
9	Mar 17	No Class (Holiday)	-	-	-	-
	Mar 19	No Class (Holiday)	-	-	-	-
10	Mar 24	EXAM	Chapters Listed	Tech Readings Listed (not Zobel)	-	-
	Mar 26	Major Project (MP) Work	-	-	-	Final Tech Slides
11	Mar 31	Review Presentations	-	-	-	-
	Apr 2	Review Presentations	-	-	-	Final Tech Review 1
12	Apr 7	Major Project Work	-	-	-	-
	Apr 9	Major Project Work	-	-	-	Draft PR Slides
13	Apr 14	Major Project Work	-	-	-	Draft Tech Review 2
	Apr 16	Project Progress Reports (PRs)	-	-	-	Final PR Slides
14	Apr 21	Major Project Work	-	-	-	Review 2 Feedback
	Apr 23	Project Discussions with Groups	-	-	-	Draft Report
15	Apr 28	Major Project Work	-	-	-	Final Tech Review 2
	Apr 30	Major Project Work	-	-	-	Draft Poster
16	May 5	Major Project Work	-	-	-	Final Report
	May 7	Project Poster Presentations	-	-	-	Final Poster
Finals	None	Rejoice, you are all done! (With <i>this</i> class, of course.)	-	-	-	-