
ENPM663 BUILDING A MANUFACTURING ROBOT SOFTWARE SYSTEM
SPRING 2025

Section:	0101 & R001	Professors:	Z. Kootbally & C. Schlenoff
Credits:	3	Pronouns:	He/Him
Course Dates:	01/27/2025 - 05/13/2025	Emails:	zeidk@umd.edu & cschleno@umd.edu
Course Times:	Wednesday (4pm-6:40pm)	Office Hours:	By appointment
Classroom:	JMP 2216		

Course Description

This hands-on course will examine the key components of manufacturing robots, including architectures, planning and control, simulation, and measurement science. Students will investigate ongoing research in these areas globally and participate in small hands-on exercises in most classes to gain a deeper understanding of how selected technologies can be applied to real-world challenges. The course will feature guest presentations from field experts and will culminate in the development of a simulation-based control system designed to address challenges outlined in the Agile Robotics for Industrial Automation Competition (ARIAC) (https://pages.nist.gov/ARIAC_docs/en/latest/). A significant amount of programming is required for this course, so prior experience with C++ or Python is essential.

Learning Outcomes

After successfully completing this course you will be able to:

- Design and develop an architecture for the project.
- Develop a behavior tree for task-level planning.
- Utilize OpenCV to extract and process part information.
- Develop and manage ROS packages.
- Operate and control a robot using MoveIt2 to perform kitting and assembly tasks.
- Leverage ROS tools (e.g., RViz and RQt) for debugging and configuring joint positions.

Required Resources

The following is a list of course-level learning outcomes.

- Course Website: elms.umd.edu
- Application/Software:
 - Ubuntu 22.04.5 LTS (Jammy Jellyfish): <https://releases.ubuntu.com/jammy/>
 - ROS 2 Iron Irwini: <https://docs.ros.org/en/iron/Installation/Ubuntu-Install-Debs.html>
 - Visual Studio Code: <https://code.visualstudio.com/>

Course Structure

- Before class meetings, students need to understand the previous lessons as they need to put this knowledge into practice in the next class. At the beginning of the course, we expect the students to spend around 4 h on assignments. As we approach the end of the course, many hours of coding are expected and assignments may take between 5 to 7 h. Quizzes will be performed solely in class (unless you are registered as a remote student) and it is not allowed for absent students to take quizzes. Reports are written during students' free time.
- Class meetings are usually split between teaching a subject followed by exercises on the subject. It is crucial that all students bring a laptop since this course is hands-on and most of the exercises are performed on the laptop. Attendance and participation are key components to perform the hands-on exercises and to present assignments. Attendance and participation are not graded but highly encouraged.
- Students who do not meet the deadlines will occur a penalty during the grading of their work. Late submissions should be avoided but exceptions can be made if more than one group needs an extension on their work submission.
- No quizzes or assignments will be dropped. The only document required in this course is an individual final report and there is no alternative to the grade of the report.
- The final project consists of testing the students' program on an unseen scenario. The students will run their program in class and the performance of their work will be graded.
- A final project presentation is required at the end of semester. Students will discuss their approach and results during the presentation.
- Each student in a group needs to bring his knowledge and experience on the table. Meetings between students of the same group are crucial. To prevent students from not contributing to group projects, a **peer review system** will be put in place where each student grades the other students in her/his group based on their contributions.

Tips for Success in this Course

1. **Participate:** We invite you to engage deeply, ask questions, and talk about the course content with your classmates. You can learn a great deal from discussing ideas and perspectives with your peers and professors. Participation can also help you articulate your thoughts and develop critical thinking skills.
2. **Manage your time:** Students are often very busy, and We understand that you have obligations outside of this class. However, students do best when they plan adequate time that is

devoted to course work. Block your schedule and set aside plenty of time to complete assignments including extra time to handle any technology related problems.

3. **Login regularly:** We recommend that you log in to ELMS-Canvas several times a week to view announcements, discussion posts and replies to your posts. You may need to log in multiple times a day when group submissions are due.
4. **Do not fall behind:** This class moves at a quick pace and each week builds on the previous content. If you feel you are starting to fall behind, check in with the instructor as soon as possible so we can troubleshoot together. It will be hard to keep up with the course content if you fall behind in the pre-work or post-work.
5. **Use ELMS-Canvas notification settings:** Pro tip! Canvas ELMS-Canvas can ensure you receive timely notifications in your email or via text. Be sure to enable announcements to be sent instantly or daily.
6. **Ask for help if needed:** If you need help with ELMS-Canvas or other technology, IT Support. If you are struggling with a course concept, reach out to me and your classmates for support.

Policies and Resources for Graduate Courses

It is our shared responsibility to know and abide by the University of Maryland's policies that relate to all courses, which include topics like:

- Academic integrity
- Student and instructor conduct
- Accessibility and accommodations
- Attendance and excused absences
- Grades and appeals
- Copyright and intellectual property

Please see the University's website for graduate course-related policies at: <https://gradschool.umd.edu/course-related-policies>

Course Guidelines

Names/Pronouns and Self-Identifications

The University of Maryland recognizes the importance of a diverse student body, and we are committed to fostering inclusive and equitable classroom environments. I invite you, if you wish, to tell us how you want to be referred to in this class, both in terms of your name and your pronouns (he/him, she/her, they/them, etc.). Keep in mind that the pronouns someone uses are not necessarily indicative of their gender identity. Visit lgbtq.umd.edu to learn more.

Additionally, it is your choice whether to disclose how you identify in terms of your gender, race, class, sexuality, religion, and dis/ability, among all aspects of your identity (e.g., should it come up in classroom conversation about our experiences and perspectives) and should be self-identified, not presumed or imposed. I will do my best to address and refer to all students accordingly, and I ask you to do the same for all of your fellow Terps.

Communication with Instructor

- **Email:** If you need to reach out and communicate with us, please email us at zeidk@umd.edu or cschleno@umd.edu. Please DO NOT email us with questions that are easily found in the syllabus or on ELMS (i.e. When is this assignment due? How much is it worth? etc.) but please DO reach out about personal, academic, and intellectual concerns/questions. While we will do our best to respond to emails within 24 hours, you will more likely receive email responses from us on **Mondays, Wednesdays** and **Thursdays** from **8:00am-5:00pm EST**.
- **ELMS:** We will send IMPORTANT announcements via ELMS messaging. You must make sure that your email & announcement notifications (including changes in assignments and/or due dates) are enabled in ELMS so you do not miss any messages. You are responsible for checking your email and Canvas/ELMS inbox with regular frequency.
- **Communication with Peers:** With a diversity of perspectives and experience, we may find ourselves in disagreement and/or debate with one another. As such, it is important that we agree to conduct ourselves in a professional manner and that we work together to foster and preserve a virtual classroom environment in which we can respectfully discuss and deliberate controversial questions. I encourage you to confidently exercise your right to free speech—bearing in mind, of course, that you will be expected to craft and defend arguments that support your position. Keep in mind, that free speech has its limit and this course is NOT the space for hate speech, harassment, and derogatory language. I will make every reasonable attempt to create an atmosphere in which each student feels comfortable voicing their argument without fear of being personally attacked, mocked, demeaned, or devalued.
 - Any behavior (including harassment, sexual harassment, and racially and/or culturally derogatory language) that threatens this atmosphere will not be tolerated. Please alert us immediately if you feel threatened, dismissed, or silenced at any point during our semester together and/or if your engagement in discussion has been in some way hindered by the learning environment.

Major Assignments

- **Individual Assignments:** Individual assignments are designed to help you reinforce and apply the concepts covered in class independently. These assignments will challenge your understanding, problem-solving skills, and ability to work through tasks on your own. Detailed instructions and submission guidelines will be provided for each assignment. Timely and thorough completion is essential for your success in the course.
- **Quizzes:** Quizzes provide an effective means to assess your understanding of the course material. They are administered at the beginning of class, either on Canvas or on paper, and typically last between 10 and 20 minutes. All quizzes are conducted under closed-notes conditions.
- **Participation & Engagement:** Active participation and engagement are essential components of this course. You are expected to contribute to class discussions, ask questions, and collaborate with peers during activities. Your involvement will not only enhance your understanding of the material but also create a dynamic and interactive learning environment.
- **Team Projects:** Team projects are a critical part of this course, designed to foster collaboration and apply course concepts to real-world scenarios. Students will work in groups to complete assignments that require collective problem-solving, creativity, and effective communication. Each team member is expected to contribute actively to the project, ensuring

equitable participation and shared responsibility. Detailed instructions and evaluation criteria will be provided for each project.

- **Final Project:** The final project represents the culmination of the knowledge and skills you have gained throughout the course. In this course, the final project focuses on developing software that is robust enough to effectively handle unforeseen ARIAC configurations and challenges.

Grading Structure

Assignment	Percentage %
Individual	20%
Quizzes	20%
Team Projects	30%
Final Project	30%
Total	100%

Table 1: Grading Distribution

Academic Integrity

For this course, some of your assignments will be collected via Turnitin on our course ELMS page. I have chosen to use this tool because it can help you improve your scholarly writing and help me verify the integrity of student work. For information about Turnitin, how it works, and the feedback reports you may have access to, visit [Turnitin Originality Checker for Students](#).

The University's Code of Academic Integrity is designed to ensure that the principles of academic honesty and integrity are upheld. In accordance with this code, the University of Maryland does not tolerate academic dishonesty. Please ensure that you fully understand this code and its implications because all acts of academic dishonesty will be dealt with in accordance with the provisions of this code. All students are expected to adhere to this Code. It is your responsibility to read it and know what it says, so you can start your professional life on the right path. **As future professionals, your commitment to high ethical standards and honesty begins with your time at the University of Maryland.**

It is important to note that course assistance websites, such as CourseHero, or AI-generated content are not permitted sources unless the instructor explicitly gives permission. Material taken or copied from these sites can be deemed unauthorized material and a violation of academic integrity. These sites offer information that might be inaccurate or biased and most importantly, relying on restricted sources will hamper your learning process, particularly the critical thinking steps necessary for college-level assignments.

Additionally, students may naturally choose to use online forums for course-wide discussions (e.g., Group lists or chats) to discuss concepts in the course. However, collaboration on graded assignments is strictly prohibited unless otherwise stated. Examples of prohibited collaboration include: asking classmates for answers on quizzes or exams, asking for access codes to clicker polls, etc.

Please visit the [Office of Undergraduate Studies' full list of campus-wide policies](#) and reach out if you have questions.

Finally, on each exam or assignment you must write out and sign the following pledge: *"I pledge on my honor that I have not given or received any unauthorized assistance on this exam/assignment"*. If you ever feel pressured to comply with someone else's academic integrity violation, please reach out to me straight away. Also, if you are **ever unclear** about acceptable levels of collaboration, **please ask!** To help you avoid unintentional violations, **the following table** lists levels of collaboration that are acceptable for each graded exercise. Each assignment will contain more specific information regarding acceptable levels of collaboration.






	 Open Notes	 Use Book	 Learn Online	 Gather Content with AI	 Ask Friends	 Work in Groups
Individual Assignments	✓	✓	✓	—	✓	—
Quizzes	—	—	—	—	—	—
Team Projects	✓	✓	✓	✓	✓	✓
Final Project	✓	✓	✓	✓	✓	✓

Table 2: Guidelines for Task Completion

Grades

All assessment scores will be posted on the course ELMS page. If you would like to review any of your grades (including the exams), or have questions about how something was scored, please email me to schedule a time for us to meet and discuss.

Late work will not be accepted for course credit so please plan to have it submitted well before the scheduled deadline. I am happy to discuss any of your grades with you, and if I have made a mistake I will immediately correct it. Any formal grade disputes must be submitted in writing and within one week of receiving the grade.

Final letter grades are assigned based on the percentage of total assessment points earned. To be fair to everyone we have to establish clear standards and apply them consistently, so please understand that being close to a cutoff is not the same as making the cut (89.99 ≠ 90.00). It would be unethical to make exceptions for some and not others.

Final Grade Cutoffs									
+	97.00%	+	87.00%	+	77.00%	+	67.00%		
A	94.00%	B	84.00%	C	74.00%	D	64.00%	F	< 60.00%
-	90.00%	-	80.00%	-	70.00%	-	60.00%		

Table 3: Final Grade Cutoffs

Course Outline

Week #	Topic	Deliverables
#1 – Jan 29	Course Overview and Introduction to ROS	
#2 – Feb 5	ROS Fundamentals - Part I	
#3 – Feb 12	ROS Fundamentals - Part II	<ul style="list-style-type: none"> • Assignment #1 Handed Out
#4 – Feb 19	Architectures	<ul style="list-style-type: none"> • Quiz #1 • Assignment #1 Due • Assignment #2 Handed Out
#5 – Feb 26	ROS Interfaces and Managed Nodes	<ul style="list-style-type: none"> • Quiz #2 • Assignment #2 Due • Assignment #3 Handed Out
#6 – Mar 5	Knowledge Representation	
#7 – Mar 12	ARIAC Sensing and Perception	<ul style="list-style-type: none"> • Quiz #3 • Assignment #3 Due • Assignment #4 Handed Out
#8 – Mar 19	SPRING BREAK	
#9 – Mar 26	Task-Level Planning - PDDL	
#10 – Apr 2	Task-Level Planning - PlanSys2	<ul style="list-style-type: none"> • Assignment #4 Due • Assignment #5 Handed Out
#11 – Apr 9	Frames, Transforms, and Motion Planning	<ul style="list-style-type: none"> • Quiz #4 • Assignment #5 Due • Final Project Handed Out
#12 – Apr 16	Guest Lecture	
#13 – Apr 23	Guest Lecture	
#14 – Apr 30	Measurement Science	
#15 – May 7	Demo & Presentation	<ul style="list-style-type: none"> • Quiz #5 • Final Project Due

Table 4: Tentative Course Outline

Note: This is a tentative schedule, and subject to change as necessary – monitor the course ELMS page for current deadlines. **Weeks #12, #13, and #14** are subject to changes. In the unlikely event of a prolonged university closing, or an extended absence from the university, adjustments to the course schedule, deadlines, and assignments will be made based on the duration of the closing and the specific dates missed.

Resources & Accommodations

Accessibility and Disability Services

The University of Maryland is committed to creating and maintaining a welcoming and inclusive educational, working, and living environment for people of all abilities. The University of Maryland is also committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of the University, or be subjected to discrimination. The [Accessibility & Disability Service \(ADS\)](#) provides reasonable accommodations to qualified individuals to provide equal access to services, programs and activities. ADS cannot assist retroactively, so it is generally best to request accommodations several weeks before the semester begins or as soon as a disability becomes known. Any student who needs accommodations should contact me as soon as possible so that I have sufficient time to make arrangements.

For assistance in obtaining an accommodation, contact Accessibility and Disability Service at 301-314-7682, or email them at adsfrontdesk@umd.edu.

Student Resources and Services

Taking personal responsibility for your own learning means acknowledging when your performance does not match your goals and doing something about it. I hope you will come talk to me so that I can help you find the right approach to success in this course, and I encourage you to visit [UMD's Student Academic Support Services](#) website to learn more about the wide range of campus resources available to you.

In particular, everyone can use some help sharpening their communication skills (and improving their grade) by visiting [UMD's Writing Center](#) and schedule an appointment with the campus Writing Center.

You should also know there are a wide range of resources to support you with whatever you might need ([UMD's Student Resources and Services](#) website may help). If you feel it would be helpful to have someone to talk to, visit [UMD's Counseling Center](#) or [one of the many other mental health resources on campus](#).

Notice of Mandatory Reporting

Notice of mandatory reporting of sexual assault, sexual harassment, interpersonal violence, and stalking: As a faculty member, I am designated as a "Responsible University Employee", and I must report all disclosures of sexual assault, sexual harassment, interpersonal violence, and stalking to UMD's Title IX Coordinator per University Policy on Sexual Harassment and Other Sexual Misconduct.

If you wish to speak with someone confidentially, please contact one of UMD's confidential resources, such as [CARE to Stop Violence](#) (located on the Ground Floor of the Health Center) at 301-

741-3442 or the [Counseling Center](#) (located at the Shoemaker Building) at 301-314-7651.

You may also seek assistance or supportive measures from UMD's Title IX Coordinator, Angela Nastase, by calling 301-405-1142, or emailing titleIXcoordinator@umd.edu.

To view further information on the above, please visit the **Office of Civil Rights and Sexual Misconduct's** website at ocrsm.umd.edu.

Basic Needs Security

If you have difficulty affording groceries or accessing sufficient food to eat every day, or lack a safe and stable place to live, please visit [UMD's Division of Student Affairs website](#) for information about resources the campus offers you and let me know if I can help in any way.

Veteran Resources

UMD provides some additional supports to our student veterans. You can access those resources at the office of [Veteran Student life](#) and the [Counseling Center](#). Veterans and active duty military personnel with special circumstances (e.g., upcoming deployments, drill requirements, disabilities) are welcome and encouraged to communicate these, in advance if possible, to the instructor.

Netiquette Policy [Optional]

Netiquette is the social code of online classes. Students share a responsibility for the course's learning environment. Creating a cohesive online learning community requires learners to support and assist each other. To craft an open and interactive online learning environment, communication has to be conducted in a professional and courteous manner at all times, guided by common sense, collegiality and basic rules of etiquette.

Participation

Given the interactive style of this class, attendance will be crucial to note-taking and thus your performance in this class. Attendance is particularly important also because class discussion will be a critical component for your learning. Each student is expected to make substantive contributions to the learning experience, and attendance is expected for every session. Students with a legitimate reason to miss a live session should communicate in advance with the instructor, except in the case of an emergency. Students who miss a live session are responsible for learning what they miss from that session. Additionally, students must complete all readings and assignments in a timely manner in order to fully participate in class.

Course Evaluation

Please submit a course evaluation through Student Feedback on Course Experiences in order to help faculty and administrators improve teaching and learning at Maryland. All information submitted to Course Experiences is confidential. Campus will notify you when Student Feedback on Course Experiences is open for you to complete your evaluations at the end of the semester. Please go directly to the [Student Feedback on Course Experiences](#) to complete your evaluations. By completing all of your evaluations each semester, you will have the privilege of accessing through Tes-tudo the evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations.

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