Carnegie Mellon University
Master of
Software Engineering

17-627: Requirements for Embedded Systems
Section A2: TR 2:00pm – 3:20pm
Section D2: F 5:00pm – 6:20pm
A2, Fall 2025, 6 Units

Instructor	Email	Office Location & Hours
Scott Pavetti	spavetti@cmu.edu	zoom, by appointment
Teaching Assistant	Email	**Office Location & Hours**
Nachiket Agni	nagni@andrew.cmu.edu	zoom, by appointment

Course Description. The purpose of this course is to understand and negotiate the factors that drive embedded systems projects. Additionally, students will experience conceptualizing and analyzing a software intensive embedded system of their choosing. The course consists of lectures, weekly assignments, in class discussions, and a semester long project. For the project component, students will create an idea for an embedded product aimed at improving people's lives in some way. This idea is developed and matured throughout the course and delivered as a ready-to-go requirements document fit for downstream consumption. This course is aimed at creating software engineers capable of being product owners or team leads of embedded systems projects. This is also the prerequisite course for Quality Management.

Prior Knowledge. Students should have a background in computer science and have some understanding of software development life cycles.

Learning Objectives. After completing this course, you will be able to:

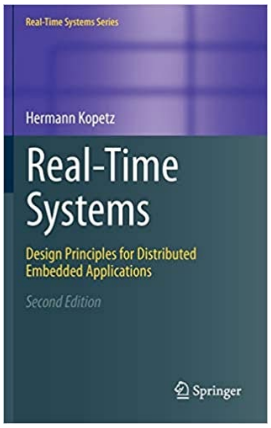
- Create and analyze requirements for software intensive embedded systems so they have quality and are suitable for downstream software engineering activities particularly verification, validation, and design.
- Analyze and identify targeted user groups and cultivate a set of diverse Personas with characteristics important to the development of software systems, and to use those personas for elicitation and refinement activities.
- Effectively use key diagramming techniques to support the analysis of software requirements in embedded systems to promote software requirements

documentation and for bridging the gap between written requirements and software architecture.

- Identify and mathematically model physical aspects of embedded systems to correctly characterize the expected behavior of the controlled system's control system requirements.

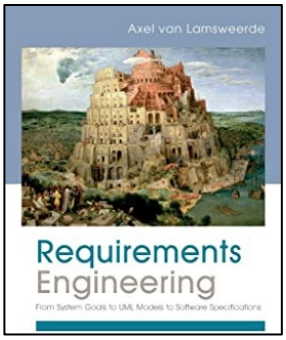
- Create a detailed concept for an embedded system that is analyzable and fit for downstream use in engineering lifecycles.

Learning Resources.



Author: Hermann Kopetz

Real-Time Systems focuses on hard real-time systems, which are computing systems that must meet their temporal specification in all anticipated load and fault scenarios. The book stresses the system aspects of distributed real-time applications, treating the issues of real-time, distribution and fault-tolerance from an integral point of view. A unique cross-fertilization of ideas and concepts between the academic and industrial worlds has led to the inclusion of many insightful examples from industry to explain the fundamental scientific concepts in a real-world setting. Compared to the first edition, new developments in complexity management, energy and power management, dependability, security, and the internet of things, are addressed. Springer, 2011. Order it from Amazon or get it from the Library at no cost.



Author: Axel van Lamsweerde (Optional Textbook)
Requirements Engineering (RE) deals with the variety of prerequisites that must be met by a software system within an organization for that system to produce stellar results. With that explanation in mind, this must-have book presents a disciplined approach to the engineering of high-quality requirements. Serving as a helpful introduction to the fundamental concepts and principles of requirements engineering, this guide offers a comprehensive review of the aim, scope, and role of requirements engineering as well as best practices and flaws to avoid. Wiley, 2009. Order it from Amazon.

Assessments. Students learn more by applying and explaining ideas to others, thus, the course requires the following activities:

- **ES Requirements Project:** In this assessment, students will create a concept for an embedded system product that is aimed at the betterment of people in the world, develop detailed requirements, use software design affordances to model requirements, and conduct peer reviews.
- **Weekly Assignments**: There will be 6 weekly assignments that are tied to reading material and lecture topics.
- **Class participation**, to enrich the discussion with your insight, relevant experience, critical questions, and analysis of the material. The quality of contribution is more important than the quantity.

Grade	Percentage Interval	Assessment	Final Grade %
A+	98-100%	Quizzes	20%
A	92-98%	Project	40%
A-	90-92%	Assignments	30%
B+	88-90%	Participation	10%
B	82-87%		
B-	80-82%		
C	70-80%		
D	60-70%		
R (F)	59% or below		

Course and Grading Policies

- **Late-work policy**: All work is expected to be handed in at the indicated due date and time. For fairness to the whole class, no late submissions will be accepted for any group work. In the first week of classes, you should receive a course schedule for each course; please use them to plan.

  Each student is allowed one late submission for individual homework assignments. You should immediately notify the course instructor before the submission deadline that you will submit late. Late work must be submitted as soon as circumstances allow, ordinarily within 24 hours of the due date. If you have any questions, you should raise them immediately rather than waiting for conflicts to arise. Late work will be assessed daily, for three days, then assessed with a score of 0. I understand that conflicts happen, so please arrange to submit late assignments ahead of time if possible.

- **Participation policy**. Class participation will be graded by in-class engagement, including asking relevant questions based on a critical review of required readings, lectures, and comments made by your peers. The lack of attendance, and the use of mobile devices, including phones and laptops, will count against your participation grade.

Course Schedule. The following schedule provides a general overview of topics and assignments. refer to the syllabus online in Canvas for specific lecture topics, reading assignments and due dates. Schedule is subject to minor changes which will be updated on canvas when they occur as well as announced during class. Readings are listed on Canvas. Please note that the schedule listed here is subject to change during the semester, and Canvas will be a more reliable source of information.

Class	Topic
Week 1	Introduction to ES, Need for Requirements Engineering, Sources of Requirements
	Elicitation
Week 2	People and Personas
	Requirement Types and Qualities
Week 3	Democracy Day
	Quality Requirements
Week 4	Operational Scenarios
	Priorities, Use Cases, Quality Attribute Scenarios
Week 5	Requirements Management
	Modeling Requirements

Class	Topic
Week 6	Requirements Quality and Reviews
	Thanksgiving – No class
Week 7	Validation and Testing Requirements
	Requirements, Risk, and Process

Academic Integrity. Honesty and transparency are important to good scholarship. Plagiarism and cheating, however, are serious academic offenses with serious consequences. If you are discovered engaging in either behavior in this course, you will earn a failing grade on the assignment in question, and further disciplinary action may be taken. Penalties are assessed after investigation and are taken on a case-by-case basis.

Use of Generative AI is strictly prohibited for all assessments in the course. Detection of unauthorized GenAI is an automatic AIV.

For a clear description of what counts as plagiarism, cheating, and/or the use of unauthorized sources, please see the University's Policy on Academic Integrity.

If you have any questions regarding plagiarism or cheating, please ask me as soon as possible to avoid any misunderstandings. For more information about Carnegie Mellon's standards with respect to academic integrity, you can also check out the Office of Community Standards & Integrity website.

Accommodation for Students Disabilities. If you have a disability and have an accommodations letter from the Disability Resources office, I encourage you to discuss your accommodation and needs with me as early in the semester as possible. I will work with you to ensure that accommodation is provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at access@andrew.cmu.edu.

Generative Artificial Intelligence (AI) Tools and Academic Integrity. During some class sessions, we may leverage generative AI tools to support your learning, provide you with an opportunity to explore how they can be used, and/or better understand their benefits and limitations. Learning how to use AI is an emerging skill, and we will work through the implications of these evolving systems together, during class sessions. However, use of generative AI will be limited to exercises during class sessions. I will always indicate when and where use of AI tools during class sessions is appropriate (and not). Examples of use during ungraded classroom exercises might include:

- brainstorming new ideas

- developing example outlines or approaches to your work, and/or
- generating different ways to talk about a problem

In contrast, you may *not* use AI tools to generate work for an assignment to be submitted for a grade, as this cannot be considered a substitute for developing the fundamental skills and expertise represented by the learning objectives of this course. Please note that generative AI tools rely on predictive models to generate content that may appear correct, but have been shown to sometimes be incomplete, inaccurate, taken without attribution from other sources, and/or biased. Consequently, an AI tool should not be considered a substitute for traditional approaches to research, and you should complete all graded assignments without any assistance from AI tools. You are ultimately responsible for the content of the information you submit and may not attempt to pass off any work generated by an AI program as your own.

Student Well-Being. I encourage you to find ways to move regularly, eat well, and reach out to your support system or me spavetti@andrew.cmu.edu if you need to. We can all benefit from support in times of stress, and this semester is no exception.

As a student, you may experience a range of challenges that can interfere with learning, such as strained relationships, increased anxiety, substance use, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may diminish your academic performance and/or reduce your ability to participate in daily activities. CMU services are available, and treatment does work. You can learn more about confidential mental health services available on campus at the Counseling and Psychological Services website. Support is always available (24/7) from Counseling and Psychological Services: 412-268-2922.

If you are worried about affording food or feeling insecure about food, there are resources on campus who can help. Email (cmu-pantry@andrew.cmu.edu) or call (412-268-8704) the CMU Food Pantry Coordinator to schedule an appointment.

We must treat every individual with respect. We are diverse in many ways, and this diversity is fundamental to building and maintaining an equitable and inclusive campus community. Diversity can refer to multiple ways that we identify ourselves, including but not limited to race, color, national origin, language, sex, disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status, or genetic information. Each of these diverse identities, along with many others not mentioned here, shape the perspectives our students, faculty, and staff bring to our campus. We, at CMU, will work to promote diversity, equity, and inclusion not only because diversity fuels excellence and innovation, but because we want to pursue justice. We acknowledge our imperfections

while we also fully commit to the work, inside and outside of our classrooms, of building and sustaining a campus community that increasingly embraces these core values.

Each of us is responsible for creating a safer, more inclusive environment.

Unfortunately, incidents of bias or discrimination do occur, whether intentional or unintentional. They contribute to creating an unwelcoming environment for individuals and groups at the university. Therefore, the university encourages anyone who experiences or observes unfair or hostile treatment based on identity to speak out for justice and support, within the moment of the incident or after the incident has passed. Anyone can share these experiences using the following resources:

- **Center for Student Diversity and Inclusion**: csdi@andrew.cmu.edu, (412) 268-2150

- **Ethics Reporting Hotline**. Students, faculty, and staff can anonymously file a report by calling **844-587-0793** or visiting **cmu.ethicspoint.com**.

All reports will be documented and deliberated to determine if there should be any following actions. Regardless of the incident type, the university will use all shared experiences to transform our campus climate to be more equitable and just.