



Carnegie Mellon University  
Master of  
Software Engineering

### 17-624: Advanced Formal Methods

MW 10:10-11:30am, GHC 4301

A2, Fall 2021, 6 Units

#### Instructor

Prof. David Garlan

Prof. Eunsuk Kang

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#### Office Location & Hours

TCS 420, by appointment

TCS 322, by appointment

#### Teaching Assistants

Simon Chu

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3SC 266, Th 5-6 pm EST

**Course Description.** This course builds on the introductory Formal Methods class (17-614) to cover more advanced techniques for modeling and reasoning about complex software systems. Concepts introduced in this course include abstraction and refinement, declarative specifications, advanced concurrency, temporal logics, and probabilistic modeling. The course will also explore applications of modeling and automated reasoning techniques in various domains, such as security, distributed computing, and cyber-physical systems.

**Prior Knowledge.** Completion of 17-614: Formal Methods or a similar course.

**Learning Objectives.** After completing this course, students will: 1. Understand how to specify and reason about operations over complex system structures; 2. Understand relationships between software artifacts at different levels of abstraction; 3. Be able to model and reason about systems with uncertainty and stochastic behaviors; and 4. Understand potential applications of modeling techniques to practical software engineering problems.

**Learning Resources.** The following textbooks are required for this course:

- **Models of Software Systems**, by David Garlan, Jeannette Wing, and Orieta Celiku. Available on Canvas.
- **Concurrency: State Models and Java Programs**, Second Edition, by Jeff Magee and Jeff Kramer. Wiley, 2006.
- **Software Abstractions: Logic, Language, and Analysis**, Revised Edition, by Daniel Jackson. MIT Press, 2011.

**Use of Zoom in the Class.** There will be no use of Zoom in this class.

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

- **Weekly homework assignments**
- **Team project**
- **Final take-home exam**
- **Class participation**

Assessment	Final Grade %
Homework	40%
Project	40%
Exam	20%

### Course and Grading Policies

- **Cooperation Policy:** We encourage you to discuss your homework with other students, but the final write-up must be your own work. It is not ok to obtain an electronic or physical copy of any other student's homework and use this as the basis for your own. If you work out ideas with someone on a whiteboard, you should erase the whiteboard before recreating your own homework. Note that when copying occurs both parties are in part to blame -- even if one person copies from another. If you have any questions about what is appropriate, please ask the instructors or the teaching assistant. Also, see the University Policy on Academic Integrity: <http://www.cmu.edu/policies/student-and-student-life/academic-integrity.html>
- **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 the group work. In the first week of classes, you should receive a course schedule for each course; please use them to plan ahead. See the grading policy on Canvas for more information about our late policy.

This semester involves regular use of technology during class. Research has shown that divided attention is detrimental to learning, so I encourage you to close any windows not directly related to what we are doing while you are in class. Please turn off your phone notifications and limit other likely sources of technology disruption, so that you can fully engage with the material, each other, and me. This will create a better learning environment for everyone.

**Attendance.** In order to attend class in person, I expect that you will abide by all behaviors indicated in [A Tartan's Responsibility](#), including any timely updates based on the current conditions.

**Facial coverings.** If you do not wear a facial covering to class, I will ask you to put one on (and if you don't have one with you, I will direct you to a distribution location on campus). If you do not comply, please remember that you will be subject to student conduct proceedings, up to and including removal from CMU. Accordingly, I will be obliged to take other measures for the safety of the whole class.

**Transferring to Fully Remove During the Semester.** If the class needs to go fully remote, you will receive an email from me and an announcement will be published on our course website on Canvas.

**Course Schedule.** The following schedule provides a general overview of topics and assignments. Please refer to the syllabus online in Canvas for specific lecture topics, reading assignments and due dates.

#	Date	Subtopic	Reading	Due
1	M 10/18	<a href="#">Course Intro</a> ↓ & <a href="#">Advanced Concurrency in FSP</a> ↓	Review <a href="#">[MK06]</a> Chapters 1-7	
2	W 10/20	<a href="#">Linear Temporal Logic</a> ↓	<a href="#">[Kat96]</a> ↓ ]	
R1	F 10/22	<a href="#">Project &amp; LTL</a> ↓		
3	M 10/25	LTL in FSP	<a href="#">[MK06]</a> Ch 14	<a href="#">HW1</a>
4	W 10/27	Abstraction & Refinement 1		
5	M 11/01	Abstraction & Refinement 2		
6	W 11/03	Probabilistic Modeling 1		
7	M 11/8	Probabilistic Modeling 2		
8	W 11/10	Probabilistic Modeling 3		
9	M 11/15	TLA+ 1		
10	W 11/17	TLA+ 2		
11	M 11/22	Petri Nets		
-	W 11/24	Thanksgiving; no classes		
12	M 11/29	[TBD]		
13	W 12/01	Project Presentations & Review		

**Accommodations for Students Disabilities.** If you have a disability and have an accommodations letter form the Disability Resources office, I encourage you to discuss your accommodations and needs with me as early in the semester as possible. I will work with you to ensure that accommodations are 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](mailto:access@andrew.cmu.edu).

**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. 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.

**Student Wellness.** We are all under a lot of stress and uncertainty at this time. Attending Zoom classes all day can take its toll on our mental health. Make sure to move regularly, eat well, and reach out to your support system or us ([eunsukk@andrew.cmu.edu](mailto:eunsukk@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](mailto: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 on the basis of 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](mailto:csdi@andrew.cmu.edu), (412) 268-2150
- **Report-It online anonymous reporting platform:** [reportit.net](https://reportit.net) username: *tartans*  
password: *plaid*

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