



Carnegie Mellon University
Master of
Software Engineering

17-635 and 17-882 Architectures for Software Systems

[M/W/F 10:40am-12:00pm, *remote instruction*]

[A3, Spring 2021, 6 Units]

Instructor	Email	Office Location & Hours
Prof. David Garlan	garlan@cs.cmu.edu	TCS 420 Fri, 5-6 and by appointment*
Dr. Bradley Schmerl	schmerl@cs.cmu.edu	Wed, 5-6, and by appointment*

Course Description. *Architectures for Software Systems* aims to teach you how to design, understand, and evaluate systems at an architectural level of abstraction. By the end of the course you will:

- Understand the technical, organizational, and business role of software architecture in software engineering.
- Recognize how architectural drivers influence the choice of architectural designs, and will be able to identify and define the key drivers for realistic software systems.
- Identify key architectural structures (styles, patterns, tactics, etc.).
- Generate architectural alternatives in a given context and choose among them Apply principles of good architectural documentation and presentation to describe a software architecture and the rationale behind its design.
- Understand the impact that open source and third party components have on architectural designs, including ways to integrate mismatched elements.
- Understand how formal notations can be used to specify architectures.
- Evaluate the fitness of an architectural design in meeting a set of system requirements and balancing quality tradeoffs.
- Be aware of the future trends in software architecture.

Prior Knowledge. Students should have had experience developing medium- to large-scale software, preferably in an industrial and team-based setting.

Lectures and Recitation: There will be two lectures and one recitation weekly. Attendance at lectures and recitations is mandatory.

Computing: A personal computer or laptop is required for this course. For some course assignments we will be using the Java programming language. You will need to download and install the Java Software Development Kit (the latest version of J2SE). You may use any editor or development environment that you like, however, each of the assignments requiring coding can be completed with a simple text editor and command line prompt.

Course Meetings: All lectures and recitations will be fully remote.

Class: Monday/Wednesday, 10:40AM - 11:50AM

Recitation: Fridays, 10:40AM – 11:50AM

Learning Resources.

Required Text: *Software Architecture in Practice, Third Edition*, by Bass, Clements, Kazman, Addison-Wesley 2013 [BCK13].

We will also use a collection of supplementary readings, which will be available through the course web site.

Auxilliary Texts: (not required, but worth owning)

- *Architecting Software Intensive Systems: A Practitioner's Guide*, Anthony Lattanze, Auerbach 2008 [Lat08].
- *Documenting Software Architectures: Views and Beyond, Second Edition*, by Paul Clements, et al. Addison-Wesley 2011 [C+11].
- *Software Architecture: Perspectives on an Emerging Discipline*, Mary Shaw and David Garlan, Prentice-Hall, 1996. [SG96]

Use of Zoom in the Class. We will be using Zoom to conduct our classes. The Zoom link is available on the Canvas course site. Please make sure that your Internet connection and equipment are set up to use Zoom and able to share audio and video during class meetings. Let us know if there is a gap in your technology set-up (garlan@cs.cmu.edu or schmerl@cs.cmu.edu) as soon as possible, and we can see about finding solutions.

Sharing video during class: Being able to see one another helps to facilitate a better learning environment and promote engaging discussions. Therefore, our default will be to expect students to have their cameras on during lectures and discussions. However, we also understand that there may be reasons students would not want to have their cameras on. If you have concerns about sharing your video, please email one of the instructors and we can discuss possible adjustments. Note: You may use a background image in your video if you wish; just check in advance that this works with your device(s) and internet bandwidth.

During our class meetings, please keep your microphone muted unless you are sharing with the class or your breakout group.

If you have a question or want to answer a question, please use the chat or the “raise hand” feature (available when the participant list is pulled up). We will be monitoring these channels in order to call on students to contribute.

Our classes may involve breakout room discussions, and those will work better if everyone in your small group has their camera turned on. During large group debriefs, you may keep your video off.

Piazza for class discussion. This term we will be using Piazza for asynchronous class discussion. The system is highly catered to getting you help fast and efficiently from classmates and instructors. Rather than emailing questions to the teaching staff, we encourage you to post

your questions on Piazza. If you have any problems or feedback for the developers, email team@piazza.com. Note that Piazza is organized into folders. Questions about assignments and the project should be directed to the `assignments_and_project` folder. Discussion about reading and lecture material should go in `discussion/week<n>`. This latter will be used for grading discussion board participation (see below).

Find our class signup link at: <https://piazza.com/cmu/spring2021/17635>

Office hours:

Bradley Schmerl Wednesday, 5-6, or appointment <http://bit.ly/2M0NDG9> to signup

David Garlan Friday, 5-6, or by appointment <http://bit.ly/2Yqt8oC> to signup

Office hour appointments are in 15 minute slots, and should be booked through the calendar at the links above. Note, if appointments are not made at least 30 minutes before the start of office hours, then office hours will be automatically canceled for the day. Please email to make a separate appointment if needed.

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

Assessment	Description	Grade %
Class participation	Attendance at lectures and recitations; level of engagement such as asking and answering questions. The quality of contribution is more important than the quantity.	10%
Discussion board participation	We will be providing an unmoderated course discussion board. Each student is expected to post at least one comment/question a week related to material of the course, and to respond to at least two other posts each week (by Sunday). The quality of contribution is more important than the quantity.	15%
Quizzes	There will be a short quiz at the start of each recitation on the material of the week. No late or make-up quizzes. The score of the lowest quiz will be dropped.	15%
Assignments	There will be 2 team assignments. Each will be allocated 2 weeks to complete. Late assignments will be penalized 10% per day.	30%
Project	Each team will produce a final project focusing on a preliminary architectural design for a relevant system, and an in-depth analysis of several architectural design choices for it.	25%
Instructor discretion	The instructors reserve a portion of the grade to account for positive and negative aspects of student performance not otherwise measured above. This includes things like general level of effort, and peer reviews from the assignments and project.	5%

Course and Grading Policies

- **Submission policy:** All assignments and projects should conform to the following:
 - All submitted assignments should be named *TeamID-AssignmentNumber* (where *TeamID* = the team id and *AssignmentNumber* = the assignment number). Example: Team1-Assignment1.docx
 - The time that the assignment is uploaded will be counted as the submission time.
 - All assignments are to be submitted to Canvas.
 - All assignments should be in either Microsoft Word or pdf format
- **Late-work policy:** All work is expected to be handed in at the indicated due date and time. Late assignments will be penalized 10% per day.
- **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.

This semester involves regular use of technology during class. Research has shown that divided attention is detrimental to learning, so we 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.

Recording of Class Sessions. All synchronous classes will be recorded via Zoom so that students in this course (and only students in the course) can watch or re-watch past class sessions. Please note that breakout rooms will not be recorded. Recordings will be made available on Canvas as soon as possible after each class session (usually within 3 hours of the class meeting). Recordings will be accessible from the course's Canvas site. Note that you are not allowed to share these recordings. This is to protect your FERPA rights and those of your fellow students.

Accommodations for Students Disabilities. If you have a disability and have an accommodations letter form the Disability Resources office, we encourage you to discuss your accommodations and needs with us as early in the semester as possible. We 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, we encourage you to contact them at 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 us 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. 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.

This semester is unlike most others. 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 the instructors if you need to. We can all benefit from support in times of stress, and this semester is no exception.

Respect for Diversity. We intend that students from all backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength, and benefit. We intend to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. We encourage and appreciate your suggestions. Please let us know if any of our class meetings conflict with your religious observations so that we can make alternate arrangements for you.

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	Major Topic	Lecture	Assignments	Readings
1	M Feb 1	Architecture Overview	What is software architecture		
2	W Feb 3		Basic Architecture Concepts		Ch 1-3 [GS94] pp.1-5
3	M Feb 8	Architecture Requirements	Architecture Drivers and Quality Attributes	A1 Assigned	Ch 4
4	W Feb 10	Styles, Platforms, Product lines, Ecosystems	Data flow & Pub/Sub		[GS94] pp.5-16
5	M Feb 15		Call/Return, Repository		
6	W Feb 17		Platforms, Frameworks, Product Lines, and Ecosystems		Ch 25 [Bos09]

7	M Feb 22	Architecture Design	Tactics for Module and C&C Views	A1 Due, A2 Assigned	Ch 5, 6, 7, 8
8	W Feb 24		Architecture Evaluation		Ch 21, [Mar+05]
9	M Mar 1	Techniques and Practices	Principles of Architecture Documentation		Ch 18
10	W Mar 3		Modeling and Analysis		
11	M Mar 8	Architecture in Practice and Future Directions	Guest Lecture TBD	A2 Due	
12	W Mar 10		Guest Lecture TBD		
13	M Mar 15		Trends and Opportunities		[GCSS04]
14	W Mar 17	Wrap-up	Review and final project presentations		[Gar 14]
	T Mar 18			Project Due	

Recitations and Quizzes

#	Date	Recitation	Quiz
1	F Feb 5	Architecture Motivation	Quiz 1 - Architecture Introduction
2	F Feb 12	Architecture Drivers	Quiz 2 - Architecture Drivers and Styles 1
3	F Feb 19	Architecture Styles	Quiz 3 - Architecture Styles
4	F Feb 26	Tactic Practice	Quiz 4 - Architecture Tactics and Evaluation
5	F Mar 5	Architecture Documentation	Quiz 5 - Techniques
6	F Mar 12	Project Progress Review	Quiz 6 - Practices

References

GS94	Introduction to Software Architecture. David Garlan and Mary Shaw. CMU Technical Report CMU-CS-94-166. 1994.
Bos09	From Software Product Lines to Software Ecosystems. Jan Bosch.
Mar+05	Architecture Reviews: Practice and Experience. J. Maranzano, S. Rozsygal, G. Warnken, D. Weiss, P. Wirth, and G. Zimmerman. <i>IEEE Software</i> 2005

GCSS04	Rainbow: Architecture-Based Self-Adaptation with Reusable Infrastructure. Garlan, Cheng, Schmerl, Steenkiste. <i>IEEE Computer</i> 0018-9162/04/2004.
Gar14	Software Architecture: A Travelogue. David Garlan, ACM978-1-4503-2865-4/14/05.