



Carnegie Mellon University
Master of
Software Engineering

17-625: Design Patterns and API Design

MW 1:30 -2:50pm, Remote (recorded)

F 8:00 – 9:00am, Remote (live)

[A2, Fall 2020, 6 Units]

Last Update: 10/20/20

Instructor

Prof. Matthew Bass

Email

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Office Location & Hours

SCR 267 (currently remote)

Zoom ID: 3609899473

By appointment

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By appointment

Teaching Assistants

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Course Description. Design patterns describe a reusable solution to a commonly recurring problem. In object-oriented programming languages, they include creational patterns for generating new objects, structural patterns for organizing and restricting access among objects, and behavioral patterns for managing inter-object communications. This course will teach the basics of software design patterns, when to apply and when not to apply them, how to tailor them to a specific context, how to compose them with other design patterns, how to make design decisions involving design patterns, and how to integrate them in the overall software development process.

This course will also introduce students to concepts in application programmer interface (API) design in order to inform students about how to design frameworks and libraries to solve common problems.

A theme for this course is exploring and understanding the dual purposes of software artifacts: communication with machines and communication with people. APIs serve as specifications for machine interactions, but they also serve to:

- Convey the structures and correct usages of software components
- Demarcate responsibilities of components
- Document communication protocols

Prior Knowledge. Students are expected to be familiar with programming in at least one, preferably object-oriented, programming language. Formal programming language training is

not required. Students may not have any formal background in algorithms, data structures, analysis, or detailed design techniques and methods.

Previous coursework in computer science (such as data structures or algorithms) is not necessary. However, students should have some experience writing small programs or software applications. Students in doubt regarding their experience should obtain instructor's permission.

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

- Collaborate effectively with other stakeholders regarding software design
- Refactor existing code to transform it according to a desired structure, while maintaining existing functionality.
- Propose and refine designs for APIs and libraries according to design requirements.
- Leverage knowledge about the applicable context, consequences, and trade-offs related to well-known design patterns to use them appropriately in software design and programming activities

Learning Resources. The course and all course materials will be distributed online and accessible with a CMU account. We recommend owning a copy of "Design Patterns: Elements of Reusable Object-Oriented Software Design" (also known as the "GoF Book"). It is also [available online via CMU](#), but since it will be heavily used in this course, it is worth having a hard copy.

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

- **Lecture and Reading Assessments:** These are short online questions derived from the required readings and lectures
- **Class participation:** There are exercises students will do in recitations in pairs or small groups to practice applying the concepts learned in the course as well as participation in online discussions in Piazza
- **Individual Homework Assignments:** These will be primarily programming and reflection assignments based on the concepts learned throughout the course
- **Final Exam**

Assessment	Final Grade %
Lecture & Reading Activities	20%
Individual Homework	30%
Final Exam	30%

Class participation	20%
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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 or makeups will be accepted for the Lecture & Reading Activities. We will, however, drop the lowest grade. The penalty for turning in Individual Homeworks late is 10%/day. In the first week of classes, you should receive a course schedule for each course; please use them to plan ahead. If you have any questions you should raise them immediately rather than waiting for conflicts to arise.
- **Participation policy.** Class participation will be graded by in-class engagement, including asking relevant questions based on a critical review of required readings and lectures, preparation for any in-class exercises, and responses on the class discussion board. The lack of attendance and participation, will count against your participation grade.

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.

Class	Lectures (questions due at 1:30 EST pm on date listed)	Quizzes	Assignments Due	Readings
10/26	Course Intro – Intro to Modularity			
10/28	Code Smells	Quiz 1		
11/2	Introduction to API Design			
11/4	Design Process	Quiz 2	Assignment 1	
11/9	General Principles of Good Design I			
11/11	General Principles of Good Design II	Quiz 3	Assignment 2	
11/16	Documentation			
11/18	Exception Design	Quiz 4	Assignment 3	
11/23	Patterns Intro	Quiz 5		Pattern Descriptions
11/25	No Class – Thanksgiving			
11/30	OOP Patterns (Context-Tailoring, Variants)			Pattern Descriptions

12/2	OOP Patterns (Pattern Compounds)	Quiz 6	Assignment 4	Pattern Descriptions
12/7	Resource Management Patterns & Functional Patterns			Pattern Descriptions
12/9	Patterns in Patterns	Quiz 7	Assignment 5	Pattern Descriptions
12/11	Final			

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.

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. 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.

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, (412) 268-2150
- **Report-It online anonymous reporting platform:** 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.