

# SWE 621: Software Design and Architecture

Master of Science in Computer Science

## Course Information

An examination of the methods, processes, and notations for working with architecture and design in software. Exploration of design as the enumeration, evaluation, and selection of design alternatives to achieve quality attributes. Surveys perspectives on design from risk minimization, domain modeling, abstraction, architectural styles, design patterns, and reuse. Offered by Computer Science. May not be repeated for credit.

## PROGRAM OBJECTIVES

After completing the program, students will demonstrate an ability to:

- 1) **Foundations of Computer Science:** apply mathematical foundations and algorithmic principles in the modeling and design of computing systems.
- 2) **Computer Systems Fundamentals:** apply fundamental concepts in computer systems to model, design, and implement a computer-based system, process, or program that meets desired needs.
- 3) **Information Processing Fundamentals:** apply fundamental concepts in information processing to model, design, and implement a computer-based system, process, or program that meets desired needs.
- 4) **Advanced Computer Systems:** use advanced concepts in computer systems to design, implement, and evaluate a computer-based system, process, component, or program.
- 5) **Advanced Information Processing:** use advanced information processing concepts to design, implement, and evaluate a computer-based system, process, component, or program.

## COURSE DESCRIPTION

An examination of the methods, processes, and notations for working with architecture and design in software. Exploration of design as the enumeration, evaluation, and selection of design alternatives to achieve quality attributes. Surveys perspectives on design from risk minimization, domain modeling, abstraction, architectural styles, design patterns, and reuse. Offered by Computer Science. May not be repeated for credit.

## COURSE METHODOLOGY

Online discussions, peer review and other exercises, writing assignments (reflections, mini-papers, essay, etc.), and video presentation, are all major components of this course and are meant to provide opportunities to collaborate with your colleagues and instructor.

## COURSE OBJECTIVES

After completing the course, learners will be able to:

- Explain software requirements, architecture and design concepts and methods for large-scale systems.
- Explain why modeling is an important aspect of modern software intensive systems.
- Develop and document software requirements and architecture and design artifacts.
- Articulate software architecture and design decisions and reason about trade-off decisions made during the architecting and design processes.

## PREREQUISITES

- Recommended Prerequisite: SWE foundation courses or equivalent.

## Instructor Information

Refer to the Blackboard course shell for section-specific instructor contact, biography, and office hours information.

## Course Resources

### TEXTBOOKS AND READINGS

- No required textbook for this course.

### COMPUTER REQUIREMENTS

#### HARDWARE

You will need access to a Windows or Macintosh computer with at least 2 GB of RAM and to a fast, reliable broadband Internet connection (e.g., cable, DSL). For optimum visibility of course material, the recommended computer monitor and laptop screen size is 13-inches or larger. You will need computer speakers or headphones to listen to recorded content. A headset microphone is recommended for live audio sessions using course tools like Blackboard Collaborate. For the computer hard disk space required to take an online course, consider and allow for the space needed to:

- The storage amount needed to install any required and additional software and
- Save your course assignments.

For hardware and software purchases, visit [Patriot Computers](#).

You are strongly encouraged to back up all contents of your computer on a regular basis. Loss of data will not excuse late or unsubmitted assignments.

#### SOFTWARE

You will need a browser and operating system that are listed compatible or certified with the Blackboard version available on the [myMason Portal](#). See [supported browsers and operating systems](#). Log in to [myMason](#) to access your registered courses. Some courses may use other learning management systems. Check the syllabus or contact the instructor for details. Online courses typically use [Acrobat Reader](#), [Flash](#), [Java](#), and [Windows Media Player](#), [QuickTime](#) and/or [Real Media Player](#). Your computer should be capable of running current versions of those applications. Also, make sure your computer is protected from viruses by downloading the latest version of Symantec Endpoint Protection/Anti-Virus software for free [here](#).

You will also need a tool such as StarUML for creating UML diagrams.

Note: If you are using an employer-provided computer or corporate office for class attendance, please verify with your systems administrators that you will be able to install the necessary applications and that system or corporate firewalls do not block access to any sites or media types.

#### UPDATING YOUR COMPUTER

Please be sure to update your computer and prepare yourself to begin using the online format BEFORE the first day of class.

## Grading Information

### GRADING SCALE

The following table describes the grading system:

GRADE	PERCENTAGE
A	94 and above
A-	90 – 93
B+	87 – 89
B	84 – 86
B-	80 – 83
C	70 – 79
F	Less than 70

### LETTER GRADING DESCRIPTIONS:

Listed below are grades and academic standards for each grade awarded.

- A:** Consistently performs above and beyond the course/assignment requirements
- B:** Meets and occasionally exceeds the course/assignment requirements
- C:** Minimally meets the course/assignment requirements
- F:** Fails to meet the course/assignment requirements

### CATEGORIES AND WEIGHTS

The following table lists the types of graded activities in this course and each category's weight in the final course grade.

ASSIGNMENT CATEGORY	% OF OVERALL COURSE GRADE
<b>Class Participation Activities</b> (Completion based activities, Reflections, and other individual assignments)	35%
<b>Mini papers</b>	15%
<b>Mid-term presentation</b>	20%
<b>Final essay</b>	30%
<b>TOTAL:</b>	<b>100%</b>

## LATE ASSIGNMENTS

Any graded assignments that are submitted late (up to 48 hrs late) will be assessed a 10% penalty. Work submitted after 48 hours after the due date will receive a grade of zero. Quizzes and Exams must be completed on-time unless an extenuating circumstance exists and is discussed with your instructor ahead of time.

## GRADED ITEM DESCRIPTIONS

### Class Participation Activities 35%

These activities include assignments that fall under one of three categories below:

1. Completion based exercises: These assignments (including but not limited to online discussions, peer reviews, and other individual assignments) provide you an opportunity to demonstrate your understanding of the topics covered. They will be graded based on completion.
2. Reflections: These assignments encourage you to reflect on the material covered and record your thoughts.
3. Other module assignments: These assignments provide you an opportunity to apply what you have learned to solve the assigned problems.

### Mini papers 15%

These assignments are intended to encourage you to delve deeper into certain topics and nurture critical thinking. You will be required to write around 500-650 words for each mini paper.

### Mid-term presentation 20%

This assignment provides you an opportunity to explore a given topic and create a video presentation explaining that topic.

### Final essay 30%

This assignment is intended to nurture critical thinking and help you demonstrate your understanding of the various topics covered in this course by applying what you have learned to address the questions posed.

## Policies and Services

Note the policies and services explained below are the same as those available through George Mason University. You are encouraged to review them in detail and follow the links to learn more about the policies you are required to abide by and the services available to you.

## MASON HONOR CODE

To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University community and with the desire for greater academic and personal achievement, we, the student members of the university community, have set forth this honor code:

**Student members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work.**

You are expected to familiarize yourself with and adhere to the Honor Code. Student members of the George Mason University community pledge not to cheat, plagiarize, steal, and/or lie in matters related to academic work.

For additional important information, including the Honor Code definitions of cheating, plagiarism, stealing, and lying, see the George Mason University [Academic Integrity page](#).

All students are expected to abide by the [GMU Honor Code](#) and the [CS Department Honor Code](#). This policy is rigorously enforced. All class-related assignments are considered individual efforts unless explicitly expressed otherwise (in writing). Review the university honor code and present any questions regarding the policies to instructor. Cheating on any assignment will be prosecuted and result in a notification of the Honor Committee as outlined in the GMU Honor Code.

**All work submitted in this course must be your own original work; use of AI writing tools, such as ChatGPT, are prohibited in this course and will be considered a violation of academic integrity. All academic integrity violations will be reported to the office of Academic Integrity.**

### ACADEMIC INTEGRITY EXPECTATIONS

1. Working online requires dedication and organization. Proper preparation is expected every week. You are expected to log in to the course each week and complete the assignments and activities on or before the due dates.
2. Students must check their GMU email messages on a daily basis for course announcements, which may include reminders, revisions, and updates.
3. It is expected that you will familiarize yourself with and adhere to the Honor Code. Student members of the George Mason University community pledge not to cheat, plagiarize, steal, and/or lie in matters related to academic work.
4. It is essential that you promptly communicate any questions or problems to the instructor.

### INDIVIDUALS WITH DISABILITIES

**The university is committed to providing equal access to employment and educational opportunities for people with disabilities.**

Mason recognizes that individuals with disabilities may need reasonable accommodations to have equally effective opportunities to participate in or benefit from the university educational programs, services, and activities, and have equal employment opportunities. The university will adhere to all applicable federal and state laws, regulations, and guidelines with respect to providing reasonable accommodations as necessary to afford equal employment opportunity and equal access to programs for qualified people with disabilities.

Applicants for admission and students requesting reasonable accommodations for a disability should call the Office of Disability Services at 703-993-2474. Employees and applicants for employment should call the Office of Equity and Diversity Services at 703-993-8730. Questions regarding reasonable accommodations and discrimination on the basis of disability should be directed to the Americans with Disabilities Act (ADA) coordinator in the Office of Equity and Diversity Services.

### EMAIL POLICY

Mason uses electronic mail to provide official information to students. Examples include notices from the library, notices about academic standing, financial aid information, class materials, assignments, questions, and instructor feedback.

Students are responsible for the content of university communication sent to their Mason e-mail account and are required to activate that account and check it regularly.

Students are also expected to maintain an active and accurate mailing address in order to receive communications sent through the United States Postal Service

## **ADDITIONAL SERVICES AND POLICIES**

### **UNIVERSITY POLICIES**

Students must follow the university policies. See [University Policies](#).

### **DIVERSITY**

George Mason University promotes a living and learning environment for outstanding growth and productivity among its students, faculty and staff. Through its curriculum, programs, policies, procedures, services and resources, Mason strives to maintain a quality environment for work, study and personal growth.

### **RESPONSIBLE USE OF COMPUTING**

You are expected to adhere to the university policy for Responsible Use of Computing. See [University Policies/Computing](#).

### **STUDENTS WITH DISABILITIES**

Students with disabilities who seek accommodations in a course must be registered with the George Mason University Office of Disability Services (ODS) and inform their instructor, in writing, at the beginning of the semester.

### **UNIVERSITY LIBRARIES**

University Libraries provides Library services for distance students.

### **WRITING CENTER**

The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing.

You can now sign up for an Online Writing Lab (OWL) session just as you may sign up for a face-to-face session in the Writing Center, which means YOU set the date and time of the appointment.

### **COUNSELING AND PSYCHOLOGICAL SERVICES (CAPS)**

The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance.

### **FAMILY EDUCATIONAL RIGHTS AND PRIVACY ACT (FERPA)**

The Family Educational Rights and Privacy Act of 1974 (FERPA), also known as the "Buckley Amendment," is a federal law that gives protection to student educational records and provides students with certain rights.

## Course Schedule

MODULE	TITLE	GRADED ACTIVITIES AND ASSIGNMENTS
1	Introduction, SDLC, Software Processes	<p><b>Topics</b></p> <ul style="list-style-type: none"> <li>● Software Engineering – Introduction</li> <li>● Software Processes</li> </ul> <p><b>Activities</b></p> <ul style="list-style-type: none"> <li>● Introduce yourself</li> <li>● Investigation – Software Engineering Trends</li> <li>● Online discussion/ seminar conversation</li> <li>● Reflection</li> </ul>
2	Agile methods overview; Designing for the user	<p><b>Topics</b></p> <ul style="list-style-type: none"> <li>● Agile Philosophy – An overview</li> <li>● How do agile methods work?</li> <li>● Scrum and XP</li> <li>● Designing for the user</li> </ul> <p><b>Activities</b></p> <ul style="list-style-type: none"> <li>● Reflection</li> </ul>
3	Requirements Engineering; Agile requirements engineering; Formulating and evaluating requirements.	<p><b>Topics</b></p> <ul style="list-style-type: none"> <li>● Requirements Engineering – Introduction</li> <li>● Requirements Engineering Process</li> <li>● Agile Requirements Engineering</li> </ul> <p><b>Activities</b></p> <ul style="list-style-type: none"> <li>● Assignment – Use case description</li> <li>● Mini Paper 1</li> </ul>
4	Introduction to Software Architecture	<p><b>Topics</b></p> <ul style="list-style-type: none"> <li>● Software Architecture – Introduction</li> <li>● Software Architecture Patterns</li> </ul> <p><b>Activities</b></p> <ul style="list-style-type: none"> <li>● Assignment – Architecture Design</li> </ul>



5	<b>Understanding quality attributes; Architecturally significant requirements</b>	<p><b>Topics</b></p> <ul style="list-style-type: none"> <li>● Architecture and non-functional requirements/ quality attributes</li> <li>● Architecture Patterns</li> <li>● Architecturally significant requirements</li> </ul> <p><b>Activities</b></p> <ul style="list-style-type: none"> <li>● Online Discussion</li> <li>● Assignment – Reverse Engineering Architecture Decisions</li> </ul>
6	<b>Designing and Evaluating an Architecture</b>	<p><b>Topics</b></p> <ul style="list-style-type: none"> <li>● Designing an architecture</li> <li>● Evaluating an architecture</li> </ul> <p><b>Activities</b></p> <ul style="list-style-type: none"> <li>● Mini Paper 2</li> </ul>
7	<b>Mid-term Presentations</b>	<p><b>Topics</b></p> <ul style="list-style-type: none"> <li>● No new lecture topics</li> </ul> <p><b>Activities</b></p> <ul style="list-style-type: none"> <li>● Mid-term presentation – video presentation</li> </ul>
8	<b>Documenting an Architecture</b>	<p><b>Topics</b></p> <ul style="list-style-type: none"> <li>● Documenting an architecture</li> </ul> <p><b>Activities</b></p> <ul style="list-style-type: none"> <li>● Online Discussion - Peer feedback</li> <li>● Assignment – 4+1 View Model</li> </ul>
9	<b>Software design</b>	<p><b>Topics</b></p> <ul style="list-style-type: none"> <li>● Software Design – Introduction</li> <li>● Design Patterns</li> <li>● Implementation issues and design metrics</li> </ul> <p><b>Activities</b></p> <ul style="list-style-type: none"> <li>● Online Discussion - Peer Reflection</li> </ul>
10	<b>Documenting design</b>	<p><b>Topics</b></p> <ul style="list-style-type: none"> <li>● Documenting software design</li> </ul>

		<ul style="list-style-type: none"> <li>An overview of UML diagrams</li> </ul> <p><b>Activities</b></p> <ul style="list-style-type: none"> <li>Online Discussion – Peer Feedback</li> <li>Assignment – UML Diagrams</li> </ul>
11	<b>Refactoring Design</b>	<p><b>Topics</b></p> <ul style="list-style-type: none"> <li>Design smells</li> <li>Refactoring to address design smells</li> <li>Software aging</li> </ul> <p><b>Activities</b></p> <ul style="list-style-type: none"> <li>Mini Paper 3</li> </ul>
12	<b>Evaluating design</b>	<p><b>Topics</b></p> <ul style="list-style-type: none"> <li>The importance of assessing the quality of design</li> <li>Evaluating designs</li> </ul> <p><b>Activities</b></p> <ul style="list-style-type: none"> <li>Online Discussion – Peer Reflection</li> </ul>
13	<b>Design for change and reuse</b>	<p><b>Topics</b></p> <ul style="list-style-type: none"> <li>Design patterns</li> <li>Why are patterns important?</li> <li>How to write software patterns?</li> <li>Software product lines and ecosystems</li> </ul> <p><b>Activities</b></p> <ul style="list-style-type: none"> <li>Assignment – Reverse Engineering Design Patterns</li> </ul>
14	<b>Final Review</b>	<p><b>Topics</b></p> <ul style="list-style-type: none"> <li>No new lecture topics</li> </ul> <p><b>Activities</b></p> <ul style="list-style-type: none"> <li>None</li> </ul>
15	<b>Final Essay</b>	<p><b>Topics</b></p> <ul style="list-style-type: none"> <li>No new lecture topics</li> </ul>

		<b>Activities</b> <ul style="list-style-type: none"><li>● Final Essay</li></ul>
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