
Software Architecture and Design

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1. Overview

Software Architecture and Design (SE464)¹ "Introduces students to the design, implementation, and evolution phases of software development. Software design processes, methods, and notation. Implementation of designs. Evolution of designs and implementations. Management of design activities." Course catalog.²

2. Contact

Lectures are held **Tuesday and Thursday from 10:00 to 11:20 in MC 4061**. Tutorials are held **Friday from 11:30 to 12:20 in RCH 112**. Lab is not scheduled and students are expected to find time in open hours to complete their work.

My office hours are **by appointment** and will be held in my office, EIT 4007. I will also be available immediately after lectures. See contact details³.

Course material, announcements, and submissions will be handled through Learn⁴.

Begin all email subjects with [SE464].

Try not to leave your questions until the last minute.

¹ <http://www.adm.uwaterloo.ca/cgi-bin/cgiwrap/infocour/salook.pl?level=ugrad&sess=1189&subject=SE&cournum=464>

² <http://www.ucalendar.uwaterloo.ca/1819/COURSE/course-SE.html#SE464>

³ <https://ece.uwaterloo.ca/~wdietl/contact.html>

⁴ <https://learn.uwaterloo.ca/d2l/home/414233>

2.1. Teaching assistants

The course is assisted by:

- Homa Aghilinasab `haghilinasab@`
- Daniel Caccamo `dgcaccam@`
- Ruoxuan Xu `ruoxuan.xu@`

Meetings by appointment.

3. Course expectations

It is expected that students attend all lectures and complete the required assignments. Lectures and tutorials will often include hands-on activities; participation in these exercises is essential to succeed in the class. Slides will be provided via Learn. Any material discussed in class (lectures & tutorials) or in the required readings will be testable unless otherwise noted.

By the end of the course you should be able to:

- propose and analyze software architectures.
- explain the strengths and weaknesses of various architectural styles and design patterns / techniques.
- communicate and rationalize architectural and design decisions.
- ideate, justify, and implement software designs.
- evaluate, compare, and contrast different architectures and designs.

4. Overview of topics

- Software architecture, architectural styles, and architectural representations
- Software design, design patterns, design representations
- Software architecture and design conception, analysis, and communication
- Architecture and design recovery / reverse engineering
- Architecture and design visualization / understanding
- Cloud / grid computing architectures

5. Course material

While the course does not have a required textbook, much of the materials will be sourced from the following texts; additional books are supplementary.

- Robert C. Martin. *Clean Architecture: A Craftsman’s Guide to Software Structure and Design*. Available for purchase online⁵.
- Richard N. Taylor, Nenad Medvidovic, and Eric Dashofy. *Software Architecture. Foundations, Theory, and Practice*. Available in the library or for purchase (e.g., through Amazon.ca⁶). Slides for this book are available online⁷.
- Ian Gorton. *Essential Software Architecture*. Available online⁸ or for purchase (e.g., through Amazon.ca⁹). Slides for this book are available online¹⁰.
- Fred P. Brooks Jr. *The Mythical Man Month*. Available in the library or for purchase (e.g., through Amazon.ca¹¹).
- Fred P. Brooks Jr. *The Design of Design*. Unfortunately not in the library but still available e.g. through Amazon.ca¹².
- *The Architecture of Open Source Applications*. Available online¹³.
- Kai Qian, Xiang Fu, Lixin Tao, Chong-wei Xu. *Software Architecture and Design Illuminated*. Available for purchase online¹⁴.

6. Course schedule

Lecture material is available through Learn¹⁵.

This is a tentative schedule that will get adapted during the term.

Week	Class
1	Introduction, organization, and overview
2	Decomposition, Non-functional properties, Architecture
3	Architectural Styles
4	Architectural Styles

⁵ https://books.google.ca/books/about/Clean_Architecture.html?id=8ngAkAEACAAJ

⁶ [http://www.amazon.ca/gp/product/0470167742?](http://www.amazon.ca/gp/product/0470167742?ie=UTF8&tag=s01ae8-20&linkCode=as2&camp=15121&creative=330641&creativeASIN=0470167742)

[ie=UTF8&tag=s01ae8-20&linkCode=as2&camp=15121&creative=330641&creativeASIN=0470167742](http://www.amazon.ca/gp/product/0470167742?ie=UTF8&tag=s01ae8-20&linkCode=as2&camp=15121&creative=330641&creativeASIN=0470167742)

⁷ <http://www.softwarearchitecturebook.com/resources/>

⁸ <http://bit.ly/9RF18P>

⁹ [http://www.amazon.ca/gp/product/3540287132?](http://www.amazon.ca/gp/product/3540287132?ie=UTF8&tag=s01ae8-20&linkCode=as2&camp=15121&creative=330641&creativeASIN=3540287132)

[ie=UTF8&tag=s01ae8-20&linkCode=as2&camp=15121&creative=330641&creativeASIN=3540287132](http://www.amazon.ca/gp/product/3540287132?ie=UTF8&tag=s01ae8-20&linkCode=as2&camp=15121&creative=330641&creativeASIN=3540287132)

¹⁰ <https://docs.google.com/viewer?url=http://www.ug.it.usyd.edu.au/~iango/home/ESA-Slides.pdf>

¹¹ [http://www.amazon.ca/gp/product/0201835959?](http://www.amazon.ca/gp/product/0201835959?ie=UTF8&tag=s01ae8-20&linkCode=as2&camp=15121&creative=330641&creativeASIN=0201835959)

[ie=UTF8&tag=s01ae8-20&linkCode=as2&camp=15121&creative=330641&creativeASIN=0201835959](http://www.amazon.ca/gp/product/0201835959?ie=UTF8&tag=s01ae8-20&linkCode=as2&camp=15121&creative=330641&creativeASIN=0201835959)

¹² [http://www.amazon.ca/gp/product/0201362988?](http://www.amazon.ca/gp/product/0201362988?ie=UTF8&tag=s01ae8-20&linkCode=as2&camp=15121&creative=330641&creativeASIN=0201362988)

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¹³ <http://aosabook.org/en/index.html>

¹⁴ https://books.google.ca/books/about/Software_Architecture_and_Design_Illumin.html?id=aK9N6596BIIC

¹⁵ <https://learn.uwaterloo.ca/d2l/home/414233>

Week	Class
5	Modeling, Design Patterns
6	Design Patterns
7	Frameworks
8	Architecture of Open-Source Applications
9	Dependency Injection, Cloud/REST Architectures
10	Service-oriented-Architectures, Microservices
11	Languages: Scala, Checker Framework, TypeScript, etc.
12	Real-time systems, IoT, AI, Blockchain, etc.
13	Outlook and summary

7. Assessment

Deliverable	Date	Format	Value
Design background	Sept 12	Learn	
Design Assignment	Oct 12	PeerScholar	10%
Midterm	Oct 23	In Class	20%
Architecture Assign.	Nov 16	PeerScholar	10%
Reading/Participation	Several	Learn	10%
Final Exam	TBD	Written	50%

This is a tentative schedule that will get adapted during the term.

Details for the assignments and reading/participation components will be provided separately.

You must pass the final exam and all assignments to pass the course.

No late submissions will be accepted.

Grades may be curved or adjusted at instructor's discretion.

8. Policies

Academic Integrity

- In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [See the academic integrity¹⁶ site for more information.]

¹⁶ <http://www.uwaterloo.ca/academicintegrity/>

- Turnitin.com: Text matching software (Turnitin®) will be used to screen assignments in this course. Turnitin® is used to verify that all materials and sources in assignments are documented. Students' submissions are stored on a U.S. server, therefore students must be given an alternative (e.g., scaffolded assignment or annotated bibliography), if they are concerned about their privacy and/or security. Students will be given due notice, in the first week of the term and/or at the time assignment details are provided, about arrangements and alternatives for the use of Turnitin® in this course. It is the responsibility of the student to notify the instructor if they, in the first week of term or at the time assignment details are provided, wish to submit the alternate assignment.

Grievance

- A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70¹⁷, Student Petitions and Grievances, Section 4.
- When in doubt please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline

- A student is expected to know what constitutes academic integrity¹⁸ to avoid committing an academic offence, and to take responsibility for his/her actions.
- A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean.
- For information on categories of offences and types of penalties, students should refer to Policy 71¹⁹, Student Discipline.
- For typical penalties check Guidelines for the Assessment of Penalties²⁰.

Appeals

- A decision made or penalty imposed under Policy 70 (Student Petitions and Grievances) (other than a petition) or Policy 71 (Student Discipline) may be appealed if there is a ground.
- A student who believes he/she has a ground for an appeal should refer to Policy 72²¹, Student Appeals.

Note for Students with Disabilities

- AccessAbility Services²², located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without

¹⁷ <http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm>

¹⁸ <http://www.uwaterloo.ca/academicintegrity/>

¹⁹ <http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm>

²⁰ <http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm>

²¹ <http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm>

²² <https://uwaterloo.ca/disability-services/>

compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the AccessAbility Services at the beginning of each academic term.

9. Acknowledgments

Thanks to Derek Rayside, Reid Holmes, and Krzysztof Czarnecki for sharing their experience and materials from previous iterations of this and a similar course, CS 446, Winter 2014²³.

²³ <https://cs.uwaterloo.ca/~rtholmes/teaching/2014winter/cs446/index.html>