Object-Oriented Design
(CS 5004 / CS 5005)

Khoury College of Computer Sciences

Northeastern University, Vancouver Campus

Summer 2024 Semester

We acknowledge that the land on which we gather is the unceded territory of the Coast Salish Peoples, including the territories of the xʷməθkʷəy̓əm (Musqueam), Sḵwx̱wú7mesh(Squamish), and səl̓ílwətaɬ (Tsleil-Waututh) Nations.

Section	Class Hours	Classroom	Instructor
CS 5004 section 4 (CRN 52811)	Monday 10:45 am – 12:45 pm	1526	Lino Coria
CS 5005 section 4 (CRN 52813)	Wednesday 10:45 am – 12:45 pm	1526	Sommer Harris

Office Hours
- Lino Coria: Monday 9:30 am – 10:30 am, Tuesday 10 am – 11 am (Pacific Time)
- Teaching Assistants (TBD)

Office Hours will be held online. Because of this, please use Microsoft Bookings to book an appointment. Also note that remote connectivity problems may cause quality of service that are beyond our control. If those issues arise, we reserve the right to end/suspend the online hours at our discretion.

Course Materials
The required reading for this course is provided on the course Canvas page. Students are expected to read each module's materials as well as view any of the supplemental videos before attempting that module's assignments. Trying to do the assignments without reading the posted material or watching the videos will make the assignments much harder than they are designed to be. For some of you, it will be necessary for you to review the module's material more than once to understand the material.

Textbooks
In addition to the material available on Canvas, there are four recommended textbooks for this class:

- **Absolute Java**, 6th Edition by Walter Savitch and Kenrick Mock, 2015. ISBN: 978- 0134041674. This is a text for students who need a background in Java and do not have it. The book is more thorough than the Java tutorials on Oracle's website.
- **Effective Java**, 3rd Edition by Joshua Block, 2018. ISBN: 978-0134685991. For students who have some Java experience, this text is a great resource for delving deeper into best practices. This text is freely available to students through Northeastern University's library website.
- **Head-First Design Patterns**, 2nd Edition by Eric Freeman, et al, 2020. ISBN: 978-0596007126. This is an easy-going and fun introduction to design patterns with examples in Java. This text is freely available to students via O'Reilly Online Learning.
- **Design Patterns: Elements of Reusable Object-Oriented Software** by Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides, 1994. ISBN: 978- 0201633610. This is the standard reference for object-oriented design patterns that belongs on every computer scientist's bookshelf. Additionally, it is freely available to students through Northeastern University's library website.

Computing Environment

You will want to download and install a professional integrated development environment (IDE) to write your programs this semester. The introductory module shows you how to work with *IntelliJ*. It is freely available and can be downloaded from *JetBrains*' website. I suggest you get *IntelliJ IDEA Ultimate*, which is free for students.

Course Description

The course provides an intensive tour of class-based program design and the design of abstractions that support the design of reusable software and libraries. It reviews typical object-oriented concepts such as information hiding, encapsulation and various forms of polymorphism. It contrasts the use of inheritance and composition as dual techniques for software reuse. It provides a deeper understanding of object-oriented design using the use of graphical design notations such as UML and object-oriented design patterns. It also examines the relationship between algorithms and data structures, as well as basic techniques for analyzing algorithm complexity. Finally, it emphasizes on testing, specifically unit testing of components.

"Think first, experiment later."

The curiosity to ask questions, try out new things and the motivation to go above and beyond is essential to extract maximum benefit from this course. This is a programming-intensive course, but it also emphasizes careful design and thorough testing.

Course Prerequisites

The course is suitable for students in the ALIGN MS in CS program. It assumes that students have been introduced to the basic principles of program design and computation in CS 5001 Intensive Fundamentals of Computer Science.

Course Objectives

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

1. Design an object-oriented solution to small and moderately sized problems.
2. Implement a given object-oriented design in the Java programming language.
3. Generate appropriate documentation for developed solutions.
4. Design unit tests for a given component and implement them.
5. Create, refine, and express a design in graphical notation such as UML diagrams.
6. Explore existing documentation to describe and use existing libraries and frameworks.

Course Structure

The course consists of 14 modules:

1. Data definitions, Classes, and Testing in Java
2. Methods for Simple Classes and Exceptions
3. Representing More Complex Forms of Data
4. Recursive Data Structures
5. Equality and Comparison
6. Hierarchical Data Representations, Uses and Sightings in Java
7. Design of Larger, More Complex Programs with Model, View, Controller
8. Design of Model
9. Controller and its Uses
10. Views
11. Art of Design – Inheritance vs. Composition
12. Art of Design – Iterator Design Pattern
13. Art of Design – Strategy Pattern
14. Art of Design - Adapters

Every two weeks, will follow the same format (starting on week 2 and allowing small shifts when the due date is on a holiday):

Day	Time	Deliverable

Monday	Class time	Team quizzes and class activities due (shifted to Wednesday if Monday is a holiday)
Tuesday	11:59 PM	Personal reflections due
Friday	11:59 PM	Labs due
Friday	11:59 PM	Homework due
Friday	11:59 PM	Project due
Sunday	11:59 PM	Individual quizzes due

Week	Sunday	Monday	Tuesday	Wed	Thursday	Friday	Saturday
	05-May	06-May	07-May	08-May	09-May	10-May	11-May
1		Welcome	Study Module 1				
	12-May	13-May	14-May	15-May	16-May	17-May	18-May
2		Quiz 1 due	Study Module 2				
		Work on Lab 1					
	19-May	20-May	21-May	22-May	23-May	24-May	25-May
3		Quiz 2 due	Study Module 3				
	Work on Lab 1					Lab 1 due	
		Work on Homework 1					
	02-Jun	03-Jun	04-Jun	05-Jun	06-Jun	07-Jun	08-Jun
4		Quiz 3 due	Study Module 4				
		Work on Lab 2					
	Work on Homework 1					HW 1 due	
			Reflection 1				
	09-Jun	10-Jun	11-Jun	12-Jun	13-Jun	14-Jun	15-Jun
5		Quiz 4 due	Study Module 5				
	Work on Lab 2					Lab 2 due	
		Work on Homework 2					

Week							
	16-Jun	**17-Jun**	**18-Jun**	**19-Jun**	**20-Jun**	**21-Jun**	**22-Jun**
6		Quiz 5 due	Study Module 6				
		Work on Lab 3					
	Work on Homework 2					HW 2 due	
	23-Jun	**24-Jun**	**25-Jun**	**26-Jun**	**27-Jun**	**28-Jun**	**29-Jun**
7		Quiz 6 due	Study Module 7				
	Work on Lab 3					Lab 3 due	
		Work on Homework 3					
	30-Jun	**01-Jul**	**02-Jul**	**03-Jul**	**04-Jul**	**05-Jul**	**06-Jul**
8		Quiz 7 due	Study Module 8				
			Work on Lab 4				
	Work on Homework 3					HW 3 due	
			Reflection 2				
	07-Jul	**08-Jul**	**09-Jul**	**10-Jul**	**11-Jul**	**12-Jul**	**13-Jul**
9		Quiz 8 due	Study Module 9				
	Work on Lab 4					Lab 4 due	
		Work on Homework 4					
	14-Jul	**15-Jul**	**16-Jul**	**17-Jul**	**18-Jul**	**19-Jul**	**20-Jul**
10		Quiz 9 due	Study Module 10				
		Work on Lab 5					
	Work on Homework 4					HW 4 due	
	21-Jul	**22-Jul**	**23-Jul**	**24-Jul**	**25-Jul**	**26-Jul**	**27-Jul**
11		Quiz 10 due	Study Module 11				
	Work on Lab 5					Lab 5 due	
		Work on Part 1 of Project					
			Design Review				
	28-Jul	**29-Jul**	**30-Jul**	**31-Jul**	**01-Aug**	**02-Aug**	**03-Aug**
12		Quiz 11 due	Study Module 12				
		Work on Lab 6					
	Work on Part 1 of Project					Part 1 due	
			Reflection 3				
13	**04-Aug**	**05-Aug**	**06-Aug**	**07-Aug**	**08-Aug**	**09-Aug**	**10-Aug**

		Quiz 12 due	Study Modules 13 and 14				
	Work on Lab 6					Lab 6 due	
		Work on Part 2 of Project					
				P1 CW			
	11-Aug	**12-Aug**	**13-Aug**	**14-Aug**	**15-Aug**	**16-Aug**	**17-Aug**
		Quiz 13 due					
14							
	Work on Part 2 of Project					Part 2 due	
	18-Aug	**19-Aug**	**20-Aug**	**21-Aug**	**22-Aug**	**23-Aug**	**24-Aug**
15							
		P2 CW				Final Grades	

Note: This calendar is subject to change. Please obtain updated version via Canvas.

Pre-class Work

This course, as well as other MSCS courses at the Vancouver campus of Northeastern University, will be taught using a pedagogical technique known as the Flipped/Hybrid classroom. This approach makes the most of our precious class time by eliminating the standard lecturing model, where course material is *introduced* to the students during class, usually via a lengthy PowerPoint presentation. In our Flipped/Hybrid classroom, you will come to class having already completed several readings where you will be introduced to the course material and complete a pre-class quiz. And then during class, you will *apply* your understanding of these core concepts through carefully chosen problems and activities, which will enable you to *solidify* your knowledge.

Flipped/Hybrid classrooms require much more focus and preparation time, for both the instructor and the students. After all, it is much easier for the instructor to read a set of pre- prepared slides and for the students to passively observe and listen. But on our campus, we will devote our class time to the computational thinking process: resolving obstacles, developing conceptual understanding, communicating solutions supported by evidence, and creating efficient algorithms that solve our problem. Through this process, you will better develop your confidence, creativity, and critical-thinking skills, preparing you to become *computer scientists* (not just programmers).

For this course to be a meaningful learning experience, you will need to come to each class well-prepared, with all assigned readings and videos complete, as well as your individual quiz finished to the

best of your ability. If you do not complete the pre-class work, you will have a challenging time following the in-class activities.

In-class Work

It is extremely important for you to become engaged in this course. Like most programming courses, we are asking you to change the way you think so that you can express your thoughts to a computer. While you have had some success with this type of thing before in previous courses, we are asking you to learn yet another language and programming paradigm for expressing solutions to problems. This is not an easy task.

Students are expected to keep up with the material as it is released each week, to ask for help when they need it (or when feeling overwhelmed), to complete assignments on time, to actively participate in class discussion, to respect your classmates' right to learn, and to refrain from disruptive behavior.

While this course is designed to for you to succeed, you will not unless you put the time in. In general, you should be prepared to spend 3-4 hours per credit hour. This means that you should plan to spend a minimum of 16-20 hours per week on this course.

Course Assessment

Final grades will reflect students' effort and performance. The course grade will be based on the following:

Quizzes		
	Individual Quizzes (x12)	6%
	Team Quizzes (x12)	6%
Labs (x6)		24%
Homework (x4)		24%
Class activities (x12)		6%
Project		
	Style and best practices (x2)	6%
	Report (x2)	10%
	Design Review	5%
	Code Walks (x2)	10%
Personal Reflections (x3)		3%
Total		**100%**

There are 13 individual quizzes, 13 team quizzes and 13 class activities. However, the individual quiz with the lowest grade will be dropped which means only 12 quizzes will be considered for the final grade. Same thing applies for the team quizzes and class activities.

Late/Makeup Policy

- All assignments have a specific due date and time.
- Reflections will not be accepted late.
- Make-up quizzes (team or individual) will not be given, and they have hard deadlines.
- Make-up class activities will not be given, and they have hard deadlines.
- Any submission related to the project (preliminary design, code, report, and code walks) will not be accepted late.
- Lab and homework assignments are due on Friday night, and it is advisable to submit your work by this deadline. However, submissions will be accepted until Sunday night for those who need extra time. Please note that while there is no penalty for late submissions, support will not be available over the weekend. Therefore, the extended deadline should be used only in cases of emergency.

Handing in Assignments

Gradescope will be used for student submission of most assignments. To use this platform, students will need to have a Northeastern email address. Answers to the most frequent questions can be found on the Help section.

For some assignments, *Gradescope* will be configured to automatically assess code quality and correctness. Students can learn from the feedback and resubmit their code if it is prior to the deadline.

Regrade Policy

If you have concerns about your grade, please reach out to the assignment's grader within one week of the grades being released. For assignments graded through Gradescope, you may submit a regrade request directly on the platform. Should your concerns remain unresolved after one week, you may then contact the course instructor via email. In your email, include the course name, section number, and detailed information about the specific part of the assignment in question (e.g., Project 3, question 2.1), along with a clear explanation of why the issue has not been satisfactorily addressed. Please be aware that the instructor may opt to review your entire assignment.

Grade Calculations

Grades will be calculated on an absolute basis: there will be no overall curving. The mapping of raw point totals to letter grades is given below.

93.00 – 100.00   A

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90.00 – 92.99      A-
86.00 – 89.99      B+
82.00 – 85.99      B
77.00 – 81.99      B-
73.00 – 76.99      C+
69.00 – 72.99      C
65.00 – 68.99      C-
0.00 – 64.99       F
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Other Policies

Attendance and Participation

It is expected that you will attend every class in person and participate. If you must miss a class for any reason (e.g., illness, family emergency, religious observance), contact me by e-mail. Regardless of the reason, it is your responsibility to catch up on the material you have missed and obtain the notes from a classmate (not from me). Missing one lecture means you also miss that week's team quiz and class activity.

Students who are absent repeatedly from class will be evaluated by faculty responsible for the course to ascertain their ability to achieve the course objectives and to continue in the course.

Academic Honesty

You are expected to read, understand, and follow the [University's policy on Academic Integrity](). Each student is expected to do his or her own work. Violations of academic integrity will result in a zero on the corresponding assignment along with harsher penalties for more widespread problems. An Academic Integrity Report will be submitted by the instructor to the Office of Student Conduct and Conflict Resolution (OSCCR).

Here are a few examples of academic dishonesty:

- Working with one or more partners on an assignment where not allowed.
- Submitting a copy of work done by another student, with or without their knowledge.
- Submitting work that was primarily found on the web or provided by someone else outside of this class.
- Submitting work by anybody who took this course in the past whether the course was here at Northeastern or at another campus or institution.
- Providing or receiving significant help to another student on an assignment.

General discussions with other students are okay but should be done away from the computer, leaving only memories.

If you are unsure about the plagiarism policy, **please ask me!**

AI Tools

In this course, we will delve into the fundamental principles of object-oriented programming and design, equipping you with the skills necessary to create well-structured, modular, and maintainable software systems. Throughout the semester, you will engage in a series of coding assignments that progressively challenge your understanding of object-oriented concepts. While we recognize the advancements in AI-assisted programming tools, such as *CoPilot*, it is essential to stress the importance of honing your coding abilities organically. To facilitate a comprehensive learning experience, the use of AI tools to support your work is permitted, but with a caveat: these tools should complement, not replace, your coding efforts. For the initial assignments, we encourage you to craft code independently, allowing you to grasp the foundational concepts effectively. As we progress, we will integrate AI tools when appropriate to enhance your coding efficiency. When employing AI tools, it is imperative to transparently acknowledge their use in your submissions.

Accommodations

The goal is for every student to succeed in this course. If you require any accommodations (e.g., childcare during class hours, extra time to complete assignments, support for a disability), let me know immediately so that we can work out appropriate arrangements. Speak to me at the end of class or contact me by e-mail, and we will set up a time to meet during the first week of the course. I look forward to learning how I can be of service to you.

Students who have disabilities who wish to receive academic services and/or accommodations should visit the Disability Resource Center (DRC) or call 844-688-6287.

If you have already done so, please provide your letter from the DRC to the instructor early in the semester to arrange those accommodations.

Classroom Conduct

The classroom principles that we will follow in the classroom are transparency, equity and inclusion, participation, active dialog, and constructive critique. Students are expected to support each other, learn from each other, and help each other grow. Students have the responsibility to conduct themselves in ways that will help them learn, yet that will not disrupt other students' learning. While

each student will be working closely with their team members, you are also expected to engage with your classmates in a respectful, kind, and helpful manner.

In the class, we encourage asking questions, sharing ideas, and engaging in discussions related to the class topics. Sometimes discussions may steer away from the course content, and the course instructor will reserve the right to re-direct it back on track.

Giving and receiving feedback is one of the core activities in this class. When giving and receiving feedback, it is important to keep in mind that we give feedback because we want all projects to succeed. Our feedback will highlight parts that work well but also point out aspects that can be improved. The feedback should not be taken personally or seen as an attack on students' knowledge or capabilities. Thus, we will learn a craft of constructive feedback and practice it in the class regularly.

Feedback

Your opinions are very important to me. All students are strongly encouraged to use the Teacher Rating and Course Evaluation (TRACE) system, at https://www.northeastern.edu/trace/, to complete your course evaluations. A reminder about TRACE should arrive via email about two weeks before the end of the course.

In addition, I will be asking for your feedback at least once, about halfway through the semester. However, if you have concerns about the course, do not wait until you are asked. Please schedule a meeting with me, and we will discuss your concerns then.

Title IX, anti-discrimination, sexual assault, and harassment

Northeastern University and its faculty are committed to creating a safe and open learning environment for all students. If you or someone you know has experienced discrimination, harassment, or sexual violence (including sexual harassment, sexual assault, dating/domestic violence, or stalking), please know that help and support are available. Northeastern strongly encourages all members of the community to take action, seek support, and report incidents of discrimination, harassment, and sexual violence to the Office for University Equity and Compliance (OUEC) through the Online Discrimination Complaint Form found at https://www.northeastern.edu/ouec/file-a-complaint/.

Please be aware that faculty members are Mandatory University Reporters who are required to disclose information about alleged discrimination, harassment, and sexual violence (including sexual harassment, sexual assault, dating/domestic violence, or stalking) to the OUEC. If the OUEC receives a report, a member of their office will reach out to offer information about available rights, support resources and pathways towards a resolution as a member of the campus community. Community members are not required to respond to this outreach.

If you, or another community member you know wishes to speak to a confidential resource who does not have this reporting responsibility, please contact any of the following confidential resources. These confidential resources are not required to report allegations of discrimination to the University without your signed release.

Find@Northeastern: Offers 24/7 mental health support via phone at 877.233.9477 (in the U.S.) or +1.781.457.7777 (outside the U.S.).

Sexual Violence Resource Center: The SVRC provides confidential, trauma-informed support services to Northeastern students who have experienced any form of sexual violence (i.e., sexual assault, sexual harassment, sexual exploitation, domestic/dating violence, and/or stalking). Request services online at https://bit.ly/svrequestform.

Confidential Resource Advisor: The CRA provides confidential, restorative informed support services to Northeastern students who have been accused of sexual or identity-based harm. Request services online at https://bit.ly/svrequestform.

Please visit https://www.northeastern.edu/ouec for a complete list of reporting options and support resources both on- and off-campus and contact the OUEC (ouec@northeastern.edu) at any time.

Expectations
1. Respect should be shown in all communications and interactions with faculty, staff, industry, peers, and all others on campus. This includes respecting the preferred methods and response times of faculty and staff.
2. Students come to class prepared and having engaged with the online course materials.
3. Students are to actively participate in course activities and discussion.
4. Any issues that arise should be communicated to the appropriate faculty or staff member proactively.
5. All course interaction including instruction, teamwork, TA advising, and course activities are to be done in English.
6. Students should come into the classroom with the goal of learning and have a "growth mindset".

Meetings
At any time during the course, if you have any concerns, speak to me at the end of class, or contact me by e-mail, and we will set up a one-on-one meeting at a mutually convenient time, either on campus or via Teams.

Wellness Resources

Wellness and Mental Health Support

As a graduate student, you may experience a range of challenges including significant stress, difficult life events, mood changes, excessive worry, or problems with eating and/or sleeping. If you or anyone you know is struggling, we strongly encourage you to seek support. Northeastern University provides several services and resources to support the overall wellness of students.

To access support, you can [book a Wellness Consultation](#) with the Vancouver Wellness Program Specialist. During this session, you can discuss your concerns and receive guidance on the next steps, along with access to resources that promote mental health and overall well-being. For same day appointments or more information, please email v.williams@northeastern.edu.

Students in need of immediate support can access [Find@Northeastern](#) for free 24/7 mental health support at 855.229.8797 (Canada) and +1.781.457.7777 (International) or [Here2Talk](#), a free 24/7 counselling service for all post-secondary students in BC at: 604-642-5212 or toll free at 1-877-857-3397.

Wellness Consultation Referral

Learning is most easily accomplished when you are physically and emotionally at your best. If you run into difficulties and need assistance, I encourage you to contact me during my office hours, reach out before or after class, or send me an email. I will do my best to support your success during the term. This includes identifying concerns I may have about your academic progress or wellbeing through a Wellness Consultation Referral. Through this process, I can connect you with the campus Wellness Program Specialist who offers support and assistance getting back on track to success. Only the Wellness Program Specialist can access any concerns I may identify, and a referral does not affect your academic record.

For more information about the Wellness Consultation Referral process or to book a consultation directly, email Victoria Williams, the Vancouver Wellness Program Specialist - v.williams@northeastern.edu.