

# CSCI-2122 --- Systems Programming

## Course Syllabus

### Instructor Information

<b>Instructor:</b>	Dr. Alex Brodsky	<b>Office:</b>	CS 208
<b>E-mail:</b>	<a href="mailto:csci2122@dal.ca">csci2122@dal.ca</a>	<b>Office Hours:</b>	TBA
<b>Lecture Time:</b>	Tuesday and Thursday 13:05 - 4:25	<b>Room No:</b>	CHEM 125
<b>Lab B01 Time:</b>	Friday 11:35 - 12:55	<b>Room No:</b>	MC 1201
<b>Lab B02 Time:</b>	Friday 13:05 - 14:25	<b>Room No:</b>	MC 1201
<b>Lab B03 Time:</b>	Wednesday 13:05 - 14:25	<b>Room No:</b>	MC 1201
<b>Lab B04 Time:</b>	Friday 16:05 - 17:25	<b>Room No:</b>	MC 1108
<b>Course Homepage:</b>	<a href="https://dal.brightspace.com/">https://dal.brightspace.com/</a>	<b>MS Teams:</b>	Code: <b>hs01g0j</b>
<b>Teaching Assistants</b>	See Brightspace		

### Important Dates

- Reading Week (no classes): November 13 - 17, 2023
- Midterm: October 19, 2023, in class
- Final Exam: TBA in the period of December 7 to 19, 2023
- Final Withdrawal Date without academic penalty: October 4, 2023
- Final Withdrawal Date with financial penalty: November 2, 2023
- Deadlines: Five assignments due at 23:59 on September 29, October 13, October 27, November 17, and December 1, plus a bonus Assignment 0 due on September 22.

### Course Description

This course presents tools, techniques, and concepts for systems programming. Students will be exposed to assembly and will be introduced to the C programming language. The course also discusses memory hierarchies, performance measurement, exception control flow, and performance related issues. Students will be involved in significant amount of low-level programming.

### Course Rationale

This course has three purposes. First, to expose students to data and code manipulation at the machine level, and discuss how high-level language constructs map to assembly. Second, to provide students with grounding in C programming and debugging at the low-level. Third, to expose students to low-level systems concepts and ideas, including: the memory hierarchy and caching; performance measurement; and exception control flow.

### Prerequisites

**Pre-req:** CSCI 1110 and CSCI 1120

**Exclusion:** CSCI 2121

## High-Level Learning Outcomes

- Manipulate data and code at the machine-level.
- Implement and debug programs of moderate complexity in a low-level language such as C.
- Describe how system-level structures, such as the memory hierarchy and process control, support and affect program execution.

## Learning Outcomes

### ***Data Representation and Assembly***

- Describe the internal representation of non-numeric data, such as characters, strings, records, and arrays.
- Convert numerical data from one format to another.
- Explain different instruction formats, such as addresses per instruction and variable length vs fixed length formats.
- Explain how subroutine calls are handled at the assembly level.
- Show how fundamental high-level programming constructs are implemented at the machine-language level.

### ***C Programming***

- Explain the C build cycle (preprocess, compile, assemble, link).
- Use pointers in C and manage memory.
- Describe the various kinds of software errors that can occur and their causes.
- Write a program in C to solve a problem of moderate complexity given a problem specification.
- Use a debugger to debug an executable program.

### ***Low Level Systems***

- Use software tools to profile and measure program performance.
- Describe the structure and types of memory inside a computer.
- Explain the basic concepts of interrupts and I/O operations.
- Explain the basic concepts of processes, system calls, and process control.

## Class Format and Course Communication

- Content will be delivered using lectures, labs, and assignments.
- Course announcements will be posted to Brightspace and MS Teams.
- It is the student's responsibility to check their Dal e-mail, Brightspace, and MS Teams on a daily basis. To access your Dal e-mail, see: <https://www.dal.ca/dept/its/o365/services/email.html>
- The instructor can be reached via Email and Microsoft Teams (join code: **hs01g0j**)
- Office hours will be posted on Brightspace
- Students must ask the instructor permission before recording class lectures.

## Texts and Resources

The text for the course is: Computer Systems: A Programmers Perspective, 3rd Edition, R. Bryant and D. O'Hallaron, Pearson (2016), ISBN 978-0-130409266-9

## Evaluation Criteria

- Academic Integrity Module: <https://dal.brightspace.com/d2l/home/178166>
  - **Must be completed by October 1<sup>st</sup> to pass the course.**
  - **Must receive 75% or better on each of the four quizzes.**
- Post-Lecture Quizzes (5%)
  - After each lecture there is a short quiz to be taken in Brightspace
  - These quizzes must be completed 24 hours before the start of the next lecture.
  - 50% of the mark is awarded for doing the quiz, and 50% for the right answers.
- Labs (10%)
  - Labs are due at 11:59pm, on the Tuesday after the lab occurs.
  - Late labs will not be accepted.
  - Labs need to be submitted electronically using Git.
- Assignments (30%)
  - Assignments are worth 6% each and are due at 23:59 on the following dates:

	Due Date	Description	Weight
<b>Assignment 1</b>	Sept 29	Basic C programming	6%
<b>Assignment 2</b>	Oct 13	Data manipulation in C	6%
<b>Assignment 3</b>	Oct 27	Linked Lists in C	6%
<b>Assignment 4</b>	Nov 10	Simple CPU Simulator	6%
<b>Assignment 5</b>	Dec 1	File operations and performance	6%
  - **No late submissions will be accepted.**
  - Assignments need to be submitted electronically via Gitlab using git.
  - No collaboration is permitted on the assignments.
  - Coding must follow guidelines outlined by the style guide on Brightspace.
  - All submitted code will be passed through the Moss Software Similarity Detection System (<https://theory.stanford.edu/~aiken/moss/>) to check for plagiarism. If a student does not wish their assignments to be submitted to Moss, they should contact the instructor.
- Midterm (15% or 0%)
  - The midterm is optional. If you choose not to write the midterm or do better on the final exam then your midterm will be worth 0% and your final will be worth 60%.
- Final Exam (40% or 55%)
  - The exam will be scheduled by the university.
  - The exam will cover all material in the course.
- Passing Requirements: To achieve a grade of C or better, all of the following are required
  - **FCS Academic Integrity Module:** <https://dal.brightspace.com/d2l/home/178166>
  - **Assignments:** Students must achieve at least a 50% average over all assignments.
  - **Tests:** Students must achieve at least a 50% average on the combined midterm and final exam.
  - **Overall Grade:** Students must achieve at least a 60% average in the course.

## Notes

- A minimum grade of C is required in this course if it is core to your FCS degree, or if it will be used as a prerequisite for a subsequent CSCI course.
- Students who receive a grade lower than C in the same required CS course twice, will be dismissed.
- The grade scale in Section 17.1 of the Academic Regulations, Undergraduate Calendar will be used.
- The instructor reserves the right to adjust a student's evaluation criteria, with the student's consent, if the instructor deems that an adjustment is warranted.

## Midterm and Final Exam Requirements

- Photo ID is required
- Closed book
- No dictionaries, notes, calculators, cell phones, PDAs, talking slide rulers, or other aids allowed.

## Tentative Schedule

Week	Lec	Topics	Assignments
Sept 5	1	Administrivia	
Sept 7	2	Chapter 1 : Introduction	
Sept 12	3	C Basics 1	Lab 1: Unix 101 redux
Sept 14	4	C Basics 2	
Sept 19	5	Information Storage	Lab 2: Simple C programs
Sept 21	6	Integer Representation	Assn 0 due (Bonus)
Sept 26	7	Program organization and Makefiles	Lab 3: Data manipulation
Sept 28	8	Pointers and memory allocation	Assn 1 due
Oct 3	9	Linked Lists in C	Lab 4: Allocation & Arrays
Oct 5	10	Program encoding and data access	
Oct 10	11	Control structure implementation	Lab 5: Linked Lists
Oct 12	12	Procedure implementation	Assn 2 due
Oct 17	13	Arrays and pointer arithmetic	Lab 6: Assembly from C
Oct 19	14	Midterm	
Oct 24	15	Putting it all together + gdb	Lab 7: More assembly
Oct 26	16	Measuring performance	Assn 3 due
Oct 31	17	File I/O	Lab 8: Debugging C programs
Nov 2	18	Linking / Slack	
Nov 7	19	Storage technology and locality	Lab 9: File I/O
Nov 9	20	Memory hierarchy and caching	Assn 4 due
Nov 13 – 17		READING WEEK	
Nov 21	21	Caching II and writing cache friendly code	Lab 10: Performance
Nov 23	22	Exceptions and Interrupts	
Nov 28	23	Processes	Lab 11: Process control
Nov 30	24	Process Control	Assn 5 due
Exams			

## Student Declaration of Absence

The Student Declaration of Absence policy shall apply. [https://www.dal.ca/campus\\_life/safety-respect/student-rights-and-responsibilities/academic-policies/student-absence.html](https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/academic-policies/student-absence.html) The student has a maximum of two (2) SDAs per course per semester. The student **must** notify the instructor of their inability to meet a deadline **before** the deadline by contacting the instructor or submitting the completed SDA. Upon notification the student has 3 days after the deadline to submit the SDA.

## Use of Plagiarism Detection Software

All submitted code may be passed through a plagiarism detection software, such as the plagiarism detector embedded in Codio, the Moss (<https://theory.stanford.edu/~aiken/moss/>) Software Similarity Detection System, or similar systems. If a student does not wish to have their assignments passed through plagiarism detection software, they should contact the instructor for an alternative. Please note, that code not passed through plagiarism detection software will necessarily receive closer scrutiny. [https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/university\\_secretariat/policy-repository/OriginalitySoftwarePolicy.pdf](https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/university_secretariat/policy-repository/OriginalitySoftwarePolicy.pdf)

## Academic Standards

Failure to properly attribute sources in your work will be treated as an academic standards issue and points may be deducted for not following citation requirements. For example, forgetting to quote text taken from other sources, failure to include in-text citations, or a failure to include required

information in the citations or references. Please see the resources on proper citation provided by the Dalhousie Writing Center (<https://dal.ca/libguides.com/c.php?g=257176&p=5001261>).

Please note that if it appears that the error was made with intent to claim other people's work as your own such as a lack of both citations and references, an allegation of plagiarism will be submitted to the Faculty Academic Integrity Officer, which could result in consequences such as a course failure.

## Responsible Computing Policy

Usage of all computing resources in the Faculty of Computer Science must be within the Dalhousie Acceptable Use Policies ([https://www.dal.ca/dept/university\\_secretariat/policies/information-management-and-technology/acceptable-use-policy-.html](https://www.dal.ca/dept/university_secretariat/policies/information-management-and-technology/acceptable-use-policy-.html)) and the Faculty of Computer Science Responsible Computing Policy. For more information please see [https://www.dal.ca/content/dam/dalhousie/pdf/faculty/computerscience/policies-procedures/fcs\\_policy\\_local.pdf](https://www.dal.ca/content/dam/dalhousie/pdf/faculty/computerscience/policies-procedures/fcs_policy_local.pdf)

## Student Health and Wellness

Taking care of your health is important. As a Dalhousie student, you have access to a wide range of resources to support your health and wellbeing. Students looking to access physical or mental health & wellness services at Dalhousie can go to the Student Health & Wellness Centre in the LeMarchant Building. The team includes: registered nurses, doctors, counsellors and a social worker. Visit [dal.ca/studenthealth](http://dal.ca/studenthealth) to learn more and book an appointment today.

Students also have access to a variety of online mental health resources, including telephone/texting counselling and workshops/training programs. Learn more and access these resources at [dal.ca/mentalhealth](http://dal.ca/mentalhealth).

## Culture of Respect<sup>1</sup>

Every person has a right to respect and safety. We believe inclusiveness is fundamental to education and learning. Misogyny and other disrespectful behaviour in our classrooms, on our campus, on social media, and in our community is unacceptable. As a community, we must stand for equality and hold ourselves to a higher standard.

### What we all need to do:

1. **Be Ready to Act:** This starts with promising yourself to speak up to help prevent it from happening again. Whatever it takes, summon your courage to address the issue. Try to approach the issue with open-ended questions like "Why did you say that?" or "How did you develop that belief?"
2. **Identify the Behaviour:** Use reflective listening and avoid labeling, name-calling, or assigning blame to the person. Focus the conversation on the behaviour, not on the person. For example, "The comment you just made sounded racist, is that what you intended?" is a better approach than "You're a racist if you make comments like that."
3. **Appeal to Principles:** This can work well if the person is known to you, like a friend, sibling, or co-worker. For example, "I have always thought of you as a fair-minded person, so it shocks me when I hear you say something like that."
4. **Set Limits:** You cannot control another person's actions, but you can control what happens in your space. Do not be afraid to ask someone "Please do not tell racist jokes in my presence anymore" or state "This classroom is not a place where I allow homophobia to occur." After you have set that expectation, make sure you consistently maintain it.

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<sup>1</sup> Source: Speak Up! © 2005 Southern Poverty Law Center. First Printing. This publication was produced by Teaching Tolerance, a project of the Southern Poverty Law Center. Full "Speak Up" document found at: <http://www.dal.ca/dept/dalrespect.html>. Revised by Susan Holmes from a document provided April 2015 by Lyndsay Anderson, Manager, Student Dispute Resolution, Dalhousie University, 902.494.4140, [lyndsay.anderson@dal.ca](mailto:lyndsay.anderson@dal.ca) [www.dal.ca/think](http://www.dal.ca/think).

5. **Find or be an Ally:** Seek out like-minded people that support your views, and help support others in their challenges. Leading by example can be a powerful way to inspire others to do the same.
6. **Be Vigilant:** Change can happen slowly, but do not let this deter you. Stay prepared, keep speaking up, and do not let yourself be silenced.

## University Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and the Senate. <https://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog&catalogid=117&loaduserredits=False>

### ***Territorial Acknowledgement***

Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people.

Dalhousie acknowledges the histories, contributions, and legacies of the African Nova Scotia people and communities who have been here for over 400 years.

### ***Internationalization***

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." <https://www.dal.ca/about-dal/internationalization.html>

### ***Academic Integrity***

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect. As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. (read more: [http://www.dal.ca/dept/university\\_secretariat/academic-integrity.html](http://www.dal.ca/dept/university_secretariat/academic-integrity.html))

### ***Accessibility***

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion please contact: [https://www.dal.ca/campus\\_life/academic-support/accessibility.html](https://www.dal.ca/campus_life/academic-support/accessibility.html) for all courses offered by Dalhousie with the exception of Truro.

### ***Conduct in the Classroom — Culture of Respect***

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

### ***Diversity and Inclusion — Culture of Respect***

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). (read more: <http://www.dal.ca/cultureofrespect.html>)

## ***Student Code of Conduct***

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. (read more: [https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/university\\_secretariat/policy-repository/Code%20of%20Student%20Conduct%20rev%20Sept%202021.pdf](https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/university_secretariat/policy-repository/Code%20of%20Student%20Conduct%20rev%20Sept%202021.pdf))

## ***Fair Dealing Policy***

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. (read more: [https://www.dal.ca/dept/university\\_secretariat/policies/academic/fair-dealing-policy-.html](https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html))

## ***Originality Checking Software***

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work, and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. (read more: [https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/university\\_secretariat/policy-repository/OriginalitySoftwarePolicy.pdf](https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/university_secretariat/policy-repository/OriginalitySoftwarePolicy.pdf))

## ***Student Use of Course Materials***

These course materials are designed for use as part of the CSCI courses at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading material to a commercial third party website) may lead to a violation of Copyright law.

## ***Learning and Support Resources***

Please see [https://www.dal.ca/campus\\_life/academic-support.html](https://www.dal.ca/campus_life/academic-support.html)