CSI 2372 Advanced Programming Concepts with C++

(3 units)
Course Components: Lecture, Laboratory, Tutorial
University of Ottawa, Faculty of Engineering
From 8th September 2021 to 8th December 2021

Fall 2021 Course Outline

- (3 hours of lecture per week, 1.5 hour tutorial per week, 1.5 hour lab per week, 3 credits)
- Differences between C++ and Java programming. C++ data types. Pointers and memory management. Object oriented programming in C++. File and stream I/O. Pre-processor macros. Templates and the Standard Template Library. Numerical computation in C++. Interfacing with hardware. Engineering applications
- Prerequisite(s): ITI 1121, ITI 1100.

Professor:

Dr. Amir EAMAN
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Course Objectives

The course explores the modern C++ language in depth. Programming in C++ as a *system programming language* reinforces students' programming skills for system programming. We'll cover most of the exciting features of C++, including direct access to memory using pointers, manipulating various C++ data types, such as strings, arrays, and pointers; applying O.O approaches and design, standard libraries (STL), STL containers and algorithms, generic and functional programming paradigms. Students will be able to design and implement reasonably complex applications in C++. (one of the key strengths of C++ is that we can write programs for nearly any processor).

- C++ Basics
- Storage classes (auto, static, extern, const)
- Pointers, Datatypes, memory management
- Arrays and pointer to arrays
- Pass by value, pass by reference, pass by address
- Memory allocation (new and delete), including proper allocation/deallocation procedure
- Function pointers
- Structures, classes, attributes, and methods
- Class constructors and destructors, O.O. Design
- Copy constructor, type conversion, and assignment
- Inheritance (private, protected, public)
- Polymorphism, virtual methods, and abstract classes
- Multiple inheritance
- Class relationship (association, aggregation, generalization)
- Exception handling
- Lambdas and functors
- Generic Programming with Template, functions and classes

- Operator overloading
- Generic containers (std:: vector, std ::array, std::string), Standard Template Library
- Associative container (std::map, std::set, std::multimap, std::multiset)
- Iterator
- Generic algorithms
- Smart pointers
- Move constructor and move assignment
- Function binding
- Abstract Data Types (ADT)

Textbook:

- [Required textbook] S. Lippman, J. Lajoie and B.E. Moo, *C++ Primer*, **5th** or 6th edition, Addision-Wesley, 2020
- Bjarne Stroustrup, *The C++ Programming Language*, 4th edition, Addison-Wesley, 2013
- Walter Savitch, K. Mock, *Absolute C++,* Pearson, Global 6th edition, 2016
- P. Deitel & H. Deitel, *C++ How To Program*, 10th edition, 2017

Lectures:

- Lectures will be online and synchronous and delivered via **Zoom** meetings.
- **Monday**, 4:00pm–5:20pm, Link to is available in the Zoom Brightspace of the course
- **Wednesday**, 2:30pm–3:50pm, Link to is available in the Zoom Brightspace of the course

On-Line Study Resources:

- The Cplusplus Resources Network (cplusplus.com/doc/tutorial/)
- Learn C++ (learncpp.com)
- C++ reference (cppreference.com)
- C++ Language Reference | Microsoft Docs
- Introduction to C++ | MIT OpenCourseWare
- Concepts avancés de programmation en C++ (Dr. Laganièr, in French)

TAs:

- Jayalakshmi Iyer   jiyer095@uottawa.ca
- Evangeline Ezekiel   eezek076@uottawa.ca
- Priya Kaladhar Patel   ppate140@uottawa.ca
- Abhishek Chandar   achan260@uottawa.ca
- Jackson Geng*   (*corrector) jgeng033@uottawa.ca

Laboratory/Tutorial *

- **LAB** Group A1: Tuesday, 8:30am–9:50am (In-person STE 0131 || Virtual)
- **LAB** Group A2: Tuesday, 8:30am–9:50am (In-person STE 2052 || Virtual)
- **LAB** Group A5: Thursday, 5:30pm–6:50pm (In-person STE 2052 || Virtual)
- The || sign is the *Logical Or* in C++! So, you can attend labs in-person or virtually, which one is appropriate for you. **TAs will be offering labs in two forms.**

- **Tutorial**: Friday, 11:30am–12:50pm (Virtual)

- * No lab/tut for the first week of the course (8th Sept—10th Sept)

Office Hours: Wednesday 4:00pm–5:00pm

GitHub repo of the course: https://github.com/aeamanuottawa/CSI2372

Course Software: GCC C++ Compiler (g++) >= 11

Evaluation:
- Assignments   28% (4, must be done individually)
- Labs   7% (approximately 7 to 10)
- Midterm   15% (20th October)
- Project* (in teams of two students- just one student submits the project) 20%
- Final Exam   30%

Project*:
Students will code the project in groups of two members. For the project, students build a challengingly extensive C++ program. During the final project delivery, you also must demonstrate that your code includes many C++ features presented in the lectures.

Attendance, Participation, and other Requirements:

- Attendance at lectures is mandatory. As per academic regulations of the faculty, students who do not attend 80% of the lectures will not be allowed to write the final examination.
- All components of the course (i.e., labs, assignments, etc.) must be fulfilled; otherwise students may receive an EIN as a final mark (equivalent to an F). This is also valid for a student who is taking the course for the second time.
- If you miss a lecture, you must make up the material. Lectures will be recorded and posted on Brightspace.
- If you miss a lab, you cannot get credit for it, but you must still make up the material. Lab material will be posted in Brightspace. Labs will *not* be recorded.
- You must meet the following minimum requirements in order to avoid an EIN as mentioned above:

- You must participate in at least 5 labs.
- You must get at least 30% on the assignment component of the course. – You must get at least 30% on the exam component of the course.

Reminders:

- Information on academic fraud can be found at these links:
  https://www.uottawa.ca/vice-president-academic/academic-
            regulationsexplained/academic-fraud
  https://www.uottawa.ca/vice-president-academic/academic-integrity/ resources-
            students/frequently-asked-questions-faq
- Students are to become familiar with the Faculty of Engineering rules and regulations; you may refer to them if you happen to miss an exam. These are within the University of Ottawas regulations sections 9.4, 9.5, and 9.6, which define conduct during an examination, and related matters:
  https://www.uottawa.ca/administration-and-governance/ policies-and-regulations
- Library resources for engineering students can be found at the following link: http: //biblio.uottawa.ca/en/research-help/research-guides-and-librarians.
- If necessary, the instructor will contact students through their official University of Ottawas e-mail address (username@uottawa.ca). If you are using a personal e-mail address, please go to the university mail management web site to set a forwarding address (https://web.uottawa.ca/cgi-bin/mailadmin/main.pl). You are responsible for ensuring you are receiving official course information in an efficient and timely manner.
- The University of Ottawa provides, upon request, appropriate academic adjustments for students who have learning disabilities, health, psychiatric or physical conditions. For more information, please contact Access Service (http://www.sass.uottawa. ca/access/).
- All materials prepared by the course professor, including course notes, assignments, sample solutions, and exam papers, are copyright. Copying or scanning them or posting them on a website is therefore a violation of copyright and is illegal.

Appendix:
- You can browse this website to find the relevant parts of the Lippman textbook (C++ Primer textbook, 5th edition) for a particular subject which we study during the course.