ITP 435 – Professional C++
Units: 4
Fall 2022

Location:
32098 – M/W 6-7:50PM in KAP 160 (Zach Metcalf)
32042 – T/Th 2-3:50PM in OHE 540 (Sanjay Madhav)

Remote Attendance:
This course does not support remote attendance. Lectures will not be recorded or available on Zoom, there are short in-person group activities during many class meetings and exams are in-person.

Office Hours:
Sanjay – Monday and Thursday 4:30-6:30PM in RRB 216
Zach – Monday 12-1PM on Zoom
Contact Info: All general course/assignments questions should be asked on Piazza (every student will receive an invitation at the start of the semester).
Personal questions and questions from prospective students should be directed via email to madhav@usc.edu.

Teaching Assistants: Posted on Piazza
TA Office Hours: Posted on Piazza
Contact Info: Via Piazza.

Course Description
This course teaches students how to use C++ as a professional developer in industry would. We will explore several different areas and applications where C++ sees significant use. We will learn applications of advanced concepts including lambda expressions, templates, secure coding, parallel programming, writing performant code, CMake, and continuous integration.

Learning Objectives
- Write C++ code for programming assignments in several different real-life applications
- Refine student's ability to design and write high-quality C++ code
- Learn how to improve the performance of C++ code
- Learn how to apply new programming paradigms (such as functional and data-oriented programming)
- Learn new ways to apply previously known C++ language constructs
- Learn how the C++ language has evolved in the C++11, 14, and 17 standards, and how to utilize these new features

Prerequisite(s): CSCI 104L *or* ITP 365

Course Notes
Lecture slides and assignments will all be posted on Blackboard. Course discussions will occur on Piazza. Assignments will be submitted through GitHub.

Suggested Readings
All the books are free online through USC's Library. (Just register with your USC email).

Bancila, Marius. *Modern C++ Programming Cookbook (Second Edition).* Packt. 2020. ISBN-10: 1800208987.
https://learning.oreilly.com/library/view/modern-c-programming/9781800208988/

Meyers, Scott. *Effective C++ (Third Edition)*. Addison-Wesley. 2005. ISBN-10: 0321334876.
https://learning.oreilly.com/library/view/effective-c-third/0321334876/

Meyers, Scott. *Effective Modern C++*. O'Reilly Media. 2015. ISBN-10: 1491903996.
https://learning.oreilly.com/library/view/effective-modern-c/9781491908419/

Description and Assessment of Assignments
There are seven different programming assignments in this course, and students will have approximately two weeks per assignment. Each assignment combines specific C++ skills with an industrial application of C++. Students are expected to complete these programming assignments ***individually***. Each assignment's instructions include a grading rubric for that assignment. In-class activities will be small group activities graded CR/NC.

Exams
There is a midterm and final exam. The final exam is cumulative.

Grading Breakdown

Item	% of Grade
Programming Assignments (7% each)	49
Midterm Exam	20
Final Exam	20
In-Class Activities	11
Total	100

Grading Scale
Course final grades are determined by the following scale
A   93-100
A-   90-92
B+   87-89
B   83-86
B-   80-82
C+   77-79
C   73-76
C-   70-72
D+   69
D   67-69
D-   66
F   65 and below

Half percentage points will be rounded up to the next whole percentage. So for instance, 89.5% is an A-, but 89.4% is a B+.

Depending on the overall class average at the end of the semester, the above grading scale may be relaxed. There is typically no extra credit.

Assignment Submission Policy
Programming assignments must be submitted to student's GitHub repositories by 11:59PM of the deadline date or will be considered late. Programming assignments that do not compile on the GitHub actions continuous integration system will receive a 0. Information about GitHub actions is provided during the first week of class.

Late Policy
Programming assignments will be accepted up to three days late, with a 15% deduction per day late. This means an assignment late by one day can receive a grade no higher than 85%, two days no higher than 70%, and three days no higher than 55%.

Extensions are only provided in the event of a *documented* reason satisfactory to the instructor, such as an illness or family emergency.

Make-up Policy for Exams
To make up for a missed exam, the student must provide a satisfactory reason (as determined by the instructor) along with documentation. Make-up exams are only allowed under extraordinary circumstances.

Plagiarism and Individual Work Policy

In this class, programming assignments are expected to represent the individual effort of each student. All programming assignment submissions will be compared with current, previous, and future students' submissions using MOSS, which is a code plagiarism identification program. If your code significantly matches another student's submission, you will be referred to SJACS with a recommended penalty of an F in the course.

It is okay to discuss solutions to specific problems with other students, but it is not okay to look through another student's code. It does not matter if this code is online or from a student you know, it is cheating. Do not share your code with anyone else in this or a future section of the course, as allowing someone else to copy your code carries the same penalty as copying the code yourself.

Course Material Policy

Do not reproduce, distribute, or post any lecture material, assignments, assignment solutions, or exams publicly without written consent of the instructor. You may take notes and make copies of course materials for your own use. You may not post course materials on sites like CourseHero. Doing so is a copyright violation and in some cases may also be an academic integrity violation that will be dealt with accordingly

Course Schedule

Note: To keep both sections synchronized, holidays will be observed in both sections (eg. both M/W and T/Th will skip the first meeting of Week 3 for Labor Day).

Week	Lecture Topics	Readings	Due Dates
1	Introduction; Tools and Testing	*Effective*: 1, 53; Bancila 624-637	
1	Modernizing Your C++ Code	*Effective*: 3, 5, 6; *Modern*: 5, 8, 12; Bancila: pp. 1-7, 32-39, 127-131	
2	Move Semantics	*Modern*: 23-25, 41, 42	
2	PA2 Notes; Parallel Programming	*Modern*: 31; Bancila: pp. 149-154	**PA1 9/2 @ 11:59PM**
3	*Labor Day (No class both sections)*		
3	Writing Optimized Code	*Effective*: 26, 30, 31	
4	Smart Pointers	*Modern*: 18-21	
4	Tries and Applications		**PA2 9/16 @ 11:59PM**
5	Sizeof and Virtual Tables	*Effective*: 35	
5	Exceptions and RTTI	Bancila: pp. 413-429	
6	Threads; Functional Programming	*Modern*: 35-37; Bancila: 399-405	
6	Applications: Genetic Algorithms		**PA3 9/30 @ 11:59PM**
7	Midterm Review		
7	**Midterm Exam (M/W is 10/5 and T/Th is 10/6)**		
8	Applications: Big Data		
8	*Fall Recess (No class both sections)*		**PA4 SUNDAY 10/16 @ 11:59PM**
9	Custom Memory Allocators	*Effective*: 49-52	
9	CMake and Bazel		
10	Template Metaprogramming Basics	Bancila: pp. 199-208	
10	More Templates	Bancila: pp. 323-331	**PA5 10/28 @ 11:59PM**
11	Design Patterns; Uniform Initializers	*Modern*: 7; Bancila: pp. 10-17	
11	Compiler Basics: Lexical Analysis		
12	Compiler Basics: Syntax Analysis		
12	Compiler Basics: Code Gen		**PA6 11/11 @ 11:59PM**
13	Google Benchmark, Test, and Mock	Bancila: pp. 606-623	
13	C++ 14/17/20 and Beyond	Bancila: pp. 57-62, 299-311	
14	Deep C/C++		
14	*Thanksgiving (No class both sections)*		
15	Selected Talks from Cppcon		
15	Final Exam Review		**PA7 12/4 @ 11:59PM**
FINAL	*Final Exam* according to the final examination schedule: M/W section is Wednesday, December 7th @ 7-9PM T/Th section is Thursday, December 8th @ 2-4PM Students **must** take the exam with their registered section at the specified time. Makeups are only allowed in an extraordinary emergency.		

"Effective" refers to Effective C++ while "Modern" refers to Effective Modern C++. For these texts, the numbers are not page numbers, but rather the item numbers referenced in the table of contents. For Bancila, you can cross-reference the table of contents on Amazon to figure out which parts to read in the USC library digital version.

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, "Behavior Violating University Standards" https://policy.usc.edu/scampus-part-b/. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Support Systems

Student Counseling Services (SCS) - (213) 740-7711 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. https://engemannshc.usc.edu/counseling/

National Suicide Prevention Lifeline - 1-800-273-8255
Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. http://www.suicidepreventionlifeline.org

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 - 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.
https://engemannshc.usc.edu/rsvp/

Sexual Assault Resource Center
For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: http://sarc.usc.edu/

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class.
https://equity.usc.edu/

Bias Assessment Response and Support
Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. https://studentaffairs.usc.edu/bias-assessment-response-support/

The Office of Disability Services and Programs
Provides certification for students with disabilities and helps arrange relevant accommodations. http://dsp.usc.edu

Student Support and Advocacy – (213) 821-4710
Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. https://studentaffairs.usc.edu/ssa/

Diversity at USC
Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. https://diversity.usc.edu/

USC Emergency Information
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible, http://emergency.usc.edu

USC Department of Public Safety – 213-740-4321 (UPC) and 323-442-1000 (HSC) for 24-hour emergency assistance or to report a crime.
Provides overall safety to USC community. http://dps.usc.edu