Lahore University of Management Sciences

CS 100 – Computational Problem Solving

Summer 2024

Instructor	Malik Jahan Khan
Room No.	SBASSE 9-G45A
Office Hours	10:30AM – 11:30AM MTWR
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Coordinator/TA	Mr. Anas Ahmad (Department Coordinator) / TBA.
TA Office Hours	To be communicated through LMS.
Course URL (if any)	lms.lums.edu.pk
Lecture	MTWR 9:30 AM - 10:30 AM
Lab	TR 11:30 AM - 2:30 PM

Course Teaching Methodology
• **Teaching Methodology:** Synchronous. Students will be guided to supplementary reading material as well. • **Lecture Details:** Although the teaching methodology is going to be synchronous, however, occasionally, there may be pre-recorded lectures. In addition, links to related reference material available online from different sources will be provided from time to time.

Class Discussion Forum
• We will be using Slack for class discussion. • These systems are highly catered to getting you help fast and efficiently from classmates, the TA, and myself. • Rather than emailing questions to the teaching staff (TAs), I encourage you to post your questions on Slack.

COURSE DESCRIPTION
This course provides a conceptual and practical introduction to programming. The focus is on finding solutions of problems and implementing them through programming rather than a particular choice of programming language. The programming tool used is 'C/C++'. This course will equip students with tools and techniques to analyze, solve, and implement a given problem programmatically.

COURSE PREREQUISITE(S)	
•	None

Course Basics				
Credit Hours	3			
Lecture(s)	Nbr of Lec(s)	22-24	Duration	60 min each, four days a week
~~Recitation~~/Lab	Nbr of Lec(s)	11-12	Duration	3 hrs each, twice a week
Tutorial	Nbr of Lec(s)	As per need	Duration	As per need

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Course Distribution	
Core	Yes (for SBASSE students, CS majors, CS minors)
Elective	Yes, can be taken as an elective
Open for Student Category	Freshmen, Sophomore
Close for Student Category	None

Examination Detail	
Midterm Exam	Yes/No: Yes Duration: 60~90 mins Preferred Date: End of 3rd week Exam Specifications: Closed book, closed notes, no calculator, no cell phones.
Final Exam	Yes/No: Yes Duration: 90~120 mins Exam Specifications: Closed book, closed notes, no calculator, no cell phones.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)	
PEO-01	Demonstrate excellence in profession through in-depth knowledge and skills in the field of Computing.
PEO-02	Engage in continuous professional development and exhibit quest for learning.
PEO-03	Show professional integrity and commitment to societal responsibilities.

COURSE OBJECTIVES (COs)	
CO-01	To teach programming fundamentals to students.
CO-02	To help students analyze and solve programming problems.
CO-03	To prepare students in programming for later courses with programming intensive content.

	COURSE LEARNING OUTCOMES (CLOs)
	At the successful completion of the course students will be able to:

CLO	Statement	Instrument	Bloom's Cognitive Level	Graduate Student Attributes Seoul Accord
1.	***use*** C++ syntax and control structures to ***code*** algorithmic solutions using standard coding conventions.	ICP, Quiz, Lab	C1 Remembering	PLO2 Enabling Knowledge
2.	***explain*** key concepts of algorithmic design in written form.	ICP, Quiz, Exam	C2 Understanding	PLO7 Communication
3.	***apply*** relevant standards and ethical considerations to writing computer programs.	Lab	C3 Applying	PLO9 Ethics / Responsibility
4.	***analyze*** the requirements for solving simple algorithmic problems.	ICP, Quiz, Exam	C4 Analyzing	PLO3 Problem Analysis / Critical Thinking and Analysis
5.	***evaluate*** the correctness of the proposed solution.	ICP, Quiz, Exam	C5 Evaluating	PLO4 Design/Development of Solutions
6.	***design*** and ***implement*** programs to solve simple algorithmic computing problems, based on the analysis of the requirements.	Lab	C6 Creating P6 Organization	PLO4 Design/Development of Solutions

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Grading Breakup and Policy

Assessment	Description	Weight (%)	CLO
Quizzes	There will be 10 to 12 quizzes. Quiz can be held in any class or lab and may be unannounced. Two quizzes will be dropped. No petitions will be accepted.	20%	1, 2, 4, 5
Labs	There are 10 to 12 lab sessions. First lab will be conducted as a guided lab. Remaining labs will be evaluated. Two labs will be dropped. No petitions will be accepted.	20%	1, 3, 6
In-Class Problems (ICPs)	ICPs are meant for deeper, interactive and collaborative understanding of the new concepts being covered in the class. There will be no ICPs in the first two classes. Most of the remaining classes will have ICPs. Four ICPs will be dropped. No petitions will be accepted.	10%	1, 2, 4, 5
Mid Term Exam	One mid-term exam will be conducted. Exam will not be dropped. Petitions will be accepted only via OSA. Mode: In-class Duration: 60~90 mins (May vary) Preferred Date: Expected in the 3rd week Exam Specifications: Closed book, Close notes, No calculator. No cell phones.	20%	2, 4, 5
Final Exam	Final exam will cover whole course content. Exam will not be dropped. Petitions will be accepted only via OSA. Duration: 90~120 mins (May vary) Exam Specifications: Closed book, Close notes, No calculator. No cell phones.	30%	2, 4, 5

- You are required to do labs alone. Any kind of collaboration is strictly prohibited.
- Your labs, assignments, and projects may be checked for plagiarism via MOSS (https://theory.stanford.edu/~aiken/moss/).
- In case any work is found plagiarized you may be awarded a zero. In addition, your case of cheating will be reported to the Disciplinary Committee.

Makeup Policy

- No petitions will be accepted for quizzes, labs, and project.
- Petitions will be accepted only for Mid and Final exams provided these are approved by the OSA.
- Please refer to Student Handbook 2022-23, page 41, article 24, titled “Makeup Policy for Graded Instruments”.
  “In the case of an instrument with multiple sub instruments, such as quizzes, the instructor may apply best (N-X) policy”.
  https://sbasse.lums.edu.pk/sites/default/files/inline-files/Undergraduate%20Student%20Handbook%202022-2023.pdf

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Code of Conduct
1. Students are required to show up in class fully prepared for the lecture. 2. Quiz may not be announced ahead of time. 3. All assessments including quizzes, labs and exams are of a given duration. Make sure you are able to start them on time.

COURSE OVERVIEW (TENTATIVE, THE ACTUAL SEQUENCE MAY BE DIFFERENT DURING THE COURSE OF THE SEMESTER)			
Module	Recommended Readings - CFE	Topics	Objectives/(CLO)
1	1.5 2.1-2.2	• Intro to computational problem solving, Scratch programming, pseudocode, algorithms. • Intro to the IDE. Edit-(preprocess)-compile-link-run cycle. • Tokens (keywords, identifiers, literals, operators, punctuation, and white-space). • Hello World program. • Statements, expressions, values and types.	CLO1-CLO6
2	2.1-2.2	• Variables, operators, assignment operator, precedence.	CLO1-CLO6
3	2.5	• Strings	CLO1-CLO6
4	3.1, 3.3, 3.4, 3.7	• Control: if, blocks. Program formatting, comments. Relational and Logic operators. Nesting ifs. Else. • Variable scoping • I/O, error messages, types of errors, debugging using print.	CLO1-CLO6
5	4.1, 4.2	• Repeating by using copy-paste (Code clones). • Programming to reduce redundancy • Loops: *While*. Counting using while. • Debugger: Stepping through a loop.	CLO1-CLO6
	4.3-4.8	• Loops: *For*. Converting *for* to *while* and back. • Unrolling loops to understand, and for speed. • Creating loops where there are differences in what is to be done using *if*. • Nesting loops. Nesting other control structures.	CLO1-CLO6
	4.3-4.8	• Loops: More practice. • *break*, *continue*.	CLO1-CLO6
6	5.1-5.5	• Functions. More types, *return*, *void* • *Functions. Recursion*	CLO1-CLO6
7	6.1-6.3	• Arrays, pointers • Pass by value, pass by reference, pass by address.	CLO1-CLO6

8	7.7	• *Structures (If time permits)*
		  ○ *Struct*
		  ○ *Class*
			CLO1-CLO6

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COURSE OVERVIEW (TENTATIVE, THE ACTUAL SEQUENCE MAY BE DIFFERENT DURING THE COURSE OF THE SEMESTER)				
Module	**Week**	**Lecture**	**Topic**	**Recommended Readings - CFE**
1.	1	1.	Introduction	Ch-01
		2.	ASCII Code, Programming Environment	Ch-01
2.		3.	Fundamental Data Types	Ch-02
		4.	Operators	Ch-03
	2	5.	Operators	Ch-03
3.		6.	Strings	Ch-02, 03, 07
4.		7.	Decision Statements (if, nested if)	Ch-03
		8.	Switch Statement	Ch-03
5.	3	9.	Loops – while, do..while	Ch-04
		10.	Loops – for	Ch-04
		11.	Loops – Nested loops	Ch-04
		12.	Mid Term	
6.	4	13.	Functions	Ch-05
		14.	Functions – Reference Parameters	Ch-05
		15.	Functions – Recursion	Ch-05
7.		16.	Arrays	Ch-06
	5	17.	Arrays	Ch-06
		18.	Arrays – 2D	Ch-06
		19.	Pointers	Ch-07
		20.	Pointers	Ch-07
	6	21.	Pointers	Ch-07
8.		22.	Structures (if time permits)	Ch-07
		23.	Structures (if time permits)	Ch-07
		24.	Recap	

Textbook

The textbook that covers most of the topics is:

- **[CFE] C++ for Everyone, (2nd Edition), Cay Horstmann, San Jose State University**
- https://bcs.wiley.com/he-bcs/Books?action=index&bcsId=6146&itemId=0470927135
- https://www.amazon.com/C-Everyone-Cay-S-Horstmann/dp/0470927135
- http://horstmann.com/cpp4everyone.html
- http://www.chegg.com/homework-help/c-for-everyone-2nd-edition-solutions-9780470927137
- **Big C++, 3rd Edition, Brief C++ 3rd Edition, by Cay Horstmann**
  - https://horstmann.com/bigcpp/
  - https://www.amazon.com/Everyone-Enhanced-Loose-Print-Companion-dp-1119455634/dp/1119455634/ref=dp_ob_title_bk

C++ Language Coding Guidelines

- https://horstmann.com/cpp4everyone/CFE_CodingGuidelines.html

Reference/Supplementary Readings

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Reference Material:

- Problem Solving with C++, (6th – 9th Edition), Walter Savitch, Addison-Wesley ISBN 0321531345. ©2009.

These reference resources are available online and are free to download.

- C++ Language Tutorial, http://www.cplusplus.com/doc/tutorial/
- C++ Made Easy, http://www.cprogramming.com/tutorial.html
- Thinking in C++, http://www.mindview.net/Books/TICPP/ThinkingInCPP2e.html

Other supplemental readings will be provided by the instructor

- Learn to use online resources.
  - Books, Lectures, Courses, Videos, …
  - http://stackoverflow.com (questions and answers about computers)
  - http://coursera.org (free online courses)
  - http://ocw.mit.edu (open courseware at MIT)
  - http://google.com (or just search for anything)
- You don't have to go at the slow pace of the class.
  Just take off on your own.
  Learn how to build web pages, or operating systems on your own.

Academic Honesty

The principles of truth and honesty are recognized as fundamental to a community of teachers and students. This means that all academic work will be done by the student to whom it is assigned without unauthorized aid of any kind. Plagiarism, cheating and other forms of academic dishonesty are prohibited. Any instances of academic dishonesty in this course (intentional or unintentional) will be dealt with swiftly and severely. Potential penalties include receiving a failing grade on the assignment in question or in the course overall. For further information, students should make themselves familiar with the relevant section of the LUMS student handbook.

Harassment Policy

SSE, LUMS and particularly this class, is a harassment free zone. There is absolutely zero tolerance for any behaviour that is intended or has the expected result of making anyone uncomfortable and negatively impacts the class environment, or any individual's ability to work to the best of their potential.

In case a differently-abled student requires accommodations for fully participating in the course, students are advised to contact the instructor so that they can be facilitated accordingly.

If you think that you may be a victim of harassment, or if you have observed any harassment occurring in the purview of this class, please reach out and speak to the instructor. If you are a victim, I strongly encourage you to reach out to the Office of Accessibility and Inclusion at oai@lums.edu.pk or the sexual harassment inquiry committee at harassment@lums.edu.pk for any queries, clarifications, or advice. You may choose to file an informal or a formal complaint to put an end of offending behavior. You can find more details regarding the LUMS sexual harassment policy at: https://mgshss.lums.edu.pk/lums-harassment-policy.

To file a complaint, please write to harassment@lums.edu.pk.

In addition to LUMS resources, SBASSE's Council on Belonging and Equity is committed to devising ways to provide a safe, inclusive and respectful learning environment for students, faculty and staff. To seek counsel related to any issues, please feel free to approach either a member of the council or email at cbe.sse@lums.edu.pk

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Appendix A
Bloom's Taxonomy (Cognitive, Psychomotor, Affective)

*(https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/)
(https://www.astate.edu/dotAsset/7a3b152c-b73a-45d6-b8a3-7ecf7f786f6a.pdf)

BLOOM's TAXONOMY - Cognitive Process Dimension		
• (C1) Remember	• Recall facts and basic concepts	• Recognizing, Recalling
• (C2) Understand	• Explain ideas or concepts	• Interpreting, Exemplifying, Classifying, Summarizing, Inferring, Comparing, Explaining
• (C3) Apply	• Use information in new situations	• Executing, Implementing
• (C4) Analyze	• Draw connection among ideas	• Differentiating, Organizing, Attributing
• (C5) Evaluate	• Justify a stand or decision	• Checking, Critiquing
• (C6) Create	• Produce new or original work	• Generating, Planning, Producing

BLOOM's TAXONOMY - Psychomotor Process Dimension

(P1) Perception (awareness), (P2) Set, (P3) Guided Response, (P4) Mechanism (basic proficiency)

BLOOM's TAXONOMY - Psychomotor Process Dimension

(A1) Receiving Phenomena, (A2) Responding to Phenomena, (A3) Valuing, (A4) Organization, (A5) Internalizing values (characterization)

Appendix B
Program Learning Outcomes (PLOs)
Student Outcomes (SOs) / Graduate Attributes (GAs)
Seoul Accord

https://www.seoulaccord.org/document.php?id=79

1. Academic Education	6. Individual and Teamwork
2. Knowledge for Solving Computing Problems	7. Communication
3. Problem Analysis	8. Computing Professionalism and Society
4. Design/ Development of Solutions	9. Ethics
5. Modern Tool Usage	10. Life-long Learning

Appendix C
ACM C.2.2: Computer Science Draft Competencies

Page 111, Computing Curricula 2020 (CC2020)

https://www.acm.org/binaries/content/assets/education/curricula-recommendations/cc2020.pdf

SDF-Software Development Fundamentals (page 113)

1. Create an appropriate algorithm to illustrate iterative, recursive functions, as well as divide-and-conquer techniques and use a programming language to implement, test, and debug the algorithm for solving a simple industry problem.
2. Decompose a program for a client that identifies the data components and behaviors of multiple abstract data types and implementing a coherent abstract data type, with loose coupling between components and behaviors.
3. Design, implement, test, and debug an industry program that uses fundamental programming constructs including basic computation, simple and file I/O, standard conditional and iterative structures, the definition of functions, and parameter passing.
4. Present the costs and benefits of dynamic and static data structure implementations, choosing the appropriate data structure for modeling a given engineering problem.
5. Apply consistent documentation and program style standards for a software engineering company that contribute to the readability and maintainability of software, conducting a personal and small-team code review on program component using a provided checklist.
6. Demonstrate common coding errors, constructing and debugging programs using the standard libraries available with a chosen programming language.
7. Refactor an industry program by identifying opportunities to apply procedural abstraction.

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Appendix D
ACM Computing Knowledge Landscape Table

https://www.acm.org/binaries/content/assets/education/curricula-recommendations/cc2020.pdf

ACM Computing Knowledge Landscape (CK)			
1. Users and Organizations	CK1.1: Social Issues and Professional Practice CK1.2: Security Policy and Management CK1.3: IS Management and Leadership CK1.4: Enterprise Architecture CK1.5: Project Management CK1.6: User Experience Design	**4. Software Development**	CK4.1: Software Quality, Verification and Validation CK4.2: Software Process CK4.3: Software Modeling and Analysis CK4.4: Software Design CK4.5: Platform-Based Development
2. Systems Modeling	CK2.1: Security Issues and Principles CK2.2: Systems Analysis & Design CK2.3: Requirements Analysis and Specification CK2.4: Data and Information Management	**5. Software Fundamentals**	CK5.1: Graphics and Visualization CK5.2: Operating Systems CK5.3: Data Structures, Algorithms and Complexity CK5.4: Programming Languages **CK5.5: Programming Fundamentals** CK5.6: Computing Systems Fundamentals
3. Systems Architecture and Infrastructure	CK3.1: Virtual Systems and Services CK3.2: Intelligent Systems (AI) CK3.3: Internet of Things CK3.4: Parallel and Distributed Computing CK3.5: Computer Networks	**6. Hardware**	CK6.1: Architecture and Organization CK6.2: Digital Design CK6.3: Circuits and Electronics CK6.4: Signal Processing

Appendix E
ACM Dispositions Table

https://www.acm.org/binaries/content/assets/education/curricula-recommendations/cc2020.pdf

ACM Dispositions			
Element	**Elaboration**	**Element**	**Elaboration**
D1 Adaptable: D2 Collaborative: D3 Inventive: D4 Meticulous: D5 Passionate: D6 Proactive:	Flexible; agile, adjust in response to change Team player; willing to work with others Exploratory; Look beyond simple solutions Attentive to detail; thoroughness, accurate Conviction, strong commitment, compelling With initiative, self-starter, independent	D7 Professional: D8 Purpose-driven: D9 Responsible: D10 Responsive: D11 Self-directed:	Professionalism, discretion, ethical, astute Goal driven, achieve goals, business acumen Use judgment, discretion, act appropriately Respectful; react quickly and positively Self-motivated, determination, independent