# Lahore University of Management Sciences

# CS 100 – Computational Problem Solving

Fall 2024

To understand how to navigate course outlines, consult: How to Use a Course Outline (http://surl.li/gpvuw )

| | |
|---|---|
| Instructor | Shafay Shamail, Maryam Mustafa |
| Room No. | SBASSE 9-G13A |
| Office Hours | To be decided |
| Email | sshamail@lums.edu.pk |
| Telephone | 8187 |
| Secretary/Coordinator/TA | NA / Mr. Afaq Butt (Department Coordinator) / |
| TA Office Hours | To be decided |
| Course URL (if any) | lms.lums.edu.pk |
| Lecture | TBA |
| Lab | TBA |
| Support Services | LUMS offers a range of academic and other services to support students. These are mentioned below, and you are encouraged to use these in addition to in-class assistance from course staff. For a complete list of campus support services available for you click here (https://advising.lums.edu.pk/#supportservices) |

| Course Teaching Methodology |
|---|
| • **Teaching Methodology:** Synchronous. Students will be guided to supplementary reading material as well.<br>• **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 / Piazza / LMS for class discussion.<br>• These systems are highly catered to getting you help fast and efficiently from classmates, the TA, and myself.<br>• Rather than emailing questions to the teaching staff (TAs), I encourage you to post your questions on class discussion board.<br>• Link to the class discussion board page will be provided later. |

| 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) | 28-30 | Duration | 50 min each, twice a week |
| ~~Recitation~~/Lab | Nbr of Lec(s) | 0/14 | Duration | 2 hrs 50 min each, once a week |

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| Tutorial | Nbr of Lec(s) | As per need | Duration | |
|---|---|---|---|---|

**Campus supports & Key university policies**

Campus Supports:

Students are strongly encouraged to meet course instructors and TA's during office hours for assistance in course-content, understand the course's expectations from enrolled students, etc. Beyond the course, students are also encouraged to use a variety of other resources. (Instructors are also encouraged to refer students to these resources when needed.) These resources include Counseling and Psychological Services/CAPS (for mental health), LUMS Medical Center/LMC (for physical health), Office of Accessibility & Inclusion/ OAI (for long-term disabilities), advising staff dedicated to supporting and guiding students in each school, online resources (https://advising.lums.edu.pk/advising-resources), etc. To view all support services, their specific role as well as contact information click here (https://advising.lums.edu.pk/#supportservices).

Academic Honesty/Plagiarism:

LUMS has zero tolerance for academic dishonesty. Students are responsible for upholding academic integrity. If unsure, refer to the student handbook and consult with instructors/teaching assistants. To check for plagiarism before essay submission, use similarity@lums.edu.pk. Consult the following resources: 1) Academic and Intellectual Integrity (http://surl.li/gpvwb), and 2) Understanding and Avoiding Plagiarism (http://surl.li/gpvwo).

LUMS Academic Accommodations/ Petitions policy:

Long-term medical conditions are accommodated through the Office of Accessibility & Inclusion (OAI). Short-term emergencies that impact studies are either handled by the course instructor or Student Support Services (SSS). For more information, please see Missed Instrument or 'Petition' FAQs for students and faculty (https://rb.gy/8sj1h )

**LUMS Sexual Harassment Policy:**

LUMS and this class are a harassment-free zone. No behavior that makes someone uncomfortable or negatively impacts the class or individual's potential will be tolerated.

To report sexual harassment experienced or observed in class, please contact me. For further support or to file a complaint, contact OAI at oai@lums.edu.pk or harassment@lums.edu.pk. You may choose to file an informal or formal complaint to put an end to the offending behavior. You can also call their Anti-Harassment helpline at 042-35608877 for advice or concerns. *For more information: Harassment, Bullying & Other Interpersonal Misconduct: Presentation (http://surl.li/gpvwt )*

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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<br>Duration: 50~90 mins<br>Preferred Date: Expected in the 7th week<br>Exam Specifications: Closed Book, Closed Notes, No Calculator, No cell phones. |
| Final Exam | Yes/No: Yes<br>Duration: 120~180 mins<br>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. | Quiz, Lab | C1<br>Remembering | PLO2<br>Enabling Knowledge |
| 2. | ***explain*** key concepts of algorithmic design in written form. | Quiz, Exam | C2<br>Understanding | PLO7<br>Communication |
| 3. | ***apply*** relevant standards and ethical considerations to writing computer programs. | Lab, Project | C3<br>Applying | PLO9<br>Ethics / Responsibility |
| 4. | ***analyze*** the requirements for solving simple algorithmic problems. | Quiz, Exam | C4<br>Analyzing | PLO3<br>Problem Analysis / Critical Thinking and Analysis |
| 5. | ***evaluate*** the correctness of the proposed solution. | Quiz, Exam | C5<br>Evaluating | PLO4<br>Design/Development of Solutions |
| 6. | ***design*** and ***implement*** programs to solve simple algorithmic computing problems, based on the analysis of the requirements. | Lab, Project | C6<br>Creating<br>P6<br>Organization | PLO4<br>Design/Development of Solutions |

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## Grading Breakup and Policy

| Assessment | Description | Weight (%) | CLO |
|---|---|---|---|
| **Quizzes** | There will be 8 to 10 quizzes.<br>Two quizzes will be dropped.<br>No petitions will be accepted. | 20% | 1, 2, 4, 5 |
| **Labs** | There are 14 lab sessions. Out of these first 2 to 3 labs will be conducted as guided labs. Next 11 to 12 labs will be evaluated.<br>Two labs will be dropped<br>No petitions will be accepted. | 20% | 1, 3, 6 |
| **Project** | A programming project will be assigned in the last month of the semester.<br>No petitions will be accepted. | 10% | 3, 6 |
| **Mid Term Exam** | One mid-term exam will be conducted.<br>Exam will not be dropped.<br>Petitions will be accepted only via OSA.<br>Mode:<br>In-class<br>Duration:<br>50~90 mins (May vary)<br>Preferred Date:<br>Expected in the 7th week<br>Exam Specifications:<br>Closed book, Close notes, No calculator. No cell phones. | 20% | 2, 4, 5 |
| **Final Exam** | Final exam will cover whole course content.<br>Exam will not be dropped.<br>Petitions will be accepted only via OSA.<br>Duration:<br>120~180 mins (May vary)<br>Exam Specifications:<br>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*

## Code of Conduct

1. Students are required to show up in class fully prepared for the lecture.
2. Quiz will 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.

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| 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<br>2.1-2.2 | • Intro to the IDE. Edit-(preprocess)-compile-link-run cycle.<br>• Tokens (keywords, identifiers, literals, operators, punctuation, and white-space).<br>• Hello World program.<br>• 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,<br>3.4, 3.7 | • Control: if, blocks. Program formatting, comments. Relational and Logic operators. Nesting ifs. Else.<br>• Variable scoping<br>• I/O, error messages, types of errors, debugging using print. | CLO1-CLO6 |
| 5 | 4.1, 4.2 | • Repeating by using copy-paste (Code clones).<br>• Programming to reduce redundancy<br>• Loops: *While*. Counting using while.<br>• Debugger: Stepping through a loop. | CLO1-CLO6 |
| | 4.3-4.8 | • Loops: *For*. Converting *for* to *while* and back.<br>• Unrolling loops to understand, and for speed.<br>• Creating loops where there are differences in what is to be done using *if*.<br>• Nesting loops. Nesting other control structures. | CLO1-CLO6 |
| | 4.3-4.8 | • Loops: More practice.<br>• *break*, *continue*. | CLO1-CLO6 |
| 6 | 5.1-5.5 | • Functions. More types, *return*, *void*<br>• *Functions. Recursion* | CLO1-CLO6 |
| 7 | 6.1-6.3 | • Arrays, pointers<br>• Pass by value, pass by reference, pass by address. | CLO1-CLO6 |
| 8 | 7.7 | • *Structures (If time permits)*<br>  ○ *Struct*<br>  ○ *Class* | CLO1-CLO6 |

| 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 | Ch-01 |
| | 2 | 3. | Programming Environment | Ch-01 |
| | | 4. | Fundamental Data Types | Ch-02 |
| 2. | 3 | 5. | Operators | Ch-03 |
| | | 6. | Operators | Ch-03 |
| | 4 | 7. | Operators | Ch-03 |
| 3. | | 8. | Strings | Ch-02, 03, 07 |
| | 5 | 9. | Strings | Ch-02, 03, 07 |
| 4. | | 10. | Decision Statements | Ch-03 |
| | 6 | 11. | Decision Statements | Ch-03 |
| | | 12. | Switch Statement | Ch-03 |
| 5. | 7 | 13. | Loops – while, do..while | Ch-04 |

| | | | | |
|---|---|---|---|---|
| | | 14. | Loops – for | Ch-04 |
| | 8 | 15. | Loops – Nested for | Ch-04 |
| | | 16. | Mid Term | |
| 6. | 9 | 17. | Functions | Ch-05 |
| | | 18. | Functions | Ch-05 |
| | 10 | 19. | Functions – Reference Parameters | Ch-05 |
| | | 20. | Functions – Recursion | Ch-05 |
| 7. | 11 | 21. | Arrays | Ch-06 |
| | | 22. | Arrays – 2D | Ch-06 |
| | 12 | 23. | Pointers | Ch-07 |
| | | 24. | Pointers | Ch-07 |
| | 13 | 25. | Pointers | Ch-07 |
| 8. | | 26. | Structures (if time permits) | Ch-07 |
| | 14 | 27. | Structures (if time permits) | Ch-07 |
| | | 28. | 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

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.

**SSE Council on Equity and Belonging**

In addition to LUMS resources, SSE's **Council on Belonging and Equity** is committed to devising ways to provide a safe, inclusive and respectful learning, living, and working 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.

**Mental Health Support at LUMS**

For matters relating to counselling, kindly email student.counselling@lums.edu.pk, or visit https://osa.lums.edu.pk/content/student-counselling-office for more information. You are welcome to write to me or speak to me if you find that your mental health is impacting your ability to participate in the course. However, should you choose not to do so, please contact the Counseling Unit and speak to a counsellor or speak to the OSA team and ask them to write to me so that any necessary accommodations can be made.

**Harassment Policy**

SSE, LUMS and particularly this class, is a harassment free zone. Harassment of any kind is unacceptable, whether it be sexual harassment, online harassment, bullying, coercion, stalking, verbal or physical abuse of any kind. Harassment is a very broad term; it includes both direct and indirect behavior, it may be physical or psychological in nature, it may be perpetrated online or offline, on campus and off campus. It may be one offense, or it may comprise of several incidents which together amount to sexual harassment. It may include overt requests for sexual favors but can also constitute verbal or written communication of a loaded nature. Further details of what may constitute harassment may be found in the LUMS Sexual Harassment Policy, which is available as part of the university code of conduct.

LUMS has a Sexual Harassment Policy and a Sexual Harassment Inquiry Committee (SHIC). Any member of the LUMS community can file a formal or informal complaint with the SHIC. If you are unsure about the process of filing a complaint, wish to discuss your options or have any questions, concerns, or complaints, please write to the Office of Accessibility and Inclusion (OAI, oai@lums.edu.pk) and SHIC (shic@lums.edu.pk) —both of them exist to help and support you and they will do their best to assist you in whatever way they can. You can find more details regarding the LUMS sexual harassment policy here.

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

**Rights and Code of Conduct for Online Teaching**

A misuse of online modes of communication is unacceptable. TAs and faculty will seek consent before the recording of live online lectures or tutorials. Please ensure if you do not wish to be recorded during a session to inform the faculty member in a timely manner. Please also ensure that you prioritize formal means of communication (email, LMS) over informal means to communicate with course staff.

## 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 |
| | • Produce new or original work | • Generating, Planning, Producing |

| | | |
|---|---|---|
| • (C6) Create | | |

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.

## Appendix D
## ACM Computing Knowledge Landscape Table

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

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