

# Foundations of Programming (CMPS)

## Course syllabus

This course introduces computer programming fundamentals such as step-by-step problem solving, data input/output, and control structures —sequence, selection, iteration— and uses the C++ language to implement them.

SESSION	TITLE	Topics	ACTIVITIES	OPTIONAL ACTIVITIES/TOPICS
1	Course introduction	<ul style="list-style-type: none"> <li>• Computer programming notions: goals and strategies, problem solving methodology</li> <li>• Advantages and challenges of teamwork</li> <li>• Learning material: Tutorials and references.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Warm up exercises</li> <li>➤ Syllabus review</li> <li>➤ Class style and policies</li> <li>➤ Construction of a tower (Icebreaker and problem-solving demonstration)</li> </ul>	<ul style="list-style-type: none"> <li>➤ Group discussion: strengths and flaws in newspaper towers.</li> </ul>
Lab	Interaction with programming environment	<ul style="list-style-type: none"> <li>• Testing the programming environment.</li> <li>• Creation of simple programs.</li> <li>• Use of variables.</li> </ul>	<ul style="list-style-type: none"> <li>➤ “Hello world”</li> <li>➤ Making figures with characters (“The Face”)</li> </ul>	<ul style="list-style-type: none"> <li>➤ Free hands-on activity.</li> <li>➤ ASCII art</li> <li>➤ Basic data input.</li> </ul>
2	Programming Elements I	<ul style="list-style-type: none"> <li>• Programming building blocks: data input and data output.</li> <li>• String of characters (messages.)</li> <li>• Basic operations: assignment, arithmetic, logical, and relational.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Concepts review: computing and problem solving.</li> <li>➤ Algorithmic problems examples and recipes.</li> <li>➤ Break down common formulas.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Plan a program in algorithmic fashion (“Movie plot generator.”)</li> <li>➤ Number sets.</li> </ul>
Lab	Data output I	<ul style="list-style-type: none"> <li>• Instructions to output results.</li> <li>• Improved data output format.</li> <li>• Random number generation.</li> </ul>	<ul style="list-style-type: none"> <li>➤ “What is your name?”</li> <li>➤ “What is your age?”</li> <li>➤ “The Storyteller”</li> </ul>	<ul style="list-style-type: none"> <li>➤ Strings of characters.</li> <li>➤ “Random greetings.”</li> <li>➤ Dice program.</li> </ul>

SESSION	TITLE	Topics	ACTIVITIES	OPTIONAL ACTIVITIES/TOPICS
3	<b>Programming Elements II</b>	<ul style="list-style-type: none"> <li>• Programming building blocks: variables, selection and iteration.</li> <li>• Data types.</li> <li>• Data arrays (variables with subindex.)</li> <li>• Language libraries.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Strings</li> <li>➤ List of strings.</li> <li>➤ “The Fortune Cookie Factory”</li> </ul>	<ul style="list-style-type: none"> <li>➤ Devise a simple program. Justify it works, without using the computer.</li> <li>➤ Difference between string and character.</li> <li>➤ Operator hierarchy.</li> </ul>
<b>Lab</b>	<b>Input/output and basic functions</b>	<ul style="list-style-type: none"> <li>• “Dialogue” with the user.</li> <li>• List (array) of strings.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Question prompt.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Introduction to conditionals and loops.</li> <li>➤ Understanding compiler errors.</li> </ul>
4	<b>Programming Structures</b>	<ul style="list-style-type: none"> <li>• Boolean expressions</li> <li>• Conditional execution</li> <li>• Iterative tasks</li> <li>• Nested structures</li> <li>• Menu-driven programs.</li> <li>• Creating formulas or procedures.</li> <li>• Testing formula or programs.</li> <li>• Precision vs. approximation.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Exercises on numerical series.</li> <li>➤ Create a formula to compute the days before Christmas given any date.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Mathematical functions with conditions (absolute value and sign.)</li> <li>➤ Decision trees</li> </ul>
<b>Lab</b>	<b>Selection and iteration statements</b>	<ul style="list-style-type: none"> <li>• Conditional statement (<i>if-then-else</i>)</li> <li>• Iterative statement: <i>for</i>, <i>while</i> and <i>do-while</i> loops.</li> </ul>	<ul style="list-style-type: none"> <li>➤ If-then cascade.</li> <li>➤ “12 days of Christmas”</li> </ul>	<ul style="list-style-type: none"> <li>➤ Review of programming elements</li> <li>➤ Algorithmic language: pseudocode and flowcharts</li> </ul>
5	<b>BREAK</b> (Fourth of July Celebration)		<ul style="list-style-type: none"> <li>➤ ASCII animation (“Fourth of July Fireworks”)</li> </ul>	<ul style="list-style-type: none"> <li>➤ Movie analysis: <i>Tron</i> (computational elements.)</li> </ul>
<b>Lab</b>	<b>Data output II</b>	<ul style="list-style-type: none"> <li>• Iterative statement: <i>for</i>, <i>while</i> and <i>do-while</i> loops.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Geometric figures generated by loops (diagonals, back diagonals, triangles, rectangles, perimeters.)</li> </ul>	<ul style="list-style-type: none"> <li>➤ “13 days of Halloween”</li> </ul>

SESSION	TITLE	Topics	ACTIVITIES	OPTIONAL ACTIVITIES/TOPICS
6	<b>Planning fundamentals I</b>	<ul style="list-style-type: none"> <li>• Planning: Brainstorm, assumptions, requirements, strategy</li> <li>• Goals and objectives.</li> <li>• Planning programs</li> </ul>	<ul style="list-style-type: none"> <li>➤ Devise a program. Justify it works, without using the computer.</li> <li>➤ Analysis and planning of the “Treasure Island” (original and extended.)</li> </ul>	<ul style="list-style-type: none"> <li>➤ Planning tic-tac-toe (decision trees)</li> </ul>
Lab	<b>Modularity I</b>	<ul style="list-style-type: none"> <li>• Use of subroutines (modules) to organize a program</li> <li>• Commenting programs</li> <li>• Variable scope</li> </ul>	<ul style="list-style-type: none"> <li>➤ Implementation of “Treasure Island” Random coordinates, figures, and game modules.</li> <li>➤ Displaying string contents.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Parameters.</li> <li>➤ Modulus operator.</li> </ul>
7	<b>Data arrays</b>	<ul style="list-style-type: none"> <li>• Modularity</li> <li>• Arrays: vector and matrix.</li> <li>• Displaying array contents</li> <li>• Data representation.</li> </ul>	<ul style="list-style-type: none"> <li>➤ “Treasure Island” (original and extended.)</li> <li>➤ Computing random coordinates</li> </ul>	<ul style="list-style-type: none"> <li>➤ “Maze generator” planning.</li> </ul>
Lab	<b>Programming techniques II</b>	<ul style="list-style-type: none"> <li>• Counters and accumulators.</li> <li>• Deterministic and non-deterministic iteration</li> <li>• Running sum.</li> <li>• Common computational problems: formula, selection, series, etc.</li> <li>• Traversing arrays.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Algorithm implementation: Fibonacci, factorial, largest number, average</li> </ul>	<ul style="list-style-type: none"> <li>➤ Introduction to data files</li> </ul>
8	<b>Planning fundamentals II</b>	<ul style="list-style-type: none"> <li>• Plan a somewhat complex device.</li> </ul>	<ul style="list-style-type: none"> <li>➤ ATM project</li> </ul>	<ul style="list-style-type: none"> <li>➤ Peer review</li> </ul>
Lab	<b>Modularity II</b>	<ul style="list-style-type: none"> <li>• Module integration</li> </ul>	<ul style="list-style-type: none"> <li>➤ ATM implementation</li> </ul>	

SESSION	TITLE	Topics	ACTIVITIES	OPTIONAL ACTIVITIES/TOPICS
9	<b>Interactivity</b>	<ul style="list-style-type: none"> <li>• Screen coordinates.</li> <li>• Enhanced keyboard input</li> </ul>	<ul style="list-style-type: none"> <li>➤ “Etch &amp; Sketch”</li> <li>➤ “The Maze”</li> </ul>	<ul style="list-style-type: none"> <li>➤ “Maze generator” review.</li> <li>➤ Color display.</li> <li>➤ Individual feedback.</li> </ul>
	<b>HTML fundamentals</b>	<ul style="list-style-type: none"> <li>• Learn basic HTML tags for webpage creation.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Write a story and display it as webpage.</li> </ul>	
<b>Lab</b>	<b>Basic Debugging</b>	<ul style="list-style-type: none"> <li>• Common errors.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Finding errors.</li> <li>➤ Correcting programs.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Concepts review.</li> </ul>
10	<i>Final project: introduction</i>	<ul style="list-style-type: none"> <li>• Discussion of final projects.</li> <li>• Team organization</li> <li>• Brainstorming</li> <li>• Initial planning</li> <li>• Integration of programming elements required.</li> </ul>	<ul style="list-style-type: none"> <li>➤ <i>Virtual pets (Tamagotchi)</i></li> </ul>	
<b>Lab</b>	<i>Prototyping</i>	<ul style="list-style-type: none"> <li>• Implementing project main features</li> </ul>		
11/12	<i>Final project development (hands-on session)</i>	<ul style="list-style-type: none"> <li>• Implementing project major features</li> <li>• Documenting project progress.</li> <li>• Project website</li> </ul>	<ul style="list-style-type: none"> <li>➤ Team feedback.</li> </ul>	
13	<i>Final project conclusion (hands-on session)</i>	<ul style="list-style-type: none"> <li>• Implementing project details.</li> <li>• Create project context.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Preparation of: presentation: poster, webpage, report, press conference, etc.</li> </ul>	
14	<i>Final project release</i>	<ul style="list-style-type: none"> <li>• Oral report.</li> <li>• Open House</li> <li>• Course review</li> </ul>	<ul style="list-style-type: none"> <li>➤ Public presentation Background, main features, technical features, Q/A session.</li> </ul>	
15	<b>Course conclusion</b>	<ul style="list-style-type: none"> <li>• Course review.</li> </ul>		

**Notes:** Each **title** gives a general description of the topics to be studied. **Topics** indicate specific points to be discussed during the session. In general, **session** refers to in-classroom meetings during the morning. **Labs** are to be held in a computer lab, and are intended to promote student-paced learning and give personal feedback. Evening session will give students additional time to complete lab work, and promote analysis of topics discussed during the day. Development of personal endeavors will be encouraged during this time.