

Foundations of Programming

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"> • General aspects. • Class style and policies • Learning material: Tutorials and references 	<ul style="list-style-type: none"> ➤ Evaluation of preliminary knowledge in Computer Science and Programming ➤ Administrative tasks 	<ul style="list-style-type: none"> ➤ Syllabus review
		<ul style="list-style-type: none"> • Advantages and challenges of teamwork 	<ul style="list-style-type: none"> ➤ Construction of a tower (Icebreaker and problem-solving demonstration) ➤ Group discussion: strengths and flaws in newspaper towers 	<ul style="list-style-type: none"> ➤ Group discussion: Learning expectations from the course
2	Programming Elements I	<ul style="list-style-type: none"> • Interaction with the programming environment • Programming building blocks: data input and data output • String of characters (messages) • Basic operations: assignment, arithmetic, logical, and relational 	<ul style="list-style-type: none"> ➤ Concepts review: computing and problem solving ➤ Algorithmic problems examples and recipes ➤ Break down common formulas 	<ul style="list-style-type: none"> ➤ Computer programming notions: goals and strategies, problem solving methodology
Lab	Data output I	<ul style="list-style-type: none"> • Testing the programming environment • Instructions to output results • Improved data output format • Use of variables 	<ul style="list-style-type: none"> ➤ “Hello world” ➤ “What is your name?” ➤ “What is your age?” ➤ “The Avatar” (making figures with characters) 	<ul style="list-style-type: none"> ➤ ASCII art: face, island, shapes ➤ Strings of characters ➤ “Turingscraft exercises

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3	Programming Elements II	<ul style="list-style-type: none"> • Programming building blocks: variables, selection and iteration • Data types • Data arrays (variables with subindex) • Random number generation 	<ul style="list-style-type: none"> ➤ “The Amazing Movie Story Generator” ➤ String of characters ➤ List of strings 	<ul style="list-style-type: none"> ➤ Difference between string and character ➤ Operator hierarchy
Lab	Input and output	<ul style="list-style-type: none"> • “Dialogue” with the user • List (array) of strings • Modulus operator 	<ul style="list-style-type: none"> ➤ Question prompt ➤ “The Writer” (madlib) ➤ “The Fortune Cookie Factory” 	<ul style="list-style-type: none"> ➤ “The Fortune Teller” ➤ Introduction to conditionals and loops ➤ Language libraries ➤ Slot machine
4	Programming Structures	<ul style="list-style-type: none"> • Boolean expressions • Conditional execution • Iterative tasks • Nested structures 	<ul style="list-style-type: none"> ➤ Truth tables ➤ Decision trees ➤ “The coin sorter” ➤ “Song 99 Bottles...” 	<ul style="list-style-type: none"> ➤ Decision tree of tic tac toe
Lab	Selection and iteration	<ul style="list-style-type: none"> • Conditional statement (<i>if-then-else</i>) • Iterative statement: <i>for</i>, <i>while</i> and <i>do-while</i> loops 	<ul style="list-style-type: none"> ➤ Maximum of n numbers ➤ If-then cascade. ➤ Iterative programs ➤ “12 days of Christmas” 	<ul style="list-style-type: none"> ➤ “13 days of Halloween”
5	BREAK (Fourth of July Celebration)	<ul style="list-style-type: none"> • Movie analysis: Computational elements in Disney’s “Tron” 	<ul style="list-style-type: none"> ➤ ASCII animation: fireworks or Moon landing 	<ul style="list-style-type: none"> ➤ Playing music in a program.
Lab	Interactivity	<ul style="list-style-type: none"> • Screen coordinates • Enhanced keyboard input 	<ul style="list-style-type: none"> ➤ Color display 	<ul style="list-style-type: none"> ➤ Review of programming elements
6	Programming techniques I	<ul style="list-style-type: none"> • Creating formulas or procedures • Testing formula or programs • Precision vs. approximation 	<ul style="list-style-type: none"> ➤ Create a formula to compute the days before Christmas given any date. ➤ Flowcharts 	<ul style="list-style-type: none"> ➤ Temperature scale transformation ➤ Quadratic equation and special cases

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Lab	Data output II	<ul style="list-style-type: none"> • Iterative statement: <i>for</i>, <i>while</i> and <i>do-while</i> loops. • Basic debugging 	<ul style="list-style-type: none"> ➤ Understanding compiler errors 	<ul style="list-style-type: none"> ➤ Finding errors ➤ Correcting programs
7	Planning fundamentals	<ul style="list-style-type: none"> • Planning: Brainstorm, assumptions, requirements, strategy • Goals and objectives. • Planning programs • Documenting programs 	<ul style="list-style-type: none"> ➤ Analysis and planning of the “Treasure Island” (Single target) 	<ul style="list-style-type: none"> ➤ Planning tic-tac-toe, hangman, deal or no deal
Lab	Plan implementation	<ul style="list-style-type: none"> • Commenting programs • Dividing program main section with comments 	<ul style="list-style-type: none"> ➤ Implementation of “Treasure Island”: Random coordinates, figures, and game modules 	
8	Data arrays	<ul style="list-style-type: none"> • Strings and arrays. • Arrays: vector and matrix. • Displaying array contents • Traversing arrays 	<ul style="list-style-type: none"> ➤ Etch & Sketch” ➤ Bouncing Ball” ➤ Displaying contents of a string ➤ Exercises with arrays and matrices 	<ul style="list-style-type: none"> ➤ Parsing strings ➤ Intelligent tic-tac-toe
Lab	Programming techniques II	<ul style="list-style-type: none"> • Counters and accumulators • Deterministic and nondeterministic iteration • Running sum • Common computational problems: formula, selection, series, etc. 	<ul style="list-style-type: none"> ➤ Implementation of “Etch & Sketch” and “Bouncing Ball” 	<ul style="list-style-type: none"> ➤ Algorithm implementation with flowcharts
9	Modularity	<ul style="list-style-type: none"> • Modularity concepts • Scope of variables 	<ul style="list-style-type: none"> ➤ Modularization of “Treasure Island” ➤ Planning “The Maze” 	<ul style="list-style-type: none"> ➤ Random maze generator
Lab	User-defined functions	<ul style="list-style-type: none"> • Global and local variables • Modularity by user-defined functions 	<ul style="list-style-type: none"> ➤ Implementing “The Maze”: Movement, Wall detection, and program modules. 	<ul style="list-style-type: none"> ➤ Parameters

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10	Selected topics	<ul style="list-style-type: none"> • Computer architecture fundamentals: CPU primitives, Boolean logic and digital circuits • Data encoding 	<ul style="list-style-type: none"> ➤ Encoded messages: ASCII and binary numbers ➤ Secret messages: Caesar's cipher 	<ul style="list-style-type: none"> ➤ Introduction to data files ➤ Movie analysis: Computer generated Imagery (CGI) in Pixar's short films
Lab	HTML fundamentals	<ul style="list-style-type: none"> • Basic HTML tags for webpage creation 	<ul style="list-style-type: none"> ➤ Type class notes and display them as webpage 	<ul style="list-style-type: none"> ➤ Introduction to javascript ➤ Individual feedback
11	Final project: introduction	<ul style="list-style-type: none"> • Discussion of final projects • Team organization • Brainstorming • Initial planning • Integration of programming elements required 	<ul style="list-style-type: none"> ➤ Virtual pets (Tamagotchi) ➤ Interactive game ➤ Timeline ➤ General requirements 	<ul style="list-style-type: none"> ➤ Decision-based game: trivia, adventure ➤ Grid-based game: checkers, submarine
Lab	Prototyping	<ul style="list-style-type: none"> • Implementing project major features • Documenting project progress. • Project website 	<ul style="list-style-type: none"> ➤ Team feedback 	
12/13	Final project development (<i>hands-on</i> sessions)	<ul style="list-style-type: none"> • Implementing project details • Create project context 	<ul style="list-style-type: none"> ➤ Preparation of: presentation: poster, webpage, report, press conference, etc. 	<ul style="list-style-type: none"> ➤ User manual (instruction guide)
14	Final project conclusion	<ul style="list-style-type: none"> • Oral report. • Open House 	<ul style="list-style-type: none"> ➤ Public presentation Background, main features, technical features, Q/A session 	<ul style="list-style-type: none"> ➤ Project review ➤ Course review
15	Course conclusion	<ul style="list-style-type: none"> • Course review 		