Syllabus

Overview
This course is a fast-paced introduction to computer science designed for students who plan to work extensively with computers (for example, engineers, biologists, physicists, and economists), as well as future concentrators who plan to take more advanced courses in the field.

The first half of the course covers foundational programming concepts such as data types, conditional execution, iteration, and recursion. It also explores the key features of object-oriented programming, and the manipulation of data stored in files and arrays.

The second half of the course provides a survey of fundamental data structures for information processing, including lists, stacks, queues, trees, and graphs. It explores the implementation of these data structures using both array-based and linked representations, and it examines classic algorithms that use these structures for tasks such as sorting, searching, and text compression. Techniques for analyzing the efficiency of algorithms are also covered. The course provides complete coverage of the syllabus for the advanced placement examination in computer science.

Prerequisites
Familiarity with precalculus. No prior programming experience is required. Students who have completed the Harvard Extension School courses CSCI E-10a, CSCI E-10b, CSCI E-22, or CSCI E-50 (CSCI-50a and CSCI E-50b) cannot earn degree credit for CSCI S-111.

Instructor
David G. Sullivan, Ph.D. (dgs@cs.bu.edu)
Senior Lecturer on Computer Science, Boston University
office hours: after lecture, and by appointment

Teaching Assistants (see the course website for office hours)
Cody Doucette (doucette@bu.edu)
Caitlin Fournier (crf18@bu.edu)
Libby James (etjames@bu.edu)
Kylie Moses (kylietmo@bu.edu)
Meeting Times and Places

*Lectures:* Mon-Fri, 8:30-11:30 a.m., Sever 113
There is one day each week without lecture – usually Wednesday, but there are exceptions. See the schedule below for more detail.

*Sections:* daily one-hour meetings from 1:30-2:30 p.m. on days when lecture is held; see the course website for locations.
Attendance at both the lectures and sections is essential, as this course moves very fast. We also encourage you to meet regularly with a member of the teaching staff to review any problems that you are having with the homework or with specific topics.

Requirements

The course is divided into ten distinct units. Units 1-5 cover programming fundamentals, and units 6-10 cover data structures and algorithms.

1. **Problem sets:** Each unit has a problem set consisting of two parts. Part I consists of short "written" problems that test your understanding of the key concepts from the unit. Your answers to Part I must be submitted as a single plain-text file. Part II consists of one or more programming problems that require you to employ the concepts from the unit. All programming problems must be completed in Java, and they must compile and run in order to be eligible for full credit.

2. **Unit tests:** At the conclusion of most units, students will take a 50-minute test on the material in that unit. Each unit test is worth 25 points. If you score less than 70% on a unit test (i.e., a 17.5 or lower), you may take a retest for a maximum score of 18.

3. **Final exam:** a three-hour comprehensive exam at the end of the course.

*Important note:* The problem sets tend to be extremely time-consuming. Don’t wait until the last minute to begin them! You should plan on devoting approximately 20-30 hours of work per week. If you have other major time commitments, you should reconsider whether to take this course.

Graduate-credit students: Students taking the course for graduate credit must complete additional homework. On most problem sets, the problems required of all students will be worth a total of 100 points; grad-credit students will complete one or two additional problems worth a total of 10 points. These grad-credit problems are typically more challenging than the other problems, and thus grad-credit students should plan to spend approximately 20% more time on the homework.

Grading Policies

Late penalties: Homework is due by 10 p.m. on the date listed on the assignment. There will be a 10% deduction for homework that is up to 24 hours late. We will not accept any homework that is more than 24 hours late. Plan your time carefully, and don’t wait until the last minute to begin an assignment. Starting early will give you ample time to ask questions and obtain assistance.

Determining the final grade: homework 50%, unit tests 25%, final exam 25%
The final exam will replace your lowest assignment grade if doing so helps your final grade. The final exam will also replace your lowest unit-test grade if doing so helps your final grade.

The final grades are not curved. The performance of the class as a whole is taken into account when assigning letter grades, but this can only improve your grade, not harm it.

Extensions and makeups will only be given in documented cases of serious illness or other emergencies. You cannot redo or complete extra work to improve your grade.

An EXT (extension) grade will be granted only in extreme circumstances (e.g., illness), and only when appropriate documentation has been provided. Please bring any such circumstances to Dr. Sullivan's attention as soon as possible.

**Academic Conduct**

Problem sets will include two types of problems:

- **individual-only** problems that you must complete on your own
- **pair-optional** problems that may be completed alone or with one other student.

Rules for individual-only problems:

- You may discuss the main ideas of a given problem with other students (provided that you acknowledge doing so in your solution), but you must complete the actual solution by yourself.
- You may not copy all or part of another person's work, even if you subsequently modify it.
- You may not view all or part of another student's work.
- You may not show all or part of your work to another student.

Rules for working with a partner on pair-optional problems:

- You may not work with more than one partner on a given assignment. (However, you are welcome to switch partners between assignments.)
- **You may not split up the work and complete it separately.**
- **You must work together at the same computer for every problem that you complete as a pair.** While you are working, the screen should be visible to both of you. One person should type, while the other person observes, critiques, and plans what to do next. You must switch roles periodically, and your solution should be a true collaborative effort.
- You must both submit the same solution to each problem that you did as a pair, and you must clearly indicate that you worked on the problem as a pair.

For both types of problems, you may not consult solutions from past semesters, or those found in books or on the Web.

If we believe that a student is guilty of academic misconduct, we will refer the matter to the Administrative Board of the Summer School, who could require withdrawal from the course and suspension from all future work at the School.

The Summer School provides resources to support academic integrity here: http://www.summer.harvard.edu/resources-policies/resources-support-academic-integrity
Summer School Policies
We also expect you to know and adhere to the general policies and procedures of the Summer School: http://www.summer.harvard.edu/policies/student-responsibilities

Accessibility Services
The Summer School is committed to providing an accessible academic community. The Accessibility Services Office offers a variety of accommodations and services to students with documented accessibility issues. This site has more information: https://www.summer.harvard.edu/resources-policies/accessibility-services

Textbooks
- CSCI S-111 coursepack. This contains all of the lecture notes for the course. It will be available from Gnomon Copy (1308 Mass Ave., across from the Yard), or you can access electronic copies of the notes on the course website.
- Optional: Building Java Programs, 4th ed. by Stuart Reges and Marty Stepp (Pearson, 2016). Older versions are also fine. This book is not required.

Course Outline

Unit 1: Getting started. Programming in Scratch (a graphical language developed at MIT that will allow us to quickly introduce a number of key programming concepts). Simple Java programs. Statements. Standard output. Procedural decomposition using simple methods.

Unit 2: Imperative programming, part I. The programming process. Data types. Literals, variables, and expressions. Definite loops. Simple conditional execution.


Unit 5: Object-oriented programming. Writing "blueprint" classes. Fields, non-static methods, and constructors. Inheritance and polymorphism.

Unit 6: Foundations of data structures. Defining and implementing an abstract data type. Memory allocation (stack and heap storage). Recursion revisited, including recursive backtracking algorithms.

Unit 7: Sorting and algorithm analysis. Sorting arrays using the following algorithms: insertion sort, selection sort, bubble sort, Shellsort, quicksort, and radix sort. Algorithm analysis: running-time analysis; big-O notation; worst-case, average-case, and best-case analyses.
**Unit 8: Sequences.** Linked lists. List, stack, and queue abstract data types, including both array and linked-list implementations of each of these ADTs. Implementing a generic collection.

**Unit 9: Trees and hash tables.** Tree overview and terminology. Data structures and algorithms for data dictionaries: binary search trees, 2-3 trees, B-trees, and hash tables. Data compression using Huffman encoding. Heaps and priority queues.


### Schedule (tentative)  
*key: BJP = Building Java Programs; L = Lafore book*

<table>
<thead>
<tr>
<th>lecture date</th>
<th>unit(s) covered</th>
<th>due dates</th>
<th>unit tests/retests</th>
<th>optional readings</th>
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<tbody>
<tr>
<td>Mon June 25</td>
<td>Unit 1</td>
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<tr>
<td>Tues June 26</td>
<td>Unit 1</td>
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<td>BJP 1</td>
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<tr>
<td>Wed June 27</td>
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<td>PS 1, part I due</td>
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<td>Unit 2</td>
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<td>Unit 3</td>
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<td>BJP 3</td>
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<td>Unit 2 test</td>
<td>BJP 5.1-4</td>
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<td>Unit 2 retest</td>
<td>BJP 7</td>
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<td>Unit 5</td>
<td>PS 4, part I due</td>
<td>Unit 3 test</td>
<td>BJP 8</td>
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<td>Unit 3 retest</td>
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<td>Unit 4 retest</td>
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<td>L 2, 3, 7 (B 13)</td>
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<td>Tues July 24</td>
<td>Unit 7</td>
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<td>Unit 5 test</td>
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<td>Wed July 25</td>
<td>No lecture</td>
<td>PS 6, part II due</td>
<td>L 4, 5 (B 16, 15)</td>
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<td>Thurs July 26</td>
<td>Unit 8</td>
<td>Unit 5 retest</td>
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<td>Fri July 27</td>
<td>Unit 8</td>
<td>PS 7, part I due</td>
<td>Unit 6 test</td>
<td>(B 14)</td>
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### Weekly Schedule

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<thead>
<tr>
<th>Day</th>
<th>Date</th>
<th>Activity</th>
<th>Assignment Due</th>
<th>Test/Retest</th>
<th>Lecture Reference</th>
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<tbody>
<tr>
<td>Mon</td>
<td>July 30</td>
<td>finish unit 8 start Unit 9</td>
<td>PS 7, part II due</td>
<td>Unit 6 retest</td>
<td>L 8 (B 17)</td>
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<td>Tues</td>
<td>July 31</td>
<td>Unit 9</td>
<td>PS 8, part I due</td>
<td>Unit 7 test</td>
<td>L 10</td>
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<td>Wed</td>
<td>August 1</td>
<td>No lecture</td>
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<tr>
<td>Thurs</td>
<td>August 2</td>
<td>Unit 9</td>
<td>PS 8, part II due</td>
<td>Unit 7 retest</td>
<td>L 12 (B 18)</td>
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<td>Fri</td>
<td>August 3</td>
<td>finish Unit 9 start Unit 10</td>
<td>PS 9, part I due</td>
<td>Unit 8 test</td>
<td>L 11</td>
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<td>Mon</td>
<td>August 6</td>
<td>Unit 10</td>
<td>PS 9, part II due</td>
<td>Unit 8 retest</td>
<td>L 13</td>
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<td>Tues</td>
<td>August 7</td>
<td>Unit 10</td>
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<tr>
<td>Wed</td>
<td>August 8</td>
<td>Wrap-up/review</td>
<td>PS 10 due</td>
<td>Unit 9 test</td>
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<td>Thurs</td>
<td>August 9</td>
<td>No lecture</td>
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<td>Unit 9 retest</td>
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<tr>
<td>Fri</td>
<td>August 10</td>
<td>Final exam, 8:30-11:30 a.m.</td>
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### Other Important Dates:
- June 27: late registration ends; course drop deadline for full-tuition refund
- July 3: course drop deadline for half-tuition refund
- July 27: last day to withdraw for a grade of WD (no refund)