

**Computer Science Fundamentals - edX MicroBachelors Syllabus****Spring 2020****Professors:** Daniel Katz-Braunschweig, Itay Tal, Rafail Portnoy, Aspen Olmsted**Teaching Assistants:** Victoria Zhong**Course Description**

This is a self-paced optional course that provides an undergraduate-level introduction to the basics of computing & programming, computer hardware & operating systems, and computer networking, that will help to prepare students for advanced undergraduate computer science course work.

**Course Objectives**

By the end of this course students should be able to:

- Describe how data is represented and how computers execute instructions to use and modify data in order to solve problems.
- Use the principle of computational thinking: how to develop algorithms using decisions, repetition, and decomposition into manageable components to solve problems.
- Implement and test moderate sized programs in the Python programming language, using constructs including variables, operators, decision statements, loops, functions, and built-in data types (numbers, strings, lists, tuples, dictionaries).
- Describe state-of-the-art in network protocols, architectures, and applications
- Process networking research
- Take into account the constraints in the thought process of networking research

**Course Structure**

**This course is conducted entirely online, which means you do not have to be on campus to complete any portion of it. You will participate in the course using edX located at <https://edx.org>.**

Students will have access to

- Active Modules needed to be watched, answering knowledge self-check quizzes;
- WebEx office hours, given by TA twice per week;



- Forum discussions, asynchronous;
- Resource links

**\*Consult with edx Online for further details about Active Learning Modules.**

### **Learning Time Rubric**

*You may choose your own weekly breakdown, such as live webinar sessions.*

<b>Learning Time Element</b>	<b>Asynchronous* / Synchronous**</b>	<b>Time on Task for Students (weekly)</b>	<b>Notes</b>
Lecture (Active Module)	Asynchronous	1.5 hours	Video format. Expect quizzes throughout the module.
Weekly Discussion Board	Asynchronous	1.0 hours	Students can interact with TA and professor via the discussion forums.
Assessment (homework)	Asynchronous	1.5 hours	Students submit their assignment by [the end of the module]

\*Asynchronous learning is defined as any non-real time student learning, such as recorded lecture, podcast, interactive module, articles, websites, etc. This also includes any student-to-student or faculty-to-student communication that may happen with an asynchronous tool, such as discussion board, chatroom, e-mail, text, etc.

\*\*Synchronous learning is defined as any real-time student-to-student and/or faculty-to-student learning, such as a live webinar session or other video/audio communication service.

### **Course Communication**

#### **Announcements -**

Announcements will be posted on edX on a regular basis. You can locate all class announcements under the *Announcements* tab of our class. Be sure to check the class announcements regularly as they will contain important information about class assignments and other class matters.

#### **Weekly Discussion Forums –**

Discussion forums are an excellent way for you to engage with the course material and with your peers. You are expected to read the discussion boards and engage in thoughtful



discussions. I will read all discussion posts and provide content clarification and feedback when necessary.]

### **Netiquette** –

When participating in an online class it is important to interact with your peers in an appropriate manner. Always use professional language (no netspeak) in your discussion board posts and emails. Please be respectful of your classmates at all times even if you disagree with their ideas.

### **Interaction Policy**

You are required to be an active online learner in this course and expected to participate in the Active Learning Modules, weekly discussion boards, virtual office hours, after having completed the readings.

### **Course requirements**

Participation is paramount to your success in this course. Be sure to log into edX multiple times a week, read all announcements, complete all Active Learning Modules, and participate in Discussion Forums.

Course evaluation will consist of by-module programming assignments, quizzes and final exams. The quizzes, providing multiple attempts, without proctoring. The final exams are closed books and utilize an online proctor.

## **Computer Hardware & Operating Systems Unit (1 credit - 6 Weeks).**

Unit Grading:

- Quizzes 40%
- Final Exam 60%

Unit Outcomes:

- understand the von Neumann model of a computer system.
- understand the basic operations and terminology associated with the CPU component



- understand the basic operations and terminology associated with memory organization
- understand the basic operations and terminology associated with disk drives
- understand the basic operations and terminology associated with various IO devices
- understand modern operating systems structure

Unit Outline:

1. Fundamentals of system hardware
2. Introduction to OS concepts
3. Processes & threads
4. Thread concurrency and deadlocks
5. Memory management

**Computer Hardware & Operating Systems Learning Time Rubric**

<b>Learning Time Element</b>	<b>Asynchronous* / Synchronous**</b>	<b>Time on Task for Students (weekly)</b>	<b>Notes</b>
Lecture (Active Module)	Asynchronous	2.0 hours	Video format. Expect quizzes throughout the module.
Weekly Discussion Board	Asynchronous	0.5 hours	Students can interact with TA and professor via the discussion forums.
Assessment (homework)	Asynchronous	1.0 hours	Students submit their assignment by [the end of the module]

**Computer Networking Unit (1 credit)**

Unit Grading:

- Quizzes 40%
- Final Exam 60%

Unit Outcomes:

- analyze the basic technologies used in communication systems.
- understand the organization of computer networks.
- apply TCP/IP protocol layers used in computer networks.

Unit Outline:



1. Overview of computer networking
2. Application layer
3. Transport layer
4. Network layer
5. Link layer
6. Overview of network security

**Networking Learning Time Rubric**

<b>Learning Time Element</b>	<b>Asynchronous* / Synchronous**</b>	<b>Time on Task for Students (weekly)</b>	<b>Notes</b>
Lecture (Active Module)	Asynchronous	2.0 hours	Video format. Expect quizzes throughout the module.
Weekly Discussion Board	Asynchronous	0.5 hours	Students can interact with TA and professor via the discussion forums.
Assessment (homework)	Asynchronous	1.0 hours	Students submit their assignment by [the end of the module]

**Basics of Computing & Programming Unit (1 credit - 9 Weeks)**

## Unit Grading:

- Labs 50%
- Quizzes 20%
- Final Exam 30%

## Unit Outcomes:

- understand binary number systems and conversion to other number systems
- understand hexadecimal number systems and conversion to other number systems
- apply numeric and string data types to represent information
- apply variables in program development
- analyze assignment and apply its components in program development
- apply basic I/O operations with different data types
- design expressions using arithmetic operations (including understanding their limitations, such as integer truncation, round-off error, division by



zero, narrowing and widening conversions, casting, precedence, and standard math library functions)

- design expressions using relational operators (including understanding floating point equality)
- design expressions using logical operators (including short-circuit)
- design selection statements (including nested selection)
- design repetition statements (including count-controlled versus event-controlled, sentinel-controlled)
- design simple data structures using lists (including using loops with lists and multi-dimensional lists)

Unit Outline:

1. Positional number systems
2. Hello World
3. Numerical data types and arithmetic expressions
4. Branching statements
5. Iterative statements [Loops]
6. Strings
7. Functions
8. Lists [Array-based sequences]

**Basics of Computing & Programming Learning Time Rubric**

<b>Learning Time Element</b>	<b>Asynchronous* / Synchronous**</b>	<b>Time on Task for Students (weekly)</b>	<b>Notes</b>
Lecture (Active Module)	Asynchronous	2.0 hours	Video format. Expect quizzes throughout the module.
Weekly Discussion Board	Asynchronous	0.5 hours	Students can interact with TA and professor via the discussion forums.
Assessment (homework)	Asynchronous	5.5 hours	Students submit their assignment by [the end of the module]