How Computers Work syllabus

Course Description

This course will introduce you to the fundamental concepts you will need to understand how modern computer systems work. They are the basic knowledge that will underpin your learning as a computer scientist. They will help you understand how computers work from the low level hardware to the architecture of complex web application.

The course will build up a picture of how computers work starting with basic ideas like abstraction and modularity. It will then cover a wide range of topics:

- How data is represented in computers
- Computer Hardware: how CPUs, Memory and other devices interact and execute programs
- Computer Operating Systems: their various components and how they manage multiple applications
- Networks: how computers communicate over the internet and how web sites work
- Machine Learning and AI: How the cutting edge of computer sciences is using data to accomplish amazing feats like machines that can recognize faces or understand speech

Throughout this course you will be applying these ideas to understanding the real computers systems that you use on a daily basis.

Course Goals and Objectives

Upon successful completion of this course, you will be able to:

1. Describe and illustrate contemporary practice in a range of areas of computing technology
2. Outline the elements that make up a computer system and describe their purpose
3. Explain the functioning of a computer system in terms of an abstract notional machine
4. Analyse and predict the behaviour of a computer system using a notional machine
5. Reason about computer systems in terms of a wide range of components and levels of abstraction such as hardware, operating systems, networks and data representations

Textbook and Readings

The essentials readings for this course will come from the following text book, which you will be able access from within some lessons on Coursera platform:

Brookshear, J.G. and D. Brylow *Computer science: an overview*. (Harlow: Pearson Education, 2015) 12th edition (Global edition).

This course does not require you to read the whole book, you will be given specific readings for each topic from these texts are listed with direct links on the Readings page for each topic.

You will also be asked to do some independent research from online sources or using the University of London digital library.

Course Outline

The course consists of 10 topics, each of which spans 2 weeks.

Topic 1: How a computer works	Learning Objectives: ● Describe and illustrate, to a basic level, contemporary practice in a range of areas of computing technology ● explain the functioning of a computer systems in terms of notional machine based on state, computer architecture and heirarchy ● analyse and predict the behaviour of a computer system using a notional machine based on state, computer architecture and hierarchy.
Topic 2: How the web works	Learning Objectives: ● describe and illustrate typical web application design ● explain the functioning of a web application in terms of an abstract notional machine ● analyse and predict the behaviour of a web application using a notional machine.

Topic 3: Data representation	Learning Objectives: • describe and illustrate how different forms of data are represented on a computer • outline forms of data storage and describe their purpose • reason about the effect of storage and data representation on the operation of computer systems.
Topic 4: Computer Architecture	Learning Objectives: • Outline the elements of a computer process and describe their purpose • Explain the functioning of a computer system in terms of an abstract notional machine of a processor • Analyse and predict the behaviour of a computer system using a notional machine of a processor
Topic 5: Operating Systems	Learning Objectives: • Describe and illustrate common functions of an operating system • Outline the components of an operating system and describe their purpose • Reason about computer systems in terms of the functioning of its operating system
Topic 6: Operating System Processes	Learning Objectives: • Describe and illustrate the functioning of processes within a modern operating system • Explain the functioning of a set of computer

	programmes in terms of an abstract notional machine of a multprocess operating system • Analyse and predict the behaviour of a computer system using a notional machine of a multiprocess operating system
Topic 7: Networks	Learning Objectives: • Describe and illustrate a number of network architectures and protocols • Reason about how different situations require different network design • Reason about how the design of a network affects its security
Topic 8: The Internet	Learning Objectives: • Describe and illustrate how local networks are connected to form a global internet and how communication is possible in such a network • Outline the elements that make up a web, or other internet, application • Explain the functioning of a web, or other internet, application based on an abstraction notional machine of internet communication and clients/server systems
Topic 9: Machine learning	Learning Objectives: • Describe and illustrate different artificial intelligence and machine learning problems and techniques • Explain the training and use of a machine learning model in terms of an abstract notional machine of the learning process • Train and debug a machine learning system based on a notional machine model of that system

Topic 10: Data Science	Learning Objectives: • Describe and illustrate how data is collected, analysed and used • Use a notional machine for machine learning to inform collecting a dataset suitable use in training • Reason about the effect of data sets used on the function of machine learning systems

Learning Activities of This Course

The course is comprised of the following elements:

- Lecture videos. In each topic the key concepts will be presented through a collection of short video lectures. You may stream these videos for playback within the browser by clicking on their titles or download the videos.
- Readings. Each topic may include several suggested readings. These are a core part of your learning, and, together with the videos, will cover all of the concepts you need for this course.
- Practice Quizzes. Each module will include practice quizzes, intended for you to assess your understanding of the topics. You will be allowed unlimited attempts at each practice quiz. Each attempt may present a different selection of questions to you. There is no time limit on how long you take to complete each attempt at the quiz. These quizzes do not contribute toward your final score in the class.
- Graded Quizzes. Each topic (2 weeks) will include 1 end of topic quiz. In topics 1-5, the end of topic quiz will contribute to your coursework grade. End of topic quizzes in the second half of the course will not contribute to your final grade, but will provide important practice for your exam. You will be allowed maximum three attempts per each quiz. Your highest score will be used when calculating your final score in the summative quiz.
- Peer Reviewed Assignments. Each topic (apart form the final two topics) includes one peer reviewed assignment. These exercises will test your understanding of the concepts in the course by applying them to understanding real world software or computer systems. You will read a short prompt, then write a short written essay in response. You will then be required to review three of your peers' submissions. Peer reviewed assignments will not contribute to your final grade, but will be valuable practice for your coursework and exam.

- Discussion Prompt. Each topic includes discussion prompts. You will see the discussion prompt alongside other items in the lesson. Each prompt provides a space for you to respond. After responding, you can see and comment on your peers' responses. All prompts and responses are also accessible from the general discussion forum and the module discussion forum.
- Interactive simulations. Some of the topics will include interactive software which help you understand certain types of computer system by interacting with simulations of them. Some of these will be like game-like. We hope they will be fun, but they also aim to provide you with valuable practical learning. The topics on machine learning will include a complete machine learning software platform that will give you practical experience of machine learning without having to know all of the technical details.

How to Pass This Course

The course has two major assessments each worth 50% of your grade:

- Coursework: this consists of several activities that you do on the Coursera platform and which will be assessed half way through course (after week 10)
- Written examination: you will take this at an examination centre in your country.

There are also several activities that are graded but have 0 weight. That means that they will not count towards your final grade, but they are a key part of your learning and you need to do them.

The mark shown on the Coursera platform is your coursework mark and you should remember that the exam counts for another 50%.

The coursework consists of several activities. This is a detailed breakdown of all of the marks.

Activity	Required?	Deadline week	Estimated time per module	% of final grade
End of topic quizzes for topics 1-5	Yes	1-10	1-2 hours	10%

Mid-point test	Yes	10	1 hour	10%
Written, staff graded coursework	Yes	10	Approximately 20 hours	30%
Written examination	Yes	22	2 hours 15 minutes	50%