Introduction to Computer Science

Course Outline

**Class:** WA100 – Introduction to Computer Science

30 hours

**Instructor:**

**Text:**  Invitation to Computer Science, 7th edition

by Michael Schneider

CENGAGE Learning

**Prerequisite:** None

**Equipment:** Each student shall be equipped with a desktop computer with the technical characteristics configured to run the programs used throughout the program:

* 20 desktop computers (including 24” monitors and mice) minimum
* Quad Core processor with Microsoft Windows 7, 8.x, or 10,
* Minimum 16 GB Ram
* Minimum 500 GB HD
* Internet access.

**Grading System:**

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|  | | **Grading Scale** | | |
| Classwork, Homework, Participation, Attendance | 10% | 90–100 | A | I - Incomplete |
| Exams/Quizzes | 50% | 80–89 | B | T - Transfer Credit |
| Presentation/Projects | 10% | 70–79 | C | E - Exempt |
| Final Exam | 30 % | 65–69 | D | W - Withdrew |
|  | **100%** | Below 65 | F | I - Incomplete |

**Course Description:**

This introduction module presents an overview of the Web Application Design & Development program and its objectives, as well as the breadth of computer science discipline without programming language specifics. The students will gain a high-level understanding of today's hardware, software, and applications, as well as a modern view of ethics in the virtual realm.

Specific coverage includes:

* An Introduction to Computer Science
* Algorithm Discovery and Design
* The Efficiency of Algorithms
* The Building Blocks: Binary Numbers, Boolean Logic, and Gates
* Computer Systems Organization
* An Introduction to System Software and Virtual Machines
* Computer Networks and Cloud Computing
* Introduction to High-Level Language Programming
* The Tower of Babel
* Compilers and Language Translation
* Models of Computation
* Simulation and Modeling
* Artificial Intelligence
* Computer Graphics and Entertainment: Movies, Games, and Virtual Communities
* Making Decisions about Computers, Information, and Society

**Overview:** This class meets for a total of 30 hours. Day classes are six hours per day, Monday through Friday.

**Objectives:** Provide a breadth-first view of Information Technology that surveys the fundamental aspects of computer science and establishes a context for subsequent courses.

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

1. Understand fundamental ideas such as the design of algorithms, algorithmic problem solving, abstraction, pseudocode and iteration.
2. Understand the basic building blocks of computer systems—binary numbers, Boolean logic, gates, and circuits. Demonstrate how these elementary concepts can be combined to construct a real computer using the Von Neumann architecture, composed of processors, memory, and input/output.
3. Describe how system software can create a more friendly, user-oriented problem-solving environment.
4. Write programs to solve interesting problems.
5. Explore important uses of computers in our modern society.
6. Address the social, ethical, and legal issues raised by pervasive computer technology.

**Requirements:** 1. Meet attendance and academic criteria.

2. Completion of all assignments.

3. Completion of the final exam.

**Graded Work:** The test average and quiz average each comprise 50% of the final grade point average. Quiz grades are based upon completion of the assignment in the time allotted, ability to follow instructions, observance of safety rules and neatness of work area.

**Attendance:** Daily attendance is required. If you anticipate an absence, consult with your instructor.

Be aware that each absence will require an equal amount of make-up time. Each student is required to maintain a minimum attendance of 85% for each course:

* If you miss more than 15% of the total hours in any one course, you will be required to make-up enough missed hours to meet the minimum course attendance requirement of 85%.
* If at the end of the cycle your attendance is less than 85% you will receive an incomplete (I) for the course, and will have 5 business days immediately following the end of the cycle to make-up the hours missed, otherwise your grade will change from an incomplete to an F, and you will be required to retake the course.
* If you miss more than 30% of the total hours in any one course, you will receive a W (withdrawal) and will be required to retake the course.

**Make-up Work:** All missed work is required to be completed as soon as possible. If you need extra help, it is your responsibility to make an appointment with your instructor at a mutually agreeable time.

**Supplies:** Hunter Business School provides all the necessary supplies.

### **Lesson Plan**

##### Day 1 of 5

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| **Name:** |  |
| **Date:** |  | **Department:** |  |

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| **Subject:** | Algorithmic Foundations of Computer Science |
| **Subject Topics:** | Chapter 1: An Introduction to Computer Science  Chapter 2: Algorithm Discovery and Design  Chapter 3: The Efficiency of Algorithms |
| **# of Students in the Class:** |  |
| **Previous Requirements:** | none |
| **Aim / Objective:** | After completion of the lesson, students will be able to:   * Understand the formal definition of computer science * Write down everyday algorithms * Determine if an algorithm is ambiguous or not effectively computable * Understand the roots of modern computer science in mathematics and mechanical machines * Summarize the key points in the historical development of modern electronic computers * Explain the benefits of pseudocode over natural language or a programming language * Represent algorithms using pseudocode * Identify algorithm statements as sequential, conditional, or iterative * Describe algorithm attributes and why they are important * Explain the purpose of efficiency analysis and apply it to new algorithms to determine the order of magnitude of their time efficiencies * Describe, illustrate, and use the algorithms from the chapter, including: sequential and binary search, selection sort, data cleanup algorithms, pattern-matching * Explain which orders of magnitude grow faster or slower than others * Describe what an intractable problem is, giving one or more examples. |
| **Technology:** | * Overhead projector |
| **Materials:** | * PowerPoint presentation |
| **Teacher/Student Input:** | * Question and Answer interactions * Class exercises |
| **Lesson Plan** | 9 AM – 10:45 AM   * Introduction * Program Overview * Overview of Computer Science, slides 3-26   10:45 AM – 11 AM   * Break   11 AM – 12 PM   * Algorithm Discovery and Design, slides 27-58 * Exercises, slide 59   12 PM – 12:30 PM   * Lunch break   12:30 PM – 3 PM   * The Efficiency of Algorithms, slides 60-108 * Exercises, slide 109 |
| **Review / Assessment:** | 8 Exercise assignments are planned to assess students understanding of the material, see slides #59 and #109 |

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### **Lesson Plan**

##### Day 2 of 5

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| **Name:** |  |
| **Date:** |  | **Department:** |  |

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| **Subject:** | The Hardware World and the Virtual Machine |
| **Subject Topics:** | Chapter 4: The Building Blocks: Binary Numbers, Boolean Logic, and Gates  Chapter 5: Computer System Organization  Chapter 6: An Introduction to System Software and Virtual Machines  Chapter 7: Computer Networks and Cloud Computing |
| **# of Students in the Class:** |  |
| **Previous Requirements:** | none |
| **Aim / Objective:** | After completion of the lesson, students will be able to:   * Translate between base-ten and base-two numbers * Explain how fractional numbers, characters, sounds, and images are represented inside the computer * Build truth tables for Boolean expressions and determine when they are true or false * Describe the relationship between Boolean logic and electronic gates * Construct circuits using the sum-of-products circuit design algorithm, and analyze simple circuits to determine their truth tables * Enumerate the characteristics of the Von Neumann architecture * Describe the components of a random access memory system, including how fetch and store operations work, and the use of cache memory to speed up access time * Explain why mass storage devices are important, and how direct access storage devices like hard drives or DVDs work * Diagram the components of a typical arithmetic/logic unit (ALU) and illustrate how the ALU data path operates for some particular computation * Describe the operation of the control unit and explain how it implements the stored program characteristic of the Von Neumann architecture * List and explain the types of instructions in a typical instruction set, and how instructions are commonly encoded * Describe non-Von Neumann parallel processing systems * Describe four types of system software * Explain the benefits of writing programs in assembly language, rather than machine language * Read and write short assembly language programs using the book’s particular assembly language * Describe how an assembler translates assembly language programs into machine instructions * List five key tasks of an operating system, and explain what each is and why it is critical to modern systems * Describe the different generations of operating systems, what the features of each generation were, and how each generation solved a drawback of the previous generation * Describe and compare different network technologies, including dial-up, broadband, and wireless * Explain how different kinds of networks (LAN, WLAN, WAN) are connected, and how communication works in each * Explain the importance of standards and protocols for communication among computing devices * Name the layers of the network protocol hierarchy, and describe the purpose of each layer * Demonstrate how protocols like the ARQ algorithm, IP, TCP, and HTTP function * Name four services that computer networks provide and explain their social impact. * Explain cloud computing and discuss its potential benefits. * Describe the highlights of the history of the Internet and the Web |
| **Technology:** | * Overhead projector |
| **Materials:** | * PowerPoint presentation * Computer hardware props |
| **Teacher/Student Input:** | * Question and Answer interactions * Class exercises |
| **Lesson Plan** | 9 AM – 10:45 AM   * The Hardware World: Binary Numbers, Boolean Logic and Gates, slides 2-32   10:30 AM – 10:45 AM   * Break   10:45 AM – 12 PM   * The Hardware World: Computer Systems Organization, slides 33-55 * Exercises, slide 56   12 PM – 12:30 PM   * Lunch break   12:30 PM – 3 PM   * System Software and Virtual Machine, slides 57-86 * Computer Networks, slides 87-133 |
| **Review / Assessment:** | 1 Exercise assignment is planned to assess students understanding of the material |

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### **Lesson Plan**

##### Day 3 of 5

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| **Name:** |  |
| **Date:** |  | **Department:** |  |

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| **Subject:** | The Software World |
| **Subject Topics:** | Chapter 9: Introduction to High Level Language Programming  Chapter 10: The Tower of Babel  Chapter 11: Compilers and Language Translation |
| **# of Students in the Class:** |  |
| **Previous Requirements:** | none |
| **Aim / Objective:** | After completion of the lesson, students will be able to:   * Explain the advantages of high-level programming languages over assembly language * Describe the general process of translation from high-level source code to object code * Name the five procedural programming languages used in the examples of this chapter * Explain the Favorite Number and Data Cleanup examples for each programming language * Explain why so many programming languages exist * List four key procedural languages and the main purpose for the development of each * Describe the purpose of each special-purpose language: SQL, HTML, and JavaScript * Describe the alternative paradigms for programming languages: functional, logic, and parallel * Name a functional programming language and a logic programming language. * Describe how logic programming languages work, and explain what facts, rules, and inference are * Explain how the MIMD model of parallel processing could be used to find the largest number in a list * List the phases of a typical compiler and describe the purpose of each phase * Demonstrate how to break up a string of text into tokens * Understand grammar rules written in BNF and use them to parse statements, drawing parse trees for them * Explain the importance of recursive definitions and avoiding ambiguity in grammar rules * Explain how semantic analysis uses semantic records to determine meaning * Show what a code generator would do, given a simple parse tree from one of the book’s example grammars * Explain the historical importance of code optimization, and why it seems less central today * Give an example of local code optimization and an example of global code optimization |
| **Technology:** | * Overhead projector |
| **Materials:** | * PowerPoint presentation |
| **Teacher/Student Input:** | * Question and Answer interactions * Class exercises |
| **Lesson Plan** | 9 AM – 10:45 AM   * Introduction to High Level Language Programming, slides 2-13 * Exercise, slide 14   10:45 AM – 11 AM   * Break   11 AM – 12:30 PM   * The Tower of Babel, slides 15-41 * Exercises, slide 42   12:30 PM – 1:00 PM   * Lunch break   1:00 PM – 3 PM   * Compilers and Language Translation, slides 43-65 * Exercises, slide 66 |
| **Review / Assessment:** | 3 Exercise assignments are planned to assess students understanding of the material |

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### **Lesson Plan**

##### Day 4 of 5

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| **Name:** |  |
| **Date:** |  | **Department:** |  |

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| **Subject:** | Applications |
| **Subject Topics:** | Chapter 13: Simulation and Modeling  Chapter 15: Artificial Intelligence  Chapter 16: Computer Graphics and Entertainment: Movies, Games and Virtual Communities |
| **# of Students in the Class:** |  |
| **Previous Requirements:** | none |
| **Aim / Objective:** | After completion of the lesson, students will be able to:   * Describe the purpose of modeling in science * List the benefits of a computational model over a physical model * Explain the tradeoff between accuracy and complexity in models * Define different types of simulation models, including discrete and continuous, deterministic and stochastic * Describe how a discrete event simulation works * Define “artificial intelligence” and describe the two types of tasks at which humans (for now) seem more capable than machines * Explain the pros and cons of various knowledge representation methods * Explain the parts of a simple neural network, how it works, and how it could be trained for recognition tasks * Explain what a robot is, and list some tasks for which robots are currently suited * Explain what a drone is, and list some tasks drones might perform in the future * Describe the transformation of movie animation caused by CGI * List the phases of the graphics pipeline * Explain how a tessellation represents a 3D graphics object * Apply a transformation matrix to translate a set of vertices |
| **Technology:** | * Overhead projector |
| **Materials:** | * PowerPoint presentation |
| **Teacher/Student Input:** | * Question and Answer interactions * Class exercises |
| **Lesson Plan** | 9 AM – 10:45 AM   * Simulation and Modeling, slides 2-29 * Exercise, slide 30   10:45 AM – 11 AM   * Break   11 AM – 12 PM   * Artificial Intelligence, slides 31-62   12 PM – 12:30 PM   * Lunch break   12:30 PM – 3 PM   * Computer Graphics and Entertainment, slides 63-90 * Exercises, slides 91-92 |
| **Review / Assessment:** | 2 Exercise assignments are planned to assess students understanding of the material |

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### **Lesson Plan**

##### Day 5 of 5

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| **Name:** |  |
| **Date:** |  | **Department:** |  |

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| **Subject:** | Applications |
| **Subject Topics:** | Chapter 17: Making Decisions about Computers, Information and Society |
| **# of Students in the Class:** |  |
| **Previous Requirements:** | None |
| **Aim / Objective:** | After completion of the lesson, students will be able to:   * Use ethical reasoning to evaluate social issues related to computing * Describe the viewpoints of music users and music publishers about the issue of music file sharing * Apply utilitarian arguments to ethical issues * Explain the purpose of a dialectic process * Explain the social tradeoffs involved in lawful intercept laws and their opposition * Use analogies to evaluate ethical issues * Provide arguments that support and oppose hackers who claim to be performing a social good * Perform deontological analysis of the duties and responsibilities of parties in an ethical issue * Describe the steps in the "paramedic method" for approaching ethical issues * Describe cyberbullying and why legal remedies are difficult to apply * Explain the potential downsides of sexting for those who engage in it |
| **Technology:** | * Overhead projector |
| **Materials:** | * PowerPoint presentation |
| **Teacher/Student Input:** | * Question and Answer interactions * Classroom discussions |
| **Lesson Plan** | 9 AM – 10:30 AM   * Making Decisions about Computers, Information and Society, slides 2-13   10:30 AM – 10:45 AM   * Break   10:45 AM – 12 PM   * Making Decisions about Computers, Information and Society, slides 14-46   12 PM – 12:30 PM   * Lunch break   12:30 PM – 3 PM   * Review of the concepts learned in the Invitation to Computer Science course * Test |
| **Review / Assessment:** | 2 classroom discussions are planned to assess students understanding of the material |

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