



Awardee of The Office of the National Coordinator for
Health Information Technology

Component 4: Introduction to Information and Computer Science

Instructor Manual Version 3.0/Spring 2012

Notes to Instructors

This Instructor Manual is a resource for instructors using this component. Each component is broken down into units, which include the following elements:

- Learning objectives
- Suggested student readings, texts, reference links to supplement the narrated PowerPoint slides
- Lectures (voiceover PowerPoint in Flash format); PowerPoint slides (Microsoft PowerPoint format), lecture transcripts (Microsoft Word format); and audio files (MP3 format) for each lecture
- Self-assessment questions reflecting Unit Objectives with answer keys and/or expected outcomes
- Application Activities (e.g., discussion questions, assignments, projects) with instructor guidelines, answer keys and/or expected outcomes

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Component Overview

For students without an IT background, this Component provides a basic overview of computer architecture; data organization, representation and structure; structure of programming languages; networking and data communication. It also includes basic terminology of computing.

Component Objectives

At the completion of this component, the student will be able to:

1. Learn correct terminology for computing and technology including for hardware, software, networks, Internet and databases
2. Identify commonly used hardware components.
3. Identify commonly used software applications and operating systems.
4. Explain the function and use of programming languages and identify commonly used languages.
5. Define what a database is, explain what querying languages are and identify commonly used database systems.
6. Describe network computing, its benefits and risks, and identify commonly used communications hardware and software components.
7. Identify security risks for computing systems and discuss potential solutions.
8. Explain the design and development process of a software information system such as an EHR.

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Likewise, the above also applies to the Curriculum Development Centers (including Columbia University, Duke University, Johns Hopkins University, Oregon Health & Science University, University of Alabama at Birmingham, and their affiliated entities).

Component 4/Unit 1

Unit Title

Basic Computing Concepts, Including History

Unit Description

This unit introduces basic computing concepts and terminology. It identifies common elements of computers, both in terms of hardware and software and provides information on selecting a computer by discussing the range of computer types, from desktops to laptops to servers. Finally, it provides a history of the development of computing and healthcare information systems over time.

Unit Objectives

By the end of this unit the student will be able to:

1. Define what a computer is. (Lecture a)
2. Describe different types of computers, including PCs, mobile devices and embedded computers. (Lecture a)
3. Define the common elements of computer systems. (Lecture a)
4. Describe the various hardware and software options for typical desktop, laptop and server systems for home and business use with a focus on healthcare systems. (Lecture b, c)
5. Explain the development of computers and the Internet, including healthcare systems, up until the present time. (Lecture d, e)

Unit Topics/Lectures

1. What is a computer
 - a. Definition of a computer
 - b. Types of computers
 - c. Common Elements of computer systems
2. Selecting a computer
 - a. Selecting a desktop
 - b. Selecting a laptop
 - c. Selecting a system for healthcare applications
3. History of Computing
 - a. The beginnings of computers
 - b. The first computers

*Indicates this link is no longer functional.

- c. Early electronic medical records
- d. Personal computers
- e. The Internet
- f. Current and future computers

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Slide 5: An IBM 704 mainframe. Lawrence Livermore National Laboratory. (n.d.). <http://commons.wikimedia.org/wiki/File:Ibm704.gif> . Retrieved November 2011, from Wikimedia Commons website: <http://commons.wikimedia.org/wiki/>. The copyright holder of this file, [Lawrence Livermore National Laboratory](#), allows anyone to use it for any purpose, provided that the copyright holder is properly attributed. Redistribution, derivative work, commercial use, and all other use is permitted.

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Slide 22: Gloria Ruth Gordon, left, and Ester Gerston wiring the right side of the ENIAC (Electronic Numerical Integrator And Computer), circa 1946. U.S. Army photo, from archives of the ARL Technical Library, courtesy of Mike Muuss. Public domain PD-US.

Lecture 1e

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Student Application Activities

comp4_unit1_activities.doc
comp4_unit1_activities_key.doc
comp4_unit1_activities_dataset_final.doc
comp4_unit1_activities_results.doc
comp4_unit1_discuss.doc
comp4_unit1_discuss_key.doc

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comp4_unit1_exercises.doc
comp4_unit1_exercises_key.doc
comp4_unit1_self_assess.doc
comp4_unit1_self_assess_key.doc

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Component 4/Unit 2

Unit Title

Internet and the World Wide Web

Unit Description

This unit covers the implications, origins, and use of the Internet and the World Wide Web, including the advantages and disadvantages of this technology.

Unit Objectives

By the end of this unit the student will be able to:

1. Define the Internet and how to connect to it. (Lecture a, b)
2. Define the World Wide Web and how to access it. (Lecture a, b)
3. Write effective search queries for Internet search engines, filter the results and evaluate credibility of information. (Lecture b)
4. Discuss security and privacy concerns on the Internet. (Lecture c)
5. Describe ethical issues for the Internet. (Lecture c, d)
6. Explore online healthcare applications and associated security and privacy issues including HIPAA. (Lecture d)

Unit Topics/Lectures

1. The Internet, its origins, and evolution
 - a. The origins of the Internet
 - b. The evolution of the Internet
2. The Internet and the World Wide Web (WWW)
 - a. The origins of the WWW
 - b. HTML, Web pages, and Web servers
 - c. Ownership of the WWW
3. Standardized communications
 - a. Internet protocols and their purpose
 - b. Internet addressing
4. The Domain Naming System (DNS)
 - a. DNS and Internet Protocol (IP)
5. Connecting to the Internet
 - a. Internet hardware
6. Internet Service Providers (ISPs)

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- a. ISP roles and fees
 - b. ISP equipment
 - c. ISPs and IP address management
 - d. ISPs and DNS
7. Internet search engines
 - a. Search engine providers
 - b. Search engine functionality
 - c. Search engine search terms and use
 8. Internet security and privacy concerns
 9. Internet devices and methods of attack
 10. Operating system and device security
 - a. File security
 - b. Internet security
 11. Password security
 - a. User accounts
 - b. Miscellaneous security considerations
 12. Trojans, viruses, worms, phishing, and hoaxes
 13. Ethical considerations of the Internet
 - a. Sharing Internet connectivity with others
 - b. Copyright infringement
 - c. Internet-based databases
 - d. False information on the Internet
 14. Online information sharing
 - a. Online privacy
 - b. Online confidentiality
 15. Federal rule emergence
 - a. Health Insurance Portability and Accountability Act (HIPAA)
 16. Electronic Health Record (EHR) systems
 - a. Online HER systems
 - b. Health care provider EHR systems
 - c. EHR security

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2.1 Figure: (PD-US, 2010)

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Component 4/Unit 3

Unit Title

Computer Hardware

Unit Description

This unit provides a foundation on how a computer functions and how data is represented in memory, input and output devices, and the CPU, including its role in system functionality.

Unit Objectives

By the end of this unit the student will be able to:

1. List the major elements of a computer (Lecture a)
2. Describe how data is stored in memory and in secondary storage (Lecture b)
3. Describe how data is represented in binary notation (Lecture b)
4. Describe the function of the central processing unit (CPU) of the computer (Lecture c)
5. Describe how data is input/output from a computer (Lecture c)
6. Describe how the elements of a computer system work together (Lecture c)
7. Explain how specialized architectures and embedded systems are used in healthcare settings (Lecture c)

Unit Topics/Lectures

1. What is a computer
 - a. Computer hardware components
 - b. System components
 - c. Motherboard ports
 - d. Motherboard buses
2. Computer input and output devices
 - a. Input devices
 - b. Output devices
3. Input/Output ports
4. Memory storage devices
 - a. Primary storage
 - b. Secondary storage
5. Data storage.

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- a. Binary data storage
- b. Data storage example
- c. Data representation in memory
- d. Data storage acronyms
- e. Data types and addressing
- 6. The Central Processing Unit (CPU)
 - a. CPU components
 - b. CPU execution
 - c. CPU performance
 - d. Evolution of the CPU
- 7. Data vs. information
- 8. Specialized health care CPUs

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Component 4/Unit 4

Unit Title

Computer Software

Unit Description

This unit covers application and system software, with a focus on healthcare systems. It also describes the functions of operating systems, presents different operating systems, and defines the purpose and usage of file systems.

Unit Objectives

By the end of this unit the student will be able to:

1. Define application vs. system software. (Lecture a)
2. Give examples of application software focusing on healthcare systems. (Lecture a)
3. Describe the functions of system software. (Lecture b)
4. List different types of operating systems. (Lecture b)
5. Explain the purpose and usage of file systems. (Lecture c)

Unit Topics/Lectures

1. Application Software
 - a. Forms of Application Software
 - b. Types of Application Software
 - c. Examples of Application Software
 - d. Components of Software
 - e. Installing and Uninstalling Software
 - f. Ethical Considerations of Software
2. System Software
 - a. Operating Systems
 - b. Utility Programs
 - c. Types and Examples of OS
3. File Systems
 - a. Computer Files
 - b. File “Containers”
 - c. File Management Utilities
 - d. File System Implementation

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Lecture 4c Images

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Slide 8: Folder Image [image on the Internet]. c 2007 [Updated 11/13/2007; cited 11/8/2011]. Available from: <http://www.clker.com/clipart-3618.html>. (PD-US).

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Slide 20: File Cabinet Image [image on the Internet]. c 2010 [Updated 6/22/2010; cited 11/8/2011]. Available from: <http://www.clker.com/clipart-system-file-manager.html>. (PD-US).

Slide 25: String on finger Image [image on the Internet]. c 2011 [Updated 5/9/2011; cited 11/8/2011]. Available from: <http://www.clker.com/clipart-reminder.html>. (PD-US).

Student Application Activities

comp4_unit4_activities.doc
comp4_unit4_activities_key.doc
comp4_unit4_discuss.doc
comp4_unit4_discuss_key.doc
comp4_unit4_self_assess.doc
comp4_unit4_self_assess_key.doc

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Component 4/Unit 5

Unit 5 Computer Programming

Unit Description

This unit discusses the purpose and types of programming languages from simple machine code to high level programming languages, including the process of compiling and interpreting. Students will use variables, loops and conditional statements to build a simple program. Finally, this unit presents some advanced programming concepts such as Object Oriented Programming.

Unit Objectives

By the end of this unit the student will be able to:

1. Define the purpose of programming languages. (Lecture a)
2. Differentiate between the different types of programming languages and list commonly used ones. (Lecture a)
3. Explain the compiling and interpreting process for computer programs. (Lecture b)
4. Learn basic programming concepts including variable declarations, assignment statements, expressions, conditional statements and loops. (Lecture c, d)
5. Describe advanced programming concepts including objects and modularity. (Lecture 3)

Unit Topics/Lectures

1. Overview of programming languages
 - a. Software development and programming
 - b. Algorithms
2. Different types of programming languages
 - a. Programming paradigms
 - b. Scripting languages
 - c. Programming languages developed for healthcare
3. Generating an executable program
 - a. Compiling
 - b. Interpreting
 - c. Java's hybrid approach
4. Programming language constructs with Java examples
 - a. Variables and datatypes
 - b. Assignment statements and expressions
 - c. Input and Output

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- d. Control Structures
 - i. Conditional Expressions
 - ii. If Statements
 - iii. Loops
- 5. Object Oriented Programming (OOP)
 - a. Objects and classes
 - b. OOP Designs
 - c. Inheritance
 - d. Modularity
 - e. Encapsulation

Unit References

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Lecture 5a Images

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Lecture 5c Images

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Lecture 5d

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Lecture 5d Charts, Tables, Figures

5.1 Table: Example of more complex conditional expressions.

Lecture 5e

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Lecture 5e Charts, Tables, Figures

5.2 Table: BMI Calculator (Hribar, 2011)

5.3 Figure: Child classes inherit all methods and instance variables from parent class (Hribar, 2011).

Student Application Activities

comp4_unit5_activities.doc

comp4_unit5_activities_key.doc

comp4_unit5_discuss.doc

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Component 4/Unit 6

Unit Title

Databases and SQL

Unit Description

This unit discusses the purposes of databases, a relational database, and the querying language SQL. Students will design a simple database using data modeling and normalization. This unit will define basic data operations, provide instruction on how to create common query statements, and discuss SQL implementation.

Unit Objectives

By the end of this unit the student will be able to:

1. Define and describe the purpose of databases (Lecture a)
2. Define a relational database (Lecture a)
3. Describe data modeling and normalization (Lecture b)
4. Describe the structured query language (SQL) (Lecture c)
5. Define the basic data operations for relational databases and how to implement them in SQL (Lecture c)
6. Design a simple relational database and create corresponding SQL commands (Lecture c)
7. Examine the structure of a healthcare database component (Lecture d)

Unit Topics/Lectures

1. The definition and purpose of databases
2. Relational databases
3. The SQL querying language
4. Data operations for databases
5. Designing a database
6. Examples of querying statements for databases
7. Examples of database tables used in a healthcare application

Unit References

Lecture 6a

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Lecture 6a Images

Slide 13: OpenOffice Calc spreadsheet example. (PD-US, 2011).

Lecture 6b

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Lecture 6b Charts, Tables, Figures

6.8 Figure: Entity-Relationship Diagram (ER diagram) (PD-US, 2012)

6.9 Figure: One-to-many relationship (PD-US, 2012)

6.10 Table: Contact attributes (PD-US, 2012)

6.11 Table: Contact table (PD-US, 2012)

6.12 Figure: Normalized database structure (PD-US, 2012)

6.13 Tables: New tables using same data from Table 6.5 (PD-US, 2012)

Lecture 6c

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Lecture 6c Charts, Tables, Figures:

6.14 Figure: View tables (PD-US, 2011).

6.15 Figure: View table columns (PD-US, 2011).

6.16 Figure: Retrieve an entry (PD-US, 2011).

6.17 Figure: Add sorting (PD-US, 2011).

6.18 Figure: Add selectivity (PD-US, 2011).

6.19 Figure: Retrieve from multiple tables (PD-US, 2011).

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- 6.20 Figure: Create a Complex SQL Statement (PD-US, 2011).
- 6.21 Figure: Modify company name (PD-US, 2011).
- 6.22 Figure: New company name (PD-US, 2011).
- 6.23 Figure: Verify again (PD-US, 2011).

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Lecture 6d Charts, Tables, Figures

- 6.24 Table: Patient table (Select elements) (PD-US).
- 6.25 Table: Site table (Select elements) (PD-US).
- 6.26 Diagram: Entity-relationship (ER) Diagram. (PD-US, 2011)
- 6.27 Table: Patient review table (Select elements) (PD-US, 2011).
- 6.28 Diagram: Entity-relationship diagram (PD-US, 2011).

Lecture 6d Images

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Student Application Activities

comp4_unit6_activities.doc
comp4_unit6_activities_key.doc
comp4_unit6_discuss.doc
comp4_unit6_discuss_key.doc
comp4_unit6_self_assess.doc
comp4_unit6_self_assess_key.doc

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Component 4/Unit 7

Unit Title Networks

Unit Description

This unit covers the history and evolution of computer networks, including the various types of network communications. Various forms of networking addressing are also covered, including network topologies, standards and protocols, logical model concepts, network hardware, and wireless communication.

Unit Objectives

By the end of this unit the student will be able to:

1. List and describe the various types of network communications and network addressing (Lecture a, b)
2. List and define the different types of networks (Lecture c)
3. Describe different network topologies (Lecture c)
4. List and describe different network standards and protocols (Lecture c, e)
5. Describe wireless communication (Lecture d)
6. List and describe network hardware (Lecture d)

Unit Topics/Lectures

1. What is a network?
 - a. A modern network example
 - b. Why networks exist and their use
 - c. Networks decrease cost
 - d. Networks serve customers
 - e. Devices connect to a network
2. Wired vs. wireless networks
 - a. Bandwidth vs. throughput
 - b. Internet Service Providers (ISPs)
3. Connecting to the Internet
 - a. Leasing an Internet Protocol (IP) address
 - b. Leasing a dynamic IP Address
 - c. Leasing a static IP address
4. IP addressing
 - a. IP address versions (IPv4 and IPv6)
5. Local Area Network (LAN) addressing
 - a. Media Access Control (MAC) addressing
 - b. Obtaining an IP address

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6. The Internet and the Domain Naming System (DNS)
 - a. What is a domain name?
 - b. ISPs and DNS
 - c. DNS and IP integration
7. Network types
 - a. Local Area Networks (LANs)
 - b. Wide Area Networks (WANs)
 - c. Metropolitan Area Networks (MANs)
8. Network topologies
 - a. Physical topologies
 - b. Logical topologies
9. Network standards and protocols
 - a. The Institute of Electrical and Electronics Engineers (IEEE)
 - b. Internet protocols
 - c. Wired and wireless networking standards
10. Wireless communications
 - a. IEEE 802.11 specifications
 - b. Wireless communication advantages and disadvantages
 - c. Wireless communication functionality and setup
11. Network hardware
 - a. Network Interface Cards (NICs)
 - b. Switch and router devices
 - c. Server devices and operating systems (OS)
 - d. Surge protectors and uninterruptible power supplies (UPS)
12. Networking logical models
 - a. The Open Systems Interconnection (OSI) model
 - b. Layers of the OSI model
 - c. Devices and the OSI model
 - d. The OSI model and health care hardware and software

Unit References

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Lecture 7a Images

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Lecture 7b Images

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Lecture 7c

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Lecture 7c Images

Slide 5: Screenshot of Computer Name/Domain Changes window. (PD-US, 2011)

Slide 10: Physical Topologies [image on the Internet]. Foobaz, (2006) [cited 2011 Nov 07]. Retrieved Jan 2012 from: http://en.wikipedia.org/wiki/Network_topology.

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comp4_unit7_exercises_key.doc
comp4_unit7_self_assess.doc
comp4_unit7_self_assess_key.doc

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Component 4/Unit 8

Unit Title Security

Unit Description

This unit covers common security concerns and safeguards, including firewalls, encryption, virus protection software and patterns, and programming for security. Additional topics include security of wireless networks, and concerns, mitigations, and regulations related to healthcare applications.

Unit Objectives

By the end of this unit the student will be able to:

1. List and describe common security concerns (Lecture a)
2. Describe safeguards against common security concerns (Lecture b)
3. Describe security concerns for wireless networks and how to address them (Lecture b and c)
4. List security concerns/regulations for health care applications (Lecture c)
5. Describe security safeguards used for health care applications (Lecture c)

Unit Topics/Lectures

1. Data and hardware security concerns
 - a. Common threats to security
 - b. Trojan horse
 - c. Viruses
 - d. Macro viruses
 - e. Personal information attacks
 - f. Worms
 - g. False information
2. How do hackers operate
3. Network security
 - a. What is network security
 - b. Authentication
 - c. Authorization
 - d. Object permissions
 - e. Mitigating security issues

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- f. Security policy
 - g. Authentication factors
 - h. Factor authentication
 - i. Hardware and software firewalls
 - j. Windows Firewall
 - k. Anti-virus (AV) software
 - l. Intrusion Protection Systems (IPS)
 - m. Data encryption
 - n. Audit of security policy practices
4. Additional security precautions
 - a. Password policies
 - b. Physical security of assets
 5. Wireless networking security
 - a. Wireless device security
 6. Health care applications and security
 7. Security of health care data
 - a. Electronic Health Record (her) systems
 - b. EHRs used by health care providers
 - c. EHR security Q & A.
 - d. Federal regulations
 8. Federal regulations
 - a. Health Insurance Portability and Accountability Act (HIPAA)
 - b. What is privacy
 - c. What is confidentiality
 9. Security of EHR record data

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Lecture 8a Images

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Slide 20: Screen shot of the folder named Picture properties dialog box. Image source: the creator of this presentation. (2011, PD-US)

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Lecture 8c Images

Slide 5: Screenshot of a partial browser address bar with a valid bank certificate. (PD-US, 2006)

Student Application Activities

comp4_unit8_discuss.doc
comp4_unit8_discuss_key.doc
comp4_unit8_exercises.doc
comp4_unit8_exercises_key.doc
comp4_unit8_self_assess.doc
comp4_unit8_self_assess_key.doc

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Component 4/Unit 9

Unit Title Information Systems

Unit Description

This unit defines information systems and describes how they are used. It discusses how an information system is designed, developed, tested, supported and maintained. Finally, it explains how information systems are used in healthcare settings, including the role of specialized information systems.

Unit Objectives

By the end of this unit the student will be able to:

1. Define an information system, how one is used and list examples. (Lecture a)
2. Describe the components of an information system. (Lecture a)
3. Describe the process developing an information system. (Lecture b)
4. Describe the different types of testing and when testing should occur. (Lecture c)
5. Describe how information systems are supported and maintained over time. (Lecture c)
6. Describe specialized information systems. (Lecture d)
7. Explain how information systems are used in healthcare. (Lecture d)

Unit Topics/Lectures

1. Information Systems Introduction
 - a. Definition
 - b. Use
 - c. Data, Information and Knowledge
 - d. Examples
2. Components of Information Systems
 - a. Processes
 - b. Stakeholders
3. Systems Development
 - a. Planning
 - b. Analysis

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- c. Design
- d. Implementation
- e. Support/Security
- 4. Testing information systems
 - a. Test plan
 - b. Test Cases
 - c. Test Sequence
 - d. Types of testing
- 5. Support and maintenance of information systems
 - a. User support
 - b. Maintenance
 - c. Security
- 6. Specialized information systems
- 7. Information systems in healthcare

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Component 4/Unit 10

Unit Title

Future of Computing

Unit Description

This unit covers five topics concerning the future of computing: trends in computing, interfaces used to communicate with computer systems, cloud computing, the changing social implications of the use of computer systems, and the ubiquity of computers in our daily lives.

Unit Objectives

By the end of this unit the student will be able to:

1. Describe the latest advances in technology.
2. Discuss the implications of advances in technology for healthcare systems, including potential risks.

Unit Topics/Lectures

1. Trends in Computing
2. User Interfaces
3. Cloud Computing
4. Social Implications
5. Ubiquitous Computing

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Student Application Activities

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Component Acronym Glossary

ACF – Administration for Children and Families
ADA – American Dental Association
ADL – activity of daily living
AHRQ – Agency for Healthcare Research and Quality
AIDS - Acquired immune deficiency syndrome
AMA – The American Medical Association
AoA – Administration on Aging
ATSDR – Agency for Toxic Substances and Disease Registry
CCU – critical care unit
CD-10-PCS - The International Classification of Diseases, 10th Revision, Procedure Coding
CDC – Centers for Disease Control and Prevention
CDHC - Consumer Driven Health Care Plans
CDS – Clinical Decision Support
CDT - Code on Dental Procedures and Nomenclature
CMS – Centers for Medicare and Medicaid Services
CPI – Consumer Price Index
CPT - Current Procedure Terminology
CT – Computerized Tomography
DNR – do-not-resuscitate order
DRG - Diagnosis Related Groups
EBM – Evidence Based Medicine
ED - Emergency Department
EDI - Electronic data interchange
EMT – emergency medical technician
EMTALA – Emergency Medical Treatment and Active Labor Act
EPO - Exclusive Provider Organization
ER – emergency room
FDA – Food and Drug Administration
FFS - Fee-for-service
GDP – gross domestic product
HCO – Health Care Organization
HCPCS - Health Care Common Procedure Coding System
HHS – Department of Health and Human Services
HIPAA – Health Insurance Portability and Accountability Act
HIT – Health Information Technology
HITECH Act - The Health Information Technology for Economic and Clinical Health Act
HIV - Human immunodeficiency virus

HMO - Health Maintenance Organization
HRSA – Health Resources and Services Administration
ICD-10-CM - The International Classification of Diseases, 10th Revision,
Clinical Modification,
ICD-9-CM - The International Classification of Diseases, Ninth Revision,
Clinical Modification
ICU – intensive care unit
IHS – Indian Health Service
IPA – independent practice association
JC – Joint Commission
JTTS – Joint Theater Trauma System
LPN – licensed practical nurse
LRN - Lab Response Network
MCO - Managed care organization
MHS – Military Health System
MRI – Magnetic Resonance Imaging
MRSA - methicillin-resistant Staphylococcus aureus
National Drug Codes (NDC
NATO – North Atlantic Treaty Organization
NIH – National Institutes of Health
NOS – Not Otherwise Specified
OIG – Office of Inspector General
OR – operating room
PA – physician assistant
PMPM - per member per month
POS - Point of Service Plan
PPO - Preferred Provider Organization
PTSD – post-traumatic stress disorder
RBRVS - Resource Based Relative Value Scale
RN – registered nurse
SAMHSA – Substance Abuse and Mental Health Services Administration
TBI – traumatic brain injury
VA – Department of Veterans Affairs



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