Curriculum Development Centers Program

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

HEALTH IT WORKFORCE CURRICULUM
COMPONENT BLUEPRINT
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Component Number: 4
Component Title: Introduction to Information and Computer Science

Component Description: 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.

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Workforce Roles:

- Clinician/Practitioner Consultant
- Implementation Support Specialist
- Practice Workflow and Information Management Redesign Specialist
- Technical/Software Support
- Trainer

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.

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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.

Component Units with Objectives and Topics

Unit 1: Basic Computing Concepts, Including History

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.

Objectives:
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)

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
    c. Early electronic medical records
    d. Personal computers

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    e. The Internet
    f. Current and future computers

Unit 2: Internet and the World Wide Web

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.

Objectives:
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)

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)
    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

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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

Unit 3 – Computer Hardware

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.

Objectives:
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)

Topics/Lectures:
1. What is a computer
    a. Computer hardware components

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    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.
    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

Unit 4 – Computer Software

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.

Objectives:
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)

Topics/Lectures:
1. Application Software
    a. Forms of Application Software
    b. Types of Application Software
    c. Examples of Application Software
    d. Components of Software

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    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

Unit 5 – Computer Programming

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.

Objectives:
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)

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

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    a. Variables and datatypes
    b. Assignment statements and expressions
    c. Input and Output
    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 6 – Databases and SQL

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.

Objectives:
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)

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

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Unit 7 – Networks

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.

Objectives:
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, d)
5. Describe wireless communication. (Lecture d)
6. List and describe network hardware. (Lecture d)

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
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)

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    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 8 – Security

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.

Objectives:
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, c)
4. List security concerns/regulations for health care applications. (Lecture c)
5. Describe security safeguards used for health care applications. (Lecture c)

Topics/Lectures:
1. Data and hardware security concerns
    a. Common threats to security
    b. Trojan horse
    c. Viruses

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    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
    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

Unit 9 – Information Systems

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.

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Finally, it explains how information systems are used in healthcare settings, including the role of specialized information systems.

Objectives:

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 for 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)

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
    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

Unit 10 – Future of Computing

Description:

This material was developed by Oregon Health & Science University, funded by the Department of Health and Human Services, Office of the National Coordinator for Health Information Technology under Award Number IU24OC000015.

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.

Objectives:

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

Topics/Lectures:

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

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