Chapter 1

Defining Information Technology

fluency5

WITH INFORMATION TECHNOLOGY skills, concepts, & capabilities

PEARSON ALWAYS LEARNING

Learning Objectives

- Explain why it's important to know the right word
- Relate the connections among hardware, software, "the experience," and data
- Define basic hardware and software terms
- Define and give examples of "idea" terms

Hardware, Software, and the Experience

- Computing in its most general form concerns data and three phenomena:
  - Hardware
  - Software, and
  - "the experience."

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Hardware, Software, and the Experience

- Hardware:
  - Computers are the physical embodiment of computation.
  - They represent one of the greatest technological achievements.
  - Few inventions are more important.

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Hardware, Software, and the Experience

- Software:
  - Embodies the programs that instruct computers in the steps needed to implement applications.
  - Software, unrestricted by the physical world, can direct a computer to do almost anything.

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Hardware, Software, and the Experience

- The Experience:
  - Together, hardware and software present a virtual world that doesn't exist, but which we experience.
  - These experiences, dictated by the interaction of the virtual and physical worlds, are new and important.

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Computers Are Everywhere

- They are in laptops, tablets, smart phones, music players, wireless mics, anti-lock brakes, TV remotes, credit card readers, etc.
  - Through 2010, 24.1 billion ARM processor chips have been shipped
  - It means that every consumer in the developed world owns more than a dozen

Computers Are Everywhere

- Looking Inside:
  - Computers don't always have keyboard and printer attached
- Notice there are metal plates covering its internal parts
  - They shield the surrounding environment from electromagnetic radiation

Figure 1.1 An iPhone 3GS when first opened

Computers Are Everywhere

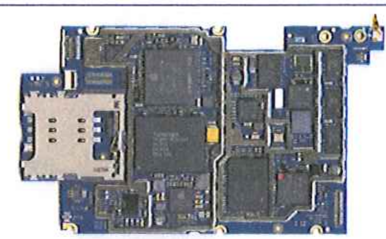

Figure 1.2 Top side of the main printed circuit board in the iPhone 3GS; for orientation, the USB port is at left, and processor and memory IC packages are identified. *32-bit describes the size of a typical operation; GB is short for gigabyte (1 billion bytes).

Computers Are Everywhere

- Head-to-Head Comparisons

Table 1.1 A comparison of features of a typical smart phone and a typical laptop

Feature	Mobile (iPhone, Android)	Laptop/Desktop
Screen*	Small (320 x 480 at ~325ppi)	Large (1440 x 900 at ~128 ppi)
Keyboard	Virtual	Standard QWERTY key
Interaction		
Screen	Multitouch	Passive
Command Initiate	Tap Screen	Click Mouse
Panning	Coverflow	Scroll bars
Zoom/Shrink	Multitouch	Mouse on Slider
Voice Communicate	Phone	iChat/Skype
Task Management	Essentially Single Task	Multitask
Operating System	iOS, Android	MacOSX, Windows
Software Source	App Stores	Standard Software Vendors

* ppi = pixels per inch

Software

- Software is a collective term for programs
- Programs are the instructions computers perform to implement applications.
- Software "instructs" the computer (hardware), by providing the steps needed to perform a task.
- The computer follows the program and carries out the instructions

Software

- The Software Stack
  - Concept used to structure and organize the software in contemporary computer systems
  - Series of layers of programs that implement user applications.
  - Each software layer implements operations used to build the layers above.

Software

Figure 1.3 The software stack for the Android smart phone; the hardware is on the bottom, the apps are on top

Software

- Referring to the figure on the previous slide:
  - To check out a video on YouTube video using a smart phone, you would:
    - use the browser application to get to YouTube
    - the browser app uses the window manager, and several other frameworks
    - the window manager uses media manager, and several other libraries
    - the media manager uses the display drivers, and several other kernel operations

Software

- Writing software is a difficult and challenging
- They instruct an agent to perform some function or action by giving a step-by-step
- process.
- The agent is anything that can follow the instructions.
- For software professionals, the agent is a computer.

Experience

- People:
  - meet online and marry
  - make unfortunate Facebook posts and lose their jobs
  - spend hours listening to music, watching videos, and playing games
- Most of our interactions with computers are recorded, virtual, and artificial

Experience

- Recorded technology
  - Oldest form of information technology is a recording a scene, performance, event, etc.
  - Digital copies are approximations of reality
  - With today's technology, in most cases the approximation is extremely accurate

Digital Information

- Transformation
  - It is easy to enhance or embellish digital information
  - Photo editing, video editing, audio remixing are widely practiced
  - *Photoshop* has become a verb describing the act of changing a digital image

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Digital Information

- Synthetic Complexity
  - The creation of new digital media means that the information is *synthesized*
  - It is an alternate version of the world
    - Examples: animations, cartoons, video games

Digital Information

- Synthetic Complexity
  - Advantages?
    - With early animations, each frame was drawn by a person and the music was recorded "live"
    - Contemporary animations are digital art also created one frame at a time, but by a computer
    - A "start scene," an "ending scene," and directions on how to modify the *start* to get to the *end* are processed by the computer to create the movie
    - Digital sounds are added and synchronized to the images

Virtual Worlds

- Virtual reality: a world created by computers to *simulate* the physical world
- It is not real, but is perceived "as if" it were
- The full VR experience is still under development…but we see it all the time:

  - Keypads on a smart phone display
  - Spreadsheet software that look like accounting paper
  - GPS displays that show a map

Virtual Worlds

- Programmers use these features because they are familiar, intuitive, easy to learn, and efficient to use
- These examples are "not real, but as if"
- Sometimes, the virtual devices are better than the real one:
  - Example: if you mistype a phone number, you can delete the wrong numbers *before* you "dial"

Artificial Worlds

- Everything else that you experience with computers is simply artificial
- Systems like iTunes, Facebook, Twitter, and Angry Birds are entirely the product of human imagination
- This means the creators had almost unlimited flexibility when designing
- This flexibility to create *anything* is one of the exciting aspects of computing

Artificial Worlds

- Extended Abilities.
  - Key advantage of software is that it can often do difficult tasks that are user-friendly
  - These are "artificial" solutions in the sense that they are not the standard techniques used previously
  - They depend on a computer to "do the work"
  - We are now "experts" at tasks that were once people's careers: for example, video editing

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Artificial Worlds

- New Phenomena.
  - Systems, such as Twitter, Facebook, YouTube, give us experiences that did not exist before they were created
  - Some aspects, such as communication via phone and snail mail, did exist
    - They were not equivalent to social networks, primarily because they are either person-to-person, or person-to-tiny group

Artificial Worlds

- New Phenomena/New Problems
  - New privacy concerns
  - Spam (junk mail)
  - Scams (the Nigerian Widow fraud)
  - online bullying
  - stalking (physically following someone)

The Data

- Data vs. Information are interchangeable works in computing
- Physical Form
  - Information is literally everywhere in the physical world
  - Much of it can be captured and converted to digital form.
  - It is always represented as bits (0's and 1's)

The Information You Use

- Most of the information used daily is delivered by the World Wide Web
- Newspapers, TV, magazines, and libraries also deliver information but in a diminishing role
- Some digital data (like GPS or ATM transactions) is not delivered at all by the Web

Sourced Content

- Sourced content is content produced for commercial purposes or to fulfill an information dissemination obligation
- Examples include newspapers, shopping, government, celebrities, etc.
- It is content that is entirely controlled by the source organization or person
- The general public cannot add new information to sourced content

Social Content

- Social content refers to information created by visitors to the site
- Examples include the social networking, media sharing, gaming, and reference
- Users generate or contribute to the content of these sites
- Although Google and other search engines do not create the content they display, they are not social networking sites

The Files and Databases

- The digital information we access through the WWW is stored on Web servers around the world as files and databases.
  - Sourced content sites create the files and databases and places them on their own servers
- Databases are everywhere; your digital music (for example, iTunes) is organized as a database, as are your photos

The Files and Databases

- Your smart phone contacts are a database, and much of the other "stuff " you've stored on your phone is organized that way, too.

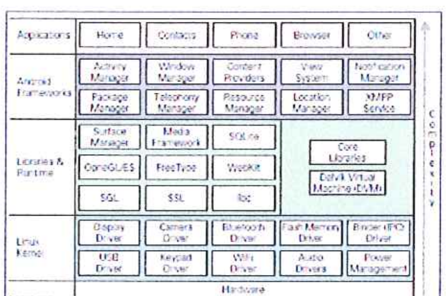

Figure 1.5 The software stack for the Android smart phone; the hardware is on the bottom, the apps are on top.

Terms of Endearment

- Not only should you learn the right computing terms, but you should also understand how to use them to benefit completely from the technology.
- There are two practical reasons for this:
  - Tech Support: Everyone needs and uses it
  - To learn a new subject, we must learn its terminology

Tech Support

- Usually, you must look up the answer yourself using the *Help* feature, or you must contact tech support
  - The technician might not know what you talking about
  - Without the right word, the search algorithm of the *Help* facility definitely won't know what you mean

Algorithms

- What's an algorithm?
  - An **algorithm** is a precise, systematic method for producing a specified result
- Important points about algorithms:
  - We use and invent algorithms all the time to solve our problems
  - Often the agent that "runs" the algorithm is a person, NOT a computer

Algorithms (cont'd)

- Computers are clueless. They need to be told what to do
- For a method to be precise enough for a computer to follow, *everything* needs to be spelled out
- Programmers make algorithms perfectly precise for computers by writing them in a programming language

Algorithms (cont'd)

- People *do* have a clue, so many things can be left out of an explanation when *people* have to follow directions
- Example:
  - After finding a letter, a computer has to be told to go back to the beginning of the letter sequence to start looking for the next letter
  - People figure that out by themselves!

Algorithm Versus Program

- Algorithms are a precise, systematic method for producing a specified result
- Programs are algorithms that have been specialized to a specific set of conditions and assumptions, and (usually) written in a specific programming language
- In most cases however, we use the terms interchangeably

The Words for Ideas

- "Abstract"
  - The word has several meanings:
    - In natural language: *to remove* can mean *to steal*
    - In computing: *to abstract* also means to remove, but this time, it's an idea or a process, and it is extracted from some form of information
- Abstractions
  - Parables and fables require us to abstract the essential point of the story so that we can learn from it

Abstractions

- Notice two key points:
  - Many, but not all the details, of the story are irrelevant to the concept
  - The abstraction has meaning beyond the story
- In computing, separating the relevant from the irrelevant, and applying the abstraction to other cases are essential

The Words for Ideas

- "Generalize"
  - Process to recognize the common idea in two or more situations
  - To **generalize** is to express an idea, concept, or process that applies to many situations
  - The statement that sums up that idea is called a **generalization**
  - If it is true most of the time, we can generalize an idea

The Words for Ideas

- "Operationally Attuned"
  - The ability to apply what we know about how a device or system works to simplify its use
  - Example:
    - We loosen lids by turning it left and tighten by turning it right
    - We know this intuitively, but knowing it *explicitly* makes us operationally attuned
- With computing, thinking about how computation works makes it simpler to use

The Words for Ideas

- "Mnemonic"
  - A mnemonic is an aid for remembering something
  - Example: *HOMES* (the Great Lakes: Huron, Ontario, Michigan, Erie, and Superior)
  - *Mary's Violet Eyes Make John Stay Up Nights* (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune)

Summary

- Recognize the three-part decomposition of everyday computing: hardware, software, and the experience.
- Recognize Web information sources: sourced and social.
- Determine how close to reality our interactions with computers are by identifying recorded, virtual, and artificial content.

Summary

- Know and use the right word because as we learn words, we learn ideas; knowing the right words helps us to communicate.
- Consider a brief list of "idea" words, such as abstract and generalize.