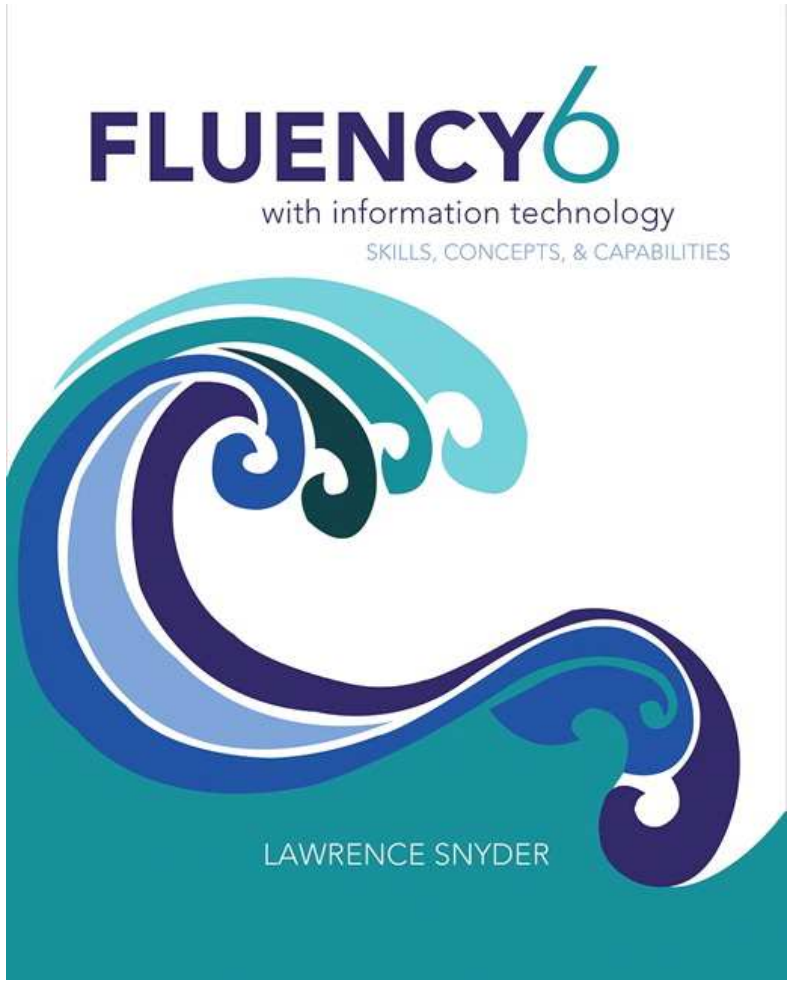


Chapter 1

Defining Information Technology

Table of Contents

Learning Objectives

- The "big idea" of computing inventions
- Explain why it's important to know the right word
- Define basic hardware and software terms
- Define and give examples of computer science's typical "idea" terms

Computation's Big Ideas

- Digitizing information -- 1890
- Stored-program computers -- 1943
- Transistors (TR) -- 1956
- Integrated circuits (IC) -- 1958
- "Personal" computers (PC) -- 1973
- The Internet -- 1969
- World Wide Web (WWW) -- 1993
- Layered Software -- 1970년대 후반이후

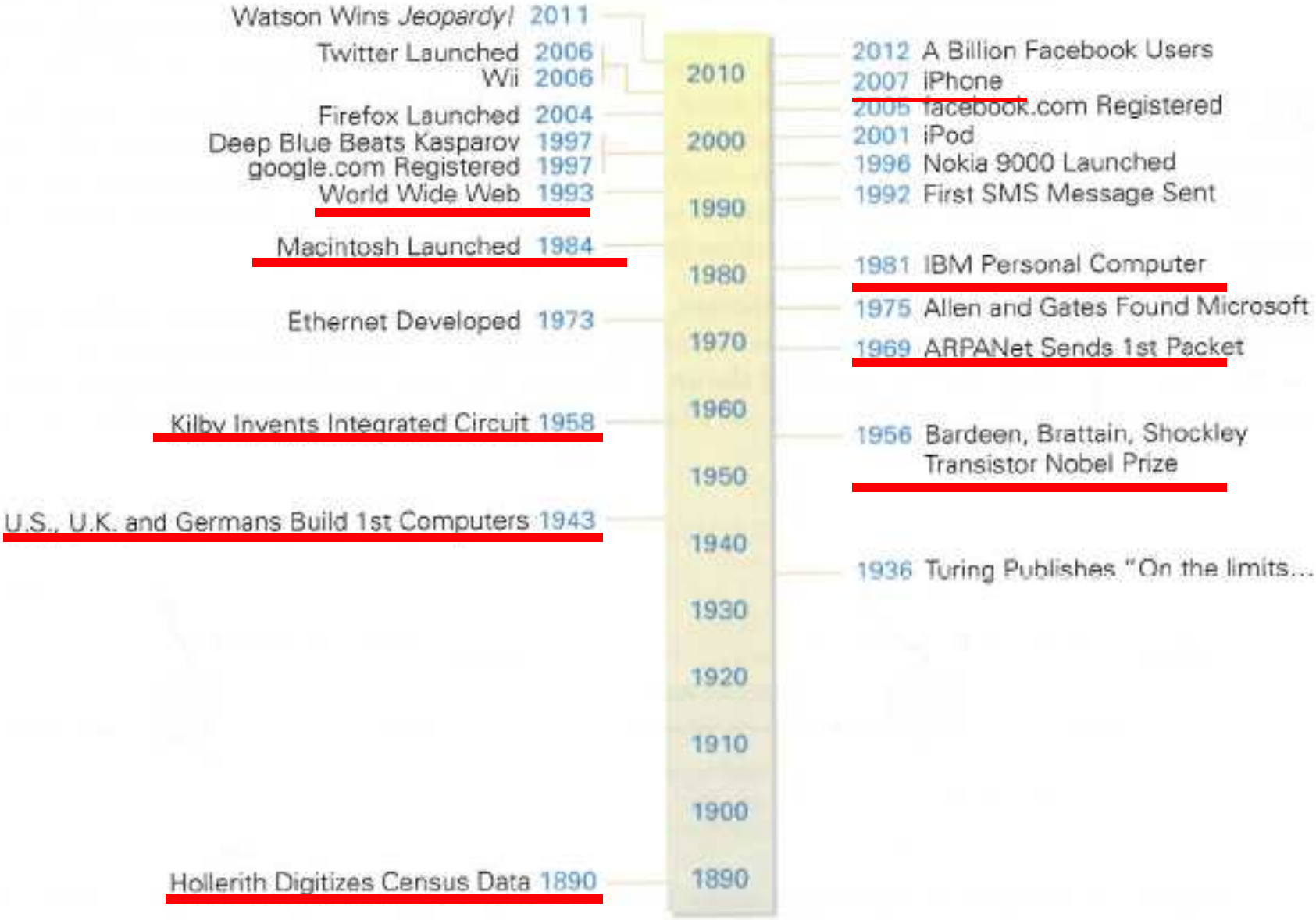
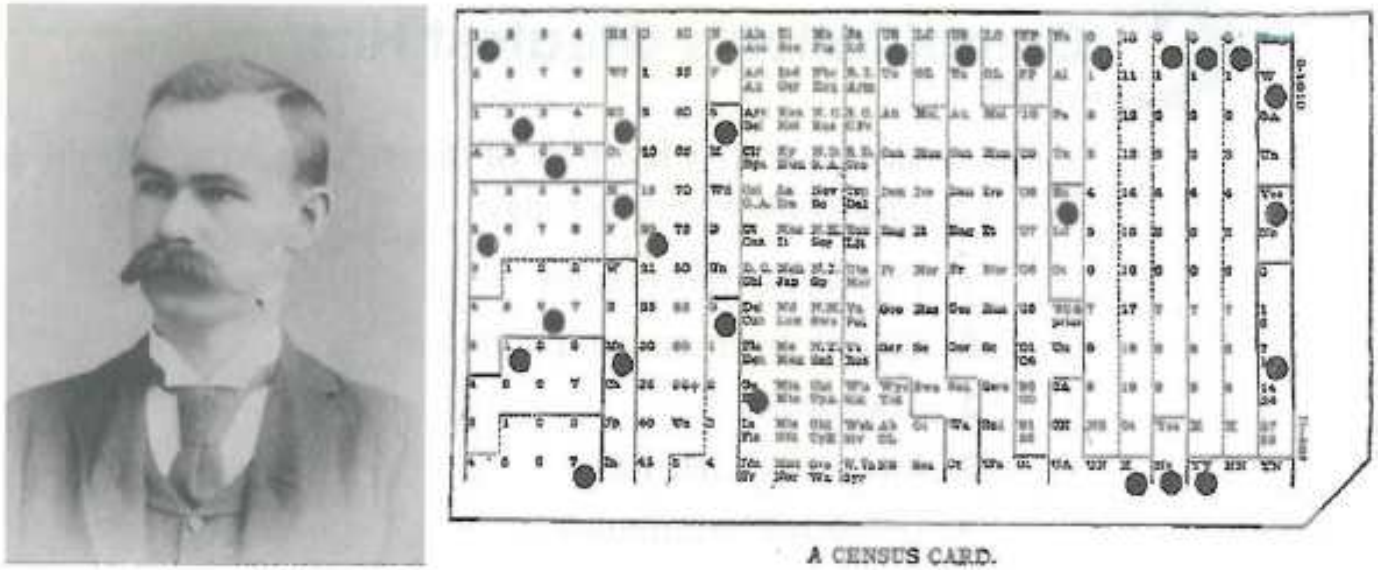


Figure 1.1 Selected Events In Computing: More than 90 years passed between the first automated use of digital information and the announcement of the PC.

Computation's Greatest Hits [1/7]

- Digitizing Information
  - – Data represented as numbers
    - Getting a machine to read digital information
  - Census data digitized (1890)
    - Herman Hollerith invented a punch card reader in 1890
    - Punch cards digitized the process (not a computer, a card reader)
    - In 1880 it took 8 years to process the data by hand in US Census Bureau
    - The punch card reader shortened the process in 1 year



A CENSUS CARD.

Figure 1.2 Digital pioneers: Herman Hollerith and the punch card he invented.

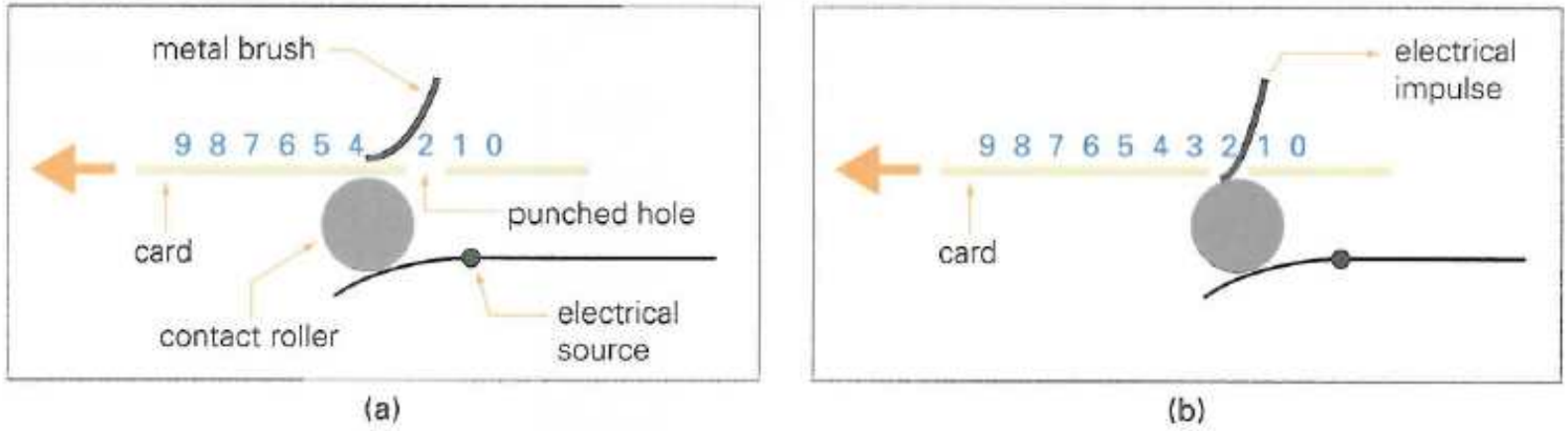


Figure 1.3 Operation of a punch card reader: (a) the card is moved leftward by a metal roller, and (b) when the hole passes over the roller, the metal brush makes an electrical connection.

Computation's Greatest Hits [2/7]

- Stored-Program Computers (1946)
  - sometimes, called Von Neumann Computer Architecture
  - Programs (instructions) stored in memory
  - Programs can be changed quickly, more complex, and autonomous
  - Central processing unit (CPU) processes the instructions
  - ENIAC: started in 1943 finished in 1946
    - University of Pennsylvania
    - 30 tons, 17,000 vacuum tubes
  - The problem: too many vacuum tubes!

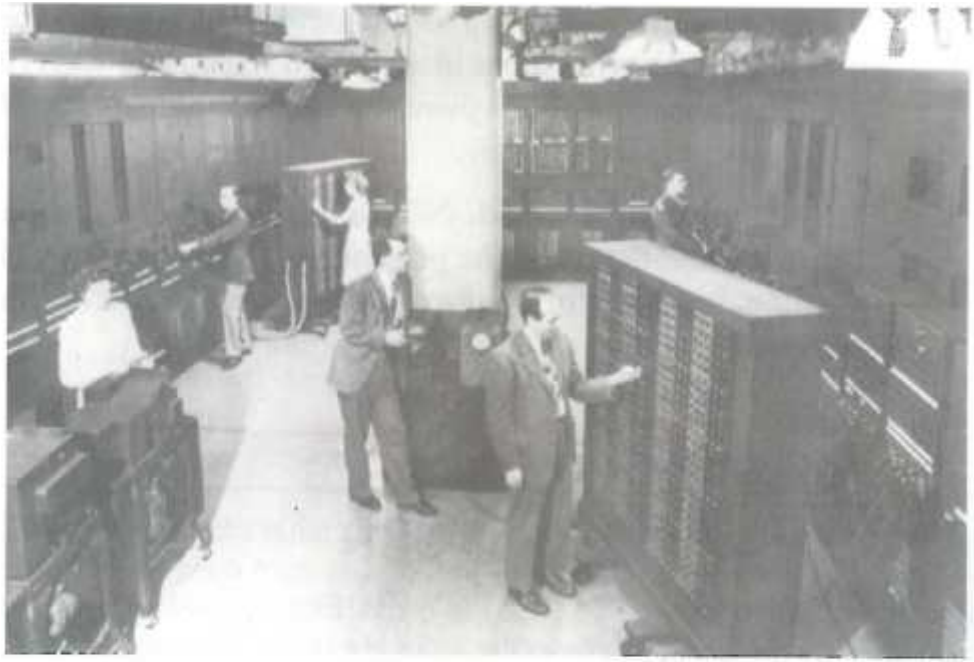
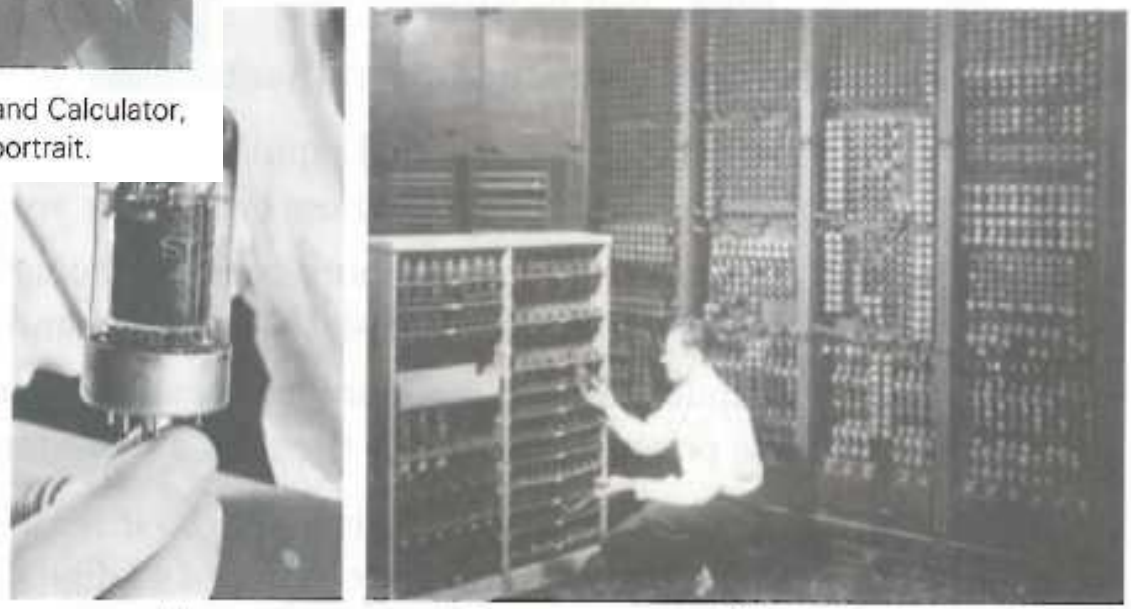


Figure 1.4 ENIAC. The Electronic Numerical Integrator and Calculator, started in 1943 and finished in 1946, shown in its formal portrait.



(a) (b)

Figure 1.5 Vacuum tubes for ENIAC: (a) ENIAC-era vacuum tube; (b) technician inspecting ENIAC's vacuum tube racks, most of which are to his right.

Computation's Greatest Hits [3/7]

- Transistors (1956) by 3 bell labs scientists
  - John Bardeen, Walter Brattain, William Shockley
  - Overcome the problems of vacuum tubes
    - Low power, less heat
    - Extremely reliable
    - Small in size and weight
  - The problem: lots of assembly required

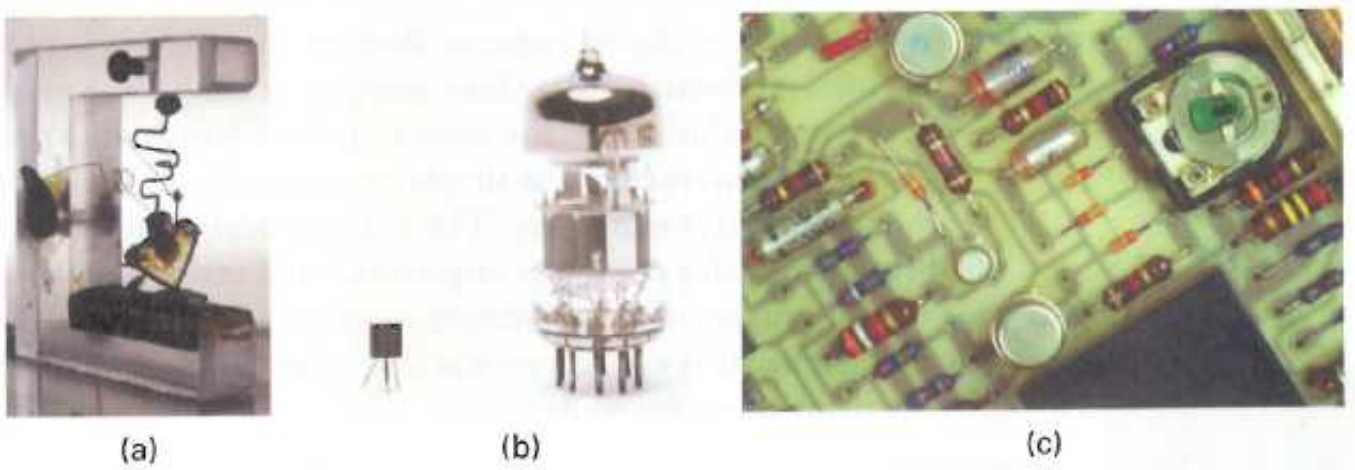
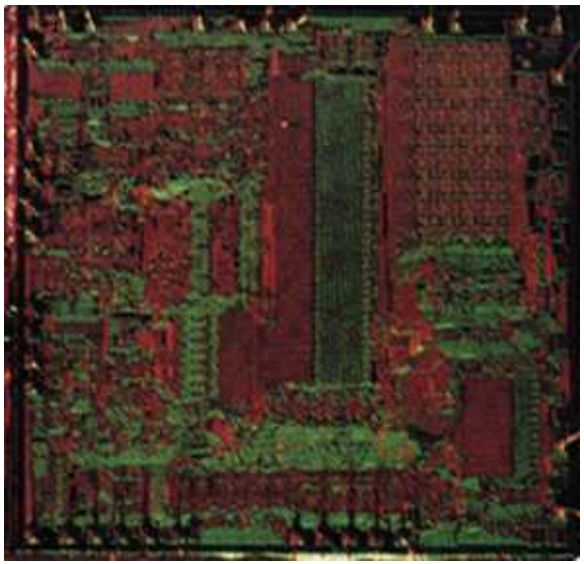


Figure 1.6 Transistors: (a) the first transistor made by Bardeen, Brattain, and Shockley; (b) a size comparison of a packaged transistor compared to a vacuum tube; and (c) a circuit board with electronic components mounted.

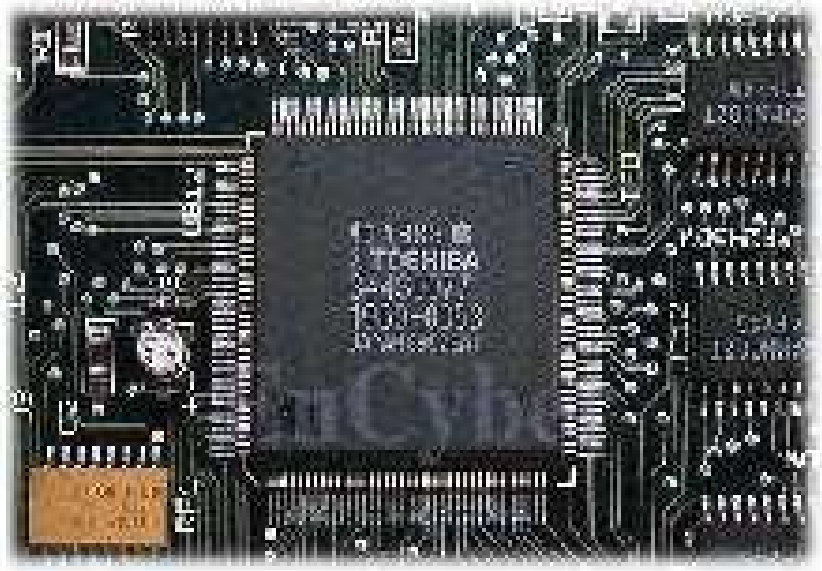
Computation's Greatest Hits [4/7]

- Integrated Circuits (IC) (1958)
  - Transistors and connective parts (e.g., wires) are fabricated together in a multistep process, called integration
  - Photolithography makes it all possible by "printing" the wires onto the circuits
    광식각법

IC 집적회로: 1958



Micro processor (VLSI): 1971



Computation's Greatest Hits [5/7]

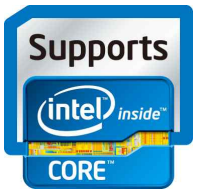
- Personal Computers (PC) (1973)
  - 1973: first personal machine, Xerox's Alto, $40,000 in 1973 (집한채 값?)
  - Famous CEO said "There is no reason for any individual to have a computer in their home."
  - How many computers do you have with you today?

Macintosh, 1984

History of Intel CPU

참고자료

- Clock velocity higher, Data processing unit longer!
  - classical CPU (1968-1975) : 4bit 4004, 8bit 8008
  - 16bit CPU : 16bit 8086(1978), 8088(1979), i80286(1982)
  - 32bit CPU : 32bit i80386(1985), i80486(1989), Pentium1 (1992)
  - 64bit CPU : Pentium**2** (1997), **Pentium3** (1998), Pentium**4** (2000), Pentium D (Dual) (2005)
  - 2006: Intel Core MicroArchitecture!
  - solo-core, double-core, triple-core, quad-core, octa-core, magni-core
- As of 2015: Intel Core i3 (2011, double-core), Intel Core i5 (2011, quad-core), and Intel Core i7 (2012, quad-core)



Computation's Greatest Hits [6/7]

- The Internet (1969)
  - A network of networks
  - ARPANet sent its first packet in 1969 (used for email and file transfer)
- HTTP and the World Wide Web (1993)
  - Universal protocol for homepage
  - Mosaic: first widely used Web browser

(a) (b)

Figure 1.7 Pioneers: (a) Sir Tim Berners-Lee (1994) at CERN showing a Web page, and (b) splash page of the "0.9 Beta" version of Mosaic, the first widely used graphical Web browser.

Computation's Greatest Hits [7/7]

- Layered Software Development (1970년대 후반이후)
  - Until 1980, programs had little structure, and were hard to understand
  - Programs at one level apply code for lower levels, and provide more advanced facilities for higher levels
  - Concept of Module
  - Concept of Information Hiding ➔ API
  - Concept of Reuse
  - Concept of Object-Oriented Programming: C++, Java

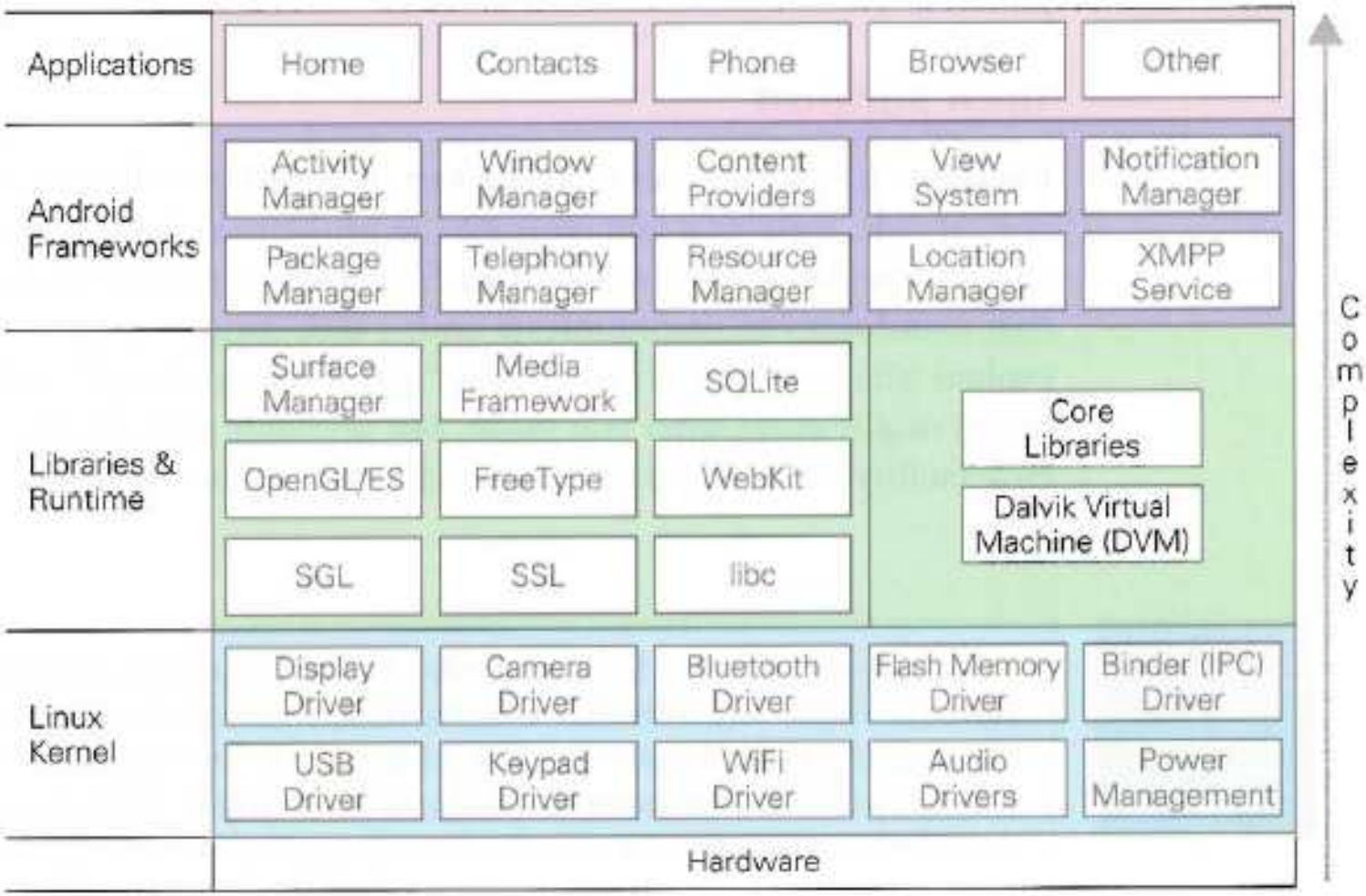


Figure 1.8 The software stack for the Android smartphone; the hardware is on the bottom, the apps are on top.

Hardware and Software

- Computing in its most general form concerns data, hardware, and software
- Hardware:
  - Computers are the physical embodiment of computation
  - They represent one of the greatest technological achievements
  - Steadily smaller and cheaper (The Moore's Law)
- Software:
  - Instruct computers with the steps needed to implement applications
  - Software, unrestricted by the physical world, can direct a computer to do almost anything

Computers are Everywhere [1/4]

- 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
    - In 2015, 16 CPUs in a mobile phone
  - It means that every consumer in the developed world owns more than a dozen
  - The era of Internet of Things (IOT)

Computers are Everywhere [2/4]

- Looking Inside: Computers don't always have keyboard and printer attached

- Notice there are metal plates covering the internal parts: They shield the surrounding environment from electromagnetic radiation

An iPhone 3GS when first opened

Computers Are Everywhere [3/4]

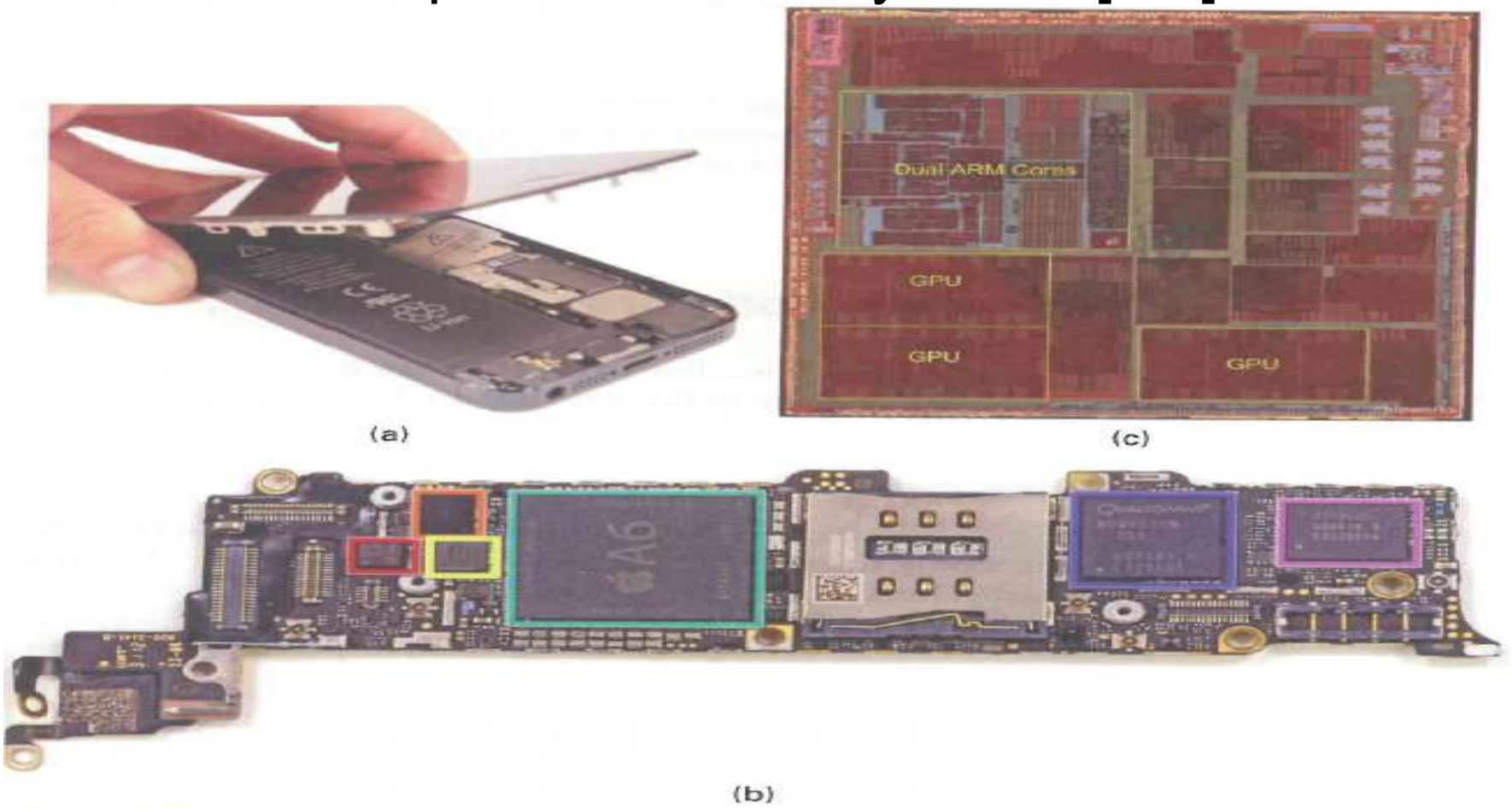


Figure 1.9 "Teardown" of the iPhone 5: (a) the open case showing that more than half of the volume seems to be a lithium-ion battery, (b) the circuit board, which contains all the electronics including the A6 main processor chip (green), and is opposite the battery, and (c) detail of the A6 chip showing two ARM processors plus three graphics processing units—all are computers.

Teardown = 분해, 해체

Computers Are Everywhere [4/4]

- Head-to-Head Comparisons: Mobile Phones vs PCs

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	Scrollbars
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 [1/3]

- 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
- 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 [2/3]

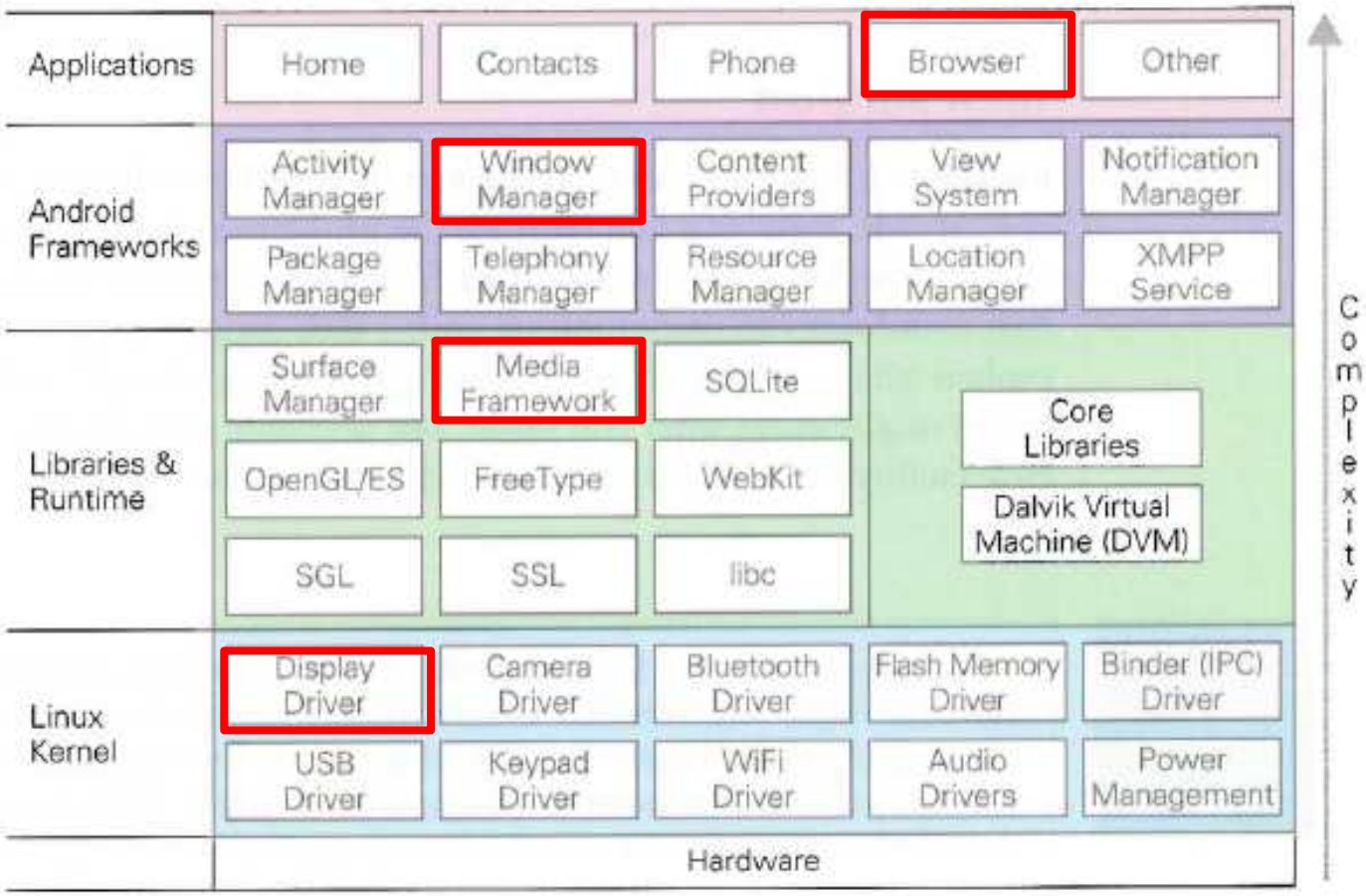


Figure 1.8 The software stack for the Android smartphone; the hardware is on the bottom, the apps are on top.

Software [3/3]

- Referring to the figure on the previous slide:
  - –To check out a video on YouTube 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
- Writing software is a difficult and challenging
  - SW instructs an agent to perform some function or action by giving a step-by-step process
  - The agent is anything that can follow the instructions of SW
  - For software professionals, the agent is a computer

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

Terms of Endearment (친근한 용어)

- Le Mot Juste [luh-MO-joost] ➔ right phrase or words
- Not only should you learn the right computing terms, but you should also understand how to use them to benefit from the technology
- If you are CS major, you should have a good command of CompSci terms
- Usually, you must look up the answer yourself using the Help feature, or you must contact the tech support
  - The technician might not know what you talking about
  - Without the right word, the search algorithm of the Help facility won't work for you

Computer vs. Algorithms vs. Program

- An algorithm is a precise, systematic method for producing a specified result
  - –We use and invent algorithms all the time to solve our problems
- Programs are algorithms that have been specialized to a specific set of conditions and assumptions, and written in a specific programming language

- People do have a clue: so many things can be left out of an explanation when people have to follow directions
- Computers are clueless. They need to be told what to do precisely
  - –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!

Some Unique CS's Concept Words [1/4]

- "Abstract", "Abstraction"
  - To remove unnecessary things
  - To separate the relevant things from the irrelevant things

- Real World Problems ➔ Computing World Problems
  - Real world Automobiles ➔ Automobiles in Programs
  - Real world Students ➔ Students in Programs

Some Unique CS's Concept Words [2/4]

- "Generalize", "Generalization"
  - 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
  - If it is true most of the time, we can generalize an idea
  - The base of program reuse in Object-Oriented Programming

Example: * apples, bananas, melons can be generalized to fruit

* 2-door-car, 4-door-car, trucks, buses can be generalized to vehicles

Some Unique CS's Concept Words [3/4]

- Many aspects of softwares are "Operationally Attuned" (동작적으로 조율된)
  - 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
- Most Window based environments ➔ trash bags, mouse operations, similar menu structures
- Desktop Metaphor, Smartphone Metaphor

Some Unique CS's Concept Words [4/4]

- "Mnemonic" [ni-MA-nik] (symbolic)
  - A mnemonic is an aid for remembering something (symbol, artifact)
    - 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)

– Many Computer Science Terms are mnemonic

–FIFO: First In First Out

–LIFO: Last In First Out

–HTTP: Hyper Text Transfer Protocol

–WWW: World Wide Web

–Etc etc…..

Summary

- We learned how to do the following:
  - Understand the major computing inventions from the past
  - Know and use the right word
  - Give informed definitions for common computer terms
  - Consider a brief list of “idea” words, such as abstract and generalize.