

FLUENCY⁶

with information technology

SKILLS, CONCEPTS, & CAPABILITIES



LAWRENCE SNYDER

Chapter 1

Defining Information Technology

History

- <http://mason.gmu.edu/~montecin/computer-hist-web.htm>
- https://en.wikipedia.org/wiki/History_of_computing_hardware
- https://en.wikipedia.org/wiki/History_of_computing
- <http://www.columbia.edu/cu/computinghistory/census-tabulator.html>

Learning Objectives

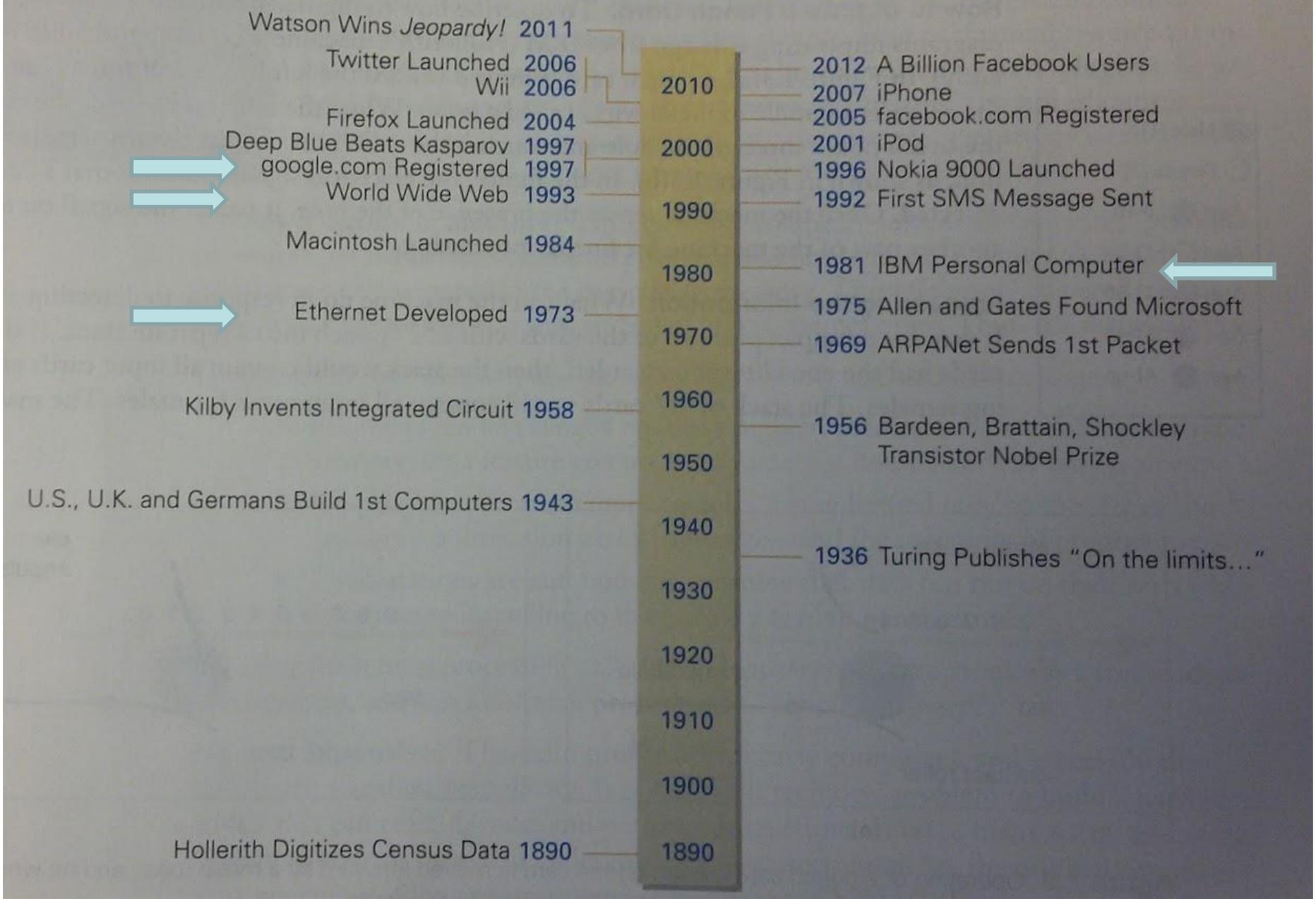
- The “big idea” of computing inventions
- Explain why it’s important to know the right word
- Define basic hardware and software terms
- Define and give examples of “idea” terms

Computation's Big Ideas

- Digitizing information
- Stored-program computers
- Transistors
- Integrated circuits
- “Personal” computers
- The Internet
- World Wide Web
- Layered Software

Brief History

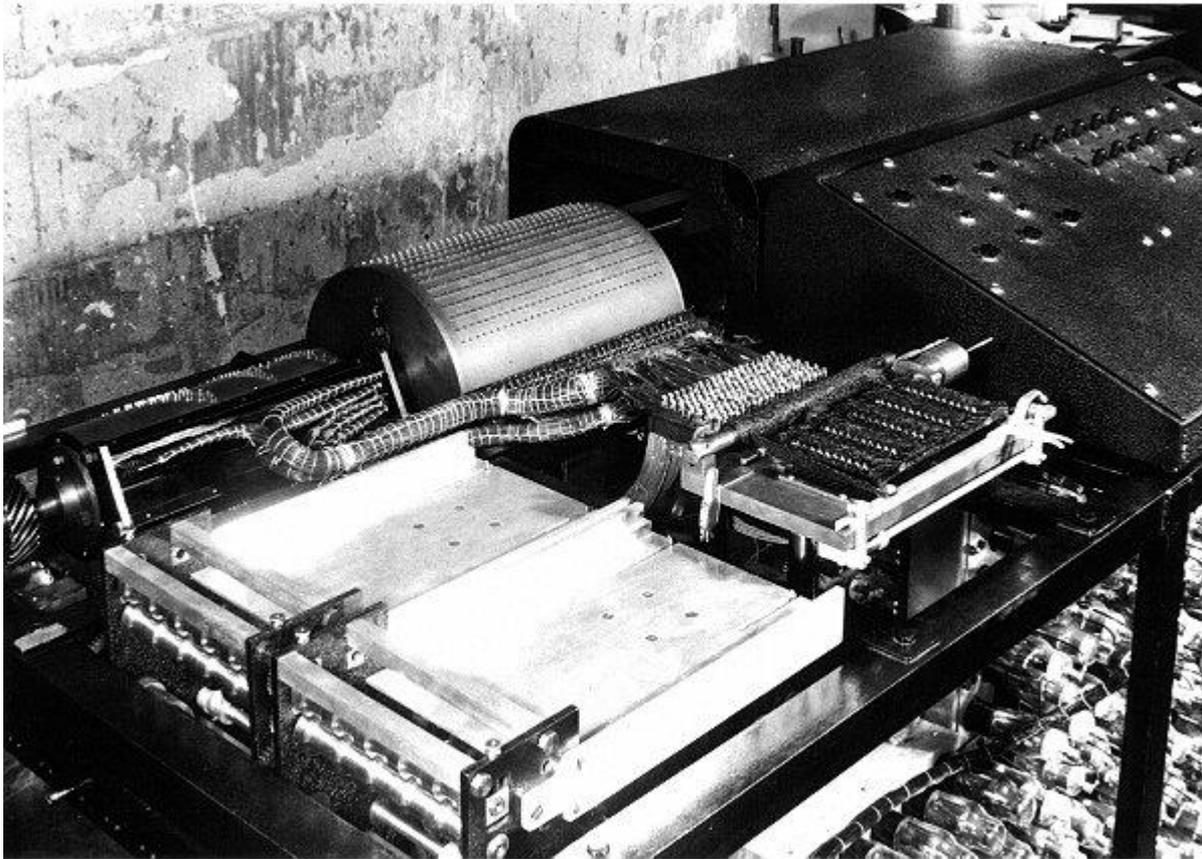
- 1200 -- Abacus used in China (reaches Japan around 1600)
 - to use an abacus you must learn the algorithm for moving the beads
- 1617 to 1630 -- Napier's Bones, then the Slide rule -- calculating devices
- 1623 -- Schickard's Calculator - interlocking gears, every 10 revolutions of a lower-order gear causes the next higher gear to increment 1 click.
- 1642 -- Pascal created the Pascaline, which could do + - * and \
- 1820 -- deColmar's Arithmometer -- first mass-produced calculating device
- 1822 -- Charles Babbage - Difference Engine was first non-human powered computing device. Was powered by the steam engine. Used to calculate the large tables of numbers used for astronomical and engineering applications.
- 1834 -- Babbage designed a new computing device that was never built. It called for 4000 precision-cut parts, and the technology of the day was not accurate enough for the task. The device called for long-term storage (punched cards) for programs and data -- ideas that are central to modern computing devices.



Computation's Greatest Hits

- Digitizing information
 - data represented as numbers
 - the breakthrough! machines reading digital info
 - census data 1880
 - it took 8 years to process the data by hand
 - census data digitized (1890)
 - punch cards digitized the process (not a computer, a card reader) – reduced processing to 6 years, saved \$5 million, and gave more statistical data.
 - Hollerith Tabulating Machine. Company he founded is now known as IBM.

Iowa's Claim to Computing Fame



- Atanasoff-Berry Computer
- 1942 - “The FIRST automatic electronic digital computer” [emphasis added] Developed at Iowa State University.
- The card reader and card punch. The punch stored intermediate results onto a punch card, which were used later in the calculation.
- The memory drum could store 30 numbers
- Was not programmable

• <http://jva.cs.iastate.edu/operation.php>

Computation's Greatest Hits

- Stored-Program Computers
 - central processing unit: instructions stored in memory (software)
 - programs can be changed quickly, more complex, and autonomous
 - large and complex: fills a room
 - vacuum tubes
 - use a lot of power
 - burn out

ENIAC, 1946

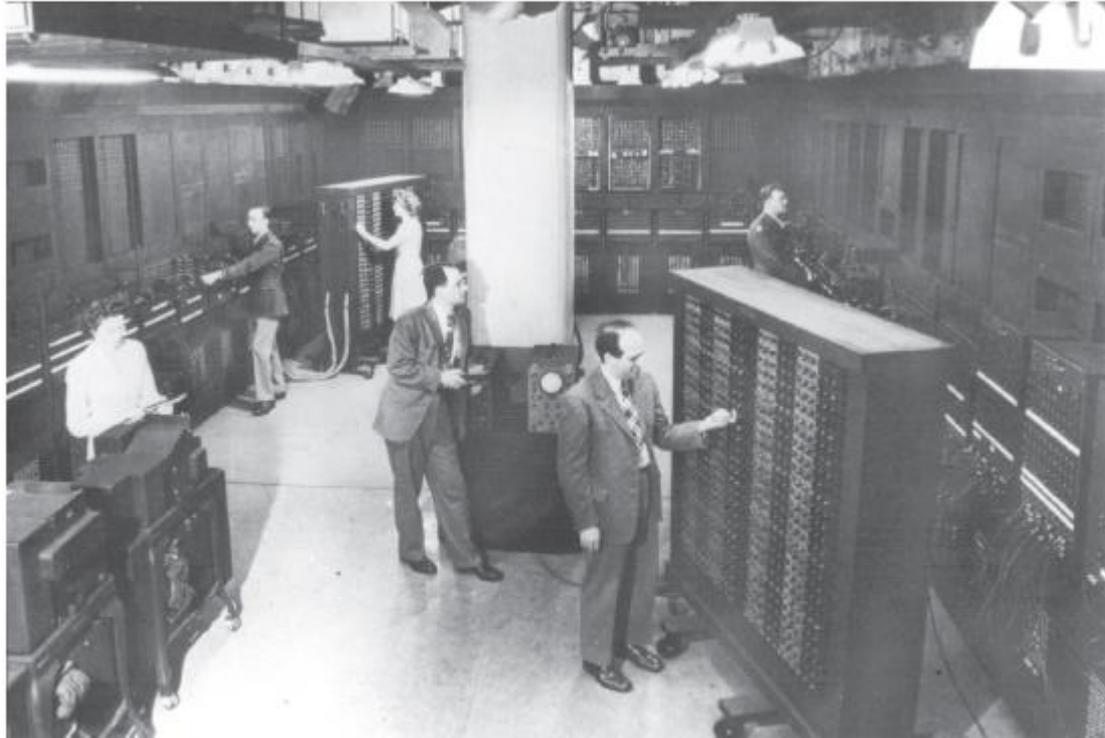
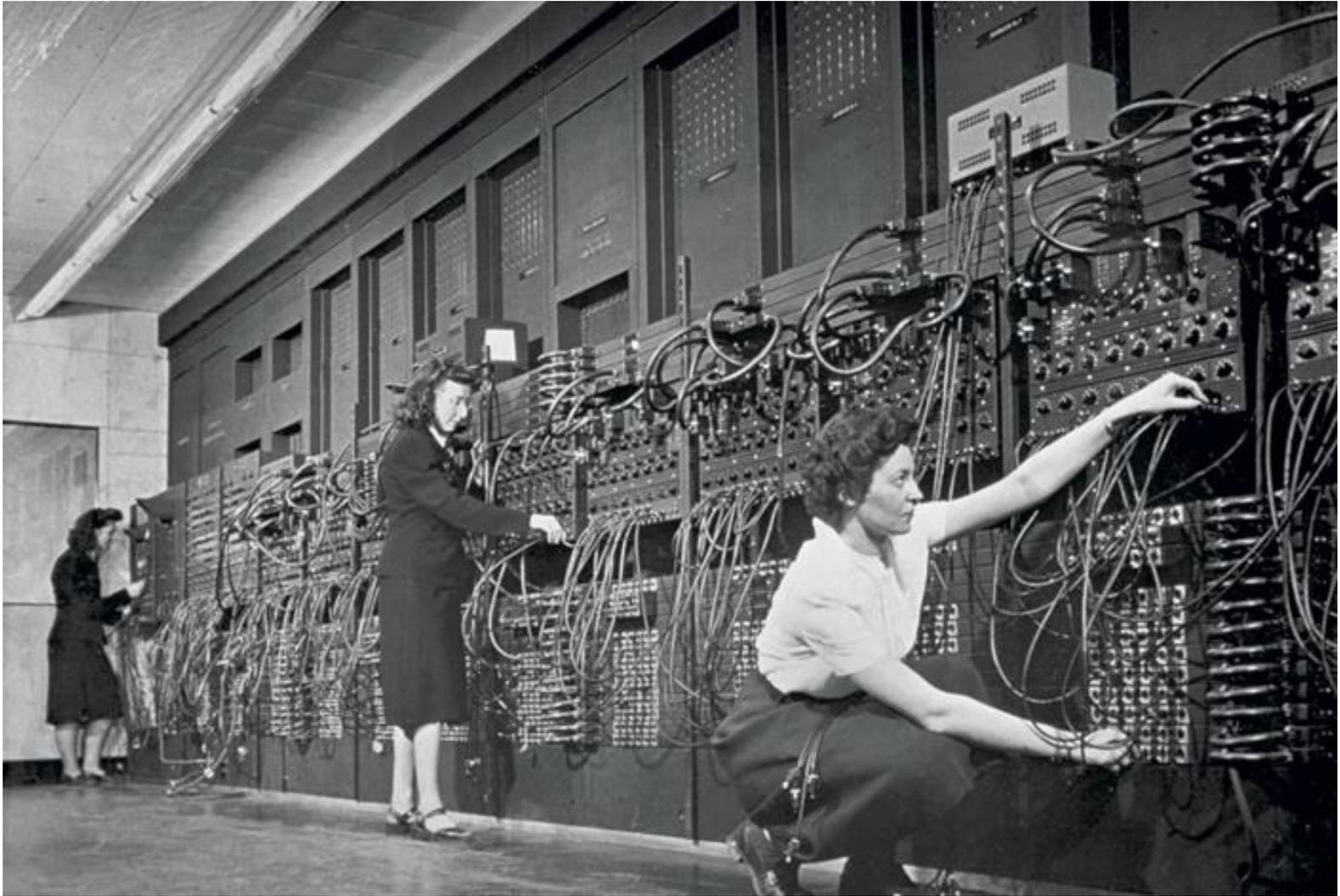


Figure 1.4 ENIAC. The Electronic Numerical Integrator and Calculator, started in 1943 and finished in 1946, shown in its formal portrait.

Programming an Early Computer



Computation's Greatest Hits

- Transistors
 - alternative to vacuum tubes
 - low power, less heat
 - extremely reliable
 - small in size and weight
 - the problem: lots of assembly required

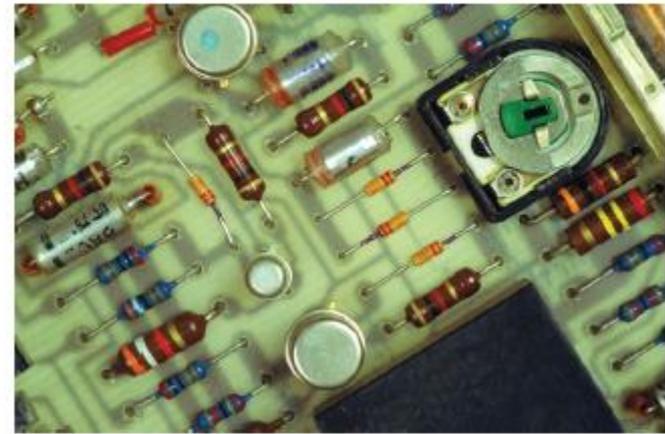
The Alternatives



(a)



(b)



(c)

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

- Integrated Circuits
 - transistors and connective parts (e.g., wires) are fabricated together in a multistep process
 - photolithography makes it all possible by “printing” the wires onto the circuits

Computation's Greatest Hits

- Personal Computers
 - 1973: first personal machine, Xerox's Alto
 - “There is no reason for any individual to have a computer in their home.”
 - how many computers do you have with you today?

Computation's Greatest Hits

- The Internet
 - a network of networks
 - ARPANet sent its first message in 1969
 - used for email and file transfer
- HTTP and the World Wide Web
 - brings the Internet to the general public
 - HTTP can transfer any file to any computer
 - Mosaic: first widely used Web browser

Computation's Greatest Hits

- Layered Software Development
 - until 1980 programs had little structure, making them difficult to write and maintain
 - programs at each level supply functionality for lower levels, and provide more advanced access for higher levels

Software Stack

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

Software Stack

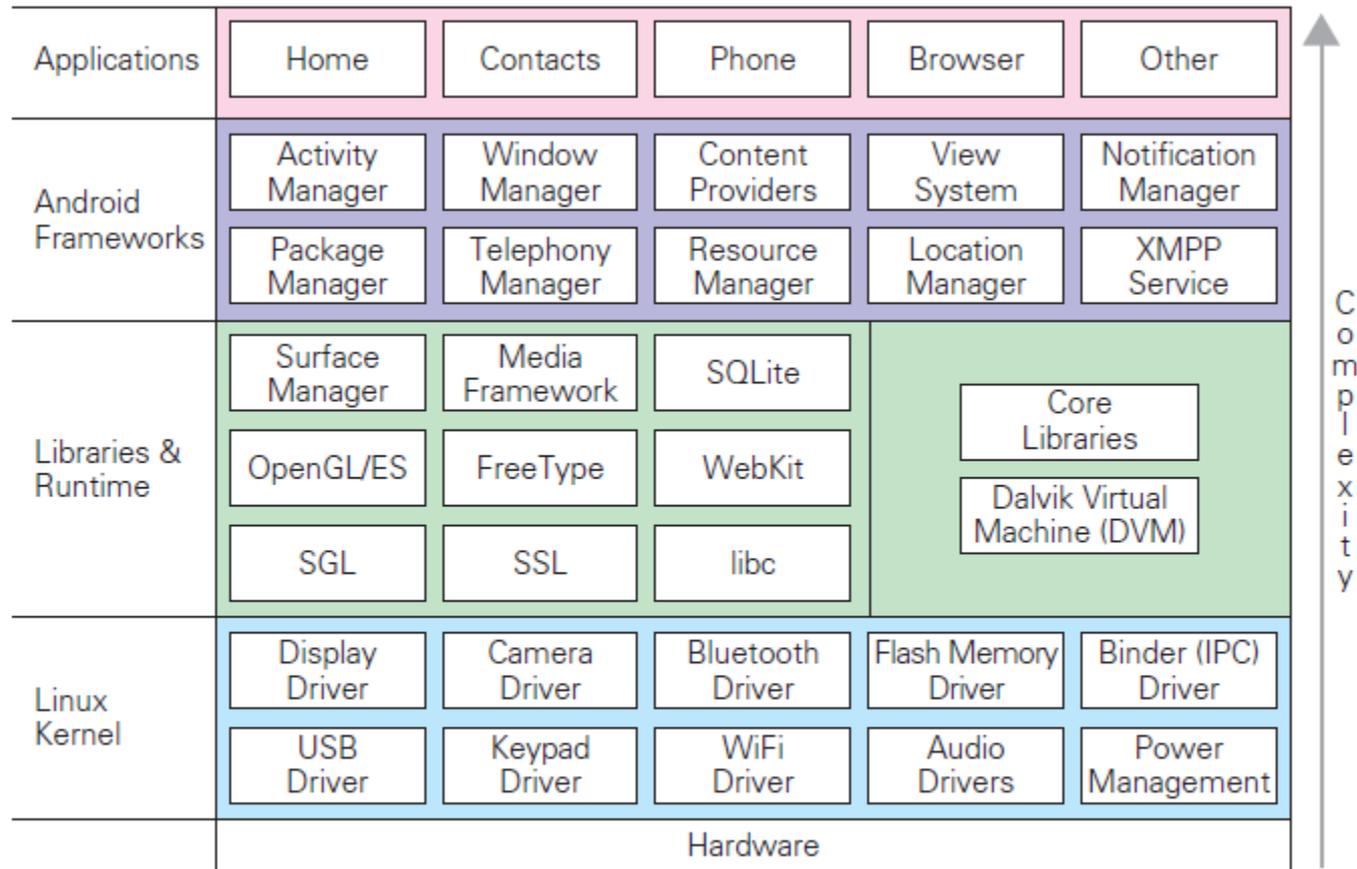


Figure 1.8 The software stack for the Android smartphone; the hardware is on the bottom, the apps are on top.

Software Stack

- 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

Terms of Endearment

- Not only should you learn the right computing terms, but you should also understand how to use them to benefit from the technology.
- There are two practical reasons for this:
 1. Tech Support: everyone needs and uses it
 2. 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 won't work for you

Find The Computer

- Processor
 - the computer itself, usually hidden inside the box
 - connects to various input and output devices
 - the variations between computers depend on
 - the devices connected to the processor
 - the software run by the system

Here's The Computer

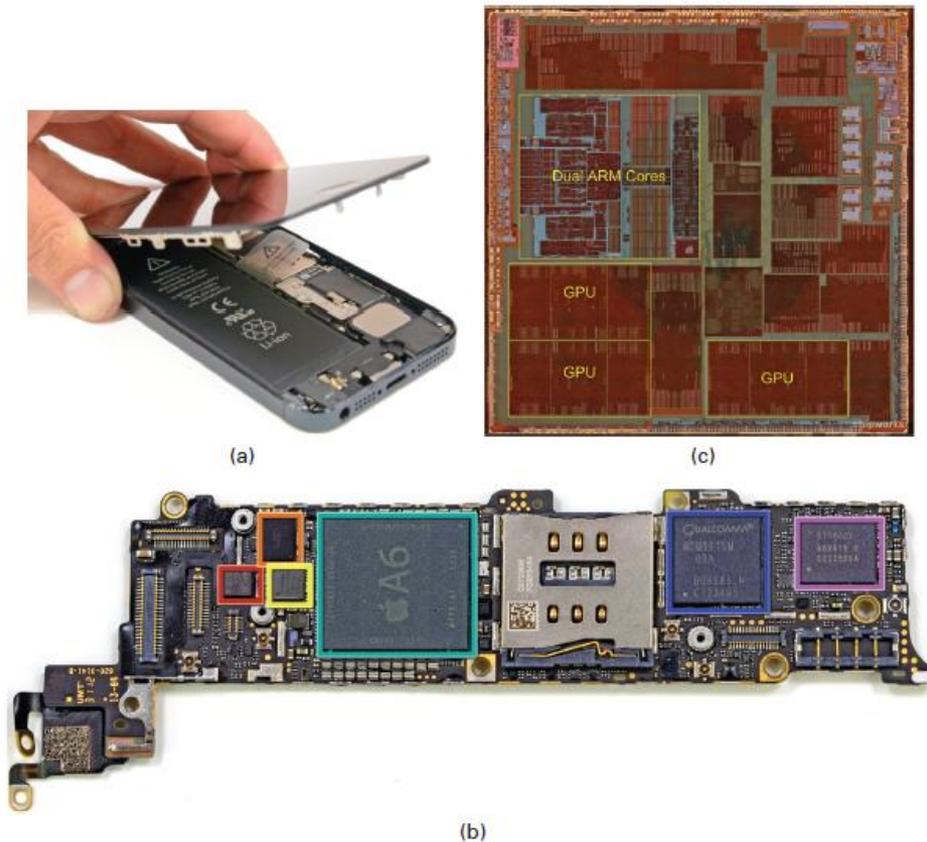


Figure 1.9 “Teardown” of the iPhone 5: (a) the open case showing that more than half of the volume seems to be a lithium-ion battery, (b) the circuit board, which contains all the electronics including the A6 main processor chip (green), and is opposite the battery, and (c) detail of the A6 chip showing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

Software

Software is the collective name for programs.

- Programs contain the instructions which form applications
- The processor follows the program and carries out the application

Algorithms

An algorithm is a precise and systematic method for producing a specified result.

- Programs express algorithms
- Example: long division

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:
 1. Many, but not all the details, of the story are irrelevant to the concept
 2. 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

We learned how to do the following:

- Know the importance of major computing inventions in the last hundred years
- 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.

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Chapter 2

*Exploring the
Human-Computer
Interface*

Learning Objectives

- Give names to computing features that you know intuitively
- Explain placeholders and the placeholder technique
- Explain how “metaphor” is used in computing
- Describe the desktop metaphor, giving examples of appropriate icons
- Describe the touch metaphor, giving sample motions
- Explain how the desktop and touch metaphors differ

Feedback

- A computer assists us, doing whatever we ask it to do
- We want our “assistant” to report on the progress of the task it is doing
- We need to know that the task was done and when to give another one
- Always expect feedback about what is happening

Consistent Interface

- Regardless of who makes the software, icons and menus tend to be similar
 - Especially so within a specific company (Microsoft for example)
 - Look for similar menu names, like *File* and *Edit*
 - Look for similar functions within the menus, like *Cut*, *Copy*, *Paste* in the *Edit* menu

Consistent Interface

- Why?
 1. Companies reuse the same code in each of their applications
 2. Helps ***you*** in learning and using new applications
 3. Certain operations are so fundamental to processing that all apps just use those operations

Clicking and Blazing

- Consistency provides a strong sense of familiarity with a new application
- With a new app, two important activities are immediately performed:
 - “Clicking Around” to explore the application to see what features are available
 - “Blazing Away” is trying the application in a way you haven’t done so before

New Instance

- Under *File* you usually find a command, *New*
 - *New* creates a “blank” instance of the kind of files the application creates
 - What is “blank information”?
 - An empty structure to hold (record) all of the properties of that file and store its content
 - Example: A new/empty address book entry is ready to hold names, images, and phone numbers about the new individual

New Instance for the Address Book

 **First Last**
Company
 Company

mobile ⇅ Phone

home ⇅ Email

home page ⇅ URL

mother ⇅ Related Name

home ⇅ User Name **AIM** ⇅

home ⇅ Add new address

note

Figure 2.1 A visual form of a blank instance of contact information from an electronic address book; the instance has structure inside the computer with empty fields, as shown.

Perfect Reproduction

- Computers encode information as a sequence of binary digits, 0's and 1's
- Because of the use of two *digits*, we call it **digital information**
- Using only 0's and 1's means that digital information can be perfectly reproduced or replicated

10010111 10101100 11001010

Exact Duplicate

- A second copy is made simply by duplicating the sequence of 0's and 1's
- This is one way digital improves on *analog* information
 - Analog information comes from or is stored on a continuously variable medium
 - A copy of an image, for example, could come out too dark or too light when compared to the original

The Perfect Reproduction Property of Digital Information

- It also doesn't matter where the copy came from:
 - Both the original and the copy are the same sequence of 1's and 0's
 - Every copy can be made from the last copy, and still be identical to the original!

Copying

- Copy/Paste/Edit
 - *Copy* and *Paste* operations are available in many applications
 - When editing a file, you can either create content from “scratch” or use *Copy/Paste* (**C/P**) to reproduce it from another location
 - *Copy/Paste* is generally faster and less error prone

How We Learn Technology

- Sometimes, the way to use a new technology is not obvious.
- Much of the technology we use we figure out on our own
 - We know intuitively what to do
 - The technology developers did that on purpose!
- Just needs some thought!

Placeholder Technique

- Find and ReplaceAll
 - In *Find/Replace* editing operations, the source content to *Find* is identified in the document
 - The target content to *Replace* it with is also identified
 - *Find/ReplaceAll (F/RA)* is an all-at-once version of *Copy/Paste*
 - Use an abbreviation of a long name or title as a placeholder, then use F/RA to put in the correct name all at once!

Placeholder Technique

- You want to replace every use of etc with etc. to fix the periods you left out.
- But that doubles periods when etc falls at the end of a sentence.
- Replacing .. will break your ellipses.
- So first replace etc. with some unused marker to hide it.
- Replace etc, then replace the marker.

Metaphors

- In computing, a **metaphor** is an icon or image used as representative or symbolic of a computation
- When designers create a technology, they use metaphors to help users know how to operate their devices without reading a manual
- Metaphors are a terrific solution!

The Desktop

- In the '70s the first personal computer (the Alto) was developed by Xerox
- It introduced a graphical user interface instead of the (usual) text user interface
- Since the Alto was designed for office use, the metaphor that was used for the screen was *desktop*
 - Other office metaphors: *files, folder, documents*

The Desktop

- Steve Jobs and Steve Wozniak founded Apple and built computers TUIs at first
- Apple Macintosh was first successful GUI PC.
- Extended ideas from Alto with new icons
- Showcased painting and drawing
- Microsoft introduced Windows a year and a half later

More Computer Metaphors

- The Mac first introduced the mouse to the public...another component in desktop metaphor
 - Apple did ***not*** invent it
 - Stanford Research Institute invented the mouse in December 1968
 - When introduced, it was stated that they called it a mouse and didn't know why they didn't change the name!



Changing Metaphors

- A new idea, the *touch* metaphor
 - Users touch the content, smart phones, tablets, and other mobile devices
 - Example: the Cover Flow mechanism for scanning through a list, using a sweeping motion of the pointer



Touch Metaphor Gestures

Table 2.1 Gestures supporting the touch metaphor

Gesture	Description	Typical Use	Typical Result
Sweep or Swipe	Move finger across surface	Scan through a list	Items sweep by, with one selected
Tap	Light one-finger tap on surface	Select or choose	Item identified
Double Tap	Light two-finger tap on surface	Launch	Selected item starts
Drag	Move selected item by pulling	Move item	Item in new position
Pinch Fingers/Pull Fingers Apart	Contract/expand separation between fingers	Shrink/zoom	Image is resized
Two-Finger Scroll	Move fingers across surface	Navigation	Move around a clipped image
Flick	Quick sweep, finger leaves surface	Express acceleration	Sustained sweep

Metaphor Relationships

- The touch metaphor is intended to simplify the use of smart phone and tablets
- This technology is not new (use of stylus and touch screen interaction at kiosks)
- Touch has no mouse
- It's possible to use the touch metaphor with a trackpad or mouse so it is not limited to mobile devices

Why is *Touch* a Metaphor?

- It's a way to eliminate the mouse, but...
- It changes how humans *interact* with the computer
 - Scrollbars using the desktop metaphor for moving through a display
 - Small screens don't have room for scrollbars
 - Direction of motion is opposite between touch and desktop metaphors

Why is *Touch* a Metaphor?

- It changes how humans *interact* with the computer
 - With the touch metaphor, your hands are “on” the content
 - You move the content to where you want it to be
 - With the desktop metaphor you “slide a window over the content”

Summary of Metaphors

- We use technical metaphors daily
 - They are 100 percent synthetic, created by imagination of the developers
 - They are meant to simplify the use of the devices.
- The touch metaphor will not replace the desktop metaphor
- Both have extensively determined how we think and behave with technology

Summary

- We can figure out software because designers use consistent interfaces, suggestive metaphors, and standard functionality
- We should explore a new application by “clicking around” and “blazing away”
- Making exact copies is a fundamental property of digital information that we use daily

Summary

- *Find* and *ReplaceAll* are standard operations that simplify our computer use
- Metaphors are essential to computer usage because they guide us in learning and using software
- The desktop metaphor is classic; the touch metaphor is newer; they will co-exist

Other Stuff

- Msconfig
- Whatsrunning – See what is currently running, adjust programs that launch at start-up
- Carbonite -- cloud backup service
- Keypass – password vault