INTRODUCTION

COMS W1001
Introduction to Information Science

Boyi Xie

Today's Topics

- General information

- Introduction to information science
  - Computers
  - Computer programs and algorithms
  - Abstraction
  - Social impacts

- What we will cover this semester

General Information

- Instructor: Boyi Xie (xie@cs.columbia.edu)
- Day/Time: Monday and Wednesday 10:10am-11:25am
- Classroom: 503 Hamilton Hall
- Textbook: Pearson Custom Computer Science COMS W1001 Introduction to Information Science
- Office hour: TBA
- TA: TBA
- Evaluation
  - Five bi-weekly homework assignments (50%)
  - Two in-class examinations (25%+25%)
- Grading
  - Top 35% some kind of A (A+, A, A-)
  - Next 40-50% some kind of B
  - The rest C, D, or F depending on circumstances

Course Objectives

- To provide an introduction to using information technology and the World Wide Web
- To explore some of the fundamental concepts involved with information storage and retrieval
- To introduce the fundamentals of algorithmic problem solving
- To provide a basic introduction to computer programming in Python

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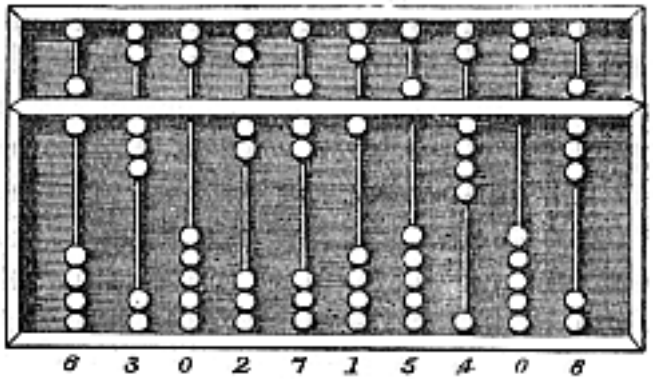
Computer Science

- Information science
  - An interdisciplinary area
  - Our focus is from the perspectives of **computer science**

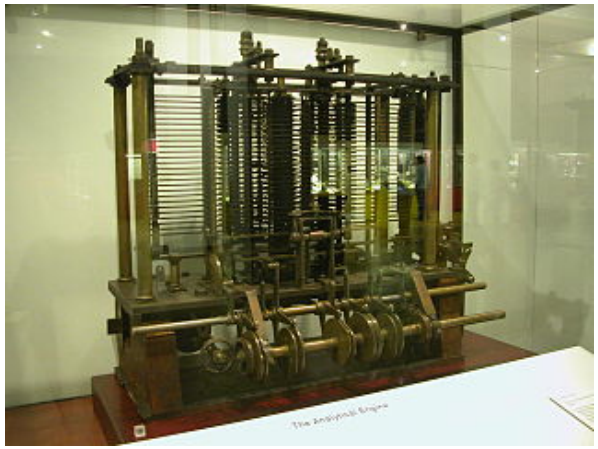
- Computer science is the discipline that seeks to build a scientific foundation for
  - Computer design
  - Computer programming
  - Information processing
  - Algorithmic solutions of problems
  - Algorithmic process itself

Brief History of Computing Machines

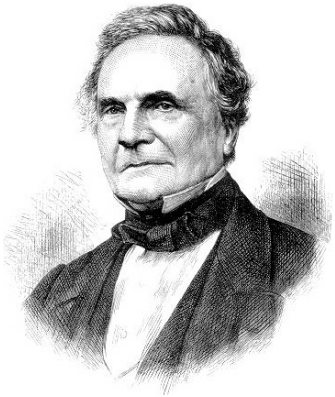


Abacus, 2nd century BC

Pascaline, 1642



Charles Babbage's Analytical Engine

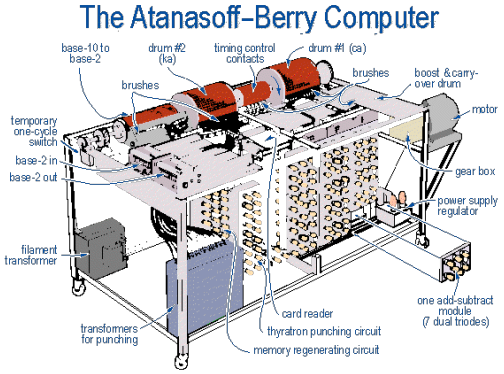


Charles Babbage (1791-1871)
Pioneer of programmable computers

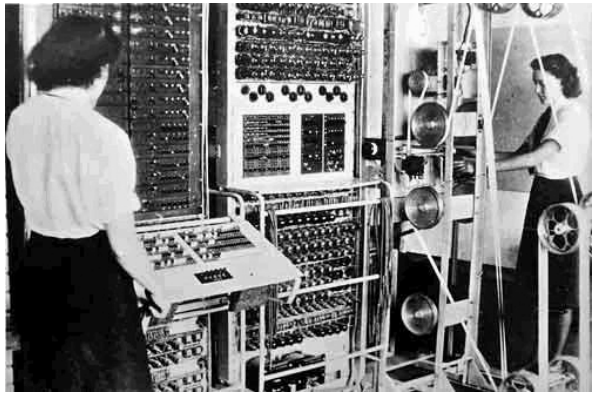
Augusta Ada Byron (1815-1852)
The first programmer

Brief History of Computing Machines

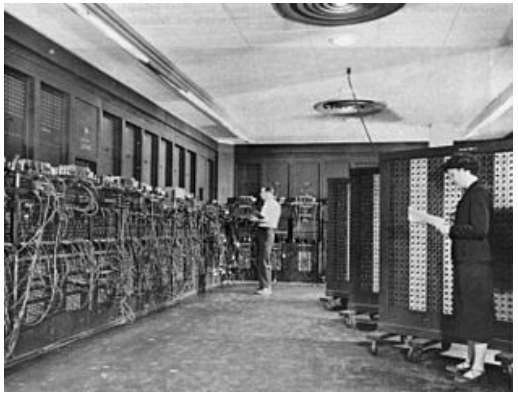
- Based on mechanical relays
  - 1940: Stibitz at Bell Laboratories
  - 1944: Mark I: Howard Aiken and IBM at Harvard
- Based on vacuum tubes
  - 1937-1941: Atanasoff-Berry at Iowa State
  - 1940s: Colossus: secret German code-breaker
  - 1940s: ENIAC (elctronic numerical integrator and calculator) : Mauchly & Eckert at Uni. of Penn.



Atanasoff-Berry machine



Colossus



ENIAC

Brief History of Computing Machines

- Mainframes (1960s, room size)
  - Multi-users share the computers
  - Offline preparation of tasks (punched cards)
  - No direct interaction btw the programmer and machine
- Minicomputers (~1970s, refrigerator size)
  - Graphical user interface, mouse, special software

IBM 3279 Colour Display Terminal (1979)

Punched card from a Fortran program

An IBM System z9 mainframe

A PDP-11, model 40, an early member of DECs 16-bit minicomputer family, on display at the Vienna Technical Museum

Brief History of Computing Machines

- Microcomputers (~1980s - now)
  - Computer hobbyists Steve Jobs and Stephen Wozniak built a commercially viable home computer and, in 1976, established Apple Computer, Inc.
  - IBM introduced its first desktop computer, called the personal computer, or PC, in 1981, whose underlying software was developed by a newly formed company known as Microsoft.

Apple III, 1980

IBM 5150 PC with IBM 5151 monitor, 1981

Brief History of Computing Machines

- Miniaturization of computers and their expanding capabilities have brought computer technology to the forefront of today's society.

- Tablets and smart phones

iPhone 6

Galaxy Note 4

Surface Pro 3

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Computer Programs and Algorithms

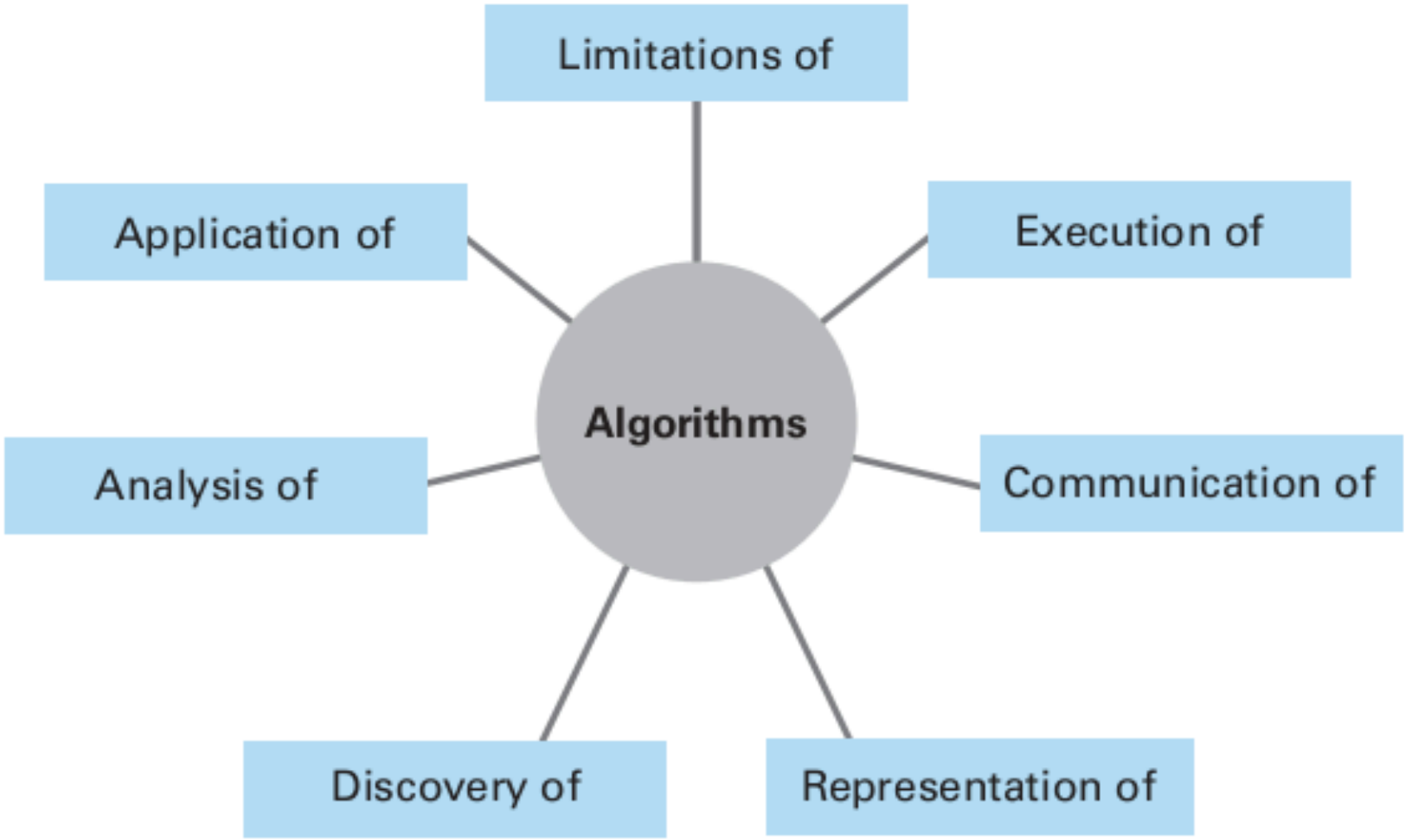
- An **algorithm** is a set of steps that defines how a task is performed
  - For cooking: recipes
  - For finding your way through a city: directions
  - For playing music: sheet music
- A representation of an algorithm is called a **program**.
- The process of developing a program, encoding it in machine-compatible form, and inserting it into a machine is called **programming**.
- Programs, and the algorithms they represent, are collectively referred to as **software**, in contrast to the machinery itself, which is known as **hardware**.

Computer Programs and Algorithms

- "Time and space" conditions restricted the complexity of the algorithms utilized in early computing machines
- More research efforts began to tax the abilities of the human mind, and were directed toward the study of algorithms and the programming process

- It is through this ability to capture and convey intelligence by means of algorithms that we are able to build machines that perform useful tasks
- The level of intelligence displayed by machines is limited by the intelligence that can be conveyed through algorithms

The Central Role of Algorithms in Computer Science



Identifying Some Questions that Provide a Focus for its Study

- Which problems can be solved by algorithmic processes?
- How can the discovery algorithms be made easier?
- How can the techniques of representing and communicating algorithms be improved?
- How can the characteristics of different algorithms be analyzed and compared?
- How can algorithms be used to manipulate information?
- How can algorithms be applied to produce intelligent behavior?
- How does the application of algorithms affect society?

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Abstraction

- The concept of abstraction permeates the study of computer science
- Abstraction refers to the distinction between the external properties of an entity and the details of the entity's internal composition
- At each level of abstraction, we view the system in terms of components, called **abstraction tools**, whose internal composition we ignore
- It allows us to concentrate on how each component interacts with other components at the same level and how the collection as a whole forms a higher-level component

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Social Impacts

- Computing technology has altered the ability of governments to exert control
- Had enormous impact on global economics
- Led to startling advances in scientific research
- Revolutionized the role of data collection, storage, and applications

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What We Will Cover

- Operating System Basics
- Networks and the Internet
- Web Design Basics - HTML
- Data Storage and Manipulation
- Spreadsheets
- Database
- Data Structure & Algorithm
- Programming in Python

Computer

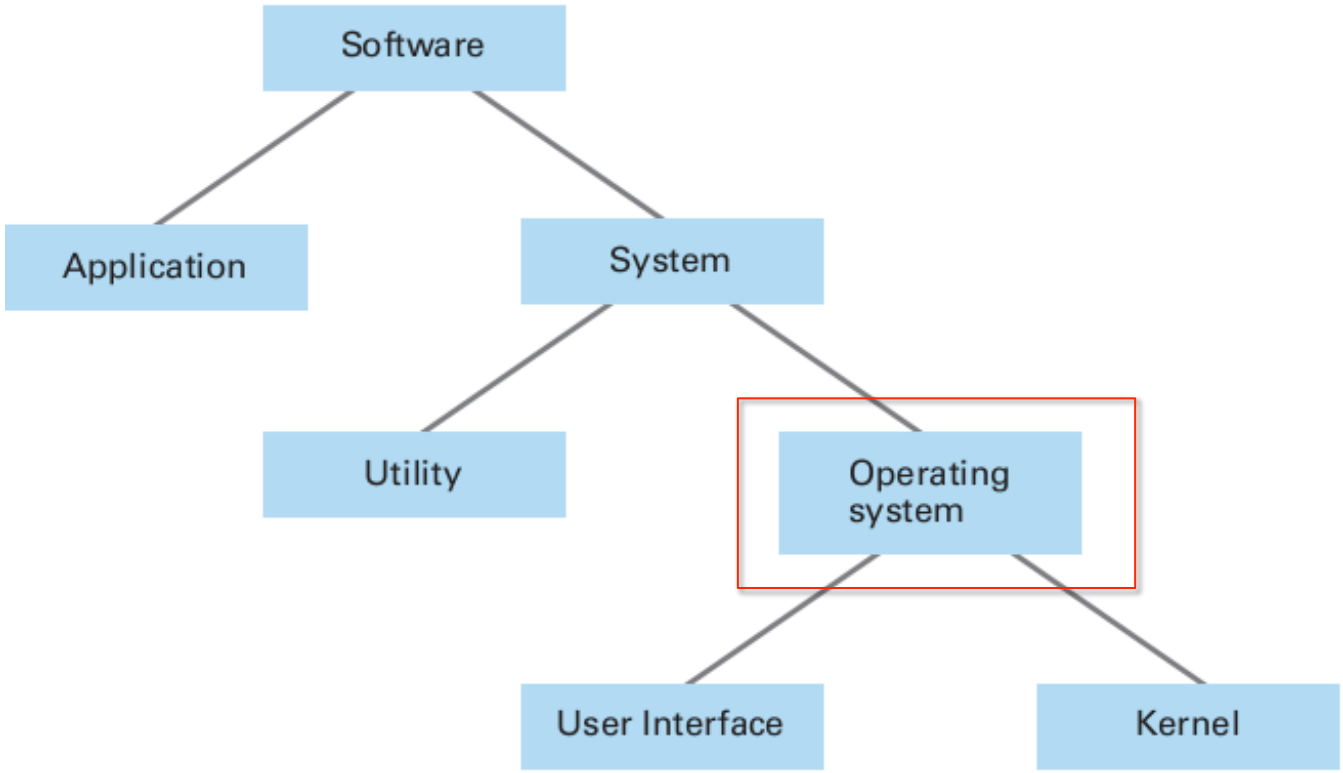
Web

Data

Programming

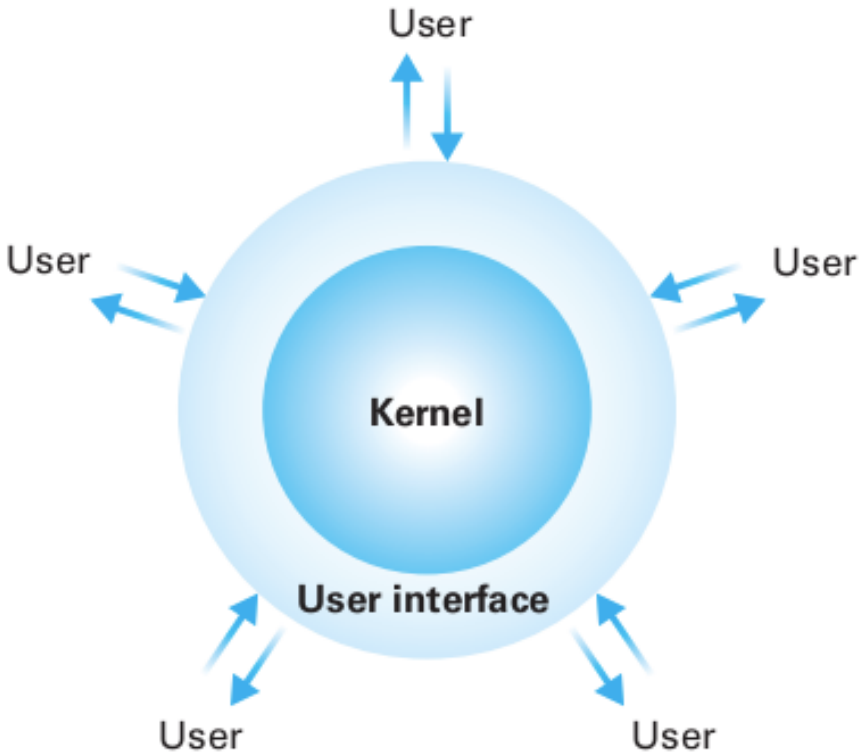
Operating System Basics

- OS in software classification



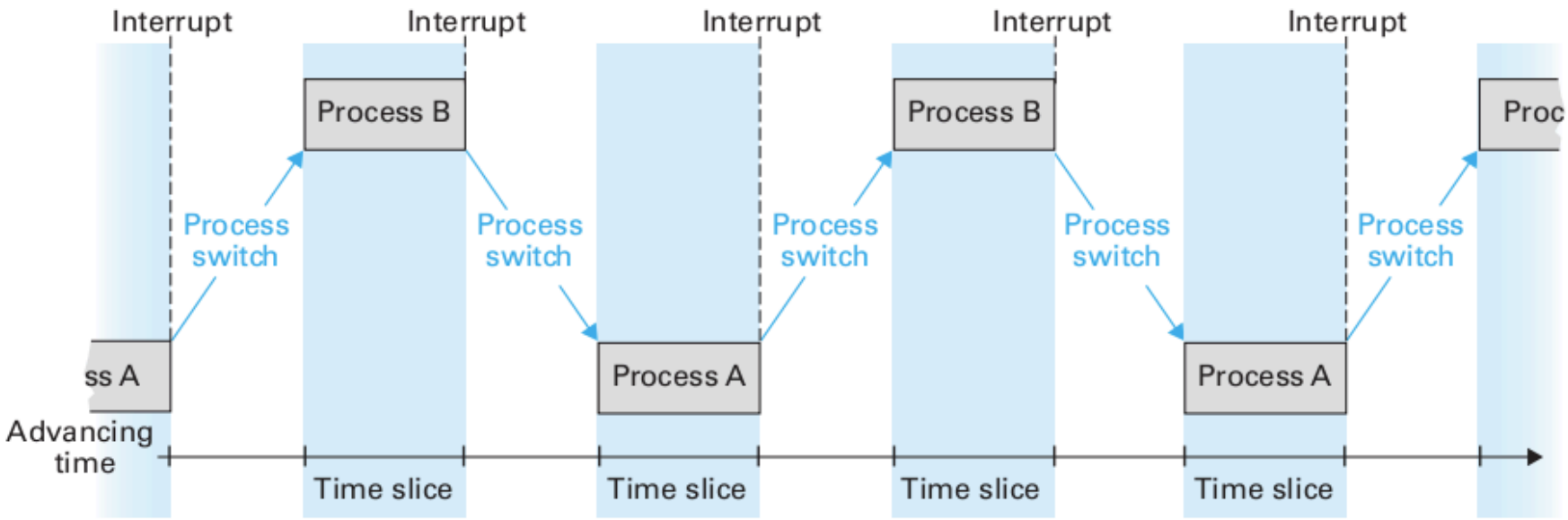
Operating System Basics

- Interaction of OS and users



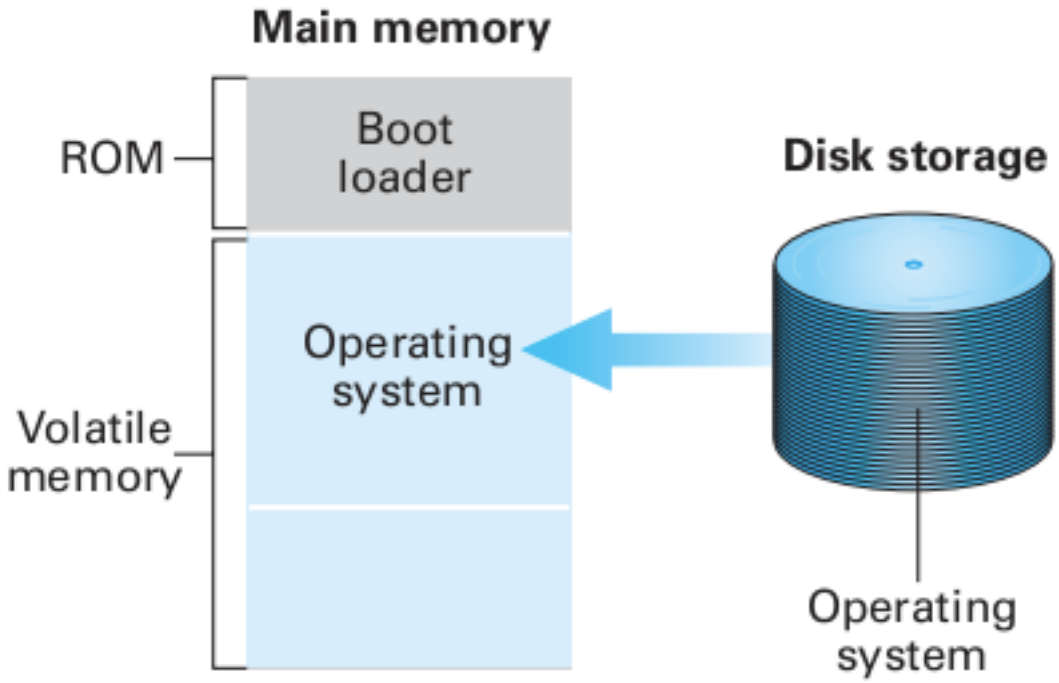
Operating System Basics

- Processes handling in OS



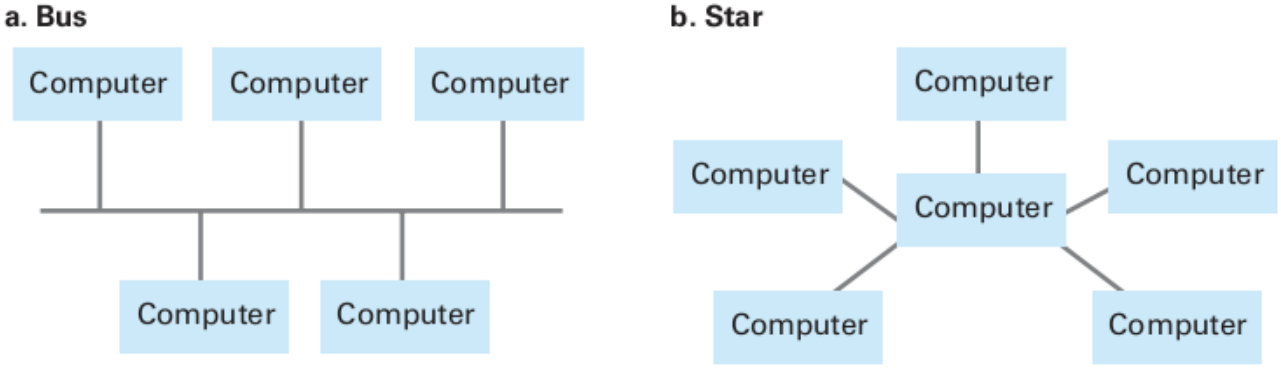
Operating System Basics

- Memory and disk storage

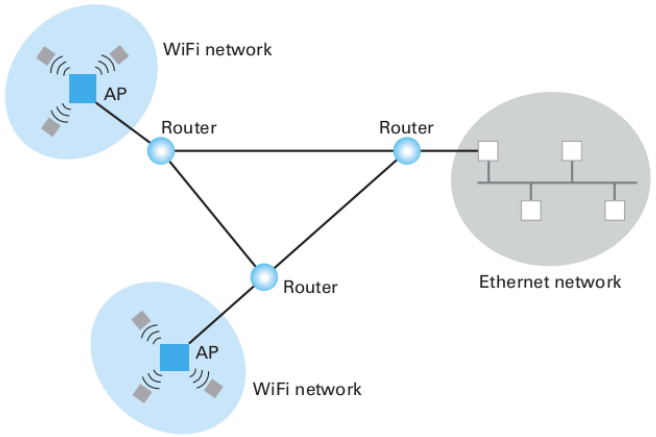


Networks

- Network topologies

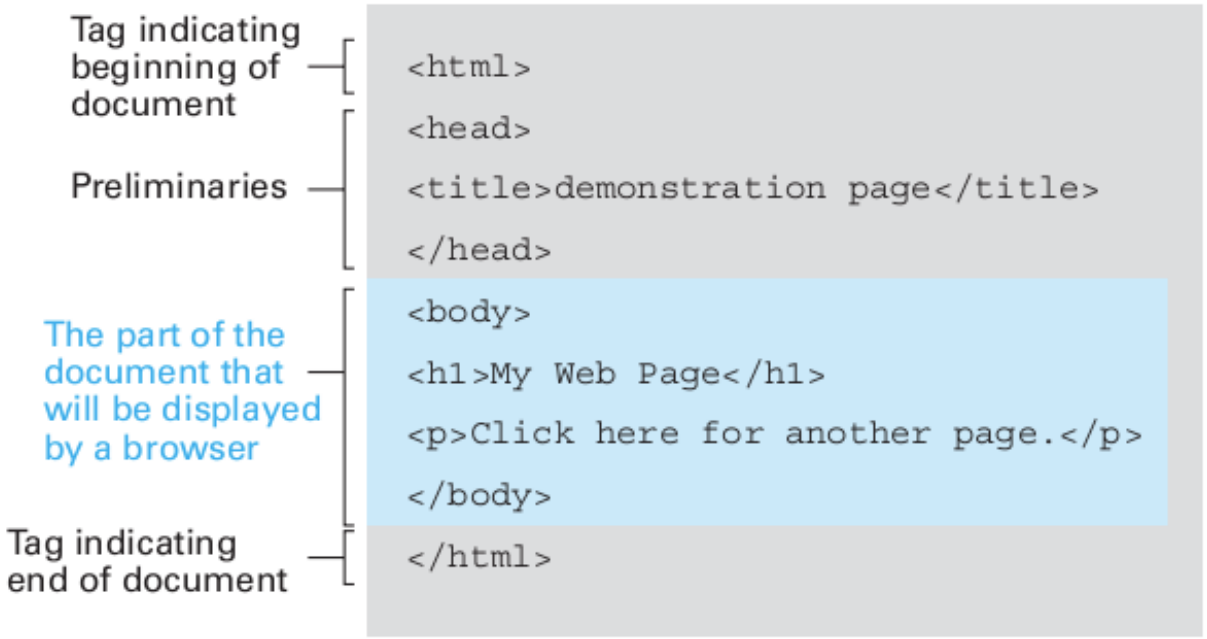


- To form an internet using routers



Web Design

- HTML



Data Storage and Manipulation

- Representing text
  - The message “Hello.” in ASCII (American Standard Code for Information Interchange)

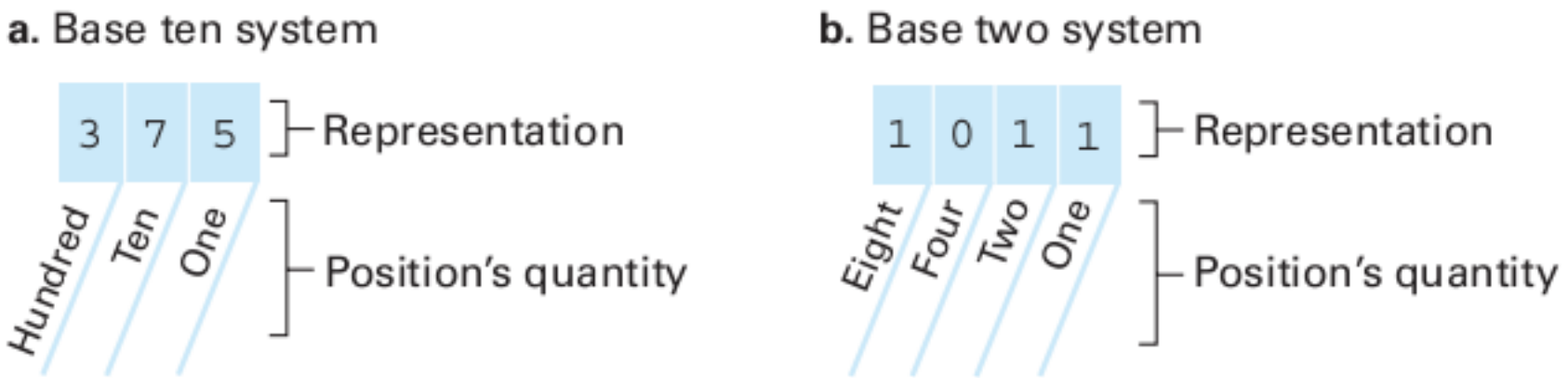
01001000	01100101	01101100	01101100	01101111	00101110
H	**e**	**l**	**l**	**o**	**.**

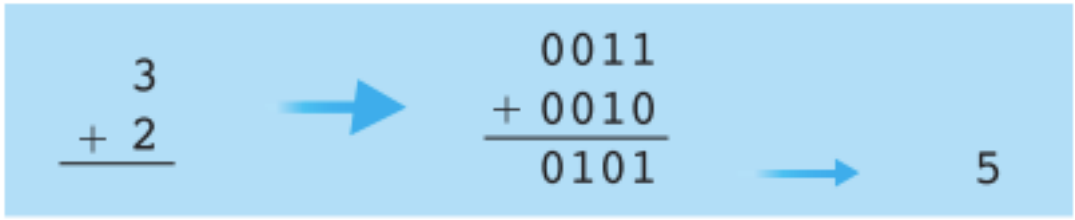
- Representing numeric values

0000	**0001**	**0010**	**0011**	**0100**	**0101**
0	1	2	3	4	5

Data Storage and Manipulation

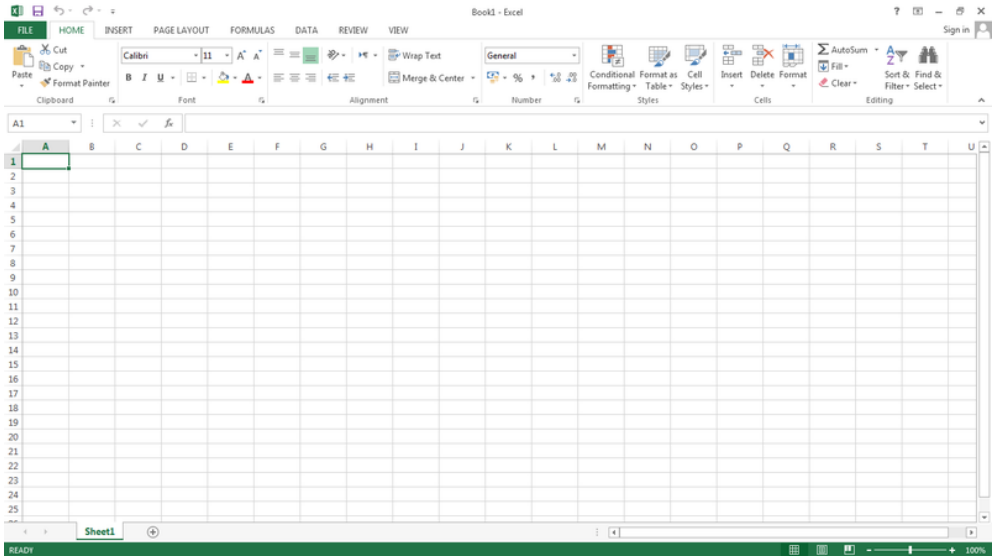
- The binary system





Spreadsheet

- Excel



Database

- Table

ID	*name*	*dept_name*	*salary*
22222	Einstein	Physics	95000
12121	Wu	Finance	90000
32343	El Said	History	60000
45565	Katz	Comp. Sci.	75000
98345	Kim	Elec. Eng.	80000
76766	Crick	Biology	72000
10101	Srinivasan	Comp. Sci.	65000
58583	Califieri	History	62000
83821	Brandt	Comp. Sci.	92000
15151	Mozart	Music	40000
33456	Gold	Physics	87000
76543	Singh	Finance	80000

(a) The *instructor* table

dept_name	*building*	*budget*
Comp. Sci.	Taylor	100000
Biology	Watson	90000
Elec. Eng.	Taylor	85000
Music	Packard	80000
Finance	Painter	120000
History	Painter	50000
Physics	Watson	70000

(b) The *department* table

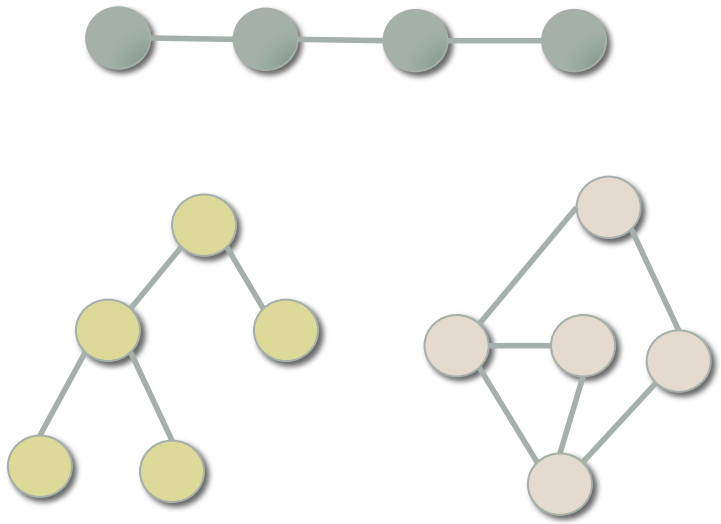
- SQL - a standard language for accessing databases

Example: Find the name of the instructor with ID 22222

```
select   name
from     instructor
where    instructor.ID = '22222'
```

Data Structure & Algorithm

- Data structure Basics
  - Data type and data abstraction
  - Basic structures: linear, tree, graph
  - Useful data types: array, list, set, map
- Algorithm
  - Time and space complexity
  - Searching
  - Sorting



Programming in Python

- Why Python
  - Easy to learn and use
  - Versatile and popular
  - Lots of online resources and support

- Learning Python
  - Basic data types
  - Control flows
  - Functions
  - File Input/Output
  - Object-Oriented Programming

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For the Next Class

- Survey (use one or two sentences)
  1. Tell me about you: name, school, major, year
  2. Why do you want to take this course?
  3. What do you expect to learn?
  4. How do you think this course can be relevant to your current major, future study, or career?
  5. Do you have any existing knowledge in computer science, e.g. programming language, web design, database, etc?
- Email to xie@cs.columbia.edu

- Read Chapter 2 Operating Systems by Brookshear
- Read CUNIX tutorial: http://www.columbia.edu/~lgw23/cs1004/

References & Photo Credits

- Brookshear, J. Glenn (2011-04-13). Computer Science: An Overview (11th Edition). Prentice Hall. Kindle Edition.
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