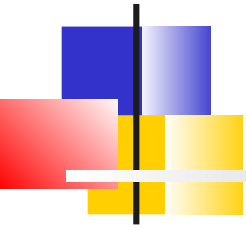
Operating System Principles

操作系统原理



Introduction

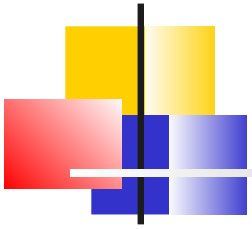
李旭东

leexudong@nankai.edu.cn

—Nankai Univ. SE.

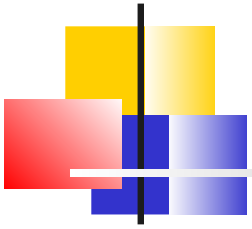
Textbook


Pearson
经典原版书库
现代操作系统
[荷] 安德鲁 S. 塔嫩鲍姆 赫伯特·博斯 著
(Andrew S. Tanenbaum) (Herbert Bos)
Modern Operating Systems (Fourth Edition)
(英文版·第4版)
机械工业出版社
China Machine Press
ANDREW S. TANENBAUM
HERBERT BOS
MODERN OPERATING SYSTEMS
Fourth Edition



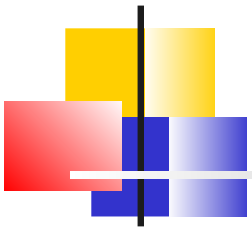
Objectives

- Computer System
- Operating System
- Operating System Zoo
- Operating System History



Computer System

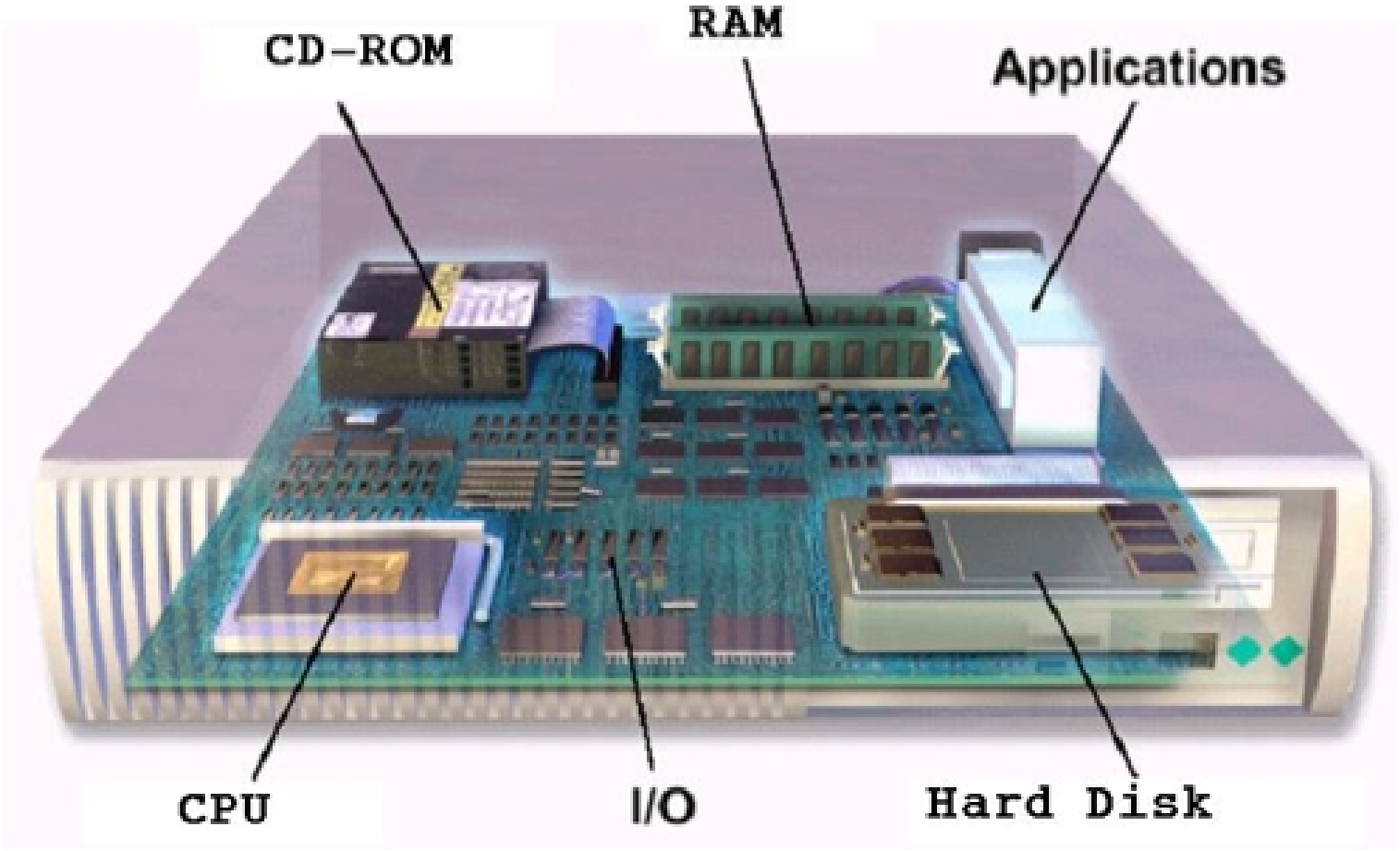
Computer System



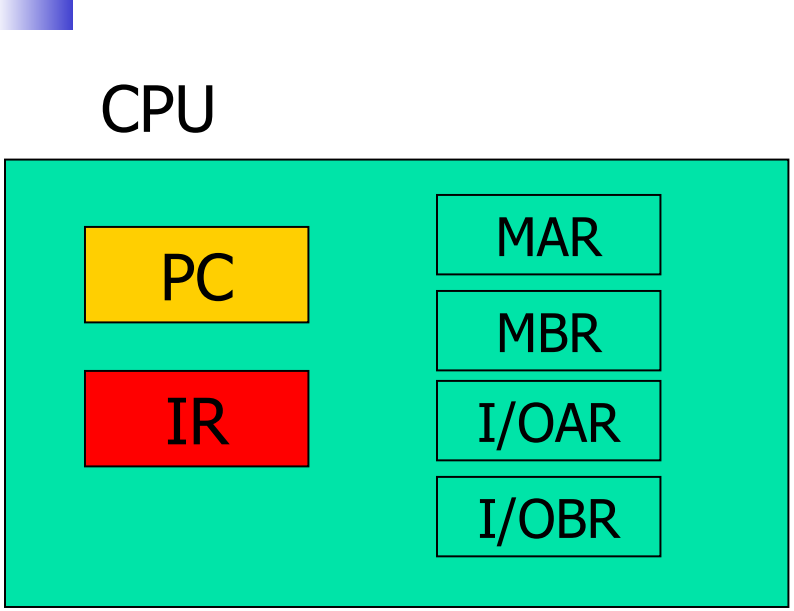
Modern Computer System

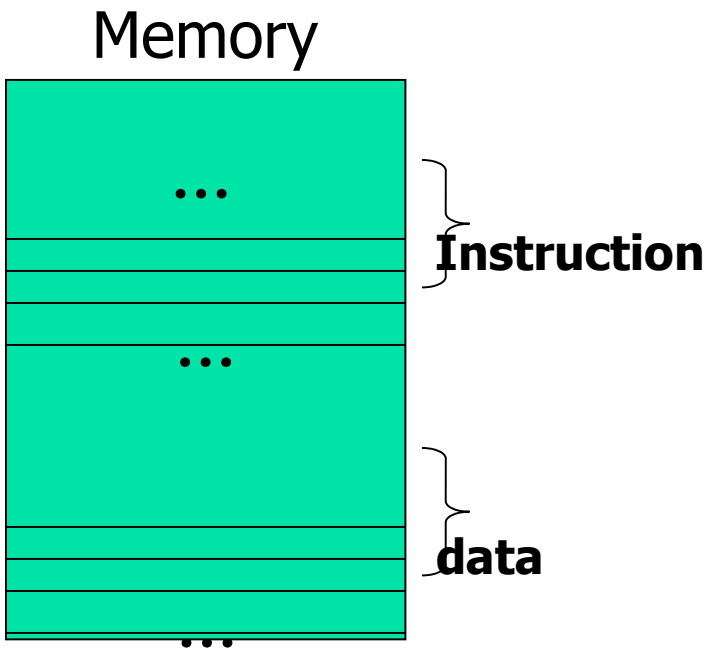
A modern computer consists of one or more processors, some main memory, disks, printers, a keyboard, a mouse, a display, network interfaces, and various other input/output devices.

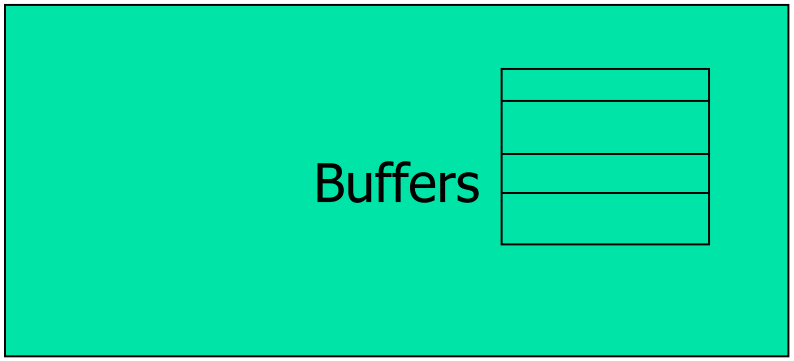
What is Inside Computer?



CPU



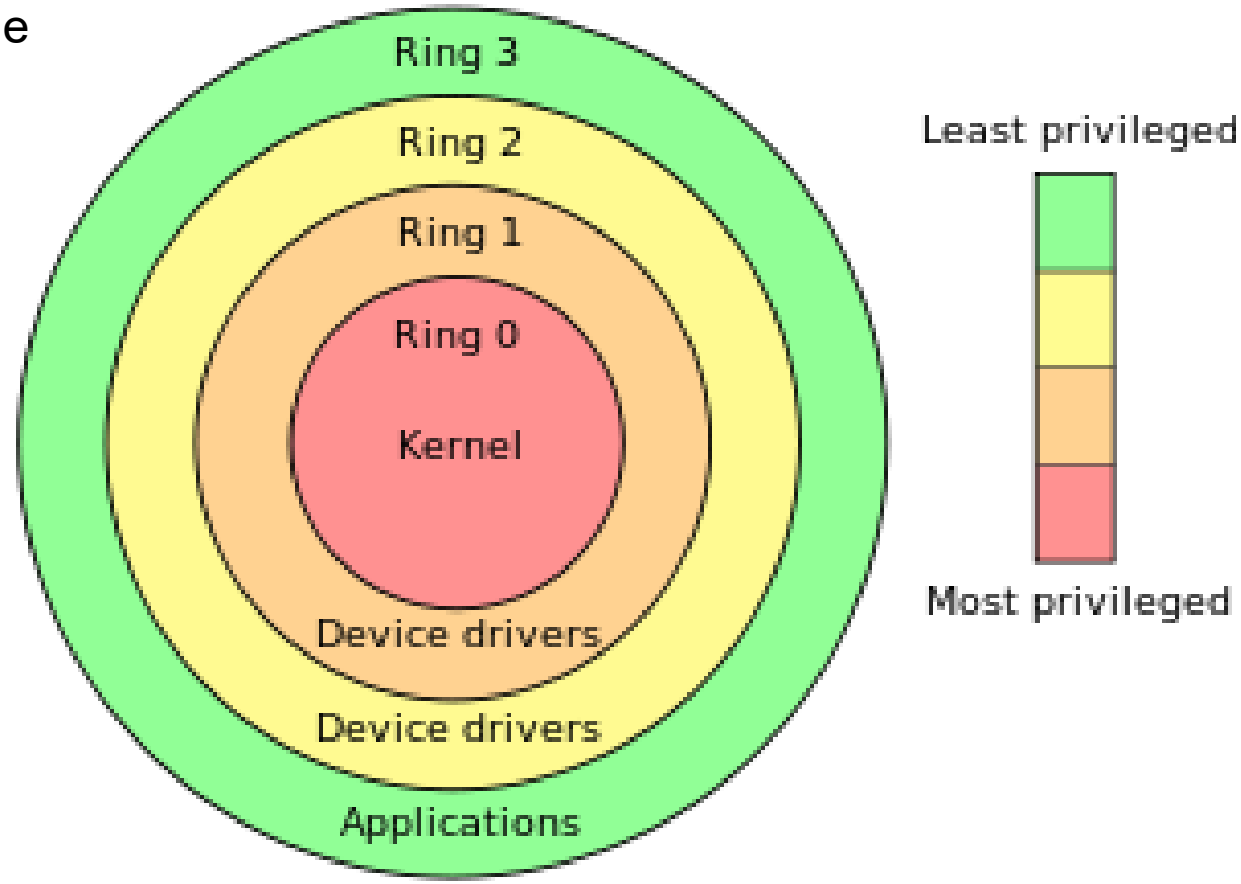




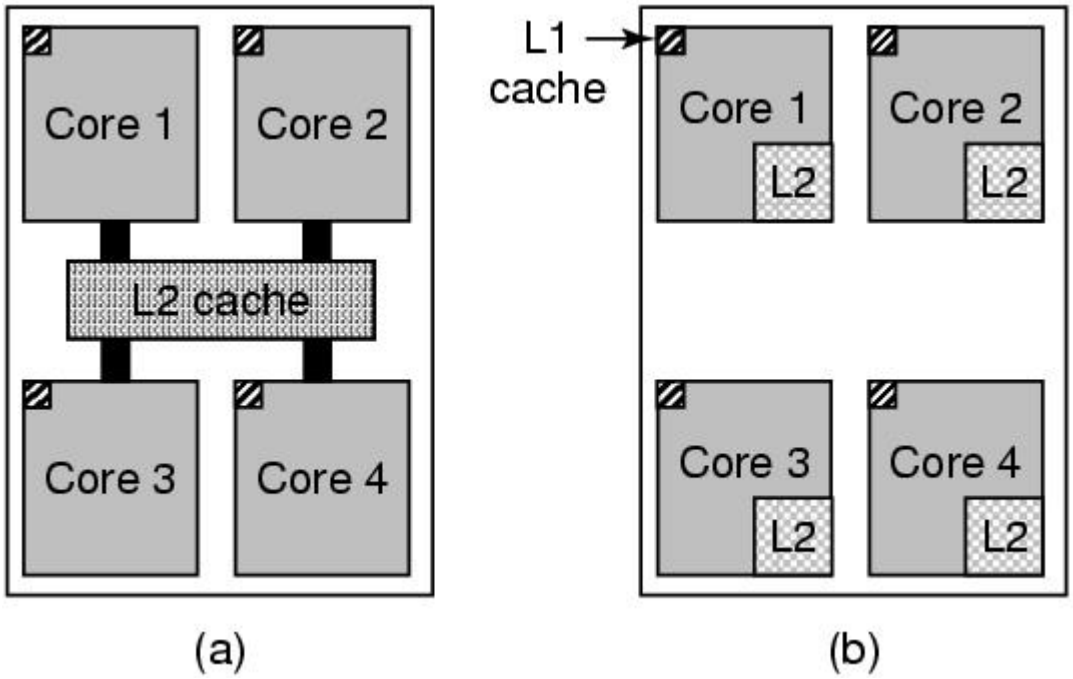
PC: Program counter
IR: Instruction register
MAR: Memory address register
MBR:Memory buffer register
Register：
CS,DS,SS,ES
AX,BX,CX,DX
SP,BP,SI,DI
IP(i.e. PC),PSW

CPU: Supervisor / Protected Mode

- Kernel Mode
- User Mode

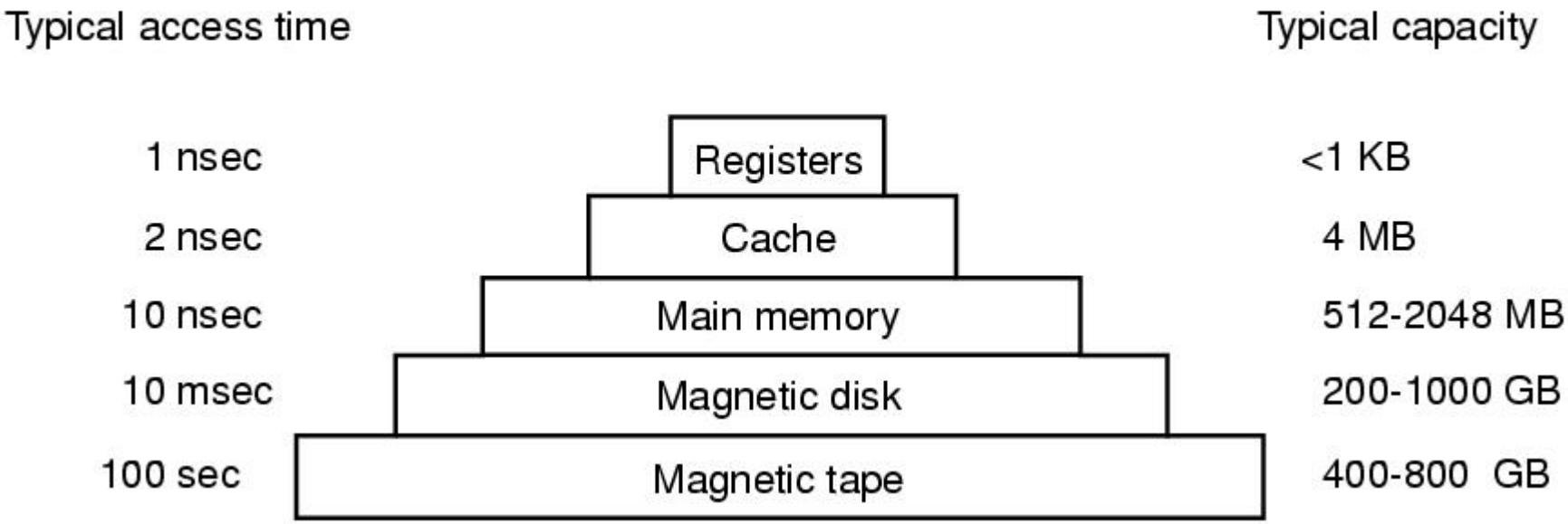


Multithreaded and Multicore Chips

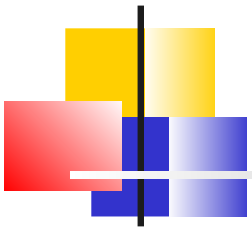


(a) A quad-core chip with a shared L2 cache.
(b) A quad-core chip with separate L2 caches.

Memory



A typical memory hierarchy
The numbers are very rough approximations

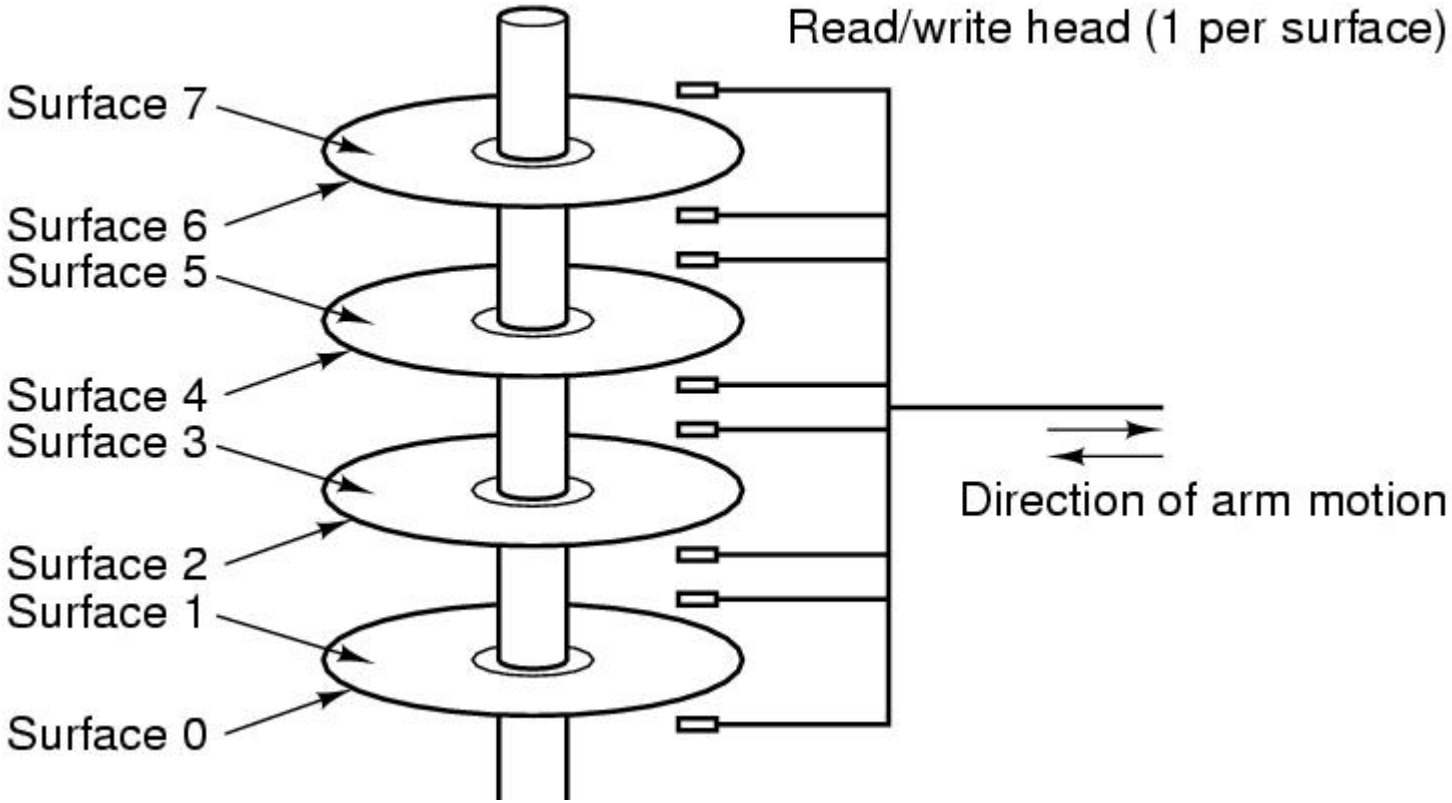


Memory

Questions when dealing with cache:

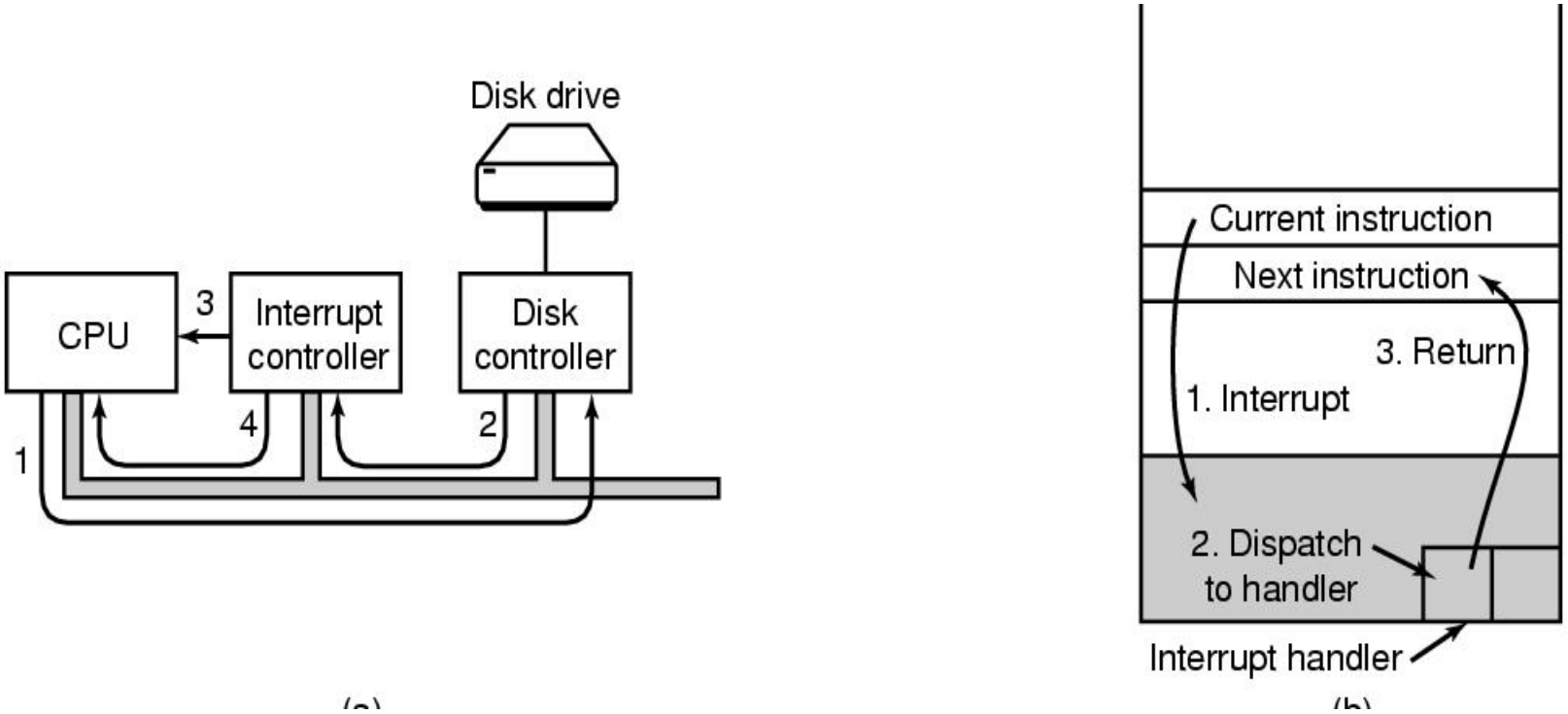
- When to put a new item into the cache.
- Which cache line to put the new item in.
- Which item to remove from the cache when a slot is needed.
- Where to put a newly evicted item in the larger memory.

Disks



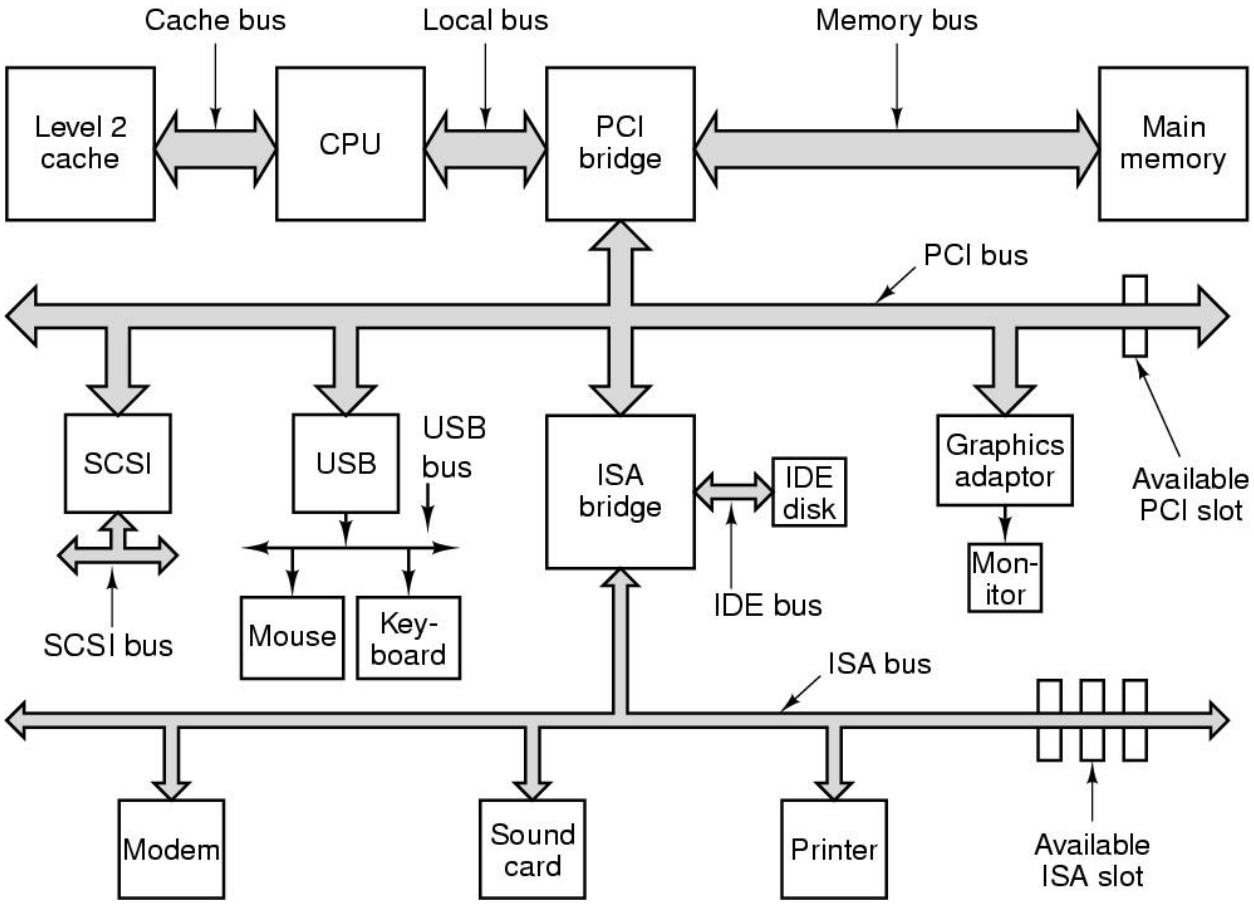
Structure of a disk drive.

I/O Devices



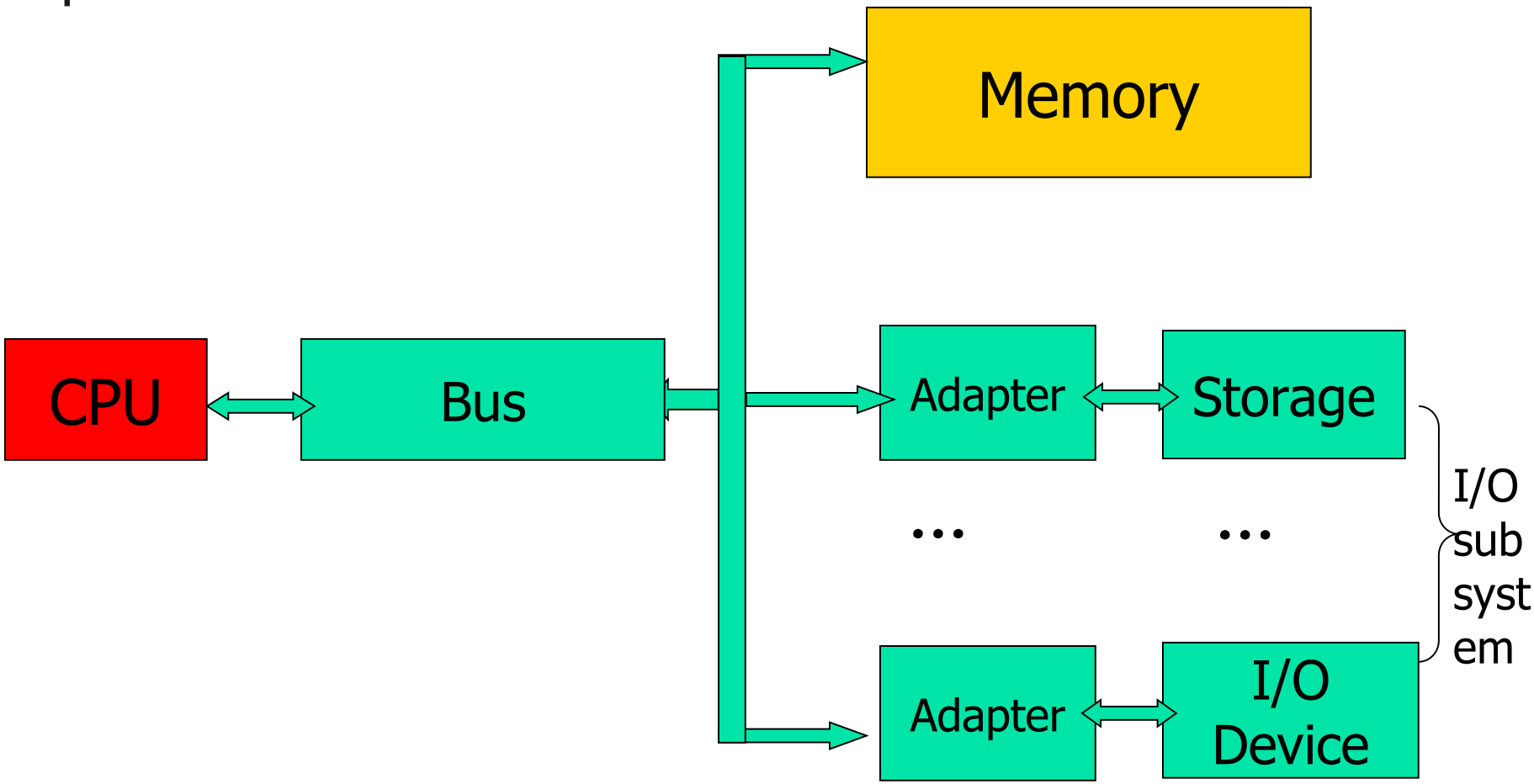
(a) The steps in starting an I/O device and getting an interrupt.

Buses

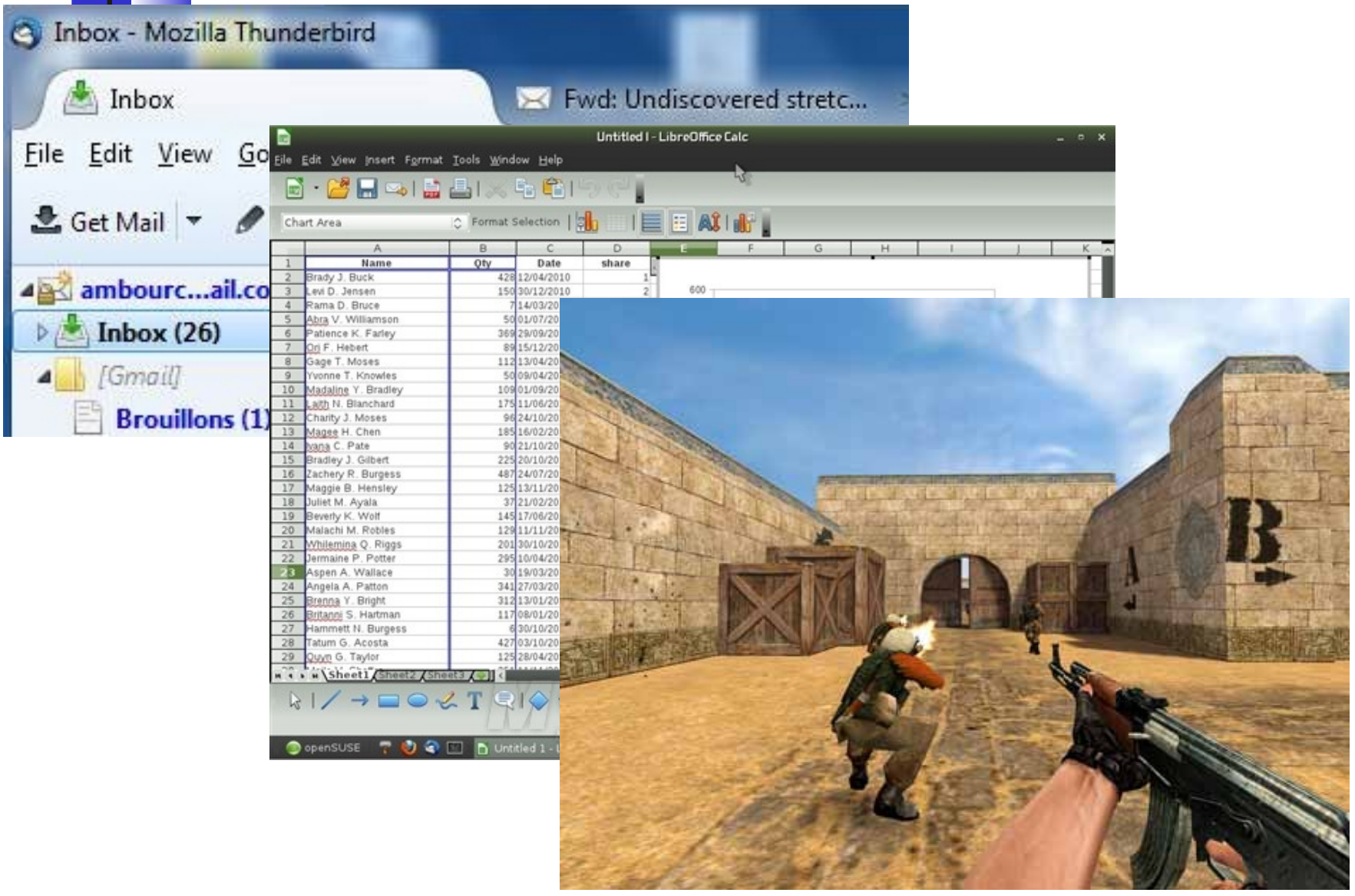


The structure of a large Pentium system

Computer System:Hardware

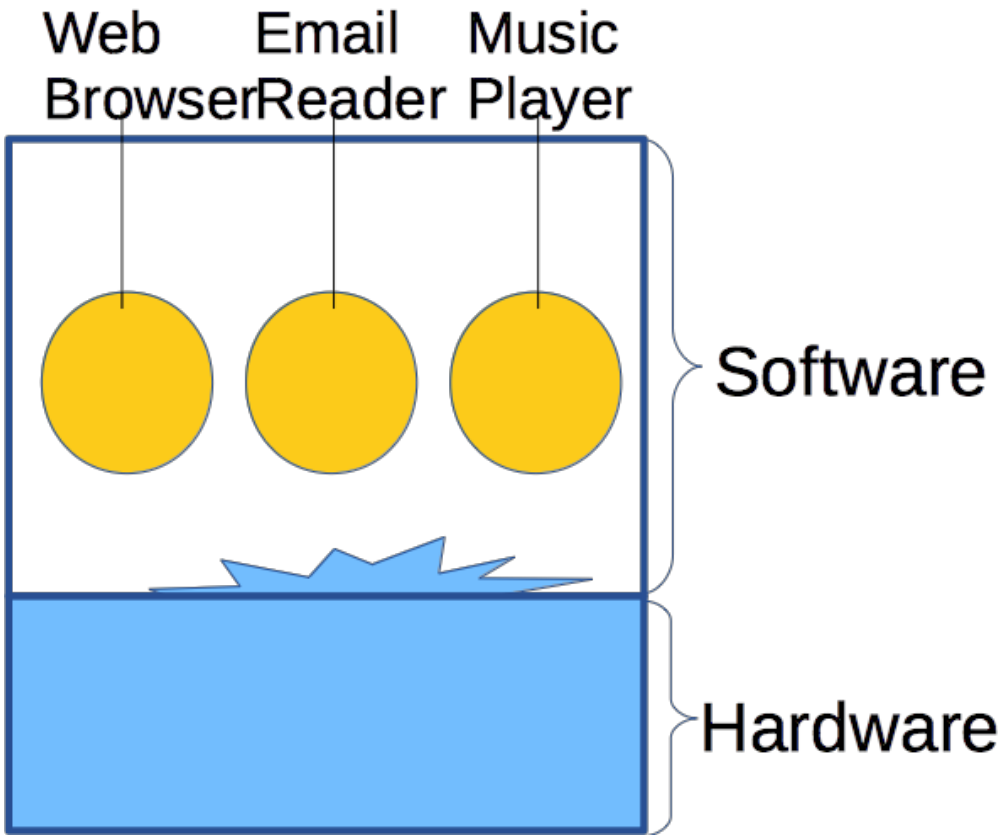


Computer System:Software

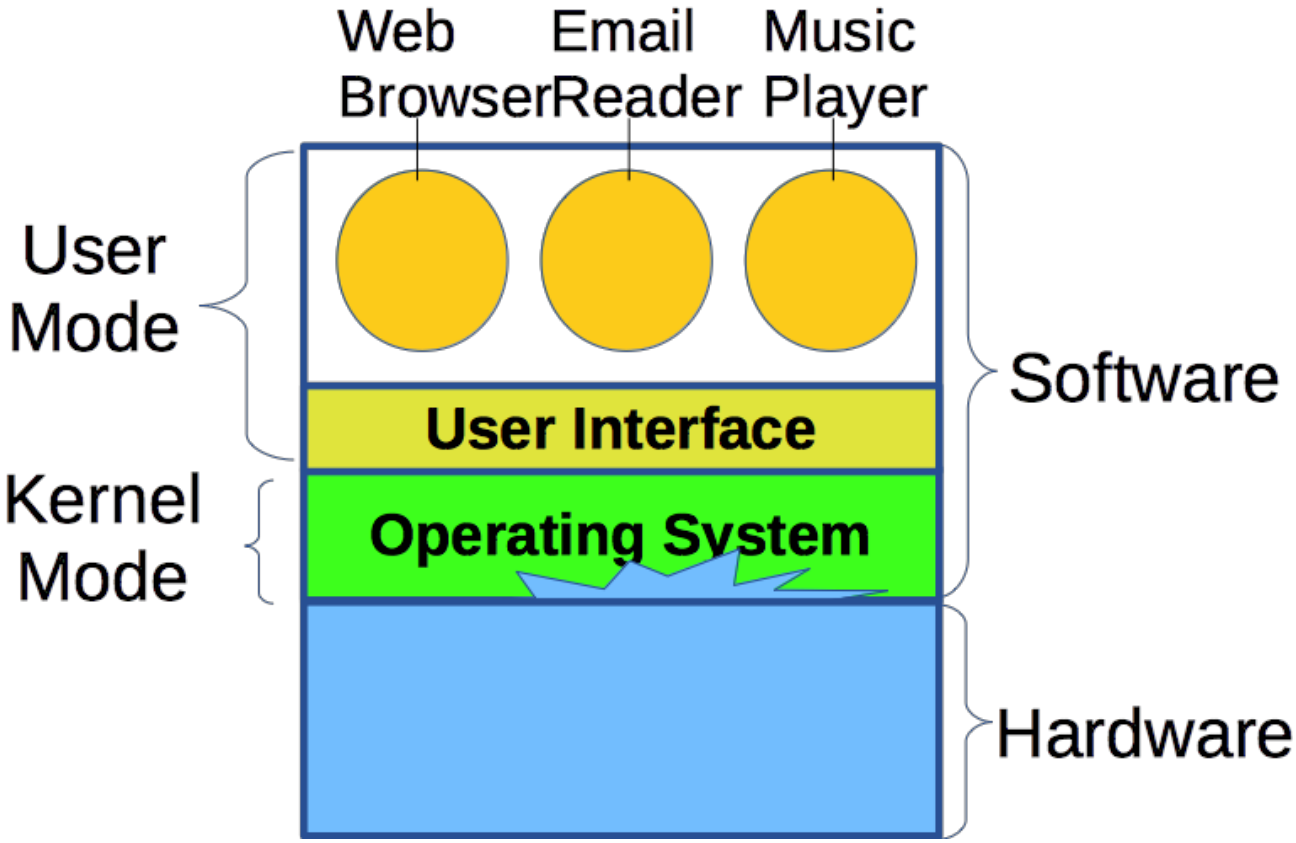


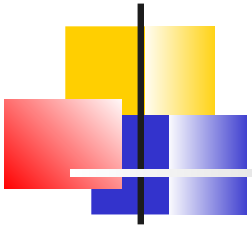
Layers of Computer System

?

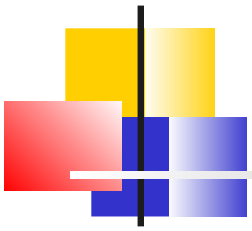


Layers of Computer System



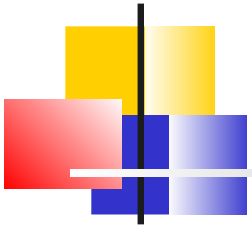


“Operating System”



Basic Services of OS

- Program Creation
- Program Execution
- Access to I/O Devices
- Controlled Access to Files
- System Access
- Error Detection and Response
- Accounting

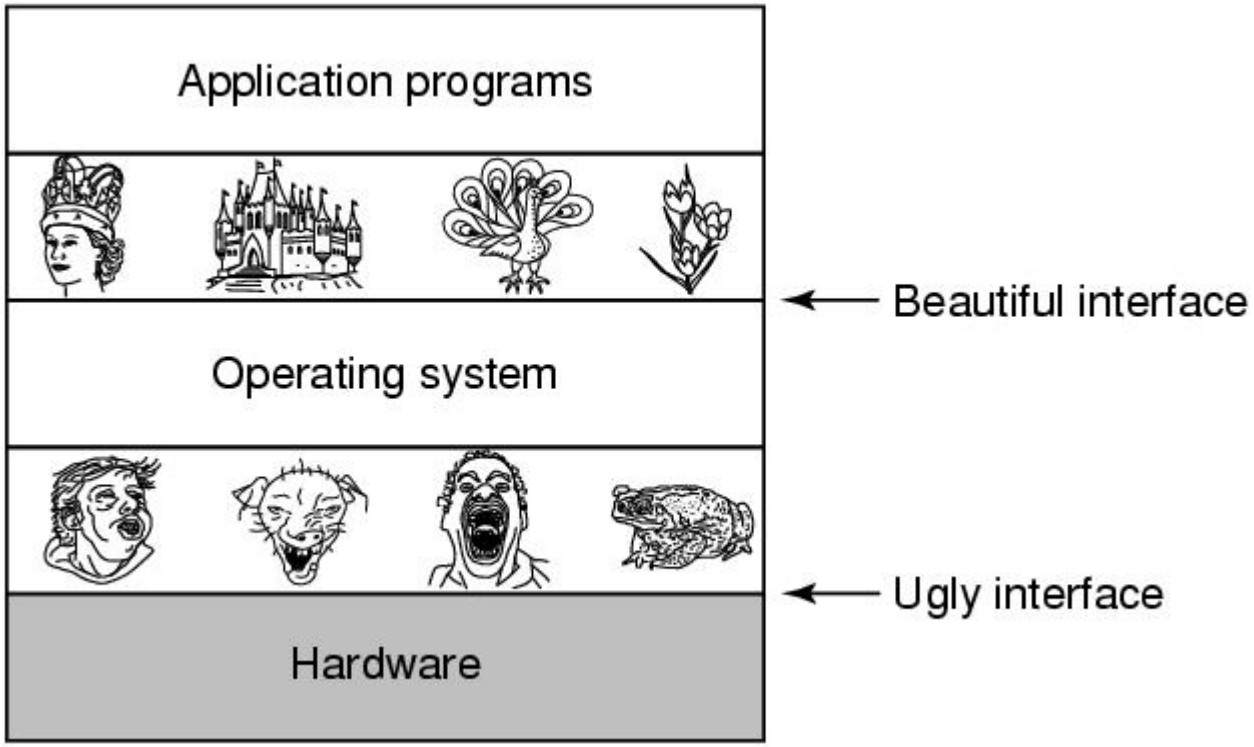


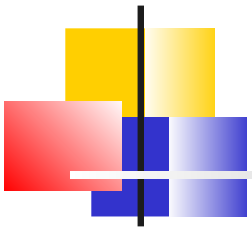
What's an Operating System?

- http://en.wikipedia.org/wiki/Operating_system
- software that manages computer hardware and software resources and provides common services for computer programs
- an essential component of the system software in a computer system
- Application programs usually require an operating system to function

What's an Operating System?

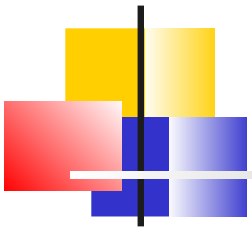
- 1.The Operating System as an Extended Machine





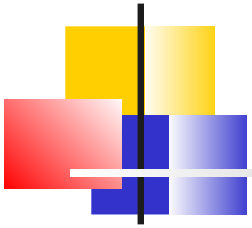
What's an Operating System?

- 2.The Operating System as a Resource Manager
  - Allow multiple programs to run at the same time
  - Manage and protect memory, I/O devices, and other resources
  - Includes multiplexing (sharing) resources in two different ways:
    - In time 时间
    - In space 空间



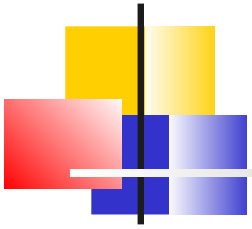
What's an Operating System?

- (3).The Operating System as a Process Manager
  - Process Creation, Scheduling, Termination
- (4).The Operating System as an Extensible Service Machine
  - New Services

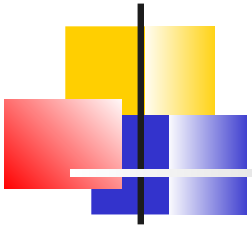


Operating System Zoo

- Mainframe OS
- Server OS
- Multiprocessor OS
- Personal Computer OS
- Handheld Computer OS
- Embedded OS
- Sensor Node OS
- Real-time OS
- Smart Card OS



History of OS



The First Computer

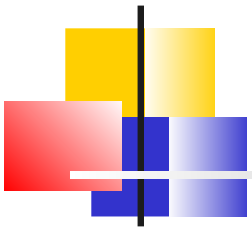
?

The Most Famous Modern Computer

- ENIAC: Electronic Numerical Integrator And Computer ['i: niæk]
  - the first electronic general-purpose computer
  - **a programmable computer**
  - Electronic: Vacuum Tubes
  - Numerical: **Binary**
  - It cost almost $500,000 (approximately $6,000,000 today)
  - ENIAC contained 17,468 vacuum tubes* 真空电子管 , 7,200 crystal diodes 晶体发光二极管 , 1,500 relays, 70,000 resistors 电阻 , 10,000 capacitors 电容 and around 5 million hand-soldered joints
  - It weighed more than 30 short tons (27 t), was roughly 8 by 3 by 100 feet (2.4 m × 0.9 m × 30 m), took up 1800 square feet (167 m*m), and consumed 150 kW of power

Vacuum Tubes

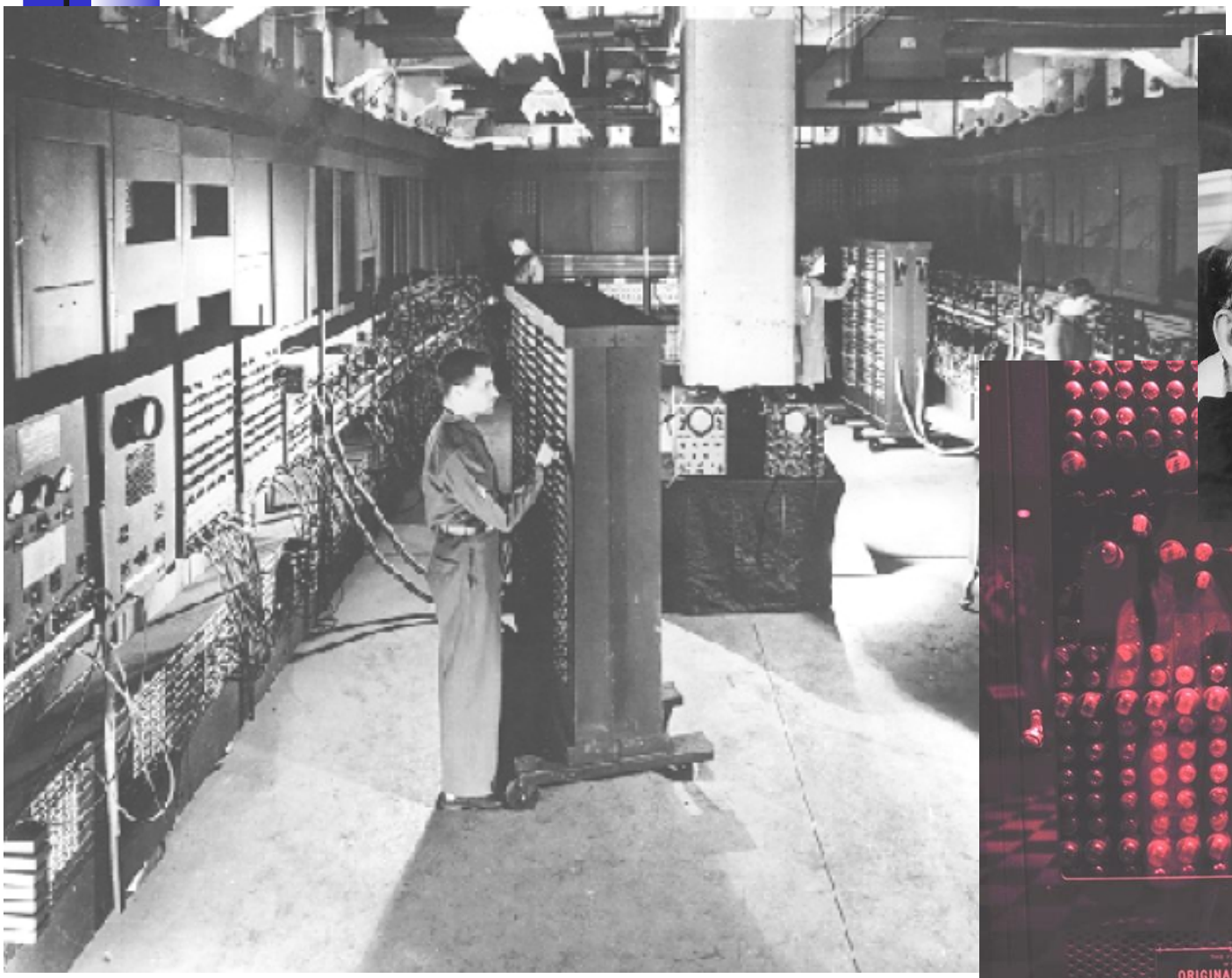
- Vacuum Tubes
  - Lee De Forest, 1906
  - Two States

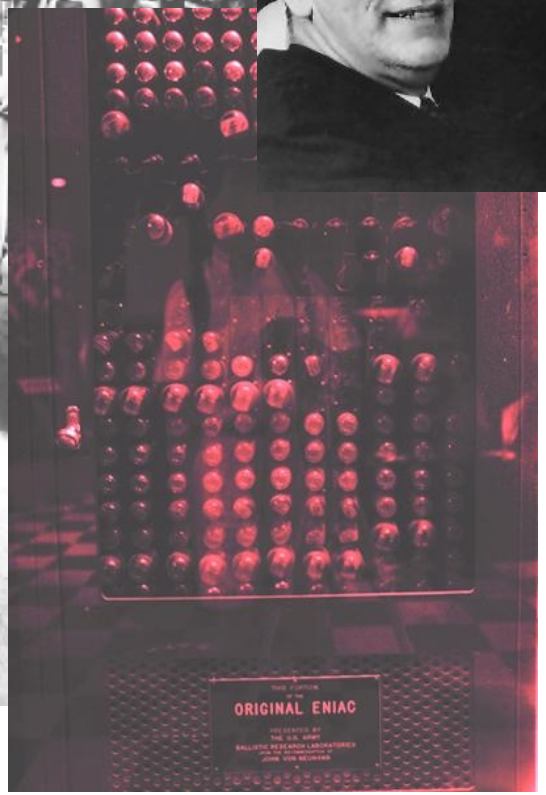


The Most Famous Modern Computer

- ENIAC was initially designed to calculate artillery firing tables for the United States Army's Ballistic Research Laboratory
- It had a speed of one thousand times that of electro-mechanical machines
- On July 29, 1947, it was turned on and was in continuous operation until 11:45 p.m. on October 2, 1955
- ENIAC was conceived and designed by John Mauchly and J. Presper Eckert of the University of Pennsylvania

ENIAC



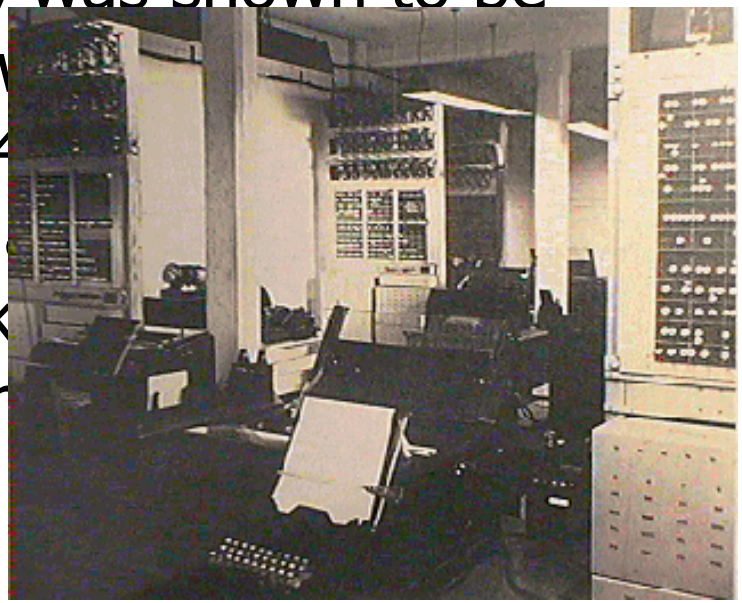


John Von Neumann

- John von Neumann: 1903 ~ 1957
  - a Hungarian and later American pure and applied mathematician, physicist, inventor, polymath, and polyglot. He made major contributions to a number of fields,including mathematics, physics , economics , computing (Von Neumann architecture, linear programming, self-replicating machines, stochastic computing), and statistics.
  - a pioneer of the application of operator theory to quantum mechanics, in the development of functional analysis, a principal member of the Manhattan Project and the Institute for Advanced Study in Princeton, and a key figure in the development of game theory and the concepts of cellular automata, the universal constructor, and the digital computer
  - Von Neumann's mathematical analysis of the structure of self-replication preceded the discovery of the structure of DNA
- Von Neumann architecture*

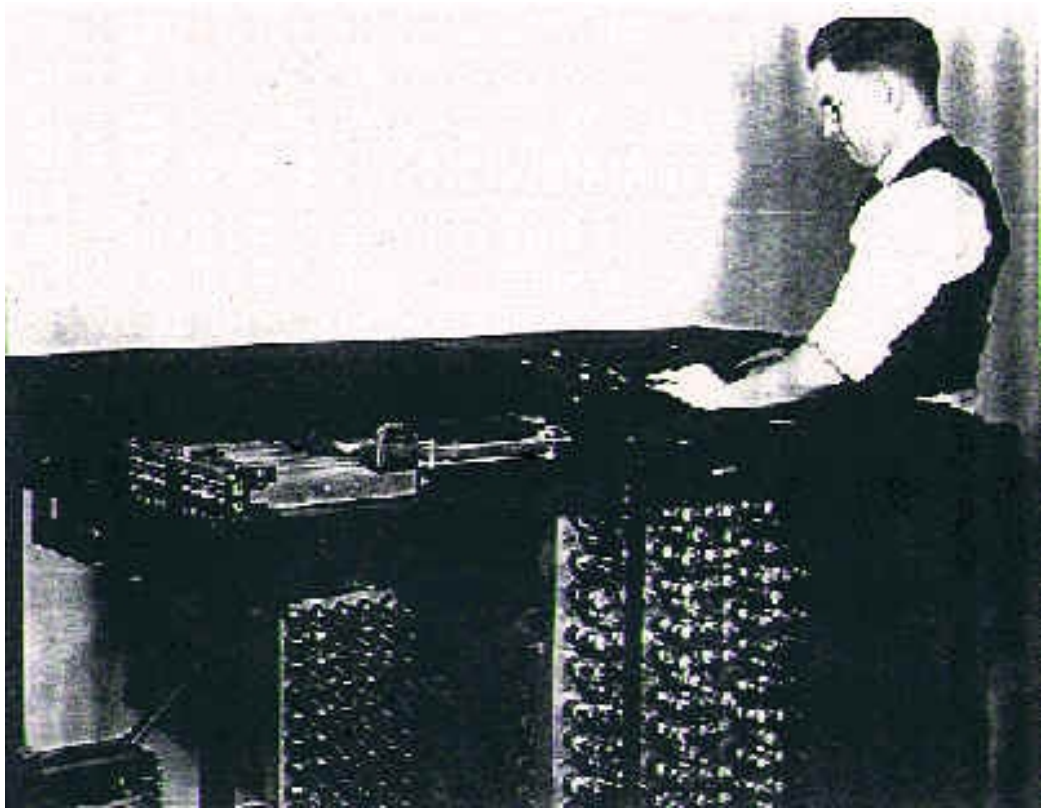
Colossus

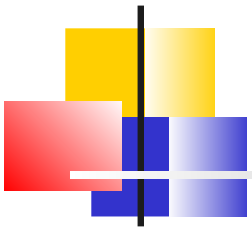
- Colossus
  - the world's first electronic digital computer that was programmable
  - developed for British codebreakers during World War II to help in the cryptanalysis of the Lorenz cipher.
  - designed by the engineer Tommy Flowers
  - The prototype, Colossus Mark 1, was shown to be working in December 1943 and w
    Bletchley Park by 5 February 194
  - An improved Colossus Mark 2 th
    to quintuple the speed,first work
    1944,just in time for the Norman



ABC

- ABC: Atanasoff-Berry Computer
  - 1939, John Vincent Atanasoff
  - The First Automatic Electronic Digital Computer



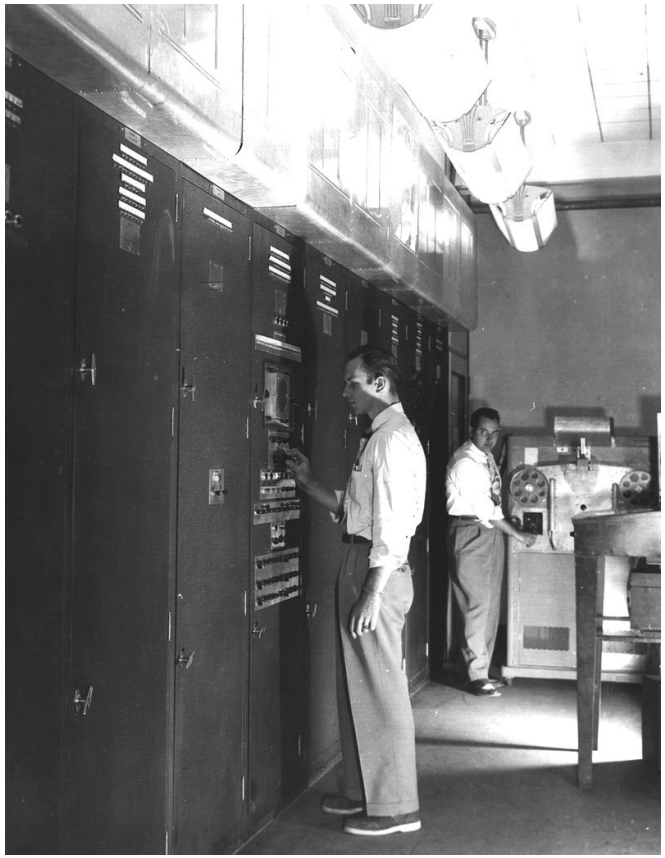


ABC: Atanasoff Berry Computer

- John Vincent Atanasoff and Clifford E. Berry
- http://www.ieee.org/web/aboutus/history_center/atanasoff.html
  - John Vincent Atanasoff conceived basic design principles for the first **electronic-digital** computer in the winter of 1937 and, assisted by his graduate student, Clifford E. Berry, constructed a prototype here in October 1939.
  - It used **binary numbers**, direct **logic for calculation**, and a **regenerative memory**. It embodied concepts that would be central to the future development of computers.
  - Atanasoff wrote most of the concepts of the first modern computer on the back of a cocktail napkin.
  - in late 1939, John V. Atanasoff teamed up with Clifford E. Berry to build a prototype. They created the first computing machine to use electricity, vacuum tubes, binary numbers and capacitors.
  - The final product was the size of a desk, weighed 700 pounds, had over 300 vacuum tubes, and contained a mile of wire. It could calculate about one operation every 15 seconds, today a computer can calculate 150 billion operations in 15 seconds.

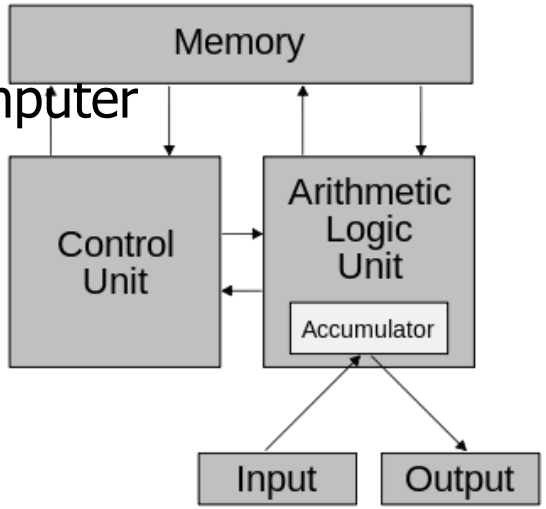
The Father of Modern Computer

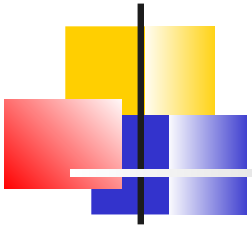
- Von Neumann architecture
- Case: In Ballistic Research Laboratory
  - EDVAC (Electronic Discrete Variable Automatic Computer)



Von Neumann architecture
冯诺依曼架构式计算机

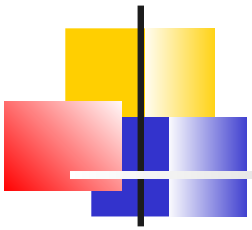
- Von Neumann Model, Princeton Model
  - This describes a design architecture for an electronic digital computer with parts consisting of **a processing unit** containing an arithmetic logic unit and processor registers, a control unit containing an instruction register and program counter, **a memory** to store both data and instructions, **external mass storage**, and **input and output** mechanisms.
  - The meaning has evolved to be any **stored-program** computer 存储程序计算机 in which an instruction fetch and a data operation cannot occur at the same time because they share a common bus.
  - advancement over ENIAC etc.,
  - EDVAC:Electronic Discrete Variable Automatic Computer
  - the Von Neumann bottleneck





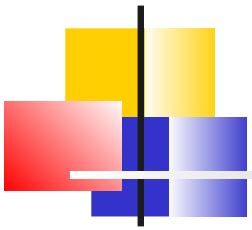
Evolution of An OS

- Maximization of resource utilization
- Hardware upgrades plus new types of hardware
- New Services
- Fixes
- User Experience



History of Operating Systems

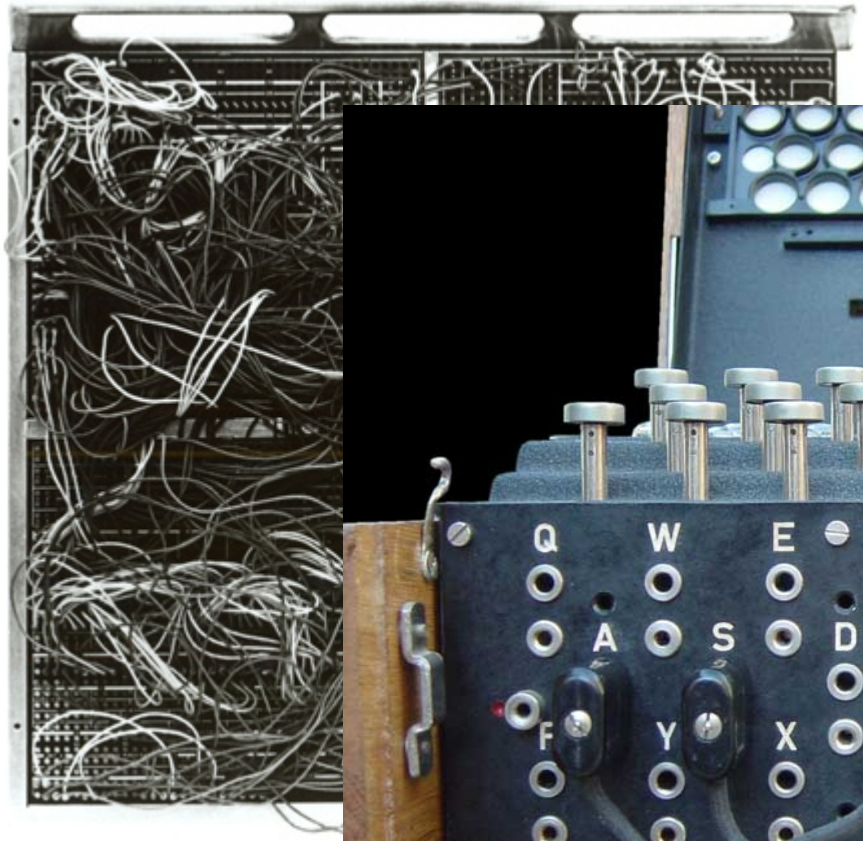
- First generation 1945 - 1955
  - vacuum tubes, plug boards
- Second generation 1955 - 1965
  - transistors, batch systems
- Third generation 1965 – 1980
  - ICs and multiprogramming
- Fourth generation 1980 – present
  - Personal computers
- Fifth generation 1990 – present
  - Mobile computers



History of OS: prehistory

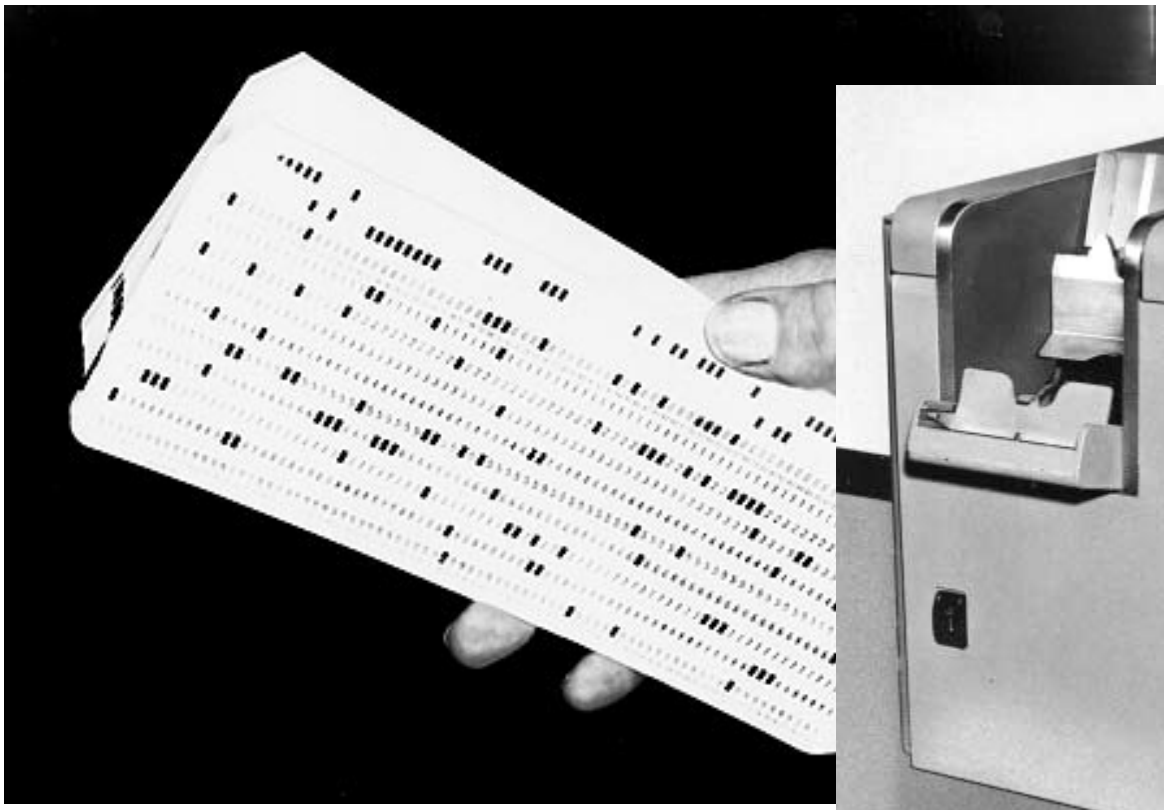
- Vacuum Tubes
- Plugboard
- No OS
- Machine Language

Plugboard



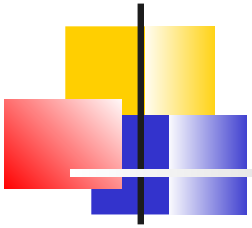
punched cards

- punched cards, Herman Hollerith, 1890



History of OS: batch system

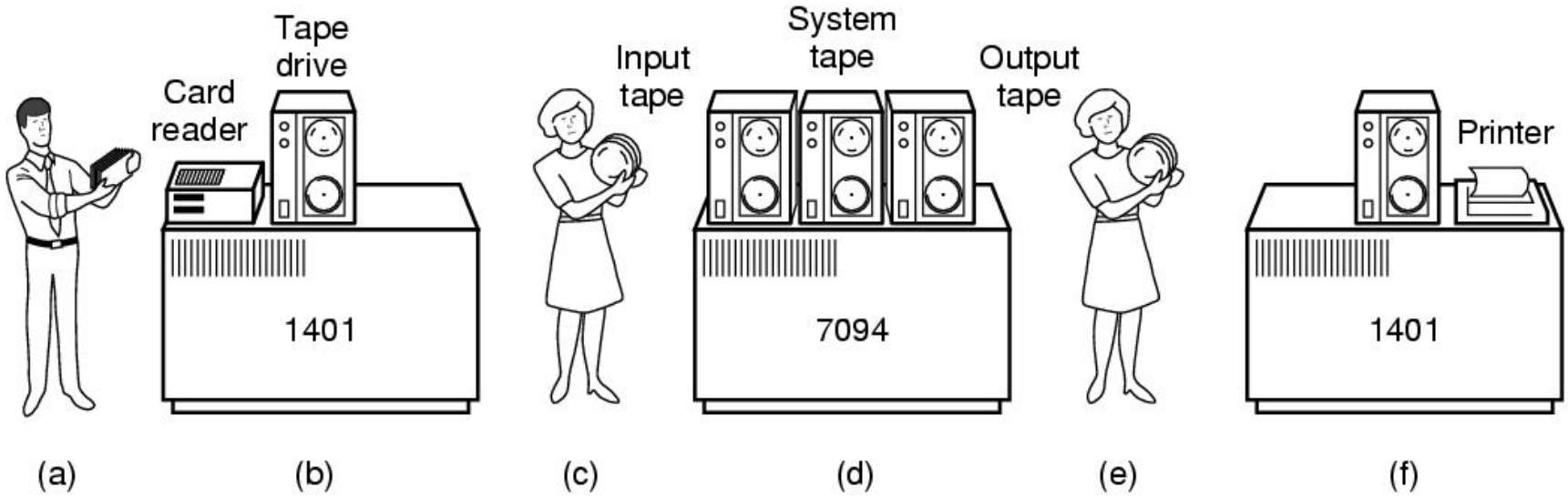
- Second Generation,1955~1965
- Transistors 晶体管 and batch system
  - Transistor:1947, John Bardeen, Walter Brattain, and William Shockley
  - Mainframes: IBM1401-> IBM7094
    - IBM7094: good at numerical calculations
    - IBM1401: business
  - Tape
  - Assembly Language, FORTRAN Math Language



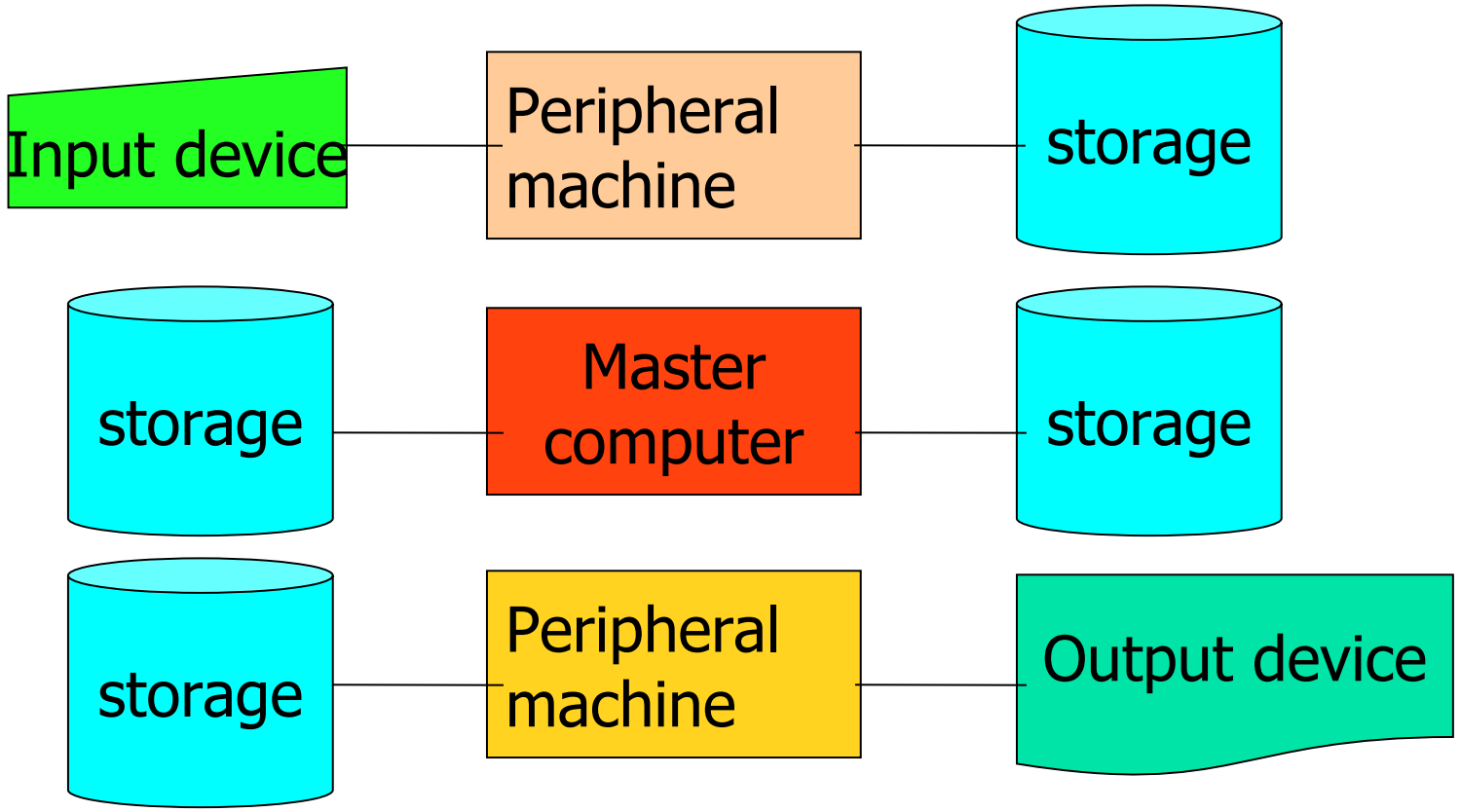
History of OS: batch system

- Second Generation,1955~1965
- Transistors and batch system (cont.,)
  - OS
    - FORTRAN Monitor System(FMS)
    - IBSYS(IBM7094 OS)
  - Job
  - off-line
  - single batch system

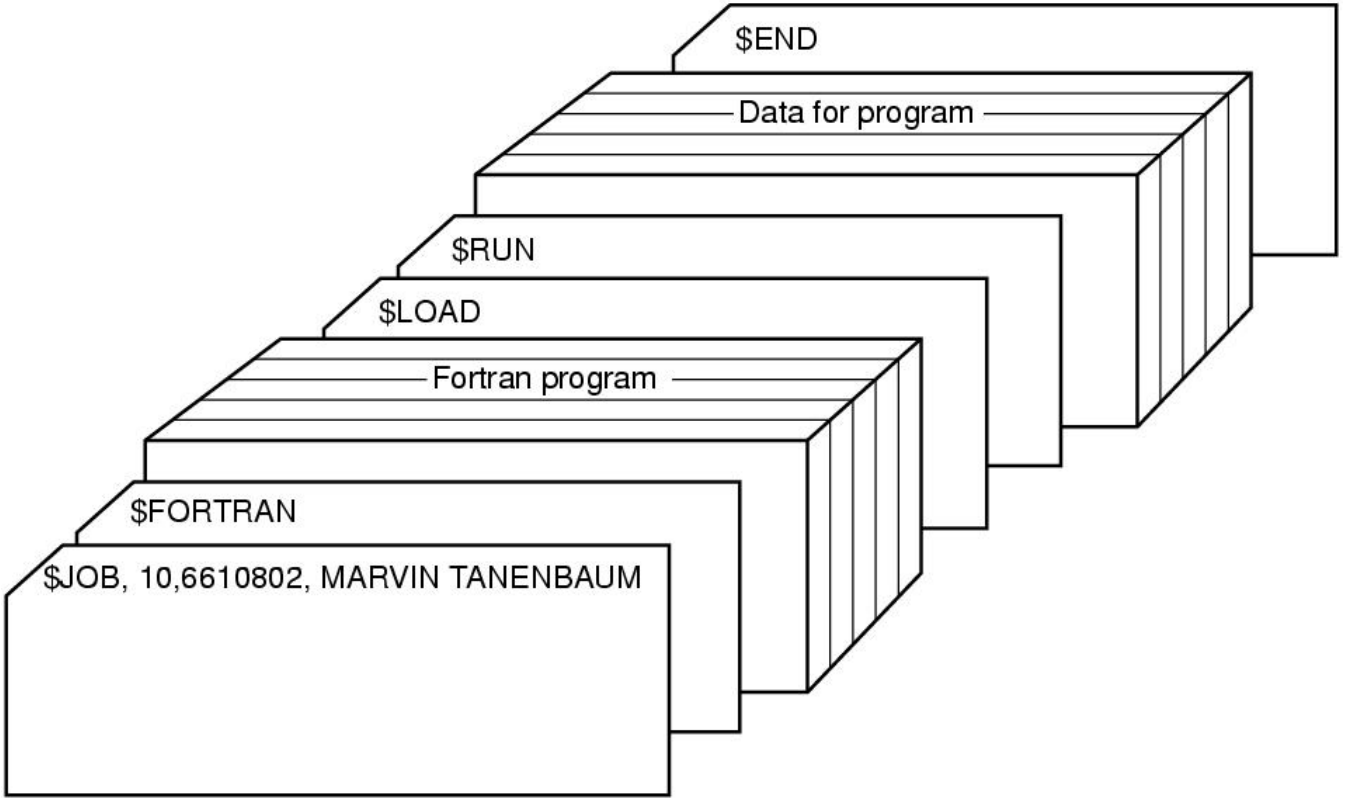
Off-Line I/O


Tape
drive
Card
reader
1401
Input
tape
System
tape
Output
tape
7094
Printer
1401
(a)
(b)
(c)
(d)
(e)
(f)

Off-Line I/O

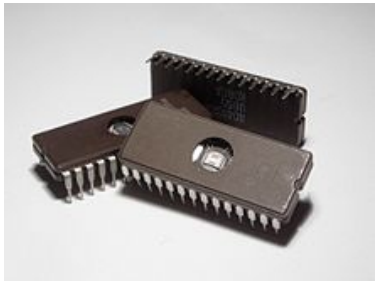

Input device
Peripheral machine
storage
storage
Master computer
storage
storage
Peripheral machine
Output device

Single Batch System



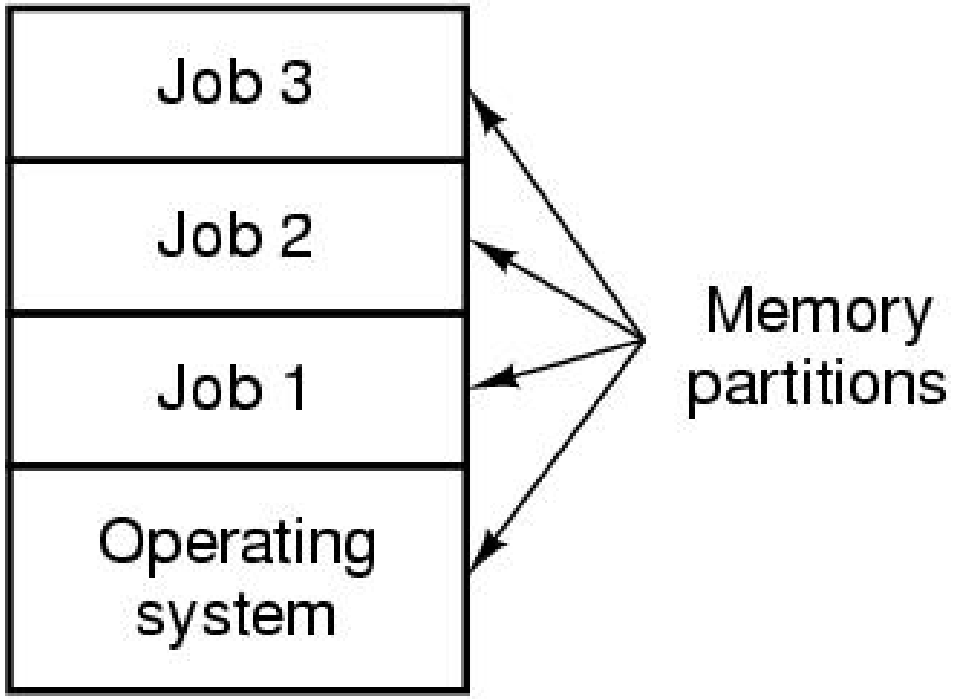
Structure of a typical FMS job.

History of OS: time sharing system

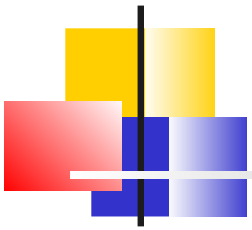


- The Third Generation, 1965~1980
- ICs and Multiprogramming
  - ICs: Integrated Circuits
    - Jack Kilby, Robert Noyce
  - Computer Architecture
    - IBM System/360, 370, 4300, 3080, 3090
  - OS/360:Fred Brooks
  - Multiprogramming*
  - Spooling*
  - timesharing: CTSS, Corbato(1962, MIT
  - PDP-1: Small Computer
  - MULTICS(MULTiplexed Information and Computing Service
    - 1965, MIT,Bell Lab,GE: GE-635, DPS8
    - computer utility
  - UNIX: Single MULTICS, Ken Thompson(Bell Lab,PDP-7)

Multi-programming



A multiprogramming system with three jobs in memory

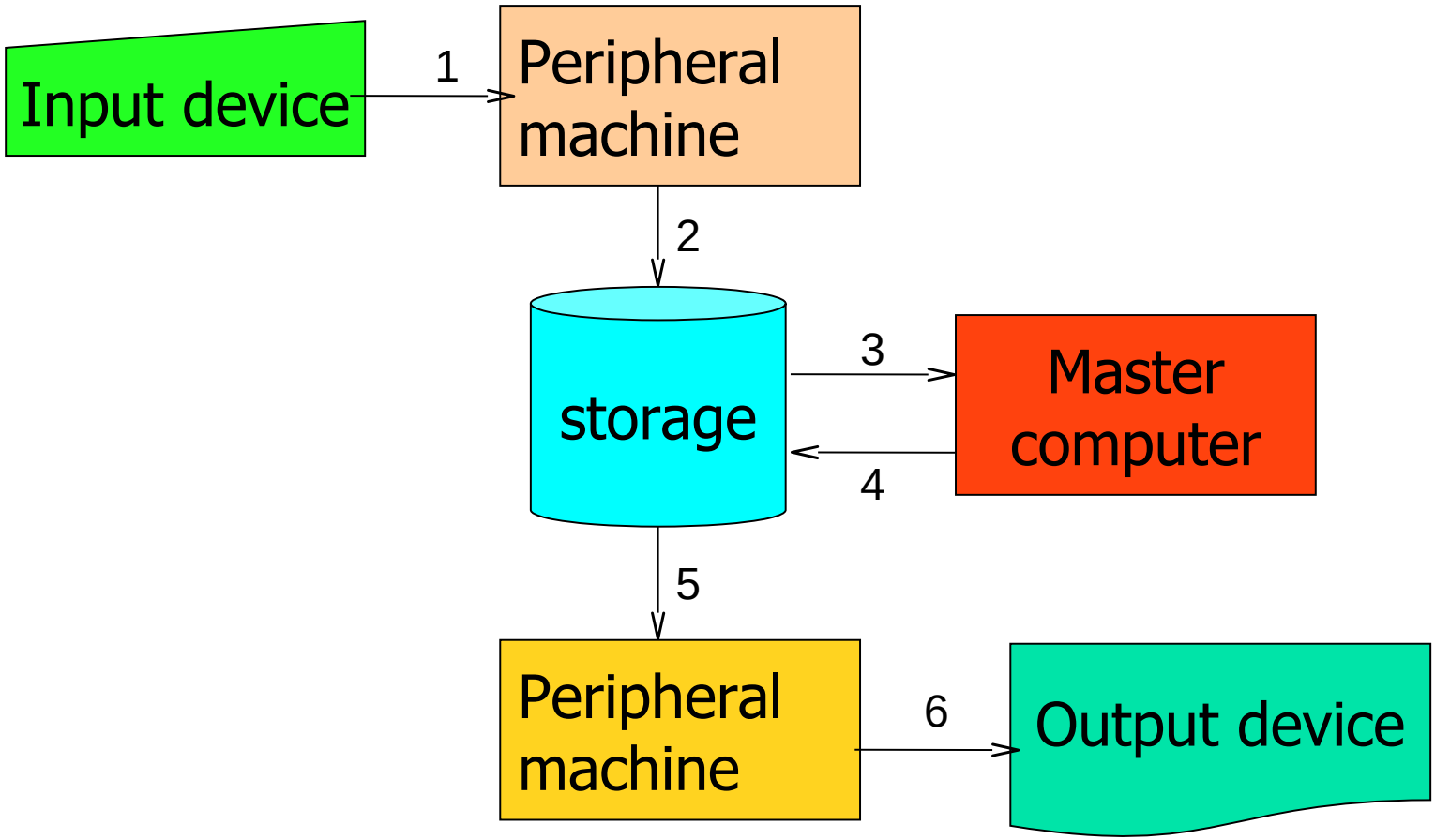


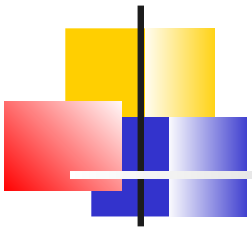
Multi-programming

- Multiprogramming
  - Multitasking is a method where multiple tasks (also known as processes) are performed during the same period of time – they are executed concurrently (in overlapping time periods, new tasks starting before others have ended) instead of sequentially (one completing before the next starts)
  - The tasks share common processing resources, such as central processing units (CPUs) and main memory

SPOOLing 假脱机

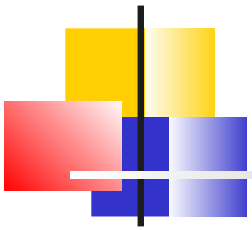
- Simultaneous Peripheral Operating On-line





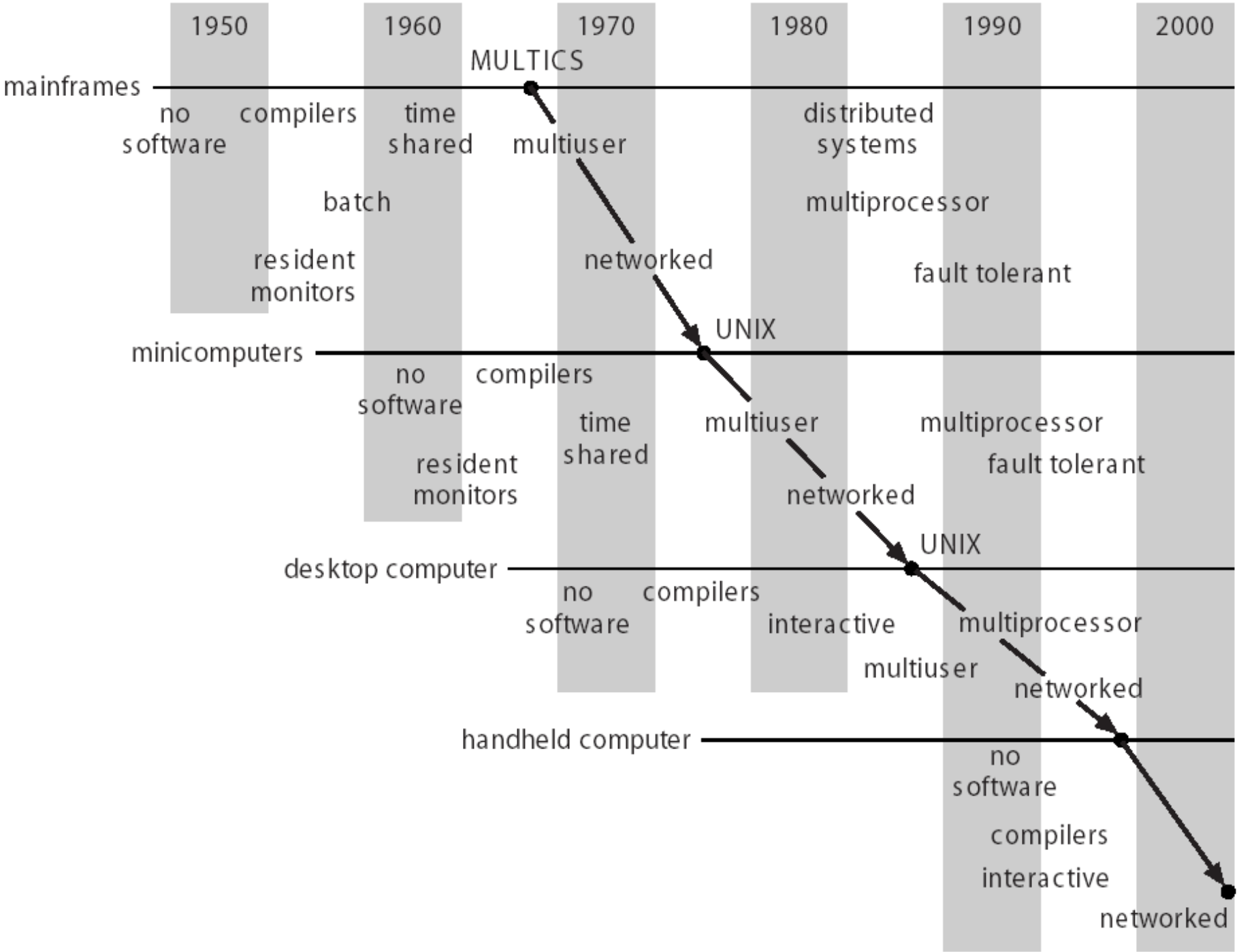
History of OS: modern

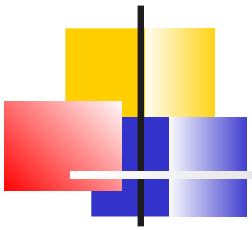
- Hardware
  - 32-bit x86-based PCs, Compaq Alpha AXP, Sun SPARC, UltraSPARC, Motorola 68000, PowerPC, PowerPC64, ARM, Hitachi SuperH, Cell, IBM S/390, MIPS, HP PA-RISC, Intel IA-64, DEC VAX, AMD x86-64, AXIS CRIS,Xtensa, Tilera TILE, AVR32 and Renesas M32R



History of OS: modern

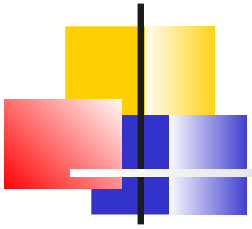
- The Fourth Generation:1980~
  - LSI(Large Scale Integration) circuits, chips technology
  - Unix*
  - Intel80x86*
  - Desktop OS for Personal Computer
    - CP/M, DOS, ...
  - Network OS
  - Distributed OS
  - GUI(Graphical User Interface), user friendly
    - X-Window System


1950
1960
1970
1980
1990
2000
MULTICS
mainframes
no software
compilers
time shared
multiuser
distributed systems
batch
multiprocessor
resident monitors
networked
fault tolerant
UNIX
minicomputers
no software
compilers
time shared
multiuser
multiprocessor
resident monitors
fault tolerant
networked
UNIX
desktop computer
no software
compilers
interactive
multiprocessor
multiuser
networked
handheld computer
no software
compilers
interactive
networked



History of OS: modern

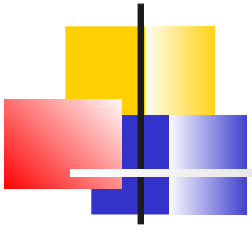
- The Fifth Generation:1990~
  - Handheld phone :1970s
  - PDA (Personal Digital Assistant): 1990, Nokia
  - Smartphone: 1997, Ericssion
  - Symbian OS
  - RIM’s Blackberry OS
  - Iphone: Apple’s iOS
  - Android
  - Windows Phone



Summary

- Computer System
- Operating System
- Operating System Zoo
- Operating System History

Q&A?



Courseware & Labs

https://github.com/albertleecn/osplab


thank you
danke
謝謝
ngiyabonga
teşekkür ederim
gracias
merci
obrigado
dziękuję
bedankt
sukriya
go raibh maith agat
terima kasih
mochchakkeram
dank je
спасибо
рахмат
Баярлалаа
faafetai lava
vinaka
blagodaram
matondo
paldies
grazzi
tapadh leat
хвала
asante
manana
obrigada
tenki
chokrane
murakoze
mauruuru
hvala
kiitos
dankie
nandri
nanni
dhanyavad
köszönöm
bayarlalaa
gràcie
enkosi
djiere dieuf
tau
mamnun
дякую
akun
dankon
aciu
chnorakaloutioun
gratias ago
gràcies
sulpáy
taiku
sagolun
kop khun krap
sobodi
dekuji
mesi
didi madloba
kam sah hamnida
তোমাকে ধন্যবাদ
najis tuke
rahmat
ありがとう
tanemirt
rahmet
grazie
arigatô
takk
dakujem
trugarez
dhanyavadagalu
shukriya
merce
мерси
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xiexie
감사합니다
ευχαριστώ