Chapter 1

Computer Abstractions and Technology

The Computer Revolution

- Progress in computer technology
  - Underpinned(加强，巩固) by Moore's Law
- Makes novel applications feasible
  - Computers in automobiles
  - Cell phones
  - Human genome project
  - World Wide Web
  - Search Engines
- Computers are pervasive

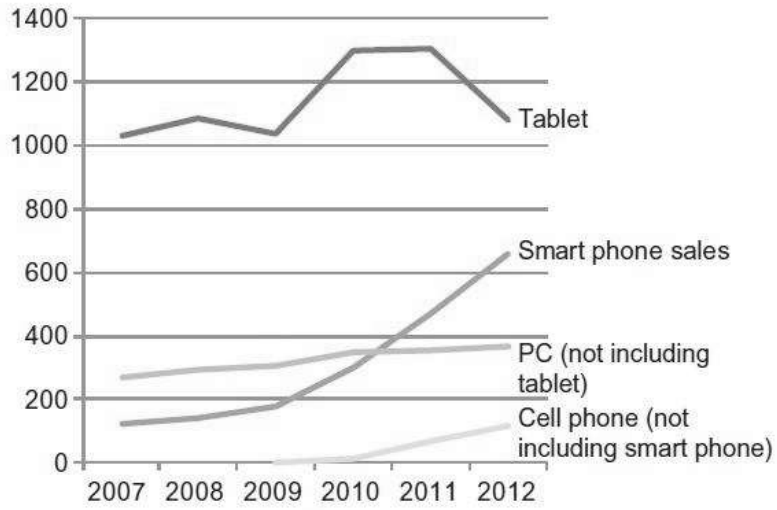
Classes of Computers

- Personal computers
  - General purpose, variety of software
  - Subject to cost/performance tradeoff
- Server computers
  - Network based
  - High capacity, performance, reliability
  - Range from small servers to building sized

Classes of Computers

- Supercomputers
  - High-end scientific and engineering calculations
  - Highest capability but represent a small fraction of the overall computer market
- Embedded computers
  - Hidden as components of systems
  - Stringent power/performance/cost constraints

The PostPC Era

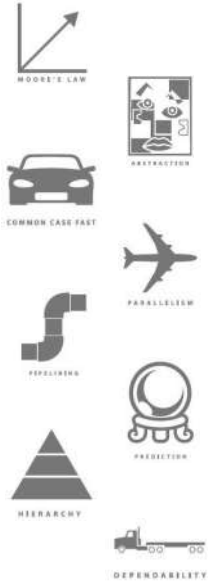


The PostPC Era

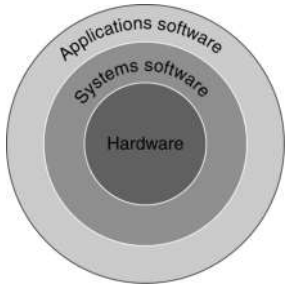
- Personal Mobile Device (PMD)
  - Battery operated
  - Connects to the Internet
  - Hundreds of dollars
  - Smart phones, tablets, electronic glasses
- Cloud computing
  - Warehouse Scale Computers (WSC)
  - Software as a Service (SaaS)
  - Portion of software run on a PMD and a portion run in the Cloud
  - Amazon and Google

Eight Great Ideas

- Design for ***Moore's Law***
- Use ***abstraction*** to simplify design
- Make the ***common case fast***
- Performance *via* ***parallelism***
- Performance *via* ***pipelining***
- Performance *via* ***prediction***
- ***Hierarchy*** of memories
- ***Dependability*** *via* redundancy



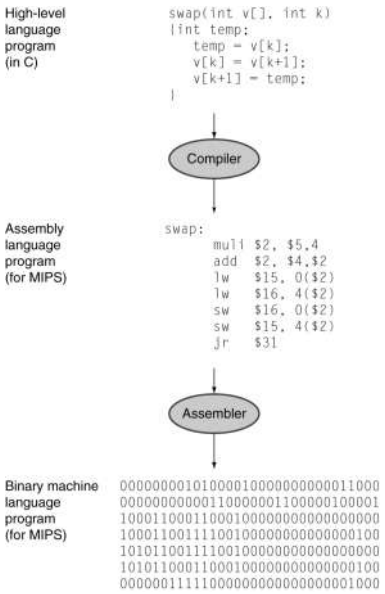
Below Your Program



- Application software
  - Written in high-level language
- System software
  - Compiler: translates HLL code to machine code
  - Operating System: service code
    - Handling input/output
    - Managing memory and storage
    - Scheduling tasks & sharing resources
- Hardware
  - Processor, memory, I/O controllers

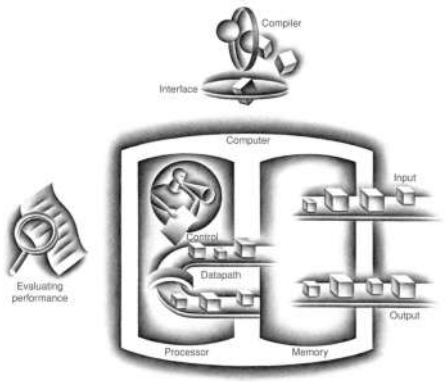
Levels of Program Code

- High-level language
  - Level of abstraction closer to problem domain
  - Provides for productivity and portability
- Assembly language
  - Textual representation of instructions
- Hardware representation
  - Binary digits (bits)
  - Encoded instructions and data



Components of a Computer

The BIG Picture



- Same components for all kinds of computer
  - Desktop, server, embedded
- Input/output includes
  - User-interface devices
    - Display, keyboard, mouse
  - Storage devices
    - Hard disk, CD/DVD, flash
  - Network adapters
    - For communicating with other computers

Touchscreen

- PostPC device
- Supersedes(取代，替代) keyboard and mouse
- Resistive(电阻的) and Capacitive(电容的) types
  - Most tablets, smart phones use capacitive
  - Capacitive allows multiple touches simultaneously

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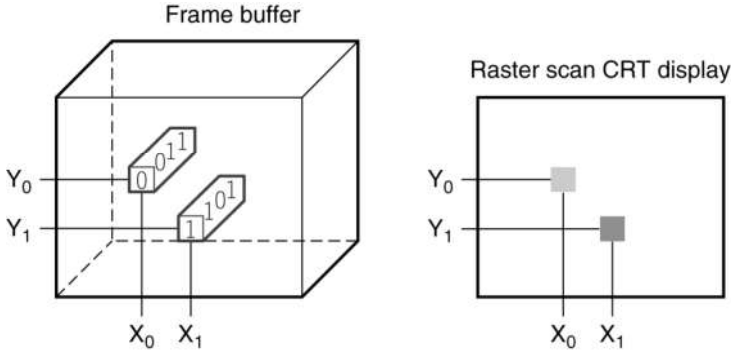
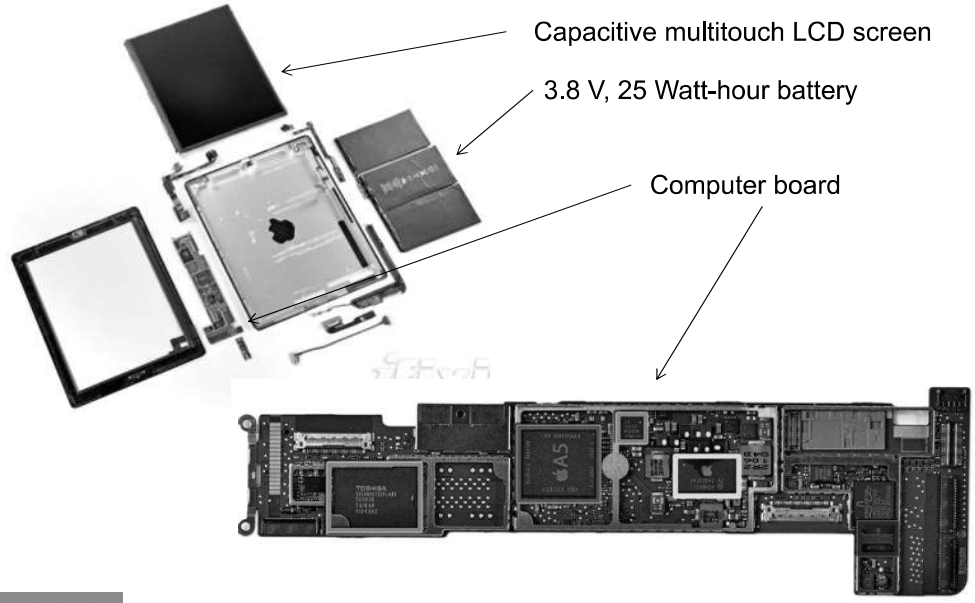
Through the Looking Glass

- LCD screen: picture elements (pixels像素)
  - Mirrors content(内容) of frame（帧） buffer memory



Opening the Box



Inside the Processor (CPU)

- Datapath: performs operations on data
- Control: sequences(序列,按次序) datapath, memory, ...
- Cache memory
  - Small fast SRAM memory for immediate(即时，立即) access to data

Inside the Processor

- Apple A5

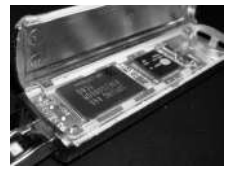
Abstractions

The BIG Picture

- Abstraction helps us deal with complexity
  - Hide lower-level detail
- Instruction set architecture (ISA)
  - The hardware/software interface
- Application binary interface
  - The ISA plus system software interface
- Implementation
  - The details underlying(隐含的; 表面下的;) and interface

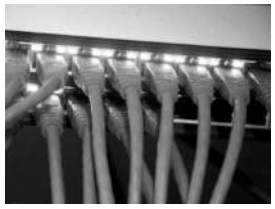
A Safe Place for Data

- Volatile(易失的; 易变的;) main memory
  - Loses instructions and data when power off
- Non-volatile(非易失的;) secondary memory
  - Magnetic(磁性的) disk
  - Flash memory
  - Optical(光学的) disk (CDROM, DVD)



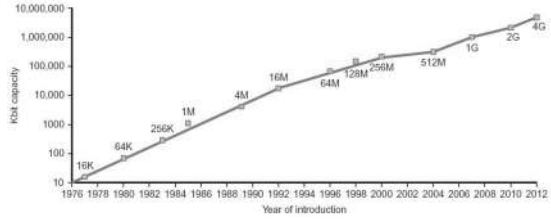
Networks

- Communication, resource sharing, nonlocal(非本地的) access
- Local area network (LAN): Ethernet
- Wide area network (WAN): the Internet
- Wireless network: WiFi, Bluetooth



Technology Trends(趋势)

- Electronics technology continues to evolve
  - Increased capacity and performance
  - Reduced cost



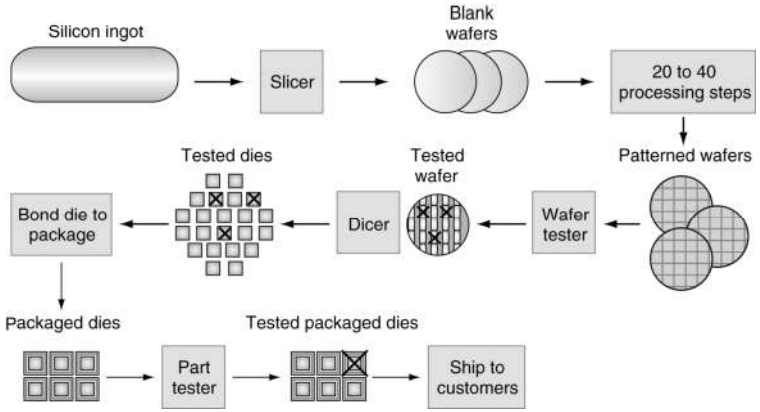
DRAM capacity

Year	Technology	Relative performance/cost
1951	Vacuum tube	1
1965	Transistor	35
1975	Integrated circuit (IC)	900
1995	Very large scale IC (VLSI)	2,400,000
2013	Ultra large scale IC	250,000,000,000

Semiconductor Technology

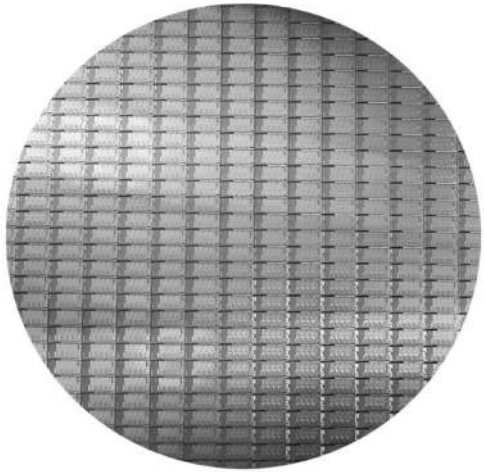
- Silicon: semiconductor(半导体)
- Add materials to transform properties(财富):
  - Conductors(导电体)
  - Insulators(绝缘体)
  - Switch(开关)

Manufacturing ICs



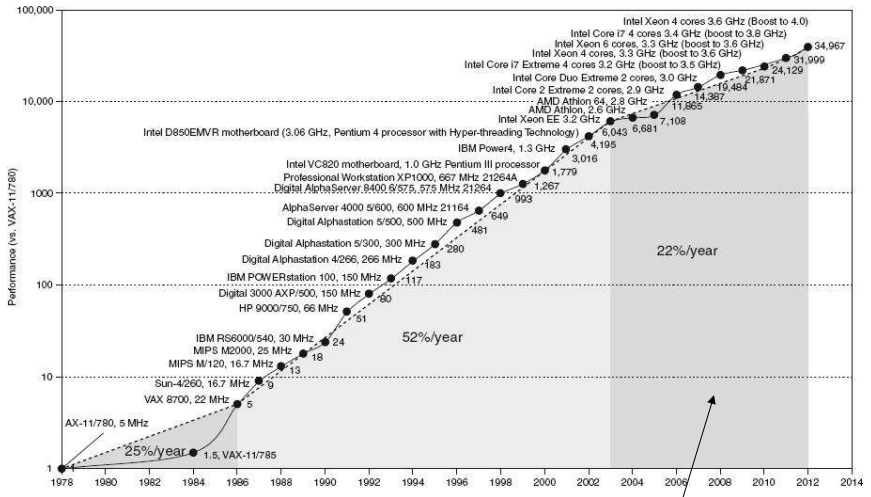
- Yield(产量; 产出; 利润;): proportion of working dies(裸片，晶粒) per wafer

Intel Core i7 Wafer



- 300mm wafer, 280 chips, 32nm technology
- Each chip is 20.7 x 10.5 mm

Uniprocessor Performance



Concluding Remarks

- Cost/performance is improving
  - Due to underlying technology development
- Hierarchical layers of abstraction
  - In both hardware and software
- Instruction set architecture
  - The hardware/software interface

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