TEXAS TECH UNIVERSITY
Department *of* Computer Science

CS5332 Advanced Operating Systems Design

Lecture 1

Instructor: Yong Chen, Ph.D.
Assistant Professor
Department of Computer Science
Texas Tech University

Course Info

- **Lecture Time**: Tue. and Thur., 11 a.m. – 12:20 p.m.
- **Lecture Location**: Engineering Center 110
- **Instructor:** Yong Chen, Ph.D., Assistant Professor
- **Email:** yong.chen@ttu.edu
- **Phone:** 806-742-3527 x230
- **Office**: ENGCTR 211-I
- **Office Hours**: Tue. and Thur., 10:00 a.m. – 11:00 a.m., or by appointment
- **Mail:** Texas Tech University, Box 43104, Lubbock, TX 79409-3104
- **More info:**
  - http://www.myweb.ttu.edu/yonchen
  - http://discl.cs.ttu.edu

Outline

- Syllabus Highlights
  - Course Description, Goals, Textbooks, Prerequisites
  - Detailed Course Topics, Computer Usage, Grading Policy
  - Course Policies
- Overview of Core Concepts of Operating Systems
  - Role of operating systems
  - Hardware review
  - Operating system concepts and system calls
  - Operating system structure
  - C project review

Syllabus Highlights – Course Description

- Computer systems are undergoing a revolution
  - Development of powerful microprocessors
  - Development of high-speed computer networks
  - Have extended the traditional computer systems to wide-area distributed systems
- The technology revolution has extended the traditional operating system roles and functionalities to an advanced and distributed manner as well

Syllabus Highlights – Course Description

- Introduces the concepts, principles, and designs of advanced and distributed systems
- Students are expected to learn the principles and gain hands-on experience on the state-of-the-art computing paradigm
- Will cover major topics including architectures, communication, synchronization, fault tolerance, etc.
- Will consist of class lectures, assignments, programming projects, one research-oriented course project and exams.

Syllabus Highlights – Course Goals

- Goal1: to understand the needs and applications of advanced and distributed computing paradigm
- Goal 2: to learn the architectures, communication, and synchronization of distributed systems
- Goal 3: to understand the designs of consistency models and fault tolerance in distributed systems
- Goal 4: to understand security management and distributed file systems design and development
- Goal 5: to learn the latest developments in advanced and distributed systems and be able to conduct initial research investigations in these areas

Syllabus Highlights – Textbooks

- Required textbook:
  - *Distributed Systems: Principles and Paradigms (2nd Edition),* by Andrew S. Tanenbaum and Maarten Van Steen
  - Publisher: Prentice Hall
  - ISBN-10: 0132392275
  - ISBN-13: 978-0132392273
- Reference book (optional):
  - Modern Operating Systems (3rd Edition), by Andrew S. Tanenbaum
  - Publisher: Prentice Hall
  - ISBN-10: 0136006639
  - ISBN-13: 978-0136006633
- Occasionally published research papers/online materials will be provided for students to read and study.

Syllabus Highlights – Prerequisites

- Operating Systems (e.g. CS4352 Operating Systems), Unix (Linux, OS X) operation and programming experiences
- Computer Architectures (e.g. CS3375 Computer Architecture)
- Programming (C/C++/Java)

- If you are not sure whether you have enough background for taking this course, please talk to me

Syllabus Highlights – Detailed Course Topics

- Overview of core concepts of operating systems
- Overview of distributed and advanced operating systems
- Architectures
- Communication
- Naming
- Synchronization
- Consistency and replication
- Fault tolerance
- Security
- Distributed file systems
- Open research discussions in distributed and advanced operating systems

Syllabus Highlights – Computer Usage

- Detailed information regarding the access will be announced later
- A small-size local cluster test bed will be used for the development of programming projects and course project
- The departmental server machines can also be used

Syllabus Highlights – Grading Policy

- All submissions are graded according to the assignment guidelines, course policies, verbal instructions/explanation and materials given in class lecture or in meetings, quality, creativity, novelty, readability and level of effort.
- Written assignments: 20%
- Programming projects: 25%
- Course project (report and presentation): 25%
- Exams: 30% (one midterm exam and one final exam, 15% each)

Syllabus Highlights – Grades

- Course Letter Grade Assignments
- A = [85, 100]
- B = [75, 85)
- C = [65-75)
- D = [60-65)
- F = [0-60)

Syllabus Highlights – Course Schedule

- Roughly 11 weeks of lectures
- Midterm exam planned in the week of Oct. 1st
- Week of Nov. 12th, independent study on course projects
- Week of Nov. 19th, Nov. 26th, course project presentations
- Week of Dec. 4th, review lecture
- Final exam: 8 a.m. – 10 a.m., Dec. 8th, Saturday

Syllabus Highlights – Course Policies

- Code of Student Conduct
- Students are expected to comply with the Texas Tech Code of Student Conduct in all aspects of this class.
- In order to assure that all students have the opportunity to gain from time spent in class, unless otherwise approved by the instructor, students are prohibited from engaging in any other form of distraction, such as reading newspapers, working on other classes, taking cell phone calls, and working on laptop computers.
- Violations of conduct including academic dishonesty, foul language, and classroom citizenship are eligible to be reported to Student Judicial Services.

Syllabus Highlights – Course Policies

- **Attendance:** Attendance is mandatory for all lectures
- **Absence due to religious observance/officially approved trips:** need to notify the instructor
- **Late Work:** assignments are due when specified, but will be accepted late (with a 10-20% penalty) till an extended hard deadline

Syllabus Highlights – Course Policies

- **Accommodations:**
- The university is committed to the principle that in no aspect of its programs, shall there be differences in the treatment of persons because of race, creed, national origin, age, sex, or disability and that equal opportunity and access to facilities shall be available to all. If you require special accommodations in order to participate, please contact the instructor during office hours or by e-mail yong.chen@ttu.edu. Students should present appropriate verification from Student Disability Services. No requirement exists that accommodations be made prior to completion of this approved university process.

Additional Information

- Will use PPT slides to present lectures, instead of blackboard/whiteboard
  - Hope you find appropriate and effective as I think
- Will focus on major and critical points
  - Distributed and advanced OS domain contains a lot of materials
  - Lectures are primarily aligned with major topics in the textbook
- Will use Blackboard system to post lectures, assignments, and collect submissions
  - Distance section students need to access the face-to-face section

Additional Information

- Will welcome questions and discussions at any time
  - Whenever it is not clear, please ask (online/offline)
- Sometimes it's hard to talk in the same language for everyone since students body and background vary largely
  - Again, please ask if it is not clear (online/offline)
  - Would like to make sure lectures are delivered clearly most cases
- Will strive for you to have a useful experience
  - Course designed: lectures/assignments/projects/research
  - Interactions needed and encouraged; without feedback, it's hard for the instructor to know your understandings
  - Offline discussions and office visits strongly encouraged

Caveats

- This course covers a variety of topics
- Can be a challenging course if you don't have enough required background and don't work hard
- On the other hand, if you complete this course with an outstanding performance, there may be great opportunities and your hard work will be paid off in your future career endeavor
  - My group looks for GRA/URA, recommendation for scholarships/fellowships/internships

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- Questions?

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What Is An Operating System (1)

A modern computer consists of:

- One or more processors
- Main memory
- Disks
- Printers
- Various input/output devices

Managing all these components requires a layer of software – the **operating system**

What Is An Operating System (2)

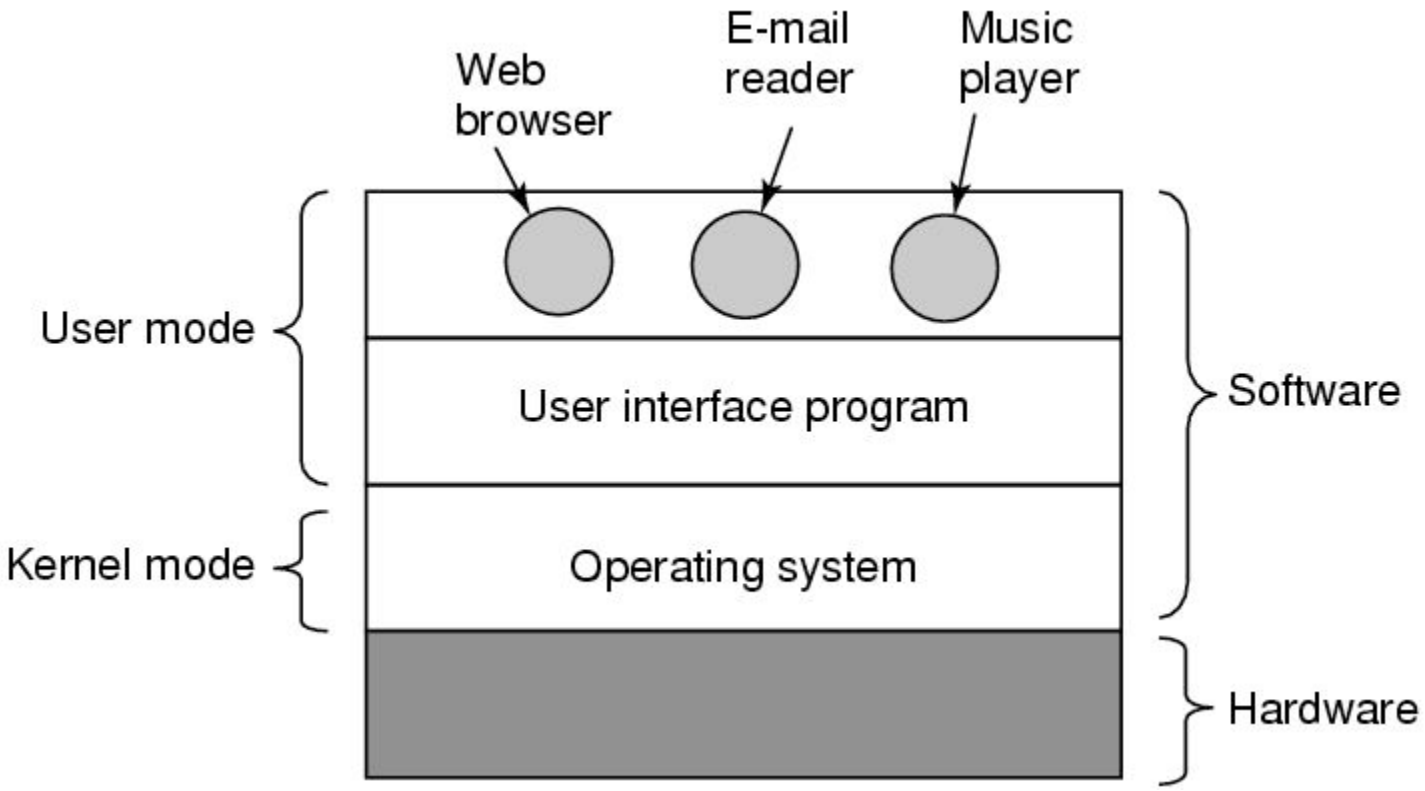

Figure 0-1. Where the operating system fits in.

The Operating System as an Extended Machine

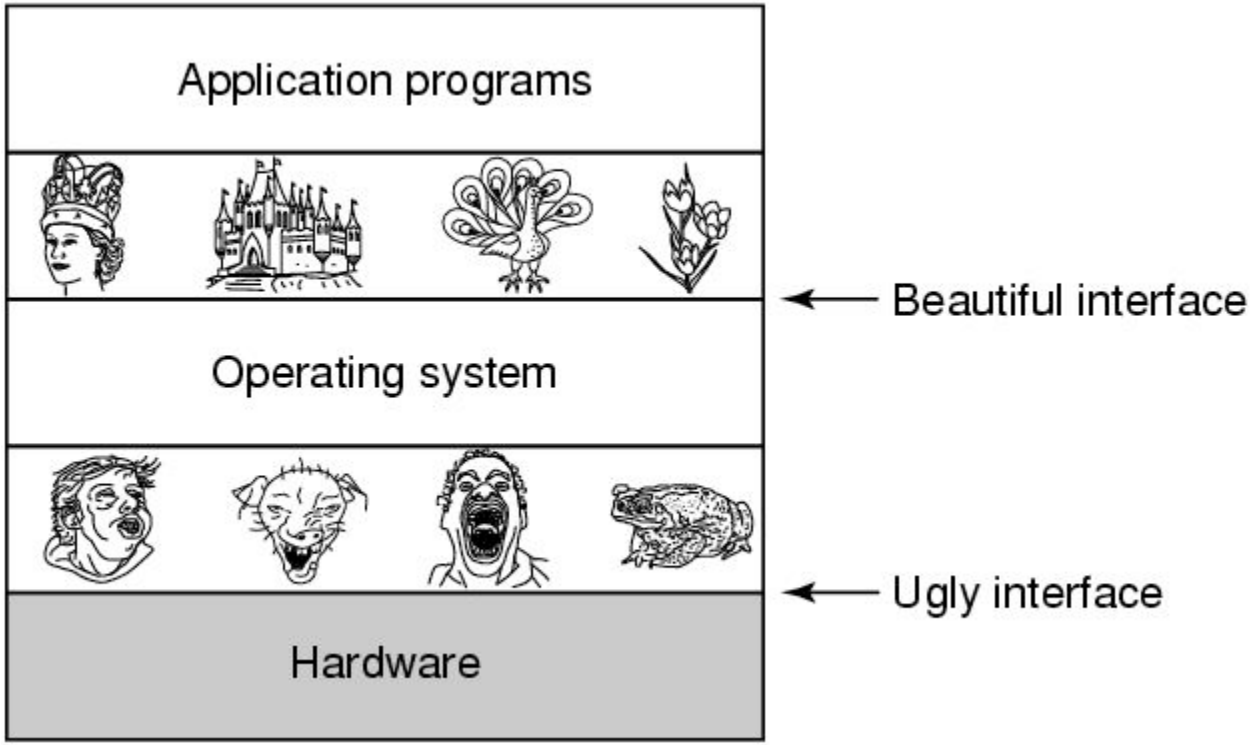

Figure 0-2. Operating systems turn ugly hardware into beautiful abstractions.

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
  - In space

Computer Hardware Review

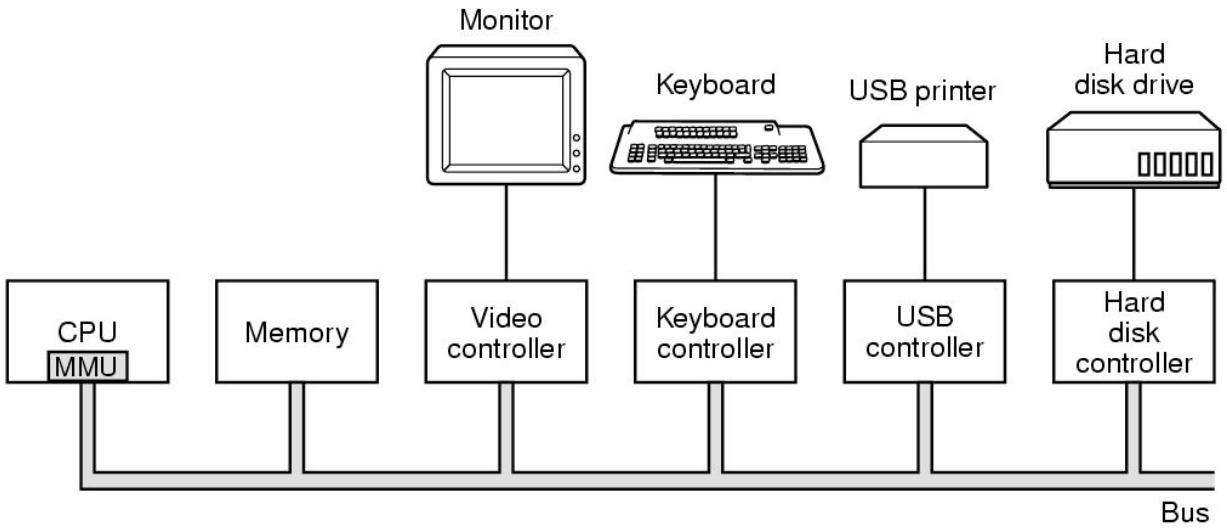

Figure 0-3. Some of the components of a simple personal computer.

CPU Pipelining

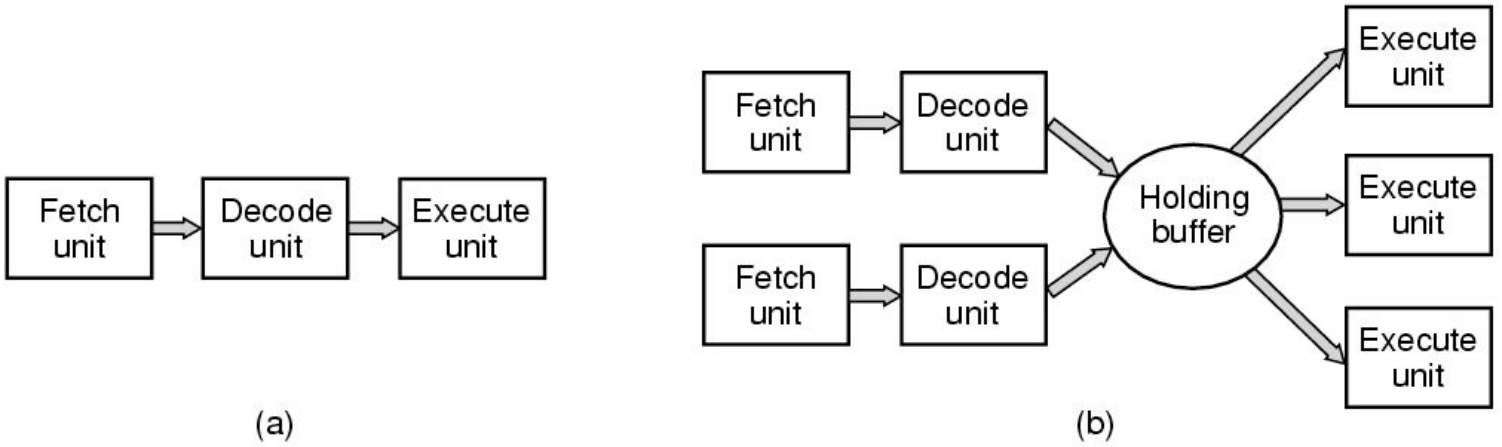

Figure 0-4. (a) A three-stage pipeline. (b) A superscalar CPU.

Multithreaded and Multicore Chips

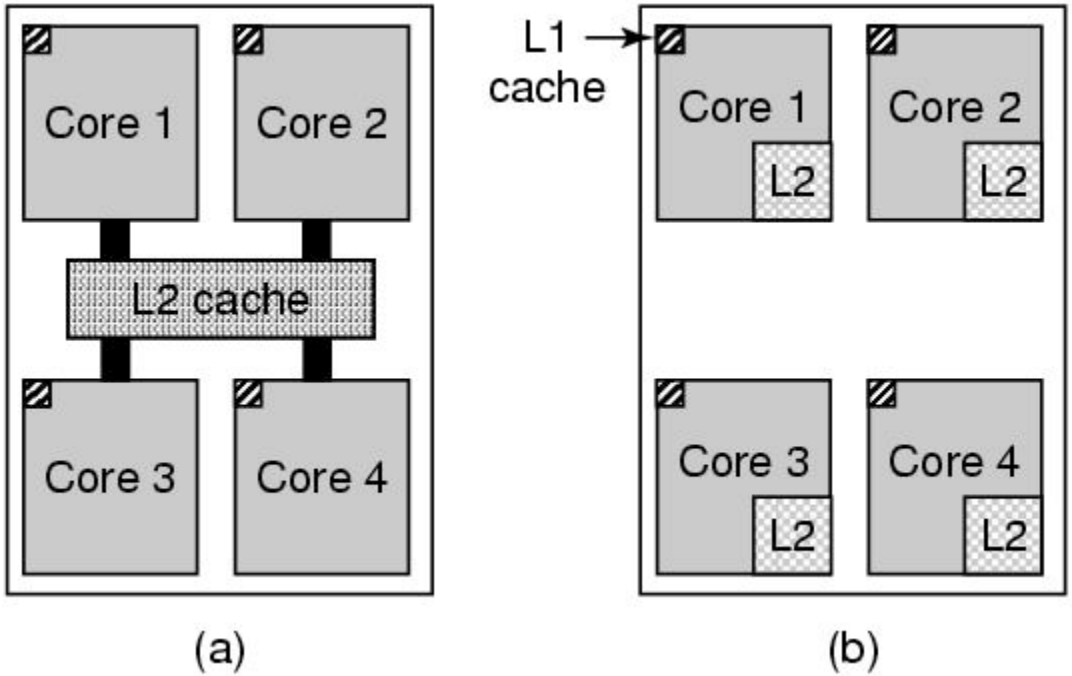

Figure 0-5. (a) A quad-core chip with a shared L2 cache. (b) A quad-core chip with separate L2 caches.

Memory (1)

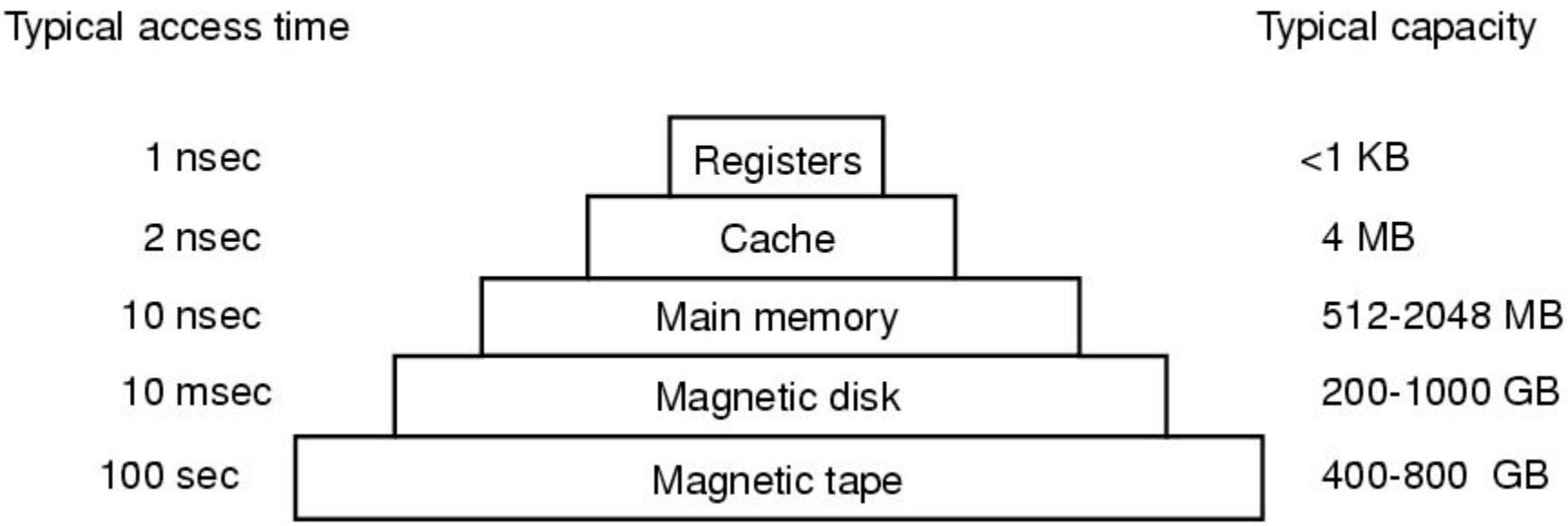

Figure 0-6. A typical memory hierarchy.
The numbers are very rough approximations.

Memory (2)

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

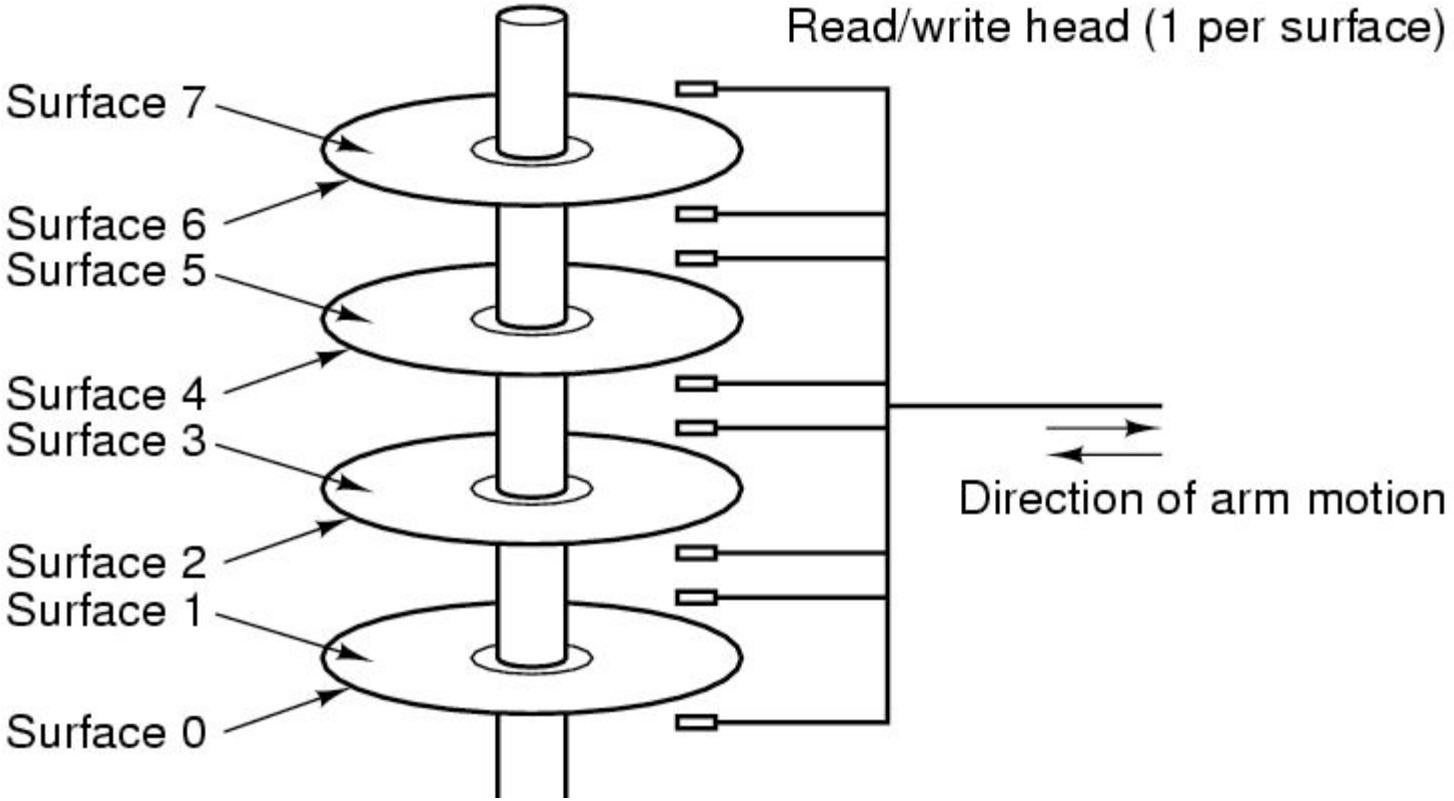

Figure 0-7. Structure of a disk drive.

I/O Devices

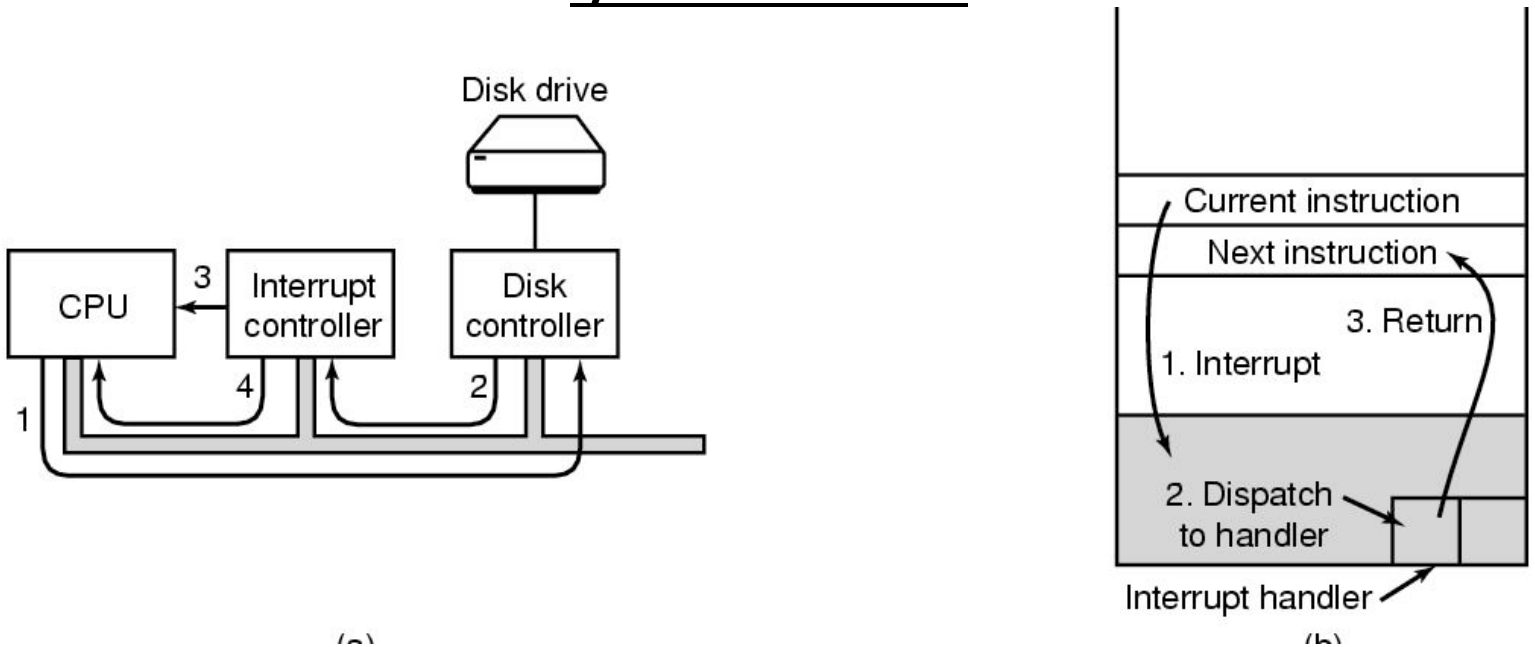

Figure 0-8. (a) The steps in starting an I/O device and getting an interrupt.

Buses

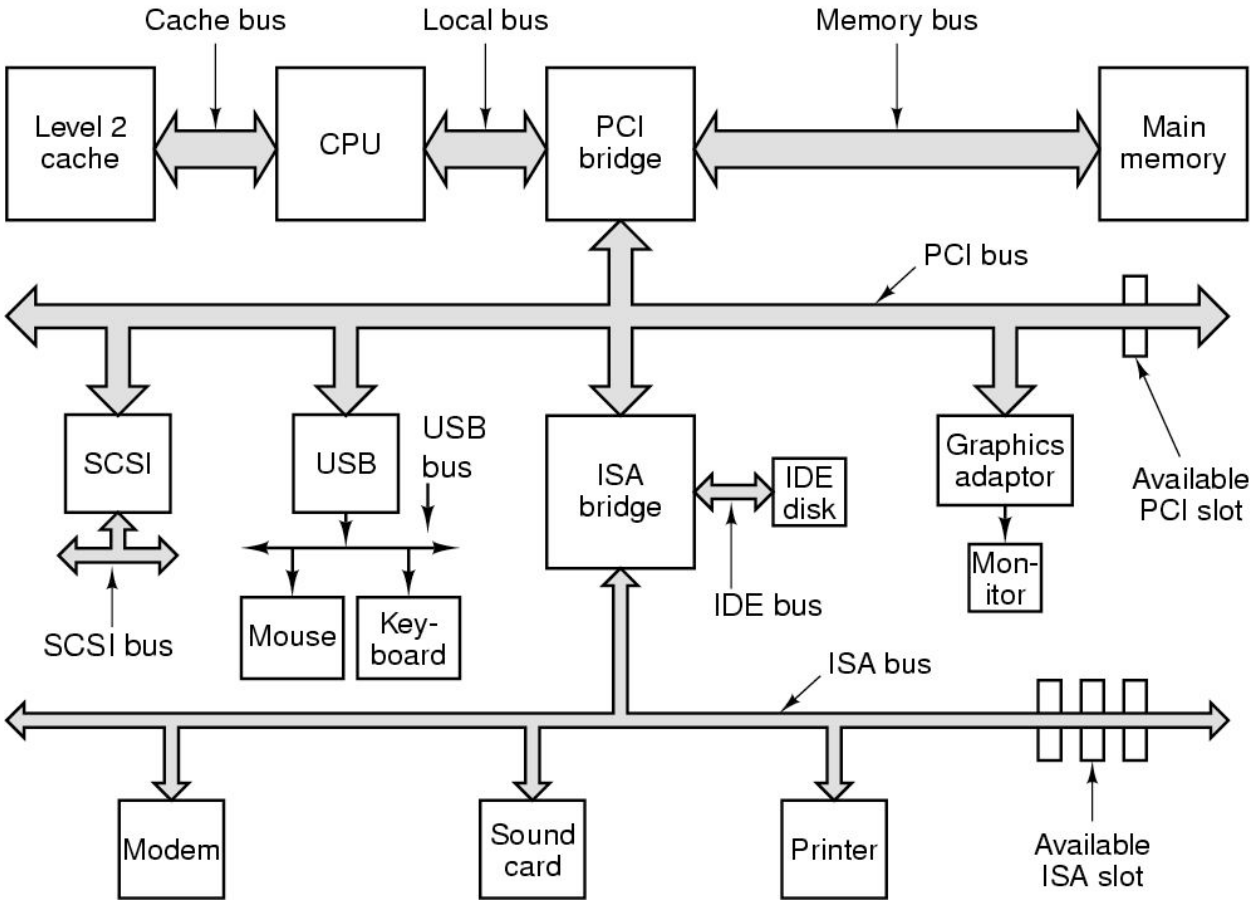

Figure 0-9. The structure of a large Pentium system

Questions?

Questions/Suggestions/Comments are always welcomed!

Write me: yong.chen@ttu.edu
Call me: 806-742-3527
See me: ENGCTR 211-I