CIS 630 - Fall 2004
Distributed Systems

Lecture 1
Characterization of Distributed Systems

University of Oregon
Department of Computer and Information Science
Course Information

- Still call “Advanced Operating Systems”
  - However, course description is correct
- Now the required core course in graduate curriculum
  - Replaces CIS 629
  - Although catalog still shows CIS 629 as the core
- Instructor
  - Prof. Allen D. Malony
- Course webpage
  - [http://www.cs.uoregon.edu/classes/04F/cis630](http://www.cs.uoregon.edu/classes/04F/cis630)
- Class: Tues./Thurs., 12:00-1:20 pm, 475 McKenzie
Course Text

- Distributed Systems: Concepts and Design
  - G. Coulouris, J. Dollimore, T. Kindberg
  - Addison-Wesley, Third Edition
  - 2001

- Text webpage
  - [http://www.cdk3.net/](http://www.cdk3.net/)

- Many reference texts listed on the course webpage

- Will follow text closely
Lectures

☑ All lectures will use computer slide presentation
   ❍ All lectures slides will be posted on webpage
   ❍ No later than end of week of lecture

☑ Lecture content
   ❍ Some text / figures come from online book materials
   ❍ Other sources of lecture content will be cited

☑ Please do not waste paper printing the slides
Assignments

- Problem sets (2)
  - Third and seventh week
  - Enforce topics and practice for exam

- Programming exercise
  - Java RMI client-server application
  - Experience programming distributed systems

- Reading discussions

- Term exam

- Term paper

- Term project
Reading Discussions

☐ Five research papers assigned to read
  ☐ Weekly, starting in third week
☐ Turn in two-page summaries
  ☐ Use as basis of discussion
☐ Gain practice reading research papers
☐ Useful for term paper
Term Exam

- There will be one exam in the course
- It will take place the first class meeting of Week 9
- It will cover topics through Week 8
  - Lecture topics
  - Research paper discussions
  - Book chapters
- Two parts
  - Exam in class
  - Take-home problem (due 12:00 pm, Nov. 29)
Term Paper

- One of the main assignments in the course
- Give you an opportunity to explore a topic of interest
  - Might not be covered by lecture or assigned readings
- Give you experience in reading research literature
- Give you experience in assimilating information
- You will present your paper in class
  - During Weeks 9 and 10
- See course webpage for paper requirements
Term Project

- Second main assignment in course
- Enhance your knowledge of distributed systems
  - Hands-on distributed application development
- Done in teams
  - 3-4 people
  - Individual and group effort identified
- Deliverables
  - Written report of accomplishments
  - Demonstration during finals week
  - Project presentations during final exam period
Course Topics

- Distributed system characterization
- Networking
- Distributed programming and processing
- Understanding time and global states
- Coordination and agreement
- Distributed data management and file systems
- Naming
- Concurrency control and distributed transactions
- Replication
- Distributed shared memory
Lecture Objectives

- Distributed system characteristics
  - components coordinating actions with messages
  - Concurrency
  - Independent failure and lack of global clock
- Place distributed systems in context
  - Internet, intranet, mobile computing
- Motivate benefits of resource sharing
  - Web as an example.
- Understanding of challenges for distribute systems
  - heterogeneity, openness, security, scalability
  - failure handling, concurrency, transparency
Characterization of Distributed Systems

☐ A distributed system is defined as one in which components at networked computers communicate and coordinate their actions only by passing messages.

☐ Definition allows for
  - Concurrent execution of programs
  - Prevents possibility of a global clock
  - Means that components can fail independently

☐ Why construct and use distributed systems?
  - Stems from a desire to share resources
  - Coordinate distributed operations
Examples of Distributed Systems

- Internet
  - Very large collection of computer networks
  - Very large distributed system of networked computers
  - Enables users to make use of a vast number of services

- Intranet
  - Portion of Internet separately administered
  - Use firewall to enforce own local security policies
  - Supports standard and specialized services

- Mobile and ubiquitous computing
  - Nomadic computing, location-aware, embedded
Typical Portion of the Internet

* Graphics from Distributed Systems: Concepts and Design, Coulouris, Dollimore, and Kindberg
Typical Intranet

* Graphics from Distributed Systems: Concepts and Design, Coulouris, Dollimore, and Kindberg
Devices in a Distributed System

Internet

Host intranet
- Wireless LAN
- Printer
- Camera
- Laptop
- Mobile phone

WAP gateway

Home intranet

WAP: Wireless Access Protocol

* Graphics from Distributed Systems: Concepts and Design, Coulouris, Dollimore, and Kindberg
Resource Sharing

- Hardware sharing and computing/data sharing
- Variety of patterns and types of resource sharing
- A service manages a collection of related resources and presents their functionality to users / applications
  - Shared resources are managed by *server* processes
  - Accepts service requests from *client* processes running on other computers and responds accordingly
  - Well-defined set of operations
  - Requests are sent in messages
- Scalability of services is a key aspect
Types of Distributed Process Interactions

- Client-server systems
  - Clients request services from servers
- Versus peer-to-peer
  - Processes have equal status
- Resources may be encapsulated as objects
  - Methods are invoked by client objects
- Basis of distributed processing mechanisms
  - Naming
  - Management of state
WWW

- Evolving system for publishing and accessing resources and services across the Internet
- The WWW and the Internet are not the same thing
- The WWW is an open system
  - Extensible in services and service providers
  - Extensible in resource types and content
- Illustrates approach to addressing scale
  - Use of hierarchical naming
  - Partitioned data
  - Caching and replication
Web Servers and Web Browsers

Internet

Web servers

www.google.com

www.cdk3.net

www.w3c.org

File system of www.w3c.org

Protocols

Activity.html

Browsers

http://www.google.com/search?q=kindberg

http://www.cdk3.net/

http://www.w3c.org/Protocols/Activity.html

URLs:
Uniform (Universal) Resource Locator

* Graphics from Distributed Systems: Concepts and Design, Coulouris, Dollimore, and Kindberg
Challenges

- Heterogeneity
- Openness
- Security
- Scalability
- Failure handling
- Concurrency
- Transparency
Transparencies

- Transparency hides the separation of components
- *Access transparency*: enables local and remote resources to be accessed using identical operations
- *Location transparency*: enables resources to be accessed without knowledge of their location
- *Concurrency transparency*: enables several processes to operate concurrently using shared resources without interference between them
- *Replication transparency*: enables multiple instances of resources to be used to increase reliability and performance without knowledge of the replicas by users or application programmers
Transparencies (continued)

- **Failure transparency**: enables the concealment of faults, allowing users and application programs to complete their tasks despite the failure of hardware or software components.

- **Mobility transparency**: allows the movement of resources and clients within a system without affecting the operation of users or programs.

- **Performance transparency**: allows the system to be reconfigured to improve performance as loads vary.

- **Scaling transparency**: allows the system and applications to expand in scale without change to the system structure or the application algorithms.