

Fall 2008, EE 557, USC

Computer Systems Architecture

Professor Kai Hwang, kaihwang@usc.edu

Lecture Hours: MW 3:30 - 4:50 pm, OHE 100D (DEN Studio D)

Office Hours: MW 10:00 am – 12 noon, EEB 212

Discussion: Friday 1:00 -1:50 pm, OHE 136 by **Simji Lee** (simlee@usc.edu)

TA Office Hours: Wed 1-2 pm, Friday 2-3 pm EEB 106

Course Description:

This course covers the system architecture of advanced computers. We study the design principles of modern CPU, memory hierarchy, I/O subsystems, system interconnects, and their interface with operating systems and compilers. We cover instruction set architecture, performance issues, advanced pipelining, parallelism at instruction/task/job levels, multi-core and multithreaded processors, multiprocessor and clustered systems, and virtual machines. We study shared-memory *symmetric multiprocessors* (SMP) and techniques to scale them to larger or cluster systems with distributed memory, network storage, and interconnection networks. Case studies include hot processors, hot interconnects, scalable multiprocessors, and superclusters on the top-500 list. The course will acquaint Masters and Ph.D. students in computer science and computer engineering with state-of-the-art computers for high-performance computing, e-commerce, and Internet/web applications.

Lecture Plans and Important Dates: (Revised Sept.3, 2008)

1. **Introduction, Instruction Sets, and Performance** (Lec.1 – 3, Chap.1, Appendices B, J)
Course Introduction, ISA, and Performance Metrics (**HW #1 due Sept.10**)
2. **Advanced Processor Architectures** (Hot Chips in Lec.4 – 8, Ch. 2, 3, Appendices A, G)
Instruction-Level Parallelism, Multicore, and Multithreading (**HW#2 due Sept.24**)
3. **Symmetric and Scalable Multiprocessor systems** (Lec.9 – 12, Chap.4, Appendix H)
Shared-memory SMP and Cache-Coherent NUMA Machines (**HW #3 due Oct.6**)
4. **Lecture 13 on Oct.8 is a Review Session of material covered in Chapters 1 – 4.**

Test No.1, October 13, 2008 in DEN Studio D (Covering Lectures 1 – 13)

5. **Memory Hierarchy and Sharing** (Lec.14 – 15, Chap.5, Appendix C)
Memory Optimization and Distributed Shared memory
6. **Distributed Storage and Interconnection Networks**
Distributed Storage and Hot System Interconnects (Lec.16 - 18, Ch.6, App. E)
(HW # 4 is due on Nov.3, 2008)
6. **Clustered Computers and Fault Tolerance** (Lec.19 – 20, Chaps.9 and 10 in Hwang/Xu)
Server clusters, High Availability, and Fault Tolerance

Test No.2, November 10, 2008 in DEN Studio D (Covering Lectures 14 - 20)

7. **Virtual Machines and Distributed Computing Systems** (Lec.21 – 24, Handout Papers)
Virtualization, P2P, Grid, and Cloud Computing (**Project Report due Nov.26**)
8. **Review of Entire Course and Future Trends (Lectures 25 - 26 on Nov.26 and Dec.1)**

Final Exam Date: December 3, 2008, 3:30 – 5:30 pm, (covering entire course, room TBA)

Prerequisite: EE 457 or passing placement test, or equivalence approved by Instructor

Textbook: John Hennessy and David Patterson, *Computer Architecture: A Quantitative Approach*, 4th Edition, Morgan Kaufmann, Sept. 2006, ISBN 0123704901 (including Appendices on CD).

Grading Policy, Important Dates, and Class Rules:

1. Four Homework Sets due **Sept.10, Sept.24, Oct.6**, and **Nov.3**. (20%)
2. Test No.1 (25%) on **Oct.13** and Test No.2 (15%) on **Nov.10** at DEN Studio D (3:30 – 4:50 pm).
3. Final Exam on **December 3** to cover the entire course, room yet to be announced. (40%)
4. No makeup tests or final exam will be given. No late homework or report will be graded.