EE 382M COMPUTER PERFORMANCE EVALUATION AND BENCHMARKING

Fall 2012 T-Th 11:00 am – 12:30 pm Unique 17010 ENS 116

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TA/Grader: TBD

Course home page will be on Blackboard (courses.utexas.edu)

Course Description: Evaluating computer architectures have become extremely difficult due to the complexity of the processors and the complexity of the applications that run on the computers. This course will focus on techniques to evaluate performance and power/energy consumption of microprocessors and computer systems. Several papers from the computer architecture, performance evaluation and workload characterization related conferences will be used as course material.

Prerequisites:

EE 360N- Undergraduate computer architecture or equivalent. If you did not take 360N at UT, please see me with info on the course you took (book, assignments, exams)

Good programming skills (C and Unix) and at least one assembly language

Text Book:

No required text book, but I'll use material from several sources including

Performance Evaluation and Benchmarking, Edited by Lizy John and Lieven Eeckhout, CRC Press, Taylor & Francis, (Optional)

Measuring Computer Performance: A Practitioner's Guide, by David Lilja, Cambridge University Press, 2000 (Optional)

A Collection of Papers from conferences and journals. Will provide list on course web page

Other References: Computer Architecture books by Hennessey & Patterson

Grading Policy:

HW Assignments, Paper Critiques, Scribing, Class Participation	30%
Test1	20%
Test2	20%
Project	30%

A = 90%, A-= 87%, B+= 83%, B=80%, C= 70%, D=60%, F= Below 60%
HW assignments will include some paper and pencil assignments, some programming assignments, paper reading/critiquing, etc. Class participation will include participating in paper discussions, discussion leading when it is your turn, being on-time to class, etc

Course contents:

- Issues in Evaluating Performance and Power/Energy of Computers
- Measurement Tools and techniques, Trace Driven and Execution Driven Simulation
- Benchmarks, CPU-intensive, commercial and database, web server
- Statistical techniques for Performance Evaluation
- Trace Generation and Validation, Synthetic Traces, Verification of Simulators
- Design of Experiments
- Analytical Modeling of Processors, Statistical modeling, Hybrid Techniques- Application of queuing theory, Markov models and probabilistic models for computer system evaluation
- Workload Characterization (Quantitative and Analytical)
- Characterization of Emerging Applications

Course Evaluation: There will be a formal course evaluation towards the end of the semester. I will also be doing several informal intermediate evaluations. I am interested in tailoring the course to result in maximum benefit for you. Please feel free to offer comments.

Academic Dishonesty: Faculty in the ECE Department are committed to detecting and responding to all instances of scholastic dishonesty and will pursue cases of scholastic dishonesty in accordance with university policy. Scholastic dishonesty, in all its forms, is a blight on our entire academic community. All parties in our community -- faculty, staff, and students -- are responsible for creating an environment that educates outstanding engineers, and this goal entails excellence in technical skills, self-giving citizenry, and ethical integrity. Industry wants engineers who are competent and fully trustworthy, and both qualities must be developed day by day throughout an entire lifetime. Scholastic dishonesty includes, but is not limited to, cheating, plagiarism, collusion, falsifying academic records, or any act designed to give an unfair academic advantage to the student. The fact that you are in this class as an engineering student is testament to your abilities. Penalties for scholastic dishonesty are severe and can include, but are not limited to a record in your academic folder, a zero on the assignment/exam, re-taking the exam in question, an F in the course, or expulsion from the University. Don't jeopardize your career by an act of scholastic dishonesty. Details about academic integrity and what constitutes scholastic dishonesty can be found at the website for the UT Dean of Students Office and the General Information Catalog, Section 11-802.

Drop Policy: An engineering student must have the Dean's approval to add or drop a course after the fourth class day of the semester. Adds and drops are not approved after the fourth class day except for good cause. "Good cause" is interpreted to be documented evidence of an extenuating nonacademic circumstance (such as health or personal problems) that did not exist on or before the fourth class day. Applications for approval to drop a course after the fourth class day should be made in the Office of Student Affairs, Ernest Cockrell, Jr. Hall 2.200

The University of Texas at Austin provides, upon request, appropriate academic adjustments for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4241 TDD or the School of Engineering Director of Students with Disabilities at 471-4321.

EE 382M Fall 2012 More Info on Grading

Paper and Pencil HW Assignments + Programming assignments + Literature Survey (Approx 400 pts)

News presentation – Each student should present an interesting news item on a modern processor with 1-2 slides to class (no more than 2 mnts + 3 mnt discussion) (25)

Paper – leading discussion – Several papers will be discussed in class. Some of these papers will be lead by students. Each student will lead the presentation (once or twice). (50 * 2 =100)

Paper Critiques, Questions based on papers – read paper and write critique before the class the paper is being discussed (10 points per writeup = approx 200)

Scribing – One student takes notes during lecture, refines it and uploads it for everybody within 36 hours after class. (25 each time)

Class Participation – At the end of each class, each student hands me a sheet indicating what their class participation grade for that day should be (on a scale of 0 to 5). Professor assigns a class participation grade based on the student's self-assessment and the professor's/TA's assessment. 2 of those grades will be dropped. (20 * 5 = 100). Remember. If you are absent, you get 0.

Be on-time
Participate in discussions
No Disruptive behavior

All of the above – expect it to be approximately 800 +- 100 points. And that will constitute 30% of the course grade.

Literature Survey and Project proposal due – October 2

Project Interim Report due – Nov 1

Project Presentations – Dec 1 and 3

Test 1 – October 16
Test 2 (20%) – Nov 20

Project and Project Proposal

There are several types of projects:

- Experiments with Simulators
- Measurements on Desktops/Servers
- Measurements on Embedded Systems (Java enabled boards, mobile systems)
- Experiments with New Benchmarks (Workload/Benchmark Characterization)
- Power Measurements/Simulation
- Analytical Models
- Create a new benchmark that can be submitted to SPEC as candidate for next suite

Reproducing results from a published paper from ISCA, ASPLOS, HPCA, or MICRO will be acceptable as a project. If you make an extension to what has been published, that will be excellent.

The **project proposal** should address

Objectives- What are you trying to find out? What's the problem you are trying to solve?

Background and Motivation - What have others done in this area? Why do you think it is important to do more work? What is the significance of this work? It is important to relate what you are doing to what others have done before.

Research Plan- How you plan to do it? Any existing simulators or tools or are you planning to build you rown tools? If developing a simulator, the level of the details. What experiments do you plan to perform?

Expected Outcome The results of the project. What would be the outcome from the project once it is completed.

Significance or impact of the work/study.

Project Proposal - 2 to 3 pages

Use at least 3 non-www references. ISCA, Micro, HPCA, ASPLOS, ISPASS, IISWC, PACT, IEEE-TC are all potential sources of references. You may use www as additional references. If you are not finding enough references talk to me early in the semester, way before the project proposal is due.

Literature Survey and Project Proposal – 7.5% of course grade
Interim Report – 2.5% of course grade
Final Project report – 20% of course grade

Suggested Project Topics:

Performance/Power Characterization of Cloud Workloads/Benchmarks (eg: Map/Reduce)

Performance/Power Characterization of Virtualization Workloads/Benchmarks(eg: SPEC Virt)

Performance/Power Characterization of Analytics Workloads/Benchmarks (eg: Graph 500)

Performance/Power Characterization of Embedded Workloads/Benchmarks (phone apps, tablet apps, sensor networks)

Performance/Power Characterization of Web Server Workloads/Benchmarks

Past Class Projects that became Papers:

1. M. Clark and L. K. John, "Performance Evaluation of Configurable Hardware Features on the AMD-K5", In Proceedings of the IEEE International Conference on Computer Design (ICCD 99), Oct 1999, pp. 102-107. (Acceptance rate: 71 accepted/220 submissions = 32%)
2. R. Radhakrishnan, J. Rubio and L. John, "Characterization of Java Applications at ByteCode and UltraSPARC Machine Code Levels", ICCD 1999, Oct 1999, pp. 281-284. (Acceptance rate: 71 accepted/220 submissions = 32%)
3. G. E. Allen, B. L. Evans, and L. K. John, "Real-Time High-Throughput Sonar Beamforming Kernels Using Native Signal Processing and Memory Latency Hiding Techniques", Proc. IEEE Asilomar Conf on Signals, Systems and Computers, Pacific Grove, CA, Oct 24-27, 1999, pp. 137-141.
4. H. Nguyen and L. John, "Exploiting SIMD Parallelism in DSP and Multimedia Algorithms Using the AltiVec Technology", Proceedings of the ACM International Conference on Supercomputing (ICS 99), Greece, June 1999, pp. 11-20. (Acceptance rate: 57 accepted/180 submissions = 32%)
5. R. Radhakrishnan and L. John, "A Performance Study of Modern Web Server Applications", Euro-Par 1999, Lecture Notes in Computer Science, Springer, pp. 239-247. (Acceptance rate: 188 acccepted/343 submissions = 55%)
6. S. Banerjee, H. R. Sheikh, L. K. John, B. L. Evans, and A. C. Bovik, "VLIW DSP vs. Superscalar Implementation of a Baseline H.263 Video Encoder", Proc. IEEE Asilomar Conf. on Signals, Systems, and Computers, vol. 2, Pacific Grove, CA, Oct 29-Nov 1, 2000, pp. 1665-1669.
7. W. Lloyd Bircher, M. Valluri, J. Law and L. John, "Runtime Identification of Microprocessor Energy Saving Opportunities", International Symposium on Low Power Electronics and Design (ISLPED), Aug 2005, pp. 275-280.
8. Jian Chen, Nidhi Nayyar, and Lizy K. John, Mapping of Applications to Heterogeneous Multi-cores Based on Micro-architecture Independent Characteristics, Third Workshop on Unique Chips and Systems (UCAS), Held in conjunction with IEEE International Symposium on Performance Analysis of Systems and Software (ISPASS), April 2007.