GEORGIA INSTITUTE OF TECHNOLOGY

College of Computing

CS6290/CS4290 — High-Performance Computer Architecture

Fall 2001

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Project 3	Due: November 2 / December 7, 2001

The default project is to do some original research in computer architecture in a group of two or three students. For example you could propose a modest extension to a paper studied in class or simply re-validate the data in some classic paper by writing your own simulator. You will be graded on how well you define your problem, survey previous work, design and conduct experiments, and present your results. The goal to shoot for is a conference paper, like the ones we've read in class. However, the limited time makes that goal hard to reach and I will reward those that aim high even if they do not completely succeed. The key is to ensure that some aspects of your work are completely done – it is very hard to grade a project where the simulator did not quite work. This type of project is especially recommended for students working on or considering a Ph.D.

As a alternatively, you may work in a group of two to survey an area within architecture that we did not have time to cover extensively in the class. The paper should summarize work in the area, giving extensive references, present opinions of others for and against various options (with references), and conclude with *your opinion* of the strengths and weaknesses of arguments presented above. You will be graded on the completeness of your survey, the accuracy of your summaries, the support you give for your opinions, and the quality of your presentation. Since a survey paper is "safer" than a research project, I will hold survey papers to a higher standard of completeness and analysis of the literature.

Proposal

Prepare a brief (one-page) proposal outlining your topic. Proposals are due by Friday, November 2th (with Project 2), but the sooner you show us a proposal, the sooner you can get feedback.

Paper

Prepare a paper of 10-ish pages with your results and conclusions. The paper should include an abstract, a body and optional appendices. The 10-page target applies to the body of the paper. The appendices may be of any length to include supporting material, but I will likely only skim them when reading the paper.

Presentation

We will divide the last three classes up into 15-minute slots for presentations. We may have to schedule some additional time if we run out. The talk should highlight the problem, the motivation and the results/conclusions. All project members should deliver part of the talk. Concentrate on keeping the talk short and sweet. 15 minutes is only about 5 or 6 slides.

Ideas for Research Topics:

- Study and characterize *predictability* of cache misses, data values, branches, etc., in benchmarks.
- Devise a technique to use "informing memory" operations to reduce memory misses, e.g. through address prediction and prefetching.
- Apply register renaming to the Java virtual machine.
- Evaluate alternate memory access techniques (besides caches) for data streams in multimedia applications.
- Study the benefits of specialized multimedia instructions implemented by Intel (MMX), Sun (VIS) and others by implementing and tuning selected algorithms.
- Study the potential benefits of dynamic compilation, e.g. the benefits of knowing run-time constants, possibly inlining all library calls, etc.
- Evaluate prospects for multiprocessors on a chip.
- Add a victim caching model to cachesim5 and evaluate victim caches.
- Implement and tune an algorithm for an IXP1200 network processor, a chip multiprocessor for networking applications (we have several IXPs available).
- Implement and tune an algorithm for a local multiprocessor, e.g. Nighthawk (16-processor SGI O2000) or Jedi (136-processor P-III cluster).

Ideas for Survey Topics:

- Contrast DSP processors to general-purpose processors.
- Dataflow machines or vector machines
- Multiscalar or speculative multiprocessor machines.
- Value prediction.
- Hardware protection and security mechanism.
- VLIW machines vs. superscalars.
- High-performance I/O, e.g. RAID.

Academic Conduct

This ought to go without saying but I'll say it anyway: all work must be your own; all material from others (quoted text, copies of figures) must be cited. If you have questions about how to do this, ask. Academic conduct is governed by the Georgia Tech Honor Code.