LSU EE 7700-2 **Homework 1** **Due: 20 October 2003**

For this assignment read Eric Rotenberg, Steve Bennett, and James E. Smith, "A trace cache microarchitecture and evaluation," *IEEE Transactions on Computers,* vol. 48, no. 2, pp. 111-120, February 1999. For authorized users the paper can be found at
`http://www.ece.lsu.edu/tca//s/roten-99.pdf`.

For the last problem look at Glenn Reinman, Brad Calder, and Todd Austin, "Optimizations enabled by a decoupled front-end architecture," *IEEE Transactions on Computers,* vol. 50, no. 4, pp. 338-355, April 2001. For authorized users the paper can be found at
`http://www.ece.lsu.edu/tca//s/reinman-01.pdf`. Concentrate on Section 5, up to and including 5.2.

Problem 1: In a system using a trace cache there is a possibility that a branch within a trace can be mispredicted.

Consider a system using the trace cache described in Rotenberg 99. The system has predicted a trace, trace A, which contains three branches. Trace A was found in the trace cache and its instructions are executing. The first of its three branches was correctly predicted but the second one was mispredicted by the next trace predictor.

(a) Write a code fragment in MIPS or some other RISC ISA. Based on that code fragment make up a trace ID for trace A. (Make up instruction addresses.) *Hint: This part is straightforward and has nothing to do with the misprediction.*

(b) When the mispredicted branch is resolved there are two ways in which a prediction for the third branch can be obtained. What are they?

(c) Adding to your code fragment if necessary, show a trace ID for the trace that is constructed after the mispredicted branch resolves. Use hierarchical sequencing, as did the system in the paper.

(d) Show the trace ID for the trace that would be constructed if hierarchical sequencing had not been used. (See Section 2.5.)

Problem 2: Estimate the amount of memory (in bytes) used by the correlated prediction table, the main table used by the next-trace predictor.

Problem 3: There is an important difference in prediction capabilities between the SEQ.n model of Rotenberg 99 and the superblock predictor described in Reinman 01. What is it? Which is better? Assume that the superblocks that are being predicted in SEQ.n (Rotenberg) and the FTB (Reinman) (See the reference at the beginning of the assignment.) When looking at Reinman 01 concentrate on Section 5, up to and including 5.2.