CS418	Advanced Computer Architecture	Spring 1995

Homework 2: Due 17 Jan

Reading

Tue	10	Jan	H&P 1.2, 1.3, 1.5
Thur	12	Jan	H&P 2.1 – 2.6
Tue	17	Jan	H&P 3.1, 3.2, 3.7, 3.8; skim 3.3–3.6

Your company, Boondoggle Inc, currently offers a workstation based on your Micro1 microprocessor. The workstation is sold with a software package that includes your Comp1 C-compiler. You've just introduced the Micro2, which is a dual-issue microprocessor, and the Comp2 compiler.

Show all of your work!

Problem 1 (2 Points)

Plot a graph of speedup (of Micro2 compared to Micro1) vs. the percentage of instructions that dual-issue. Speedup should be on the y-axis and the percentage of instructions that dual-issue should be on the x-axis.

Problem 2 (3 Points)

In the Micro2/Comp2 configuration, 50% of the instructions can dual-issue. For the next update to the Micro/Comp configuration, you are considering two options:

- Design a quad-issue machine (issue up to four instructions per cycle) named Micro3 and continue to use Comp2. Using Comp2 with Micro3, 50% of the instructions will be able to quad-issue, 10% tri-issue (3inst/cycle), 10% dual-issue, and 30% single-issue.
- Design a new compiler (Comp3) that can schedule instructions so that 80% of the instructions can dual-issue and continue to use the Micro2 design.

Calculate the speedup for both options (Micro3/Comp2 and Micro2/Comp3), as compared to the current Micro2/Comp2 configuration.

Problem 3 (3 Points)

In order to keep up with the competition, you need to double performance each year. The performance of the Micro2/Comp2 configuration is currently average. Boondoggle Inc only has enough money to begin to upgrade either the microprocessor (from Micro2 to Micro3) or or the compiler (from Comp2 to Comp3). The hardware enhancement will take one year to develop and the software enhancement will take three months. If you begin one of the projects now, which of the two options is the better choice, in terms of its relative performance compared to the rest of the market at the end of its development?

Problem 4 (2 Points)

After the initial meeting comparing the two options, you realize that the hardware designers overlooked the fact that in order for Micro3 to achieve close to its potential performance, you need to increase the memory bandwidth over that required for Micro2. The Micro2 currently has a hit ratio of 80% and an average latency for a miss of 10 cycles.

You have two options for increasing the memory bandwidth:

- Keep the cache size the same but use faster memory (hit ratio = 80%, average latency for a cache miss = 5 cycles)
- Increase the size of the cache using the current memory chips (hit ratio = 90%, average latency for a cache miss = 10 cycles).

What is the average access time for each cache configuration?

Problem 5 (2 Points)

The selling price of typical Micro2/Comp2 configuration is currently $10,000. The accountants project that the prices of similarly configured Micro3/Comp2 and Micro2/Comp3 machines will be $10,500 and $10,200 respectively. Ignoring inflation, which one of the three examples (Micro2/Comp2, Micro3/Comp2, and Micro2/Comp3) offers the best price/performance ratio?