EE2016 Microprocessor Theory & Lab. July-Nov, 2019

Tutorial 8: Microprocessor Performance Assessment

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Instructions:

1. Try the problems independently. You may take help of TAs.
2. The solutions would be uploaded only for the problems part (in the next week in moodle)
3. The last problem involves the 'hit' & 'miss' related to cache. Plan to cover this in next class.
4. Regarding the speed up factor & Amdhal's law refer to Stallings page no: 56 & 57

1 Review Questions

1. What is most fundamental unit for time in a microprocessor, to which all other events are synchronized (in synchronous timing systems)?
2. What are the two major components of time that a processor takes to excute a given instruction?
3. How does the memory access part of the instruction compares with the decode and execute part of the same, in terms of time? Which component is greater and why?

2 Problems

1. A benchmark program is run on a 40 MHz processor. The executed program consists of 100,000 instruction executions, with the following instruction mix and clock cycle count:

   Include table

Instruction Type	Instruction Count	Cylces per instruction
Integer arithmetic	45000	1
Data transfer	32000	2
Floating point	15000	2
Control transfer	8000	2

   Determine the effective CPI, MIPS rate, and execution time for this program.

2. Consider two different machines, with two different instruction sets, both of which have a clock rate of 200 MHz. The following measurements are recorded on the two machines running a given set of benchmark programs:

Machine \ Instruction Type	Instruction Count (millions)	Cylces per instruction
Machine A		
Arithmetic and logic	8	1
Load & store	4	3
Branch	2	4
Others	4	3
Machine B		
Arithmetic and logic	10	1
Load and store	8	2
Branch	2	4
Others	4	3

(a) Determine the effective CPI, MIPS rate and execution time for this program.

(b) Comment on the results.

3. Consider the execution of a program which results in the execution of 2 million instructions on a 400-MHz processor. The program consists of four major types of instructions. The instruction mix and the CPI for each instruction type are given below based on the result of a program trace experiment:

Instruction Type	CPI	Instruction Mix
Arithmetic & logic	1	60 %
Load/ store with cache hit	2	18 %
Branch	4	12 %
Memory reference with cache miss	8	10 %

(a) Compute the average CPI when the program is executed on a uniprocessor with the above trace results.

(b) Compute the corresponding MIPS rate.

4. Consider problem 3 for the calculation of average CPI and MIPS rate. Now assume that the program can be executed in eight parallel tasks or threads with roughly equal number of instructions executed in each task. Execution is on an 8-core system with each core (processor) having the same performance as the single processor originally used. Coordination and synchronization between the parts adds an extra 25,000 instruction executions to each task. Assume the same instruction mix as in the example for each task, but increase the CPI for memory reference with cache miss to 12 cycles due to contention for memory.

(a) Determine the average CPI.

(b) Determine the corresponding MIPS rate.

(c) Calculate the speedup factor.

(d) Compare the actual speedup factor with the theoretical speedup factor determined by Amdhal's law.