Date: January 24, 2020

Assignment 1 – Computer Organization
Class - 4CSE

Practice Questions

[The objective is to get you in the habit of writing clear, precise and neat descriptions with diagrams preferably and also to look up various textbooks/material to find it.]

1. Let assume that a benchmark has 100 instructions: 25 instructions are loads/stores (each take 2 cycles) 50 instructions are adds (each takes 1 cycle) 25 instructions are square root (each takes 50 cycles) what is the CPI for this benchmark?
2. Suppose we have two implementations of the same instruction set architecture (ISA). For some program, Machine A has a clock cycle time of 10 ns and a CPI of 2.0 .Machine B has a clock cycle time of 20 ns and a CPI of 1.2.Which machine is faster for this program, and by how much? Assume total instructions are 1000000000 mhz.
3. A benchmark program is run on a 400 MHz processor. The executed program consists of 100,000 instruction executions, with the following instruction mix and clock cycle count:

INSTRUCTION TYPE	INSTRUCTION COUNT	CYCLE PER INSTRUCTION
Integer arithmetic	450000	1
Data transfer	320000	2
Floating point	150000	2
Control transfer	80000	2

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

4. 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:

INSTRUCTION TYPE	INSTRUCTION COUNT (millions)	CYCLES PER INSTRUCTION
Machine A		
Arithmetic and logic	8	1
Load and 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

Determine the effective CPI, MIPS rate, and execution time for each machine.

5. Four benchmark programs are executed on three computers with the following results:

	COMPUTER A	COMPUTER B	COMPUTER C
PROGRAM 1	1	10	20
PROGRAM 2	1000	100	20
PROGRAM 3	500	1000	50

PROGRAM 4	100	800	100

The table shows the execution time in seconds, with 100,000,000 instructions executed in each of the four programs. Calculate the MIPS values of each program on each of 3 machines. Based on these ratings, draw a clear conclusion regarding relative performance of 3 computers and also rank processors according to their performance.

6. A program of 2000000 instructions is to be executed by 3 processors. The respective frequencies are 150 MHz, 200 MHz, 250 MHz with CPI of 2, 3 and 1.Processor A uses 35%, B uses 40% and C uses 25% of instructions of the program. Determine total CPU time required to execute the whole program by 3 processors. Clearly mention average CPI of 3 processors and calculate MIPS rate.
7. Look at the following problem:

Benchmark	Processor		
	X	Y	Z
1	20	10	40
2	40	80	20

   a. Compute the arithmetic mean value for each system using X as the reference machine and then using Y as the reference machine. Argue that intuitively the three machines have roughly equivalent performance and that the arithmetic mean gives misleading results.
   b. Compute the geometric mean value for each system using X as the reference machine and then using Y as the reference machine. Argue that the results are more realistic than with the arithmetic mean.
8. A 500mhz processor has 100000 instructions with following data:

INTEGER	1 CPI	60%
FLOAT	2 CPI	20%
LOAD`	4 CPI	10%
MEMORY	6 CPI	10%

   a. Determine the average CPI.
   b. Determine the corresponding MIPS rate.
   c. Calculate total execution time.
9. We want to compare computers R1 and R2, which differ that R1 has the machine instructions for the floating point operations, while R2 has not (FP operations are implemented in the software using several non-FP instructions). Both computers have a clock frequency of 400 MHz. In both we perform the same program, which has the following mixture of commands.

Type the command	Dynamic Share of instructions in program (p_i)	Instruction duration (Number of clock periods CPI_i)	
		R1	R2
FP addition	16%	6	20
FP multiplication	10%	8	32
FP division	8%	10	66
Non - FP instructions	66%	3	3

Calculate the MIPS for the computers R1 and R2.

10. Let a program have 40 percent of its code enhanced to run 2.3 times faster. What is the overall system speedup S?

11. Which speed up could be achieved according to Amdahl's Law for infinite number of processes if 5% of a program is sequential and the remaining part is ideally parallel? How?
    (A) Infinite
    (B) 5
    (C) 20
    (D) 50
12. Assume that a program runs in 100 seconds on a machine, with multiply operations responsible for 80 seconds. How much do I have to improve the speed of multiplication if I want my program to run 2 times faster?
13. Floating point instructions are improved to run twice as fast, but only 10% of the time was spent on these instructions originally. How much faster is the new machine?
    How much faster is the new machine if the floating point instructions becomes 100 times faster?
14. We are interested in two implementations of two similar but still different ISA, one with and one without special real number instructions. Both machines have 1000MHz clock.
    Machine With Floating Point Hardware - MFP implements real number operations directly with the following characteristics:
    - real number multiply instruction requires 6 clock cycles
    - real number add instruction requires 4 clock cycles
    - real number divide instruction requires 20 clock cycle.
    - Any other instruction (including integer instructions) requires 2 clock cycles.

    Machine with No Floating Point Hardware - MNFP does not support real number instructions. The number of integer instructions needed to implement each real number operations are as follows:

    - real number multiply needs 30 integer instructions
    - real number add needs 20 integer instructions
    - real number divide needs 50 integer instructions.

    Consider Program P with the following mix of operations:

    - real number multiply 10%
    - real number add 15%
    - real number divide 5%
    - other instructions 70%

    a. Find MIPS rating for both machines.
    b. If Program P on MFP needs 300,000,000 instructions, find time to execute this program on each machine.
    c. Calculate MFLOPS for both computers.
15. Suppose that we are considering an enhancement that runs 10 times faster than the original machine but it is usable only 40% of the time. What is the overall speedup gained by incorporating the enhancement?

16. For a given high-level language program, two compilers produced the following executed instruction counts:

	Instruction counts (in millions) for each instruction class		
Code from:	**A**	**B**	**C**
Compiler 1	**5**	**1**	**1**
Compiler 2	**10**	**1**	**1**

The machine is assumed to run at a clock rate of 100 MHz. Determine the effective CPI, MIPS rate, and execution time for both the compilers.

17. For the RISC machine with the following instruction mix given:

OPERATION	FREQUENCY	CPI(i)	% TIME
ALU	50%	1	23%
LOAD	20%	5	45%
STORE	10%	3	14%
BRANCH	20%	2	18%

If a CPU design enhancement improves the CPI of load instructions from 5 to 2, what is the resulting performance improvement from this enhancement?

For Submission

- No submission right now.