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**CS 465 - Homework 1 – Fall 2016**

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Part 2 (30% of grade for homework 1): Exercises related to chapter 1.

1. [20% of homework 1] Assume that the CPI for arithmetic, load/store, and branch

instructions of a processor is 1, 10, and 6, respectively. Also assume that on a single

processor a program requires the execution of 2.56 ∗ 109 arithmetic instructions, 1.28 ∗

109 load/store instructions, and 1.28 ∗ 108 branch instructions. Assume that each

processor has a 2 GHz clock frequency.

1. Find the total execution time (in sec) for this program on a single processor.

|  |  |  |  |
| --- | --- | --- | --- |
|  | arithmetic instructions | load/store instructions | branch instructions |
| CPI | 1 | 10 | 6 |
| Instruction count | 2.56\*10^9 | 1.28\*10^9 | 1.28\*10^8 |

b. Assume that, as the program is parallelized to run over multiple cores, the

number of arithmetic and load/store instructions per processor is divided by 0.8

∗ p (where p is the number of processors) but the number of branch instructions

per processor remains the same. Find the total execution time for this program

on 2 and 8 processors and show the relative speedup.

Execution time for 2 processors: 0.8\*p=0.8\*2=1.6

Relative speed up

Execution time for 8 processors: 0.8\*p=0.8\*8=6.4

Relative speed up

c. If the CPI of the arithmetic instructions was tripled, what would be the impact on

the execution time of the program on 1, 2, or 8 processors? Point out the general

trend you observe.

Execution time for 1 processors:

Execution time for 2 processors: 0.8\*p=0.8\*2=1.6

Execution time for 8 processors: 0.8\*p=0.8\*8=6.4

The trend is that the times are increasing which means that the exaction is becoming slower for each different processors.

d. To what should the CPI of load/store instructions be reduced in order for a

single processor to match the performance of 8 processors using the original CPI

values?

We need to find the load store to match the time so we need to solve the

Equation for the load/store.

load/store = 0.125

2. [10% of homework 1] Consider a computer running a program that requires 320 sec,

with 90 sec spent executing floating point (FP) instructions, 100 sec executing

Load/Store (L/S) instructions, 60 sec spent executing branch (BR) instructions, and 70

sec spent executing integer (INT) instructions.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Total running Time | floating point (FP) instructions | Load/Store (L/S) instructions | branch (BR) instructions | integer (INT) instructions |
|  | 320 | 90 | 100 | 60 | 70 |
| a | 297.5 | 67.5 | 100 | 60 | 70 |
| b | 313 | 90 | 100 | 60 | 63 |
| c | 245 | 90 | 100 | 60-80=-20 | 70 |

a. By how much is the total time reduced if the time for FP instructions is reduced

by 25% (assuming all other instructions are not changed)?

FP= 0.25\*90=22.5 Total time= 320-22.5=297.5

b. By how much is the time for INT instructions reduced if the total time is reduced

by 10% (assuming all other instructions are not changed)?

INT=0.10 \*70=7 Total time= 320-7=313

c. Can the total time be reduced by 25% by reducing only the time for branch

instructions?

Total time needs to be reduced by = 0.25 \*320= 80 but the branch instructions takes only 60 seconds so it will be impossible to be reduced less than it takes. Reducing the branch instructions will not help in this case.