Name: Ningyuan Zhang

Section: K

Instructor: Joseph Zambreno

Date: 10/9/2016

Home Work #5 Solutions

1)

(a)

Compiler A CPI = 1.1 / (1.0E9 \* 1.0E-9) = 1.1

Compiler B CPI = 1.5 / (1.2E9 \* 1.0E-9) = 1.25

(b)

fB / fA = (Instruction count(B) \* CPI(B)) / (Instruction count(A) \* CPI(A)) = 1.37

(c)

CPU time(A) / CPU time(New) = (Instruction count \* CPI)(A) / (Instruction count \* CPI)(New) = (1.0E9 \* 1.1)(A) / (6.0E8 \* 1.1)(New) = 1.67

CPU time(B) / CPU time(New) = (Instruction count \* CPI)(B) / (Instruction count \* CPI)(New) = (1.2E9 \* 1.25)(A) / (6.0E8 \* 1.1)(New) = 2.27

2)

(a)

multiplication:

time after improvement = (20 / 4) + 80 = 85

speed up = 100 / 85 = 1.18

memory access:

time after improvement = (50/ 2) + 50 =75

speedup = 100 / 75 = 1.33

both:

time after improvement = (20 / 4) + (50 / 2) + 30 = 60

speedup = 100 / 60 = 1.67

(b)

Suppose the percentage of time used by multiply is a%, the percentage of memory access is b%:

(100 - a) + a / 4 = (100 - b) + b / 2

b = 1.5a (0 < a, b < 100)

3)

(a)

The CPI for Mbase: 2 \* 0.4 + 3 \* 0.25 + 3 \* 0.25 + 5 \* 0.1 = 2.8

The CPI for Mopt: 2 \* 0.4 + 2 \* 0.25 + 3 \* 0.25 + 4 \* 0.1 = 2.45

(b)

MbaseTime / TimeMopt = (Instruction count \* CPI(Mbase) \* CycleTime(Mbase)) / (Instruction count \* CPI(Mopt) \* CycleTime(Mopt)) = (2.8 \* (1 / 2.5GHz)) / (2.45 \* (1 / 3.0GHz)) = 1.37

(c)

multiply instructions:

CPUTime = Instruction count \* CPI \* Cycle time = Instruction count \* 0.15 \* 12 \* cycle time = 1.8 \* Instruction count \* cycle time

all instructions:

CPUTime = Instruction count \* CPI \* Cycle time = (Instruction count \* 0.15 \* 12 + Instruction count \* 0.85 \* 4) \* cycle time = 5.2 \* Instruction count \* cycle time

percentage of time CPU spend on doing multiplication:

1.8 / 5.2 = 34.6%

(d)

original hardware:

CPUTime = Instruction count \* CPI \* Cycle time = (Instruction count \* 0.15 \* 12 + Instruction count \* 0.85 \* 4) \* cycle time = 5.2 \* Instruction count \* cycle time

new hardware:

CPUTime = Instruction count \* CPI \* Cycle time = (Instruction count \* 0.15 \* 8 + Instruction count \* 0.85 \* 4) \* 1.2cycle time = 5.52 \* Instruction count \* cycle time

Performance(New) / Performance(Original) = 5.2 / 5.52 = 0.942