

EGC442 Introduction to Computer Architecture

Test 1

First Name: I	Last Name:
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- You are allowed to print a copy of the instruction sheet. http://www.engr.newpaltz.edu/~bai/EGC442/Instructin%20set%20reference.pdf
- Your submission must be in a single PDF file
- Make sure you submit before the deadline of 1:45 PM. I will not accept late submission by email.
- You must adhere to the honor code. Any evidence of misconduct will be dealt with strictly per syllabus.

Question 1 (10 points)

Convert -12.75₁₀ to single precision IEEE 754 format. Show your representation in binary.

$$\frac{8 + 2 + 3 - 25}{100 \cdot 11} = 1.10011 \times 2^{3}$$

$$CXP = 127 + 3 = 130$$

IT	1000	00101	10011000	-	*	-	0
1							

Question 2 (10 points)

A program runs in 100 seconds. Multiply and divide operations are responsible for 30 and 40 of those seconds, respectively. Would it be possible to run the program 2 times faster?

- 3 a. By improving the multiplication alone. If yes, by what factor?
- b. By improving the division alone. If yes, by what factor?
- 4 c. By improving the multiplication and division by the same factor. If yes, by what factor?

ctor? Mult Divide other
$$100 = 30 + 40 + 30$$

2X 1

$$\frac{70}{20} = 3.5X$$

Question 3 (15 points)

Suppose we have two implementations of the same instruction set architecture. Computer A has a clock cycle time of 200 ps and a CPI of 2.0 a program with 2×10^6 instructions, and computer B has a clock cycle time of 350 ps and a CPI of 1.2 for the same program.

- 3 a. How many clock cycles each computer execute?
- b. What is the execution time of each processor?c. What is the MIPS rating of each processor?
- d. Which processor is a better processor? Why?

$$T_A = 200 \times 10^{-12}$$
 $CPT_A = 2$ $N_A = 2 \times 10^6$
 $T_B = 350 \times 10^{-12}$ $CPT_B = 1.1$

2. $CLK_A = 2 \times 10^6 \times 2 = 4 \times 10^6$
 $CLK_B = 2 \times 10^6 \times 1.2 = 2.4 \times 10^6$

b. $Texe_A = 2 \times 10^6 \text{ instr} \times 2 \frac{cc}{instr} \times 200 \times 10^{-12} \text{ sec} = 800 \times 10^6 \text{ sec}$
 $Texe_B = 2 \times 10^6 \text{ instr} \times 1.2 \frac{clK}{instr} \times 350 \times 10^{-12} \frac{sec}{clK} = 840 \times 10^6 \text{ sec}$

c. $MIPS_A = \frac{2 \times 10^6}{10^6 \times 800 \times 10^6} = 2500$
 $MIPS_B = \frac{2 \times 10^6}{10^6 \times 840 \times 10^6} = 2381$

d. A is better due to lower execution

0-5 Small mistake 5-10 Med. 10-15 Big mistakes

Question 4 (15 points)

Replace the following C code by a set of equivalent MIPS instructions. Assume x, y, z, and i are in registers \$t4, \$t5, \$t6, and \$a2, respectively, and the staring address for array

a is in register \$s4.
$$\Rightarrow$$
 \$\forall f', \$\fo

OUT:

Question 5 (10 points)

Assume \$s3 has 5002, and words addressed 5000..5002 have the data shown:

5000: 0x99 5001: 0x77 5002: 0x23 5003:0x23 5004:0x6E

5005:0x34

5006:0x13

5007:0x34

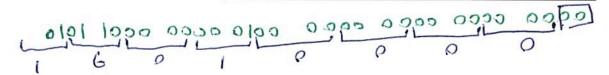
- a. What address will be computed by lw \$t0, -2(\$s3) O X 5000
- b. What value will be put in \$11 by lw \$11, 2(\$s3)

\$61=0X65341334

Question 6 (15 points)

The following code segment is partially converted to machine code. Complete the conversion by placing appropriate values in the empty machine code fields of *sub*, *beq*, and *j* instructions.

	63		sel.	+ 97	4+1		
Loop: sub \$t1, \$t1, \$a2	0x58040000	0	9	6	9	0	0X22
lw \$t0, 0(\$t1)	0x58040004	35	9	8	0		
beq \$t0, \$s5, Exit	0x58040008	4	8	21	2	(3)	
addi \$s5, \$s5, 1	0x5804000C	8	21	21	1		
j Loop	0x58040010	2	OX 1	601	000	0 3	
Exit:	0x58040014	xxxxxx					



Question 7 (10 points)

Compare the number of gate delays for the critical paths of the following 32-bit adders

- i. Only using ripple carry
 - ii. Using carry lookahead at the first level and ripple carry at between them
 - iii. Using carry lookahead at the first and second level and ripple carry between second levels.

i.
$$32 \times 2 = 64$$
 gate delays
ii. $32/4 = 8$ modules
 $8\times 3 = 24$ gabe delays

$$\frac{32}{16} = 2$$

$$2 \times 5 = 10$$
 gale delays

Question 8 (15 points)
Show the internal architecture of the most significant bit of a 4-bit ALU as specified below.

$S_2S_1S_0$	Functions		
000	AND (A ^ B)		
001	XOR (A ⊕ B)		
010	ADD (A+B)		
110	Subtract (A - B)		
1 1 1	SLT		

