Indian Institute of Information Technology Sri City, Chittoor

Mid Term 1 Examination– April 2023

Computer Architecture

Maximum Marks: 30
Date: 20th April 2023

Time Duration: 90 mins
Course Code: CS0200

Instructions

1. This is a **closed book** exam.
2. Write the answers clearly and legibly in the given answer sheet, using pen (NOT pencil).
3. **Write your roll no. and other details on the front page of the answer sheet.**
4. **All questions are compulsory. All sub-parts of a question should be written together.**
5. Follow all other instructions given by the invigilator during the exam.
6. **Attach the question paper with the answer sheet.**

Multiple Objective Questions (1*10 = 10 Marks)

1. For a given architecture, what improvements can you make to a system or program in order to increase performance?
   a. reduce the number of cycles for a program
   b. reduce the clock cycle time
   c. increase the clock rate
   d. All of the above

2. Our favorite program runs in 20 seconds on computer A, which has a 500MHz. clock. Calculate the number of clock cycles taken by the program.
   a. $4*10^9$
   b. $5*10^9$
   c. $10*10^9$
   d. $5*10^{10}$

3. Suppose we have two computers, Computer A has a clock cycle time of 300 ps and a CPI of 2.0 for some program, Computer B has a clock cycle time of 500 ps and a CPI of 1.5 for the same program. Which machine is faster for this program, and by how much?
   a. A, 1.2
   b. B, 1.2
   c. A, 1.25
   d. B, 1.25

4. If x is of datatype "int", does that imply $x^2 >= 0$?
   a. Always True
   b. Always False
   c. False for some cases
   d. x^2 cannot be calculated

5. Identify the correct formula for the execution time of a program?
   a. (cycles / program) x (seconds / cycle)
   b. Total_Cycles x (1 / clock rate)
   c. instruction count x CPI x (1 / clock rate)
   d. All of the above

6. What is the range of normalize significand in IEEE representation?
   a. 0.0 <= |significand| < 1.0
   b. 0.1<= |significand| <= 0.2
   c. 1.0 <= |significand| < 2.0
   d. 1.0 ≤ |significand| <= 2.0

7. What does the expression $1 + (a << 3) + \sim a$ evaluate to?
   a. $a + 8$
   b. $a * 7$
   c. $a / 4$
   d. None of the above

8. Variable x has 4-byte representation 0x01234567 and is stored in address 0x100, According to little endian, what is the value stored at the address 0x102
   a. 23
   b. 32
   c. 45
   d. 54

9. Assume x has to be divided by 64 by using right shift. What is the bias to be added to x to make sure that the division rounds up when x is negative?
   a. 6
   b. 5
   c. 63
   d. 64

10. For x any y declared as 'int', what is the result of the following statement?

$$x > 0 \&\& y > 0 => x + y > 0$$

   a. Always true
   b. Always false
   c. Sometimes false, sometimes true
   d. None of the above

Descriptive Questions

Q.1

a. What do you understand by context switching? Explain its process by giving a suitable diagram. [1+2 = 3Marks]

b. A car manufacturing company has promised their customers that the next release of a new engine will show a 4× performance improvement. You have been assigned the task of delivering on that promise. You have determined that only 90% of the engine can be improved. How much (i.e., what value of *s*) would you need to improve this part to meet the overall performance target of the engine? [3 Marks]

c. A compiler designer is trying to decide between two code sequences for a particular machine. Based on the hardware implementation, there are three different classes of instructions: Class A, Class B, and Class C, and they require one, two, and three cycles (respectively). The first code sequence has 5 instructions: 2 of A, 1 of B, and 2 of C. The second sequence has 6 instructions: 4 of A, 1 of B, and 1 of C.

- Which sequence will be faster? How much? [2 Marks]
- What is the CPI for each sequence? [2 Marks]

2a) We are running programs on a machine with the following characteristics:

- Values of type int are 32 bits. They are represented in two's complement, and they are right shifted arithmetically. Values of type unsigned are 32 bits.
- Values of type float are represented using the 32-bit IEEE floating point format, while values of type double use the 64-bit IEEE floating point format.

We generate arbitrary values x, y, and z, and convert them to other forms as follows:

```
/* Create some arbitrary values */
int x = random();
int y = random();
int z = random();
/* Convert to other forms */
unsigned ux = (unsigned) x;
unsigned uy = (unsigned) y;
double dx = (double) x;
double dy = (double) y;
double dz = (double) z;
```

For each of the following C expressions (in the table), you are to indicate whether or not the expression *always* yields 1.

If so, write YES If not, write NO You will be graded on each problem as follows:

- If you don't write any answer, you get 0 points.
- If you write correct answer, you get 1 points.
- If you write the wrong answer, you get -0.5 points (so don't just guess wildly).

For each problem, write the puzzle expression in your answer sheet and then write your answer in a tabular format similar to the one given below.

S.No	Puzzle	Answer (YES / NO)
I.	$(x < y) == (-x > -y)$	
II.	$((x + y) << 4) + y - x == 17 * y + 15 * x$	
III.	$ux - uy == -(y - x)$	
IV.	$ux >> 3 == ux/8$	
V.	$x \,\&\, (x - 1) != 0$	

(5 marks)

2b) Convert the following value into IEEE single precision representation. **(5 marks)**

25.75_{10}

********** ALL THE BEST **********