IT5002-Midterm-Qns

Computer Systems and Applications (National University of Singapore)

IT5002 2021/22 Semester I
Backup Midterm Paper

1. This paper is only to be used in the event of a serious LumiNUS failure. Otherwise this paper should be completed online in the LumiNUS Quiz Tool.

2. This is an open-internet paper. You can use any tool (compilers, code converters, online forums, etc.), as long as you **DO NOT COMMUNICATE WITH ANYONE NOR RECEIVE COMMUNICATIONS FROM ANYONE. IF YOU DO SO YOU WILL BE DEEMED TO HAVE CHEATED AND SERIOUS DISCIPLINARY ACTION WILL BE TAKEN AGAINST YOU.**

3. You may ask questions at this link: https://forms.gle/bXuZiv5kkCtX84pv9. Your questions must be phrased in a way that can be answered with a "YES" or a "NO", with no further elaboration. If your question is not appropriately phrased, you may be asked to rephrase, or you may be ignored.

4. This paper consists of FOURTEEN (14) questions on FIVE (5) printed pages including this page. Marks are indicated, and total 40 marks, forming 20% of your final course grade.

5. You may complete this paper electronically on your tablet, print it out and write down your answers, or simply write your answers on a blank piece of paper. If you use a blank piece of paper, ensure that your answers are properly labeled so that we can identify which question (or which part of a question) your answer belongs to.

6. This paper is 60 minutes long.

7. **ENSURE THAT YOUR NAME, STUDENT NUMBER AND TUTORIAL GROUP NUMBER ARE CLEARLY WRITTEN ON YOUR ANSWER SHEET. IF YOU FAIL TO WRITE ANY OF THESE YOUR PAPER MAY NOT BE GRADED AND YOU WILL RECEIVE ZERO FOR THIS ASSESSMENT!**

8. At the end of the assessment, submit your answers as a PDF named TYY_Axxxxxx.pdf, where TYY is your tutorial group number, and Axxxxxx is your student number. **IF YOU SUBMIT USING AN INCORRECT NAMING, YOUR SCRIPT MAY NOT BE GRADED AND YOU WILL RECEIVE ZERO FOR THIS ASSESSMENT!**

9. IF LUMINUS IS AVAILABLE, Submit to your personal folder in the MIDTERMS->Txx folder, where Txx is your tutorial group number. If LumiNUS is not available, email your script, PROPERLY NAMED TYY-Axxxxxx.pdf, to cs2100.papers@gmail.com. Here TYY is your tutorial group number and Axxxxx is your student number. **REMINDER: IF YOU SUBMIT USING AN INCORRECT NAMING, YOUR SCRIPT MAY NOT BE GRADED AND YOU WILL RECEIVE ZERO FOR THIS ASSESSMENT!**

All rules in the Standard Operating Procedures are to be observed. Failure to do so may result in disciplinary action being taken against you.

NAME: _____ STUDENT ID: _____

TUTORIAL GROUP NO: _____

Questions.

Q1. What is the result of this subtraction in base 5? (2 marks)

$212_5 - 113_5 =$ _____$_5$

Q2. We are given the following sum in an unknown base v. (2 marks)

$$\begin{array}{r} 213_v \\ +\ 124_v \\ \hline 340_v \end{array}$$

The unknown base v is base _____

Q3. We are given the following subtraction in an unknown base w: (2 marks)

$$\begin{array}{r} 211_w \\ -\ 112_w \\ \hline 33_w \end{array}$$

The unknown base w is base _____

Q4. We have the following conversion in an unknown base x: (1 mark)

$3233_x = 11101111_2$

The unknown base x is base _____

For Q5 and Q6 we consider a 12-bit floating point number system, with one sign bit, 6 exponent bits in 2's complement, and 5 mantissa bits stored without any kind of rounding, with one hidden bit.

Q5. In this number system, the smallest (most negative) exponent possible is _____ and the largest exponent possible is _____. (4 marks)

Q6. The hexadecimal representation of -23.203125 in this number system is 0x_____. Use as few hexadecimal digits as possible. (1 mark)

Q7. We consider a 16-bit signed number system in excess-4096. In this a number system, the most negative number is _____ and the most positive number is _____. (1 mark)

Q8. In this question we consider the 3-digit radix complement of a number in base 7, called the 3-digit 7s complement representation. (2 marks each = 4 marks)

Find the following two decimal numbers in 3-digit 7s complement:

112_{10} = _____$_{7s}$

-213_{10} = _____$_{7s}$

Q9. Using your answers from the previous question, find the following in 3-digit 7's complement: (2 marks)

$112_{10} - 213_{10}$ = _____$_{7s}$

In Questions 10 to 13 we will consider the following MIPS assembly program. This program processes an array A of integers.

```
        addi $t0, $zero, 0
        addi $t1, $zero, 0
        addi $t2, $s3, 0
        addi $t3, $s4, -1
        sll $t3, $t3, 2
        add $t3, $s3, $t3
a:      slt $t4, $t1, $s4
        beq $t4, $zero, e
b:      slt $t4, $t2, $t3
        beq $t4, $zero, d
        lw $t4, 0($t2)
        lw $t5, 4($t2)
        slt $t6, $t4, $t5
        beq $t6, $zero, c
        sw $t4, 4($t2)
        sw $t5, 0($t2)
        addi $t0, $zero, 1
c:      addi $t2, $t2, 4
        j b
d:      beq $t0, $zero, e
        addi $t0, $zero, 0
        addi $t2, $s3, 0
        addi $t1, $t1, 1
        j a
e:
```

Q10. Choose ALL of the statements that are TRUE about this program. (2 marks)

a. Array A's base address is in register $s3.
b. Register $t1 contains the address of the current element from array A being processed.
c. Register $t3 will contain the address of the last element of the array.
d. This program reads A[i] and A[i+1], and swaps them if A[i] < A[i+1]
e. If Register $t0 is 1, the program exits.

Q11. When this program is run on an array with 5 elements, what is the MINIMUM number of instructions that will be executed? (3 marks)

Answer: _____ instructions.

Q12. When this program is run on an array with 5 elements, what is the MAXIMUM number of instructions that will be executed? (3 marks)

Answer: _____ instructions.

Q13. Suppose Array A contains the following elements (element 0 is on the left):

6, 5, 9, 2, 3

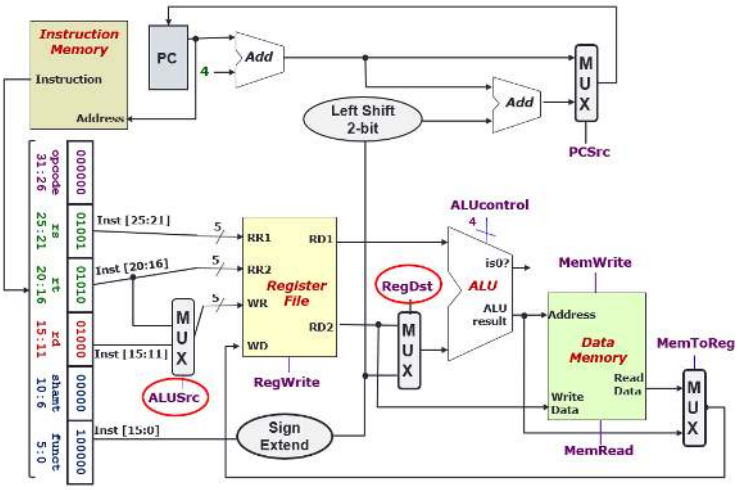
Write down the contents of Array A after running this program. (5 marks)

Answer: _____

Q14.

In a previous tutorial, Mr. De Blunder had accidentally swapped the inputs of the RegDst multiplexer, resulting in incorrect execution.

That problem has now been fixed, but in the process Mr. De Blunder accidentally swapped the RegDst and ALUSrc signals; he wired the ALUSrc signal to the RegDst multiplexer, and the RegDst signal to the ALUSrc multiplexer! This blunder is shown below, with the swapped signals circled.



Assume that each register has been initialized to its own register number. That is, register $1 contains 1, $2 contains 2, $3 contains 3, etc. Note that for non-shift instructions, shamt (shift amount) is **always zero.**

What is the result written back at the end of each of the following operations? Write your answers in decimal. (2 marks each = 8 marks)

a. sub $2, $3, $2 $2 will contain _____ after execution.

b. addi $5, $6, 7 $5 will contain _____ after execution.

c. ori $7, $8, 14336 $7 will contain _____ after execution.

d. sll $10, $10, 1 $10 will contain _____ after execution.