Computer Science and Engineering

2021 Sample Final

Answer all questions in the space provided

Student Last Name: _____

Student First Name: _____

Student ID: _____

Prism Login: _____

Section	Points	Marks
A	33	
B	33	
C	34	
Total	**100**	

Section A

A1.
Assume that registers $s0 and $s1 hold the values 0x80000000 and 0xD0000000, respectively. What is the value of $t0 for the following assembly code?

```
add $t0, $s0, $s1
add $t0, $t0, $s0
```

$t0 = 0xD0000000

A2.
For the following C/Java statement, what is the corresponding MIPS assembly code? Assume that the variables f, g, h, and i are given and could be considered 32-bit integers as declared in a C program. Use a minimal number of MIPS assembly instructions.

f = g + (h − 5);

```
addi f, h, -5  #  no subi
add f, f, g
```

A3.
Provide the type, assembly language instruction, and binary representation of instruction described by the following MIPS fields:

op=0x28, rs=4, rt=8, const=0xc

op=0x28, rs=4, rt=8, const=0xc

10 1000 00100 01000 0000 0000 0000 1100

sb $a4 $t0 0xc

sb $t0, 0xc($a4)
I type

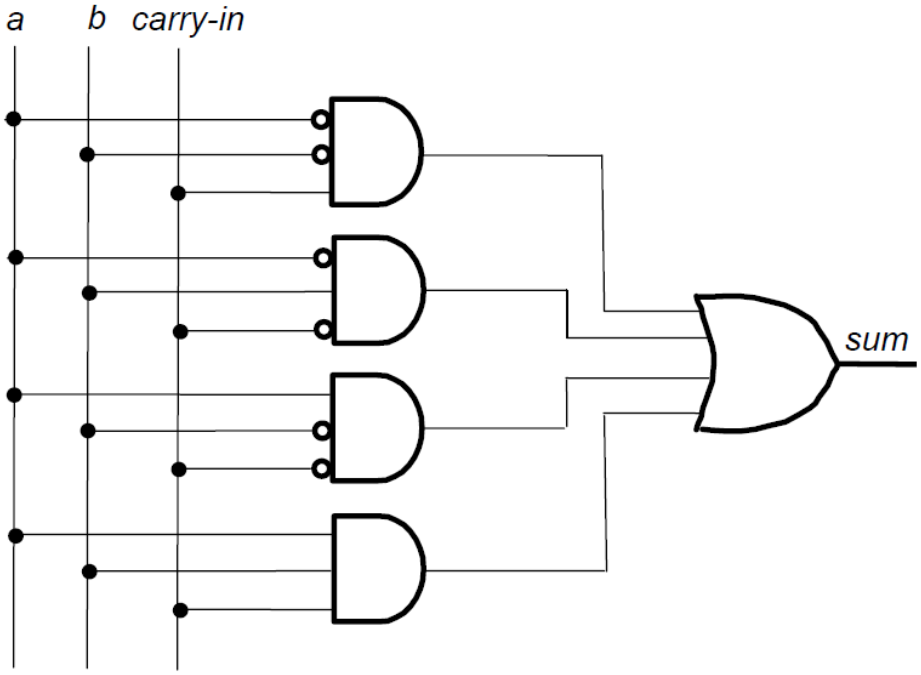
A4.

A5.
…

Section B

B1.
Use AND, OR, and NOT logic circuits to draw a combinational logic block that produces the sum output of 1-bit adder. Label clearly inputs and the output.

Answer.



B2.
Simplify the following function symbolically:

$\overline{A}C + AB + A\overline{B}C$

Answer.

$= \overline{A}C + A.(B + \overline{B}C)$

$= \overline{A}C + A.(B + C)$

$= \overline{A}C + AB + AC$

$= (\overline{A} + A).C + AB$

$= C + AB$

B3.
Show the IEEE 754 binary representation of the number -0.75_{10} in single and double precision.

Answer.
$-0.75 = (-1)^1 \times 1.12 \times 2^{-1}$
S = 1
Fraction = $1000\ldots00_2$
Exponent = –1 + Bias
Single: $-1 + 127 = 126 = 01111110_2$
Double: $-1 + 1023 = 1022 = 01111111110_2$
Single: 1011111101000…00
Double: 1011111111101000…00

B4.

B5.

B6.
…

Section C

C1.
Consider the diagram of the Single Cycle Data Path. On the diagram, show only those lines and components that will be used to execute a MIPS add instruction. Trace the lines and circle the components using a coloured pen. Do not pay attention to control signals when answering this question.

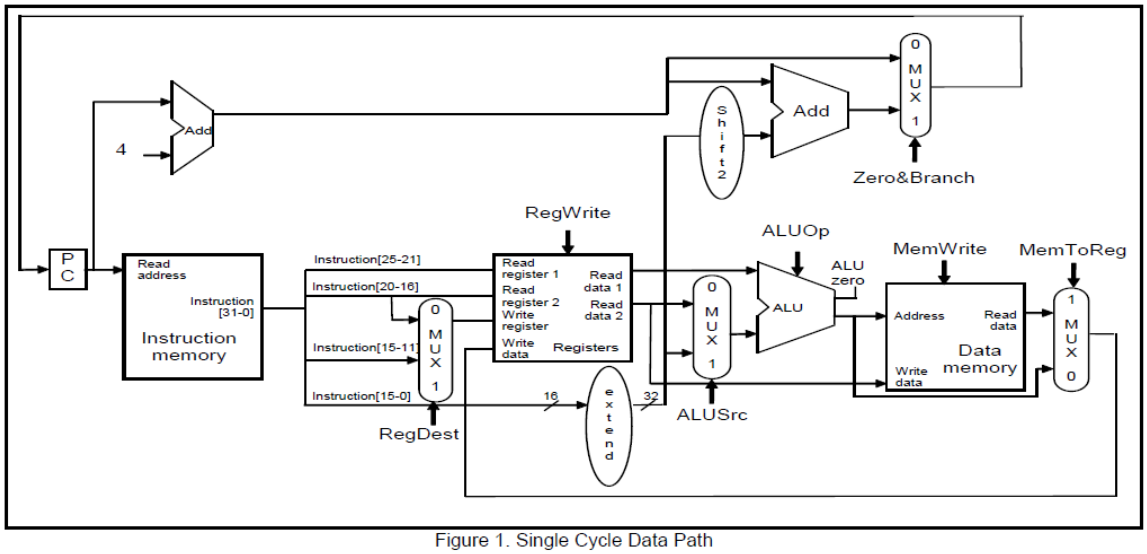
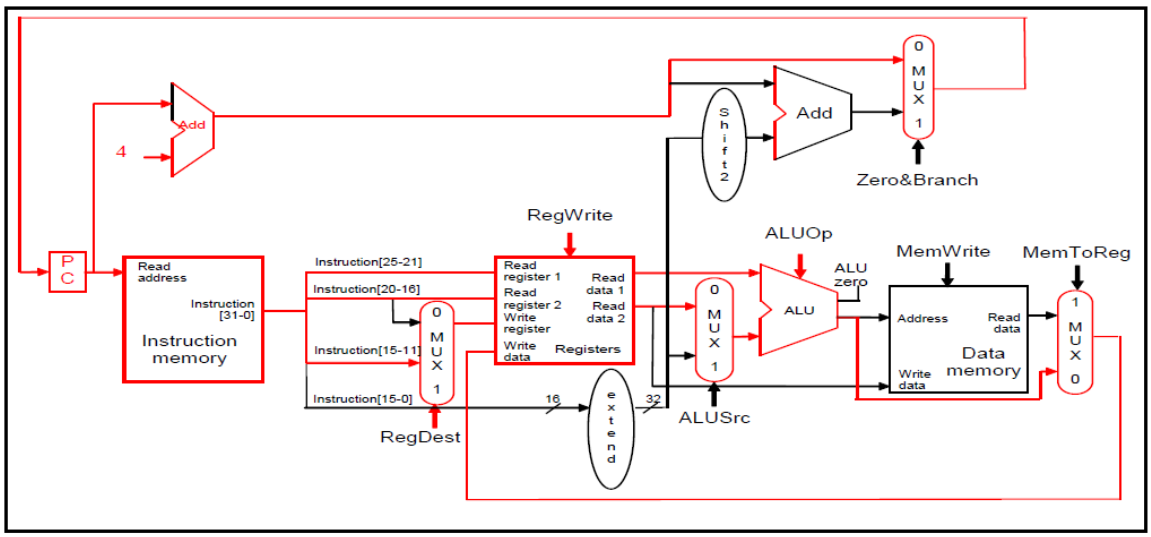


Figure 1. Single Cycle Data Path

Answer.



C2.

In this example, we limit our attention to eight instructions: load word (lw), store word (sw), add (add), subtract (sub), AND (and), OR (or), set less than (slt), and branch on equal (beq).

Compare the average time between instructions of a single-cycle implementation, in which all instructions take one clock cycle, to a pipelined implementation. The operation times for the major functional units in this example are 200 ps for memory access, 200 ps for ALU operation, and 100 ps for register file read or write. In the single-cycle model, every instruction takes exactly one clock cycle, so the clock cycle must be stretched to accommodate the slowest instruction.

Answer.

See page 274 of textbook.

C3.

C4.

…