Final Exam - Summer 2019

CMPE 012: Computer Systems and Assembly Language

University of California, Santa Cruz

DO NOT BEGIN UNTIL YOU ARE TOLD TO DO SO.

This exam is closed book and closed notes. Only 4-function calculators are permitted. Answers must be written on the attached sheets to be graded. All work must be written on the exam.

On this page, write your last name, first name, CruzID, row and seat numbers, and the CruzIDs of the people to your immediate left and right. Once you are permitted to begin, write your CruzID on all subsequent pages of the exam.

You must sit in your assigned seat. Keep your student or government issued ID on your desk. Brimmed hats must be removed or turned around backwards. Only unmarked water bottles are permitted. Backpacks must be placed at the front of the room or along the walls. Your cell phone must be on a setting where it will not make noise or vibrate.

For full credit, you must show your work, and your handwriting must be clearly legible.

There are 7 questions on this exam. Questions are worth 4 - 12 points each. You only need to earn 36 points to receive 100%. Questions total 54 points, however the maximum number of points you can earn is 45 points (125%).

This table is for CMPE 012 staff only.

QUESTION	POSSIBLE POINTS	POINTS EARNED
1	4	
2	6	
3	6	
4	8	
5	12	
6	8	
7	10	
TOTAL	54	sum: score: (max 45)

_____ _____ _____

Row # Seat # CruzID

_____ _____

Your Last Name Your First Name

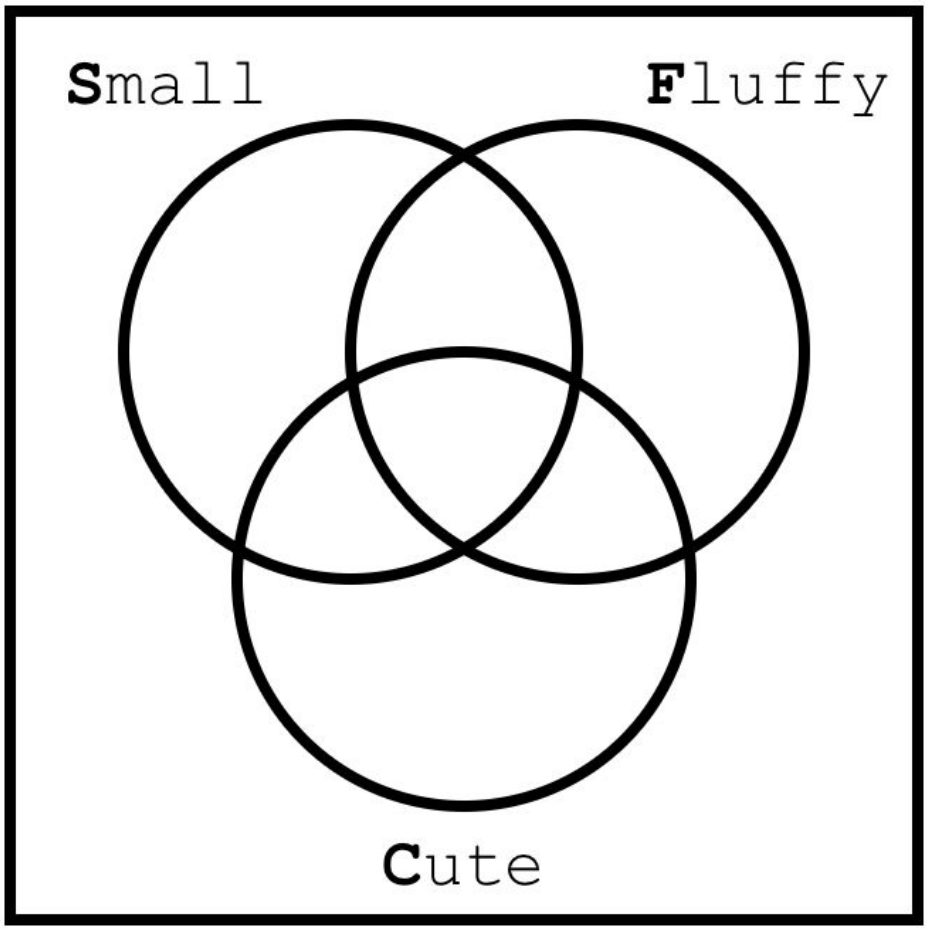
_____ _____

CruzID of person to left CruzID of person to right

Question 1: Boolean Algebra _____ / 4 pt

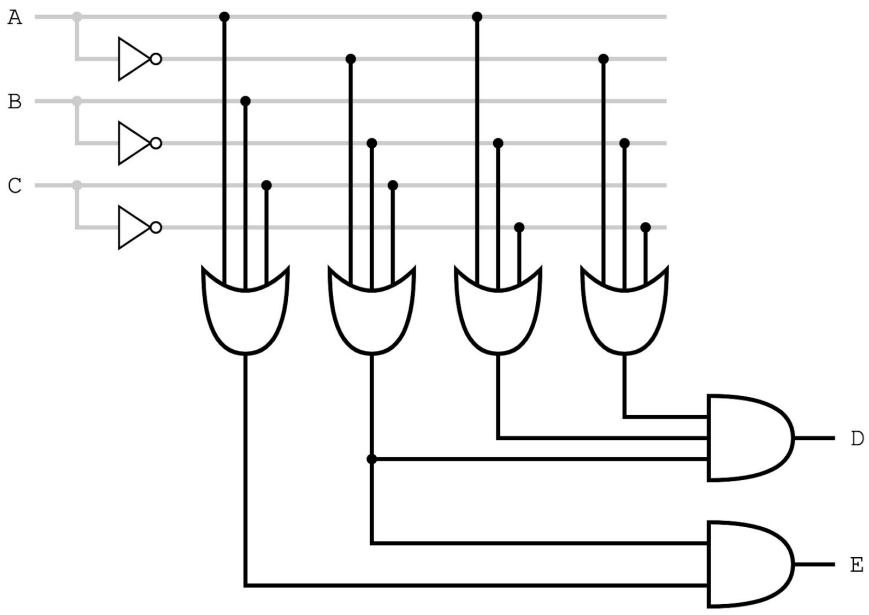
Shade the appropriate areas of the Venn Diagram to match the following Boolean expression. Assume shaded areas are where the expression equals TRUE:

S'FC' + SF + C + S'F'C'



Question 2: Combinational Logic _____ / 6 pt

Complete the truth table for the following PLA. Write the unsimplified sum of products and product of sums solutions for each of the two outputs, D and E.



Truth Table ___ / 2 pt

Write your answer here

A	B	C	D	E
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

Output D ___ / 2 pt

Write your answer here

Sum of Products

D =

Product of Sums

D =

Output E ___ / 2 pt

Write your answer here

Sum of Products

E =

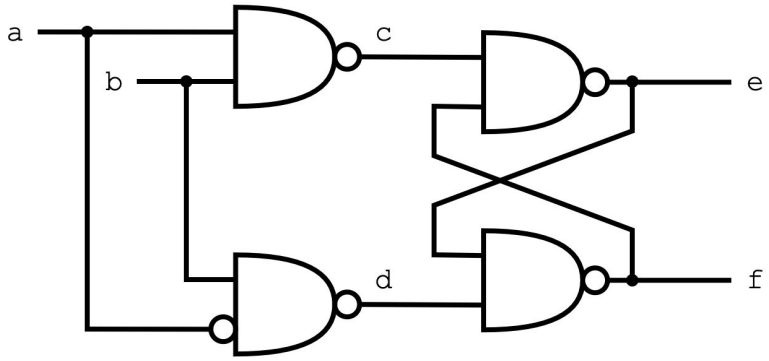
Product of Sums

E =

You may show your work on this page if needed

Question 3: Sequential Logic _____ / 6 pt

Complete the truth table and timing diagram for the following circuit.



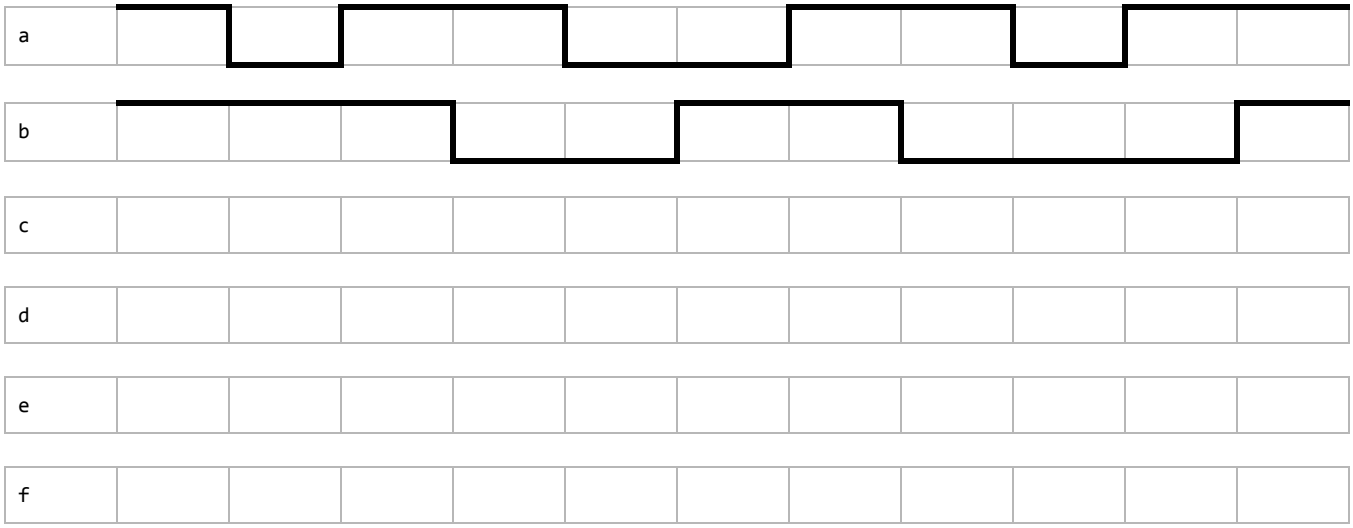
Truth Table ___ / 2 pt

Write your answer here

a	b	c	d	e	f
0	0				
0	1				
1	0				
1	1				

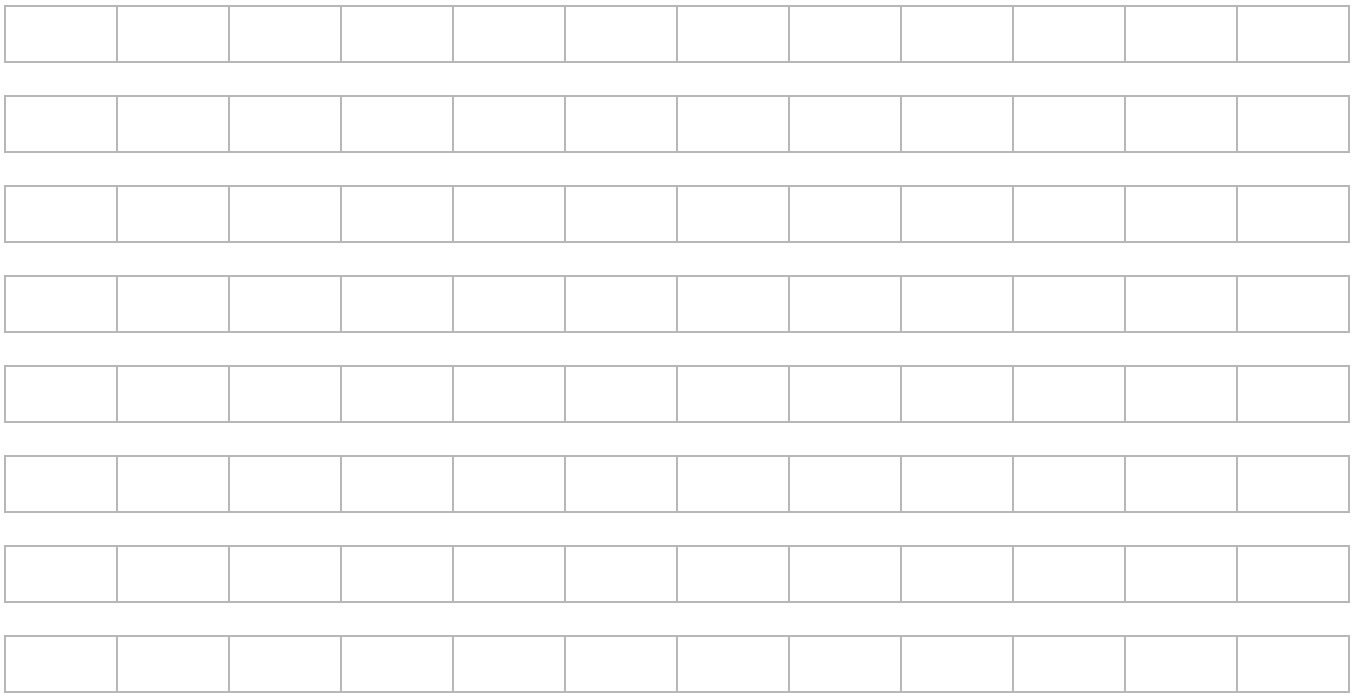
Timing Diagram ___ / 4 pt

Write your answer here



You may show your work on this page if needed

These are extra blank timing diagrams that you may use.



Question 4: Floating Point Conversion _____ / 8 pt

Convert the decimal fraction -0.9 to IEEE single precision floating point format. Follow the steps below, writing all answers in the boxes provided.

Part A - Fractional Binary Form ___ / 2 pt

Write the number in fractional binary form. Indicate if the number is positive (+) or negative (-) in the first blank. Indicate the location of the binary point and where the number repeats if necessary.

Write your answer here

_____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____

(+/-)

Show your work below

Part B - Scientific Notation ___ / 1 pt

Express your answer from Part A in scientific notation.

Write your answer here

Show your work below

Part C - Field Values ___ / 4 pt

Determine the values for each of the fields in the IEEE single precision floating point format.

Write your answer here

Show your work below

Part D - Final Answer ___ / 1 pt

Use your answer from Part C to convert -0.9 to IEEE single precision floating point format. Express your answer using hexadecimal digits.

Write your answer here

0x _____ _____ _____ _____ _____ _____ _____ _____

Show your work below

You may show your work on this page if needed

Question 5: Data Movement, Syscalls _____ / 12 pt

The following program is executed. Assume little endian memory storage. Assume "some_data" is the label for address 0x10010000. At different points of the program, you will be asked to write the values stored in registers and memory.

```
.data
some_data: .byte 0x66 0x6c 0x75 0x78 0x00 0x80

.text
addiu   $v0   $zero     4   # instruction 1
la      $a0   some_data     # instruction 2  <----- show regs & mem (1 pt)
syscall                     # instruction 3  <----- show console    (1 pt)

addiu   $v0   $zero     34  # instruction 4
syscall                     # instruction 5  <----- show console    (2 pt)

add     $t0   $zero    $a0  # instruction 6

lw      $a0    ($a0)        # instruction 7  <----- show regs & mem (1 pt)
syscall                     # instruction 8  <----- show console    (2 pt)

lb      $t1   3($t0)        # instruction 9
sh      $t1   2($t0)        # instruction 10 <----- show regs & mem (2 pt)

addiu   $v0   $zero     4   # instruction 11
add     $a0   $zero    $t0  # instruction 12 <----- show regs & mem (1 pt)
syscall                     # instruction 13 <----- show console    (2 pt)
```

*What is the state of memory and registers after instruction **2**? If unknown, write '?'*

MEMORY

ADDRESS	DATA
0x10010005	0x
0x10010004	0x
0x10010003	0x
0x10010002	0x
0x10010001	0x
0x10010000	0x

REGISTERS

REGISTER	VALUE
$a0	0x
$v0	0x
$t0	0x
$t1	0x

*What is shown in the console window after instruction **3**? Write "___" to indicate a space.*

*What is shown in the console window after instruction **5**?*

Write "___" to indicate a space. Hint: Include text printed from previous syscalls.

*What is the state of memory and registers after instruction **7**? If unknown, write '?'*

MEMORY

ADDRESS	DATA
0x10010005	0x
0x10010004	0x
0x10010003	0x
0x10010002	0x
0x10010001	0x
0x10010000	0x

REGISTERS

REGISTER	VALUE
$a0	0x
$v0	0x
$t0	0x
$t1	0x

*What is shown in the console window after instruction **8**?*

Write "___" to indicate a space. Hint: Include text printed from previous syscalls.

*What is the state of memory and registers after instruction **10**? If unknown, write '?'*

MEMORY

ADDRESS	DATA
0x10010005	0x
0x10010004	0x
0x10010003	0x
0x10010002	0x
0x10010001	0x
0x10010000	0x

REGISTERS

REGISTER	VALUE
$a0	0x
$v0	0x
$t0	0x
$t1	0x

*What is the state of memory and registers after instruction **12**? If unknown, write '?'*

MEMORY

ADDRESS	DATA
0x10010005	0x
0x10010004	0x
0x10010003	0x
0x10010002	0x
0x10010001	0x
0x10010000	0x

REGISTERS

REGISTER	VALUE
$a0	0x
$v0	0x
$t0	0x
$t1	0x

*What is shown in the console window after instruction **13**?*

Write "___" to indicate a space. Hint: Include text printed from previous syscalls.

Question 6: MIPS Instruction Encoding, Data Path _____ / 8 pt

Part A - Instruction Encoding ___ / *4 pt*

Encode the following instruction. Express your answer using hexadecimal digits.

```
lb $8 7($3)
```

Write your answer here

0x _____ _____ _____ _____ _____ _____ _____ _____

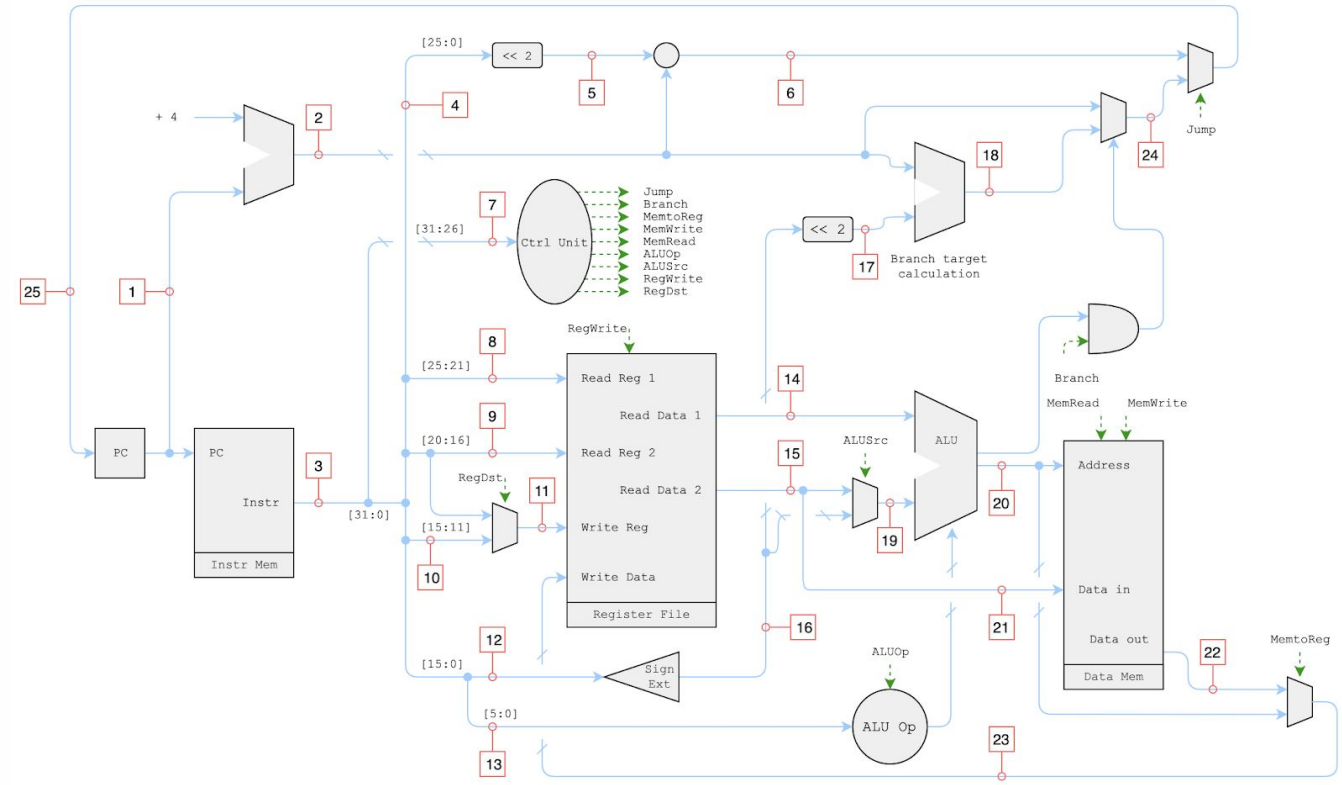
Show your work below

Part B - Data Path *___ / 4 pt*

Assume the following initial conditions:

```
$v0   0x1001aa00   | $t0  0x10010000   | $t6  0x10016600   | $s2  0xDEADBEEF
$v1   0x1001bb00   | $t1  0x10011100   | $t7  0x10017700   | $s3  0xFACE0FFF
$a0   0x1001cc00   | $t2  0x10012200   | $t8  0x10018800   | $s4  0xBAAAAAAA
$a1   0x1001dd00   | $t3  0x10013300   | $t9  0x10019900   | $s5  0xFEEDBABE
$a2   0x1001ee00   | $t4  0x10014400   | $s0  0xBAADCAFE   | $s6  0x5EA51DE0
$a3   0x1001ff00   | $t5  0x10015500   | $s1  0xC0FFEEEE   | $s7  0x00000000
```

Use your answer from Part A to determine the values on the wires listed in the table below. Refer to the following datapath diagram.



WIRE	VALUE (IN HEX)
11	0x
12	0x
14	0x
15	0x
16	0x
17	0x
19	0x
20	0x

Question 7: MIPS Instruction Encoding, Data Path _____ / 10 pt

Part A - Instruction Encoding ___ / *4 pt*

Encode the branch instruction from the following code. Express your answer using hexadecimal digits. (Hints: BTA = pc + 4 + offset, immediate field = offset >> 2)

```
ADDRESS   INSTRUCTION

0x1000          beq $s0 $s0 label
0x1004          nop
0x1008          nop
0x100C          nop
0x1010    label: nop
```

Write your answer here

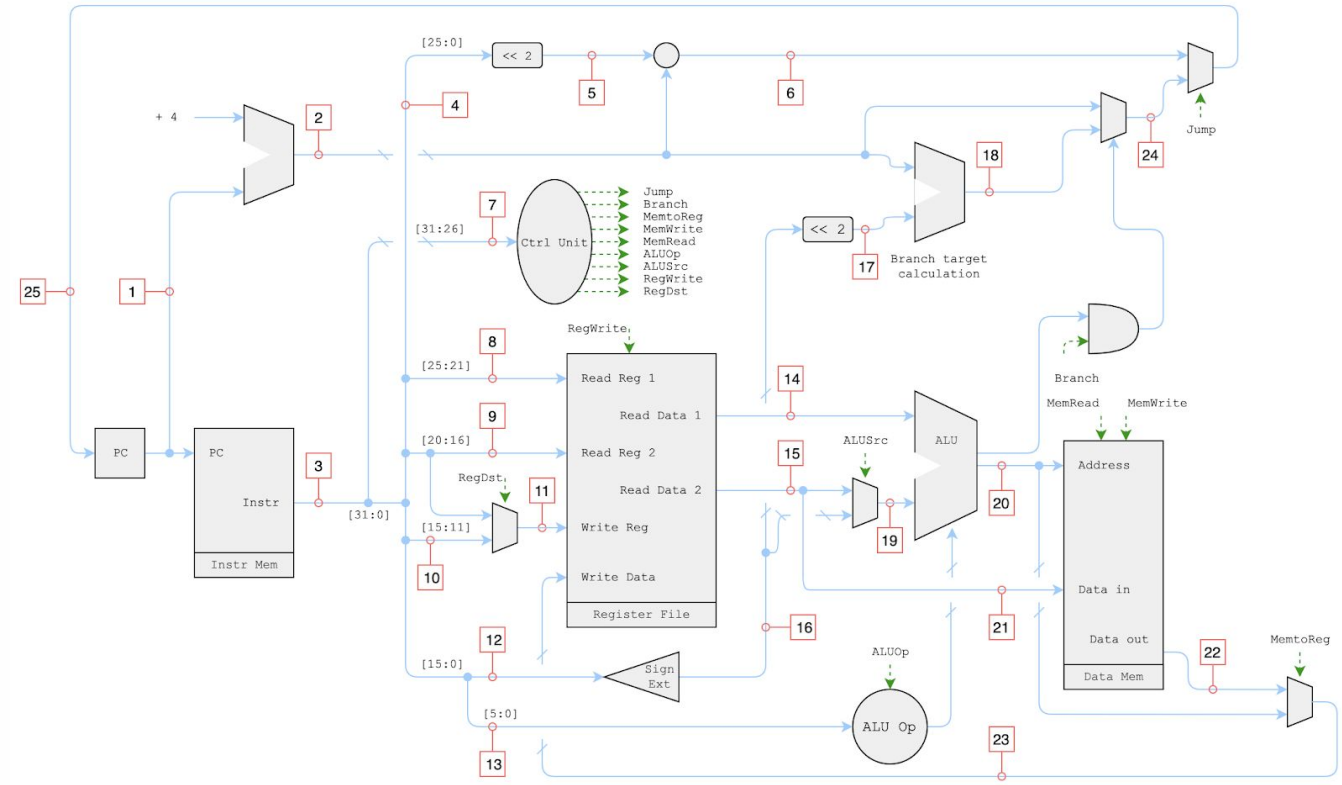
0x _____ _____ _____ _____ _____ _____ _____ _____

Show your work below

Part B - Data Path *___ / 6 pt*

Determine the values for the wires listed in the table below for the branch instruction encoded in Part A.

Use your answer from Part A to determine the values on the wires listed in the table below. Refer to the following datapath diagram.



WIRE	VALUE (IN HEX)
1	
2	
3	
7	
8	
9	
12	
16	
17	
18	
24	
25	