

## Review Test Submission: Midterm 2

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Course	CS-3853-001-Spring-2020-Computer Architecture
Test	Midterm 2
Started	4/8/20 3:53 PM
Submitted	4/8/20 4:53 PM
Due Date	4/8/20 5:15 PM
Status	Completed
Attempt Score	49 out of 50 points
Time Elapsed	59 minutes out of 1 hour and 15 minutes
Instructions	<ol style="list-style-type: none"> <li>1. Please let me know ASAP if you have technical difficulties.</li> <li>2. The length of this exam is one hour and 15 minutes (i.e., <b>75 minutes</b>). I will not force submission, and <b>your submission may be late for &lt;10 minutes</b>. But I will take <b>20% late penalty</b> for any submissions that are late for more than 10 minutes. It is much better to submit in-time than wait. <b>For students who need special accommodation, the test length is based on the time set by SDS.</b></li> <li>3. This exam is closed-book, closed-notes, and closed-everything. Please be honest.</li> <li>4. Please answer all the questions and check your answers before submission.</li> <li>5. This exam will be <b>manually graded</b>. Please ignore the auto-grading.</li> <li>6. Test must be finished in one sitting.</li> <li>7. Test must be taken during the designated time (Apr 8th 4pm to 5:15pm, 2020), unless explicitly permitted by the instructor.</li> </ol>
Results Displayed	Submitted Answers, Correct Answers, Feedback, Incorrectly Answered Questions

## Question 1

2 out of 2 points



The simple RISC architecture we learned in this class has five stages. What operations does the second stage perform? Please give all the operations performed in that stage.

Selected Answer: The second stage Instruction Decode (ID) performs the Instruction Decode and Register Read operations.

Correct Answer: Instruction decode and register read.

Response [None Given]

Feedback:

## Question 2

2 out of 2 points



A multiplexer is used to select inputs. What are the two inputs to the multiplexer used in the **writeback** (WB) stage?

Selected Answers: 3. Mem Data

4. ALU\_Out

Correct Answers: 3. Mem Data

4. ALU\_Out

## Question 3

3 out of 3 points



Why immediate values in the instructions cannot be directly used for ALU operations? How does the CPU process the immediate values before using them as ALU operands?

Selected Answer: The immediate values are initially encoded as instructions, so we must use sign extension to be able to pass it through the ALU.

Correct Answer: Because the immediate values have fewer bits than the operands used for ALU. Immediate values need to be "sign extended": extending a immediate value with fewer bits (e.g., 16 bits) to an immediate value with more bits (e.g., 32 bits) while retaining the sign.

Response Feedback: [None Given]

#### Question 4

1 out of 1 points



In our simple CPU implementation, which stage does the CPU check the condition of a branch instruction?

Selected Answer: Memory Stage

Correct Answer: EX

Response Feedback: [None Given]

#### Question 5

2 out of 2 points



What is the difference between an exception and an interrupt?

Selected Answer: An exception is generated from software inside the processor, and interrupt is generated outside of the processor from external sources.

Correct Answer: An interruption is an exception generated by an external source.

Response Feedback: [None Given]

#### Question 6

1 out of 1 points



In our simple CPU implementation, which stage does the CPU completes a branch instruction?

Selected Answer: ME

Correct Answer: ME

#### Question 7

2 out of 2 points



What is the motivation of employing separated instruction cache and data cache?

Selected Answer: To avoid running into structural hazards.

Correct Answer: To eliminate structural hazards for memory accesses.

Response Feedback: [None Given]

#### Question 8

2 out of 2 points



Why **assume-taken** is not a solution to control hazards?

Selected Answer: Assume-taken, as opposed to assume-not taken, is not a solution because branch target is computed at execution stage far from when the next instruction needs to be provided.

Correct Answer: Assume taken still requires computing the branch target, which will not be available until after the execution stage.

Response [None Given]  
Feedback:

**Question 9**

1 out of 1 points



Consider a pipelined RISC CPU with 15 stages. What is maximum speedup of this CPU over a non-pipelined implementation?

Selected Answer: Stages =  $m = 15$ , assuming infinite instructions for maximum speedup,  
Speedup = 15

Correct Answer: 15

Response Feedback: [None Given]

**Question 10**

1 out of 1 points



Given a 3-bit Global Branch History Buffer, how many Branch History Tables do we need?

Selected Answer: 3-bit.  $m = 3 = 3$  branches  
 $BHT = 2^m = 2^3 = 8$  Branch History Tables

Correct Answer: 8

Response Feedback: [None Given]

**Question 11**

0 out of 1 points



A branch that is used to check a loop's condition is better predicted with a 2-bit saturating counter.

Selected Answer: False

Correct Answer: True

**Question 12**

12 out of 12 points



Please fill the following table with branch predictor states and branch outcome predictions using the 2-bit saturated counter. For taken, please write "T". For not taken, please write "NT".

State	Prediction	Actual Branch Outcome
00	NT	Not Taken
[2.00]	[2.NT]	Not Taken
[3.00]	[3.NT]	Not Taken
[4.00]	[4.NT]	Not Taken
[5.00]	[5.NT]	Taken
[6.01]	[6.NT]	Taken
[7.11]	[7.T]	Taken
[8.11]	[8.T]	Not Taken
[9.10]	[9.T]	Not Taken
[10.00]	[10.NT]	Not Taken

Specified Answer for: 2.00 00

Specified Answer for: 2.NT NT

Specified Answer for: 3.00 00

Specified Answer for: 3.NT NT

Specified Answer for: 4.00 00

Specified Answer for: 4.NT NT

Specified Answer for: 5.00 00

Specified Answer for: 5.NT NT

Specified Answer for: 6.01 ✓ 01  
 Specified Answer for: 6.NT ✓ NT  
 Specified Answer for: 7.11 ✓ 11  
 Specified Answer for: 7.T ✓ T  
 Specified Answer for: 8.11 ✓ 11  
 Specified Answer for: 8.T ✓ T  
 Specified Answer for: 9.10 ✓ 10  
 Specified Answer for: 9.T ✓ T  
 Specified Answer for: 10.00 ✓ 00  
 Specified Answer for: 10.NT ✓ NT

<b>Correct Answers for: 2.00</b>		
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>
✓ <i>Exact Match</i>	00	
<b>Correct Answers for: 2.NT</b>		
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>
✓ <i>Exact Match</i>	NT	
<b>Correct Answers for: 3.00</b>		
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>
✓ <i>Exact Match</i>	00	
<b>Correct Answers for: 3.NT</b>		
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>
✓ <i>Exact Match</i>	NT	
<b>Correct Answers for: 4.00</b>		
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>
✓ <i>Exact Match</i>	00	
<b>Correct Answers for: 4.NT</b>		
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>
✓ <i>Exact Match</i>	NT	
<b>Correct Answers for: 5.00</b>		
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>
✓ <i>Exact Match</i>	00	
<b>Correct Answers for: 5.NT</b>		
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>
✓ <i>Exact Match</i>	NT	
<b>Correct Answers for: 6.01</b>		
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>
✓ <i>Exact Match</i>	01	
<b>Correct Answers for: 6.NT</b>		
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>
✓ <i>Exact Match</i>	NT	
<b>Correct Answers for: 7.11</b>		
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>
✓ <i>Exact Match</i>	11	
<b>Correct Answers for: 7.T</b>		
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>
✓ <i>Exact Match</i>	T	
<b>Correct Answers for: 8.11</b>		

Evaluation Method	Correct Answer	Case Sensitivity
✓ Exact Match	11	
<b>Correct Answers for: 8.T</b>		
Evaluation Method	Correct Answer	Case Sensitivity
✓ Exact Match	T	
<b>Correct Answers for: 9.10</b>		
Evaluation Method	Correct Answer	Case Sensitivity
✓ Exact Match	10	
<b>Correct Answers for: 9.T</b>		
Evaluation Method	Correct Answer	Case Sensitivity
✓ Exact Match	T	
<b>Correct Answers for: 10.00</b>		
Evaluation Method	Correct Answer	Case Sensitivity
✓ Exact Match	00	
<b>Correct Answers for: 10.NT</b>		
Evaluation Method	Correct Answer	Case Sensitivity
✓ Exact Match	NT	

## Question 13

20 out of 20 points



Consider the code segment below. Assume that every pipeline stage takes a single cycle. Assume X and Y are constants. Assume that at the branch instruction, R2 is not zero and **the branch will be taken**. Assume data bypassing/forwarding is implemented. Assume there is no branch prediction (or any other control hazard solutions). You may not reorder instructions. You can fill the pipeline slots with stalls/bubbles as needed. The instructions are in the format of "opcode, dest, src1, src2".

```

L0: mov R1, [X]
    mov R2, [Y]
    sub R2, R2, R1
    jnz R2, L1
    ...
    ...
L1: add R3, R4, R5

```

Please fill the following table to represent the execution of this code on a standard 5-stage RISC pipeline. From empty cells (empty cycles), please write "\_" (underscore).

Cycles	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
mov R1, [X]	[1.IF]	[1.ID]	[1.EX]	[1.ME]	[1.WB]	[1.X1]	[1.X2]	[1.X3]	[1.X4]								
mov R2, [Y]		[2.IF]	[2.ID]	[2.EX]	[2.ME]	[2.WB]	[2.X1]	[2.X2]	[2.X3]	[2.X4]							
sub R2, R2, R1			[3.IF]	[3.ID]	[3.BU]	[3.EX]	[3.ME]	[3.WB]	[3.X1]	[3.X2]	[3.X3]						
jnz R2, L1				[4.IF]	[4.BU]	[4.ID]	[4.EX]	[4.ME]	[4.WB]	[4.X1]	[4.X2]	[4.X3]					
add R3, R4, R5					[5.BU1]	[5.BU2]	[5.BU3]	[5.BU4]	[5.IF]	[5.ID]	[5.EX]	[5.ME]	[5.WB]	[5.X1]	[5.X2]	[5.X3]	[5.X4]

Specified Answer for: 1.IF ✓ IF

Specified Answer for: 1.ID ✓ ID

Specified Answer for: 1.EX ✖ E

Specified Answer for: 1.ME ✖ M

Specified Answer for: 1.WB ✖ W

Specified Answer for: 1.X1 ✔ \_

Specified Answer for: 1.X2 ✔ \_

Specified Answer for: 1.X3 ✔ \_

Specified Answer for: 1.X4 ✔ \_

Specified Answer for: 2.IF ✔ IF

Specified Answer for: 2.ID ✔ ID

Specified Answer for: 2.EX ✖ E

Specified Answer for: 2.ME ✖ M

Specified Answer for: 2.WB ✖ W

Specified Answer for: 2.X1 ✔ \_

Specified Answer for: 2.X2 ✔ \_

Specified Answer for: 2.X3 ✔ \_

Specified Answer for: 2.X4 ✔ \_

Specified Answer for: 3.IF ✔ IF

Specified Answer for: 3.ID ✔ ID

Specified Answer for: 3.BU ✖ B

Specified Answer for: 3.EX ✖ E

Specified Answer for: 3.ME ✖ M

Specified Answer for: 3.WB ✖ W

Specified Answer for: 3.X1 ✔ \_

Specified Answer for: 3.X2 ✔ \_

Specified Answer for: 3.X3 ✔ \_

Specified Answer for: 4.IF ✔ IF

Specified Answer for: 4.BU ✖ B

Specified Answer for: 4.ID ✔ ID

Specified Answer for: 4.EX ✖ E

Specified Answer for: 4.ME ✖ M

Specified Answer for: 4.WB ✖ W

Specified Answer for: 4.X1 ✔ \_

Specified Answer for: 4.X2 ✔ \_

Specified Answer for: 4.X3 ✔ \_

Specified Answer for: 5.BU1 ✖ B

Specified Answer for: 5.BU2 ✖ B

Specified Answer for: 5.BU3 ✖ B

Specified Answer for: 5.BU4 ✖ B

Specified Answer for: 5.IF ✔ IF

Specified Answer for: 5.ID ✔ ID

Specified Answer for: 5.EX ✖ E



Specified Answer for: 5.ME ✖ M

Specified Answer for: 5.WB ✖ W

Specified Answer for: 5.X1 ✔ \_

Specified Answer for: 5.X2 ✔ \_



Specified Answer for: 5.X3  \_Specified Answer for: 5.X4  \_**Correct Answers for: 1.IF****Evaluation Method** *Exact Match***Correct Answer**

IF

**Case Sensitivity****Correct Answers for: 1.ID****Evaluation Method** *Exact Match***Correct Answer**

ID

**Case Sensitivity****Correct Answers for: 1.EX****Evaluation Method** *Exact Match***Correct Answer**

EX

**Case Sensitivity****Correct Answers for: 1.ME****Evaluation Method** *Exact Match***Correct Answer**

ME

**Case Sensitivity****Correct Answers for: 1.WB****Evaluation Method** *Exact Match***Correct Answer**

WB

**Case Sensitivity****Correct Answers for: 1.X1****Evaluation Method** *Contains***Correct Answer**

-

**Case Sensitivity****Correct Answers for: 1.X2****Evaluation Method** *Contains***Correct Answer**

-

**Case Sensitivity****Correct Answers for: 1.X3****Evaluation Method** *Contains***Correct Answer**

-

**Case Sensitivity****Correct Answers for: 1.X4****Evaluation Method** *Contains***Correct Answer**

-

**Case Sensitivity****Correct Answers for: 2.IF****Evaluation Method** *Contains***Correct Answer**

IF

**Case Sensitivity****Correct Answers for: 2.ID****Evaluation Method** *Contains***Correct Answer**

ID

**Case Sensitivity****Correct Answers for: 2.EX****Evaluation Method** *Contains***Correct Answer**

EX

**Case Sensitivity****Correct Answers for: 2.ME****Evaluation Method** *Contains***Correct Answer**

ME

**Case Sensitivity****Correct Answers for: 2.WB****Evaluation Method** *Exact Match***Correct Answer**

WB

**Case Sensitivity****Correct Answers for: 2.X1****Evaluation Method** *Contains***Correct Answer**

-

**Case Sensitivity**

<b>Correct Answers for: 2.X2</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	-		
<b>Correct Answers for: 2.X3</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	-		
<b>Correct Answers for: 2.X4</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	-		
<b>Correct Answers for: 3.IF</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Exact Match	IF		
<b>Correct Answers for: 3.ID</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Exact Match	ID		
<b>Correct Answers for: 3.BU</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	BU		
✔ Contains	ST		
<b>Correct Answers for: 3.EX</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	EX		
<b>Correct Answers for: 3.ME</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	ME		
<b>Correct Answers for: 3.WB</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Exact Match	WB		
<b>Correct Answers for: 3.X1</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	-		
<b>Correct Answers for: 3.X2</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	-		
<b>Correct Answers for: 3.X3</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	-		
<b>Correct Answers for: 4.IF</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Exact Match	IF		
<b>Correct Answers for: 4.BU</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	BU		
✔ Contains	ST		
<b>Correct Answers for: 4.ID</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Exact Match	ID		
<b>Correct Answers for: 4.EX</b>			





<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	EX		
<b>Correct Answers for: 4.ME</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	ME		
<b>Correct Answers for: 4.WB</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Exact Match	WB		
<b>Correct Answers for: 4.X1</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	-		
<b>Correct Answers for: 4.X2</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	-		
<b>Correct Answers for: 4.X3</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	-		
<b>Correct Answers for: 5.BU1</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	BU		
✔ Contains	ST		
<b>Correct Answers for: 5.BU2</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	BU		
✔ Contains	ST		
<b>Correct Answers for: 5.BU3</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	BU		
✔ Contains	ST		
<b>Correct Answers for: 5.BU4</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	BU		
✔ Exact Match	ST		
<b>Correct Answers for: 5.IF</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Exact Match	IF		
<b>Correct Answers for: 5.ID</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Exact Match	ID		
<b>Correct Answers for: 5.EX</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	EX		
<b>Correct Answers for: 5.ME</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	
✔ Contains	ME		
<b>Correct Answers for: 5.WB</b>			
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>	



✔ <i>Exact Match</i>	WB	
<b>Correct Answers for: 5.X1</b>		
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>
✔ <i>Contains</i>	-	
<b>Correct Answers for: 5.X2</b>		
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>
✔ <i>Contains</i>	-	
<b>Correct Answers for: 5.X3</b>		
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>
✔ <i>Contains</i>	-	
<b>Correct Answers for: 5.X4</b>		
<b>Evaluation Method</b>	<b>Correct Answer</b>	<b>Case Sensitivity</b>
✔ <i>Contains</i>	-	

Monday, May 11, 2020 1:59:27 PM CDT

← OK

