

Final Exam S1

Computer Architecture

Answer on the worksheet

Duration: 1 hr 30 min.

Last name: First name: Group:

Exercise 1 (2 points)

Convert the following numbers from the source form into the destination form. Do not write down the result in a fraction or a power form (e.g. write down 0.25 and not $\frac{1}{4}$ or 2^{-2}). Write down the result only (do not show any calculation).

Number to Convert	Source Form	Destination Form	Result
10011101.01	Binary	Decimal	
B5.4	Hexadecimal	Decimal	
126	Decimal	Hexadecimal	
101011001.11101	Binary	Hexadecimal	

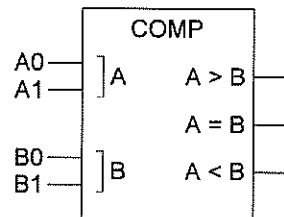
Exercise 2 (5 points)

Perform the following 8-bit binary operations (the two operands and the result are 8 bits wide). Then, convert the result into unsigned and signed decimal values. If an overflow occurs, write down 'ERROR' instead of the decimal value.

Operation	Binary Result	Decimal Value	
		Unsigned	Signed
11101101 + 11101110			
11110000 – 11001010			
01101110 – 11011110			
11111111 – 11111111			
11111111 + 11111111			

Exercise 3 (4 points)

We want to design the following comparator:



The A and B inputs are 2-bit unsigned integers ($A0$ and $B0$ are the LSBs):

- If $A > B$, the ' $A > B$ ' output is set to 1 and the other outputs are set to 0.
- If $A = B$, the ' $A = B$ ' output is set to 1 and the other outputs are set to 0.
- If $A < B$, the ' $A < B$ ' output is set to 1 and the other outputs are set to 0.

1. Complete the following truth table:

A1	A0	B1	B0	A > B	A = B	A < B
0	0	0	0			
0	0	0	1			
0	0	1	0			
0	0	1	1			
0	1	0	0			
0	1	0	1			
0	1	1	0			
0	1	1	1			
1	0	0	0			
1	0	0	1			
1	0	1	0			
1	0	1	1			
1	1	0	0			
1	1	0	1			
1	1	1	0			
1	1	1	1			

2. Without using Karnaugh maps, give the most simplified expression of the ' $A = B$ ' output. Use the **EXCLUSIVE-OR** operator to simplify the expression. Write down the result only (do not show any calculation).

3. Complete the Karnaugh maps below and give the most simplified expressions of the ' $A > B$ ' and ' $A < B$ ' outputs. No points will be given to an expression if its Karnaugh map is wrong.

		B1 B0			
$A > B$		00	01	11	10
A1 A0	00				
	01				
	11				
	10				

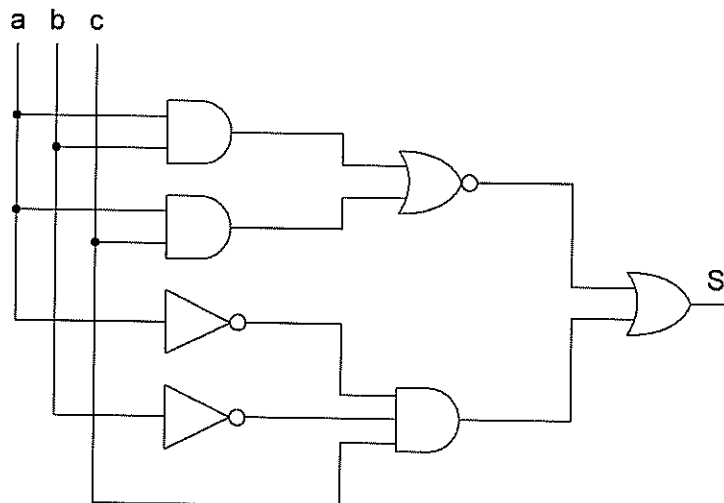
' $A > B$ ' =

		B1 B0			
$A < B$		00	01	11	10
A1 A0	00				
	01				
	11				
	10				

' $A < B$ ' =

Exercise 4 (3 points)

We want to simplify the following circuit diagram:



1. Without any simplifications, give the S output in terms of a , b and c .

2. Simplify the expression of S by using the algebraic method. Show all calculations.

3. From the simplified expression, draw a new circuit diagram by using three NOT gates, one AND gate and one OR gate.

Exercise 5 (6 points)

Let us consider the truth tables below. A , B , C and D are the inputs. U , V , W , X , Y and Z are the outputs.

A	B	C	U	V
0	0	0	0	1
0	0	1	1	1
0	1	0	0	1
0	1	1	1	1
1	0	0	0	1
1	0	1	0	0
1	1	0	0	0
1	1	1	0	1

A	B	C	W	X
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	0	0

A	B	C	D	Y	Z
0	0	0	0	0	1
0	0	0	1	0	0
0	0	1	0	0	1
0	0	1	1	Φ	0
0	1	0	0	0	0
0	1	0	1	0	Φ
0	1	1	0	0	0
0	1	1	1	Φ	Φ
1	0	0	0	Φ	1
1	0	0	1	Φ	0
1	0	1	0	1	1
1	0	1	1	1	0
1	1	0	0	1	0
1	1	0	1	1	Φ
1	1	1	0	1	0
1	1	1	1	1	Φ

1. Write down the minterm canonical form of U .

2. Write down the maxterm canonical form of V .

3. Complete the Karnaugh maps below (circles included) and give the most simplified expression for each output. **No points will be given to an expression if its Karnaugh map is wrong. For the time being, do not simplify by using the EXCLUSIVE-OR operator.**

		BC				
		W	00	01	11	10
A	0					
	1					

W =

		C	
		0	1
AB	00		
	01		
	11		
	10		

X =

		CD			
		Y	00	01	11
AB	00				
	01				
	11				
	10				

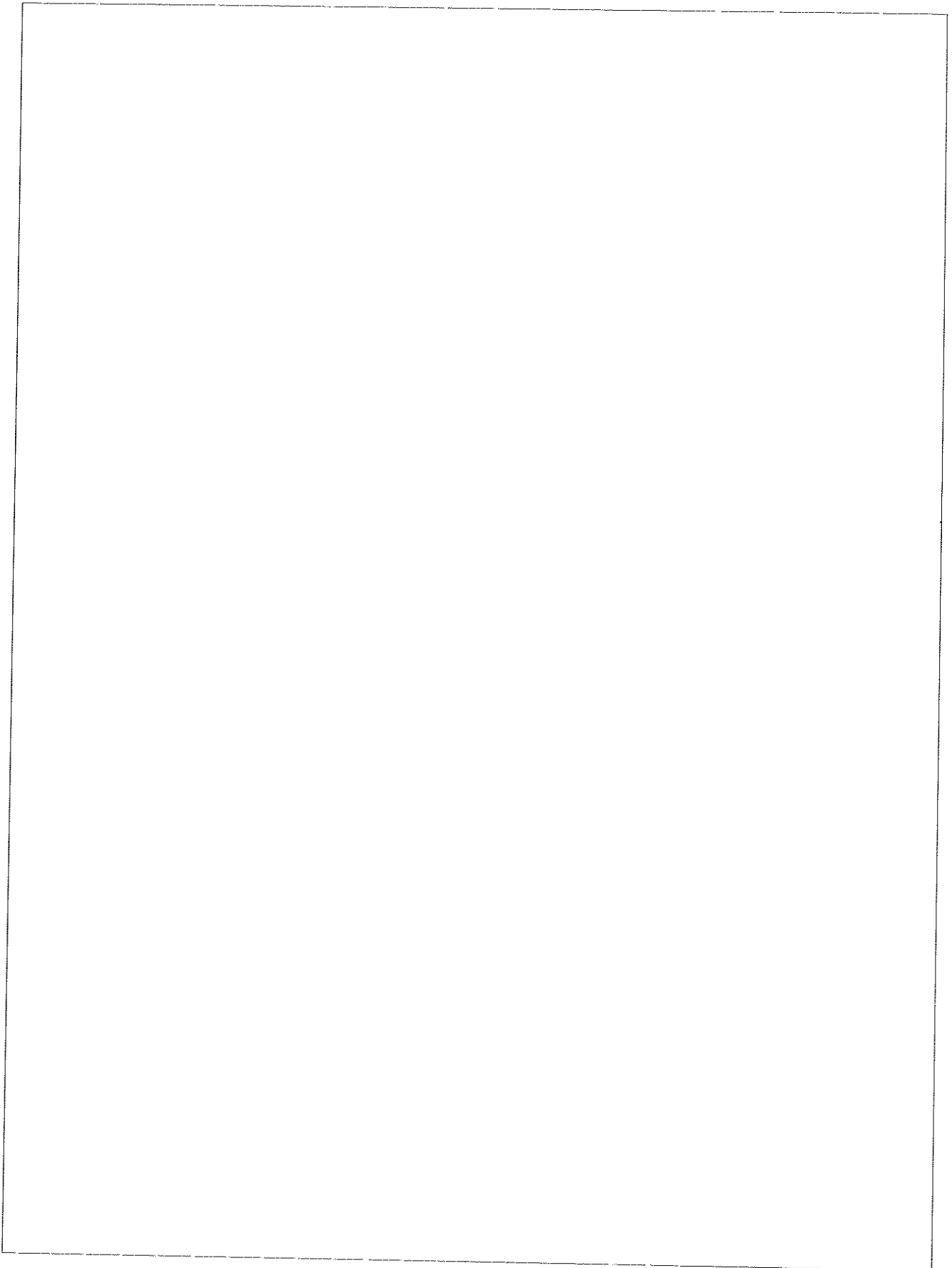
Y =

		CD				
		Z	00	01	11	10
AB	00					
	01					
	11					
	10					

Z =

4. See if some of the W , X , Y and Z outputs can be simplified by using the EXCLUSIVE-OR operator. If so, simplify them and write down the new expressions.

Feel free to use the blank space below if you need to:

A large, empty rectangular box with a thin black border, intended for the student to provide answers or show work during the exam.