Computer Organization and Structure

1. Hexadecimal (base 16) is also a commonly used numbering system for representing values in computers. The following table shows pairs of hexadecimal numbers.

|	A	B
1	0D34	DD17
2	BA1D	3617

    a. What is the sum of A and B if they represent unsigned 16-bit hexadecimal numbers? The result should be written in hexadecimal. Show your work.

    b. What is the sum of A and B if they represent signed 16-bit hexadecimal numbers stored in sign-magnitude format? The result should be written in hexadecimal. Show your work.

    c. Convert A into a decimal number, assuming it is unsigned. Repeat assuming it stored in sign-magnitude format. Show your work.

The following table also shows pars of hexadecimal numbers.

	A	B
1	BA7C	241A
2	AADF	47BE

    d. What is A - B if they represent unsigned 16-bit hexadecimal numbers? The result should be written in o hexadecimal. Show your work.

    e. What is A - B if they represent signed 16-bit hexadecimal numbers stored in sign-magnitude format? The result should be written in hexadecimal. Show your work.

    f. Convert A into a binary number. What makes base 16 (hexadecimal) an attractive numbering system for representing values in computers.

2. Given two versions of the functional block diagrams of multiply algorithm as below:
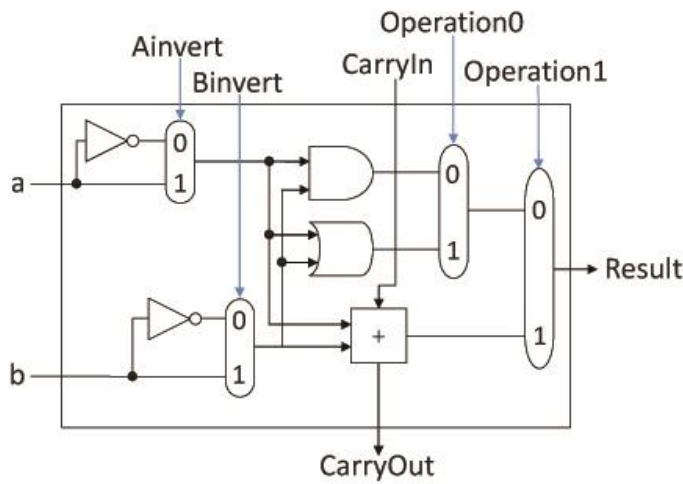

(a)   (b)
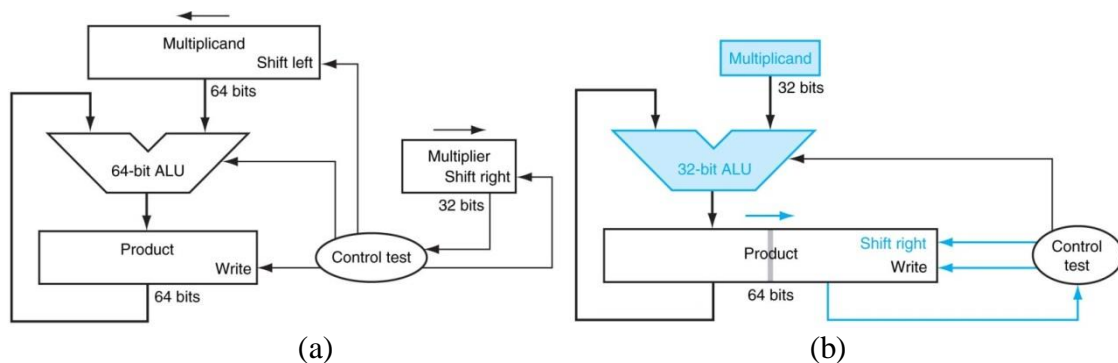
    a. Please make a comparison and list the difference between these two versions. Please

also explain which version is better and the reason.

b. Calculate 0010_2 x 0011_2 using the version shown in (b), and list the contents of all the registers after each of four iterations (fill the table below).

Iteration	Multiplicand	Product
0 (initial)	0010	
1		
2		
3		
4		

3. The following diagram gives a 1-bit ALU. Complete the table by specifying the control signals for the desired operations. For a don't care signal, use '**X**'.

Operations	Ainvert	Binvert	CarryIn	Operation0	Operation1
a + b					
a − b					
a or b					
a and b					
a nor b					

4. A majority function is generated in a combinational circuit when the output is equal to 1 if the input variables have more 1's than 0's. The output is 0 otherwise.

   a. Please write the truth table for a 4-input majority function.
   b. What are the functions in sum of products forms? (you can just use "little *m*" notation)
   c. Please use the Karnaugh map to find the minimum sum of products form and the minimum sum of products form for the complement.
   d. Please draw the logic schematic by using AND, OR, and INVERT gates.

5. In a Von Neumann architecture, groups of bits have no intrinsic meanings by themselves. What a bit pattern represents depends entirely on how it is used. The following table

shows bit patterns expressed in hexadecimal notation.

1	0x24A60004
2	0xAFBF0000

a. What decimal number does the bit pattern represent if it is a two's-complement integer? An unsigned integer?
b. If this bit pattern is placed into the Instruction Register, what MIPS instruction will be executed?
c. What decimal number does the bit pattern represent if it is a floating point number? Use the IEEE 754 standard.

The following table shows decimal numbers.

1	-1609.5
2	-983.8125

d. Write down the binary representation of the decimal number, assuming the IEEE 754 single precision format.
e. Write down the binary representation of the decimal number, assuming the IEEE 754 double precision format.
f. Write down the binary representation of the decimal number, assuming it was stored using the single precision IBM format (base 16, instead of base 2, with 7 bits of exponent).
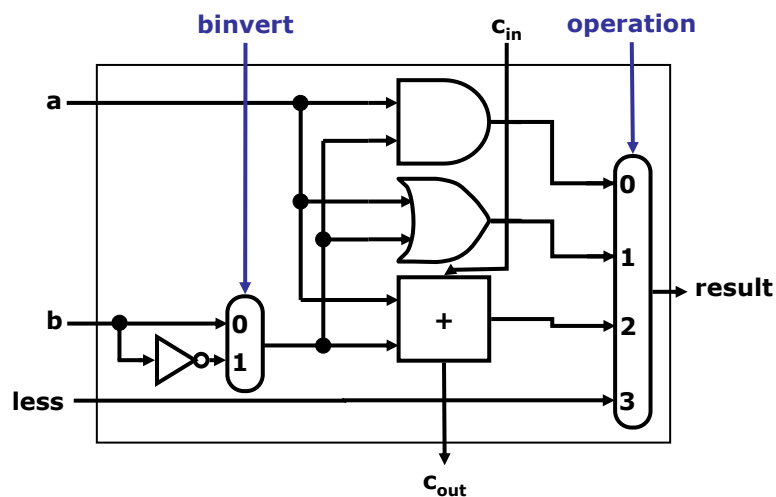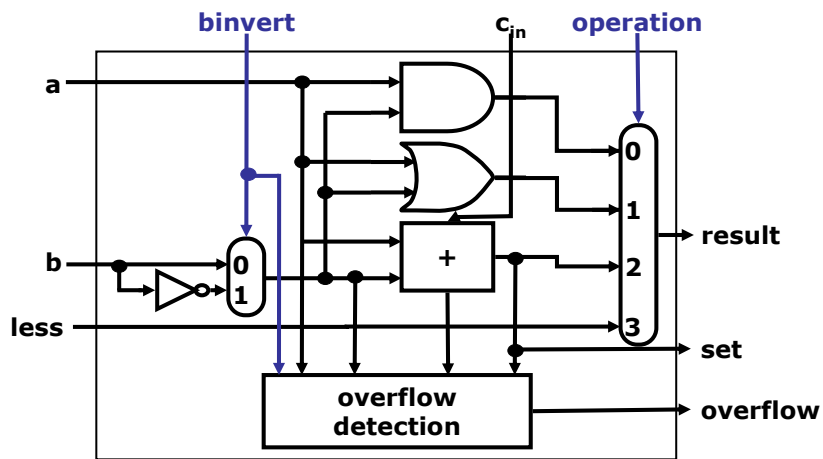

Figure 1: A 1-bit ALU that performs AND, OR, and addition on a and b or b'.

Figure 2: A 1-bit ALU for the most significant bit.