Tutorial 4
CSE 112 Computer Organization

Note:
The tutorial uses the following acronyms:
CSA: Carry Select Adder
RCA: Ripple Carry Adder
X[a:b] is a signal of length (a-b+1). It is to be interpreted as a wire array.

Q1

a. Write the binary unsigned representation of the following numbers:
   i. 7
   ii. 10
b. Multiply the following numbers by 2 and convert the product to binary unsigned representation:
   i. 7
   ii. 10
c. Multiply the following numbers by 4 and convert the product to binary unsigned representation:
   i. 7
   ii. 10
d. Divide the following numbers by 2 and convert the quotient and the remainder to binary unsigned representation:
   i. 7
   ii. 10
e. Divide the following numbers by 4 and convert the quotient and the remainder to binary unsigned representation:
   i. 7
   ii. 10

Do you see any pattern between the numbers and the output in binary format while solving parts **a** to **e**?
Can you create a circuit to multiply binary unsigned numbers with 2^k(for a **fixed k**) and generate the product?
Can you create a circuit to divide binary unsigned numbers by 2^k(for a **fixed k**) and generate the quotient and the remainder?

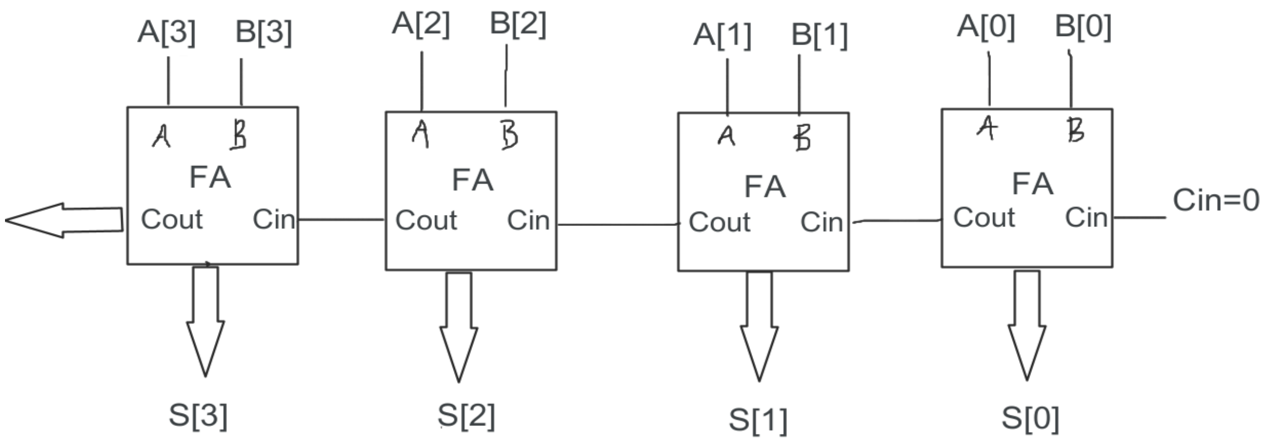
Q2 Compare Carry Select Adder (CSA) with Ripple Carry Adder (RCA) by filling the following table with faster/slower in the performance column and larger/smaller in the resource utilization column. **Also, explain your answer with *valid reasoning*.**

Adder Type	**Performance**	**Resource Utilization**
CSA		
RSA		

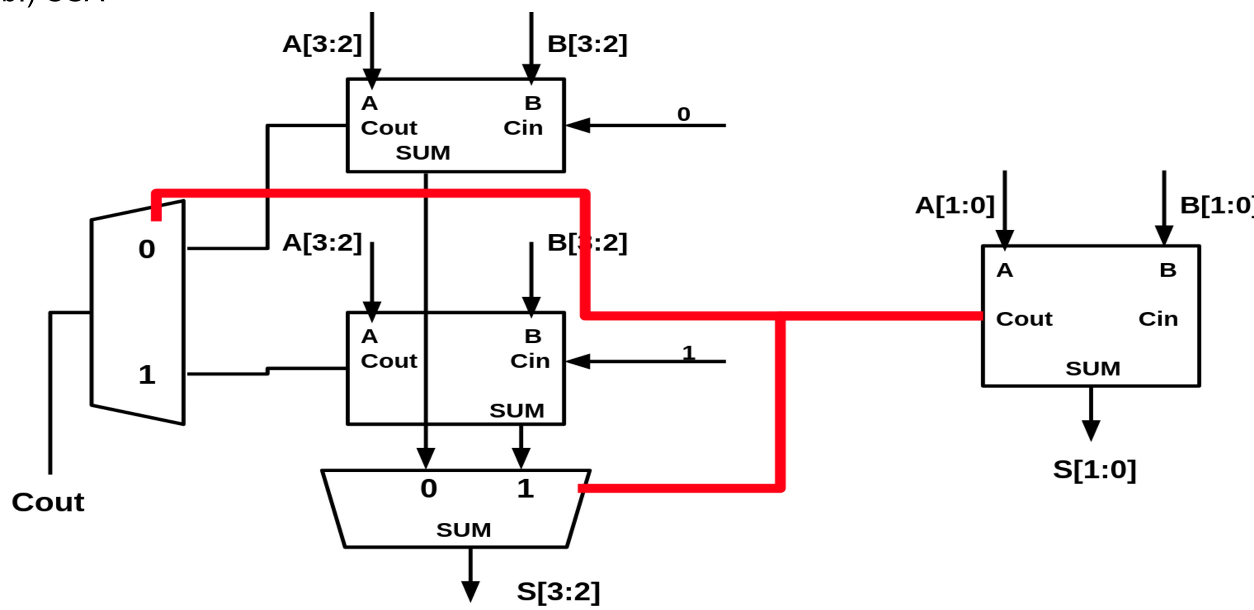
Q3

Suppose the value of A[3:0] = 0011 and B[3:0] = 0001, write down 0 or 1 to denote the state of each wire in the following RCA and CSA circuits:

a.) RCA

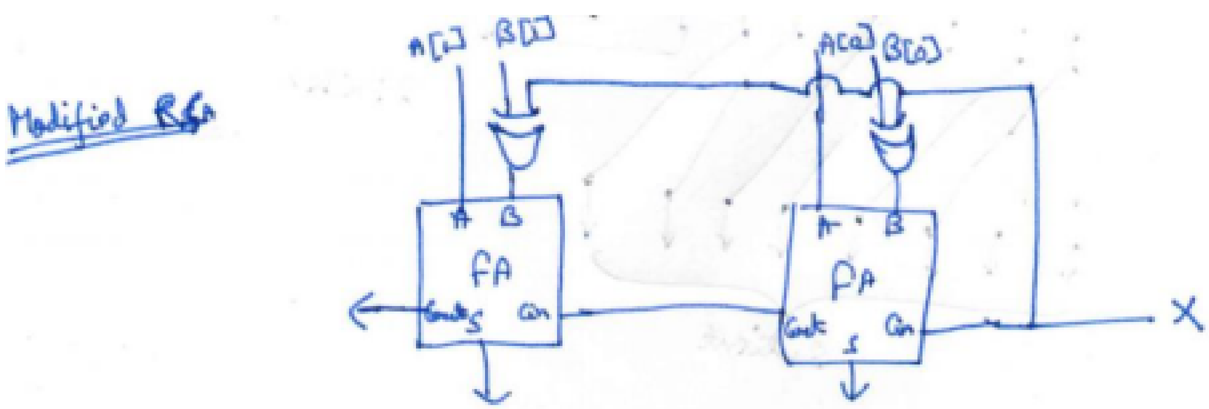


b.) CSA



Q4

Analyze the following modified circuit of RCA. The circuit operates on two inputs A[1:0] and B[1:0], where A[1:0] and B[1:0] are in 2's complement notation. What do you think the wire X is controlling? What happens when X is 0, and what happens when X is 1?



Q5

We need to perform the following operations, where numbers are represented in 2's complement:

a) -87 + 256

b) 490 + 22

For each case:

1. Determine the minimum number of bits required to represent both summands. You might need to sign-extend one of the summands, since for proper summation, both summands must have the same number of bits.
2. Perform the binary addition in 2’s complement arithmetic. The result must have the same number of bits as the summands.
3. Determine whether there is overflow.
4. If there was an overflow, then redo the computation by sign extending both summands.
5. If we want to avoid overflow, what is the minimum number of bits required to represent both the summands and the result?

Q6

(i)For the following values of A and B, compute A+B and A-B. Note that both are denoted using 2’s complement notation:

a. A = 0111 and B = 0011

b. A = 1110 and B = 1101

c. A = 1110 and B = 0011

d. A = 0011 and B = 1110

(ii)Propose a **logic to detect Overflow** in 2’s Complement Addition.

Q7

Multiply the following pairs of numbers represented in **binary unsigned representation**:

a. 3 and 4

b. 10 and 1

c. 9 and 3

Q8

Multiply the following pairs of numbers represented in **binary signed magnitude representation**:

a. 1001 and 1010

b. 0011 and 1111

c. 0101 and 0110

Can you come up with a circuit to generate **just the sign bit** of the product of two 8 bit numbers represented in signed magnitude notation?

Q9

a. Convert the following number in **decimal notation to binary unsigned fixed point notation**.

i. 10.5

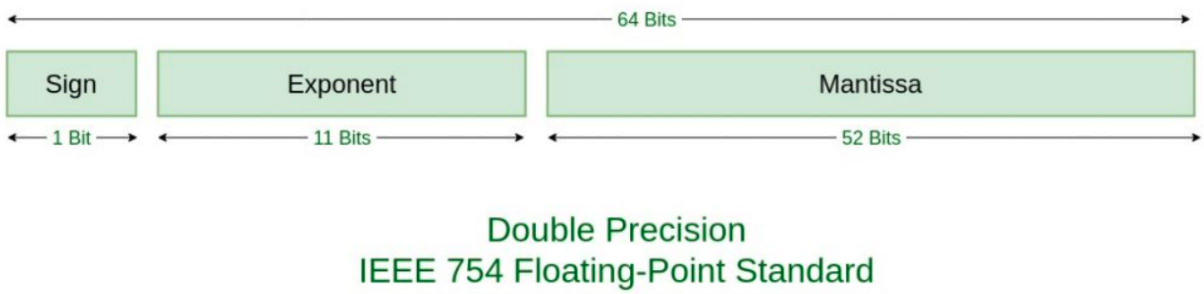
ii. 19.25

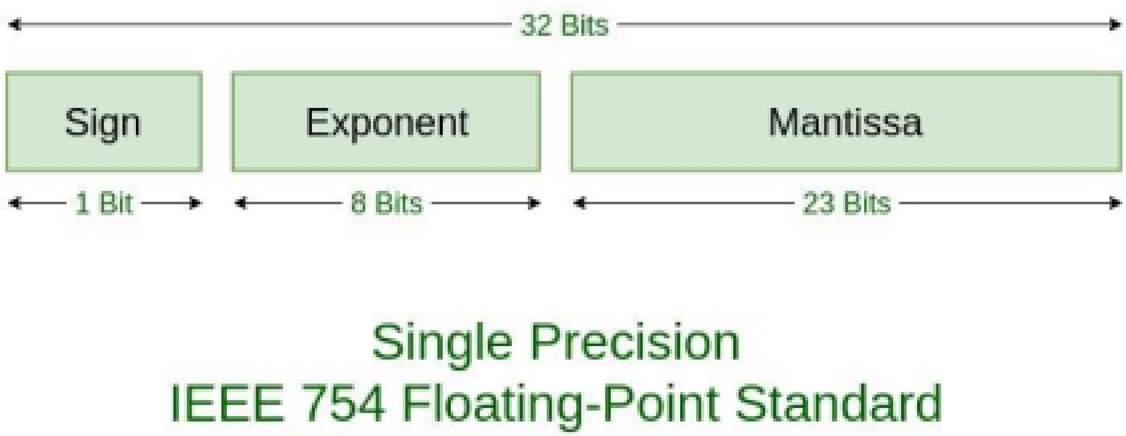
iii. 24.6

b. Convert the following numbers in **binary unsigned fixed point notation to decimal notation**.

i. 111.101
ii. 101.01
iii. 1.10101010101010….. (... means the 10 is repeated indefinitely)

Q10
Represent the -12.25 as
a) Single precision floating point numbers in IEEE754 format
b) Double Precision floating point numbers in IEEE754 format





Source: https://www.geeksforgeeks.org/ieee-standard-754-floating-point-numbers/