Task:

1- Add two 3-bit binary numbers 100 and 011 using circuit below. Fill in input, intermediate and output bits in space provided.
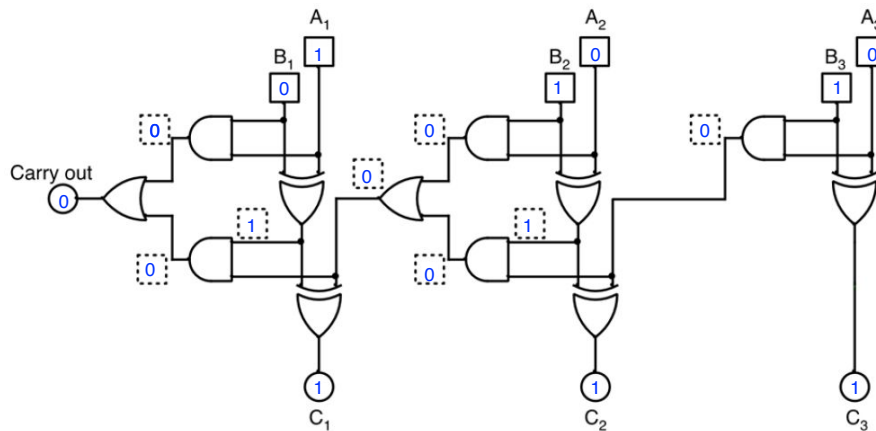
2- Add two 3-bit binary numbers 101 and 100 using circuit below. Fill in input, intermediate and output bits in space provided.
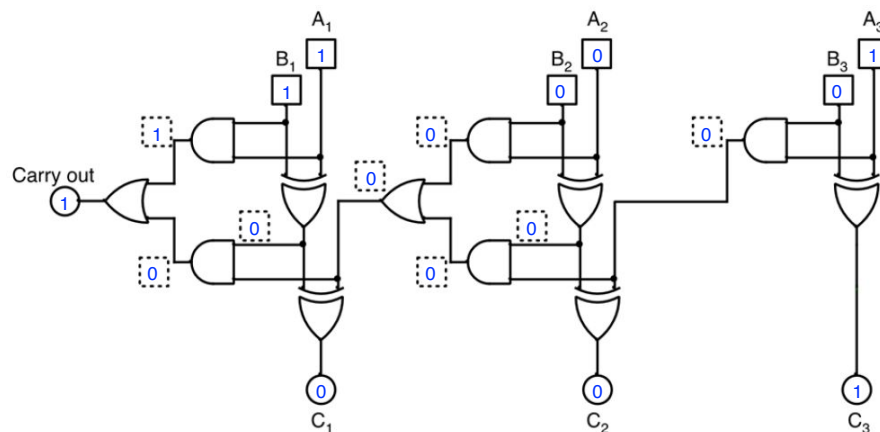
3- Implement a simple subroutine called *swap* that swap the values of two variables with each other, i.e., it takes the values in the memory location *X and Y*, swap them, and returns to where the original program left off.

```
JnS Swap
Halt

Swap, HEX 0
Load X
Store Temp
Load Y
Store X
Load Temp
Store Y
JumpI Swap

X, DEC 2
Y, DEC 5
Temp, DEC 0
```

4- Identify and briefly explain the roles of the three main components of a Central Processing Unit

CPU comprises of three components: Arithmetic Logic Unit (ALU), Registers and Control Unit.

ALU implements basic computation like addition, subtraction, etc.
Registers combine and collect all registers into a single circuit.
Control Unit performs the fetch-decode-execute cycle through control signals and the control signals
mainly do things like: read/write register and memory address, perform operations in ALU.

5- Describe the difference between a direct jump and an indirect jump instruction, using the MARIE system as an example.

Jump X	Based on the example given, if Jump X is executed, it will jump to the X's address with has the memory of
JumpI X	HEX 5. If JumpI X is executed, it will jump to the memory stored at the address of X, which is HEX 5. Let's say if the address of "Value" is HEX 5, JumpI will then jump to the "Value".
X, HEX 5	
..	Hence, we can say that direct jump (Jump) directs the user to the memory at X. On the other hand,
..	indirect jump (JumpI) will direct the user to the memory address stored at X.
Value, DEC 10	

6- Identify which MARIE instruction corresponds to the following RTL code:

```
MAR     ← X
MBR     ← PC
M[MAR]  ← MBR
MBR     ← X
AC      ← 1
AC      ← AC+MBR
PC      ← AC
```

Store X
Load 1
Add X

7- Briefly explain the concept of a flipflop circuit. Name a computer component where a flipflop is used.

Flip-flop circuit is a type of sequential circuit. It functions by setting and resetting the bit to stored. In the circuit, the "set button" is used to set the output bit to 1, while the "reset button" is used to reset the output bit to 0. This is done by allowing the output to loop backwards and negating it to become 0. Flip flop is commonly used by registers in a CPU.

8- Briefly explain the difference between *sequential* and *combinational* circuits.

Sequential circuit will output the bits that depend on the sequence of inputs and outputs. Example such as flip flop, the loop is used to negate the bit as to reset the bit to 0. This means that the output depends on the sequence of inputs.

Combinational circuits are circuits that output bits that depend on arithmetic operations. Example such as half-adders or full-adders where it performs addition operation on the inputs while outputting the bits in the form of "carry out" and "result".

FIT1047
SUPPLEMENTARY WORKSHEET -02
WEEK 04

[Prepared by Haidar Al-Khalidi]