Remember to bring this along to your lab!

CS2100 Computer Organisation
Lab #10: Using Logisim II
(Week 13: 15 – 19 April 2024)
[This document is available on Canvas and course website https://www.comp.nus.edu.sg/~cs2100]

Name: ________________________________ Student No.: ___________________

Lab Group: _____

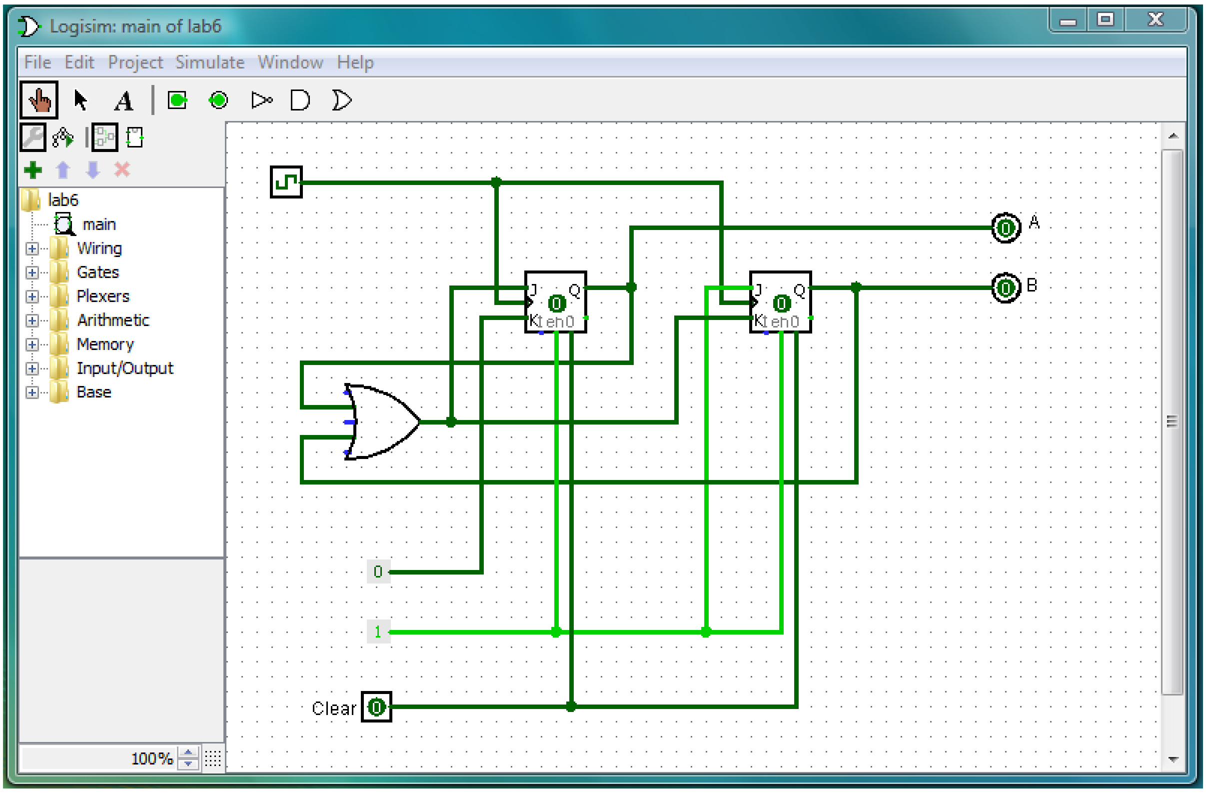
This is your final lab! ☺
Please complete at least ten minutes before the hour.

Objective:
In this experiment, you will use **logisim** to analyse and design sequential circuits.

Complete Part I before coming to your lab!

Part I

1. Run logisim, open the file **lab10.circ**. The circuit is shown below.



2. The circuit consists of two JK flip-flop and an OR gate. Note the following:
   - The outputs of the two JK flip-flops are labelled *A* and *B*, which form the state of the circuit.
   - The Clock  is connected to the clock inputs of the flip-flops.
   - The logic constant 1 is connected to the Enable inputs of the flip-flops.
   - The Clear switch  is connected to the clear inputs of the flip-flops. Hence when Clear = 1, it clears the contents of both flip-flips to 0, bringing the circuit to the initial state of *AB*=00.

- The flip-flop inputs are as follows:

  For flip-flop *A*: $\boldsymbol{JA = A + B}$; $\boldsymbol{KA = 0}$

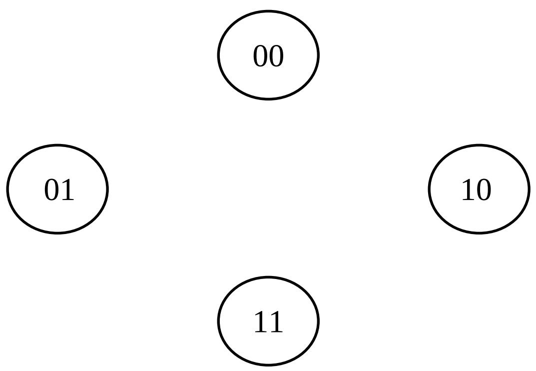
  For flip-flop *B*: $\boldsymbol{JB = 1}$; $\boldsymbol{KB = A + B}$

3. Complete the following table: [6 marks]

Present state		Flip-flop inputs				Next state	
A	***B***	***JA***	***KA***	***JB***	***KB***	$\boldsymbol{A^+}$	$\boldsymbol{B^+}$
0	0						
0	1						
1	0						
1	1						

4. Verify the correctness of your table above by testing the circuit in Logisim.
   a) Click on "Clear" input to get 1. This clears both flip-flops to 0, bringing the circuit to the initial state of *AB*=00.
   b) Click on "Clear" input to get 0 before you proceed. This puts the flip-flops in their normal operation mode.
   c) Clicking the "Clock" input toggles its value. When the "Clock" value changes from 0 to 1 (i.e. a rising edge), the flip-flops react according to the commands at their J and K inputs.
   d) Click the "Clock" input several times to simulate the square wave, and watch the outputs of the flip-flops change their values. Do the values follow your table above?
   e) If at any point of time you want to reset the flip-flops to the initial state of 00, go to step (a) above.

5. Complete the state diagram below. [4 marks]



Part II

6. During the lab session, you will design a sequential circuit. Your labTA will provide you with the flip-flop inputs. Copy down the flip-flop inputs below:

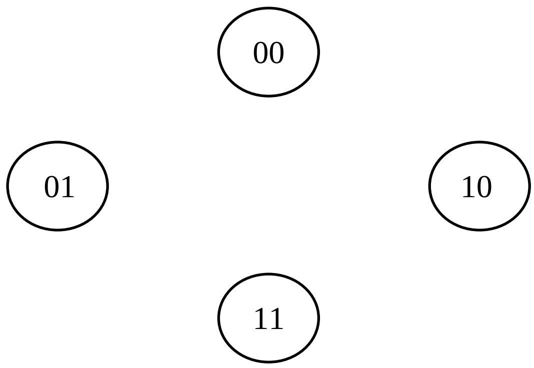
   For flip-flop *A*: ***JA* = ______________;** ***KA* = ______________**

   For flip-flop *B*: ***JB* = ______________;** ***KB* = ______________**

7. Complete the following table: [6 marks]

Present state		Flip-flop inputs				Next state	
A	***B***	***JA***	***KA***	***JB***	***KB***	***A*⁺**	***B*⁺**
0	0						
0	1						
1	0						
1	1						

8. Complete the state diagram below. [4 marks]



9. You do not need to implement this circuit.

10. As this is your final lab, your lab report will not be returned to you.

Total: 20 marks