Assignment-3

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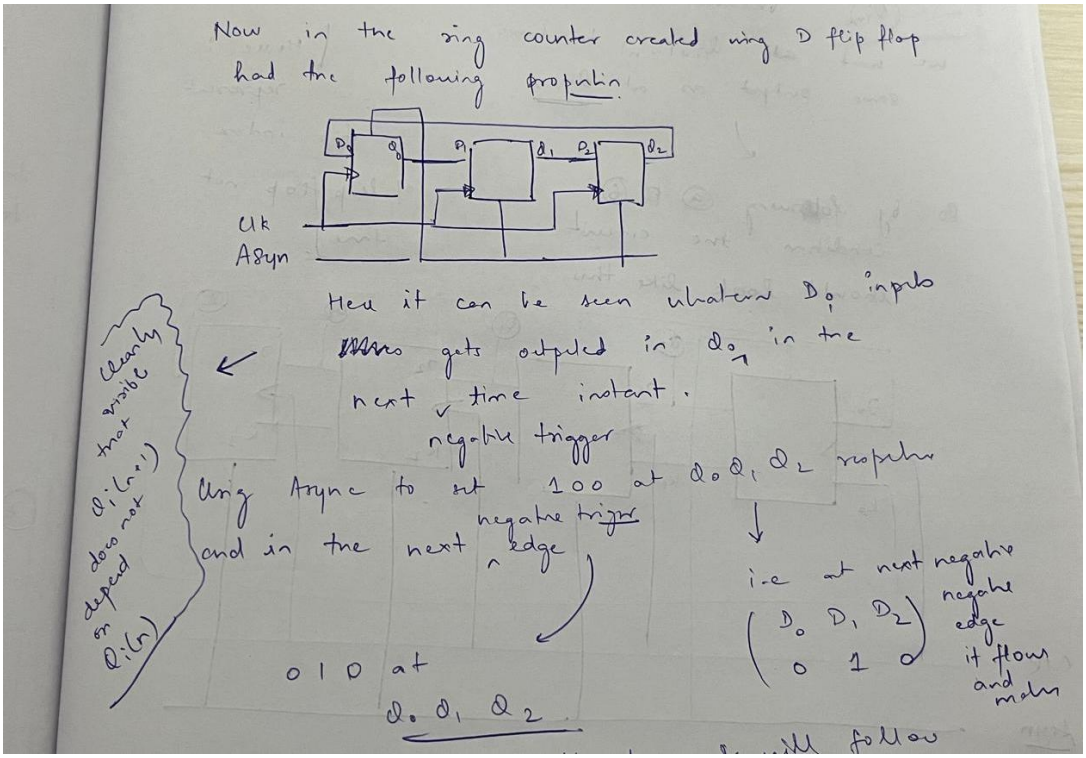
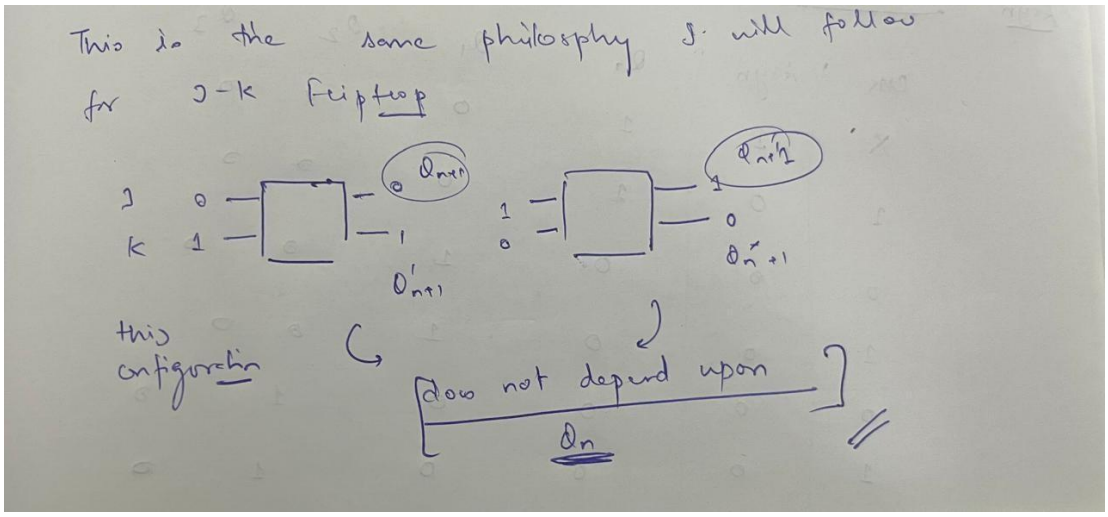
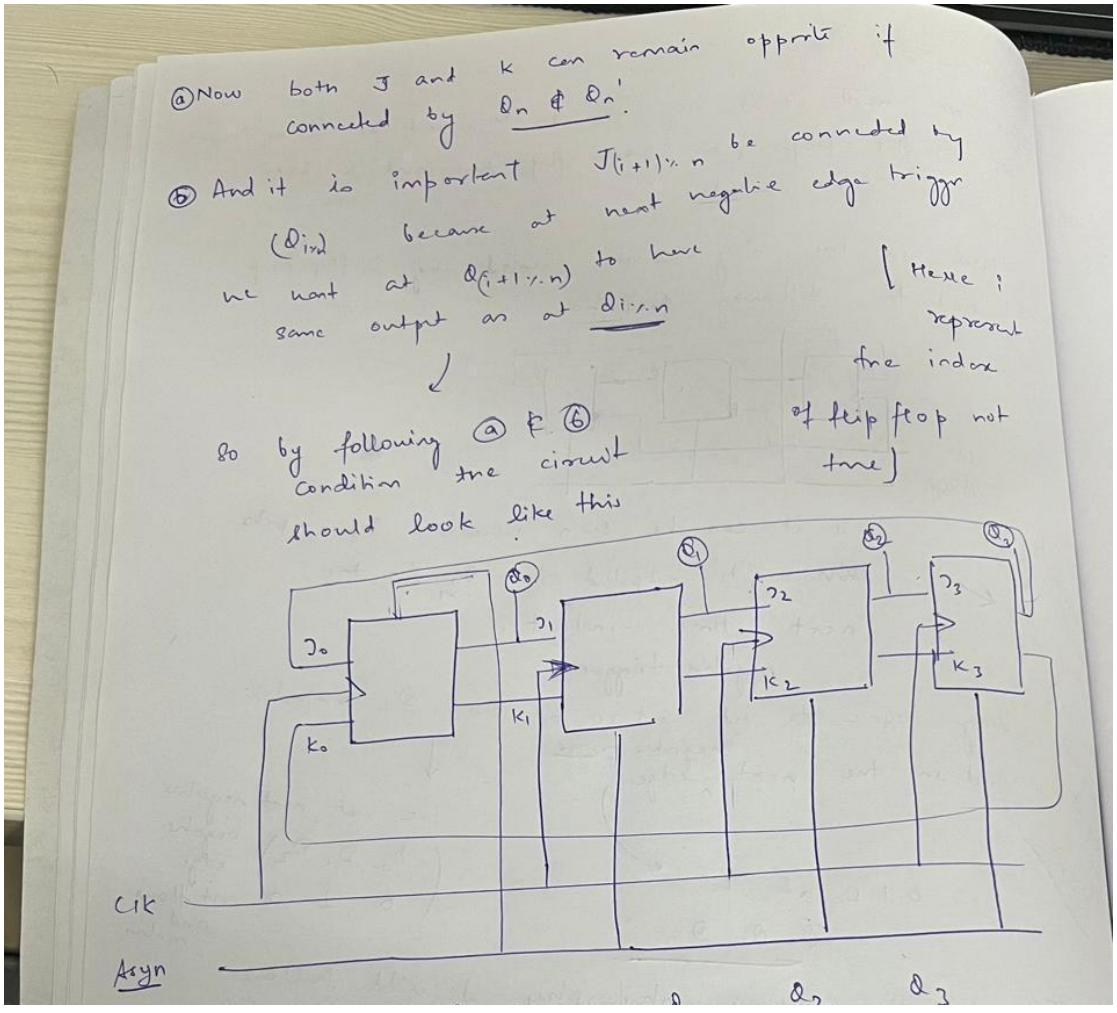
Q1(Ring Counter)

Since 4bit ring counter is needed so there will be a requirement of 4 bit flip-flop as each flip flop represents a bit in the counter





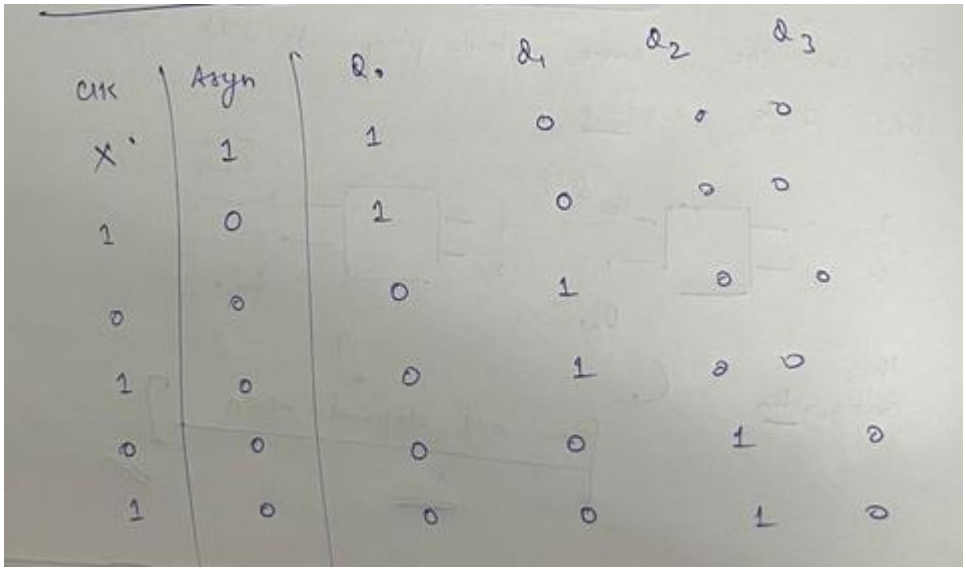
And using that I designed the circuit:

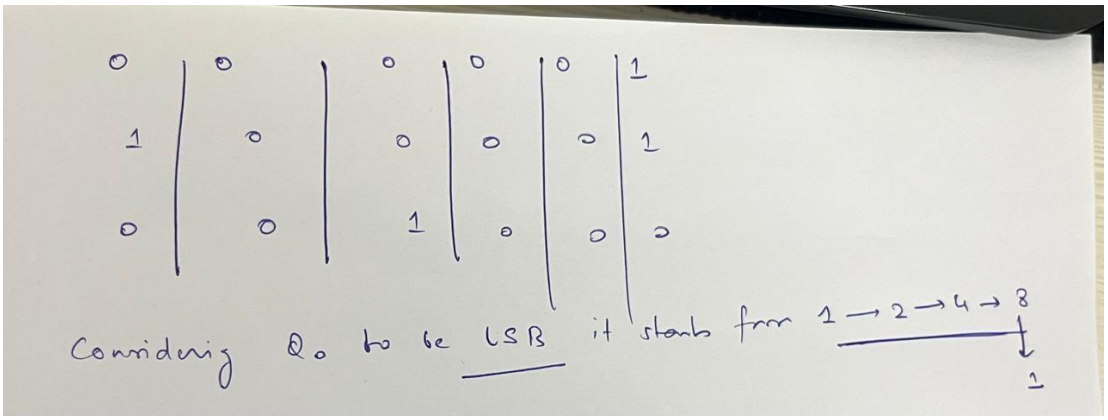


In this when preset==1 then output is always 1and clear ==1 then output is always 0 independant of the clock signal as in the case where Q0 = 1 and rest are set to 0

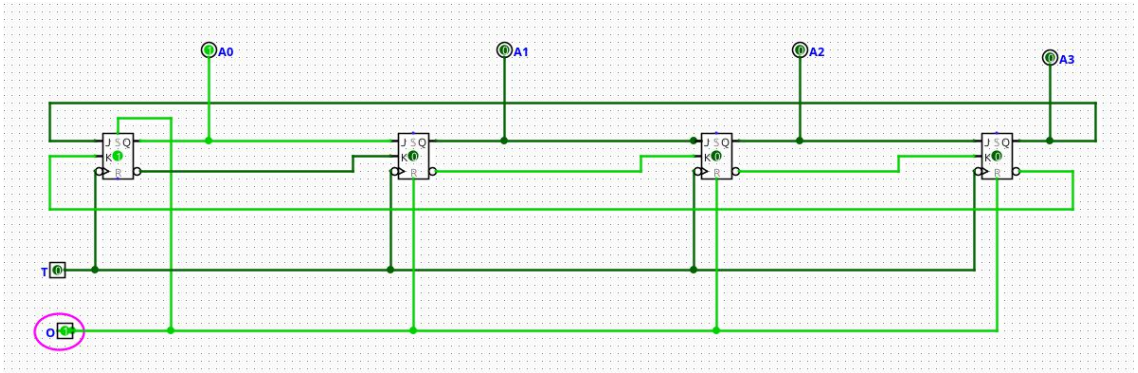
And the truth tabel for it:

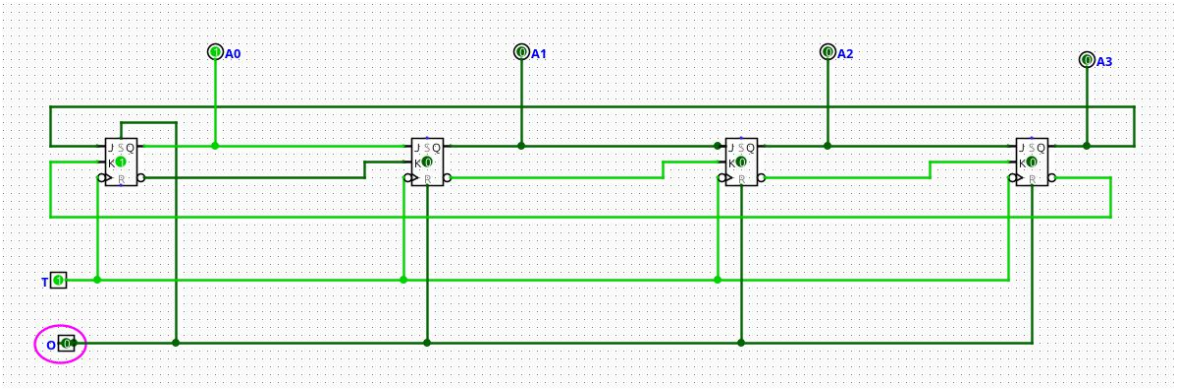
Here Q_i is the state after clock change



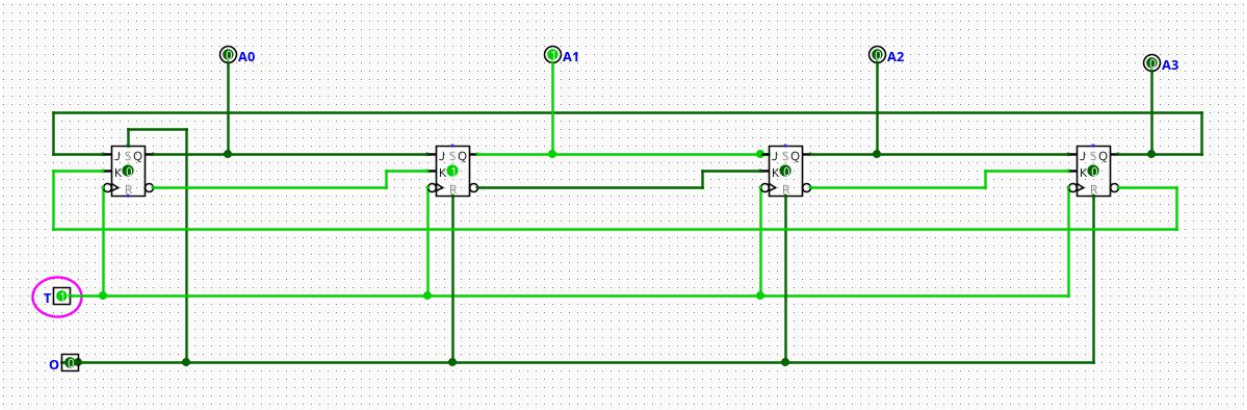


The below is the circuit for the above test vector

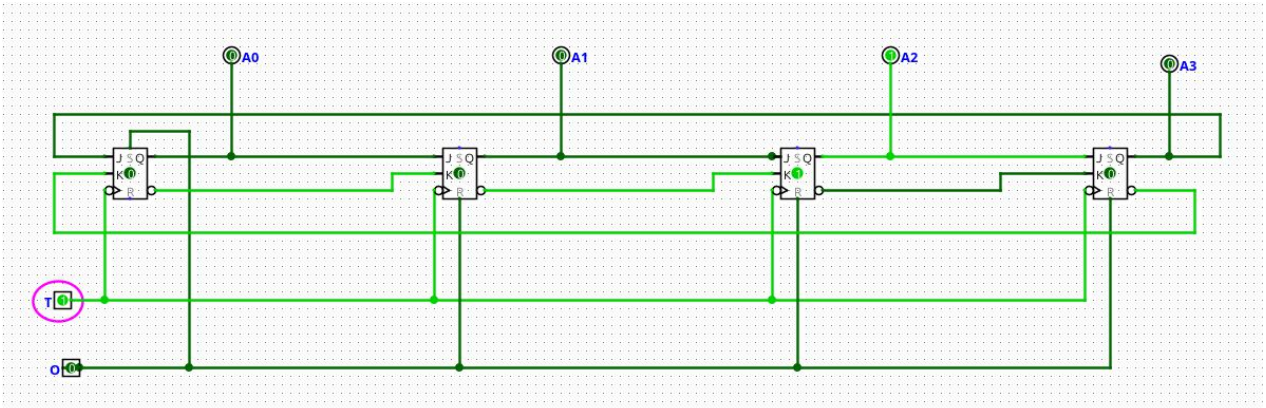


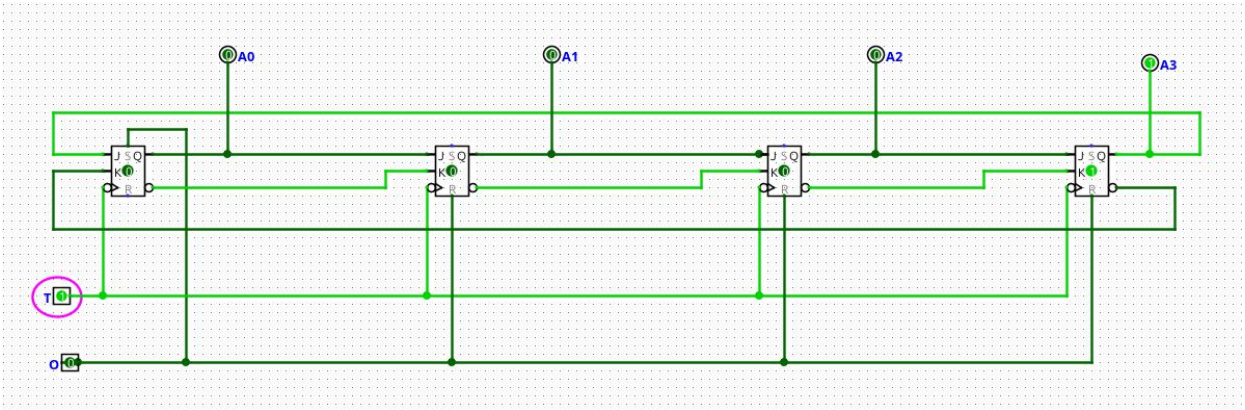


In the next negative edge trigger it is moving to the next flip flop which is A1

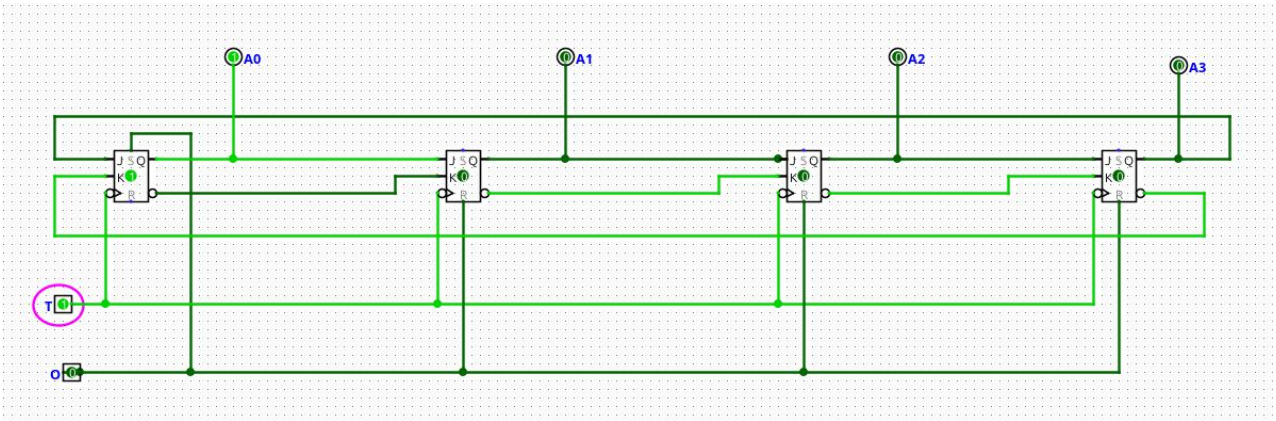


Moving to A2





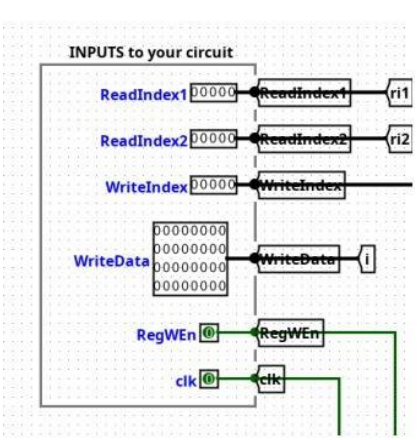
And again moving to the starting A0 in the next negative edge trigger

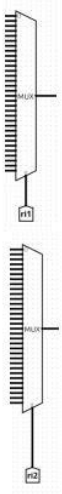


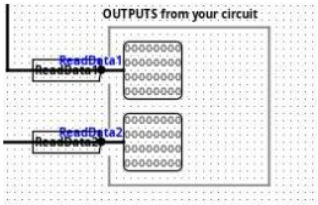
Q2(Register FIle)

ReadIndex1 and ReadIndex2:

(used for getting the register number to be read which in R type instruction and I type are s,t and s repectively)are connected to the selection lines of both mux using a tunnel and is connected further to the output section of the circuit as the input line are carrying 32 bit data sended from the register whose value is to be read

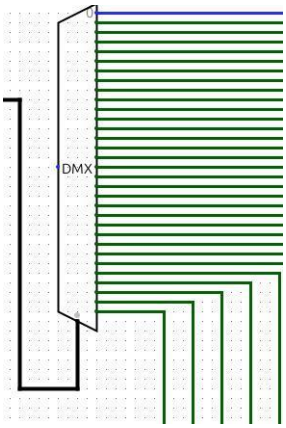






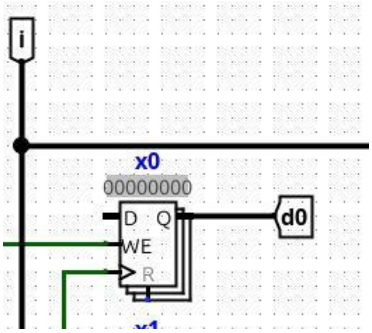
Next WriteIndex is used as a selection line for the demux

Here demux role is to select that line connected further to that register whose data needs to be written



The writeData in the input contains the data that needs to written in the register and is connected using the tunnel of i such that further it is connected to each register's data line except x0 as in it data is always zero as shown below

x0 register

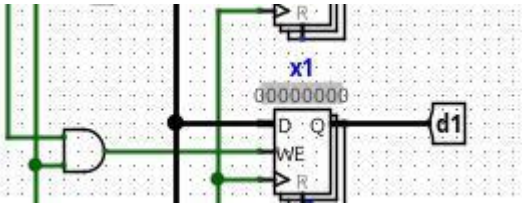


Now since i tunnel is connected to every register (except x0) so how to ensure that data only goes into the desired register whenever required

There I made used of the enable pin in the register such that it is connected by an AND gate such that the inputs to it are

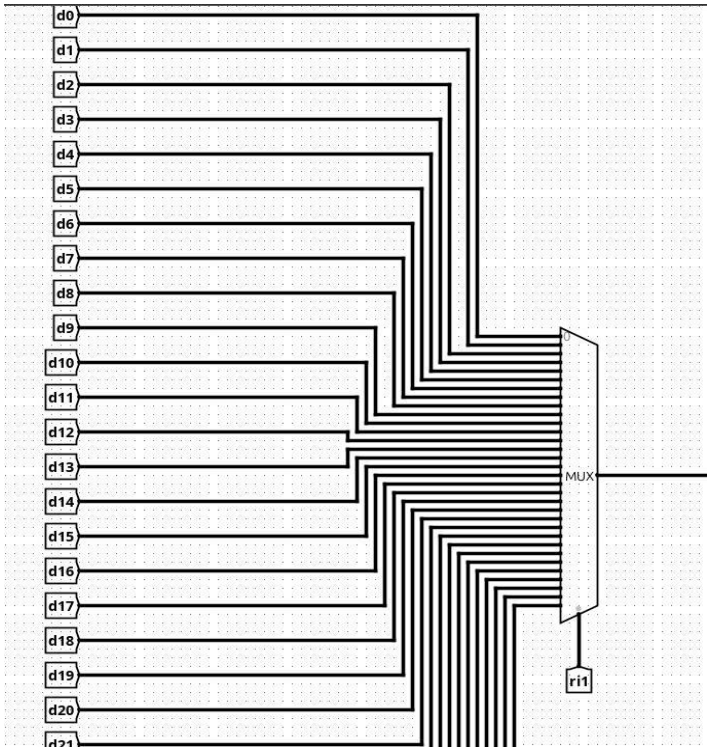
1. the selected line from demux connecting to the register
2. and RegWEn which is a type of control signal which controls that whether write operation are allowed in the register file or not

This is shown below:



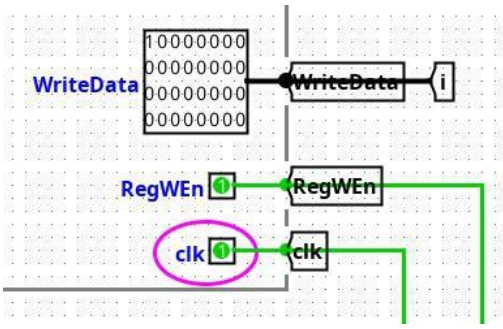
R line in the register is connected with the clock line such that operations are performed in the desired register on edge trigger here the register is positive edge trigger

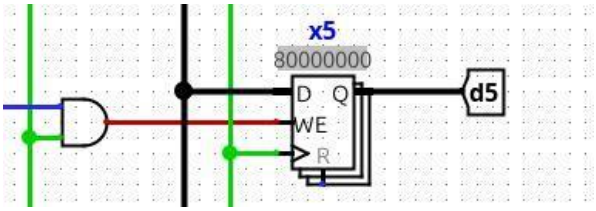
Q line (Output from the register) connected with the mux which is used for selecting the register on which read operation needs to be performed

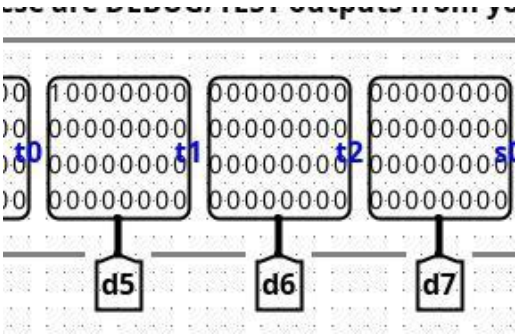


Testing:

- Write operation in register x5 after trigger clk from 0 to 1 and output visible in the debugging section in t0 as data goes into d5

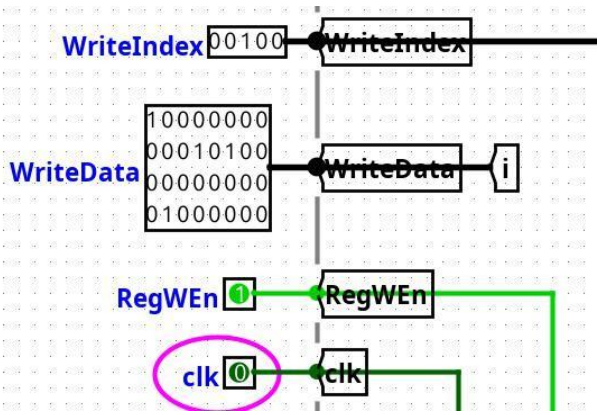


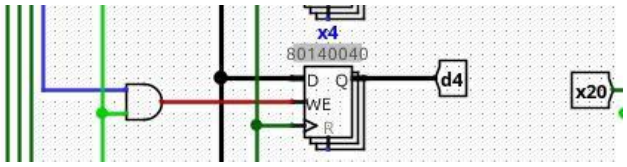


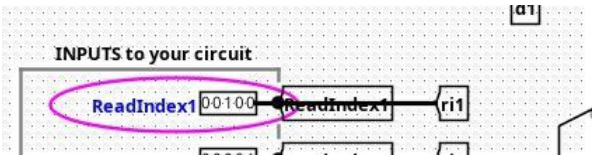


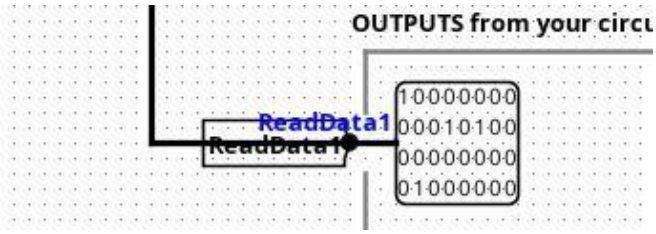
- Performing read operation

  writing in x4 and then reading it








OUTPUTS from your circu
ReadData1
ReadData1
10000000
00010100
00000000
01000000