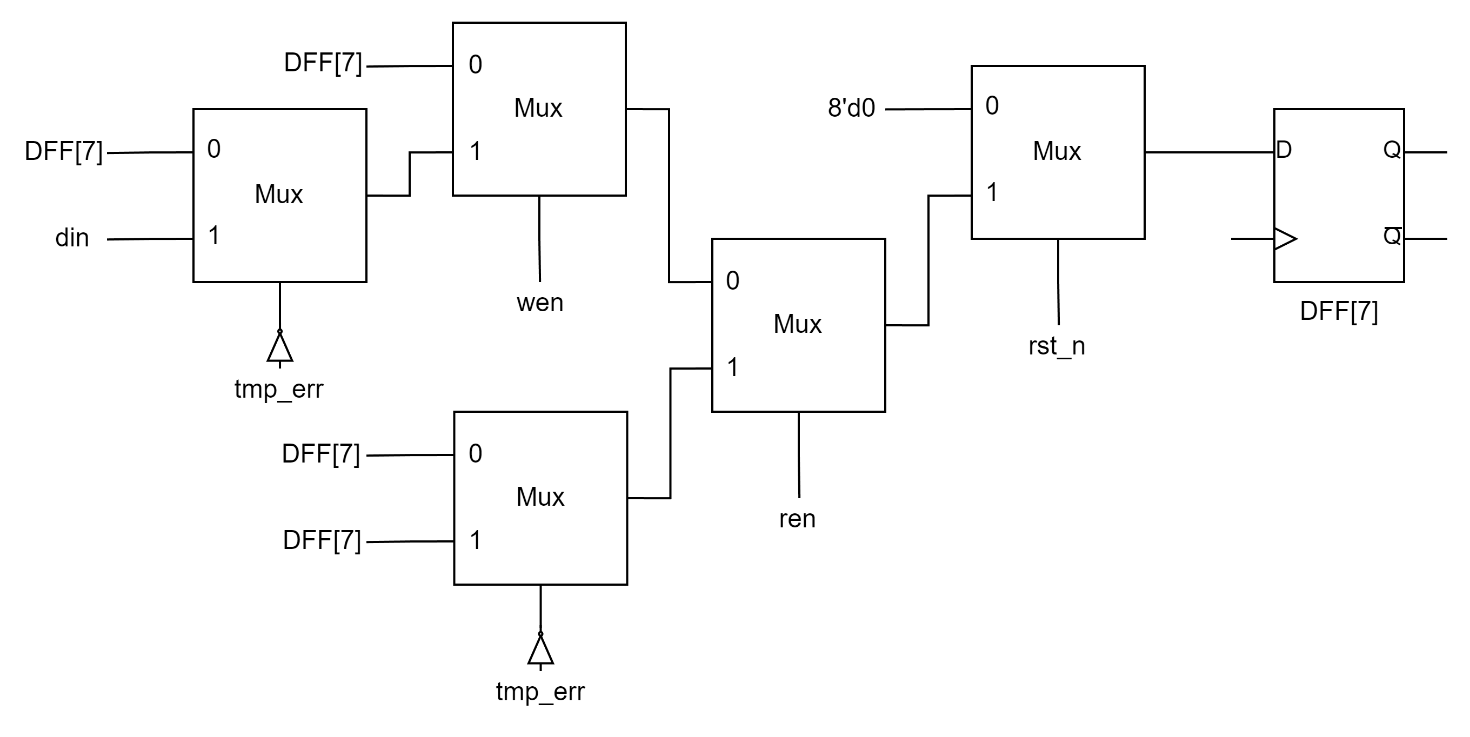
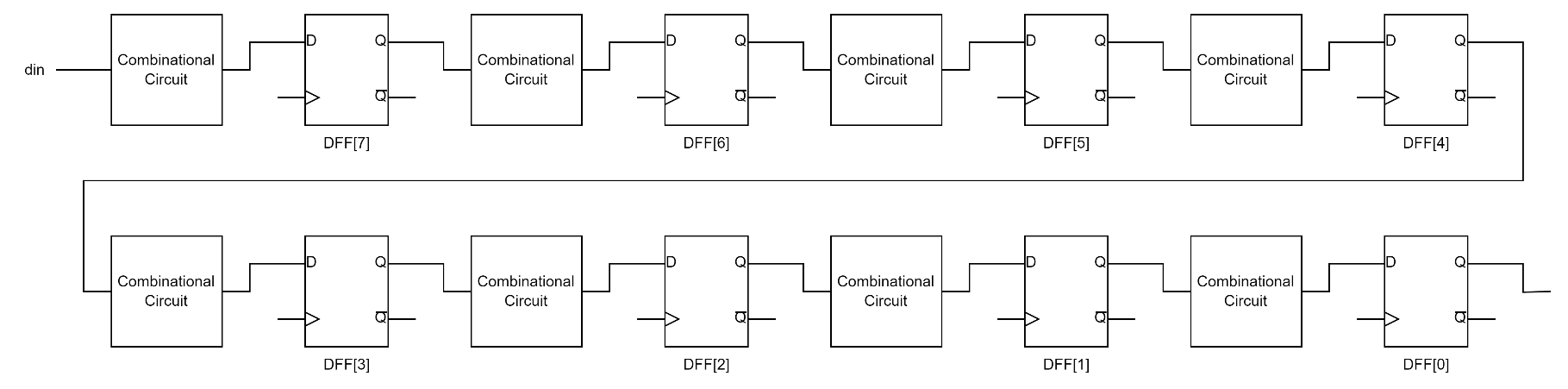
**Hardware Design and Lab: Lab3**

1. **Advanced Question: First-In First Out (FIFO) Queue**
2. **Block Diagram**

****

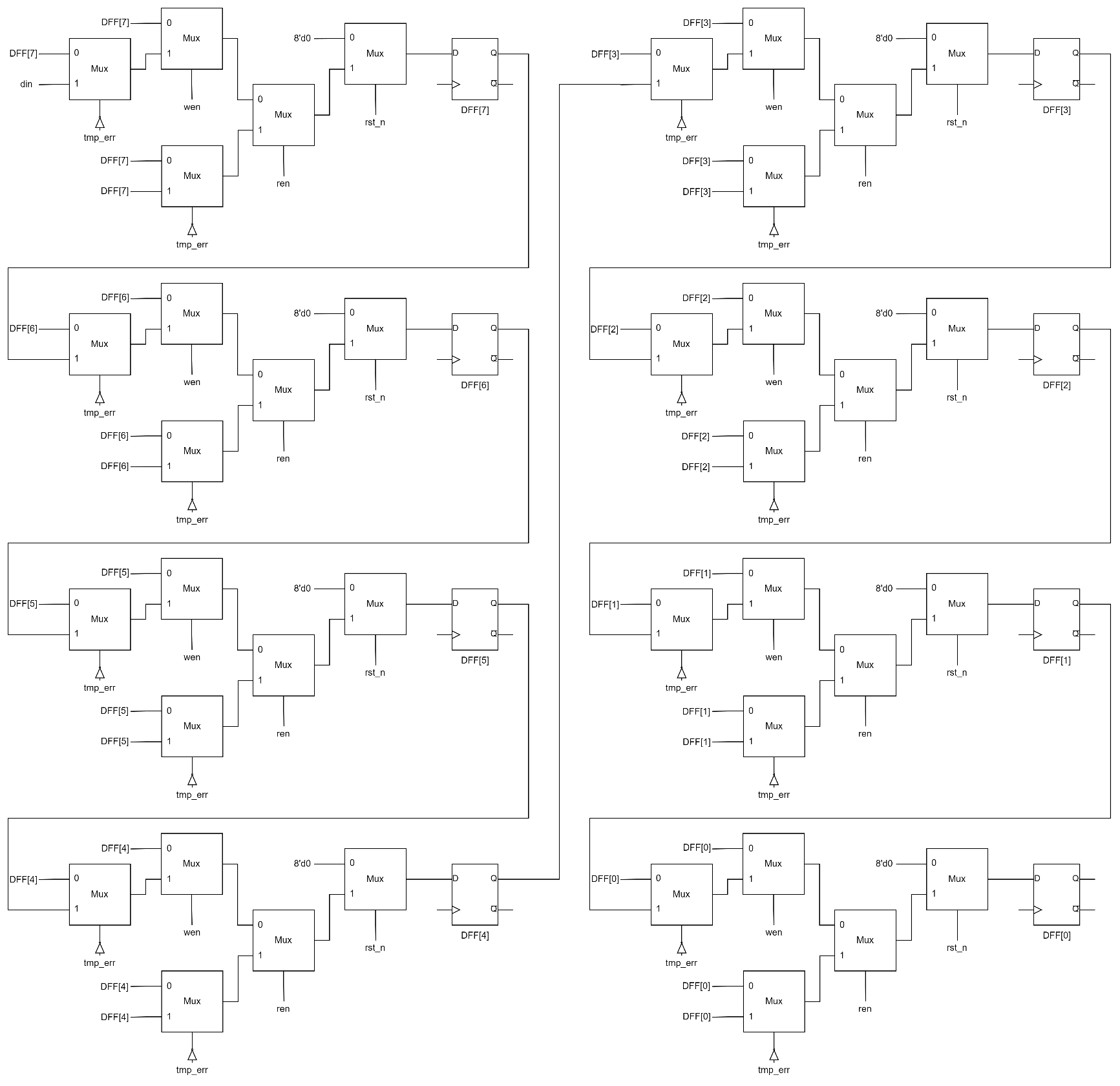
Picture 1.1

This is the combinational circuit for each DFF in the queue.

****

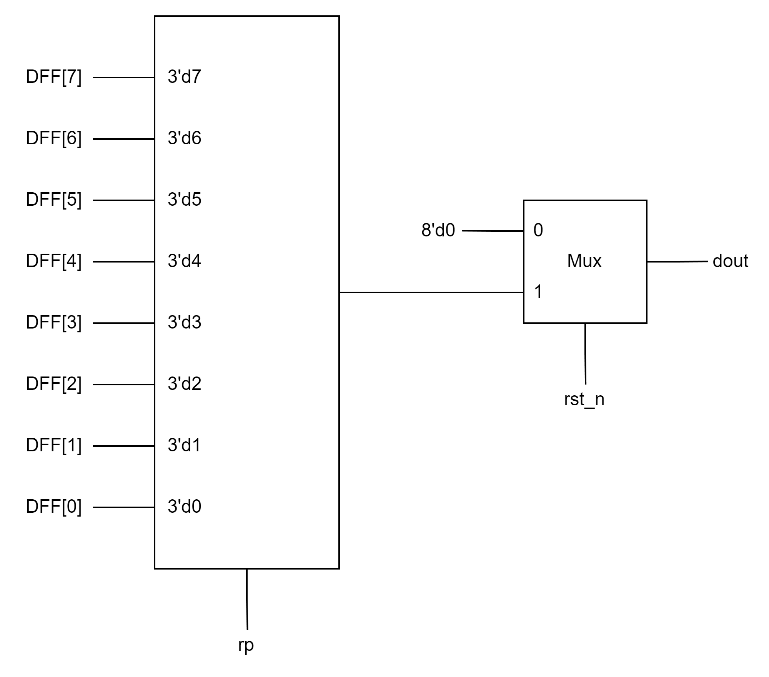
Picture 1.2

This is the architecture of the 8-bits FIFO Queue.

****

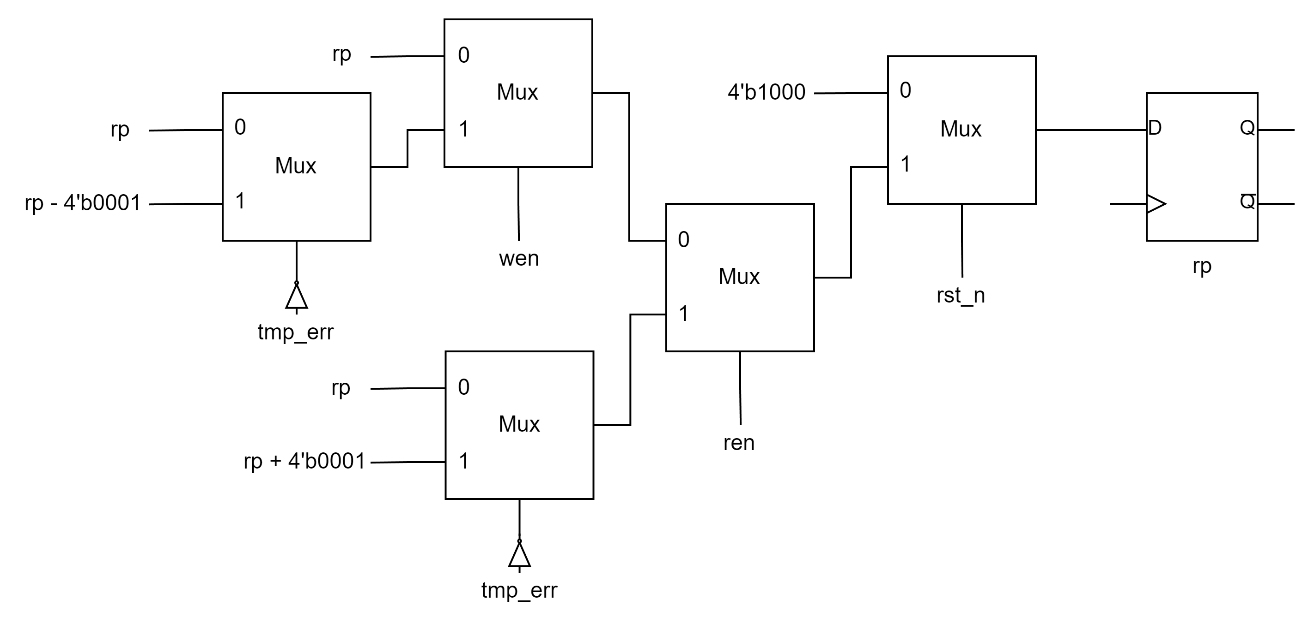
Picture 1.3

This is the block diagram of the 8-bits FIFO Queue.

****

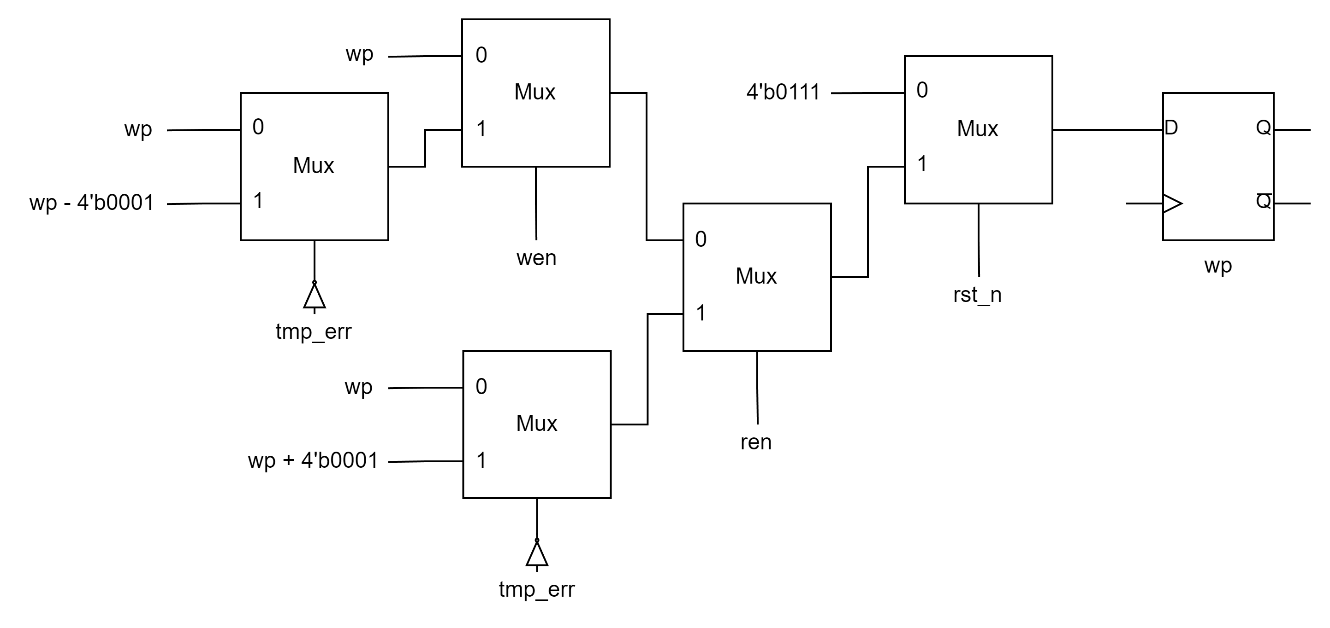
Picture 1.4

Choose the **dout** by **rp (read pointer)**.

****

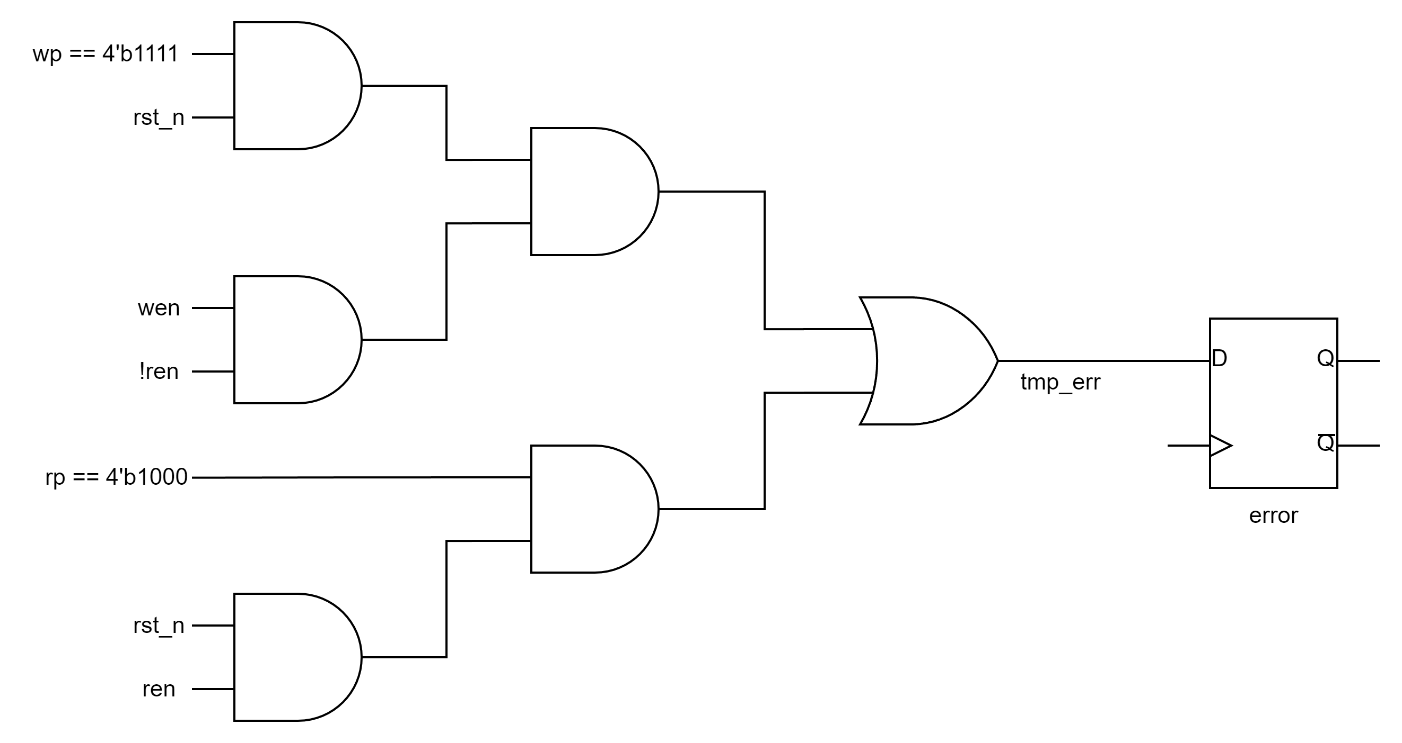
Picture 1.5

This is how I define **rp**. (read pointer)

****

Picture 1.6

This is how I define **wp**. (write pointer)

****

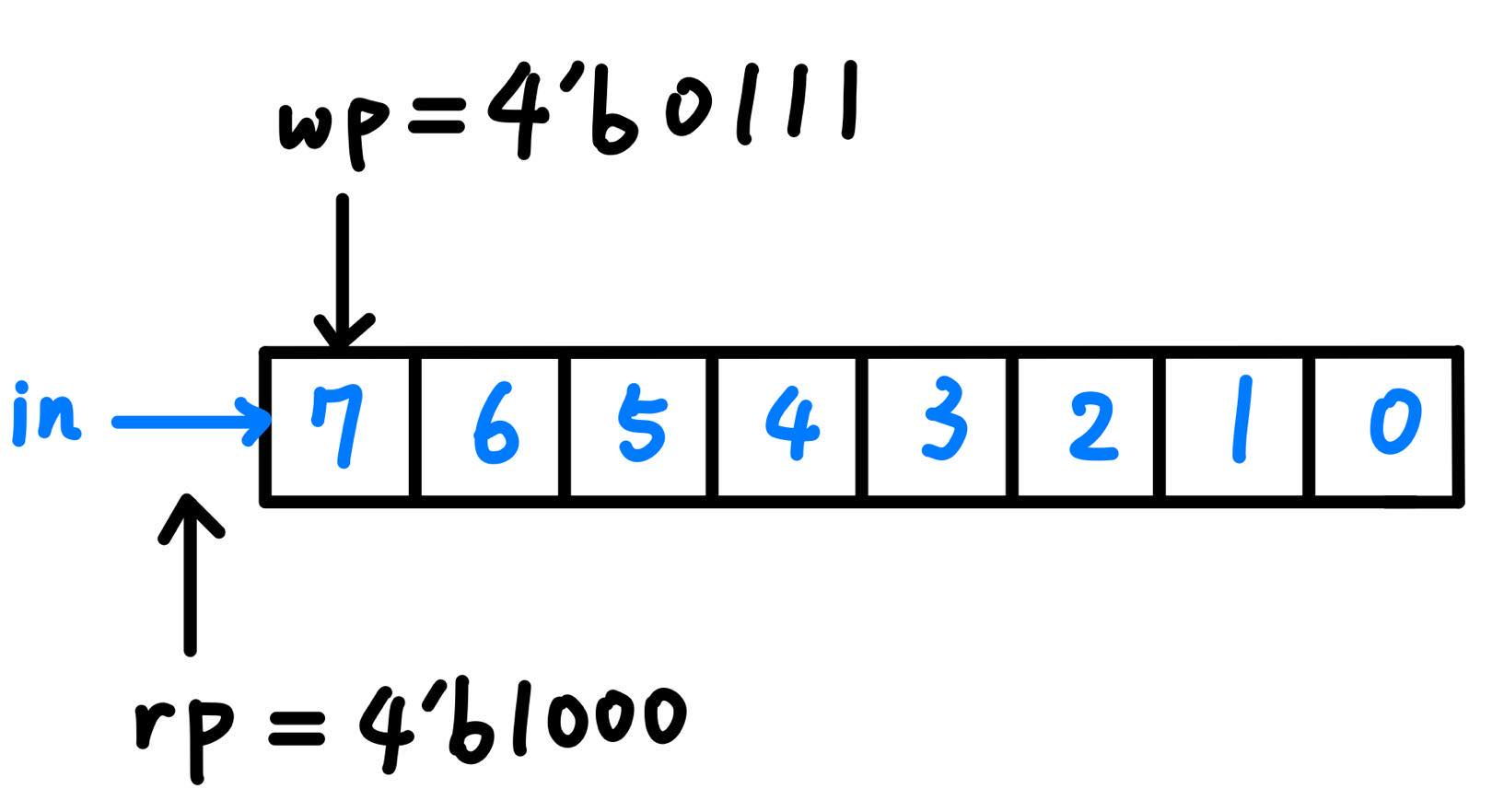
Picture 1.7

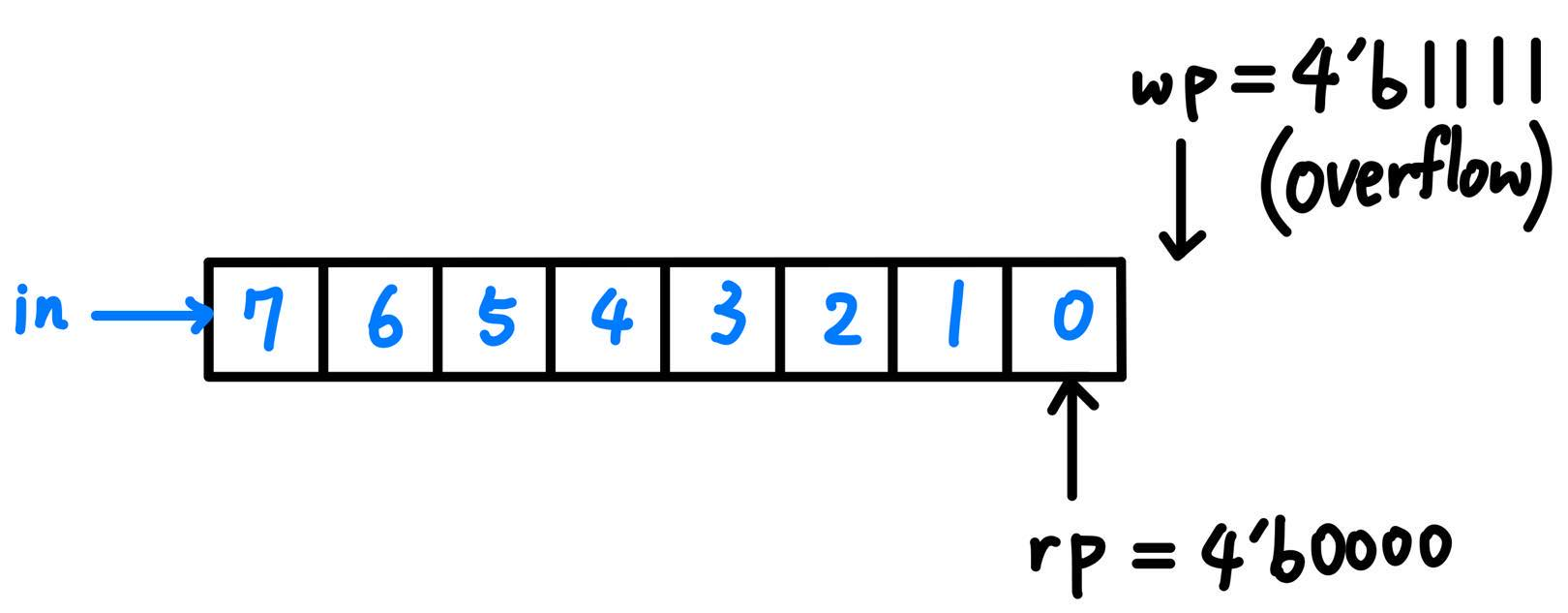
This is how I define **error** and **tmp\_err**.

1. **Explanation**

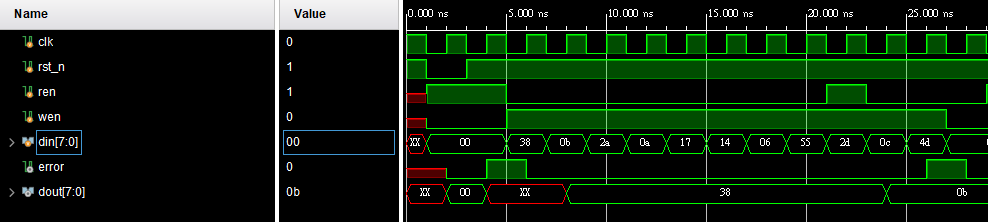
In the beginning, I reset **rp** (read pointer) and **wp** (write pointer) to **4'b0111** and **4'b1111** respectively. If writing data into queue is successful, both of **rp** and **wp** will -1 as moving the pointers to the next DFF. If reading data out of queue is successful, both of **rp** and **wp** will +1 as moving the pointers to the previous DFF. The data in the queue will only be passed to the next DFF while writing is successful. Otherwise, they will be kept in the same DFF. The error cases are that

**rp == 4'b1000** and **ren == 1'b1**, which means reading failed, or **wp == 4'b1111 (overflow when writing)**, **ren == 1'b0** and **wen == 1'b1**, which means writing failed. In these cases, **error** will be pulled up for a clock cycle.

Picture 1.8 Reading failed

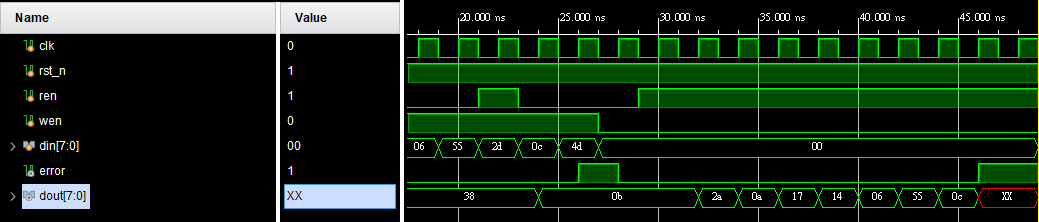
Picture 1.9 Writing failed

1. **Testbench**

****

Picture 1.10 Wave form 1

I test my design with the input in the lecture slide to see if there is something wrong or not. As the wave form showed in Picture 1.10m it looks like everything is correct. However, it only tests the condition of writing failed. Therefore, I let it read out all the data in the queue to check the condition of reading failed.



Picture 1.11 Wave form 2

As the result showed in Picture 1.11, we can see that the condition of reading fail is also correct.

1. **Advanced Question: Round-Robin FIFO Arbiter**
2. **Block Diagram**