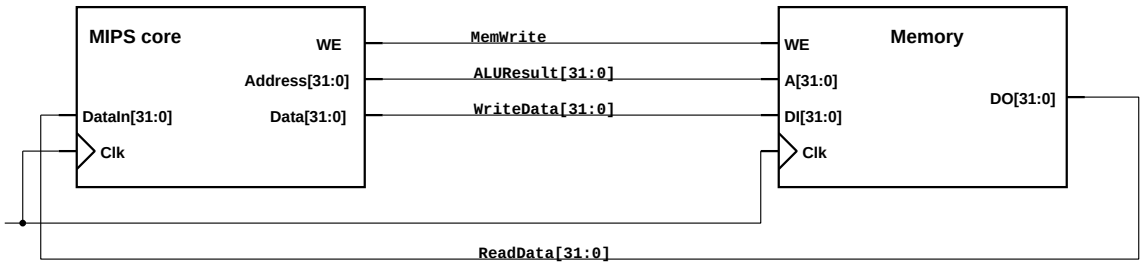
5. (10 points) Seen below is a simplified block diagram of a single-cycle MIPS architecture showing the core to memory interface as covered in the class and lab exercises.



The ADC is connected to the system through a memory mapped interface:

- The MIPS processor can write to `Start` pin of the ADC.
- The MIPS processor can read the `Done` pin and the 8-bit `DataOut` value from the ADC.

The three pins of the ADC are mapped to the following memory addresses:

```
Start   0xFFFF FF00
Done    0xFFFF FF40
DataOut 0xFFFF FF80
```

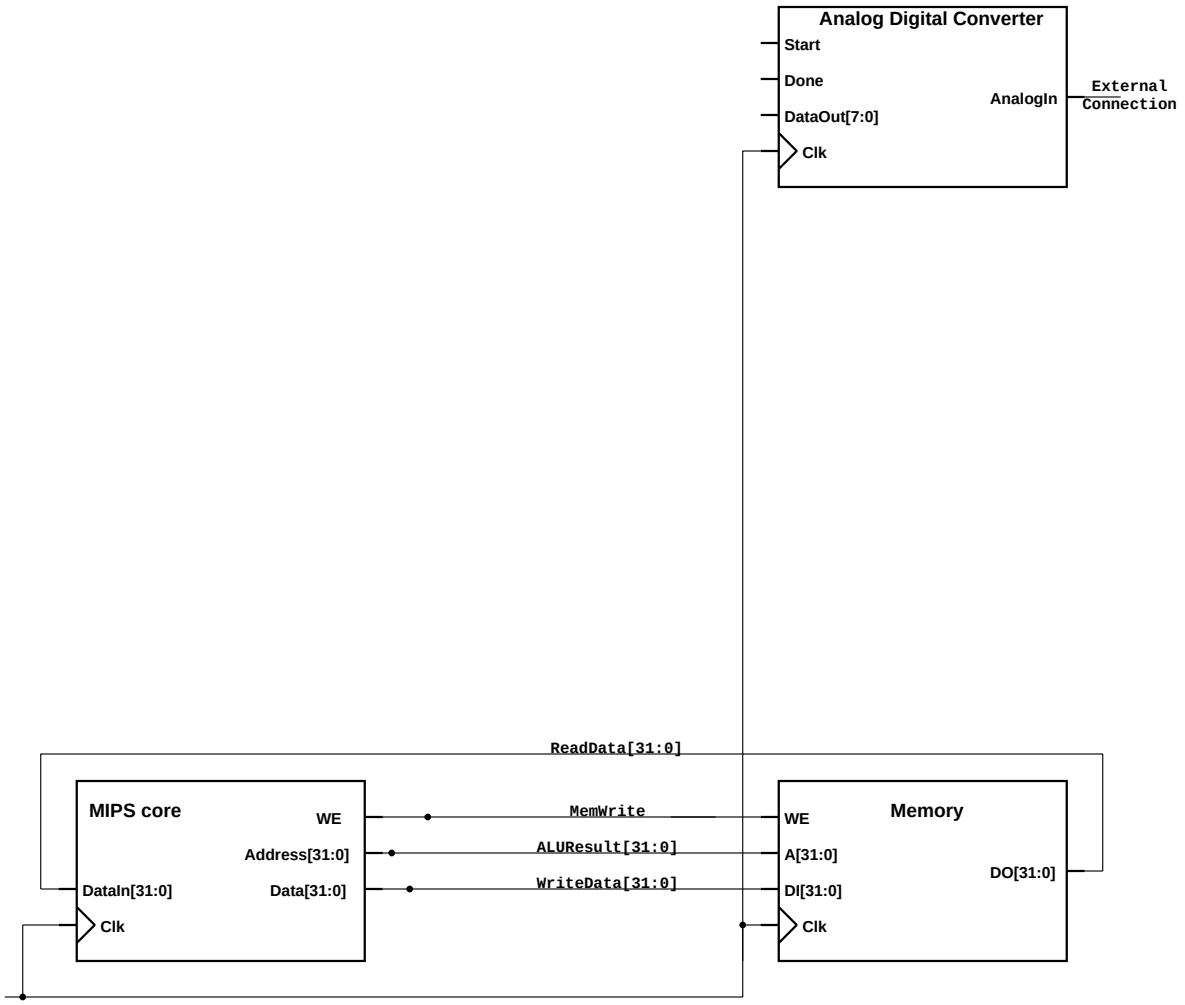
Make the necessary connections and if necessary add multiplexers, registers, flip-flops so that the processor can read and write to the ADC just as reading/writing to the memory without interfering with the memory. In case you need to compare a value with a memory address, you may use a comparator block that takes two 32-bit inputs and outputs 1 if they match, as shown below.

More specifically, complete the following two functions:

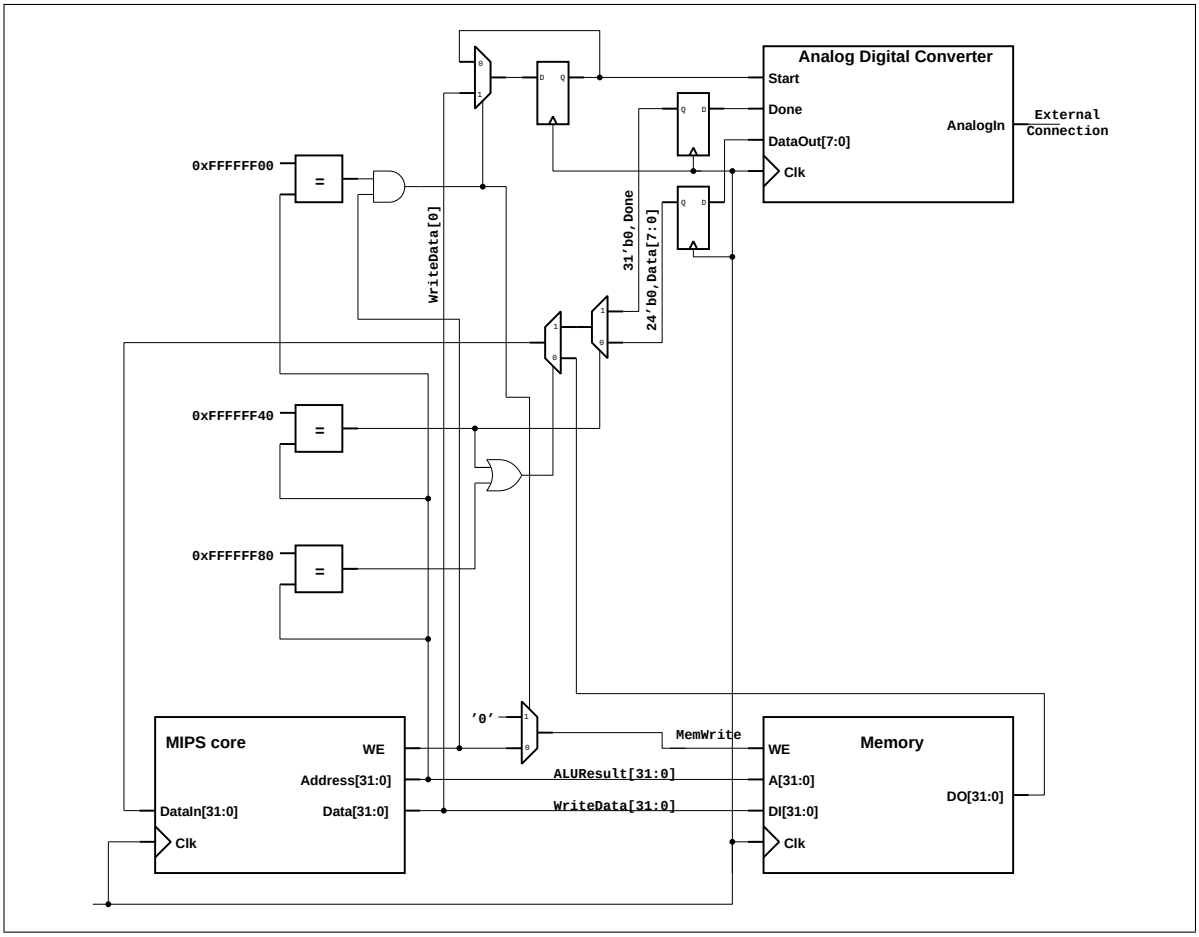
(a) The input for `Start`

(b) The reading of the output for `Done` and `DataOut`

Please draw on the schematic on the next page.


Analog Digital Converter
Start
Done
DataOut[7:0]
Clk
AnalogIn
External Connection
ReadData[31:0]
MIPS core
WE
Address[31:0]
DataIn[31:0]
Data[31:0]
Clk
MemWrite
ALUResult[31:0]
WriteData[31:0]
Memory
WE
A[31:0]
DI[31:0]
DO[31:0]
Clk

Solution:


Analog Digital Converter
Start
Done
DataOut[7:0]
Clk
AnalogIn
External Connection
0xFFFFFF00
=
WriteData[0]
31'b0, Done
24'b0, Data[7:0]
0xFFFFFF40
=
0xFFFFFF80
=
'0'
MemWrite
MIPS core
WE
Address[31:0]
Data[31:0]
DataIn[31:0]
Clk
ALUResult[31:0]
WriteData[31:0]
Memory
WE
A[31:0]
DI[31:0]
Clk
DO[31:0]