Programmable Circuits

A simple circuit: Count

- We’ve known registers, ALU, ROM, PC, and IR. Let’s build blocks, putting them together to create a simple circuit, count. Of course, you can use these components to build more complex circuits.

- This circuit is composed of two parts: execution logic and control logic.
  - **Execution logic** is to **execute an instruction**. It contains:
    - Two registers: RA and RB
    - An ALU has one control bit, which can control the two operators: Add and Pass input B to output.
    - The ALU has two inputs. Input A is from RA. Input B is one of \{RB, 1, 0, -1\}, which is the output of a MUX controlled by two bits: $S_0$ and $S_1$.
    - The ALU output is either stored in RA or RB, controlled by the control bit $O_0$ of a DEMUX. If $O_0$ is 0, output of ALU is stored in RA; Otherwise, it’s stored in RB.
  - **Control logic** contains a program memory (e.g., a ROM), a PC, and a IR, which is **in charge of the program execution**.
    - The **program** is a set of instructions. The instruction set is the space of all possible control signals. In this example, the space is $2^4$ number of instructions.
    - PC tacks the address of the next instruction.
    - IR stores the current instruction, which is a sequence of control bits of the execution logic.