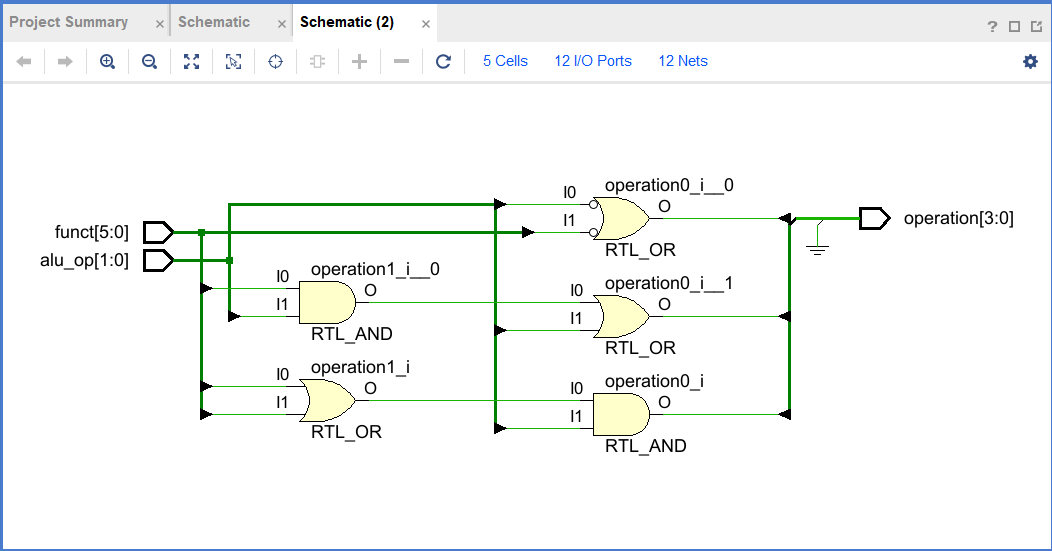
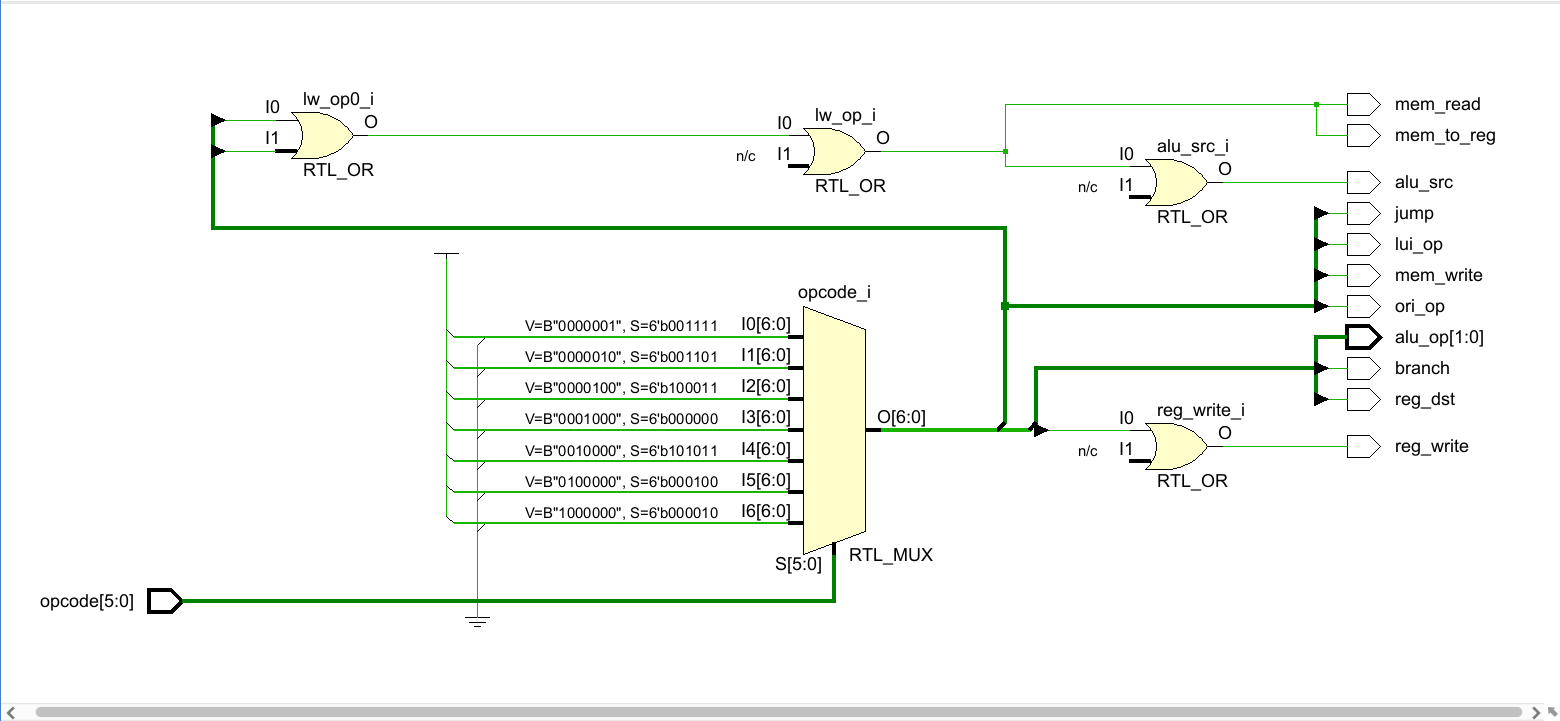
Lab2:report

1. Architecture Diagrams



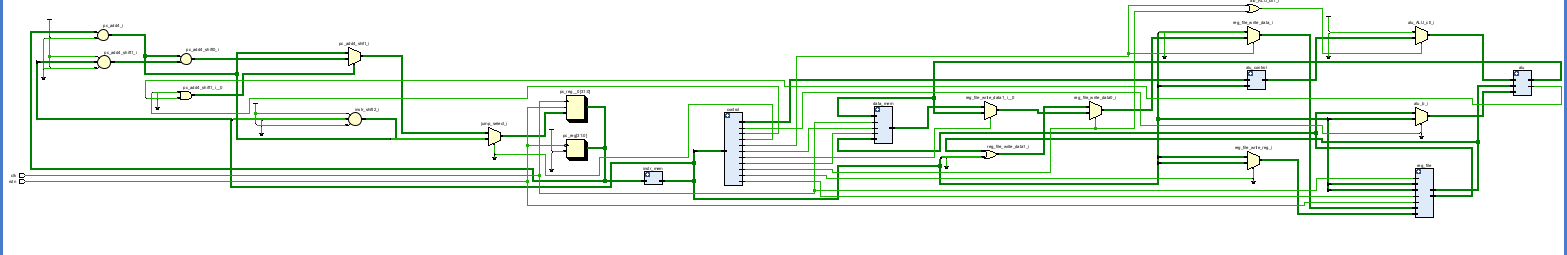
ALU control design

I follow the figure in textbook to implement. For operation[3], since it is always zero, assign it =0. For operation[2], it equals to one when alu\_op[0] = 1 or alu\_op[1] = 1 and funct[1] = 1. For operation[1], it equals to one when funct[2] = 0 or alu\_op[1] = 0. For operation[0], it equals to one when either funct[0] = 1 or funct[3] = 1 and alu\_op[1] = 1.



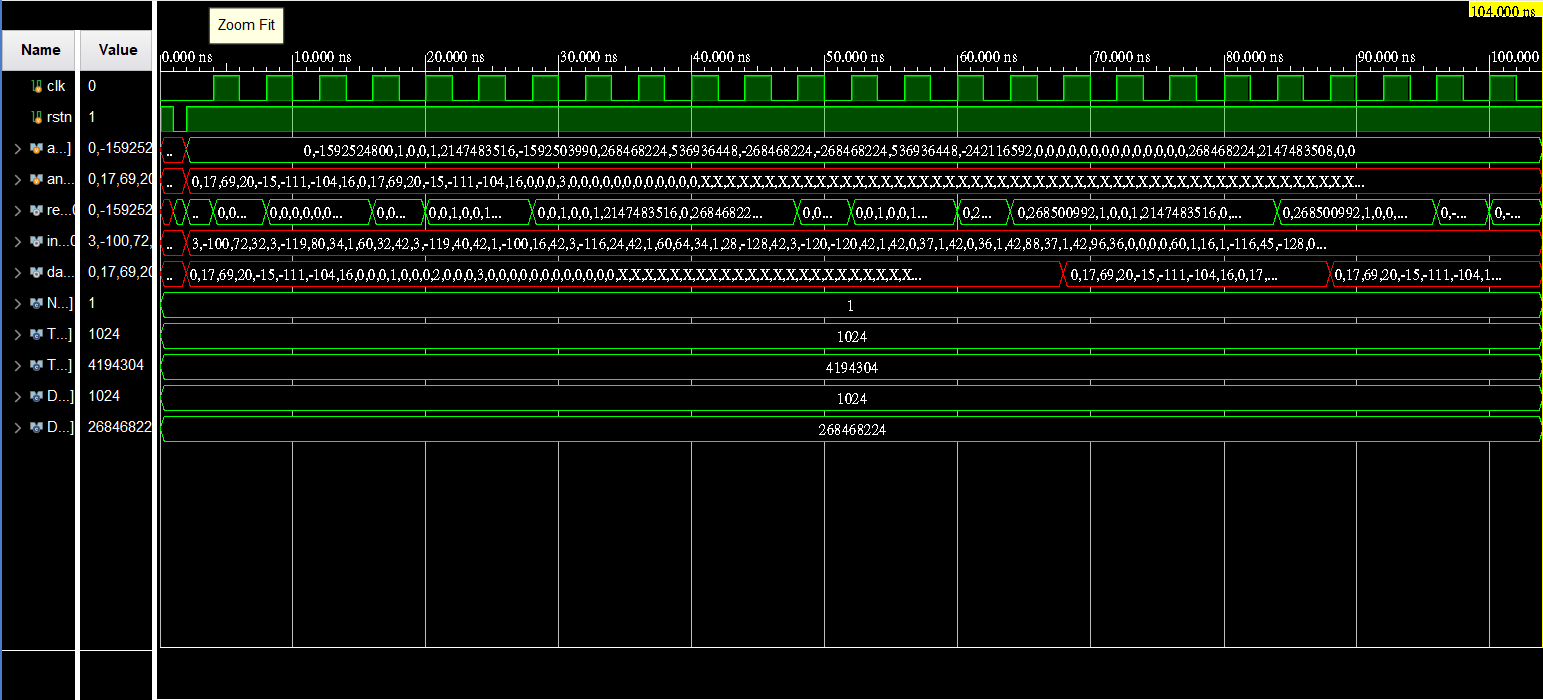
Main control design

When opcode equals to 001111, the operation must be lui. When opcode equals to 001101, the operation must be ori. When opcode equals to 000010, the operation must be jump. For lw, it equals to one when lui = 1 or ori = 1 or opcode = 100011(representing lw itself). Reg\_dst equals to 1 when opcode = 000000 because R-format’s rd in instruction[15:11].



Single-cycle processor design

2. Experimental Result



3. Answer the following Questions

1. When does write to register/memory happen during the clock cycle? How about read?

2. Translate the "branch" pseudo instructions ( blt , bgt , ble , bge ) in the Green Card into real instructions. Only at register can be modified, and other common registers should not be modified.

blt:

slt $t1 rs rt,

beq $1 1 Label

bgt: slt $t1 rt rs,

beq $1 1 Label

ble :

slt $t1 rt rs,

neq $t1 1 Label

bge:

slt $t1 rs rt,

neq $t1 1 Label

3. Give a single beq assembly instruction that causes infinite loop. (consider that there's no delay slot)

start: beq $zero $zero start

Because $zero is always zero, it will be a infinite loop.

4. The j instruction can only jump to instructions within the "block" defined by "(PC+4)[31:28]”. Design a method to allow j to jump to the next block (block number +1) using another j.

5. Why a Single-Cycle Implementation Is Not Used Today?

First, because it run one command exactly in one cycle, the cycle length must be long enough. However, it will cause excessively long cycle, and reduce the overall performance.

Next, single-cycle design needs the complex control units because it needs to control all operations in one cycle. This will increase the design complexity and cost.