



3.

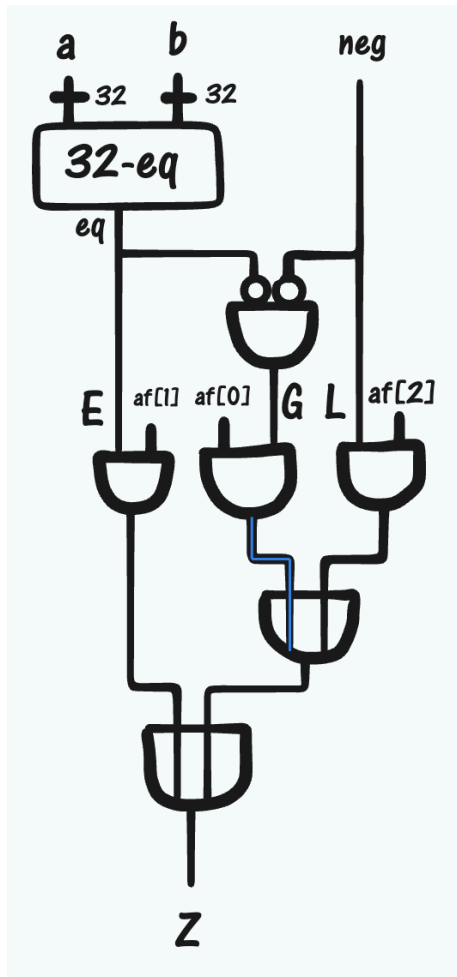
$$L = neg$$

Check equality with equality tester

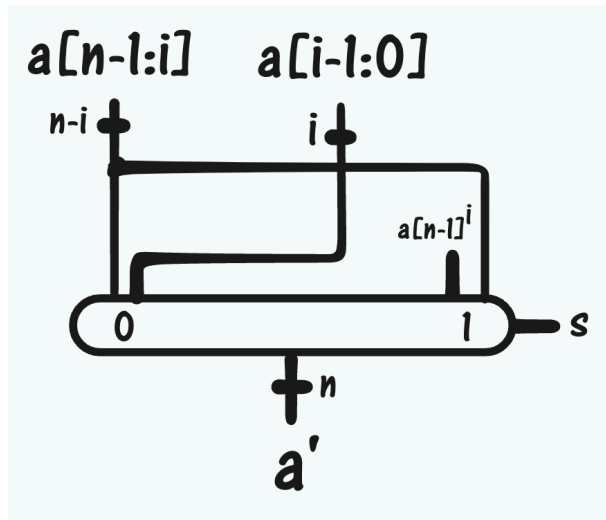
$$E = eq$$

Then

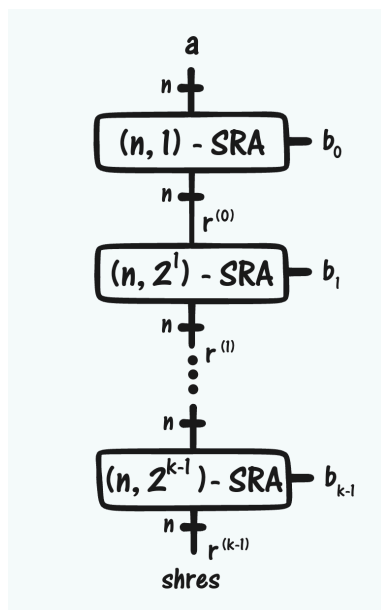
$$G = \overline{L} \wedge \overline{E} = \overline{(neg \vee eq)}$$



4.



5.



6.

010010	<i>beqz</i>
010101	<i>bnez</i>
010110	<i>jr</i>
010111	<i>jalr</i>
110010	<i>j</i>
110011	<i>jal</i>

$$\begin{aligned}
jtype(c) &\equiv opc(c)[5 : 4] = 11 \\
alui(c) &\equiv itype(c) \wedge opc(c) = 00 \\
alu(c) &= alui(c) \vee alur(c) \\
b(c) &= opc(c)[5 : 4] = 01 \wedge (opc(c)[1 : 0] = 01 \vee opc(c)[1] = 0) \\
j(c) &\equiv jtype(c) \wedge opc(c)[0] = 0 \\
jal(c) &\equiv jtype(c) \wedge opc(c)[0] = 1 \\
jr(c) &\equiv b(c) \wedge opc(c)[2 : 0] = 110 \\
jarl(c) &\equiv b(c) \wedge opc(c)[1 : 0] = 11 \\
jump(c) &\equiv jr(c) \vee jalr(c) \vee j(c) \vee jal(c) \\
jb(c) &\equiv jump(c) \vee b(c) \\
ifill(c) &\equiv \begin{cases} imm(c)[15] & opc(c)[3] = 1 \vee opc(c)[0] = 0 \vee b(c) \\ 0 & \end{cases} \\
xtimm(c) &\equiv ifill(c)^{16} imm(c) \\
rop(c) &\equiv \begin{cases} c.gpr(rt(c)) & rtype(c) \\ xtimm(c) & \end{cases} \\
af(c)[3 : 0] &\equiv \begin{cases} opc(c)[3 : 0] & itype(c) \\ fun(c)[3 : 0] & rtype(c) \end{cases} \\
ares(c) &\equiv alures(lop(c), rop(c), af(c)) \\
bres(c) &\equiv c.gpr(rs(c))[0] = opc(c)[0] \\
btarget(c) &\equiv \begin{cases} c.gpr(rs(c)) & jr(c) \vee jarl(c) \\ c.pc +_{32} sxtimm(c) & b(c) \\ c.pc +_{32} sxtiindex(c) & \end{cases}
\end{aligned}$$

7. replace the branch condition evaluation unit with a 32-bit zero tester and SLA with SRA. ALU also changes.

$$\begin{aligned}
sxtimm(c) &\equiv I[15]^{16} I[15 : 0] \\
sxtiindex(c) &\equiv I[25]^6 I[25 : 0]
\end{aligned}$$

