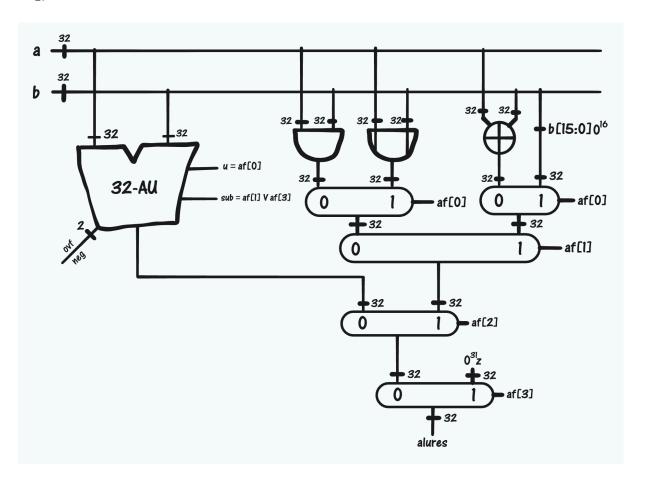
1.

af[3:0]	alures[31:0]	avfalu
0000	$a +_{32} b$	$[a] + [b] \not\in T_{32}$
0001	$a +_{32} b$	0
0010	$a{32} b$	$[a] - [b] \not\in T_{32}$
0011	$a{32} b$	0
0100	$a \wedge b$	0
0101	$a \lor b$	0
0110	$a\oplus b$	0
0111	$a[15:0]0^{16}$	0
1000	0_{32}	0
1001	$a > b?1_{32} : 0_{32}$	0
1010	$a = b?1_{32} : 0_{32}$	0
1011	$a \ge b?1_{32}:0_{32}$	0
1100	$a < b?1_{32} : 0_{32}$	0
1101	$a \neq b?1_{32}:0_{32}$	0
1110	$a \le b?1_{32}:0_{32}$	0
1111	1 ₃₂	0

2.



3.

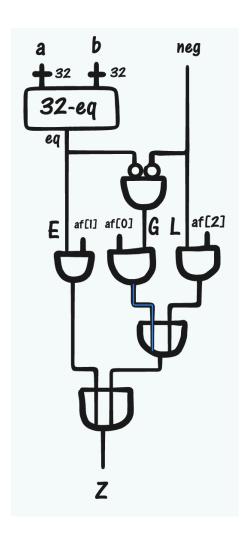
$$L = neg$$

Check equality with equality tester

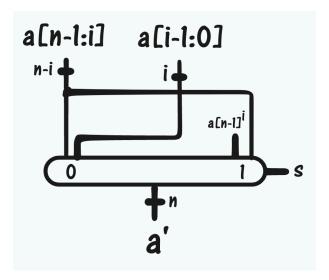
$$E = eq$$

Then

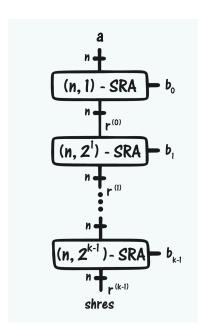
$$G=\overline{L}\wedge\overline{E}=\overline{(neg\vee eq)}$$



4.



5.



6.

010010	beqz
010101	bnez
010110	jr
010111	jalr
110010	j
110011	jal

```
jtype(c) \equiv opc(c)[5:4] = 11
       alui(c) \equiv itype(c) \land opc(c) = 00
        alu(c) = alui(c) \lor alur(c)
            b(c) = opc(c)[5:4] = 01 \land (opc(c)[1:0] = 01 \lor opc(c)[1] = 0)
            j(c) \equiv jtype(c) \land opc(c)[0] = 0
         jal(c) \equiv jtype(c) \land opc(c)[0] = 1
          jr(c) \equiv b(c) \land opc(c)[2:0] = 110
       jarl(c) \equiv b(c) \land opc(c)[1:0] = 11
    jump(c) \equiv jr(c) \lor jalr(c) \lor j(c) \lor jal(c)
          jb(c) \equiv jump(c) \lor b(c)
     ifill(c) \equiv \begin{cases} imm(c) \mid v \mid b(c) \end{cases} \quad opc(c)[3] = 1 \lor opc(c)[0] = 0 \lor b(c)
  xtimm(c) \equiv ifill(c)^{16}imm(c)
\begin{split} 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} \end{split}
      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) \lor jarl(c) \\ c.pc +_{32} sxtimm(c) & b(c) \\ c.pc +_{32} sxtiindex(c) & \end{cases}
```

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

$$sxtimm(c) \equiv I[15]^{16}I[15:0]$$

 $sxtiindex(c) \equiv I[25]^{6}I[25:0]$

