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CSCI 4593 - Midterm Resubmission

① RISC-V (Machine → Hex)

jal x9, -9044

imm[20|10:1|11|19:12]	rd	opcode
-9044	x9	jal
1100 1010 1101 1111 1011	01001	1101111

9044 = 0000 0010 0011 0101 0100
-9044 = 1111 1101 1100 1010 1011
(+1)
= 1111 1101 1100 1010 1100
[20 | 10:1 | 11 | 19:12]
1100 1010 1101 1111 1011

binary = 11001010 1101 1111 1011 0100 1101111
hex = 0xcaafa4ef

answer: 0xcaafa4ef

② RISC-V (Machine → Hex)

SltiU x12, x23, -984

imm[11:0]	rs1	funct3	rd	opcode
-984	x23	011	x12	0010011
1100 0010 1000	10111	011	01100	0010011

984 = 0011 1101 1000
-984 = 1100 0010 0111
(+1)
= 1100 0010 1000
[11:0]
1100 0010 1000

binary = 1100 0010 1000 1011 1011 0110 0001 0011
hex = 0xC2863693

answer: 0xC2863693

③ RISC-V (Machine - Hex)

345 = 101011001
[11:0]
0001 0101 1001

lb x20, 345(x27)

imm [11:0]	rs1	funct3	rd	opcode
345	x27	000	x20	0000011
0001 0101 1001	11011	000	10100	0000011

binary = 0001 0101 1001 1101 1000 1010 0000 0011

hex = 0x159d8a03

answer: 0x159d8a03

④ RISC-V (Machine → Hex)

2768 = 1010 1101 0000
[12|10:5] [4:1|11]
0010 110 1000 1

bltu x11, x23, 2768

imm [12|10:5]	rs2	rs1	funct3	imm[4:1|11]	opcode
2768	x23	x11	110	—	1100011
0010 110	10111	01011	110	1000 1	1100011

binary = 0010 1101 0111 0101 1110 1000 1110 0011
hex = 0x2d75e8e3
answer: 0x2d75e8e3

⑤ x5 = 0xcc556677

sh x5, 40(x0)
srai x5, x5, 24 x5 = 0xffffffcc
sh x5, 42(x0)
lh x7, 42(x0) x7 = 0xffffffcc

[MEM]
[28] = 0x6677
[2a] = 0xffcc

answer: x7 = 0xffffffcc

⑥ PC = 0x00000460

```
ori x9, x0, 0xdef      x9 = 0xdef
srli x10, x9, 1        x10 = 0x6f7
blt x9, x10, 12        branch to 12
                       if x10 < x9 ✓
```

x9 = 0xdef (3567)
1101 1110 1111
x10 = 0x6f7 (1783)
0110 1111 0111

	PC
ori	+4
srli	+4
blt	+16
	+20

PC = PC + 20
= 0x460 + 0x14
= 0x4C4

answer: PC = 0x4C4

⑦ answer: 0x1

⑧ x5 = 0x56789abc

```
sb x5, 61(x0)
srai x6, x5, 8      x6=0x567899
sh x6, 62(x0)
srai x6, x6, 16     x6 = 0x56
sb x6, 60(x0)
lw x7, 60(x0)       x7 = 0x789abc56
```

[MEM]
[3c] = 0x56
[3d] = 0xbc
[3e] = 0x789a

answer: 0x789abc56

⑨
```
sh x16, -56(x7)     no dependencies
xor x4, x7, x16     x16 dependent on sh
lh x9, -20(x4)      x4 dependent on xor
bne x4, x9, 324     x4 & x9 dependent
```

ⓐ sh ID/EX xor EX/MEM lh MEM/WB
0, 2, 2

ⓑ forwarding in MEM/WB
0, (2-1), (2-1)
0, 1, 1

ⓒ forwarding in EX/MEM & MEM/WB
0, (2-2), (2-1)
0, 0, 1

answer: ⓐ 0,2,2 ⓑ 0,1,1 ⓒ 0,0,1