

Computation Structures — Tutorial 11

December 12, 2017

1 A β Machine with a 2-Stage Pipeline

1. Give a plausible implementation of `NOP()`.
2. Give a *software* solution to the jump problems for each of the following programs:

| | | | | | | | |
|-----|---|-------|----------------|-----|---|-------|-----------------|
| (a) | 1 | Main: | ADDC(R31,0,R1) | (b) | 1 | Cas1: | ADDC(R1,4,R1) |
| | 2 | | ADDC(R31,2,R2) | | 2 | | SUBC(R2,12,R2) |
| | 3 | Incr: | ADDC(R1,5,R1) | | 3 | | CMPLT(R1,R2,R0) |
| | 4 | | SUBC(R2,1,R2) | | 4 | | BNE(R0,Cas2) |
| | 5 | | BT(R2,Incr) | | 5 | | MULC(R1,5,R1) |
| | 6 | Oper: | ADD(R1,R3,R3) | | 6 | | BR(rtn) |
| | | | | | 7 | Cas2: | MULC(R2,5,R2) |
| | | | | | 8 | | BR(rtn) |

2 A β Machine with a 4-Stage Pipeline

1. Give a software *and* a hardware solution to the data conflicts problems for the following program:

```
1 ADD(R1,R2,R3)
2 SUB(R3,R4,R5)
3 MULC(R2,5,R17)
4 ADD(R5,R1,R1)
5 SUB(R17,R1,R17)
```

2. Give a *hardware* solution to the data conflicts problems for the following program:

```
1 LD(R1,0,R4)
2 ADD(R1,R4,R5)
3 XOR(R3,R4,R6)
```

3. If the β Machine features 2 *bypasses*, what will be the result stored at 0x1000 after the execution of the following program? Why?

```
1 ADDC(R31,3,R0)
2 SUBC(R0,1,R1)
3 MUL(R0,R1,R2)
4 XOR(R0,R2,R3)
5 ST(R3,0x1000,R31)
```