

Digital Design and Computer Architecture LU

# Lab Protocol

## Exercise IV

Group 25

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Vienna, June 25, 2019

# Forwarding Simulation

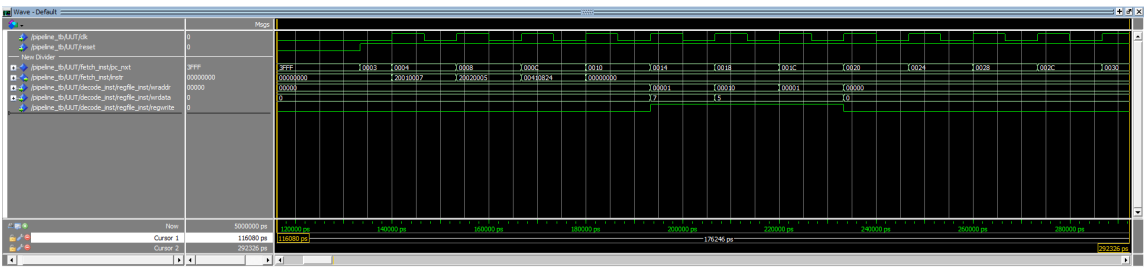


Figure 1: Simulation screenshot for Listing ??.

Make sure that at least the following signals are visible in Figure ??: the program counter in the fetch stage, the instruction being fetched, and the signals `wraddr`, `wrdata`, and `regwrite` of the register file.

Listing 1: Assembler example with forwarding

```
addi $1, $0, 7
addi $2, $0, 5
and $1, $2, $1
nop
nop
```

# Branch Hazards Simulation

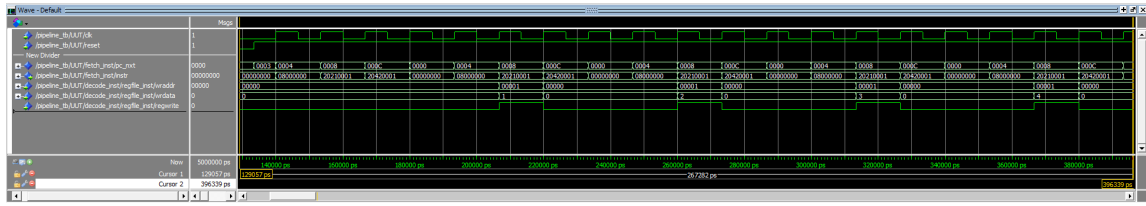


Figure 2: Simulation screenshot for Listing ??.

Make sure that at least the following signals are visible in Figure ??: the program counter in the fetch stage, the instruction being fetched, and the signals `wraddr`, `wrdata`, and `regwrite` of the register file.

Listing 2: Assembler example with branch delay slot

```
loop:  j loop
      addi $1, $1, 1
      addi $2, $2, 1
      nop
```

## Synthesis Results

Table 1: Resource usage by entity, including resources used by sub-entities.

	LC Combinationals	LC Registers	Memory Bits
Fetch Stage	90	14	131072
Decode Stage	1486 (1312)	1070(46)	0
– Register File	174	1024	0
Execute Stage	1125 (624)	153	0
– ALU	501	0	0
Memory Stage	395 (232)	101	0
– Jump Unit	4	0	0
– Memory Unit	159	0	0
Write-Back Stage	49	71	0
Forwarding Unit	16	0	0
Control Unit	0	0	0
Sum	3161	1409	131072

**Question:** What is the maximum frequency of your design?

**Answer:** 100.41 MHz at 0C, 93.12 MHz at 85C in the slow Models and 182.98 MHz in the fast 0C Model (all Models with 1200mV)

**Question:** Where is the critical path of your design?

**Answer:** From mem\_inst|sig\_aluresult\_in to exec\_inst|sig\_op\_before\_fwd.imm