

CSE340: Computer Architecture

Assignment 3

Chapter 4 (The Processor)

Total Marks: 15 (Marks are indicated in third brackets after each question)

Question 1 [Marks: 3]

Consider the code sequence below:

lw \$t0,36(\$t1)

lw \$t2,40(\$t0)

lw \$t3,44(\$t2)

sll \$t3,\$t2,2

sub \$t0,\$t3,\$t2

addi \$t0,\$t0,2

srl \$t0,\$t3,2

For the next questions, you will need to **draw** the appropriate diagram showing the pipeline stages and hazard removal methods.

- a) If you only use **Stall** to overcome the data hazard how many clock cycles would you need for executing the above code sequence? **Draw the diagram for pipelining as well as calculate the CPI.**
- b) If you use **Stall and Forwarding** to overcome the data hazard how many clock cycles would you need for executing the above code sequence? **Draw the diagram for pipelining as well as calculate the CPI.**

Question 2 [Marks: 6]

Consider the below set of instructions. Identify the data hazards and overcome the hazards using all the available methods [**Stalling, Stalling + Forwarding, Stalling + Forwarding + Code Scheduling**]. Your answer should contain all the necessary diagrams, required total cycle count in each solution along with average CPI. You will need to draw the diagrams clearly using 2B or darker pencils.

add \$10,\$11,\$12

add \$13,\$10,\$11

sub \$7,\$13,\$6

lw \$8,40(\$7)

sll \$3,\$8,2

addi \$11,\$9,\$6

Question 3 [Marks: 2]

Consider the following duration for each stage:

IF = 260 ns

ID = 270 ns

EX (addition) = 450 ns

EX (subtraction) = 350 ns

MEM = 200 ns

WB = 290 ns

Now answer the following questions:

- a) By how many ns the single cycle datapath clock period is greater than the 5 stage pipeline clock period?
- b) For a single cycle datapath, what is the duration, in ns, to execute 6 sub instructions, 8 lw instructions and 1 add instruction?

Question 4 [Marks: 4]

- a) Draw a complete single cycle datapath having control units and control signals.
- b) Draw the datapath for the instruction **lw \$9, 16(\$11)**. (You can use a colored pen to specify the wires used).