

CS 2200 Homework 5

Fall 2018

Instructions:

- Please print a copy of the assignment and hand write your answers. No electronic submissions are allowed. **Please print as one double-sided page. Do NOT staple multiple sheets together. There will be a 50 point penalty if you do not.**
- This is an individual assignment. You may discuss concepts but not the answers.
- Due Date: **10/3/18 – 6:00 PM** in recitation. Bring your BuzzCard. Show up on time.

Name: _____ GT Username: _____ Section: _____

1. Branching instructions like BNE occur quite often in assembly code. Let's say that an engineer proposes to improve the BNE instruction such that it takes one-fourth time to execute, and BNE instruction makes up 33% of the total instructions. If a program takes 80 ns to execute before the improvement, find:
 - a. Time taken to execute the program after the improvement.
 - b. Speedup achieved by the improvement.
2. Let's say that we have a destination 500 miles away, and we can take a C-150 or a bus. The C-150 has a speed of 100 miles/hour and can transport at most 2 people. The bus has a speed of 40 miles/hour and can transport 30 people. Fill out the latency and throughput for C-150 and bus.

	Latency (in <i>Hours</i>)	Throughput (in <i>People per Hour</i>)
C-150		
Bus		

3. Consider the pipelined LC-2200 architecture as described in the textbook. Suppose we want to implement the following BOB-2200 instruction.

SLT DR, SR1, SR2

- a. Write the pipeline stage next to each operation in which it occurs (not all stages may be used, and some stages may be used more than once)

Operation	Stage
• Write 0 or 1 to destination register	_____
• Increment the PC	_____
• Get values from SR1 and SR2	_____
• Retrieve instruction from memory	_____
• Compare SR1 and SR2	_____

- b. What are the **minimum** contents that must be placed in each pipeline buffer in order to support this instruction in normal program execution? **Write each value and its corresponding number of bits in parenthesis.**

FBUF	DBUF	EBUF	MBUF
- Fetched Instruction (32 bits)			

- c. Calculate the total number of bits that each buffer must hold:

FBUF _____ bits **DBUF** _____ bits **EBUF** _____ bits **MBUF** _____ bits

4. Give two examples of structural hazards that require a pipeline to have additional hardware compared to the datapath used in Project 1, and identify what additional hardware would be needed.