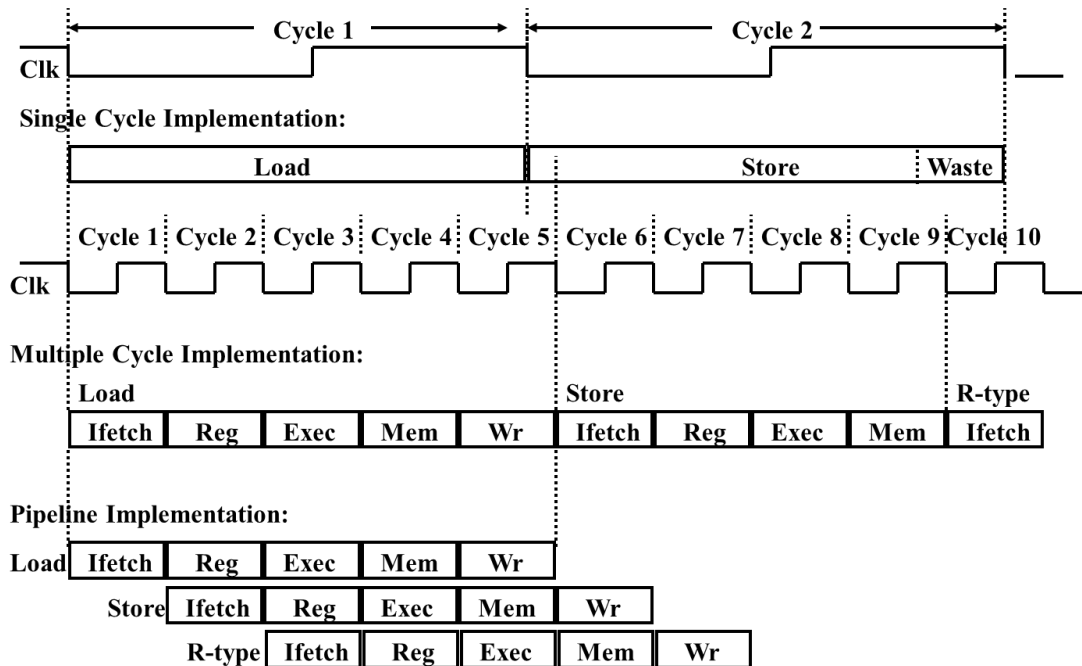# ENGR xD52: Quiz 0

This quiz is to be done closed notes and without human interaction. You may use MARS and its help file.

Describe all work. You have 30 minutes. Email to comparch14@gmail.com

The Best Slide Ever

Refer to The Best Slide Ever for this section:

1. Generally speaking, which implementation style optimizes:
   a. Average Instruction Throughput
   b. Average Instruction Latency
   c. Maximum Instruction Latency
   d. Functional Unit Re-use
2. Rank the implementation styles in order of increasing instruction decoder complexity.
3. What is the approximate Balancing Penalty of the Multi-Cycle Implementation? Give your answer as a percentage. Give your reasoning in 1 to 2 sentences.
4. From the diagram it appears that the Multi-Cycle and Pipelined Implementations have similar clock periods. Is this a reasonable and/or safe assumption? Support your answer in 2-3 sentences.

The Best Program Ever

(From http://www.cs.bilkent.edu.tr/~will/courses/CS224/MIPS%20Programs/vowel_a.htm)

```
#-----------------------------------------------
# vowelp - takes a single character as a
# parameter and returns 1 if the character
# is a (lower case) vowel otherwise return 0.
# a0 - holds character
# v0 - returns 0 or 1
#-----------------------------------------------
vowelp: li $v0,0
  beq $a0,'a',yes
  beq $a0,'e',yes
  beq $a0,'i',yes
  beq $a0,'o',yes
  beq $a0,'u',yes
  jr $ra
yes: li $v0,1
  jr $ra
#-----------------------------------------------
# vcount - use vowelp to count the vowels in a
# string.
# a0 - holds string address
# s0 - holds number of vowels
# v0 - returns number of vowels
#-----------------------------------------------
vcount:
  sub $sp,$sp,16    # save registers on stack
  sw $a0,0($sp)
  sw $s0,4($sp)
  sw $s1,8($sp)
  sw $ra,12($sp)
  li $s0,0          # count of vowels
  move $s1,$a0      # address of string
nextc: lb $a0,($s1) # get each character
  beqz $a0,done     # zero marks end
  jal vowelp        # call vowelp
  add $s0,$s0,$v0   # add 0 or 1 to count
  add $s1,$s1,1     # move along string
  j nextc
done: move $v0,$s0  # use $v0 for result
  lw $a0,0($sp)     # restore registers
  lw $s0,4($sp)
  lw $s1,8($sp)
  lw $ra,12($sp)
  add $sp,$sp,16
  jr $ra5
```

5. Fill out the following chart. This may require you to make assumptions for missing data. Give explanation about any assumed information. Express Type Frequency as a percentage or as a fraction.

Instruction Type	Type Frequency	CPI (Single Cycle)	CPI (Multi Cycle)	CPI (Pipeline)
ALU		1	4	1
Load		1	5	2
Store		1	4	1
Branch		1	3	2
Jump (and Link)		1	2	1
	Average CPI			
	Clock Speed		10 MHz	10 MHz
	MIPS			

6. Compare the execution speed of The Best Program Ever on the 3 given processors. How much faster is the fastest option than the slowest?