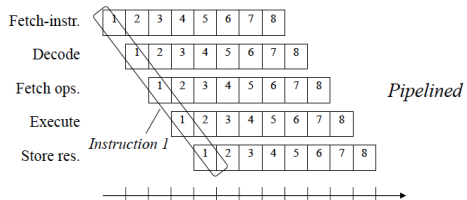


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ECEN3213 Homework 2 Spring 2022

**Due Date: Monday, Feb 28th, 2022 through Canvas
(Total 45 Points)**

1. Assuming a microprocessor has a 5-stage instruction cycle (fetch instruction, decode, fetch operands, execute, and store results) and it uses pipelining. Each stage takes one clock. How many clocks are needed to run 100 instructions on this microprocessor? Explain your results. (5 points)



2. Number Conversion: (10 points)

a) $(131)_{10}$ = $(10000011)_2$ (8-bit binary number)

b) $(47)_{10}$ = $(00101111)_2$ (8-bit binary number)

$$c) (10101111)_2 = (175)_{10}$$

$$d) (10100001010001)_2 = (2861)_{16}$$

$$e) (273)_8 = (BB)_{16}$$

$$f) (10011100110101)_2 = (25465)_8$$

$$g) (11011011)_{2c} = (219)_{10}$$

$$h) (00101001)_{2c} = (41)_{10}$$

$$i) (53)_{10} = (110101)_{2c} \quad (8\text{-bit two's complement})$$

$$j) (-53)_{10} = (-110101)_{2c} \quad (8\text{-bit two's complement})$$

3. What is the number of bits of the following terms in the ARM number system? (4 points)

Nibble 8 Word 32 Half Word 16 Double Word 64

4. Write the ASCII code (hexadecimal numbers) representation of the following string.
Note there is a space after each comma. (3 points)

String: *ECEN3213 is about ARM and Pi!*

ASCII Code:

65 63 66 65 03 02 01 03 69 73 61 62 66 75 74 41 52 40 61 65 64 50 69 21

5. In Raspberry Pi GPIO, why is it not a good idea to directly use an output pin to drive an LED without a resistor? (3 points)

*It would either burn up the LED
or blow up the GPIO*

Bouncing is a process by which two metal surfaces when coming close in contact or opened generate multiple signals. debouncing is a kind of hardware and software that ensures only a single signal is to be generated from switches.

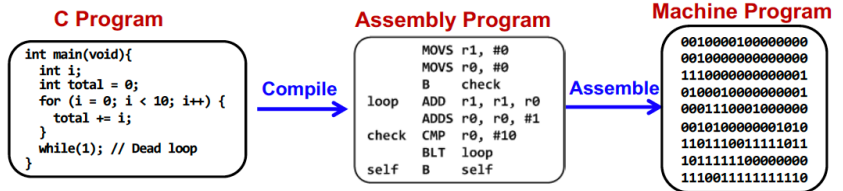
In digital IO if we want to set a manual switch for input in a circuit we have to implement debouncing so that a single signal is as input. So, it appears as a single press rather than multiple press

6. What is debouncing and why do we need debouncing in digital IO? (4 points)

debouncing ensures only a single signal is to be generated from switches.

in digital IO we want de-bouncing so that when we have a switch in the circuit it appears as a single press instead of multiple.

7. Given the following sequence of C code, assembly code and machine code, answer



the questions. (6 points)

- 1) What is the assembly code for “while (1)” in the C code? (2 points)

BLT loop

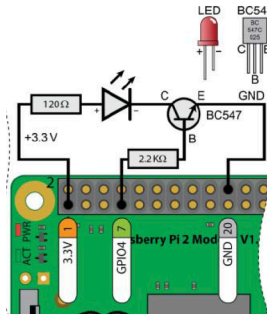
- 2) How is the variable “total” represented in the assembly code? (2 points)

Movs r0, #0

3) Which line in the assembly code realizes “total += i”? (2 points)

ADDS r0, r0, #1

8. In the following circuit for LED control, assume the voltage across the LED is 2V when it is on. Answer the following questions (10 points):



1) Estimate the current (in mA) through the LED when GPIO4 (7) outputs low. (5 points)

0mA

2) Estimate the current (in mA) through the LED when GPIO4 (7) outputs high. (5 points)

16mA

