American University of Beirut

Faculty of Engineering and Architecture

Department of Electrical and Computer Engineering

EECE 200-Introduction to Engineering – Fall 2014

Homework 2

Homework2 consists of two parts:

- Part 1 is questions related to topics covered during the lectures.
- Part 2 is based on LabVIEW, and the concepts covered will help you with the project later on.

Part 1: (85 pts → 100 pts)

Problem 1 (Circuits and Electronics): [15 points]

Apple recently (September 2014) released the iPhone 6 smart phone. It has an A8 processor which has several powerful properties.

a. Find out some properties of the A8 processor in terms of number of transistors and technology used, size, clock speed. [3points]

b. If the A8 processor now has 2 billion transistors. Suppose after few years, Apple will announce its new smart phone whose processor has 13 billion transistors. What year would that be? [6points]

c. Suppose Moore's Law said that the number of transistors would triple every two years, how many transistors would be on this chip in the year 2025? [6points]

Problem 2 (Computer Hardware): [16 points]

Consider the following expression:

$$O=[(A.B)' + C] \oplus [\ (A+C)+(B \oplus C)'\ ]$$

a. Find the truth table of the following expression (output O in terms of three inputs A, B, and C). [10 points]

b. Write the following expression in terms of AND, OR, NAND, NOR, NOT and XOR gates. [6points]

Problem 3 (Communications and Signals): [19 points]

The following audio signal **X (t) = 1.5 cos (1250t)** Volts is to be transmitted via a communication link using digital communication system.
(In the following exercises, make sure to indicate units whenever necessary).

a. What are the two main steps in Analog to Digital conversion? [2 points]
b. What is the minimum sampling rate required to sample this signal? Why? [2 point]
c. If the signal is sampled at a rate of 500 samples/sec. Find the values of the first five samples, starting with t=0. Show all your calculations. [5 points]

The samples are quantized to 256 discrete levels that correspond to full range of +/- 1.5Volts (All zeros is -1.5V and all ones is +1.5V).

d. If 256 quantization levels are used, what is the required bits/sample of the A/D converter? [1 point]
e. Find the binary representation of the first five samples starting at t=0. Show all your calculations. [5 points]
f. How can we improve sampling of a signal? Does it have any drawbacks? [2 points]
g. How can quantization be improved? What is the disadvantage of this improvement? [2 points]

Problem 4 (Project Management): [35 points]

Consider the following list of activities for an engineering project along with the expected duration in days. The activities are shown in the table below:

Activity	Predecessor	Duration in days
A	None	2
B	None	4
C	A	8
D	C	6
E	C	4
F	B	6
G	E,F	2
H	D,E	1
I	G	4
J	H,I	8

a. Show the network diagram representation of this project. [4 points]

b. Identify the paths from start to end of the project and the duration of each path. [4 points]
c. Indicate the critical path based on observations from part (b). Justify. [1.5points]
d. Find the earliest start and the earliest finish of each task. [10 points]
e. Find the latest start and latest finish of each task. [10 points]
f. Find the float time (slack time= LS-ES=LF-EF). [2.5 points]

g. Indicate the critical path based on observations from part (f). Justify. [2 points]
h. Find the minimum project completion time. [1 point]

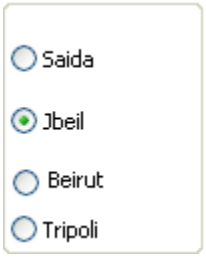
Part 2: (35 pts→100 pts)

Exercise 1: (5 pts)

Part A (2 pts)

Create a "radio button" control to allow the user to select among multiple options as follows. You can always right click the structure to modify its properties.

What is the capital of Lebanon?



Create a numeric indicator, then connect it to the radio button control. Try selecting different options and check the indicator result (you can place your program in a while loop to keep it running)

- Take a snapshot of the front panel showing the radio button you created along with the indicator showing the result when you select "Beirut".

Part B (3 pts)

Repeat the same exercise and questions in part a using "ring" structure instead of radio button. Hint: "Check Ring and Enumerate" library in front panel.

- Take a snapshot of the front panel showing the "ring" structure you created along with the indicator showing the result when you select "Beirut".
- Upload your complete VI including parts A and B (name it exercise1_yourname)

Exercise 2: (14.5 pts)

Part A (4.5 pts)

Create a tab container (Front Panel→ Modern→ container). Add pages to have a total of 5 tabs, rename the tabs according to your choice. Right click on its corresponding VI on block diagram and change it to indicator. Create numeric control THEN connect it to the tab structure. Try to input different numbers and watch out the effect on the front panel (you can place your program in a while loop to keep it running)

a. Which tab (write its name) is being selected when you input the number "3"? Take a snapshot of the result.

b. Remove the numeric control, write click to the tab structure input to create a constant. Try different values and check the result. Take a snapshot of the block diagram showing the list of options you can select from the constant.

Part B (5.5 pts)

In the first tab, the user should input a number, and LABVIEW should display a message stating "multiple of 3" or "Not multiple of 3". Hint: Use "Quotient & Remainder" Block, case structure, comparison block, string indicator.

a. Take snapshot(s) of the block diagram.
b. Take 2 snapshots of the front panel showing the 2 messages with the input control.
c. Right click on the control and go to properties and try to limit the user input between 0 and 50, i.e. If the user tries to input a number greater than 50, he is not allowed and a 50 is inputted instead. Experiment with values outside the range. Record the steps you did to achieve the requirements.

Part C (3.5 pts)

In the second tab, create a Boolean switch that controls a Boolean LED indicator. Go to properties of the indicator and choose two different colors (other than the default) indicating the (ON/OFF) status of the switch with different display text on the indicator according to switch status.

Allow the user to press "Escape" button on the keyboard to toggle between the two states of the switch controlling the LED Boolean indicator. (Check properties→ Key Navigation of the pushbutton).

a. Take 2 snapshot of the front panel showing both states of the LED
b. Record briefly the steps you did to modify the switch and LED properties as requested above
c. Upload your complete VI including parts A, B and C (name it exercise2_yourname)

Exercise 3: (11 pts)

Create a 2D constant string array with 2 rows and 5 columns. Fill the first row with 5 names and the second with their corresponding ages.

Part A (4 pts)

Create a VI that allows the user to select a specific age from the array and extract its value to an indicator. You can use "index array" block that allows you to select any element from an array by inputting proper indices. In your case, and since we are always pointing to the second row, the user should write in one number and accordingly the content of that element (age) should be extracted to an indicator.

- Take a snapshot of the block diagram showing the logic and the array that you created and another snapshot of the front panel showing the result of one of your selections.

Part B (3 pts)

Use “Replace Array subset” to replace the element at third column, first row by the name “Jane” and display the new array as an indicator on the front panel.

- Take a snapshot showing your block diagram and the front panel with the new array updated.

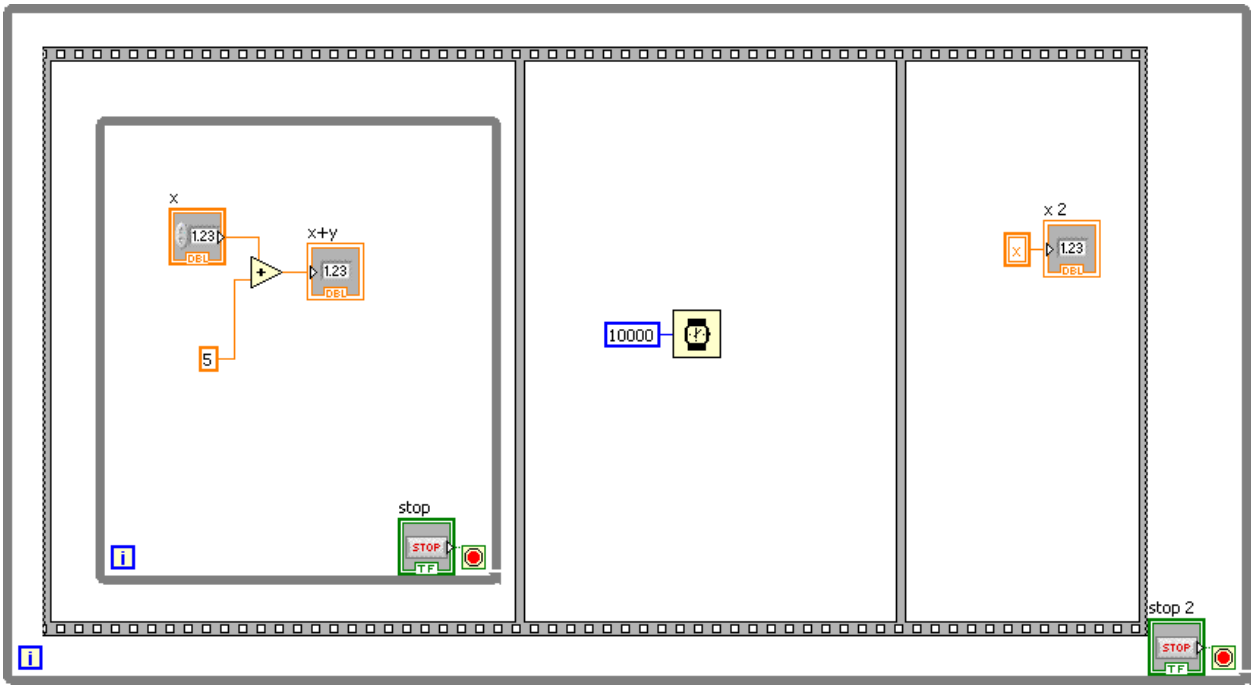
Part C (4 pts)

Use a numeric knob control to replace the element at third column, second row with the corresponding value set by the user. Since the array is of string type, LABVIEW will not allow you to connect the numeric knob to “Replace Array subset”. Hence it should be changed to string type before connection. To do this, use “Format to String” block to change from numeric to string (input the knob to input 1 terminal, create a string constant with value (%d) and connect it to “format string” terminal)

- Take a snapshot showing your block diagram and the front panel with the new array updated according to the knob value.
- Upload the complete VI including parts A, B, and C (name it exercise3_yourname)

Exercise 4: (4.5 pts)

Build the VI below. (Hint: do not forget that when the user inputs a number to the control on front panel, he needs to press outside or enter to take effect)



a. Explain in details the function of this program from logic design and user perspective (how and when are the values updates along with the flow of the program)
b. Upload the VI (name it exercise4_yourname)