Engin 103 April 21, 2009 back to e-syllabus	Topics: CW11 CW12 Project 3 Topic Assignment Logbook questions

back

Engineering 103 –UMass Boston
CW 11
(In-Class-Work 11)

Digital and Analog representations and conversions

Find in Chapter 4 of DCE (Horenstein) the answers to the following questions (15 min max.)

1.- State the relation between Assembly Code; Programming Language; and Compiler

2.- What is a digital signal? Do an A/D conversion for 2003 with the minimum number of bits, and a D/A conversion for 0101 1010 1101 0010

3.- Do a A/D conversion for 0.5 with 8 bits of information, being 1 the highest number, using no "binary dot" in the binary representation of eight bits; and a second version using a 'binary dot' between two groups of four bits, with the second groups using **negative** decreasing powers of 2 from left two right.

By alphabetical order of the last names, the first two students in each team will submit Word file cw11_XX_a.doc, the next two students will submit Word file cw11_XX_b.doc, to the *files* folder in the server. These files need to be uploaded to the server today to receive credit.

What is a digital signal? Computers work with digital signals; the electronics does 5V (on) and 0V (off). A digital signal is composed of 0's and 1's, like binary numbers.

Analog	Digital
0	0000
1	0001
2	0010
3	0011
8	1000
15	1111
16	0001 0000
255	1111 1111

Analog to Digital conversion (A/D):

We want to write 2003 (an analog number) in digital (or binary) format:

$127 = 1*10^2 + 2*10^1 + 7*10^0$ (using powers of 10; since we use decimal system)

$127 = \quad 2^7 \quad 2^6 \quad 2^5 \quad 2^4 \quad 2^3 \quad 2^2 \quad 2^1 \quad 2^0$

In binary system, numbers are just 0 or 1, starting from the left, let's insert either 1 or 0 in front of the powers of 2:

$127 = 0*\ 2^7 + 1*\ 2^6 + 1*\ 2^5 + 1*\ 2^4 + 1*\ 2^3 + 1*\ 2^2 + 1*\ 2^1 + 1*\ 2^0$

127 -> 0111 1111

Now convert 2003 into digital format:

Digital to Analog conversion (D/A):

$1001 = 1*2^3 + 0*\ 2^2 + 0*\ 2^1 + 1*\ 2^0 = 9$

1001 -> 9

Now convert 0101 1010 1101 0010 into analog format:

More on CW11:

2)

A/D conversion:

2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1

What is the highest binary number using 8 bits of information? Answer: 255

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

D/A conversion: 0101 1010 1101 0010 -> ?

3) Represent 0.5 in binary/digital:

a) First alternative:

Decimal system	Binary or Digital system
1	1111 1111 (255)
0.5	1000 0000 (128)

b) Second alternative: using a "binary dot"

$2.5 = 2*\ 10^0 + 5 * 10^{-1}$ (to the right of the dot: negative powers of 10)

We can use this in binary or digital format as well: to the right of the "binary dot" use negative powers of 2:

				2	·	5			
Decimal	$0*10^3$	$0*10^2$	$0*10^1$	$2*10^0$	.	$5*10^{-1}$	$0*10^{-2}$	$0*10^{-3}$	$0*10^{-4}$
Binary	$0*2^3$	$0*2^2$	$1*2^1$	$0*2^0$	.	$1*2^{-1}$	$0*2^{-2}$	$0*2^{-3}$	$0*2^{-4}$

2.5 -> 0010.1000

back

Engineering 103 –UMass Boston

CW 12

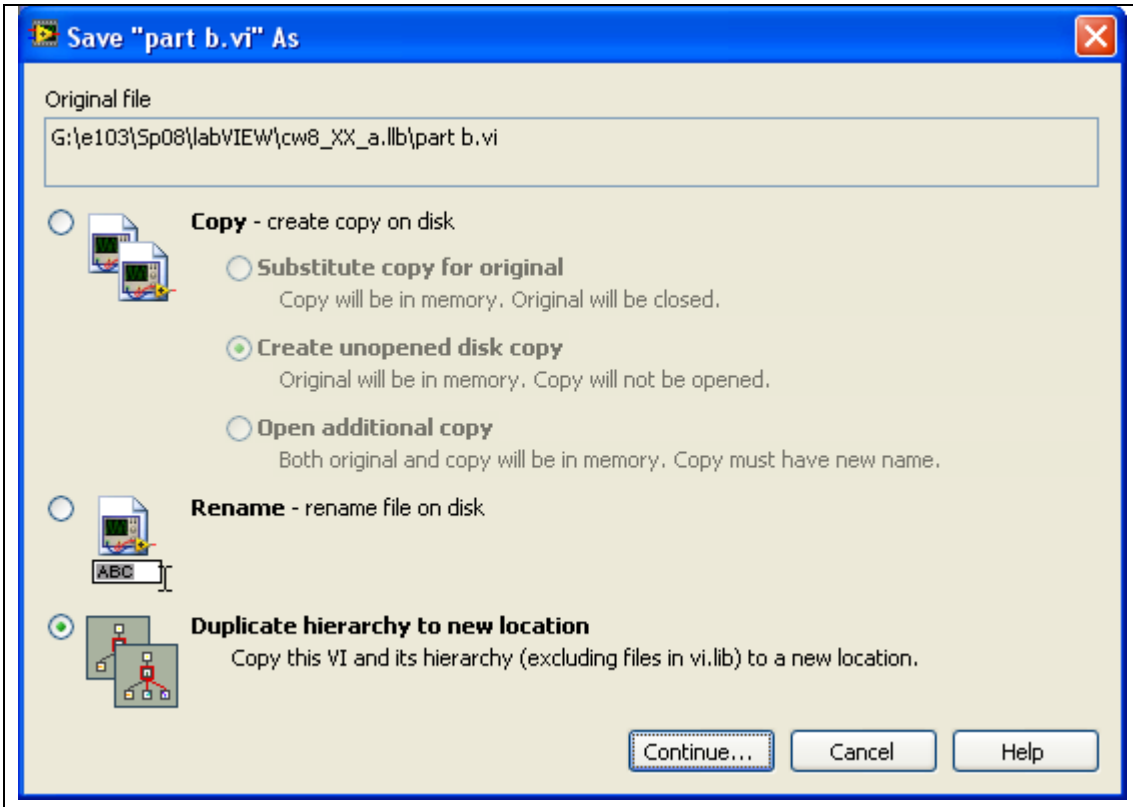
(In-Class-Work 12)

Plotting two sinusoids with arbitrary frequencies, their sum, and spectrum.
Starting with the LabVIEW Virtual Instrument (VI) to plot a function in CW8, create a modified VI that allows the user to change the frequency of the sinusoids within the Front Panel. Use one Waveform Graph for the two sinusoids, another for their sum, and a third one for their Spectrum. Use "FFT.vi" to compute the spectrum of the combined signal, then takes the absolute value to plot.

Please insert names and dates within the Front Panels. In each team, students working together at a computer numbered between 1 and 10 will submit LabVIEW LLB file cw12_XX_a.llb, students working at a computer numbered between 11 and 20 will submit LabVIEW LLB file cw12_XX_b.llb, to the *files* folder in the server. Replace XX by 01 if team 1, etc. These files need to be uploaded to the server today to receive credit. Include your names within the files.

*Remember that this is an individual work (turn it in, as instructed, with your name and date). Home-works and class-works count 20% toward the course grade. Class-works are done in class.

Once you have opened the LLB file for CW8, to save it as a new LLB file for CW12, use Save As, then select Duplicate Hierarchy to New Location as shown below



Sinusoids:

Period T: time separation between consecutive peaks or troughs (time to complete one cycle)
Linear frequency f=1/T or number of cycles per second

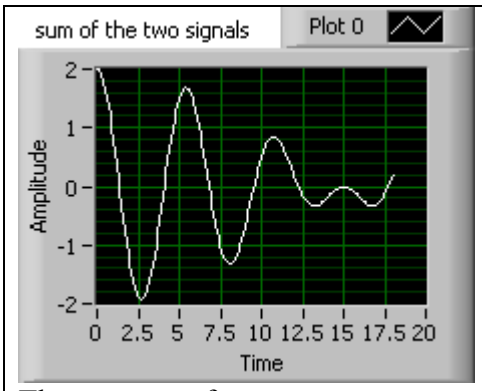
$$A\cos(\omega \cdot t) = A\cos\left(\frac{2\pi t}{T}\right)$$

A=Amplitude
ω= Angular frequency; ω=2πf=2π/T

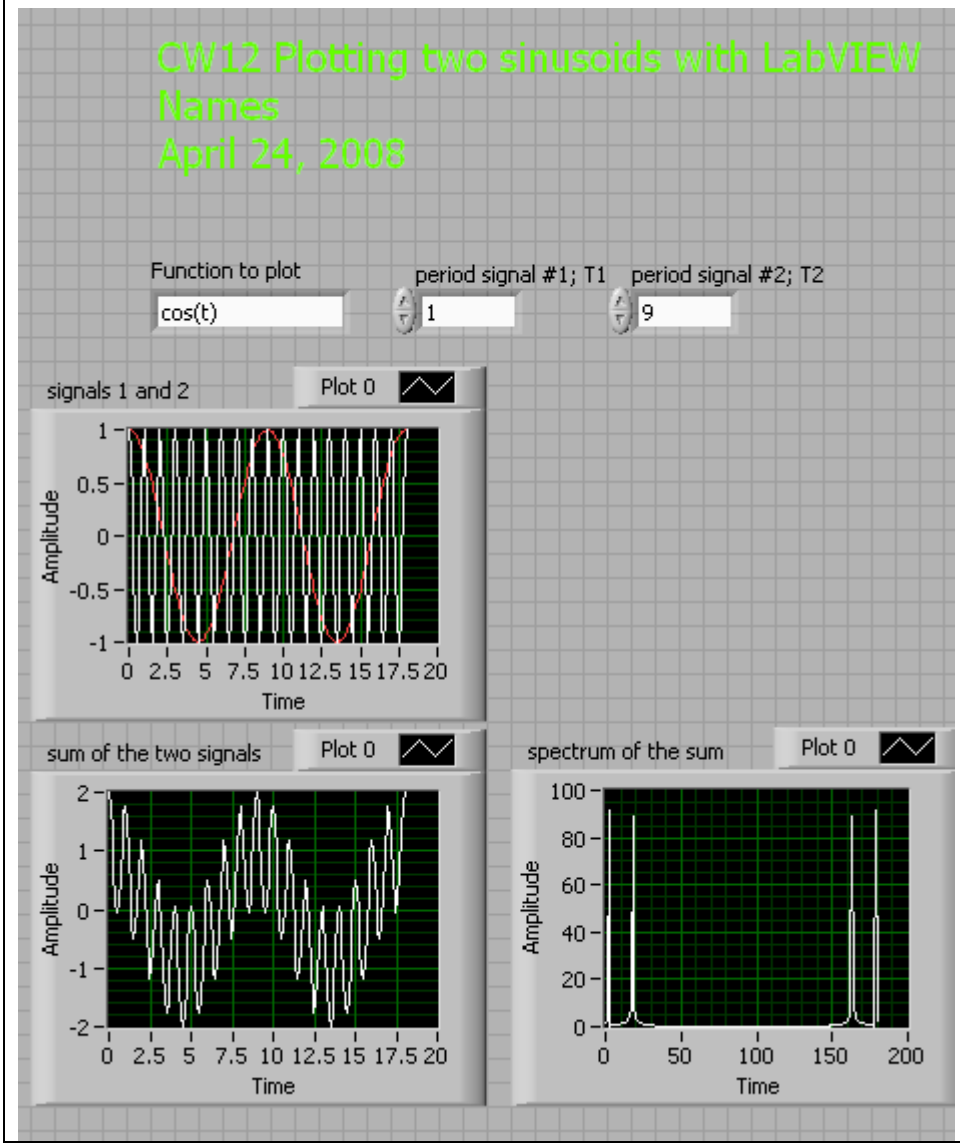
	$A\cos\left(\frac{2\pi t}{T}\right)$	cos(t) (Plotted in CW8)
Amplitude	A	1
Period	T	T=2π
Angular frequency	$\frac{2\pi}{T}$	1

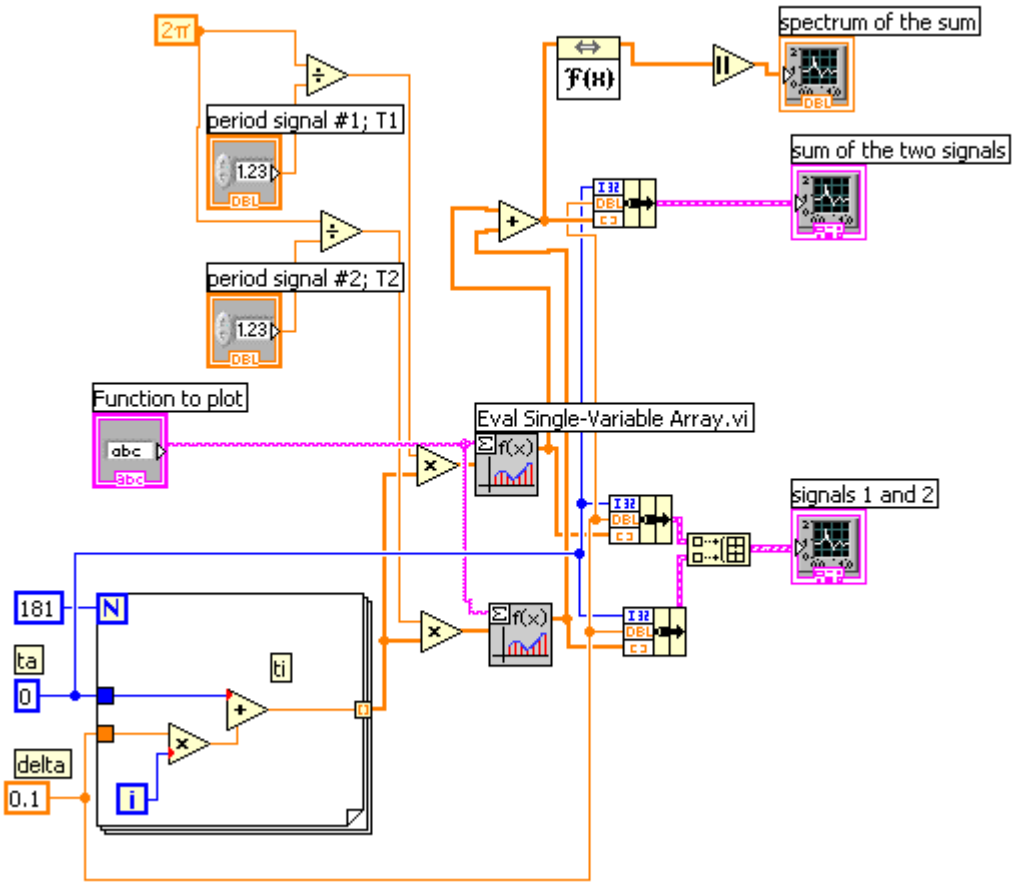
We will modify the VI for CW8 so the user can choose an angular frequency (or a period).

Spectrum: distribution of different frequency components of a signal



There are two frequency components in this signal, its spectrum will show two peaks





back

Project 3

Project	Description	Team
A	Predict the max. temp. for the next day using previous days' temperatures, using polynomial and other models	6
B	Predict the oil price for next week using previous weeks' prices, using polynomial and other models	10
C	Detect the frequency spectrum of a given signal using Fourier Transforms	4
D	Say the decimal number for a four-digit binary number	5
E	Make a 8 keys piano	2
F	Solve the quadratic equation with distinction of cases for the discriminant	8
G	A VI that can calculate the areas and volumes of 5 different 3D geometrical	3

	shapes	
H	A VI that produces interesting sounds from the combination of 2 or more sine waves with different frequencies	**9**
I	A VI that produces a chirp sound, that is a sound whose frequency is changing with time	**7**
J	Make a "sound recording utility" that can record voice from a microphone, display it and its FFT, then save it into a file. When a 'playback button' is pressed it will play the recorded sound.	**1**

back

LOGBOOK: example of a logbook page

-Use a quadrille notebook; number all pages; date all entries
-Write your notes for all activities, thoughts, problems and solutions, and learning conclusions related to Engin 103. You should write down progress, outcomes, and conclusions on projects and teamwork; conclusions from class work (including LabVIEW) and homework.
-In addition you should answer in the logbook all questions listed in these notes in blue, as shown below:

43) What are the information required by an XY Graph? What did we use the 'Build Array' for? Specify the LabVIEW version you are using and describe how to insert an "Array" of 'Numeric Controls" in the Front Panel. Also where to find the 'Linear Fit.vi' and what inputs and outputs we are using in this exercise.

44) a) Binary numbers: write 0.625 and 0.875 using 8 bit binary numbers with a "binary dot" between the two groups of four bits. b) Can you write 0.626 using 8 bits with four bits after the dot? Explain if we could achieve exact calculations using a digital computer. Can you offer a solution?

back