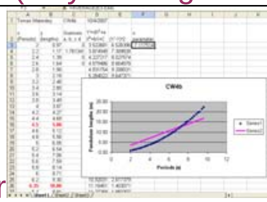
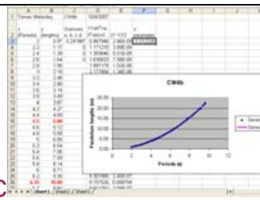
Engin 103 March 24, 2009 back to e-syllabus	Topics: CW4 (Cont.) Introduction to LabVIEW CW5 Circuit Analysis with LabVIEW I Circuit Analysis with LabVIEW II Logbook questions

CW4 (Part b ii)

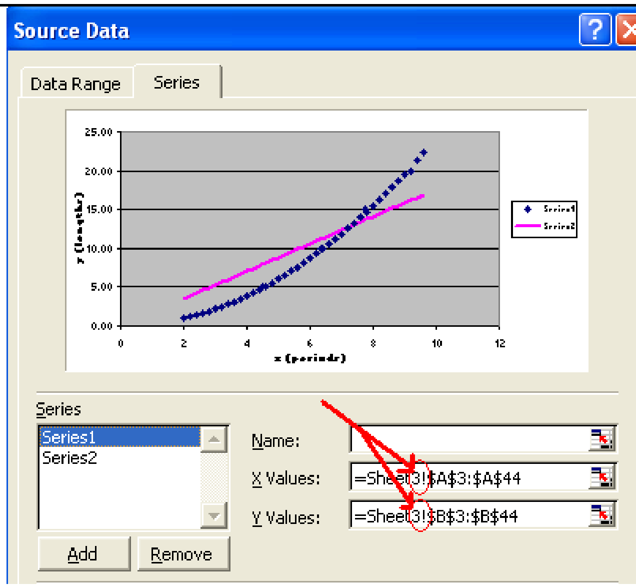
b) (ii) In Sheet #3 using only the highest order term in each model

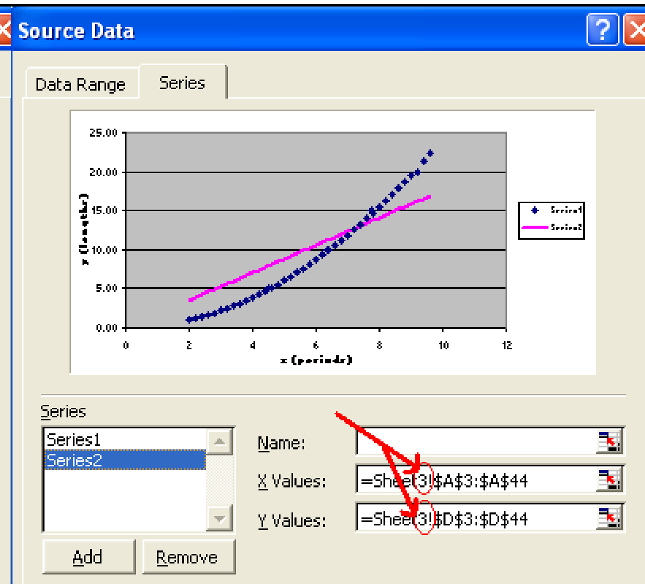
Model (only leading terms)	Coefficients	S parameter
Linear 	A= B= C= D=	
Quadratic 	A= B= C= D=	
Cubic 	A= B= C= D=	

Q&A

1) After copying Sheet#2 to Sheet#3, do I need to check the two series in the graph?

Yes, nn Sheet#3, right click inside the graph, select “Source Data” click on “Series”, and make sure the X and Y values for each series refer to Sheet3, see figures below.



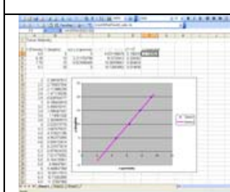
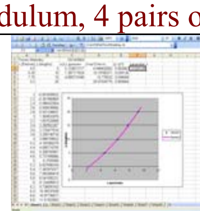
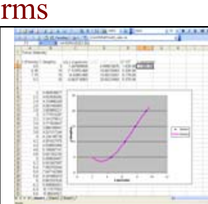
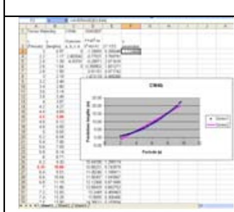
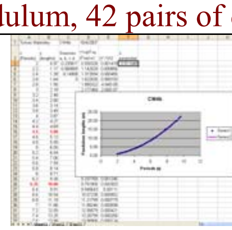
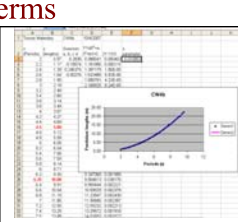


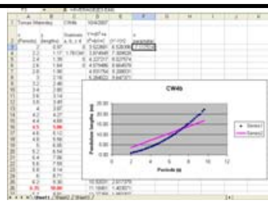
2) How do I get the different models with only the leading terms without changing the formula in cell D3?

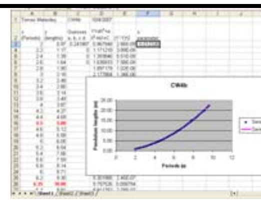
If you already have a cubic formula in D3-D44, you can get the cubic, quadratic, and linear models using only the leading terms by allowing Solver to change C6, C3, or C4, respectively. Notice that at the same time, in Sheet#3, to obtain the cubic model cells C3 through C5 should contain a zero, for the quadratic model, cell C4 through C6 should contain a 0, and for the linear model, cells C3, C5, and C6 should contain a 0.

3) So what is the best model if we use only the leading term?

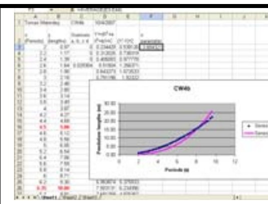
The summary of CW4 results is shown in the table below.

Linear	Quadratic	Cubic
	Pendulum, 4 pairs of data, used all terms	
		 Best
	Pendulum, 42 pairs of data, used all terms	
		 Best s=0.010853
	Pendulum, 42 pairs of data, used only leading terms	





Best s=0.012326



When only the leading term was used, the quadratic model showed the lowest s parameter. This means our data behave more in line with a quadratic term rather than a cubic or a linear term. In deed, based on Newton's Laws and the Universal Law of Gravitation, the period of an ideal pendulum (mass of string is negligible, bob is not so large, and friction is ignored) is given by

$$T = 2\pi\sqrt{\frac{L}{g}} \qquad \text{or} \qquad L = \frac{gT^2}{4\pi^2}$$

where T is the period, L is the length, and g is the acceleration of gravity.

From the value of the coefficient A, you can derive the constant acceleration of gravity g. In fact a method to measure this constant at different latitudes and longitudes is to measure the periods of a pendulum of different lengths, then extract g from the coefficient of the quadratic term.

4) While doing data modeling, can we distinguish between an engineer and a scientist approach?

Engineers tend to make a more precise model of a system (getting lower s parameter) by including additional terms. Scientists tend to idealize a system in quest of a universal model that is simpler, but also less accurate when applied to a real system. Precision and universality satisfy a complementary relation similar to that of the uncertainty principle in quantum mechanics.

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Introduction to LabVIEW

-LabVIEW: background for HW1 questions 4 and 5. **How to locate different functions within the Front Panel** (user interface: inputs and outputs quantities) **and within the Block Diagram** (programmer interface: operations, analysis).

-Things belonging to the Front Panel will be found under **Controls palette**, abbreviation is C, which can be brought up by 'right-clicking' (click on the mouse's right button) on the Front Panel.

-Things belonging to the Block Diagram will be found under **Functions palette**, abbreviation is F, which can be brought up by 'right-clicking' on the Block Diagram.

-Things to operate VI (Virtual Instruments) will be found under **Tools palette**, abbreviation is T, which can be brought up by clicking on Window, then select 'Show Tools Palette'

For example, where to locate 'Array'?. We start by guessing whether this is an input/output or an operation, it is more of a numeric input utility, so right-click on the Front Panel to bring up the Controls palette (C), then select sub-palette All Controls, then select sub-palette Array and Cluster, to find Array in the first button. So the complete location for Array reads C/All Controls/Array and Cluster.

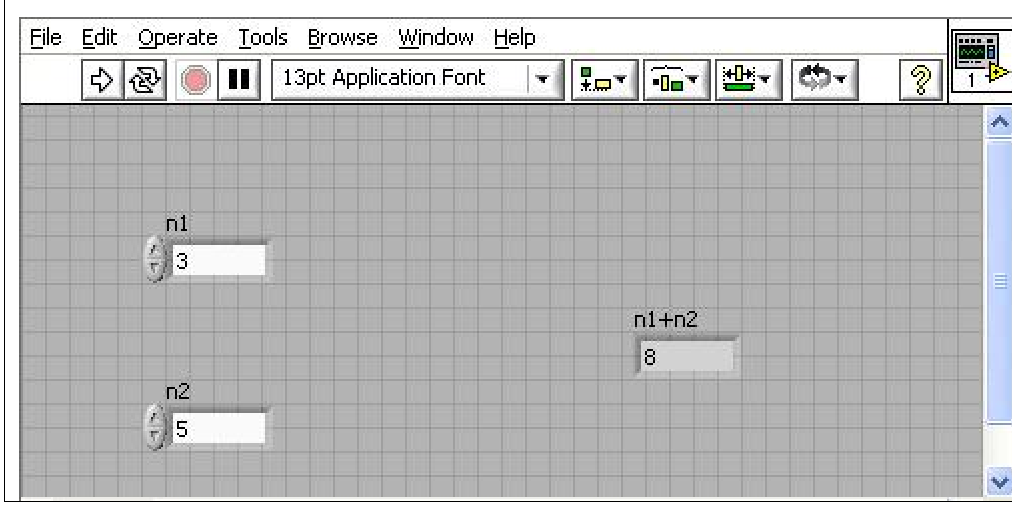
For example where to locate 'Reciprocal'?. This is more of an operation (getting the reciprocal of x is doing 1/x). So right-click on the Block Diagram to bring up the Functions palette (F), then select All Functions, then Numeric, and find Reciprocal under button 1/x. So the location for Reciprocal is F/All Functions/Numeric

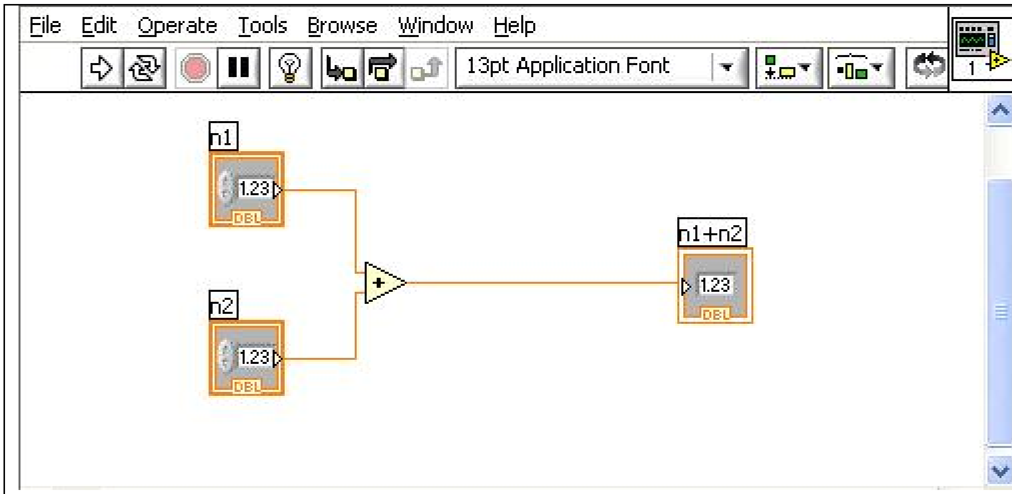
-As a background to changing values on a Numeric Control, we make a simple addition VI. We will need two inputs (Numeric Controls) and one output (Numeric Indicator) in the Front Panel, where the user will input the numbers she/he would like to add, where she/he will read the result, respectively. We should label the inputs as n1 and n2, and the output as n1+n2. This is necessary to identify identical elements on the Block Diagram, and as part of the user interface. **Label** can be entered by typing into the blank box that is shown when an element is placed in the Front Panel. The blank box can be brought up by right-click on the element and select '**Show Label'**. To edit labels, select the Text tool, under Tools Palette, then click on the label.

To tell LabVIEW how to produce the output from these inputs, the programmer goes to the Block Diagram to place the addition operation (F/All Functions/Numeric), then wire the inputs n1 and n2 into the left terminals of the addition by selecting the **wiring too**l (under T), click to start, click to end, double-click to finish a wiring. Note that since the addition is commutative, n1 and n2 can be individually connected to either the left upper terminal or the left lower terminal of the addition operator. Should we have a division, the upper terminal is divided by the lower terminal, or the left terminals are different. In a subtraction, the upper terminal is subtracted by the lower one.

If we need to remove any piece of wire, use the **Select tool** (arrow under T) to select that piece, then hit 'backspace' on the keyboard.

Then it comes to put in values into the Numeric Controls to test our addition VI: using the **Operate Value tool** (finger, under T) and click on the left handles to increase or decrease by an integer unit. To run the VI, click on the **Run button** (right arrow in the upper left corner), the results should show as expected. If we would like to scan through different inputs and outputs without having to hit the Run button every time we change the inputs, then use **Run Continuously** (found to the right of the Run button). Under this mode, the VI should be stopped before any modification can be made.





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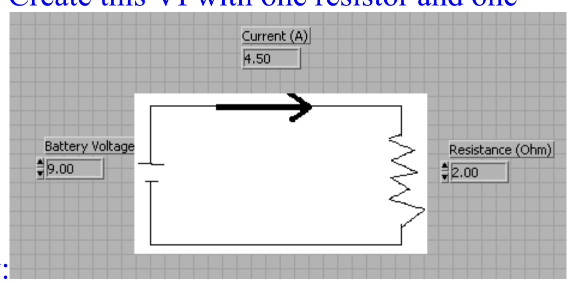
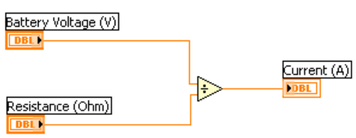
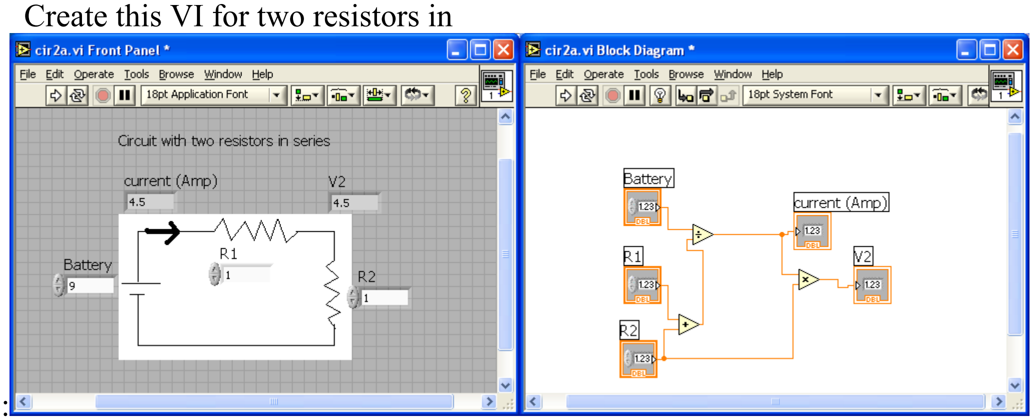
CW5: Introduction to LabVIEW

a) Create this VI with one resistor and one battery:

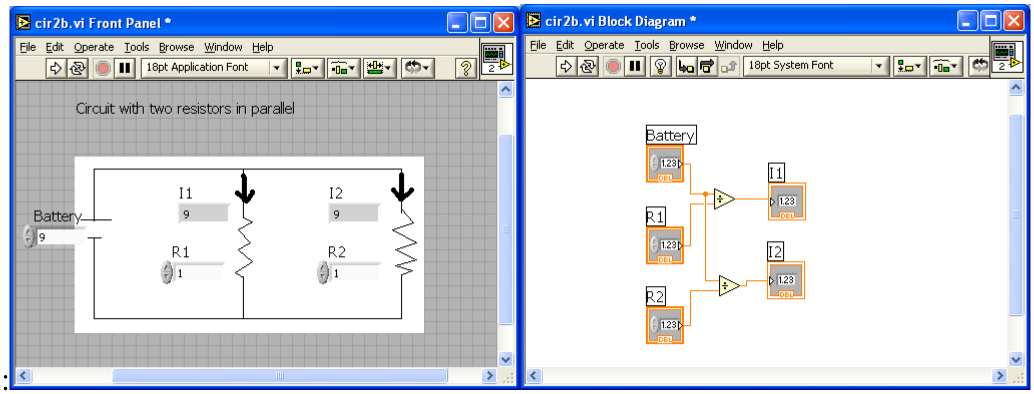




b) Create this VI for two resistors in series:



c) Create this VI for two resistors in parallel:

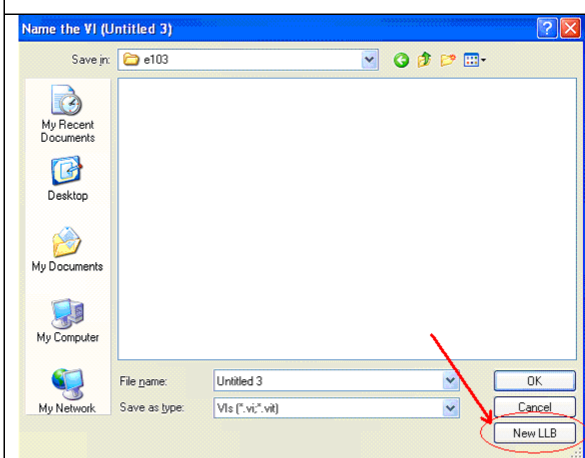


In each team, students working together at a computer numbered between 1 and 10 will submit LabVIEW LLB file cw5_XX_a.llb, students working at a computer numbered between 11 and 20 will submit LabVIEW LLB file cw5_XX_b.llb, to the *files* folder in the server. Replace XX by 01 if team 1, etc.

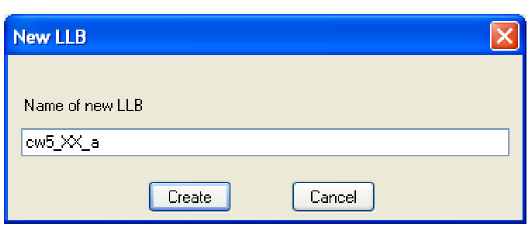
Include your names within the files.

Save each VI into a LLB file (LabVIEW library) as follows:

Creating library file cw5_XX_a.llb and saving part a) in there.

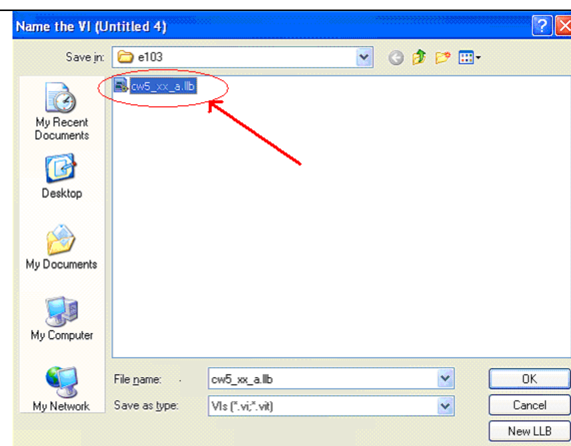


After select Save, click on New LLB

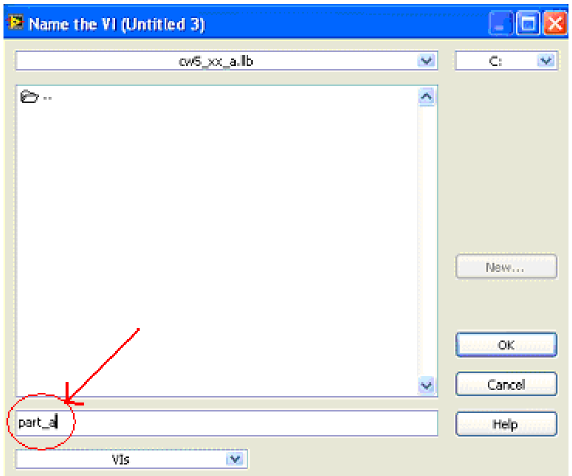


Type in “cw5_XX_a”, where XX is the two digit team number, and “a” or “b” based on your subgroup within the

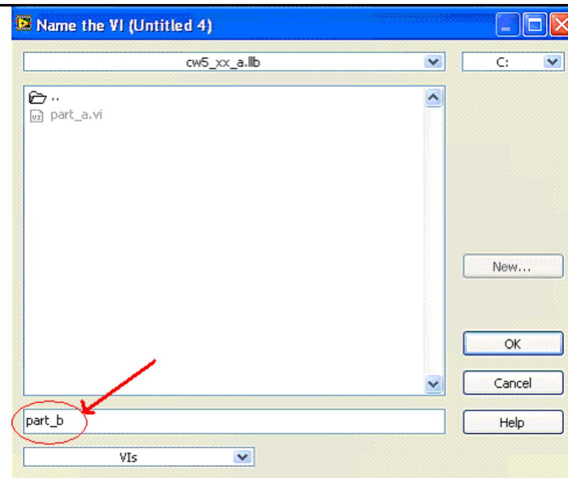
Saving part b) or c) into cw5_XX_a.llb



After select Save, double click on the library you created cw5_XX_a.llb team. Then click Create.



Type in the file name for the VI: in this case “part_a”. Then click OK



Type in the file name for the VI: in this case “part_b”. Then click OK

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Circuit Analysis with LabVIEW I (see also link in the e-syllabus).

Example: a VI that solves a simple electrical circuit with one battery and one resistance:

Developing a Virtual Instrument consists of the following steps:
1) Define the problem you want to solve, specify what will be the inputs and the outputs.
The inputs are the battery voltage V (in Volts) and the resistance of the light bulb R in (in Ohms). The output is the current flowing in the circuit I (in Amps)

2) Determine the equations or operations needed to produce the outputs from the inputs
We need an equation that gives I in terms of V and R. It is Ohm’s law:
$I=V/R$

3) Implement the controls and indicators and graphs in the Control Panel and the operations in the Block Diagram
Control panel: enter a numeric control for V, another one for R; a numeric indicator (without handle on the left side) for the current I

Block Diagram: enter the “divide” operation, then wire V and R to this operator, and the output to I

4) Fix any error and implement modifications as needed

If there is a broken wire, that needs to be fixed
If there is no error, the arrow on the upper left corner (“Run”) is not broken

5) Test the final results against expected theoretical values.
Enter V=9V; R=2 Ohm, I should read 4.5 A
In circuits with more than one resistor, if the output does not agree with our calculation, the Block Diagram needs to be revised.

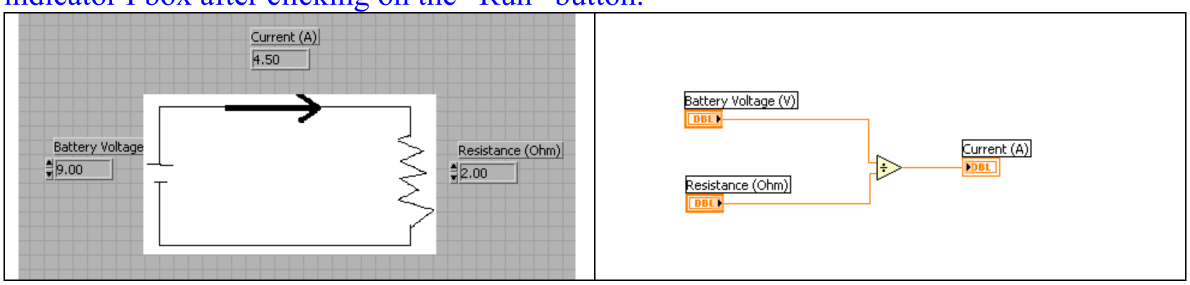
Insert a text box by clicking on “A” (Edit Text) in the tool palette
Insert a circuit diagram made in Paint by selecting (using the dotted rectangle in Paint left menu), then Edit/Copy; then in the Front Panel of LabVIEW, Edit/Paste

Front Panel: enter two numeric controls, label them as V and R; enter one numeric indicator, label it as I

Block Diagram: enter the “Divide” operator from Arith/Compare/Numeric
Group V and R together with the “Divide” on the left side of the Block Diagram, and the I on the right.

Check if the “Run” button is continuous

Enter values in the Numeric Controls V and R boxes and check the result at the numeric indicator I box after clicking on the “Run” button.



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Circuit Analysis with LabVIEW II (see also link in e-syllabus)

Example: a VI that solves a simple electrical circuit with one battery and two resistors in series.

1) Define inputs: V; R1; R2
Define outputs: V2 (voltage across R2); and I (current for this circuit of 2 resistances in series

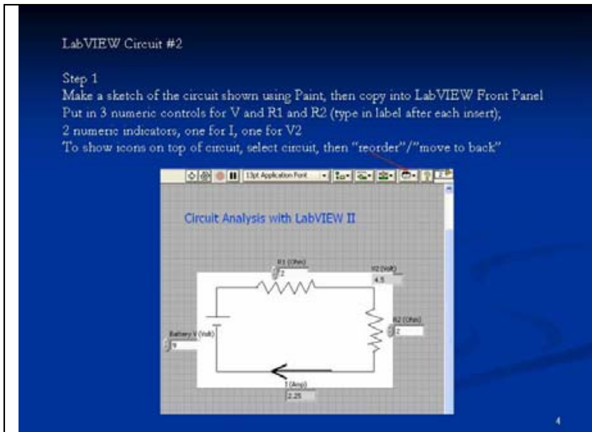
2) Equations: I=V/(R1+R2); V2=I*R2

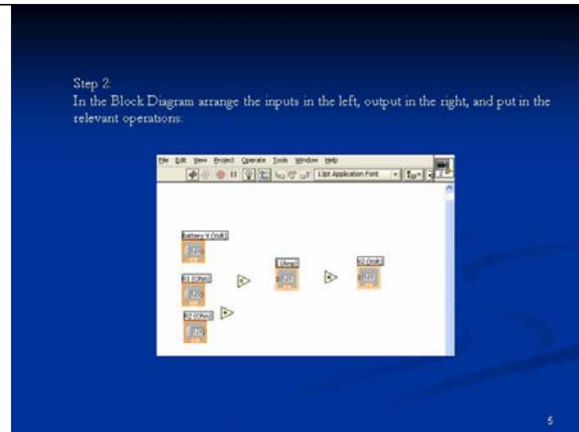
3) Front Panel: Circuit diagram using Paint; then enter three numeric controls for V, R1, and R2; two numeric indicators for V2 and I
Block Diagram: order elements for least number of cross wires (to facilitate the debugging

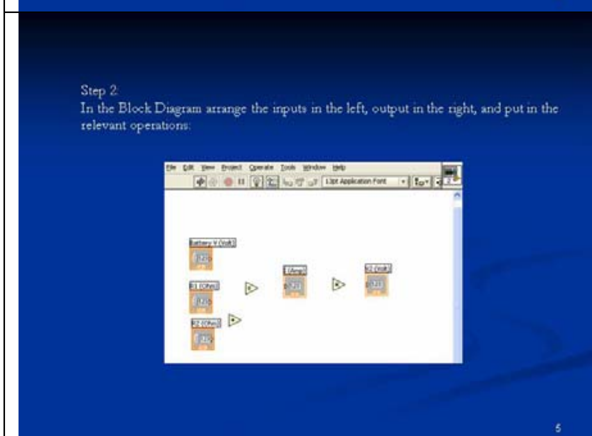
process), group V, R1, R2 on the left, I and V2 on the right
Enter an “add” operator, a division (both for producing I from V, R1 and R2 using the given equation), and a “multiply” to produce V2 from I and R2.
Use “Connect Wire” in the tools palette to connect the elements

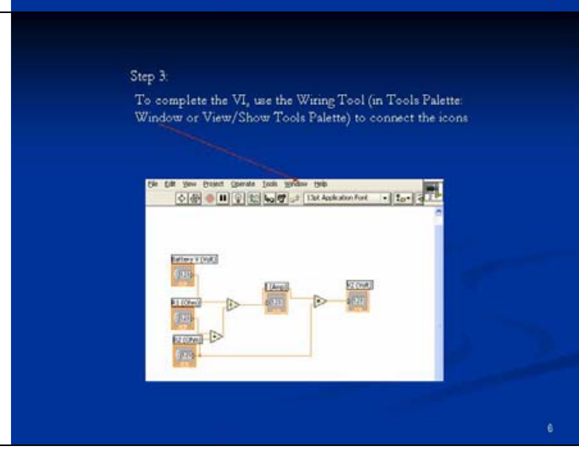
4) Check for errors.

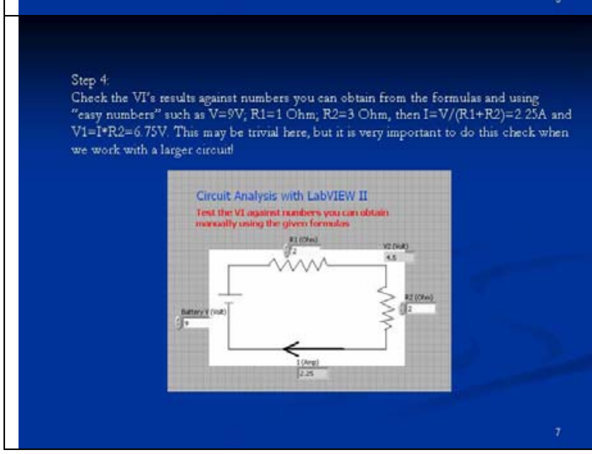
5) Testing: enter V=9 V; R1=2 Ohm; R2=2 Ohm; I should read 9/4=2.25 Amp; and V2 should read 2.25*2= 4.5V



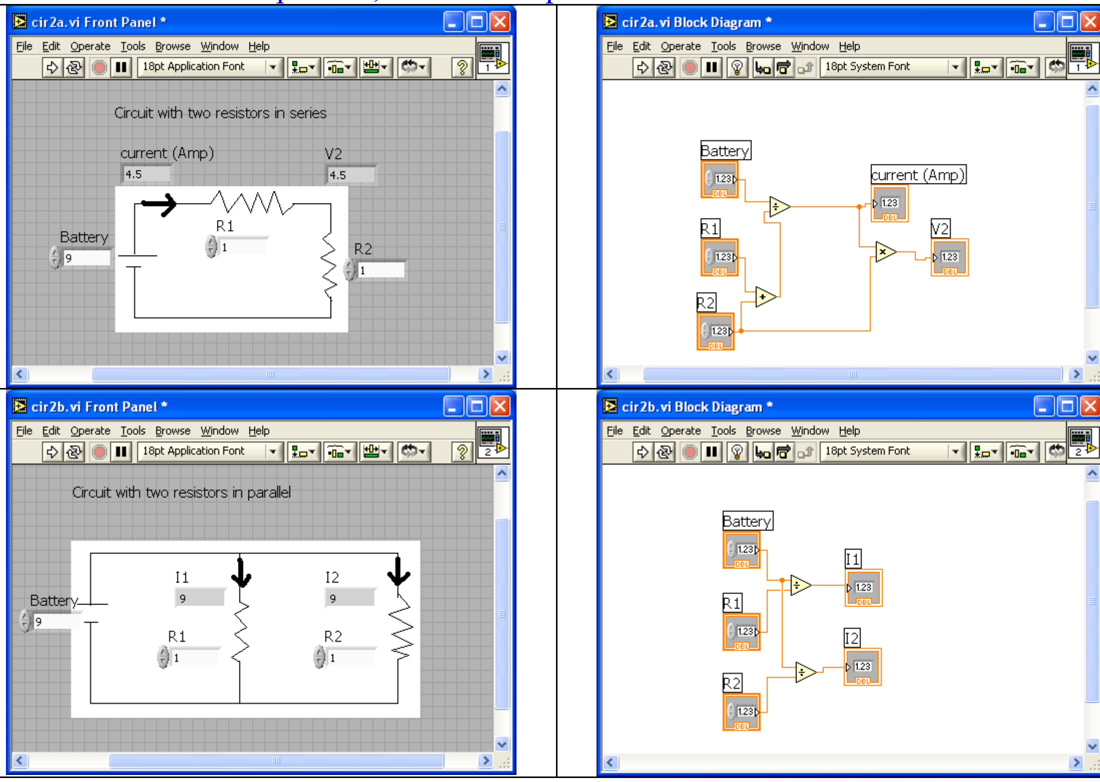








To compare how much current is flowing through each resistor when they are connected in series or in parallel, we can set up the two Virtual Instruments below:



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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:

25) Insert the three tables shown in CW4 with values of the polynomial coefficients and s parameters in the logbook. Describe the differences in the graphs of the three tables in CW4.

26) Calculate the constant acceleration of gravity g (in m/s^2) using the quadratic coefficient A from your table #3 of CW4 using the formula provided above; show the calculations and the final result in your logbook

27) What is the difference between a Numeric Control and a Numeric Indicator? List

examples of each category using the two examples shown above, that is, Circuit Analysis with LabVIEW I and II. What happens if you wire into a Numeric Control?

28) To implement V/R: should I wire V to the upper left terminal of the Divide operation or to its lower left terminal? Why? How do you save existing numeric values within the Front Panel? (if no extra action is taken next time you open the VI, the Front Panel boxes only show default values of zeros)

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