Engin 103 October 27, 2011 back to e-syllabus	Topics: CW8 Circuit Analysis with LabVIEW IV Logbook questions

Engineering 103 –UMass Boston

CW 8

(In-Class-Work 8)

Circuit Analysis with LabVIEW IV: Follow Instructions in today's class notes, produce a VI that solves a circuit with one battery and six resistors, producing four outputs: total current I, and voltages V2, V4, and V6, now using three **subVI**'s: "parallel", "V_next", and "I_after"

In each team, students working together at a computer numbered between 1 and 10 will submit LabVIEW LLB file cw8_XX_a.llb, students working at a computer numbered between 11 and 20 will submit LabVIEW LLB file cw8_XX_b.llb, to the *files* folder in the server. Replace XX by 01 if team 1, etc.

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.

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Circuit Analysis with LabVIEW IV (See also the link with the same name in the e-syllabus)

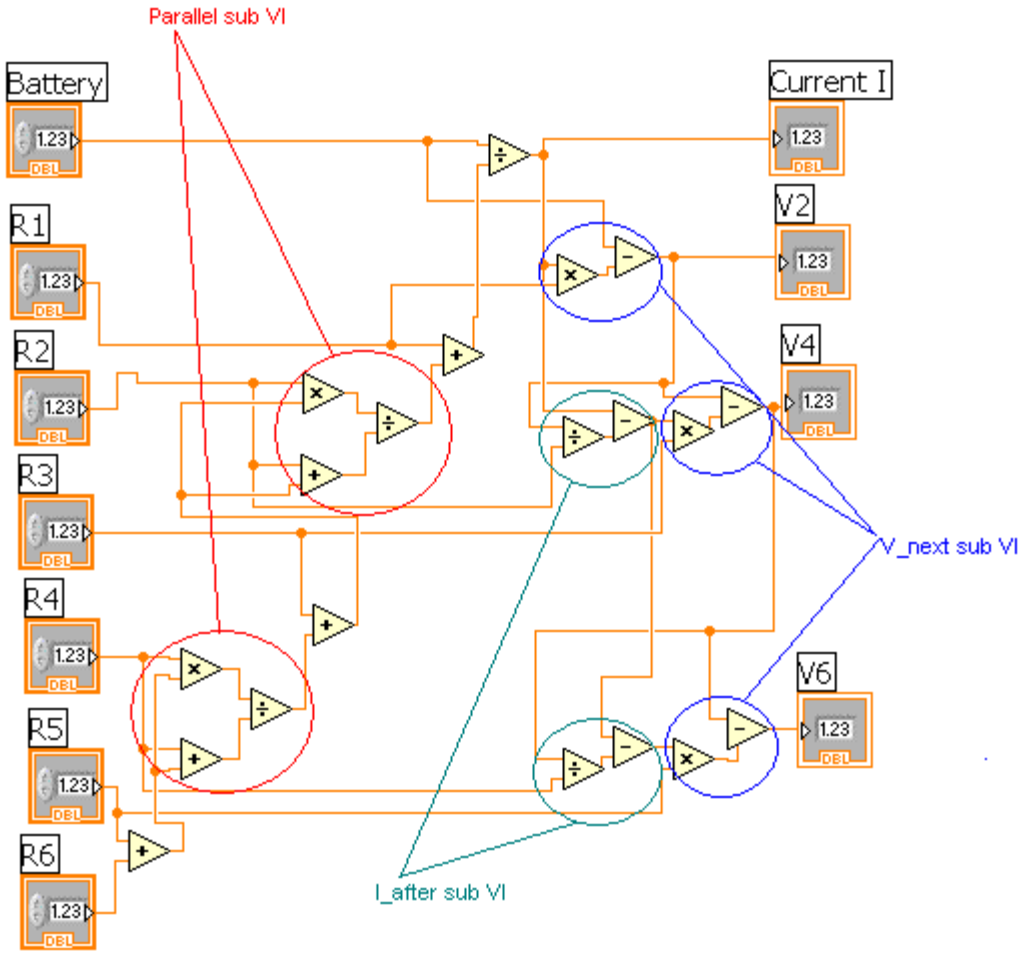
If you observe the Block Diagram in the Virtual Instrument we built for Circuit Analysis with LabVIEW III, there are three repeating groups of operations as shown in the figure below. For each group we will create a sub-VI that we will call in every time we need to perform that same group of operations. Sub-VI's, subroutines, or super operators are commonly used in programming languages, with the goals of simplifying the codes for reading and debugging.

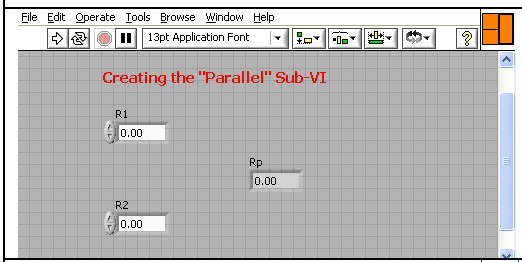
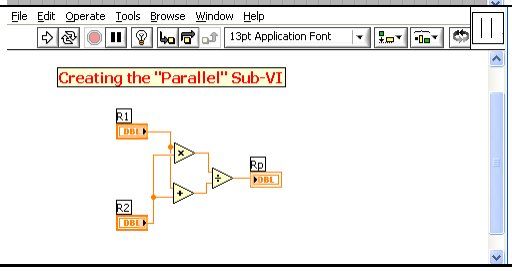
$$I = \frac{V}{R1 + R2 \left\| \left\{ R3 + \left[R4 \left\| \left(R5 + R6 \right) \right. \right] \right\} \right.} \quad (1)$$

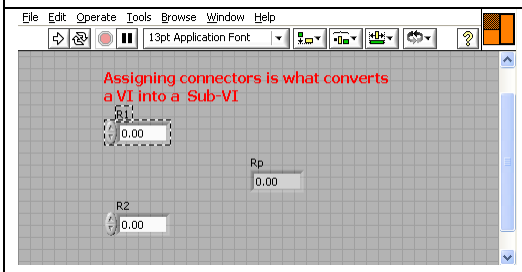
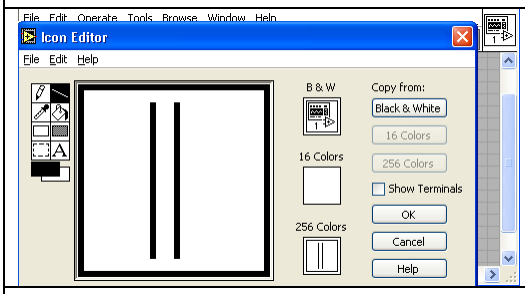
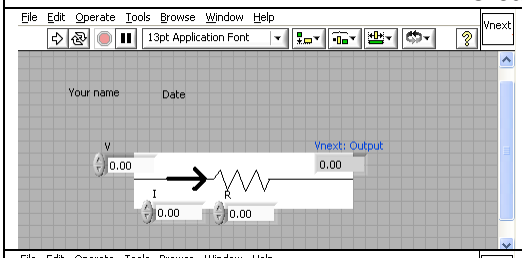
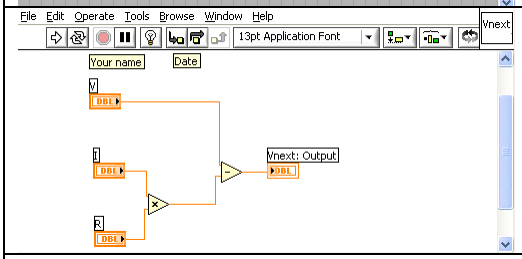
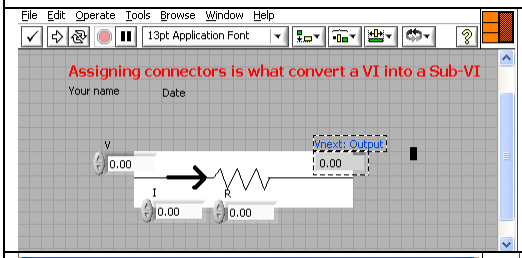
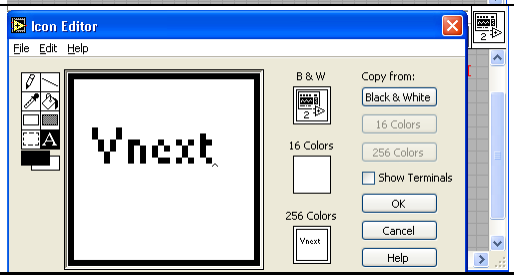
$$V2 = V - I \cdot R1 \quad (2)$$

$$V4 = V2 - \left(I - \frac{V2}{R2} \right) \cdot R3 \quad (3)$$

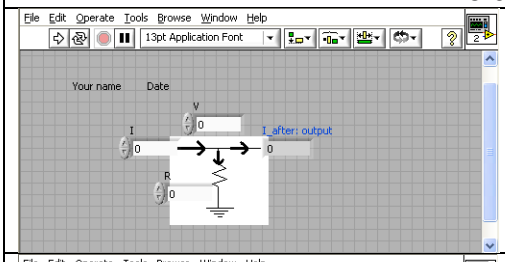
$$V6 = V4 - \left[\left(I - \frac{V2}{R2} \right) - \frac{V4}{R4} \right] \cdot R5 \quad (4)$$



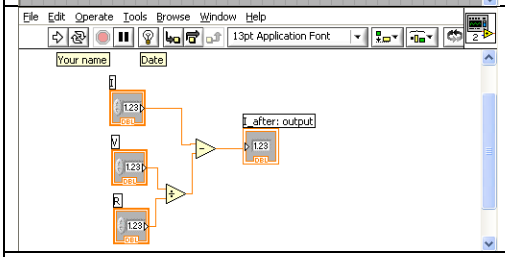
Creating the Parallel subVI	
	(a) Place two numeric controls labeled as R1 and R2, and one indicator as Rp into the Front Panel
	(b) In the Block Diagram produce Rp using the formula: Rp= (R1*R2)/(R1+R2)

Converting a VI into a subVI	
	(a) Right click on the icon, select Show Connectors, then pair the left connectors with numeric controls (by right clicking on one and another consecutively) and the right ones with numeric indicators
	(b) Double click on the icon, use dotted rectangle to select icon contents, then hit backspace to delete. Use line to draw two vertical bars to represent the Parallel subVI. Then click OK.
Creating the Vnext subVI	
	(a) As with the Parallel subVI, we start creating the VI by placing three numeric controls labeled as V, I, and R, and one numeric indicator as Vnext
	(b) In the Block Diagram, Vnext is given by the expression: Vnext = V – I*R
Converting a VI into a subVI	
	(a) To convert the Vnext VI into a subVI connectors are assigned as with the Parallel subVI. Use “Patterns” to select the correct number of input and output terminals on the left and right, respectively
	(b) And the icon is edited to indicate its function

Creating the I_after subVI

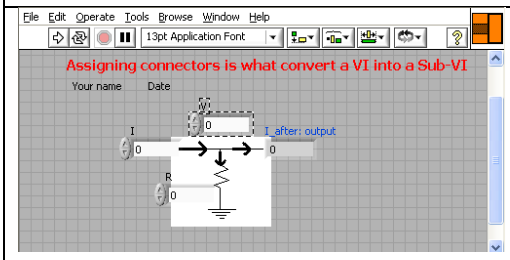


a) The subVI can be created by inserting the inputs I, V, R as numeric controls and output I_after as numeric indicator, in the Front Panel.

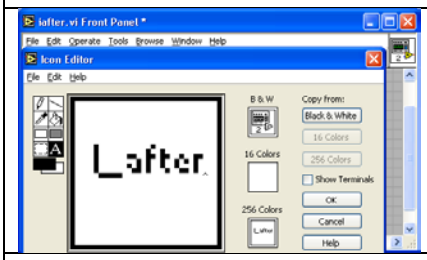


b) Then connecting them together in the Block Diagram according to
I_after = I – V/R

Converting it into a subVI



a) Right-click on icon, Show Connector, then pair Front Panel's elements with connectors on icon by clicking on the element then on its corresponding connector in the icon.



b) The icon can be edited to indicate its function by using the Dotted Rectangle (to select)/Backspace (to delete) /A (text box). Then type in "I_after" and click OK.

Parallel Sub-VI	How to use it?
$\left[R_A \parallel R_B\right] = \left[\dfrac{R_A \cdot R_B}{R_A + R_B}\right]$	
$\left[R4 \parallel (R5+R6)\right] = \left[\dfrac{R4 \cdot (R5+R6)}{R4+R5+R6}\right]$	$R_A = R4;$ $R_B = R5+R6$
$R2 \parallel \left\{R3 + \left[R4 \parallel (R5+R6)\right]\right\} =$ $\dfrac{R2 \cdot \left\{R3 + \left[\dfrac{R4 \cdot (R5+R6)}{R4+R5+R6}\right]\right\}}{R2 + \left\{R3 + \left[\dfrac{R4 \cdot (R5+R6)}{R4+R5+R6}\right]\right\}}$	$R_A = R2;$ $R_B = \left\{R3 + \left[R4 \parallel (R5+R6)\right]\right\}$

$$I = \frac{V}{R1 + \dfrac{R2 \cdot \left\{ R3 + \left[\dfrac{R4 \cdot (R5 + R6)}{R4 + R5 + R6} \right] \right\}}{R2 + \left\{ R3 + \left[\dfrac{R4 \cdot (R5 + R6)}{R4 + R5 + R6} \right] \right\}}} \qquad I = \frac{V}{R1 + R2 \| \left\{ R3 + \left[R4 \| (R5 + R6) \right] \right\}}$$

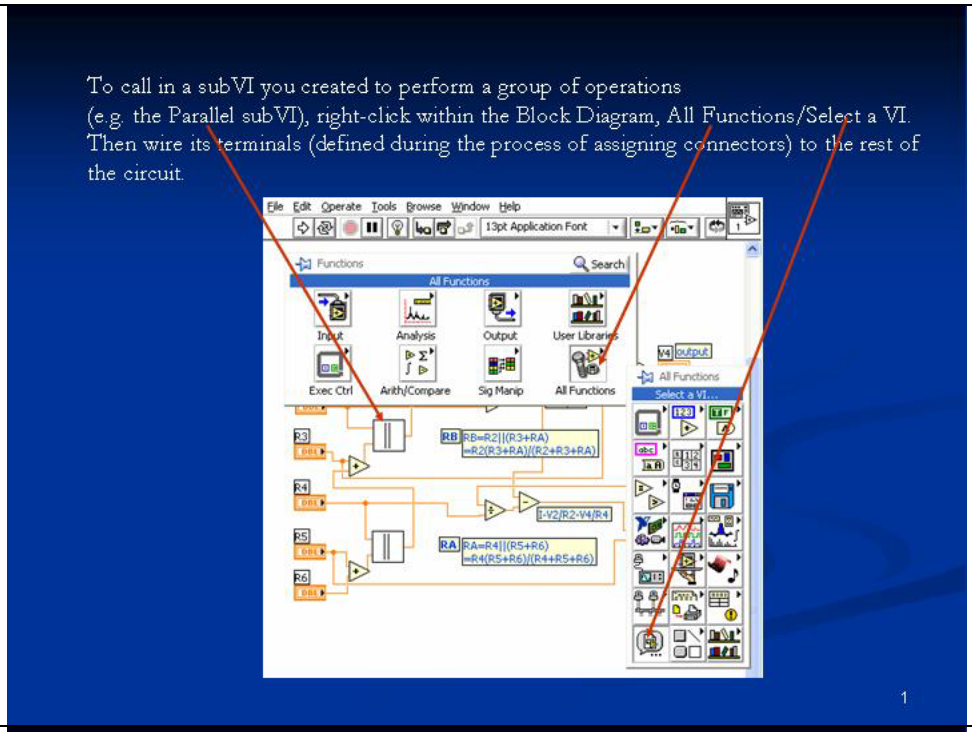
V_next	$V_{Next} = V - I \cdot R$
$V2 = V - I \cdot R1$ Eq. 2	$V_{Next} = V2;$ $V = V;$ $I = I;$ $R = R1$
$V4 = V2 - \left(I - \dfrac{V2}{R2} \right) \cdot R3$ Eq. 3	$V_{Next} = V4;$ $V = V2;$ $I = \left(I - \dfrac{V2}{R2} \right);$ $R = R3;$
$V6 = V4 - \left[\left(I - \dfrac{V2}{R2} \right) - \dfrac{V4}{R4} \right] \cdot R5$ Eq. 4	$V_{Next} = V6;$ $V = V4;$ $I = \left[\left(I - \dfrac{V2}{R2} \right) - \dfrac{V4}{R4} \right];$ $R = R5;$
I_after	$I_{After} = I - \dfrac{V}{R}$
$I = \left(I - \dfrac{V2}{R2} \right)$	$I_{After} = I;$ $I = I;$ $V = V2;$ $R = R2;$
$I = \left[\left(I - \dfrac{V2}{R2} \right) - \dfrac{V4}{R4} \right]$	$I_{After} = I;$ $I = \left(I - \dfrac{V2}{R2} \right)$ $V = V4;$ $R = R4;$

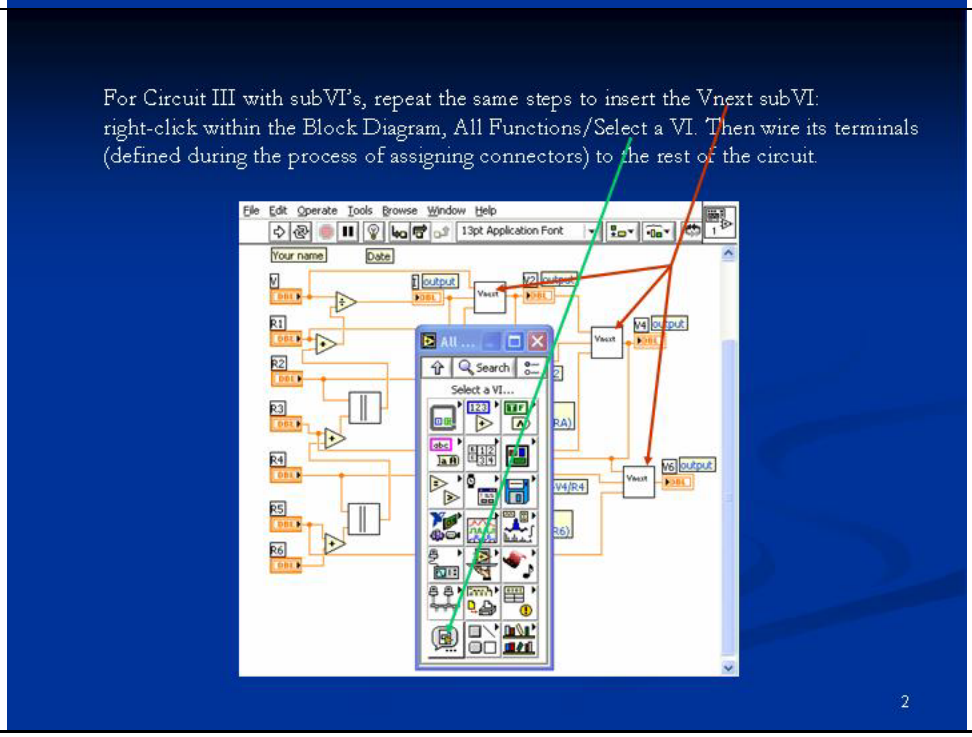
$V2 = V - I \cdot R1$ (2)

$V4 = V2 - \left(I - \dfrac{V2}{R2} \right) \cdot R3$ (3)

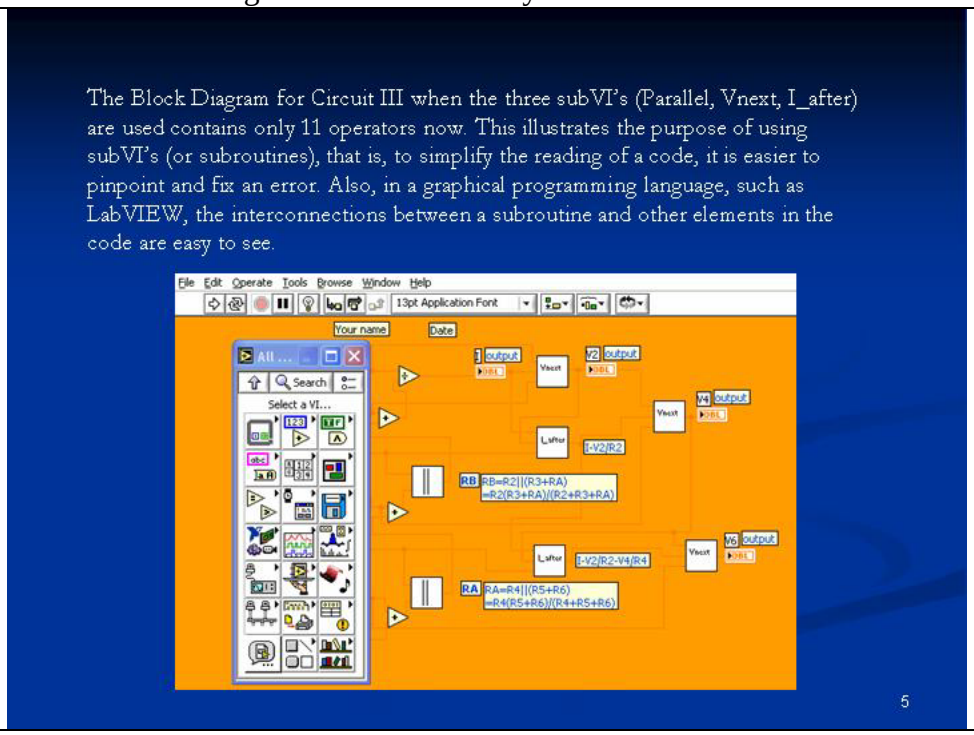
$$V6 = V4 - \left[\left(I - \frac{V2}{R2}\right) - \frac{V4}{R4}\right] \cdot R5 \qquad (4)$$

How to call in a subVI





What the Block Diagram for Circuit Analysis III with subVI would look like?



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Circuit Analysis with LabVIEW IV (Cont. , see also the link with the same name in the e-syllabus)

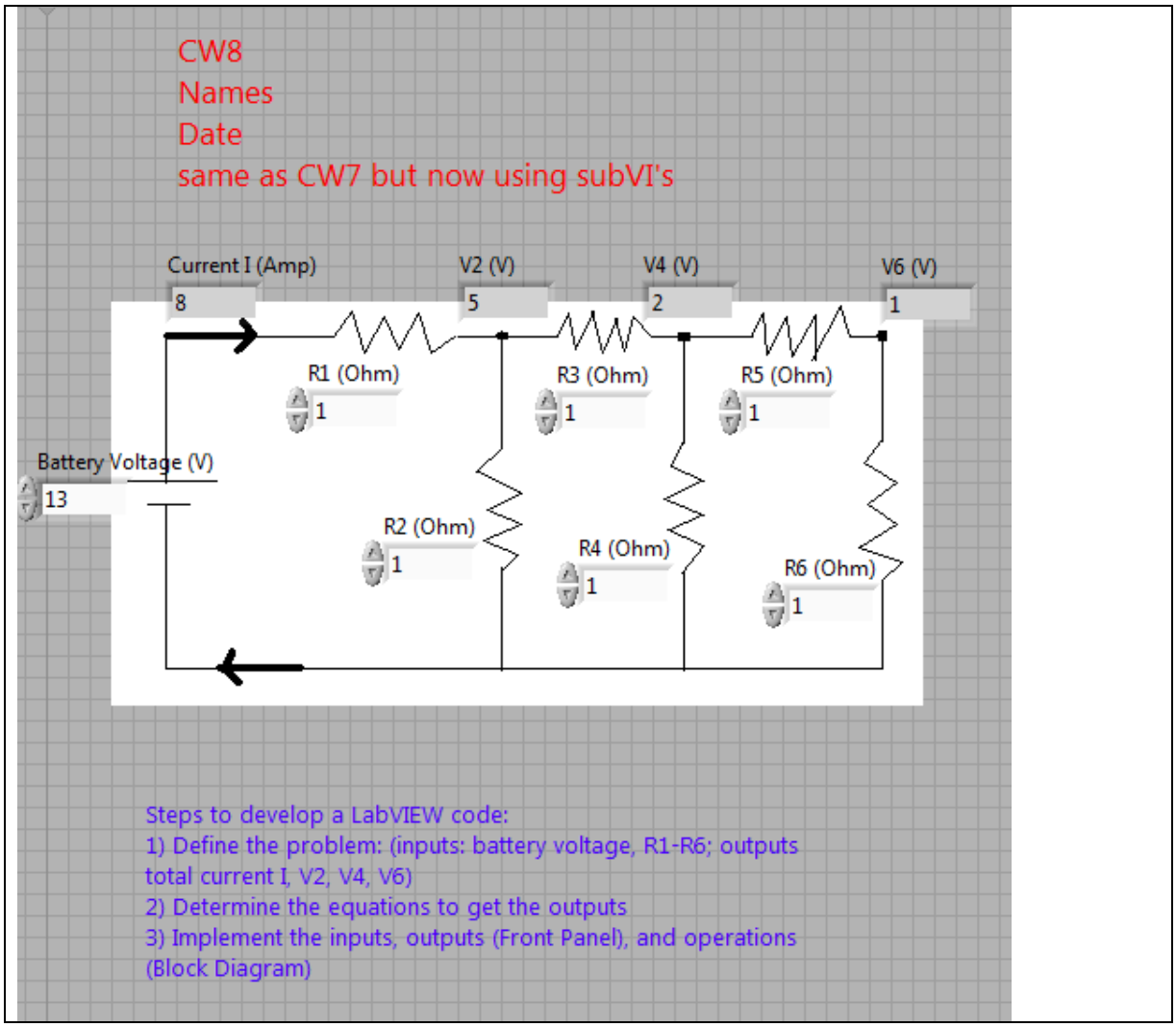
If you observe the Block Diagram in the Virtual Instrument we built for Circuit Analysis with LabVIEW III, there are three repeating groups of operations as shown in the figure below. For each group we will create a sub-VI that we will call in every time we need to perform that same group of operations. Sub-VI's, subroutines, or super operators are commonly used in programming languages, with the goals of simplifying the codes for reading and debugging.

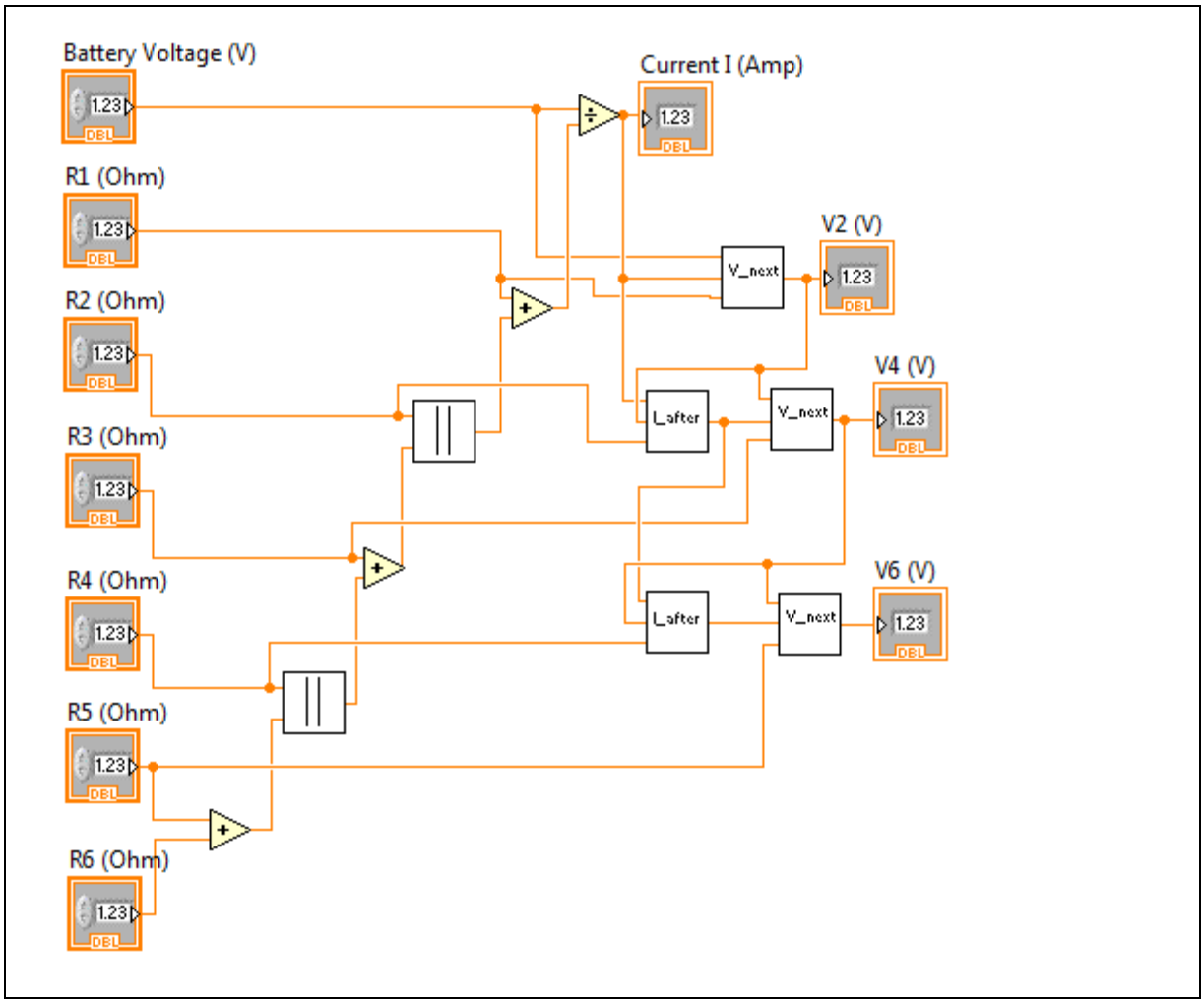
$$I = \frac{V}{R1 + R2 \left\| \left\{ R3 + \left[R4 \left\| \left(R5 + R6 \right) \right. \right] \right\}} \qquad (1)$$

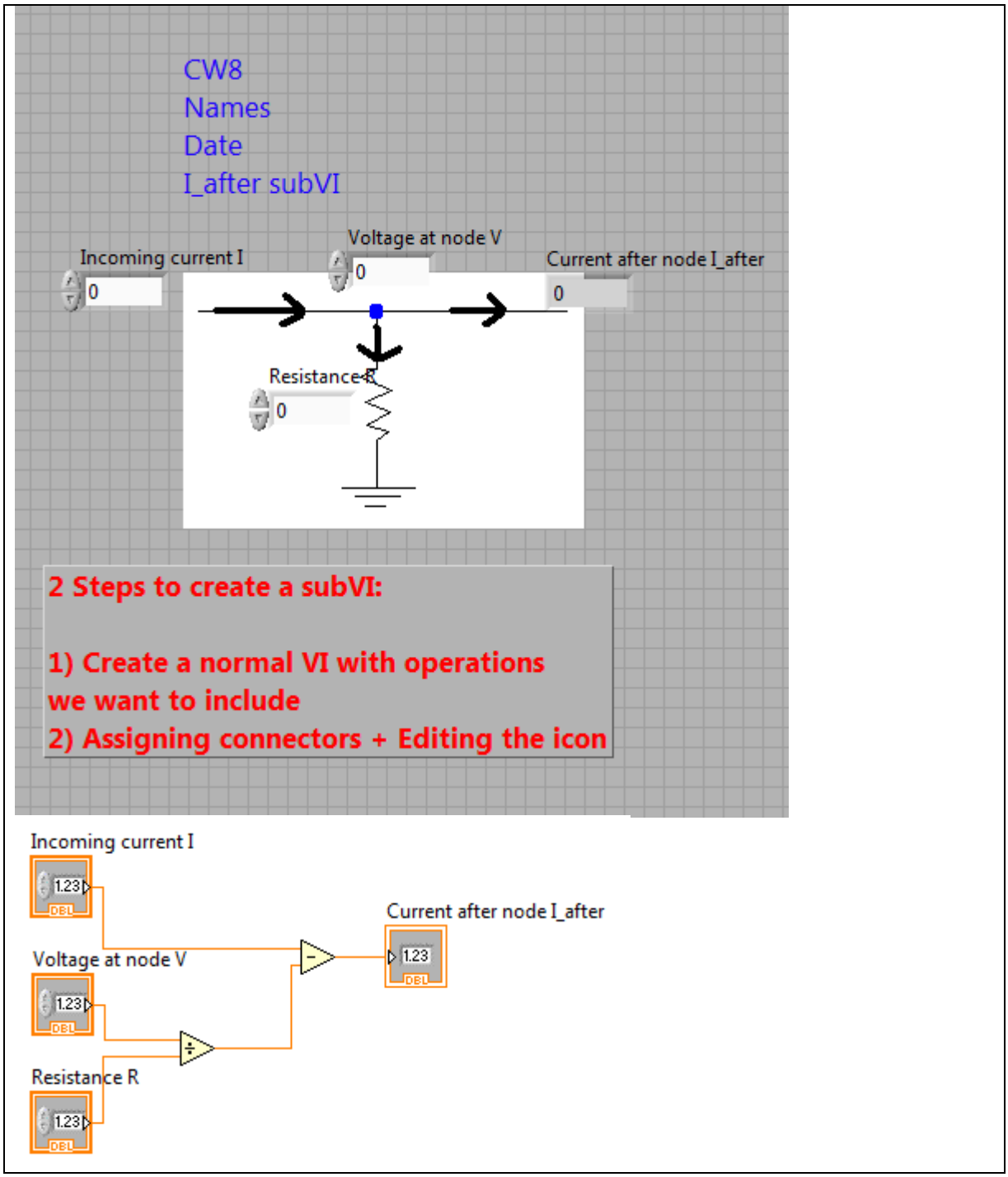
$$V2 = V - I \cdot R1 \qquad (2)$$

$$V4 = V2 - \left(I - \frac{V2}{R2} \right) \cdot R3 \qquad (3)$$

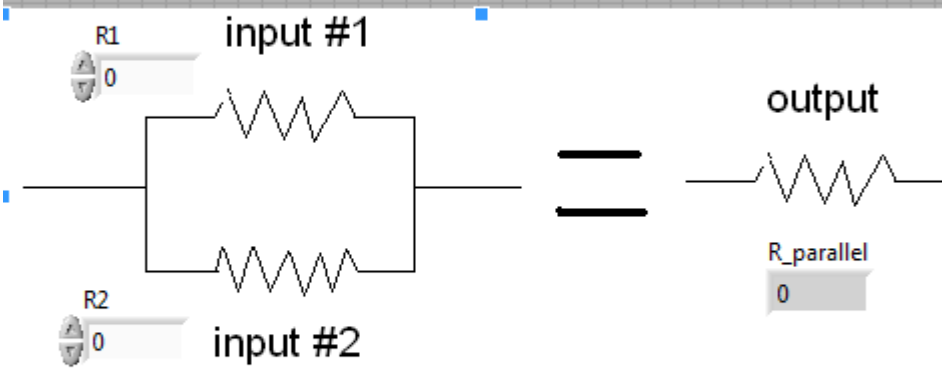
$$V6 = V4 - \left[\left(I - \frac{V2}{R2} \right) - \frac{V4}{R4} \right] \cdot R5 \qquad (4)$$


CW8
Names
Date
same as CW7 but now using subVI's
Current I (Amp)
8
V2 (V)
5
V4 (V)
2
V6 (V)
1
R1 (Ohm)
1
R3 (Ohm)
1
R5 (Ohm)
1
Battery Voltage (V)
13
R2 (Ohm)
1
R4 (Ohm)
1
R6 (Ohm)
1
Steps to develop a LabVIEW code:
1) Define the problem: (inputs: battery voltage, R1-R6; outputs total current I, V2, V4, V6)
2) Determine the equations to get the outputs
3) Implement the inputs, outputs (Front Panel), and operations (Block Diagram)


Battery Voltage (V)
Current I (Amp)
R1 (Ohm)
V2 (V)
R2 (Ohm)
V4 (V)
R3 (Ohm)
R4 (Ohm)
V6 (V)
R5 (Ohm)
R6 (Ohm)
V_next
I_after
1.23
DBL

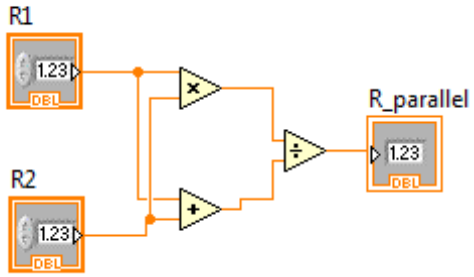

CW8
Names
Date
I_after subVI
Incoming current I
0
Voltage at node V
0
Current after node I_after
0
Resistance R
0
2 Steps to create a subVI:
1) Create a normal VI with operations we want to include
2) Assigning connectors + Editing the icon
Incoming current I
1.23
DBL
Voltage at node V
1.23
DBL
Resistance R
1.23
DBL
Current after node I_after
1.23
DBL

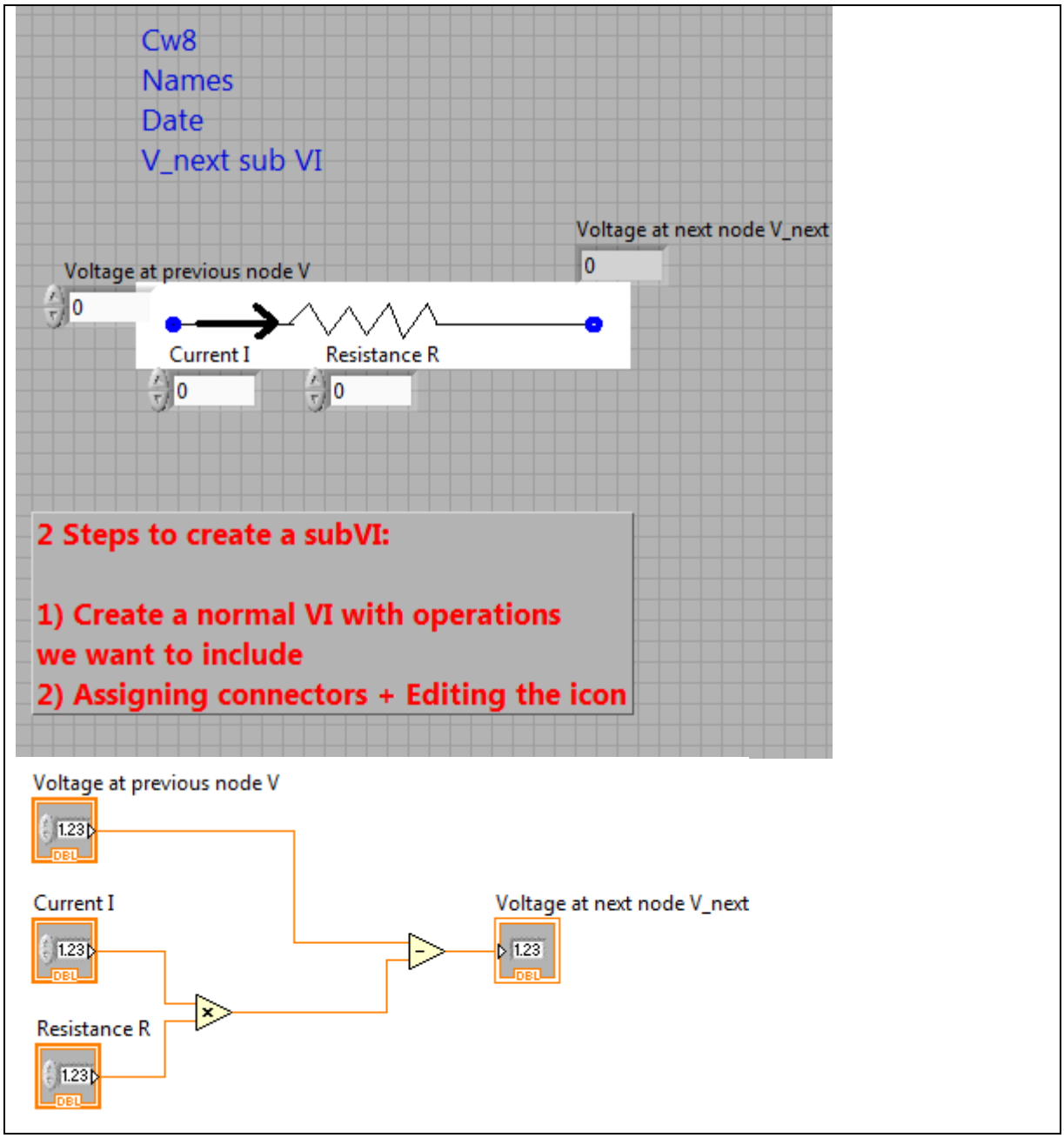
CW8
Names
Date
Parallel sub-VI

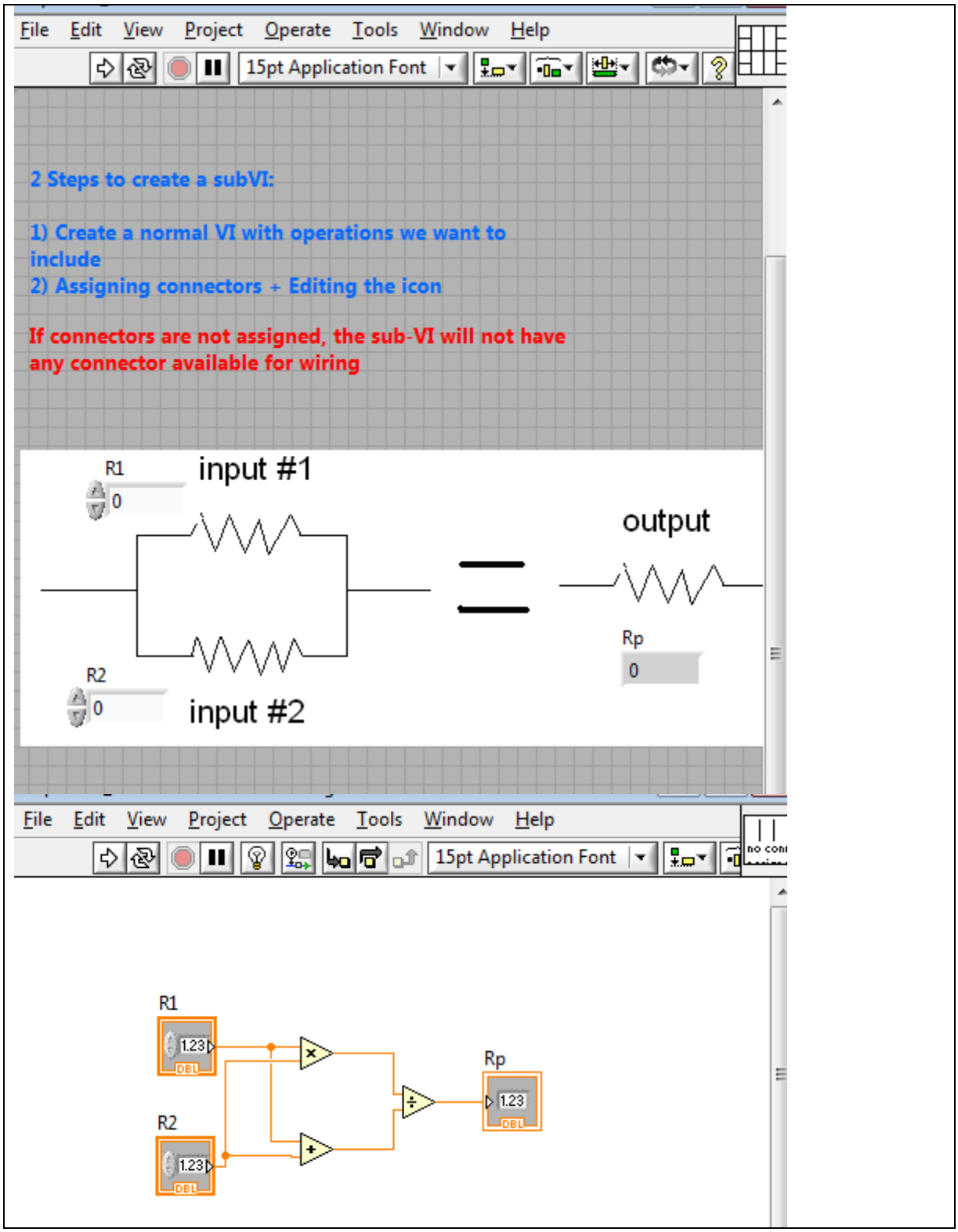


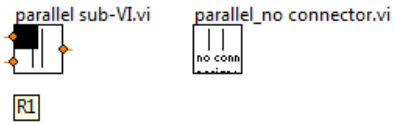
2 Steps to create a subVI:

1) Create a normal VI with operations we want to include
2) Assigning connectors + Editing the icon




Cw8
Names
Date
V_next sub VI
Voltage at next node V_next
0
Voltage at previous node V
0
Current I
Resistance R
0
0
2 Steps to create a subVI:
1) Create a normal VI with operations we want to include
2) Assigning connectors + Editing the icon
Voltage at previous node V
Current I
Resistance R
Voltage at next node V_next
1.23
DBL


File Edit View Project Operate Tools Window Help
15pt Application Font
2 Steps to create a subVI:
1) Create a normal VI with operations we want to include
2) Assigning connectors + Editing the icon
If connectors are not assigned, the sub-VI will not have any connector available for wiring
R1
0
input #1
output
Rp
0
R2
0
input #2
File Edit View Project Operate Tools Window Help
15pt Application Font
R1
1.23
DBL
R2
1.23
DBL
Rp
1.23
DBL



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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:

31) How many sub-VI's did you create in this exercise? What is the difference between creating a VI and creating a sub-VI?
32) How do you call in a sub-VI? How do you wire it? What would happen if you did not properly assign connectors when creating the sub-VI?
33) Specify the inputs and outputs, with clear details, for your team Virtual Instrument to be presented as Part I of Project 2. Write the equations that allow the calculation of the outputs from the inputs, explain each variable in your equations.
34) Insert a snapshot of the Front Panel (FP) and Block Diagram (BD) of your team's VI for Part I of Project 2, explain why did you use those specific LabVIEW elements in the FP and BD.

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