
LabVIEW Essentials 1 & 2

Training Exercises

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1.0 Overview

1.01 Gallagher Engineering LLC

Gallagher Engineering LLC is an Automation & LabVIEW Consulting Company based out of Traverse City, MI. Gallagher Engineering produces quality turn-key Automated Test Equipment (ATE) with limited lead-times and competitive pricing. Support is available for all project requirements including Scope of Work (SOW), mechanical design, electrical wiring, enclosure fabrication, system design, software programming, and validation testing.

A Certified LabVIEW Developer & Trainer is available for all LabVIEW Programming projects ranging from simple data acquisition to complex inter-process control & synchronization programs. Typical services include: code reviews, code refactoring, program design & development, software training, object oriented programming design, and Graphical User Interface (GUI) designs.

1.02 LabVIEW Essentials 1 & 2

LabVIEW Essentials 1 focuses on providing essential LabVIEW knowledge to Novice Programmers (e.g. Engineers) in order to perform basic programming tasks. Course Topics cover:

- LabVIEW Integrated Development Environment (IDE) Overview
- User Interface Objects (Front Panel)
- Essential Block Diagram Functions
- Basic Data Acquisition, Analysis, and File I/O
- State Machine Architecture Design & Development
- Programming Best Practices

LabVIEW Essentials 2 completes the "Essentials" training course by covering all basic LabVIEW Programming functionality and Small Program Development (i.e. Application Builds). Course Topics cover:

- Inter-Process Communication Basics
- Advanced Data Acquisition & Analysis
- Advanced State Machine Architecture Design & Development
- Custom Graphical User Interface Designs
- Small Program Development
- Application Build (.exe)

1.03 Legal

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1.04 Quick Reference

Common Mouse Cursors

Wire Spool

Used for Wiring Objects



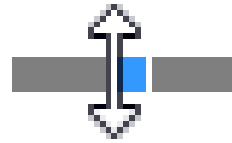
Selection Arrow

Used for Selecting Objects



Resize Cursor

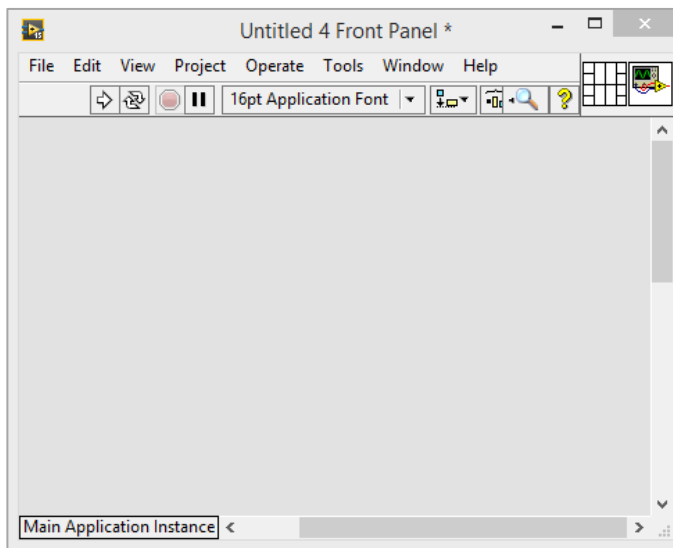
Used for Resizing Objects



Common Windows

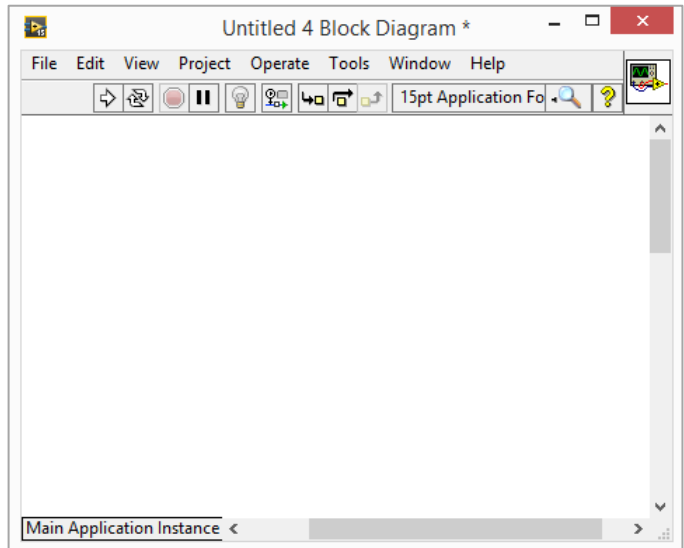
Front Panel

Graphical User Interface



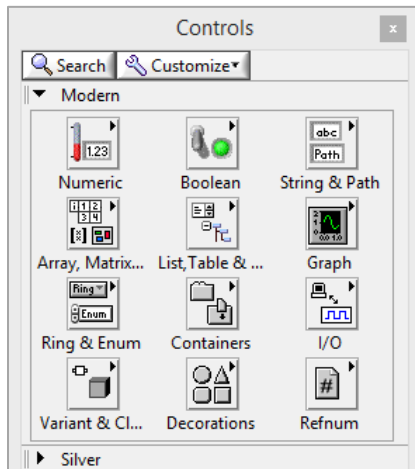
Block Diagram

Programming Area



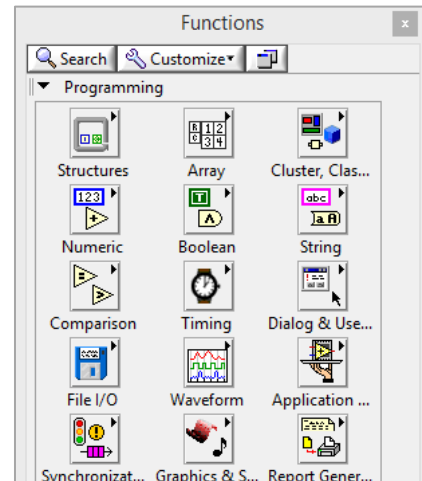
Controls Palette

Access to Front Panel Controls



Functions Palette

Access to Block Diagram Functions



	<u>Function</u>	<u>Shortcut</u>
	Tile FP & BD Windows	Ctrl + T
	Undo last action	Ctrl + Z
	Copy Selected Object	Ctrl + C
	Paste Copied Object	Ctrl + V
	Select All Objects	Ctrl + A
	Help Dialog	Ctrl + H
	Run VI	Ctrl + R
	New VI	Ctrl + N
	Save VI	Ctrl + S
	VI Properties	Ctrl + I
	Remove Broken Wires	Ctrl + B
	Switch FP/BD	Ctrl + E
	Close FP/BD	Ctrl + W
	Create SubVI from Selected Code	Edit - CreateSubVI
	Tools Palette	Shift + RightClick
	Move Selected Objects in greater Increments	Shift + Arrow
	Copy selected object(s)	Ctrl + Drag
	Align Objects on FP/BD	Ctrl + Shift + A

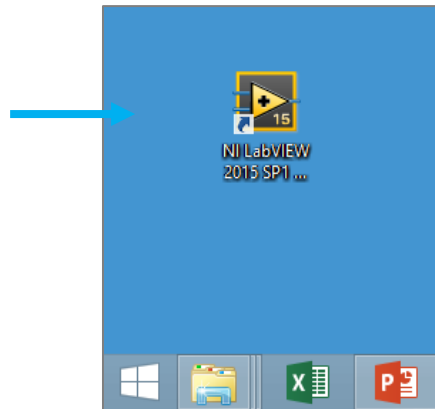
2.0 Graphical Programming

2.01 Wiring Basics

1. Environment Setup

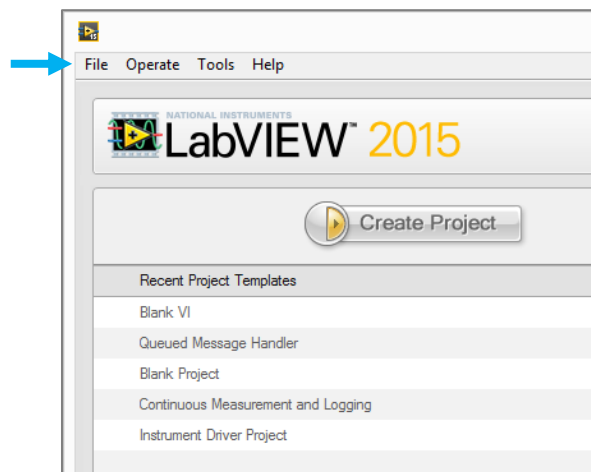
1.1. Open LabVIEW 2015 Application

1.1.1. Shortcut located on computer's Desktop

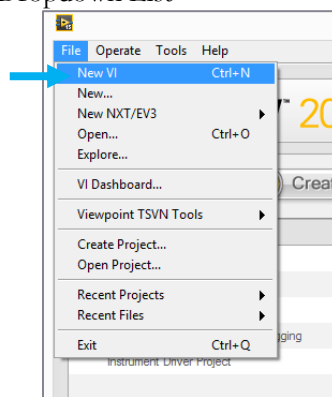


1.2. Create New VI File

1.2.1. Click on 'File' within the Menu Bar

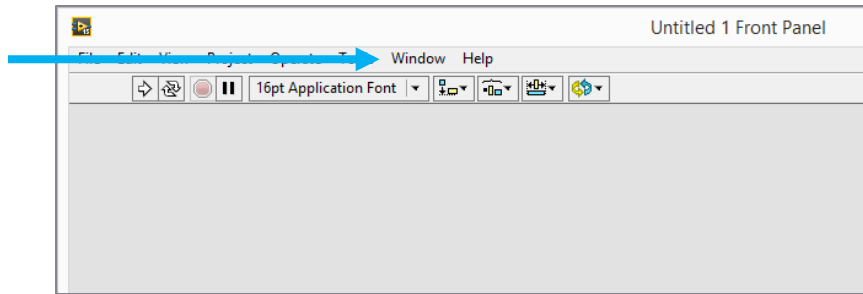


1.2.2. Click on 'New VI' from the Dropdown List

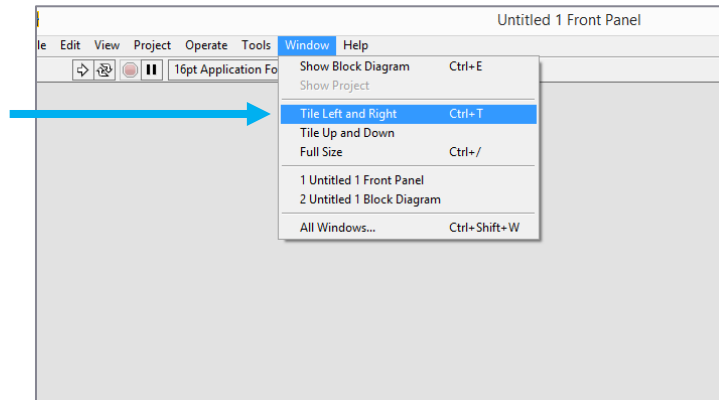


All mouse "Click" instructions are assumed to be Left-Click operations unless noted otherwise

- 1.3. Tile Front Panel and Block Diagram
 - 1.3.1. Click on 'Window' within the Menu Bar

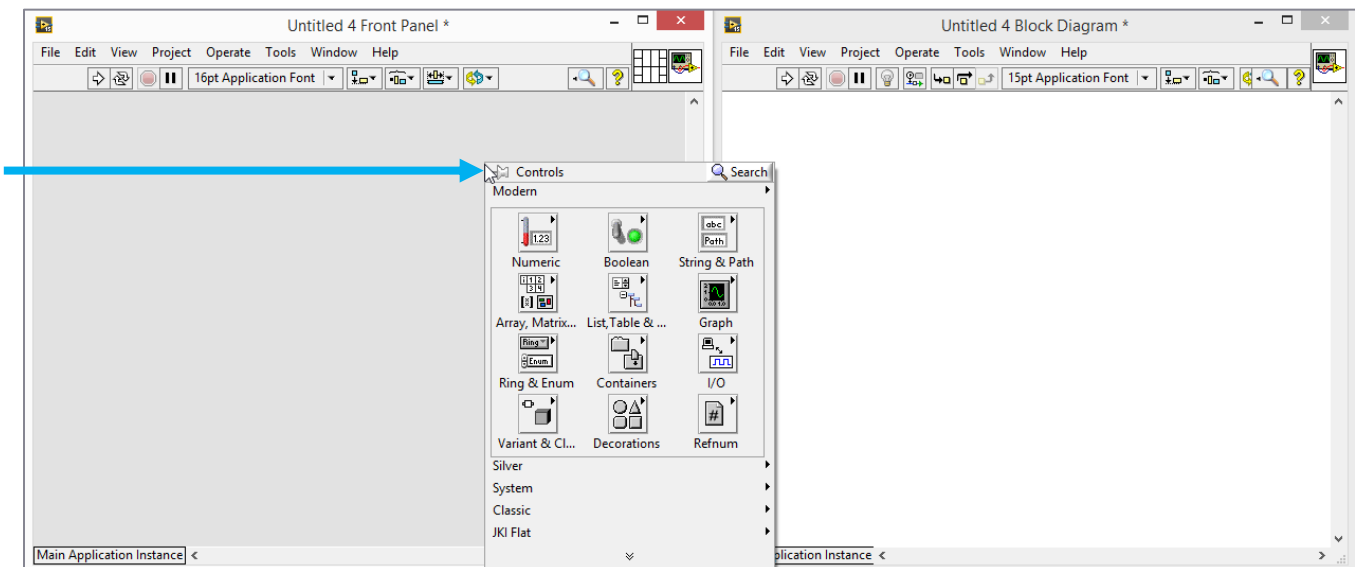


- 1.3.2. Click on 'Tile Left and Right' from the Dropdown List



2. Create Front Panel Controls

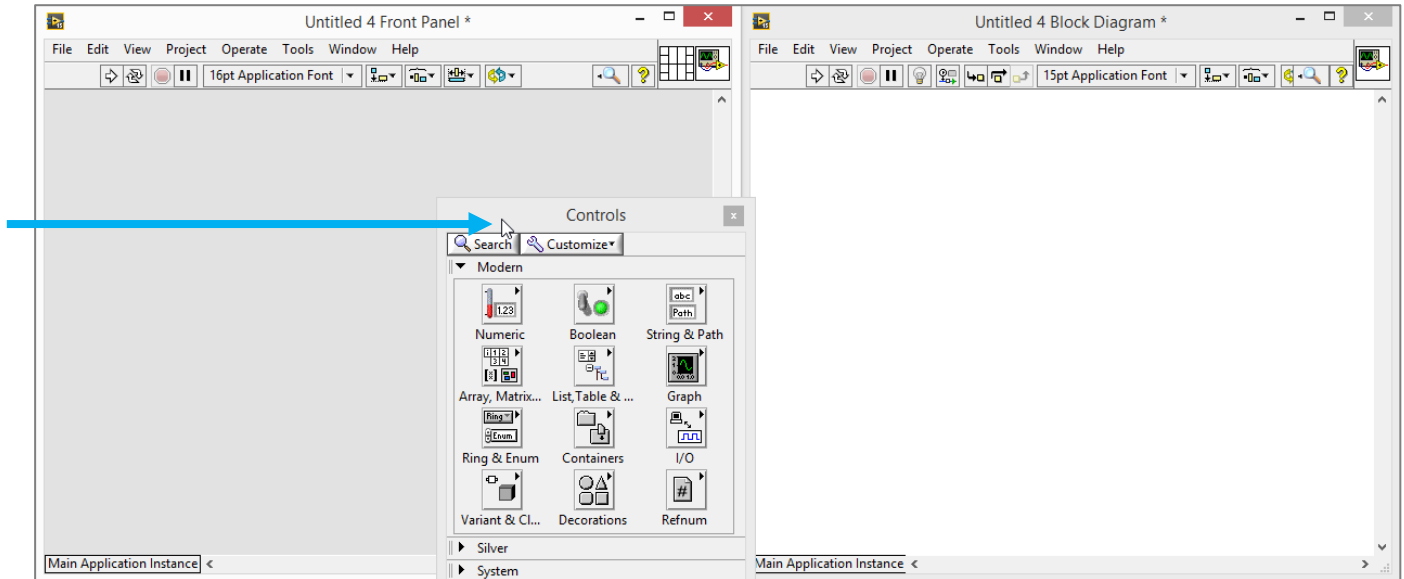
- 2.1. Open Controls palette on Front Panel screen (Grey Background)
 - 2.1.1. Right Click anywhere on Front Panel (Grey Background) - a temporary Controls palette will appear
 - 2.1.2. Click the 'pin' icon to pin the Controls palette open



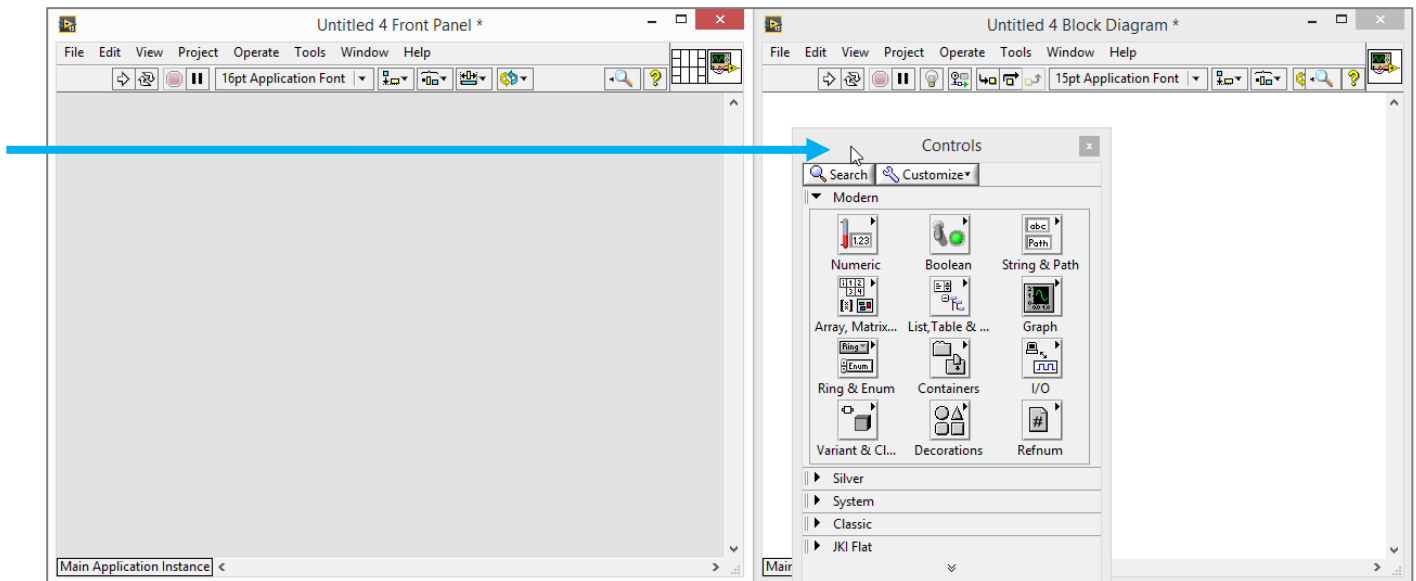
Multiple Control Palettes can be open at one time (i.e. not limited to only 1)
 Drag palette edges to increase/decrease palette size

2.2. Move Controls Palette for easier viewing of Front Panel

2.2.1. Click & Drag on Title Bar of Controls Palette

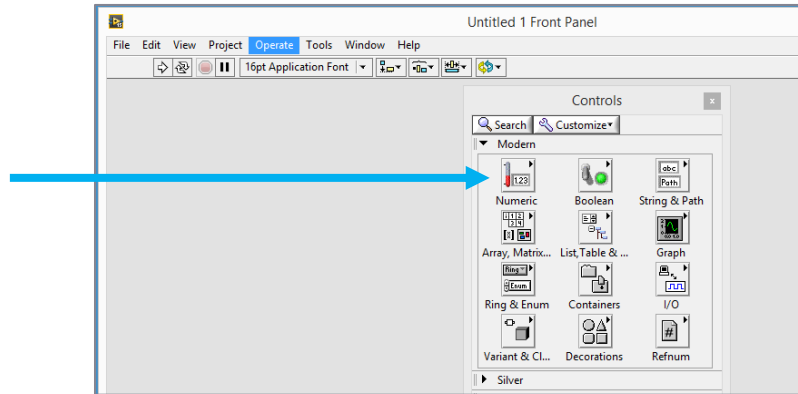


2.2.2. Release Mouse Click after moving Controls Palette

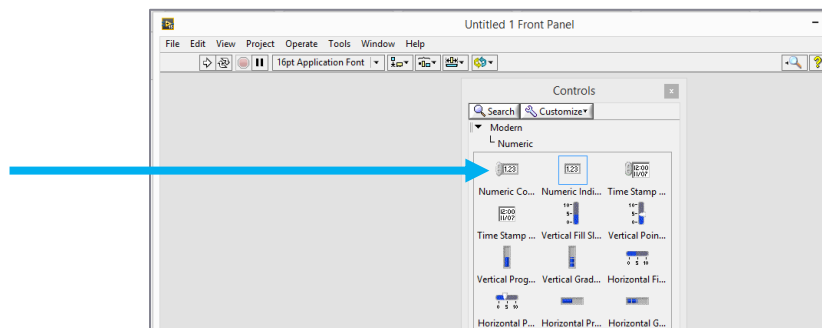


2.3. Add Numeric Controls

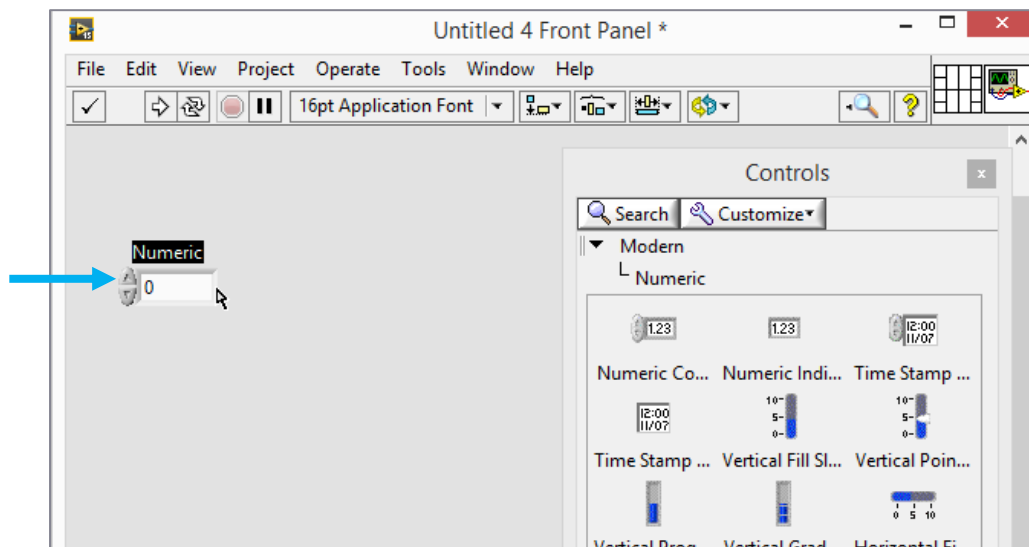
2.3.1. Click on the 'Numeric' Palette Icon



2.3.2. Click on the 'Numeric Control' icon within the Controls Palette



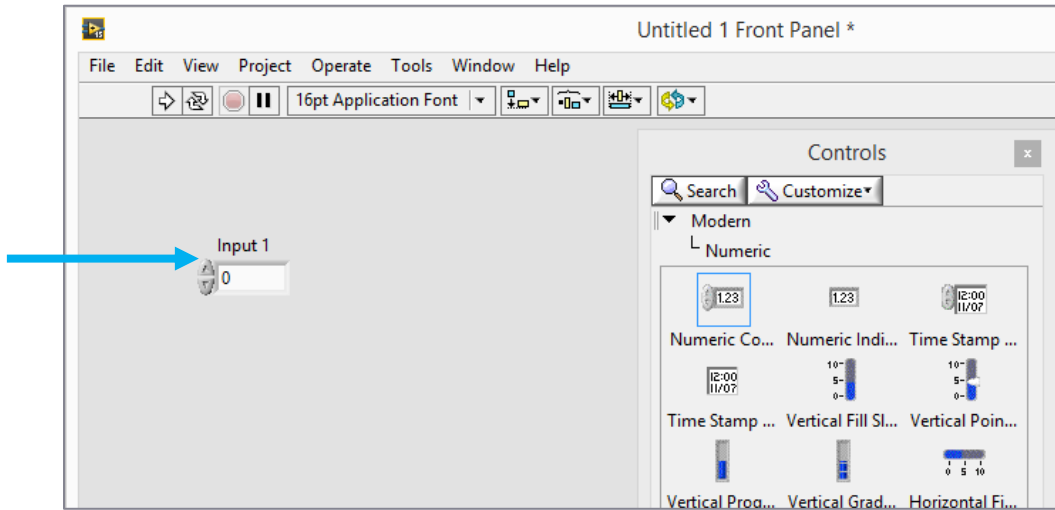
2.3.3. Click on the Left Side of the Front Panel to “drop” selected Numeric Control



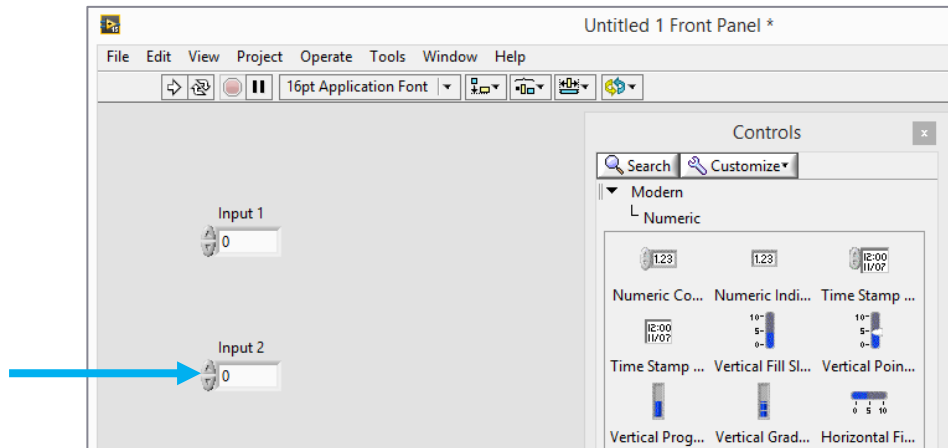
2.3.4. Change the Control's Label to "Input 1"

2.3.4.1. Control's Label is selected by default after placing on Front Panel, type "Input 1" then click anywhere on the screen to confirm change

2.3.4.2. If Control's Label is no longer selected (e.g. user clicked somewhere else), Double Click on the default Control's label of "Numeric" then type "Input 1" and click anywhere on the screen to confirm change

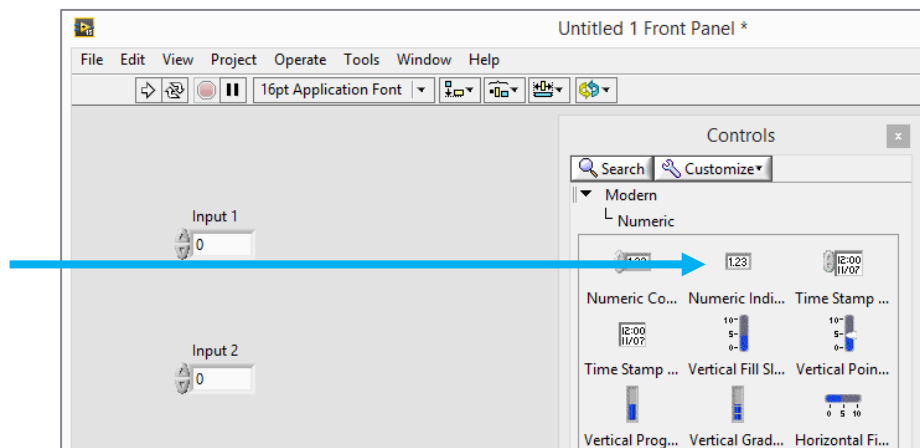


2.3.5. Repeat Steps 2.2.1 – 2.2.4 to create another Front Panel Numeric Control and label it "Input 2"

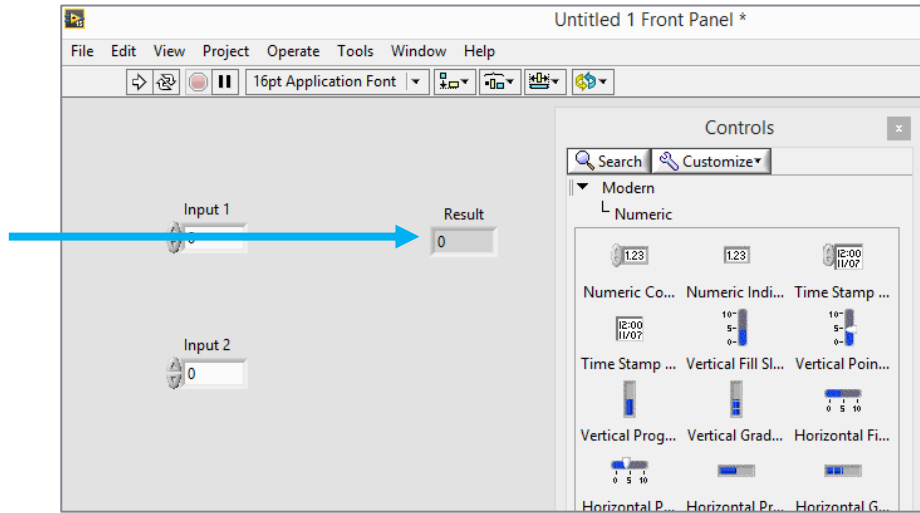


3. Create Front Panel Indicator

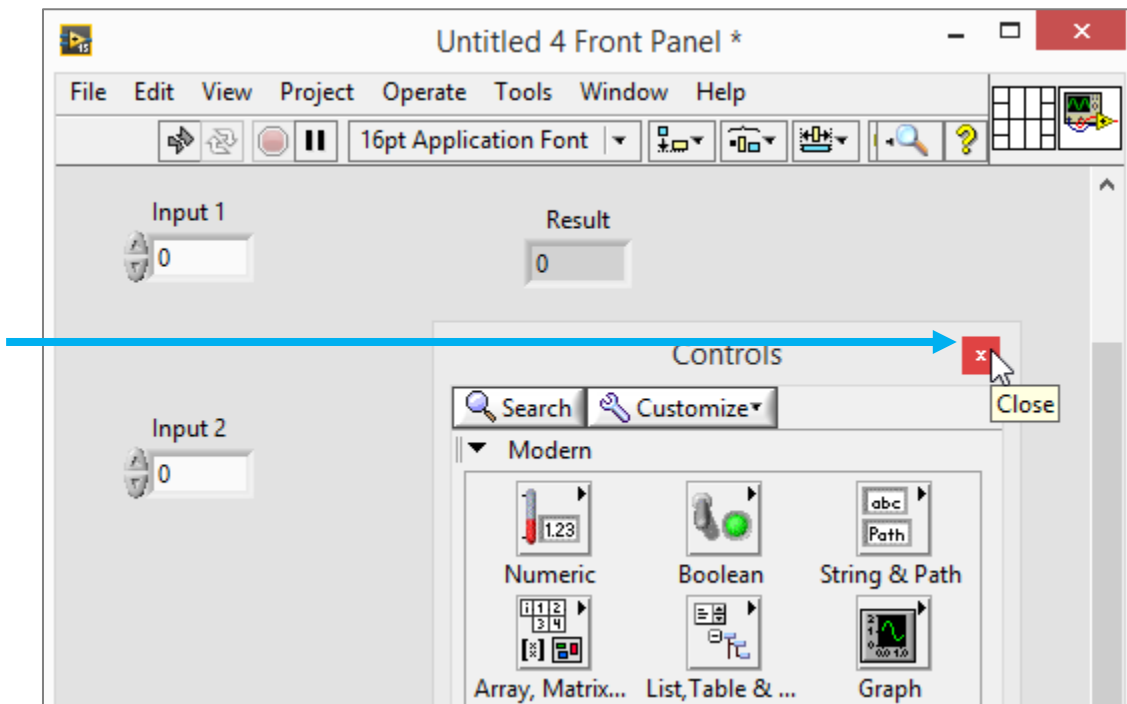
3.1. Click on the 'Numeric Indicator' icon with the Controls Palette



- 3.2. Click anywhere on the Front Panel to “drop” the selected Numeric Indicator
- 3.3. Change the Numeric Indicator’s Label from “Numeric” to “Result”
 - 3.3.1. Indicator’s Label is selected by default after placing on Front Panel, type “Result”
 - 3.3.2. If Indicator’s Label is no longer selected (e.g. user clicked somewhere else), Double Click on the default Indicator’s label of “Numeric” then type “Result”



- 3.4. Close the Controls Palette
 - 3.4.1. Click on the Control Palette’s Red “X” to close the Controls Palette



The Controls Palette can be re-opened by Right-Clicking anywhere on the Front Panel’s “Grey” Space

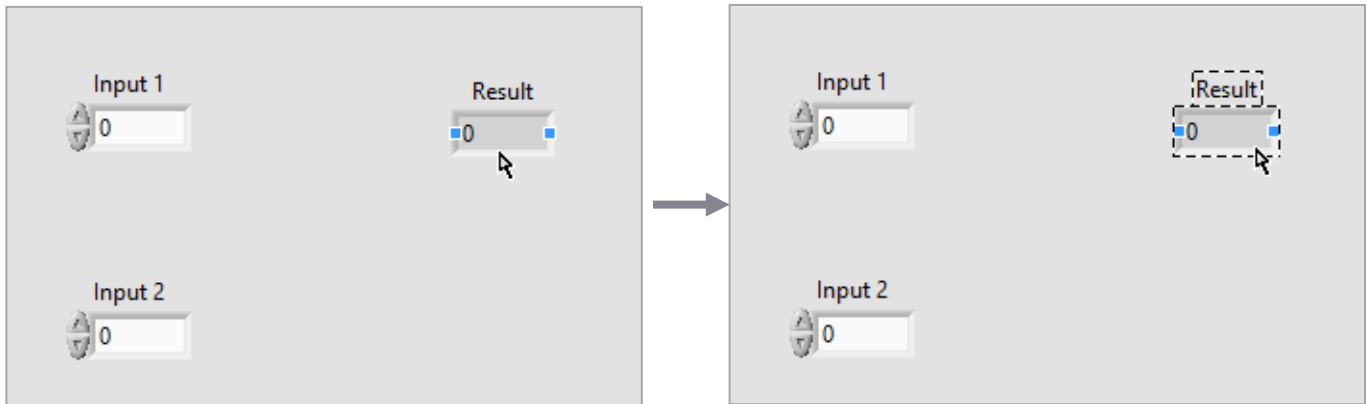
4. Move Front Panel Objects

4.1. Hover Cursor over bottom edge of Result Control until Selection Arrow appears (not Text cursor)

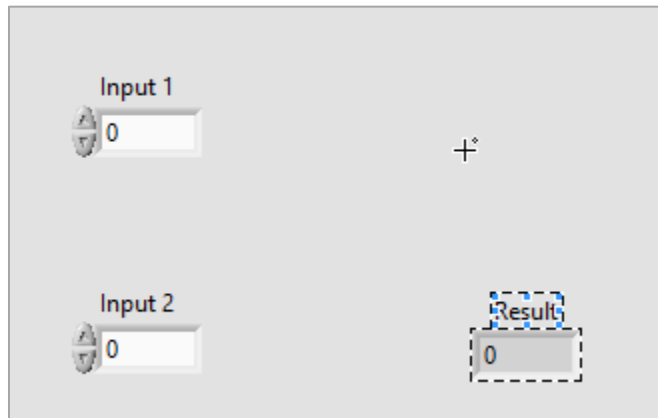
Note | Do not hover directly over the Control Input area (“0”) or the actual text “Result”

4.2. Once Selection Arrow Appears, Left-Click Mouse

4.3. Result Control should now be selected (dotted outline)



4.4. Hold the ‘Down’ Arrow Key until the Result Control is located as shown below

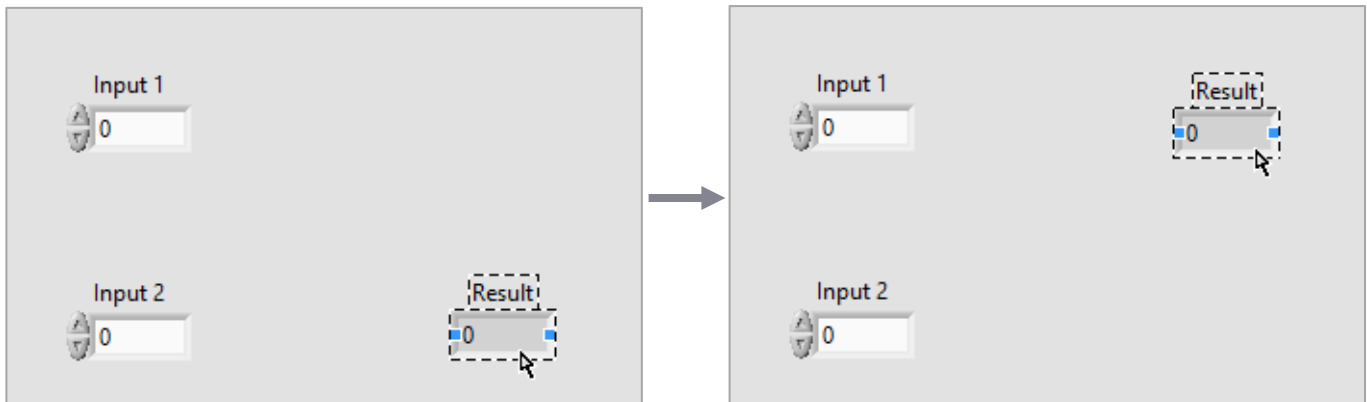


4.5. Click & Drag Result Control

4.5.1. Hover cursor over Result Control’s bottom edge until Selection Arrow appears

4.5.2. Click & Drag Result Control upwards until as shown below

4.5.3. Click anywhere on Front Panel (Grey Area) to deselect Result Control

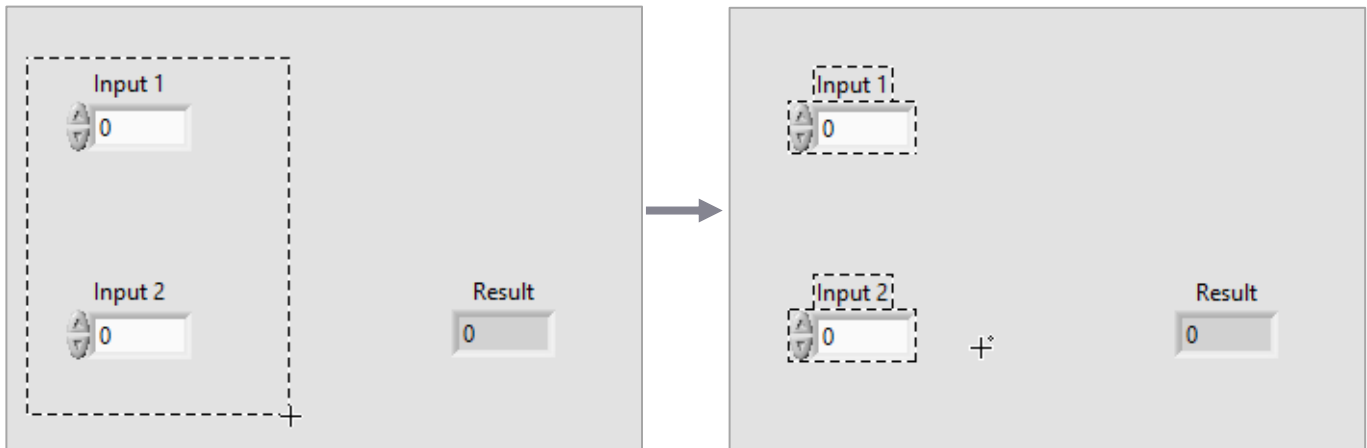


4.6. Move Input 1 & 2 Controls

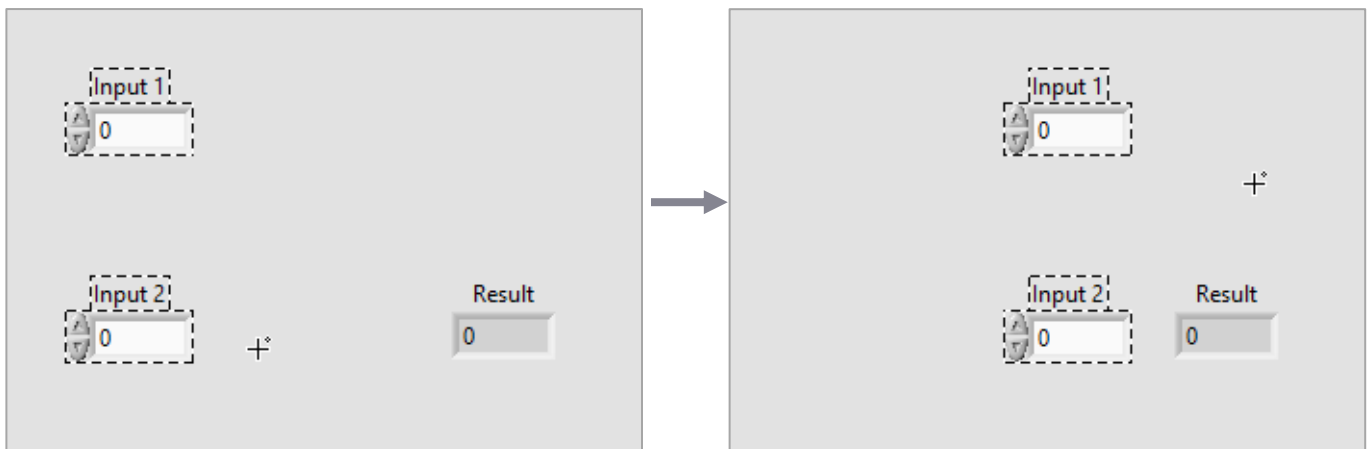
4.6.1. Drag Selection Box around Input 1 & 2

4.6.2. Click & Drag Selection Box around Input 1 & 2 Controls on the Front Panel

4.6.3. Input 1 & 2 Controls should now be selected (dotted outline)



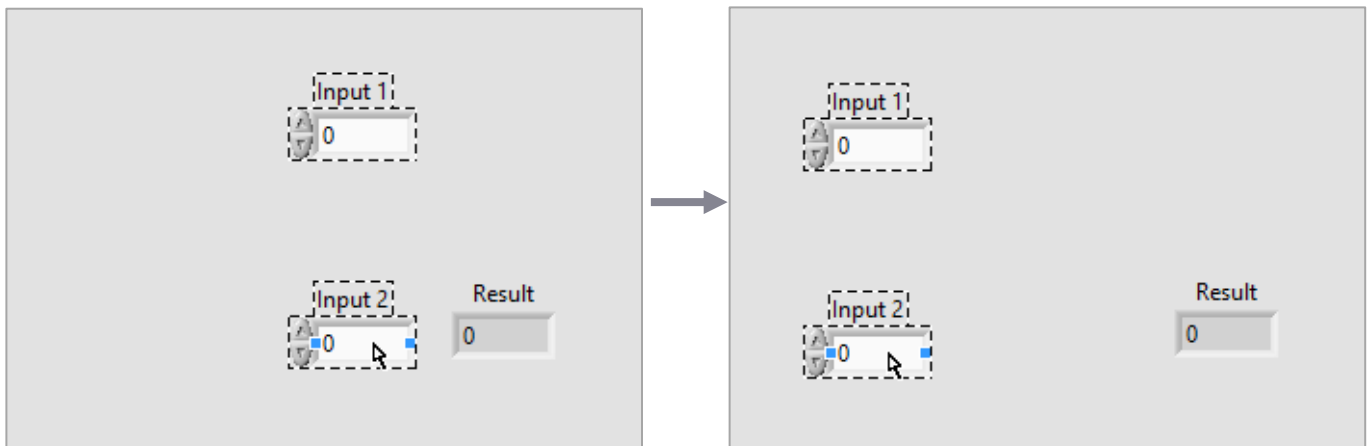
4.6.4. Hold 'Shift' Key down then press & hold the 'Right' Arrow Key down until Controls are located as shown below



4.7. Click & Drag Input 1 & 2 Controls

4.7.1. Hover over Input 2 Control until Arrow Cursor appears

4.7.2. Click & Drag Selected Objects back to their original position as shown below

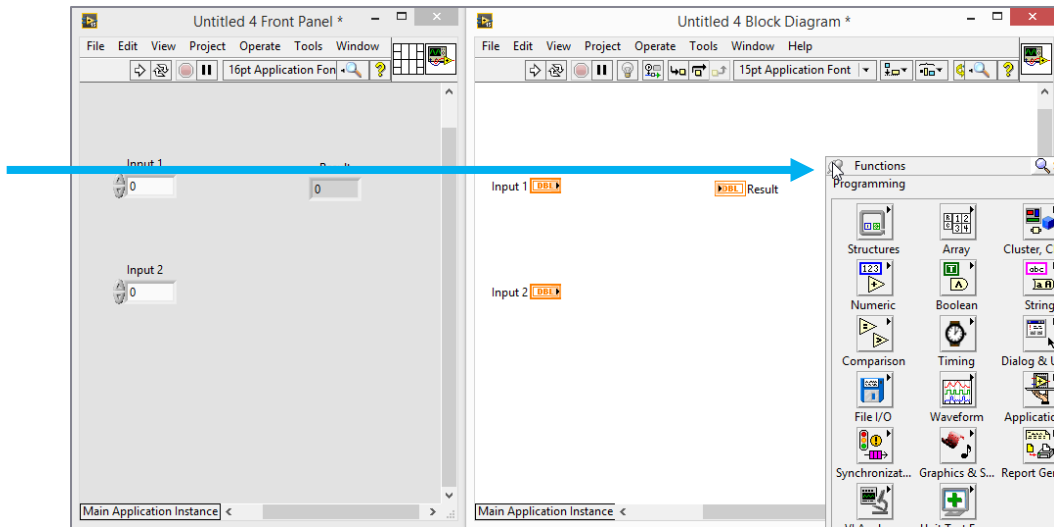


5. Add Block Diagram 'Add' Function

5.1. Open Functions palette on Block Diagram screen (White Background)

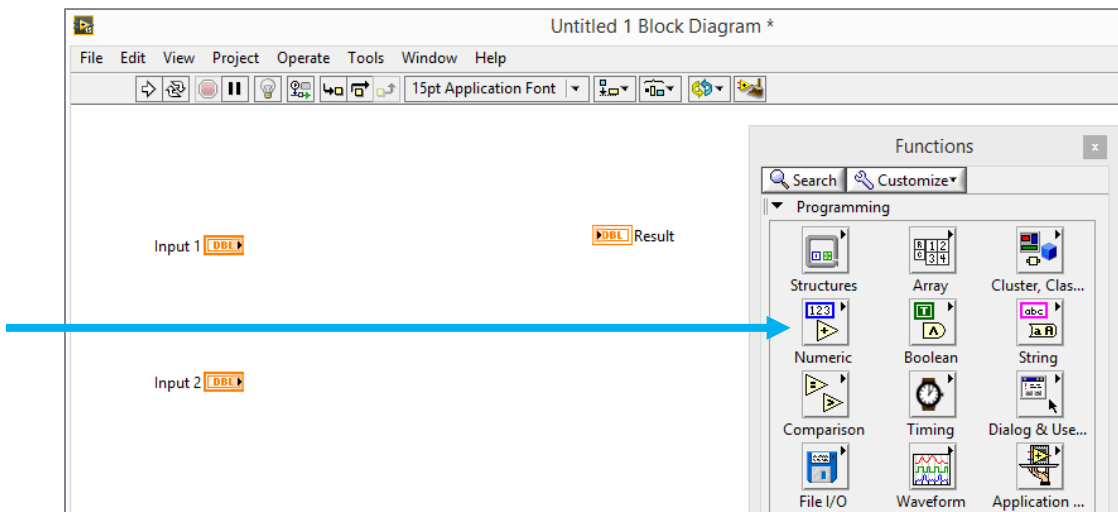
5.1.1. Right Click anywhere on Block Diagram – a temporary Functions palette will appear

5.1.2. Click the 'pin' icon to pin the Functions palette open

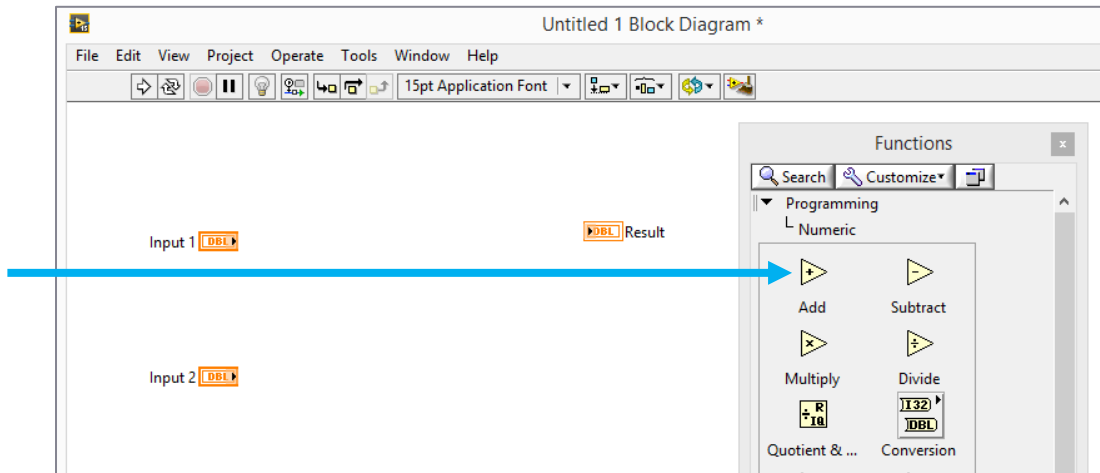


5.2. Add "Add" function to Block Diagram

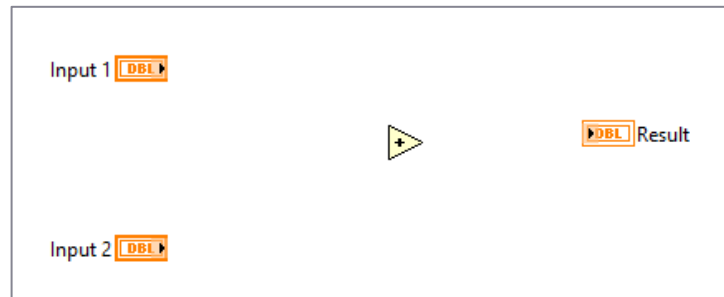
5.2.1. Click on the 'Numeric' Palette Icon



5.2.2. Click on the 'Add' Icon

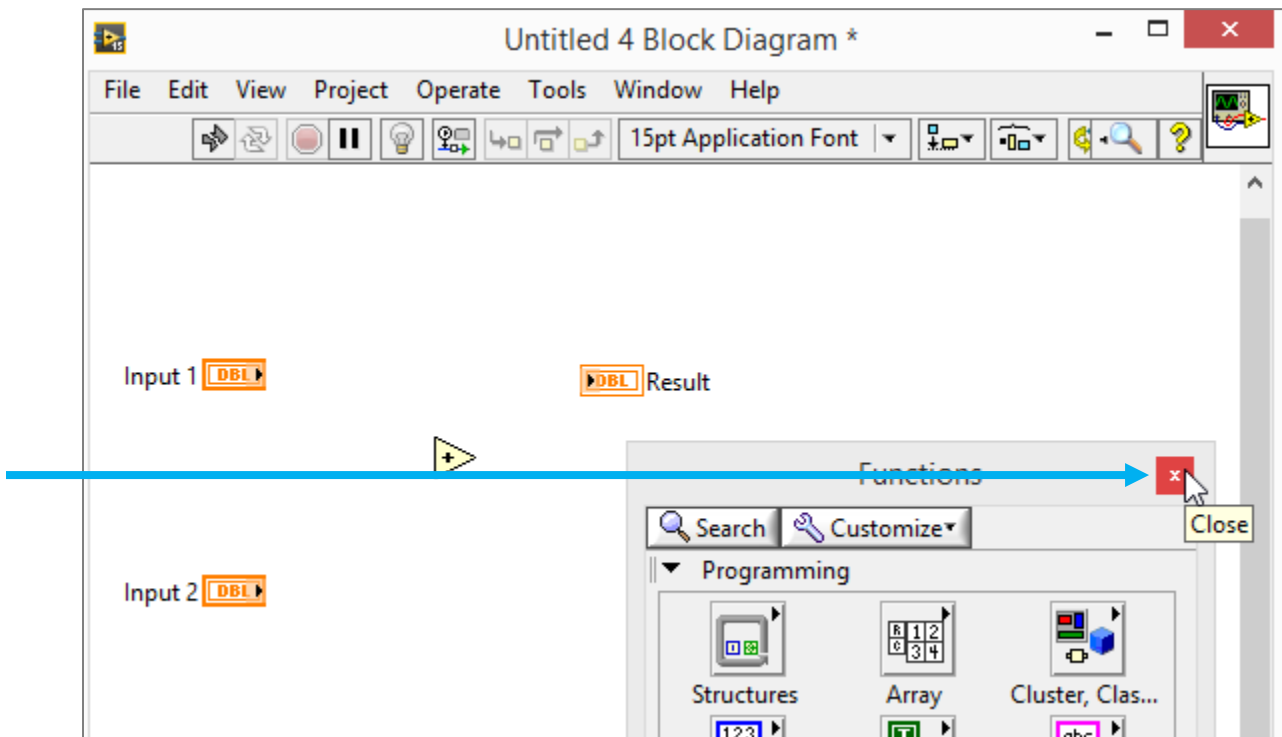


5.2.3. Click in the middle on the Block Diagram to “drop” the selected Add function in between the Input & Result terminals



5.3. Close Function Palette

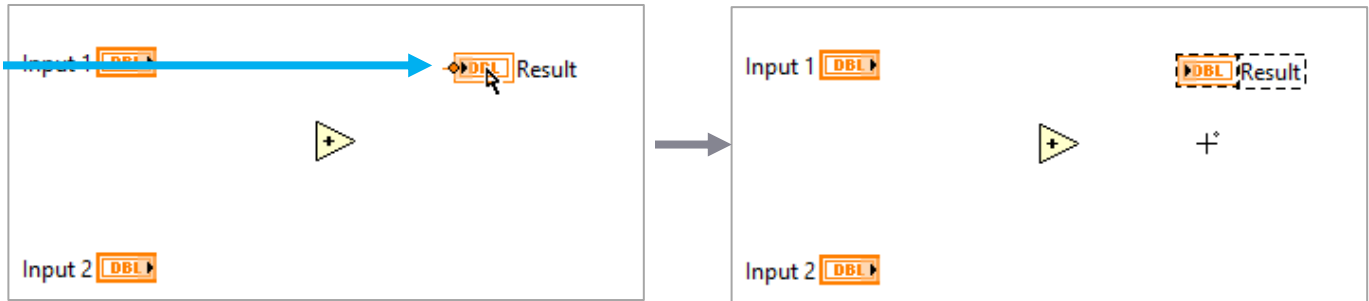
5.3.1. Click on the Function Palette’s Red “X” to close the Function Palette



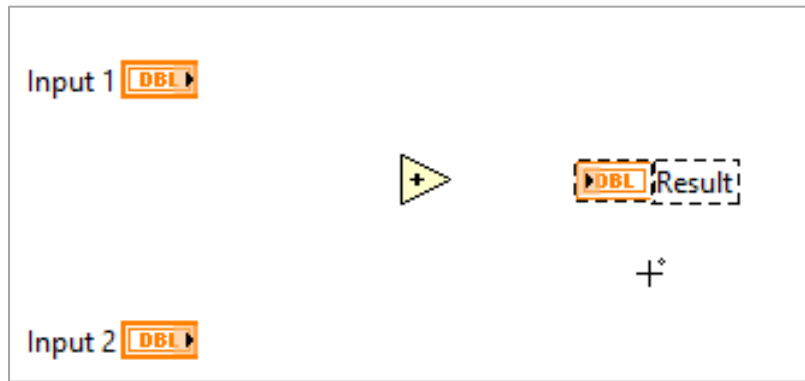
The Function Palette can be re-opened by Right-Clicking anywhere on the Block Diagram’s “White” Space

6. Move Block Diagram Objects

- 6.1. Hover Cursor over Result Terminal Box until Selection Arrow appears (not Wire Spool)
Note | Do not hover over the actual text “Result” as this would only select the label box
- 6.2. Once Selection Arrow Appears, Left-Click Mouse
- 6.3. Result Terminal should now be selected (dotted outline)

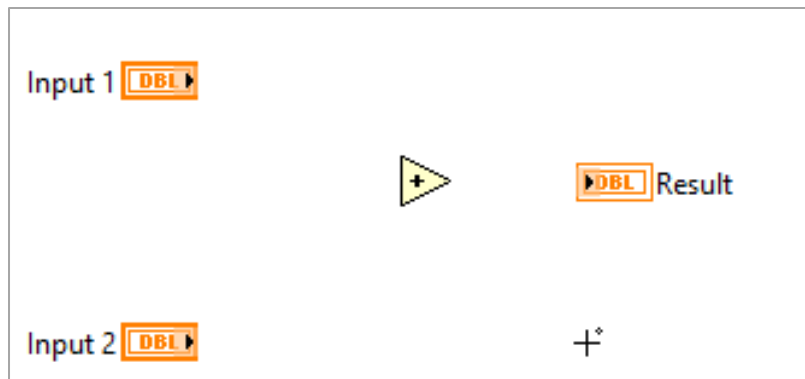


- 6.4. Hold ‘Shift’ Key & Press the ‘Down’ Arrow Key to move the Result Terminal in line with the Add function



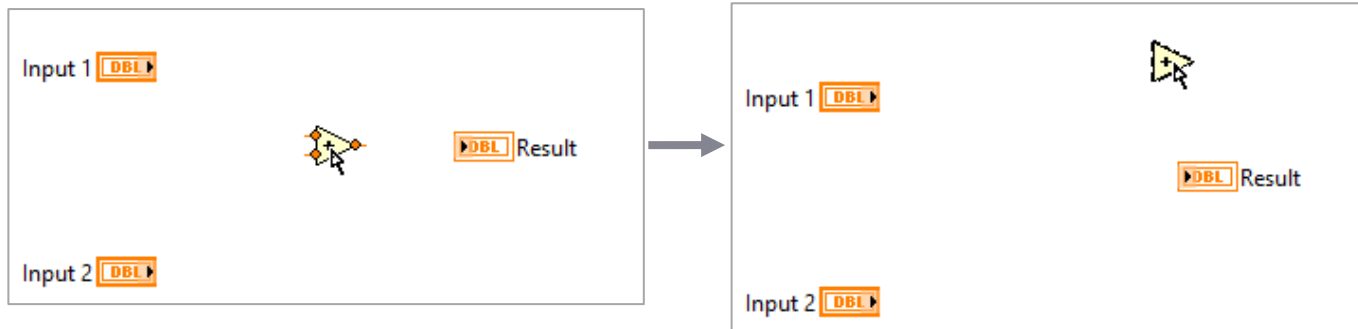
Holding the ‘Shift’ key while using the Arrow Keys moves items by 8 pixels instead of 1

- 6.5. Deselect Result Terminal by clicking mouse anywhere on Block Diagram “white” area (no more dotted outline)

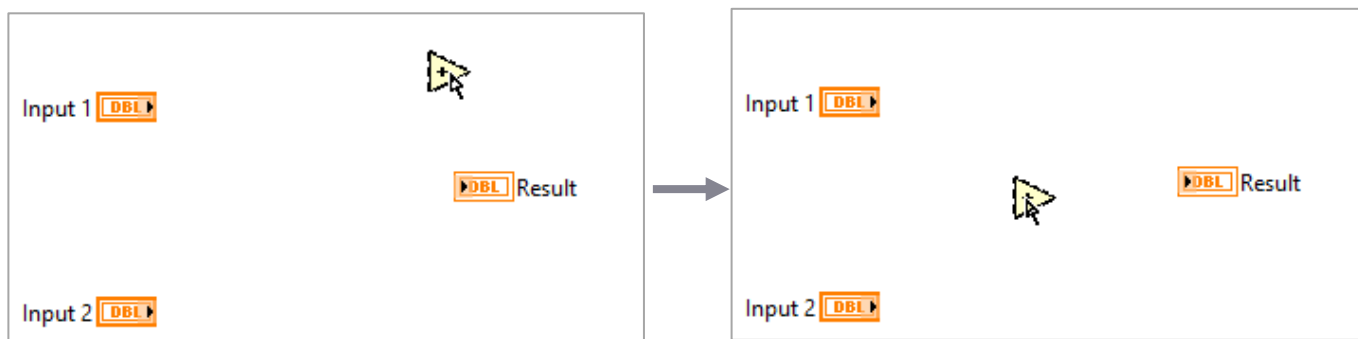


6.6. Hover Cursor over center of Add Function until Selection Arrow appears (not wire spool)

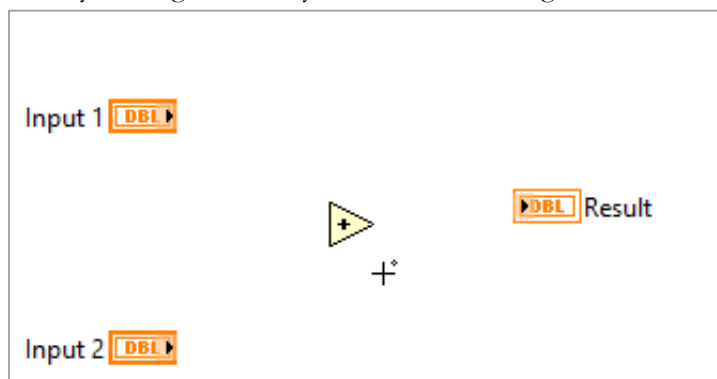
6.7. Click & Drag Add function above the Result Terminal then release mouse click



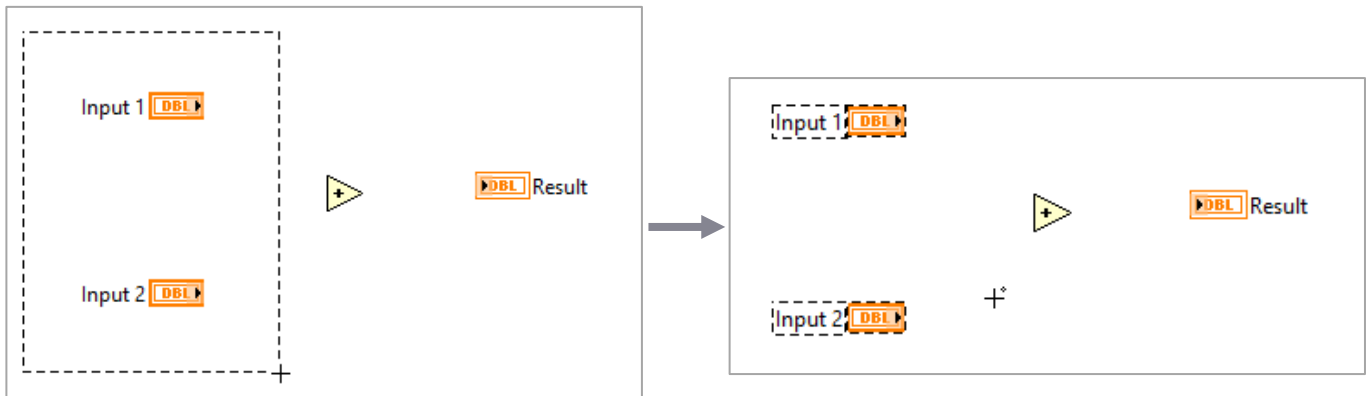
6.8. Repeat step above (Click & Drag) to move the Add Function back to its original location (Centered)



6.9. Deselect Add Function by clicking mouse anywhere on Block Diagram “white” area (no more dotted outline)



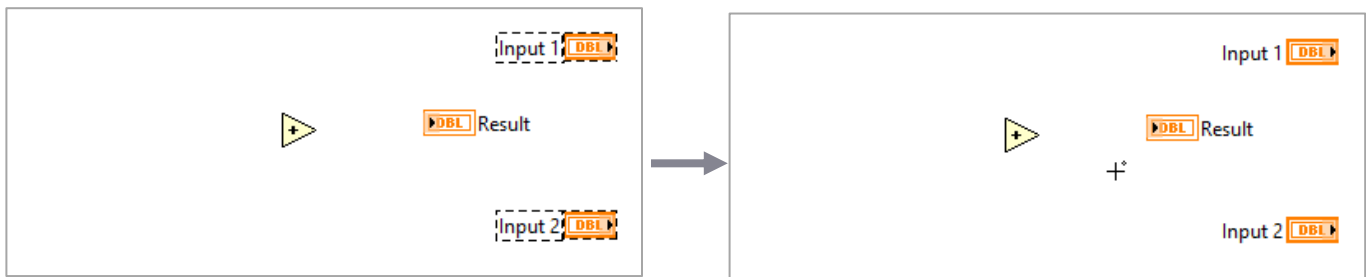
- 6.10. Move Input 1 & Input 2 Block Diagram Terminals
- 6.11. Click & Drag a Selection Box over Input 1 & 2 Terminals



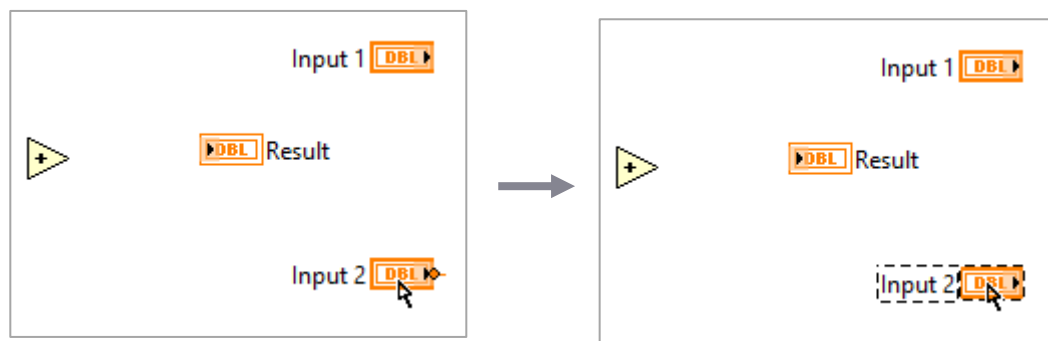
6.12. Use 'Right' Arrow Key to move Input 1 & 2 Terminals to location shown below



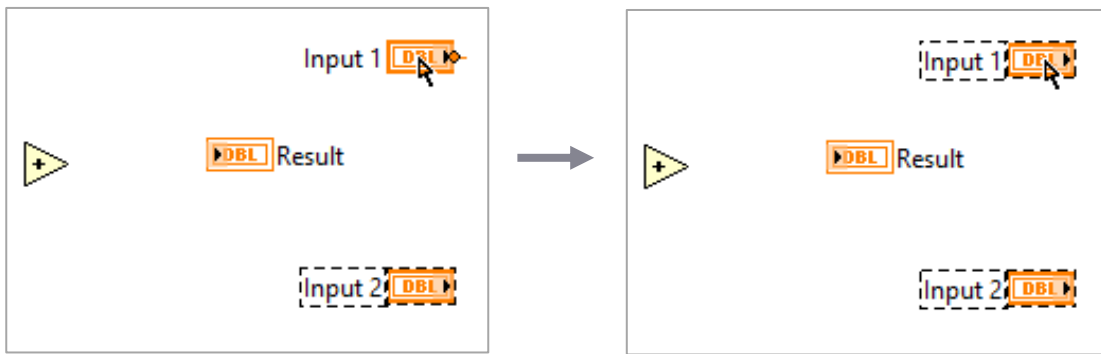
6.13. Deselect Input 1 & 2 Terminals by clicking any on Block Diagram's "white" area



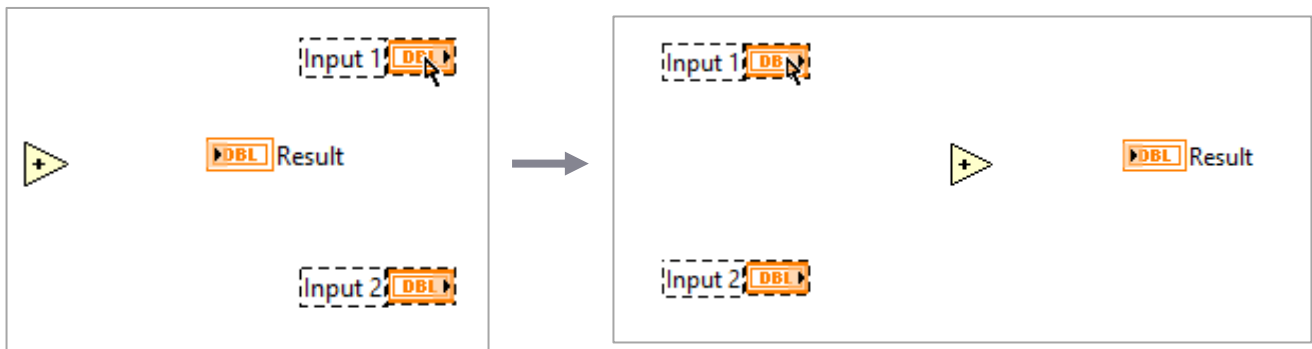
- 6.14. Hold Down the keyboard's 'Shift' Key
- 6.15. Hover Mouse over Input 2's Terminal until Selection Arrow Appears
- 6.16. Left-Click Mouse to Select Input 2 Terminal ('Shift' Key is still being held down)



- 6.17. Hover mouse over Input 1 Terminal until selection arrow appears
- 6.18. Left-Click Mouse to Select Input 1 Terminal ('Shift' Key is still being held down)
- 6.19. Release 'Shift' Key



- 6.20. With both Input 1 & 2 Terminals select, hover mouse over any of the selected items (e.g. Input 1) until selection Arrow Appears
- 6.21. Click & Drag to move objects back to original location as shown below

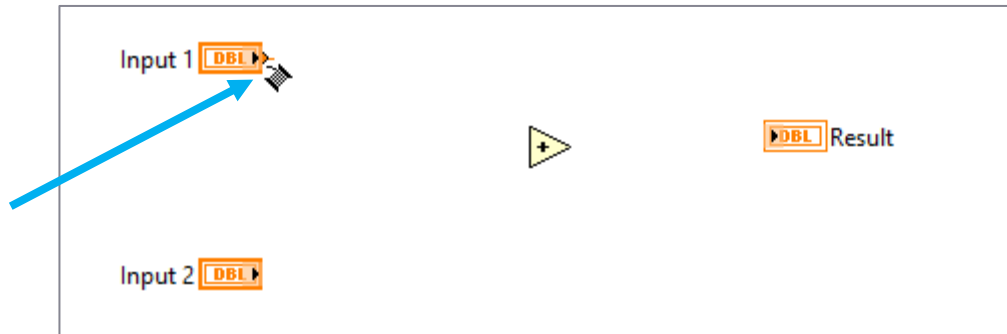


- 6.22. Deselect objects by clicking anywhere within the Block Diagram's "White Space"

7. Wire Block Diagram Objects

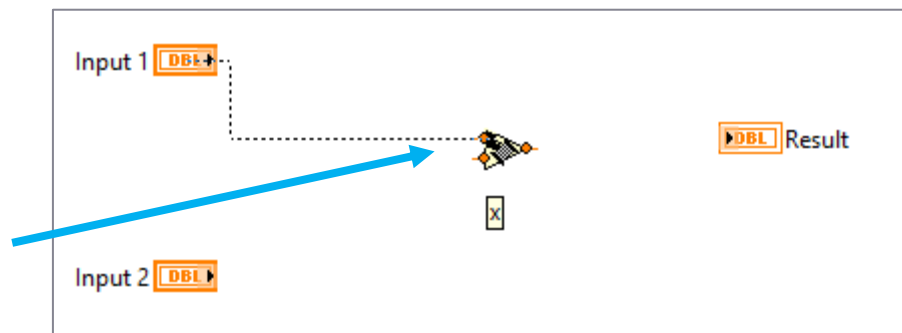
7.1.1. Hover cursor over small 'Arrow' icon of Input 1 Terminal (cursor should automatically turn into a Wire Spool icon)

7.1.2. Click mouse when Wire Spool icon appears



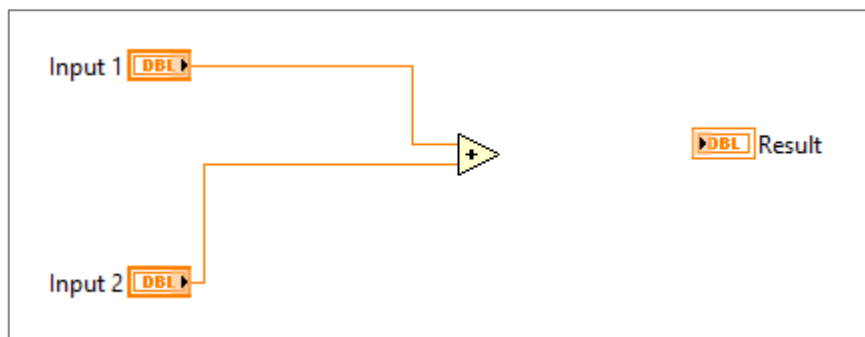
7.1.3. Hover mouse over top Input of Add function until Wire Spool appears (there is a Top and Bottom "Input" of the Add Function – careful to wire just the Top input)

7.1.4. Click mouse when Wire Spool icon appears



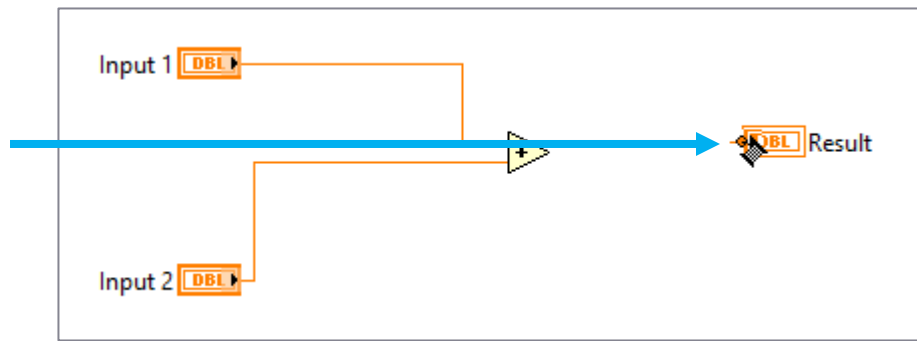
Press 'Escape' key or Right-Click mouse while wiring (i.e. dotted wire line) to undo a wire

7.1.5. Repeat steps 4.3.1 – 4.3.4 to wire Input 2 Terminal to Add Function



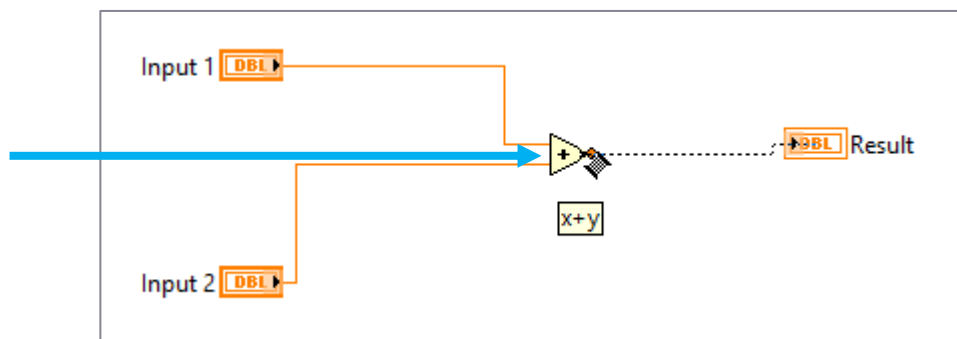
7.1.6. Hover cursor over small 'Arrow' icon of Result Terminal (cursor should automatically turn into a Wire Spool icon)

7.1.7. Left Click mouse when Wire Spool icon appears



7.1.8. Hover mouse over Output of Add function until Wire Spool appears

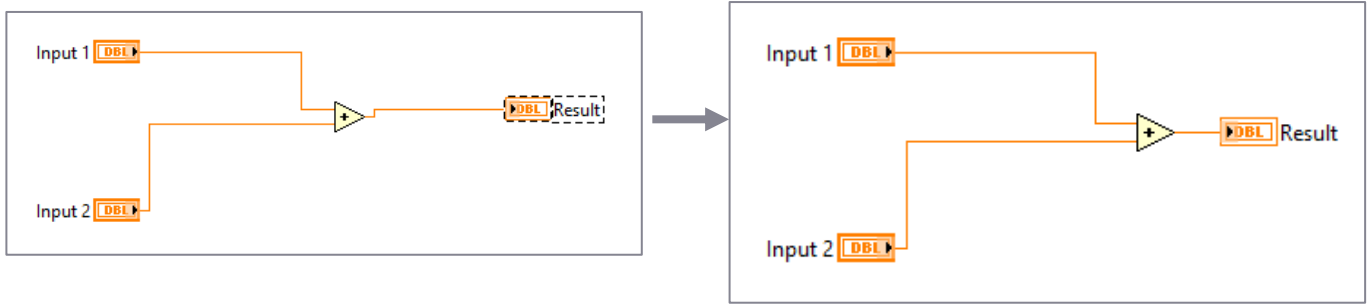
7.1.9. Left-Click mouse when Wire Spool icon appears



Wiring Order does not affect functionality of program – you may wire in any order/arrangement

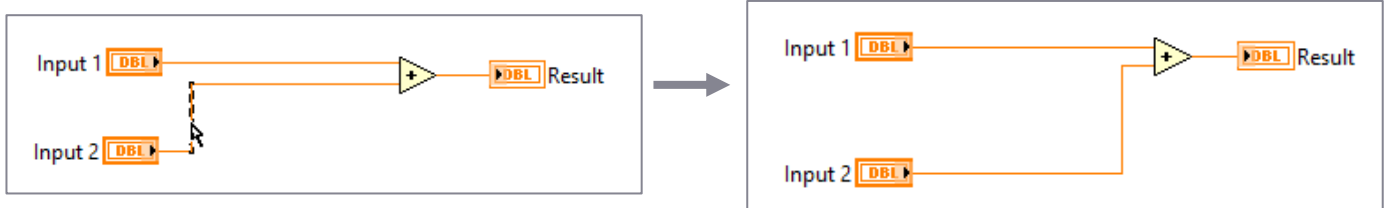
8. Cleanup Wiring

- 8.1. Click on Result Terminal (not the “Result” Text, but the actual Square Box labeled DBL)
- 8.2. Use Arrow Keys to move Terminal to reduce wire length and bend(s)
- 8.3. Click off of Terminal to deselect (e.g. Click in open white area on Block Diagram)



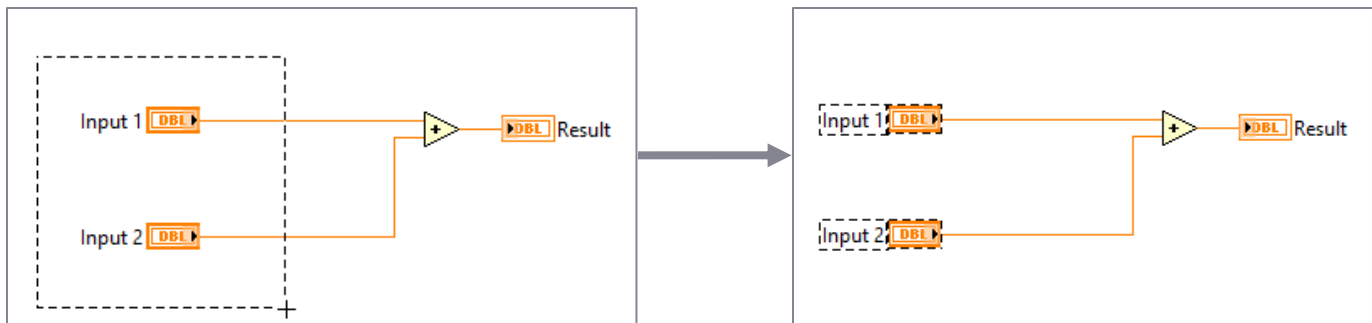
8.4. Finish cleaning up wiring (reducing length and bends) using the following additional techniques:

- 8.4.1. Click on an individual wire
 - 8.4.1.1. Hover mouse directly on top of Wire until Arrow icon appears then Left-Click Mouse
- 8.4.2. Move selected Wire using Arrow Keys (shown below)
- 8.4.3. Click off of Wire to deselect (e.g. Click in open white area on Block Diagram)



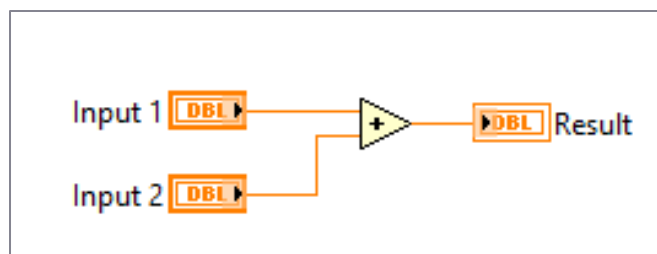
Hovering the mouse directly on top of a wire produces the Arrow “Selection” Icon
Hovering the mouse slightly away from wire produces the Wire Spool Icon

- 8.4.4. To select multiple items to Move at a time, hold down the ‘Shift’ Key while selecting items (e.g. multiple terminals) or Click & Drag selection box around desired items (shown below)



Holding the ‘Shift’ key while using the Arrow Keys moves items by 8 pixels instead of 1

8.5. Continue moving block diagram items until the following layout is achieved



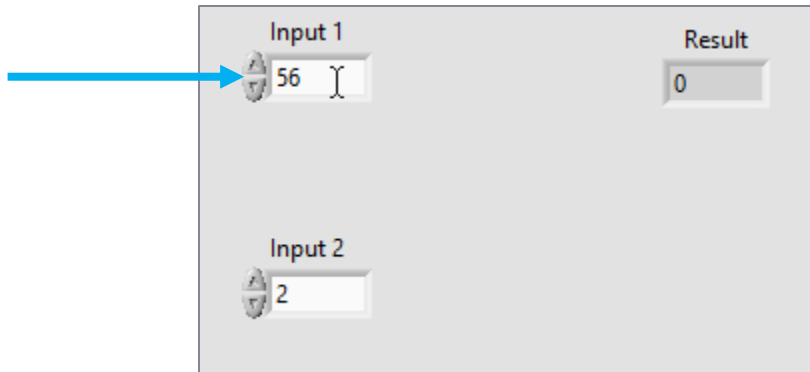
9. Run Program

9.1. Run One Time

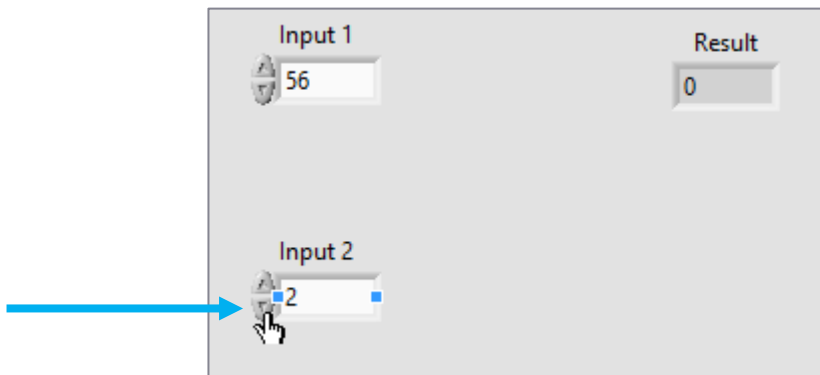
9.1.1. Enter values for Front Panel Inputs (Grey Screen)

9.1.1.1. Hover cursor over Input 1 Control and click when it becomes a 'Text' icon

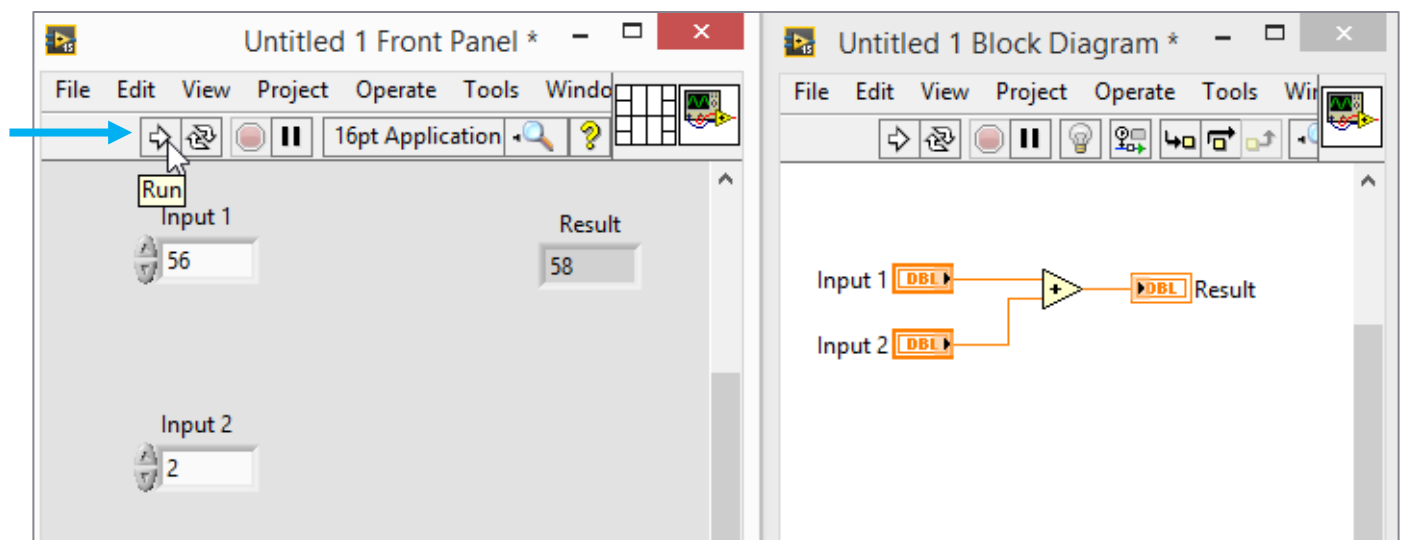
9.1.1.2. Enter any numeric value then click off of Input 1 (this confirms the value)



9.1.2. Press Increment/Decrement buttons on side of Input 2 Control (This changes the value by increments/decrements of 1)



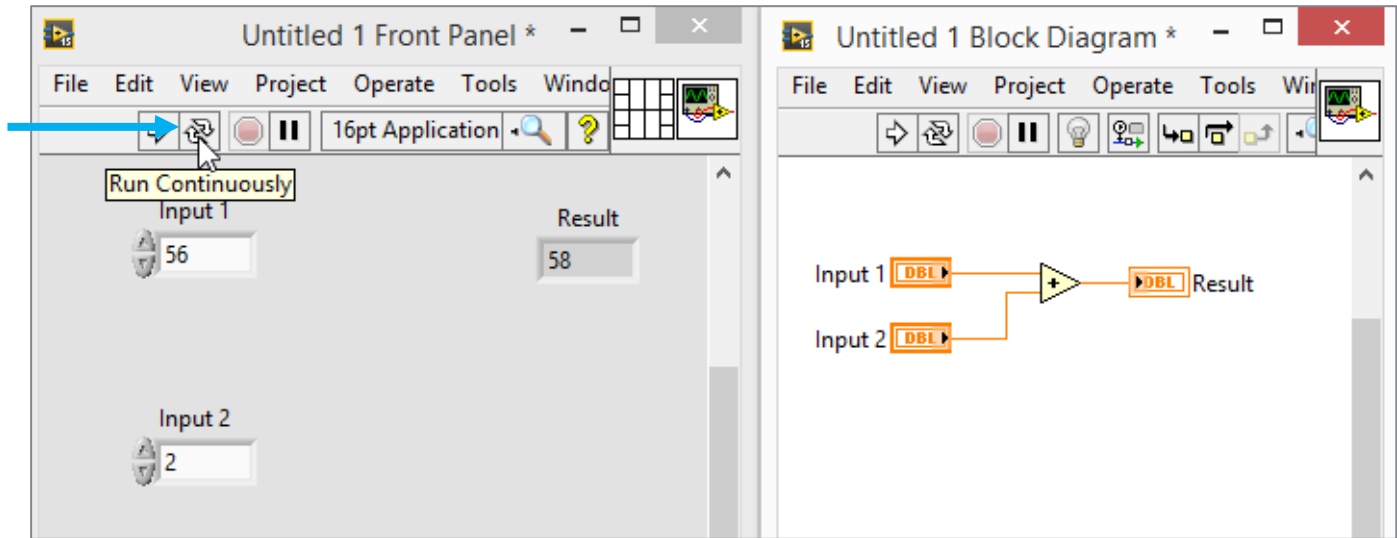
9.1.3. Click the 'Run' (Play Button) icon on either the Front Panel or Block Diagram to run the program and observe the 'Result' value change



9.1.4. Repeat Steps 5.1.1 – 5.1.3 above using different Input values

9.2. Run Continuously

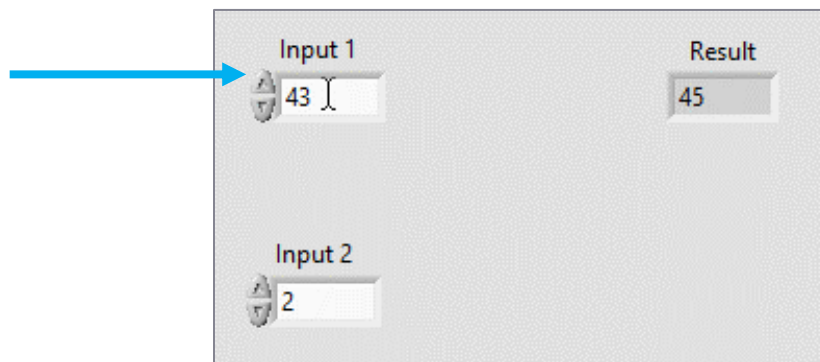
9.2.1. Click the 'Run Continuously' (two arrows circling) icon on either the Front Panel or Block Diagram



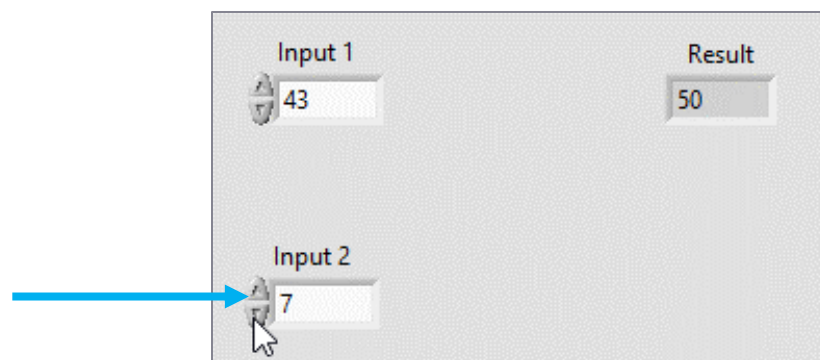
9.2.2. Enter values for Front Panel Inputs (Grey Screen)

9.2.2.1. Hover cursor over Input 1 Control and click when it becomes a 'Text' icon

9.2.2.2. Enter any numeric value then click off of Input 1 (this confirms the value)

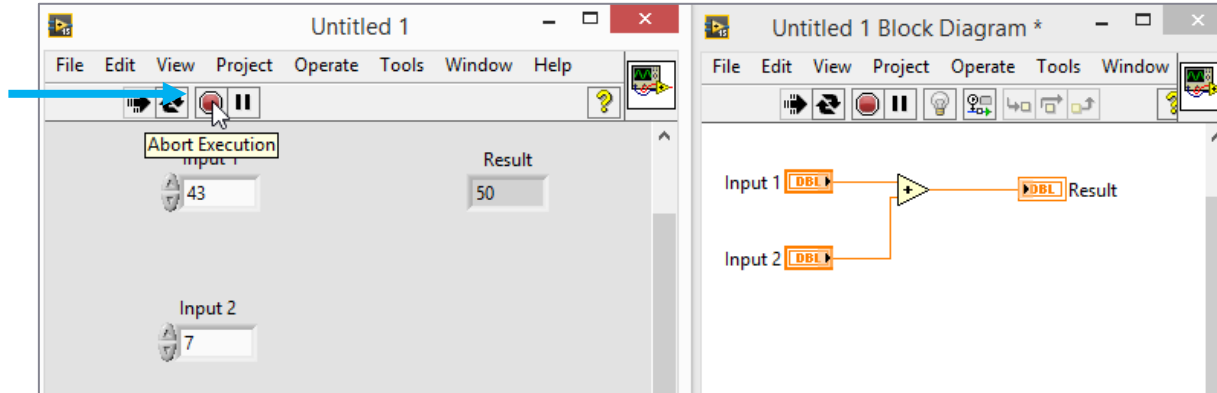


9.2.3. Press Increment/Decrement buttons on side of Input 2 Control (This changes the value by increments/decrements of 1)



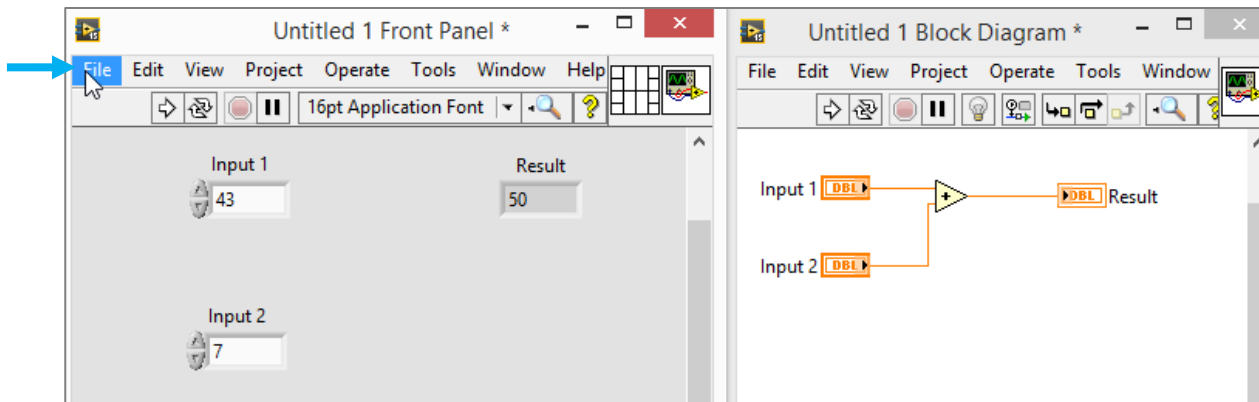
The 'Run Continuously' Function is rarely used and not recommended for any application. It is only being used here for training purposes.

9.2.4. Click the 'Abort Execution' (Stop Sign) icon on either the Front Panel or Block Diagram to Stop the program.

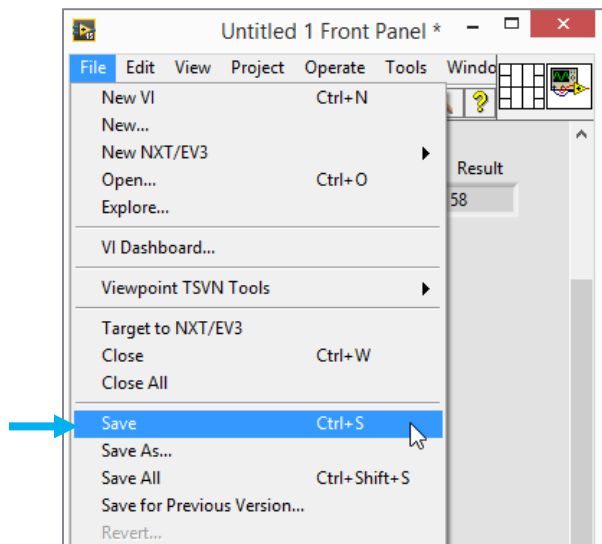


10. Save Program

10.1. Click on 'File' within the Menu Bar



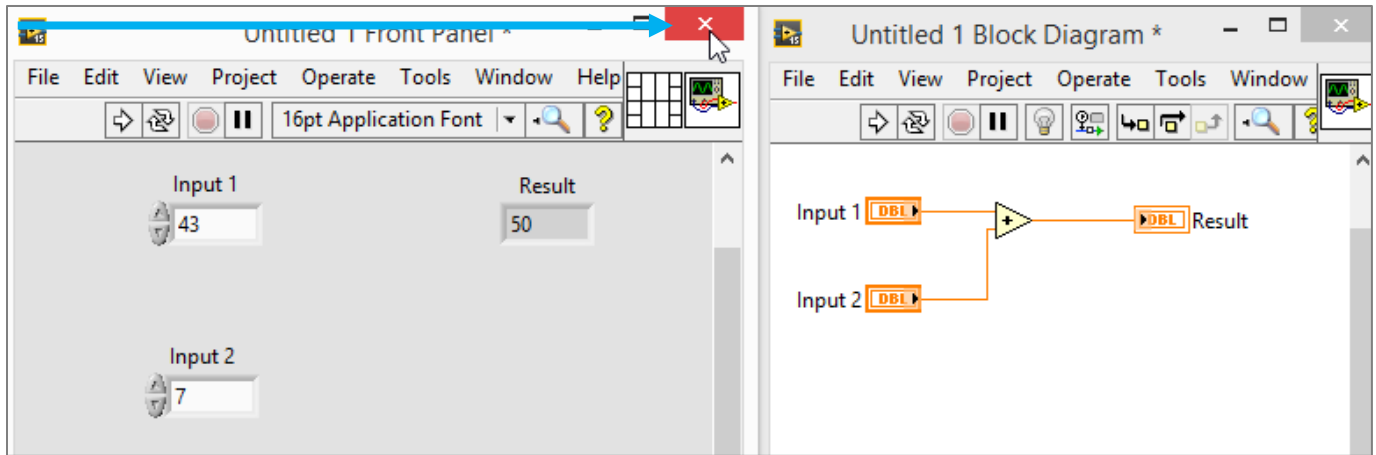
10.2. Click on 'Save' from the Dropdown List



10.3. Save File as 'Exercise 2.01' within the default directory

11. Close VI File(s)

11.1. Click on the red 'X' on the Front Panel Screen (this closes both the Front Panel & Block Diagram)



12. Exercise Complete