UiO : University of Oslo

FYS3240

PC-based instrumentation and microcontrollers

LabVIEW programming I

LabVIEW basics

Spring 2013 – Lecture #2

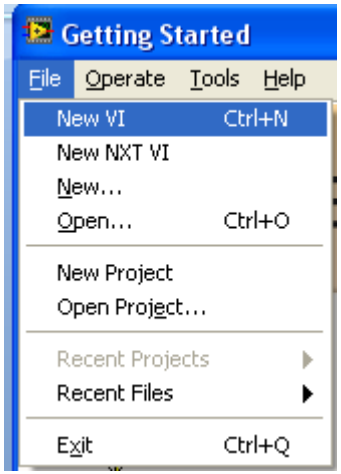
Bekkeng 8.1.2013

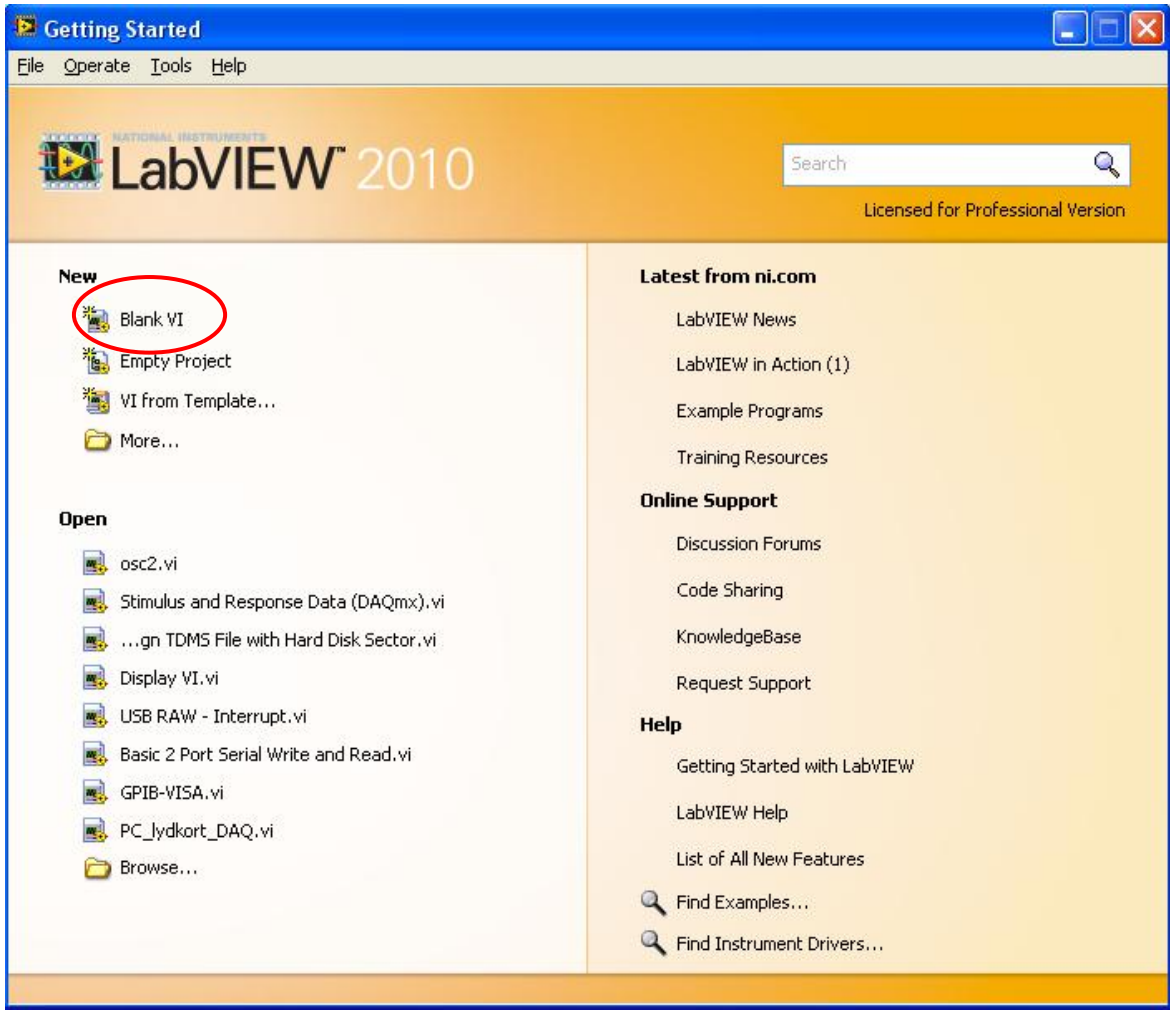
Virtual Instruments

- LabVIEW programs are called virtual instruments, or **VIs**, because their appearance and operation imitate physical instruments, such as oscilloscopes and multimeters.
  - A LabVIEW program has the file ending *.vi, e.g. **test.vi**
- LabVIEW contains a comprehensive set of tools for acquiring, analyzing, displaying, and storing data, as well as tools to help you troubleshoot code you write.
- In LabVIEW a VI is:
  - A LabVIEW program when it is the top-file
  - A SubVI when a VI is used in another VI
    - A SubVI is similar to a function in other programming languages

LabVIEW – Start up

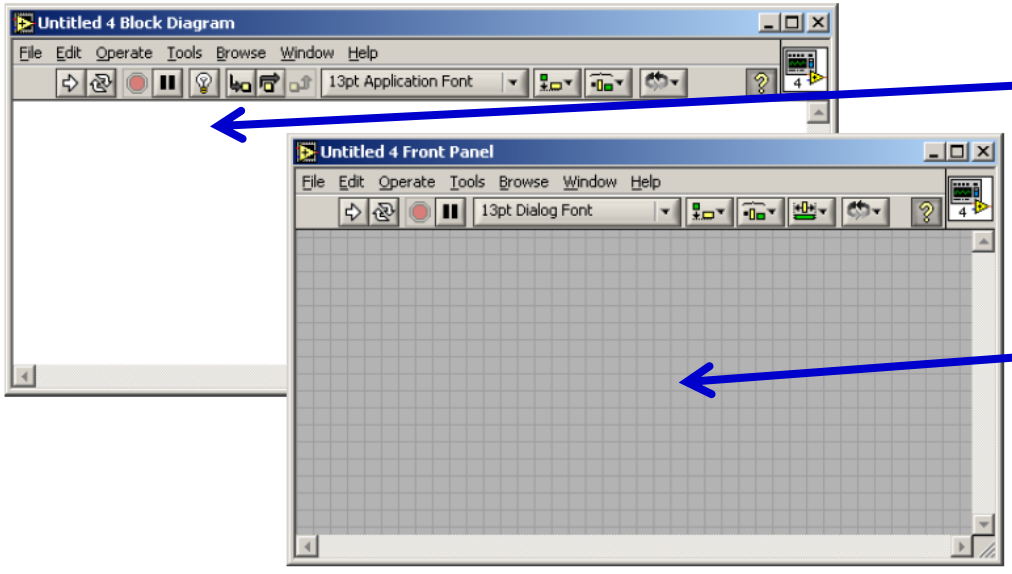
- Click **Blank VI**
- or select **File – New VI**





LabVIEW – Blank VI (Untitled)

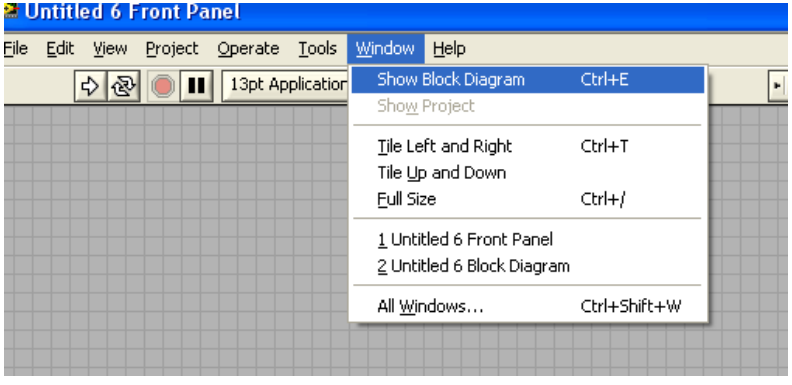
Two windows appear – '**Block Diagram**' & '**Front Panel**'



The block diagram contains the graphical source code

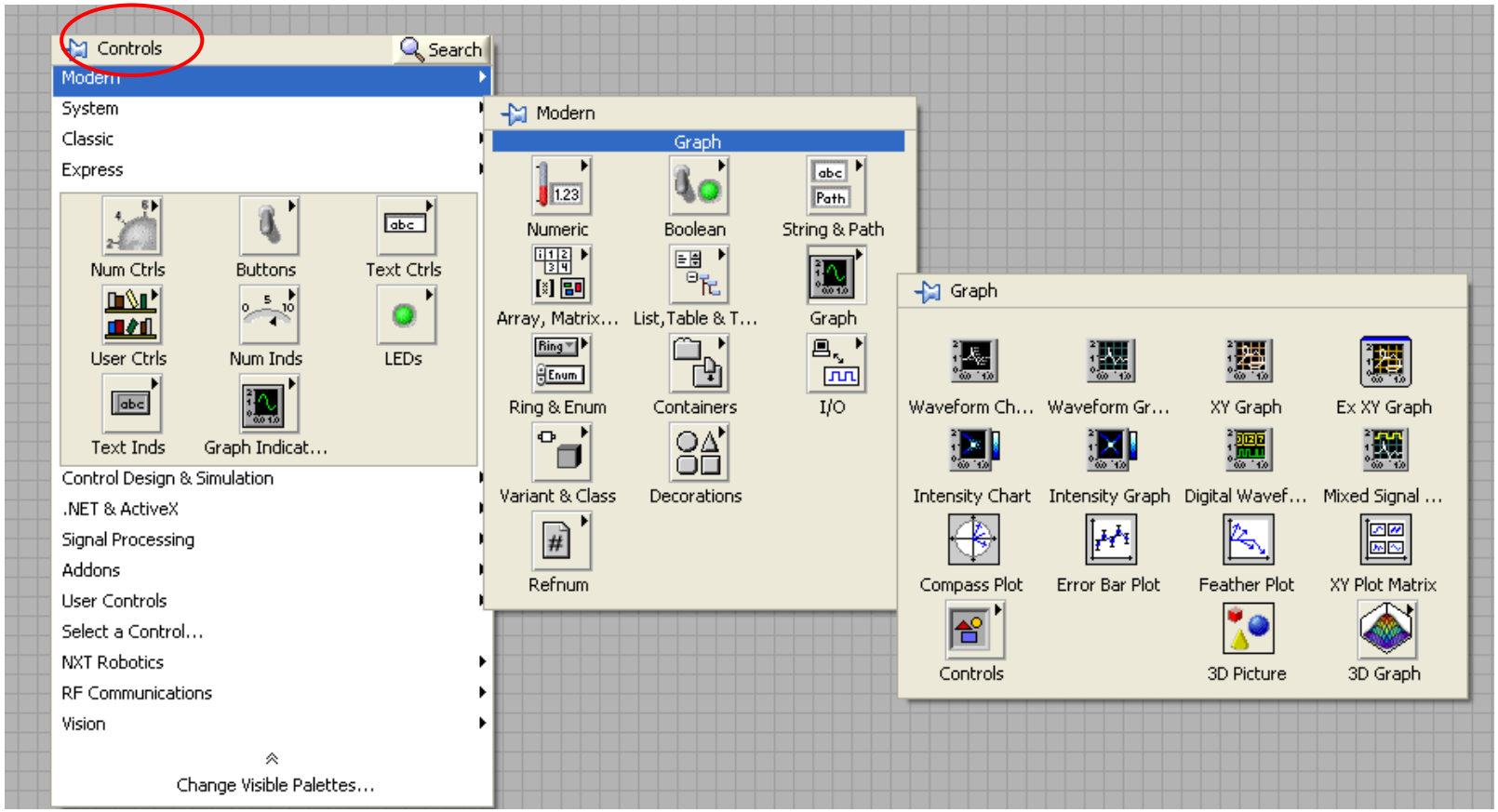
The front panel is the **user interface (GUI)** of a VI. You build the front panel by using controls and indicators

Select window to show:



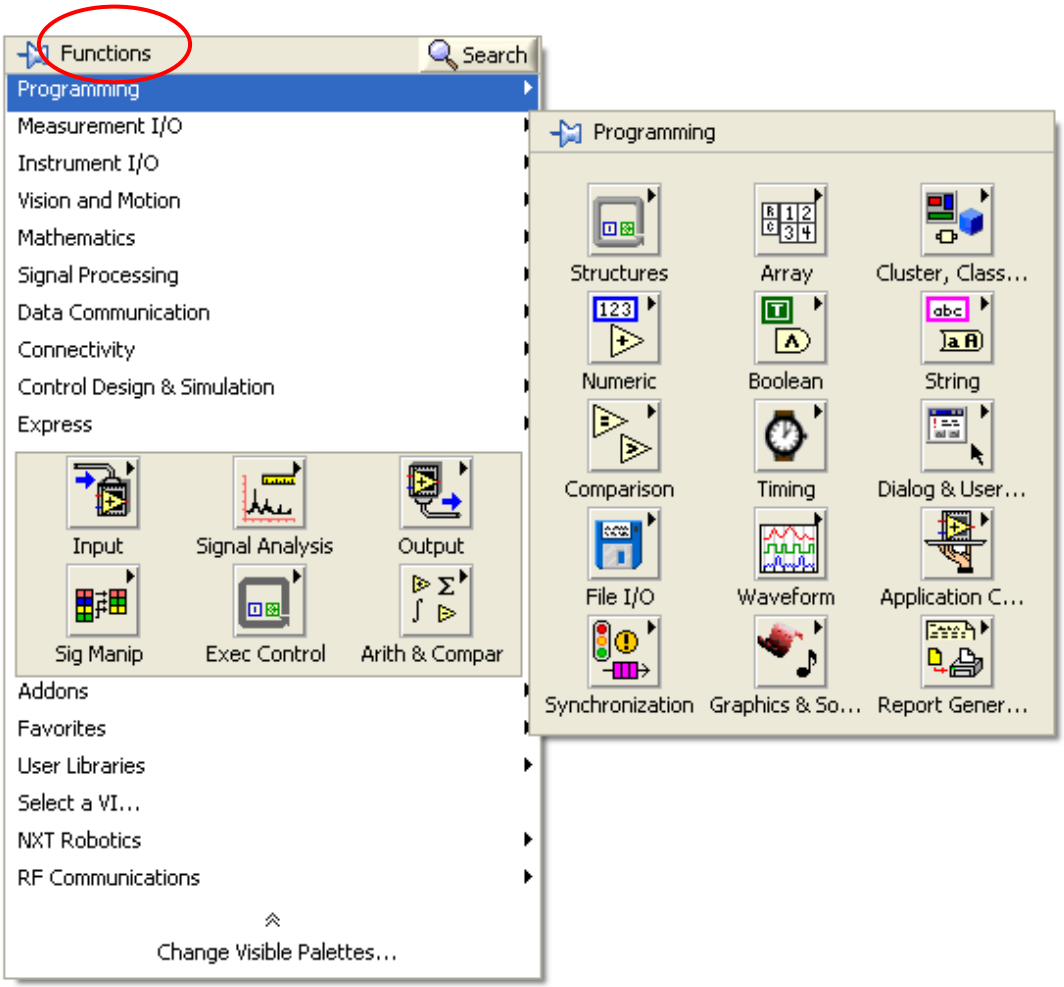
LabVIEW – Front Panel (the GUI)

Right mouse click to open important '**Controls**' palette:



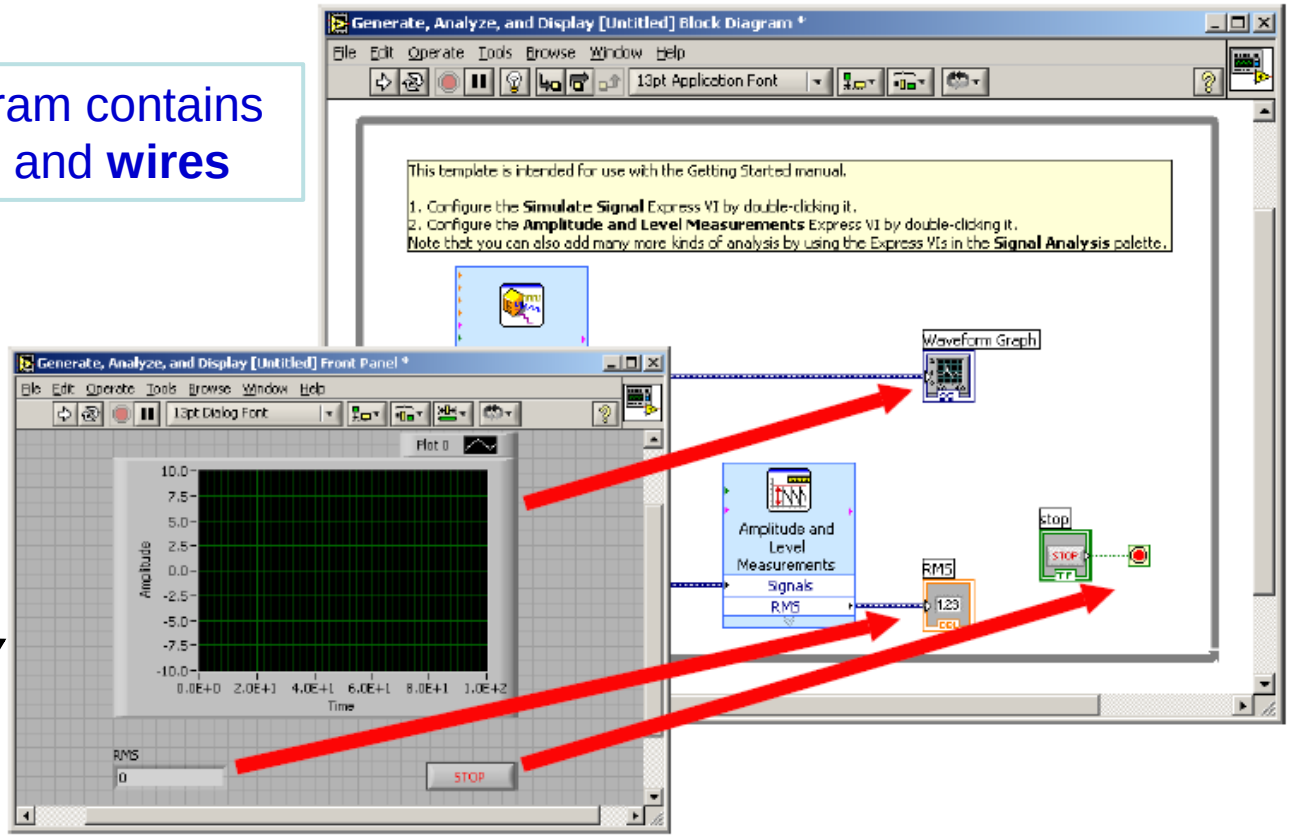
LabVIEW– Block Diagram

Right mouse click to open '**Functions**' palette:



Relationship between Block Diagram and Front Panel

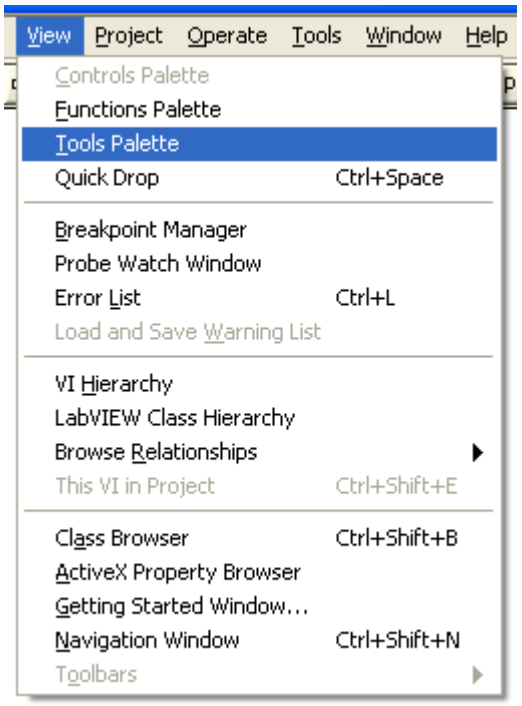
The block diagram contains **Icons** (objects) and **wires**

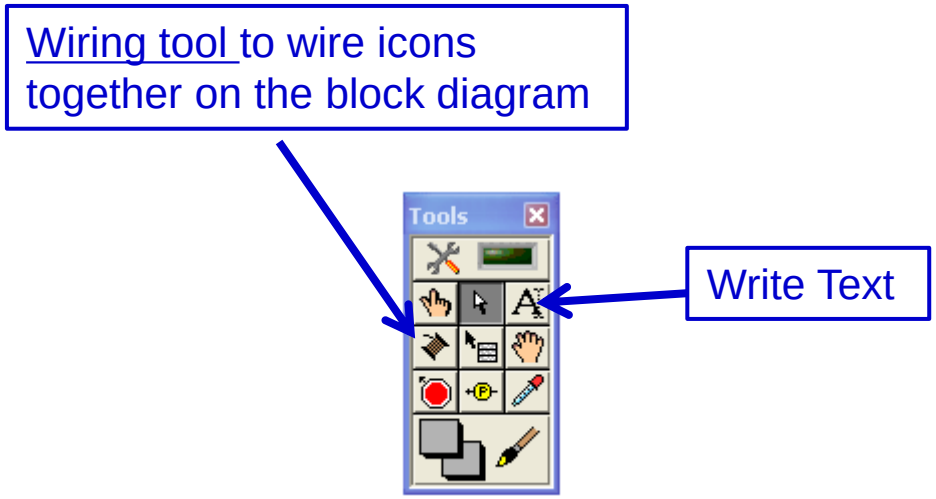


GUI (Front Panel)

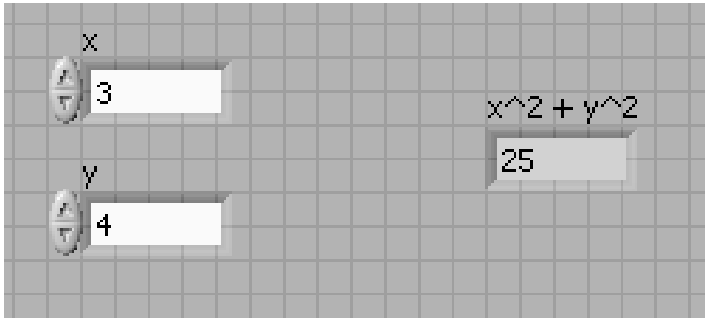
Tools palette

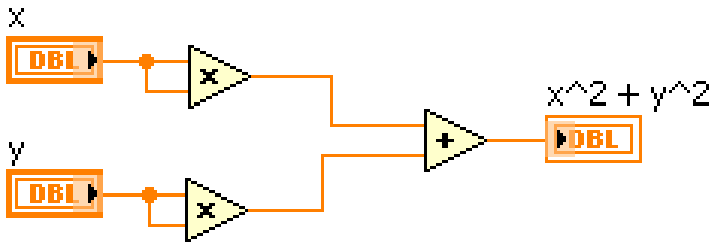
- Used on Block Diagram & Front Panel





Standard LabVIEW VIs - Example





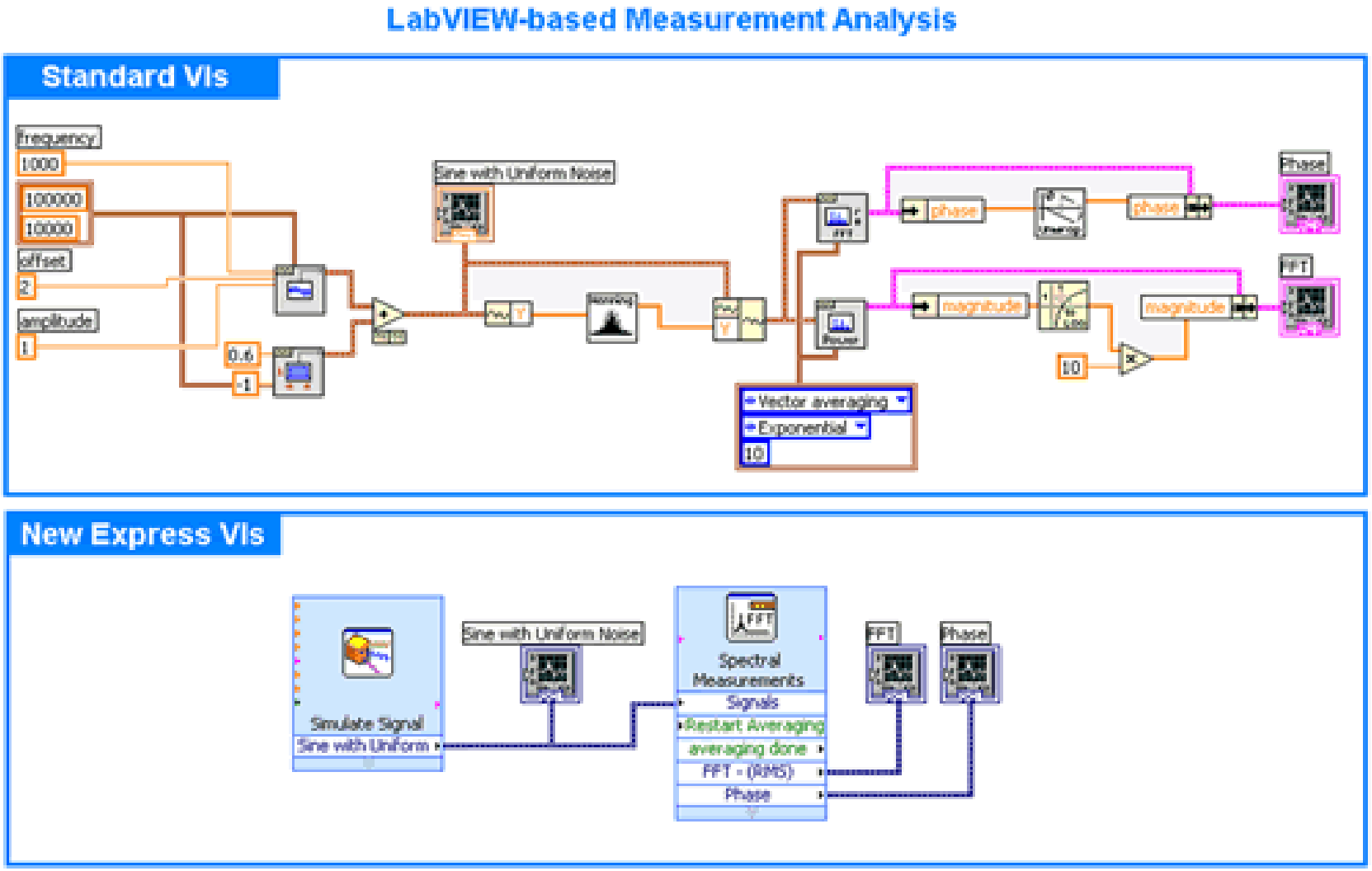
LabVIEW demo

Express VI

LabVIEW Express VIs

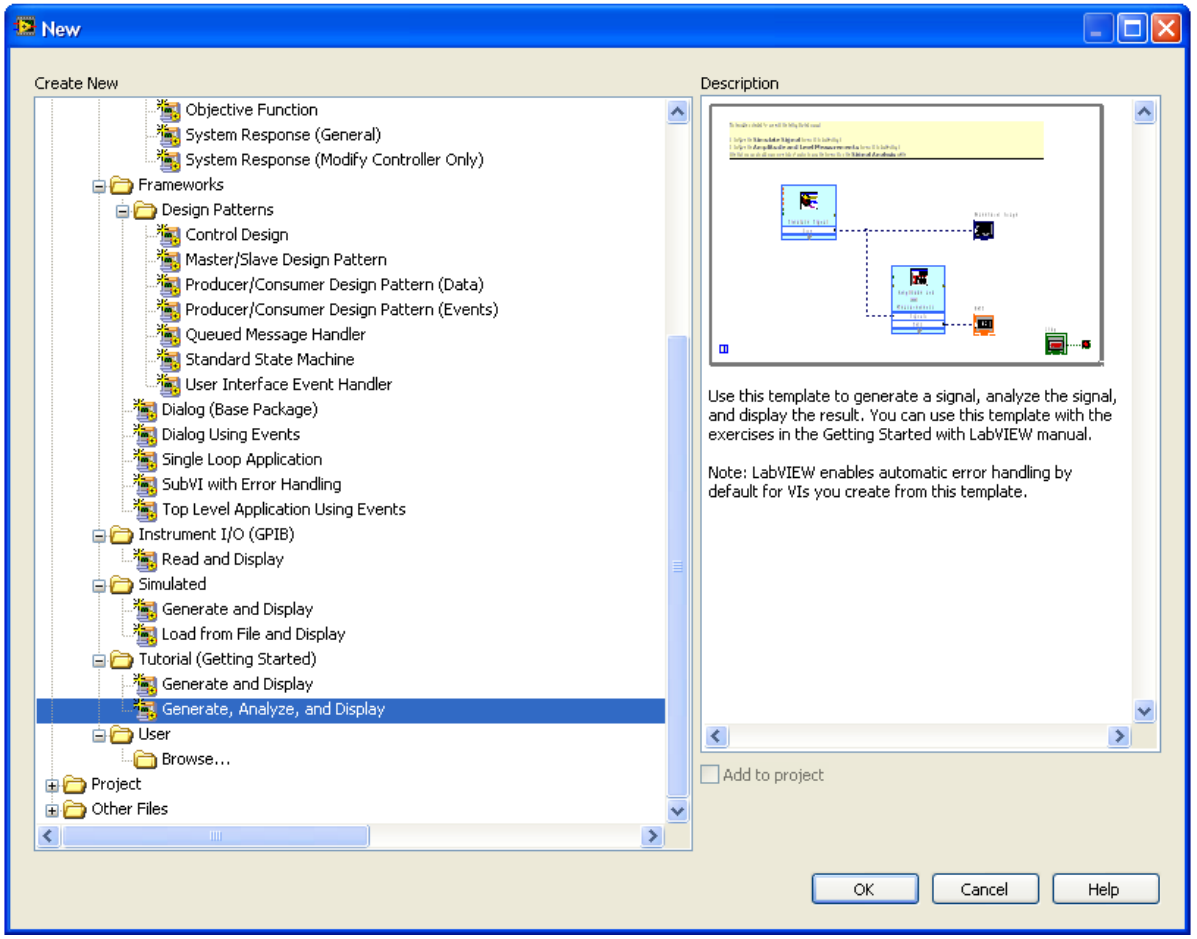
- LabVIEW includes **configuration-based** Express VIs
- With Express VIs for e.g. signal processing you can interactively explore the various analysis algorithms, while immediately seeing the results on the configuration dialog.
- **The complexity associated with adding analysis and signal processing algorithms into your measurement and automation applications is significantly reduced by using Express VIs.**
- You configure them with dialog boxes (instead of programming)
- The Express VIs encompass the most common functions
- **However, there is some overhead involved when choosing to use ExpressVIs instead of using lower level VIs**
  - The Express VIs can degrade performance (speed). Specially the "Write to Measurement File" Express VI should not be used for high speed data streaming in DAQ applications

Standard VIs vs. Express VIs



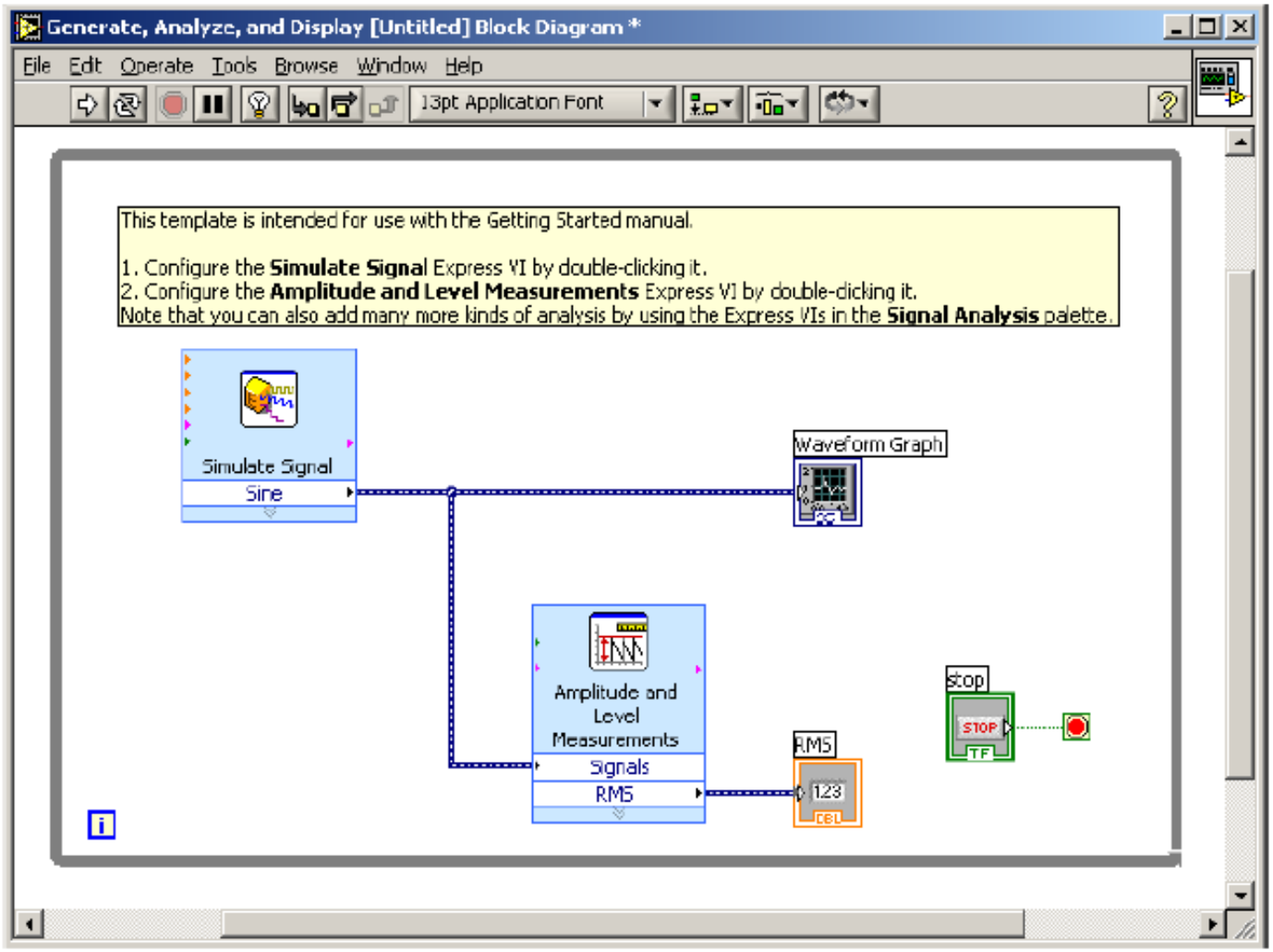
Example with Express VIs

Tutorial Name: 'Generate, Analyze, and Display'
(from **File – New**)



Example with Express VIs II

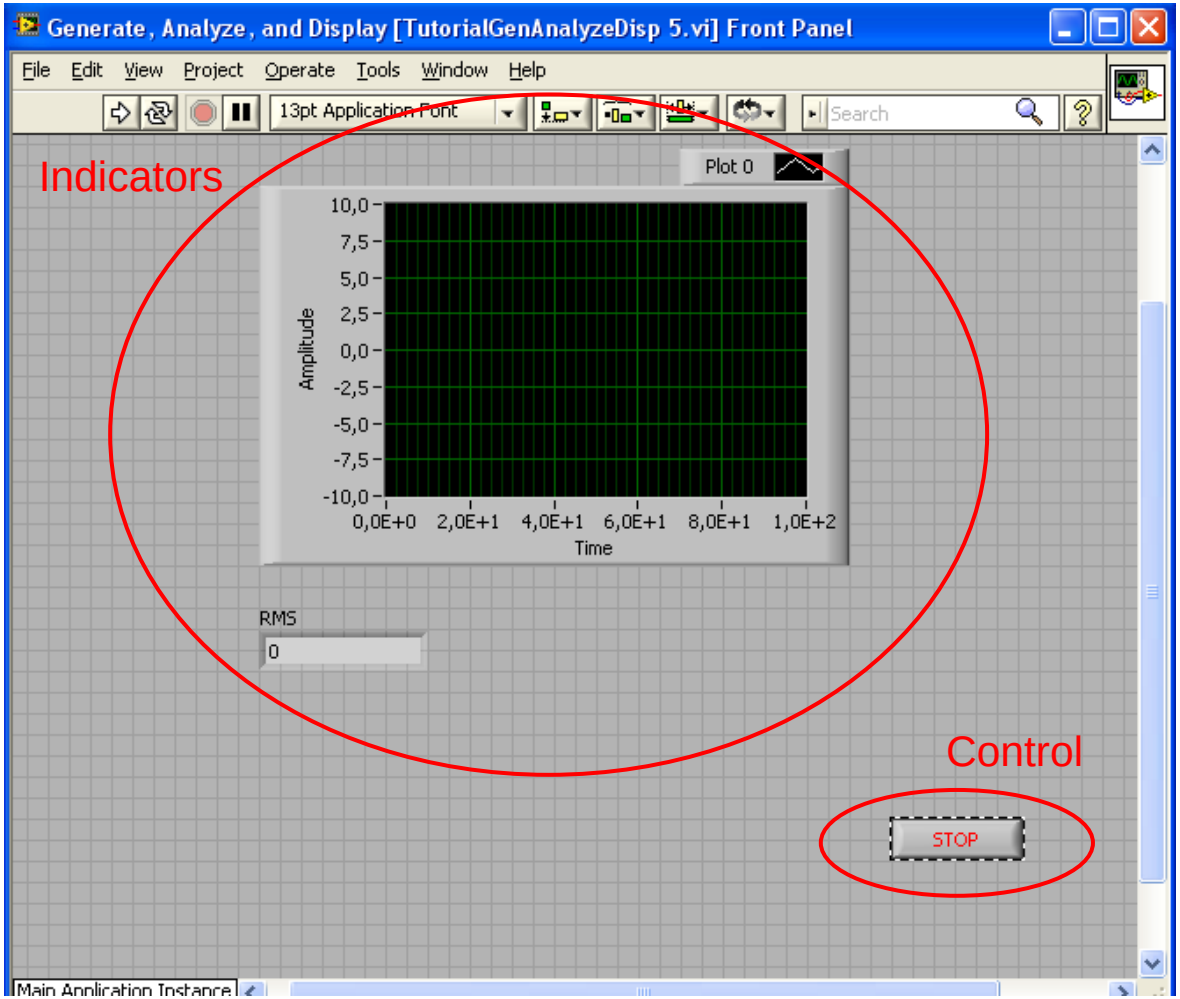
Block Diagram:



LabVIEW demo

Example with Express VIs III

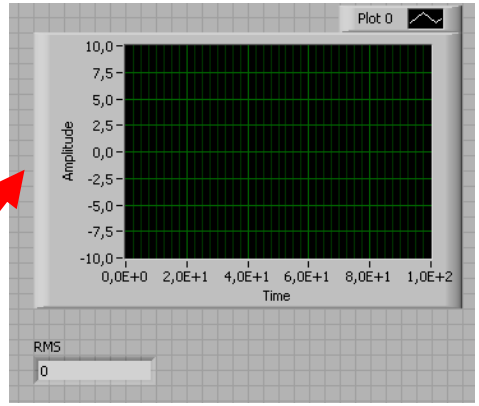
Front Panel:



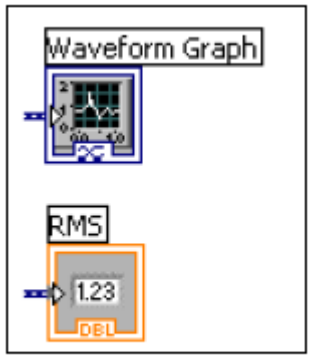
LabVIEW - Indicators

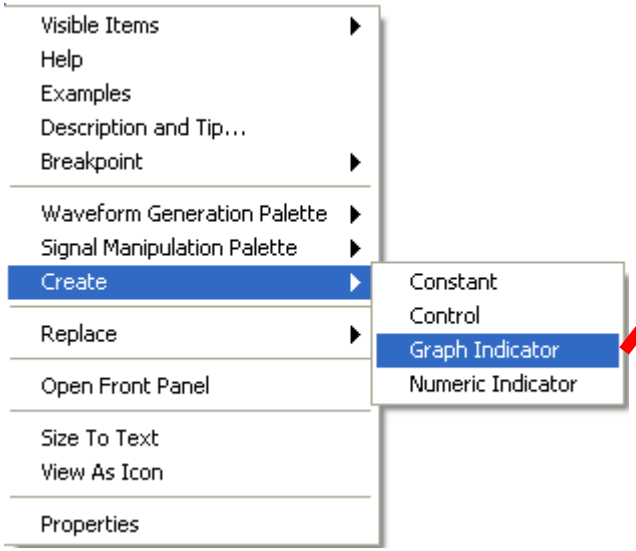
- Select the wiring tool 
- Right-click the VIs I/O connections

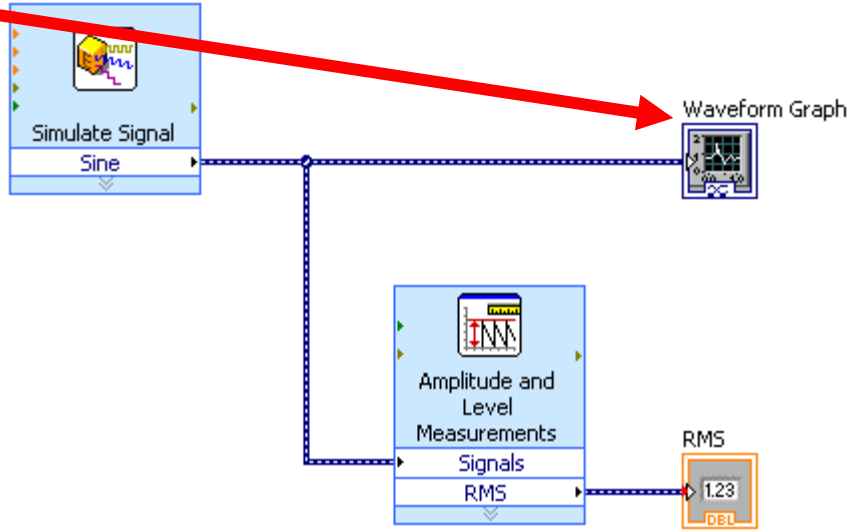
Front Panel



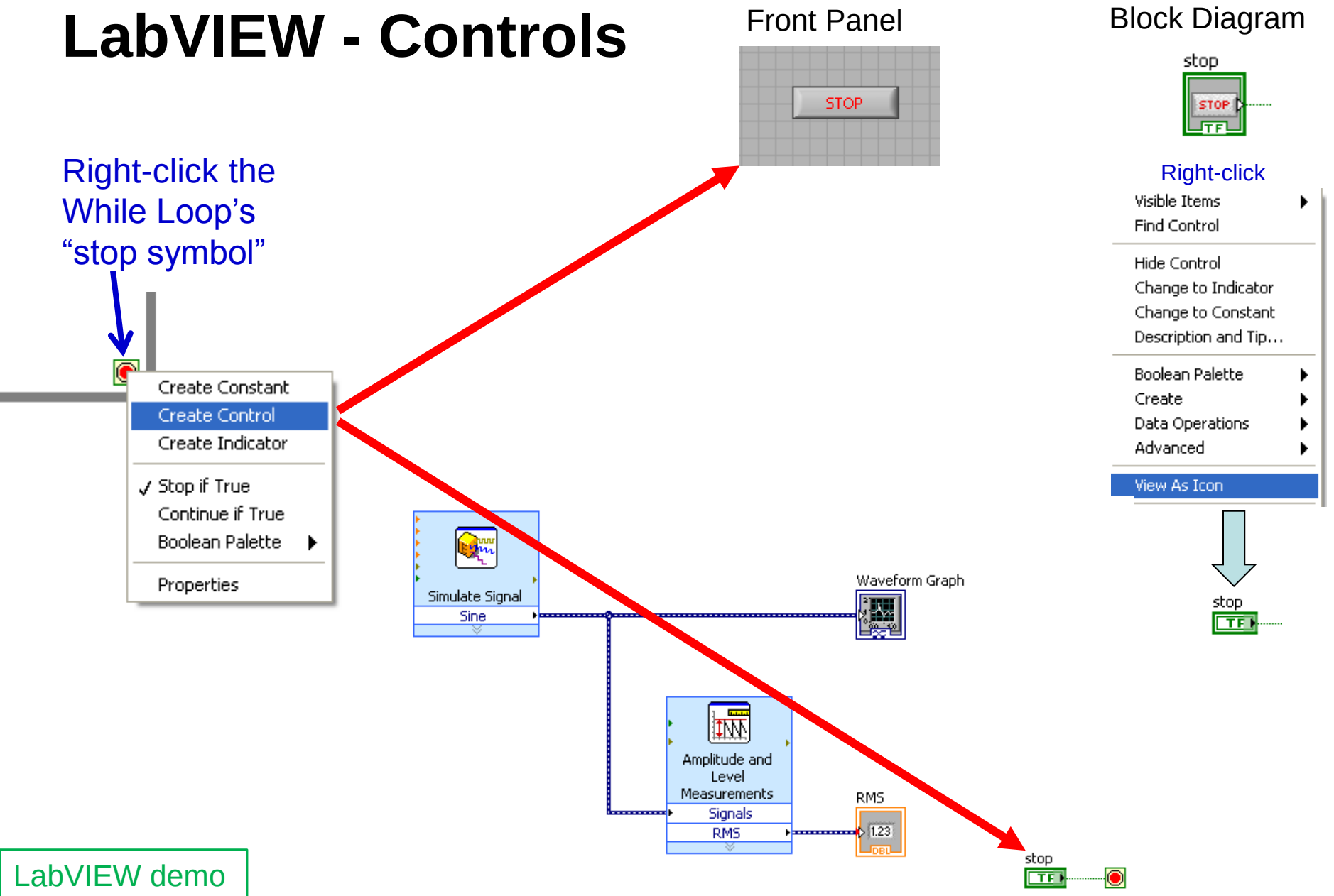
Block Diagram







LabVIEW - Controls



LabVIEW demo

LabVIEW Data Types

- Color coding of terminals and block diagram wires

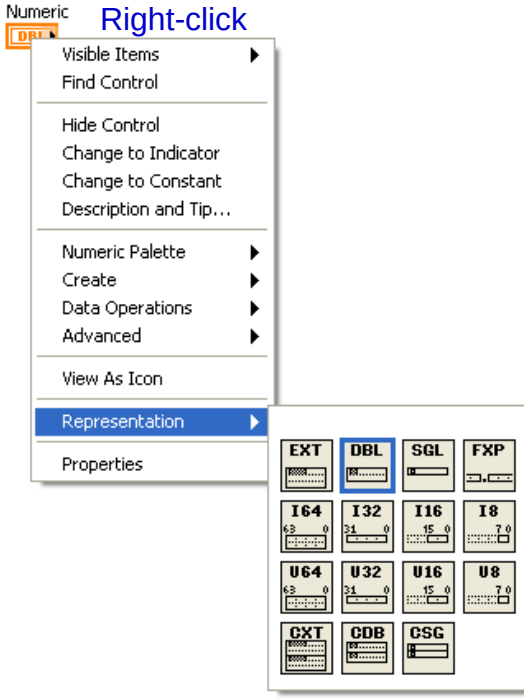
Floating-point numbers

Integer

String

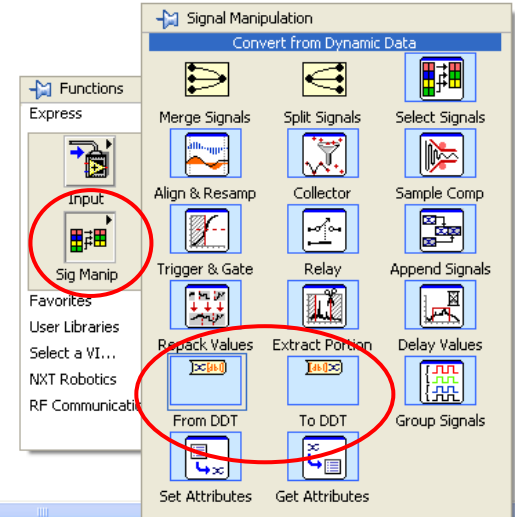

Dynamic

Boolean



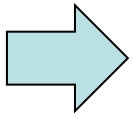
The **dynamic data type** is a special type for use with Express VIs. Because **dynamic data undergoes an automatic conversion** to match the indicator to which it is wired, Express VIs can slow down the block diagram execution speed

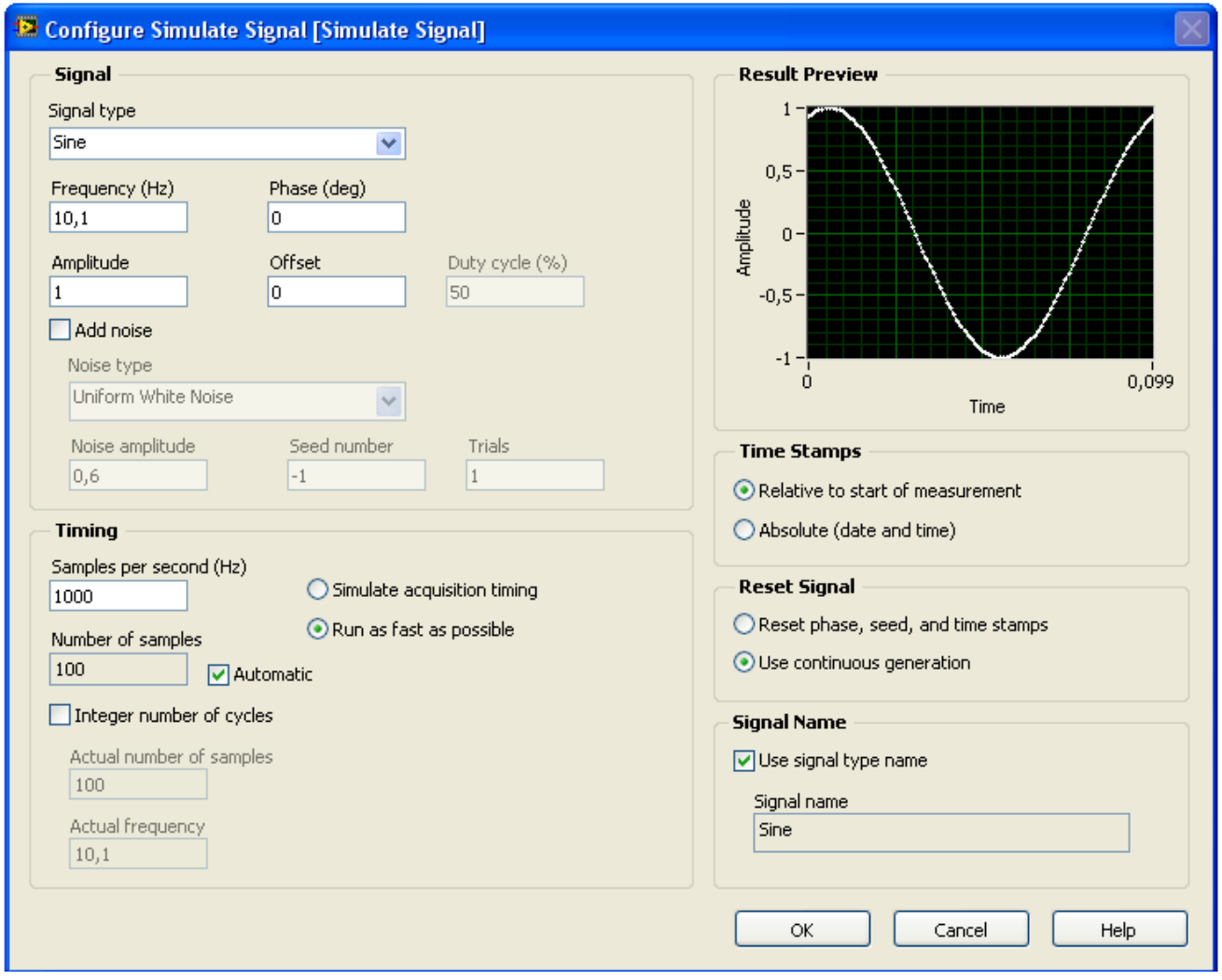
Use the Convert from/to Dynamic Data Express VI to convert dynamic data to/from numeric, Boolean, waveform, and array data for use with other VIs and functions



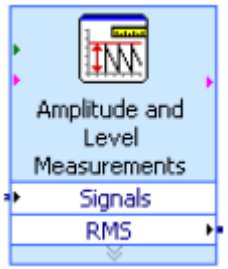
LabVIEW Express VI – Simulate Signal

Double-click for properties

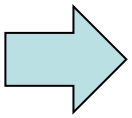


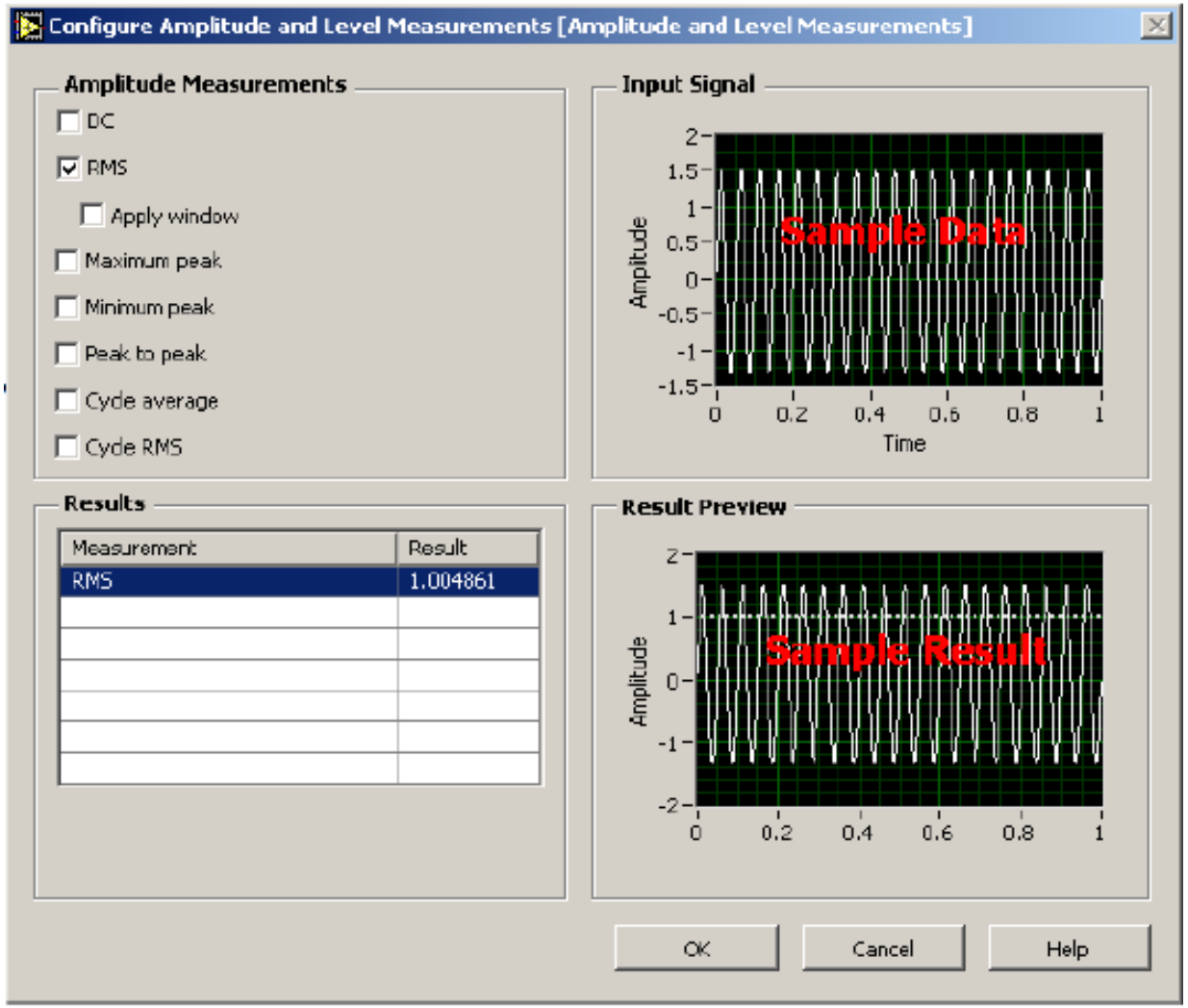


LabVIEW Express VI – Amplitude and Level Measurements

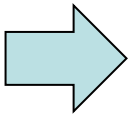


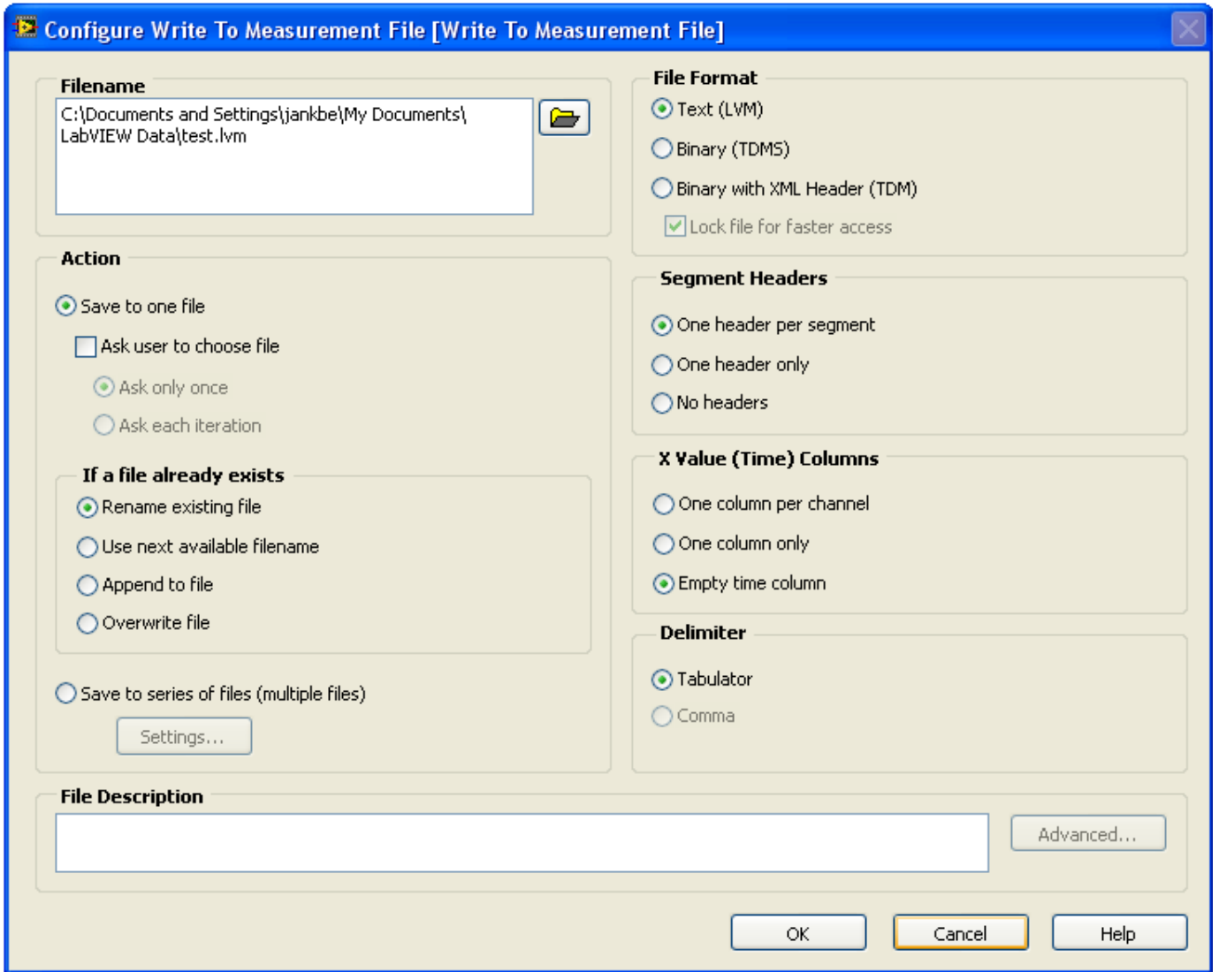
Double-click for properties



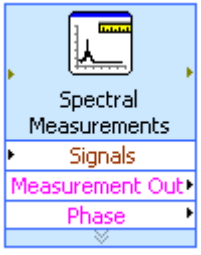


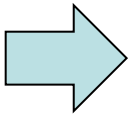
LabVIEW Express VI – Write to File

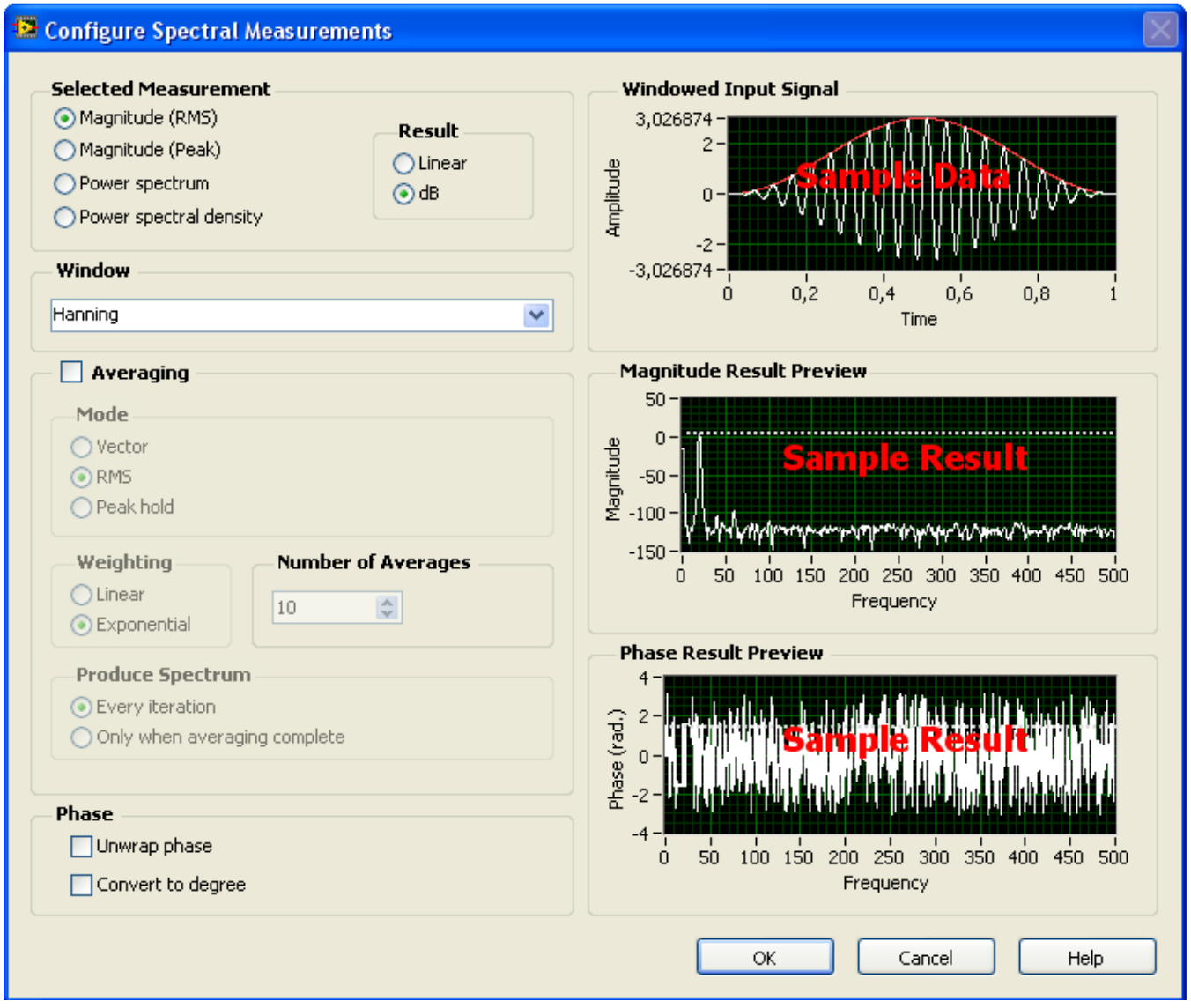




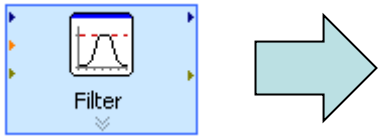
LabVIEW – FFT Express VI

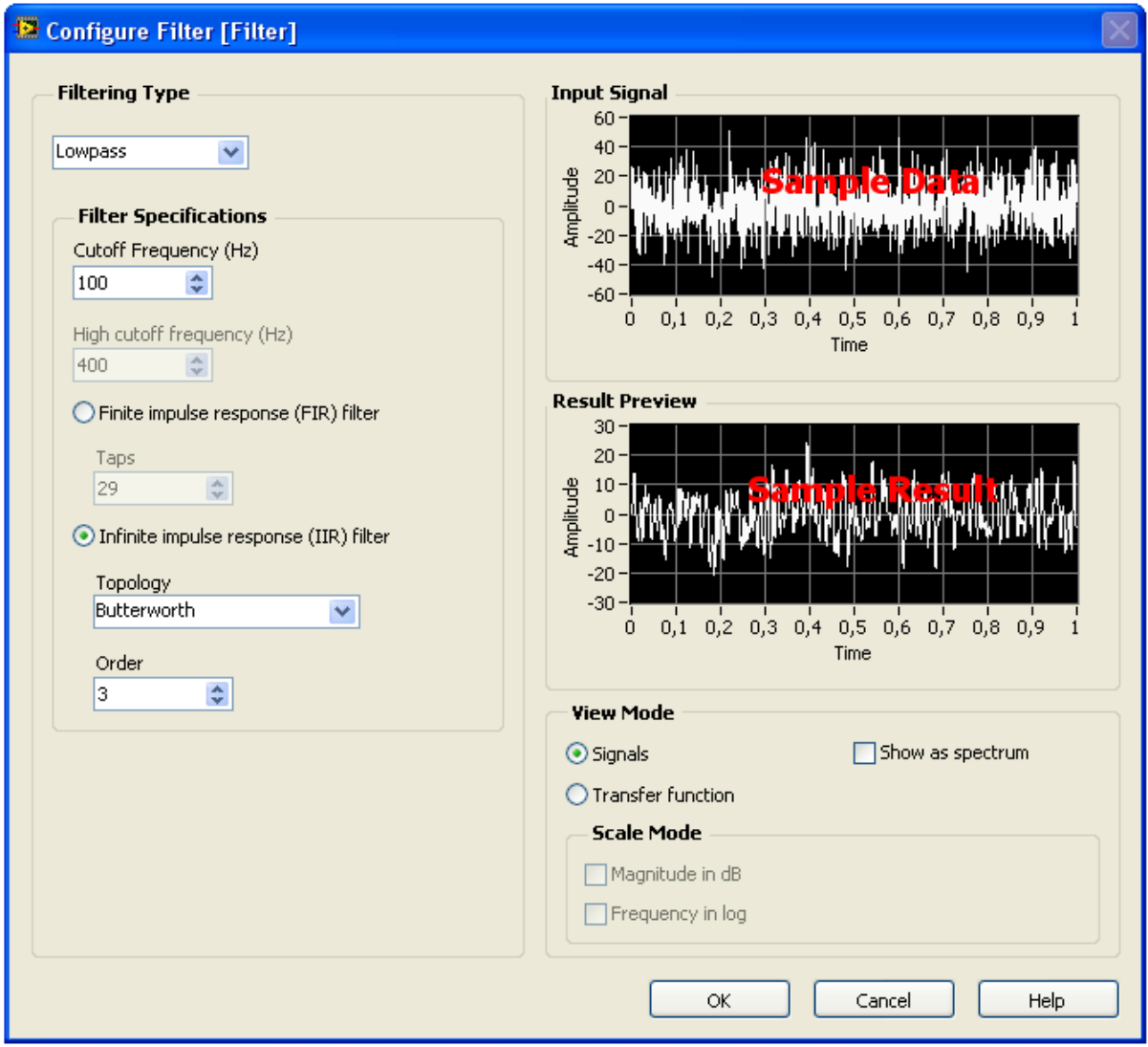






LabVIEW – Digital Filter Express VI

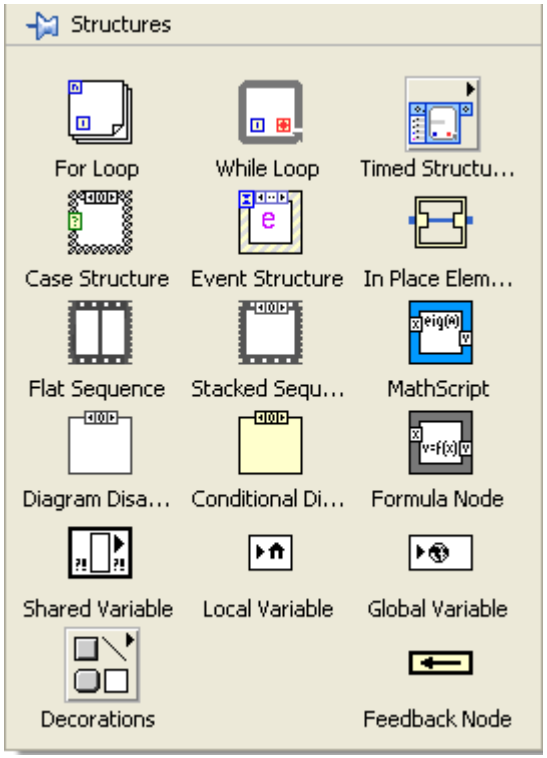




LabVIEW demo
- Signal generation, filtering, FFT, and Write to file

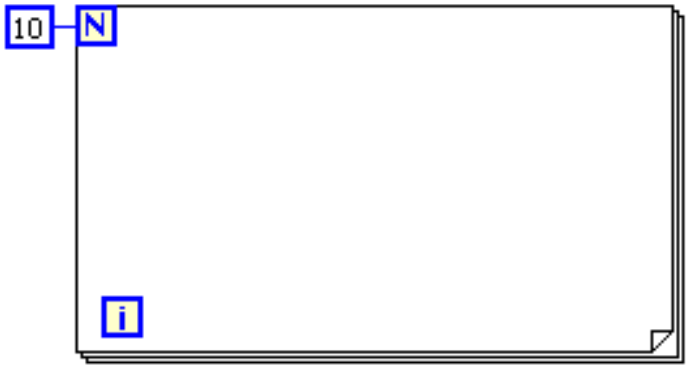
Loops

Functions – Programming – Structures:



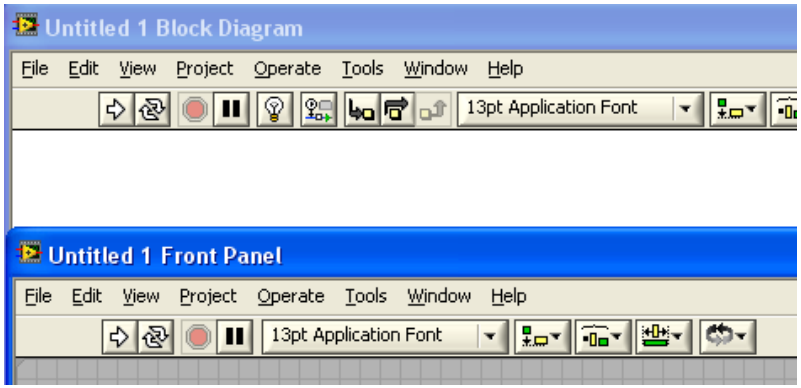
While Loop:

For Loop:



Note: Unless in emergency situations, never use the 'abort button'. Always program in a 'stop button'.

Program Start, Abort execution and Error indication



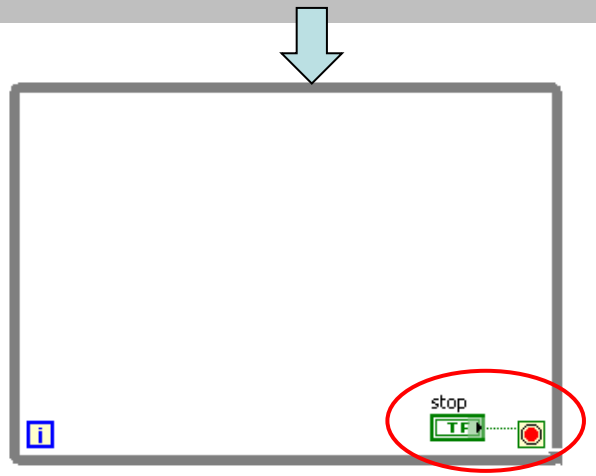
- Aborting a VI that uses external resources, such as external hardware, might leave the resources in an unknown state by not resetting or releasing them properly. Design the VIs you create with a **stop button** and use it to avoid this problem.

Start (RUN) program button

Program Running indicator

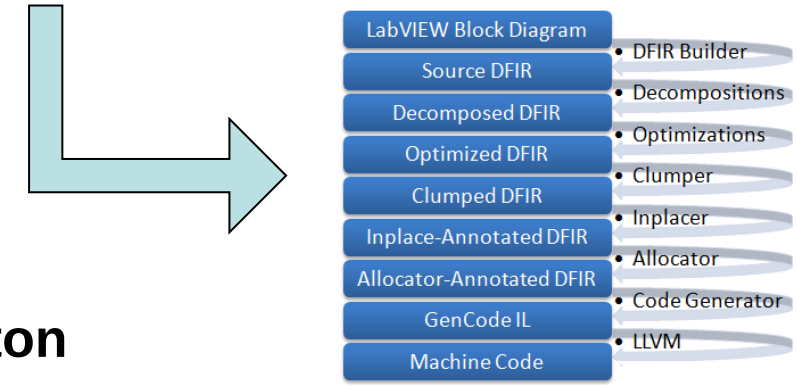
Broken arrow – error in program

Abort Execution button



How VIs are compiled

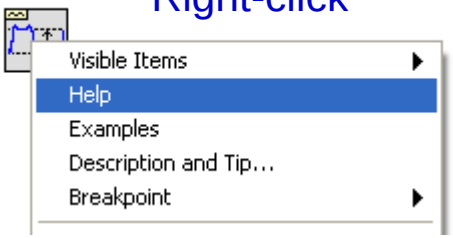
- When you push the Run button, LabVIEW (the G- compiler) translates the block diagram into clumps of **machine code** for your platform
- **LabVIEW will automatically compile your VI during load, run or save (if necessary).** In general, any change that is non cosmetic will set a flag indicating that the VI needs to be recompiled. When this flag is set the VI will automatically compile when you run or save.
- Beginning with LabVIEW 2009 and continuing in LabVIEW 2010 many optimizations were added to the LabVIEW compiler to speed up run-time performance of both VIs and executables

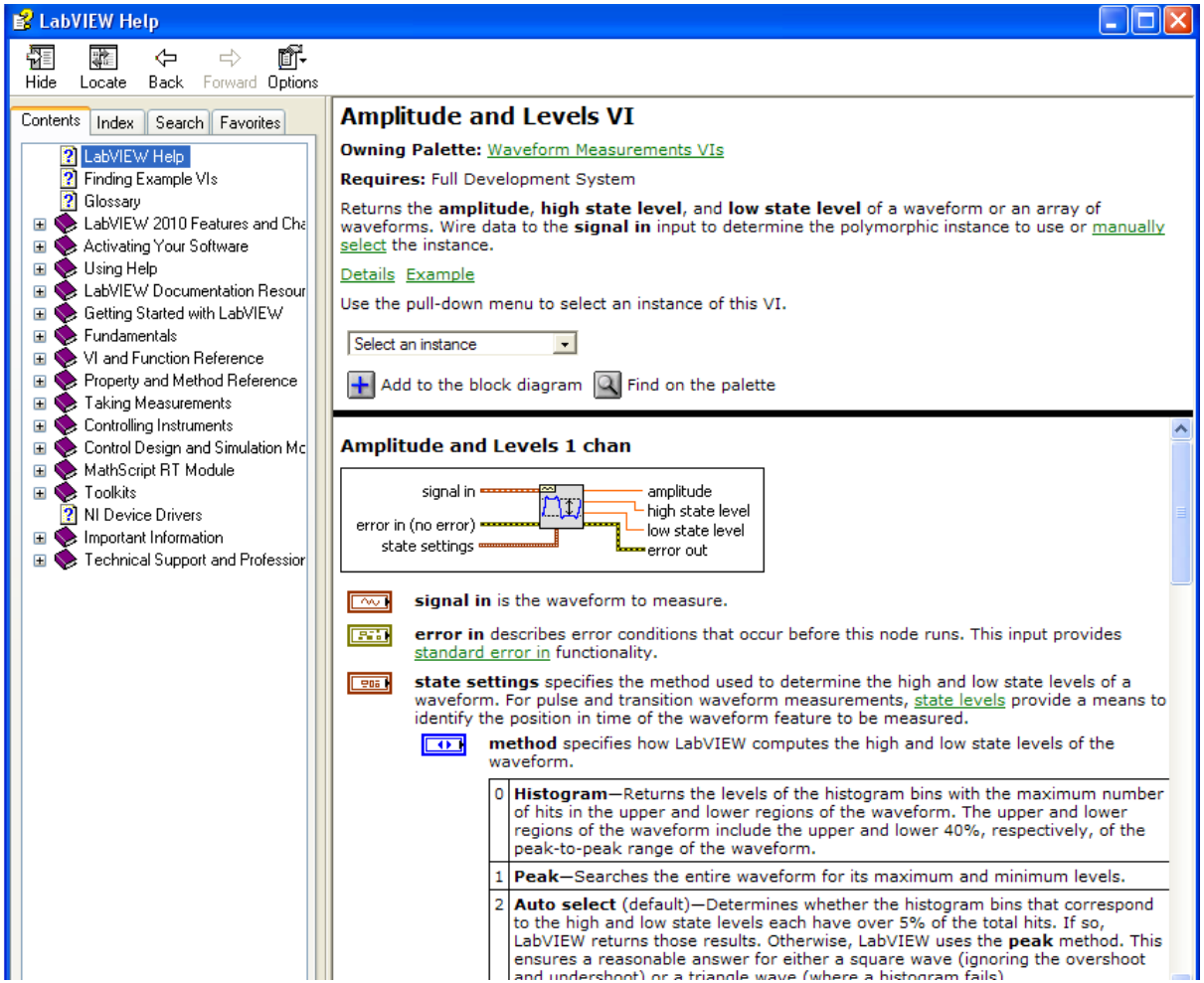


Start (RUN) program button

Standard LabVIEW VI – Help

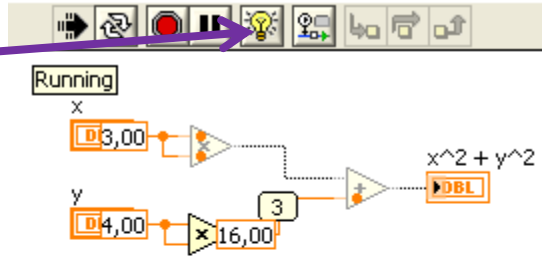
Right-click



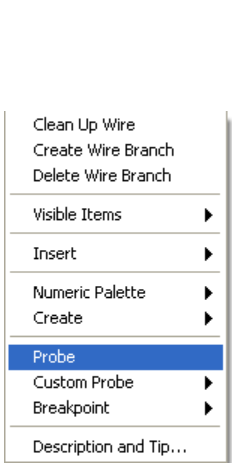


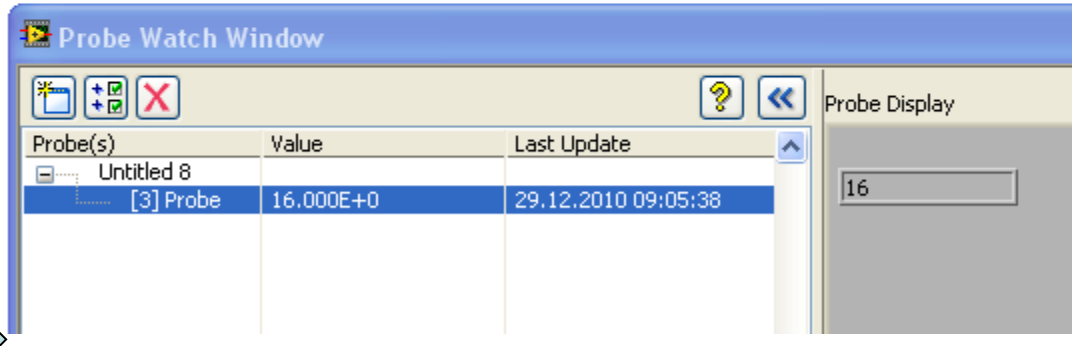
LabVIEW debugging techniques

- Execution highlighting



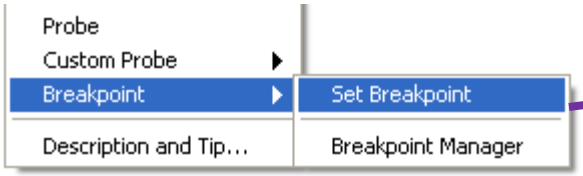
- Single-stepping
- Probe

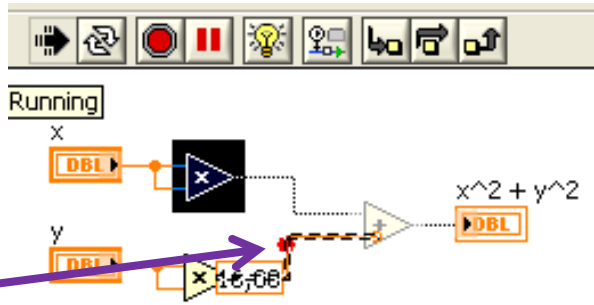




Right-click wire

- Breakpoints

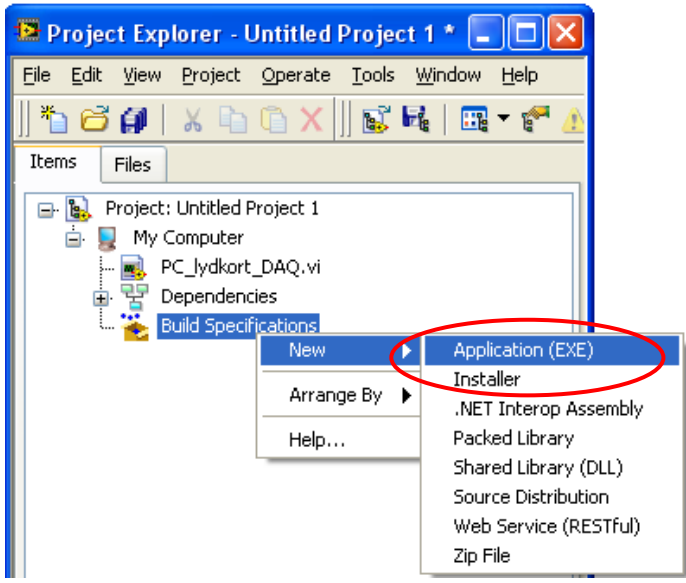




LabVIEW demo

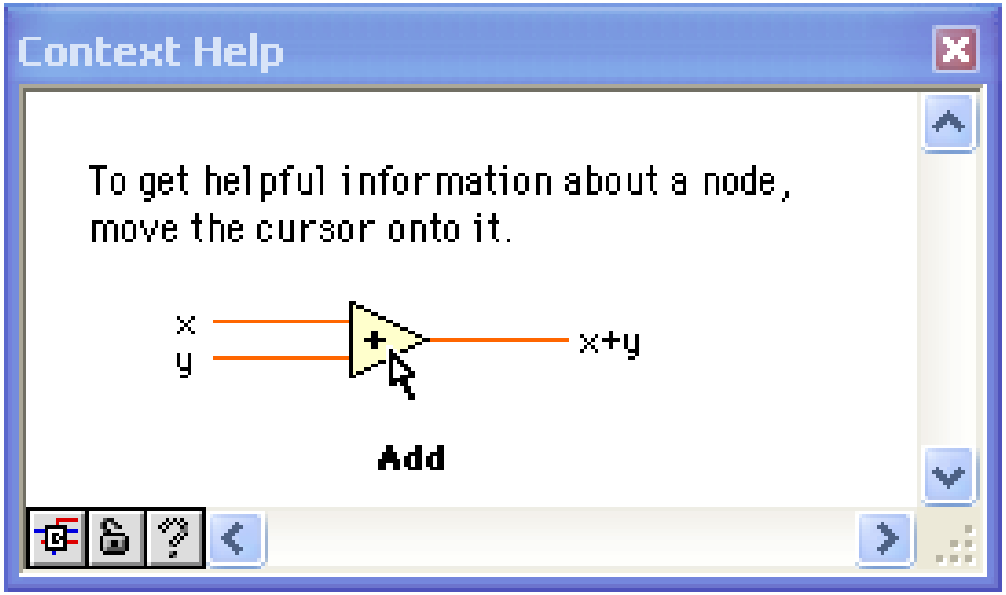
Projects in LabVIEW & Executables

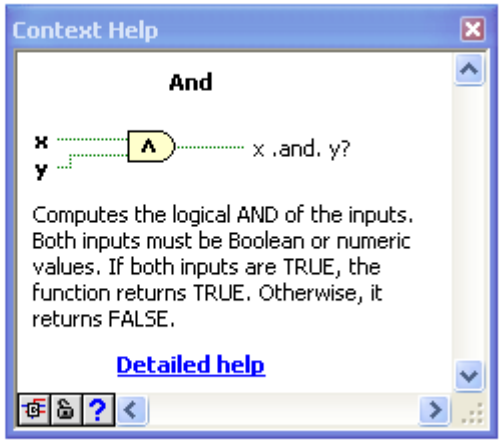
- Projects in LabVIEW consist of VIs, files necessary for those VIs to run properly, and supplemental files such as documentation or related links. Use the **Project Explorer** window to manage projects in LabVIEW
- **File – New Project**
- Adding files to the project:
  - Right-click “My Computer”, and select **Add – File ..**
- Create a stand-alone windows application (e.g. *.exe file)
  - You must have a project open and saved to configure a build specification.
  - The **LabVIEW Run-Time Engine** must be installed on any computer on which users run the application or shared library. You can distribute the LabVIEW Run-Time Engine with the application or shared library. You can also include the LabVIEW Run-Time Engine in an **installe**r



LabVIEW – Help I

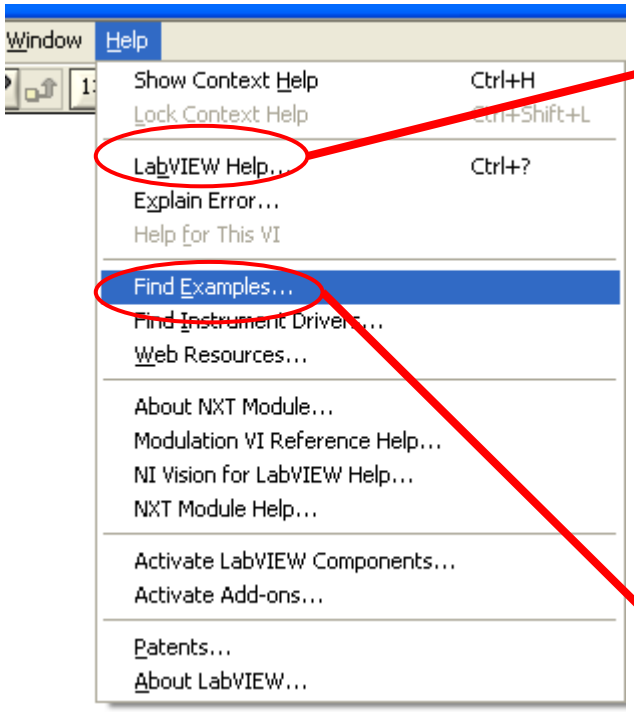
- Select **Help»Show Context Help** from the front panel or the block diagram
- Move the cursor over to the graphical symbol to see the help information
- Very useful when looking at functions in the '**Functions**' palette:

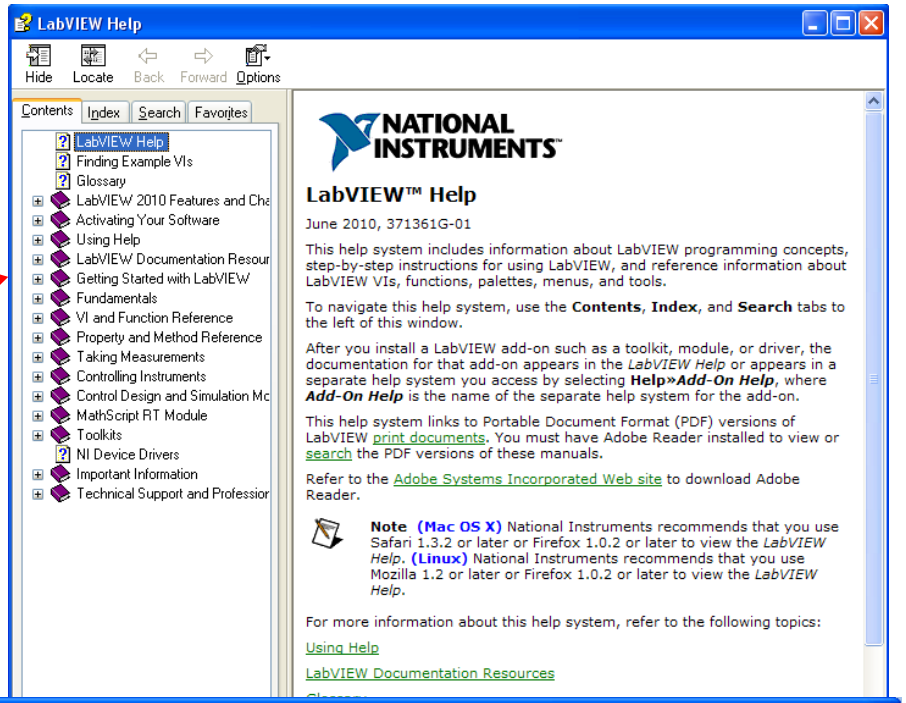


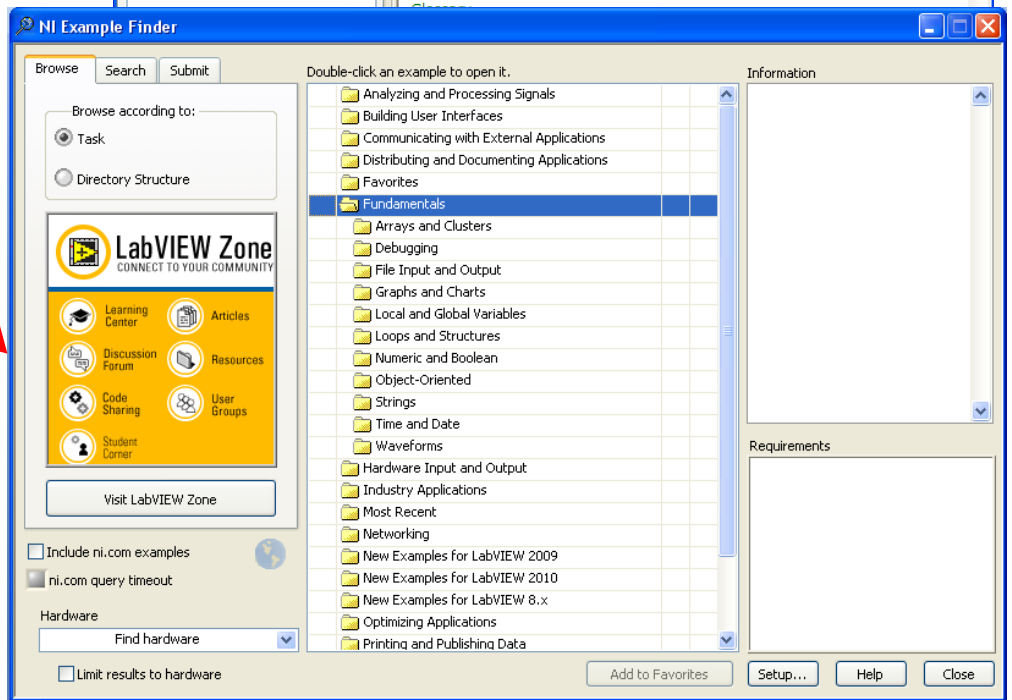


LabVIEW demo

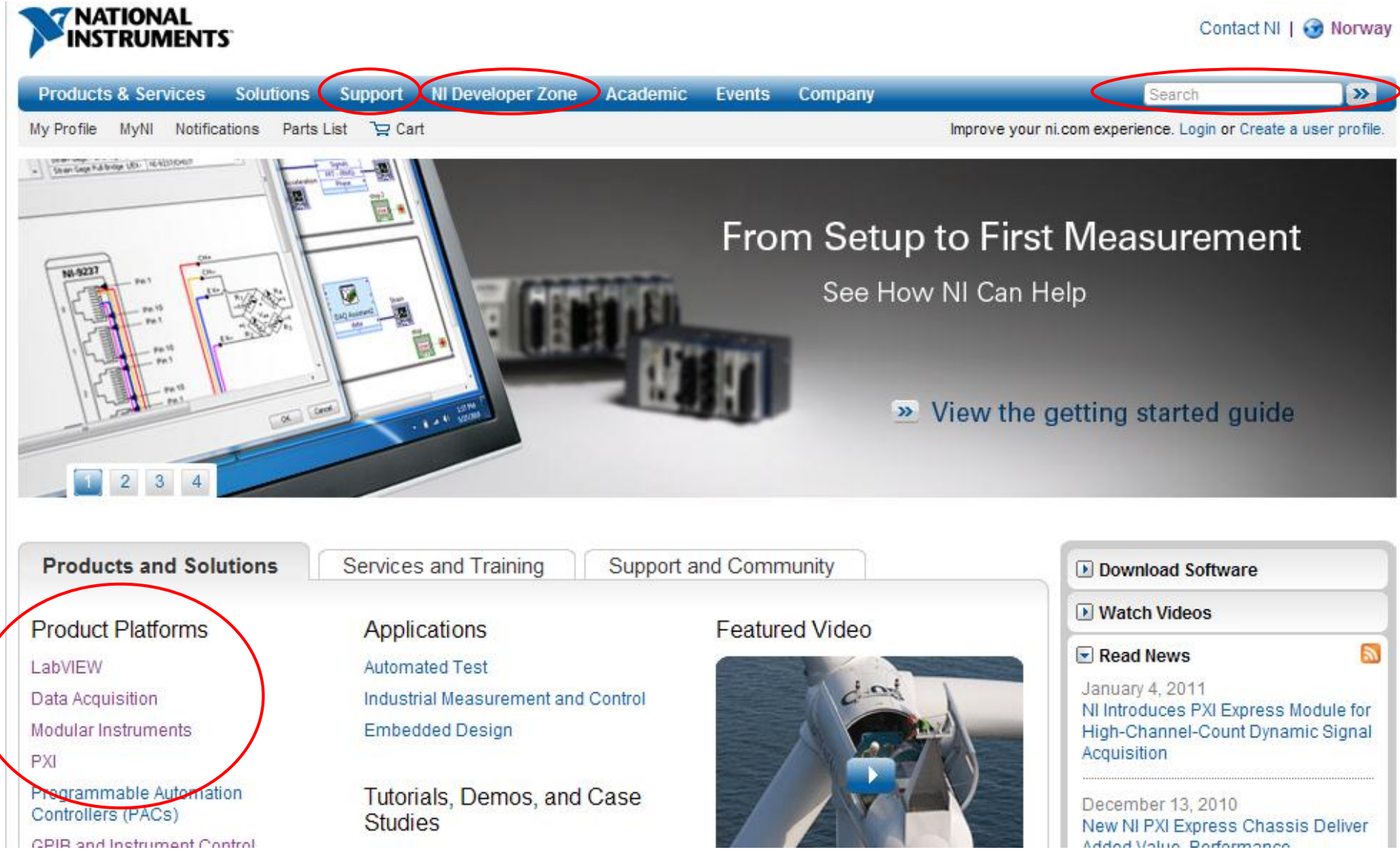
LabVIEW Help II





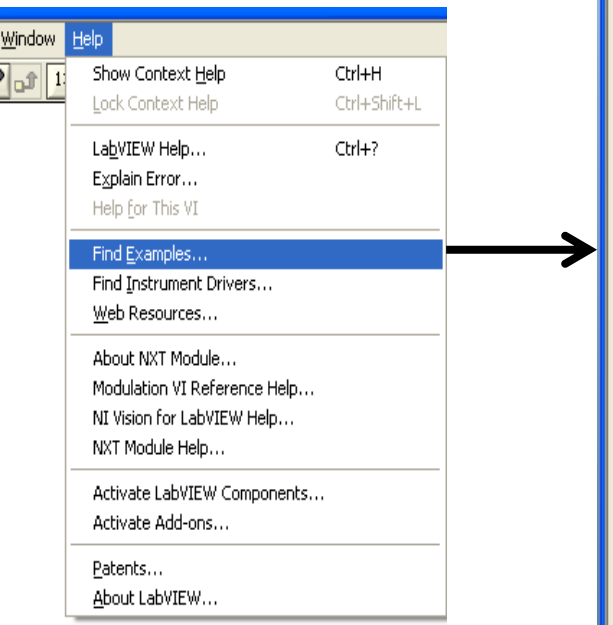


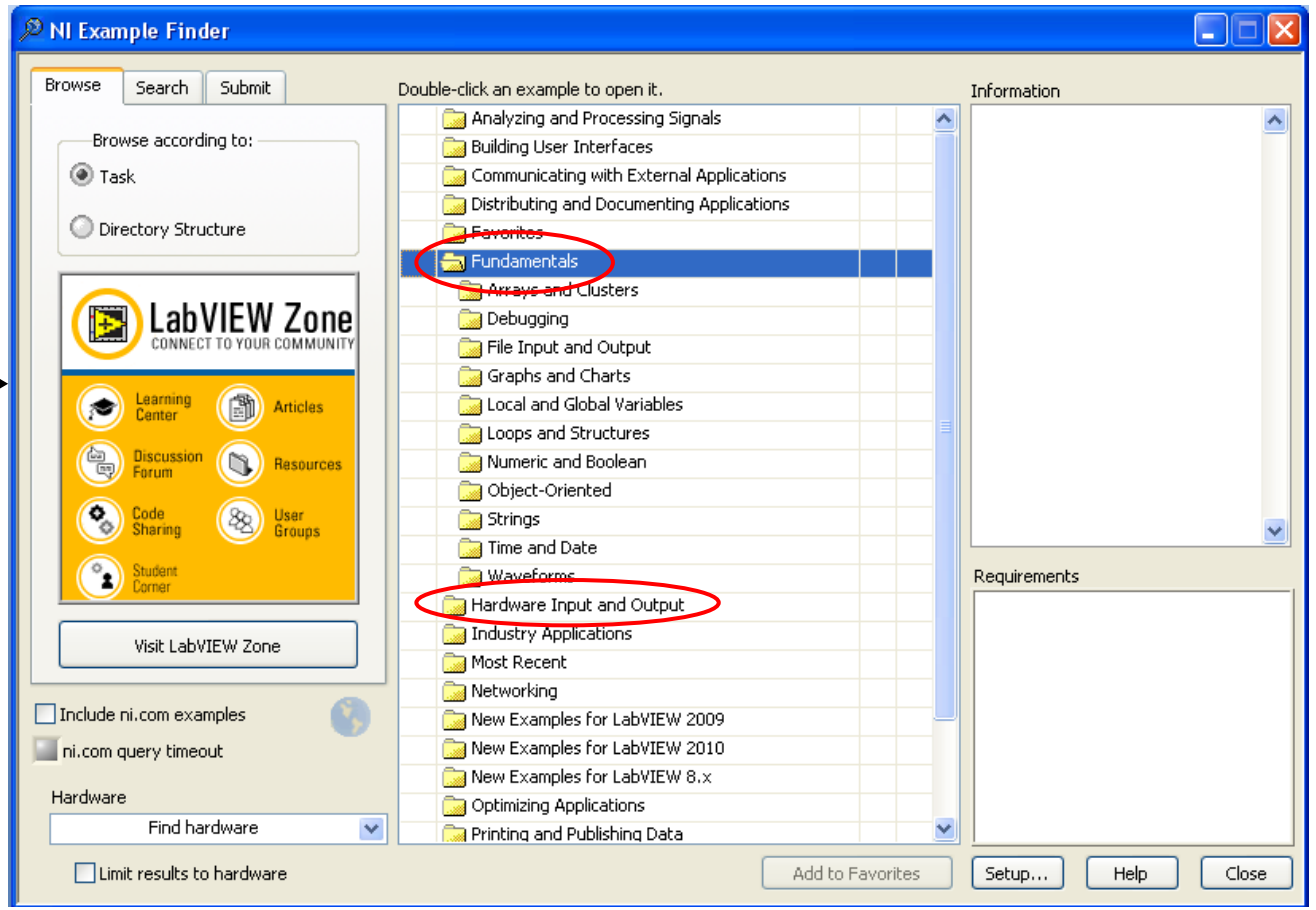
LabVIEW Help III - www.ni.com



NI Example Finder

- Search or browse through example programs
- Modify an existing example program to fit your application
- Copy and paste from an example into your own program





Further introduction to LabVIEW

- ”**Getting Started with LabVIEW**” pdf file
- ”**LabVIEW Fundamentals**” pdf file