Agenda

- LabVIEW – a History
- LabVIEW for Instrumentation and Data Acquisition
- LabVIEW Development and Features
- LabVIEW at CERN
- LabVIEW – the Future
Background

National Instruments

1.0 For Mac
2.0 Compiled Language
3.0 Multiplatform
4.0 Professional Development
5.0 Real-Time
6i Internet Ready
7 Express PDA and FPGA
8 Embedded and Distributed Intelligence
8.5 Multicore
8.6 Web Services
20.0 20th Anniversary Edition
2009 2009 Do More
2010 Performance
2011 Stability
2012 Proficiency
2012

3
## Background

### Software Used for Data Acquisition and Instrument Control

<table>
<thead>
<tr>
<th>Software</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI LabVIEW</td>
<td>40%</td>
</tr>
<tr>
<td>Microsoft Visual C/C++</td>
<td>35%</td>
</tr>
<tr>
<td>Microsoft Visual Basic</td>
<td>30%</td>
</tr>
<tr>
<td>Microsoft Visual Basic 6.0</td>
<td>25%</td>
</tr>
<tr>
<td>NI - LabWindows™/CVI</td>
<td>20%</td>
</tr>
<tr>
<td>Microsoft C#</td>
<td>15%</td>
</tr>
<tr>
<td>The MathWorks, Inc. - MATLAB®</td>
<td>10%</td>
</tr>
<tr>
<td>NI Measurement Studio</td>
<td>5%</td>
</tr>
<tr>
<td>Agilent VEE</td>
<td>10%</td>
</tr>
<tr>
<td>NI TestStand</td>
<td>5%</td>
</tr>
<tr>
<td>Agilent IO Libraries Suite</td>
<td>2%</td>
</tr>
<tr>
<td>Python</td>
<td>1%</td>
</tr>
<tr>
<td>GeoTest ATEasy</td>
<td>1%</td>
</tr>
<tr>
<td>Other</td>
<td>1%</td>
</tr>
<tr>
<td>Don't use</td>
<td>1%</td>
</tr>
</tbody>
</table>

Note: The chart shows the percentage of software usage for data acquisition and instrument control.
「DAQ & Instrumentation」

Bridging hardware and software
Measurement challenges

- Conflicting programming approaches
- Disparate drivers
- Timing, triggering, and synchronization
- Fixed soft/hardware
- Changing requirements
- ...
Measurement challenges

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Interface</th>
<th>Conditioning?</th>
<th>Software</th>
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</thead>
<tbody>
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<td><img src="image1" alt="Sensor" /></td>
<td><img src="image2" alt="Interface" /></td>
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<td><img src="image3" alt="Software" /></td>
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<tr>
<td><img src="image4" alt="Sensor" /></td>
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<td><img src="image6" alt="Software" /></td>
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<td><img src="image11" alt="Interface" /></td>
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<td><img src="image12" alt="Software" /></td>
</tr>
</tbody>
</table>

*Heterogeneous systems*
Modular Instruments

Compact DAQ

PXI

Compact RIO

PXI/PXIe modules

chassis
Integration

Bridging hardware and software
Multilanguage integration
Introduction to LabVIEW
Application development

- Program as you think
Abstraction
Expressing concepts and ideas without focus on syntax
Application development

LabVIEW Front Panel
The user interface of a VI

LabVIEW Block Diagram
The source code of a VI

Functions:
Virtual Instruments
Graphical interface
Dataflow

- Data driven execution
Dataflow

- Data driven execution
Parallelism
Intrinsic inclination
Comparison with text

```
for (i = 0; i < 10; i++)
{
    /* loop body */
}
```

```
for (i = 0; i < 10; i++)
{
    if(check(i)) break;
}
```
Comparison with text

```c
if condition1 then
    -- statements;
elseif condition2 then
    -- more statements
elseif condition3 then
    -- more statements;
else
    -- other statements;
end if
```

```c
switch (n) {
    case 5:
        printf("Small number.");
        break;
    case 100:
        printf("Large number.");
        break;
    default:
        printf("Outside range");
        break;
}
```
LabVIEW to the pin

- LabVIEW FPGA
LabVIEW to the pin

- Xilinx FPGA
  - IP integration
  - Vivado Export

- NVIDIA CUDA GPU
「LabVIEW at CERN」
LabVIEW at CERN

550 LabVIEW Users

30+ Project clients

CERN LabVIEW Support

LabVIEW™ Center of Excellence
The access challenge
Custom hardware

- CTRP-PMC (CERN)
- PMC carrier (Kontron)
- Fine delay-FMC (CERN)
- FMC carrier (INCAA)
- White rabbit timing
- Low latency machine learning (Cogito Instruments)
Example applications

- LHC collimators
- LINAC4 emittance meters
- Kicker Magnets
- AWAKE
- CLIC
- MedAustron
- …
LabVIEW NextGen

CurrentGen

NextGen (NXG)

Vector graphics

New editor
LabVIEW NXG Web Module

- Compile LabVIEW and run within web-page (Javascript)
- View compiled code on any device

- Try www.webvi.io
- Create web UI in NXG, interface with LabVIEW CurrentGen application
Support for emerging technology

- Extensive HW and SW support of RF
  - Vector Signal Transceiver (VST) with accessible FPGA
  - 5G research and metrology
- Autonomous vehicles
- Industrial Internet of Things (IIoT)
Thank you

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Credits

● National Instruments

● CERN EN-SMM group
「Spare Slides」

For that unforeseen moment …
Hello!

I’m Poppy
Modular Instruments

Compaq DAQ

PXI modules

chassis