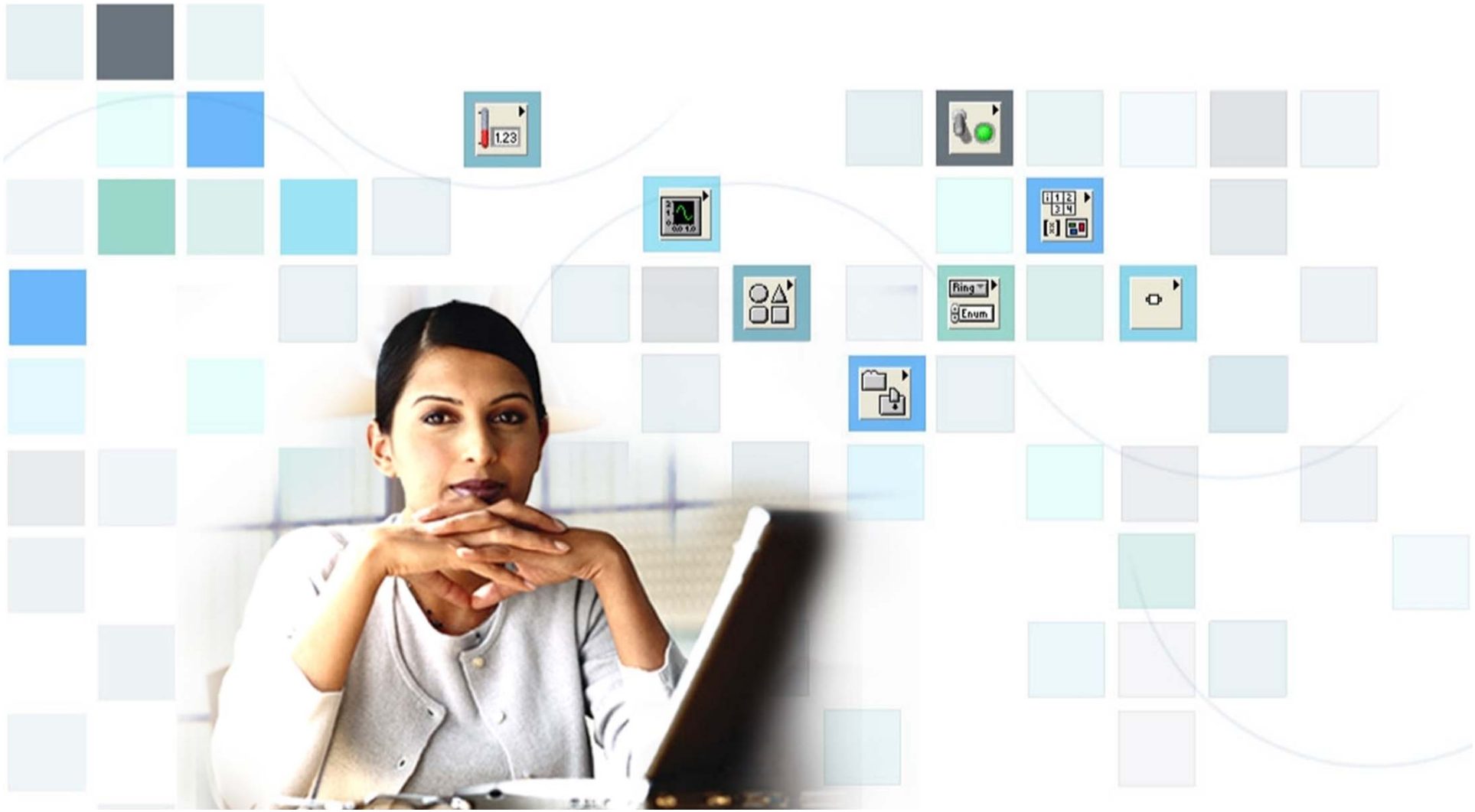
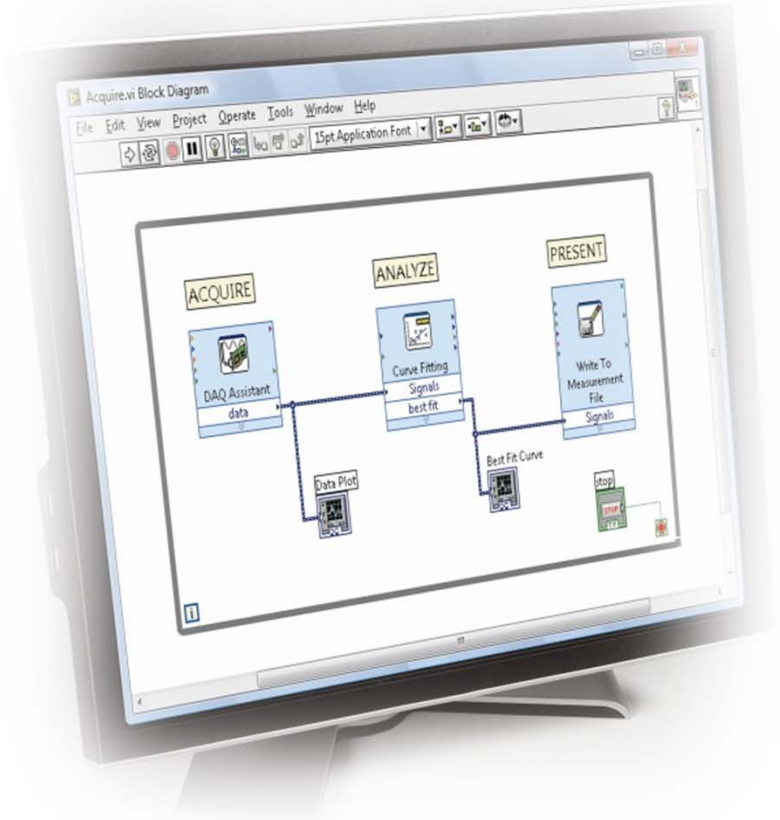
LabVIEW Data Acquisition and Signal Conditioning Course



What You Need To Get Started



Computer running Windows Vista/XP/2000 with the following software installed:

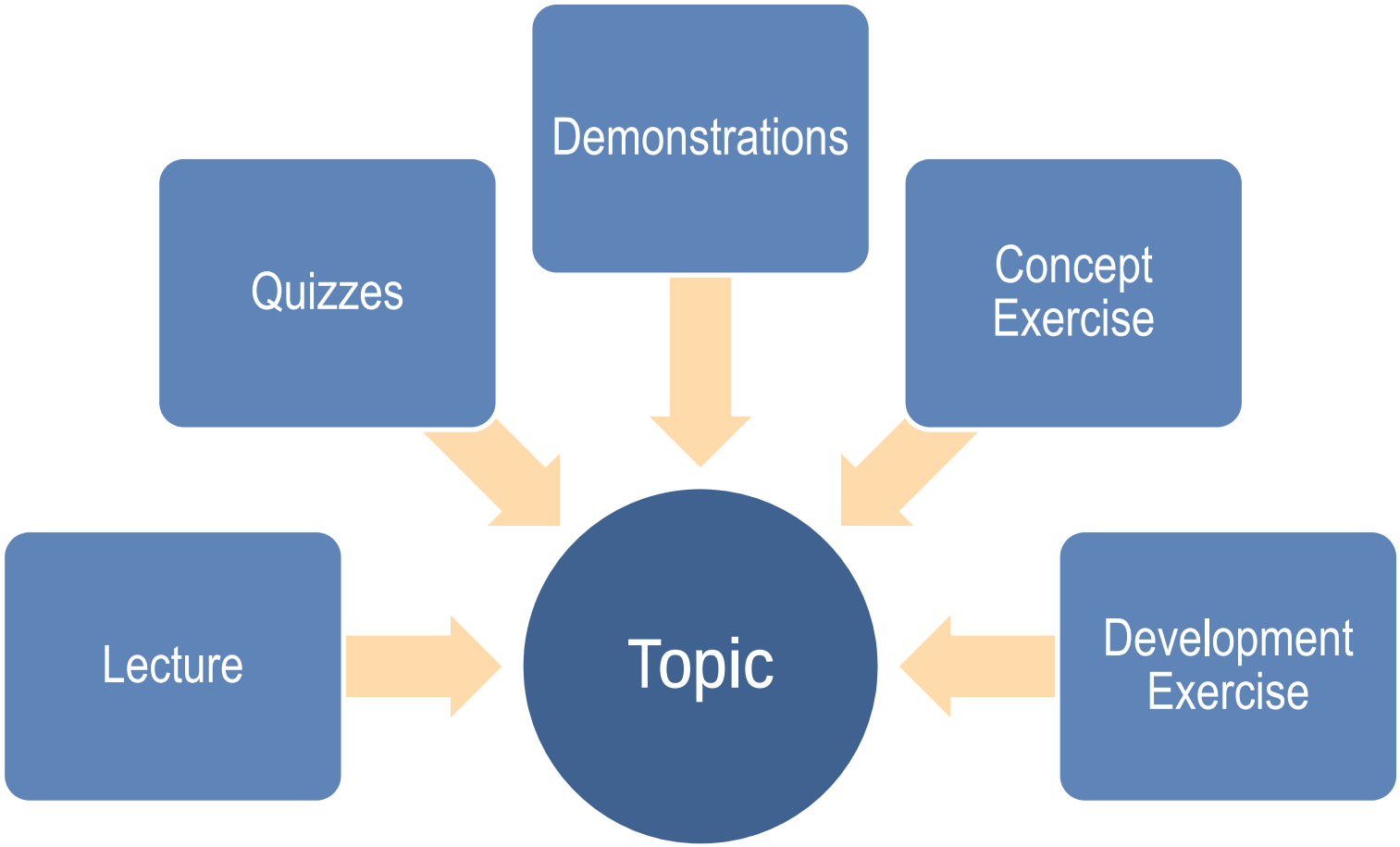
- LabVIEW 2009 or later
- NI-DAQmx 9.0.2 or later

- LabVIEW Data Acquisition and Signal Conditioning Course Manual
- LabVIEW Data Acquisition and Signal Conditioning Exercise Manual
- LabVIEW Data Acquisition and Signal Conditioning Course CD
- Multifunction DAQ device
- BNC-2120, wires, BNC cables, and DAQ cable
- cDAQ chassis, NI 9219 module, and sensors
- USB cable

File Locations

The course installer places the course files in the following location:

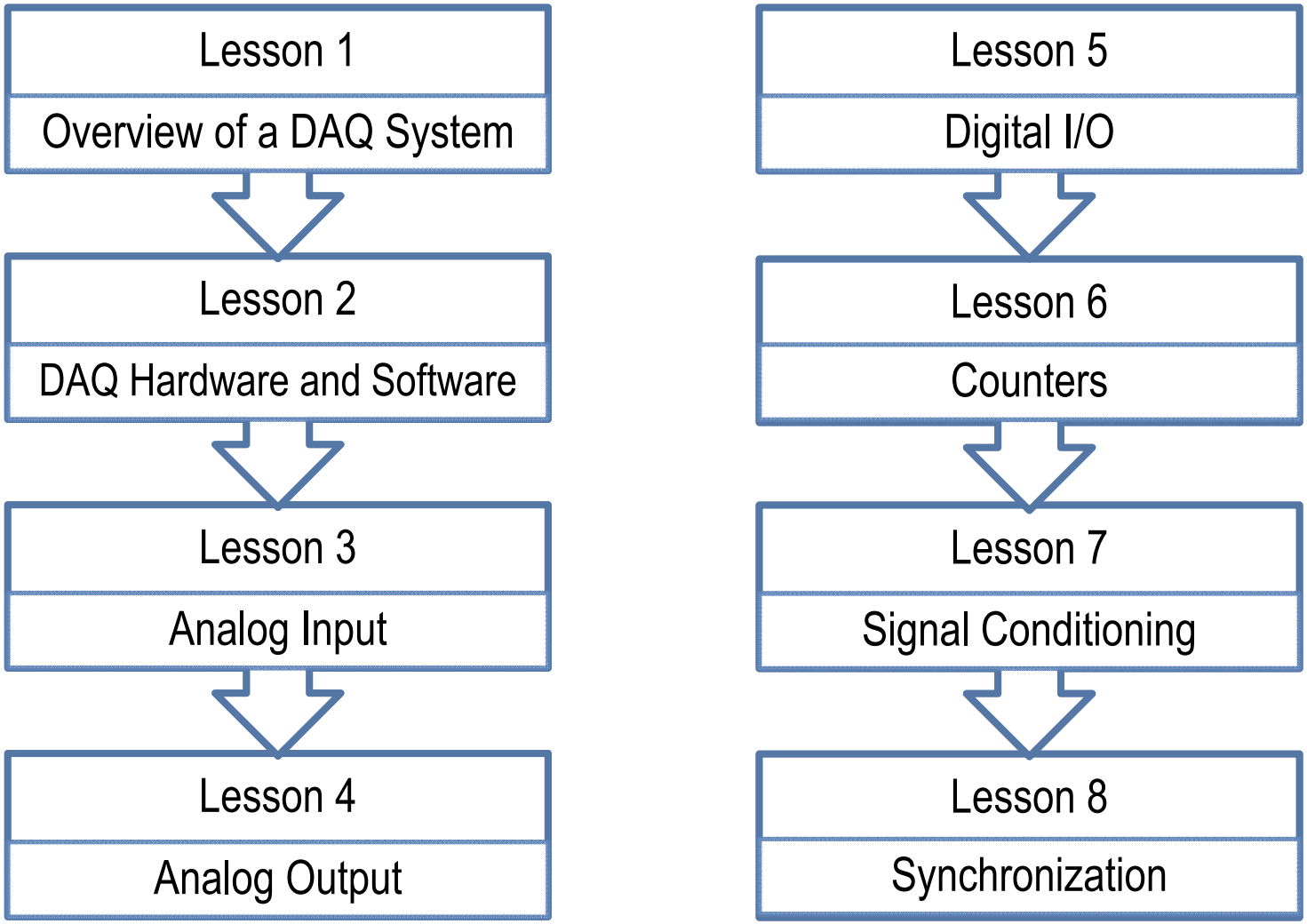
Instructional Methods



Getting The Most Out Of This Course

- Ask questions!
- Experiment with hands-on exercises to understand the methods used
- Explore solutions
- Implementations explore a possible solution—you may find a better one

Course Learning Map



Course Goals

This course prepares you to:

- Acquire analog, digital and counter measurements
- Output analog, digital and counter signals
- Effectively choose and use signal conditioning
- Analyze, process and log data
- Synchronize operations between multiple tasks and devices

Configuring Your LabVIEW Environment

- Options Dialog Box
  - Block Diagram page
    - Uncheck **Place front panel terminals as icons** to place control and indicator terminals in a compact format
    - Configure **Block Diagram Cleanup** to customize your block diagram
  - Controls/Functions Palettes page
    - Select **Load palettes during launch** to make Search Palettes immediately usable after launch
    - Set Palette to **Category (Icons and Text)**

Lesson 1
Overview of a Data Acquisition System

TOPICS

A. DAQ System Overview
B. Sensors
C. Signals
D. DAQ Hardware
E. Signal Conditioning
F. DAQ Software

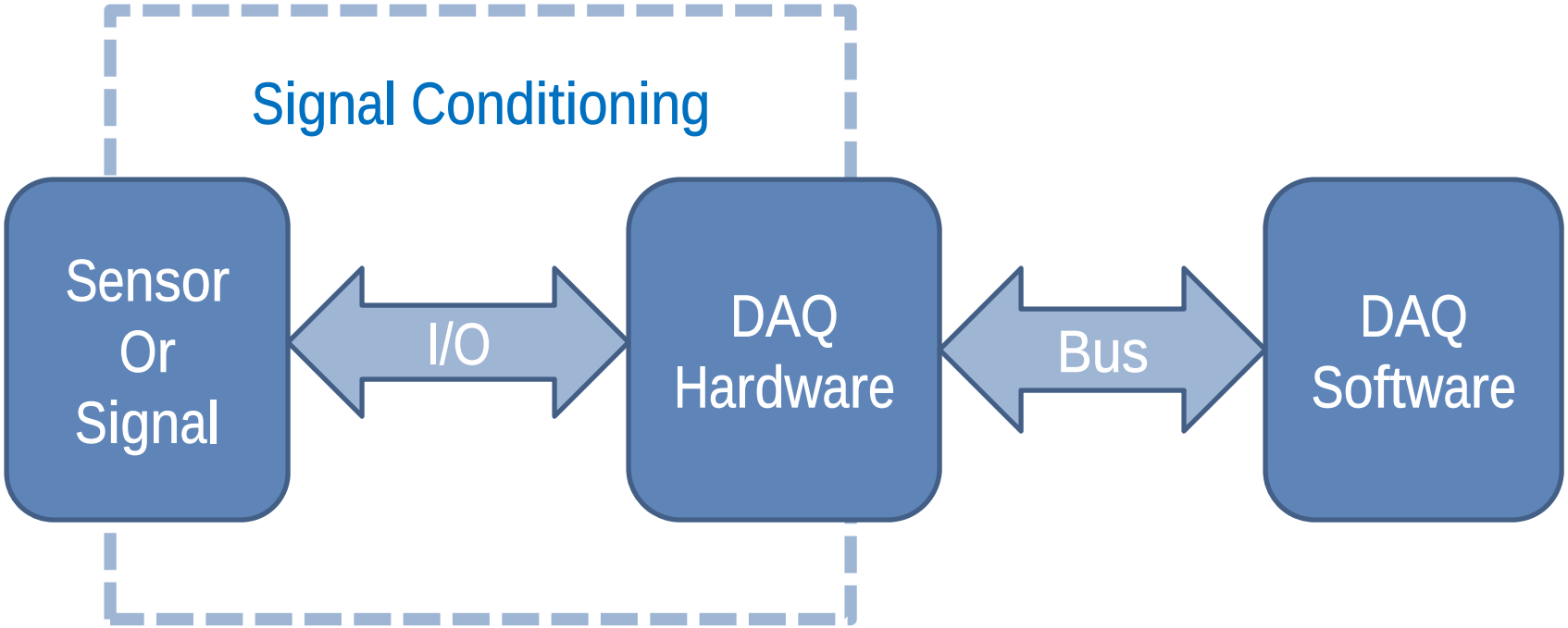
A. DAQ System Overview

Data Acquisition (DAQ)–the automatic collection of data from sensors, instruments, and devices in a factory, laboratory, or in the field.

Purpose

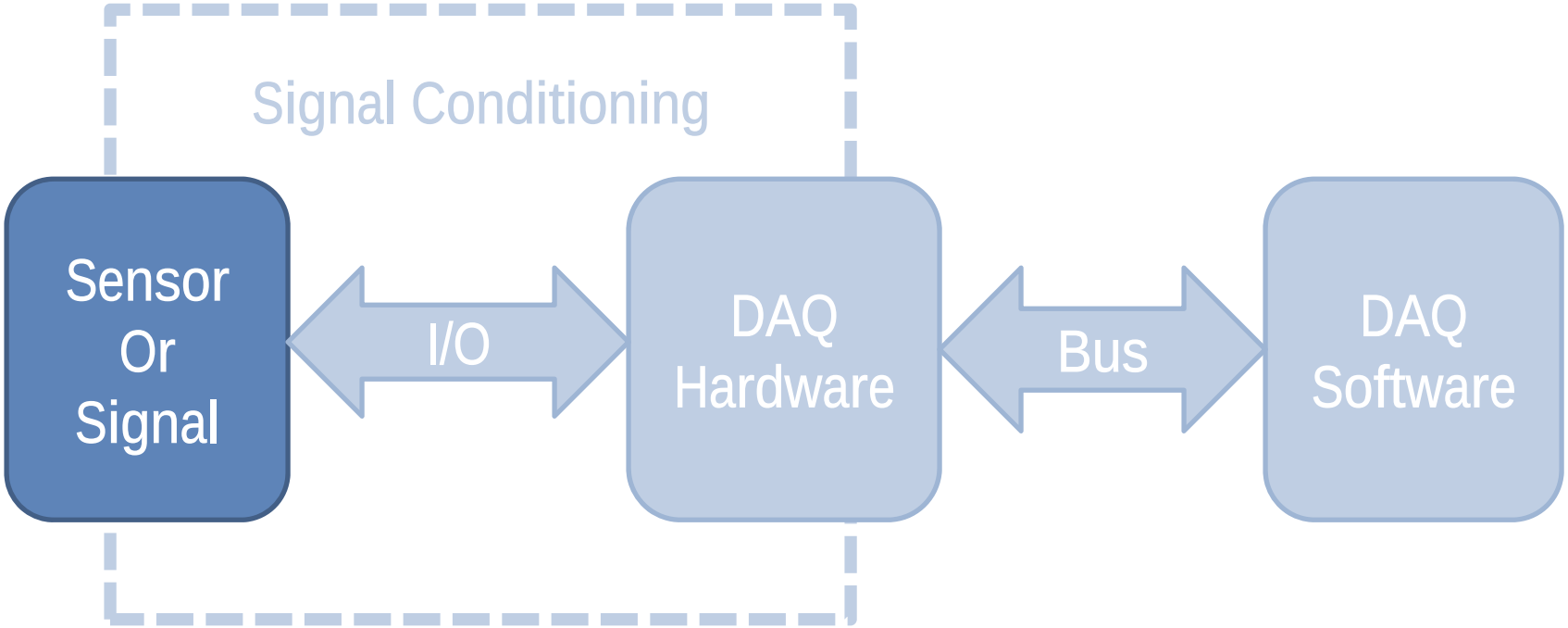
To measure an electrical or physical phenomenon such as voltage, current, temperature, pressure, or sound

DAQ System Overview

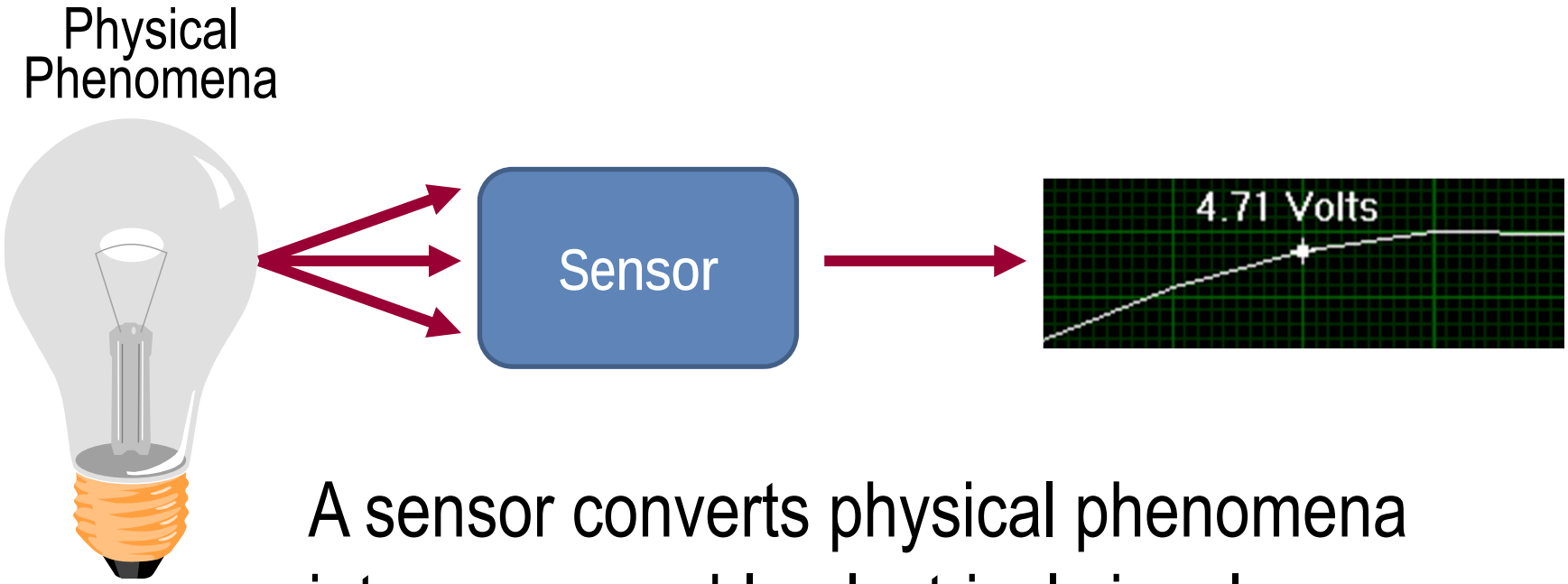


B. Sensor Overview

- What is a sensor?
- Types of sensors



What is a Sensor?



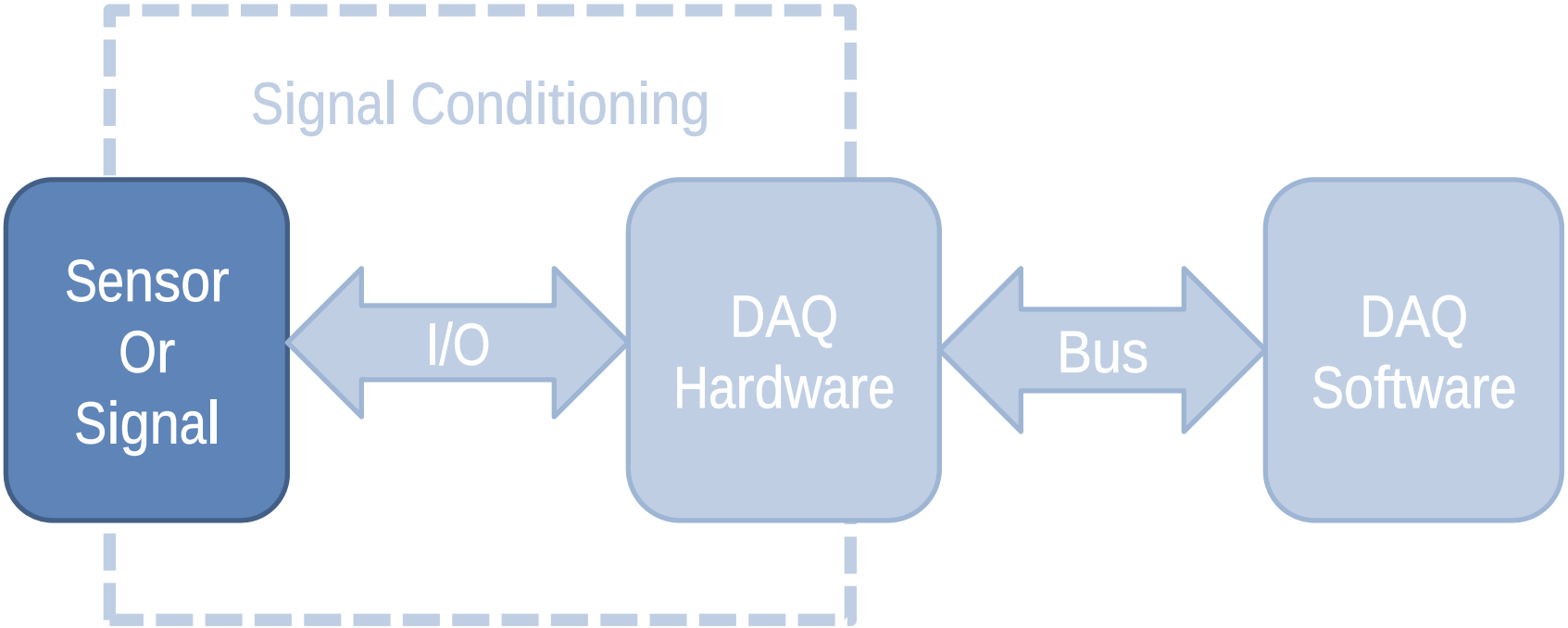
A sensor converts physical phenomena into measureable electrical signals

Types of Sensors

Phenomena	Sensors
Temperature	Thermocouples Resistive Temperature Devices (RTDs) Thermistors
Strain and Pressure	Strain gages Piezoelectric transducers
Sound	Microphone
Vibration	Accelerometer
Position and Displacement	Potentiometers Linear voltage differential transformer Optical encoder
Fluid	Head meters Rotational flowmeters
pH	pH electrodes
Light	Vacuum tube Photo sensors

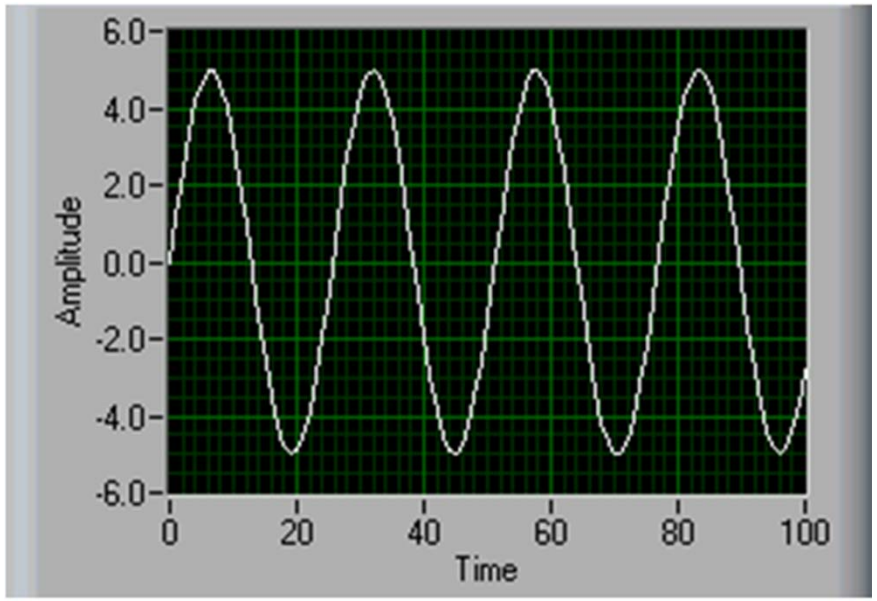
C. Signal Overview

- Signal classification
- Signal information

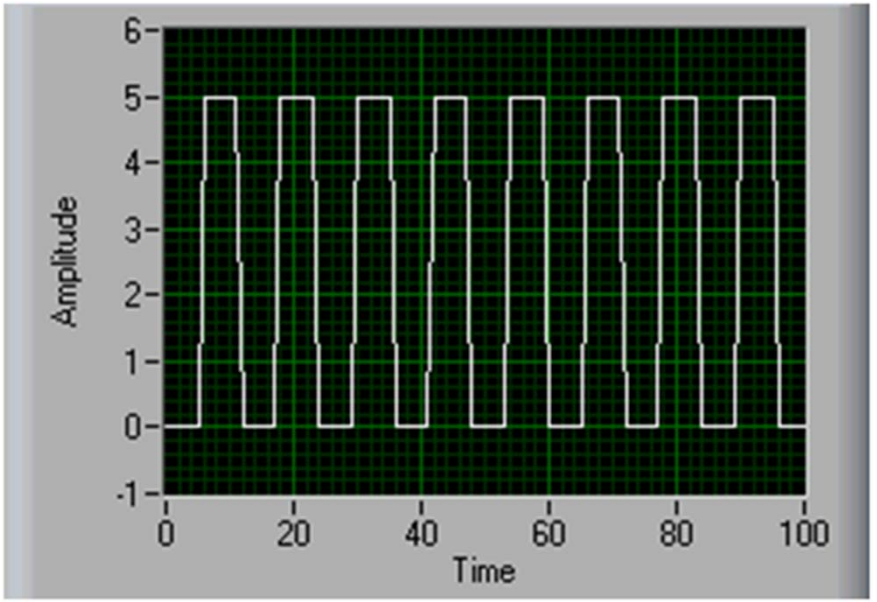


Signal Classification

Analog



Digital



Analog Signals

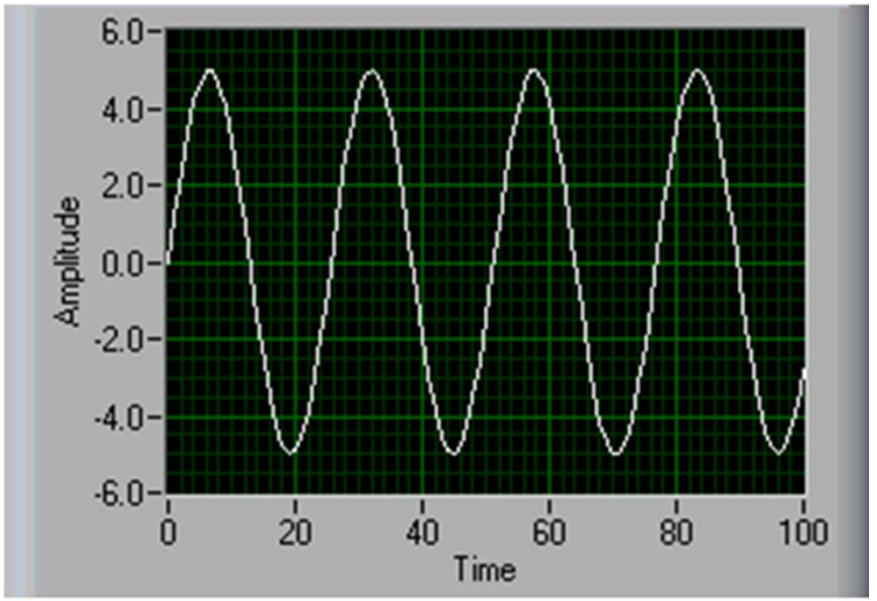
Continuous signal

- Can be at any value with respect to time

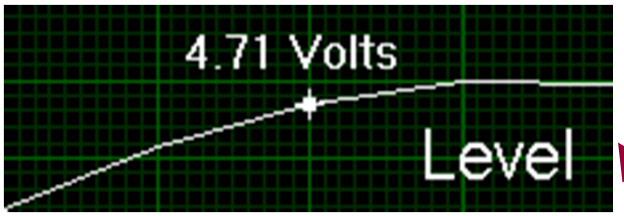
Three types of information

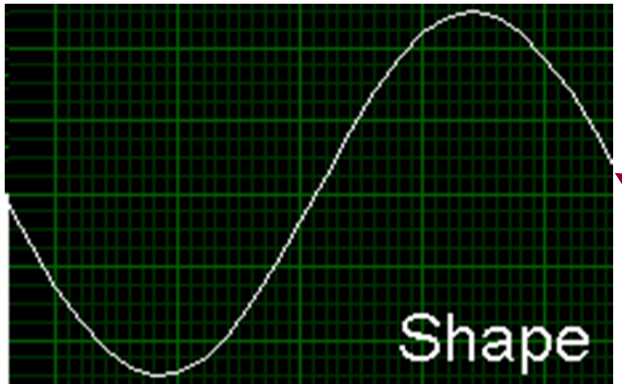
- Level
- Shape
- Frequency
  (Analysis required)

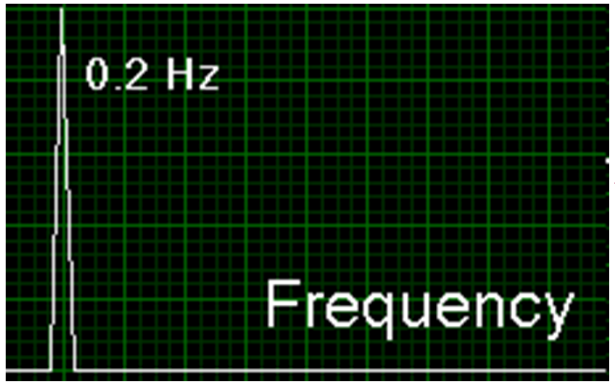
Analog



Analog Signal Information

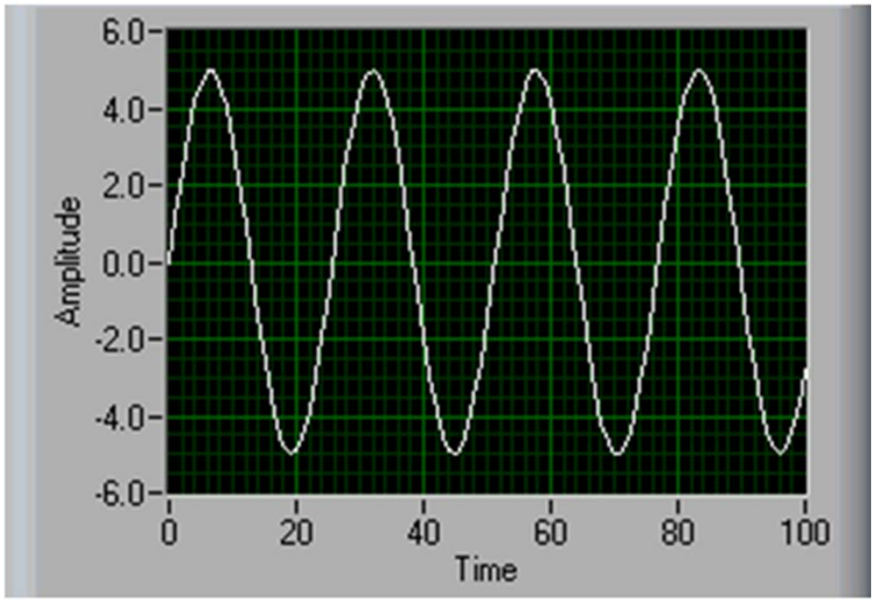




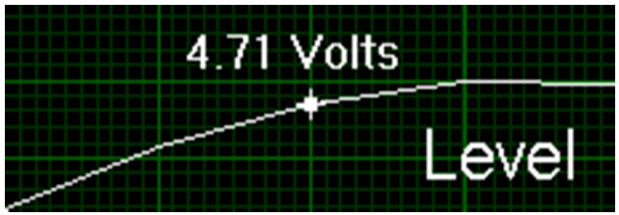


Analysis Required

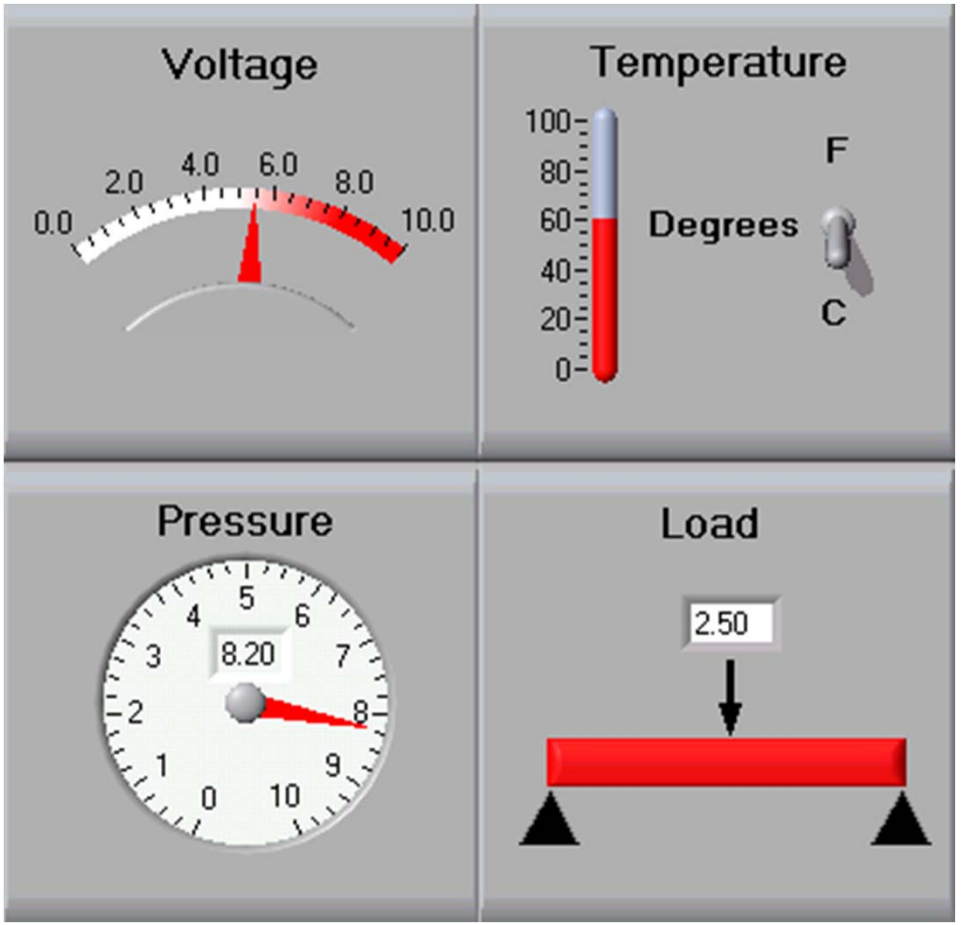
Analog



Analog Signal – Level Examples

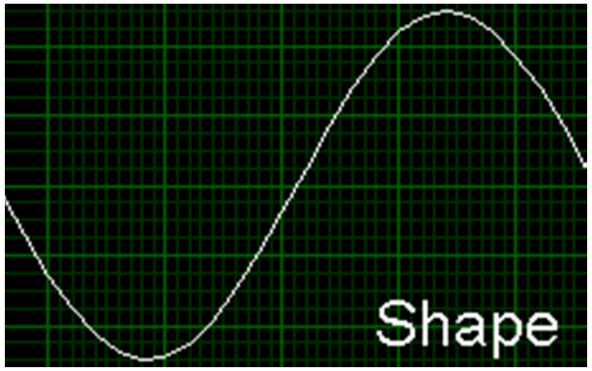


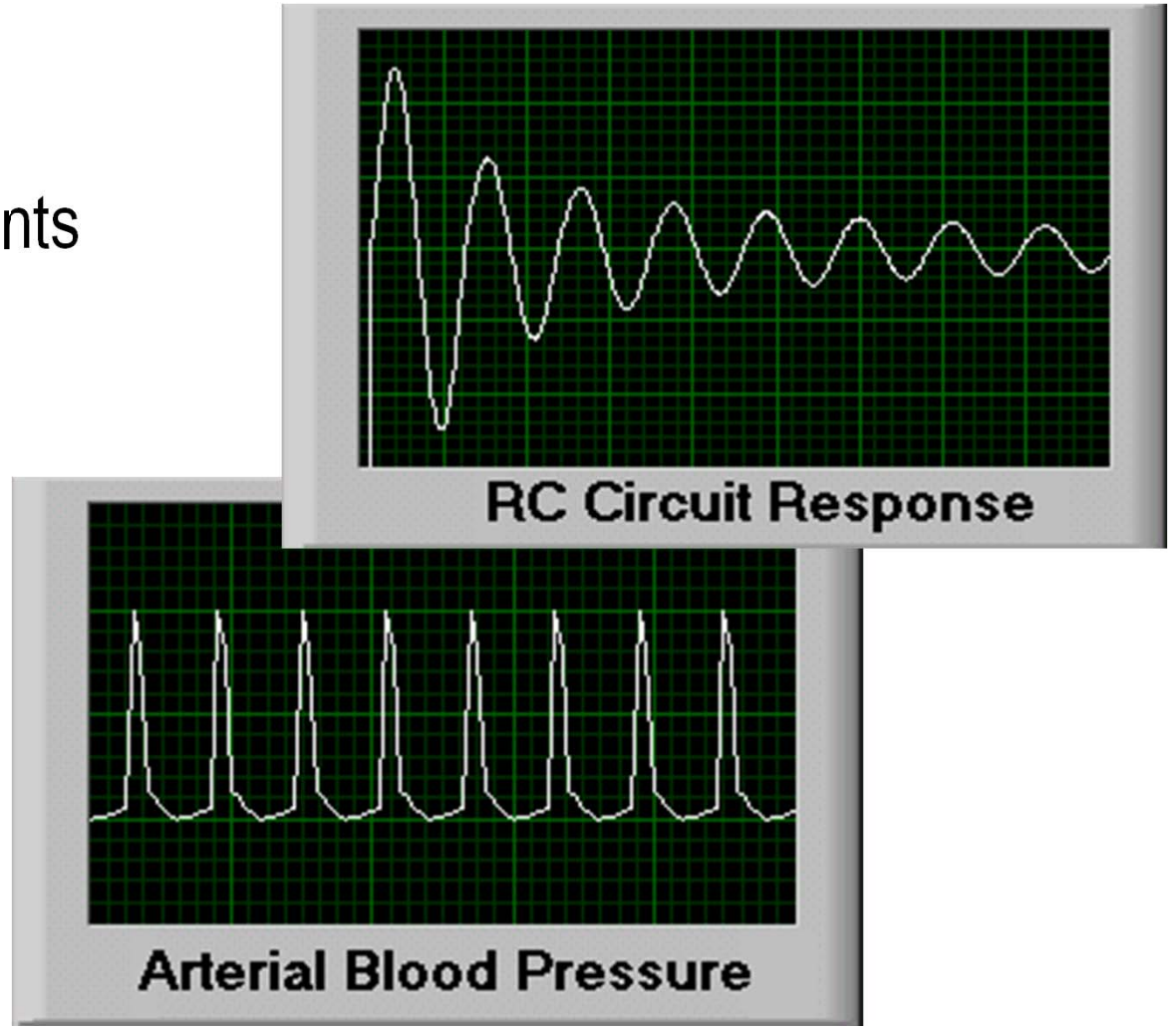
Common examples of level measurements



Analog Signal – Shape Examples

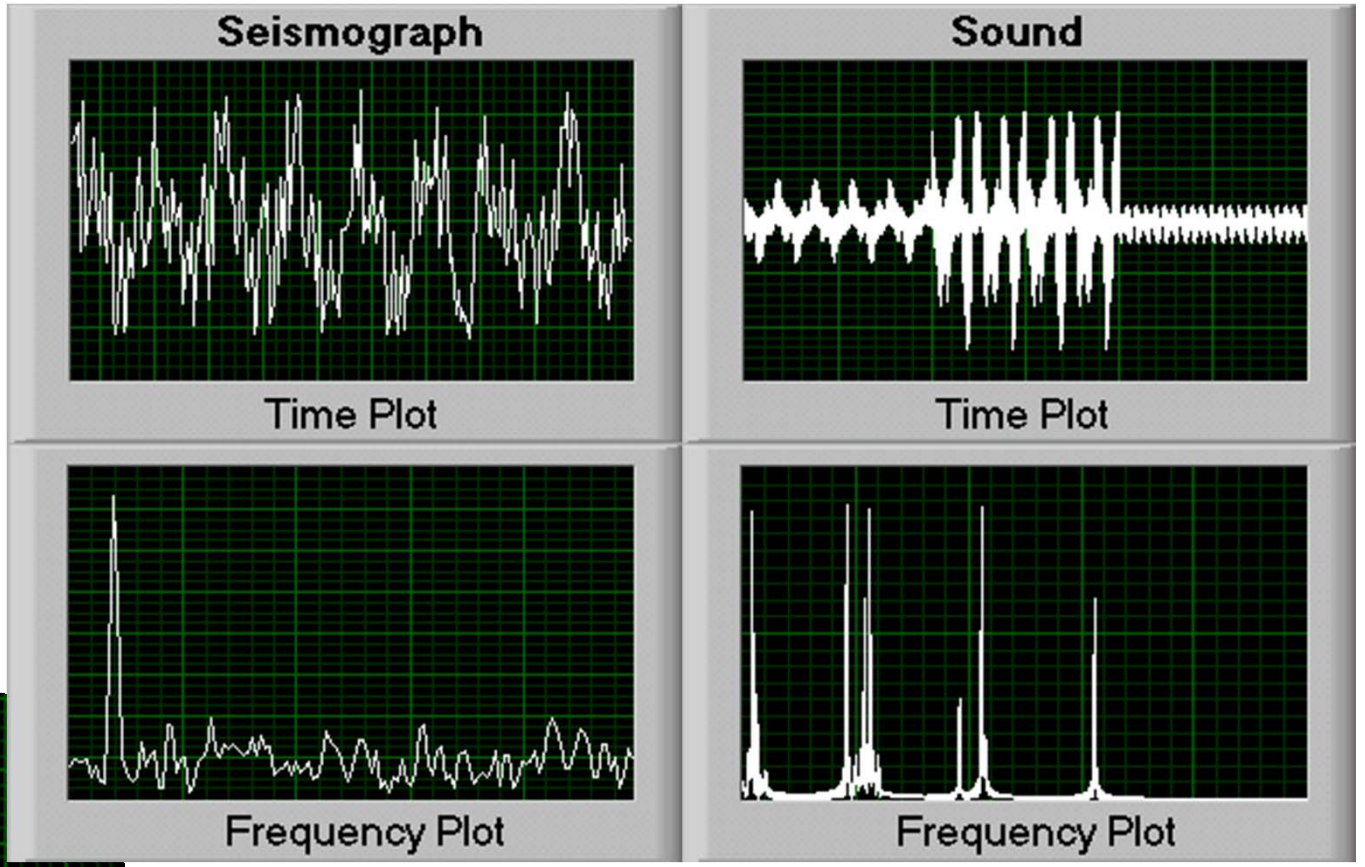
Common examples
of shape measurements

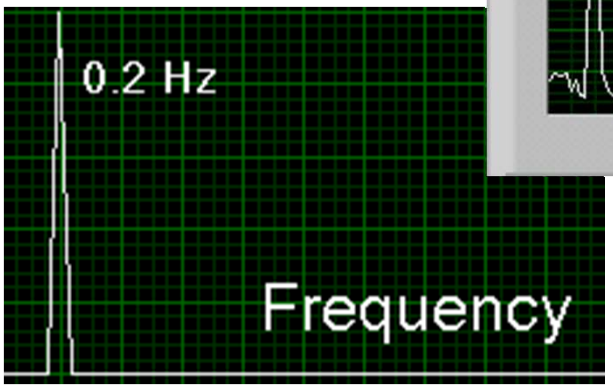




Analog Signal – Frequency Examples

Common examples of frequency measurements





Analysis Required

Digital Signals

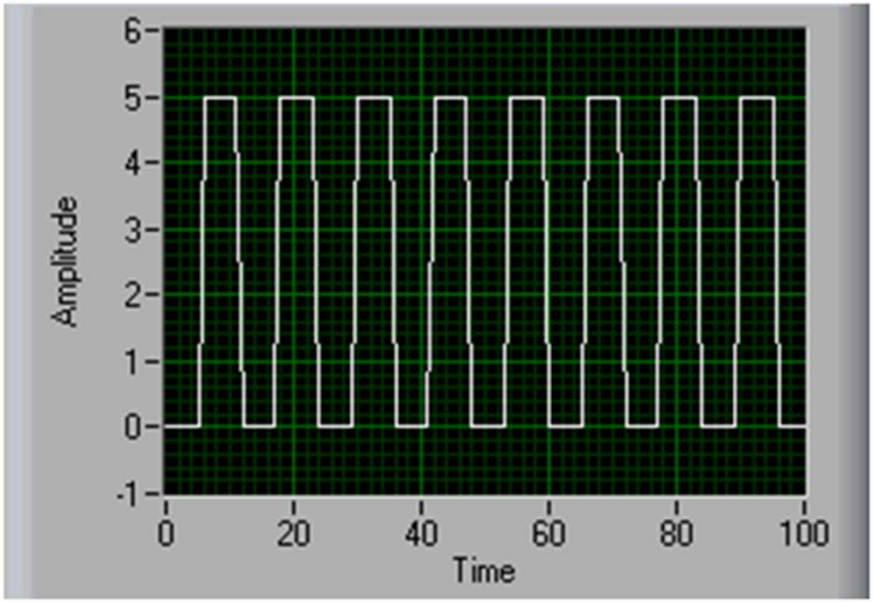
Two possible levels:

- High/On
- Low/Off

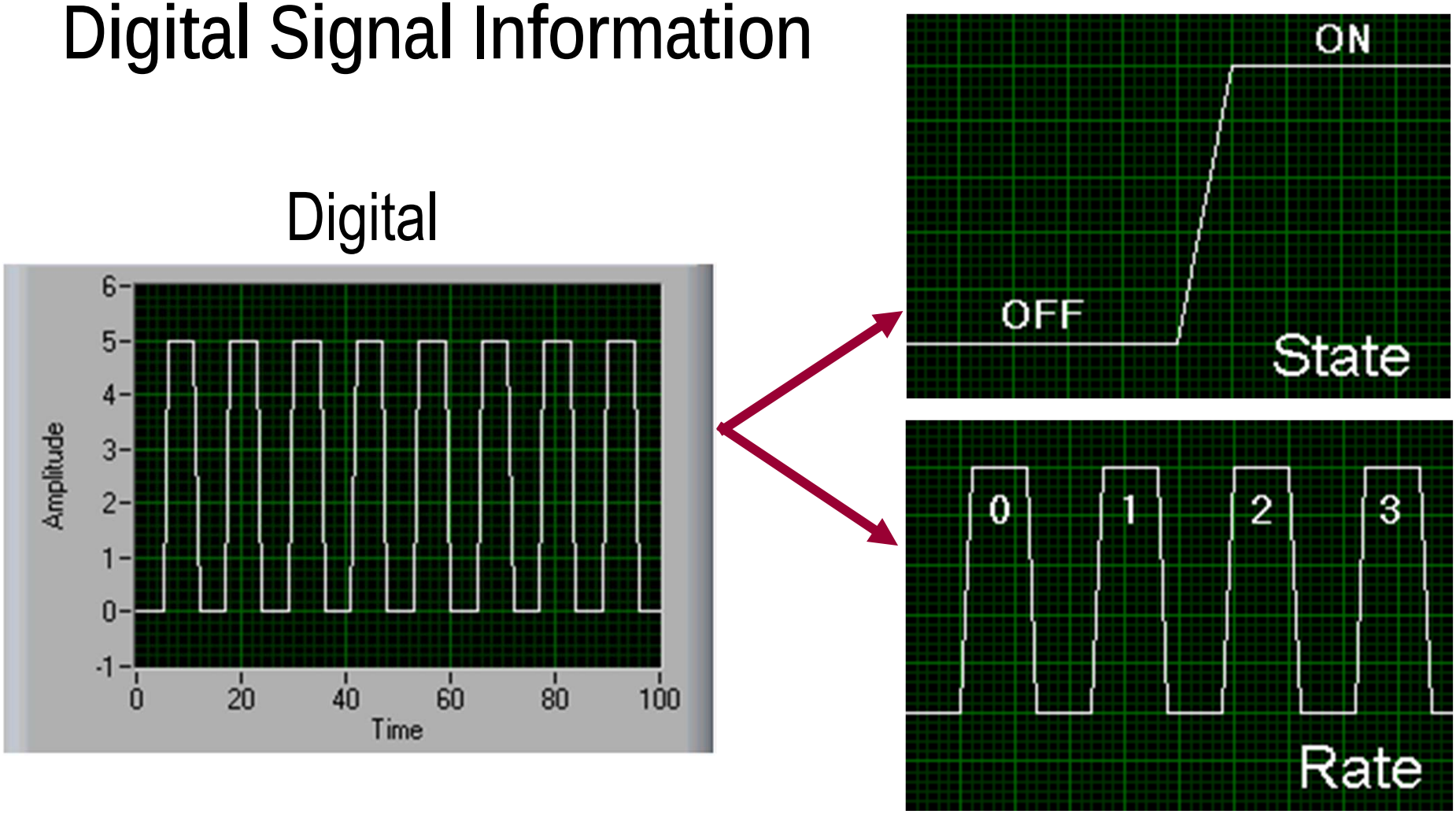
Two types of information:

- State
- Rate

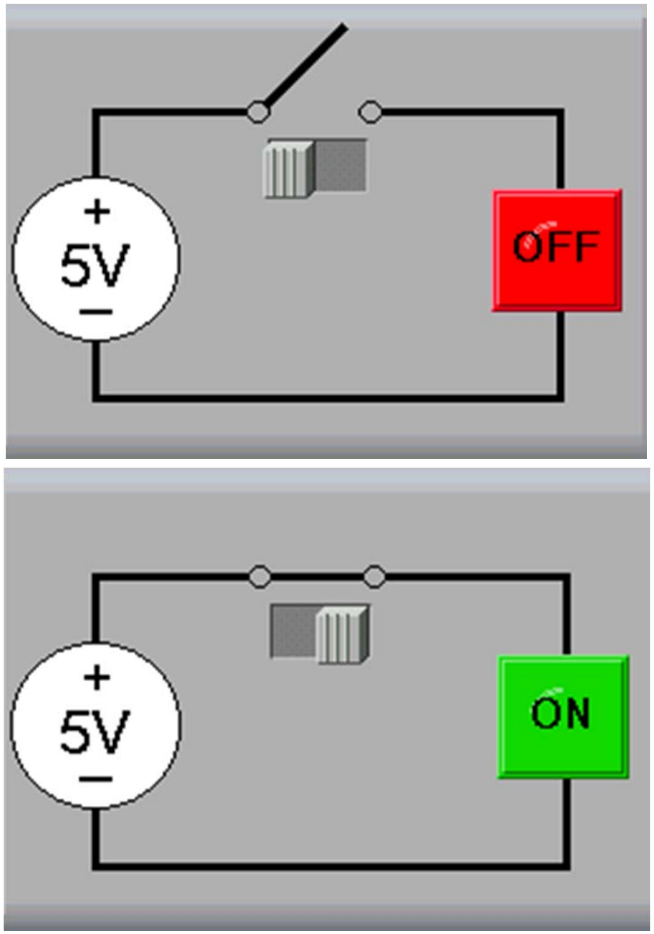
Digital Signal Example

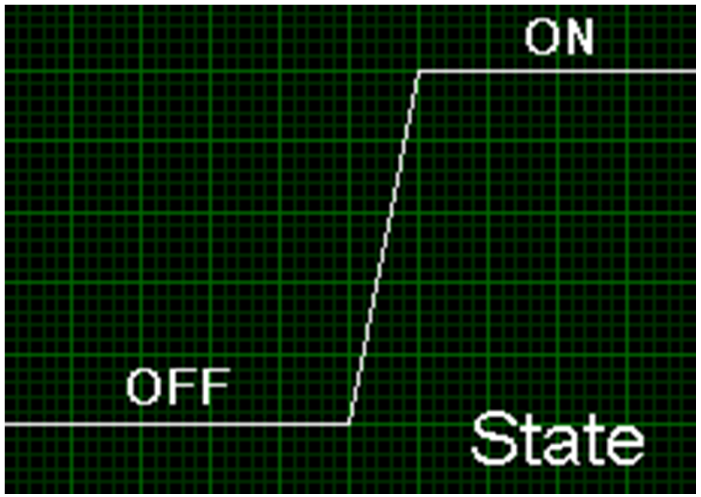


Digital Signal Information



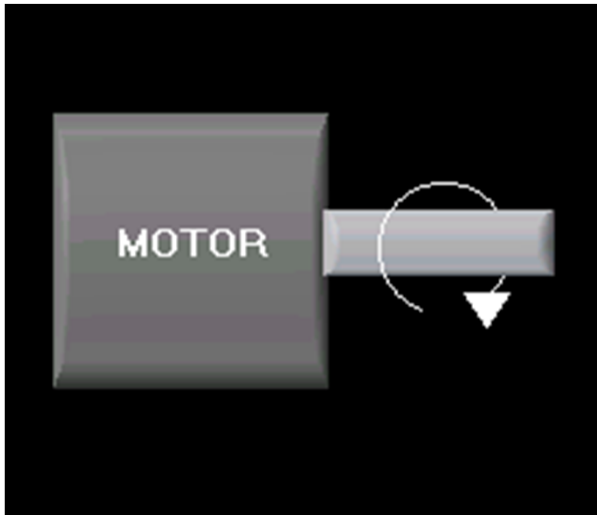
Digital Signal – State Example



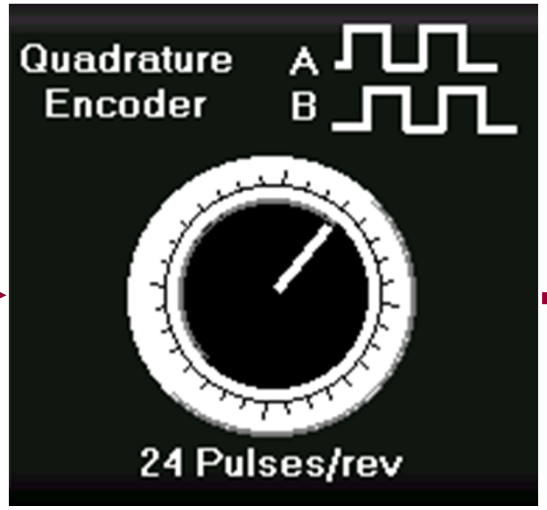


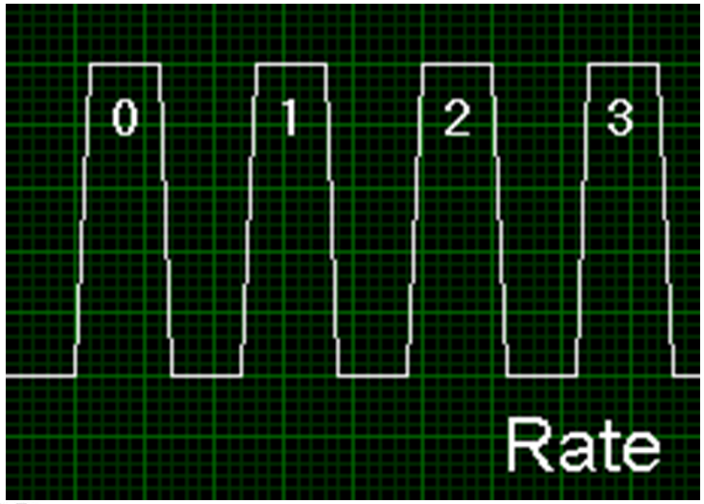
Position of the switch determines the state of the signal

Digital Signal – Rate Example

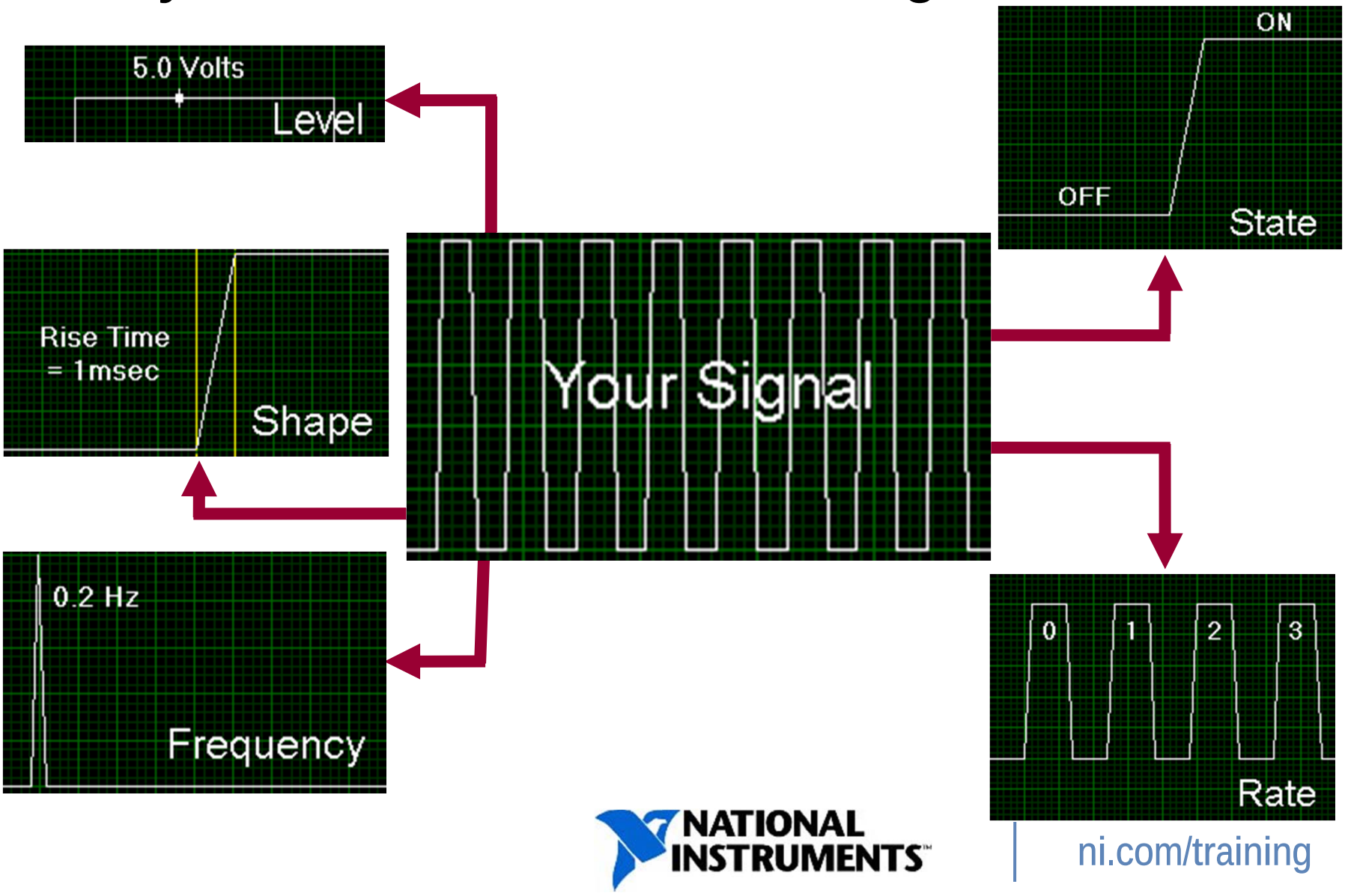


- Shaft spins
- Encoder converts rotation into two digital pulse trains
- Measure the rate of the pulse train





5 Ways to Measure the Same Signal



NATIONAL INSTRUMENTS

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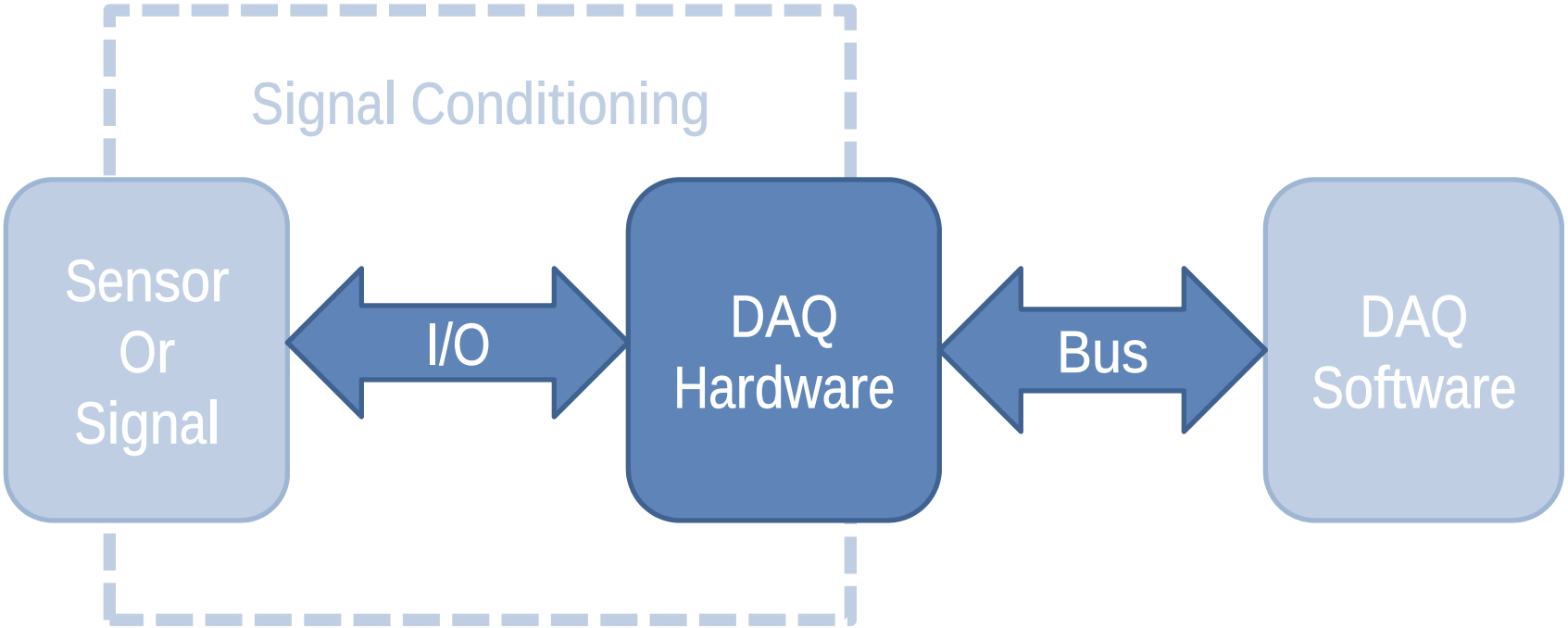
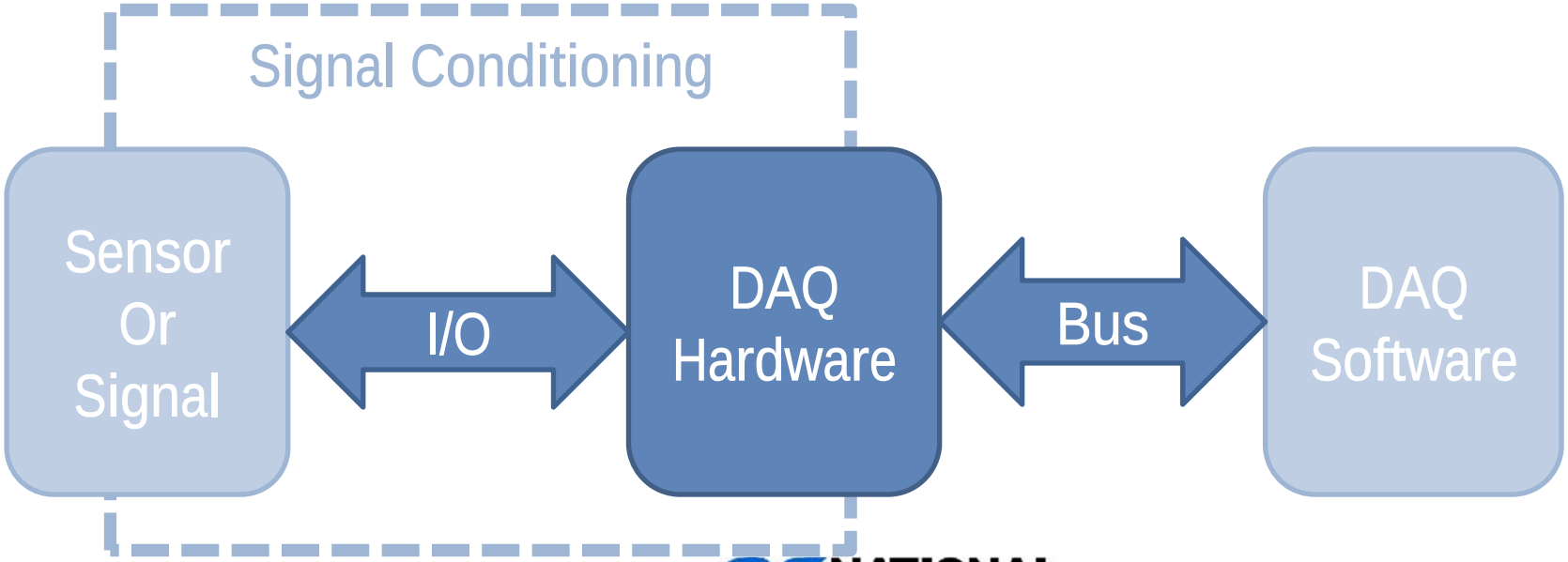
D. DAQ Hardware Overview

- Purpose of DAQ hardware
  - Transfer data between your sensor/signal and your software



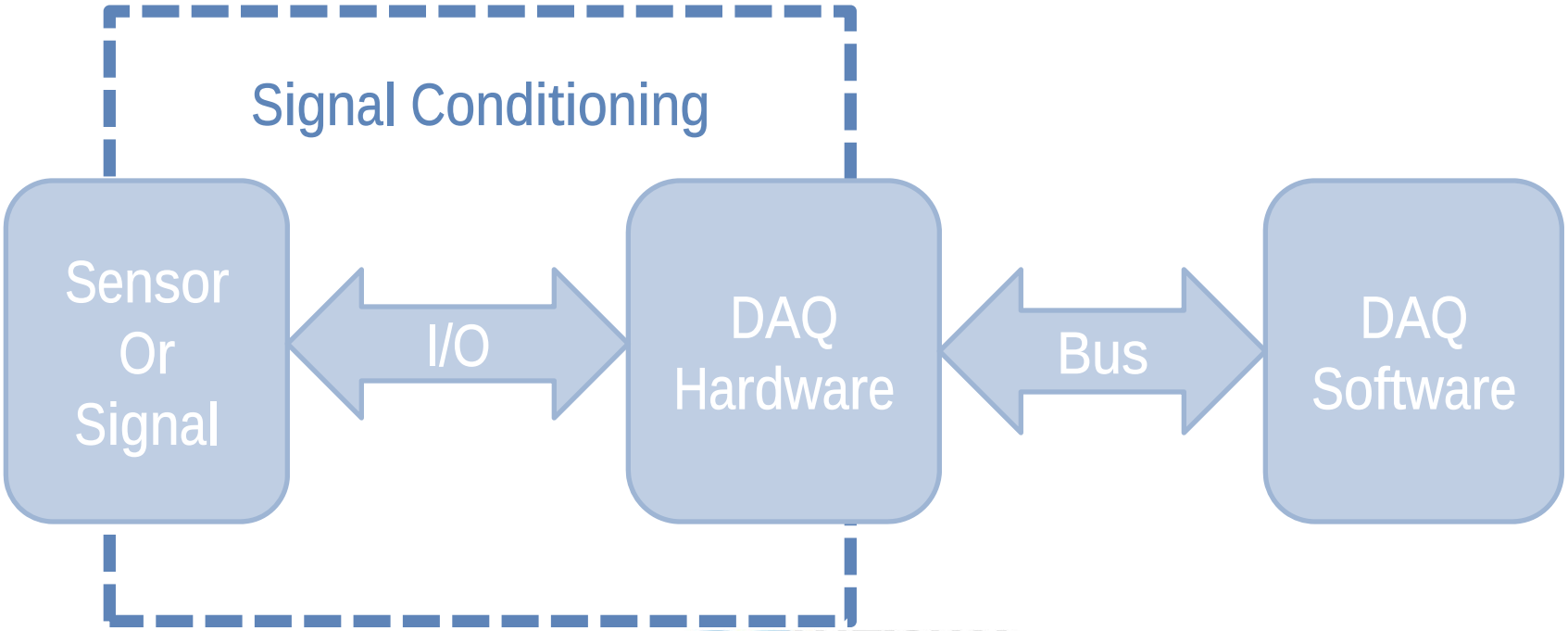
DAQ Hardware Overview

- DAQ hardware
  - Can both acquire and generate analog and digital signals
  - Transfers signals to and from DAQ software through a bus (PCI, PCIe, PXI, PXIe, USB, etc)



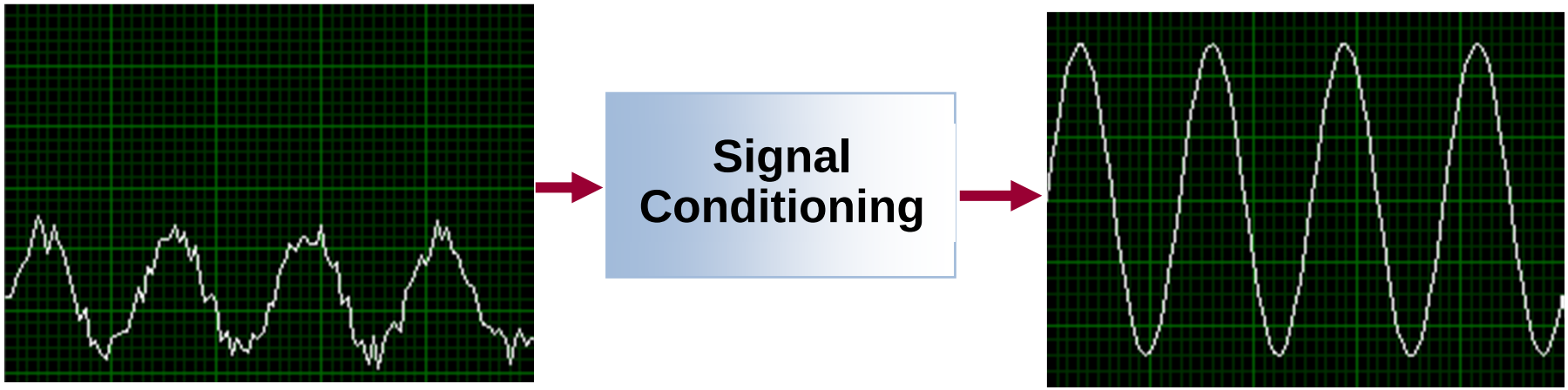
E. Signal Conditioning Overview

- Purpose of signal conditioning
- Where signal conditioning occurs
- Signal conditioning examples



Purpose of Signal Conditioning

- Signal conditioning takes a signal that is difficult for your DAQ device to measure and makes it easier to measure
- Signal conditioning is not always required
  - Depends on the sensor or signal being measured

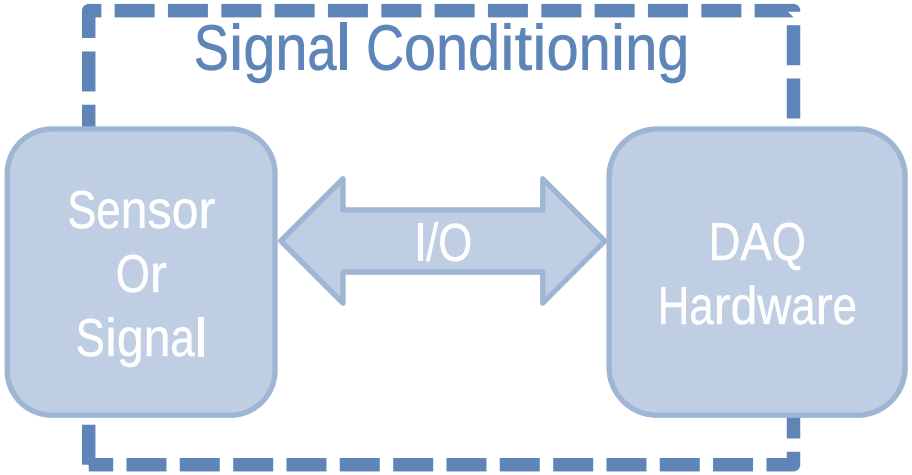


Noisy, Low-Level Signal

Filtered, Amplified Signal

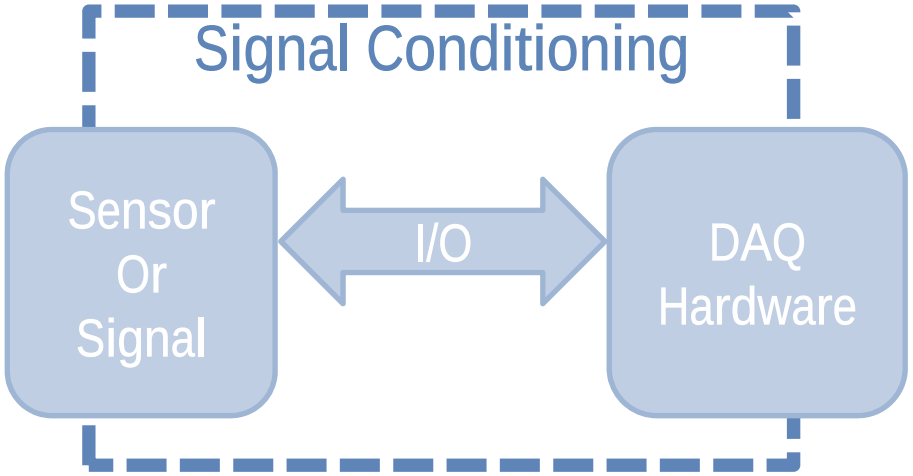
Where Signal Conditioning Occurs

- Can occur in:
  - Sensor
  - Path between the sensor and DAQ hardware
  - DAQ hardware



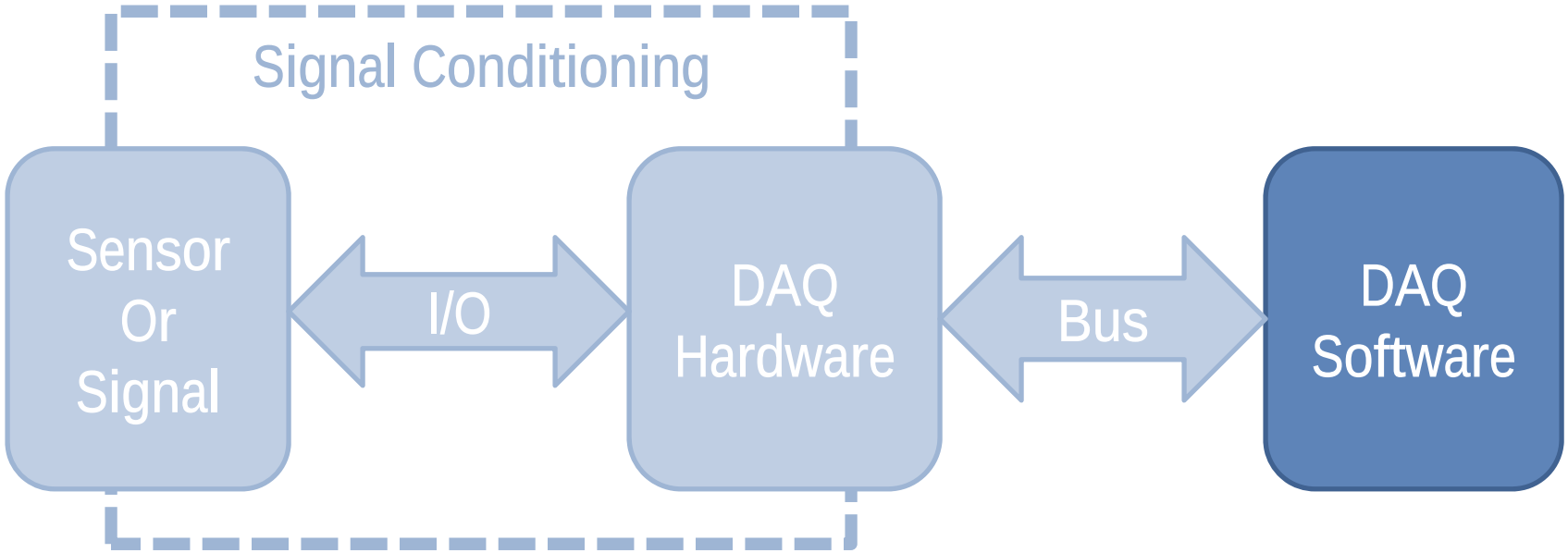
Signal Conditioning Example

- Strain gage
  - Needs to receive excitation voltage
  - Outputs a low voltage
- Signal conditioning for strain gages
  - Provide excitation voltage
  - Complete bridge circuit
  - Amplify the signal
  - Filter out noise



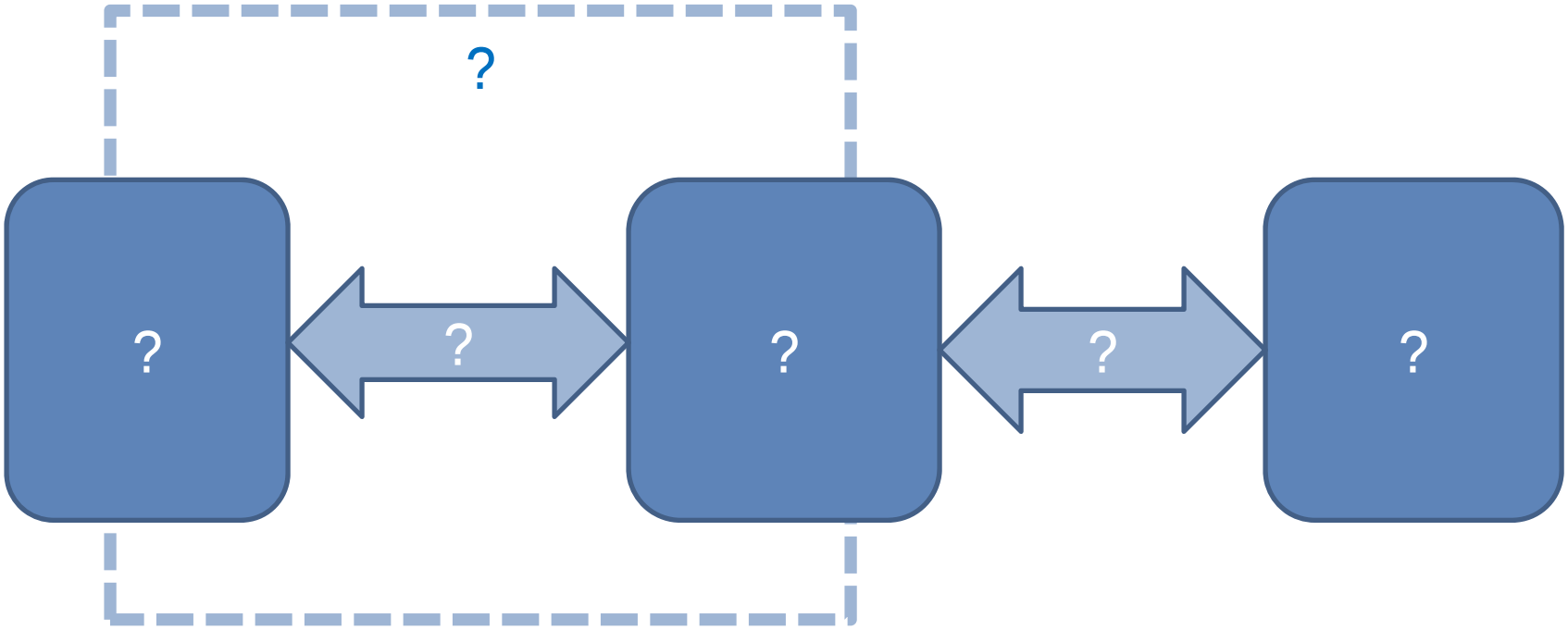
F. DAQ Software Overview

- After acquiring data, you usually still need to do more
  - Signal processing, generate a report, interact with data, etc.



Summary—Quiz

1. List the components of a Data Acquisition System.



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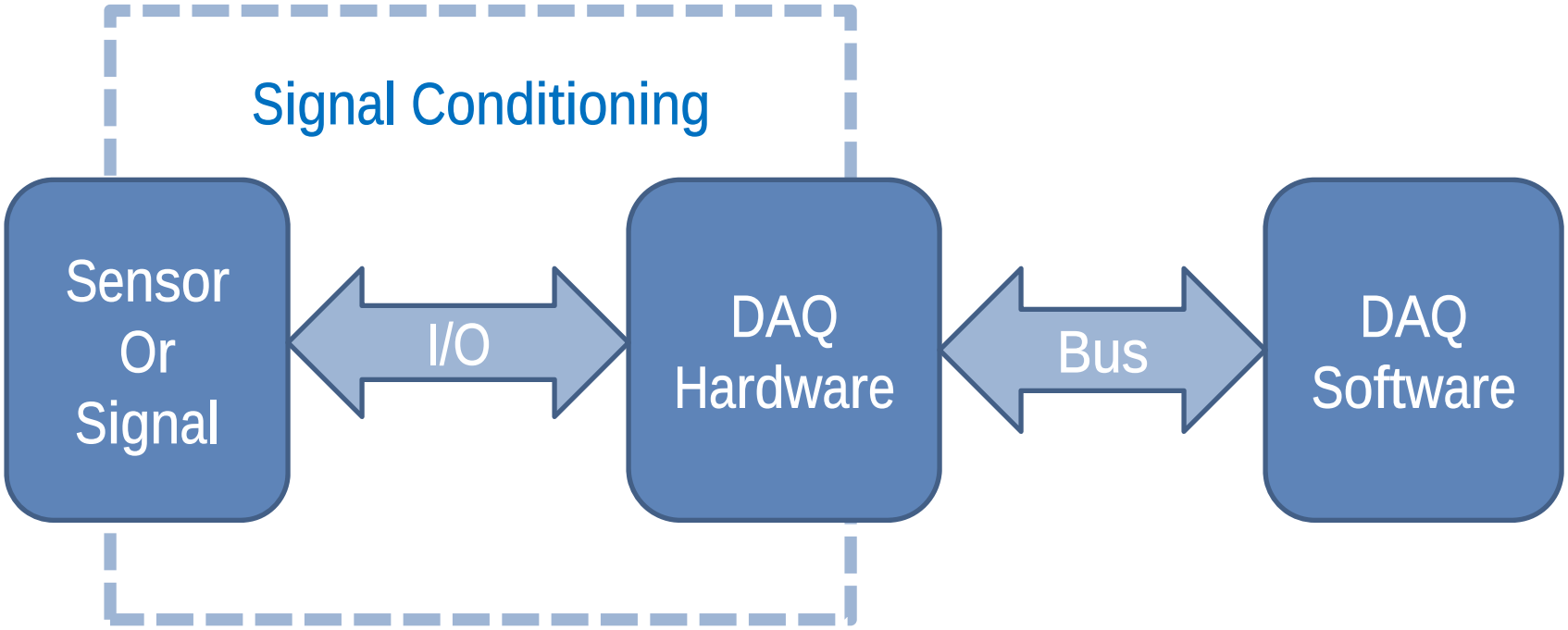
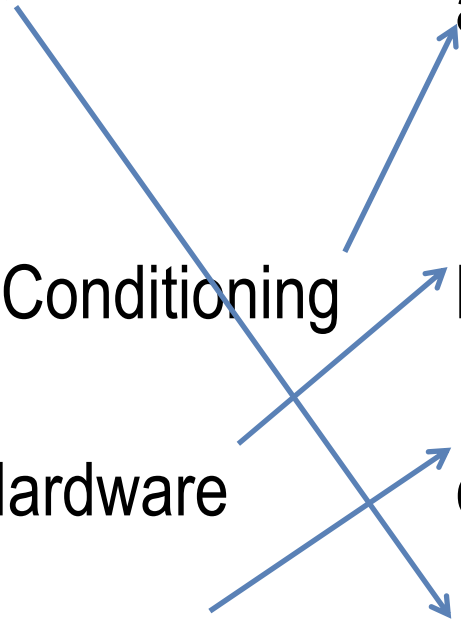


Summary–Matching Quiz

1. Sensor	a) Takes a signal that is difficult for your DAQ device to measure and makes it easier to measure
2. Signal Conditioning	b) Transfers signals to and from software through a bus
3. DAQ Hardware	c) Operates on data after it has been acquired
4. DAQ Software	d) Converts physical phenomena into measurable electrical signals

Summary–Matching Quiz Answer



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4. DAQ Software	d) Converts physical phenomena into measurable electrical signals

Summary–Quiz

2. Name the 3 types of measurements that can be made of analog signals.

Summary–Quiz Answer

2. Name the 3 types of measurements that can be made of analog signals.
   - Level
   - Shape
   - Frequency

Summary–Quiz

3. Name the 2 types of measurements that can be made from digital signals.

Summary–Quiz Answer

3. Name the 2 types of measurements that can be made from digital signals.
   - State
   - Rate