Most things we want to measure, for example, temperature or pressure, are continuously varying. The sensor data must be converted to a digital format before it can be interpreted by a microprocessor.

Applying power to a sensor so that it produces a usable output is called excitation. Analog circuitry excites filters and amplifies the raw sensor signal, a process called signal conditioning. Once processed in this way, the signal is sent to an ADC, short for analog-to-digital converter. The output of the ADC is typically 8, 12, 16, or 24 bits. Data from an ADC is usually converted to a serial format, such as I2C, SPI or RS-232.

Certain sensors, humidity in particular, incorporate the analog front end on a single chip solution, producing a digital output easily connected to a microprocessor.

The raw output of most sensors is easily corrupted, hence, signal conditioning circuitry is located very close to the sensor, helping to shield against external interference. Once converted, the digital signal can easily be transmitted over great distances with minimal error.

It is helpful to use a microcontroller for sensor systems. This device consists of a microprocessor with a built-in analog-to-digital converter. In this course, you'll be using the Cypress PSoC series of microcontrollers. This microcontroller also contains amplifiers, multiplexers, comparators, timers, counters, and shift registers. It minimizes the number of discrete components between the sensor and the microcontroller. It is a hardware programmable part. You design electronic circuits implemented as real hardware inside the PSoC chip. The hardware then interacts with the code you write in a seamless manner. The design environment for this part is called PSoC creator, and includes schematic capture in addition to a code editor.

In addition, a handful of inexpensive sensors and actuators will be made available for you to purchase for this course, and future ones that are part of the specializations.

Normally, you would need an expensive bench-top digital oscilloscope to take sensor readings, such as this one from Agilent. You may use this type of scope if you have access to one at work or school. However, for this class, you may also purchase a much lower cost oscilloscope, that you can connect to your laptop PC. We give you some suggestions of devices to purchase in the course syllabus. We hope you share our enthusiasm for building things. It's the best way to learn.