

5.5 Analogue and digital data

As we have already learnt from earlier chapters, computers work with **digital data**, which is defined as discrete, fixed values in a given range.

However, in the real world, physical measurements (i.e. data) are not digital but are continuously variable, producing an infinite number of values within a given range. For example, length, weight, temperature, pressure, etc. can take any value, depending on the accuracy to which they are measured. These values are measured by an **analogue device** which represents physical measurement on a continuous analogue scale, as illustrated in Figure 5.5. The speedometer represents speed by showing the position of a pointer on a dial, while the thermometer represents temperature by the height of the liquid column.

The data is known as **analogue data**. Most control and monitoring applications use devices called **sensors** to measure these physical, analogue quantities. Examples of sensors and their use in monitoring and control applications are discussed in Chapter 7.



Figure 5.5 Examples of analogue devices

However, computers can only understand and manipulate digital data.

Analogue data would not make any sense to the computer and may even cause some damage. To enable data in analogue form (often the input from a sensor) to be processed by a computer, it needs to be changed into a digital form. This is done using an **analogue to digital converter (ADC)**.

Alternatively, if the computer is being used to control a device, such as a motor or a valve, the device may need to be controlled by continuously variable voltages. There would be no use sending out a digital signal. It would first need to be changed into an analogue signal, requiring another device, known as a **digital to analogue converter (DAC)**.

Example of a control system

This example shows why there is a need to convert analogue to digital and also digital to analogue as part of control system involving a computer:

Figure 5.6 shows a computer being used to control a furnace heated by burning gas supplied from a gas source (the amount of gas is controlled by a valve which can have an infinite number of positions).

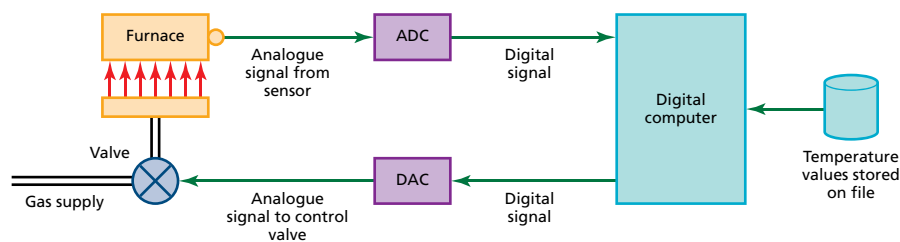


Figure 5.6 Control system for a furnace

A sensor is used to measure temperature in the furnace and it sends readings in analogue form (small electric currents/voltages). This data is converted into digital by an ADC and is fed to a computer, which compares the input temperature with the required temperature stored on a file. If any action is needed (furnace temperature is too low or too high) then a digital signal is sent out from the computer. This signal is converted into an electric current/voltage (i.e. analogue) so that the valve can be regulated (i.e. opened or closed to control the gas supply and hence the furnace temperature).