
Analog vs. Digital
The Final Battle

Analog and Digital Signals

- Are these Analog or Digital?
  - Volume control on a Radio
  - Traffic Lights
  - Motor bike throttle
  - Dimmer switch
  - Light switch
  - Water Tap
  - Music on a CD
  - Music on atap

Analog and Digital Signals

- We seem to live in an analog world- things can be louder or quieter, hotter or colder, longer or shorter, on a “sliding scale”.

- Digital signals aren’t on a sliding scale-they’re either ON or OFF (We call these “1” and “0”). There is no “in between”.

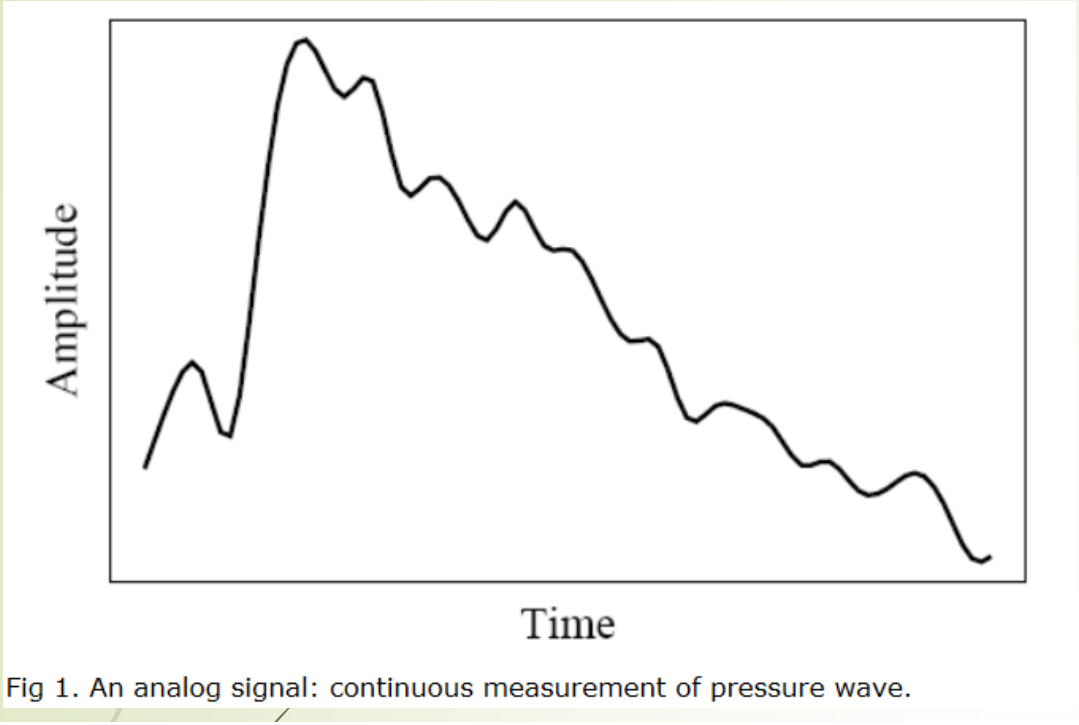


Fig 1. An analog signal: continuous measurement of pressure wave.

An analog signal is a signal that can be continuously, or infinitely, varied to represent any small amount of change.

Example:

A digital thermostat in a room displays a temperature of 72°. An analog thermometer measures the room temperature at 72.482°. The analog value is continuous and more accurate, but the digital value is more than adequate for the application and significantly easier to process electronically.

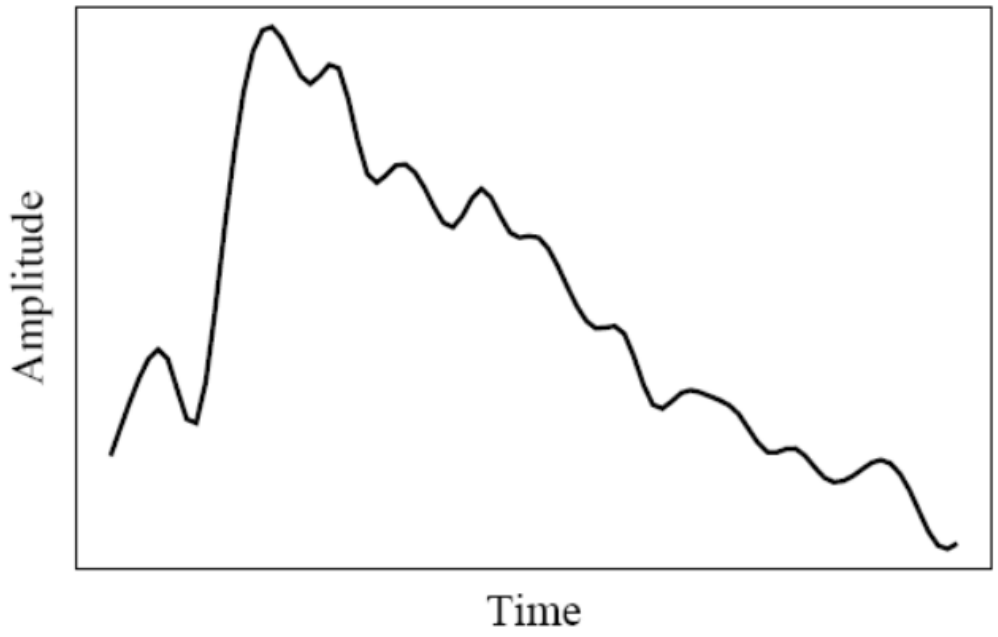
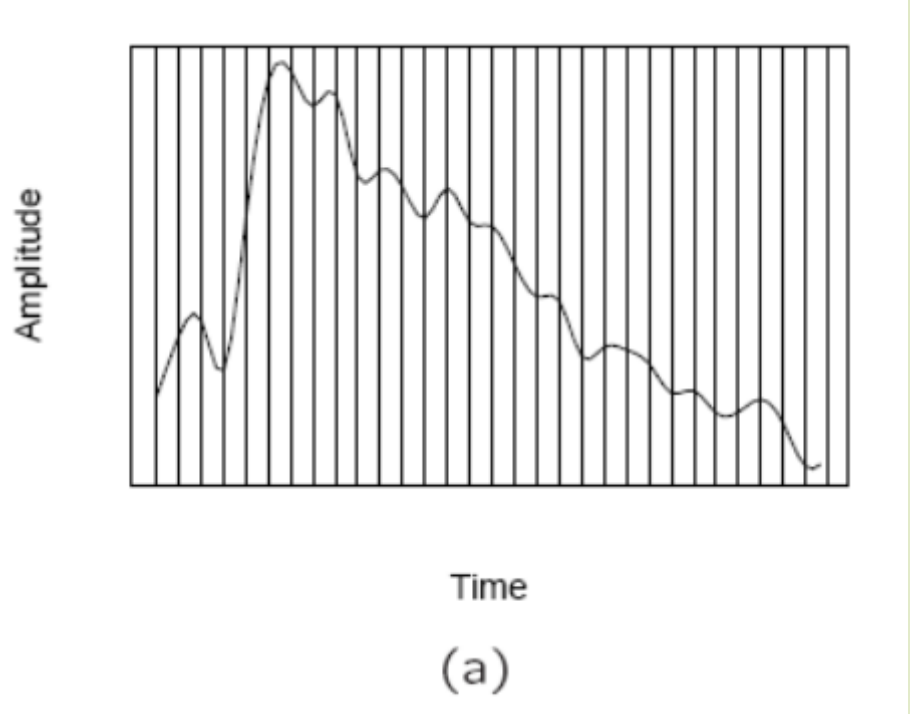
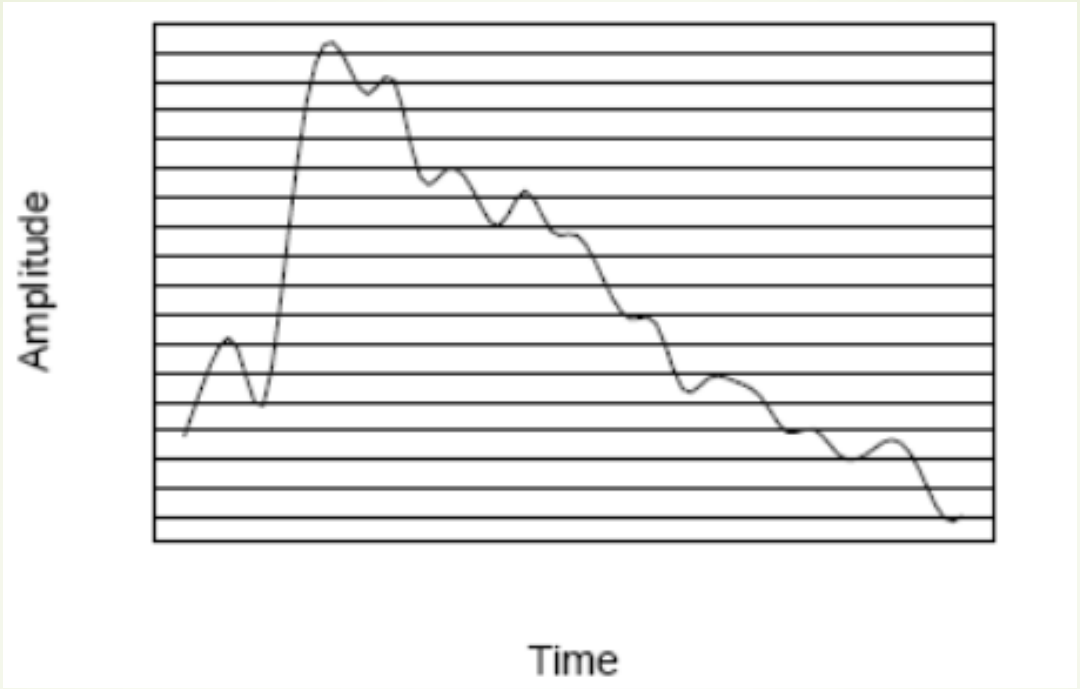


Fig 1. An analog signal: continuous measurement of pressure wave.

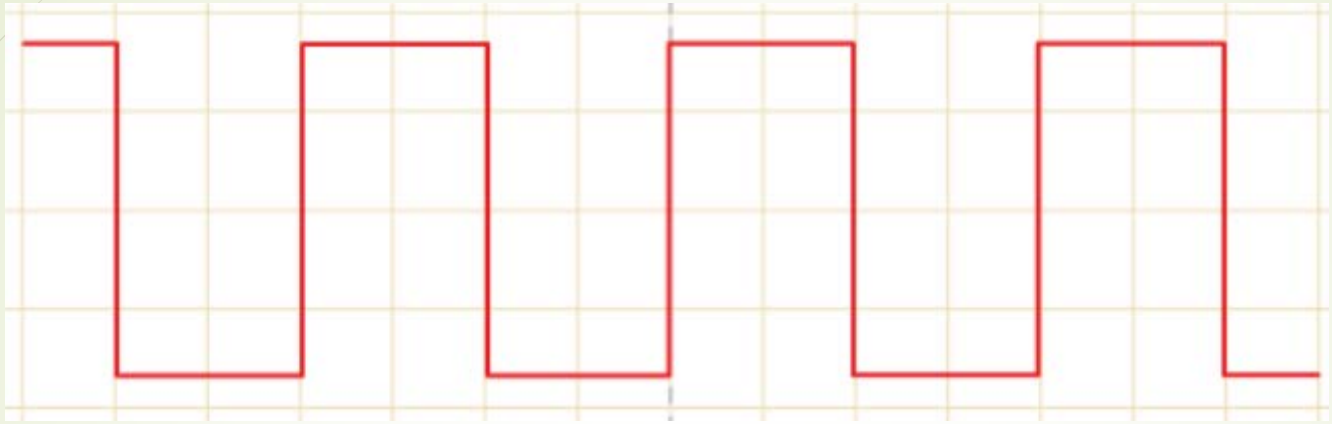


Sampling the analog signal in the time dimension

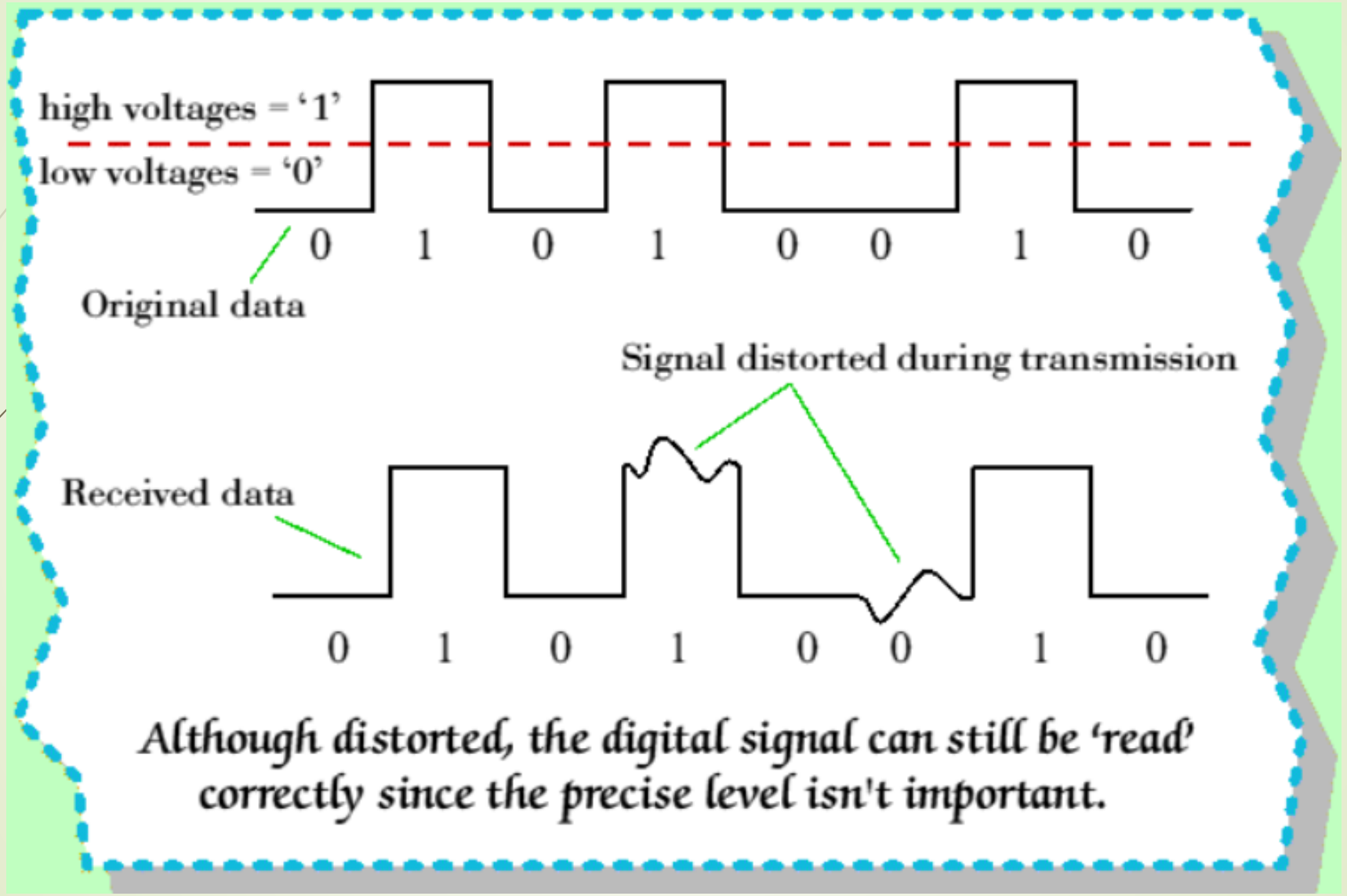
Signals that are discrete in time but continuous in amplitude are referred to as discrete-time signals.



Quantization is sampling the analog signal in the amplitude dimension.

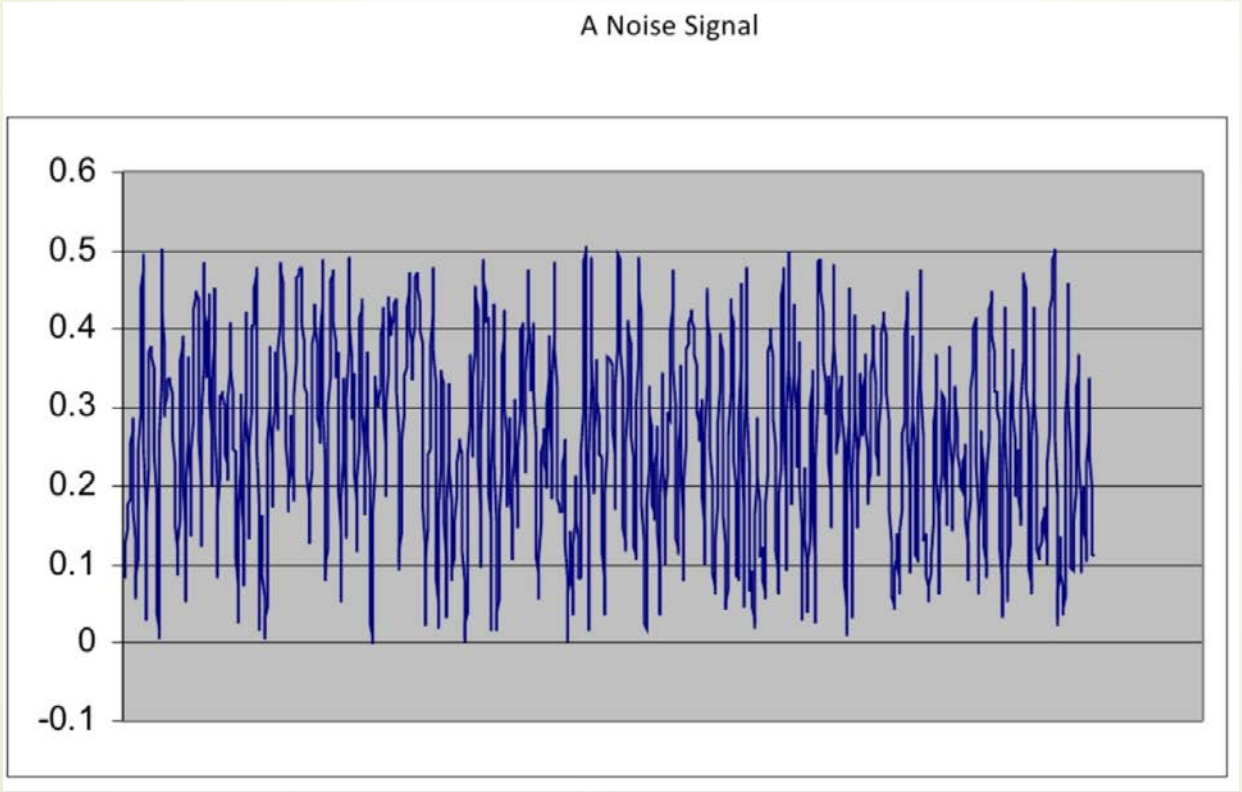


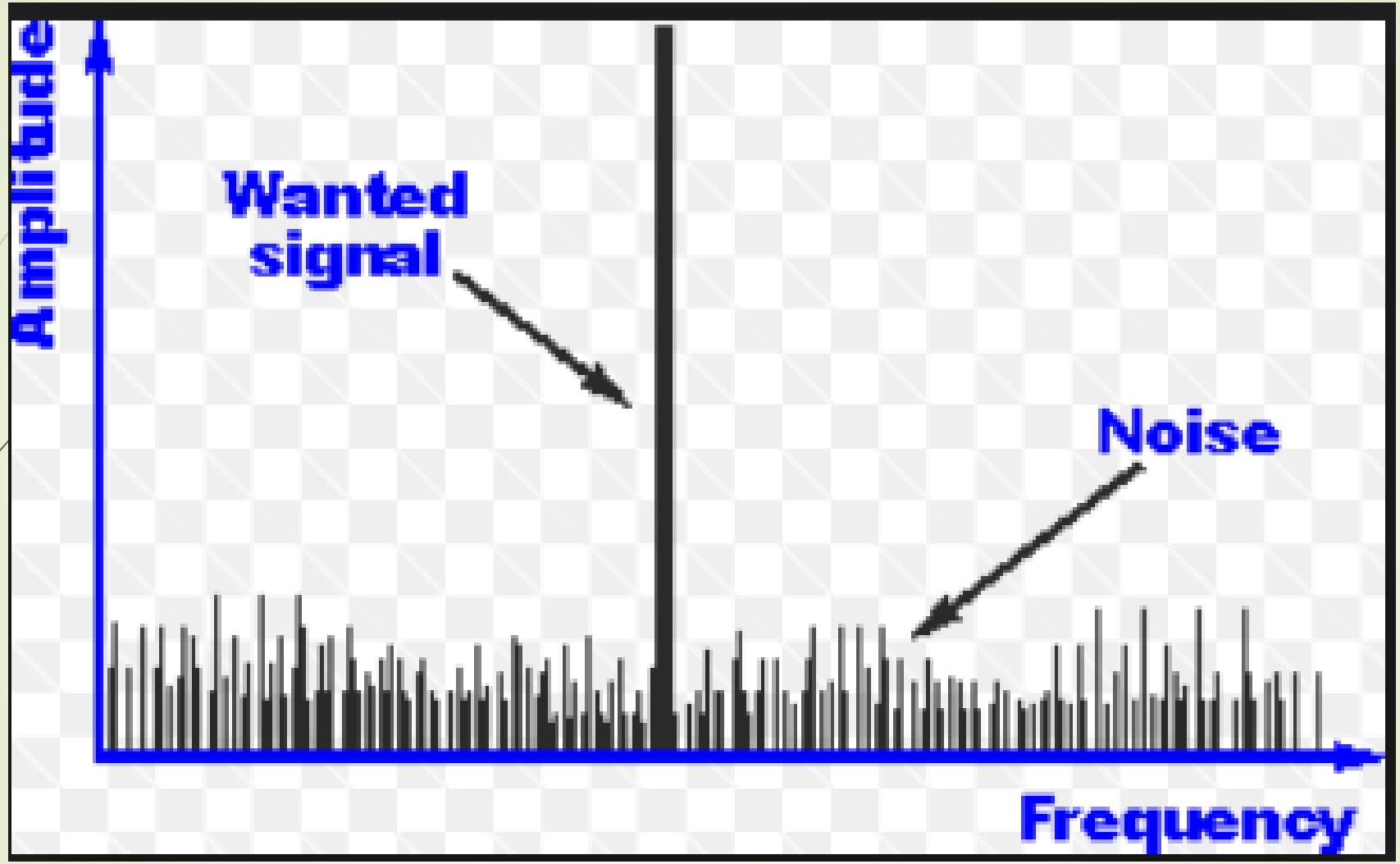
Digital signals are discrete in both time and amplitude

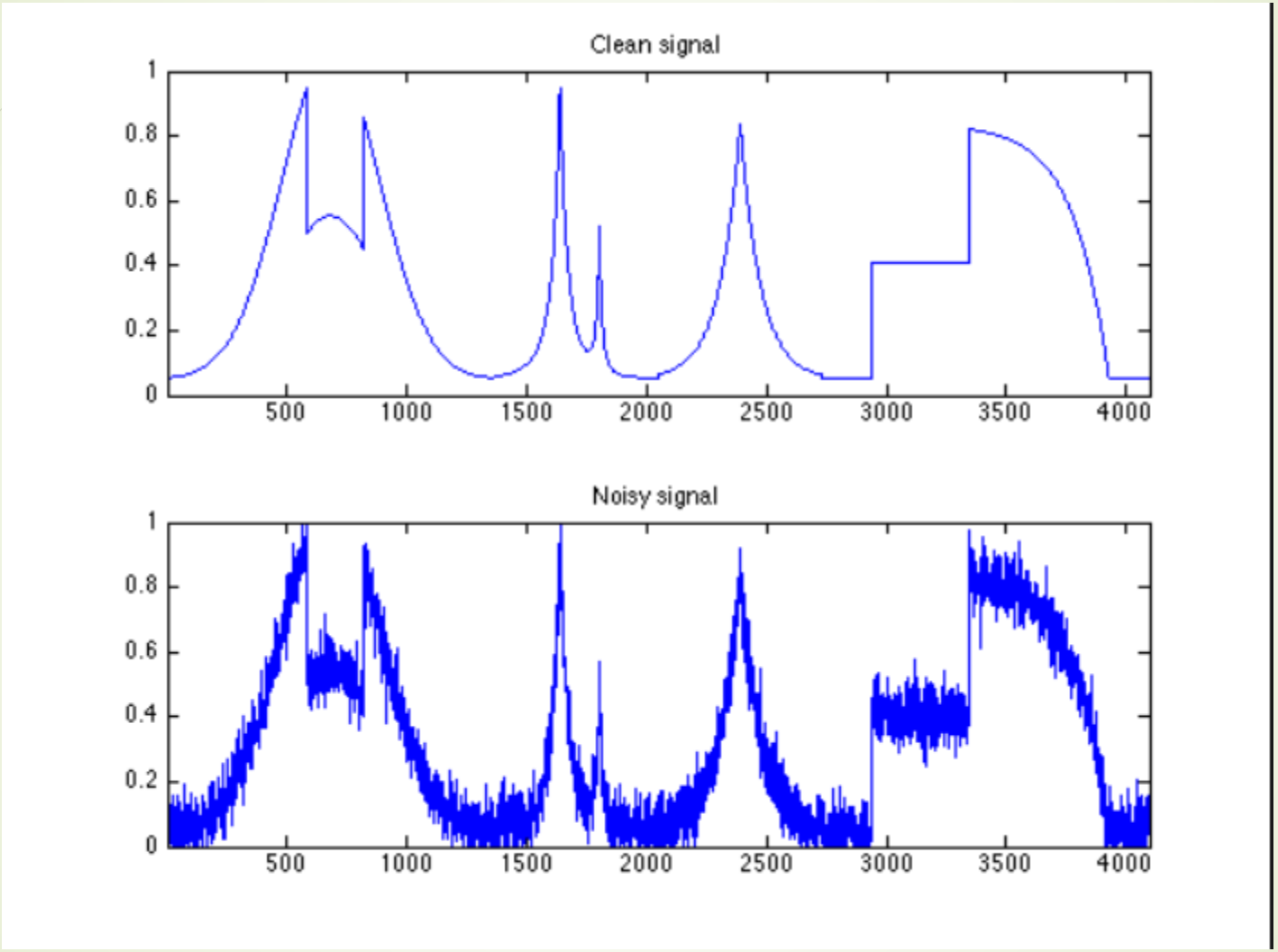

high voltages = '1'
low voltages = '0'
0 1 0 1 0 0 1 0
Original data
Signal distorted during transmission
Received data
0 1 0 1 0 0 1 0
Although distorted, the digital signal can still be 'read' correctly since the precise level isn't important.

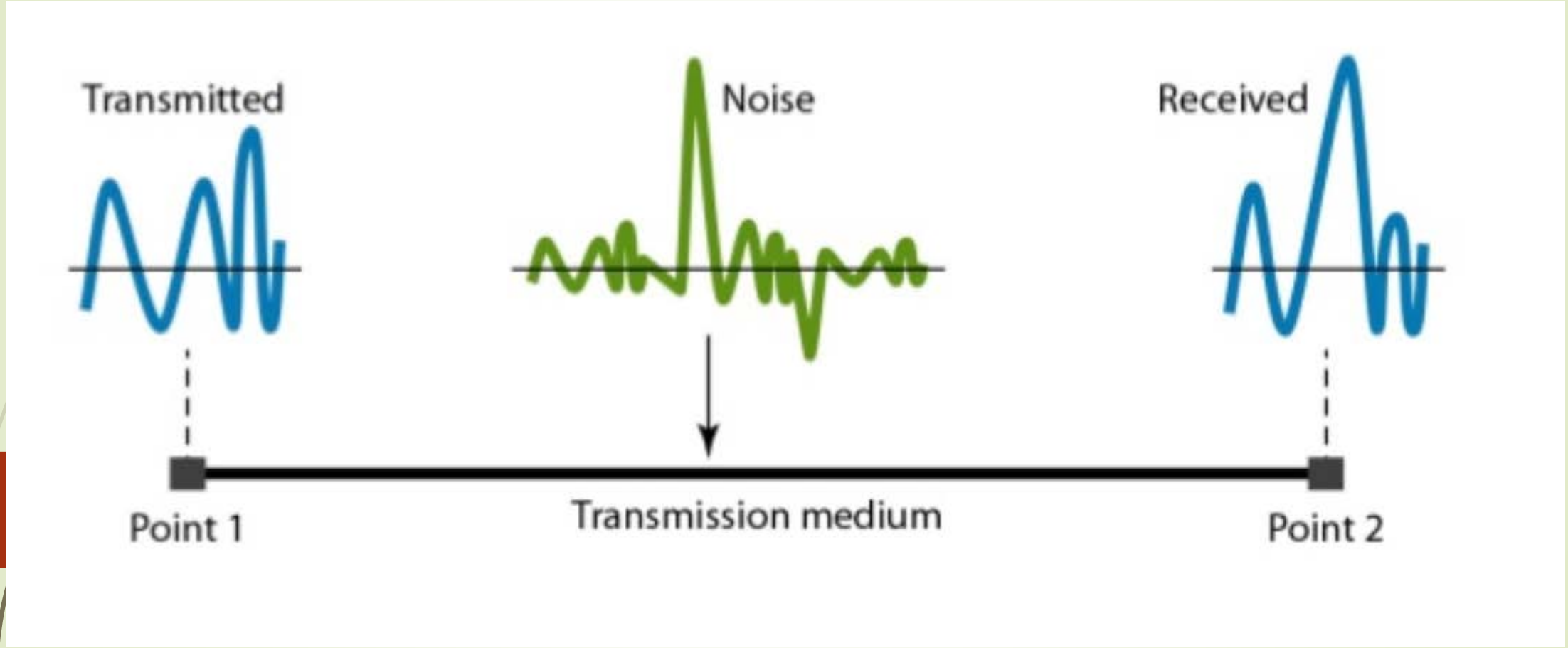
The problem with analog signals is noise-

-hiss on the sound and speckly dots on the picture



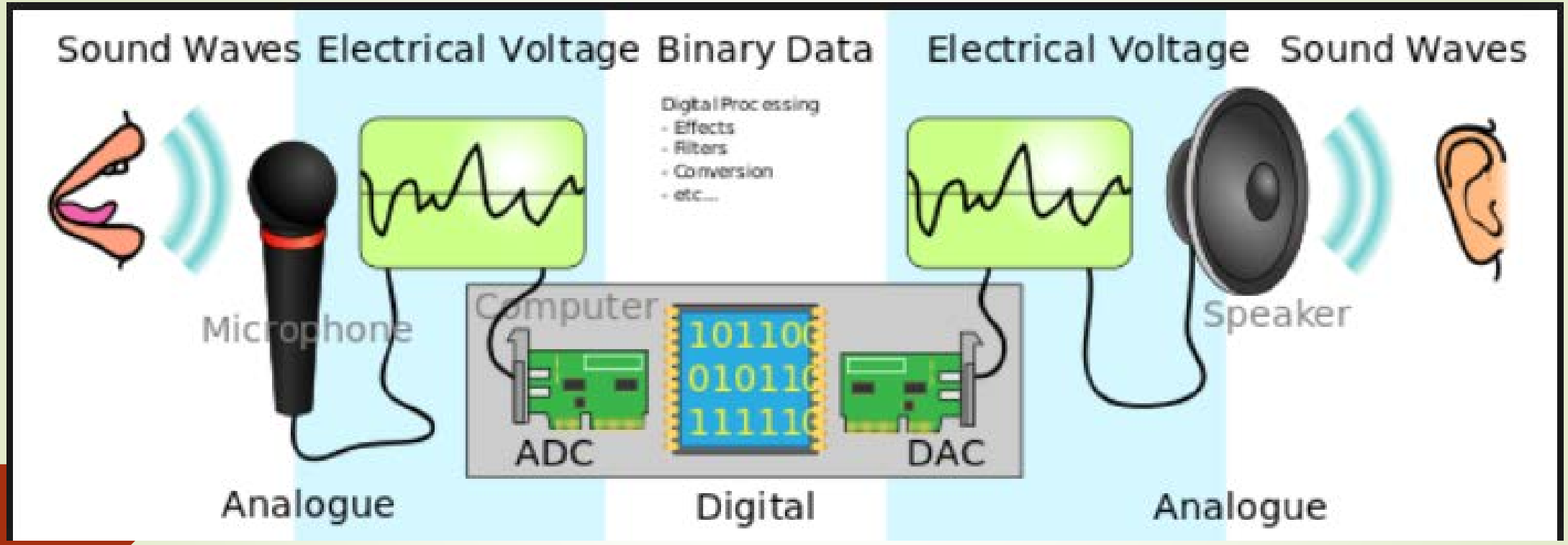

Amplitude
Wanted signal
Noise
Frequency


Clean signal
1
0.8
0.6
0.4
0.2
0
500
1000
1500
2000
2500
3000
3500
4000
Noisy signal
1
0.8
0.6
0.4
0.2
0
500
1000
1500
2000
2500
3000
3500
4000


Transmitted
Noise
Received
Point 1
Transmission medium
Point 2

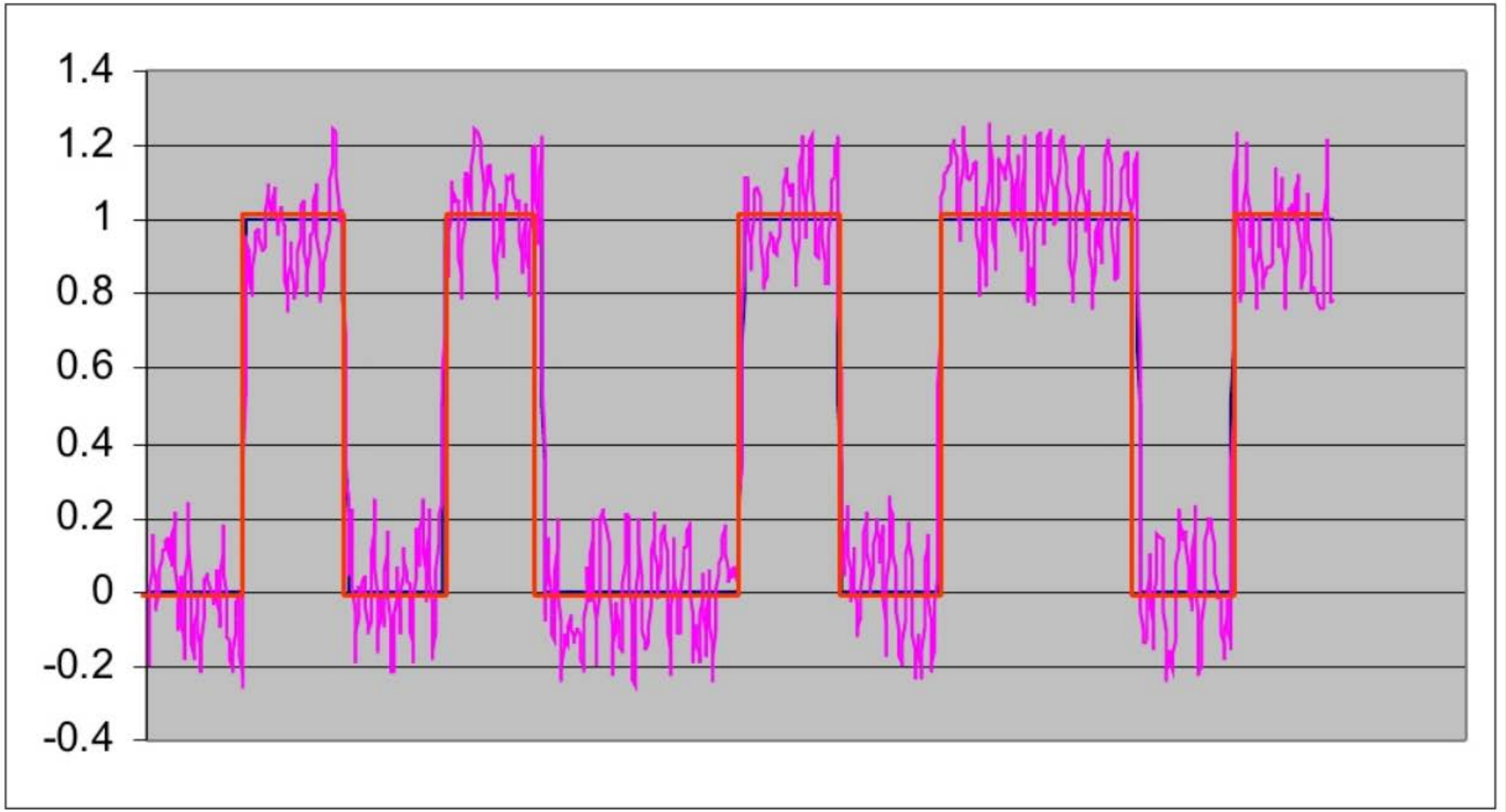
When we send a signal over a long distance, the signal gets weaker, so we need to boost (amplify) it.

The problem is that we end up boosting the noise as well.


Sound Waves
Electrical Voltage
Binary Data
Electrical Voltage
Sound Waves
Digital Processing
- Effects
- Filters
- Conversion
- etc...
Microphone
Computer
101100
010110
111110
ADC
DAC
Speaker
Analogue
Digital
Analogue

- If we convert the signal into digital form, then send it, it still gets weaker and noise still creeps in.

  However, because its digital, the receiver can work out what the signal is supposed to look like behind all that noise, and reconstruct a “clean” signal.



The signal only consists of ‘1’s and ‘0’s so it can be recovered exactly.
This can be done as many times as necessary.

Analog and Digital Signals

Analog Signals

- Continuous
- Infinite range of values
- More exact values, but more difficult to work with

Digital Signals

- Discrete
- Finite range of values (2)
- Not as exact as analog, but easier to work with

Digital technology, breaks the signal into binary format, where audio or video data is represented by a series of "1"s and "0"s.

A. True

B. False

Laptops, touch screen, Ipod, Compact Discs and DVD's are good examples of digital technology.

A. True

B. False

In the analog format, the translation of data may vary in amplitude.

A. ◯ True

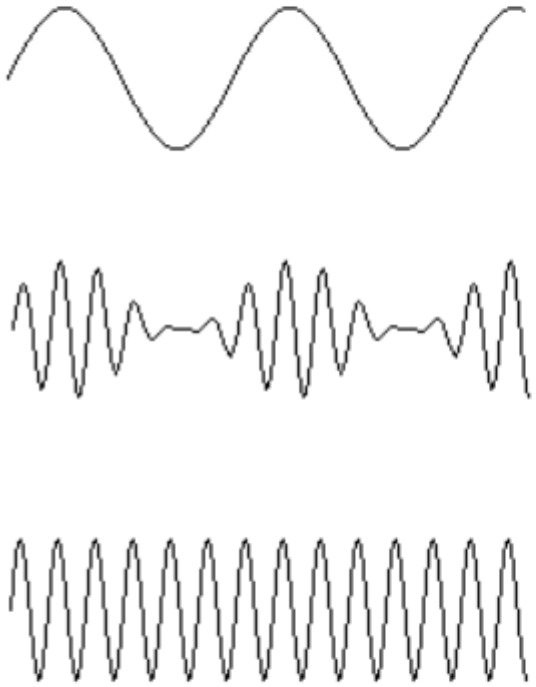
B. ◯ False

In **digital technology**, the analog wave is **sampled** at some interval, and then turned into **numbers** that are stored in the digital device.

A. ◯ True

B. ◯ False

This is how analog signal looks like.



A. True

B. False

Digital offers better clarity, but analog gives you richer quality.

A. True

B. False

In **analog technology**, a wave is recorded or used in its original form.

A. True

B. False

What is an analog signal?

- ○ A signal made of physical waves (like light or sound)
- ○ A signal made of electrical impulses OR physical waves
- ○ A signal made of electrical impulses
- ○ None of the other answers are correct