

Introduction to Computer Science

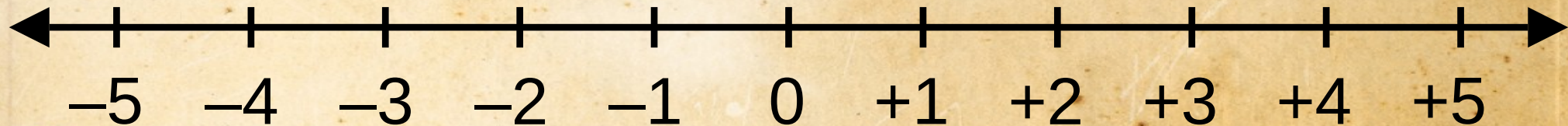
Analog vs Digital

Lecture Contents

- Vocabulary:
 - discrete, continuous, analog, digital
 - transmitter, receiver, repeater

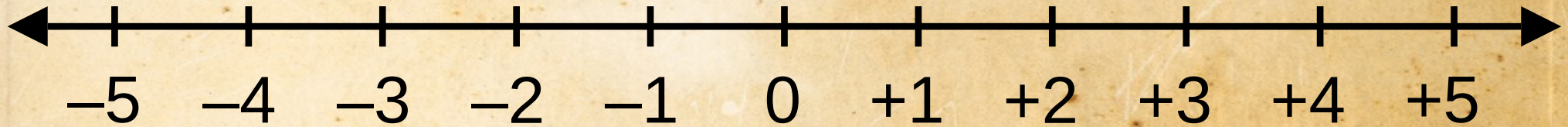
Vocabulary - *continuous*

- Information that is *continuous* can take any value within a range, with no gaps.
 - The real numbers
 - The real numbers between -5 and $+5$
 - Many natural values: temperature, time, distance, sound volume ...



Vocabulary - *discrete*

- Information that is *discrete* takes on only set values within a range, with no gaps.
 - The integers
 - The integers between -5 and $+5$
 - Things we count: classmates, atomic number, cells, sides on a polygon, ...

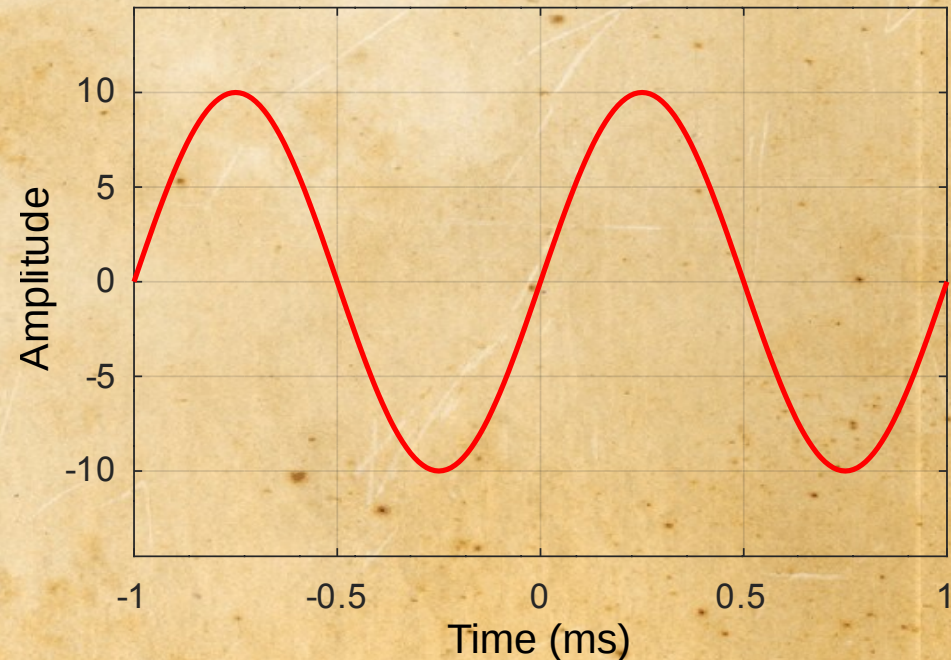


Vocabulary - *analog*

- An *analog* signal is represented by values that are *continuously* variable.
 - Sound waves (voice), radio waves
 - Electronic voltages and currents
 - Light intensity
 - Paintings, images on film or paper

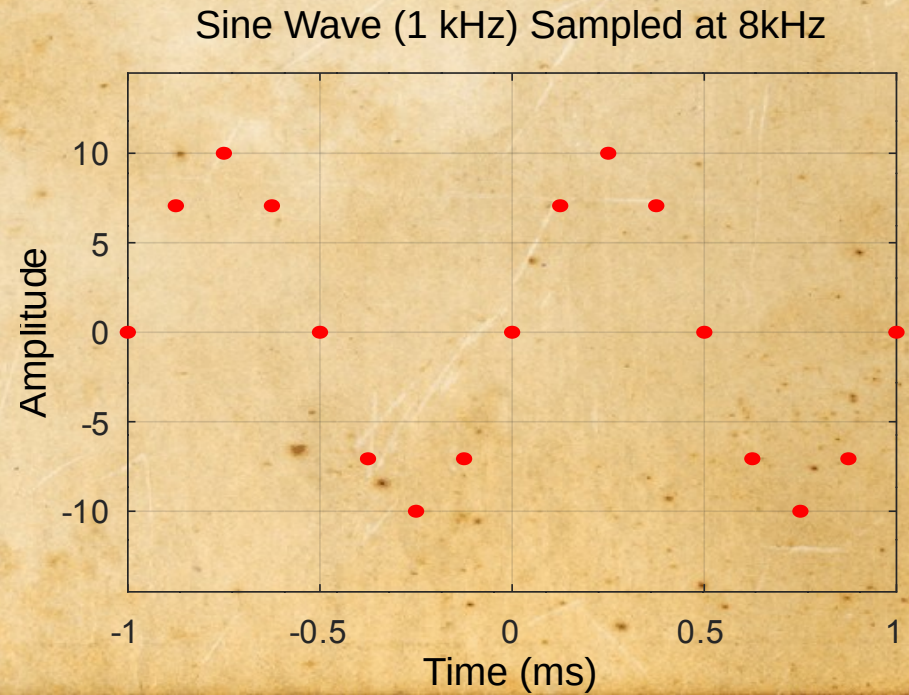
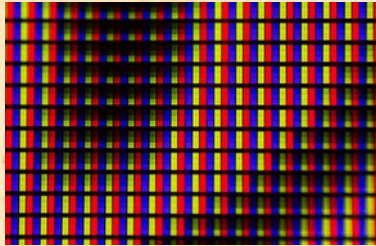


Sine Wave (1 kHz)



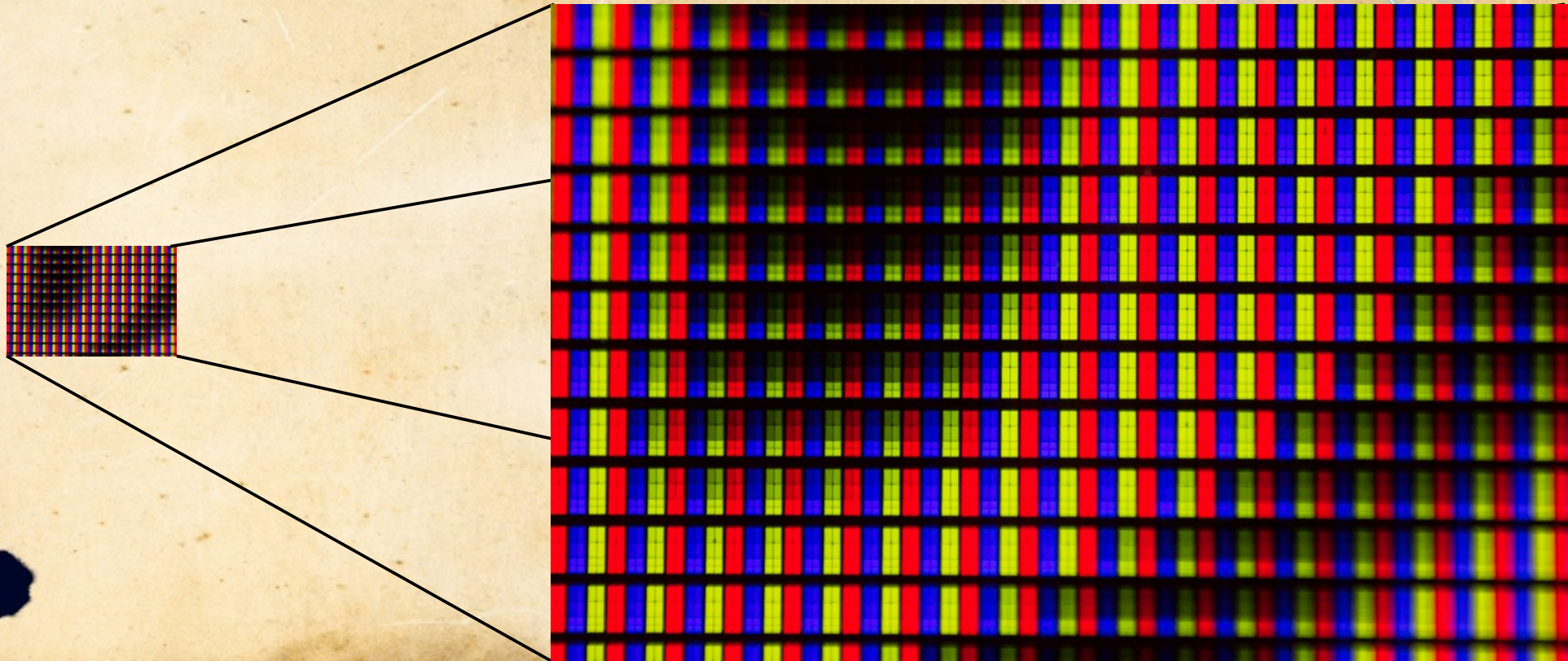
Vocabulary - *digital*

- An *digital* signal is represented by a set of *discrete* values.
- Real-world analog signals are often converted into digital signals
 - Digital audio, video, photos
 - mp3 audio, mp4 video, jpg, png
 - Digital Computers



Vocabulary - *digital*

- An *digital* signal is represented by a set of *discrete* values.



Examples of *analog* and *digital* devices

- *Analog*

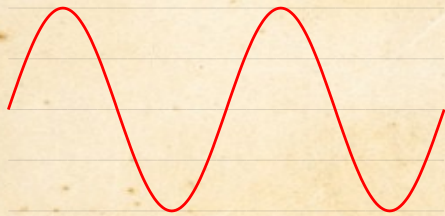


- *Digital*



Noise

- Transmitted signals lose power as they travel
 - There is a limited distance we can transmit



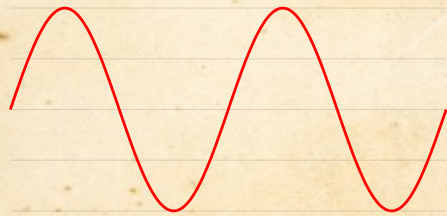
transmitter



receiver

Noise

- Transmitted signals lose power as they travel
 - We can send further by receiving the signal and re-transmitting it.
 - This is done by a *repeater*.



transmitter



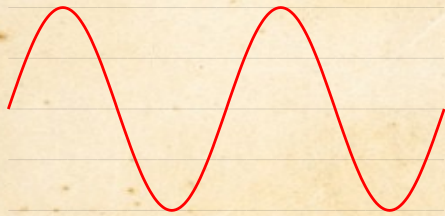
repeater



receiver

Noise

- Unfortunately, when we also receive noise.
 - Noise is from weather, outer space, interference, the circuitry, etc...



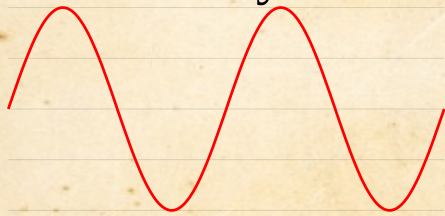
transmitter



receiver

Noise

- Unfortunately, when we also receive noise.
 - Noise is from weather, outer space, interference, the circuitry, etc...
 - When we amplify the signal, we also amplify the noise.
 - Every time we need to repeat, the signal gets more noisy.



transmitter

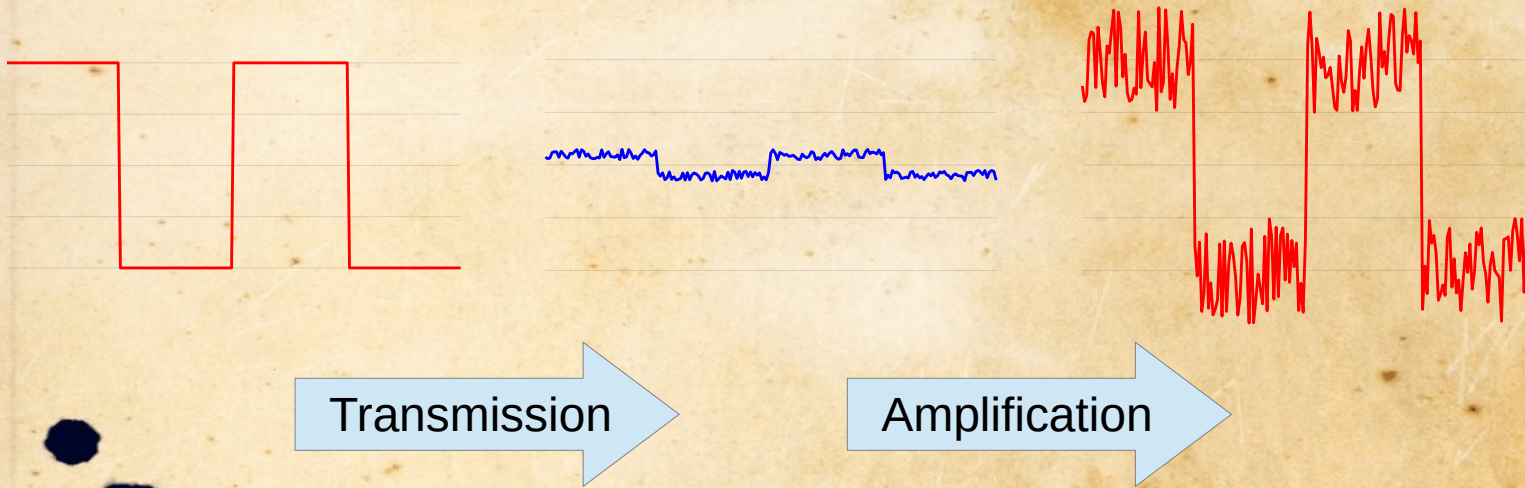


receiver



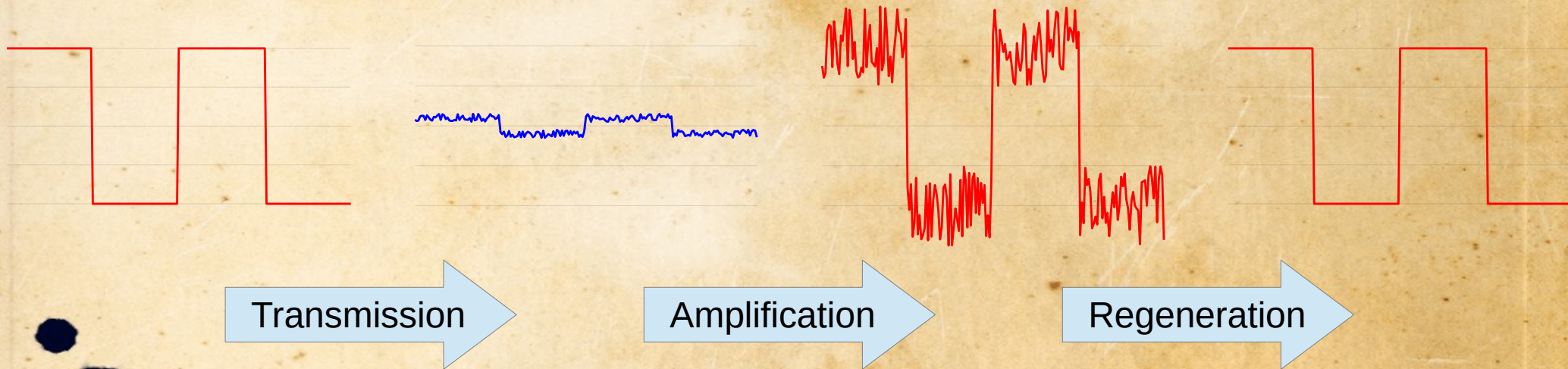
Noise

- Digital signals also pick up noise...



Noise

- Digital signals also pick up noise...
 - But with a **digital repeater**, we can **regenerate** the original signal because only certain values are valid.



With a **digital repeater**, we get a clean, fresh copy of the original signal!
(It can still be a problem when the noise overwhelms the signal.)

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