COMP120: Creative Computing: Tinkering

7: An Introduction to Digital Sound

Learning outcomes

- **Recognise** how audio is used in games
- **Explain** what sound is and how it can be represented digitally
- **Write** a program that will produce a sound

FALMOUTH
UNIVERSITY

Introduction

https://www.youtube.com/watch?v=oF7POPv1GyQ

FALMOUTH
UNIVERSITY

How are sounds used in Games?

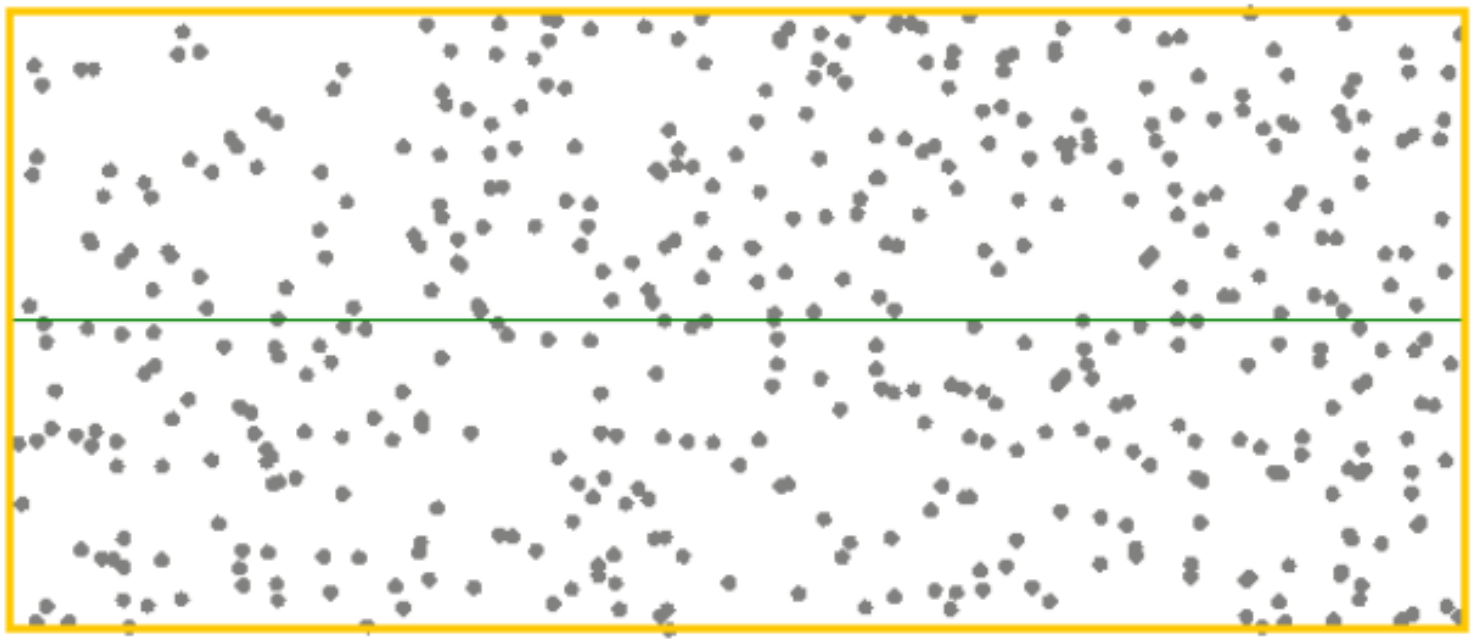
- For the next 10 mins, in pairs:
  - Discuss one or two games that use sounds in an interesting way
  - What was interesting about the use?

FALMOUTH
UNIVERSITY

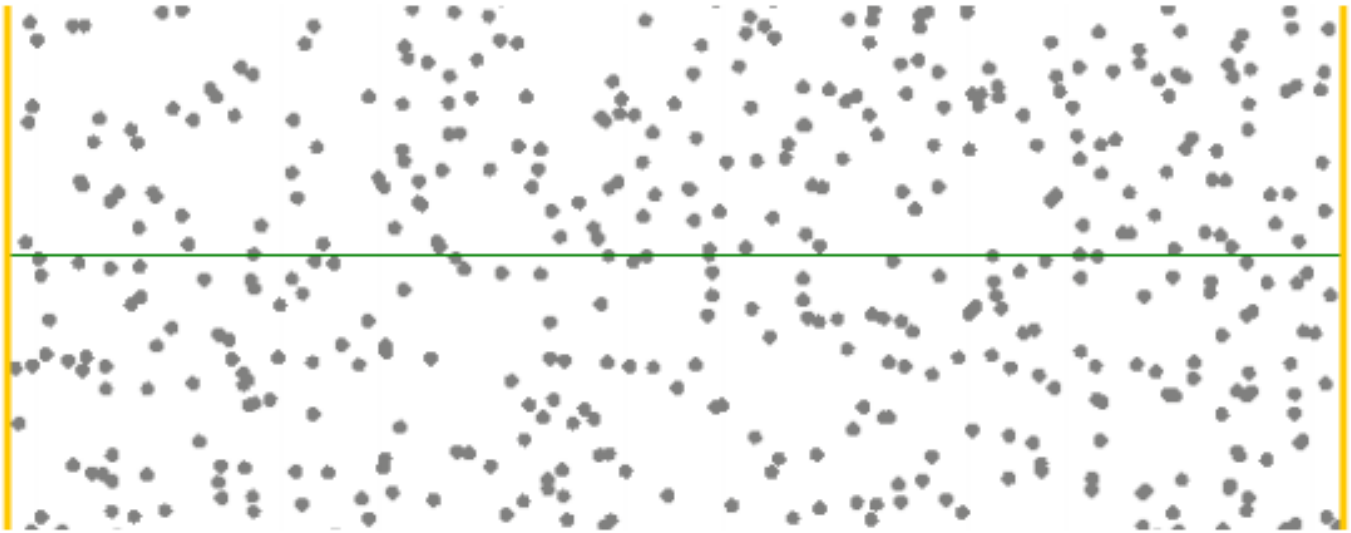
What is sound? What is a wave?

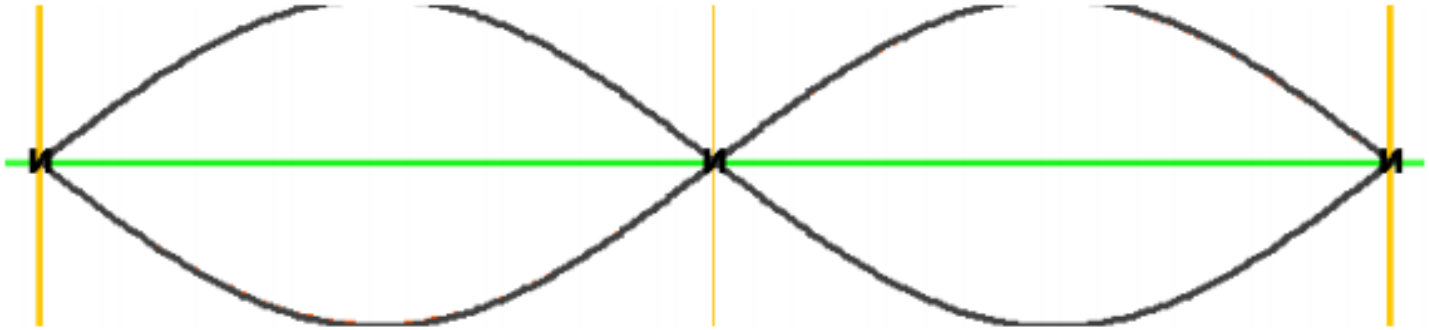
Quick Definition: A wave of compression and refraction in an elastic medium, such as air, which can be detected by an animals sense of hearing

What is Sound?

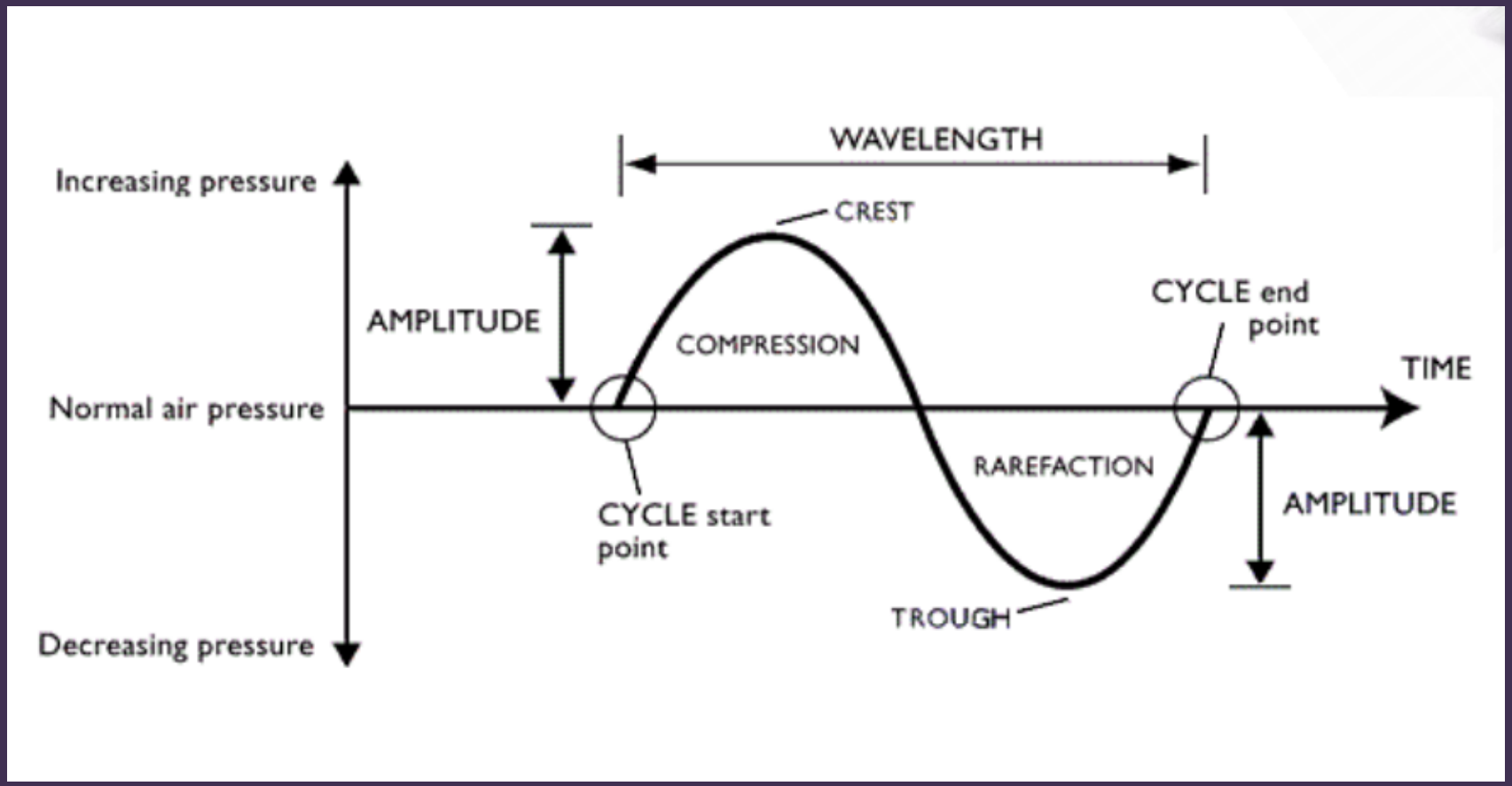


What is a Wave?





What is a Wave?



What is Sound?

What is Sound?

- Many animals are able to sense sound in two key ways: **volume** and **pitch**.

What is Sound?

- Many animals are able to sense sound in two key ways: **volume** and **pitch**.
- **Volume:** The intensity of the change in pressure, as signified by the amplitude of a wave

What is Sound?

- Many animals are able to sense sound in two key ways: **volume** and **pitch**.
- **Volume:** The intensity of the change in pressure, as signified by the amplitude of a wave
- **Pitch:** The frequency of the change, as signified by the length of the wave and its velocity (i.e., the speed of sound)

FALMOUTH
UNIVERSITY

How can sounds be represent digitally?

How Can Sound Be Represented Digitally?

How Can Sound Be Represented Digitally?

- One method is to represent the wave itself and one approach to do this is **L**inear **P**ulse Code **M**odulation (LPCM).

How Can Sound Be Represented Digitally?

- One method is to represent the wave itself and one approach to do this is **L**inear **P**ulse Code **M**odulation (LPCM).
  - An array of integers is created

How Can Sound Be Represented Digitally?

- One method is to represent the wave itself and one approach to do this is **L**inear **P**ulse Code **M**odulation (LPCM).
  - An array of integers is created
  - The value of these integers represents the amplitude of the wave

How Can Sound Be Represented Digitally?

- One method is to represent the wave itself and one approach to do this is **L**inear **P**ulse Code **M**odulation (LPCM).
  - An array of integers is created
  - The value of these integers represents the amplitude of the wave
    - With linear coding, the way how bytes correspond to real-world measures - called *quantisation* - is uniform across the range

How Can Sound Be Represented Digitally?

- One method is to represent the wave itself and one approach to do this is **L**inear **P**ulse Code **M**odulation (LPCM).
  - An array of integers is created
  - The value of these integers represents the amplitude of the wave
    - With linear coding, the way how bytes correspond to real-world measures - called *quantisation* - is uniform across the range
  - The positions in the array represent time, and so each element contains a sample of the wave amplitude

How Can Sound Be Represented Digitally?

How Can Sound Be Represented Digitally?

How Can Sound Be Represented Digitally?

- **Sample Rate:** How many samples are taken per second (consequently, how much time is represented by each element in the array)?

How Can Sound Be Represented Digitally?

- **Sample Rate:** How many samples are taken per second (consequently, how much time is represented by each element in the array)?
- **Bit Depth:** How many bits are available to represent the value?

How Can Sound Be Represented Digitally?

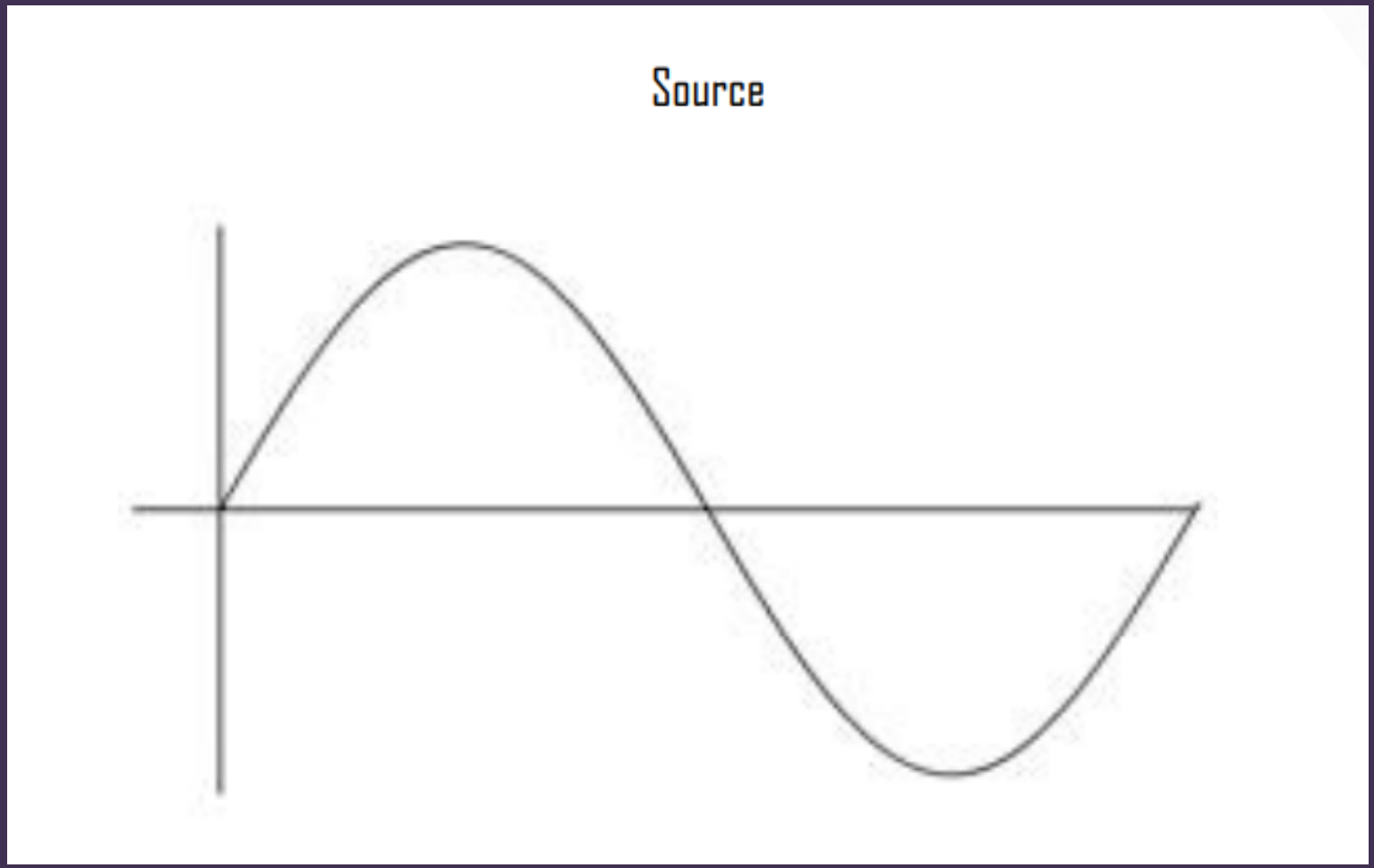
How Can Sound Be Represented Digitally?

- **Sample Rate:** i.e., range of frequencies which can be recorded array)?

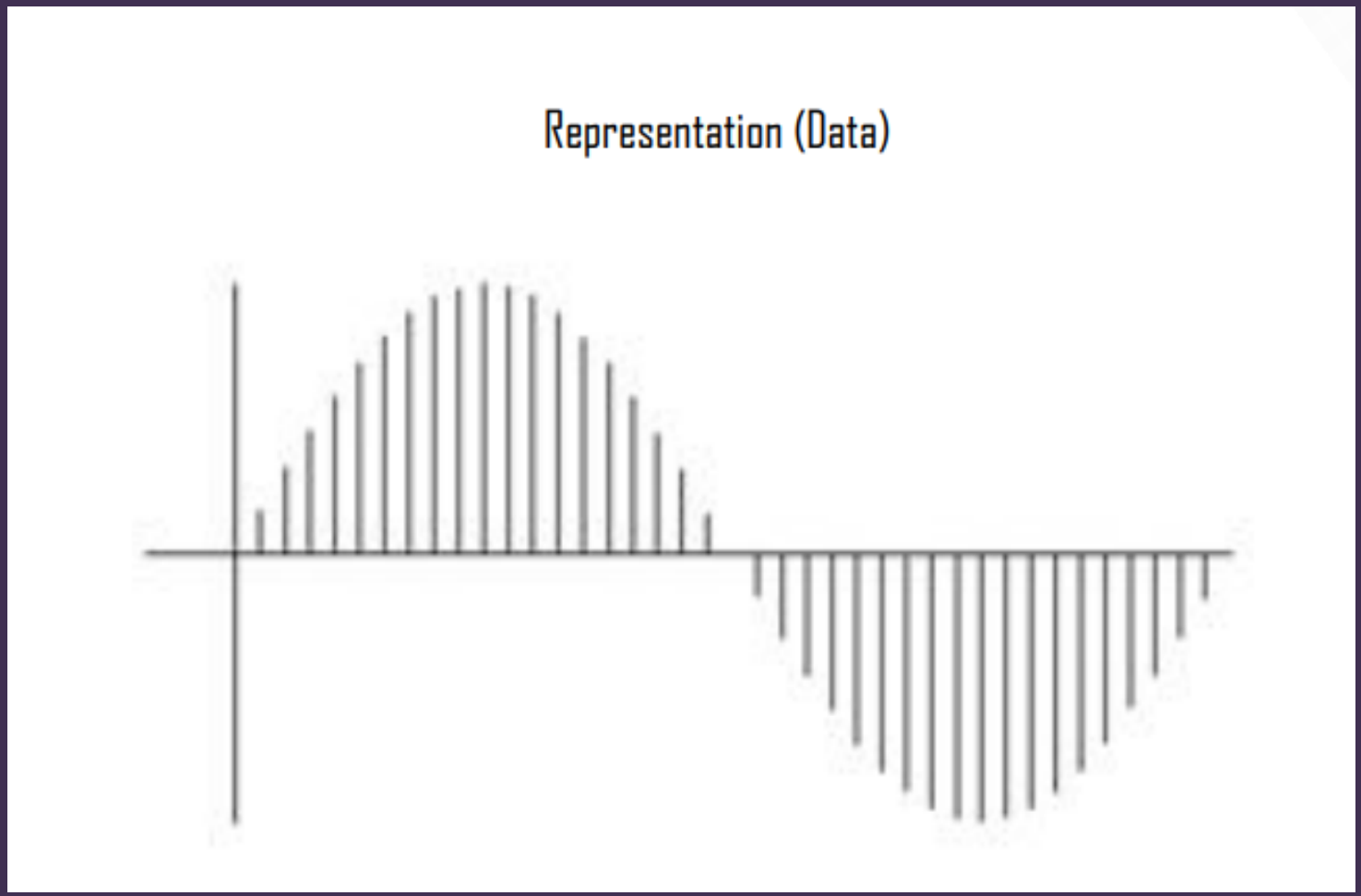
How Can Sound Be Represented Digitally?

- **Sample Rate:** i.e., range of frequencies which can be recorded array)?
- **Bit Depth:** i.e., the number of amplitude levels which can be represented

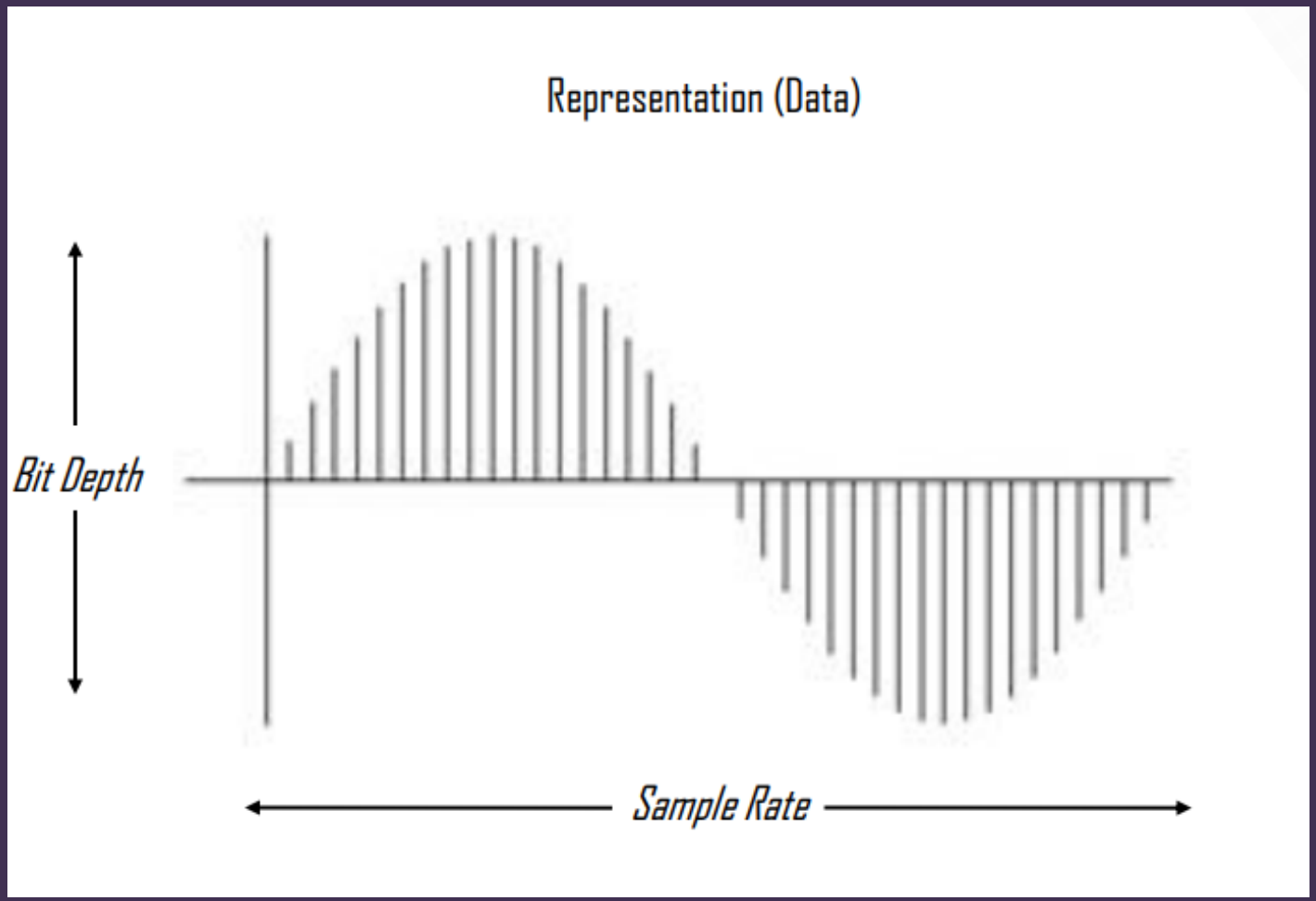
How Can Sound Be Represented Digitally?



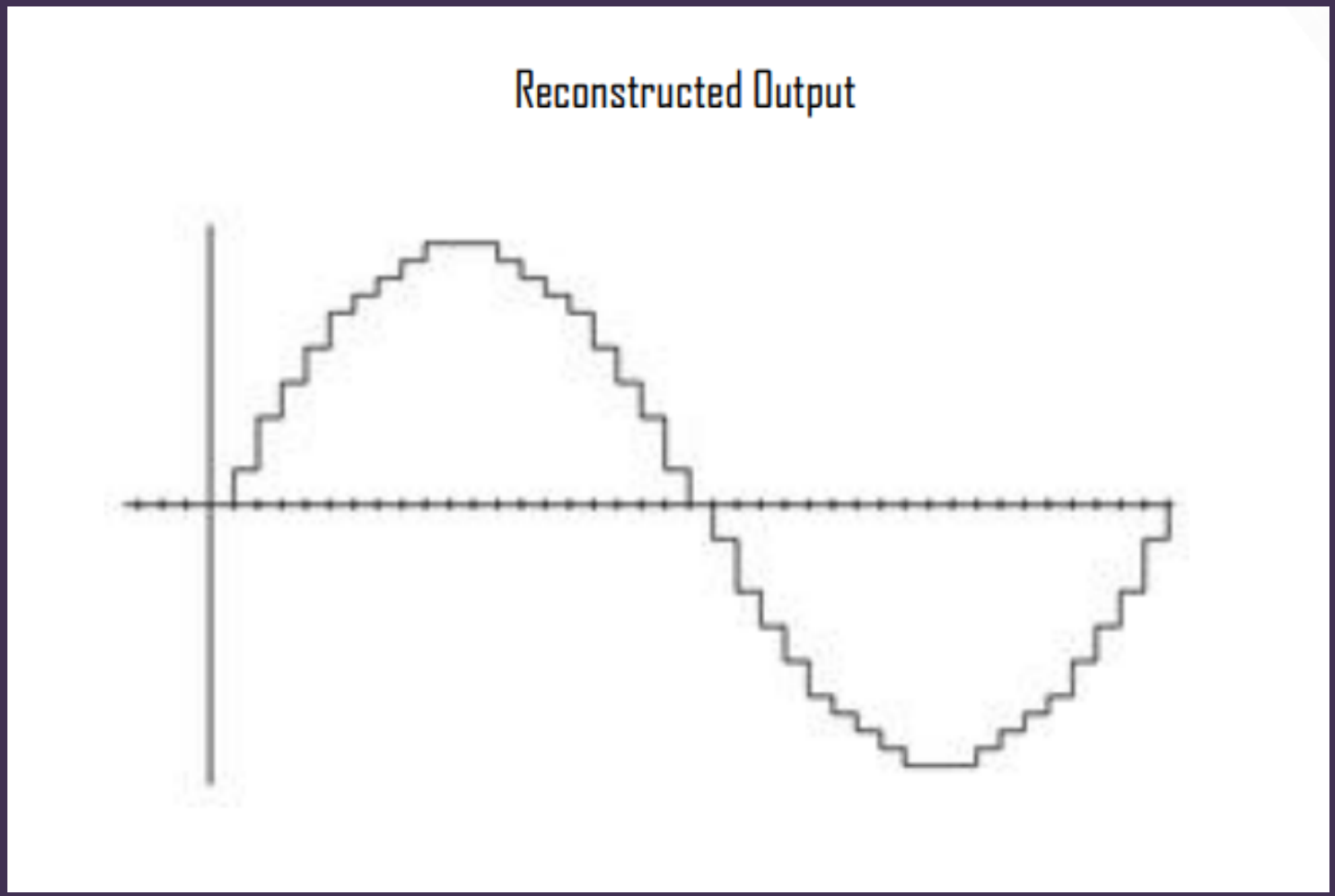
How Can Sound Be Represented Digitally?



How Can Sound Be Represented Digitally?



How Can Sound Be Represented Digitally?



FALMOUTH
UNIVERSITY

Can I write a program to create sound

Live Coding - Pygame Mixer

Exercise 1 - Playing sound and Music

1. Initialise Pygame and create a basic application which displays a window
2. Initialise Pygame mixer
3. Load some music
4. Play music when a key has been pressed
5. Load in a sound
6. Play sound when a key has been pressed
7. Experiment with some of the mixer and sound functions - `https://www.pygame.org/docs/ref/mixer.html`

Live Coding - SndArray

Live Coding - Save File

Exercise 2 - Manipulating Sound

1. Write an **algorithm** to increase the volume of the sound
2. Write this sound to a new file

Stretch Goal: Generate a tone using the sin() maths function and save this sound to a file

FALMOUTH
UNIVERSITY

Additional Resources

Additional Resources

- **How sound works:**
  `http://www.explainthatstuff.com/sound.html`
- **Frequently Asked Questions:**
  `http://www.sciforums.com/threads/speakers-how-do-they-produce-different-sounds-s97540/`