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

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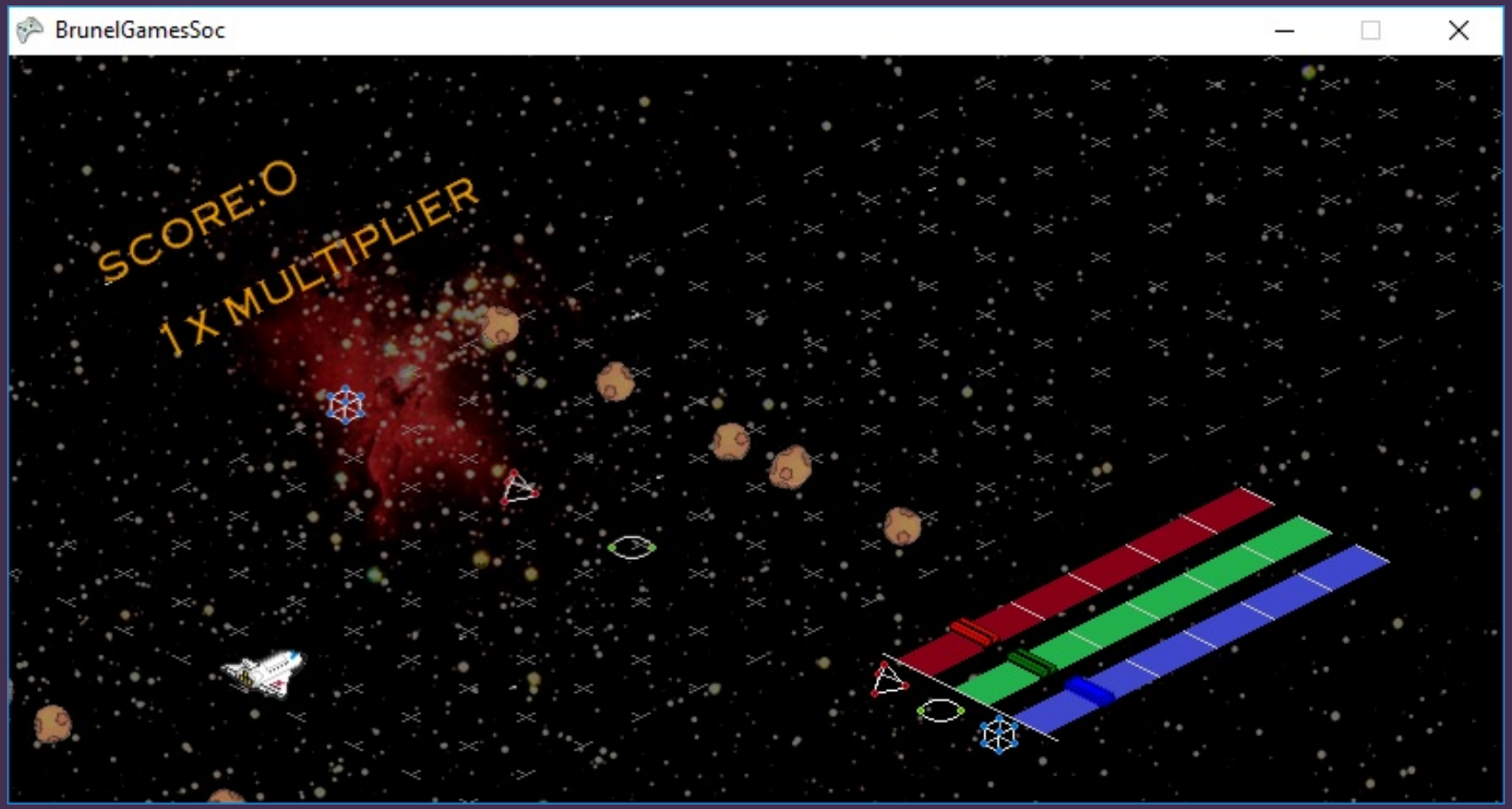
How are sounds used in Games?

Audio in Games



Astroclysm - X48 2008

Audio in Games

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

https://www.dropbox.com/sh/vrodjzp0zerimik/AAA_OSczn YHq9HWgoP0p0K2wa?dl=1

Audio 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?

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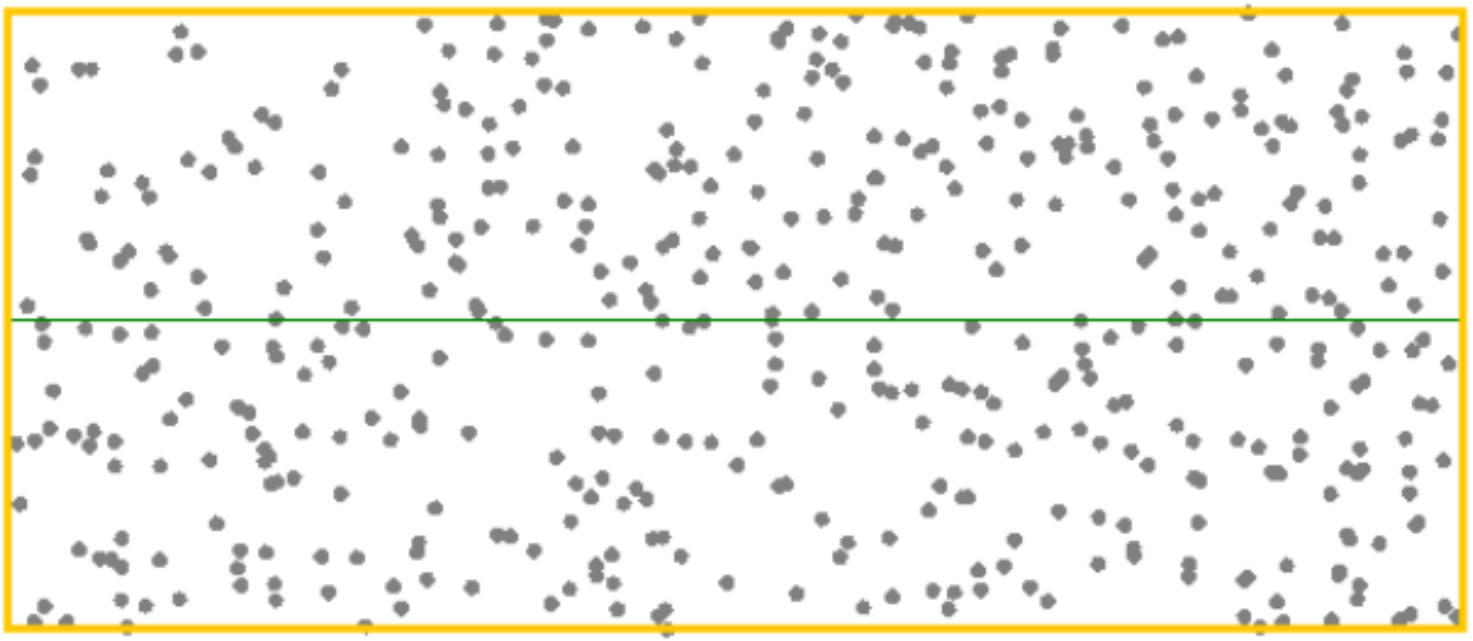
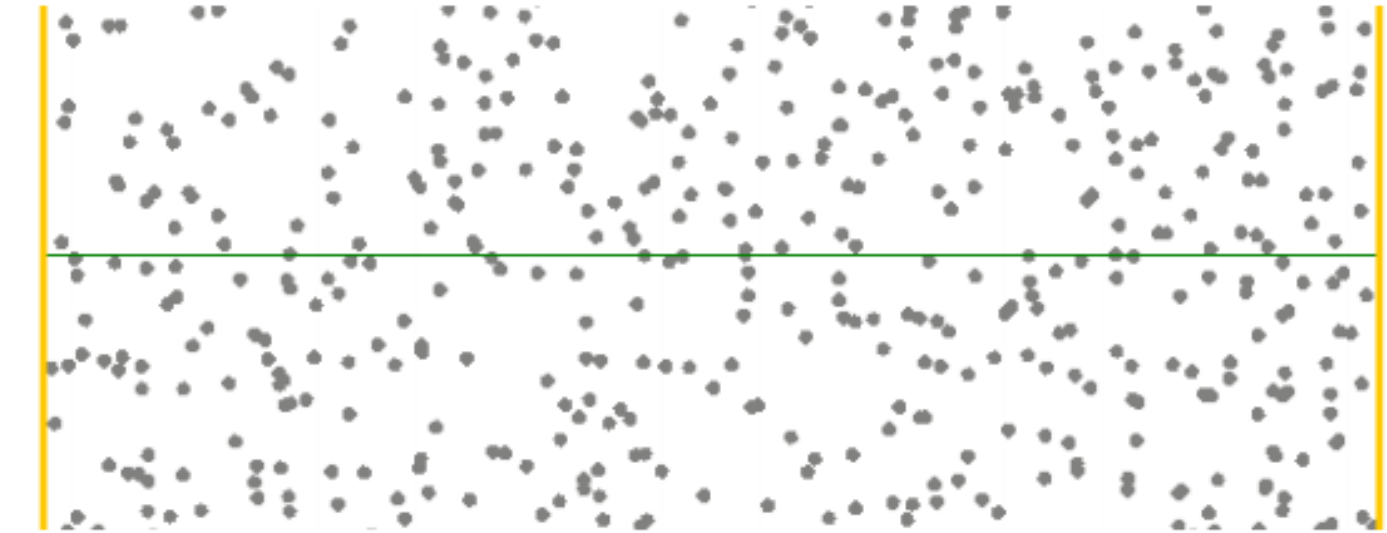
What is sound? What is a wave?

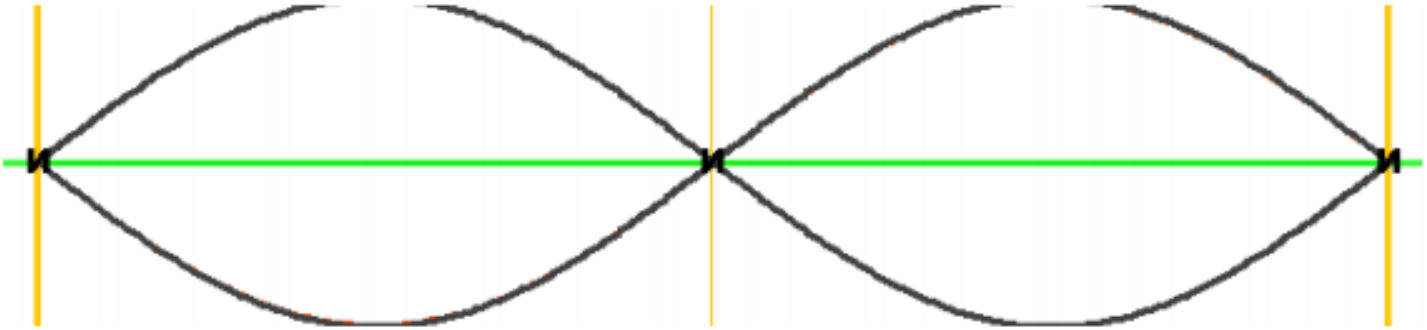
Quick Definition: A wave of compression and refraction in an elastic medium, such as air, which can be detected by an animals sense of hearing

What is Sound?

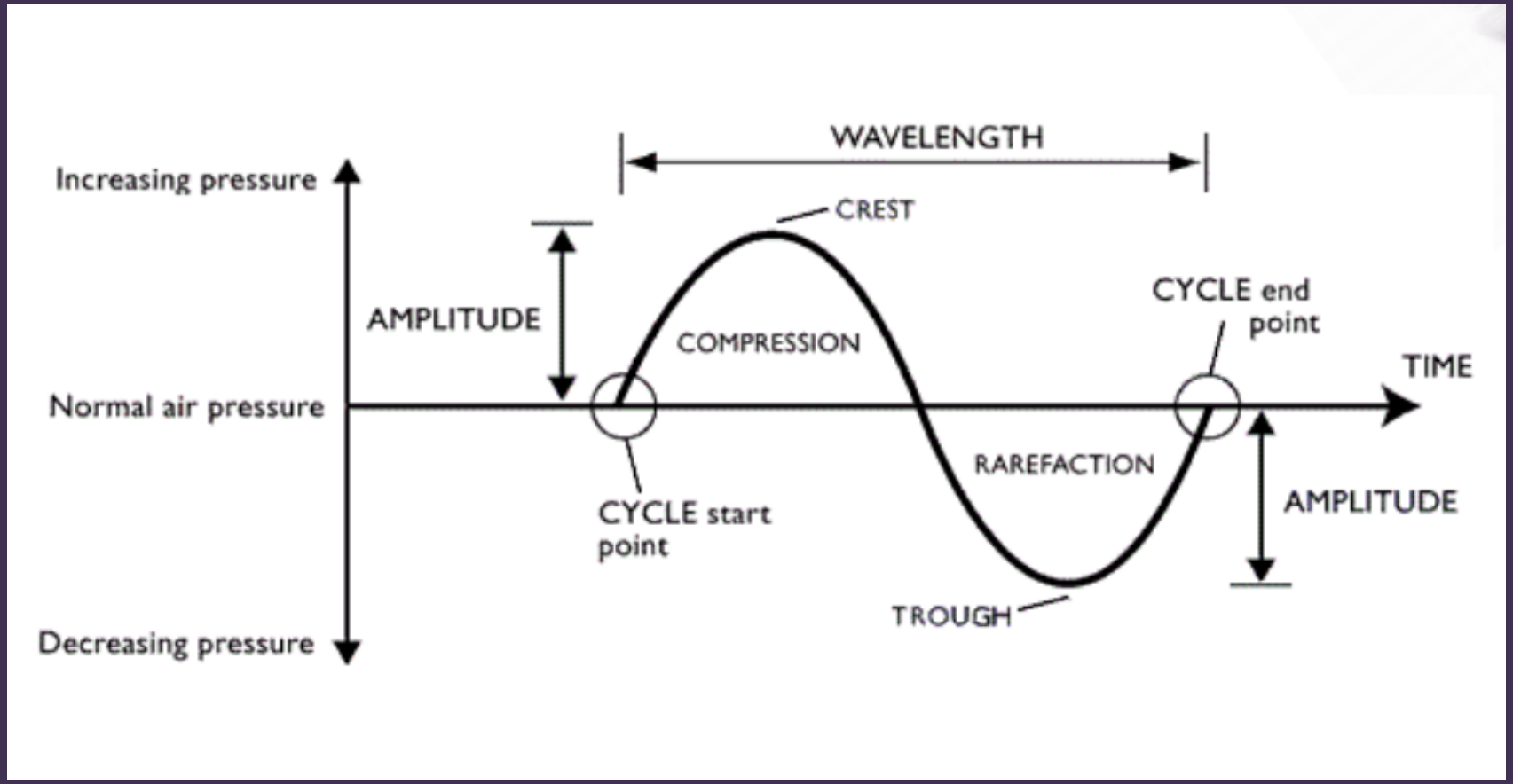


What is a Wave?





What is a Wave?



What is Sound?

- 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)

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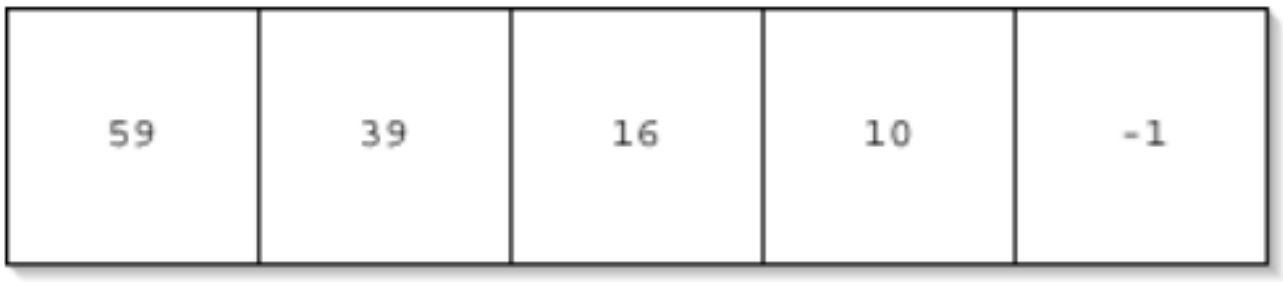
How can sounds be represent digitally?

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).
  - 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?



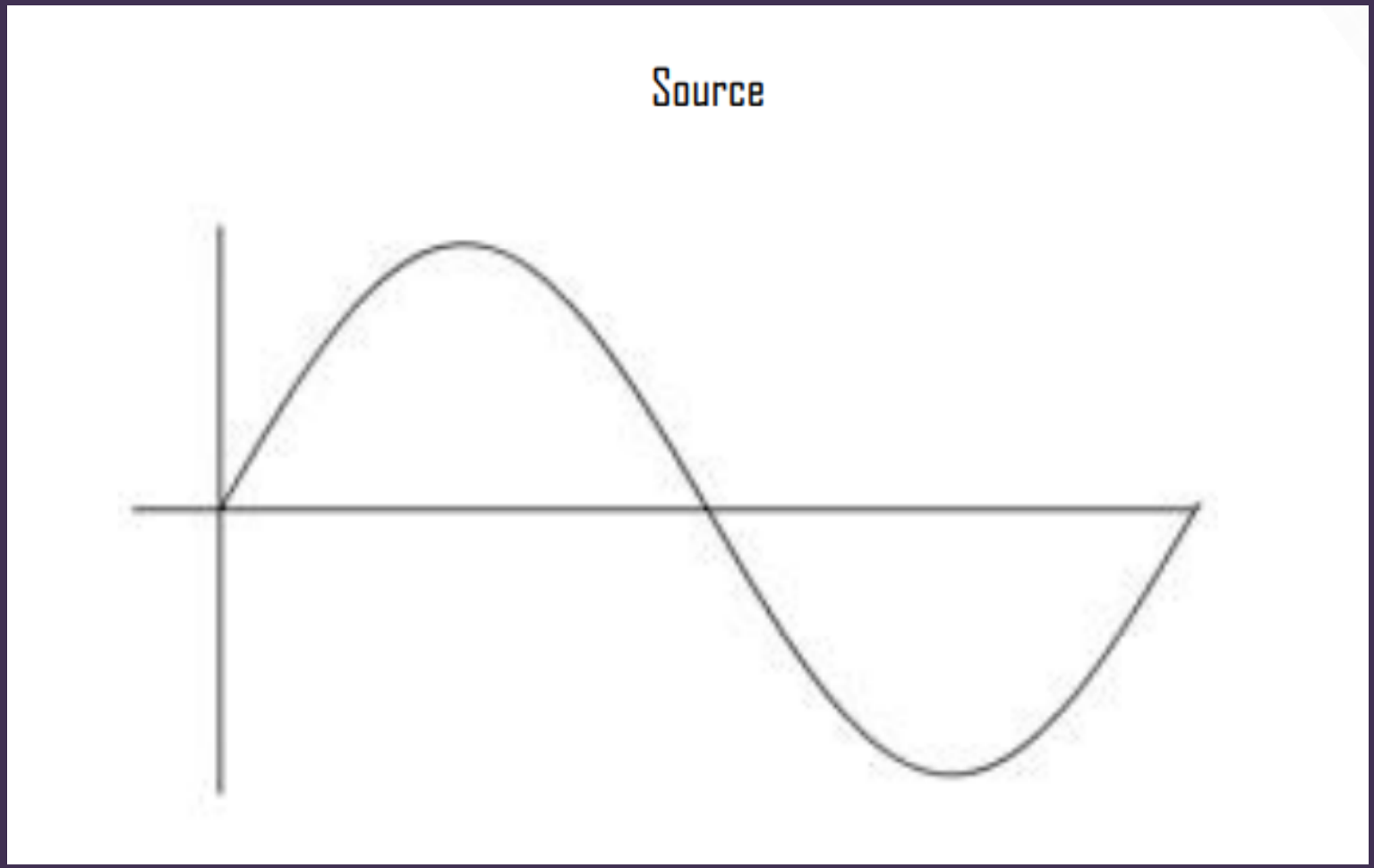
How Can Sound Be Represented Digitally?

- **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?

- **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?



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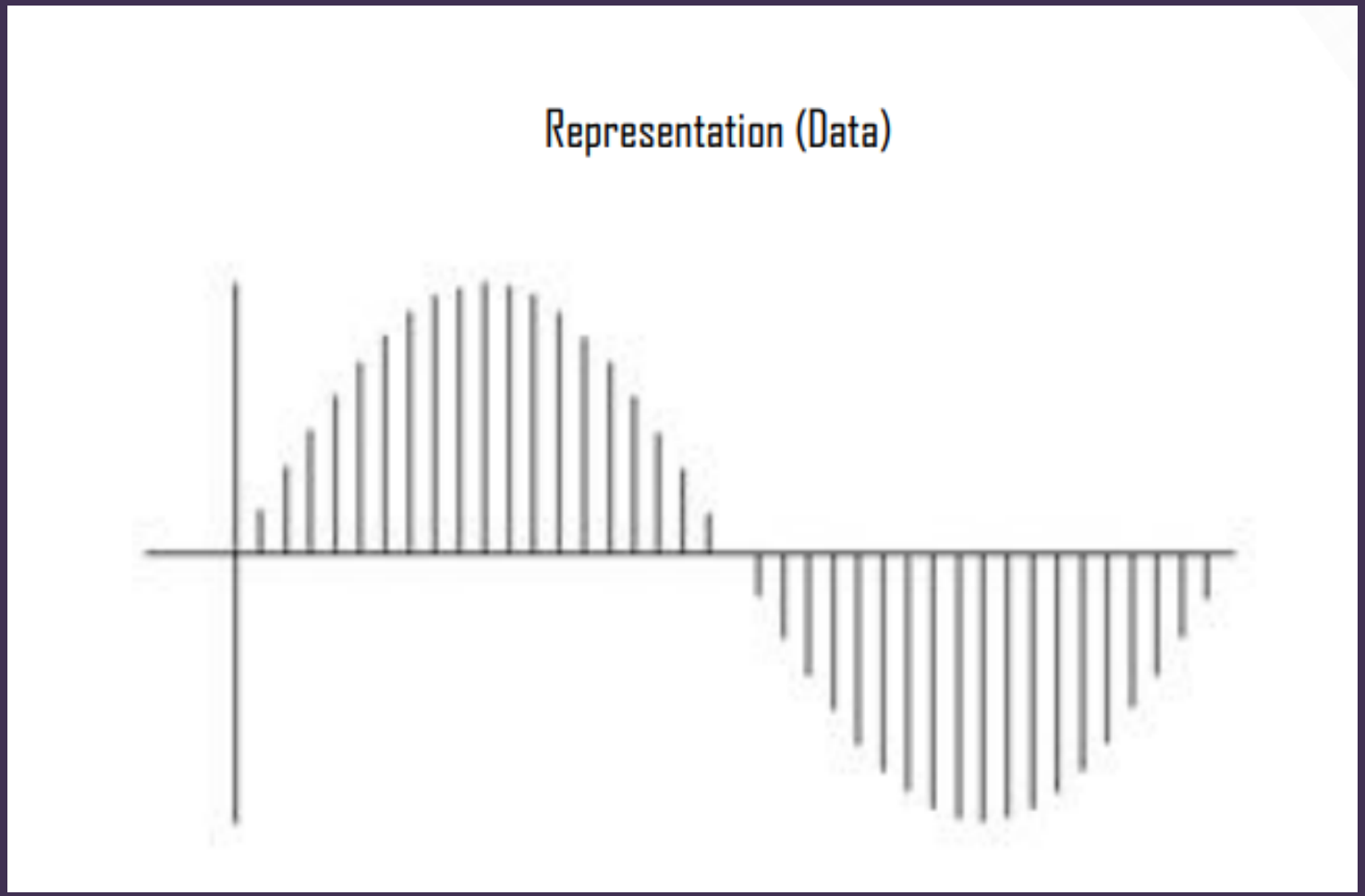

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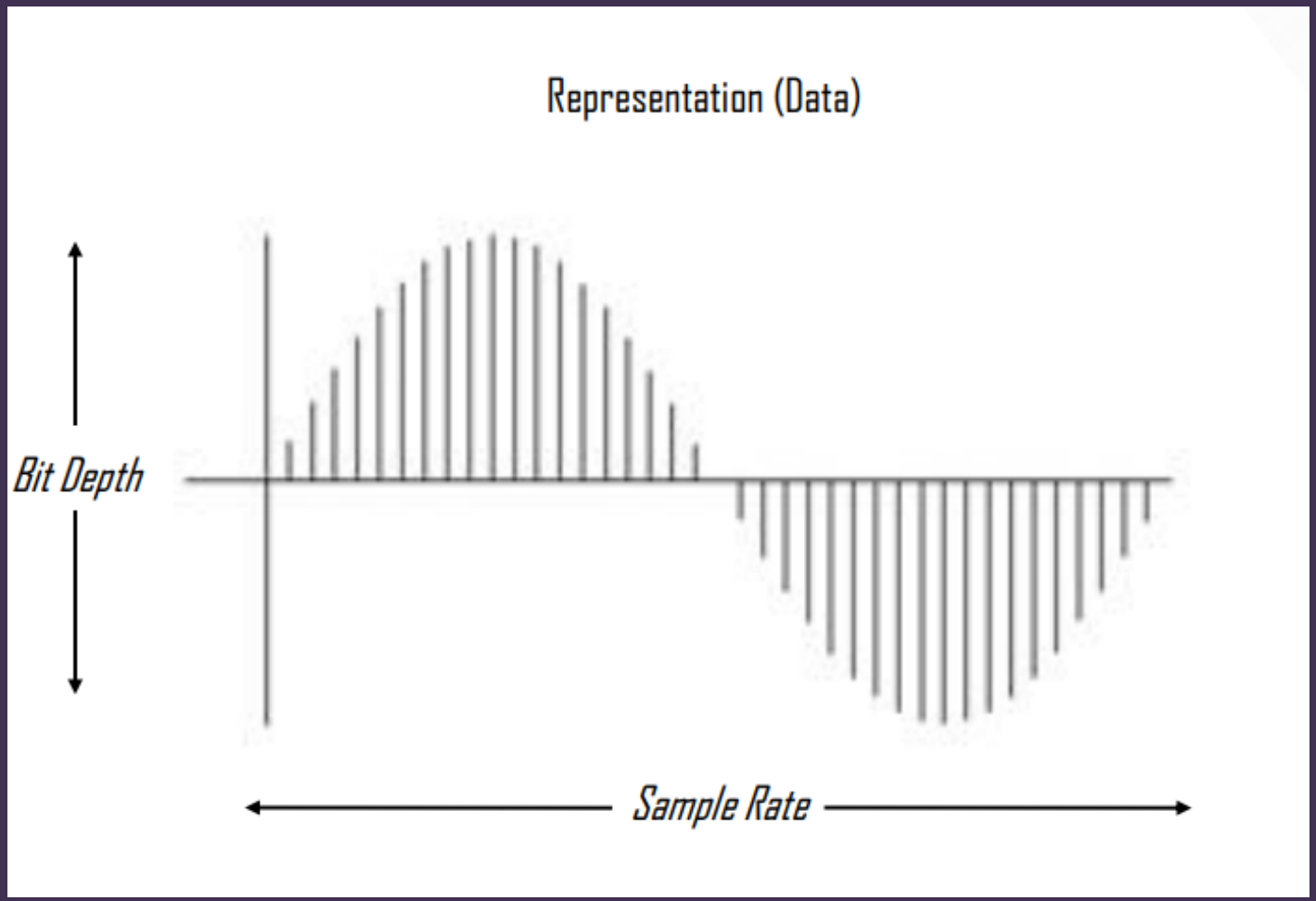

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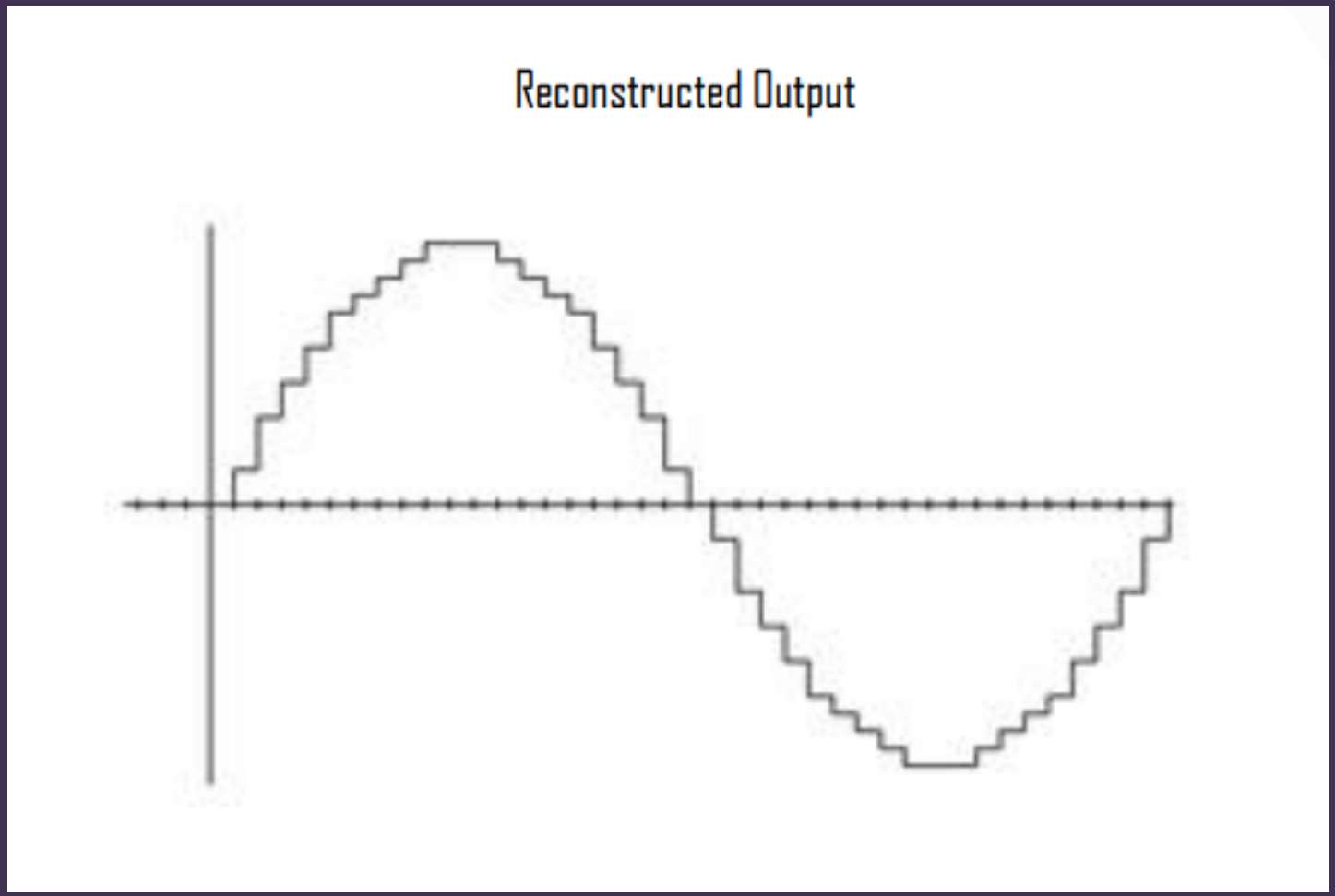

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Audio in PyGame

Sound Effects in PyGame

1. Have a wav file handy
2. Initialise Pygame
3. Load a sound to memory by instantiating a new pygame.mixer.Sound object
4. Play the sound when a key has been pressed

Playing a Sound

```
import pygame, sys
from pygame.locals import *

pygame.init()
pygame.display.set_mode((250, 250), 0, 32)
sound = pygame.mixer.Sound('sample.wav')

while True:
    for event in pygame.event.get():
        if event.type == QUIT:
            pygame.quit()
            sys.exit()
        if event.type == KEYDOWN:
            if event.key == ord('p'):
                sound.play()
```

Music in PyGame

1. Have an ogg file handy
2. Initialise Pygame
3. Load the music to pygame.mixer using music.load()
4. Play the music
5. Control the music with the play() and stop() functions

Playing Music

```
import pygame, sys
from pygame.locals import *

pygame.init()
pygame.display.set_mode((250, 250), 0, 32)

pygame.mixer.music.load('music.ogg')
pygame.mixer.music.play(-1, 0.0)

while True:
    for event in pygame.event.get():
        if event.type == QUIT:
            pygame.quit()
            sys.exit()
```

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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/`

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PASS Challenge

PASS Challenge

Review the WAVE and PyGame mixer modules at:

`https://docs.python.org/3.6/library/wave.html`

`https://www.pygame.org/docs/ref/mixer.html`

PASS Challenge

- In pairs
- **Implement** audio i/o in Python
- **Read** a wave file as a wave_read object
- **Play** audio in PyGame using the PyGame Mixer
- **Write** a new wave file as a wave_write object

You can learn more about audio:

`https://inventwithpython.com/chapter19.html`