PYGAME PT. 1

- Pygame is an open source game development library to create real-time graphics-based games.
- You can find the standard documentation here https://www.pygame.org/
- Pygame comes preinstalled on the Raspberry Pi!

Installing Pygame (type this in your Terminal / Powershell, not the interactive Python shell)

```
pip install pygame
```

Initializing Pygame

```
import pygame
pygame.init()
```

Create a window screen

```
width = 800
height = 600
gamewindow = pygame.display.set_mode((width,height))
```

The main game loop

```
from pygame.locals import *

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

Controlled frame rate (recommended in case of high CPU load)

...

```
clock = pygame.time.Clock()
```

...

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

    clock.tick(60)
```

amount of maximum frames per second

See:
https://
www.pygame.org/docs/
ref/time.html

Inserting an image

```
width = 800
height = 600
gamewindow = pygame.display.set_mode((width,height))
```

```
while True:
```

```
for event in pygame.event.get():
    if event.type == QUIT:
        exit()
```

```
img = pygame.image.load("images/cat.jpg")
```

```
gamewindow.blit(img, (0,0))
```

```
pygame.display.update()
```

Drawing a line

```
screen = pygame.display.set_mode((800, 600))

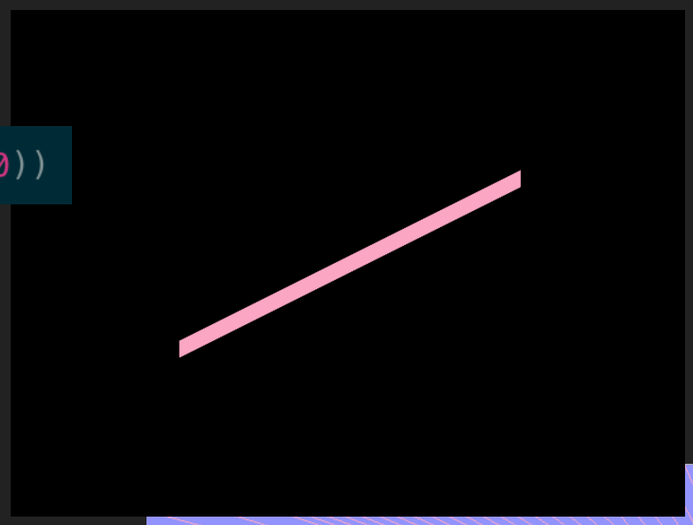
color = (255, 170, 200)

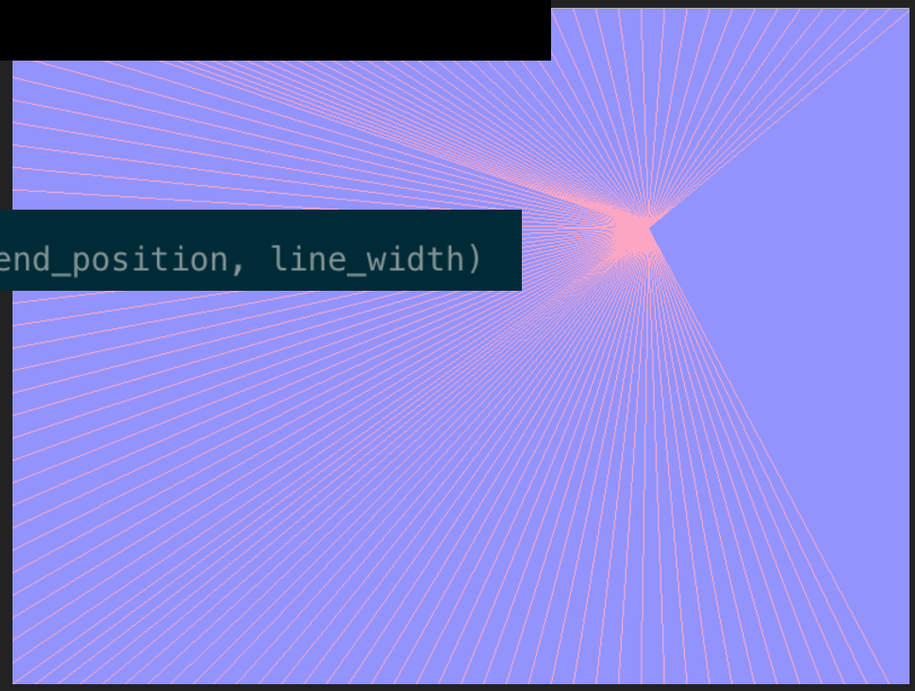
start_position = (200, 400)
end_position = (600, 200)

line_width = 20

pygame.draw.line(screen, color, start_position, end_position, line_width)

pygame.display.update()
```





Note: Use draw.aaline to draw an antialiased line.

Drawing a rectangle

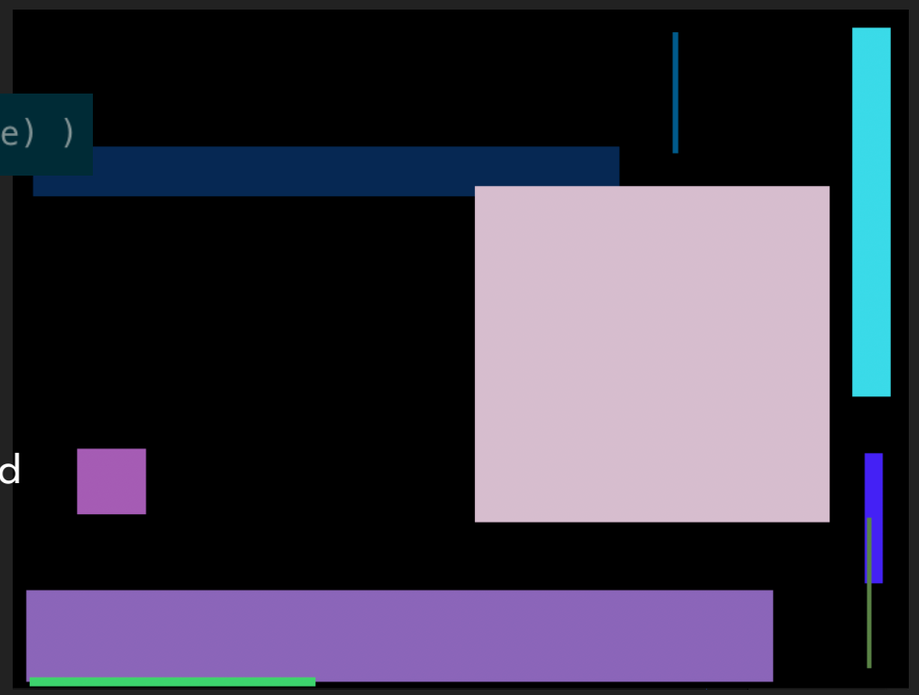
```
screen = pygame.display.set_mode((800, 600))
```

```
color = (200,30,100)
x,y = 200, 100
position = (x,y)
width = 400
height = 400
size = (width, height)
```

```
pygame.draw.rect(screen, color, (position, size) )
```

```
pygame.display.update()
```

Note: You can also use surface.fill() to create filled rectangles. This will take less computational resources and can be hardware accelerated.



1. a.) Create a program that generates rectangles of random colors, sizes and positions.
   Make sure the rectangles are never cropped but contained entirely within the limits of the screen.

1. b.) Make this an animation where rectangles of different colors, sizes and positions are created newly in every frame.

1. c.) Research about the various additional "flags" of the display.set_mode() function. Remove the border and title bar from the display. Find out how to close your program with the key "q".

Drawing a polygon

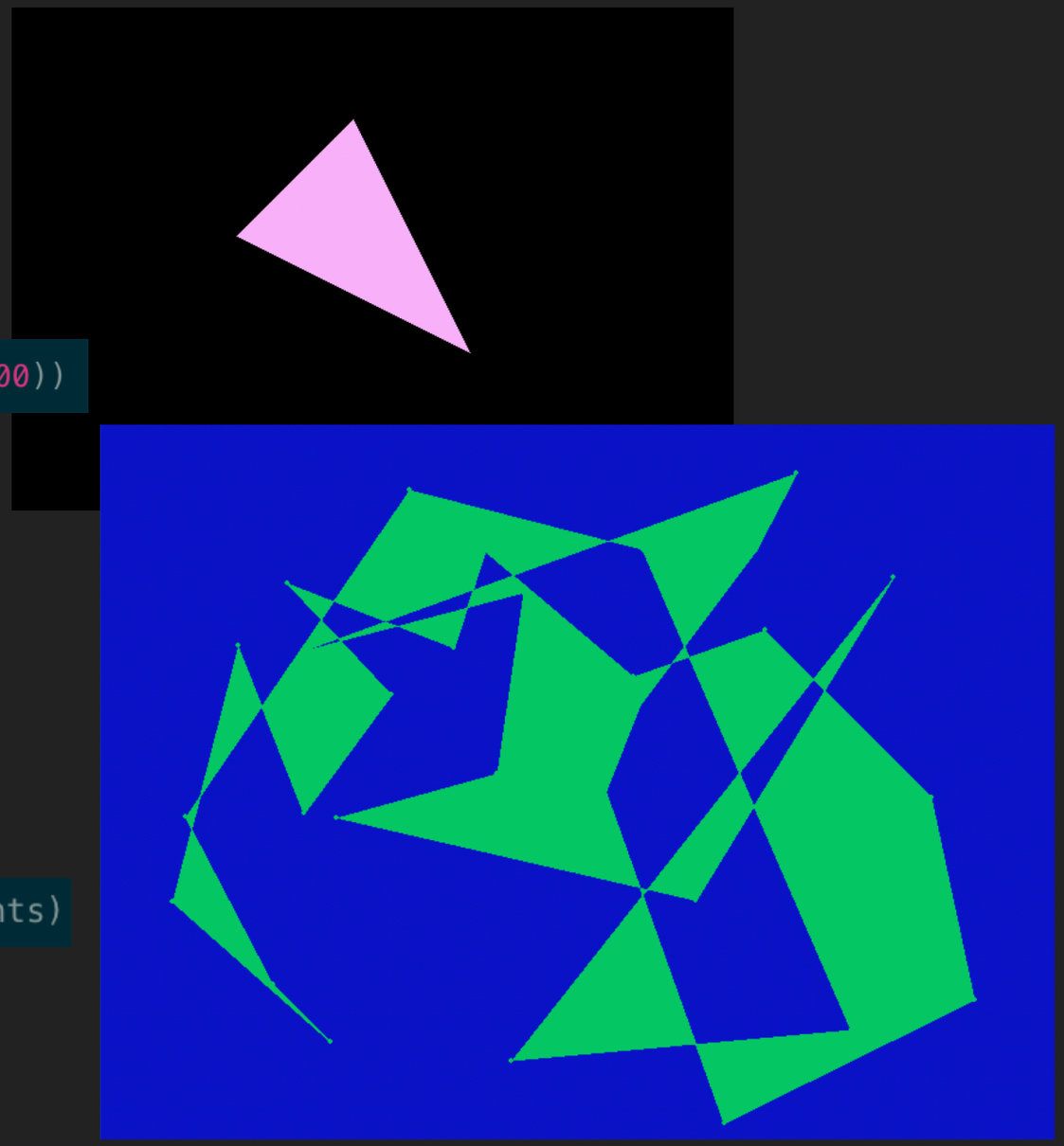
```
screen = pygame.display.set_mode((800, 600))

color = (250, 180, 250)

pos1 = (200, 200)
pos2 = (300, 100)
pos3 = (400, 300)
points = [pos1, pos2, pos3]

pygame.draw.polygon(screen, color, points)

pygame.display.update()
```



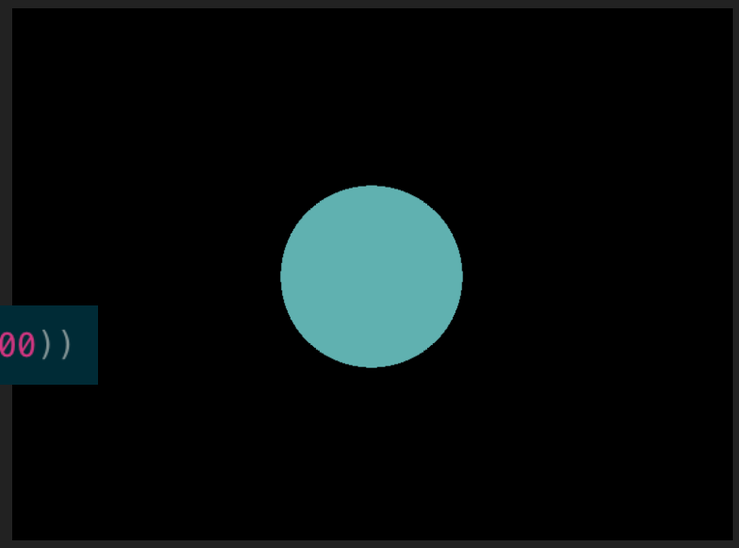
Drawing a circle

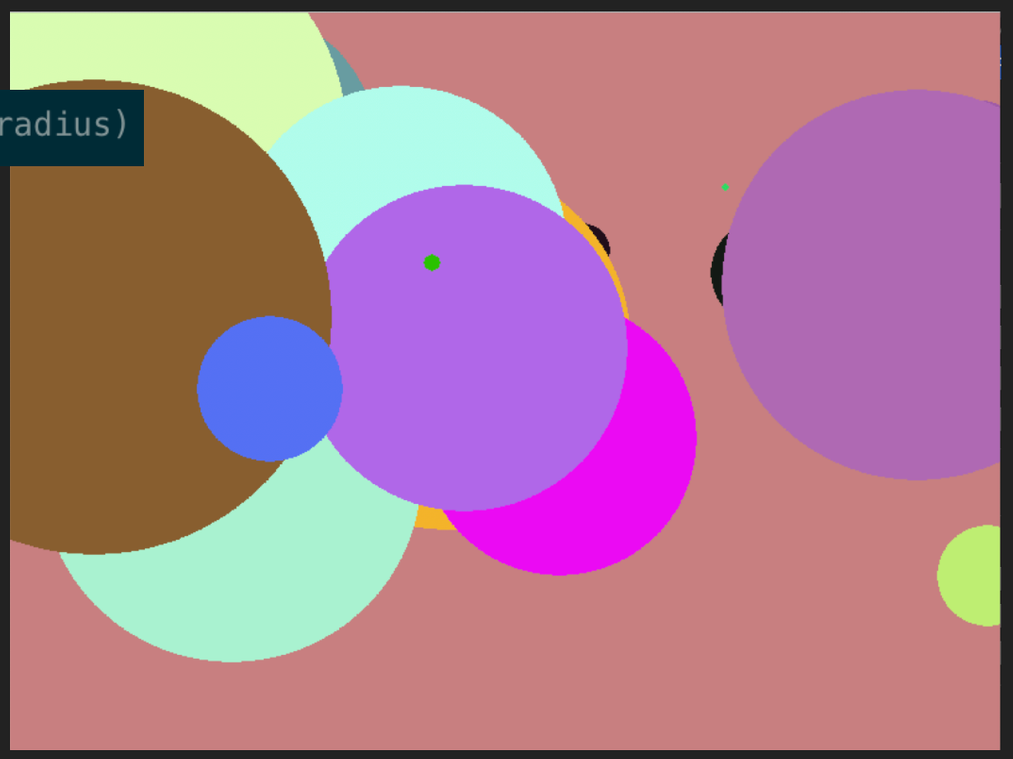
```
screen = pygame.display.set_mode((800, 600))

color = (100, 180, 180)
position = (400, 300)
radius = 100

pygame.draw.circle(screen, color, position, radius)

pygame.display.update()
```





Drawing an ellipse

```
screen = pygame.display.set_mode((800, 600))

color = (180, 180, 110)

position = (200, 250)
width = 400
height = 100
ellipse_rectangle = ( position, (width, height) )

pygame.draw.ellipse(screen, color, ellipse_rectangle)


pygame.display.update()
```

Drawing an arc

```
from math import pi

screen = pygame.display.set_mode((800, 600))

color = (180, 180, 110)
rectangle = (200, 200, 400, 200)
start_angle = 0
stop_angle = pi

pygame.draw.arc(screen, color, rectangle, start_angle, stop_angle)

pygame.display.update()
```

Drawing multiple lines

```
screen = pygame.display.set_mode((800, 600))

color = (255, 170, 200)

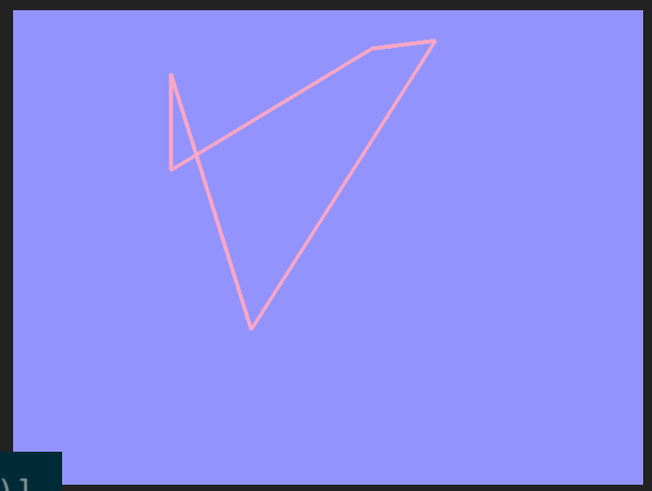
connect_points = True

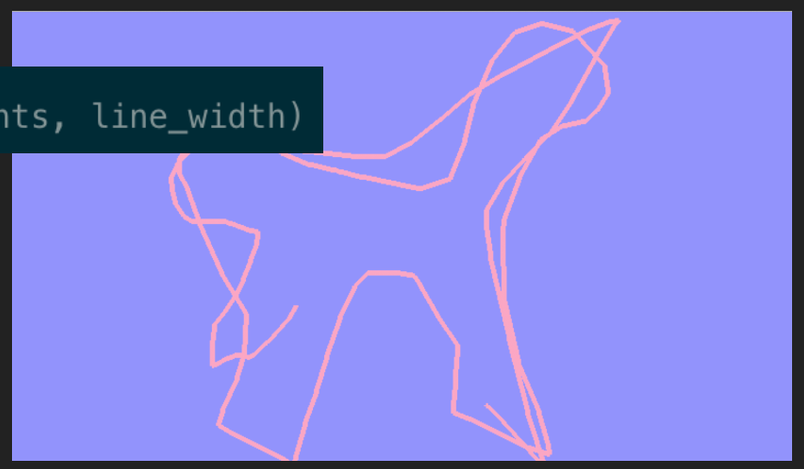
points = [(200,200), (452,48), (530,39),(300,400), (200,80)]

line_width = 20

pygame.draw.lines(screen, color, connect_points, points, line_width)

pygame.display.update()
```





Note: Use draw.aalines to draw antialiased lines.

2. Research about the mouse module in the Pygame documentation. Write a program that picks up the cursor's current position and draws an object at these coordinates.

Setting and getting pixel values

```
image = pygame.image.load("images/tobe1.jpg")
image_size = image.get_rect().size #get image size of the loaded image

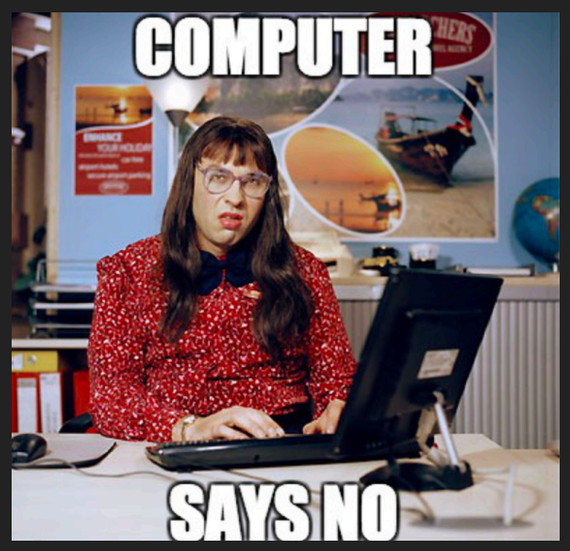
screen = pygame.display.set_mode((image_size))
```

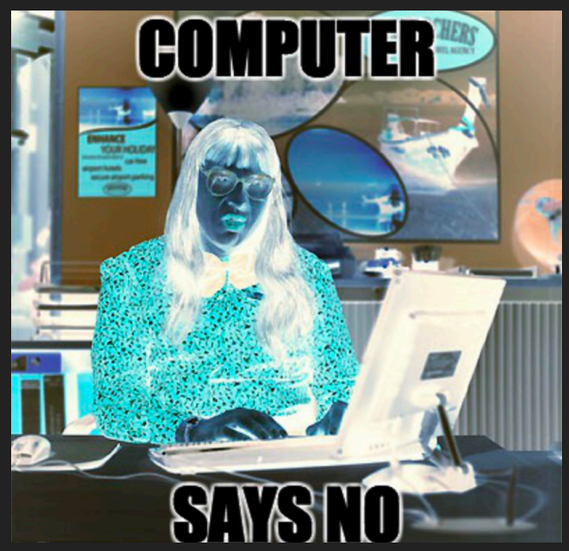
```
for y in range(image_size[1]):
    for x in range(image_size[0]):
        pix_color = image.get_at((x,y))
        screen.set_at((y,x), (pix_color))
```

3. Load an image of your choice. Invert the colors. Save it as a new picture.

4. Load an image of your choice. Find a pattern of your choice to move pixels regularly from one position to another in the whole image.

5. Use get_at() and set_at() to move pixels of an image to another position during the game loop. Use random values and reposition the pixels in a way so the original structure is destroyed.





result of exercise 3

Move with keys

```
x,y = 0, 0
move_x, move_y = 0, 0
```

- ```
  while True:
  ```

```
    if event.type == KEYDOWN:
        if event.key == K_LEFT:
            move_x = -1
        elif event.key == K_RIGHT:
            move_x = +1
        elif event.key == K_UP:
            move_y = -1
        elif event.key == K_DOWN:
            move_y = +1

    elif event.type == KEYUP:
        if event.key == K_LEFT:
            move_x = 0
        elif event.key == K_RIGHT:
            move_x = 0
        elif event.key == K_UP:
            move_y = 0
        elif event.key == K_DOWN:
            move_y = 0

    x+= move_x
    y+= move_y

    screen.fill((0,0,0))
    screen.blit(background, (x,y))

    pygame.display.update()
```
```

Adding text

Defining parameters

```
myfont = pygame.font.SysFont("futurattc", 19)

mytext = "Hello TechBasics Fans"
aliasing = False
fontcolor = (0,0,255)
bgcolor = (0,255,0)
```

▶

```
myfont = pygame.font.Font("OpenSans-Regular.ttf", 19)
```

Use
font.Font()
for custom fonts. (Save the .ttf-file in the same folder as your script.)

Render surface

```
mysurface = myfont.render(mytext, aliasing, fontcolor, bgcolor)
```

Save to image

```
pygame.image.save(mysurface, "pygameTextToImage.png")
```

Display on screen

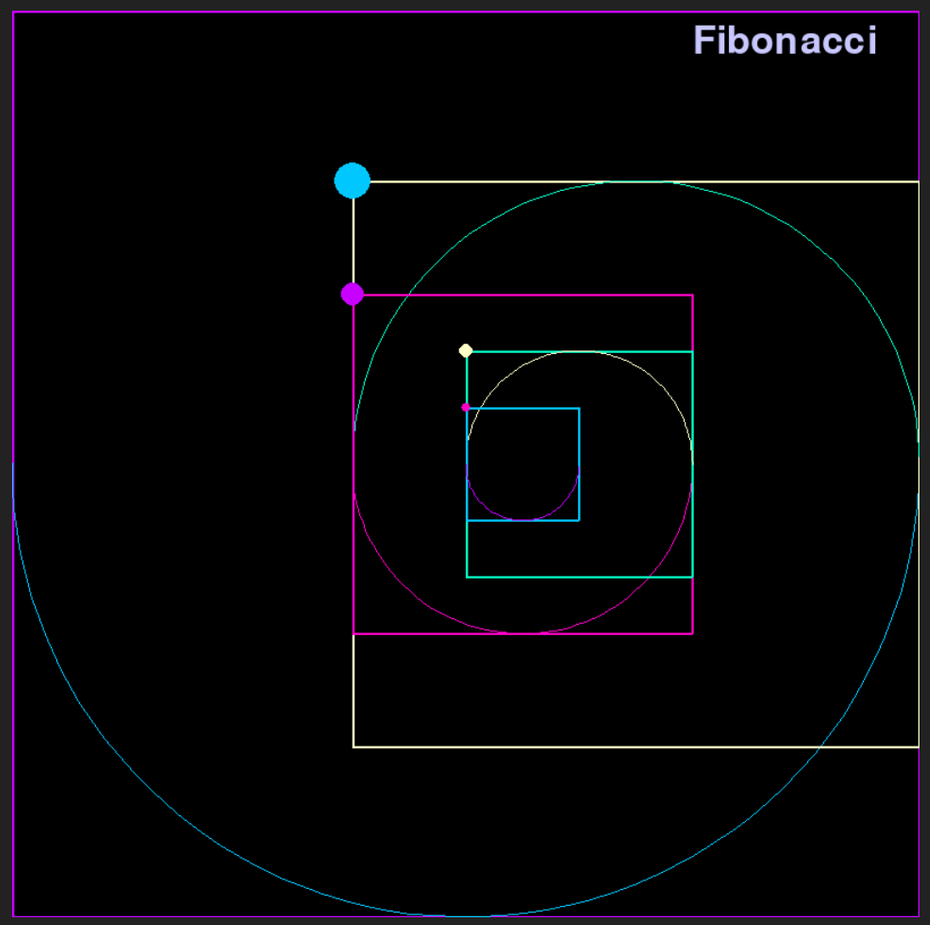
```
gamewindow = pygame.display.set_mode((800,600))
```

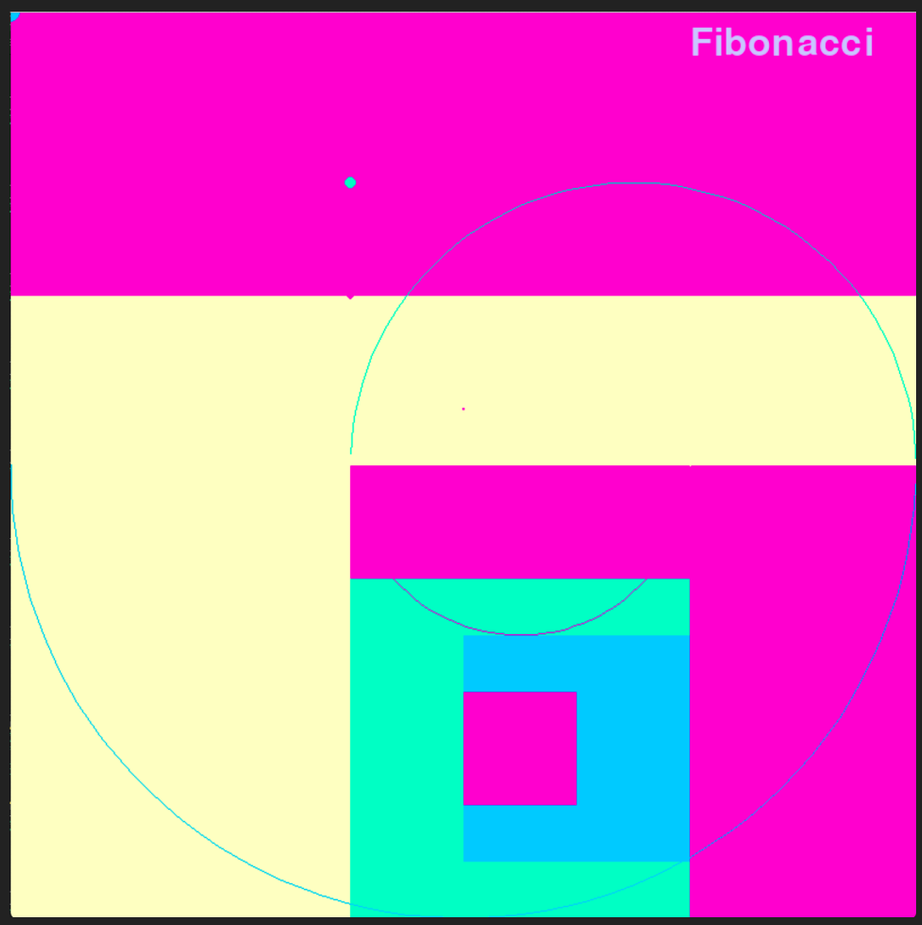
```
while True:
    for event in pygame.event.get():
        if event.type == QUIT:
            pygame.quit()
            exit()

    gamewindow.blit(mysurface, (0,0))
    pygame.display.update()
```

6. Research about the Fibonacci series and use it to draw geometrical forms. Use the ratios for the shapes of circles and rectangles.

7. Use another number sequence and create an artwork with it. Research on http://oeis.org.





Simple Music Player

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

init()
clock = time.Clock()

screen = display.set_mode((300,100), NOFRAME)
display.set_caption("Music Player")
screen.fill((150,150,250))
```

```
#The actual audio player
mixer.music.load("Sound/NyanCat.mp3")
mixer.music.play()

#Button to pause
draw.rect( screen, (0,100,200), ((30, 30),( 50, 50)) )
#Button to play
triangle = [ (110, 30), (110,80), (160, 55) ]
draw.polygon( screen, (0,200,100), triangle )

display.update()
```

```
while True:
    for e in event.get():
        if e.type == QUIT:
            quit()
            exit()
        if e.type == KEYDOWN:
            if e.key == K_q:
                quit()
                exit()
```

```
    #wait for mouse to get clicked over button location
    x,y = mouse.get_pos()
    if mouse.get_pressed()[0]:
        if (30 < x < 80) and (30 < y < 80):
            mixer.music.pause()
        elif (110 < x < 160) and (30 < y < 80):
            mixer.music.play()
```

```
    clock.tick(60)
```

Installing MoviePy for Conda:

```
conda install -c conda-forge moviepy
```

alternative installation modes:
https://anaconda.org/conda-forge/moviepy

Minimal Video Player:

```
from pygame import *
from moviepy.editor import *

clip = VideoFileClip("Videos/raccoon1.mp4")
clip.preview()

quit()
```

Installation of OpenCV for Anaconda

```
conda install -c conda-forge opencv
```

instructions for alternative installation methods:
https://anaconda.org/conda-forge/opencv

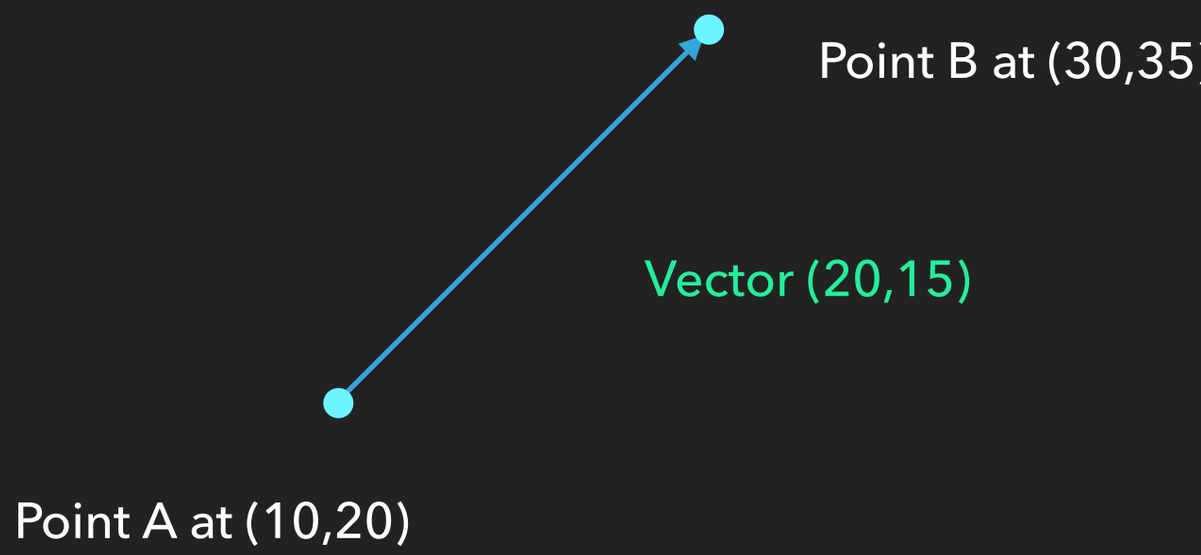
Documentation and useful links

https://docs.opencv.org/
https://opencv-python-tutroals.readthedocs.io/en/latest/index.html
https://www.geeksforgeeks.org/python-play-a-video-using-opencv/

```python
import cv2

cap = cv2.VideoCapture("Videos/raccoon1.mp4")

if cap.isOpened() == False:
    print("Error opening file.")

cap.set(cv2.CAP_PROP_FPS, 25)

while cap.isOpened():
    ret, frame = cap.read()
    if ret == True:
        cv2.imshow("Frame", frame)

        if cv2.waitKey(10) & 0xFF == ord("q"):
            break

    else:
        break

cap.release()

cv2.destroyAllWindows()
```

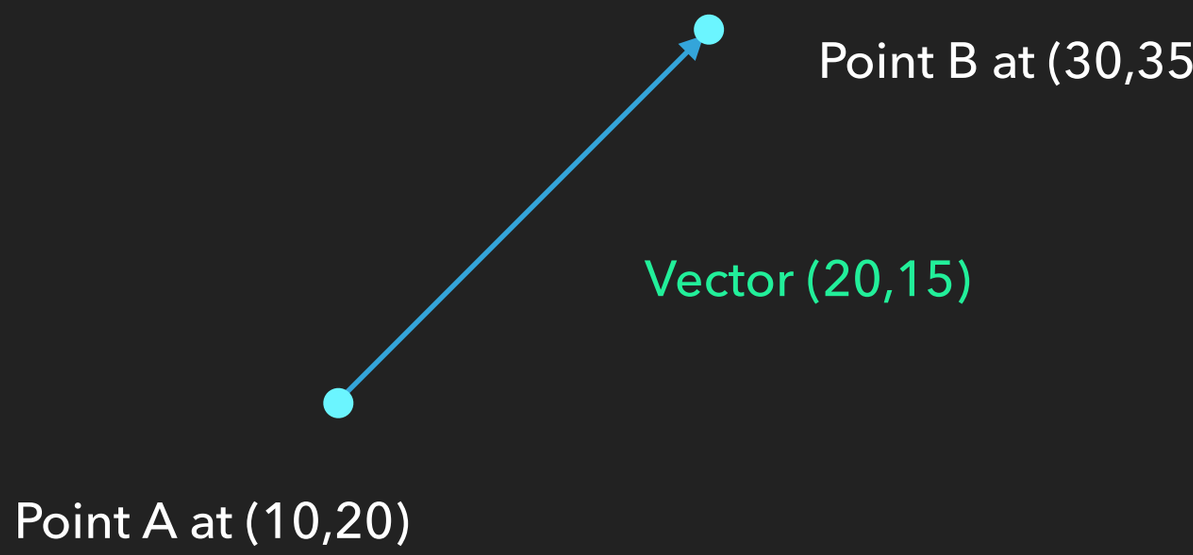
Vectors:

are mathematical representations of a directional change.
A vector is the difference between the coordinates of point A and B.



The magnitude of a vector is the distance between two points:

Vector AB length = sqrt(20*20+5*5) = 25



A vector can be normalized to express its unit vector, which has no information about the magnitude and is often used to represent the heading.
A unit vector has always a length of 1. We obtain it by dividing the components by the magnitude.

Vector (20,15)
–> 20/25 = 0.8
–> 15/25 = 0.6

Unit Vector (0.8,0.6)

Installation of OpenGL for Python

```
pip install PyOpenGL PyOpenGL_accelerate
```

instructions for alternative installation methods:
http://pyopengl.sourceforge.net/

Documentation

https://www.khronos.org/registry/OpenGL-Refpages/gl4/
https://www.opengl.org//documentation/

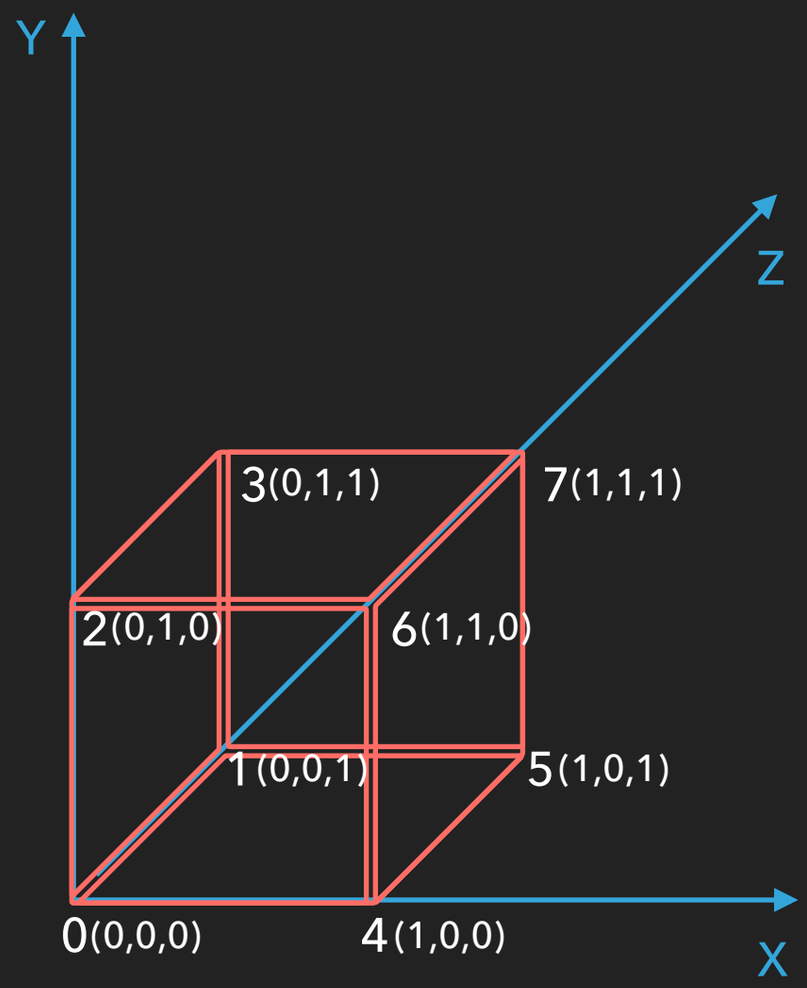
Rotate a Cube

The nodes of 3-dimensional objects are also called "vertices" (singular: vertex).

Each vertex is defined by a tuple of 3 values, indicating their position in a 3D space.

A cube can be described by a set of 8 vertices, containing their coordinates on the X-, Y- and Z-axis, f.i.:

0 (0,0,0),
1 (0,0,1),
2 (0,1,0),
3 (0,1,1),
4 (1,0,0),
5 (1,0,1),
6 (1,1,0),
7 (1,1,1)

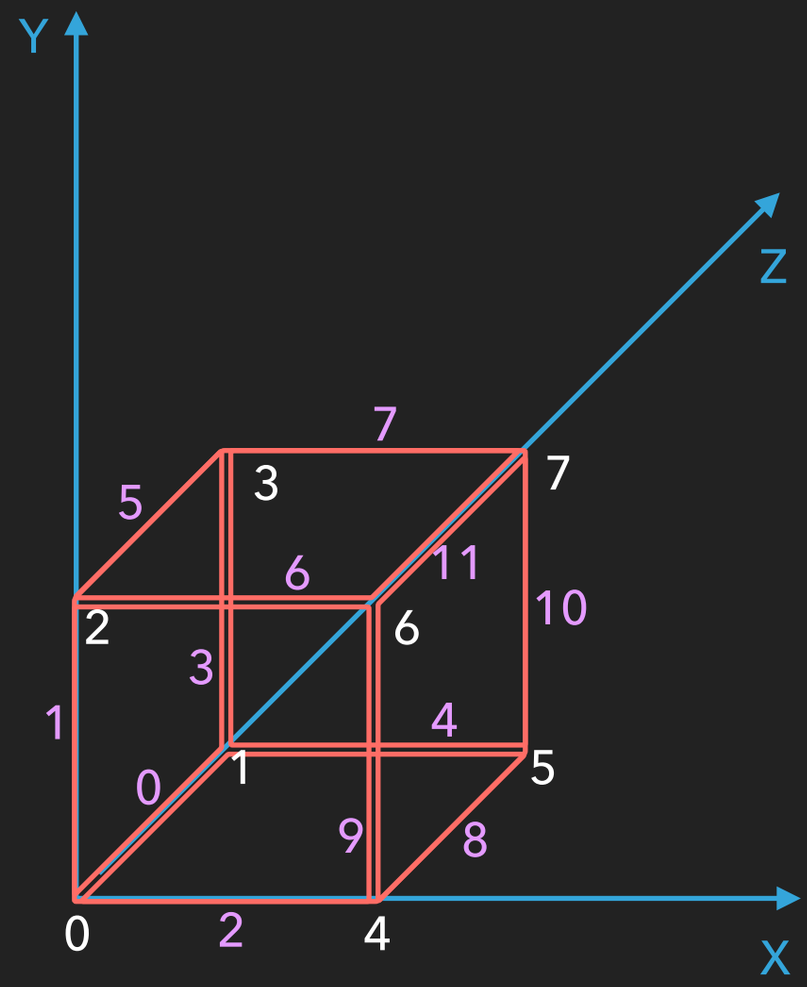


A 3D object is also defined by the way its nodes connect, i.e. by its edges. Every node connects to 3 other points.

A cube is defined by 12 edges.

We can specify which vertices connect with each other with a set of 12 tuples.

```
0   (0,1),
1   (0,2),
2   (0,4),
3   (1,3),
4   (1,5),
5   (2,3),
6   (2,6),
7   (3,7),
8   (4,5),
9   (4,6),
10  (5,7),
11  (6,7)
```



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

from OpenGL.GL import *
from OpenGL.GLU import *

init()
clock = time.Clock()
width = 1000
height = 800
```

```
screen = display.set_mode((width,height), DOUBLEBUF | OPENGL)
```

```
fieldOfView = 45
aspectRatio = (width/height)
clippingPlane_near = 0.1
clippingPlane_far = 50

gluPerspective(fieldOfView, aspectRatio, clippingPlane_near, clippingPlane_far)
```

```
vertices = (
    (0,0,0),
    (0,0,1),
    (0,1,0),
    (0,1,1),
    (1,0,0),
    (1,0,1),
    (1,1,0),
    (1,1,1)
    )

edges = (
    (0,1),
    (0,2),
    (0,4),
    (1,3),
    (1,5),
    (2,3),
    (2,6),
    (3,7),
    (4,5),
    (4,6),
    (5,7),
    (6,7)
    )
```

```
def Cube():
    glBegin(GL_LINES)
    for edge in edges:
        for vertex in edge:
            glVertex3fv(vertices[vertex])
    glEnd()
```

```
glTranslatef(0.0,0.0, -5)
```

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

        if e.type == KEYDOWN:
            if e.key == K_q:
                quit()
                exit()
```

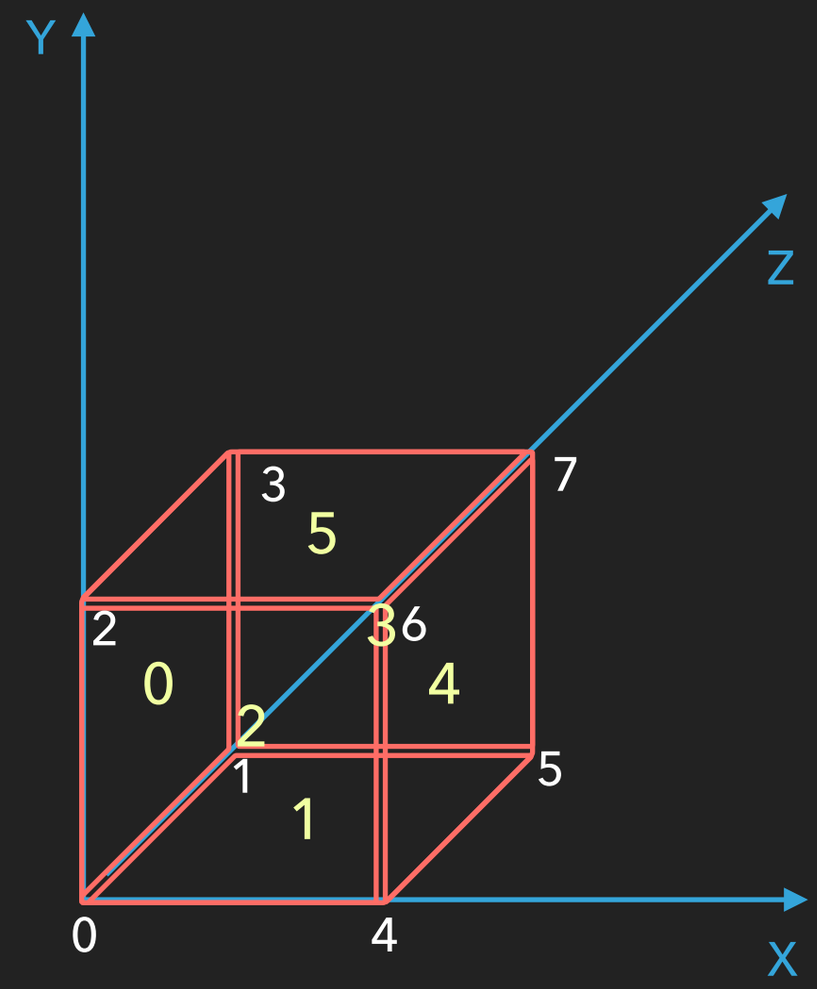
```
    glRotatef(1,3,1,1)

    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT)

    Cube()

    display.flip()
```

```
    clock.tick(60)
```

Colouring the surfaces

A cube also consists of 6 surfaces. Every surface is defined by the 4 vertices it is composed of.

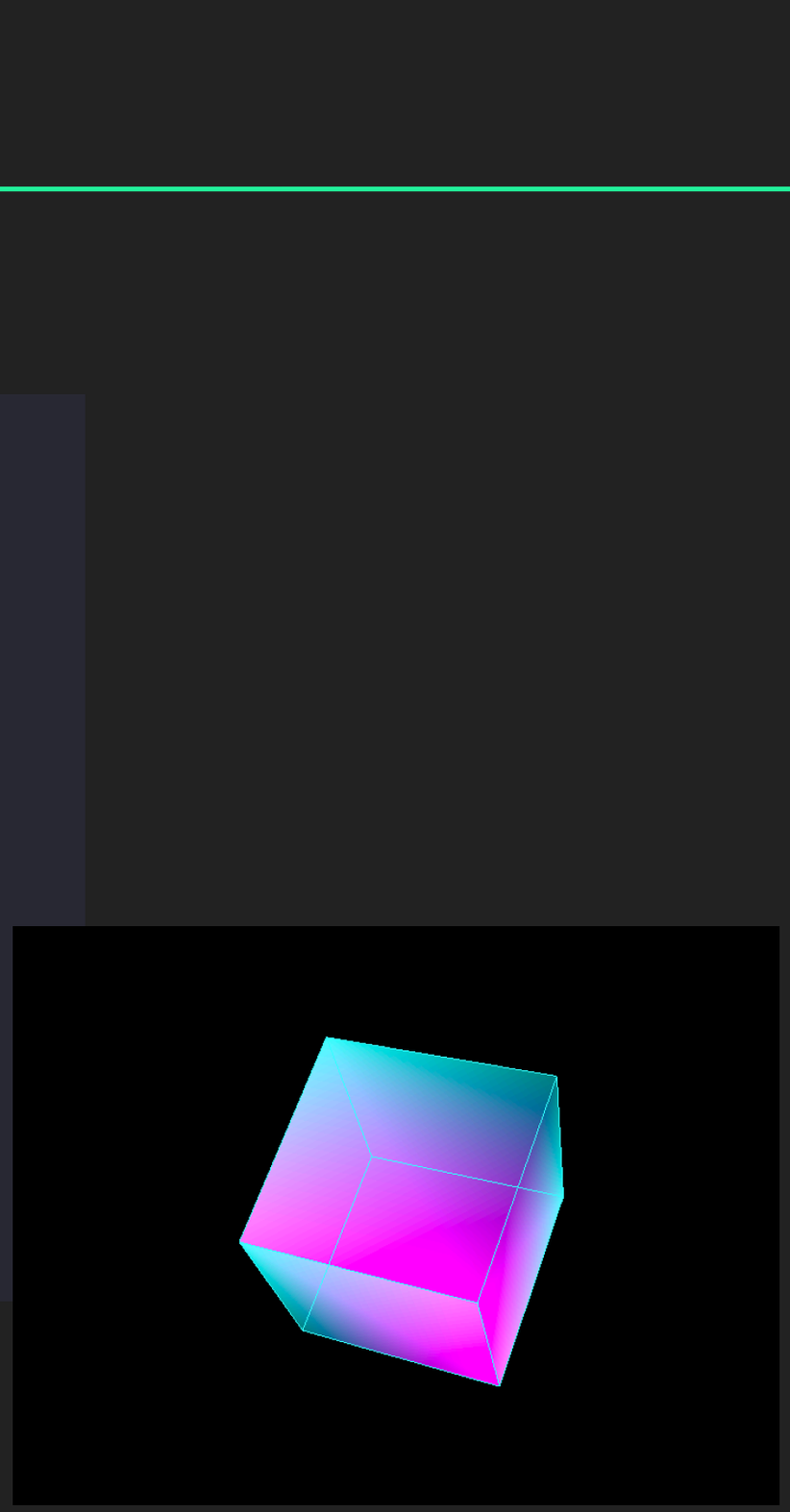
0 (0, 1, 3, 2),
1 (0, 1, 5, 4),
2 (0, 2, 6, 4),
3 (7, 3, 1, 5),
4 (7, 6, 4, 5),
5 (7, 6, 2, 3)



OpenGL colours are defined in between the range of 0 and 1.

```
colors = (
    (0.5,0.5,1),
    (0,0.5,0.5),
    (1,0,1),
    (1,0.5,1),
    (0.5,1,1),
    (0.5,1,1)
)
```

```
def Cube():
    glBegin(GL_QUADS)
    for surface in surfaces:
        x = 0
        for vertex in surface:
            x += 1
            glColor3fv(colors[x])
            glVertex3fv(vertices[vertex])
    glEnd()

    glBegin(GL_LINES)
    for edge in edges:
        for vertex in edge:
            glVertex3fv(vertices[vertex])
    glEnd()
```



1. Experiment with the vertices to create various shapes.

2. Make an object move from left to right and reappear when it has passed over the right edge.