# Sujal Burad EE21B144 Week 5

May 4, 2023

## 0.1 Libraries :

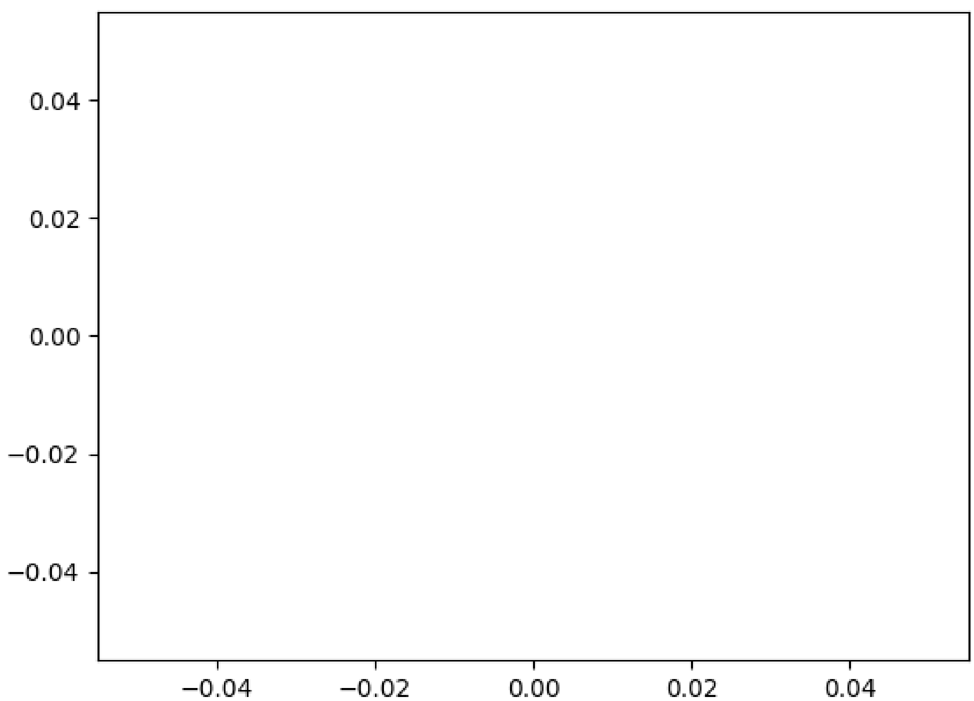
[1]:
```
# Magic command below to enable interactivity in the JupyterLab interface
%matplotlib ipympl
# Some basic imports that are useful
import numpy as np
import matplotlib.pyplot as plt
from matplotlib.animation import FuncAnimation
```

## 0.2 init () and update ():

This is used to initialize the plot, and then update the plot during the transformation.

[2]:
```
fig, ax = plt.subplots()
xdata, ydata = [], []
ln, = ax.plot([], [], 'red')
total_data = []

def init():
    ax.set_xlim(-1.2, 1.2)
    ax.set_ylim(-1.2, 1.2)

    return ln,

def update(frame):
    count_1 = int(frame)

    if(int(frame) >= 5): # To get the reverse animation of figures, i.e from 8␣
↪to 7 to 6 to 5 to 4 to 3
#     if(int(frame) >= 6):
#         count_2 = 6 - int(frame)
        count_2 = 5 - int(frame)
#         xc, yc, xs, ys = polygon_coordinates(count_2 + 9, count_2 + 8,t)
        xc, yc, xs, ys = polygon_coordinates(count_2 + 8, count_2 + 7,t)
        xdata, ydata = morph(xs, ys, xc, yc, frame - count_1)
        total_data.append(xdata)
        total_data.append(ydata)
        ln.set_data(total_data[-2], total_data[-1])
```

```python
        total_data.clear()
        return ln,


    # To get the forward animation of figures, i.e from 3 to 4 to 5 to 6 to 7 to 8
    elif(frame >= count_1 and frame <= (count_1 + 1)):
        xc, yc, xs, ys = polygon_coordinates(count_1 + 3, count_1 + 4, t)
        xdata, ydata = morph(xs, ys, xc, yc, frame - count_1)
        total_data.append(xdata)
        total_data.append(ydata)
        ln.set_data(total_data[-2], total_data[-1])
        total_data.clear()
        return ln,
```




## 0.3 Mapping function ():

To map the vertex of a polygon to the coming polygon. To understand the below function, I have taken the example of conversion from triangle (3) to square (4). The same is valid for the conversions of other polygons also. Since in the animation, vertices are being split, each vertex of the triangle gets mapped to two of the vertices of square. Considering the x coordinates, we can say that :(I am moving in the anticlockwise direction, and the starting coordinate(1,0)) gets repeated a] 1 gets mapped to 1 b] -0.5 gets mapped to 0, and -1 c] -0.5 gets mapped to -1, and 0 (The other vertex of triangle with x coordinate as -0.5) d] 1 gets mapped to 1 The y-coordinates also gets respectively mapped.

The variables x_before, y_before, x_after, y_after are calculated using this mapping.

[3]:
```
# m = first polygon, with number of sides = m
# n = second polygon, with number of sides = n
# x_before, y_before = to map with x_after, y_after, with the help of  m_x, m_y,␣
 ↪n_x, n_y.
# General case is for m < n. The 'check' variable is used to check when m > n,␣
 ↪and make the respective changes

def mapping(m, n, m_x, m_y, n_x, n_y, t, check):
    total = int(len(t)/m)
    x_before = []
    y_before = []
    x_after = []
    y_after = []
    for i in range(0, len(m_x), 2):
        x_before.extend(np.linspace(m_x[i], m_x[i+1], total))
        y_before.extend(np.linspace(m_y[i], m_y[i+1], total))
        x_after.extend(np.linspace(n_x[i], n_x[i+1], total))
        y_after.extend(np.linspace(n_y[i], n_y[i+1], total))


    x_before = np.array(x_before)
    x_after = np.array(x_after)
    y_before = np.array(y_before)
    y_after = np.array(y_after)

    if(check == 1):
# Here the values of x_before and x_after, and y_before and y_after gets␣
 ↪interchanged
# This is done when m < n
        d_x_before = x_before
        d_y_before = y_before
        x_before = x_after
        y_before = y_after
        x_after = d_x_before
        y_after = d_y_before
    else:
        pass
    return x_before, y_before, x_after, y_after
```

## 0.4 point_split() :

It is used to find proper splitting of the coordinates that will be used by the mapping function above.

[4]:
```
def point_split(m, n, m_x_coord, m_y_coord, n_x_coord, n_y_coord, t):
    if(len(m_x_coord) > len(n_x_coord)): # To get the value of 'check',␣
 ↪depending on whether m<n or m>n
        check = 1
        dupli_x = n_x_coord
        n_x_coord = m_x_coord
        m_x_coord = dupli_x
        dupli_y = n_y_coord
        n_y_coord = m_y_coord
        m_y_coord = dupli_y

    else:
        check = 0

#  m_x, m_y, n_x, n_y are useful for mapping in the above function
# I have updated the values in m_x, m_y, n_x, and n_y in the way they will be␣
 ↪mapped
    m_x = []
    m_y = []
    n_x = []
    n_y = []

    m_x.append(1)
    m_y.append(0)

    for i in range(1, len(m_x_coord)):
        m_x.append(m_x_coord[i])
        m_x.append(m_x_coord[i])
        m_y.append(m_y_coord[i])
        m_y.append(m_y_coord[i])

    m_x.append(1)
    m_y.append(0)

    for i in range(len(n_x_coord)):
        n_x.append(n_x_coord[i])
        n_y.append(n_y_coord[i])

        if(i>=2 and i<=len(n_x_coord)-2):
            n_x.append(n_x_coord[i])
            n_y.append(n_y_coord[i])
    n_x.append(1)
    n_y.append(0)
```

```
#     print('mx coord ', m_x_coord)
#     print('nx coord ', n_x_coord)
#     print('mx ', m_x)
#     print('nx ', n_x)
#     print('my ', m_y)
#     print('ny ', n_y)

    return mapping(m, n, m_x, m_y, n_x, n_y, t, check)
```

## 0.5 polygon_coordinates () :

This function finds the x and y coordinates of both the polygon that will be used during a particular transformation

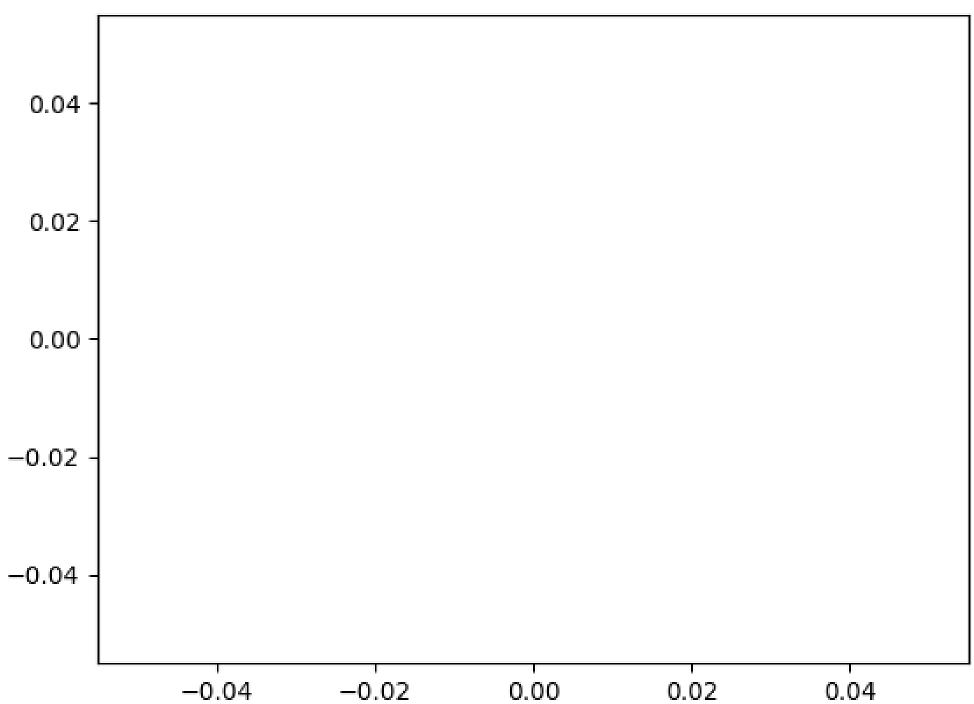
[5]:
```
# m_x_coord, m_y_coord - list containing all the x and y coordinate of 1st␣
↪polygon
# n_x_coord, n_y_coord - list containing all the x and y coordinate of 2nd␣
↪polygon
def polygon_coordinates(m, n, t):
    angle_m = 2 * np.pi/m
    angle_n = 2 * np.pi/n

    m_x_coord = []
    m_y_coord = []
    n_x_coord = []
    n_y_coord = []

    for i in range(m):
        m_x_coord.append(np.cos(angle_m * i))
        m_y_coord.append(np.sin(angle_m * i))

    for i in range(n):
        n_x_coord.append(np.cos(angle_n * i))
        n_y_coord.append(np.sin(angle_n * i))

    return point_split(m, n, m_x_coord, m_y_coord, n_x_coord, n_y_coord, t)
```

## 0.6 morph ():

This is used in morphing the polygon from one type to another

[6]:
```
def morph(x1, y1, x2, y2, alpha): # The morphing function is the same as the one␣
↪used in week 5 presentation
    xm = alpha * x1 + (1-alpha) * x2
    ym = alpha * y1 + (1-alpha) * y2
    return xm, ym
```

```
t = np.linspace(0, 2 * np.pi, 840) # Total points should be the lcm of 3, 4, 5, 6, 7, 8
if len(t) % 4 != 0:
    raise BaseException("Number of points should be multiple of 3, 4, 5, 6, 7, 8")


# The forward and reversed transformation done in the update function dependent on the value of frames
# The total number of transformations are 10, first 5 are the forward one and the other 5 are the reversed one

# The value of frames and interval can be changed as per need to alter the speed of transformation.
ani = FuncAnimation(fig, update, frames=np.linspace(0, 10, 1000), init_func = init, blit=True, interval=10,repeat=False)
# ani = FuncAnimation(fig, update, frames=np.linspace(0, 12, 1000), init_func = init, blit=True, interval=10,repeat=False)
plt.show()
```



```
[ ]:
```