In week 2 lab we learnt how to control *Kobo* mobile base (referred to as **robot** here onwards). The control command for this robot is a **Twist** message. Here's how we create a **Twist** message

```
velocity_msg = Twist()
velocity_msg.linear.x = 0.2
velocity_msg.angular.z = 0.2
```

The two components being set are equivalent to *v* and *w* command for a Unicycle.

The current exercise requires you to control the robot to make it move along an 8 curve (as depicted in the accompanying animation). We will do this incrementally:

Part A)

Write a python script to generate waypoints (x,y) and plot them:

$$x = A\cos(at)$$
$$y = A\sin(bt)$$

with A = 4, a=1, b=2

Part B)

Write a ROS node that takes one waypoint at a time, use this waypoint as a target/goal point and using the robots current location (from/odom) as a start point. Calculate following error terms

E_pos = Euclidean distance between start point and target point
E_theta = Difference between the current heading and desired heading ( angle made by the straight line connecting the start and target points)

Plot these two quantities for each of the waypoints.

Part C)

Write a ROS node that uses E_pos and E_theta and applies the following proportional control law to obtain values of v and w and publish a Twist message to steer the robot towards the target. You will need to tune the values of constants **K1** and **K2**.

v = **K1** * E_pos
w = - **K2** * E_theta

Plot the motion of the robot (x,y values from /odom data) for various values of K1 and K2.

Part D)

In the report, add a section for each of the parts (A, B and C). Add code and plots.