1 Conider a robot moving on a horizontal plane. The position of the robot on the plane is defined by the coordinates (x, y) and its orientation if defined by θ. The robot is able to measure its linear and angular velocities, respectively v and ω and consider the motion can be modeled by

$$\dot{x} = v \cos\theta$$
$$\dot{y} = v \sin\theta$$
$$\dot{\theta} = \omega$$

Also assume that v and ω measurements are affeted by noises which are characterized by independent normal distributions with zero mean and variences $\sigma_v^2 = 0.5^2$ and $\sigma_\omega^2 = 0.05^2$.

The robot is able to measure its distance and bearing (in its own reference frame) to two beacons, respectively located at $(0, 0$ and $(10, 0)$. These meaurements are affected by noises characterized by independent normal distributions with zero mean and variances $\sigma_r^2 = 0.5^2$ and $\sigma_\psi^2 = 0.1^2$.

The file `data.txt` contains data relevant to the problem. Its columns are $t, x, y, \theta, v, \omega, r_1, \psi_1, r_2, \psi_2$.

(a) Implement an algorithm that estimates the position and orientation of the robot based on the measurements of linear and angular velocities. Consider that the initial position and orientation of the robot are known (values x, y, θ from the first row of the data file). Also obtain the variance of such estimate. Compare the estimates with the actual values of position and orientation.

(b) Implement an algorihtm based on an extended Kalman filter to estimate the position and orientation of the robot based on the measurements of linear and angular velocities and also on the distances and bearings to the two beacons. Compare the estimates with the actual values of position and orientation.

(c) Repeat the previous point, using now an unscented Kalman filter.