The ultimate goal of this project is the implementation and testing of a simultaneous localization and mapping (SLAM) system for a robot equipped with a laser that measures distance and bearing to landmarks located in the operation area.
The position of the robot on the plane is defined by the coordinates (x, y) and its orientation is 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

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

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 has a laser systems that is able to measure its distance (r) and bearing (ψ, in the robot own reference frame) to landamarks located in the operation area. These meaurements are affected by noises characterized by independent normal distributions with zero mean and variances $\sigma_r^2 = 0.5^2$ and $\sigma_\psi^2 = 0.1^2$.

Task 1
Consider that there are two landmaks located at $(0, 0$ and $(10, 0)$, and that the initial pose of the robot is known. Design and implement an algorihtm 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. Use the data in file `data1.txt` to test the algorithm. The columns of this file are $t, x, y, \theta, v, \omega, r_1, \psi_1, r_2, \psi_2$.

Task 2
Now assume that laser system has a finite field of view. When each landmark is not within the field of view $(\pm\frac{\pi}{4})$ the range measurement returns 0. Adapt the previous algorithm to take into account this field of view constraint. Use the data in file `data2.txt` to test the algorithm. The columns of this file are $t, x, y, \theta, v, \omega, r_1, \psi_1, r_2, \psi_2$.

Task 3
Now assume that besides the field of view constraint the laser system only returns the range/bearing to the closest landmark, not proving information to which lankmark the measrument refers . Update to algorithm to deal with such feature. Use the data in file `data3.txt` to test the algorithm. The columns of this file are $t, x, y, \theta, v, \omega, r, \psi$.

Task 4
Consider now that there are several beacons in the operation are, that the laser system still has the above field of view constraint and that it only returns the information to the closest landmark. Also assume that you have no prior information about the initial robot pose.
Design and implement an algorithm (based on the SLAM concept) to estimate the position of the robot and the lcoations of the landmarks in the operation area.
Now assume that besides the field of view constraint the laser system only returns the range/bearing to the closest landmark, not proving information to which lankmark the measrument refers . Update to algorithm to deal with such feature. Use the data in file `data4.txt` to test the algorithm. The columns of this file are $t, x, y, \theta, v, \omega, r, \psi$.

Produce a small report with the relevant data in each task. Also produce videos showing the evolution of the real time robot pose estimates for the several tasks.