Lab3 Questions

1) The lidar unit has a sampling rate of 5Hz for a complete scan and the camera has a frame rate of up to 120 fps, however the documentation states that the maximum implemented is 90 fps. This results in a sampling time of 0.2s for the lidar and 0.011s for the camera. This matters since no matter how fast the subscriber node is the sampling time determines the minimum time how fast the system can react. It also shows us what the critical part is. No matter how fast the post process, a change in the environment can take up to 0.2s till it's shown in the sensor lidar data. It also gives an idea of relative publishing differences between the two data streams.
2) We technically implemented the ability to do all of PID, but we primarily relied on proportional because it was the most straightforward approach.
3) The proportional controller achieves a steady state through the constant feedback from both the camera and the lidar sensor. It also utilizes these to respond to the environment in through changes like carpet or Sean's finger. Additionally, the wheels are controlled by fully separated PID controllers which results in a stable state.
    a. Integration windup occurs when the summing of the errors prevents the proper movement of the control system, which was mitigated by enabling an integrator reset.
    b. We handled quick changes within our derivative controller by limiting the response to changes in the system for instance the robot was speed capped.
4) A system is unstable if it fails to return to a steady state for instance if the robot started chasing an object then the object disappeared and the robot continued straight forever. Or it keeps on moving even though the tracked object is stationary.
5) Our algorithm used the camera to determine the relative angle of the object. Then we cross referenced that angle with the lidar data and got the distance of the object at that specified angle. For both the distance and the angle the difference to the desired values got calculated and passed into their respective PID controllers to calculate the velocity vector.