Point Cloud Learning Assignment (Day 7 - 9)

Q1. Load & Visualize a Point Cloud from. bag File in Rviz

1. Use the rosbag info <filename>.bag command to :
   - List all topics
   - Identify topics of type sensor_msgs/PointCloud2
   - Note their message count and timestamps
2. Play a ROS .bag file that includes sensor_msgs/PointCloud2 topics.
3. Open RViz and:
   - Add the correct **PointCloud2** display
   - Set:
     a. Color transformer (e.g., RGB, Intensity)
     b. Point size
     c. Background color
4. Take and submit:
   - One screenshot of RViz default view
   - One screenshot with custom visualization settings
5. Briefly explain:
   - How you identified the right topic from rosbag info
   - Any errors or issues (TF, topic not visible, etc.) and how you resolved them

Q2. Apply Outlier Filtering to a Raw .pcd File

Using your .pcd file:

1. Apply **Radius Outlier Filtering**
   - Parameters used: radius, nb_points
   - Show before and after screenshots
2. Apply **Statistical Outlier Filtering**
   - Parameters used: nb_neighbors, std_ratio
   - Show before and after screenshots
3. Compare both filtered outputs
   - Which one removed noise more effectively?
   - When would you prefer each?

Q3. Full Preprocessing Pipeline in Python (Open3D)

Write a Python script (or use Jupyter notebook) to :

1. **Load** the .pcd file
2. **Clean** the data (remove invalid/NAN points)
3. **Apply filtering** (choose radius or statistical)
4. **Center** the cloud to the origin
5. **Normalize** the cloud (scale to unit size)
6. **Downsample** using voxel grid (e.g., voxel size = 0.05)

Submit:

- Screenshots after each step
- Comments or print() statements showing point count before/after

Q4. Customize Visualization in Open3D or RViz

Using the filtered cloud, adjust:

- **Color scheme** (e.g., RGB or intensity)
- **Point size** / voxel size
- **Background color** (dark/light theme)
- Take a screenshot of your customized view.

Q5. Analyze and Reflect

Answer these based on your hands-on experience:

- Which step had the biggest impact on cloud quality?
- Did normalization or downsampling change the visual appearance?
- How did filtering affect the structure vs noise in your cloud?
- What were your best parameter combinations for:

a) Radius filter
b) Statistical filter
c) Voxel size