Task: Assignment 1 - *Detection of line segments and circular arcs* documentation

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This project implements a Sequential RANSAC algorithm for detecting **circles** and **line segments** from 2D LIDAR scans provided in polar coordinates. The final output visualizes the detected structures and remaining points in **PLY format** for inspection in Meshlab.

My Contributions

I wrote the initial implementation, including:

- Loading and parsing the LIDAR files

- Implementing polar-to-Cartesian conversion

- Writing the first draft of the circle and line RANSAC algorithms

- Structuring the pipeline that iteratively extracts shapes

- Initial PLY export function

- Debugging numerical issues such as division-by-zero and unstable sampling

- Running and testing the algorithm on the required datasets (x+1, x+11, x+21)

AI (ChatGPT and Grok AI) Contributions

AI was used as a **pair-programming assistant** for the following tasks:

1. **Code Refactoring**

   - Simplified and optimized function structure

   - Improved clarity of variable naming

   - Enhanced modular design (separate functions for line fitting, circle fitting, RANSAC loops)

2. **Commenting and Documentation**

   - Generated meaningful inline comments

   - Helped create docstrings

3. **Debugging Assistance**

   - Identified a few numerical edge cases

   - Suggested corrections for circle parameter estimation

   - Assisted in fixing validation bounds for line length and circle radius

   - Helped correct the PLY file structure so that Meshlab loads it correctly

4. **Improving the Final Code Quality**

   - Guided restructuring the pipeline to clearly separate:

     - Shape extraction

     - Inlier removal

     - Re-estimation of models

   - Recommended careful inlier cleanup between iterations

○ Ensured both circle and line models are attempted every RANSAC round

AI did **not** write the entire project. All algorithmic decisions, logic, testing, selection of thresholds, and implementation-specific details were performed and verified by me.

Prompts I used with AI:

- "Refactor my RANSAC code to improve structure and readability."

- "Help me debug errors in circle fitting and line fitting."

- "Suggest improvements for re-estimating circle and line models using inliers."

- "Explain how to correctly write PLY files with RGB colors."

- "Check if my implementation meets the assignment requirements."

- "Add clear comments and docstrings to my code."