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Project Proposal: Point Cloud Segmentation Benchmark for College Campus

1. Objective

The primary objective of this project is to establish a robust benchmark dataset and processing pipeline for segmentation of large-scale LiDAR point clouds collected over the college campus. This benchmark will serve as a foundation for further research in 3D spatial analysis, urban digital twins, and machine learning-based semantic segmentation.

2. Plan

a. Data Aggregation

- Merge all collected point cloud files (from multiple zones of the campus) into a single comprehensive dataset.
- Ensure proper alignment and coordinate consistency across merged datasets.

b. Data Downsampling

- Apply voxel grid downsampling to remove overlaps and duplicate points.
- Balance data reduction with preservation of structural details critical for segmentation.
- Optimize dataset size for computational feasibility.

c. Segmentation & Refinement

- Employ semi-automated segmentation techniques.
- Manually refine and correct the segmentation to ensure accurate labelling of campus elements such as buildings, trees, roads, open spaces, and infrastructure.
- Establish a consistent taxonomy/classification system for semantic categories.

d. Data Tiling & Representation

- Divide the large dataset into manageable tiles for easy storage, visualization, and analysis.
- Ensure tiles overlap appropriately to avoid boundary inconsistencies.
- Generate metadata and indexing for efficient access and benchmark usability.

3. Dataset Overview

Based on the currently available IIITB campus LiDAR scans, the dataset possesses the following characteristics:

1. All tiles are present in **.laz format**.
2. A **downsampled version** exists for each tile.
3. The tiles are currently **unregistered**, and manual registration is required before aggregation.
4. For each tile **.bag files, calibration data, and trajectory information** are available.
5. Each tile captures important standard LiDAR features such as **intensity, number of returns, GPS time, and scan angle rank**.

Dataset Summary

Tile Name	Raw Point Cloud		Downsampled Point Cloud		Description
	File size	**No. of Points**	**File Size**	**No. of Points**	
AryaRama	5.06 GB	429.5 M	383 MB	35.8 M	Aryabhatta + Ramanujan + Football Ground
BacLila	6.40 GB	535.6 M	457 MB	42.6 M	Back of Lilavati + Bhaskara (Detailed) + Basketball Court + Roads
Garden	4.31 GB	341.6 M	319 MB	29.1 M	Front Garden
Parking	2.42 GB	216 M	185 MB	17.1 M	Parking Lot + Garden + Generator (Colourised Available)
VisLila	5.79 GB	478 M	465 MB	38 M	Visvesvaraya + Lilavati + Back garden
Total	**23.98 GB**	**2 B**	**1.81 GB**	**162.6 M**	-