CSL-523: Computational Geometry (Autumn 2025-26)
Coding Project 1 (CP1) – Initial Proposal

Group No: 21

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Project Title:
`Art Gallery Problem with Minimum Wiring Cost and Heuristic Extensions`

Problem Statement:
The Art Gallery Problem (AGP) asks for the minimum number of cameras needed to cover a polygon. For a simple polygon with n vertices, $\lfloor n/3 \rfloor$ cameras are always sufficient. We will implement the classical pipeline: polygon generation, trapezoidalization, triangulation, dual graph construction, and 3-coloring to obtain feasible camera sets.

Proposed Extension: Minimum Wiring Cost
In practical surveillance, cameras must connect to a server placed on the boundary, with wires restricted to walls. Total cost is defined as

$$\text{Cost} = C_g \times \#\text{cameras} + C_w \times \text{wire length},$$

where C_g is camera cost and C_w is wiring cost per unit. For any camera set, the optimal wiring is computed in $O(n)$ using the cycle-gap method (perimeter minus the largest gap between consecutive terminals).

Heuristic Extensions
Since color-class sets may not minimize cost, we will explore:

- **Greedy set-cover:** pick cameras maximizing new coverage per gap, then compute wiring.
- **Local search:** swap cameras to reduce total cost.
- **Comparison:** baseline (3-color) vs. heuristic solutions.

Expected Outcome:
A GUI-based tool where users can draw polygons, place the server, and visualize cameras and wiring. We will implement the 3-coloring baseline with wiring cost and attempt heuristics for better results.

Deliverables:

- Classical AGP with wiring-cost evaluation.
- Heuristic extensions for cost minimization (time permitting).
- GUI visualization of cameras, server, and wiring.
- Report with analysis, screenshots, and YouTube demo.