Panel Verification Manual and Report

Purpose

This script verifies the validity of a photovoltaic (PV) panel grouping generated by an optimization algorithm.

It ensures all electrical and structural constraints are met, including:

- Panel data consistency
- String-level voltage and current checks
- Group-level parallel string consistency

Required Files

- best_individual.csv: Optimized panel selection with group/string information.
- dataset1.csv: Full dataset containing all panel specifications.

Checks Performed

1. Panel Parameter Consistency Check:
   - Each panel in best_individual is matched to dataset1 by ID.
   - Voc, Isc, Vmp, Imp values are compared within a tolerance of 1e-3.

2. String-Level Constraint Check:
   - Voltage range for each string must be between 360 V and 400 V.
   - Current uniformity: All Imp values must be within ±10% of the minimum Imp in the string.
   - Also computes:
     * Average voltage per string
     * Current deviation percentage (Imp Error)

3. Group-Level Parallel Voltage Check:
   - Within each group, string voltages must be consistent.
   - Reports max/min voltage, range, standard deviation, and relative difference.

4. Statistical Summary:
   - Global average of string voltages
   - Global average of string current error

Output

- Verification summary printed to terminal and saved as panel_verification_summary.txt
- Full details include per-string validation results and per-group voltage consistency checks