This code is designed to evaluate and optimize orbital configurations for Landolt, with the goal of maximizing nighttime visibility from the Rubin/LSST, Mason, Palomar, and SNIFS observatories. It simulates satellite positions and visibility under constraints like airmass, local darkness, and eclipse conditions. Outputs include CSV datasets and visual plots to aid in orbit selection.

File Summaries

1. settings.py
Stores configuration parameters. Some notable parameters to tweak:

- **eccentricity**
- **inclo**: Inclination
- **nodeo:** For circular geostationary orbits, controls the satellite's longitude.
- **argpo** (Argument of Perigee): Orientation of the elliptical orbit in its orbital plane.
    - **Only matters if** the orbit is **elliptical** (i.e., ecco ≠ 0).
- **mo** (Mean Anomaly)**: Satellite's position along the orbit at the epoch (start time).**
- **start, end**
- **tdelta:** Time step **in milliseconds** between samples.

2. STRAIGHTRUN.py
Core simulation engine. Given a specific inclination, eccentricity, and RAAN, it:

- Initializes a satellite orbit.
- Computes satellite positions over time.
- Calculates eclipse percentages.
- Determines visibility (based on altitude and darkness) from all four observatories.
- Saves raw coordinates and telescope visibility data to CSV files.
- Plots a world map with the satellite ground track.

3. runbaby.py
Runs a complete grid of inclination/RAAN combinations, evaluates each orbit using TLEconstructor.func(), and stores visibility and eclipse stats in a NumPy array. The results (air2res30night.npy) are used by 2dplotter.py for visualization.

4. 2dplotter.py
Makes contour maps to visualize orbit quality across a grid of inclination and RAAN values. It:

- Loads output from orbit grid simulations (e.g. air2res30night.npy).

- Sets weights for each observatory to define how much wegith each observatory's visibility and eclipse days should have.
- Allows using either the minimum visibility percentage or weighted visibility across the observatories to color the plots (by manually commenting the code).
- Plots weighted eclipse day contours.
- Outputs PNG images summarizing visibility quality.

5. TLEconstructor.py
Simulates a satellite orbit with given parameters using the SGP4 model. It computes satellite position, altitude, eclipse status, and visibility from the four observatories over time, and outputs data to CSV files for later analysis.

6. optimize_orbit.py
Performs a grid search over inclination and RAAN to find the orbit with the best combined score, with the score defined as weighted visibility across observatories plus a weight for the number of nights in eclipse. Returns the best orbit parameters and prints summaries.

7. score.py
Offers a flexible scoring function for evaluating individual orbits. Computes visibility percentages and eclipse nights for a given RAAN and inclination. Outputs structured metrics for comparison or optimization.

Optimize Orbit Workflow

1. Define simulation parameters in settings.json.
2. Run runbaby.py to evaluate a grid of orbits.
3. Visualize orbit performance using 2dplotter.py.
4. Use optimize_orbit.py or score.py to refine or analyze individual orbits.

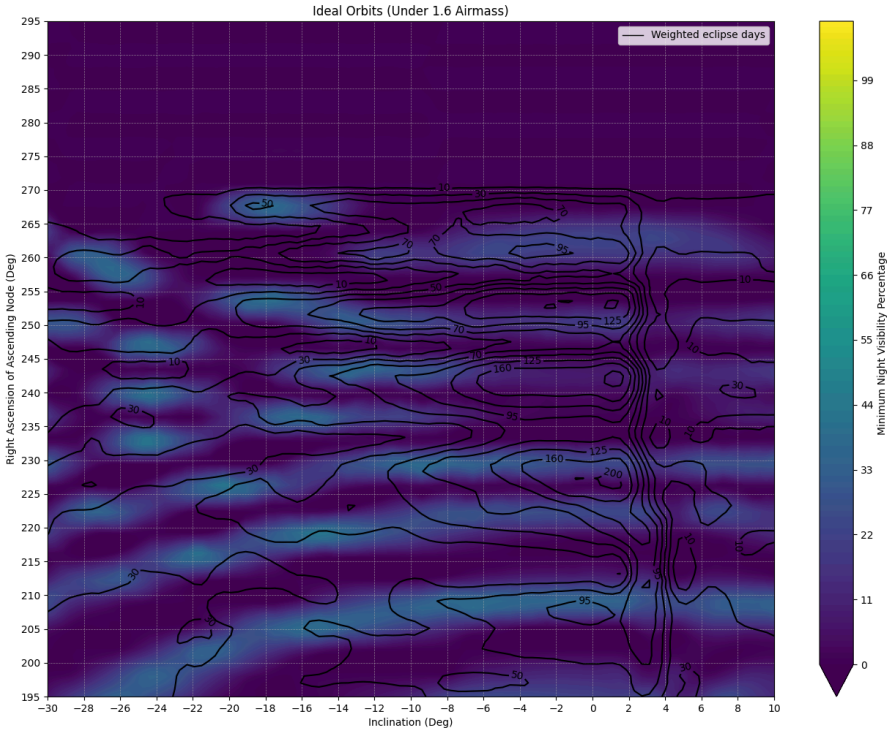
Definitions

- **Visibility %:** Fraction of nighttime samples where the satellite is above the airmass threshold.

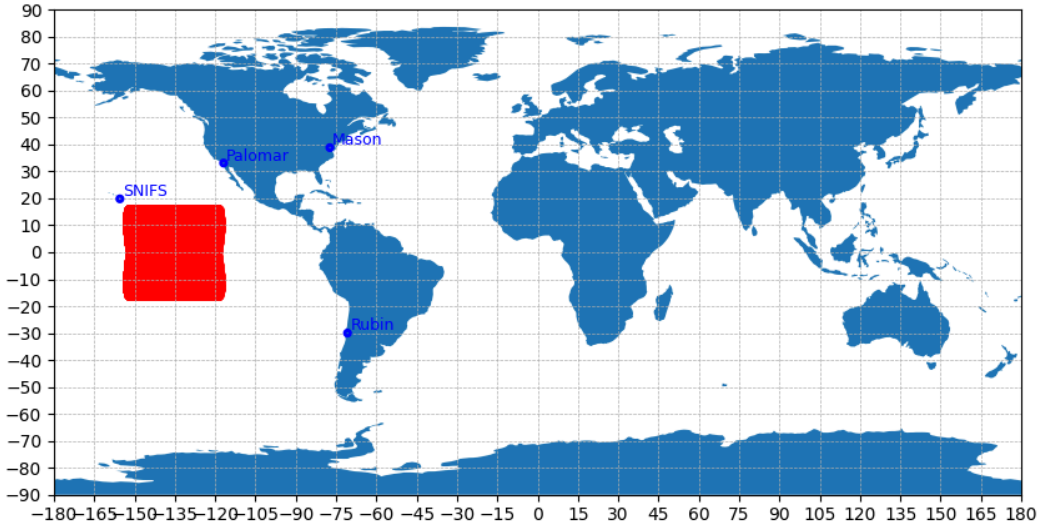
Telescope	Lat (°)	Lon (°)
Rubin	−30.0000	−70.7493
Mason	+38.8282	−77.3053
Palomar	+33.1000	−116.8649
SNIFS	+19.8200	−155.4694

Example Outputs

Contour Map



World Map



Orbit Score

```
Orbit Score Results:
RAAN: 230.00 deg, Inclination: -8.00 deg
Threshold Altitude (for airmass 1.6): 38.68 deg

Telescopes: Rubin
  Visibility: 57.9% (8490 / 14669)
  Eclipse Nights: 86
  Avg Airmass (visible): 1.336

Telescopes: Mason
  Visibility: 38.2% (5428 / 14205)
  Eclipse Nights: 86
  Avg Airmass (visible): 1.343

Telescopes: Palomar
  Visibility: 57.0% (8269 / 14497)
  Eclipse Nights: 89
  Avg Airmass (visible): 1.408

Telescopes: SNIFS
  Visibility: 34.3% (5108 / 14907)
  Eclipse Nights: 84
  Avg Airmass (visible): 1.231

Average Visibility: 46.8%
Average Eclipse Nights: 86.25
Average Airmass (visible): 1.330
```