Sun Position Algorithm

Function: `GetSunZone`

This function determines the **sun zone** (e.g., sunrise, morning, noon, evening, sunset, or night) for a given **latitude, longitude, and UTC time**. It dynamically calculates sunrise and sunset times based on the location and adjusts for **time zone and daylight saving time (DST)**.

Steps:

1- Determine Local Time

- Estimate the **time zone offset** from longitude.
- Convert the UTC time to local time.

2 - Apply Daylight Saving Time (DST)

- Adjust time if **DST is active** based on the location and date.

3 - Calculate Sunrise & Sunset Times

- Use astronomical formulas to compute **sunrise and sunset** dynamically.
- Compute **solar noon** (midway between sunrise and sunset).

4 - Determine the Sun Zone

- Compare the local time against calculated sunrise, **noon**, and sunset to assign the correct sun zone:
  - **Sunrise** → 1 hour before & after sunrise.
  - **Morning** → Between sunrise and noon.
  - **Noon** → ±1 hour around noon.
  - **Evening** → Between noon and sunset.
  - **Sunset** → 1 hour before & after sunset.
  - **Night** → Any time outside these ranges.

Supporting Functions:

1. **`EstimateTimeZoneOffset`**
   - Approximates the time zone based on **longitude** (`longitude / 15`).
2. **`IsDaylightSavingTime`**
   - Determines if **DST is active** based on latitude, longitude, and month.

3. `CalculateSunriseSunset`
    - Computes **sunrise and sunset** times using solar declination and hour angle.

Test Cases:

Latitude	Longitude	Date Time	Result
31.95677	35.93550	6/1/2024 7:30:00 AM	morning.png
31.95677	35.93550	6/1/2024 8:30:00 PM	night.png
-33.57349	20.64253	3/1/2025 2:00:00 PM	evening.png
66.46222	-171.12870	9/25/2025 5:00:00 PM	sunset.png
51.59111	-0.45416	11/29/2025 4:30:00 AM	sunrise.png

References:

https://en.wikipedia.org/wiki/Position_of_the_Sun

https://www.youtube.com/watch?v=xOZl00iMySU

some help from chatGPT

Tested by

https://www.suncalc.org/