**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/>