Task 1

In the beginning, Installing NumPy and Pandas libraries would be a must in order to begin with this assignment:

In [1]:

```
# pip install numpy
```

In [2]:

```
# pip install pandas
```

In [3]:

```
import numpy as np
import pandas as pd
import datetime
import requests
import json
from pyarrow import DictionaryValue
```

- **Get every 31st day starting from 20th June 2022 to 24th December 2022. For automated solution:**

In [4]:

```
selected_dates = pd.date_range(start='2022-06-20', end='2022-12-24', freq='31D')
display(selected_dates)
```

```
DatetimeIndex(['2022-06-20', '2022-07-21', '2022-08-21', '2022-09-21',
               '2022-10-22', '2022-11-22', '2022-12-23'],
              dtype='datetime64[ns]', freq='31D')
```

Now we have six dates between the specified range and as we can see the type, they formed in a datetime format as they are dates

- **Look up the documentation of pandas's date_range and get these datetime values, then turn them into strings matching the format YYYY-MM-DD.**

In [5]:

```
# astype(str) will help us to convert datetime format data to strings
string_dates = selected_dates.astype(str)
display(string_dates)
```

```
Index(['2022-06-20', '2022-07-21', '2022-08-21', '2022-09-21', '2022-10-22',
       '2022-11-22', '2022-12-23'],
      dtype='object')
```

- **Look up the documentation of the sunrise-sunset api under https://sunrise-sunset.org/api, and use it to get all the data from the API for these days for the latitude 47.5620815 and longitude 19.0516735:**

we use this api url for getting every and each sunset/sunrise information about specified dates. we put them in a list as a json response format file and in addition, the status for our responses is okay.

In [6]:

```
sunset_list = []
for dates in string_dates:
  document_url = "https://api.sunrise-sunset.org/json?lat=47.5620815&lng=19.0516735&date=
"f"{dates}"
```

```
  response = requests.get(document_url)
  api_result = response.json()
  sunset_list.append(api_result["results"])
print(sunset_list)
print("status code: ", response.status_code)
```

```
[{'sunrise': '2:44:04 AM', 'sunset': '6:46:40 PM', 'solar_noon': '10:45:22 AM', 'day_leng
th': '16:02:36', 'civil_twilight_begin': '2:05:21 AM', 'civil_twilight_end': '7:25:23 PM'
, 'nautical_twilight_begin': '1:09:03 AM', 'nautical_twilight_end': '8:21:41 PM', 'astron
omical_twilight_begin': '11:38:36 PM', 'astronomical_twilight_end': '9:52:08 PM'}, {'sunr
ise': '3:06:28 AM', 'sunset': '6:34:00 PM', 'solar_noon': '10:50:14 AM', 'day_length': '1
5:27:32', 'civil_twilight_begin': '2:30:32 AM', 'civil_twilight_end': '7:09:56 PM', 'naut
ical_twilight_begin': '1:40:40 AM', 'nautical_twilight_end': '7:59:48 PM', 'astronomical_
twilight_begin': '12:35:44 AM', 'astronomical_twilight_end': '9:04:43 PM'}, {'sunrise': '
3:46:09 AM', 'sunset': '5:47:45 PM', 'solar_noon': '10:46:57 AM', 'day_length': '14:01:36
', 'civil_twilight_begin': '3:14:45 AM', 'civil_twilight_end': '6:19:10 PM', 'nautical_tw
ilight_begin': '2:33:58 AM', 'nautical_twilight_end': '6:59:56 PM', 'astronomical_twiligh
t_begin': '1:48:47 AM', 'astronomical_twilight_end': '7:45:07 PM'}, {'sunrise': '4:27:39
AM', 'sunset': '4:46:06 PM', 'solar_noon': '10:36:53 AM', 'day_length': '12:18:27', 'civi
l_twilight_begin': '3:58:29 AM', 'civil_twilight_end': '5:15:16 PM', 'nautical_twilight_b
egin': '3:22:14 AM', 'nautical_twilight_end': '5:51:31 PM', 'astronomical_twilight_begin'
: '2:44:48 AM', 'astronomical_twilight_end': '6:28:57 PM'}, {'sunrise': '5:11:09 AM', 'su
nset': '3:45:23 PM', 'solar_noon': '10:28:16 AM', 'day_length': '10:34:14', 'civil_twilig
ht_begin': '4:41:23 AM', 'civil_twilight_end': '4:15:09 PM', 'nautical_twilight_begin': '
4:05:33 AM', 'nautical_twilight_end': '4:50:59 PM', 'astronomical_twilight_begin': '3:29:
58 AM', 'astronomical_twilight_end': '5:26:34 PM'}, {'sunrise': '5:57:05 AM', 'sunset': '
3:02:41 PM', 'solar_noon': '10:29:53 AM', 'day_length': '09:05:36', 'civil_twilight_begin
': '5:24:40 AM', 'civil_twilight_end': '3:35:06 PM', 'nautical_twilight_begin': '4:46:45
AM', 'nautical_twilight_end': '4:13:01 PM', 'astronomical_twilight_begin': '4:10:08 AM',
'astronomical_twilight_end': '4:49:38 PM'}, {'sunrise': '6:27:56 AM', 'sunset': '2:57:42
PM', 'solar_noon': '10:42:49 AM', 'day_length': '08:29:46', 'civil_twilight_begin': '5:53
:52 AM', 'civil_twilight_end': '3:31:46 PM', 'nautical_twilight_begin': '5:14:34 AM', 'na
utical_twilight_end': '4:11:04 PM', 'astronomical_twilight_begin': '4:37:02 AM', 'astrono
mical_twilight_end': '4:48:35 PM'}]
status code:  200
```

- **Create a dataframe from the results, whose index labels are the dates. The name of the index should be 'date'. Display the dataframe.**

In [7]:

```
np.random.seed(0)
# create an array of the specified dates from string dates list
# renamed the first column as index named "dates" with values of sunset_list
df = pd.DataFrame(sunset_list, index=string_dates).rename_axis("dates")
display(df)
```

dates	sunrise	sunset	solar_noon	day_length	civil_twilight_begin	civil_twilight_end	nautical_twilight_begin	nautical_twilight_
2022-06-20	2:44:04 AM	6:46:40 PM	10:45:22 AM	16:02:36	2:05:21 AM	7:25:23 PM	1:09:03 AM	8:21:41
2022-07-21	3:06:28 AM	6:34:00 PM	10:50:14 AM	15:27:32	2:30:32 AM	7:09:56 PM	1:40:40 AM	7:59:48
2022-08-21	3:46:09 AM	5:47:45 PM	10:46:57 AM	14:01:36	3:14:45 AM	6:19:10 PM	2:33:58 AM	6:59:56
2022-09-21	4:27:39 AM	4:46:06 PM	10:36:53 AM	12:18:27	3:58:29 AM	5:15:16 PM	3:22:14 AM	5:51:31
2022-10-22	5:11:09 AM	3:45:23 PM	10:28:16 AM	10:34:14	4:41:23 AM	4:15:09 PM	4:05:33 AM	4:50:59
2022-11-22	5:57:05 AM	3:02:41 PM	10:29:53 AM	09:05:36	5:24:40 AM	3:35:06 PM	4:46:45 AM	4:13:01
2022-12-23	6:27:56 AM	2:57:42 PM	10:42:49 AM	08:29:46	5:53:52 AM	3:31:46 PM	5:14:34 AM	4:11:04

- **What, if anything, can you conclude from quickly looking at the solar_noon and day_length columns and the values of the index? You can answer in a markdown cell.**

we created a new sub-dataframe for describing the columns and the values of the index so it would be easier to conclude them:

In [8]:

```
df1 = df[["solar_noon", "day_length"]]
display(df1)
```

dates	solar_noon	day_length
2022-06-20	10:45:22 AM	16:02:36
2022-07-21	10:50:14 AM	15:27:32
2022-08-21	10:46:57 AM	14:01:36
2022-09-21	10:36:53 AM	12:18:27
2022-10-22	10:28:16 AM	10:34:14
2022-11-22	10:29:53 AM	09:05:36
2022-12-23	10:42:49 AM	08:29:46

We used plot figures for comparing the columns as following:

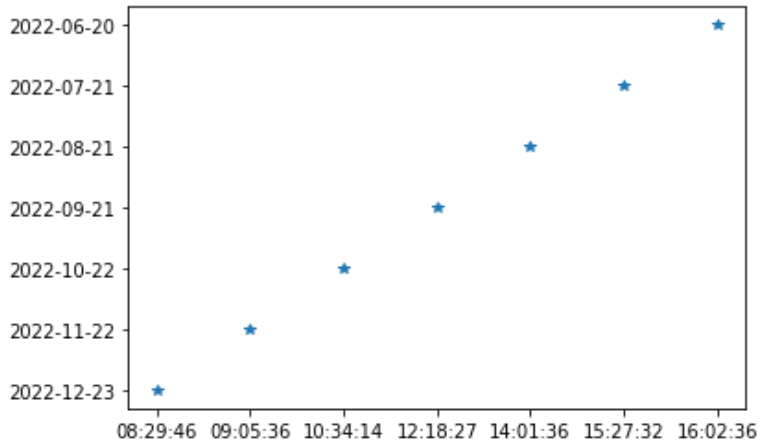
In [84]:

```
import matplotlib.pyplot as plt

display(df1["day_length"].min(), df1["day_length"].max())
sorted_df1 = df1.sort_values("day_length", ascending=True)

plt.plot(sorted_df1['day_length'],sorted_df1.index, '*')
```

```
'08:29:46'

'16:02:36'
```

Out[84]:

```
[<matplotlib.lines.Line2D at 0x7f999208cbd0>]
```

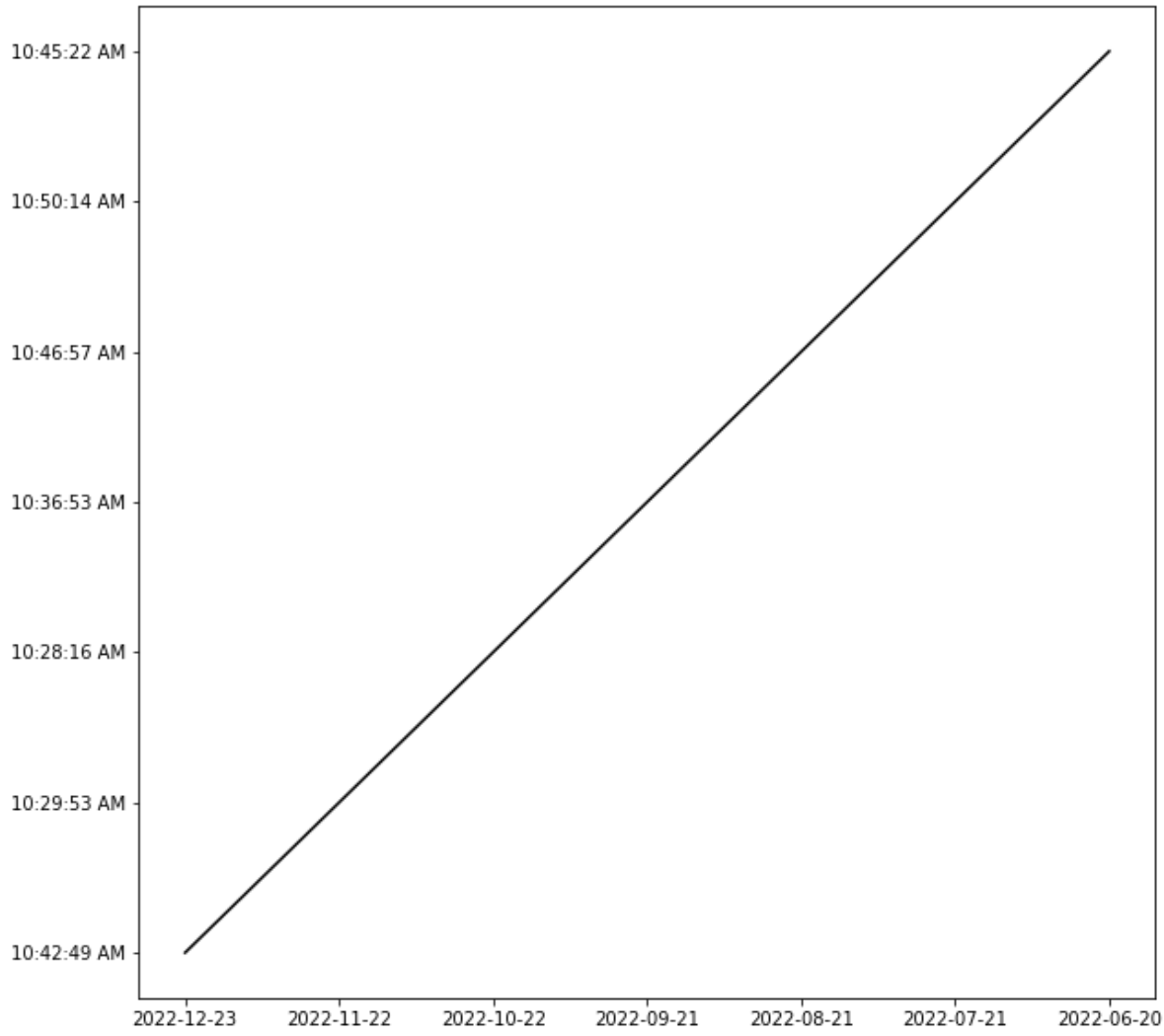


As we are able to observe, the more we go forward in the dates, the shorter the days are going to be.

In [85]:

```
fig, ax = plt.subplots(figsize=(10, 10))

ax.plot(sorted_df1.index,
```

```
        sorted_df1['solar_noon'],
        color='Black')
plt.show()
```



Also we see that when we are going through the year to first of December, we are facing sooner solar noon in the sky.

Task 2 - 1

- **Turn the "solar_noon" column into datetime type.** [link text](#)**Pay attention to getting the correct date (incl. year, month, day).**

In [11]:

```
# Using the dataframe index to avoid getting current datetime
df['solar_noon'] = df.index +" "+df["solar_noon"]
df.head()
```

Out[11]:

dates	sunrise	sunset	solar_noon	day_length	civil_twilight_begin	civil_twilight_end	nautical_twilight_begin	nautical_twilight_
2022-06-20	2:44:04 AM	6:46:40 PM	2022-06-20 10:45:22 AM	16:02:36	2:05:21 AM	7:25:23 PM	1:09:03 AM	8:21:41
2022-07-21	3:06:28 AM	6:34:00 PM	2022-07-21 10:50:14 AM	15:27:32	2:30:32 AM	7:09:56 PM	1:40:40 AM	7:59:48
2022-08-21	3:46:09 AM	5:47:45 PM	2022-08-21 10:46:57	14:01:36	3:14:45 AM	6:19:10 PM	2:33:58 AM	6:59:56

	sunrise	sunset	solar_noon	day_length	civil_twilight_begin	civil_twilight_end	nautical_twilight_begin	nautical_twilight_
2022-09-21	4:27:39 AM	4:46:06 PM	2022-09-21 10:36:53 AM	12:18:27	3:58:29 AM	5:15:16 PM	3:22:14 AM	5:51:31
2022-10-22	5:11:09 AM	3:45:23 PM	2022-10-22 10:28:16 AM	10:34:14	4:41:23 AM	4:15:09 PM	4:05:33 AM	4:50:59

Then change the solar_noon column into the datetime format. As it is visible in the table info, Dtype changed to datetime format.

In [12]:

```
df["solar_noon"] = pd.to_datetime(df["solar_noon"])
df
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 7 entries, 2022-06-20 to 2022-12-23
Data columns (total 10 columns):
 #   Column                       Non-Null Count  Dtype         
---  ------                       --------------  -----         
 0   sunrise                      7 non-null      object        
 1   sunset                       7 non-null      object        
 2   solar_noon                   7 non-null      datetime64[ns]
 3   day_length                   7 non-null      object        
 4   civil_twilight_begin         7 non-null      object        
 5   civil_twilight_end           7 non-null      object        
 6   nautical_twilight_begin      7 non-null      object        
 7   nautical_twilight_end        7 non-null      object        
 8   astronomical_twilight_begin  7 non-null      object        
 9   astronomical_twilight_end    7 non-null      object        
dtypes: datetime64[ns](1), object(9)
memory usage: 616.0+ bytes
```

Task 2 - 2

- **Create a new column which contains your datetime column localized to the Budapest time zone. bold text**

In [13]:

```
# convert the time zone to Budapest local time
t_Budapest = df["solar_noon"].dt.tz_localize('Europe/Budapest')
# creating the Budapest_time columns as the last column
df["Budapest_time"] = t_Budapest
display(df["Budapest_time"])
df
```

```
dates
2022-06-20   2022-06-20 10:45:22+02:00
2022-07-21   2022-07-21 10:50:14+02:00
2022-08-21   2022-08-21 10:46:57+02:00
2022-09-21   2022-09-21 10:36:53+02:00
2022-10-22   2022-10-22 10:28:16+02:00
2022-11-22   2022-11-22 10:29:53+01:00
2022-12-23   2022-12-23 10:42:49+01:00
Name: Budapest_time, dtype: datetime64[ns, Europe/Budapest]
```

Out[13]:

dates	sunrise	sunset	solar_noon	day_length	civil_twilight_begin	civil_twilight_end	nautical_twilight_begin	nautical_twilight_
2022-06-20	2:44:04 AM	6:46:40 PM	2022-06-20 10:45:22	16:02:36	2:05:21 AM	7:25:23 PM	1:09:03 AM	8:21:41

dates	sunrise	sunset	solar_noon	day_length	civil_twilight_begin	civil_twilight_end	nautical_twilight_begin	nautical_twilight_
2022-07-21	3:06:28 AM	6:34:00 PM	2022-07-21 10:50:14	15:27:32	2:30:32 AM	7:09:56 PM	1:40:40 AM	7:59:48
2022-08-21	3:46:09 AM	5:47:45 PM	2022-08-21 10:46:57	14:01:36	3:14:45 AM	6:19:10 PM	2:33:58 AM	6:59:56
2022-09-21	4:27:39 AM	4:46:06 PM	2022-09-21 10:36:53	12:18:27	3:58:29 AM	5:15:16 PM	3:22:14 AM	5:51:31
2022-10-22	5:11:09 AM	3:45:23 PM	2022-10-22 10:28:16	10:34:14	4:41:23 AM	4:15:09 PM	4:05:33 AM	4:50:59
2022-11-22	5:57:05 AM	3:02:41 PM	2022-11-22 10:29:53	09:05:36	5:24:40 AM	3:35:06 PM	4:46:45 AM	4:13:01
2022-12-23	6:27:56 AM	2:57:42 PM	2022-12-23 10:42:49	08:29:46	5:53:52 AM	3:31:46 PM	5:14:34 AM	4:11:04

Task 3 - 1

- **Display the usual basic information (columns, datatypes, non-null counts) about the dataframe.**

In [88]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 7 entries, 2022-06-20 to 2022-12-23
Data columns (total 11 columns):
 #   Column                        Non-Null Count  Dtype
---  ------                        --------------  -----
 0   sunrise                       7 non-null      object
 1   sunset                        7 non-null      object
 2   solar_noon                    7 non-null      datetime64[ns]
 3   day_length                    7 non-null      object
 4   civil_twilight_begin          7 non-null      object
 5   civil_twilight_end            7 non-null      object
 6   nautical_twilight_begin       7 non-null      object
 7   nautical_twilight_end         7 non-null      object
 8   astronomical_twilight_begin   7 non-null      object
 9   astronomical_twilight_end     7 non-null      object
 10  Budapest_time                 7 non-null      datetime64[ns, Europe/Budapest]
dtypes: datetime64[ns, Europe/Budapest](1), datetime64[ns](1), object(9)
memory usage: 972.0+ bytes
```

As it's visible in the table info, Budapest time type changed to date time with Europe/Budapest time zone and every columns has 7 values which are not null. we can also see the start and end of the indexes. So totally we have 11 columns.

Task 3 - 2

- **Display the dataframe sorted by solar_noon in descending order:**

In [16]:

```
# sorting by solar_noon will be by dates and it will be like the upside-down of initial t
able
final_df = df.sort_values(by=["solar_noon"], ascending=False)
display(final_df)
```

dates	sunrise	sunset	solar_noon	day_length	civil_twilight_begin	civil_twilight_end	nautical_twilight_begin	nautical_twilight_
2022-12-23	6:27:56 AM	2:57:42 PM	2022-12-23 10:42:49	08:29:46	5:53:52 AM	3:31:46 PM	5:14:34 AM	4:11:04

dates	sunrise	sunset	solar_noon	day_length	civil_twilight_begin	civil_twilight_end	nautical_twilight_begin	nautical_twilight_
2022-11-22	5:57:05 AM	3:02:41 PM	2022-11-22 10:29:53	09:05:36	5:24:40 AM	3:35:06 PM	4:46:45 AM	4:13:01
2022-10-22	5:11:09 AM	3:45:23 PM	2022-10-22 10:28:16	10:34:14	4:41:23 AM	4:15:09 PM	4:05:33 AM	4:50:59
2022-09-21	4:27:39 AM	4:46:06 PM	2022-09-21 10:36:53	12:18:27	3:58:29 AM	5:15:16 PM	3:22:14 AM	5:51:31
2022-08-21	3:46:09 AM	5:47:45 PM	2022-08-21 10:46:57	14:01:36	3:14:45 AM	6:19:10 PM	2:33:58 AM	6:59:56
2022-07-21	3:06:28 AM	6:34:00 PM	2022-07-21 10:50:14	15:27:32	2:30:32 AM	7:09:56 PM	1:40:40 AM	7:59:48
2022-06-20	2:44:04 AM	6:46:40 PM	2022-06-20 10:45:22	16:02:36	2:05:21 AM	7:25:23 PM	1:09:03 AM	8:21:41

Task 3 - 3

- **Display the first two columns:**

In [17]:

```
df[final_df.columns[:2]]
```

Out[17]:

dates	sunrise	sunset
2022-06-20	2:44:04 AM	6:46:40 PM
2022-07-21	3:06:28 AM	6:34:00 PM
2022-08-21	3:46:09 AM	5:47:45 PM
2022-09-21	4:27:39 AM	4:46:06 PM
2022-10-22	5:11:09 AM	3:45:23 PM
2022-11-22	5:57:05 AM	3:02:41 PM
2022-12-23	6:27:56 AM	2:57:42 PM

Task 4 - 1

- **Display the part of the dataframe where day_length is shorter than 14:00:00.**

In [18]:

```
shorter_than_2 = final_df[final_df["day_length"] < "14:00:00"]
display(shorter_than_2)
```

dates	sunrise	sunset	solar_noon	day_length	civil_twilight_begin	civil_twilight_end	nautical_twilight_begin	nautical_twilight_
2022-12-23	6:27:56 AM	2:57:42 PM	2022-12-23 10:42:49	08:29:46	5:53:52 AM	3:31:46 PM	5:14:34 AM	4:11:04
2022-11-22	5:57:05 AM	3:02:41 PM	2022-11-22 10:29:53	09:05:36	5:24:40 AM	3:35:06 PM	4:46:45 AM	4:13:01
2022-10-22	5:11:09 AM	3:45:23 PM	2022-10-22 10:28:16	10:34:14	4:41:23 AM	4:15:09 PM	4:05:33 AM	4:50:59
2022-09-21	4:27:39 AM	4:46:06 PM	2022-09-21 10:36:53	12:18:27	3:58:29 AM	5:15:16 PM	3:22:14 AM	5:51:31

Task 4 - 2

- **Display the part of the dataframe where day_length is longer than 14:00:00, but shorter than 16:00.**

In [19]:

```
between_2_4 = final_df[(final_df["day_length"] < "16:00:00") & (final_df["day_length"]>
"14:00:00")]
display(between_2_4)
```

dates	sunrise	sunset	solar_noon	day_length	civil_twilight_begin	civil_twilight_end	nautical_twilight_begin	nautical_twilight_
2022-08-21	3:46:09 AM	5:47:45 PM	2022-08-21 10:46:57	14:01:36	3:14:45 AM	6:19:10 PM	2:33:58 AM	6:59:56
2022-07-21	3:06:28 AM	6:34:00 PM	2022-07-21 10:50:14	15:27:32	2:30:32 AM	7:09:56 PM	1:40:40 AM	7:59:48