

data

December 6, 2023

1 Proyek Optika Intensitas Cahaya Matahari selama 24 Jam

Nama : Firman Qashdus Sabil

NIM : 210321606892

Offering: AB

1.1 Import Library

```
[ ]: import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import matplotlib
```

1.2 Pengaturan Fonts Plot

```
[ ]: rc_fonts = {
    "text.usetex": True,
    "font.size": 12,
    "mathtext.default": "regular",
    "axes.titlesize": 18,
    "axes.labelsize": 16,
    "legend.fontsize": 14,
    "xtick.labelsize": 12,
    "ytick.labelsize": 12,
    "figure.titlesize": 18,
    "text.latex.preamble": r"\usepackage{amsmath,amssymb,bm}",
    "font.family": "serif",
    "font.serif": "Times",
}
matplotlib.rcParams.update(rc_fonts)
```

1.3 Data Cuaca

Sumber [visualcrossing weather data](#)

```
[ ]: data_cuaca = pd.read_csv("dataset/krebet senggrong 2023-11-10 to 2023-11-11 ->
Weather Data.csv")
data_cuaca
```

```
[ ]:
      name      datetime  temp  feelslike  dew  humidity \
0  krevet senggong 2023-11-10T00:00:00 18.9      18.9 17.4      91.01
1  krevet senggong 2023-11-10T01:00:00 18.6      18.6 17.3      92.15
2  krevet senggong 2023-11-10T02:00:00 18.5      18.5 17.1      91.56
3  krevet senggong 2023-11-10T03:00:00 18.6      18.6 16.9      89.84
4  krevet senggong 2023-11-10T04:00:00 18.7      18.7 16.7      88.16
5  krevet senggong 2023-11-10T05:00:00 18.5      18.5 16.5      88.14
6  krevet senggong 2023-11-10T06:00:00 20.3      20.3 17.0      81.34
7  krevet senggong 2023-11-10T07:00:00 23.5      23.5 17.2      67.76
8  krevet senggong 2023-11-10T08:00:00 25.9      25.9 17.1      58.33
9  krevet senggong 2023-11-10T09:00:00 28.4      28.7 16.6      48.80
10 krevet senggong 2023-11-10T10:00:00 30.0      29.9 15.9      42.55
11 krevet senggong 2023-11-10T11:00:00 31.2      30.9 15.5      38.72
12 krevet senggong 2023-11-10T12:00:00 29.3      29.5 16.4      45.73
13 krevet senggong 2023-11-10T13:00:00 23.8      23.8 18.9      74.05
14 krevet senggong 2023-11-10T14:00:00 24.0      24.0 19.0      73.62
15 krevet senggong 2023-11-10T15:00:00 23.6      23.6 19.5      77.80
16 krevet senggong 2023-11-10T16:00:00 22.6      22.6 19.8      84.21
17 krevet senggong 2023-11-10T17:00:00 21.6      21.6 19.7      88.95
18 krevet senggong 2023-11-10T18:00:00 21.3      21.3 19.8      91.16
19 krevet senggong 2023-11-10T19:00:00 21.2      21.2 19.7      91.16
20 krevet senggong 2023-11-10T20:00:00 20.6      20.6 19.8      95.17
21 krevet senggong 2023-11-10T21:00:00 20.1      20.1 19.8      98.16
22 krevet senggong 2023-11-10T22:00:00 20.5      20.5 19.9      96.36
23 krevet senggong 2023-11-10T23:00:00 20.6      20.6 19.8      95.17
24 krevet senggong 2023-11-11T00:00:00 20.6      20.6 19.7      94.58
25 krevet senggong 2023-11-11T01:00:00 20.5      20.5 19.7      95.17
26 krevet senggong 2023-11-11T02:00:00 20.4      20.4 19.6      95.17
27 krevet senggong 2023-11-11T03:00:00 19.9      19.9 19.3      96.34
28 krevet senggong 2023-11-11T04:00:00 19.7      19.7 19.2      96.94
29 krevet senggong 2023-11-11T05:00:00 19.3      19.3 19.0      98.15
30 krevet senggong 2023-11-11T06:00:00 20.8      20.8 19.4      91.70
31 krevet senggong 2023-11-11T07:00:00 22.7      22.7 19.7      83.18
32 krevet senggong 2023-11-11T08:00:00 24.7      24.7 19.4      72.38
33 krevet senggong 2023-11-11T09:00:00 27.2      28.3 18.8      60.13
34 krevet senggong 2023-11-11T10:00:00 28.0      29.0 18.6      56.66
35 krevet senggong 2023-11-11T11:00:00 27.6      28.8 19.0      59.47
36 krevet senggong 2023-11-11T12:00:00 27.0      28.4 19.8      64.75
37 krevet senggong 2023-11-11T13:00:00 27.3      28.6 19.5      62.44
38 krevet senggong 2023-11-11T14:00:00 27.3      28.6 19.4      62.05
39 krevet senggong 2023-11-11T15:00:00 26.0      26.0 20.0      69.54
40 krevet senggong 2023-11-11T16:00:00 24.0      24.0 20.8      82.31
41 krevet senggong 2023-11-11T17:00:00 22.4      22.4 20.7      90.12
42 krevet senggong 2023-11-11T18:00:00 21.3      21.3 20.3      94.03
43 krevet senggong 2023-11-11T19:00:00 21.1      21.1 19.9      92.86
44 krevet senggong 2023-11-11T20:00:00 20.9      20.9 19.9      94.01
45 krevet senggong 2023-11-11T21:00:00 20.6      20.6 20.0      96.36
```

46	krebet	senggrong	2023-11-11T22:00:00	20.5	20.5	20.0	96.96
47	krebet	senggrong	2023-11-11T23:00:00	20.3	20.3	19.8	96.95

	precip	precipprob	preciptype	snow	...	sealevelpressure	cloudcover	\
0	0.0	0	NaN	0	...	1014	100.0	
1	0.0	0	NaN	0	...	1014	100.0	
2	0.0	0	NaN	0	...	1013	100.0	
3	0.0	0	NaN	0	...	1013	100.0	
4	0.0	0	NaN	0	...	1014	100.0	
5	0.0	0	NaN	0	...	1014	80.3	
6	0.0	0	NaN	0	...	1015	96.1	
7	0.0	0	NaN	0	...	1015	81.3	
8	0.0	0	NaN	0	...	1015	18.5	
9	0.0	0	NaN	0	...	1014	90.7	
10	0.0	0	NaN	0	...	1013	94.8	
11	0.1	100	rain	0	...	1012	99.1	
12	0.3	100	rain	0	...	1011	100.0	
13	1.3	100	rain	0	...	1012	100.0	
14	0.7	100	rain	0	...	1012	98.0	
15	2.5	100	rain	0	...	1012	99.3	
16	2.5	100	rain	0	...	1012	100.0	
17	2.7	100	rain	0	...	1013	98.0	
18	1.4	100	rain	0	...	1014	88.2	
19	1.1	100	rain	0	...	1014	100.0	
20	0.0	0	rain	0	...	1015	100.0	
21	0.3	100	rain	0	...	1016	99.5	
22	0.3	100	rain	0	...	1015	98.6	
23	0.0	0	NaN	0	...	1014	95.6	
24	0.0	0	NaN	0	...	1014	98.0	
25	0.2	100	rain	0	...	1013	96.8	
26	0.0	0	NaN	0	...	1013	48.1	
27	0.0	0	NaN	0	...	1013	35.6	
28	0.0	0	NaN	0	...	1014	14.3	
29	0.0	0	NaN	0	...	1015	11.1	
30	0.0	0	NaN	0	...	1015	87.4	
31	0.0	0	NaN	0	...	1015	100.0	
32	0.0	0	NaN	0	...	1015	61.4	
33	0.1	100	rain	0	...	1015	97.5	
34	0.4	100	rain	0	...	1014	100.0	
35	0.9	100	rain	0	...	1014	97.2	
36	0.7	100	rain	0	...	1013	64.3	
37	1.0	100	rain	0	...	1012	42.3	
38	0.0	0	rain	0	...	1011	16.9	
39	1.3	100	rain	0	...	1011	17.6	
40	1.6	100	rain	0	...	1012	44.5	
41	1.1	100	rain	0	...	1013	57.5	
42	1.5	100	rain	0	...	1013	13.9	

43	1.2	100	rain	0 ...	1014	14.8
44	0.0	0	rain	0 ...	1015	25.8
45	0.2	100	rain	0 ...	1015	31.0
46	0.3	100	rain	0 ...	1015	37.5
47	0.0	0	NaN	0 ...	1015	40.4

	visibility	solarradiation	solarenergy	uvindex	severerisk	\
0	24.1	0	0.0	0	10	
1	24.1	0	0.0	0	10	
2	24.1	0	0.0	0	10	
3	24.1	0	0.0	0	10	
4	24.1	0	0.0	0	10	
5	24.1	0	0.0	0	10	
6	24.1	67	0.2	1	10	
7	24.1	272	1.0	3	10	
8	24.1	521	1.9	5	10	
9	24.1	789	2.8	8	10	
10	24.1	928	3.3	9	10	
11	22.6	959	3.5	10	10	
12	21.9	478	1.7	5	10	
13	6.9	140	0.5	1	10	
14	8.0	202	0.7	2	10	
15	6.1	178	0.6	2	10	
16	8.3	99	0.4	1	10	
17	5.7	36	0.1	0	10	
18	8.5	1	0.0	0	10	
19	7.1	0	0.0	0	10	
20	5.9	0	0.0	0	10	
21	20.3	0	0.0	0	10	
22	24.1	0	0.0	0	10	
23	24.1	0	0.0	0	10	
24	24.1	0	0.0	0	10	
25	24.1	0	0.0	0	10	
26	24.1	0	0.0	0	10	
27	24.1	0	0.0	0	10	
28	24.1	0	0.0	0	10	
29	22.7	0	0.0	0	10	
30	22.1	68	0.2	1	10	
31	24.1	280	1.0	3	10	
32	24.1	512	1.8	5	10	
33	23.7	761	2.7	8	10	
34	9.4	878	3.2	9	10	
35	10.4	965	3.5	10	10	
36	12.0	944	3.4	9	30	
37	9.3	814	2.9	8	30	
38	12.0	702	2.5	7	30	
39	11.7	620	2.2	6	30	

40	6.2	389	1.4	4	30
41	19.4	141	0.5	1	30
42	6.5	6	0.0	0	10
43	8.2	0	0.0	0	10
44	8.3	0	0.0	0	10
45	8.1	0	0.0	0	10
46	24.1	0	0.0	0	10
47	24.1	0	0.0	0	10

	conditions	icon	stations
0	Overcast	cloudy	remote
1	Overcast	cloudy	remote
2	Overcast	cloudy	remote
3	Overcast	cloudy	remote
4	Overcast	cloudy	remote
5	Partially cloudy	partly-cloudy-day	remote
6	Overcast	cloudy	remote
7	Partially cloudy	partly-cloudy-day	remote
8	Clear	clear-day	remote
9	Overcast	cloudy	remote
10	Overcast	cloudy	remote
11	Rain, Overcast	rain	remote
12	Rain, Overcast	rain	remote
13	Rain, Overcast	rain	remote
14	Rain, Overcast	rain	remote
15	Rain, Overcast	rain	remote
16	Rain, Overcast	rain	remote
17	Rain, Overcast	rain	remote
18	Rain, Partially cloudy	rain	remote
19	Rain, Overcast	rain	remote
20	Overcast	cloudy	remote
21	Rain, Overcast	rain	remote
22	Rain, Overcast	rain	remote
23	Overcast	cloudy	remote
24	Overcast	cloudy	remote
25	Rain, Overcast	rain	remote
26	Partially cloudy	partly-cloudy-night	remote
27	Partially cloudy	partly-cloudy-night	remote
28	Clear	clear-night	remote
29	Clear	clear-day	remote
30	Partially cloudy	partly-cloudy-day	remote
31	Overcast	cloudy	remote
32	Partially cloudy	partly-cloudy-day	remote
33	Rain, Overcast	rain	remote
34	Rain, Overcast	rain	remote
35	Rain, Overcast	rain	remote
36	Rain, Partially cloudy	rain	remote

37	Rain, Partially cloudy	rain	remote
38	Clear	clear-day	remote
39	Rain	rain	remote
40	Rain, Partially cloudy	rain	remote
41	Rain, Partially cloudy	rain	remote
42	Rain	rain	remote
43	Rain	rain	remote
44	Partially cloudy	partly-cloudy-night	remote
45	Rain, Partially cloudy	rain	remote
46	Rain, Partially cloudy	rain	remote
47	Partially cloudy	partly-cloudy-night	remote

[48 rows x 24 columns]

1.4 Kompilasi Data Pengukuran Intensitas Cahaya, Cuaca, dan Posisi Matahari

```
[ ]: data_percobaan = pd.read_csv("dataset/Analisis Data Proyek Optika - Sheet1.
    ↪csv", header=[0,1])
data_percobaan = data_percobaan.rename(columns=lambda x: x if not 'Unnamed' in_
    ↪str(x) else '')
data_percobaan
```

[]:	No.	Jam	Posisi Matahari (°)	Intensitas (lux)			\
			Azimuth	Altitude	Deklinasi	Data 1	Data 2
0	1	19:00	247.52	-22.76	-17.146	0	0
1	2	20:00	241.78	-36.18	-17.158	0	0
2	3	21:00	232.21	-48.66	-17.170	0	0
3	4	22:00	215.27	-59.03	-17.181	0	0
4	5	23:00	186.96	-64.54	-17.193	0	0
5	6	00:00	155.16	-62.13	-17.205	0	0
6	7	01:00	133.73	-53.33	-17.216	0	0
7	8	02:00	121.68	-41.51	-17.228	0	0
8	9	03:00	114.64	-28.40	-17.240	0	0
9	10	04:00	110.28	-14.69	-17.251	0	0
10	11	05:00	107.53	0.00	-17.263	312	306
11	12	06:00	105.91	13.72	-17.274	6662	6622
12	13	07:00	105.33	28.00	-17.286	25453	25518
13	14	08:00	106.06	42.29	-17.298	59230	57291
14	15	09:00	109.14	56.22	-17.309	82439	81723
15	16	10:00	119.34	70.07	-17.321	116971	116969
16	17	11:00	161.98	80.27	-17.332	153597	153391
17	18	12:00	230.15	75.20	-17.344	146211	146961
18	19	13:00	247.85	62.26	-17.355	119068	119679
19	20	14:00	252.94	48.24	-17.367	29602	29658
20	21	15:00	254.46	33.99	-17.379	11497	11355
21	22	16:00	254.35	19.70	-17.390	9445	9475
22	23	17:00	253.14	5.54	-17.402	1706	1720

23	24	18:00	250.87	-8.82	-17.413	0	0
----	----	-------	--------	-------	---------	---	---

		Intensitas rata-rata (lux)	Suhu udara (*C)	Kelembapan udara (%)
Data 3				
0	0	0.000000	21.2	91.16
1	0	0.000000	20.6	95.17
2	0	0.000000	20.1	98.16
3	0	0.000000	20.5	96.36
4	0	0.000000	20.6	95.17
5	0	0.000000	20.6	94.58
6	0	0.000000	20.5	95.17
7	0	0.000000	20.4	95.17
8	0	0.000000	19.9	96.34
9	0	0.000000	19.7	96.94
10	310	309.333333	19.3	98.15
11	6681	6655.000000	20.8	91.70
12	25326	25432.333330	22.7	83.18
13	58964	58495.000000	24.7	72.38
14	80571	81577.666670	27.2	60.13
15	117208	117049.333300	28.0	56.66
16	153631	153539.666700	27.6	59.47
17	146004	146392.000000	27.0	64.75
18	119120	119289.000000	27.3	62.44
19	30156	29805.333330	27.3	62.05
20	11450	11434.000000	26.0	69.54
21	9425	9448.333333	24.0	82.31
22	1755	1727.000000	22.4	90.12
23	0	0.000000	21.3	94.03

1.5 Data Maksimum dan Minimum

```
[ ]: minimum = data_percobaan.min()
minimum
```

```
[ ]: No. 1
Jam 00:00
Posisi Matahari (°) Azimuth 105.33
Altitude -64.54
Deklinasi -17.413
Intensitas (lux) Data 1 0
Data 2 0
Data 3 0
Intensitas rata-rata (lux) 0.0
Suhu udara (*C) 19.3
Kelembapan udara (%) 56.66
dtype: object
```

```
[ ]: maksimum = data_percobaan.max()
maksimum
```

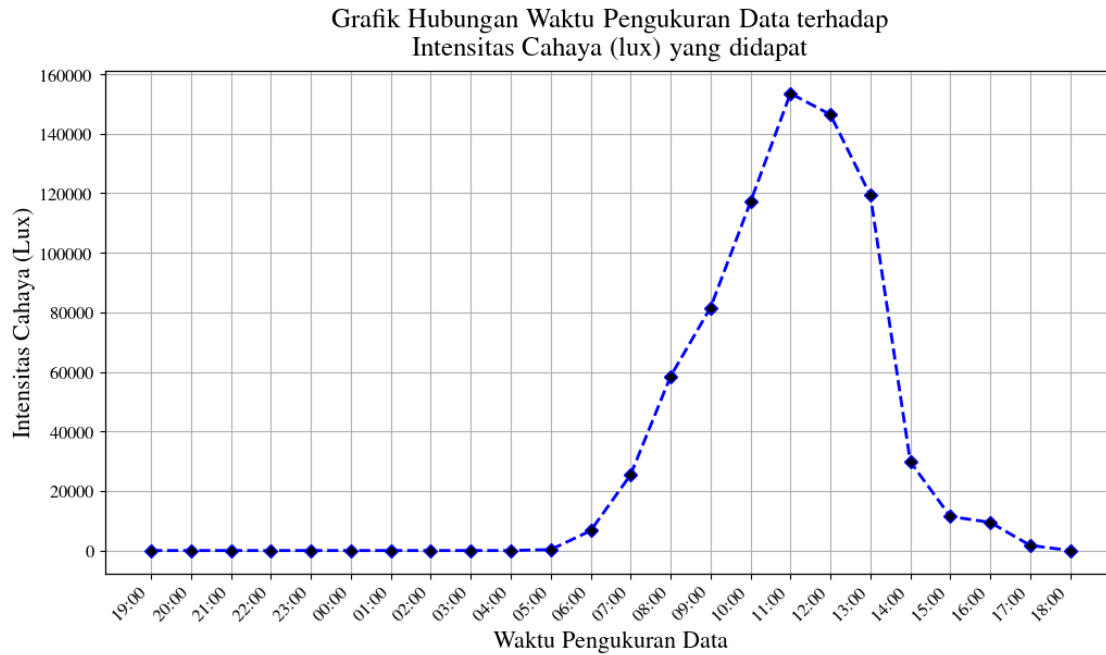
```
[ ]: No.                24
Jam                    23:00
Posisi Matahari (°)    Azimuth    254.46
                        Altitude    80.27
                        Deklinasi    -17.146
Intensitas (lux)        Data 1      153597
                        Data 2      153391
                        Data 3      153631
Intensitas rata-rata (lux)    153539.6667
Suhu udara (*C)        28.0
Kelembapan udara (%)    98.16
dtype: object
```

1.6 Plot Intensitas Cahaya Matahari Tiap Jam selama 24 Jam

```
[ ]: intensitas_cahaya = data_percobaan["Intensitas rata-rata (lux)"]
waktu_pengukuran = data_percobaan["Jam"]

figure, (grafik_1) = plt.subplots(1, 1, figsize=(12, 6))
grafik_1.plot(waktu_pengukuran, intensitas_cahaya, linewidth=2,
              color='blue', linestyle="--", marker="D", markerfacecolor='black')
grafik_1.grid()
grafik_1.set_title(
    '''Grafik Hubungan Waktu Pengukuran Data terhadap
    Intensitas Cahaya (lux) yang didapat''', pad=10)
grafik_1.set_xlabel(r'Waktu Pengukuran Data')
grafik_1.set_ylabel('Intensitas Cahaya (Lux)')
plt.xticks(ticks=waktu_pengukuran, rotation=45, ha='right')
for axis in ['top', 'bottom', 'left', 'right']:
    grafik_1.spines[axis].set_linewidth(0.9)

figure.savefig("dataset/grafik waktu vs intensitas.pdf", format="pdf",
              bbox_inches='tight')
```

1.7 Plot Intensitas Cahaya Matahari terhadap Suhu Udara

1.7.1 Filtering & Sorting Data

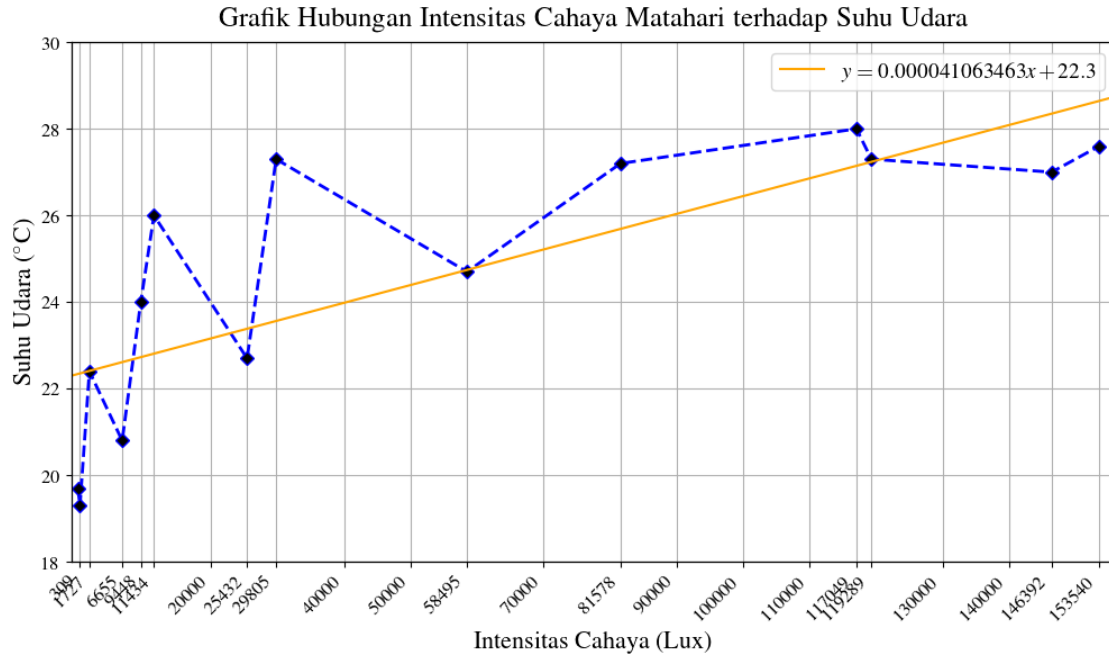
```
[ ]: data_intensitas_vs_suhu = data_percobaan.loc[9:22, [
    "Intensitas rata-rata (lux)", "Suhu udara (*C)"]].copy(deep=True).
    ↪sort_values(by=["Intensitas rata-rata (lux)"])
data_intensitas_vs_suhu
```

```
[ ]:      Intensitas rata-rata (lux)  Suhu udara (*C)
```

9	0.000000	19.7
10	309.333333	19.3
22	1727.000000	22.4
11	6655.000000	20.8
21	9448.333333	24.0
20	11434.000000	26.0
12	25432.333330	22.7
19	29805.333330	27.3
13	58495.000000	24.7
14	81577.666670	27.2
15	117049.333300	28.0
18	119289.000000	27.3
17	146392.000000	27.0
16	153539.666700	27.6

1.7.2 Plot Data

```
[ ]: intensitas_cahaya_filtered = data_intensitas_vs_suhu["Intensitas rata-rata"  
    ↳(lux)"]  
suhu_udara = data_intensitas_vs_suhu["Suhu udara (*C)"]  
  
figure, (grafik_intensitas_vs_suhu) = plt.subplots(1, 1, figsize=(12, 6))  
grafik_intensitas_vs_suhu.plot(intensitas_cahaya_filtered, suhu_udara,  
    ↳linewidth=2,  
                                color='blue', linestyle="--", marker="D",  
    ↳markerfacecolor='black')  
  
grafik_intensitas_vs_suhu.set_title('Grafik Hubungan Intensitas Cahaya  
    ↳Matahari terhadap Suhu Udara', pad=10)  
grafik_intensitas_vs_suhu.set_xlabel(r'Intensitas Cahaya (Lux)')  
grafik_intensitas_vs_suhu.set_ylabel('Suhu Udara ( $^{\circ}\text{C}$ )')  
grafik_intensitas_vs_suhu.axis([-1000, 156000, 18, 30])  
m, b = np.polyfit(intensitas_cahaya_filtered, suhu_udara, deg=1)  
plt.axline(xy1=(0, b), slope=m, label=f'$y = {m:.12f}x + {b:.1f}$',  
    ↳color='orange')  
grafik_intensitas_vs_suhu.legend()  
grafik_intensitas_vs_suhu.grid()  
plt.xticks(ticks=np.setdiff1d(np.append(np.arange(0, 160000, 10000),  
    ↳intensitas_cahaya_filtered), [  
        0, 10000, 30000, 80000, 60000, 150000, 120000])), rotation=45,  
    ↳ha='right')  
for axis in ['top', 'bottom', 'left', 'right']:  
    grafik_intensitas_vs_suhu.spines[axis].set_linewidth(0.9)  
  
figure.savefig("dataset/grafik intensitas vs suhu.pdf", format="pdf",  
    ↳bbox_inches='tight')
```



1.8 Plot Intensitas Cahaya Matahari terhadap Kelembapan Udara

1.8.1 Filtering & Sorting Data

```
[ ]: data_intensitas_vs_kelembapan = data_percobaan.loc[9:22, [
    "Intensitas rata-rata (lux)", "Kelembapan udara (%)"]].copy(deep=True).
    ↪sort_values(by=["Intensitas rata-rata (lux)"])
data_intensitas_vs_kelembapan
```

```
[ ]:      Intensitas rata-rata (lux)  Kelembapan udara (%)
```

9	0.000000	96.94
10	309.333333	98.15
22	1727.000000	90.12
11	6655.000000	91.70
21	9448.333333	82.31
20	11434.000000	69.54
12	25432.333330	83.18
19	29805.333330	62.05
13	58495.000000	72.38
14	81577.666670	60.13
15	117049.333300	56.66
18	119289.000000	62.44
17	146392.000000	64.75
16	153539.666700	59.47

1.8.2 Plot Data

```
[ ]: intensitas_cahaya_filtered = data_intensitas_vs_kelembapan[
    "Intensitas rata-rata (lux)"]
kelembapan_udara = data_intensitas_vs_kelembapan["Kelembapan udara (%)"]

figure, (grafik_intensitas_vs_kelembapan) = plt.subplots(1, 1, figsize=(12, 6))
grafik_intensitas_vs_kelembapan.plot(intensitas_cahaya_filtered,
    ↪kelembapan_udara, linewidth=2,
    color='blue', linestyle="--", marker="D",
    ↪markerfacecolor='black')

grafik_intensitas_vs_kelembapan.set_title(
    'Grafik Hubungan Intensitas Cahaya Matahari terhadap Kelembapan Udara',
    ↪pad=10)
grafik_intensitas_vs_kelembapan.set_xlabel('Intensitas Cahaya (Lux)')
grafik_intensitas_vs_kelembapan.set_ylabel('Kelembapan Udara (%)')
grafik_intensitas_vs_kelembapan.axis([-1000, 156000, 55, 98])
m, b = np.polyfit(intensitas_cahaya_filtered, kelembapan_udara, deg=1)
plt.axline(xy1=(0, b), slope=m,
    label=f'$y = {m:.12f}x {b:+.1f}$', color='orange')
grafik_intensitas_vs_kelembapan.legend()
grafik_intensitas_vs_kelembapan.grid()
plt.xticks(ticks=np.setdiff1d(np.append(np.arange(0, 160000, 10000),
    ↪intensitas_cahaya_filtered), [
    0, 10000, 30000, 80000, 60000, 150000, 120000])), rotation=45,
    ↪ha='right')
for axis in ['top', 'bottom', 'left', 'right']:
    grafik_intensitas_vs_kelembapan.spines[axis].set_linewidth(0.9)

figure.savefig("dataset/grafik intensitas vs kelembapan.pdf", format="pdf",
    ↪bbox_inches='tight')
```

Grafik Hubungan Intensitas Cahaya Matahari terhadap Kelembapan Udara

