Øving1

September 10, 2023

1 Øving 1

1.1 Oppgave 2

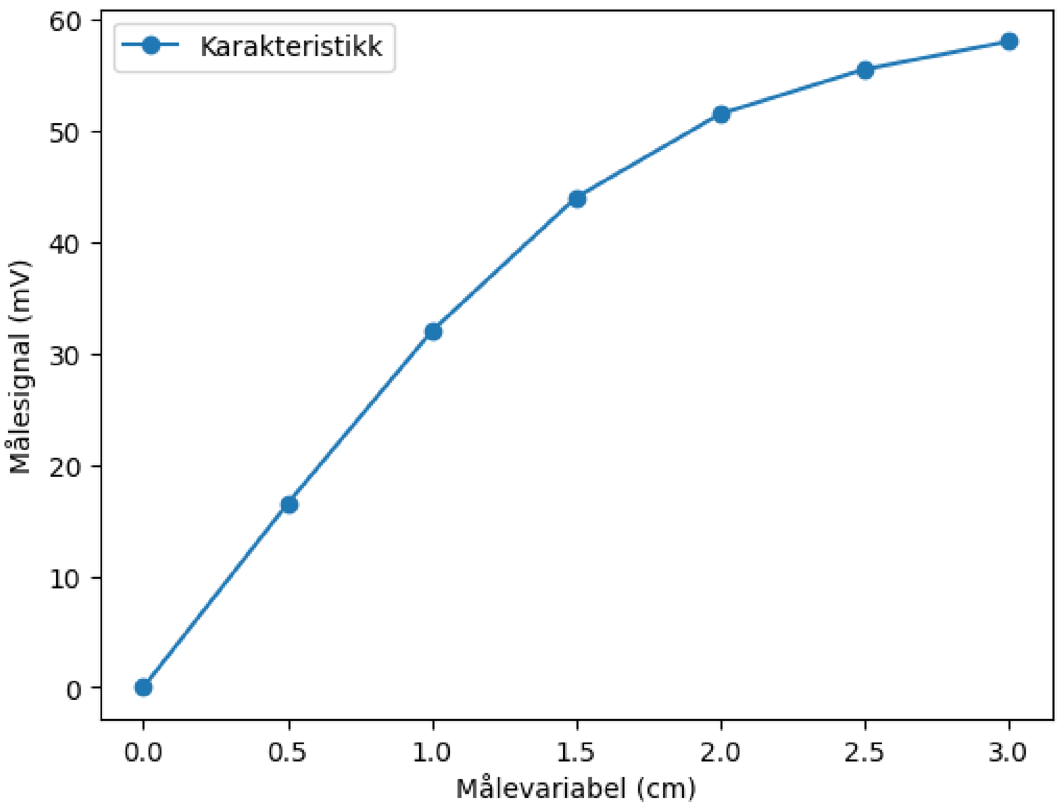
1.1.1 a)

[ ]:
```
import numpy as np
import matplotlib.pyplot as plt
import uncertainties as unc
```

[ ]:
```
xs = [0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0]
ys = [0.0, 16.5, 32.0, 44.0, 51.5, 55.5, 58.0]
```

[ ]:
```
def plot_characteristic():
    plt.plot(xs, ys, "-o", label="Karakteristikk")
    plt.xlabel('Målevariabel (cm)')
    plt.ylabel('Målesignal (mV)')
```

[ ]:
```
plot_characteristic()
plt.legend()
plt.show()
```

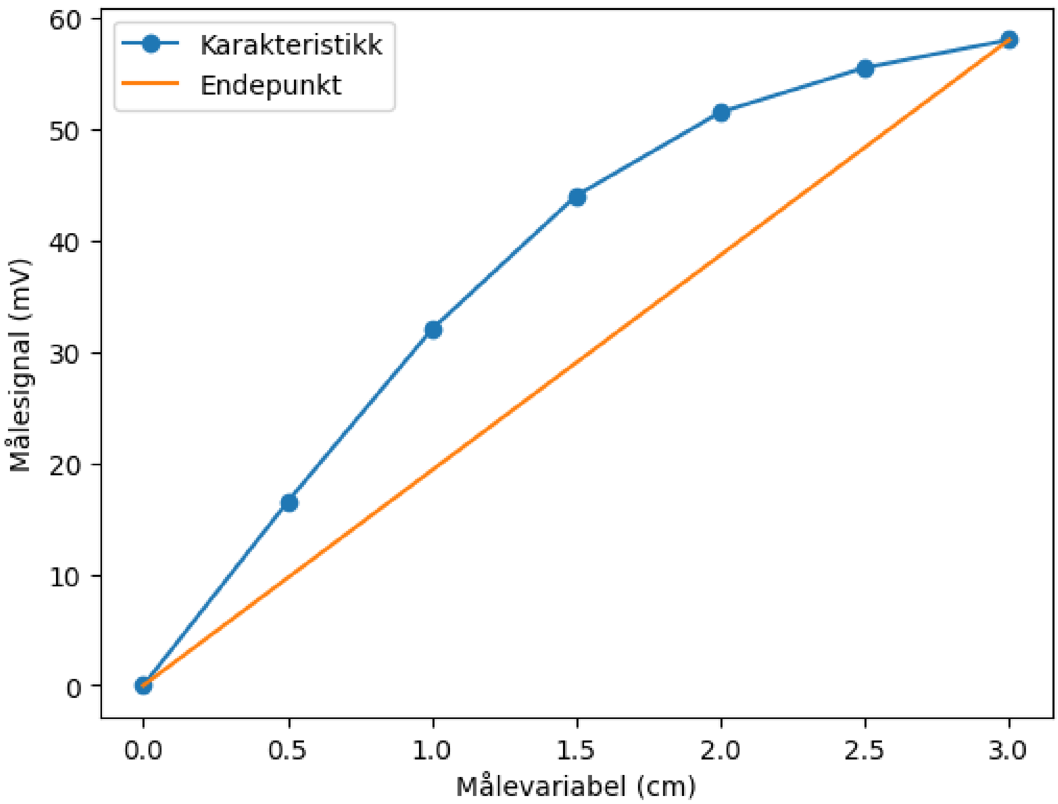


1.1.2 b)

```
[ ]: min_x = xs[0]
     max_x = xs[-1]

     min_y = ys[0]
     max_y = ys[-1]

     def f_endpoint(x):
         a = (max_y - min_y) / (max_x - min_x)
         b = min_y - a * min_x
         return a * x + b

     def plot_endpoints():
         xs = np.linspace(min_x, max_x, 10)
         ys = f_endpoint(xs)
         plt.plot(xs, ys, label="Endepunkt")
```

```
[ ]: plot_characteristic()
     plot_endpoints()
     plt.legend()
```

```
plt.show()
```



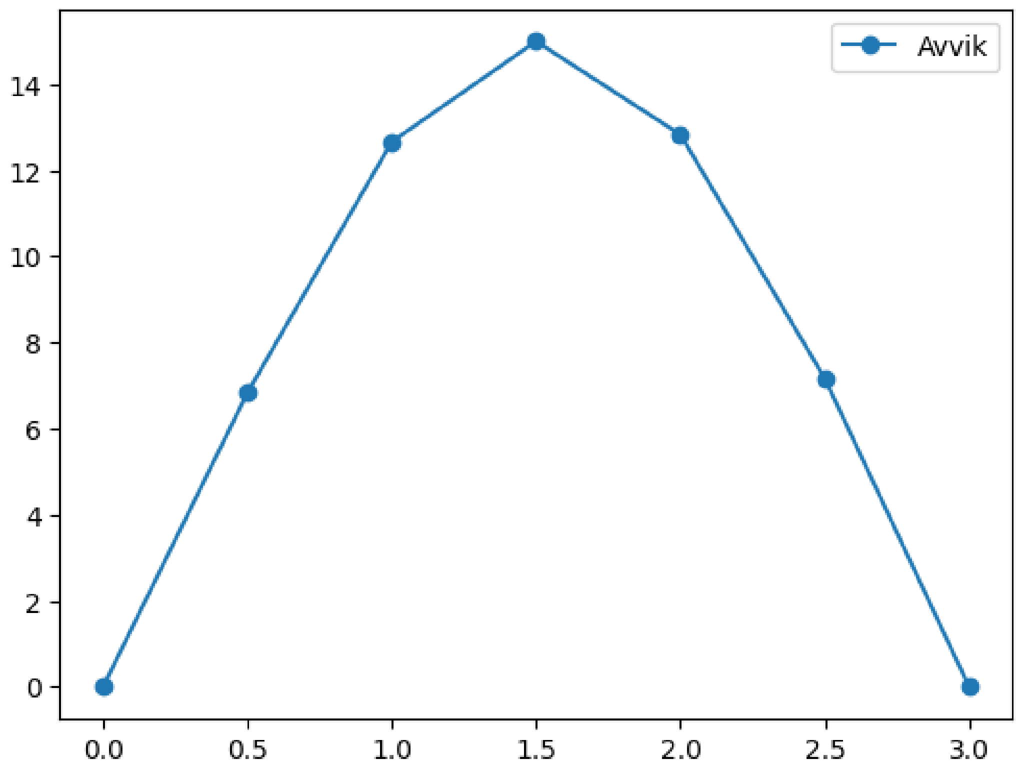
[ ]:
```
print("a = ", (max_y - min_y) / (max_x - min_x))
```

```
a =  19.333333333333332
```

1.1.3 c)

[ ]:
```
error_xs = xs
error_ys = [y - f_endpoint(x) for x, y in zip(xs, ys)]

def plot_error():
    # TODO: Should this curve be in %?
    plt.plot(error_xs, error_ys, "-o", label="Avvik")
```

[ ]:
```
plot_error()
plt.legend()
plt.show()
```



[ ]:
```
max_error = max(zip(error_xs, error_ys), key=lambda item: item[1])
max_error_y = max_error[1]
max_endpoint_based_nonlinearity = max_error_y / (max_y - min_y) * 100
```

[ ]:
```
print(f"Maksimalt endepunktbasert ulinearitet i prosent av måleomfanget:
↪\n{max_error_y}%")
```

```
Maksimalt endepunktbasert ulinearitet i prosent av måleomfanget:
15.0%
```

1.2 Oppgave 3

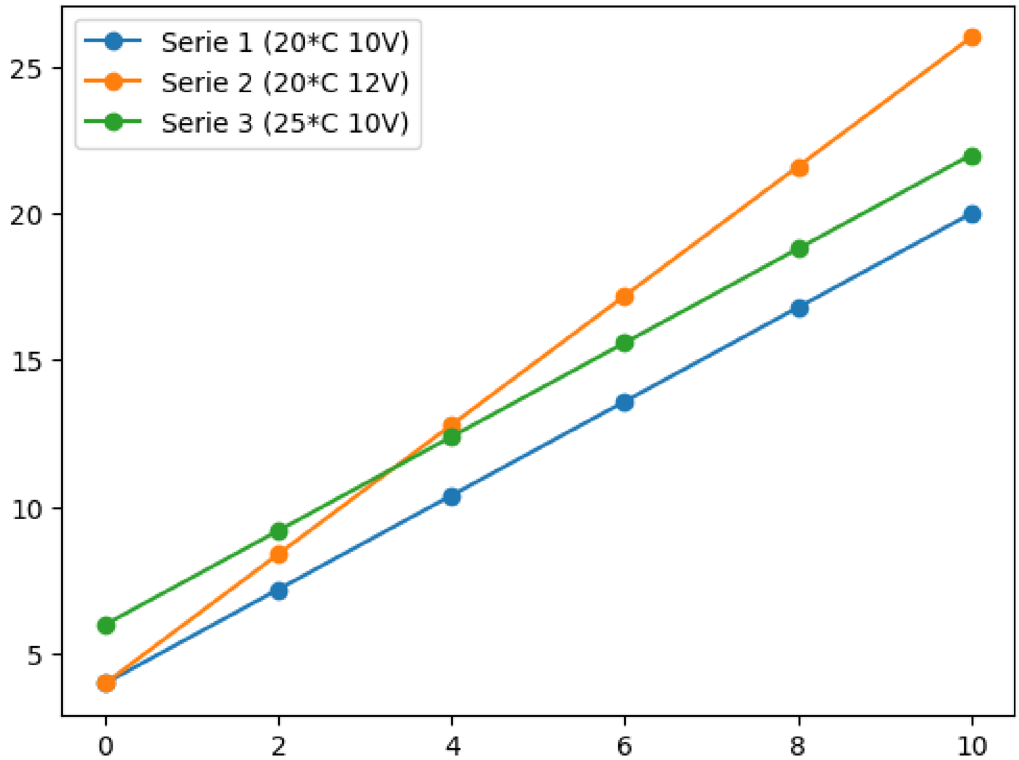
1.2.1 a)

Plotte datasettet

[ ]:
```
xs = [0.0, 2.0, 4.0, 6.0, 8.0, 10.0]

series_1_ys = [4.00, 7.20, 10.4, 13.6, 16.8, 20.0]
series_2_ys = [4.00, 8.40, 12.8, 17.2, 21.6, 26.0]
series_3_ys = [6.00, 9.20, 12.4, 15.6, 18.8, 22.0]
```

[ ]:
```
plt.plot(xs, series_1_ys, "-o", label="Serie 1 (20*C 10V)")
plt.plot(xs, series_2_ys, "-o", label="Serie 2 (20*C 12V)")
```

```
plt.plot(xs, series_3_ys, "-o", label="Serie 3 (25*C 10V)")
plt.legend()
plt.show()
```



Bestemme parametrene Leser av grafen og ser at temperaturen forsterker signalet hele vegen mens spenningen kun øker signalet med en konstant verdi. - IM: Spenning - II: Temperatur

$K = \frac{O_{maks} - O_{min}}{I_{maks} - I_{min}}$

[ ]:
```
omax = series_1_ys[-1]
omin = series_1_ys[0]

imax = xs[-1]
imin = xs[0]

k = (omax - omin) / (imax - imin)
```

$a = O(I_{min})$

[ ]:
```
a = omin
```

$K_I = \frac{\Delta O(I_{min})}{\Delta I_I}$

[ ]:
```python
ki = (series_3_ys[0] - series_1_ys[0]) / (25 - 20)
```

$I_{50\%} = \frac{I_{maks}+I_{min}}{2}$

[ ]:
```python
# Siden vi har en lineær funksjon, så kan imax brukes i stede
# i_center = ((imin + imax) / 2)
i_center = imax
```

$K_M = \frac{1}{I_{50\%}} * (\frac{\Delta O(I_{50\%})}{\Delta I_M})$

[ ]:
```python
# Siden vi har en lineær funksjon, så kan omax brukes i stede
# lower_mid_index = len(series_2_ys) // 2
# series_1_o_center = (series_1_ys[lower_mid_index] +␣
↪series_1_ys[lower_mid_index + 1]) / 2
# series_2_o_center = (series_2_ys[lower_mid_index] +␣
↪series_2_ys[lower_mid_index + 1]) / 2
# delta_o_center = series_2_o_center - series_1_o_center

delta_o_center = series_2_ys[-1] - series_1_ys[-1]

km = (1/i_center) * ((delta_o_center / (12 - 10)))
```

Svar

[ ]:
```python
print(f"K: {k}")
print(f"Km: {km}")
print(f"Ki: {ki}")
print(f"a: {a}")
```

```
K: 1.6
Km: 0.30000000000000004
Ki: 0.4
a: 4.0
```

1.2.2 b)

[ ]:
```python
def signal(i, ii, im):
    return (k + km * im) * i + (ki * ii) + a
```

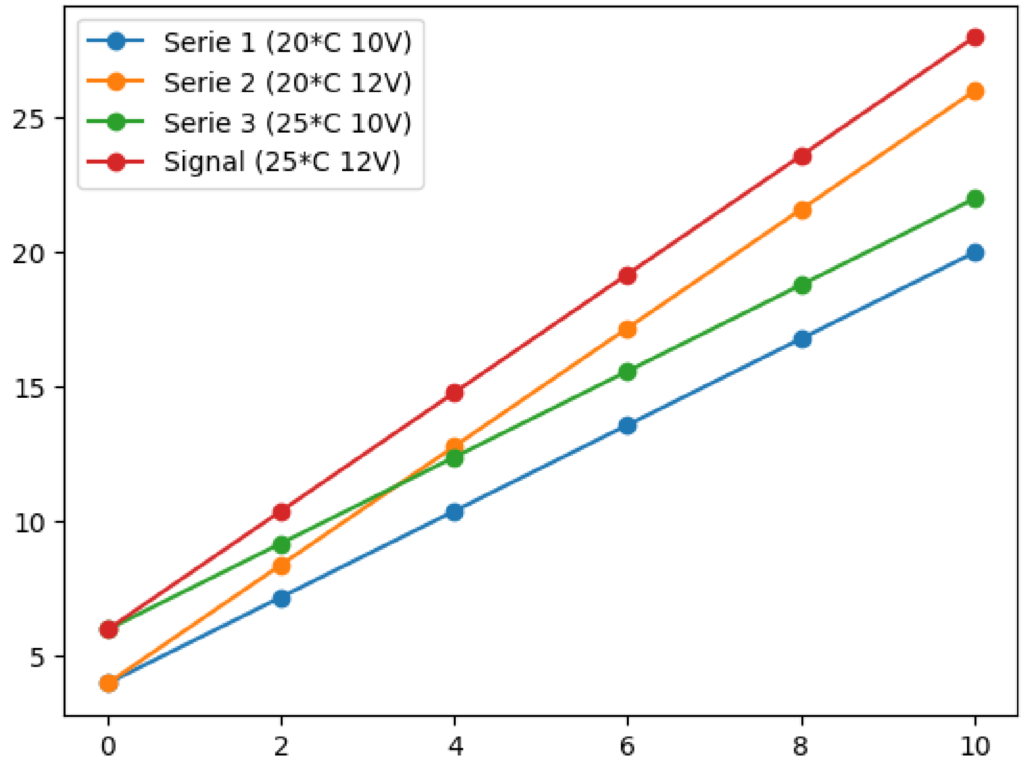
[ ]:
```python
o = signal(5.0, 5.0, 2.0)
```

[ ]:
```python
print(f"Signal: {o:.2f} mA")
```

```
Signal: 17.00 mA
```

[ ]:
```python
plt.plot(xs, series_1_ys, "-o", label="Serie 1 (20*C 10V)")
plt.plot(xs, series_2_ys, "-o", label="Serie 2 (20*C 12V)")
plt.plot(xs, series_3_ys, "-o", label="Serie 3 (25*C 10V)")
```

```
plt.plot(xs, [signal(x, 5.0, 2.0) for x in xs], "-o", label="Signal (25*C 12V)")
plt.legend()
plt.show()
```



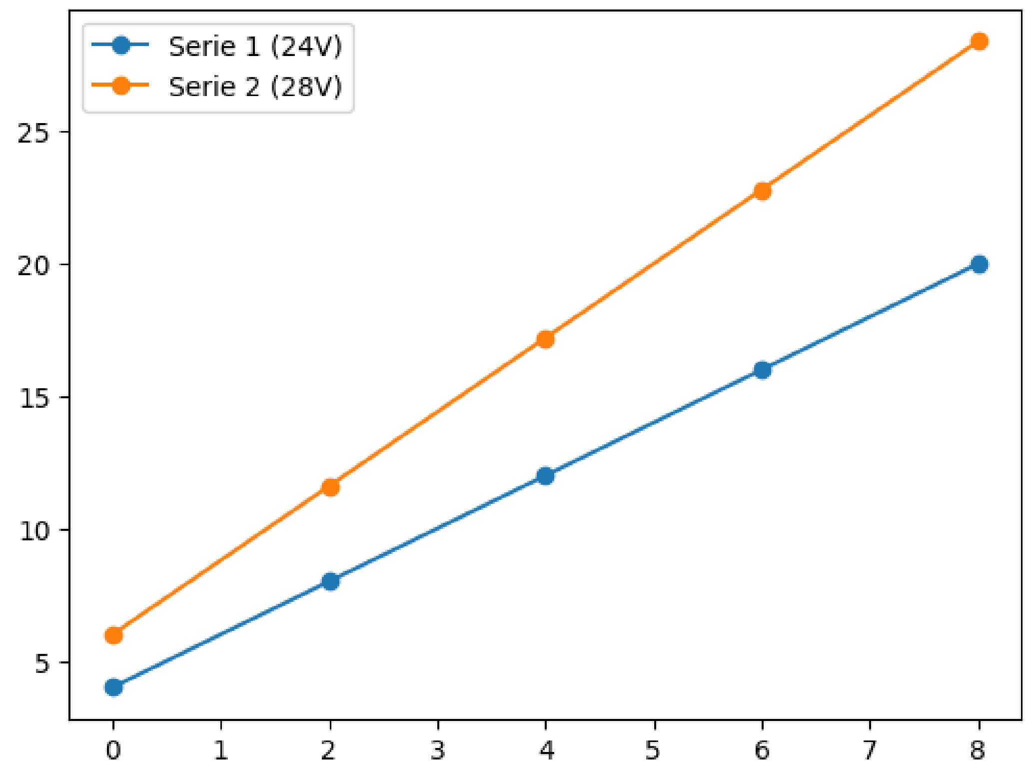
1.3 Oppgave 4

1.3.1 a)

Plotte datasettet

[ ]:
```
xs = [0.0, 2.0, 4.0, 6.0, 8.0]
series_1_ys = [4.00, 8.00, 12.0, 16.0, 20.0]
series_2_ys = [6.00, 11.6, 17.2, 22.8, 28.4]
```

[ ]:
```
plt.plot(xs, series_1_ys, "-o", label="Serie 1 (24V)")
plt.plot(xs, series_2_ys, "-o", label="Serie 2 (28V)")
plt.legend()
plt.show()
```



Bestemme parametrene Ser på grafen at spenningen bidrar både i form av konstantledd og forsterkning av signalet. - IM: Spenning - II: Spenning

$K = \frac{O_{maks} - O_{min}}{I_{maks} - I_{min}}$

[ ]:
```
omax = series_1_ys[-1]
omin = series_1_ys[0]

imax = xs[-1]
imin = xs[0]

k = (omax - omin) / (imax - imin)
```

$a = O(I_{min})$

[ ]:
```
a = omin
```

$K_I = \frac{\Delta O(I_{min})}{\Delta I_I}$

[ ]:
```
ki = (series_2_ys[0] - series_1_ys[0]) / (28 - 24)
```

$I_{50\%} = \frac{I_{maks} + I_{min}}{2}$

[ ]:
```
# Siden vi har en lineær funksjon, så kan imax brukes i stede
# i_center = ((imin + imax) / 2)
i_center = imax
```

Siden spenningen påvirker både konstantledd og forsterkningen må vi ta hensyn til det ved å trekke fra K_I.

$K_M = \frac{1}{I_{50\%}} * (\frac{\Delta O(I_{50\%})}{\Delta I_M} - K_I)$

[ ]:
```
# Siden vi har en lineær funksjon, så kan omax brukes i stede
# lower_mid_index = len(series_2_ys) // 2
# series_1_o_center = (series_1_ys[lower_mid_index] +␣
 ↪series_1_ys[lower_mid_index + 1]) / 2
# series_2_o_center = (series_2_ys[lower_mid_index] +␣
 ↪series_2_ys[lower_mid_index + 1]) / 2
# delta_o_center = series_2_o_center - series_1_o_center

delta_o_center = series_2_ys[-1] - series_1_ys[-1]

km = (1/i_center) * ((delta_o_center / (28 - 24)) - ki)
```

Svar

[ ]:
```
print(f"K: {k}")
print(f"Km: {km}")
print(f"Ki: {ki}")
print(f"a: {a}")
```

```
K: 2.0
Km: 0.19999999999999996
Ki: 0.5
a: 4.0
```

1.3.2 b)

[ ]:
```
def signal(i, ii, im):
    return (k + km * im) * i + (ki * ii) + a
```

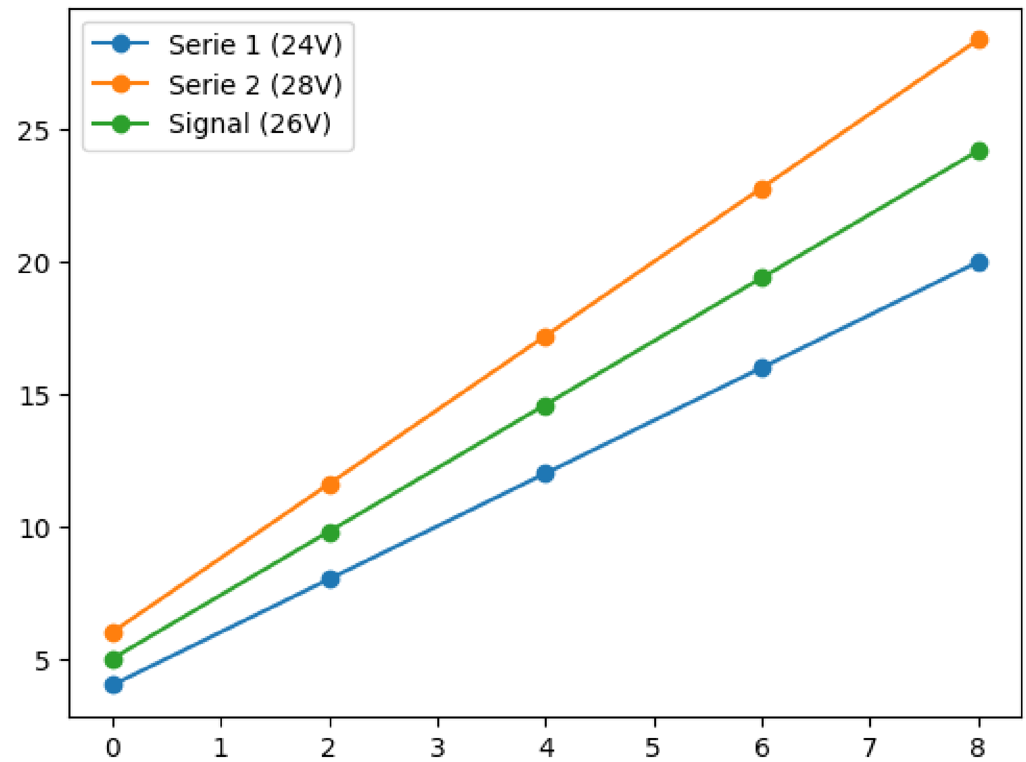
[ ]:
```
o = signal(5.0, 2.0, 2.0)
```

[ ]:
```
print(f"Signal: {o:.2f} mA")
```

```
Signal: 17.00 mA
```

[ ]:
```
plt.plot(xs, series_1_ys, "-o", label="Serie 1 (24V)")
plt.plot(xs, series_2_ys, "-o", label="Serie 2 (28V)")
plt.plot(xs, [signal(x, 2.0, 2.0) for x in xs], "-o", label="Signal (26V)")
plt.legend()
```

```
plt.show()
```



[ ]:

```

```

1.4 Oppgave 5

1.4.1 a)

Tilbakekoblingen under slipper kun gjennom signaler hvis viseren ikke er i riktig posisjon. Hvis viseren ble flyttet manuellt og inngangssignalet forblir likt vil tilbakekoblingen motarbeide den eksterne kraften påtrykt viseren.

`flowchart LR`

```
A[I]
B((+))
C[Kv]
D[Ks]
E[O]
F[K]

A -->|+| B --> C --> D --> E
```

```
D --> F -->|-| B
```

$\frac{O}{I} = \frac{Kv*Ks}{1+Kv*Ks*K}$

$\frac{O}{I} = \frac{0.2*0.05}{1+0.2*0.05*1000}$

$\frac{O}{I} = \frac{0.01}{1+0.01*1000}$

$\frac{O}{I} = \frac{0.01}{1+10}$

$\frac{O}{I} = \frac{1}{1100}$

1.4.2 b)

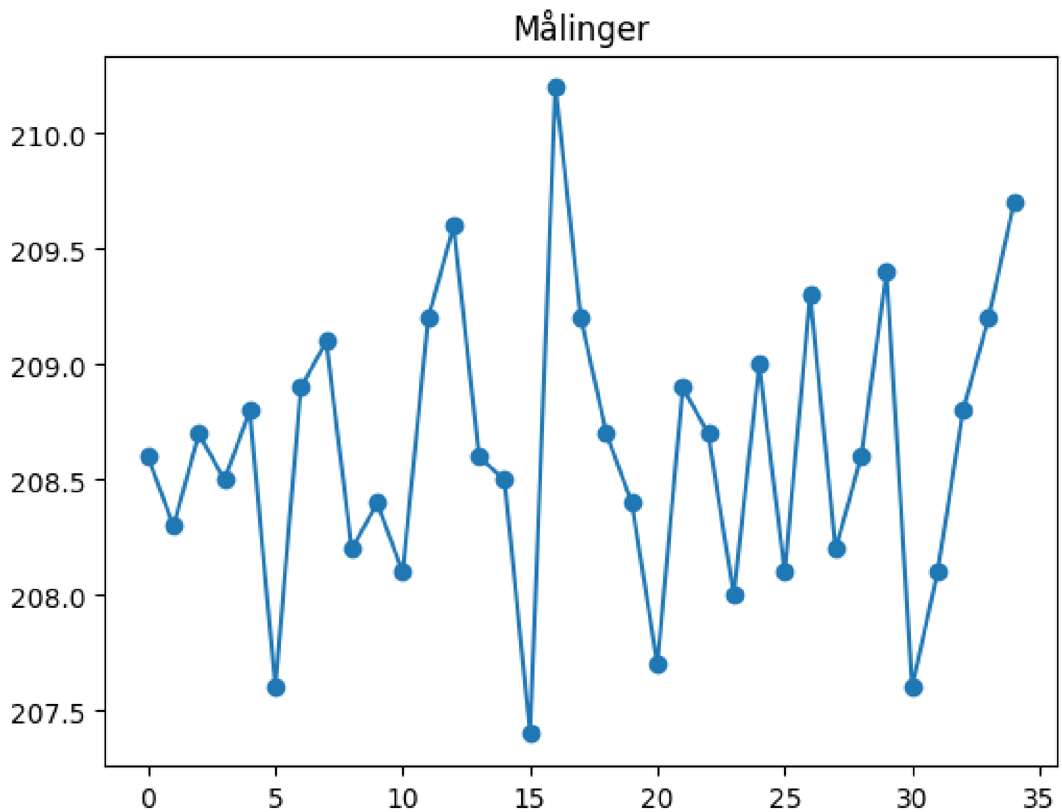
[ ]:
```
0.1*(1/1100)
```

[ ]: 9.090909090909092e-05

1.5 Oppgave 6

[ ]:
```
values = [
    *[208.6, 208.3, 208.7, 208.5, 208.8, 207.6, 208.9, 209.1, 208.2, 208.4],
    *[208.1, 209.2, 209.6, 208.6, 208.5, 207.4, 210.2, 209.2, 208.7, 208.4],
    *[207.7, 208.9, 208.7, 208.0, 209.0, 208.1, 209.3, 208.2, 208.6, 209.4],
    *[207.6, 208.1, 208.8, 209.2, 209.7],
]
```

[ ]:
```
plt.plot(values, "-o")
plt.title("Målinger")
plt.show()
```



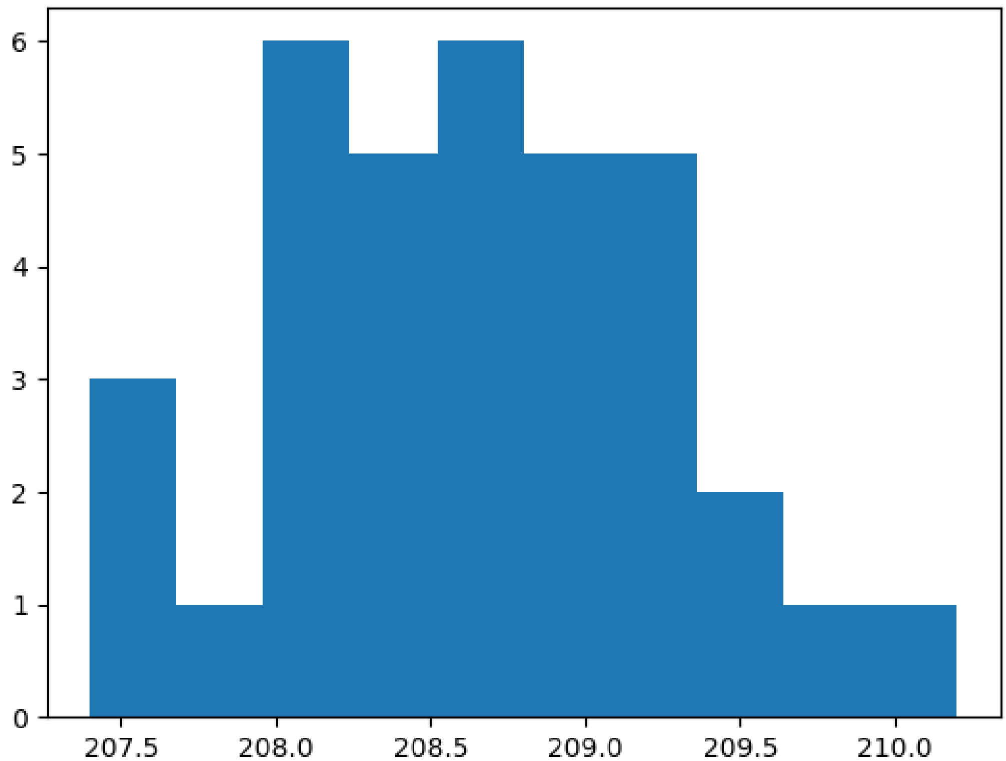
[ ]:
```
midvalue = sum(values)/len(values)
```

[ ]:
```
S = np.sqrt((1/(len(values) - 1))*sum([(x-midvalue)**2 for x in values]))
```

[ ]:
```
print(f"Estimat: {unc.ufloat(midvalue, S):.1f}")
```

```
Estimat: 208.6+/-0.6
```

[ ]:
```
plt.hist(values)
plt.show()
```



0
1
2
3
4
5
6
207.5
208.0
208.5
209.0
209.5
210.0