Soft Computing Praktik

~ ~ Meet 06 ~ ~

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CONTOH KASUS: MESIN CUCI OTOMATIS

Sebuah pabrik mesin cuci akan membuat sebuah **mesin cuci otomatis berbasis fuzzy** yang dapat mengatur **kecepatan putar** mesin berdasarkan **banyaknya pakaian** dan **tingkat kekotoran**. Mesin cuci telah dilengkapi dengan sensor yang dapat mendeteksi banyaknya pakaian dan tingkat kekotoran pakaian. Spesifikasinya sebagai berikut:

□ **Kecepatan putar mesin** dalam pencucian minimal 500 rpm (lambat) dan maksimal 1200 rpm (cepat)

□ **Banyaknya pakaian** dinyatakan dengan nilai 0-100 yang mana nilai <= 40 termasuk sedikit dan >= 80 termasuk banyak.

□ **Tingkat kekotoran** dinyatakan dengan nilai 0-100 yang mana nilai 0-40 adalah rendah, 50 adalah sedang, dan 60-100 adalah tinggi.

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Berdasarkan berbagai pengujian terhadap prototype mesin, diperoleh aturan sebagai berikut:

□ [R1] Jika pakaian **sedikit** dan kekotoran **rendah**, maka putaran **lambat**

□ [R2] Jika pakaian **sedikit** dan kekotoran **sedang**, maka putaran **lambat**

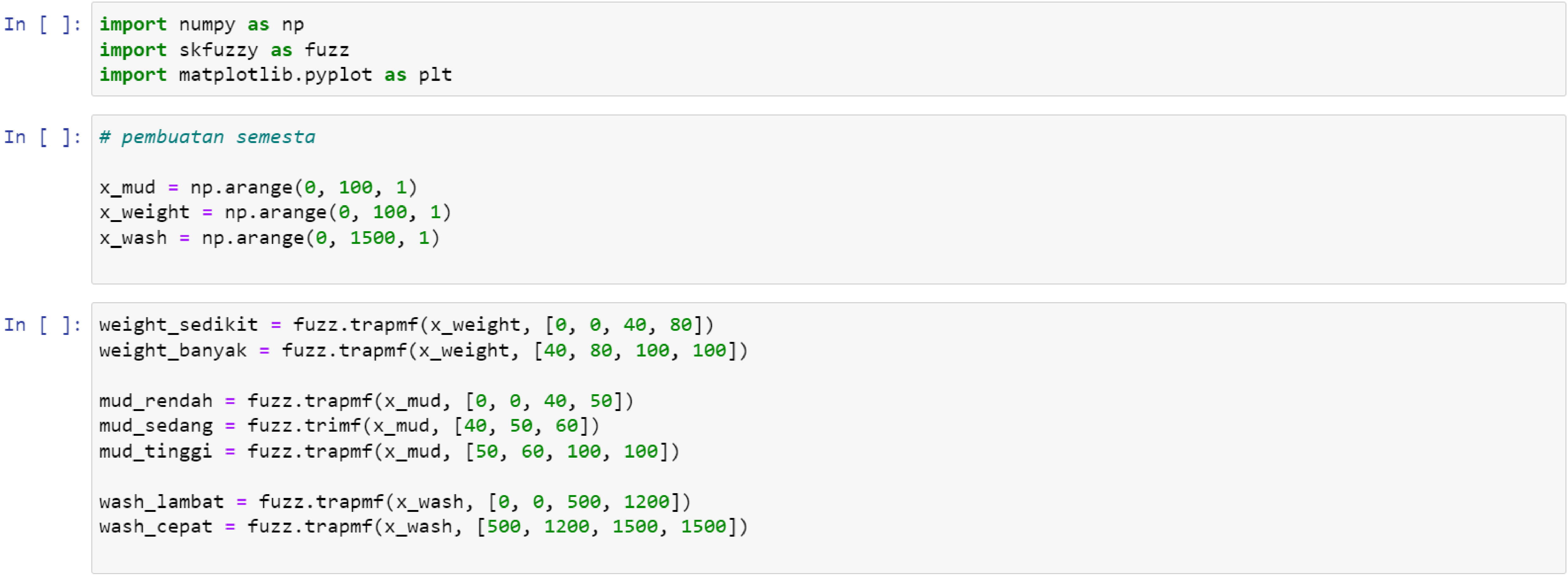
□ [R3] Jika pakaian **sedikit** dan kekotoran **tinggi**, maka putaran **cepat**

□ [R4] Jika pakaian **banyak** dan kekotoran **rendah**, maka putaran **lambat**

□ [R5] Jika pakaian **banyak** dan kekotoran **sedang**, maka putaran **cepat**

□ [R6] Jika pakaian **banyak** dan kekotoran **tinggi**, maka putaran **cepat**

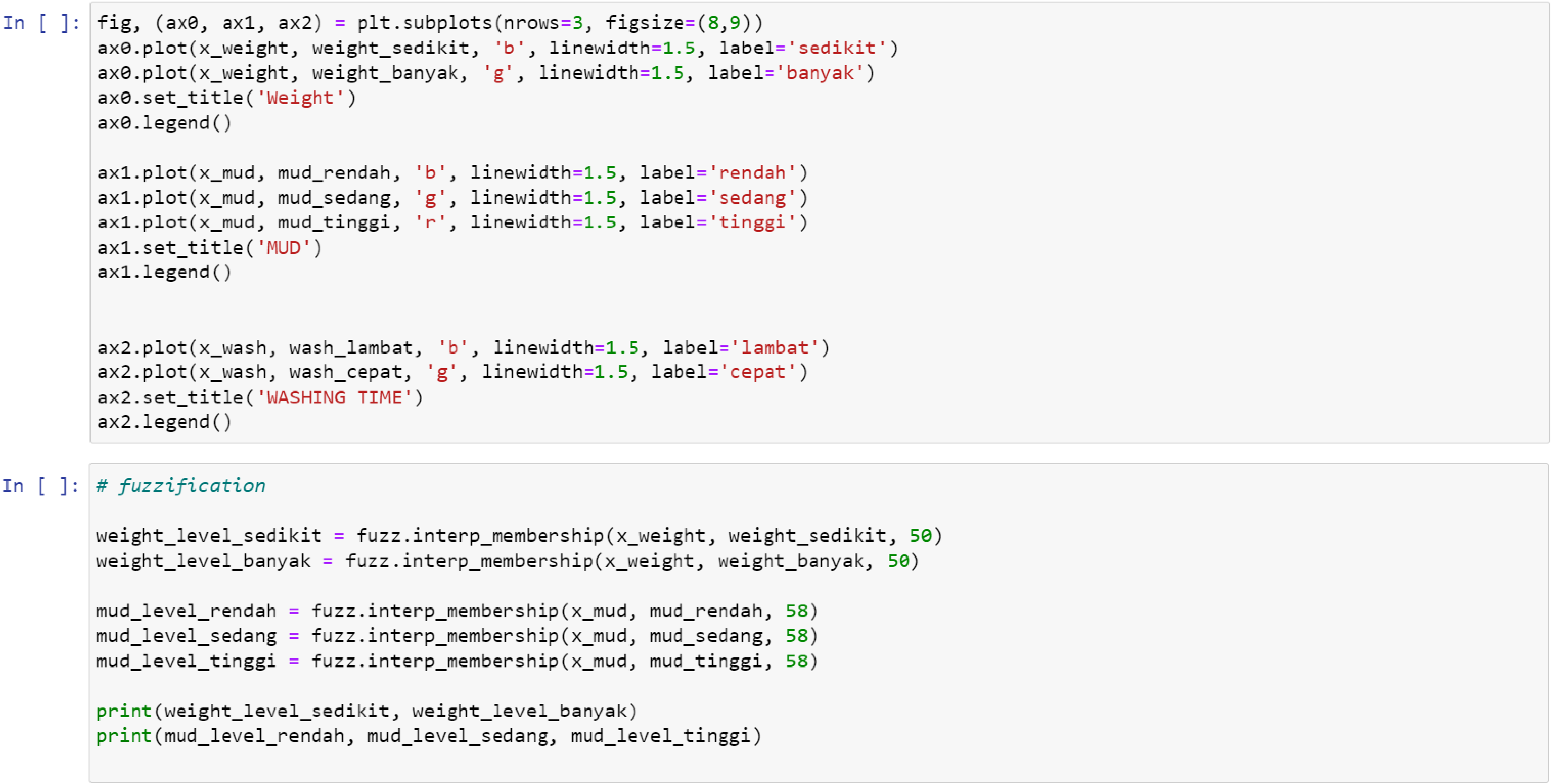
Berapa rpm kecepatan putar yang harus dihasilkan mesin jika pada proses pencucian ternyata banyaknya pakaian bernilai **50** dan tingkat kekotoran bernilai **58** ?



```
In [ ]: import numpy as np
        import skfuzzy as fuzz
        import matplotlib.pyplot as plt
```

```
In [ ]: # pembuatan semesta

        x_mud = np.arange(0, 100, 1)
        x_weight = np.arange(0, 100, 1)
        x_wash = np.arange(0, 1500, 1)
```

```
In [ ]: weight_sedikit = fuzz.trapmf(x_weight, [0, 0, 40, 80])
        weight_banyak = fuzz.trapmf(x_weight, [40, 80, 100, 100])

        mud_rendah = fuzz.trapmf(x_mud, [0, 0, 40, 50])
        mud_sedang = fuzz.trimf(x_mud, [40, 50, 60])
        mud_tinggi = fuzz.trapmf(x_mud, [50, 60, 100, 100])

        wash_lambat = fuzz.trapmf(x_wash, [0, 0, 500, 1200])
        wash_cepat = fuzz.trapmf(x_wash, [500, 1200, 1500, 1500])
```



In [ ]:

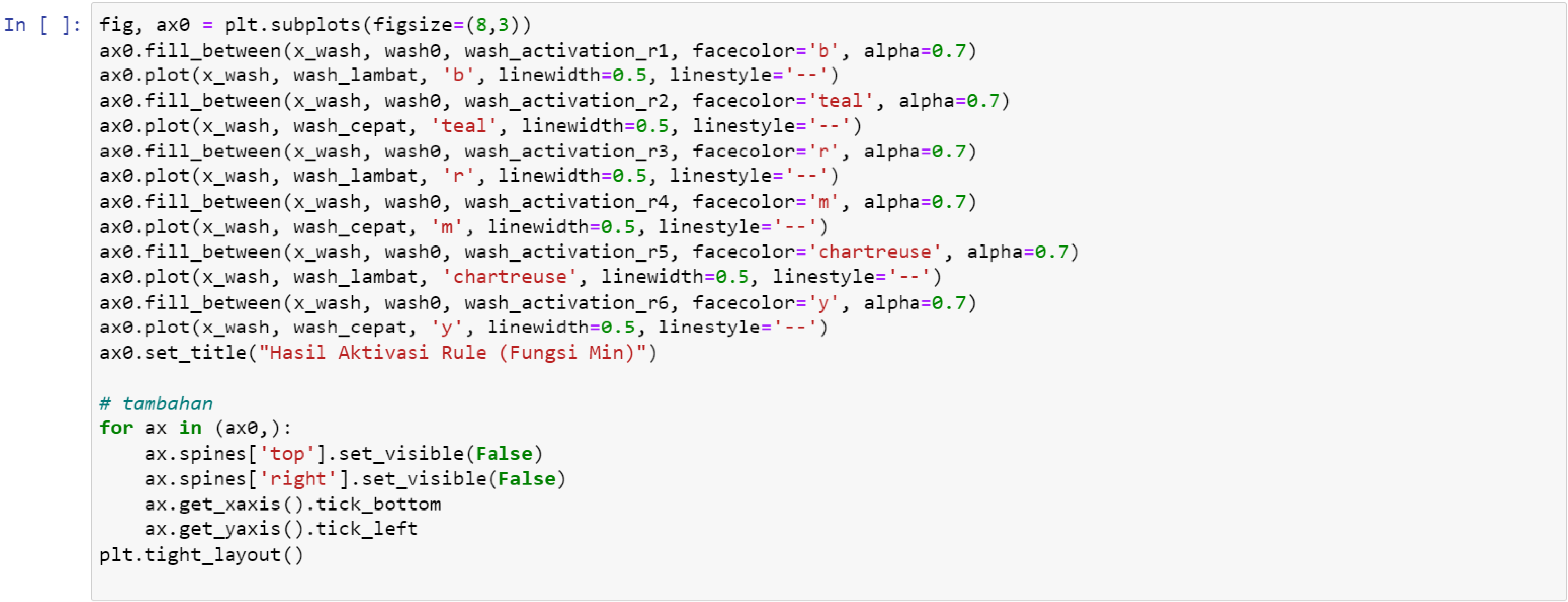
```
fig, (ax0, ax1, ax2) = plt.subplots(nrows=3, figsize=(8,9))
ax0.plot(x_weight, weight_sedikit, 'b', linewidth=1.5, label='sedikit')
ax0.plot(x_weight, weight_banyak, 'g', linewidth=1.5, label='banyak')
ax0.set_title('Weight')
ax0.legend()

ax1.plot(x_mud, mud_rendah, 'b', linewidth=1.5, label='rendah')
ax1.plot(x_mud, mud_sedang, 'g', linewidth=1.5, label='sedang')
ax1.plot(x_mud, mud_tinggi, 'r', linewidth=1.5, label='tinggi')
ax1.set_title('MUD')
ax1.legend()


ax2.plot(x_wash, wash_lambat, 'b', linewidth=1.5, label='lambat')
ax2.plot(x_wash, wash_cepat, 'g', linewidth=1.5, label='cepat')
ax2.set_title('WASHING TIME')
ax2.legend()
```

In [ ]:

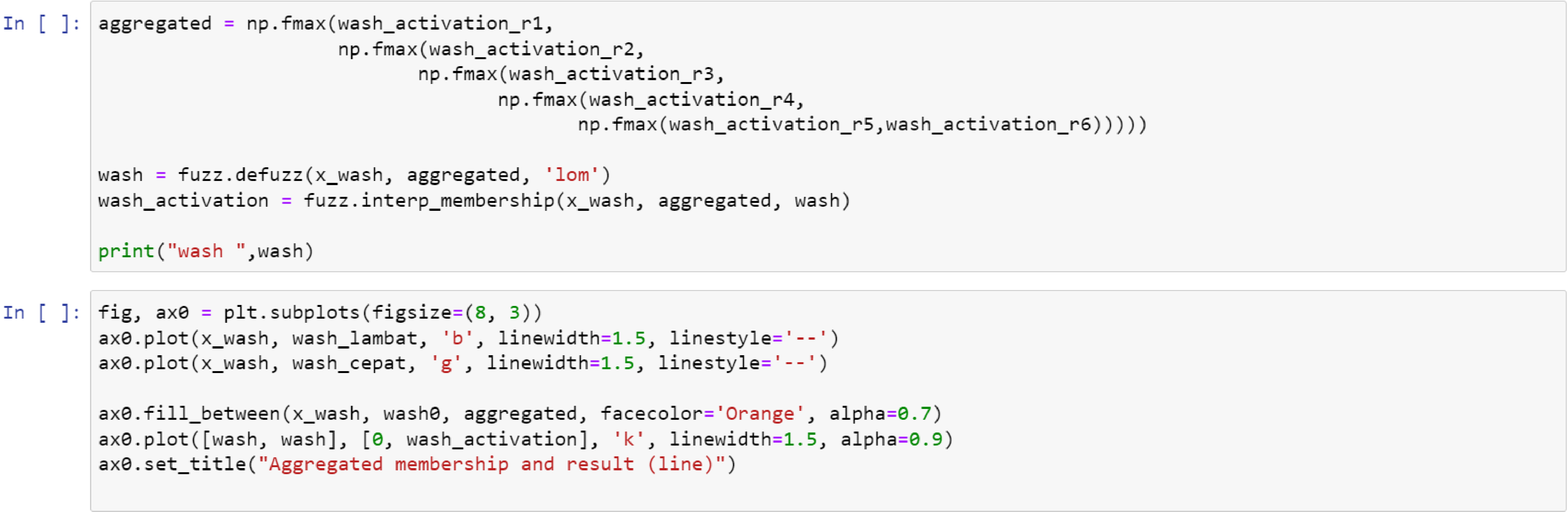
```
# fuzzification

weight_level_sedikit = fuzz.interp_membership(x_weight, weight_sedikit, 50)
weight_level_banyak = fuzz.interp_membership(x_weight, weight_banyak, 50)

mud_level_rendah = fuzz.interp_membership(x_mud, mud_rendah, 58)
mud_level_sedang = fuzz.interp_membership(x_mud, mud_sedang, 58)
mud_level_tinggi = fuzz.interp_membership(x_mud, mud_tinggi, 58)

print(weight_level_sedikit, weight_level_banyak)
print(mud_level_rendah, mud_level_sedang, mud_level_tinggi)
```

In [ ]:

```python

# Lambat
active_rule1 = np.fmin(weight_level_sedikit, mud_level_rendah)
# Lambat
active_rule2 = np.fmin(weight_level_sedikit, mud_level_sedang)
# cepat
active_rule3 = np.fmin(weight_level_sedikit, mud_level_tinggi)
# Lambat
active_rule4 = np.fmin(weight_level_banyak, mud_level_rendah)
# cepat
active_rule5 = np.fmin(weight_level_banyak, mud_level_sedang)
# cepat
active_rule6 = np.fmin(weight_level_banyak, mud_level_tinggi)

print(active_rule1, active_rule2, active_rule3, active_rule4, active_rule5, active_rule6)

# ----------------------------------------------------------------------
wash_activation_r1 = np.fmin(active_rule1, wash_lambat)
wash_activation_r2 = np.fmin(active_rule2, wash_lambat)
wash_activation_r3 = np.fmin(active_rule3, wash_cepat)
wash_activation_r4 = np.fmin(active_rule4, wash_lambat)
wash_activation_r5 = np.fmin(active_rule5, wash_cepat)
wash_activation_r6 = np.fmin(active_rule6, wash_cepat)


wash0 = np.zeros_like(x_wash)
```



```
fig, ax0 = plt.subplots(figsize=(8,3))
ax0.fill_between(x_wash, wash0, wash_activation_r1, facecolor='b', alpha=0.7)
ax0.plot(x_wash, wash_lambat, 'b', linewidth=0.5, linestyle='--')
ax0.fill_between(x_wash, wash0, wash_activation_r2, facecolor='teal', alpha=0.7)
ax0.plot(x_wash, wash_cepat, 'teal', linewidth=0.5, linestyle='--')
ax0.fill_between(x_wash, wash0, wash_activation_r3, facecolor='r', alpha=0.7)
ax0.plot(x_wash, wash_lambat, 'r', linewidth=0.5, linestyle='--')
ax0.fill_between(x_wash, wash0, wash_activation_r4, facecolor='m', alpha=0.7)
ax0.plot(x_wash, wash_cepat, 'm', linewidth=0.5, linestyle='--')
ax0.fill_between(x_wash, wash0, wash_activation_r5, facecolor='chartreuse', alpha=0.7)
ax0.plot(x_wash, wash_lambat, 'chartreuse', linewidth=0.5, linestyle='--')
ax0.fill_between(x_wash, wash0, wash_activation_r6, facecolor='y', alpha=0.7)
ax0.plot(x_wash, wash_cepat, 'y', linewidth=0.5, linestyle='--')
ax0.set_title("Hasil Aktivasi Rule (Fungsi Min)")

# tambahan
for ax in (ax0,):
    ax.spines['top'].set_visible(False)
    ax.spines['right'].set_visible(False)
    ax.get_xaxis().tick_bottom
    ax.get_yaxis().tick_left
plt.tight_layout()
```



```
In [ ]: aggregated = np.fmax(wash_activation_r1,
                             np.fmax(wash_activation_r2,
                                    np.fmax(wash_activation_r3,
                                           np.fmax(wash_activation_r4,
                                                  np.fmax(wash_activation_r5,wash_activation_r6)))))

        wash = fuzz.defuzz(x_wash, aggregated, 'lom')
        wash_activation = fuzz.interp_membership(x_wash, aggregated, wash)

        print("wash ",wash)
```

```
In [ ]: fig, ax0 = plt.subplots(figsize=(8, 3))
        ax0.plot(x_wash, wash_lambat, 'b', linewidth=1.5, linestyle='--')
        ax0.plot(x_wash, wash_cepat, 'g', linewidth=1.5, linestyle='--')

        ax0.fill_between(x_wash, wash0, aggregated, facecolor='Orange', alpha=0.7)
        ax0.plot([wash, wash], [0, wash_activation], 'k', linewidth=1.5, alpha=0.9)
        ax0.set_title("Aggregated membership and result (line)")
```

Coba jalankan kode program yang barusan Anda ketikkan