

ipynb

June 27, 2025

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

[2]: with open("data.csv", "r") as file:
    line = file.readline()
    values = [float(v) for v in line.strip().split(",")]

[3]: data = np.array(values).reshape(-1, 2)

[4]: center = np.mean(data, axis=0)

[5]: centered = data - center

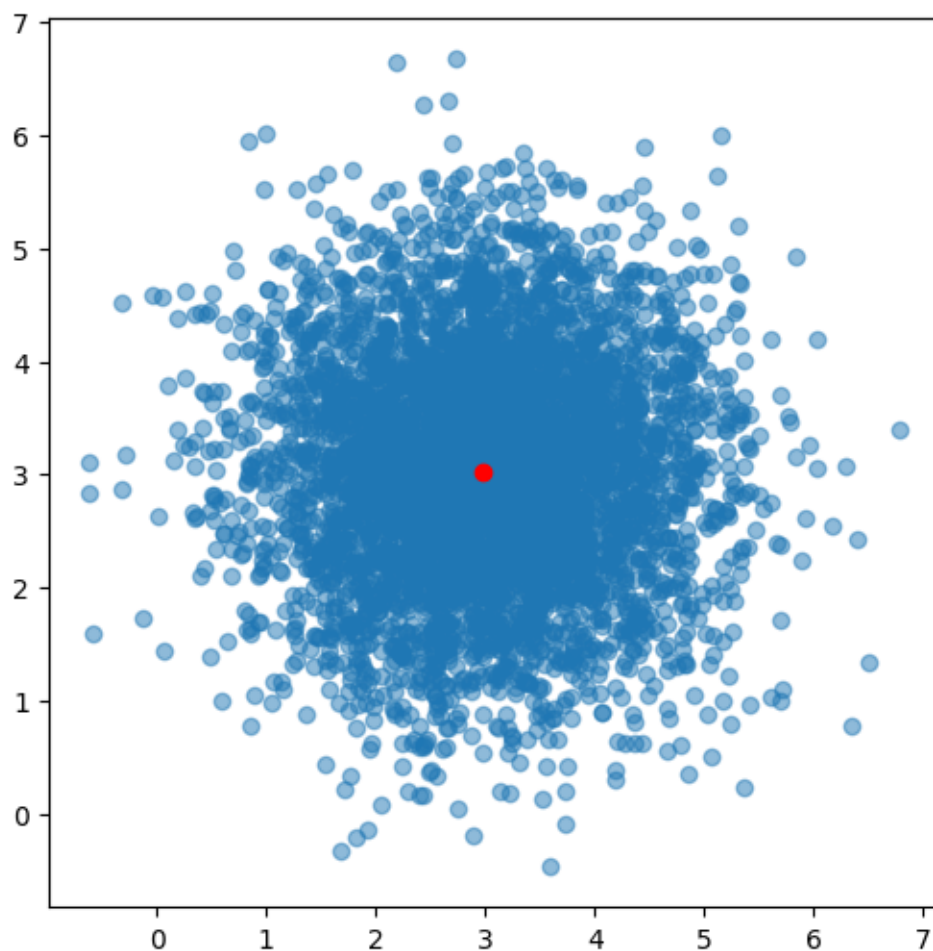
[6]: U, S, VT = np.linalg.svd(centered)

[7]: principal_axes = VT.T

[8]: angle_rad = np.arctan2(principal_axes[1, 0], principal_axes[0, 0])

[9]: plt.figure(figsize=(6, 6))
plt.scatter(data[:, 0], data[:, 1], alpha=0.5)
plt.scatter(center[0], center[1], color='red', label='Środek')

[9]: <matplotlib.collections.PathCollection at 0x1d33c5dfed0>
```



```
[10]: for i in range(2):
        vec = principal_axes[:, i]
        scale = S[i] / np.sqrt(len(data))
        plt.plot(
            [center[0], center[0] + vec[0] * scale],
            [center[1], center[1] + vec[1] * scale],
            label=f'Oś PCA {i+1}'
        )

plt.axis('equal')
plt.grid(True)
plt.legend()
plt.title(f'Kąt obrotu: {np.degrees(angle_rad):.2f}°')
plt.show()
```

