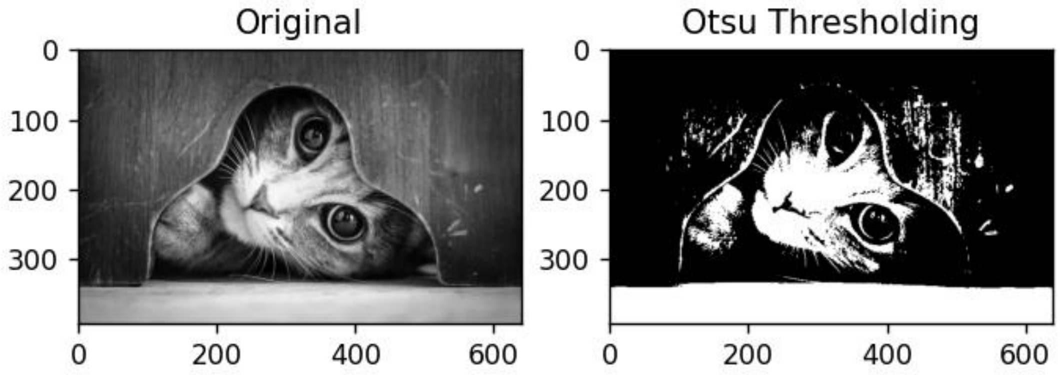
Comment

透過實作 Otsu’s thresholding，理解其利用灰階直方圖統計資訊，嘗試每一個閾值將圖像區分為前景與背景，並選取能使類間變異最大化的閾值。該方法不需人工設定參數，適用於目標與背景灰度分布差異明顯的場景，能有效提升二值化的自動化與穩定性。

Photo



Program

```
import cv2

import numpy as np

import matplotlib.pyplot as plt



def otsu_threshold(image):

    pixel_counts = np.bincount(image.ravel(), minlength=256)

    total_pixels = image.size



    sum_total = np.dot(np.arange(256), pixel_counts)
```

```
sumB = 0
wB = 0
maximum = 0
threshold = 0

for i in range(256):
    wB += pixel_counts[i]
    if wB == 0:
        continue

    wF = total_pixels - wB
    if wF == 0:
        break

    sumB += i * pixel_counts[i]
    mB = sumB / wB
    mF = (sum_total - sumB) / wF

    # 類間變異
    var_between = wB * wF * (mB - mF) ** 2

    if var_between > maximum:
        maximum = var_between
        threshold = i
    return threshold

# 讀取灰階圖像
img = cv2.imread('cat.jpg', cv2.IMREAD_GRAYSCALE)

# 計算 Otsu 閾值
thresh_val = otsu_threshold(img)

# 應用閾值二值化
_, thresh_img = cv2.threshold(img, thresh_val, 255, cv2.THRESH_BINARY)

# 顯示結果
print(f"Otsu Threshold Value: {thresh_val}")
cv2.imwrite('otsu_result.jpg', thresh_img)
plt.subplot(1,2,1)
plt.title("Original")
plt.imshow(img, cmap='gray')
plt.subplot(1,2,2)
plt.title("Otsu Thresholding")
plt.imshow(thresh_img, cmap='gray')
plt.show()
```