سهند نوعی 9923087

https://colab.research.google.com/drive/1AgVlIlaBZzXclpIM_QmpoTvlkPKYjjB-#scrollTo=dgXWBTXpggBW

آماده سازی نوت بوک

> 1. قبل از هر کاری، با استفاده از مسیر نوشته شده در خط پایین، یک کپی از این نوتبوک در گوگل درایو خودتان بسازید و تمرین را در آن نسخه حل کنید.

File --> Save a copy in Drive

> 2. برای دسترسی به تصاویر مورد نیاز در این تکلیف، بدون اعمال هیچ تغییری در بلوک زیر، آن را اجرا کنید. با این کار فایل های مربوط به تکلیف (تصاویر) دانلود و در فولدر کولب شما قرار داده می شوند. انجام این مرحله پس از هر بار قطع شدن از کولب و اتصال دوباره، ضروری است. یعنی اگر مثلا یک سوال را حل کردید و بعد کولب را بستید یا مدتی با آن کار نکردید و اتصالتان به طور خودکار قطع شد، در اقدام بعدیتان برای نوشتن بقیه‌ی تمرین، حتما این بلوک باید دوباره اجرا شود.

> RUN THIS BLOCK WITHOUT ANY CHANGE to download the data

Show code

```
--2024-01-25 02:34:53--  https://drive.google.com/uc?export=download&id=1vJrAqaPADRn0bH
Resolving drive.google.com (drive.google.com)... 74.125.31.113, 74.125.31.139, 74.125.3
Connecting to drive.google.com (drive.google.com)|74.125.31.113|:443... connected.
HTTP request sent, awaiting response... 303 See Other
Location: https://drive.usercontent.google.com/download?id=1vJrAqaPADRn0bHn6GCSdqGwQ0vZ
--2024-01-25 02:34:53--  https://drive.usercontent.google.com/download?id=1vJrAqaPADRn0
Resolving drive.usercontent.google.com (drive.usercontent.google.com)... 173.194.217.13
Connecting to drive.usercontent.google.com (drive.usercontent.google.com)|173.194.217.1
HTTP request sent, awaiting response... ^C
Archive:  HW4_data.zip
  End-of-central-directory signature not found.  Either this file is not
  a zipfile, or it constitutes one disk of a multi-part archive.  In the
  latter case the central directory and zipfile comment will be found on
  the last disk(s) of this archive.
unzip:  cannot find zipfile directory in one of HW4_data.zip or
        HW4_data.zip.zip, and cannot find HW4_data.zip.ZIP, period.
```

Imports

فراخوانی کتابخانه ها

```
###
import numpy as np
import cv2 as cv
import matplotlib.pyplot as plt
###
```

Any Helper Functions

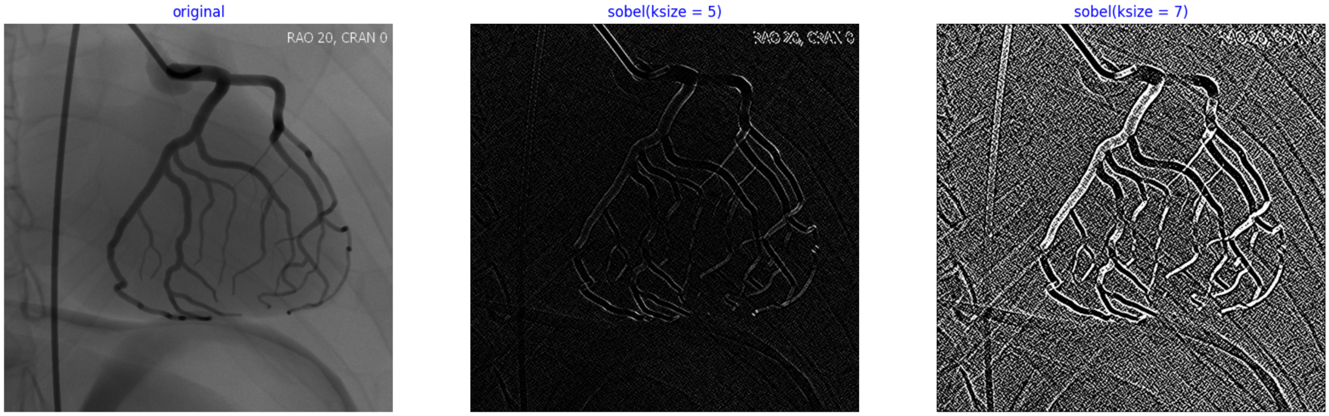
در صورت نیاز یا برای راحتی خودتان می‌توانید توابع کمکی (مثلا برای عملیات‌های پر تکرار) این جا تعریف کنید (همه در همین بلوک).

```
###
def show(image, title):
    max_intensity = np.max(image)
    min_intensity = np.min(image)
    plt.title(title, color="blue")
    plt.imshow(image, cmap="gray", vmin=min_intensity, vmax=max_intensity)
    plt.axis("off")
    plt.show()


def show_plots(images_list, titles_list, rows=1):
    columns = len(images_list)
    fig, axes = plt.subplots(rows, columns, figsize=(20, 20))
    for i in range(columns):
        if rows == 1:
            axes[i].imshow(images_list[i], cmap="gray", vmin=np.min(images_list[i]), vmax=n
            axes[i].set_title(titles_list[i], color="blue")
            axes[i].axis("off")
        if rows >= 2:
            axes[0, i].imshow(images_list[i], cmap="gray", vmin=np.min(images_list[i]), vma
            axes[0, i].set_title(titles_list[i], color="blue")
            axes[0, i].axis("off")

            bin_num = (np.max(images_list[i]) - np.min(images_list[i]) + 1) / 4
            bin_num = int(np.ceil(bin_num))
            hist, bins = np.histogram(images_list[i], bins=bin_num, range=(np.min(images_li
            axes[1, i].bar(bins[:-1], hist)
    plt.show()

###
```

Question 5: Edge Detection (15%)

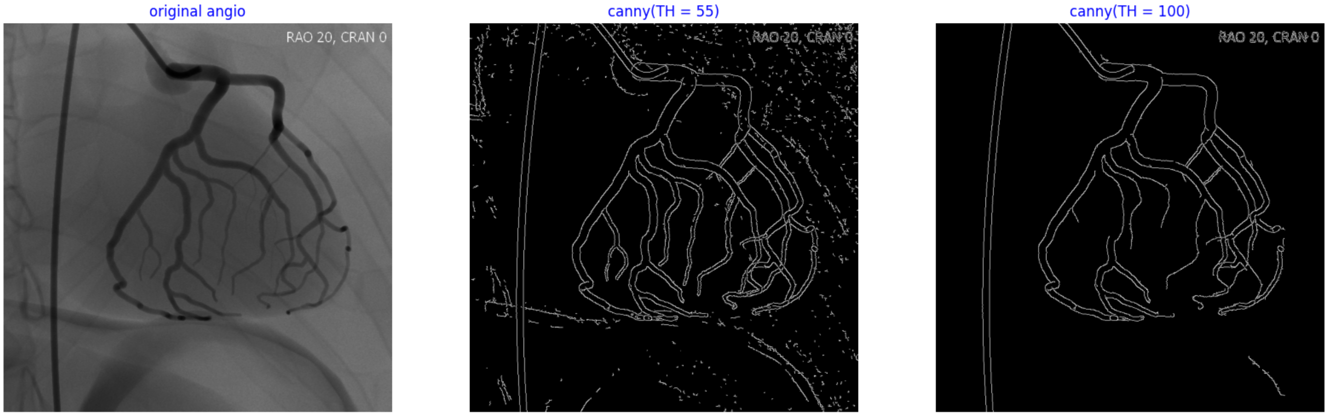
Q5 - Part 1 (Sobel) (5%)

```
#@title Q5 - Part 1 (Sobel) (5%)
###
angio = cv.imread("angio.png", cv.IMREAD_GRAYSCALE)
# print(angio.dtype)
sobel = cv.Sobel(angio, ddepth=-1, dx=1, dy=1, ksize=5)
sobel2 = cv.Sobel(angio, ddepth=-1, dx=1, dy=1, ksize=7)
show_plots([angio, sobel, sobel2], ["original", "sobel(ksize = 5)", "sobel(ksize = 7)"])
###
```



Q5 - Part 2 (Canny) (5%)

```
#@title Q5 - Part 2 (Canny) (5%)
###
th1 = 55
th2 = 100
canny = cv.Canny(angio, 30, th1)
canny2 = cv.Canny(angio, 30, th2)
show_plots([angio, canny, canny2], ["original angio", f"canny(TH = {th1})", f"canny(TH = {t
###
```



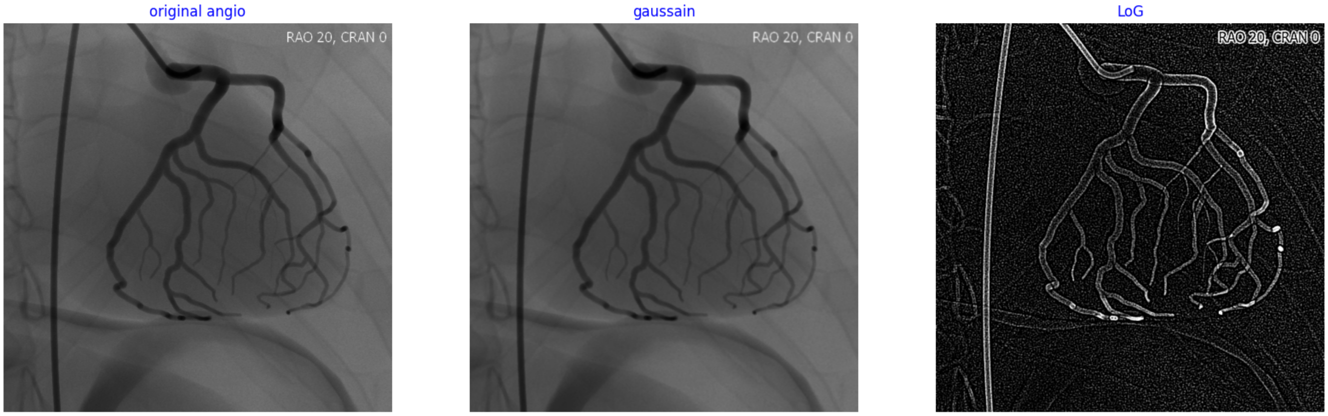
original angio

canny(TH = 55)

canny(TH = 100)

Q5 - Part 3 (LoG) (5%)

```
#@title Q5 - Part 3 (LoG) (5%)
###
gaussian = cv.GaussianBlur(angio, ksize=(3, 3), sigmaX=1)
laplacian_of_gaussian = cv.Laplacian(gaussian, ksize=5, ddepth=-1)
show_plots([angio, gaussian, laplacian_of_gaussian], ["original angio", "gaussain", "LoG"])
###
```

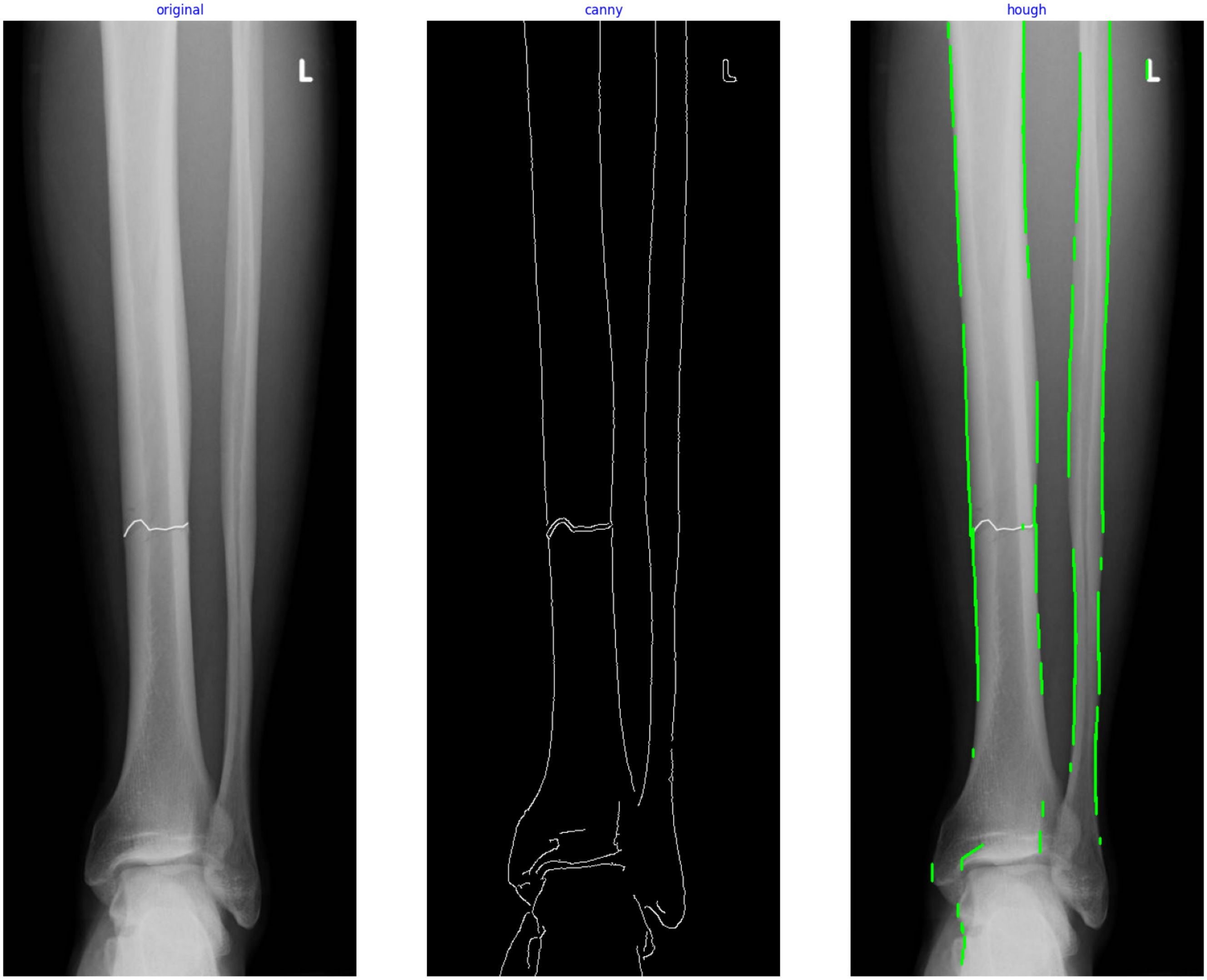


original angio gaussain LoG

Question 6: Hough Transform (15%)

Q6 - Part 1 (60%)

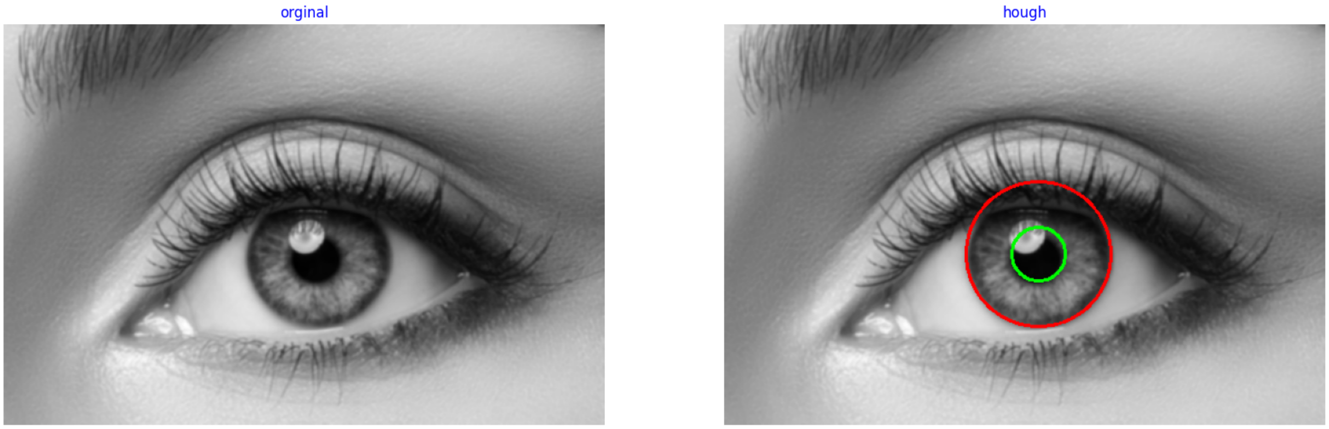
```
#@title Q6 - Part 1 (60%)
###
bone = cv.imread("bone.jpg", cv.IMREAD_GRAYSCALE)
hough_bone = cv.cvtColor(bone,cv.COLOR_GRAY2BGR)
bone_gaussian = cv.GaussianBlur(bone, ksize=(5, 5), sigmaX=2.5)
bone_canny = cv.Canny(bone_gaussian, 30, 80)
lines = cv.HoughLinesP(bone_canny, rho=1, theta=1, threshold=20, minLineLength=5, maxLineGa
for line in lines:
    x1, y1, x2, y2 = line[0]
    cv.line(hough_bone, (x1, y1), (x2, y2), (0, 255, 0), 2)
show_plots([bone, bone_canny, hough_bone], ["original", "canny", "hough"])
###
```



original
canny
hough
L
L
L

Q6 - Part 2 (40%)

```
#@title Q6 - Part 2 (40%)
###
eye = cv.imread("eye.jpg", cv.IMREAD_GRAYSCALE)
eye = cv.GaussianBlur(eye, ksize=(7, 7), sigmaX=1)
circles = cv.HoughCircles(eye, cv.HOUGH_GRADIENT, 1, 1, param2=99)
circles = np.uint16(np.around(circles))
hough_circles = cv.cvtColor(eye,cv.COLOR_GRAY2BGR)
# print(circles)
for i in circles[0]:
    cv.circle(hough_circles, (i[0], i[1]), i[2], (255, 0, 0), 2)
    cv.circle(hough_circles, (i[0], i[1]), 24, (0, 255, 0), 2)

show_plots([eye, hough_circles], ["orginal", "hough"])
###
```



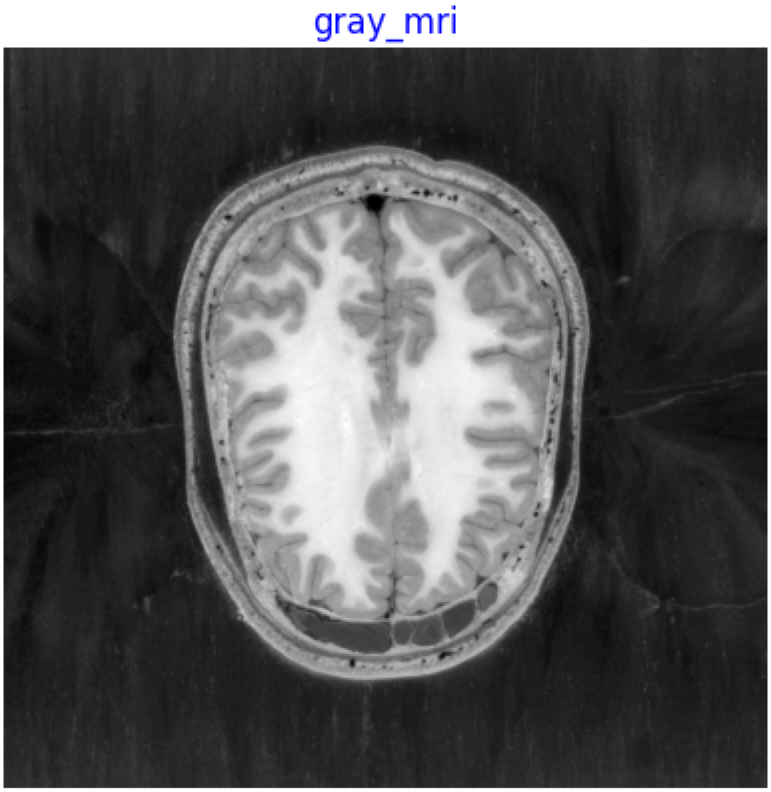
Question 7: Feature-Based Registration (20%)

```
###
# mrif = cv.imread("MRIF.png", cv.IMREAD_GRAYSCALE)
# mris = cv.imread("MRIS.png", cv.IMREAD_GRAYSCALE)
# show_plots([mrif, mris], ["MRIF", "MRIS"])

# %matplotlib notebook
# from matplotlib.backend_bases import MouseButton
# import matplotlib.colors as mcolors
# import ipywidgets as wdg

# colors = list(mcolors.BASE_COLORS.keys())
# fig, ax = plt.subplots(1, 2)
# fig.tight_layout()
# pic1_points = []
# pic2_points = []
# ax[0].imshow(mrif, cmap='gray')
# ax[1].imshow(mris, cmap='gray')
# txt = wdg.Textarea(
#  value='',
#  placeholder='',
#  description='event:',
#  disabled=False
# )
# display(txt)

# def on_click(event):
#      if event.button is MouseButton.LEFT:
#          axs = event.inaxes

#          x, y = int(event.xdata), int(event.ydata)

#          if axs == ax[0] and len(pic1_points) < num_points:
#              pic1_points.append([x, y])
#              axs.scatter(x, y, marker="x", color=colors[len(pic1_points)-1], s=200)
#          elif axs == ax[1] and len(pic2_points) < num_points:
#              pic2_points.append([x, y])
#              axs.scatter(x, y, marker="x", color=colors[len(pic2_points)-1], s=200)
#          else:
#              txt.value = 'It is enough. go to the next section.'
# plt.connect('button_press_event', on_click)
# plt.show()

###
```

Question 8: Similarity-based Segmentation (20%)

Q8 - Part 1

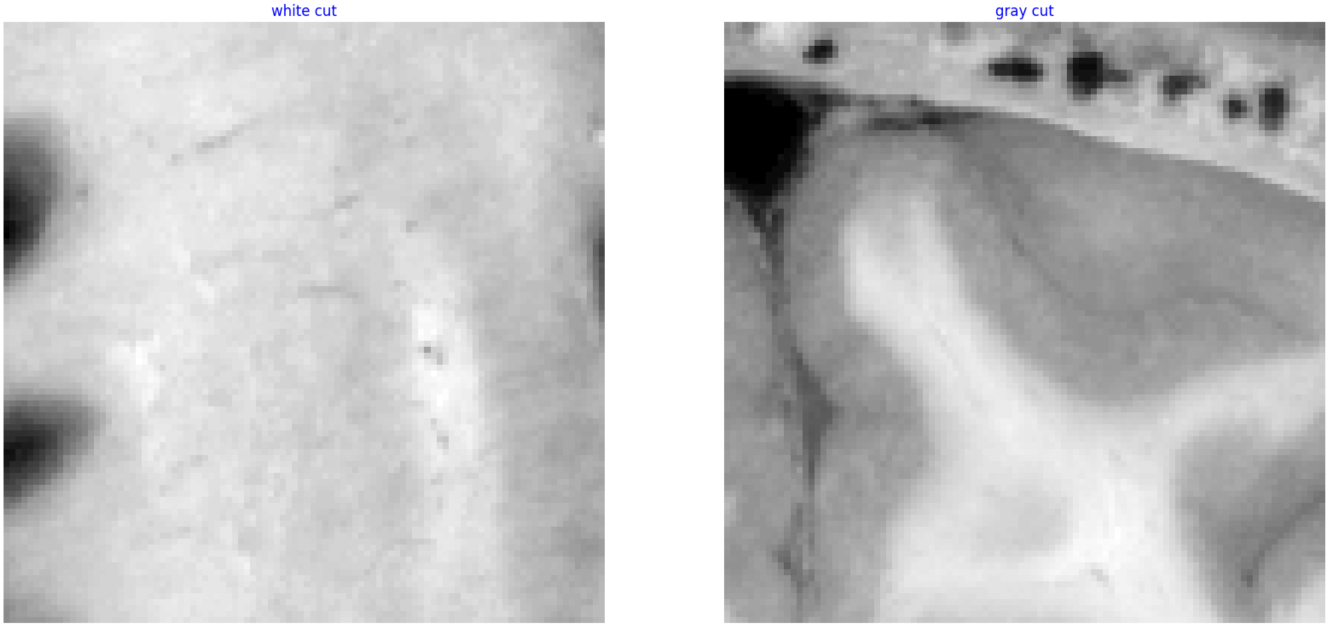
```
#@title Q8 - Part 1
###
gray_mri = cv.imread("/content/Color_MRI.png", cv.IMREAD_GRAYSCALE)
show(gray_mri, "gray_mri")
###
```



Q8 - Part 2

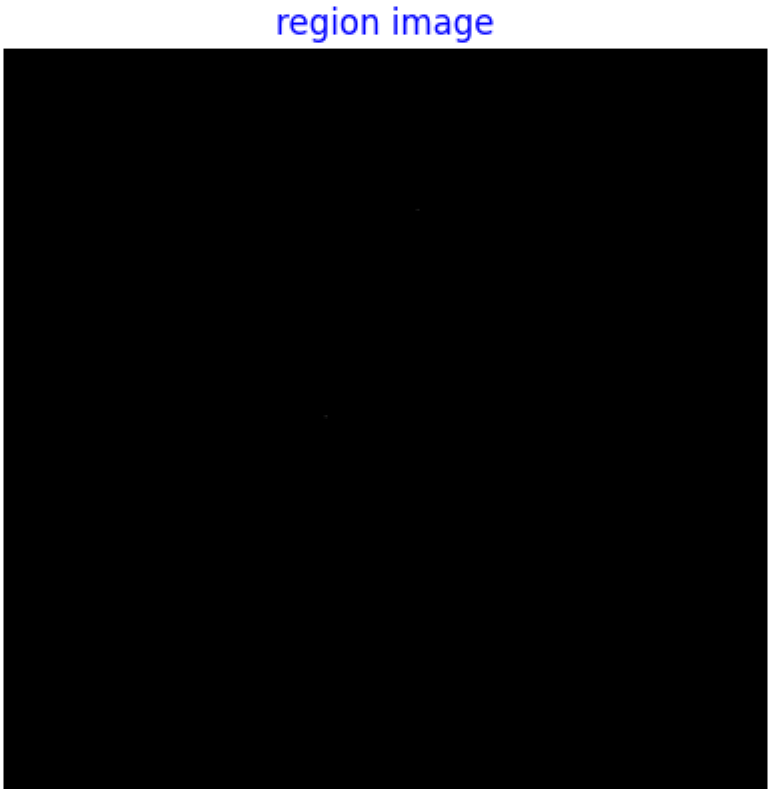
```
#@title Q8 - Part 2
###
white_cut = gray_mri[350:450, 300:400]

white_seed = (400, 350)
print(gray_mri[white_seed])

gray_cut = gray_mri[150:250, 400:500]
gray_seed = (175, 450)
print(gray_mri[gray_seed])

show_plots([white_cut, gray_cut], ["white cut", "gray cut"])
###
```

```
206
118
```



Q8 - Part 3 (5%)

```
#@title Q8 - Part 3 (5%)
###
region_image = np.zeros(gray_mri.shape, dtype=np.uint8)
region_image[white_seed] = 245
region_image[gray_seed] = 170
show(region_image, "region image")
###
```



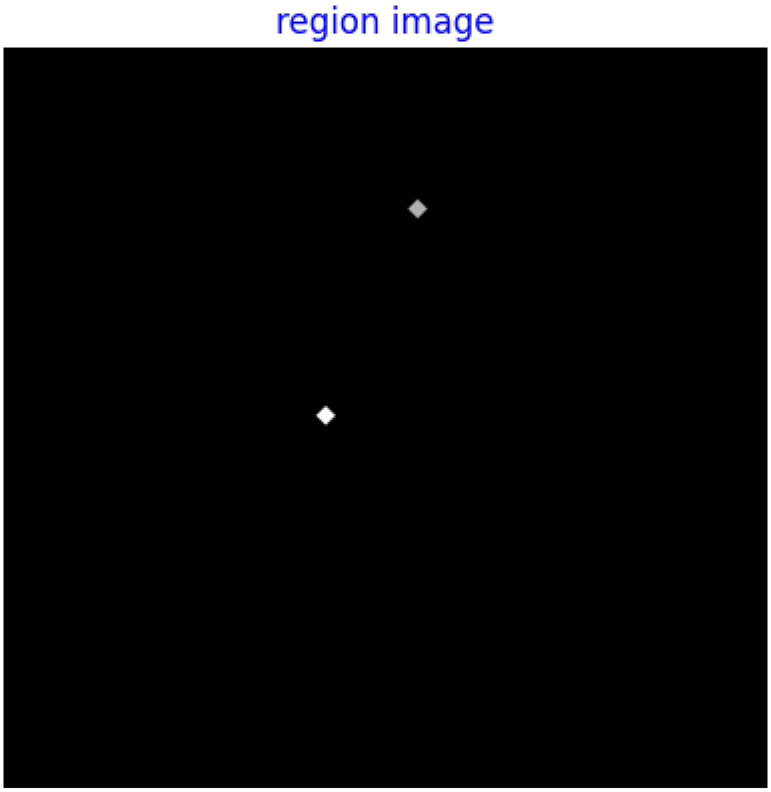
Q8 - Part 4 (50%)

```
#@title Q8 - Part 4 (50%)
###
def region_growing(max_distance, threshold_type, seed, kernel, region_image, base_image, it
    seed_value = base_image[seed]
    seed_region = region_image[seed]

    ## find the threshold
    threshold = 0
    if threshold_type == 'constant':
        threshold = seed_value
    elif threshold_type == 'variable':
        total = 0
        count = 0
        for i in range(region_image.shape[0]):
            for j in range(region_image.shape[1]):
                if region_image[i, j] == seed_region:
                    total += base_image[i, j]
                    count += 1
        threshold = total / count

    ## select current region pixels
    region_separated = np.zeros(region_image.shape, dtype=np.uint8)
    for i in range(region_image.shape[0]):
        for j in range(region_image.shape[1]):
            if region_image[i, j] == seed_region:
                region_separated[i, j] = 255

    ## find candidate pixels for the current region
    region_expanded = cv.morphologyEx(region_separated, cv.MORPH_DILATE, kernel, iterations
    region_candidates = region_expanded - region_separated

    ## see if any of the candidates belong to the current region
    for i in range(region_candidates.shape[0]):
        for j in range(region_candidates.shape[1]):
            if region_candidates[i, j] > 0:
                original_intensity = base_image[i, j]
                if abs(int(original_intensity) - int(threshold)) <= max_distance:
                    region_candidates[i, j] = seed_region
                else:
                    region_candidates[i, j] = 0

    ## true if the current region has changed
    is_changed = np.sum(region_candidates) != 0

    ## produce the final array of regions
    region_image += region_candidates

    return is_changed, region_image
###
```

Q8 - Part 5 (15%)

```
#@title Q8 - Part 5 (15%)
###
kernel = np.array([[0, 1, 0], [1, 1, 1], [0, 1, 0]], np.uint8)
is_changed, region_image = region_growing(50, 'constant', white_seed, kernel, region_image,
is_changed, region_image = region_growing(50, 'constant', gray_seed, kernel, region_image,
print(is_changed)
show(region_image, "region image")
###
```

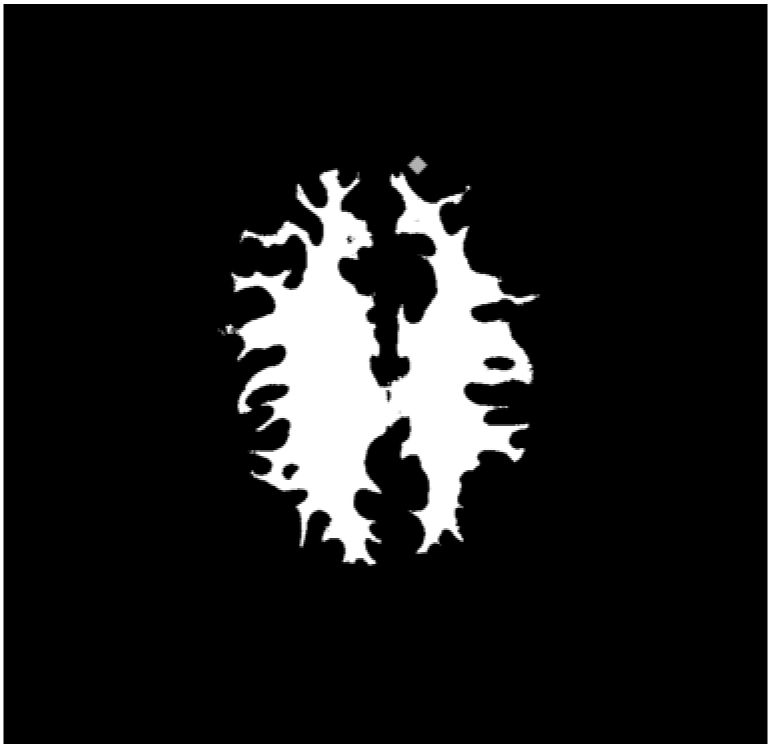
```
True
```



Q8 - Part 6 (10%)

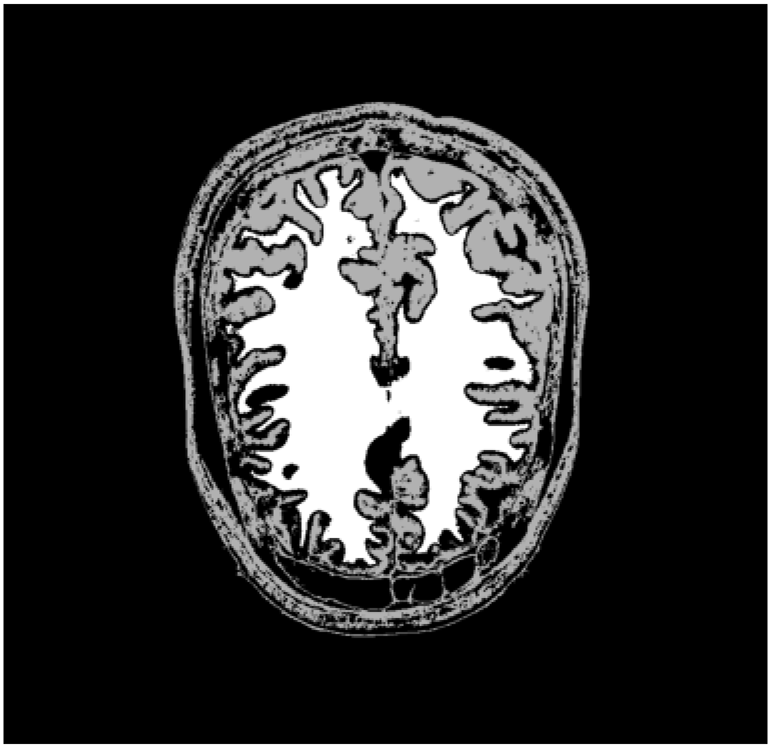
```
#@title Q8 - Part 6 (10%)
###
i = 0
while True:
    is_changed, region_image = region_growing(40, 'constant', white_seed, kernel, region_im
    if not is_changed:
        break
    i += 1
    if i % 100 == 0:
        print(i)

show(region_image, "region image")
white_constant = np.array(region_image)
while True:
    is_changed, region_image = region_growing(20, 'constant', gray_seed, kernel, region_ima
    if not is_changed:
        break
    i += 1
    if i % 100 == 0:
        print(i)

show(region_image, "region image")
total_constant = np.array(region_image)
print(f'iterations for constant threshold: {i}')

i = 0
while True:
    is_changed, region_image = region_growing(25, 'variable', white_seed, kernel, region_im
    if not is_changed:
        break
    i += 1
    if i % 100 == 0:
        print(i)

show(region_image, "region image")

white_variable = np.array(region_image)
while True:
    is_changed, region_image = region_growing(15, 'variable', gray_seed, kernel, region_ima
    if not is_changed:
        break
    i += 1
    if i % 100 == 0:
        print(i)

show(region_image, "region image")
total_variable = np.array(region_image)
print(f'iterations for variable threshold: {i}')
###
```

region image



```
100
200
```

region image



```
iterations for constant threshold: 260
```

region image