HW3

September 27, 2024

[ ]:
```
import numpy as np
import matplotlib.pyplot as plt
from PIL import Image
import os

image_path = 'C:/Users/ashwi/Desktop/CMU/FALL_2024/Modern_Control_Theory/
 ↪Homework/MCT_HW3/CMU_Grayscale.png'
image = Image.open(image_path)
image_matrix = np.array(image)
# print(image_matrix)
# print(np.shape(image_matrix))
m,n = np.shape(image_matrix)
U, E, V = np.linalg.svd(image_matrix)
#E = np.reshape(E,(-1,1))
print(np.shape(U))
print(np.shape(E))
print(np.shape(V))
```

```
(675, 675)
(675,)
(1200, 1200)
```

[ ]:
```
#Defining some useful functions

def findi(ratio, m, n):
    i = int(ratio*m*n/(m+n+1))
    print(i)
    return i

def gen_image(U, E, V, i):
    E = np.diag(E[:i])
    im = U[:, 0:i] @ E[0:i] @ V[0:i, :]
    return im
```

[ ]:
```
i_50 = findi(0.5, m, n)
i_10 = findi(0.1, m, n)
i_05 = findi(0.05, m, n)
```

```
i_50_image = gen_image(U,E,V,i_50)
i_10_image = gen_image(U,E,V,i_10)
i_05_image = gen_image(U,E,V,i_05)
```

```
215
43
21
```

[ ]:
```
def save_image(image, compression_level, title, output_path):
    output_filename = f'compressed_{compression_level}.png'
    output_path_final = os.path.join(output_path, output_filename)

    plt.imshow(image,cmap='gray')
    plt.title(f"{title}")
    plt.axis('off')
    plt.savefig(output_path_final)
    plt.show()

    # if os.path.exists(output_path_final):
    #     print(f"Image successfully saved at: {output_path_final}")
    # else:
    #     print("Failed to save the image.")
```

[ ]:
```
plt.imshow(image,cmap='gray')
plt.title("Original Image")
plt.axis('off')
plt.show()

save_image(i_50_image, 50, f"Compressed to 50%, No: of singular values={i_50}",␣
 ↪"C:/Users/ashwi/Desktop/CMU/FALL_2024/Modern_Control_Theory/Homework/MCT_HW3/
 ↪Compressed_Images")
save_image(i_10_image, 10, f"Compressed to 10%, No: of singular values={i_10}",␣
 ↪"C:/Users/ashwi/Desktop/CMU/FALL_2024/Modern_Control_Theory/Homework/MCT_HW3/
 ↪Compressed_Images")
save_image(i_05_image, 5,f"Compressed to 5%, No: of singular values={i_05}", "C:
 ↪/Users/ashwi/Desktop/CMU/FALL_2024/Modern_Control_Theory/Homework/MCT_HW3/
 ↪Compressed_Images")
```

Original Image

Compressed to 50%, No: of singular values=215

Compressed to 10%, No: of singular values=43

Compressed to 5%, No: of singular values=21

[ ]:
```
#################
NOTEBOOK_NAME = "HW3.ipynb"
!apt-get install -y pandoc > /dev/null 2>&1
!sudo apt-get install texlive-xetex texlive-fonts-recommended␣
 ↪texlive-plain-generic > /dev/null 2>&1
!pip install nbconvert > /dev/null 2>&1
```

```
from google.colab import drive, files
drive.mount('/content/drive')
notebook_path = rf'/content/drive/MyDrive/Colab Notebooks/{NOTEBOOK_NAME}'

import os
if os.path.exists(notebook_path):
  !jupyter nbconvert --to pdf "{notebook_path}" > /dev/null 2>&1
  pdf_filename = notebook_path.replace('.ipynb', '.pdf')
  files.download(pdf_filename)
else:
  print("Notebook not found. Please check the path.")
#################
```