svd_demo_image_compression

August 27, 2021

1 A simple demo of applying SVD for image compression

2 Author: March J. Luo

[4]:
```
import numpy as np
import matplotlib.pyplot as plt
from matplotlib import image
```

3 Loading original image

[5]:
```
rgb = image.imread('cat.jpeg')

plt.imshow(rgb)
plt.show()
```

[5]:
```
<matplotlib.image.AxesImage at 0x7fafcfd93400>
```

4 Converting RGB to gray-scale image

[8]:
```
r = rgb[:,:,0] / 255
g = rgb[:,:,1] / 255
b = rgb[:,:,2] / 255

gray = 0.2989 * r + 0.5870 * g + 0.1140 * b

plt.imshow(gray, cmap=plt.get_cmap('gray'), vmin=0, vmax=1)
plt.show()
```

[34]:
```
gray.shape
```

[34]: (183, 275)

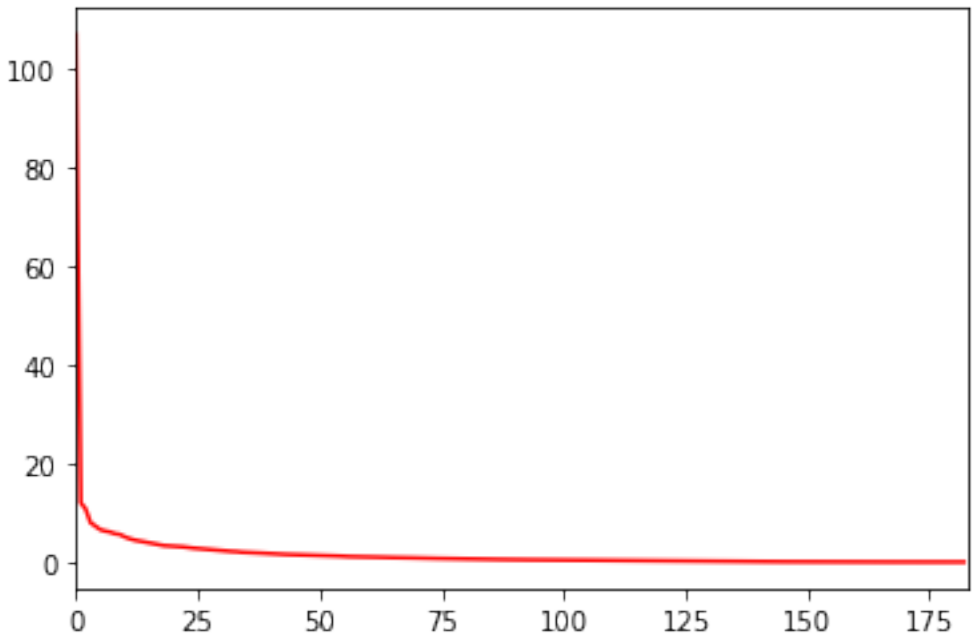
5 SVD decomposing

[32]:
```
u, sigma, vt = np.linalg.svd(gray)
```

[15]:
```
n_sigma = len(sigma)
```

6 Singular value distribution

[16]:
```
plt.plot(sigma, c = 'red')

plt.xlim([0, n_sigma])

plt.show()
```

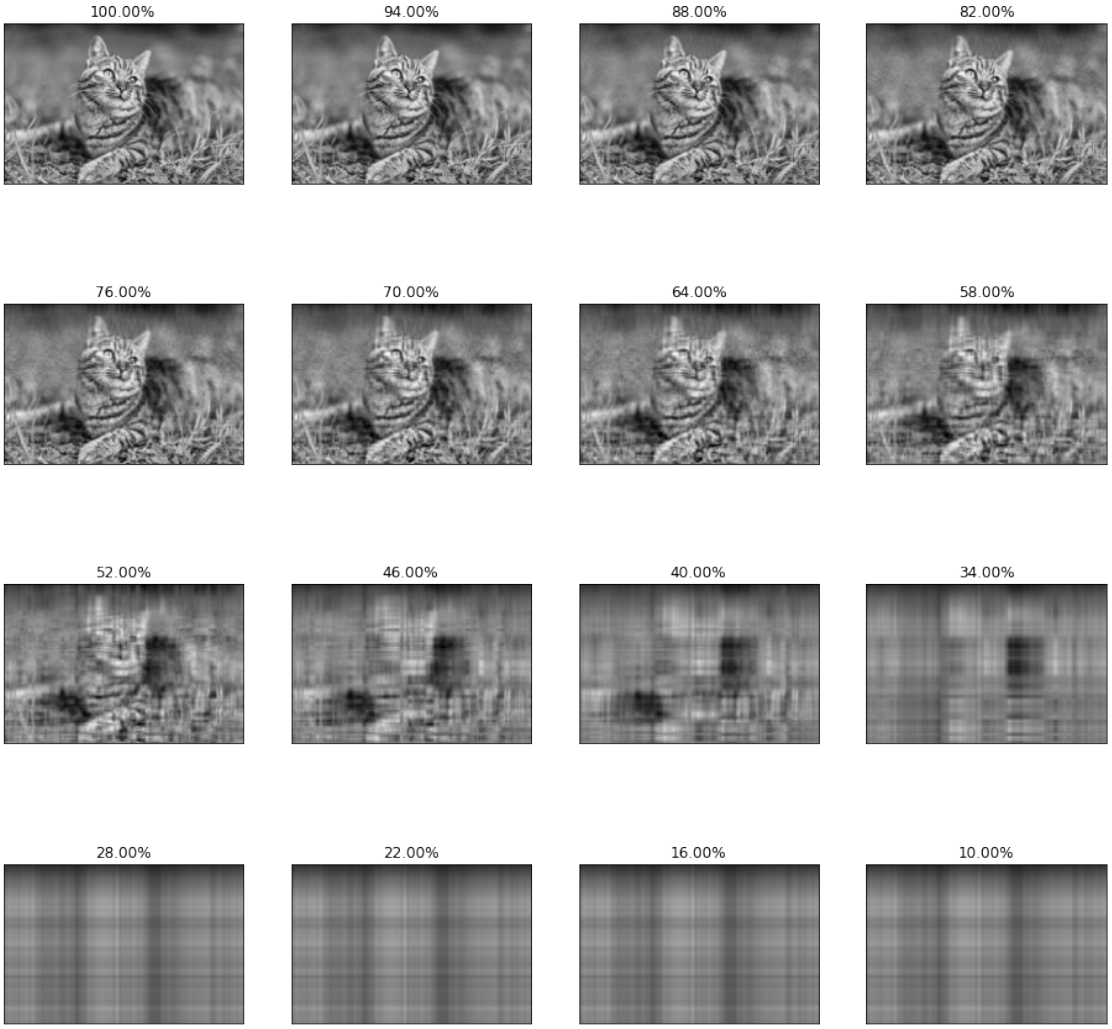


7 Recreating image by using k components

[38]:
```
# Recreating the image by keeping up to the p percentage
# of the sigmas
def recreate_image(u, sigma, vt, p):

    # image size
    m = len(u)
    n = len(v)

    #print(f"m={m} n={n}")

    sigma_ = np.zeros((m,n))
    sigma_total = sum(sigma) + 1e-8
    sigma_cur = 0.0 + 1e-8

    for i in range(len(sigma)):
```

```
        sigma_[i,i] = sigma[i]

        sigma_cur += sigma[i]

        if sigma_cur / sigma_total > p:
            break

    image_ = u @ sigma_ @ vt

    return image_
```

[42]:
```
nrows = 4
ncols = 4
subfig_width = 4
subfig_height = 4
figsize = (ncols * subfig_width, nrows * subfig_height)

fig, axes = plt.subplots(nrows = nrows,
                         ncols = ncols,
                         figsize = figsize)

axes_flat = axes.flat

percents = np.linspace(1, 0.1, num = nrows * ncols, endpoint = True)

for row in range(nrows):
    for col in range(ncols):
        idx = row * ncols + col

        p = percents[idx]

        label = f"{p * 100:.2f}%"

        ax = axes_flat[idx]

        ax.set_xticks([])
        ax.set_yticks([])

        image_ = recreate_image(u, sigma, vt, p)

        ax.imshow(image_, cmap = "gray", vmin = 0, vmax = 1)

        ax.title.set_text(f"{label}")

plt.show()
```


100.00%
94.00%
88.00%
82.00%
76.00%
70.00%
64.00%
58.00%
52.00%
46.00%
40.00%
34.00%
28.00%
22.00%
16.00%
10.00%

[ ]: