In [1]:
```
from matplotlib.image import imread
import matplotlib.pyplot as plt
import numpy as np
import os
```

In [2]:
```
plt.rcParams['figure.figsize'] = [16,8]
A = imread('11.webp')
X = np.mean(A,-1)
```

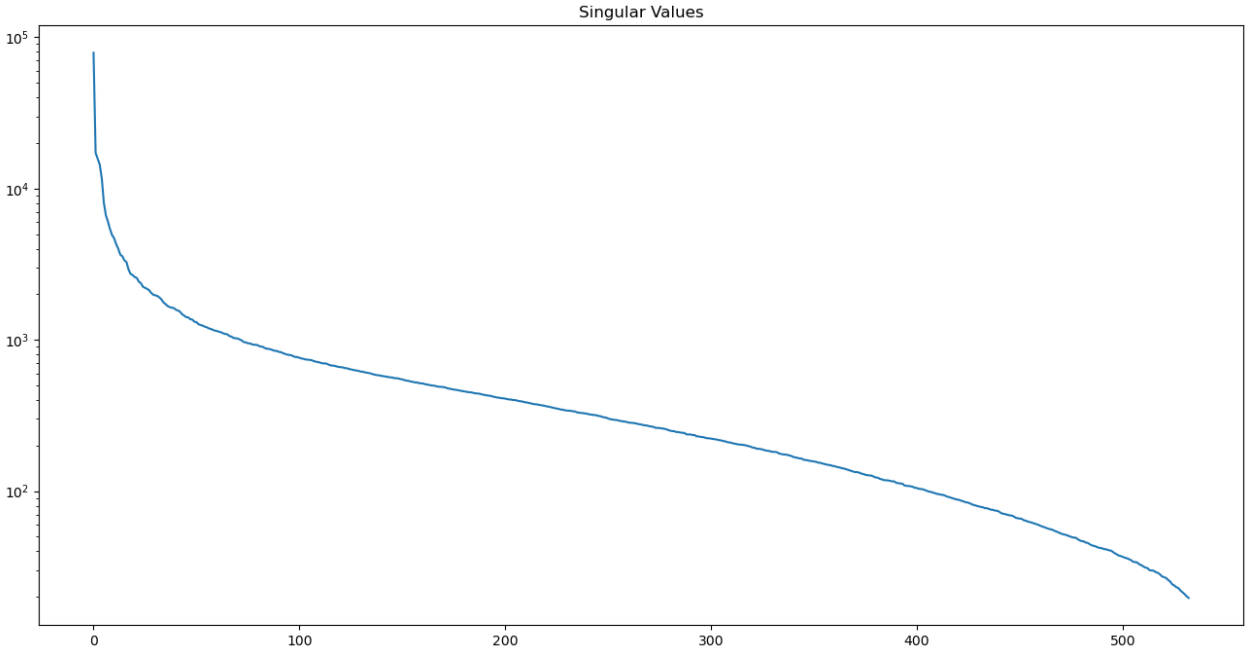
In [4]:
```
img = plt.imshow(X)
img.set_cmap('gray')
plt.axis('off')
```

Out[4]: (-0.5, 799.5, 532.5, -0.5)

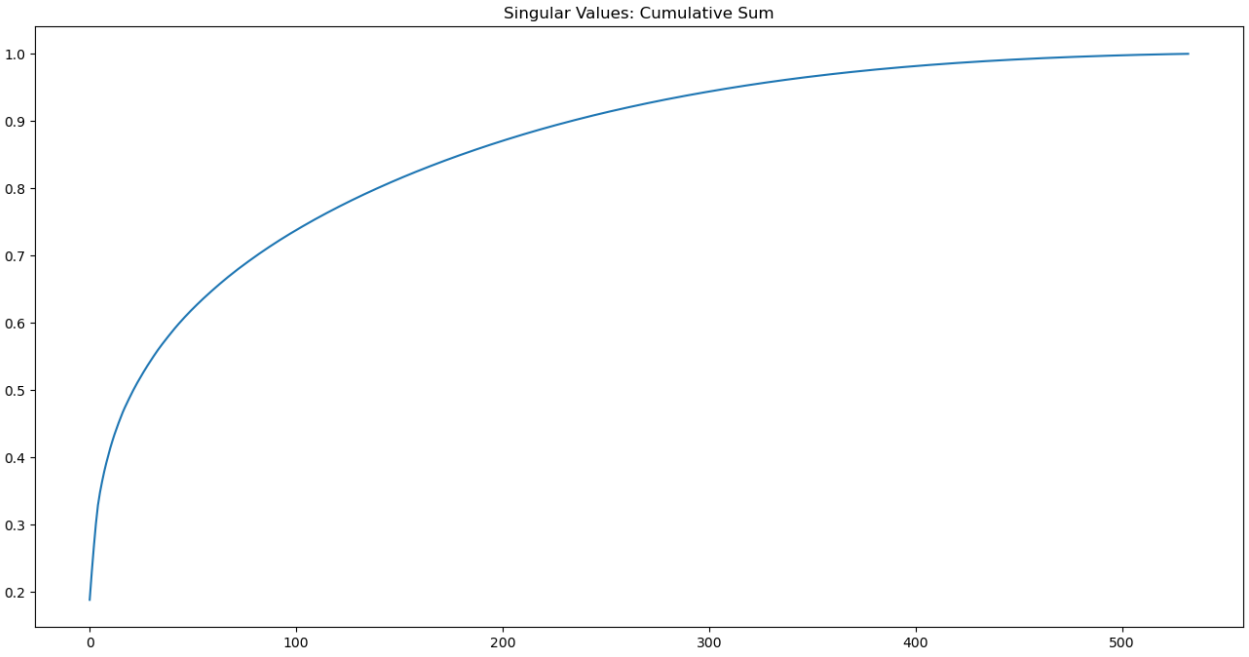
In [5]:
```
U, S, VT = np.linalg.svd(X,full_matrices=False)
S = np.diag(S)
```

In [6]:
```
r=230
Xapprox = U[:,:r]@S[0:r,:r]@VT[:r,:]
plt.figure(0)
img = plt.imshow(Xapprox)
img.set_cmap('gray')
plt.axis('off')
plt.title('r='+str(r))
plt.show()
```

In [7]:
```
plt.figure(1)
plt.semilogy(np.diag(S))
plt.title('Singular Values')
plt.show()
```



In [8]:
```
plt.figure(2)
cumulative_sum_ratio = np.cumsum(np.diag(S)) / np.sum(np.diag(S))
plt.plot(cumulative_sum_ratio)
plt.title('Singular Values: Cumulative Sum')
plt.show()
index_x = np.argmin(cumulative_sum_ratio <= 0.9)
```


Singular Values: Cumulative Sum
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
100
200
300
400
500

In [ ]: