```
!pip install pillow
```

```
Requirement already satisfied: pillow in /usr/local/lib/python3.11/dist-packages (11.1.0)
```

```
from PIL import Image
```

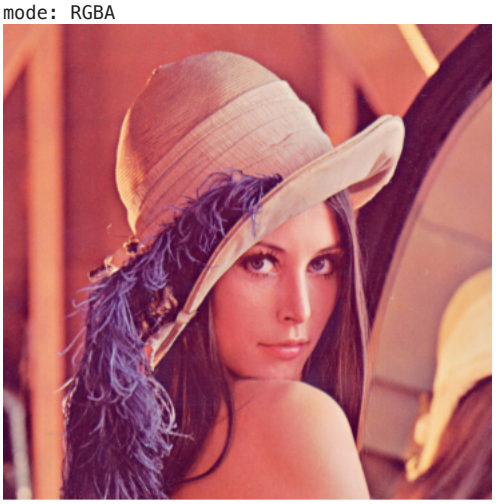
Double-click (or enter) to edit

```
image_colored = Image.open("/content/drive/MyDrive/AI and ML/lenna_image.png")
```

Display image details and show image

```
print("format:", image_colored.format)
print("size:", image_colored.size)
print("mode:", image_colored.mode)
display(image_colored)
```

```
format: PNG
size: (366, 357)
mode: RGBA
```



Converting RGBA mode to RGB

```
image_colored = image_colored.convert("RGB")
print(image_colored.mode)
```

```
RGB
```

Convert image to gray scale

```
image_gray = image_colored.convert("L")
display(image_gray)
```

```
print("format:", image_gray.format)
print("size:", image_gray.size)
print("mode:", image_gray.mode)
```

```
format: None
size: (366, 357)
mode: L
```

```
width, height = image_gray.size
channels = len(image_gray.getbands())

print(f"image shape (gray): {height}, {width}, {channels}")

image_size_grayed = width * height * 1
print(f"image size (gray):", image_size_grayed)
```

```
image shape (gray): 357, 366, 1
image size (gray): 130662
```

```
width, height = image_colored.size
channels = len(image_colored.getbands())

print(f"image shape (gray): {height}, {width}, {channels}")

image_colored = width * height * 3
print(f"image size (gray):", image_colored)
```

```
image shape (gray): 357, 366, 3
image size (gray): 391986
```

Double-click (or enter) to edit

```
import numpy as np
image_array_colored = np.array(image_colored)
image_array_colored.shape
```

```
(357, 366, 3)
```

```
red_channel = image_array_colored[:, :, 0]
print(red_channel )
display(red_channel )
```

```
[[225 224 226 ...  92  90  91]
 [225 224 224 ...  91  90  91]
 [223 223 224 ...  93  91  91]
 ...
 [ 88  92  95 ... 148 162 175]
 [ 88  92  96 ... 154 168 177]
 [254 254 254 ... 255 255 255]]
ndarray (357, 366) show data
```

```
red_channel = image_array_colored.copy()
red_channel[:, :, 1] = 0
red_channel[:, :, 2] = 0
display(red_channel)
```

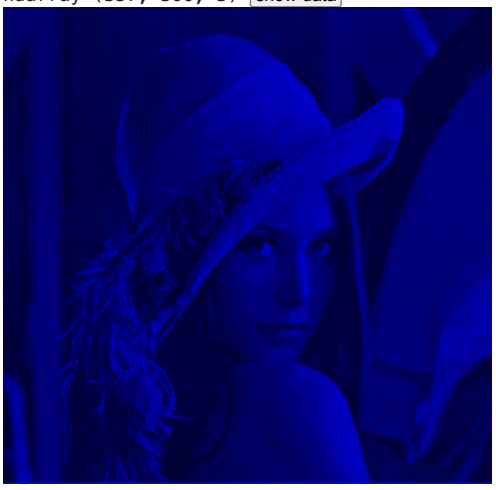
ndarray (357, 366, 3) show data

```
green_channel = image_array_colored.copy()
green_channel[:, :, 0] = 0
green_channel[:, :, 2] = 0
display(green_channel)
```

ndarray (357, 366, 3) show data

```
blue_channel = image_array_colored.copy()
blue_channel[:, :, 0] = 0
blue_channel[:, :, 1] = 0
display(blue_channel)
```

ndarray (357, 366, 3) show data



```
r, g, b = image_colored.split()
display(r)
display(g)
display(b)
```

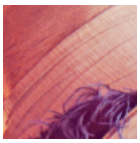
```
row_100 = image_array_colored[100,:,:]
print(row_100)
```

```
[[169  63  76]
 [166  65  75]
 [170  64  76]
 ...
 [210 132 122]
 [209 133 116]
 [208 134 126]]
```

```
col_50 = image_array_colored[:,50,:]
print(col_50)
```

```
[[160  61  82]
 [163  63  82]
 [166  61  74]
 ...
 [ 82  19  67]
 [ 79  18  66]
 [254 254 254]]
```

```
left = 100
upper = 50
right = 200
lower = 150
cropped_image = image_colored.crop((left,upper,right,lower))
display(cropped_image)
```



```
image_array = np.zeros((100,100,3), dtype=np.uint8 )
image_from_array = Image.fromarray(image_array)
image_from_array.show()
```

```
display(image_from_array)
```

```
image_from_array.save("out.jpg")
```

```
import numpy as np
import matplotlib.pyplot as plt
from PIL import Image
```

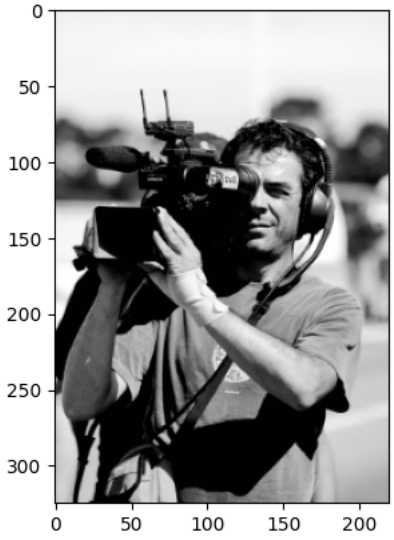
```
image = Image.open("/content/drive/MyDrive/AI and ML/camera_man.png").convert("L")

image_array = np.array(image)
print(image_array.shape)

data = image_array.copy()

plt.imshow(image_array, cmap="gray")
plt.show()
```

```
(325, 220)
```




```
mean = np.mean (data, axis = 0)
centered_data = data - mean
centered_data = centered_data
```

```
centered_data.shape
```

```
(325, 220)
```

```
cov_matrix = np.cov(centered_data, rowvar=False)
cov_matrix
```

```
array([[6147.9765812 , 6202.87468186, 6082.14505223, ...,  932.57215575,
         902.71013295,  899.66165242],
       [6202.87468186, 6576.35540361, 6654.37268756, ...,  839.97424501,
         813.64422602,  812.7574264 ],
       [6082.14505223, 6654.37268756, 7034.65540361, ...,  755.91622032,
         732.85039886,  731.70125356],
```

```
...,
[ 932.57215575,  839.97424501,  755.91622032, ..., 2850.10736942,
 2787.64168091, 2730.1254416 ],
[ 902.71013295,  813.64422602,  732.85039886, ..., 2787.64168091,
 2751.24602089, 2713.80998101],
[ 899.66165242,  812.7574264 ,  731.70125356, ..., 2730.1254416 ,
 2713.80998101, 2696.01496676]])
```