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6.2 Image Arithmetic

```
from __future__ import print_function
import numpy as np
import argparse
import cv2
from google.colab.patches import cv2_imshow

ap = argparse.ArgumentParser()
ap.add_argument("-f", "--image", required = True,
help = "Path to the image")
args = vars(ap.parse_args())

image = cv2.imread('trex.png')
print("Original")
cv2_imshow(image)

print("max of 255: {}".format(cv2.add(np.uint8([200]), np.uint8
                                      ([100]))))
print("min of 0: {}".format(cv2.subtract(np.uint8([50]), np.uint8
                                         ([100]))))

print("wrap around: {}".format(np.uint8([200]) + np.uint8([100]))
)
print("wrap around: {}".format(np.uint8([50]) - np.uint8([100])))

```

```
Original
```

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```
max of 255: [[255]]
min of 0: [[0]]
wrap around: [44]
wrap around: [206]
```

```
[2]  1 M = np.ones(image.shape, dtype = "uint8") * 100
```

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```
1 M = np.ones(image.shape, dtype = "uint8") * 100
2 added = cv2.add(image, M)
3 print("Added")
4 cv2_imshow(added)
5
6 M = np.ones(image.shape, dtype = "uint8") * 50
7 subtracted = cv2.subtract(image, M)
8 print("Subtracted")
9 cv2_imshow(subtracted)
10 cv2.waitKey(0)
11
12
```

Added

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Subtracted

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```
# Hàm GrayScale:
#Đầu vào là 1 ảnh bất kỳ:
image = cv2.imread('trex.png')

def grayScale(image):
  newImage = np.zeros(image.shape, dtype = np.uint8)

  height, width, _  = image.shape

  for i in range(height):
    for j in range(width):
      color = image[i, j]
      newImage[i, j] = int(0.299*color[0] + 0.587*color[1]
                           + 0.114*color[2])

  return newImage
```

[4]

```
#Đầu ra là 1 ảnh trắng đen
gray_scale =  grayScale(image)
cv2_imshow(gray_scale)
```

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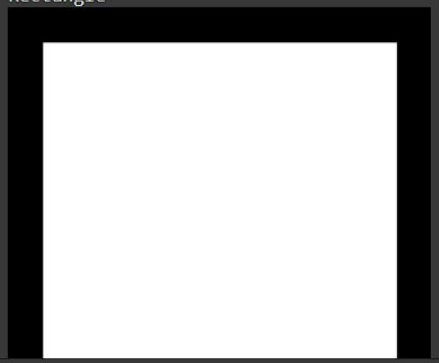
6.3 Bitwise Operations

```
1 import numpy as np
2 import cv2
3
4 rectangle = np.zeros((300, 300), dtype = "uint8")
5 cv2.rectangle(rectangle, (25, 25), (275, 275), 255, -1)
6 print("Rectangle")
7 cv2_imshow(rectangle)
8
9 circle = np.zeros((300, 300), dtype = "uint8")
10 cv2.circle(circle, (150, 150), 150, 255, -1)
11 print("Circle")
12 cv2_imshow(circle)
13
```

Rectangle



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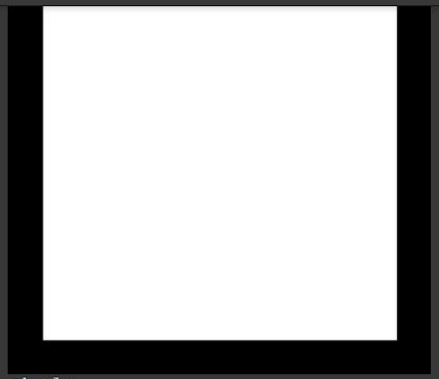
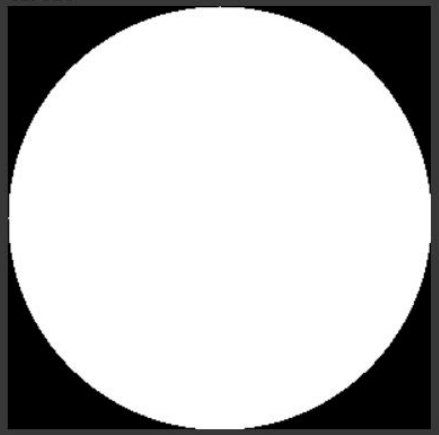


Circle



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```
1 bitwiseAnd = cv2.bitwise_and(rectangle, circle)
2 print("AND")
3 cv2_imshow(bitwiseAnd)
4 cv2.waitKey(0)
5
6 bitwiseOr = cv2.bitwise_or(rectangle, circle)
7 print("OR")
8 cv2_imshow(bitwiseOr)
9 cv2.waitKey(0)
10
11 bitwiseXor = cv2.bitwise_xor(rectangle, circle)
12 print("XOR")
13 cv2_imshow(bitwiseXor)
14 cv2.waitKey(0)
15
16 bitwiseNot = cv2.bitwise_not(circle)
17 print("NOT")
18 cv2_imshow(bitwiseNot)
19 cv2.waitKey(0)
```

```
OR
```

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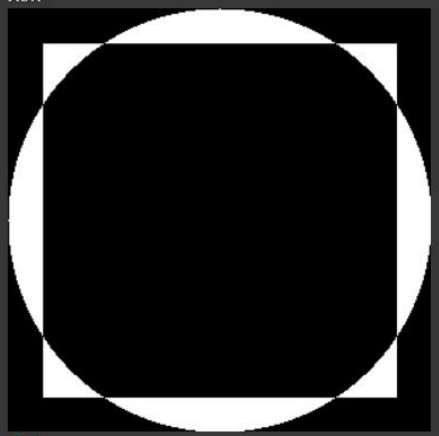
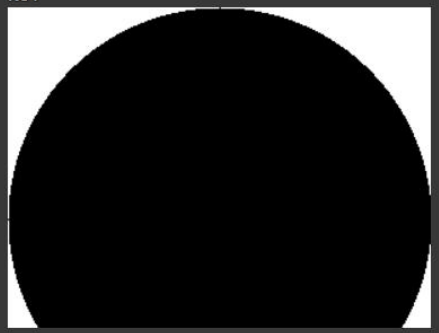
XOR



NOT



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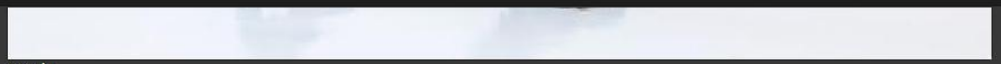
6.4 Masking

```
0s
1 import numpy as np
2 import argparse
3 import cv2
4
5 ap = argparse.ArgumentParser()
6 ap.add_argument("-f", "--image", required = True,
7                 help = "Path to the image")
8 args = vars(ap.parse_args())
9
10 image = cv2.imread('trex.png')
11 print("Original")
12 cv2_imshow(image)
13
14 mask = np.zeros(image.shape[:2], dtype = "uint8")
15 (cX, cY) = (image.shape[1] // 2, image.shape[0] // 2)
16 cv2.rectangle(mask, (cX - 75, cY - 75), (cX + 75 , cY + 75), 255,-1)
17 print("Mask")
18 cv2_imshow(mask)
19
20 masked = cv2.bitwise_and(image, image, mask = mask)
21 print("Mask Applied to Image")
22 cv2_imshow(masked)
23 cv2.waitKey(0)
24
```



Mask

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0s

Mask Applied to Image

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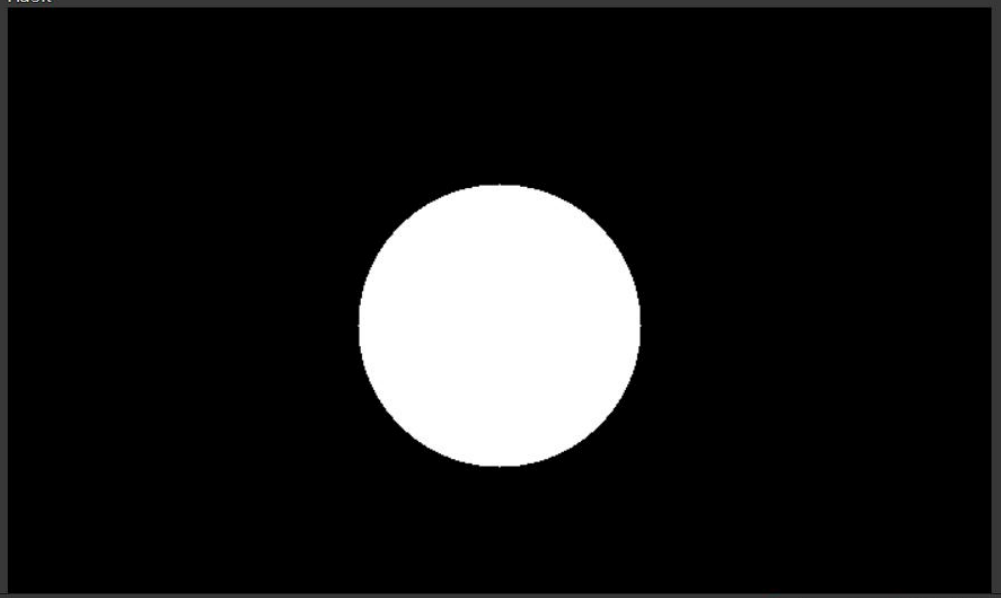
```
[8]  1 mask = np.zeros(image.shape[:2], dtype = "uint8")
     2 cv2.circle(mask, (cX, cY), 100, 255, -1)
     3 masked = cv2.bitwise_and(image, image, mask = mask)
     4 print("Mask")
     5 cv2_imshow(mask)
     6 print("Mask Applied to Image")
     7 cv2_imshow(masked)
     8 cv2.waitKey(0)
```

Mask



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```
Mask Applied to Image
```

```
-1
```

6.5 Splitting and Merging Channels

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6.5 Splitting and Merging Channels

```
[9]  1 import numpy as np
     2 import argparse
     3 import cv2
     4
     5 ap = argparse.ArgumentParser()
     6 ap.add_argument("-f", "--image", required = True,
     7                 help = "Path to the image")
     8 args = vars(ap.parse_args())
     9
    10 image = cv2.imread('trex.png')
    11 (B, G, R) = cv2.split(image)
    12
    13 print("Red")
    14 cv2_imshow(R)
    15 print("Green")
    16 cv2_imshow(G)
    17 print("Blue")
    18 cv2_imshow(B)
    19 cv2.waitKey(0)
    20
    21 merged = cv2.merge([B, G, R])
    22 print("Merged")
    23 cv2_imshow(merged)
    24 cv2.waitKey(0)
    25 cv2.destroyAllWindows()
```

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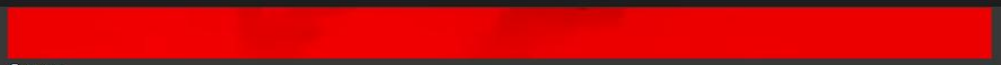
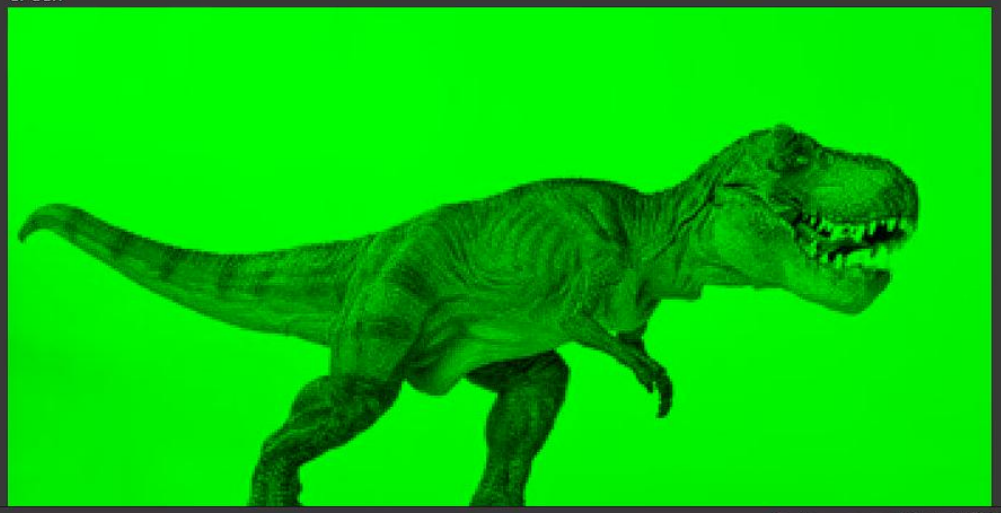
```
[10]  1 zeros = np.zeros(image.shape[:2], dtype = "uint8")
      2 print("Red")
      3 cv2_imshow(cv2.merge([zeros, zeros, R]))
      4 print("Green")
      5 cv2_imshow(cv2.merge([zeros, G, zeros]))
      6 print("Blue")
      7 cv2_imshow(cv2.merge([B, zeros, zeros]))
      8 cv2.waitKey(0)
      9
```



Green



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6.6 Color Spaces

```
1 import numpy as np
2 import argparse
3 import cv2
4
5 ap = argparse.ArgumentParser()
6 ap.add_argument("-f", "--image", required = True,
7                help = "Path to the image")
8 args = vars(ap.parse_args())
9
10 image = cv2.imread('trex.png')
11 print("Original")
12 cv2_imshow(image)
13
14 gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
15 print("Gray")
16 cv2_imshow(gray)
17
18 hsv = cv2.cvtColor(image, cv2.COLOR_BGR2HSV)
19 print("HSV")
20 cv2_imshow(hsv)
21
22 lab = cv2.cvtColor(image, cv2.COLOR_BGR2LAB)
23 print("L*a*b*")
24 cv2_imshow(lab)
25 cv2.waitKey(0)
```

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C7 Histograms

7.2 GrayScale Histograms

[12]

```
from matplotlib import pyplot as plt
import argparse
import cv2

ap = argparse.ArgumentParser()
ap.add_argument("-f", "--image", required = True,
                help = "Path to the image")
args = vars(ap.parse_args())

image = cv2.imread('trex.png')
image = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
print("Original")
cv2_imshow(image)

hist = cv2.calcHist([image], [0], None, [256], [0, 256])

plt.figure()
plt.title("Grayscale Histogram")
plt.xlabel("Bins")
plt.ylabel("# of Pixels")
plt.plot(hist)
plt.xlim([0, 256])
```

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```
17 plt.figure()
18 plt.title("Grayscale Histogram")
19 plt.xlabel("Bins")
20 plt.ylabel("# of Pixels")
21 plt.plot(hist)
22 plt.xlim([0, 256])
23 plt.show()
24 cv2.waitKey(0)
25
```

Original

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7.3 Color Histograms

```
#Code theo numpy và pandas:

from matplotlib import pyplot as plt
import numpy as np
import pandas as pd


def colorHistograms(image):
  colors = ("red", "green", "blue")
  channel_ids = (0, 1, 2)

  # create the histogram plot, with three lines, one for
  # each color
  plt.xlim([0, 256])
  for channel_id, color in zip(channel_ids, colors):
      histogram, bin_edges = np.histogram(image[:, :,
                                          channel_id],
                                          bins=256,
                                          range=(0, 256))
      draw = plt.plot(bin_edges[0:-1], histogram, color=color)
  return draw

image = cv2.imread('trex.png')
colorHistograms(image)
plt.title("Color Histogram")
plt.xlabel("Bins")
```

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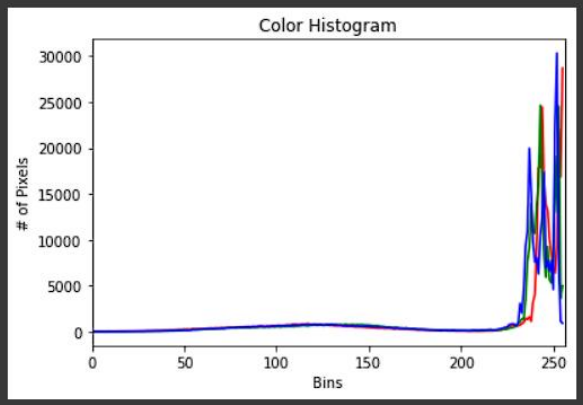
```
21   return draw
22
23 image = cv2.imread('trex.png')
24 colorHistograms(image)
25 plt.title("Color Histogram")
26 plt.xlabel("Bins")
27 plt.ylabel("# of Pixels")
28
29 plt.show()
30
31
32
```




```
[36] 1 from __future__ import print_function
     2 from matplotlib import pyplot as plt
     3 import numpy as np
```

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[36]

```
from __future__ import print_function
from matplotlib import pyplot as plt
import numpy as np
import argparse
import cv2

ap = argparse.ArgumentParser()
ap.add_argument("-f", "--image", required = True,
                help = "Path to the image")

args = vars(ap.parse_args())
image = cv2.imread('trex.png')
print("Original")
cv2_imshow(image)

chans = cv2.split(image)

colors = ("b", "g", "r")
plt.figure()
plt.title("'Flattened' Color Histogram")
plt.xlabel("Bins")
plt.ylabel("# of Pixels")

for (chan, color) in zip(chans, colors):
 hist = cv2.calcHist([chan], [0], None, [256], [0, 256])
 plt.plot(hist, color = color)
 plt.xlim([0, 256])


```

```
Original
```

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[36]

```
from __future__ import print_function
from matplotlib import pyplot as plt
import numpy as np
import argparse
import cv2

ap = argparse.ArgumentParser()
ap.add_argument("-f", "--image", required = True,
                help = "Path to the image")

args = vars(ap.parse_args())
image = cv2.imread('trex.png')
print("Original")
cv2_imshow(image)

chans = cv2.split(image)

colors = ("b", "g", "r")
plt.figure()
plt.title("'Flattened' Color Histogram")
plt.xlabel("Bins")
plt.ylabel("# of Pixels")

for (chan, color) in zip(chans, colors):
 hist = cv2.calcHist([chan], [0], None, [256], [0, 256])
 plt.plot(hist, color = color)
 plt.xlim([0, 256])


```

```
Original
```

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```
fig = plt.figure()

ax = fig.add_subplot(131)
hist = cv2.calcHist([chans[1], chans[0]], [0, 1], None,
                    [32, 32], [0, 256, 0, 256])
p = ax.imshow(hist, interpolation = "nearest")
ax.set_title("2D Color Histogram for G and B")
plt.colorbar(p)

ax = fig.add_subplot(132)
hist = cv2.calcHist([chans[1], chans[2]], [0, 1], None,
                    [32, 32], [0, 256, 0, 256])
p = ax.imshow(hist, interpolation = "nearest")
ax.set_title("2D Color Histogram for G and R")
plt.colorbar(p)

ax = fig.add_subplot(133)
hist = cv2.calcHist([chans[0], chans[2]], [0, 1], None,
                    [32, 32], [0, 256, 0, 256])
p = ax.imshow(hist, interpolation = "nearest")
ax.set_title("2D Color Histogram for B and R")
plt.colorbar(p)

print("2D histogram shape: {}, with {} values".format(
    hist.shape, hist.flatten().shape[0]))

hist = cv2.calcHist([image], [0, 1, 2],None,
                    [8, 8, 8], [0, 256, 0, 256, 0, 256])
print("3D histogram shape: {}, with {} values".format(
    hist.shape, hist.flatten().shape[0]))

plt.show()
```

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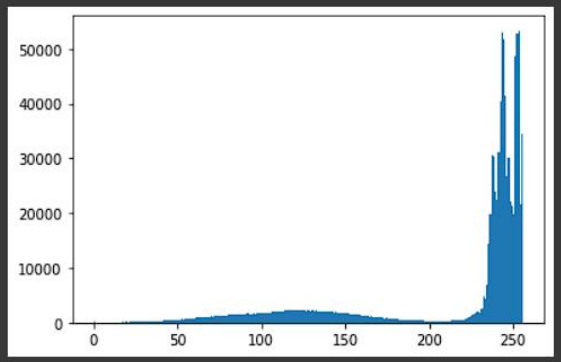
7.4 Histogram Equalization

```
1 #Code theo numpy và pandas:
2
3
4 image = cv2.imread('trex.png')
5
6 plt.hist(image.ravel(),256,[0,256])
7 plt.show()
```




```
[56] 1 import numpy as np
     2 import argparse
     3 import cv2
```

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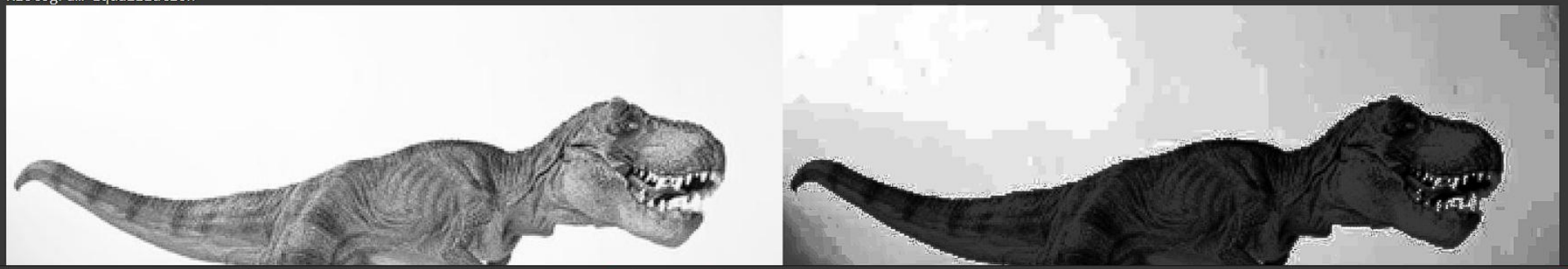
```
1 import numpy as np
2 import argparse
3 import cv2
4
5 ap = argparse.ArgumentParser()
6 ap.add_argument("-f", "--image", required = True,
7 help = "Path to the image")
8 args = vars(ap.parse_args())
9
10 image = cv2.imread('trex.png')
11 image = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
12
13 eq = cv2.equalizeHist(image)
14
15 print("Histogram Equalization")
16 cv2_imshow(np.hstack([image, eq]))
17 cv2.waitKey(0)
18
```

```
Histogram Equalization
```



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7.5 Histograms and Masks

```
from matplotlib import pyplot as plt
import numpy as np
import argparse
import cv2

def plot_histogram(image, title, mask = None):
 chans = cv2.split(image)
 colors = ("b", "g", "r")
 plt.figure()
 plt.title(title)
 plt.xlabel("Bins")
 plt.ylabel("# of Pixels")

 for (chan, color) in zip(chans, colors):
  hist = cv2.calcHist([chan], [0], mask, [256], [0, 256])
  plt.plot(hist, color = color)
  plt.xlim([0, 256])

```

[19]

```
ap = argparse.ArgumentParser()
ap.add_argument("-f", "--image", required = True,
                help = "Path to the image")
args = vars(ap.parse_args())

image = cv2.imread('trex.png')
print("Original")
cv2.imshow(image)
```

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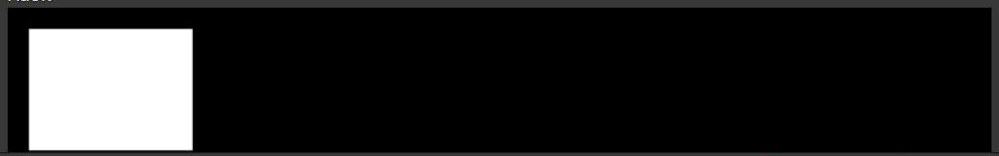
```
[18]
17  plt.xlim([0, 256])
18
```

```
1  ap = argparse.ArgumentParser()
2  ap.add_argument("-f", "--image", required = True,
3                  help = "Path to the image")
4  args = vars(ap.parse_args())
5
6  image = cv2.imread('trex.png')
7  print("Original")
8  cv2_imshow(image)
9  plot_histogram(image, "Histogram for Original Image")
10
11 mask = np.zeros(image.shape[:2], dtype = "uint8")
12 cv2.rectangle(mask, (15, 15), (130, 100), 255, -1)
13 print("Mask")
14 cv2_imshow(mask)
15
16 masked = cv2.bitwise_and(image, image, mask = mask)
17 print("Applying the Mask")
18 cv2_imshow(masked)
19
20 plot_histogram(image, "Histogram for Masked Image", mask = mask)
21 plt.show()
22
```

Mask



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