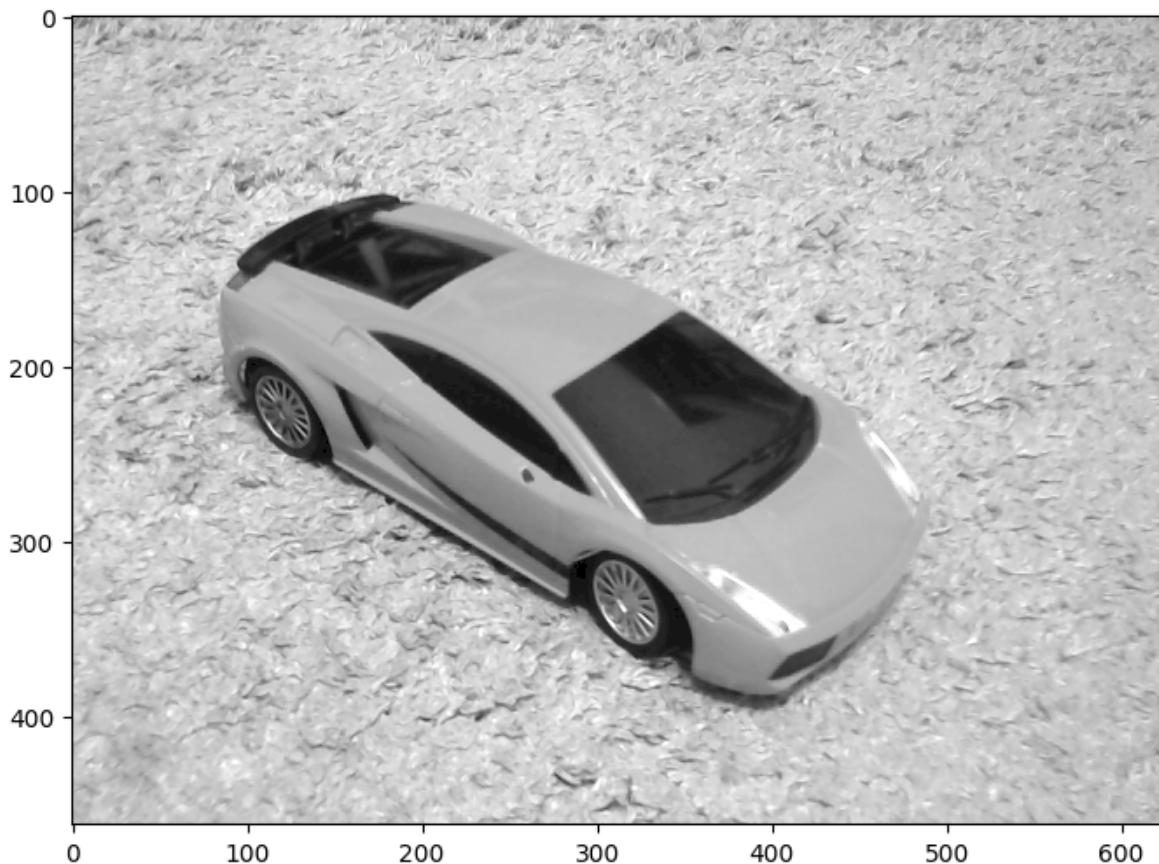


Bhavesh Waghela - N01639685

```
In [1]: import numpy as np
import cv2
import matplotlib.pyplot as plt
# from matplotlib import style
# style.use('dark_background')
```

```
In [4]: img1 = cv2.imread('/content/drive/MyDrive/Image Processing Humber/Car.png', 0)
```

```
In [5]: plt.figure(figsize=(12,6))
plt.imshow(img1, cmap = 'gray')
plt.show()
```



```
In [6]: #Image output is a 2D complex array. 1st channel is real and 2nd imaginary. Fo
#the input image needs to be converted to float32 and the output will be compl
#the magnitude out of this Complex number.
```

```
dft = cv2.dft(np.float32(img1),flags = cv2.DFT_COMPLEX_OUTPUT)
```

```
In [7]: dft.shape
```

```
Out[7]: (462, 623, 2)
```

In [8]: *# Rearranges a Fourier transform by shifting the zero-frequency component to the top left corner of the image (array).*

```
dft_shift1 = np.fft.fftshift(dft)
```

In [9]: dft_shift1.dtype

Out[9]: dtype('float32')

In [10]: *#The magnitude of the function is 20. log(abs(f)), For values that are 0 we make them small. So we can add 1 to the array to avoid seeing a warning. dft_shift[:, :, 0] will be the zero-frequency component.*

```
magnitude_spectrum1 = 20*np.log(cv2.magnitude(dft_shift1[:, :, 0], dft_shift1[:, :, 1])) + 1
```

In [11]: magnitude_spectrum1.shape

Out[11]: (462, 623)

In [12]: magnitude_spectrum1.dtype

Out[12]: dtype('float32')

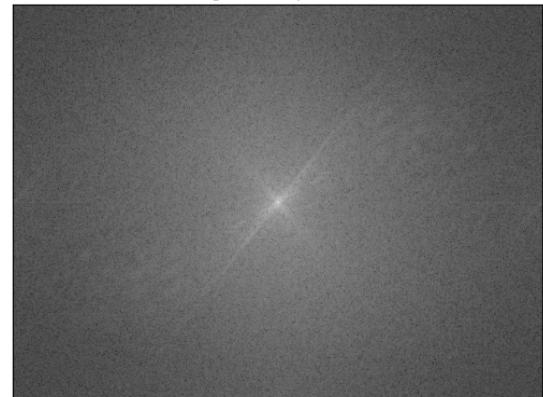
In [13]: *# visualize input image and the magnitude spectrum*

```
plt.figure(figsize = (14,7))
plt.subplot(121)
plt.imshow(img1, cmap = 'gray')
plt.title('Input Image')
plt.xticks([])
plt.yticks([])
plt.subplot(122)
plt.imshow(magnitude_spectrum1, cmap = 'gray')
plt.title('Magnitude Spectrum')
plt.xticks([])
plt.yticks([])
plt.show()
```

Input Image



Magnitude Spectrum



LOW PASS FILTER

```
In [75]: def low_pass_filter(image, radious):
    image_to_mask = image
    rows, cols = image_to_mask.shape
    crow, ccol = rows//2 , cols//2      # center

    # create a mask first, center square is 1, remaining all zeros
    mask = np.zeros((rows, cols, 2), np.float32)

    #Note that the the mask.shape is (rows, cols, 2) which matches the returned
    r = radious
    center = [crow, ccol]
    x, y = np.ogrid[:rows, :cols]
    mask_area = (x - center[0]) ** 2 + (y - center[1]) ** 2 <= r*r
    mask[mask_area] = 1

    mask_to_plot = cv2.magnitude(mask[:, :, 0] ,mask[:, :, 1])

    plt.imshow(mask_to_plot, cmap = 'gray')
    plt.show()

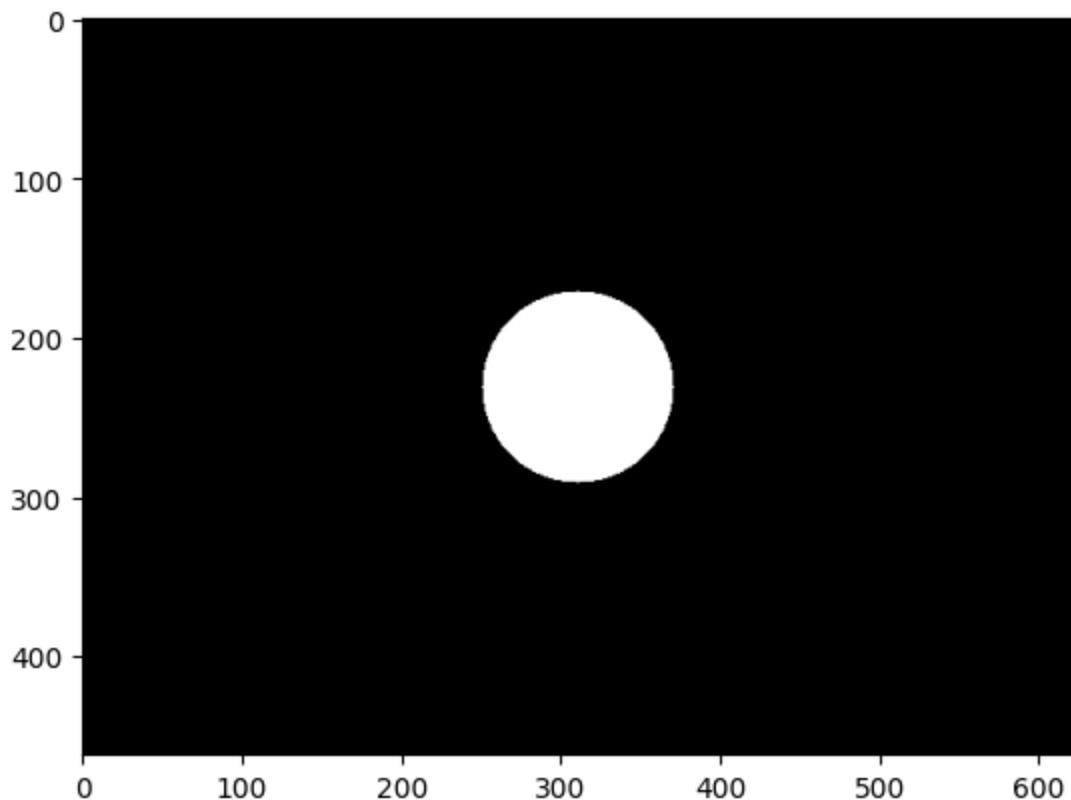
    dft_image = cv2.dft(np.float32(image_to_mask),flags = cv2.DFT_COMPLEX_OUTPUT
    dft_shift1_image = np.fft.fftshift(dft_image)

    # apply mask and inverse DFT
    fshift = dft_shift1_image * mask
    f_ishift = np.fft.ifftshift(fshift)
    img_back = cv2.idft(f_ishift)
    img_back_image = cv2.magnitude(img_back[:, :, 0],img_back[:, :, 1])

    return img_back_image
```

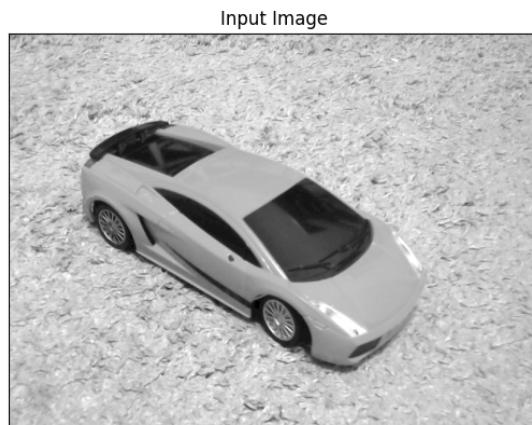
```
In [82]: car = cv2.imread('/content/drive/MyDrive/Image Processing Humber/Car.png', 0)

masked_car = low_pass_filter(car, 60)
```



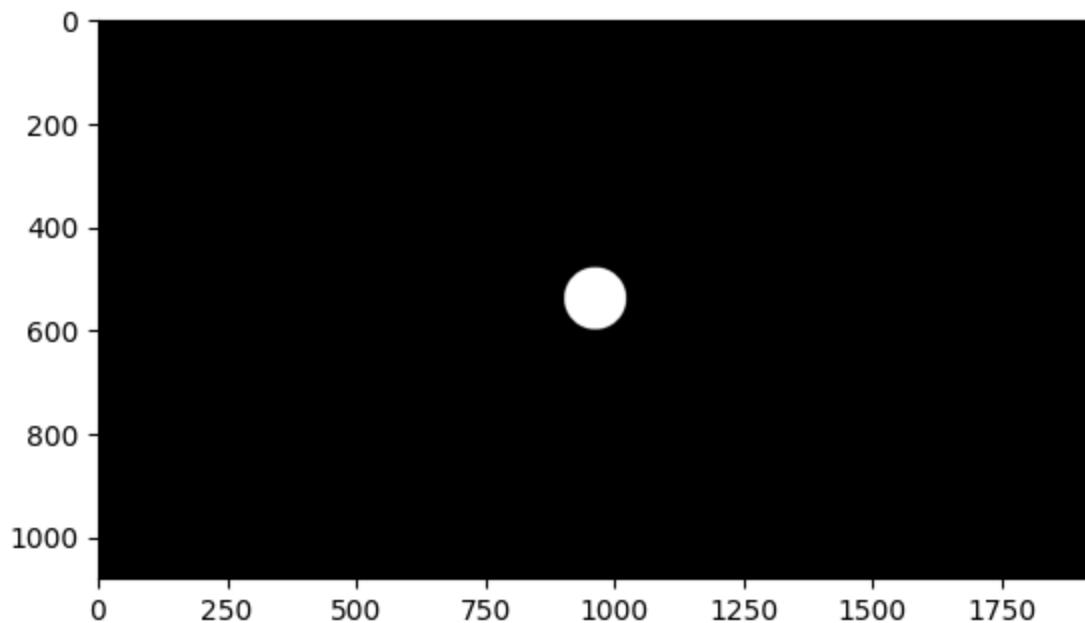
```
In [83]: plt.figure(figsize = (14,7))
plt.subplot(121)
plt.imshow(car, cmap = 'gray')
plt.title('Input Image')
plt.xticks([])
plt.yticks([])

plt.subplot(122)
plt.imshow(masked_car, cmap = 'gray')
plt.title('Low Pass Filtered Image')
plt.xticks([])
plt.yticks([])
plt.show()
```



```
In [84]: bus = cv2.imread('/content/drive/MyDrive/Image Processing Humber/SchoolBus.png')

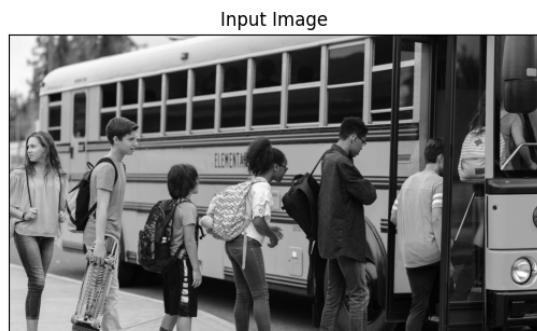
masked_bus = low_pass_filter(bus,60)
```



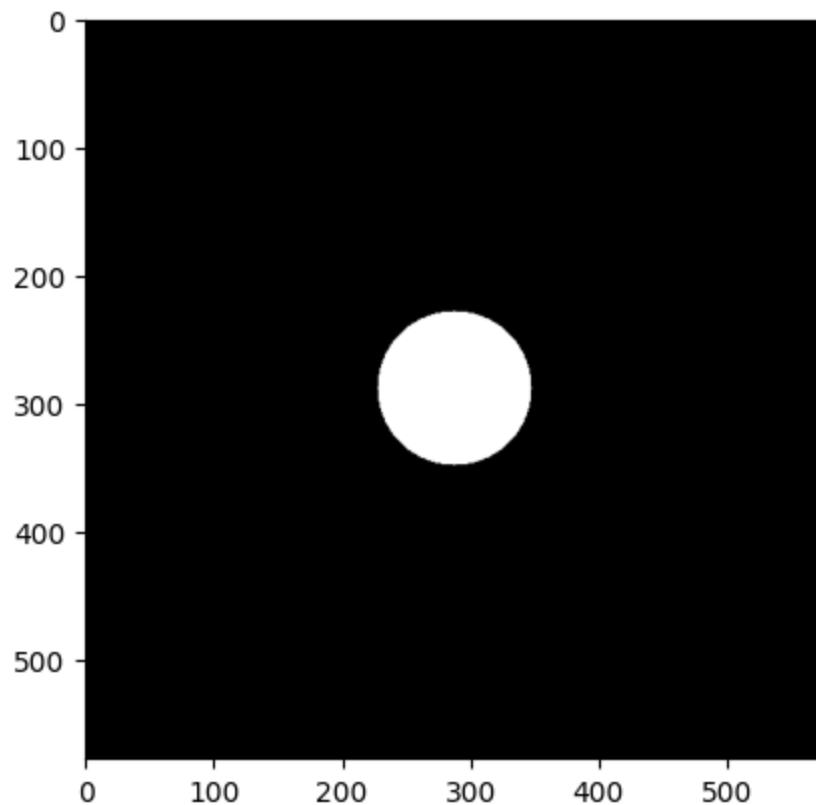
```
In [85]: plt.figure(figsize = (14,7))
plt.subplot(121)
plt.imshow(bus, cmap = 'gray')
plt.title('Input Image')
plt.xticks([])
plt.yticks([])

plt.subplot(122)
plt.imshow(masked_bus, cmap = 'gray')
plt.title('Low Pass Filtered Image')
plt.xticks([])
plt.yticks([])

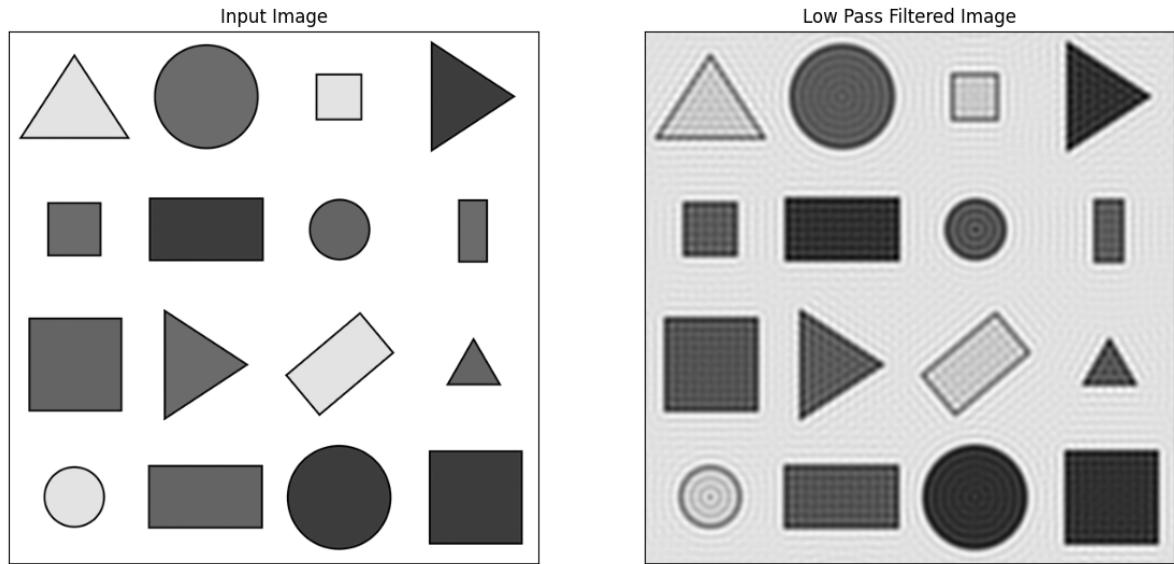
plt.show()
```



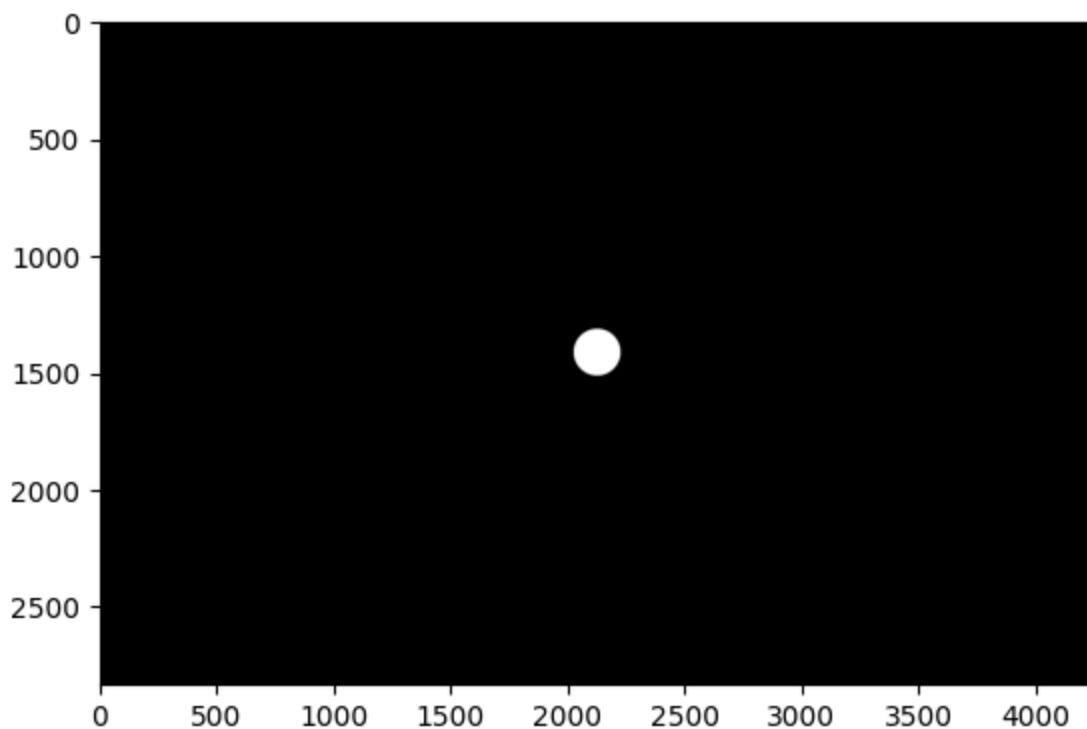
```
In [86]: shapes = cv2.imread('/content/drive/MyDrive/Image Processing Humber/Geometrica  
masked_shapes = low_pass_filter(shapes, 60)
```



```
In [87]: plt.figure(figsize = (14,7))
plt.subplot(121)
plt.imshow(shapes, cmap = 'gray')
plt.title('Input Image')
plt.xticks([])
plt.yticks([])
plt.subplot(122)
plt.imshow(masked_shapes, cmap = 'gray')
plt.title('Low Pass Filtered Image')
plt.xticks([])
plt.yticks([])
plt.show()
```



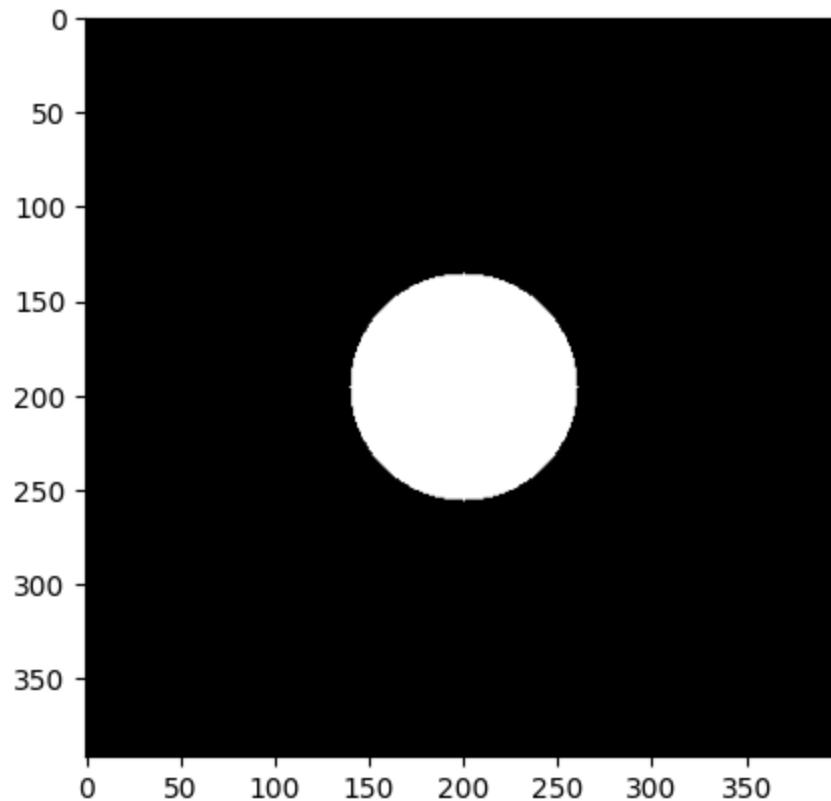
```
In [88]: workers = cv2.imread('/content/drive/MyDrive/Image Processing Humber/Workers.jpg')
masked_workers = low_pass_filter(workers, 100)
```



```
In [89]: plt.figure(figsize = (14,7))
plt.subplot(121)
plt.imshow(workers, cmap = 'gray')
plt.title('Input Image')
plt.xticks([])
plt.yticks([])
plt.subplot(122)
plt.imshow(masked_workers, cmap = 'gray')
plt.title('Low Pass Filtered Image')
plt.xticks([])
plt.yticks([])
plt.show()
```



```
In [158]: txt_img = cv2.imread('/content/drive/MyDrive/Image Processing Humber/Text.png'  
masked_txt_img = low_pass_filter(txt_img, 60)
```



```
In [159]: plt.figure(figsize = (14,7))
plt.subplot(121)
plt.imshow(txt_img, cmap = 'gray')
plt.title('Input Image')
plt.xticks([])
plt.yticks([])
plt.subplot(122)
plt.imshow(masked_txt_img, cmap = 'gray')
plt.title('Low Pass Filtered Image')
plt.xticks([])
plt.yticks([])
plt.show()
```

Input Image

that Newport Street and Oxford Street, passing as they do through your fine Victoria Square, and running in connection with a most important thoroughfare like Knowsley Street at one end and finished with a fine architectural ornament like Holy Trinity Church at the other, ought to have developed into the great shopping street instead of Bradshawgate. As soon, however, as I took my investigations a little further afield I discovered how this was, and that it was because, while Bradshawgate is in every sense of the word a thoroughfare, reaching practically in one direction to Manchester, Newport Street and Oxford Street are closed to all practical purposes, at one end by the rather exceptional school buildings at the top of Bath Street, shown in the accompanying photograph (Slide No. 13), and by the fact that it has no direct outlet to the south at its other end which would convert Moncrieffe Street into what

Low Pass Filtered Image

that Newport Street and Oxford Street, passing as they do through your fine Victoria Square, and running in connection with a most important thoroughfare like Knowsley Street at one end and finished with a fine architectural ornament like Holy Trinity Church at the other, ought to have developed into the great shopping street instead of Bradshawgate. As soon, however, as I took my investigations a little further afield I discovered how this was, and that it was because, while Bradshawgate is in every sense of the word a thoroughfare, reaching practically in one direction to Manchester, Newport Street and Oxford Street are closed to all practical purposes, at one end by the rather exceptional school buildings at the top of Bath Street, shown in the accompanying photograph (Slide No. 13), and by the fact that it has no direct outlet to the south at its other end which would convert Moncrieffe Street into what

HIGH PASS FILTER

```
In [90]: def high_pass_filter(image, radious):
    image_to_mask = image
    rows, cols = image_to_mask.shape
    crow, ccol = rows//2 , cols//2      # center

    # create a mask first, center square is 1, remaining all zeros
    mask = np.ones((rows, cols, 2), np.float32)

    #Note that the the mask.shape is (rows, cols, 2) which matches the returned
    r = radious
    center = [crow, ccol]
    x, y = np.ogrid[:rows, :cols]
    mask_area = (x - center[0]) ** 2 + (y - center[1]) ** 2 <= r*r
    mask[mask_area] = 0

    mask_to_plot = cv2.magnitude(mask[:, :, 0] ,mask[:, :, 1])

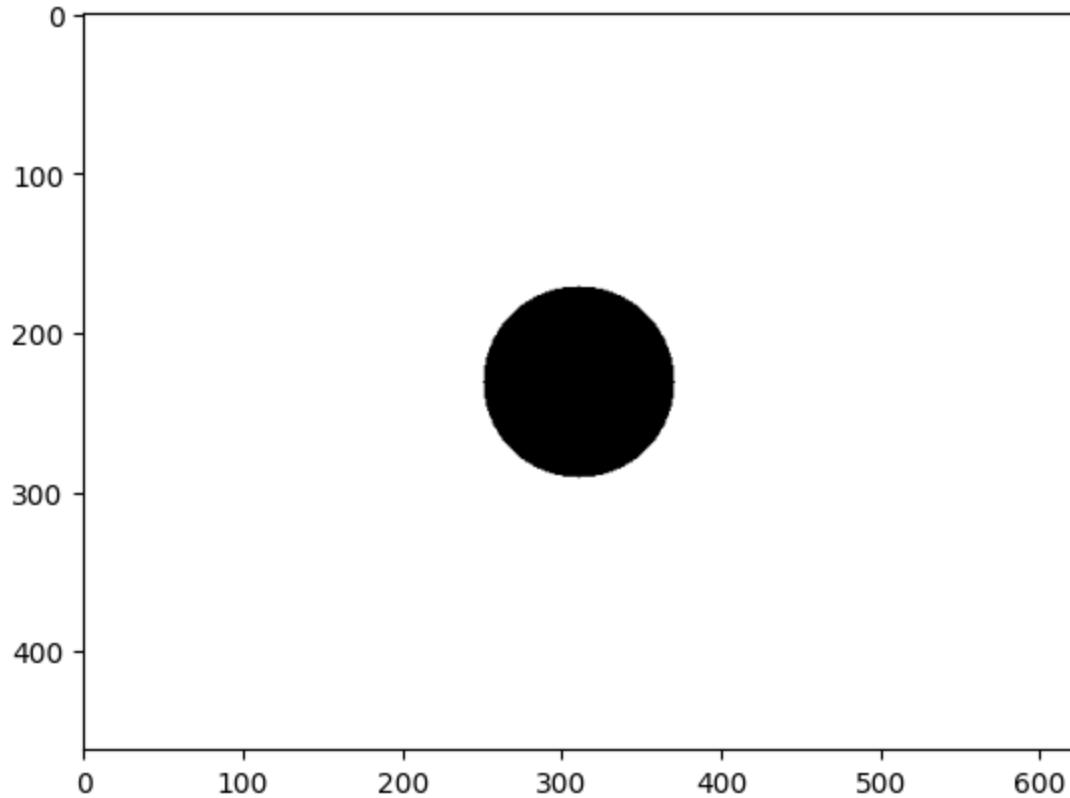
    plt.imshow(mask_to_plot, cmap = 'gray')
    plt.show()

    dft_image = cv2.dft(np.float32(image_to_mask),flags = cv2.DFT_COMPLEX_OUTPUT
    dft_shift1_image = np.fft.fftshift(dft_image)

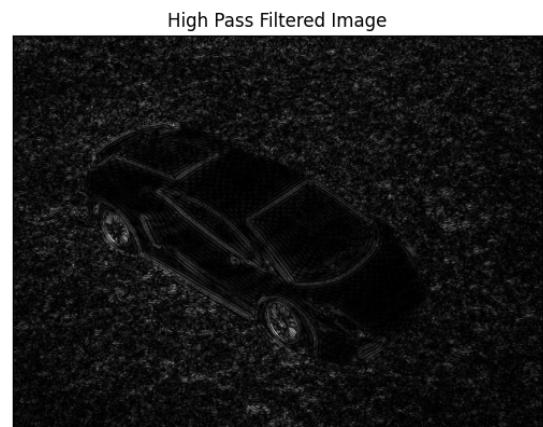
    # apply mask and inverse DFT
    fshift = dft_shift1_image * mask
    f_ishift = np.fft.ifftshift(fshift)
    img_back = cv2.idft(f_ishift)
    img_back_image = cv2.magnitude(img_back[:, :, 0],img_back[:, :, 1])

    return img_back_image
```

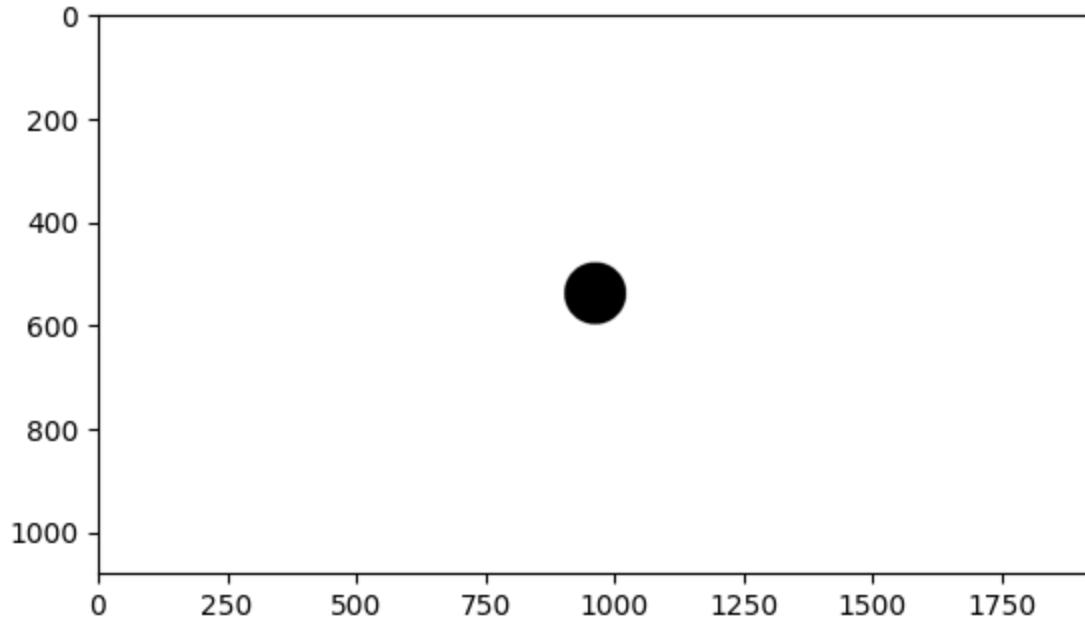
```
In [91]: high_masked_car = high_pass_filter(car, 60)
```



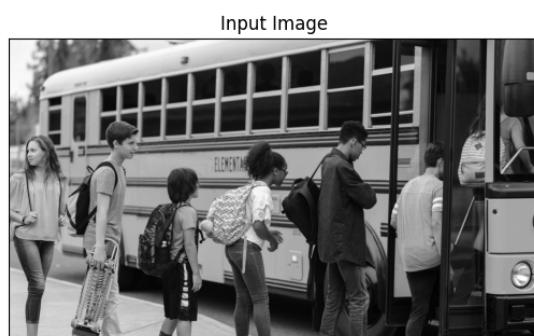
```
In [166]: plt.figure(figsize = (14,7))
plt.subplot(121)
plt.imshow(car, cmap = 'gray')
plt.title('Input Image')
plt.xticks([])
plt.yticks([])
plt.subplot(122)
plt.imshow(high_masked_car, cmap = 'gray')
plt.title('High Pass Filtered Image')
plt.xticks([])
plt.yticks([])
plt.show()
```



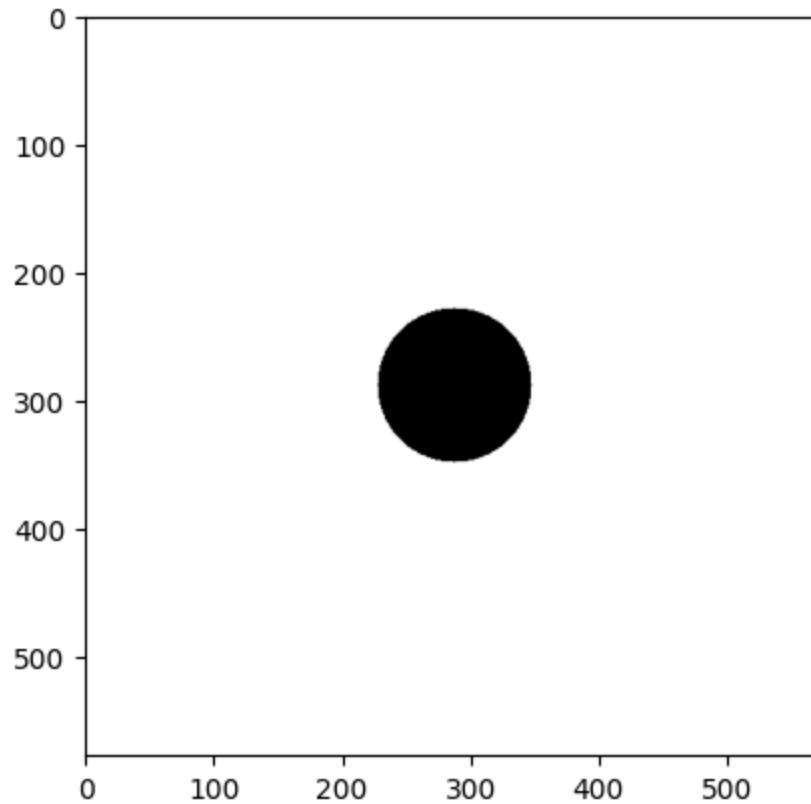
```
In [93]: high_masked_bus = high_pass_filter(bus, 60)
```



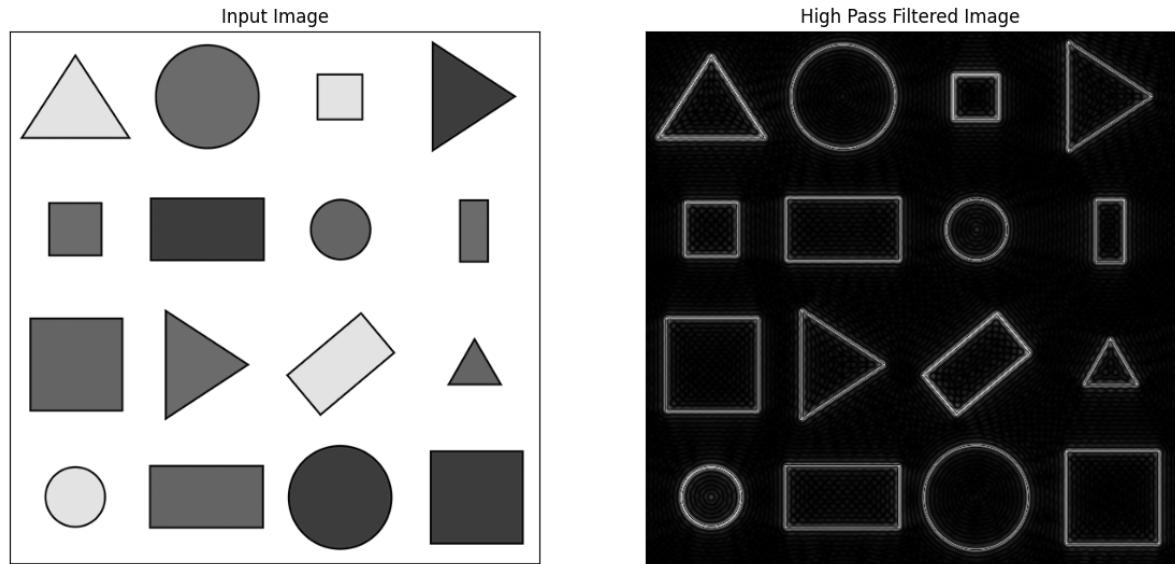
```
In [165]: plt.figure(figsize = (14,7))
plt.subplot(121)
plt.imshow(bus, cmap = 'gray')
plt.title('Input Image')
plt.xticks([])
plt.yticks([])
plt.subplot(122)
plt.imshow(high_masked_bus, cmap = 'gray')
plt.title('High Pass Filtered Image')
plt.xticks([])
plt.yticks([])
plt.show()
```



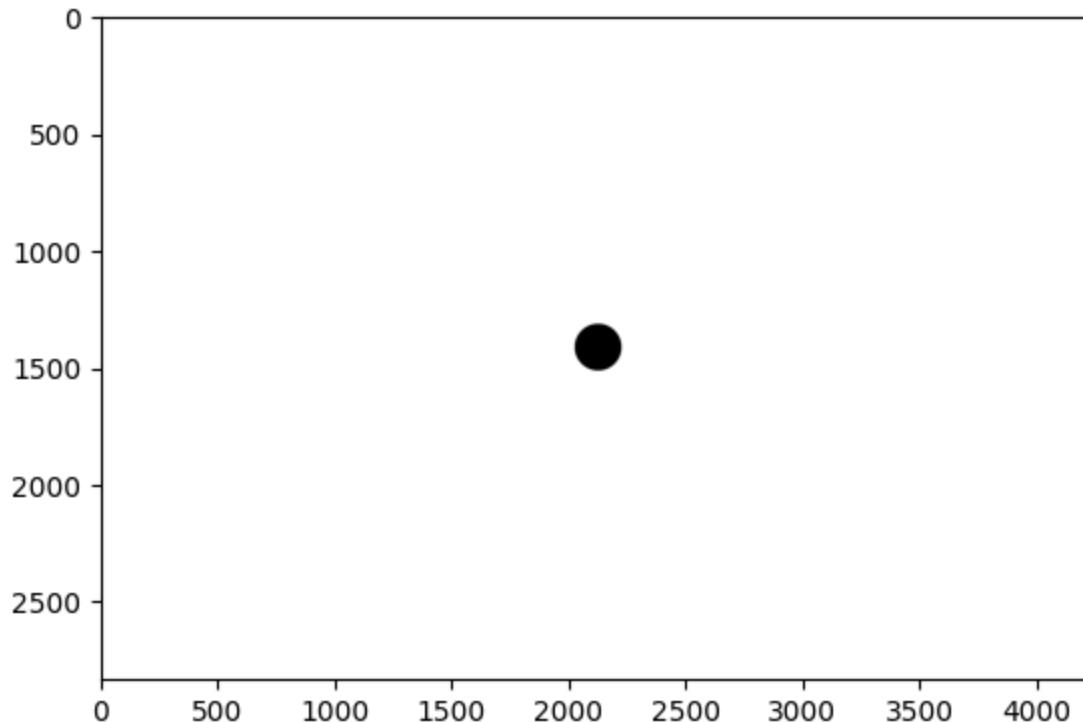
```
In [96]: high_masked_shapes = high_pass_filter(shapes, 60)
```



```
In [164]: plt.figure(figsize = (14,7))
plt.subplot(121)
plt.imshow(shapes, cmap = 'gray')
plt.title('Input Image')
plt.xticks([])
plt.yticks([])
plt.subplot(122)
plt.imshow(high_masked_shapes, cmap = 'gray')
plt.title('High Pass Filtered Image')
plt.xticks([])
plt.yticks([])
plt.show()
```



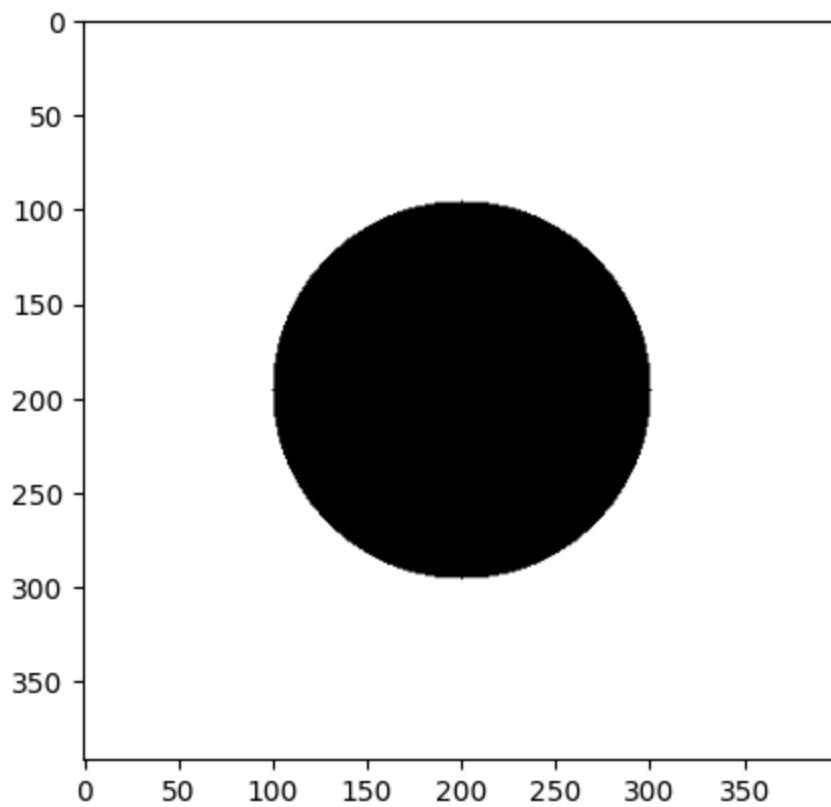
```
In [101]: high_masked_workers = high_pass_filter(workers, 100)
```



```
In [163]: plt.figure(figsize = (14,7))
plt.subplot(121)
plt.imshow(workers, cmap = 'gray')
plt.title('Input Image')
plt.xticks([])
plt.yticks([])
plt.subplot(122)
plt.imshow(high_masked_workers, cmap = 'gray')
plt.title('High Pass Filtered Image')
plt.xticks([])
plt.yticks([])
plt.show()
```



```
In [160]: high_masked_txt_img = high_pass_filter(txt_img, 100)
```



```
In [162]: plt.figure(figsize = (14,7))
plt.subplot(121)
plt.imshow(txt_img, cmap = 'gray')
plt.title('Input Image')
plt.xticks([])
plt.yticks([])
plt.subplot(122)
plt.imshow(high_masked_txt_img, cmap = 'gray')
plt.title('High Pass Filtered Image')
plt.xticks([])
plt.yticks([])
plt.show()
```

Input Image

that Newport Street and Oxford Street, passing as they do through your fine Victoria Square, and running in connection with a most important thoroughfare like Knowsley Street at one end and finished with a fine architectural ornament like Holy Trinity Church at the other, ought to have developed into the great shopping street instead of Bradshawgate. As soon, however, as I took my investigations a little further afield I discovered how this was, and that it was because, while Bradshawgate is in every sense of the word a thoroughfare, reaching practically in one direction to Manchester, Newport Street and Oxford Street are closed to all practical purposes, at one end by the rather exceptional school buildings at the top of Bath Street, shown in the accompanying photograph (Slide No. 18), and by the fact that it has no direct outlet to the south at its other end which would convert Moncrieffe Street into what

High Pass Filtered Image

that Newport Street and Oxford Street, passing as they do through your fine Victoria Square, and running in connection with a most important thoroughfare like Knowsley Street at one end and finished with a fine architectural ornament like Holy Trinity Church at the other, ought to have developed into the great shopping street instead of Bradshawgate. As soon, however, as I took my investigations a little further afield I discovered how this was, and that it was because, while Bradshawgate is in every sense of the word a thoroughfare, reaching practically in one direction to Manchester, Newport Street and Oxford Street are closed to all practical purposes, at one end by the rather exceptional school buildings at the top of Bath Street, shown in the accompanying photograph (Slide No. 18), and by the fact that it has no direct outlet to the south at its other end which would convert Moncrieffe Street into what

Thresholding to improve the visibility of the text image.

```
In [106]: txt_img = cv2.imread('/content/drive/MyDrive/Image Processing Humber/Text.png')
```

In [107]: txt_img

Out[107]: ndarray (392, 400, 3) show data

that Newport Street and Oxford Street, passing as they do through your fine Victoria Square, and running in connection with a most important thoroughfare like Knowsley Street at one end and finished with a fine architectural ornament like Holy Trinity Church at the other, ought to have developed into the great shopping street instead of Bradshawgate. As soon, however, as I took my investigations a little further afield I discovered how this was, and that it was because, while Bradshawgate is in every sense of the word a thoroughfare, reaching practically in one direction to Manchester, Newport Street and Oxford Street are closed to all practical purposes, at one end by the rather exceptional school buildings at the top of Bath Street, shown in the accompanying photograph (Slide No. 13), and by the fact that it has no direct outlet to the south at its other end which would convert Moncrieffe Street into what

```
array([[[255, 255, 255],  
        [255, 255, 255],  
        [255, 255, 255],  
        ...,  
        [255, 255, 255],  
        [255, 255, 255],  
        [255, 255, 255]],  
  
      [[255, 255, 255],  
       [255, 255, 255],  
       [255, 255, 255],  
       ...,  
       [255, 255, 255],  
       [255, 255, 255],  
       [255, 255, 255]],  
  
      [[255, 255, 255],  
       [255, 255, 255],  
       [255, 255, 255],  
       ...,  
       [255, 255, 255],  
       [255, 255, 255],  
       [255, 255, 255]],  
  
      ...,  
  
      [[255, 255, 255],  
       [255, 255, 255],  
       [255, 255, 255],  
       ...,  
       [250, 250, 250],  
       [251, 251, 251],  
       [252, 252, 252]],  
  
      [[254, 254, 254],  
       [254, 254, 254],  
       [255, 255, 255],  
       ...,  
       [251, 251, 251],  
       [252, 252, 252],  
       [253, 253, 253]],  
  
      [[253, 253, 253],  
       [254, 254, 254],  
       [255, 255, 255],  
       ...,  
       [251, 251, 251]],
```

```
[253, 253, 253],  
[254, 254, 254]]], dtype=uint8)
```

```
In [170]: from google.colab.patches import cv2_imshow  
# applying different thresholding  
# techniques on the input image  
# all pixels value above 120 will  
# be set to 255  
ret, thresh1 = cv2.threshold(img, 195, 255, cv2.THRESH_BINARY)  
ret, thresh2 = cv2.threshold(img, 190, 255, cv2.THRESH_BINARY_INV)  
ret, thresh3 = cv2.threshold(img, 200, 255, cv2.THRESH_TRUNC)  
ret, thresh4 = cv2.threshold(img, 180, 255, cv2.THRESH_TOZERO)  
ret, thresh5 = cv2.threshold(img, 180, 255, cv2.THRESH_TOZERO_INV)  
  
# the window showing output images  
# with the corresponding thresholding  
# techniques applied to the input images  
print('Binary Threshold')  
cv2_imshow(thresh1)  
print('Binary Threshold Inverted')  
cv2_imshow(thresh2)  
print('Truncated Threshold')  
cv2_imshow(thresh3)  
print('Set to 0')  
cv2_imshow(thresh4)  
print('Set to 0 Inverted')  
cv2_imshow(thresh5)  
  
# De-allocate any associated memory usage  
if cv2.waitKey(0) & 0xff == 27:  
    cv2.destroyAllWindows()
```

Binary Threshold

that Newport Street and Oxford Street, passing as they do through your fine Victoria Square, and running in connection with a most important thoroughfare like Knowsley Street at one end and finished with a fine architectural ornament like Holy Trinity Church at the other, ought to have developed into the great shopping street instead of Bradshawgate. As soon, however, as I took my investigations a little further afield I discovered how this was, and that it was because, while Bradshawgate is in every sense of the word a thoroughfare, reaching practically in one direction to Manchester, Newport Street and Oxford Street are closed to all practical purposes, at one end by the rather exceptional school buildings at

```
In [153]:
```

