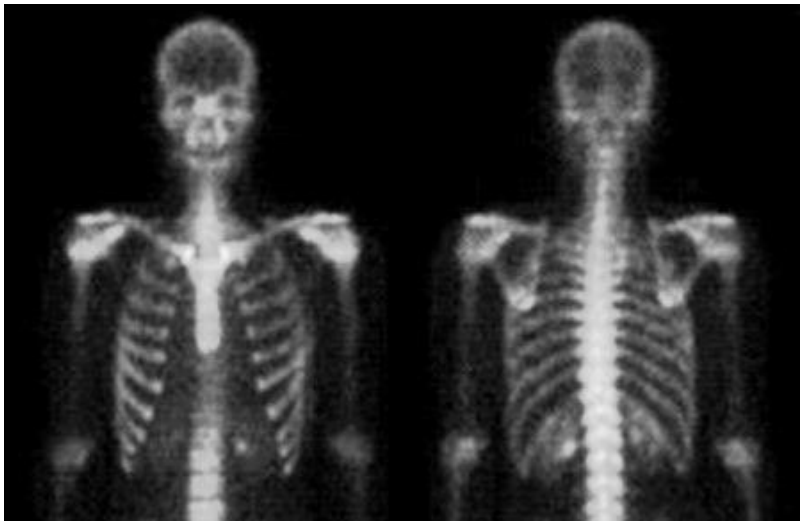
Assignment 1 - Enhancement of Skeleton Image

Starting:

```
import cv2
import numpy as np

# Open the image.
img = cv2.cvtColor(cv2.imread("xraycropped.jpg"), cv2.COLOR_BGR2GRAY)

# Function to map each intensity level to output intensity level.
def pixelVal(pix, r1, s1, r2, s2):
  if (0 <= pix and pix <= r1):
    return (s1 / r1)*pix
  elif (r1 < pix and pix <= r2):
    return ((s2 - s1)/(r2 - r1)) * (pix - r1) + s1
  else:
    return ((255 - s2)/(255 - r2)) * (pix - r2) + s2

# Define parameters.
r1 = 1
s1 = 0
r2 = 100
s2 = 190

# Vectorize the function to apply it to each value in the Numpy array.
pixelVal_vec = np.vectorize(pixelVal)

# Apply contrast stretching.
contrast_stretched = pixelVal_vec(img, r1, s1, r2, s2)

# Apply Power Law Transformation
gamma_corrected = np.array(
  255*(contrast_stretched / 255) ** 0.7, dtype='uint8')

cv2.imshow('Ater Contrast Correction', gamma_corrected)
cv2.imwrite("gamma_corrected.jpg",gamma_corrected)
cv2.waitKey(0)
```

After applying Piecewise-contrast stretch:



After applying Power Law Transformation:

Applying a Smoothing Box filter of 3x3

Code:

```
#Libraries Used
import cv2
from PIL import Image
import numpy as np
from google.colab.patches import cv2_imshow

im=cv2.imread("/content/gamma_corrected.jpg")
im=cv2.cvtColor(im, cv2.COLOR_BGR2GRAY)
cv2_imshow(im)

resolution=im.shape
im=np.array(im)
new_image=np.array(im)

#Code adds replication rows and columns to the image on the borders
#Should be added according to the filter used
#Adding Rows
#At Front
im= np.concatenate([[im[0]],im],axis=0)
#At End
im=np.concatenate([im,[im[resolution[0]-1]]],axis=0)
#At Front
im=np.transpose(im)
im=np.concatenate([[im[0]],im],axis=0)
#At End
im=np.concatenate([im,[im[resolution[0]-1]]],axis=0)
im=np.transpose(im)
#---------------------------------------------------------------
resolution=im.shape
print("Resolution:",resolution)

for x in range(1,resolution[0]-2):
 for y in range(1,resolution[1]-2):
  new_image[x][y]=im[x][y]
```

```
#Smoothing Average Filter
#5x5 Kernal
sum = 0
for x in range(1,resolution[0]-2):
for y in range(1,resolution[1]-2):
 for i in range(x-1,x+2): #change the values of in this case 1,2 according to the filter (3x3)
  for j in range(y-1,y+2):#change the values of in this case 1,2 according to the filter (3x3)
    sum= sum+int(im[i][j]) #looping to calculating sum of filter
 new_image[x][y]=(sum/9) #new resultant image intensities are assigned
 sum=0 #reinitializing the sum variable
#Display Message Prompt
print("Image Processed...Successfully.")
print("")
cv2.imwrite("Smooth.jpg",new_image)
new_image=cv2.imread("/content/Smooth.jpg")
cv2_imshow(new_image)
```

Findings:

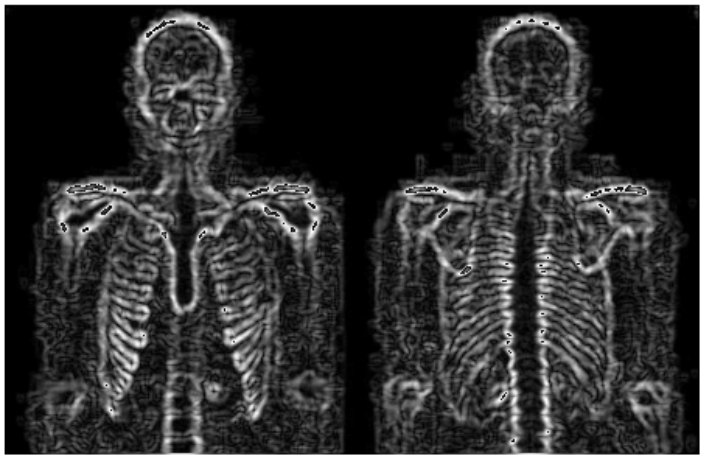
By increasing the size of the filter, the image gets blurred.

As the filter size increases the image gets more and more blurred.

Why?

As the size of the box filter increases more intensities are weighted to form the resultant intensity pixel. Hence, the details of the image are lost with the use of a filter that has a larger NxN size.

Applying Sharpening Filters (Sobet Operator) and getting edges



Code:

```
#Sobet Operator
im=cv2.imread("/content/Smooth.jpg")

#Converting to 2dlist
original_image= np.array(im)
new_image=np.array(im)

resolution=im.shape
print("Resolution:",resolution)

hsum = 0
vsum = 0
sum = 0
for x in range(1,resolution[0]-1):
for y in range(1,resolution[1]-1):
 #Horizantal edges
 for i in range(x-1,x+2): #change the values of in this case 1,2 according to the filter (3x3)
  if (i==(x-1)):
   hsum = hsum -
(int((original_image[i][y-1])[0])+2*(int((original_image[i][y])[0]))+int((original_image[i][y+1])[0]))
  elif (i==(x+1)):
   hsum = hsum +
int((original_image[i][y-1])[0])+2*(int((original_image[i][y])[0]))+int((original_image[i][y+1])[0])
```

```
 #Vertical Edges
 for j in range(x-1,x+2):
  vsum = vsum + -1*(int((original_image[i][y-1])[0])) + int((original_image[i][y+1])[0])
 sum = abs(abs(vsum)+abs(hsum))
 new_image[x][y]=original_image[x][y]-sum #new resultant image intensities are assigned
 hsum=0 #reintializing the sum variable
 vsum=0 #reintializing the sum variable

#Display Message Prompt
print("Image Processed...Successfully.")
print("")
kernel = np.array([[0, 0, 0],
            [-1, 3,-1],
            [0,0,0]])

new_image = cv2.filter2D(src=im, ddepth=-1, kernel=kernel)
#new_image=cv2.cvtColor(im, cv2.COLOR_BGR2GRAY)
cv2.imwrite("Sobet.jpg",new_image)
```

Adding Edge Values to Smoothed Image

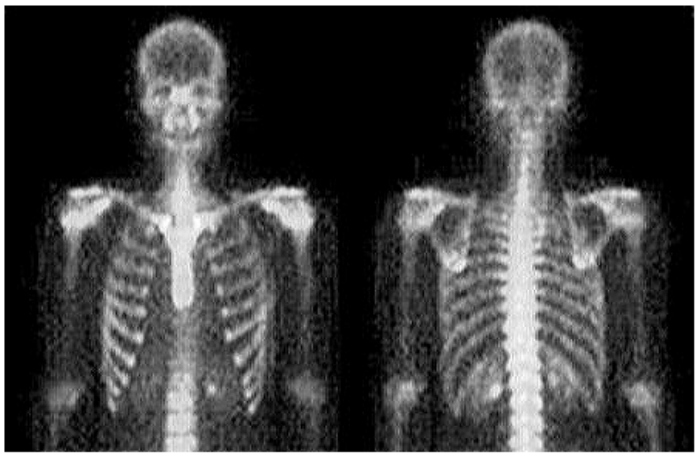
Code:

```
#Laplacian Filter
im=cv2.imread("/content/Sobet.jpg")

kernel = np.array([[0,-1,0],
            [-1,5,-1],
```

```
        [0,-1,0]])

new_image = cv2.filter2D(src=im, ddepth=-1, kernel=kernel)
cv2.imwrite("Sharp_LF.jpg",new_image)
```

Applying Laplacian Filter (Edges)

Final Laplacian Image (Sharped)

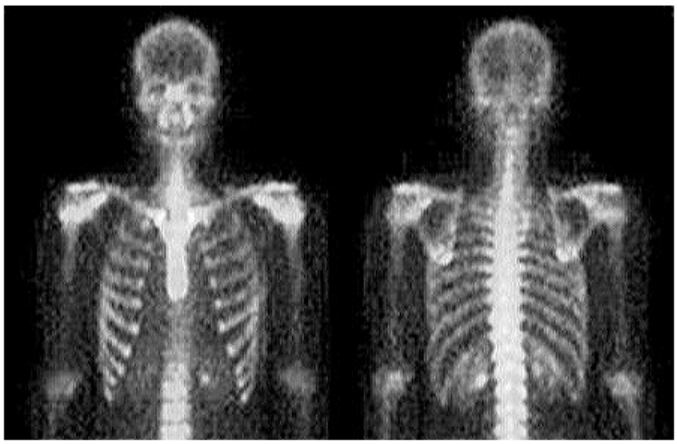


Added Median Filter to Remove Noise in the Picture

Noise Removed Picture

Code :

```
#median Filter
import cv2
import numpy as np
from skimage.util import random_noise
from scipy import ndimage
img = cv2.imread("Sharp_LF.jpg")
grayscale = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
noise_img = random_noise(grayscale, mode='gaussian')
noise_img = np.array(255*noise_img, dtype = 'uint8')
im1 = ndimage.filters.median_filter(noise_img, size = (5,5))
cv2.imshow('original ',img)
cv2.imshow('Median image', im1)
cv2.imwrite('noiseremoved.jpg', im1)

cv2.waitKey(0)
```



Interpolated Original Picture For Clear View

Interpolated Image

Code :

```
import cv2
```

```
import numpy as np

img = cv2.imread('noiseremoved.jpg')
bilinear_img = cv2.resize(img,None, fx = 10, fy = 10, interpolation = cv2.INTER_LINEAR)
cv2.imshow('original ',img)
cv2.imshow('BiLinear Image', bilinear_img)
cv2.imwrite('interpolated.jpg', bilinear_img)
```

End
