DIP Lab 2

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1. Proj03-01 - Image Enhancement Using Intensity Transformations (30%)

- **Explanation:**
  - Change class of input image to double before processing, and scale back to 0~255 to obtain grey-scale image.
  - c is a constant given by user. In this report, c is fixed as 1.

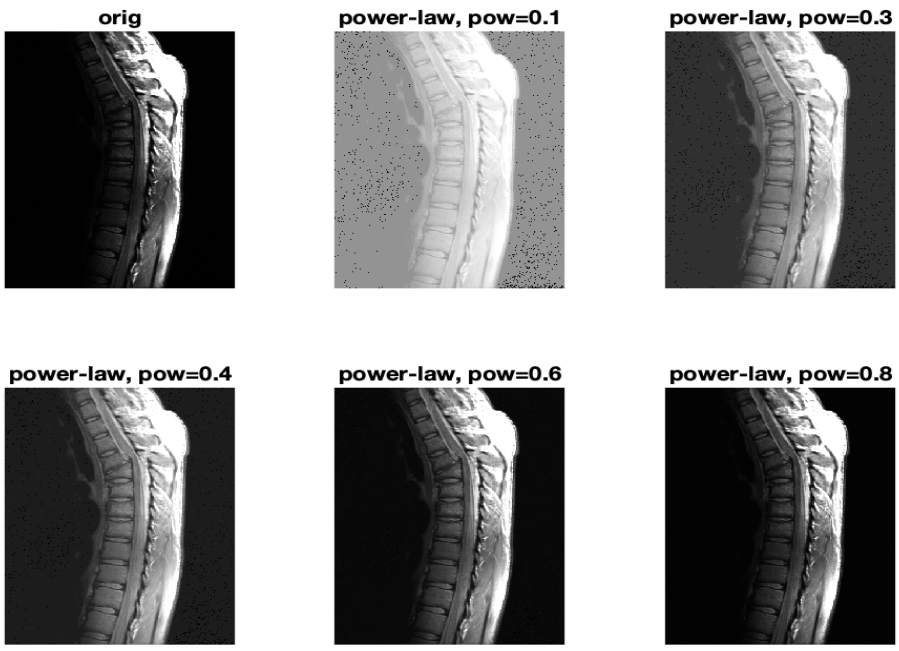
```
% Log transformation:

% Log in matlab is natural log (base e)
img_new = c * log(1+double(img_orig));
% Scale the new image to 0~255
img_new = uint8(255 * mat2gray(img_new));


% Power-law transformation:

img_new = c * double(img_orig).^pow;
img_new = uint8(255 * mat2gray(img_new));
```

- **Result:**



- **Comparison:**

  Log transformation enhance the intensity of low-level values, while the high-level values are compressed. The result is as predicted, for the fraction of the spine shown in low-level values can be seen clearly after the transformation.

  In power-law transformation, if the power of the equation > 1, it maps high-level values to a wider range, clearify the bright parts of the image; if the power < 1, it maps low-level values to a wider range, clearify the dark parts of the image. For this input image, we want to clearify the dark parts to see the fraction of the spine. Hence, **we tried power=0.1, 0.3, 0.4, 0.6, 0.8** to see which obtains the best result. For this case, **pow=0.4 seems the best**.

  We use **c=1** for both results to maintain consistency. The curves of both intensity transformation functions (pow=0.4 for power-law transformation) seem similar, so the output result images are also similar. The higher-level values of log transformation seems to be compressed more.

2. Proj03-02 – Histogram Equalization (30%)

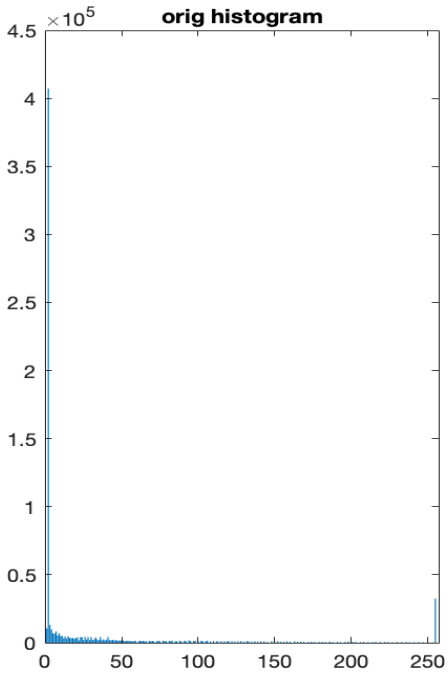
- **Explanation:**

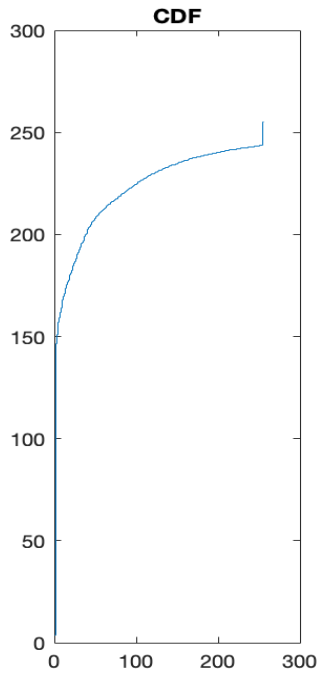
  Draw histogram and implement histogram equalization.

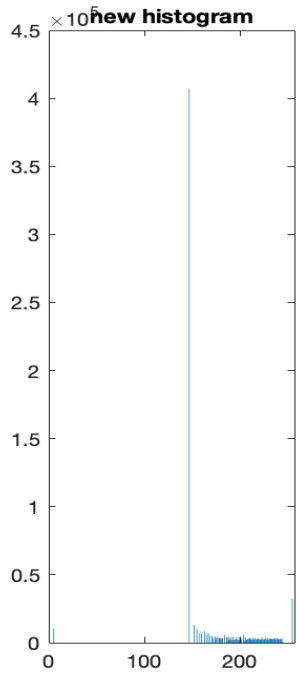
  Histogram: x axis indicates the intensity of the pixels. For grey scale image, x ranges from 0 to 255; y axis indicates the frequecy of a given intensity

  For histogram equalization, calculate PDF, CDF, and round the values to obtain transition table.

- **Result:**







- **Comparison:**

  The original image is composed mostly by low-level values, and mostly black (intensity=0), which is shown by the histogram.

  The CDF of original image also shows that the intensity of pixels are mostly low, the slope is higher in low-level x axis. There are also some white (intensity=255) pixels, so the slope rises in x=255.

  The new image after image equalization has a more uniform distribution of histogram. Hence the result new image is clearified.

3. Proj03-03 & Proj03-05 – Spatial Filtering, Unsharp Masking (40%)

- **Explanation:**

  Implement a spatial filtering function, and then use it for unsharp masking.

  Method for unsharp masking:

  - Blur the original image with 3x3 average filtering
  - Subtract the blurred image from the original to obtain the mask
  - Add the mask to original image to unsharp: G = F + k * mask

- **Result:**

- **Comparison:**

  Image after unsharp masking is more clear as expected. We use **k=10** to emphasize the unsharp effect. To unsharp more, we can use a larger mask for blurring (3x3 for current result), or larger k constant.