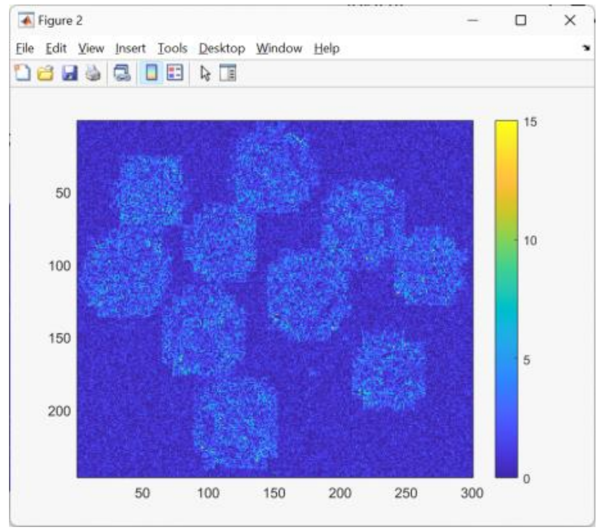
Lecture 3

Use JPEG Compressor to compress digital images (cont'd):

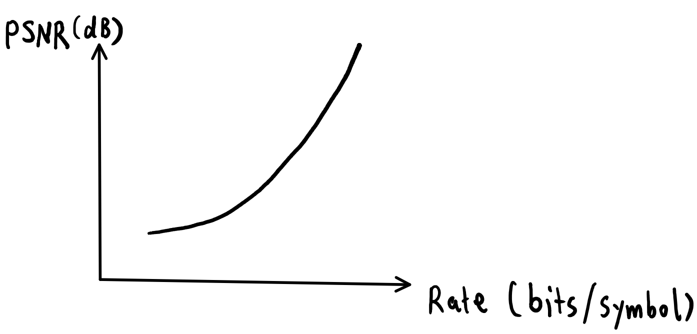
```
>> I = imread('coins.png');
>> imwrite(I, 'bitstream_q90.jpg', 'quality', 90);
>> Z = imread('bitstream_q90.jpg');
>> imshow(Z)

>> Zd = double(Z);
>> Id = double(I);
>> diff = Zd - Id;
>> min(diff(:))
ans =
  -13
>> max(diff(:))
ans =
   15
>> psnr(I, Z)
ans =
  42.4284
```

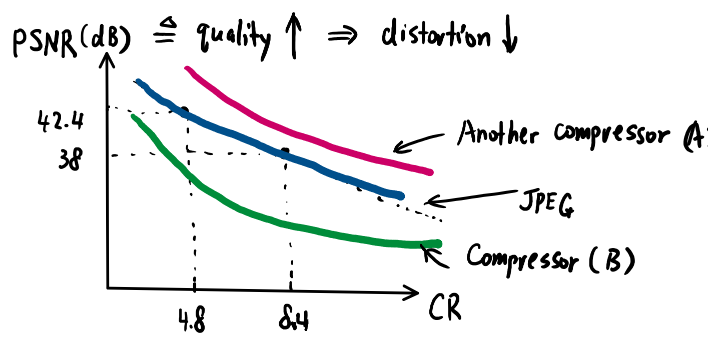


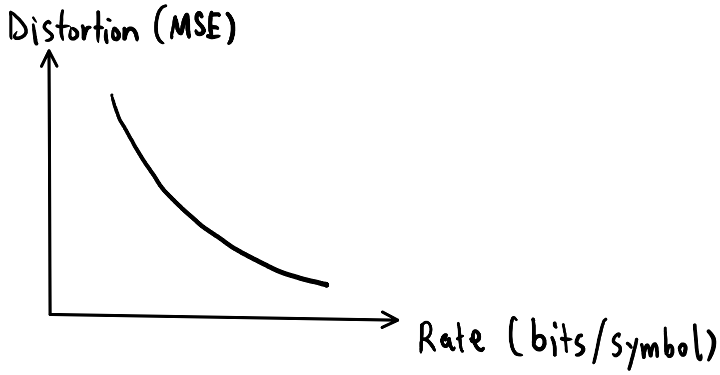

```
>> figure;
>> imagesc(abs(diff)); colorbar
```

15,269 bytes bitstream_q90.jpg => CR = 73800/15269 = 4.8333:1

Rate/Distortion Curve (tradeoffs)







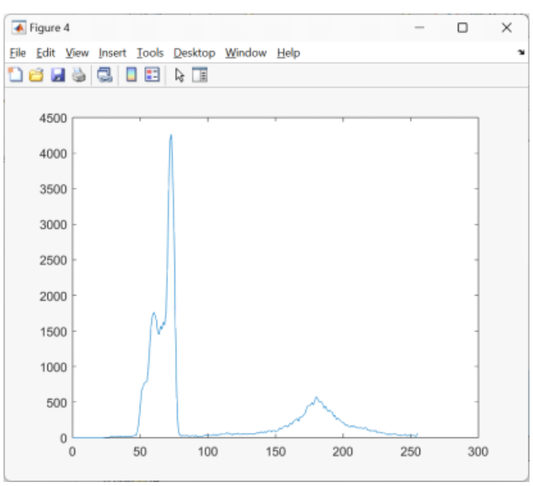
- Lossless Image Compression

```
>> imwrite(I, 'bitstream_lossless.jpg', 'mode', 'lossless');
>> J = imread('bitstream_lossless.jpg');
>> isequal(I,J)
ans =
  logical
   1    => Lossless Compression
```

39,186 bitstream_lossless.jpg => CR = 73800/39186 = 1.8833

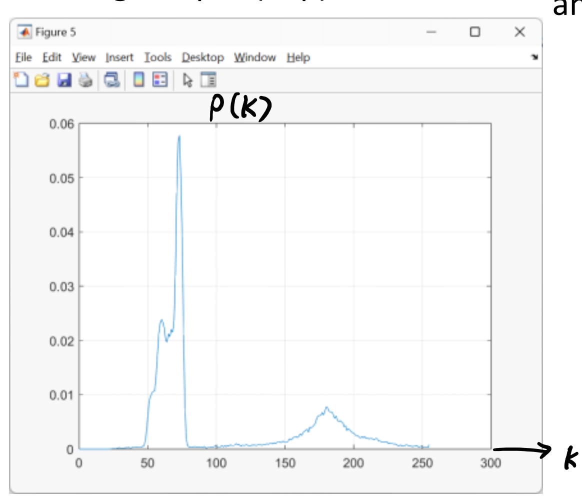
- Histogram

```
>> [c, b] = imhist(I);
>> figure; plot(b, c)
```




```
>> p = c/73800;
>> figure; plot(b, p);
```

```
>> sum(p)
ans =
    1
```



- Entropy

Entropy is a statistical measure of randomness that can be used to characterize the texture of the input image.

Entropy

Entropy is defined as `-sum(p.*log2(p))`, where `p` contains the normalized histogram counts returned from `imhist`.

$$\text{Entropy} = \sum_{k=0}^{255} -p(k) \cdot \log_2 p(k)$$

```
>> entropy(I)
ans =
   6.3162
```

bits/symbol $\Rightarrow CR = \dfrac{8 \text{ bits/symbol}}{6.3162 \text{ bits/symbol}}$ = 8/6.3162 = 1.2666 : 1

```
>> K = randi(255, 512, 512);
>> figure; imshow(uint8(K))
>> entropy(uint8(K))

ans =

   7.9937
```