Multimedia-Lecture-Six
Data Compression

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Data Compression Concept

Most of the real data is very redundant. Data Compression is basically defined as a technique that decreases the size of data.

It reduces the storage space and hence storage cost, also reduces time to retrieve and transmit data.

Data-compression techniques can be divided into two major families:
- Lossy Data Compression.
- Lossless Data Compression.

Lossy and Lossless Compression

Original Image

Lossless Compression

Original Lena Image (12KB size)

Lena Image, Compressed (85% less information, 1.8KB)

Lena Image, Highly Compressed (96% less information, 0.56KB)

Data Compression with C#

o Compression Using RLE Method

o Image Compression with the DCT Method

o Entropy Function

o JPEG Algorithm

Encoding Data Using RLE Method

Run Length Encoding (RLE): is a simple compression algorithm used to compress sequences containing subsequent repetitions of the same character.



```
int[] x = { 5, 5, 2, 1, 1, 1, 1, 3 };
List<int> y = new List<int>();
int c = 1;
for (int i = 0; i < x.Length - 1; i++)
    {
      if (x[i] == x[i + 1])
        {
           c++;
        }
    else
        {
          y.Add(c);
          y.Add(x[i]);
          c = 1;
        }
    }
y.Add(c);
y.Add(x[x.Length - 1]);
Console.WriteLine(string.Join(", ", y));
```

What is The Output??

Image Compression Using DCT Method

Discrete Cosine Transform(DCT):

The discrete cosine transform (DCT) represents an image as a sum of sinusoids of varying magnitudes and frequencies. The dct2 function computes the two-dimensional discrete cosine transform (DCT) of an image.
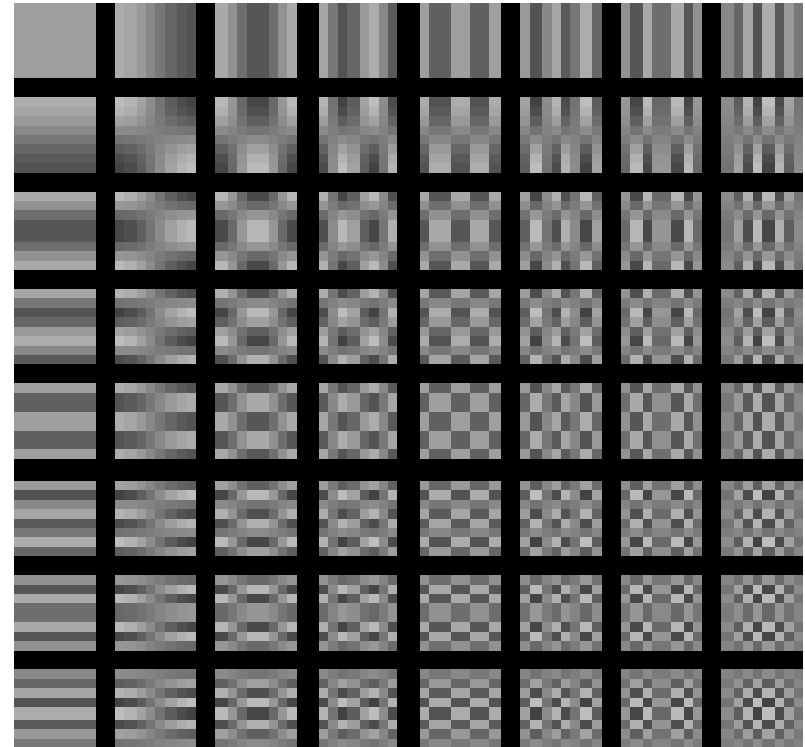
```
 // Load the image as a grayscale image
Mat imageMat = CvInvoke.Imread(imagePath, ImreadModes.Grayscale);

// Convert the image to a 32-bit floating-point image
Mat floatImage = new Mat()
imageMat.ConvertTo(floatImage, DepthType.Cv32F);

// Perform DCT on the grayscale image
CvInvoke.Dct(floatImage, floatImage, DctType.Forward);

// At this point, 'floatImage' contains the DCT coefficients of the image
// You can manipulate or process these coefficients as needed

// Perform inverse DCT to return to the spatial domain (time domain)
CvInvoke.Dct(floatImage, floatImage, DctType.Inverse);

// Convert the image back to 8-bit unsigned integer (grayscale) for display
Mat outputMat = new Mat();
floatImage.ConvertTo(outputMat, DepthType.Cv8U);

// Display or save the processed image
CvInvoke.Imwrite("output_image.png", outputMat);
```

Try to compute compression ratio:

Uncompressed Size / Compressed Size.

Compression Image

Entropy Function

The definition of entropy is aimed at identifying often-occurring symbols as short codeword.
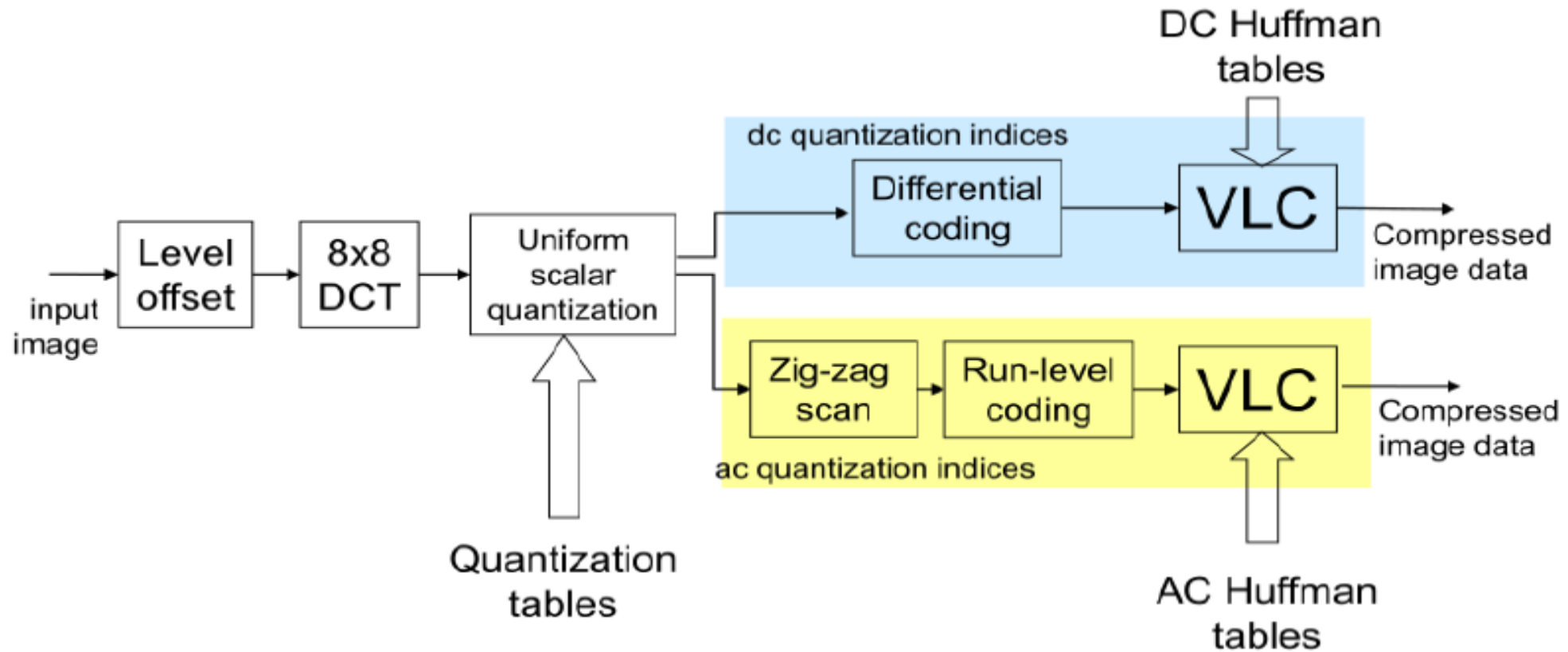
For example, E occurs frequently in English, so we would give it a shorter code than Q.

$$\eta = H(s) = \sum_{i=0}^{n} p_i \log_2 \frac{1}{p_i} = -\sum_{i=0}^{n} p_i \log p_i$$

Pi: is the probability that symbol Si in S will occur.

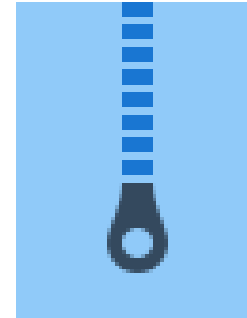$\log_2 (\frac{1}{p_i})$ Indicates the amount of information contained in characters.

JPEG Algorithm

Exercise:

Write a C#-code to:

    a. Read an RGB image.

    b. Convert it to Binary Image.

    c. Apply RLE method on Binary Image.

That's All