Compression and Graphics

COMP370

Intro to Computer Architecture

Pictures

- Vector – Pictures are drawn as a series of lines. The hardware draws a line from point A to point B.
- Raster – Pictures are represented as a matrix of picture elements or pixels.

Picture Size and Resolution

- Screen resolution is measured in horizontal and vertical pixels per inch.
- A good monitor can display about 90 pixels per inch.
- A good printer can print about 600 to 1200 pixels per inch.
- True size of a picture depends on the number of pixels and the device.

Pixel

- Each pixel has a color.
- Monochrome pictures have only two colors.
- The color is usually represented as three numbers that are the intensity of the three primary colors, Red, Green and Blue (RGB)
- The pixel represents both the color and the intensity or darkness of the pixel.

Bits / Pixel

- The number of bits it takes to represent a pixel depends on the number of possible colors.
- Black and white requires only 1 bits per pixel.
- Full color pictures require 24 bits per pixel
- Simple graphics can use 4 or 8 bits per pixel

Graphics Formats

- There are many formats for graphical data
  - BMP
  - JPEG
  - GIF
  - TIFF
  - PNG
  - etc.

Bit Mapped File

- BMP is a very simple format for graphics.
- Used frequently by Microsoft system.
- Each pixel is stored as a number. The number of bits per pixel is determined by the number of different colors.

BMP format

BMP File Header	Stores general information about the BMP file.
Bitmap Information (DIB header)	Stores detailed information about the bitmap image.
Color Palette	Stores the definition of the colors being used for indexed color bitmaps.
Bitmap Data	Stores the actual image, pixel by pixel.

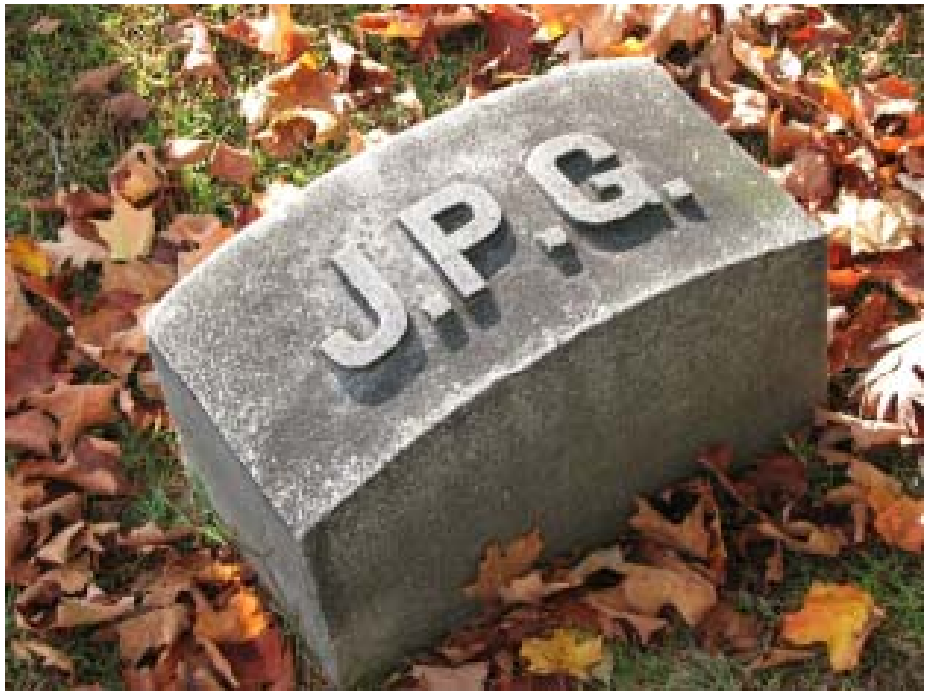
BMP Efficiency

- Each pixel in a BMP file is represented by a number.
- There is no compression.
- It does not matter how “complex” the image, the file size is determined by the number of pixels or the size of the picture.

JPEG files

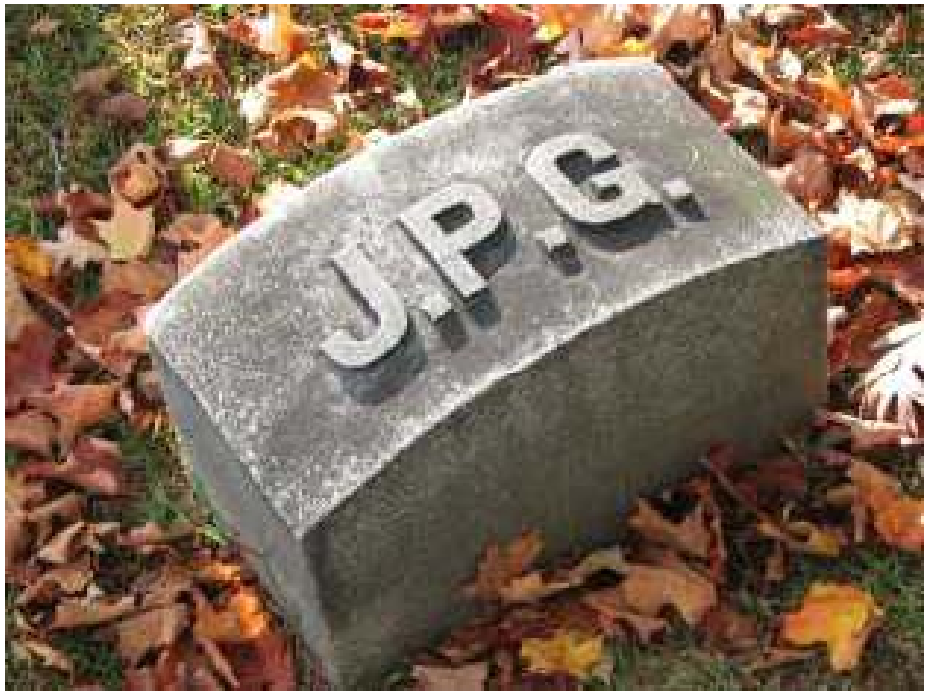
- The JPEG format was created by the Joint Photographic Experts Group
- JPEG is a commonly used method of compression for photographic images
- JPEG uses lossy compression. Some image quality is lost.
- You can control the level of compression and therefore the image quality.
- JPEG uses a Discrete cosine transform for compression.

JPEG Example



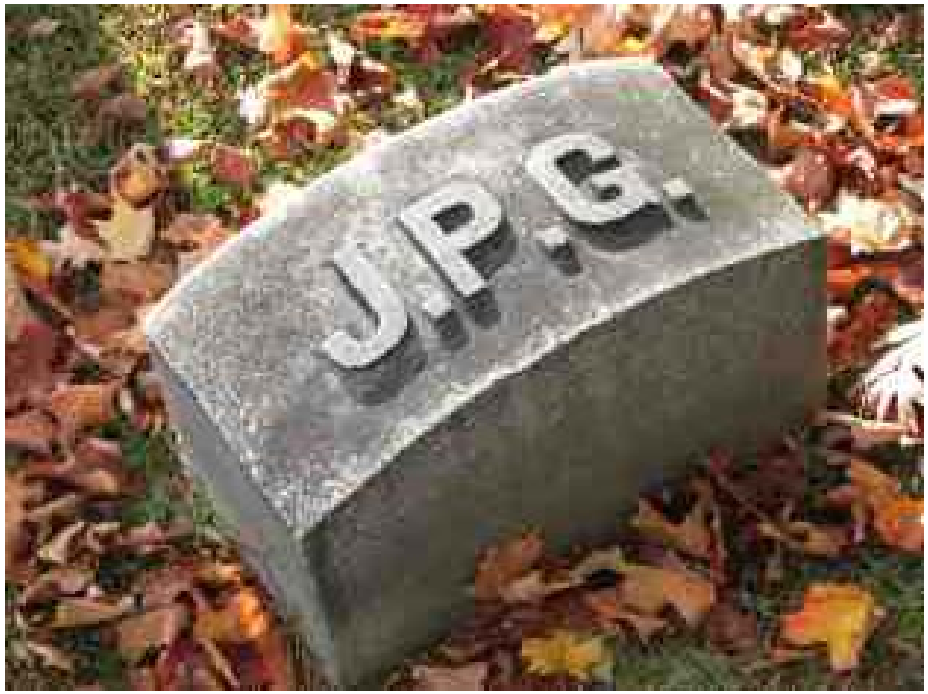
- Q = 100
- 81.3 KB
- 219,726 bytes if BMP
- 37% of BMP

JPEG Example



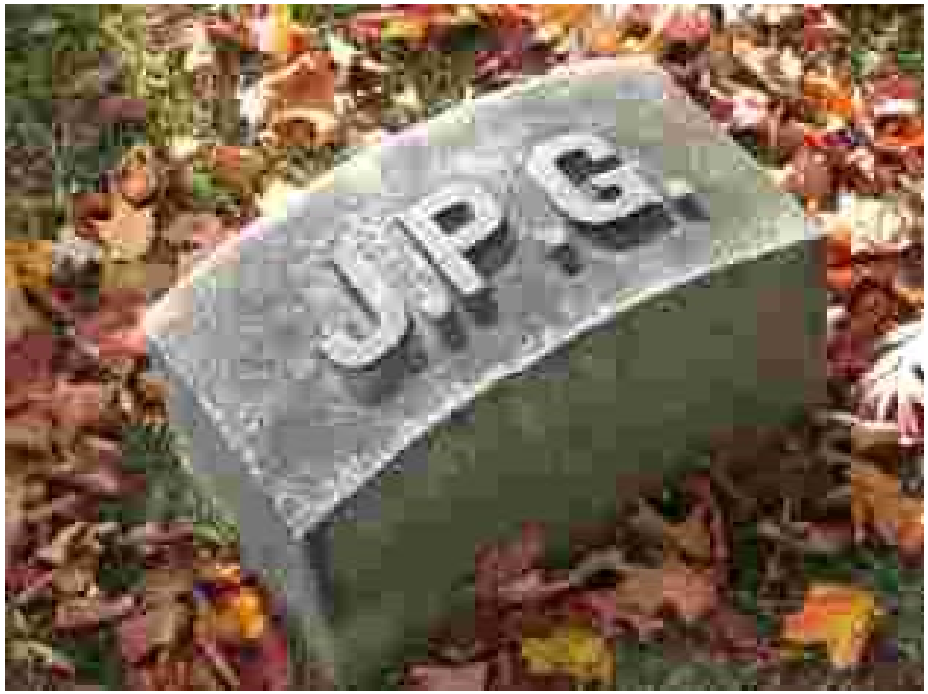
- Q = 50
- 14.7 KB
- 18% of Q100
- 6.7% of BMP

JPEG Example



- Q = 25
- 9.32 KB
- 11.5% of Q100
- 4.2% of BMP

JPEG Example



- Q = 10
- 4.67 KB
- 5.7% of Q100
- 2.1% of BMP

JPEG Example

- Q = 1
- 1.48 KB
- 1.8% of Q100
- 0.67% of BMP

JPEG Artifacts

Recommendations

- BMP files are not distorted in any way, but they are large.
- JPEG works well for photographs
- GIF works well for diagrams or charts.

Text Compression Methods

- Reduce the number of bits per character
- Create a table of used characters. The data is represented as indexes into the table.
- Store repeating characters as a special marker and a run length.
- Lempel-Ziv-Welch (LZW) compression.

LZW Compression

- Lempel-Ziv-Welch (LZW) is a universal lossless data compression algorithm created by Abraham Lempel, Jacob Ziv, and Terry Welch in 1984
- It creates a table of strings
- Each time a new string is found it is entered in the table.
- Data is represented as indexes into the table.

LZW Algorithm

```
w = NIL;
add all possible charcodes to the dictionary
for (every character c in the uncompressed data) do
   if ((w + c) exists in the dictionary) then
      w = w + c;
   else
      add (w + c) to the dictionary;
      add the dictionary code for w to output;
      w = c;
   endif
done
add the dictionary code for w to output;
display output;
```