* Run-Length Encoding
  + A single character may be repeated over and over again in a long sequence
  + Replace a repeated sequence with
    - A flag character
    - Repeated character
    - Number of repetitions
  + \*n8
    - \* is the flag character
    - N is the repeated character
    - 8 is the number of times n is repeated
    - Example
      * Original: bbbbbbbbjjjkllqqqqqq+++++
      * Encoded: \*b8jjjkll\*q6\*+5
      * Compression ratio is 15/26 = 60%
    - This type of repetition doesn’t occur in English text; usually might be used in PDF, MP3, etc files
* Huffman Encoding
  + The best of the encoding types
  + Use variable-length bit strings to represents each character. More frequently used letters have shorter to represent them.
  + To decode, look for match left ot right, bit by bit, record letter when a match is found being where you left off, going left or right
  + Example
    - Decode: 1011111001010
    - DRAB = 1011 111 00 1010
  + Example
    - ROADBED
    - 111 110 00 1011 1010 01 1011
* Representing audio information
  + A stereo sends and electrical signal to a speaker to produce sound
  + This signal is an analog representation of the sound wave
  + The voltage in the signal varies in direct proportion to the sound wave
  + Digitize the signal by sampling
    - Periodically measure the voltage
    - Record the numeric value
    - How often to sample? About 40K per second
  + CDs store info digitally
    - Low intensity laser is pointed at the disc
    - Laser light reflects strongly if the surface is smooth; poorly if the surface is pitted
* Audio Formats
  + WAV, AU, AIFF, VQF, MP3
  + MP3 (MPEG-2, audio layer 3 file) is dominant
    - Analyzes the frequency spread and discards information that cant be heard by humans
    - Bit stream is compressed using a form of Huffman encoding to achieve additional compression
    - It is lossy and lossless
* Representing Images and Graphics
  + Color perception of the frequencies of light that can reach the retinas of our eyes
  + Composed of red, green, and blue
  + Color is expressed as RGB value – three numbers that indicate the relative contribution of each of these three primary colors
  + RGB value of (255,255,0) maximizes the contribution of red and green and minimizes the contribution of blue, which results in a bight yellow
  + Color depth
    - The amount of data that is used to represent a dcolor
  + Hicolor
    - A 16-bit color depth: five bits used for each number in an RGB value with the extra bit sometimes used to represent transparency
  + True color
    - A 24-bit color depth: eight bits used for each number in an RGB value
* Digitized images and graphics
  + Digitizing a picture
    - Representing it as a collection of individual dots called pixels
  + Resolution
    - The number of pixels use to represent a picture
  + Raster graphics
    - Storage of data on a pixel by pixel basis
    - Bitmap, gif, jpeg, and png are raster-graphics formats
  + Bitmap
    - Contains the pixel color values of the image from left to right and top to bottom
  + Jpeg
    - Average of the pixel over short distances
* Vector graphics
  + A format that describes an image in terms of lines and geometric shames
  + A vector graphic is a series of commands that describe a line’s direction, thickness, and color
  + The file sizes tend to be smaller because not every pixel is described
  + Can be resized mathematically and changes can be calculated dynamically as needed
  + Not good for real world images
* Representing video
  + Almost all video codecs use lossy compressions to minimize the huge amounts of data associated with video
  + Video codec COmpressor/DECompressor
  + Temporal compression
    - Technique Based on difference between consecutive frames
  + Spatial compression
    - Technique based on removing redundant information within a frame
* Ethical Issues
  + Patriot Act
  + Title II controversial provision
  + Brandon Mayfield, case implications
* Bob Beamer
  + Developed Fortran, Cobol, Simula
  + Worked on ascii
  + Created concept of escape character