

Chapter Last

Loss Compression Algorithms

Lossy Compression

- ☞ There is loss of some information.
- ☞ The loss of this data is such that the object looks more or less like the original.
- ☞ This method is used where absolute data accuracy is not essential.
- ☞ Lossy compression is the most commonly used compression type.

Cont...

- ☞ Lossy compression - reduces a file by permanently eliminating certain redundant information
 - ☞ Exploit redundancy and human perception
 - ☞ Applied to audio, image, and video
- ☞ **Examples:** JPEG and MPEG
- ☞ Lossy techniques usually achieve higher compression rates than lossless ones but the latter are more accurate.

Cont...

- Our eyes and ears cannot distinguish subtle changes. In such cases, we can use a Lossy data compression method.
- These methods are cheaper—they take less time and space when it comes to sending millions of bits per second for images and video.

Cont...

- Several methods have been developed using Lossy compression techniques.
 - **JPEG** (*Joint Photographic Experts Group*) encoding is used to compress pictures and graphics,
 - **MPEG** (*Moving Picture Experts Group*) encoding is used to compress video, and
 - **MP3** (*MPEG audio layer 3*) for audio compression.

Image compression

JPEG encoding

- ✎ As discussed in Chapter 3, an image can be represented by a two-dimensional array (table) of picture elements (pixels).
- ✎ A grayscale picture of 307,200 pixels (640 x 480) is represented by 2,457,600 bits, and a color picture is represented by 7,372,800 bits.
- ✎ In JPEG, a grayscale picture is divided into blocks of 8×8 pixel blocks to decrease the number of calculations because, as we will see shortly, the number of mathematical operations for each picture is the square of the number of units.

Main Steps in JPEG Image Compression

- ✎ Transform RGB to YIQ or YUV and subsample color.
- ✎ Perform DCT on image blocks.
- ✎ Apply Quantization.
- ✎ Perform Zig-zag ordering and run-length encoding.
- ✎ Perform Entropy coding.

JPEG Image Compression steps

☞ Perform DCT(Discrete concise transform) on image blocks

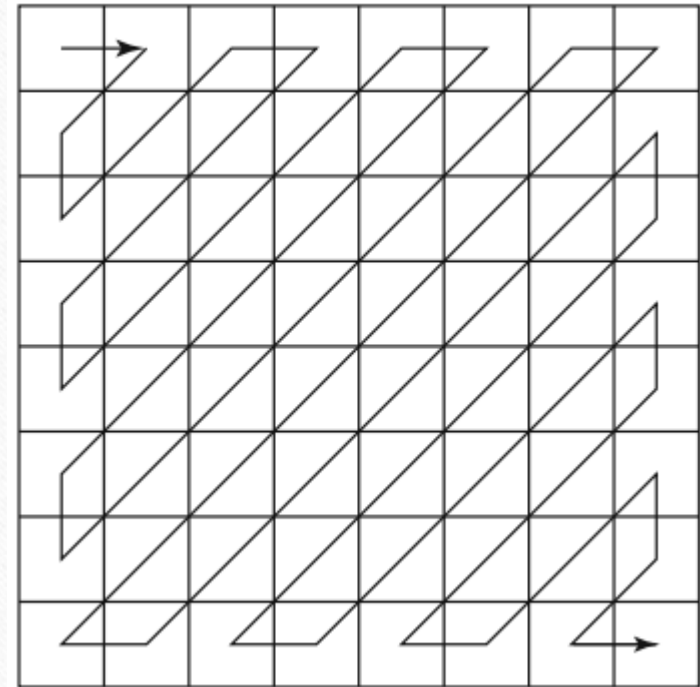
- ☞ Each image is divided into 8X8 pixel blocks to decrease the number of calculations.
- ☞ 2D DCT is applied to each block image $f(i,j)$, with output being the DCT coefficients $F(u,v)$ for each block.

☞ Apply Quantization

- ☞ The quantization step in JPEG is aimed at reducing the total number of bits needed for a compressed image
- ☞ $F(u,v)$ represents a DCT coefficient, $Q(u,v)$ is a “quantization matrix” entry, and $\hat{F}(u,v)$ represents the quantized DCT coefficients which JPEG will use in the succeeding entropy coding

Cont...

- 👉 Zig-zag ordering and run-length encoding
- 👉 **zigzag** scan order has a good chance of concatenating long runs of zeros.
- 👉 RLC is effective when we use an addressing scheme, making it most likely to hit a long run of zeros: a zig-zag scan used to turn the 8X8 matrix into a 64-vector



Quantization & Compression

Quantization:

-  After T table is created, the values are quantized to reduce the number of bits needed for encoding.
-  Quantization divides the number of bits by a constant, then drops the fraction. This is done to optimize the number of bits and the number of 0s for each particular application.

Quantization & Compression cont...

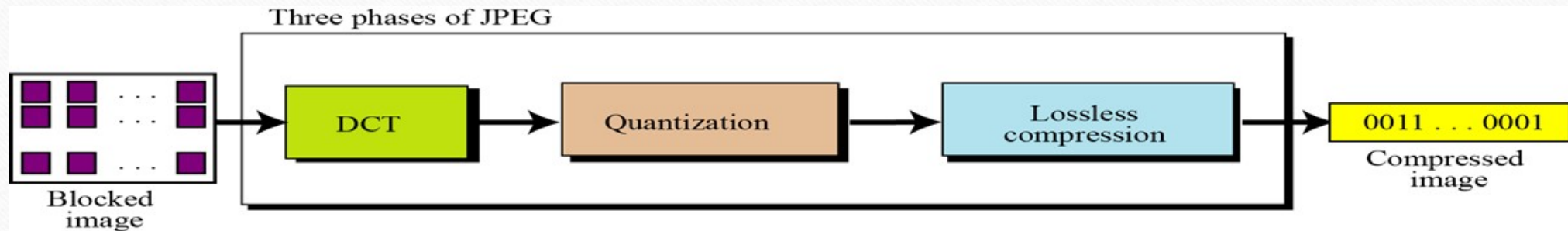
☞ Compression:

- ☞ Quantized values are read from the table and redundant 0s are removed.
- ☞ To cluster the 0s together, the table is read diagonally in an zigzag fashion. The reason is if the table doesn't have fine changes, the bottom right corner of the table is all 0s.
- ☞ JPEG usually uses lossless run-length encoding at the compression phase.

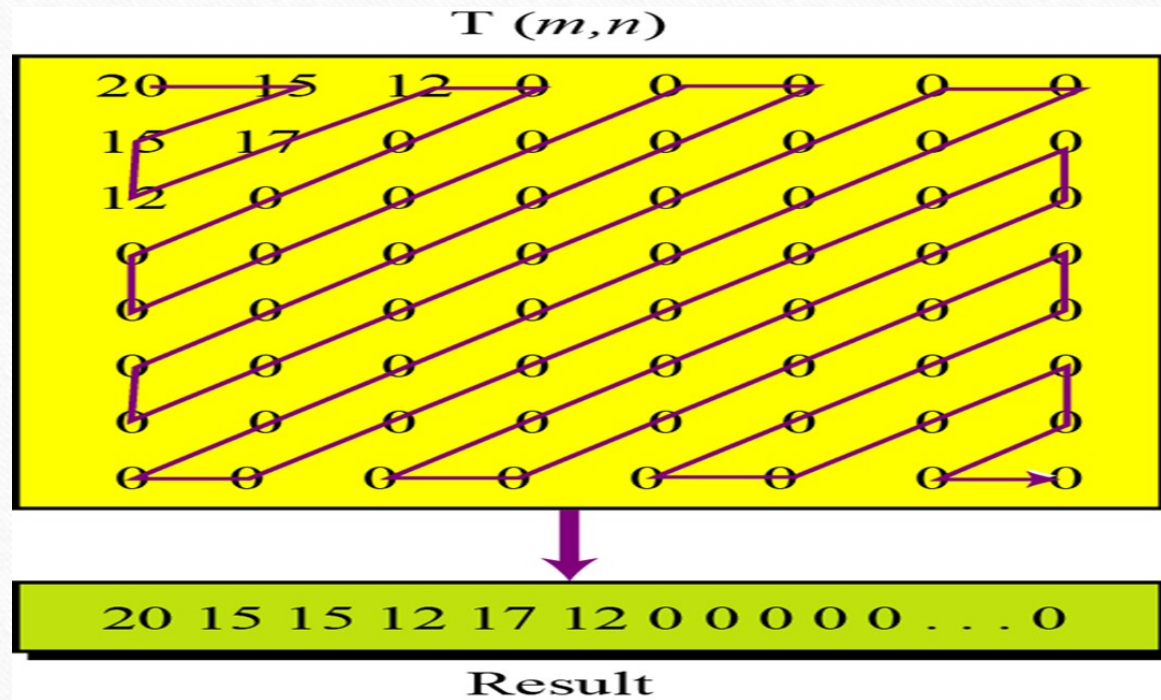
JPEG Encoding

👉 Basic idea:

- 👉 Change the picture into a linear (vector) sets of numbers that reveals the redundancies.
- 👉 The redundancies is then removed by one of lossless compression methods.



JPEG Encoding



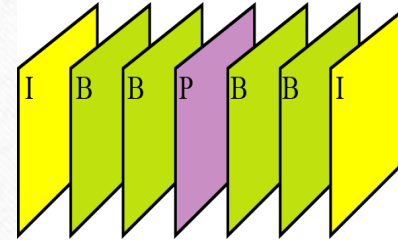
Video compression - MPEG encoding

- ✎ **The Moving Picture Experts Group (MPEG)** method is used to compress video.
- ✎ In principle, a motion picture is a rapid sequence of a set of frames in which each frame is a picture.
- ✎ In other words, a frame is a spatial combination of pixels, and a video is a temporal combination of frames that are sent one after another.

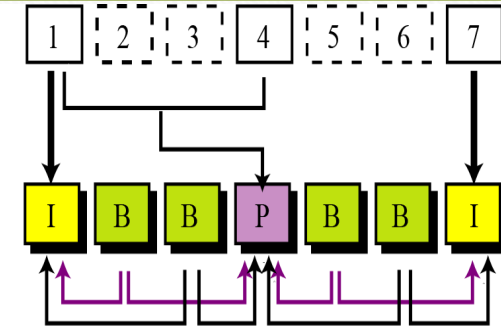
Video compression cont...

- ✎ Compressing video, then, means spatially compressing each frame and temporally compressing a set of frames.
- ✎ **Spatial compression** : The spatial compression of each frame is done with JPEG, or a modification of it.
- ✎ Each frame is a picture that can be independently compressed.

Video compression cont...



a. Frames



b. Frame construction

- 👉 **Temporal compression** : In temporal compression, redundant frames are removed.
- 👉 When we watch television, for example, we receive 30 frames per second. However, most of the consecutive frames are almost the same.
- 👉 For example, in a static scene in which someone is talking, most frames are the same except for the segment around the speaker's lips, which changes from one frame to the next.

Audio compression

- ✎ Audio compression can be used for ***speech*** or ***music***.
- ✎ For speech we need to compress a 64 kHz digitized signal, while for music we need to compress a 1.411 MHz signal.
- ✎ Two categories of techniques are used for audio compression: ***predictive encoding*** and ***perceptual encoding***.

Predictive encoding

- ✎ In **predictive encoding**, the differences between samples are encoded instead of encoding all the sampled values.
- ✎ This type of compression is normally used for speech.
- ✎ Several standards have been defined such as GSM (13 kbps), G.729 (8 kbps), and G.723.3 (6.4 or 5.3 kbps).

Perceptual encoding

- ☞ The most common compression technique used to create CD-quality audio is based on the ***perceptual encoding technique***.
- ☞ This type of audio needs at least 1.411 Mbps, which cannot be sent over the Internet without compression.
- ☞ MP3 (MPEG audio layer 3) uses this technique.

Compression Algorithms

- ✎ Compression methods use mathematical algorithms to reduce (or compress) data by eliminating, grouping and/or averaging similar data found in the signal.
- ✎ Different Although there are various compression methods, including Motion JPEG, only MPEG-1 and MPEG-2 are internationally recognized standards for the compression of moving pictures (video).

The End

If you have any questions
you are welcome to ask!!!!