

3. Define and describe the measures of performance for compression techniques. How they are used to evaluate efficiency

→ Compression Ratio

* Show how much the original data size is reduced after compression.

$$CR = \frac{\text{original Size}}{\text{compressed size}}$$

- * Higher CR → Better size reduction
- * used to compare different compression technique

→ Compression Efficiency

Show how much storage space is saved

$$\text{compression efficiency} = \frac{\text{original Size} - \text{compressed size}}{\text{original size}} \times 100$$

- * Help measure storage or bandwidth saving
- * useful in network transmission system

→ Bit Rate

Number of bits used per second / per pixel

$$\text{Bit Rate} = \frac{\text{Total bits in compressed image}}{\text{Number of pixels}}$$

- * Lower bit rate → more compression
- * But very low bit rate may reduce quality

→ Distortion

used mainly in lossy compression

$$MSE = \frac{1}{N} \sum (\text{original} - \text{compressed})^2$$

lower MSE → Better quality

- * used in image and view compression
- * Balances compression and visual quality

→ Compression Time

Time taken to compress data

- * Important in real-time system.
- * Fast compression needed for streaming and communication

→ Entropy

minimum average number of bits required to represent data.

$$H = -\sum p(x) \log_2 p(x)$$

- * compares algorithm performance without theoretical limit
- * Good compression approaches entropy value

→ Compression efficiency is evaluated by balancing :

- Size Reduction
- Quality preservation
- Speed (compression / decompression time)
- Resource usage (complexity, memory)