IMAGE AND VIDEO COMPRESSION

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Why Compression?

- Why do we need compression?
- Why can we actually compress images?
- Why should we compress .. :P
- Why not compression ?

Why do we need to compress?

- At any given time, the ability of the Internet to transfer data is fixed
- Increase the rate of digital image data transfer or **data rate** (Megabit per second or Mb/s)
- Reduce the total amount of digital storage required or **data capacity** (Megabyte or MByte).
- Many files can be combined into one compressed document making sending easier, provided combined file size is not huge.

Why Can We Compress?

- **Coding redundancy**

  Most 2-D intensity arrays contain more bits than are needed to represent the intensities

- **Spatial redundancy**

  Neighboring pixels are not independent but correlated

- **Temporal redundancy**
- **Irrelevant information**

  Most 2-D intensity arrays contain information that is ignored by the human visual system

Why not Compress?

- **Loss of data**

  Many a times, effective compression leads to loss of data which is not desirable.

- **Complexity**

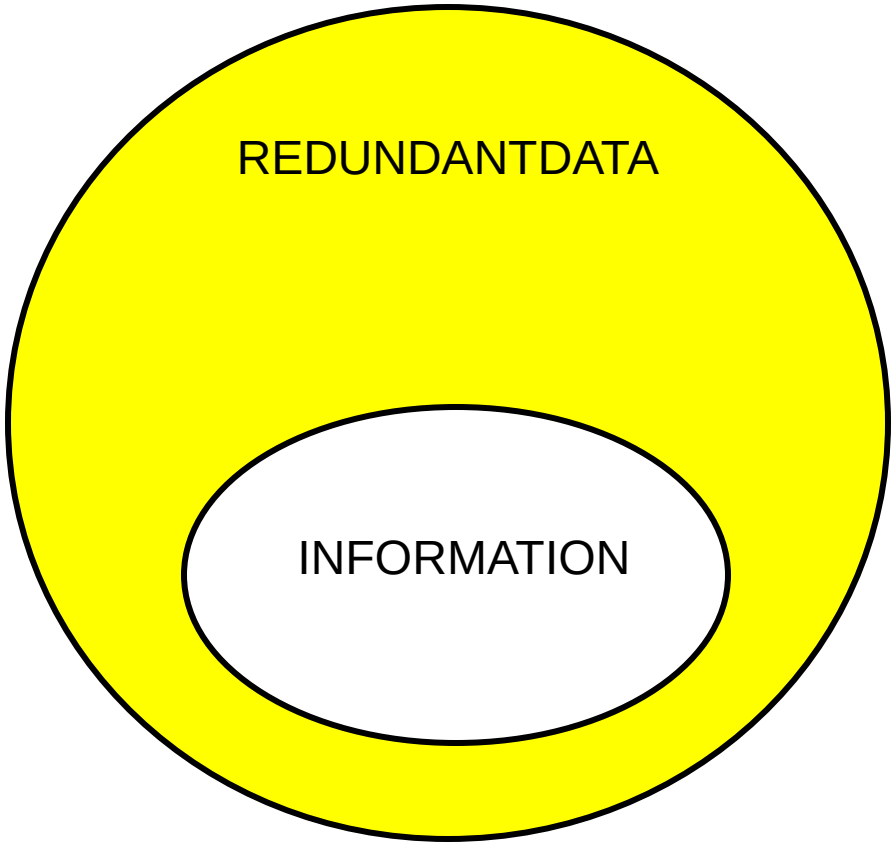
  Sometimes coding and decoding complexity is not feasible to carry out compression

Examples of redundancy

a b c

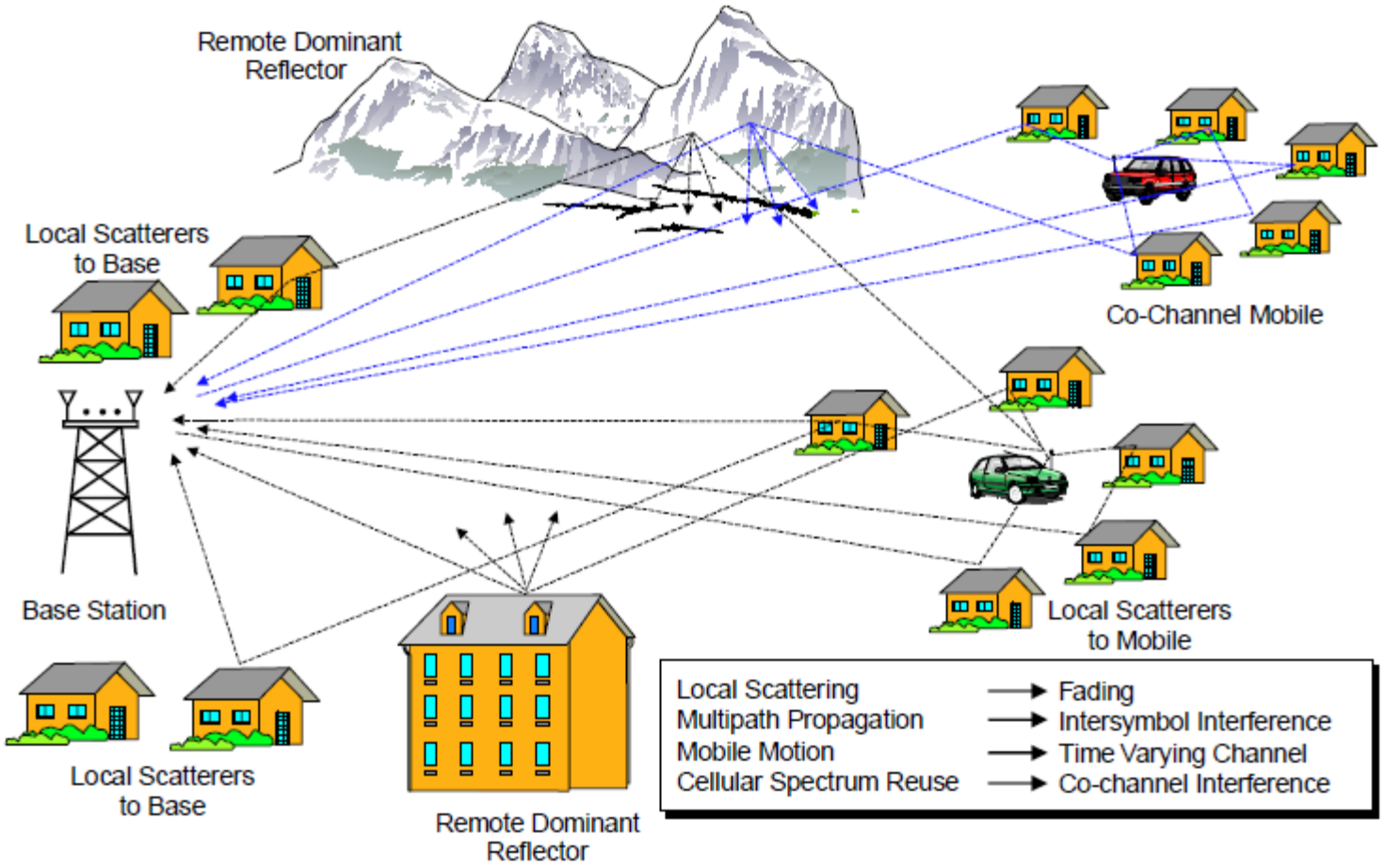
FIGURE 8.1 Computer generated 256 × 256 × 8 bit images with (a) coding redundancy, (b) spatial redundancy, and (c) irrelevant information. (Each was designed to demonstrate one principal redundancy but may exhibit others as well.)

Information vs Data



DATA = INFORMATION + REDUNDANT DATA

Channels


Remote Dominant Reflector
Local Scatterers to Base
Co-Channel Mobile
Base Station
Local Scatterers to Mobile
Local Scatterers to Base
Remote Dominant Reflector
Local Scattering → Fading
Multipath Propagation → Intersymbol Interference
Mobile Motion → Time Varying Channel
Cellular Spectrum Reuse → Co-channel Interference

Communication Channel

Busy / Corrupt Channel

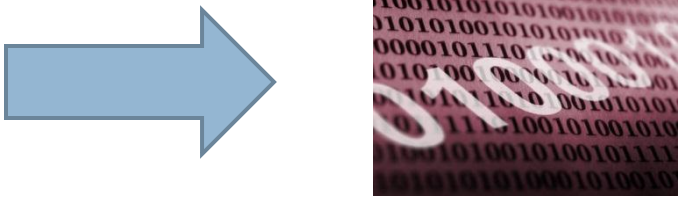
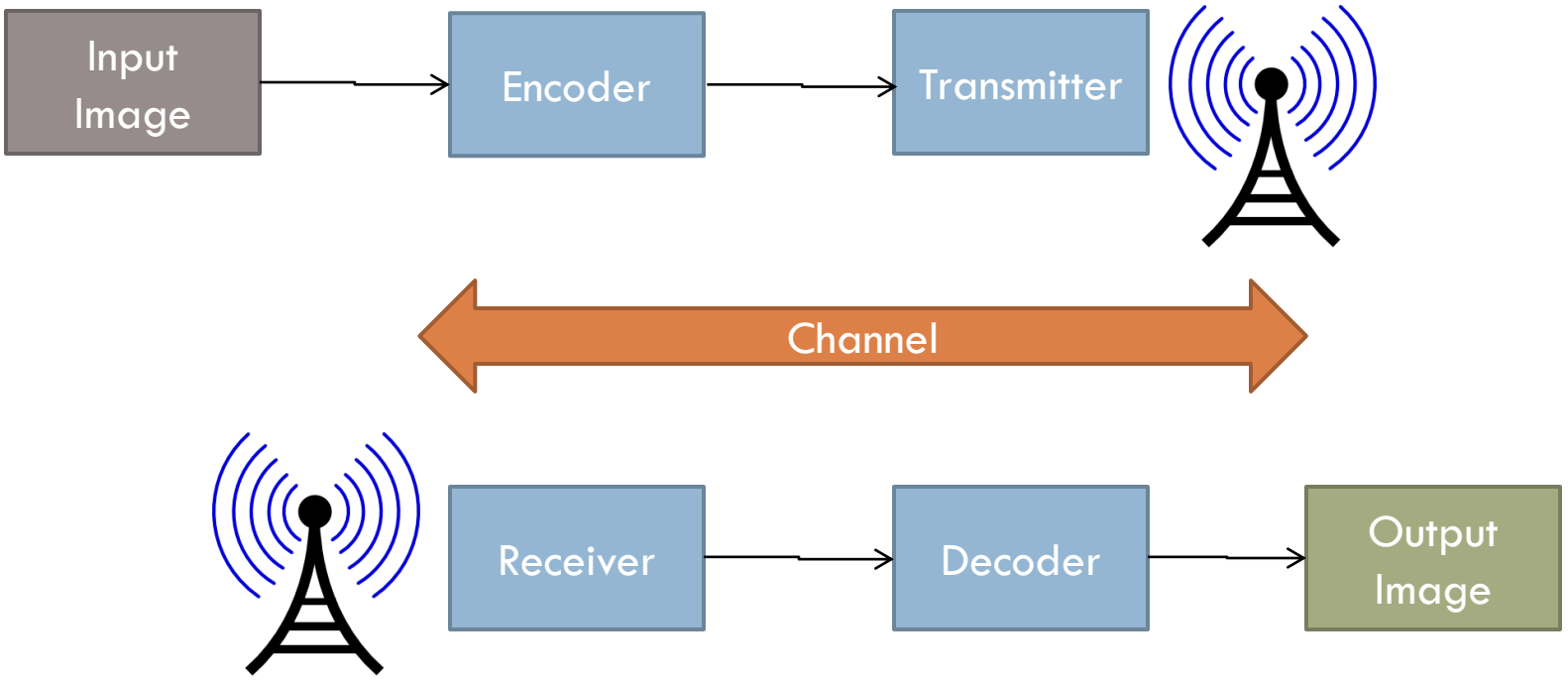


Image Compression Techniques

- Run Length Encoding
- Bit Plane Encoding

General Schema



Run Length Encoding

- Run-length Encoding, or **RLE** is a technique used to **reduce the size of a repeating string of characters.**
- This repeating string is called a *run*, typically RLE encodes a run of symbols into two bytes , a **count** and a **symbol.**
- RLE can compress any type of data
- RLE cannot achieve high compression ratios compared to other compression methods
- It is easy to implement and is quick to execute.
- Run-length encoding is supported by most bitmap file formats such as TIFF, BMP and PCX

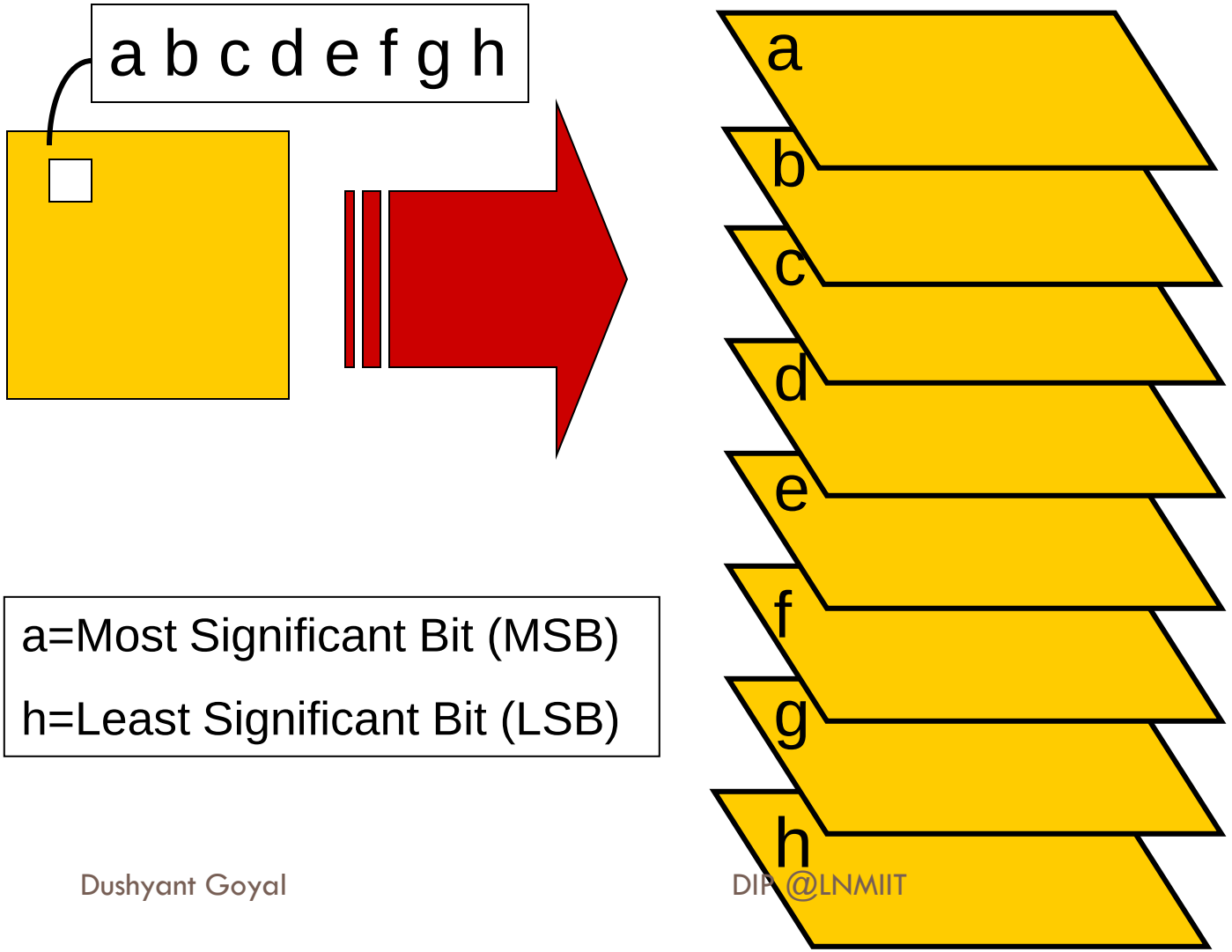
Example RLE

WWWWWWWWWWWWBWWWWWWWWWWWWBB
BWWWWWWWWWWWWWWWWWWWWWWWWBW
WWWWWWWWWWWWW

RLE coding:

12W1B12W3B24W1B14W

Bit Plane Encoding



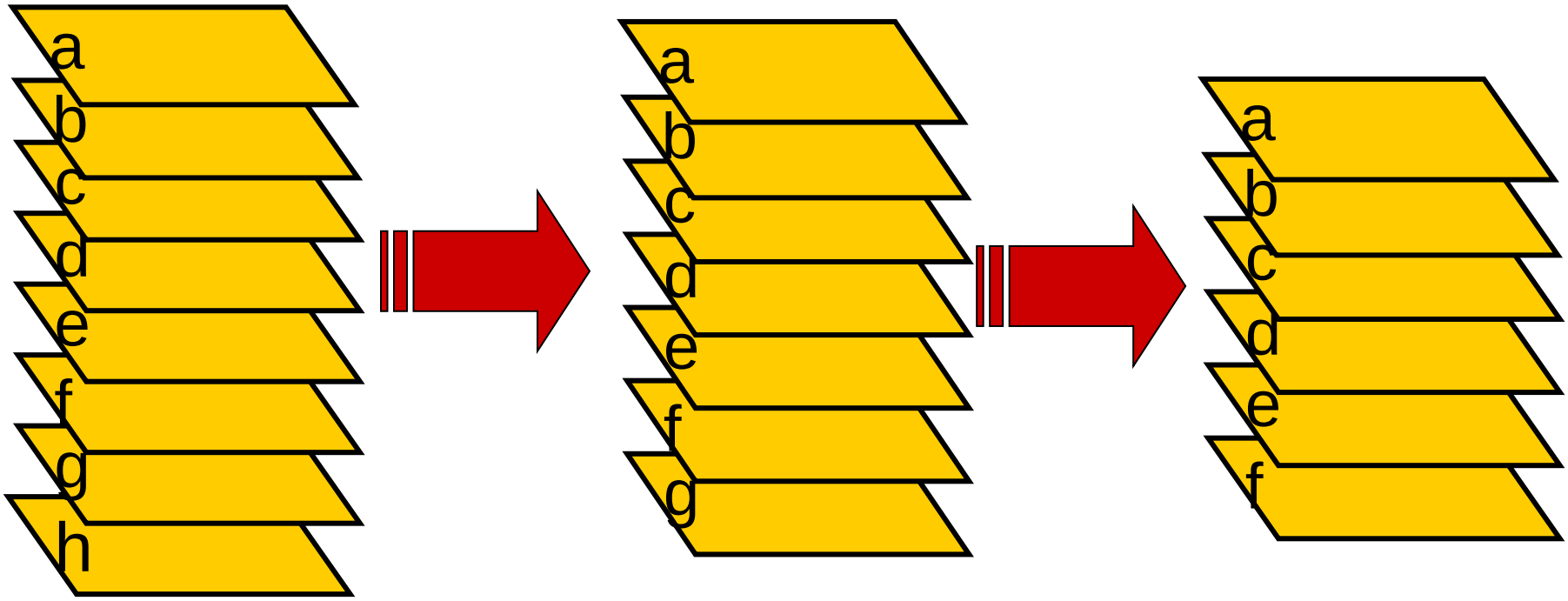
a=Most Significant Bit (MSB)

h=Least Significant Bit (LSB)

Bit Plane Encoding

Compression Ratio
CR= 7/8 = 0.87

Compression Ratio
CR= 6/8 = 0.75

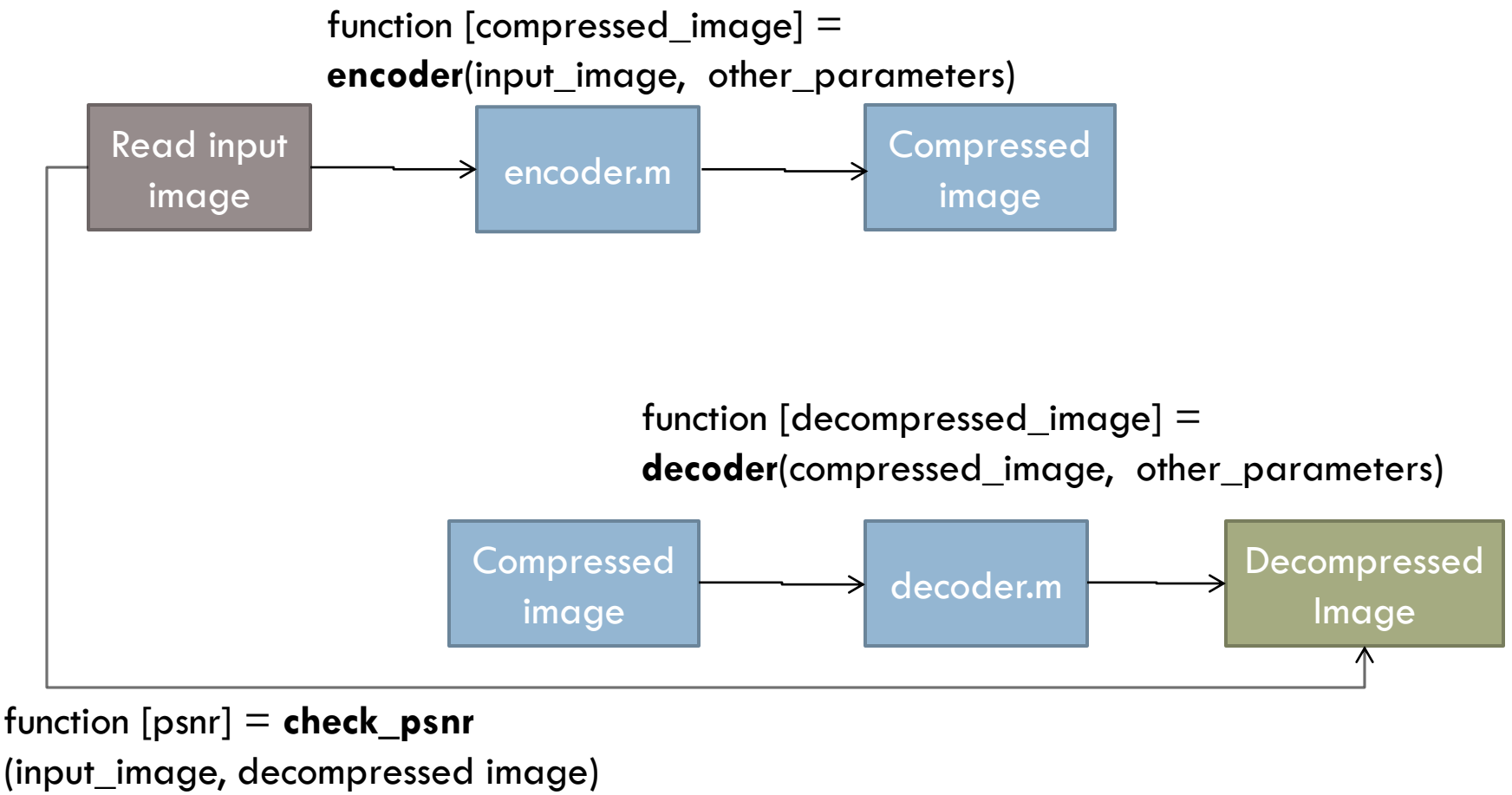


Uncompressed

Least Significant Bit Removed (Divide by 2)

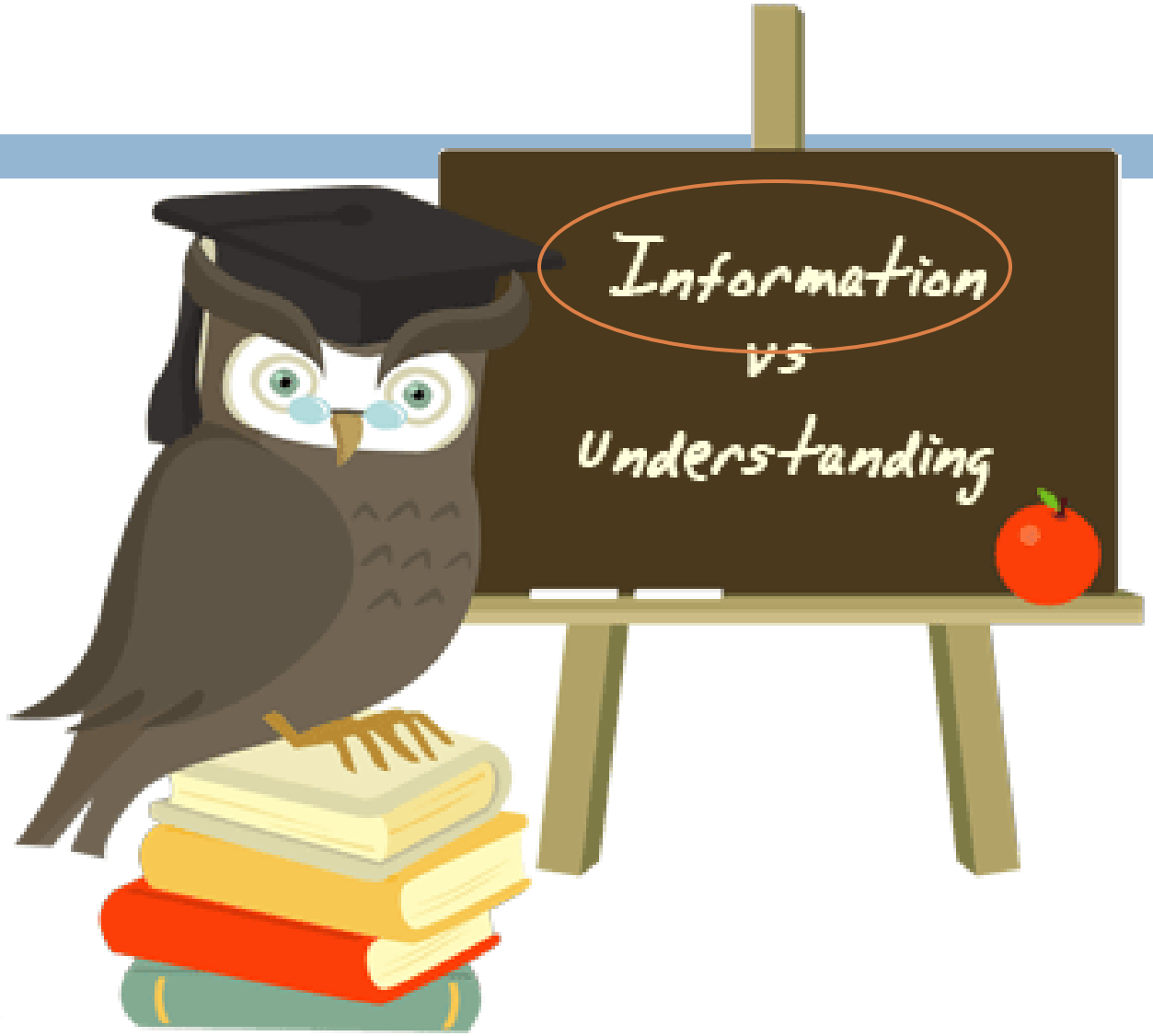
2 Least Significant Bit Removed (Divide by 4)

Implementation perspective



Lossless or Lossy Compression

- Lossless compression
  - There is no information loss, and the image can be reconstructed exactly the same as the original
  - Applications: Medical imaging, Satellite images, etc
- Lossy compression
  - Information loss is tolerable
  - Many-to-1 mapping in compression eg. quantization
  - Applications: commercial multimedia distribution (DVD) and movies


Information
vs
Understanding

JPEG (Intra-frame coding)

- "Joint Photographic Expert Group". Voted as international standard in 1992.
- Works with color and gray-scale images, e.g., satellite, medical, etc (almost all kinds of images)
- Lossy and lossless

Examples of varying JPEG compression ratios

500KB image, minimum compression

40KB image, half compression

11KB image, max compression

What is MPEG ?

- "Motion Picture Expert Group", established in 1990 to create standard for delivery of audio and video.
- MPEG-1 : target VHS (Video Home System) quality on a CD-ROM (320 x 240 + CD audio @ 1.5 Mbits/sec) .

Doubts ??