Compression

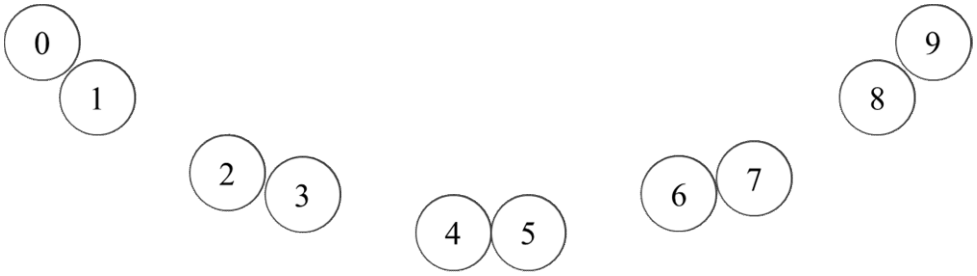
이진영

Compression

- Recently, UHD, 3D, and 360-degree immersive images, thanks to advanced displays
- Need for data compression, due to limited bandwidth and storage
- Data representation in a compact form
- Image compression for a single image, and video compression for multiple images

Various Image Types

- Color for 2D, multiple color for stereo, multiple color and depth views for 3D and 360-degree



Images from MPEG standards

Compression Standards

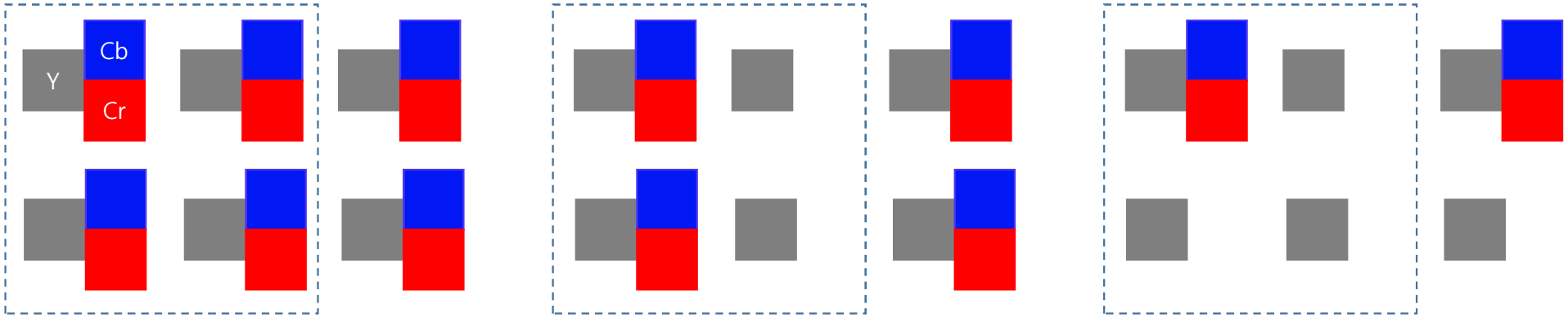
- Joint Photographic Experts Group (JPEG) for image compression
  - JPEG, JPEG2000…
- Moving Picture Experts Group (MPEG) for video compression
  - MPEG-2/4, H.264/AVC, HEVC, VVC …
- International standardization meeting for development of compression standards

Measurements

- The number of bits needed to represent a source image in a compact form
- PSNR measuring an objective quality of an compressed image
- Subjective quality assessment that evaluates compression artifacts, such as MOS
- Compression time that represents complexity of the processing

Data Loss – Chroma Subsampling

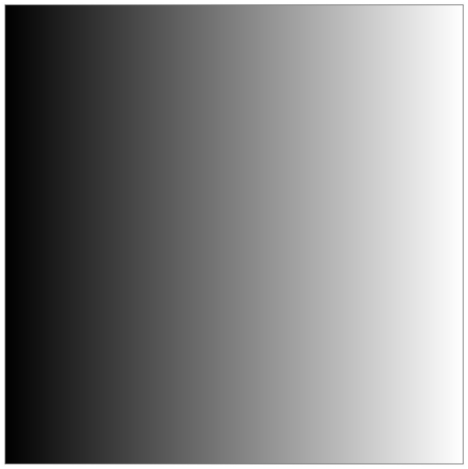
- Less resolution for chroma components (Cb, Cr), compared to a luma component (Y)
- Lower perception for color differences in human visual system
- Y:Cb:Cr = 4:4:4, 4:2:2, 4:2:0…



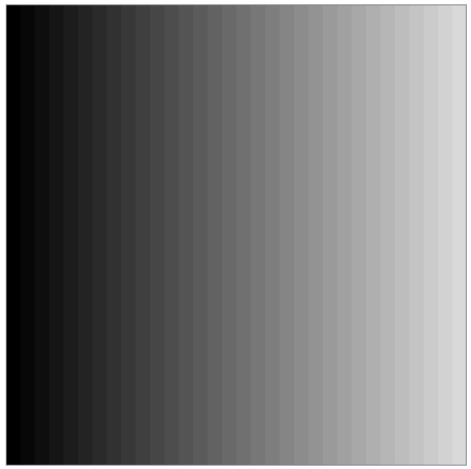
4:4:4 4:2:2 4:2:0

Data Loss – Bit Depth

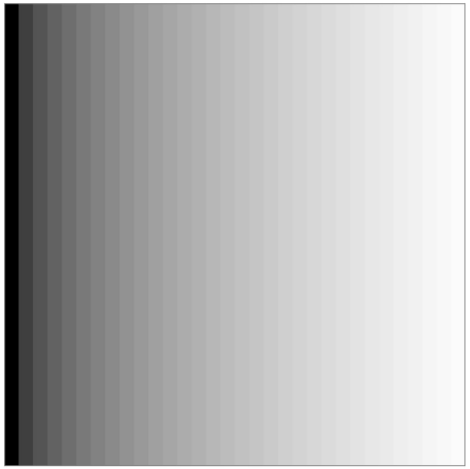
- The number of bits employed to indicate each pixel or each color component
- More accurate color representation in higher bit depth
- For example, 256, 1024, and 4096 different representations in 8, 10, and 12 bit depth, respectively



8 bit depth



5 bit depth



5 bit depth
(Gamma Encoding)

Encoding and Decoding

- Encoding from images to bitstream in a sender (Original image → Encoded bitstream)
- Decoding from bistream to images in a receiver (Encoded bitstream → Reconstructed image)

Encoding Decoding

Experiment – Encoding

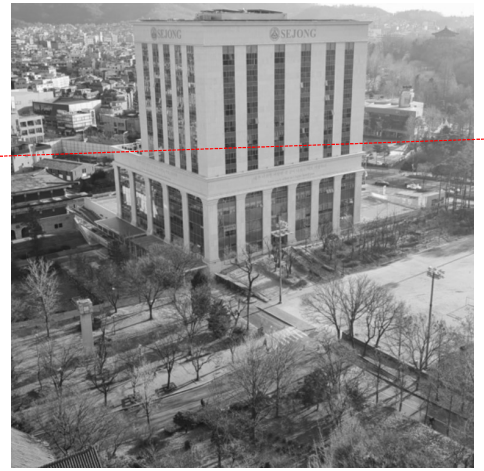
- Conversion from 8 to 4 bit-depth (Simply, ÷16 without rounding and then ×16) → Data loss
- Generation of bitstream with fixed-length codes (bitstream.txt)
- 0(0000), 16(0001), 32(0010), 48(0011), 64(0100), 80(0101), 96(0110), 112(0111), 128(1000), 144(1001), 160(1010), 176(1011), 192(1100), 208(1101), 224(1110), 240(1111)
- The number of bits (file size)
- Encoding complexity (Program execution time)

Experiment – Decoding

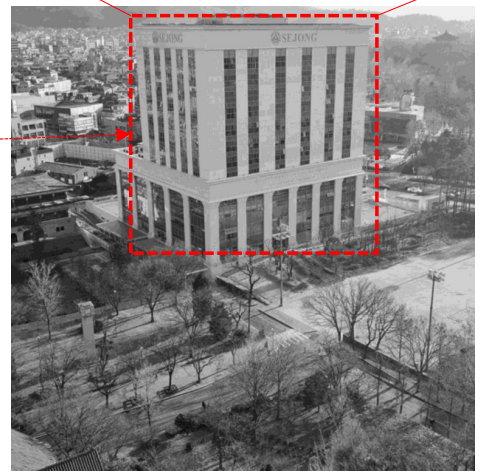
- Reconstruction of a 4 bit-depth image from a received bitstream (reconstruction.bmp)
- 0000(0), 0001(16), 0010(32), 0011(48), 0100(64), 0101(80), 0110(96), 0111(112), 1000(128), 1001(144), 1010(160), 1011(176), 1100(192), 1101(208), 1110(224), 1111(240)
- PSNR between original and reconstructed (decoded) images
- MOSs of original and reconstructed (decoded) images
- Decoding complexity (Program execution time)

Result

- File size of AICenterY.bmp = 768,486 Bytes
- File size of bitstream.txt = 1,048,576 Bytes
- PNSR of reconstruction.bmp = 29.20 dB
- Encoding time =0.04 sec
- Decoding time = 0.05 sec
- Subject Quality



AICenterY.bmp



reconstruction.bmp

Comparison

	File Size [Byte]	PSNR [dB]
Original (8 bit-depth, RGB/YYY.bmp)	768,486	99.99
Compression to 4 bit-depth (*.txt)	1,048,576	29.20
Compression to 2 bit-depth (*.txt)	524,288	16.60

AICenterY.bmp

4-bit-depth.bmp

2-bit-depth.bmp