

Image Compression and Coding Exercises

1. Recap the Huffman coding example on page 17 of the handout. For the source symbol table shown on page 4 of the handout, construct a Huffman code and calculate its average number of bits and compression ratio. Is it better than code 2 shown in the table?
2. What is predictive coding? What is the difference between the lossless predictive coding and lossy predictive coding? What is optimal Difference Pulse Code modulation (DPCM) and why only a sub-optimal, empirical DPCM is used in practice?
3. Derive the Lloyd-Max quantiser's decision and reconstruction levels for L=4 and uniform probability density function,

$$p(s) = \begin{cases} \frac{1}{2A}, & -A \leq s \leq A, \\ 0, & \text{otherwise} \end{cases}$$

4. In transform coding, what is the advantage of using DCT over DFT? In Matlab, reconstruct the basis functions of DFT and DCT shown on pages 25 and 26 of the handout respectively. Can you extend them to 8×8 blocks?
5. In transform coding, how is the compression achieved? What kind of transform is ideal or suitable for compression? What kind of images are difficult to compress or have low compression ratio? Give an example.
6. Draw a diagram or flow chart of JPEG encoder and decoder. Several video coding standards are based on block DCT scheme, describe the H.261 encoder by a function diagram. What are the improvements of H.264 over its previous standards?