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Neptun kód: ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

1. 10 point What considerations lead to the introduction of interlaced television system? The explanation should include perceptual aspects of choosing the frame rates in SD systems.

2. 15 point Calculate the active bitrate of a 4k UHDTV video stream (number of active pixels: 3840x2160 at frame rate of 60 Hz, with progressive scanning) if the chroma components are subsampled with a sampling scheme 4:2:2 and components are represented in 10 bits/sample!

3. 15 point Draw and analyize (give the transfer function) the block diagram of a feedback differential quantizer and the corresponding decoder! By using this analysis explain, why feedback structure is used in the encoder side instead of the more simple feedforward structure!

4. 10 point What is chroma subsampling? What are the most commonly used chroma subsampling schemes? What is the compression factor of the 4:2:0 scheme, compared to the 4:2:2 scheme?

5. 20 point Given a 2x2 sized pixel matrix, with the luminance values being

$$\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}.$$

Give the DCT coefficient matrix (i.e. give the 2D Discrete Cosine Transform), if the elements of the 1D transform matrix are given as $\mathbf{A} = A[k, m] = \sqrt{\frac{2}{N}}\, \alpha(k) \cos\left[\frac{\pi}{N}\left(m + \frac{1}{2}\right) k\right]$, where

$$\alpha(k) = \begin{cases} \frac{1}{\sqrt{2}} & \text{if } k \equiv 0 \\ 1 & \text{if } k \neq 0. \end{cases}$$

and k is the index of the DCT coefficient, m is the pixel index.

6. 20 point Draw the block diagram of an MPEG encoder! Explain the steps of the encoding process if the applied GOP structure is IBBP!

7. 4 point What are the basic axioms of image processing?

8. 3 point List the types of edge detection algorithms!

9. 3 point List the steps of Canny edge-filtering!