

Foundations of Multimedia technologies Exam. 2020.06.18.

Please give the answers in the blank space below the questions and on further additional blank papers *with indicating the name, Neptun ID and the no. of the given question!*

Total: 100 points 0-40 points: failure (1), 41-55 points: poor (2), 56-70 points: satisfactory (3), 71-85 points: good (4), 86-100 points: excellent (5)

Név: _____
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 UHD TV 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 4:2:0 and components are represented in 10 bits/sample!
3. **15 point** What is the goal of motion estimation? What is the goal of block matching (the explanation should include illustration)? Name several frequently used block matching algorithms.
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!