# Multimedia systems
The second homework

Homework assignment date: May 16, 2023

Deadline for submitting homework: May 27, 2023

Student: _____

1. In the video system, the total number of lines is 819, the vertical frequency is 50 Hz, interlaced scanning is used, the number of lines in active frame 737, and the duration of the horizontal blanking interval is 8.04 µs.
   a) For the image content shown below, draw the content of the highlighted lines and indicate the total line duration, the duration of the active part of the line, the duration of the horizontal blanking interval and the corresponding amplitude levels in volts.
   b) Calculate the duration of the active part of the frame.
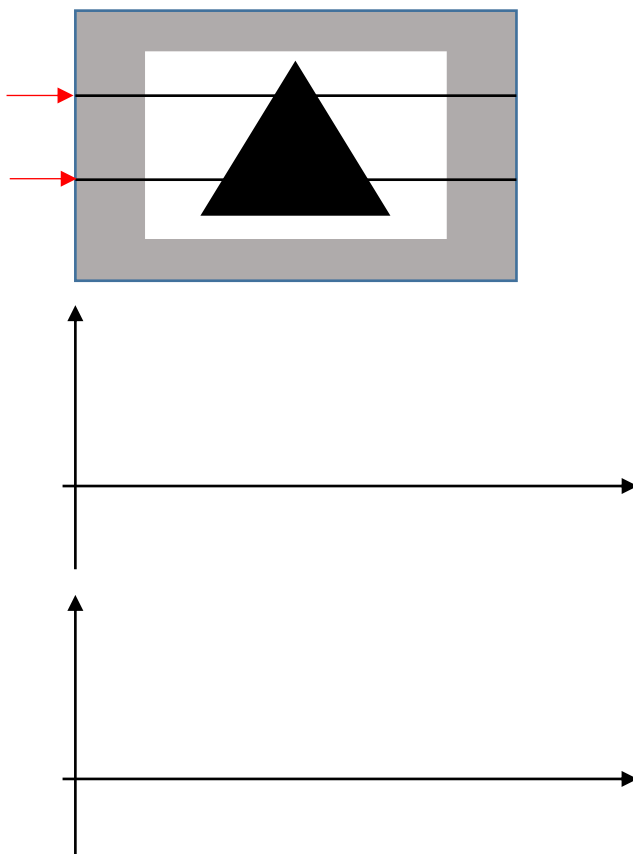
2. For saturated yellow image, calculate the luminance component and chrominance components (color difference signal for red ($E'_R-E'_Y$) and color difference signal for blue ($E'_B-E'_Y$)) in the EBU primary color system for which $E'_Y = 0.30\ E'_R + 0.59\ E'_G + 0.11\ E'_B$ and in the ITU-R BT.709 primary color system for which $E'_Y = 0.213\ E'_R + 0.715\ E'_G + 0.072\ E'_B$. Draw the yellow color from both systems in a color vector display and calculate the amplitude and phase of the yellow color for each system.

3. For 525/60 SDTV system, in which the sampling frequency of the luminance signal is 18 MHz, the active picture format is 960x486, and 10 bits/sample is used to encode the video samples, calculate the gross and useful bit-rate for 4:4:4, 4:2:2, 4:2:0 and 4:1:1 formats.

4. For 1280x720/50/P HDTV system, in which the total number of lines is 750, the sampling frequency of the luminance signal is 74.25 MHz, 10 bits/sample is used to encode the video signal samples, and the sampling structure is 4:2:2, calculate the total line duration, the number of samples in the active line taking into account all three signal components, the duration of the active part of the image, and the gross and useful bit-rate.

5. Specify the input block of 3x3 picture elements. The block should be obtained by entering the last nine digits of your JMBAG number. For example, if your JMBAG is 0036123456, the block would look like this:

0	3	6
1	2	3
4	5	6

Quantization matrix is:

2	3	5
3	4	6
5	6	7

a) Calculate the DCT coefficients for the given input block and then quantize the DCT coefficients. Round the obtained quantized coefficients to the nearest integer.
b) Calculate the compression ratio (CR) as the ratio of the number of picture elements of the input block and the number of nonzero quantized DCT coefficients.
c) Perform inverse quantization and IDCT. Round the obtained coefficients to the nearest whole number (it gives reconstructed block).
d) Calculate the PSNR (round to two decimal places) between the input and reconstructed block if the samples are encoded with 4 bits.