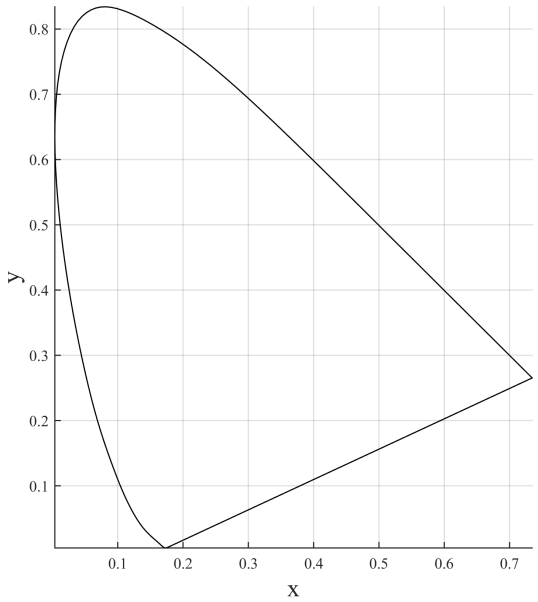
Foundations of Multimedia technologies Midterm exam. 2019.05.23.
Please give the answers in the blank space below the questions and on further additional blank papers *with indicating the name, Neptun ID and the no. of the given question*!
Total: 40 points 0-19 points: failure (1), 20-24 points: poor (2), 25-29 points: satisfactory (3), 30-34 points: good (4), 35-40 points: excellent (5)

Name: _____
Neptun ID: _____

1. [15 point] The RGB $\rightarrow$ XYZ transform matrix for the ITU-709 HDTV system is defined as:

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 0.4124 & 0.3576 & 0.1805 \\ 0.2126 & 0.7152 & 0.0722 \\ 0.0193 & 0.1192 & 0.9505 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}_{ITU-709}$$

   (a) [8 point] Calculate the xy chromaticity coordinates of the RGB primaries and the white point! Mark the location of these points in the horse-shoe diagram below, and illustrate the gamut of the color space (i.e. the location of the reproducible colors)!



   (b) [7 point] The ITU-709 RGB coordinates of an arbitrary color C are given as

$$C = \begin{bmatrix} 0 \\ 0.635 \\ 0.635 \end{bmatrix}.$$

   Calculate the luminance and the color difference components $(Y, R-Y, B-Y)$ of this color, illustrate its location in the $B-Y, R-Y$ coordinate system and calculate the hue and saturation of the given color point!

2. [10 point] What is chroma-subsampling, why was it introduced and what does the chroma subsampling scheme notation indicate? Describe the chroma subsampling schemes, used in the SD studio standard (ITU-601), in MPEG-1 and in MPEG-2!

3. [5 point] Calculate the active bitrate of a $1920 \cdot 1080/30/P$ format HD video stream if the chroma components are subsampled with a sampling scheme 4:2:2 and components are represented in 10 bits/sample!

4. [5 point] What was the common motivation behind creating the HDTV and UHDTV standards? List some improvements of UHDTV compared to HDTV!

5. [5 point] Calculate the optimal viewing distance for a HDTV display with the aspect ratio of 16:9 and the diameter being 60 inches (153 cm) in case of watching a full HD content with 1080 active lines!