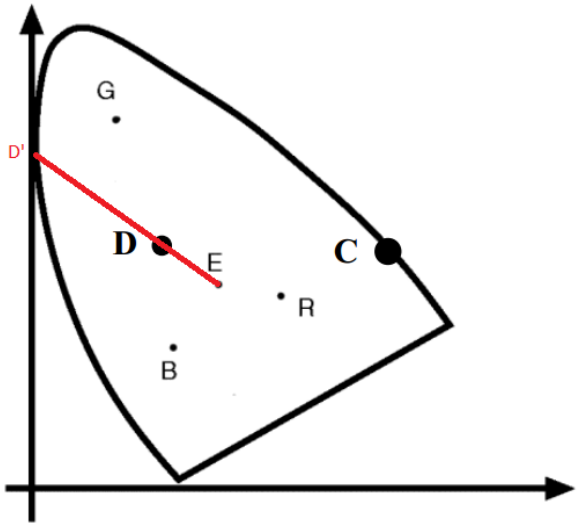
Color Theory

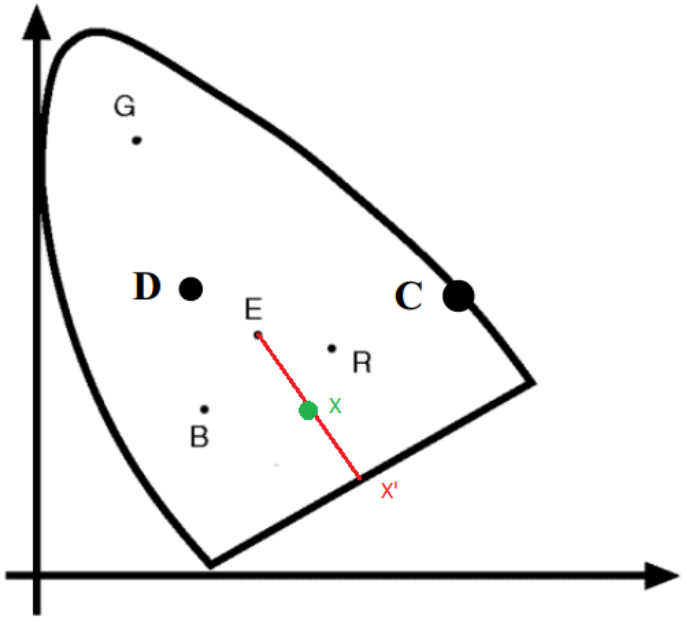
Assume E is the equiluminous point.

- In the image alongside find the dominant wavelength of color D. Show this wavelength.
  A:



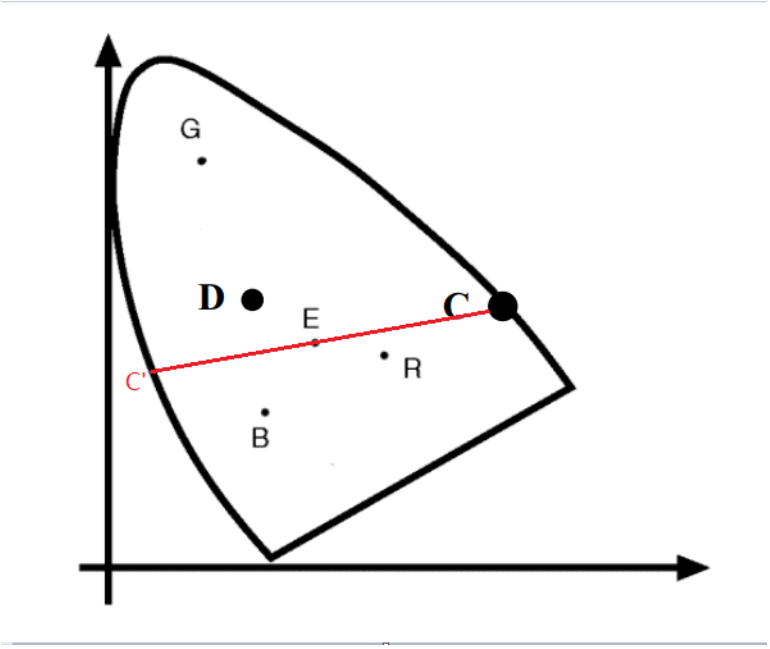
The wavelength represented by D' is the dominant wavelength of color D.

- Do all colors have a dominant wavelength? Explain your reasoning.
  A: No.



For color X we know that it can be produced by E and color X'. However, color X' is on the line of purples. That is to say, X' cannot be represented by one wavelength.

- Find the color which is complimentary to the color C and plot its location. What colors in the three dimensional RGB color space map to the equiluminous point E upon projection into the 2D chromaticity space.
  A:

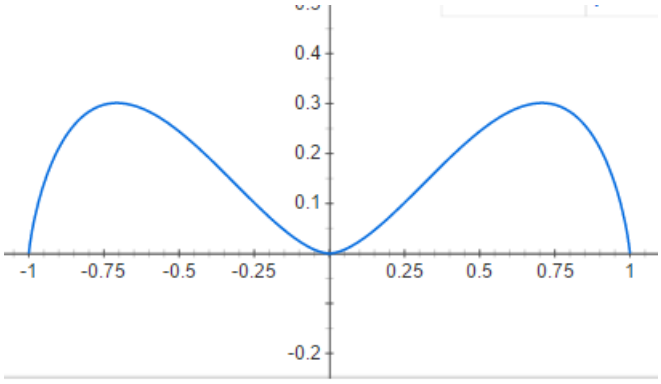


C' is complimentary to C'.
E represents the RGB color in which R=G=B.

Generic Compression

- Write down the entropy function and plot it as a function of *x*.
  A:

$$H(x) = -(x^2 log_2 x^2 + (1 - x^2) log_2 (1 - x^2))$$



- From your plot, for what value of *x* does the Entropy become a minimum?
  A: when $x = 0$ *or* $x = \pm 1$, the Entropy becomes minimum.
- Although the plot visually gives you the value of *x* for which the entropy in minimum, can you now mathematically find out the value(s) for which the entropy is a minimum?
  A: Let $H'^{(x)} = 2x log_2 (1 - x^2) - 2x log_2 x^2 = 0$, we have $x = 0$ *or* $x =$

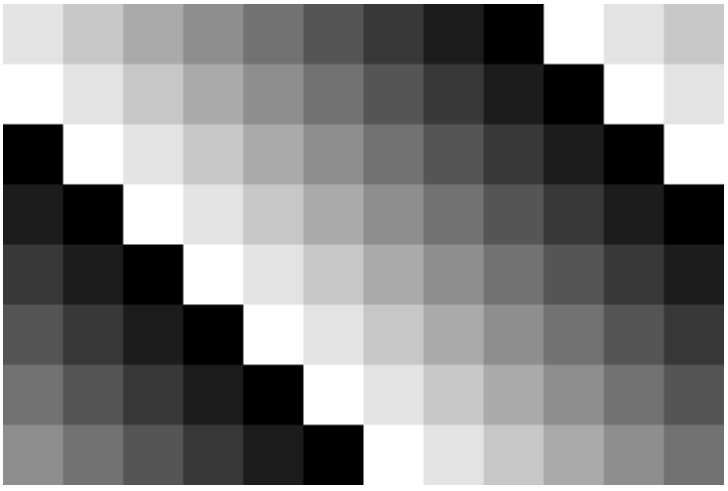
$\pm\frac{1}{\sqrt{2}}$. Taking these including boundary condition $x = \pm 1$ back to $H(x)$, we know $x = 0$ *or* $x = \pm 1$ are minima while $x = \pm\frac{1}{\sqrt{2}}$ are maxima.

• Can you do the same for the maximum, that is can you find out value(s) of *x* for which the value is a maximum?

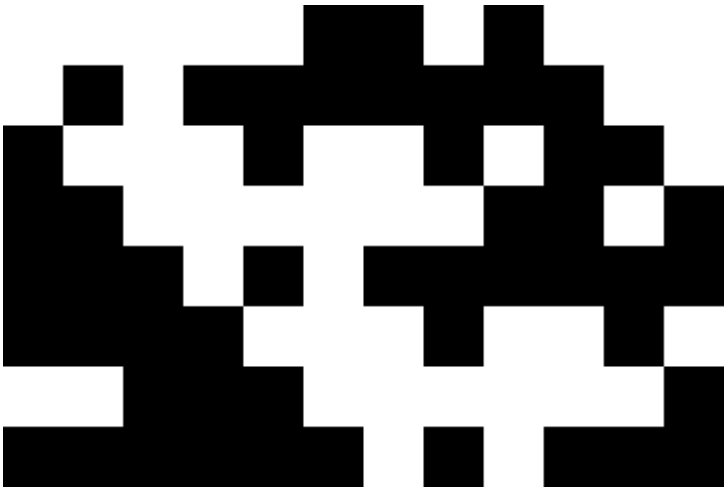
A: As analyzed above, while $x = \pm\frac{1}{\sqrt{2}}$, $H(x)$ has maximum value.

Image Dithering

• Plot the image and make sure that you submit a "zoomed" in image which properly shows all image gray values.



• Compute the output of a dithering operation using the dithering matrix D given below. Assume that the image top left coordinate indexes are [0, 0]. Show a graphical binary image plot of the dithered output.



• What if the image block's top left coordinate indexes start with [1, 1]. Show a graphical binary image plot of the dithered output.