Image Processing 1 - Exercise 6 - WiSe 2012/13

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a

The probability of a pixel to be one of the following is :

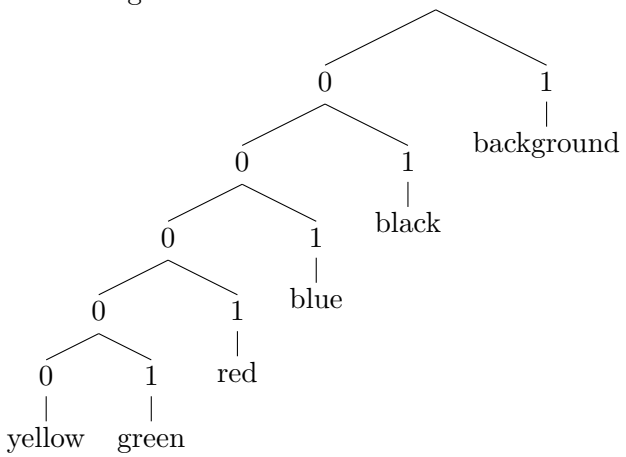
- background $.9$
- black $.1 \times .8 = .08$
- yellow $.1 \times .01 = .001$
- blue $.1 \times .12 = .012$
- red $.1 \times .05 = .005$
- green $.1 \times .02 = .002$

Therefore, the entropy of the documents would be :

$$\begin{aligned} H &= \sum P(g) log_2 \frac{1}{P(g)} \\ &= .9 \times log_2 \frac{1}{.9} + .08 \times log_2 \frac{1}{.08} + .001 \times log_2 \frac{1}{.001} + .012 \times log_2 \frac{1}{.012} \\ &\quad + .005 \times log_2 \frac{1}{.005} + .002 \times log_2 \frac{1}{.002} \\ &= 0.57100 \end{aligned}$$

b

Design the Huffman code according to the Huffan code tree shown below :



Thus the codes for each pixel should be :

- background `1`
- black `01`
- yellow `00000`
- blue `001`
- red `0001`
- green `00001`

c

The average code word length is

$$\begin{aligned}\bar{L} &= .9 \times 1 + .08 \times 2 + .001 \times 5 + .012 \times 3 + .005 \times 4 + .002 \times 5 \\ &= 1.1310\end{aligned}$$

d

The redundancy of the 4-bit-code is

$$4 - H = 3.4290$$

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Source code can be found in `src/segment.py`.

Original and segmented picture are as shown below: