HW1, EECS 203A
Fall 2004. UCI
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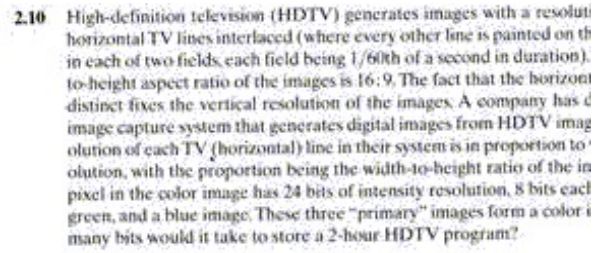
Problem 2.10 statment



2.10 High-definition television (HDTV) generates images with a resoluti horizontal TV lines interlaced (where every other line is painted on th in each of two fields, each field being 1/60th of a second in duration). to-height aspect ratio of the images is 16:9. The fact that the horizon distinct fixes the vertical resolution of the images. A company has d image capture system that generates digital images from HDTV imag olution of each TV (horizontal) line in their system is in proportion to olution, with the proportion being the width-to-height ratio of the in pixel in the color image has 24 bits of intensity resolution, 8 bits eacl green, and a blue image. These three "primary" images form a color i many bits would it take to store a 2-hour HDTV program?

Problem 2.10 solution

First calculate the number of pixels in each frame.

$$\begin{aligned}\text{Number of vertical lines} &= \frac{16}{9}\text{number of horizontal lines}\\ &= \frac{16}{9}1125\\ &= 2000\end{aligned}$$

Since this is interlaced, then one frame is made up of two fields each is $\frac{1125}{2}\times 2000$ pixels, and each is $\frac{1}{60}$ seconds long. (2 fields make up one frame)
Hence number of pixels in $\frac{1}{30}$seconds $= 2\times\frac{1125}{2}\times 2000 = 2,250,000$ pixels
Hence number of pixels in one second (using 30 fps) $= 30\times 2250\,000 = 67\,500\,000$ pixels
Then using 24 bits per pixel, we get $67\,500\,000\times 24 = 1620\,000\,000$ bits/second.
Then 2 hrs will require $1620\,000\,000\times 2\times 60\times 60 = 11,664,000,000,000$ bits or
$\frac{11664\,000\,000\,000}{8} = \boxed{1,458,000,000,000 \text{ bits}} = \frac{1458\,000\,000\,000}{8} = 182,250,000,000$ bytes[1]

[1] This is about 180 GBytes. MPEG-2 compression (1:50) this will go down to 3.6 GB (enough to fit on one DVD disk)

HW1, Problem 2.19
ECS 203A.
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Problem:
Show that an operator that computes median of a subinage area S is nonlinear.
Solution:
An operator F is linear if

$$F\left[\alpha S_1 + \beta S_2\right] = \alpha F\left[S_1\right] + \beta F[S_2]$$

To show that median is nonlinear operator, only need to provide one example of such case.
Conside image S_1 given by $\{2,4,1\}$ and S_2 given by $\{6,5,9\}$
Let $\alpha = 1$ and $\beta = 1$ (since definition is valid for any scalars α, β)
Apply the median operator on $S_1$and S_2
$\alpha F[S_1] = F[S_1] = F\{2,4,1\} = 2$
$\alpha F[S_2] = F[S_2] = F\{6,5,9\} = 5$
So

$$\alpha F\left[S_1\right] + \beta F[S_2] = 2 + 5 = 7 \tag{1}$$

Now add the two images togother (addition is by element to element) we get
$S_1 + S_2 = \{2,4,1\} + \{6,5,9\} = \{8,9,10\}$
So

$$F\left[\alpha S_1 + \beta S_2\right] = F\left[S_1 + S_2\right] = F\left\{8,9,10\right\} = 8 \tag{2}$$

Compare (1) and (2) above we see they not equal.
Hence the operator F (median) is not linear.