T-61.5100 Digital image processing, Exercise 1/07

1. Suppose that a flat area with center at (x_0, y_0) is illuminated by a light source with intensity distribution

$$i(x, y) = Ke^{-\left[(x-x_0)^2+(y-y_0)^2\right]}.$$

The reflectance $r(x, y)$ of the area is 1 and $K = 255$. If the resulting image is digitized using n bits of intensity resolution, and the eye can detect an abrupt change of eight shades of intensity between adjacent pixels, what value of n will cause visible false contouring?

2. A common measure of transmission for digital data is the number of bits transmitted per second (bit/s). Generally, transmission is accomplished in packets consisting of a start bit, a byte (8 bits) of information, and a stop bit. Using this approximation, answer the following:

   (a) How many minutes would it take to transmit a 512×512 image with 256 gray levels at 9600 bit/s?

   (b) What should be the capacity (bit/s) of a digital transfer channel, if images described in item a. (25 images/second) are to be transferred in real time?

3. In many image analysis problems a 'Mexican-hat' function can be successfully applied (figure 1a). This function is approximated using the function in figure 1b. Demostrate Mach bands in one dimension using this function. What would happen to a black ball on white background in two dimensions?

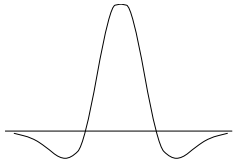

Fig. 1a.

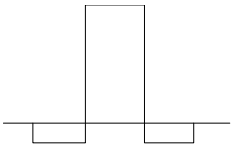

Fig 1b.

4. Consider the image segment shown below.

   (a) Let $V = \{0, 1\}$ and compute D_4-, D_8- ja D_{m}-distances between p and q.

   (b) Repeat for $V = \{1, 2\}$.

	3	1	2	$\boxed{1}$	$\leftarrow q$
	2	2	0	2	
	1	2	1	1	
$p \rightarrow$	$\boxed{1}$	0	1	2	

5. Consider the two image subsets S_1 and S_2 shown below. For $V = \{1\}$, determine how many

   (a) 4-connected

   (b) 8-connected

   (c) m-connected

components there are in S_1 and S_2. Are S_1 and S_2 adjacent?

	S_1				S_2				
0	0	0	0	0	0	0	1	1	0
1	0	0	1	0	0	1	0	0	1
1	0	0	1	0	1	1	0	0	0
0	0	1	1	1	0	0	1	1	1
0	0	1	1	1	0	0	1	1	1