Tutorial 3: Texture Retrieval and Shape-retrieval
(SEMESTER II: 2001-2002)

CS4241 Multimedia Information Systems

1. Consider these three gray-level texture images having only three gray-levels (0,1,2):

(A)

1	1	1	1
0	0	0	0
1	1	1	1
0	0	0	0
1	1	1	1
0	0	0	0
1	1	1	1
0	0	0	0

(B)

1	1	1	1
1	1	1	1
0	0	0	0
0	0	0	0
1	1	1	1
1	1	1	1
0	0	0	0
0	0	0	0

(C)

2	2	2	2
1	1	1	1
2	2	2	2
1	1	1	1
2	2	2	2
1	1	1	1
2	2	2	2
1	1	1	1

Choose an appropriate value of **d** and compute the gray-level co-occurrence matrix for all the three images. Use this feature to determine which two images are most similar.

2. Consider the matching of Tamura *directionality* feature using the normalized direction histogram for two images Q and D:

$$SIM_{\text{dir}}(Q,I) \;=\; \sum_{k=0}^{n-1}\left(\{1 \;-\; \frac{|NH_D(Q,k) \;-\; NH_D(I,k)|}{\max\left(NH_D(Q,k), NH_D(I,k)\right)}\}NH_D(Q,k)\right)$$

where n is number of quantized angles. Now this has a problem similar to that of the simple color histogram technique – perceptual similarity of adjacent bins of the histogram is ignored. Suggest a method, with appropriate mathematical expressions, for taking *perceptual similarity of angles* into account for this technique.

3. Develop a *relevance feedback* technique for texture image retrieval using the Tamura feature of *contrast* F_{contrast}. Provide precise mathematical expressions for your technique.

4. By comparing the turning angle profile of a large rectangle which is aligned to the axes and a small rectangle which is inclined with respect to the axes, show how the method of turning angles works. Explain how it achieves scale and rotation invariance.

5. This is about properties of Fourier descriptors:

   a) Compute the the first three Fourier shape descriptors of the object ABC with coordinates of boundary points given by $A = (0,-1)$, $B = (1,0)$, and $C = (0,1)$.

   b) Using the properties of Fourier descriptors and the descriptors of object ABC, compute the first three Fourier descriptors of object PQR where $P = (1,-1)$, $Q = (2,0)$ and $R = (1,1)$