Practise session 8: Segmentation.

1. Optimal thresholding, linear distributions. (1p)
   Suppose that an image contains the intensity distributions shown in Fig. 1 where $p_1(z)$ corresponds to the intensity of objects, and $p_2(z)$ to the intensity of the background.
   a) Now assume priori probabilities $P_1 = P_2$ and find the optimal threshold T between object and background pixels.
   b) What is the threshold T for the case $P_1 = 0.25$ and $P_2 = 0.75$?

2. Optimal thresholding, Gaussian distributions. (1p)
   An image is composed of small, non-overlapping blobs with the mean gray-value $\mu_o = 150$ and the variance $\sigma_o = 400$ scattered on a background with the mean gray-value $\mu_b = 25$ and the variance $\sigma_b = 625$. The blobs occupy approximately 20% of the image area. Propose a technique, based on thresholding, to find the blobs. Determine the threshold value in the specific case.

3. Region growing. (1p)
   Perform region growing for the image in Fig. 2. First choose the pixel with value 9 as the seed point, and then repeat the region growing using the top right corner pixel with value 6. Perform the growing of the region using the following criterion: a neighbor pixel (8-neighborhood assumed) is connected to the region, if its gray-value differs less than 2 units from the current mean of the previously selected pixels. Show the steps of your algorithm.

4. Split and merge (1p)
   Assume that $Q(R_i) = true$ for a region R_i if all pixels in $R_i$have the same intensity. Now the split and merge algorithm can be described as follows:

   1. While $Q(R_i) = false$ for region R_i, split region R_i into four disjoint quadrants.
   2. While $Q(R_i \cup R_k) = true$ for regions R_i and R_k, and R_i and R_k are adjacent, merge the regions R_i and R_k.

   Apply the algorithm to the image in Fig. 3. Name each region as they are formed (e.g. the first split creates regions R_i, R_2, R_3 and R_4) and draw the corresponding quadtree showing how the split and merge proceeds.

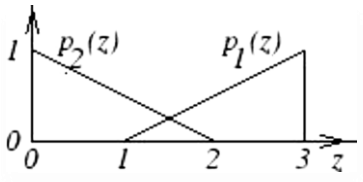

Fig. 1. Two intensities.

5	5	8	6
4	8	9	7
2	2	8	3
3	3	3	3

Fig. 2. A region.

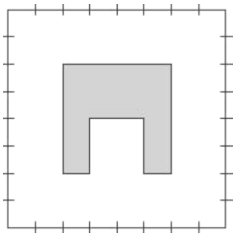

Fig. 3. An 8x8 image.