Fourth Year Mechatronics Department
CSE496: Digital Image Processing
Sheet #06: Image Segmentation
Spring 2015

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1- Write a computer algorithm for the Global thresholding technique in case of segmenting an image into three regions. In this case, the algorithm will estimate two thresholds, T1 and T2.
2- Write a computer algorithm for the adaptive thresholding technique.
3- Apply the global thresholding technique to segment the following image into two regions (object/background).

10	20	30	40
20	50	60	70
30	60	100	120
40	70	120	150

4- Assume that the PDFs of intensities inside and outside an object are given by $p_1(z) = Ae^{-z/255}$ and $p_2(z) = Be^{(z-255)/255}$ respectively. Assume that the prior probability of the object is 0.4 find the optimal threshold for this segmentation case. Note: you need to find the parameters A and B first considering the properties of the PDF/PMF.
5- Assume that the PDFs of intensities inside and outside an object are given by $p_1(z) = \frac{1}{\pi b}\frac{1}{1+(\frac{z-a1}{b})^2}$ and $p_2(z) = \frac{1}{\pi b}\frac{1}{1+(\frac{z-a2}{b})^2}$ respectively where a2>a1.
   a. Prove that the above PDFs are already normalized.
   b. Find the optimal threshold for segmentation assuming equal priors.
   c. What will be the probability of error corresponding to the optimal threshold?
6- Assume that the PDFs of intensities inside and outside an object are given by $p_1(z) = N(50,100)$ and $p_2(z) = N(170,150)$ respectively ($N(\mu,\sigma^2)$ is a Gaussian distribution where the first parameter is the mean while the second number is the variance). Find the optimal threshold for segmentation assuming that the object prior probability is 0.7.
7- Given the following sets of intensity samples taken from inside and outside an object respectively { 49, 48, 46, 46, 45, 44, 43, 42, 40, 39}, { 219, 217, 216, 217, 217, 216, 215, 214, 214, 214}:-

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a. Estimate the object and background parameters assuming Gaussian distributions.
b. Assuming equal priors, find the optimal threshold parameter for segmentation.
c. Classify the following intensity into their corresponding regions {60, 70, 80, 90, 120, 140,190, 220, and 250}.

8- Given the following sets of color-vector samples taken from inside and outside an object respectively { $\begin{bmatrix}146\\125\\140\end{bmatrix}$, $\begin{bmatrix}130\\121\\140\end{bmatrix}$, $\begin{bmatrix}110\\105\\125\end{bmatrix}$, $\begin{bmatrix}202\\201\\197\end{bmatrix}$, $\begin{bmatrix}160\\144\\144\end{bmatrix}$, $\begin{bmatrix}67\\64\\75\end{bmatrix}$, $\begin{bmatrix}19\\18\\23\end{bmatrix}$, $\begin{bmatrix}20\\22\\32\end{bmatrix}$, $\begin{bmatrix}20\\21\\26\end{bmatrix}$, $\begin{bmatrix}82\\81\\112\end{bmatrix}$}, {$\begin{bmatrix}148\\124\\96\end{bmatrix}$, $\begin{bmatrix}154\\137\\111\end{bmatrix}$, $\begin{bmatrix}181\\168\\136\end{bmatrix}$, $\begin{bmatrix}185\\172\\153\end{bmatrix}$, $\begin{bmatrix}114\\87\\60\end{bmatrix}$, $\begin{bmatrix}159\\142\\122\end{bmatrix}$, $\begin{bmatrix}163\\138\\107\end{bmatrix}$, $\begin{bmatrix}149\\132\\102\end{bmatrix}$, $\begin{bmatrix}169\\155\\129\end{bmatrix}$, $\begin{bmatrix}140\\114\\87\end{bmatrix}$}:-

a. Estimate the object and background parameters assuming Gaussian distributions.
b. Assume equal priors, classify the following intensity into their corresponding regions {$\begin{bmatrix}100\\124\\96\end{bmatrix}$, $\begin{bmatrix}154\\100\\111\end{bmatrix}$, $\begin{bmatrix}11\\68\\16\end{bmatrix}$, $\begin{bmatrix}85\\72\\53\end{bmatrix}$, $\begin{bmatrix}114\\150\\16\end{bmatrix}$}. Note that for computation issues, you need to use $\log(P_1)+\log(p_1(z))$ and $\log(P_2)+\log(p_2(z))$ instead of $P_1p_1(z)$ and $P_2p_2(z)$.
