CS/RBE 549 Computer Vision Name:_____
Fall 2019 Due: Monday 9 Sep 2019

HW #2

1. You have been asked to develop a medical imaging system to process a time series of 3-dimensional images of the heart, yielding a 4-dimensional image array with indices x, y, z, t. Give two distinct connectivity relations that could be used. What are a pixel's neighbors under each connectivity relation?

2. In homogeneous coordinates, a rotation followed by a translation is represented by

$$\begin{bmatrix} \boldsymbol{R} & \vdots & \vec{T} \\ \cdots & & \cdots \\ 0 & \vdots & 1 \end{bmatrix}$$

What is the inverse operation? Hint: It is not $\begin{bmatrix} \boldsymbol{R^{-1}} & \vdots & -\vec{T} \\ \cdots & & \cdots \\ 0 & \vdots & 1 \end{bmatrix}$.

3. An image has object and background pixels whose brightness values are distributed according to the Rayleigh distribution with parameters σ_o and σ_b with $0 < \sigma_b < \sigma_o$. The probability of a pixel having brightness k is given by

$$P_o(k) = \frac{k}{{\sigma_o}^2} e^{\frac{-k^2}{2{\sigma_o}^2}} \text{ and } P_b(k) = \frac{k}{{\sigma_b}^2} e^{\frac{-k^2}{2{\sigma_b}^2}}$$

Ima Robot wants to segment the image into object and background.

   a. Assuming that background and object pixels are equally likely, find the decision rule that maximizes the probability of a correct decision, that is, pick the greater of P_o and P_b.
   b. How does your answer to a. change if background and object pixels are *not* equally likely? Suppose that there are N_o object pixels and N_b background pixels, so that the total number of pixels is $N=N_o+N_b$. What is the new threshold T?

4. Not for extra credit: Binarize your selfie from HW0 in 2 ways:

   a. Threshold the image such that ~50% of the pixels are black and ~50% are white.
   b. Some other method of your choosing. Explain your method.