2011 INTRODUCTION TO GRAPHICS NOTES

ADDITIONAL NOTES AND EXERCISES

JAN KAUTZ

DEPARTMENT OF COMPUTER SCIENCE, UNIVERSITY COLLEGE LONDON

LECTURE 4: BASIC IMAGE PROCESSING

HISTOGRAM EQUALIZATION

Histogram Equalization makes the histogram as uniform as possible, effectively increasing the contrast of an image. Given the normalized histogram $p(r_k)$, one can show that the Cumulative Distribution Function (CDF) $T(r_k)$ can be used for this. $T(r_k)$ is defined as:

$$s_k = T(r_k) = \int_0^{r_k} p(w)dw$$

A flat histogram $p^f(r_k) = 1$ has a CDF of $T^f(r_k) = r_k$. Since, we want the histogram of $p(r_k)$ to be more like $p^f(r_k)$, we set $T(r_k) = T^f(r_k)$, which yields $r_k := s_k$. Please note that care has to be taken to bring r_k into the correct range. E.g., for an 8-bit image, you want to multiply s_k by 255.

ADDITIONAL SOURCES

Many introductory texts exist on image processing. See for example *Java2D, Knudsen*, Chapter 10 or *The Computer Image, Watt and Policarpo*, Sections 9.1 and 10.2.1, 10.2.2.

EXERCISES

1. Think about some common image operations you might use in a paint package such as Photoshop or GIMP. Which could be implemented more quickly with interleaved arrays (RGBA in a single array), and which could be implemented more quickly with separate arrays?
2. How would you do histogram equalization for colour images? Why is the simple solution problematic?