UNIVERSIDADE NOVA DE LISBOA
Faculdade de Ciências e Tecnologia
Departamento de Informática

TESTE

Disciplina: **Computação Multimédia**
2º Teste

30 de Maio de 2014

1) The image histograms can be altered in different ways by changing the pixels to improve the image quality.

   a) Write a set of functions in C/C++ or a class in C + + to apply a linear transformation (mx + b) to the histogram of a grayscale image in grayscale. The method or function that applies the transformation may have the following signature:
   `void applyLinearTransform(unsigned char *img, int w, int h, int m, int b)`.

   b) Considering the previous function (**`applyLinearTransform`**) applied to grayscale images specify the values to use for the parameters m and b, so that histograms taking values between 10 and 128 will take values between 0 and 255.

2) Multimedia retrieval systems typically use metadata multimedia information and not directly the multimedia information.

   a) What are the reasons for this option?
   b) Describe two types of metadata used in multimedia information stating how they can be used.

3) The result of a convolution filter can be calculated as follows for each pixel in an image I(x,y):

$$G_1[j, k] = (I[j + 1, k + 1] + 2I[j + 1, k] + I[j + 1, k - 1]) - (I[j - 1, k + 1] + 2I[j - 1, k] + I[j - 1, k - 1])$$
$$G_2[j, k] = (I[j - 1, k - 1] + 2I[j, k - 1] + I[j + 1, k - 1]) - (I[j - 1, k + 1] + 2I[j, k + 1] + I[j + 1, k + 1])$$
$$G[j, k] = |G_1[j, k]| + |G2[j, k]|$$

   a) Specify the masks to apply this filter in the form of 3x3 matrices.

   b) What is the result of applying this filter? Justify the answer by applying the filter to representative image fragments. Consider a grayscale image, with 8 bits per pixel.

4) A set of 24 Gabor filters will be applied to a I(x, y) image to evaluate texture features. We can assume that there is a **`Image mkKernel(int kernel)`**function that accepts as a parameter the number of the kernel and returns the corresponding image of this kernel.

   a) What are the main steps for implementing these filters in order to evaluate texture features that can be used to compare images.
   b) Give a concrete example of application of these filters to photographic images, justifying your answer.

5) Consider a set of images where noise with the following characteristics was added: 2% of the pixels in random positions, were altered to the values 0 or 255. Which of the following filters should be used to remove noise? Describe the expected results for each of the filters.
   - Median filter
   - Convolution filter:

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   1/9 1/9 1/9
   1/9 1/9 1/9