COMP70058 Computer Vision

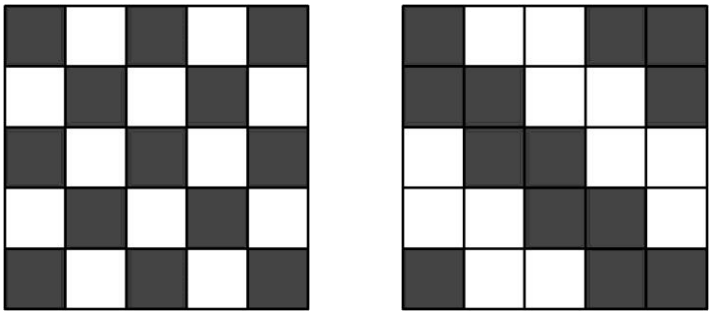
Tutorial 3 – Texture and Region Based Segmentation

1. In lecture 7, we explained how cross-correlation can be used for template matching to localise an object in an image. For applications in which the brightness of the image and template can vary due to different lighting conditions, the images can be first normalized. This is typically done at every step by subtracting the mean and dividing by the standard deviation. This refinement is called normalized cross-correlation and it is mathematically defined as:

$$C(u,v) = \frac{\sum_{x,y}\left[I(x,y) - \overline{I_{u,v}}\right]\left[T(x-u,y-v) - \bar{T}\right]}{\sqrt{\sum_{x,y}\left[I(x,y) - \overline{I_{u,v}}\right]^2 \sum_{x,y}\left[T(x-u,y-v) - \bar{T}\right]^2}}$$

(a) Perform normalised cross-correlation to localise the Queen's Tower on the provided image of the Imperial South Kensington Campus using the image "Tempate.png" as your template. Display the matched area on the "Scene.png" image.
(b) Repeat the above process using the smaller template provide in "Tempate_small.png".
(c) Describe your results and explain why they are different. What does this tell you about the limitations of cross-correlation for identifying objects in real-world images?

2. The following two pictures represent image windows onto two different textured images. The images are bi-level, with the black pixels having grey level 0 and the white having grey level 1. Both patterns have mean of one half and high variance.



Calculate the co-occurrence matrices for the horizontal, vertical and diagonal directions with distances of one and two pixels respectively (there are eight in total).

Remember that from a given pixel in a given direction, say horizontal, you should look in both directions for co-occurrences. You can save yourself work by noting the symmetry in the patterns. No assumptions should be made about the values of neighbouring pixels outside the window. Only co-occurrences inside the window should be counted.

From the co-occurrence matrices, compute an eight by one characteristic vector for each region using:

a) Energy
b) Entropy
c) Maximum.

Which one would give the best discrimination?