Homework #5

1. Show that the function
\[ d_t(u, v) = |u_1 - v_1| + |u_2 - v_2| \]
is a distance function.

2. By using the notion of the distance transform, based on the Euclidean distance function, propose a procedure that calculates the translation invariant erosion of a shape \( F \) by a disk structuring element of radius \( r \).

3. You are given the following shape \( F \):

   ![Shape Image](image)

   What is the Euclidean distance between points \( A \) and \( B \)? What is their geodesic distance? What is the relationship between the Euclidean and geodesic distance?

4. The following binary image \( F \) is to be segmented into its constituents. By using the binary watershed transform, determine the watershed lines associated with this segmentation problem.
5. From the following grayscale image we are interested in extracting the internal region labeled by $\mathcal{R}$. Propose a watershed based technique, which is based on a pair of internal/external markers, that allows you to do so.

![Image of a region labeled \( \mathcal{R} \)](image)

6. The following grayscale image is to be segmented into three non-overlapping regions, each containing a single object. Propose a simple algorithm that allows you to do so.

![Image of a segmented grayscale image with three objects](image)