Laboratory work №1. Potentials method

In potentials method each pixel of the given binary image (fig. 1) is associated with the value of it's potential. In basic version of the method every black pixel's potential equals to one, otherwise to zero. Thus the image could be encoded by the sequence of its potentials. For example, the first image in fig.1 will be presented as 1,1,1,1,1,1,1,0,0,0,0,0… (row by row).

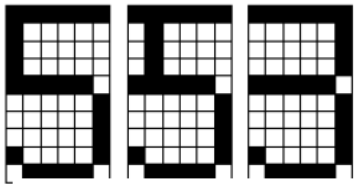
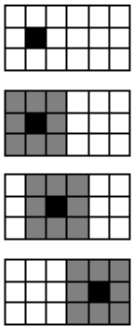


Figure 1. An example of binary image

The following improvement in the encoding method may be proposed:
We associate with each firing element of the field of receptors (the image of our case) a certain function equal to one on this element, on adjacent elements and to zero- on the sites of the receptor field, distant from the given one by more than one unit. Suppose that each digit of the image code, except for zero and one, can take other, including fractional, values equal to the potential value on the corresponding element of the receptor field. An example is on the fig. 2.



This image represents the basic potentials method

This one represents modified method with fractional values of adjacent elements.

The code of this image is following $\frac{1}{2}\frac{1}{2}\frac{1}{2}000\frac{1}{2}1\frac{1}{2}000\frac{1}{2}\frac{1}{2}\frac{1}{2}000.$

The code of this image with shifted firing element is $0\frac{1}{2}\frac{1}{2}\frac{1}{2}000\frac{1}{2}1\frac{1}{2}000\frac{1}{2}\frac{1}{2}\frac{1}{2}00.$

Figure 2. Modified potentials method

Using potentials in the receptor space, we took as the distance between two points the number of distinguished bits in the codes of the corresponding figures, or the Euclidean distance between the points. In the modification method the greater distances between the elements of the figures on image in the receptor field correspond to larger distances in the receptor space.

Let's apply the modified encoding method on more complex figures. We will use the following rule: every firing element of the receptor field has its own potential equal to one, and increases the potentials of all (including the firing) elements adjacent to it horizontally, vertically and diagonally.

The distance between the two fives (see Fig. 3, a and b) will then be 2.25, and the distance between the five in Fig. 3, a and the triple of Fig. 3, c - 5.22.

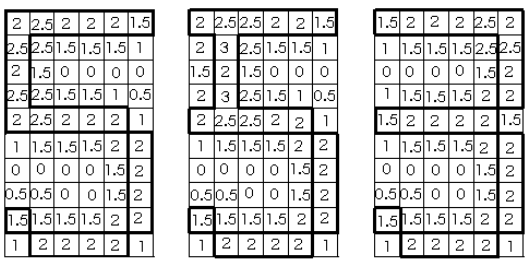


Figure 3. Usage of potentials

Thus, when potentials are used on the receptor field, the distance between objects of different images turns out to be much larger than the distance between two objects of the same image, although with the "old" encoding method these distances were the same. This is because the new encoding method better reflects the mutual removal of the elements of the figures on the receptor field, and therefore better conveys the differences between the figures.

You need to implement the modified potentials method and show how it works on any dataset. Please find the suggested dataset here https://yadi.sk/d/5X1w_Riy3UePaz. Feel free to use any programming language, but Python is recommended.