Homework #3

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1. Erosion and Dilation

1) Apply dilation to the given binary image using the above structuring element.

$$\begin{pmatrix}
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&1&1&1&0&0&0&0&0&0&0&0&0&0\\
0&0&1&1&1&1&1&0&0&0&0&0&0&0&0&0\\
0&0&1&1&1&1&1&0&0&0&0&0&1&1&1&0\\
0&0&1&1&1&1&0&0&0&0&0&1&1&1&1&0\\
0&0&0&1&1&0&0&0&0&0&1&1&1&1&1&0\\
0&0&0&0&0&0&0&0&0&1&1&1&1&1&0&0\\
0&0&0&0&0&0&0&0&1&1&1&1&1&0&0&0\\
0&0&0&0&0&0&0&1&1&1&1&1&0&0&0&0\\
0&0&0&0&0&0&1&1&1&1&1&0&0&0&0&0\\
0&0&0&0&0&1&1&1&1&1&0&0&0&0&0&0\\
0&0&0&0&0&1&1&1&1&1&1&1&1&0&0&0\\
0&0&0&0&0&1&1&1&1&1&1&1&1&0&0&0\\
0&0&0&0&0&0&1&1&1&1&1&1&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0
\end{pmatrix}$$

The above image shows the result of applying dilation to the given binary image. The painted ones as pink should be one(1), and the others should be zero(0). The structuring element is [[1 1 0] [1 1 1] [0 1 1]] array. Therefore, when we apply dilation, if the center of a part of the matrix is 1, then we could change 0 to 1 in the part of the matrix as the shape of the structuring element.

2) Apply erosion to the given binary image using the above structuring element.

$$\begin{pmatrix}
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&1&1&1&0&0&0&0&0&0&0&0&0&0\\
0&0&1&1&1&1&1&0&0&0&0&0&0&0&0&0\\
0&0&1&1&1&1&1&0&0&0&0&0&1&1&1&0\\
0&0&1&1&1&1&0&0&0&0&0&1&1&1&1&0\\
0&0&0&1&1&0&0&0&0&0&1&1&1&1&1&0\\
0&0&0&0&0&0&0&0&0&1&1&1&1&1&0&0\\
0&0&0&0&0&0&0&0&1&1&1&1&1&0&0&0\\
0&0&0&0&0&0&0&1&1&1&1&1&0&0&0&0\\
0&0&0&0&0&0&1&1&1&1&1&0&0&0&0&0\\
0&0&0&0&0&1&1&1&1&1&0&0&0&0&0&0\\
0&0&0&0&0&1&1&1&1&1&1&1&1&0&0&0\\
0&0&0&0&0&1&1&1&1&1&1&1&1&0&0&0\\
0&0&0&0&0&0&1&1&1&1&1&1&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0
\end{pmatrix}$$

The above image shows the result of applying erosion to the given binary image. The painted ones as blue should be one(1), and the others should be zero(0). The structuring element is [[1 1 0] [1 1 1] [0 1 1]] array. Therefore, when we apply erosion, if the position of the structuring element is matched with value 1, the given binary image must have value 1 equally. If not, the part of the matrix changed as 0 values. And if all values match with the structuring element, the center would remain its 1 value.

2. Textures

a) 6. It's because there are 6 numbers of 3x3 neighborhoods that match the X.

b) ⅔. As we get in question 2a, the 3x3 neighborhood numbers which match the ones of X were 6, and the number of the dark center ones among 6 was 4. So it is 4/6 = ⅔

c) 9. It's because 9 numbers of neighborhoods exist that match neighborhoods of X.

d) ⅔. As we get in question 2d, the number of 4 pixel neighborhoods was 9, and the number of the dark center ones among 9 was 6. So it is 6/9 = ⅔

3. Security issues in artificial intelligence

We cannot deny that artificial intelligence improves our world more efficiently. But there are some problems that cannot be ignored below the huge development. The free deepfake face-swapping app had lots of attention by the reason of amusement, that normal people could make the video as they were in the movie scenes or TV show. But the problem happens when they use this application to others.

The BBC news on July 19, 2017 broadcasted the problem of deepfake by introducing the video called 'Fake Obama created using AI video tool'. In the video, Obama, a former president, looks like to give a presentation. But the important thing is, it's a deepfake video, which means the whole video is a fake. Like this case, if someone make deepfake video with someone who has enormous influence like a president, the national rights can be lost. Furthermore, if someone makes sexual deepfake video with other people, the damage that people receive would be inestimable. To prevent these cases, we should set some rules.

First of all, We have to enact legislation to strengthen penalties for production, distribution, possession, and viewers of illegal deepfake videos. Of course, there would be risks with this law. The owner of deepfake video may inadvertently view or download video. Therefore, for alternative solutions, we should solve this problem as a technological way.

Developing artificial intelligence with the ability to extract original photos from processed images should be a solution. In other words, the solution could be 'developing artificial intelligence that distinguishes deep fake images and videos'. From the Korea Advanced Institute of Science and Technology has released a smartphone app that detects deep fakes. In this app, if we upload a part of the video as a photo, the application tells you how likely the video is to be a deepfake.

There are various solutions to counter deepfakes, but the important thing is to know how wrong the abuse of deepfakes is. As AI develops, education on technical ethics is also necessary.