Consider the 5x5 matrix below as an example of a toy image. A convolution is a moving dot product applied to the image. Shown next to the image is a toy 3x3 convolution which we apply across the entire image from left to right while shifting down by one row. For example the top left value of the new matrix is given by the dot product of the convolution (-1, -1, 1, -1, 1, -1, 1, -1, -1) with the top left 3x3 of the image (2,3,7,6,4,10,4,5,8).

| 2 | 3 | 7 | 2 | 1 |
|---|---|---|---|---|
| 6 | 4 | 10 | 4 | 2 |
| 4 | 5 | 8 | 9 | 2 |
| 5 | 6 | 7 | 2 | 1 |
| 6 | 9 | 5 | 0 | 4 |

| -1 | -1 | 1 |
|---|---|---|
| -1 | 1 | -1 |
| 1 | -1 | -1 |

| -19 | -18 | ? |
|---|---|---|
| ? | ? | ? |
| ? | ? | ? |

Above we see on the right the output of a convolution. In a convolutional neural network (our eventual goal) we activate the output of the convolutional filter with for example sign(x), sigmoid(x), or relu(x). If we do the sign activation on the above output we get the matrix shown below.

| -1 | -1 | ? |
|---|---|---|
| ? | ? | ? |
| ? | ? | ? |