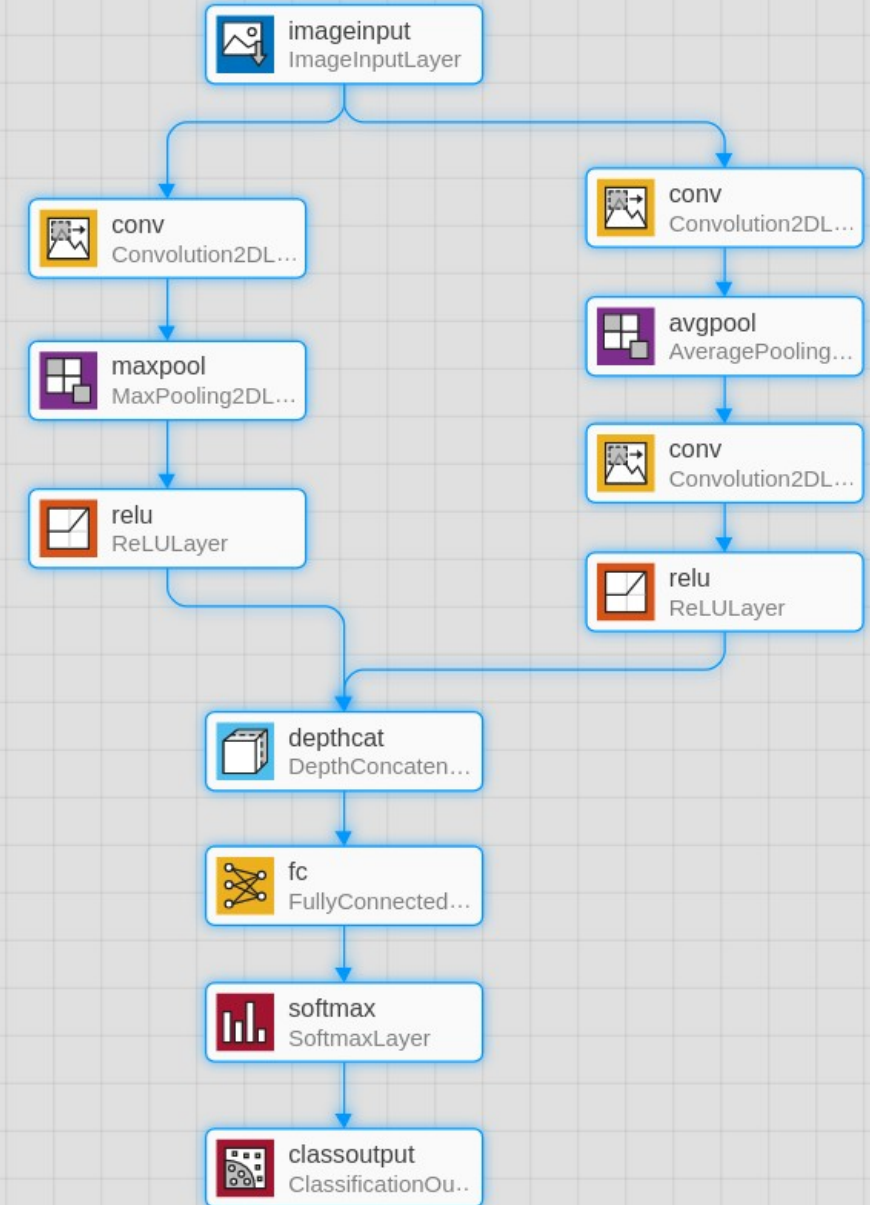
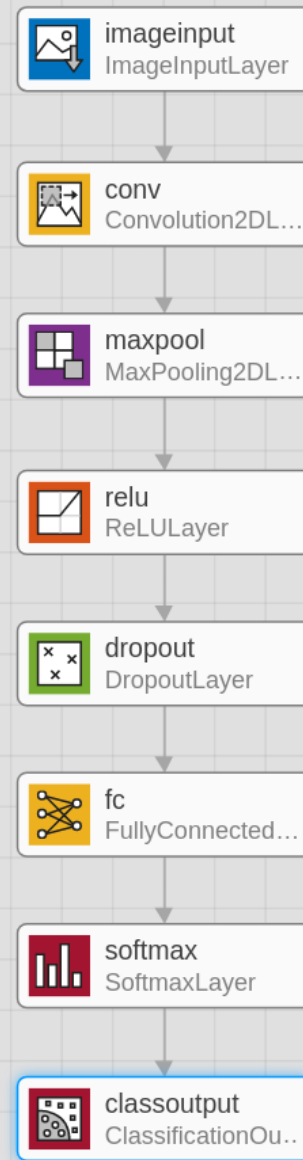
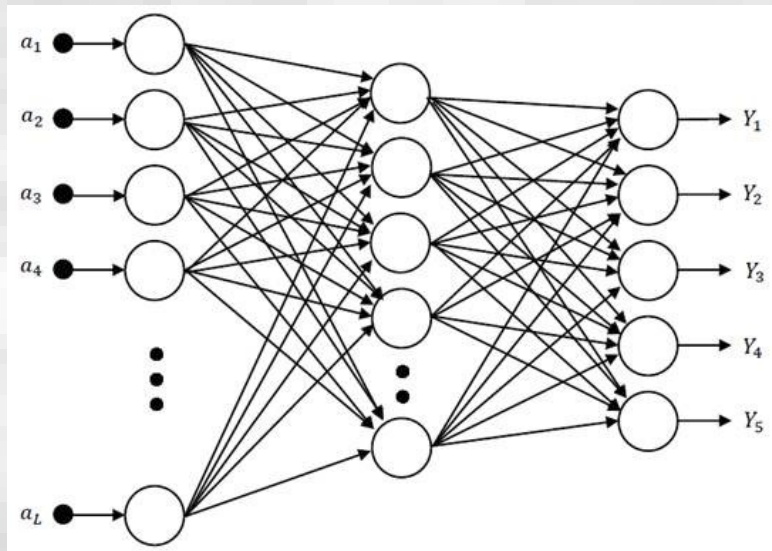


# Архитектура



# Вход

1365



2048



224



224

# Свертка

|    |    |    |   |
|----|----|----|---|
| 1  | 3  | -1 | 0 |
| 2  | -2 | 0  | 5 |
| 4  | 1  | -1 | 3 |
| -3 | 0  | 1  | 2 |

|   |    |
|---|----|
| 1 | 0  |
| 2 | -1 |

|    |    |    |
|----|----|----|
| 7  | -1 | -6 |
| 9  | 1  | -5 |
| -2 | 0  | -1 |

# Свертка

$$1*1+3*0+2*2+(-2*-1)=7$$

|    |    |    |   |
|----|----|----|---|
| 1  | 3  | -1 | 0 |
| 2  | -2 | 0  | 5 |
| 4  | 1  | -1 | 3 |
| -3 | 0  | 1  | 2 |

|   |    |
|---|----|
| 1 | 0  |
| 2 | -1 |

|    |    |    |
|----|----|----|
| 7  | -1 | -6 |
| 9  | 1  | -5 |
| -2 | 0  | -1 |

# Свертка

|    |    |    |   |
|----|----|----|---|
| 1  | 3  | -1 | 0 |
| 2  | -2 | 0  | 5 |
| 4  | 1  | -1 | 3 |
| -3 | 0  | 1  | 2 |

|   |    |
|---|----|
| 1 | 0  |
| 2 | -1 |

$$1*1+3*0+2*2+(-2*-1)=7$$

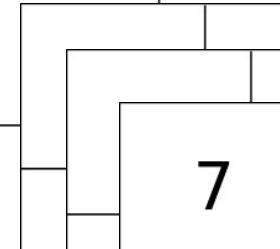
$$3*1-1*0-2*2+0*-1=-1$$

|    |    |    |
|----|----|----|
| 7  | -1 | -6 |
| 9  | 1  | -5 |
| -2 | 0  | -1 |

# Свертка

|    |    |    |   |
|----|----|----|---|
| 1  | 3  | -1 | 0 |
| 2  | -2 | 0  | 5 |
| 4  | 1  | -1 | 3 |
| -3 | 0  | 1  | 2 |

The diagram illustrates a stack of 5 rectangles, each divided into four quadrants labeled 1, 0, 2, and -1. The rectangles are stacked such that the top rectangle is offset to the right and up, revealing the quadrants of the rectangles underneath. The top rectangle's quadrants are labeled 1 (top-left), 0 (top-right), 2 (bottom-left), and -1 (bottom-right). The other 4 rectangles are identical but their labels are not visible as they are obscured by the top rectangle.



A 3x3 grid of numbers is shown, with a stack of four such grids behind it, creating a 3D effect. The numbers in the grid are:

|    |    |    |
|----|----|----|
| 7  | -1 | -6 |
| 9  | 1  | -5 |
| -2 | 0  | -1 |

# Свертка



|    |   |    |
|----|---|----|
| 2  | 4 | 9  |
| -5 | 1 | 7  |
| -2 | 0 | -1 |



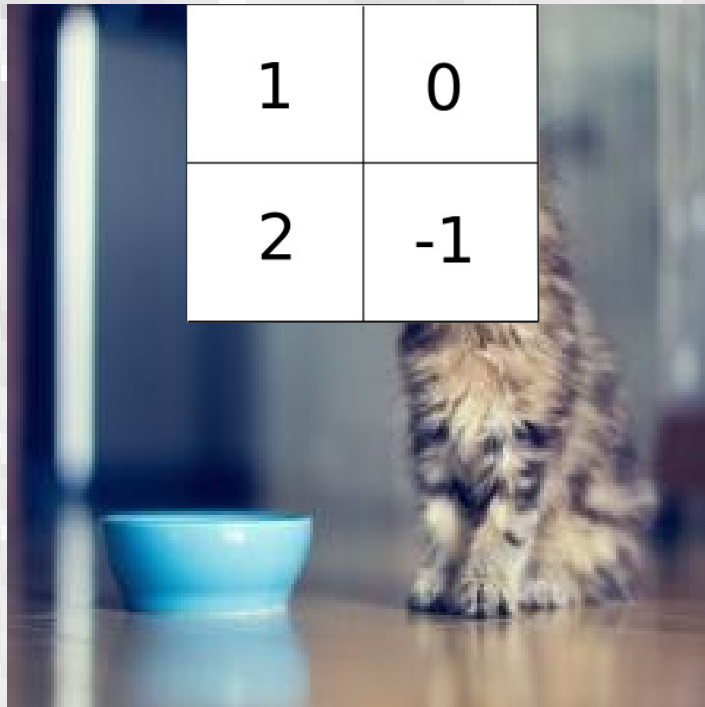
# Свертка



|    |   |    |
|----|---|----|
| 2  | 4 | 9  |
| -5 | 1 | 7  |
| -2 | 0 | -1 |



# Свертка



|    |   |    |
|----|---|----|
| 2  | 4 | 9  |
| -5 | 1 | 7  |
| -2 | 0 | -1 |

# Свертка



|    |   |    |
|----|---|----|
| 2  | 4 | 9  |
| -5 | 1 | 7  |
| -2 | 0 | -1 |

# Ректификация (ReLU)

|    |    |    |
|----|----|----|
| 7  | -1 | -6 |
| 9  | 1  | -5 |
| -2 | 0  | -1 |

$$f(x) = \max(0, x)$$

|   |   |   |
|---|---|---|
| 7 | 0 | 0 |
| 9 | 1 | 0 |
| 0 | 0 | 0 |

# Субдискретизация (pooling)

|    |    |    |   |
|----|----|----|---|
| 1  | 3  | -1 | 0 |
| 2  | -2 | 0  | 5 |
| 4  | 1  | -1 | 3 |
| -3 | 0  | 1  | 2 |

|  |  |
|--|--|
|  |  |
|  |  |

## Субдискретизация (pooling)

|    |    |    |   |
|----|----|----|---|
| 1  | 3  | -1 | 0 |
| 2  | -2 | 0  | 5 |
| 4  | 1  | -1 | 3 |
| -3 | 0  | 1  | 2 |

|   |  |
|---|--|
| 3 |  |
|   |  |

## Субдискретизация (pooling)

|    |    |    |   |
|----|----|----|---|
| 1  | 3  | -1 | 0 |
| 2  | -2 | 0  | 5 |
| 4  | 1  | -1 | 3 |
| -3 | 0  | 1  | 2 |

|   |   |
|---|---|
| 3 | 5 |
|   |   |

# Субдискретизация (pooling)

|    |    |    |   |
|----|----|----|---|
| 1  | 3  | -1 | 0 |
| 2  | -2 | 0  | 5 |
| 4  | 1  | -1 | 3 |
| -3 | 0  | 1  | 2 |

|   |   |
|---|---|
| 3 | 5 |
| 4 |   |

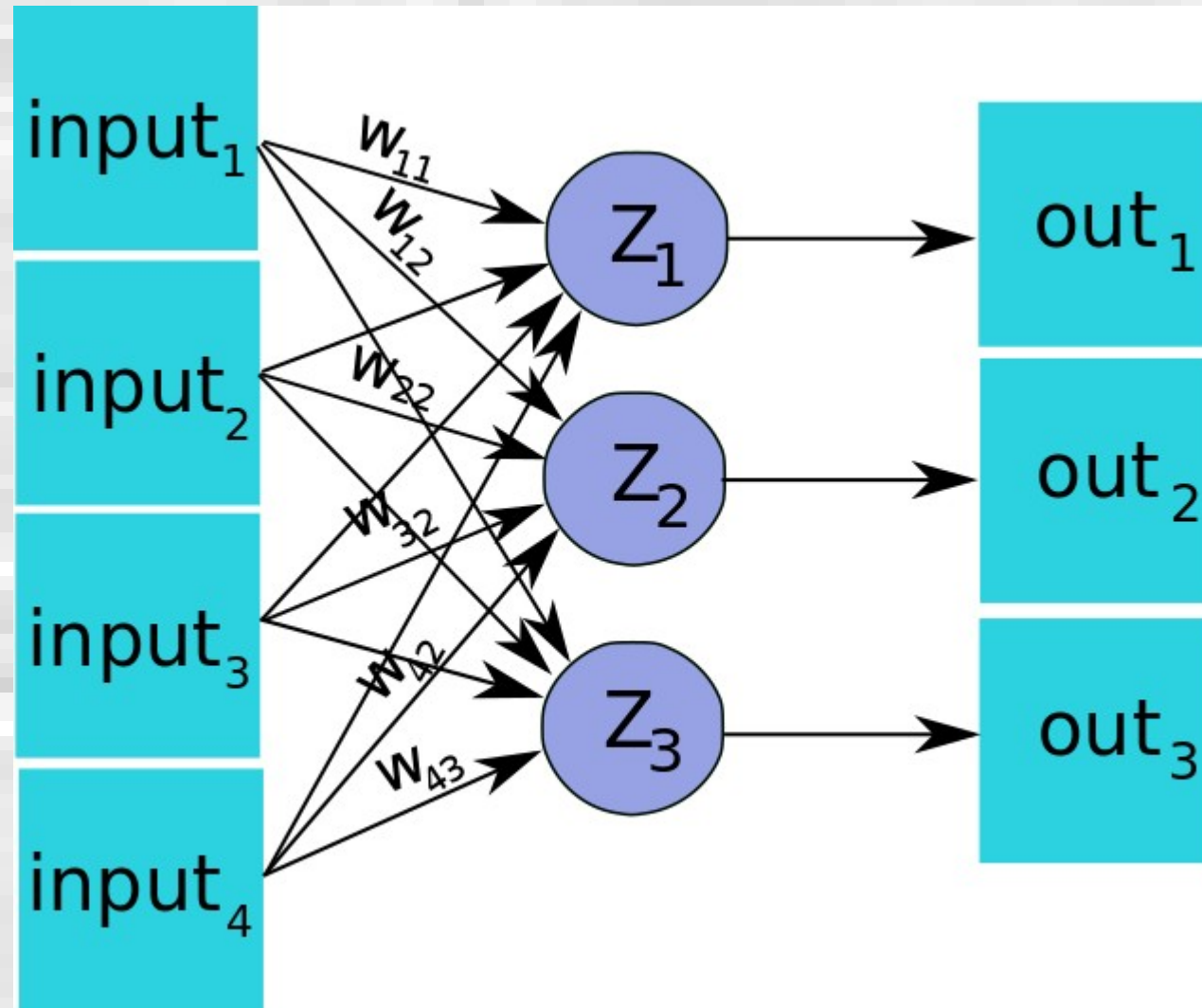


# Субдискретизация (pooling)

|    |    |    |   |
|----|----|----|---|
| 1  | 3  | -1 | 0 |
| 2  | -2 | 0  | 5 |
| 4  | 1  | -1 | 3 |
| -3 | 0  | 1  | 2 |

|   |   |
|---|---|
| 3 | 5 |
| 4 | 3 |

# Полносвязный слой

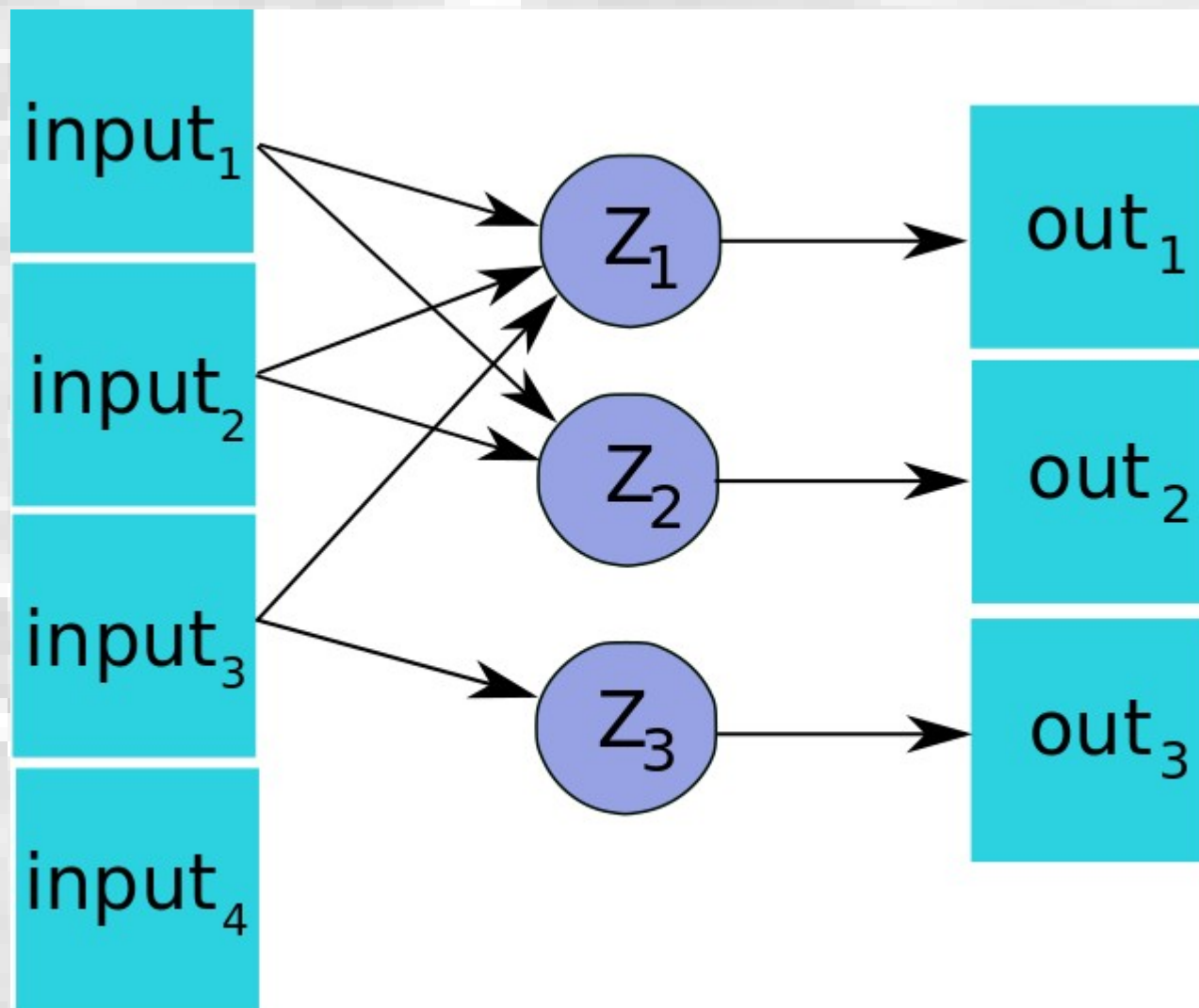


# Softmax

$$p(C_k|x) = \frac{p(x|C_k)p(C_k)}{\sum_{j=1}^K p(x|C_j)p(C_j)} = \frac{e^{a_k}}{\sum_{j=1}^K e^{a_j}}$$

$$a_k = \ln p(x|C_k)p(C_k)$$

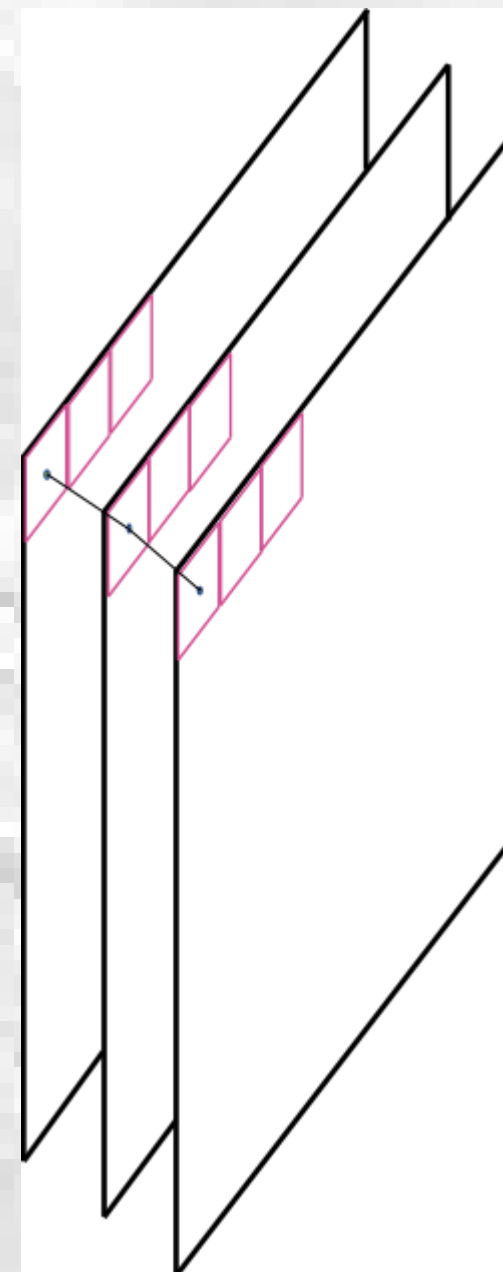
# Слой нормализации: dropout



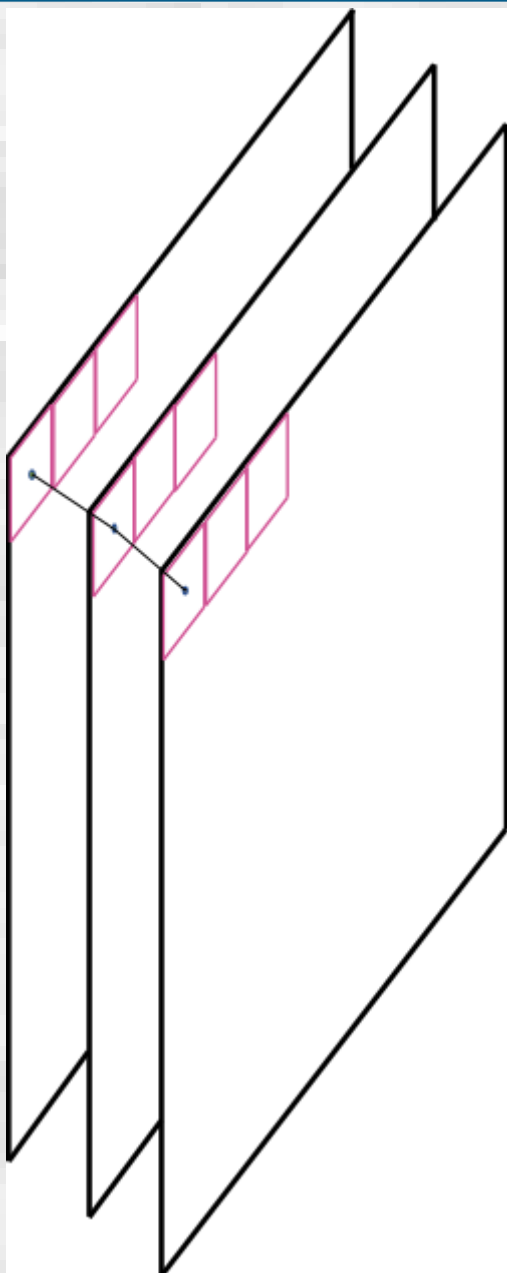
# Слои нормализации: BatchNormalization

$$\hat{x}_i = \frac{x_i - \mu_B}{\sigma_B^2 + \epsilon}$$

$$\hat{y}_i = \gamma \hat{x}_i + \beta$$



# Слой нормализации: CrossChannelNormalization



$$x' = \frac{x}{\left( K + \frac{\alpha \cdot SS}{windowChannelSize} \right)^\beta}$$