

# Нейронные сети

## *Математический разбор*

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# Введение

Для следующего цикла будет расписаны действия за одну итерацию

for i in range(16):

```
prediction = neural_network(input_params, weights) # Home work
```

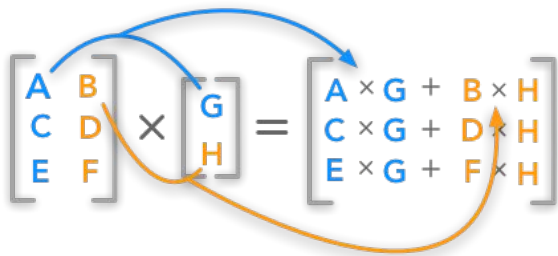
```
error = (prediction - goal_prediction) ** 2
```

```
delta = prediction - goal_prediction
```

```
weight_deltas = np.outer(delta, input_params) # Home work
```

```
weights = weights - (weight_deltas * alpha)
```

# Prediction



weight\_param

$$\begin{bmatrix} 0.1 ; 0.1 ; -0.3 \\ 0.1 ; 0.2 ; 0.0 \\ 0.0 ; 1.3 ; 0.1 \end{bmatrix}$$

input\_param

$$\begin{bmatrix} 8.5 \\ 0.65 \\ 1.2 \end{bmatrix}$$

x

=

$$0.85 + 0.065 - 0.36$$

$$0.85 + 0.13 + 0$$

$$0 + 0.845 + 0.12$$

$$= \begin{bmatrix} 8.5 * 0.1 + 0.65 * 0.1 + 1.2 * (-0.3) ; 8.5 * 0.1 + 0.65 * 0.2 + 1.2 * 0 ; 8.5 * 0 + 0.65 * 1.3 + 1.2 * 0.1 \end{bmatrix} =$$

$$= \begin{bmatrix} 0.5550 ; 0.9800 ; 0.9650 \end{bmatrix}$$

# Error

$$\begin{array}{c} \text{prediction} \\ \left( \begin{array}{c} 0.555 \\ 0.98 \\ 0.965 \end{array} \right) \end{array} - \begin{array}{c} \text{goal\_prediction} \\ \left( \begin{array}{c} 0.1 \\ 1 \\ 0.1 \end{array} \right) \end{array}^2 = \left( (0.555-0.1)^2; (0.98-1)^2; (0.965-0.1)^2 \right) =$$
$$= \left( 0.207 ; 0.0004 ; 0.7482 \right)$$

# Delta

$$\begin{array}{cc} \text{prediction} & \text{goal\_prediction} \\ \left( \begin{array}{c} 0.555 \\ 0.98 \\ 0.965 \end{array} \right) & - \left( \begin{array}{c} 0.1 \\ 1 \\ 0.1 \end{array} \right) \end{array} = \left( 0.555-0.1 ; 0.98 - 1 ; 0.965-0.1 \right) =$$
$$= \left( 0.455; -0.02 ; 0.865 \right)$$

# Weight deltas

$$\begin{bmatrix} a_1 \\ a_2 \\ \dots \\ a_N \end{bmatrix} \cdot [b_1, b_2, \dots, b_N] = \begin{bmatrix} a_1 b_1 & a_1 b_2 & \dots & a_1 b_N \\ a_2 b_1 & a_2 b_2 & \dots & a_2 b_N \\ \dots & \dots & \dots & \dots \\ a_N b_1 & a_N b_2 & \dots & a_N b_N \end{bmatrix}$$

внешнее умножение

$$\begin{array}{c} \text{delta} \\ a1 \\ a2 \\ a3 \end{array} \begin{pmatrix} 0.4550 \\ -0.0200 \\ 0.8650 \end{pmatrix} \times \begin{array}{c} \text{input\_params} \\ \begin{pmatrix} 8.5 ; 0.65 ; 1.2 \end{pmatrix} \\ b1 \quad b2 \quad b3 \\ \text{кол-во} \quad \% \quad \text{кол-во} \\ \text{игр} \quad \text{побед} \quad \text{фанатов} \end{array} =$$

$$= \begin{pmatrix} 0.4550*8.5 ; 0.4550*0.65 ; 0.4550*1.2 \\ -0.0200*8.5 ; -0.0200*0.65 ; -0.0200*1.2 \\ 0.8650*8.5 ; 0.8650*0.65 ; 0.8650*1.2 \end{pmatrix} = \begin{pmatrix} 3.8675 ; 0.2958 ; 0.5460 \\ -0.1700 ; -0.0130 ; -0.0240 \\ 7.3525 ; 0.5623 ; 1.0380 \end{pmatrix}$$

# New weights

$$\begin{array}{c} \text{weight\_param} \\ \left( \begin{array}{l} 0.1 ; 0.1 ; -0.3 \\ 0.1 ; 0.2 ; 0.0 \\ 0.0 ; 1.3 ; 0.1 \end{array} \right) - \begin{array}{c} \text{weight\_deltas} \\ \left( \begin{array}{l} 3.8675 ; 0.2958 ; 0.5460 \\ -0.1700 ; -0.0130 ; -0.0240 \\ 7.3525 ; 0.5623 ; 1.0380 \end{array} \right) \end{array} \times \begin{array}{c} \text{alpha} \\ 0.01 \end{array} = \end{array}$$

$$\begin{array}{c} \text{weight\_param} \\ \left( \begin{array}{l} 0.1 ; 0.1 ; -0.3 \\ 0.1 ; 0.2 ; 0.0 \\ 0.0 ; 1.3 ; 0.1 \end{array} \right) - \begin{array}{c} \text{weight\_deltas} \\ \left( \begin{array}{l} 0,038675 ; 0,002958 ; 0,00546 \\ -0.001700 ; -0.000130 ; -0.000240 \\ 0.073525 ; 0.005623 ; 0,010380 \end{array} \right) \end{array} = \begin{array}{c} \text{new\_weights} \\ \left( \begin{array}{l} 0,038675 ; 0,0970 ; -0,30546 \\ 0,1017 ; 0,20013 ; 0,000240 \\ -0,073525 ; 1,294377 ; 0,08962 \end{array} \right) \end{array}$$