

IZVODI PRAVILA UČENJA

$$E_i = \frac{1}{2} (t_i - o_i)^2$$

$$o_i = \frac{w_1 f_1 + w_2 f_2 + \dots + w_m f_m}{w_1 + w_2 + \dots + w_m}$$

$$f_k = p_k \cdot x + g_k \cdot y + b_k$$

$$\overline{w_k} = \frac{w_k}{w_1 + w_2 + \dots + w_m}$$

$$z_k = \mu_{A_k}(x_i) = \frac{1}{1 + e^{b_k(x_i - a_k)}} \quad w_k = z_k \cdot \beta_k$$

$$\beta_k = \mu_{B_k}(y_i) = \frac{1}{1 + e^{c_k(y_i - c_k)}}$$

$$p_k \longrightarrow f_k \longrightarrow o_i \longrightarrow E_i$$

$$\frac{dE_i}{dp_k} = \frac{dE_i}{do_i} \cdot \frac{do_i}{df_k} \cdot \frac{df_k}{dp_k}$$

$$\frac{dE_i}{do_i} = -(t_i - o_i) \quad \frac{do_i}{df_k} = \frac{w_k f_k}{w_1 + w_2 + \dots + w_m} = \overline{w_k} \cdot f_k$$

$$\frac{dE_i}{dp_k} = -(t_i - o_i) \cdot \overline{w_k} \cdot f_k \cdot x_i$$

$$g_k \longrightarrow f_k \longrightarrow o_i \longrightarrow E_i$$

$$\frac{dE_i}{dg_k} = \frac{dE_i}{do_i} \cdot \frac{do_i}{df_k} \cdot \frac{df_k}{dg_k} = -(t_i - o_i) \cdot \overline{w_k} \cdot y_i$$

$$r_k \rightarrow f_k \rightarrow o_i \rightarrow E_i$$

$$\frac{dE_i}{dr_k} = \frac{dE_i}{do_i} \cdot \frac{do_i}{df_k} \cdot \frac{df_k}{dr_k} = -(t_i - o_i) \cdot \bar{w}_k$$

$$M_k \rightarrow L_k \rightarrow w_k \rightarrow o_i \rightarrow E_i$$

$$\frac{dE_i}{dM_k} = \frac{dE_i}{do_i} \cdot \frac{do_i}{dw_k} \cdot \frac{dw_k}{dL_k} \cdot \frac{dL_k}{dM_k}$$

$$\frac{do_i}{dw_k} = \frac{f_k \cdot \sum_{j=1}^m w_j - \sum_{j=1}^m w_j f_j}{\left(\sum_{j=1}^m w_j\right)^2} = \frac{\sum_{j=1}^m w_j (f_k - f_j)}{\left(\sum_{j=1}^m w_j\right)^2}$$

$$\frac{dw_k}{dL_k} = \beta_k$$

$$\frac{dL_k}{dM_k} = L_k(1 - L_k) \cdot b_k$$

$$\frac{dE_i}{dM_k} = -(t_i - o_i) \cdot \frac{\sum_{j=1}^m w_j (f_k - f_j)}{\left(\sum_{j=1}^m w_j\right)^2} \cdot \beta_k \cdot L_k(1 - L_k)$$

$$b_k \rightarrow L_k \rightarrow w_k \rightarrow o_i \rightarrow E_i$$

$$\frac{dE_i}{db_k} = \frac{dE_i}{do_i} \cdot \frac{do_i}{dw_k} \cdot \frac{dw_k}{dL_k} \cdot \frac{dL_k}{db_k}$$

$$\frac{dL_k}{db_k} = L_k \cdot (1 - L_k) \cdot (n_k - x_i)$$

$$\frac{dE_i}{db_k} = -(t_i - o_i) \cdot \frac{\sum_{j=1}^m w_j \cdot (f_k - f_j)}{\left(\sum_{j=1}^m w_j\right)^2} \cdot \beta_k \cdot L_k \cdot (1 - L_k) \cdot \underbrace{(n_k - x_i)}$$

$$c_k \rightarrow \beta_k \rightarrow w_k \rightarrow o_i \rightarrow E_i$$

$$\frac{dE_i}{dc_k} = \frac{dE_i}{do_i} \cdot \frac{do_i}{dw_k} \cdot \frac{dw_k}{d\beta_k} \cdot \frac{d\beta_k}{dc_k}$$

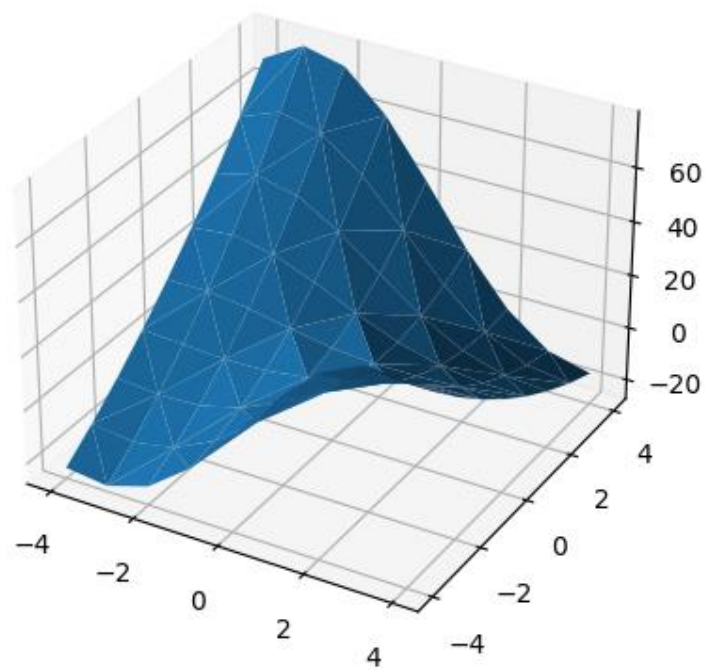
$$\frac{dw_k}{d\beta_k} = L_k \quad \frac{d\beta_k}{dc_k} = \beta_k (1 - \beta_k) \cdot c_k$$

$$d_k \rightarrow \beta_k \rightarrow w_k \rightarrow o_i \rightarrow E_i$$

$$\frac{dE_i}{dd_k} = \frac{dE_i}{do_i} \cdot \frac{do_i}{dw_k} \cdot \frac{dw_k}{d\beta_k} \cdot \frac{d\beta_k}{dd_k}$$

$$\frac{d\beta_k}{dd_k} = \beta_k \cdot (1 - \beta_k) \cdot (d_k - y_i)$$

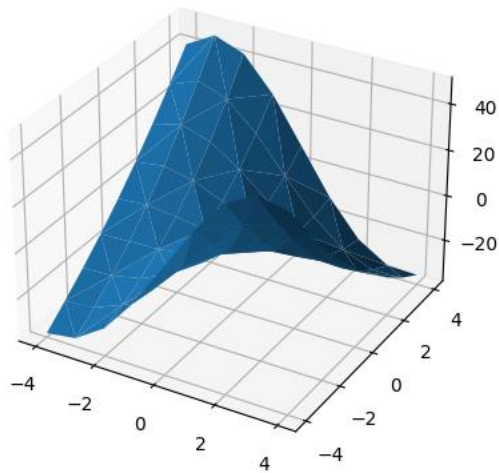
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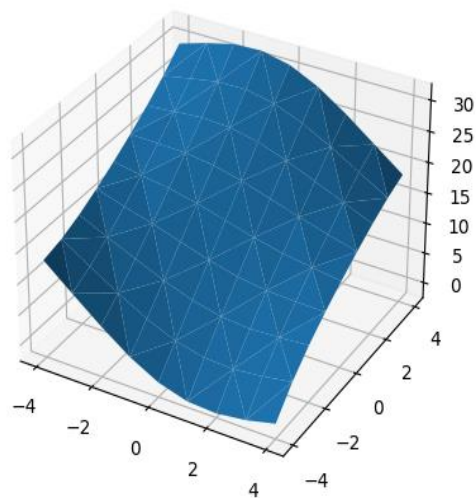
1 PRAVILO

SGD

FUNKCIJA GREŠKE

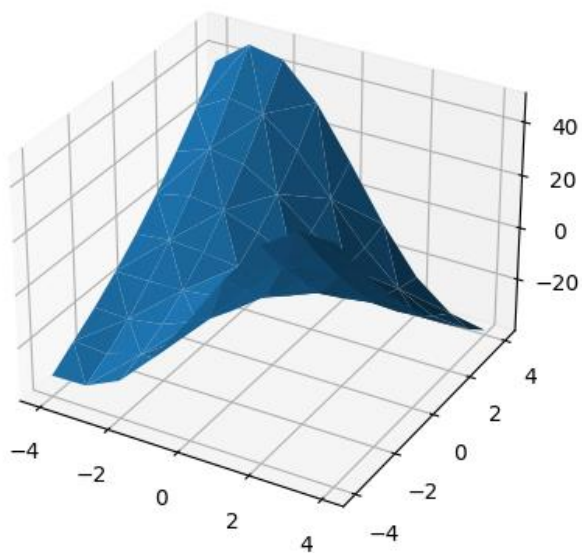


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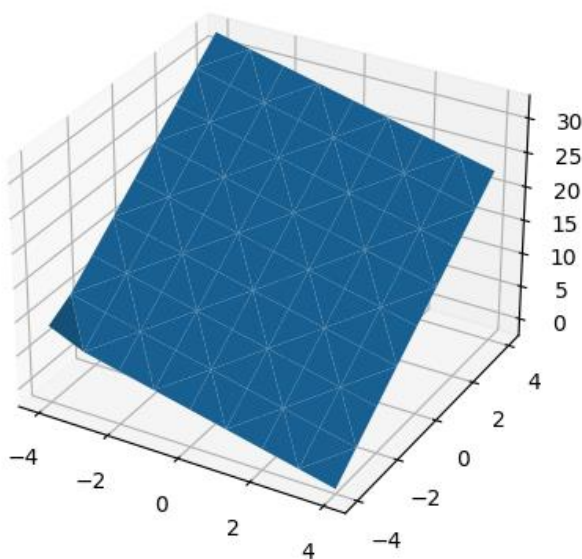


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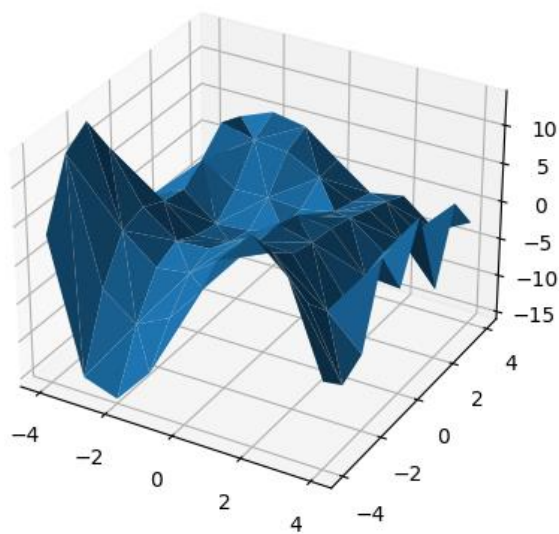
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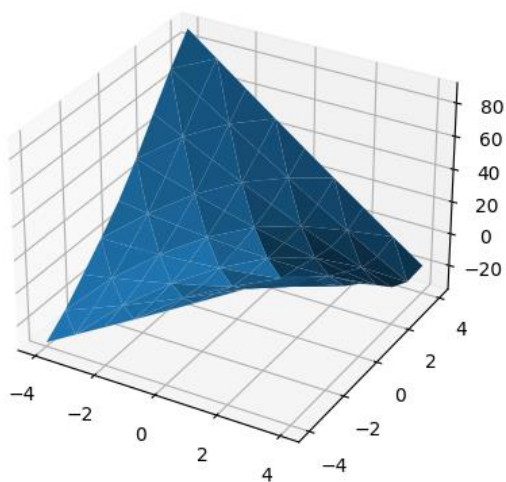
2 PRAVILA

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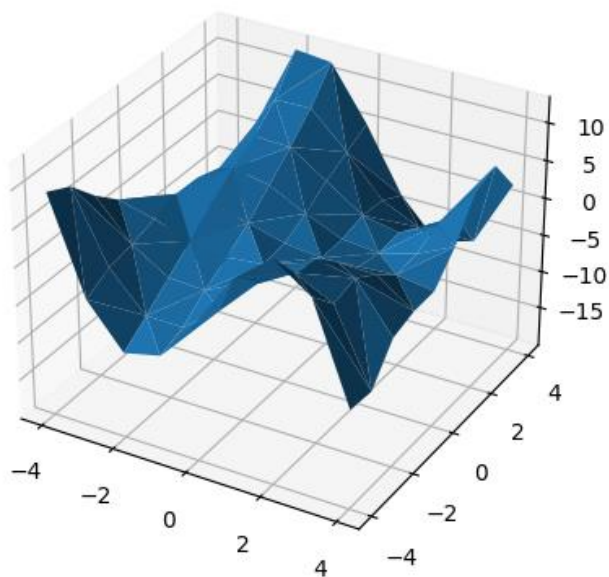


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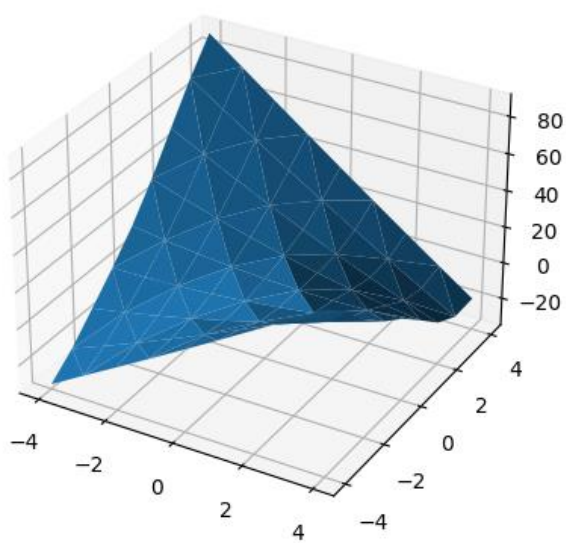


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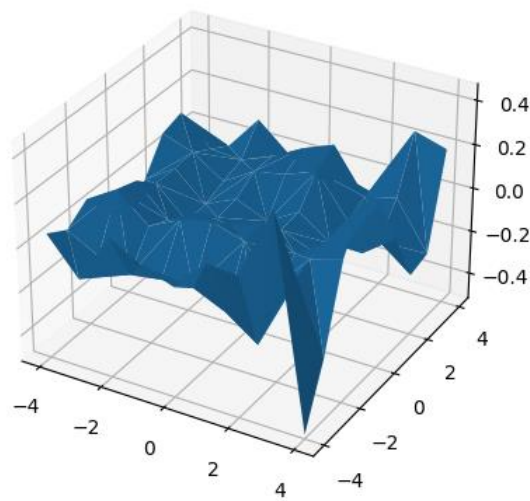
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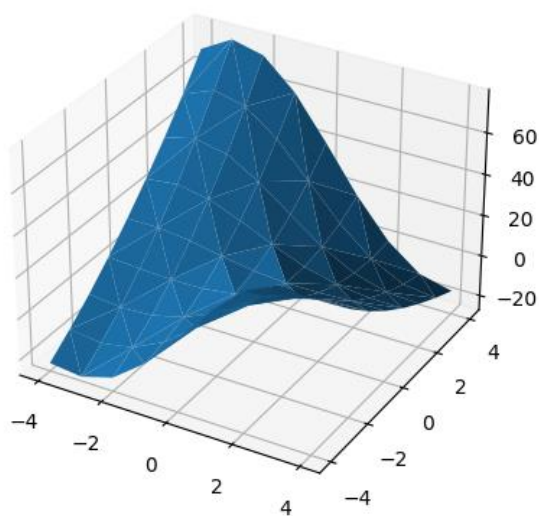
10 PRAVILA

SGD

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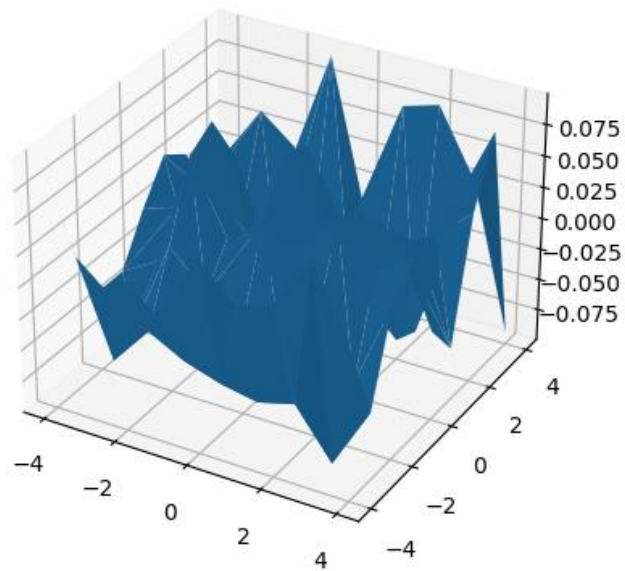


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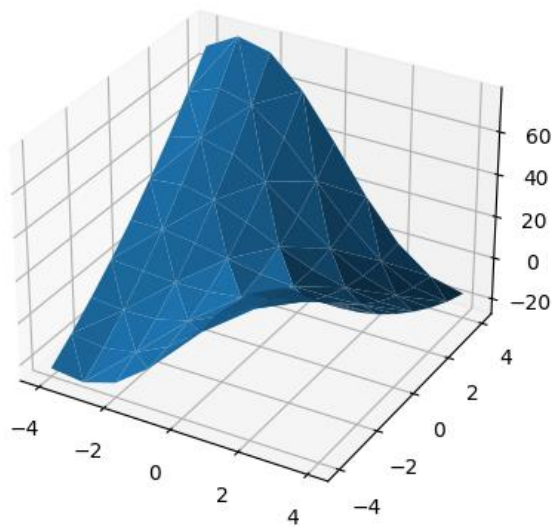


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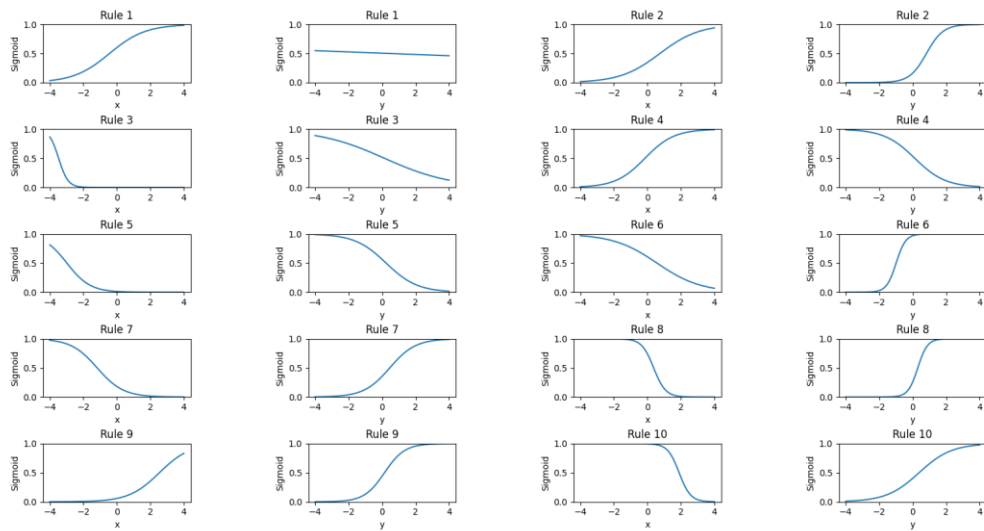
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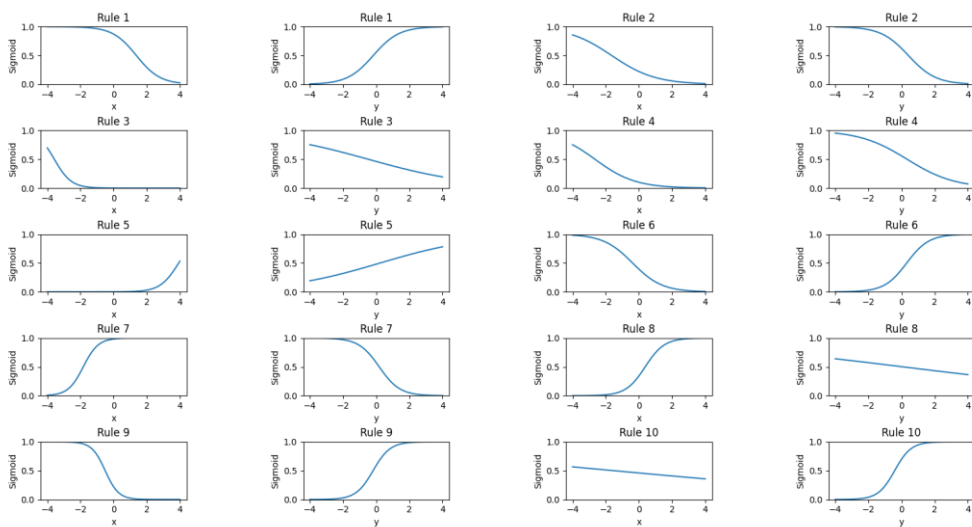
NAUČENA FUNKCIJA



SIGMOIDE ZA OPTIMALAN SUSTAV SGD

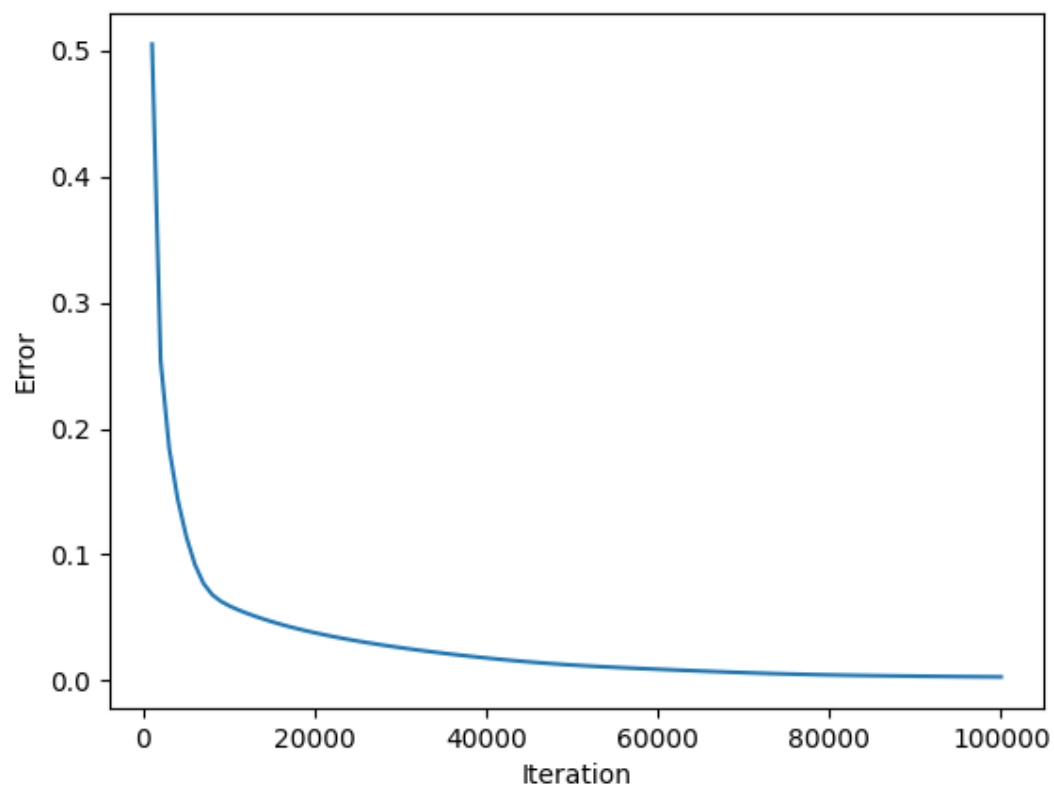


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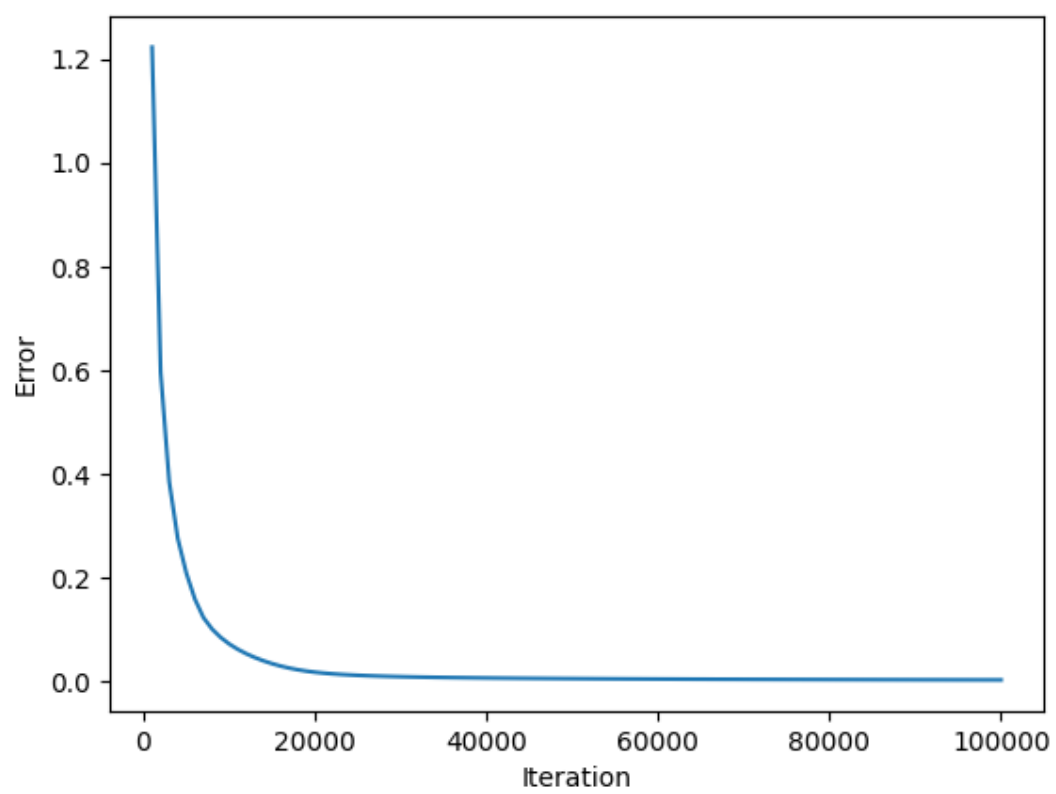


GREŠKE PO ITERACIJAMA ZA OPTIMALAN SUSTAV

SGD

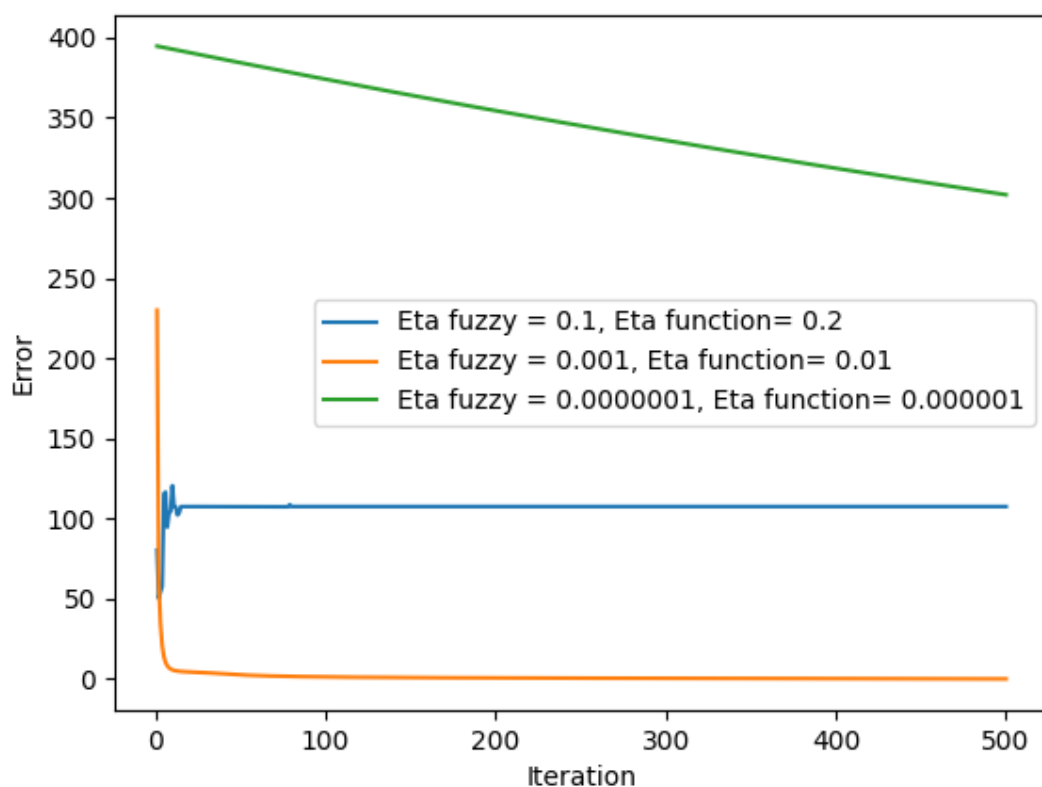


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GREŠKE PO ITERACIJAMA ZA RAZLIČIZE STOPE UČENJA

SGD



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