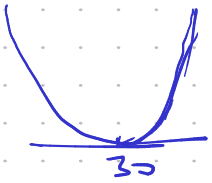
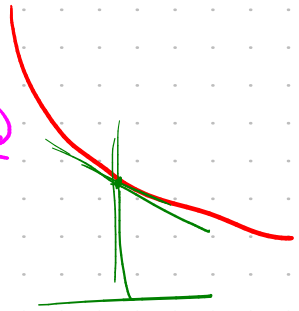
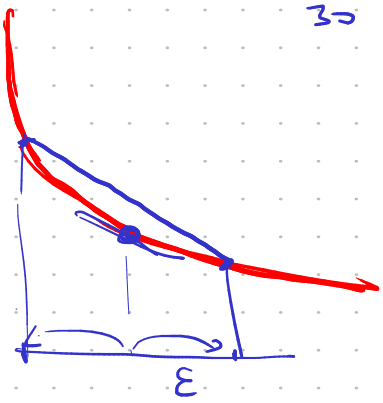
① $y = c - x$

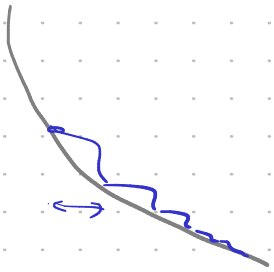
$L(c) = (c-30)^2$



$\frac{f(x+\varepsilon)-f(x-\varepsilon)}{2\varepsilon}$

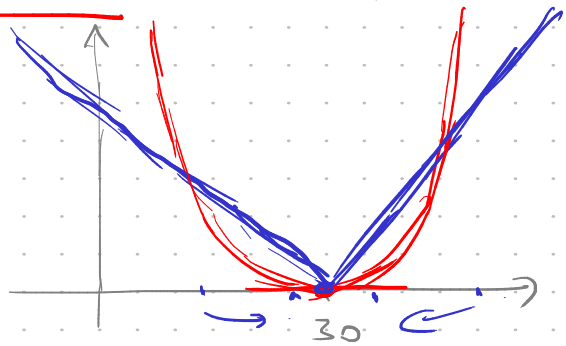






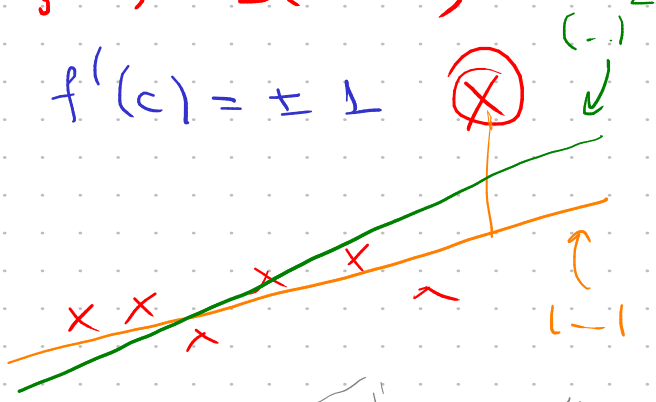
$x_{k+1} = x_k - \alpha \cdot f'(x_k)$

② $(c-30)^2$ или $|c-30|$?



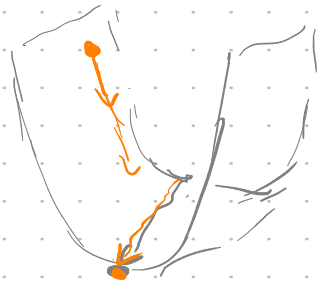
$f'(c) = 2(c-30)$

$f'(c) = \pm 1$



③ Влияние η

$x_{k+1} = x_k - \eta \cdot f'(x_k)$



④ Размерность 2

$y = cx + b$

$L(\underline{b}, \underline{c})$

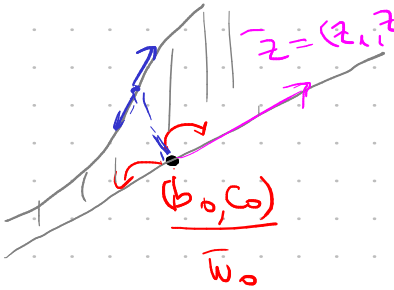
$\frac{\partial L}{\partial b}$ $\frac{\partial L}{\partial c}$

$\left.\frac{\partial L}{\partial b}\right|_{(b_0,c_0)} \approx \frac{L(b_0+\varepsilon, c_0) - L(b_0-\varepsilon, c_0)}{2\varepsilon}$



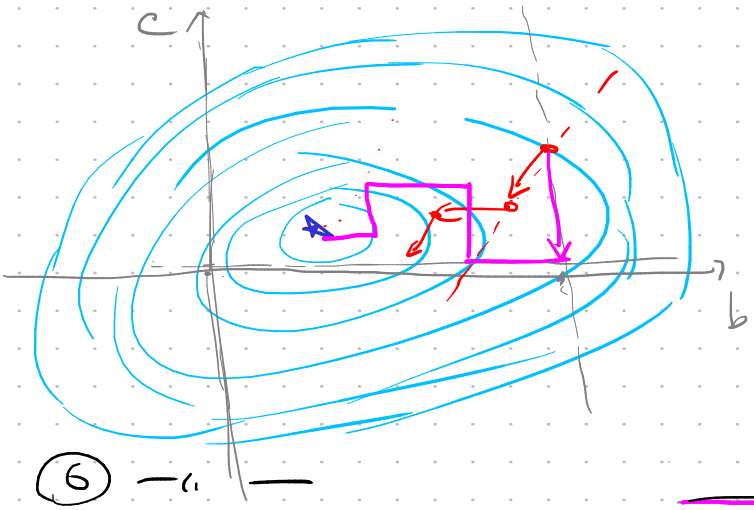
$\nabla_{(b,c)} L = \left(\frac{\partial L}{\partial b}, \frac{\partial L}{\partial c} \right)$





$\frac{L(\bar{w}_0 + \varepsilon \cdot \bar{z}) - L(\bar{w}_0 - \varepsilon \cdot \bar{z})}{2\varepsilon}$

(5) По очереди или вместе?



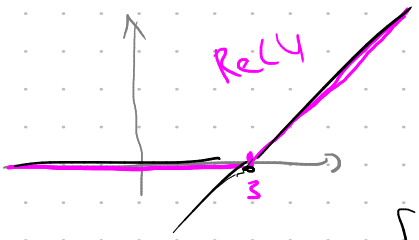
$$\bar{x}_{k+1} = \bar{x}_k - \alpha \cdot \nabla_x L(\bar{x}_k)$$

$$\bar{x}_{k+1} = \left(x_{k_1} - \alpha \cdot \frac{\partial L}{\partial x_1}\Big|_{x_{k_1}}, x_{k_2}\right)$$

— " —

$$\left(x_{k+1,1}, \ldots\right)$$

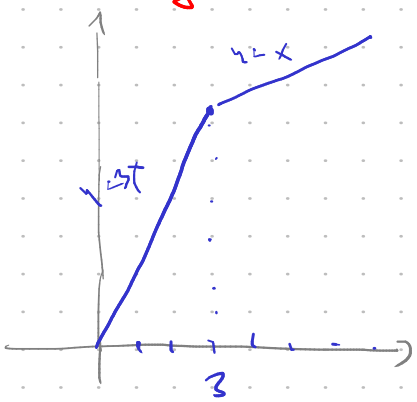
(6) — " —



(7) Больше параметров

3 сф. × 30 руб.

след. × 10 руб.



$$y = 30x - 20 \cdot \left[\#\text{сф. сверх 3}\right] + \varepsilon =$$

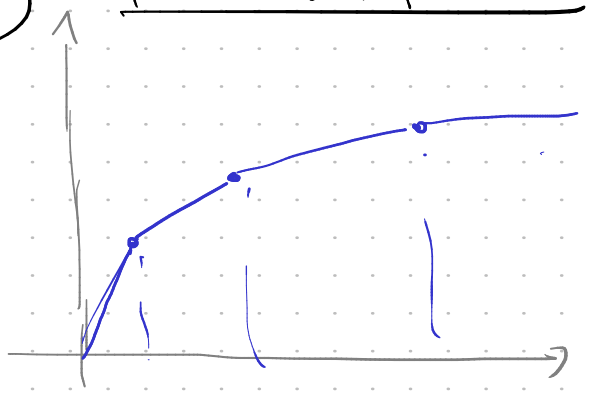
$$= 30x - 20 \cdot \max(0, x-3) + \varepsilon$$

$$\boxed{y = c \cdot x + d \cdot \max(0, x - t)}$$

$$(c, d, t)$$

$$c = 30, \quad d = -20, \quad t = 3$$

(8) Несколько переломов



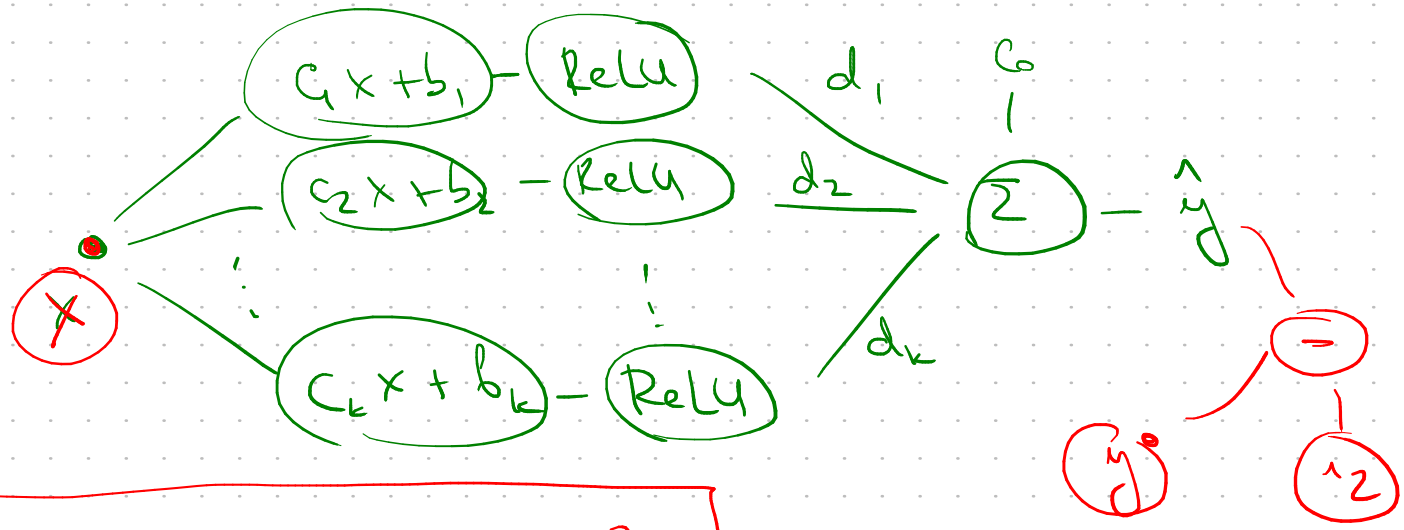
$$y = c_0 + d_1 \cdot \max(0, c_1 x + b_1)$$

$$+ d_2 \max(0, c_2 x + b_2) + \ldots$$

$$\ldots + d_k \max(0, c_k x + b_k)$$

$$\hat{y} = c_0 + \sum_{j=1}^{k} d_j \max(0, c_j x + b_j)$$

trainable parameters



$$L(c, d, b) = \sum_n (y_n - \hat{y}_n)^2$$

$$L = (y - \hat{y})^2$$

