$$f'(x) = \lim_{\Delta x \to 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

$$\begin{aligned} f'(x) &= \lim_{\Delta x \to 0} \frac{f(x + \Delta x) - f(x - \Delta x)}{2\Delta x} \\ &= \lim_{\Delta x \to 0} \frac{-f(x - \Delta x) + f(x + \Delta x)}{2\Delta x} \\ &\Rightarrow \\ 2\Delta x f'(x) &\approx -f(x - \Delta x) + f(x + \Delta x) \end{aligned}$$

if $\Delta x = 1$, the weight vector (filter) will be: [-1,0,+1]

$$\begin{aligned} 2f'(x) &\approx -1 \times f(x-1) + 0 \times f(x) + 1 \times f(x+1) \\ &= [-1, 0, 1] \times [f(x-1), f(x), f(x+1)]^T \end{aligned}$$

One of the edge detection operators is Prewitt filter:

-1	0	$+1$
-1	0	$+1$
-1	0	$+1$

Require: Objective function $E(.)$ to be minimized using SGD.
1: Choose an initial vector of parameters w and learning rate η.
2: **repeat**
3: Randomly shuffle examples in the training set.
4: **for** i=1, . . . , n **do**
5: $w = w - \eta \nabla E_i(w)$
6: **end for**
7: **until** an approximate minimum is obtained.