$$\min_{x \in \mathbb{R}} (x-5)^2$$

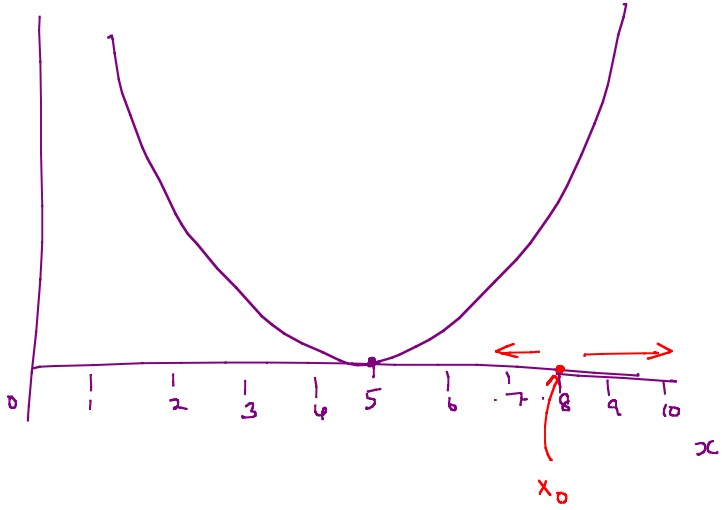
Approach :-

- Start with $x_0 \in \mathbb{R}$ [arbitrary choice]
- for $t = 1, \dots, T$
- update

$$x_{t+1} = x_t + d$$

(d: direction)

- end.



"good direction to move"

Given x, what is a good direction?

Want $d < 0$ if $x > 5$ then $\leftarrow$

Want $d > 0$ if $x < 5$ then $\rightarrow$

$\Rightarrow$ direction d will depend on x.
i.e d must be a function of x

$f(x) = (x-5)^2$

$f'(x) = 2(x-5)$

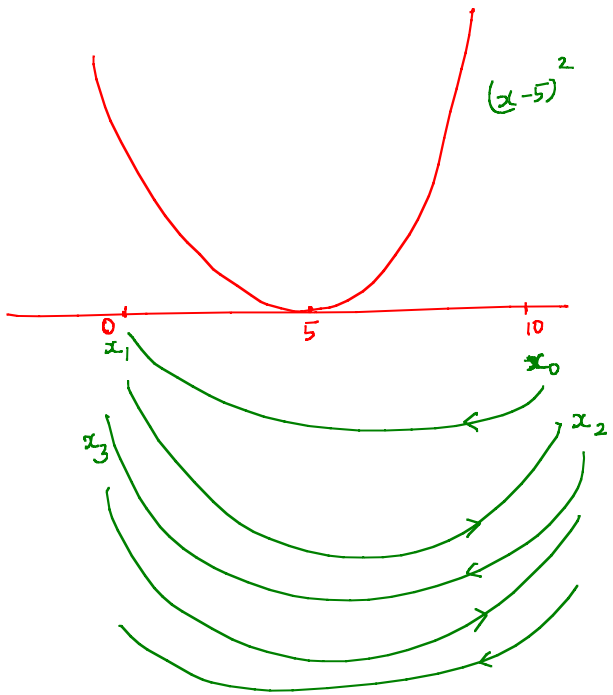
$x > 5 \Rightarrow -f'(x) < 0$

$x < 5 \Rightarrow -f'(x) > 0$

CHOOSE $\boxed{d = -f'(x)}$

$f(x) = (x-5)^2$ $\quad f'(x) = 2(x-5)$

$\rightarrow$ $\boxed{x_{t+1} = x_t + d}$ where $\boxed{d = -f'(x)}$



Example

$x_0 = 10$

$d = -f'(x_0) = -2(x_0-5) = -2(10-5)$
$= -2 \cdot 5 = -10$

$x_1 = x_0 + d = x_0 - f'(x_0) = 10 + (-10) = 0$

$x_2 = x_1 + d = x_1 + (-f'(x_1)) = 0 + (-2(0-5))$
$= 0 + 10 = 10$

Problem: Not the direction but "amount"