

Important announcements

Feb 25

- grades for midterm 1 are out
- example for linear regression

Gradient Descent

Can we always find a closed form expression
for $w^* = \underset{w \in \mathcal{W}}{\operatorname{argmin}} g(w)$? => No!

Linear regression is closed form because of the squared loss & linear function class

Ex: $g(w) = w^2 + e^w$, $g'(w) = 2w + e^w$, $g''(w) = 2 + e^w \geq 0$

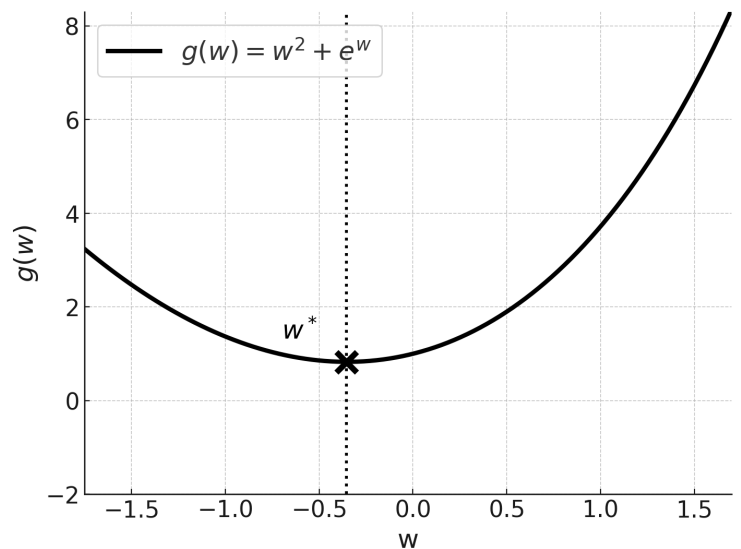
g is convex

$$g'(w) = 2w + e^w = 0$$

$$\rightarrow 2w = -e^w$$

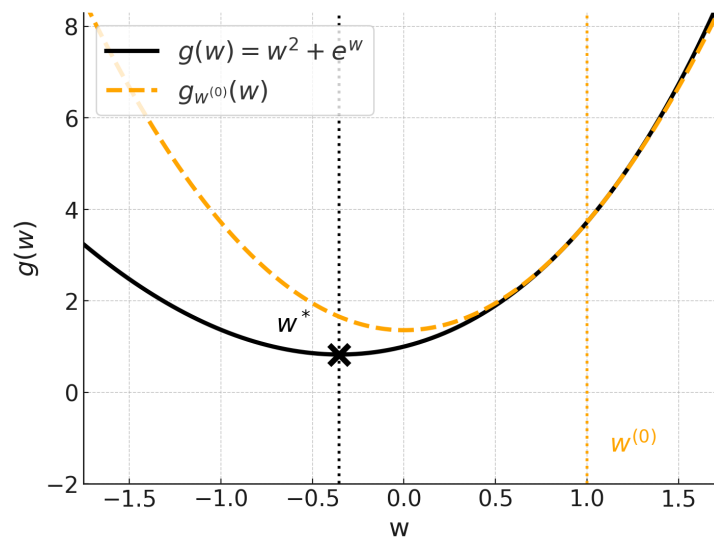
No way to solve for w !

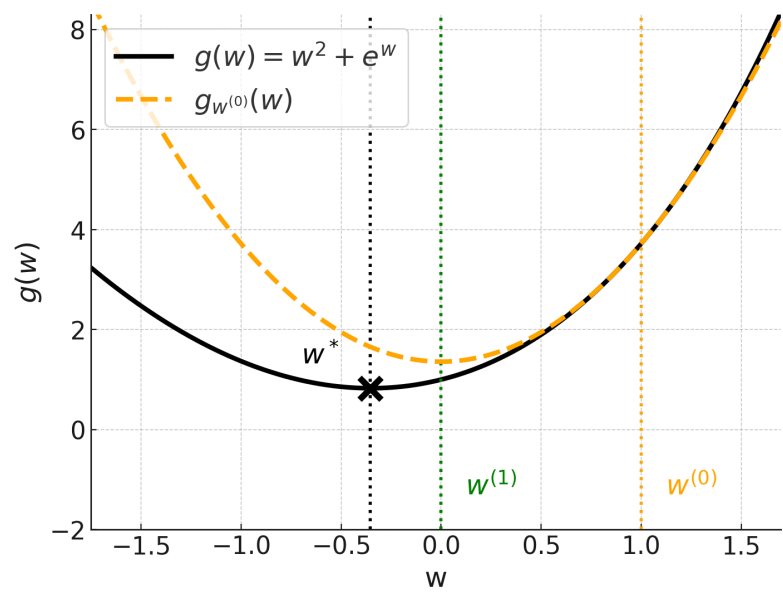
\rightarrow No closed form solution
although $g(w)$ convex.



Gradient descent helps with this problem

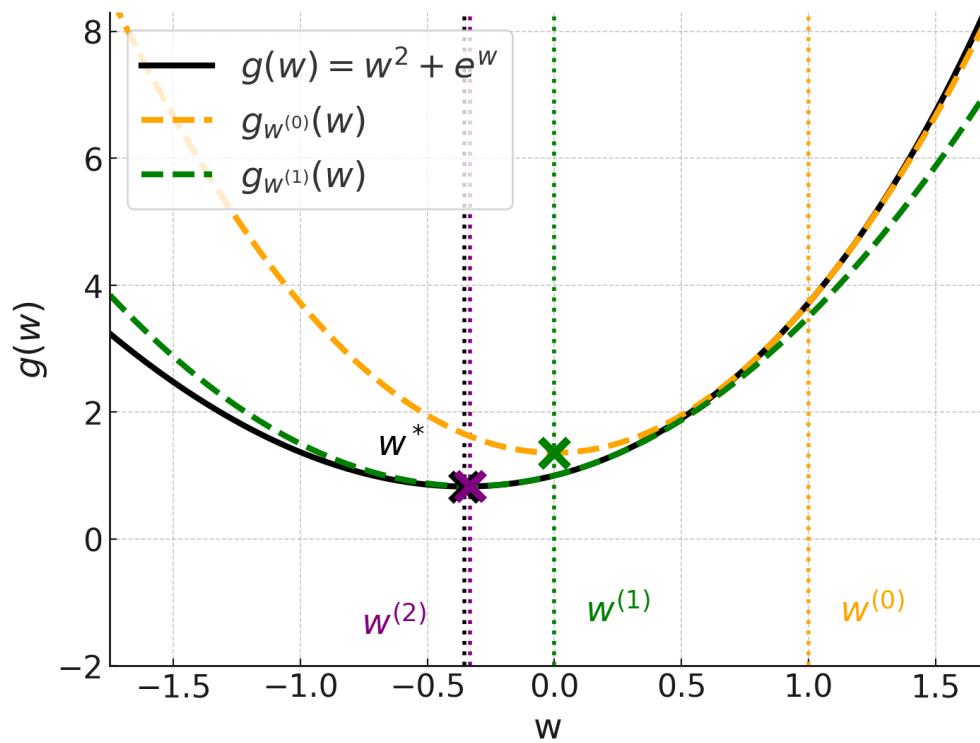
Second-Order Gradient Descent





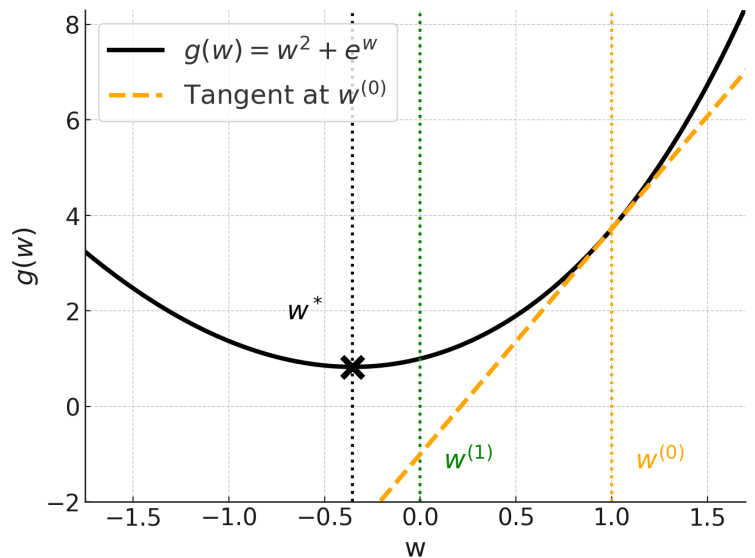
\mathbb{E}_x :

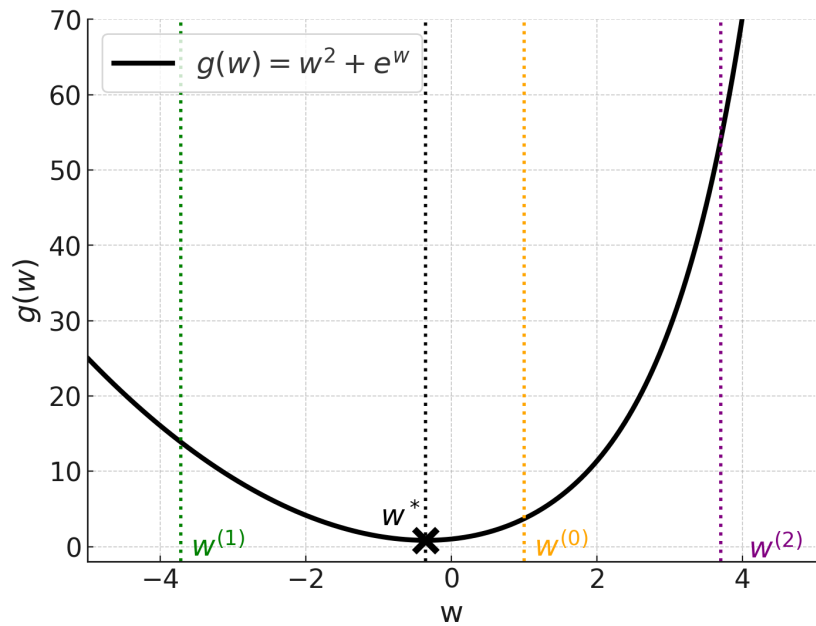
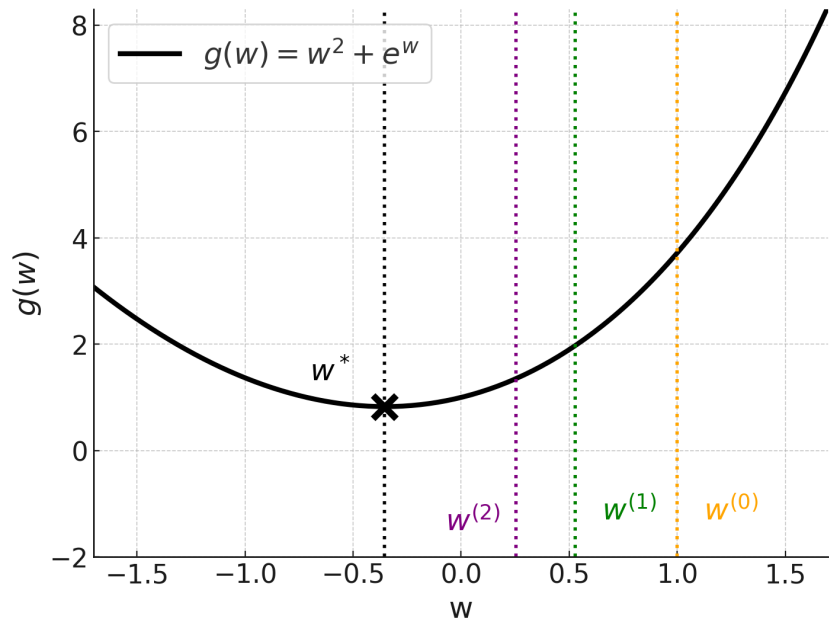
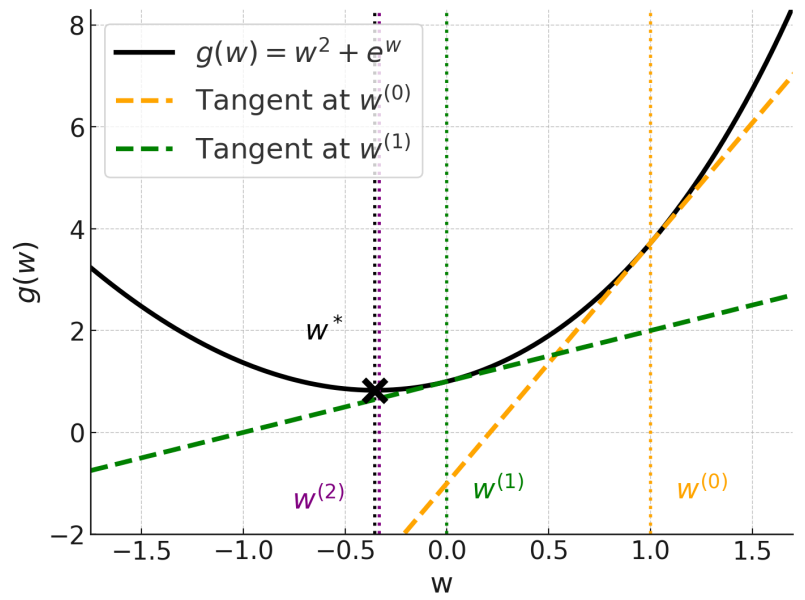
\mathbb{E}_x :



(First-Order) Gradient Descent

Ex:

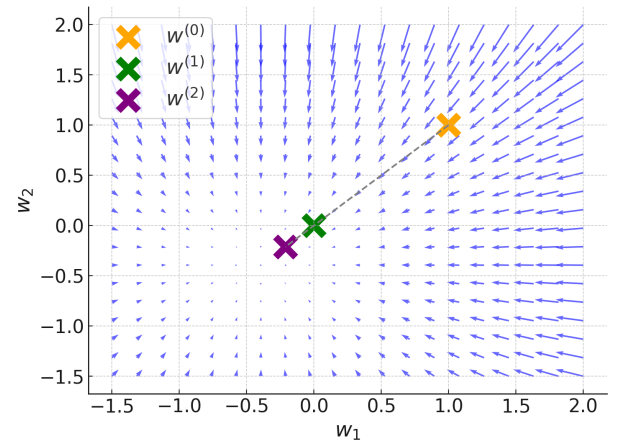
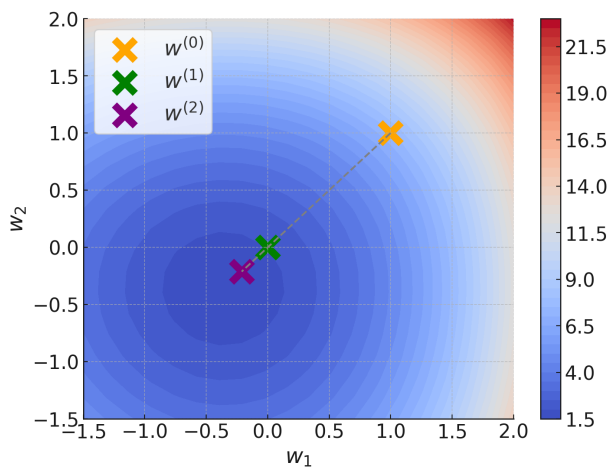
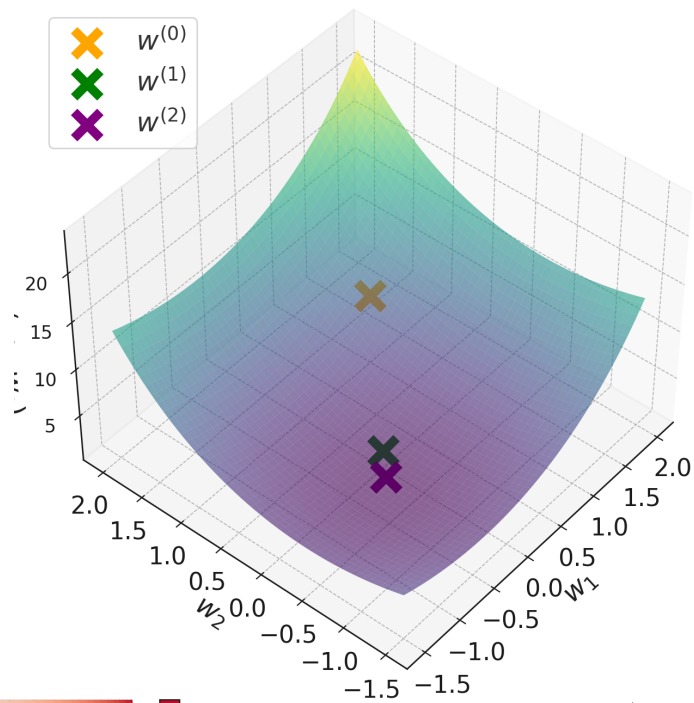




$\sqrt[n]{x}$

Multivariate Gradient Descent

E_x ?



Ex: $g(w_1, w_2) = (1 - w_1)^2 + 100(w_2 - w_1^2)^2$

