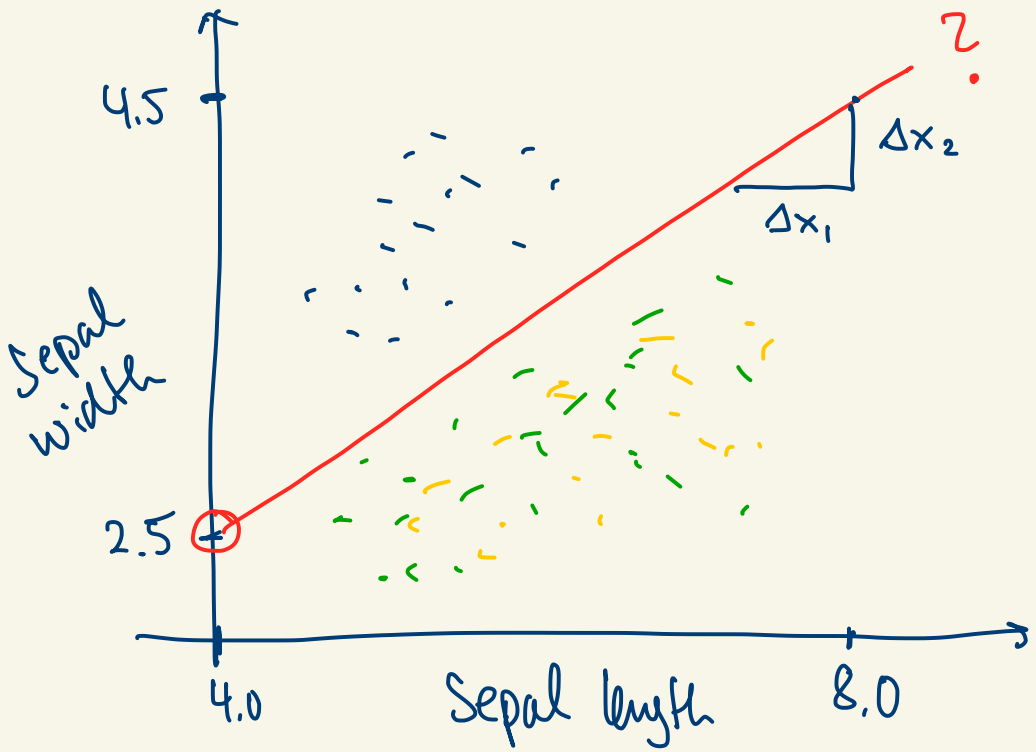
Perceptronnet

$$f(\vec{x}) = \begin{cases} 1 & \text{if } \vec{w} \cdot \vec{x} + b > 0 \\ 0 & \text{ellers} \end{cases}$$



x_1: sepal length

x_2: sepal width

$w_1 x_1 + w_2 x_2 + b = 0$ er decision bound

$w_2 x_2 = -w_1 x_1 - b$

$x_2 = -\frac{w_1}{w_2} x_1 - \frac{b}{w_2}$

def $a = \frac{w_1}{w_2}$

Fra den røde linja

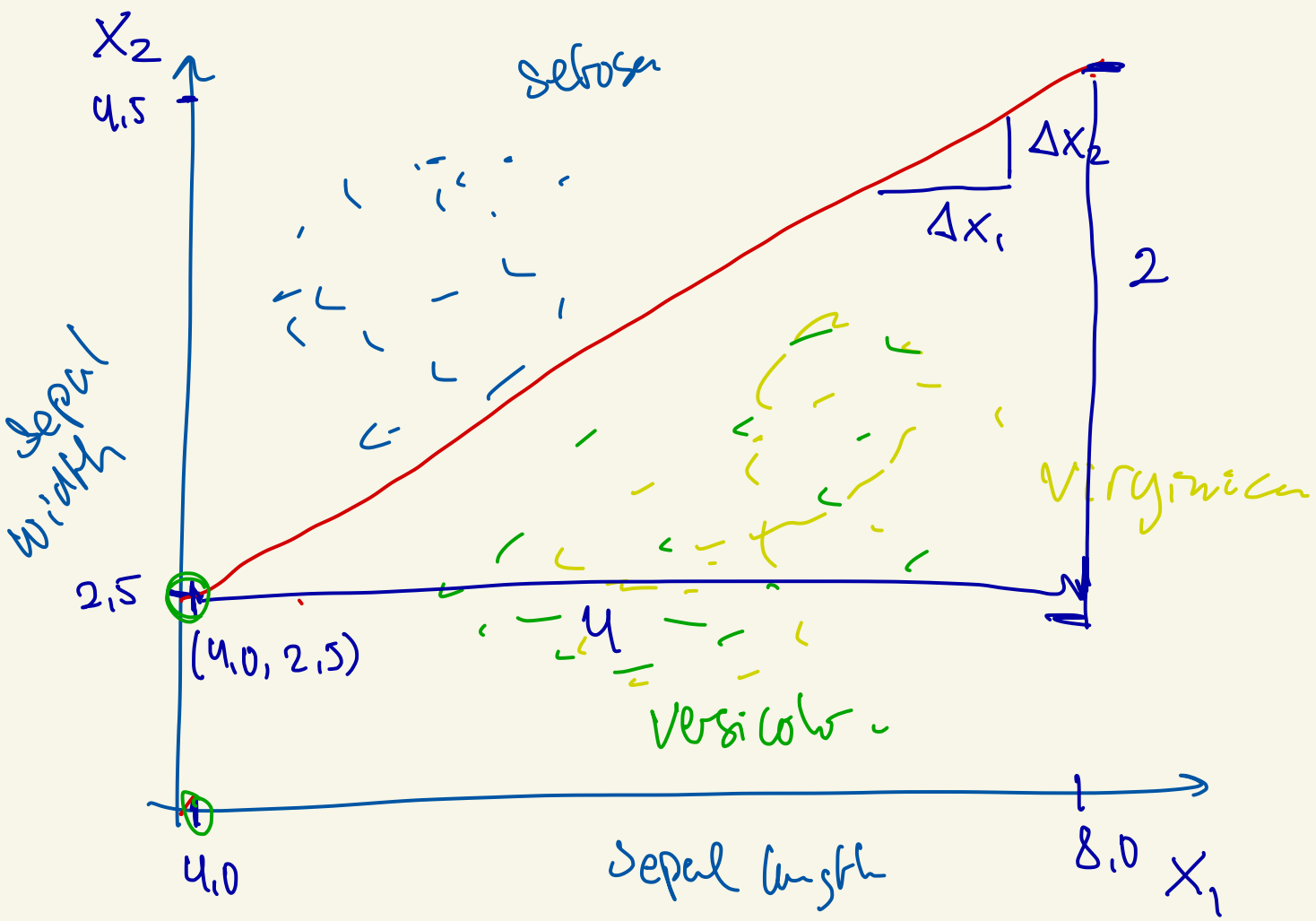
$\frac{\Delta x_2}{\Delta x_1} = \frac{1}{2} \Rightarrow -\frac{w_1}{w_2} = \frac{1}{2}$

Hva med $-\frac{b}{w_2}$?

eg. for $x_1 = 4$, får vi $x_2 = \frac{1}{2} \cdot 4 - \frac{b}{w_2}$

Så $-\frac{b}{w_2} = \frac{1}{2}$

Perceptron: $f(\vec{x}) = \begin{cases} 1 : \vec{w} \cdot \vec{x} + b > 0 : w_1 x_1 + w_2 x_2 + b \\ 0 \quad \text{else} \end{cases}$



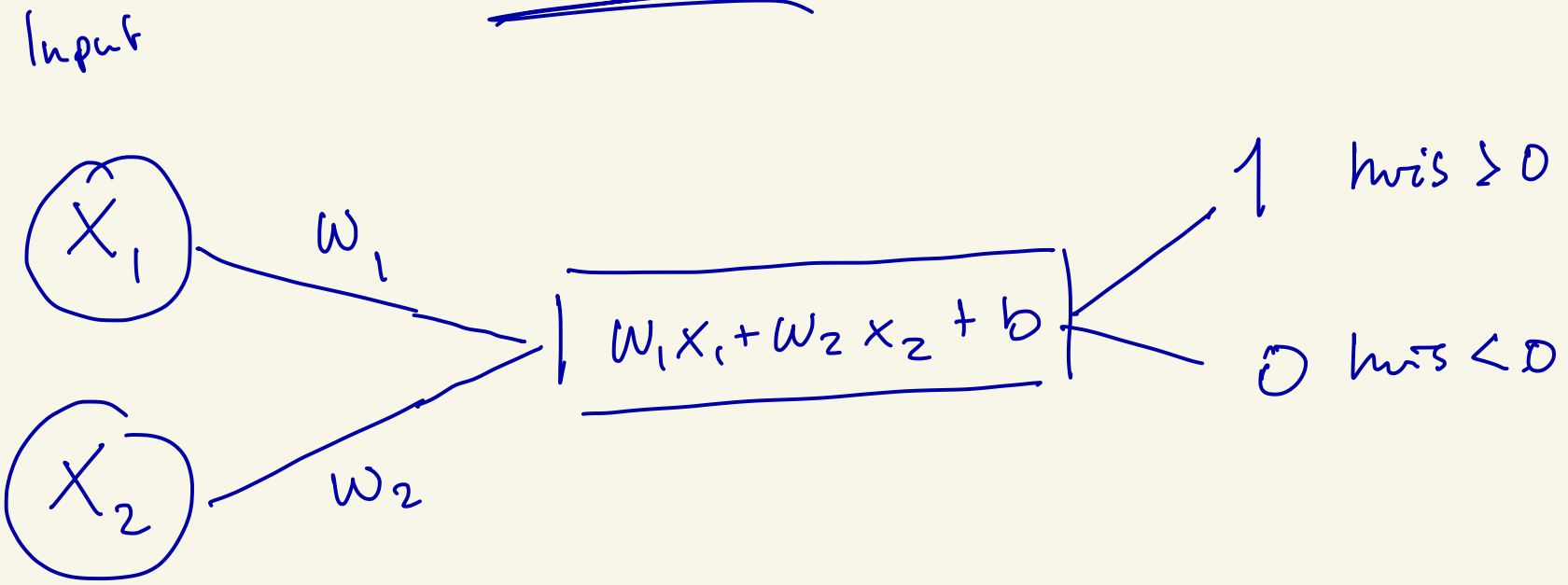
$w_1 = 1$

$w_2 = 1$

$b = 2$

$\frac{\Delta x_2}{\Delta x_1} = \frac{2}{4} = \frac{1}{2}$

Perceptron



$$f(\vec{x}) = 0$$

$$x_1 w_1 + x_2 w_2 + b = 0$$

$$w_2 x_2 = -w_1 x_1 - b$$

$$x_2 = -\underbrace{\frac{w_1}{w_2}} x_1 - \frac{b}{w_2}$$

$$\frac{-w_1}{w_2} = \frac{1}{2}$$

$$\Rightarrow \begin{cases} w_2 = -1 \\ w_1 = \frac{1}{2} \\ b = \frac{1}{2} \end{cases}$$

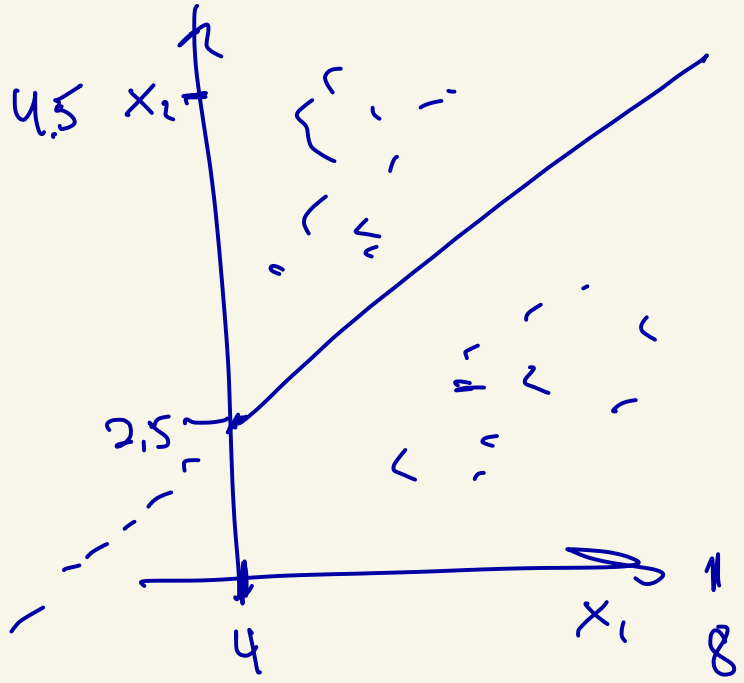
$$\begin{cases} w_1 = 1 \\ w_2 = 1 \\ b = 2 \end{cases}$$

$$\boxed{x_1 = 4} \rightarrow x_2 = 2{,}5$$

$$x_2 = \frac{1}{2} \cdot 4 - \frac{b}{w_2} \Rightarrow 2 - \frac{b}{w_2} = 2{,}5 \Rightarrow -\frac{b}{w_2} = \frac{1}{2}$$

$$w_1 x_1 + w_2 x_2 + b = 0$$

$$x_2 = -\frac{w_1}{w_2} x_1 - \frac{b}{w_2}$$



$$x_2 = a x_1 + b$$

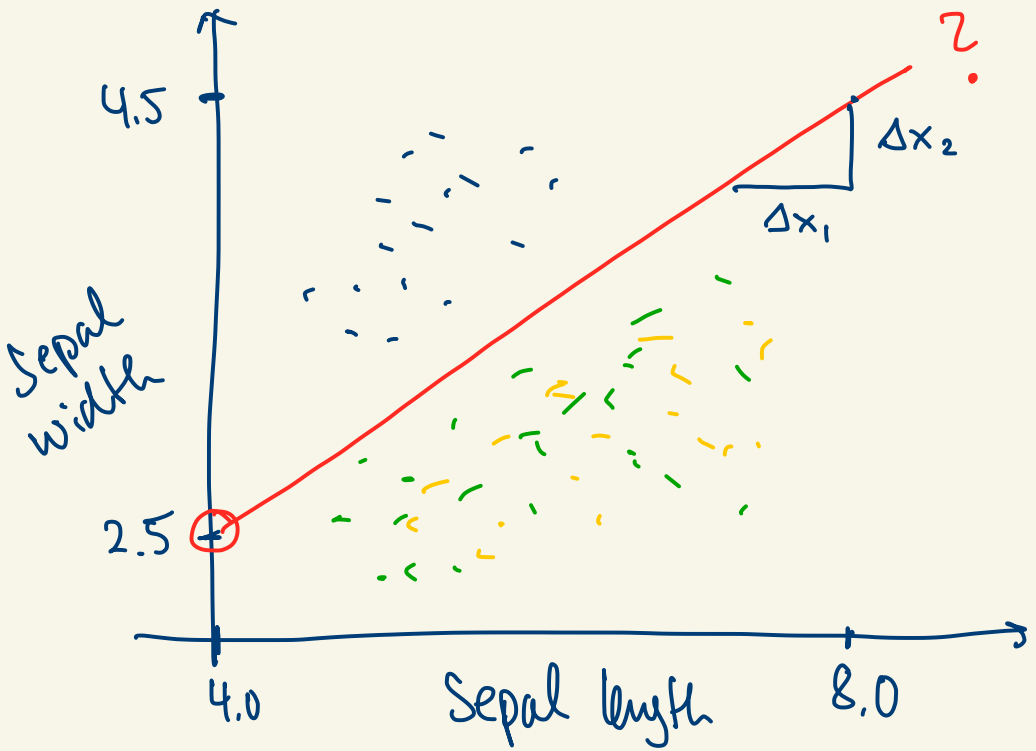
$a = \frac{1}{2}$ $\quad$ $b = -\frac{1}{2}$

X_2
X_1
ω_2
ω_1
$\beta + \omega_2 + X_2 \omega_1 + X_1 \omega_2$
0
1

Time 2

Perceptronet

$$f(\vec{x}) = \begin{cases} 1 & \text{if } \vec{w} \cdot \vec{x} + b > 0 \\ 0 & \text{ellers} \end{cases}$$

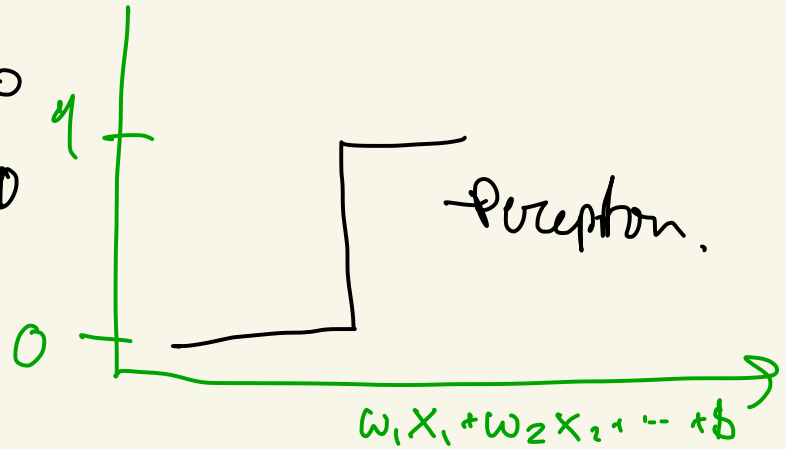


Utvider til neuron

Aktiveringsfunksjon

$\rightarrow$ 0 if $z < 0$

1 if $z \geq 0$



Perseptron: $z = w_1x_1 + w_2x_2 + b \dots$

(en type AN).

Etterpå

Neuron:

f.eks. $z = w_1x_1 + w_2x_2 + b$.

$\Rightarrow$ $f(z) = \dfrac{e^z}{1+e^z}$

aktiv

Cost. ↓ Prediksjoner ↓ treningsdata.

1) Mål: $C = \sum_i \left(\hat{y}_i - y_i \right)^2$

2) Metode:

Backprop → $\frac{\partial C}{\partial w_{ij}}$

Gradient descent: $w_{ij} -= \gamma \frac{\partial C}{\partial w_{ij}}$

La oss kode, for da ser vi alt sammen?

→ Men først planlegge koden! →

Trening av perseptronet m/PyTorch

Først sier jeg hva vi skal. Så gjør vi det.

- Sette device ("cpu")
- Initialisere vekter
- Konvertere data til torch-tensorer
- Forward propagation → loss.
- Backpropagation ← $\frac{\partial C}{\partial w_1}, \frac{\partial C}{\partial w_2}, \frac{\partial C}{\partial b}$
- Oppdatere vekter.

$$w_1 \leftarrow w_1 - \gamma \frac{\partial C}{\partial w_1}$$

La oss sette i gang!

Modellen vår

$$z = x_1 w_1 + x_2 w_2 + b$$

$$f(z) = \frac{e^z}{1 + e^z}$$

Setosa if $f(z) < 0{,}5$

ikke setosa ellers

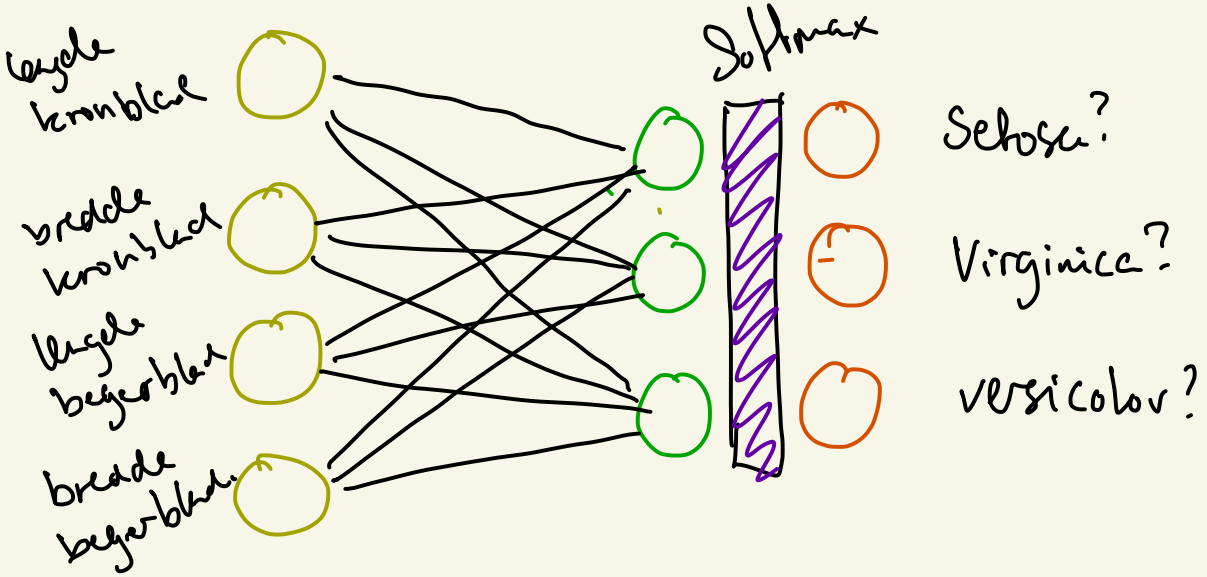
Hvordan kan en bedre modell se ut?

a) Hvilke data trenger vi → flere typer blader.

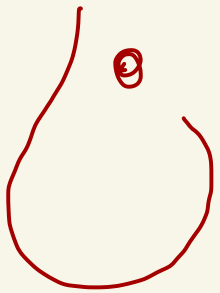
b) Hva slags nevralt nettverk trenger vi? → Mer kompleks output.

Softmax

$$\frac{e^{z_i}}{\sum_{j=1}^{k} e^{z_j}}$$



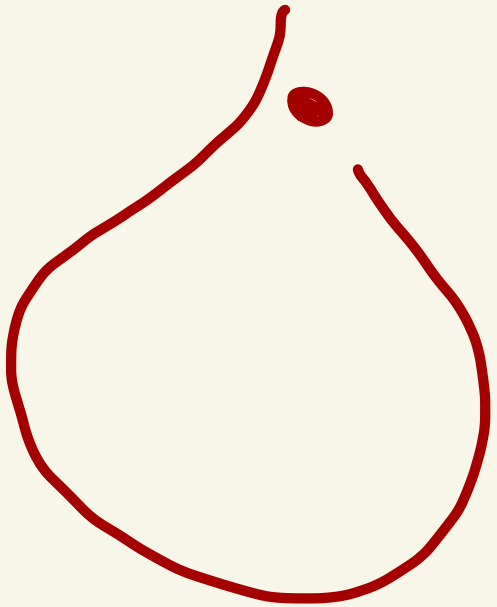
Veien videre



Sjekk ut PyTorch

Når man først er i gang er det mye man kan få til med gode, åpne treningsdata.

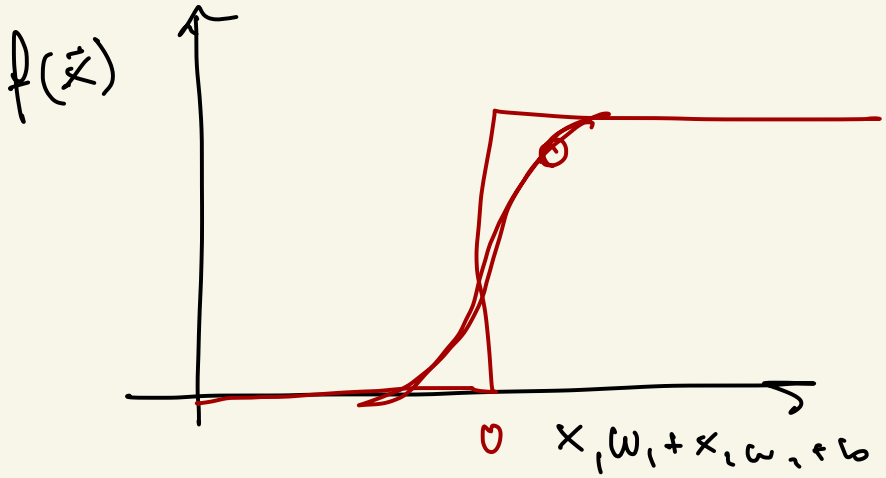
Neurale nett m/PyTorch



Perseptron

$$f(\vec{x}) = \begin{cases} 1 & \vec{w} \cdot \vec{x} + b > 0 \\ 0 & \text{ellers} \end{cases}$$

$$w_1 x_1 + w_2 x_2 + b$$



Perceptron

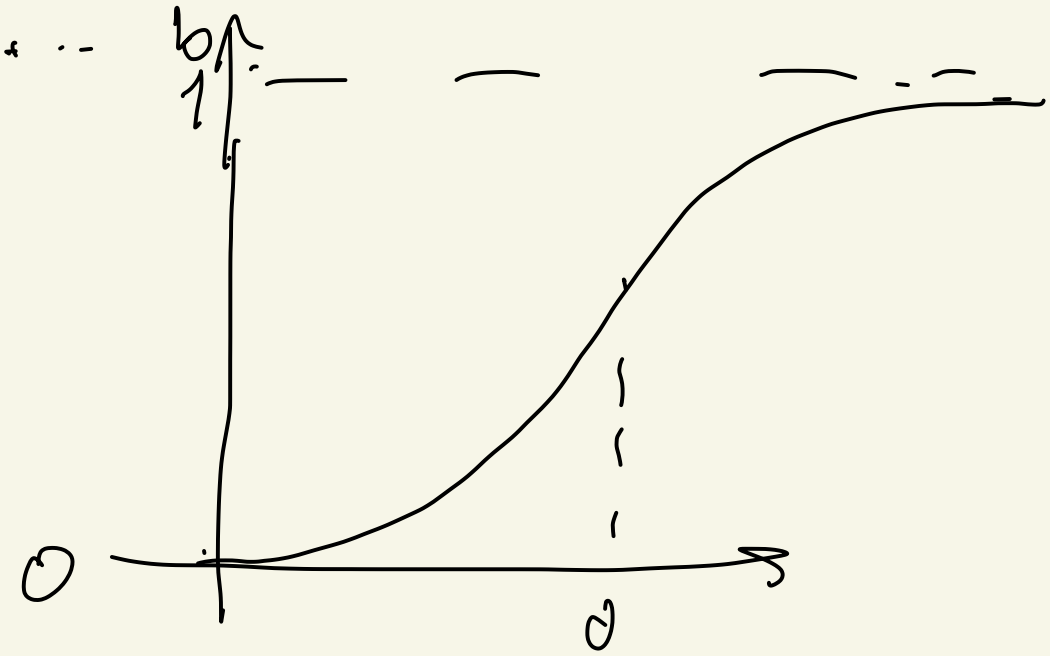
↓

"Mykere" neuron

$$f(z) = \begin{cases} 1 & \text{if } z > 0 \\ 0 & \text{ellers} \end{cases}$$

$$z = w_1 x_1 + w_2 x_2 + \cdots$$

$$f(z) = \frac{e^z}{1+e^z}$$



w_1, w_2, b

1) el mål: loss. $C = \sum_i (\hat{y}_i - y_i)^2$

2) Metode: Backpropagation

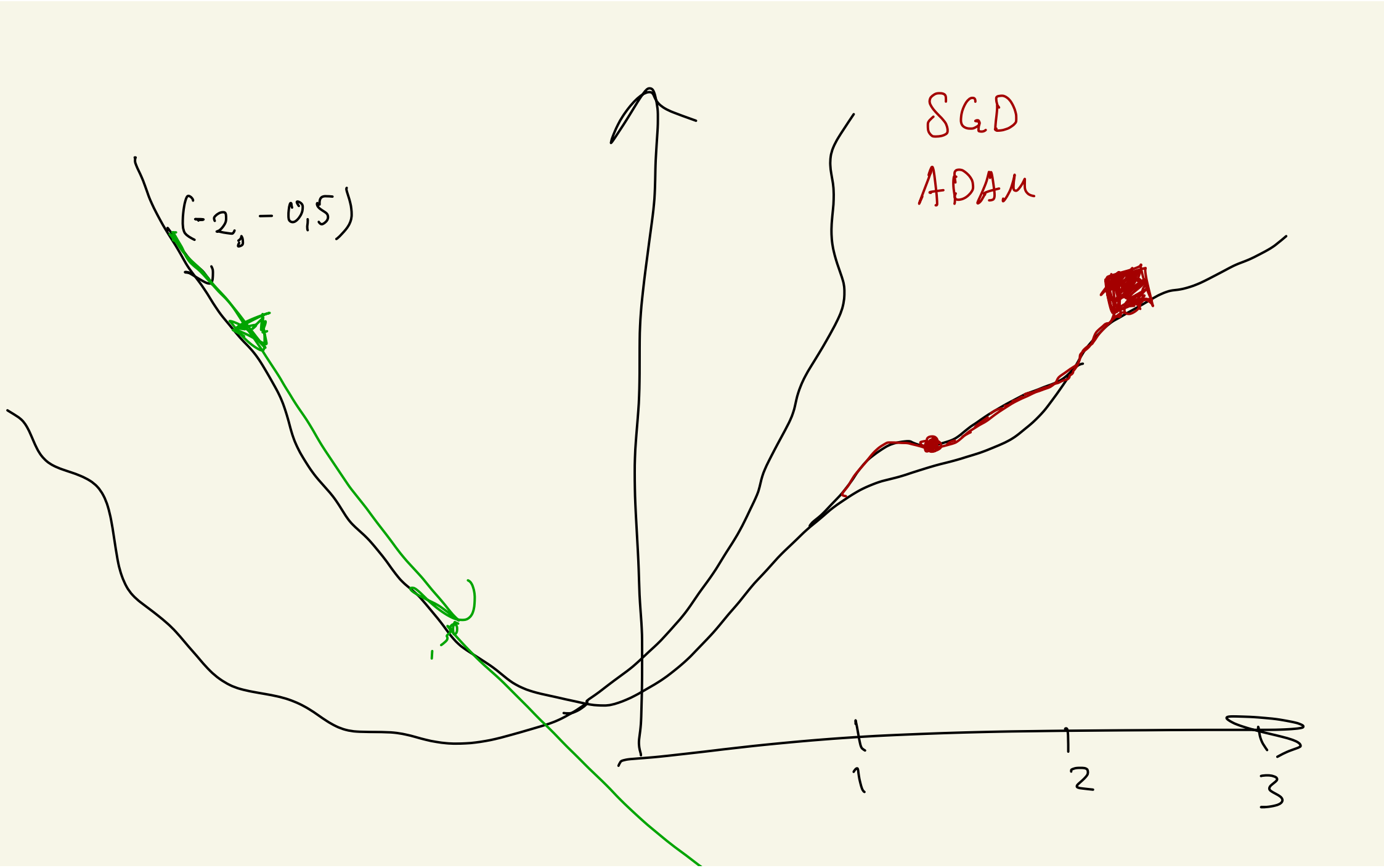
$\rightarrow \frac{\partial C}{\partial w_i} : \frac{\partial C}{\partial w_1}, \frac{\partial C}{\partial w_2}, \frac{\partial C}{\partial b}$

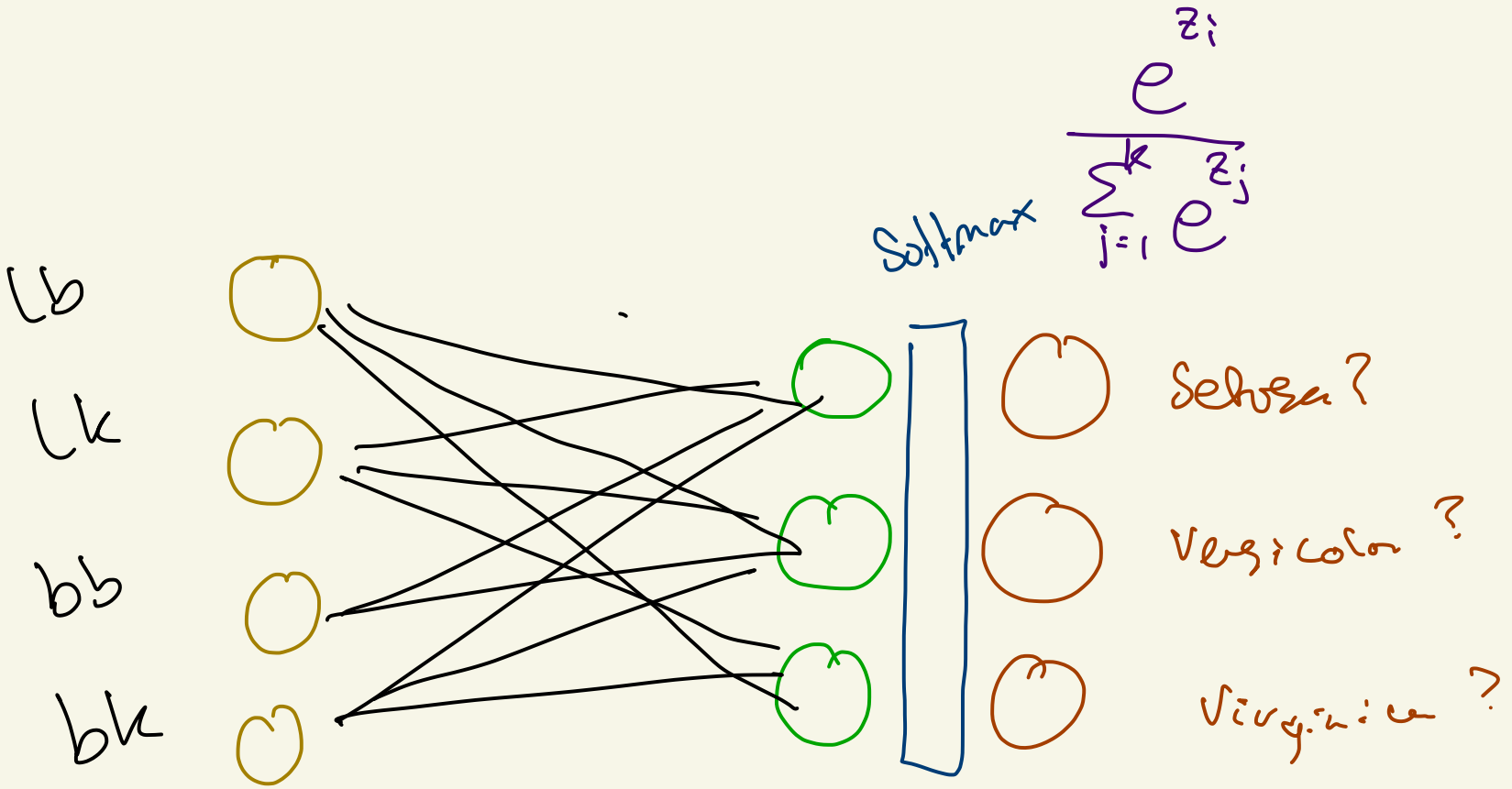
Gradient descent

$w_i \rightarrow w_i - \gamma \frac{\partial C}{\partial w_i}$

Trene nett m/ PyTorch.

- Velge prosessor device ("cpu")
- Initialisere vekter. $w_1, w_2 \cdots$
- Konvertere data til torch-Tensorer.
- Forward prop
- Backprop
- Oppdatere vekter. $w_i := \gamma \frac{\partial L}{\partial w_i}$


SGD
ADAM
(-2, -0,5)
1
2
3


lb
lk
bb
bk
Softmax
$\frac{e^{z_i}}{\sum_{j=1}^{k} e^{z_j}}$
Setosa?
Versicolor?
Virginica?