MINITEL

MACHINE LEARNING

01 SUPERVISED MACHINE LEARNING : REGRESSION AND CLASSIFICATION

THÉO GACHET

UNE SÉRIE DE FORMATIONS

PARTIE 1 : SUPERVISED MACHINE LEARNING : REGRESSION AND CLASSIFICATION

Introduction to Machine Learning
Regression with multiple input
Classification

PARTIE 2 : ADVANCED LEARNING ALGORITHMS

Neural Networks
Neural Networks training
Advice for applying Machine Learning
Decision Trees

PARTIE 3 : UNSUPERVISED LEARNING, RECOMMENDERS, REINFORCEMENT LEARNING

Unsupervised Learning
Recommander Systems
Reinforcement Learning

01 SUPERVISED MACHINE LEARNING : REGRESSION AND CLASSIFICATION

SUPERVISED VS. UNSUPERVISED ML

What is Machine Learning ?
Supervised Learning
Unsupervised Learning
Jupyter Notebooks
Lab : Python and Jupyter Notebooks

REGRESSION MODEL

Linear regression model
Lab : Model representation
Cost function formula
Cost function intuition
Visualizing the cost function
Visualization examples
Lab : Cost function

TRAIN THE MODEL WITH GRADIENT DESCENT

Gradient descent
Implementing gradient descent
Gradient descent intuition
Learning rate
Gradient descent for linear regression
Running gradient descent
Lab : Gradient descent

01

SUPERVISED VS. UNSUPERVISED MACHINE LEARNING

THÉO GACHET

Supervised learning

x → y

x: input

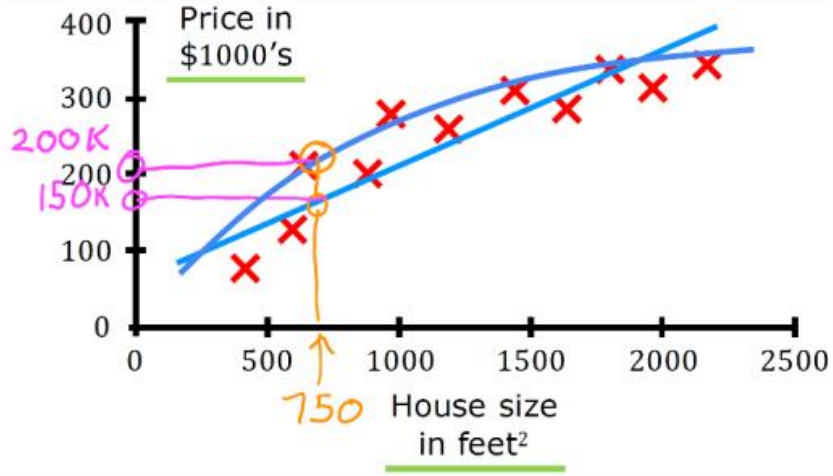
y: output label

Learns from being given data labeled with the "right answers"

Regression

Predict a number

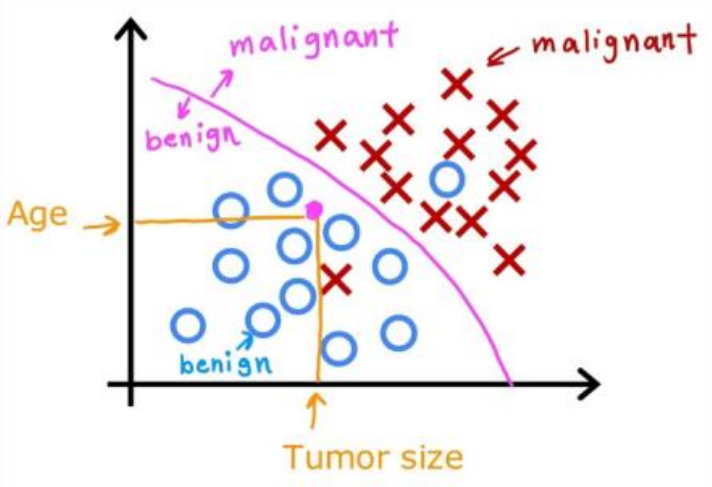
Infinitely many possible outcomes



Classification

Predict categories

Small number of possible outputs



Unsupervised Learning

Data only comes with inputs x, but not output labels y
Algorithm has to find structure (= something interesting in unlabeled data)

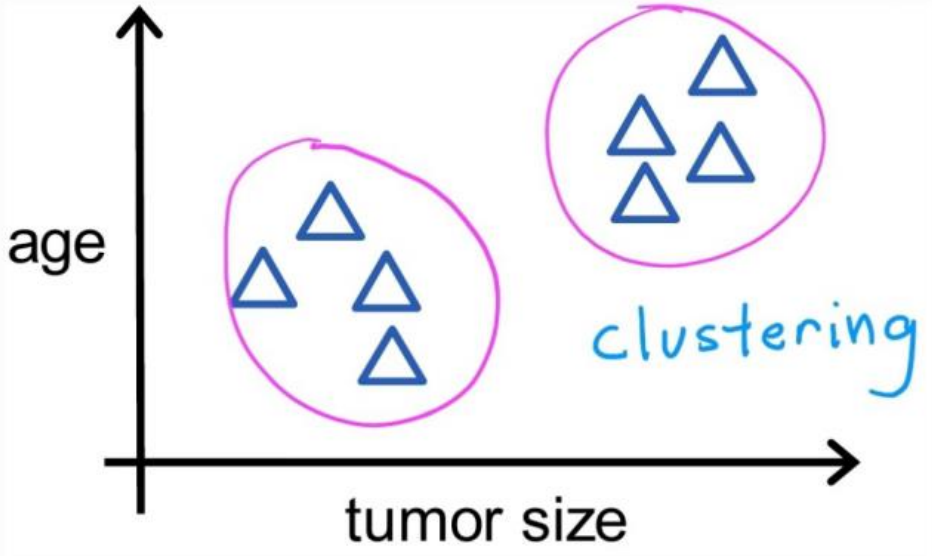
Clustering
Group similar data points together.

Anomaly detection
Find unusual data points.

Dimensionality reduction
Compress data using fewer numbers.

Clustering

Example : Google News



MINITEL

LAB-01

INTRODUCTION TO PYTHON AND JUPYTER NOTEBOOKS

THÉO GACHET

QUESTIONS ?

SUR UN CONCEPT ? UNE IDÉE ?
SUR UN DÉTAIL DU CODE ?
(ENVIE D'UNE PAUSE ?)

N'HÉSITEZ PAS !

IL N'Y A PAS DE QUESTION BÊTE, SI VOUS AVEZ UN DOUTE, D'AUTRES ONT SÛREMENT LE MÊME

02 REGRESSION MODEL

THÉO GACHET

Linear Regression Model

Terminology

x	y
$x^{(1)}$	$y^{(1)}$
⋮	⋮
$x^{(m)}$	$y^{(m)}$

(training set)

x = "input" variable / feature

y = "output" variable / "target" variable

m = number of variables in the training set

w = weight / b = bias

(x, y) = single training example

$(x^{(i)}, y^{(i)})$ = i^{th} training example

training set

↓

learning algorithm

↓

$x \rightarrow [f] \rightarrow \hat{y}$

feature — model — prediction (estimated y)

target

$f_{w,b}(x) = wx + b$ (written $f(x)$)

Linear regression with one variable.

Univariate linear regression.

one variable

MINITEL

LAB-02

MODEL REPRESENTATION

THÉO GACHET

QUESTIONS ?

SUR UN CONCEPT ? UNE IDÉE ?
SUR UN DÉTAIL DU CODE ?
(ENVIE D'UNE PAUSE ?)

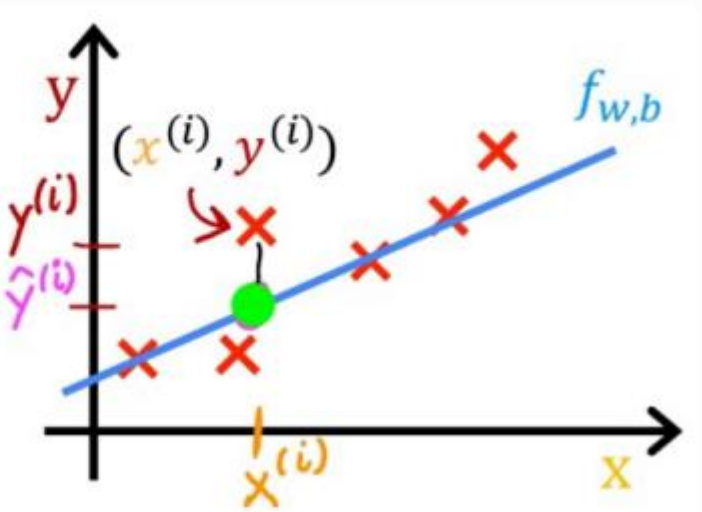
N'HÉSITEZ PAS !

IL N'Y A PAS DE QUESTION BÊTE, SI VOUS AVEZ UN DOUTE, D'AUTRES ONT SÛREMENT LE MÊME

Cost Function

$$\hat{y}^{(i)} = f_{w,b}(x^{(i)}) = w x^{(i)} + b$$

Find (w, b) such as $\hat{y}^{(i)} \approx y^{(i)} \quad \forall (x, y)$

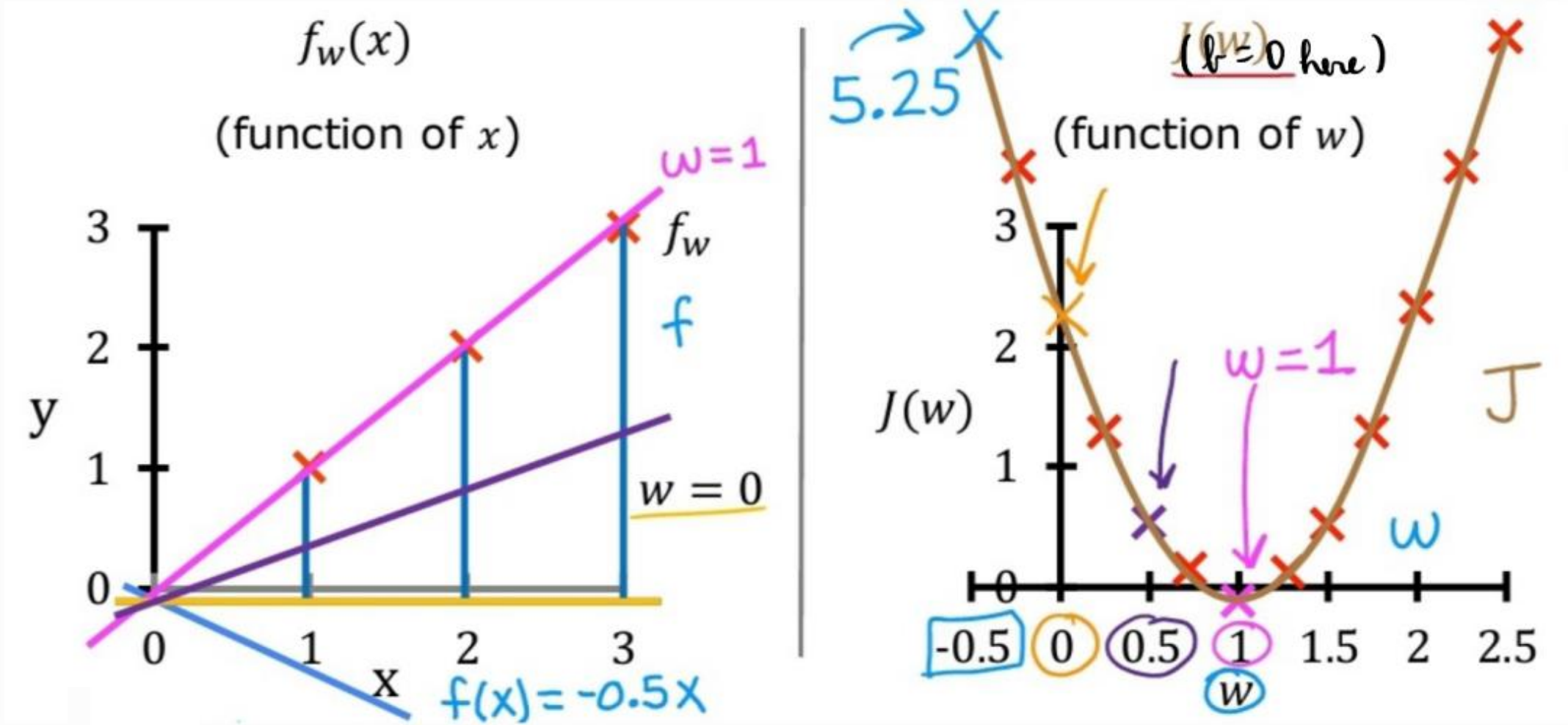


Squared error cost function

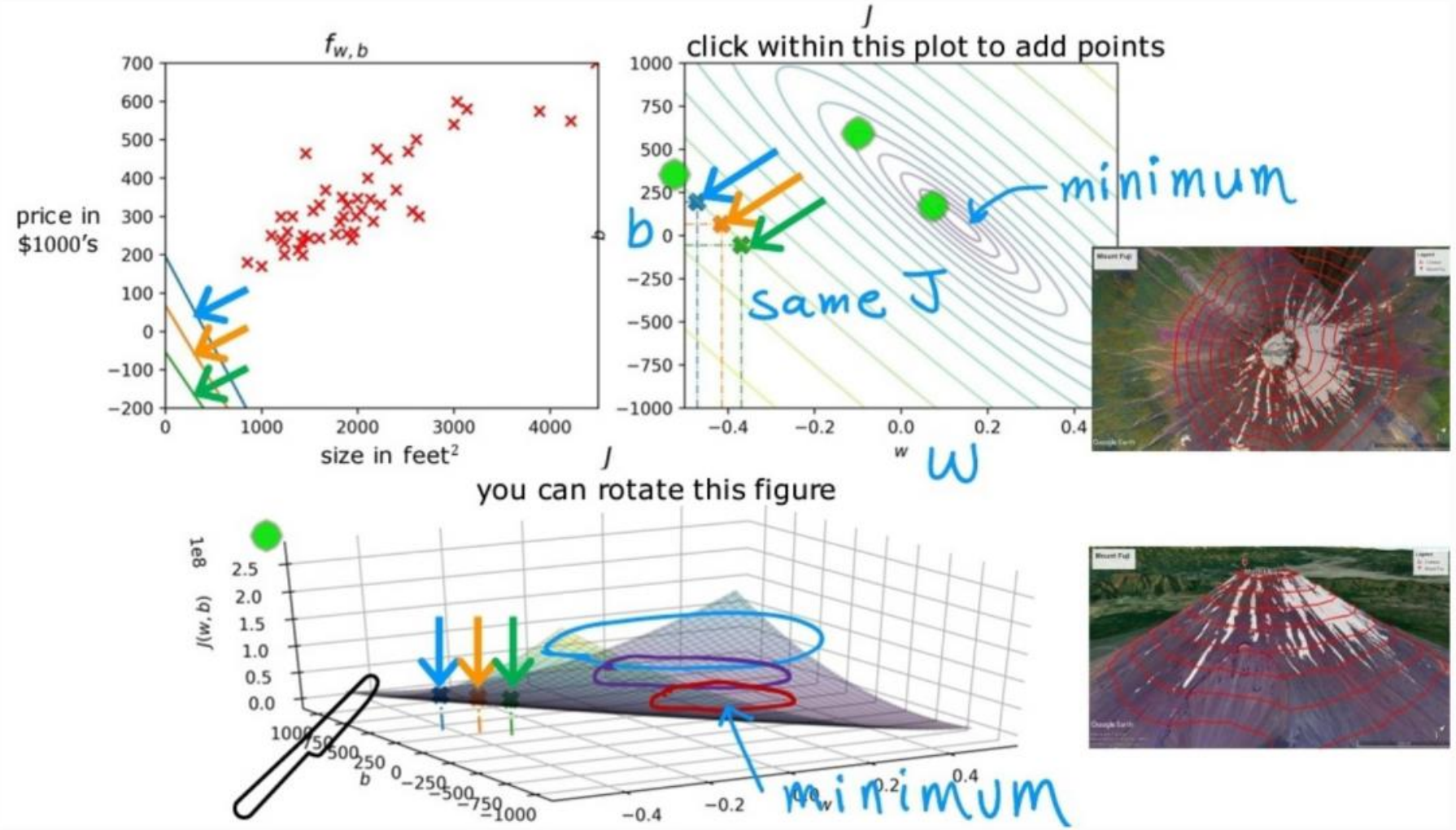
$$J(w, b) = \frac{1}{2m} \sum_{i=1}^{m} \left(\underbrace{f_{w,b}(x^{(i)})}_{\hat{y}^{(i)}} - y^{(i)} \right)^2$$

goal : to minimize $J(w,b)$

Cost Function Intuition



Visualizing the Cost Function → 3D Surface Plot vs. Contour Plot



MINITEL

LAB-03

COST FUNCTION

THÉO GACHET

QUESTIONS ?

SUR UN CONCEPT ? UNE IDÉE ?
SUR UN DÉTAIL DU CODE ?
(ENVIE D'UNE PAUSE ?)

N'HÉSITEZ PAS !

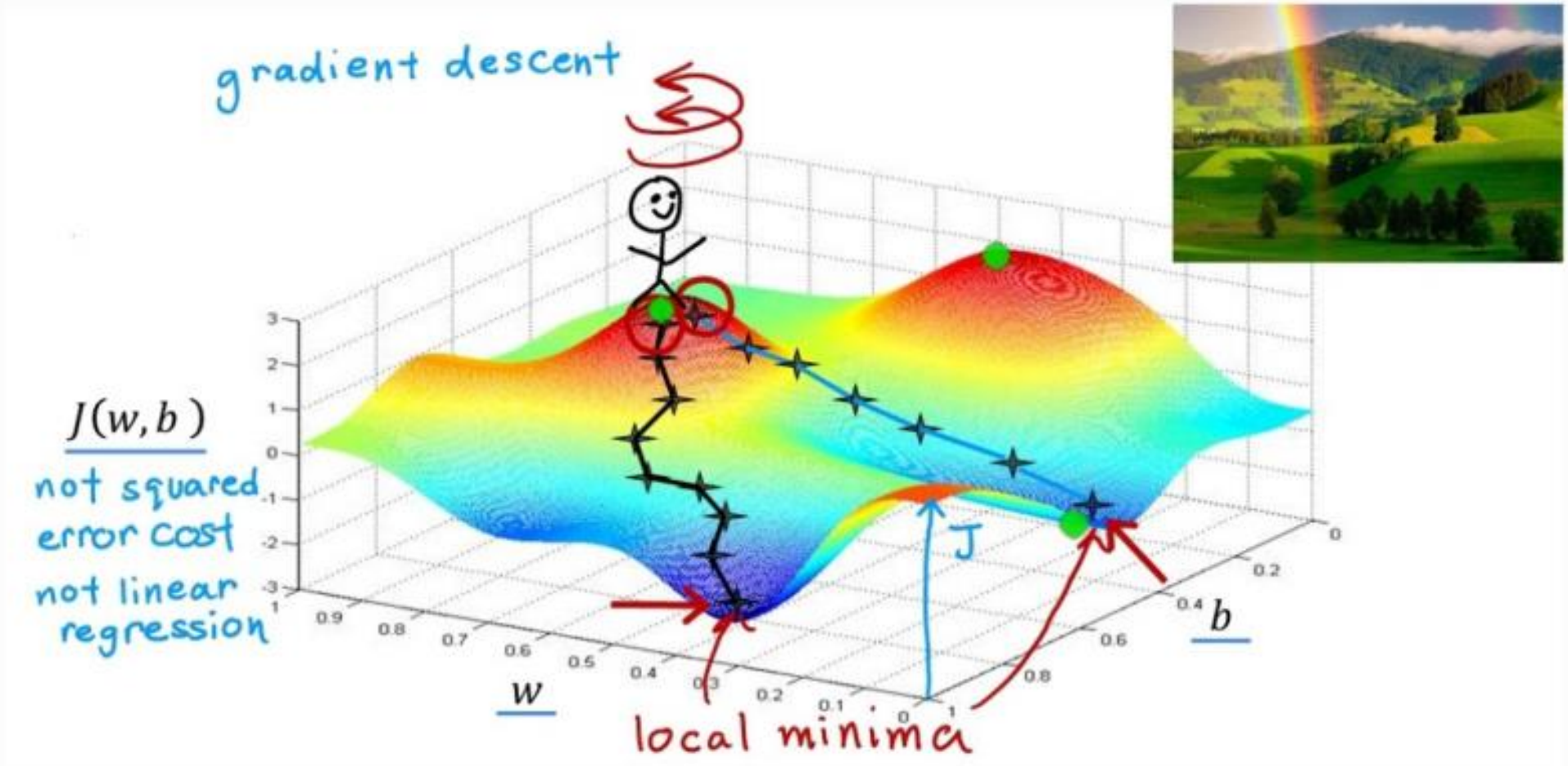
IL N'Y A PAS DE QUESTION BÊTE, SI VOUS AVEZ UN DOUTE, D'AUTRES ONT SÛREMENT LE MÊME

03

TRAIN THE MODEL WITH GRADIENT DESCENT

THÉO GACHET

Gradient Descent



Gradient Descent Algorithm

Repeat until convergence :

$$w = w - \alpha \frac{\partial}{\partial w} J(w, b)$$

$$b = b - \alpha \frac{\partial}{\partial b} J(w, b)$$

α : learning rate

Simultaneous update : ⚠

$$tmp\_w = w - \alpha \frac{\partial}{\partial w} J(w, b)$$

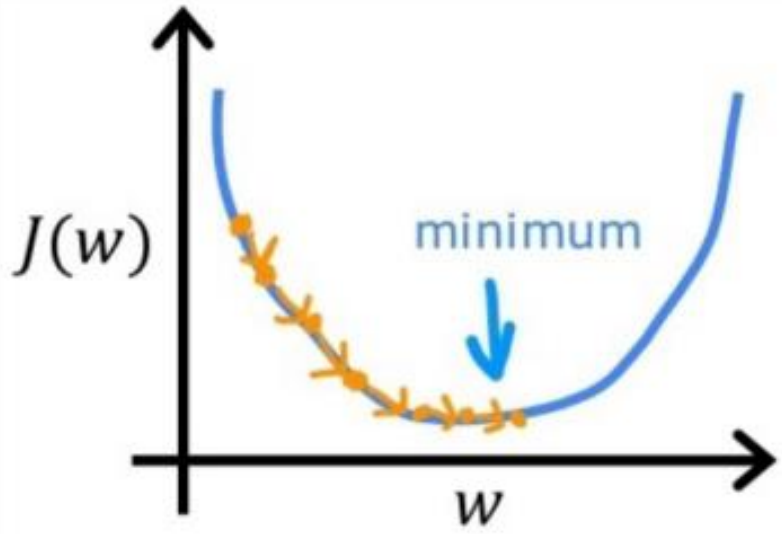
$$tmp\_b = b - \alpha \frac{\partial}{\partial b} J(w, b)$$

$$w = tmp\_w$$

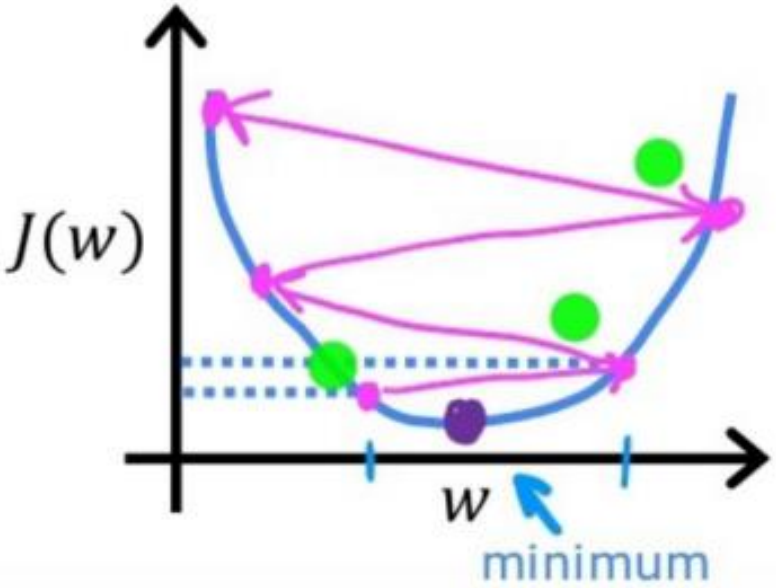
$$b = tmp\_b$$

Batch = each step of gradient descent uses all the training examples

Learning Rate



If α is too small...
Gradient descent may be slow.



If α is too large...

Gradient descent may:
- Overshoot, never reach minimum
- Fail to converge, diverge

MINITEL

LAB-04

GRADIENT DESCENT FOR LINEAR REGRESSION

THÉO GACHET

QUESTIONS ?

SUR UN CONCEPT ? UNE IDÉE ?
SUR UN DÉTAIL DU CODE ?
(ENVIE D'UNE PAUSE ?)

MINITEL

MACHINE LEARNING

01 SUPERVISED MACHINE LEARNING : REGRESSION AND CLASSIFICATION

THÉO GACHET