Lecture 0 : introduction

By : Khalil idrissi

lecture 0 : intro
lecture 1 : linear regression
lecture 2 : SVMs
lecture 3 : dealing with images
lecture 4 : Neural network and backprop
lecture 5 : CNN, transfer learning and behavioral clonning
lecture 6 : autoencoders and image segmentation
lecture 7 : object detecion
lecture 8 : RNN ,LSTM, GRU
lecture 9 : decision trees, random forests, bagging, boosting, stacking
lecture 10 : Variational AE and GANs
lecture 11 : representation learning
lecture 12 : PCA and K-means clustering
lecture 13 : intro to Reinforcement learning

By : Khalil idrissi

lecture 0 : intro
lecture 1 : linear regression
lecture 2 : SVMs
lecture 3 : dealing with images
lecture 4 : Neural network and backprop
lecture 5 : CNN, transfer learning and behavioral clonning
lecture 6 : autoencoders and image segmentation
lecture 7 : object detecion
lecture 8 : RNN ,LSTM, GRU
lecture 9 : decision trees, random forests, bagging, boosting, stacking
lecture 10 : Variational AE and GANs
lecture 11 : representation learning
lecture 12 : PCA and K-means clustering
lecture 13 : intro to Reinforcement learning

By : Khalil idrissi

Today

- intro to the jargon
- working with pandas

By : Khalil idrissi

What is AI ?

AI is a term that encapsulates all the methods and techniques that make a system behavior intelligent

"Intelligence is not a single, unitary ability, but rather a composite of several functions. The term denotes that combination of abilities required for survival and advancement within a particular culture." A. Anastasi [2]

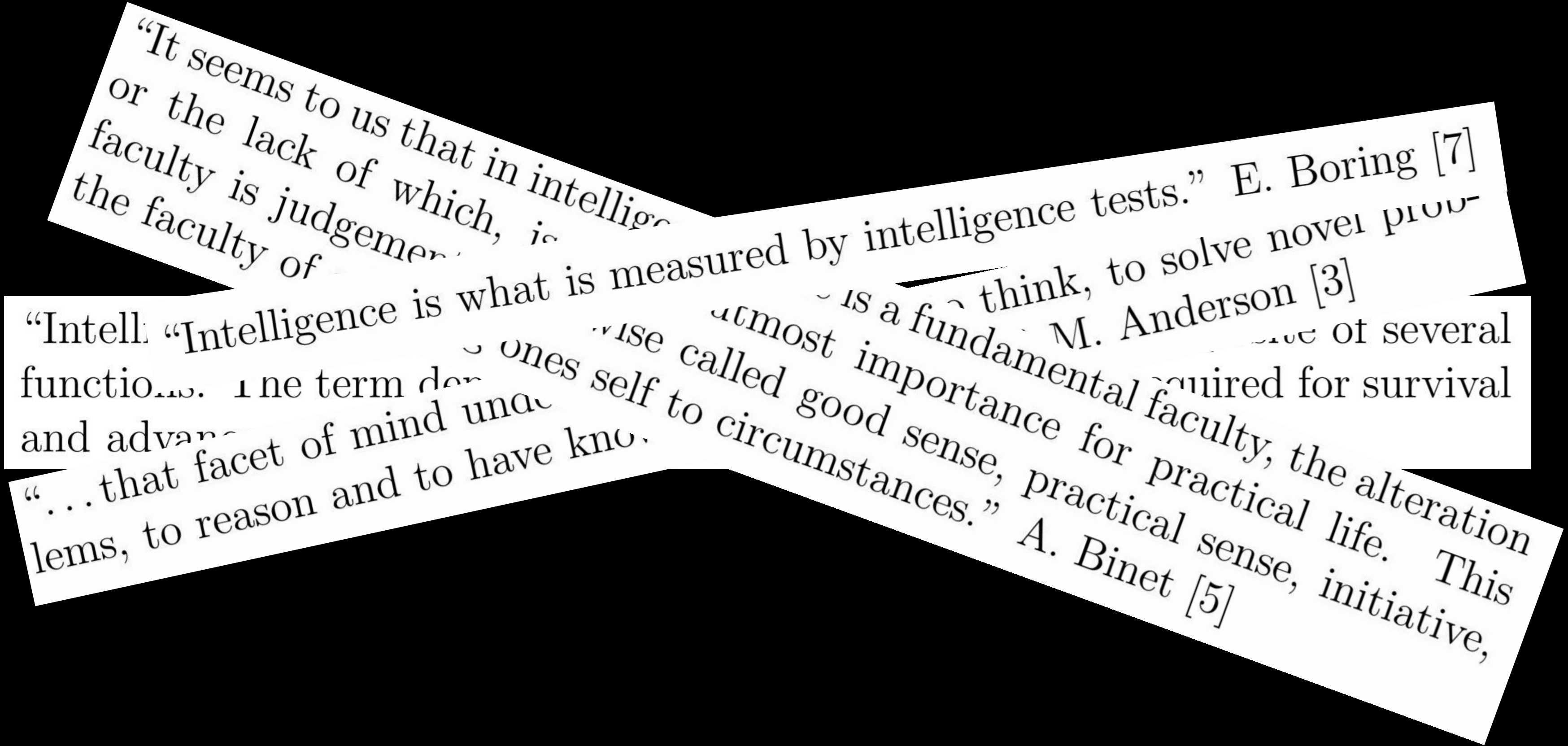
"Intelligence is not a single, unitary [illegible] functions. The term [illegible] and adva[illegible]

"...that facet of mind underlying our capacity to think, to solve novel problems, to reason and to have knowledge of the world." M. Anderson [3]

[illegible] of several [illegible]ities required for survival [illegible]ture." A. Anastasi [2]

"It seems to us that in intelligence there is a fundamental faculty, the alteration or the lack of which, is of the utmost importance for practical life. This faculty is judgement, otherwise called good sense, practical sense, initiative, the faculty of adapting ones self to circumstances." A. Binet [5]

"Intelligence is not only the ability to reason; it is also the ability to perform effectively along several functions. The term dep[illegible] required for survival and advan[illegible] that facet of mind under[illegible] to think, to solve novel problems, to reason and to have kno[illegible]" M. Anderson [3]


“It seems to us that in intellig
or the lack of which, is
faculty is judgemen
the faculty of
is a fundamental faculty, the alteration
utmost importance for practical life. This
wise called good sense, practical sense, initiative,
ones self to circumstances.” A. Binet [5]
“Intelligence is what is measured by intelligence tests.” E. Boring [7]
“Intell
of several
functio
he term de
quired for survival
and advan
“. . . that facet of mind unde
think, to solve novel prob-
lems, to reason and to have kno
M. Anderson [3]

"It seems to us that in intelligence tests." E. Boring [7]

"Intelligence is what is measured by intelligence tests." E. Boring [7]

"Intelligence is what is measured by intelligence tests." E. Boring [7]

"We shall use the term 'intelligence' to mean the ability of an organism to solve new problems ..." W. V. Bingham [6]

"It seems to us that in ... by intelligence tests." E. Boring [7]

"... a quality that is intellectual and not emotional or moral: in measuring it we try to rule out the effects of the child's zeal, interest, industry, and the like. Secondly, it denotes a general capacity, a capacity that enters into everything the child says or does or thinks; any want of 'intelligence' will therefore be revealed to some degree in almost all that he attempts;" C. L. Burt [8]

"We shall use the term ... solve new problems ..." W. V. Bingham ...

... think, to solve novel prob- ... Anderson [3]

... of several ... survival ...

"It seems to us that in ... by intelligence tests." E. Boring [7]

"... a quality that is intellectual and not emotional or moral: in measuring it we try to rule out the effects of the child's zeal, interest, industry, and the like. Secondly, it denotes a general capacity, a capacity that enters into ... ink, to solve novel prob- ... nderson [3]

... of several ... rvival

the child says or does or thinks; any want of 'intelligen...

revealed to some degree in almost all that he ...

functio...

and advan... of ...

"We shall use the term 'int...

"A person possesses intelligence insofar as he has learned, or can learn, to adjust himself to his environment." S. S. Colvin quoted in [35]

"It seems

"...the ability to plan and structure one's behavior with an end in view." J. P. Das

out the effects of the child's zeal, interest, industry, and the like.
econdly, it denotes a general capacity, a capacity that enters into
the child says or does or thinks; any want of 'intelligen
revealed to some degree in almost all that he
functio
and advan
"We shall use the term 'int

"A person possesses intelligence insofar as he has learned, or can learn, to adjust himself to his environment." S. S. Colvin quoted in [35]

"It seems

"...the ability to plan and structure one's behavior with an end in view." J. Das

"The capacity to learn or to profit by experience." W. F. Dearborn quoted in [35]

revealed to some degree in almost all that he

"A person possesses intelligence insofar as he has learned, or

adjust himself to his environment." S. S. Colvin quoted in [35]

"It seems

"...the ability to plan and structure one's behavior with an end in view." J. Das

"The capacity to learn or to profit by experience." W. F. Dearborn quoted in [35]

revealed to some degree in almost

"We shall use the term

"A person possess

adjust hi

"The capacity to learn or to profit by experience." W. F. Dearborn quoted in [35]

ectual and not emotional

the efforts of the child's

intelligence

ink, to solve novel

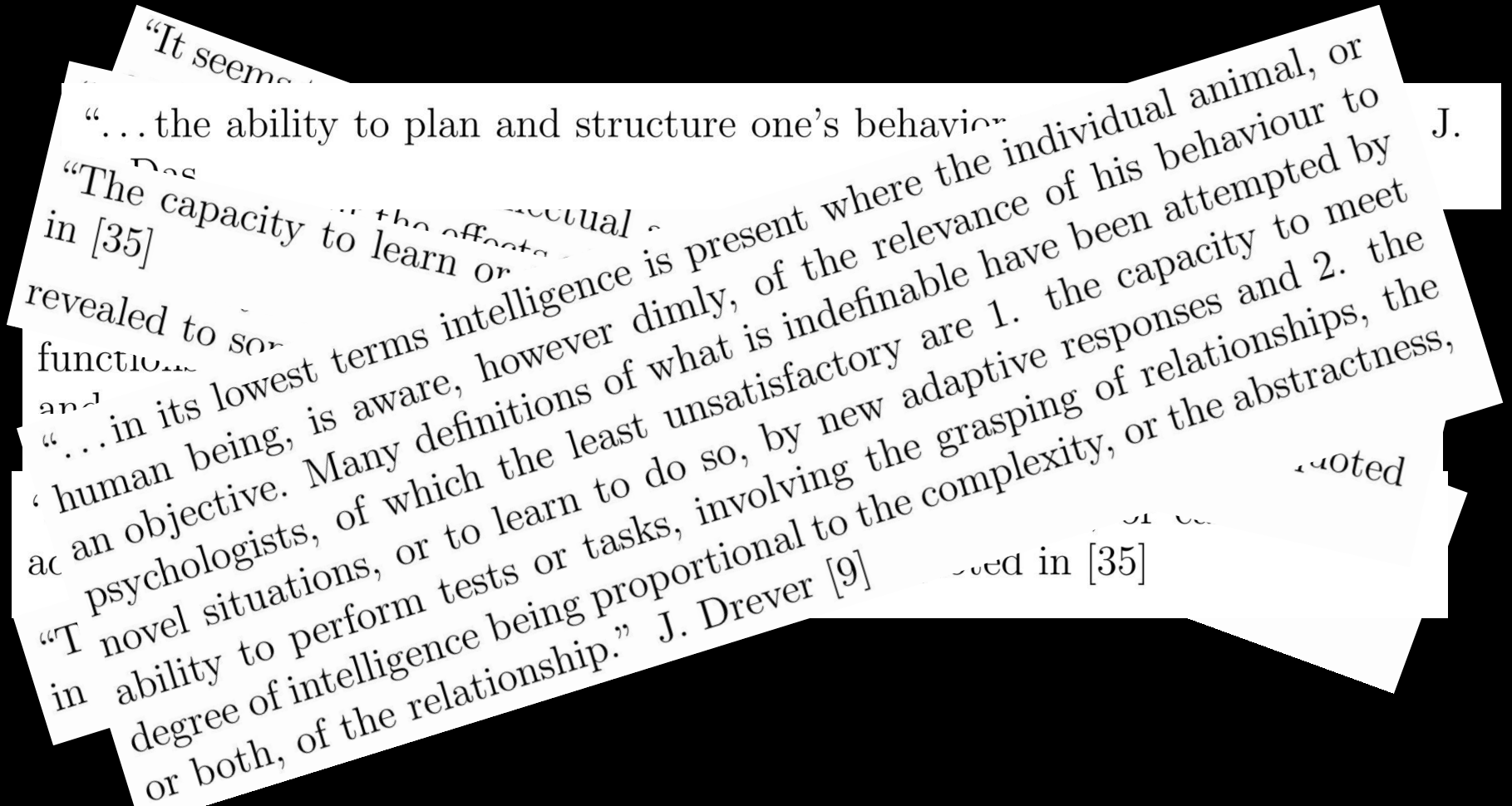
al

rvival

easuring it

as he has learned, or

S. S. Colvin quoted in [35]


"It seems
"...the ability to plan and structure one's behavior
J.
"The capacity to learn or
in [35]
revealed to so
functio
and
"...in its lowest terms intelligence is present where the individual animal, or
human being, is aware, however dimly, of the relevance of his behaviour to
an objective. Many definitions of what is indefinable have been attempted by
psychologists, of which the least unsatisfactory are 1. the capacity to meet
novel situations, or to learn to do so, by new adaptive responses and 2. the
ability to perform tests or tasks, involving the grasping of relationships, the
degree of intelligence being proportional to the complexity, or the abstractness,
or both, of the relationship." J. Drever [9]
uoted
ed in [35]

"It seems

"...the ability to plan and structure one's behavior

"The

in "Intelligence A: the biological substrate of mental ability, the brains' neu-
roanatomy and physiology; Intelligence B: the manifestation of intelligence A,
and everything that influences its expression in real life behavior; Intelligence
C: the level of performance on psychometric tests of cognitive ability." H. J.
Eysenck.

human

an objective.

psychologists, or

novel situations, or to

ability to perform tests or ta

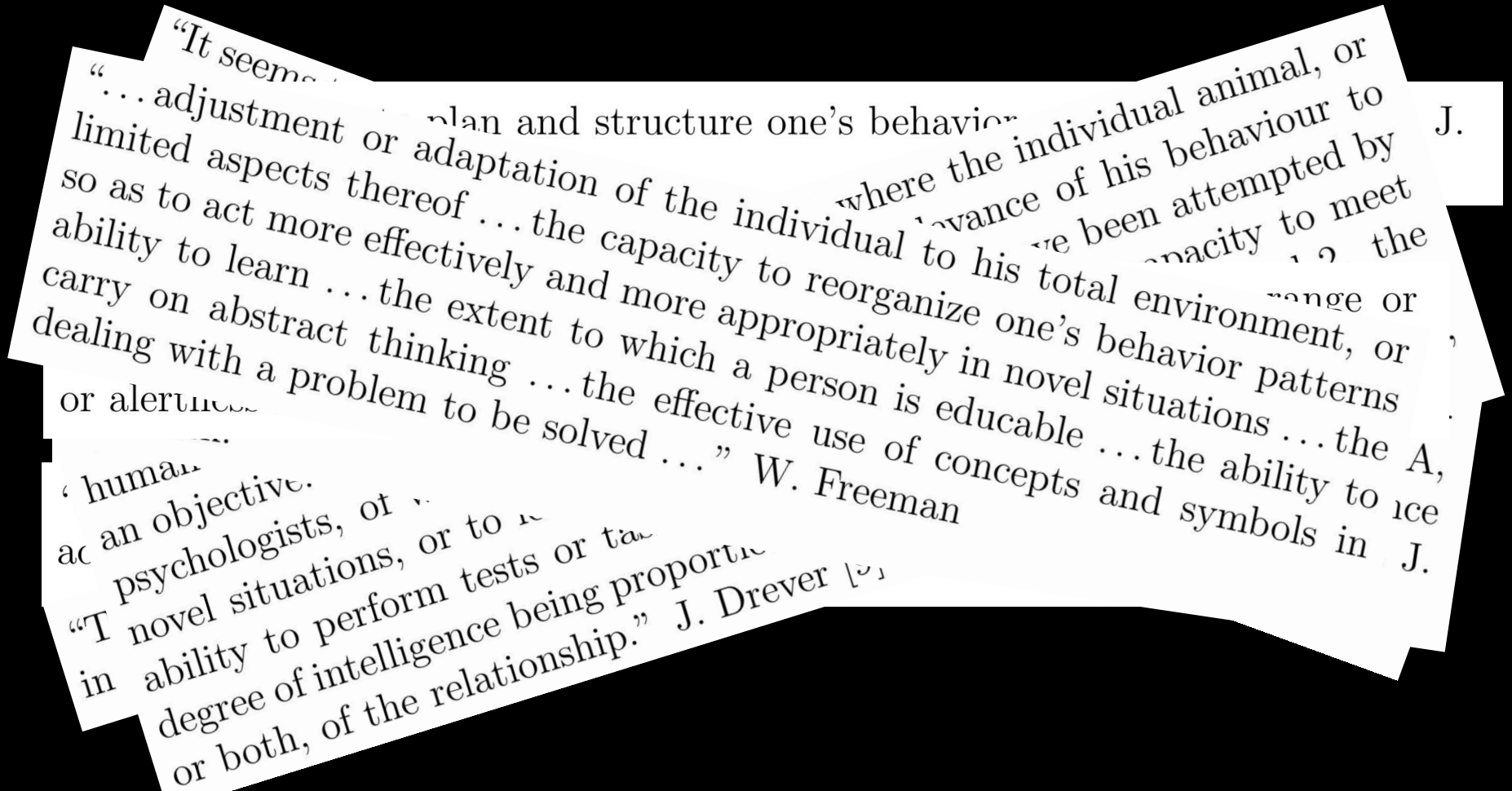
degree of intelligence being proportio

or both, of the relationship." J. Drever [

is present where the individual animal, or
of the relevance of his behaviour to
enable have been attempted by
1. the capacity to meet
sponses and 2. the
tionships, the
actness,

J.

"Sensory capacity, capacity for perceptual recognition, quickness, range or flexibility or association, facility and imagination, span of attention, quickness or alertness in response." F. N. Freeman quoted in [35]


"It seems
plan and structure one's behavior
where the individual animal, or
J.
. . . adjustment or adaptation of the individual to his total environment, or
limited aspects thereof . . . the capacity to reorganize one's behavior patterns
so as to act more effectively and more appropriately in novel situations . . . the A,
ability to learn . . . the extent to which a person is educable . . . the ability to
carry on abstract thinking . . . the effective use of concepts and symbols in J.
dealing with a problem to be solved . . . " W. Freeman
or alert
human
an objective.
psychologists, or
novel situations, or to
"T
in ability to perform tests or ta
degree of intelligence being proport
or both, of the relationship." J. Drever

"It seems ... plan and structure one's behavior ... where the individual animal, or ... J.

"... adjustment or adaptation of the individual to his total environment, or limited aspects thereof ... the capacity to reorganize one's behavior patterns so as to act more effectively and more appropriately in novel situations ... the ability to learn ... the extent to which a person is educable ... the ability to carry on abstract thinking ... the effective use of concepts and symbols in dealing with a problem to be solved ..." W. Freeman

"... performing an operation on a specific type of content to produce a particular product." J. P. Guilford

"It seems

"... adjustment or adaptation of the individual animal, or limited aspects thereof ... the capacity to so as to act more effectively and more ability to learn ... the extent to carry on abstract thinking dealing with a problem or alertness

"Sensation, perception, association, memory, imagination, discrimination, judgement and reasoning." N. E. Haggerty quoted in [35]

"... the resultant of the process of acquiring, storing in memory, retrieving, combining, comparing, and using in new contexts information and conceptual skills." Humphreys

"An intelligence is the ability to solve problems, or to create products, that are valued within one or more cultural settings." H. Gardner [11]

"Sensation, perception, association, memory, imagination, discrimination, judgment and reasoning." N. E. Haggerty quoted in [35]

"...the resultant of the process of acquiring, storing in memory, retrieving, combining, comparing, and using in new contexts information and conceptual skills." Humphreys

"An intelligence is the ability to solve problems, or to create products, that are valued within one or more cultural settings." H. Gardner [11]

"The capacity for knowledge, and knowledge possessed." V. A. C. Henmon [16]

"...the resultant of the process of acquiring, storing in memory, retrieving, combining, comparing, and using in new contexts information and conceptual skills." Humphreys

"...cognitive ability." R. J. Herrnstein and C. Murray [17]

"An intelligence is
are valued within one or more cultural settings." H. Gardner [11]

...justment or adaptation of the individual ...plan and structure one's behavior ...where the individual ... J.
limited aspects thereof ... the capacity to ... vance of his behaviour ...
so as to act more effectively and ... gination, discrimination, judge-
ability to learn ... ..., the
carry ...

"The capacity for knowledge, and knowledge possessed." V. A. C. Henmon [16]

"Sensation, perception, ... ducable ... the ability to ... ce
ment and reasoning." N. E. Hagg... tive use of concepts and symbols in ...
...ed ..." W. Freeman

"...the resultant of the process of acquiring, storing in memory, retrieving, ...ic-
combining, comparing, and using in new contexts information and conceptual skills." Humphreys

"... cognitive ability." R. J. Herrnstein and C. Murray [17]

"An intelligence is
are valued within one or more cultural settings." H. Gardner [11]

justment or adaptation of the individual
limited aspects thereof ... the capacity to
so as to act more effectively and
ability to learn
carry

plan and structure one's behavior
where the individual
vance of his behaviour
gination, discrimination, judge-
J.
the

"The capacity for knowledge, and knowledge possessed." V. A. C. Henmon [16]

"Sensation, perception,
ment and reasoning." N. E. Hagg
ed ..." W. Freeman

ctive use of concepts and symbols in
ducable ... the ability to
ations ... the A,
ice

"...1"... the ability to solve hard problems." M. Minsky [26]
combining, comparing, and using in new contexts information and conceptual skills." Humphreys

, retrieving,
ic-

"...cognitive ability." R. J. Herrnstein and C. Murray [17]

"An intelligence is
are valued within one or more cultural settings." H. Gardner [11]

"Any system ...that generates adaptive behviour to meet goals in a range of environments can be said to be intelligent." D. Fogel [10]

"The capacity for knowledge, and knowledge possessed." V. A. C. Henmon [16]

"...the ability to solve hard problems." M. Minsky [26]

"...cognitive ability." R. J. Herrnstein and C. Murray [17]

"An intelligence is
are valued within one or more cultural settings." H. Gardner [11]

"Any system ...that generates adaptive behviour to meet goals in a range of environments can be said to be intelligent." D. Fogel [10]

"The capacity for knowledge, and knowledge possessed." V. A. C. Henmon [16]

"Intelligent systems are expected to work, and work well, in many different environments. Their property of intelligence allows them to maximize the probability of success even if full knowledge of the situation is not available.

"...the ability to solve hard problems." M. Minsky [26]

skills." Humphreys

"...cognitive ability." R. J. Herrnstein and C. Murray [17]

"An intelligence is
are valued within one or more cultural settings." H. Gardner [11]

"Any system ...that generates adaptive behviour to meet goals in a range of environments can be said to be intelligent." D. Fogel [10]

"...the ability of a system to act appropriately in an uncertain environment, where appropriate action is that which increases the probability of success, and success is the achievement of behavioral subgoals that support the system's ultimate goal." J. S. Albus [1]

"Intelligent systems are expected to work, and work well, in many different environments. Their property of intelligence allows them to maximize the probability of success even if full knowledge of the situation is not available.

Functi
enviro

"...the ability to solve hard problems." M. Minsky [26]

skills." Humphreys

"... the essential, domain-independent skills necessary for acquiring a wide range of domain-specific knowledge – the ability to learn anything. Achieving this with 'artificial general intelligence' (AGI) requires a highly adaptive, general-purpose system that can autonomously acquire an extremely wide range of specific knowledge and skills and can improve its own cognitive ability through self-directed learning." P. Voss [38]

"... the ability to solve hard problems." M. Minsky [26]

AI is a term that encapsulates all the methods and techniques that make a system behavior like human’s

AI is a term that encapsulates all the methods and techniques that make a system behavior like human's

AI is a term that encapsulates all the methods and techniques that make a system behavior like human's

On the Measure of Intelligence

François Chollet *
Google, Inc.
fchollet@google.com

November 5, 2019

Abstract

To make deliberate progress towards more intelligent and more human-like artificial systems, we need to be following an appropriate feedback signal: we need to be able to define and evaluate intelligence in a way that enables comparisons between two systems, as well as comparisons with humans. Over the past hundred years, there has been an abundance of attempts to define and measure intelligence, across both the fields of psychology and AI. We summarize and critically assess these definitions and evaluation approaches, while making apparent the two historical conceptions of intelligence that have implicitly guided them. We note that in practice, the contemporary AI community still gravitates towards benchmarking intelligence by comparing the *skill* exhibited by AIs and humans at specific tasks, such as board games and video games. We argue that solely measuring skill at any given task falls short of measuring intelligence, because skill is heavily modulated by prior knowledge and experience: unlimited priors or unlimited training data allow experimenters to "buy" arbitrary levels of skills for a system, in a way that masks the system's own generalization power. We then articulate a new formal definition of intelligence based on Algorithmic Information Theory, describing intelligence as *skill-acquisition efficiency* and highlighting the concepts of *scope*, *generalization difficulty*, *priors*, and *experience*, as critical pieces to be accounted for in characterizing intelligent systems. Using this defi-

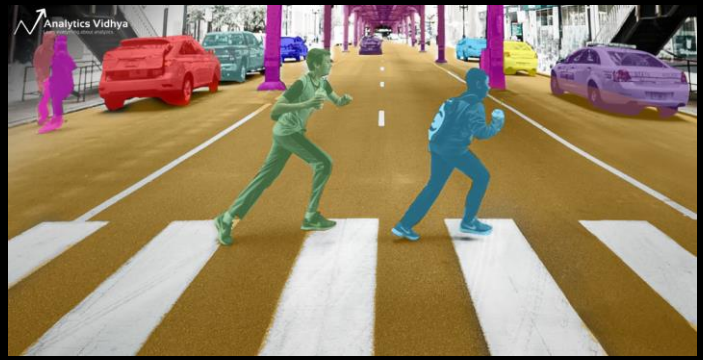
Link (press ctrl + Link)

Applications of AI

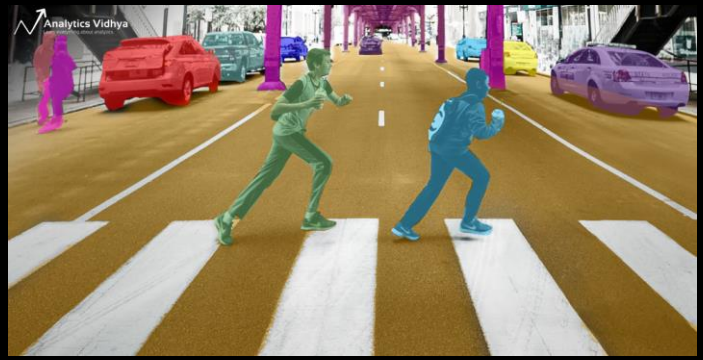
Applications of AI

Applications of AI

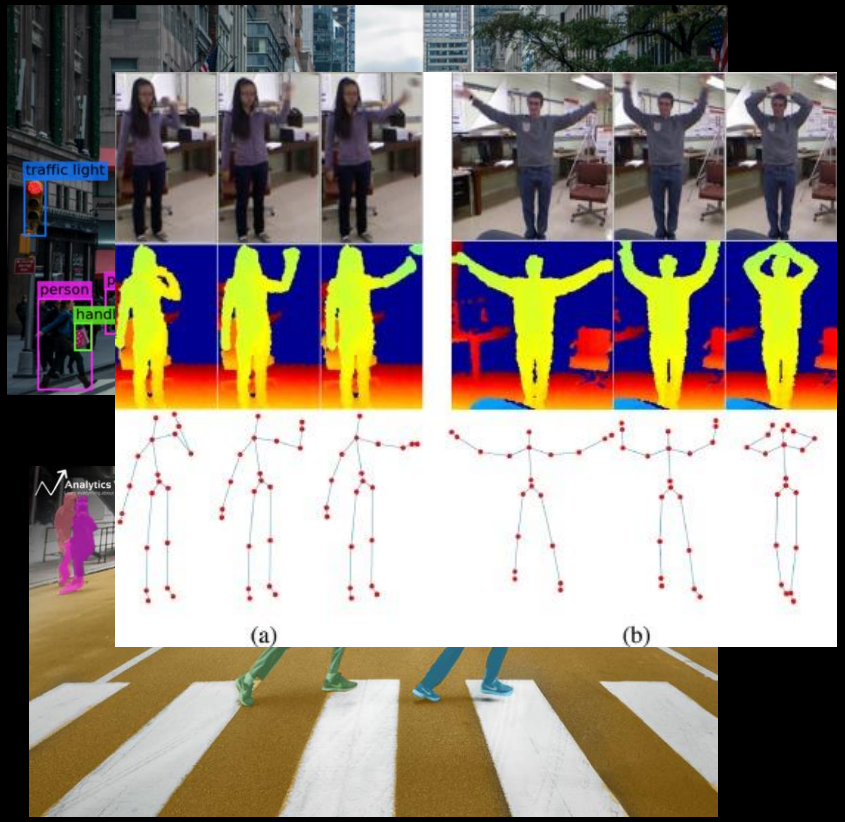
Applications of AI



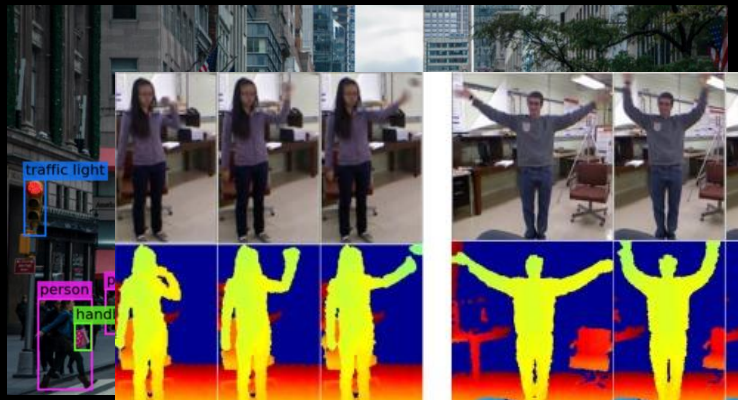
Applications of AI

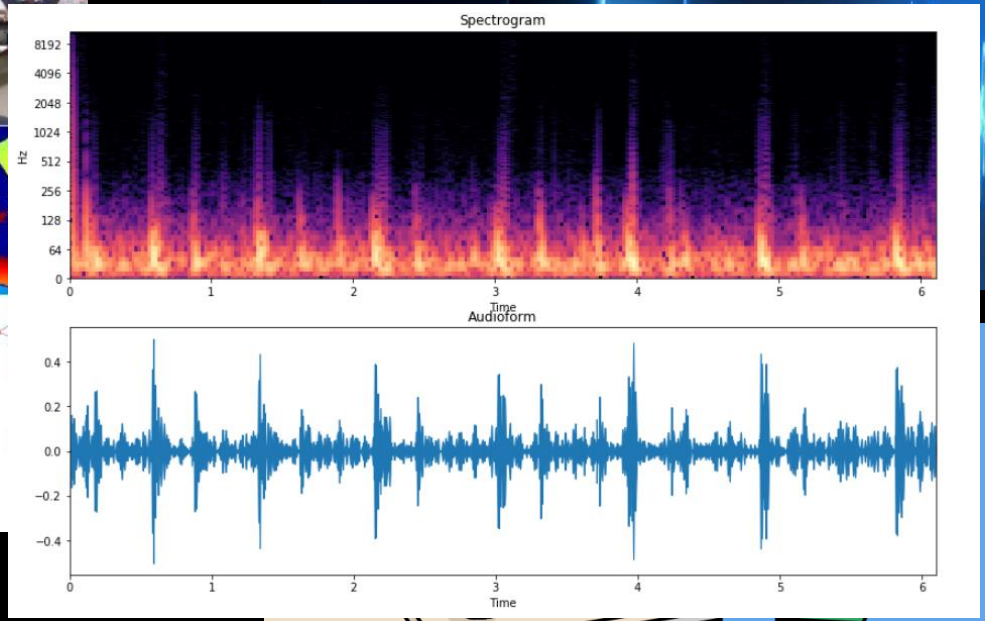


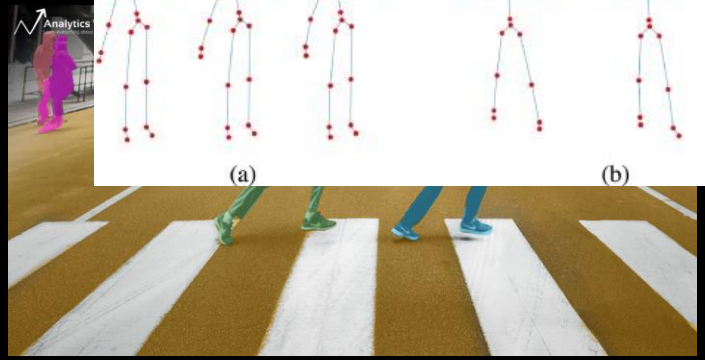
Applications of AI



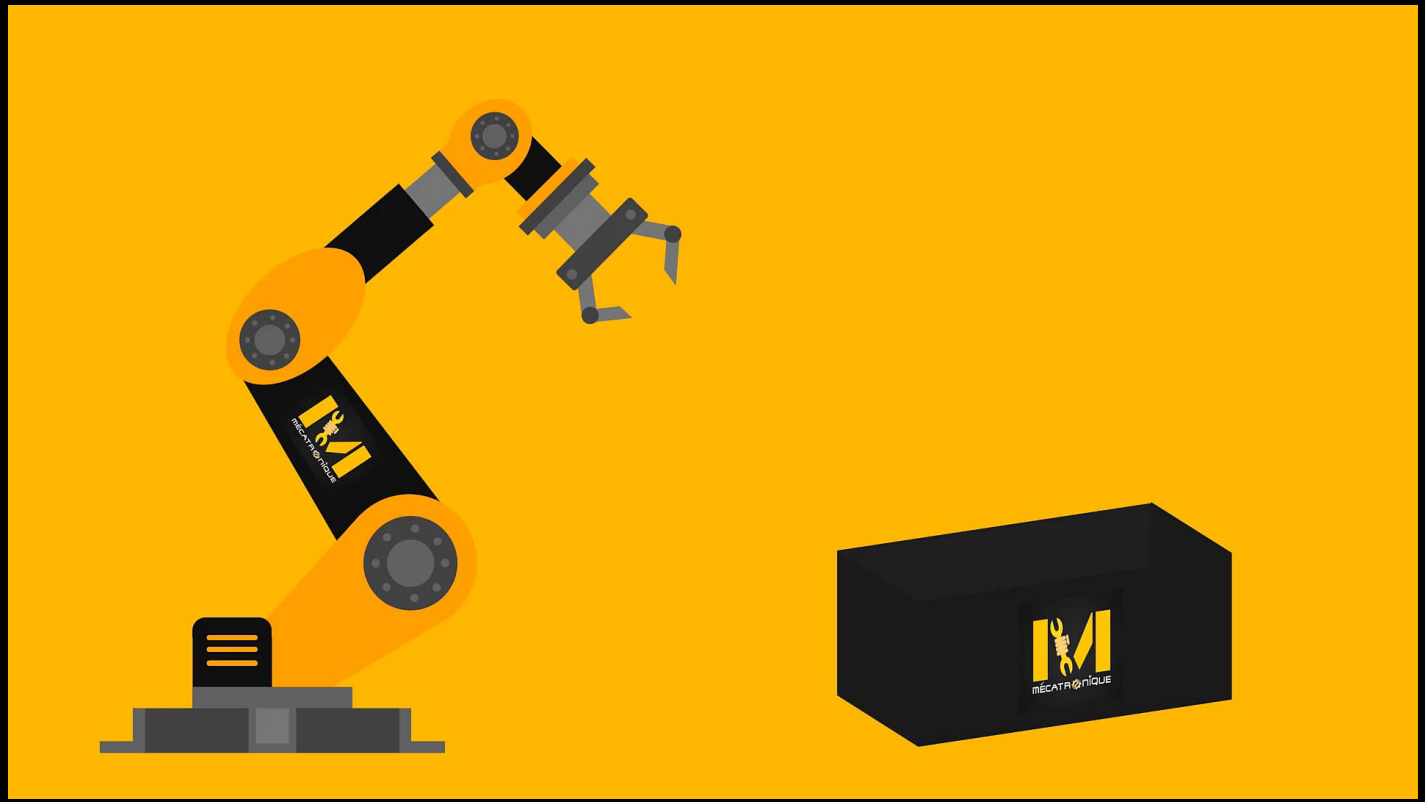
Applications of AI



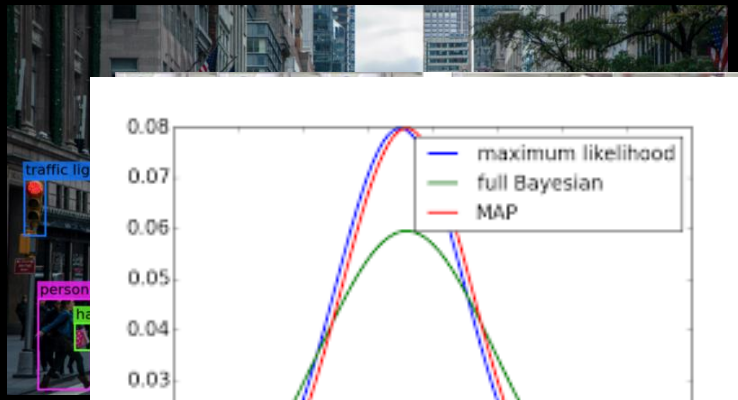


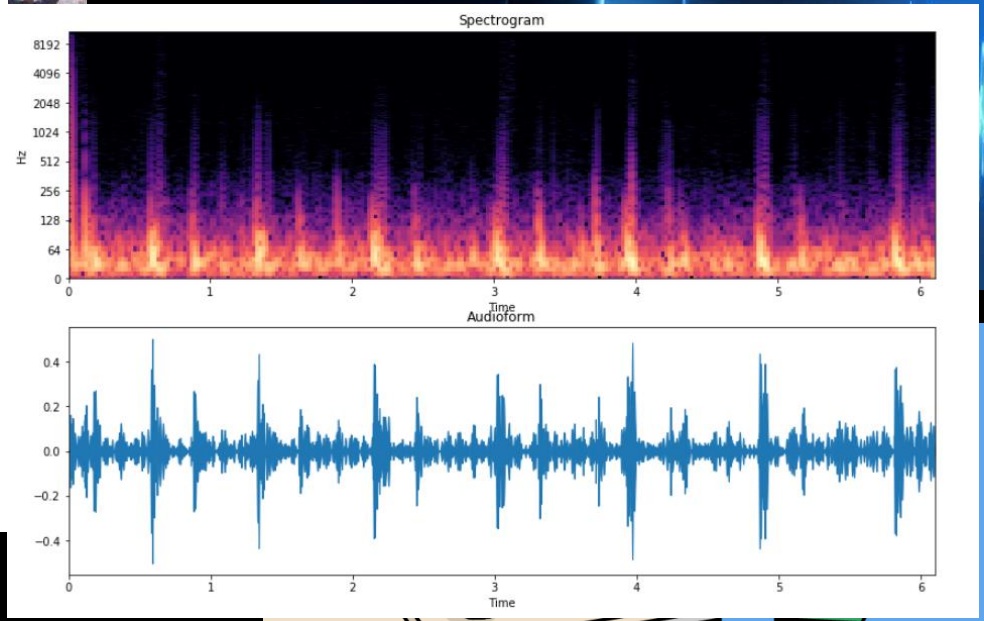


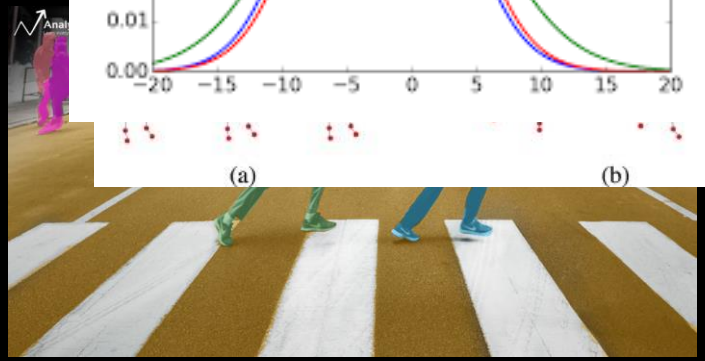
Applications of AI



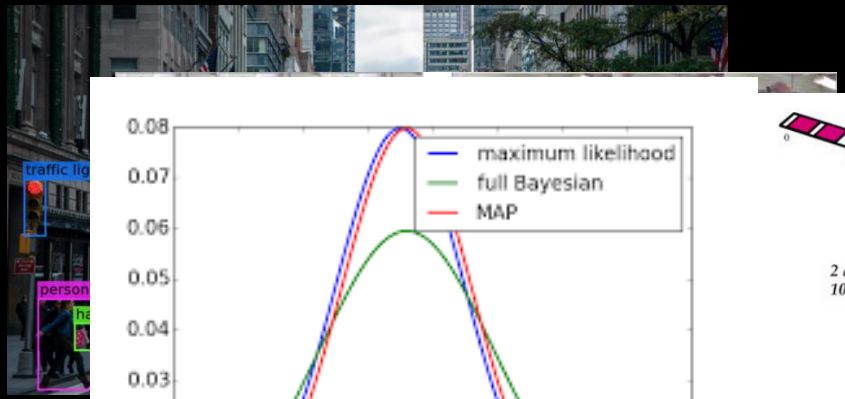
Applications of AI

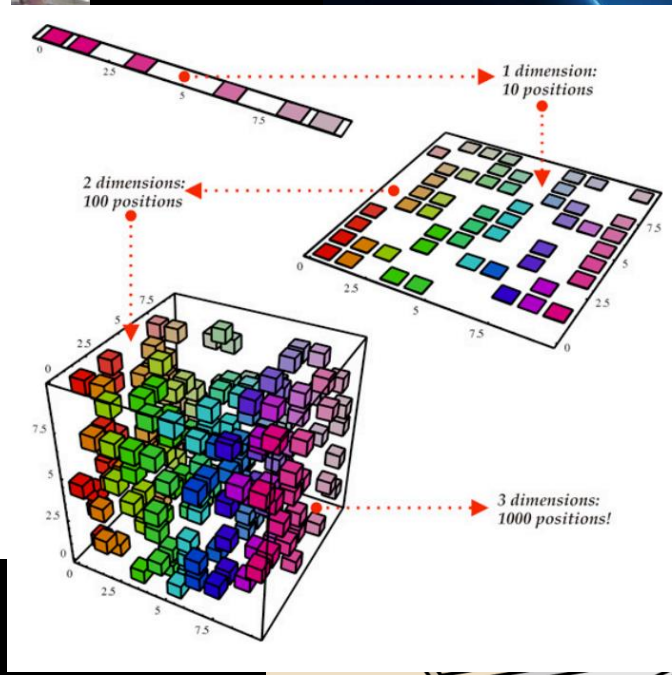


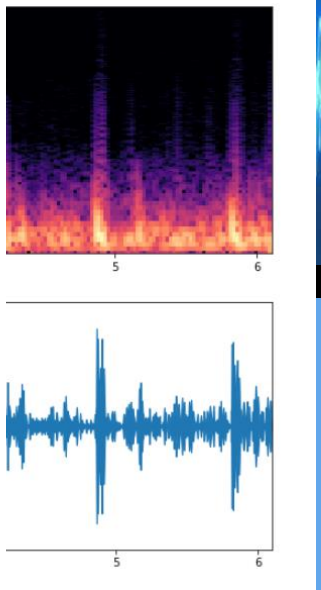


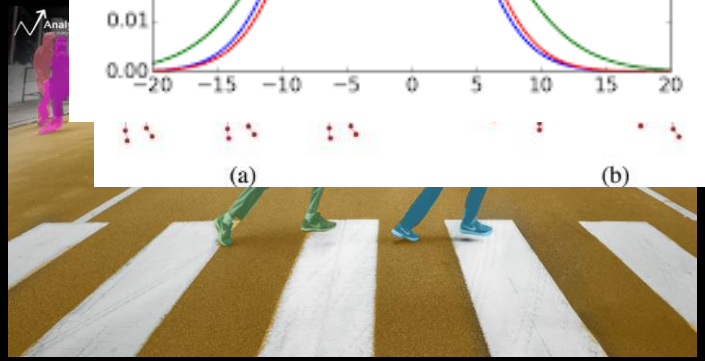


Applications of AI










A
B
C

All images are fake

Multiple approaches for AI

Multiple approaches for AI

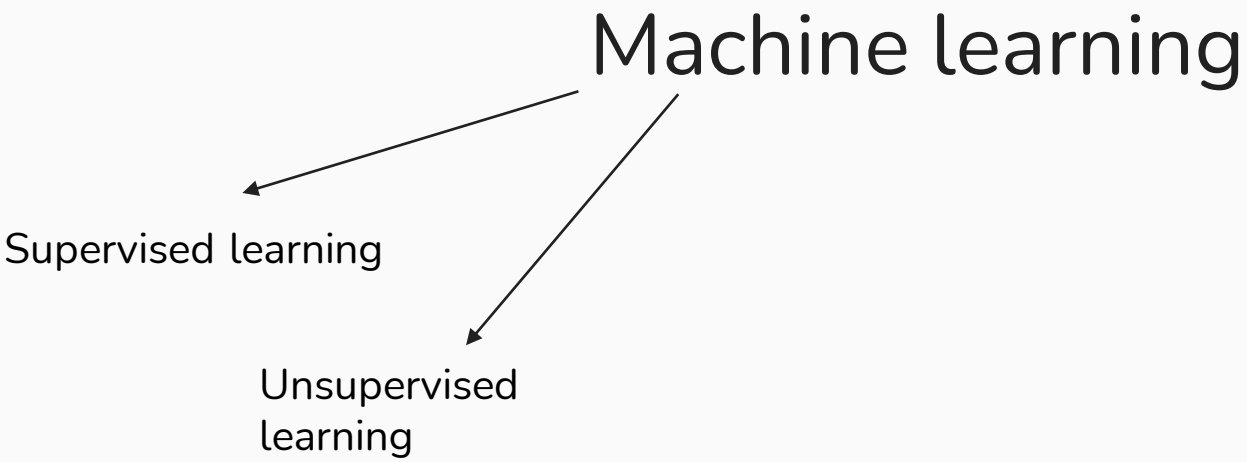
Machine learning

Multiple approaches for AI

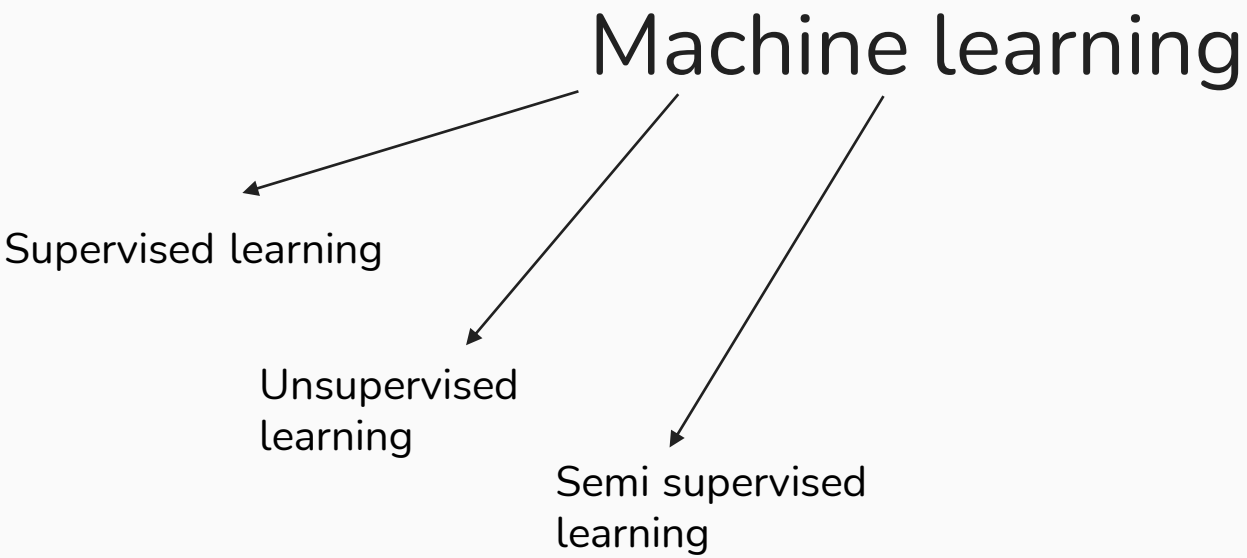
Machine learning

Supervised learning

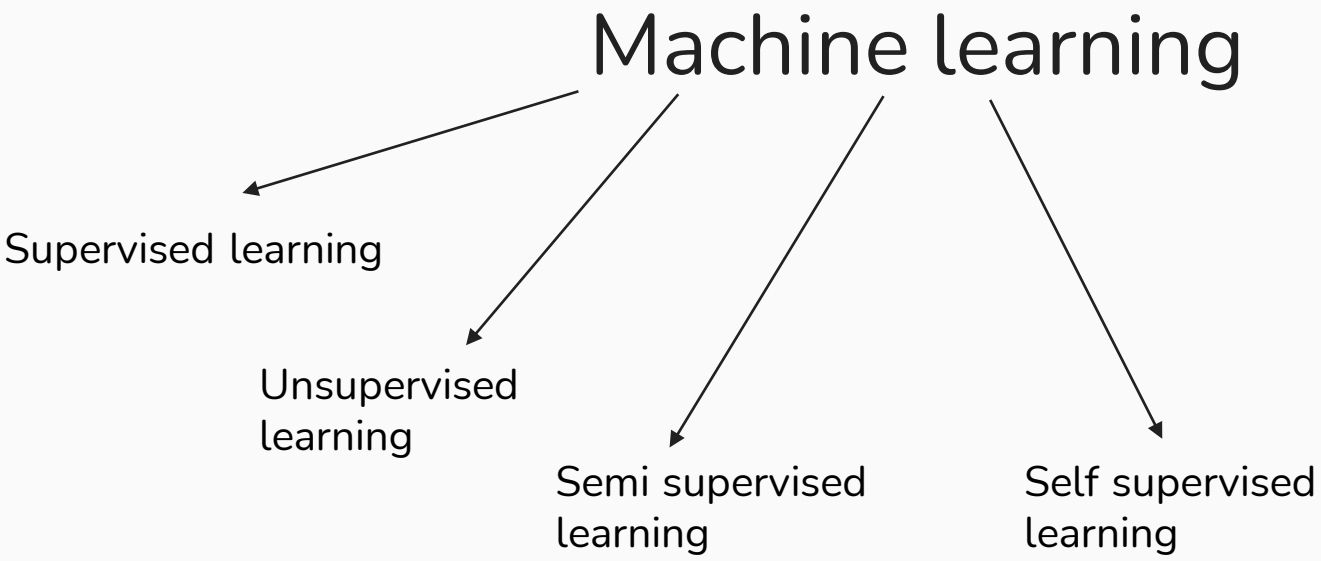
Multiple approaches for AI



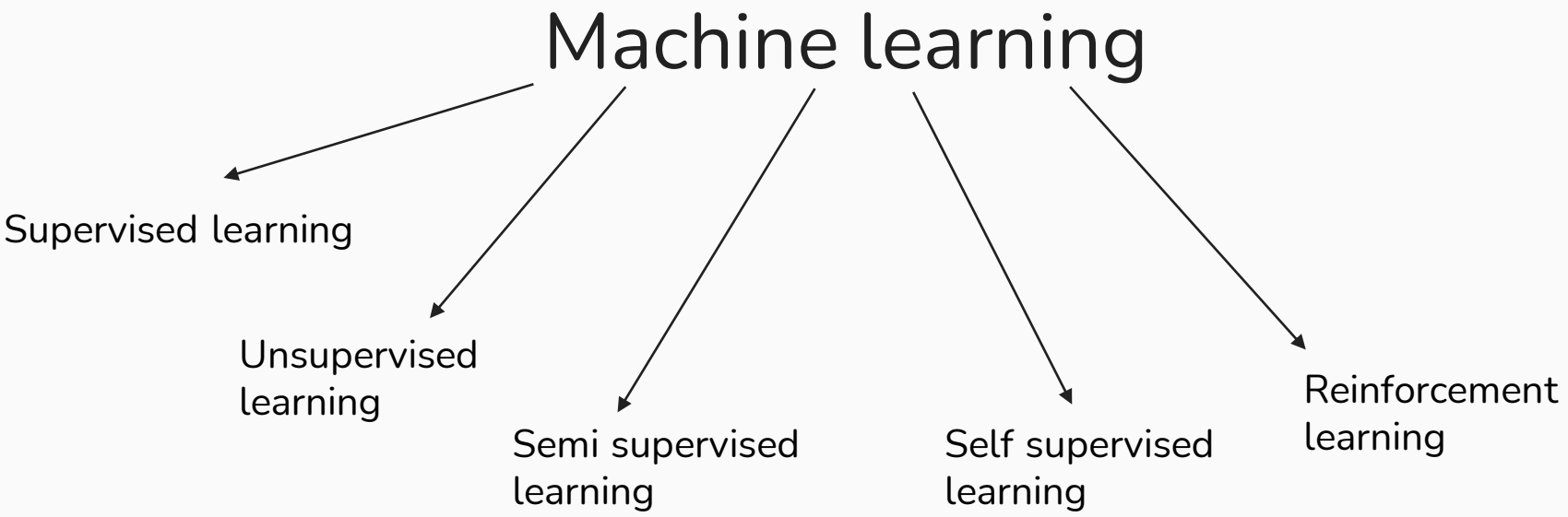
Multiple approaches for AI



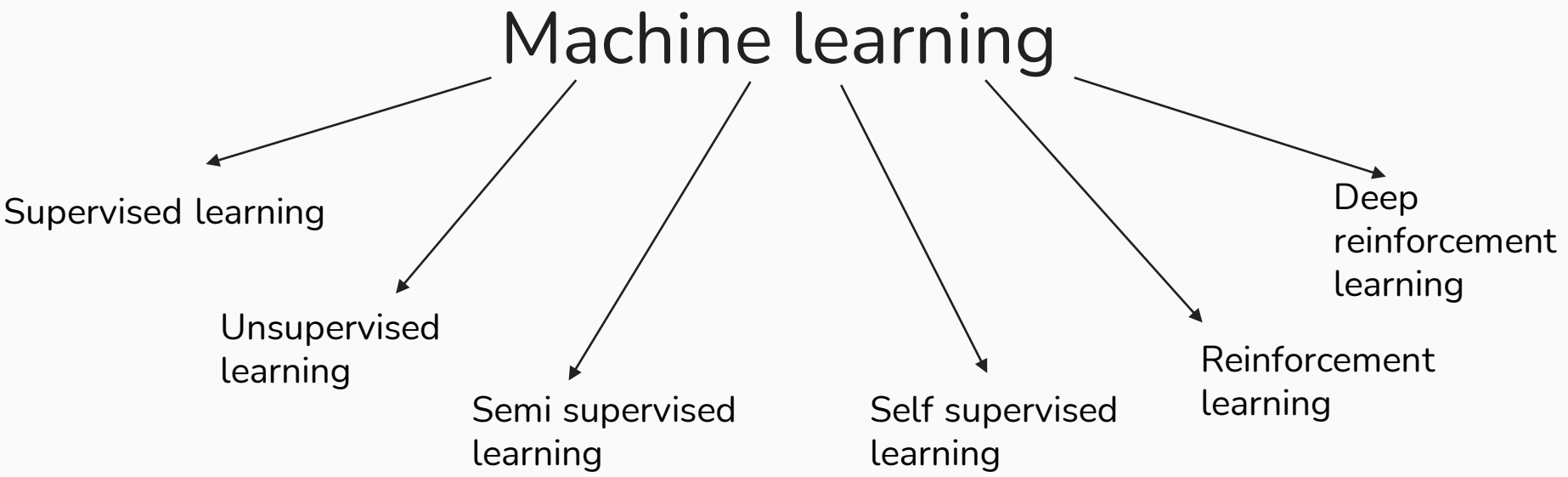
Multiple approaches for AI



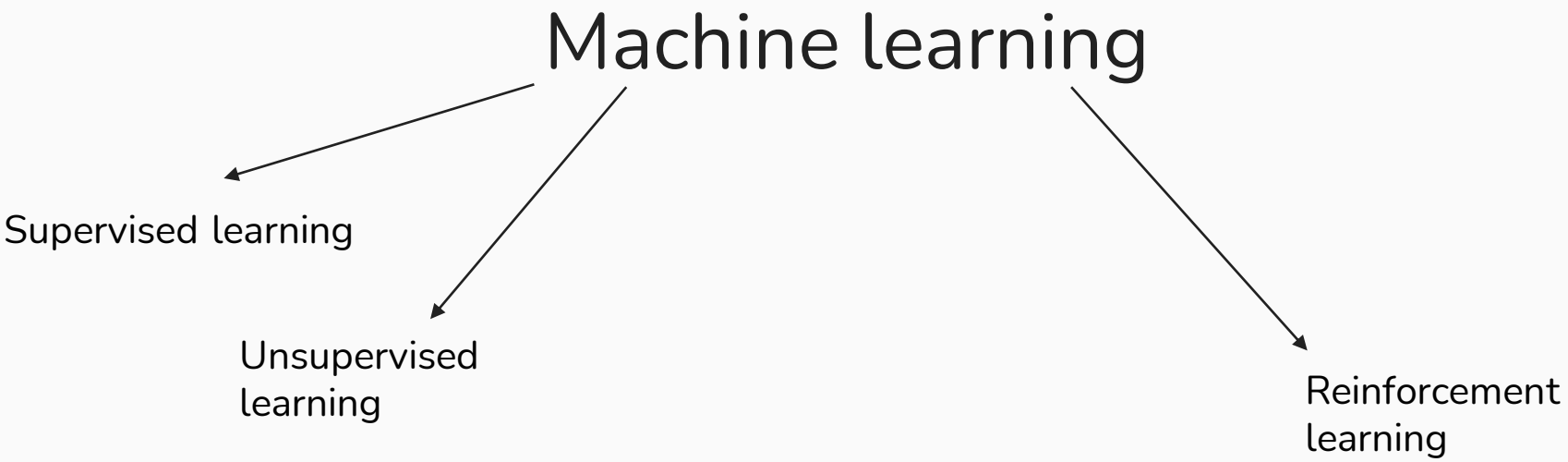
Multiple approaches for AI



Multiple approaches for AI



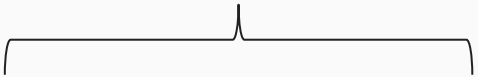
Multiple approaches for AI



example

1- data preprocessing

1- data preprocessing



1- data preprocessing

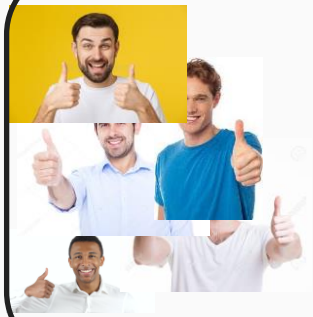
1- data preprocessing

Thumbs up

Thumbs down

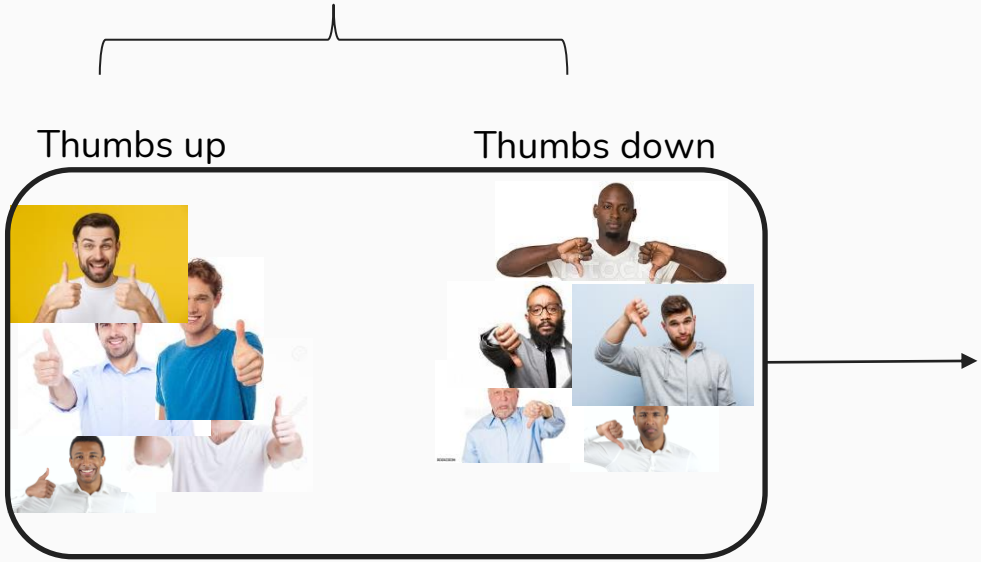
1- data preprocessing

Thumbs up



Thumbs down

1- data preprocessing



1- data preprocessing

2-training

Thumbs up

Thumbs down

1- data preprocessing

2-training

Thumbs up

Thumbs down

1- data preprocessing

2-training

Thumbs up

Thumbs down

3- testing

3- testing

New image

3- testing

New image 

3- testing

New image

3- testing

New image

Either
thumbs up or
thumbs down

Other example

DATA:

Size (m^2)	Price (Dh)
160	120 000
170	110 000
224	168 000
500	300 000
122	80 000
50	25 000
…	…

DATA:

Size (m²)	Price (Dh)
160	120 000
170	110 000
224	168 000
500	300 000
122	80 000
50	25 000
…	…

DATA:

Size (m²)	Price (Dh)
160	120 000
170	110 000
224	168 000
500	300 000
122	80 000
50	25 000
…	…

DATA:

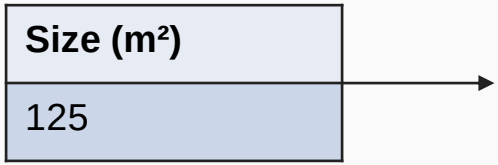
Size (m²)	Price (Dh)
160	120 000
170	110 000
224	168 000
500	300 000
122	80 000
50	25 000
…	…

TRAINING:

TESTING:

Size (m^2)
125

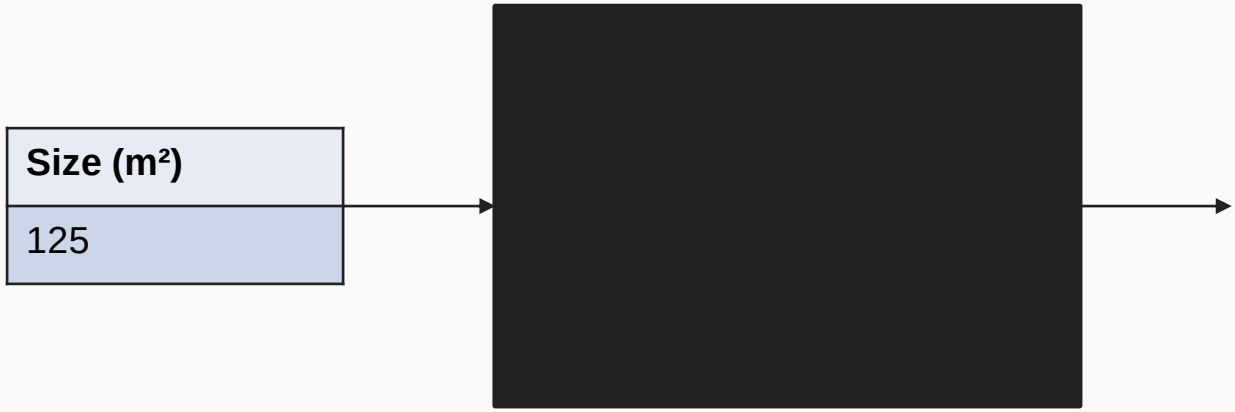
TESTING:



TESTING:

Size (m^2)
125

TESTING:

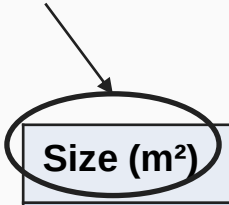


TESTING:

Size (m^2)	Price (Dh)
160	120 000
170	110 000
224	168 000
500	300 000
122	80 000
50	25 000
…	…

Size (m^2)	Price (Dh)
160	120 000
170	110 000
224	168 000
500	300 000
122	80 000
50	25 000
…	…

x=feature or independent variable



Size (m^2)	Price (Dh)
160	120 000
170	110 000
224	168 000
500	300 000
122	80 000
50	25 000
…	…

x=feature or independent variable

Size (m^2)	Price (Dh)
160	120 000
170	110 000
224	168 000
500	300 000
122	80 000
50	25 000
…	…

x=feature or independent variable

y=label or target variable

Size (m^2)	Price (Dh)
160	120 000
170	110 000
224	168 000
500	300 000
122	80 000
50	25 000
…	…

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

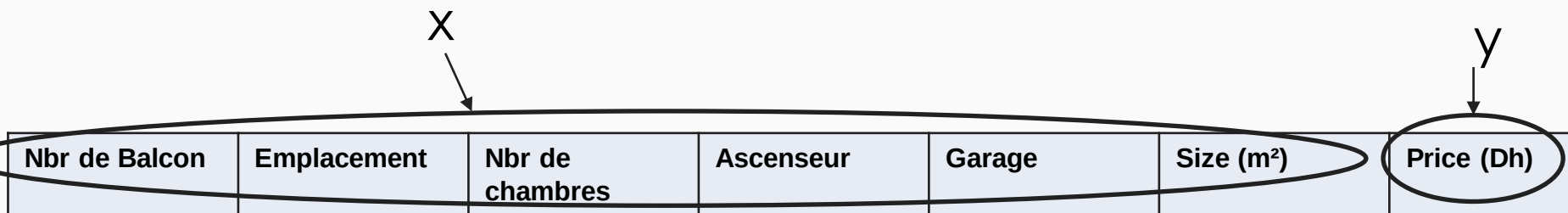
Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

X

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

X

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…



Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

Dataset

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

Dataset

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

Dataset

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

Dataset

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

Dataset

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

Dataset

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

Dataset

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000

Dataset

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000

Dataset

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000

x_1

Dataset

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000

x_1

Dataset

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000

x_1

y_1

Dataset

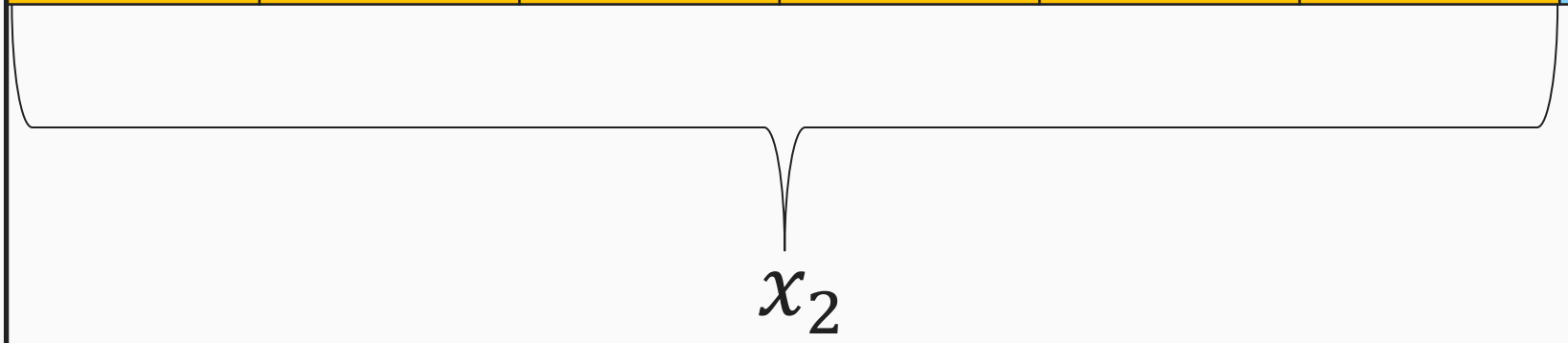
Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000

Dataset

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000

Dataset

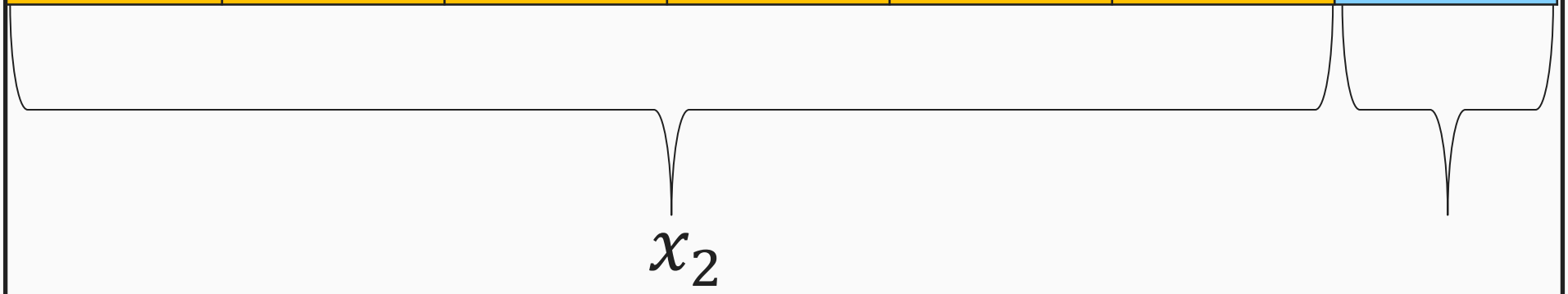
Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000



x_2

Dataset

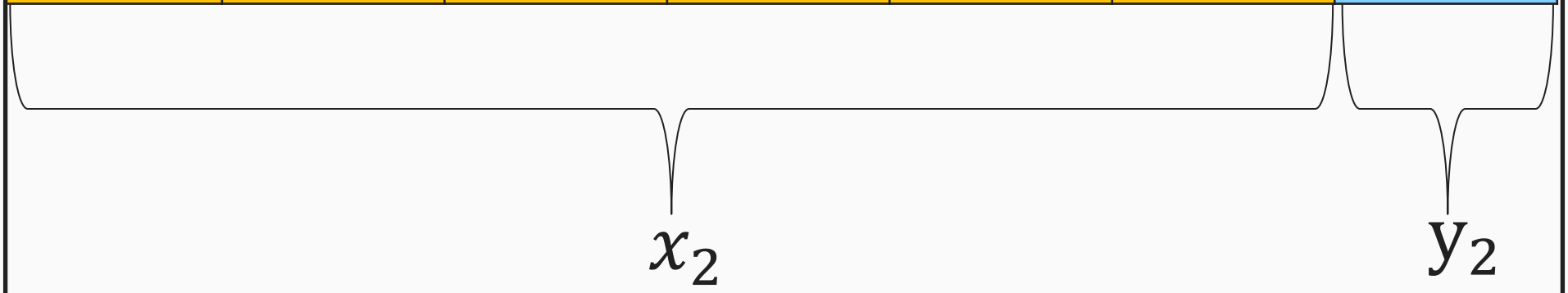
Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000



x_2

Dataset

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000

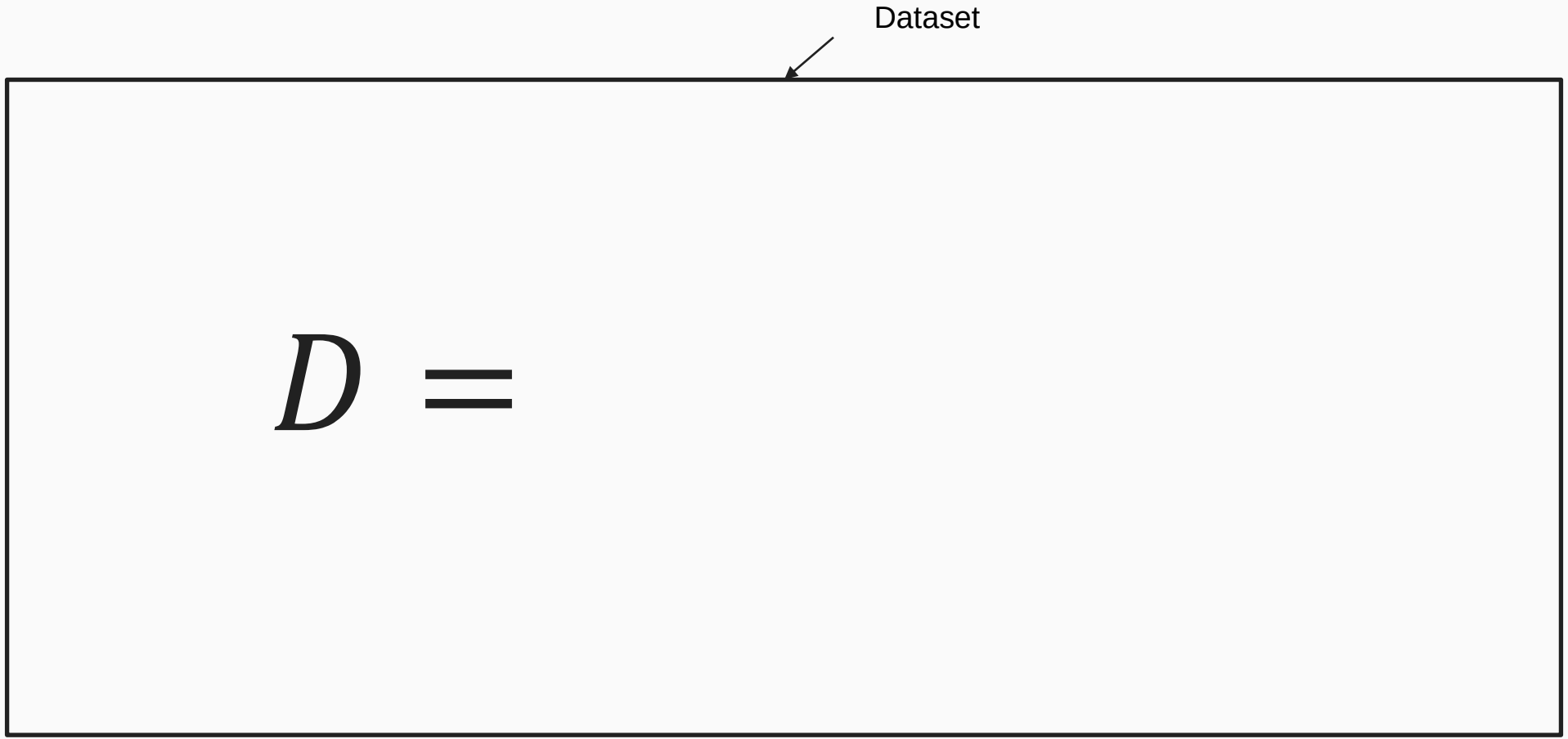


Dataset

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

Dataset

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…


Dataset
$D =$

Dataset

$$D = \{(\quad)\}_{i=1}^{N}$$

Dataset

$$D = \{(x_i, y_i)\}_{\mathrm{i}=1}^{N}$$

Dataset

$$D = \{(x_i, y_i)\}_{\mathrm{i}=1}^{N}$$

$x_i =$ feature i
$y_i =$ label i
$N =$ number of training examples(number of rows)

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m^2)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

x_i is 6 D vector :

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

x_i is 6 D vector :

$$D = \{(2, Mimosas, 4, \text{oui}, \text{oui}, 160; 120\ 000\ ), \dots\}_{\text{i=1}}^{N}$$

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

x_i is 6 D vector :

$$D = \{(2, Mimosas, 4, \text{oui}, \text{oui}, 160; 120\ 000\ ), \dots\}_{\text{i=1}}^{N}$$

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

x_i is 6 D vector :

$$D = \{(2, Mimosas, 4, \text{oui}, \text{oui}, 160; 120\ 000\ ), \dots\}_{i=1}^{N}$$

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

x_i is 6 D vector :

$$D = \{(2, Mimosas, 4, \text{oui}, \text{oui}, 160; 120\ 000\ ), \dots\}_{i=1}^{N}$$

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

x_i is 6 D vector :

$$D = \{(2, Mimosas, 4, \text{oui}, \text{oui}, 160; 120\ 000\ ), \dots\}_{i=1}^{N}$$

Dataset

$$D = \{(x_i, y_i)\}_{\mathrm{i}=1}^{N}$$

$x_i =$ feature i
$y_i =$ label i
$N =$ number of training examples(number of rows)

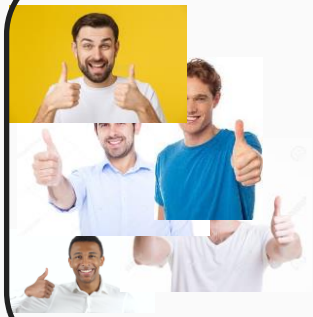
Dataset

$$D = \{(x_i, y_i)\}_{i=1}^{N}$$

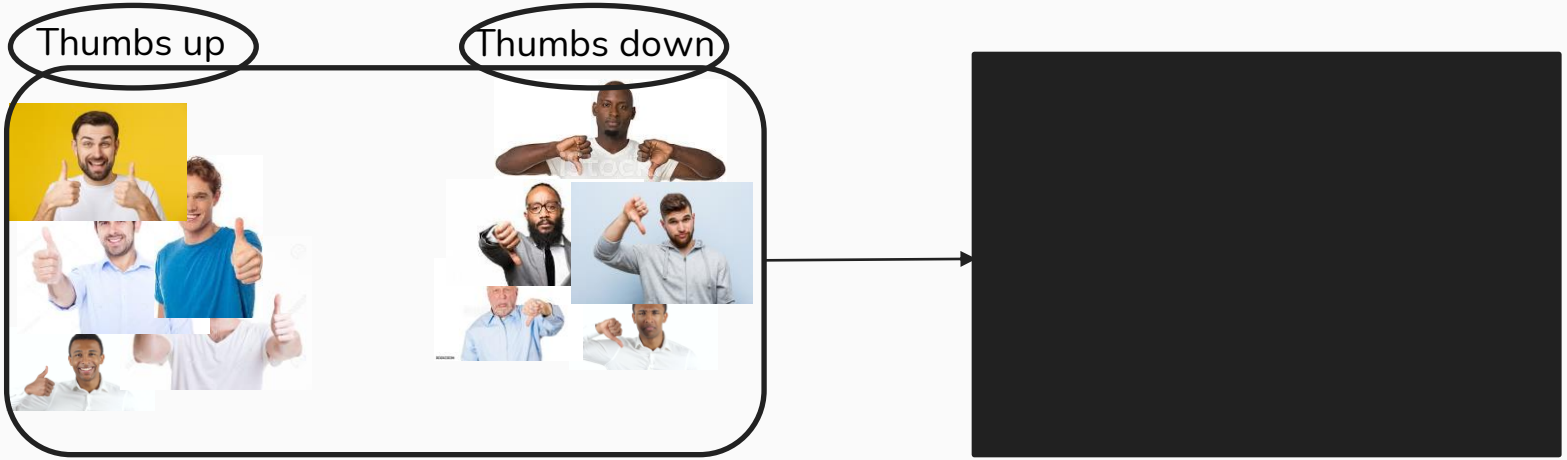
x_i = feature i
y_i = label i
N = number of training examples(number of rows)

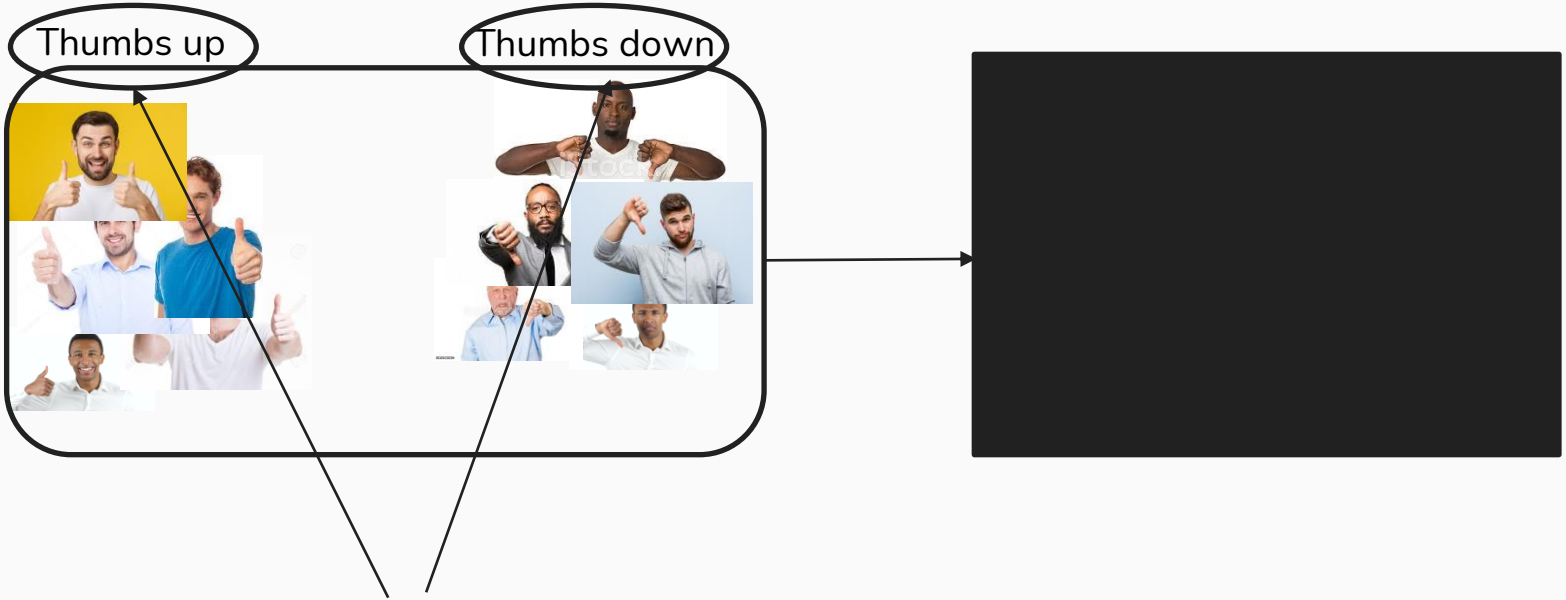
Supervised learning

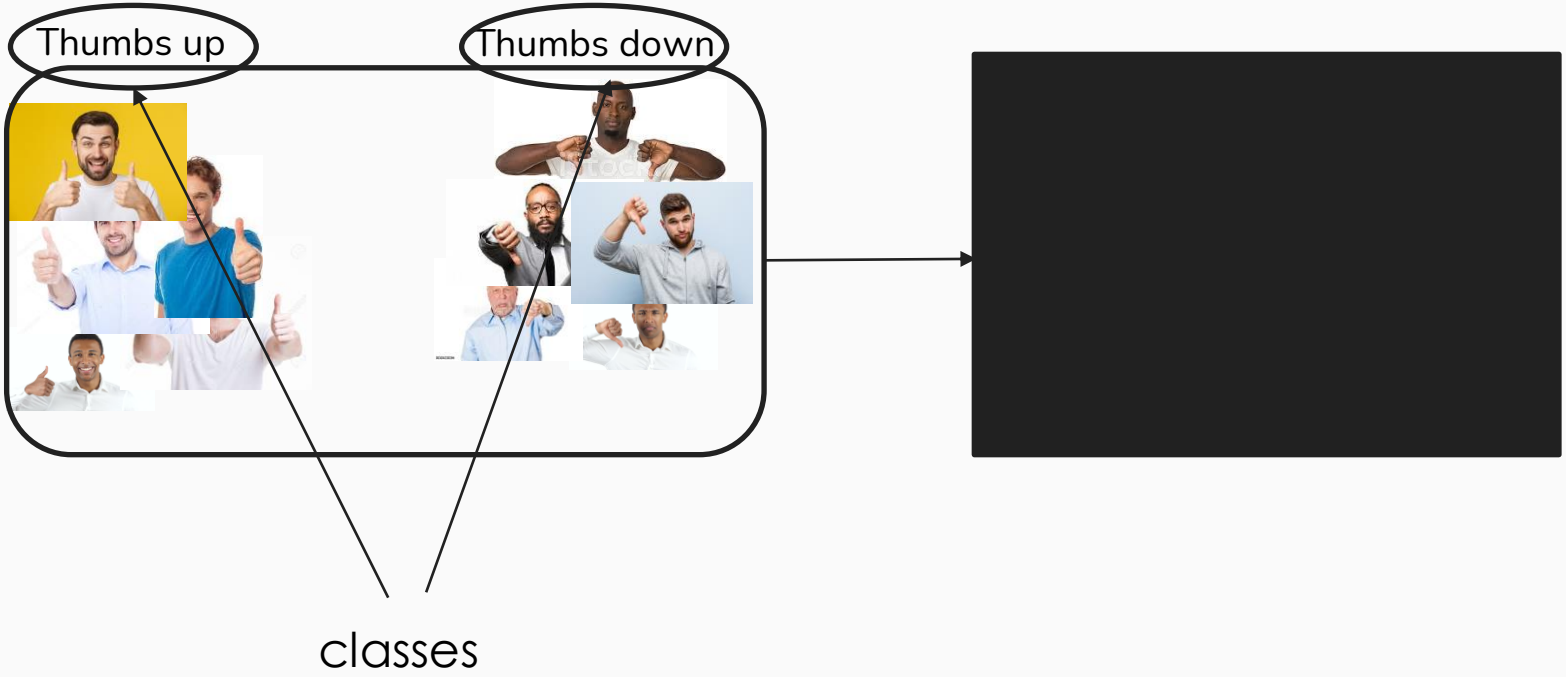
Thumbs up

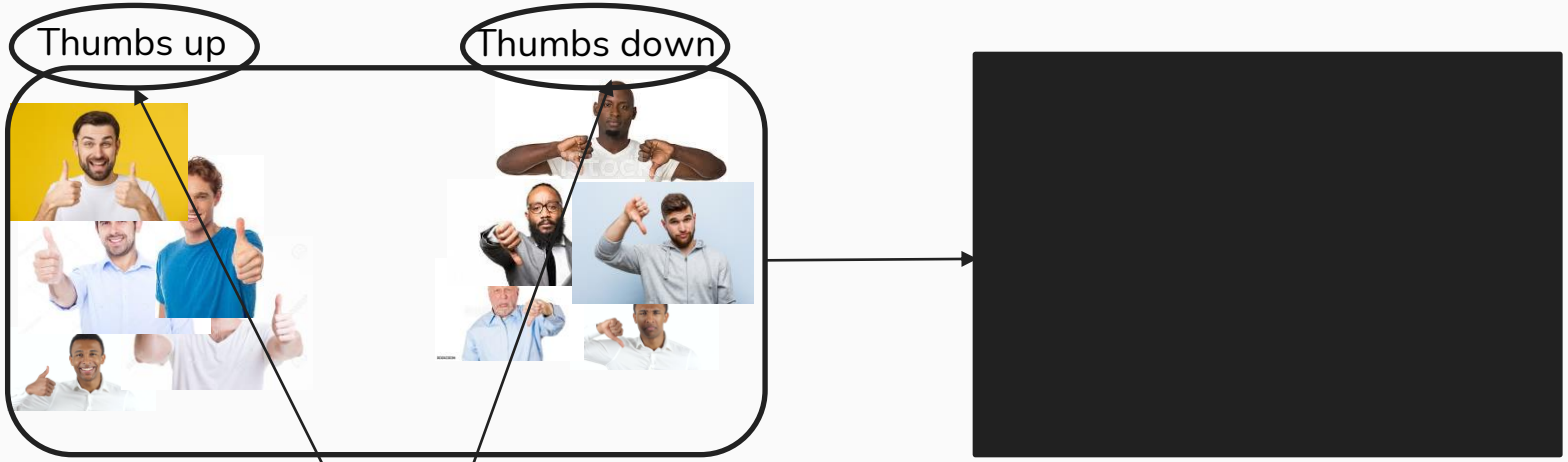


Thumbs down


Thumbs up
Thumbs down


Thumbs up
Thumbs down


Thumbs up
Thumbs down
classes



classes → Classification problem (prediction of a class)

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

Prediction of **price** $\in \mathbb{R}$

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

Prediction of **price** $\in \mathbb{R}$

Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

Prediction of **price** $\in \mathbb{R}$ ⟶

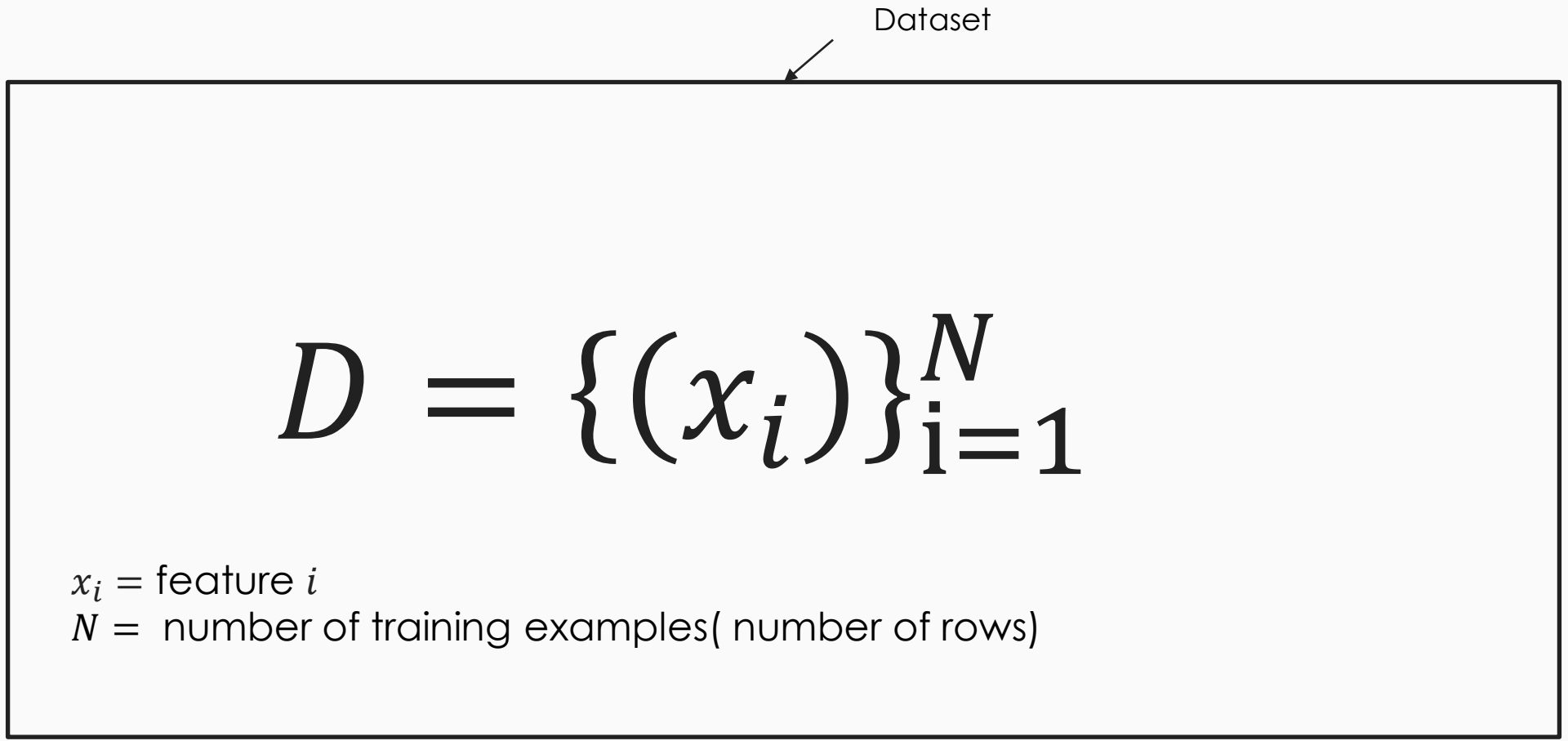
Nbr de Balcon	Emplacement	Nbr de chambres	Ascenseur	Garage	Size (m²)	Price (Dh)
2	Mimosas	4	Oui	Oui	160	120 000
2	La ville haute	3	Oui	Oui	170	110 000
1	Bir rami	4	Oui	Non	224	168 000
4	Hay riad	6	Oui	Oui	500	300 000
0	melah	2	Non	Non	122	80 000
0	kesba	1	Non	non	50	25 000
…	…	…	…	…	…	…

Prediction of **price** $\in \mathbb{R}$ ⟶ Regression problem

Dataset

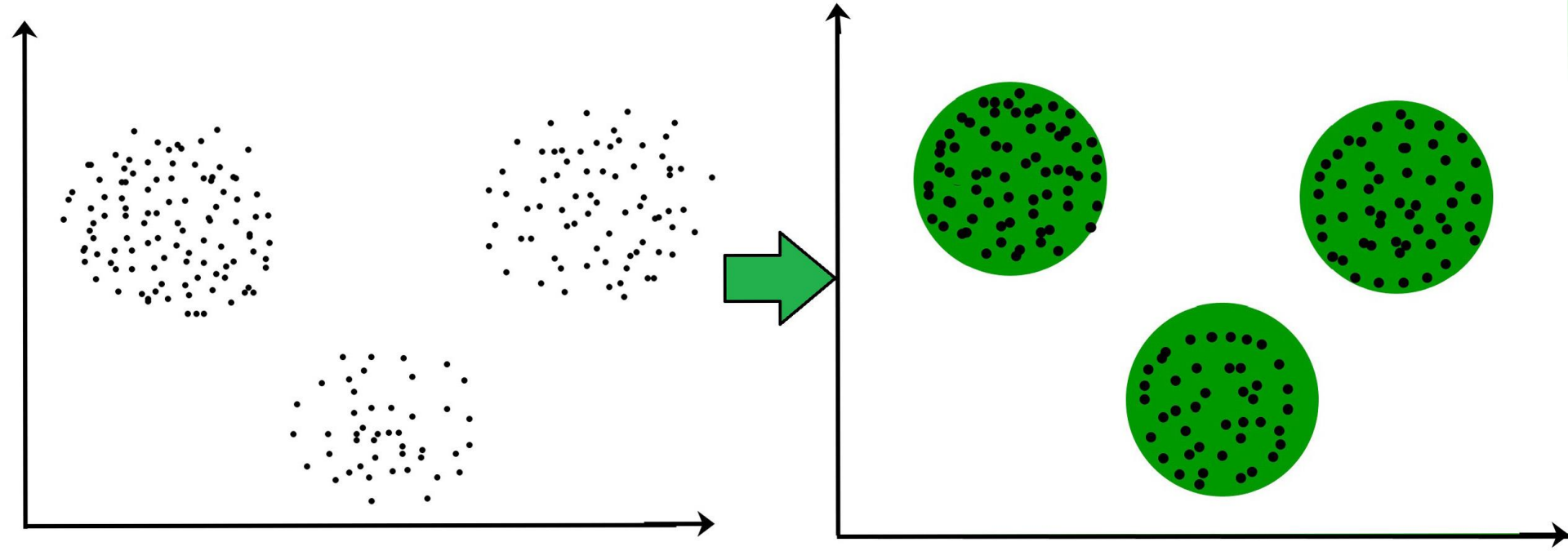
$$D = \{(x_i)\}_{\mathrm{i}=1}^{N}$$

$x_i =$ feature i
$N =$ number of training examples(number of rows)

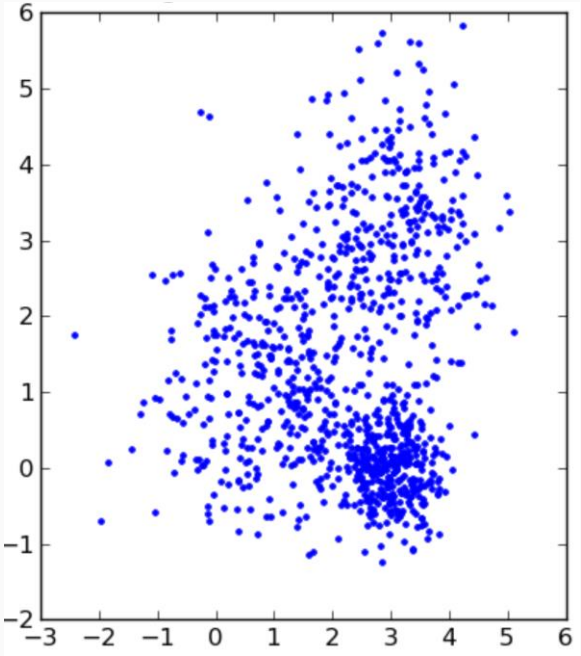


Unsupervised learning

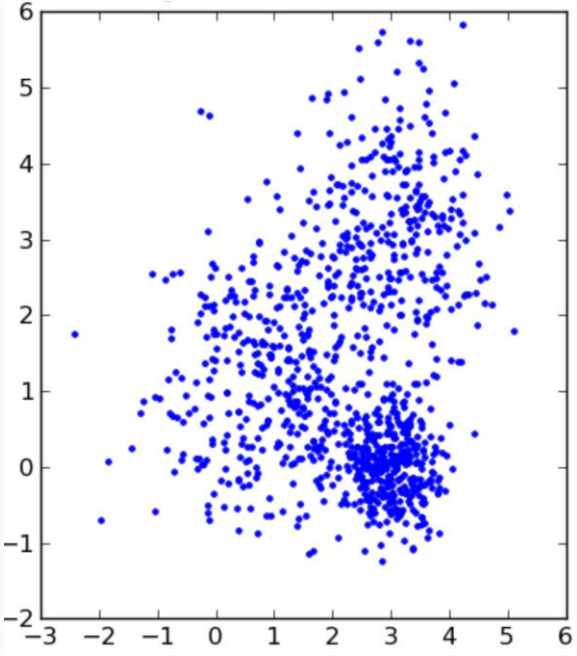
exemple: Discovering clusters



exemple: Discovering clusters

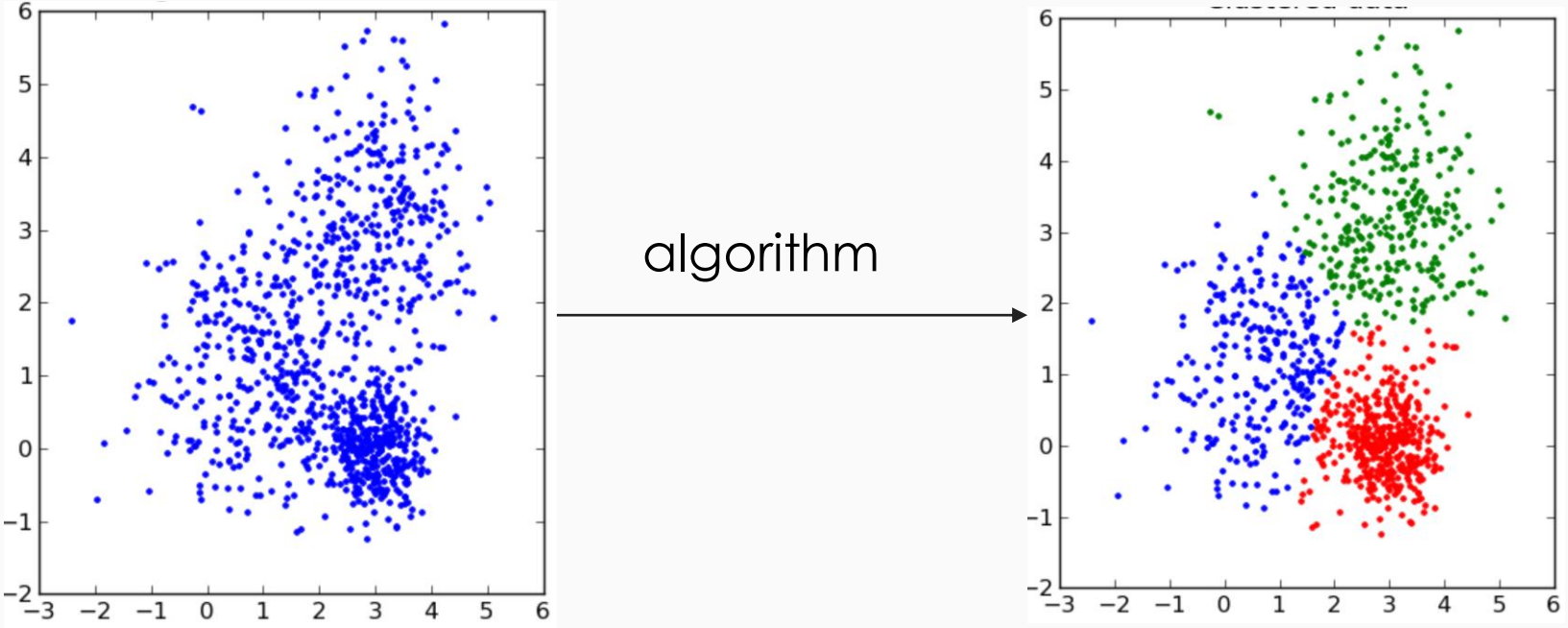


exemple: Discovering clusters



algorithm

exemple: Discovering clusters



Classification :

the goal is to learn a mapping from input x to output y

where:

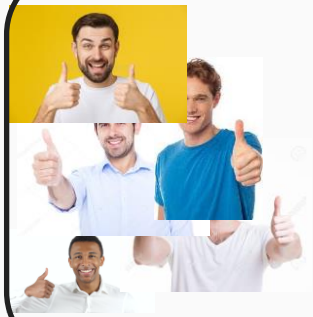
$$y \in \{1, \dots, c\}$$

If $c = 2$ ⟶ binary classification

If $c > 2$ ⟶ multi-class classification

Thumbs up

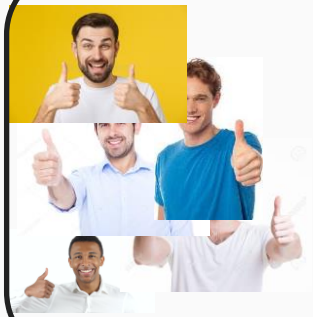
Thumbs down



y= thumbs up or down

Thumbs up

Thumbs down



y= thumbs up or down

$$f(img) = y$$

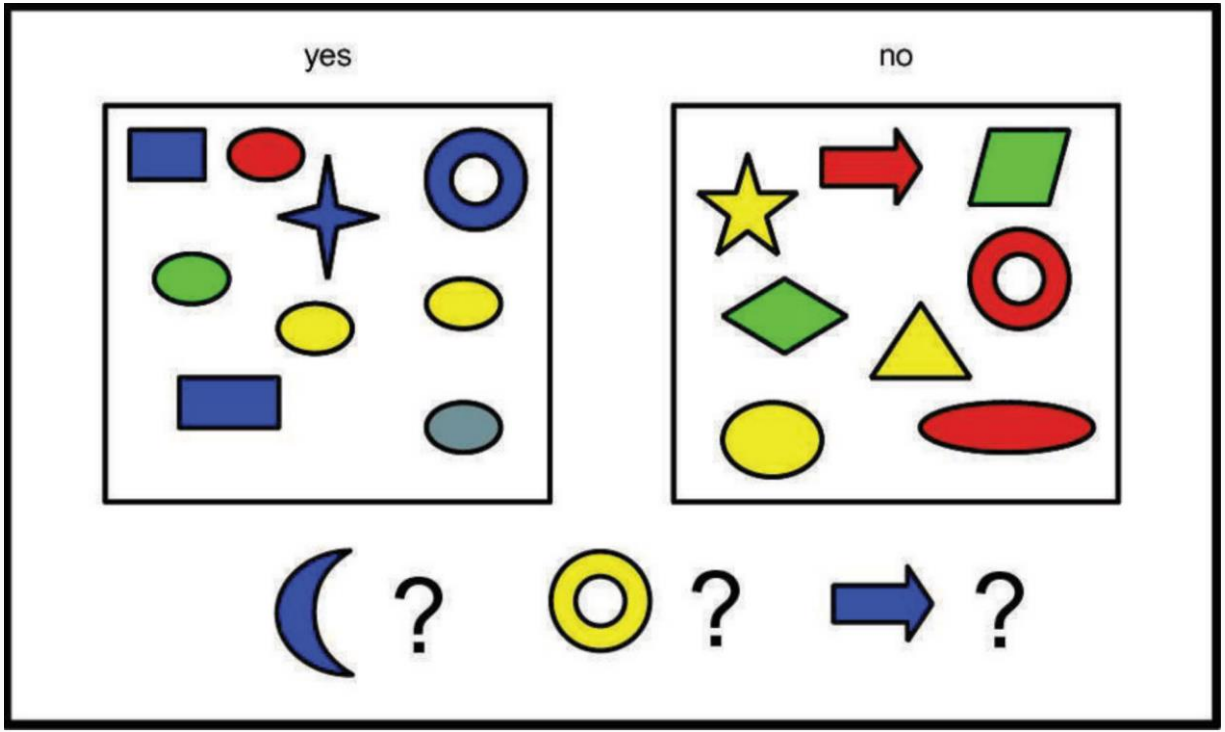
Thumbs up

Thumbs down

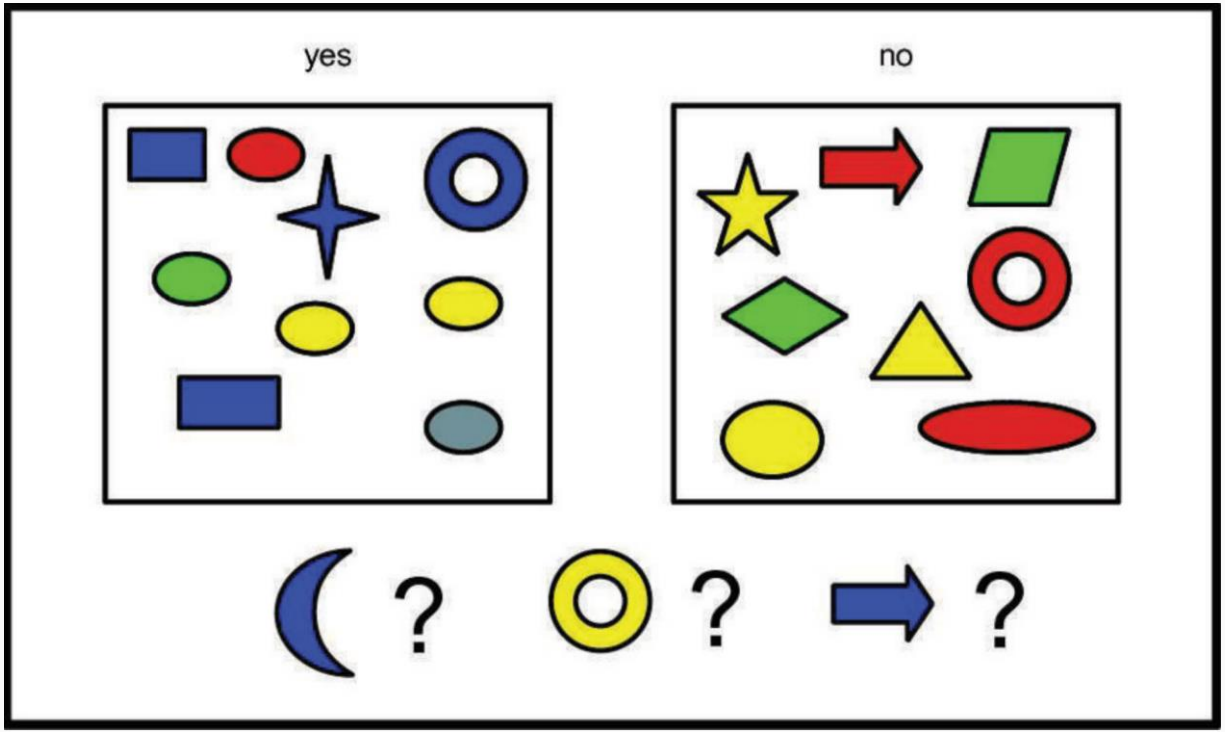
y= thumbs up or down

Et même en terme de probabilité:

Et même en terme de probabilité:



Et même en terme de probabilité:



Taken from :Machine Learning A Probabilistic Perspective by Kevin P. Murphy

Denote the probability distribution over labels (yes and no) given the input x and the training set D by:

Denote the probability distribution over labels (yes and no) given the input x and the training set D by:

$$p(y|\mathrm{x}, D)$$

Denote the probability distribution over labels (yes and no) given the input x and the training set D by:

$$p(y|\mathrm{x}, D)$$

It is a vector of length 2 (C=2):

Denote the probability distribution over labels (yes and no) given the input x and the training set D by:

$$p(y|\mathrm{x}, D)$$

It is a vector of length 2 (C=2):

$$\left(p(y = \mathrm{yes}|\ \raisebox{-0.3em}{  }\ , D) \quad p(y = \mathrm{no}|\ \raisebox{-0.3em}{  }\ , D)\right)$$

Denote the probability distribution over labels (yes and no) given the input x and the training set D by:

$$p(y|\mathrm{x}, D)$$

It is a vector of length 2 (C=2):

$$\left(p(y = \mathrm{yes}|\ \text{  }\ , D) \quad p(y = \mathrm{no}|\ \text{  }\ , D)\right)$$

Par exemple:

Denote the probability distribution over labels (yes and no) given the input x and the training set D by:

$$p(y|\mathrm{x}, D)$$

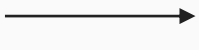
It is a vector of length 2 (C=2):

$$\left(p(y = \text{yes}|\ \text{  }\ , D) \quad p(y = \text{no}|\ \text{  }\ , D)\right)$$

Par exemple:

$$\left(p(y = \text{yes}|\ \text{  }\ , D) \quad p(y = \text{no}|\ \text{  }\ , D)\right) = (0.8 \quad 0.2)$$

$$\left(p(y = \text{yes}|\ \text{  }\ , D) \quad p(y = \text{no}|\ \text{  }\ , D)\right) = (0.8 \quad 0.2)$$

  appartient à la classe yes

Q&A

end