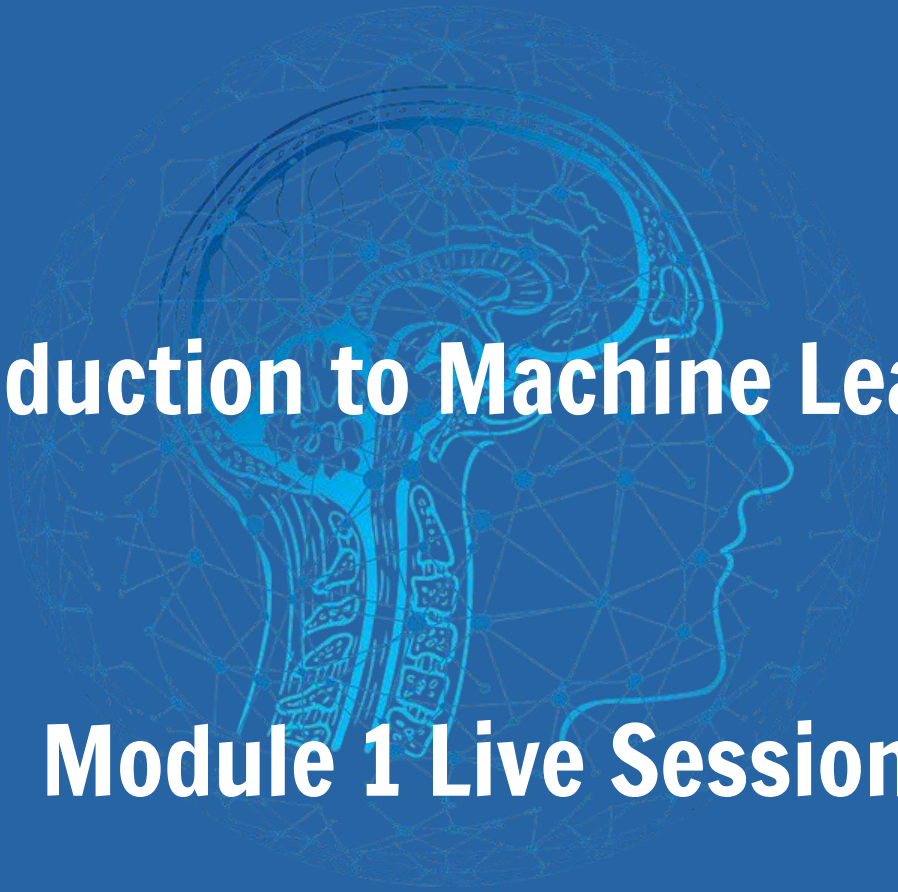
Imperial College London

Introduction to Machine Learning

We will be starting shortly…

Imperial College London



Introduction to Machine Learning

Module 1 Live Session

Welcome!

JOSIAH WANG

Module 0, 1
Optional lab exercises
Website/Support

ANTOINE CULLY

Modules 2, 6, 7
Coursework 1

MAREK REI

Modules 3, 4, 5
Coursework 2

CONTACT US

Ed for shared questions

Email for private issues

TEACHING ASSISTANTS

Adam Marcus
Akis Kefalas
Athanasios Vlontzos
Carles Balsells Rodas
Christina Karakosta
Ekin Ozturk
Fabrizio Russo
Hadrien Reynaud
Harry Coppock
Konstantinos Barmpas
Kyriaki-Margarita Bintsi
Najla Al Futaisi
Padmanaba Srinivasan
Rolandos-Alexandros Potamias
Turkay Kart

Today

- Q&A
  - You ask questions
    - In chat
    - Raise hands
  - We answer
- Some discussions and quizzes

Administrative questions?

Week 3 Materials (Module 2)

Released today!

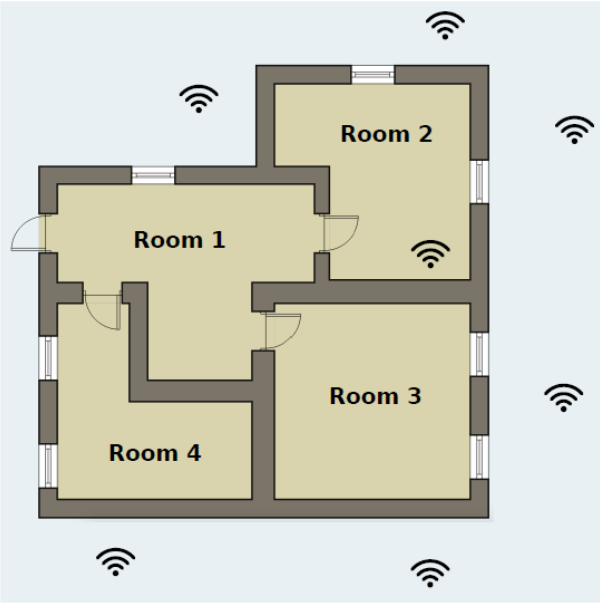
~~Exam~~ TRA rubrics

3 out of 3 questions, 90 minutes

Coursework

Coursework 1

- 40% of coursework (12% of module grade)
- Implement decision trees from scratch
  - Python Standard Library
  - NumPy
  - Matplotlib



- To be released on Monday morning
  - Specs and code will be on CATE and/or Scientia
- Form your groups of 4 people
  - Can change until you submit coursework 1
- Please contribute to your group!
  - We have the right to scale your marks for problem cases!

Q: Coursework group size < 4?

No

What is Artificial Intelligence?

How does it relate to Machine Learning?

What did you come up with?

intelligence
Artificial
intelligent
machines
learning
machine
human
computers
computer
humans
decisions
AI
ML
make
able
given
problems
solve
program
data
way
like
task
ability
learn
create
tasks
skills
made
recognise
demonstrated
humanlike
simulation
achieve
inputs
fields
acting
bigger
etc
contains
area
broad
field
adapt
perform
even
may
widerranging
discipline
superset
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act
level
always
input
use
system
let
makes
think
mimic
study
agent
refers
based
whether
solving
models
tech
help
appear
high
wide
enable
one
wider
origin
possible
behind
generate
nonhumananimal
ultimately
general
solution
hopes
properly
motivation
capable
though
sense
artifical
training
falls
just
react
rely
cant
type
classify
uses
conclusions
draw
believe
lot
term
dont
jobs
stages
neuroscience
deal
autonomously
reason
greater
comprising
skills
deduce
doesnt
ifelse
capabilities
decision
empower
derived
see
judgment
commonly
designing
attempts
expect
topic
decide
marketing
trained
levels
easy
straightforwardly
interdisciplinary
model
goal
similar
actually
original
threshold
manner
philosophy
given
usn
performing
Specifically
around
mimick
actions
instructed
software
math
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things
understood
apply
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feedback
involves
mathematical
invitate
intelligien
order
update
picture
perspectives
obtainable
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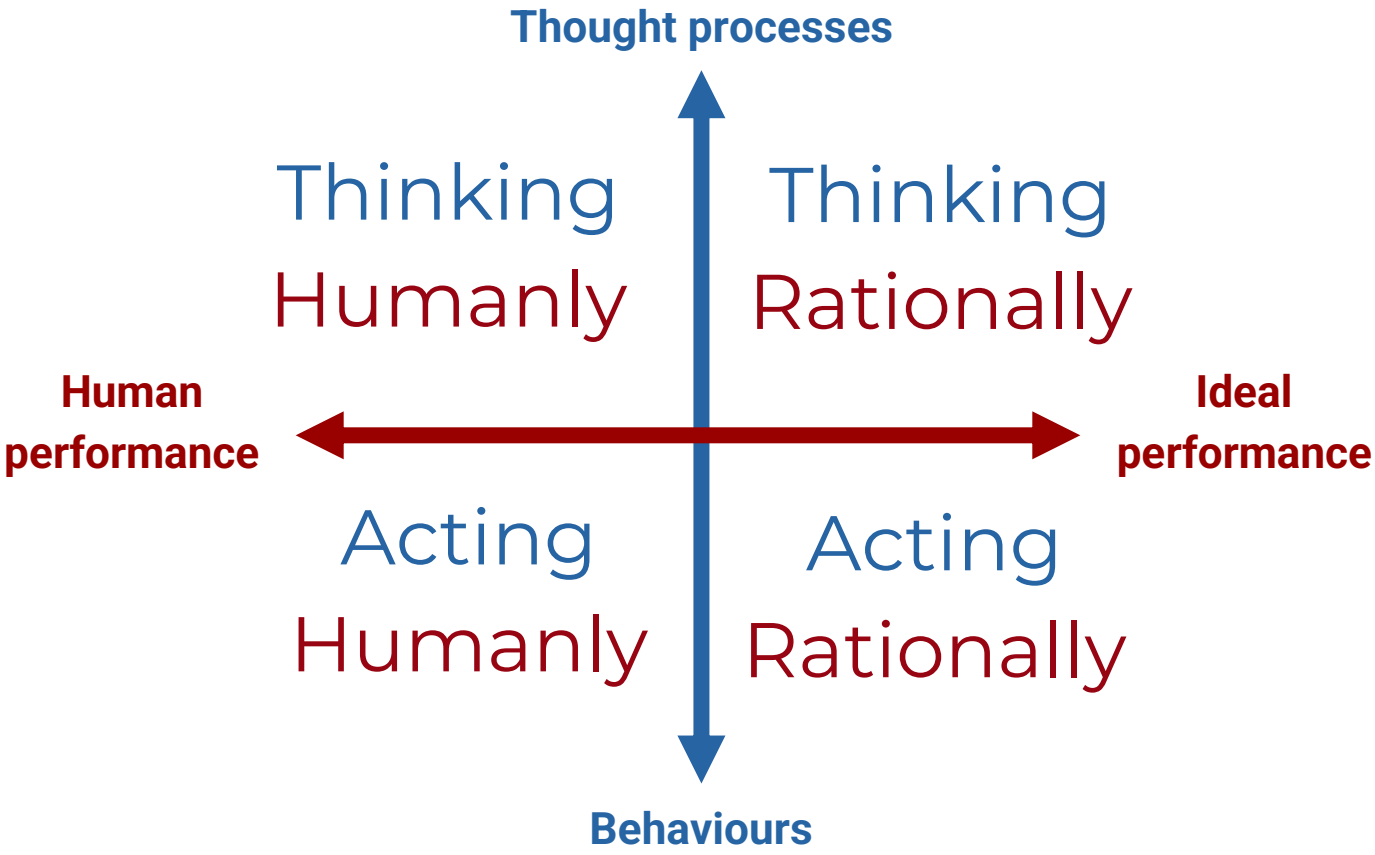
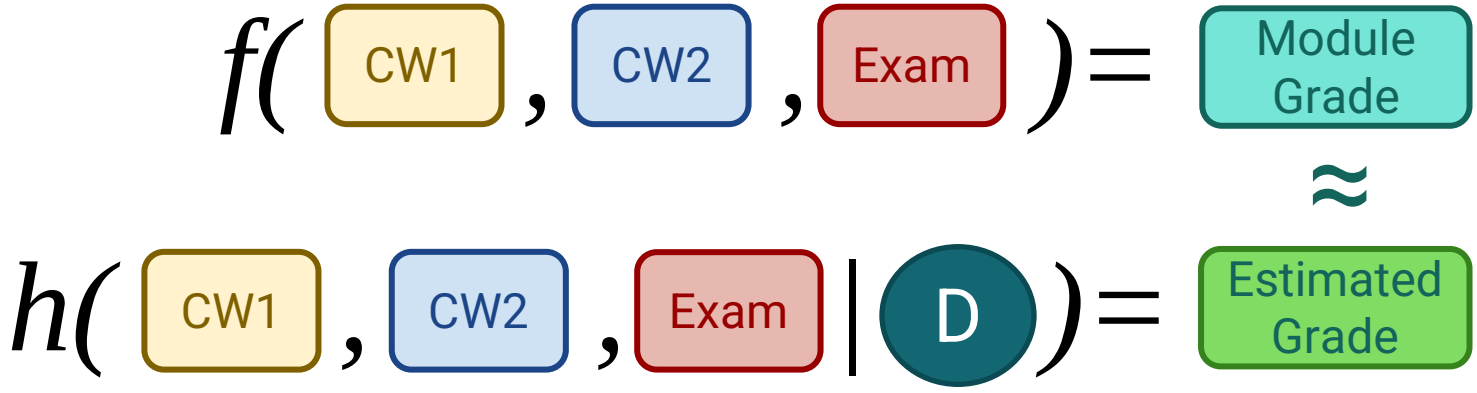
Artificial
human


Thought processes
Thinking Humanly
Thinking Rationally
Human performance
Ideal performance
Acting Humanly
Acting Rationally
Behaviours

So, what *exactly* is Machine Learning?

What did *you* think?

humans
response
improve
study
statistic
forecast
robots
without
changing
order
enables
beep
outputs
enacts
amazing
used
building
also
results
certain
decisions
give
input
task
cluster
Subset
underlying
learned
set
models
dynamic
returns
unsupervised
ability
based
receives
mainly
eventsdata
asking
form
enable
forms
Create
efforts
unseen
machines
Using
training
techniques
distinctive
make
evolves
work
learn
algorithms
spot
mathematics
able
classification
broad
well
time
act
giving
predict
complete
model
AI
making
via
mimick
let
works
classify
place
perform
given
aiming
gathers
intended
change
actual
knows
Setting
design
boop
done
kind
trains
inputoutput
learning
data
deal
math
like
prior
analyse
loads
computers
intelligence
supervised
parameter
draw
lot
problems
process
program
identifying
gerneralize
exist
human
computer
adapts
ML
context
presupplied
ingestion
word
input
adapt
dataset
new
teach
future
learns
solve
framework
improved
usually
apply
way
goal
tasks
train
use
commands
examples
recognizing
perceive
various
uses
concerned
estimation
feeding
collection
rules
accordance
class
just
result
past
performed
updates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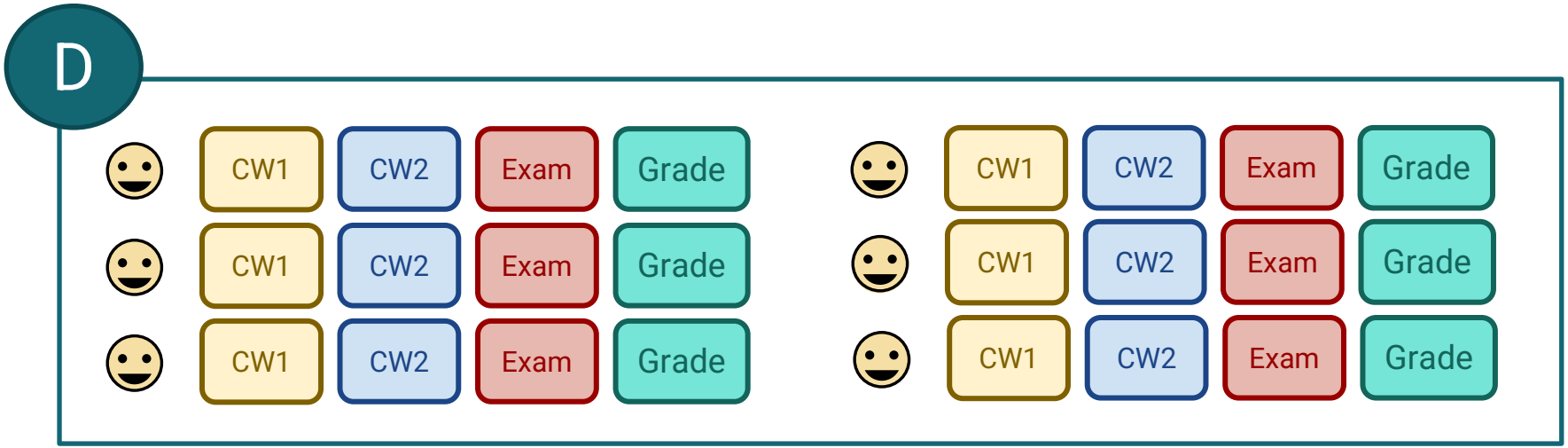
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CW1 CW2 Exam Grade
CW1 CW2 Exam Grade
CW1 CW2 Exam Grade
CW1 CW2 Exam Grade
CW1 CW2 Exam Grade
CW1 CW2 Exam Grade

Machine Learning settings

Quiz!

- Supervised, unsupervised or reinforcement learning?

Go to **www.menti.com**
and use the code
5635 1795

Quiz!

- Supervised, unsupervised or reinforcement learning?

“You want to identify the different distinct groups of people who are turning up at hospital A&Es with COVID. Understanding this case-mix will help the hospital to better respond to the needs of these different types of patients.”

www.menti.com Code: **5635 1795**

Quiz!

- Supervised, unsupervised or reinforcement learning?

“A book distributor has a collection of books, which it has classified into different categories, e.g. ‘Young adults’, ‘Biography’, and ‘Horror’. It wants to use this information to build a system to classify its new products automatically.”

www.menti.com Code: **5635 1795**

Quiz!

- Supervised, unsupervised or reinforcement learning?

“You work for Spotify and want to group together similar songs based on their characteristics (e.g. their tempo and their lyrics). You want to do this so you can create playlists with similar songs and suggest them to users.”

www.menti.com Code: **5635 1795**

Quiz!

- Supervised, unsupervised or reinforcement learning?

“You are trying to train a robot to open your fridge and bring you an ice-cold 0% Heineken beer.”

www.menti.com Code: **5635 1795**

Classification and regression

The two most popular ML tasks

Classification

$f($ $) = y$ Discrete/ categorical

Regression

$f($ $) = y$ Real-valued/ continuous

Quiz!

- Classification or regression?

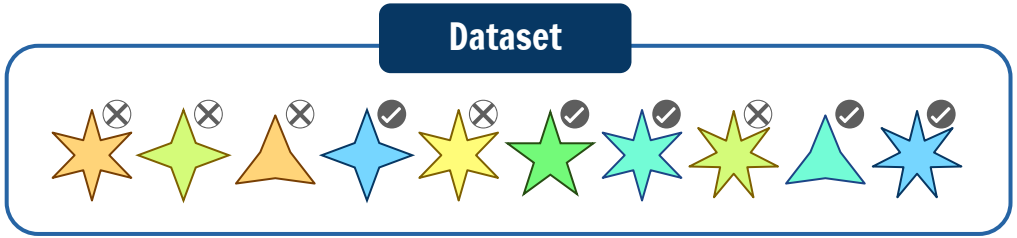
“You want to predict the number of people who will arrive at a hospital with COVID-19 the next day. You can use information about how many people have tested positive and historic information about how many positive tests have resulted in people arriving at hospital.”

Quiz!

- Classification or regression?

“You are trying to predict whether an individual has COVID-19 based on their current symptoms. You can use historical data from people have previously tested positive or negative and what their symptoms were at the time.”

Are you a good binary classifier?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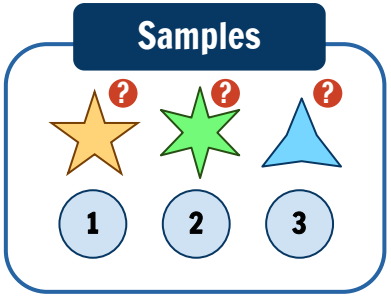
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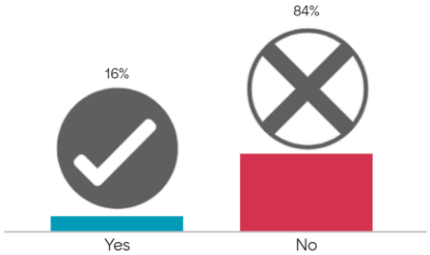
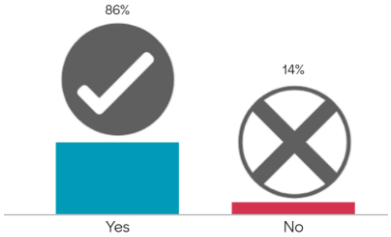

16%
84%
Yes
No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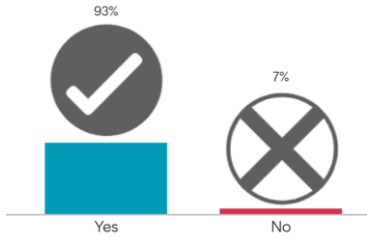
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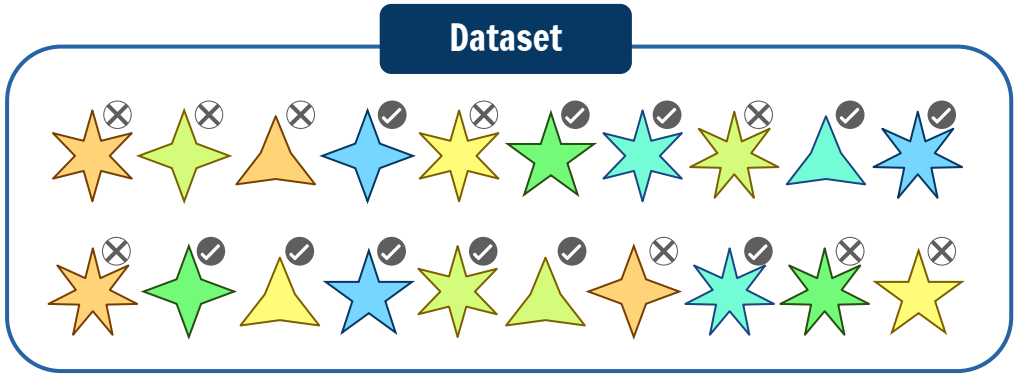
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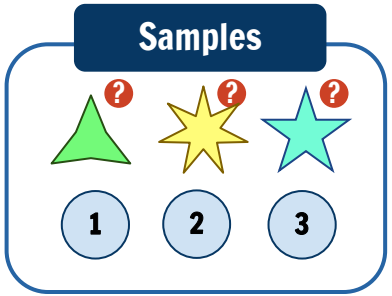
Samples
1
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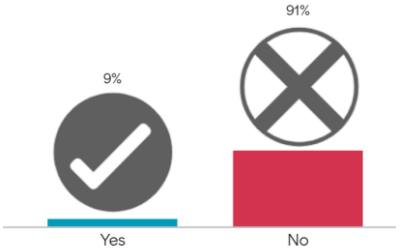
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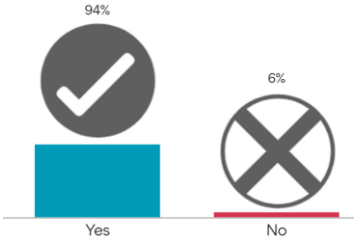
Yes
No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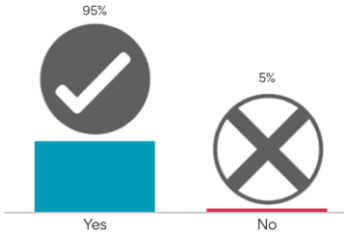
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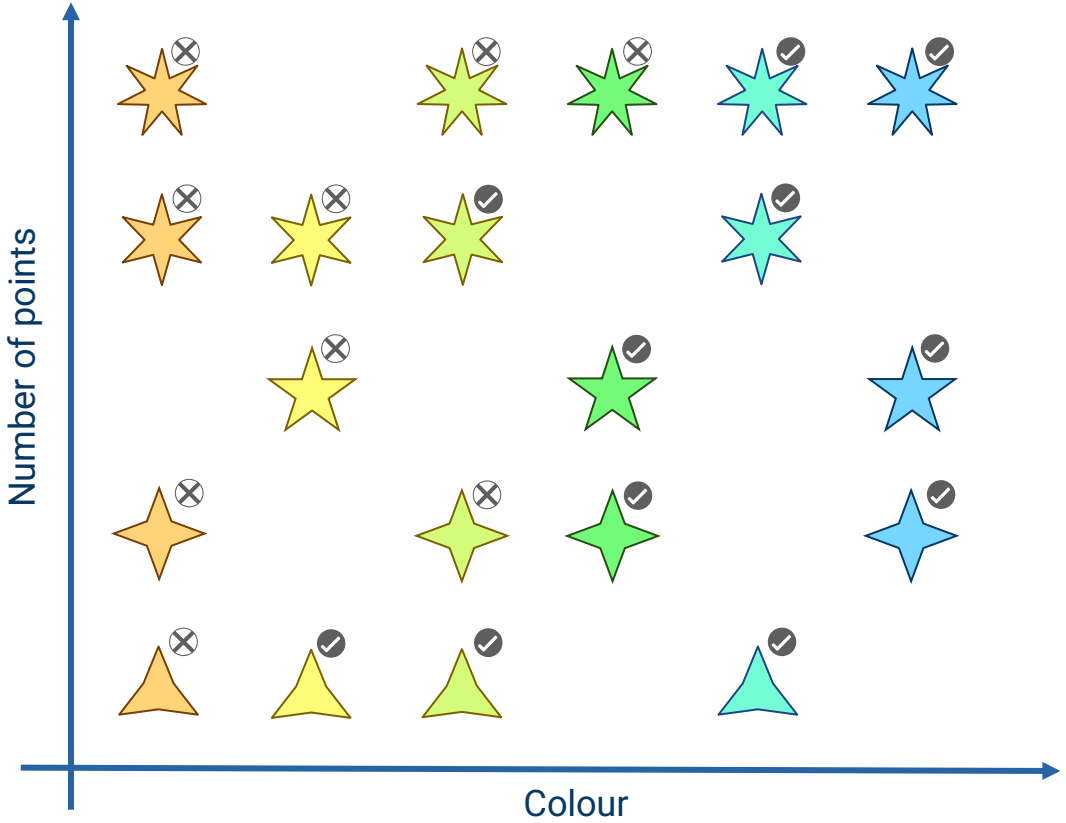
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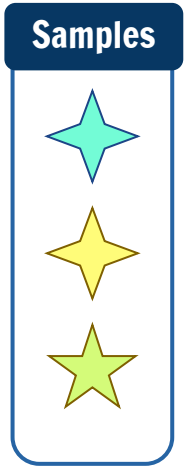
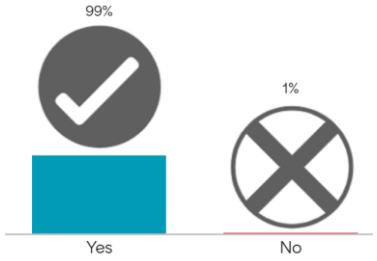

Samples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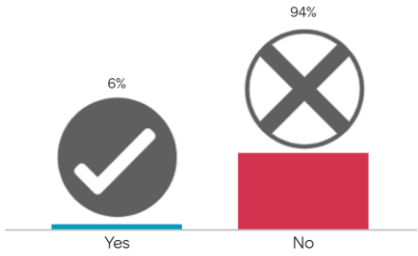
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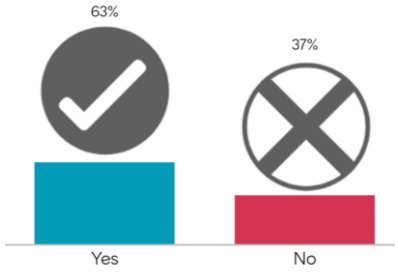
63%
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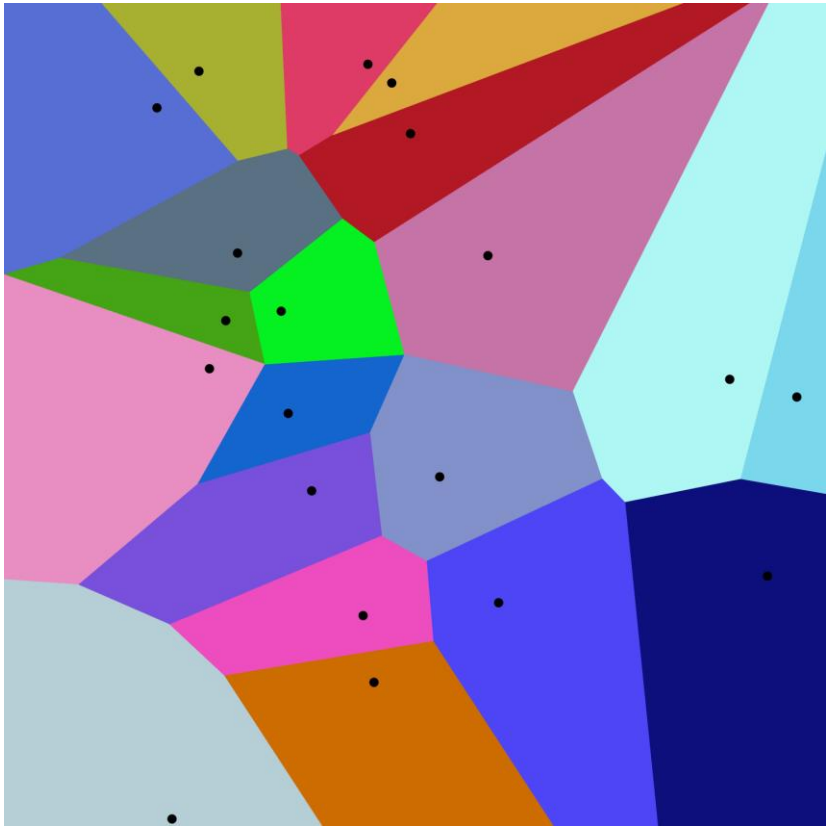
The supervised learning pipeline

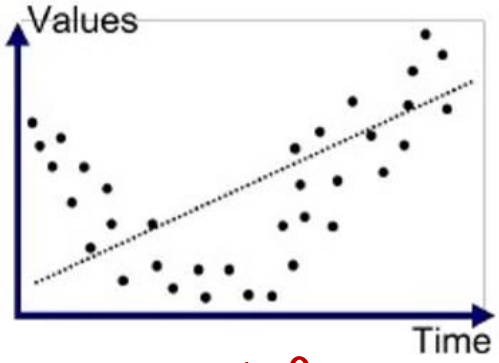
Voronoi diagram



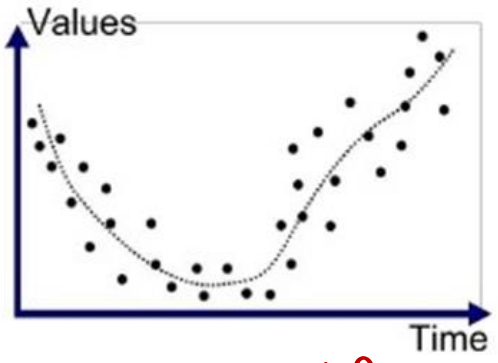
By Balu Ertl - Own work, CC BY-SA 4.0,
https://commons.wikimedia.org/w/index.php?curid=38534275

Bias-variance trade-off

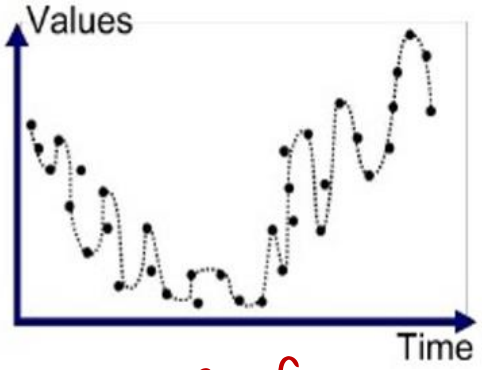
One of the most important ML concepts!



Underfit



Robust, good fit



Overfit

Low variance

High bias

Bias-variance trade-off

High variance

Low bias

Computational Learning Theory

Occam's razor: *More things should not be used than are necessary.*

Is 85% accuracy any good?

“It is all relative…”

Baseline

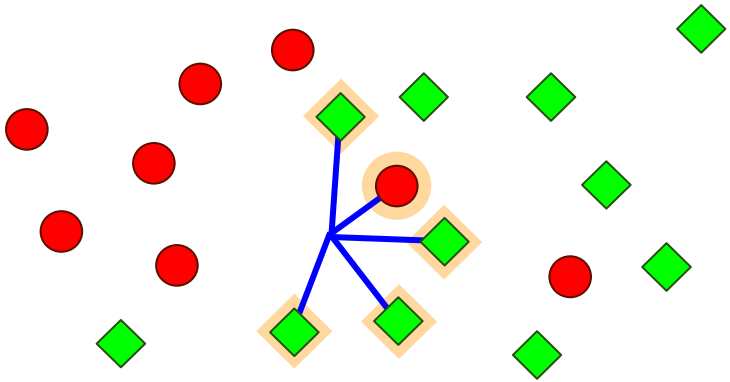
Chance/random performance [lower bound]

Is there a stronger baseline? **e.g. most frequent class baseline**

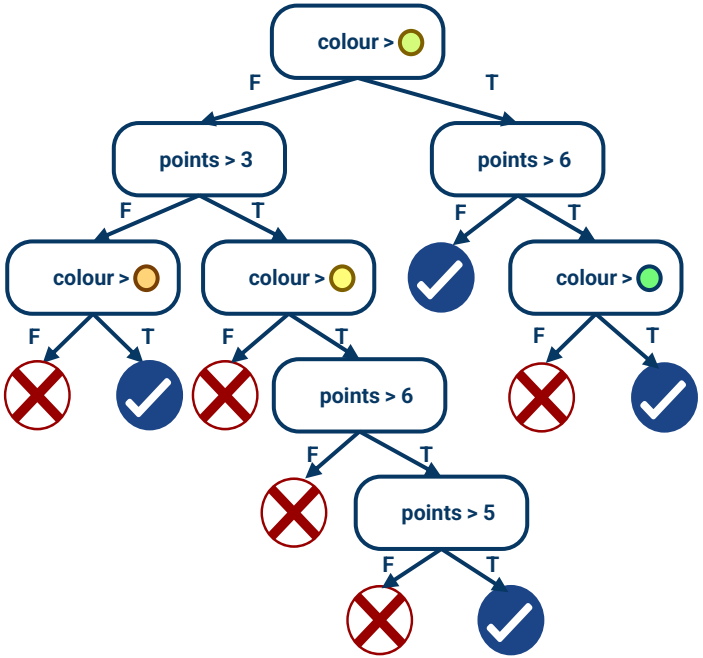
The base performance before any improvements

Coming up next week...

k Nearest Neighbours



Decision Trees



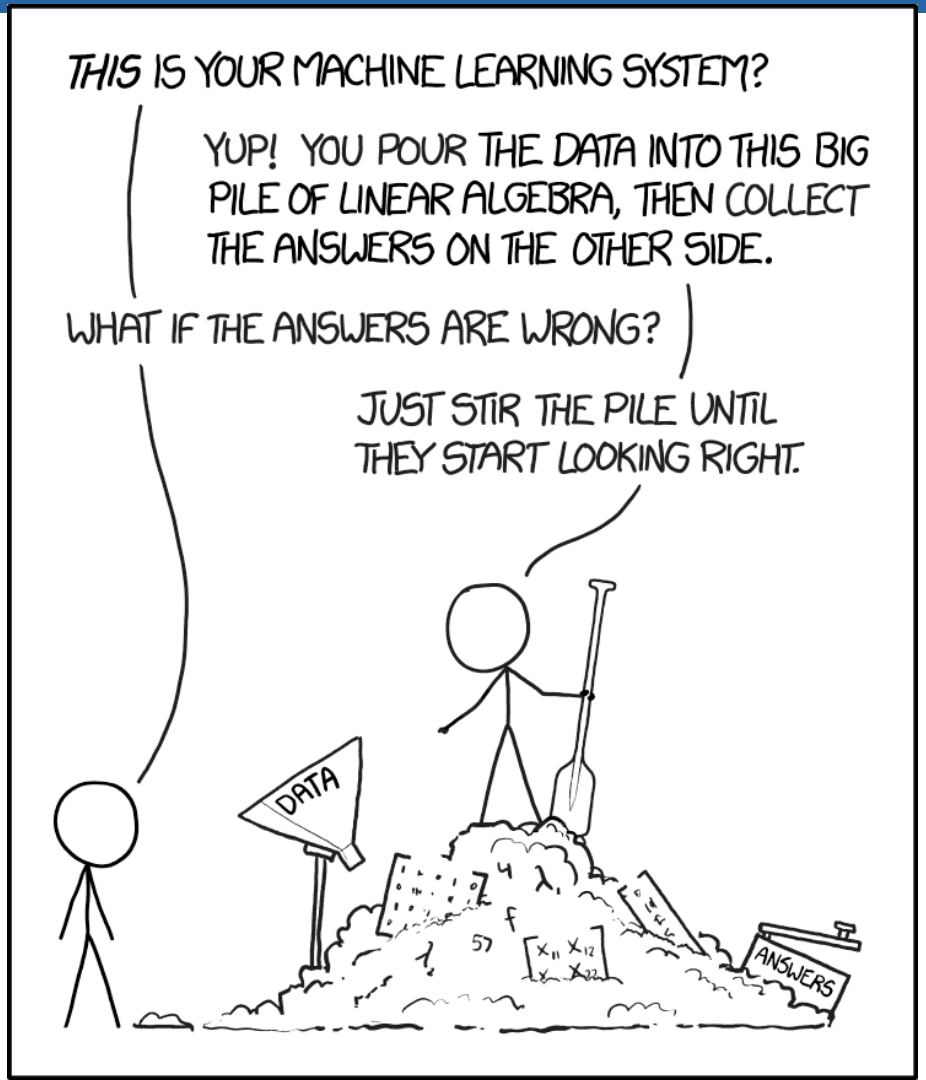
Any last questions?

Any feedback for us?

- It's anonymous!

Go to **www.menti.com**
and use the code
8244 4568

https://www.menti.com/ns859tu54f


THIS IS YOUR MACHINE LEARNING SYSTEM?
YUP! YOU POUR THE DATA INTO THIS BIG PILE OF LINEAR ALGEBRA, THEN COLLECT THE ANSWERS ON THE OTHER SIDE.
WHAT IF THE ANSWERS ARE WRONG?
JUST STIR THE PILE UNTIL THEY START LOOKING RIGHT.
DATA
ANSWERS