



Machine Learning

Examples of Applications of Machine Learning

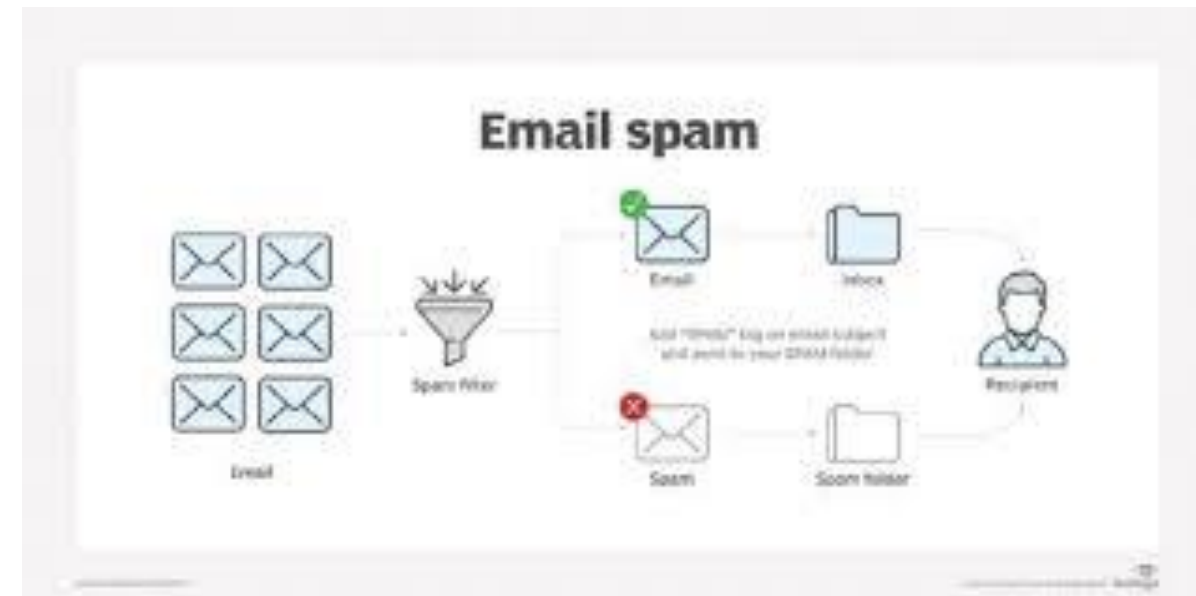
Aude G. Billard , aude.billard@epfl.ch

*Learning Algorithms and Systems Laboratory
School of Engineering, EPFL*

<http://lasa.epfl.ch>

The great success of AI

Big successes



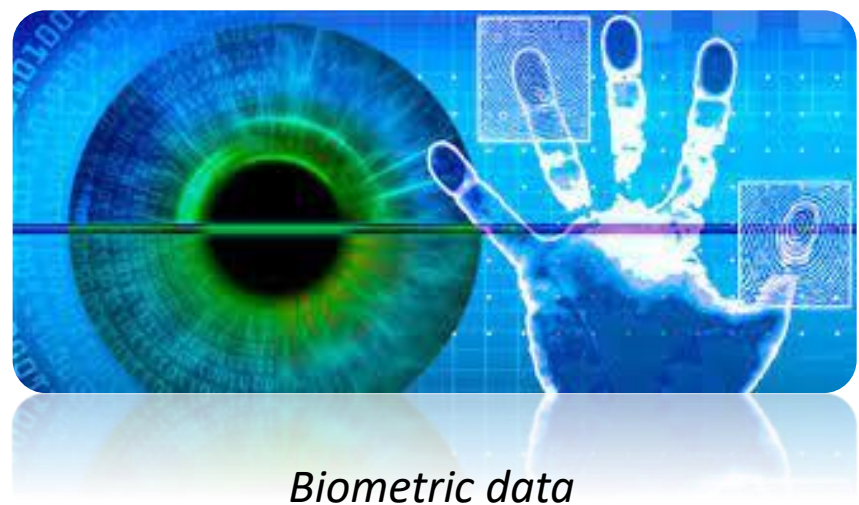
Big successes



Fingerprint Recognition



Voice Recognition



Biometric data

Les grands succès de l'IA





<https://github.com/facebookresearch/Detectron>

Automatic detection of vehicles and pedestrians



Mercedes - Benz



Audi



Navya (France) / Car Postal (CH)



Nissan



Uber



Waymo (google)



Honda



Tesla

Autonomous Driving



Autonomous Driving

ChatGPT

Computer program

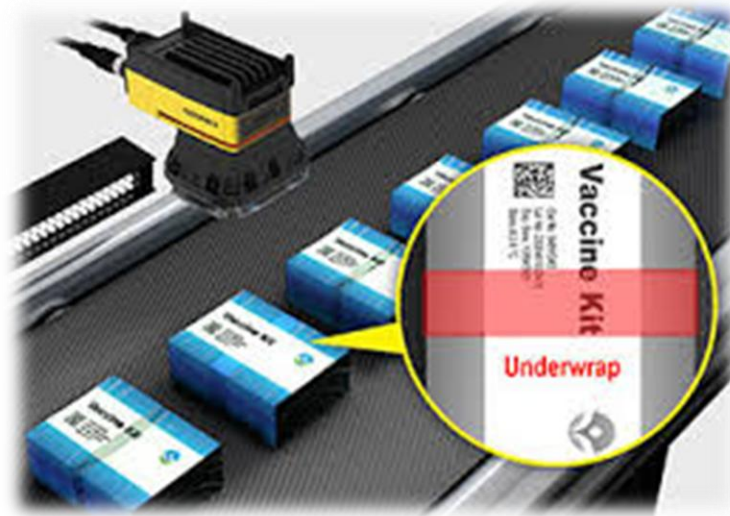




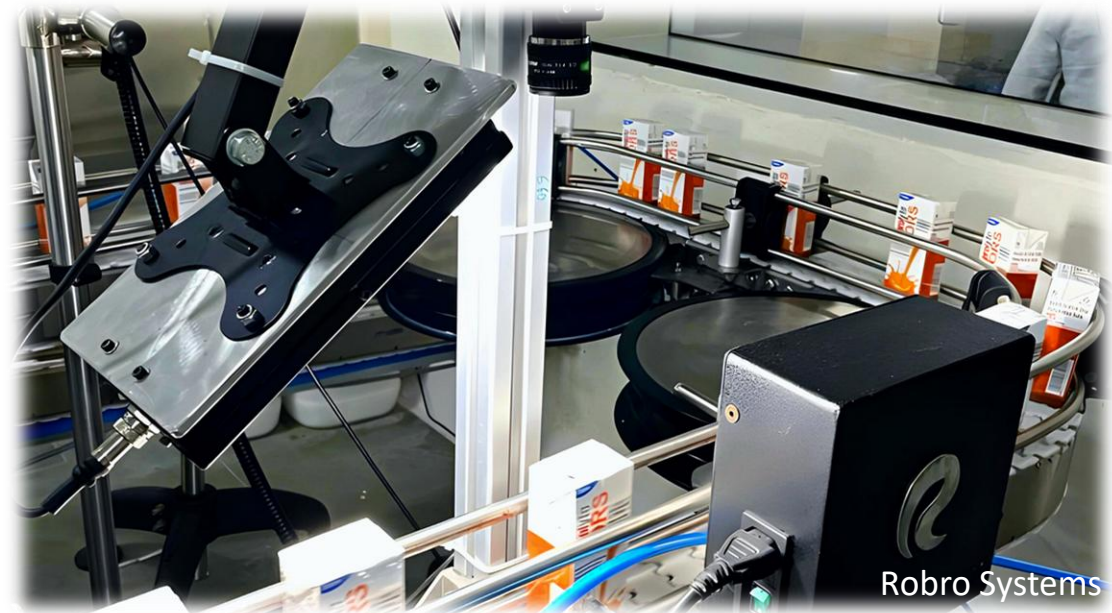
Fast robot control

Machine Learning in Factories

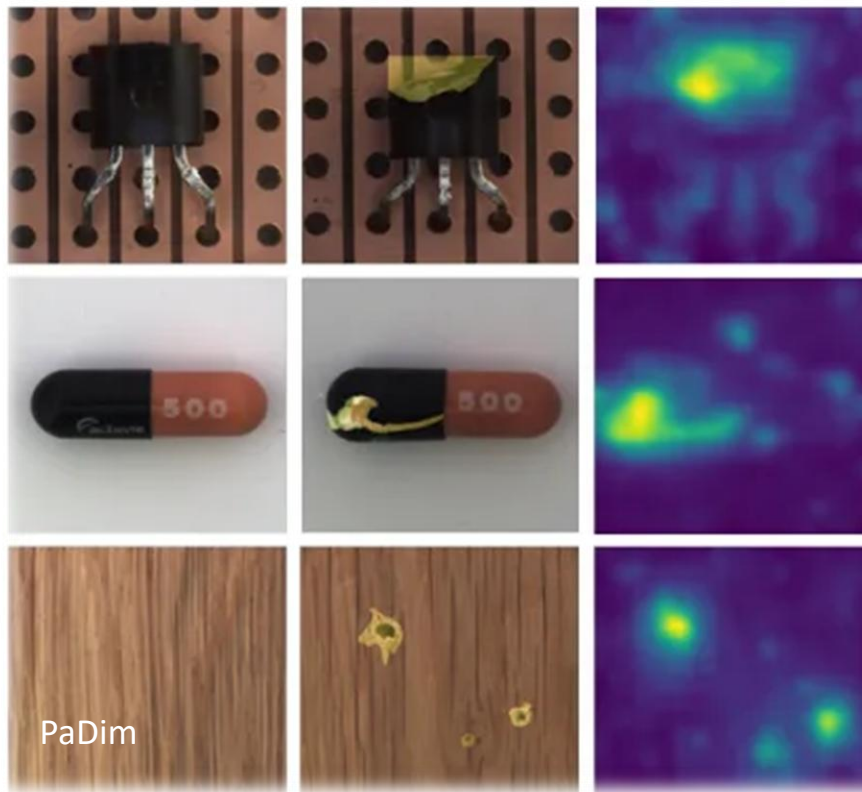
Quality Control



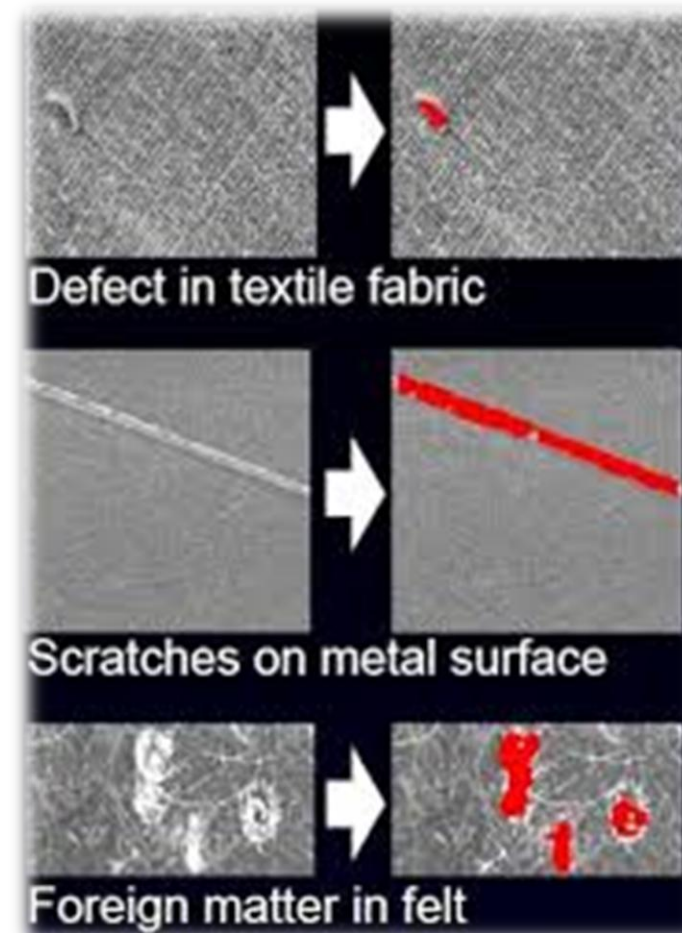
Automatic Inspection of Packaging



Quality Control



Automatic detection of defaults



Quality Control



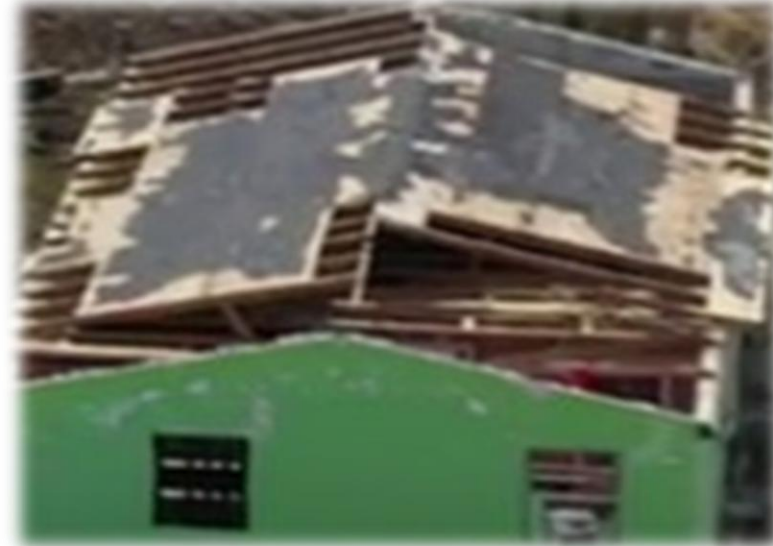
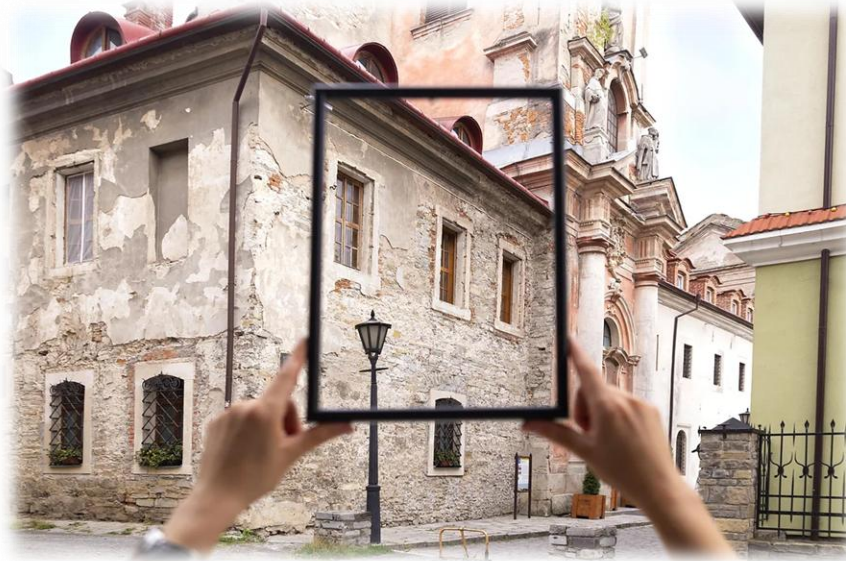
Automatic Selection

Automatic Scan



Repair and design

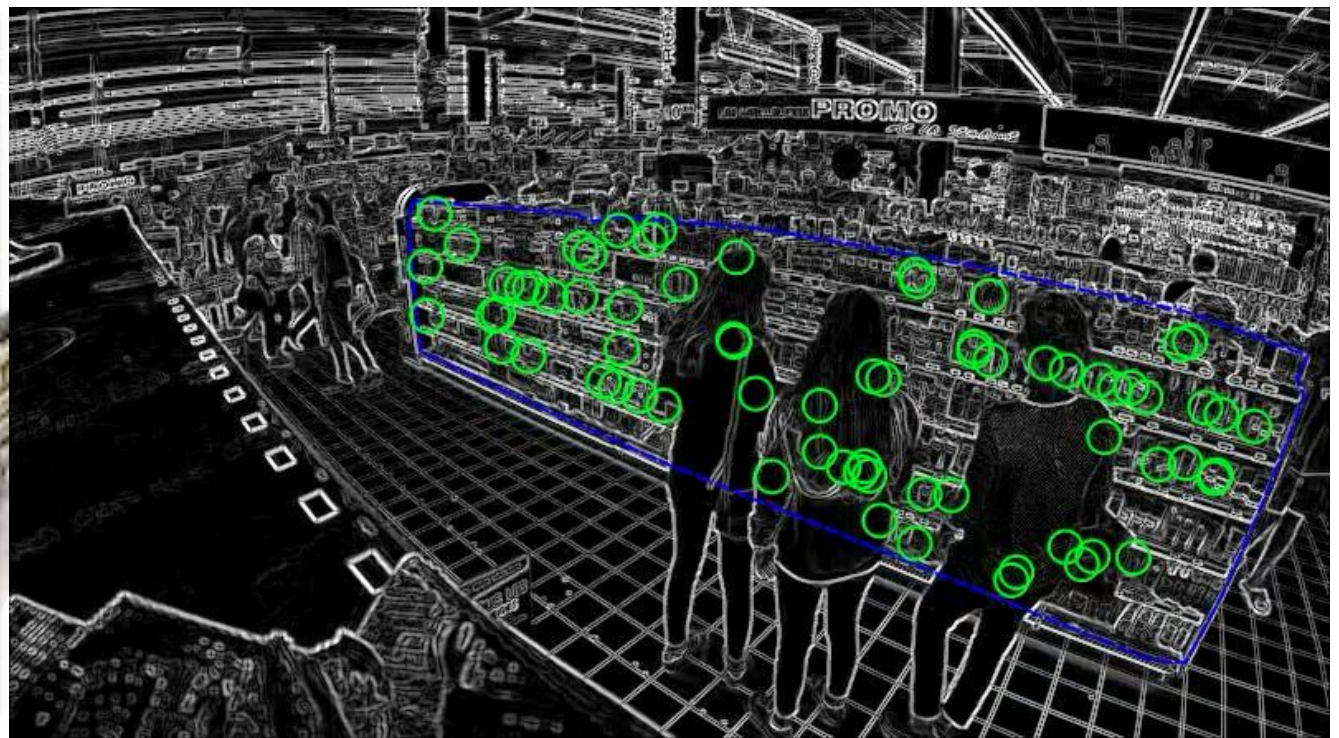
Reconstructing volumes from 2D images



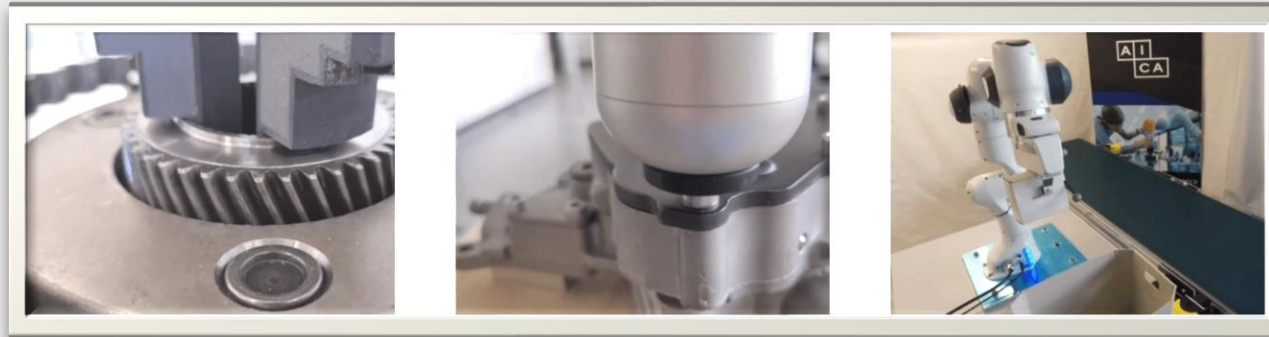
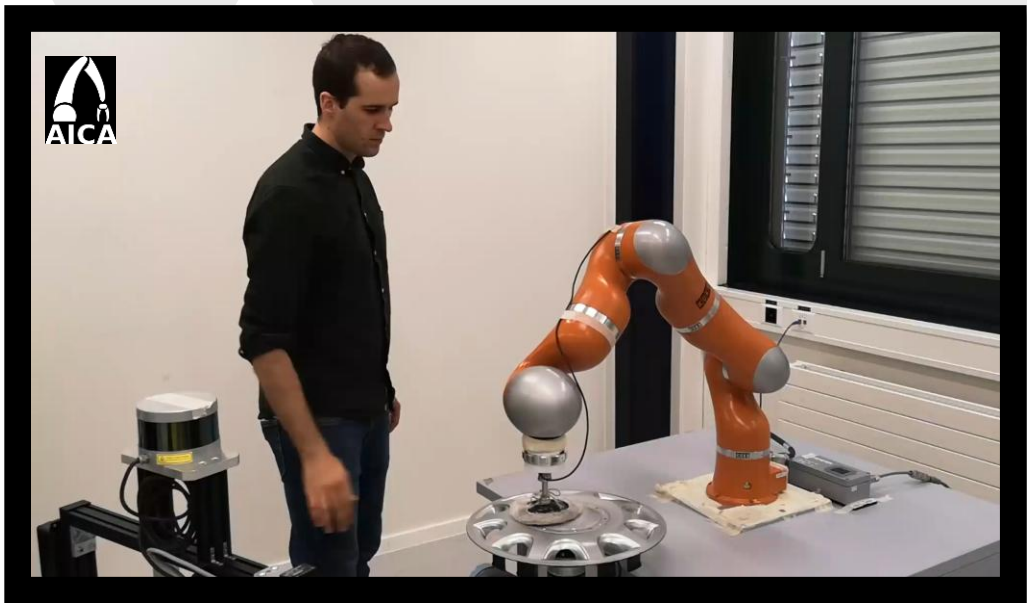


General Data Protection Regulation

Gold



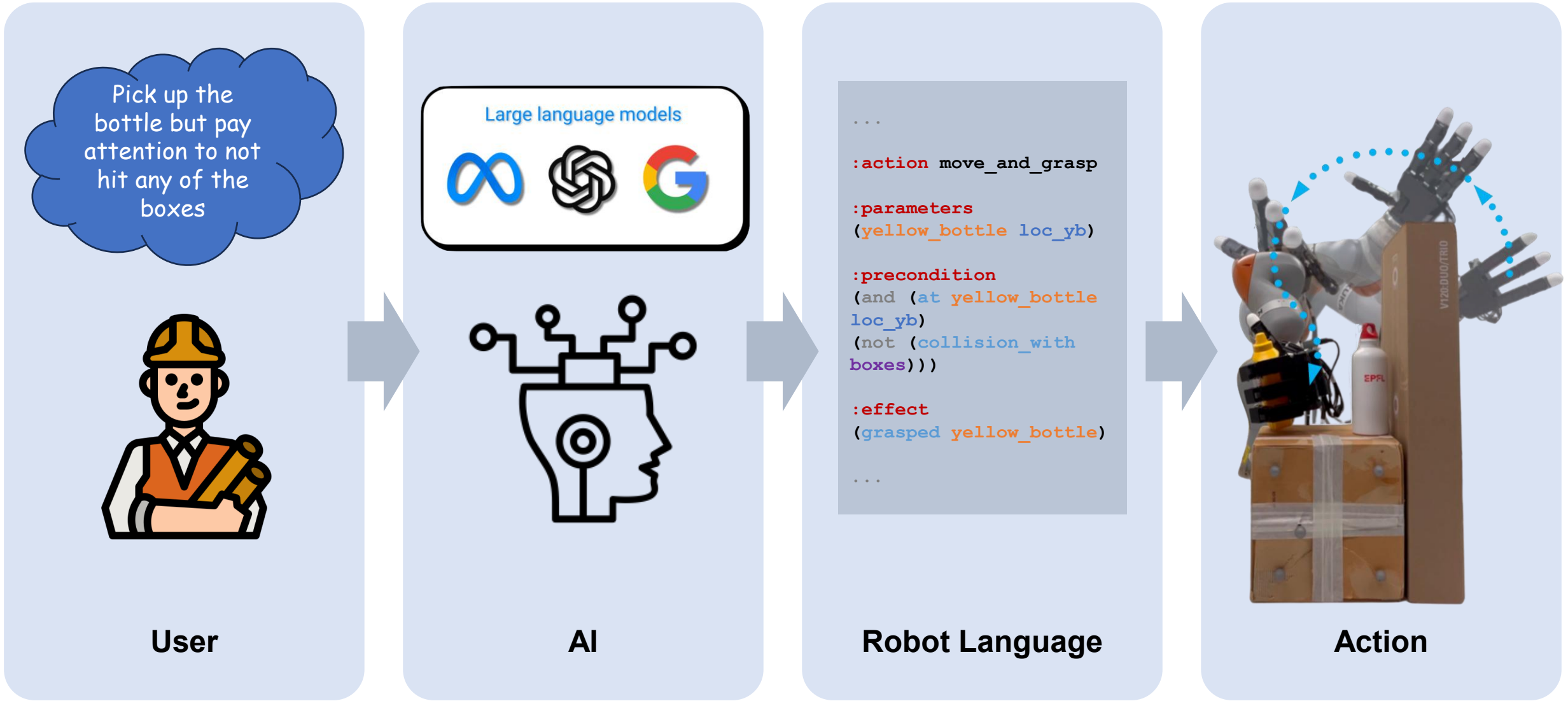
AI CA



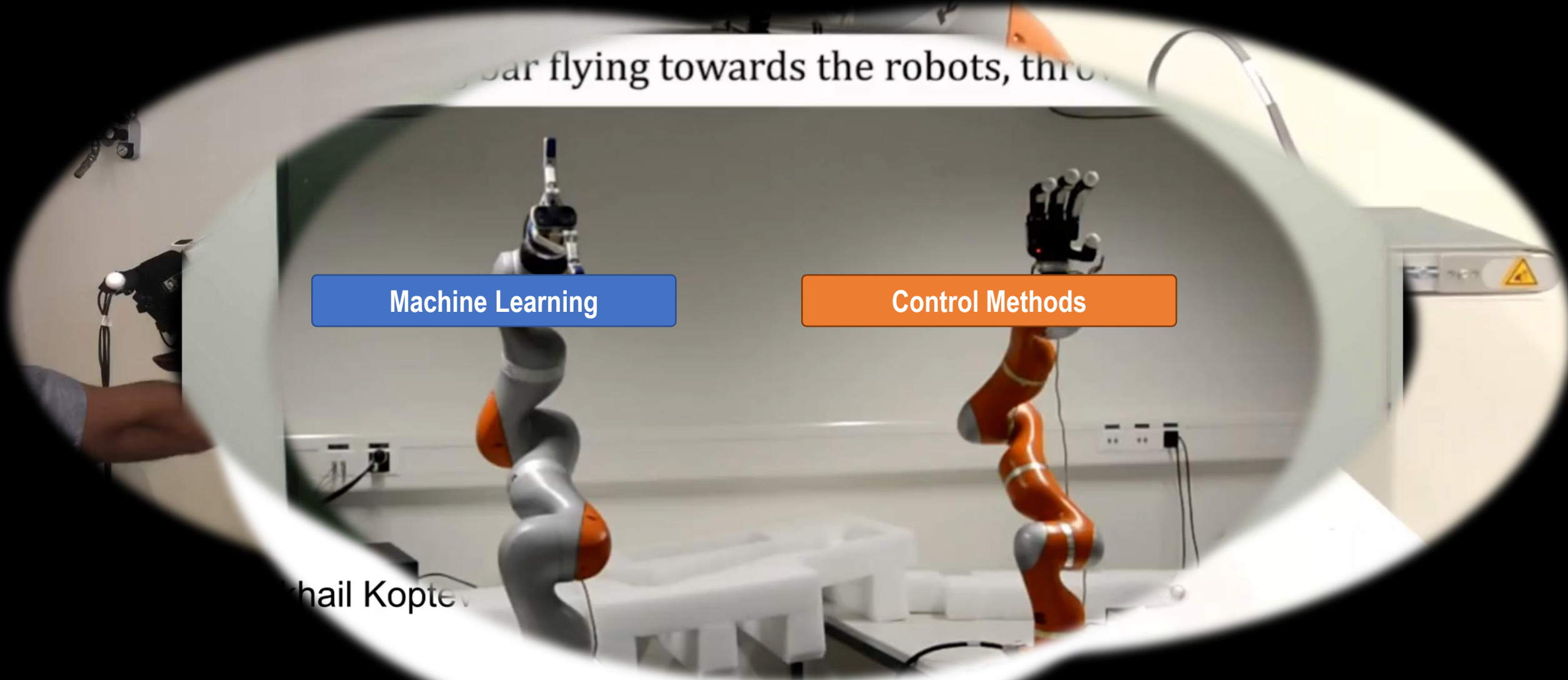
The Future



Connect multiple information sources



Control Robot through Natural Language



Machine Learning

Control Methods

Michael Koptev

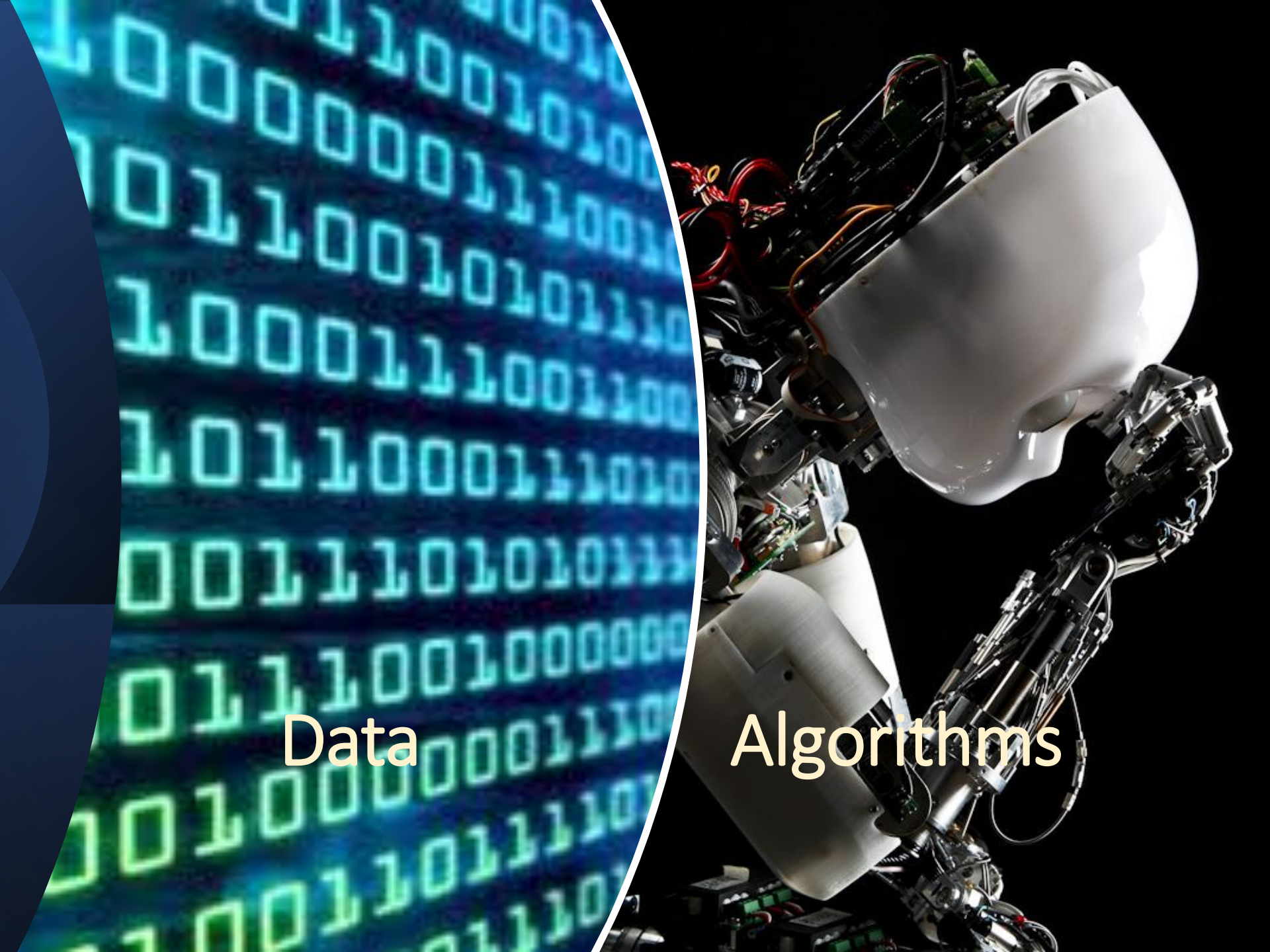
[1] LASA, EPFL, Switzerland
University of Pennsylvania, USA

A few caveats

Principle of AI

Data

Algorithms



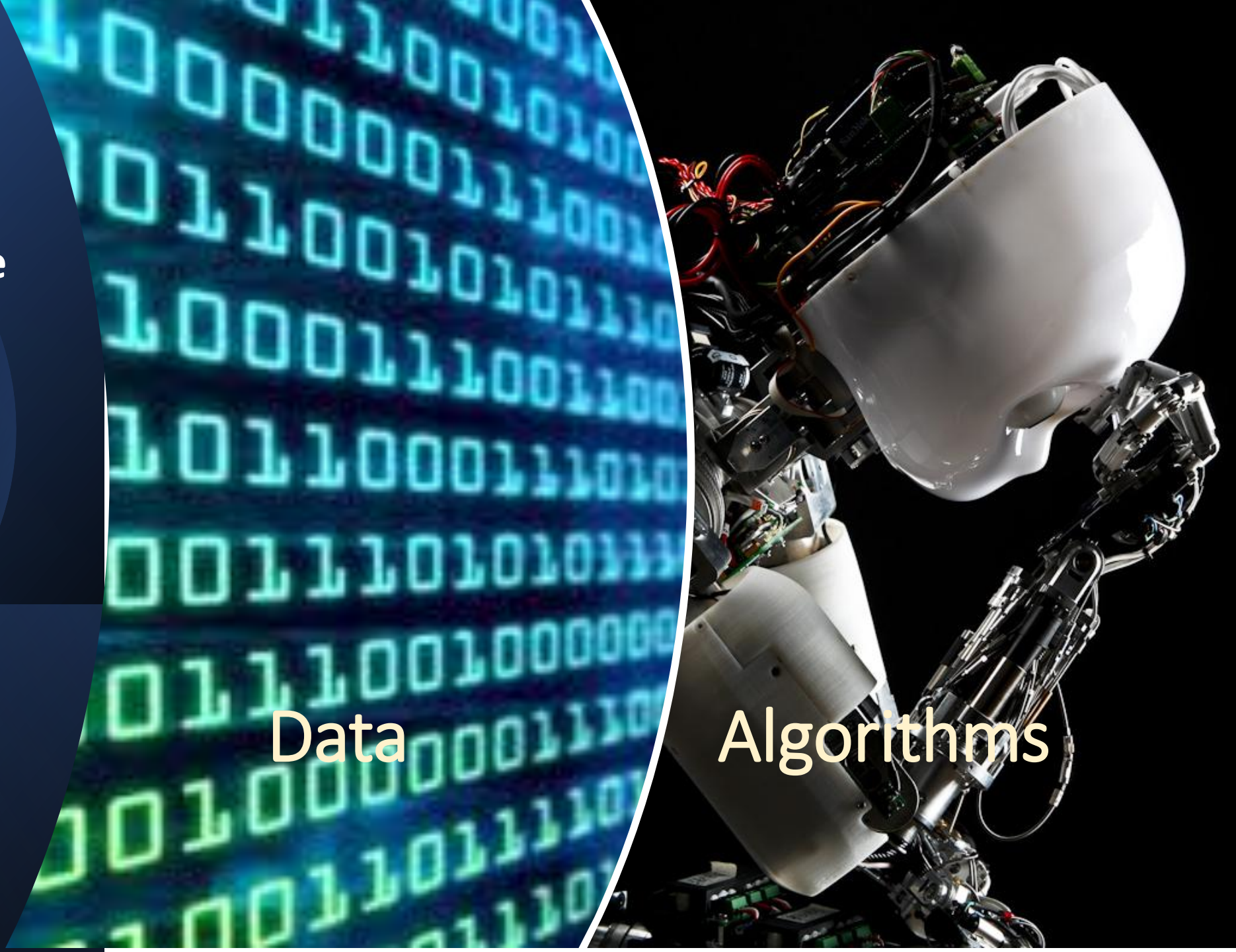
Data Will Solve Robotics and Automation: True or False? – Debate

ICRA 2025



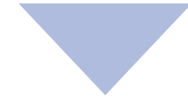
Data

Algorithms



Data Quality

Biases Dataset



Amplification
of biases

Biased Dataset

Amplification
of Biases

High-paying occupations

ARCHITECT



LAWYER



POLITICIAN



DOCTOR



CEO



JUDGE



ENGINEER



Low-paying occupations

JANITOR



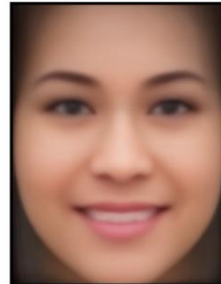
DISHWASHER



FAST-FOOD WORKER



CASHIER



TEACHER



SOCIAL WORKER

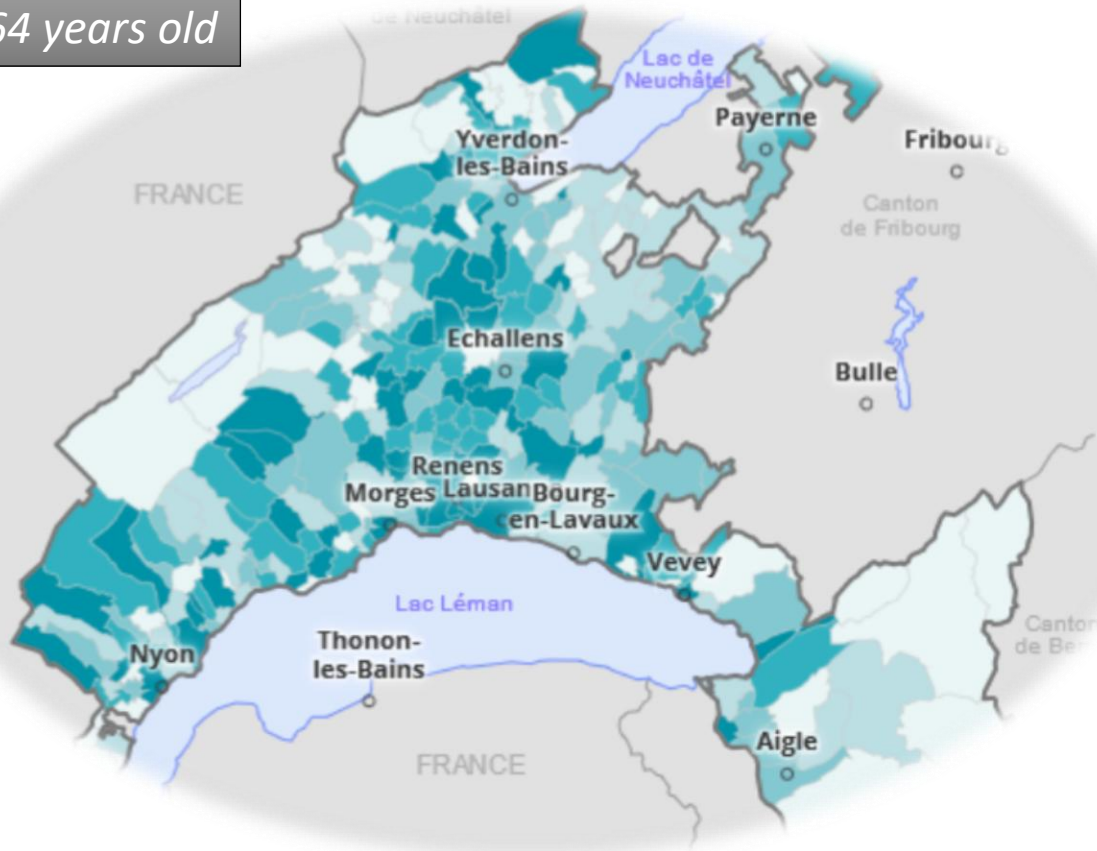


HOUSEKEEPER

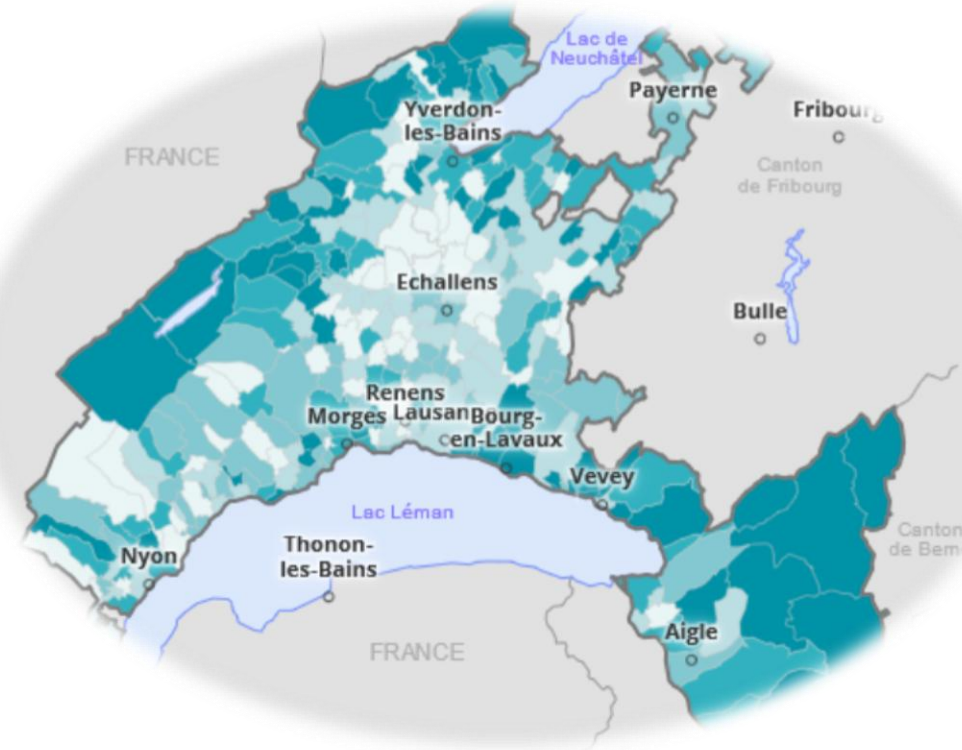


Statistical distribution of population

20-64 years old

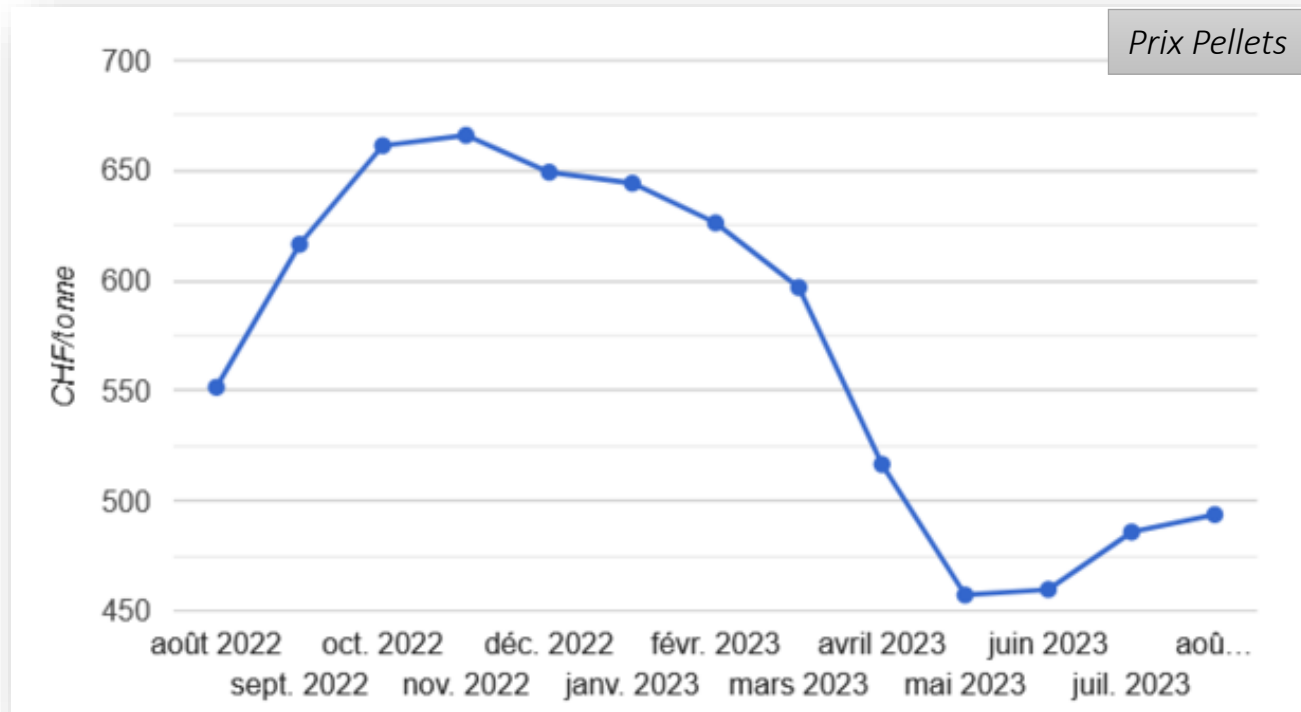


>64 years old

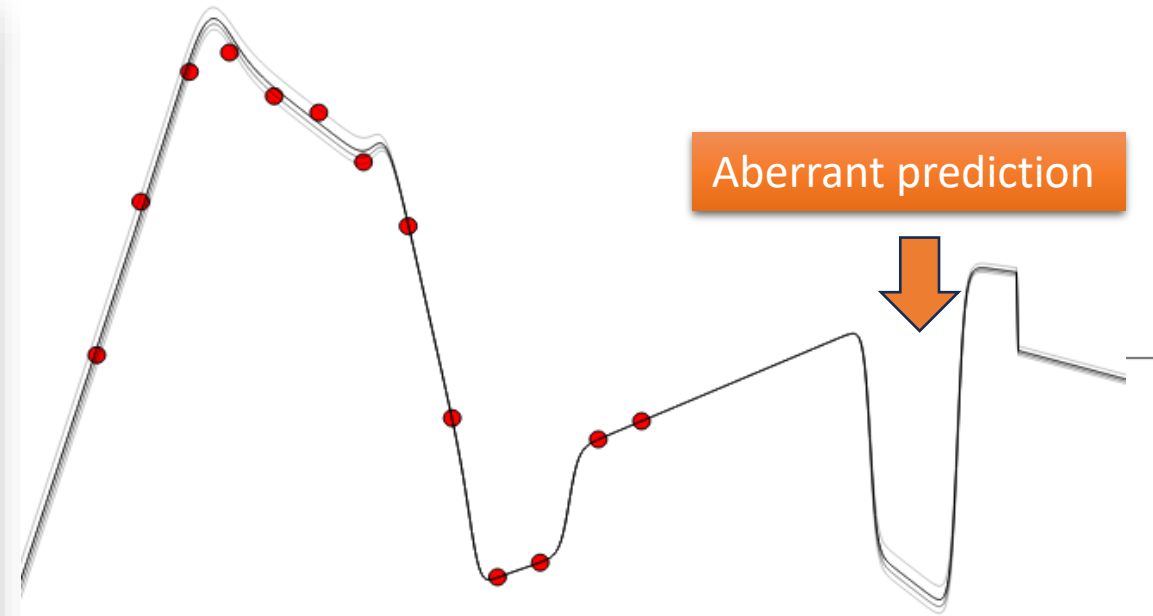


Distribution Age of the Population

Prediction far from data



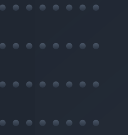
Source: Pellets.ch



Aberrant prediction

Large uncertainty on prediction

Deepfake





Machine Learning I Course

Practicalities for this course

Class Format

Flipped Class format

Offline

Watch videos

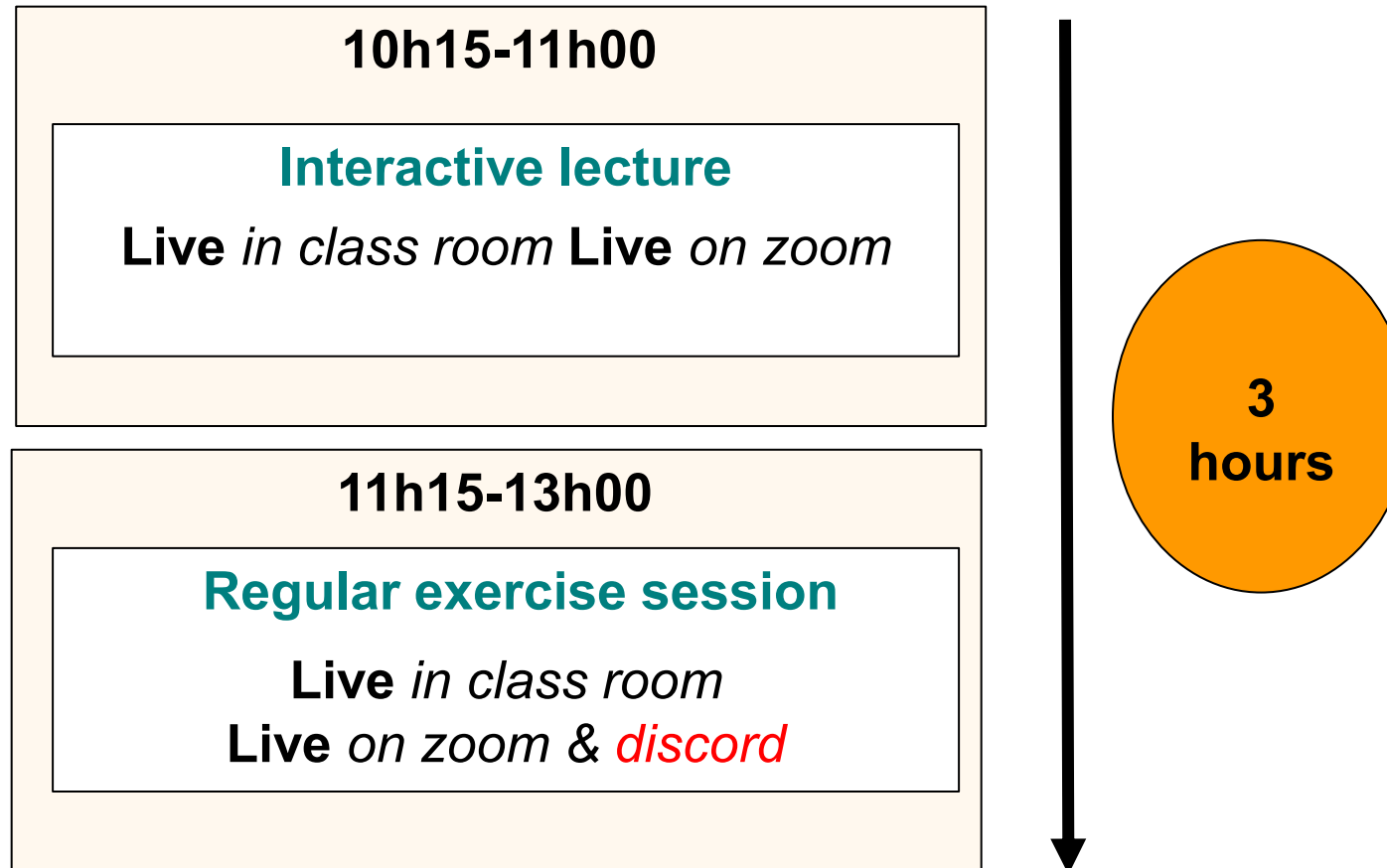
Quiz

1 hour

*You can watch videos between 9h15-10am or before.
But you must watch the videos before coming to class!*

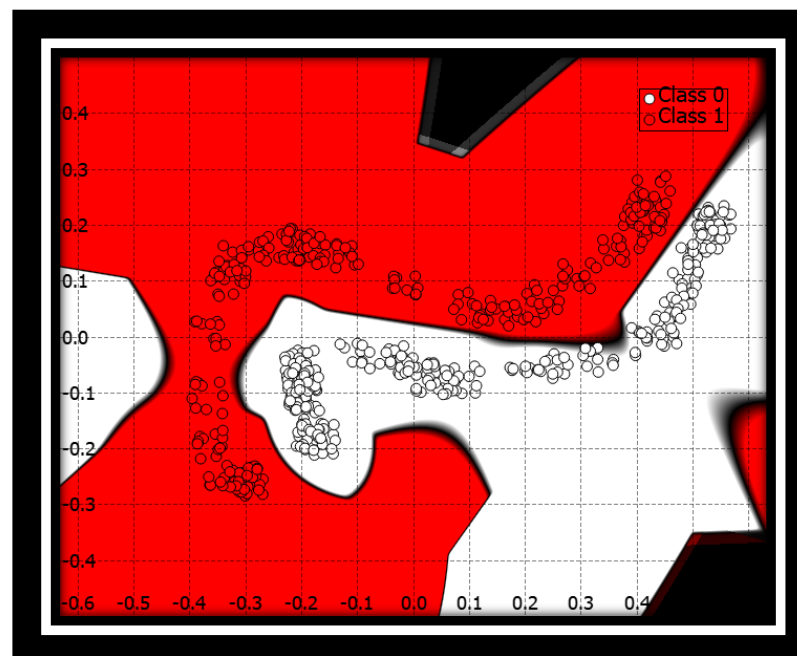
*The quizzes are optional – they are meant to prepare you for
the final exam that will be a multiplechoice.*

Class Format



Practice sessions on computer

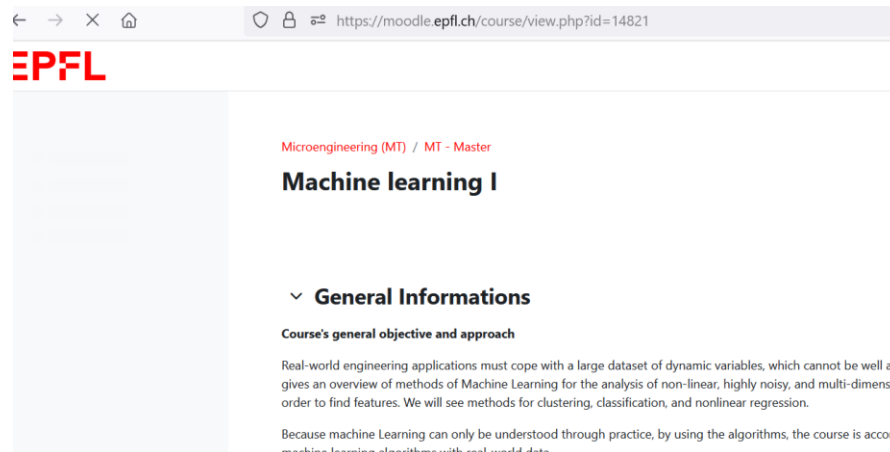
9h15-13h00 In class only
Bring Your Own Device



4
hours

<http://mldemos.epfl.ch>

Material for the class



← → × 🏠 🔒 <https://moodle.epfl.ch/course/view.php?id=14821>

EPFL

Microengineering (MT) / MT - Master

Machine learning I


▼ **General Informations**

Course's general objective and approach

Real-world engineering applications must cope with a large dataset of dynamic variables, which cannot be well approximated. This course gives an overview of methods of Machine Learning for the analysis of non-linear, highly noisy, and multi-dimensional data in order to find features. We will see methods for clustering, classification, and nonlinear regression.

Because machine Learning can only be understood through practice, by using the algorithms, the course is accompanied by exercises and machine learning algorithms with real-world data.

- Videos
- Quizzes
- Slides
- Exercises
- Solutions
- Lecture Notes



← → ↺ 🏠 🔒 <https://tube.switch.ch/channels/7e86d16d>

EPFL

LASA - Machine Learning Courses

Aude Billard, École polytechnique fédérale de Lausanne (EPFL)

<https://tube.switch.ch/channels/7e86d16d>

Complete repository
of all videos

Software

Instructions to install the software on moodle

https://moodle.epfl.ch/course/view.php?id=14821



80%



EPFL

MOODLE

FR | EN | D

=====

Software *MachineLearningDemos*

A suite of algorithms has been implemented for you in the form of a user-friendly program that allows you to play with data and to study how each method performs in different tasks of classification, clustering and regression. The software runs on Windows and requires the .Net Framework 3.0 (which should be installed in your machine already, but if it isn't, pick it up [here](#)).

Download MLDemos [here](#)

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Grading Scheme

Midterm (0%) – On-line Quiz – Self-evaluation

Written Exam (100)% of the grade

Multiple-Choices

3 hours long

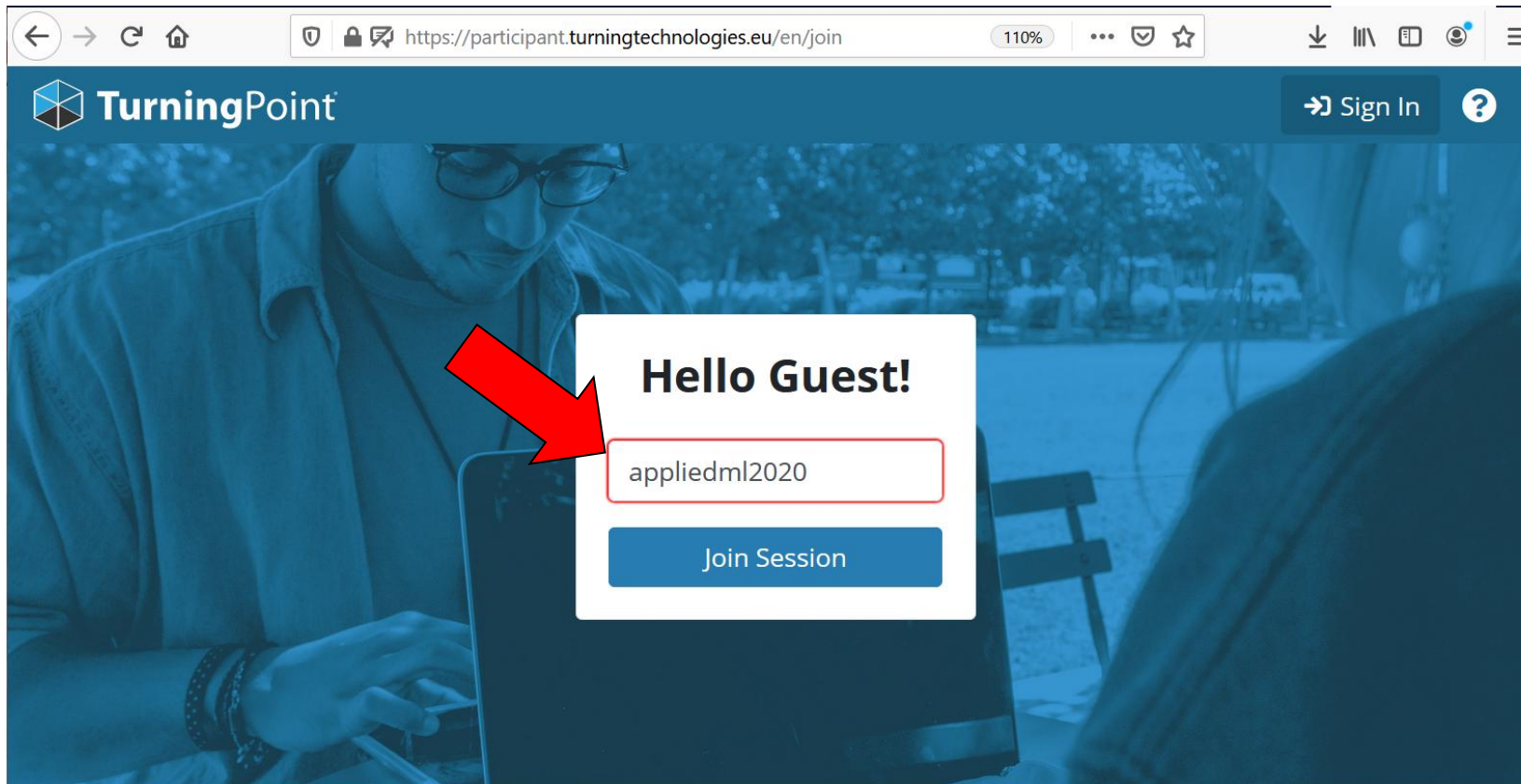
Closed book

Allowed 1 A4 recto-verso page with *handwritten notes*

Test polling system

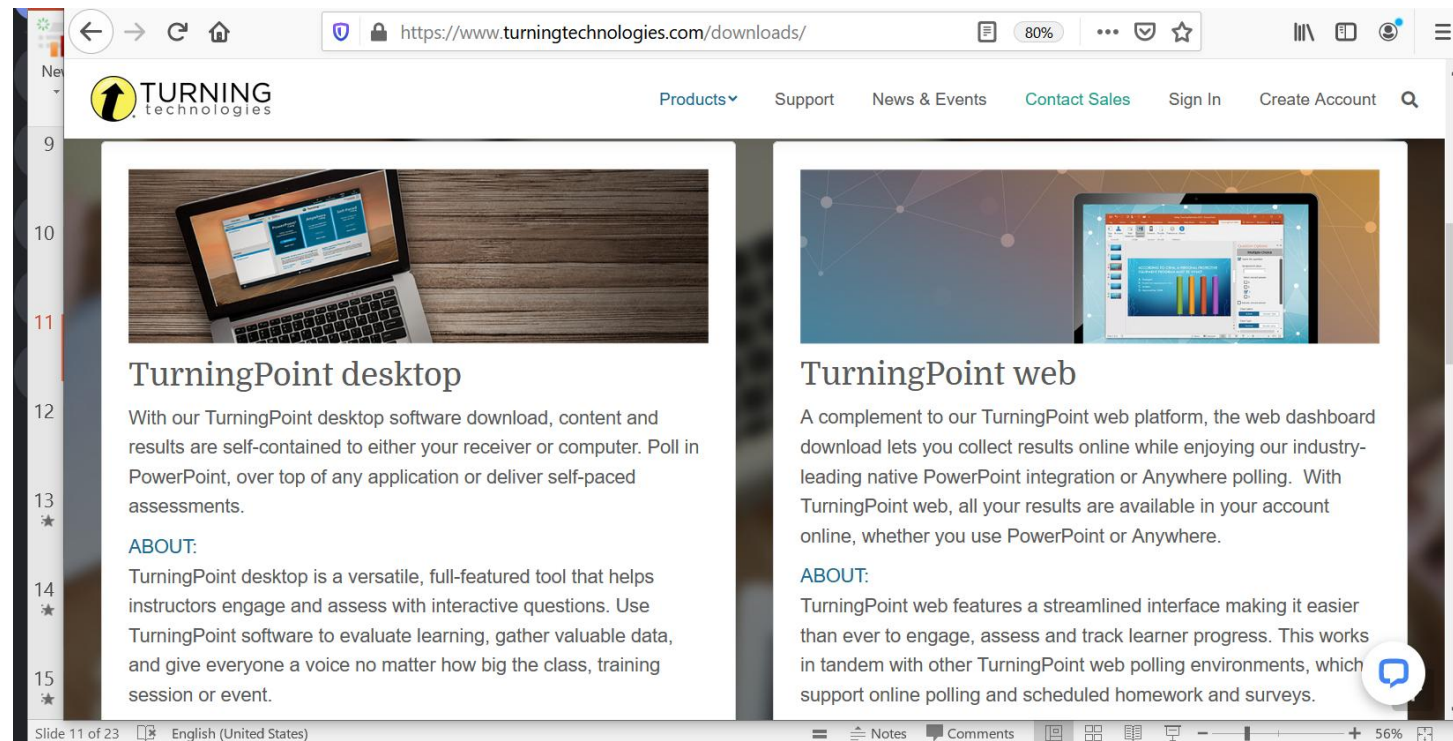
<https://participant.turningtechnologies.eu/en/join>

Access as GUEST and enter the session id: *appliedml2020*



Test polling system

<https://www.turningtechnologies.com/downloads/>



The screenshot shows the 'Downloads' page on the TurningPoint Technologies website. The page features two main sections: 'TurningPoint desktop' and 'TurningPoint web'. The 'TurningPoint desktop' section includes an image of a laptop displaying the software interface and text describing the self-contained software download. The 'TurningPoint web' section includes an image of a tablet displaying the web dashboard and text describing the online dashboard download. The website header includes the TurningPoint Technologies logo and navigation links for Products, Support, News & Events, Contact Sales, Sign In, and Create Account. The browser address bar shows the URL 'https://www.turningtechnologies.com/downloads/'.

TurningPoint desktop

With our TurningPoint desktop software download, content and results are self-contained to either your receiver or computer. Poll in PowerPoint, over top of any application or deliver self-paced assessments.

ABOUT:

TurningPoint desktop is a versatile, full-featured tool that helps instructors engage and assess with interactive questions. Use TurningPoint software to evaluate learning, gather valuable data, and give everyone a voice no matter how big the class, training session or event.

TurningPoint web

A complement to our TurningPoint web platform, the web dashboard download lets you collect results online while enjoying our industry-leading native PowerPoint integration or Anywhere polling. With TurningPoint web, all your results are available in your account online, whether you use PowerPoint or Anywhere.

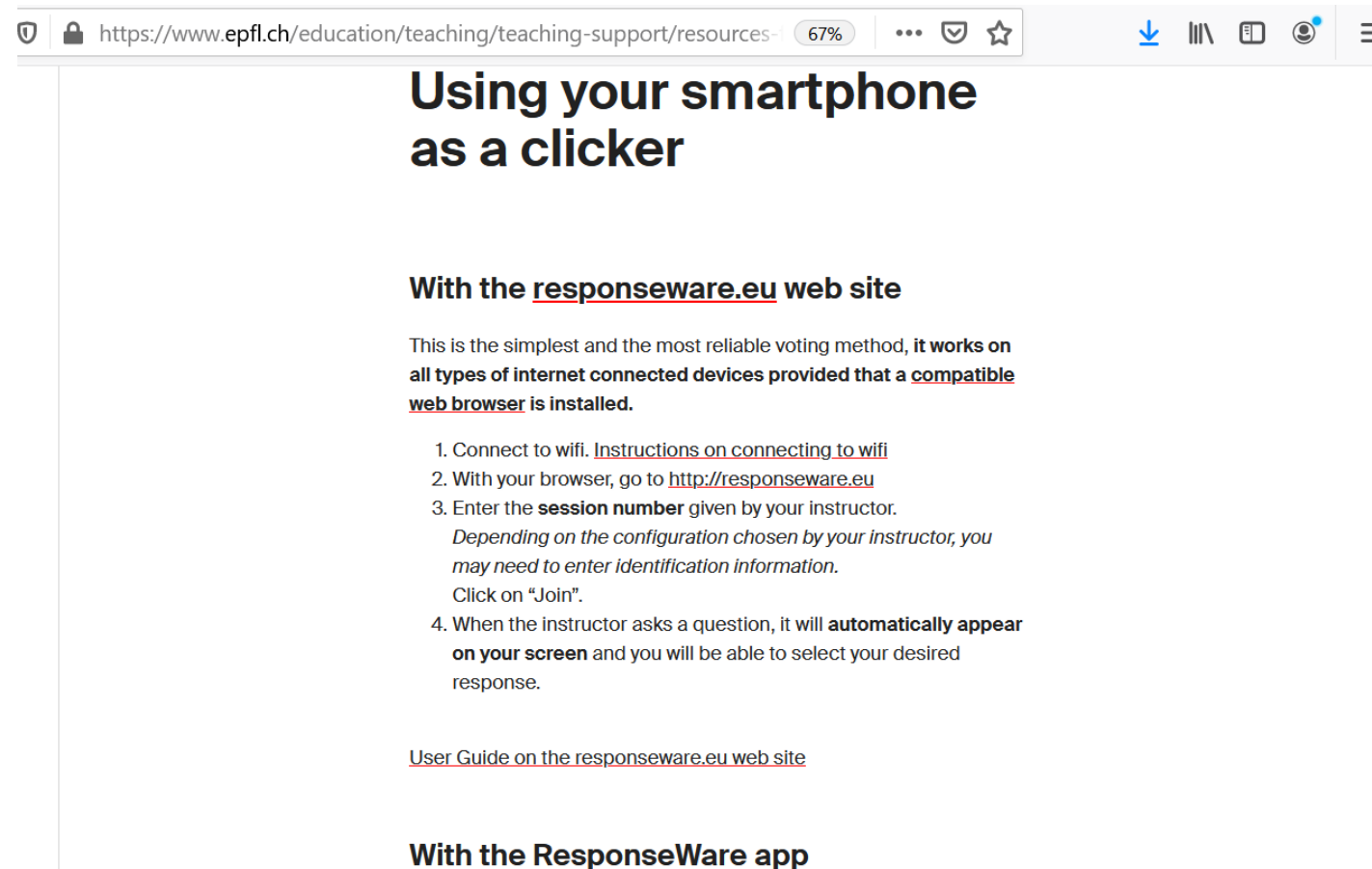
ABOUT:

TurningPoint web features a streamlined interface making it easier than ever to engage, assess and track learner progress. This works in tandem with other TurningPoint web polling environments, which support online polling and scheduled homework and surveys.

You can also install either the mobile version (for android or iphone), or the desktop, but we encourage you to use only the web version.

Instructions

<https://www.epfl.ch/education/teaching/teaching-support/resources-for-students/student/using-your-smartphone/>



The screenshot shows a web browser window with the address bar displaying the URL: <https://www.epfl.ch/education/teaching/teaching-support/resources-for-students/student/using-your-smartphone/>. The page content is as follows:

Using your smartphone as a clicker

With the responseware.eu web site

This is the simplest and the most reliable voting method, **it works on all types of internet connected devices provided that a [compatible web browser](#) is installed.**

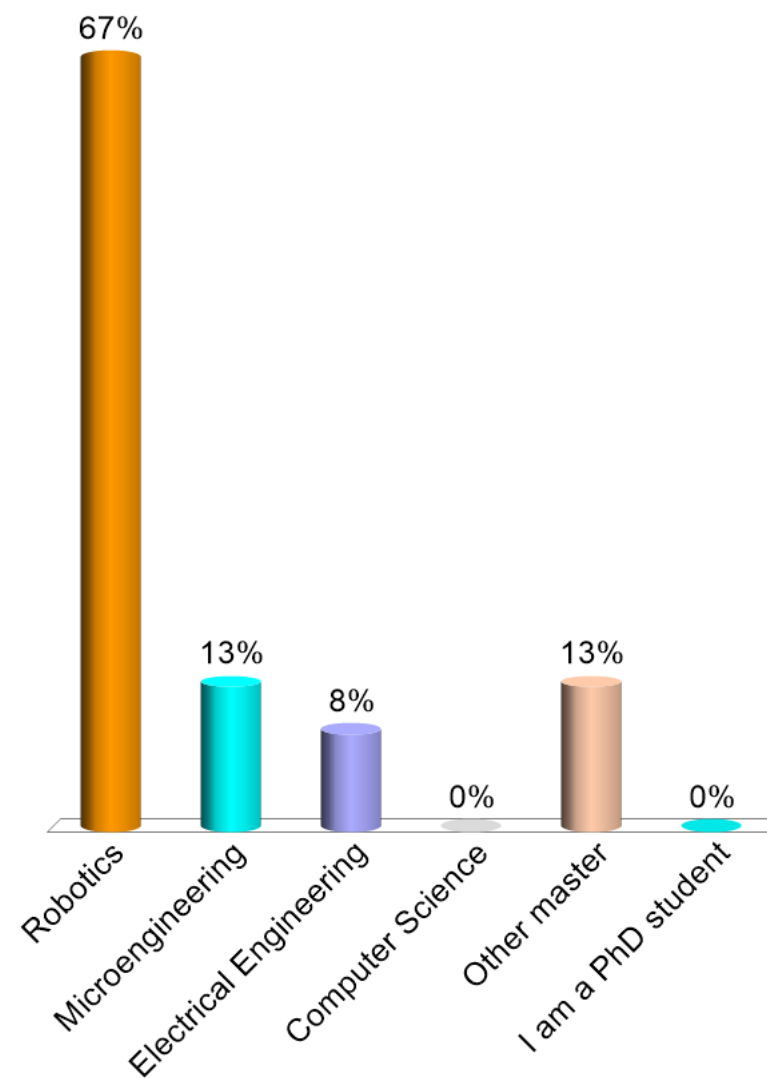
1. Connect to wifi. [Instructions on connecting to wifi](#)
2. With your browser, go to <http://responseware.eu>
3. Enter the **session number** given by your instructor.
Depending on the configuration chosen by your instructor, you may need to enter identification information.
Click on "Join".
4. When the instructor asks a question, it will **automatically appear on your screen** and you will be able to select your desired response.

[User Guide on the responseware.eu web site](#)

With the ResponseWare app

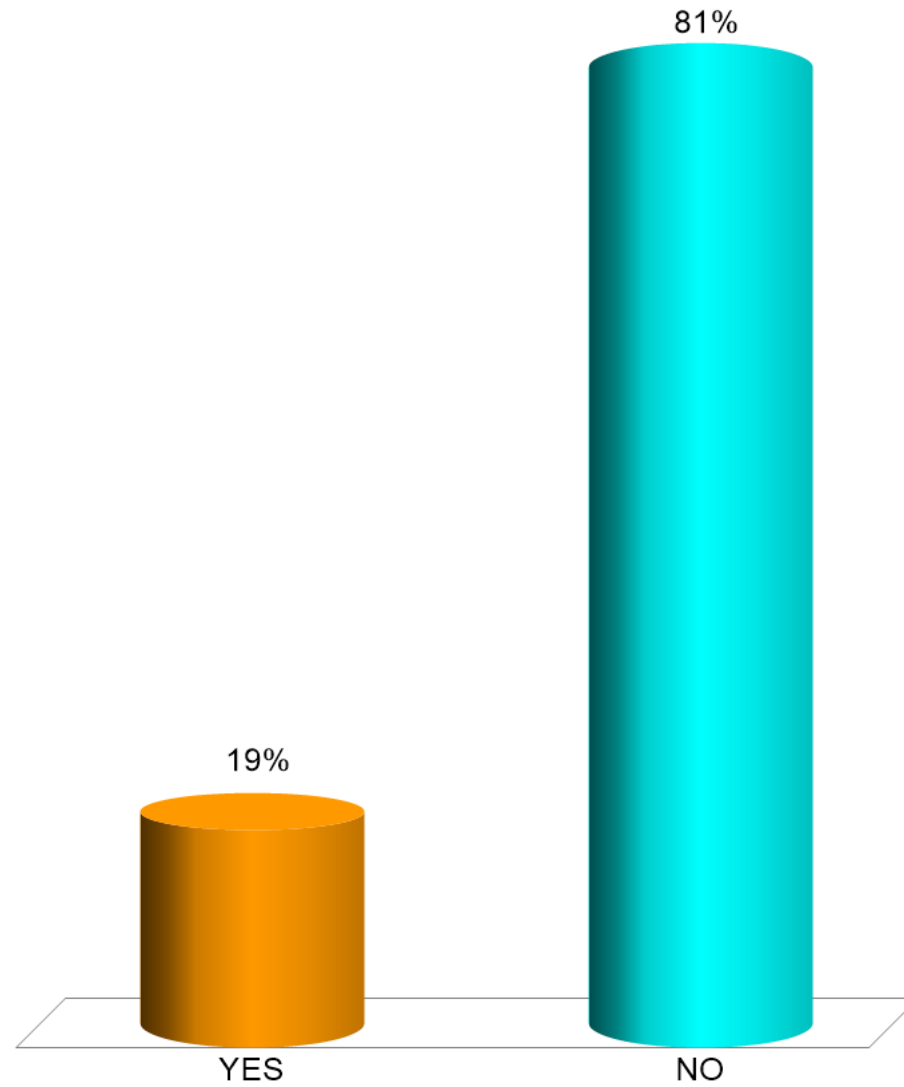
Which master do you follow?

- A. Robotics
- B. Microengineering
- C. Electrical Engineering
- D. Computer Science
- E. Other master
- F. I am a PhD student



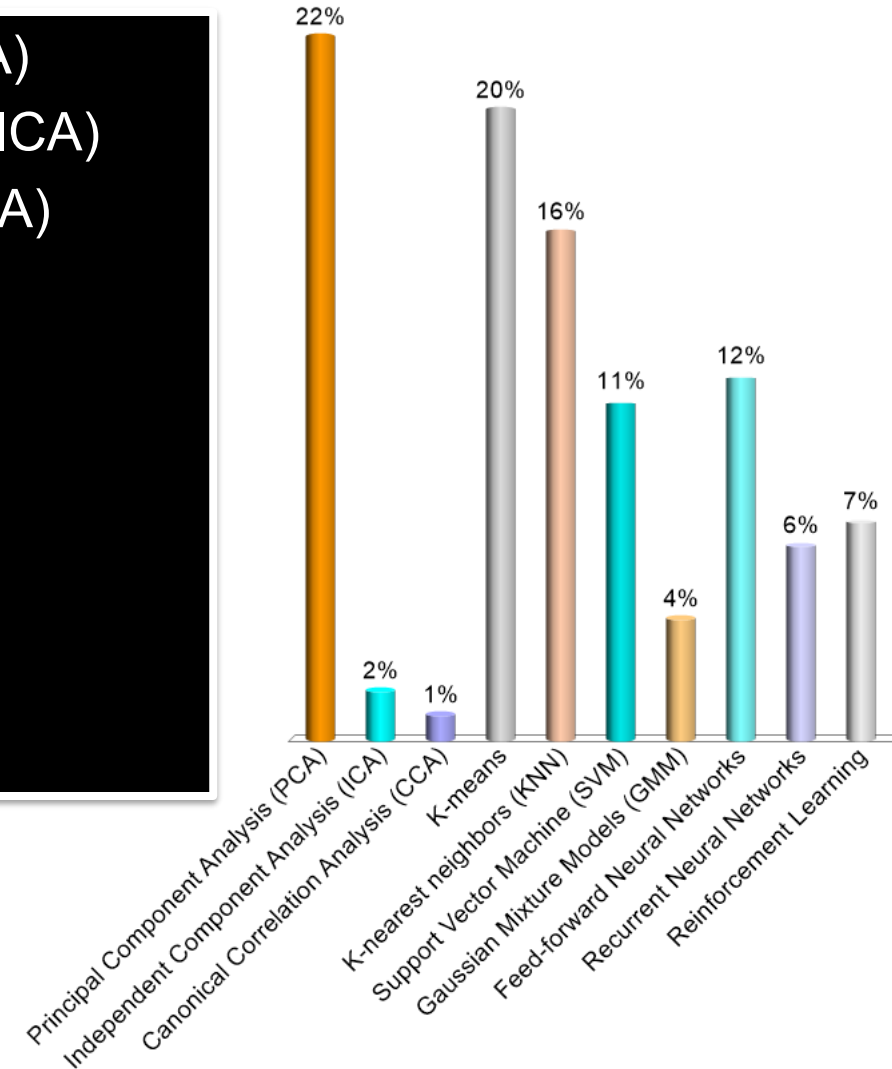
Have you taken a
Machine Learning course before?

- A. YES
- B. NO



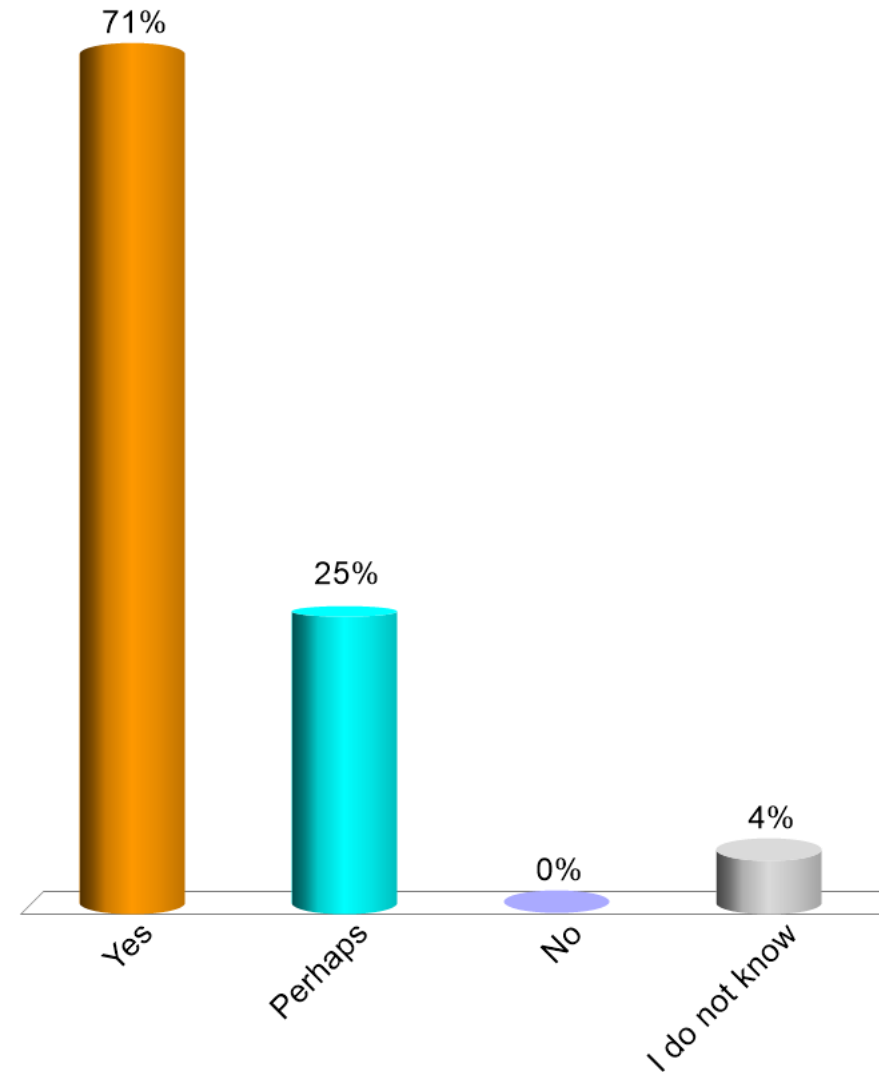
If you took a ML course before, which of these topics have you seen before

- A. Principal Component Analysis (PCA)
- B. Independent Component Analysis (ICA)
- C. Canonical Correlation Analysis (CCA)
- D. K-means
- E. K-nearest neighbors (KNN)
- F. Support Vector Machine (SVM)
- G. Gaussian Mixture Models (GMM)
- H. Feed-forward Neural Networks
- I. Recurrent Neural Networks
- J. Reinforcement Learning



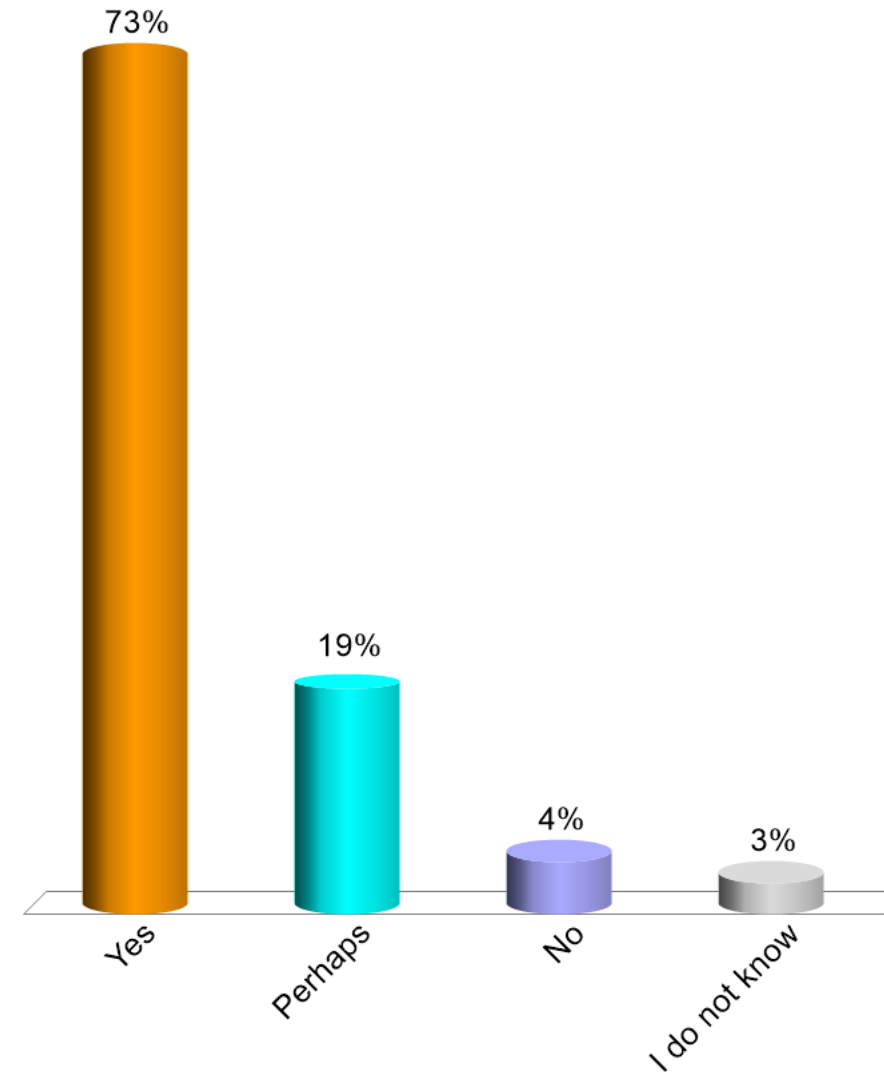
Do you expect to have to use machine learning once you have graduated?

- A. Yes
- B. Perhaps
- C. No
- D. I do not know



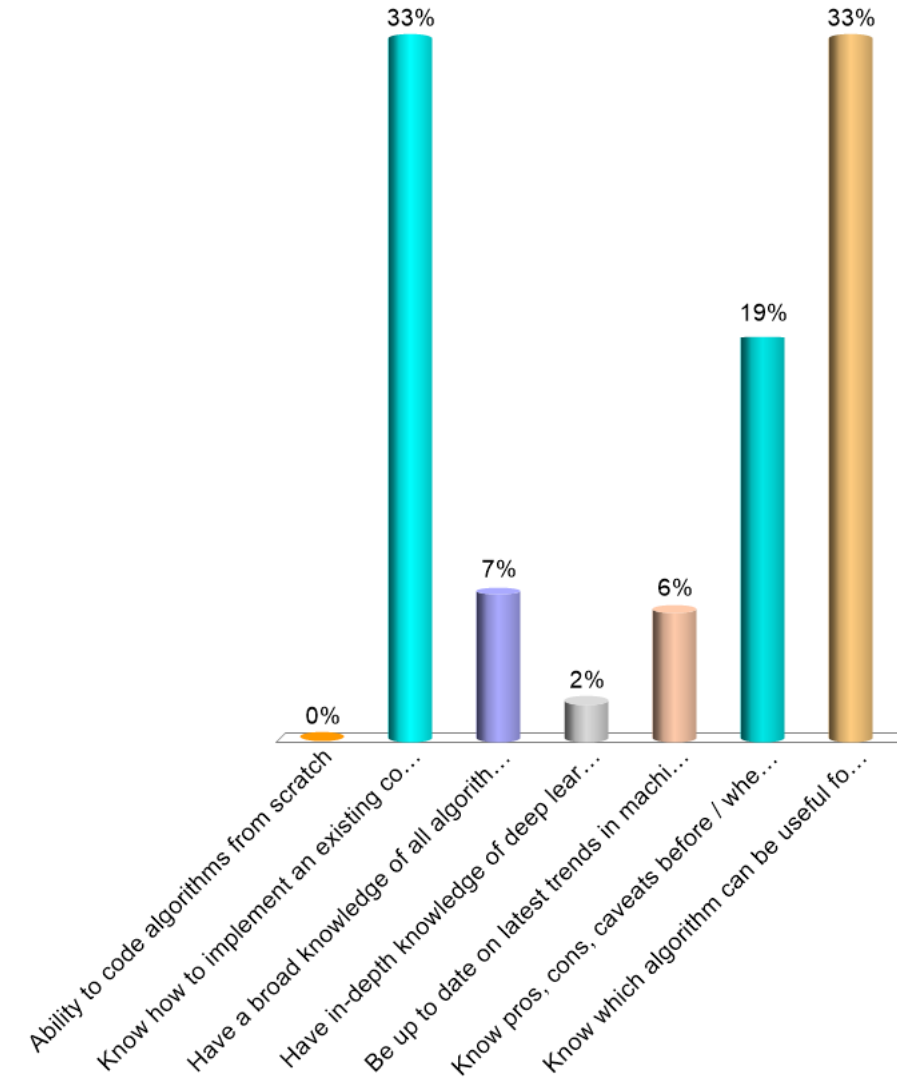
Do you think that having taken a machine learning course will be a plus when you seek a job?

- A. Yes
- B. Perhaps
- C. No
- D. I do not know



Which of the following skills do you think employers are looking for when hiring someone with machine learning training?

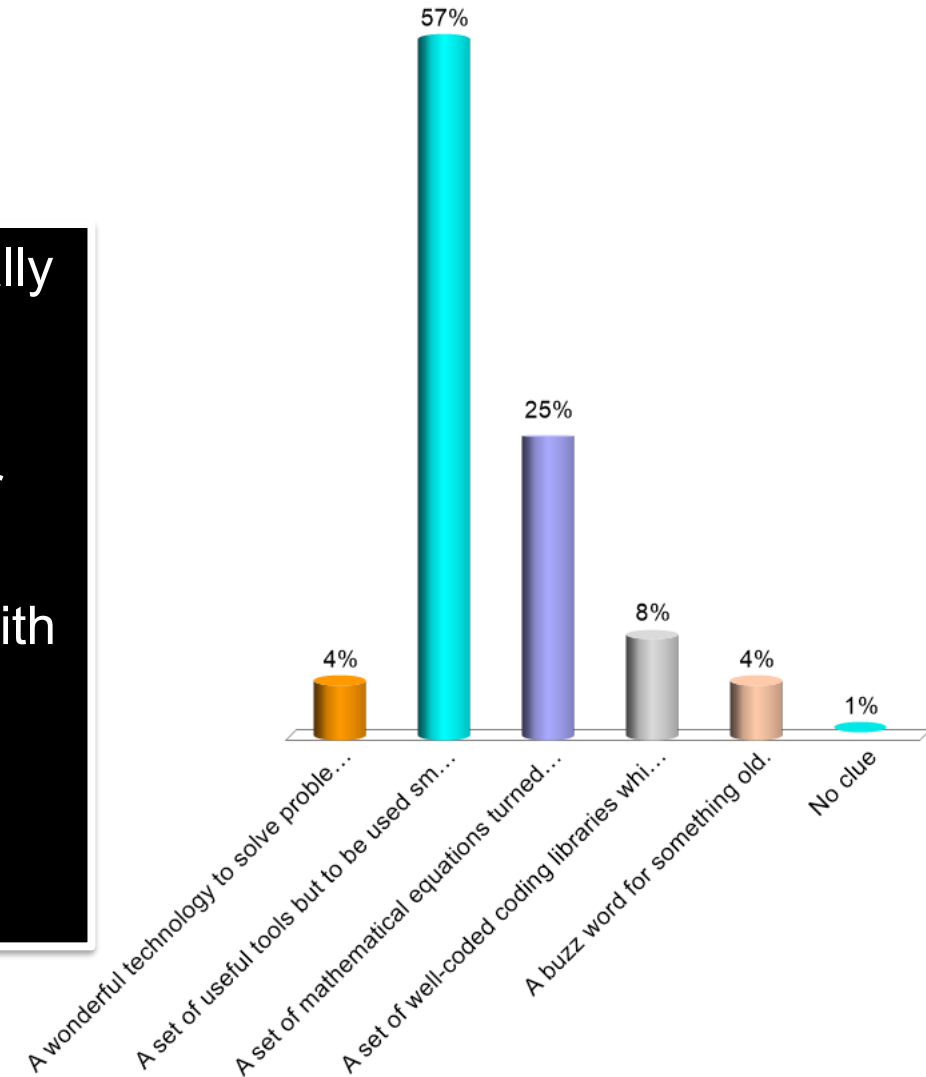
- A. Ability to code algorithms from scratch
- B. Know how to implement an existing code for a specific application
- C. Have a broad knowledge of all algorithms in machine learning
- D. Have in-depth knowledge of deep learning
- E. Be up to date on latest trends in machine learning
- F. Know pros, cons, caveats before / when using machine learning
- G. Know which algorithm can be useful for which application



What is machine learning to you?

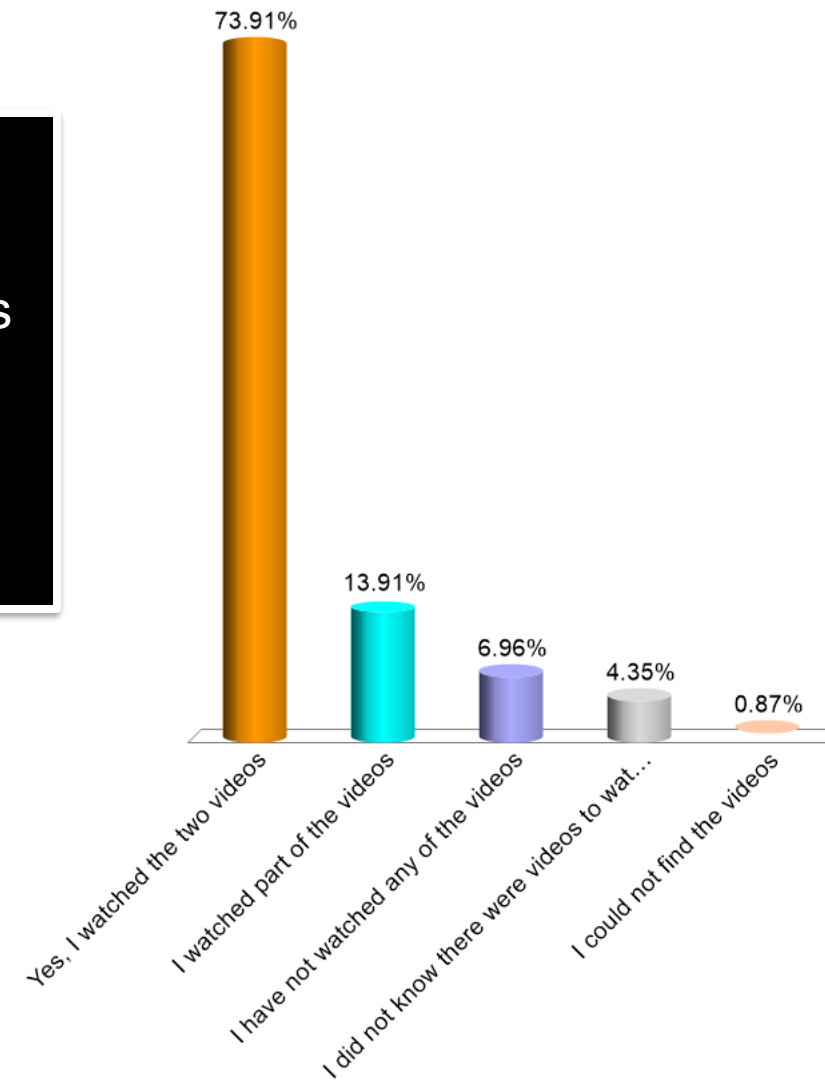
Multiple answers possible

- A. A wonderful technology to solve problems automatically without me needing to think.
- B. A set of useful tools but to be used smartly.
- C. A set of mathematical equations turned into computer code.
- D. A set of well-coded coding libraries which I can use with little knowledge of the theory.
- E. A buzz word for something old.
- F. No clue



Have you watched the videos for this class prior to joining the class?

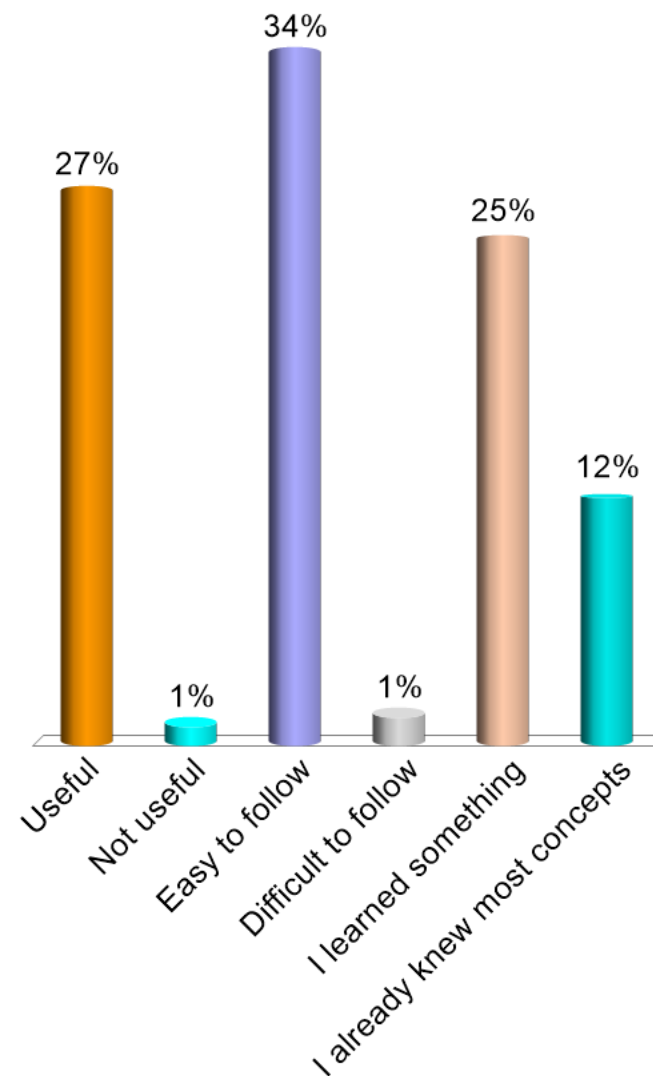
- A. Yes, I watched the two videos
- B. I watched part of the videos
- C. I have not watched any of the videos
- D. I did not know there were videos to watch
- E. I could not find the videos



Qualify the content of the videos

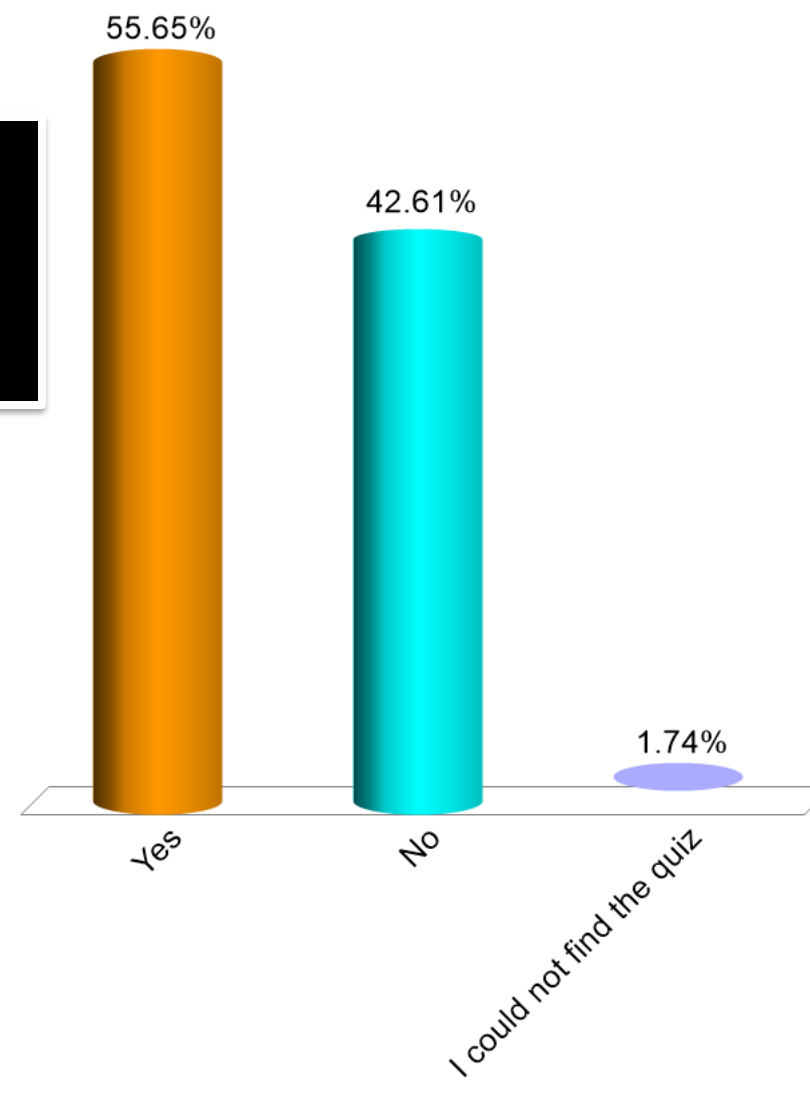
Multiple answers possible

- A. Useful
- B. Not useful
- C. Easy to follow
- D. Difficult to follow
- E. I learned something
- F. I already knew most concepts



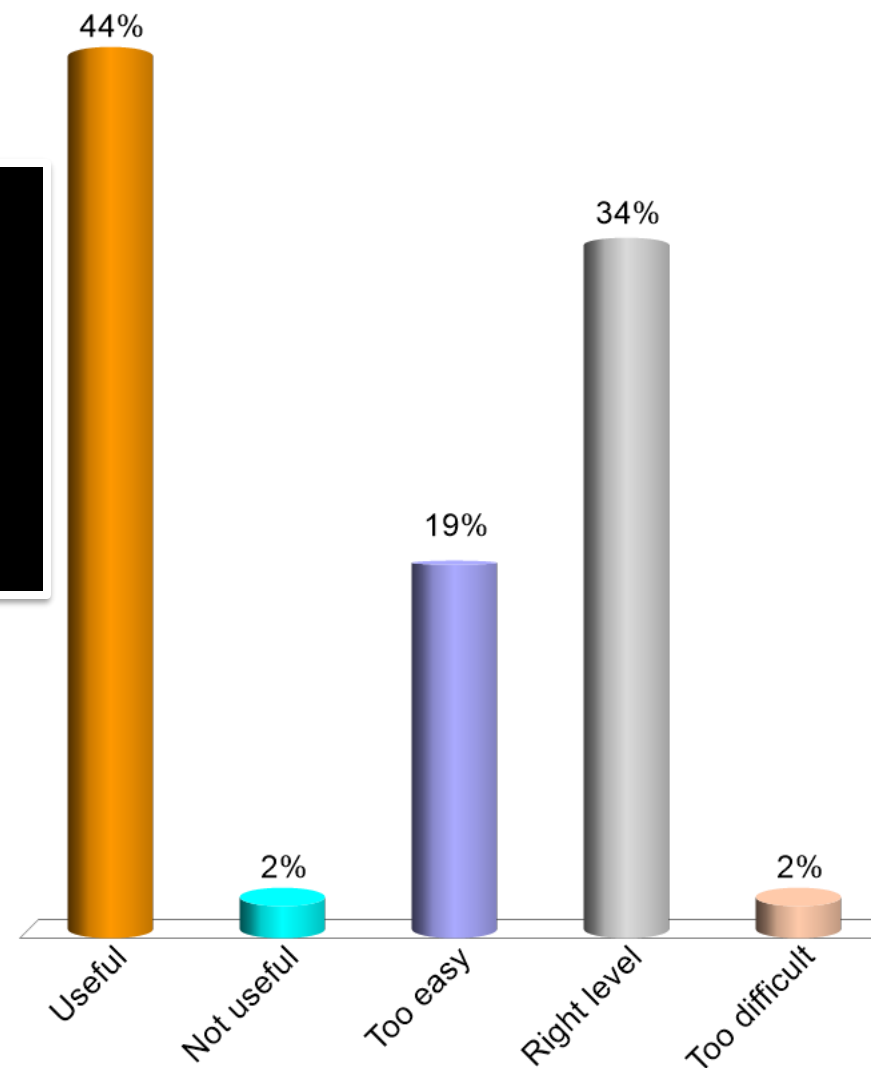
Have you taken the quiz for this class
prior to joining the class?

- A. Yes
- B. No
- C. I could not find the quiz



Qualify the content of the quiz

- A. Useful
- B. Not useful
- C. Too easy
- D. Right level
- E. Too difficult

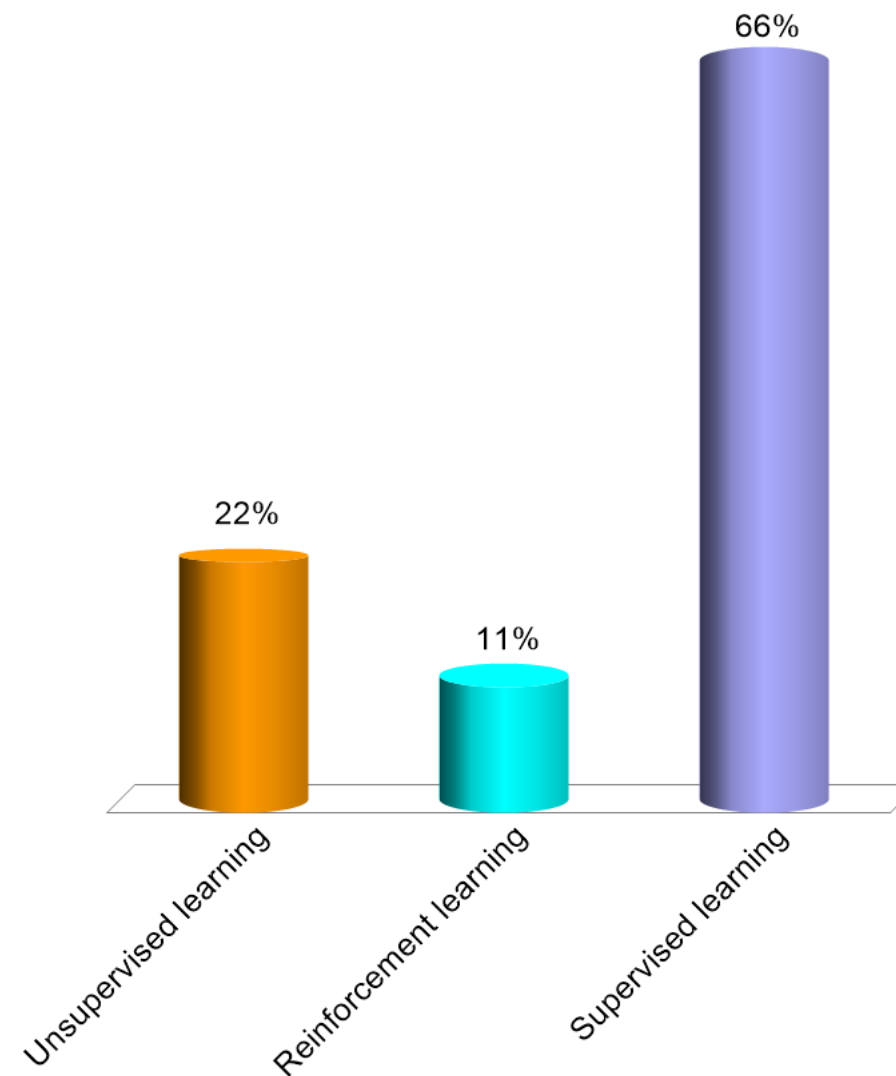


Applied Machine Learning Course

Recap of concepts seen in the videos

What type of learning is classification?

- A. Unsupervised learning
- B. Reinforcement learning
- C. Supervised learning



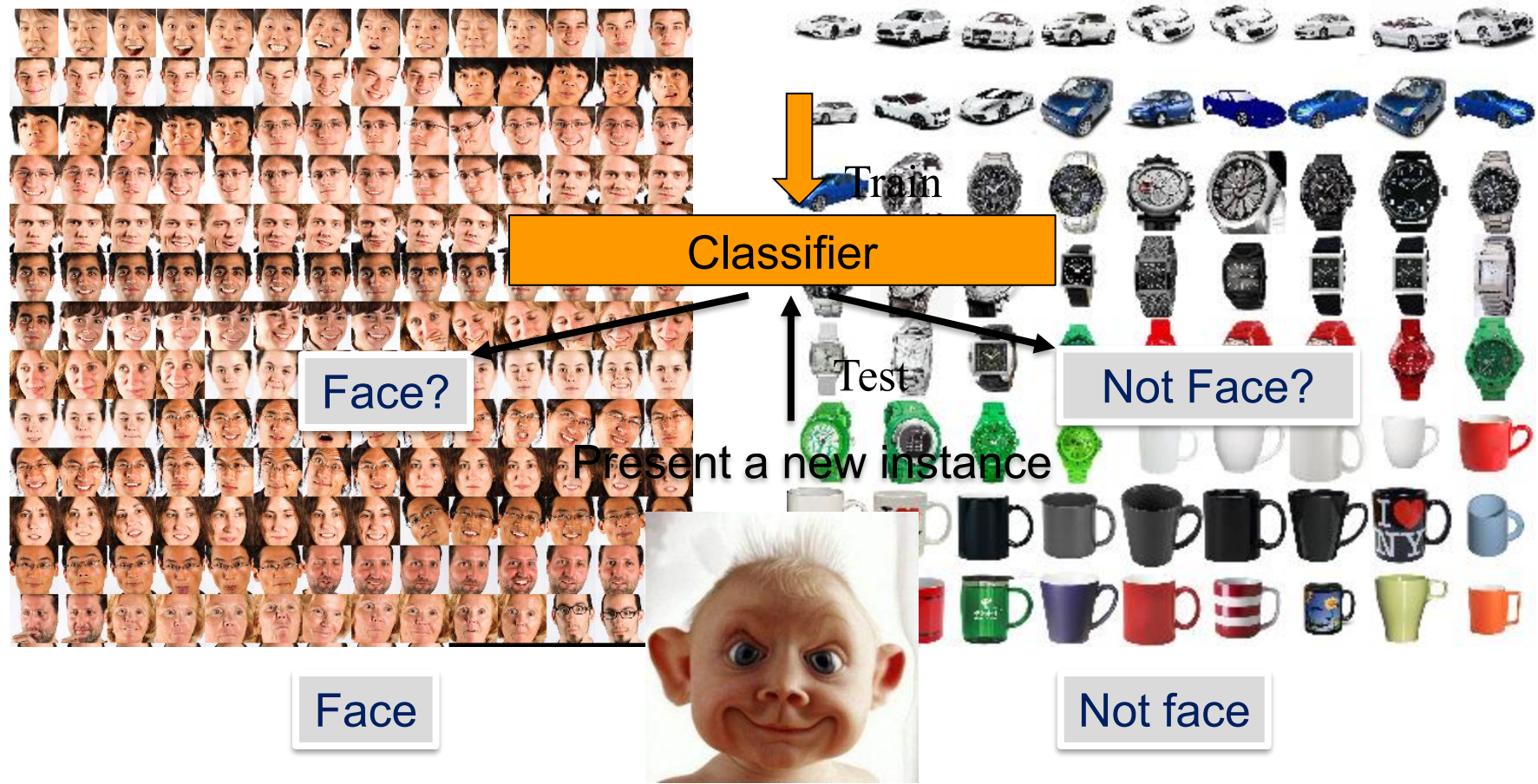
Classification is a type of *supervised learning*

The classifier learns a mapping between

- a set of inputs (e.g. images) and
- a set of desired outputs (class labels).

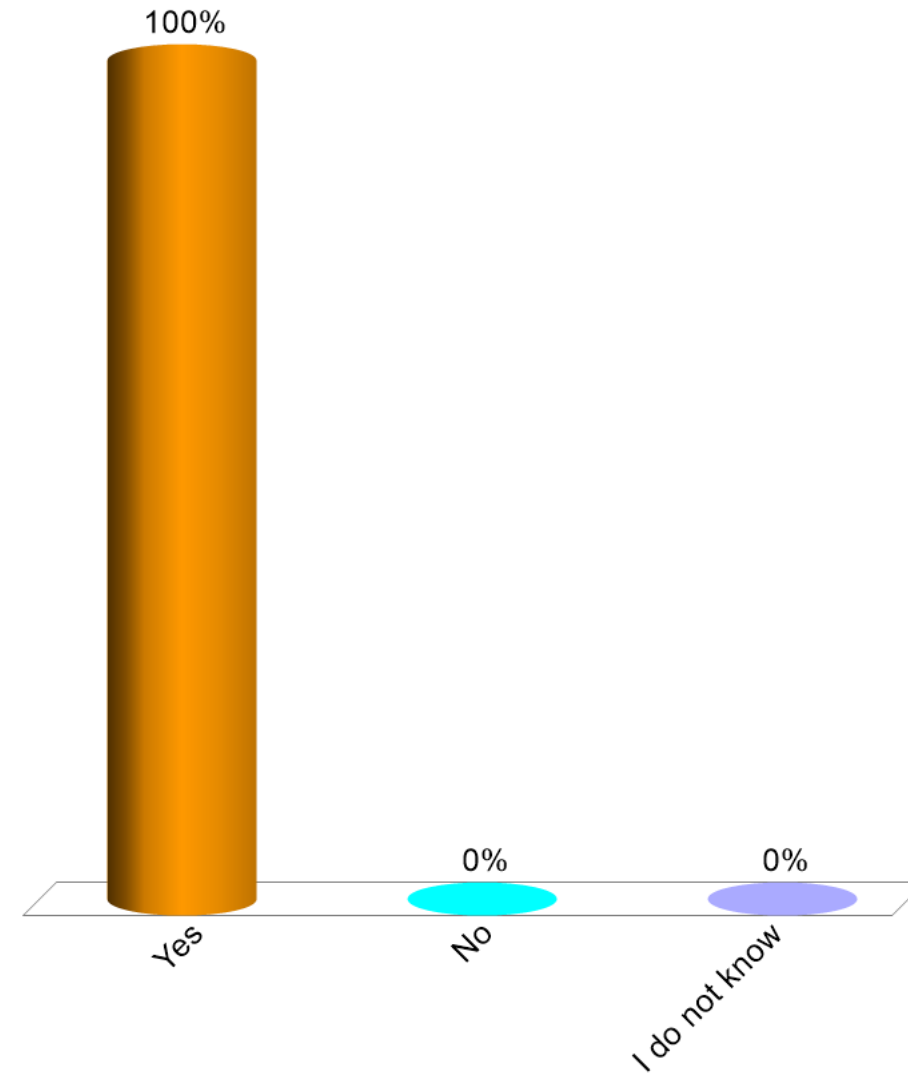
Classification: example

Gather instances of the two classes



Can classification of face vs. no face
suffer from unbalanced datasets?

- A. Yes
- B. No
- C. I do not know

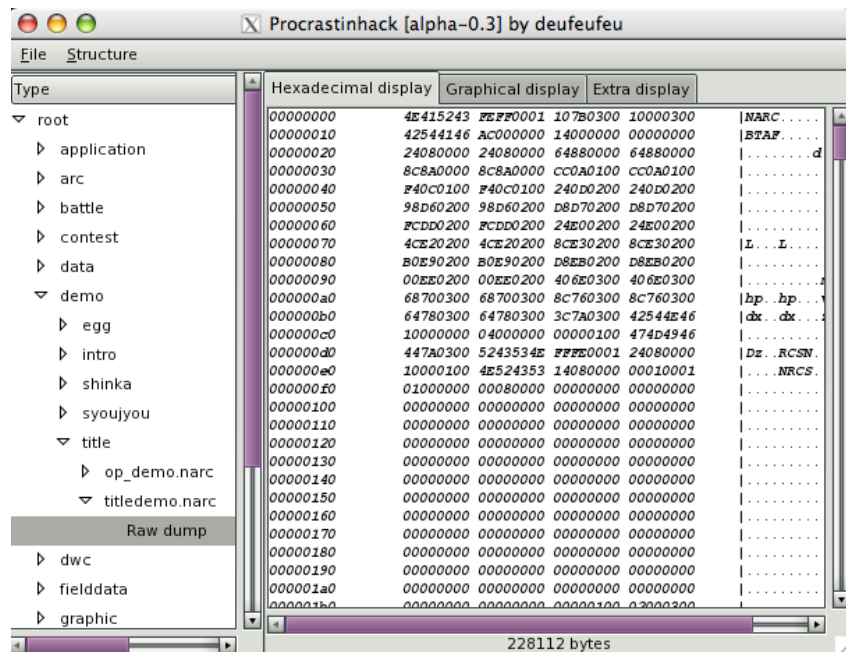
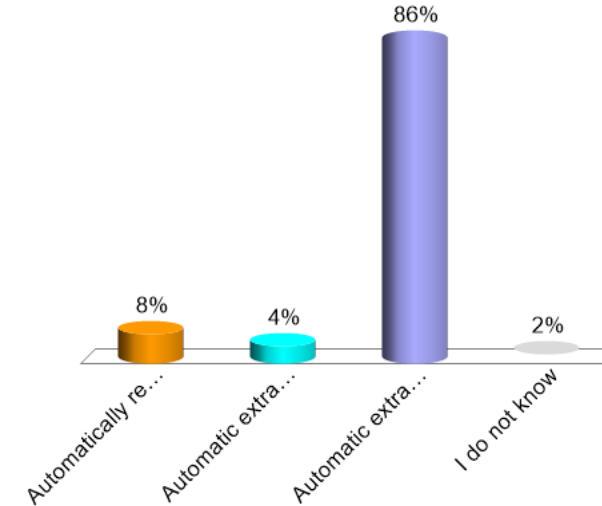


Datasets composed of samples of
faces versus non faces classes
can be severely unbalanced

There are more examples of images of objects that are
not faces than of images of faces.

What does *structure discovery* refer to in machine learning?

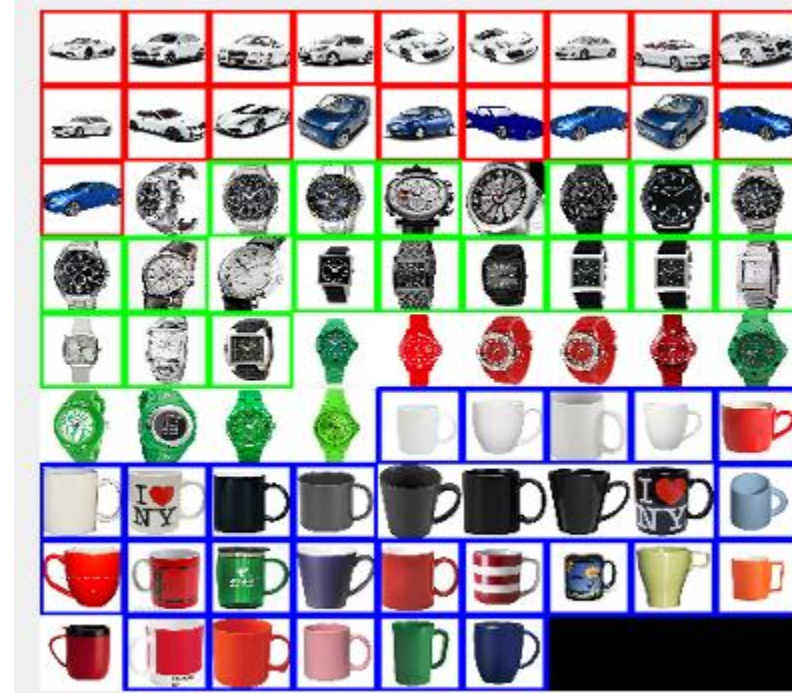
- A. Automatically reordering of data in a spreadsheet
- B. Automatic extraction of outliers
- C. Automatic extractions of regularities in dataset
- D. I do not know



Structure discovery: Clustering

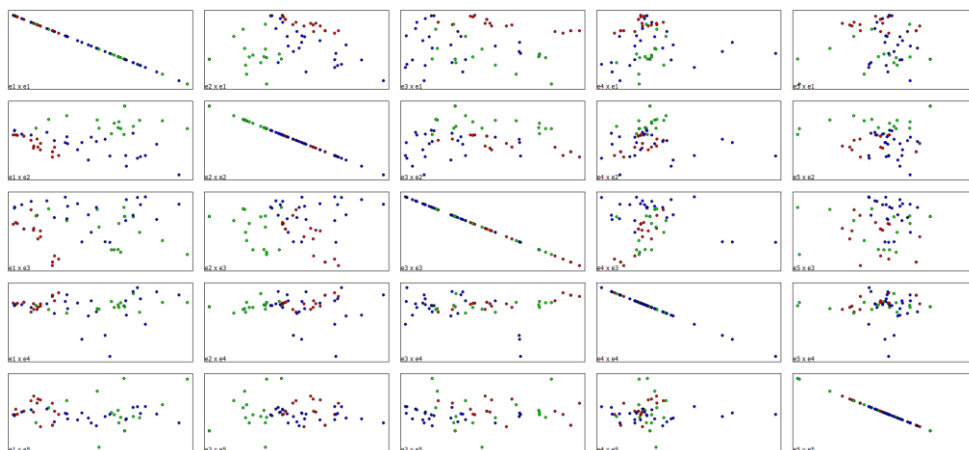


Raw data

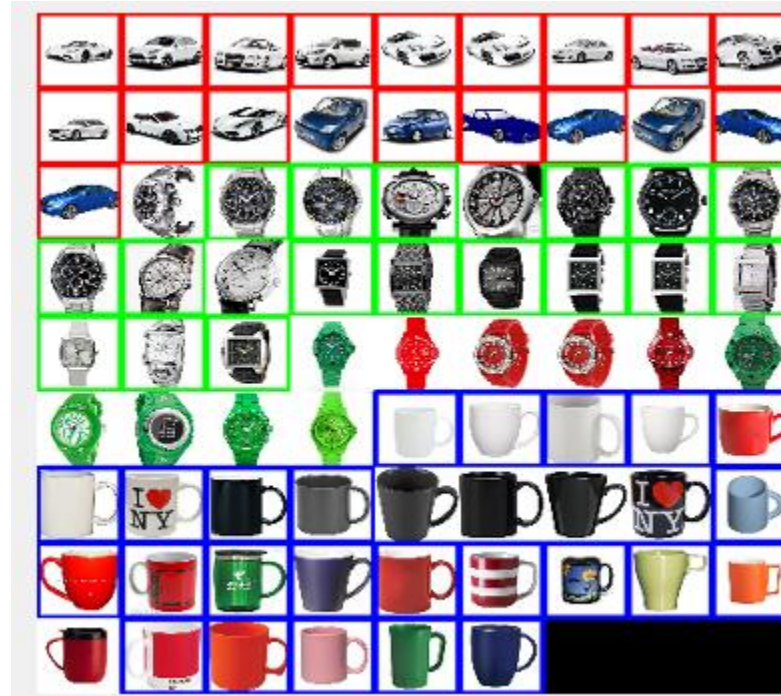


True labels

Structure discovery: Clustering

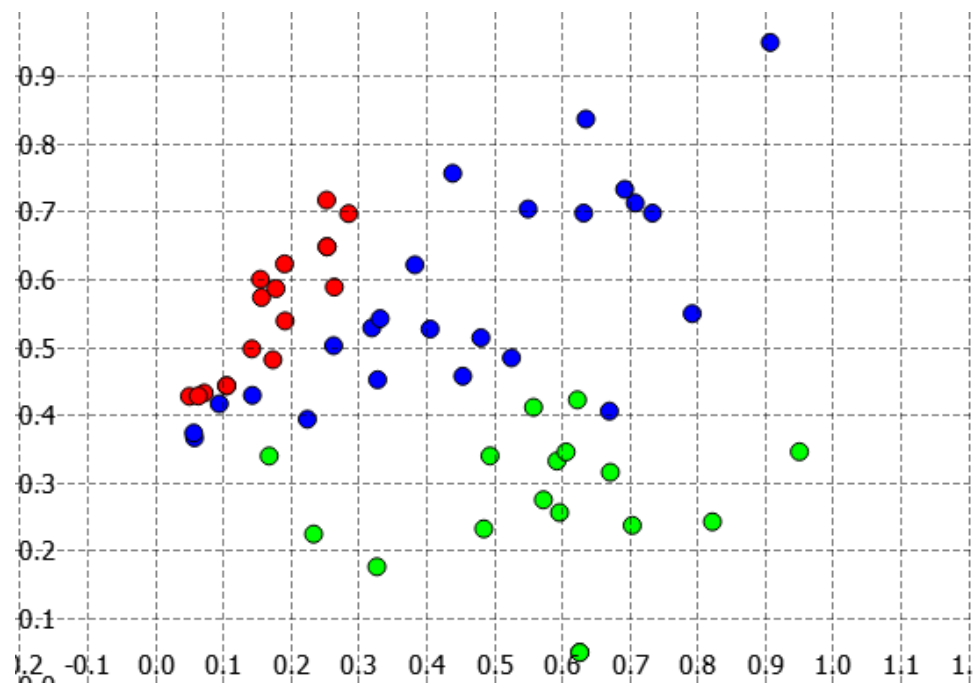


Distribution of data in pixel space

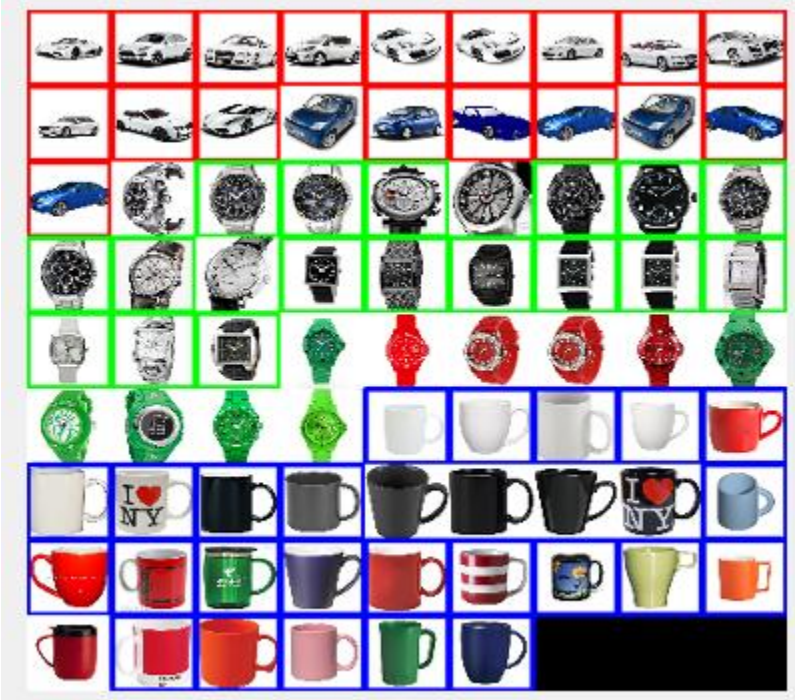


True labels

Structure discovery: Clustering

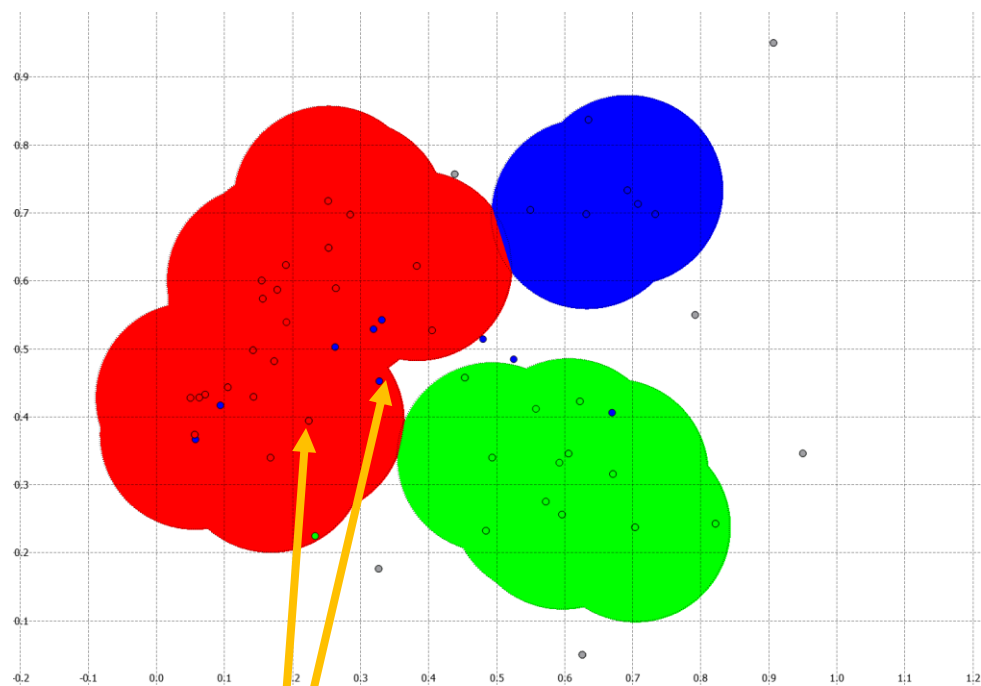


Distribution in low dimensional space

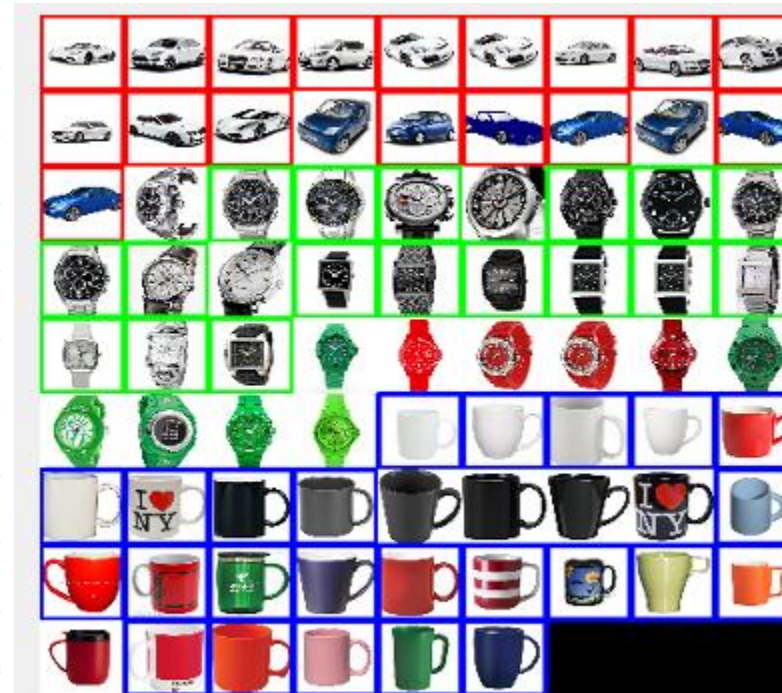


True labels

Structure discovery: Clustering



Automatic grouping



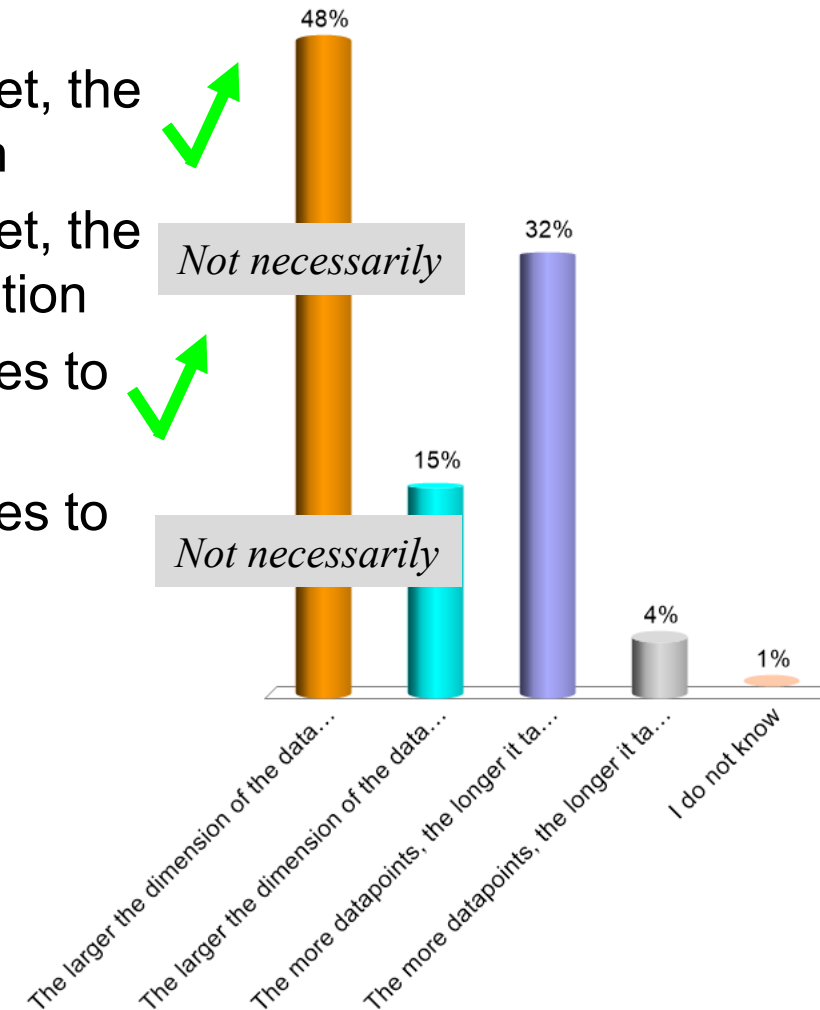
True labels

Lack of ground truth and lack of clear separation can lead to erroneous grouping

What is the curse of dimensionality?

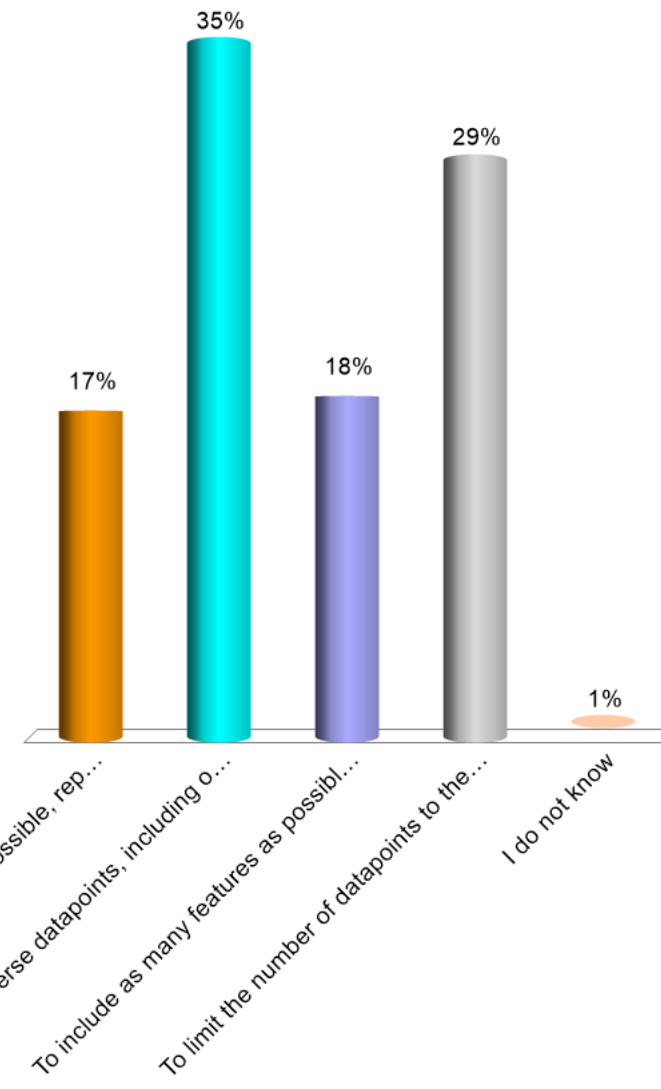
- A. The larger the dimension of the dataset, the longer it takes to compute the solution
- B. The larger the dimension of the dataset, the more difficult it is to find a correct solution
- C. The more datapoints, the longer it takes to compute the solution.
- D. The more datapoints, the longer it takes to gather the dataset.
- E. I do not know

2 correct answers



When you select your dataset, what should you pay attention to?

- A. To have as many data as possible, representative of the group you care most about.
- B. To have diverse datapoints, including outliers.
- C. To include as many features as possible about your dataset.
- D. To limit the number of datapoints to the memory and maximal resources of your system.
- E. I do not know



Multiple answers possible

When you select your dataset, what should you pay attention to?

- A. To have as many data as possible, representative of the group you care most about.
- B. To have diverse datapoints, including outliers.
- C. To include as many features as possible about your dataset.
- D. To limit the number of datapoints to the memory and maximal resources of your system.
- E. I do not know

A. Yes, have balanced classes!
To distinguish this group from the rest (face vs. no face).

B. Yes, but take the proportion of outliers into account when computing performance

C. Not if some features are really known to be irrelevant. The more features, the more data required

D. Yes, if you care about real-world applications on embedded platforms. No, if you can increase your computer resources.

TODO LIST BEFORE NEXT CLASS

❖ **Go to moodle:**

- 1: Watch the videos of this lecture (*40 minutes*)
- 2: Do the quiz (*2-3 min*)

- 3: Watch the video of the next lecture on PCA (*40 minutes*)
- 4: Do the quiz (*2-3 min*)

❖ **Install software:**

- Turning point
- Discord
- Mldemos