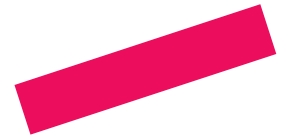


EMBEDDED VISION DESIGN 3

MACHINE LEARNING & DEEP LEARNING

JEROEN VEEN

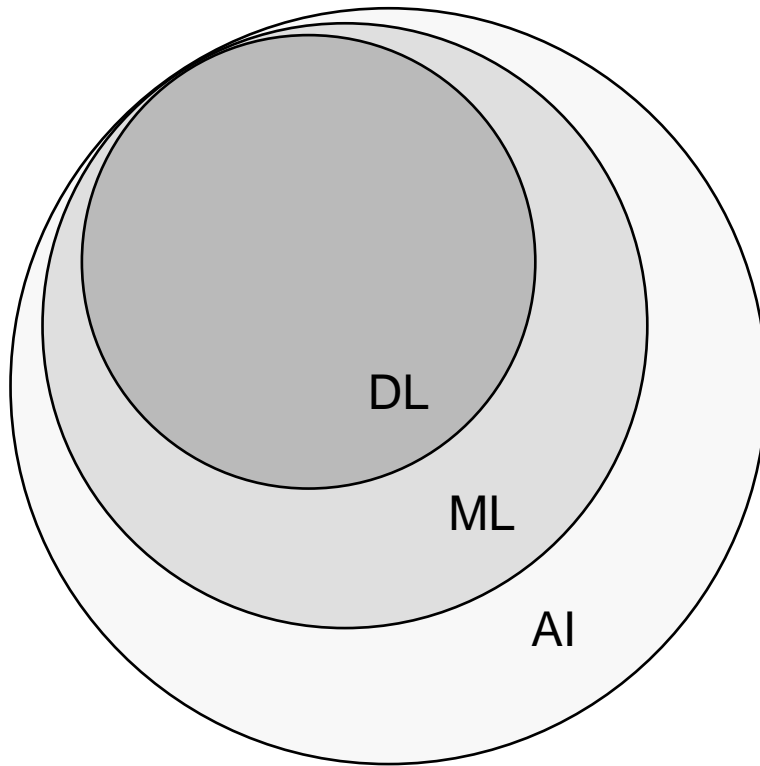


HAN_UNIVERSITY
OF APPLIED SCIENCES

CONTENTS

- Introduction
- Organization
- Why machine learning?
- Machine learning approaches
- Learning pipeline

DEFINING AI, DL & ML




- Strong AI vs Applied AI
- Cognitive replication
- Rational process

Machine learning

- Performs predictive analysis
- Just fancy math & pattern matching

APPLICATIONS

padlet



jeroen veen • een minuut

EVD3

Applications of machine vision and learning

Self-driving vehicles

taken from Tesla's autopilot





Image generation

taken from Google's Deep Lucid Dreaming

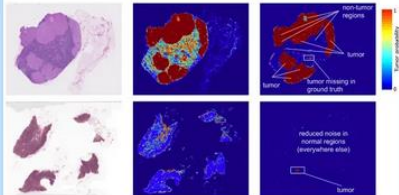


Automatically image captioning

taken from IBM's Adversarial Semantic Alignment for Improved Image Caption

Computer aided oncology

taken from Google's deep learning tumor prediction heat maps



Neural Style Transfer

taken from "A Neural Algorithm of Artistic Style"




Image Detection and Classification

taken from "Photo Colorization"





Photo Colorization

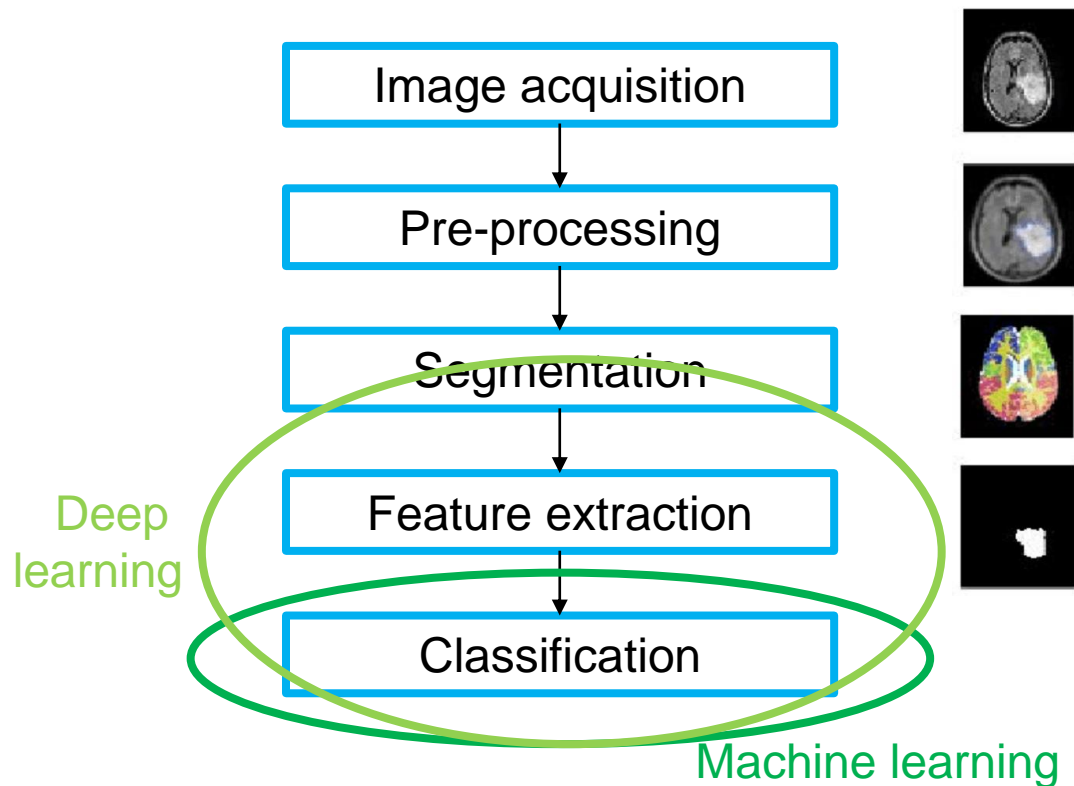
taken from "Photo Colorization"



https://padlet.com/jeroen_veen/zul8z8tbvhqpvb8t

MACHINE LEARNING APPLIED TO VISION

- Classical image processing



APPLES AND ORANGES

- <https://www.youtube.com/watch?v=cKxRvEZd3Mw&feature=youtu.be>

Weight	Texture	Label
150 g	Bumpy	Orange
170g	Bumpy	Orange
140g	Smooth	Apple
130g	Smooth	Apple
...

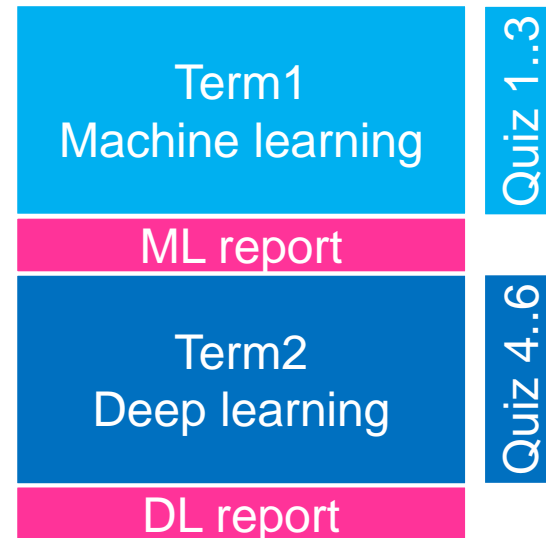
examples

features

labels

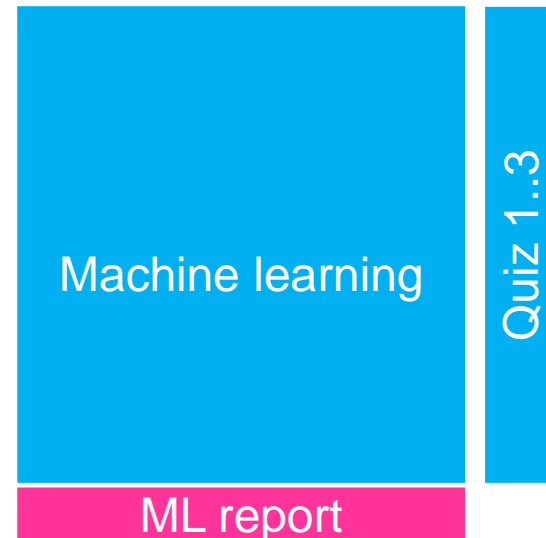
ORGANIZATION OF THE WORKSHOP (VT)

- Theory with integrated quizzes.
- Hands-on with 2 mini-projects
- Final mark:
80% ML + DL report,
20% quiz results
- Schedule on MS Teams



ORGANIZATION OF THE WORKSHOP (DT)

- Theory with integrated quizzes.
- Hands-on with mini-project
- Final mark:
80% ML report,
20% quiz results
- Live demo or short clip,
showing your deployed model



QUIZ

- Individual, multiple choice questions
- Online: <http://www.socrative.com> room **1PTGB6PY**
- Open book quiz, so books and slides can be consulted
- **HAN student number**, so NOT your name, nickname or anything else.
- Quiz starts exactly at class hour and takes 10 minutes.
- Be on time and have your equipment prepared.
- During the quiz: no entering or leaving the classroom, and silence

QUIZ EXAMPLE

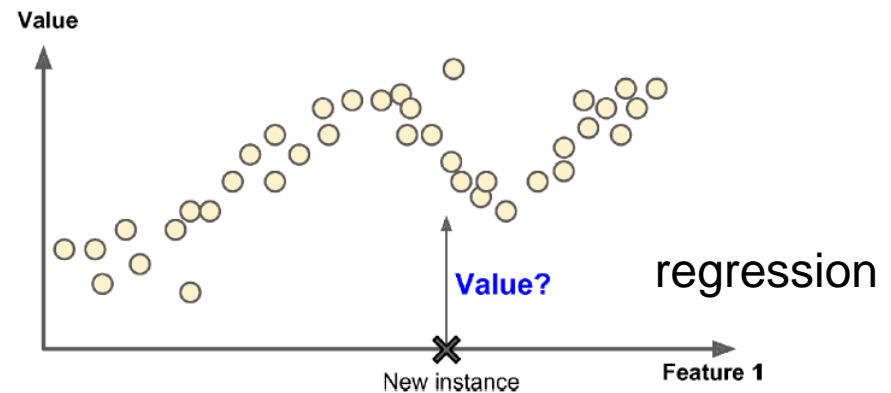
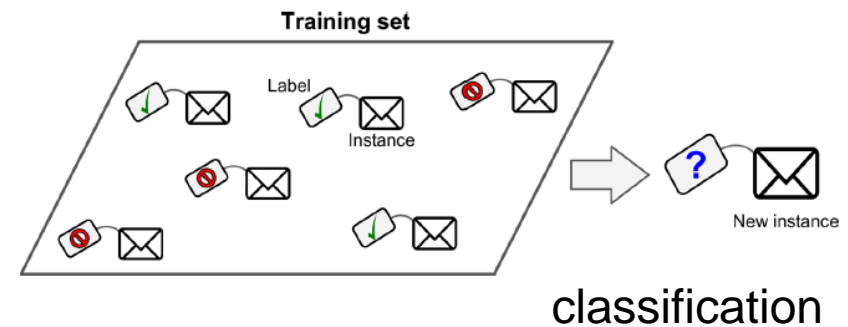
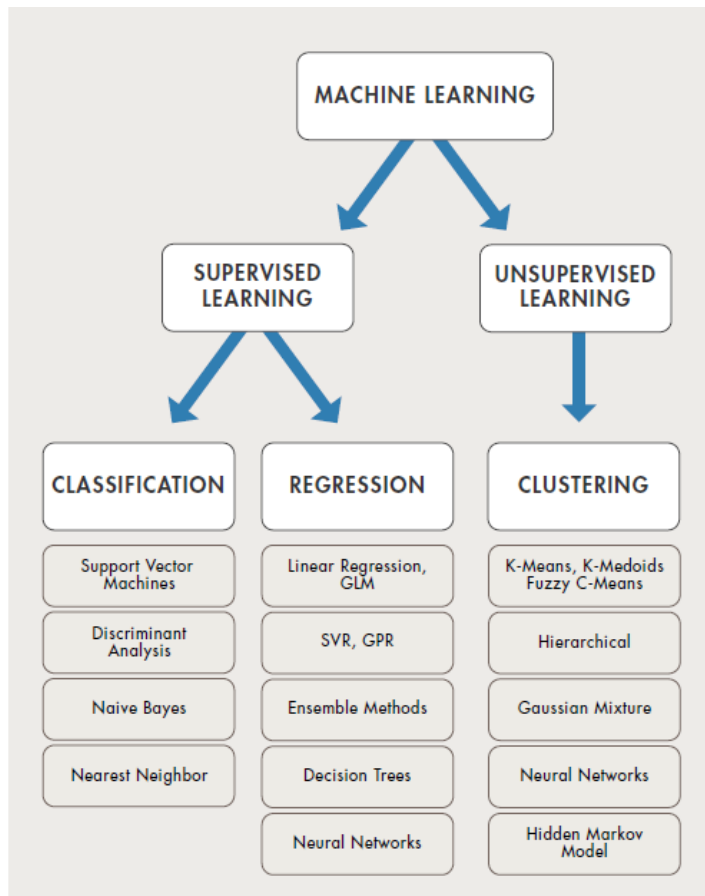
<https://b.socrative.com/>

Room code: **1PTGB6PY**

EVD3 ASSIGNMENTS

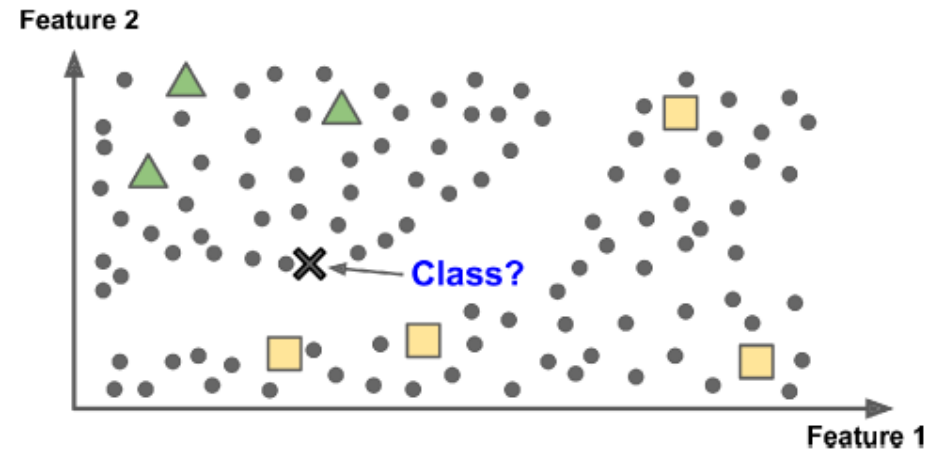
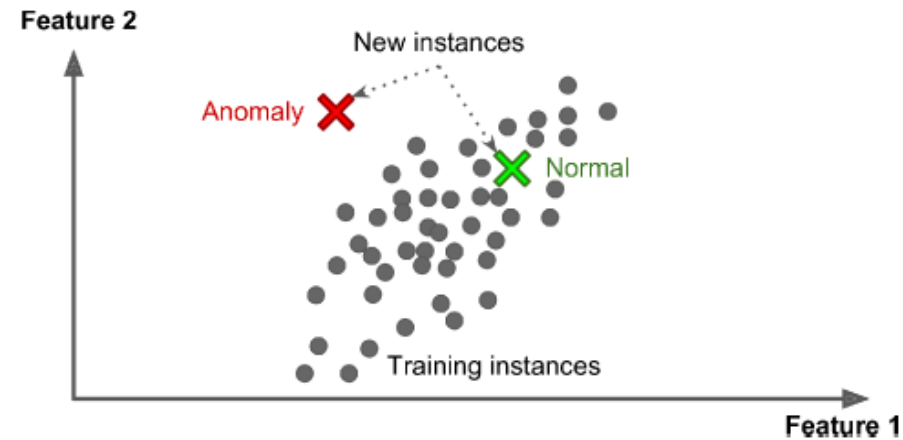
- A project team will consist of 3 students.
- Portfolio building using template
- Deliver intermediate results via HandIN
- Template and schedule on MS Teams

MACHINE LEARNING APPROACHES



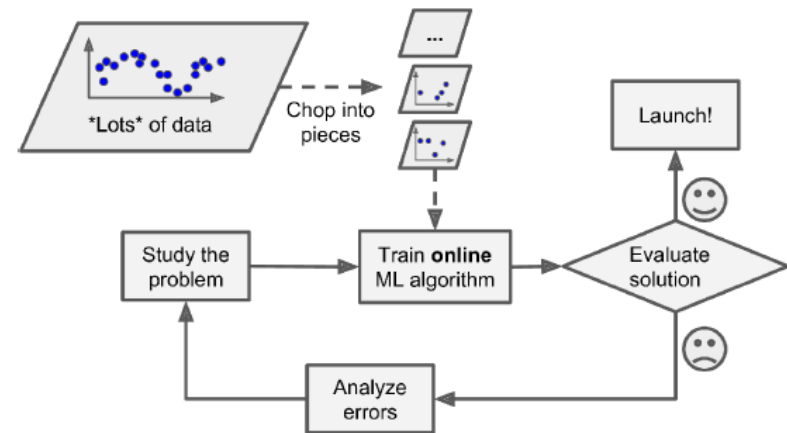
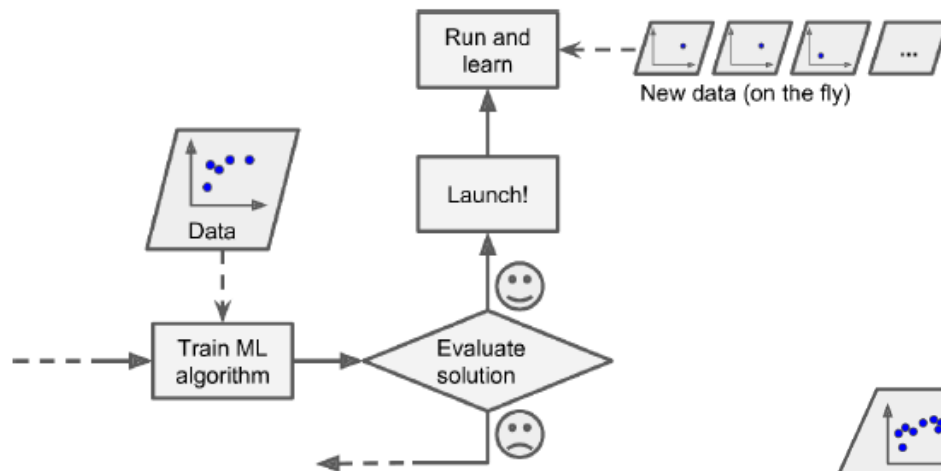
Source: Géron, ISBN: 9781492032632

UNSUPERVISED AND SEMI-SUPERVISED LEARNING



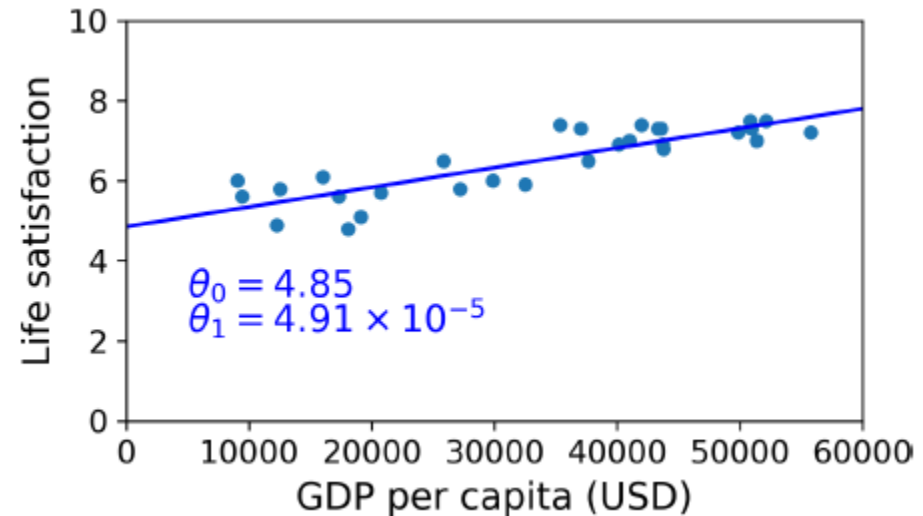
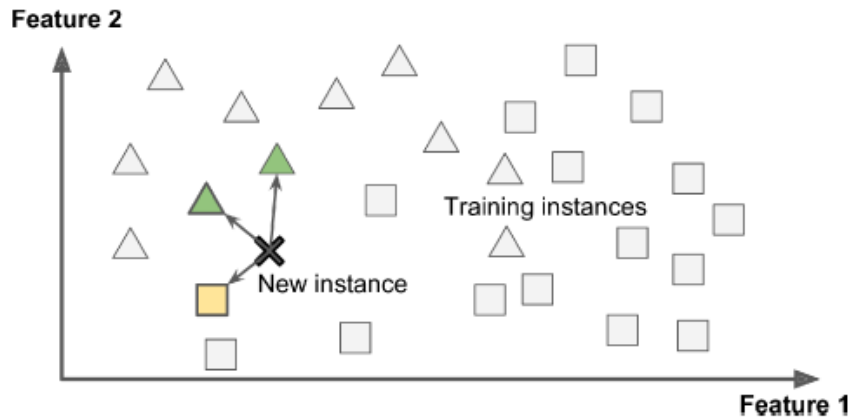
Source: Géron, ISBN: 9781492032632

BATCH VS ONLINE LEARNING



Source: Géron, ISBN: 9781492032632

INSTANCE-BASED VERSUS MODEL-BASED LEARNING



Source: Géron, ISBN: 9781492032632

ML PITFALLS

- Massive amounts of training data is needed
- Labelling is tedious and error prone
- No relationship exists between input and output
- Solution is not transparent
- Solution fails to generalize
- Bias

WORKFLOW

Deep Learning and Machine Learning in the Design Engineering Workflow

Images, video, sound, vibration, etc.;
real data and data synthesized from
simulation

Access Data



Sensors



Files



Databases

Feature engineering for machine learning;
domain-specific signal preprocessing

Analyze Data



Data
exploration



Preprocessing



Domain-specific
algorithms

Deep learning and machine learning
algorithms; statistical methods

Develop



AI model



Algorithm
development



Modeling and
simulation

Learning algorithms deployed for
inference

Deploy



Desktop apps

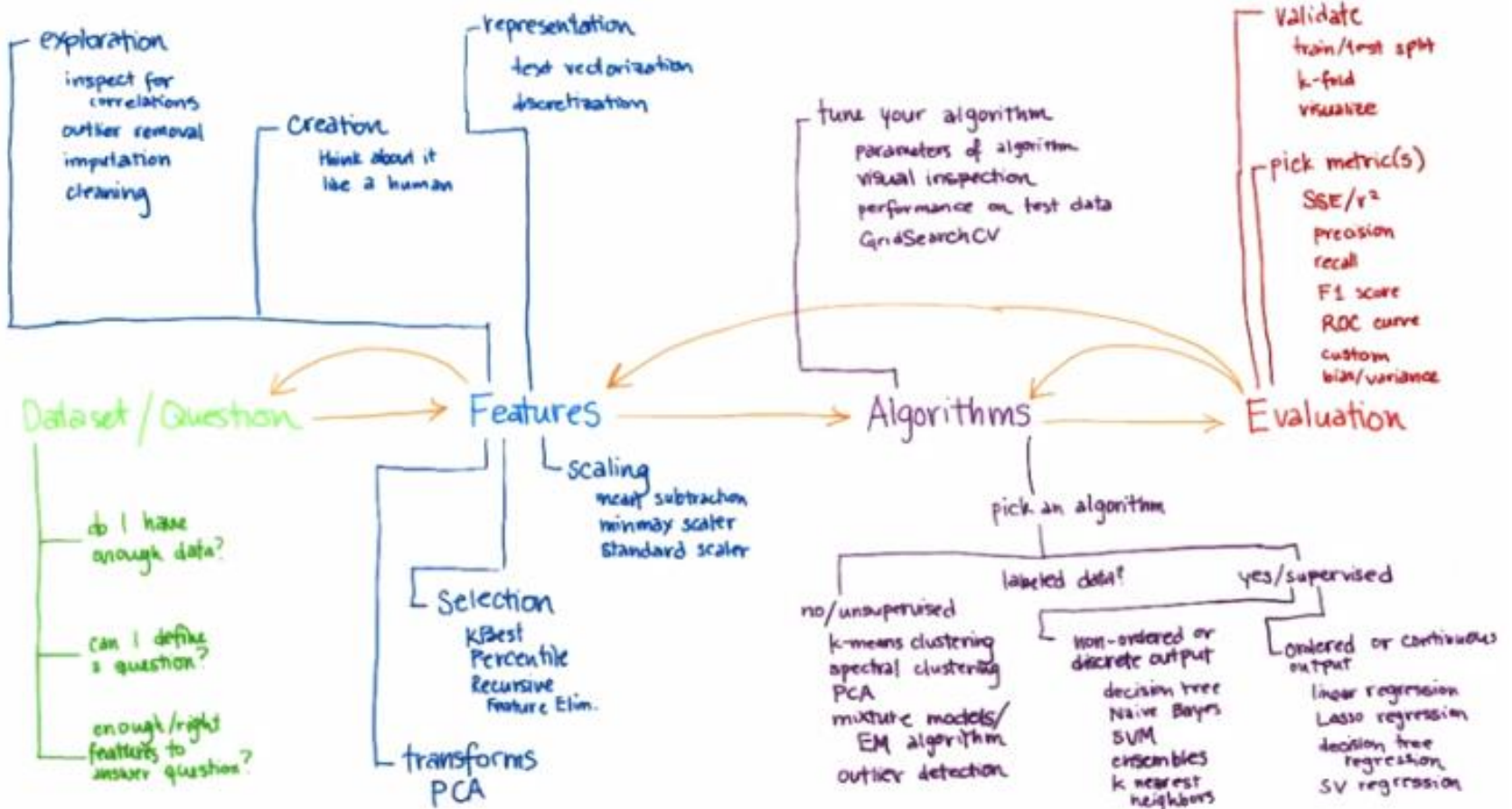


Enterprise
systems



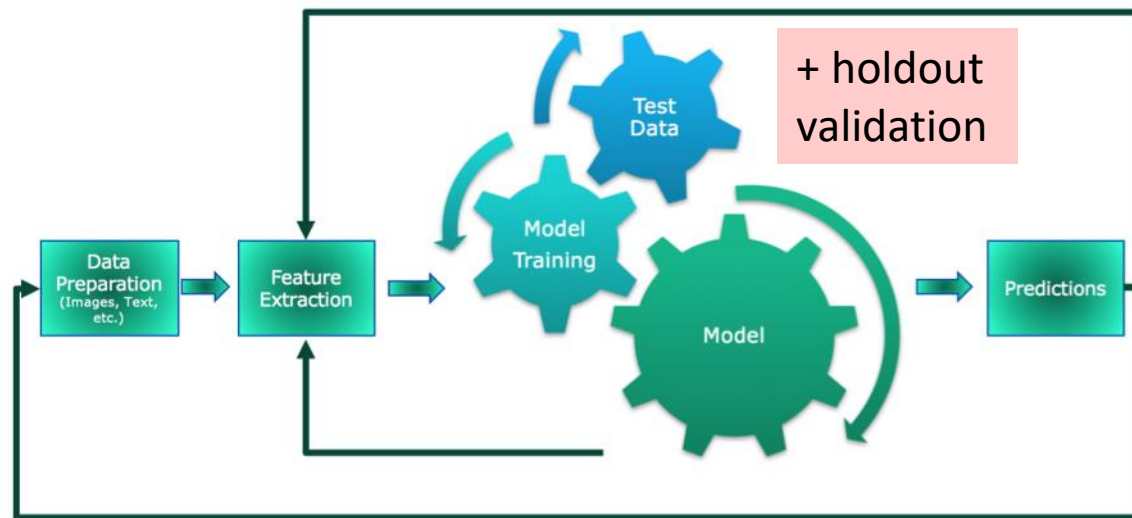
Embedded
devices

WORK FLOW



AUTOMATE MACHINE LEARNING WORKFLOW

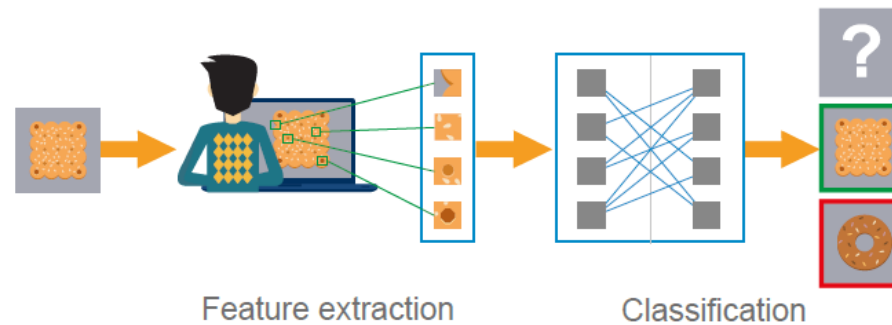
A Standard Machine Learning Pipeline



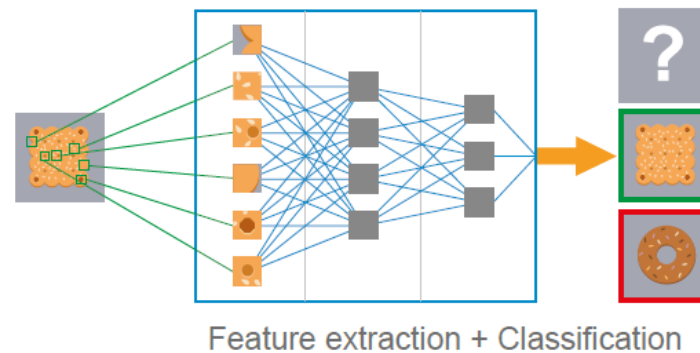
Source: Western Digital

MACHINE LEARNING VS DEEP LEARNING

Machine Learning



Deep Learning



Source: Basler, Artificial Intelligence in Image Processing

ETHICS

- Self-adjustment can go horribly wrong
- Think of 'sampling bias', 'exclusion bias' and 'prejudice bias'
- Context matters
- Transparency is becoming important
General Data Protection Regulation (GDPR)
- **It is vital that developers take responsibility!**

Uber drivers to launch legal bid to uncover app's algorithm

Union wants ride-sharing firm to increase transparency and disclose how data is used



OVERCOMING THE HYPE

- DL is not mature tech, lots of issues, constantly changing
- Not the only way of analysis and not the best
- E.g. self-driving cars combine with expert system
- You need sufficient and reliable data

	TECHNIQUE	DESCRIPTION
Anomaly Detection	Dynamic z-scores	Standard distribution measures are calculated for a given data set and uses a dynamic z-score threshold to detect anomalies
Leading/Lagging Indicators	Cross correlation	Measures with shared time series dimensions are analyzed to identify the time shift with the greatest correlation
Trend Lines	Regression analysis	Best fit line for time series data is estimated, and picks out the positive and negative trends that stand out the most
Data Segmentation	K-means clustering	Data points are recursively separated into logical groupings based on a set of local means

COMING UP - DATA

Weight	Texture	Label
150 g	Bumpy	Orange
170g	Bumpy	Orange
140g	Smooth	Apple
130g	Smooth	Apple
...

examples

features

labels

Pls read
theory before
next class

- Sampling noise, do you have sufficient data?
- Sampling bias, is your data representative?
- Data mismatch, is your data reliable?