University of Amsterdam
Informatics Institute

AMLAB
Amsterdam
Machine Learning Lab

Machine Learning 1

Lecture 1.3 - Types of Machine Learning

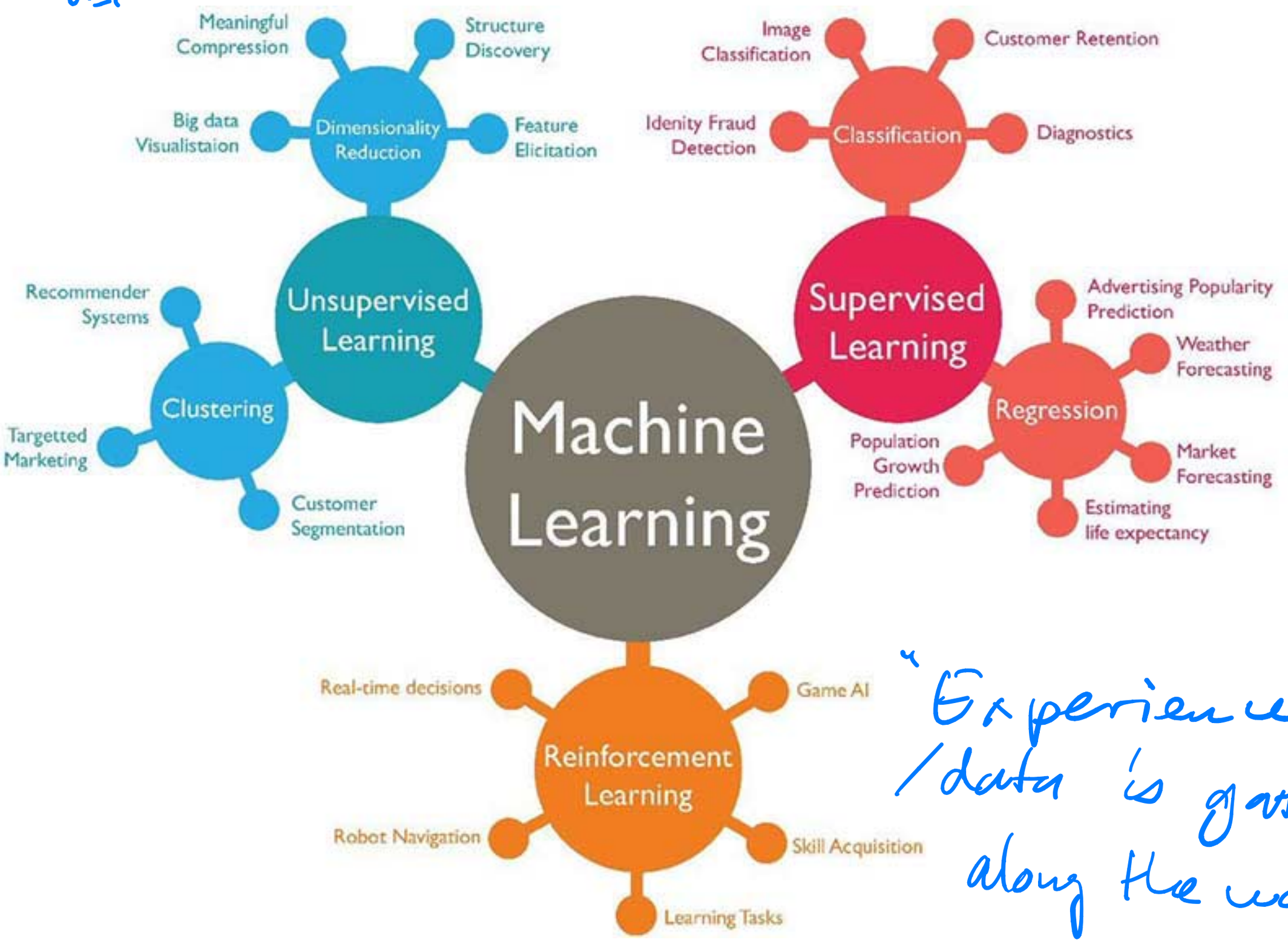
Erik Bekkers

(Bishop 1.0 and 1.1)

Slide credits: Patrick Forré and Rianne van den Berg

Image credit: Kirillm | Getty Images

$\{x_i\}_{i=1}^N$ $\{x_i\}_{i=1}^N$ $\{t_i\}_{i=1}^N$



"Experience" / data is gathered along the way

Image source : www.techleer.com

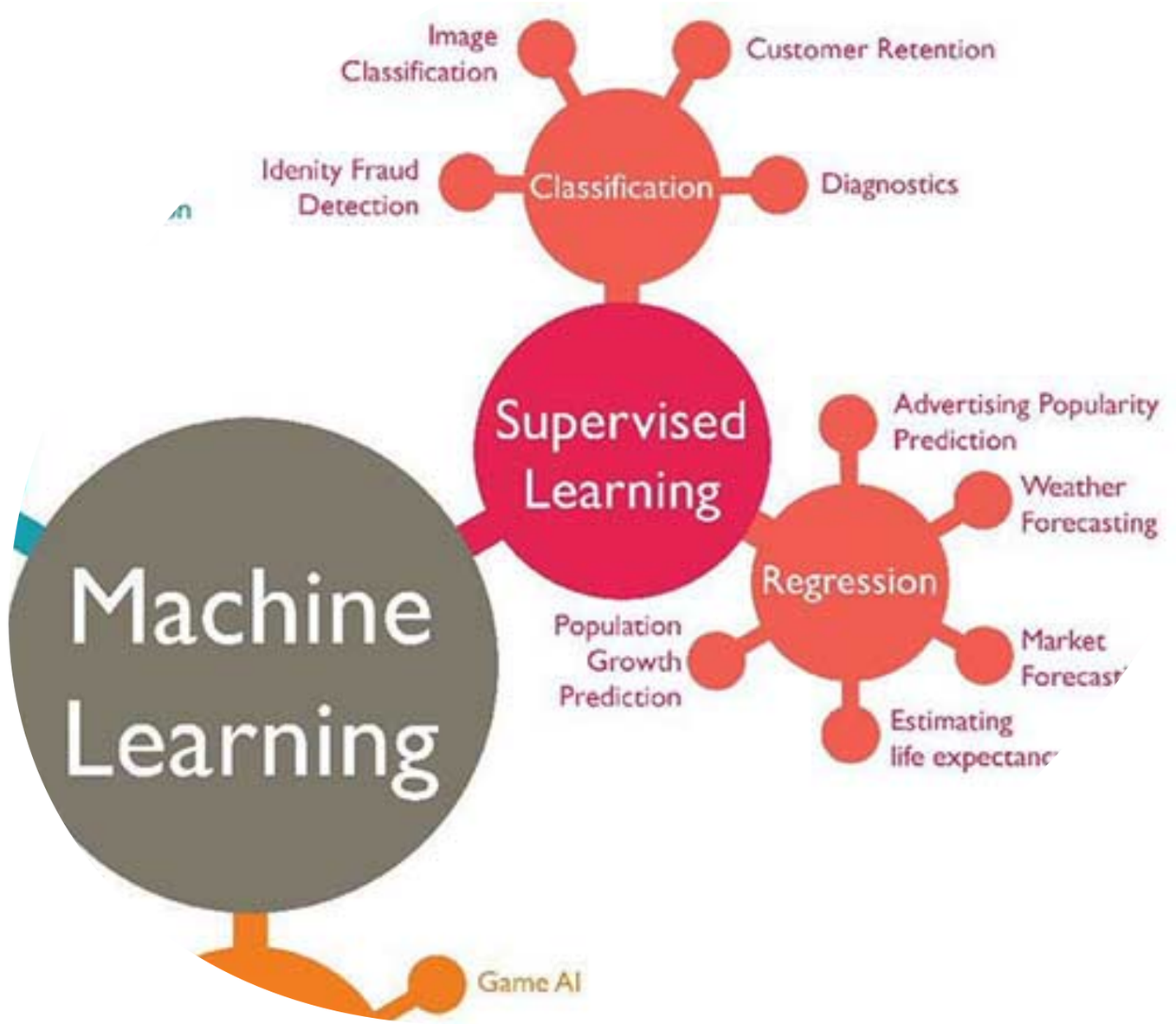
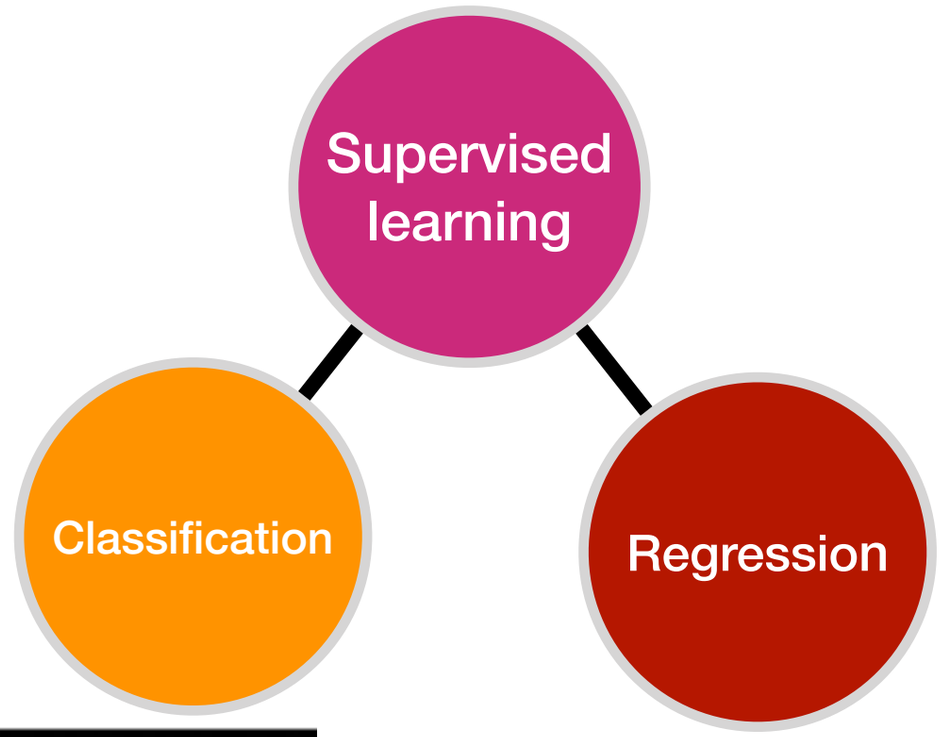
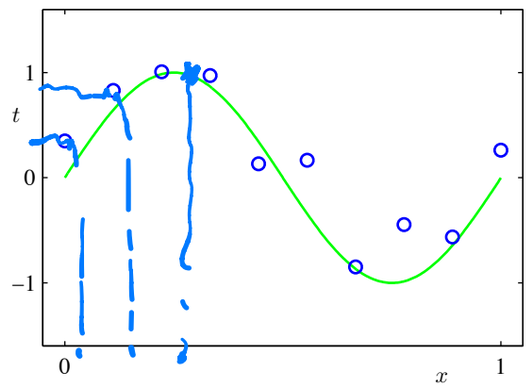


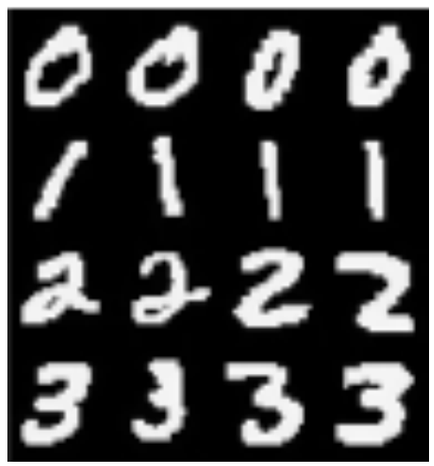
Image source : www.techleer.com

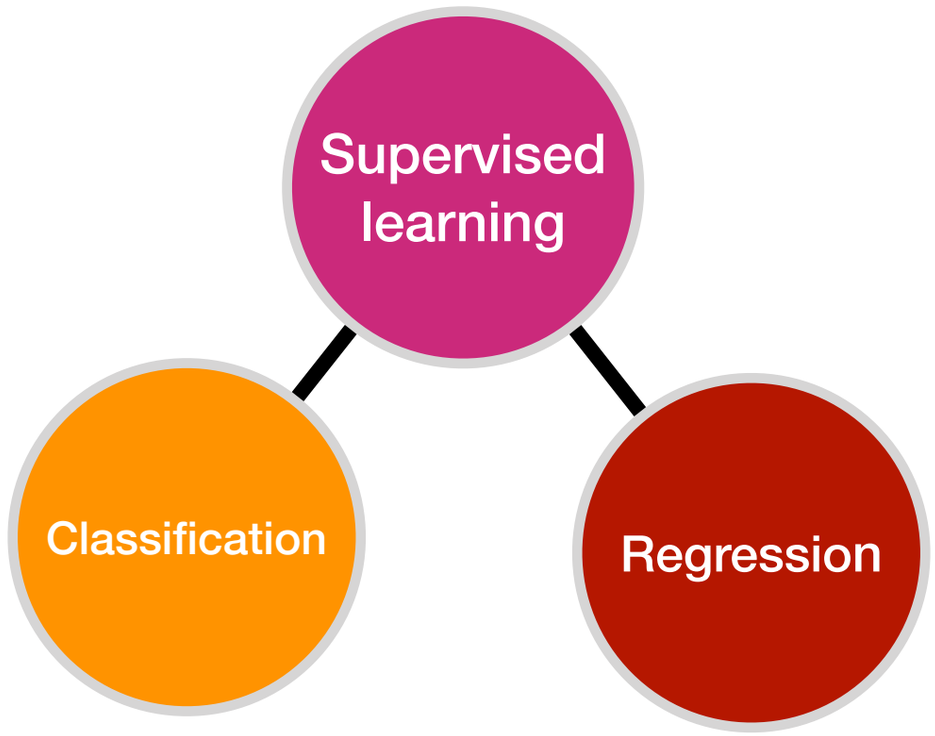
Supervised learning

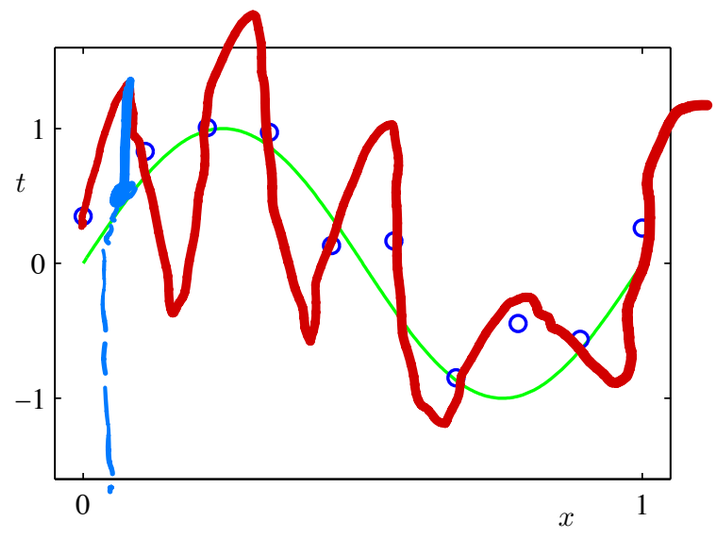


Dataset		
features: $\{\mathbf{x}_1, \ldots, \mathbf{x}_N\}$	**x =** 	**x = 0.25**
targets: $\{t_1, \ldots, t_N\}$	**t = 2**	**t = 0.707**
	discrete	continuous

Supervised learning

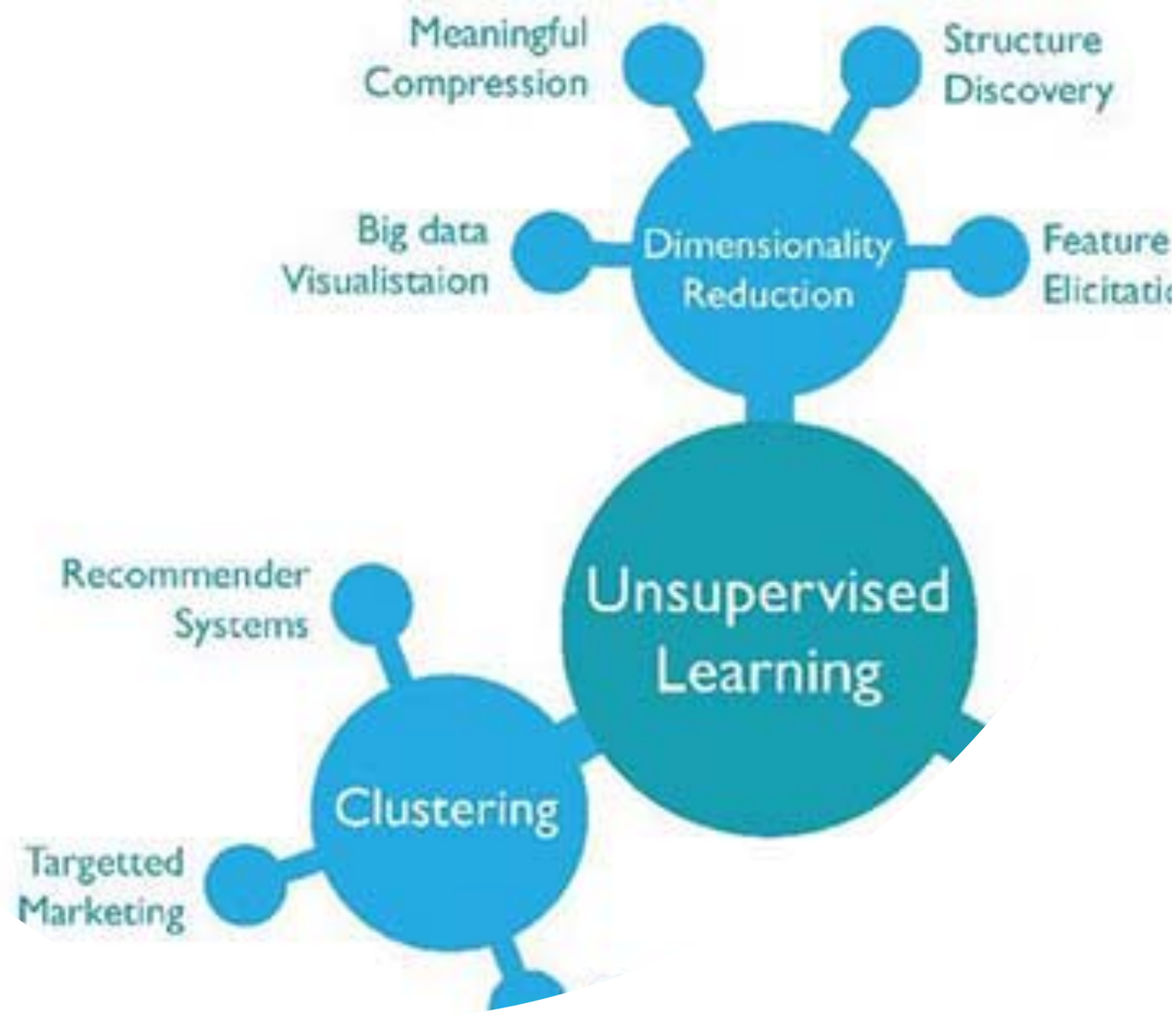




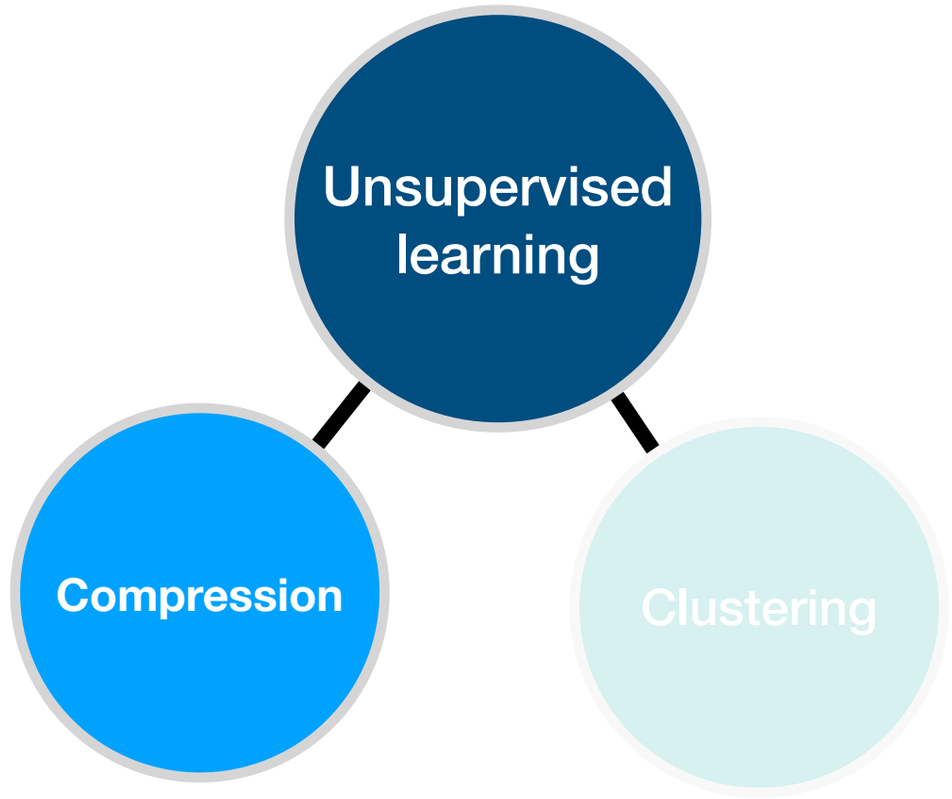


Task: Find function f such that f(**x**) ≈ t for all known and unknown (**x**, t)

generalization

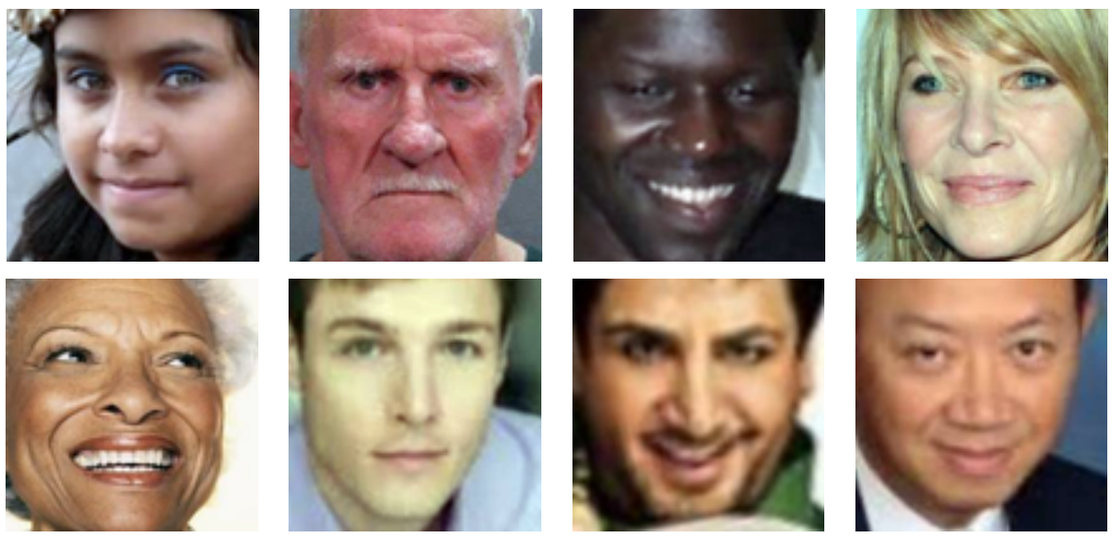

Meaningful
Compression
Structure
Discovery
Big data
Visualistaion
Dimensionality
Reduction
Feature
Elicitatio
Unsupervised
Learning
Recommender
Systems
Clustering
Targetted
Marketing

Unsupervised learning



100 x 108

Dataset:



...

Task: Compression

why ? Save on disk space

Unsupervised learning

Dataset: 100×100=10,000

Task: Compress image

Method: Expand along principle components (PCA) ~ Ch 12

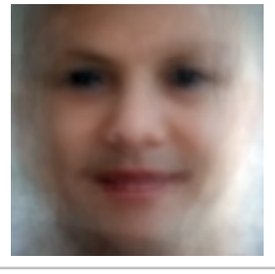
Result:

Save M=150 & coefficients

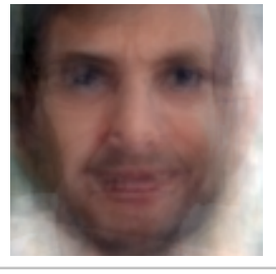
Original

$$\approx \sum_{i=1}^{M} \alpha_i \mu_i$$

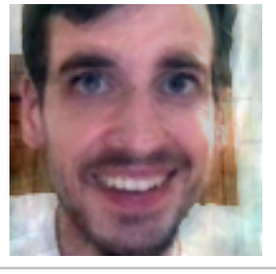
M=1



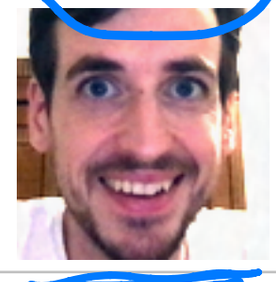
M=10



M=50

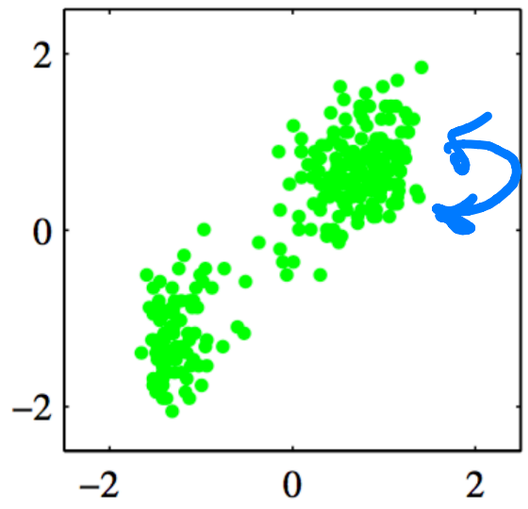


M=150

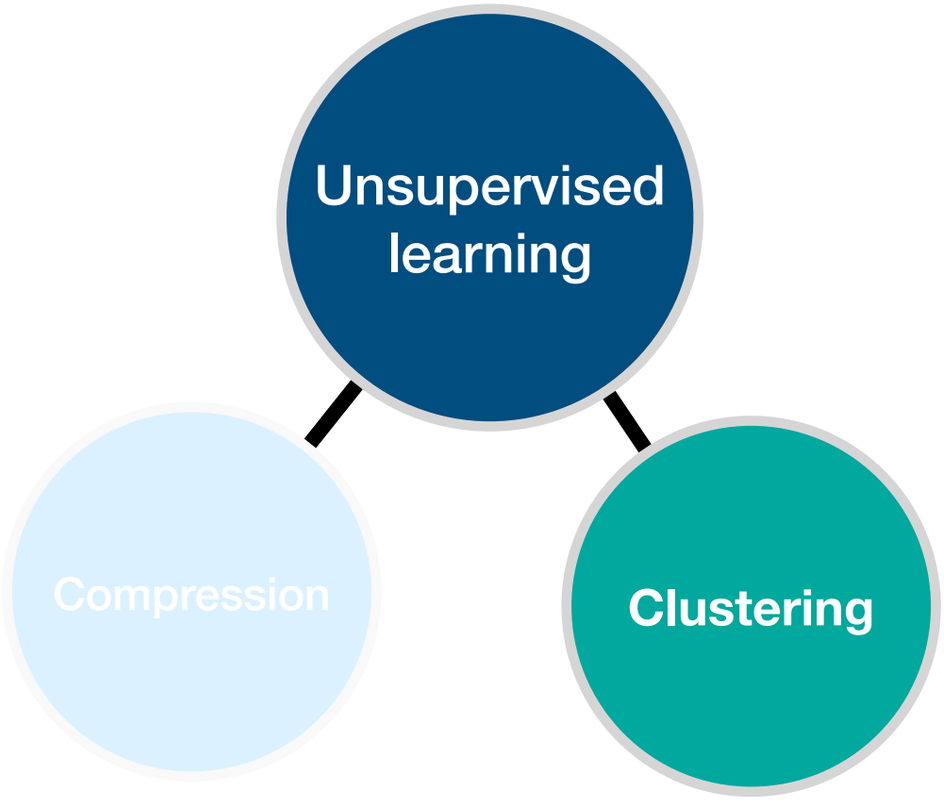


Unsupervised learning

Dataset:

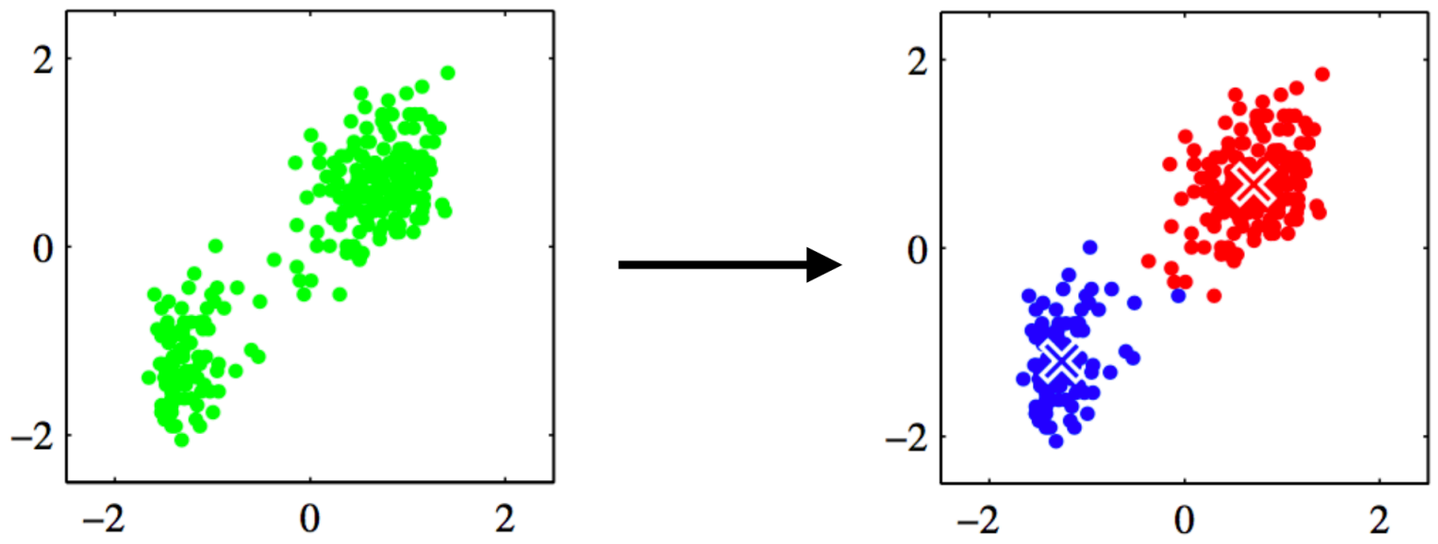


similar



Task: Assign every datapoint to a cluster (hidden class variable)

Result:



Dataset

Final clustering

Other types of learning

Semi-supervised learning

- data points: $\{x_1, \ldots, x_n\}$
- targets: $\{t_1, \ldots, t_k\}$ (k<n)

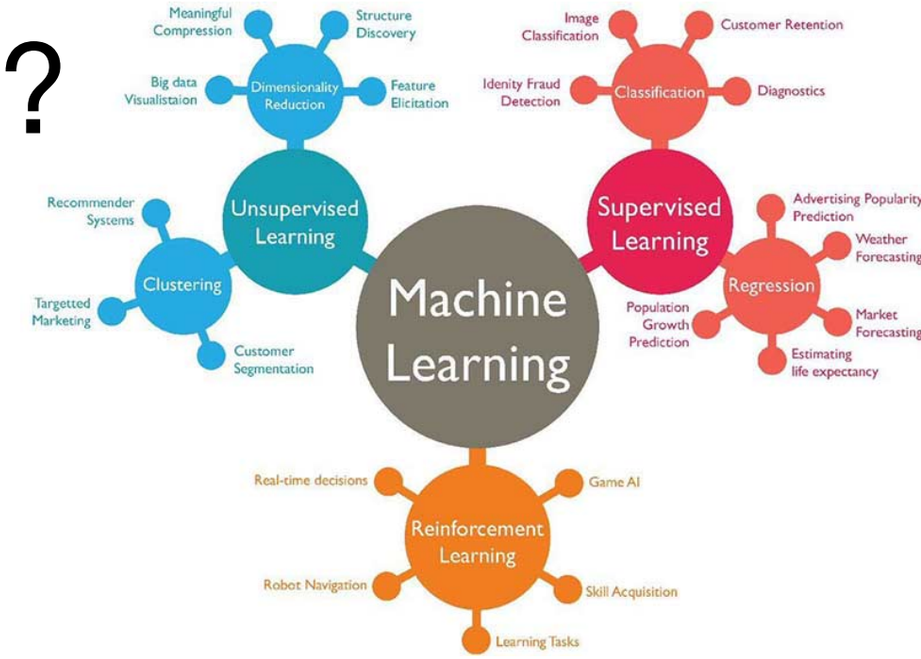
- Not all datapoints have a known target/label!
- Use all data, also those with unknown target, to create predictor.

Other types of learning

Reinforcement Learning

- Dynamic environment: provides information on its state.
- Agent: takes actions, receives rewards from environment.
- Task: maximize total reward
- Learning by trial and error
- Application: Games
  Robotics

What is machine learning?



"A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P if its performance at tasks in T, as measured by P, improves with experience E."

- Tom M. Mitchell

Machine Learning, Tom Mitchell, McGraw Hill, 1997