SWIFT
SHENZHEN UNIVERSITY WEBANK INSTITUTE OF FINTECH
深大微众金融科技学院

Chapter 1: Introduction

# Artificial Intelligence and Machine Learning

# Instructor

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Currently, Max is working as a Senior Data Scientist at BCG. He obtained PhD in Machine Learning for Robotics Vision from Monash University, MSc from Imperial College London, and BEng from Huazhong University of Science and Technology.

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# Evaluation

30% Assignment

30% Mid-term exam

40% Final project

# Source materials

Artificial Intelligence - A Modern Approach / Stuart Russell and Peter Norvig
http://aima.cs.berkeley.edu/

Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems/ Aurélien Géron

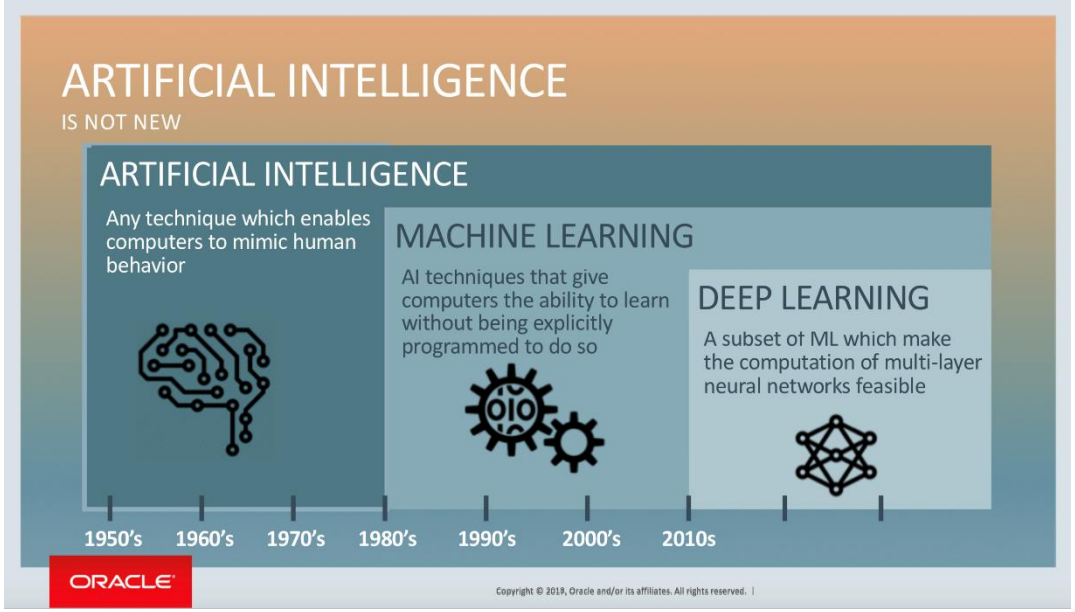
Python Data Science Handbook
https://jakevdp.github.io/PythonDataScienceHandbook/

# Syllabus

Week 1: Intro
Week 2: Intelligent Agents and Problem Solving  (Basic AI logic)
Week 3: Supervised ML (1)
Week 4: Supervised ML (2)
Week 5: Supervised ML (3)
Week 6: Unsupervised ML
Week 7: Validation, evaluation, and hyperparameter tuning
Week 8: Deep learning (1)
Week 9: Deep learning (2)
Week 10: Industrial applications
Week 11: Summary and final project

# What is AI, ML, DL, and their relationships?

**AI** means getting a computer to mimic human behavior in some way.
**Machine learning** is a subset of AI, and it consists of the techniques that enable computers to figure things out from the data and deliver AI applications.
**Deep learning**, meanwhile, is a subset of machine learning that enables computers to solve more complex problems.



# What are the main domains in AI?

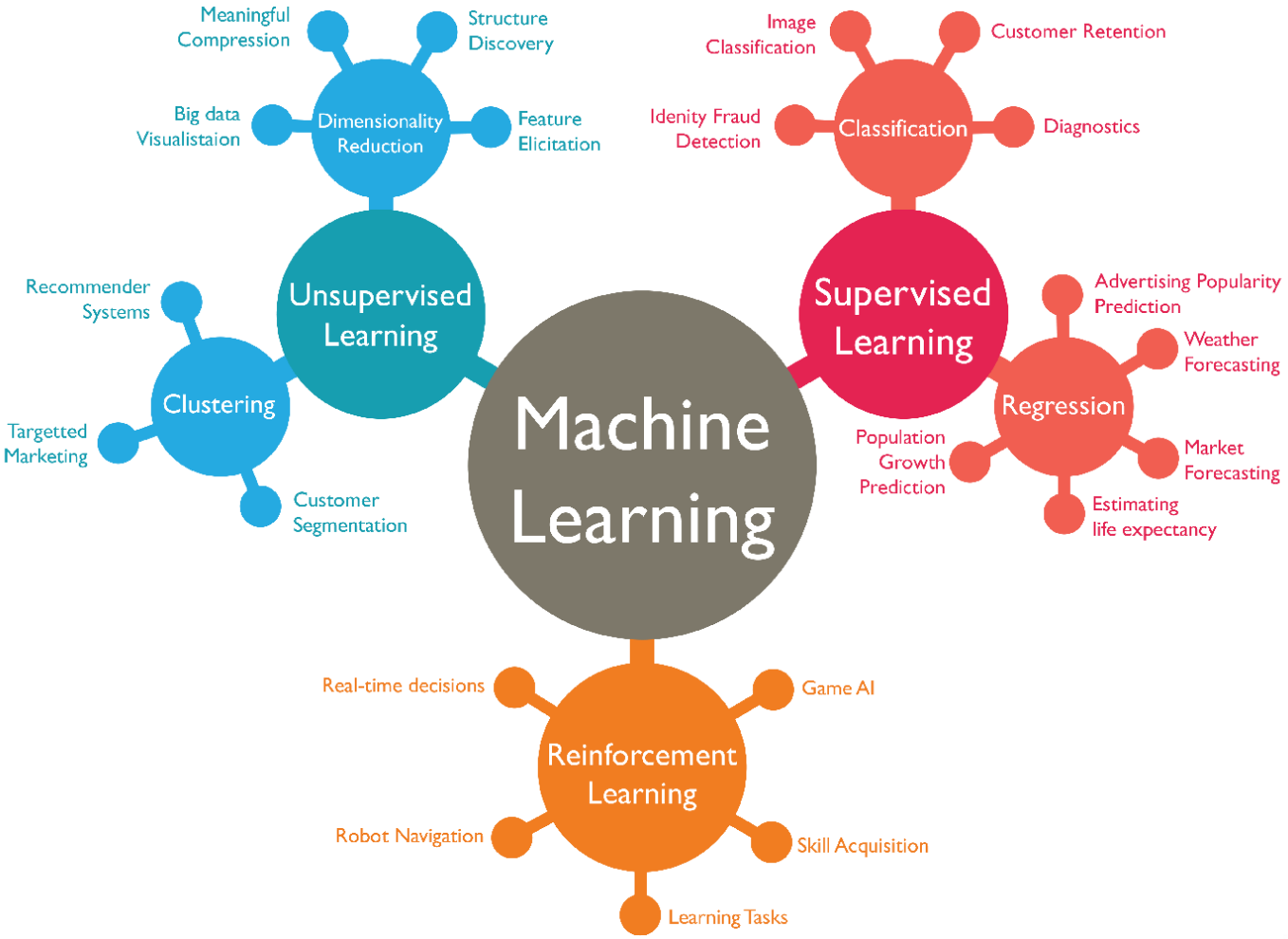
Searching

Planning

Learning

...

# What are the main domains in ML?



# Supervised learning

$$y = f(x)$$

We know y and x, but we don't know f().

We try to identify the "best" f() which can match between x and y

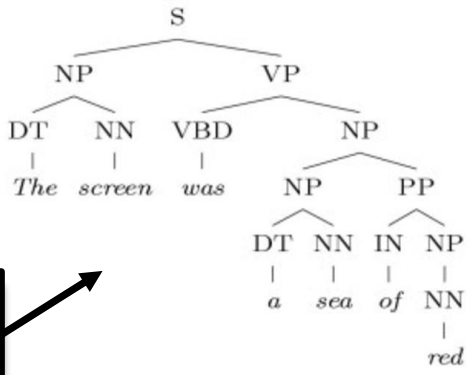
# Supervised Learning Examples

Classification → cat

Face Detection →

The screen was a sea of red

Language Parsing →

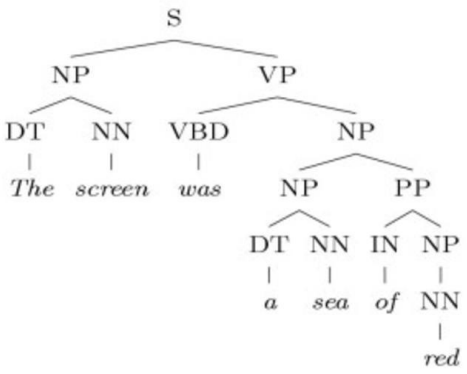



Structured Prediction

# Supervised Learning Examples

cat $= f($  $)$

$= f($  $)$

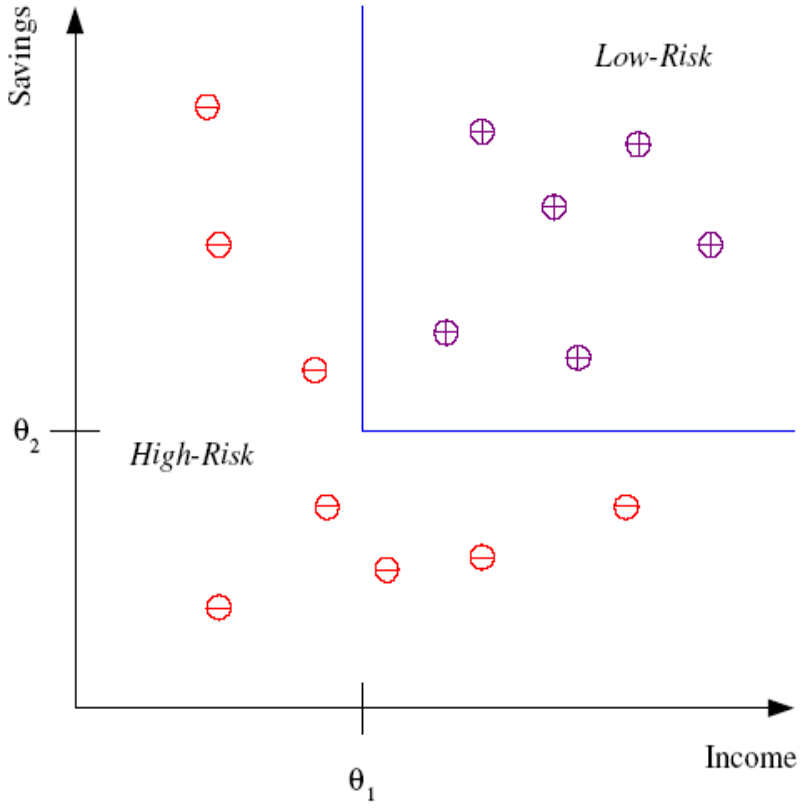



$= f($ The screen was a sea of red $)$

# Classification

Example: Credit scoring

Differentiating between low-risk and high-risk customers from their *income* and *savings*



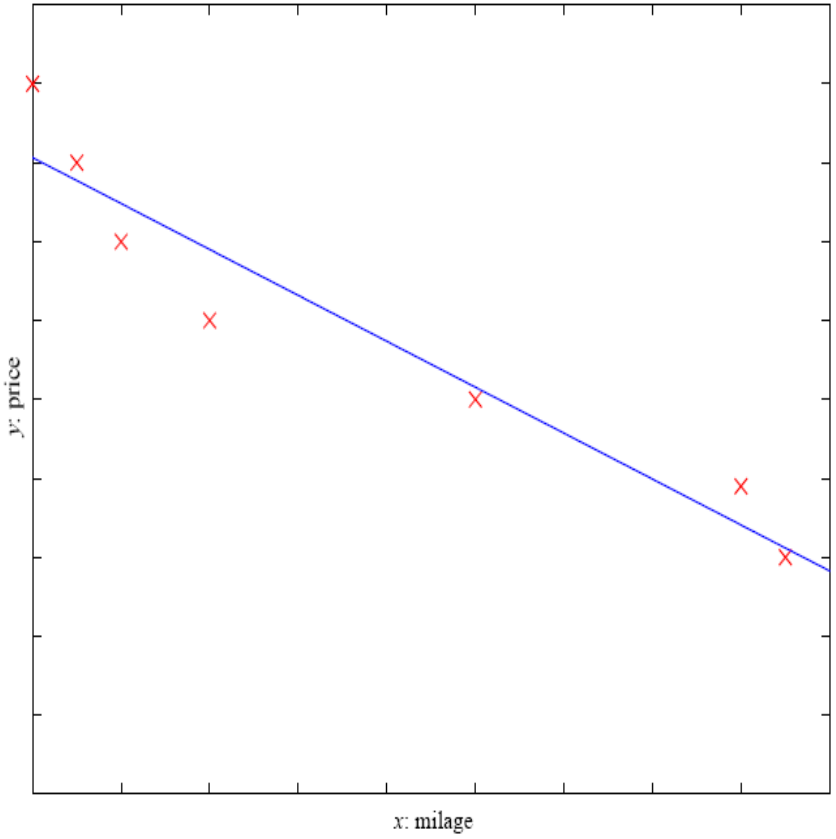

Discriminant: IF *income* > $\theta_1$ AND *savings* > $\theta_2$
THEN low-risk ELSE high-risk

# Regression

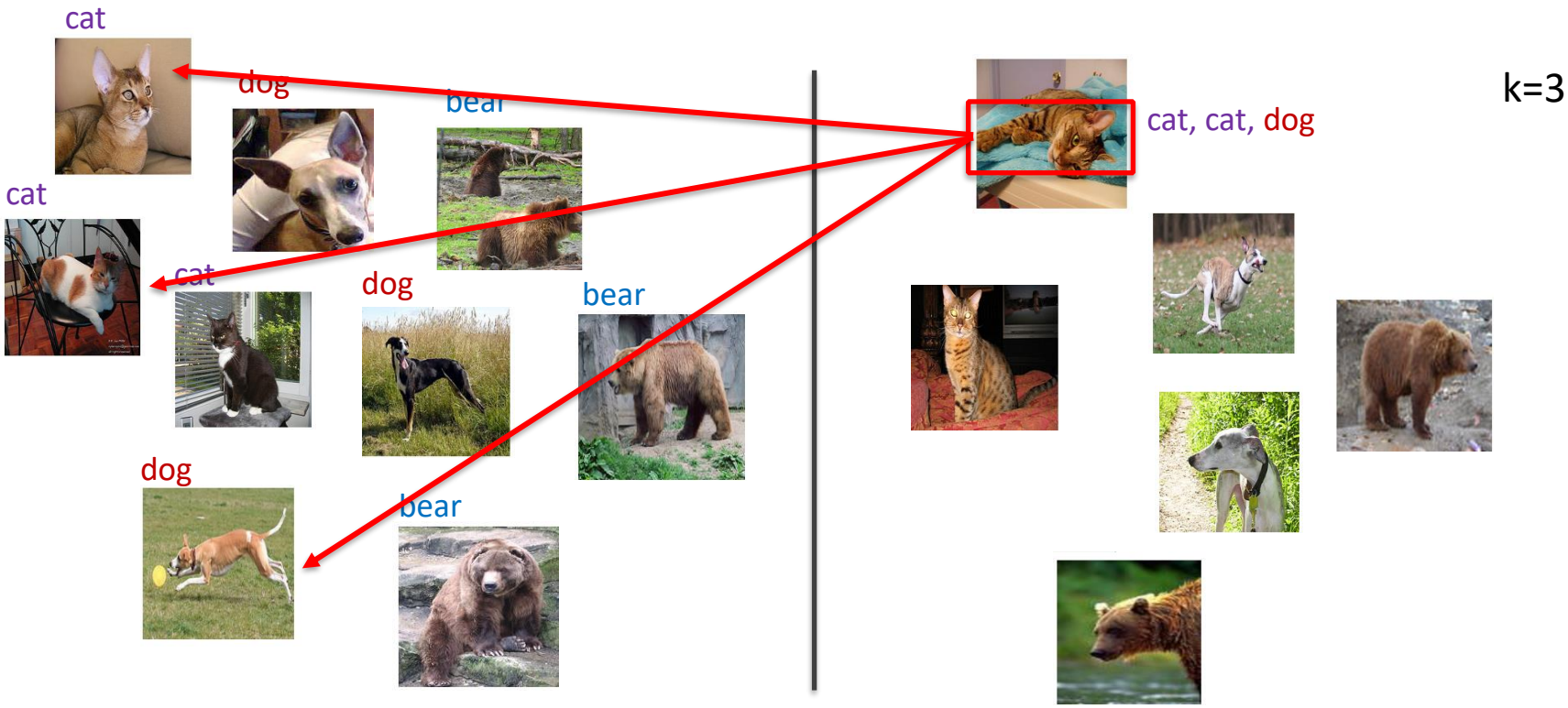
Example: Price of a used car
x : car attributes
y : price

$y = g(x \mid q)$

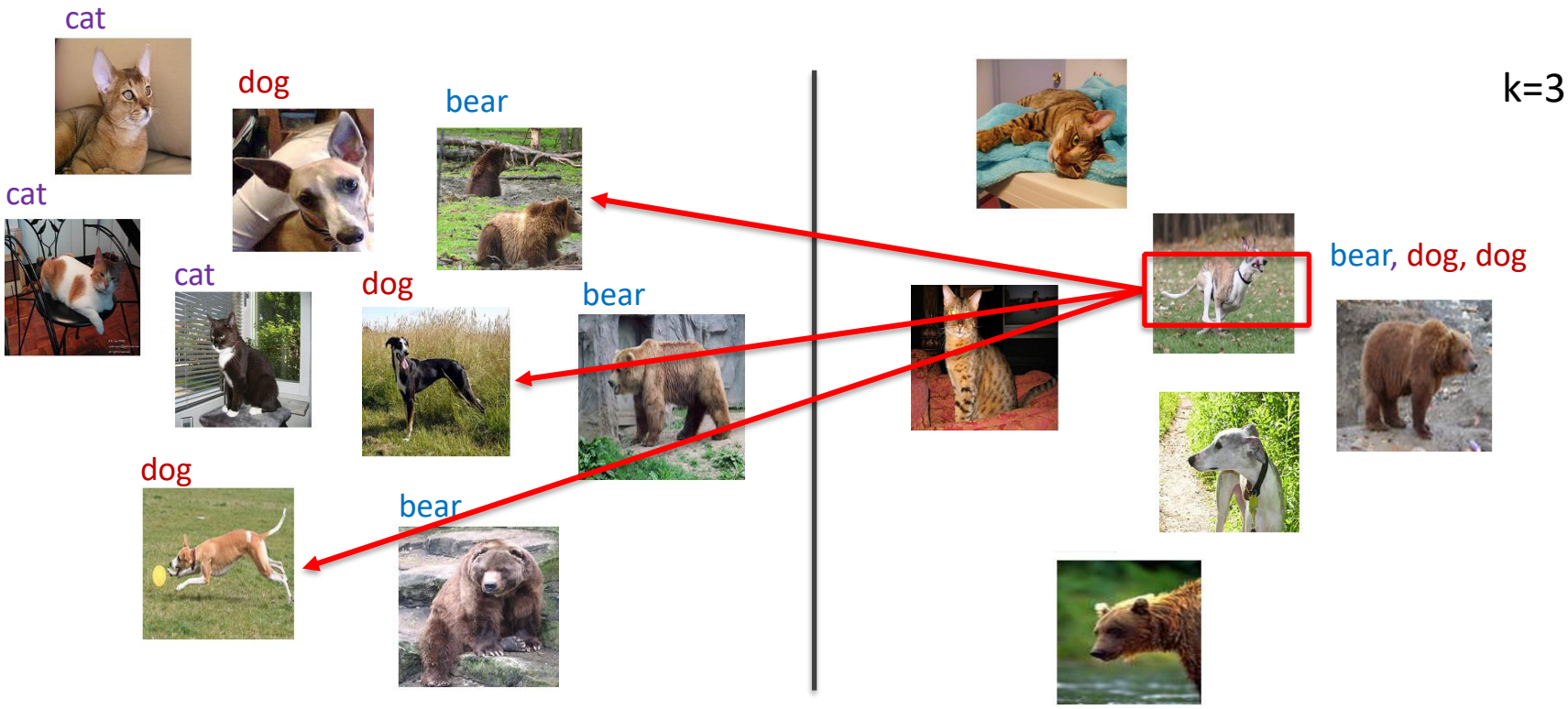
g ( ) model, q parameters



# Supervised Learning – k-Nearest Neighbors



# Supervised Learning – k-Nearest Neighbors



Supervised Learning – k-Nearest Neighbors

- How do we choose the right K?
- How do we choose the right features?
- How do we choose the right distance metric?

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Answer: Just choose the one combination that works best!
**BUT** not on the test data.

Instead split the training data into a ”Training set” and a ”Validation set” (also called ”Development set”)

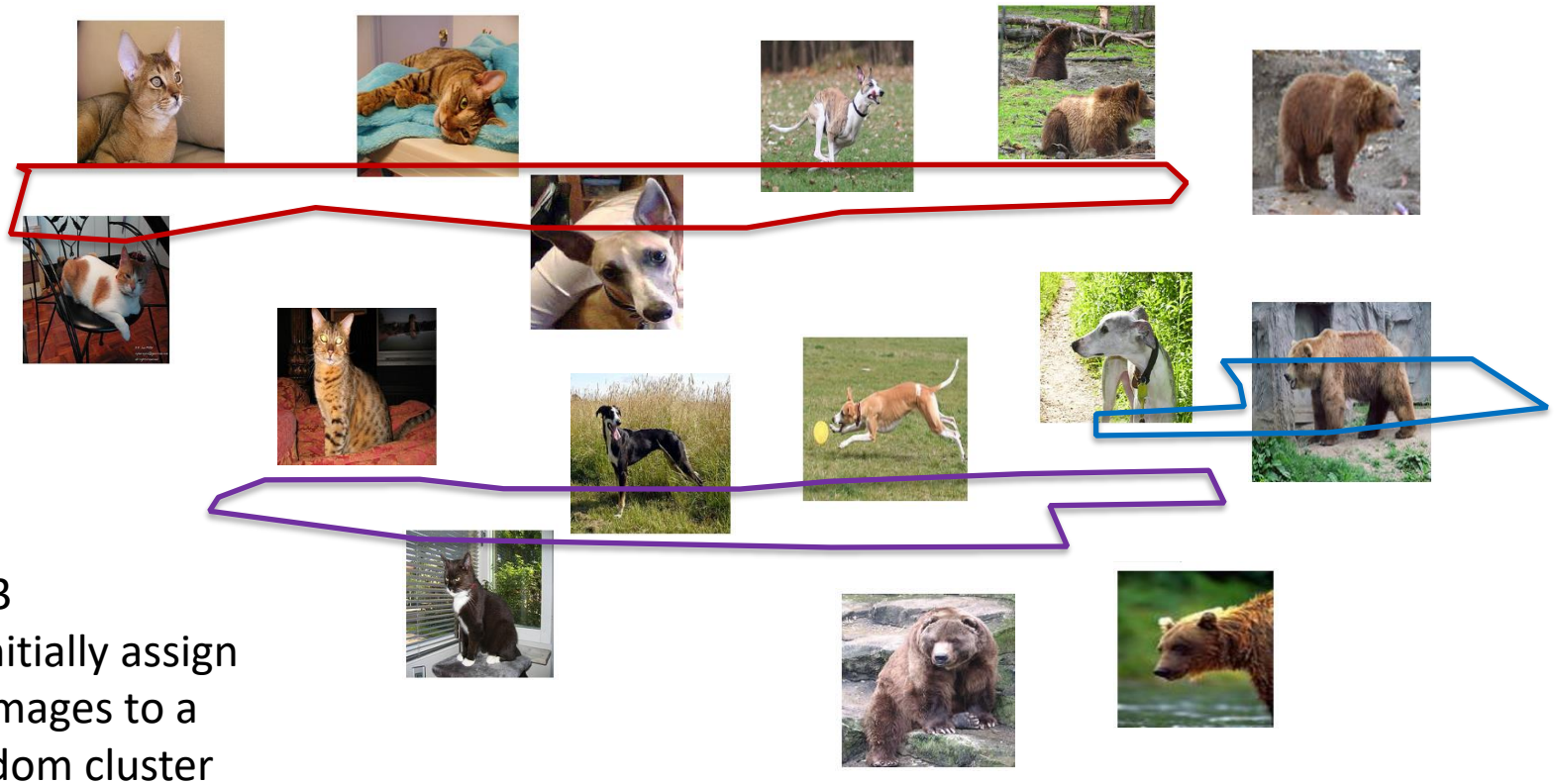
# Unsupervised Learning

x1, x2, x3, x4, …

- We only x, we try to discover some relationship between x

- Learning “what normally happens”
- Grouping similar instances

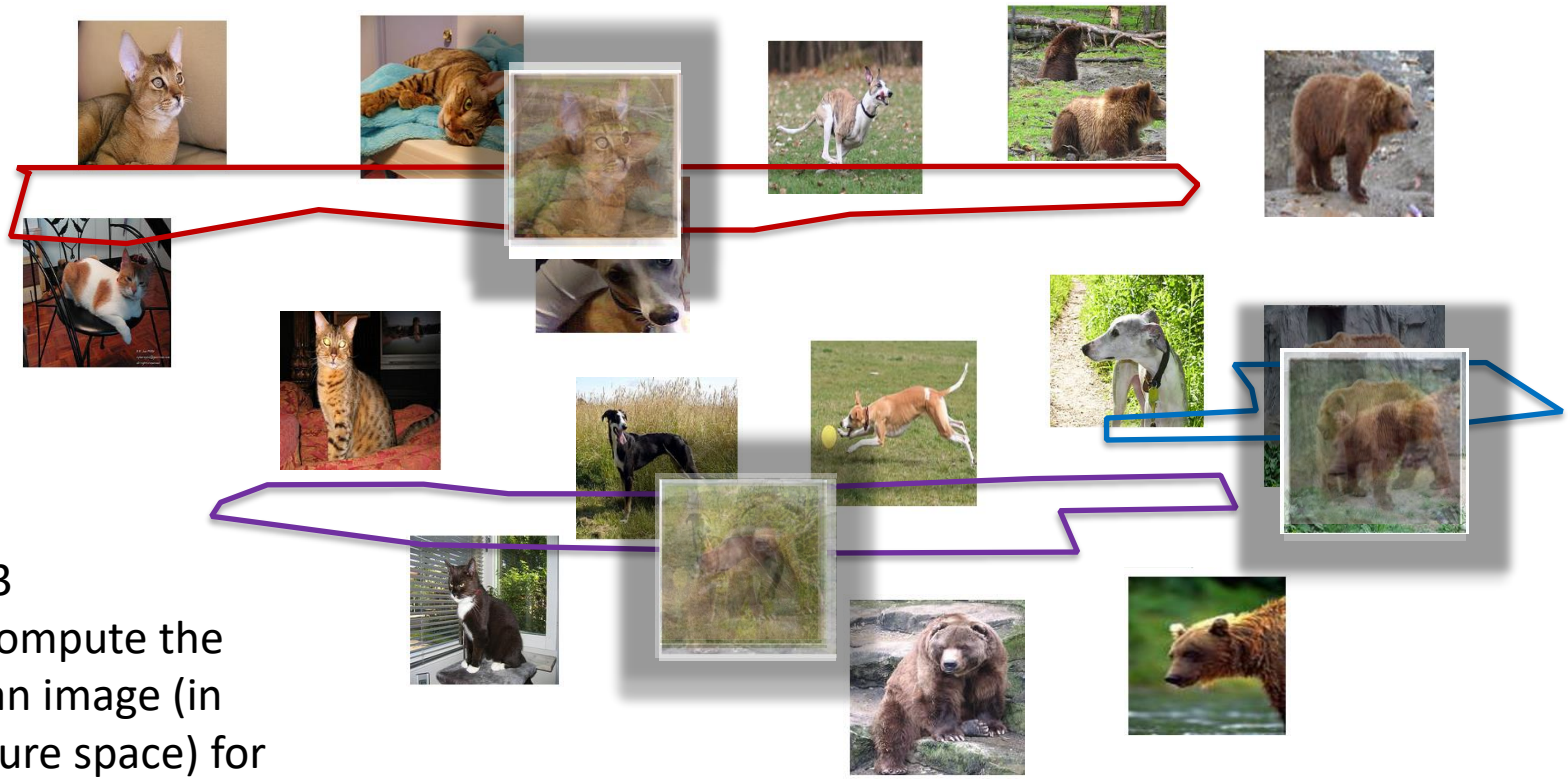
# Unsupervised Learning – k-means clustering



k = 3

1. Initially assign all images to a random cluster

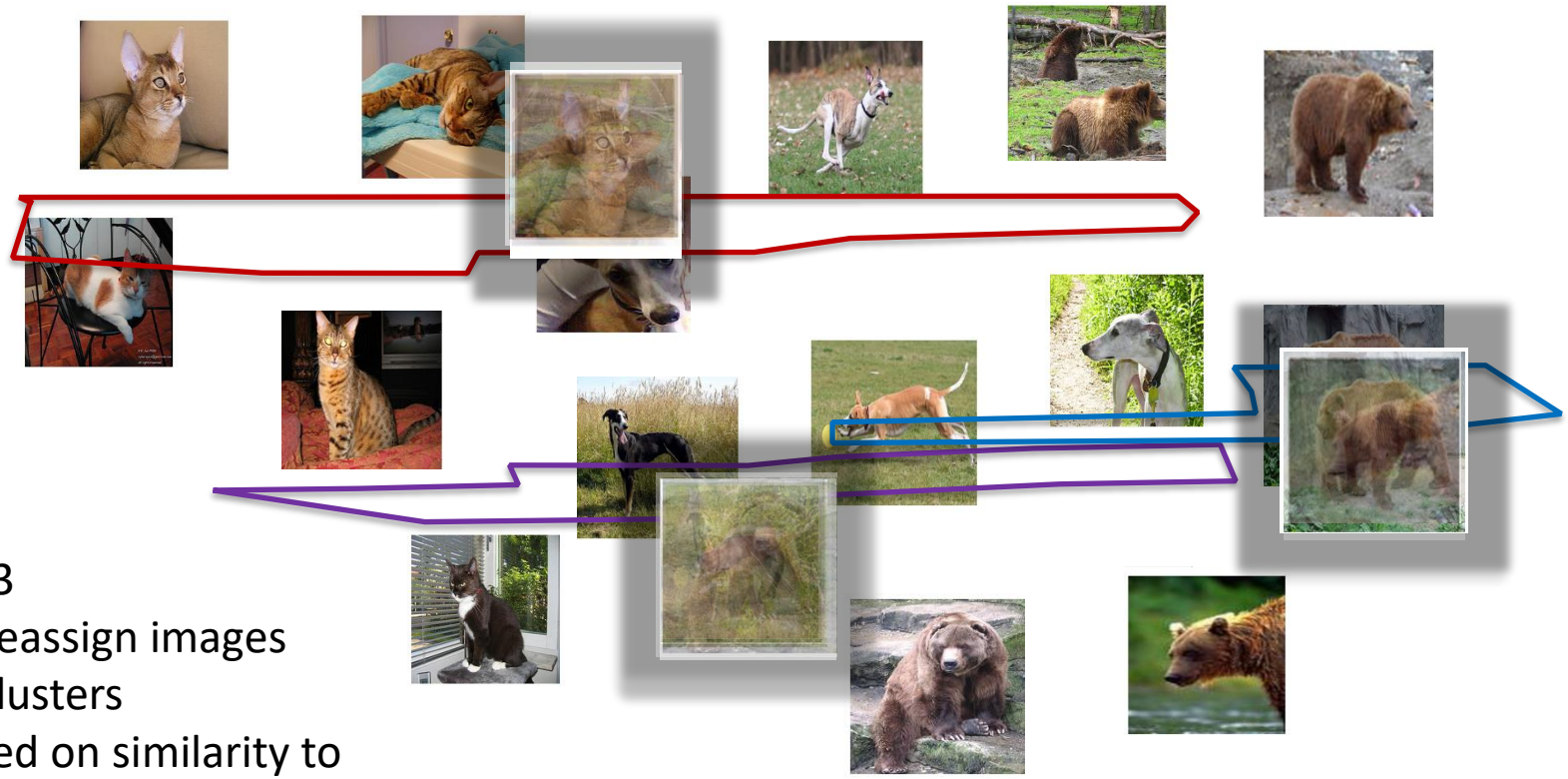
# Unsupervised Learning – k-means clustering



k = 3

2. Compute the mean image (in feature space) for each cluster

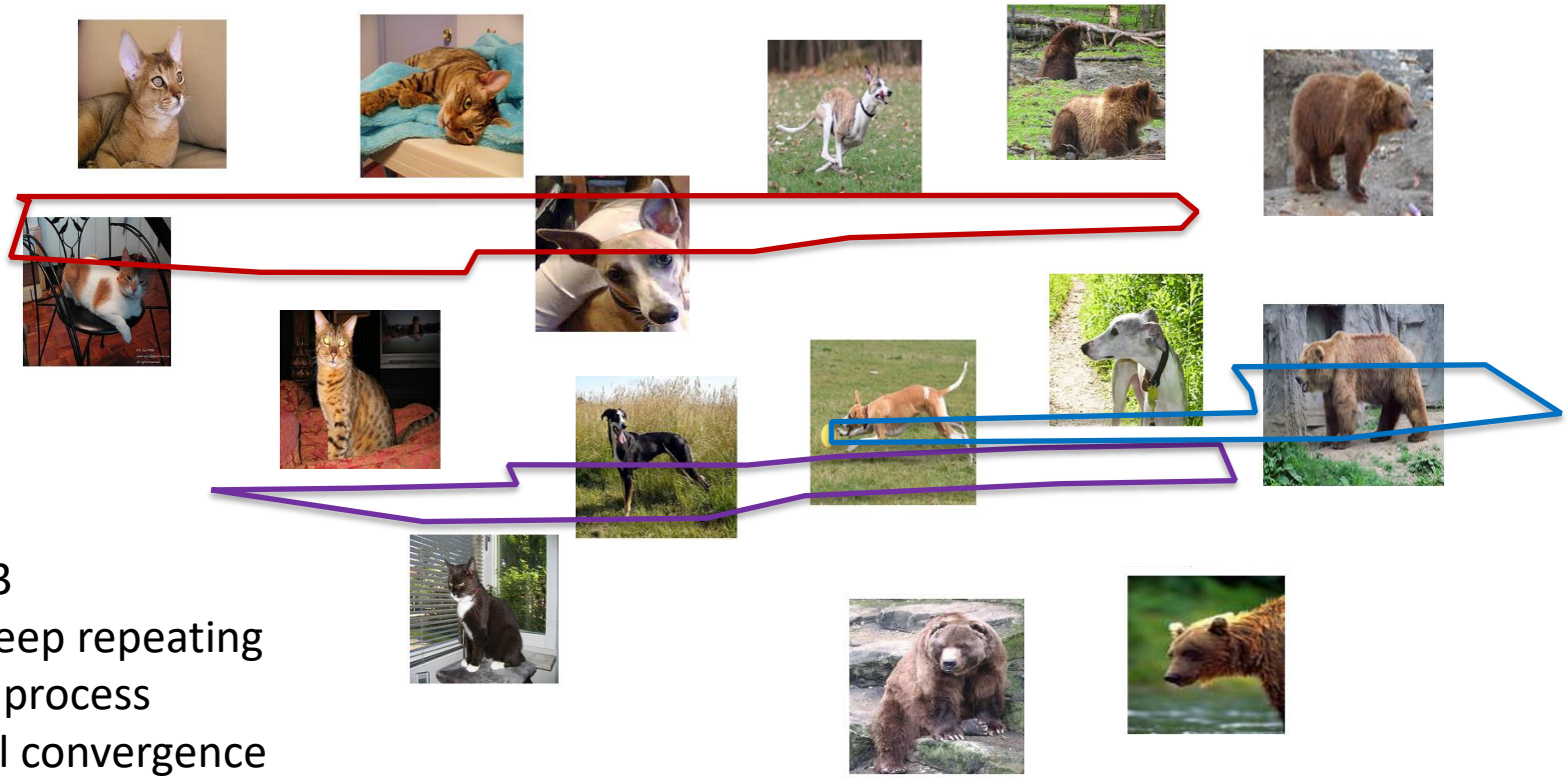
# Unsupervised Learning – k-means clustering



k = 3

3. Reassign images to clusters based on similarity to cluster means

# Unsupervised Learning – k-means clustering



k = 3

4. Keep repeating this process until convergence

Unsupervised Learning – k-Means clustering

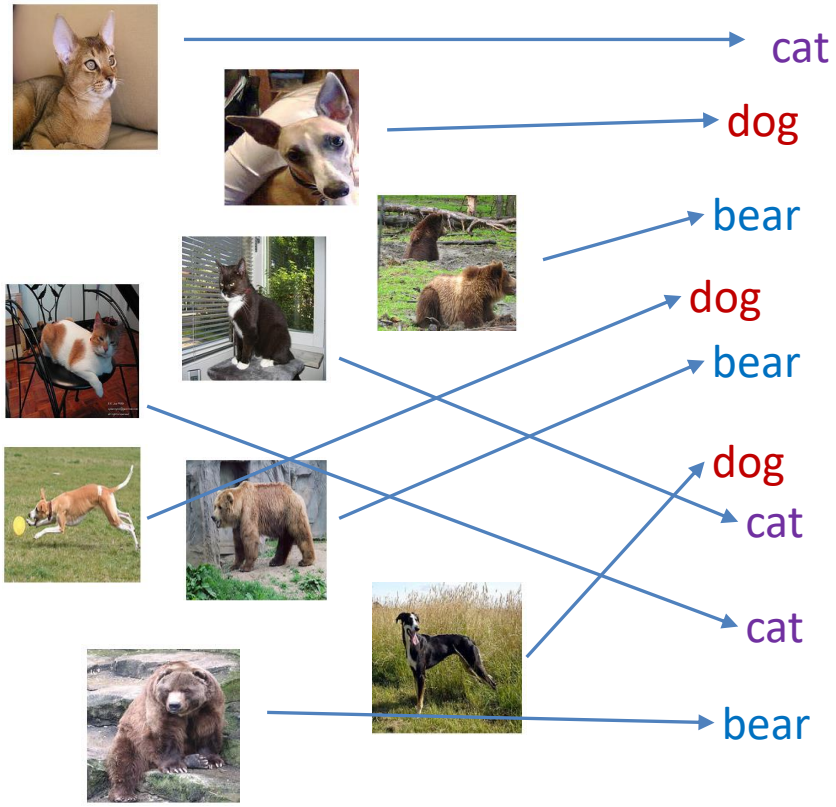
- How do we choose the right K?
- How do we choose the right features?
- How do we choose the right distance metric?
- How sensitive is this method with respect to the random assignment of clusters?

Answer: Just choose the one combination that works best!
**BUT** not on the test data.

Instead split the training data into a ”Training set” and a ”Validation set” (also called ”Development set”)

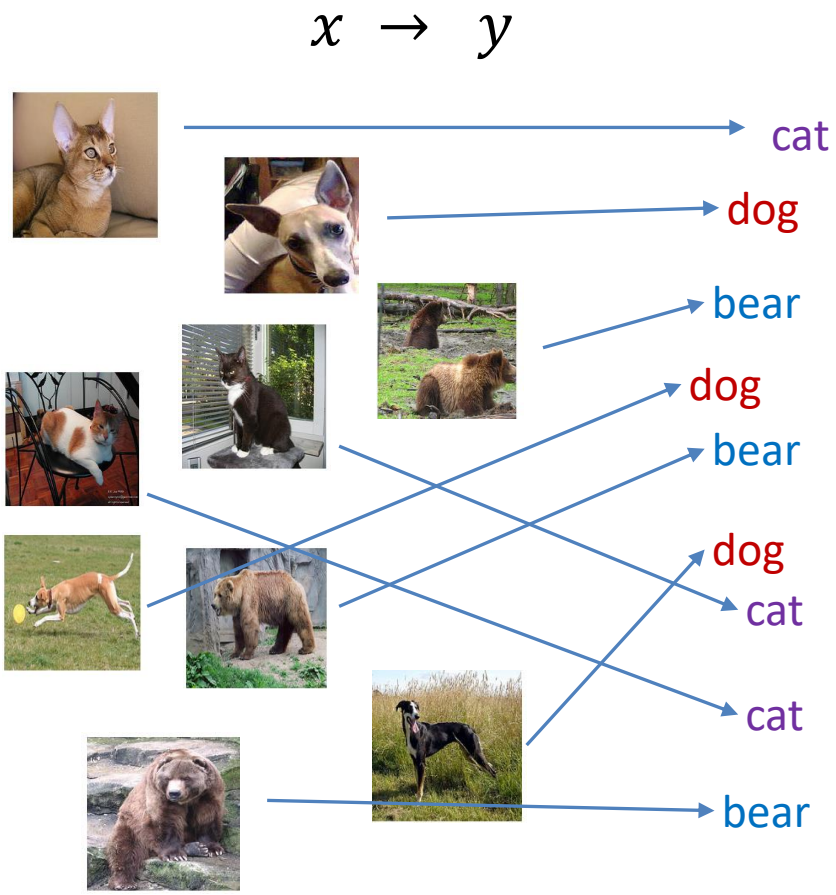
# Supervised Learning vs Unsupervised Learning

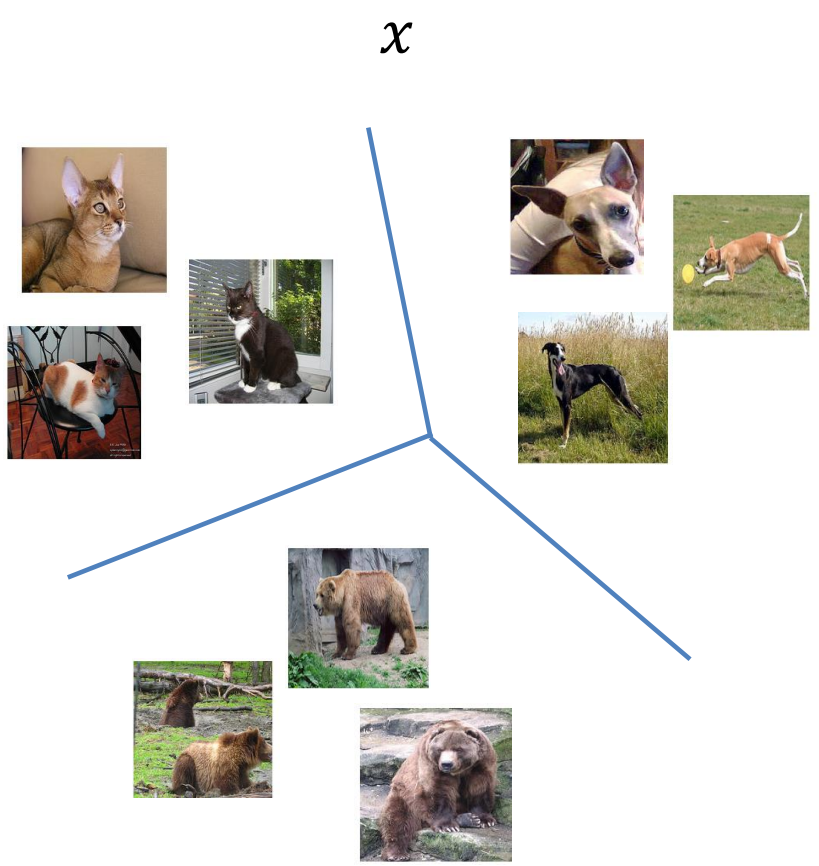
$x \rightarrow y$



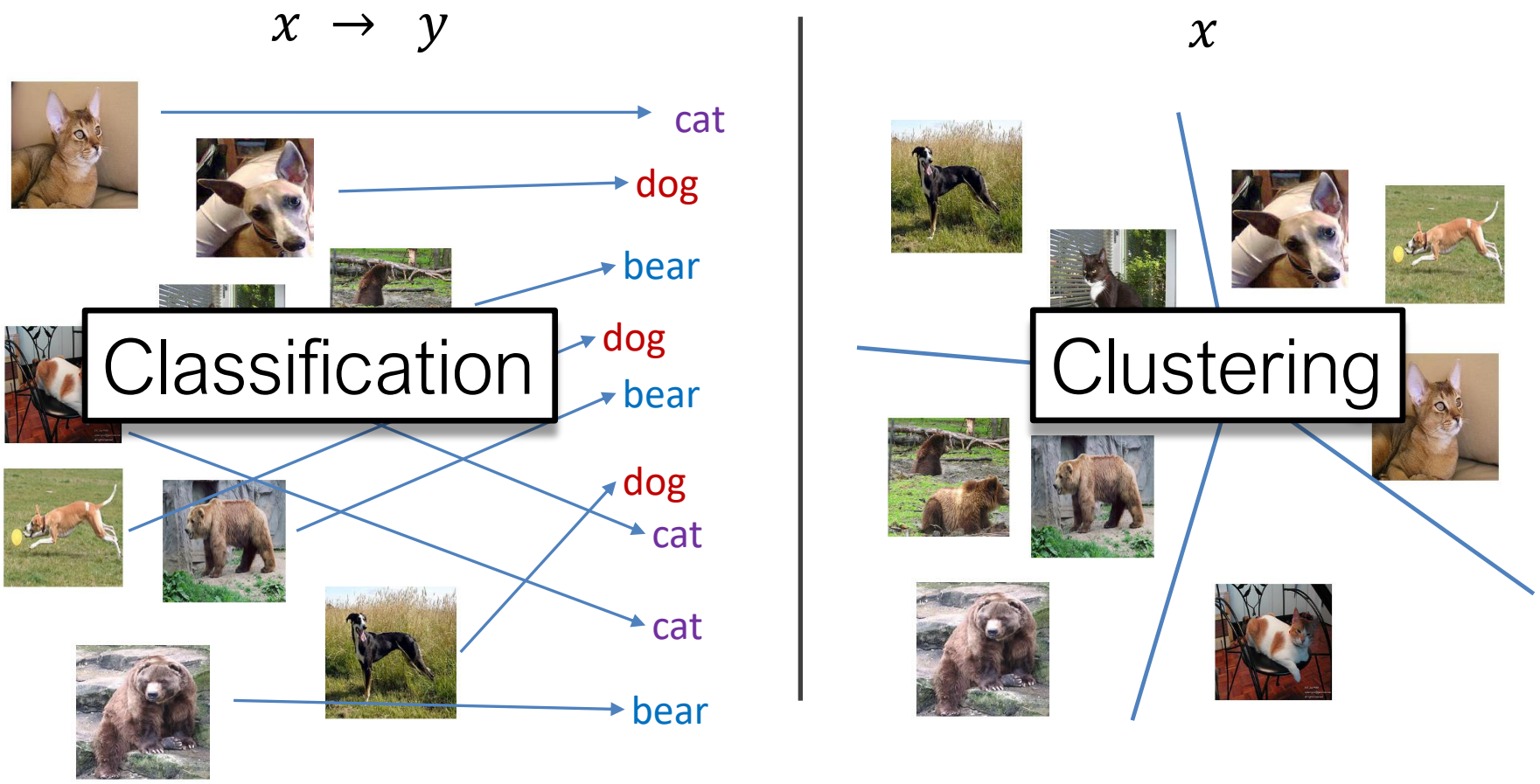

$x$

# Supervised Learning vs Unsupervised Learning



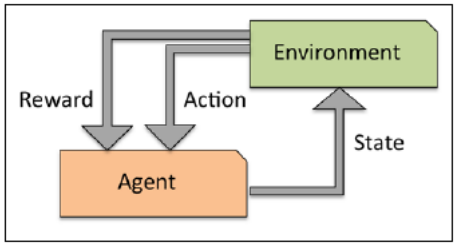



# Supervised Learning vs Unsupervised Learning

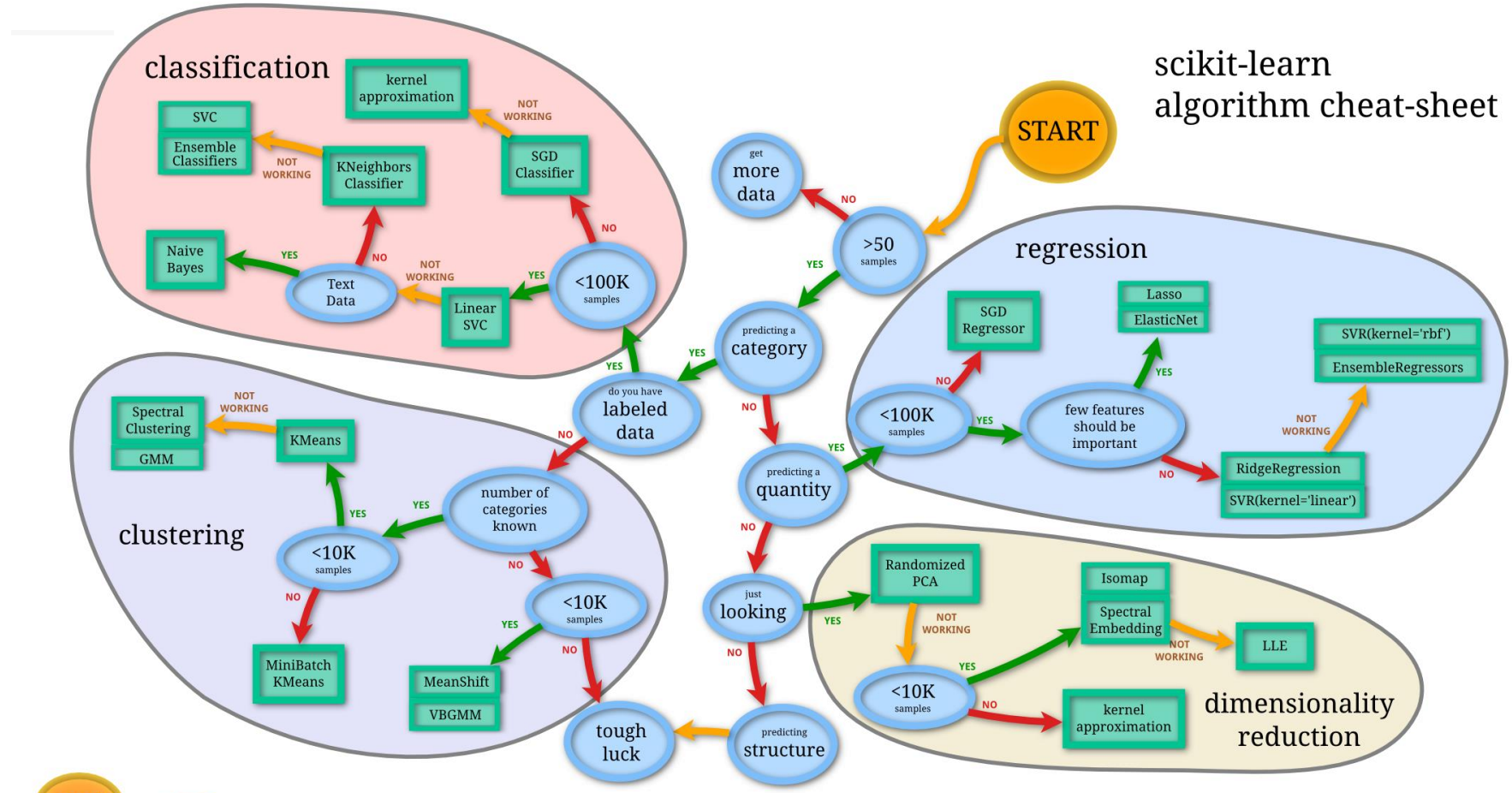


# Reinforcement Learning

- Learning a policy: A sequence of outputs
- No supervised output but delayed reward
- Credit assignment problem
- Game playing
- Robot in a maze
- Multiple agents, partial observability, ...

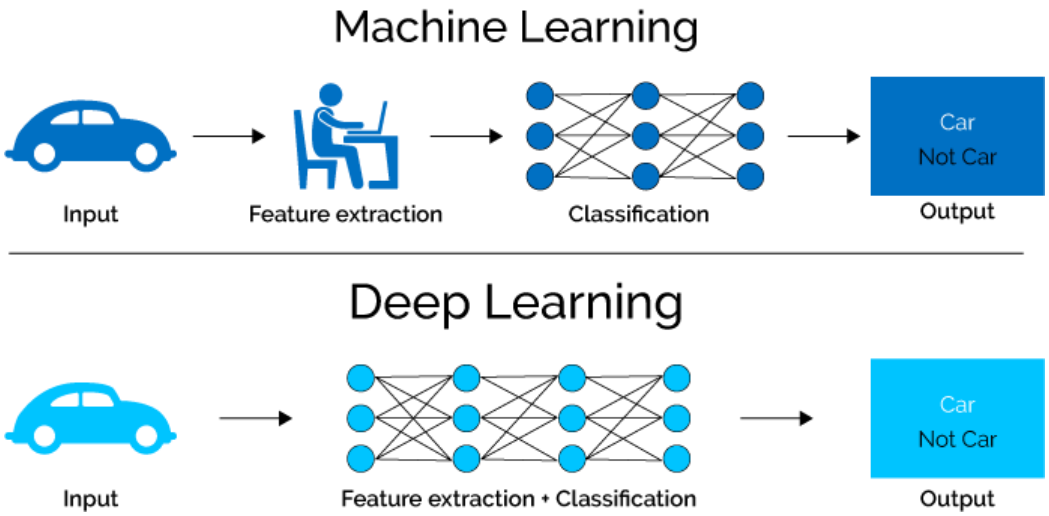


# Python for ML

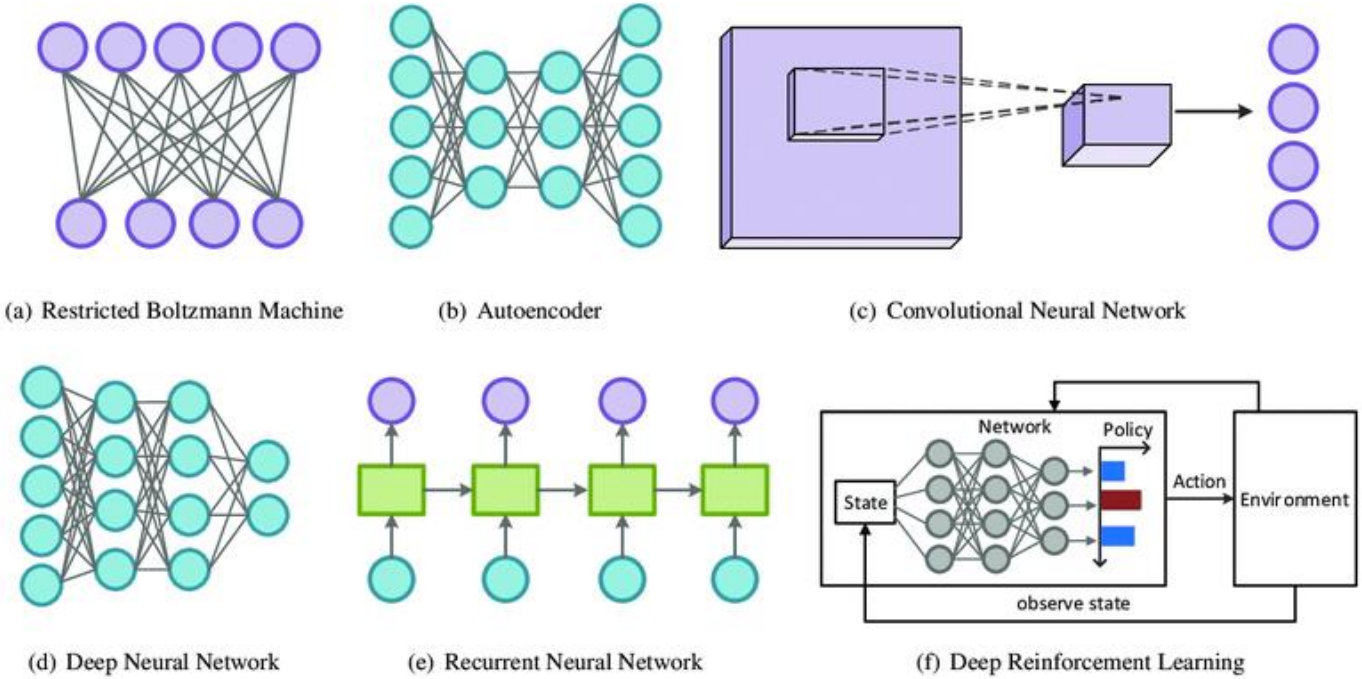


# What is DL?

A machine learning subfield of learning **representations** of data. Exceptional effective at **learning patterns**.
Deep learning algorithms attempt to learn (multiple levels of) representation by using a **hierarchy of multiple layers**
If you provide the system **tons of information**, it begins to understand it and respond in useful ways.



# What are the main domains in DL?




(a) Restricted Boltzmann Machine (b) Autoencoder (c) Convolutional Neural Network

(d) Deep Neural Network (e) Recurrent Neural Network (f) Deep Reinforcement Learning

# THANKS

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