Modul 1: Introduction

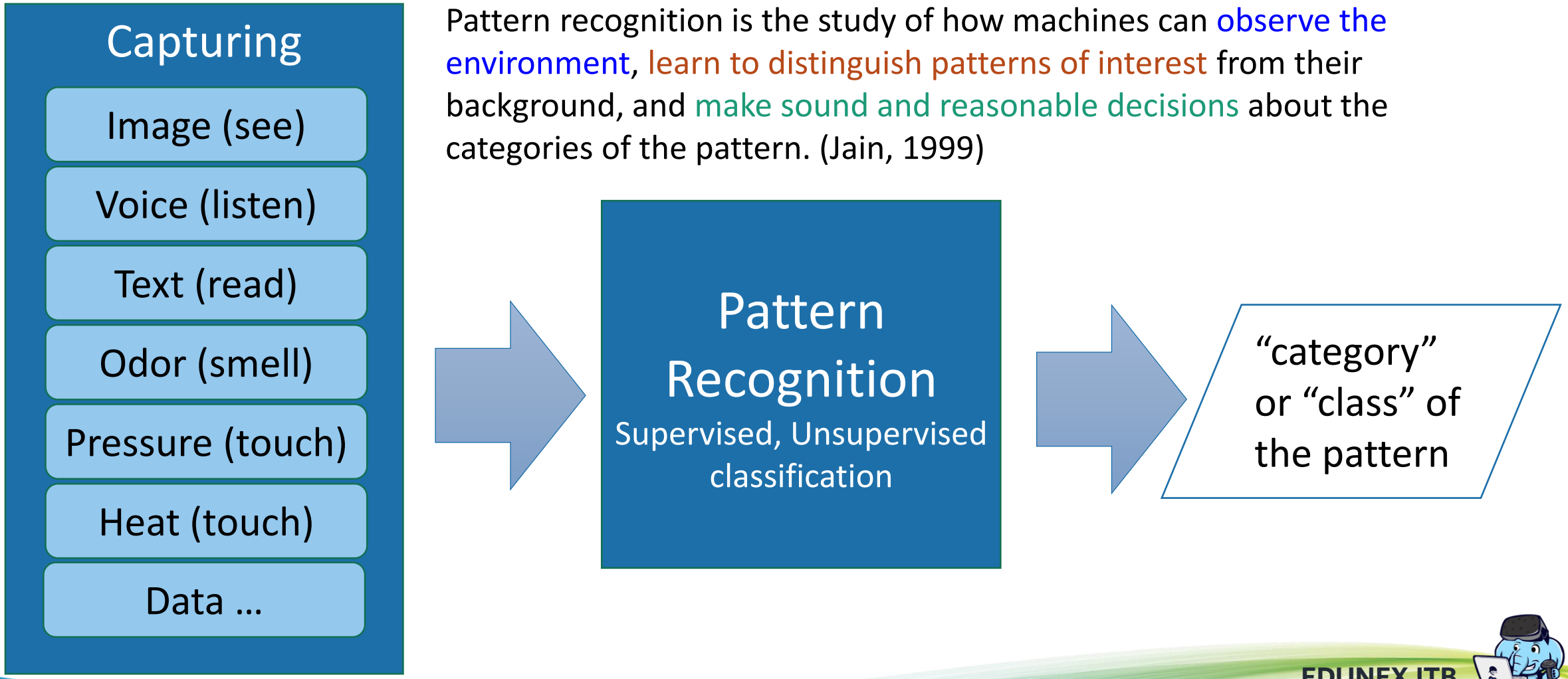
03 Supervised vs Unsupervised Classification

Masayu Leylia Khodra
(masayu@informatika.org)

KK IF – Teknik Informatika – STEI ITB

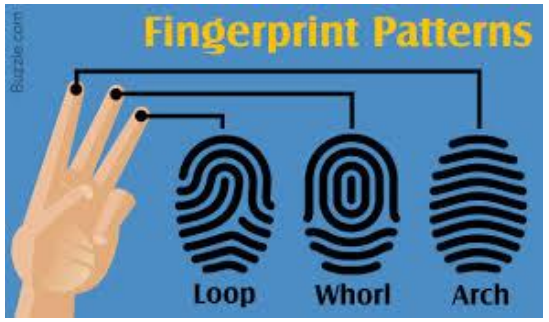
Pengenalan Pola
(*Pattern Recognition*)

Human-like Pattern Recognition



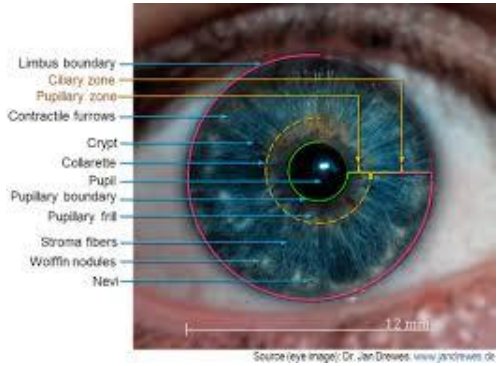
Pattern recognition is the study of how machines can observe the environment, learn to distinguish patterns of interest from their background, and make sound and reasonable decisions about the categories of the pattern. (Jain, 1999)

Pattern



https://sciencestruck.com/identifying-types-of-fingerprints-patterns

Palmprint



https://indranilsinharoy.com/2014/12/05/dissertation_series/
https://www.bayometric.com/biometric-system-architecture/

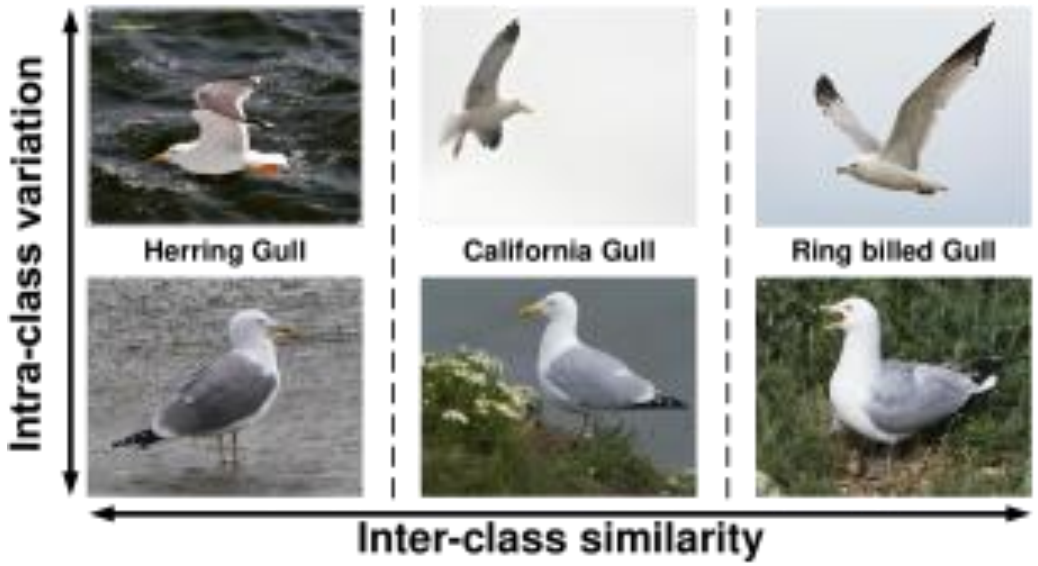
Signature

Regex pattern in information extraction

```
import re
email = re.compile('\w+@\w+\.[a-z]{3}')
text = "To email Guido, try guido@python.org or the older address guido@google.com."
email.findall(text)
```

```
['guido@python.org', 'guido@google.com']
```

Pattern Class

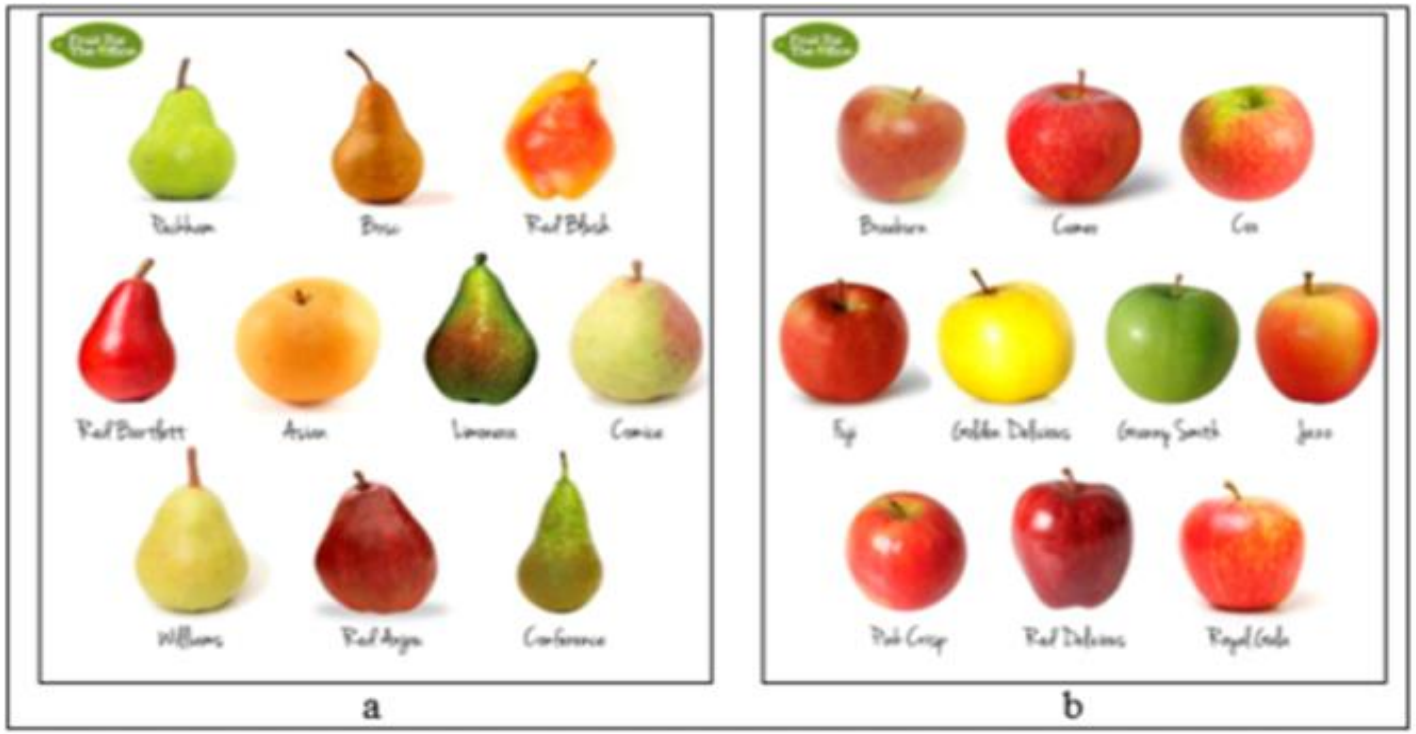


https://www.groundai.com/project/fine-grained-visual-recognition-with-batch-confusion-norm/1

- A collection of similar object, not necessarily identical.
- Variability: intra-class variability, inter-class variability
- Problem: high intra-class variability, low inter-class variability

Intra-class Variability

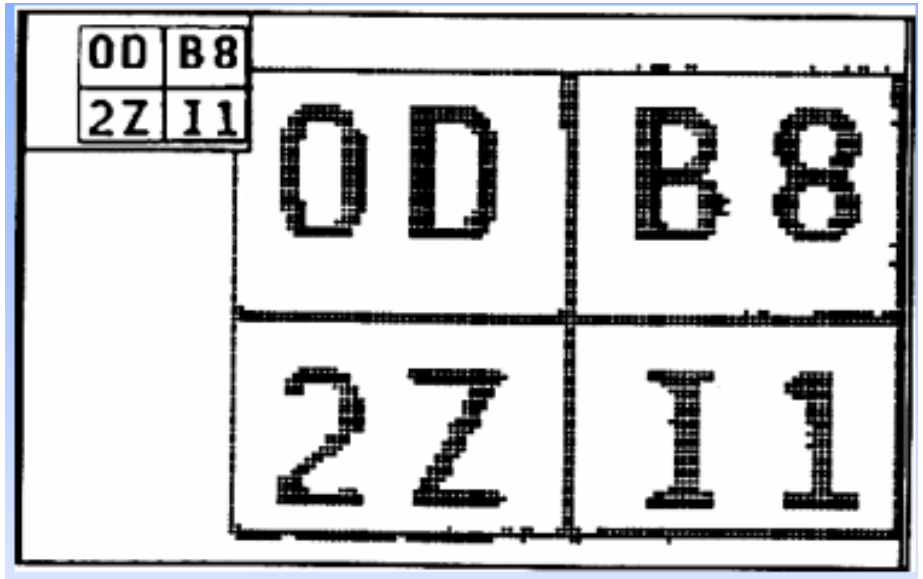
Different appearances of different objects in the same category

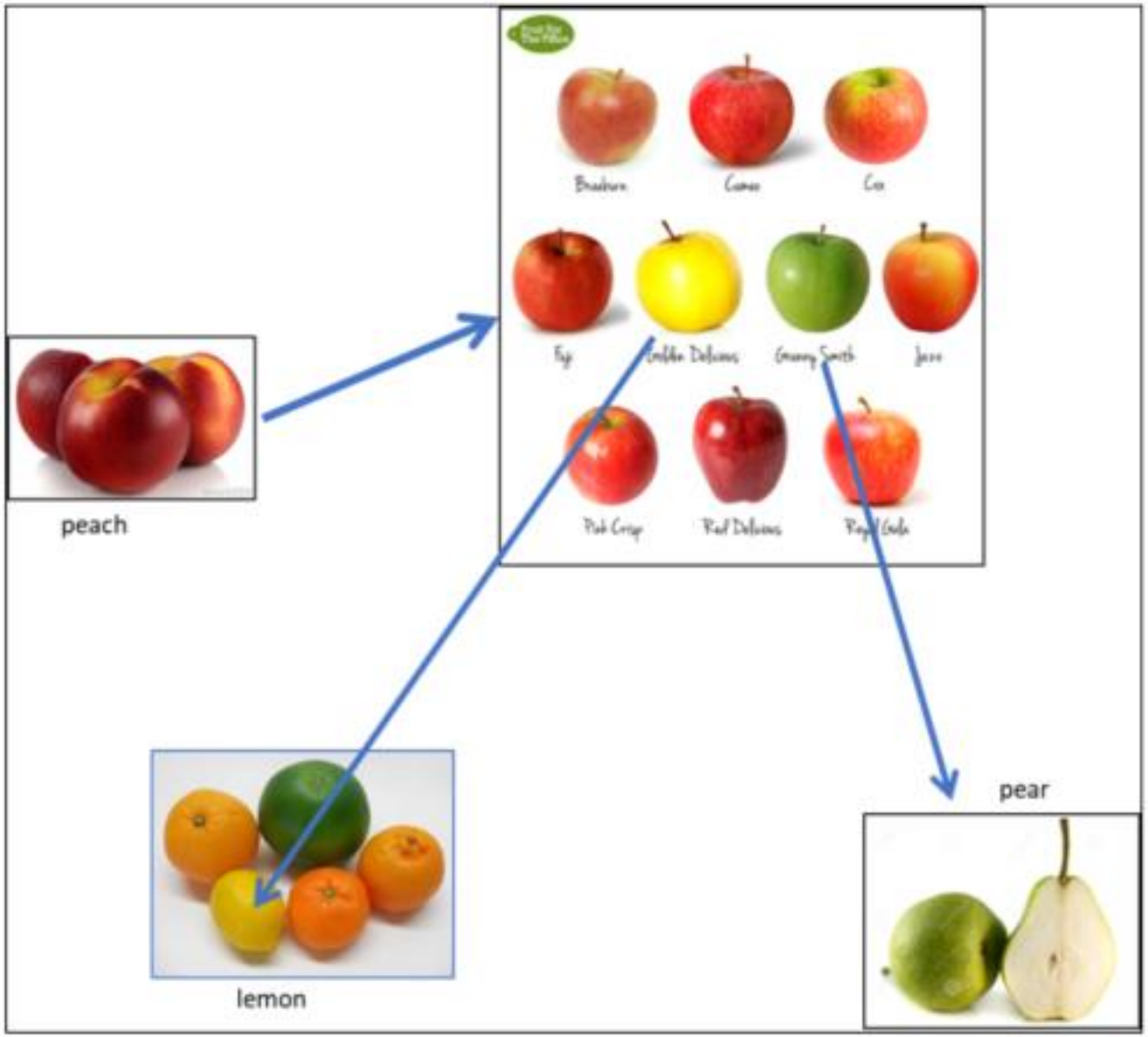


high intra-class variability

Inter-class Variability

Different appearances of different objects for different category

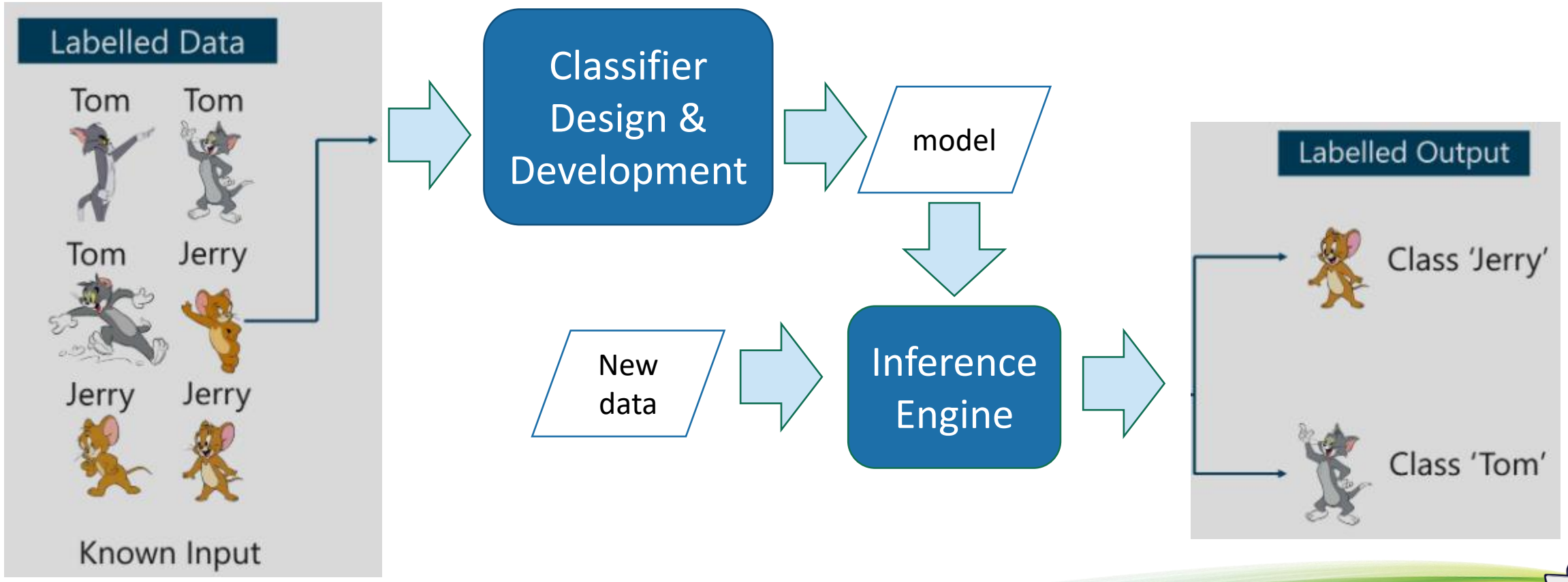




low inter-class variability

Supervised Classification

- Labeled training samples for classifier design



https://www.edureka.co/blog/artificial-intelligence-with-python/

Labeled Dataset

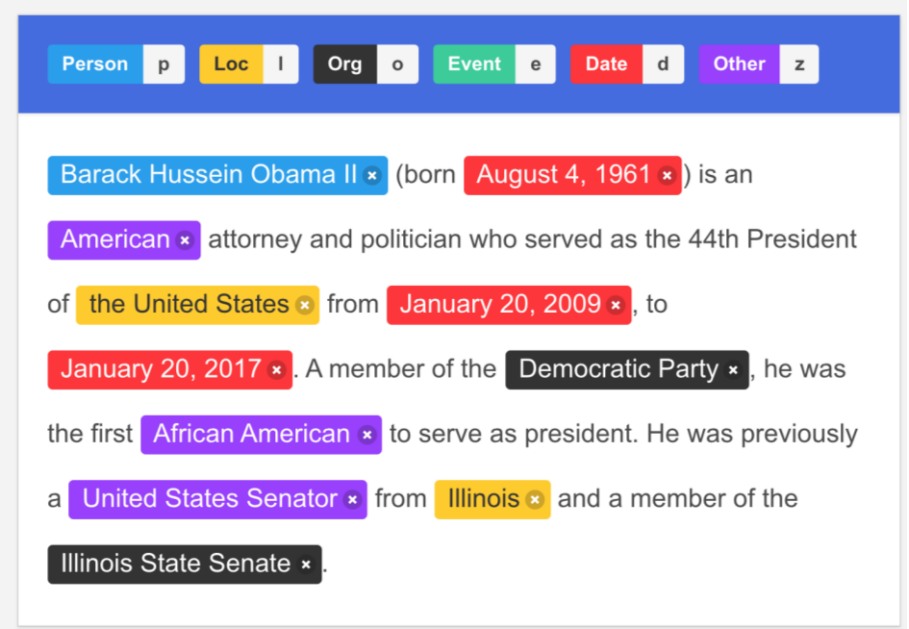
Structured dataset

user ID	time	price ($)	purchased
4783	Jan 21 08:15.20	7.95	yes
3893	March 3 11:30.15	10.00	yes
8384	June 11 14:15.05	9.50	no
0931	Aug 2 20:30.55	12.90	yes

Image dataset

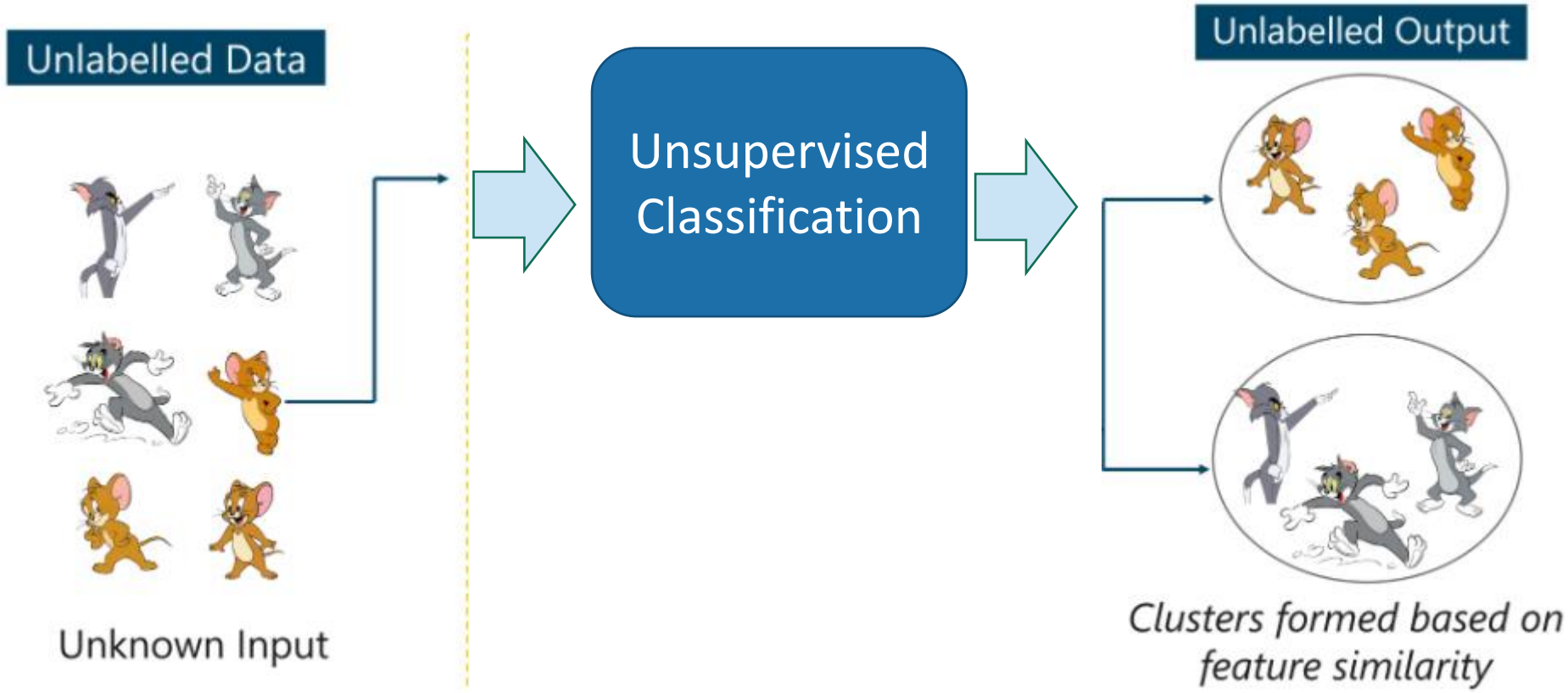
image	label
	cat
	not cat
	cat
	not cat

Text dataset



Unsupervised Classification

- Training samples are unlabeled



https://www.edureka.co/blog/artificial-intelligence-with-python/

Summary

Pattern class: variability

Supervised Classification

Unsupervised Classification

Next: Pattern Recognition as Intelligent Agent

Modul 1: Introduction

04 Pattern Recognition & Intelligent Agent

Masayu Leylia Khodra
(masayu@informatika.org)

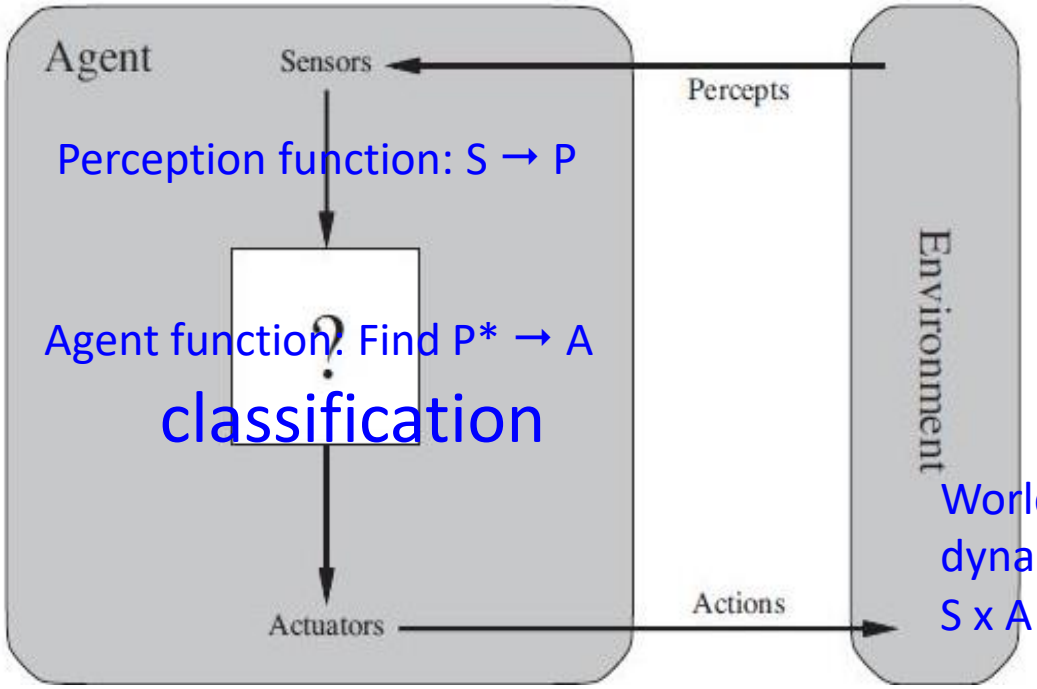
KK IF – Teknik Informatika – STEI ITB

Pengenalan Pola
(*Pattern Recognition*)

Pattern Recognition

- Pattern recognition is the study of how machines can observe the environment, learn to distinguish patterns of interest from their background, and make sound and reasonable decisions about the categories of the pattern. (Jain, 1999)

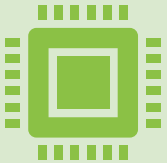
P – the percept space



A – the action space

U – utility function: S → real (or S* → real)

Intelligent Agent



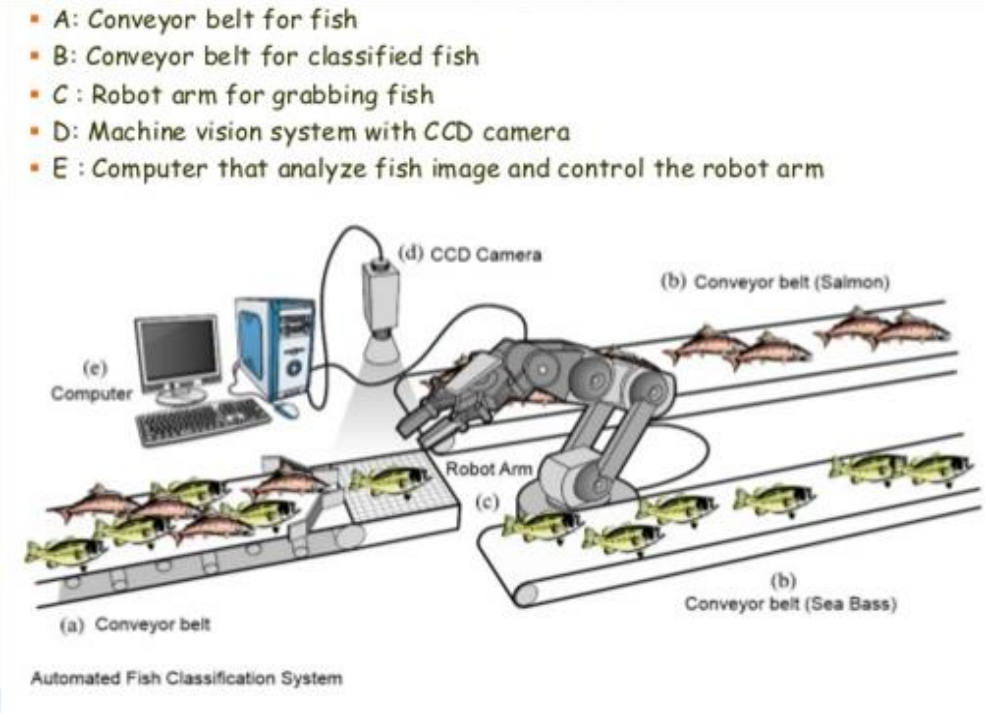
Agents:

- Anything that can be viewed as perceiving its environment through sensors and acting upon that environment through effectors.
- computational agents that behave autonomously

Rational Agent: For each possible percept sequence, a rational agent should select an action that is expected to maximize its performance measure, given the evidence provided by the percept sequence and whatever built-in knowledge the agent has.

PEAS

- An agent is completely specified by the agent function mapping percept sequences to actions
- First specify the setting for intelligent agent design. PEAS: Performance measure, Environment, Actuators, Sensors



P: % fish in correct conveyor belt (B)

E: Conveyor belts (A & B) with fish

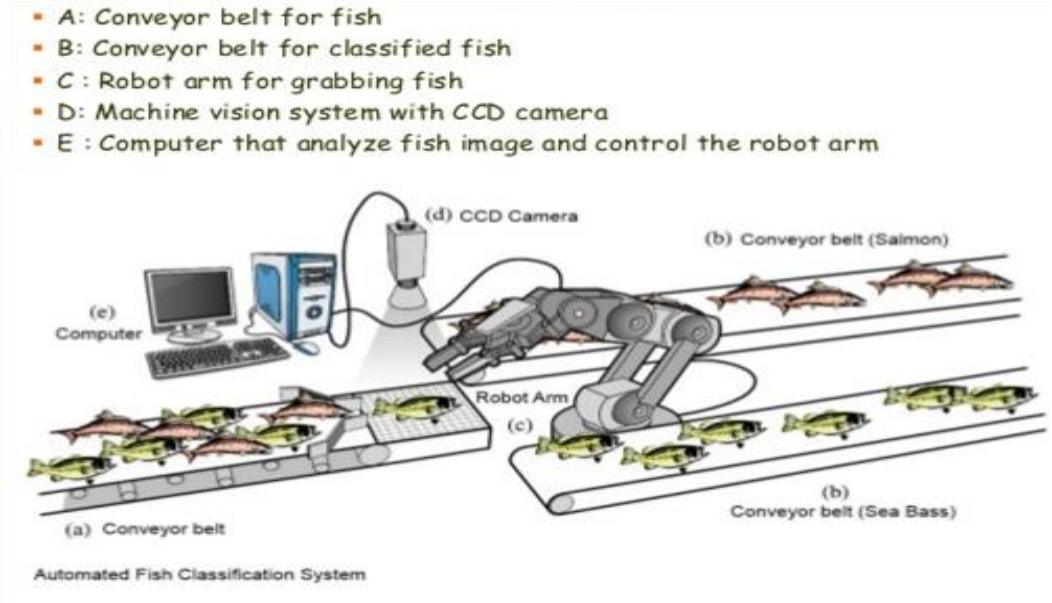
A: robot arm (C)

S: camera (D), robot arm sensors

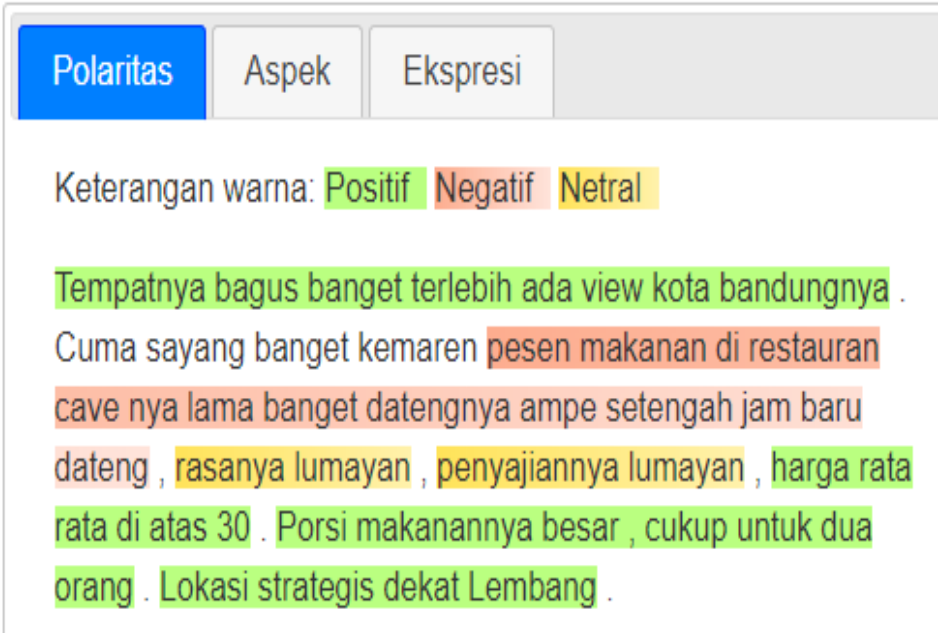
Environment Types

Fully observable (vs. partially observable)	Deterministic (vs stochastic vs strategic)	Episodic (vs. sequential)
Static (vs. dynamic vs semidynamic)	Discrete (vs. continuous)	Single agent (vs. multiagent)

Environment Types: Examples

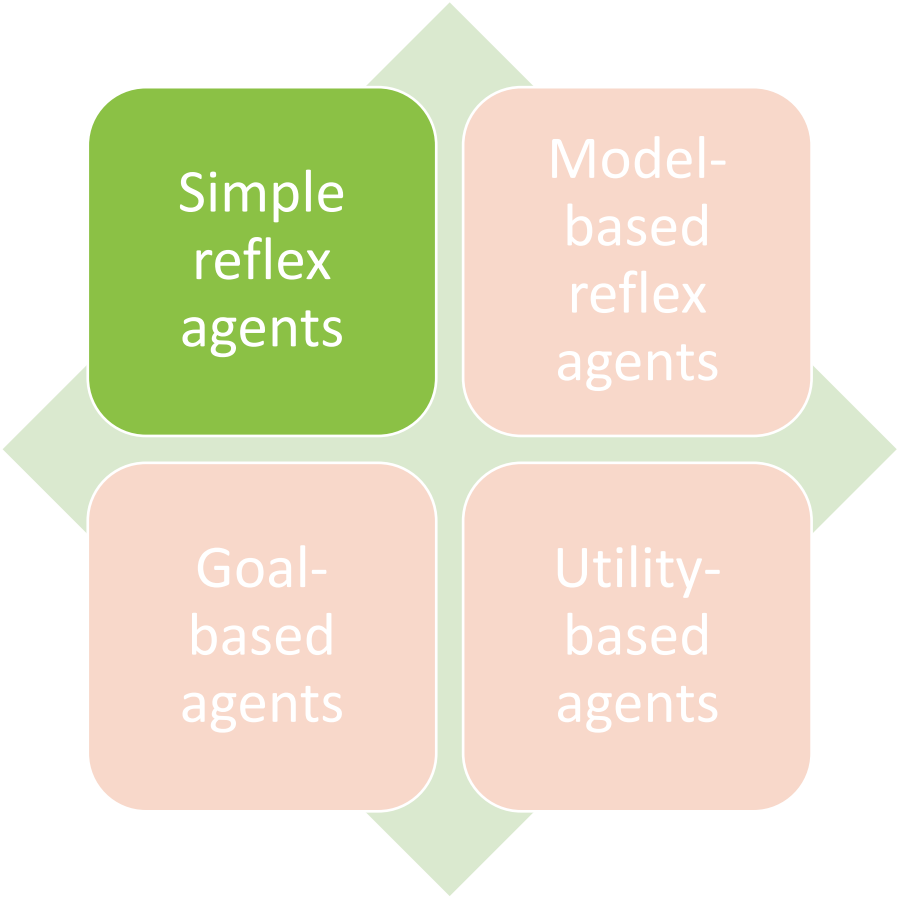


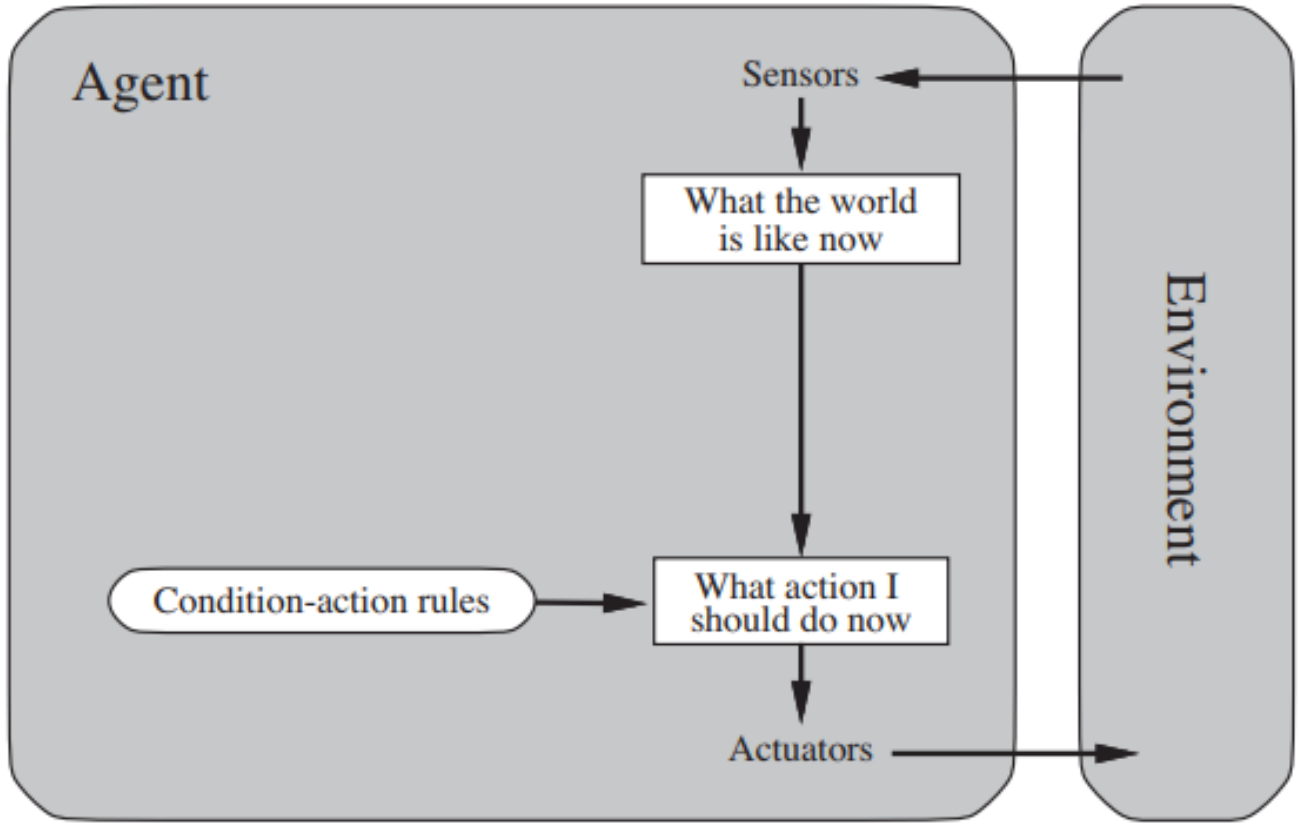
- Partially observable, single agent, stochastic, episodic, dynamic, continuous



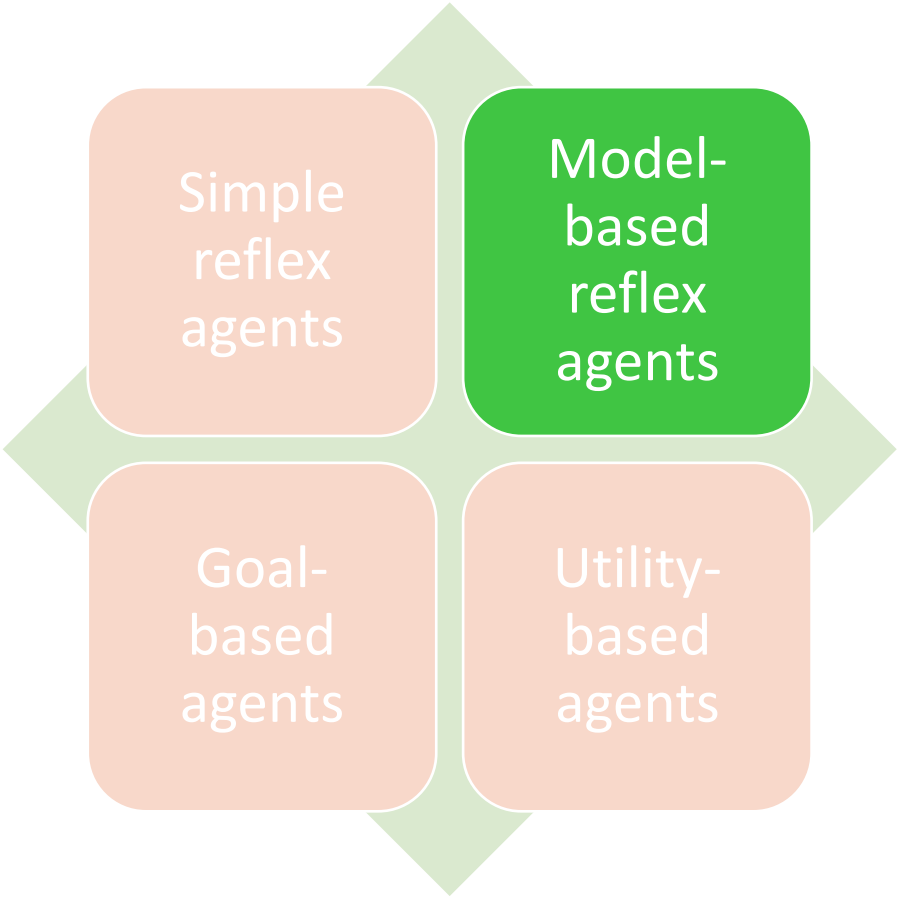
- Fully observable, single agent, deterministic, sequential, static, discrete

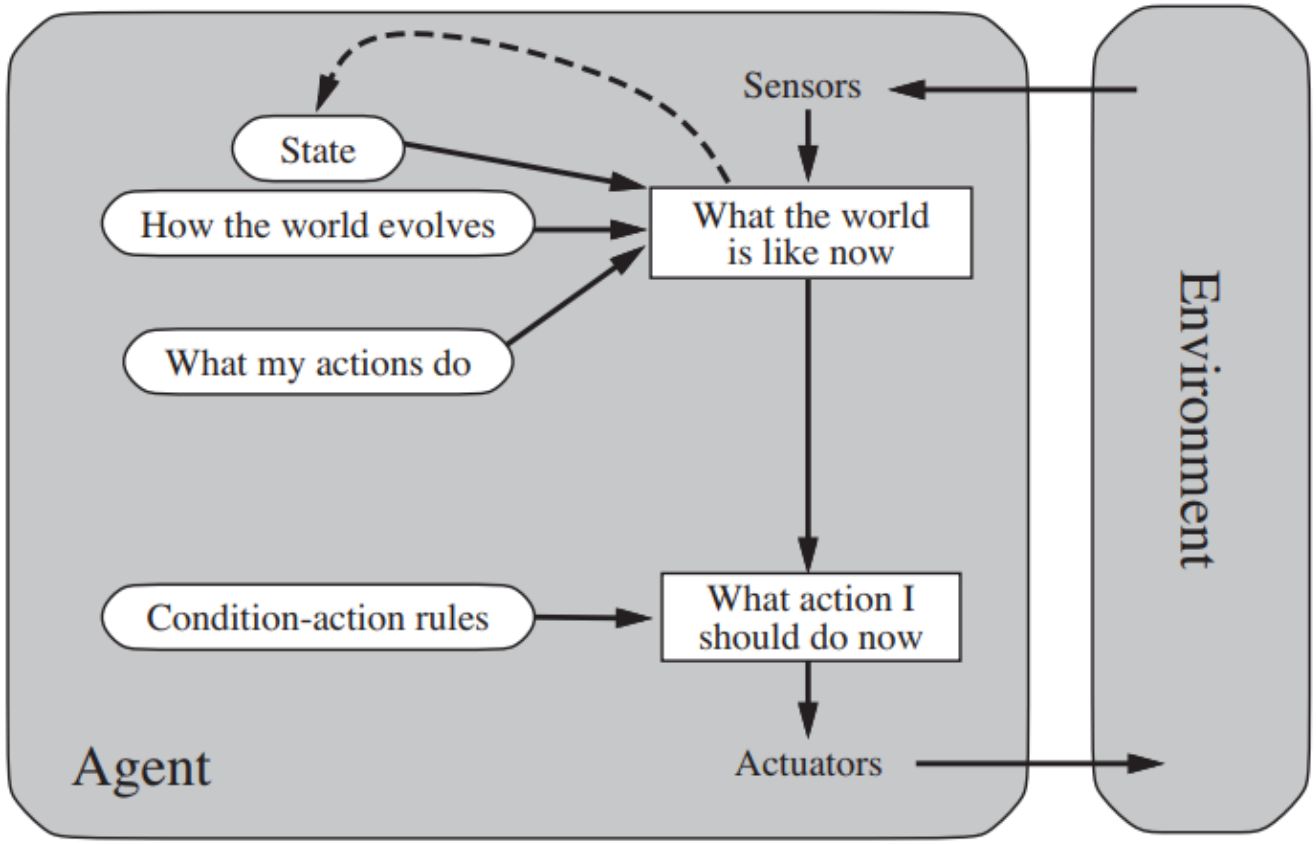
Basic Types: Simple Reflex Agents





Basic Types: Model-based Reflex Agents





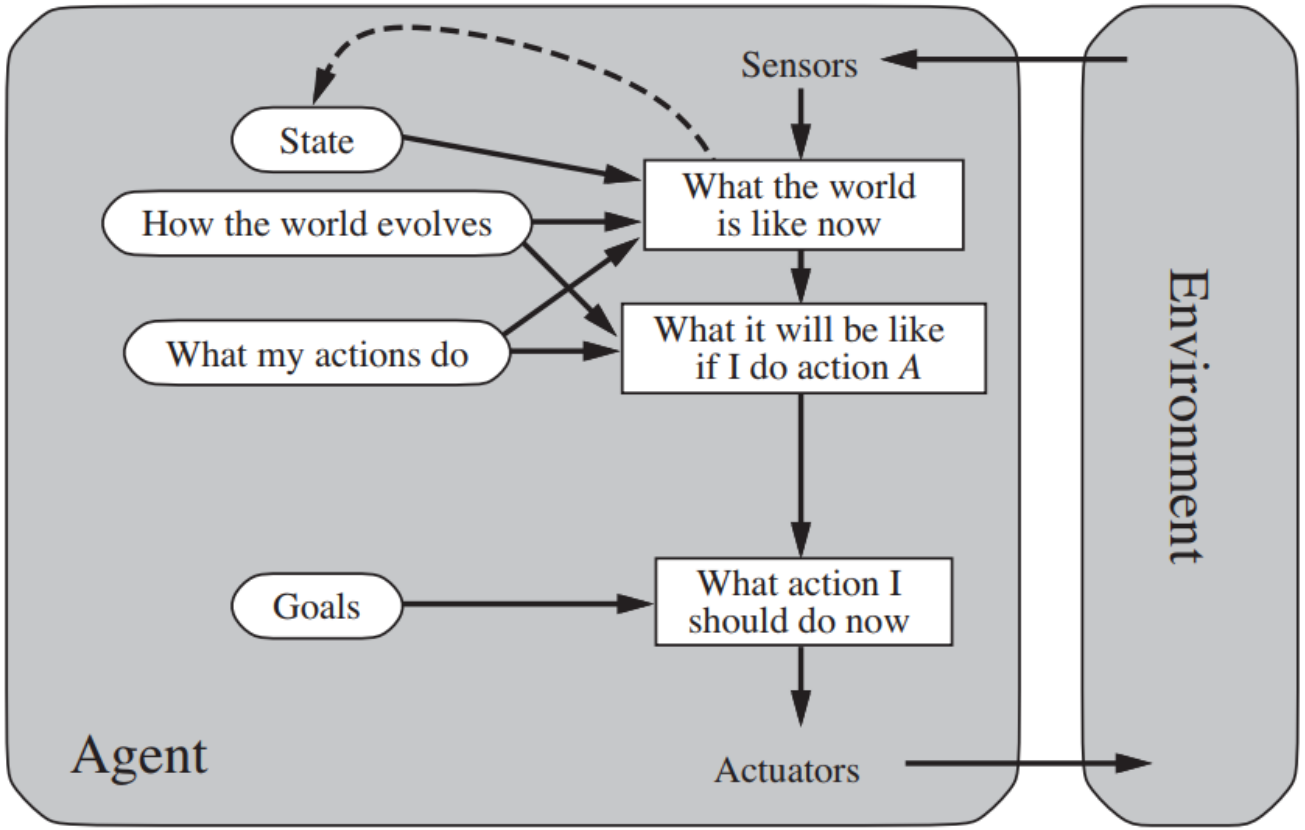
Basic Types: Goal-based Agents

Simple reflex agents

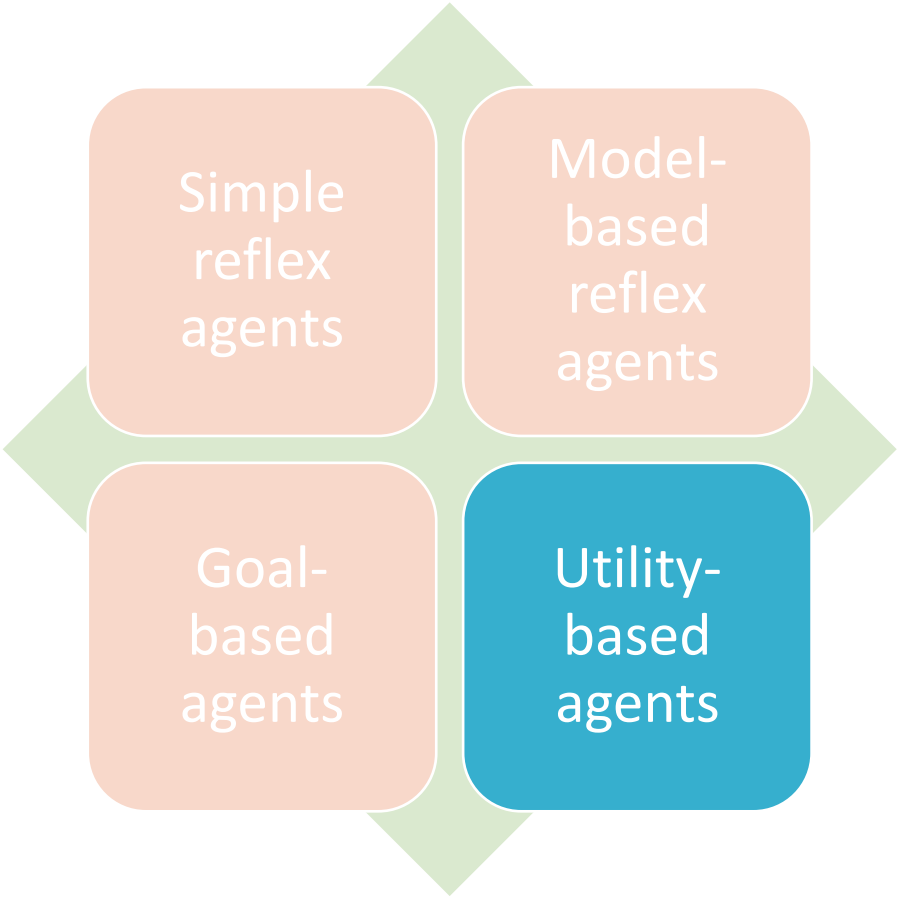
Model-based reflex agents

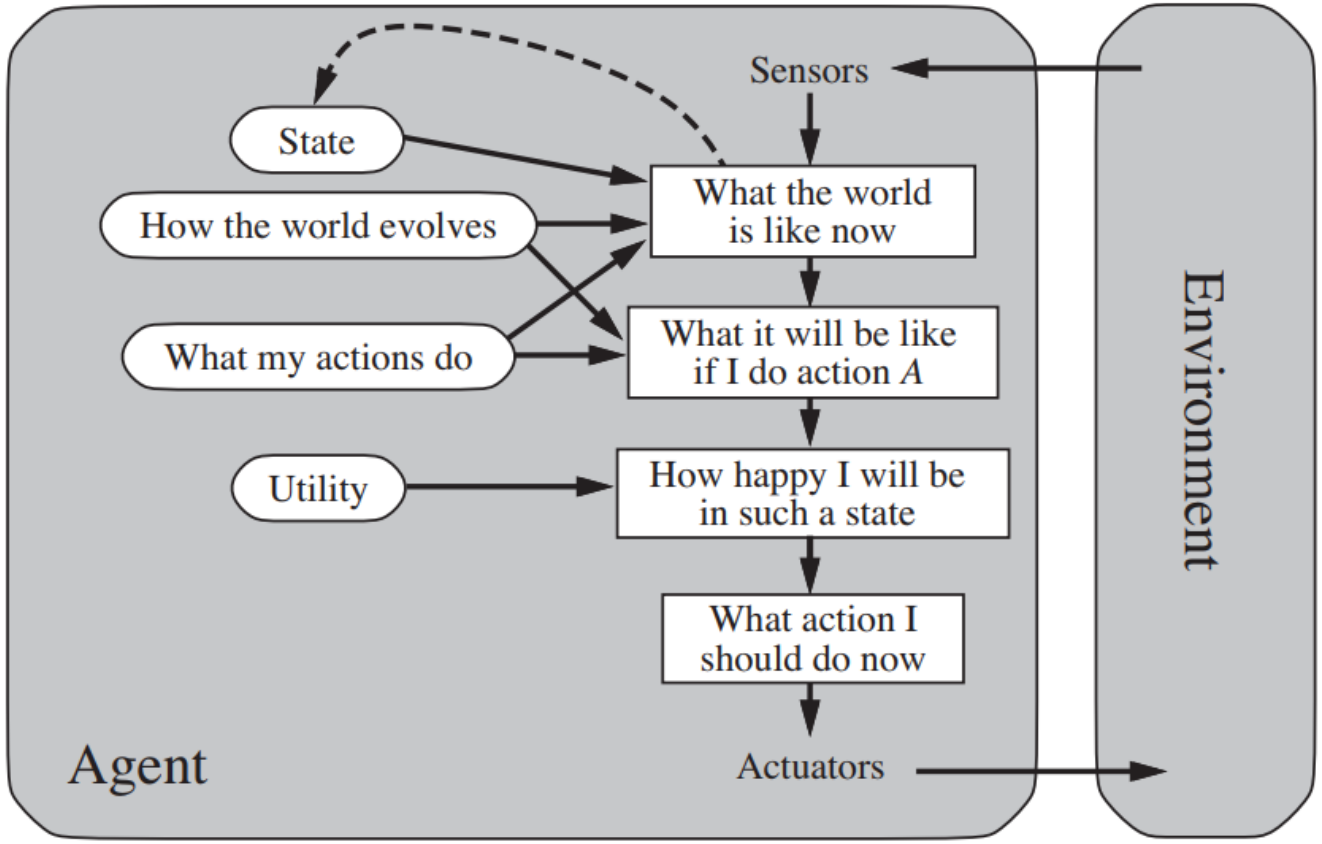
Goal-based agents

Utility-based agents

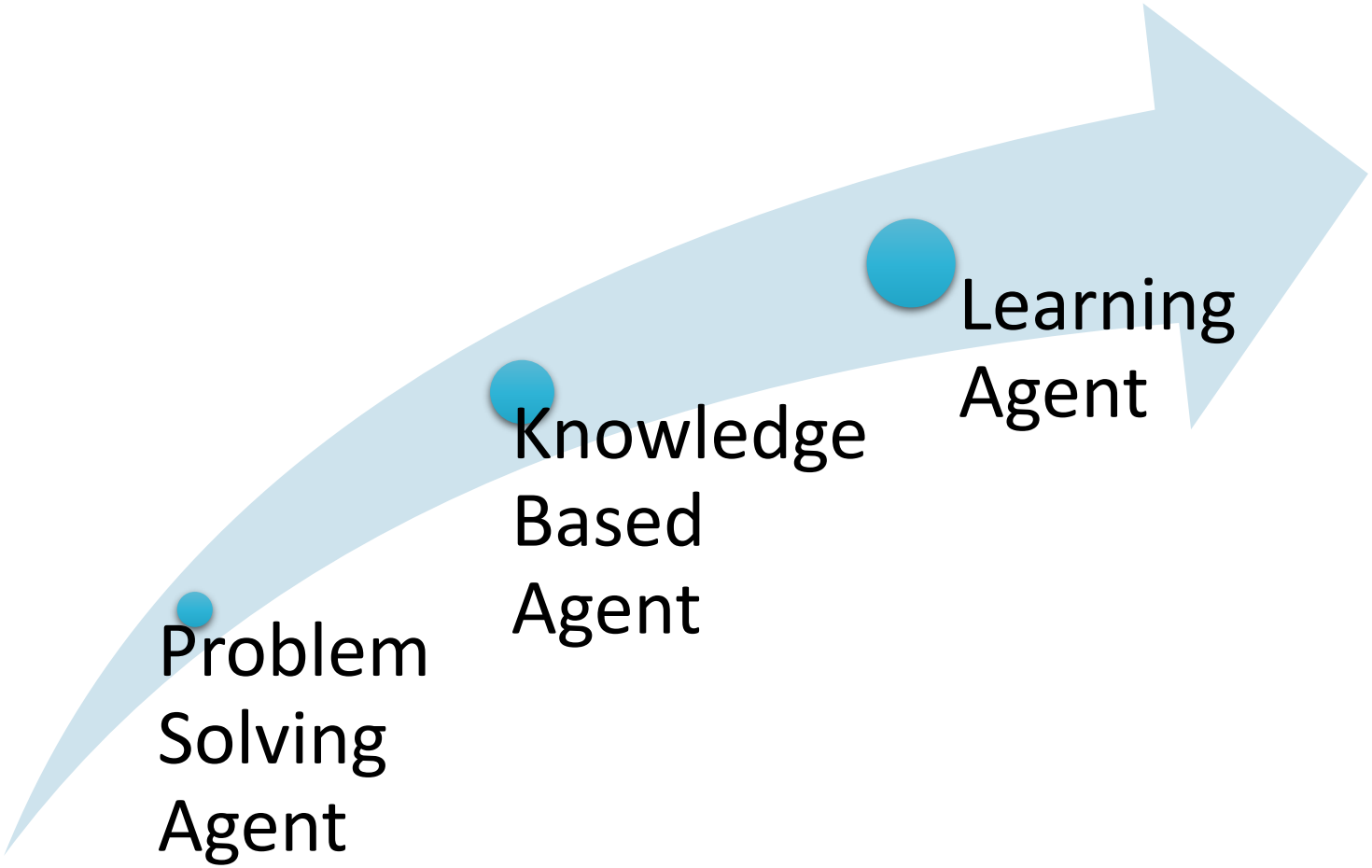


Basic Types: Utility-based Agents





Leveling of Agent



Summary

PR & Agent | PEAS | Environment types | Agent Types | Agent Level

Next: Pattern Recognition Approaches

Modul 1: Introduction

05 Pattern Recognition Approaches

Masayu Leylia Khodra
(masayu@informatika.org)

KK IF – Teknik Informatika – STEI ITB

Pengenalan Pola
(*Pattern Recognition*)

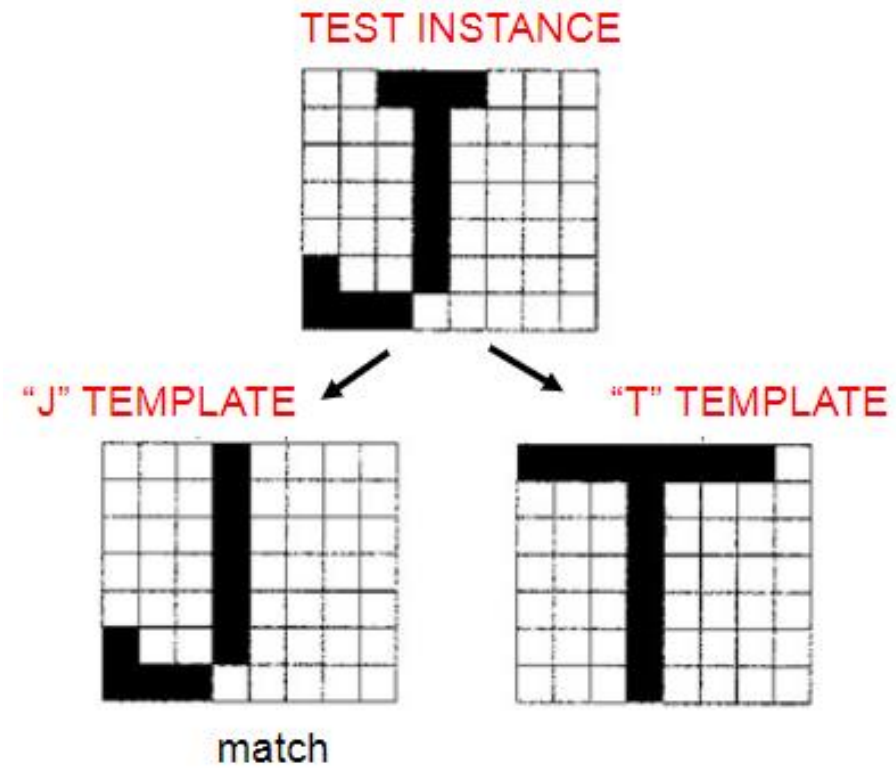
Pattern Recognition Approaches

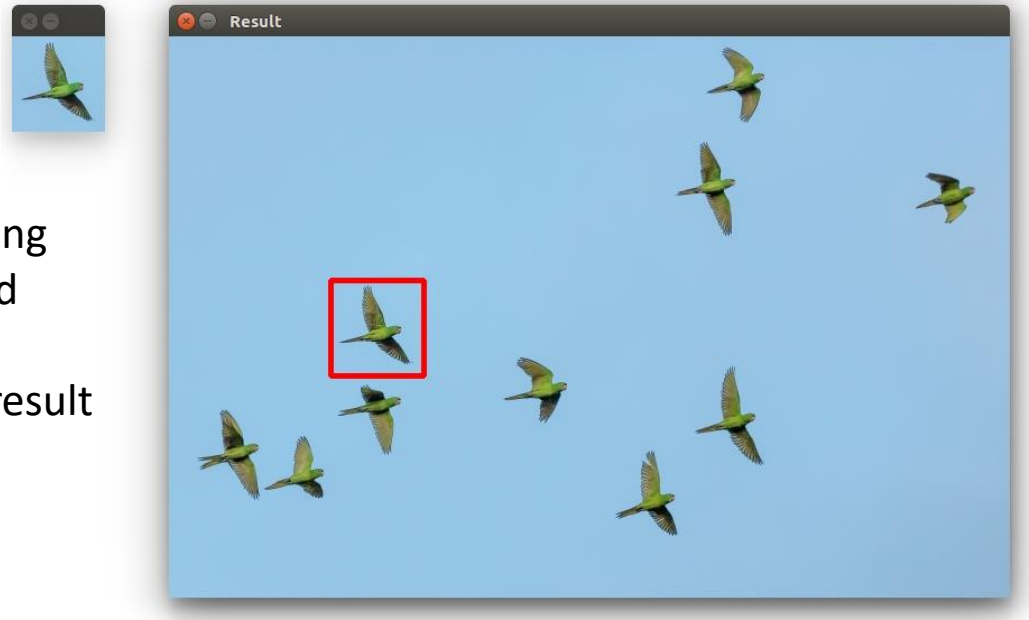
Knowledge-based

Template matching	Statistical decision	Structural/syntactic	Neural Networks
• Recognition function: similarity measure	• Recognition function: Discriminant function	• Recognition function: rules, grammar	• Recognition function: neural networks

Machine learning

Template Matching Approach





Template matching with OpenCV and Python.
Template (left), result image (right)

https://pythonspot.com/object-detection-with-templates/

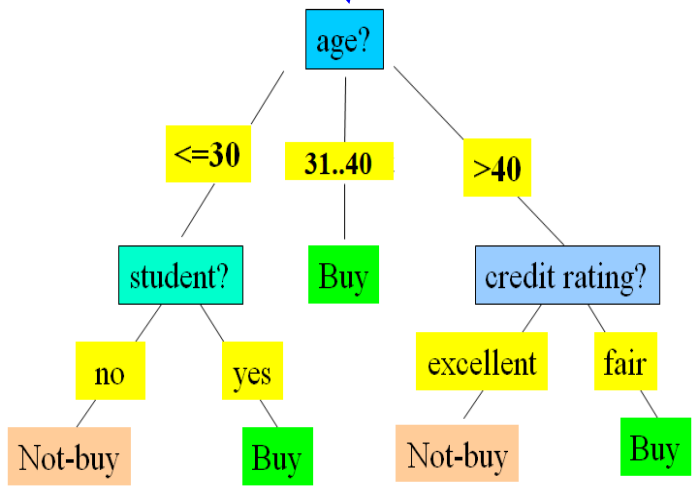
Statistical Decision / Machine Learning Approach

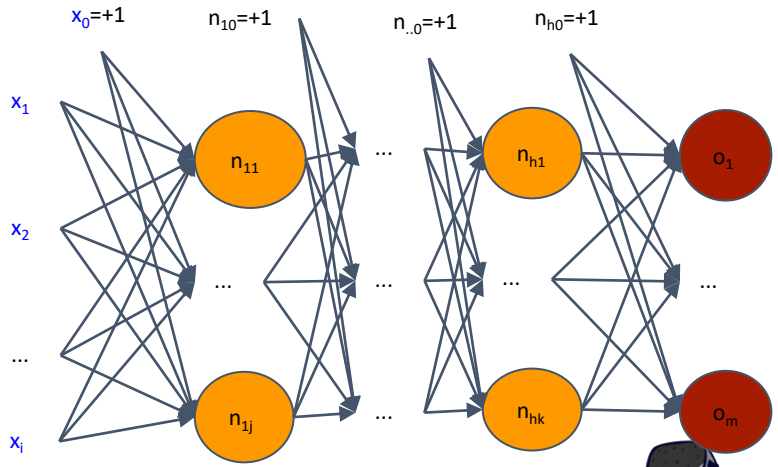
N-feature vector

age	income	student	credit_rating	buys_computer
<=30	high	no	fair	no

Discriminant function

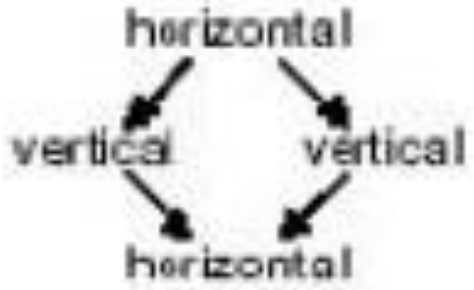
Class	Yes	No
P	0.643	0.357
P(age<=30|Y)	0.222	0.6
P(age<=31..40|Y)	0.445	
P(age>40|Y)	0.333	
….		





Structural Approach

Example: Differentiate between square and triangle

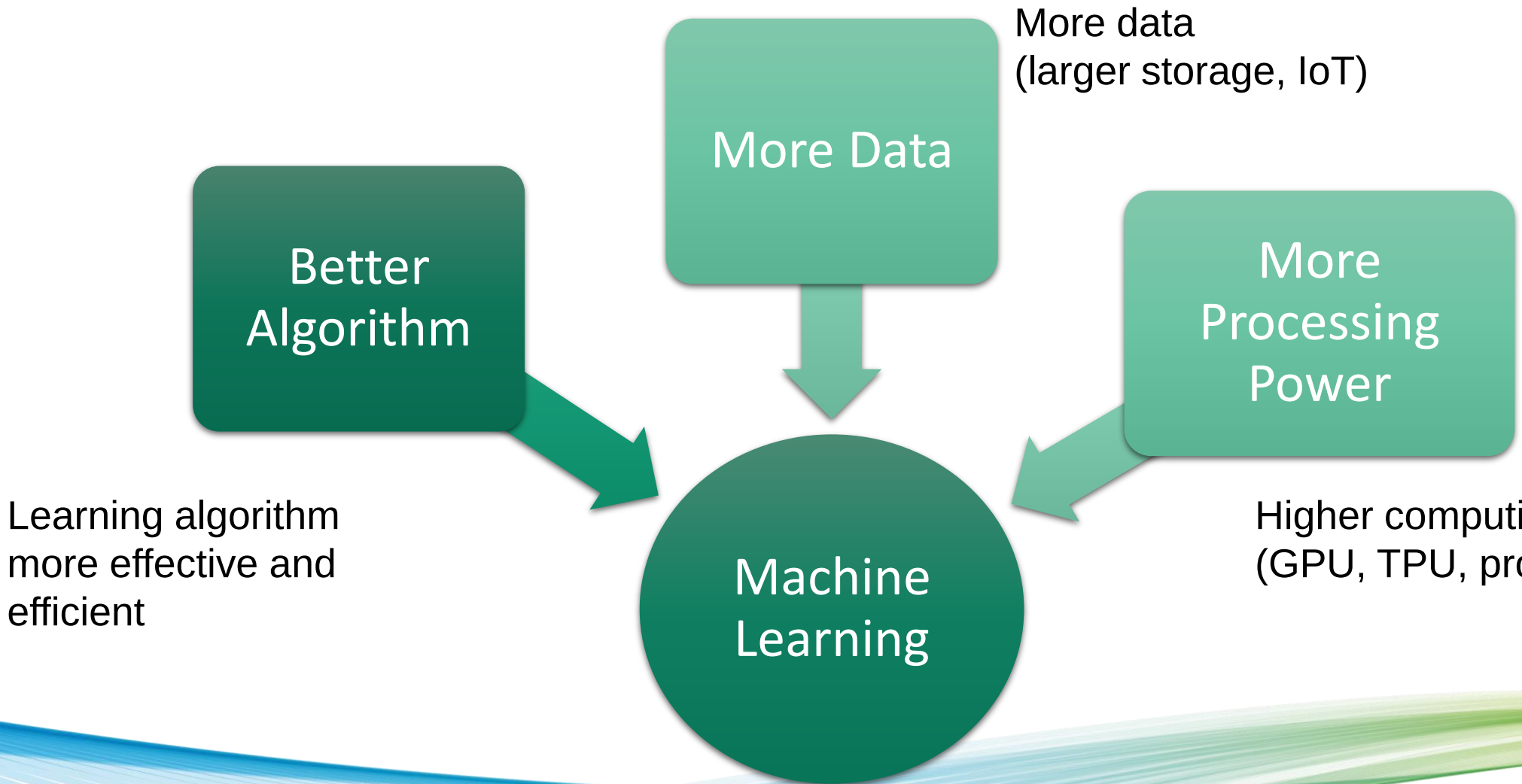


https://www.byclb.com/TR/Tutorials/neural_networks/ch1_1.htm

A structural approach extracts morphological features and their interrelationships, encoding them in relational graphs;

Classification is performed by parsing the relational graphs with syntactic grammars.

Why Machine Learning?



Summary

PR Approaches

Template-matching approach

Statistical decision approach

Structural approach

Next: Classification and Pattern Recognition System