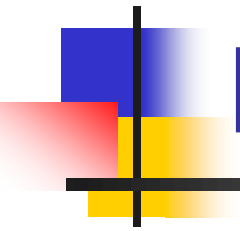
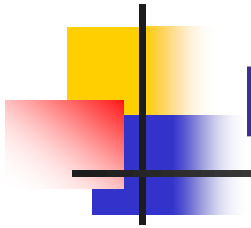


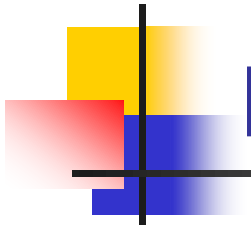
Learning from observations

- Inductive Learning - learning from examples
  - Machine Learning



Learning & Adaptation

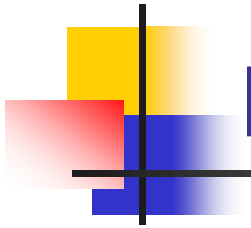
- ”Modification of a behavioral tendency by expertise.” (Webster 1984)
- ”A learning machine, broadly defined is any device whose actions are influenced by past experiences.” (Nilsson 1965)
- ”Any change in a system that allows it to perform better the second time on repetition of the same task or on another task drawn from the same population.” (Simon 1983)
- ”An improvement in information processing ability that results from information processing activity.” (Tanimoto 1990)



Machine Learning

- Machine learning involves automatic procedures that learn a task from a series of examples

- Most convenient source of examples is data



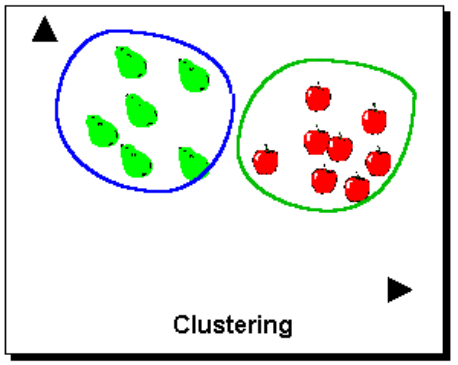
Learning

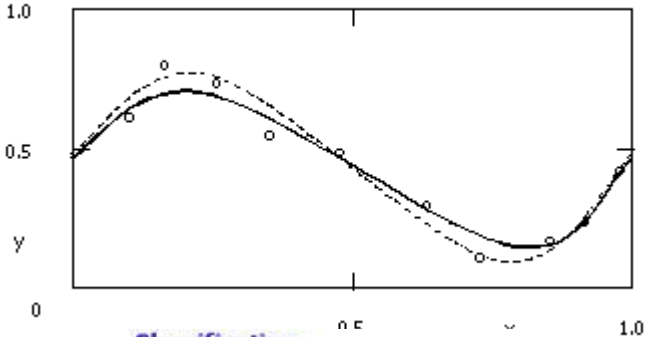
Definition:

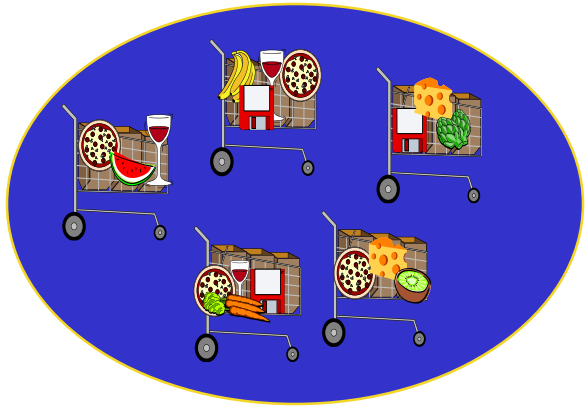
A computer program is said to **learn** from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience.

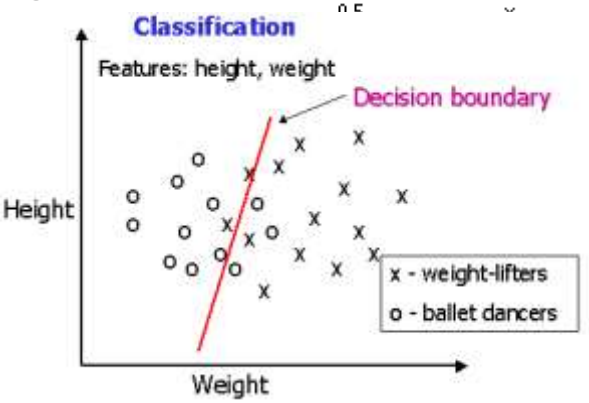
Machine Learning Models

- Classification
- Regression
- Clustering
- Time series analysis
- Association Analysis
- Sequence Discovery
- ….





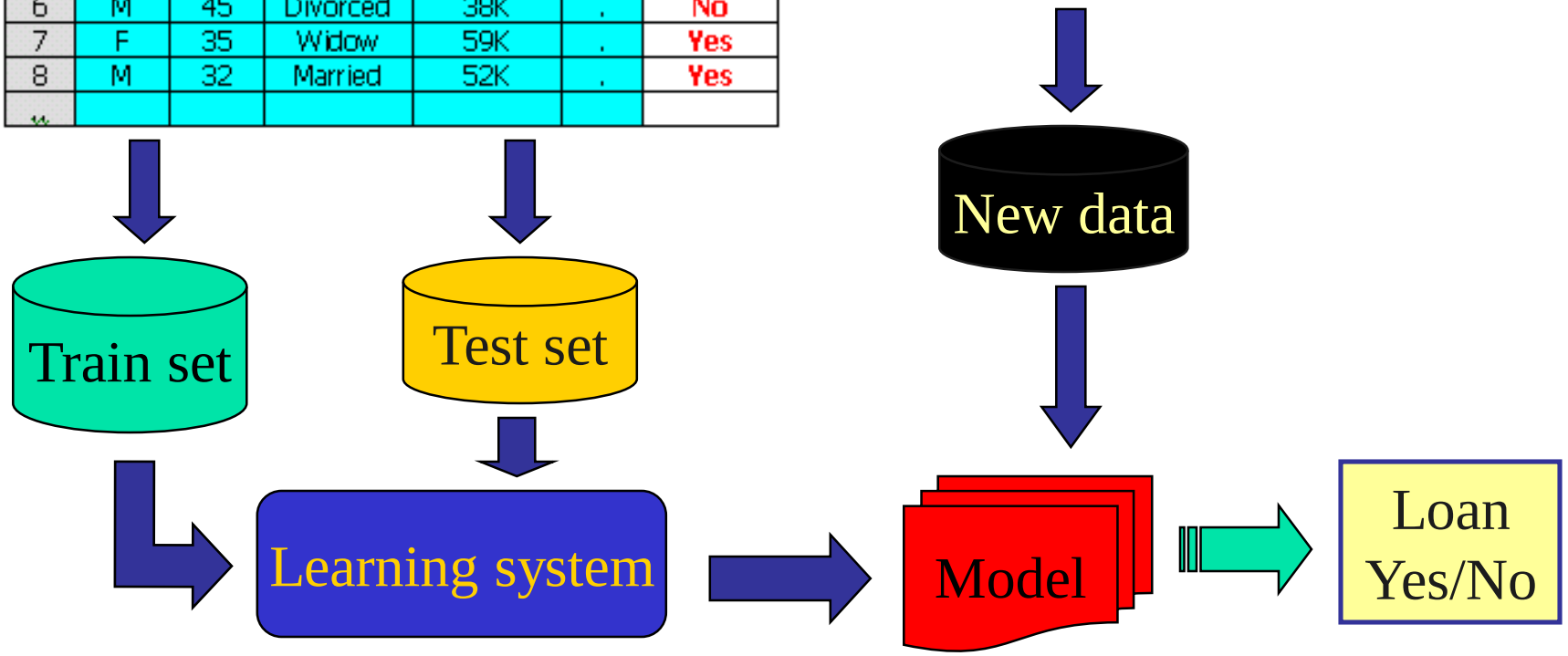


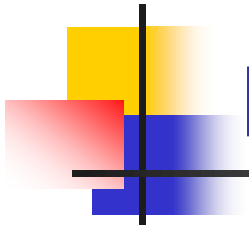


Classification example

No	Sex	Age	Marital status	Net Income	...	Loan
1	F	38	Married	45K	.	Yes
2	M	42	Married	66K	.	Yes
3	F	52	Single	43K	.	No
4	M	50	Single	70K	.	No
5	F	27	Married	40K	.	No
6	M	45	Divorced	38K	.	No
7	F	35	Widow	59K	.	Yes
8	M	32	Married	52K	.	Yes
..						

Sex	Age	Marital status	Net Income	...	Loan
F	28	Married	44K	.	?
M	47	Divorced	95K	.	?
F	30	Single	45K	.	?
M	55	Single	69K	.	?
M	45	Married	41K	.	?

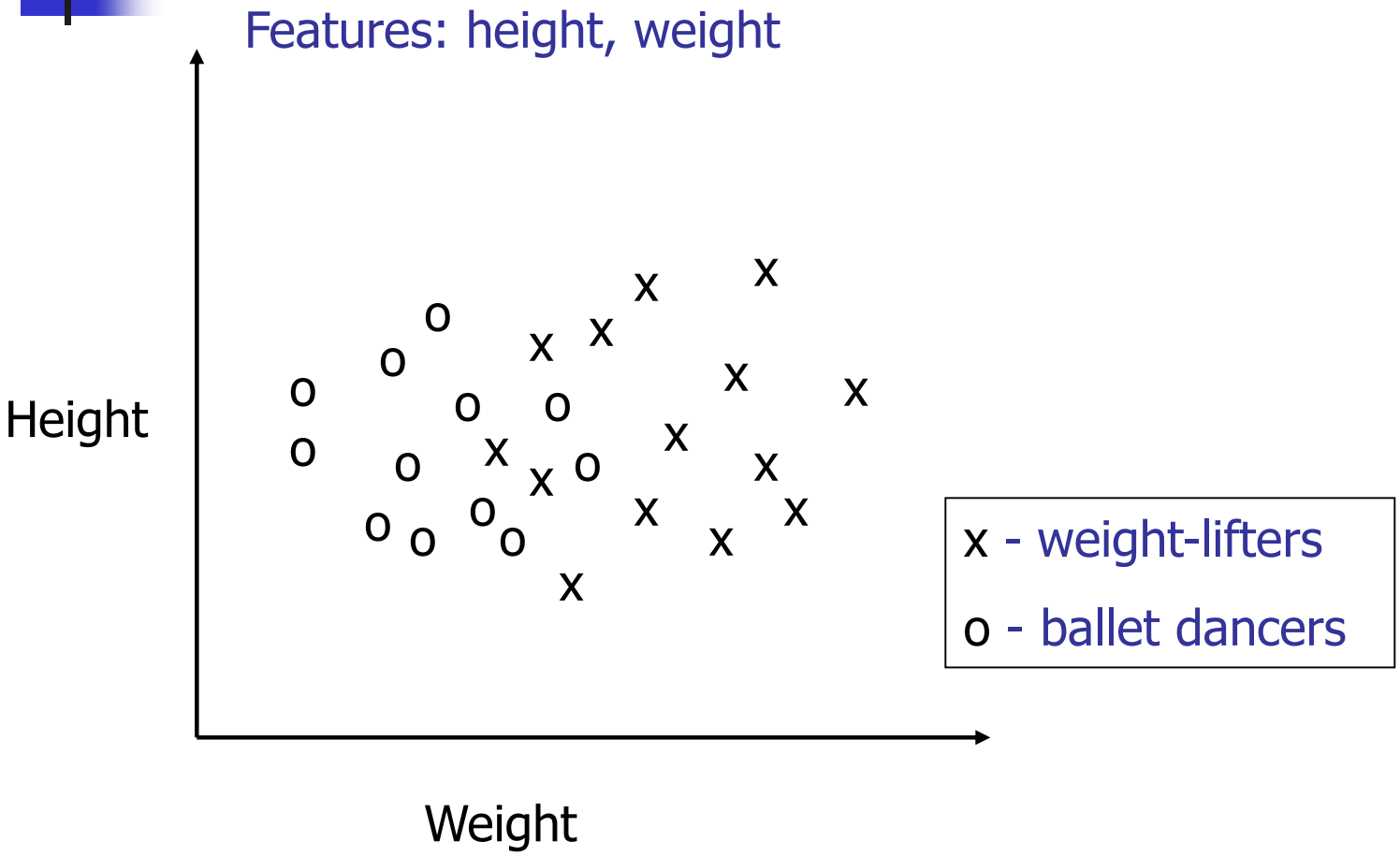




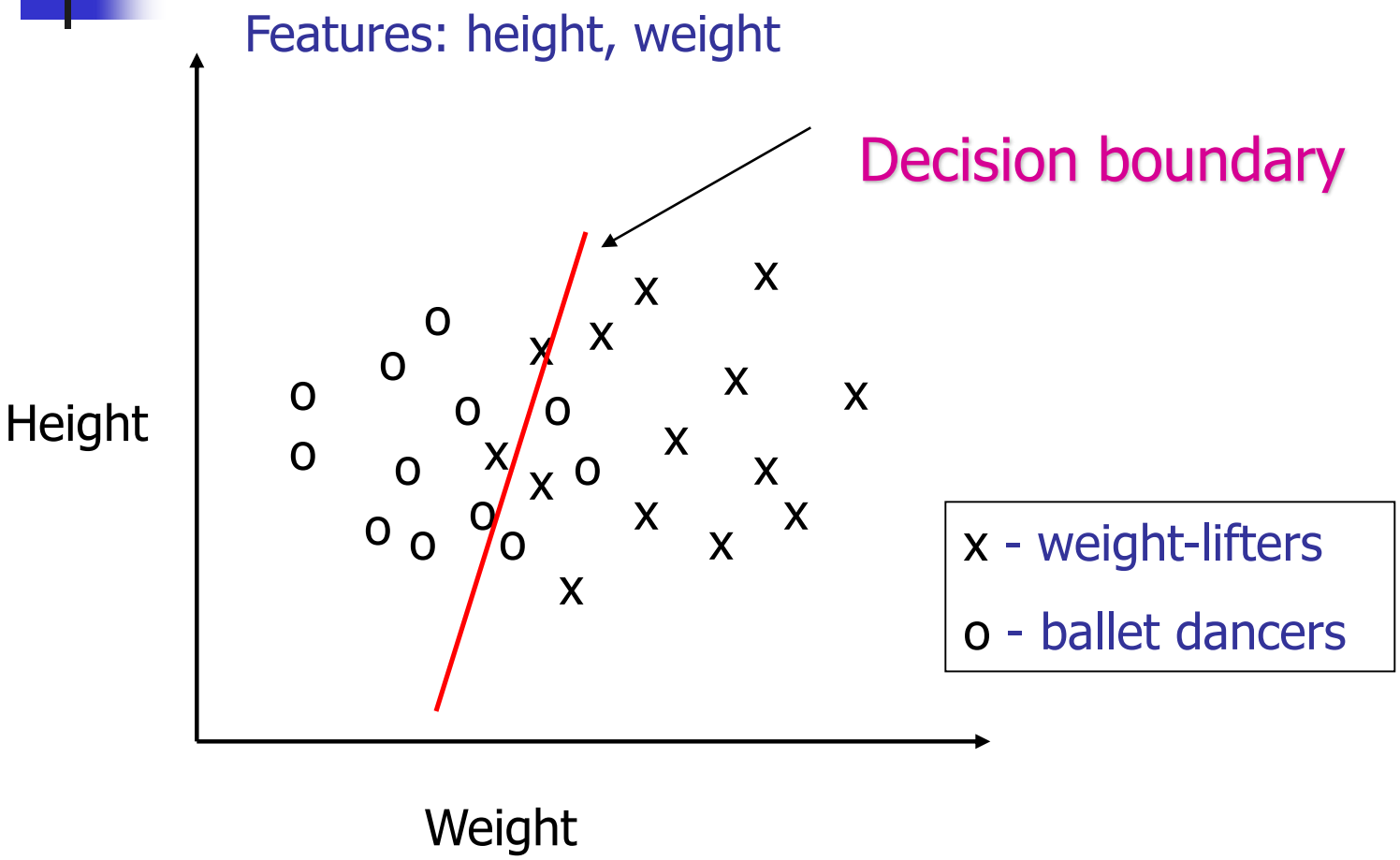
Machine Learning Methods

- Artificial Neural Networks
- Decision Trees
- Instance Based Methods (CBR, k-NN)
- Bayesian Networks
- Evolutionary Strategies
- Support Vector Machines
- ..

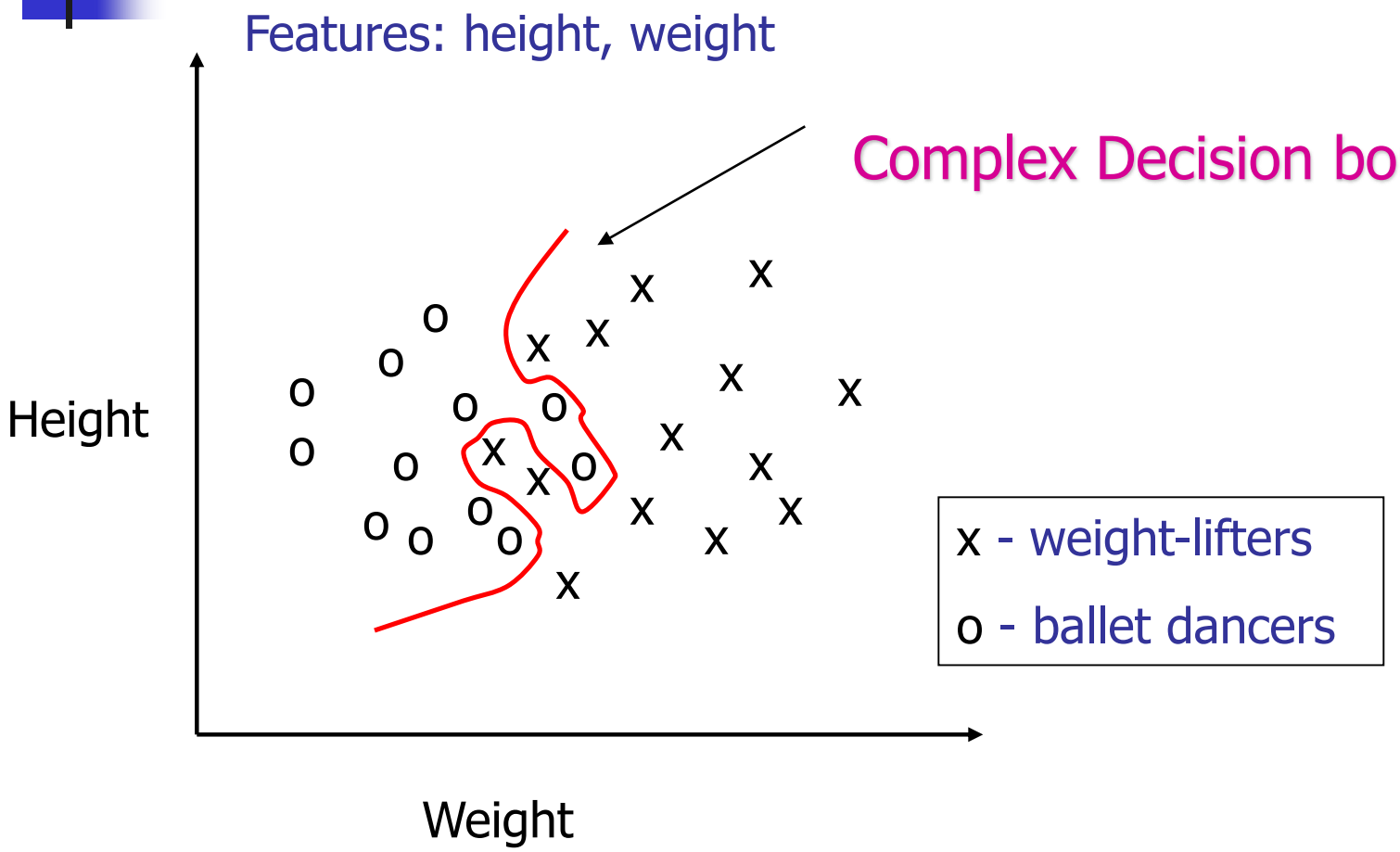
Classification example



Classification example - Simple Model



Classification example - Complex model



Note: A simple decision boundary is better than a complex one - It GENERALIZES better.

Learning Paradigms

- Supervised learning - with teacher
  - inputs and correct outputs are provided by the teacher
- Reinforced learning - with reward or punishment
  - an action is evaluated
- Unsupervised learning - with no teacher
  - no hint about correct output is given