Neural Computation

25. September 2023

Module team

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Office hour:
Every Friday 1pm-2pm
in Room UG 37

Module structure

- In-person-sessions
  - Mondays 12noon and Thursdays 1pm
  - **Carefull, rooms change**
- Videos
  - Released weekly
  - **Watch them until Thursday**
- Excercises
  - Released weekly
  - Python and PDFs

Module plan

Week	Date	Topic	Edgbaston lecturer	Dubai lecturer	CA	Exam
1	25th Sep	Introduction and Linear Models	Alex	Kashif		
2	2nd Oct	Gradient Descent Methods and Linear Classification	Jinming	Kashif		
3	9th Oct	MLP and Backpropagation	Alex	Kashif		
4	16th Oct	Convolutional Neural Networks	Jinming	Kashif		
5	23rd Oct	Auto-encoders (AEs)	Jinming	Kashif		
6	30th Oct	Consolidation week, assessment and Q/A	Alex	Kashif	CA1 (10%)	
7	6th Nov	Variational AEs	Jinming	Kashif		
8	13th Nov	Generative Adversarial Networks	Jinming	Kashif		
9	20th Nov	Recurrent Neural Networks	Jinming	Kashif		
10	27th Nov	Transformers	Alex	Kashif		
11	4th Dec	Diffusion Models	Alex	Kashif	CA2 (10%)	
May/June 2024						Final exam (80%)

Contact us:

- Office hours
  - See Canvas

Alex Krull:
Every Friday 1pm-2pm in
Room UG 37

- Teams
  - See Canvas

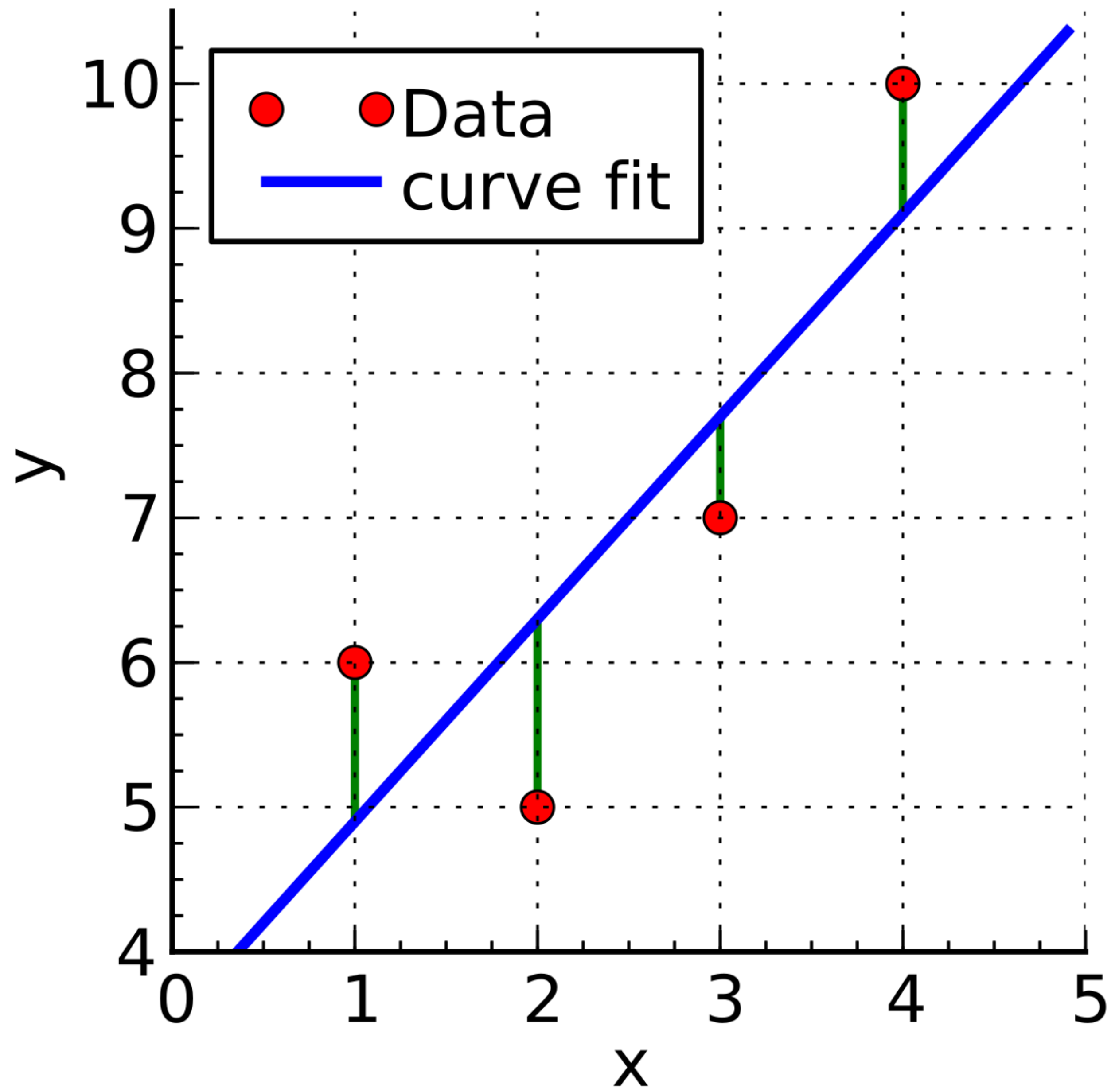
Artificial Intelligence

Machine Learning

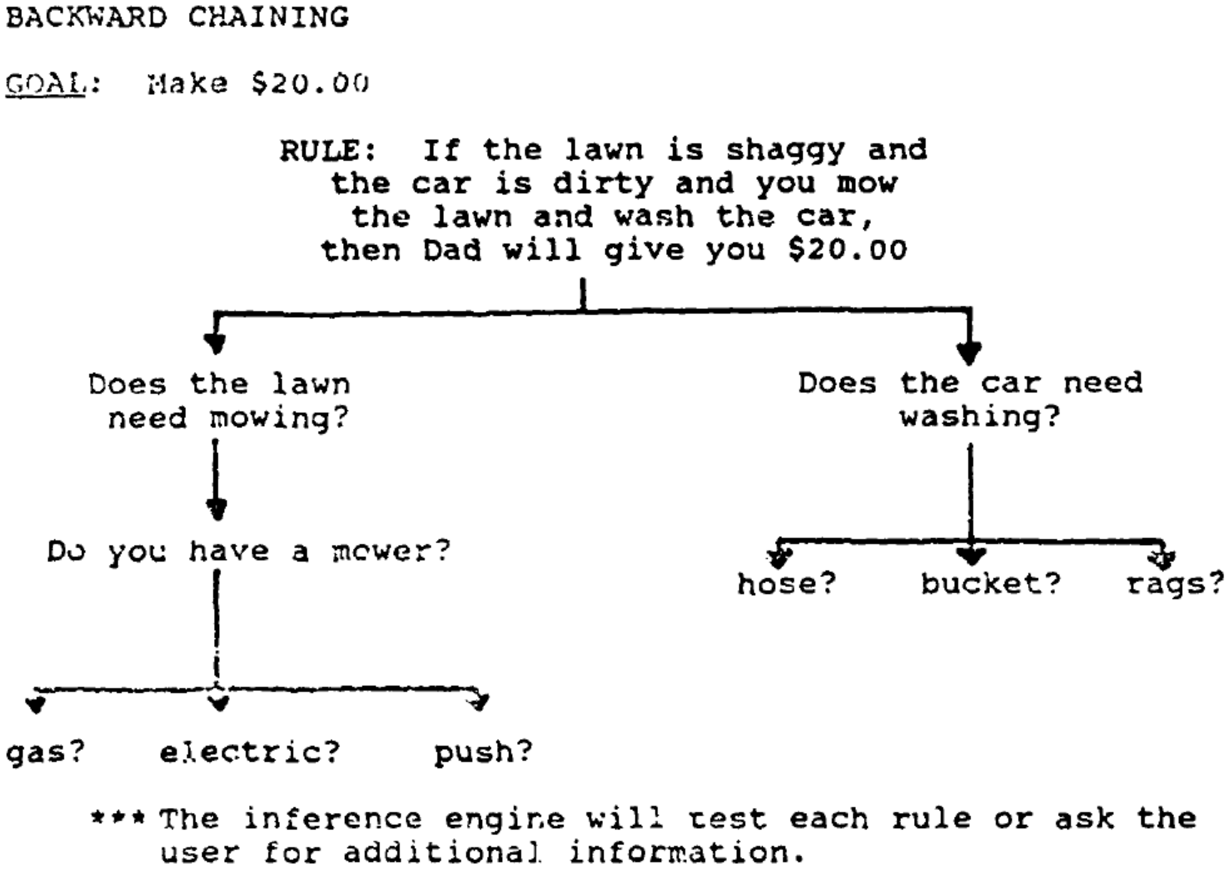
Neural Computation
(Deep Learning)

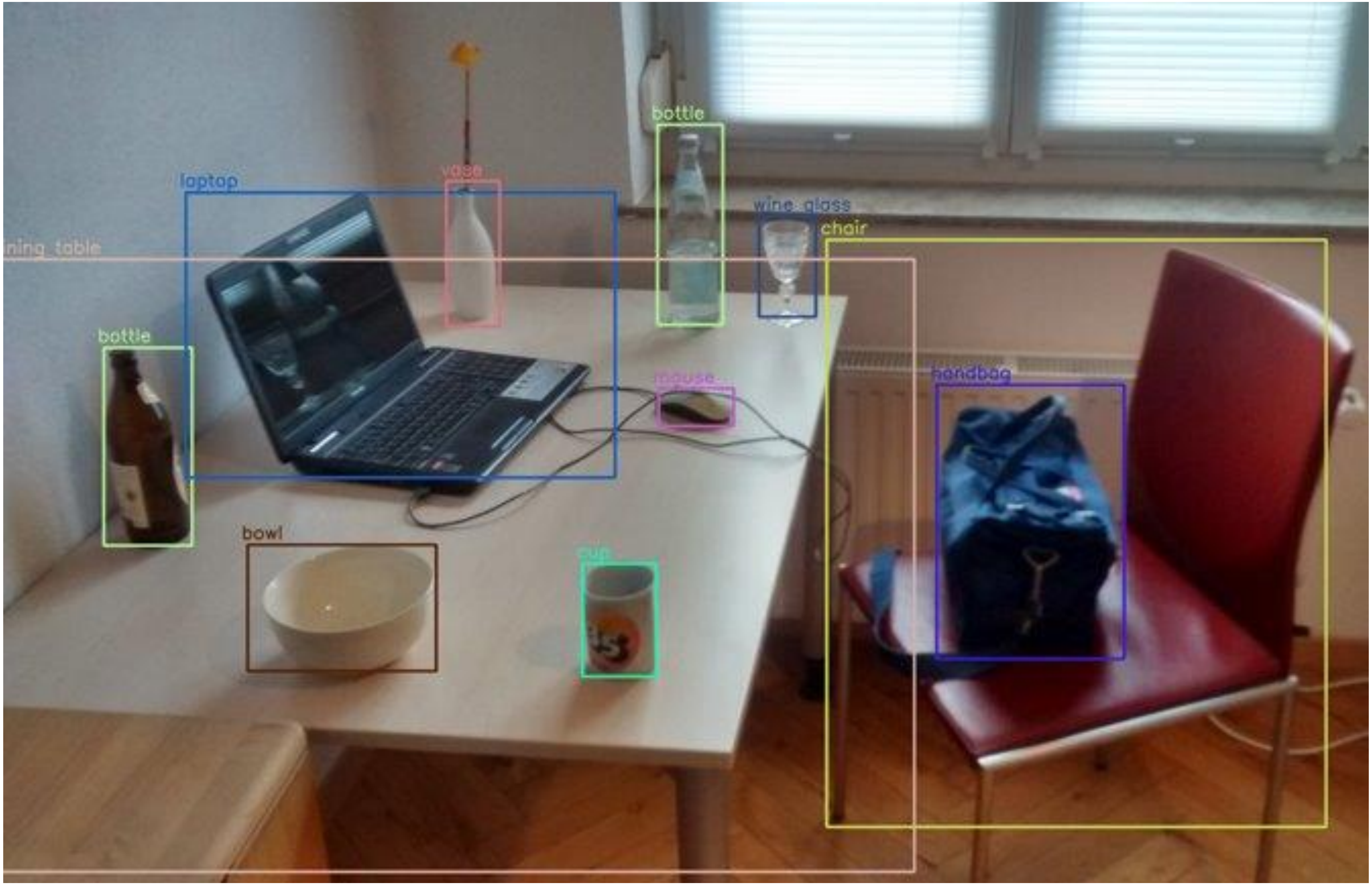

BORIS
ELECTRONIC CHESS COMPUTER
I EXPECTED THAT
OPERATION MANUAL
BORIS
THE TALKING
CHESS COMPUTER
from to
E7-E5 00
hrs min sec
BORIS
RESET
ON
OFF
TIME
RANK
B/W ENTER
BORIS IS KING
Patent Pending

Linear Regression

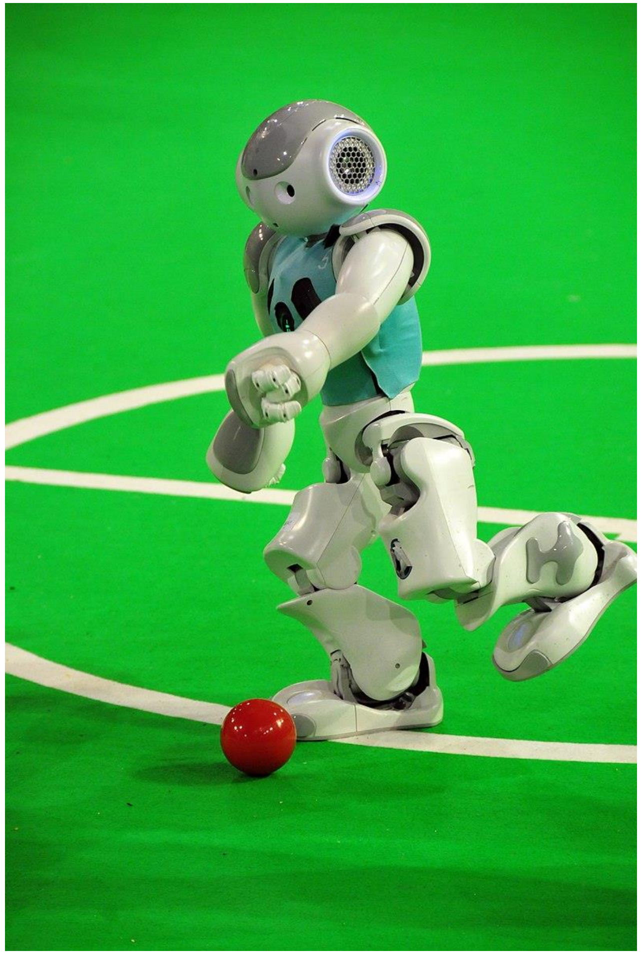


Expert Systems

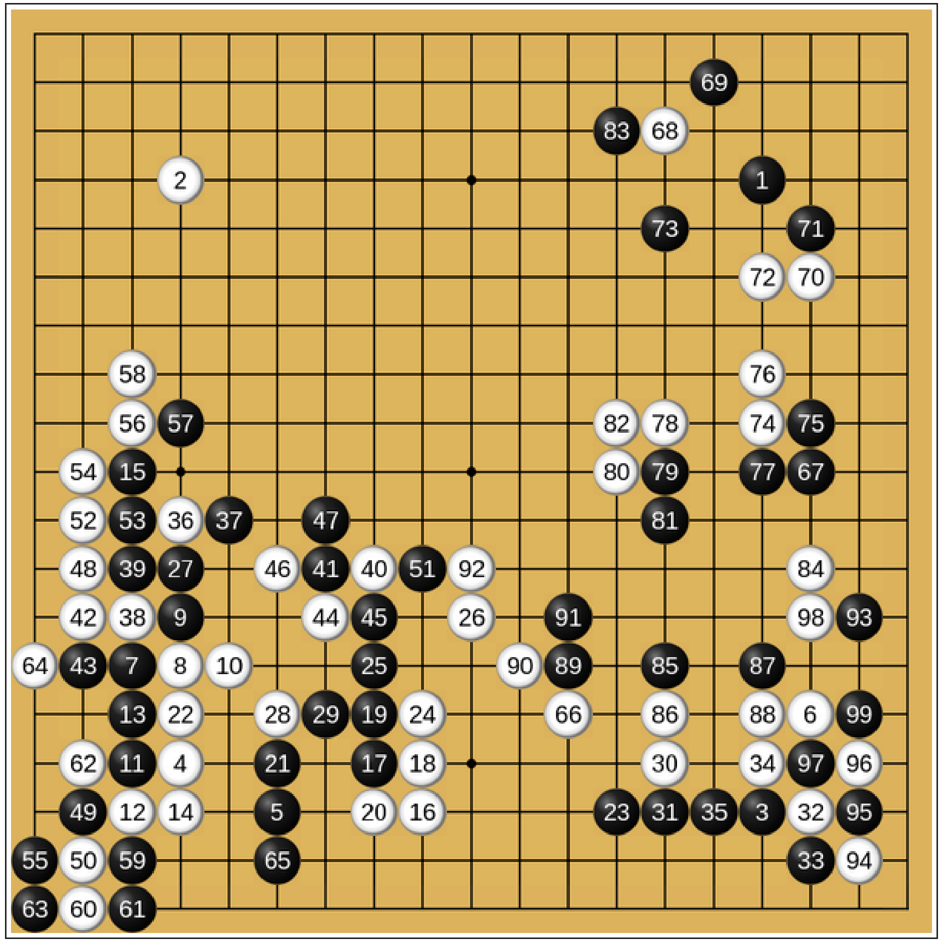



bottle
laptop
vase
wine_glass
chair
bottle
mouse
handbag
bowl
cup

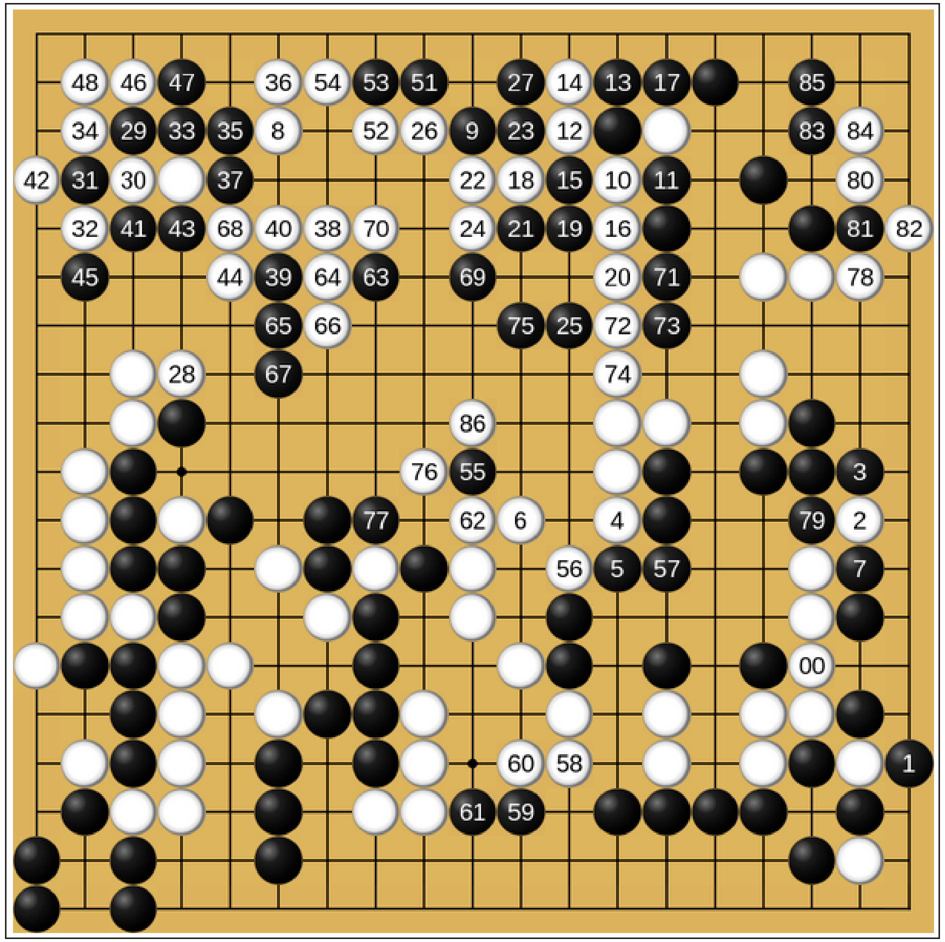

KUKA



AlphaGo



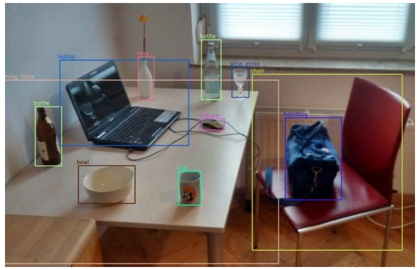
First 99 moves

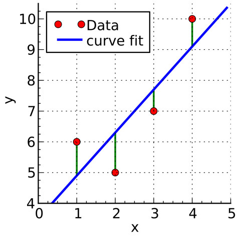


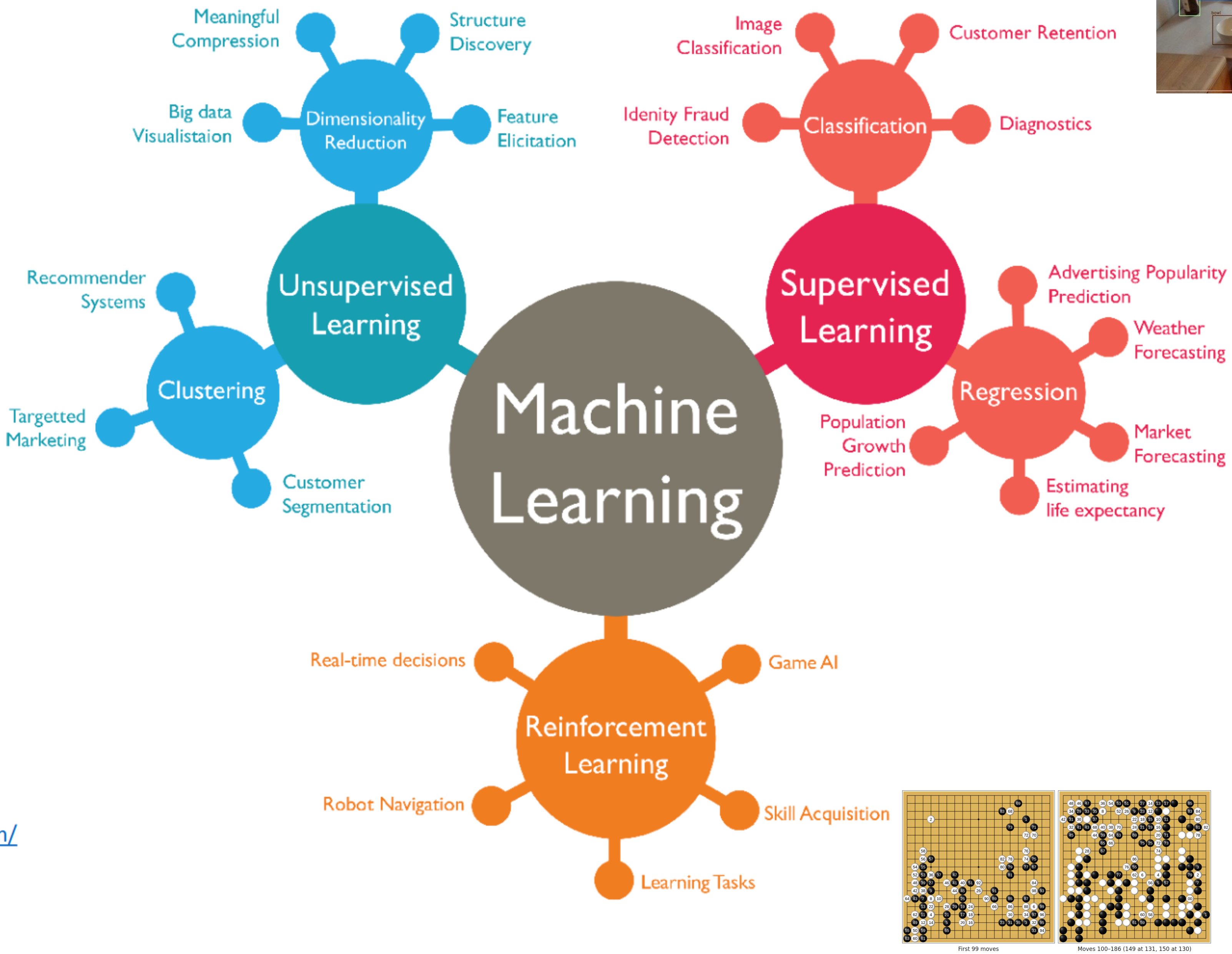
Moves 100–186 (149 at 131, 150 at 130)

DALL-E-2

Types of machine learning







https://towardsdatascience.com/machine-learning-types-2-c1291d4f04b1

What is machine learning?

- Definition by Tom Mitchell (1997)
  - An algorithm is said to learn from Experience E with respect to some class of Tasks T and Performance Measure P, if its Performance P at Task in T improves with Experience E
- Toy block building
  - E: knowledge of physical world
  - T: building a tower with toy block
  - P: how tall the tower is

Classification (T)

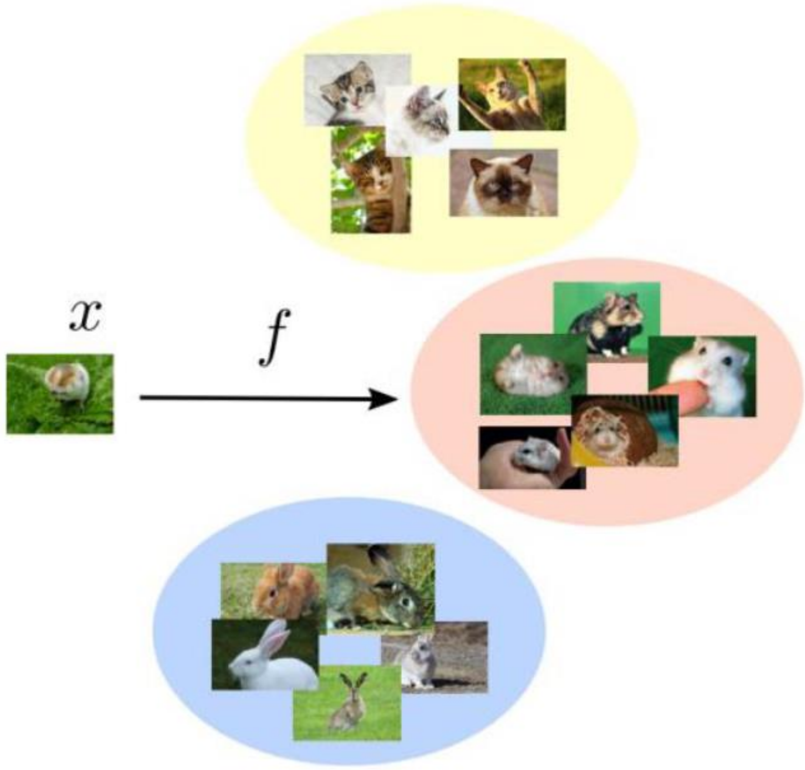
Performance (P) ?

- Construct a function

$$f: \mathbb{R}^d \mapsto \{1, \dots, k\}$$

such that if an object with features $\boldsymbol{x} \in \mathbb{R}^d$ belongs to a class $y \in \{1, \dots, k\}$ then

$$f(\boldsymbol{x}) = y$$



Experience(E)

$$D = \{(\boldsymbol{x}^1, y^1), (\boldsymbol{x}^2, y^2), \dots, (\boldsymbol{x}^n, y^n)\}$$

where $\boldsymbol{x} \in \mathbb{R}^d$ and $y \in \{1, \dots, k\}$

Regression (T)

- Predict a numerical output given some input, i.e., a function

$$f: \mathbb{R}^d \mapsto \mathbb{R}$$

- Example: house price prediction
  - Input: House information (living size, lot size, location, # floors)
  - Output: Price

Experience(E)

$$D = \{(\boldsymbol{x}^1, y^1), (\boldsymbol{x}^2, y^2), \dots, (\boldsymbol{x}^n, y^n)\}$$

where $\boldsymbol{x} \in \mathbb{R}^d$ and $y \in \mathbb{R}$

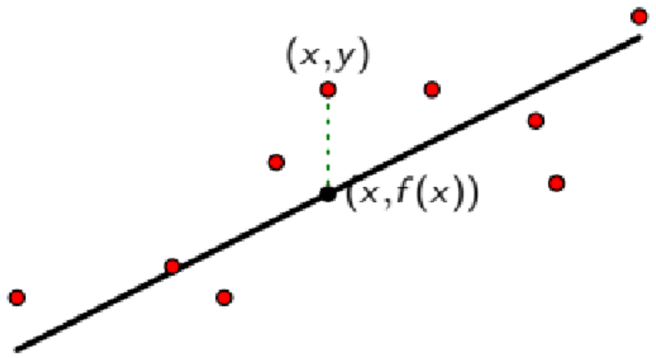
Performance (P) ?

Performance (P)

(Loss function)

- For classification, accuracy is a common performance measure
  - Proportion of correctly classified examples (typically reported as a percentage)

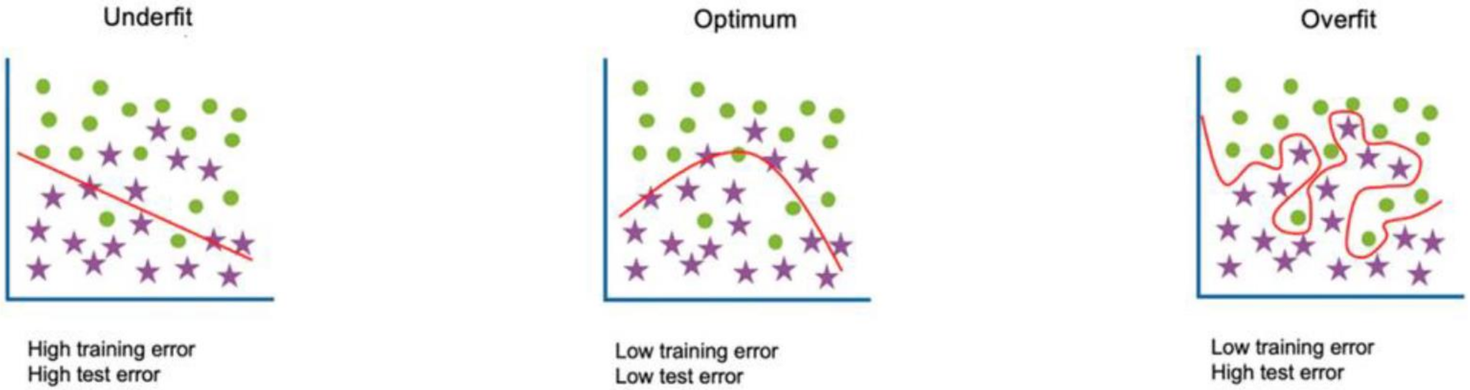
- For regression, residual is a common performance measure
  - e.g., mean of sum of square of differences



Learning is adjusting parameters

Underfitting and overfitting

- Loosely speaking, we say a model underfits when
  - training performance is poor
- We say a model overfits when
  - training performance is good but
  - test performance is poor



How to prevent:

- Overfitting
- Underfitting

?