Machine Learning – Introduction

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Machine Learning

Known under many names:

- Machine Learning
- Artificial Intelligence
- Pattern Recognition
- Data Mining
- Data Assimilation
- Big Data

Machine Learning

Examples:

- Spam Filtering
- Optical Character Recognition (OCR)
- Search Engines
- Computer Vision
- Natural Language Processing (NLP)
- Advertising
- Fraud Detection
- Robotics
- Data Prediction
- Material Discovery
- Astronomy

Human Learning

How do we learn?
Sensory stimulation

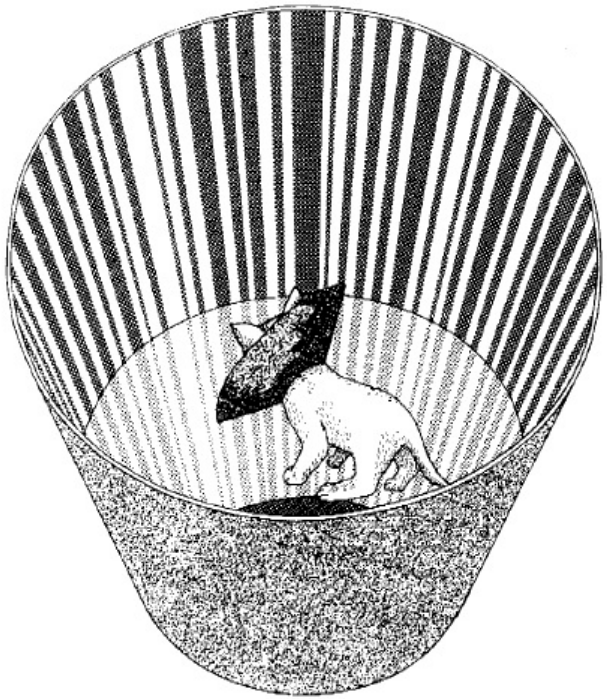
- Holy Roman Emperor Frederic II (13th century),
- spoke six languages himself,
- desired to determine the "god given" language.
- Allegedly raised newborns without human interactions,
- physical needs satisfied.
- All children died.

$\Rightarrow$ Without experience, no learning.

Animal Learning

Vision

- Sir Colin Blakemore, Grahame Cooper (1970),
- kittens brought up in an environment with either only horizontal or only vertical lines.
- Horizontal kittens show no reaction to vertical lines.
- Vertical kittens show no reaction to horizontal lines.
- No brain activity,
- blind to certain lines.



Human Learning

Vision

- Only what the environment presents is learnt.
- Efficient preparation for the future.
- Also true for human vision.
- Australian aborigines have the sharpest vision ever measured,
- about four times better than those of white ethnicity.
- Ophthalmologist Professor Fred Hollows corrected the vision of an elderly Aboriginal man back to the average white person's vision with glasses. The reaction was *"Thank you for trying, but this is hopeless. I used to be able to see much better."*
- Wide open landscapes are their environment,
- good vision in the distance is vital for survival.

Learning

Conclusion

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- How does a machine "experience"?
- A machine can measure physical quantities
- What should be measured?
- And how should this then be interpreted?

Teaching

Learning versus teaching

- Traditional teaching is from the front of the class.

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- Instructions are given.
- Procedural programming.
- Object oriented programming makes instructions dependent on the nature of the data.

Discovery

- Learning is much more fun when we make a discovery ourselves.
- Teacher led learning.
- Beautifully illustrated by Galileo.
- The inclined plane experiment is repeated by school children all over the world again and again.


DISCORSI
E
DIMOSTRAZIONI
MATEMATICHE,
intorno à due nuoue ſcienze
Attenenti alla
MECANICA & I MOVIMENTI LOCALI,
del Signor
GALILEO GALILEI LINCEO,
Filoſofo e Matematico primario del Sereniſſimo
Grand Duca di Toſcana.
Con vna Appendice del centro di grauità d'alcuni Solidi.
IN LEIDA,
Appreſſo gli Elſeuirii. M. D. C. XXXVIII.

Learning

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- *Supervised learning*: Some information is given, but conclusions are drawn independently.

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- The relationship is not linear. If it takes time t_1 to travel distance d_1 and time t_2 to travel distance d_2, then

$$\frac{d_1}{d_2} = \frac{t_1^2}{t_2^2}.$$

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- Linear relationship between a primary parameter and a secondary parameter $\Rightarrow$ kernel trick.

Learning

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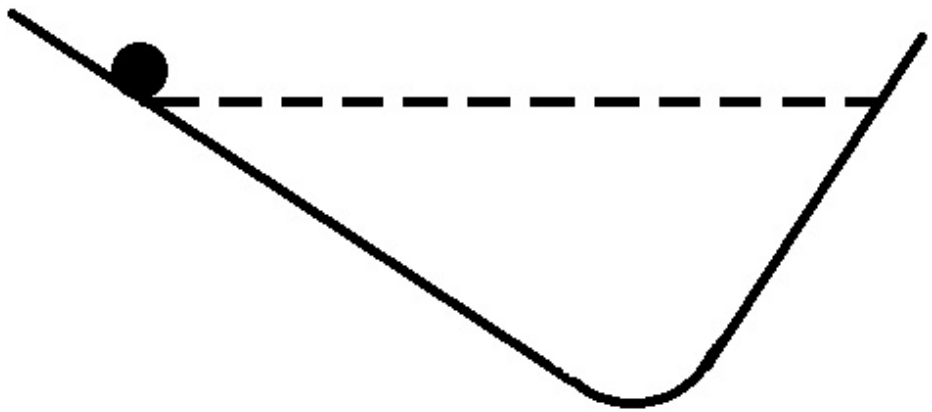
- *Feature detection*: Which parameters influence the outcome?
- Weight does not influence the experiment, however the inclination does.
- And last, but most importantly, Galileo was an *unsupervised learner*.



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- Deep learning: putting experiences in context,
- Unsupervised learning: making sense of our experiences,
- Supervised learning: some external input,
- Teaching: completely governed by external input.

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