Digital Humanities

Digital Humanities for Medieval Philosophical Sources

10. Artificial Intelligence

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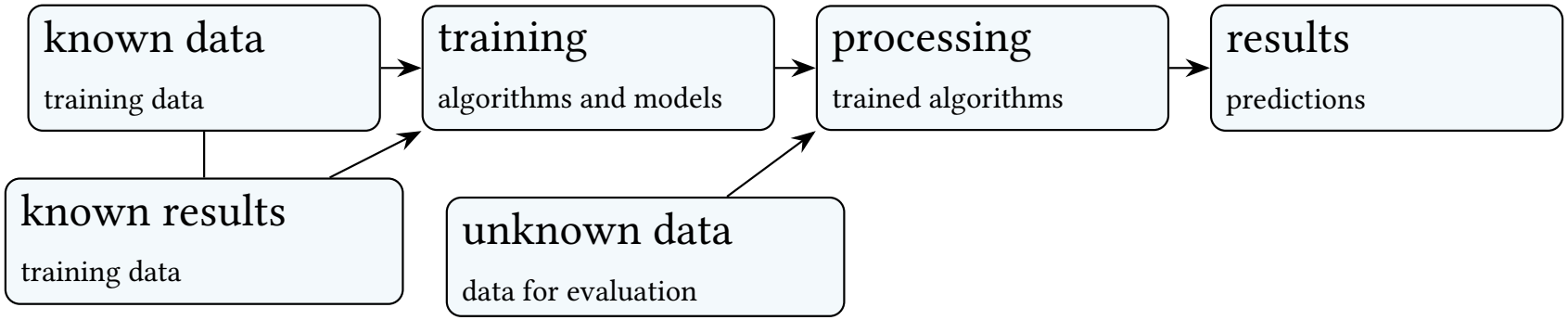
https://www.dhcluj.ro/dhm/

Artificial Intelligence (AI) = computer systems which are capable to solve problems by mimicking "cognitive" functions of the human mind.

Machine Learning (ML) = part of AI which studies the application of algorithms and statistical models without precise instructions, but based on patterns and inferences, through which the system makes decisions and emits predictions.

Instruction-based programming (classical programming):

ML-based programming:



ML: Blackbox model:

- Model = a description of a system of data based on statistical assumptions.
- Algorithm = a finite sequence of instructions that performs a given task.
- In computer processing, a data set is defined by a model and the corresponding data content. Data is processed by algorithms considering the model.
- In ML, the algorithms are generated by the computer system through inferences and statistical analyses of existing data (= training), then they can be applied to new data which correspond to the same model (= prediction)

The training

- Required components:
  - *Example:* Image recognition
  - the data model
    - it must correctly and completely describe the data
    - *Ex:* Data structure description in an image file format
  - the training data set
    - it must be statistically representative and comprise many entries
    - *Ex:* Tens of thousands of quality images and as varied as possible
  - the valid results for the training data
    - they must be correct and cover any detail expected in the results
    - *Ex:* Labels for each image
  - the adequate software and hardware system
    - the quality must be verified, system requirements are very high
    - *Ex:* Software that supports image processing, computing power (cloud?)

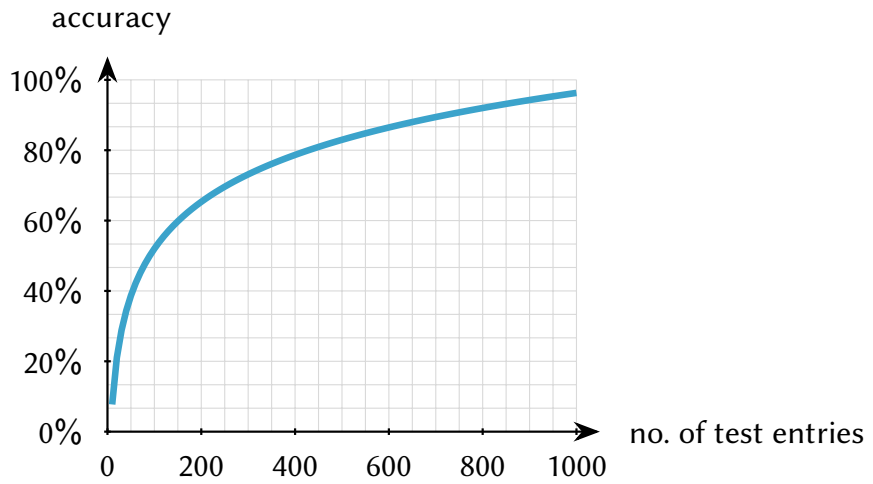
The prediction

- it will return a result set corresponding to new data, together with an indication of the accuracy of predictions

Ex: The most probable labels for the new images, and the accuracy percentage for each association

!!! The result is not cathegoric, neither necessary correct, but it is the state which the system reaches by aplying the trained algorithms from the model

- The accuracy grows logarithmic as more training data is entered:



- It is impossible to reach an accuracy of 100% (that is, absolute certitude), but most often an accuracy of 90%–99% is considered acceptable, depending on the goal.
- A large part of the effort is involved in preparing the data.

Depending on the types of data and on the types of expected results, there are different approaches of machine learning and of data models.

- The artificial intelligence is extremely specialized and requires the correct choice of the model and learning types in order to produce satisfying results.
- AI is an extremely dynamic domain today, and the approaches frequently change, therefore an exhaustive presentation is not possible.

Types of machine learning

- Supervised learning
  - training on a known model
- Unsupervised learning
  - detecting the structure of an unknown data set
- Semi-supervised learning
  - training with a known data set, then improvement with unknown data
- Reinforcement learning
  - based on reward
- Anomaly detection
  - identification of rare items
- Association rules
  - identification of rules in an unknown data set

Types of models

- Artificial neural networks
  - model based on a collection of processing nodes (“artificial neurons”) which are interconnected (“synapses”)
- Decision trees
  - a predictive model which starts from observing an element to generate conclusions regarding the element value depending on its position in the tree
- Support vector machines
  - supervised learning methods which predict if an element falls in one of 2 possible categories
- Bayesian networks
  - graphic model which represents a set of variables and their associated features
- Regression analysis
  - statistical methods of estimating the relationship between the input variables and their associated features
- Genetic algorithms
  - search algorithms which simulate the natural selection to generate new genotypes
- Foundation models (base models)
  - very large AI models, trained on a vast quantity of data and adaptable to a multitude of tasks, e.g. chat

End of the course