**Machine learning: Trends, perspectives, and prospects**

* Machine learning lets computers improve automatically through experience.
* Today, it is one of the fastest growing technical fields.
  + Recent progress has been due to development of new learning algorithms, low costs of computation and availability of online data.
* Machine learning has emerged as the prefered method for developing software for computer vision, speech recognition, natural language processing, robot control, etc.
* A machine learning model can be trained by showing it examples of the desired input-output behaviour, so it can sometimes be easier than manually anticipating and programming the desired response for all possible inputs.
  + Machine learning is the merging of computational theory with conventional statistics.
* A learning problem can be defined as the problem of improving some performance measure when executing some task using experience.
* Machine learning can be viewed as searching through a large space of candidate programs, guided by experience, to find a program that optimizes the performance metrics.
  + Many algorithms focus on approximating a function using existing data (input-output pairs) and the learning problem is to improve the accuracy of the approximation.
* Massive amounts of data has pushed for the development of more machine learning algorithms with different characteristics: being able to work with unlabeled data, minimizing privacy effects, etc.
* The most widely used ML methods are supervised learning methods.
  + Supervised learning systems always include a collection of (x, y) pairs where x is the input data and y is the output data associated with x.
    - The goal is to produce a prediction y\* in response to a never seen before input.
  + Supervised learning algorithms include classifiers, regressors, object detection in images, etc.
  + Supervised learning systems normally form predictions via a learned mapping f(x) which produces an output y for each input x.
  + Some examples of supervised learning algorithms are: decision trees, decision forests, logistic regression, linear regression, support vector machines, neural networks, kernel machines and Bayesian classifiers. Also various of these methods can be combined to create ensemble models.
  + One of the highest performing algorithms in supervised learning is deep neural networks, which are multilayer networks of various neurons, which each compute a certain function.
    - The optimization of neural networks is often gradient based optimization algorithms to adjust parameters in the functions.
    - Multiprocessing can be used to modify various parameters at the same time.
* Another paradigm of machine learning is unsupervised learning.
  + Unsupervised learning consists only of unlabeled data and the algorithm is tasked in finding patterns, structures and similarities in the data.
  + Some of the tasks used with unsupervised learning algorithms are clustering and dimensionality reduction.
* A third major ML paradigm is reinforcement learning.
  + Reinforcement learning indicates the best action to take, instead of predicting an output.
    - The difference in a stock trading bot would be: supervised learning predicts the stock price while reinforcement learning just tells if it would be better to buy, hold or sell.
  + Reinforcement learning uses rewards to train the algorithm: if the algorithm indicates the correct action there is a positive reward, if not there is a negative reward.
  + Reinforcement learning uses many concepts from control-theory, such as: value iteration, policy iteration, etc.
* Other paradigms include semi-supervised learning, which can help augment labeled data using unlabeled data.