

Foundation to Machine Learning

Waziri Sheboghola

University of Dodoma

April 10, 2019

Truth

Machines don't learn.

Machine Learning

Subfield of computer science that is concerned with building algorithms, which rely on the collection of examples of the world problems to become useful.

Applications

- Text classification
- Natural Language Processing
- Computer vision tasks, eg. Image recognition, face recognition
- Medical diagnosis
- Recommendation systems
- Games eg. AlphaGo
- Speech recognition eg. Siri, Google Home

Types of Machine Learning

Machine Learning problems can be:-

- 1 Supervised Learning
- 2 Unsupervised Learning
- 3 Reinforcement Learning

Supervised Learning

Terminologies

- Example: an object or instance of data used
- Dataset: collection of examples
- Features: set of attributes, often represented as vector (feature vector), associated with an object
- Labels/Target
 - ① In classification, category associated with an example
 - ② In regression, real-valued numbers

Supervised Learning

Goal

The goal of Supervised Learning algorithm is to use the dataset to create a model that takes feature vector as input and output information that allows to deduce a label for that feature vector.

Unsupervised Learning

- Unlabeled examples

Goal

The goal of Unsupervised Learning is to create a model that take a feature vector and either transform it into another vector or a value that can be used to solve a problem.

- Clustering, model return cluster id
- Dimensionality reduction, model return a feature vector that have fewer features

Reinforcement Learning

Think of a machine in a certain environment that is able to perceive the state of that environment as vector of features. The machine can execute actions in every state. Different actions brings different rewards and could also move the machine from one state to another.

Goal

The goal of Reinforcement Learning algorithm is to learn a **policy**.

Policy is a function that takes the feature vector of a state and output an optimal action to execute in that state.

How it works?

Example

Let's consider a problem in which we want to predict whether a person has cancer or not.

How it works?

- 1 Let's frame this as supervised learning problem in which we first start with gathering data.
- 2 Data for supervised learning problems is a collection of pairs inputs, outputs

After having data, we need to choose a Learning algorithm .

How it works?

Model

$$y = wx + b$$

Goal

The goal of Learning algorithm is to leverage the dataset and find optimal values of parameters **w** and **b**.

How?

How it works?

Optimization

What you'll hear the most with regard to a model?

- 1 Parameters
- 2 Hyperparameters

What you'll hear the most with regard to a model?

- Parameters are variables that define the model learned by the learning algorithm. They are modified by the learning algorithm based on the training data. We train models to find these variables.
- Hyperparameter is a property of learning algorithm mostly, having a numerical value. They influence the way the algorithm works.

Fundamental Algorithms

- 1 Linear regression
- 2 Logistic regression
- 3 Decision tree
- 4 Random Forest *
- 5 Support Vector Machine
- 6 k-Nearest Neighbors
- 7 Neural Networks

Linear Regression

Best practices

- Feature Engineering
- Learning algorithm selection
- Data splitting
- Underfitting and overfitting
- Regularization
- Model performance assesment
- Hyperparameter tuning

Thank you.