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Machine Learning Engineering

1. Supervised Learning :-

Regression

Linear Regression

Logistic Regression

Polynomial Regression

Ridge Regression & Lasso Regression

Working

Math behind the Intuition

Learning the concepts of Coefficient and Residuals

Cost function

Feature scaling

Non-Linearity and non-Invertibility

Optimizing Linear Functions

Standard Error

Gradient decent intuition

Hypothesis Representation

Regularized Regressions

Regularization

L1 and L2 Regularization

Filter method

Wrapper method

Embedded Method

Decision Boundary

Case study using SciKit Learn

Classification

KNN

Intuition

Eager and Lazy Classifiers

Other names of KNN classifiers

How to Choose k?

Distance metrics used in KNN

Mathematically Demystifying KNN Algorithm

Weighted KNN

Characteristics of KNN Algorithm

Strength and weakness

Weighted KNN

Improvements of KNN performance

Fuzzy KNN

Case Study using SciKit Learn

Applying cross validation techniques and analyzing the Algorithm behaviour.

Improvisation on the Algorithm



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Support Vector Machine

Intuition

Visualize in Vector space

Large Margin Intuition

Significance of Binary Labels [+1, -1]

Inequalities and region

Maximum Margin: Formalization

Linear Support Vector machine
Non-Linear SVM
Hard Margin and Soft Margin
Kernel Tricks
C parameter?
Decision Functions
Multiclass Problem
Challenges on Multiclass classification
Polynomial Kernel
Gaussian RBF Kernel
SVR
Kernelized SVM
Tweak Performance
Upweighting
Drift Problem
Case Study using SciKit Learn
Strength and weakness



Naive Bayes Algorithm

Intuition
Demystifying Probability
Conditional Probability
Bayes Theorem
Estimation of probability for the Dataset
Likelihoods
Gaussian, Bernoulli, Multinomial.
Discriminant Functions
Expectation Maximization Algorithm –EM
Case Study using SciKit Learn
Strength and weakness

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Decision Tree Classifiers

Intuition

Training and Visualization

Predictions

Estimating Class Probabilities

Computational Complexity

CART Algorithm

HUNTS Algorithm

Gini Index, Entropy and Classification Error

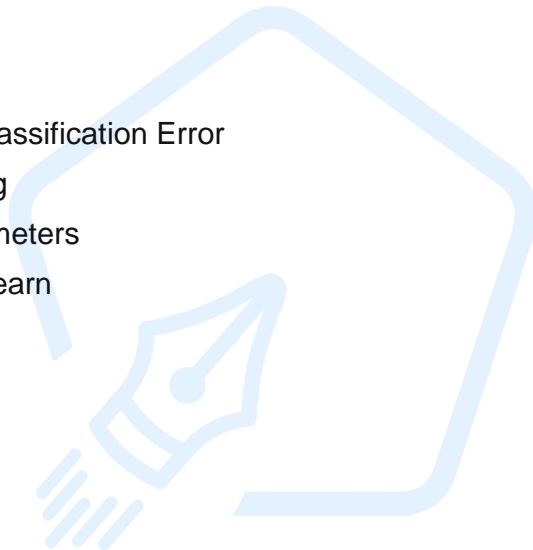
Bagging and Bootstrapping

Regularization Hyperparameters

Case Study using SciKit Learn

Data Fragmentation

Tree Replication



Ensemble Learning & Random Forest

Intuition

Voting Classifiers

Bagging and Pasting in Scikit-Learn

Out-of-Bag Evaluation

Random Patches and Random Subspaces

Random Forests

Boosting

AdaBoost

Gradient Boosting

Stacking

XGBoost

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Feature Importance
Advantages and Disadvantages of The Algorithm
Performance Evaluation
Case Studies using Scikit-Learn

2. Unsupervised Learning :-

[Introduction to clustering](#)

Introduction to clustering
Types of Clustering
Optimizing Objective
Data Characteristics
Prototype Based Approach
o K Means
Improvised K-Means Paper Implementations
Graph Based Approach
o Hierarchical Clustering
Density Based Approach
o DBSCAN



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K MEANS *Mastering The Future*

Intuition
Prototype Based Approach
Mathematically Demystifying KNN Algorithm
Expoloring K
Elbow Method
Characteristics of K-Means Clustering
Random Initialization
Data compression techniques
Distance Metrics for K Means

Strength and Weakness
Time and Space Complexity
Performance Evaluation
Improvised K-Means Implementations
Case Study using SciKit-Learn

Hierarchical Clustering

Intuition
Graph based approach
Agglomerative and Divisive
Dendrograms
Proximity Methods
Strength and Weakness
Time and Space Complexity



DBSCAN

Intuition
Density Based Approach
Mathematically Demystifying DBSCAN Algorithm
Analyzing Core points Border Point and Noise Points
Clustering Tendency
Cluster Evaluation Metrics
Cohesion and Separation
Silhouette coefficient
Time and space complexity
Strength and Weakness
Case Study using SciKit-Learn

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Distance Measurements

Euclidian Distances
Squared Euclidian Distances
Manhattan Distance
Minkowski distance
Cosine measure
Jaccard distance

Data Mining

Association Analysis –Apriori Algorithm
Anomaly Detection

Natural Language Processing

Python Texts
Working with Text PDF and Other Files
Spacy Basics, NLTK
Stemming, Lemmatization, Stop Words
Speech Tagging and Named Entity Recognition
Text Classification
Semantics and Sentimental Analysis
Topics Modeling's
Case Study using TensorFlow
Case Studies And Implementation Of NLP:

Sentimental Analysis
Chabots

Deep Learning Engineering

Artificial Neural Network - ANN

Transforming Biological neuron to Artificial Neurons

Logical Computations with Neurons

Single Layer Perceptron

Sequential Modelling

Multi-Layer Perceptron

Activation Functions

Loss functions

Vanishing/Exploding Gradients Problems

Batch Normalization

Learning Rates

Train Test and Validation

Overfitting and Underfitting Problems

Dealing with Data Augmentation.

One Hot Encoding

Dropout

Gradient Clipping

Convolution Neural Network - CNN

Intuition

Zero Padding

Convolution Layers

Max Pooling

Back Propagation

Weights and its Importance

Classification MLPs

Backpropagation



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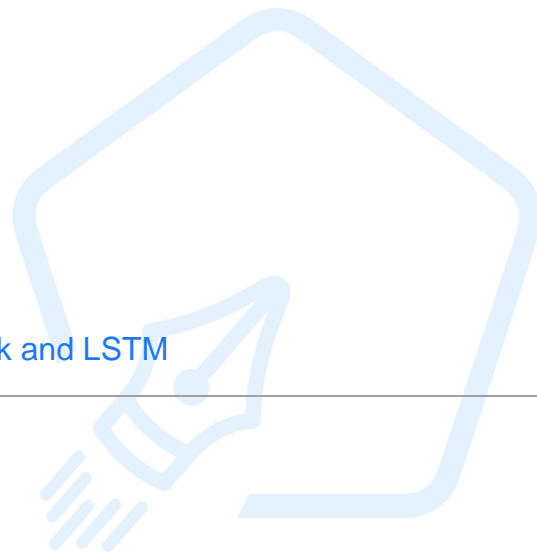
Dealing with Augmented Data
Reusing Pretrained Layers
Transfer Learning with Keras
Unsupervised Pretraining
Faster Optimizers
Momentum Optimization
Batch Size
Max-Norm Regularization
Fine Tuning
CNN Architectures
Self-Organizing Maps
Boltzmann Mechanism
Autoencoders

Recurrent Neural Network and LSTM

Intuition
RNN
Bidirectional RNN'S
LSTM
Memory Requirements

Deep Diving into Neural Network

Discussion on LeNet-5
Discussion on AlexNet
Discussion on GoogLeNet
Discussion on VGGNet
Discussion on ResNet
Using Pretrained Models from Keras
Pretrained Models for Transfer Learning
Classification and Localization



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Object Detection
Fully Convolutional Networks (FCNs)
You Only Look Once (YOLO)
Time Series Analysis
Generative Adversarial Network
Deploying Deep Learning Models using Django

Exploring Neural Network using TensorFlow and Keras

TensorFlow and Keras Initiation
Tensors and Operations
Tensors with NumPy
Placeholders
Type Conversions
Variables
Data Structures Indepth
TensorFlow Functions and Graphs
Building an Image Classifier
Using Sequential API to build Regression MLP
Using Sequential API to build Complex Models
Using the Sub classing API Saving and Restoring a Model
Implementing Callbacks
Visualization Using Tensor Board
Fine-Tuning Neural Network Hyperparameters
Hidden Layers
Learning Rate, Batch Size and Other Hyperparameters
Customizing Metrics, Layers, Training Loops , Models and Training Algorithms
Custom Loss Functions
Autograph and Tracing
TF Function Rules

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Fine Tuning Data Science Algorithm

Demystifying Diagnostic Report for Learning Models

Feature Engineering and Model Selection

Underfitting and overfitting

Bias, Variance Trade-off / F1 scores

Confusion matrix

Accuracy metrics

Univariate, Bivariate, Multivariate Dataset

Evaluating machine learning model

ROC Curves

Hyper parameter tuning

Importance of Data and its quality

Attributes Types

Feature selection and Feature extraction

Stepwise Selection

Loss Function

Curse of Dimensionality

ChiSquare Test

Impact on Outliers

Cohen's D Statistics

Error Analysis

General Distance metrics

Graph analysis on Datasets

Regularization

MSE, RMSE, MSE

Feature Slicing

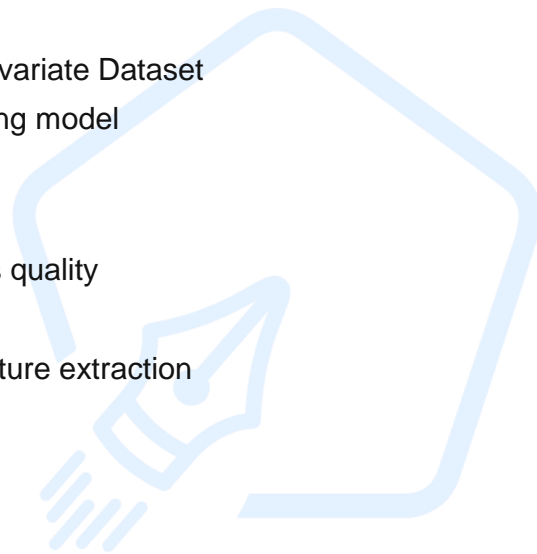
Correlation and Causation

Training /Validation /Testing Data

Learning Rate

Confidence Intervals

Degree of Freedom



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Coefficients and Collinearity

P value

Dimensionality Reduction Techniques

1. PCA

2. LDA

3. QDA

Intuition on Dimensionality Reduction

Geometrical intuition.

Alternative formulation of PCA: distance minimization

Eigenvalues and eigenvectors.

PCA for dimensionality reduction and visualization.

Visualize MNIST dataset.

Limitations of PCA

Ts-SNE Estimator for Dimensionality Reduction

Impact on Algorithm



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Cross Validation Techniques

Holdout Method

K-Fold Cross Validation

Stratified K-Fold Cross Validation

Leave-One-Out Cross Validation

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