PENTAGON SPACE
Mastering The Future

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 intuation
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

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

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

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

K MEANS

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

Distance Measurements

Euclidian Distances

Squared Euclidian Distances

Manhattan Distance

Minkowski distance

Cosine measure

Jaccard distance

Data Mining

Association Analysis –Apriori Algorithm

Anomaly Detection

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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

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

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 Initation
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 / F1scores
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

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

Cross Validation Techniques

Holdout Method

K-Fold Cross Validation

Stratified K-Fold Cross Validation

Leave-One-Out Cross Validation