AI Using Python

Python

Duration: 6 Months

Introduction To Python

- Why Python
- Application areas of python
- Python implementations
  - Cpython
  - Jython
  - Ironpython
  - Pypy
- Python versions
- Installing python
- Python interpreter architecture
  - Python byte code compiler
  - Python virtual machine(pvm)

Writing and Executing First Python Program

- Using interactive mode
- Using script mode
  - General text editor and command window
  - Idle editor and idle shell
- Understanding print() function
- How to compile python program explicitly

Python Language Fundamentals

- Character set
- Keywords
- Comments
- Variables
- Literals
- Operators
- Reading input from console
- Parsing string to int, float

Python Conditional Statements

- If statement
- If else statement
- If elif statement
- If elif else statement
- Nested if statement

Looping Statements

- While loop
- For loop
- Nested loops
- Pass, break and continue keywords

Standard Data Types

- Int, float, complex, bool, nonetype
- Str, list, tuple, range
- Dict, set, frozenset

String Handling

- What is string
- String representations
- Unicode string
- String functions, methods
- String indexing and slicing
- String formatting

Python List

- Creating and accessing lists
- Indexing and slicing lists
- List methods
- Nested lists
- List comprehension

Python Tuple

- Creating tuple
- Accessing tuple
- Immutability of tuple

Python Set

- How to create a set
- Iteration over sets
- Python set methods
- Python frozenset

Python Dictionary

- Creating a dictionary
- Dictionary methods
- Accessing values from dictionary
- Updating dictionary
- Iterating dictionary
- Dictionary comprehension

Python Functions

- Defining a function
- Calling a function
- Types of functions
- Function arguments
  - Positional arguments, keyword arguments
  - Default arguments, non-default arguments
  - Arbitrary arguments, keyword arbitrary arguments
- Function return statement
- Nested function
- Function as argument
- Function as return statement
- Decorator function
- Closure
- Map(), filter(), reduce(), any() functions
- Anonymous or lambda function

Modules & Packages

- Why modules
- Script v/s module
- Importing module
- Standard v/s third party modules
- Why packages
- Understanding pip utility

File I/O

- Introduction to file handling
- File modes
- Functions and methods related to file handling
- Understanding with block

Regular Expressions(Regex)

- Need of regular expressions
- Re module
- Functions /methods related to regex
- Meta characters & special sequences

Object Oriented Programming

- Procedural v/s Object Oriented Programming
- OOP Principles
- Defining a Class & Object Creation
- Inheritance
- Encapsulation
- Polymorphism
- Abstraction
- Garbage Collection
- Iterator & Generator

Exception Handling

- Difference Between Syntax Errors and Exceptions
- Keywords used in Exception Handling
  - try , except , finally , raise , assert
- Types of Except Blocks
- User-defined Exceptions

GUI Programming

- Introduction to Tkinter Programming
- Tkinter Widgets
- Layout Managers
- Event handling
- Displaying image

Multi-Threading Programming

- Multi-processing v/s Multi-threading
- Need of threads
- Creating child threads
- Functions /methods related to threads
- Thread synchronization and locking

SQL Using MySQL

Introduction to RDBMS

- What is Relational Database Package
- Difference between SQL & Database
- Installing MySQL Server database

SQL Basic

- DDL: Create, Alter, Drop, etc.
- DML: Insert, Update, Delete ,etc.
- DQL : Select
- Autoincrement field
- SQL Comments
- SQL Aliases
- Savepoint & rollback

SQL Constraints

- Not NULL, Unique key
- Primary key, Check
- Default, Foreign key

SQL Operators

- Arithmetic operators
- Logical operators
- Conditional operators
- Like, between, in operators

SQL Clauses

- Order by
- Where
- Limit/top
- Group by
- having

SQL Joins

- Inner Join
- Left Join
- Right Join
- Full Join

SQL View

- creating view
- updating view
- fetching data from view

SQL Functions

- String functions
- Aggregate functions
- Date & time functions

Stored Procedures & Functions

- Understanding stored procedures and their key benefits
- Working with stored procedures
- Studying user-defined functions

Working with CSV Files:

- How to write result to csv file
- How to read csv file

Python Database Connectivity

- Database Drivers and connectors
- Creating connection object
- Understanding cursor object
- Executing SQL statements using cursor
- Fetching records from cursor
- Storing and retrieving Date and Time

MONGODB

Introduction To MongoDB

- Understanding NoSQL DB
- NoSQL vs. SQL DB
- Understanding Mongo DB
- Downloading & Installation
- Introduction of MongoDB shell and Compass
- Understanding database, collection & document

Crud Operations

- Insert Document
- Delete Document

- Update Document
- Query Document

Operators In MongoDB

- Query and Projection operators
- Update operator
- Aggregation Pipeline operators

Methods In MongoDB

- limit and sort
- bulk methods
- other methods

Indexing And Relationships

- Types of Indexes
- Creating an Indexes
- Dropping an Indexes
- Defining Relationships between Documents

Python Connectivity With MongoDB

- Introduction to pymongo
- Installing pymongo module
- MongoClient
- Getting database and collection
- CRUD operations
- Range Queries

Statistics & Analytics

Introduction to Statistics

- Sample or population
- Measures of central tendency
  - Arithmetic mean
  - Harmonic mean
  - Geometric mean
  - Mode
  - Quartile
    - First quartile
    - Second quartile(median)
    - Third quartile
  - Standard deviation

Probability Distributions

- Introduction to probability
- Conditional probability
- Normal distribution
- Uniform distribution
- Exponential distribution
- Right & left skewed distribution
- Random distribution
- Central limit theorem

Hypothesis Testing

- Normality test
- Mean test
  - T-test
  - Z-test
  - ANOVA test
- Chi square test
- Correlation and covariance

Numpy Package

- Difference between list and numpy array
- Vector and matrix operations
- Array indexing and slicing

Pandas Package

Introduction to pandas

- Labeled and structured data
- Series and dataframe objects

How to load datasets

- From excel
- From csv
- From html table

Accessing data from Data Frame

- at & iat
- loc & iloc
- head() & tail()

Exploratory Data Analysis (EDA)

- describe()
- groupby()
- crosstab()
- boolean slicing / query()

Data Manipulation & Cleaning

- Map(), apply()
- Combining data frames
- Adding/removing rows & columns
- Sorting data
- Handling missing values
- Handling duplicacy
- Handling data error

Handling Date and Time

Data Visualization using matplotlib and seaborn packages

- Scatter plot, lineplot, bar plot
- Histogram, pie chart,
- Jointplot, pairplot, heatmap
- Outlier detection using boxplot

Machine Learning

Introduction To Machine Learning

- Traditional v/s Machine Learning Programming
- Real life examples based on ML
- Steps of ML Programming
- Data Preprocessing revised
- Terminology related to ML

Supervised Learning

- Classification
- Regression

Unsupervised Learning

- Clustering

KNN Classification

- Math behind KNN
- KNN implementation
- Understanding hyper parameters

Performance metrics

- Math behind KNN
- KNN implementation
- Understanding hyper parameters

Regression

- Math behind regression
- Simple linear regression
- Multiple linear regression

- Polynomial regression
- Boston price prediction
- Cost or loss functions
  - Mean absolute error
  - Mean squared error
  - Root mean squared error
  - Least square error
- Regularization

Logistic Regression for classification

- Theory of logistic regression
- Binary and multiclass classification
- Implementing titanic dataset
- Implementing iris dataset
- Sigmoid and softmax functions

Support Vector Machines

- Theory of SVM
- SVM Implementation
- kernel, gamma, alpha

Decision Tree Classification

- Theory of decision tree
- Node splitting
- Implementation with iris dataset
- Visualizing tree

Ensemble Learning

- Random forest
- Bagging and boosting
- Voting classifier

Model Selection Techniques

- Cross validation
- Grid and random search for hyper parameter tuning

Recommendation System

- Content based technique
- Collaborative filtering technique
- Evaluating similarity based on correlation
- Classification-based recommendations

Clustering

- K-means clustering
- Hierarchical clustering
- Elbow technique
- Silhouette coefficient
- Dendogram

Text Analysis

- Install nltk
- Tokenize words
- Tokenizing sentences
- Stop words customization
- Stemming and lemmatization
- Feature extraction
- Sentiment analysis
- CountVectorizer
- TfidfVectorizer
- Naive bayes algorithms

Dimensionality Reduction

- Principal component analysis(PCA)

Open CV

- Reading images
- Understanding gray scale image
- Resizing image

- Understanding haar classifiers
- Face, eyes classification
- How to use webcam in open cv
- Building image data set
- Capturing video
- Face classification in video
- Creating model for gender prediction

Deep Learning & Neural Networks

Introduction To Artificial Neural Network

- What is artificial neural network (ANN)?
- How neural network works?
- Perceptron
- Multilayer perceptron
- Feedforward
- Back propagation

Introduction To Deep Learning

- What is deep learning?
- Deep learning packages
- Deep learning applications
- Building deep learning environment
  - Installing tensor flow locally
  - Understanding google colab

Tensor Flow Basics

- What is tensorflow?
- Tensorflow 1.x v/s tensorflow 2.x
- Variables, constants
- Scalar, vector, matrix
- Operations using tensorflow
- Difference between tensorflow and numpy operations
- Computational graph

Optimizers

- What does optimizers do?
- Gradient descent (full batch and min batch)
- Stochastic gradient descent
- Learning rate , epoch

Activation Functions

- What does activation functions do?
- Sigmoid function,
- Hyperbolic tangent function (tanh)
- ReLU –rectified linear unit
- Softmax function
- Vanishing gradient problem

Building Artificial Neural Network

- Using scikit implementation
- Using tensorflow
- Understanding mnist dataset
- Initializing weights and biases
- Gradient tape
- Defining loss/cost function
- Train the neural network
- Minimizing the loss by adjusting weights and biases

Modern Deep Learning Optimizers and Regularization

- SGD with momentum
- RMSprop
- AdaGrad
- Adam
- Dropout layers and regularization
- Batch normalization

Building Deep Neural Network Using Keras

- What is keras?
- Keras fundamental for deep learning
- Keras sequential model and functional api
- Solve a linear regression and classification problem with example
- Saving and loading a keras model

Convolutional Neural Networks (CNNs)

- Introduction to CNN
- CNN architecture
- Convolutional operations
- Pooling, stride and padding operations
- Data augmentation
- Building,training and evaluating first CNN model
- Model performance optimization
- Auto encoders for CNN
- Transfer learning and object detection using pre-trained CNN models
  - LeNet
  - AlexNet
  - VGG16
  - ResNet50
  - Yolo algorithm

Word Embedding

- What is word embedding?
- Word2vec embedding
  - CBOW
  - Skipgram
- Keras embedding layers
- Visualize word embedding
- Google word2vec embedding
- Glove embedding

Recurrent Neural Networks (RNNs)

- Introduction to RNN
- RNN architecture
- Implementing basic RNN in tensorflow
- Need for LSTM and GRU
- Deep RNN/LSTM/GRU
- Text classification using LSTM
- Prediction for time series problem
- Seq-2-seq modeling
- Encoder-decoder model

Generative Adversarial Networks (GANs)

- Introduction to GAN
- Generator
- Discriminator
- Types of GAN
- Implementing GAN using neural network

Speech Recognition APIs

- Text to speech
- Speech to text
- Automate task using voice
- Voice search on web

Projects(Any Four)

- Stock Price Prediction Using LSTM
- Object Detection
- Attendance System Using Face Recognition
- Facial Expression and Age Prediction
- Neural Machine Translation
- Hand Written Digits& Letters Prediction

- Number Plate Recognition
- Gender Classification
- My Assistant for Desktop
- Cat v/s Dog Image Classification

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