**Course Curriculum**

**Python**

* Introduction to Data Science
  + Introduction to Data Science
  + Discussion on Course Curriculum
  + Introduction to Programming
* Python Basics
  + Introduction to Python: Installation and Running (Jupyter Notebook, .py file from terminal, Google Colab)
  + Data types and type conversion
  + Variables
  + Operators
  + Flow Control : If, Elif, Else
  + Loops
  + Python Identifier
  + Building Funtions (print, type, id, sys, len)
* Python - Data Types & Utilities
  + List, List of Lists and List Comprehension
  + List creation
  + Create a list with variable
  + List mutable concept
  + len() || append() || pop()
  + insert() || remove() || sort() || reverse()
  + Forward indexing
  + Backward Indexing
  + Forward slicing
  + Backward slicing
  + Step slicing
* Set
  + SET creation with variable
  + len() || add() || remove() || pop()
  + union() | intersection() || difference()
* Tuple
  + TUPLE Creation
  + Create Tuple with variable
  + Tuple Immutable concept
  + len() || count() || index()
  + Forward indexing
  + Backward Indexing
* Dictionary and Dictionary comprehension
  + create a dictionary using variable
  + keys:values concept
  + len() || keys() || values() || items()
  + get() || pop() || update()
  + comparision of datastructure
  + Introduce to range()
  + pass range() in the list
  + range() arguments
  + For loop introduction using range()
* Functions
  + Inbuilt vs User Defined
  + User Defined Function
  + Function Argument
  + Types of Function Arguments
  + Actual Argument
  + Global variable vs Local variable
  + Anonymous Function | LAMBDA
* Packages
* Map Reduce
* OOPs
* Class & Object
  + what is mean by inbuild class
  + how to creat user class
  + crate a class & object
  + \_\_init\_\_ method
  + python constructor
  + constructor, self & comparing objects
  + instane variable & class variable
* Methods
  + what is instance method
  + what is class method
  + what is static method
  + Accessor & Mutator
* Python DECORATOR
  + how to use decorator
  + inner class, outerclass
  + Inheritence
* Polymorphism
  + duck typing
  + operator overloading
  + method overloading
  + method overridding
  + Magic method
  + Abstract class & Abstract method
  + Iterator
  + Generators in python
* Python - Production Level
  + Error / Exception Handling
  + File Handling
  + Docstrings
  + Modularization
* Pickling & Unpickling
* Pandas
  + Introduction, Fundamentals, Importing Pandas, Aliasing, DataFrame
  + Series – Intro, Creating Series Object, Empty Series Object, Create series from List/Array/Column from DataFrame, Index in Series, Accessing values in Series
  + NaN Value
  + Series – Attributes (Values, index, dtypes, size)
  + Series – Methods – head(), tail(), sum(), count(), nunique() etc.,
  + Date Frame
  + Loading Different Files
  + Data Frame Attributes
  + Data Frame Methods
  + Rename Column & Index
  + Inplace Parameter
  + Handling missing or NaN values
  + iLoc and Loc
  + Data Frame – Filtering
  + Data Frame – Sorting
  + Data Frame – GroupBy
  + Merging or Joining
  + Data Frame – Concat
  + DataFrame - Adding, dropping columns & rows
  + DataFrame - Date and time
  + DataFrame - Concatenate Multiple csv files
* Numpy
  + Introduction, Installation, pip command, import numpy package, Module Not Found Error, Famous Alias name to Numpy
  + Fundamentals – Create Numpy Array, Array Manipulation, Mathematical Operations, Indexing & Slicing
  + Numpy Attributes
  + Important Methods- min(),max(), sum(), reshape(), count\_nonzero(), sort(), flatten() etc.,
  + adding value to array of values
  + Diagonal of a Matrix
  + Trace of a Matrix
  + Parsing, Adding and Subtracting Matrices
  + "Statistical Functions: numpy.mean()
  + numpy.median()
  + numpy.std()
  + numpy.sum()
  + numpy.min()"
  + Filter in Numpy
* Matplotlib
  + Introduction
  + Pyplot
  + Figure Class
  + Axes Class
  + Setting Limits and Tick Labels
  + Multiple Plots
  + Legend
  + Different Types of Plots
  + Line Graph
  + Bar Chart
  + Histograms
  + Scatter Plot
  + Pie Chart
  + 3D Plots
  + Working with Images
  + Customizing Plots
* Seaborn
  + catplot() function
  + stripplot() function
  + boxplot() function
  + violinplot() function
  + pointplot() function
  + barplot() function
  + Visualizing statistical relationship with Seaborn relplot() function
  + scatterplot() function
  + regplot() function
  + lmplot() function
  + Seaborn Facetgrid() function
  + Multi-plot grids
  + Statistical Plots
  + Color Palettes
  + Faceting
  + Regression Plots
  + Distribution Plots
  + Categorical Plots
  + Pair Plots
* Scipy
  + Signal and Image Processing (scipy.signal, scipy.ndimage):
  + Linear Algebra (scipy.linalg)
  + Integration (scipy.integrate)
  + Statistics (scipy.stats)
  + Spatial Distance and Clustering (scipy.spatial)
* Statsmodels
  + Linear Regression (statsmodels.regression)
  + Time Series Analysis (statsmodels.tsa)
  + Statistical Tests (statsmodels.stats)
  + Anova (statsmodels.stats.anova)
  + Datasets (statsmodels.datasets)

**Mathematics**

* Set Theory
  + Data Representation & Database Operations
* Combinatorics
  + Feature Selection
  + Permutations and Combinations for Sampling
  + Hyper parameter Tuning
  + Experiment Design
  + Data Partitioning and Cross-Validation
* Probability
  + Basics
  + Theoretical Probability
  + Empirical Probability
  + Addition Rule
  + Multiplication Rule
  + Conditional Probability
  + Total Probability
  + Probability Decision Tree
  + Bayes Theorem
  + Sensitivity & Specificity in Probability
  + • Bernouli Naïve Bayes, Gausian Naïve Bayes, Multinomial Naïve Bayes
* Distributions
  + Binomial, Poisson, Normal Distribution, Standard Normal Distribution
  + Guassian Distribution, Uniform Distribution
  + Z Score
  + Skewness
  + Kurtosis
  + Geometric Distribution
  + Hyper Geometric Distribution
  + Markov Chain
* Linear Algebra
  + Linear Equations
  + Matrices(Matrix Algebra: Vector Matrix Vector matrix multiplication Matrix matrix multiplication)
  + Determinant
  + Eigen Value and Eigen Vector
* Euclidean Distance & Manhattan Distance
* Calculus
  + Differentiation
  + Partial Differentiation
  + Max & Min
* Indices & Logarithms

**Statistics**

* Introduction
  + Population & Sample
  + Reference & Sampling technique
* Types of Data
  + Qualitative or Categorical – Nominal & Ordinal
  + Quantitative or Numerical – Discrete & Continuous
  + Cross Sectional Data & Time Series Data
* Measures of Central Tendency
  + Mean, Mode & Median – Their frequency distribution
* Descriptive statistic Measures of symmetry
  + skewness (positive skew, negative skew, zero skew)
  + kurtosis (Leptokurtic, Mesokurtic, Platrykurtic)
* Measurement of Spread
  + Range, Variance, Standard Deviation
* Measures of variability
  + Interquartile Range (IQR)
  + Mean Absolute Deviation (MAD)
  + Coefficient of variation
  + Covariance
* Levels of Data Measurement
  + Nominal, Ordinal, Interval, Ratio
* Variable
  + Types of Variables.
  + Categorical Variables - Nomial variable & ordinal variables
  + Numerical Variables: discreate & continuous
  + Dependent Variable
  + Independent Variable
  + Control Moderating & Mediating
* Frequency Distribution Table
  + Nominal, Ordinal, Interval, Ratio
* Types of Variables
  + Categorical Variables - Nomial variable & ordinal variables
  + Numerical Variables: discreate & continuous
  + Dependent Variable
  + Independent Variable
  + Control Moderating & Mediating
* Frequency Distribution Table
  + Relative Frequency, Cumulative Frequency
  + Histogram
  + Scatter Plots
  + Range
  + Calculate Class Width
  + Create Intervals
  + Count Frequencies
  + Construct the Table
* Correlation, Regression & Collinearity
  + Pearson & Spearman Correlation Methods
  + Regression Error Metrics
* Others
  + Percentiles, Quartiles, Inner Quartile Range
  + Different types of Plots for Continuous, Categorical variable
  + Box Plot, Outliers
  + Confidence Intervals
  + Central Limit Theorem
  + Degree of freedom
* Bias and Variance in ML
* Entropy in ML
* Information Gain
* Surprise in ML
* Loss Function & Cost Function
  + Mean Squared Error, Mean Absolute Error – Loss Function
  + Huber Loss Function
  + Cross Entropy Loss Function
* Inferential Statistics
  + Hypothesis Testing: One tail, two tail and p-value
  + Formulation of Null & Alternate Hypothesis
  + Type-I error & Type-II error
  + Statistical Tests
  + Sample Test
  + ANOVA Test
  + Chi-square Test
  + Z-Test & T-Test

**SQL**

* Introduction
  + DBMS vs RDBMS
  + Intro to SQL
  + SQL vs NoSQL
  + MySQL Installation
* Keys
  + Primary Key
  + Foreign Key
* Constraints
  + Unique
  + Not NULL
  + Check
  + Default
  + Auto Increment
* CRUD Operations
  + Create
  + Retrieve
  + Update
  + Delete
* SQL Languages
  + Data Definition Language (DDL)
  + Data Query Language
  + Data Manipulation Language (DML)
  + Data Control Language
  + Transaction Control Language
* SQL Commands
  + Create
  + Insert
  + Alter, Modify, Rename, Update
  + Delete, Truncate, Drop
  + Grant, Revoke
  + Commit, Rollback
  + Select
* SQL Clause
  + Where
  + Distinct
  + OrderBy
  + GroupBy
  + Having
  + Limit
* Operators
  + Comparison Operators
  + Logical Operators
  + Membership Operators
  + Identity Operators
* Wild Cards
* Aggregate Functions
* SQL Joins
  + Inner Join & Outer Join
  + Left Join & Right Join
  + Self & Cross Join
  + Natural Join

**EDA & ML**

* EDA
  + Univariate Analysis
  + Bivariate Analysis
  + Multivariate Analysis
* Data Visualisation
  + Various Plots on different datatypes
  + Plots for Continuous Variables
  + Plots for Discrete Variables
  + Plots for Time Series Variables
* ML Introduction
  + What is Machine Learning?
  + Types of Machine Learning Methods
  + Classification problem in general
  + Validation Techniques: CV,OOB
  + Different types of metrics for Classification
  + Curse of dimensionality
  + Feature Transformations
  + Feature Selection
  + Imabalanced Dataset and its effect on Classification
  + Bias Variance Tradeoff
* Important Element of Machine Learning
* Multiclass Classification
  + One-vs-All
  + Overfitting and Underfitting
  + Error Measures
  + PCA learning
  + Statistical learning approaches
  + Introduce to SKLEARN FRAMEWORK
* Data Processing
  + Creating training and test sets, Data scaling and Normalisation
  + Feature Engineering – Adding new features as per requirement, Modifying the data
  + Data Cleaning – Treating the missing values, Outliers
  + Data Wrangling – Encoding, Feature Transformations, Feature Scaling
  + Feature Selection – Filter Methods, Wrapper Methods, Embedded Methods
  + Dimension Reduction – Principal Component Analysis (Sparse PCA & Kernel PCA), Singular Value Decomposition
  + Non Negative Matrix Factorization
* Regression
  + Introduction to Regression
  + Mathematics involved in Regression
  + Regression Algorithms
  + Simple Linear Regression
  + Multiple Linear Regression
  + Polynomial Regression
  + Lasso Regression
  + Ridge Regression
  + Elastic Net Regression
* Evaluation Metrics for Regression
  + Mean Absolute Error (MAE)
  + Mean Squared Error (MSE)
  + Root Mean Squared Error (RMSE)
  + R²
  + Adjusted R²
* Classification
  + Introduction
  + K-Nearest Neighbors
  + Logistic Regression
  + Support Vector Machines (Linear SVM)
  + Linear Classification
  + Kernel-based classification
  + Non-linear examples
  + 2 features forms straight line & 3 features forms plane
  + Hyperplane and Support vectors
  + Controlled support vector machines
  + Support vector Regression
  + Kernel SVM (Non-Linear SVM)
  + Naives Bayes
  + Decision Trees
  + Random Forest / Bagging
  + Ada Boost
  + Gradient Boost
  + XG Boost
  + Evaluation Metrics for Classification
* Clustering
* Introduction
* K-Means Clustering
  + Finding the optimal number of clusters
  + Optimizing the inertia
  + Cluster instability
  + Elbow method
* Hierarchical Clustering
* Agglomerative clustering
* DBSCAN Clustering
* Association Rules
  + Market Basket Analysis
  + Apriori Algorithm
* Recommendation Engines
  + Collaborative Filtering
  + User based collaborative filtering
  + Item based collaborative filtering
  + Recommendation Engines
* Time Series & Forecasting
  + What is Time series data
  + Different components of time series data
  + Stationary of time series data
  + ACF, PACF
  + Time Series Models
  + AR
  + ARMA
  + ARIMA
  + SARIMAX
* Model Selection & Evaluation
* Over Fitting & Under Fitting
  + Biance-Variance Tradeoff
  + Hyper Parameter Tuning
  + Joblib And Pickling
* Others
  + Dummy Variable, Onehotencoding
  + gridsearchcv vs randomizedsearchcv
* ML Pipeline
* ML Model Deployment in Flask

**Power BI**

* Introduction
  + Power BI for Data scientist
  + Types of reports
  + Data source types
  + Installation
* Basic Report Design
  + Data sources and Visual types
  + Canvas and fields
  + Table and Tree map
  + Format button and Data Labels
  + Legend,Category and Grid
  + CSV and PDF Exports
* Visual Sync, Grouping
  + Slicer visual
  + Orientation, selection process
  + Slicer: Number, Text, slicer list
  + Bin count,Binning
* Hierarchies, Filters
  + Creating Hierarchies
  + Drill Down options
  + Expand and show
  + Visual filter,Page filter,Report filter
  + Drill Thru Reports
* Power Query
  + Power Query transformation
  + Table and Column Transformations
  + Text and time transformations
  + Power query functions
  + Merge and append transformations
* DAX Functions
  + DAX Architecture,Entity Sets
  + DAX Data types,Syntax Rules
  + DAX measures and calculations
  + Creating measures
  + Creating Columns

**Deep Learning**

* Deep learning at Glance
  + Introduction to Neural Network
  + Biological and Artificial Neuron
  + Introduction to perceptron
  + Perceptron and its learning rule and drawbacks
  + Multilayer Perceptron, loss function
  + Neural Network Activation function
* Training MLP: Backpropagation
* Cost Function
* Gradient Descent Backpropagation - Vanishing and Exploding Gradient Problem
* Introduce to Py-torch
* Regularization
* Optmizers
* Hyperparameters and tuning of the same
* TENSORFLOW FRAMEWORK
  + Introduction to TensorFlow
  + TensorFlow Basic Syntax
  + TensorFlow Graphs
  + Variables and Placeholders
  + TensorFlow Playground
* ANN (Artificial Neural Network)
  + ANN Architecture
  + Forward & Backward Propagation, Epoch
  + Introduction to TensorFlow, Keras
  + Vanishing Gradient Descend
  + Fine-tuning neural network hyperparameter
  + Number of hidden layers, Number of neurons per hidden layer
  + Activation function
  + INSTALLATION OF YOLO V8, KERAS, THEANO
* PY-TORCH Library
* RNN (Recurrent Neural Network)
  + Introduction to RNN
  + Back Propagation through time
  + Input and output sequences
  + RNN vs ANN
  + LSTM (Long Short-Term Memory)
  + Different types of RNN: LSTM, GRU
  + Biirectional RNN
  + Sequential-to-sequential architecture (Encoder Decoder)
  + BERT Transformers
  + Text generation and classification using Deep Learning
  + Generative-AI (Chat-GPT)
* Basics of Image Processing
  + Histogram of images
  + Basic filters applied on the images
* Convolutional Neural Networks (CNN)
  + ImageNet Dataset
  + Project: Image Classification
  + Different types of CNN architectures
  + Recurrent Neural Network (RNN)
  + Using pre-trained model: Transfer Learning

**Natural Language Processing (NLP)**

* Natural Language Processing (NLP)
  + Text Cleaning
  + Texts, Tokens
  + Basic text classification based on Bag of Words
* Document Vectorization
  + Bag of Words
  + TF-IDF Vectorizer
  + n-gram: Unigram, Bigram
  + Word vectorizer basics, One Hot Encoding
  + Count Vectorizer
  + Word cloud and gensim
  + Word2Vec and Glove
  + Text classification using Word2Vec and Glove
  + Parts of Speech Tagging (PoS Tagging or POST)
  + Topic Modelling using LDA
  + Sentiment Analysis
* Twitter Sentiment Analysis Using Textblob
  + TextBlob
  + Installing textblob library
  + Simple TextBlob Sentiment Analysis Example
  + Using NLTK’s Twitter Corpus
* Spacy Library
  + Introduction, What is a Token, Tokenization
  + Stop words in spacy library
  + Stemming
  + Lemmatization
  + Lemmatization through NLTK
  + Lemmatization using spacy
  + Word Frequency Analysis
  + Counter
  + Part of Speech, Part of Speech Tagging
  + Pos by using spacy and nltk
  + Dependency Parsing
  + Named Entity Recognition(NER)
  + NER with NLTK
  + NER with spacy

**Computer Vision**

* Human vision vs Computer vision
  + CNN Architecture
  + Convolution – Max Pooling – Flatten Layer – Fully Connected Layer
  + CNN Architecture
  + Striding and padding
  + Max pooling
  + Data Augmentation
  + Introduction to OpenCV & YoloV3 Algorithm
* Image Processing with OpenCV
  + Image basics with OpenCV
  + Opening Image Files with OpenCV
  + Drawing on Images, Image files with OpenCV
  + Face Detection with OpenCV
* Video Processing with OpenCV
  + Introduction to Video Basics, Object Detection
  + Object Detection with OpenCV
* Reinforcement Learning
  + Introduction to Reinforcement Learning
  + Architecture of Reinforcement Learning
  + Reinforcement Learning with Open AI
  + Policy Gradient Theory
* Open AI
  + Introduction to Open AI
  + Generative AI
  + Chat Gpt (3.5)
  + LLM (Large Language Model)
  + Classification Tasks with Generative AI
  + Content Generation and Summarization with Generative AI
  + Information Retrieval and Synthesis workflow with Gen AI
* Time Series and Forecasting
  + Time Series Forecasting using Deep Learning
  + Seasonal-Trend decomposition using LOESS (STL) models.
  + Bayesian time series analysis
* MakerSuite Google
  + PaLM API
  + MUM models
* Azure ML