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| Course Name | Machine Learning Specialty |
| Course Duration | 5 Day (40 hours) |
| Time Division | Break: 15 + 45 + 15 mins |
| Course Outcomes | Understand the fundamentals of Data Science and Machine Learning. |
| | Analyze and preprocess data proficiently using Python. |
| | Apply Supervised Machine Learning techniques for regression and classification. |
| | Apply Unsupervised Machine Learning for clustering and natural language |
| | Introduction to Deep learning concepts |

Important Note:

- Courseware – Reference material/ppt along with lab files/exercises will be provided

| Module | Content |
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| Module 01 | Introduction to Data Science & Machine Learning |
| 1.1 | Need for Data Science and Machine Learning |
| 1.2 | Types of Analytics |
| 1.3 | Lifecycle of a Data Science project |
| 1.4 | Skills for a Data Scientist role |
| 1.5 | Types of Machine Learning |
| Module 02 | Python for Data Analysis & Pre-processing |
| | Introduction to Python |
| 2.1 | Python Libraries – NumPy, Pandas, matplotlib, Seaborn scikit-learn, TensorFlow, Keras, Pytorch |
| 2.2 | Exploratory Data Analysis (EDA) |
| 2.3 | Data Cleaning Techniques, Handling Missing Data, Handling Categorical Data |
| 2.4 | Introduction to EDA, 2D Scatter-plot, 3D Scatter-plot, Pair plots |
| 2.5 | Univariate, Bivariate, and Multivariate Analysis, Box-plot |
| | Data Pre-Processing |
| 2.6 | Need for Data Pre-Processing |
| 2.7 | Handling Missing Values |
| 2.8 | Label-Encoding for Categorical Data |
| 2.9 | Hot-Encoding for Categorical Data Explained |
| | Data Transformation |
| 2.10 | Need for Data Transformation |
| 2.11 | Concept of Data Normalization |
| 2.12 | Data Normalization Techniques - Standard Scalar & Minmax |
| 2.13 | Train, Test & Validation of Data |
| Module 03 | Supervised Machine Learning – Regression |
| 3.1 | Simple Linear Regression |
| 3.2 | Concept of Linear Regression |
| 3.3 | Ordinary Least Square and Regression Errors |
| 3.4 | Data Processing & Train and Test of Model |
| 3.5 | Model Evaluation Parameters like R-squared, Score, RMSE and their Interpretations |
| 3.6 | Prediction Plot & its Interpretation |
| 3.7 | Hands-on Problem |
| 3.8 | Multiple Linear Regression |
| 3.9 | Concept of Multiple Linear Regression |
| 3.10 | Degrees of Freedom |
| 3.11 | Adjusted R-Squared |
| 3.12 | Assumptions of Multiple Linear Regression - Linearity, Multicollinearity, Autocorrelation, Endogeneity, Normality of Residuals, Homoscedasticity, etc. |

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| 3.13 | Concept of time-lag data in Autocorrelation |
| 3.14 | Concept of Dummy variable trap |
| 3.15 | Hands-on Problem |
| Module 04 | Supervised Machine Learning - Classification |
| | Logistic Regression |
| 4.1 | Concept of Logistic Regression |
| 4.2 | Concept of Stratification |
| 4.3 | Concept of Confusion Matrix |
| 4.4 | Hands-on Problem |
| | Support Vector Machine (SVM) |
| 4.5 | Common Sensical Intuition of SVM |
| 4.6 | Mathematical Intuition of SVM |
| 4.7 | Different types of SVM Kernel Functions |
| 4.8 | Hands-on Problem (Preferred: IRIS Classification Problem) |
| | Decision Tree Classifier |
| 4.9 | Intuition Behind Decision Trees |
| 4.10 | Optimal Model Selection Criterion in Decision Tree |
| 4.11 | Hands-on Problem |
| | Random Forest Classifier |
| 4.12 | Ensemble Learning and Random Forests |
| 4.13 | Bagging and Boosting |
| 4.14 | Hands-on Problem |
| | Evaluation Metrics for Classification Models |
| 4.15 | Need for Evaluation and Accuracy Paradox |
| 4.16 | Different Measures for Classification Models - Accuracy, Precision, Recall, F1 Score, etc. |
| 4.17 | Threshold and Adjusting Thresholds |
| 4.18 | AUC ROC Curve |
| 4.19 | Hands-on Problem |
| Module 05 | Feature Selection and Dimensionality Reduction |
| | Univariate Feature Selection |
| 5.1 | Feature Selection Importance |
| 5.2 | Concept of Univariate Feature Selection |
| 5.3 | F-Test for Regression and Classification |
| 5.4 | Hands on F-test (p value analysis) |
| 5.5 | Chi-Squared for Classification |
| 5.5 | Feature Selection Techniques - SelectKBest, SelectPercntile & Generic Univariate Select |
| 5.6 | Hands-on Chi-squared (p value analysis) |
| | Recursive Feature Elimination (RFE) |
| 5.7 | Concept of Recursive Feature Elimination (RFE) |
| 5.8 | Feature Importance Score/Feature Ranking |
| 5.9 | Hands-on RFE |
| | Principle Component Analysis (PCA) |
| 5.10 | Need to reduce dimensions and Importance of PCA |
| 5.11 | Mathematical Intuition of PCA & Steps to calculate PCA |
| 5.12 | Hands-on PCA (Model Comparisons with PCA & without PCA recommended) |
| Module 06 | Cross validation & Hyperparameter Tuning |
| | Cross Validation |
| 6.1 | Importance of Cross Validation |
| 6.2 | Parameter & Implementation of Cross Validation |

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| 6.3 | Hands-on Problem (Drawing inference from results) |
| | Hyperparameter Tuning |
| 6.4 | Concept of Hyperparameter Tuning |
| 6.5 | Grid Search & Randomized Search |
| 6.6 | Hands-on GridSearchCV (analyse results) |
| Module 07 | Supervised Machine Learning – Natural Language Processing |
| 7.1 | Introduction to NLP |
| 7.2 | Basic Concepts of NLP: Tokenization, stop words, Stemming, Lemmatization, etc. |
| 7.3 | Tfidf Vector and its mathematical intuition |
| 7.4 | Recommendation system example |
| Module 08 | Supervised Machine Learning – Clustering |
| 8.1 | Introduction to Clustering |
| 8.2 | Mathematical intuition behind cluster formation |
| 8.3 | Elbow method & its mathematical intuition |
| 8.4 | K-means Clustering Implementation (numerical) |
| 8.5 | K-means Clustering Implementation (natural language processing) |
| 8.6 | Introduction to Clustering |
| Module 09 | Introduction to Deep Learning |
| 9.1 | Need & Applications of Deep Learning |
| 9.2 | Working of Artificial Neural Network |
| 9.3 | Backend (TensorFlow) & Frontend (Keras) |
| 9.4 | Concept of Tensor |
| 9.5 | Keras Model Building Overview - Construct, Compile & Evaluate |
| 9.6 | Activation Function |
| 9.7 | Loss Functions |
| 9.8 | Optimization Techniques |
| 9.9 | Evaluation metrics for Deep Learning |