



Post Graduate Diploma in Computer Science and Artificial Intelligence

Detailed Curriculum



Course 1: Programming with Python

Python is a powerful programming language, and versatile in its use in data analysis. It can also be integrated with web apps or a production database. Being a full-fledged programming language, it is the single best language to learn for data scientists and computer scientists. In this course, you will build your proficiency in Python as it applies to Data Science - the common functions, libraries, related packages, and techniques to visualize and make inferences about the data.

Number of Weeks- 5

Number of Quizzes- 5

Number Projects- 2

- Installation of Python, Python packages overview, Shortcuts
- Data structures in Python - List, Tuples, Dictionaries, Sets, Conditional statements, functions
- Numpy - Array, Matrix, Selection techniques, Pandas - Series, Dataframes, Indexing, Saving & Loading dataframes
- Visualization using Python - Matplotlib, Seaborn, Barplot, scatter plot, Point plot, Pairplots.
- Univariate, Multivariate, analysis, Scaling & Normalization, Imputing missing values, Working with outliers.

Course 2: Data Structures & Algorithms

A well written algorithm with appropriate data structures form the basis of any program, and gives one the ability to manipulate data efficiently. In this course, you will learn about common data structures and algorithms that are used in solving various computational problems, with an emphasis on what's needed for AI & Data Science problems.

Number of Weeks- 7

Number of Quizzes- 7

Number Projects- 2

- Arrays, Array operations, Search (linear search vs. binary search) and Sort (Bubble Sort, Insertion Sort, Quick Sort, Merge Sort) review.
- Definition of linked list, types of linked list, adding & removing an element, clearing the linked list, searching & sorting.



- Structure & principle of stacks, declaration and initialization, push & pop an element, check if the stack is empty, peek an element.
- Definition & implementation of queues, Queue operations, Enqueue & dequeue an element, getFront & getRear in Queue.
- Linear & Non-linear data structures, Trees & tree traversal, B-Trees, node relationships, adding & removing an element.
- Overview of Graph theory, Nodes, edges, cycles, subgraphs, directed & undirected graphs, adding & removing an element.
- Binary Tree & Binary Search Tree, Properties, Implementing Binary Trees, Operations.

Course 3: Design & Analysis of Algorithms

Algorithms are the heart of computer science and data science. These instructional blueprints allow us to solve any problem using calculation, data processing, and reasoning tasks. Algorithms also tend to be a lot more useful if they are efficient both in terms of time and space. In this course, you will learn about the design and analysis of such algorithms, emphasizing methods of application.

Number of Weeks- 5

Number of Quizzes- 5

Number Projects- 2

- Time & space complexity of algorithms, Analysis of algorithms.
- What is the divide & conquer algorithm? When to use them? Time complexity of D&C algorithm, Iterative solution, Advantages & Disadvantages of D&C algorithm.
- Greedy search algorithm -definition, Huffman coding algorithm, Pseudocode and implementation, How to approach a greedy algorithm problem.
- Properties of dynamic programming strategy, Fibonacci series, Least common subsequence, Knapsack problem, Longest palindrome substring.
- Breadth-first search, Depth-first search, Shortest path algorithm, Minimum Spanning Trees, Traveling Salesman Problem.

Course 4: Databases - SQL and NoSQL

Organizations store their data using a combination of relational & non relational databases. Software professionals and data scientists are expected to know how to access & query the database, and to perform analyses on the extracted data. The



objective of this course is to make you proficient with the querying, accessing and working with the data across both SQL and NoSQL databases.

Number of Weeks- 4

Number of Quizzes- 4

Number Projects- 2

- Introduction to database, Brief overview of relationship, RDBMS, Creating a database
- Overview of Joins - Inner, Outer joins, aggregations, connect to database using Python
- Executing SQL commands, My SQL workbench, List of commands in SQL, Data control language, Transactional control language
- Types of NoSQL database, CAP theorem, Introduction to Cassandra, Applications of Cassandra DB

Course 5: Machine Learning

Machine learning allows computers to do what comes naturally to humans and animals: learn from experience. Machine learning algorithms use computational methods to “learn” information directly from data without relying on a predetermined equation as a model. The algorithms adaptively improve their performance as the number of samples available for learning increases. In this course you will learn some of the most popular Machine Learning algorithms, their applicability and implementation.

Number of Weeks- 5

Number of Quizzes- 5

Number Projects- 2

- Intro to ML, Linear Regression, Multivariate Linear regression, Training/Test Splits, Under/Overfitting
- Logistic regression, Odds ratio, Performance measures - Precision & Recall.
- Introduction to conditional probability, Bayes theorem, Naive Bayes, K Nearest neighbors, distance measures, KNN Classifier.
- Introduction to Unsupervised Learning, Types of clustering, K Means clustering, Hierarchical clustering, Evaluation measures
- Curse of dimensionality, dimensionality reduction, Eigenvalues & vectors, Principal component analysis



Course 6: Advanced Machine Learning

In this course, you will build on your understanding of Machine Learning and learn how to combine techniques (ensemble techniques) using decision trees and random forest algorithms. You will also learn how to improve the model performance of machine learning models while dealing with issues of model complexity.

Number of Weeks- 5

Number of Quizzes- 5

Number Projects- 2

- Error, Sources of Error, Bias and Variance, Ablative Analysis of ML algorithms
- Decision Trees, Entropy, Gini Index, Relative error, Classification & Regression trees
- Bagging, Boosting, Stacking, Ensemble methods, Random forest algorithm
- Introduction to Feature Engineering, K Fold cross validation, Bootstrap sampling, Up and down sampling
- Model performance measures - ROC, AUC, Building a ML pipeline, Grid search, Randomised search

Course 7: Deep Learning for AI

Deep Learning, a specialized and advanced family of machine learning algorithms, works well when massive volumes of data, typically unstructured and disparate, is available. Deep Learning models are capable of solving such complex tasks such as recognizing objects within an image and translating speech in real time. In this course you will learn about Deep Learning and Neural Networks, and how to implement them in the real world.

Number of Weeks- 6

Number of Quizzes- 6

Number Projects- 2

- Maths basics for Deep Learning, Functions & Derivatives, Optimizing a continuous function, Loss functions, Gradient descent
- Neural Networks Basics, Parameters vs Hyperparameters, Hyperparameter tuning, Activation functions, Softmax



- Feed forward Neural network, Backpropagation, Gradient descent, Learning rate & tuning, Cross-entropy loss
- Data pre-processing, Data augmentation, Batch Normalization, dropout, hardware requirements
- Introducing CNNs, convolution, pooling, CNNs for image classification, Transfer Learning, Intro to RNNs for sequential data
- Applications to CV & NLP - Digit recognition, Sentiment analysis

Course 8: Capstone

Through a comprehensive Capstone project, the students design and develop an end-to-end solution to a problem that reflects existing challenges in the real world.

Number of Weeks- 4

- Project proposal - scope, data, plan
- Initial report including EDA, challenges & proposed solutions
- Submit intermediate report including results to date
- Submit final report, demonstrate solution, and present findings