

ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Syllabus for Ph.D. Entrance Examination

Section 1: Engineering Mathematics

Linear Algebra: Matrices, determinant, rank, system of linear equations and solutions, eigenvalues and eigenvectors, LU decomposition, singular value decomposition

Calculus and optimization: Functions of a single variable, Limits, continuity and differentiability. Maxima and minima. Mean value theorem. Integration, optimization involving a single variable

Probability and Statistics: Random variables. Uniform, normal, exponential, Poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem.

Section 2: Digital Logic Boolean algebra. Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).

Section 3: Programming, Data Structures and Algorithms: Programming in Python, basic data structures: stacks, queues, linked lists, trees, hash tables; Search algorithms: linear search and binary search, basic sorting algorithms: selection sort, bubble sort and insertion sort; divide and conquer: mergesort, quicksort; introduction to graph theory; basic graph algorithms: traversals and shortest path.

Section 4: Databases: ER-model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control

Section 5: Machine Learning: (i) Supervised Learning: regression and classification problems, simple linear regression, multiple linear regression, ridge regression, logistic regression, k-nearest neighbour, naive Bayes classifier, linear discriminant analysis, support vector machine, decision trees, bias-variance trade-off, cross-validation methods such as leave-one-out (LOO) cross-validation, k-folds cross-validation, multilayer perceptron, feed-forward neural network; (ii) Unsupervised Learning: clustering algorithms, k-mean, hierarchical clustering, dimensionality reduction, principal component analysis.