

Evolutionary Algorithms

B.E. Sem. VII [INFT]

(Elective – I)

EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical Exam	–	–
Oral Exam	–	25
Term Work	–	25

Prerequisite : Data Structures and Algorithms, Knowledge of Programming Language / Tool (C/C++/Java)

Objective : The objective of the course is to understand the working of Evolutionary algorithms such as Genetic Algorithm, Genetic Programming, Evolutionary Algorithms and Evolutionary Programming with their application in the various aspects of Computer engineering.

SYLLABUS

1. Evolutionary Computation (EC)

The Historical Development of EC, Principles of Darwinian natural selection, Overview of Genetic Algorithms (GA), Genetic Programming (GP), Evolutionary Strategies (ES), Evolutionary Programming (EP), Features of Evolutionary Computation, Genes and Population Genetics, The Genotype/Phenotype Dichotomy, Broad Applicability, Hybridization with Other Methods, Parallelism, Applications of Evolutionary Computation.

2. Genetic Algorithms (GA)

Overview of Conventional Optimization and Search Techniques, Simple Genetic Algorithm, Comparison with Other Optimization Techniques, Application of GA (Data analysis and prediction, Genetic algorithms in financial markets, GA in search, optimization, and machine learning), GA Terminologies: Individual, Genes, Fitness, Population, Encoding, Breeding, Termination Implicit Parallelism, Case Study of Traveling Salesman Problem.

3. Advanced Operators in GA

Diploidy, Dominance and Abeyance, Multiploid, Inversion and Reordering, Niche and Speciation, Micro-operators, Non-binary Representation, Multi-objective Optimization, Combinatorial Optimization, GA classifications: SGA, Parallel GA, Hybrid GA.

4. Genetic Programming (GP)

Introduction, Comparison with GA, Primitives of GP, Attributes, Terminals, Function set, Operators in GP, Steps in GP, Improving genetic programming with statistics, Genetic programming with tree genomes, linear genomes, and graph genomes, Implementation of genetic programming, GP Applications. Case study of Santa-Fe-trial, Case study of John Muir Trail.

5. Foundations of Evolutionary Algorithms

Schemas and the two-armed bandit problem, Mathematical models for simple genetic algorithms, Where to use evolutionary algorithms? Theoretical advantages and disadvantages of evolutionary algorithms over alternative methods (hill-climbing, simulated annealing, etc.), Co-evolutionary Algorithms: Cooperative co-evolution, Competitive co-evolution, Swarm intelligence and ant colony optimization.

6. Evolutionary Strategies (ES)

Introduction, Comparison with GA & GP, Operators, Gaussian Mutation Operator, Intermediate Recombination Operator, Application of ES for Image Enhancement.

7. Evolutionary Programming (EP)

Introduction, Comparison with GA, GP & ES. Selection mechanism, Applications of ES.

8. Multi-Objective Evolutionary Optimization

Pareto optimality, Multi-objective evolutionary algorithms. Learning Classifier Systems: Basic ideas and motivations, Main components and the main cycle. Theoretical Analysis of Evolutionary Algorithms: Schema theorems, Convergence of EAs, Computational time complexity of EAs, No free lunch theorem.

9. Application of Genetic Algorithm to Image Processing

Designing Texture Filters with Genetic Algorithms, Genetic Algorithm Based Knowledge Acquisition on Image Processing, Object Localization in Images Using Genetic Algorithm, Problem Description, Image Preprocessing, The Proposed Genetic Algorithm Approach.

References :

1. Introduction to Genetic Algorithm (*Sivanandam, Deepa*) Springer.
2. An Introduction to Genetic Algorithm (*Melanie Mitchell*) PHI.
3. Genetic Algorithms in Search, Optimisation and Machine Learning (*D.E. Goldberg*) Addison-Wesley.
4. Genetic Algorithms + Data Structures = Evolution Programs (*Zbigniew Michalewics*) Springer Verlag, 1997.
5. Genetic Algorithms (*Goldberg*) Pearson Education.
6. Evolutionary Computation1: Basic Algorithms and Operators (*T. Back, D. B. Fogel and Michalewicz*) 2000.
7. Introduction to Evolutionary Computing (*A. E. Eiben and J.E. Smith*) Springer, 2003.
8. Genetic Programming: An Introduction (*W. Banzhaf et al. Morgan Kaufmann*) 1999.
9. Genetic Programming: On the Programming of Computers by Means of Natural Selection (*J. R. Koza*) 1992
10. The Simple Genetic Algorithm — Foundations And Theory (*Vose Michael D*) Phi.
11. Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications (*Rajasekaran S., Pai G.A. Vijayalakshmi*) Phi.
12. Genetic Algorithms - Principles and Perspectives: A Guide to GA Theory (*Reeves, C. R. and Rowe, J. E.*) 2003.
13. Genetic Algorithms and Grouping Problems (*Falkenauer. E.*) 1998.

