SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Department of Biotechnology	LP: BT 22031
~~B.E~~/B.Tech/~~M.E/M.Tech~~ : Biotechnology Regulation: 2022 PG Specialisation : -NA- Sub. Code / Sub. Name : BT 22031 / Fundamentals of Algorithms for Biotechnologists (H&M) Unit : 1	Rev. No: 00 Date: 08/07/2024

Unit Syllabus: **INTRODUCTION TO ALGORITHMS** **(9 h)**

DNA computing: Motivation, DNA structure, processing and computational operations, steps involved in DNA computation, Filtering models: Adleman's experiment, Lipton's solution, Scope and Applications of DNA computing. Search Algorithms: Hill climbing, Simulated annealing:-introduction, Simulated annealing algorithm

Objective:
To learn the foundational understanding of algorithmic concepts like problemsolving strategies, data structures, and algorithm analysis

Session No *	Topics to be covered	Ref	Teaching Aids
1.	Introduction to Algorithmic Concepts - Problem-Solving	T1(2-5)	GCR
2.	DNA Computing - Motivation and DNA Structure	T4(14)	GCR
3.	DNA Processing and Computational Operations	T5(13-16)	GCR
4.	Steps Involved in DNA Computation	T2(19-21)	GCR
5.	Filtering Models in DNA Computing - Adleman's Experiment	T3(23-31)	GCR
6.	Filtering Models in DNA Computing - Lipton's Solution	T3(34-41)	GCR
7.	Scope and Applications of DNA Computing	T3(32,33)	GCR
8.	Introduction to Search Algorithms - Hill Climbing	T3(32,33)	GCR
9.	Introduction to Search Algorithms - Simulated Annealing Algorithm	T1(62)	GCR
Content beyond syllabus covered (if any): NA			

* Session duration: 50 minutes

SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Sub. Code / Sub. Name: BT **22031** / Fundamentals of Algorithms for Biotechnologists (H&M)

Unit : II

Unit Syllabus: **GENETIC ALGORITHM (9 h)**

Genetic Algorithm: Basic Concepts, Reproduction, Cross over, Mutation, Fitness Value, Optimization using GAs; Applications of GA in bioinformatics

Objective:
To apply algorithmic thinking to solve problems related to sequence analysis, gene prediction, and protein structure analysis.

Session No *	Topics to be covered	Ref	Teaching Aids
10.	Introduction to Genetic Algorithms	T2(73-132)	GCR
11.	Core Concepts of Genetic Algorithms	R1(177-179)	GCR
12.	Reproduction in Genetic Algorithms	R2(365-387)	GCR
13.	Crossover in Genetic Algorithms	T2(333-363)	GCR
14.	Mutation Techniques in Genetic Algorithms	T1(138-145)	GCR
15.	Genetic Algorithms Cycle	T4(160-179)	GCR
16.	Fitness Value and Evaluation	T1(310-319)	GCR
17.	Optimization Using Genetic Algorithms	T2(543-568)	GCR
18.	Applications of Genetic Algorithms in Bioinformatics	T2(569-617)	GCR

Content beyond syllabus covered (if any):
NA

* Session duration: 50 mins

SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Sub. Code / Sub. Name: BT **22031** / Fundamentals of Algorithms for Biotechnologists (H&M)

Unit: III

Unit Syllabus: **HIDDEN MARKOV MODEL (9 h)**

Markov processes and Markov Models, Hidden Markov Models. Forward and Backward Algorithms, Most probable state path: Viterbi algorithm, Parameter Estimation for HMMs:-Baum-Welch Algorithm, Applications of profile HMMs for multiple alignment of proteins and for finding genes in the DNA.

Objective:
To analyze and interpret biological data using computational tools and algorithms.

Session No *	Topics to be covered	Ref	Teaching Aids
19.	Introduction to Markov Processes	T1(193-196)	GCR
20.	Introduction to Markov Models	T1(188-193)	GCR
21.	Building Markov Models	R3(188-190)	GCR
22.	Introduction to Hidden Markov Models	R4(212-215)	GCR
23.	Forward Algorithm for HMMs	R5(216-217)	GCR
24.	Backward Algorithm for HMMs	T2(171-195)	GCR
25.	Decoding Biological Sequences with HMMs	T2(196-226)	GCR
26.	Viterbi Algorithm	T2(196-226)	GCR
27.	Parameter Estimation for HMMs: Baum-Welch Algorithm	T2(618-641)	GCR

Content beyond syllabus covered (if any):

NA

* Session duration: 50 mins

SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Sub. Code / Sub. Name: BT **22031** / Fundamentals of Algorithms for Biotechnologists (H&M)

Unit: IV

Unit Syllabus: **SUPPORT VECTOR MACHINES** **(9 h)**

Introduction, hyperplane separation (maximum and soft margin hyperplanes), linear classifier, Kernel functions, Large Margin Classification, Optimization problem with SVM, Applications of SVM in bioinformatics. Bayesian network: Bayes Theorem, Inference and learning of Bayesian network, BN and Other Probabilistic Models.

Objective:

To develop basic algorithms for solving biological problems.

Session No *	Topics to be covered	Ref	Teaching Aids
28.	Applications of Profile HMMs for Multiple Alignment of Proteins	T2(469-487)	GCR
29.	Applications of HMMs for Finding Genes in DNA	T2(488-509)	GCR
30.	Hyperplane Separation	T2(687-702)	GCR
31.	Linear Classifiers and Kernel Functions	T2(510-527)	GCR
32.	Large Margin Classification & Optimization	T2(527)	GCR
33.	Implementing SVMs for Biological Data	T2(528)	GCR
34.	Bayes' Theorem	T2(531-532)	GCR
35.	Learning Bayesian Networks	T2 (789 – 822)	GCR
36.	Inference in Bayesian Networks	T3(1060-1086)	GCR
Content beyond syllabus covered (if any): NA			

* Session duration: 50 mins

SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Sub. Code / Sub. Name: BT **22031** / Fundamentals of Algorithms for Biotechnologists (H&M)

Unit: V

Unit Syllabus: **ARTIFICIAL NEURAL NETWORK** **(9 h)**

Artificial Neural Network: Historic evolution – Perceptron, characteristics of neural networks terminology, models of neuron Mc Culloch – Pitts model, Perceptron, Adaline model, Basic learning laws, Topology of neural network architecture, single layer ANN, multilayer perceptron, back propagation learning, input - hidden and output layer computation, back propagation algorithm, Applications of ANN.

Objective:
To evaluate the efficiency and effectiveness of different algorithmic approaches in biotechnology.

Session No *	Topics to be covered	Ref	Teaching Aids
37.	Introduction to Artificial Neural Networks	T3(978-979)	GCR
38.	Models of Neurons: McCulloch-Pitts Model and Perceptron	T5(979)	GCR
39.	Adaline Model and Basic Learning Laws	T1(820-825)	GCR
40.	Topology of Neural Network Architecture	T1(188-190)	GCR
41.	Single Layer Artificial Neural Networks	T1(207-12)	GCR
42.	Multilayer Perceptron and Backpropagation Learning	T1(207-12)	GCR
43.	Input, Hidden, and Output Layer Computation	T4(857)	GCR
44.	Backpropagation Algorithm	T1(231-33)	GCR
45.	Applications of Artificial Neural Networks in Biotechnology	T3(959-962)	GCR
Content beyond syllabus covered (if any): NA			

* Session duration: 50 mins

SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Sub Code / Sub Name: BT **22031**/ Fundamentals of Algorithms for Biotechnologists

Reference Books:

1. Sung, W. K. "Algorithms for Next-Generation Sequencing", First Edition, CRC Press, 2017.
2. Rout, R. K., Umer, S., Sheikh, S. & Sangal, A. L. "Artificial Intelligence Technologies for Computational Biology", First Edition, CRC Press, 2022.
3. Mäkinen, V., Belazzougui, D., Cunial, F. & Tomescu, A. I. "Genome-Scale Algorithm Design: Bioinformatics in the Era of High-Throughput Sequencing", First Edition, Cambridge University Press, 2023.
4. Arabnia, H. R. & Tran, Q. N. "Emerging Trends in Applications and Infrastructures for Computational Biology, Bioinformatics, and Systems Biology: Systems and Applications", First Edition, Elsevier Science, 2016.
5. Ismail, H. D. "Bioinformatics: A Practical Guide to NCBI Databases and Sequence Alignments", First Edition, CRC Press, 2022.

Text Books:

1. T. Compeau, P. & Pevzner, P. "Bioinformatics Algorithms: An Active Learning Approach", Second Edition, Active Learning Publishers, 2018.
2. Rocha, M. & Ferreira, P. G. "Bioinformatics Algorithms: Design and Implementation in Python", First Edition, Elsevier Science, 2018.
3. Gagniuc, P. A. "Algorithms in Bioinformatics: Theory and Implementation", First Edition, Wiley, 2021.
4. Botwright, R. "Bioinformatics: Algorithms, Coding, Data Science And Biostatistics", First Edition, Rob Botwright, 2024.
5. Sofi, M. Y., Shafi, A. & Masoodi, K. Z. "Bioinformatics for Everyone", First Edition, Elsevier Science, 2021.

	Prepared by	Approved by
Signature		for 8/7/24
Name	Mr. S. Naga Vignesh	Prof. E. Nakkeeran
Designation	Assistant Professor	Head of the Department
Date	08/07/2024	08/07/2024

Remarks *:

The same lesson plan will be followed in subsequent future.