University of Engineering & Management, Jaipur

Syllabus for BSc Computer Science Admission Batch 2026

SEMESTER 6

S. No.	Subject Code	Subject Name	L	T	P	Total Contact Hrs	Credit Points
Theory							
1	BSCCS601	Artificial Intelligence	3	1	0	4	4
2	BSCCS602	Computer Graphics	3	1	0	4	4
3	BSCCS603	Data Mining	3	1	0	4	4
4	BSCCS604	General Studies & Current Affairs -VI	3	1	0	4	4
Practical							
5	BSCCS691	Artificial Intelligence Lab	0	0	2	2	2
6	BSCCS692	Computer Graphics Lab	0	0	2	2	2
7	BSCCS693	Data Mining Lab	0	0	2	2	2
Sessional							
8	BSCCS694	Machine Learning	0	2	0	2	2
		Total	12	6	6	24	24

Artificial Intelligence

Credit: 06

Course Objective

This course introduces the basic concepts and techniques of Artificial Intelligence (AI). The course aims to introduce intelligent agents and reasoning, heuristic search techniques, game playing, knowledge representation, reasoning with uncertain knowledge.

Course Learning Outcomes

On successful completion of this course, students will be able to:

1. Identify problems that are amenable to solution by specific AI methods
2. Represent knowledge in Prolog and write code for drawing inferences.
3. Identify appropriate AI technique for the problem at hand
4. Compare strengths and weaknesses of different artificial Intelligence techniques.
5. Sensitive towards development of responsible Artificial Intelligence

Detailed Syllabus

Unit 1

Introduction: Introduction to artificial intelligence, background and applications, Turing test, rational agents, intelligent agents, structure, behaviour

and environment of intelligent agents.

Unit 2

Knowledge Representation: Propositional logic, first order predicate logic, resolution principle, unification, semantic nets, conceptual dependencies, frames, scripts, production rules, conceptual graphs.

Unit 3

Reasoning with Uncertain Knowledge: Uncertainty, non-monotonic reasoning, truth maintenance systems, default reasoning and closed world assumption, Introduction to probabilistic reasoning, Bayesian probabilistic inference, introduction to fuzzy sets and fuzzy logic, reasoning using fuzzy logic.

Unit 4

Problem Solving and Searching Techniques: Problem characteristics, production systems, control strategies, breadth first search, depth first search, hill climbing and its variations, heuristics search techniques: best first search, A* algorithm, constraint satisfaction problem, means-end analysis.

Unit 5

Game Playing: introduction to game playing, min-max and alpha-beta pruning algorithms. Prolog Programming: Introduction to Programming in Logic (PROLOG), Lists, Operators, basic Input and Output.

Unit 6

Understanding Natural Languages: Overview of linguistics, Chomsky hierarchy of grammars,parsing techniques.

Unit 7

Ethics in AI, Fairness in AI, Legal perspective

Artificial Intelligence Lab

1. Write a prolog program to calculate the sum of two numbers.

2. Write a Prolog program to implement max(X, Y, M) so that M is the maximum of two numbers X and Y.

3. Write a program in PROLOG to implement factorial (N, F) where F represents thefactorial of a number N.60

4. Write a program in PROLOG to implement generate_fib(N,T) where T represents the Nth term of the fibonacci series.

5. Write a Prolog program to implement GCD of two numbers.

6. Write a Prolog program to implement power (Num,Pow, Ans) : where Num is raised to the power Pow to get Ans.

7. Prolog program to implement multi (N1, N2, R) : where N1 and N2 denotes the numbers to be multiplied and R represents the result.

8. Write a Prolog program to implement memb(X, L): to check whether X is a member of L or not.

9. Write a Prolog program to implement conc (L1, L2, L3) where L2 is the list to be appended with L1 to get the resulted list L3.

10. Write a Prolog program to implement reverse (L, R) where List L is original and List R is reversed list.

11. Write a program in PROLOG to implement palindrome (L) which checks whether a list L is a palindrome or not.

12. Write a Prolog program to implement sumlist(L, S) so that S is the sum of a given list L.

13. Write a Prolog program to implement two predicates evenlength(List) and oddlength(List) so that they are true if their argument is a list of

even or odd length respectively.

14. Write a Prolog program to implement nth_element (N, L, X) where N is the desired position, L is a list and X represents the Nth element of L.

15. Write a Prolog program to implement maxlist(L, M) so that M is the maximum number in the list.

16. Write a prolog program to implement insert_nth (I, N, L, R) that inserts an item I into Nth position of list L to generate a list R.

17. Write a Prolog program to implement delete_nth (N, L, R) that removes the element on Nth position from a list L to generate a list R.

18. Write a program in PROLOG to implement merge (L1, L2, L3) where L1 is first ordered list and L2 is second ordered list and L3 represents the merged list.

References

1. Rich, E. & Knight,K. (2012). Artificial Intelligence. 3rd edition. Tata McGraw Hill.

2. Russell, S.J. & Norvig, P. (2015) Artificial Intelligence - A Modern Approach. 3rd edition.Pearson Education

Additional Resources:

1. Bratko, I. (2011). Prolog Programming for Artificial Intelligence. 4th edition. Pearson Education

2. Clocksin, W.F. & Mellish (2003), Programming in PROLOG. 5th edition. Springer

3. Kaushik, S. (2011). Artificial Intelligence. Cengage Learning India.

4. Patterson, D.W. (2015). Introduction to Artificial Intelligence and Expert Systems. 1st edition.Pearson Education.

Web Resources

1. https://cyber.harvard.edu/topics/ethics-and-governance-ai

2. https://royalsocietypublishing.org/doi/full/10.1098/rsta.2018.0085

3. https://arxiv.org/abs/1812.02953

Computer Graphics

Credit: 06

Course Objective

This course introduces fundamental concepts of Computer Graphics with focus on modelling, rendering and interaction aspects of computer graphics. The course emphasizes the basic principles needed to design, use and understand computer graphics system.

Course Learning Outcomes

On successful completion of the course, students will be able to:

1. Describe Standard raster and vector scan devices as well as Graphical Input and output devices

2. Implement algorithms for drawing basic primitives such as linecircle and ellipse.

3. Implement algorithms for line clipping and polygon clipping and filling.

4. Implement a 3D object representation scheme and carryout 2D and 3D Transformation, 3D projections

5. Implement visible surface determination algorithms, Illumination models and surface rendering methods, color models

6. Implement a simple computer animation algorithm

Detailed Syllabus

Unit 1

Introduction: Introduction to Graphics systems, Basic elements of Computer graphics, Applications of computer graphics. Architecture of Raster and Random scan display devices, input/output devices.

Unit 2

Drawing and clipping primitives: Raster scan line, circle and ellipse drawing algorithms, Polygon filling, line clipping and polygon clipping algorithms

Unit 3

Transformation and Viewing: 2D and 3D Geometric Transformations, 2D and 3D Viewing Transformations (Projections- Parallel and Perspective), Vanishing points.

Unit 4

Geometric Modeling: Polygon Mesh Representation, Cubic Polynomial curves (Hermite and Bezier).

Unit 5

Visible Surface determination and Surface Rendering: Z-buffer algorithm, List-priority algorithm and area subdivision algorithm for visible surface determination. Illumination and shading models, RGB color model and Basics of Computer Animation.

Computer Graphics Lab

1. Write a program to implement Bresenham's line drawing algorithm.

2. Write a program to implement mid-point circle drawing algorithm.

3. Write a program to clip a line using Cohen and Sutherland line clipping algorithm.

4. Write a program to clip a polygon using Sutherland Hodgeman algorithm.

5. Write a program to fill a polygon using Scan line fill algorithm.

6. Write a program to apply various 2D transformations on a 2D object (use homogeneous coordinates).

7. Write a program to apply various 3D transformations on a 3D object and then apply parallel and perspective projection on it.

8. Write a program to draw Hermite /Bezier curve.

References

1. Baker, D.H. (2008). Computer Graphics. 2nd edition. Prentice Hall of India.

2. Foley, J. D., Dam, A.V, Feiner, S. K., & Hughes, J. F. (1995). Computer Graphics: Principles and Practice in C. 2nd edition. Addison-Wesley Professional.

Additional Resources:

1. Bhattacharya, S. (2018). Computer Graphics. Oxford University Press

2. Cohen, D. I. A. (2011). Introduction to Computer Theory. 2nd edition. Wiley India.

3. Marschner, S., & Shirley, P. (2017) Fundamentals of Computer Graphics. 4th edition. CRC Press

4. Rogers, D. F. (1989). Mathematical Elements for Computer Graphics. 2nd edition. McGraw Hill.

Data Mining

Credit: 06

Course Objective

This course introduces data mining techniques and enables students to apply these techniques on real-life datasets. The course focuses on three main data mining techniques: Classification, Clustering and Association Rule Mining tasks.

Course Learning Outcomes

On successful completion of the course, students will be able to do following:

1. Pre-process the data, and perform cleaning and transformation.

2. Apply suitable classification algorithm to train the classifier and evaluate its performance.

3. Apply appropriate clustering algorithm to cluster data and evaluate clustering quality

4. Use association rule mining algorithms and generate frequent item-sets and association rules

Detailed Syllabus

Unit 1

Introduction to Data Mining - Applications of data mining, data mining tasks, motivation and challenges, types of data attributes and measurements, data quality. Data Pre-processing - aggregation, sampling, dimensionality reduction, Feature Subset Selection, Feature Creation, Discretization

and Binarization, Variable Transformation.

Unit 2

Classification: Basic Concepts, Decision Tree Classifier: Decision tree algorithm, attribute selection measures, Nearest Neighbour Classifier, Bayes Theorem and Naive Bayes Classifier, Model Evaluation: Holdout Method, Random Sub Sampling, Cross-Validation, evaluation metrics, confusion matrix.

Unit 3

Association rule mining: Transaction data-set, Frequent Itemset, Support measure, Apriori Principle, Apriori Algorithm, Computational Complexity, Rule Generation, Confidence of association rule.

Unit 4

Cluster Analysis: Basic Concepts, Different Types of Clustering Methods, Different Types of Clusters, K-means: The Basic K-means Algorithm, Strengths and Weaknesses of K-means algorithm, Agglomerative Hierarchical Clustering: Basic Algorithm, Proximity between clusters, DBSCAN: The DBSCAN Algorithm, Strengths and Weaknesses.

Data Mining Lab

Section 1: Preprocessing

Q1. Create a file “people.txt” with the following data:

Age agegroup height status yearsmarried

21 adult 6.0 single -1

2 child 3 married 0

18 adult 5.7 married 20

221 elderly 5 widowed 2

34 child -7 married 3

i) Read the data from the file “people.txt”.

ii) Create a ruleset E that contain rules to check for the following conditions:

1. The age should be in the range 0-150.

2. The age should be greater than yearsmarried.

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3. The status should be married or single or widowed.

4. If age is less than 18 the agegroup should be child, if age is between 18 and 65 the

agegroup should be adult, if age is more than 65 the agegroup should be elderly.

iii) Check whether ruleset E is violated by the data in the file people.txt.

iv) Summarize the results obtained in part (iii)

v) Visualize the results obtained in part (iii)

Q2. Perform the following preprocessing tasks on the dirty_iris datasetii

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1. Calculate the number and percentage of observations that are complete.

2. Replace all the special values in data with NA.

3. Define these rules in a separate text file and read them.

(Use editfile function in R (package editrules). Use similar function in Python).

Print the resulting constraint object.

– Species should be one of the following values: setosa, versicolor or virginica.

– All measured numerical properties of an iris should be positive.

– The petal length of an iris is at least 2 times its petal width.

– The sepal length of an iris cannot exceed 30 cm.

– The sepals of an iris are longer than its petals.

4. Determine how often each rule is broken (violatedEdits). Also summarize and plot the

result.

Find outliers in sepal length using boxplot and boxplot.stats

Q3. Load the data from wine dataset. Check whether all attributes are standardized or not (mean

is 0 and standard deviation is 1). If not, standardize the attributes. Do the same with Iris dataset.

Section 2: Data Mining Techniques

Run following algorithms on 2 real datasets and use appropriate evaluation measures to compute

correctness of obtained patterns:

Q4. Run Apriori algorithm to find frequent itemsets and association rules

4.1 Use minimum support as 50% and minimum confidence as 75%

4.2 Use minimum support as 60% and minimum confidence as 60 %

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Q5. Use Naive bayes, K-nearest, and Decision tree classification algorithms and build classifiers.

Divide the data set into training and test set. Compare the accuracy of the different classifiers

under the following situations:

5.1 a) Training set = 75% Test set = 25%

b) Training set = 66.6% (2/3rd of total), Test set = 33.3%

5.2 Training set is chosen by i) hold out method ii) Random subsampling iii) CrossValidation. Compare the accuracy of the classifiers obtained.

5.3 Data is scaled to standard format.

Q6. Use Simple Kmeans, DBScan, Hierachical clustering algorithms for clustering. Compare

the performance of clusters by changing the parameters involved in the algorithms.

Recommended Datasets for DataMining practicals

1. UCI Machine Learning repository.

2. KDD Datasets

3. Open data platform, Government of India (https://data.gov.in/)

References

1. Han, J., Kamber, M.,& Jian,P. (2011). Data Mining: Concepts and Techniques. 3rd edition Morgan Kaufmann

2. Tan, P.-N., Steinbach, M., & Kumar, V. (2005). Introduction to Data Mining. 1st Edition. Pearson Education.

Additional Resources

1. Gupta, G. K. (2006). Introduction to Data Mining with Case Studies. Prentice-Hall of India.

2. Hand, D., & Mannila, H. & Smyth, P. (2006). Principles of Data Mining. Prentice-Hall of India.

3. Pujari, A. (2008). Data Mining Techniques. 2nd edition. Universities Press.

Machine Learning

Credit: 06

Course Objective

The course aims at introducing the basic concepts and techniques of machine learning so that a student can apply machine learning techniques to a problem at hand.

Course Learning Outcomes

On successful completion of this course, the student will be able to:

1. Differentiate between supervised and unsupervised learning tasks.

2. Differentiate between linear and non-linear classifiers.

3. Describe theoretical basis of SVM

4. Implement various machine learning algorithms learnt in the course.

Detailed Syllabus

Unit 1

Introduction: Basic definitions, Hypothesis space and inductive bias, Bayes optimal classifier and Bayes error, Occam's razor, Curse of dimensionality, dimensionality reduction, feature scaling, feature selection methods.

Unit 2

Regression: Linear regression with one variable, linear regression with multiple variables, gradient descent, logistic regression, over-fitting, regularization. performance evaluation metrics, validation methods.

Unit 3

Classification: Decision trees, Naive Bayes classifier, k-nearest neighbor classifier, perceptron, multilayer perceptron, neural networks, back-propagation algorithm, Support Vector Machine (SVM), Kernel functions.

Unit 4

Clustering: Approaches for clustering, distance metrics, K-means clustering, expectation maximization, hierarchical clustering, performance evaluation metrics, validation methods.

Practical

For practical Labs for Machine Learning, students may use softwares like MABLAB/Octave or Python. For later exercises, students can create/use their own datasets or utilize datasets from online

repositories like UCI Machine Learning Repository (http://archive.ics.uci.edu/ml/).

1. Perform elementary mathematical operations in Octave/MATLAB like addition, multiplication, division and exponentiation.

2. Perform elementary logical operations in Octave/MATLAB (like OR, AND, Checking for Equality, NOT, XOR).

3. Create, initialize and display simple variables and simple strings and use simple formatting for

variable.

4. Create/Define single dimension / multi-dimension arrays, and arrays with specific values like array of all ones, all zeros, array with random values within a range, or a diagonal matrix.

5. Use command to compute the size of a matrix, size/length of a particular row/column, load data from a text file, store matrix data to a text file, finding out variables and their features in the current scope.

6. Perform basic operations on matrices (like addition, subtraction, multiplication) and display specific rows or columns of the matrix.

7. Perform other matrix operations like converting matrix data to absolute values, taking the negative of matrix values, additing/removing rows/columns from a matrix, finding the maximum or minimum values in a matrix or in a row/column, and finding the sum of some/all elements in a matrix.

8. Create various type of plots/charts like histograms, plot based on sine/cosine function based on data from a matrix. Further label different axes in a plot and data in a plot.

9. Generate different subplots from a given plot and color plot data.

10. Use conditional statements and different type of loops based on simple example/s.

11. Perform vectorized implementation of simple matrix operation like finding the transpose of a matrix, adding, subtracting or multiplying two matrices.

12. Implement Linear Regression problem. For example, based on a dataset comprising of existing set of prices and area/size of the houses, predict the estimated price of a given house.

13. Based on multiple features/variables perform Linear Regression. For example, based on a number of additional features like number of

bedrooms, servant room, number of balconies, number of houses of years a house has been built – predict the price of a house.

14. Implement a classification/ logistic regression problem. For example based on different features of students data, classify, whether a student is suitable for a particular activity. Based on the available dataset, a student can also implement another classification problem like checking whether an email is spam or not.

15. Use some function for regularization of dataset based on problem 14.

16. Use some function for neural networks, like Stochastic Gradient Descent or backpropagation- algorithm to predict the value of a variable based on the dataset of problem 14.

References

1. Flach, P. (2015). Machine Learning: The Art and Science of Algorithms that Make Sense of

Data. Cambridge University Press.

2. Mitchell, T.M. (2017). Machine Learning. McGraw Hill Education.

Additional References:

1. Christopher & Bishop, M. (2016). Pattern Recognition and Machine Learning. New York:

Springer-Verlag

2. Haykins, S.O. (2010). Neural Networks and Learning Machines. 3rd edition. PHI.