Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Shri Vaishnav Institute of Information Technology

Choice Based Credit System (CBCS) in the light of NEP-2020

B.Tech CSE(Machine Learning & Cloud Computing in association with Google Cloud)

SEMESTER-V (2023-27)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME					L	T	P	CREDITS
			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTCS501N	DCC	Theory of Computation	60	20	20	0	0	3	1	0	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. To introduce concepts in automata theory and theory of computation.
2. To identify different formal language classes and their relationships.
3. To design grammars and recognizers for different formal languages.

COURSE OUTCOMES:

Upon completion of the subject, students will be able to:

1. Ability to relate practical problems to languages, automata, and computability.
2. Ability to demonstrate an increased level of mathematical sophistication.
3. Ability to apply mathematical and formal techniques for solving problems.

SYLLABUS

UNIT I — 10 HOURS

Introduction: Alphabets, Strings and Languages; Automata and Grammars, Deterministic finite Automata (DFA)-Formal Definition, Simplified notation: State transition graph, Transition table, Language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA, Minimization of Finite Automata, Distinguishing one string from other, Myhill-Nerode Theorem.

UNIT II — 8 HOURS

Regular Expression (RE): Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Arden's Theorem, Non-Regular Languages, Pumping Lemma for regular Languages. Application of Pumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages, FA with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of FA.

UNIT III — 9 HOURS

Context Free Grammar (CFG) and Context Free Languages (CFL): Definition, Examples, Derivation, Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure properties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Membership, Pumping lemma for CFLs.

UNIT IV — 7 HOURS

Push Down Automata (PDA): Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG.

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BTCS501N	**DCC**	**Theory of Computation**	**60**	**20**	**20**	**0**	**0**	**3**	**1**	**0**	**4**

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

UNIT V 8 HOURS

Turing machines (TM): Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, TM as Computer of Integer functions, Universal TM, Church's Thesis, Recursive and recursively enumerable languages, Halting problem, Introduction to undecidability, undecidable problems about TM, NP hard and NP complete problem, Post correspondence problem (PCP), Modified PCP, Introduction to recursive function theory.

TEXTBOOKS:

1. J. E. Hopcraft, R. Motwani and J. D. Ullman, *Introduction to Automata Theory, Languages, and Computation*, 3rd Ed., Pearson, 2013.
2. P. Linz, S. H. Rodger, *An Introduction to Formal Languages and Automata*, 7th Ed., Jones & Bartlett Learning, 2023.

REFERENCE:

1. J. C. Martin, *Introduction to Languages and Theory of Computations*, 4th Ed., Tata McGraw Hill, 2010.
2. C. Papadimitriou, and C. L. Lewis, *Elements of the Theory of Computation*, PHI, 1997.
3. Michael Sipser, *Introduction to Theory of Computation*, 3th Ed., Cengage Learning, 2013.
4. K. L. P Mishra & N. Chandrasekaran, *Theory of Computer Science*, 3th Ed., PHI Learning, 2006

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SEMESTER-V (2023-27)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME					L	T	P	CREDITS
			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTCS502N	DCC	**Introduction to Artificial Intelligence**	**60**	**20**	**20**	**30**	**20**	**3**	**0**	**2**	**4**

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. Know how computer system adapts, evolves and learns.
2. To gain expertise in one of fastest growing areas of Computer Science that covers topics related to human intelligence and its applications in industry, defense, healthcare, agriculture and many other areas.
3. Provides a rigorous, advanced and professional graduate-level foundation in Artificial Intelligence

COURSE OUTCOMES:

Upon completion of the subject, students will be able to:

1. Build intelligent agents for search and games
2. Solve AI problems through programming with Python
3. Learning optimization and inference algorithms for model learning
4. Design and develop programs for an agent to learn and act in a structured environment.

SYLLABUS

UNIT I — 10 HOURS

Introduction: Concept of AI, history, current status, scope, agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Search graph and Search tree.

UNIT II — 9 HOURS

Search Algorithms: Random search, Search with closed and open list, Depth first and Breadth first search, Heuristic search, Best first search, A* algorithm, Game Search.

UNIT III — 8 HOURS

Probabilistic Reasoning: Probability, conditional probability, Bayes Rule, Bayesian Networks- representation, construction and inference, temporal model, hidden Markov model.

UNIT IV — 7 HOURS

Markov Decision process: MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.

UNIT V — 8 HOURS

Reinforcement Learning: Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning- Q learning.

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BTCS502N	DCC	**Introduction to Artificial Intelligence**	**60**	**20**	**20**	**30**	**20**	**3**	**0**	**2**	**4**

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TEXTBOOKS:

1. Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, 3rd Ed., Prentice Hall.
2. Elaine Rich and Kevin Knight, *Artificial Intelligence*, Tata McGraw Hill.

REFERENCE:

1. M. C. Trivedi, *A Classical Approach to Artificial Intelligence*, Khanna Publishing House, Delhi.
2. Saroj Kaushik, *Artificial Intelligence*, Cengage Learning India, 2011.
3. David Poole and Alan Mackworth, *Artificial Intelligence: Foundations for Computational Agents*, Cambridge University Press, 2010.
4. https://nptel.ac.in/courses/106105077
5. https://nptel.ac.in/courses/106106126
6. https://aima.cs.berkeley.edu
7. https://ai.berkeley,edu/project_overview.html (for Practical)

LIST OF PRACTICALS

1. Write a program to conduct uninformed and informed search.
2. Write a program to conduct game search.
3. Write a program to construct a Bayesian network from given data.
4. Write a program to infer from the Bayesian network.
5. Write a program to run value and policy iteration in a grid world.
6. Write a program to do reinforcement learning in a grid world.
7. Mini Project work.

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			THEORY			PRACTICAL					
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BTMLCC 531	DCC	Tensor Flow on Google Cloud	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. To Understand the TensorFlow Ecosystem and its Integration with Google Cloud.
2. To Grasp the Concepts of Building and Training Neural Networks with Keras.
3. To Comprehend Data Input Pipelines for Large Datasets using tf.data.
4. To Recognize the Role of Vertex AI in the Machine Learning Workflow.
5. To Understand Strategies for Scaling TensorFlow Model Training and Prediction.

COURSE OUTCOMES:

Upon completion of the subject, students will be able to:

1. Construct and train basic to intermediate neural network models using TensorFlow's Keras API.
2. Efficiently prepare and preprocess diverse datasets for TensorFlow model training using the tf.data
3. Utilize Google Cloud's Vertex AI platform to manage and execute TensorFlow model training jobs, including monitoring progress and accessing logs.
4. Deploy trained TensorFlow models to Google Cloud for online predictions and perform batch inference using Vertex AI Prediction.
5. Identify and apply appropriate strategies for scaling TensorFlow model training and serving on Google Cloud to handle large datasets and high traffic

SYLLABUS

UNIT I

Build, Train and Deploy ML Models with Keras on Google Cloud, Introduction to the TensorFlow ecosystem, Introduction to Tensor flow, Tensor Flow API hierarchy' Components of Tensor flow: Tensors and variables Design and Build an Input Data Pipeline.

UNIT II

Introduction, An ML recap, Training on large datasets with tf.data API, Working in-memory and with files,Getting the data ready for model training, Embeddings.

UNIT III

Building Neural Networks with the Tensor Flow and Keras API, Introduction Activation functions, Training neural networks with TensorFlow 2 and the Keras Sequential API, Serving models in the cloud, Introducing the Keras Sequential API on Vertex AI Platform, Training neural networks with TensorFlow 2 and the Keras Functional API.

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME					L	T	P	CREDITS
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BTMLCC 531	DCC	Tensor Flow on Google Cloud	60	20	20	30	20	3	0	2	4

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UNIT IV

Build a DNN using the Keras Functional API, Model subclassing, Regularization basics, How can we measure model complexity: L1 vs. L2 Regularization.

UNIT V

Training at Scale with Vertex AI, Introduction, Training at scale with Vertex AI, Training at Scale with Vertex AI Training Service.

REFERENCE:

https://www.cloudskillsboost.google/course_templates/8

TensorFlow on Google Cloud

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			THEORY			PRACTICAL					
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BTMLCC 532	DCC	Feature Engineering & Production ML System	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

UNIT I

Feature Engineering Introduction:- Introduction, Feature Store benefits, Feature Store terminology and concepts, The Feature Store data model, creating a Feature Store, Serving features: Batch and online, Raw Data to Features Introduction, Overview of feature engineering, Raw data to features, Good features versus bad features, Features should be known at prediction-time, Features should be numeric, Features should have enough examples, Bringing human insight, Representing features.

UNIT II

Feature Engineering:- Introduction, Machine learning versus statistics, Basic feature engineering, Advanced feature engineering: Feature crosses, Bucketize and Transform Functions, Predict housing prices,Estimate taxi fare, Temporal and geolocation features.

UNIT III

Preprocessing and Feature Creation:- Introduction, Apache Beam and Dataflow, Dataflow terms and concepts, TensorFlow Transform, Analyze phase, Transform phase, Supporting serving, Architecting ML systems, Data extraction, analysis, and preparation, Model training, evaluation, and validation, Trained model, prediction service, and performance monitoring, Training design decisions ,Serving design decisions.

UNIT IV

Designing Adaptable ML Systems:- Introduction, Adapting to data, Changing distributions, Right and wrong decisions System failure, Concept drift, Actions to mitigate concept drift, Tensor Flow data validation, Components of Tensor Flow data validation.

UNIT V

Designing High-Performance ML Systems:- Introduction, Predictions, Why distributed training is needed Distributed training architectures, Tensor Flow distributed training strategies, Mirrored strategy, Multi-worker mirrored strategy, TPU Speed Data Pipelines, Inference, Machine Learning on Hybrid Cloud, Kubeflow, Optimizing TensorFlow for mobile.

REFERENCE:

Feature Engineering

Production ML Systems

Chairperson	Chairperson	Controller of Examination	Registrar
Board of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Faculty of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

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BTMLCC 532	DCC	Feature Engineering & Production ML System	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Chairperson	Chairperson	Controller of Examination	Registrar
Board of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Faculty of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

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BTIT507M	**SEC**	**Programming with Python**	**0**	**0**	**0**	**60**	**40**	**0**	**0**	**4**	**2**

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COURSE OBJECTIVES:

The student will have ability to:

1. To develop proficiency in creating based applications using the Python Programming Language.
2. To be able to understand the various data structures available in Python programming language and apply them in solving computational problems.
3. To be able to do testing and debugging of code written in Python.
4. To be able to draw various kinds of plots using Py Lab.
5. To be able to use generators for generating series like Fibonacci.

COURSE OUTCOMES:

Upon completion of the subject, students will be able to:

1. Ability to create robust applications using the Python programming language.
2. Ability to test and debug applications written using the Python programming language.
3. Ability to create applications for solving computational problems using the Python Programming Language.

SYLLABUS

UNIT I — 10 HOURS

Introduction to Python: The basic elements of Python, Branching programs, Strings and Input, Iteration. Functions, Scoping and Abstraction: Functions and Scoping, Specifications, Recursion, Global variables, Modules, Files.

UNIT II — 9 HOURS

Testing and Debugging: Testing, Debugging. Structured Types, Mutability and Higher order Functions: Tuples, Lists and Mutability, Functions as Objects, Strings, Tuples and Lists, Dictionaries.

UNIT III — 8 HOURS

Exceptions and assertions: Handling exceptions, Exceptions as a control flow mechanism, Assertions. Classes and Object oriented Programming: Abstract Data Types and Classes, Inheritance, Encapsulation and information hiding.

UNIT IV — 7 HOURS

Numpy and Pandas: Python list vs NumPy arrays, Creating a NumPy Array, Basic ndarray,Shape of NumPy array, Size of NumPy array, Random numbers in ndarray, The Shape and Reshaping of NumPy Array, Dimensions of NumPy array, Reshaping a NumPy array, Flattening a NumPy array, Transpose of a NumPy array, Indexing and Slicing of NumPy Array.

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BTIT507M	**SEC**	**Programming with Python**	**0**	**0**	**0**	**60**	**40**	**0**	**0**	**4**	**2**

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Pandas Series, Pandas DataFrames, Common Operations in Pandas, How to Deal With Missing Data in Pandas, How To Merge DataFrames in Pandas, How To Join DataFrames in Pandas, How to Concatenate DataFrames in Pandas. Data Input and Output in Pandas, How to Save Pandas DataFrames Data visualization.

UNIT V **8 HOURS**

Matplotlib: Matplotlib Introduction, Line Chart, Scatter Plot , Bar Graph, Histogram, Subplots , Pie Chart , Pyplot, Matplotlib with Pandas and Numpy. Specify Color, Markings and Lline Styles, Adjust Thickness, Label Tilte, and Legend.

TEXTBOOKS:

1. John V Guttag. “Introduction to Computation and Programming Using Python”, Prentice Hall of India.
2. Allen Downey, Jeffrey Elkner and Chris Meyers "How to think like a Computer Scientist, Learning with Python", Green Tea Press.
3. Mark Lutz "Learning Python" O'Reilly Media; 5 edition.
4. David Beazley "Python Cookbook, Third edition" O'Reilly Media.

REFERENCE:

1. Python Essential Reference, 4th Edition Addison-Wesley Professional.
2. Mark Lutz "Programming Python: Powerful Object-Oriented Programming "David Beazley "Python Cookbook" Third edition, O'Reilly Media.

LIST OF PRACTICALS

1. Write a Python Program to Print Hello world!
2. Write a program to demonstrate different number data types in Python.
3. Write a program to perform different Arithmetic Operations on numbers in Python.
4. Write a Program to Swap Two Variables.
5. Write a Program to Convert Celsius to Fahrenheit.
6. Write a Program to Find the Largest Among Three Numbers.
7. Write a Program to Check Prime Number.
8. Write a Program to Find the Factorial of a Number.
9. Write a Program to Print the Fibonacci sequence.
10. Write a program to create, append, and remove lists in python.
11. Write a program to demonstrate working with tuples in python
12. Write a program to demonstrate working with set in python.
13. Write a program to demonstrate working with dictionaries in python.
14. Write a program to find reverse of given number using function.

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BTIT507M	**SEC**	**Programming with Python**	**0**	**0**	**0**	**60**	**40**	**0**	**0**	**4**	**2**

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15. Write a python Program to call data member and function using classes and objects.
16. Write a program to read 3 subject marks and display pass or failed using class and object.
17. Write a program in Python to handle user defined exception for given problem.
18. Write a program using a Numpy module to create an array and check the following:
    a. Type of array
    b. Axes of array
    c. Shape of array
    d. Type of elements in array
19. Write a python program to concatenate the dataframes with two different objects.
20. Write a Python program to Demonstrate how to Draw a Scatter Plot, Bar Graph and Pie Chart using Matplotlib.

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BTIT508M	SEC	No Sql and MongoDB	0	0	0	30	20	0	0	2	1

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OUTCOMES:

Upon completion of the subject, students will be able to:

CO1: Understanding NoSQL Database Concepts.
CO2: Demonstrate Proficiency in MongoDB Operations.
CO3: Investigate Advanced MongoDB Features.
CO4: Design Database and Data Modelling Skills.
CO5: Apply NoSQL development tools on Real-World Scenarios.

SYLLABUS

UNIT I — HOURS

NoSQL Database: Types of NoSQL Database, Brief History of NoSQL Databases, NoSQL Database Features, Relational database vs NoSQL database example, Differences between RDBMS and NoSQL databases, NoSQL use cases, NoSQL Database Misconceptions.

UNIT II — HOURS

Introduction to MongoDB: MongoDB Atlas, MongoDB and Document Object Model, CRUD Operation, MongoDB Aggregation, Using $match and $group Stages in a MongoDB Aggregation Pipeline, Using $sort and $limit Stages in a MongoDB Aggregation Pipeline, Using $project, $count, and $set Stages in a MongoDB Aggregation Pipeline, Using $out Stage in a MongoDB Aggregation Pipeline.

UNIT III — HOURS

MongoDB Indexes: Using MongoDB Indexes in Collections, Creating a Single Field Index in MongoDB, Creating a Multikey Index in MongoDB, Working with Compound Indexes in MongoDB, Deleting MongoDB Indexes.

UNIT IV — HOURS

Atlas Search: Using Relevance-Based Search and Search Indexes, creating a Search Index with Dynamic Field Mapping, Creating a Search Index with Static Field Mapping, Using search and Compound Operators, Grouping Search Results by Using Facets.

UNIT V — HOURS

MongoDB Data Modelling: Types of data relationships, modelling, embedding data in documents, referencing data in documents, scaling data model, Using Atlas Tools for Schema Help, MongoDB transactions.

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			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTIT508M	SEC	No Sql and MongoDB	0	0	0	30	20	0	0	2	1

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

TEXT BOOKS:

1. MongoDB University, https://learn.mongodb.com/
2. Marko Aleksendric, Arek Borucki, Leandro Domingues. Mastering MongoDB 7.0. Fourth Edition: Achieve data excellence by unlocking the full potential of MongoDB, 4 th Edition. MongoDB Press.
3. Rachelle Palmer, Ben Perlmutter, Ashwin Gangadhar, Nicholas Larew, Sigfrido Narváez , Thomas Rueckstiess, Henry Weller, Richmond Alake, Shubham Ranjan. Building AI Intensive Python Applications: Create intelligent apps with LLMs and vector databases. 1 st Edition. MongoDB Press.

List of Mini Projects:

1. Build a Mini-Application: Create a sample application (e.g., a task manager, blog platform, or e commerce site) using MongoDB as the database backend. Implement all CRUD functionalities and data modeling techniques learned in class.

2. Performance Benchmarking: Conduct performance tests comparing the execution time of queries on indexed versus non-indexed collections to understand the importance of indexing in MongoDB.