

**DIVISION OF ARTIFICIAL
INTELLIGENCE AND
MACHINE LEARNING**

LIST OF NEW COURSES

Sl. No	Course Code	Course Name	L	T	P	Credits
1	23AI2001	Artificial Intelligence for Cyber Security	3	0	0	3
2	23AI2002	Artificial Intelligence in Web Development	3	0	0	3
3	23AI2003	Artificial Intelligence in Web Development Lab	0	0	3	1.5
4	23AI2004	Conversational Artificial Intelligence	3	0	0	3
5	23AI2005	Conversational Artificial Intelligence Lab	0	0	3	1.5
6	23AI2006	Cyber Threat Intelligence and Analytics	3	0	0	3
7	23AI2007	Cyber Threat Intelligence and Analytics Lab	0	0	3	1.5
8	23AI2008	Edge Artificial Intelligence	3	0	0	3
9	23AI2009	Essentials of Generative Artificial Intelligence	3	0	0	3
10	23AI2010	Essentials of Information Retrieval	3	0	0	3
11	23AI2011	Software Engineering for Artificial Intelligence Systems	3	0	0	3
12	23AI2012	Foundation of Generative Adversarial Networks	3	0	0	3
13	23AI2013	Foundation of Natural Language Processing	3	0	0	3
14	23AI2014	Project Requirement Specification	0	0	2	1

SKILL BASED COURSES

Sl. NO	Course Code	Course Name	L	T	P	Credits
1	24AI2501	Machine Learning with PyTorch	0	0	2	1
2	24AI2502	Machine Learning with Scikit-learn	0	0	2	1
3	24AI2503	Machine Learning with TensorFlow	0	0	2	1

Course Code	Artificial Intelligence for Cyber Security	L	T	P	C
23AI2001		3	0	0	3

Course Objectives:

Enable the students to:

1. Identify and predict security threats using Artificial Intelligence algorithms
2. Analyze the effectiveness of Artificial Intelligence cybersecurity algorithms and tools
3. Develop intelligent systems that can detect unusual and suspicious patterns and attacks by developing strong network security defenses using Artificial Intelligence algorithms

Course Outcomes:

The students will be able to:

1. Identify email threats such as spamming and phishing using AI algorithms
2. Predict the antivirus limits in threat detection
3. Choose appropriate network intrusions and detect anomalies with machine learning
4. Analyze the strength of biometric authentication procedures with deep learning
5. Determine suspicious patterns and attacks with Cloud AI, thereby allowing to protect network and corporate assets
6. Demonstrate the applicability and necessity of the usage of Artificial Intelligence in multiple domains of cybersecurity

Module: 1	Introduction To AI for Cyber Security	7 Hours
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Applying AI in Cybersecurity - Evolution in AI: from Expert System to Data Mining - Types of Machine Learning - Algorithm Training and Optimization - Getting to know Python Libraries - AI in the Context of Cyber Security.

Module: 2	Detecting Cyber Security Threats with AI	7 Hours
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Detecting Spam with Perceptron - Spam Detection with SVMs - Phishing Detection with Logistics Regression and Decision Trees - Spam Detection with Naive Bayes - NLP to the Rescue.

Module: 3	Malware Threat Detection	7 Hours
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Malware Analysis at a Glance - Decision Tree Malware Detectors - Detecting Metamorphic Malware with HMMs - Advanced Malware Detection with Deep Learning.

Module: 4	Network Anomaly Detection with AI	8 Hours
Network Anomaly Detection Techniques - Classify Network Attacks - Detecting Botnet Topology - Different ML Algorithms for Botnet Detection.		
Module: 5	Protecting Sensitive Information And Assets	8 Hours
Authentication Abuse Prevention - Account Reputation Scoring - User Authentication with Keystroke Recognition- Biometric Authentication with Facial Recognition.		
Module: 6	Fraud Prevention with Cloud Ai Solutions	8 Hours
Introducing Fraud Detection Algorithms - Predictive Analytics for Credit Card Fraud Detection - IBM Watson Cloud Solutions - Importing Sample Data and Running Jupyter Notebook in the Cloud - Evaluating the Quality of Prediction.		
Total Lectures		45 Hours
Text Books		
1	Alessandro Parisi. (2019). <i>Hands-on Artificial Intelligence for Cyber Security</i> , Packt publisher. ISBN No: 9781789804027.	
2	Ravi Das. (2021). <i>Practical AI for Cybersecurity (1st Edition)</i> . CRC Press. ISBN No: 9781032605258.	
Reference Books		
1	Taimur Ijlal. (2022). <i>Artificial Intelligence (AI) Governance and Cyber-Security: A beginner's handbook on securing and governing AI systems</i> . ISBN: 9781399932448.	
2	Zhixin Pan and Prabhat Mishra. (2023). <i>Explainable AI for Cybersecurity</i> . Springer International Publishing AG. ISBN: 978-3031464782.	
Recommended by Board of Studies	24.04.2024	
Approved by Academic Council	11.05.2024	

Course Code	Artificial Intelligence in Web Development	L	T	P	C
23AI2002		3	0	0	3
Course Objectives:					
Enable the students to:					
<ol style="list-style-type: none"> 1. Gain knowledge about the design and development of interactive web applications 2. Analyze the open source web application framework to facilitate the creation of responsive web applications 3. Develop enterprise applications using frontend and backend scripting language 					
Course Outcomes:					
The Students will be able to:					
<ol style="list-style-type: none"> 1. Identify the relevant properties and methods to facilitate dynamic web application development 2. Apply client side scripting language for client side validation 3. Represent data manipulation and event handling using jQuery 4. Construct dynamic web applications using suitable server-side technologies integrated with the database 5. Develop extensible web applications using the Model View Controller (MVC) framework 6. Design a website using AI tools 					
Module: 1	HTML and CSS	7 Hours			
Overview of HTML - Backgrounds and color gradients -Fonts and Text Styles - List Styles and Table Layouts - Overview of CSS - CSS selectors - Box model, Positioning and Layouts, Effects and Controls in CSS - Overview of Bootstrap.					
Module: 2	JavaScript and JSON	8 Hours			
Overview of JavaScript, JavaScript - Functions and Events - Document Object Model - JSON Introduction - JSON Syntax - JSON Data Types - JSON Schema - JSON Security Concerns - JSON and NoSQL.					
Module: 3	jQuery	7 Hours			

Fundamentals of jQuery and Selectors - jQuery Methods to Access HTML Attributes - jQuery Methods for Traversing - jQuery Manipulators - jQuery Events and Effects.		
Module: 4	Node.JS	8 Hours
Node.js Introduction - Modules and Npm - Event Loop - Asynchronous Code - Callback Functions - Event Emitters - Event Listener - Exception Handling - File System - Web Programming - Database Module - Database Query.		
Module: 5	MongoDB	8 Hours
NoSQL Database - MongoDB Shell - Operations in MongoDB - Mongoose Node Module.		
Module: 6	AI in Web Development	7 Hours
AI Tools for Web Development - Website Building using AI Tools - AI Based Client Side Script Generation.		
Total Lectures		45 Hours
Text Books		
1	DT Editorial Services. (2016). <i>HTML 5 Black Book: Covers CSS3, JavaScript, XML, XHTML, Ajax, PHP and jQuery (2nd Edition)</i> . Dreamtech Press. ISBN: 9789351199076.	
2	Adam Bretz and Colin J Ihrig. (2014). <i>Full Stack JavaScript Development with MEAN</i> . SitePoint. ISBN: 9780992461256.	
Reference Books		
1	Lindsay Bassett. (2015). <i>Introduction to JavaScript Object Notation: A To-the-Point Guide to JSON (1st Edition)</i> . O'Reilly Media, ISBN: 9781491929483.	
2	Jeff Dickey. (2015). <i>Write Modern Web Apps with the MEAN Stack: Mongo, Express, AngularJS, and Node.js</i> . Peachpit Press. ISBN: 978-0133930153.	
3	Simon Holmes and Clive Herber. (2019). <i>Getting MEAN with Mongo, Express, Angular, and Node (2nd Edition)</i> . Manning Publications. ISBN: 978-1617294754.	
Recommended by Board of Studies		24.04.2024
Approved by Academic Council		11.05.2024

Course Code	Artificial Intelligence in Web Development Lab	L	T	P	C
23AI2003		0	0	3	1.5
Course Objectives:					
Enable the students to:					
<ol style="list-style-type: none"> 1. Design dynamic websites with good aesthetic sense using HTML5 and CSS3 2. Analyze problems as well as identify the technologies appropriate to their solutions 3. Develop hands on experience using latest technologies integrated with database 					
Course Outcomes:					
The Students will be able to:					
<ol style="list-style-type: none"> 1. Select the latest standards like HTML5 for designing attractive static web pages and separate design from content using CSS3 2. Apply necessary Bootstrap classes to create responsive web pages 3. Illustrate different functionality of client side scripting language 4. Choose appropriate server side scripting languages and web services to transfer data and add interactive components to web pages 5. Analyze multiple web technologies to create advanced web components 6. Implement AI tools to create Web Pages 					
List of Exercises					
<ol style="list-style-type: none"> 1. Design a Website Using Html5 [Form Elements + Media Elements] 2. Web Page Design Using Html5 and Advanced Css3 3. Responsive Website design using Bootstrap 4. Javascript – Dom Elements and Events 5. Javascript – Timer Functions and Objects 6. Working with Jquery 7. Working with Json and Nosql 					

8. Working with Node.Js
9. Integration of Node.Js with Database Module
10. Working with Nosql Database, Mongodb
11. Design a Website using AI Tools - I
12. Design a Website using AI Tools – II

Recommended by Board of Studies	24.04.2024
Approved by Academic Council	11.05.2024

Course Code	Conversational Artificial Intelligence	L	T	P	C
		3	0	0	3

Course Objectives:

Enable the students to:

1. Acquire foundational knowledge of chatbots, including key concepts and terminologies
2. Develop practical skills in machine learning using various algorithms to create customized models
3. Represent conversational AI systems and learn strategies to deliver better customer experiences

Course Outcomes:

The Students will be able to:

1. Represent the fundamentals of conversational Artificial Intelligence
2. Recognize the basic building components for programming for intelligent systems
3. Analyze the natural language processing techniques to develop conversational applications
4. Create and implement conversational intelligence systems and chatbots
5. Examine the importance of intelligent techniques in conversational technologies
6. Predict the performance metrics to carry out analytics on conversational systems

Module: 1	Fundamentals of Conversational Artificial Intelligence	7 Hours
Introduction - Case studies - Modes of Engagement for Humans - Historical Context and Impact of AI – Underlying Technologies - Natural Language Processing - Artificial Intelligence and Machine Learning - Natural Language Generation (NLG) - Speech-To-Text - Text-To-Speech and Computer Vision - Market Trends and Key Players - Microsoft - Google - Amazon - Meta - Messaging Platforms - Facebook - WhatsApp - Smart Speakers - Alexa - Google Home.		

Module: 2	Foundational Blocks for Programming and NLP	8 Hours
Python Programming Concepts - Node Basics - Evaluation - Basic Concepts and Phases of Natural Language Processing - Chatbot Basics - General Chatbot Architecture and Applications - Intents - Entities - Utterances - Variables and Fulfillment - Lexical Knowledge Networks - WordNet - Verbnet - PropBank - Lexical analysis - Part-of-Speech Tagging - Parsing and Semantic Analysis - Information Extraction and Sentiment Analysis.		

Module: 3	Building Conversational Artificial Intelligence Systems	8 Hours
Fundamentals of Conversational Systems - NLU - DM and NLG - Chatbot Framework and Architecture - Conversational AI Flow and Design - Intent Classification - Machine Learning and Deep Learning Methods - Dialogue Management Strategies - Natural Language Generation – UX Design - APIs and SDKs - Usage of Conversational Design Tools - Introduction to Testing Frameworks - Building a Chat Bot Application.		

Module: 4	Role of Artificial Intelligence in Conversational Technologies	7 Hours
Machine Learning Technologies in Conversational Systems - Automatic Speech Recognition (ASR) - NLP - Advanced Dialog Management - Language Translation Services - Emotion and Sentiment Analysis - Information Extraction for Effective Conversations - Case Studies.		

Module: 5	Contact Centers and Ethics	7 Hours
Introduction to Contact Centers - Impact and Terminologies - Trends and Case Studies - The Role of Virtual Agents - Assistants in Contact Center - Ethics in Conversational AI Systems.		

Module: 6	Conversational Analytics and Future Trends	8 Hours
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Conversation Analytics - The Need of Metrics - Introduction to Conversational Metrics – Robots and Sensory Applications - Overview of XR Technologies (Augmented Reality and Virtual Reality) in Conversational Systems - XR Based Commerce and Market Innovations - Integration with Real-World Applications.

Total Lectures	45 Hours
Text Books	
1	Micheal McTear. (2020). <i>Conversational AI: Dialogue Systems, Conversational Agents and chatbots (1st Edition)</i> . Morgan and Claypool. ISBN: 9781636390321.
2	Luis Fernando D Haro, Zoraida Callejas and Satosh Nakamura. (2021). <i>Conversational Dialogue Systems for the Next Decade (1st Edition)</i> . Springer. ISBN:9789811583971.
Reference Books	
1	Srini Janarthanam. (2017). <i>Chatbots and Conversational UI Development (1st Edition)</i> . Packt Publishers. ISBN: 9781788294669.
2	Diana Perez-marin and Ismael Pascual-Nieto. (2011). <i>Conversational Agents and Natural Language Interaction (1st Edition)</i> . IGI Global publishers. ISBN: 9781609606176.
Recommended by Board of Studies	24.04.2024
Approved by Academic Council	11.05.2024

Course Code	Conversational Artificial Intelligence Lab	L	T	P	C
23AI2005		0	0	3	1.5

Course Objectives:

Enable the students to:

1. Explore python and libraries related to conversational AI
2. Implement, build and test conversational AI systems / chatbots
3. Employ AI and ML algorithms to create real-world applications

Course Outcomes:

The Students will be able to:

1. Interpret the fundamental concepts of conversational AI and programming blocks.
2. Implement NLP methods in building robust conversational AI chatbots.
3. Create intuitive chatbots and intelligent conversational systems.
4. Analyze ML's impact on conversational technology.
5. Evaluate and test system effectiveness using relevant metrics.

List of Exercises

1. Study of basics of python programming related to conversational AI
2. Implementation of lexical analysis
3. Implementation of syntactic analysis
4. Implementation of Sentimental Analysis
5. Implementation of natural language processing using python libraries.
6. Testing of chatbot frameworks
7. Implementation of voice bots
8. Implementation of a generic chat bot
9. Implementation of a bot for a class room discussion application.
10. Implementation of a bot for a simple medical diagnosis application.

Recommended by Board of Studies	24.04.2024
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Course Code	Cyber Threat Intelligence And Analytics	L	T	P	C
23AI2006		3	0	0	3

Course Objectives:

Enable the students to:

1. Gain knowledge on the basic concepts of cyber threat intelligence
2. Describe the intelligence cycle and issues that affect threat intelligence
3. Analyze and gather information in order to support decision making

Course Outcomes:

The students will be able to:

1. Represent cyber threat intelligence and improvement from antiquity to the present day
2. Examine how threat intelligence helps to manage risks and how a threat actor goes about attempting to achieve their desired goal
3. Describe the threat intelligence cycle and elements that comprise the threat intelligence program
4. Summarize the issues that affect the suitability of sources of intelligence for inclusion in a threat intelligence program
5. Analyze the linking of a cyber incident to a specific threat actor
6. Interpret the practice of transforming information into intelligence

Module: 1	Introduction to Cyber Threat Intelligence	7 Hours
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Cyber Threat Intelligence - History of Threat Intelligence - Emergence of Private Sector Intelligence Sharing - Utility of Threat Intelligence - Developing Cyber Threat Intelligence.

Module: 2	Threat Environment	7 Hours
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Threat Classification - Risk and Vulnerability - Threat Actors - Tactics - Techniques and Procedures Victimology - Threat Landscape - Attack Vectors - Vulnerabilities and Exploits - The Kill Chain - Untargeted vs. Targeted Attacks.

Module: 3	Applying Intelligence	7 Hours
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Planning Intelligence Gathering - The Intelligence Cycle - Situational Awareness - Goal Oriented Security and Threat Modelling - Strategic - Operational and Tactical Intelligence - Incident Preparedness and Response.

Module: 4	Collecting Intelligence	8 Hours
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Hierarchy of Evidence - Understanding Intelligence - Third Party Intelligence Reports - Tactical and Operational Reports - Strategic Threat Reports - Internal Incident Reports - Root Cause Analysis - Active Intelligence Gathering.

Module: 5	Generating Intelligence	8 Hours
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The Intelligence Cycle in Practice - Sources of Data - Searching Data - Threat Hunting - Transforming Data into Intelligence - Sharing Intelligence - Measuring the Effectiveness of Generated Intelligence.

Module: 6	Attribution and Professionalism	8 Hours
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Crime and Punishment - Standards of Proof - Mechanisms of Attribution - Attack Attributes- Professional Ethics - Professionalism in Engineering - Legal and Ethical Environment - Planning - Collection - Analysis and Processing - Managing the Unexpected - Continuous Improvement.

Total Lectures	45 Hours
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Text Books

1	Martin Lee. (2023). <i>Cyber Threat Intelligence</i> . John Wiley & Sons. ISBN: 9781119861751.
2	Jean Nestor M. Dahj. (2022). <i>Mastering Cyber Intelligence: Gain comprehensive knowledge and skills to conduct threat intelligence for effective system defense</i> . Packt Publishing. ISBN: 9781800209404.

Reference Books

1	Zheng Xu, Kim-Kwang Raymond Choo, Ali Dehghantanha, Reza Parizi and Mohammad Hammoudeh. (2020). <i>Cyber Security Intelligence and Analytics (1st Edition)</i> . Springer. ISBN: 9783030152345.
2	David M. Cooney Jr. (2019). <i>The Cyber Intelligence Handbook</i> . ISBN: 9781082404382.
3	Elias Bou-Harb and Nataliia Neshenko (2021). <i>Cyber Threat Intelligence for the Internet of Things (1st Edition)</i> . Springer Nature Switzerland AG. ISBN: 9783030458607.

Recommended by Board of Studies	24.04.2024
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Approved by Academic Council	11.05.2024
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Course Code	Cyber Threat Intelligence and Analytics Lab	L	T	P	C
23AI2007		0	0	3	1.5

Course Objectives:

<p>Enable the students to:</p> <ol style="list-style-type: none">1. Analyze the various cyber threat intelligence tools2. Employ malware analysis tools to enable effective threat detection3. Explore how Splunk can be used to solve problems more efficiently
<p>Course Outcomes:</p> <p>The students will be able to:</p> <ol style="list-style-type: none">1. Identify the open source intelligence tools used to collect data2. Employ tools to capture and display real-time details of network traffic3. Analyze malware using various malware analysis tools4. Recognize the installation and configuration of Splunk Platform5. Apply the knowledge gained on Splunk to create knowledge objects and visualizations6. Create and manage reports and alerts
<p>List of Exercises:</p> <ol style="list-style-type: none">1. Collecting and Analyzing data for cyber threat analysis using Recon-ng Tool2. Collecting information for security monitoring using AlienVault Tool3. Monitoring Network traffic for potential threats using Wireshark4. Malware Analysis to improve threat intelligence using Malcom5. Assessing Antivirus Detection Performance using PAFish6. Sharing and analysis of cyber threat intelligence data using MISP7. Installation and Configuration of Cyber threat Intelligence tool - Splunk Enterprise8. Introduction to the Cyber threat intelligence tool - Splunk reports, dashboards and events9. Detection of threats in Splunk web interface by creating knowledge objects10. Creating visualizations in Splunk using Splunk's Search Processing Language and Splunk Web interface11. Empowering Threat Intelligence through Scheduled Reporting in Splunk12. Monitoring potential cyber threats by setting up alerts in Splunk
<p>Recommended by Board of Studies</p>

Course Code	Edge Artificial Intelligence	L	T	P	C
23AI2008		3	0	0	3

Course Objectives:

Enable the students to:

1. Deploy AI algorithms and models directly on edge devices such as smartphones and other devices, instead of relying solely on cloud-based processing
2. Interpret data locally on the device in real-time, reducing latency and enabling faster response times
3. Apply on critical applications where immediate action is required, such as autonomous vehicles or industrial automation

Course Outcomes:

The students will be able to:

1. Interpret the fundamental concepts of edge artificial intelligence
2. Design the architecture of edge artificial intelligence
3. Analyze the various algorithms used in various situations in edge artificial intelligence
4. Represent the various tools available to implement the edge artificial intelligence
5. Implement the edge artificial intelligence libraries and predefine frameworks
6. Examine the various edge AI datasets and process the data sets

Module: 1	Edge AI-Introduction	8 Hours
	Need of Edge AI - Edge AI vs Regular AI - Hardware of Edge AI - Sensors - Signals and Sources of Data - Types of Sensors and Signals - Acoustic and Vibration - Visual and Scene - Motion and Position - Optical - Electromagnetic and Radiation.	

Module: 2	Edge AI Architecture	7 Hours
Processors for Edge AI - Edge AI Hardware Architecture - Microcontrollers and Digital Signal Processors - System-on-Chip - Deep Learning Accelerators - FPGAs and ASICs - Edge Servers Multi - Device Architectures.		

Module: 3	Algorithms for Edge AI	8 Hours
Working with Data Streams - Digital Signal Processing Algorithms - Combining Features and Sensors - Artificial Intelligence Algorithms - Postprocessing algorithms - Optimization for Edge Devices - Choice of algorithm - Compression and Optimization - On-Device Training.		
Module: 4	Edge AI- Tools	7 Hours
Software Engineering - Operating Systems - Programming and Scripting Languages - Distributed Computing – Containerization - Cloud Providers - Working with Data - Data Capture - IoT Device Management - Data Storage and Management - Data Pipelines.		
Module: 5	Edge Intelligence	7 Hours
Machine Learning at the Edge Computing - ML Development Workflow - Edge ML Tools - Edge ML Frameworks - Edge ML Hardware - Optimizing ML Pipelines for Edge Devices - Edge Devices Connectivity - Wireless Connectivity - Wi-Fi in Edge Computing - Bluetooth Low Energy.		
Module: 6	Applications and Tools	8 Hours
Wearable's - TSN and Distributed Real-Time Computing - Intelligent Connected Vehicles - Future Intelligent Connected Vehicles - Securing the Automotive Edge - Development Tools - Debugging Real-Time Applications.		
Total Lectures		45 Hours
Text Books		
1	Daniel Situnayake and Jenny Plunkett. (2023). <i>AI at the Edge: Solving Real-World Problems with Embedded Machine Learning</i> . O'Reilly Media. ISBN: 9781098120207.	
2	Robert Oshana. (2022). <i>Essentials of Edge Computing</i> . NXP Semiconductors. ISBN: 9781667827926.	
Reference Books		
1	Ajit Singh. (2020). <i>Edge Computing Simply In Depth (2nd Edition)</i> . ISBN: 9798610038025.	
2	Perry Lea. (2020). <i>IoT and Edge Computing for Architects (2nd Edition)</i> . Packt Publishing. ISBN: 9781839214806.	
Recommended by Board of Studies	24.04.2024	
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Course Code	Essentials of Generative Artificial Intelligence	L	T	P	C
23AI2009		3	0	0	3
Course Objectives:					
Enable the students to:					
<ol style="list-style-type: none"> 1. Gain knowledge on the principles of generative AI and its applications 2. Analyze the versatility and practicality of generative models in addressing diverse real-world problems 3. Apply Generative AI techniques to real-world problems 					
Course Outcomes:					
The students will be able to:					
<ol style="list-style-type: none"> 1. Represent the basic principles and concepts of generative artificial intelligence 2. Explore different types of generative models and their underlying architectures 3. Design a generative adversarial network for image synthesis and style transfer applications 4. Select the appropriate reinforcement learning model for generative tasks 5. Apply generative AI techniques to generate realistic images, texts, and other types of data 6. Analyze ethical considerations and challenges related to generative AI 					
Module: 1	Introduction to Generative AI	7 Hours			
Overview of Generative AI and its Applications - Introduction to Generative models - Generative models vs. Discriminative models - Probabilistic Generative Models - Challenges of Generative models.					
Module: 2	Variational Autoencoders	7 Hours			

Autoencoders - Building a Variational Autoencoder - Training the Variational Autoencoder - Analysis of the Variational Autoencoder - Applications of Variational Autoencoders - Image Generation - Data Compression.		
Module: 3	Generative Adversarial Networks	7 Hours
Introduction to Generative Adversarial Networks - The Discriminator - The Generator - Training the Generative Adversarial Networks - Challenges - Architectural variations - DCGAN - WGAN - CGAN - Generative Adversarial Networks Applications - Image Synthesis and Style Transfer.		
Module: 4	Sequence Generation with Recurrent Neural Networks	8 Hours
Long Short-Term Memory Networks - Tokenization -The Long Short-Term Memory Architecture - The Embedding Layer - Recurrent Neural Networks Extensions - Stacked Recurrent Networks - Gated Recurrent Units - Bidirectional Cells - Encoder-Decoder Model - Applications for Sequence Generation - Text Generation and Music Generation.		
Module: 5	Reinforcement Learning for Generative Tasks	8 Hours
Introduction to Reinforcement Learning - Markov Decision Process - Policy Gradients - Generative Adversarial Imitation Learning - Training process - Applications of Reinforcement Learning - Game Playing and Robotics.		
Module: 6	Advances in Generative AI	8 Hours
Advances in Image Generation - ProGAN - Self Attention GAN - Applications of Generative Modeling - Domain Adaptation and Transfer Learning in Generative AI - Ethical considerations and challenges in Generative AI.		
Total Lectures		45 Hours
Text Books		
1	David Foster. (2019). <i>Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play</i> . O'Reilly Publisher (1 st Edition). ISBN: 9781492041948.	
2	Rafael Valle (2019). <i>Hands-On Generative Adversarial Networks with Keras</i> . Packt Publishing. ISBN: 9781789538205.	
Reference Books		
1	Joseph Babcock, Raghav Bali. (2021). <i>Generative AI with Python and TensorFlow 2: Create images, text, and music with VAEs, GANs, LSTMs, Transformer models</i> (1 st Edition). Packt publisher. ISBN: 9781800200883.	
2	Jakub M. Tomczak. (2021). <i>Deep Generative Modeling</i> . Springer. ISBN: 9783030931582.	
Recommended by Board of Studies		24.04.2024
Approved by Academic Council		11.05.2024

Course Code	Essentials of Information Retrieval	L	T	P	C
23AI2010		3	0	0	3
Course Objectives:					
Enable the students to:					
<ol style="list-style-type: none"> 1. Gain knowledge on the basic principles and concepts of information retrieval 2. Explore search engines index and retrieve information 3. Apply search strategies and query languages to retrieve information from databases 					
Course Outcomes:					
The students will be able to:					
<ol style="list-style-type: none"> 1. Interpret the fundamental principles and concepts of information retrieval 2. Describe how search engines work and the basic algorithms used in information retrieval 3. Apply various information retrieval techniques to retrieve relevant information from different sources 4. Analyze the performance of an information retrieval system using relevant metrics 5. Evaluate the effectiveness of information retrieval systems in meeting user information needs 6. Design and develop an information retrieval system for a specific domain or use case 					

Module: 1	Boolean Retrieval	7 Hours
Information Retrieval Problem - A first take at building an inverted index - Processing Boolean queries - The Extended Boolean Model vs. Ranked Retrieval - Document Delineation and Character Sequence Decoding - Determining the Vocabulary of Terms - Faster Postings List Intersection via Skip Pointers - Positional Postings and Phrase Queries.		
Module: 2	Dictionaries and Tolerant Retrieval	7 Hours
Search structures for dictionaries - Wildcard queries - Spelling correction - Phonetic correction - Hardware basics - Blocked sort-based indexing - Single-pass in-memory indexing - Distributed indexing - Dynamic indexing - Other types of indexes.		
Module: 3	Index Compression	7 Hours
Statistical properties of terms in information retrieval - Dictionary compression - Postings file compression - Parametric and zone indexes - Term frequency and weighting - The vector space model for scoring - Variant TF-IDF Functions.		
Module: 4	Probabilistic Retrieval	8 Hours
Modeling Relevance - The Binary Independence Model - The Robertson/Sparck Jones Weighting Formula - Term Frequency - Document Length: BM25 - Relevance Feedback - Field Weights - BM25F - Generating Queries from Documents - Language Models and Smoothing - Ranking with Language Models - Kullback-Leibler Divergence - Divergence from Randomness - Passage Retrieval and Ranking.		
Module: 5	Fusion and Metalearning	8 Hours
Search-Result Fusion - Stacking Adaptive Filters - Stacking Batch Classifiers - Bagging - Boosting - Multi category Ranking and Classification - Learning to Rank - Traditional Effectiveness Measures - Text Retrieval Conference (TREC) - Statistics in Evaluation - Minimizing Adjudication Effort - Nontraditional Effectiveness Measures.		
Module: 6	XML Retrieval	8 Hours
The Structure of the Web - Queries and Users - Static Ranking - Dynamic Ranking - Evaluating Web Search - Web Crawlers - The Essence of XML - Paths, Trees, and FLWORs - Indexing and Query Processing - Ranked Retrieval - Evaluation.		
Total Lectures		45 Hours
Text Books		
1	Christopher D. Manning, Prabhakar Raghavan and Hinrich Schtze. (2008). <i>Introduction to Information Retrieval</i> . Cambridge University Press. ISBN: 9780521865715.	
2	Stefan Büttcher, Charles L. A. Clarke and Gordon V. Cormack. (2016). <i>Information Retrieval: Implementing and Evaluating Search Engines</i> . MIT Press. ISBN: 9780262026512.	
Reference Books		
1	Ricardo Baeza-Yates and Ribeiro-Neto. (2010). <i>Modern Information Retrieval: The Concepts and Technology behind Search (2nd Edition)</i> . Addison-Wesley Educational Publishers Inc. ISBN: 9780321416919.	
2	Croft, Metzler and Strohman. (2010). <i>Search Engines: Information Retrieval in Practice</i> . ISBN: 9780133001594.	
3	Büttcher, Clarke and Cormack. (2010). <i>Information Retrieval – Implementing and Evaluating Search Engines</i> . MIT Press. ISBN: 978-0262528870.	
Recommended by Board of Studies	24.04.2024	
Approved by Academic Council	11.05.2024	

Course Code	SOFTWARE ENGINEERING FOR ARTIFICIAL INTELLIGENCE SYSTEMS	L	T	P	C
23AI2011		3	0	0	3
Course Objectives:					
Enable the student to:					
<ol style="list-style-type: none"> Identify and apply the appropriate software life cycle model to design the high-level AI system Design the structure and behavior of the software system using UML diagrams 					

3. Apply software testing and quality assurance techniques at the module level to ensure good quality software

Course Outcomes:

The student will be able to:

1. Design an effective software engineering process to develop AI based software-intensive systems
2. Translate the requirements specification into an implementable design
3. Construct UML diagrams along with design strategies and design patterns
4. Analyze the various architectural design methods
5. Evaluate the system using various testing strategies
6. Develop AI based software system with quality measures

Module: 1	Process Models	7 Hours
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Prescriptive Process models - Waterfall model - Incremental process models - Evolutionary process models - Criteria for Selecting Software Process Models - Concurrent models - Unified Process - Agile process models - Agile Teams - Agile open source tool -Jira software.

Module: 2	Understanding Requirements	7 Hours
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Requirement engineering - Eliciting requirements - Building the analysis model-pro - Negotiating requirements - Preparation of Baseline requirements for an real time application - Requirements monitoring - Validating requirements - Practice of open source Requirement management tools - Jira Software - UML diagrams - SRS Preparation with UML.

Module: 3	Software Design	8 Hours
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Design process - concepts - Abstraction - Architecture - Patterns, Separation of concerns - Modularity, Information hiding, Functional Independence - Refinement - Aspects – Refactoring - Object oriented design concepts - Design classes - Dependency inversion - Design for test - Architectural styles - Designing class based components - Cohesion and coupling - Domain engineering - User interface analysis and design - Define various UML Diagrams using ArgoUML.

Module: 4	Fundamentals of Testing	8 Hours
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Object oriented testing strategies - Verification and Validation - Unit Test - Integration Test - Test case Preparation using Selenium - Testing web applications - Content testing - User interface testing - Component level testing - Navigation testing - Configuration testing- Security testing - Performance testing - White box testing - Black box testing - Automated testing tool Practice using Selenium - Review techniques Informal and Formal technical review.

Module: 5	Software Quality Assurance	7 Hours
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Statistical Software Quality Assurance - Six sigma and ISO 9000 - Software Configuration Management - SCM Repository and SCM Process - Software measurement - Metrics for software quality - DevOp tools - Demonstration of Jenkins.

Module: 6	Agile AI	8 Hours
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Introduction - Agile AI Processes and Outcomes - The Agile Approach - AI Processes in Businesses Today - Understanding AI Tools - Contrasting Machine Learning and AI - The role of Open Source in Innovation – Tooling - The Fundamentals of Machine Learning Projects - The Machine Learning Life - Distributed Workloads and Hybrid Environments - Use cases.

Total Lectures	45 Hours
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Text Books

1	Roger Pressman S., Bruce R. Maxim, (2020), "Software Engineering: A Practitioner's Approach", 9 th Edition, McGraw- Hill, ISBN13: 9781259872976.
2	Carlo Appugliese, Paco Nathan, William Roberts, (2020), "Agile AI", O'Reilly Media, Inc, ISBN: 9781492074977.

Reference Books

1	Ian Sommerville, (2016), "Software Engineering", 9 th Edition, Pearson Education Ltd, ISBN: 1-292-09613-6.
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2	Martin Kleppmann, (2017), "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems", Shroff/O'Reilly, ISBN: 978-9352135240.
3	Titus Winters, Tom Mansreck, and Hyrum Wright, (2020), "Software Engineering at Google: Lessons Learned from Programming Over Time", Shroff/O'Reilly, ISBN: 978-9352139743.
4	Rod Stephens, (2015), "Beginning Software Engineering", John Wiley & Sons, Inc., ISBN: 978-1-118-96914-4.
Recommended by Board of Studies	24.04.2024
Approved by Academic Council	11.05.2024

Course Code	Foundation of Generative Adversarial Networks	L	T	P	C
		3	0	0	3

Course Objectives:

Enable the students to:

1. Gain knowledge on fundamental concepts and principles of Generative Adversarial Networks (GANs)
2. Examine GAN variants and its architectures
3. Apply GAN in real-world applications

Course Outcomes:

The students will be able to:

1. Describe the architecture and components of typical Generative Adversarial Networks (GAN) model
2. Identify different variants of GANs
3. Analyze the performance of GAN model using suitable criteria
4. Apply GAN for tasks such as image generation, voice, Music and Song
5. Develop proficiency in implementing GAN models using popular deep learning frameworks
6. Examine the Future of GAN

Module: 1	Fundamentals of GAN	7 Hours
Artificial Neural Network (ANN) Fundamentals and Architecture - ANN Implementation - Deep Learning (DL) Fundamentals and Architecture - DL Implementation - Generative Adversarial Networks (GANs) Fundamentals - Develop GAN Models - Issues in GAN - Training Approaches and Implementation.		
Module: 2	Variants of GANs	8 Hours
Deep Convolutional GAN (DCGAN) - DCGAN for CelebA & MNIST - Conditional GAN (cGAN) - Cycle GAN - Semi-Supervised GAN (SGAN) - Wasserstein GAN (WGAN) - Least Squares GAN (LSGAN).		
Module: 3	Data Preprocessing and Model Evaluation	7 Hours
Data Preprocessing - Data Cleaning - Data Transformation - Balancing Data - Data Augmentation - Data Reduction - Dataset Partitioning - Data Preparation Steps and Issues - Model Evaluation - Hyperparameter Setting - Optimize the Model – Bias and Variance - Identifying Weakness in a Model - Model Evaluation - Model Evaluation Issues and Implementation Tips.		
Module: 4	GAN Deep Learning Frameworks	7 Hours
TensorFlow and Keras Fundamentals - Tensors - TensorFlow - Indexing and Slicing - Building NN using TensorFlow - Building a CNN using TensorFlow - Keras - TensorFlow Issues - Keras Issues - Keras Functional API for Complex Models - Building Your First GAN with PyTorch - Creating DCGAN with PyTorch.		
Module: 5	Applications of GAN	8 Hours
GANs for Images - Architectures - Image Synthesis - Image Restoration using SRGAN - Image Synthesis using GAN Issues - Implementation Tips for Image Synthesis using GANs - GANs for Voice and Music - Sound - Audio Synthesis - Human Voice Conversion - Song Conversion - Song Conversion using TensorFlow - Issues in GANs for Voice and Music - Implementation Tips in GANs for Voice and Music.		
Module: 6	Future of Generative Modeling	8 Hours

The Transformer - Positional Encoding - Multihead Attention - The decoder - BERT - GPT-2 – MuseNet - Advances in Image Generation - ProGAN - Self Attention GAN (SAGAN) - BigGAN -StyleGAN - AI Art-AI Music.

Total Lectures	45 Hours
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Text Books

1	Mehdi Ghayoumi. (2024). <i>Generative Adversarial Networks in Practice (1st Edition)</i> . CRC Press Taylor and Francis Group. ISBN: 9781032248448.
2	Jakub Langr and Vladimir Bok. (2019). <i>GANs in Action: Deep learning with Generative Adversarial Networks</i> . Manning. ISBN: 9781617295560.
3	John Hany and Greg Walters. (2019). <i>Hands-On Generative Adversarial Networks with PyTorch 1.x</i> . Pack Publishing. ISBN: 9781789530513.

Reference Books

1	Ian Goodfellow, Yoshua Bengio, and Aaron Courville. (2016). <i>Deep Learning</i> . MIT Press. ISBN: 9780262035613.
2	Rafael Valle. (2019). <i>Hands-On Generative Adversarial Networks with Keras</i> . Pack Publishing. ISBN: 9781789538205.
3	Josh Kalin. (2018). <i>Generative Adversarial Networks Cookbook</i> . Pack Publishing. ISBN: 9781789139907.

Recommended by Board of Studies	24.04.2024
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Approved by Academic Council	11.05.2024
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Course Code	Foundation of Natural Language Processing	L	T	P	C
23AI2013		3	0	0	3

Course Objectives:

Enable the students to:

1. Achieve a deep grasp and comprehensive understanding of NLP principles and techniques
2. Develop skills in text preprocessing, modeling, and classification
3. Explore ethical considerations and biases in NLP applications

Course Outcomes:

The students will be able to:

1. Develop foundational knowledge in the principles and methodologies underlying natural language processing (NLP)
2. Cultivate proficiency in employing a comprehensive range of NLP techniques, from elementary concepts to complex modeling strategies
3. Acquire the skills to preprocess textual data, develop language models, and apply various classification algorithms effectively
4. Investigate the application of deep learning techniques, such as recurrent neural networks (RNNs) and long short-term memory networks (LSTMs), in NLP tasks
5. Excel in sequence labeling methods, including part-of-speech tagging and named entity recognition
6. Describe the ethical issues and biases inherent in the development and application of NLP models

Module: 1	Text Processing Basics	7 Hours
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Introduction to Natural Language Processing - Regular Expressions - Text Normalization - Edit Distance - Words - Corpora - Simple Unix Tools for Word Tokenization - Word Tokenization - Normalization - Lemmatization and Stemming - Sentence Segmentation - N-gram Language Models.

Module: 2	Language Models and Text Classification	8 Hours
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Evaluating Language Models - Training and Test Sets - Perplexity - Naive Bayes Classifiers for Text Classification and Sentiment Analysis - Training the Naive Bayes Classifier - Optimizing for Sentiment Analysis - Precision - Recall - F-measure - Test sets and Cross-validation - Statistical Significance.

Module: 3	Advanced Modeling Techniques	8 Hours
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Logistic Regression in Text Classification - The Sigmoid Function - Classification with Logistic Regression - Multinomial Logistic Regression - Introduction to Vector Semantics and Embeddings -

Lexical Semantics - Vector Semantics - Words and Vectors - Measuring Similarity and Relevance - Cosine Similarity - TF-IDF - Pointwise Mutual Information (PMI).		
Module: 4	Deep Learning for NLP	8 Hours
Overview of Neural Networks and its Application in NLP - Feedforward Neural Networks - Training Neural Nets - Neural Language Modeling - Introduction to Recurrent Neural Networks (RNNs) -Long Short-Term Memory Networks (LSTMs) - Encoder and Decoder Models - Attention Mechanisms.		
Module: 5	Sequence Processing and Named Entity Recognition	7 Hours
Sequence Labeling for Parts of Speech and Named Entities - Detailed Look at Part-of-Speech Tagging and Named Entity Recognition (NER) - Implementing HMM for Part-of-Speech Tagging - Conditional Random Fields (CRFs) for NER.		
Module: 6	Word Embeddings in NLP	7 Hours
Deep Dive into Word2Vec and its Applications - Advanced Vector Space Models for Semantic Analysis - Exploring Bias and Ethics in Word Embeddings and AI - Visualizing and Evaluating Embeddings - Advanced Techniques in NLP.		
Total Lectures		45 Hours
Text Books		
1	Daniel Jurafsky and James H. Martin. (2023). <i>Speech and Language Processing</i> . 3 rd Edition. Pearson publications. ISBN: 978-0131873216.	
2	Raymond S. T. Lee. (2023). <i>Natural Language Processing: A Textbook with Python Implementation</i> . Springer Verlag, Singapore. ISBN: 9789819919987.	
Reference Books		
1	Palash Goyal, Sumit Pandey, and Karan Jain. (2018). <i>Deep Learning for Natural Language Processing</i> . Apress. ISBN: 978-1800569375.	
2	Daniel Jurafsky and James H. Martin. (2015). <i>Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition</i> (2 nd Edition). Pearson Education India. ISBN: 9780135041963.	
3	Lane, Howard, and Hapke. (2019). <i>Natural Language Processing in Action</i> . Manning. ISBN: 9781617294631.	
Recommended by Board of Studies	24.04.2024	
Approved by Academic Council	11.05.2024	

Course Code	Project Requirement Specification	L	T	P	C
23AI2014		0	0	2	1
Course Objectives:					
Enable the students to:					
<ol style="list-style-type: none"> 1. Gain knowledge on the principles, processes, and methodologies of project development 2. Develop comprehensive project plans, execute tasks efficiently, and manage resources effectively to achieve project objectives to achieve project objectives 3. Create project charters, plans, reports, and documentation necessary for project management and communication 					
Course Outcomes:					
The students will be able to:					
<ol style="list-style-type: none"> 1. Interpret project objectives, scope, stakeholders, constraints, assumptions and deliverables during the project initiation phase 2. Identify the necessary hardware and software requirements of the project 3. Describe the functional and non-functional requirements of the project 4. Develop a hierarchical decomposition of project tasks to organize work and facilitate planning and resource allocation 5. Analyze various scheduling techniques such as Gantt charts or network diagrams to create a timeline for project activities and milestones 6. Present the project specification through oral presentation 					
List of Exercises:					

<ol style="list-style-type: none"> Define the specific problem domain information Identify the basic scope and significance of the project Classify the requirement analysis of the project Evaluation of the functional and non-functional demands of the project Apply Unified Modeling Language (UML) to project design model implementation Select appropriate user interface design techniques and models Identify the most appropriate software tools for implementing the project Final review of the consolidated project requirement analysis 	
Recommended by Board of Studies	24.04.2024
Approved by Academic Council	11.05.2024

Course Code	Machine Learning with PyTorch	L	T	P	C
24AI2501		0	0	2	1

Course Objectives:

Enable the students to:

- Gain knowledge on concepts in PyTorch like dynamic computation graphs
- Construct various types of neural network architectures using PyTorch
- Explore the techniques to prepare the data to be fed into PyTorch

Course Outcomes:

The students will be able to:

- Develop the PyTorch models using various optimization algorithms.
- Identify the techniques to monitor the training progress and prevent overfitting problems.
- Construct machine learning models for classification and regression problems.
- Examine the advanced topics in PyTorch, such as transfer learning, model interpretability, and distributed training.
- Recognize the custom layers, integrating PyTorch with other libraries and frameworks.
- Create the models on different platforms such as cloud services, edge devices, or mobile applications.

List of Experiments:

- Install and set up PyTorch environment
- Implement neural networks with PyTorch module
- Build model and optimize the model parameters
- Implement optimizers for model training
- Evaluate models in PyTorch
- Implement custom loss functions and metrics
- Implement model interpretation and visualization techniques

Exercises from the above list will be approved by the HoD during the start of the semester.

Recommended by Board of Studies	24.04.2024
Approved by Academic Council	11.05.2024

Course Code	Machine Learning with Scikit-Learn	L	T	P	C
24AI2502		0	0	2	1

Course Objectives:

Enable the students to:

- Gain knowledge on machine learning concepts including supervised learning and unsupervised learning
- Explore the scikit-learn library including its API
- Develop machine learning models such as linear regression, logistic regression, decision tree and support vector machine

Course Outcomes:

The students will be able to:

- Construct an unsupervised learning model such as clustering techniques
- Evaluate and validate the machine learning models for the given datasets
- Identify the techniques of feature selection and extraction for required data
- Demonstrate the creation of machine learning pipelines in scikit-learn library

<ol style="list-style-type: none"> 5. Select the appropriate machine learning algorithm for real-world problems 6. Apply the scikit-learn on real-world datasets to gain practical experience in solving machine learning tasks.
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List of Experiments:

<ol style="list-style-type: none"> 1. Install and setup scikit-learn environment 2. Implement data preprocessing techniques using NumPy and Pandas for data manipulation 3. Implement supervised learning models such as Support Vector Machines (SVM), Decision Trees and Random Forests for classification problems 4. Implement supervised learning models such as Linear Regression and Ridge Regression for Regression problems 5. Evaluate the model using evaluation metrics for classification and regression tasks 6. Implement unsupervised learning models such as K-Means clustering and hierarchical clustering algorithms

Exercises from the above list will be approved by the HoD during the start of the semester.

Recommended by Board of Studies	24.04.2024
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Approved by Academic Council	11.05.2024
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Course Code	Machine Learning with Tensorflow	L	T	P	C
24AI2503		0	0	2	1

Course Objectives:

Enable the students to:

1. Gain knowledge on concepts and principles of TensorFlow like tensors, operations and graphs
2. Construct the various types of neural networks including convolutional neural networks using the TensorFlow library
3. Develop the models and fine-tune with TensorFlow environment

Course Outcomes:

The students will be able to:

1. Construct the machine learning models using TensorFlow library
2. Build and train machine learning models involving real-world datasets with TensorFlow
3. Develop transfer learning model and fine-tuning pre-trained models using TensorFlow
4. Solve real-world problems through hands-on projects using TensorFlow environment
5. Evaluate the model performance using evaluation metrics
6. Interpret AI practices related to TensorFlow and machine learning

List of Experiments:

1. Install and setup TensorFlow environment
2. Load a prebuilt dataset
3. Build a neural network machine learning model that classifies images
4. Train the neural network model and fine-tune the parameters
5. Evaluate the model using evaluation metrics
6. Classify images of clothing
 - (i) Import the Fashion MNIST dataset
 - (ii) Explore the data
 - (iii) Preprocess the data

Exercises from the above list will be approved by the HoD during the start of the semester.

Recommended by Board of Studies	24.04.2024
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Approved by Academic Council	11.05.2024
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