Adani University
Department of CSE (AI-ML)

Teaching Scheme

SEMESTER VII							
Sr no	**Category**	**Course title**	**Hours / week**			**TOT**	**Credits**
			L	**T**	**P**		
		Summer Internship	--	--	--	--	2
1	Professional Core Course	Soft Computing	3	0	2	5	4
2	Professional Core Course	Computer Vision	3	0	2	5	4
3	Professional Elective Course *(MOOC)*	*Edge Computing / Blockchain Technology*	3	0	0	3	3
4	Professional Elective Course	Computational Linguistics and Natural Language Processing / Advanced Network Protocol / Gen AI and Applications	3	0	2	5	4
5	Professional Elective Course	Reinforced Learning / Big Data Analytics	3	0	0	5	3
6	Open Elective	Cyber Crime and Mitigation / Social and Information Networks	3	0	0	3	3
7	Project Work	Mini Project	--	--	--	--	2
			18	**0**	**6**	**26**	**25**

Edge Computing [MOOC]

Course Code	:
Course Name	: Edge Computing
Pre-requisites, if any	: None
Credit Points	: 3 – 0 – 0 [Online MOOC]
Offered	: Professional Elective Course
Semester	: VII

Self-Paced Learning with MOOC:

This course is designed to be studied flexibly through suggested MOOC platforms. This provides flexibility to the learners to cover the contents in their understandable pace. The courses available at NPTEL or Coursera like platforms are available for specified course and you may choose to learn from any such recognized source.

Note:

1. There is a course coordinator assigned to the course to assist your learning and help you in understanding complex concepts.
2. Please fetch approval of the learning platform from the course coordinator in case the courses are preferred from online sources apart from those suggested in the curriculum.
3. There shall be an assessment on the online platform which you must comply with and finish the course at the stipulated time.
4. The certification is a choice, however, not mandatory.
5. There shall be an end semester assessment for the MOOC course pursued.

Course Coordinator:

Full Name: Dr, Vaishali Chourey
Faculty and Address with room number: CSE (AI-ML)
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Email: Vaishali.chourey@adaniuni.ac.in
Consultation Times: 10:00-5:00 Monday to Friday
Students will be contacted throughout the Session via email with important information relating to this Course.

Course Objectives:

By participating in and understanding all facets of this Course a student will:

1. Learn various innovations from cloud computing to edge computing
2. Apply edge computing principles with different use case of edge computing
3. Implement different techniques for distributed data analytics over edge devices

Course Outcomes:

CO-1 Understand the concepts of Edge copmuting and its importance

CO-2 Analyze the key architectures and design of Edge Systems

CO-3 Explore security principles and Protocols

CO-4 Evaluate various Edge Computing tools and services

Course Outline:

Unit	Content	Hrs.
1	Introduction to Cloud and Edge Computing, Overview of edge computing and its significance in distributed systems, Edge Computing to support User Applications Edge computing architectures, Models and Platforms, Network Function Virtualization Management and Orchestration	8
2	Data Security and Privacy Models for/on Edge Computing, Principles of Cybersecurity, Intrusion Detection and Prevention Strategies Specific to Edge Environments, Essential Security Protocols, Data Transmission Security	8
3	Computing, Resource allocation and Storage Models for Edge Computing, Networking Models and Protocols for/on Edge Computing	6
4	Human-in-the-loop Models for Multi-access Edge Computing, Distributed Big Data Computing Platforms for Edge Computing	6
5	Collaborative Platforms and Technologies for Edge Computing – Case Studies	8

Method of Delivery:

MOOC Courses available online through following sources:

- AWS Skillbuilder Course
  - AWS Edge Storage, Data Transfer, and File Transfer Services Getting Started
  - AWS SimuLearn: Edge to Cloud Architecture for Digital Twins
- Google Cloud Skill Boost
- Coursera
  - Edge Computing Fundamentals

- NPTEL
    - Edge Computing bBy Prof. Rajiv Misra, IIT Patna
- Microsoft Azure

Study time: Self paced learning

Textbooks: (For literature reference)

1. Javid Taheri, Shuiguang Deng, "Edge Computing: Models, technologies and applications", IET
2. Rajkumar Buyya and Satish Narayana Srirama, "Fog and Edge Computing Principles and Paradigms", John Wiley & Sons, Inc.
3. "OpenFog Reference Architecture for Fog Computing", Industry IoT Consortium, OpenFog_Reference_Architecture_2_09_17.pdf
4. Barrie Sosinsky, Cloud Computing Bible, Wiley India Pvt. Ltd
5. Kai Hwang, Distributed and Cloud Computing, Elsevier

Blockchain Technology [MOOC]

Course Code	:
Course Name	: Blockchain Technology
Pre-requisites, if any	: Programming, Data Security, Network Security, Networking, Data Structures, Distributed Computing.
Credit Points	: 3
Offered	: B.Tech in CSE
Semester	: 7

Course Coordinator:

Full Name: Dr. Tejas M. Modi
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Faculty Room: CSE Faculty Room, 4th floor.
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Consultation Times: 10:00-5:00 Monday to Friday
Students will be contacted throughout the Session via email with important information relating to this Course.

Self-Paced Learning with MOOC:

This course is designed to be studied flexibly through suggested MOOC platforms. This provides flexibility to the learners to cover the contents in their understandable pace. The courses available at NPTEL or Coursera like platforms are available for specified courses and you may choose to learn from any such recognized source.

Note:

1. There is a course coordinator assigned to the course to assist your learning and help you in understanding complex concepts.
2. Please fetch approval of the learning platform from the course coordinator in case the courses are preferred from online sources apart from those suggested in the curriculum.
3. There shall be an assessment on the online platform which you must comply with and finish the course at the stipulated time.
4. The certification is a choice, however, not mandatory.
5. There shall be an end semester assessment for the MOOC course pursued.

Course Objectives:

Introduce the student with a conceptual foundation to understand the concepts of block chain technology, the consensus, different blockchain versions,

functional/operational aspects of cryptocurrency eco-system in block chain technology.

Course Outcomes:

After learning the course, the students should be able to:

CO-1 Ability to explain the essential concepts of the basic concepts of distributed technologies and cryptography primitives.
CO-2 Ability to understand basic concepts of Blockchain fundamentals.
CO-3 Ability to compare various blockchain versions and their implementation.
CO-4 Ability to apply knowledge of security, applications, and use cases of Blockchain technology concepts in real time application.

Course Outline:

Unit	Content	Hrs.
1	**Introduction:** Introduction, Background and History, Purpose and Scope, Money, Currency, Ledgers, Bitcoin Core, Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. **Crypto Primitives:** Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems	11
2	**Blockchain Fundamentals:** Introduction, Advantage over conventional distributed database, Block chain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Block chain application, Soft & Hard Fork, Private and Public block chain.	12
3	**Blockchain 1.0:** Bitcoin blockchain, the challenges, and solutions, Nakamoto consensus, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use **Blockchain 2.0:** Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts. **Blockchain 3.0:** Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain	11
4	**Privacy, Security issues in Blockchain:** Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining, GHOST, Vulnerability, Attacks.	11

	Applications: Internet of Things, Medical Record Management System, Domain Name Service, and future of Block chain. **Use Cases**: Finance, Industry, Blockchain in Government and Security	

Method of delivery:

MOOC

Textbooks:

1. Mark Gates, Block chain: Ultimate guide to understanding block chain, bit coin, crypto currencies, smart contracts and the future of money, Wise Fox Publishing and Mark Gates.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press.
3. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, Hands-On Block chain with Hyper ledger: Building decentralized applications with Hyperledger Fabric and Composer.
4. Josh Thompson, Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming, Create Space Independent Publishing Platform.
5. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System.

Reference Books:

1. Arshdeep Bahga, Vijay Madisetti, Block chain Applications: A Hands-On Approach, Vpt publishers.
2. Andreas Antonopoulos, Mastering Bitcoin: Unlocking Digital Crypto currencies, O'Reilly Media.
3. Melanie Swa, Block chain, O'Reilly Media.

Additional Materials:

NPTEL (https://nptel.ac.in/courses/106105184/)

Computational Linguistics and Natural Language Processing

Course Code :
Course Name : Computational Linguistics and Natural Language Processing
Pre-requisites, : Pro
Credit Points : 4 (3-0-2)
Offered : CSE (AI-ML)
Semester : VII (Professional Core Course)

Course Coordinator:

Full Name: Dr. Tejas M. Modi
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Consultation Times: 10:00-5:00 Monday to Friday

Course Objectives:

Students with prior programming knowledge are given an introduction to computational linguistics. This course reviews and evaluates the models, algorithms, and methodologies that are prevalent in contemporary language technology from a linguistically informed approach.

Course Outcomes:

Sr. No	CO Statement
CO-1	Understand essential concepts and techniques in computational linguistics.
CO-2	Evaluate computational models from a linguistically informed perspective
CO-3	Analyse modern tools and techniques for NLP applications
CO-4	Develop learning autonomy and the ability to deepen your programming knowledge through self-study

Course Outline:

Unit	Content	Hrs.
1	Fundamental Algorithms for NLP, Regular Expressions, Tokenization, Word and Sub word Tokenization, Word Normalization, Lemmatization and Stemming, Sentence Segmentation, Minimum Edit Distance	11
2	N-gram Language Models, Evaluating Language Models: Training and Test Sets, Perplexity, Sampling sentences from a language	7

	model, generalizing vs. overfitting the training set, Smoothing, Interpolation, and Backoff	
3	Naive Bayes, Naive Bayes Classifiers, Optimizing for Sentiment Analysis, Text Classification, and Sentiment, Logistic Regression, The sigmoid function, Classification with Logistic Regression, Multinomial logistic regression, Learning in Logistic Regression, The cross-entropy loss function, Regularization	10
4	Vector Semantics and Embeddings, Neural Networks, Feedforward networks for NLP: Classification, Training the neural language, RNNs and LSTMs for NLP Tasks, The Transformer, Large Language Models, Masked Language Models, Model Alignment, Prompting, and In-Context Learning	14
5	NLP Applications with Case Studies - Machine Translation, Chatbots and Dialogue Systems, Speech Recognition, Text-to-Speech	

Textbooks:

1. Jurafsky and Martin, An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition with Language Models
2. Bird, S., E. Klein and E. Loper (2009) Natural Language Processing with Python, O'Reilly Media.

Reference Books:

1. Bolshakov, Gelbukh, Computational Linguistics -Models, Resources and Applications,

Additional Materials:

1. https://www.coursera.org/learn/introduction-to-large-language-models
2. https://www.coursera.org/specializations/natural-language-processing#courses

Advanced Network Protocol

Course Code	:
Course Name	: Advance Network Protocol
Pre-requisites, if any	: Data Communication and Computer Network
Credit Points	: 4
Offered	: 3-0-2
Semester	: 6

Course Coordinator:

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Consultation Times: 10:00-5:00 Monday to Friday
Students will be contacted throughout the Session via email with important information relating to this Course.

Course Objectives:

Introduce the student with a conceptual foundation for the study of various advance network protocols in the layered architecture reference models (OSI and TCP/IP) and next generation of network, i.e., Software defined network.

Course Outcomes:

After learning the course, the students should be able to:

CO-1 Ability to explain the essential concepts of computer networks by understanding the different protocols and its implementation.
CO-2 Ability to solve networking problems in by considering different techniques such as: multiprotocol label switching, quality of service management, and multicasting techniques.
CO-3 Ability to compare various distributed system concepts such as DNS, multimedia transport protocols, content delivery networks.
CO-4 Ability to apply knowledge of application layer protocols and next generation of networking concepts in the real time networking application.

Course Outline:

Unit	Content	Hrs.
1	**Introduction to Networks & Data Communications:** Overview of data communication models OSI, TCP/IP. Data link layer- ARP, RARP- Internet Multicasting, NAT, VPN – Differentiated and Integrated Services – SONET, MPLS -Next generation Internet architectures, Green Communication Networks, and Data Center Networking.	09
2	**Internetworking:** Inter and Intradomain Routing, CMP, BGP, IPv6, Multicast Routing Protocols, Multi-Protocol Label Switching, Virtual Private Networks, High-speed transport protocols, Quality of Service Mechanisms, Improving QoS in Internet, DiffServ and IntServ Architectures, RSVP.	10
3	**Distributed Systems:** Naming, DNS, DDNS, Caching, Issues of Scaling in Internet and Distributed Systems, Caching Techniques for Web, Protocols to Support Streaming Media, Multimedia Transport Protocols, Content Delivery Networks, Overlay and P2P Networks.	12
4	**Applications and Other Networking Technologies:** Application Layer Protocol- Telnet -HTTP- TFTP - FTP - SMTP - Ping Finger, Bootstrap Network Time Protocol- SNMP. RTP, RTSP, SIP, VoIP, Security Systems, SSH, PGP, TLS, IPSEC, DDoS Attack, Mitigation in Internet, Security in MPLS.	08
5	**Software Defined Network:** Comparison between SDN and traditional networks, SDN controller, Switch design, Open Flow Protocol. Network Function Virtualization -NFV Architecture, Use cases, NFV Orchestration and NFV for 5G.	06

Practical work:

This laboratory focuses on developing applications of inter-process communication tools such as pipes, FIFOs, message queues, ipv6 network configuration, and sockets. Broadly applications will be following:

- Develop basic network client-server programs to exchange data, and stream audio and video.
- To develop a chat application.
- To develop a networked multi-party game.
- Simulation of the routing algorithms.
- Exercises to explore transport protocols.
- Simulation of the distributed systems.
- Configure ipv4 network with multiple subnets.
- Configure ipv6 network in any simulator.

Textbooks:

1. Data Communication & Networking: By Behrouz A. Forouzan. Tata McGraw Hill.
2. Andrew S. Tanenbaum, "Computer Networks" Pearson.
3. Software Defined Networks: A Comprehensive Approach, Morgan Kaufmann.

Reference Books:

1. Madhow, U., Fundamentals of Digital Communication, Cambridge University Press.
2. James Kurose and Keith Ross, Computer Networking: A Top-Down Approach, Pearson.
3. Stallings, W., Data and Computer Communications, Pearson.
4. Lathi, B. P. & Ding, Z., Modern Digital and Analog Communication Systems, Oxford University Press.
5. Ajit Pal, "Data Communication and Computer Networks", PHI.
6. Dimitri Bertsekas, Robert G. Gallager, "Data Networks", Prentice Hall.
7. Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud by William stalling.

Additional Materials:

NPTEL (http://nptel.ac.in/courses/106105081/)
http://nptel.ac.in/courses/106105082/)

1. Journals & Articles:
   (i) The International Journal of Computer and Telecommunications Networking:http://www.journals.elsevier.com/computer-networks
   (ii) International Journal of Computer Networks & Communication (IJCNC)
2. Audio Visual Aids: Introduction of Network Topologies
   (i) Introduction of Network topologies: http://www.lynda.com/Network-Administration-tutorials/Introduction-network-topologies/184144/187962-4.html
   (ii) OSI Model description: http://www.lynda.com/Network-tutorials/OSI-model-vs.-TCPIP-model/410333/422271-4.html
3. Web address: Data communication introduction
   (i) http://www.angelfire.com/ne/BadriShrestha/Datacommunication.html
   (ii) http://www.tutorialspoint.com/data_communication_computer_network/data_communication_computer_network_tutorial.pdf

Gen AI and Applications

Course Code :
Course Name : Gen AI and Applications
Pre-requisites, if any : AI Fundamentals
Credit Points : 4 (3-0-2)
Offered : Professional Elective Course
Semester : VII

Course Coordinator:

Full Name : Dr. Krupali Donda
Faculty and Address with room number: Department of ICT
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Email: Krupali.donda@adaniuni.ac.in
Consultation Times: 10:00-5:00 Monday to Friday
Students will be contacted throughout the Session via email with important information relating to this Course.

Course Objectives:

To provide a foundational understanding of generative models, including Variational Autoencoders (VAEs), Generative Adversarial Networks (GANs), and transformer-based models like GPT. This course also encourages hands-on learning through projects and tools (e.g., OpenAI APIs, Hugging Face, Stable Diffusion) to build creative AI-driven applications.

Course Outcomes:

After learning the course, the students should be able to:

1. Explore the mathematical and algorithmic underpinnings of generative AI systems.
2. Implement skills to **design, implement, and evaluate** generative models for various data types
3. Apply Gen AI in real-world domains such as content generation, design, education, healthcare, and creative industries
4. Highlight ethical considerations, biases, and responsible AI practices in the development and deployment of generative systems

Unit	Content	Hrs.
1	**Introduction to Generative AI:** Overview of Generative AI, Generative vs Discriminative AI, Categories of Generative Models (Explicit vs Implicit), Applications, Ecosystem: OpenAI, Hugging Face, Stability.ai, Responsible and Ethical Use	06

2	**Variational Autoencoders and Diffusion Models:** Autoencoder Architecture Recap, Variational Autoencoders (VAE), Diffusion Models: DDPM, DDIM, Stable Diffusion and Latent Diffusion, Comparison: VAEs vs GANs vs Diffusion	07
3	**Generative Adversarial Networks (GANs):** GAN Architecture: Generator & Discriminator, Loss Functions and Training Instability, GAN Variants: DCGAN, cGAN, CycleGAN, StyleGAN, Evaluation Metrics: IS, FID, Applications	10
	Transformers and Attention Mechanisms: Self-Attention and Multi-Head Attention, Transformer Encoder-Decoder Architecture. Positional Encoding, Comparison with CNNs and RNNs, Foundation for LLMs	
	Large Language Models (LLMs) and Foundation Models: Pretrained Language Models: GPT, BERT, T5, LLaMA, In-Context Learning and Fine-Tuning, Instruction Tuning and RLHF, LLM Ecosystem: OpenAI, Anthropic, Meta, Alignment, Bias, and Hallucination	
	Prompt Engineering and Retrieval-Augmented Generation (RAG): Prompt Design Techniques: Zero-shot, Few-shot, CoT, Prompt Failures and Refinement, Retrieval-Augmented Generation (RAG), Embeddings and Vector Search (FAISS, Pinecone), LangChain and LlamaIndex Overview, Prompt Injection and Security	

Reinforcement Learning

Course Code :
Course Name : Reinforcement Learning
Pre-requisites, if any : Probability, Linear Algebra, Python Programming, Machine Learning Basics
Credit Points : 3-0-1
Offered Semester : VII

Course Coordinator:
Full Name: Dr. Nikita Joshi
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Consultation Times: 10:00-5:00 Monday to Friday
Students will be contacted throughout the Session via email with important information relating to this Course.

Course Objectives:

To provide an in-depth understanding of Reinforcement Learning (RL) techniques, from foundational concepts to advanced algorithms. Students will learn how agents can learn optimal behaviors through interaction with environments, and gain practical experience by implementing RL algorithms.

Course Outcomes:

CO1: Understand the foundational concepts of reinforcement learning, including Markov Decision Processes, reward structures, and value functions.
CO2: Analyze and implement classical RL methods such as Dynamic Programming, Monte Carlo, and Temporal-Difference learning.
CO3: Apply reinforcement learning algorithms like Sarsa, Q-learning, and policy gradient methods to solve sequential decision-making problems.
CO4: Design and evaluate RL agents using function approximation techniques and integrate them into environments using tools like OpenAI Gym.

Course Outline:

Unit	Content	Hrs.
1	**Introduction to Reinforcement Learning:** Introduction to Reinforcement Learning, Reinforcement Learning Framework, Elements of Reinforcement Learning, Examples of RL Problems, Limitations and Scope of RL, Roadmap of the Book	3
2	**Bandits and Markov Decision Processes:**	8

	An n-Armed Bandit Problem, Action-Value Methods, Incremental Implementation, Tracking a Nonstationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandits, Associative Search (Contextual Bandits), The Agent–Environment Interface, Goals and Rewards, Returns, Unified Notation for Episodic and Continuing Tasks, The Markov Property, Markov Decision Processes, Value Functions, Optimal Value Functions, Optimality and Approximation	
3	**Dynamic Programming and Monte Carlo Methods:** Policy Evaluation, Policy Improvement, Policy Iteration, Value Iteration, Asynchronous Dynamic Programming, Generalized Policy Iteration, Efficiency of Dynamic Programming, Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off-policy Prediction via Importance Sampling, Incremental Implementation, Off-Policy Monte Carlo Control, Importance Sampling on Truncated Returns	10
4	**Temporal-Difference Learning:** TD Prediction, Advantages of TD Prediction Methods, Optimality of TD(0), Sarsa: On-Policy TD Control, Q-Learning: Off-Policy TD Control, Games, Afterstates, and Other Special Cases, n-Step TD Prediction, The Forward View of TD(λ), The Backward View of TD(λ), Equivalences of Forward and Backward Views, Sarsa(λ), Watkins's Q(λ), Off-policy Eligibility Traces using Importance Sampling, Implementation Issues, Variable λ	12
5	**Approximation, Planning and Policy Gradient Methods:** Models and Planning, Integrating Planning, Acting, and Learning, When the Model Is Wrong, Prioritized Sweeping, Full vs. Sample Backups, Trajectory Sampling, Heuristic Search, Monte Carlo Tree Search, Value Prediction with Function Approximation, Gradient-Descent Methods, Linear Methods, Control with Function Approximation, Should We Bootstrap?, Off-policy Approximation of Action Values, Policy Gradient Methods, REINFORCE Algorithm, Actor-Critic Algorithms	12

Practical work:

1. Introduction to OpenAI Gym and Agent-Environment Interface

2. Implementation of k-Armed Bandit Problem using ε-greedy and Softmax Strategy
3. Solving Grid World using Policy Evaluation and Policy Iteration
4. Value Iteration on FrozenLake-v1 Environment
5. Monte Carlo Prediction and Control on Blackjack-v1
6. Implementing TD(0) Learning on Gridworld Environment
7. SARSA vs Q-Learning on CliffWalking-v0 Environment
8. Implementing REINFORCE Algorithm for CartPole-v1
9. Actor-Critic Implementation with Function Approximation
10. Mini-project: Training a Deep Q-Network (DQN) on CartPole-v1 or MountainCar-v0

Textbooks:

1. Sutton, R. S., & Barto, A. G. (2018). *Reinforcement Learning: An Introduction* (2nd ed.)

Reference Books:

1. Richard S. Sutton, Andrew G. Barto, and Francis Bach, *Introduction to Reinforcement Learning* Springer,
2. Marco Wiering & Martijn van Otterlo (Editors), *Reinforcement Learning: State-of-the-Art* Springer, 2012

Additional Materials:

1. **Coursera – Reinforcement Learning Specialization**
   By University of Alberta (taught by Sutton & Barto)
   https://www.coursera.org/specializations/reinforcement-learning
2. **David Silver's Reinforcement Learning Course (UCL)**
   https://www.davidsilver.uk/teaching/
   Highly recommended by experts—includes slides and lecture videos.

Big Data Analytics

Course Code :
Course Name : Big Data Analytics
Pre-requisites, if any : Basics of Database Management Systems, Programming Fundamentals, Data Communication and Computer Networks
Credit Points : 3-0-0
Offered Semester : VII

Course Coordinator:
Full Name: Dr. Nikita Joshi
Faculty and Address with room number: 4th floor faculty room
Telephone: 57412
Email:Nikita.joshi@adaniuni.ac.in
Consultation Times: 10:00-5:00 Monday to Friday
Students will be contacted throughout the Session via email with important information relating to this Course.

Course Objectives:

This course aims to help students understand the core concepts, architecture, and technologies behind Big Data systems. It focuses on storage, processing, and management techniques suitable for handling large-scale datasets. Students will work with distributed frameworks like Hadoop and Spark to perform real-world data processing tasks. The course also explores various NoSQL databases designed for managing unstructured and semi-structured data. Additionally, students will learn about analytical techniques, real-world applications, ethical concerns, and emerging trends in the field of Big Data.

Course Outcomes:

CO1: Explain the characteristics, challenges, and opportunities in Big Data.
CO2: Apply Hadoop and Spark frameworks for distributed data processing.
CO3: Utilize NoSQL databases for efficient Big Data storage and retrieval.
CO4: Analyze and apply scalable Machine Learning techniques for Big Data analytics.
CO5: Critically evaluate Big Data applications and address privacy and ethical challenges.

Course Outline:

Unit	Content	Hrs.
1	**Introduction to Big Data:** Definition and Evolution of Big Data, Importance of Big Data, Traditional vs. Big Data Processing, Characteristics of Big Data (Volume, Variety, Velocity, Veracity), Types of Data (Structured, Semi-structured, Unstructured), Key Challenges in Big Data Management, Applications of Big Data.	3
2	**Big Data Frameworks and Architectures**: Introduction to Distributed and Parallel Computing, Need for Distributed Systems in Big Data, Hadoop Ecosystem Overview, HDFS Architecture, MapReduce Programming Model, Job Execution Workflow, Limitations of Traditional MapReduce, Introduction to Real-time and Batch Processing.	8
3	**NoSQL Databases for Big Data Storage:** Introduction to NoSQL, Difference between RDBMS and NoSQL databases, CAP theorem, Types of NoSQL Databases: Key-Value Stores, Document Databases, Column-Family Stores, Graph Databases, Data Modeling in NoSQL, Sharding and Replication Strategies.	10
4	**Big Data Processing using Apache Spark** Introduction to Apache Spark, Spark vs Hadoop MapReduce, Spark ecosystem overview, Spark architecture, Understanding RD D concepts, DataFrames and Datasets in Spark, Lazy Evaluation and DAG in Spark, Basic Transformations, Basic Actions, Introduction to SparkSQL, Fault tolerance in Spark	12
5	**Big Data Analytics Techniques** Big Data Analytics overview and importance, Data Preprocessing techniques for Big Data , Scalable Machine Learning algorithms, Clustering algorithms for Big Data , Classification algorithms for Big Data , Introduction to Apache Spark MLlib components , Introduction to Streaming Analytics, Challenges of Machine Learning in Big Data	9
6	**Big Data Applications, Ethics and Case Studies** Big Data in E-commerce , Big Data in Healthcare, Big Data in Banking and Finance, Big Data in Social Media, Big Data in IoT and Smart Cities, Introduction to Cloud-based Big Data solutions , Security and Privacy issues in Big Data, Ethical and Legal concerns, Bias and fairness in Big Data Analytics	3

Textbooks:

1. Big Data: Principles and Best Practices of Scalable Real-Time Data Systems", Nathan Marz and James Warren, Manning Publications

Reference Books:

1. "Learning Spark: Lightning-Fast Big Data Analysis" Authors: Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia Publisher: O'Reilly Media
2. "Hadoop:The Definitive Guide", Tom White, O'Reilly Media.
3. "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pramod J. Sadalage and Martin Fowler, Addison-Wesley.
4. "Fundamentals of Big Data Analytics", David Loshin, Morgan Kaufmann

Additional Materials:

- Big Data Specialization – Coursera
  https://www.coursera.org/specializations/big-data
- Free Big Data and Spark Foundation Course – Intellipaat
  https://intellipaat.com/academy/course/big-data-and-spark-foundation-course
- Data Analytics – Mining and Analysis of Big Data – Alison
  https://alison.com/course/data-analytics-mining-and-analysis-of-big-data-revised

Cyber Crime and Mitigation

Course Code :
Course Name : Cyber Crime and Mitigation
Pre-requisites, if any : Basic fundamental knowledge of computer networks.
Credit Points : 03 (3-0-0)
Offered Semester : VI (Open Elective), 3 Divisions

Course Coordinators:

Full Name: Ritika Ladha
Faculty: Computer Science and Engineering (AI-ML)
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Consultation Times: 10:00-5:00 Monday to Friday

Students will be contacted throughout the Session via email with important information relating to this Course.

Course Objectives:

By participating in and understanding all facets of this Course a student will:

1. Achieve basic understanding of Cyber Security tools and its applications.
2. Learn how to effectively identify a security breach as a cyber-crime.
3. Appreciate and understand different classes of cyber-crime.
4. Gain familiarity with key legislation and provisions for cyber-crime.

Course Outcomes:

CO-1 Analyze effects and implications of cyber-crime on organizations.
CO-2 Apply tools and methodologies for reviewing cyber-crime.
CO-3 Comprehend cyber-crime and legal landscape around the world.
CO-4 Describe the basics of computer forensics and its relevance for mitigation of cyber-crime.

Course Outline:

Unit	Content	Hrs.
1	Definition and Origin of the Word, Cybercrime, and Information Security, who are Cyber Criminals, Classification of cybercrimes, Cybercrimes against persons, Crimes against person's property, Cybercrimes against Government, Cybercrimes against Society at large, Causes of Cybercrime, Impact and effects of cybercrimes, Various Cybercrimes case studies, Cyber Crime Era: Survival Mantra for Netizens.	10

2	Cybercrime: Mobile and Wireless devices, Trend mobility, authentication service security, Attacks on mobile phones, mobile phone security Implications for organizations, Organizational measurement for Handling mobile, Security policies and measures in mobile computing era.	7
3	Tools and methods used in cybercrime: Proxy servers and Anonymizers, Phishing, Password cracking, Key loggers and Spy wares, Virus and worm, Trojan Horse and Backdoors-Steganography, DoS and DDoS Attacks, SQL Injection, Buffer overflow, Attacks on wireless network, Phishing, and Identity Theft.	10
4	Cybercrime and the legal landscape around the world, The Indian IT Act 2000, Challenges to Indian law and cybercrime scenario in India, Consequences of not addressing the weakness in IT Act, Digital Signatures and the Indian IT Act, Amendments to Indian IT Act, Cybercrime and Punishment, Cyberlaw Technology, and students.	10
5	Understanding computer forensic: Historical background of cyber forensic, Forensic analysis of e-mail, Digital forensic life cycle, Network forensic, Setting up a computer forensic Laboratory, Relevance of the OSI 7 Layer model to computer Forensic-Computer forensic from compliance perspectives.	8

Textbooks:

1. Cyber Security : Understanding Cyber Crimes , Computer Forensics and Legal Perspectives By Nina Godbole, Sunit Belapur , Wiley
2. Understanding Cyber Crime: Phenomena and Legal Challenges Response, ITU 2012
3. Building Internet Firewalls: Internet and Web Security by Elizabeth D. Zwicky, Simon Cooper, , D. Brent Chapman, Addison -Wesley Professional Computing Series

Reference Books:

1. Penetration Testing with Shellcode: Detect, exploit, and secure network-level and operating system vulnerabilities by Hamza Megahed ,Packt Publishing Publisher.
2. Network Monitoring and Analysis: A Protocol Approach to Troubleshooting by Ed Wilson, Prentice Hall publisher (January 9, 2000)
3. Symantec Endpoint Protection Standard Requirements by Gerardus Blokdyk,5 STAR Cooks publisher.

Social and Information Networks

Course Code :
Course Name : Social and Information Networks
Pre-requisites, if any : Python programming
Credit Points : 3
Offered : CSE(AI-ML)
Semester : VII

Course Coordinator:
Full Name: Maitri Vaghela
Department of CSE
Faculty Room: CSE Faculty Room, 4th floor.
Telephone: 7226945220
Email: maitri.vaghela@adaniuni.ac.in
Consultation Times: 10:00-5:00 Monday to Friday
Students will be contacted throughout the Session via email with important information relating to this Course.

Course Objectives: his course provides training on the concepts and techniques in social networking. Areas emphasized include social networking for business and professional use; introduction to social network analysis and social network developer tools; understanding public sector media and privacy issues; and using social network concepts for solving real-world issues.

Course Outcomes:
CO-1 Understand the components of social networks modelling and visualization.
CO-2 Understand the role of semantic web in social networks.
CO-3 Familiarize with the security concepts of social networks.
CO-4 Find out various applications of social networks.

Unit	Content	Hrs.
1	**Introduction**: Introduction to social network analysis Fundamental concepts in network analysis social network data notations for social network data Graphs and Matrices. **Measures and Metrics**:Strategic network formation - network centrality measures: degree, betweenness, closeness, eigenvector - network centralizationdensity reciprocity transitivity ego network measures for ego network - dyadic network triadic network - cliques - groups-clustering search.	7
2	**Community networks:** Community structure - modularity, overlapping communities - detecting communities in social networks – Discovering	6

	communities: methodology, applications - community measurement - evaluating communities – applications	
3	**Models:** Small world network - WattsStrogatz networks - Statistical Models for Social Networks Net- work evolution models: dynamical models, growing models - Nodal attribute model: expo- nential random graph models Preferential attachment - Power Law - random network model: Erdos-Renyi and Barabasi-AlbertEpidemics - Hybrid models of Network Formation.	7
4	**Semantic web:** Modelling and aggregating social network data developing social semantic application eval- uation of web-based social network extraction Data Mining Text Mining in social network Tools case study. **Visualization:** Visualization of social networks novel visualizations and interactions for social networks ap plications of social network analysis tools - sna: R Tools for Social Network Analysis - Social Networks Visualiser (SocNetV) Managing Trust in online social network Security and Privacy in online social network security requirement for social network in Web 2.0 - Say It with Colors: Language-Independent Gender Classification on Twitter - Friends and Circles - TUCAN: Twitter User Centric ANalyzer	10

Practical work:

To be performed per week in the given order during lab hours. The list is not limited but can be extended as per the instructions of course faculty.

1. Installation of python, be familiar with python editor and perform basic operation: print and assign.
2. Write a program to implement calculator using control flow statements.
3. Write a program to demonstrate the use of various types of operators, functions, and module.
4. Write a program to understand the use of sequences such as string, tuple, list, dictionary and set.
5. Introduction pyhton libraries: Numpy, Pandas.
6. Write a program to perform read, write operation on file and how to handle dataframe.
7. Write a program to plot various graphs using matplotlib.
8. Read Iris data set and understand the distribution of data with different plots.
9. Write a program to classify the flower species from Iris dataset using supervised machine learning model.

Textbooks / Reference Books:

3. Reema Thareja, Python Programming using Problem Solving Approach, Oxford University Press.
4. Kenneth A. Lambert, Fundamentals of Python – First Programs, CENGAGE.

5. Sandeep Nagar, Introduction to Python for Engineers and Scientists, Apress publication.
6. Gowrishankar S and Veena A, Introduction to Python Programming, CRC Press/Taylor & Francis Publication.

Learning websites / platforms:

1 NPTEL https://nptel.ac.in/courses/106106145,
2 https://archive.nptel.ac.in/courses/106/106/106106182,
3 https://nptel.ac.in/courses/106106212