RAMAKRISHNAMISSIONVIDYAMANDIRA

BelurMath,Howrah-711202,WestBengal,India
A Residential Autonomous College affiliated to the University of Calcutta,ACollegewithPotential for Excellence,DBTStarCollege

Departmentof ComputerScience and Electronics

SyllabusforM.Sc.ComputerScience &Machine Intelligence

DURATION:4SEMESTERS

TOTALCREDIT:84

FULLSYLLABUSWITHCOURSE OUTCOME

RAMAKRISHNAMISSIONVIDYAMANDIRA

SyllabusforM.Sc.ComputerScience &Machine Intelligence

SEMESTER– I

Coursecode	Coursetitle	Credits	Marks	No.ofHours/Week		
				L	T	P
Theoretical						
CSMICC1T	ArtificialIntelligence(AI)	4	50	5	1	0
CSMICC2T	EssentialStatisticsandMathematicsforAIand Machine Learning(ML)	4	50	5	1	0
CSMICC3T	AdvancedAlgorithmsandDataStructures	4	50	5	1	0
Practical						
CSMIP1 P	AIProblemSolvingLab usingPython &Statistics EssentialsusingRProgrammingLab	4	25+25	0	2	6
CSMIP2 P	AdvancedAlgorithmsandDataStructures Lab	4	25+25	0	2	6
	Total	**20**	**250**			

SEMESTER– II

Coursecode	Coursetitle	Credits	Marks	No.ofHours/Week		
				L	T	P
Theoretical						
CSMICC4T	IntroductiontoMachineLearning	4	50	5	1	0
CSMICC5T	Advanced ArchitectureandSystemProgramming	4	50	5	1	0
CSMICC6T	Internet-of-Things(IoT)	4	50	5	1	0
Practical						
CSMIP3 P	MachineLearningLab,Advanced ArchitectureandSystem ProgrammingLab	2+2	25+25	0	2	6
CSMIP4 P	IoTLabusingRaspberryPi/Arduino,MinorProjectandPresentation	2+2	25+25	0	2	6
	Total	**20**	**250**			

SEMESTER– III

Coursecode	Coursetitle	Credits	Marks	No.ofHours/Week		
				L	T	P
Theoretical						
CSMICC7T	IntroductiontoDeepLearning	4	50	5	1	0
CSMICC 8 T	DataScience andNatural LanguageProcessing(NLP)	4	50	5	1	0
CSMIE 1 T	Elective-I	4	50	5	1	0
Practical						
CSMIP5 P	DeepLearningLab,Data Scienceand NLPLab	4	25+25	0	2	6
CSMIP6 P	Elective-ILab andProjectDesigning	4	25+25	0	2	6
	Total	**20**	**250**			

SEMESTER– IV

Coursecode	Coursetitle	Credits	Marks	No.ofHours/Week		
				L	T	P
CSMIE 2 T	Elective-II	4	50	5	1	0
CSMIP7 P	Dissertation/Project	14	125	0	2	16
CSMIP8 P	ResearchMethodologyand PresentationLab	2	25	0	2	2
CSMIP9 P	GrandViva	4	50	0	0	0
	Total	**24**	**250**			

ELECTIVEPAPERS
(ChooseElectiveIandElectiveIIfromthefollowinglists)

PaperName
Elective-I
ComputerVision
Cybersecurity
BigDataAnalytics
AdvancedDatabaseManagementSystems
Elective-II
ImageProcessing
Bioinformatics
VLSIDesign
Blockchain

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SyllabusM.Sc.ComputerScience&MachineIntelligence

Semester-II(January-June)

CourseCode: CSMI CC 4 TCredit: 4CourseType: CoreCourseTheory

CourseOutcome:

The Introduction to Machine Learning course deals with different topics in supervised and unsupervised learning methodologies which in turn helps the students to have basic understandings of different fundamental issues and challenges. Moreover, the course will cover different models of data classification and clustering techniques, their merits and limitations, different use cases and applications of these methods which help the students to understand the strength and weakness of different machine learning approaches. As a whole students are supposed to be able to design and implement various real-world application in this field.

Key Learning Objectives:

- Preprocess and analyze the characteristics of different types of standard data
- Build skills to work on standard machine learning library e.g., Scikit-Learn
- Build skills to implement different classification and clustering techniques as per requirement to extract valuable information from any type of data set.
- Can train a classier on an unknown data set to optimize its performance
- Develop novel solutions to identify significant features in data e.g., identify the feedback of potential buyers over online markets to increase the popularity of different products

CSMICC4T:Introduction to Machine Learning

Credit:4 **Marks:50**

Introduction **[3L]**

Overview of Machine Learning (ML), Features of ML; History of ML; Classification of ML, Different types of ML Methods; Applications of ML; ML Life cycle; epoch, iteration, batch in ML;

Supervised Learning **[20L]**

Classification and Regression; Generalization, Overfitting, Underfitting; relation of Model Complexity to Data Size;

Supervised ML Algorithms: K-Nearest Neighbors, Linear Models, Naïve Bayes Classifiers,Decision Trees, Ensemble using Bagging and boosting Ensembles of Decision Trees, AdaboostKernelized SVM, Introduction to Neural Networks; Different performance metricslike precision, Fscore etc.

Uncertainty Estimates from Classifiers: The Decision Function, Predicting probabilities, Uncertainty in Multiclass Classification

Unsupervised Learning and Preprocessing **[20L]**

Types of Unsupervised Learning, Challenges in Unsupervised Learning;

Preprocessing and Scaling: Different kinds of Preprocessing, Applying Data Transformation,Scaling Training and Test Data, The Effect of Preprocessing on Learning as well as featureextraction;

Dimensionality Reduction, Feature Extraction, and Manifold Learning: Principal Component Analysis (PCA), Non-Negative Matrix Factorization (NMF), Manifold Learning with t-SNE;

Clustering: K-Means Clustering, Agglomerative Clustering, DBSCAN; Comparing and evaluation of Clustering Algorithms

Representing Data and Engineering Features **[7L]**

Categorical Variables: One-Hot-Encoding, Numbers can Encode Categorical; Binning,Discretization, Linear Models, and Trees; Interactions and Polynomials; Univariate Nonlinear Transformations;

Automatic Feature Selection:Univariate Statistics, Model-Based Feature Selection, Iterative Feature Selection;

Model Evaluation and Improvement **[10L]**

Cross-Validation: Cross-Validation in Scikit-learn, Benefits of Cross-Validation, Stratified k-Fold Cross-Validation and other strategies;

Grid Search: Simple Grid Search, Problem of Overfitting the parameters and the Validation Set, Grid Search with Cross-Validation;

Evaluation Metrics and Scoring: Metrics for Binary Classification, Metrics for Multiclass Classification, Regression Metrics;

Text/References:

1. Introduction to Machine Learning with Python: A Guide for Data Scientists by Andreas C. Müller, Sarah Guido, O'Reilly Media; ISBN-10: 1449369413.
2. Deep Learning; An MIT Press book; Ian Goodfellow and YoshuaBengio and Aaron Courville
3. Machine Learning, The Art and Science of Algorithms that Make Sense of Data, Peter Flach, Cambridge Press
4. Machine Learning, Tom M. Mitchell, McGraw Hill Education (India) Private Limited
5. Understanding Machine Learning: From Theory to Algorithms, ShaiShalev-Shwartz and Shai Ben-David, Cambridge University Press.
6. Machine Learning: A Probabilistic Perspective, Kevin Murphy, MIT Press, 2012.
7. Pattern Recognition by S. Theodoridis and K. Koutroumbas. ISBN: 0-12-685875-6.
8. Introduction to Machine Learning by E. Alpaydin. ISBN: 978-0262-32573-8.
9. Pattern Classification by R. O. Duda, P. E. Hart and D. G. Stork. ISBN: 978-0-471-05669-0.
10. Introduction to Information Retrieval by C. D. Manning, P. Raghavan and H. Schutze. ISBN: 978-0-521-86571-5.
11. Pattern Recognition and Machine Learning by C. M. Bishop. ISBN: 978-0387-31073-2.
12. Data Mining with Decision Trees: Theory and Applications by L. Rokach and O. Maimon, World Scientific Pub Co Inc. 2007. ISBN 978-9814590075.
13. Machine Learning by Tom Mitchell, McGraw-Hill, 1997. ISBN 0070428077.
14. The Elements of Statistical Learning by J. H. Friedman, R. Tibshirani, and T. Hastie. ISBN: 978-0387-84884-6.

Journals/Periodicals:

1. Journal of Machine Learning Research
2. Wiley International Journal of Intelligent Systems
3. Elsevier Pattern Recognition

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SyllabusforM.Sc.ComputerScience &Machine Intelligence

CourseCode: CSMI CC5T

Credit:4CourseType: CoreCourseTheory

CourseOutcome:

By the end of the course, the students will be able to learn pipelining concepts with a prior knowledge of stored program methods. They will also gain knowledge about memory hierarchy and mapping techniques. Students will get an in-depth understanding of parallel architecture and interconnection network. This course will also help the students to understand the language processing activities of the different type of language processors like Assembler, Loader, Linkers, Macros, Compilers and also their implementation.

KeyLearningObjectives:

The course is intended to provide the need, foundation concepts and usage of parallel architecture and parallel processing. Also, the students will be provided with the knowledge of the different features and functions of different type of language processors.

- To understand the basic principles and necessity of pipelining.
- To distinguish between serial, parallel and pipeline architecture.
- To learn about the features and functions of the different type of language processors.
- To understand the data structures and algorithms used for development of different phases of those processors.
- To implement the small modules of different phases of compiler design.

CSMI CC 5 T: Advanced Computer Architecture & System Programming

Credit: 4 **Marks: 50**

Introduction to Parallel Architecture [8L]
Computing Paradigms, Basic Parallel Processing Architecture, Flynn's Classification- SISD, MISD,SIMD,MIMD structures, Collision Vector, Minimal Average Latency (MAL), Serial, Parallel &Concurrent Computation, CISC vs RISC, Structure of Instruction of Instruction Sets andDesirable Attributes.

Pipelining [7L]
Basic Concepts of Pipelining, Instruction Pipelining, Hazards, Reservation Tables, Collision, Latency,Dynamic Pipeline, Vector Processing & Vector Processors.

Memory Systems [6L]
Cache Memory : Structure, Analysis & Design, Advanced Optimization of Cache Performance, VirtualMemory: Structure, Analysis & Design.

Multiprocessor Architecture [5L]
Loosely Coupled & Tightly Coupled Systems, Concurrency & Synchronization, Scalability, Models ofConsistency, Application of SIMD Structure.

Interconnection Network [5L]
Definition, Types of Interconnected Networks; Baselines, Shuffle-Exchange, Omega, Cuba, Comparison& Application.

Data Flow Architecture [5L]
Introduction, Different forms of Data Flow Architecture, Data Flow Graphs, Petrinets.

Overview of Language Processors [2L]
Evolution of the components of a programming system – Assemblers, loaders, macros, compilers; formalsystems – formal specification, formal grammars, classification of grammars, Backus-Naur Form;conversion of regular expression to NDFA; Language processing activities.

Assemblers [3L]
Elements of Assembly Language Programming; Design of Assembler – data structure, algorithm; TableProcessing – different searching and sorting techniques.

Macro Language & Macro Processor [4L]
Macro Instructions; Features of a Macro Facility; Implementation of Two-pass Macro Processor,Single-pass Macro processor – data structures and algorithms. Implementation of Macro calls withinMacros.

Loaders & Linkers [4L]

Basic Loader Functions – Design of an Absolute Loader, a simple Bootstrap Loader; Machine-DependentLoader features – relocation, program linking, data structure and algorithm for a linking loader ; Machine-Independent Loader features – automatic library search, loader options;

Compilers & Interpreters [11L]

Phases of Compiler – Databases and algorithms, role of Lexical Analyzer, Specification of Tokens,design oflexical analysis ,role of parsers, different parsing techniques, Syntax DirectedTranslation definition, definition and implementation of Syntax Directed Definitions, TranslationSchemes, Intermediate Code Generation through implementation of Three-Address statements , Issuesin the design of code generator,Runtime Storage management,code-generation algorithm,Machine independent and Machine dependant optimizations.; Interpreters – Use of interpreters, Overviewof interpretation.

Texts/References:

1. Advanced Computer Architecture: Parallelism, Scalability, Programmability, Kai Hwang, McGraw-Hill.
2. Computer Architecture and Parallel Processing, Kai Hwang, Briggs, McGraw-Hill.
3. Computer Architecture: A Quantitative Approach, D.A. Patterson, J.L. Hennessy, D. Goldberg, Addison-Wesley
4. Systems Programming and Operating Systems ; D.M. Dhamdhere ; Tata McGraw Hill.
5. System Software: An Introduction to Systems Programming ; Leland L. Beck ; Addison-Wesley.
6. Systems Programming ; John J. Donovan ; Tata McGraw Hill.
7. Alfied V. Aho, Ravi Sethi, Jeffrey D. Ullman. Compilers: Principles, Techniques and Tools, Addison-Wesley.

Journals/Periodicals:

1. International Journal of Architectural Computing
2. ACM Transactions on Architecture & Code Optimization
3. Journal of Parallel and Distributed Computing

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SyllabusM.Sc.ComputerScience&MachineIntelligence

CourseCode: CSMI CC6T **Credit: 4**

CourseType: CoreCourseTheory

CourseOutcome:

1. Students will be able to understand the application areas of Internet of Things (IoT).
2. Students will be able to grow the theoretical background of implementation of IoT.
3. Students will be able to understand various architectures of developing IoT solutions.
4. Students will get accustomed with working with sensors, actuators related to IoT.
5. Students will be able to learn other associated technologies like cloud computing.
6. Students will be able to implement IoT based solutions using Arduino/ Raspberry Pi.

KeyLearningObjectives:

1. To learn about the various use cases of Internet of Things (IoT) in social and various industrial domains.
2. To understand the IoT as an emerging industrial standard.
3. To develop the fundamental idea of various architectures and related protocols related to IoT.
4. To gain practical experience by developing IoT solutions though standard open source software and hardware.
5. To experience the role of IoT in development of interdisciplinary technologies like cloud computing.

CSMI CC6T:Internet of Things (IoT)

Credit:4 **Marks:50**

Introduction to IoT **[9]**

Use Cases of IoT in Society, Manufacturing, Healthcare, Banking, and Communication; Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Communication models & APIs.

M2M to IoT **[8]**

Concepts of Cyber-physical-system (CPS), The Vision-Introduction, From M2M to IoT,M2M towards IoT-the global context, Differing Characteristics. Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT,

IoT Reference Architecture[15]

Getting Familiar with IoT Architecture, Basics of IoT Networking;Connectivity technologies; Various architectural views of IoT such as Functional, Information,Operational and Deployment. Constraints affecting design in IoT world- Introduction, Technical designConstraints.

IoT Physical Servers and Cloud Communications[8]

Introduction to Cloud Storage models andcommunication, Cloud Computing fundamentals, Cloud Computing service model, Cloud computingmanagement and security; APIs Web Server – Web Server for IoT, Cloud for IoT.

IoT Computing[10]

Introduction to Python for IoT, Introduction to different IoT tools, Introduction toArduino/Raspberry Pi; Implementation of IoT with Arduino/Raspberry, Cloud Computing, FogComputing, Connected Vehicles, Case studies, Data Aggregation for the IoT in Smart Cities, Privacy andSecurity Issues in IoT.

Text/References:

1. “Designing The Internet of Things” by McEwen, Cassimally; Wiley.
2. “The Internet of Things: Key Applications and Protocols” by Hersent, Wiley.
3. “Internet of Things: Principles and Paradigms” by RajkumarBuyaa and Amir V Dastjerdi.
4. “Cloud Computing” by RajkumarBuyya; 1st Edition; Wiley.
5. “The Internet of Things” by Samuel Greengard.
6. “The Fourth Industrial Revolution” by Klaus Schwab.
7. “Getting Started With Internet Of Things” by CunoPfister.
8. “Learning Internet Of Things” by Peter Waher.

Journals/Periodicals:

1. IEEE Internet of Things Journal
2. Internet of Things, Elsevier
3. Internet of Things - Open Access Research, Springer
4. IoT, MDPI Journal

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Syllabus M.Sc. Computer Science & Machine

IntelligenceCourseCode: CSMI P3PCredit:4

CourseType: Practical

Machine Learning Lab &Advanced ArchitectureandSystemProgrammingLab

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Credit:4 **Marks:50**

Machine Learning Lab

Credit:2 **Marks:25**

Introduction to ML Package:

Design and implementation of different experiments in Machine Learning using packages like NumPy, Scipy, Pandas, Seaborn, Scikit-Learn, Matplotlibetc in Python

Supervised Learning:

Method to implement different classifiers in Scikit-learn, tune their parameters and evaluate the performance using the standard benchmark data sets from UCI and UCR machine learning repository for binary and multi-class scenario;

Unsupervised Learning:

Method to implement different clustering in Scikit-learn, tune their parameters and evaluate the performance using the standard benchmark data sets from UCI and UCR machine learning repository for binary and multi-class scenario, feature extraction from existing data set, Different external like RandIndex and internal measure evaluation;

Working with Dataset:

Dataset, Types of data in datasets; Need of dataset; Loading the dataset; Methods to load CSV data file: load CSV with python standard library, NumPy, and Pandas; Method to deal with raw data; Method to check dimensions of data; Procedure to check attribute's data type; Statistical summary of data; Review of class distribution, correlation between attributes, skew of attribute distribution; Handling of different Machine Learning datasets and uses of toolkits;

Data visualization

Data visualization using univariate plots: Histograms, density plots, box and whisker plots, etc.; Multivariate plots: correlation matrix plot, scatter matrix plot

Text/References:

1. Introduction to Machine Learning with Python: A Guide for Data Scientists, Andreas C. Müller and Sarah Guido, O'Reilly
2. Machine Learning, The Art and Science of Algorithms that Make Sense of Data, Peter Flach, Cambridge press
3. Machine Learning, Tom M. Mitchell, McGraw Hill Education (India) Private Limited
4. Understanding Machine Learning: From Theory to Algorithms, ShaiShalev-Shwartz and Shai Ben-David,Cambridge University Press.
5. Machine Learning: A Probabilistic Perspective, Kevin Murphy, MIT Press, 2012.
6. Learning of keras and tensorflow

Advanced ArchitectureandSystem ProgrammingLab

Credit:2 **Marks:25**

Familiarization with Computer Architecture Simulation Software like MIPS/ Tejas / GEM5
Simulation of Assembly Language Program
Simulation of Data Cache
Memory Reference Visualization
Simulation of Pipeline and Instruction Level Parallelism
Simulation of Data Level Parallelism and Multiprocessing

Text/References:

1. Computer Architecture: A Quantitative Approach, D.A. Patterson, J.L. Hennessy, D. Goldberg, Addison-Wesley.
2. Computer Architecture and Parallel Processing, Kai Hwang, Briggs, McGraw-Hill.

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IntelligenceCourseCode: CSMI P4P **Credit:4**

CourseType: Practical

IoT Lab using Raspberry Pi/Arduino, Minor Project and Presentation

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Credit:4 **Marks:50**

IoT Lab using Raspberry Pi/Arduino

Credit:2 **Marks:25**

Implementationofvariousapplications by using LEDs, Seven Segment Display interface, Piezo Buzzer, Arduino, and sensors;
Implementation of problems like different types surveillance system, automation system etc.

Text/References:

1.Building Arduino Projects for the Internet of Things: Experiments with Real-World Applications by AdeelJaved

2. Internet of Things with Arduino Cookbook by Marco Schwartz

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Minor Project and Presentation

Credit:2 **Marks:25**

Design, implementation and presentation of Minor Project