BansilalRamnathAgarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Syllabus for
F.Y.M.Tech. 2020
(Computer Engineering)

Department of
Computer Engineering

Department of Computer Engineering

First Year M. Tech. Computer Engineering (FYMT) - Semester I (Pattern 2020)

Course Code	Course		Teaching Scheme		Examination Scheme					Total	Credits
			L	P	CIE	ISE	SCE	ESE	TW/ OR		
CSPA11201	Mathematical Foundation of Computer Science	TH	3	-	20	30	20	30	-	100	3
CSPA11202	Operating System Design	TH	3	-	20	30	20	30	-	100	3
CSPA11203	AI and Machine Leaning	TH	3	-	20	30	20	30	-	100	3
CSPA11204	Program Elective I	TH	3	-	20	30	20	30	-	100	3
CSPA11205	Program Elective II	TH	3	-	20	30	20	30	-	100	3
IOEP11206	Open Elective	CE	2	-	-	-	-	-	50	50	2
CSPA11207	Research Methodology	CE	2	-	-	-	-	-	50	50	2
CSPA11208	Laboratory 1	CE-OR	-	4	-	-		-	50	50	2
AP1	Audit Course I	-	-	-	-	-		-	-	-	-
	Total		19	4	100	150	100	150	150	650	21

Course Code	**Program Elective I**
CSPA11204A	Soft Computing
CSPA11204B	Data Preparation and Analysis
CSPA11204C	System Security

Course Code	**Program Elective II**
CSPA11205A	Information Retrieval and Web Mining
CSPA11205B	Advanced Wireless and Mobile Network
CSPA11205C	Web Analytics and Development

Course Code	**Open Elective**
IOEP11206A	Soft computing Techniques
IOEP11206B	Ethical Hacking
IOEP11206C	Product Design Engineering

Audit course I

- English for Research Paper Writing
- Disaster Management
- Sanskrit for Technical Knowledge
- Value Education
- Constitution of India
- Pedagogy Studies
- Stress Management by Yoga

- Personality Development through Life Enlightenment Skills

First Year M. Tech. Computer Engineering (FYMT) - Semester II (Pattern 2020)

Course Code	Course		Teaching Scheme		Examination Scheme					Total	Credits
			L	P	CIE	ISE	SCE	ESE	TW /OR		
CSPA12201	Data Sciences	TH	3	-	20	30	20	30	-	100	3
CSPA12202	Cyber Physical System	TH	3	-	20	30	20	30	-	100	3
CSPA12203	Deep Leaning	TH	3	-	20	30	20	30	-	100	3
CSPA12204	Program Elective IV	TH	3	-	20	30	20	30	-	100	3
CSPA12205	Program Elective V	TH	3	-	20	30	20	30	-	100	3
IOEP12206	Open Elective 2	CE	2	-	-	-	-	-	50	50	2
CSPA12207	Intellectual Property Rights	CE	2	-	-	-	-	-	50	50	2
CSPA12208	Laboratory II	CE-	-	4	-	-	-	-	50	50	2
AP2	Audit Course II	-	-	-	-	-					
	Total		19	4	100	150	100	150	150	650	21

Course Code	**Program Elective IV**	**Course Code**	**Program Elective V**
CSPA12204A	Augmented and Virtual reality	CSPA12205A	Social Media Analysis
CSPA12204B	Big Data Analytics	CSPA12205B	Wireless Access Technologies
CSPA12204C	Usability Engineering	CSPA12205C	Optimization Techniques

Course Code	**Open Elective**
IOEP12206A	Project Planning and Management
IOEP12206B	BlockChain Technology
IOEP12206C	Data Science for Engineers

Audit course II

- English for Research Paper Writing
- Disaster Management
- Sanskrit for Technical Knowledge
- Value Education
- Constitution of India
- Pedagogy Studies
- Stress Management by Yoga
- Personality Development through Life Enlightenment Skills

F.Y.M.Tech.

Pattern2020

Syllabus Structure

Mathematical Foundation of Computer Science(CSPA11201)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
Formative Assessment: 50 Marks
Summative Assessment: 50 Marks

Prerequisites

- Discrete Mathematics

Course Objectives

- To understand the mathematical fundamentals that is prerequisites for a variety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.
- To develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design and concurrency
- To study various sampling and classification problems

Course Outcomes

After completion of the course, student will be able to

1. Apply graph-theoretic models of data structures and state machines to solve problems of connectivity and constraint satisfaction (e.g. scheduling)
2. Understand the basic notions of discrete and continuous probability
3. Understand the methods of statistical inference
4. Understand the role that sampling distributions play in statistical inference methods
5. Perform correct and meaningful statistical analyses of simple to moderate complexity
6. Understand discrete time Markov chains and their role into computer science problems

Unit I	**Graph Theory**

Simple Graphs: Isomorphism, Bipartite Graphs &Matchings , Coloring , Connectivity , Forests & Trees

Directed Graphs and Partial Orders : Scheduling, Partial Orders, Linear Orders, Product Orders, Equivalence Relations

Communication Networks: Routing Problems, Network Diameter, Switch Count, Network Latency, Congestion, 2-D Array, Butterfly, Benes ˇ Network

Planar Graphs: Euler's Formula, Bounding the Number of Edges in a Planar Graph, Coloring Planar Graphs, Classifying Polyhedra

Unit II	**Random Variables**

Discrete Random Variables: The Probability Mass Function, Distribution Functions, Special Discrete Distributions , The Probability Generating Function ,Discrete Random Vectors, Independent Random Variables.

Continuous Random Variables: The Exponential Distribution , The Reliability and Failure Rate,Some Important Distributions, Functions of a Random Variable, Jointly Distributed Random

Variables, Order Statistics, Distribution of Sums, Functions of Normal Random Variables	
Unit III	**Statistical Inference Expectations**
Sampling: Probabilistic and non-probabilistic**,** Parameter Estimation **Expectation:** Moments, Expectation Based on Multiple Random Variables, Transform Methods ,Moments and Transforms of Some Distributions , Computation of Mean Time to Failure, Inequalities and Limit Theorems Distributions: Mixture Distributions , Conditional Expectation, Imperfect Fault Coverage and Reliability , Random Sums Hypothesis Testing: one-sided and two-sided tests, z-test, t-test	
Unit IV	**Regression Analysis**
Regression and Analysis of Variance: Least-squares Curve Fitting , The Coefficients of Determination , Confidence Intervals in Linear Regression, Trend Detection and Slope Estimation , Correlation Analysis, Simple Nonlinear Regression , Higher-dimensional Least-squares Fit ,Analysis of Variance	
Unit V	**Stochastic Processes and Discrete-Time Markov Chains**
Classification of Stochastic Processes, The Bernoulli Process, The Poisson Process Renewal Processes, Availability Analysis, Random Incidence, Renewal Model of Program Behavior Computation of n-step Transition Probabilities, State Classification and Limiting Probabilities, Distribution of Times Between State Changes, Markov Modulated Bernoulli Process, Irreducible Finite Chains with Aperiodic States	
Unit VI	**Continuous-Time Markov Chains**
The Birth–Death Process , Other Special Cases of the Birth–Death Model, Non-Birth–Death Processes Markov Chains with Absorbing States, Solution Techniques, Automated Generation	

Reference Books

1. K.Trivedi,"Probability and Statistics with Reliability, Queuing, and Computer Science Applications". Wiley.
2. Kenneth H. Rosen, "Discrete Mathematics and its Applications", 6th edition, McGraw-Hill, 2007. ISBN 978-0-07-288008-3.
3. U Dinesh Kumar, "Business Analytics", Wiley
4. John Vince, "Foundation Mathematics for Computer Science", Springer.
5. M. Mitzenmacher and E. Upfal, "Probability and Computing: Randomized Algorithms and Probabilistic Analysis"
6. Alan Tucker, "Applied Combinatorics", Wiley

Course Coordinator

BoS Member

BoS Chairman

Department of Computer Engineering

Operating System Design (CSPA11202)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisites

- Basic knowledge of Operating System

Course Objectives

- To Introduce the basic concepts of operating system
- To learn about various design techniques
- To learn process management
- To learn memory management and its relevant design techniques
- To learn virtualization concept

Course Outcomes

After completion of the course, student will be able to

1. Explain the functions, structures and history of operating systems design
2. Give details about the design issues associated with operating systems
3. Master various process management concepts including scheduling, synchronization, deadlocks
4. Apply the concepts of memory management including virtual memory
5. Master issues related to file system interface and implementation, disk management
6. Be familiar with protection security mechanisms, and various types of operating systems design including Unix

Unit I	**Introduction**

System levels, Hardware Resources, Resource management, Virtual Computers, The Hardware Interface, The CPU, Memory and Addressing, Interrupts, I/O Devices, The Operating System Interface, Information and Meta-Information, Naming Operating System Objects, Device as Files, The process Concept, Communication between Processes, UNIX-Style Process Creation, Standard Input and Standard Output, The User Interface to an Operating Design Techniques: Operating Systems and Design, Design Problems, Design Techniques, Two Level Implementation, Interface Design, Connection in Protocols, Interactive and Programming Interfaces, Decomposition Patterns.

Unit II	**Process Management and IPC**

Introduction process, System Initialization, System Call Interrupt Handling, Program Error Interrupts, Disk Driver Subsystem, Implementation of Waiting, Flow of Control Through the Operating System, Signaling in an Operating System, Interrupts in the Operating System, Operating Systems as Event and Table Managers, Process Implementation, Examples of Process Implementation, Patterns of Inter process communication, New message-passing system calls, IPC Patterns, Failure of Processes, Processes: Everyday Scheduling, Preemptive Scheduling Methods, Policy versus Mechanism in Scheduling, Scheduling in Real Operating Systems, Deadlock, Two Phase Locking, Starvation, Synchronization, Semaphores, Programming Language Based Synchronization Primitives, Message Passing Design Issues Design Techniques: Indirection, Using State Machines, Win Big Then Give Some Back, Reentrant Programs, Using Models for Inspiration, Adding a New Facility To a System

Unit III	**Memory Management**
Levels of Memory Management, Linking and Loading a Process, Variations in Program Loading, The Memory Management Design Problem, Dynamic Memory Allocation, Keeping Track of the Blocks, Multiprogramming Issues, Memory Protection, Memory Management System Calls, Virtual Memory, Virtual Memory Systems. Design Techniques: Multiplexing, Late binding, Static Versus Dynamic, Space-Time Tradeoffs, Simple Analytic Models	
Unit IV	**Virtualization and Virtual Machine**
Introduction,Storagevirtualization,NAS,SAN,Virtual CPU,Process virtual Machine,Virtual Machine, Hosted versus native virtual machines,Intel ugliness	
Unit V	**File systems**
The File Abstraction, File Naming, File System Objects and Operations, File System Implementation, File Systems Organization,Remote File systems Design Techniques: Caching, Optimization and Hints, Hierarchical Names, Naming of Objects, Unification of Concepts.	
Unit VI	**I/O and Resource Management**
I/O Devices, I/O Systems ,Issues, Types of Resources, Integrated Scheduling, Queuing Models of Scheduling, Real- time Operating Systems, Protection of Resources, User Authentication, Mechanisms for Protecting Hardware Resources, Representation of Protection Information, Mechanisms For Software Protection, The Use of Cryptography in Computer Security, The Client Server Model	

Reference Books

1. Charles Crowley, " Operating System: A Design-Oriented Approach", Tata McGraw-Hill
2. Understanding Full Virtualization, Para virtualization, and Hardware Assist, VMware white paper, © 2007 VMware.
3. Understanding Virtualization, IBM Systems Magazine, November 2004.
4. The NFS Distributed File Service: NFS White Paper, Sun Microsystems, March 1995
5. Introduction to Xen Virtualization, OpenSuse documentation.
6. Live Migration of Virtual Machines, Christopher Clark, Keir Fraser, Steven Hand, Jacob Gorm Hansen†, Eric Jul†, Christian Limpach, Ian Pratt, Andrew Warfield. University of Cambridge Computer Laboratory.
7. Johan De Gelas, "Hardware Virtualization: the Nuts and Bolts", AnandTech, March 17, 2008.

Course Coordinator

BoS Member

BoS Chairman

Department of Computer Engineering

Artificial Intelligence and Machine Learning (CSPA11203)(BIDA)

Teaching Scheme	**Examination Scheme**
Credits:	Formative Assessment: Marks
Lectures: Hrs/week	Summative Assessment: Marks

Prerequisites: Knowledge of Programming, Engineering Mathematics III

Course Objectives

- To understand human learning aspect and relate it with machine learning concepts.
- To understand nature of the problem and apply machine learning algorithm.
- To find optimized solution for given problem.
- To learn- to implement train, and validate neural network, and improve understanding of the on-going research in computer vision and multimedia field.

Course Objectives :

- To understand the various characteristics of intelligent agents.
- To learn the different search strategies in AI.
- To learn how to represent knowledge in solving AI problems.
- To introduce the concepts of learning

- Differentiate between supervised, unsupervised machine learning approaches.
- Apply specific supervised or unsupervised machine learning algorithm for a particular problem.
- Analyse and suggest the appropriate machine learning approach for the various types of problem

Unit I: Introduction
Introduction to Artificial Intelligence (AI), History and Future of AI, Intelligent Agent- Agent and Environment, Rationality, The nature of Environment, Problem Solving by Searching- State Space Search

Unit II : Problem Solving Search
Problem Solving by Searching- Uninformed Search, Informed Search-A* Search-Heuristics-Local Search Algorithms and Optimization-Hill Climbing, , Constraint Satisfaction Problem (CSP)- Backtracking search for CSP, Games- Single Agent Games, Two-Agent Games-Optimal Decisions in Games-Min-Max Algorithm, Alpha Beta Pruning, Stochastic Games

Unit III : Knowledge Representation and Logic
Knowledge representation using Propositional logic, Knowledge Representation using First Order Logic(FOL), Reasoning using FOL, Resolution using FOL, Use of predicate calculus,, Rule Based System

Unit IV : Introduction to Machine Learning

Introduction-Classic and adaptive machines, Relationship between Artificial Intelligence, Machine Learning, and Data Science, Definition and Features of Machine Learning, Machine Learning Approaches, Machine Learning Techniques, Applications of Machine Learning.

Feature Engineering- Creating training and test sets, managing categorical data, Managing missing features, Data scaling and normalization, Feature selection and Filtering

Unit V : Supervised Learning and Unsupervised Learning

Linear regression- Linear models, Linear Regression and higher dimensionality, Ridge, Lasso and ElasticNet, Polynomial regression

Logistic regression-Linear classification, Logistic regression, Implementation and Optimizations,

Support Vector Machine(SVM)- Linear Support Vector Machines, Kernel based classification, Non-linear Examples.

Clustering Fundamentals- Basics, K-means: Finding optimal number of clusters, DBSCAN, Spectral Clustering. Evaluation methods based on Ground Truth- Homogeneity, Completeness, Adjusted Rand Index, Hierarchical Clustering, Expectation maximization clustering, Agglomerative Clustering-Dendrograms.

Unit VI: Learning using Neural Network

Learning Using Neural Network, Perception, Gradient Descent, Multi Layer Network, Activation Functions, Applications of Neural Network.
Probabilistic Learning-Bayesian Learning

Text Books :

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.

2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998

3. Ethem Alpaydin, " Introduction to Machine Learning", PHI 2nd Edition-2013, ISBN 978-0-262-01243-0

Reference Books

1. Tom Mitchell "Machine Learning" McGraw Hill Publication, ISBN : 0070428077 9780070428072
2. Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Limited**,** ISBN-10: 1785889621, ISBN-13: 978-1785889622

Program Elective I
Soft Computing (CSPA11204A)

Teaching Scheme
Credits : 3
Lectures : 3Hrs/week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisites

- None

Course Objectives

- To design and develop intelligent systems in the framework of soft computing.
- To acquire knowledge of scientific application-driven environments.
- To apply concepts of machine learning in the intelligent system in order get complete automated system.

Course Outcomes

After completion of the course, students will be able to

1. Understand importance of soft computing
2. Know about the basics of soft computing techniques and also their use in some real life situations.
3. Solve the problems using neural networks techniques.
4. Find the solution using different fuzzy logic techniques.
5. Use the genetic algorithms for different modelling.
6. Implement the algorithms of soft computing

Unit I	**Soft Computing Basics**

Introduction, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing. Introduction: Neural networks, application scope of neural networks, fuzzy logic, genetic algorithm, machine learning.

Unit II	**Neural Networks**

Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto associative and hetro-associative memory, perceptron model, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient; back propagation algorithm, factors affecting back propagation training, applications.

Unit III	**Fuzzy Logic**

Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion. Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications&Defuzzifications, Fuzzy Controller, Fuzzy rule base and approximate reasoning: truth values and tables in fuzzy logic, fuzzy propositions formation of rules ,decomposition of compound rules, aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference system, fuzzy expert systems

Unit IV	**Genetic Algorithm**
Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, Traditional algorithm Vs genetic algorithm, simple GA, general genetic algorithm, schema theorem, Classification of genetic algorithm, Holland classifier systems, genetic programming, applications of genetic algorithm, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional method, applications.	
Unit V	**Machine Learning**
Learning form Examples - Inductive Concept Learning - Sequence Prediction - Effect of Noise in Input. Learning by Analogy- Concept formation - Derivational Analogy. Learning by Observation and Discovery - Search for Regularity- Conceptual Clustering, Computational Learning Theory	
Unit VI	**Applications of Computational Intelligence**
Shortest Path Algorithm, Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency Prediction – Soft Computing for Color Recipe Prediction, Stock Marker Forecasting	

Reference Books

1. S. Rajsekaran& G.A. Vijaya Lakshmi Pai, "Neural Networks,Fuzzy Logic and Genetic Algorithm:Synthesis and Applications", Prentice Hall of India.
2. N.P.Padhy,"Artificial Intelligence and Intelligent Systems", Oxford University Press.
3. J S R Jang, CT Sun and E. Mizutani, "Neuro-Fuzzy and Soft Computing", PHI PVT LTD.
4. Sivandudam and Deepa, "Principles of soft computing", John Mikey India.

Course Coordinator

BoS Member

BoS Chairman

Program Elective I
Data Preparation and Analysis (CSPA11204B)

Teaching Scheme
Credits : 3
Lectures : 3Hrs/week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisites

- UG level course in Data Structures

Course Objectives

- To prepare the data for analysis
- To develop meaningful Data for Visualizations

Course Outcomes

After completion of the course, students will be able to

1. Extract the data for performing the Analysis
2. Work in a business environment in which data preparation occurs.
3. Prepare data marts for statistical analysis
4. Summarize concepts of data quality
5. Read data from databases and clean the data for statistical analysis
6. Develop strategies for dealing with imperfect real world data

Unit I	**Data Gathering and Preparation**
Data formats, Data Sources, Data parsing and transformation, Scalability and real-time issues, Data Preparation, The Challenges of Sharing Lots of Files	

Unit II	**Data Cleaning**
Understanding Data Problem, Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation	

Unit III	**Describing Data**
Preparing Data Tables, understanding relationships, Building Data Transformation Workflows	

Unit IV	**Understanding Data**
Identifying and understanding groups, Building models from Data, Strategies for Dealing with Large Datasets	

Unit V	**Exploratory Analysis**
Descriptive and comparative statistics, , Machine Learning for Large Datasets , Clustering and association, Hypothesis generation, Building a Data Classification System	

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Unit VI	**Visualization**
Designing Visualizations, time series, Geo located data, Correlations and connections, Hierarchies and networks, interactivity, Study of various tools for Data Visualization	

Reference Books

1. Glenn J. Myatt , "Making sense of Data : A practical Guide to Exploratory Data Analysis and Data Mining", Willey publication, First Edition
2. Michael Manoochehri, "Data Just Right: Introduction to Large-Scale Data & Analytics", Addison-Wesley Data and Analytics

Course Coordinator

BoS Member

BoS Chairman

Department of Computer Engineering

Program Elective I
System Security (CSPA11204C)

Teaching Scheme
Credits : 3
Lectures : 3Hrs/week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisites

- Buffer Overflow
- Unix Access Control and File System Permissions
- Basic Ideas about Discretionary and Mandatory Access control
- Securing Web Browser and Servers
- http vs https and IPsec

Course Objectives.

- To study Operating system security and malwares
- To study security issues in internet protocols.
- To study network defense tools
- To understand computer, network and information security

Course Outcomes

After completion of the course, student will be able to

1. Take leading roles in planning, organizing, managing, designing and configuring security solutions in public and private organizations
2. Be familiar with state-of-the-art security technologies and best practices
3. Understand Operating system security and malwares
4. Study security issues in internet protocols.
5. Study network defense tools
6. Understand computer, network and information security

Unit I	**Introduction**
Control hijacking attacks: exploits and defenses, Buffer Overflows: Attacks and Defenses for the Vulnerability of the Decade, Basic Integer Overflows, Bypassing Browser Memory Protections	
Unit II	**Access Control**
Principle of least privilege, access control, and operating systems security, SetUID Demystified, Operating Systems Security, Malwares: viruses, Worms, Trojans, Rootkits.	
Unit III	**Dealing with Legacy Codes**
Dealing with legacy code: sandboxing and isolation, Traps and Pitfalls: Practical Problems in System Call Interposition Based Security Tools, Efficient Software-Based Fault Isolation	
Unit IV	**TCP/IP security issues**
Security issues in Internet protocols: TCP, DNS, and routing, A look back at Security Problems in the TCP/IP Protocol Suite, DNS cache poisoning,	

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Unit V	**Network Defense Tools**
Network defense tools: Firewalls, VPNs, Intrusion Detection, and filters, A Security Evaluation of DNSSEC with NSEC3, Distributed Firewalls, Bro: A System for Detecting Network Intruders in Real-Time, Unwanted traffic: denial of service attacks: Details of a recent large-scale DDoS event, Practical network support for IP Traceback, A DoS-Limiting Network Architecture	
Unit VI	**Case Studies**
Case Study, real world malware attacks, vulnerabilities	

Reference Books

1. Crispin Cowan, et al , "Buffer Overflows: Attacks and Defences for the Vulnerability of the Decade", http://crypto.stanford.edu/cs155/papers/cowan-vulnerability.pdf
2. Bypassing Browser Memory Protections, http://www.blackhat.com/presentations/bh-usa-08/Sotirov_Dowd/bh08-sotirov-dowd.pdf
3. Set UID Demystified, Chen, Dean, and Wagner, 2002. https://crypto.stanford.edu/cs155/papers/setuid-usenix02.pdf
5. T. Jaegeri , "Operating Systems Security" , 2008. Chapter 4, Security in Ordinary Operating Systems. https://crypto.stanford.edu/cs155/papers/ossecurity.pdf
6. T. Garfinkel, "Traps and Pitfalls: Practical Problems in System Call Interposition Based Security Tools", https://crypto.stanford.edu/cs155/papers/traps.pdf

Course Coordinator

BoS Member

BoS Chairman

Program Elective II
Information Retrieval and Web Mining (CSPA11205A)

Teaching Scheme
Credits : 3
Lectures : 3Hrs/week

Examination Scheme
Formative Assessment :50 Marks
Summative Assessment : 50 Marks

Prerequisites

- Probability Theory
- Database Management
- Web Programming

Course Objectives

- To provide students an understanding of the fundamental techniques for IR, design and usability, document management and searching the web
- To cover the important concepts, principles , algorithms, and data/file structures that are necessary to design, and implement Information Retrieval
- To equip with sound skills to solve computational search problems
- To appreciate how to evaluate search engines
- To appreciate the different applications of IR techniques in the Internet or Web environment
- To give clear relevance and significance of IR and Web Mining to modern society

Course Outcomes
After completion of the course, student will be able to

1. Understand the difficulty of representing and retrieving documents
2. Understand the latest technologies for linking, describing and searching the web.
3. Understand and analyze the relationship between ir, hypermedia, and semantic models.
4. Be familiar with techniques for conveying the meaning of documents or hypermedia content,
5. Be familiar with classical techniques of information retrieval, and the additional techniques employed by web search engines sufficient to understand how web search engines work and how they could be improved.
6. Be familiar with the fundamentals of hypermedia systems sufficient to know how to develop a good web hypermedia and why a web site is good or bad

Unit I	**Information Retrieval Basics**

Goals and history of IR. The impact of the web on IR. Components of an IR system, Boolean and vector-space retrieval models; ranked retrieval; text-similarity metrics; TF-IDF (term frequency/inverse frequency) weighting; cosine similarity. Simple tokenizing, stop-word removal, and stemming; inverted indices, Index Construction and compression.

Unit II	**Information Retrieval Models**

Probabilistic Information Retrieval, Language Modeling for Information Retrieval, Adhoc Retrieval, Latent Semantic Indexing, Relevance feedback, Pseudo relevance feedback, Query expansion, Query languages, POS tagging,

Unit III	**Specific topics in IR**
Focused Retrieval, Transfer Learning, Learning to Rank, Personalization, Cross Language IR, Digital Libraries, Bibliographic systems, Patent Search, E-learning, Security Issues, Parallel and distributed IR	
Unit IV	**Web Mining**
Web Structure, content and usage mining, Web Crawling, Indexes, Search engines; spidering; metacrawlers; directed spidering; link analysis (e.g. hubs and authorities, Google PageRank), Information Extraction, spam filtering, XML retrieval, Recent trends in Web search	
Unit V	**Performance metrics**
Recall, precision, and F-measure; Social Networks : Social Web, Blogs, Wikis, Forums, Social Network analysis, Recommender systems, Information Filtering, Collaborative filtering and content-based recommendation of documents and products.	
Unit VI	**Semantic web**
Web 3.0, Ontology, OWL, RDF Schema, Knowledge representation, Multimedia Retrieval, Content based Image retrieval, Pattern Matching and classification for IR. Structured Data Extraction: Wrapper Generation, Information Integration, Opinion Mining and Sentiment Analysis,	

Reference Books

1. Yates&Neto, "Modern Information Retrieval", Pearson Education, ISBN 81-297-0274-6 (2011). Christopher D. Manning, PrabhakarRaghavan, HinrichSchütze , "Introduction to Information Retrieval" (available online at http://nlp.stanford.edu/IR-book/)
2. Chakrabarti, S., "Mining the Web", Morgan Kaufmann (An Imprint of Elsevier) 2005.
3. B. Liu , "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data ", Springer, Second Edition, 2011
4. C.J. Rijsbergen, "Information Retrieval", (http://www.dcs.gla.ac.uk/Keith/Preface.html)

Course Coordinator

BoS Member

BoS Chairman

Department of Computer Engineering

Program Elective II
Advanced Wireless and Mobile Network (CSPA11205B)

Teaching Scheme
Credits : 3
Lectures : 3Hrs/week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisites
- Computer Networks

Course Objectives
- To be familiar with the wireless/mobile market and the future needs andchallenges.
- To be familiar with key concepts of wireless networks, standards, technologies and their basicoperations
- To learn how to design and analyze various medium access
- To learn how to evaluate MAC and network protocols using network simulation softwaretools.
- To be familiar with the wireless/mobile market and the future needs andchallenges.

Course Outcomes
After completion of the course, students will be able to
1. Demonstrate advanced knowledge of networking and wireless networking
2. Understandvarious types of wireless networks, standards, operations and use cases
3. Design WLAN, WPAN, WWAN, Cellular based upon underlying propagation andperformance analysis
4. Demonstrate knowledge of protocols used in wireless networks and learn simulating wireless networks
5. Design wireless networks exploring trade-offs between wire line and wireless links
6. Develop mobile applications to solve some of the real world problems

Unit I	**Introduction**

Wireless Networking Trends, Key Wireless Physical Layer Concepts, MultipleAccess Technologies - CDMA, FDMA, TDMA, Spread Spectrum technologies,Frequency reuse, Radio Propagation and Modelling, Challenges in MobileComputing: Resource poorness, Bandwidth, energy etc.

WirelessLocal Area Networks:
IEEE 802.11 Wireless LANs Physical & MAC layer, 802.11 MAC Modes (DCF& PCF) IEEE 802.11 standards, Architecture & protocols, Infrastructure vs.Adhoc Modes, Hidden Node & Exposed Terminal Problem, Problems, FadingEffects in Indoor and outdoor WLANs, WLAN Deployment issues

Unit II	**Wireless Cellular Networks**

1G and 2G, 2.5G, 3G, and 4G, Mobile IPv4, Mobile IPv6, TCP over WirelessNetworks, Cellular architecture, Frequency reuse, Channel assignmentstrategies, Handoff strategies, Interference and system capacity, Improvingcoverage and capacity in cellular systems, Spread spectrum Technologies.

Unit III	**Wireless Sensor Networks**

WiMAX (Physical layer, Media access control, Mobility and Networking), IEEE802.22, Wireless Regional Area Networks, IEEE 802.21 Media Independent Handover, Overview

Wireless Sensor Networks : Introduction, Application, Physical, MAC layer and Network Layer, PowerManagement, Tiny OS Overview.

Unit IV	**Wireless PANs**
Bluetooth AND Zigbee, Introduction to Wireless Sensors,.	
Unit V	**Security**
Security in wireless Networks Vulnerabilities, Security techniques, Wi-FiSecurity, DoS in wireless communication.	
Unit VI	**Advanced Topics**
IEEE 802.11x and IEEE 802.11i standards, Introduction to Vehicular AdhocNetworks	

Reference Books

1. Schiller J., "Mobile Communications", Addison Wesley 2000
2. Stallings W., "Wireless Communications and Networks", Pearson Education 2005
3. Stojmenic Ivan, "Handbook of Wireless Networks and Mobile Computing", John Wiley and SonsInc 2002
4. Yi Bing Lin and ImrichChlamtac," Wireless and Mobile Network Architectures", John Wiley andSons Inc 2000
5. Pandya Raj, "Mobile and Personal Communications Systems and Services", PHI 200

Course Coordinator

BoS Member

BoS Chairman

Department of Computer Engineering

Program Elective II

Web Analytics and Development (CSPA11205C)

Teaching Scheme
Credits : 3
Lectures :3Hrs/week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisites

- Statistics
- Networking

Course Objectives

- To explore use of social network analysis
- To understand growing connectivity andcomplexity in the world ranging from small groups to WWW

Course Outcomes

After completion of the course, student will be able to

1. Become familiar with core research communities, publications, focused on web and social media analytics and research questions engaged in it
2. Recognize the role of web analytics within the digital marketing landscape
3. Identify, define and interpret commonly used web metrics
4. Understand and discuss clickstream data collection techniques, their impact on metrics, and their inherent limitations
5. Gain a practical understanding of common monitoring or analysis tasks and techniques used in web analytics
6. Effectively use the resulting insights to support website design decisions, campaign optimization, search analytics, etc

Unit I	**Introduction**
Social network and Web data and methods, Graph and Matrices,Basic measures for individuals and networks, Information Visualization, The Bold New World of Web Analytics	
Unit II	**Web Analytics Tools**
Click Stream Analysis, A/B testing, Online Surveys, Study of Google Analytics, Spring Metrics, Woopra, Clicky, Mint, Chartbeat, Kissmetrics, User Testing, Mouseflow, Crazy Egg	
Unit III	**Web Search and Retrieval**
Search Engine Optimization, Web Crawling andindexing, Ranking Algorithms, Web traffic models	
Unit IV	**Making Connection**
Link Analysis, Random Graphs and Network evolution, Social, Connects: Affiliation and identity, Connection Search, Collapse, Robustness Social involvements and diffusion of innovation, study of Web Analytics Connector	
Unit V	**Advanced Topics**
Understand advertising using analytics, Web-based Analytics and software product, Affiliate, Internet, and Referral marketing	

Department of Computer Engineering

Unit VI	**Recent Trends**
Study of Artificial Intelligence, Virtual Reality, Internet of Things (IoT), Static Websites for Online Content, Cinemagraphs to Gain Popularity, Modular Designs for Web Development	

Reference Books

1. Hansen, Derek, Ben Sheiderman, Marc Smith. "Analyzing Social Media Networks withNodeXL: Insights from a Connected World". Morgan Kaufmann, 304, 2011
2. AvinashKaushik,"Web Analytics 2.0: The Art of Online Accountability", 2009.
3. Easley, D. & Kleinberg, J. Networks, "Crowds, and Markets: Reasoning About a HighlyConnected World", New York: Cambridge University Press, 2010.
4. http://www.cs.cornell.edu/home/kleinber/networks-book/

Course Coordinator

BoS Member

BoS Chairman

Open Elective I	
Soft computing Techniques (IOEP11206A)	
Teaching Scheme	**Examination scheme**
Credits :2	**CIE: NA**
Lectures :2 hrs / week	**ISE: NA**
	SCE: NA
	ESE: NA
	PR/OR/ TW:50
Prerequisite: UG level mathematics	

Course Objectives:

1. To make students aware about soft computing techniques /AI techniques
2. To impart knowledge about working of ANN, applications of ANN
3. To impart knowledge about working of Genetic programming, applications of GP
4. To impart knowledge about working of Support vector Regression and Model Tree, applications of SVR and MT

Course Outcomes:

Upon completion of this course, students will be able to –

1. Understand working of ANN and design temporal and cause effect ANN models
2. Understand working of Genetic programming and design temporal and cause effect GP models
3. Understand working of Support Vector Regression and design temporal and cause effect SVR models
4. Understand working of Model Tree and design temporal and cause effect MT models

Unit I : Artificial Neural Networks (4 hrs)

Introduction to computing, hard computing-soft computing, AI and Soft computing, ANN as a soft computing technique, Biological neural network, artificial neuron, working of an artificial neural network, network training, validation and testing, standard Back propagation algorithm, introduction of first order, second order and global training algorithms

Unit II : Neural network design and applications (4 hrs)
important aspects of artificial network design, types of neural networks, Applications of ANN in temporal and cause effect modeling
Unit III : Genetic programming (4 hrs)
Introduction to Genetic programming, genetic operators, variants in GP, Algorithm of GP, GP parameters Application of GP in temporal and cause effect modeling
Unit IV: Support Vector Regression and and Model Tree (4 hrs)
Introduction to Support vector machines, Support Vector Regression, basics of SVR, Application of MT in temporal and cause effect modeling. Introduction to Model Tree, M5 Algorithm, Application of MT in temporal and cause effect modeling
Term work: 1. Design cause effect model using ANN, GP, SVR and MT for the same problem and compare their results. Students will prepare a single report of these four applications.
Text books: 1. Bose, N. K., Liang, P. (1998), "Neural Network Fundamentals with Graphs, Algorithms and Applications", Tata McGraw-Hill Publication. 2. Kosko, B., (1992), "Neural Networks and Fuzzy systems", Prentice Hall, Englewood Cliffs, NJ 3. Wasserman, P.D., (1993), " Advanced methods in neural computing", Van Nostrand Reinhold, New York
Reference Books: Publications in ASCE, Science Direct, Springer, Wiley, IEEE journals and/or similar peer reviewed international unpaid journals

Department of Computer Engineering

Open Elective

Ethical Hacking (IOEP11206B)

Teaching Scheme
Credits : 2
Lectures : 2 Hrs/week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : NA

Prerequisites :	
•	
Course Objectives :	
•	Understand basics of network security and hacking
•	Aware of legal perspective of cybercrime including Indian IT ACT 2008
•	Learn techniques of gathering network information
•	Identify security tools including, but not limited to intrusion detection and firewall Software
Course Outcomes :	
	After completion of the course, student will be able to
1.	Use basics knowledge of network security and hacking
2.	Understand and use the IT Laws as and when required
3.	Gather required information to perform a attack
4.	Use various tools and methods for Vulnerability Assessment

Unit I :	**Introduction to Network and security**
Basics of Computer Networks: OSI Model, TCP/IP Model, Network topology (Physical & logical), Network Hardware Components: Connectors, Repeaters, hubs, NICs, Bridges and Switches. **Basics of Computer Networks Security:** Essential Terminology, Elements of Information Security, Types of Hackers, Steps for Ethical hacking, Types of Attacks.	
Unit II :	**Legal Perspective and Network Protocols**
The Indian IT Act, Challenges to Indian law, Cybercrime scenario in India, 2008 amendments to Indian IT Act, Intellectual property in the cyberspace. **Understanding Network Protocols:** TCP,UDP,ICMP, Server Protocols: FTP,HTTP,SMTP, Introduction to OWASP.	
Unit III :	**Information Gathering Techniques**
Active information gathering, passive information gathering, Trace route, Interacting with DNS Servers, SNMP and SMTP attacks.	
Unit IV :	**Port Scanning and Vulnerability Assessment**
Target Enumeration and Port Scanning Techniques: Scanning for Open Ports and Services, Types of Port Scanning, Firewall/IDS Evading Techniques **Vulnerability Assessment:** Vulnerability Scanners and How Do They Work, Pros and Cons of a Vulnerability Scanner, Vulnerability Assessment with Nmap, Nessus	

Text Books :		
	1	Rafay baloch, "Ethical hacking and Penetration Testing guide", CRC press, 2015, ISBN: 13: 978-1-4822-3162-5 (eBook - PDF)
	2	Nina Godbole, SunitBelapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", WILEY Publications, 2015, ISBN:978-81-265-2179-1
Reference Books :		
	1	Behrouz Fourzon, " Data Communication and Computer Networks", Pearson Education,5th edition ISBN : 978-0070634145
	2	Andrew S. Tanenbaum, " Computer Networks", International Economy Edition, 5th edition ISBN: 10: 9332518742

Department of Computer Engineering

Open Elective I
Product Design Engineering (IOEP11206C)

Teaching Scheme	**Examination Scheme**						
Credits: 2 Lecture (L): 2 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	NA	NA	NA	NA	NA	50	50

Course Objectives: The course will help students

- To understand basic techniques for particular phases of product development
- Make and manage design teams for product development in a company.

Course Outcomes: By the end of the course, Students will be able to

1. Describe an engineering design and development process
2. Employ engineering, scientific, and mathematical principles to execute a design from conceptto finished product
3. Create 3D solid models of mechanical components from the perspective of aesthetic, ergonomicand functional requirement using CAD software
4. Work collaboratively on a team.
5. Create new product based on mechanical design engineering.
6. Investigate contemporary issues and their impact on provided solution.

Unit I: Introduction to Product Design **(6 Hrs.)**

Characteristics of Successful Product Development, Innovative Thinking, Challenges to Product Development, Product Development Process, Concept Development, Economics – Cost Vs Performance, Design Considerations

Unit II: Product Development Process **(6 Hrs.)**

Product development process- Identification of customer needs- customer requirements, product development process flows. Product specifications and concept generation, concept selection, concept screening, concept testing, reverse engineering, product architecture

Unit III: Product Design Tools **(6 Hrs.)**

Creativity and Problem Solving –Creativity methods-Theory of Inventive Problem Solving (TRIZ), Product function tree, Life cycle analysis, Quality Function Deployment, Competing Product Analysis, SWOT analysis, Failure Mode Effect Analysis.

Unit IV: Design for Manufacture and Assembly **(6 Hrs.)**
Design for assembly, design for disassembly, design for environment, design for graphics and packaging
Text books:
1. Product Design-Techniques in Reverse Engineering and New Product Development, Kevin Otto, Kristion Wood, Pearson Education, ISBN 978-81-7758-821-7. **2.** Karl T.U. And Steven D.E., Product Design and Development, McGraw Hill, Ed 2000.
Reference books:
1. Dieter GE, Engineering Design-Material and Processing Approach, McGraw Hill, Ed 2000

Department of Computer Engineering

Research Methodology (CVPA11207)

Teaching Scheme	**Examination Scheme**						
Credits: 2 Lecture (L): 2 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	NA	NA	NA	NA	NA	50	50

Prerequisite: Basic statistical tools

Course Objectives: The course will help students

1. To introduce to the concept of research and research problem
2. To understand research ethics
3. Get introduced to the concept of Intellectual property rights.
4. To understand developments in IPR

Course Outcomes: By the end of the course, Students will be able to

1. Define research and formulate a research problem
2. Discuss the importance of Research Design and Literature Review
3. Discuss classification of data and preliminary data analysis
4. Write a research proposal to a suitable funding agency

Unit I: Introduction to Research and Research problem (6 Hrs.)

Meaning of research, types of research, process of research, Objectives of research, Research and Scientific Method, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, defining a research problem (Real life example or case study), formulation of research hypotheses, Qualities of a good Hypothesis, Null Hypothesis & Alternative Hypothesis. Hypothesis Testing -Logic & Importance

Unit II: Research Design and Literature Review (6 Hrs.)

Research Design- Concept and Importance in Research, different research designs in research studies, Literature survey- Definition of literature and literature survey, need of literature survey, elements and objectives of literature survey, sources of literature-monographs-patents – web as a source, Critical literature review – Identifying gap areas from literature review and strategies of literature survey, Errors in research.

Unit III: Data and Data Analysis (6 Hrs.)

Classification of data, benefits and drawbacks of data, qualitative methods of data collection, types of data analysis, Sampling, sample size, sample design, Testing of hypothesis and Goodness of Fit: Definition of null and alternative hypothesis, student's 't' distribution, Chi-square distribution, F-test, analysis of variance techniques, introduction to non-parametric tests. Regression Analysis – Simple Linear Regression, Multiple linear Regression

Unit IV: Report, Research Proposal and Funding Agencies **(6 Hrs.)**
Need of effective documentation, types of reports and their format. Essentials of a research proposal. Different funding agencies for research. Research briefing, presentation styles, elements of effective presentation, writing of research paper, presenting and publishing paper, patent procedure, ethical issues.
Text books:
1. Dr. C. R. Kothari, Research Methodology: Methods and Trends', New Age InternationalPublishers. **2.** Wayne Goddard and Stuart Melville, Research Methodology: An Introduction **3.** Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners
Reference books:
1. Deepak Chawla and Neena Sondhi, Research Methodology**:** concepts and cases, Vikas Publishing House Pvt. Ltd. (ISBN 978-81-259-5205-3) **2.** Louis Cohen, Manion, Morrison , Research Methods in Education, Routledge (Taylor& Francis Group) /Cambridge University Press India Pvt. Ltd.-ISBN-978-0-415-58336-7 **3.** Sekaran Uma and Roger Bougie, Research Methods for Business, Wiley, India.

Department of Computer Engineering

Laboratory I (CSPA11208)

Teaching Scheme
Credits : 2
Practical : 4Hrs/week
Oral : 50 marks

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Course Objectives

- To develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design and concurrency
- To study various sampling and classification problems
- To Introduce the basic concepts of operating system
- To learn about various design techniques
- Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains
- Implement deep learning algorithms and solve real-world problems

Course Outcomes

After completion of the course, student will be able to

1. Understand the basic notions of discrete and continuous probability
2. Understand the methods of statistical inference, and the role that sampling distributions play in those methods.
3. Perform correct and meaningful statistical analyses of simple to moderate complexity
4. Explain the functions, structures and history of operating systems design
5. Give details about the design issues associated with operating systems
6. Master various process management concepts including scheduling, synchronization, deadlocks

General Instructions

- Design and implementation should be done using latest 64-bit C++/JAVA/ Python/QT 5.1 and above, Cuda C++ or such latest 64-bit programming tools.
- Development Tools such as MATLAB/OPENCV/OPENMP/NS3 or equivalent may be used if required to interface the developed classes to the simulators.
- Student can refer UCI datasets/Routers data sets or other benchmark datasets to implement the assignments, whenever is required.

List of Experiments

A. Mathematical Foundation of Computer Science

1. The data set is a data frame with three columns, time, duration and size, which give the duration in seconds and size in bytes of internet downloads at given times at a University. Compute

   a) the minimum, the maximum, and the quartiles for the duration and size of the downloads. Plot duration against size and log-duration against log-size

   b) Compute a 95% confidence interval for the mean of the log size of the down-loads.

c) Break the data into two groups according to whether the time of observation is smaller or larger than 972500. Use the t-test to compare the means of the log size for the two groups. Does it make a difference in the comparison above whether we assume equal variances in the two groups or not.

2. Contrary to the popular expectation, try calculating the probability of getting 50 heads and 50 tails on 100 flips of fair coins? This expectation is known as the gambler's fallacy! An approximate answer would suffice!

3. Generate 100 samples from Student's t distribution with 4 degrees of freedom and generate the qqplot for this sample. Generate another sample of same size, but now from at distribution with 30 degrees of freedom and generate the q-q plot. Do you see any difference ?

B. Operating System Design

1. Write a program to implement semaphore for IPC.
2. Write a program to implement sleeping-barber problem.
3. Write a program to implement page table management.
4. Write a program to implement Network operating system in lab.

C. AI & Machine Learning

List of Assignments

1. Implement A* approach for any suitable application.
2. Assignment on Constraint Satisfaction Problem: Implement graph colouring problem.
3. Implementation of Min-Max Algorithm
4. Write a program to do : A dataset collected in a cosmetics shop showing details of customers and whether or not they responded to a special offer to buy a new lip-stick is shown in table below. Use this dataset to build a decision tree, with Buys as the target variable, to help in buying lip-sticks in the future. Find the root node of decision tree. According to the decision tree you have made from previous training data set, what is the decision for the test data: [Age < 21, Income = Low, Gender = Female, Marital Status = Married]?

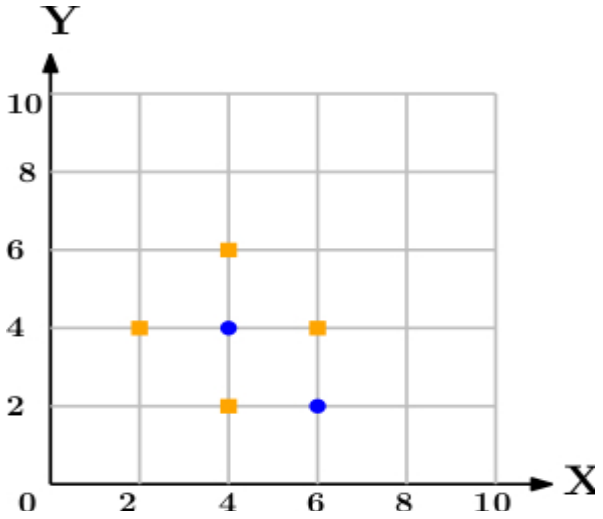
ID	Age	Income	Gender	Martial Status	Buys
1	<21	High	Male	Single	No
2	<21	High	Male	Married	No
3	21-35	High	Male	Single	Yes

4	>35	Medium	Male	Single	Yes
5	>35	Low	Female	Single	Yes
6	>35	Low	Female	Married	No
7	21-35	Low	Female	Married	Yes
8	<21	Medium	Male	Single	No
9	<21	Low	Female	Married	Yes
10	>35	Medium	Female	Single	Yes
11	<21	Medium	Female	Married	Yes
12	21-35	Medium	Male	Married	Yes
13	21-35	High	Female	Single	Yes
14	>35	Medium	Male	Married	No

5. Write a program to do following:
We have given a collection of 8 points. P1=[0.1,0.6] P2=[0.15,0.71] P3=[0.08,0.9] P4=[0.16, 0.85] P5=[0.2,0.3] P6=[0.25,0.5] P7=[0.24,0.1] P8=[0.3,0.2]. Perform the k-mean clustering with initial centroids as m1=P1 =Cluster#1=C1 and m2=P8=cluster#2=C2. Answer the following

1] Which cluster does P6 belongs to?
2] What is the population of cluster around m2?
3] What is updated value of m1 and m2?

6. In the following diagram let blue circles indicate positive examples and orange squares indicate negative examples. We want to use k-NN algorithm for classifying the points. If k=3, find the class of the point (6,6).



Implement Convolutional Neural Network for Image Classification. **(Consider automobiles image Data set to classify it into two wheelers and four wheelers automobiles, or Consider animals data set to classify the images as Cat, Dog etc.)**

8. Implement Recurrent Neural Network for Sentiment Analysis (**for Twitter Data set)**

Course Coordinator

BoS Member

BoS Chairman

Department of Computer Engineering

Data Sciences (CSPA12201)

Teaching Scheme
Credits : 3
Lectures : 3Hrs/week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisites
- Databases

Course Objectives
- To provide the knowledge and expertise to become a proficient data scientist
- To demonstrate an understanding of statistics and machine learning concepts that are vital for data science
- To critically evaluate data visualizations based on their design and use for communicating stories from data
- To produce code to statistically analyze a dataset using tools like Python and R

Course Outcomes
After Completion of the course, students will be able to
1. Describe the Data Science Process and how its components interact
2. Apply basic machine learning algorithms (Linear Regression, k-Nearest Neighbors (k-NN), k-means, Naive Bayes) for predictive modeling
3. Build their own recommendation system using existing components
4. Identify common approaches used for Feature Generation and Selection
5. Use the tools and technology like Hadoop, Python and R
6. Create effective visualization of given data

Unit I	**Introduction: What Is Data Science?**

Big Data: Overview, Data Structures, Analyst Perspective on Data Repositories, BI Versus Data Science , Current Analytical Architecture. Drivers of Big Data, Examples of Big Data Analytics
Data Analytics Lifecycle: Discovery, Data Preparation, Data Preparation, Model Planning, Model Building, Communicate Results, Operationalize
Statistical Inference: Populations and Samples, Populations and Samples of Big Data, Modeling, Exploratory Data Analysis, Philosophy of Exploratory Data Analysis, The Data Science Process, A Data Scientist's Role

Unit II	**Analytical Theory and Methods**

Linear Regression, k-Nearest Neighbors (k-NN), k-means, Apriori algorithm, Spam Filters, Naive Bayes, and Wrangling, Logistic Regression, Decision Trees.

Unit III	**Extracting meaning from Data**

The Kaggle model, feature selection for better data science (case study)
Recommendation Engine: Nearest Neighbor Algorithm Review, The Dimensionality Problem, Singular Value Decomposition (SVD), Principal Component Analysis (PCA), Alternating Least Squares
Time Stamps and Financial Modeling : Timestamps, Financial Modeling, In-Sample, Out-of-Sample, and Causality, Preparing Financial Data, Log Returns, Case study.

Unit IV:	**Mining and Analyzing Data**
Mining **-Network Graphs:** Social networks as graphs, Clustering of graphs, Direct discovery of communities in graphs, Partitioning of graphs, Neighborhood properties in graphs Case Study: Google's Hybrid Approach to Social Research **Time Series Analysis**: Overview, Box-Jenkins Methodology, ARIMA Model. **Text Analysis:** Steps , Collecting Raw Text , Representing Text, Term Frequency—Inverse Document Frequency (TFIDF) , Categorizing Documents by Topics , Determining Sentiments , Gaining Insights	
Unit V	**Technology and Tools**
Analytics for Unstructured Data , MapReduce , Apache Hadoop **The Hadoop Ecosystem**: Pig, Hive, HBase, Mahout. **SQL Essentials:** Joins, Set Operations, Grouping Extensions, In-Database Text Analysis **Advanced SQL :** Window Functions, User-Defined Functions and Aggregates, Ordered Aggregates MADlib NoSQL , Data Lakes	
Unit VI	**Data Visualization and Representation**
Basic principles, ideas and tools for data visualization, Visualization of Numerical Data, Visualization of Non-Numerical Data, The Visualization Dashboard Data Science and Ethical Issues : Discussions on privacy, security, ethics	

Reference Books

1. Cathy O'Neil and Rachel Schutt."Doing Data Science, Straight Talk From The Frontline", O'Reilly.
2. Author Edition, "Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", EMC Education Services, Wiley, India
3. U Dinesh Kumar, "Business Analytics", Wiley
4. Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012

Course Coordinator

BoS Member

BoS Chairman

Department of Computer Engineering

Cyber Physical System (CSPA112202)

Teaching Scheme
Credits : 3
Lectures : 3Hrs/week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisites

- Principles of Imperative Computation
- Integration, Differential Equations, and Approximation

Course Objectives

- To learn IoT concepts and technologies
- To Understand IoT Market perspective
- To Understand State of the Art – IoT Architecture
- To study IoT protocol stacks and Real World IoT Design Constraints

Course Outcomes

After completion of the course, students will be able to

1. Understand the core principles behind CPSs and develop models and controls
2. Identify safety specifications and critical properties of CPSs
3. Understand abstraction and system architectures and learn how to design by invariant
4. Reason rigorously about CPS models and verify CPS models of appropriate scale
5. Understand the semantics of a CPS model
6. Develop an intuition for operational effects

Unit I	**Introduction**

The IoT Paradigm, smart objects, bits and atoms, IoT value chains, An IoT architecture outline. What is the IoT and why is it important? Elements of an IoT ecosystem. Technology drivers. Business drivers, TypicalIoT applications. Trends and implications.

Unit II	**IoT Technologies**

Technologies behind the IoT, RFID + NFC, Wireless networks + WSN, RTLS + GPS, Agents and multiagent systems. Wireless technologies for IoT. Edge connectivity and protocols.Zigbee

Unit III	**IoT Reference Architecture**

Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control. Industrial Automation- Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things

Unit IV	**Internet of Things Privacy, Security and Governance**

Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

Unit V	**Identity Management Models in IoT**
Introduction, Vulnerabilities of IoT, Security requirements, Challenges for a secure Internet of Things, identity management, Identity portrayal, Different identity management model: Local identity, Network identity, Federated identity, Global web identity, Identity management in Internet of Things, User-centric identity management, Device-centric identity management,Hybrid identity management.	
Unit VI	**Trust Management in IoT**
Introduction, Trust management life cycle, Identity and trust, Third party approach, Public key infrastructure, Attribute certificates, Web of trust models, Web services security, SAML approach, Fuzzy approach for Trust, Access control in IoT, Different access control schemes, Authentication and Access control policies modeling.	

Reference Books

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
2. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
3. J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016.
4. Keysight Technologies, "The Internet of Things: Enabling Technologies and Solutions for Design and Test", Application Note, 2016.

Course Coordinator

BoS Member

BoS Chairman

Department of Computer Engineering

Teaching Scheme

Credits : 3

Lectures : 3 Hrs/week

Examination Scheme

Formative Assessment : 50 Marks

Summative Assessment : NA

Deep Learning (CSPA12203)

Prerequisites :

- Linear Algebra, Analysis, Probability, Python programming and Numerical Optimization

Course Objectives :

- To introduce the fundamental principles for Deep Learning (DL).
- To explain the variants of DL with their applications
- To explore the DL frameworks
- To apply DL concepts for NLP

Course Outcomes:

After completion of the course, student will be able to

1. Understand the fundamental principles, theory and approaches for learning with deep neural networks

2. Understand the main variants of deep learning (such convolutional and recurrent architectures), and their typical applications

3. Apply the key concepts, issues and practices when training and modeling with deep architectures; as well as have hands-on experience in using deep learning frameworks for this purpose

4. Implement basic versions of some of the core deep network algorithms (such as backpropagation) for popular applications in NLP.

Unit I :	**Introduction**
Feedforward Neural networks. Gradient descent and the backpropagation algorithm. Unit saturation, aka the vanishing gradient problem, and ways to mitigate it. RelU Heuristics for avoiding bad local minima. Heuristics for faster training. Nestors accelerated gradient descent. Regularization. Dropout, Eigenvalues and eigenvectors, Eigenvalue Decomposition, Basis Principal Component Analysis and its interpretations, Singular Value Decomposition	
Unit II :	**Convolutional Neural Networks**
Architectures: LeNet,AlexNet, ZF-Net, VGGNet,GoogLeNet, ResNet,, convolution / pooling layers, Sentence Classification using Convolutional Neural Networks Deep learning frameworks: Tensorflow, Keras	
Unit III	**Recurrent Neural Networks :**
LSTM, GRU, Encoder Decoder architectures	
Unit IV :	**Deep Unsupervised Learning**
Autoencoders (standard, sparse, denoising, contractive, etc), relation to PCA Variational Autoencoders, Adversarial Generative Networks, Autoencoder and DBM	
Unit V :	**Applications of Deep Learning to NLP**
Introduction to NLP and Vector Space Model of Semantics,Word Vector Representations: Continuous Skip-Gram Model, Continuous Bag-of-Words model (CBOW), Glove, Evaluations and Applications in word similarity, analogy reasoning, Named Entity Recognition, Opinion Mining using Recurrent Neural Networks,Parsing and Sentiment Analysis using Recursive Neural Networks,Dialogue Generation with LSTMs	
Unit VI :	**Dynamic memory networks**
Attention and memory models, Applications of Dynamic Memory Networks in NLP,Recent Reseearch in NLP using Deep Learning,Factoid Question Asnwering, similar question detection,Dialogue topic tracking, Neural Summarization,Smart Reply	

Text Books :	
1	Bengio, Yoshua. "Learning deep architectures for AI." Foundations and trends in Machine Learning 2.1 (2009): 1127.
2	Hochreiter, Sepp, and Jargen Schmidhuber. "Long short -term memory." Neural computation 9.8 (1997): 17351780.
3	Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016
Reference Books :	
1	. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004
2	Neural Networks and Deep Learning by Michael Nielsen (Dec 2014)

Department of Computer Engineering

Program Elective – IV

Augmented and Virtual Reality (CSPA12204A)

Teaching Scheme	**Examination Scheme**
Credits:4	Formative Assessment:50 Marks
Lectures:3Hrs/week	Summative Assessment:50 Marks

Prerequisites: Discrete Mathematics, Data Structures and Theory of Computation

Course Objectives

- To make students know the basic concept and framework of Augmented Reality (AR) and Virtual Reality (VR).
- To introduce students the technology for multimodal user interaction and perception in AR & VR, in particular the visual, audial and haptic interface along with behavior.
- To aware students the technology for managing large scale AR & VR environment in real time.
- To provide students with an introduction to the AR & VR system framework and development tools along with mini projects.
- To teach about the differences between AR & VR, along with an extension of work towards Mixed Reality (MR).

Course Outcomes

After completion of the course, student will be able to

1. To understand the basic concept and framework of virtual reality
2. To understand the technology for multimodal user interaction and perception in VR Decide and apply algorithmic strategies to solve a given problem
3. To apply VR Tools in real time environment.
4. To understand Augmented reality
5. Design and prototype effective AR/VR applications using state-of-the-art tools
6. Compare AR/VR to other approaches; match technology to needs and use cases
7. Articulate trends and trajectories in current and future AR/VR systems

Unit I: Introduction

- The historical development of VR: Scientific landmarks Computer Graphics, Real-time computer graphics, Flight simulation, Virtual environments, Requirements for VR, benefits of Virtual reality.
- Introduction to Virtual Reality Fundamental Concept and Components of Virtual Reality, Primary Features and Present Development on Virtual Reality.
- Physiology, Psychology and the Human Experience

Unit II: Visual Computation in Virtual Reality

- Fundamentals of Computer Graphics; Real time rendering technology; Principles of

Stereoscopic Display; Software and Hardware Technology on Stereoscopic Display

- Multiple Modals of Input and Output Interface in Virtual Reality. Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based3D Menus & 3DScanner etc; Output --Visual / Auditory / Haptic Devices
- Position and Motion Trackers
- Navigation and Manipulation Interfaces

Unit III: Environment Modeling in Virtual Reality

- Geometric Modeling; Behavior Simulation; Physically Based Simulation
- Camera tracking and 3D Rendering for Immersive Environments
- Sound in Immersive Environments
- Modeling the Physical world

Unit IV: Haptic & Force Interaction in Virtual Reality

- Concept of haptic interaction; Principles of touch feedback and force feedback; Typical structure and principles of touch/force feedback facilities in applications
- HARDWARE TECHNOLOGIES FOR 3D USER INTERFACES: Visual Displays Auditory Displays, Haptic Displays, Choosing Output Devices for 3D User Interfaces.

Unit V: VR Development Tools

- Frameworks of Software Development Tools in VR; Modeling Tools for VR; X3D Standard; Vega, MultiGen, Virtoolsetc
- VIRTUAL REALITY APPLICATIONS: Engineering, Architecture, Education, Medicine, Entertainment, Science, Training.

Unit VI: Augmented Reality

- Augmented Reality System Structure of Augmented Reality; Key Technology in AR; General solution for calculating geometric & illumination consistency in the augmented environment.
- 3D User Interfaces for the Real World, AR Interfaces as 3D Data Browsers, 3D Augmented Reality Interfaces, Augmented Surfaces and Tangible Interfaces, Agents in AR, Transitional AR-VR Interfaces - The future of 3D User Interfaces, Questions of 3D UI Technology, 3D Interaction Techniques, 3D UI Design and Development, 3D UI Evaluation and Other Issues.
- Introduction and applications of Mixed Reality

Text Books

Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press,2003/2006.

Reference Books:

1. Alan B Craig, William R Sherman and Jeffrey D Will, Developing Virtual Reality Applications: Foundations of Effective Design, Morgan Kaufmann, 2009.
2. Gerard Jounghyun Kim, Designing Virtual Systems: The Structured Approach, 2005.
3. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, 3D User Interfaces, Theory and Practice, Addison Wesley, USA, 2005.
4. Oliver Bimber and Ramesh Raskar, Spatial Augmented Reality: Meging Real and Virtual Worlds, 2005.
5. Burdea, Grigore C and Philippe Coiffet, Virtual Reality Technology, Wiley Interscience, India, 2003.

6. John Vince, Virtual Reality Systems, Addison Wesley, 1995.
7. Howard Rheingold, Virtual Reality: The Revolutionary Technology and how it Promises to Transform Society, Simon and Schuster, 1991.
8. William R Sherman and Alan B Craig, Understanding Virtual Reality: Interface, Application and Design (The Morgan Kaufmann Series in Computer Graphics). Morgan Kaufmann Publishers, San Francisco, CA, 2002
9. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.

Course Coordinator

BoS Member

BoS Chairman

Program Elective IV
Big Data Analytics (CSPA12204B)

Teaching Scheme
Credits : 3
Lectures : 3Hrs/week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisites

- Knowledge of Probability Theory, Statistics and Programming

Course Objectives

- To understand big data for business intelligence.
- To learn business case studies for big dataanalytics.
- To understandNoSQL big data management.
- To perform map-reduce analytics usingHadoop and related tools

Course Outcomes

After completion of the course, students will be able to

1. Describe big data and use cases from selected business domains
2. Explain NoSQL big data management
3. Install, configure, and run Hadoop and HDFS
4. Perform map-reduce analytics using Hadoop
5. Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics
6. Write case studies in Business Analytic and intelligence

Unit I	**Introduction**

What is big data, why big data, convergence of key trends, unstructured data,industry examples of big data, web analytics, big data and marketing, fraud andbig data, risk and big data, credit risk management, big data and algorithmictrading, big data and healthcare, big data in medicine, advertising and big data,big data technologies, introduction to Hadoop, open source technologies, cloudand big data, mobile business intelligence, Crowd sourcing analytics, inter andtrans firewall analytics.

Unit II	**NoSQL**

Introduction to NoSQL, aggregate data models, aggregates, key-value anddocument data models, relationships, graph databases, schemalessdatabases,materialized views, distribution models, sharding, master-slave replication, peerpeerreplication, sharding and replication, consistency, relaxing consistency,version stamps, map-reduce, partitioning and combining, composing map-reducecalculations.

Unit III	**Data Formats**

Data format, analysing data with Hadoop, scaling out, Hadoop streaming,Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFSconcepts, Java interface, data flow, Hadoop I/O, data integrity, compression,serialization, Avro, file-based data structures

Unit IV	**MapReduce Workflows**

MapReduce workflows, unit tests with MRUnit, test data and local tests,anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classicMap-reduce and YARN, job scheduling, shuffle and sort, task execution,MapReduce types, input formats, output formats

Unit V	**Hbase**
Hbase, data model and implementations, Hbase clients, Hbase examples,praxis.Cassandra, Cassandra data model, Cassandra examples, Cassandra clients,Hadoop integration.	
Unit VI	**Advanced Topics**
Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts.Hive, data types and file formats, HiveQL data definition, HiveQL datamanipulation, HiveQL queries.	

Reference Books

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic", Wiley CIO Series
2. Michele Chambers, AmbigaDhiraj Michael Minelli , "Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013
3. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012
4. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.

Course Coordinator

BoS Member

BoS Chairman

Department of Computer Engineering

Program Elective IV

Usability Engineering (CSPA12183C)

Teaching Scheme
Credits : 3
Lectures : 3Hrs/week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisites

- Human Computer Interface

Course Objectives

- To describe the human centered design process and usability engineeringprocess and their roles in system designand development.
- To discuss usability designguidelines, theirfoundations, assumptions, advantages, and weaknesses.
- To describe basics of human subjects research and complete a basic human subjects research certification form.
- To design a user interface based on analysis ofhuman needs and prepare a prototypesystem.
- To assessuser interfacesusing different usability engineering techniques.

Course Outcomes

After completion of the course, students will be able to

1. Define and distinguish between the different types of user interface,
2. Exploit cognitive and social factors that make interactive software usable
3. Apply key design principles and guidelines that assist user interface designers
4. Understand the limitations of guidelines
5. Apply techniques of Usability Engineering across the development lifecycle
6. Develop a sound usability test and evaluation plan for a particular design project

Unit I	**Introduction to Human-Computer Interaction as an emerging field**

Disciplines contributing to HCI, Human Information Processing Psychology of everyday things, Importance of human factors in design – cultural , emotional , technological, business, Need Satisfaction curve of technology, Levels of human computer interaction

Unit II	**Foundations of User Interface Design (U.I.D)**

Goals of UID, Goal directed Design, User Interface Models, Understanding and Conceptualizing Interface, Psychology of users designing for collaboration and communication, Process of Interaction Design, Standards & Guidelines, Usability Testing, GIU,

Unit III	**Human Factors**

The importance of User Interface – UI and Software Designer – Goals of UI design – Motivations for human factors in Design – Understanding user needs and requirements

Unit IV	**Models**
Theories – Different models - Object - Action Interface Model - Principles for Design – Data display and entry guidelines. Case Study to be taken with latest application	
Unit V	**Design Process**
User Interface Design Process – Classes of UI design – Principles of good design – Evaluating design using the principles – Choice of color – Task oriented approach for UI - Case study. GUI design process - Design of icons – Use of metaphors – GUI style guides and toolkits – Portability – GUI design and object oriented approach – Case study.	
Unit VI	**Usability**
The viewpoint of user, customer and designer –Usability specification – Description of stages in usability specification and evaluation. Case Study to be taken with latest application, Information Related: Information Search and Visualization – Hypermedia and WWW. HCI Standards: ECMA – ISO – BSI guide.	

Reference Books

1. Linda Mcaulay, "HCI for Software Designers", International Thompson Computer Press, USA,1998.
2. Ben Schneiderman, "Designing the User Interface", Pearson Education, New Delhi,2005.
3. Alan Cooper, "The Essentials of User Interface Design", IDG Books, New Delhi,1995.
4. Jacob Nielsen, "Usability Engineering", Academic Press, 1993.

Course Coordinator

BoS Member

BoS Chairman

Department of Computer Engineering

Program Elective V

Social Media Analysis (CSPA12205A)

Teaching Scheme
Credits : 3
Lectures : 3Hrs/week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisites

- Databases
- Statistics

Course Objectives

- To understand social network and its usage
- To model and visualize the social network
- To mine users interest in the social network

Course Outcomes

After completion of the course, students will be able to

1. Understand the interest of user based on his usage in social media
2. Understand the model and methods of Social networking
3. Predict the possible next outcome of the social network
4. Assess social networking opportunities for marketing
5. Understand the link between qualitative and quantitative methods of social network analysis
6. Understand how social technologies impact society and vice versa

Unit I	**Introduction**

Introduction to Web ,Emergence of the Social Web – Statistical Properties of Social Networks - Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities ,Web-based networks

Unit II	**Graphs and Network relation**

Introduction to networks and relations. Introduction to graph .graph representations, analyzing relationships to understand people and groups, binary and valued relationships, symmetric and asymmetric relationships, multimode relationships, Using graph theory for social networks analysis adjacency matrices, edge lists, adjacency lists, graph traversals and distances, depth first traversal, breadth first traversal paths and walks, Dijkstra's algorithm, graph distance and graph diameter,
social networks vs. link analysis, ego centric and socio centric density

Unit III	**Methods and Models**

core methods: The Kernighan-Lin(KL) algorithm, Agglomerative/Divisive Algorithms, Spectral Algorithms, Emerging trends: Community Discovery in Dynamic Networks, Community Discovery in heterogeneous Network

Unit IV	**Applications and emerging trends**

social media networking applications – Accessing applications hosted in a cloud computing, Case study of social networking sites (like Twitter, Facebook, Blog data) analysis ,Behavior Analytics Individual behavior, collective behavior

Unit V	**Text and opinion mining**
Text Mining in Social Networks -Opinion extraction – Sentiment classification and clustering - Temporal sentiment analysis - Irony detection in opinion mining - Wish analysis - Product review mining – Review Classification – Tracking sentiments towards topics over time	
Unit VI	**Emerging Fields and Problems**
Community Discovery in Dynamic Networks , Community Discovery in Heterogeneous Networks , Community Discovery in Directed Networks , Coupling Content and Relationship Information for Community Discovery, Content delivery network features and types	

Reference Books

1. CharuAgarwal, "Social Network Data Analytics",Springer, 11 edition
2. Reza Zafarani, Mohammad Ali Abbasi, and HuanLiu,"Social Media Mining: An Introduction", Cambridge University Press, 2014.
3. MaksimTsvetovatAlexnderKouznetsov, "Social Network Analysis for Startups Finding connections on the social web", O'Reilly Media, 2011.
4. John Scott . "Social Network Analysis", 3rd edition, SAGE Publications, 2012

Course Coordinator

BoS Member

BoS Chairman

Department of Computer Engineering

Program Elective V

Wireless Access Technologies (CSPA12205B)

Teaching Scheme
Credits : 3
Lectures : 3Hrs/week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisites
- Wireless Networks

Course Objectives
- To overview of wireless access technologies, Fixed wireless access networks. Terminalmobility issues regarding wireless access to Internet
- To introduce various Network topologies, hotspot networks, Communication linkspoint-to-point, point-to-multipoint, multipoint-to-multipoint.
- To provide an overview of Standards for most frequently used wireless access networks:WPAN, UWB, WLAN, WMAN, WWAN. Network services. Wireless access network planning, design and installation.
- To get and insight of Wireless networking security issues, Wireless access networkexploitation and management, software requirements, link quality control.

Course Outcomes
After completion of the course, students will be able to
1. Interpret basic terms and characteristics of wireless access networks
2. Compare various wireless access technologies
3. Analyse measurements of wireless access network parameter
4. Apply system thinking to understand the wireless network evolution, requirements, standardization, architecture, air-interface, protocols, procedures, performance and security
5. Assess security issues in wireless networks
6. Choose modulation technique for wireless transmission

Unit I	**Introduction**

Necessity for wireless terminals connectivity and networking. Wirelessnetworking advantages and disadvantages, Overview of wireless accesstechnologies. Narrowband and broadband networks, fixed and nomadicnetworks. Wireless local loop (WLL), Public Switched Telephone Network(PSTN) interfaces.

Unit II	**Fixed Wireless Access (FWA) Networks**

Fixed wireless access (FWA) networks, frequency bands fordifferent networks. Criterions for frequency bands allocation, Networktopologies, hotspot networks. Communication links: point-to-point (PTP), pointto-multipoint (PMP), multipoint-to-multipoint (MTM).

Unit III	**Standards**

Standards for most frequently used wireless access networks: WPAN(802.15, Bluetooth, DECT, IrDA), UWB (Ultra-Wideband), WLAN (802.11,Wi-Fi, HIPERLAN, IrDA), WMAN (802.16, WiMAX, HIPERMAN,HIPERACCESS), WWAN (802.20), Other technologies for broadband wirelessaccess, Local Multipoint Distribution Service (LMDS), Multichannel MultipointDistribution Service (MMDS). Ad Hoc networks, Network services. Servicestypes based on carrier frequency and bandwidth.

Unit IV	**Wireless Access Networks Planning**
Wireless access networks planning, design and installation. Servicesprovision, legislative and technical aspects, Technical and economical factors fornetwork planning: expenses, coverage, link capacity, network complexity andcarrier-to-interference ratio (C/I). Base station or access point allocation. Base station and access point equipment.Terminal mobility issues regarding wireless access to Internet.Wireless networking security issues.	
Unit V	**Example**
Example of laptop or handheld PC wireless connection in real environment. PC wireless interface equipment.Wireless access network exploitation and management, software requirements,link quality control.Business model, wireless network services market, market research andmarketing, service providers, wireless data application service providers(WDASP) and their role on public telecommunication services market, billingsystems.	
Unit VI	**Recent Trends**
Recent trends in wireless networking and various access mechanism,new standards of wireless communication.	

Reference Books

1. Martin P. Clark, "Wireless Access Networks: Fixed Wireless Access and WLL networks – Designand Operation", John Wiley & Sons
2. D. H. Morais, "Fixed Broadband Wireless Communications: Principles and PracticalApplications", Prentice Hall, Upper Saddle River
3. R. Pandya, "Introduction to WLLs: Application and Deployment for Fixed and BroadbandServices", IEEE Press, Piscataway

Course Coordinator

BoS Member

BoS Chairman

Department of Computer Engineering

Program Elective V

Optimization Techniques (CSPA12205C)

Teaching Scheme
Credits : 3
Lectures : 3Hrs/week

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisites

- Linear Algebra and Numerical Methods

Course Objectives

- To provide insight to the mathematical formulation of real worldproblems.
- To optimize these mathematical problems using nature based algorithms. And the solution isuseful specially for NP-Hard problems.

Course Outcomes

After completion of the course, students will be able to

1. Formulate optimization problems.
2. Understand and apply the concept of optimality criteria for various types of optimization problems.
3. Solve various constrained and unconstrained problems in Single variable as well asmultivariable.
4. Apply the methods of optimization in real life situation.
5. Feasibility study for solving an optimization problem
6. Investigate, study, develop, organize and promote innovative solutions for various applications

Unit I	**Engineering application of Optimization**
Engineering application of Optimization, Formulation of design problems asmathematical programming problems.	
Unit II	**General Structure**
General Structure of Optimization Algorithms, Constraints, The FeasibleRegion.	
Unit III	**Branches of Mathematical Programming: Optimization**
Branches of Mathematical Programming: Optimization using calculus,Graphical Optimization, Linear Programming, Quadratic Programming,Integer Programming, Semi Definite Programming.	
Unit IV	**Optimization Algorithms**
Optimization Algorithms like Genetic Optimization, Particle SwarmOptimization, Ant Colony Optimization etc.	
Unit V	**Real life Problems**
Real life Problems and their mathematical formulation as standardprogramming problems.	
Unit VI	**Recent trends**
Applications of ant colony optimization, genetics and linear andquadratic programming in real world applications.	

Reference Books

1.Laurence A. Wolsey (1998). "Integer programming", Wiley. ISBN 978-0-471-28366-9.
2. Andreas Antoniou , "Practical Optimization Algorithms and Engineering Applications".
3. An Introduction to Optimization Edwin K., P. Chong & Stanislaw h. Zak.
4. Dimitris Bertsimas; Robert Weismantel (2005), " Optimization Over Integers. Dynamic Ideas",ISBN 978-0-9759146-2-5.
5. John K. Karlof (2006), "Integer Programming: Theory And Practice", CRC Press. ISBN 978-0-8493-1914-3.

Course Coordinator

BoS Member

BoS Chairman

Open Elective II
Project Planning and Management (IOEP12206A)

Teaching Scheme	Examination scheme
Credits :2	**CIE: NA**
Lectures :2 hrs / week	**ISE: NA**
	SCE: NA
	ESE: NA
	PR/OR/ TW:50

rerequisite: UG level mathematics

Course Objectives:

1. To impart knowledge of project life cycle.
2. To introduce students to Project Identification Process, Project Initiation
3. To understand studies related to Pre-Feasibility Study and Project feasibility Studies.
4. To construct CPM, PERT network for a project.
5. To introduce students to Steps in Risk Management, Risk Identification, Risk Analysis and Reducing Risks
6. To introduce students to process of project Performance Measurement, Evaluation and closeout.

Course Outcomes:

Upon the completion of the course, students will be able to

1. Understand phases of project life cycle
2. Understand the Project Identification Process, Project Initiation.
3. Understand Pre-Feasibility Study and Project feasibility Studies of a project.
4. Construct CPM, PERT network for a project.
5. Understand the concept of Risk Management
6. Understand the process of project Performance Measurement, Evaluation and closeout.

Unit I: Basics of Project Management (PM) (6Hrs)

Introduction, Need, Project Management Knowledge Areas and Processes, Concept of Organizational Structure and types, The Project Life Cycle (preferably with case study), Essentials PM.

Unit–II: Project Identification and Selection (6Hrs)

Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point. Case study is preferred

Unit -III: Project Planning (6Hrs)

Introduction, Need for Project Planning, Work Breakdown Structure (WBS), LOB, CPM and PERT, Network Cost System, Resource Allocation, Scheduling, Project Cost Estimate and Budgets.

Unit -IV: Project Risk Management and Quality Management (6Hrs)

Introduction, Risk, Risk Management, Role of Risk Management in Overall Project Management, Steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks. Introduction to Quality, Quality Concepts, Value, Engineering. Case study is preferred.

Unit V: Project Performance Measurement, Evaluation and closeout (6Hrs)

Introduction, Performance Measurement, Productivity, Project Performance Evaluation, Benefits and Challenges of Performance Measurement and Evaluation, Controlling the Projects. Project Close-out, Steps for Closing the Project, Project Termination, and Project Follow-up. Case study is preferred

Unit VI - Operation Research in Management	**(6Hrs)**
Introduction, Operation Research as tool for Decision Support System, Overview of OR Research Techniques, Formulation of Linear Programming Problem, Linear Programming Models, Assumptions of Linear Programming, Graphical Method and Simplex method for solving LP problem.	

Students are encouraged to register for On-line course in the relevant above course approved by authority.

Text books:

1. Operations Research by Premkumar Gupta and D.S. Hira, S. Chand Publications (2014)
2. Project Management – K Nagrajan – New age International Ltd.
3. Project Management – Ahuja H.N. – John Wiely, New York.

Open Elective
Blockchain Technology(IOEP12206B)

Teaching Scheme	**Examination Scheme**
Credits : 2	**Formative Assessment : 50 Ma**
Lectures : 2 Hrs/week	**Summative Assessment :**

Prerequisits

Knowledge of programming language and
script language

Course Objectives :

- To introduce fundamentals of Blockchain
- To explain Bitcoin Blockchain
- To explain Ethereum Architecture & Components
- To discuss Emerging Trends in Blockchain and Use cases

Course Outcomes:

After completion of the course, student will be able to

1. Explain fundamental knowledge of Blockchain (Understand)
2. Illustrate Bitcoin Blockchain (Understand)
3. Summarise Ethereum Architecture & Components (Understand)
4. Explore emerging trends in Blockchain and Use cases (Understand)

Unit I :	**Overview of Blockchain**

Introduction to Blockchain, History of Blockchain, Network and protocols, Smart Contract and Consensus Algorithms, Blockchain users and adoption, Blockchain challenges

Unit II :	**Bitcoin Blockchain**
Blockchain TOC Bitcoin/Blockchain data structures, Keys as Identity, Digital Signatures, Hashes, Hashes as Addresses, Hash Pointers and Data Structures, Blockchain transactions, Blockchain block structure	
Unit III :	**Ethereum Architecture & Components**
Evolution of Ethereum, Ethereum Components, Ethereum Virtual Machine, Types of Transactions, Solidity language, Ethereum Smart Contracts, Tokenization, Dapps.	
Unit IV :	**Emerging Trends in Blockchain and Use cases**
Introduction of Hyperledger, Corda, Ripple, R3. Blockchain and cloud computing, Blockchain and Artificial Intelligence, Blockchain use cases in Health Care, Banking, Government Sector, Supply Chain Management, Identity Management, etc.	

Text Books :

1. Mastering Bitcoin: Unlocking Digital Crypto currencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa, O'Reilly
3. Mastering Ethereum Building Smart Contracts and DApps, Andreas M. Antonopoulos, Gavin Wood, O'Reilly
4. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric

- **Reference Books :**

1. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits
2. Etherium Yellow Paper : "Ethereum: A Secure Decentralised Generalised Transaction Ledger Petersburg", Dr. Gavin Wood

Open Elective II

Data Science for Engineers (IOEP12206C)

Teaching Scheme
Credits : 2
Lectures : 2 Hrs/week

Examination Scheme
TW/OR: 50 Marks

Prerequisite: 10 hrs of pre-course material will be provided.

Course Objectives:

- Introduce the mathematical foundation.
- Introduce data science algorithms and data analytics.
- Introduce a practical capstone case study.

Course Outcomes:

At the end of the course, students will be able to:

1. Describe a flow process for data science problems.
2. Classify data science problems.
3. Correlate results to the solutions.
4. Construct use cases to validate approach.

Unit I : Linear Algebra Basics

Linear algebra for data science, Algebraic view - vectors, matrices, product of matrix & vector, rank, null space, solution of over-determined set of equations and pseudo-inverse), Geometric view - vectors, distance, projections, eigenvalue decomposition.

Unit II : Statistics and Optimization:

Statistics (descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates) and Optimization.

Unit III : Linear regression:

Typology of data science problems and a solution framework, Simple linear regression and verifying assumptions used in linear regression, Multivariate linear regression, model assessment, assessing importance of different variables, subset selection.

Unit IV : Classification techniques

Classification using logistic regression, Classification using kNN and k-means clustering.

Text Books :

1. Gilbert Strang, "Introduction to Linear Algebra," 2nd Ed., Wellesley-Cambridge Press.

Reference Books :

1. Douglas Montgomery and George Runger "Applied Statistic and Probability for engineers," 6th Ed., Wiley.

Department of Computer Engineering

Intellectual Property Rights (CSPA2207)

Teaching Scheme	**Examination Scheme**						
Credits: 2 Lecture (L): 2 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	NA	NA	NA	NA	NA	50	50

Prerequisite: NA

Course Objectives: The course will help students

- Explain the importance of ideas, concept and creativity
- Transfer the knowledge about the IPR required for Engineer's
- Describe the how IPR creates National wealth
- Teach National and International IP System

Course Outcomes: By the end of the course, students will be able to

1. Explain property and Intellectual property their nature, importance and objectives. (Understand)
2. Discuss types of IPR: Patents, Designs, Trademarks (Registered and unregistered trademarks),Copyright, Traditional Knowledge, Geographical Indications, Trade Secrets, Idea Patenting
3. Understand the process of patenting, development and International scenario: WIPO, TRIPs
4. Explain administration of patent system.

Unit I: Introduction to the concepts Property and Intellectual Property (6 Hrs.)

Introduction to the concepts Property and Intellectual Property, Nature and Importance of Intellectual Property Rights, Objectives of understanding Intellectual Property Rights, IPR and IITs

Unit II: Intellectual Property Rights (6 Hrs.)

Understanding the types of Intellectual Property: - Patents, Designs, Trademarks (Registered and unregistered trademarks), Copyright, Traditional Knowledge, Geographical Indications, Trade Secrets, Idea Patenting, (Case Studies)

Unit III: New Developments in IPR (6 Hrs.)

New Developments in IPR, Process of Patenting and Development: technological research, innovation, patenting, development, understanding of IPR issues in cyber world, International Scenario: WIPO, TRIPs, Indian Patent Office

Unit IV: Administration of Patent System **(6 Hrs.)**
Administration of Patent System – Patenting under Indian Patent Act, Patenting under PCT, Patent Rightsand its Scope, Licensing and transfer of technology, Patent information and database. Provisional and Non-Provisional Patent Application and Specification.
Term work:
Text books:
1. Resisting Intellectual Property by Halbert, Taylor & Francis Ltd ,2007 **2.** Industrial Design by Mayall, Mc Graw Hill **3.** Intellectual Property in New Technological Age by Robert P. Merges, Peter S. Menell, Mark A. Lemley
Reference books:
1. Intellectual Property Rights under WTO by T. Ramappa, S. Chand Introduction to Design by Asimov, Prentice Hall

Department of Computer Engineering

Laboratory III (CSPA12185)

Teaching Scheme
Credits : 2
Practical:4Hrs/week
Oral : 50 Marks

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Course Objectives

- To criticallyevaluate data visualizations based on their design and use for communicating stories from data
- To produce code to statistically analyze a dataset using tools like Python and R
- To learn IoT concepts and technologies
- To Understand State of the Art – IoT Architecture
- To study IoT protocol stacks and Real World IoT Design Constraints

Course Outcomes

After Completion of the course, students will be able to

1. Create effective visualization of given data
2. Use the tools and technology like Hadoop, Python and R.
3. Identify common approaches used for Feature Generation and Selection
4. Understand the core principles behind CPSs and develop models and controls
5. Identify safety specifications and critical properties of CPSs
6. Understand abstraction and system architectures and learn how to design by invariant

General Instructions

- Design and implementation should be done using latest 64-bit C++/JAVA/ Python/R/QT 5.1 and above, Cuda C++ or such latest 64-bit programming tools.
- Development Tools such as MATLAB/OPENCV/OPENMP/NS3 or equivalent may be used if required to interface the developed classes to the simulators.
- Student can refer UCI datasets/Routers data sets or other benchmark datasets to implement the assignments, whenever is required.

List of Experiments

A. Data Sciences

1.Design and implement the distributed architecture for the Hadoop or similar recent architecture Prepare architecture diagram and installation document to be used for distributed Application

2. Build a Database for a client server application using NoSQL . Perform various queries on it. (Build ERP/Digital Library/On line shopping /on line Examination or similar kind of system)

3. Using ETL tool (Pentaho or any other similar tool) design a multidimensional data ware house for a hypothetical system. Use Standard datasets to build the DWH system

4. Design and implement a Business Intelligent system based on Big data analytics. Compare and Analyze your result using standard Data set.

5. Study and implement two journal (IEEE Transactions/ACM /Elsevier/Springer) papers published in the current year based on Data Sciencedomain

B. Cyber Physical System

1. a. Study of Connectivity and configuration of Raspberry-Pi /Beagle board circuit with basic peripherals, LEDS. Understanding GPIO and its use in program.

   b. Understanding the connectivity of Raspberry-Pi /Beagle board circuit with temperature sensor. Write an application to read the environment temperature. If temperature crosses a threshold value, the application indicated user using LEDSs

2. Study of different CPU frequency governors. Write an application to change CPU frequency of Raspberry-Pi /Beagle board

3. Write an application using Raspberry-Pi /Beagle board to control the operation of stepper motor.

4. Write an application using Raspberry-Pi /Beagle board to control the operation of a hardware simulated traffic signal.

5.Write an application using Raspberry-Pi /Beagle board to control the operation of a hardware simulated lift elevator

6.Study and implement one journal (IEEE Transactions/ACM /Elsevier/Springer) papers published in the current year based on Cyber Physical Systemdomain

C. Deep Learning

1. implement convolution neural network on bird and aero plane database

2. Implement recurrent neural network using python

Course Coordinator

BoS Member

BoS Chairman