DEPARTMENT OF ADVANCED STUDIES AND RESEARCH
JIS UNIVERSITY

Department of Advanced Studies and Research, JIS University

2 Years M. Tech in Computer Science and Engineering (with specialization in Data Science)
Session 2019-2020

1st Semester

Sl. No.		Subject Code	Subject Name	Class Load/Week			Credit
				L	T	P	
1	Core Courses	PDS1001	Probability and Statistics	3	0	0	3
2		PDS1002	Pattern Recognition and Machine Learning	3	0	0	3
3		PDS1003	Database Management System	3	0	0	3
4		PDS1004	IoT and Cloud Computing	3	0	0	3
5	CBCS	PBB1007	Offered by other centres / departments / MOOC Courses	3	1	0	4
6	Labs	PDS1101	Programming and Data Structure Lab	0	0	3	3
7		PDS1102	Machine Learning Lab	0	0	3	2
Total Credits							**21**

2nd Semester

Sl. No.		Subject Code	Subject Name	Class Load/Week			Credit
				L	T	P	
1	Core Courses	PDS2001	Big Data Analytics	3	0	0	3
2		PDS2002	Advanced Machine Learning	3	0	0	3
3		PDS2003	Blockchain Technology and Applications	3	0	0	3
4		PDS2004	Elective 1	3	0	0	3
6	CBCS	PBB2007	Offered by other centres / departments / MOOC Courses	3	1	0	4
7	Labs	PDS2101	Big Data Analytics Lab	0	0	3	2
8		PDS2102	Advanced Machine Learning Lab	0	0	3	2
9		PDS2103	IoT and Cloud Computing Lab	0	0	3	2
Total Credits							**22**

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Internship (during Semester Break) in Industry / Academic Institutions.

3rd Semester

Sl. No.		Subject Code	Subject Name	Class Load/Week			Credit
				L	T	P	
1	Core Courses	PDS3101	Data Visualization	3	0	0	3
2		PDS3102	Elective-2	3	0	0	3
3	Sessional	PDS3201	Thesis Part-I with Seminar	-	-	-	14
4		PDS3202	Internship Project with Seminar	-	-	-	4
			Total Credits				**24**

4th Semester

Sl. No.	Subject Code	Subject Name	Class Load/Week			Credit
			L	T	P	
1.	PDS4201	Thesis Part-II with Seminar and Viva-Voce	-	-	-	24
		Total Credits				**24**

Elective 1	Elective 2
Business Analytics	Information & System Security
Data Security	Social and Web Media Analytics
Advanced Web Technology	Natural Language Processing
Optimization Techniques	Speech and Signal Processing
Biostatistics and Medical Analytics	Applied Statistics

Total Credits = [21+22+24+24] = 91

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2 Years M.Tech in Computer Science and Engineering (with specialization in Data Science)

Detailed Course Syllabus ||

Semester 1

Probability and Statistics

Course Outcomes:
CO1: Students will be able to understand descriptive statistics
CO2: Understand Probability
CO3: Identifying analytical models
CO4: Apply and implementation of Basic concepts of Stochastic processes

Probability: Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem and independence.

Random Variables: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, probability and moment generating function, median and quantiles.

Special Distributions: Discrete uniform, binomial, geometric, hypergeometric, Poisson, continuous uniform, exponential, gamma, Pareto, normal, lognormal, Cauchy.

Joint Distributions: Joint, marginal and conditional distributions, product moments, correlation and regression, independence of random variables, bivariate normal distribution.

Transformations: functions of random vectors, distributions of sums of random variables.

Sampling Distributions: The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions.

Descriptive Statistics: Graphical representation, measures of locations and variability.

Estimation: Unbiasedness, consistency, the method of moments, maximum likelihood estimation, confidence intervals for parameters in one sample, two sample problems of normal populations, confidence intervals for proportions.

Testing of Hypotheses: Null and alternative hypotheses, the critical and acceptance regions, two types of error, power of the test, tests for one sample and two sample problems for normal populations, tests for proportions, Chisquare goodness of fit test and its applications.

Introduction to stochastic process and Markov Random Process

Books & References:

- Fundamentals of Statistics: Gun Gupta and DasGupta
- Outline of Statistical Theory: Gun Gupta and DasGupta
- Douglas C Montgomery et al., Introduction to Linear Regression Analysis, Wiley, 2016.
- Statistical Hypothesis Testing: Casella and Berger

Pattern Recognition and Machine Learning

Course Outcomes:

CO1: Students will be able to understand pattern recognition

CO2: Understand parametric and non-parametric techniques

CO3: Identify graphical models

CO4: Apply and implement Machine Intelligence

Introduction to Pattern Recognition: Different Paradigms of Pattern Recognition, Representations of Patterns and Classes, Metric and non-metric proximity measures, Feature Extraction, Feature Selection. Principal Component Analysis and Dimensionality Reduction.

Tree Classifiers: (a) Decision Trees: CART, C4.5, ID3. (b) Random Forests.

Supervised Methods: Bayesian Decision Theory, Discriminant Classifiers: Decision Boundary, Support Vector Machines

Unsupervised Methods: (a) Fisher Linear Discriminant and Locally Linear Embedding, (b) Clustering - K-Means, Expectation Maximization and Mean Shift, Density-based, Hierarchical.

Parametric Techniques: (a) Maximum Likelihood Estimation (b) Bayesian Parameter Estimation (c) Sufficient Statistics.

Non-Parametric Techniques: (a) Kernel Density Estimators (b) Nearest Neighbour Methods.

Classifier Ensembles: (a) Bagging (b) Boosting / AdaBoost

Graphical Models: (a) Introductory ideas and relation (b) Bayesian Networks (c) Sequential Models - State-Space Models, Hidden Markov Models and Dynamic Bayesian Networks.

Introduction to Machine Intelligence, Problem Space Representation, Heuristic Search Techniques, Knowledge Representation, Predicate Logic, Reasoning under uncertainty, Statistical Reasoning, Planning, Learning, Expert System Design, Expert System Shell, Case Studies.

Books & References:

- C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
- R. O. Duda, P. E. Hart, and D. G. Stork. Pattern Classification. Wiley, 2001.
- S. Haykin. Neural Networks: A Comprehensive Foundation. Prentice-Hall of India, New Delhi, 2007.

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Database Management System

Course Outcomes:

CO1: Students will be able to understand database management

CO2: Understand relational database design

CO3: Identify database connection through java/python/PHP

CO4: Apply concurrency control and recovery

Introduction to database management, data abstraction and system structure.

Entity relational model, entity set, relationship sets, mapping cardinalities, keys, E-R diagrams.

Relational model, database schema, relational algebra, outer join and manipulation of databases.

Tuple relational calculus: Example queries, formal definitions; SQL: Query processing and optimization, set operations, aggregate functions, data definition language and views, comparison of queries in relational algebra, SQL, tuple relation calculus.

Relational database design, various normal forms, functional dependencies, canonical cover, lossless join, dependency preservation, multi-valued dependency and higher normal forms; Object relational databases; Object oriented models and relations – generalization, specialization, aggregation; Functions and polymorphism; Object oriented SQL; Commercial object relational database systems – MySQL, Oracle, IBMDB2.

Concurrency control and recovery: Transactions management and ACID property.

Object Relational Databases, XML/ Semi Structured and NoSQL databases.

Serializability and testing for serializability, concurrency control schemes, lock-based protocols, two-phase locking protocols, graph-based protocols, time stamp-based protocols, deadlocks.

Recovery systems, log-based recovery, deferred and immediate database modification, object oriented database design.

Books & References:

- A Silberschatz, H Korth and S Sudarshan, Database System Concepts, 6th Ed., McGraw-Hill, 2010.
- R Elmasri, S Navathe, Fundamentals of Database Systems, 6th edition, Addison-Wesley, 2010.
- H Garcia-Molina, JD Ullman and Widom, Database Systems: The Complete Book,2nd Ed., Prentice-Hall, 2008.

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IoT and Cloud Computing

Course Outcomes:

CO1: Students will be able to understand IOT

CO2: Understand Sensors and Sensor Networks

CO3: Identify RPI Hardware

CO4: Apply Cloud interfacing with IoT Devices

Module 1: Introduction to IoT:
History of IoT, Components of IoT, Impact and benefits of IoT, Basics of networking, TCP/IP protocol, IPv4, Basics of IPv6, Addressing schemes, Resolving drawbacks of existing addressing schemes

Module 2: Sensors and Sensor Networks:
Introduction to Sensors, Different types of sensors, actuators, transducers,Sensors and Actuator Internals: Temperature, Pressure and Relative Humidity Sensor, Soil Humidity Sensor, Gas Sensor, PIR Sensors, Proximity Sensors, etc. Parameters of sensors, Classification of sensors, Errors in sensors Wireless Sensor Network (WSN): Introduction, Design, Properties of WSNs, Issues in deploying a WSN, Connectivity technologies in WSNs (e.g., Bluetooth), Benefits and limitations of Bluetooth technology, Sensor nodes, Communication challenges between sensor nodes (Issues related to selfish nodes, dumb nodes, etc.), Energy management, Security challenges.

Module 3: Introduction to IoT Devices:
RPI Hardware Details: PIN OUT Diagram, GPIO Internal Circuitry, Alternate function pin circuitry, Detailed Hardware Specs of RPI. Arduino UNO Hardware Details: ATmega 328P, Digital I/O Pins, PWM Digital I/O Pins, Analog Input Pin, DC, Current Input Pin, SRAM, EEPROM. Node MCU firmware with ESP8266 Development Kit: ESP 8266 wifi Module with TCP/IP Protocol, Auduino IDE for ESP8266. Interfacing with ESP8266.
Raspberry Pi Setup and Administration: OS LOADING, Post boot configuration, SSH Configuration, Serial Console on Rpi, Wiring Pi,I2c,SPI setup, DHCP server and DHCP client configuration, Wi- Fi Configuration, IP Configuration, Port Forwarding On RPi

Module 4: Realization of IoT Systems Raspberry Pi (RPi):
RPi Interfacing and Programming: GPIO IN/OUT, GPIO PULL HIGH/LOW, Peer to peer connection using FTP protocol, HTTP SERVER in python, Cronjob, MQTT Publisher Program, MQTT Broker, MQTT Subscriber, HTTP server, HTTP Client, RPi ADC Programming, Actuator On/Off and Sensor Reading Monitoring in HTTP server, Analog output control with RPi, GSM Modem, SPI interfacing, I2C interfacing, Touch screen Interfacing, Bluetooth Communication RPi, RPi Interrupts, RPi to RPi communication BT/Ethernet/Wi-Fi/RS232,Camera handling using RPi, FR using RPi.

Module 5: Introduction to Cloud Computing
Definition and Essential Characteristics of Cloud Computing, History and Evolution of Cloud Computing, Key Considerations for Cloud Computing, Key Cloud Service Providers and Their Services, Cloud Adoption - Necessity, Cloud Adoption - Some case studies, Virtual Machine, Cloud Infrastructure, Cloud Networks, Cloud Security, Risks and vulnerabilities of Cloud Computing.

Module 6: Cloud interfacing with IoT Devices
IoT cloud Interfacing, communication and Simulations: Blynk (IoT platform with free Cloud, Android mobile apps)

Rapberry Pi – Azure IoT Simulations (using ECS-6), IoT solutions with Microsoft Azure, Arduino-MQTT - Microsoft Azure, DHT11 sensor data to IoT Hub using Node MCU.

Books & References:

- Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012.
- Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014

- Francis da Costa, “Rethinking the Internet of Things: A Scalable Approach to ConnectingEverything”, 1st Edition, Apress Publications, 2013
- Cuno P Fister, Getting Started with the Internet of Things, O‟Reilly Media, 2011, ISBN: 978-1- 4493-9357-1
- Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach” McGraw-Hill Osborne Media; 1st edition [ISBN: 0071626948], 2009.
- Dimitris N. Chorafas, “Cloud Computing Strategies” CRC Press; 1st edition [ISBN: 1439834539],2010.

Programming and Data Structure Lab

Course Outcomes:

CO1: Students will be able to understand Python
CO2: Understand Panadas
CO3: Identify Data visualization in python using Matplotlib
CO4: Apply and implement Capstone project Python:

Module: 1. Introduction to the cPython distribution, Deassembled python compiled file using disc library, python object reference and introduction to GC., Simple debugging technique using jupytor environment.

Module: 2. Operator, Constant and variables in python, DataTypes, Statements, Iterator, Looping, Generator, Functions, Lists, Dictionaries

Module: 3. Decorator, Magic methods, List apprehension, Lambda function.

Module: 4. OOP's in Python

Module: 5. Exception handing, Multi-threading, serialization

Module: 6. NumPy Standard data types, The Basics of NumPy Arrays, Array Attributes, Array indexing, Array Slicing: accessing sub array, Reshaping Of Arrays, Concatenation & Splitting of Array, Computation on NumPy arrays, Universal Functions (optional), Aggregations (Summing the values, min, max), Array Broadcasting (optional), Comparisons, masks, Boolean logic, NumPy Sorting (ex. np.sort, np.argsort), Structured Arrays, Creation of structured arrays, Record Arrays.

Module: 7. Panadas: Introducing Pandas Objects, Pandas Series Object, Pandas Data Frame Object, Pandas Index Object, Data operations in Panda, Data Selection in Series, Data Selections in DataFrame, Handling Missing Data, Combining Dataset (pd.concat,pd.appened), merge and join, Aggregating and Grouping (GroupBy: Split, Apply, Combine), Pandas String, Pandas Time Series.

Module: 8. Advanced DtatFrame Methods

Module: 9. Data visualization in python using Matplotlib: Display Plots, Histograms, Binnings, and Density, 3D ploting

Module: 10. Introduction to sklearn.

Hands-on (assignment)

1. Indexing & slicing with shorthand's notation. Formatted and f'-string, sprint formatting in console output.

2. Design and implementation of function in Python that takes variable arguments and Implementation of Iterator in Python, Implementation of customize Generator using Python

3. Design and implementation of method overloading using weakly typed (implicit) design. lambda Map Filter with console input.

4. Creation of Packages and Sub Packages using Python. Regular Expression use cases in Python

5. IO and Exception Handling using Python Design and implementation of Multithreading application using Python. implementation of Decorator Pattern using Python

6. Read write update .csv,.txt,.html,.xml connectivity to DB engine using Pandas.

Capstone project:

1. Data Exploration, Feature Engineering, Predictive modeling using linear regression algorithm (using Scikit-Learn,Numpy, Panadas,Matplot Library) on available EcommerceCustomer dataset of Kaggle repository

2. Data Exploration,Feature Engineering ,Predictive modeling using KNN algorithm (using Scikit-Learn, Pandas , Numpy, Matplot Library) on available EcommerceCustomer dataset of Kaggle repository

3. Data Exploration,Feature Engineering ,Predictive modeling using Logistic Regression algorithm (using Scikit-Learn, Pandas , Numpy, Matplot Library) on available Titanic dataset of Kaggle repository

Books & References:

- Dive into Python, Mike
- Learning Python, 4th Edition by Mark Lutz
- Programming Python, 4th Edition by Mark Lutz
- Introduction to Machine Learning with Python: A Guide for Data Scientists by Andreas C. Müller, Sarah Guido

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Machine Learning Lab

Course Outcomes:

CO1: Students will be able to understand implementation of polynomial curve fitting

CO2: Understand gradient descent optimization

CO3: Identify SVMs for regression

CO4: Apply and implement Radial Basis Function in ANN

Implementation of Polynomial Curve Fitting

Implementation Bayesian curve fitting

The Curse of Dimensionality using Python

Implementation of Nearest-neighbour methods

Bayesian Linear Regression implementation

Implementation of the perceptron algorithm

Gradient descent optimization

Implementation of Diagonal approximation

Implementation of Bayesian Neural Network

Implementation of Radial Basis Function in ANN.

Implementation of Logistic Regression

SVMs for regression

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Detailed Course Syllabus || Semester 2

Big Data Analytics

Course Outcomes:

CO1: Students will be able to understand big data and Hadoop

CO2: Understand Apache Spark basics

CO3: Identify partitioning and shuffling

CO4: Apply and implement Data to Cluster

Module: 1. Introduction to Big Data: Polyglot Persistence, Gravity of 3V, NAS-SAN, Code to Data paradigm, Why Sharding is hard? Distributed challenges, Replication strategies.

Module: 2. Apache Hadoop: Hadoop overview and History, Overview of Hadoop, Ecosystem, Hadoop's core – GFS, HDFS and MapReduce.

Module: 3. Apache Spark: Spark First Principles, DataFrames, Spark Types and Datasets, Spark SQL, RDDs. Introduction to SCALA.

Module: 4. Resource Management: YARN, Zookeeper

Module: 5. Relational data stores with Hadoop: using Apache Hive.

Module: 6. Non-Relational data stores with Hadoop: Why NoSQL? Cassandra, Mongo DB.

Module: 7 (optional). Querying Data Interactively: Presto.

Module: 8. Data to Cluster: Apache Kafka- Setting up and publishing web logs, Apache Flume – Setting up and publishing logs.

Module: 9. Data Streams: Apache Spark Streaming.

Books & References:

- Tom White, Hadoop: The Definitive Guide. Fourth Edition (2015). O'Reilly Publishers.
- J.Lin, Ch. Dyer, Data-Intensive Text Processing with MapReduce. Morgan and Claypool Publishers, 2010.

- Edward Capriolo, Dean Wampler, Jason Rutherglen, Programming Hive: Data Warehouse and Query Language for Hadoop. First Edition (2012), O'Reilly Publishers.
- Lars George, HBase: The Definitive Guide-Random Access to your Planet-Sized Data. First Edition (2011). O'Reilly Publishers.

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Advanced Machine Learning

Course Outcomes:

CO1: Students will be able to understand preliminaries of deep neural learning

CO2: Understand convolutional networks

CO3: Identify Recurrent Neural Network

CO4: Apply and implement parallel and distributed deep learning

Module 1: Deep Neural Network
Introduction to Deep Learning:
A brief overview of supervised, unsupervised, reinforcement learning, Difference between classifications, regression, Traditional classifiers
Multilayer Perceptron:
Feed-Forward Neural Network with Backpropagation
Different activation functions their advantages and disadvantages:
Sigmoid (vanishing gradient problem), ReLU (exploding gradient problem), Leaky ReLU, tanh, etc.
Various loss and cost functions: MSE, log-loss, cross-entropy, hinge loss, etc.
Bias vs Variance trade-off, Regularization: L2 regularization, early stopping, data augmentation, Ensembling, Dropout, etc. Optimization: Gradient Descent (GD), Batch GD, Stochastic GD, Minibatch GD, GD with momentum, Adagrad, RMSprop, Adam, etc.

Module 2: Convolutional Neural Network
Introduction to Convolution Neural Network (CNN),
Different operations of CNN (convolution, pooling),
Different concepts of CNN (Kernel, Filter, Padding, Stride)
Different CNN architecture (LeNet, AlexNet, VGG Net, GoogLeNet, SqueezeNet, Xception net, Residual block and ResNet, Dense Net, etc.)
Transfer Learning, Similarity learning, Siamese Net, Triplet Net

Module 3: Recurrent Neural Network
Introduction to sequential learning (Recurrent Neural Network: RNN),
Backpropagation through time. Different RNN architectures: Gated Recurrent Unit (GRU), LSTM, Bi-directional LSTM, Deep RNN

Module 4: Advanced Topics on Deep Learning
Autoencoder: Denoising autoencoder, Sparse autoencoder, Variational autoencoders, etc.
Generative Adversarial Network (GAN) and some of its variants, e.g., DCGAN, CycleGAN

Module 5: Applications of Deep Learning
Application of Deep Learning (DL) in Computer Vision:
Object Segmentation: U-Net, V-Net
Object Detection: RCNN, YOLO, etc.
Application of DL in Natural Language Processing (NLP): e.g., Sentiment Analysis from reviews

Module 6: Reinforcement Learning
Introduction to Reinforcement Learning, Deep Q-learning

Books & References:

- Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.
- Aston Zhang et al., Dive into Deep Learning, https://d2l.ai/, 2020.
- S. Haykin. Neural networks: A comprehensive foundation. Prentice-Hall of India, New Delhi, 2007.
- R. S. Sutton and A. G. Barto, Reinforcement Learning: An Introduction, MIT Press, 2018.

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Blockchain Technology and its Applications

Course Outcomes:

CO1: Students will be able to understand Blockchain Technology and its Importance

CO2: Understand Basic Crypto Primitives

CO3: Identify Elements of a Blockchain

CO4: Apply and implement blockchain

Module 1: Introduction to Blockchain Technology and its Importance:
What is Blockchain, The Model of Distributed Systems for Decentralization, Cryptographic Primitives – I, Cryptographic Primitives – II, Cryptographic Primitives – III, Crypto Primitives I – Cryptographic Hash**,** Cryptographic Primitives – IV, Cryptographic Primitives – V, The Evolution of Cryptocurrencie, Open Consensus and Bitcoins

Basic Crypto Primitives II – Digital Signature
Bitcoin Mining and Beyond, Smart Contracts and the Permissioned Models of Blockchain, Blockchain Elements – I, Blockchain Elements – II, Blockchain Elements – III, Blockchain Elements – IV, Blockchain Elements – V, Permissionless Model and Open Consensus,Nakamoto Consensus (Proof of Work), Limitations of PoW: Forking and Security

Module 2: Elements of a Blockchain:

Beyond PoW, Ethereum 1, Ethereum 2, Ethereum 3, Ethereum4, Blockchain Consensus I – Permissionless Models, Consensus for Permissioned Models, State Machine Replication as Distributed Consensus, Paxos, Paxos: Safety and Liveness, Byzantine Faults, Blockchain Consensus II – Permissioned Models, Byzantine Agreement Protocols, Safety and Liveness of PBFT, Enterprise Blockchains, Hyperledger Fabric 1, Hyperledger Fabric 2

Module 3: Smart Contract Hands-On I and II – Ethereum Smart Contracts (Permissionless Model)

Smart Contract Hands-On I, Hyperledger Fabric 3, Hyperledger Fabric 4,Consensus Scalability, Bitcoin-NG, Collective Signing (CoSi), Smart Contract Hand On II, ByzCoin, Algorand, Identity Management – I, Identity Management – II, Identity Management – III

Module 4: Decentralized Identity Management

Blockchain Interoperability – I, Blockchain Interoperability – II, Blockchain Interoperability – III, Hyperledger Indy I, Hyperledger Indy II,Blockchain Interoperability, Hyperledger Aries,Blockchain Security – I,Blockchain Security – II, Blockchain Security – III, Use Cases

Module 5: Blockchain Applications

A Potential Use Case: From a Critics Perspective, Blockchain in Financial Services, Public Sector Use Cases, Blockchain for Decentralized Marketplace (Part 1) Blockchain for Decentralized Marketplace
2) Healthcare Domain
3) Identity Management

Big Data Analytics Lab

Course Outcomes:
CO1: Students will be able to understand big data and Hadoop
CO2: Understand HIVE
CO3: Identify Spark Streaming
CO4: Apply and implement AWS and Spark Streaming

1. Hadoop Configuration and architectural framework of Apache Spark setup with virtualization.

2. Design and deployment of map with key-value tuple to multiple cluster and reduce for multi row dependent functional operations.

3. Statistical analysis of numeric with pivot table using excel sheet.

4. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations (Design/Development of Solutions)

5. Design implementation of HIVE

6. NLP for storing, processing, querying on MongoDB.

7. Data Ingest with Flume for Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

8. Implementation of Spark Streaming; Optimization with Partitioners; Deployment of Wide and Narrow Dependencies; Capstone Project.

9. Performing various operations on AWS or Azure

Advanced Machine Learning Lab

Course Outcomes:
CO1: Students will be able to understand deep network
CO2: Understand convolution neural networks
CO3: Identify recurrent neural network
CO4: Apply and implement deep learning techniques on Computer Vision

Hands-on Deep Networks: Implementing feed-forward and back-propagation, usage of various activation function, understanding overfitting and underfitting issues, training/validation/test data. Regularization, Various Optimization functions, various performance measures and loss functions.

Hands on Convolutional Neural Networks (CNN): implementing of convolutional and pooling layers, usage of padding, filter, stride. Employing transfer learning, Usage of various state-of-the-art architectures, e.g., LeNet-5, VGG, Inception Net, etc.

Hands on Recurrent Neural Networks (RNN): Usage of GRU, LSTM. Understanding backpropagation through time. Implementing various RNNs, e.g., many-to-many, one-to-many, many-to-one, etc.

Hands on advanced topics on deep learning, e.g., Autoencoder, GAN

Various applications of deep learning techniques on Computer Vision, Natural Language Processing.

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IoT and Cloud Computing Lab

Course Outcomes:

CO1: Students will be able to understand Raspberry Pi Setup and Administration

CO2: Understand Platform movement by stepper motor

CO3: Identify GSM Modem

CO4: Apply and implement Implementation of cloud data ingestion service using MQTT

Raspberry Pi Setup and Administration: OS LOADING, Post boot configuration, SSH Configuration, Serial Console on Rpi, Wiring Pi,I2c,SPI setup, DHCP server and DHCP client configuration, Wi- Fi Configuration, IP Configuration, Port Forwarding On RPi

GPIO IN/OUT. GPIO PULL HIGH/LOW. HTTP SERVER in python. Cronjob. MQTT Publisher Program. MQTT Broker. MQTT Subscriber. Netcat Client. Netcat Server. HTTP server. HTTP Client. RPi ADC Programming. RPi ADC Programming with its own designed ADC board via serial port (16F877A IC). RPi sensor Data Aggregating and packet formation. Actuator On/Off and Sensor Reading Monitoring in HTTP server. Camera handling. Face recognition (RPi 4) with OpenCV. Object detection & recognition. Speech recognition. Analog output control with Rpi. Platform movement by stepper motor using RPi. RS232 interfacing & communication. GSM Modem. SPI interfacing. I2C interfacing. Remote Camera fid. GPS Module Interfacing. Touch screen Interfacing. Basics of UI of KIOSK. Rpi Controlled Drone for Agriculture. Rpi controlled robotics. Bluetooth Communication RPI. Ble Beacon Tracking with RPi. Audio Interfacing with RPI with Sound Port. Audio Interfacing with RPi Zero W without sound port. Raspberry Pi Interrupts. Socket Communication. RPi to RPi communication BT/Ethernet/Wi-Fi/RS232.

Implementation of cloud data ingestion service using MQTT. Implementation and customization of cloud data ingestion service using HTTP, basic analysis and visualization after data ingestion. Reverse communication from cloud to IOT device using notification. Capstone Project on IoT to cloud communication and vice-versa.

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Detailed Course Syllabus || Semester 3

Data Visualization

Course Outcomes:

CO1: Students will be able to understand data visualization

CO2: Understand Data Representation

CO3: Identify Univariate scatter plots

CO4: Apply and implement Implementation Graph data visualization; Annotation

Module 1:

Defining data visualization; Visualization workflow: describing data visualization workflow, process in practice

Module 2:

Data Representation: chart types: categorical, hierarchical, relational, temporal & spatial; 2-D: bar charts, Clustered bar charts, dot plots, connected dot plots, pictograms, proportional shape charts, bubble charts, radar charts, polar charts, Range chart, Box-and-whisker plots

Module 3:

Univariate scatter plots, histograms word cloud, pie chart, waffle chart, stacked bar chart, back-to-back bar chart, treemap and all relevant 2-D charts. 3-D: surfaces, contours, hidden surfaces, pm3d coloring, 3D mapping; multi-dimensional data visualization; manifold visualization;

Module 4:

Graph data visualization; Annotation

Texts/References:

Andy Kirk, Data Visualization A Handbook for Data Driven Design, Sage Publications, 2016

Philipp K. Janert, Gnuplot in Action, Understanding Data with Graphs, Manning Publications, 2010.