RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE
SEMESTER: EIGTH (C.B.C.S.)
BRANCH: INFORMATION TECHNOLOGY

Subject : Elective-IV Social Networks **Subject Code : BTIT801T.1**

Load	Credit	Internal Marks	University Marks	Total Marks
03 Hrs	03	30	70	100

Aim : To understand social networks and use of tools for social network analysis.
Prerequisite(s): Discrete Mathematics

Course Objective/Learning Objective:

1	To understand highly interconnected and hence more complex social networks
2	To represent connected social networks in form of graph
3	To apply graph theory, sociology, game theory
4	To use tools and extract statistics from social networks

Course Outcome:
At the end of this course Student are able to:

CO1	Learn social networks , its types and representation
CO2	Understand weak ties, strong and weak relationships , homophily and calculate
CO3	Analyse links
CO4	Understand Power Laws and Rich-Get-Richer Phenomena
CO5	Understand Small World Phenomenon

Week 1: Introduction
Week 2: Handling Real-world Network Datasets
Week 3: Strength of Weak Ties
Week 4: Strong and Weak Relationships (Continued) & Homophily
Week 5: Homophily Continued and +Ve / -Ve Relationships
Week 6: Link Analysis
Week 7: Cascading Behaviour in Networks
Week 8: Link Analysis (Continued)
Week 9: Power Laws and Rich-Get-Richer Phenomena
Week 10: Power law (contd..) and Epidemics
Week 11: Small World Phenomenon
Week 12: Pseudocore (How to go viral on web)

References:

- https://onlinecourses.nptel.ac.in/noc23_cs19/preview
- Networks, Crowds and Markets by David Easley and Jon Kleinberg, Cambridge University Press, 2010
- (available for free download).
- Social and Economic Networks by Matthew O. Jackson, Princeton University Press, 2010.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE
SEMESTER: EIGHT(C.B.C.S.)
BRANCH: INFORMATION TECHNOLOGY

Subject : Elective-VI Reinforcement Learning

Subject Code : BTIT801T.2

Load	Credit	Internal Marks	University Marks	Total Marks
03 Hrs	03	30	70	100

Prerequisite(s): Learnings & Neural Netowrks

Course Objective/Learning Objective:

1	It aims to model the trial-and-error learning process that is needed in many problem situations where explicit instructive signals are not available.
2	It has roots in operations research, behavioral psychology and AI.
3	The goal of the course is to introduce the basic mathematical foundations of reinforcement learning.
4	It highlight some of the recent directions of research

Course Outcome:

At the end of this course Student are able to:

CO1	Understand Bandit algorithm and its mathematical formulation.
CO2	Use dynamic programming for reinforcement learning
CO3	Perform function approximation and apply LSM
CO4	Fit Q, DQN & Policy Gradient for Full RL
CO5	Use combinatorial models for complex problems

Week 1 Introduction
Week 2 Bandit algorithms – UCB, PAC
Week 3 Bandit algorithms –Median Elimination, Policy Gradient
Week 4 Full RL & MDPs
Week 5 Bellman Optimality
Week 6 Dynamic Programming & TD Methods
Week 7 Eligibility Traces
Week 8 Function Approximation
Week 9 Least Squares Methods
Week 10 Fitted Q, DQN & Policy Gradient for Full RL
Week 11 Hierarchical RL
Week 12 POMDPs

References

- https://archive.nptel.ac.in/courses/106/106/106106143/
- R. S. Sutton and A. G. Barto. Reinforcement Learning - An Introduction. MIT Press. 1998.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE
SEMESTER: EIGTH (C.B.C.S.)
BRANCH: INFORMATION TECHNOLOGY

Subject : **GPU Architectures and Programming** **Subject Code :** **BTIT801T.3**

Load	Credit	Total Marks	Internal Marks	University Marks	Total
03 Hrs (Theory)	03	100	30	70	100

Aim : To understand GPU architecture basics in terms of functional units and then dive into the popular CUDA programming model commonly used for GPU programming.
Prerequisite(s): Programming and Data Structure, Digital Logic, Computer architecture

Course Objective/Learning Objective:

1	To introduce basics of conventional CPU architectures, their extensions for single instruction multiple data processing (SIMD)
2	To understand concept in the form of single instruction multiple thread processing (SIMT) as is done in modern GPUs.
3	To teach architecture specific details
4	To introduce different architecture-aware optimization techniques relevant to both CUDA and OpenCL

Course Outcome:
At the end of this course Student are able to:

CO1	Understand conventional CPU architectures, their extensions for single instruction multiple data processing (SIMD)
CO2	Program in CUDA about data space & synchronization
CO3	Apply optimization on kernals, thtreads etc
CO4	Learn basics of OpenCL
CO5	Design an application using neural networks

Week 1: Review of Traditional Computer Architecture – Basic five stage RISC Pipeline, Cache Memory, Register File, SIMD instructions
Week 2: GPU architectures - Streaming Multi Processors, Cache Hierarchy, The Graphics Pipeline
Week 3: Introduction to CUDA programming
Week 4: Multi-dimensional mapping of dataspace, Synchronization
Week 5: Warp Scheduling, Divergence
Week 6: Memory Access Coalescing
Week 7: Optimization examples : optimizing Reduction Kernels

Week 8: Optimization examples : Kernel Fusion, Thread and Block Coarsening
Week 9: OpenCL basics
Week 10: CPU GPU Program Partitioning
Week 11: Application Design : Efficient Neural Network Training/Inferencing
Week 12: Application Design : Efficient Neural Network Training/Inferencing,cont'd

References:

- https://onlinecourses.nptel.ac.in/noc23_cs61/preview
- “Computer Architecture -- A Quantitative Approach” - John L.Hennessy and David A. Patterson
"Programming Massively Parallel Processors" - David Kirk and Wen-mei Hwu
- Heterogeneous Computing with OpenCL” -- Benedict Gaster,Lee Howes, David R. Kaeli

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE
SEMESTER: EIGTH (C.B.C.S.)
BRANCH: INFORMATION TECHNOLOGY

Program Elective-VII

Subject : **Predictive Analytics - Regression and Classification** **Subject Code :** **BTIT802 T.1**

Load	Credit	Total Marks	Internal Marks	University Marks	Total
03 Hrs (Theory)	03	100	30	70	100

Aim : To The course will provide an overview of fundamental ideas in statistical **predictive** models.
Prerequisite(s): Probability and Statistics

Course Objective/Learning Objective:

1	The course will provide an overview of fundamental ideas in statistical predictive models
2	. The objective is to understand how statistical models handle prediction problems.
3	The stress will be on understanding the construction of the models and implementation.
4	It is a core course if students aspire to be Data Scientists.

Course Outcome:
At the end of this course Student are able to:

CO1	To understand predictive models, LSM, Normal equations and GMT
CO2	Understand regression models and infer its statistical inference
CO3	Check model assumptions and bias variance tradeoff.
CO4	Perform regression analysis in various programming languages
CO5	Apply regression models and classification for predictive analysis

Week 1:
- Landscape of the predictive models.
- Least Squares method

Week 2:
- Normal Equations:
- Gauss Markov theorem

Week 3:
- The geometry of Regression Model and Feature Engineering
- Statistical Inference of Regression Coefficient

Week 4:
- Checking Model Assumptions
- Model Comparison with R-squared, RMSE, AIC or BIC

Week 5:
- Model Complexity and Bias-Variance tradeoff
- Feature selection and Dimension Reduction

Week 6:
- Multicollinearity and Variance Inflation Factor
- Regularization with LASSO, Ridge and Elastic Net
- Ridge Regression with Python

Week 7:
- Regression Analysis with Python
- Regression Analysis with R
- Regression Analysis with Julia

Week 8: Major Applications of Regression Models
- Capital Asset Pricing Model
- Bootstrap Regression
- Time Series Forecasting with Regression Model
- Granger Causal model.

Week 9:
- Logistic Regression
- MLE of coefficient of Logistic Regression

Week 10:
- Fit Logistic Regression with optim function in R
- Fit Logistic Regression with glm function in R
- Fit Logistic Regression with sklearn in Python
- Fit Logistic Regression in Julia

Week 11:
- Logistic Regression and Inference
- Discriminant Analysis

Week 12:
- Multinomial Logit Regression
- Generalised Linear Regression
- Poisson Regression
- Negative Binomial Regression

References:

1) https://onlinecourses.nptel.ac.in/noc23_ma46/preview

2)An Introduction to Statistical Learning by James, Witten, Hastie, and Tibshirani, Springer (https://www.statlearning.com/)

3) The Elements of Statistical Learning by Hastie, Tibshirani, and Friedman, Springer (https://hastie.su.domains/Papers/ESLII.pd)

4) Regression and Other Stories by Gelman, Hill, and Vehtari, by Cambridge University Press (https://avehtari.github.io/ROS-Examples/)

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER: EIGTH (C.B.C.S.)

BRANCH: INFORMATION TECHNOLOGY

Subject : **Data Analytics with Python** Subject Code : BTIT802T.2

Load	Credit	Total Marks	Internal Marks	University Marks	Total
03 Hrs (Theory)	03	100	30	70	100

Aim : To give hands-on experience using python for creating analytics models

Prerequisite(s): Nil

Course Objective/Learning Objective:

1	To learn analytics using python programming language
2	Learn hypothesis testing and ANOVA model
3	Regression models and its implementation
4	Learn clustering and classification

Course Outcome:

At the end of this course Student are able to:

CO1	Understand data analytics and Python fundamentals
CO2	Perform sampling using various methods and perform hypothesis test or ANOVA test
CO3	Fit linear regression model and calculate various errors
CO4	Apply ROC
CO5	Apply clustering and classification using python programming

Week 1	:	Introduction to data analytics and Python fundamentals
Week 2	:	Introduction to probability
Week 3	:	Sampling and sampling distributions
Week 4	:	Hypothesis testing
Week 5	:	Two sample testing and introduction to ANOVA
Week 6	:	Two way ANOVA and linear regression
Week 7	:	Linear regression and multiple regression
Week 8	:	Concepts of MLE and Logistic regression
Week 9	:	ROC and Regression Analysis Model Building
Week 10	:	c^2 Test and introduction to cluster analysis
Week 11	:	Clustering analysis
Week 12	:	Classification and Regression Trees (CART)

References:

- https://archive.nptel.ac.in/courses/106/107/106107220/
- McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".
- Swaroop, C. H. (2003). A Byte of Python. Python Tutorial.
- Ken Black, sixth Editing. Business Statistics for Contemporary Decision Making. "John Wiley & Sons, Inc".
- Anderson Sweeney Williams (2011). Statistics for Business and Economics. "Cengage Learning".
- Douglas C. Montgomery, George C. Runger (2002). Applied Statistics & Probability for Engineering. "John Wiley & Sons, Inc"
- Jay L. Devore (2011). Probability and Statistics for Engineering and the Sciences. "Cengage Learning".
- David W. Hosmer, Stanley Lemeshow (2000). Applied logistic regression (Wiley Series in probability and statistics). "Wiley-Interscience Publication".
- Jiawei Han and Micheline Kamber (2006). Data Mining: Concepts and Techniques. "
- Leonard Kaufman, Peter J. Rousseeuw (1990). Finding Groups in Data: An Introduction to Cluster Analysis. "John Wiley & Sons, Inc".

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER: EIGTH (C.B.C.S.)

BRANCH: INFORMATION TECHNOLOGY

Subject : **Computer Vision** **Subject Code :** **BTIT802T.3**

Load	Credit	Total Marks	Internal Marks	University Marks	Total
03 Hrs (Theory)	03	100	30	70	100

Aim : The course will have a comprehensive coverage of theory and computation related to imaging geometry, and scene understanding. It will also provide exposure to clustering, classification and deep learning techniques applied in this area.

Prerequisite(s): Liner Algebra, Vector Calculus, Data Structures and Programming

Course Objective/Learning Objective:

1	To cover theory and computation related to imaging geometry, and scene understanding.
2	To learn feature extraction and matching
3	To process various parameters in images
4	To expose to clustering, classification and deep learning techniques applied in this area.

Course Outcome:

At the end of this course Student are able to:

CO1	Understand 2-D Projective Geometry, homography
CO2	Understand camera and stereo geometry
CO3	Detect and match features
CO4	Process color and range in images
CO5	Apply clustering, classification and deep learning models

Week 1: Fundamentals of Image processing
Week 2: 2-D Projective Geometry, homography, and Properties of homography
Week 3: Camera geometry
Week 4: Stereo geometry
Week 5: Stereo geometry
Week 6: Feature detection and description
Week 7: Feature matching and model fitting
Week 8: Color processing
Week 9: Range image processing
Week 10: Clustering and classification
Week 11: Dimensionality reduction and sparse representation
Week 12: Deep neural architecture and applications

Books and references

- https://archive.nptel.ac.in/courses/106/105/106105216/
- Multiple View Geometry in Computer Vision: R. Hartley and A. Zisserman, Cambridge University Press.
- Computer Vision: Algorithms & Applications, R. Szeleski, Springer.
- Computer vision: A modern approach: Forsyth and Ponce, Pearson.