Central University of Karnataka

ಕರ್ನಾಟಕ ಕೇಂದ್ರೀಯ ವಿಶ್ವವಿದ್ಯಾಲಯ

कर्नाटक केंद्रीय विश्वविद्यालय

Doctor of Philosophy
in Computer Science

Program Code: DPCSC

Course Structure and Syllabus
(Draft)

Department of Computer Science
School of Computer Science

DOCTOR OF PHILOSOPHY IN COMPUTER SCIENCE

(Effective from the academic year 2020-2021)
(For Central University of Karnataka, Kalaburagi)

DEPARTMENT OF COMPUTER SCIENCE

The Department of Computer Science established in 2012 in the School of Computer Science. Currently the Department of Computer Science offers Master of Computer Applications (MCA).

ELIGIBILITY FOR ADMISSION

M.Phil. with course work or Master's degree in Computer Science/ Master of Computer Applications from any University/Institute recognized by the UGC / MHRD or foreign university (as per the AIU foreign equivalence list) with at least 55% marks (50% for SC, ST, OBC {NON CREAMY LAYER}, PWD and Kashmiri Migrant and non-migrants Students) and who have scored a minimum of 50% marks (45% for SC, ST, OBC {NON CREAMY LAYER}, PWD and Kashmiri Migrant and non-migrants Students) in the Central Universities

Common Entrance Test 2020. The entrance test is only an eligibility criterion for successful candidates for personal interaction in the ratio of upto 1:10 for final selection.

DURATION OF COURSE

As per the university norms.

MEDIUM OF INSTRUCTION

The medium of instruction shall be English.

OTHER PROVISIONS

All the other provisions relating to attendance, reappearance in examinations, repeal and saving clauses, removal of difficulties, etc., shall be as per the existing norms of other PhD degree courses of Central University of Karnataka, Kalaburagi.

Program Structure of Structure of PhD Course work

SL No	Sub Code	T=Theory P=Practical	Course Type	Course type	Title	Credits	Weekly workload	L+T+P+W+S	Duration of Exam (Min.)	IA (40 %)	End sem. Exam (60 %)	Total Marks
1	DCSTC10001	T	Core: 1	CC	Research Methodology	4	4	3+1+0=4	150	40	60	100
2	DCSTC10002	T	Core: 2	CC	Data analysis, programming and Computational concepts	4	4	3+1+0=4	150	40	60	100
3	DCSTA10101	T	Ability Enhancement Compulsory course	AEC	Research and Publication Ethics (RPE)	2	2	2+0+0=2	75	20	30	50
4	DCSTD10201 to DCSTD10210	T	Discipline Specific Elective: I	DSE	Research Specific Course (to be selected from Pool of topics)	4	4	3+1+0=4	150	40	60	100
						14						**350**

Discipline Specific Electives (DSE)

Sl. No.	Course Code	Title
1.	DCSTD10201	Computer Vision
2.	DCSTD10202	Machine Learning
3.	DCSTD10203	Computational Cognitive Neuroscience
4.	DCSTD10204	Biometrics
5.	DCSTD10205	Robotics
6.	DCSTD10206	Natural Language Processing
7.	DCSTD10207	Document Image Analysis
8.	DCSTD10208	Human Computer Interaction
9.	DCSTD10209	Remote Sensing and GIS
10.	DCSTD10210	Medical Diagnostic Imaging

DCSTC10001: Research Methodology

Credits: 4 **IA: 40 Marks**
Contact Hrs (L:T:P): 4 (3:1:0) **End Exam: 60 Marks**

This is common course offered by the University. The syllabus content will be as prescribed by the University.

DCSTC10002: Advances in Computer Science

Credits: 4 **IA: 40 Marks**
Contact Hrs (L:T:P): 4 (3:1:0) **End Exam: 60 Marks**

Unit-1 [15 hrs]

Advanced Python:

Data structures: Lists comprehensions and slicing, tuples, sets, dictionaries, libraries: numpy, pandas etc., Iterators, Lambda expressions, filters, classes and modules.
Tensors, multidimensional data, Scalar, Vector, Matrix, Shape of Tensor, Reshape, Transpose, Concatenation and stacking etc.
Reading data from various sources: CSV, files-text, JSON, URL, cloud storage etc.

Unit-2 [15 hrs]

Exploratory Data Analysis and Visualization: Introduction to Exploratory Data Analysis (EDA) and visualization, importance of EDA, Data sources.
Data Preprocessing/cleaning: Missing values detection and imputation, transformations and type conversions, Outliers detections etc.
Data analysis: Data statistics, Grouping and filtering, Correlations, Variation, information gain, data/variable selection for modeling.
Visualization: Understanding data through various plots- bar chart, line chart, pie charts, scatter plots etc. Plotting distributions, correlation and heat maps, plotting time-series data. Tools and libraries for plotting and visualization.

Unit-3 [15 hrs]

Probability and Statistics: Probability, Bayes' theorem. Probability models: Discrete and continuous distributions. Binomial, Poisson, Gaussian (Normal) distribution, Parameter estimation using Maximum likelihood estimation, Simulation of data: Uses of simulation, Advantages and disadvantages of simulation.
Regression analysis, Simple and multiple regression, Logistic regression as a classifier, Classification: Discriminant function, Bayes classifier. Data reduction techniques: Principle Components Analysis (PCA), Factor Analysis, Cluster analysis. Model Selection for the data, The Curse of Dimensionality.

Unit-4 [15 hrs]

Computational Mathematics:

Introduction: mathematical modeling, review of Taylor series, numerical error (floating-point representation, computer arithmetic, round-off errors, and loss of significance in numerical computations).
Locating Roots of Equations: bisection method, Newton's method, secant method, introduction to the solution of systems of nonlinear equations - Newton's method for systems.
Solving Systems of Linear Equations: direct methods (LU factorization), basic iterative methods (Jacobi, Gauss-Seidel and SOR).
Interpolation: polynomial interpolation, piecewise polynomial and spline interpolation
Numerical Integration: Newton-Cotes methods, adaptive quadrature.

Reference Books:

1. Undergraduate Diagnostic Imaging Fundamentals by Brent Burbridge is licensed under a Creative Commons, Attribution-NonCommercial-ShareAlike 4.0 International License.
2. Programming Python by Lutz Mark, ISBN:9789350232873, Publication: Shroff.

3. Hands-On Exploratory Data Analysis with Python: Perform EDA techniques to understand, summarize, and investigate your data. by Suresh Kumar Mukhiya, Usman Ahmad, ISBN-13: 978-1789537253, Packt Publishing Limited 2020.
4. Interactive Data Visualization for the Web, 2nd Edition, by Scott Murray, 2017, Publisher: O'Reilly, ISBN: 9781491921289.
5. Kale B.K. (1999): A first Course on Parametric Inference-Narosa Pulication
6. Geofrey Gordon (1999): System Simulation, PHI, Second ed.
7. Draper N. R. and Smith H. (1998): Applied Regression Analysis, 3rd Ed. Wiley.
8. Montgomery, D. C., Peck E. A. and Vining, G. (2001): Introduction to Linear Regression Analysis, 3rd Ed. Wiley.
9. Anderson T. W. (1984): An Introduction to Multivariate Analysis, 2nd Ed., John Wiley.
10. Hosmer D. W. and Lemeshow S. (2000): Applied Logistic Regression, 2nd Ed. Wiley New York.
11. Han and Kamber (2000): Data Mining: Concepts and Techniques, Morgan Gaufmann.
12. Gupta S.C. and Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & Sons Publications, New Delhi.
13. Cleve Moler, Numerical Computing with MATLAB, SIAM. S. C. Chapra & R. P. Canale, Numerical Methods for Engineers, 6th Edition, McGraw Hill, 2009.
14. An introduction to numerical analysis, by Endre Suli and David Mayers.
15. Numerical Mathematics and Computing, 7th Edition, by Ward Cheney and David Kincaid.
16. James Demmel, Applied Numerical Linear Algebra, Siam, Philadelphia, 1997.
17. Gene H. Golub and Charles F. Van Loan, Matrix Computations, The Johns Hopkins University Press, Baltimore, 1988.
18. Roger A. Horn and Charles R. Johnson, Matrix Analysis, Cambridge University Press, 1985.

DCSTA10101: Research and Publication Ethics (RPE)

Credits: 2 **IA: 20 Marks**
Contact Hrs (L:T:P): 2 (2:0:0) **End Exam: 30 Marks**

Unit-1 [15 hrs]

RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)
1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgements and reactions

RPE 02: SCIENTIFIC CONDUCT (5 hrs.)
1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

RPE 03: PUBLICATION ETHICS (7 hrs.)
1. Publication ethics: definition, introduction and importance
2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

PRACTICE

Unit-2 [15 hrs]

RPE 04: OPEN ACCESS PUBLISHING(4 hrs.)
1. Open access publications and initiatives
2.SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

RPE 05: PUBLICATION MISCONDUCT (4 hrs.)
A. Group Discussions (2 hrs.)
1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad
B. Software tools (2 hrs.)
Use of plagiarism software like Turnitin, Urkund and other open source software tools

RPE 06: DATABASES AND RESEARCH METRICS (7 hrs.)
A. Databases (4 hrs.)
1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

B. Research Metrics (3 hrs.)
1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
2. Metrics: h-index, g index, i10 index, altmetrics

Reference Books:

1. Bird, A. (2006). Philosophy of Science. Routledge.
2. MacIntyre, Alasdair (1967) A Short History of Ethics. London.
3. P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978-9387480865
4. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition. National Academies Press.
5. Resnik, D. B. (2011). What is ethics in research & why is it important. National Institute of Environmental Health Sciences, 1-10. Retrieved from https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm
6. Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179-179.
7. https://doi.org/10.1038/489179a
8. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance(2019), ISBN:978-8 1 -939482-1-7. http://www.insaindia.res.in/pdf/Ethics Book.pdf

DCSTD10201: Computer Vision

Credits: 4 **IA: 40 Marks**
Contact Hrs (L:T:P): 4 (3:1:0) **End Exam: 60 Marks**

Unit-1 [15 hrs]

Introduction: Background, requirements and issues, human vision

Image formation geometry and photometry: Geometry, photometry (brightness and color), quantization, camera calibration.

Image segmentation and Feature Extraction: Various methods of image segmentation, edge detection, object proposals, SIFT features.

Unit-2 [15 hrs]

Multi-view Geometry: Shape from stereo and motion, feature matching, surface fitting, Active ranging.

Object Recognition – Traditional Methods: HoG/SIFT features, Bayes classifiers, SVM classifiers.

Unit-3 [15 hrs]

Introduction to Neural Networks: Artificial neural networks, loss functions, backpropagation and SGD, Batch Normalization.

Object Recognition – Deep Learning Methods: Image classification, object detection and semantic segmentation, adversarial attacks. Various neural network architectures, visualization techniques.

Unit-4 [15 hrs]

Motion analysis and Activity Recognition: Motion detection and tracking, Inference of human activity from image sequences

Examples: Face recognition, Image grounding, Visual question answering.

Reference Books:

1. "Computer Vision: A Modern Approach", D. Forsyth and J. Ponce, 2010.
2. "Deep Learning: Algorithms and Applications", I. Goodfellow, Y. Bengio and A. Courville, 2017 (online version available at no cost for personal use).
3. "A Guide to Convolutional Neural Networks for Computer Vision", S. Khan, H. Rahmani, S. Shah and M. Bennamoun, 2018
4. "Computer Vision: Algorithms and Applications", Richard Szeliski, 2010 (online version available at no cost for personal use).

DCSTD10202: Machine Learning

Credits: 4 **IA: 40 Marks**
Contact Hrs (L:T:P): 4 (3:1:0) **End Exam: 60 Marks**

Unit-1 [15 hrs]

Introduction: Definition of learning systems. Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation

Inductive Classification: The concept learning task. Concept learning as search through a hypothesis space. General-to-specific ordering of hypotheses. Finding maximally specific hypotheses. Version spaces and the candidate elimination algorithm. Learning conjunctive concepts. The importance of inductive bias.

Decision Tree Learning: Representing concepts as decision trees. Recursive induction of decision trees. Picking the best splitting attribute: entropy and information gain. Searching for simple trees and computational complexity. Occam's razor. Overfitting, noisy data, and pruning.

Unit-2 [15 hrs]

Ensemble Learning: Using committees of multiple hypotheses. Bagging, boosting, and DECORATE. Active learning with ensembles.

Experimental Evaluation of Learning Algorithms: Measuring the accuracy of learned hypotheses. Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing.

Computational Learning Theory: Models of learnability: learning in the limit; probably approximately correct (PAC) learning. Sample complexity: quantifying the number of examples needed to PAC learn. Computational complexity of training. Sample complexity for finite hypothesis spaces. PAC results for learning conjunctions, kDNF, and kCNF. Sample complexity for infinite hypothesis spaces, Vapnik-Chervonenkis dimension.

Rule Learning: Propositional and First-Order: Translating decision trees into rules. Heuristic rule induction using separate and conquer and information gain. First-order Horn-clause induction (Inductive Logic Programming) and Foil. Learning recursive rules. Inverse resolution, Golem, and Progol.

Unit-3 [15 hrs]

Artificial Neural Networks: Neurons and biological motivation. Linear threshold units. Perceptrons: representational limitation and gradient descent training. Multilayer networks and backpropagation. Hidden layers and constructing intermediate, distributed representations. Overfitting, learning network structure, recurrent networks.

Support Vector Machines: Maximum margin linear separators. Quadractic programming solution to finding maximum margin separators. Kernels for learning non-linear functions.

Bayesian Learning: Probability theory and Bayes rule. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logisitic regression. Bayes nets and Markov nets for representing dependencies.

Instance-Based Learning: Constructing explicit generalizations versus comparing to past specific examples. k-Nearest-neighbor algorithm. Case-based learning.

Unit-4 [15 hrs]

Text Classification: Bag of words representation. Vector space model and cosine similarity. Relevance feedback and Rocchio algorithm. Versions of nearest neighbor and Naive Bayes for text.

Clustering and Unsupervised Learning: Learning from unclassified data. Clustering. Hierarchical Aglomerative Clustering. k-means partitional clustering. Expectation maximization (EM) for soft clustering. Semi-supervised learning with EM using labeled and unlabled data.

Language Learning: Classification problems in language: word-sense disambiguation, sequence labeling. Hidden Markov models (HMM's). Veterbi algorithm for determining most-probable state sequences. Forward-backward EM algorithm for training the parameters of HMM's. Use of HMM's for speech recognition, part-of-speech tagging, and information extraction. Conditional random fields (CRF's). Probabilistic context-free grammars (PCFG). Parsing and learning with PCFGs. Lexicalized PCFGs.

Reference Books:

1. Machine Learning, Tom Mitchell, McGraw Hill.
2. Ensemble Learning Thomas G. Dietterih Department of Computer Siene Oregon State University Corvallis, Oregon 97331-3202 USA
3. Generative and Discriminative Classifiers: Naive Bayes and Logistic Regression, Machine Learning , Tom M. Mitchell, Draft of October 1, 2020

DCSTD10203: Computational Cognitive Neuroscience

Credits: 4 **IA: 40 Marks**
Contact Hrs (L:T:P): 4 (3:1:0) **End Exam: 60 Marks**

Unit-1 [15 hrs]

Introduction: The Computational Approach, Emergent Phenomena, Why Should We Care about the Brain? AI, ML, and Neuroscience.

The Neuron: Basic Biology of a Neuron as Detector, Dynamics of Integration: Excitation vs. Inhibition and Leak, Computing Activation Output, Mathematical Formulations, Exploration of the Individual Neuron.

Unit-2 [15 hrs]

Networks: Biology of the Neocortex, Categorization and Distributed Representations, Bidirectional Excitatory Dynamics and Attractors, Inhibitory Competition and Activity Regulation.

Learning: Biology of Synaptic Plasticity, The eXtended Contrastive Attractor Learning (XCAL) Model, Self-Organizing Learning: Long Time Scales and the BCM Model, Error-Driven Learning: Short Time Scale Floating Threshold, The Leabra Framework.

Unit-3 [15 hrs]

Brain Areas: Navigating the Functional Anatomy of the Brain, Comparing and Contrasting Major Brain Areas, Perception and Attention: What vs. Where, Motor Control: Parietal and Motor Cortex Interacting with Basal Ganglia and Cerebellum, Memory: Temporal Cortex and the Hippocampus, Language: All Together Now, Executive Function: Prefrontal Cortex and Basal Ganglia.

Perception and Attention: Biology of Perception, Oriented Edge Detectors in Primary Visual Cortex, Invariant Object Recognition in the What Pathway, Spatial Attention and Neglect in the Where/How Pathway.

Unit-4 [15 hrs]

Motor Control and Reinforcement Learning: Basal Ganglia, Action Selection and Reinforcement Learning, Dopamine and Temporal Difference Reinforcement Learning, The Actor-Critic Architecture for Motor Learning, The PVLV Model of DA Biology, Cerebellum and Error-Driven Learning.

Memory: Episodic Memory, The Hippocampus and Pattern Separation / Pattern Completion, Complementary Learning Systems, Familiarity and Recognition Memory, Priming: Weight and Activation-Based.

Reference Books:

1. Computational Cognitive Neuroscience, Randall C. O'Reilly Yuko Munakata Michael J. Frank Thomas E. Hazy Contributors.

DCSTD10204: Biometrics

Credits: 4 **IA: 40 Marks**
Contact Hrs (L:T:P): 4 (3:1:0) **End Exam: 60 Marks**

Unit-1 [15 hrs]

Introduction: Person Recognition, Biometric Systems, Biometric Functionalities, Biometric System Errors, The Design Cycle of Biometric Systems, Applications of Biometric Systems, Security and Privacy Issues.

Unit-2 [15 hrs]

Fingerprint Recognition: Introduction, Friction Ridge Pattern, Fingerprint Acquisition, Feature Extraction, Matching , Fingerprint Indexing, Fingerprint Synthesis, Palmprint.
Face Recognition: Introduction, Image Acquisition, Face Detection, Feature Extraction and Matching., Advanced Topics.

Unit-3 [15 hrs]

Iris Recognition: Introduction, Design of an Iris Recognition System, Image Acquisition, Iris Segmentation., Iris Normalization, Iris Encoding and Matching, Iris Quality, Performance Evaluation.
Additional Biometric Traits: Introduction, Ear detection, Gait, Hand Geometry, Soft Biometrics.

Unit-4 [15 hrs]

Multibiometrics: Introduction, Sources of Multiple Evidence, Acquisition and Processing Architecture, Fusion Levels.
Security of Biometric Systems: Introduction, Adversary Attacks, Attacks at the User Interface, Attacks on Biometric Processing, Attacks on the Template Database.

Reference Books:

1. Introduction to Biometrics, Anil Kumar Jain, Arun A. Ross, and Karthik Nandakumar, Springer.

DCSTD10205: Robotics

Credits: 4 **IA: 40 Marks**
Contact Hrs (L:T:P): 4 (3:1:0) **End Exam: 60 Marks**

Unit-1 [15 hrs]

Introduction: History of robots, Classification of robots, Present status and future trends. Basic components of robotic system. Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom. Mechanisms and transmission, End effectors, Grippers-different methods of gripping, Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, Cam type gripper, Magnetic grippers, Vacuum grippers, Air operated grippers; Specifications of robot.

Unit-2 [15 hrs]

Drive systems and Sensors: Drive system- hydraulic, pneumatic and electric systems Sensors in robot – Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.

Unit-3 [15 hrs]

Kinematics and Dynamics of Robots: 2D, 3D Transformation, Scaling, Rotation, Translation, Homogeneous coordinates, multiple transformation, Simple problems. Matrix representation, Forward and Reverse Kinematics Of Three Degree of Freedom, Homogeneious Transformations, Inverse kinematics of Robot,Robot Arm dynamics, D-H representationof robots, Basics of Trajectory Planning.

Unit-4 [15 hrs]

Robot Control, Programming and Applications: Robot controls-Point to point control, Continuous path control, Intelligent robot, Control system for robot joint, Control actions, Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Adaptive control. Introduction to Robotic Programming, On-line and off-line programming, programming examples. Robot applications-Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting.

Reference Books:

1. M. P. Groover, N. G. Odrey, M. Weiss, R. N Nagel, A. Dutta, “Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012.
2. Craig. J. J. “Intro. to Robotics-mechanics and control”, Addison-Wesley, 1999.
3. S.R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education., 2009.
4. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, "Robotics Engineering an Integrated Approach", PHI Learning., 2009.
5. F. N. Nagy, A. Siegler, "Engineering foundation of Robotics", Prentice Hall Inc., 1987.
6. P.A. Janaki Raman, "Robotics and Image Processing an Introduction", Tata McGraw Hill Publishing company Ltd., 1995.
7. Carl D. Crane and Joseph Duffy, "Kinematic Analysis of Robot manipulators", Cambridge University press, 2008.
8. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “Robotics control, sensing, vision and intelligence”, McGraw Hill Book co, 1987
9. Ray Asfahl. C., “Robots and Manufacturing Automation”, John Wiley & Sons Inc.,1985.

DCSTD10206: Natural Language Processing

Credits: 4 **IA: 40 Marks**
Contact Hrs (L:T:P): 4 (3:1:0) **End Exam: 60 Marks**

Unit-1 [15 hrs]
Introduction, Machine Learning and NLP, ArgMax Computation, WSD: WordNet, Wordnet; Application in Query Expansion, Wiktionary; semantic relatedness, Measures of WordNet Similarity, Resnick's work on WordNet Similarity, Parsing Algorithms.

Unit-2 [15 hrs]
Evidence for Deeper Structure; Top Down Parsing Algorithms, Noun Structure; Non-noun Structure and Parsing Algorithms, Probabilistic parsing; sequence labeling, PCFG, Probabilistic parsing; Training issues, Arguments and Adjuncts, Probabilistic parsing; inside-outside probabilities, Speech: Phonetics, HMM.

Unit-3 [15 hrs]
Morphology, Graphical Models for Sequence Labelling in NLP, Phonetics, Consonants (place and manner of articulation) and Vowels, Forward Backward probability; Viterbi Algorithm, Phonology, Sentiment Analysis and Opinions on the Web, Machine Translation and MT Tools - GIZA++ and Moses.

Unit-4 [15 hrs]
Text Entailment, POS Tagging, Phonology; ASR, Speech Synthesis, HMM and Viterbi, Precision, Recall, F-score, Map, Semantic Relations; UNL; Towards Dependency Parsing, Universal Networking Language, Semantic Role Extraction, Baum Welch Algorithm; HMM training, Baum Welch Algorithm; HMM training.

Reference Books:

1. Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
2. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
3. Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
4. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.
5. Radford, Andrew et. al., Linguistics, An Introduction, Cambridge University Press, 1999.
6. Journals: Computational Linguistics, Natural Language Engineering, Machine Learning, Machine Translation, Artificial Intelligence.
7. Conferences: Annual Meeting of the Association of Computational Linguistics (ACL), Computational Linguistics (COLING), European ACL (EACL), Empirical Methods in NLP (EMNLP), Annual Meeting of the Special Interest Group in Information Retrieval (SIGIR), Human Language Technology (HLT).

DCSTD10207: Document image Analysis

Credits: 4 **IA: 40 Marks**
Contact Hrs (L:T:P): 4 (3:1:0) **End Exam: 60 Marks**

Unit-1 [15 hrs]

Character Recognition, Evolution and Development: Generation and Recognition of Characters. History of OCR, Development of New Techniques, Recent Trends and Movements.

Tools for Image Pre-Processing: Generic Form Processing System, A Stroke Model for Complex Background Elimination, A Scale-Space Approach for Visual Data Extraction, Data Pre-Processing.

Unit-2 [15 hrs]

Feature Extraction, Selection and Creation: Feature Extraction, Feature Selection for Pattern Classification, Feature Creation for Pattern Classification.

Pattern Classification Methods: Overview of Classification Methods, Statistical Methods, Artificial Neural Networks, Support Vector Machines, Structural Pattern Recognition, Combining Multiple Classifiers, A Concrete Example.

Unit-3 [15 hrs]

Word and String Recognition: Introduction, Character Segmentation, Classification-Based String Recognition, HMM-Based Recognition, Holistic Methods For Handwritten Word Recognition.

Unit-4 [15 hrs]

Case Studies: Automatically Generating Pattern Recognizers with Evolutionary Computation, Offline Handwritten Chinese Character Recognition, Segmentation and Recognition of Handwritten Dates on Canadian Bank Cheques.

Reference Books:

1. Character Recognition Systems: A Guide for Students and Practitioners Mohamed Cheriet, Nawwaf Kharma, Cheng-Lin Liu, Ching Suen, Wiley Inerscience SBN: 978-0-470-17652-8, November 2007.
2. Feature Extraction Approaches for Optical Character Recognition: Yampolskiy, Briviba Scientific Press.
3. Knowledge based Intelligent techniques in Character Recognition Jain, Lazerrini, CRC Press.
4. Hand written character Recognition: A Mile Stone to achieve: Bahatil, Lambert Academic Publication.

DCSTD10208: Human Computer Interaction

Credits: 4 **IA: 40 Marks**
Contact Hrs (L:T:P): 4 (3:1:0) **End Exam: 60 Marks**

Unit-1 [15 hrs]

Introduction: Course objective and overview, Historical evolution of the field.

Interactive system design (theory and practice): Concept of usability – definition and elaboration, HCI and software engineering, GUI design and aesthetics.

Model-based Design and evaluation: Basic idea, introduction to different types of models, GOMS family of models (KLM and CMN-GOMS), Fitts' law and HickHyman's law, Model-based design case studies.

Unit-2 [15 hrs]

Guidelines in HCI: Shneiderman's eight golden rules, Norman's seven principles, Norman's model of interaction, Nielsen's ten heuristics with example of its use, Heuristic evaluation, Contextual inquiry, Cognitive walkthrough.

Empirical research methods in HCI: Introduction (motivation, issues, research question formulation techniques), Experiment design and data analysis (with explanation of one-way ANOVA).

Unit-3 [15 hrs]

Task modeling and analysis: Hierarchical task analysis (HTA), Engineering task models and Concur Task Tree (CTT).

Dialog Design: Introduction to formalism in dialog design, design using FSM (finite state machines), State charts and (classical) Petri Nets in dialog design.

Cognitive architecture: Introduction to CA, CA types, relevance of CA in IS design, Model Human Processor (MHP).

Unit-4 [15 hrs]

Object Oriented Programming: OOP- Introduction, OOM- Object Oriented Modeling of User Interface Design.

Design – Case Studies: Case Study 1- MultiKey press Hindi Text Input Method on a Mobile Phone, Case Study 2 – GUI design for a mobile phone based Matrimonial application, Case Study 3 – Employment Information System for unorganised construction workers on a Mobile Phone.

Reference Books:

1. Dix A., Finlay J., Abowd G. D. and Beale R. Human Computer Interaction, 3 rd edition, Pearson Education, 2005.
2. Preece J., Rogers Y., Sharp H., Baniyon D., Holland S. and Carey T. Human Computer Interaction, Addison-Wesley, 1994.
3. B. Shneiderman; Designing the User Interface, Addison Wesley 2000 (Indian Reprint).
4. Y. Rogers, H. Sharp, J. Preece: Interaction Design 3rd Edition Wiley 2011.
5. F. Bentley, E. Barrett: Building Mobile Experiences MIP Press Cambridge 2012.
6. Jacob Nieilsen; Useability Engineering; Morgan Kaufmann, Academic Press, London, 1993.

DCSTD10209: Remote Sensing and GIS

Credits: 4 **IA: 40 Marks**
Contact Hrs (L:T:P): 4 (3:1:0) **End Exam: 60 Marks**

Unit-1 [15 hrs]

Introduction to remote sensing: Spatial data acquisition, Application of remote sensing.

Electromagnetic energy and remote sensing: Electromagnetic energy, Energy interaction in the atmosphere, Energy interactions with the Earth's surface.

Sensors and platforms: Sensors, Platforms, Image data characteristics, Data selection criteria.

Aerial cameras: Aerial camera, Spectral and radiometric characteristics, CCD as image recording device, Spatial characteristics, Relief displacement, Aerial photography missions, Recent developments in aerial photography.

Unit-2 [15 hrs]

Multispectral scanners: Whiskbroom scanner, Pushbroom sensor, Some operational Earth observation systems**.**

Active sensors: Radar, Laser scanning.

Remote sensing below the ground surface: Gamma-ray surveys, Gravity and magnetic anomaly mapping, Electrical imaging, Seismic surveying.

Unit-3 [15 hrs]

Radiometric correction: From satellite to ground radiances: the atmospheric correction, Atmospheric correction in the visible part of the spectrum.

Geometric aspects: Two-dimensional approaches, Three-dimensional approaches.

Image enhancement and visualisation: Perception of colour, Visualization of image data, Filter operations, Colour composites.

Visual image interpretation: Image understanding and interpretation, Application of visual image interpretation,

Unit-4 [15 hrs]

Digital image classification: Principle of image classification, Image classification process, Validation of the result, Problems in image classification.

Thermal remote sensing: Principles of Thermal Remote Sensing, Processing of thermal data, Thermal applications.

Imaging Spectrometry: Reflection characteristics of rocks and minerals, Pre-processing of imaging spectrometer data, Atmospheric correction of imaging spectrometer data, Thematic analysis of imaging spectrometer data, Applications of imaging spectrometry data, Imaging spectrometer systems.

Reference Books:

1. Principles of Remote Sensing, Norman Kerle, Lucas L. F. Janssen and Gerrit C. Huurneman (eds.) (ITC Educational Textbook Series; 2), Third edition.

DCSTD10210: Medical Diagnostic imaging

Credits: 4 **IA: 40 Marks**
Contact Hrs (L:T:P): 4 (3:1:0) **End Exam: 60 Marks**

Unit-1 [15 hrs]

Introduction: Online DICOM Image Viewer (ODIN): An Introduction and User Manual, CanMEDS Roles, CAR – Diagnostic Imaging Referral Guidelines, ACR – Appropriateness Criteria, Image Gently.

Principles of Radiation Biology and Radiation Protection: Radiation in Medical Imaging: The x-ray Tube, Ionizing Radiation: Basic Concepts, Radiation Interaction with Biological Matter, Classification of Radiation Damage, Radiation Protection for Healthcare Workers, Radiation Protection for Patients, Ionizing Radiation: Fetus and Neonate, Appropriateness of Imaging Guidelines, Principles of Radiation Biology and Radiation.

Principles of Imaging Techniques: X-rays, Mammography, Fluoroscopy, Angiography, Computed Tomography (CT), Ultrasound (US), Magnetic Resonance Imaging (MRI), Nuclear Medicine.

Contrast Media in Radiology: Contrast Media in Radiology.

Unit-2 [15 hrs]

Approach to Reviewing X-ray Imaging: General Approach to Reviewing x-ray Imaging, Approach to the Chest x-ray (CXR), Approach to the Abdominal x-ray (AXR).

Brain and Spine: Intracranial Hemorrhage – Traumatic, Ischemic Stroke, Tumours of the Brain, Hydrocephalus, Low Back Pain, Spine Fracture.

Breast: Introduction to Breast Imaging, Palpable Breast Mass, BI-RADS, Breast – References,

Cardiovascular: Normal, Labelled, Chest x-ray, with Cardiovascular, Structures, Enlarged Cardiac Silhouette, Aortic Dissection and Aneurysm, Congestive Heart Failure.

Unit-3 [15 hrs]

Chest: Normal, Labelled, Chest x-ray, Tubes and Catheters, Atelectasis, Lobar and Lung Collapse – Suspected Lung, Malignancy, Pleural Effusion, Pneumonia, Pneumothorax, Emphysema, Solitary Lung Nodule, Multiple Lung Nodules, Pulmonary Thromboembolism.

Gastrointestinal and Abdominal: Cholecystitis, Intestinal Perforation-Pneumoperitoneum, Ileus, Intestinal Obstruction, Appendicitis, Diverticulitis, Toxic Megacolon, Liver Tumour, Jaundice, Gastrointestinal and Abdominal – References,

Gynecology and Obstetrics: Benign and Malignant Tumours of the Female, Reproductive System, Normal Pregnancy, Ectopic Pregnancy, Placenta Previa.

Head and Neck: Thyroid – Palpable Nodule, Facial Trauma, Sinusitis/Mastoiditis, Retropharyngeal Abscess – Child, Epiglottitis – Child.

Unit-4 [15 hrs]

Interventional / Vascular (Invasive): Percutaneous Biopsy, Percutaneous Fluid Drainage, Venous Access, Inferior Vena Cava Filter.

Musculoskeletal Radiology: Clavicle Fracture, Acromioclavicular Joint Separation, Rotator Cuff, Glenohumeral Dislocation – Anterior and Posterior, Elbow Fractures, Hand and Wrist Fractures, Pelvic Fracture, Hip Fracture – Femoral Neck Fracture, Knee Trauma – Acute Fractures, Ankle Trauma, Fractures, Degenerative Joint Diseases – Hip, Erosive Arthritic Condition – RA.

Pediatric: Non-Accidental and Accidental Trauma, Foreign Body Ingestion/Aspiration, Urinary Tract Infection and Suspected Vesico-, Ureteral Reflux, Pyloric Stenosis, Tumors Unique to Children – Wilms Tumour.
Urogenital: Urinary Tract Calculus, Renal Tumour, Hematuria, Testicular Tumour, Testicular Torsion.
Normal, Reference Images, Unlabelled and Labelled, Head and Neck, Chest, Abdomen, Pelvis, Musculoskeletal, Pediatric.

Reference Books:

1. Undergraduate Diagnostic Imaging Fundamentals by Brent Burbridge is licensed under a Creative Commons, Attribution-NonCommercial-ShareAlike 4.0 International License.

Chairman
BoS in Computer Science