1. OBJECTIVES OF THE PROGRAM

This M.Phil programme in Computer Science, aims at exposing the students to the area of Machine Intelligence and its applications in other research areas of Computer Science and to introduce the research methodology in Computer Science.

The major Objectives are:

- To provide an understanding of principles and methods in research activities.
- To identify critical and relevant research problems in Computer Science.
- To select the appropriate methods/techniques to solve an identified problem.
- To model, implement and analyze the methodology developed for the solution.
- To provide a comprehensive understanding of techniques and algorithms in the areas of Machine Intelligence.
- To introduce another research area of Computer Science from among Information Security, Information Theory and Coding, Medical Image Processing, and Big Data Analytics.
- To provide an exposure to identify, analyze and criticize relevant research literature
- To understand the best practices and methods in scientific writing and publishing
- To motivate and inspire the students to pursue their doctoral programmes.

2. Programme Structure

The M.Phil will be a (12 month) regular full-time programme. Students are integrated into the research culture of the Department. Students are guided by the respective guides and motivate them to undergo further research.

The degree is awarded following the successful completion of a period of research which includes the submission of a thesis, and its subsequent oral examination, together with a series of Departmental reports and seminars. The thesis is expected to display a comprehensive particular knowledge of some part or aspect of the field of study, and to make some original contribution to knowledge or understanding.

Admission Eligibility Criteria

A Masters Degree with 60% aggregate marks (OR CGPA of above 6.5 on a 10point scale or equivalent) in Computer Science/ Computer Applications/ Information Technology or an equivalent degree recognised by the University.

Admission process will be as per the rules and regulations of the University.

Number of Seats

Depending on the number of eligible Faculty with a Faculty: Student ratio 1:2

Duration

One year with two Semesters

Evaluation

The examinations for the three theory papers will be conducted at the end of Semester I and the evaluation of the Dissertation and the Viva-Voce will be conducted at the end of Semester II.

Theory Papers

All the theory papers should have Continuous Assessment (CA) for 40 marks and End Semester Assessment (ESA) for 60 marks.

A maximum of 40 marks can be awarded for CA as per the criteria given below.
Attendance - 5
Mid Semester Examination – 15
Assignment – 10
Seminar/Lab assignments/viva – 10

Dissertation

In the case of Dissertation, 120 marks will be awarded by the respective supervising teacher on the basis of following criteria.

Assignment – 10, Publications – 20, Presentation of work – 50, Report – 40.

The remaining 180 marks will be awarded through the assessment done by the panel of teachers in the department on the basis of following criteria.

Presentation of work - 90, Publications – 30, Report – 60

Viva –Voce examination (for 100 marks) will be conducted by a panel of examiners in which there will one or more external examiners and one or more teachers from the Department including the respective guide.

Grading of results

Based on the overall performance in the examinations, grades will be assigned as per the following scheme.

Grade A - 60% and above

Grade B - 50% and above but below 60%

Failure - Below 50%

5. Scheme and Syllabus

There shall be three theory papers out of which papers I and II shall be common papers to all the candidates and paper III shall be an elective paper in the specific area in which dissertation is done.

Scheme of the programme

Semester –I			
Course	*Evaluation*		
	CA	*ESA*	*Total*
COS711 Research Methodology	40	60	100
COS712 Machine Intelligence	40	60	100
COS70xx Elective	40	60	100
Semester Total			300
Semester –II			
COS713 Dissertation & Viva Voce	**Evaluation of Dissertation - 300 Viva Voce - 100**		
Semester Total			400
Total			**700**

List of Electives:

1. **COS701 BigData Analytics**
2. **COS702 Information Security**
3. **COS703 Information Theory and Coding**
4. **COS704 Medical Image Processing**

DETAILED SYLLABUS

COS711 Research Methodology

Module - I

Objectives and types of research: Motivation and objectives – Research methods vs Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical.

Research Formulation – Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis.

Module - II

Research design and methods – Research design – Basic Principles- Need of research design — Features of good design – Important concepts relating to research design – Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction, Development of Models. Developing a research plan - Exploration, Description, Diagnosis, Experimentation. Determining experimental and sample designs.

Data Collection and analysis: Execution of the research - Observation and Collection of data - Methods of data collection – Sampling Methods- Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Hypothesis-testing - Generalization and Interpretation.

Module - III

Reporting and thesis writing – Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports – Illustrations and tables - Bibliography, referencing and footnotes - Oral presentation – Planning – Preparation – Practice – Making presentation – Use of visual aids - Importance of effective communication.

Application of results and ethics - Environmental impacts - Ethical issues - ethical committees - Commercialisation – Copy right – royalty - Intellectual property rights and patent law – Trade Related aspects of Intellectual Property Rights – Reproduction of published material – Plagiarism - Citation and acknowledgement - Reproducibility and accountability.

Text Books:

- Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
- Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.

Reference:

- Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
- Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
- Wadehra, B.L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.
- Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.

- Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
- Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
- Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.
- Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
- Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall.
- Satarkar, S.V., 2000. Intellectual property rights and Copy right. Ess Ess Publications.

COS712 Machine Intelligence

Module - I

Introduction to knowledge engineering and Machine intelligence – knowledge, challenges in knowledge computing, intelligent systems, scope and applications of machine intelligence;

Machine Learning – Introduction, Input, Feedback and types of learning methods;

Supervised Learning - Rule induction & Decision trees, classifiers and its Evaluation-Accuracy, precision and recall, F1-value, ROC curve, Scoring and ranking; Support Vector Machines and Kernels;

Module - II

Unsupervised Learning - Principal components analysis, **Self-organizing maps**;

Reinforcement Learning –Introduction and applications, Q learning, Monte Carlo Methods for evaluation;

Artificial Neural Networks – Introduction, Neuron model, Single layer, Multi layer feed forward network, Learning algorithm, Back propagation network.

Module - III

Fuzzy Logic - Fuzzy sets, Membership function – interference in fuzzy logic, Introduction to neuro fuzzy systems.

Genetic Algorithms - binary and real representation schemes, selection methods, crossover and mutation operators for binary and real coding.

Introduction to Swarm Intelligence and Ant-colony optimization techniques

Text Books:

- N.P.Padhy,"Artificial Intelligence and Intelligent Systems" Oxford University Press.
- S. Rajsekaran & G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications" Prentice Hall of India.

Reference:

- Laurance Fausett, Englewood cliffs, N.J., 'Fundamentals of Neural Networks',Pearson Education, 1992.
- Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 1997.
- S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, Wiley India Edition, 2nd Edition, 2013.
- Simon Haykin, 'Neural Networks', Pearson Education, 2003.
- M.Gen and R,Cheng, Genetic algorithms and Optimization, Wiley Series in Engineering Design and Automation, 2000.

Electives

COS701 BigData Analytics

Module - I

Introduction: Fundamentals of data mining, Data Mining Functionalities, Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture. Methods for Data Cube Computation, Associations and Correlations: Efficient and Scalable Frequent Item set Mining Methods, Mining Various

Kinds of Association Rules, Introduction to Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification Based on Concepts from Association Rule Mining.

Module - II

Introduction to BigData –Challenges of Conventional Systems, Evolution of Analytic Scalability, Analytic Processes and Tools;

Stream Data - Stream Data Model and Architecture, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Real time Analytics Platform(RTAP) Applications, Case study on Stock Market Predictions.

Frequent Itemsets and Clustering - Mining Frequent Itemsets, Market Based Model, Apriori Algorithm, Handling Large Data Sets in Main Memory, Limited Pass Algorithm, Counting Frequent Itemsets in a Stream, Clustering High Dimensional Data, CLIQUE and PROCLUS, Clustering for Streams and Parallelism.

Module - III

Frameworks - MapReduce, Hadoop, Hive, MapR, NoSQL Databases, Hadoop Distributed File Systems, Approaches to modeling in Analytics, Intelligence from unstructured information, Text analytics, Industry challenges and application of Analytics

Text Books:

- Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
- Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
- Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", Morgan Kaufmann, 2nd Ed., 2005.

Reference:

- Margaret H. Dunham, "Data Mining: Introductory and Advanced Topics", Prentice Hall, 1 st Ed., 2002.
- Da Ruan, Guoqing Chen, Etienne E. Kerre, Geert Wets, "Intelligent Data Mining: Techniques and Applications (Studies in Computational Intelligence)", Springer, 1st Ed., 2010.
- Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.
- Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007
- Pete Warden, "Big Data Glossary", O'Reilly, 2011.
- Jiawei Han, MichelineKamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.
- C. Bishop, Pattern Recognition and Machine Learning, Springer 2007

COS702 Information Security

Module - I

Network Security and System Security: Introduction to Network Security – Symmetric Encryption and Message Confidentiality – Public-key Cryptography and Message Authentication – Authentication Application – Electronic Mail Security – IP Security – Web Security – Network Management Security - Intruders – Malicious Software – Firewalls. Conventional Encryption: Classical Technique –Modern technique – Algorithms; Public Key Cryptography: Public Key Cryptography – Introduction to Number Theory – Message Authentication and Hash Function – HASH and MAC Algorithm – Digital Signature and Authentication protocol.

Module - II

Network Security Practice: Authentication Application – Electronic Mail Security – IP Security Program Security and System Security: Secure programs – Non-malicious program errors – viruses and Worms – Memory and address protection – control access to general objects – File protection mechanism – user

authentication – Trusted operating system design and assurance – Intrusion Detection system. System Security and Web Security: Intruders,– Firewall - Managing Access – Password management - Web Security requirements – SSL and TLS – SET; Client Side Security : Using SSL – Active Content – Web Privacy.

Module - III

Database Security: Database as a Networked Server – Securing database-to-database communication – Reliability and Integrity of database – sensitive data – inference multilevel database. Wireless Network Security: Mobile Security – Encryption Schemes in WLANs – Basic approach to WLAN security and Policy Development – WLAN intrusion process – WLAN security solutions. Digital Watermarking and Steganography: Models of Watermarking – Basic Message Coding – Watermark Security – Content Authentication – Steganography - Steganalysis.

Text Books:

- William Stallings, "Cryptography and Network Security: Principles and Practice", Prentice Hall, 6th ed., March 2013. ISBN-13: 978-0133354690.
- Charles P. Pfleeger, Shari Lawrence Pfleeger and Jonathan Margulies, "Security in Computing", Prentice Hall, 5th ed., January 2015. ISBN-13: 978-0134085043.

Reference:

- John Rittinghouse and James F. Ransome, "Wireless Operational Security", Digital Press (Elsevier), 1st ed., February 2004. ISBN-13: 978-1555583170.
- Ron Ben-Natan, "Implementing Database Security and Auditing", Digital Press (Elsevier), 1st ed., April 2005. ISBN-13: 978-1555583347.
- Lincoln D. Stein, "Web Security: A Step-by-Step Reference Guide", Addison Wesley, 1st ed., December 1997. ISBN-13: 978-0201634891.
- Ingemar Cox, Matthew Miller, Jeffrey Bloom, Jessica Fridrich and Ton Kalker, "Digital Watermarking and Steganography", Morgan Kaufmann Publishers, 2nd ed., November 2007. ISBN-13: 978-0123725851.
- Neil Johnson, Zoran Duric and Sushil Jajodia, "Information Hiding: Steganography and Watermarking-Attacks and Countermeasures", Springer, 2001 ed., October 2012. ISBN-13: 978-1461369677.

COS703 Information Theory and Coding

Module - I:

Introduction: Compression Techniques, Modeling and Coding, Mathematical Preliminaries for Lossless compression: Information Theory, Models, Coding: Uniquely decodable codes, Prefix codes, Kraft-McMillan Inequality. Huffman Coding: Minimum Variance Huffman Codes, Length of Huffman Codes, Adaptive Huffman Coding, Golomb codes, Rice codes, Tunstall codes, Applications of Huffman Coding. Arithmetic Coding: Coding a sequence, Generating a binary code, Comparison of Huffman and arithmetic coding, Applications.

Module - II:

Dictionary Techniques: Static Dictionary, Digram coding, Adaptive Dictionary, LZ77, LZ78, LZW algorithms, Applications. Context-based Compression: Prediction with partial match (ppm), Burrows-Wheeler Transform (BWT). Old JPEG standard, CALIC, JPEGLS, Run-Length Coding, JBIG, JBIG2.

Module - III:

Mathematical Preliminaries for Lossy Coding: Distortion Criteria, Rate Distortion Theory. Scalar Quantization: Quantization problem, Uniform Quantizer, Lloyd-Max Quantizer, Adaptive Quantization, Nonuniform Quantization, Entropy-Coded Quantization,. Vector Quantization: LBG Algorithm, Tree Structured and Structured Vector Quantizers. Differential Coding: Basic algorithm, DPCM. Transform Coding: Transforms of Interest, JPEG.

Text Books:

- Khalid Sayood, "Introduction to Data Compression", Morgan Kaufmann Publishers, 3rd Ed., 2005.
- David Salomon, "Data Compression – The Complete Reference", Springer, 3rd Ed., 2004.

Reference:

- Alistair Moffat, Andrew Turpin, "Compression and Coding Algorithms", Kluwer Academic Publishers, 1st Ed., 2002.
- Vasudev Bhaskaran, Konstantinos Konstantinides, "Image and Video Compression Standards", Kluwer Academic Publishers, 2nd Ed., 2003.
- Mark Nelson, Jean-Loup Gailly, "The Data Compression Book", John Wiley & Sons, 2nd Ed., 1995.
- John Miano, "Compressed Image File Formats", Addison Wesley Professional, 1st Ed., 1999.
- Peter Wayner, "Compression Algorithms for Real Programmers", Morgan Kaufmann, 1st Ed., 1999.

COS706 Medical Image Processing

Module - I

Introduction to Image processing - Elements of Image Processing, Image Processing Techniques, Digital Image Classification, Image Types, Applications of Image Processing. Spatial Domain Filtering, Filtering in the Frequency domain, Image Restoration, Image Compression, Wavelet based Image Compression, Morphological Image Processing, Image Segmentation.

Module II

Medical Image Processing: Introduction to medical imaging, challenges; Medical Image Formation Principles: X-Ray and Computed Tomography(CT) imaging , Basic principles of CT, 2D Image reconstruction-Fourier space and filtered back projection methods, Iterative reconstruction, 3D reconstruction basics; Imaging Modalities, mathematical principles, applications.

Medical Image Storage: Archiving and Communication Systems and Formats Picture archiving and communication system (PACS), Formats - DICOM, Radiology Information Systems (RIS) and Hospital Information Systems (HIS). Medical Image Visualization: Fundamentals of visualization, different generations of visualization techniques, surface and volume rendering/visualization.

Module III

Medical Image Segmentation: Histogram-based methods, Region growing, watersheds, Multispectral Techniques, Segmentation by Fuzzy clustering methods and issues, Active Contour models, Segmentation with Neural Networks, Segmentation with deformable models; Medical Image Registration: Introduction, Intensity-based methods, Joint histograms, Information theory measures, cost functions, clinical applications of Image registration; Medical Image Search and Retrieval: Current technology in medical image search, content-based image retrieval, new trends; Applications: Image Guided Surgery, Image Guided Therapy, Computer Aided Diagnosis/Diagnostic Support Systems.

Text Books:

- Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing",3rd Ed., PHI, 2007.
- Anil K. Jain, "Fundamentals of Digital image Processing", Prentice Hall, US Ed., 1989.
- Bankman I.N. "Hand book of Medical Imaging-Processing and Analysis" , Academic Press.
- Bovik A.I. "Handbook of Image and Video processing", Academic Press.
- Jiri Jan, "Medical Image Processing, Reconstruction and Restoration- Concepts and Methods", CRC Tayler & Francis, 2006.

References:

- William K. Pratt, "Digital Image Processing: PIKS Scientific Inside", Wiley Interscience, 4th Ed., 2007.
- Azriel Rosenfield, Avinash C. Kak, "Digital Picture Processing", Morgan Kaufmann, 2nd Ed., 1982. 3. Bernd Jahne, "Digital Image Processing", Springer, 6th Ed., 1997.
- Azriel Rosenfield, Avinash C. Kak, "Digital Picture Processing", Morgan Kaufmann, 2nd Ed., 1982. 3. Bernd Jahne, "Digital Image Processing", Springer, 6th Ed., 1997.

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Appendix III

UNIVERSITY OF KERALA

M. PHIL PROGRAMME IN COMPUTER SCIENCE

DEPARTMENT OF COMPUTER SCIENCE

UNIVERSITY OF KERALA

SCHEME AND SYLLABUS

Department of Computer Sciences
University of Kerala Kariavattom
Thiruvananthapuram
2016

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