Ramakrishna Mission Vivekananda Educational & Research Institute

(Deemed-to-be-university by Govt. of India u/s 3 of UGC act 1956)

Academic Program Brochure

DEPARTMENT OF COMPUTER SCIENCE

Belur Campus

Abstract

This brochure provides relevant information about the Department of Computer Science, Ramakrishna Mission Vivekananda Educational and Research Institute (RKMVERI) for prospective employers. It comprises a brief introduction of the Institute and the Department followed by descriptions of the twin academic programmes, namely, M.Sc Computer Science) and M.Sc (Big Data Analytics), offered by the department of computer science. It also gives brief descriptions of the faculty members who contributed in preparing the 2020-22 batch of students.

This is our first of the many upcoming efforts in inviting prospective employers for the students of our department. We have a batch of quality students trained by an excellent group of faculty members. According to the feedback from our faculty members, most of our students from the current out-going batches will be a valuable inclusion to any company.

Dates for campus interviews are fixed on a first-come, first-served basis. It may be mentioned here that the Institute does not charge any placement fee. We do hope that this placement brochure will be useful to employers visiting the Institute. Any suggestion for improving the brochure is most welcome.

Education is the manifestation of perfection already in man.

Vivekananda

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1. Message from the HoD

1.1 The Institution

Ramakrishna Mission Vivekananda Educational and Research Institute (RKMVERI) is a Deemed-to-be-University that is administered by the Ramakrishna Mission- a charitable, philanthropic, and spiritual organization with over a century old legacy.

Government of India declared RKMVERI, through a Gazetted Notification dated 5 January 2005, as a *de novo* Deemed-to-be-University under Section 3 of UGC Act, 1956. It has four campuses in key locations at Belur (Howrah District, WB, Main campus), Coimbatore (Tamil Nadu), Ranchi (Jharkand), and Narendrapur (Kolkata, WB). The Deemed-to-be-University status was confirmed by the MHRD Notification in 2012.

The School of Mathematical Sciences comprising the Departments of Mathematics, Physics and Computer Science, is functional since July 2008 and headquartered in Belur.

1.2 Areas of Academics

This University provides post graduate courses on subjects as varied as mathematical sciences, sports science and yoga, agricultural biotechnology, plant breeding and genetics, rural & tribal development, disability management & special education, general & adapted physical education, Indian cultural & spiritual heritage, sanskrit, and music.

1.3 Notable Laurels

It is a matter pride that RKMVERI is the pioneer in the country in offering courses in Disability Management & Special Education at our Coimbatore campus. RKMVERI has carved out a mainsteam academic venture in this gap area offering undergraduate, postgraduate, and doctoral programs.

In March 2019 this university was accredited by NAAC (National Academic Accreditation Council) with the A++ grade, the highest, with the total cgpa of 3.66 out of 4.

1.4 Degree Programs

The Department of Computer Science at RKMVERI offers two Post graduate degree programs, namely, MSc in Computer Science (CS) and MSc in Big Data Analytics (BDA) with the following program outcomes in perspective.

- Inculcate critical thinking to carry out scientific investigation objectively and not getting biased with preconceptions.

- Equip the student with skills to analyze problems, formulate a hypothesis, evaluate and validate results, and draw reasonable conclusions thereof.
- Prepare students for pursuing research or careers in industry in mathematical sciences and allied fields
- Imbibe effective scientific and/or technical communication in both oral and writing.
- Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate the highest standards of ethical issues in mathematical sciences.
- Create awareness towards becoming an enlightened citizen with commitment to deliver one's responsibilities within the scope of bestowed rights and privileges.

1.5 Linkages with reputed institutions

Thanks to the locational advantage, with prior permission from the Dean of academics in ISI kolkata, our students get to credit some courses alongside ISI's Masters' students. This way the students get better exposure. This also is an opportunity for our students to interact with a larger group of intellectual peers. Often times we invite professors from ISI, Kolkata to teach our students

The current batch of students are tutored additionally by reputed professors IIT-Kanpur on some specialized topics in Statistics, and Analytics.

1.6 The CS-BDA Synergy

The CS and BDA curriculum are designed in such a way that the CS students have adequate bandwidth to credit some advanced courses (full or partial) along side the BDA students. Thus, a student of CS is also equipped to be a Data Analyst. Likewise, while the BDA student

prepares to become a data scientist may be choose to strengthen the most needed computational skills or get exposure to technology.

The fourth semester is dedicated to executing a Master's Project which is a 12 credit course. The students can choose to do an academic or an industrial project depending on their preferences and available opportunities. The student presentation of the project work is evaluated by the subject experts invited from other institutions.

1.7 Contact details

Dhyanagamyananda (*alias.* Swathy Prabhu)
Head, Department of Computer Science
PO Belur Math, Dist. Howrah, Pin 711202,
West Bengal, India

Mobile: 8910922042 Land: (033) 26549999 Fax : (033) 26544640
e-mail: cs@gm.rkmvu.ac.in swathyprabhu@gmail.com
placement cell : bdaplacement@gm.rkmvu.ac.in

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2. Faculty details

2.1 In-house Faculty

- **Sarvottamananda**, Professor [PhD, IIT-Kanpur (India)].
  – *Vice Chancellor* of the institute.
  – Research interests: *Computational Geometry, Center-points, Intersection Radii*.
- **Subir K. Ghosh**, Professor [PhD, TIFR/University of Bombay (India)].
  – *Fellow of Indian Academy of Sciences*.
  – *Ex-Professor of TIFR-Bombay (India)*.
  – *Adjunct Professor of IIT-Kharagpur (India)*.
  – *Visiting Professor of NBHM (National Board for Higher Mathematics)*.

– Research interests: *Computational Geometry and Applications, Robot Motion Planning, Geometric Graph Theory and Applications, Discrete Mathematics, Algorithms: Sequential, Parallel, On-line and Approximation*.

- **Dhyanagamyananda**, Assistant Professor [PhD, Indian Statistical Institute (India)
  – Research interests: Graph Theory, Graph Coloring.
- **Sudipta Das**, Assistant Professor [PhD, IISc-Bangalore (India)].
  – Post-doc from *ISI-Kolkata (India)*.
  – Research interests: Reliability, Stochastic Processes, Data Analytics, Real Time Systems.
- **Br. Tamal**, Assistant Professor [PhD, University at Buffalo (SUNY Buffalo), NY (USA)].
  – ex-Lecturer, University of Rochester, USA
  – Research interests: Artificial Intelligence, Machine Learning, Decision Theory, Database Systems, Networking, Computer Security
- **Br. Mrinmay**, Assistant Professor [PhD, Penn State University (USA)].
  – M.S. and PhD from Penn State University (USA).
  – Research interests: Operations Research, Optimization
- **Shastravidyananda**, Assistant Professor [M.Tech (CS), Jadavpur University, Kolkata (India)]
- **Joydeep Mukherjee**, Assistant Professor [PhD, Institute of Mathematical Sciences-Chennai (India)].
  – Research interests: Graph Theory, String Graphs, Computational Geometry.

2.2 Adjunct Faculty

- **Naveen Narisetty**, Adjunct Professsor[PhD, University of Michigan (USA)].
  – *Assistant Professor in University of Illinois, Urbana Champagne (USA).*
  – Research interests: High Dimensional Data, Model Selection, Bayesian Computation, Functional Data, Quantile-based Inference, Censored Data, Data Depth.
- **Sandip Das**, Adjunct Professor [PhD, ISI-Kolkata (India)].
  – *Professor of ISI-Kolkata (India).*
  – Research interests: Computational and combinatorial geometry, Graph theory and combinatorics, Algorithms.
- **Sudebkumar P. Pal**, Adjunct Professor [PhD, IISc-Bangalore (India)].
  – *Professor of IIT-Kharagpur (India).*
  – Research interests: Design and analysis of algorithms, Computational and combinatorial geometry, Graph theory and combinatorics.
- **Anil Maheswari**, – *Professor of Carleton University, Canada.*
  – Research interests: Design and analysis of algorithms, Computational and combinatorial geometry, Graph theory, Randomization.

2.3 Visiting Faculty

- **Arijit Chakrabarty**, [PhD, Cornell University (USA)].
  – *Associate Professsor in ISI, Kolkata (India).*
  – Research interests: Random Matrix Theory, Heavy Tailed Distribution, Large Deviation, Long Range Dependnce.
- **Krishanu Maulik**, [PhD, Cornell University (USA)].
  – *Associate Professor of ISI-Kolkata (India).*
  – Research interests: Applied Probability and Stochastic Process, Internet Traffic Modelling, Regular Variation, Heavy Tailed Distribution.
- **Raghu Nandan Sengupta**, [FPM (PhD) in Operations Management, IIM Calcutta (India)].
  – *Professor of Dept. of Industrial Management Engg., IIT-Kanpur (India).*
  – Research interests: Sequential Estimation, Statistical and Mathematical Reliability Theory, Risk Analysis and its Optimisation Techniques in Finance, Meta-heuristic Techniques.
- **Sujoy Kumar Biswas,** [PhD, University of California, Santa Cruz].
  –*Director and Principal Scientist of AIMP LABS, Kolkata.*
  – *Visiting Scientist, Electronics and Communication Science Unit, ISI-Kolkata (India).*
  – Research interests: Computer Vision (Visual Recognisation), Statistical Machine Learning.

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3. MSc in Big Data Analytics

The MSc in Big Data Analytics is a 4-semester PG degree program. As of now there only a less than 10 institutions in all over India and only one such in West Bengal that offers this degree program. In the first three semesters the students are taught the core concepts, techniques and tools required for large-scale data analysis.

The curriculum for this degree programme is a mix of basic mathematics, statistics, operations research and state-of-the-art big data technologies such as, NoSQL, Hadoop, Spark, etc. Laboratory sessions and tutorials will put these elements to practice through the execution of use cases extracted from real life domains.

3.1 MSc BDA - Objective Statement

The BDA degree program is designed to inculcate in student the following.

- Basic understanding of statistical methods, probability, mathematical foundations, and computing methods relevant to data analytics.
- Knowledge about storage, organization, and manipulation of structured data.
- Understanding of the challenges associated with big data computing.
- Training in contemporary big data technologies
- Understanding about the analytics chain beginning with problem identification and translation, followed by model building and validation with the aim of knowledge discovery in the given domain.
- Applying dimensionality reduction techniques in finding patterns/features/factors in big data.
- Estimation of various statistics from stored and/or streaming data in the iterative process of model selection and model building.
- Future event prediction associated with a degree of uncertainty.
- Modelling optimization techniques such as linear programming, non-linear programming, transportation techniques in various problem domains such as marketing and supply chain management.
- Skill to interpret analytical models to make better business decisions.

3.2 Course List

The list of courses offered in this degree programme are as follows. Occasion permitting some of the advanced topics are taught with the assitance of Professors from ISI-Kolkata, and other reputed institutions.

DA100	Programming for Data Science
DA101	Data Structures and Algorithms (bridge course)
DA102	Basic Statistics using R
DA103	Linear Algebra and Matrix Computation
DA104	Probability and Stochastic processes
DA210	Advanced Statistical Methods
DA220	Machine Learning
DA330	Advanced Machine Learning and Deep Learning
DA205	Data Mining
DA310	Multivariate Statistics
CS246	Artificial Intelligence (Reinforcement Learning)
CS342	Computer Vision
CS247	Optimization for Machine Learning
CS326	Optimization algorithms
DA230	Enabling Technologies for Big Data (Hadoop, Spark etc)
DA311	Time Series Analysis and Forecasting
DA242	Introduction to Econometrics and Finance
DA301	Summer Project
DA401	MSc Analytics Project with Thesis

This two-year degree programme comprises 90 credits, where each credit is equal to 15 teaching hours.

The fourth semester is dedicated for the 12-credit Master's degree Project. The students can choose to do either an academic or an industrial project depending on their preferences. At the close of the project

period the students need to present their work before an elite panel of faculty members, and also submit a dissertation on the topic of the work.

3.3 Research publications from students' thesis

1. Sayanta Paul, Sree Kalyani Jandhyala and Tanmay Basu. *Early Detection of Signs of Anorexia and Depression Over Social Media using Effective Machine Learning Frameworks*, published in Proceedings of CLEF 2018 Working Notes, Avignon, France.
2. Avideep Mukherjee and Tanmay Basu. *An Effective Nearest Neighbor Classification Technique Using Medoid Based Weighting Scheme*, published in Proceedings of the Fourteenth International Conference on Data Science, pp. 231-234, Las Vegas, USA, 2018.

   The rewrite of the above contribution later got published in Springer Nature Applied Sciences (2020) 2:1009 | https://doi.org/10.1007/s42452-020-2738-8
3. Ritam Majumder and Tanmay Basu. *Towards Developing Effective Machine Learning Frameworks to Identify Toxic Conversations Over Social Media*, published in Proceedings of the Fourteenth International Conference on Data Science, pp. 239-240, Las Vegas, USA, 2018.
4. Anurag Banerjee and Tanmay Basu. *Yet Another Weighting Scheme for Collaborative Filtering Towards Effective Movie Recommendation*, published in Proceedings of the Fourteenth International Conference on Data Science, pp. 237-238, Las Vegas, USA, 2018.
5. Arnab Roy and Tanmay Basu. *Effective Grouping of Unlabeled Texts using A New Similarity Measure for Spectral Clustering*, published in Proceedings of the Fourteenth International Confer-

ence on Data Science, pp. 181-184, Las Vegas, USA, 2018

6. Shubhaditya Goswami, Sukanya Pal, *Simon Goldsworthy and Tanmay Basu. An Effective Machine Learning Framework for Data Elements Extraction from the Literature of Anxiety Outcome Measures to Build Systematic Review*, accepted for publication in Proceedings of Business Information Systems, Sevilla, Spain, 2019.
7. S. Das and S. Das, *Deciding an optimal time to release a software which is debugged periodically*. International Conference on Mathematical Methods in Reliability, June 2019, Hongkong.

3.4 Transferable Skills

Through the medium of course work the students obtain relevant skill and proficiency in,

R (Statistical Programming Language)
Python for Machine Learning (Programming language)
Linux (operating system)
Scikit-Learn, Pytorch (machine learning tool)
Hadoop, (Big Data technology)
Report preparation and presentation in Latex
Data Visualazation using ggplot2, matplotlib, seaborn
SQL, and No-SQL
Communicative English.

3.5 Internship, Placement, and Research

The curriculum of MSc Big Data Analytics mandates the students to carry out a 5-month degree project during the fourth semester. The

degree project can be carried out through corporate internship, or academic internship in various institutes of the student's choice.

Since the inception of this program, our students have underwent paid internship at corporates such as TCS Pvt. Ltd, Dr. Reddy Labs, Tata Steel Pvt Ltd, ZS Associates, Autowiz Pvt Ltd., RS Software Pvt. Ltd. etc, and have later got placed at their respective companies owing to their competetive performance during the internship.

The Big Data Analytics programs also gives strong emphasis on Research by engaging the students in the study of contemporary research topics in Machine Learning and Artificial Intelligence. As a result we could continually turn over a couple of students every year to pursue research in reputed institutions like IIT Kanpur, Indian Statistical Institute, TCG-Crest Kolkata. We also have a couple of students securing research positions in KAUST Saudi Arabia, and NTU Singapore.

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4. MSc in Computer Science

Computer Science plays a pivotal role in this era of digital revolution. Its presence in today's world is ubiquitous. There is a great demand, both in industry and in academia, for computer science graduates who have sound knowledge of the underlying concepts and principles governing computer science as well as the ability to apply them to solve real-world problems.

The Department of Computer Science at RKMVERI trains students to achieve both these goals, which will enable them to excel in their professional careers - whether in academics, research labs, or industry.

4.1 MSc CS - Objective Statement

The MSc CS degree program is designed to inculcate in student the following.

- Understanding of the theoretical underpinnings in computing and computing systems.
- Knowledge of the interfacing of s/w with h/w through the study of computer architecture, compilers, and systems programming.
- Knowledge about storage, organization, and manipulation of structured data.
- Knowledge and application of various algorithms, algorithmic methods, and data structures in solving computational problems drawn from various fields such as computational geometry, distributed systems, data mining, mobile computing, computer vision, artificial intelligence etc.
- Understanding of the linkages that optimization techinues has with machine learning, deep learning, data mining, computer vision etc
- Knowledge of complexity classes and its appearance in algorithm design.
- Develop workable solutions for problems drawn either from social context or from research corpus.
- Develop s/w applications for handheld devices in Android.
- Use software development tools, software systems in modern computing platforms.
- Communicate computer science concepts, designs, and solutions effectively and professionally.

4.2 Course List

MSc Computer Science is a two year curriculum with 90 credits, where each credit is equal to 15 teaching hours. The program curriculum that the 2018-20 batch of students underwent comprises the following table of courses.

CS327	Cryptology
CS230	Machine Learning
CS218	Algorithms for Data Science
CS342	Computer Vision
CS212	Computational Geometry
CS222	Optimization Techniques
CS246	Artificial Intelligence
CS312	Approximation and Online algorithms
CS304	Topics in graph algorithms
CS229	Android Programming for Handheld Devices
CS222	Java Technologies
CS200	Theory of Computation
CS201	Discrete Mathematics
CS300	Computational Complexity
CS206	Probability and Stochastic processes
CS110	Design and Analysis of Algorithms
CS211	Advanced Algorithms
CS305	Topics in Enumerative Combinatorics
CS123	Concepts of Programming Languages
CS128	Oracle for Database Administrator

4.3 About the students

- Number of students in MSc CS (2020-2022 batch) is 7.

- These students are all from West Bengal and they have their first degree in computer science.

Relevant skills obtained through the courses: The students are well versed with

C, C++, Java, R, Python (programming languages)
Linux (operating system)
Scikit-Learn (machine learning tool)
Hadoop, (big data technology)
Preparation of reports and presentations in Latex
Communicative English

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5. Computational Resources

RKMVERI is a member institution of the National Knowledge Network (NKN). which provides us Gigabit Internet parterning with BSNL. The various units such as Academic Quarters, Hostels, and Guest Houses are internetworked by campus wide lan. Besides Hostels the rest of all the locations have uninterrrupted Wifi access.

The Belur Main Campus has altogether 6 computer labs interconnected by a Gigabit LAN. They are,

- Fully airconditioned Big Data Lab equipped with 30 workstations powered by Intel Xeon E3-1225 V5 processors setup with the sponsorship of Tata Consultancy Services Ltd. in 2017
- Fully airconditioned Machine learning lab equipped with 30 numbers of Ryzen7 powered 16GB RAM workstations, setup

Figure 5.1: Big Data Lab

with the sponsorship of Indian Oil Corporation Ltd. in 2019.

- The same year (2019) department procured a 32 core (64 thread)-256 GB RAM ASUS server powered by Intel Gold Scalable processors with base frequency of 2.3GHz.

- **GPU Resources:**
  Hi-Performance Computing (HPC) cluster is equipped with
  - 5 GPU servers powered by Asus RTX 2080 Ti graphics card
  - 2 GPU servers powered by founder's edittion NVIDIA RTX 3080
  - HP Z8 workstation with the latest Nvidia Quadro GV100 graphics Card and 64GB RAM,

  These HPC machines are available 24×7 hrs for remote access for the department students to run Vision, AI, and ML related projects. Using the wake-on-lan feature the servers are optimally

Figure 5.2: Machine Learning Lab

powered by the students themselves from remote.

- Two fully airconditioned generic computing labs each having 20 seating capacity, and one non-a/c 16 seater lab.