Rajeev Kumar

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Rajeev Kumar is a Professor of Computer Science at **JNU** New Delhi**.** He holds a PhD degree in Computer Engineering from **Univ. Sheffield,** an M.Tech. degree in Computer Sc. & Tech. from **Univ. Roorkee** (now, IIT Roorkee)**,** and an M.Sc. degree in Physics (Electronics) from **Univ. Allahabad.** His primary education was in a river-side *Gurukul*, Shri Dugdheshwar Sanskrit Mahavidyalaya at Pilibhit.

Earlier, he served the Indian Institutes of Technology (**IITs) at Kharagpur & Kanpur** and Birla Institute of Technology & Science (**BITS) Pilani**. Prior to his academic tenure, he worked as a Scientist in the Department of Science and Technology (**DST)** Hyderabad and New Delhi and Defence R & D Organization **(DRDO)** Dehradun. He has done a visiting assignment at National Semiconductors (**NSC**) Germany and has visited several universities in UK, USA, Germany, Switzerland, Japan, S. Korea, and Singapore.

Research: He has four decades of experience in research and teaching. His research interests include machine learning, scientometrics, programming language, software system, multimedia & evolutionary optimization. He has published over 200 research articles in international journals and conferences. He has supervised fourteen doctoral theses, over eighty master theses, and hundred undergraduate projects. He is currently supervising eight doctoral and three master students. He has worked on industrial-funded projects from Microsoft and NSC, the NSC project was in close collaboration with their units in USA, Germany, and Israel. He founded *Data to Knowledge* (D2K) Lab in JNU. His h-index, on Google Scholar, is 25.

Teaching: Rajeev has designed and taught several Computer Science & Engineering courses ranging from freshman to senior graduate level. He has taught programming (C/C++/C#/Java/R/Python), core and advanced (Data Struct., Algorithms, Compiler, Software Engg, Pattern Classification, Machine Learning), application (Image/Video Processing, Computer Vision, Multimedia Sys.), and specialized courses (Statistics, Evolutionary Comp, Research Method, etc.). In JNU, he introduced a course on *Academic Ethics*. His teaching focuses on enhanced student engagement for active learning, creativity, and innovation.

Academic Leadership: He served as a Senator in IITs Kharagpur/Kanpur and BITS, member of the Court and Academic Council in JNU, and several other academic bodies, e.g., Board of Studies, Statutory Comm. of Institutes/Universities. He worked for reforms/revisions in curriculum, academic structure, regulations, and ordinances. He worked as an active member, a crisis handler in most committees. He is known for out-of-box solutions for complex problems in simpler manner.

Public Policy: Rajeev has contributed significantly towards framing public policies for higher education. He reformed policies for IITs admission examinations bringing transparency and accuracy through well-defined processes. He was instrumental in introducing a ***common* examination** and ***common counseling*** (JoSAA) for admissions in all IITs/NITs/IIITs/CFTIs in India. Almost all admission & competitive examinations, in most disciplines, have been reformed following this model. His proposal for an independent body led to the setting of the National Testing Agency (**NTA**). The inclusion of common examinations in NEP 2020 is a testimony of his work, leading to **CUETs** in Central Univ. His proposal for **common counselling in CUs** is being worked-out. India's Supreme Court hailed him as *one of the many unsung heroes who helped in improving the system*.

He defined quantitative Academic Performance Indices (**APIs**) in 2009 for engineering faculty. He co-authored/authored *output based quantifiable* accreditation guidelines, from 2009 to 2011, for UG engineering programs. These were in public use since 2011; this also led to setting up National Board of Accreditation (**NBA**) as an autonomous body. This work led India acquire permanent membership of **Washington Accord** in June 2014. Revised guidelines are in public use now.

Services: He has been a regular reviewer in several journals/conferences and served in Technical Program Committees. He delivered several keynote addresses, invited lectures, and tutorials in conferences.

His academic and administrative experience of four decades spanning Univ./Insts. across India and abroad and combined with his 24/7 work-ethics as a team player with difference, *reform-centric,* and *student-oriented* leadership, *legal accumenship*, and having *wider* perception, is an asset to the Institute he serves. ***

About Me:

- **Education:** I obtained Ph.D. in Computer Engineering from Univ. Sheffield, England, M.Tech. in Computer Sc. & Tech. from Univ. Roorkee (now, IIT Roorkee), and MSc in Physics (Electronics) from Univ. Allahabad.
    - My PhD thesis was nominated for the distinguished CS thesis award in UK.
    - I was awarded Univ. Medal for being the first rank holder in MTech.
- **Experience:** I have over four decades of research and teaching experience working in:
    - Academic Institutions: BITS Pilani, IIT Kharagpur, IIT Kanpur, and JNU New Delhi.
    - Research Organization: DRDO (DEAL), Dehradun.
    - Industry: National Semiconductors, Germany (Visiting).
- **In Academic Bodies:** I have been an active and contributory member in most types of academic bodies:
    - National:
        - Chief Examiner, GATE Computer Science (IITs)
        - Chair/Member, NBA Accreditation Teams: Assorted
    - Institute:
        - Univ. Court, Academic Council (JNU): 1 years
        - Senate (IIT Kharagpur, BITS): 11 years
        - Senate Sub-Committee: Undergraduate Program (IIT Kharagpur): 8 years
        - Research Board (BITS): 2 years
        - Lib. Comm. (BITS): 2 years
    - Department:
        - CSE Academic Comm. (IIT Kharagpur, BITS, JNU): 16 years
        - Doctoral Scrutiny Committee (IIT Kharagpur): Assorted
    - Other Institutes (selected recent ones): Banasthali Univ., Poorvanchal Univ., etc.: 2 years, IIT Patna
- **In Academic Admin**.: I have been actively involved in a variety of the following academic administration; I was also a crisis handler:
    - National:
        - Chair, NBA UG Engineering Accreditation Guidelines Draft Comm.
        - Reforms in JEE and JEE (Adv.) resulting in a common examination for CFTIs.
        - Formulation of Common Counselling for all UG engineering admissions, JoSSA.
        - Conceptualization of National Testing Agency (NTA).
    - Institute:
        - Anti-Plagiarism Policy Draft Comm., (JNU): 1 year
        - Intellectual Property Management Comm. (JNU): 1 year
    - Department/School:
        - Prof.-in-Charge, Data-to-Knowledge (D2K) Lab, SC&SS, JNU: 6 years
        - CSE Admin. Committee (IIT Kharagpur): 5 years
        - Professor-in-Charge, Dept. CSE Lib. (IIT Kharagpur): 2 years
        - Faculty – Student Comm. (JNU): 4 years
    - International Level
        - Program Chair, Publication Chair, Publicity Chair, etc. for international conferences.
- **Research Leadership:** Directed large teams of Research Associates and Doctoral/Master's thesis students in IIT Kharagpur and JNU. I founded Data to Knowledge (D2K) Lab in JNU.
    - In JNU, I solely supervised more than twenty thesis students at a time.
    - There were few tens of Machine Learning Course students worked for their projects.
    - The D2K Lab produced significant number of quality research papers, published in decent Journals and presented in conferences.
    - There were seminars by students and external experts.

- **Public Policies:** I have maintained a delicate balance between stakeholders, namely Government and academicians while developing impact-driven public policies:
  - As Chair of an NBA (National Board of Accreditation) team, I drafted outcome-based UG-Engineering accreditation guidelines. This led to India's entry into the Washington Accord and worldwide recognition of Indian UG-Engineering degrees.
  - Pioneered transparency, common examination, and common counselling in Engineering admissions. This has been adopted by almost all other admissions in the country. The inclusion of common examinations in NEP 2020 is a testimony of my work. My proposal for Common Examinations for Central Universities introduced CUETs in CUs.
  - My proposal for an independent body led to the founding of the National Testing Agency (NTA).
  - Proposed Common Counselling for all admissions in Central Universities. (Under consideration)
  - Proposed measures and processes for mental well-beings, early alert generations, and grievance redressals for preventing unfortunate incidences in IITs. (Under consideration)

- **Teaching:** I subscribe to an *active* learning style of teaching. I draw upon fundamental concepts as well as emerging technologies to keep the subject material relevant and interesting.
  - Taught, developed, and restructured core and advanced courses in Computer Sc. & Engg. for UG and PG students in IIT Kharagpur, BITS Pilani, JNU.
  - Introduced university-wide course on Academic Ethics at JNU.
  - Delivered tutorials for international conference ACM GECCO: USA, UK (funding: Google Inc.)
  - Keynote/Invited addresses in Faculty Development Programs/Short Term Courses.
  - Conceptualized Dual-degree (BTech + MTech) program combining Comp Sc with Social Sc.

- **Research:** My research interests include machine learning, scientometrics, programming language, software systems, multimedia, evolutionary optimization, and academic governance & ethics.
  - Published over 200 research articles in international journals and conferences.
  - Research papers in leading international conf. in USA, UK, Germany, Canada, Japan, S. Korea, etc.
  - Invited/research talks in several universities in USA, Germany, Switzerland, Japan, S. Korea, etc.
  - Key-note & tutorial speakers in several int. conferences. Reviewer in several journals, conferences.
  - Supervised 14 doctoral, 80 master theses. Currently supervising 8 doctoral and 3 master students.
  - Worked on industrial-funded projects from Microsoft and National Semiconductors (NSC).
  - Awarded *Test of Time* award in ISCE 2022 for the paper presented in ISEC 2011.
  - Founded *Data to Knowledge* (D2K) Lab in JNU's School of Computer & Systems Sciences.
  - *h-index*, on Google Scholar from incomplete data, is 25, which is good in sub-fields of CS.

- **Industry Collaboration: Research**
  - National Semiconductors (Germany, Israel) for developing System SW tools, simulators, compilers, etc. for their CR16X series of processors. In this work, Prof. Richard Brown, Univ. Michigan USA was another collaborator. We made per week deliveries for their design engineers, which were regularly used by many categories of stakeholders, from system designers to application users. (2001 – 2006)
  - Member, IT Advisory Comm., Canara Bank (2022 onwards)

- **Industry Collaboration: Teaching**
  - Developed courseware for .NET/C# as emerging technology (funding: Microsoft Inc. USA). (2004-07)
  - Taught Multimedia & OOS Courses to employees of Wipro & SW industries at Bangalore/Hyderabad under BITS Industry Collaboration (Off-Campus) program. (1997- 2000)

I have undertaken a wide spectrum of academic and administrative responsibilities over the past 37 years in premier academic and research institutions in India and abroad. My initial learning at DRDO: *technology transformation for end-users*, guided me towards *in-depth knowledge* and *simplified governance*. These strengths combined with my 24/7 work-ethics as a team player, inside-outside perception, and legal acumen-ship will be an asset for academic leadership. * * *

Personal Information

- Nationality : Indian
- Date of birth : March 12, 1959
- Marital Status : Widower with two children

Education

- Ph.D. in Computer Engineering (1997)
  University of Sheffield, UK
  Thesis "Feature Selection, Representation & Classification" nominated for best Thesis award in UK

- M.Tech. in Computer Science & Technology
  University of Roorkee (now, IIT Roorkee), India
  University Medalist being the first ranker

- M.Sc. in Physics (Electronics specialization)
  University of Allahabad, India
  Third Rank in the University

- B.Sc. in Maths, Physics & Chemistry
  Rohilkhand University, India

Research Scholar

- Commonwealth Research Scholar (March 1994 – Feb 1997), University of Sheffield, UK

- UGC Research Scholar (July 1980 – Nov 1983), University of Allahabad, India

Employment

- June 2015 onwards: Professor, School of Computer & Systems Sciences,
  Jawaharlal Nehru University (JNU), New Delhi, India

- April 2007 – June 2015: Professor, Department of Computer Science & Engineering,
  Indian Institute of Technology (IIT), Kharagpur, India

- Dec 2000 – April 2007: Assoc. Professor, Department of Computer Science & Engineering,
  Indian Institute of Technology (IIT), Kharagpur, India

- Feb 2000 – Dec 2000: Professor, Department of Computer Science & Information Systems,
  Birla Institute of Technology & Science (BITS), Pilani, India

- April 1997 – Jan 2000: Assoc. Professor, Department of Computer Science & Information Systems,
  Birla Institute of Technology & Science (BITS), Pilani, India

- June 1986 – March 1995: Scientist, Defense R & D Organization (DRDO),
  Defense Electronics Applications Lab (DEAL), Dehradun, India

- Dec 1983 – June 1986: Scientist, Department of Science & Technology (DST),
  Survey of India, Hyderabad / New Delhi, India

Visiting Positions

- July 2013 – May 2014: Visiting Professor, Department of Computer Science & Engineering,
  Indian Institute of Technology (IIT), Kanpur, India

- June 2005 – May 2006: Visiting Faculty, Department of Computer Science & Engineering,
  Indian Institute of Technology (IIT), Kanpur, India

- May 2002 – July 2002: Visiting Design Engineer, National Semiconductors GmbH, Germany

Teaching Courses (Graduate and undergraduate)

- Foundations of Computing (C, C++, Java, Python)
- Data Structures & Algorithms (Core & Adv.)
- Compiler Construction (Core & Adv.)
- Object-Oriented Programming (C++, Java, C#)
- Object-Oriented Analysis & Design (UML)
- Programming Methodology
- Multimedia Systems
- Machine Learning
- Research Methodology
- Academic Ethics
- Programming & Data Structures (C, C++, Java)
- Design & Analysis of Algorithms
- Software Engineering (Core & Adv.)
- Object-Oriented Language Implementation
- Object-Oriented Software Engineering
- Software Architecture
- Image & Video Processing
- Evolutionary Computing
- (Bio-)Statistics (with R) @ Life Sciences
- Technical Writing

Research Interests

- Machine Learning: Outlier Detection, Medical Image Analysis, Edu. Data Mining, & Scientometrics.
- Programming Languages & Software Engineering.
- Multimedia & Social Networks.
- Evolutionary Multiobjective Combinatorial Optimization & Nature Inspired Algorithms.

Selected Sponsored Research & Industrial Projects

Educational Data Mining	2018 - 19	INR 500K	University Grants Commission
Virtual Lab – Programming & Data Structure Lab	2010 – 12	INR 1500 K	Min. Human Resource Dev., Government of India
NPTEL Video Course Development – Compiler, Multimedia	2010 – 13	---	Min. Human Resource Dev., Government of India
Object Oriented (C#/.NET centric) Courseware Development	2004 – 07	USD 22 K	Microsoft Corp., USA
Multiobjective Evolutionary Algorithms for Combinatorial Optim.	2002 – 07	INR 1000 K	Min. Human Resource Dev., Government of India
Software Tools for Embedded Systems (*co*-PI)	2003 – 06	USD 100 K	National Semiconductors Corp., Germany/USA
Software Tools for CR Processors (*co*-PI)	2001 – 03	USD 225 K	National Semiconductors Corp., Germany/USA
Convergence of Multiobjective Optim.	2001 – 03	INR 100 K	IIT Kharagpur

Theses/Projects Supervision

	Completed	Ongoing
Doctoral	8+6*	8
Graduate (by research)	4	--
Graduate (M.Tech., MPhil, MSc)	~ 70 + 10*	3
Undergraduate projects	~ 100 + 20*	--

*: In joint supervision.

Publications

Book	1
Edited Books (Conf. Proceedings)	3
Chapters in Edited Books	4
Published Tutorials	3
Journal Research Articles	80
International Conference/Workshop Research Articles	~110
National Conference/Workshop Research Articles	~20

International Work / Collaboration: Research

Visitor	GaTech Atlanta, US	ML, PL	Feb-Mar 2023
Visitor	NUS, Singapore	ML, PL	June, Dec. 2022
Visitor	UPenn, Rice Univ, USA	Prog. Lang., ML	May 2022
Visitor	NUS, Singapore	Multimedia, ML	July 2019
Visitor	Rice Univ., USA	Machine Learning	Mar. 2018
Visitor	Univ. Sheffield, UK	Evo. Algo. Comb. Optim.	July 2007
Visitor	GIST, S. Korea	Evo. Algo. Comb. Optim.	Mar. 2007
Visitor	TU Darmstadt, Germany	Prog. Lang., Multimedia	Sep. 2006
Visitor	Aizu Univ., Japan	Evo. Algo. Comb. Optim.	Jan.2005
Visitor	UIUC, USA	Multimedia, Evo. Algo	July 2003
Visitor	ETHZ Switzerland	Multi-obj. Evo. Algo.	June 2002
Visitor	MIT, CMU: USA	Machine Vision	July 1996
PhD, TA	Sheffield Univ., UK	Comp. Engg.	Mar 1994 to Apr 1997

International Industry Collaboration: Research

Design Engineer	NSC Germany	SW Sys. Tools: Compiler, Simulator etc.	May – July 2002 Oct. 2001

Industry Collaboration: Teaching

Microsoft Research USA	Object Oriented (C#/.NET centric) Courseware	2004 – 07
Wipro & SW Industries	Object Oriented Sys Development, Multimedia Systems	1998 – 2000

Public Policy: In the Service of the Nation

- Worked for Common Examination and Common Counselling in Central Universities (2018 onward)
- Pioneered Common Examinations and Common Counselling for UG Admissions in IITs, NITs, IIITs, CFTIs, etc. with wide-spread reforms in IIT-JEE (2006 - 15) (Based on IIT-JEE Reform Proposals, Sep. 06, Oct. 08, Feb. 10, Sep. 10, July 11, Aug. 14, Nov. 15)
- Authored: NBA Accreditation Guidelines for UG Engg. Programs, May 11. In Public use: July 2011 to Jan. 2013. This led India acquiring permanent membership of Washington Accord in June 2014. http://www.nbaind.org/Files/engineering-programs.pdf
- Co-Authored: NBA Revised guidelines for Accreditation UG Engg. Programs, July 09. In Public Use: July 2009 to June 2011. http://www.nbaind.org/Files/Report%202009.pdf

External Services (a few recent ones)

- Expert, NTA Tech. Comm. (2023)
- Expert, IT Advisory Comm., Canara Bank (2022 Onward)
- Expert, Tech. Comm., Agriculture Scientists Recruitment Board (ASRB), Dept. Agri. Res. Edu. (2022)
- Ext. Member, Board of Studies, Banasthali Univ. (2019 - 22), Poorvanchal Univ. (2018 - 20)
- Member, Apex Committee for DRDO Awards 2016, Dept. Def. R & D, Govt. of India
- Chairman/Expert Member, National Accreditation Board (NBA) Visiting Committees to Engineering Institutions (2007 onwards)
- CSE Expert, UPSC, New Delhi

Academic Administration @ JNU New Delhi (2015 onwards)

- Founder Director, *Data to Knowledge* (D2K) Lab, SC&SS, JNU (2016 onwards)
- Member, Faculty – Student Comm., School Comp. & Sys. Sci. (2015 – 2019)
- Member, Univ. Anti-Plagiarism Policy Draft Comm. (2016 - 17)
- Member, Univ. IPR Policy Draft Comm. (2017)
- Chairman, AICTE Programme Approval Comm., School Comp. & Sys. Sci. (2015-16)
- Member, MCA Re-structuring Comm., School Comp. & Sys. Sci. (2016).

Academic Administration @ IIT Kharagpur (2001- 2015)

- Member, Senate (2007 – 15),
- Undergraduate Program Evaluation Committee (UGPEC): CSE coordinator (2001-05); (2007 – 11)
- Member, CSE Academic Committee, IIT Kgp (2001 – 05; 2007 – 11)
- Member, CSE Dept. Administrative Committee, IIT Kgp (2004 - 05, 2006 - 10)
- Professor-in-Charge Library, CSE and Liaison with Central Library, IIT Kgp (2006 – 08)
- Member, Doctoral Scrutiny Committee(s);
- Chief Examiner, GATE Computer Sc (2005)
- Professor-In-Charge, JEE Examination Centre(s),
- Faculty Advisor/Counselor/Mentor, Faculty, PGDIT and PGDST Programs

Academic Administration/Work @ BITS Pilani (1997 – 2000)

- Updated CS and IS Curriculum and Introduced/Restructured Courses
- Introduced Lab Components in CS Courses
- Faculty, Distance Education @ Wipro and others
- Resource Faculty, Teaching Workshops
- Member – Academics, Doctoral, Research & Consultancy, Recruitment, Library, Senate.

New Courses Developed / Restructured

- Bio-Statistics [2018] @ JNU – *bringing computation with R*
- Academic Ethics [2016] @ JNU
- Software Engineering [2006] – *bringing synergy with Trusted Computing* @ IIT Kharagpur
- OO Sys. Implementation [2005] –*synergy in PLI, SE, VEE for trusted computing* @ IIT Kanpur
- Foundations of Computing [2005] – *with Java* @ IIT Kanpur
- Multimedia Systems [1998, 2001] @ BITS Pilani, IIT Kharagpur
- Evolutionary Algorithm [1999] @ BITS Pilani
- Programming Language & Compiler Construction [1998] @ BITS Pilani
- Data Structures & Algorithms [1998] @ BITS Pilani
- Computational Intelligence [1998] @ BITS Pilani

Awards & Professional Recognition

- Affiliation with Professional Bodies
  - Fellow, IETE, India

- Fellow, ISSA, India
- Senior Member, ACM, USA
- Senior Member, IEEE, USA
- Entrusted with Drafting Washington Accord based UG Engg. Accreditation Guidelines
  - Drafted the 3rd fully Revised Edition (May 11); In National Use since May 2011. India acquired permanent membership of Washington Accord in June 2014.
  - Conducted National Awareness Workshops for Institutes and Assessors (2009)

- Tech. Paper Reviewer, Conference Organization, Conf. Program Committee Member : In many
- RTI Citizen's Runner-up Award for Public Services (2009)
- Karmaveer Chakra (2013)
- ISEC's *Test of Time* Award for the ISEC 2011 Paper (2022)

Tutorials

- Evo. Multi-criteria Optim. @ GECCO-07, London; GECCO-08, Atlanta; GECCO-09, Montréal.
- Architecture exploration for embedded system design @ HiPC-04, Bangalore.
- Multimedia system design for QoS @ HiPC-03, Hyderabad.
- Multimedia system @ ITPC-03, Kathamandu.

Invited Talks / Seminars

Machine Learning & Data Analytics

- D2K: Machine Learning & Data Intelligence @ FDP, JIIT Noida, Jan. 2023.
- Evolution of a perceptron to massively connectionist deep learning architecture with applications @ UPES Dehradun, Dec. 2021.
- Evolving a perceptron to massively connectionist deep learning architecture with applications @ Rajiv Gandhi University, Itanagar, Sep. 2021
- Intro. to Prob. Theory in ML @ NIT Jalandhar, Sep. 2020
- The Pedagogy of AI for Multidisciplinary Students @ Huawei AI Educator Symp, Mumbai, Dec. 2019
- ML: Research Directions and Applications @ FDP, KEIT Ghaziabad, June 2019.
- AI: Issues and Current Trends @ World TelComm. & Info. Society Day, C-DoT Delhi, June 2018.
- ML: Issues & Research Directions @ ML Workshop, IMS Ghaziabad, Jan. 2018.
- Trends in Outlier Detection: Issues & Challenges @ Data Mining STC, NSIT Delhi, Nov. 2017.
- Data-mining by meta-learning @ IARCS Course, 2004.
- Meta-learning of high-dim. spaces for scaling and generalization in data mining @ IIIT-H, 2000.
- Scaling and generalization in data mining by meta learning of data patterns @ IETE Pilani, 1999.
- Hybrid computational intelligent systems @ KanGAL, IIT Kanpur, 1997.
- Hierarchical organization of intelligent models @ TIET Patiala, 1997.
- Hybrid Intelligent models @ BITS Pilani, 1997.

Education, Sc. & Tech., E-Office & Governance

- Ethical Writing: Learning form experiences of day-to-day live examples @ ICARS Delhi, June 2020.
- Scientometrics and Publication Ethics @ VJTI Mumbai, Dec. 2019.
- E-Governance with AI / ML @ Refresher Course, UGC-HRDC, JNU, July 2018, Aug. 2019.
- Crisis in HEIs in India: A Technological Perspective @ Press Club of India, JNUTA, Nov. 2018.
- Evolution of Paperless PhD: A journey from stone-age to paperless age, in Seminar series on Decoding Sc. & Tech. for everyone @ JNU, Oct. 2018.
- Academy Autonomy: Gurukuls and Today's HEI @ ISSCA Workshop, Delhi Univ., Feb. 2018.
- Academic Autonomy vs. Quality in Education: from Gurukul to Today's Institutions. A plenary talk in Workshop for Growth of Science & Technology, VBS Purvanchal Univ., Sep. 2017.

- Personal Computers to Personalized Computing for Socializing and Banking: A Paradigm Shift in Computing & Comm. Research, Ind. Social Science Congress (ISSC), Andhra Univ., Mar. 2015.

Programming Languages & Software Systems

- Software Engineering and Runtime Systems @ NIT Rourkela, May 2009.
- Object oriented software engg. :: concepts and practices @ NIT Durgapur, Thapar Univ., 2008.
- Virtual execution environment for trusted computing @ NIT Rourkela, October 2008.
- Object oriented software engineering:: A Lecture series @ JIITU Noida, September 2008.
- Programming pearls and pitfalls @ JIITU Noida, January 2008.
- Multiple polymorphic arguments in object-oriented lang. @ IIT Delhi, TU-Darmstadt, 2006.
- Object oriented language implementation course – a working proposal @ Microsoft, 2006.
- Reusable plug-in software components for dependable systems @ EuroIndia, 2004.
- Software tools for extensible CompactRisc processors @ National, Munich, June 2002.
- Message dispatch in object-oriented systems @ IIIT Hyderabad, 2000.

Evolutionary Multiobjective Combinatorial Optimization (EMCO)

- EMCO: Issues and Research Directions @ UGC HRDC, JNU, Sep. 2015.
- EMCO: A keynote talk @ ICCC, Noida, Sep. 2008.
- EMCO - solving hard problems @ Gwangju IST, S. Korea, Mar. 2007.
- Solving hard problems in EMO - a practitioner's approach @ KanGAL, IIT Kanpur, 2006.
- Convergence in multiobjective genetic optim. & combinatorial prob. @ IlliGAL UIUC, 2003.
- Convergence in multiobjective genetic optim. using rank-histograms @ ETH Zurich, June 2002.
- Population driven computational paradigm for search and optimization @ BITS PIlani, 2000.
- A practical approach to EMO @ IIT Roorkee, 1997.

Multimedia & Embedded Systems

- Video coding – history & practices: Keynote talk @ Int. Conf. SP, SATI Vidisha (2016).
- Video transcoding: algorithms and architectures @ TU-Darmstadt, 2006.
- Networked multimedia @ DPN Conf., Kharagpur, 2004.
- Globalization through miniaturized multimedia devices @ Allahabad Univ. (2004).
- Embedded System Design @ Galgotias Noida, 2004.
- Design space exploration tools for embedded systems @ CEERI (2004), EuroIndia (2004).
- Transcoding and QoS for multimedia traffic @ MONET, UIUC (2003).
- Teaching with tech.: multimedia in computer aided learning @ Kendriya Vidyalaya (2003).
- On QoS: reality check @ H*i*PC Trusted Internet Workshop, 2002.
- Triplet geometric representation: novel local invariants for robust recognition @ CMU, 1996.

Research Publications (in reverse chronology)

Book

[1] Soham S. Chakraborty, Rajeev Kumar, and PP Chakrabarti. Static Analysis and Optimization of Object-Oriented Systems – Concepts and Approaches. 2012. Lap Lambert Academic Publishing GmbH, Germany. ISBN 978-3-8484-1353-9.

Edited Volumes (Conf. Proceedings)

[2] Sanjay Kumar Jena, Rajeev Kumar, Ashok Kumar Turuk, and Manoranjan Dash (2011) Proc. Int. Conf. Communication, Computing, and Security (ICCCS), Rourkela, India, Feb. 12-14, 2011. ACM.

[3] Sanjay Ranka, Srinivas Aluru, Rajkumar Buyya, Yeh-Ching Chung, Sumeet Dua, Ananth Grama, Sandeep K. S. Gupta, Rajeev Kumar, Vir V. Phoha (2009) Proc. Contemporary Computing – 2nd Int. Conf., IC3 2009, Noida, India, August 17-19, 2009. Springer.

[4] Ajit Pal, Ajay Kshemkalyani, Rajeev Kumar, and Arobinda Gupta (2005) Distributed Computing - Proc. Int. Workshop Distributed Computing (IWDC). LNCS vol. 3741, Dec. 2005. ISBN 3-540-309-59-4. Springer.

Edited Book Articles

[5] Sonal Tuteja and Rajeev Kumar (2020) An Architecture for Data Unification in E-commerce using Graph. In: Kapur P. et al. (eds) *Strategic System Assurance and Business Analytics. Asset Analytics* (Performance and Safety Management), chapter 30, pages 407-417. Springer, Singapore. doi: 10.1007/978-981-15-3647-2_30

[6] Akanksha Mukhriya and Rajeev Kumar (2018) Exploring Ensembles for Unsupervised Outlier Detection: An Empirical Analysis. In: Chakraverty S., Goel A., Misra S. (eds) *Towards Extensible and Adaptable Methods in Computing*, pages 225 – 237. Springer. doi: 10.1007/978-981-13-2348-5_17

[7] Rajeev Kumar and PK Singh (2007) Pareto Evolutionary Algorithm Hybridized with Local Search for Biobjective TSP. In Hybrid Evolutionary Systems: Chap 6, 2007. Studies in Computational Intelligence Series, Springer.

[8] Rajeev Kumar (2004) On Machine Learning with Multiobjective Genetic Optimization. In Carlos A. Coello Coello, and Gary B. Lamont (Eds.), Applications of Multiobjective Evolutionary Algorithms, Chap. 17: 393 - 425, December 2004. ISBN 981-256-106-4. World Scientific.

Published Tutorials

[9] Rajeev Kumar. A Tutorial on "Evolutionary Multiobjective Combinatorial Optimization (EMCO)" -- A Specialized Tutorial. In Proc. Genetic and Evolutionary Computation Conference (GECCO-2009), Montréal, pp. 3413-3436, 09 July 2009. ACM.

[10] Rajeev Kumar. A Tutorial on "Evolutionary Multiobjective Combinatorial Optimization." A Specialized Tutorial in Genetic and Evolutionary Computing Conference (GECCO), Atlanta, pp. 2805 - 2828, 13 July 2008. ACM.

[11] Rajeev Kumar. A Tutorial on "Evolutionary Multiobjective Combinatorial Optimization." A Specialized Tutorial in Genetic and Evolutionary Computing Conference (GECCO), London, pp. 3366 - 3390, 08 July 2007. ACM.

Research Articles in Refereed Journals, Conf Proceedings, and Newsletters

[12] Neeraj Pathak and Rajeev Kumar (2023) Entropy guided evolutionary search for solving Sudoku. *Progress in Artificial Intelligence*. Springer. https://doi.org/10.1007/s13748-023-00297-7

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Doctoral Thesis Supervision:

In progress @ JNU

[1] Priti Kumari. Scientometrics of CS publications. (by May 2023)
[2] Neha Kumari. A safe generic type system for Java. (by Dec. 2023)
[3] Akhilesh Rawat. Assessing generalization in deep learning architecture with medical image analysis. (by Dec. 2023)
[4] Om Prakash. Machine intelligence with multi-modal media for social welfare. (by Dec. 2023)
[5] Gouranga Duari. Hierarchical clustering of outliers. (by March 2024)
[6] Bhupendra Kumar. Pattern discovery & clustering in ordinal survey data: algorithms and applications. (by March 2024)
[7] Farheen. Deep learning for sequential data: architecture, algorithms, & applications.
[8] Irfan Zaboo. FSA Extraction from Sequential Neural Networks.

Graduated / Submitted @ JNU

[9] Akanksha Mukhriya. Ensemble learning for unsupervised outlier detection: algorithms and applications. Oct. 2022.
[10] Neeraj Pathak. Hybrid evolutionary algorithms for solving hard combinatorial problems. Aug. 2022.
[11] Sonal Tuteja. Graph model for schema and data mapping. July 2022.
[12] Roopam Sadh. Knowledge discovery from quantitative survey data with pattern clustering and machine learning. March 2022.
[13] Sonam Chhikara. Information theoretic image steganalysis for LSB steganography. (deceased 2019).

Graduated @ IIT Kharagpur

[14] Mahesh Shirole. Concurrency Test Scenario Generation using UML Transition Sequences. Feb. 2021.
[15] Soma Saha. Unifying Heuristics and Evolutionary Computing for Characterizing and Solving Certain Combinatorial Optimization Problems, Sep. 2014.
[16] Pravanjan Choudhury. Task Scheduling on Embedded Multiprocessors, Jan. 2013. (*with Prof. P.P. Chakrabarti*)
[17] Subrat Kumar Panda. Simulation-Based Verification of Pipelined Processors, May 2010. (*with Prof. P.P. Chakrabarti*)
[18] Vasant Patil. Efficient Algorithms for Video Transcoding, October 2009.
[19] Dipankar Das. Functional and Performance Verification for Multiprocessor Embedded Applications, July 2009. (*with Prof. P.P. Chakrabarti*)
[20] Sandip Aine. Design and Control of Anytime Algorithms, September 2008. (*with Prof. P.P. Chakrabarti*)
[21] Pramod Singh. Multiobjective Combinatorial Optimization with Hybridization of EA, March 2008. (*with Prof. P.P. Chakrabarti*)
[22] Durga Prasad Mohapatra. Dynamic Slicing of Object-Oriented Programs, September 2005. (*with Prof. R. Mall*)
[23] Ashok Turuk. QoS Provisioning in WDM Networks, February 2005.

Master Thesis Supervision: M.Tech., MS (by Research), and MPhil

In progress @ JNU

[1] Biraja Mishra. Anomaly Detection from Medical Time-Signals with Deep Learning. (by June 2023)
[2] Luv Kumar. Hybridized Anomaly Detectors for Social Networks. (by June 2023)
[3] Sai Teja Tangudu. Cost-Sensitive Learning for Class Imbalance Data. (by June 2023)

Graduated @ JNU

[4] Khumaningthou Khumanthem. Interpreting outlier detection scores in ensembles. Jan. 2023.
[5] Saurabh Tewari. Social network for blended learning model. Jan. 2023.
[6] Junaciya K. Assessing generalization in medical image data. Oct. 2022.
[7] Anish Sharma. Automata modelling with recurrent neural networks. Sep. 2022.
[8] Trishita Mukherjee. Anomaly detection in complex graphs. Aug. 2022.
[9] Pooja Singh. Assessing generalization in imbalanced datasets. Aug. 2022.
[10] Gargi Mishra. Fairness in outlier detection ensembles. Aug. 2022.
[11] Surabhi Shrivastav. Abnormality detection in medical images with deep learning. Oct. 2021.
[12] Suresh Vyas. Meta-learning in ensembles. Oct. 2021.
[13] Anjali Gautam. Time series prediction with deep learning. Sep. 2021.
[14] Dipanjana De. Modelling automata by sequential neural networks. Aug. 2021.
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[16] Akhilesh Rawat. Outlier detection in high dimensional datasets. June 2021.
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[18] Priti Kumar. Scientometrics of computer science publications in journals and conferences. July 2018.
[19] Neha Kumari. A framework for runtime type genericity in Java generics. July 2018.
[20] Akanksha Mukhriya. Unsupervised outlier detection ensembles. July 2016.
[21] Neeraj Pathak. Hybrid evolutionary bi-objective optimization. July 2016.

Graduated @ IIT Kharagpur

[22] Mounika Kommuri, Test-case generation for concurrent sequence transitions, May 2012.
[23] Surender Kumar, Static analysis of generic object oriented programs, May 2012.
[24] S. Harikrishnan, Space efficient multi-method dispatch in object oriented languages, May 2012.
[25] Gyan Baboo, Multiobjective combinatorial optimization with EA, May 2012.
[26] Swadhin Barisal, Safer Java Programming Language Environment, May 2011.
[27] Krunal Modi, Graph Topology Generation, May 2011. (with Nilanjan Banerjee, UArk)
[28] Amit Suthar, Generation of test cases from UML diagrams using EAs, May 2010.
[29] Abhiram Kasina, Trusted Computing, May 2010.
[30] Mohammad Aslam, Multiobjective combinatorial optimization with GP, May 2010
[31] Sri Harsha Dandibhotle, Multiobjective combinatorial optimization with EAs, May 2010
[32] Siddharth Tiwary, Register Allocation May 2009. (with Jens Palsberg, UCLA)
[33] Anchal Nema, Concurrent Programs, May 2009.
[34] Neeraj Kumar, OO Testing, May 2009.
[35] Kundan Singh, Synchronization and Race Condition, May 2009
[36] Paresh Tolay, Multiobjective combinatorial optimization for Graph Coloring with GP, May 2009.
[37] Bipul Kumar Bal, Multiobjective combinatorial optimization for BDMST with GP, May 2009
[38] Krishna Banka, Multiobjective combinatorial optimization with GP, May 2008
[39] Ashwin Joshi, Multiobjective combinatorial optimization with GP, May 2008
[40] Soham Chakraborty, Type analysis & optimization of OO Systems, Feb. 2008. [with PPChak]
[41] Sanjay Chaterjee, Algorithms for post-compilation power optimization in embedded processors, Dec. 2006. [with PPChak]
[42] Arnab Sarkar, Low-Overhead Real-Time Proportional Fair Scheduling, May 2006. [with PPChak]
[43] T. Kalyani, Video transcoding: H.264 to MPEG-II bit-streams, May 2006. [with JM]

[44] Atul Bhartia, Video transcoding: Arbitrary resizing of H.264 bit-streams, May 2006. [with JM]
[45] Anshuman Mishra, Software watermarking scheme for Java class files, May 2006. [with PPChak]
[46] Vikram Agarwal, Multiple polymorphic arguments in object-oriented languages, May 2005.
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[48] Amit Gupta. Optimizing binaries using pattern matching, May 2005.
[49] Mrinmoy Ghosh, Compiler backend generation and optimization for extensible architectures, June 2004. [with PPChak]
[50] Sant Saran Gupta. Code compression in variable length RISC processors, May 2004.
[51] Arnab Roy. Simulation based verification of microprocessor pipeline simulators, May 2004. [with PPChak]
[52] Vasant Patil, Video transcoding algorithms, May 2004.
[53] Anil Mangolia, Preprocessor for multimethods in object-oriented languages, Jan 2003.
[54] GK Rao, QoS support for multimedia traffic with transcoding, Jan 2003.
[55] K. Krishnakumar, RWA in WDM networks, May 2002.
[56] Arun Kumar, Modelling of multimedia traffic, May 2002.
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[58] B. Srikanth Reddy, Modelling of multimedia traffic, May 2001.

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[59] S. Prasanth, Network topology design using multiobjective EA, Dec 2000.
[60] MS Sudarshan, Network topology design using multiobjective EA, Dec 2000
[61] Ishan Banerjee, Polymorphism in cipher design, Dec 2000
[62] V. Devtha, Video temporal segmentation, Dec 2000.
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[65] Bhanu Prakash, Hybrid learning algorithm for vector quantization, May 2000.
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[67] Vishnu Makkapati, Encoding of multi-/hyper-spectral image data, Dec 1999.
[68] Mahesh Agarwal, Face recognition, Dec 1999.
[69] SK Santhanakrishnan, Communication network topology design using multiobjective EA, Dec 1999.
[70] N. Vinay Kumar, Object oriented toolkit for multiobjective EA, May 1999.
[71] Dilip Jain, Multiobjective optimization with evolutionary algorithm, May 1998. [with NC]
[72] ... and several others.

Supervision of Research Associates in Consultative/Sponsored Projects: IIT Kharagpur

[1] Pritam Khanda, MHRD's Virtual Lab, 2010-11.
[2] Soham Chakraborty, Microsoft's Object-Oriented Technology, 2004-06.
[3] P. Sankar Muthu, MHRD's Multiobjective EAs for Combinatorial Optimization Problems, 2004-05.
[4] Panchali Sen, Microsoft's Object-Oriented Technology, 2003-04.
[5] Dipankar Das, NSC's Software Tools for Embedded Systems, 2003-04. [jointly with PPChak]
[6] Sandip Aine, NSC's Software Tools for Embedded Systems, 2003-04. [jointly with PPChak]
[7] Arnab Sarkar, NSC's Software Tools for Embedded Systems, 2003-04. [jointly with PPChak]
[8] Vibha Rathi, NSC's Software Tools for Embedded Systems, 2003-04. [jointly with PPChak]
[9] Sanjay Chaterjee, NSC's Software Tools for Embedded Systems, 2003-04. [jointly with PPChak]
[10] Samik Das, NSC's Software Tools for Embedded Systems, 2003-04. [jointly with PPChak]
[11] Subrat Panda, NSC's Software Tools for Extensible CompactRISC Processors, 2002-04. [jointly with PPChak]
[12] Rakesh Gupta, NSC's Software Tools for Extensible CompactRISC Processors, 2002-03. [jointly with PPChak]
[13] Mrinmoy Ghosh, NSC's Software Tools for Extensible CompactRISC Processors, 2001-04. [jointly with PPChak]
[14] Banit Agarwal, NSC's Software Tools for Extensible CompactRISC Processors, 2001-03. [jointly with PPChak]
[15] Debjit Sinha, NSC's Software Tools for Extensible CompactRISC Processors, 2001-02. [jointly with PPChak]
[16] Supratik Mazumdar, NSC's Software Tools for Extensible CompactRISC Processors, 2001-02. [jointly with PPChak]
[17] Rahul Chaudhry, NSC's Software Tools for Extensible CompactRISC Processors, 2001-02. [jointly with PPChak] [@ Yale U.]

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Selected Sponsored/Consultancy Projects:: Completed

[1] *Sponsored Project* : Educational Data Mining
Funded by : UGC, Govt. of India
Period : 2018 – 19 *Amount* : INR 500 K
Principal Investigator : Rajeev Kumar *Co-Investigator* : ---

[2] *Sponsored Project* : Programming and Data Structures Virtual Lab
Funded by : MHRD, Govt. of India
Period : 2010 – 12 *Amount* : INR 1500 K
Principal Investigator : Rajeev Kumar *Co-Investigator* : ---

The course is the basic core course which is usually done by every engineering student of all engineering branches in their first year of study. A student is introduced to the basic concepts of programming and an algorithmic approach to problem solving. Since this is the first course in programming, the lab plays a very important role in understanding the programming concepts and problem solving using computer. In the absence of a lab, this course remains an abstract course. Through the lab, a student understands the intricacies of programming and problem solving.

For programming, the general and most versatile, C-language is being used currently. However, the next phase of Virtual Lab can have Java programming language as the medium of the problem solving.

[3] *Consultancy Project* : Object Oriented (C#/.NET centric) Courseware Development
Funded by : Microsoft Corp., USA (*under Global CFP*)
Period : 2004 – 07 *Amount* : USD 22 K
Principal Consultant : Rajeev Kumar *Co-Consultant* : ---

The course is designed primarily to bring synergy and interplay among the following components – Object Oriented Technology (OOT) for better programming methodologies and code reuse, Programming Language Design and Implementation (PLDI) for better understanding of language semantics, Virtual Execution Environment (VEE) for an insight of the runtime system providing extensible and safer computing towards code certification, and Software Engineering (SE) for trusted and reusable system.

The course was introduced as a graduate level course at IIT Kanpur and is offered since then at IIT Kharagpur. Many research articles are the outcome of this activity.

[4] *Sponsored Project* : Multiobjective Evolutionary Algorithms for Combinatorial Optim.
Funded by : MHRD, Govt. of India
Period : 2002 – 07 *Amount* : INR 1000 K
Principal Investigator : Rajeev Kumar *Co-Investigator* : ---

Most combinatorial problems are computationally *hard*. In a multiobjective setting, the major challenge is to obtain a set of many representative diverse solutions across the desired/optimal Pareto-front. In simple treatments, multiple objectives are combined in an *ad hoc* manner to yield a scalar objective. Other conventionally used optimization heuristics model the multiobjective problem in a single objective domain treating all but one of the objectives as constraints. In this project, the standard single objective problems (with or without constraints), e.g., spanning tree, 0/1 knapsack, traveling salesman, graph coloring etc., are recasted into their respective biobjective optimization problems. Empirically, it is shown that the solutions obtained with multiobjective evolutionary algorithms (MOEA) as black-box optimization tools, cover a larger range and are superior, in terms of diversity and convergence, to the deterministic heuristics.

Outcome of this sponsored research project is reflected in many research publications. Another, important spin-off of this research activity is that the tutorial on "Evolutionary Multiobjective Combinatorial Optimization (EMCO)," which became a regular feature at ACM's GECCO till 2009, the lead conference in this area.

[5] *Consultancy Project* : Software Tools for Embedded Systems
Funded by : National Semiconductors Corp., Germany/USA
Period : 2003 – 06 *Amount*: USD 100 K
Principal Consultant : Prof. P.P. Chakrabarti *Co-Consultant* : Rajeev Kumar

[6] *Consultancy Project* : Software Tools for CR Family of Processors
Funded by : National Semiconductors Corp., Germany/USA
Period : 2001 – 03 *Amount*: USD 225 K
Principal Consultant : Prof. P.P. Chakrabarti *Co-Consultant* : Rajeev Kumar

These two consultancy projects were due to the collaborative research between IIT Kharagpur and the Compact RISC (CR) Processing groups of National Semiconductor Corporation (NSC) located at Germany and Israel. University of Michigan (UoM) was another partner in this activity looking into the hardware related aspects whereas IIT Kharagpur concentrated on software related issues.

Twin projects were focused on development of software tools for rapid reduction in the time to market a custom solution based on the CR family of processors. This included software development tools, architecture exploration and evaluation tools and Instruction Set Architecture (ISA) verification tools. The aim was to help NSC develop tools that would speed up the development of new architectures (like functional and performance simulators), produce systems software tools (like Debuggers, Assemblers, Linkers, Compilers) for customers and rapidly explore the design space by providing tools for extensible CR processors (ISA verification and software toolset for CR-X). This effort also aimed at developing the Software Quality Assurance (QA) framework for the tools produced by this activity.

The project activity had three primary parts, namely tools for CR16C, extension of the toolset to handle CR16C family of processors, and development of scalable toolset concept for the extensible CR (CR-X). The CR-X activity also aimed at developing a mechanism so that the toolset can be automatically generated for CR based processors. Generation of tests and testing the software in a proper QA framework was a very important goal. The platform for development was Linux. The effort aimed at maximum use of available GNU following the GNU rules/coding standards.

While working on these twin projects, the project team encountered many interesting issues and challenges, solutions to some of those culminated in several research publications.

[7] *Sponsored Project* : Convergence of Multiobjective Evolutionary Algorithms
Funded by : IIT Kharagpur
Period : 2001 – 03 *Amount*: INR 100 K
Principal Investigator : Rajeev Kumar *Co-Investigator* : ---

In multiobjective optimizations, solutions which are non-dominated at some stage in the computations, become dominated by a superior solution at some later stage. Moreover, for most of the real-world problems, the desired/optimal Pareto front is *unknown*. This project was aimed at extending the previous work (GALESIA, 1997) and to incorporate the notion of convergence in multiobjective evolutionary algorithms (MOEA).

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