



Rajeev Kumar, PhD (Sheffield Univ.)

Professor, Computer Science & Engineering (CSE)

Formerly: Professor @ IIT Kharagpur, IIT Kanpur, BITS Pilani, JNU Delhi;

Formerly: Scientist @ DRDO (DEAL) Dehradun, DST (Survey) Hyd/Delhi

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[GitHub](#) | [LinkedIn](#) | [Google Scholar](#) | [Research Gate](#) | [ORCID](#) | [Facebook](#)

Rajeev Kumar, an **academician and consultant** with 40+ years in teaching, research & development, has served at **IIT Kharagpur**, **IIT Kanpur**, **BITS Pilani**, and **JNU**. He has also worked as a Scientist at India's **DRDO** and **DST** and was a Visiting **Design Engineer** at National Semiconductors **Germany**. He is a **motivational speaker** and **mentor**.

He holds a **Ph.D.** in Computer Engineering from **Univ. Sheffield**, an **M.Tech.** in Computer Sc. & Tech. from **Univ. Roorkee** (now IIT Roorkee), an **M.Sc.** in Physics (Electronics) from **Univ. Allahabad**, and an **LL.M. (Professional)** from **National Law Univ. Delhi**.

R & D: His initial learning at DRDO culminated in *technology transformation for end-users*. His research interests include machine/deep learning, ethics in AI, medical image analysis, multimedia, programming languages, software systems, evolutionary optimization, and scientometrics. He has published over **250 research articles** in international journals and conferences, several in lead venues. He has supervised **20 doctoral**, **over 80 master theses**, and 100 UG projects. He founded the **Data to Knowledge (D2K)** Lab at JNU. He worked on industry-funded projects from **Microsoft USA** and **NSC USA**; the NSC project was in close collaboration with their USA, Germany, and Israel units. He is a reviewer for lead venues. He delivered several keynote/invited lectures and tutorials at conferences. He visited several universities in the USA, UK, Germany, Switzerland, Japan, S. Korea, and Singapore. His h-index on Google Scholar is 25.

Teaching: Rajeev has designed and taught several CSE courses 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.). At JNU, he introduced the *Academic Ethics* course. His teaching is participative and interactive; he focuses on active learning, thinking, creativity, and innovation with flexible workloads/assessments.

Academic Leadership: He served as a Senator in IITs Kharagpur/Kanpur and BITS, a member of the Court and Academic Council at JNU, and educational bodies, such as the Board of Studies, and Statutory Comm. He worked for reforms in curriculum, academic structure, regulations, and ordinances. He is known as a **crisis handler** with **out-of-box solutions** to complex challenges.

Public Policy: His contributions to higher education policy are significant. He reformed **IIT admission exams** by introducing **transparency through micro-level SOPs**. He pioneered the **common examination and counseling (JoSAA/CSAB)** for IITs/NITs/IITs/CFTIs, a widely adopted model across disciplines. The inclusion of common examinations in **NEP 2020**, leading to **CUETs** for Central Universities, highlights his impact. His prototype for common counseling in Central Universities, developed with the Ministry, is set for future use. He advocated for the Research Advisory Comm. (RAC) and Ethics course for PhD Students in JNU, both adopted by UGC. India's Hon'ble Supreme Court hailed him as *one of the many unsung heroes who helped in improving the system*.

He authored ABET-guided *output-based quantifiable* accreditation guidelines and defined Academic Performance Indices (**APIs**) for the National Board of Accreditation (**NBA**). The guidelines, originally used in 2011, have since been modified and are in use by both the NBA and NAAC. This work enabled India to join the Washington Accord in June 2014.

With over four decades of academic and administrative experience across universities and institutions in India and abroad, he has cultivated a deep passion for teaching, research, curriculum development, faculty mentoring, and institution building. His **reform-focused, student-centered leadership, 24/7 work ethic, open communication, legal insight, and broad vision** make him a valuable asset. * * *

1-Page Brief.

▪ Education:

- **Ph.D. (Computer Engg.), Univ. Sheffield**, England. The thesis was nominated for the Distinguished Computer Science thesis award in UK.
- **M.Tech. (Computer Sc. & Tech.), Univ. Roorkee** (now, IIT Roorkee). Awarded the Univ. Medal for being the first ranker.
- **M.Sc. (Physics - Electronics), Univ. of Allahabad**. 3rd ranker.
- **LL.M. (Professional), National Law University, Delhi**.

▪ Experience: Teaching, Research & Development: Four Decades.

- **Professor: IIT Kharagpur** (15y), **IIT Kanpur** (2y), **BITS Pilani** (4y), and **JNU** (9y) New Delhi.
- **Scientist: Survey of India (DST)**, Hyd'bad/New Delhi (3y); **DRDO (DEAL)**, Dehradun (8y).
- **Design Engineer: National Semiconductors (NSC)**, Germany (Visiting); Projects with **Microsoft**.

▪ Teaching

- Cover fundamentals with emerging technologies to keep the subject material relevant and employable.
- Focus on student engagement for *active* learning, thinking, creativity, and innovation with enjoyment.
- Introduced a variety of assignments, e.g., tiny (few sentences), 2-pages, and large – covering different aspects, incl. hands-on experiences of course contents at different paces spread throughout semester.
- Introduced parallel evaluation in which students also self-evaluate, followed by closeness match.
- Taught, developed and restructured core and advanced courses for U.G. and P.G. students.
- Introduced new courses, incl. a pan-university course on Academic Ethics at JNU.
- Comfortable in teaching smaller to large classes of a few hundred students.

▪ Research: Research interests include machine/deep learning, ethics in AI, medical image analysis, multimedia, medical image analysis, programming language, evolutionary optim., and scientometrics.

- Published over 250 research articles in international journals and conf. proc. Reviewer.
- Presented papers in lead international conf. in USA, UK, Germany, Canada, Japan, S. Korea, etc.
- Invited/research talks in universities abroad, international conferences, FDPs, STCs, etc.
- Program Chair, Publication Chair, Publicity Chair, etc. in several international conferences.
- Supervised 20 doctoral and 80 master theses and over 100 undergraduate projects.
- 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 School of Computer & Systems Sciences, JNU. The D2K Lab produced quality research papers in decent Journals and conf. proceedings.
- *h-index*, on Google Scholar (from incomplete data), is 25, which is good in sub-fields of C.S.

▪ Industry Collaboration: R & D

- Member, Board's IT Strategy Group and I.T. Advisory Comm., Canara Bank (2022 - Present)
- Core Design Engineer, National Semiconductors Team with members from Germany, Israel & U.S. for developing System S.W. 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)
- NET/C# Project, Microsoft Inc. USA (2004 – 07).

▪ Industry Collaboration: Teaching

- Developed courseware for .NET/C# as an emerging technology (**Microsoft Inc. USA**). (2004-07)
- Faculty, Multimedia & Object-Oriented System Courses for Wipro/S.W. Industry employees @ Bangalore/Hyderabad under BITS Industry Off-Campus Collaboration Program. (1997- 2000)

Pursuing Adjunct Professor-ship @ Premier Tech. Inst. & Univ.

With his extensive and varied experience in academics — student, faculty, and institution builder — he aims to contribute and advise on **value additions** for institutions and leaders, going beyond the typical faculty role:

- **Teaching Specialized Research Courses in Academic and Leadership Programs**
 - Research courses in emerging technologies to undergraduate/postgraduate/research students
 - CS/AI/ML Courses in Core Technologies for an in-depth understanding of concepts
 - **Executive / Leadership Programs on Academic Autonomy, Regulations, Policy, etc.**
- **Tech. Talks in FDPs, Conferences, Seminar and Hands-on Workshop Series**
 - FDP and seminar series on standard technologies with guests/experts and in-house faculty/students.
 - Hands-on workshop on the latest tools/technologies with external experts and in-house developers.
- **Research Advisor for UG Projects / Masters / PhD Thesis / Research Centers**
 - Inculcating the spirit of research & publications: identify and catch them early via research courses,
 - Define Master/PhD thesis dissertation: applicable theory, concept, technology, and applications
 - Strengthen technical writing skills and research plans in phases.
- **Faculty Mentor, In-house Peer Review, & Thesis Evaluation**
 - Mentoring young faculty for effective teaching, learning, evaluation, and grading (TLEG),
 - Teaching workshops and FDPs for TLEG and Institute's services,
 - In-house peer review of faculty for self-assessment and feedback. Thesis Evaluation.
- **Curriculum Revision / Restructuring**
 - Involved with UG/PG/Research curriculum updates since the 1990s at IITs, BITS, JNU, and others.
 - This exercise should be done regularly to prepare graduating students with the latest technologies.
- **Strengthening Placement Skills & Employability**
 - Developing code-labs for hands-on coding experience through the process of building applications.
 - Working on industry-supported toolkits and developing applications and newer features.
- **Improving Academic SoPs for Self-Regulatory Administration**
 - Continuous monitoring of Academic/Administrative SoPs for improvement aimed at zero government
 - Shifting towards self-regulatory governance and no-delay grievance redressal system.
- **Institutional Committee Chair/Member for Out-of-Box Solutions**
 - Worked in several committees at all levels – department, Institute, national, and international
 - In Institutional academic/administrative committees in academic interest as a crisis handler.
- **Ranking, Accreditation, and Interfacing with External Agencies**
 - Drafted accreditation guidelines for public use with academicians, government, international agencies
 - Practical understanding of ranking/accreditation parameters and their interplay
- **Legal Counselling & Acumen-ship for Academic Matters, incl. Disciplinary Proc.**
 - Handled several types of academic leadership tasks with active participation as a crisis handler,
 - Handled several academic legal cases via Special Leave Petitions (SLPs) and Writ Petitions (WPs),
 - Excellent in Service/CCS (CCA) Rules, Disciplinary Proc., and Administrative Laws.
- **Public Policies for Institutional Buildup**
 - Defining policies for institutional built-up and defining rational & minimal SoPs
 - Quality upgradation, Ranking improvement, etc.

Education & Professional Experience

Personal Information

- Nationality : Indian
- Date of birth : March 12, 1959
- Marital Status : Widower with two children:
Son (S.W. Engg: Agoda | ex- Google, Microsoft, Grab | MBA: NUS, NYU | ISB);
Daughter (Faculty, GaTech Atlanta | PDF: Univ Penn | PhD: Rice Univ)

Education

- **Ph.D. in Computer Engineering (1997)**
University of Sheffield, UK
Thesis: Feature Selection, Representation & Classification.
Thesis nominated for best Thesis award in UK.
- **M.Tech. in Computer Science & Technology (1992)**
University of Roorkee (now, IIT Roorkee), India
Dissertation: *Performance Study of Simulated Multiprocessor for Functional Programs.*
University Medalist being the first ranker
- **M.Sc. in Physics (Electronics) (1979)**
University of Allahabad, India
Third Rank in the University
- **LL.M. (Professional) (2024)**
National Law University, Delhi India

Research Scholar

- **University of Sheffield, UK:** Commonwealth Research Scholar: March 1994 – March 1997.
- **University of Allahabad, India:** UGC Research Scholar: July 1980 – Dec 1983.

Employment

- **Jawaharlal Nehru University (JNU), New Delhi, India**
School of Computer & Systems Sciences (SC&SS)
Professor: June 2015 – March 2024.
- **Indian Institute of Technology (IIT), Kharagpur, India**
Department of Computer Science & Engineering (CSE)
Professor: April 2007 – June 2017; Assoc. Professor: Dec 2000 – April 2007.
- **Birla Institute of Technology & Science (BITS), Pilani, India**
Department of Computer Science & Information Systems (CSIS)
Professor: Feb 2000 – Dec 2000; Assoc. Professor: April 1997 – Jan 2000.
- **Defense R & D Organization (DRDO), India**
Defense Electronics Applications Lab (DEAL), Dehradun, India
Scientist C: July 1989 – April 1995; Scientist B: June 1986 – June 1989.
R&D: Image Processing, Computer Vision, Machine Learning, Military Intelligence.
- **Department of Science & Technology (DST), India**
Survey of India, Hyderabad / New Delhi, India
Deputy Superintending Surveyor: Dec 1983 – June 1986.

Visiting Positions

- **Indian Institute of Technology (IIT), Kanpur, India**
Department of Computer Science & Engineering,
Visiting Professor: July 2013 – May 2014; Visiting Assoc. Professor: June 2005 – May 2006.
- **National Semiconductors GmbH, Germany.**
Oct. 2001, May – July 2002: Visiting Design Engineer.

Academic Tasks & Leadership

▪ External Academic Institutions

- Member/Coordinator, Peer Team, National Assessment & Accreditation Council (NAAC) (2024)
- Ext. Member, CSE Curriculum Revision, IIT Patna (2022, 2024)
- Advisor, Cyber Security Upskilling Edu. Inst., VMSB Uttarakhand Tech. Univ, Dehradun (2024)
- Member, Faculty Selection Board
- Ext. Member, Faculty of Maths. & Computing, Banasthali Univ. (2019 - 22)
- Ext. Member, Board of Studies, Dept. CSE & Dept. CS Applications, Poorvanchal Univ. (2018 - 20)
- Chairman/Expert, National Accreditation Board (NBA) Visiting Committees to Engg. Instt. (2007 - 18)
- Visiting Professor, IIIT Noida (2007-10)
- (several others)

▪ National level:

- CS Expert: NTA Tech. Eval. Comm. (2023 – 24),
- CS Expert: Faculty Selections: ASRB (2022), DRDO (2016-18), UPSC (2014), etc.
- Chair/Member, NBA UG/PG Accreditation Teams (2006 – 2018).
- Chair, NBA UG Engineering Accreditation Guidelines Draft Comm. (2010 – 11).
- Chief Examiner, GATE Computer Science, IITs (2005).
- Professor-In-Charge, JEE Examination Centre(s), IIT Kharagpur (2001 – 04).

▪ Institute/University level: IIT Kharagpur, BITS Pilani, and JNU New Delhi

- JNU: Member, University Court, and Academic Council (2022 - 2024).
- JNU: Member, Intellectual Property Management Comm. (2017)
- JNU: Co-opted Member, Anti-Plagiarism Policy Draft Comm. (2016 - 17).
- JNU: Conceptualized Dual-degree program combining Comp Sc with Social Sc (2016-17).
- IIT Kharagpur: Senator (2007 – 2015)
- IIT Kharagpur: Member, UG Prog. Eval. Senate Sub-Comm. (UGPEC) (2001-05, 2007-11)
- BITS Pilani: Senator (1997 – 2000).
- BITS Pilani: Resource Faculty, Intensive Teaching Workshop (1997 – 2000)
- BITS Pilani: Member, Research & Consultancy Board (1997 - 1999).
- BITS Pilani: Member, Library Comm. (1997 – 1999).

▪ Department/School level: BITS Pilani, IIT Kharagpur, and JNU New Delhi.

- JNU: Founder Director, *Data to Knowledge* (D2K) Lab, SC&SS (2016 – 2024)
- JNU: Member, Special Comm. (a.k.a. Board of Studies), School Comp. Sys. Sc. (2015 – 2024)
- JNU: Member, Student - Faculty Comm., School Comp. & Sys. Sci. (2015 – 2019)
- JNU: Chair, AICTE's MTech. Prog. Approval Comm., School Comp. & Sys. Sci. (2015 – 2016)
- IIT Kharagpur: CSE Academic Comm, (2001-05, 2007 - 11)
- IIT Kharagpur: CSE Administrative Comm., (2004-05, 2006-10)
- IIT Kharagpur: Doctoral Scrutiny Committees: Assorted (2001 – 2011)
- IIT Kharagpur: Faculty Advisor/Counselor/Mentor and Faculty PGDIT and PGDST (2001-08)
- IIT Kharagpur: Professor-in-Charge, CSE Library & Liaison with Central Library (2006 – 08)
- BITS Pilani: Member, C.S. & I.S. Group (1997 – 2000).

Teaching (Undergraduate and Graduate)

- 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
- Programming Methodology
- Multimedia Systems
- Machine/Deep Learning (Core & Adv.)
- Artificial Intelligence
- Academic Ethics
- Research Methodology
- 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
- Pattern Classification
- Evolutionary Computing
- (Bio-)Statistics (with R) @ Life Sciences
- Technical Writing

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*
- O.O. Sys. Implementation [2005] – *synergy in PLI, S.E., 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

Industry Teaching Collaboration: National & International

Microsoft Research USA	Object Oriented (C#/.NET centric) Courseware	2004 – 07
Wipro & S.W. Industries	Object Oriented System Development, Systems @ BITS Multimedia Pilani	1998 – 2000

Awards & Professional Recognition

- ISEC's *Test of Time* Award for the ISEC 2011 Paper (2022)
- Karmaveer Chakra (2013)
- Hon'ble Supreme Court's *Unsung Hero* (2011)
- RTI Citizen's Runner-up Award for Public Services (2009)
- Commonwealth Scholarship (1994 – 97)
- Affiliation with Professional Bodies
 - Fellow, IETE, India
 - Fellow, ISSA (Indian Social Science Academy), India
 - Senior Member, ACM, USA
 - Senior Member, IEEE, USA

Recognition as Student

- Class Representative, MTech (CST), Dept. Electronic & Computer Engg., Univ Roorkee (1991- 92)
- Prefect, Sir GN Jha Hostel, Univ of Allahabad, (1981-83)
- ... (others)

Research: R & D, Industrial Consultancy, and Services

Research Interests

- Machine Learning: Generalization, Outlier Detection, and AI & Ethics.
- Multimedia: Medical Image Analysis, Multi-Modeling, and Social Networks.
- Scientometrics and Edu. Data Mining.
- Programming Language System and Software Engineering.
- Evolutionary Multiobjective Combinatorial Optimization (EMCO): Nature Inspired Algorithms (NIA).

Publications

Book	1
Edited Books (Conf. Proceedings)	3
Chapters in Edited Books	4
Published Tutorials (USA)	3
Journal Research Articles	~80
International Conference/Workshop Research Articles	~150
National Conference/Workshop Research Articles	~20

Theses & Student Projects Supervision

	Completed	Ongoing
Doctoral	19 (6*)	1
Graduate (by research)	4	--
Graduate (M.Tech., MPhil, MSc)	~ 80 (10*)	---
Undergraduate projects	~ 120 (20*)	--

*: In joint-supervision.

Industry R & D Consultancy

Advisor	IT Advisory Comm. Canara Bank India	Banking SW, Online, Data Analytics Tools, etc.	2022 - Present
Design Engineer	NSC Germany	SW System Tools: Compiler, Simulator etc.	2001 – 06

Services: R & D and Tech. Institutions:

- Member, Selection Board, Recruitment & Assessment Centre (RAC), DRDO, New Delhi (2017, 2024)
- CSE Expert, NTA Tech. Eval. Comm. (2023 – 24)
- Expert, Tech. Comm., Agriculture Scientists Recruitment Board (ASRB), Dept. Agri. Res. Edu. (2022)
- Member, Apex Committee for DRDO Awards (2016)
- CSE Expert, UPSC, New Delhi (2014)
- Secretary cum Treasurer, IEEE Kharagpur Centre (2002 – 04)
- Secretary, IETE Local Centre, Dehradun (1988 – 90, 1992 – 94)
- ... (several more)

Global R & D Projects & Collaboration

Academia Industry Research Projects

University Grants Commission	Educational Data Mining	2018 - 19	INR 500K
Min. Human Resource Dev., Government of India	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	---
Microsoft Corp., USA	Object Oriented (C#/.NET centric) Courseware Development	2004 – 07	USD 22 K
Min. Human Resource Dev., Government of India	Multiobjective Evolutionary Algorithms for Combinatorial Optim.	2002 – 07	INR 1000 K
National Semiconductors Corp., Germany/USA	Software Tools for Embedded Systems (co-PI)	2003 – 06	USD 100 K
National Semiconductors Corp., Germany/USA	Software Tools for C.R. Processors (co-PI)	2001 – 03	USD 225 K
IIT Kharagpur	Convergence of Multiobjective Optim.	2001 – 03	INR 100 K

Visitor @ Universities Abroad

Visitor	GaTech Atlanta, US	ML, PL	Feb.2023, April 2024
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	ETH Zurich Switzerland	Multi-obj. Evo. Algo.	June 2002
Visitor	MIT, CMU: USA	Machine Vision	July 1996
PhD, TA	Sheffield Univ., U.K.	Comp. Engg.	Mar 1994 to Apr 1997

Tutorials and Invited Talks in FDPs, Workshops, & Conferences

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 / FDPs /STCs

Academic Leadership, Governance, Ethics, and Education Technology

- FDP: Technology-driven paradigm shifts in teaching, learning, and evaluation for enlightened minds @ Central Agriculture University, Imphal, Sep. 2024.
- FDP: NEP 2020: Transforming the regulatory system of HEIs @ ABESIT Gzb, Aug. 2024.
- FDP: Enlightened Edu: Nurturing Minds with Discipline, Ethics, & Joy @ LNMIIT Jaipur, Mar. 2024.
- Ethical Writing: Learning from 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, Decoding Sc. & Tech. @ JNU, Oct. 2018.
- Academy Autonomy: Gurukuls and Today's HEI @ ISSCA Workshop, Delhi Univ., Feb. 2018.
- Academic Autonomy from Gurukul to Today's Institutions @ 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.
- NBA Trainer's Workshop on Revised Guidelines for Accrediting UG Engineering Programs: @ Indian States Capitals, Jan – Mar. 2011.
- On Enhanced Quality in Teaching and Research @ IIITU, Noida, Dec. 2009.
- AICTE/NBA Revised Guidelines for Accrediting UG Engineering Programs: Awareness Workshops for Assessors & Managers @SPEC, Mumbai, June 2009; JNTU Hyderabad & UTU Ddn, Aug 2009.
- Towards Value-Added Professionalism @ Maharaja Agrasen Mahavidyalaya, Bareilly, Oct. 2009.
- Quality in Education, Research and Services @ Dhirubhai Ambani IICT Gandhinagar, Nov. 2008.
- A document that serves the reader @ BITS Pilani, Sep. 1997.

Machine Learning, Intelligent Systems, Stochastic Optimization, & Data Analytics

- Sparc Workshop: Optimization in Intelligent Systems: Real-world Challenges and Building Trust (Part I & II), @ ABV-IIITM Gwalior, Sep. 2024.
- FDP: D2K: Machine Learning & Data Intelligence @ IIIT Noida, Jan. 2023.
- Evolution of a perceptron to massively connectionist DL architecture @ UPES Dehradun, Dec. 2021.
- FDP: Evolving massively connectionist DL architecture @ Rajiv Gandhi Univ., Itanagar, Sep. 2021.
- FDP: Intro. to Prob. Theory in ML @ NIT Jalandhar, Sep. 2020.
- The Pedagogy of AI for Multidisciplinary Students @ Huawei AI Educator Symp, Mumbai, Dec. 2019.
- FDP: ML: Research Directions and Applications @ 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.
- EMCO: Issues and Research Directions @ UGC HRDC, JNU, Sep. 2015.
- EMCO: A keynote talk @ IC3, IIIT Noida, Sep. 2008.
- EMCO - solving hard problems @ UIET Kanpur, Feb. 2007; Gwangju IST, S. Korea, Mar. 2007.

- Solving hard problems in EMO - a practitioner's approach @ KanGAL, IIT Kanpur, 2006.
- Data-mining by meta-learning @ IARCS Course, Siddhartha Academy, Vijayawada, 2004.
- Convergence in multiobjective genetic & combinatorial optim. @ IlliGAL UIUC, 2003; IITKgp.
- Convergence in multiobjective genetic optim. using rank-histograms @ ETH Zurich, June 2002.
- Meta-learning of high-dim. spaces for scaling and generalization in data mining @ IIIT-H, 2000.
- Population driven computational paradigm for search and optimization @ BITS Pilani, 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.
- A practical approach to EMO @ IIT Roorkee, 1997.
- Hybrid Intelligent models @ BITS Pilani, 1997.

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.

Multimedia & Embedded Systems

- Video coding – history & practices: Keynote talk @ Int. Conf. S.P., SATI Vidisha (2016).
- Embedded Systems: Design & Validation @ Gwangju Inst. Sc. & Tech. (GIST), S. Korea. Mar 2007.
- 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 @ HiPC Trusted Internet Workshop, 2002.
- Triplet geometric representation: novel local invariants for robust recognition @ CMU, 1996.
- Triplet point representation and hierarchical neural net classifier @ ESG, Sheffield. Univ., June 1995.

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Public Policies for IITs/CFTIs/CUs/HEIs

Actively involved in drafting policies for HEIs, maintaining a delicate balance between stakeholders: Government and academicians while developing impact-driven public policies. **Most are in Public Use**

IIT JEE Reforms (2006 – 2015)

Pioneered transparency, common examination (JEE), common counselling (JoSAA/CSAB), and systematic reforms in Engg. admissions for IITs/NITs/IITs/CFTIs. The proposal led to institution of National Testing Agency (NTA). These concepts have been adopted for admissions in most disciplines in the country.

- I. Prior to 2006, IITs admission examination/processes were marred with several types of irregularities, irrationalities, ad hoc-ism, etc., due to the complete opaqueness of the system. For example,
 - (a) **Student(s) with marks as high as 279 were not admitted, though students with fewer marks of 154 were admitted.** The then IIT-JEE subject cut-offs {37, 48, 55} in 2006 became single digits {1, 4, 3} & {5, 0, 3} in subsequent years, respectively in 2007 and 2008 out of 182 in Maths, Physics, Chemistry, making IIT-JEE a laughing stock in public.
 - (b) There were **errors in questions and answer keys**; ambiguous instructions in the question paper led to wide-ranging manipulations.
 - (c) A student was admitted to multiple institutions, leading to a national waste of time, resources, efforts, etc. **Hundreds of seats remained unfilled**, leading to backdoor admissions.

A student was unaware of why one was selected/rejected due to the opaqueness of the system.

- II. As a Professor at IIT Kharagpur, I **discovered several such irregularities through research & analysis of admission-specific data**. The Hon'ble High Court termed the then situation of IITs admissions with "*a proverbial situation of it being darkest beneath the lamp ... if becomes known to the world at large, may make them (IITs) a laughing stock in the eyes of their clients.*"
- III. My **tenacious decade-long efforts** of cleaning up IITs admissions led to wide-ranging reforms in admissions through transparency, well-defined *prior* decision-making, and standardized processes, as
 - (a) **Subject cut-offs were fixed** a priori at 10% of the Max. Marks for GEN category and others;
 - (b) Students were allowed to carry the question paper, **model answer keys were uploaded**, and feedback about correctness was given. The **corrected answer keys** were uploaded and used for final evaluation.
 - (c) A carbon copy of the ORS was made available to candidates, and the **evaluated ORS** was uploaded for verification of marks before the announcement of the final result;
 - (d) Pioneered **Common Examination (JEE (Main))** for UG Engineering admissions;
 - (e) Conceptualized **Common Counselling (JoSAA/CSAB)** for UG engineering admissions in all CFTIs. Multiple rounds of counselling for filling most seats through centralized seat allocation.
 - (f) Institution of National Testing Agency (NTA) for most admission (MCQ-based) examinations.

The above methodologies have been adopted by most UG and PG admissions and MCQ-based examinations across almost **all professional disciplines**, benefitting millions of students every year.

- IV. **The Hon'ble Supreme Court** hailed me as ***one of the many unsung heroes who helped in improving the system.*** The Apex court also asked, "*IITs and the candidates who now participate in the examinations must, to a certain extent, thank the appellants for their efforts in bringing such transparency and accuracy in the ranking procedure.*" Furthermore, inclusion of common examinations in NEP 2020 and the adoption of CUET for UG/PG programs with common counseling are live examples in action.

Quantifiable Accreditation Guidelines: A Paradigm Shift in Regulations: In Public Use (2008 – 2011)

Authored NBA Accreditation ABET Compliance, Guidelines for U.G. Engg. Programs. Conducted National Awareness Workshops (Public use: July 2009 to Jan. 2013).

- V. Co-authored *output-based quantifiable* accreditation guidelines for UG Engg. Programs and defined quantitative Academic Performance Indices (**APIs**) for engineering faculty (2009).
- VI. Authored solely *output-based quantifiable* ABET-guided accreditation guidelines for UG Engg. Programs. Conducted All-India workshops for awareness and training. The National Board of Accreditation (NBA) was made an autonomous body. (2009 – 2011)
- VII. This work led India to join the **Washington Accord** in June 2014. Revised guidelines are in public use.

Misc. Proposals submitted to the Ministry (2018 – 2023)

- VIII. **Grievance Redressal** by a neutral third party in HEIs (Nov. 2018).
- IX. **Common Entrance Examinations** in Central Universities led to **CUET**: My proposal differed from the CUET 2022; however, the current CUET is inching towards my proposal after Delhi University adopted CLAT for its LLB Program 2023 (March 2021). Including Common Examinations in **NEP 2020** is a testimony of this work.
- X. **Prevent suicides** in IITs, resulting in a draft OM in Feb. 2023: Proposed measures and processes for mental well-beings, early alert generations with the involvement of several stakeholders, and grievance redressals (GR) for preventing unfortunate incidences in IITs. Most of these measures have been adopted by IITs for the prevention of suicides (2022 - 23). This proposal was an extension of my Grievance Redressal Proposal for CFTIs (Nov. 2022 – Feb. 2023)
- XI. **Implementation of Common Counselling** for CUET (Oct. 2022 – Apr 2023). The Prototype developed with the 'Samarth' (DU) was planned for Common Counselling 2024 and onward.

Academic Services at JNU (2015 – 2024)

- (a) Proposed **dual-degree programs** in engineering with social sciences and admissions and counselling through **JEE** (Mains) and **JoSAA** (2016–17), led to the School of Engineering in JNU.
- (b) Drafted JNU's **anti-plagiarism** policy (2016-17); replaced by UGC Regulations, 2018. Initiated IPR policy (2017).
- (c) **AICTE recognition** of the M.Tech. Program (2016 – 17),
- (d) Addition of **laboratory courses** in the academic programs of the School (2015 – 16),
- (e) Institution of Research Advisory Committee (**RAC**) for every PhD student in the School (2015– 16). It was later adopted by JNU and subsequently adopted in **UGC Regulations, 2018**.
- (f) Introduced **Academic Ethics** course for thesis students (2016–18),
- (g) Initiated a **seminar series** combining sciences and social sciences (2018),
- (h) Suggested to have a **common protesting venue** in JNU for minimizing disruptions in work (later, Hon'ble High Court directed for the same), etc. (2016),
- (i) Suggested adopting the existing national level entrance examination be considered for admissions for all postgraduate and doctoral admissions, e.g., **GATE and NIMCET** for admissions in MTech and MCA of the School of Computer & Systems Sciences (2018 – 21),
- (j) **Adopted a new work culture** in Feb. 2016, through which no teaching or research guidance has been interrupted due to any lockdown, strikes, protests, etc. (2016 onwards).

Most of the above are in public use. **Some of these are/were being counted as flagship initiatives** of the former Vice-Chancellor, Prof. M. Jagadesh Kumar (now, Chairman UGC).

Articles, Opinions, & News: In Media

Opinion / Op-Ed / Blog Pages

- [1] [Times of India Opinion Blog: Rajeev Kumar](#)
- [2] [Hindu Opinion & Op-Ed Pages: Rajeev Kumar](#)
- [3] [Eklavya JEE 2006](#)

Opinion / Op-Ed Articles and Interviews

- [4] Rajeev Kumar. [Decoding SC judgment: NEET skeletons tumble, unanswered questions persist](#). Times of India Opinion. Aug, 12, 2024.
- [5] Rajeev Kumar. [Pen'n'paper just won't pass](#). Economics Times (Opinion). June 27, 2024.
- [6] Rajeev Kumar. [Preventing another NEET fiasco](#). Hindu (Op-Ed). June 26, 2024.
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- [9] Rajeev Kumar. Student suicides: [Despite complaint mechanisms in place in higher educational institutions, many suffer in silence](#). *Indian Express*, Mar 16, 2023.
- [10] [AI can further reform the admission process in IITs](#) (Interview) CXO TV. Dec. 13, 2019.
- [11] [This professor's campaign reformed the opaque IIT admissions](#) (Interview) *Scroll-In*. Aug. 10, 2018.
- [12] Know Your Rights (Interview). *The Scholars' Avenue*. IIT Kharagpur. Mar 17, 2010.

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- [14] [Academics decry PhD credit denial: UGC's retirement clause unfair to supervisors](#). Telegraph: Sep 12, 2024
- [15] [Dip in research students in Indian top universities](#). Telegraph: September 03, 2024.
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- [28] Post of professors most among teaching vacancies in C.U.s. Indian Express: Dec. 13, 2022.
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- [30] IIT plan diploma as a valve for stress: exit option after 2 years. Telegraph: Nov 01, 2022.
- [31] Temple crops up inside university of Hyderabad: Telegraph: April 13, 2022.

- [32] UGC backs education tech for online courses. Telegraph: April 03, 2022.
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 - [43] Pitfalls of JNU online classes. Telegraph: June 22, 2020.
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- [50] [Former JNU Professor & whistleblower alleges theft of research. His efforts for redressal remain unaddressed.](#) EdexLive: Sep. 05, 2024.
 - [51] Dalit student left in lurch as JNU sits on thesis. Telegraph, Feb. 20, 2024.
 - [52] JNU's Honest: 4-months Inquiry continuing in four years. New Laundry, Nov. 06, 2023.
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 - [55] High court allows JNU scholars to keep current supervisor. Times of India: May 11, 2022.
 - [56] Whistleblower professor's student gets PhD from IIT Kharagpur after 6 years. PTI: Mar 01, 2021
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 - [60] Whistleblower ex-IIT Kharagpur professor gets posting at JNU. Hindustan Times: Aug. 27, 2017
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- [2] Sanjay Kumar Jena, Rajeev Kumar, Ashok Kumar Turuk, and Manoranjan Dash (2011) Proc. Int. Conf. Communication, Computing, and Security (ICCCS-11), Rourkela, India, Feb. 12-14, 2011. ACM, New York. ISBN: 978-1-4503-0464-1
- [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 Inc. ISBN:978-3-642-03546-3
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Doctoral (PhD) Thesis Supervision

In progress @ JNU

- [1] Farheen. Deep learning for sequential data: architecture, algorithms, & applications. (by June 2024).

Graduated @ JNU

- [2] Bhupendra Kumar. Pattern discovery & clustering in ordinal survey data: algorithms and applications. Jan 2024.
- [3] Gouranga Duari. Decomposition for outlier detection. Jan 2024.
- [4] Akhilesh Rawat. Assessing generalization in deep learning architecture with medical image analysis. Jan 2024.
- [5] Neha Kumari. A safe generic type system for Java. Nov. 2023.
- [6] Priti Kumari. Scientometrics of computer science research publications. July 2023.
- [7] Akanksha Mukhriya. Ensemble learning for unsupervised outlier detection: algorithms and applications. Oct. 2022.
- [8] Neeraj Pathak. Hybrid evolutionary algorithms for solving hard combinatorial problems. Aug. 2022.
- [9] Sonal Tuteja. Graph model for schema and data mapping. July 2022.
- [10] Roopam Sadh. Knowledge discovery from quantitative survey data with pattern clustering and machine learning. March 2022.

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- [11] Om Prakash. Machine intelligence with multi-modal media for social welfare. Under Investigation: Publication Misconduct: March 2024.
- [12] Irfan Zaboo. FSA Extraction from Sequential Neural Networks. (Registration Cancelled: Feb. 2024)
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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 E.A., 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: MTech, MS & MPhil

Graduated @ JNU

- [1] Biraja Mishra. Anomaly Detection from Medical Time-Signals with Deep Learning. June 2023.
- [2] Law Kumar. Hybridized Anomaly Detectors for Social Networks. June 2023.
- [3] Sai Teja Tangudu. Cost-Sensitive Learning for Class Imbalance Data. June 2023.
- [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.
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- [16] Akhilesh Rawat. Outlier detection in high dimensional datasets. June 2021.
- [17] Aditya Kumar. Assessing generalization in deep learning networks. April 2021.
- [18] Priti Kumar. Scientometrics of computer science publications in journals and conferences. July 2018.
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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.
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- [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, Univ. Ark., USA)
- [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 Prof. Jens Palsberg, UCLA, USA)
- [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 O.O. Systems, Feb. 2008. [with Prof. P.P. Chakrabarti]
- [41] Sanjay Chatterjee, Algorithms for post-compilation power optimization in embedded processors, Dec. 2006. [with Prof. P.P. Chakrabarti]
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- [44] Atul Bhartia. Video transcoding: Arbitrary resizing of H.264 bit-streams, May 2006. [with Prof. J. Mukherjee]
- [45] Anshuman Mishra. Software watermarking scheme for Java class files, May 2006. [with Prof. P.P. Chakrabarti]
- [46] Vikram Agarwal. Multiple polymorphic arguments in object-oriented languages, May 2005.
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Supervision of Research Associates: IIT Kharagpur

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Consultancy & Sponsored Projects

- [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* : ---

This sponsored project aimed to develop a framework for educational data mining for HEIs. In this work, Deep/Machine Learning (DL/ML) techniques were employed for knowledge extraction from voluminous data about HEIs. This project developed tools and techniques for Data-to-Knowledge (D2K) extraction.

- [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 introductory core course, usually done by every engineering student from all engineering branches in their first year of study. Students are introduced to the basic programming concepts and an algorithmic problem-solving approach. Since this is the first course in programming, the lab plays a critical role in understanding programming concepts and problem-solving using computers. In the absence of a lab, this course remains an abstract course. A student understands the intricacies of programming and problem-solving through the lab.

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

- [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 a 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 (S.E.) 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 obtaining many representative, diverse solutions across the desired/optimal Pareto-front. In simple treatments, multiple objectives are combined ad hoc to yield a scalar objective. Other conventionally used optimization heuristics models 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 recast 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 to the deterministic heuristics in terms of diversity and convergence.

The outcome of this sponsored research project is reflected in many research publications. Another important spin-off of this research activity is 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 C.R. 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 (C.R.) National Semiconductor Corporation (NSC) processing groups located in 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 focused on software tool development for rapid reduction in the time to market a custom solution based on the C.R. family of processors. It 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, and Compilers) for customers, and rapidly explore the design space by providing tools for extensible C.R. processors (ISA verification and software toolset for CR-X). This effort also aimed to develop the Software Quality Assurance (Q.A.) framework for the tools produced by this activity.

The project activity had three primary parts: tools for CR16C, an extension of the toolset to handle the CR16C family of processors, and a scalable toolset concept for the extensible C.R. (CR-X). The CR-X activity also aimed at developing a mechanism to generate the toolset for C.R.-based processors automatically. The critical goals were to generate tests and test the software in a proper Q.A. framework. 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, and 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 that 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 aimed to extend the previous work (GALESIA, 1997) and incorporate the notion of convergence in multiobjective evolutionary algorithms (MOEA).

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