Modern Applications of Numerical Linear Algebra Methods

……

Overview

Solutions of many modern scientific problems, like data clustering, data compression and compressive sensing, are obtained by using linear algebra techniques, in particular eigenvalue and singular value decompositions. It nowadays becomes more and more the case that the amounts of data to be analyzed is vast, thus the term **Big Data** is coined. Another requirement is the fast development of fast software for such problems. **Julia**, as a new programming language, aims to be ideal for such purpose. As the last language in the long line of languages from Fortran, C, Java, Matlab, and Python, it corrects most of the shortcomings of the predecessors, by being both, easy to program and develop solutions to complex problems and, at the same time, be very fast in execution.

Module A **Short Julia Course**	Lecture 1: Introduction to Julia Lecture 2: Advanced Julia – working with packages Tutorial 1: Problem solving session with examples in Julia – using polymorphism
Module B **Eigenvalue and singular value decompositions**	Lecture 3: Symmetric eigenvalue decomposition – definitions an perturbation theory Lecture 4: Symmetric eigenvalue decomposition – algorithms and error analysis Lecture 5: Singular value decomposition – definitions and perturbation theory Lecture 6: Singular value decomposition – algorithms and error analysis Lecture 7: Fast algorithms for structured matrices Lecture 8: Fast updating of the singular value decomposition Tutorial 2: Problem solving session with examples in eigenvalue decomposition Tutorial 3: Problem solving session with examples in singular value decomposition Tutorial 4: Problem solving session with examples in fast algorithms for structured matrices and updating of the singular value decomposition

Module C **Applications**	Lecture 9: Data clustering-k-means algorithm Lecture 10: Graph bi-partitioning using eigenvectors of Laplace matrix Lecture 11: Graph multi-partitioning Lecture 12: Multi-partitioning of bipartite graphs Lecture 13: Sparse+ low-rank splitting using singular value decomposition Lecture 14: Application of sparse-low-rank splitting to video extraction Lecture 15: Signal decomposition using eigenvalue decomposition of Hankel matrices Lecture 16: Fast eigenvalue decomposition of Hankel matrices Lecture 17: Compressed sensing – problems and definitions Lecture 18: Compressed sensing – sparse signal reconstruction with 11 minimization Lecture 19: Principal component analysis – basic theory and algorithms Lecture 20: Principal component analysis applications Tutorial 5: Problem solving session with examples in data clustering and graph bi-partitioning Tutorial 6: Problem solving session with examples in graph multi-partitioning including document clustering. Tutorial 7: Problem solving session with examples on sparse+low-rank splitting Tutorial 8: Problem solving session with examples in signal decomposition using Eigenvalue decomposition Tutorial 9: Problem solving session with examples in sparse signal reconstruction with 11 minimization Tutorial 10: Problem solving session with examples in principal component analysis
You Should Attend If…	▪ You are students at all levels (BTech/MSc/MTech/PhD) or Faculty from reputed academic institutions and technical institutions. ▪ You are executives, engineers and researchers from manufacturing, service and government organizations including R&D laboratories.
Maximum No. of Participants	**50**
Credit Points	**2**
Fees	The participation fees for taking the course is as follows: **Participants from abroad : US $500** **MSc/M.Phil/B.Tech/M. Tech. Students: Rs. 500** **Ph.D. Student Participants: Rs. 1500** **Post Doctoral Participants: Rs. 2000** **Faculty Participants: Rs. 3000** **Government Research Organization Participants: Rs. 8000** **Industry Participants: Rs.15000** The above fee is towards participation in the course, the course material, computer use for tutorials and assignments, and laboratory equipment usage charges. The participants may be provided with hostel accommodation, depending on the availability, on payment basis register for any questions please send an email to safique@iiti.ac.in

The Faculty

Professor Ivan Slapnicar is the Full Professor of Mathematics at the University of Split, Croatia, primarily working at the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture. He is the author of the chapter on *Symmetric Matrix Eigenvalue Techniques* in the *Handbook of Linear Algebra, 2nd Edition,* L. Hogben, ed., CRC Press, Boca Raton, 2014, and the coauthor of the seminal paper by *J. Demmel et al., Computing the singular value decomposition with high relative accuracy,* Linear Algebra Appl, 299 (2189) 1999. He received the *Fulbright-Schuman International Lecturer/Educator Grant* in Aug Dec 2014, when he visited Massachusetts Institute of Technology and worked with the Julia Group at CSAIL. He also received the *EU FP7 People "Marie Curie" Intra European Fellowship* from April 2009 until March 2010, which he spent as a research scientist at Technical University Berlin. In 2001/2002 he was Visiting Professor at the Utah State University. He also made shorter visits to the Pennsylvania State University, Universidad de Chile, Fernuniversitaet Hagen, Germany, and ETH Zurich. In January 2013.

Prof. Soumyendu Raha is working in Department of Computational & Data Sciences (formerly academic section of SERC), Indian Institute of Science (IISc), Bangalore 560012, India. His research interests are Computational Study of Stochastic Differential-Algebraic and stiff Stochastic Differential Equations etc.

Dr. Bibhas Adhikari is an Assistant Professor in the Department of Mathematics, Indian Institute of Technology Kharagpur, India. His research interests include applied linear algebra, theory of complex networks, and graph theoretic techniques in quantum information.

Dr. Sk. Safique Ahmad working as an assistant professor in the Discipline of Mathematics IIT Indore. His research interest lies inside Numerical Linear Algebra, Stability of Stochastic Differential Equations (SDEs) and Quaternion Linear Algebra.

Duration:

27th June to 5th July, 2016

Course Coordinator:

Dr. Sk. Safique Ahmad
Assistant Professor and Head
Discipline of Mathematics
School of Basic Sciences
IIT Indore, Khandwa Road, Simrol
Indore 452020, Madhya Pradesh

Tel: +91 731 2438 947 (O)
Email: safique@iiti.ac.in

http://iiti.ac.in/people/~safique/

http://www.gian.iitkgp.ac.in/GREGN