

# KANIKA SOOD

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## EDUCATION

**University of Oregon**, Oregon, USA June 2019 (Expected)  
PhD, Computer and Information Science GPA 3.77 (Scale of 4)  
Advisor: Boyana Norris  
Title: Solver suggestion techniques for large sparse linear systems

**University of Oregon**, Oregon, USA Sep 2012 - Jun 2014  
M.S. Computer and Information Science GPA 3.70 (Scale of 4)

**Mody Institute of Technology & Science**, Rajasthan, India Aug 2007- May 2011  
B.Tech, Computer Science GPA 8.23 (Scale of 10)

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## RELEVANT COURSES

Artificial Intelligence, Machine Learning, Data Mining, Compiler Design, Database Processing, Database Issues, Graph Theory, Automata Theory, Introduction to Logic, Algorithms & Complexity, Distributed Systems

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## TECHNICAL SKILLS

**Languages:** Python, C, C++, Java, MySQL

**Web Technologies:** HTML, XML, JavaScript, PHP

**Tools:** Eclipse, Netbeans, Coq

**Databases:** MySQL, DBVisualizer, DB2, phpMyAdmin

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## PROFESSIONAL EXPERIENCE

- **Argonne National Lab**, *Givens Associate* Jun 2017- Sep 2017  
Develop methodology for analyzing revision control and issue tracking data to estimate productivity and analyse ECP projects. Develop new productivity metrics and test them on multiple projects. Generate estimates of effort and productivity improvement or degradation over a given time period.
  - **Schlumberger**, *REMS Intern, Software Technology Innovation Center* Jun 2016- Sep 2016  
Identify and understand I/O pattern in the tomography application for the equation solver module. Set up the environment for the tomography application on Google cloud Storage. Design and run benchmark for serial and parallel evaluation of GCS performance from C++. Rewrite the read pattern for the application using C++ API for GCS. Quantify network latency and bandwidth.
  - **University of Oregon**, *Research Assistant, High Performance Computation Lab* Sep 2014- Present  
Design and build performance model for optimal numerical method selection for large sparse linear systems for Portable Extensible Toolkit for Scientific Computing (PETSc). Model the convergence behavior and the communication overhead for parallel Krylov methods to make solver recommendations.
  - **University of Oregon**, *Instructor, Computer & Information Science* Jun 2014- Sep 2014  
**Course:** *Fluency with Information Technology (CIS 110)*
  - **University of Oregon**, *Teaching Assistant* Sep 2012- Jun 2014  
**Courses:** Object Oriented Programming, Intro. to Programming and Problem Solving, Fluency with Information Technology, Python Programming
  - **SPICE**, *Volunteer* Jan 2017 - Present
  - **Thinkersmith, WICS, University of Oregon**, *Volunteer* Nov 2013 - Present
  - **IIT Delhi**, India, *Summer Intern* Jul 2013 - Sep 2013
  - **IBM**, India, *Associate Systems Engineer* Jun 2011- Aug 2012  
Secure digital distribution of movie content for the first time in Indian theaters via satellite. Development server testing and sanity testing for cinema modules. Translated business functionalities into technical solutions and worked with vendor and portal developers for technical implementation. Partnered with Bharti sales teams for product demonstrations to Bharti's prospective customers.
  - **NTPC Ltd.**, India, *Intern* May 2010- Jul 2010
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## PAPER PUBLICATIONS

- *Comparative Performance Modeling of Parallel Preconditioned Krylov Methods* IEEE International Conference on High Performance Computing and Communications (HPCC) | Dec 2017.
- *Solver Schemes for Linear Systems*, Comprehensive Position Paper, University of Oregon | Dec 2016.
- *Performance-based numerical solver selection in the Lighthouse framework*. SIAM Journal on Scientific Computing | Mar 2016.
- *Lighthouse: An automated solver selection tool*. Software Engineering for High Performance Computing in Computational Science and Engineering (SEHPCCSE) | Nov 2015.
- *Lighthouse: A taxonomy-based solver selection tool*. Proceedings of the Second Workshop on Software Engineering for Parallel Systems (SEPS) | Oct 2015.
- *Automated Selection of Numerical Solvers*. Technical Report, University of Oregon | Oct 2015.

## POSTER PUBLICATIONS

- *Comparative Performance Modeling of Parallel Preconditioned Krylov Methods*, Petsc User Meeting 2017, Boulder, Colorado | June 2017 [[Petsc User Meeting Poster](#)]
- *Maximizing Usability and Performance in Numerical Software*, SIAM-CSE 2017, Georgia, Atlanta | March 2017 [[SIAM Poster 2017](#)]
- *Automating Sparse Linear Solver Selection with Lighthouse*, Supercomputing 2015, Austin, Texas | November 2015 [[Supercomputing Poster 2015](#)]
- *Automating Sparse Linear Solver Selection*, Systems, Programming, Languages and Applications: Software for Humanity (SPLASH), Pittsburgh | October 2015 [[SPLASH Poster 2015](#)]
- *Machine Learning Approaches for Linear Solver Selection*, ACM International Symposium on High-Performance Parallel and Distributed Computing (HPDC) | Oregon | June 2015 [[HPDC Poster 2015](#)]

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## PROJECTS

- **Matrix-free approach for selecting iterative Krylov methods** Sep 2017 - Present  
The Krylov solution of the linearized system is computed by using approximations of matrix-vector products based only on the function computing the current discretized solution approximation at each grid point. Because there is no explicit matrix, it is impossible to compute most of the features used in our ML-based solver selection. Hence, a different set of features must be defined and computed for matrix-free approaches. We present initial results using features based on matrix-free eigenvalue approximation, infinity norm, and structural problem features.
- **Comparative Performance Modeling of Parallel Krylov Methods** Feb 2017 - Sep 2017  
Comparing the scalability of parallel Krylov methods given different input properties without requiring extensive empirical measurements. We consider the PETSc implementations of Newton-Krylov methods to produce scalability rankings based on our new comparative modeling approach. The model-based ranking is validated by comparison with empirical scalability results on a numerical simulation of driven fluid flow in a cavity.
- **Happiness Detection Project** Jan 2017 - Feb 2017  
Face detection followed by smile detection was applied in MATLAB for this work. President election inauguration as input to identify the happy zones in the seating areas. The inauguration photos are segmented into multiple images.
- **Solver Selection in Finite Element Multiphysics Simulations** Feb 2016 - Dec 2016  
Defining of a new set of linear system properties, which are used as the features in the machine learning problem specification. We then apply the classification to a set of examples in the MOOSE framework, achieving high accuracy when targeting problems in the more limited domain of finite element multi-physics applications.
- **PhD Directed Research Project** Sep 2014 - Oct 2015  
**Title:** Automated selection of numerical solvers  
A generalizable machine learning-based workflow for classifying arbitrary sparse linear systems using different-sized feature sets and a comparative analysis of the solver classification results for a variety of input problems belonging to different domains and various machine-learning methods, achieving up to 87% accuracy in identifying the well-performing linear solution methods in PETSc.

- **Master's Thesis** Jan 2014 - Jun 2014  
**Title:** Comparison of Functional Dependency extraction methods and an application of DFS  
 Given the raw data, normally looking for FD takes exponential time with respect to the number of attributes. Over the past, heuristics have been given to reduce the time using efficient algorithms. My tasks involved reviewing the algorithms and developing a more efficient algorithm.
  - **Database Design and Applications** (Masters course project)  
 Developed a relational database (using MySQL), implemented advanced features like triggers etc. and web-based applications to access this database (using PHP).
  - **Data Classification Project** (Masters course project)  
 Worked on and implemented a few classic classification Machine Learning algorithms (ID3, Naïve Bayes, Logistic Regression, Perceptrons etc.) on real life data sets.
  - **Leveraging Natural Language Processing On Sentiment Analysis** (Masters course project)  
 Leveraged NLTK for the purpose of sentiment analysis on user-generated product reviews using a corpus of reviews extracted from Amazon.com.
  - **Face Recognition System** (Bachelors course project)  
 Took in several facial images and generated an image of the same human with a different expression using the Principal Component Analysis (PCA) technique in MATLAB.
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## HONORS

- Best paper finalist for IEEE HPCC | Thailand Dec 2017
- Awarded SC'17 Volunteer Award | Colorado Nov 2017
- Awarded SC'17 Student Travel Award | Colorado | \$600 July 2017
- Awarded PETSc User Meeting Travel Award | Colorado | \$655 Jun 2017
- Awarded SIAM Student Travel Award | Georgia | \$800 Feb 2017
- Served as a mentor on the BE Mentor-Protege Program at SIAM'17 Feb 2017
- Served on SC16 HPC Undergraduate program panel SC'16 | Utah Nov 2016
- Awarded 2016 Intern Video Competition Winner | Schlumberger Aug 2016
- Awarded Erwin and Gertrude Juilfs Scholarship | \$1,000 Jun 2016
- Awarded SE4SCIENCE travel grant | Texas | \$500 May 2016
- Awarded Graduate Research Fellowship Sep'14 - Present
- Awarded Graduate Teaching Fellowship Sep'12- Jun'14
- Certified Database Associate of IBM 2009
- Ranked in top 5% of undergraduate institution 2008-2011
- Level-1 certified in French language 2011
- Literary Head of college club Xperia 2009-2011
- Head of college horse riding committee 2008-2011
- Third highest scorer in Board Examination (CBSE) | Grade 12 and 10 2007, 2005