Stanford

Madeleine Udell

Assistant Professor of Management Science and Engineering and, by courtesy, of Electrical Engineering

Bio

BIO

Madeleine Udell is Assistant Professor of Management Science and Engineering at Stanford University, with an affiliation with the Institute for Computational and Mathematical Engineering (ICME) and courtesy appointment in Electrical Engineering.

She completed her PhD at Stanford in Computational and Mathematical Engineering and a postdoctoral fellowship at the Center for the Mathematics of Information at Caltech.

Her research aims to accelerate and simplify large-scale data analysis and optimization,

with impact on challenges in healthcare, finance, marketing, operations, and engineering systems design, among others.

Her work in optimization seeks to detect and exploit novel structures,

leading to faster and more memory-efficient algorithms,

automatic proofs of optimality, better complexity guarantees,

and user-friendly optimization solvers and modeling languages.

Her work in machine learning centers on challenges of data preprocessing, interpretability, and causality,

which are critical to practical application in domains with messy data.

Her awards include the Kavli Fellowship (2023), Alfred P. Sloan Research Fellowship (2021), an NSF CAREER award (2020), and an ONR Young Investigator Award (2020).

ACADEMIC APPOINTMENTS

- Assistant Professor, Management Science and Engineering
- Assistant Professor (By courtesy), Electrical Engineering
- Member, Bio-X
- Member, Institute for Computational and Mathematical Engineering (ICME)

PROFESSIONAL EDUCATION

- BS, Yale University , Mathematics and Physics (2009)
- PhD, Stanford University , Computational and Mathematical Engineering (2015)

LINKS

- http://web.stanford.edu/~udell: http://web.stanford.edu/~udell

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

Professor Udell builds the mathematical and computational foundations needed for

scalable, accessible, and responsible data-driven decisionmaking in high-stakes domains, with impact on challenges in healthcare, finance, marketing, operations, and engineering.

She develops new efficient algorithms to accelerate and automate optimization and data science, and new frameworks that empower users to invoke these algorithms and interpret the resulting decisions, motivated by the view that hidden mathematical structure in the data, algorithms, and procedures that humans use to make decisions can accelerate and automate verifiable AI-driven methods.

Teaching

COURSES

2025-26

- Introduction to Applied Statistics: MS&E 125 (Spr)
- Optimization: CME 307, MS&E 311 (Aut)
- Optimization: OIT 676 (Aut)
- Safe and Constrained AI: MS&E 318 (Win)

2023-24

- Applied Data Science: CME 218, MS&E 218 (Aut)
- Ases Breakthrough: MS&E 478 (Spr)
- Optimization: CME 307, MS&E 311 (Win)

2022-23

- Introduction to Applied Statistics: MS&E 125 (Spr)
- Optimization: CME 307, MS&E 311 (Spr)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Samuel Liu, Akshay Rao, Maximilian Schaller

Postdoctoral Faculty Sponsor

Yushun Zhang

Doctoral Dissertation Advisor (AC)

Shaghayegh Fazliani, Wenzhi Gao

Master's Program Advisor

Laurence Allen, Yakir Bela, Ignacio Guarna, Annabelle Jayadinata, Nathan Luk, Antoine Maechler, Jasleen Sihota, Dhruv Vaze

Doctoral (Program)

Henry Robbins, Vincent Wang, Wanyu Zhang

Publications

PUBLICATIONS

- **Scalable approximate optimal diagonal preconditioning** *COMPUTATIONAL OPTIMIZATION AND APPLICATIONS*
  Gao, W., Qu, Z., Udell, M., Ye, Y.
  2026

- **GeNIOS: an (almost) second-order operator-splitting solver for large-scale convex optimization** *MATHEMATICAL PROGRAMMING COMPUTATION*
  Diamandis, T., Frangella, Z., Zhao, S., Stellato, B., Udell, M.
  2026

- **RANDOMIZED NYSTROM PRECONDITIONED INTERIOR POINT-PROXIMAL METHOD OF MULTIPLIERS** *SIAM JOURNAL ON SCIENTIFIC COMPUTING*
  Chu, Y., Santos, L., Udell, M.
  2026; 48 (1): A132-A159

- **LLMs for Cold-Start Cutting Plane Separator Configuration**
  Lawless, C., Li, Y., Wikum, A., Udell, M., Vitercik, E.
  edited by Tack, G.
  SPRINGER INTERNATIONAL PUBLISHING AG.2025: 51-69

- **Gradient Methods with Online Scaling**
  Gao, W., Chu, Y., Ye, Y., Udell, M.
  edited by Haghtalab, N., Moitra, A.
  JMLR-JOURNAL MACHINE LEARNING RESEARCH.2025

- **Interpretable Prediction and Feature Selection for Survival Analysis**
  Van Ness, M., Udell, M., ACM
  ASSOC COMPUTING MACHINERY.2025: 1421-1432

- **Provable and Practical Online Learning Rate Adaptation with Hypergradient Descent**
  Chu, Y., Gao, W., Ye, Y., Udell, M.
  edited by Singh, A., Fazel, M., Hsu, D., Lacoste-Julien, S., Berkenkamp, F., Maharaj, T., Wagstaff, K., Zhu, J.
  JMLR-JOURNAL MACHINE LEARNING RESEARCH.2025: 10768-10800

- **gcimpute: A Package for Missing Data Imputation** *JOURNAL OF STATISTICAL SOFTWARE*
  Zhao, Y., Udell, M.
  2024; 108 (4)

- **PROMISE: Preconditioned Stochastic Optimization Methods by Incorporating Scalable Curvature Estimates** *JOURNAL OF MACHINE LEARNING RESEARCH*
  Frangella, Z., Rathore, P., Zhao, S., Udell, M.
  2024; 25

- **DNAMite: Interpretable Calibrated Survival Analysis with Discretized Additive Models**
  Van Ness, M., Block, B., Udell, M.
  edited by Hegselmann, S., Zhou, H., Healey, E., Chang, T., Ellington, C., Mhasawade, Tonekaboni, S., Argaw, P., Zhang, H.
  JMLR-JOURNAL MACHINE LEARNING RESEARCH.2024: 805-823

- **OptiMUS: Scalable Optimization Modeling with (MI)LP Solvers and Large Language Models**
  AhmadiTeshnizi, A., Gao, W., Udell, M.
  edited by Salakhutdinov, R., Kolter, Z., Heller, K., Weller, A., Oliver, N., Scarlett, J., Berkenkamp, F.
  JMLR-JOURNAL MACHINE LEARNING RESEARCH.2024: 577-596

- **A greedy Galerkin method to efficiently select sensors for linear dynamical systems** *LINEAR ALGEBRA AND ITS APPLICATIONS*
  Kouri, D. P., Hua, Z., Udell, M.
  2023; 679: 275-304

- **Sparse Data Reconstruction, Missing Value and Multiple Imputation through Matrix Factorization** *SOCIOLOGICAL METHODOLOGY*
  Sengupta, N., Udell, M., Srebro, N., Evans, J.
  2023; 53 (1): 72-114
- **The Missing Indicator Method: From Low to High Dimensions**
  Van Ness, M., Bosschieter, T. M., Halpin-Gregorio, R., Udell, M., ACM
  ASSOC COMPUTING MACHINERY.2023: 5004-5015
- **Interpretable Survival Analysis for Heart Failure Risk Prediction**
  Van Ness, M., Bosschieter, T., Din, N., Ambrosy, A., Sandhu, A., Udell, M.
  edited by Hegselmann, S., Parziale, A., Shanmugam, D., Tang, S., Asiedu, M. N., Chang, S., Hartvigsen, T., Singh, H.
  JMLR-JOURNAL MACHINE LEARNING RESEARCH.2023: 574-593
- **RANDOMIZED NYSTROM PRECONDITIONING** *SIAM JOURNAL ON MATRIX ANALYSIS AND APPLICATIONS*
  Frangella, Z., Tropp, J. A., Udell, M.
  2023; 44 (2): 718-752
- **From Human Days to Machine Seconds: Automatically Answering and Generating Machine Learning Final Exams**
  Drori, I., Zhang, S. J., Shuttleworth, R., Zhang, S., Tyser, K., Chin, Z., Lantigua, P., Surbehera, S., Hunter, G., Austin, D., Tang, L., Hicke, Y., Simhon, et al
  ASSOC COMPUTING MACHINERY.2023: 3947-3955
- **Data-Efficient and Interpretable Tabular Anomaly Detection**
  Chang, C., Yoon, J., Arik, S. O., Udell, M., Pfister, T., ACM
  ASSOC COMPUTING MACHINERY.2023: 190-201
- **A strict complementarity approach to error bound and sensitivity of solution of conic programs** *OPTIMIZATION LETTERS*
  Ding, L., Udell, M.
  2022
- **NysADMM: faster composite convex optimization via low-rank approximation**
  Zhao, S., Frangella, Z., Udell, M.
  edited by Chaudhuri, K., Jegelka, S., Song, L., Szepesvari, C., Niu, G., Sabato, S.
  JMLR-JOURNAL MACHINE LEARNING RESEARCH.2022
- **Online Missing Value Imputation and Change Point Detection with the Gaussian Copula**
  Zhao, Y., Landgrebe, E., Shekhtman, E., Udell, M., Assoc Advancement Artificial Intelligence
  ASSOC ADVANCEMENT ARTIFICIAL INTELLIGENCE.2022: 9199-9207
- **CONTROLBURN: Feature Selection by Sparse Forests**
  Liu, B., Xie, M., Udell, M., ASSOC COMP MACHINERY
  ASSOC COMPUTING MACHINERY.2021: 1045-1054
- **Scalable Semidefinite Programming** *SIAM JOURNAL ON MATHEMATICS OF DATA SCIENCE*
  Yurtsever, A., Tropp, J. A., Fercoq, O., Udell, M., Cevher, V.
  2021; 3 (1): 171-200
- **Robust Non-Linear Matrix Factorization for Dictionary Learning, Denoising, and Clustering** *IEEE TRANSACTIONS ON SIGNAL PROCESSING*
  Fan, J., Yang, C., Udell, M.
  2021; 69: 1755-1770
- **RANDOMIZED SKETCHING ALGORITHMS FOR LOW-MEMORY DYNAMIC OPTIMIZATION** *SIAM JOURNAL ON OPTIMIZATION*
  Muthukumar, R., Kouri, D. P., Udell, M.
  2021; 31 (2): 1242-1275
- **TenIPS: Inverse Propensity Sampling for Tensor Completion**
  Yang, C., Ding, L., Wu, Z., Udell, M.
  edited by Banerjee, A., Fukumizu, K.
  MICROTOME PUBLISHING.2021

- **ON THE SIMPLICITY AND CONDITIONING OF LOW RANK SEMIDEFINITE PROGRAMS** *SIAM JOURNAL ON OPTIMIZATION*
  Ding, L., Udell, M.
  2021; 31 (4): 2614-2637
- **An Optimal-Storage Approach to Semidefinite Programming Using Approximate Complementarity** *SIAM JOURNAL ON OPTIMIZATION*
  Ding, L., Yurtsever, A., Cevher, V., Tropp, J. A., Udell, M.
  2021; 31 (4): 2695-2725
- **Dynamic Assortment Personalization in High Dimensions** *OPERATIONS RESEARCH*
  Kallus, N., Udell, M.
  2020; 68 (4): 1020-1037
- **Low-Rank Tucker Approximation of a Tensor from Streaming Data** *SIAM JOURNAL ON MATHEMATICS OF DATA SCIENCE*
  Sun, Y., Guo, Y., Luo, C., Tropp, J., Udell, M.
  2020; 2 (4): 1123-1150
- **AutoML Pipeline Selection: Efficiently Navigating the Combinatorial Space**
  Yang, C., Fan, J., Wu, Z., Udell, M., ASSOC COMP MACHINERY
  ASSOC COMPUTING MACHINERY.2020: 1446-1456
- **Missing Value Imputation for Mixed Data via Gaussian Copula**
  Zhao, Y., Udell, M., ASSOC COMP MACHINERY
  ASSOC COMPUTING MACHINERY.2020: 636-646
- **Polynomial Matrix Completion for Missing Data Imputation and Transductive Learning**
  Fan, J., Zhang, Y., Udell, M., Assoc Advancement Artificial Intelligence
  ASSOC ADVANCEMENT ARTIFICIAL INTELLIGENCE.2020: 3842-3849
- **Optimal Design of Efficient Rooftop Photovoltaic Arrays** *INFORMS JOURNAL ON APPLIED ANALYTICS*
  Udell, M., Toole, O.
  2019; 49 (4): 281-294
- **Optimal Design of Efficient Rooftop Photovoltaic Arrays** *INFORMS JOURNAL ON APPLIED ANALYTICS*
  Udell, M., Toole, O.
  2019; 49 (4): 293-294
- **Factor Group-Sparse Regularization for Efficient Low-Rank Matrix Recovery**
  Fan, J., Ding, L., Chen, Y., Udell, M.
  edited by Wallach, H., Larochelle, H., Beygelzimer, A., d'Alche-Buc, F., Fox, E., Garnett, R.
  NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2019
- **Why Are Big Data Matrices Approximately Low Rank?** *SIAM JOURNAL ON MATHEMATICS OF DATA SCIENCE*
  Udell, M., Townsend, A.
  2019; 1 (1): 144-160
- **Fairness Under Unawareness: Assessing Disparity When Protected Class Is Unobserved**
  Chen, J., Kallus, N., Mao, X., Svacha, G., Udell, M., Assoc Comp Machinery
  ASSOC COMPUTING MACHINERY.2019: 339-348
- **STREAMING LOW-RANK MATRIX APPROXIMATION WITH AN APPLICATION TO SCIENTIFIC SIMULATION** *SIAM JOURNAL ON SCIENTIFIC COMPUTING*
  Tropp, J. A., Yurtsever, A., Udell, M., Cevher, V.
  2019; 41 (4): A2430-A2463
- **OBOE: Collaborative Filtering for AutoML Model Selection**
  Yang, C., Akimoto, Y., Kim, D., Udell, M., Assoc Comp Machinery
  ASSOC COMPUTING MACHINERY.2019: 1173-1183
- **Online high rank matrix completion**
  Fan, J., Udell, M., IEEE Comp Soc

IEEE.2019: 8682-8690

- **Causal Inference with Noisy and Missing Covariates via Matrix Factorization**
  Kallus, N., Mao, X., Udell, M.
  edited by Bengio, S., Wallach, H., Larochelle, H., Grauman, K., CesaBianchi, N., Garnett, R.
  NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2018

- **Frank-Wolfe Style Algorithms for Large Scale Optimization** *LARGE-SCALE AND DISTRIBUTED OPTIMIZATION*
  Ding, L., Udell, M.
  edited by Giselsson, P., Rantzer, A.
  2018; 2227: 215-245

- **Limited memory Kelley's Method Converges for Composite Convex and Submodular Objectives**
  Zhou, S., Gupta, S., Udell, M.
  edited by Bengio, S., Wallach, H., Larochelle, H., Grauman, K., CesaBianchi, N., Garnett, R.
  NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2018

- **Disciplined Multi-Convex Programming**
  Shen, X., Diamond, S., Udell, M., Gu, Y., Boyd, S., IEEE
  IEEE.2017: 895–900

- **Graph-Regularized Generalized Low-Rank Models**
  Paradkar, M., Udell, M., IEEE
  IEEE.2017: 1921-1926

- **PRACTICAL SKETCHING ALGORITHMS FOR LOW-RANK MATRIX APPROXIMATION** *SIAM JOURNAL ON MATRIX ANALYSIS AND APPLICATIONS*
  Tropp, J. A., Yurtsever, A., Udell, M., Cevher, V.
  2017; 38 (4): 1454-1485

- **Sketchy Decisions: Convex Low-Rank Matrix Optimization with Optimal Storage**
  Yurtsever, A., Udell, M., Tropp, J. A., Cevher, V.
  edited by Singh, A., Zhu, J.
  MICROTOME PUBLISHING.2017: 1188-1196

- **Fixed-Rank Approximation of a Positive-Semidefinite Matrix from Streaming Data**
  Tropp, J. A., Yurtsever, A., Udell, M., Cevher, V.
  edited by Guyon, Luxburg, U. V., Bengio, S., Wallach, H., Fergus, R., Vishwanathan, S., Garnett, R.
  NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2017

- **Bounding duality gap for separable problems with linear constraints** *COMPUTATIONAL OPTIMIZATION AND APPLICATIONS*
  Udell, M., Boyd, S.
  2016; 64 (2): 355-378

- **DISCOVERING PATIENT PHENOTYPES USING GENERALIZED LOW RANK MODELS.** *Pacific Symposium on Biocomputing. Pacific Symposium on Biocomputing*
  Schuler, A., Liu, V., Wan, J., Callahan, A., Udell, M., Stark, D. E., Shah, N. H.
  2016; 21: 144-155

- **Revealed Preference at Scale: Learning Personalized Preferences from Assortment Choices**
  Kallus, N., Udell, M., ACM
  ASSOC COMPUTING MACHINERY.2016: 821-837

- **The Sound of APALM Clapping: Faster Nonsmooth Nonconvex Optimization with Stochastic Asynchronous PALM**
  Davis, D., Udell, M., Edmunds, B.
  edited by Lee, D. D., Sugiyama, M., Luxburg, U. V., Guyon, Garnett, R.
  NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2016

- **Introduction** *FOUNDATIONS AND TRENDS IN MACHINE LEARNING*
  Udell, M., Horn, C., Zadeh, R., Boyd, S.

2016; 9 (1): 2-+

- **FACTORIZATION FOR ANALOG-TO-DIGITAL MATRIX MULTIPLICATION**
  Lee, E. H., Udell, M., Wong, S., IEEE
  IEEE.2015: 1061–65
- **Revenue Maximization for Broadband Service Providers Using Revenue Capacity**
  Mehmood, H., Udell, M., Cioffi, J., IEEE
  IEEE.2015
- **Incorporation of flexible objectives and time-linked simulation with flux balance analysis.** *Journal of theoretical biology*
  Birch, E. W., Udell, M., Covert, M. W.
  2014; 345: 12-21
- **Analyzing patterns of drug use in clinical notes for patient safety.** *AMIA Summits on Translational Science proceedings AMIA Summit on Translational Science*
  LePendu, P., Liu, Y., Iyer, S., Udell, M. R., Shah, N. H.
  2012; 2012: 63-70