

Spencer Krieger

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POSITIONS HELD

June 2016 – present

PhD Student

University of Arizona, Computer Science
PhD Advisor: John Kececioglu

January 2014 – April 2016

Research Assitant

Brigham Young University, Chemistry and Biochemistry
Research Advisor: Roger Harrison

EDUCATION

August 2016 - Present

PhD in Computer Science

University of Arizona

August 2016 - May 2020

MS in Computer Science

University of Arizona

April 2016

BS in Biochemistry

Brigham Young University
Computer Science minor

RESEARCH INTERESTS

Algorithms in bioinformatics (network biology, cell-signaling pathway analysis, shortest path in hypergraphs; structural bioinformatics, protein secondary structure prediction); personal medicine (genomics, personal genomics)

RESEARCH PROJECTS

Protein Secondary Structure Prediction (2016-present, University of Arizona, Department of Computer Science) - We have developed a fast and accurate protein secondary-structure predictor that uses dynamic programming and a variant of nearest-neighbor classification on a learned distance function, which avoids a conventional sequence-database homology search. Our method achieves 86.0% accuracy on benchmark datasets and runs in half the time of state-of-the-art tools (which achieve 84.0% or less accuracy on the same datasets).

Shortest Hyperpaths in Cell-Signaling Networks (2017-present, University of Arizona, Department of Computer Science) - We model cell-signaling pathways as directed hypergraphs, and find the shortest hyperpath from a set of receptors to a set of transcription factors to assist biologists in finding the proteins involved in disease pathways. We proved that in our new formulation of shortest hyperpaths as an integer linear program (ILP), that for ordinary directed graphs, the number of constraints is linear in the size of the graph.

Grade-of-Service Node-Weighted Steiner Tree Problem (2018-2019, University of Arizona, Department of Computer Science) - The grade-of-service node-weighted steiner tree problem (GSNST) is a generalization of the node-weighted steiner tree problem (NST). NST is approximable within $2 \ln |T|$, where T is the number of terminals, given a reduction from the set cover problem. Surprisingly, we developed an approximation algorithm that approximates the seemingly harder GSNST within the same factor ($2 \ln |T|$).

Separation and Preconcentration of Pertechnetate From Nuclear Waste Using Ion Chromatography (2014-2016, Brigham Young University, Department of Chemistry and Biochemistry) - Using large macrocyclic molecules, we were able to separate pertechnetate, a common ingredient in cancer treatments, from nuclear reactor waste.

PAPERS

Spencer Krieger and John Kececioglu, "Boosting the Accuracy of Protein Secondary Structure Prediction Through Nearest Neighbor Search and Method Hybridization", Conditionally accepted to the 28th International Conference on Intelligent Systems in Molecular Biology (ISMB 2020), Montreal, Canada doi.org/10.1093/bioinformatics/btaa336

Faryad Darabi Sahneh, Alon Efrat, Stephen Kobourov, Spencer Krieger and Richard Spence, "An Approximation Algorithm for the Grade-of-Service Node-Weighted Steiner Tree Problem." preprint at arxiv.org/abs/1811.11700

PAPERS UNDER REVIEW

Spencer Krieger and John Kececioglu, "Ensemble Methods for Protein Secondary Structure Prediction." (In preparation for submission to the ACM's Conference on Bioinformatics, Computational Biology, and Health Informatics (ACM-BCB 2020))

PAPERS IN PREPARATION

Spencer Krieger and John Kececioglu, "Protein Secondary Structure Prediction Without Homology Search." (In Preparation, 2020)

Spencer Krieger, Dan DeBlasio, Travis Wheeler, and John Kececioglu, "Protein Multiple Sequence Alignment with Predicted Secondary Structure" (In Preparation, 2020)

Spencer Krieger and John Kececioglu, "Inferring Reaction Pathways in Cell-Signalling Networks: Shortest Hyperpaths in Directed Hypergraphs by Integer Linear Programming." (In Preparation, 2020)

Wai Ning Chan, Jacob P. Warren, Spencer P. Krieger, Benjamin L. Vestal, Roger G. Harrison, "Separation and preconcentration of perchlorate from ionic solutions by ion exchange chromatography." (In Preparation, 2020)

SOFTWARE RELEASED

Nnessy: Nearest-neighbor-based prediction of protein secondary structure without searching for homology, version 1.0, July 2020.
<http://nnessy.cs.arizona.edu>

Ssylla: Protein secondary structure prediction by an ensemble leveraging accuracy estimation, version 0.1, July 2020.
<http://ssylla.cs.arizona.edu>

TALKS

"Boosting the Accuracy of Protein Secondary Structure Prediction Through Nearest Neighbor Search and Method Hybridization", 28th International Conference on Intelligent Systems in Molecular Biology (ISMB 2020), July 15, 2020

"Predicting Protein Secondary Structure Through Nearest Neighbor Search and Method Hybridization", 16th Student Council Symposium preceding ISMB 2020 (SCS 2020), July 10, 2020

"Making Data Structures Persistent", CSC 630 (Great Results in Discrete Algorithms), Department of Computer Science, University of Arizona, April 25, 2019

"Breaking Through the Accuracy and Speed Barrier for Protein Secondary Structure Prediction Without Homology Search", A Peer Organized Student Seminar (POSSE), Department of Computer Science, University of Arizona, February 1, 2019

"A Cutting Planes, Integer Linear Programming Method to Solve the Multi-level Node-Weighted Steiner Tree Problem Exactly", CSC 620 (Multilevel Graph Representation), Department of Computer Science, University of Arizona, April 2, 2018

"Separation of Pertechnetate From Nuclear Waste", Spring Research Conference, Brigham Young University, March 19, 2016

"Selective Preconcentration of Perrhenate Using Ion Chromatography", Spring Research Conference, Brigham Young University, March 21, 2015

POSTERS

"Boosting the Accuracy of Protein Secondary Structure Prediction Through Nearest Neighbor Search and Method Hybridization", 28th International Conference on Intelligent Systems in Molecular Biology (ISMB 2020), July 15-16, 2020

"Predicting Protein Secondary Structure Through Nearest Neighbor Search and Method Hybridization", 16th Student Council Symposium preceding ISMB 2020, July 10-11, 2020

"Separation of Pertechnetate From Nuclear Waste", Spring Research Conference, Brigham Young University, March 19, 2016

"Selective Preconcentration of Perrhenate Using Ion Chromatography", Spring Research Conference, Brigham Young University, March 21, 2015

AWARDS

Best talk for "Predicting Protein Secondary Structure Through Nearest Neighbor Search and Method Hybridization", 16th Student Council Symposium preceding ISMB 2020 (SCS 2020), July 10, 2020, \$250

Graduate Student Service Award, Department of Computer Science, University of Arizona, April, 2020, \$100

Galileo Circle Scholar Award, College of Science, University of Arizona, August 2018 - May 2019, \$2,000

Undergraduate Research Award, College of Physical and Mathematical Sciences, Brigham Young University, April 2014 - April 2016, \$10,000

PROFESSIONAL SERVICE

Web Committee Chair, Student Council, International Society for Computational Biology (ISCB), 2018 - Present

Web Committee Member, Student Council, International Society for Computational Biology (ISCB), 2017-2018

DEPARTMENT AND UNIVERSITY SERVICE

Vice President (and Cofounder), Graduate Student Council, Department of Computer Science, University of Arizona, September 2018 - Present

Graduate Affairs Committee Member, Department of Computer Science, University of Arizona, September 2018 - Present

Faculty Recruiting Committee Graduate Student Liaison, Department of Computer Science, University of Arizona, January 2019 - Present

CONFERENCE PARTICIPATION

The 28th Conference on Intelligent Systems For Molecular Biology (ISMB), Student Council Symposium Web Chair, July 13-17, 2020, virtual

The 27th Conference on Intelligent Systems For Molecular Biology (ISMB), Student Council Symposium Web Chair, July 21-25, 2019, Basel, Switzerland

The 26th Conference on Intelligent Systems For Molecular Biology (ISMB), Student Council Symposium Web Chair, July 6-10, 2018, Chicago, IL

The 25th Conference on Intelligent Systems For Molecular Biology (ISMB), Student Council Volunteer, July 21-25, 2017, Prague, Czech Republic