Ideas for projects CompSci 276 - Winter 2020

For a project class students can be engaged in either an idea of their own that they will explore (theoretically and/or empirically). Alternatively, you can select a paper as a basis of your project. Projects are for individual students but you can also get in pairs if justified by the magnitude of the project (e.g., multiple papers involved or more in depth exploration.) In more details:

- Come up with your own idea. Must be relevant to the class.
- Join research by selecting a paper, presenting it to the class and writing a project report summarizing and analyzing the paper. I recommend that you connect with authors of the selected paper(s) to obtain slides. Also, it is desirable, whenever possible to re-evaluate the code in work involving empirical evaluation. A list of papers from which you can select are advised below. These include papers based on UCI research and known researchers in the field as well as a subset of UAI 2019 paper. Earlier UAI papers (2018) can be considered too.

Important: papers are divided into two classes: Priority 1 (high priority papers) and Priority 2 (lower priority papers). You should provide a selection of 2 papers: the first from the first priority group of papers, and the other from either the first or second priority papers.

Possible Projects Papers

Priority 1:

1. Suzuki, Joe, and Jun Kawahara. "Branch and Bound for Regular Bayesian Network Structure Learing." In *UAI*. 2017.
   https://www.ics.uci.edu/~dechter/courses/ics-276/_papers/78.pdf
2. Roy, Chiradeep, Mahesh Shanbhag, Mahsan Nourani, Tahrima Rahman, Samia Kabir, Vibhav Gogate, Nicholas Ruozzi, and Eric D. Ragan. "Explainable Activity Recognition in Videos using Dynamic Cutset Networks." Draft for *IUI Workshops*. 2019.
   https://www.ics.uci.edu/~dechter/courses/ics-276/_papers/demo_paper.pdf
3. Wrona, Michał. "Relational Width of First-Order Expansions of Homogeneous Graphs with Bounded Strict Width." *arXiv arXiv:2001.06676* (2020).
   https://www.ics.uci.edu/~dechter/courses/ics-276/_papers/relational-width.pdf
4. Philippe Jégou, Hélène Kanso, Cyril Terrioux. On the Relevance of Optimal Tree Decompositions for Constraint Networks. *Proceedings of the 30th International Conference on Tools with Artificial Intelligence (ICTAI)*, Nov 2018, Volos, Greece.
   https://www.ics.uci.edu/~dechter/courses/ics-276/_papers/relevance-tree-decomposition.pdf
5. Bargiacchi, Eugenio, Timothy Verstraeten, Diederik M. Roijers, and Ann Nowé. "Model-based Multi-Agent Reinforcement Learning with Cooperative Prioritized Sweeping." *arXiv preprint arXiv:2001.07527* (2020).
   https://www.ics.uci.edu/~dechter/courses/ics-276/_papers/RL-paper.pdf

6. Karan, Subhadeep. "High Performance Algorithms for Exact Structure Learning of Bayesian Networks." PhD diss., State University of New York at Buffalo, 2019. https://www.ics.uci.edu/~dechter/courses/ics-276/_papers/structure-learning.pdf
7. Simoncini, David, David Allouche, Simon de Givry, Céline Delmas, Sophie Barbe, and Thomas Schiex. "Guaranteed discrete energy optimization on large protein design problems." *Journal of chemical theory and computation* 11, no. 12 (2015): 5980-5989. https://www.ics.uci.edu/~dechter/courses/ics-276/_papers/GuaranteedDiscreteEnergyOptimizationOnLargeProteinDesignProblems.pdf
8. Cutset Bayesian Networks: A New Representation for Learning Rao-Blackwellised Graphical Models, Tahrima Rahman, Shasha Jin and Vibhav Gogate, https://www.ics.uci.edu/~dechter/courses/ics-276/_papers/ccn_ijcai19.pdf
9. Distributed Gibbs: A Linear-Space Sampling-Based DCOP Algorithm, Duc Thien Nguyen, William Yeoh , Hoong Chuin Lau, Roie Zivan, https://www.ics.uci.edu/~dechter/courses/ics-276/_papers/distributed-Roie-Yeoh.pdf
10. Efficient Search-Based Weighted Model Integration, Zhe Zeng, Guy Van den Broeck, https://www.ics.uci.edu/~dechter/courses/ics-276/_papers/Guy-Zeng-2018.pdf
11. Look Ma, No Latent Variables: Accurate Cutset Networks via Compilation, Tahrima Rahman, Shasha Jin, Vibhav Gogate, https://www.ics.uci.edu/~dechter/courses/ics-276/_papers/ICML_2019_paper1.pdf
12. Expansion-based QBF Solving on Tree Decompositions, Gunther Charwat, Stefan Woltran, https://www.ics.uci.edu/~dechter/courses/ics-276/_papers/qbf-tree-decomposition.pdf
13. On the Relevance of Optimal Tree Decompositions for Constraint Networks, Philippe Jégou, Hélène Kanso, Cyril Terrioux, https://www.ics.uci.edu/~dechter/courses/ics-276/_papers/relevance-tree-decomposition.pdf
14. 7478 (AAAI2020): Parallel AND/OR Search for Marginal MAP Radu Marinescu, Akihiro Kishimoto, Adi Botea
15. 4127: Beyond Trees: Analysis and Convergence of Belief Propagation in Graphs with Multiple Cycles Roie Zivan, Omer Lev, Rotem Galiki

- Anytime bounds on queries (Research at UCI)

16. [R255] Radu Marinescu, Rina Dechter, Alexander Ihler, Akihiro Kishimoto, and Adi Botea. "Anytime Recursive Best-First Search for Bounding Marginal MAP" in Proceedings of AAAI 2019.
17. [R254] Qi Lou, Rina Dechter, and Alexander Ihler. "Interleave Variational Optimization with Monte Carlo Sampling: A Tale of Two Approximate Inference Paradignms" in Proceedings of AAAI 2019
18. [R253] Radu Marinescu, Junkyu Lee, Rina Dechter, and Alexander Ihler. "AND/OR Search for Marginal MAP" Journal of Artificial Intelligence Research (JAIR) volume 63, 2018. 2019. (includes [R235] Radu Marinescu, Junkyu Lee, Alexander Ihler, and Rina Dechter. "Anytime Best+Depth-First Search for Bounding Marginal MAP" in Proceedings of AAAI 2017.)
19. [R249] Qi Lou, Rina Dechter, and Alexander Ihler. "Finite-sample Bounds for Marginal MAP" in Proceedings of UAI 2018.
20. [R247] Radu Marinescu, Rina Dechter, and Alexander Ihler. "Stochastic Anytime Search for Bounding Marginal MAP" in Proceedings of IJCAI 2018.
21. [R233] Qi Lou, Rina Dechter, and Alexander Ihler. "Anytime Anyspace AND/OR Search for Bounding the Partition Function" in Proceedings of AAAI 2017.
22. [R250] Junkyu Lee, Alexander Ihler, and Rina Dechter. "Join Graph Decomposiion Bounds for Influence Diagrams" in Proceedings of UAI 2018.

- AND/OR search with Look-ahead

23. [R236] William Lam, Kalev Kask, Javier Larrosa, and Rina Dechter. "Residual-Guided Look-Ahead in AND/OR Search for Graphical Models" Journal of Artificial Intelligence Research (JAIR), volume 60, 2017.
24. [R241] William Lam, Kalev Kask, Javier Larrosa, and Rina Dechter. "Subproblem Ordering Heuristics for AND/OR Best-First Search" Journal of Computer and System Sciences (JCSS), volume 94, 2018.

- Height vs width pseudo-trees: what are the tradeoffs? (extend the following work)

25. [R243] Héctor Otero Mediero. "Search Algorithms for Solving Queries on Graphical Models and the Importance of Pseudo-trees in their Complexity" UCI ICS Technical Report, June 2017.

Possible Projects by Researchers or Topics

- **Vibhav Gogate** http://www.hlt.utdallas.edu/~vgogate/papers.html

26. [C 48] Li Chou, Wolfgang Gatterbauer and Vibhav Gogate, "Dissociation-Based Oblivious Bounds for Weighted Model Counting", UAI 2018.
27. [C 46] Sara Rouhani, Tahrima Rahman and Vibhav Gogate, "Algorithms for the Nearest Assignment Problem", IJCAI 2018.
28. [C 43] Somdeb Sarkhel, Deepak Venugopal, Nicholas Ruozzi, and Vibhav Gogate, "Efficient Inference for Untied MLNs", IJCAI 2017.

- **Rodrigo de Salvo Braz**

29. https://arxiv.org/abs/1707.08704: Exact Inference for Relational Graphical Models with Interpreted Functions: Lifted Probabilistic Inference Modulo Theories. (revised version including supplementary material pdf, original pdf, original supplementary materials pdf, bibtex) UAI-17: Conference on Uncertainty in Artificial Intelligence.
30. [R231] Rodrigo de Salvo Braz, Ciaran O'Reilly, Vibhav Gogate, and Rina Dechter. "Probabilistic Inference Modulo Theories" in Proceedings of the International Joint Conference on Artificial Intelligence 2016 (IJCAI 2016)

- **Adnan Darwiche**

31. http://reasoning.cs.ucla.edu/

- **Roni Khardon**

32. Hao Cui and Roni Khardon, "Lifted Stochastic Planning, Belief Propagation and Marginal MAP" (http://www.cs.tufts.edu/~roni/PUB/planinf2018-lifted-plan-map.pdf)

Priority 2:

from UAI 2019: http://auai.org/uai2019/accepted.php

Here is a small selected recommended papers from UAI2019.

- ID: 6 Conditional Expectation Propagation, Zheng Wang, Shandian Zhe
- ID: 19 One-Shot Inference in Markov Random Fields, Hao Xiong, Yuanzhen Guo, Yibo Yang, Nicholas Ruozzi
- ID: 24 Learning Factored Markov Decision Processes with Unawareness, Craig Innes, Alex Lascarides
- ID:127 Towards Robust Relational Causal Discovery, Sanghack Lee, Vasant Honavar
- ID: 221 Belief Propagation: Accurate Marginals or Accurate Partition Function -- Where is the Difference, Christian Knoll, Franz Pernkopf
- ID:262 How to Exploit Structure while Solving Weighted Model Integration Problems, Samuel

Papers from UAI 2018: http://auai.org/uai2018/accepted.php#top

(red are recomended)

- ID: 54 Stochastic Learning for Sparse Discrete Markov Random Fields with Controlled Gradient Approximation Error , Sinong Geng, Zhaobin Kuang, Jie Liu, Stephen Wright, David Page
- ID: 65 Learning the Causal Structure of Copula Models with Latent Variables , Ruifei Cui, Perry Groot, Moritz Schauer, Tom Heskes
- ID: 117 Constraint-based Causal Discovery for Non-Linear Structural Causal Models with Cycles and Latent Confounders , Patrick Forré, Joris M. Mooij
- ID: 142 Causal Learning for Partially Observed Stochastic Dynamical Systems , Søren Wengel Mogensen, Daniel Malinsky, Niels Richard Hansen
- ID: 198 Identification of Personalized Effects Associated With Causal Pathways , Ilya Shpitser, Eli Sherman
- ID: 201 Fast Counting in Machine Learning Applications , Subhadeep Karan, Matthew Eichhorn, Blake Hurlburt, Grant Iraci, Jaroslaw Zola
- ID: 208 Causal Discovery in the Presence of Measurement Error , Tineke Blom, Anna Klimovskaia, Sara Magliacane, Joris M. Mooij
- ID: 234 Abstraction Sampling in Graphical Models , Filjor Broka, Rina Dechter, Alexander Ihler, Kalev Kask
- ID: 239 Estimation of Personalized Effects Associated With Causal Pathways , Razieh Nabi, Phyllis Kanki, Ilya Shpitser
- ID: 253 Finite-sample Bounds for Marginal MAP , Qi Lou, Rina Dechter, Alexander Ihler
- ID: 263 A Unified Particle-Optimization Framework for Scalable Bayesian Sampling , Changyou Chen, Ruiyi Zhang, Wenlin Wang, Bai Li, Liqun Chen
- ID: 292 Adaptive Stratified Sampling for Precision-Recall Estimation , Ashish Sabharwal, Yexiang Xue
- ID: 312 Dissociation-Based Oblivious Bounds for Weighted Model Counting , Li Chou, Wolfgang Gatterbauer, Vibhav Gogate

- ID: 317 Block-Value Symmetries in Probabilistic Graphical Models , Gagan Madan, Ankit Anand, Mausam, Parag Singla
- ID: 320 Max-margin learning with the Bayes factor , Rahul G. Krishnan, Arjun Khandelwal, Rajesh Ranganath, David Sontag
- ID: 322 Lifted Marginal MAP Inference , Vishal Sharma, Noman Ahmed Sheikh, Happy Mittal, Vibhav Gogate, Parag Singla
- ID: 342 Decentralized Planning for Non-dedicated Agent Teams with Submodular Rewards in Uncertain Environments , Pritee Agrawal, Pradeep Varakantham, William Yeoh
- ID: 346 Causal Identification under Markov Equivalence , Amin Jaber, Jiji Zhang, Elias Bareinboim
- ID: 351 The Variational Homoencoder: Learning to learn high capacity generative models from few examples , Luke B. Hewitt, Maxwell I. Nye, Andreea Gane, Tommi Jaakkola, Joshua B. Tenenbaum
- ID: 362 Bayesian optimization and attribute adjustment , Stephan Eismann, Daniel Levy, Rui Shu, Stefan Bartzsch, Stefano Ermon
- ID: 367 Join Graph Decomposition Bounds for Influence Diagrams, Junkyu Lee, Alexander Ihler, Rina Dechter
- ID: 372 Causal Discovery with Linear Non-Gaussian Models under Measurement Error: Structural Identifiability Results, Kun Zhang, Mingming Gong, Joseph Ramsey, Kayhan Batmanghelich, Peter Spirtes, Clark Glymour

Papers from UAI 2017: http://auai.org/uai2017/accepted.php

- ID: 78 Branch and Bound for Regular Bayesian Network Structure Learning, Joe Suzuki; Jun Kawahara
- ID: 242 Exact Inference for Relational Graphical Models with Interpreted Functions: Lifted Probabilistic Inference Modulo Theories, Rodrigo de Salvo Braz; Ciaran O'Reilly
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- ID: 197 Iterative Decomposition Guided Variable Neighborhood Search for Graphical Model Energy Minimization, Abdelkader Ouali; David Allouche; Simon de Givry; Samir Loudni; Yahia Lebbah; Francisco Eckhardt; Lakhdar Loukil
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- ID: 291 Learning the Structure of Probabilistic Sentential Decision Diagrams, Yitao Liang; Jessa Bekker; Guy Van den Broeck
- ID: 160 On Loopy Belief Propagation -- Local Stability Analysis for Non-Vanishing Fields, Christian Knoll; Franz Pernkopf
- ID: 100 Regret Minimization Algorithms for the Follower's Behaviour Identification in Leadership Games, Lorenzo Bisi; Giuseppe De Nittis; Francesco Trov`ò; Marcello Restelli; Nicola Gatti
- ID: 298 Robust Model Equivalence using Stochastic Bisimulation for N-Agent Interactive DIDs, Muthukumaran Chandrasekaran; Junhuan Zhang; Prashant Doshi; Yifeng Zeng
- ID: 234 SAT-Based Causal Discovery under Weaker Assumptions, Zhalama; Jiji Zhang; Frederick Eberhardt; Wolfgang Mayer

- ID: 26 Shortest Path under Uncertainty: Exploration versus Exploitation, Zhan Wei Lim; David Hsu; Wee Sun Lee
- ID: 217 Stein Variational Adaptive Importance Sampling, Jun Han; Qiang Liu
- ID: 239 Stein Variational Policy Gradient, Yang Liu; Prajit Ramachandran; Qiang Liu; Jian Peng
- ID: 45 Submodular Variational Inference for Network Reconstruction, Lin Chen; Forrest W. Crawford; Amin Karbasi
- ID: 106 Supervised Restricted Boltzmann Machines, Tu Dinh Nguyen; Dinh Phung; Viet Huynh; Trung Le
- ID: 134 Synthesis of strategies in influence diagrams, Manuel Luque; Manuel Arias; Francisco Javier Díez
- ID: 87 The Binomial Block Bootstrap Estimator for Evaluating Loss on Dependent Clusters, Matt Barnes; Artur Dubrawski
- ID: 56 The total belief theorem, Chunlai Zhou; Fabio Cuzzolin
- ID: 266 Treatment-Response Models for Counterfactual Reasoning with Continuous-time, Continuous-valued Interventions, Hossein Soleimani; Adarsh Subbaswamy; Suchi Saria
- ID: 136 Triply Stochastic Gradients on Multiple Kernel Learning, Xiang Li; Bin Gu; Shuang Ao; Huaimin Wang; Charles X. Ling
- ID: 162 Value Directed Exploration in Multi-Armed Bandits with Structured Priors, Bence Cserna; Marek Petrik; Reazul Hasan Russel; Wheeler Ruml
- ID: 132 Weighted Model Counting With Function Symbols, Vaishak Belle
- ID: 263 Why Rules are Complex: Real-Valued Probabilistic Logic Programs are not Fully Expressive (Best Student Paper) , David Buchman; David Poole