WWU
MÜNSTER

Statistical Relational Artificial Intelligence (StaRAI)

End

living.knowledge

Tanya Braun
Data Science Group, Computer Science Department

Contents (*preliminary*)

Not part of the winter 2022 / 23 term (mis-planned on my part as I still did not know that the term ends a week before the official semester end)

1. Introduction
- Context, motivation
- Agent framework

2. Foundations
- First-order logic
- Probability theory
- Probabilistic graphical models (PGMs)

3. Probabilistic Relational Models (PRMs)
- Parfactor models, Markov logic networks
- Semantics, inference tasks

4. Lifted Inference
- Exact inference
- Approximate inference, specifically sampling

5. Lifted Learning
- Parameter learning
- Relation learning
- Approximating symmetries

6. Lifted Sequential Models and Inference
- Parameterised models
- Semantics, inference tasks, algorithm

7. Lifted Decision Making
- Preferences, utility
- Decision-theoretic models, tasks, algorithm

8. Continuous Space and Lifting
- Lifted Gaussian Bayesian networks (BNs)
- Probabilistic soft logic (PSL)

Goals

- On a technical level
  - Understand and explain the modelling, algorithm, solution approach, …
    in terms of
    - Main idea
    - Use cases
    - Advantages / disadvantages
  - Understand and explain the connection between the different models and algorithms
- On a more general level
  - Assess problems and current research in the context of artificial intelligence
  - Insight into combining apparently diametrically opposed disciplines (here logic & probability)
- Get a well-rounded overview of different aspects of lifted inference up to state-of-the art research (we should get up to at least 2020)

Main Sources

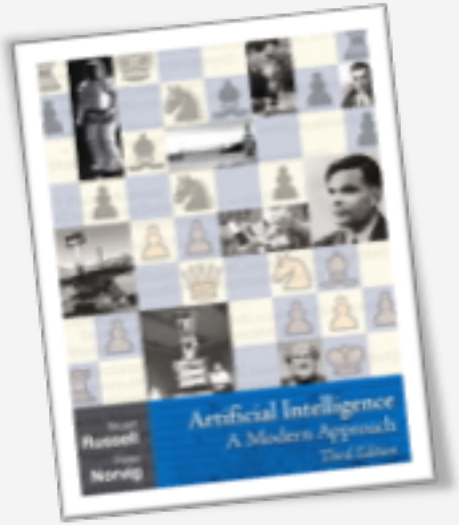
Further research papers referenced in slides

- Lifted Inference and Learning in Statistical Relational Models
  - Guy Van den Broeck, PhD thesis, 2013
- Lifted Probabilistic Inference by Variable Elimination
  - Nima Taghipour, PhD thesis, 2013
- Rescued from a Sea of Queries: Exact Inference in Probabilistic Relational Models
  - Tanya Braun, PhD thesis, 2020
- Taming Exact Inference in Temporal Probabilistic Relational Models
  - Marcel Gehrke, PhD thesis, 2022

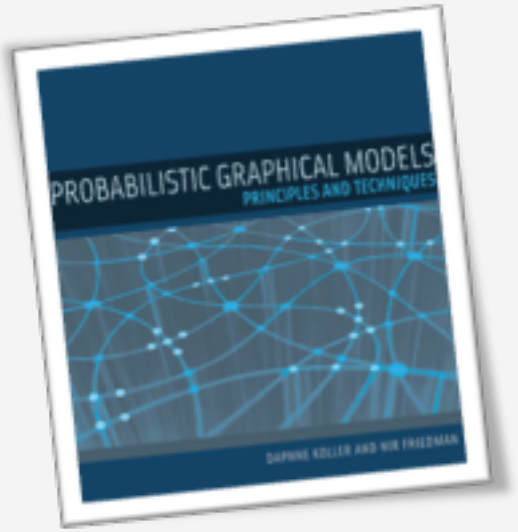
http://web.cs.ucla.edu/~guyvdb/phd/guyvdb-phdthesis.pdf
https://lirias.kuleuven.be/1656026?limo=0
https://www.ifis.uni-luebeck.de/~braun/Diss/Braun_diss.pdf
https://www.ifis.uni-luebeck.de/uploads/tx_wapublications/Diss_Gehrke_public_02.pdf

Literature: Introductory Books & Books on Foundations

- Artificial Intelligence – A Modern Approach (3rd ed.)
  - Stuart Russell, Peter Norvig
  - Basics on agents, logic, reasoning under uncertainty



- Probabilistic Graphical Models
  - Daphne Koller, Nir Friedman
  - General PGMs for reasoning under uncertainty



- Modelling and Reasoning with Bayesian Networks
  - Adnan Darwiche
  - BNs for reasoning under uncertainty

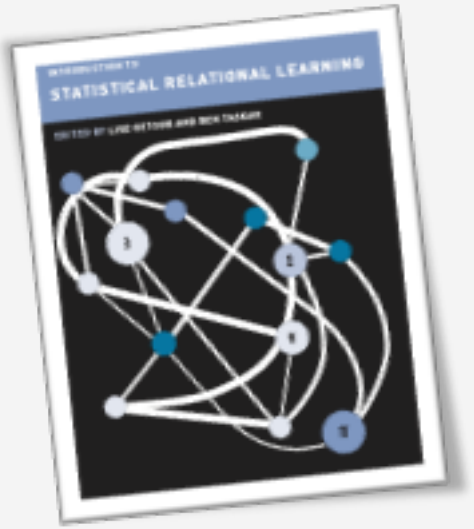
http://aima.cs.berkeley.edu

https://mitpress.mit.edu/books/probabilistic-graphical-models

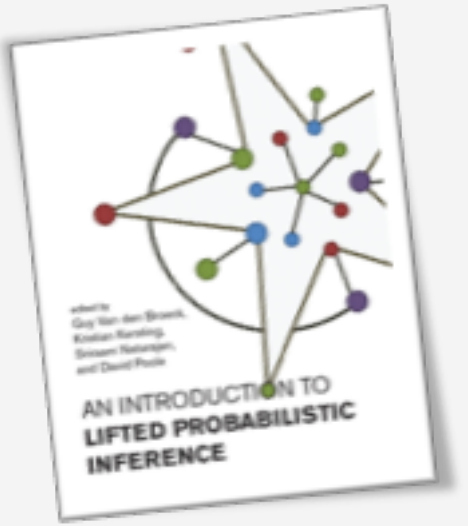
https://www.cambridge.org/core/books/modeling-and-reasoning-with-bayesian-networks/8A3769B81540EA93B525C4C2700C9DE6

Literature: Books on StaRAI

- Introduction to Statistical Relational Learning
  - Editors:
    Lise Getoor, Ben Taskar



- An Introduction to Lifted Probabilistic Inference
  - Editors:
    Guy Van den Broeck, Kristian Kersting, Sriraam Natarajan, David Poole



https://mitpress.mit.edu/books/introduction-statistical-relational-learning
https://mitpress.mit.edu/books/introduction-lifted-probabilistic-inference

Oral Exam: Organisational Stuff

- Days:
  - 7 Feb, afternoon
  - 8 Feb, afternoon
  - 9 Feb, morning
- Schedule
  - Announced via Learnweb last week
  - In case of changes, I will notify you via Learnweb
- Place
  - My office
    (Room 609, Einsteinstr. 62, 6th floor)
- If necessary according to your "Prüfungsordnung": Registration
  - One week before the exam

Questions?

- Q&A Session as part of last exercise session
  - 26th January, 2023, 4.15pm – 5.45pm
- Use Learnweb discussion forum
  - So everybody can participate and possibly learn something from the exchange
- Write an email
  - Less preferable than the previous method because of the given reason but still a totally valid form of contact

- Now?