Presentation

Probabilistic Graphical Models

Jerónimo Hernández-González

About me

- Lecturer at UB
- Previously at UPV-EHU, AEPIA, IIIA-CSIC
- PhD in Machine Learning (University of the Basque Country, 2015)
  Learning PGMs for weakly supervised classification
- Research lines:
  - Weakly supervised learning
    (Crowd learning)
  - PGMs (Bayesian networks) for classification
  - Approximate inference in PGMs
  - Applied research: embryo selection, software defect, citizen science, etc.

By the end of the semester...

you will know...

- what probabilistic graphical models (PGMs) are
  - The probabilistic approach to machine learning
  - Types of PGMs
- which types of queries we can ask to them
  I.e., how to make a query...
  - when it can be answered in polynomial time (exact)
  - when it **cannot** be answered efficiently (approximate)
- how a PGM can be inferred from data

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you will be able to...

- apply the studied algorithms to problems of your interest
- translate PGMs and algorithms into code

Content

- Introduction
- Representation
  - Markov networks (Undirected)
  - Bayesian networks (Directed)
  - Temporal and plate models
- Inference
  - Exact (Variable elimination)
  - Approximate (Belief propagation / Sampling / Variational)
- Learning
  - Parametric learning
  - Structural learning
  - (In)complete data
- Real-world examples

Evaluation

30 % Participation

Dairy work, Problem/Programming assignments, Forums**

30 % Presentation

40 % Test

**You need to initiate at least 1 debate; you need to engage in at least 2 debates initiated by your classmates

Test

What: Show the acquisition of the subject's contents

How: Development/multiple-choice questions

When: May 17th

Presentation

What: (i) Present a state-of-the-art work

A paper of your choice from PGM conference:

`https://dblp.org/db/conf/pgm/`

(ii) carry out your own work with PGMs

Some practical work using some of the techniques seen in class

(iii) explain in depth a PGM topic

How:

- Choose a classmate and prepare a presentation for your colleagues ($\sim$ 15 min.)
- Notify in the forum's thread your choice before May 17th!
- No topic-paper-work can be presented more than once

When: May 24th

Examples of topics (iii) for your presentation

- Explain, in terms of PGMs, a classical model such a GMMs, HMMs, Kalman Filters, ...
- Log-linear models
- Conditional Random Fields
- Learning Markov Networks
- Structural learning based on conditional independence tests
- Structural learning with the K2 algorithm
- k-dependence Bayesian classifier
- Causality

Calendar

Feb. 22 *Intro*	Mar. 1	Mar. 8	Mar. 15
Mar. 22	Mar. 29	Apr. 5 No class	Apr. 12 No class
Apr. 19	Apr. 26	May 3 No class	May 10
May 17 Test	May 24 Presentations		

Bibliography

- Koller, D., and Friedman, N. (2009). Probabilistic Graphical Models: Principles and Techniques. The MIT Press.
- Murphy, K.P. (2012). Machine Learning. A Probabilistic Perspective. The MIT press.
- Castillo, E., Gutiérrez, J.M., and Hadi, A.S. (1997). Expert Systems and Probabilistic Network Models. Monographs in Computer Science, Springer.

Coursera

- Daphne Köller (Stanford University) teaches a PGM course in Coursera
- Specialization (3 courses)
  (Video lectures, Questions, Programming assignments)
  `https://www.coursera.org/specializations/probabilistic-graphical-models`
- A lot of her material is used in these lessons
- You might be interested in enrolling (partially free)

Strongly recommended

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