

Algorithms for Graphical Models (AGM)

Module overview

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Date : 2011/10/17 10 : 22 : 02

The red and the green

A simple example of probabilistic reasoning to get you started.

Murders in Florida (1973-78)

| Murderer | Sentence | |
|----------|----------|-------|
| | Death | Other |
| Black | 59 | 2547 |
| White | 72 | 2185 |

- ▶ 3.2% of white murderers get the death sentence
- ▶ 2.3% of black murderers get the death sentence

Crime and Punishment in Florida

The Yule-Simpson Paradox

| Victim | Murderer | Sentence | |
|--------|----------|----------|-------|
| | | Death | Other |
| Black | Black | 11 | 2309 |
| | White | 0 | 111 |
| White | Black | 48 | 238 |
| | White | 72 | 2074 |

- ▶ For Black victims, 4.7% of Black murderers get death vs 0% for White murderers.
- ▶ For White victims, 16.8% of Black murderers get death vs 3.4% for White murderers.

The official (and true) learning outcomes

- ▶ Apply appropriate techniques from graphical modelling to handle uncertainty in real-world situations;
- ▶ Understand the sources of computational complexity in probabilistic inference;
- ▶ Understand the basics of Monte Carlo computation;
- ▶ Write Python programs to implement graphical modelling algorithms

Time to see a graphical model

- ▶ Bayesian networks are, by far, the most popular graphical model.
- ▶ Netica only runs under Windows, look for it under the Modelling sub-menu
- ▶ A password is required for full functionality.

Lecture overheads You're seeing some. Generally brief. Some slides are just prompts.

Scripts The scripts for the demos and animations will be provided.

gPy This is a collection of Python modules from which all scripts import their core functionality.

People Let's arrange a suitable time for the AGM surgeries now.

- ▶ *Algorithms for Graphical Models* by James Cussens
- ▶ This covers all *assessable* material.
- ▶ The current version is available from the module web page.
- ▶ I may add to it as the module progresses.

- ▶ *Probabilistic Networks and Expert Systems* by Cowell, Dawid, Lauritzen and Spiegelhalter
- ▶ Excellent book, now available in paperback at a little under £30.
- ▶ The library has 2 on ordinary loan, 2 on 1-week loan and one on short loan (in the 'key texts' section).

- ▶ *Probabilistic Graphical Models: Principles and Techniques* by Daphne Koller & Nir Friedman (MIT Press)
- ▶ A snip at £62.95

Why Python?

- ▶ This module focuses on the underlying *algorithms* for graphical models.
- ▶ On the one hand we don't want to clutter the presentation of the algorithms, on the other we want to avoid vagueness.
- ▶ Hence Python: high-level 'executable pseudo-code'
- ▶ Also has easy graphics (Tkinter).

Answers to exercises will be provided, but exercises will not be marked. So it is up to you to

1. Do the exercises (in practical sessions and in your own time)
2. Ensure that you are getting a reasonable number of questions correct
3. Check that you understand the answers to exercises
4. Seek help (during practicals, during surgeries) if you are having problems.

- ▶ There is yet more teaching material which you can reach via the module page
<http://www-course.cs.york.ac.uk/agm/>
- ▶ This is where all the online stuff is, including the code.
- ▶ Lecture overheads are PDF.
- ▶ A good idea to use acroread to print to a PostScript file and then psnup them before printing.

- ▶ It's open and partly assessed by whether your code passes various *unittests* — extreme assessment!
- ▶ 'Clarifications' are conducted entirely by email
- ▶ Submission is electronic
- ▶ Hand out: Wed/9/Autumn
- ▶ Hand in: Wed/3/Spring