Project in Probabilistic Models Spring 2011: Introductory lecture

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Project in Probabilistic Models

Course code:	582637
Credit points:	2 cr
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Office hours:	Please make an appointment by email
Prerequisites:	582636 Probabilistic Models

Graphical model structure learning

- Why do we want to learn the structure

Graphical model structure learning

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  - Scientific discovery
  - More efficient density modelling

Graphical model structure learning

- Why do we want to learn the structure
  - Scientific discovery
  - More efficient density modelling
- Potential challenges
  - Uncertainty about the correct structure (weak links, limited data, ...)
  - Learning of correlation instead of causation, equivalent structures

The project task

- Infer the structure and corresponding distributions of a discrete graphical model
- Data: 2500 samples of 21 variables (all discrete with 3 values)
- The network connectivity has been extracted from a real network, but the probability model is synthetic
- Required outputs:
  - Ranked list of all possible arcs in the model
  - Normalised probability distribution over a set of 1500 test vectors

The data

- The training and test data sets are available in Moodle

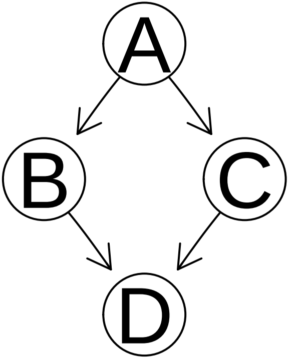
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	2	2	3	1	2	2	1	2	3	1	3	3	2	2	2	3	2	1	1	1
2	3	3	3	2	3	2	1	3	3	1	3	3	2	2	3	1	2	1	2	1
1	1	2	3	1	2	2	3	3	1	2	3	3	2	2	1	1	3	1	1	3
3	3	3	1	3	1	2	3	2	1	2	3	3	2	3	3	1	1	3	2	2
3	3	1	1	3	2	1	3	1	1	1	3	3	2	3	3	3	3	1	1	2
3	1	3	1	3	3	2	2	3	1	3	2	3	2	3	3	1	1	1	2	2

...

Ranked arc list

- Return a list of all potential 420 arcs in the model in ranked order with ones you believe to be active in the beginning
- Example:

```
A B
A C
B D
C D
A D
B A
B C
C A
C B
D A
D B
D C
```



Test set probabilities

- Return a normalised list of probabilities (must sum to 1) for the test vectors (in order)
- Example:

```
3.941543e-01
1.637665e-02
3.199843e-01
1.524029e-02
7.287055e-04
1.392376e-03
3.395783e-09
2.521234e-01
```

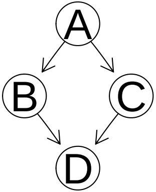
Evaluation of the predictions

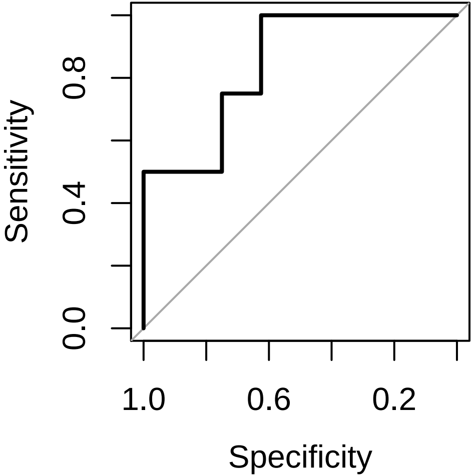
- Ranked arc list
  - Evaluated using the area under ROC curve
- Predicted probabilities
  - Evaluated using the Kullback–Leibler divergence between the true distribution and the prediction

$$D_{KL} = \sum_i p_i \log \frac{p_i}{q_i}$$

Area under ROC example

A	B
A	C
A	D
D	B
C	D
B	C
B	D
B	A
C	A
C	B
D	A
D	C





Here: AUC=0.8438

Scoreboard

- All the scores will be published *anonymously* on a scoreboard together with brief descriptions of the methods used
- You will receive an email notification with your own score
- *Positions on the scoreboard will not be used as a criterion for course grading!*

Return instructions

- There are four deadlines during the course (always on Tuesdays)
  - 5 April
  - 12 April
  - 19 April
  - 26 April (final DL)
- You must return all your submissions to the course Moodle area
- The return consists of
  - Predictions as specified above
  - 1 line public summary of the methods you have used for the score board
  - 1/2 page diary of your progress

Final return instructions

- The final return (26 April) consists of
  - Your final predictions
  - 1 line summary of the methods
  - A written report of the project containing introduction, methods, results and discussion
    - The weekly diary entries will be included in the report
  - All source code used

Using existing software

- Using existing software in your project *is permitted* if the software is freely available for academic use
    - Use of commercial packages *is not allowed*
- Using own code is rewarded in grading but not required
- *Remember to give proper credit to packages you use!*

Return logistics: Moodle

- All returns must be made to Moodle `https://moodle.helsinki.fi`
- You must log in using your University (non-CS) account
- Please register to the course “Project in Probabilistic Models, spring 2011”
  - The course registration key is “structure”
- For more instructions, please see “Student guide” on Moodle home page

Schedule of the meetings for the rest of the course

- Course meetings on Thursdays at 16-18
- Mandatory attendance on feedback sessions starting 7 April

24 March	Q+A session
31 March	**No meeting**
7 April	First feedback session
14 April	Second feedback session
21 April	**Easter holiday, no meeting**
28 April	Final session

Grading

- The grading will be based on your returned reports and presentations given during course sessions
- The following will positively influence your grade:
    - Effort put to the problem, innovativeness
    - Good presentations of your work during the course
    - Being able to improve your performance during the course and learn from previous results
    - Use of own software
- Score board positions *will not be used* in grading!

Final warning

- In case you are tempted: the test data *do not come from the same distribution* as the training data. Using them in training the model *is not recommended*!

Questions?

- Any questions?