Overall Course Outline

I. Learning Bayesian Networks
II. Probabilistic Approaches to Natural Language Understanding
III. Probabilistic Approaches in Robotics (MDPs and POMDPs)
VI. Game-Theoretic Approaches to Multi-Agent Systems

Each of these topics will be covered in roughly four weeks.
I. Learning Bayesian Networks

II. Probabilistic Approaches to Natural Language Understanding

III. Probabilistic Approaches in Robotics (MDPs and POMDPs)

IV. Game-Theoretic Approaches to MAS

V. Organization

1. Bayesian Networks – Introduction / Repetition

**structure:** The graph structure encodes the factors of a JPD:

- nodes represent variables,

- edges represent "direct dependencies".

**parameters:** Specified by a conditional probability table (CPT) attached to each node quantify direction / strength of dependencies:

\[ p(x \mid \text{fanin}(x)) \]

\[ p(x_1, \ldots, x_n) = \prod_{i=1}^{n} p_i(x_i \mid \text{fanin}(x_i)) \]

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2. Learning Parameters

If we know

- which variables may influence which others (the structure),
- but not the exact quantities (the parameters),
- and we have data,

we can estimate the parameters from data.
If we know

- which variables may influence which others (the structure),
- but not the exact quantities (the parameters),
- and we have data with some missing value,

we still can estimate the parameters from data (as well as the missing values).

Figure 2: Bayesian network structure with unknown parameters.

Learning structure requires

- the specification of a model selection criterion as well as
- a search procedure over a subspace of possible graph structures.

Figure 3: Different bayesian network structures.
Text books


Bayesian Networks Software

open source:


open source, based on commercial software:


commercial software:

• Hugin ([http://www.hugin.com](http://www.hugin.com))

...and there are many others ([see](http://www.ai.mit.edu/~murphyk/Bayes/bnsolt.html)).
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Exercises and tutorials

- Weekly Tutorials by Niels Landwehr, Alexander Scivos and Karen Tso
  first tutorial at Fr. 18.11. 10:00 – 11:45.

- One exercise sheet per week
  first sheet at Tue. 8.11.

- Sheets are due next Tuesday
  and will be discussed the following Friday in tutorial.
Wissenschaftliche Hilfskräfte

Zwei offene Stellen als wissenschaftliche Hilfskraft in der Gruppe CGNM:

- Interesse an Maschinellem Lernen / Datenanalyse / wissenschaftlichem Programmieren

- Sehr gute Java- oder C++-Kenntnisse.

Zunächst für 1/2 Jahr, aber wir haben vor allem Interesse an Studenten, die mindestens 1 – 1 1/2 Jahre bleiben möchten.

Bei Interesse, Email schicken oder vorbeischauen.

References


