UBC MLRG (Summer 2016): Miscellaneous

Some images from this lecture are taken from Google Image Search.
Changepoint Detection

• 540 covers hidden Markov models:
  – Finds latent “modes” and latent dynamics in time-series.

• Changepoint detection:
  – Task of finding breakpoints where time series distribution changes.

• Key advantage:
  – May be easier than fitting generative HMM.

• Key applications:
  – Bioinformatics.
  – Econometrics.
Sub-Modularity

• 540 covers convexity:
  – Class of continuous functions that is easy to minimize.

• Sub-modularity:
  – Class of discrete functions that is easy to minimize.
  – Algorithms also exist for approximate maximization.

• Key advantage:
  – Expands class of efficiently-solvable problems.

• Applications:
  – Computer vision.
  – Sensor networks.

• Related: QUBO.
Relational Models

• 540 covers **Bayesian networks:**
  – Describes relationships between variables.

• **Probabilistic relational models and Markov logic networks:**
  – We have “types” of variables and probabilities on logical statements.

• Key advantage:
  – More expressive language.

• Applications:
  – Adding probabilities to databases.

• Related: sum-product networks.
Continuous Graphical Models

- 540 covers **discrete** and **Gaussian** graphical models:
  - Convenient due to conjugacy.
- **Nonparanormal** and **Gaussian-copulas** models:
  - More flexible continuous distributions.
- **Key advantage:**
  - Gaussians are very restricted class.
- **Applications:**
  - Stock market crash of 2008.
Grammars

• 540 covers Markov models:
  – Useful for modeling sequence data with Markov assumption.
  – Can be generalized to Bayesian networks.

• Probabilistic context-free grammars:
  – Different generalization using “recursive” Markov assumption.

• Key advantage:
  – Dependencies at different scales.

• Applications:
  – Natural language processing.
  – RNA secondary structure.

• Related: And-Or trees, image grammars.
Spectral Methods

• 540 covers expectation maximization:
  – Only finds local optimum.

• Spectral methods:
  – Consistent estimators.

• Key advantage:
  – No local minima if you have enough data.

• Applications:
  – All the usual HMM applications.