turliuc_oct_2013_static

Unknown Author

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In [5]:
```
# put here all the imports, styles etc.
from IPython.display import Image, HTML, Latex
import pandas as pd
#HTML("""
#<style>
#.div.cell{
#    font-size: 100%;
#}
#.rendered_html{
#    font-size: 150%;
#}
#</style>
#""")
```

Probabilistic Logic - A Biased Review

Călin-Rareș Turliuc

01 November 2013Summary

1. Short Bio
2. (General) Introduction and Motivation
3. My Research (Probabilistic Abduction)
4. Demo
5. Future work, Conclusions

Short Bio

- First Name: *Rareș* (rah-rehsh)
- Msc 2011, PhD (started April 2012, s: A. Russo, K. Broda)
- steering committee (also 2012)
- raresct

Interests

Computing

- machine learning
- probabilistic logic (inference, learning)
- applications

Non-Computing

- history of religions
- fantastic novels
- music (esp. rock & metal)
- starcraft II

- tennis, ping pong, pool & sauna

Introduction

Big Data

To find a smaller needle in the haystack,

you need a bigger haystack.Introduction (2)

State of the Art: Statistical Machine Learning (ML)

Pros

- it works (+/- theoretical ML)
- it scales (only some algorithms for now)

ConsIntroduction (3)

States of the Art of the 60's: Logic

Pros

- white box (almost)
- it should work (rules, proofs, soundness, completeness)
- it should scale (only one operator: resolution, most proofs are tree-like)

Cons

- **should**
- no numbers

Motivation

Why did statistics and logic diverge?

Hint: Quant-Qual

Were they ever compared?

Spoiler: Yes!Motivation (2)Motivation (3)Motivation (4)

Best of Both Worlds? How?Motivation (5)

Best of Both Worlds? How?Motivation (6)

Best of Both Worlds? How?Probabilistic AbductionProbabilistic Abduction (2)

$$grass\_is\_wet \leftarrow rained$$
$$grass\_is\_wet \leftarrow sprinkler\_on$$
$$shoes\_wet \leftarrow grass\_wet$$

Query:

$$Q = \{shoes\_wet\}$$

Abducibles (in this case they are our solutions):

$$rained$$
$$sprinkler\_on$$

Probability over abducibles:

$$P(rained) = 0.6$$
$$P(\neg rained) = 0.4$$

$$P(sprinkler\_on) = 0.7$$
$$P(\neg sprinkler\_on) = 0.3$$

Truth value assignment to the abducibles are independent events.

```
In [10]: df = pd.read_csv('pix/sprinkler.csv', sep=" ", quotechar='"')
         df
```

```
Out [10]:   rained_last_night sprinkler_was_on  P(rained_last_night,
         sprinkler_was_on)
         0              False            False
         0.12
         1              False             True
         0.28
         2               True            False
         0.18
         3               True             True
         0.42
```

Probabilistic Abduction (3)

Inference

Probabilistic abduction should be non-minimal.

Incorporate evidence as integrity constraints. E.g.:

IC =

$$ic \leftarrow sprinkler\_on$$

(i.e. we observe that the sprinkler was off)

The goal is to compute:

$$P(Q|IC)$$

In our case:

$$P(Q|IC) = \frac{P(Q, IC)}{P(IC)} = \frac{0.18}{0.18 + 0.12} = 0.6$$

Probabilistic Abduction (4)

Parameter learning

Observe queries:

$$Q_1, \ldots, Q_n$$

Question: Probability of the abducibles that maximizes the joint probability of the queries.

Answer: Expectation-Maximization (EM) algorithm (better: Variational EM)Demo

One line music recommender system!Future Work and Conclusions

Done

- probabilistic-logical inference + constraints
- application in a biological gene network model
- hopefully interesting demo

To Do

- more applications, benchmarks
- scale inference and learning
- parameter learning demo
- better parameter learning methods
- structure learning

Thank you!

Slides on github.