Probabilistic Programming

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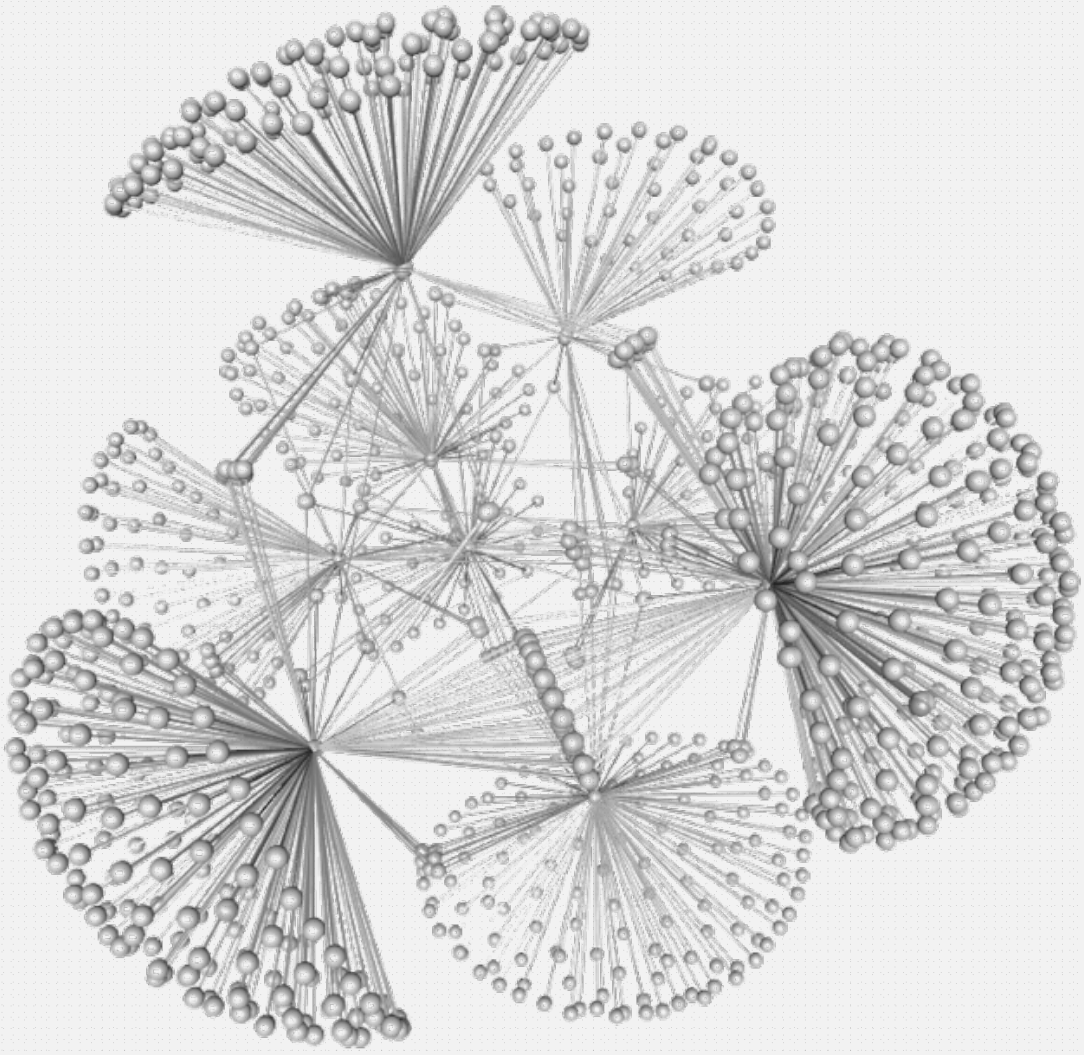

Academisch Jaar 2020

H05N0A: Capita Selecta : Artificial Intelligence

Contents

Below's our solution for the given challenges. The questions in each section of the original assignment are answered in a section with the same title.

```
person(a).
person(b).
person(c).
0.2::stress(X) :- person(X).
0.1::friends(X,Y) :- person(X), person(Y).
0.3::smokes(X) :- stress(X).
0.4::smokes(X) :- friends(X,Y), smokes(Y).
query(smokes(a)).
```

Code snippet 1: PROBLOG program used throughout.

Probabilistic Inference Using Weighted Model Counting

SRL to CNF

First the program is grounded. This is a matter of collecting all atoms involved in all proofs of the query.

```
0.2::stress(a).
0.2::stress(b).
0.2::stress(c).

0.1::friends(a,a).
0.1::friends(a,b).
0.1::friends(a,c).

0.1::friends(b,a).
0.1::friends(b,b).
0.1::friends(b,c).

0.1::friends(c,a).
0.1::friends(c,b).
0.1::friends(c,c).

0.3::smokes(a) :- stress(a).
0.3::smokes(b) :- stress(b).
0.3::smokes(c) :- stress(c).

0.4::smokes(a) :- friends(a,a), smokes(a).
0.4::smokes(a) :- friends(a,b), smokes(b).
0.4::smokes(a) :- friends(a,c), smokes(c).
```

```
0.4::smokes(b) :- friends(b,a), smokes(a).
0.4::smokes(b) :- friends(b,b), smokes(b).
0.4::smokes(b) :- friends(b,c), smokes(c).

0.4::smokes(c) :- friends(c,a), smokes(a).
0.4::smokes(c) :- friends(c,b), smokes(b).
0.4::smokes(c) :- friends(c,c), smokes(c).
```

Code snippet 2: Relevant ground program.

The proofs of the query make for the following (nested) trie, where colourings indicate the presence of loops :

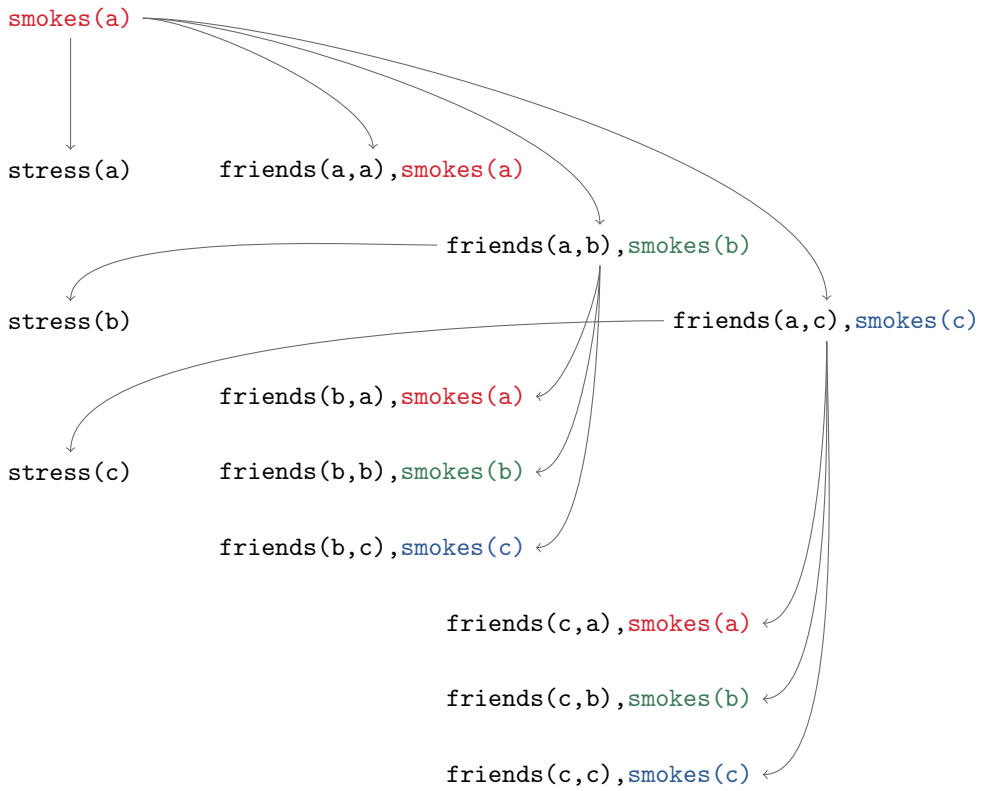

Figure 1: SLG-tree produced while turning the ground program into a boolean formula. Coloured atoms refer to loops.

The loops can be removed while retaining the semantics through the use of auxiliary variables. For example :

```
0.2::stress(a).
0.2::stress(b).
0.2::stress(c).

0.1::friends(a,b).
0.1::friends(a,c).
0.1::friends(b,c).
0.1::friends(c,b).

0.3::p(b).
0.3::p(c).

0.3::smokes(a) :- stress(a).
smokes(b) :- stress(b), p(b).
smokes(c) :- stress(c), p(c).

0.4::smokes(a) :- friends(a,b), smokes(b).
0.4::smokes(a) :- friends(a,c), smokes(c).
```

```
0.4::smokes(b) :- friends(b,c), stress(c), p(c).
0.4::smokes(c) :- friends(c,b), stress(b), p(b).

query(smokes(a)).
```

Code snippet 3: Relevant ground program without cycles.

SRL to PGM

PGM to CNF

Weighted Model Counting

Lifted Inference

Parameter Learning