Learning Sum-Product Networks

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The need for SPN

Sum-Product Networks (SPNs) are a type of probabilistic model[1]

- for Pobabilistic Graphical Models (PGMs) there exist multi-purpose inference tools
  - the computational effort scales unproportional to the complexity of the graph
  - solution: using approximate inference

[1] H. Poon and P. Domingos, *Sum-Product Network: a New Deep Architecture*, UAI 2011

The need for SPNs

Why should you work on SPNs?

- exact tractable inference
- NN for which structure learning is easy

SPNs represent probability distributions and a corresponding exact inference machine for the represented distribution at the same time

Section 1

Representation

Density estimation

(Different kinds of) Inference

Tractable Probabilistic Models

Sum-Product Networks

Scopes

Structural Properties

Section 2

Inference

Complete evidence

Marginal inference

MPE inference

Section 3

Interpretation

Interpretation

- probabilistic model
- deep feedforward neural network

Network Polynomials

Arithmetic Circuits

Differences with ACs:

- probabilistic semantics
  - learning
  - sampling
- no shared weights

SPNs as BNs I

Zhao

SPNs as BNs II

Peharz

Section 4

Learning

Structure Learning

LearnSPN

LearnSPN-b

New Structure Learning Tendencies

Parameter Learning

Hard/Soft Parameter Learning

Bayesian Parameter Learning

Parameter Learning VS LearnSPN

Collapsed Variational Inference is useless : D

Section 5

Representation Learning

Extracting Embeddings

Classification

Filtering Embeddings

Random Marginal Queries

Encoding/Decoding Embeddings

MPN as autoencoders[2].

[2] Vergari et al. Encoding and Decoding Representations with Sum-Product Networks, 2016, to appear

Section 6

Applications

Applications I: computer vision

Applications II: language modeling

Applications III: activity recognition

Applications IV: speech

Trends & What to do next

Section 7

References

awesome-spn

A curated and structured list of resources about SPNs[3].
`https://github.com/arranger1044/awesome-spn`

[3] Inspired by the SPN page http://spn.cs.washington.edu/ at the Washington University