IV-Applications
Applications of tnreason

Logik für Erklärbare KI: Technische Einführung in das ENEXA Projekt

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15.+16. July, 2024

Contraction Calculus

Tensors appear naturally when representing factored systems, such as in

- ► Probabilistic Representation: Probability tensors
- ► Logical Representation: Semantic tensors

Reasoning amounts to calculate contractions of the representations

- ► Probabilistic Inference: Marginal distributions
- ► Locial Inference: Model counts (to decide entailment)

tnreason is a tool for contraction calculus

encoding represents semantic and probability tensors and engine executes their contractions.

Efficient Contraction Calculus

Efficient tensor representations by contractions of tensor networks

- ▶ Representation of empirical distributions $\mathbb{P}^D$ by datacores θ^{D_k}
- ▶ Representations of complex formulas f by connective encodings θ°

Localized algorithms demand only contractions with small number of open variables

- ▶ Gibbs Sampling
- ▶ Alternating Weight Optimization

Advanced: Algorithms with small number of tensor cores based on *Message Passing Approaches*.

Approaching Use Cases with tnreason

⟳ enexa

Buildtime (Generation of a model):

tnreason.knowledge.HybridKnowledgeBase

- ► Elicitation from experts: Generation of formulas
- ► Calibration on Data: Optimization of weights to probabilistic formulas given data
- ► *Advanced Approach: Neuro-Symbolic AI*

Runtime (Usage of the model):

tnreason.knowledge.InferenceProvider

- ► Analysis of distributions by queries
- ► Infering missing information based on evidence
- ► Sampling random data from the model