I-Tensors
Implementations in tnreason

Foundations of Neuro-Symbolic AI

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Demonstration package in python:

tnreason

tnreason = Tensor-Network Reasoning

Functionality:

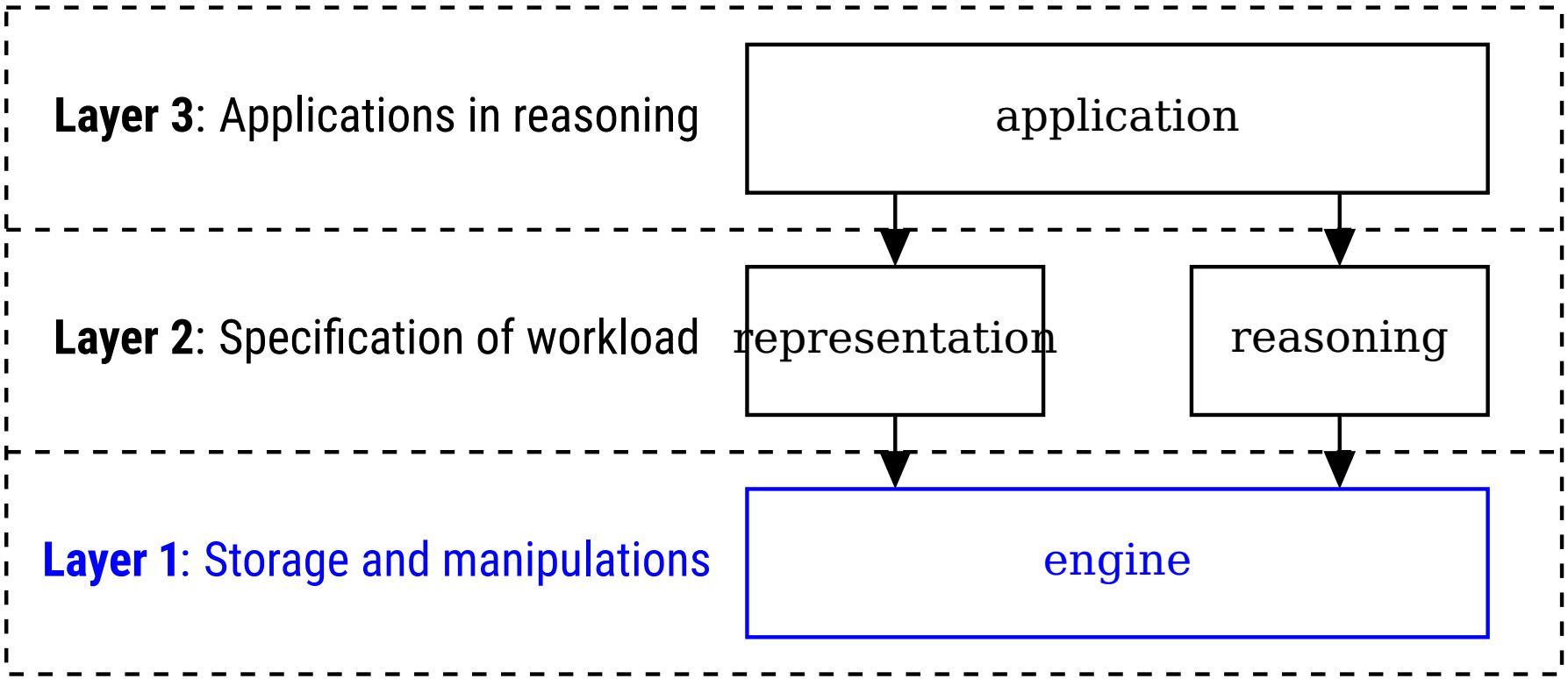
- Inference of Factored Systems based on logical and probabilistic concepts
- Neuro-Symbolic Reasoning Methods based on parametrized logics

tnreasonis structured in four subpackages and three layers

- Layer 1: Storage and numerical manipulations, by subpackage engine, "Tensor Networks" -> building "tn" of tnreason
- Layer 2: Specification of workload, subpackage representation specific for storage, subpackage reasoning specific for manipulations
- Layer 3: Applications in reasoning, by subpackage application, "Reasoning" -> building "reason" of tnreason

Implementation in tnreason**:**
Subpackage engine

The subpackage engineis dedicated to tensor networks and contractions.



Subpackage engine: Cores

Each Tensor core has attributes

- values (array-like): storing the value of the coordinates
- colors (list of str): specifying the name of the variables represented by its axes
- name (str): to distinguish from other cores

The implemented core types differ in the values argument. Cores are instantiated by

```
engine.getCore(coreType)(coreValues, coreColors, coreName)
```

Subpackage engine: Contractions

Reflected in the notation

$$\left\langle \tau^{\mathcal{G}} \right\rangle_{[\mathcal{V}]}$$

a contraction is defined by

- Tensor Network $\tau^{\mathcal{G}}$, i.e. a dictionary of tensor cores
- Open Variables $\mathcal{V}$

Contraction calls are done by

```
engine.contract(contractionMethod, coreDict, openColors)
```

Where

- contractionMethod: str, chooses one of the contraction providers
- coreDict: Dictionary of TensorCores (of the above formats), representing the Tensor Network $\tau^{\mathcal{G}}$
- openColors: List $\mathcal{V}$ of str, each str identifying a color, that is a variable to be left open in the contraction

Installation

tnreasonis maintained on github:

https://github.com/EnexaProject/enexa-tensor-reasoning

Installation using pip:

```
!pip install tnreason
```