Deep Algorithmic Question Answering

Motivation
Ability to reason in a step-by-step “algorithmic” manner that can be inspected and verified for its correctness in the domain of question answering (QA).

We propose Deep Algorithmic Question Answering (1), an approach to algorithm reasoning for QA based on three desirable properties: interpretability, generalizability, and robustness. We conclude that they are best achieved with a combination of hybrid and compositional AI.

Problem
- Tasks such as the automatic selection of KBs and relevant knowledge, choice of inference algorithms, and how to combine them, are all important to fully automate the QA process.
- We argue that these tasks should be part of the AI models which are built for QA tasks, as they are key ingredients in the full automation of the QA process.

Proposed Model
Hybrid inference graphs with functional nodes.

Inference Graph
Constructed and expanded dynamically through the decompositions of its functional nodes using rules that are learned (see Fig. 2).

Functional nodes
- Represent data
- Specify operations to be applied
- Encode a model to convert between the symbolic and vectorized representations of the node.

A Systems Approach
Improving the inference capabilities and explainability of QA systems via “whole system reasoning” [1,2].

Automatic Knowledge Source Selection [3]

Aim:
- Discover new knowledge sources.
- Identify and align equivalent entities and relationships (properties) across different knowledge graphs (KGs)

Process:
- Discovery
  - Crawl websites following linked data URIs
  - (in Schema.org or JSON-LD formats)
  - Introspection: “Upper Ontology” to capture metadata about KGs.
  - Alignment: Update existing upper ontology

Usage:
- LOOKUP operation uses upper ontology to find KGs that have relevant data.

Automatic Statistical Model Selection

GPY-ABCD [4]:
- A more configurable implementation of the ABCD (Automatic Bayesian Covariance Discovery) system
- An iterative modular Gaussian Process regression framework
- A flexible class of nonparametric models to fit data
- Produces short text descriptions of fit models

SMART: Statistical Methodology Advisor at Reasoning Time
- Selects and performs statistical methods given a query and data features;
- Uses an ontology of various query tags, statistical methods and output types.

References: