ARTIFICIAL INTELLIGENCE AND DATABASES AIDB Lab @ BSB 365, 366

Knowledge Representation & Reasoning

Reasoning and Planning with Possible Worlds

Interaction of multiple autonomous agents require those agents to reason about their own as well as the other agents' beliefs in the process of achieving a goal.



- We look at some of the interesting problems in this area from logic-based knowledge representation standpoint.
- We use Epistemic Logic and Kripke's *possible worlds* semantics to model an agent's knowledge about the world.

Case-Based Reasoning

Ontologies

An ontology is a formal explicit description of the concepts and relationships used to represent a domain



Ontologies help to share common understanding of the structure of information among people and software agents



Ontology Enrichment is the process of augmenting an existing ontology in various dimensions.

In particular, we work on enriching ontologies with new properties and property axioms using natural language processing and data mining techniques.

In Program Analysis: We work on building ontologies to represent the details of software programs and use the same to improve the effectiveness of static program analysis tasks.

Case-Based Reasoning (CBR) is a problem solving paradigm inspired by the human way of using past experiences to solve new problems.



Knowledge in a CBR system is distributed across four containers namely Case base, Similarity, Adaptation and Vocabulary. We work in:

- Case base maintenance, with focus on competence based models involving single case and compositional adaptation.
- Formalizing cross-container interactions and knowledge tradeoffs and their impact on CBR maintenance.
- Estimating case base complexity using Fractal dimensions.
- Case-based recommender systems that exploit tradeoffs between products to learn user preferences.

AI for Education

Compiling Textbooks from Wikipedia

Wikipedia has good reference value and broad coverage. However, its pedagogic value is typically less compared to carefully crafted learning resources like textbooks. We explore challenges in compiling a textbook on a given topic from relevant Wikipedia articles, and present an approach towards assisting humans in this task.

Ontology Applications

In Vehicle Assembly: Ford Motor Company uses an AIbased system to manage process planning for vehicle assembly. We have re-engineered their ontology into semantic web OWL/RDF format.

Knowledge-Base Editor for Rules: We develop an editor to update the rules of an organization. The rules are created and updated based on a standardized vocabulary associated with the organization. The vocabulary is standardised by the domain expert and a knowledge engineer using the Web Ontology Language (OWL) and associated tools.

Natural Language Processing



We use topic labeling to reduce label acquisition overheads in text classication.

Some of our works in text mining are: extracting brain region mentions from biomedical texts, predicting focus time of documents and community question answering. In Information Retrieval, we revisit and understand user interaction using theory of Quantum Physics.

Text Mining Text mining is the process of examining large tions of written resources to extract facts, relationships and assertions that would otherwise remain buried in the . ss of textual big data

BioNLP

Meaningful Sentenc

Meaningful Sentences

Protein Sequences

Compositional BIRDISONTHETREE

Building Word Problem Solvers

In science education, word problems are a type of textbook problems designed to enable students apply abstract mathematical concepts to real world scenarios. A word problem solver has two main modules: Natural Language Understanding (NLU) module and Representation & Reasoning module. Such solvers have applications in intelligent tutoring systems. We work on building solvers for elementary school level math word problems and high school level kinematics word problems.

MCQ Generation

We develop systems that can automatically generate domain-specific multiple choice questions (MCQs) taking Description Logic ontology of the domain as input. The generated questions are semantically close to ones generated by humans. Also, the system can be potentially used for controlling the difficulty levels of generated question-sets to achieve specific pedagogical goals.



Natural Language Generation In (NLG), we work on time-series summarization.

English Lexico

Protein

Words

Protein Lexicon

Driven by the fundamental premise that protein molecules have a language of their own, we explore the parallels between English sentences and protein sequences to apply NLP techniques on long standing open problems in protein domain.

Faculty

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