A FUZZY KNOWLEDGE REPRESENTATION MODEL FOR STUDENT PERFORMANCE ASSESSMENT

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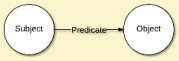
INTRODUCTION

The state of the art of representing knowledge in intelligent educational systems has recently improved significantly.

What is the Semantic Web?

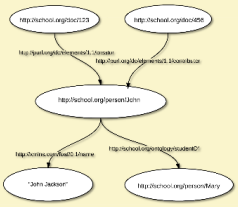
- It converts the current unstructured web of documents into a **web of data**.
- It builds on the standard Resource Description Framework (RDF).
- It uses Uniform Resource Identifiers (URIs) to represent resources.

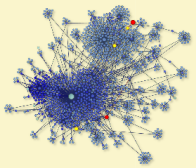


An RDF triple.

Semantic Web technologies support a more accurate representation of:

- Learners and trainers
- Learners' needs
- Learning components
- Learning goals
- Assessments





Ontologies

- Specification of a conceptualization on a domain of interest
- Concepts, properties, instances, annotations
- Use OWL2 language based on Description Logics (DL)

MODELLING EDUCATIONAL DATA

Main goal of our research:

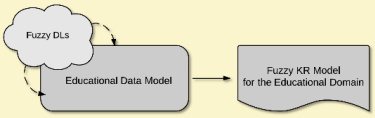
- Representing incompleteness and vagueness in an educational environment.
- Argumentation and reasoning over this domain.

Our methodology makes use of:

- Model descriptive features
- Qualities (e.g.: Good, Bad)
- Attributes (e.g.: Skill, Success)
- Modifiers (e.g.: Very, High)
- Web standard languages.

Our main contribution:

- Modelling of educational data containing fuzzy classes.
- Extending the educational environment by creating different fuzzy sets regarding educational needs and demands.



Example:

English	Description Logics
1. John is a student.	Student(John)
2. John has a level of knowledge of 9/10.	levelOfKnowledge(John, .9)
3. John is a successful student.	?

How to model "successful student"?

Warning: No exact definition for a fuzzy class!

A fuzzy class definition may depend on:

- different properties
- measurements
- values
- expectations.

RELATED WORK

DL-Learner is a machine-learning framework for learning concepts in Description Logics and the Web Ontology Language. It widens the scope of Inductive Logic Programming to Description Logics and the Semantic Web.

fuzzyDL is a Description Logic Reasoner supporting Fuzzy Logic and fuzzy Rough Set reasoning. It extends the classical Description Logics to the fuzzy case and has a significant applicability in Logic-based Fuzzy Control Systems.

FUTURE WORK

Research directions towards related work

- Providing assessments and supporting for decision making in intelligent educational systems.

Main task

- Evaluation of fuzzy knowledge representation models for the educational domain by studying fuzzy class expressions.

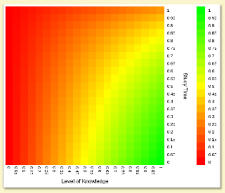
Methodology

- Using argumentation theory based on OWL class expressions for engineering ontologies as a step towards intelligent learning approaches.
- Utilizing our knowledge representation model as background for learning class expressions in DL-Learner with fuzzy capabilities.

Further research

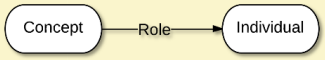
- Evaluating the model by studying fuzzy class expressions in an inductive learning setting.
- Extending our research with knowledge representation models using fuzzy concepts influenced by multi-variable input values.

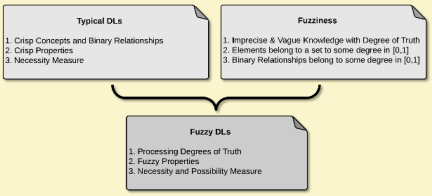
  As the success of a student might depend on more than one property (e.g.: Level of Knowledge, Study Time), we will be able to optimize the refinement of the fuzzy concept "Successful Student".



PRELIMINARIES

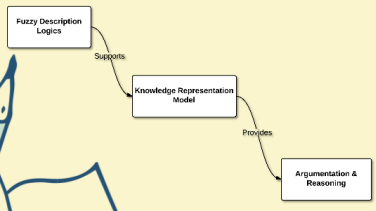
A Description Logic-based triple:





In Fuzzy Description Logics:

- Concepts denote fuzzy sets of individuals.
- Roles denote fuzzy binary relations.



USE-CASE DESCRIPTION

Our use-case dataset: **Performance Assessment Results of Students (PARS)**.

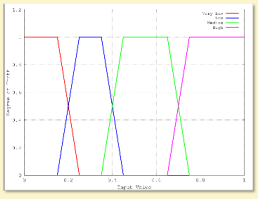
Main Properties in PARS
Study time for goal object materials
Study time for related object materials
Exam performance for goal objects
Exam performance for related objects
Level of Knowledge

- Every property instance has a degree of truth belonging to [0, 1].

Fuzzy modifiers are able to allocate a degree of truth to a fuzzy instance.

Statements	Description
<High, (.7, 1]> <Low, (.2, .4]>	"High" corresponds to a degree of truth of at least 70%. "Low" to 20-40%.
SuccessfulStudent ≡ Student ⊓ ∃ levelOfKnowledge.High	A successful student is a student who has a high level of knowledge.
SuccessfulStudent(John)	John is a successful student.
SuccessfulStudent ≡ Student ⊓ ∃ levelOfKnowledge.High ⊓ ∃ studyTime.Low	[Alternative definition.] A successful student is a student who has a high level of knowledge and studies a low amount of hours.

A fuzzy modifier is a function from [0, 1] to [0, 1] which applies to a fuzzy set to change its membership function.



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This work was presented at The 14th IEEE International Conference on Advanced Learning Technologies (ICALT2014) in Athens, Greece, July 7-9, 2014.