

Ontology Authoring Inspired by Dialogue

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Ontology Authoring

- Importance of correct and complete authoring of ontologies. Domain experts often have little expertise with logic.
- Authors often misunderstand the meaning of the different logical constructs, and fail to anticipate the logical conclusions that follow from them (Rector et al 2004, Dzabor et al 2006).
- Most ontology authoring is carried out using Protégé, which hides some aspects of the logic and provides an easy “point and click” interface.

Towards Human-oriented Authoring

- Controlled natural languages (CNLs) have been developed to express OWL concepts and axioms (Power 2012, Denaux et al 2014, ...)
- A CNL parser can be embedded in an authoring interface. In theory, a CNL means that an author only needs to understand NL, not logic.
- A sequence of commands using a CNL (“add X, delete Y, ...”) gives rise to a kind of dialogue...

The “What if...?” project: How we can exploit/adapt techniques from natural language dialogue systems to make such dialogues more natural and useful?

What is natural dialogue
like?

(How does one design a
dialogue system?)

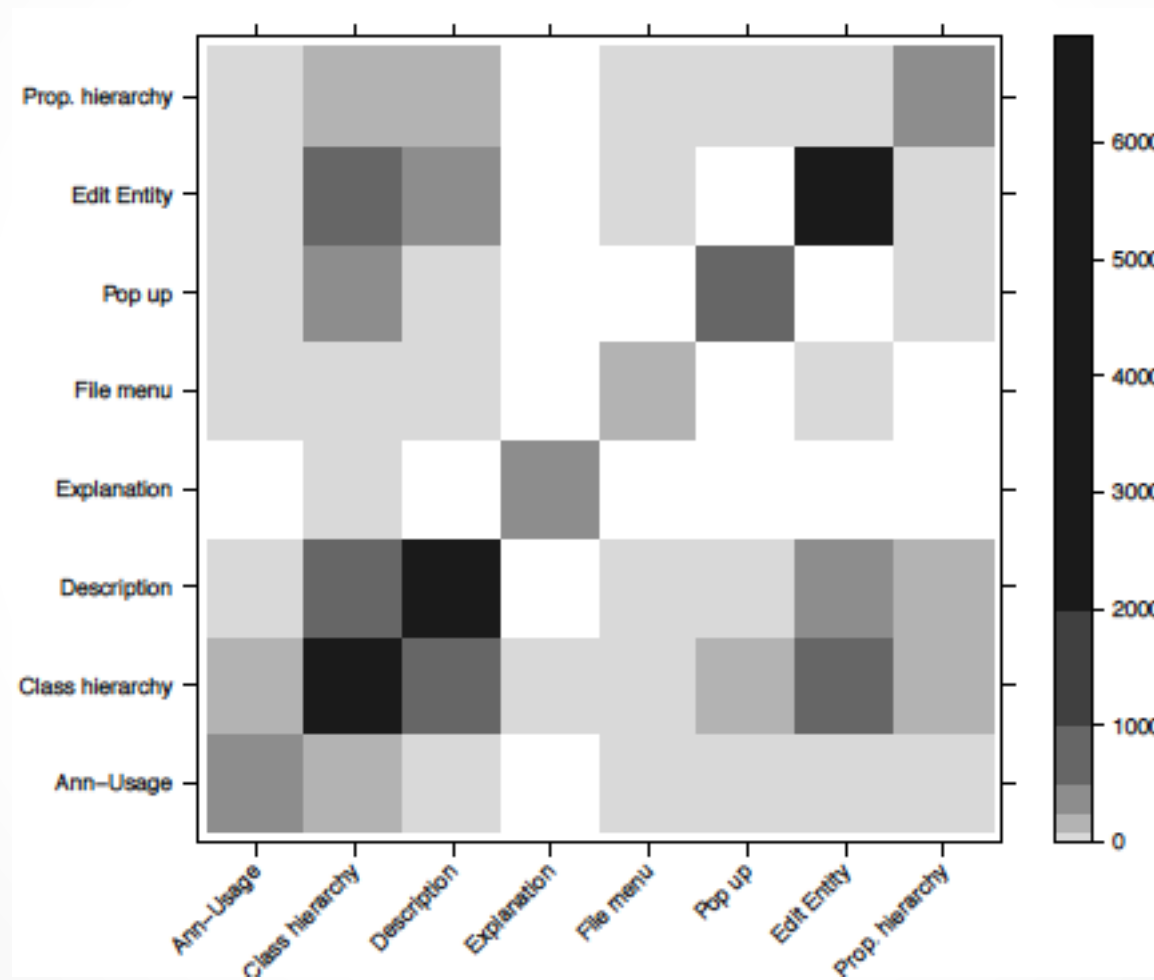
Some characteristics of NL dialogue systems

1. Use of corpus analysis to determine relevant speech acts/dialogue moves and transitions between them.
2. Use of feedback and mixed initiative.
3. Consideration of user goals and cooperative interaction.

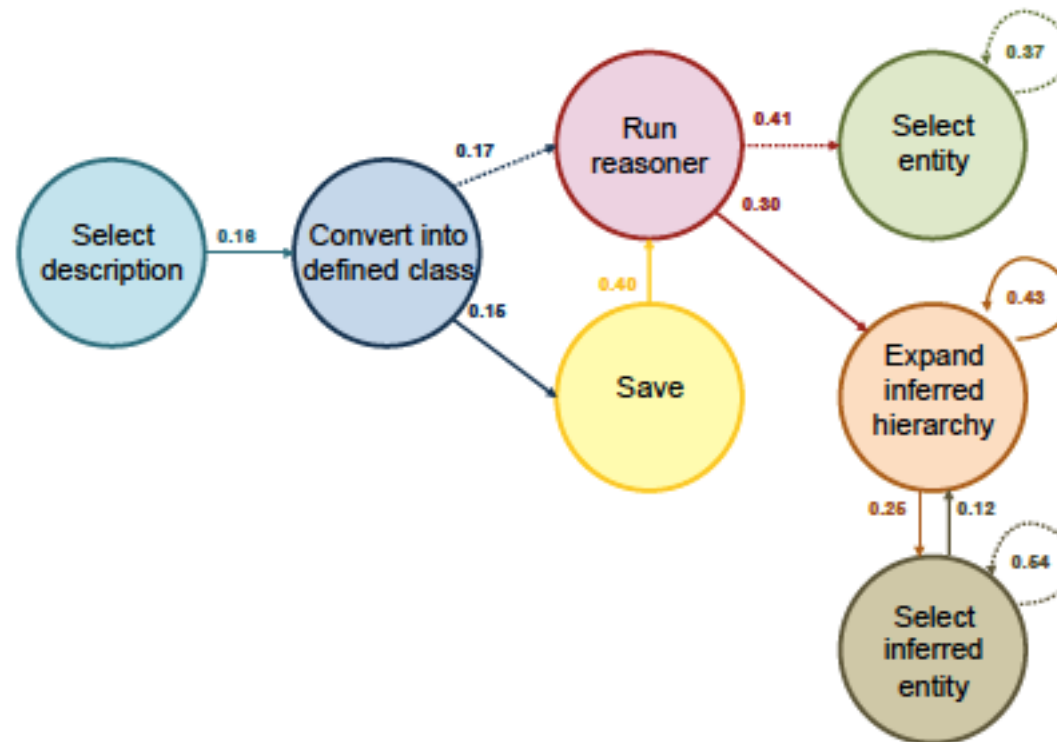
1. Corpus analysis

- We instrumented Protégé to record mouse clicks and other actions.
- We used eye tracking to record sequences of fixations within the interface
- We investigated sequences of actions (Vigo et al, CHI 2015)

Transitions



Larger patterns



Exploration, editing and reasoning activities

2. Mixed initiative

- Although the user is the domain expert, the system understands logic and reasoning better.
- Feedback: implications of actions of the user
- BUT in any sufficiently powerful logic, there are *infinitely* many new facts that are true when an axiom is added!
- So there is a content selection problem (as in NLG) (Parvizi et al, KEOD 2014).

Ways of choosing content

- Syntax driven:
 - Our reasoner produces all entailments of particular forms, with a coverage extending that of (Denaux et al 2012).
 - Remove subsumptions by negations.
 - Choose axioms with maximal signature sets.
- Logic driven:
 - Treat subsumptions of/by unsatisfiable classes specially
 - Choose more specific subsumptions over less specific ones
- Discourse driven:
 - Choose axioms that mention classes appearing recently in the dialogue?
 - Exploit possible more complex dialogue structures in terms of determining “focus of attention”?
- Pragmatics driven:
 - Choose axioms relevant to the user's goals (see next...)?

3. Goals and Cooperativeness

- Selection of feedback should depend on the user's goals that are not yet achieved.
- Goals of ontology authors – to produce ontologies that can answer *competency questions*, e.g.
 - What culinary roles does a given potato have?
 - Which bodies in the solar system are planets?

But (as long as the vocabulary is there) these questions can be asked at any point in ontology authoring – can't directly tell whether the goals are achieved or not!

Exploiting Presuppositions

- CQs have natural language presuppositions
 - “What X are Y?” presupposes that some X are Y and some X are not Y (Levinson 1983, Zuber 1983)
- The user can be told if a presupposition is currently violated (Ren et al, ESWC 2014). E.g:

CQ: Which processes implement a given algorithm?

Example possible violations:

- No process could possibly implement an algorithm (satisfiability test)
- Currently no process can be inferred to implement an algorithm
- Every process currently implements all algorithms

Where we are: interface

The interface is divided into three main panels. The left panel, titled 'Class hierarchy', shows a tree structure of classes. The middle panel, titled 'History log', shows a list of user actions and system responses. The right panel, titled 'Task list', shows a list of goals and tasks.

Class hierarchy

- Thing
 - CakeFilling
 - Food
 - PizzaBase
 - PizzaTopping
 - Pizza**
 - Icecream
 - TestPizza
 - Nothing
 - Cake
 - CheeseyVegetableTopping
 - CreamCake
 - CheeseCake

History log

14:38:07>> User: Retract that a TomatoTopping is a Cake.
Some of the changes are listed below.
Asserted deleted axioms:
TomatoTopping SubClassOf Cake

14:38:21>> User: Retract that a TomatoTopping is a FruitTopping.
Some of the changes are listed below.
Asserted deleted axioms:
TomatoTopping SubClassOf FruitTopping
Inferred added axioms:
EquivalentClasses: Cake, CheeseCake, CheeseyVegetableTopping, CreamCake, Nothing
FrenchPizza SubClassOf NamedPizza
Inferred...

The following tests have passed:
Satisfiability check of [Pizza and hasTopping some TomatoTopping]
Existence/satisfiability of Class [TomatoTopping]

Task list

- Goals
 - What pizza has meaty topping?
 - What pizza has which fish topping?
 - What pizza has tomato topping?
 - Satisfiability check of [Pizza and hasTopping some TomatoTopping]
 - Satisfiability check of [Pizza and not (hasTopping some TomatoTopping)]
 - Existence/satisfiability of Class [TomatoTopping]
 - Existence/satisfiability of ObjectProperty [hasTopping]
 - Existence/satisfiability of Class [Pizza]
 - What cake has which dairy topping?
 - Satisfiability check of [Cake hasTopping some DairyTopping]
 - Satisfiability check of [Cake and not (hasTopping some DairyTopping)]
 - Existence/satisfiability of Class [DairyTopping]
 - Existence/satisfiability of ObjectProperty [hasTopping]
 - Existence/satisfiability of Class [Cake]
 - What cake has which cake filling?
 - Satisfiability check of [Cake hasFilling some CakeFilling]
 - Satisfiability check of [Cake and not (hasFilling some CakeFilling)]
 - Existence/satisfiability of Class [Cake]
 - Existence/satisfiability of ObjectProperty [hasFilling]
 - Existence/satisfiability of Class [CakeFilling]

Manchester Syntax **OWL Simplified English**

Where next?

- Evaluation with users
- Integration
 - Speech acts and larger dialogue structures – compatibility of our interface with the empirical findings
 - CNL for competency questions
 - More serious experimentation with entailment selection heuristics
 - “What if...?” questions and associated interactions

Answering “What if...?” Questions

“What if ...?” involves a combination of:

1. Checkpoint/backup/undo mechanism
2. Feedback on actions (“what has...?”)

embedded within a dialogue framework.....