

# Experiences applying GATE to Semantic Web Technologies

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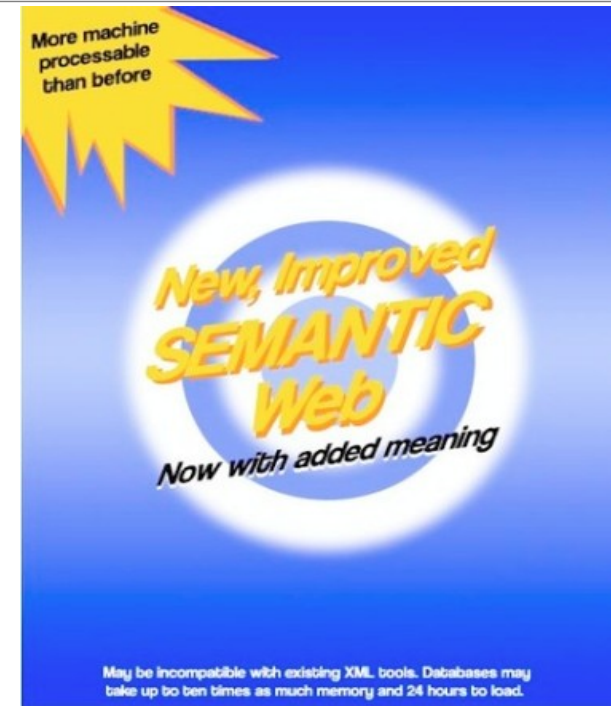
- **Background**
- **GATE embedded to STs**
  - IVEA
  - SALT
  - Semanta
- **GATE as an Interface to STs**
  - CLOnE, ROA
- **Conclusion and Future Work**

# Background I: Semantic Web



Combination of standard data models and explicit semantics supports:

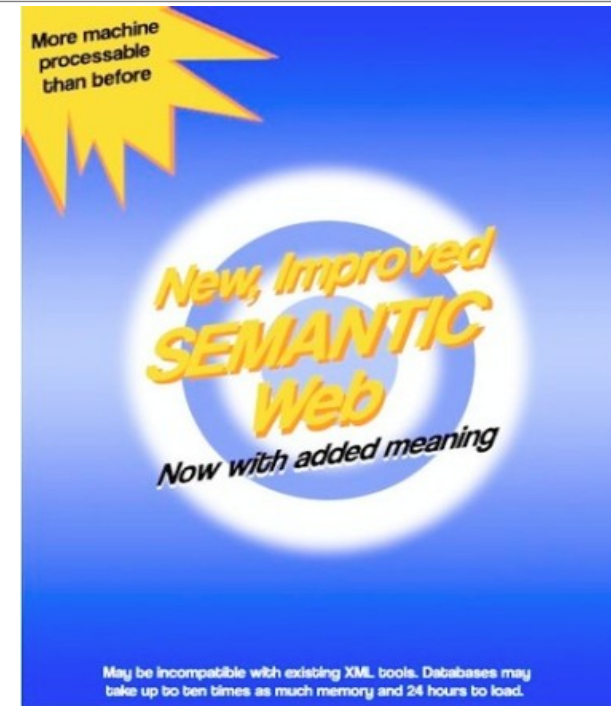
- information exchange and interoperability
- data integration
- improved search and retrieval
- reasoning and inference



# Background I: Semantic Web



- conventional web is intended for human consumption
- content consists largely of natural language text, images, video, etc.
- Semantic Web seeks to make data more amenable to automated forms of information processing
- standard data model + explicit semantics  
Resource Description Framework (RDF)  
core data model + some semantics
- Web Ontology Language (OWL)  
more advanced semantics  
OWL typically used to create ontologies that describe the conceptual structure of a specific domain of interest



# Background II: The Semantic Desktop



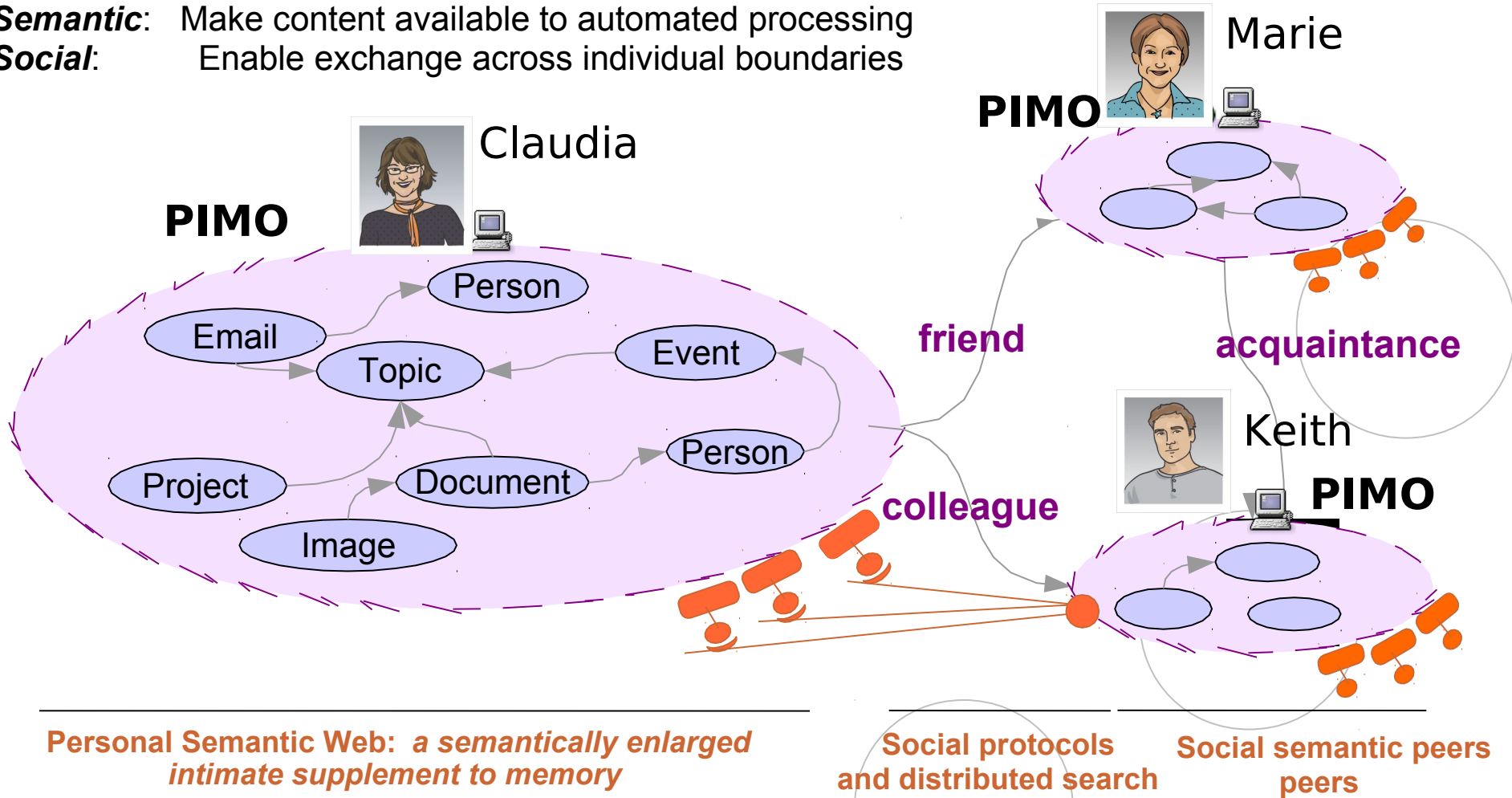
Digital Enterprise Research Institute

www.deri.ie

**Desktop:** Help individuals in managing information on the Web/their PC

**Semantic:** Make content available to automated processing

**Social:** Enable exchange across individual boundaries

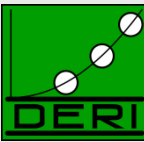


**Personal Semantic Web: a semantically enlarged intimate supplement to memory**

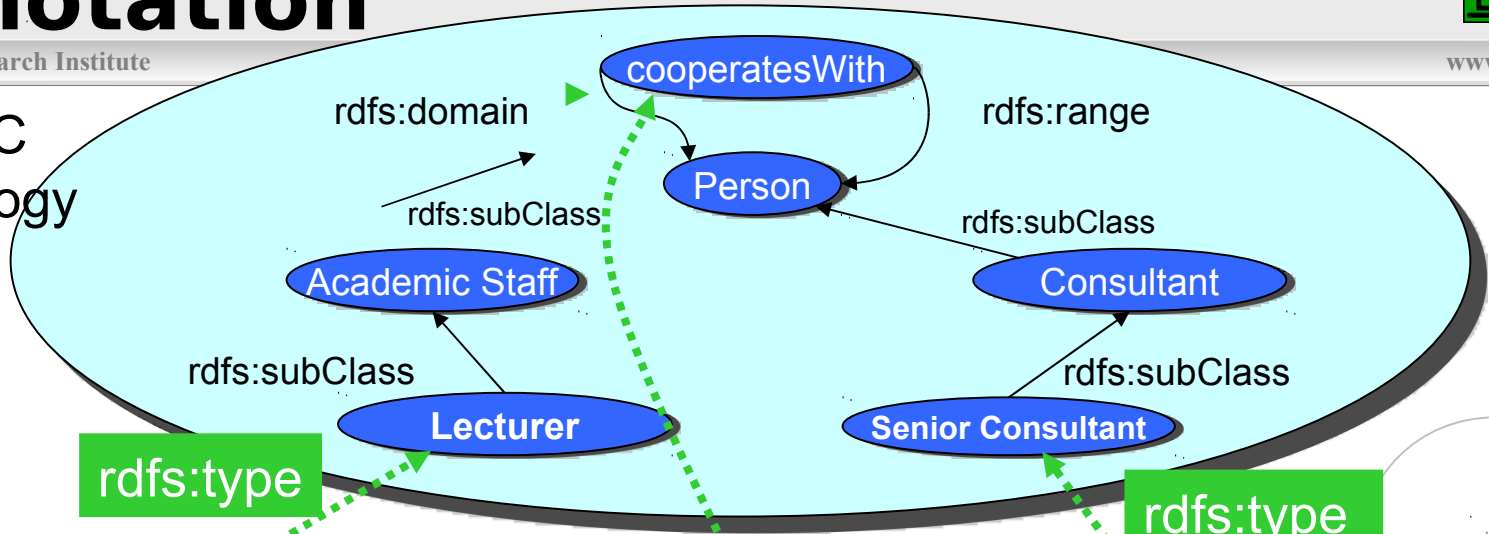
**Social protocols and distributed search**

**Social semantic peers peers**

# Background III: Semantic Annotation



SWRC  
Ontology



Annotation

```

:sha a swrc:Lecturer;
    swrc:name "Siegfried Handschuh".

:sha swrc:cooperatesWith
    http://www.dfki.de/~declerck#tde.
  
```


```

:tde a swrc:SeniorConsultant;
    swrc:name "Thierry Declerck".
  
```

swrc:cooperatesWith


Web  
Page

**Siegfried Handschuh**



He is presenting together with [Therry Declerck](#) a tutorial at ESWC 06

**Thierry Declerck**



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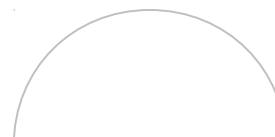
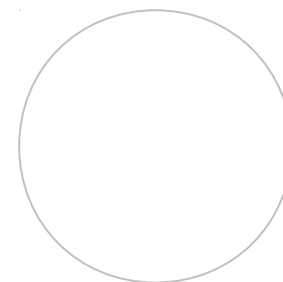
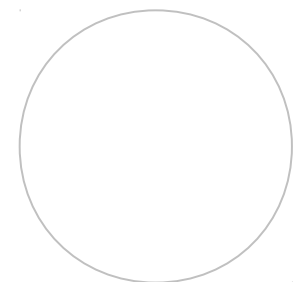
Links have explicit meaning!

URL

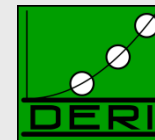
<http://www.siegfried-handschuh.net>

<http://www.dfki.de/~declerck/>

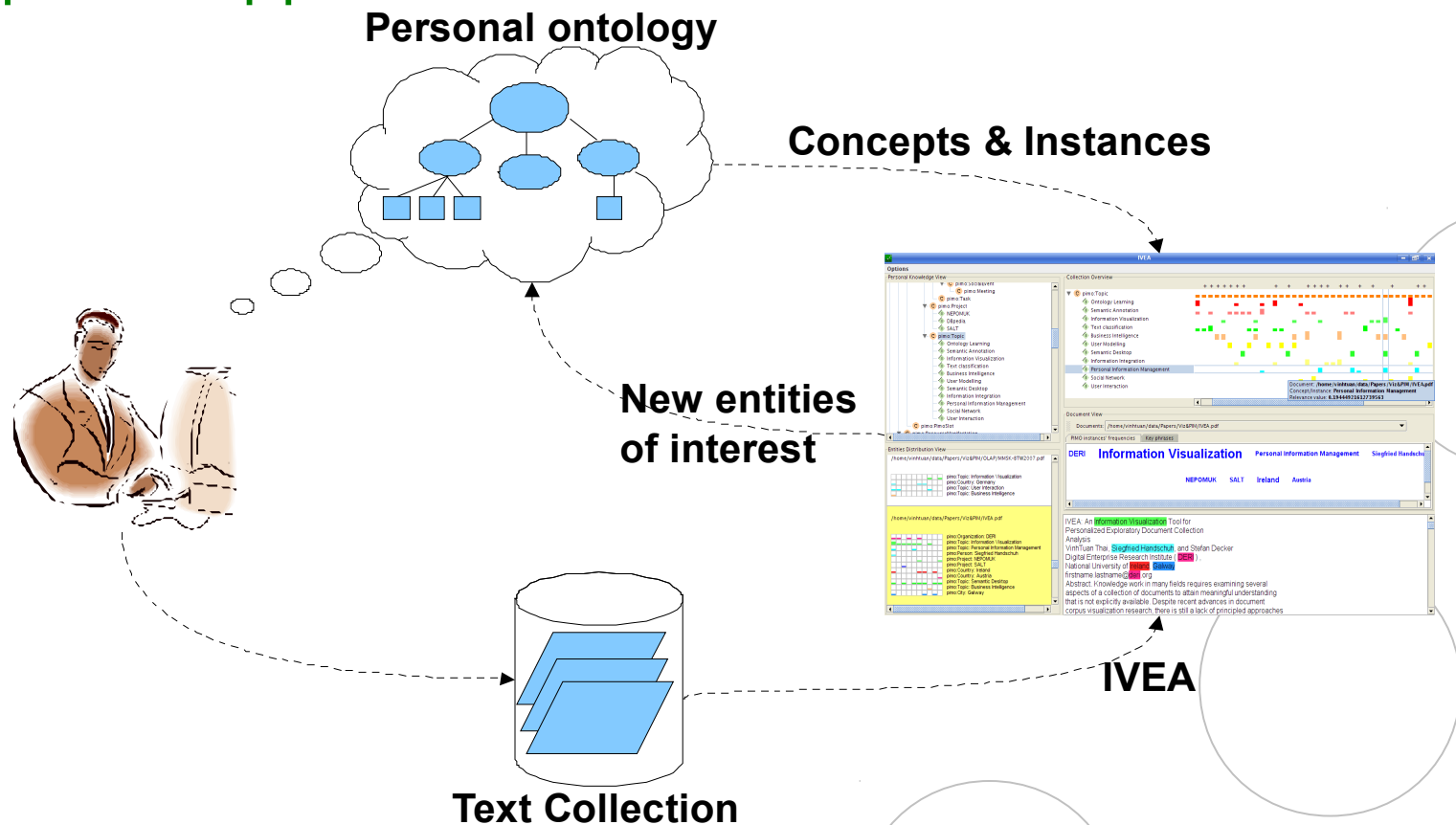
# Embedding GATE in Semantic Web Applications I: IVEA



# IVEA: Information Visualization for Exploratory Document Collection Analysis



## Proposed approach



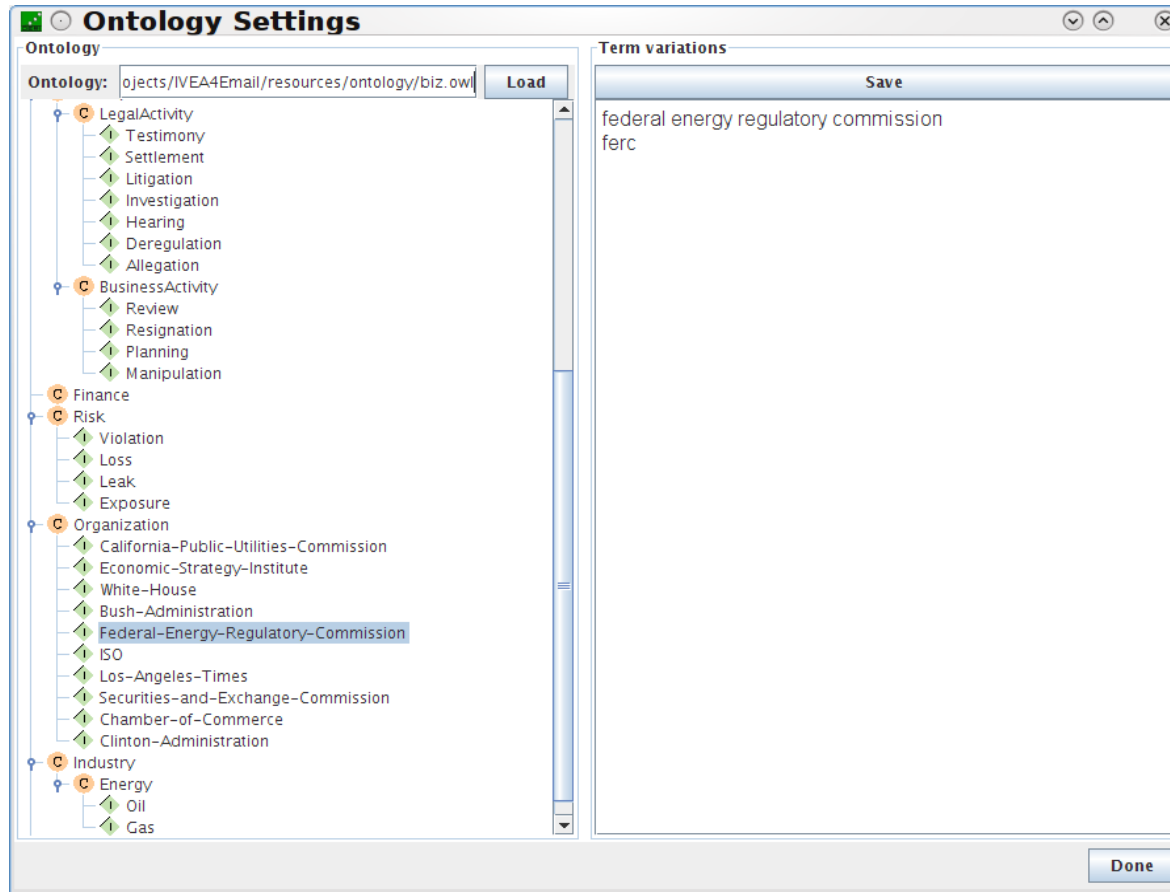


## Proposed approach

### – Advantages:

- aligned with the **users' interests**
- **user-controlled**
- flexibility to explore at **different levels of detail**
- dynamic **ontology enrichment**

→ **more personalized** to the users



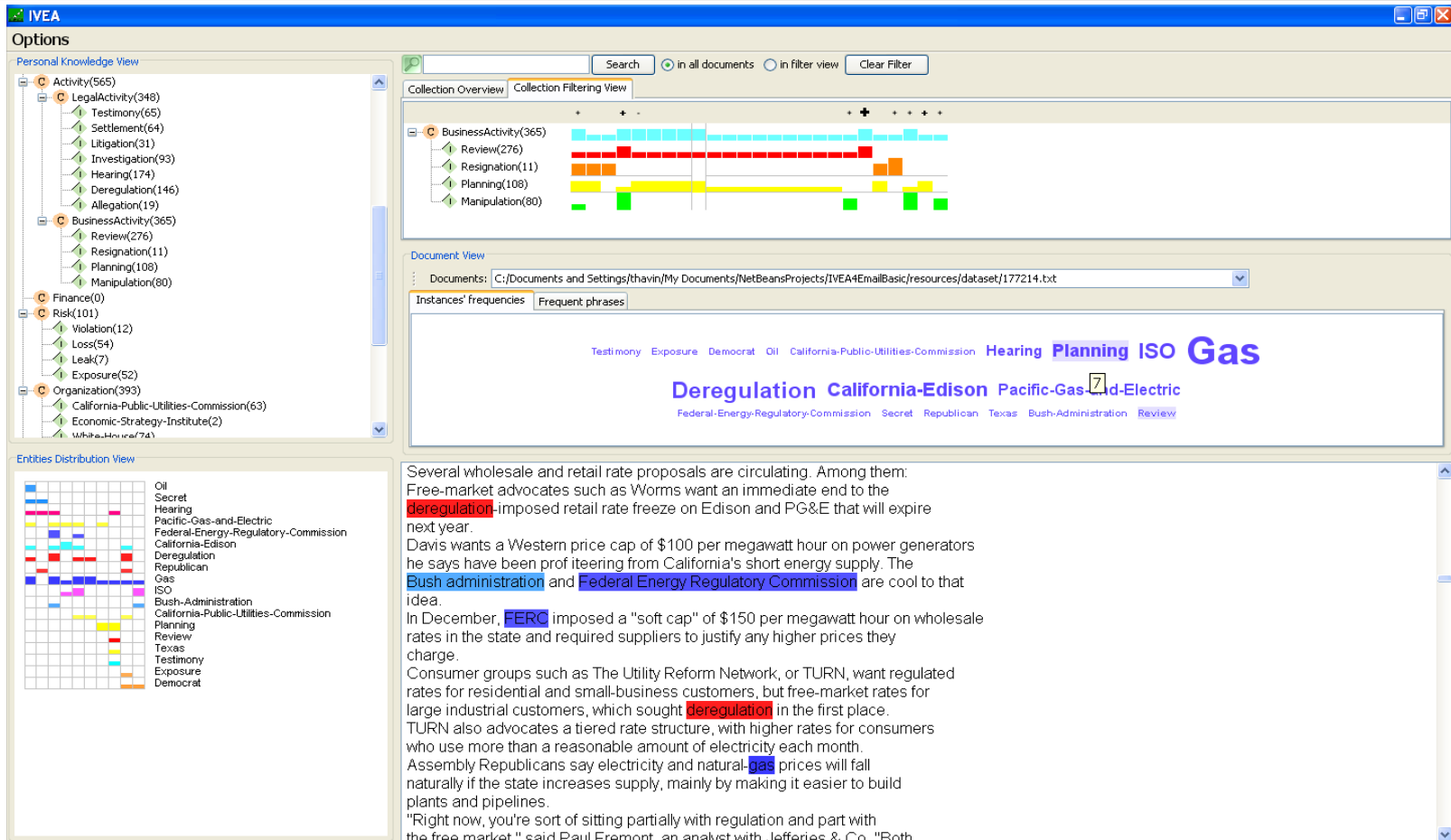
**Ontology Settings**

Ontology:

- LegalActivity
  - Testimony
  - Settlement
  - Litigation
  - Investigation
  - Hearing
  - Deregulation
  - Allegation
- BusinessActivity
  - Review
  - Resignation
  - Planning
  - Manipulation
- Finance
- Risk
  - Violation
  - Loss
  - Leak
  - Exposure
- Organization
  - California-Public-Utilities-Commission
  - Economic-Strategy-Institute
  - White-House
  - Bush-Administration
  - Federal-Energy-Regulatory-Commission
  - ISO
  - Los-Angeles-Times
  - Securities-and-Exchange-Commission
  - Chamber-of-Commerce
  - Clinton-Administration
- Industry
  - Energy
    - Oil
    - Gas

**Term variations**

federal energy regulatory commission  
ferc



**Options**

**Personal Knowledge View**

- Activity(565)
  - LegalActivity(348)
    - Testimony(65)
    - Settlement(64)
    - Litigation(31)
    - Investigation(93)
    - Hearing(174)
    - Deregulation(146)
    - Allegation(19)
  - BusinessActivity(365)
    - Review(276)
    - Resignation(11)
    - Planning(108)
    - Manipulation(80)
  - Finance(0)
  - Risk(101)
    - Violation(12)
    - Loss(54)
    - Leak(7)
    - Exposure(52)
  - Organization(393)
    - California-Public-Utilities-Commission(63)
    - Economic-Strategy-Institute(2)
    - Whistleblower(74)

**Collection Overview** | Collection Filtering View

Search:  |  in all documents |  in filter view | Clear Filter

**Document View**

Documents: C:/Documents and Settings/thavin/My Documents/NetBeansProjects/IVEA4EmailBasic/resources/dataset/177214.txt

Instances' frequencies | Frequent phrases

Testimony Exposure Democrat Oil California-Public-Utilities-Commission **Hearing Planning ISO Gas**

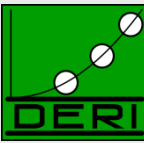
**Deregulation California-Edison Pacific-Gas and Electric**

Federal-Energy-Regulatory-Commission Secret Republican Texas Bush-Administration Review

Several wholesale and retail rate proposals are circulating. Among them: Free-market advocates such as Worms want an immediate end to the **deregulation**-imposed retail rate freeze on Edison and PG&E that will expire next year. Davis wants a Western price cap of \$100 per megawatt hour on power generators he says have been profiteering from California's short energy supply. The **Bush administration** and **Federal Energy Regulatory Commission** are cool to that idea. In December, **FERC** imposed a "soft cap" of \$150 per megawatt hour on wholesale rates in the state and required suppliers to justify any higher prices they charge. Consumer groups such as The Utility Reform Network, or TURN, want regulated rates for residential and small-business customers, but free-market rates for large industrial customers, which sought **deregulation** in the first place. TURN also advocates a tiered rate structure, with higher rates for consumers who use more than a reasonable amount of electricity each month. Assembly Republicans say electricity and natural-**gas** prices will fall naturally if the state increases supply, mainly by making it easier to build plants and pipelines. "Right now, you're sort of sitting partially with regulation and part with the free market" said Paul Fremont, an analyst with Jefferies & Co. "Both

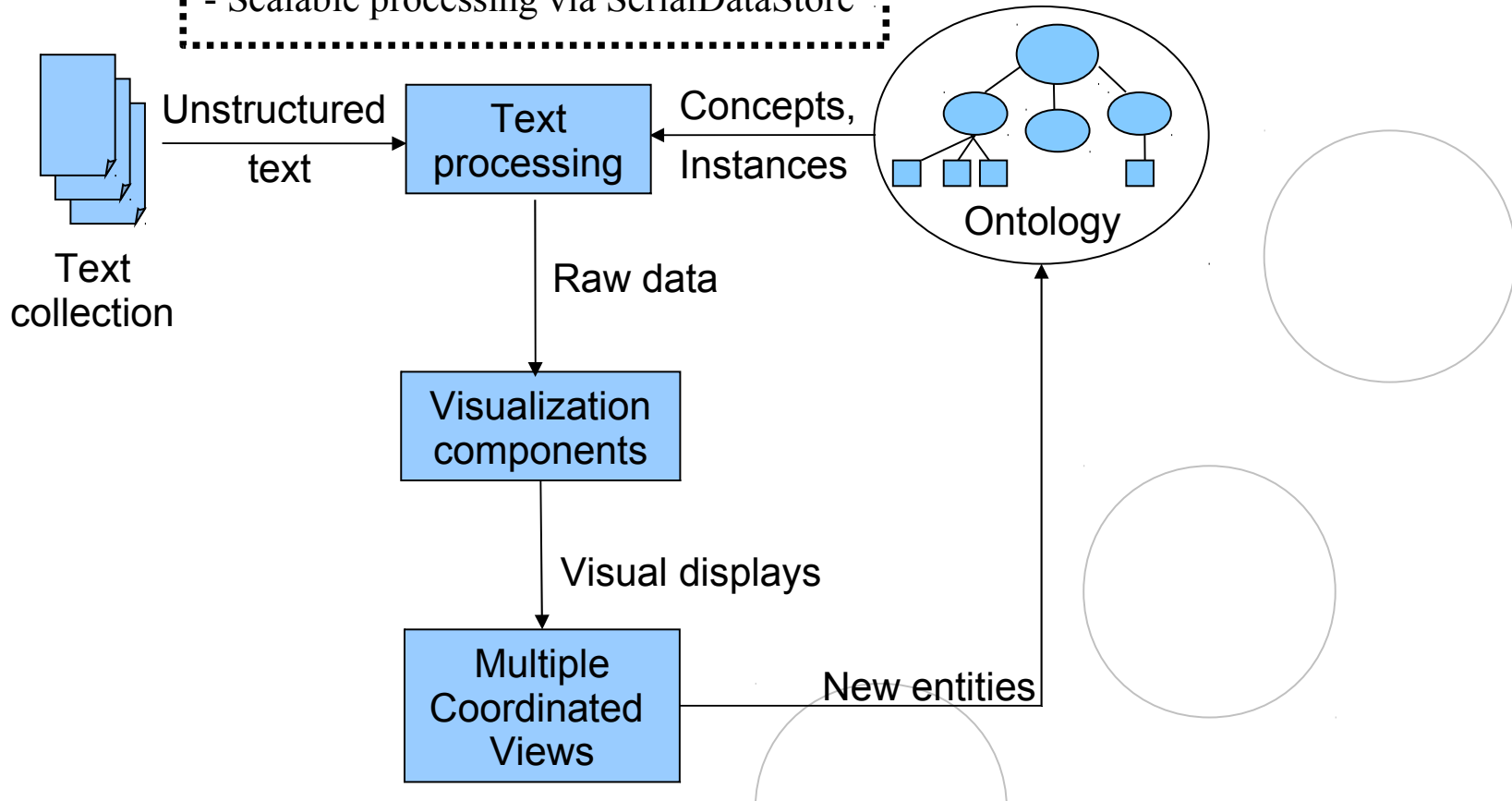
<http://smile.deri.ie/projects/ivea>

# Role of GATE in IVEA



GATE is used for:

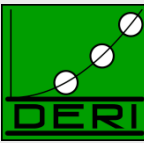
- Sentence and Fragment Identification
- Ontology-based annotation of texts
- Scalable processing via SerialDataStore



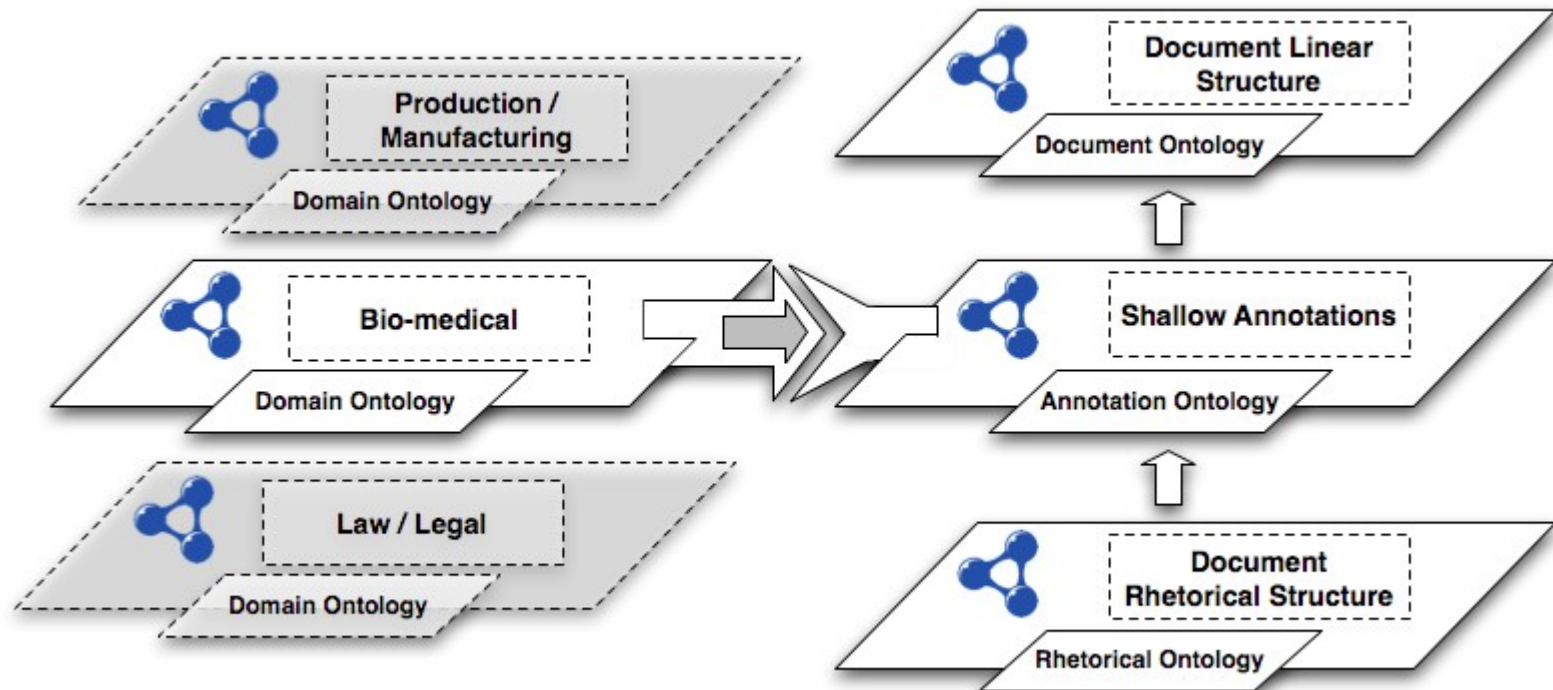
# Embedding GATE in Semantic Web Applications II: SALT



# SALT - Semantically Annotated LaTeX



## SALT Ontologies



## ■ High-level

- **Automatic extraction of discourse knowledge items (i.e., claims, positions, arguments) from scientific publications**

## ■ Low-level

- **Rule-based extraction of rhetorical relations from the discourse, according to RST (Rhetorical Structure Theory)**

- **Empirical analysis**
- **Signalling discourse markers (cue-phrases)**
  - **Rhetorical relations:** however, although, but
- **Two types of information**
  - **Discourse related information:** type of rhetorical relations, roles of text spans
  - **Algorithmic information:** position, surrounding punctuation
- **Result: Cue-phrases - Rhet. relations mapping**



## ■ Extraction of rhetorical relations

### ■ GATE plugin

### ■ Empirical information encoded into fields for JAPE grammars

#### ■ relation

#### ■ whereToLink: A, B

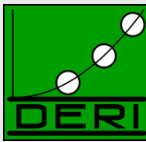
#### ■ statuses: SN, NS, NN

#### ■ breakAction: NORMAL,

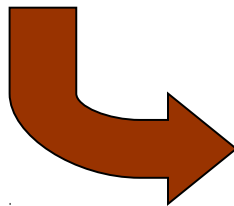
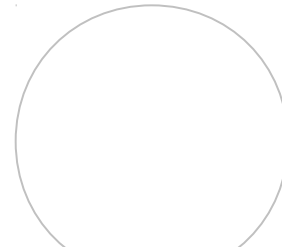
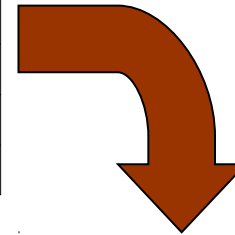
#### ■ place: B, M, A

Relation: Concession				
cue phrase	place	whereToLink	breakAction	statuses
. Although	B	A	NORMAL_THEN_COMMA	SN
, although	B	B	NORMAL_THEN_COMMA	NS
. However,	B	B	NORMAL	NS
, however	B	B	NORMAL	NS
, however,	M	B	NONE	NS
; however,	B	B	NORMAL_THEN_COMMA	NS
regardless	B	B	NORMAL_THEN_COMMA	NS
, though	B	B	NORMAL_THEN_COMMA	NS

# Approach (cont.)



Relation: Concession				
cue phrase	place	whereToLink	breakAction	statuses
. Although	B	A	NORMAL_THEN_COMMA	SN
, although	B	B	NORMAL_THEN_COMMA	NS
. However,	B	B	NORMAL	NS
, however	B	B	NORMAL	NS
, however,	M	B	NONE	NS
; however,	B	B	NORMAL_THEN_COMMA	NS
regardless	B	B	NORMAL_THEN_COMMA	NS
, though	B	B	NORMAL_THEN_COMMA	NS

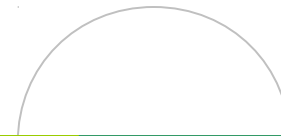
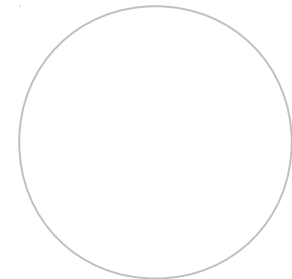
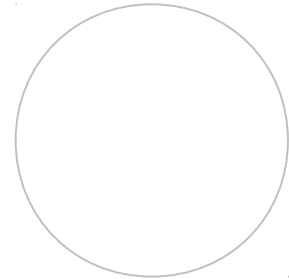


```
Rule:CuePhRule1 ({Token.string == ','})  
  ({Token.string == "while"}):cuePhrase1  
  →  
:cuePhrase1.CUE_PHRASE = {kind = 'cuePh',  
  relation = "antithesis", place = B,  
  breakAction = NORMAL_THEN_COMMA,  
  statuses = NN, whereToLink = B, rule =  
  "CuePhRule1"}
```

# Embedding GATE in Semantic Web Applications III: Semanta



- Motivation
- Semantic Email
  - Email Action Items
  - Email Ad-hoc Workflows
- Semanta
  - Architecture
  - Email workflow support
  - Email workflow visualisation
  - Email workflow representation
  - Desktop Data Integration
- Evaluation & Discussion
- Conclusion



## Email remains the most popular means of *Electronic Communication*

- Asynchronous Communication
- Flexible, dynamic nature

## Email is also a *Virtual Workplace*

- *Collaborative Environment*
- Knowledge creation, management and sharing

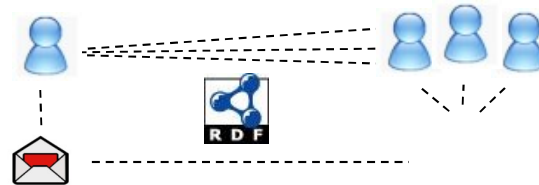
## Lacks clear structure & real semantics → Email Problems

- Email Tracking
- Email Classification
- Email Retrieval
- *Email Overload*

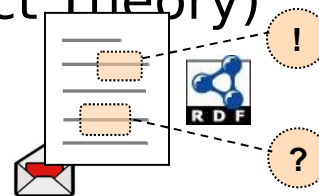


## Annotated Email

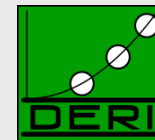
- i. *Thread metadata* - Email Sequence, Social, Temporal Metadata



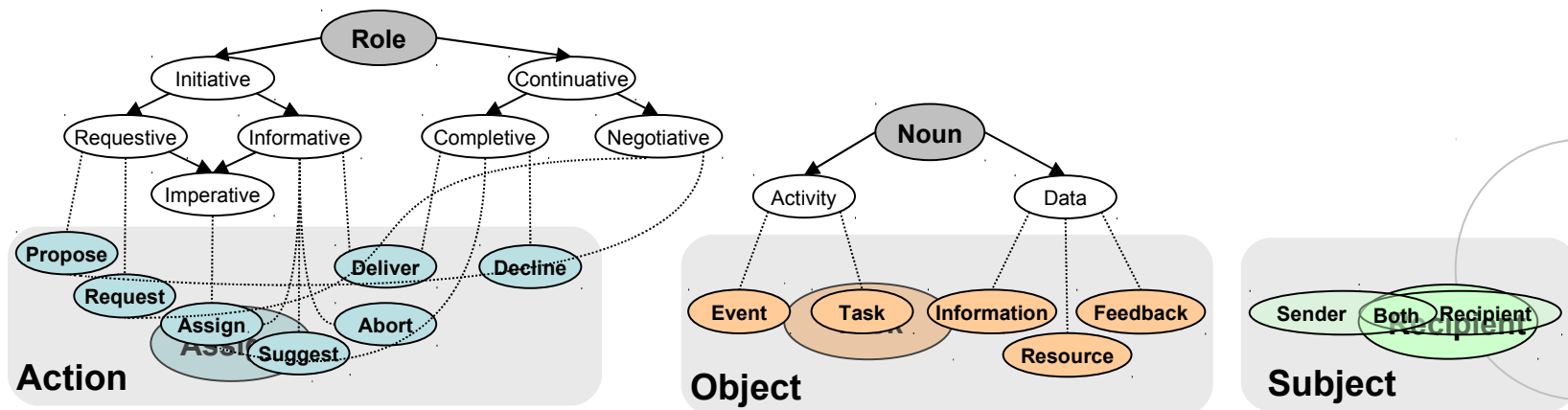
- ii. *Content metadata* - Action Items in written dialogue (based on Speech Act Theory)



# Email Action Items



## Speech Act Model: [**Action**, **Object**, **Subject**]

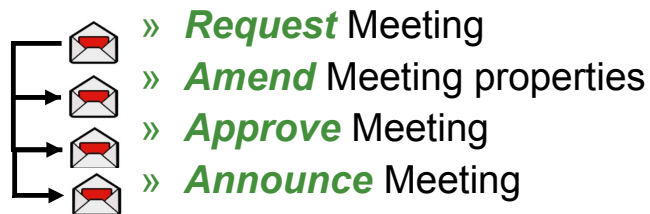


Example “...Please make sure you have the document ready!...”

Email Conversations carry out concurrent, implicit, well-formed *Workflows*

Email Action Item = Start/Continuation of a Workflow

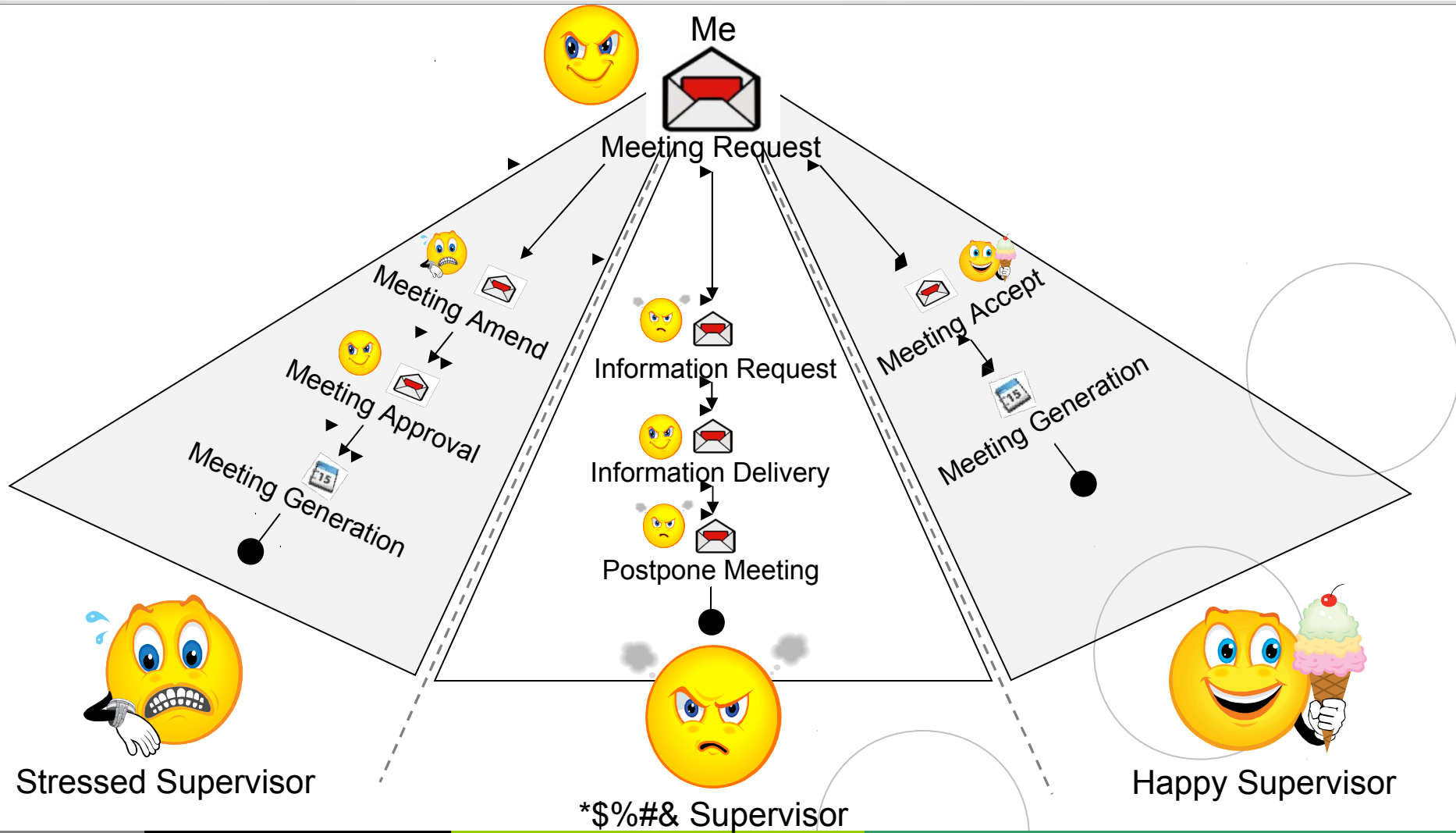
Example:



• *Workflow Artefacts* - Events, Tasks, People, Projects...



# Email Ad-Hoc Workflows

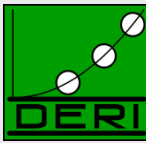


Stressed Supervisor

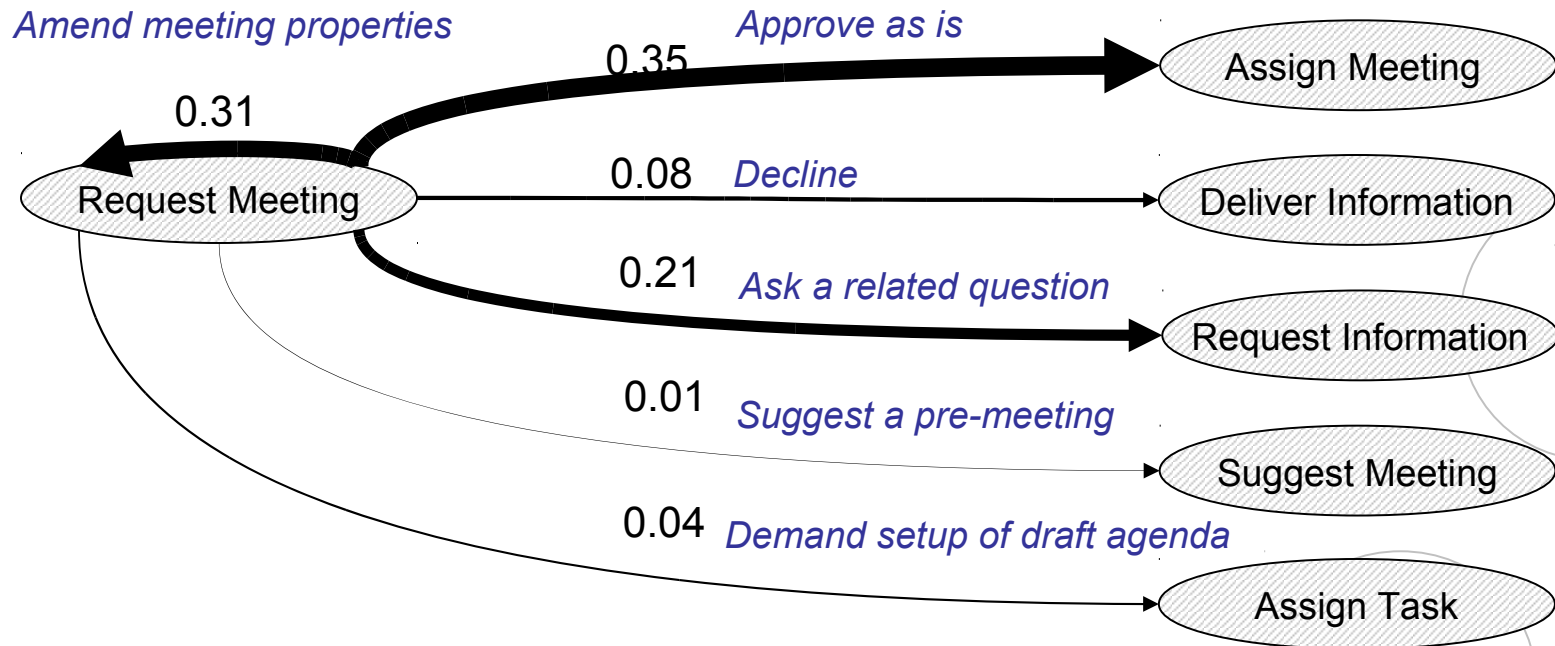
\*\$%#& Supervisor

Happy Supervisor

# Modelling Email Ad-Hoc Workflows

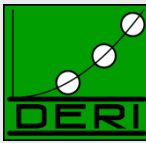


- There exist *trends*



- Provide support for the *most-likely* Action Item reactions
- Leave open the option for *any other* reaction

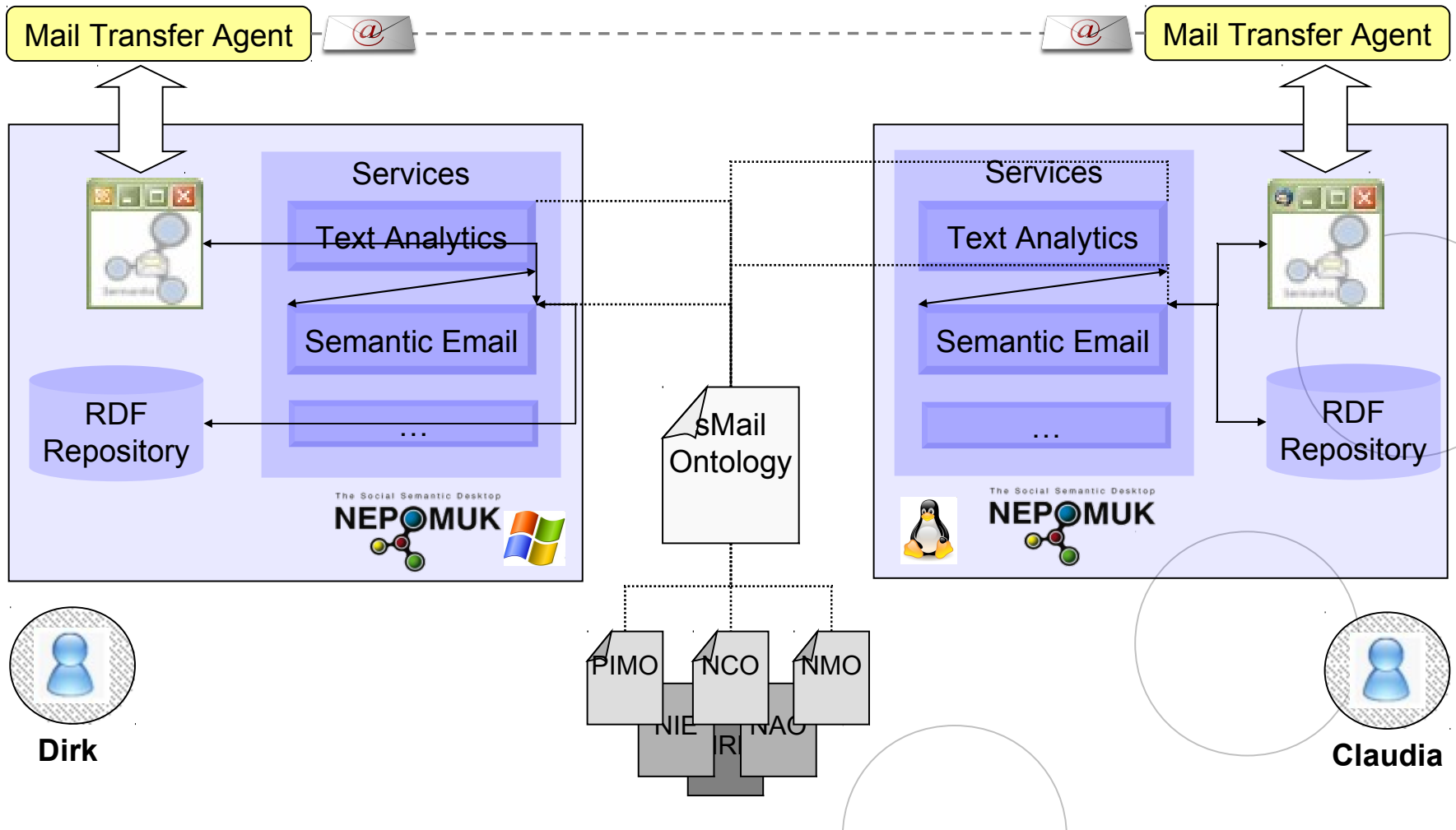
# Semanta - Features



- ❖ Semi-automatic Action Items *Detection*
- ❖ Supporting Email Action Item *Handling*
- ❖ Email Action Item (Workflow) *Tracking*
- ❖ Email Workflow *Visualisation*
- ❖ Email-generated Event/Task *Recognition*
- ❖ Email attachment *Reminders*
- ❖ Email ↔ Desktop *Knowledge Integration*

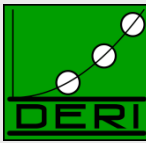


# Semanta - Architecture





# Email Workflow Visualisation



- Pending Incoming Action Items :- Personal Email Todo's
- Pending Outgoing Action Items :- Sent requests which remain unanswered
- All Items :- All sent & received items

## WORKFLOW

Individual Items in all views can be shown in their CONTEXT

The screenshot shows a web application window titled "Email Action Items". It has three tabs: "Pending Incoming", "Pending Outgoing", and "All Items". The "Pending Incoming" tab is selected, showing a list of four items:

- Please prepare your ... 01/10/2008 @10:03
- Do either of you hav... 01/10/2008 @18:07
- Dirk, can we discuss... 02/10/2008 @12:14
- We're meeting at the... 02/10/2008 @19:34

The third item, "Dirk, can we discuss...", is highlighted. A red box highlights the detailed view of this item, which includes a description and a context table.

Description: Martin requested an event from You on Thursday, 2 Oct 2008

Context			
Item	From	To	Date
Meeting tomorrow			
Dirk, can we discuss the review...	W., Martin	You	02/10/2008 @12:13
What is there to be discussed?	You	W., Martin	02/10/2008 @13:17
The way forward!	W., Martin	You	02/10/2008 @13:35

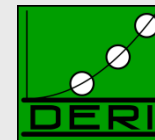
# Email Workflow Representation



The screenshot illustrates an email workflow. It starts with an email window titled "Meeting tomorrow - Message (HTML)". A red arrow points from the "Reply" button in this window to another window titled "RE: Meeting tomorrow - Message (HT...)", which also has a "Reply" button. A second red arrow points from the "Reply" button in the second window to a third window titled "Can we discuss the review tomorrow afternoon? >>> Yes". This third window has a "Related Email" button. A red arrow points from the "Related Email" button to a calendar appointment window. The appointment window has a "Related Email" tab selected, showing the subject "Can we discuss the review tomorrow afternoon? >>> Yes", start time "Thu 09/10/2008 08:00", end time "Thu 09/10/2008 08:30", and a reminder of "15 minutes". The appointment is titled "Meeting with Manager".

**Workflow Artefacts**

# Desktop Data Integration

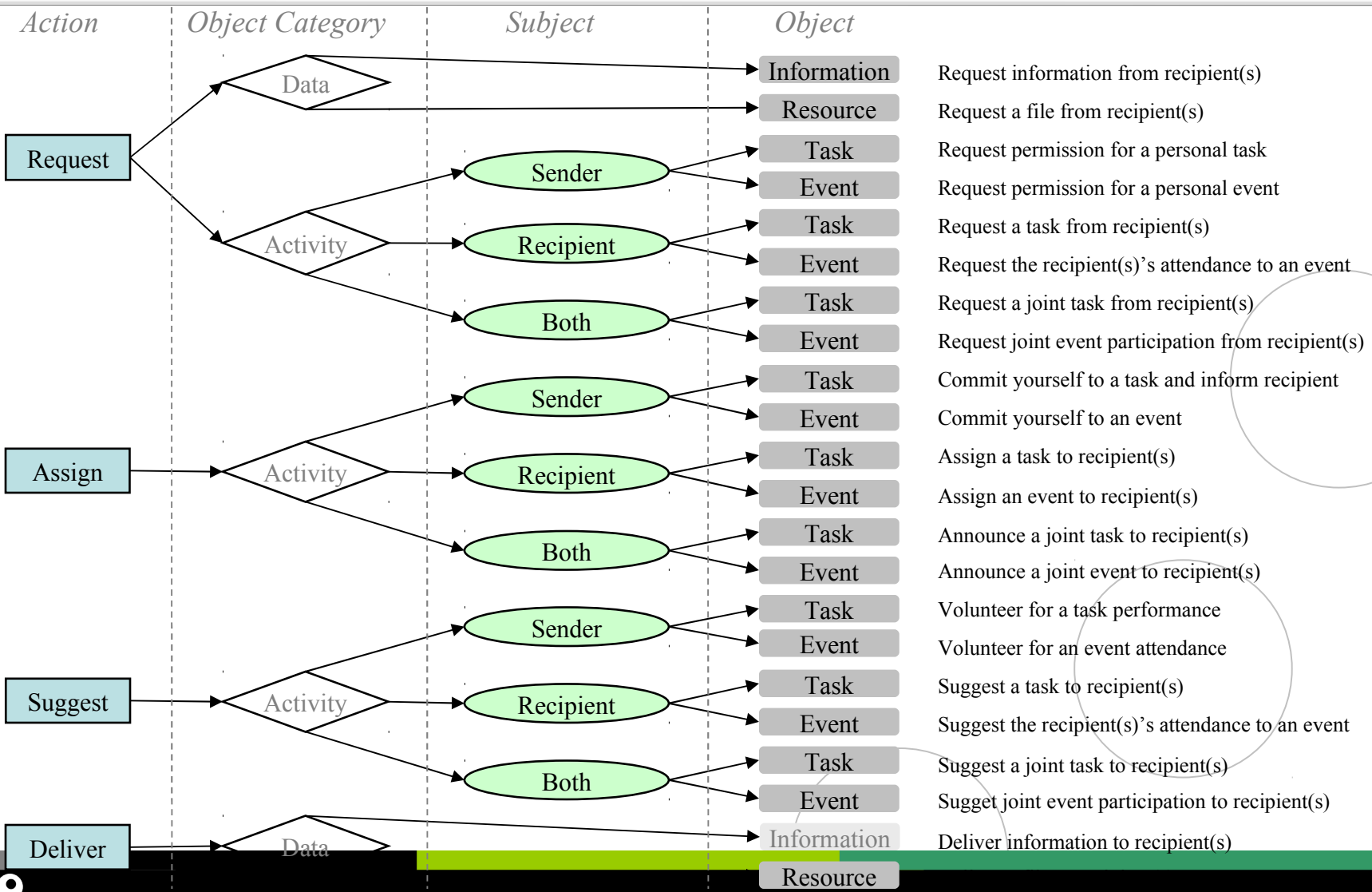


The screenshot displays the Nepomuk Semantic Desktop application. The main window is titled "Nepomuk - Your Semantic Desktop" and features a menu bar (Nepomuk, File, Window, Help) and a toolbar with icons for Search, PIMO, and DataWrapper. A search bar contains the URI: `http://nepomuk.semanticdesktop.org/users/semanta#EV0000000094A63322902`. The interface is divided into several panes:

- ClassBrowser:** A tree view on the left showing a hierarchy of classes. "Social Event (1)" is highlighted with a red box.
- Pimo Tree View:** A tree view on the right showing the instance "Meeting (-)", which is also highlighted with a red box.
- PIMO Editor:** A window on the right titled "PIMO Editor: Can we discuss the review tomorrow". The main content area, outlined in red, displays the event details:
  - Title:** Can we discuss the review tomorrow at noon? >>> Yes
  - URL:** `http://nepomuk.semanticdesktop.org/users/semanta#EV063322902685F6`
  - Rating:** 5 stars
  - Type:** Social Event
  - Tags:** Meeting with Dirk, attendee
  - Attendees:** Dirk Hageman (Person), Martin Williams (Person)
- Pimo Timeline:** A pane at the bottom left showing a timeline of events.



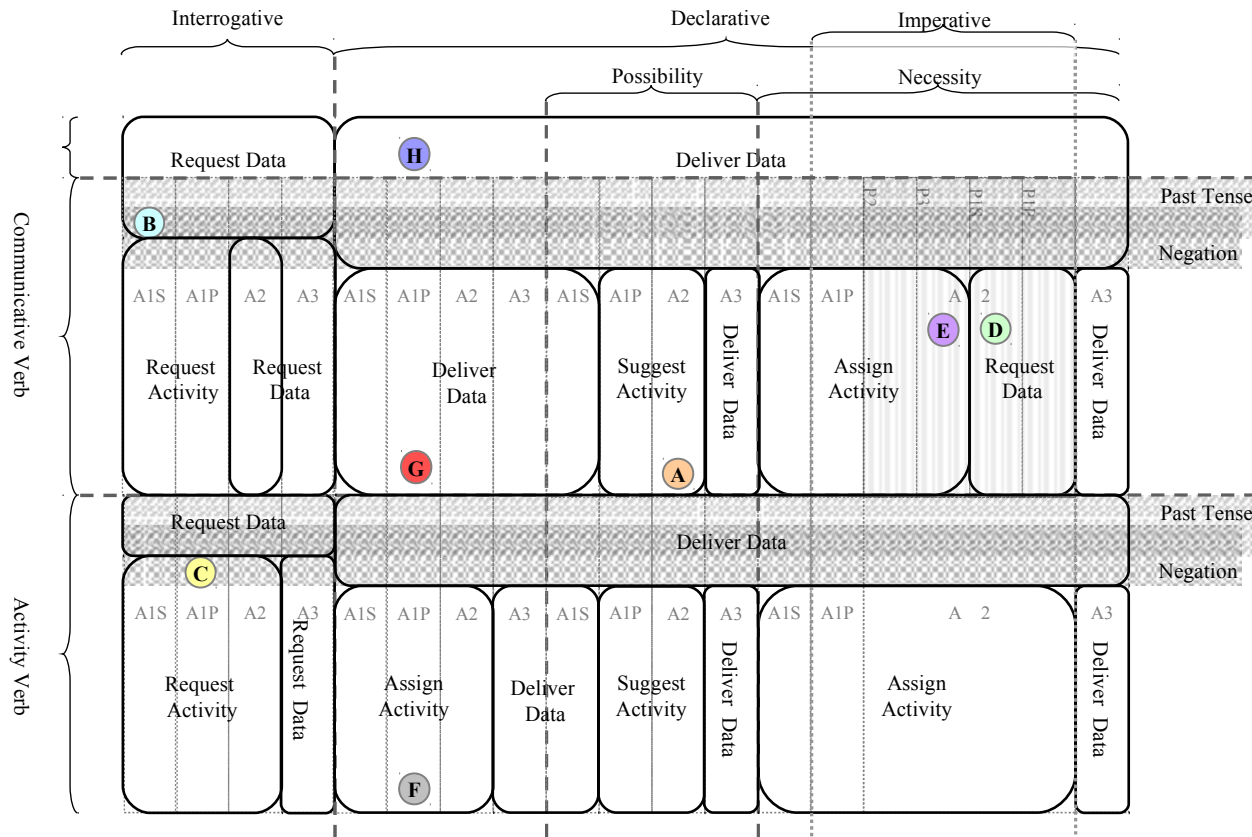
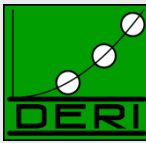
# 21 Classes for Email Speech Act Classification



# Classification Model

- **Classification Task - elicit e-mail speech acts from e-mail content**
- **Classification Model maps a text clause into exactly one of the 21 classes**
- **Text classification is based on:**
  - **Sentence Form (Interrogative, Declarative, Imperative)**
  - **Verbal Modality (Possibility, Necessity)**
  - **Verb Type (Activity, Communicative, Other)**
  - **Semantic Role (Agent, Patient, 1<sup>st</sup>/2<sup>nd</sup>/3<sup>rd</sup> Person Singular/Plural)**
  - **Negation (Presence of)**
  - **Grammatical Tense (Past and Non-Past)**

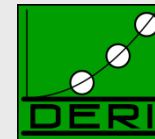
# Graphical Representation of Classification Model



## Examples

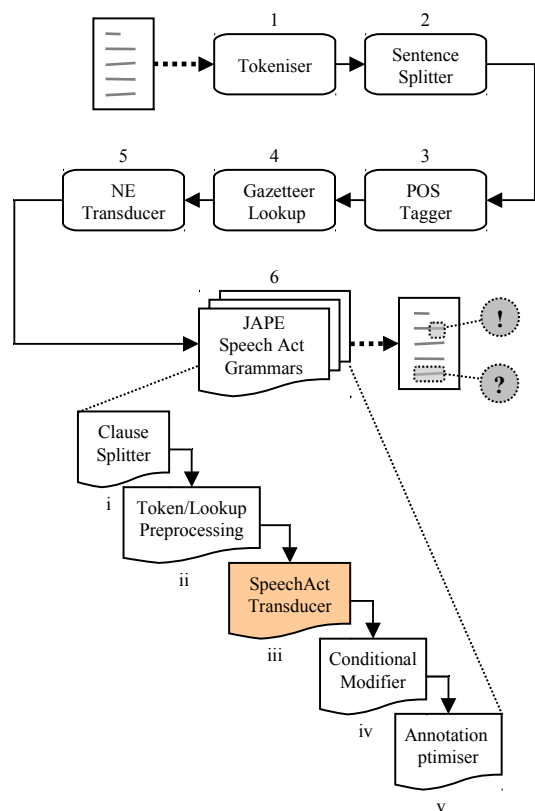
A	You should forward it to me.
B	Haven't I sent you the file?
C	Didn't we need to discuss today?
D	You still have to send me the info!
E	You must email them the data.
F	We are attending the meeting.
G	We are sending you the files.
H	We are happy.

# Gate Implementation



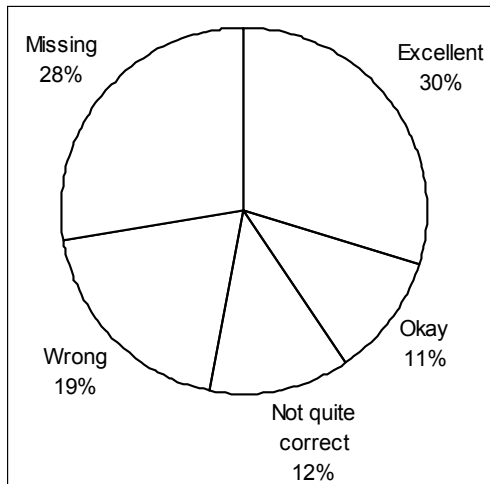
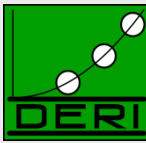
*The Pipeline*

*Speech Act Transducer*



- **Performs bulk of pattern matching**
- **Intermediate annotations matched to 1 class**
- **Consists of 58 rules**
- **Rules fire within 14 different phases**
- **Text matched in the initial phases not considered later**

# Evaluation - Some Results

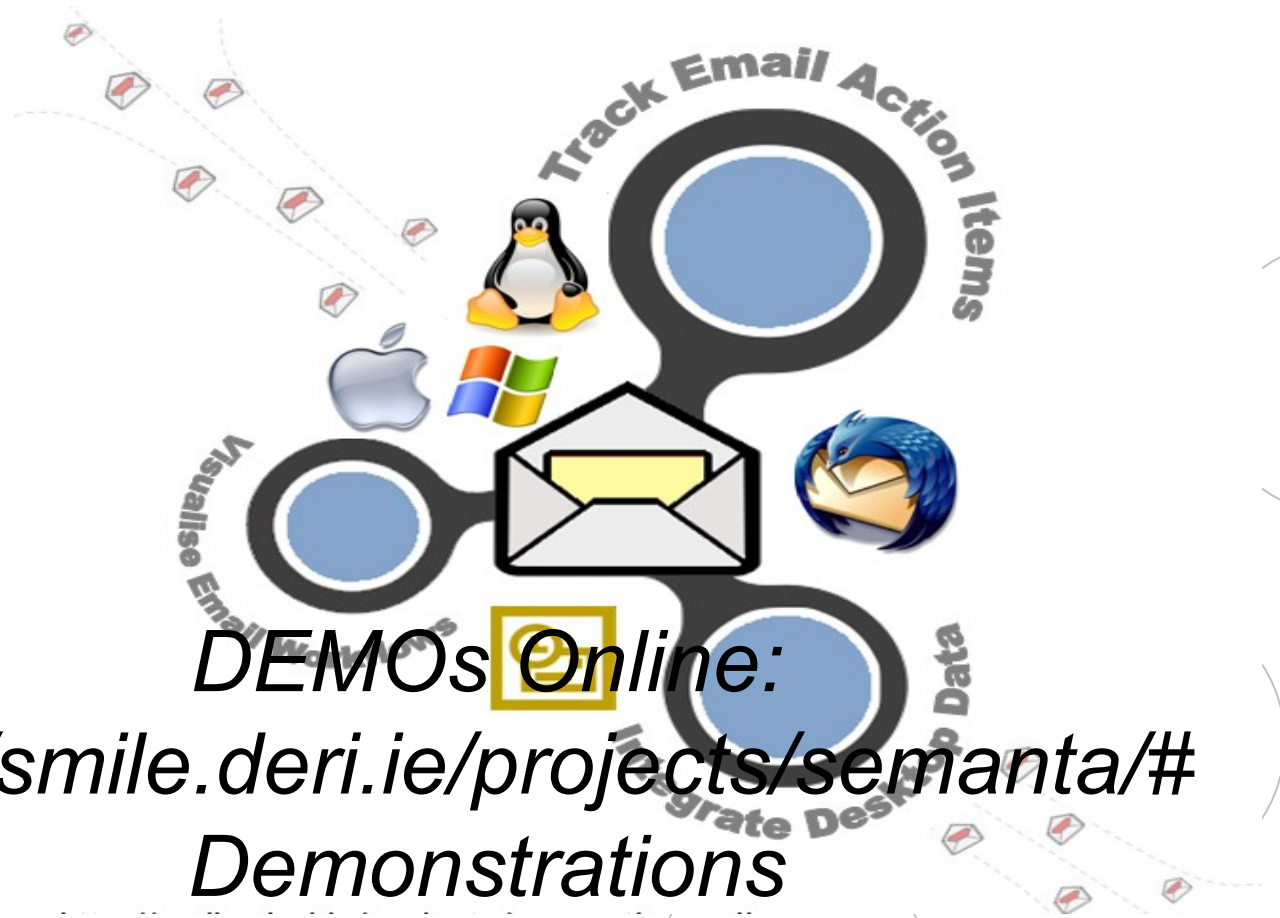


- **12 E-mail users rated results of automatic classification**
- **Ratings: Excellent, Okay, Not quite correct, Wrong**
- **Evaluators asked to highlight missing e-mail Action Items**
- **F-measure of 0.58 (Precision 0.56, Recall 0.60)**
- **Earlier human inter-annotator agreement: 0.811**
- **Conclusion: Not reliable for automatic classification**
- **Result: Employed semi-automatic to provide suggestions**

# Semanta - Semantic Email in Action



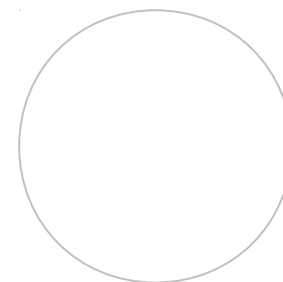
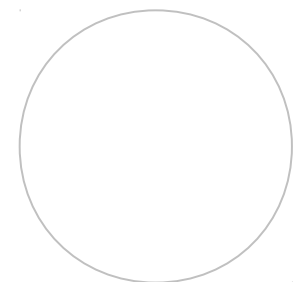
titute



DEMOs Online:

<http://smile.deri.ie/projects/semanta/#Demonstrations>

# Interfacing to Semantic Web Technologies with GATE : CLOnE and ROA



## Problem

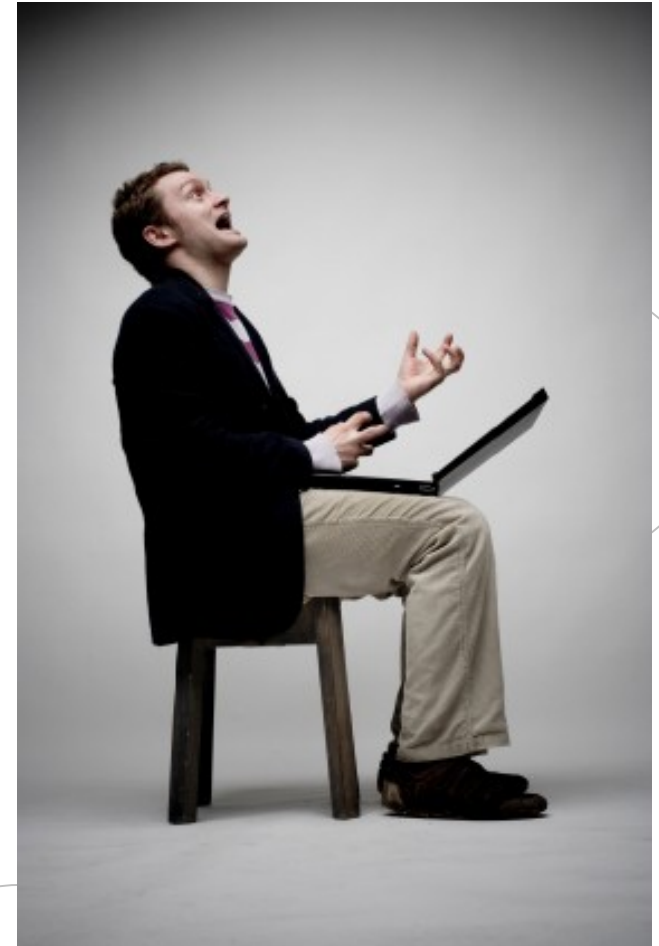
- Domain experts are not Ontology Engineers !!

## Goal

- allows a quick easy first draft of a complex Ontology
- creation of small to medium sized Ontologies by novice users

## Support

- large percentage of an initial Ontology would naturally consist of taxonomic relations and simple properties/relations





## Controlled Language for Ontology Engineering

### What is Controlled Language?

### What is the Problem with Controlled Language?

- Habitability Problem
- Learning Curve

### Our Contribution

- Round Trip Ontology Authoring :  
Combining Controlled Language with  
Language Generation
- Empirical Evidence

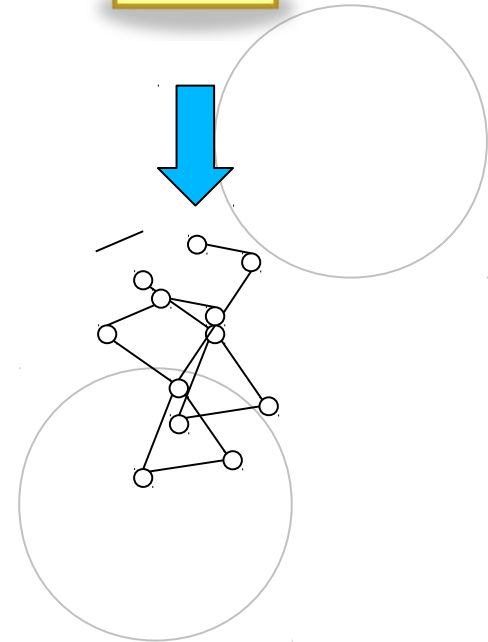


# Goals: Controlled Language



## Provide controlled language for basic ontology-editing functions

- **easy to learn** from examples and simple rules
- relatively **easy to deploy** (Java, GATE)
- **unambiguous**
- **compact** (e.g., create many classes or instances with one sentence)
- **natural** but grammatically lax



Outcome: →

## CLOnE: Controlled Language for Ontology Editing.

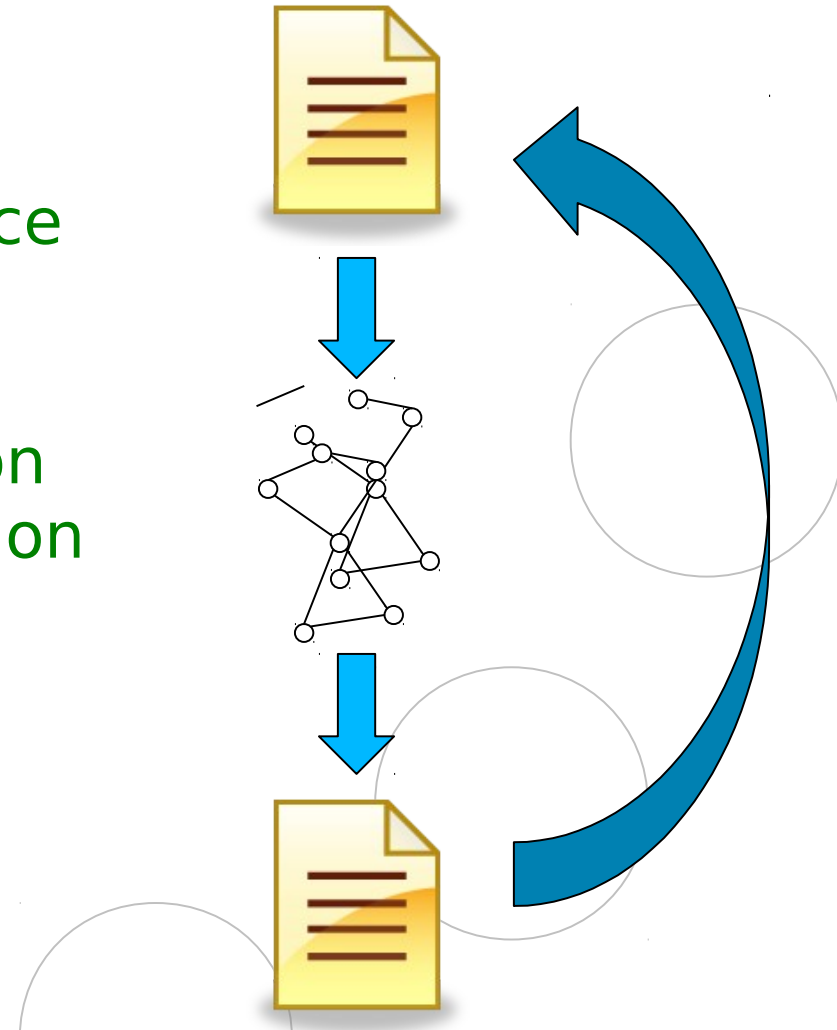
# Goals: RoundTrip Ontology Authoring (ROA)



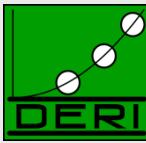
Improve on existing user-friendliness

Ease CLOnE learning experience using Natural Language Generation (NLG)

Simple Ontology summarisation via Natural Language Generation



# Research Questions- RoundTrip Ontology Authoring (ROA)



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Can NLG effectively substitute for **CL style guides**?

Can NLG help ease the **habitability problem**?

Can NLG improve on previous **evaluation results**?



# What is NLG?



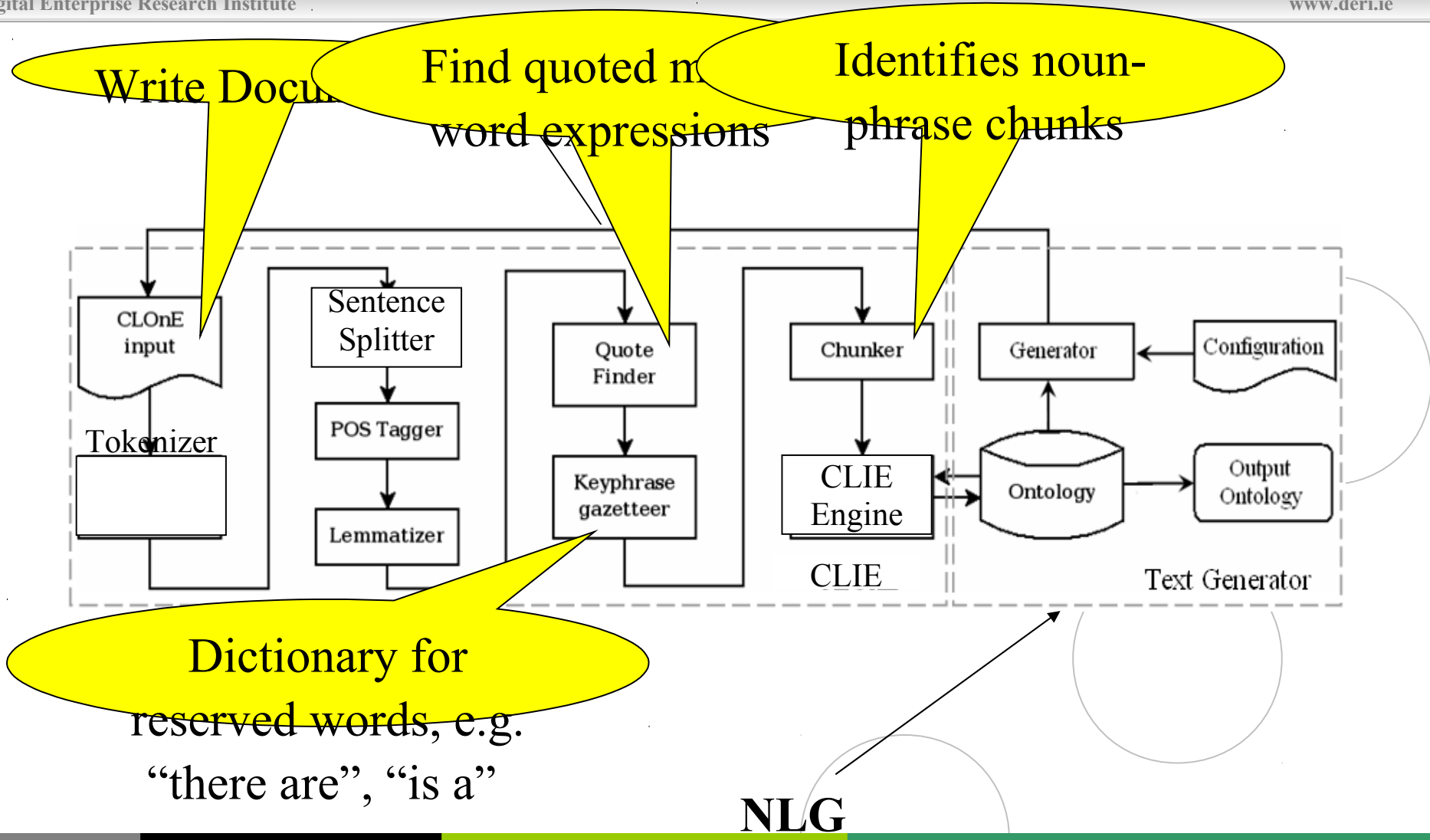


# Examples of CLOnE in ROA



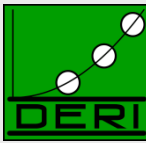
Example	Pattern	Usage
<i>Forget everything</i>	Forget everything.	Clean Ontology
<i>There are researcher, universities and conferences.</i>	There is/are <CLASSES>.	Create classes.
<i>Brian Davis and Simon Scerri are 'Ph.D. Scholar'.</i>	<INSTANCES> is/are <CLASS>.	Create instances of the class.
<i>'Ph.D. Scholar' is a type of student.</i>	<SUB-CLASSES> is a type of <CLASS>.	Make sub-classes.
<i>Professor supervises student.</i>	<CLASSES/INSTANCES> <VERB PROPERTY> <CLASSES/INSTANCES>	Create the property

# ROA - Processing Pipeline

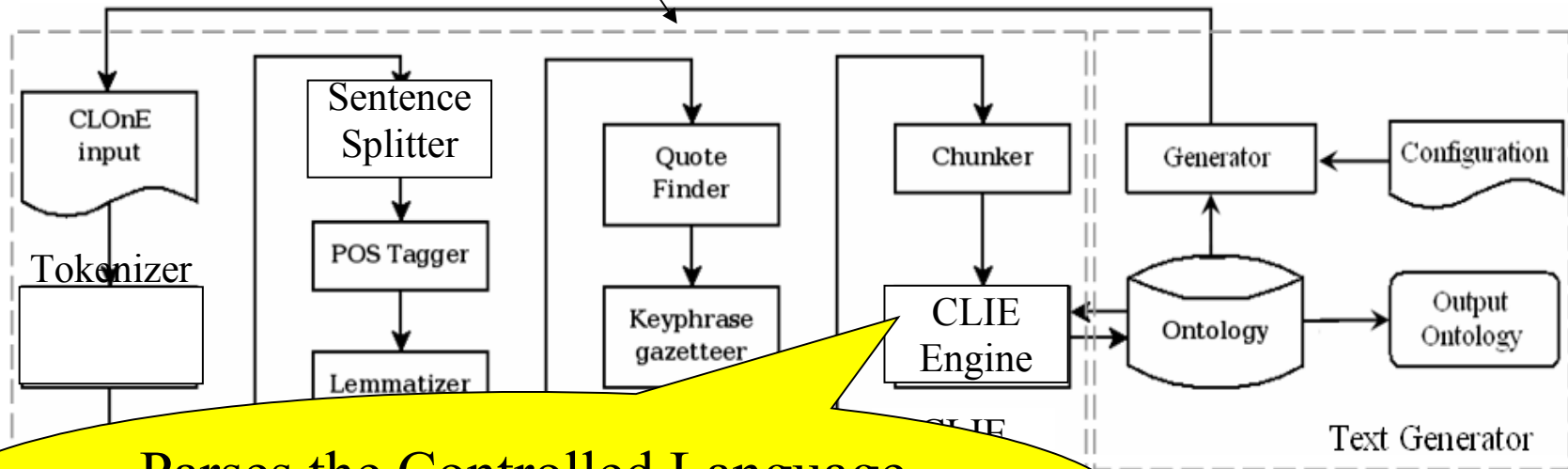




# ROA - Processing Pipeline



CLIE



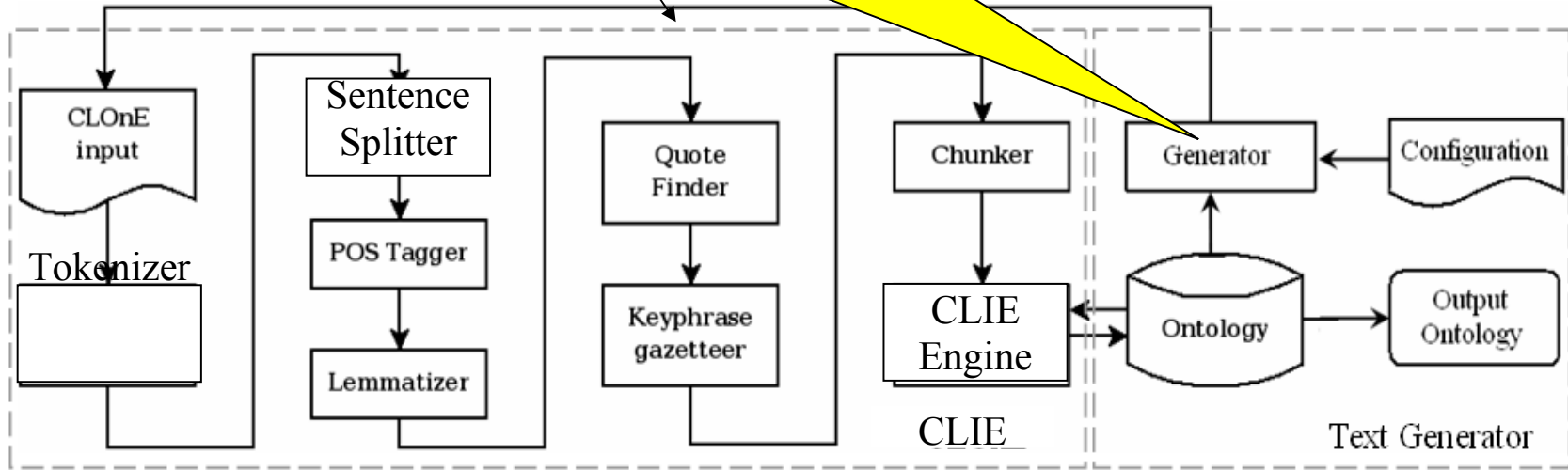
Parses the Controlled Language and extracts classes, properties, instances and populates the Ontology using Gate Ontology

NLG

# ROA - Processing Pipeline

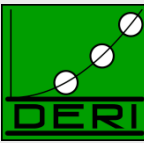


Text generator flattens Ontology into Triples matches to configuration file template slots

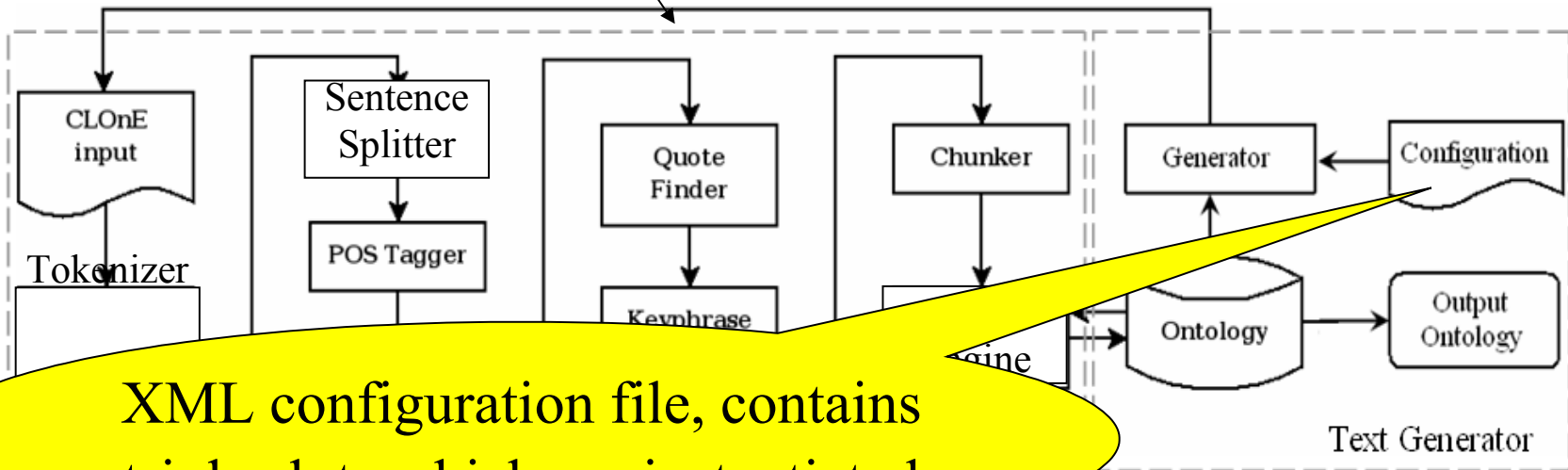


NLG

# ROA - Processing Pipeline



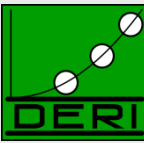
CLIE



XML configuration file, contains triple slots which are instantiated and copied to phrase templates

NLG

# ROA: Generator Output



Messages



CL Document



CLIE



Text Generator



Generated Ontology

Annotation Sets

Annotations

Co-reference Editor

Text

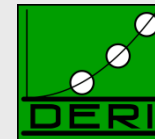
//This is the textual representation of an ontology.

There are Conferences, Researchers and Universities. Staff and Student are types of Researcher. 'Ph.D. Scholar' is a type of Student. Professor and 'Senior Researcher' are types of Staff.

'Ahmad Ali Iqbal' and 'Brian Davis' are 'Ph.D. Scholar'. 'Hamish Cunningham' is a Professor. 'Kalina Bontcheva' and 'Siegfried Handschuh' are 'Senior Researchers'.

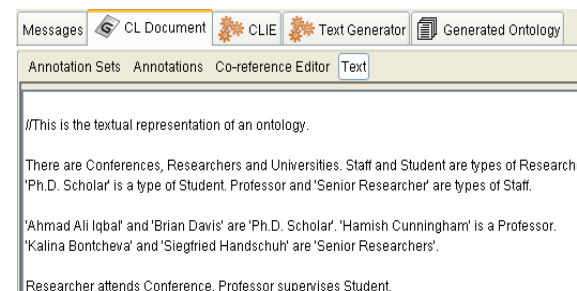
Researcher attends Conference. Professor supervises Student.

# Evaluation: Compare with Protégé

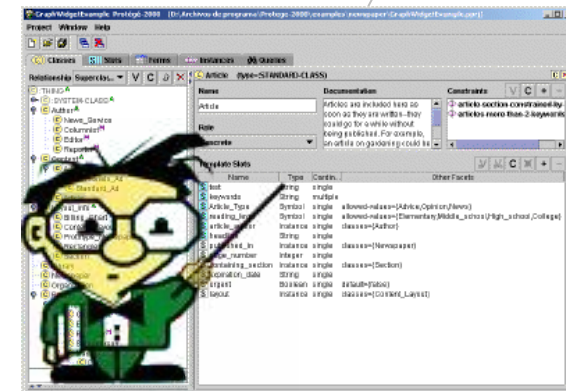


## Evaluation: Compare ROA with Protégé

- Protégé is the **standard tool** for ontology authoring
- **Previous work** compared CLOnE with Protégé.
  - compare ROA with CloNE – it was necessary to include Protégé in order to repeat the experiment
- **Note:** We make **no claims** that Protégé would be replaced by ROA !



VS



## Methodology based on previous Controlled Language (CLOnE) evaluation

- Ensured fair comparison between ROA and CLOnE
- Using the **System Usability Scale (SUS)**<sup>1</sup>

## CLOnE reference manual and example withheld!

- Substituted with text generator



<sup>1</sup> [http://en.wikipedia.org/wiki/System\\_Usability\\_Scale](http://en.wikipedia.org/wiki/System_Usability_Scale)



## Preparation

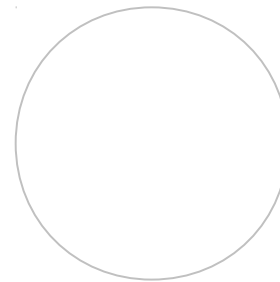
- Pre-test questionnaire to let users rate their own knowledge of ontologies and CLs
- Short manual on ontologies and both tools

## Sample Quality

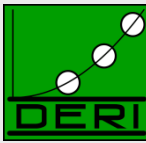
- Bigger sample size !
- Tighter control over bias!
- Consistent evaluation values between Researcher and Industry groups

## Evaluation Type:

- Repeated measures, tasked-based evaluation

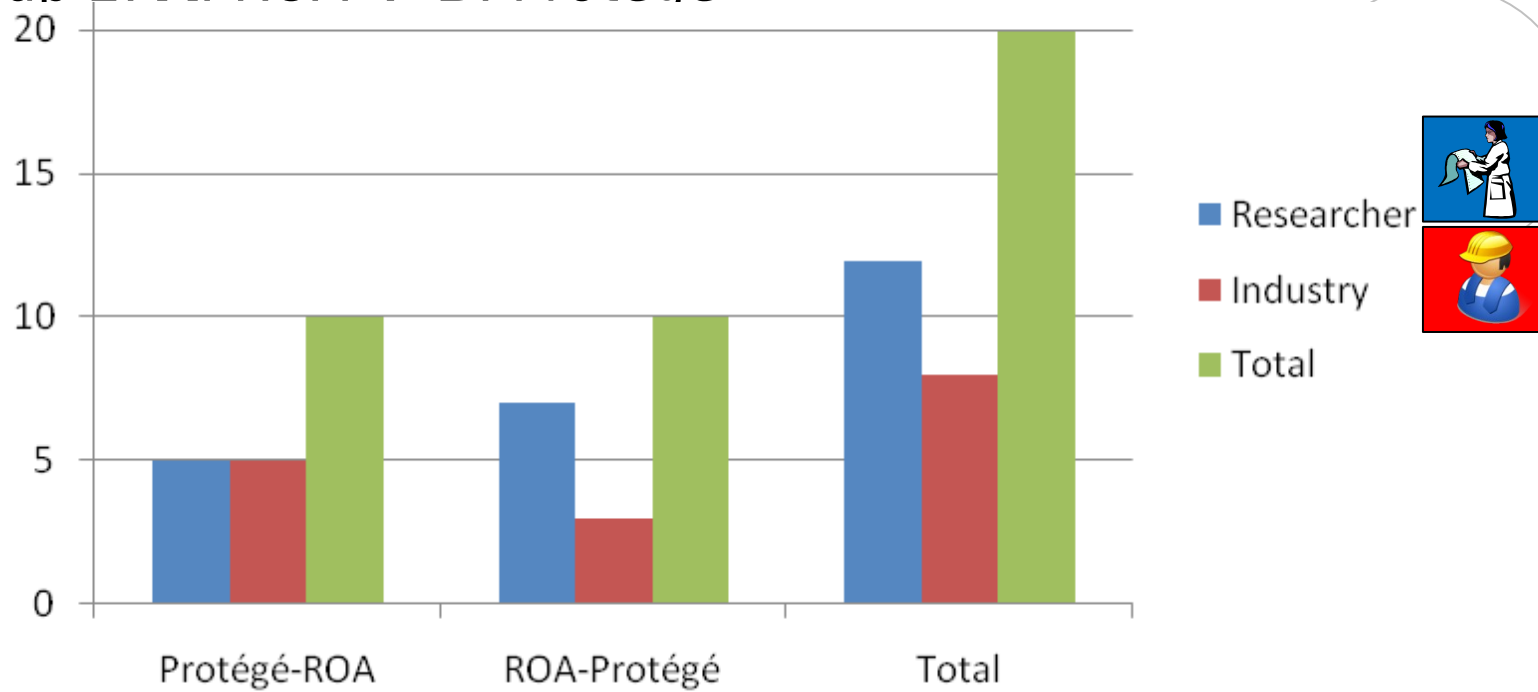


# Evaluation: Tasks



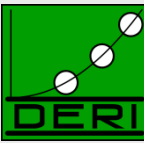
Two progressive lists of 6 simple tasks,  
task list A & B

- Group 1: **A**: Protégé → **B**: ROA
- Group 2: **A**: ROA → **B**: Protéaé



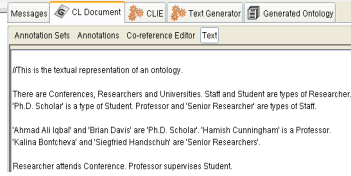


# Evaluation results: ROA vs. Protégé

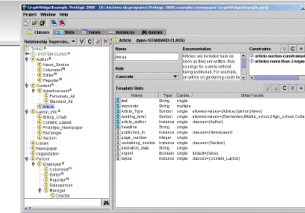


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ROA



Protégé

**High SUS score**



■ Low SUS score

Suitable for both Tasks



■ Suitable for both Tasks

**Industrial Users**



■ Industrial Users

**Non-Expert Users**



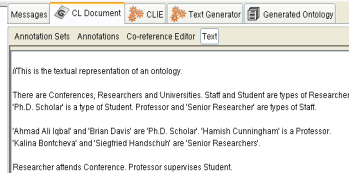
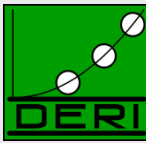
■ Non-Expert Users

**Less Time**

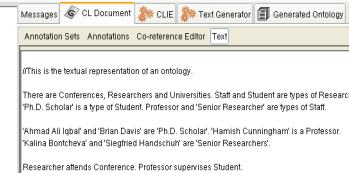


■ More Time

# Evaluation results: ROA vs. CLOnE?



ROA



CLOnE

**Maintained Interest**



■ Waning Interest

**No Manual needed**



■ Manual needed

**Less Time**



■ More Time

**Higher Satisfaction**



■ Lower Satisfaction

Overall new evaluation allows to make claims over the entire population.

## Summary

IVEA

SALT

Semanta

## Ongoing and Future work

- Scalable processing in IVEA with GATE
- ML for SALT
- ML for Semanta



## IVEA

<http://smile.deri.ie/projects/ivea>

Contact Point: VinhTuan Thai

## SALT

<http://salt.semanticauthoring.org/>

Contact Point: Tudor Groza

## Semanta

<http://smile.deri.ie/projects/semanta/>

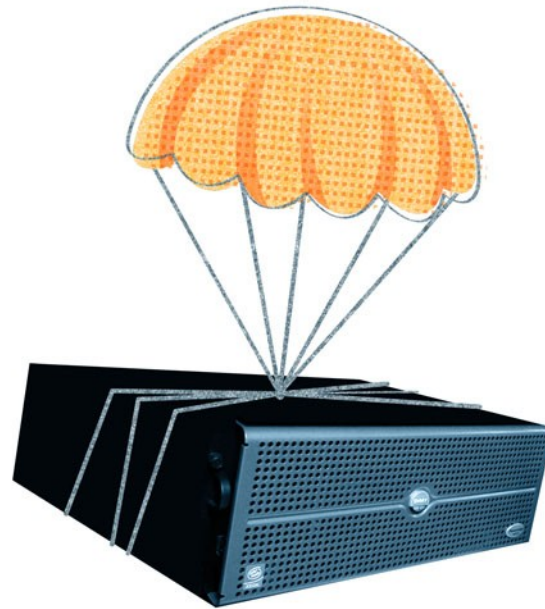
Contact Point: Simon Scerri

## CLOnE and ROA

<http://smile.deri.ie/evaluation/2008/ROA>



# Backup Slides



95% confidence intervals of SUS scores (SUS baseline is 65 to 70%)

Tool	Confidence Intervals	
	Task list B	Combined
	29- 51	32- 49
	69- 84	68- 79

Results are similar to CLOnE (within SUS base line)



Measure	Measure	Pearson's	Spearman's	Correlation
Pre- test	ROA time	- 0.41	- 0.21	weak -
Pre- test	Protege time	- 0.28	- 0.35	none
Pre- test	ROA SUS	- 0.02	- 0.00	none
Pre- test	Protege SUS	- 0.32	- 0.29	weak-
ROA time	Protege time	0.53	0.58	+
ROA time	ROA SUS	- 0.65	- 0.52	-
Protege time	Protege SUS	0.53	0.56	+
ROA time	Protege SUS	- 0.14	- 0.10	none
Protege time	ROA SUS	- 0.02	- 0.09	none
ROA SUS	Protege SUS	0.04	- 0.01	none
ROA SUS	R/ P Preference	0.58	0.56	+
Protege SUS	R/ P Preference	- 0.01	0.10	none

# Shallow NLG - Pros and Cons



## Advantages

- easy to use for non-experts (non NLG)
- easy for domain experts to understand.
- easy and fast to implement

## Disadvantages

- difficult to maintain
- Extending is expensive
- output is OK
- cannot handle a domain shift





# Deep NLG - Pros and Cons



## Advantages

- Maintainable
- Improved Text quality
- Multilinguality
- Standard conformance

## Disadvantages

- Need experts
- Overgeneration
- Difficulty scaling

