Research on NLP for RE at the FBK-SE research unit:
A Report

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NLP4RE @ REFSQ 2019

FBK-**SE** Research Unit


- One of the research unit of the biggest Research Institute of FBK, the ICT-Information and Communication Technology research center (https://ict.fbk.eu/), founded ~ 35 years ago as an **AI-research** center
- Two main research areas: **Requirements Engineering** and **Testing**
- Part of the **Smart Digital Industry** High Impact Initiative at the ICT research institute

Past Research on NLP for RE

- Manual analysis of **unstructured textual** specification at support of **formal** specification
- Automated analysis of **online discussions**: speech-act based analysis

From Unstructured text to Semi-formal Requirements
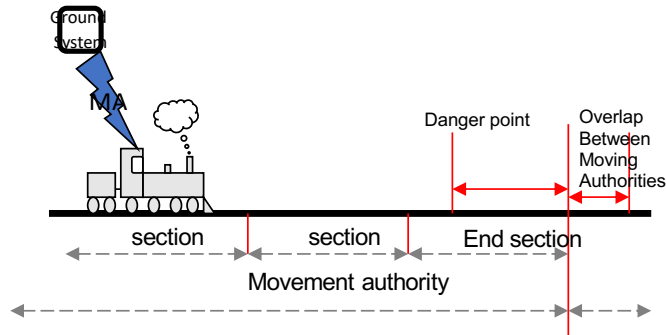
Example from the "Movement Authority" section of the Specifications

1.2.   For each section composing the Movement Authority the following information shall be given;

1.2.1   Length of the section

1.2.2   Optionally, Section time-out value and distance from beginning of section to Section Time-out stop location

…

7.8.4.1.1 The End Section timer shall be started on-board when the train passes the End Section danger location given by its front end.

- EURAILCHECK ERA project
  - Railways, an **highly technical** domain
  - NL textual specification document may contain **entity** definitions, **functional** aspect, etc.

Methodology for the analysis and validation of requirements specifications
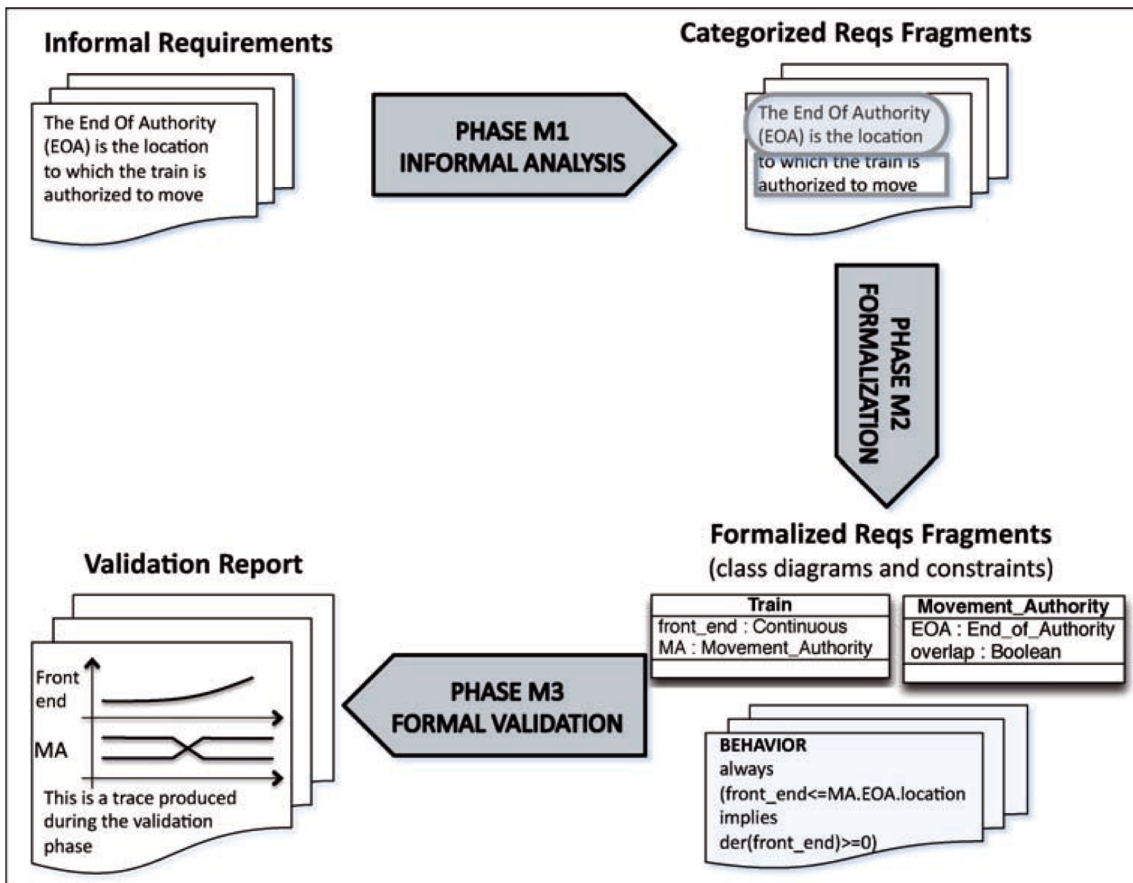
1. Identification of categories by looking at **linguistic patterns** (manual analysis)
   - E.g. glossary term; functionality

2. Formalization into Linear Temporal Logic formulae

3. Verification and validation via model-checking

Alessandro Cimatti, Marco Roveri, Angelo Susi, Stefano Tonetta:
Validation of requirements for hybrid systems: A formal approach. ACM Trans. Softw. Eng. Methodol. 21(4): 22:1-22:34 (2012)

Speech-act based analysis technique*
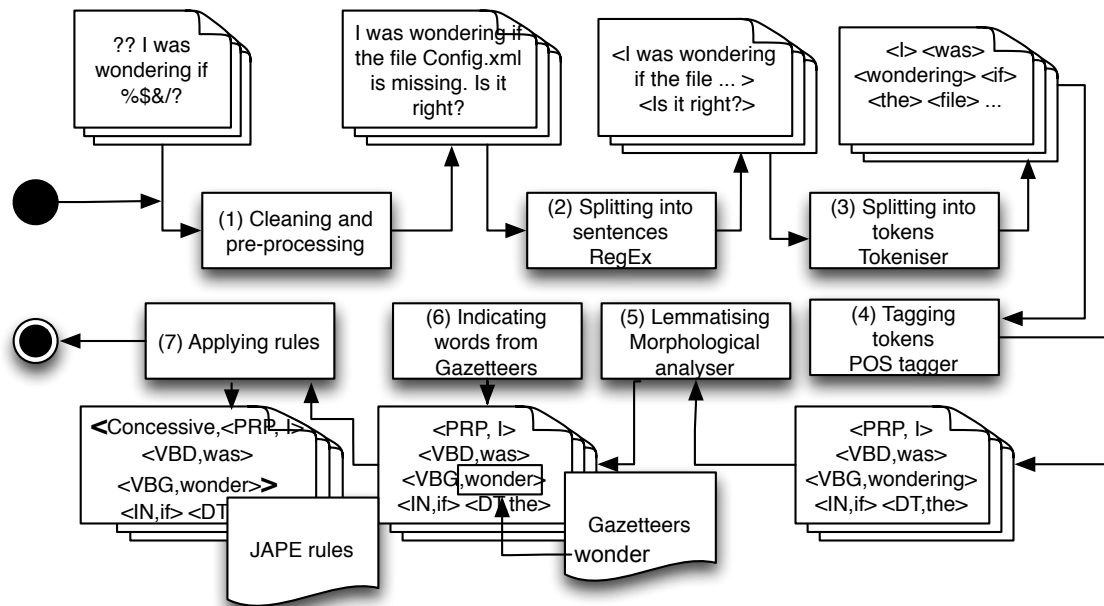
- **Speech-acts**[1] (*when we speak we affect the behaviour of the audience*)

- Example:
  - "I have a problem when saving the document, please check it"

- NLP tools support the analysis of text to discover speech-acts
  - Part-Of-Speech taggers, key words
  - speech-act categories (ref. *illocutionary act*): e.g. informative, responsive, requestive and assertive, etc.
  - 142 lexico-syntatic rules for each speech-act category

[1]Austin (1962), Searle (1969), Bach and Harnish (1979)

* Itzel Morales-Ramirez PHD Thesis / Morales-Ramirez, Perini, Ceccato CAISE-forum14

Automated analysis of online discussions
Using SA-based analysis technique

Morales-Ramirez, Kifetew, Perini, CAISE17 and IS journal 2018
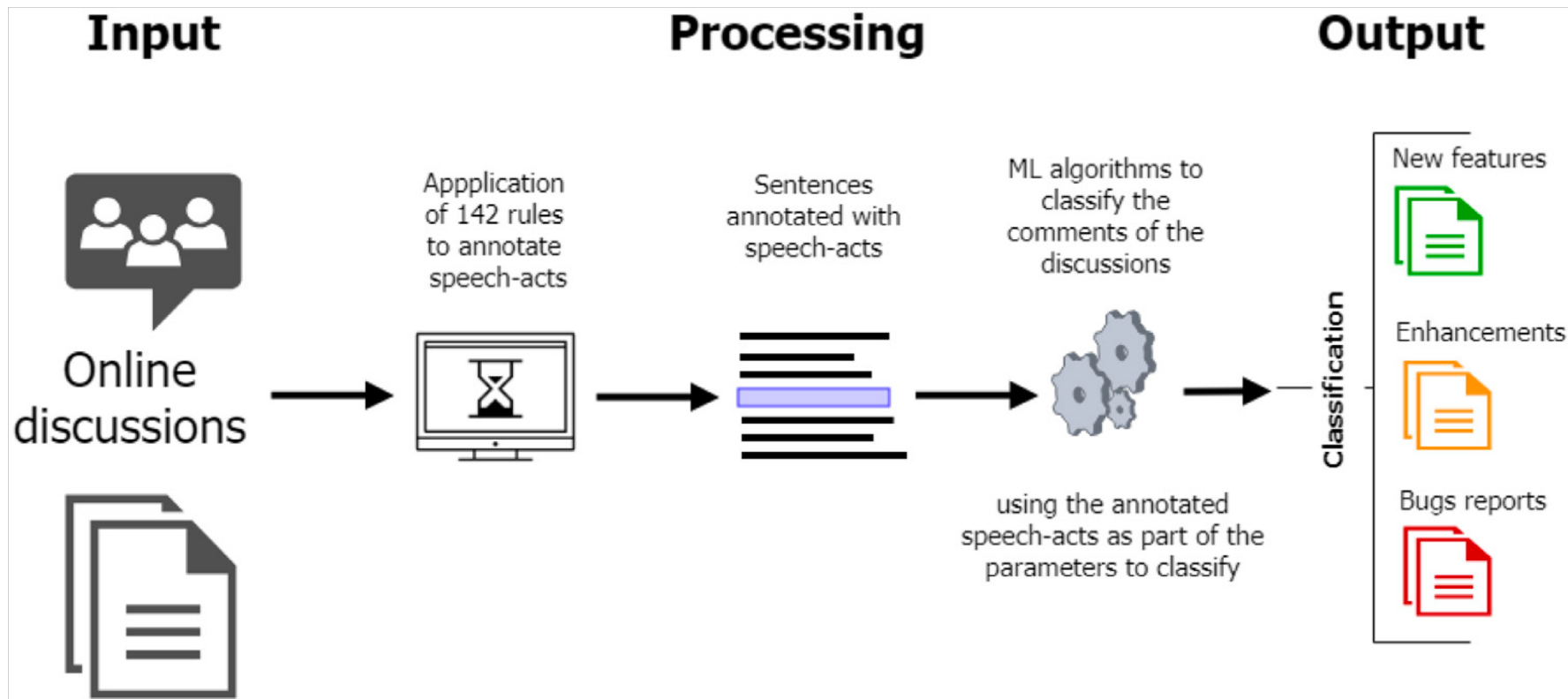
Automated analysis of online discussions

RQ: Can the speech-acts be used as parameters to classify defect reports, and feature or enhancement requests?

AOO:Using the 43 parameters.

	RF			J48			SMO		
	P	R	F-M	P	R	F-M	P	R	F-M
Enhancement	0.87	0.76	**0.81**	0.79	0.74	0.77	0.77	0.53	0.63
Other	0.79	0.89	**0.84**	0.76	0.81	0.78	0.64	0.84	0.73

AOO:using 25 parameters (no speech acts).

	RF			J48			SMO		
	P	R	F-M	P	R	F-M	P	R	F-M
Enhancement	0.84	0.74	**0.79**	0.77	0.71	0.74	0.70	0.48	0.57
Other	0.77	0.86	**0.81**	0.73	0.79	0.76	0.60	0.80	0.69

- Apache Open Office (AOO) dataset
  - user feedback gathered from the AOO issue tracking system
  - 161K textual comments (2001-2017)
- Parameters
  - E.g. number of informative / responsive / requestive and assertive expressions, attach / logFile / urlLink
- 3 ML algorithms in WEKA[1]
  - Random Forest
  - J48
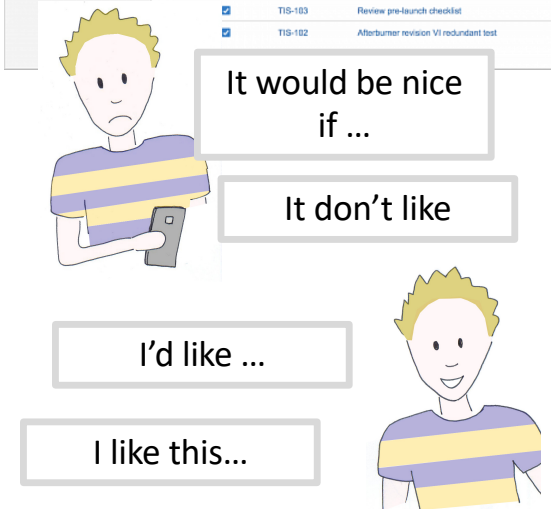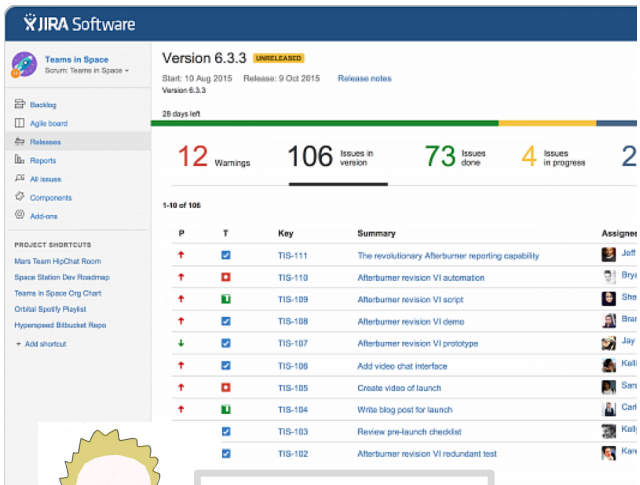 - SMO

[1]https://www.cs.waikato.ac.nz/ml/weka/

[*] Morales-Ramirez, Kifetew, Perini, IS journal 2018. *Speech-acts based analysis for requirements discovery from online discussions*
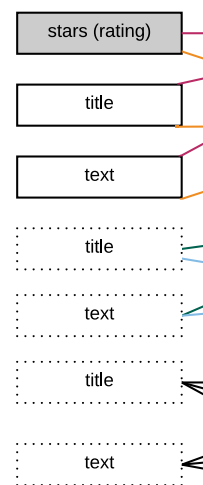
Ongoing

- User-feedback driven Issue Prioritization
- App review analysis at support of RE decisions
  - Jacek Dabrowski, Emmanuel Letier, Anna Perini, and Angelo Susi. Finding and analyzing app reviews related to specic features: A research preview. (REFSQ 2019, **on Thursday 9:30**
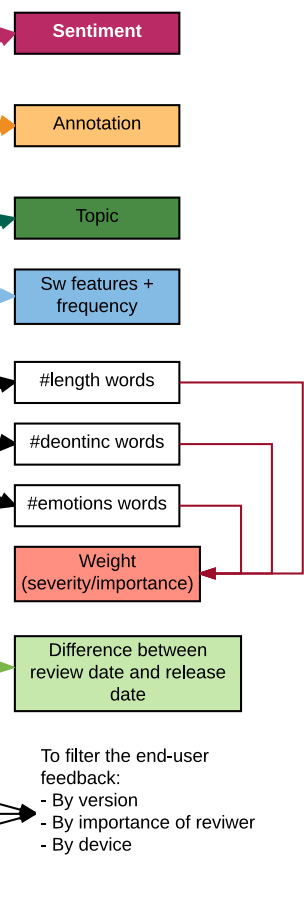
User-feedback driven Issue Prioritization

Basic properties

Derived properties

- stars (rating) → Sentiment
- title → Annotation
- text
- title → Topic
- text → Sw features + frequency
- title
- text → #length words
- text → #deontinc words
- → #emotions words
- Weight (severity/importance)
- date → Difference between review date and release date
- version
- reviewer
- device

To filter the end-user feedback:
- By version
- By importance of reviwer
- By device

a) Associating feedback to issues (bug/ feature requests)
- *e.g. term-based similarity technique*, like cosine similarity (properties: features, topics)

b) Extract properties of feedback

c) Infer issue rankings based on associated feedback's properties
- Calculating *aggregate function*, e.g. *sentiment / severity* about the related issues, by mean of the set of values of the derived properties

* Based on RE:NEXT 2017 paper

Concluding Remarks

- FBK-SE experience:
  - Type of data
    - NL textual document in **highly technical** domains (e.g. Railways domain)
    - NL textual messages in **online discussion** about **software use and development**
    - NL textual messages in **online user feedback**

- Objective/Tasks:
  - Formal specification of system requirements for the purpose of **automated requirements verification**
  - **Automated classification** of online discussion into **issue type** (e.g. bug, new or enhanced functionalities)
  - Automated **support** to software developers / **requirements engineers**

- FBK-SE Future:
  - Combining **model-driven** and **data-driven** engineering
  - Preferred application domain: Smart Industry

Thank you for your attention
Questions?