



Technische
Universität
Berlin



 @andivogelsang

 andreas.vogelsang@tu-berlin.de

Towards Explainable Requirements Engineering Tools

GI-Dagstuhl-Seminar ES4CPS

Andreas Vogelsang

Technische Universität Berlin

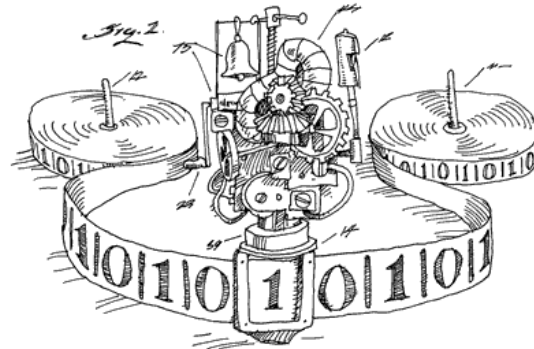
07.01.2019

Automation and AI in RE/SE



Automation and AI in RE/SE

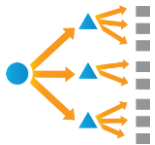
The Machine



Problems



Categorization



Traceability



Prioritization



Quality Assurance

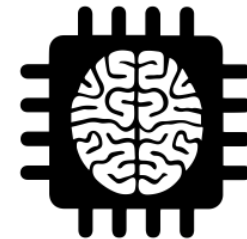
Technologies




Natural Language Processing



Information Retrieval



Machine Learning 4

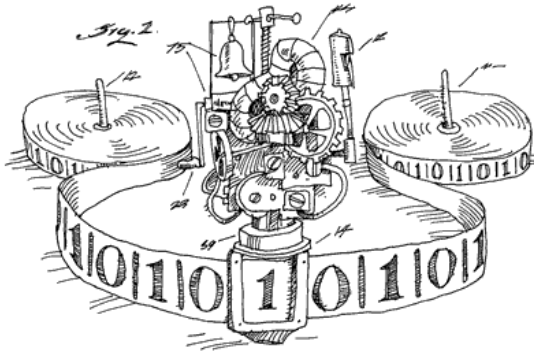
Why?  Consequences?




The Requirements Engineer

Message of this talk

The Machine



Why?  Consequences?

We need more research towards
explainable and **actionable**
RE tools.



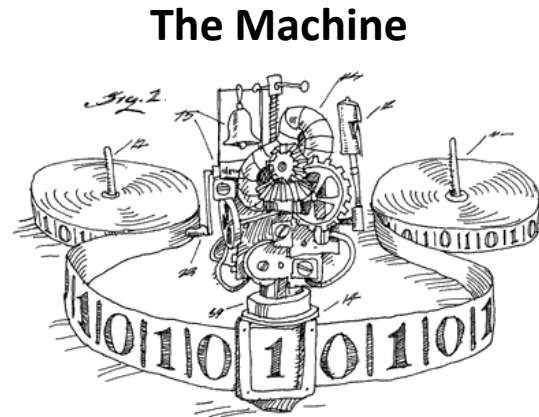
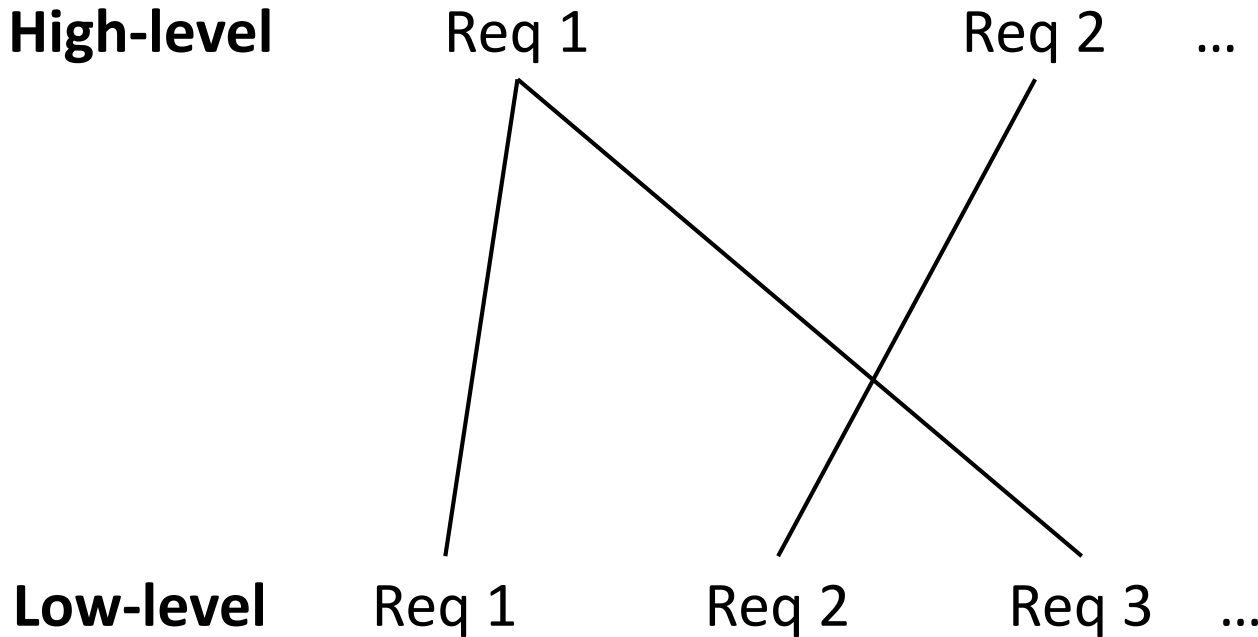
The Requirements Engineer

Working Definition

Explainable: The tool provides hints or indication on the rationale *why* the tool made a decision.

Actionable: The tool provides hints or indication on how the user can *influence* the decision by changing the processed data.

Example: Automated Trace Link Recovery



Precision: 40%
Recall: 85%

Example: Automated Trace Link Recovery



High-level

Req 1

RE: Why is Req 2 related?

Tool: ...

→ Not *explainable*

RE: Why is Req 11 not in the list?

What can I do to change that?

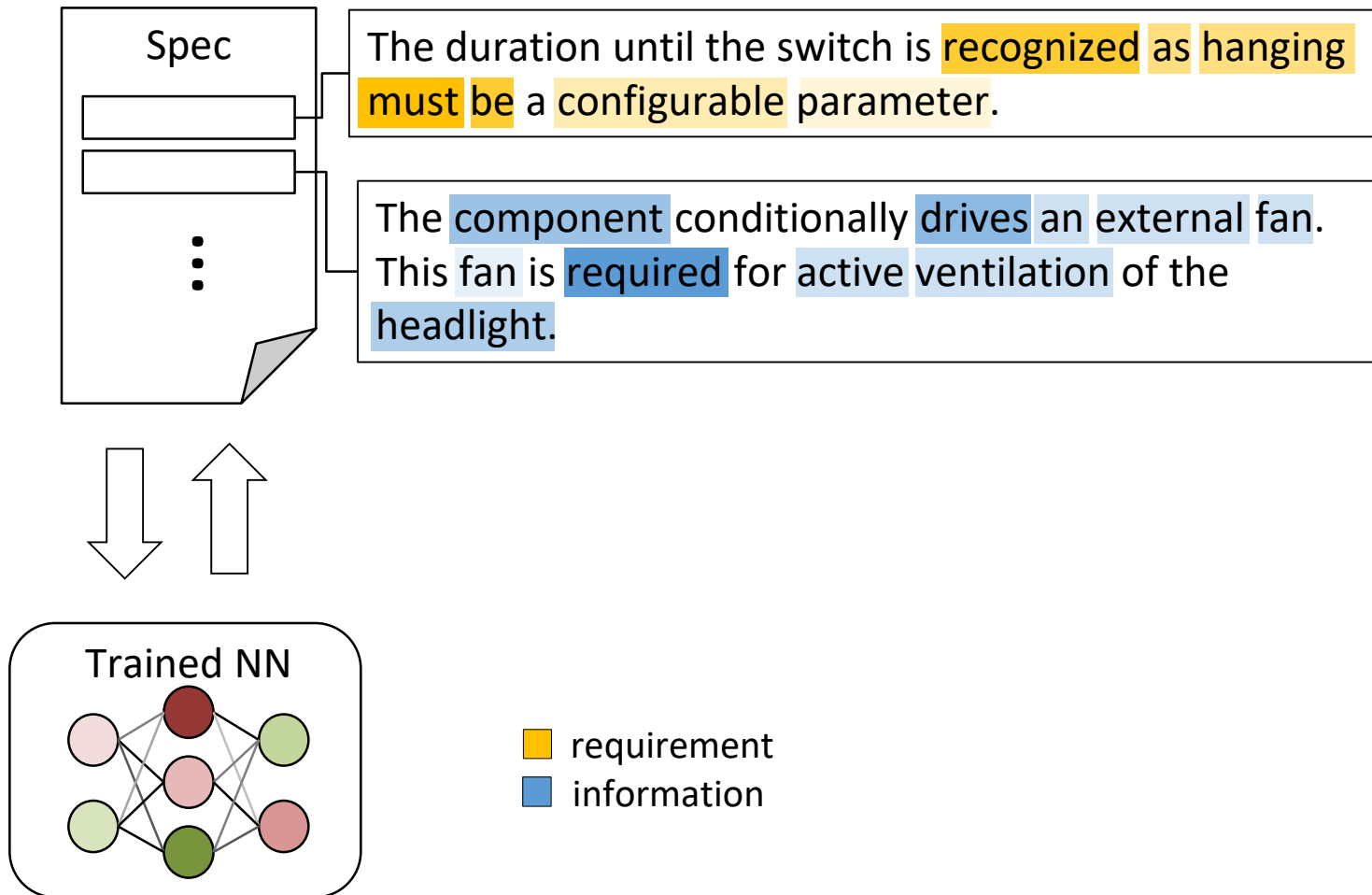
Tool: ...

→ Not *actionable*

Low-level

- ✓ Req 1
- ✗ Req 2
- ✓ Req 3
- ✗ Req 4
- ✓ Req 5
- ✓ Req 6
- ✗ Req 7
- ✗ Req 8
- ✗ Req 9
- ✗ Req 10
- Req 11

Towards Explainable RE Tools

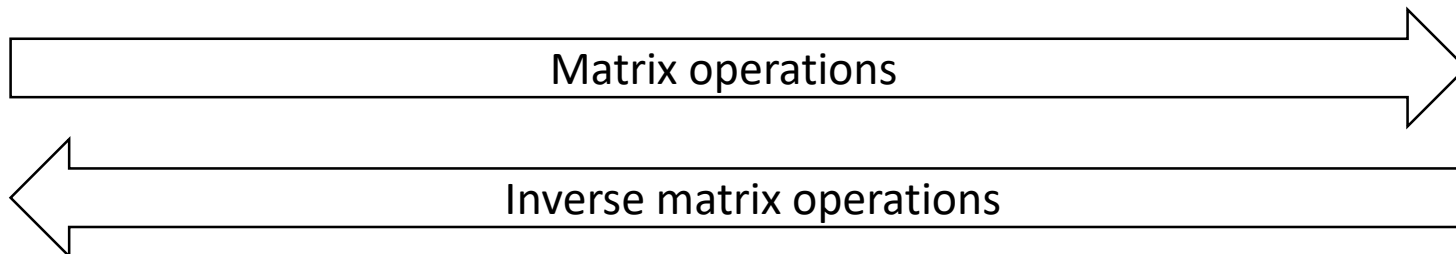
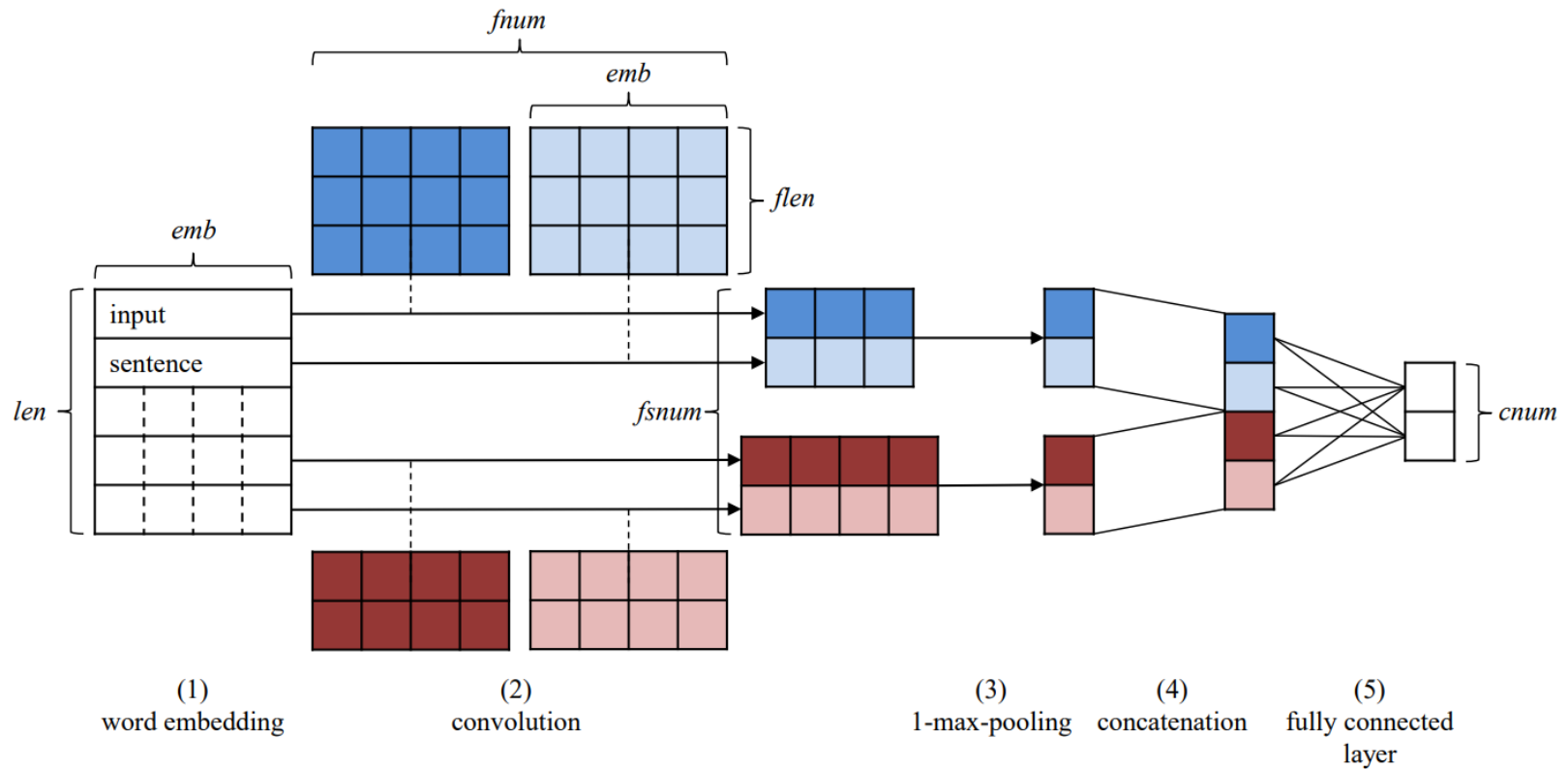


Winkler, Vogelsang: "Automatic Classification of Requirements Based on Convolutional Neural Networks". (AIRE'16)

Winkler, Vogelsang: "What does my Classifier Learn? A Visual Approach to Understanding Natural Language Text Classifiers", *NLDB'17*

Tracing Decisions in Neural Networks

Convolutional Neural Network



Tracing Decisions in Neural Networks

The duration until the switch is recognized as hanging must be a configurable parameter.

- Requirement: 0.85
- Information: 0.23

Document Influence Matrix

Word	Requirement	Information
The	-0.5	0.7
duration	1.1	-0.5
...
must	4.7	-3.5
be	3.8	0.5
...

Tracing Decisions in Neural Networks

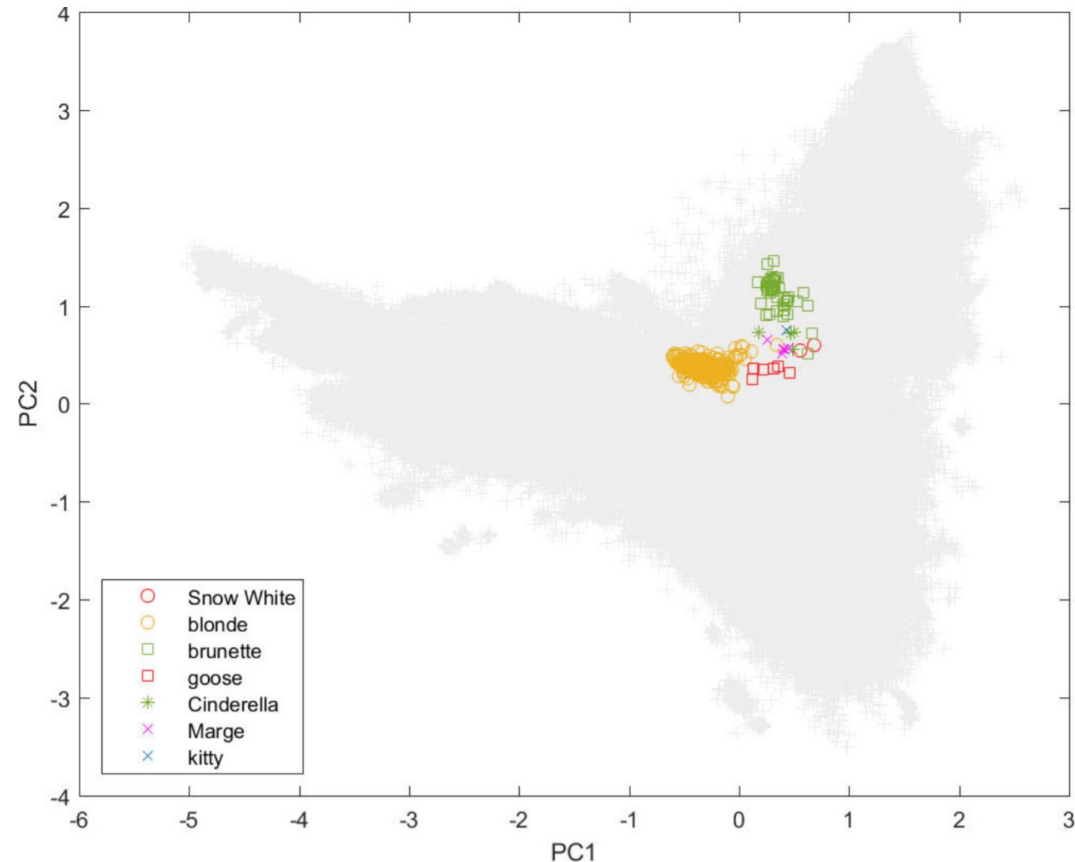
Dataset	Requirements ²
Classes	■ requirement ■ information
requirement	the duration until the switch is recognized as hanging must be a configurable parameter .
information	the component conditionally drives an external fan . this fan is required for active ventilation of the headlight .
Dataset	Questions
Classes	■ description ■ numeric ■ human ■ entity ■ abbreviation ■ location
description	why did the chicken cross the road ?
numeric	how long does it take sunlight to reach earth ?
human	which of the following people is not associated with andy warhol ?
Dataset	Movie Reviews
Classes	■ positive ■ negative
positive	both a successful adaptation and an enjoyable film in its own right .
negative	just a bunch of good actors flailing around in a caper that's neither original nor terribly funny .
negative	... unbearably lame .
positive	it's a minor comedy that tries to balance sweetness with coarseness , while it paints a sad picture of the singles scene .

Beyond Explaining: Insights through Tools

Using deep recurrent neural networks to learn and generate jokes
(based on 11,000 unchanged jokes from the Internet)

Q: What do you call a car that feels married?

A: A cat that is a beer!



Some Experiments on RE Data

Learn and create Smart Home user stories
(based on 3,000 crowd-sourced user stories [1])

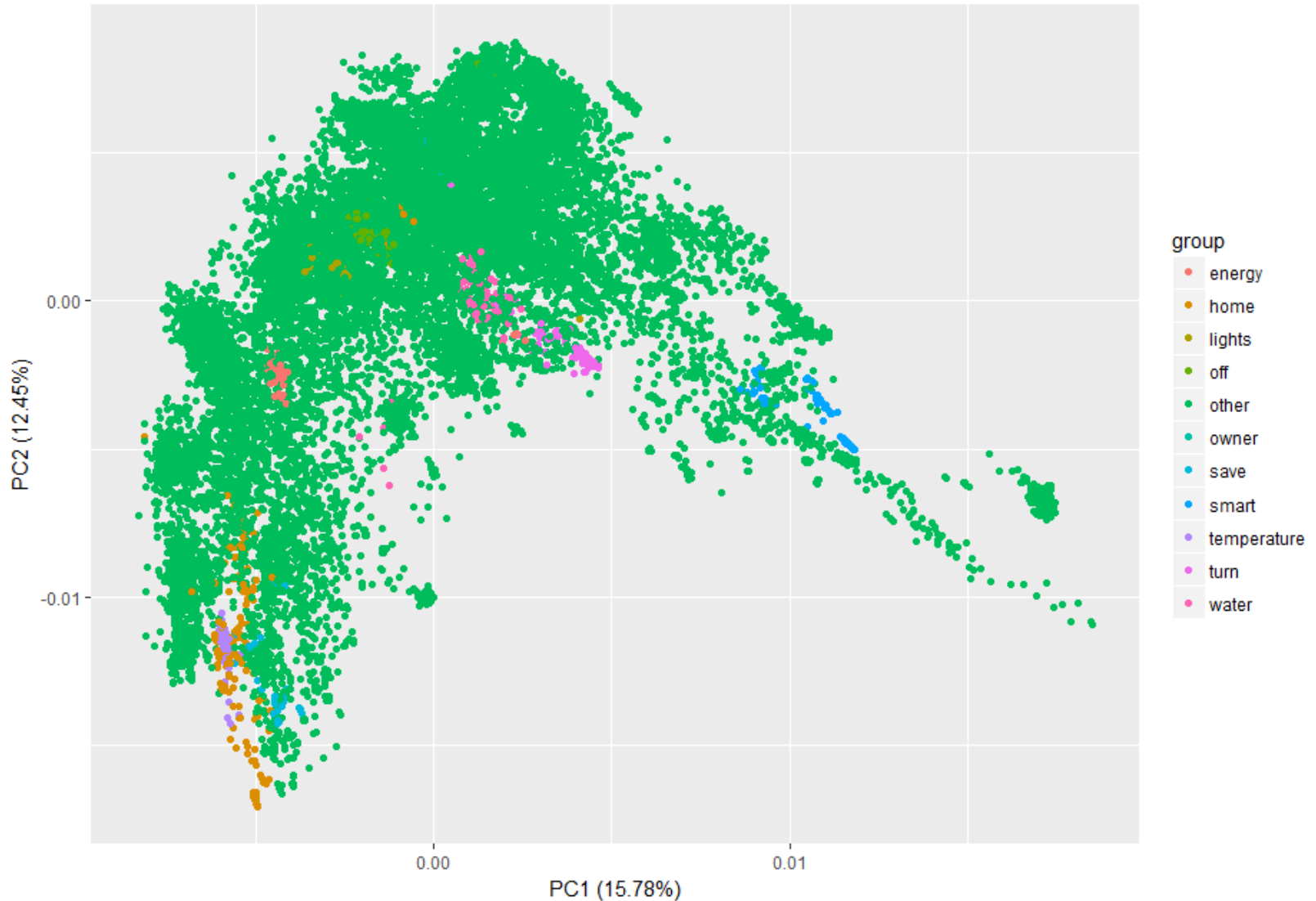
As a home occupant, I want window and keep my kids to clean them so that I can contrrap of preper when I have having bion

Learn and create automotive requirements
(based on 15,000 industrial automotive requirements)

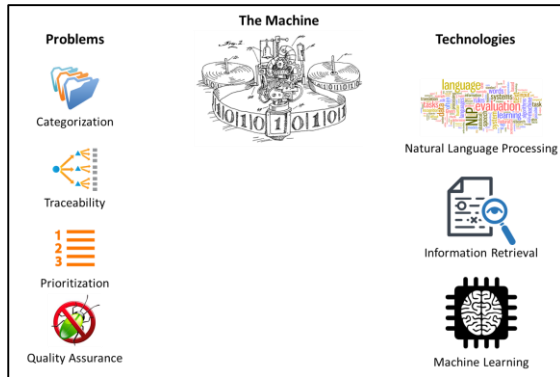
Wird das signal mit dem wert " 0 x1 " empfangen , muss die lehne der 0 . sitzreihe die funktionsvoraussetzung erfüllt sind .

Some Experiments on RE Data

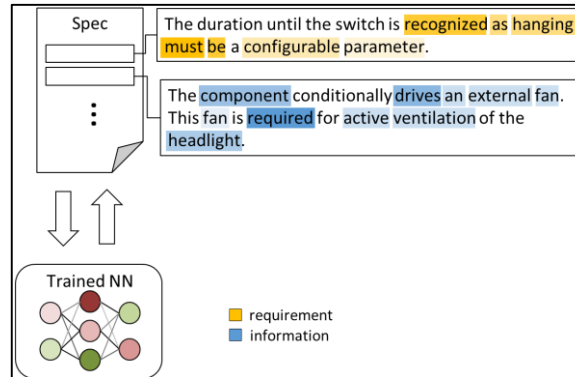
Activation of neurons while „reading“ 1,000 random smart home user stories



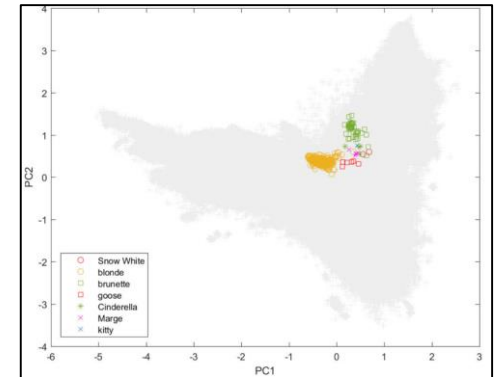
Summary and Conclusions



AI in RE



Explainable RE Tools



Insights through
Tools

More research is needed towards **explainable and actionable** RE/SE tools.