

Requirements Conversations: A New Frontier in AI-for-RE



Fabiano Dalpiaz
Requirements Engineering Lab
Utrecht University, the Netherlands
August 16, 2022

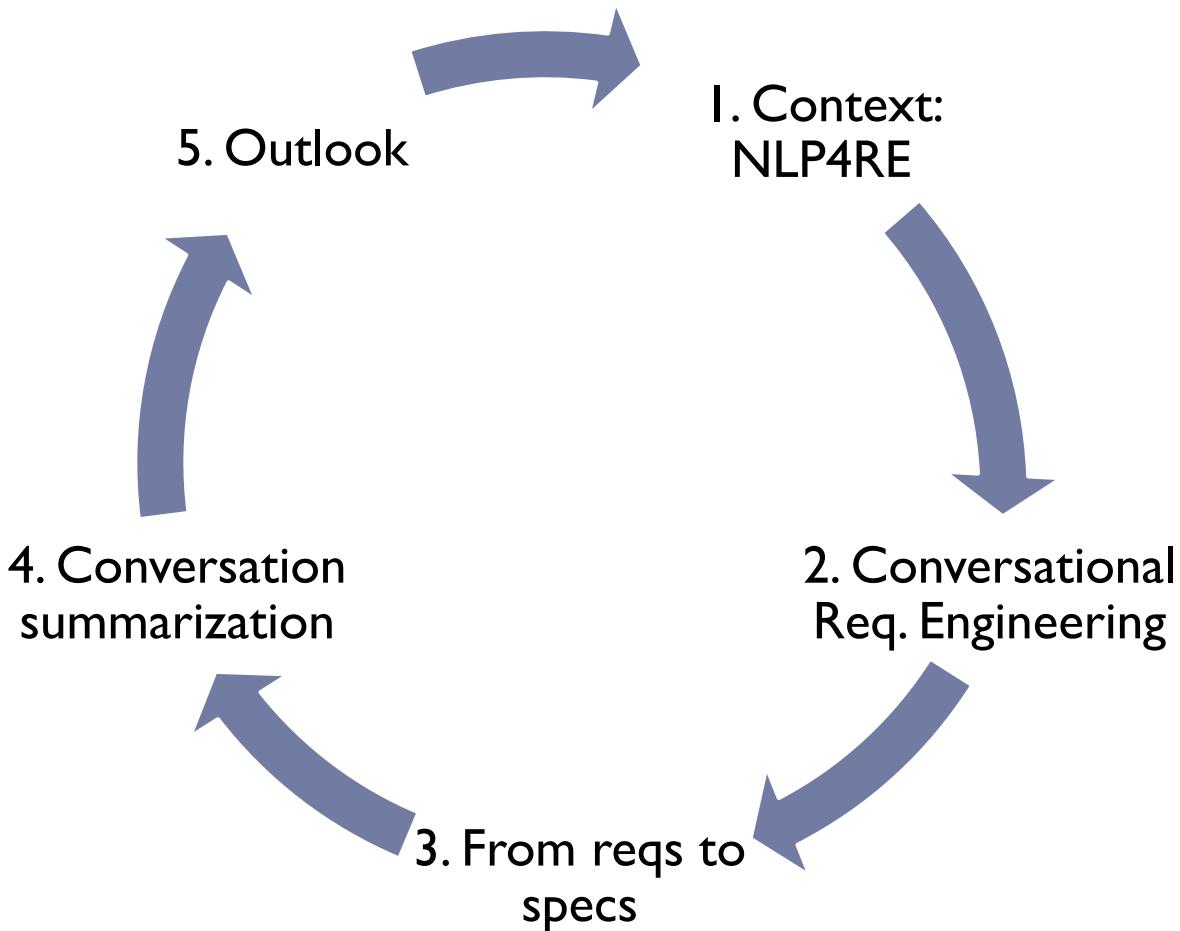


f.dalpiaz@uu.nl

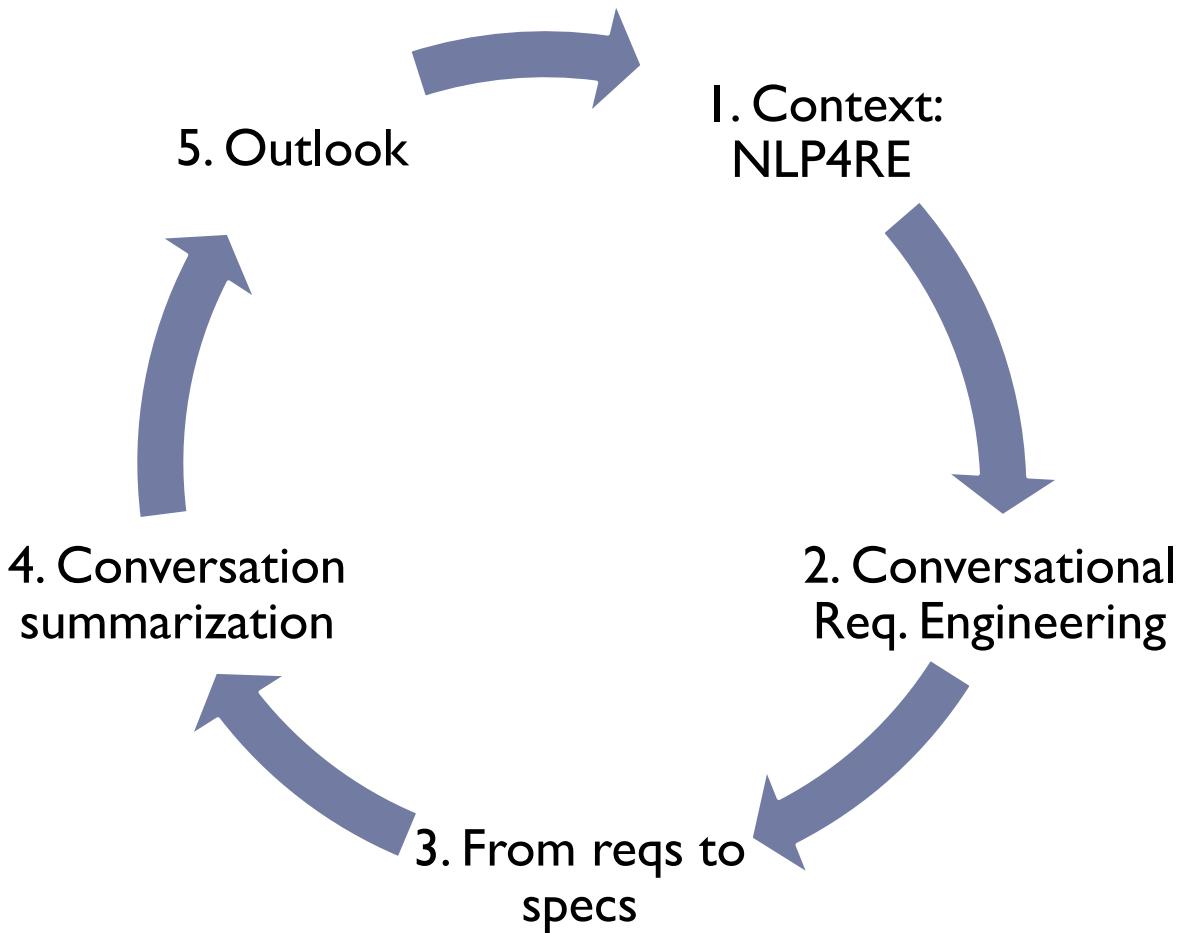


@FabianoDalpiaz

Outline and Acks



Outline and Acks



Nikita van den Berg



Tjerk Spijkman



Sjaak Brinkkemper



Xavier de Bondt

I. Context: NLP for Requirements Engineering (NLP4RE)

Natural Language Processing for Requirements Engineering

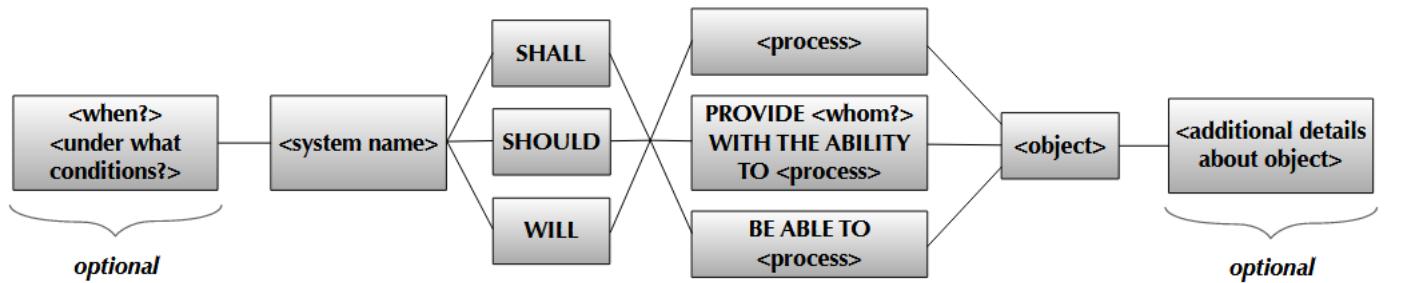
The Best Is Yet to Come

Fabiano Dalpiaz, Alessio Ferrari, Xavier Franch, and Cristina Palomares



Fabiano Dalpiaz, Alessio Ferrari, Xavier Franch, and Cristina Palomares. "Natural language processing for requirements engineering: The best is yet to come." *IEEE Software* 35, no. 5 (2018): 115-119.

RE practice: most reqs. are in natural language



Rupp's template & ISO/IEC/IEEE 29148

The <system name> shall <system response>.
 WHILE <in a specific state> the <system name> shall <system response>
 WHEN <trigger> the <system name> shall <system response>
 ...

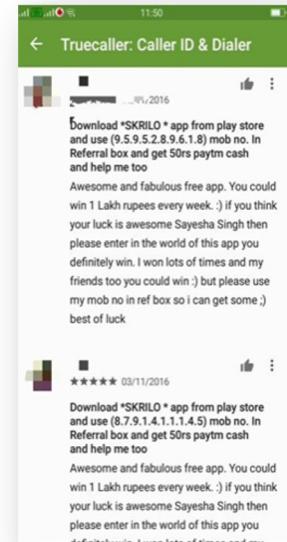
EARS

Use cases

Use Case Name		
Description – a brief summary of what the use case is about		
Scenario	A quick summary of what is going to happen in the use case – exclude actor	
Triggering event	What the actor does in relation to the system – should be first in flow of events	
Actors	List the primary actors – the ones with their hands on the keyboard	
Related use cases	Comma separated list of related use cases	
Stakeholders	Who is interested in the result of this use case and their role in it	
Pre-condition	What needs to be in place before this use case can execute	
Post-condition	How will the system have changed as a result of this use case	
Flow of events	Actor	System
	1. The first event should be the triggering event	
Exception	A list of things that could go wrong and how the system responds	

ID	<TITLE>		
As	<user>		
I want	<what>		
because	<value>		
Feature\Epic name\			
MoScOW	Bus. Value	Risk	Effort

User stories



App store reviews

RE Research: 4 categories of NLP4RE tools

I. Find defects / deviations from good practice

As a Consumer, I want to know that the data I am downloading is good myself or run into annoying bugs later on.

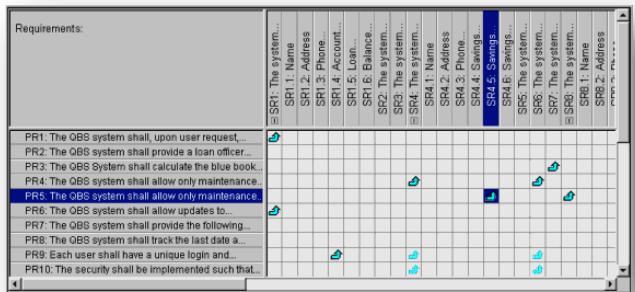
As a Consumer, I want to be able to get the data for a data package even I can still use it and my app or analysis keeps working.

As a consumer, I want to view the data package, so that I can get a sense.

As a Developer, I want to list all DataPackages requirements for my project DataPackage that my project depends on, so that the project can be determined of the DataPackage schema changes.

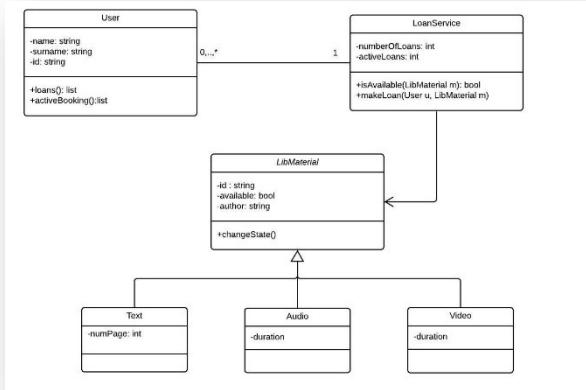
As a Publisher, I want to version my Data Package and keep multiple versions break consumer systems when I change my datapackage.

3. Infer trace links between NL requirements and other artifacts

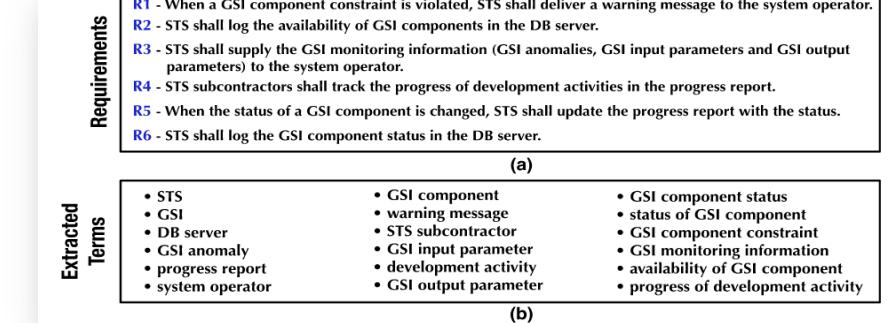


Daniel Berry, Ricardo Gacitua, Pete Sawyer, and Sri Fatimah Tjong. "The case for dumb requirements engineering tools." In *International Working Conference on Requirements Engineering: Foundation for Software Quality*, pp. 211-217. 2012.

2. Generate models from NL requirements



4. Identify key abstractions from NL documents



An active area of research!

Tool Type	Tool Name (Study ID)	No. Tools	Percent
Modeling	OICSI (S678), NL-OOPS (S553), EA-Miner (S499), CM-Builder (S343), Circe (S34), LIDA (S623), NIBA Toolset (S272), RETNA (S108), aToucan (S909), DBDT (S31), Cico (S34), NL2UMLviaSBVR (S70), RADD-NLI (S121), SUGAR (S190), GRACE (S208), AREMCD (S219), RUCM (S227), RSILingo (S266), Zen-ReqConfig (S482), TREx (S496), NAPLES (S499), GeLangUML (S551), ConstraintSoup (S600), C&L (S707), AnModeler (S799), SBEAVER (S813), KCMP Dynamisch (S272), Xtext (S20), Kheops (S35), Visual Narrator (S683), ProcGap (S800), FeatureX (S772), CMT & FDE (S261), VoiceToModel (S765)	34	26.15%
Detection	ARM (S861), SREE (S812), RQA (S903), AnaCon (S41), REGICE (S55), NARCIA (S56), LELIE (S75), SRRDirector (S86), MIA (S114), KROSA (S178), NAI (S226), QuARS (S232), CAR (S252), CARL (S298), RAVEN (S303), ReqSAC (S370), RAT (S376), MaramaAIC (S395), RESI (S432), RECAA (S447), DeNom (S448), RETA (S450), AQUSA (S501), Dowser (S644), QAMiner (S661), LeCA (S701), S-HTC (S258), CNLP(S464), Pragmatic Ambiguity Detector (S256), ReqAligner (S663), REAssistant (S662)	31	23.85%
Extraction	findphrases (S13), AbstFinder (S307), FENL (S71), NAT2TESTSCR (S131), NLP-KAOS (S132), SAFE (S385), AUTOANNOTATOR (S433), UCTD (S453), GUEST (S598), Guidance Tool (S688), SpecQua (S743), NAT2TEST (S744), semMet (S777), Test2UseCase (S810), OCLgen (S845), Text2Policy (S872), GaiusT (S888), SNACC (S891), Doc2Spec (S897), ARSENAL (S915), MaTREx tool (S284), ELICA (S2), CHOReOS (S520), GuideGen (S907)	24	18.46%
Classification	ASUM (S129), RUBRIC (S223), WCC (S257), NFR2AC tool (S306), ALERTme (S332), PUMConf (337), FFRE (S341), AUR-BoW (S500), SEMIOS (S550), CRISTAL (S629), CoReq (S672), SD (S674), ACRE (S757), SOVA R-TC (S778), SMAA (S788), CSLLabel (S892), HeRA (S718), NFR Locator (S758), SURF (S910), NFRFinder (S647)	20	15.38%
Tracing & Relating	Coparvo (S24), Trustrace (S25), Histrace (S25), CoChalR (S26), HYPERDOCSY (S38), ReqSimile (S171), LGRTL (S198), CQV-UML (S400), TiQi (S651), REVERE (S717), LiMonE (S723), ESPRET (S792), COCAR (S805), RETRO (S934), WATson (S302)	15	11.54%
Search & Retrieval	RE-SWOT (S174), IntelliReq (S602), ReqWiki (S711), iMapper (S784), PriF (S802), WIKINA (S686)	6	4.62%
Total		130	100%

Liping Zhao, Waad Alhoshan, Alessio Ferrari, Keletso J. Letsholo, Muideen A. Ajagbe, Erol-Valeriu Chioasca, and Riza T. Batista-Navarro.

"Natural Language Processing (NLP) for Requirements Engineering: A Systematic Mapping Study." *ACM Computing Surveys* 54:3, 2022

An active area of research!

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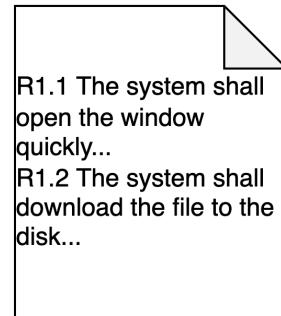
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Main artifact for
AI-based tools

- R1.1 The system shall open the window quickly...
- R1.2 The system shall download the file to the disk...

Specification

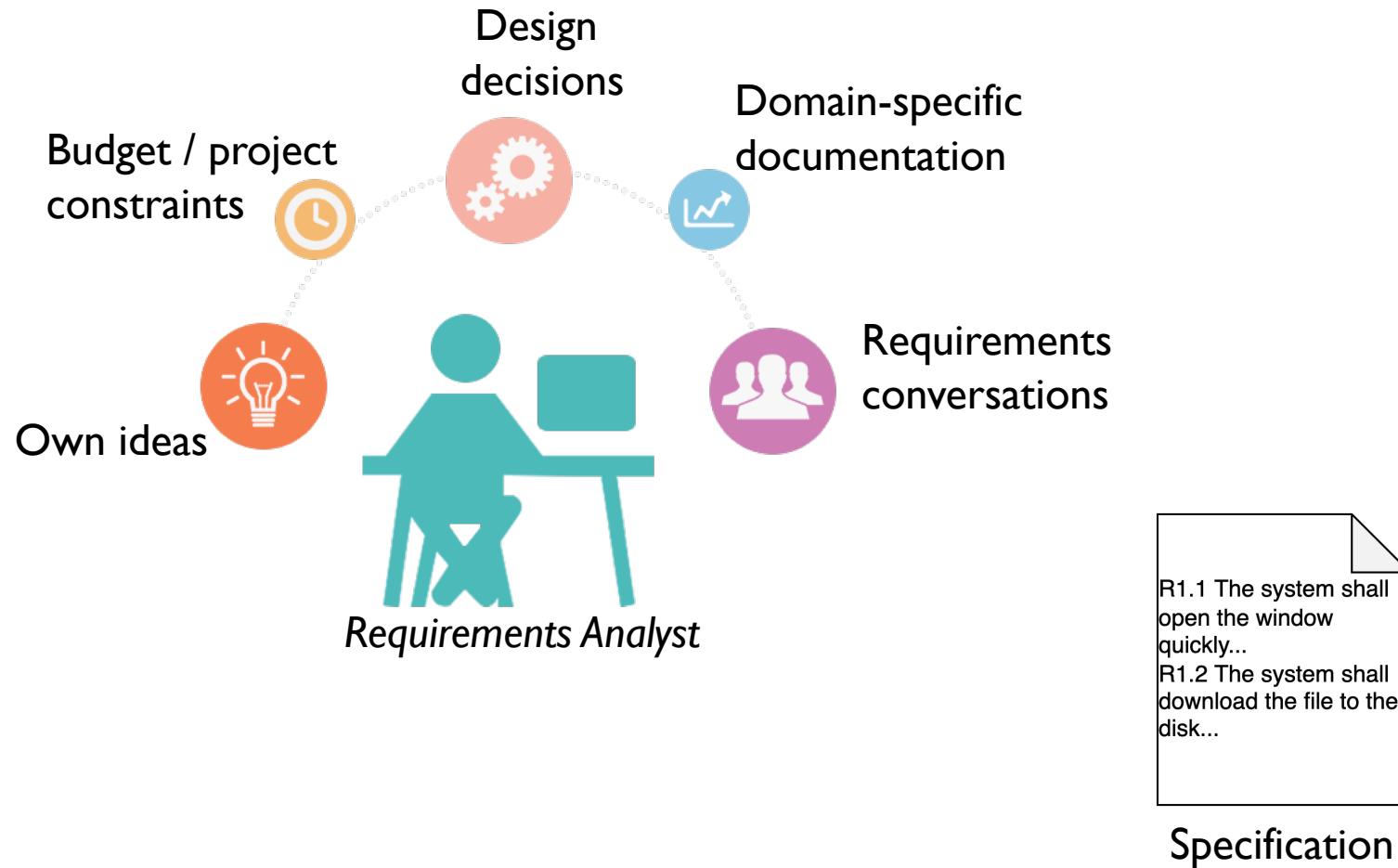
Elicitation: the root of (all) NL requirements



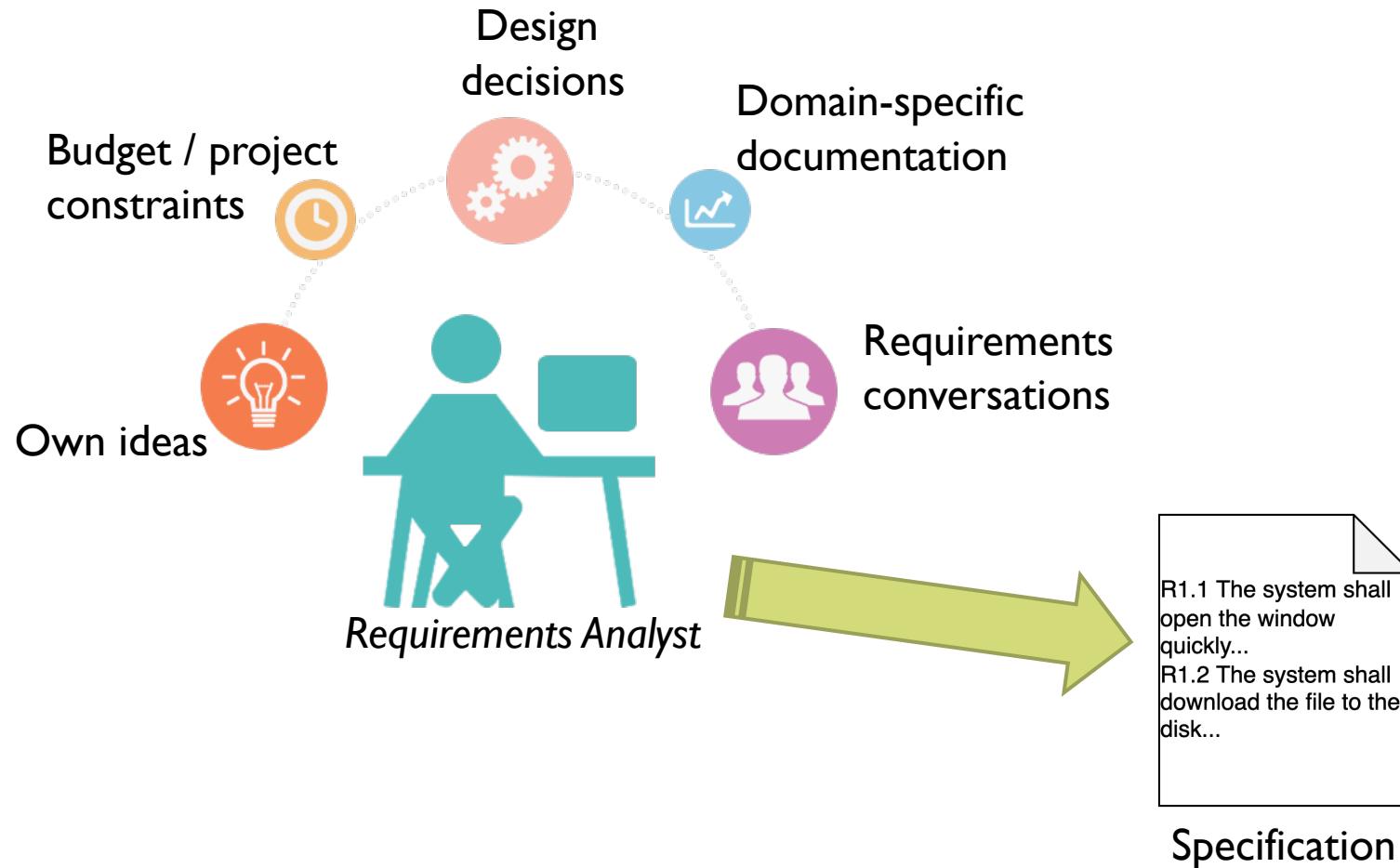
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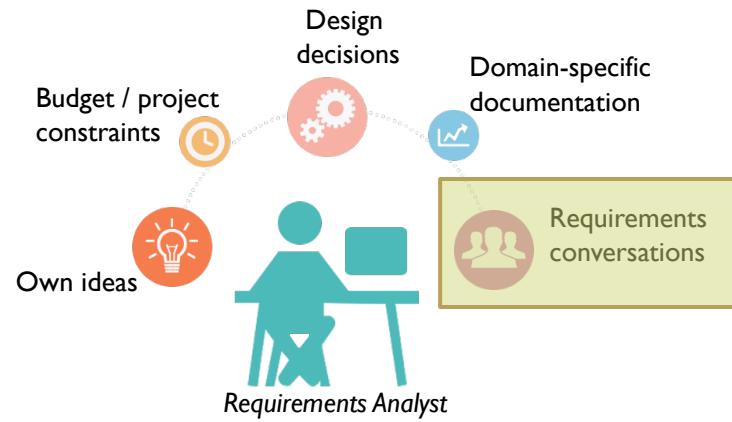
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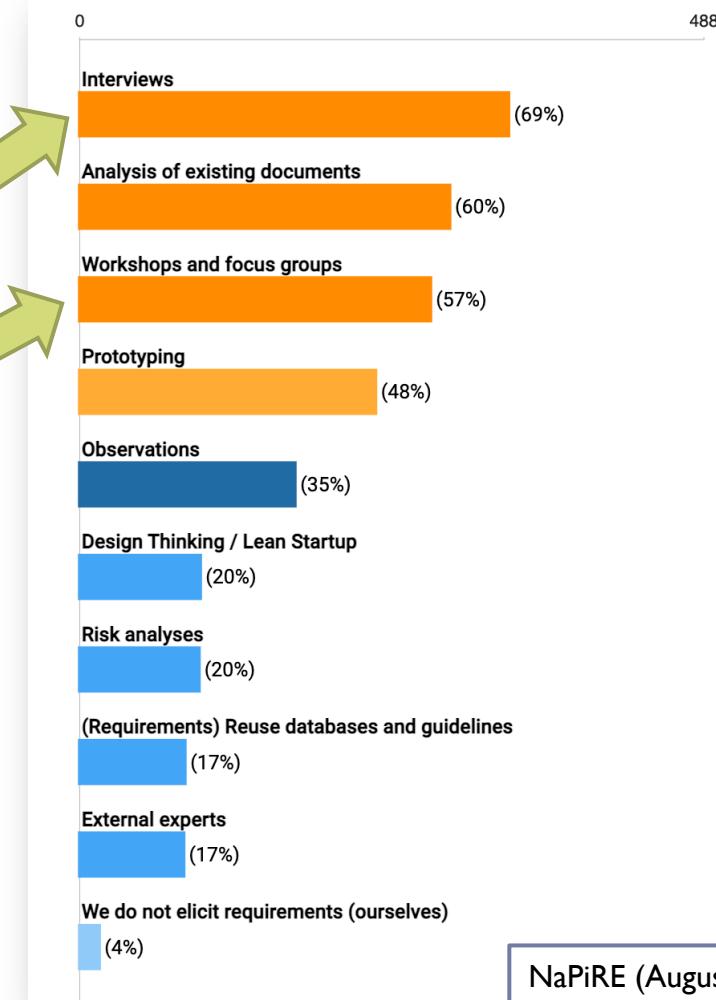
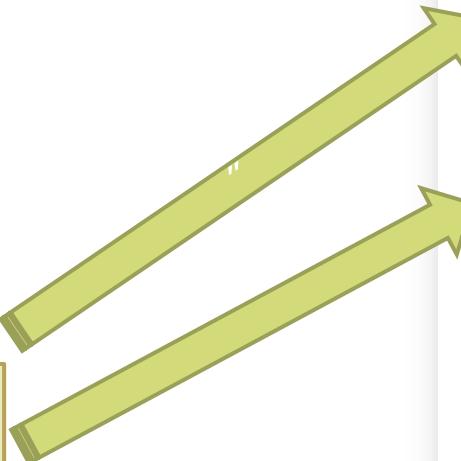
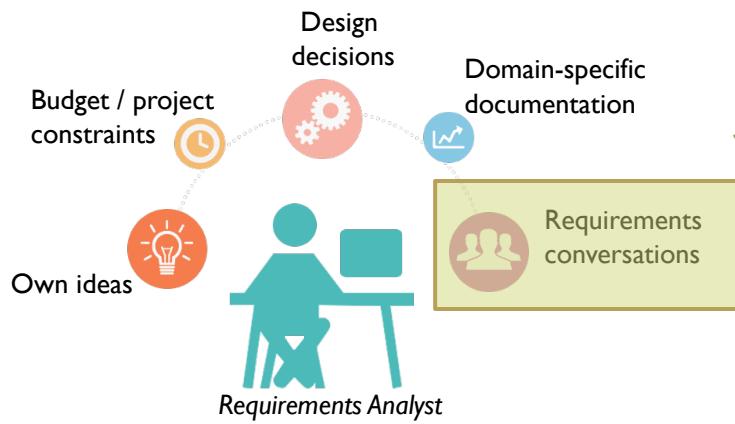
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Elicitation is heavily centered on conversations!

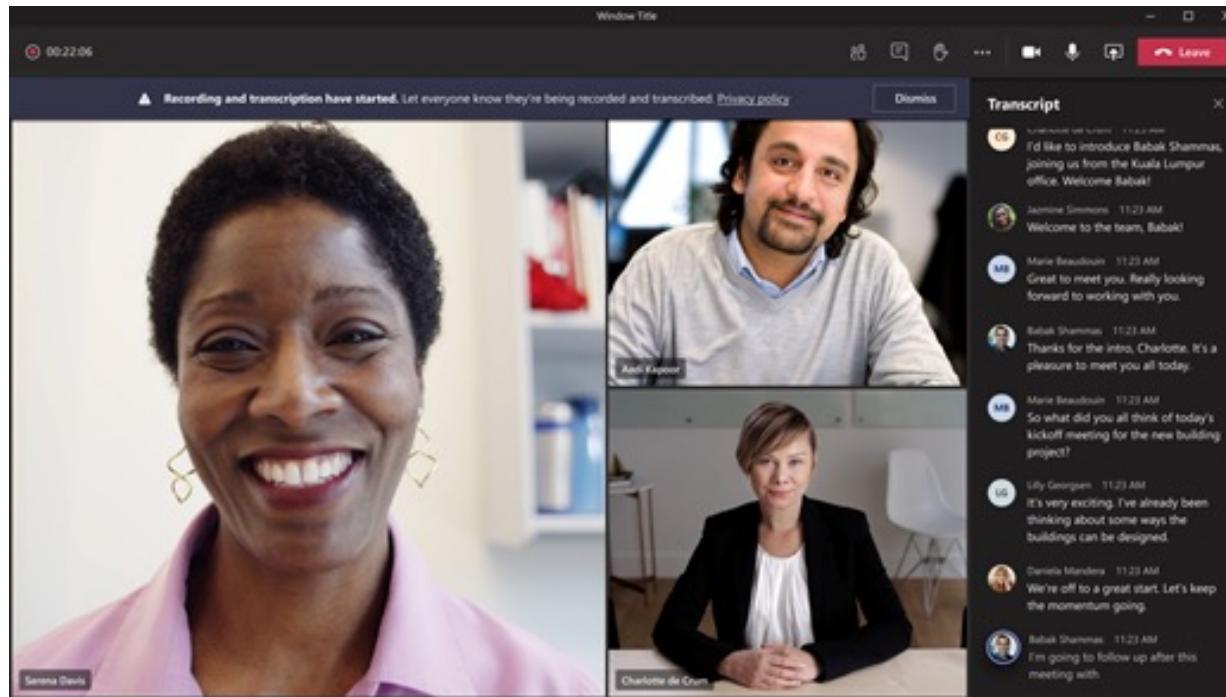


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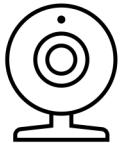


NaPiRE (August 8, 2022)
<http://www.re-survey.org/#/explore>

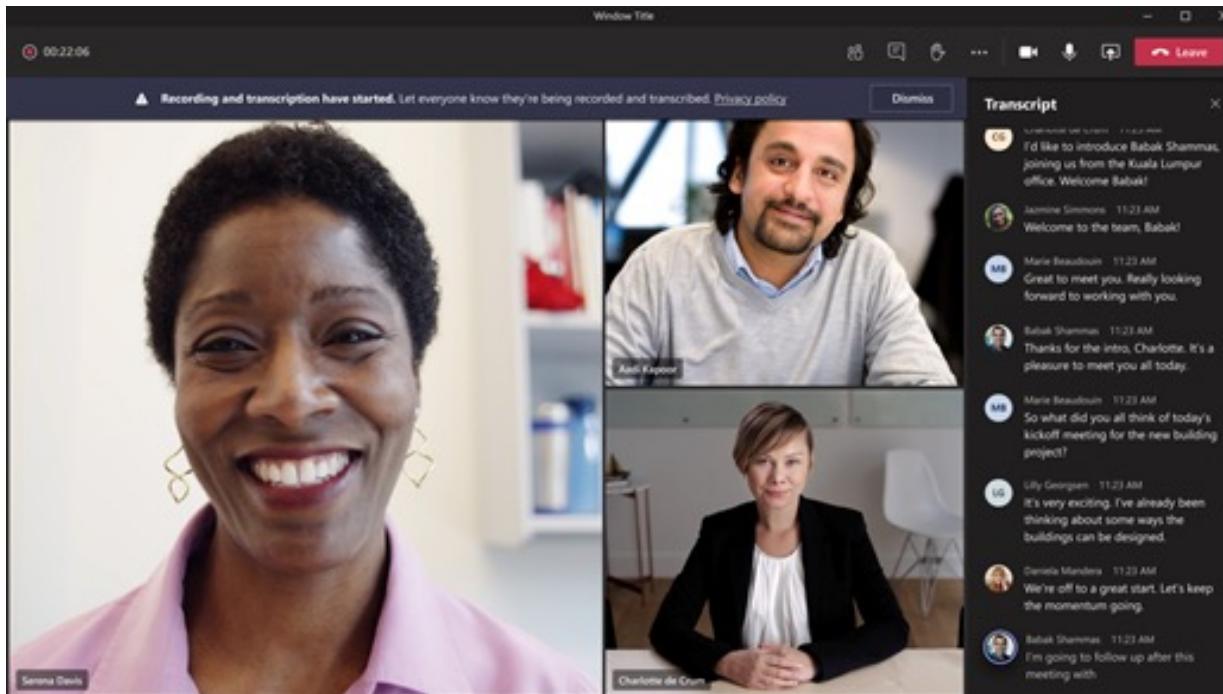
Timeliness: why researching conversations now?



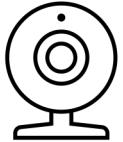
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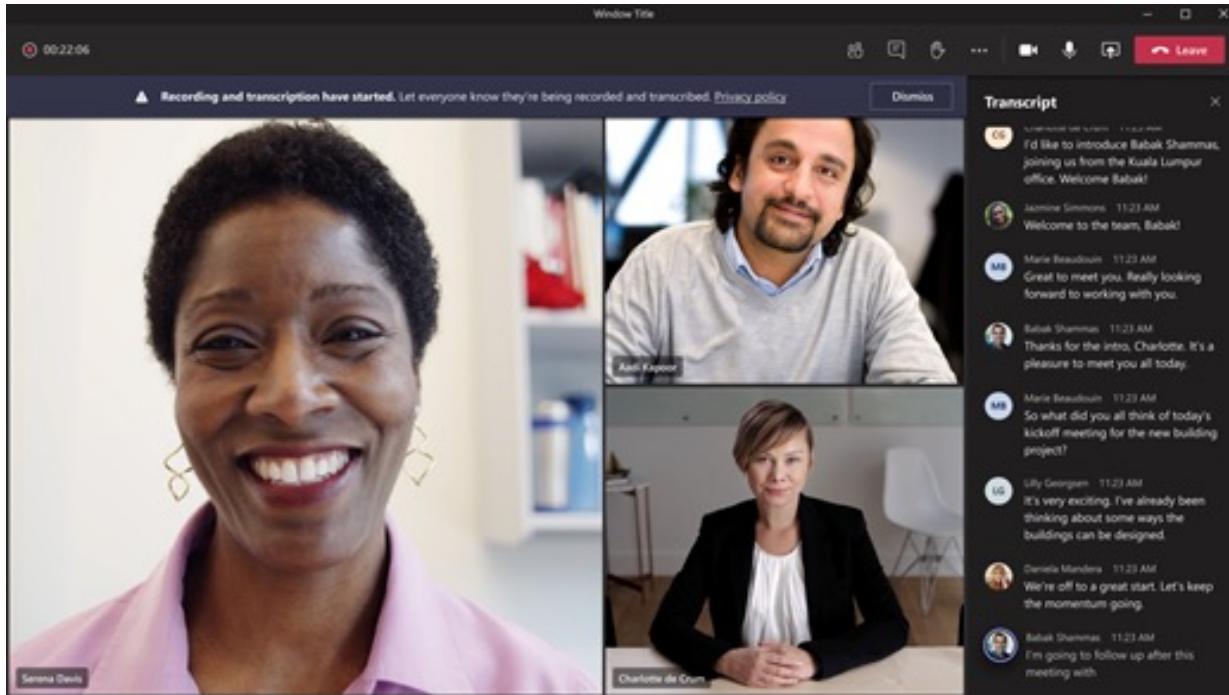
Increased remote work
and collaboration



Timeliness: why researching conversations now?



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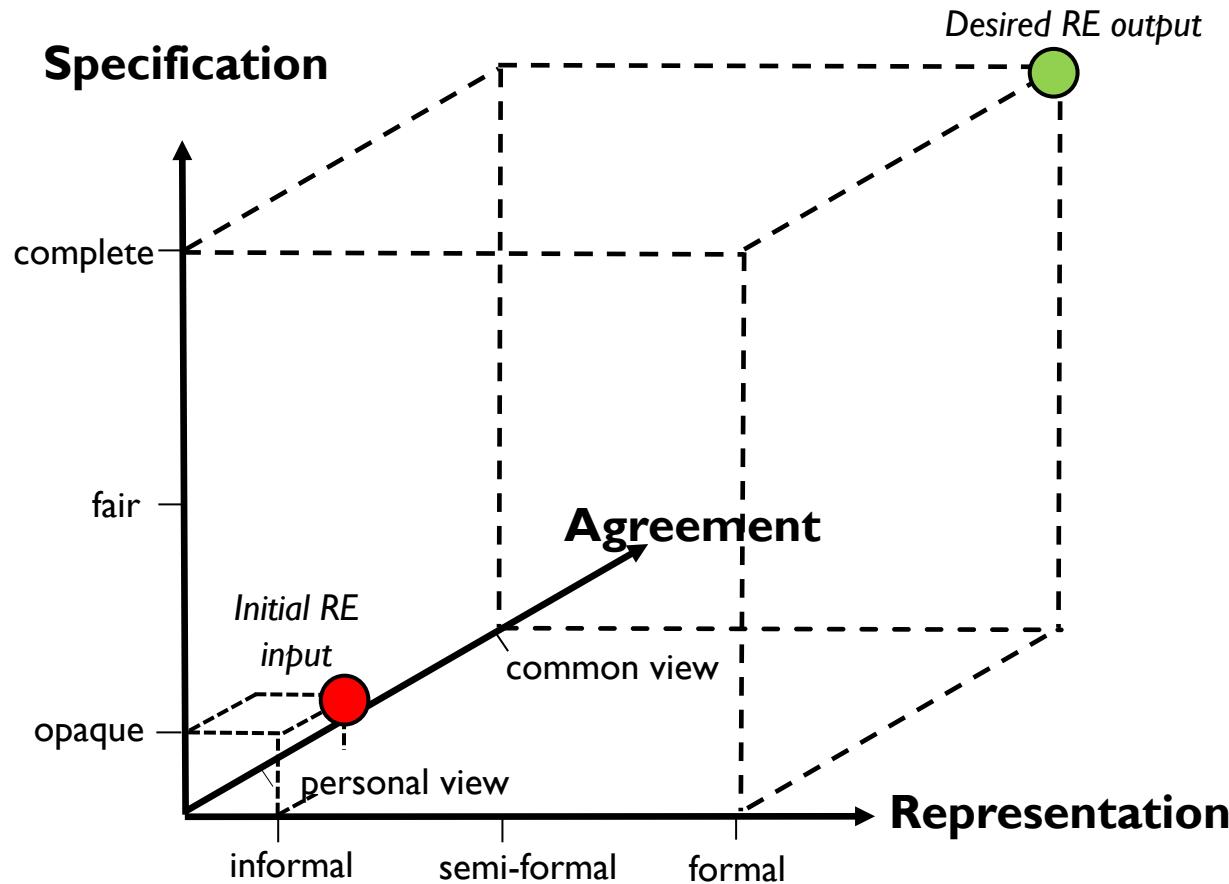


Automated
transcription

2. Conversational RE

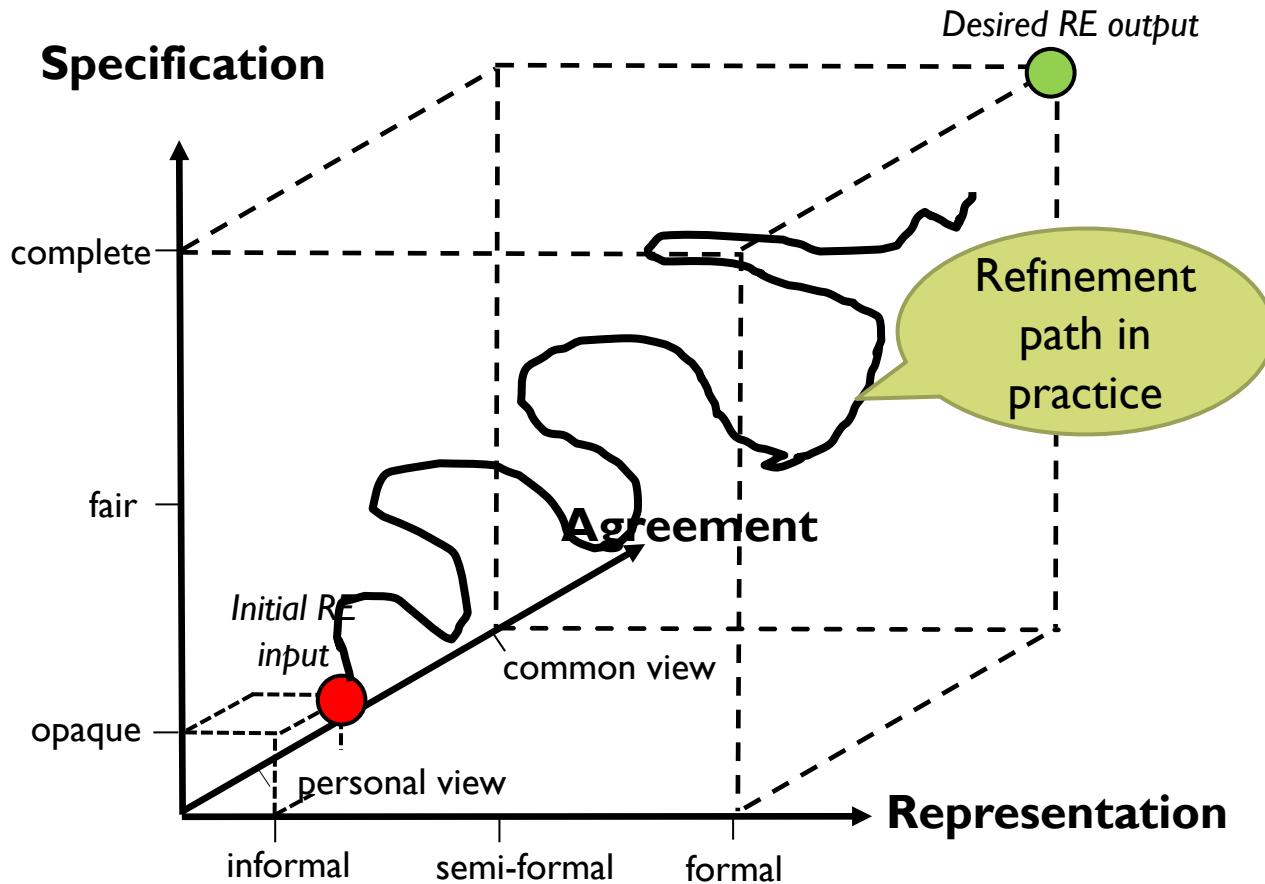


Background theory: Refinement in RE



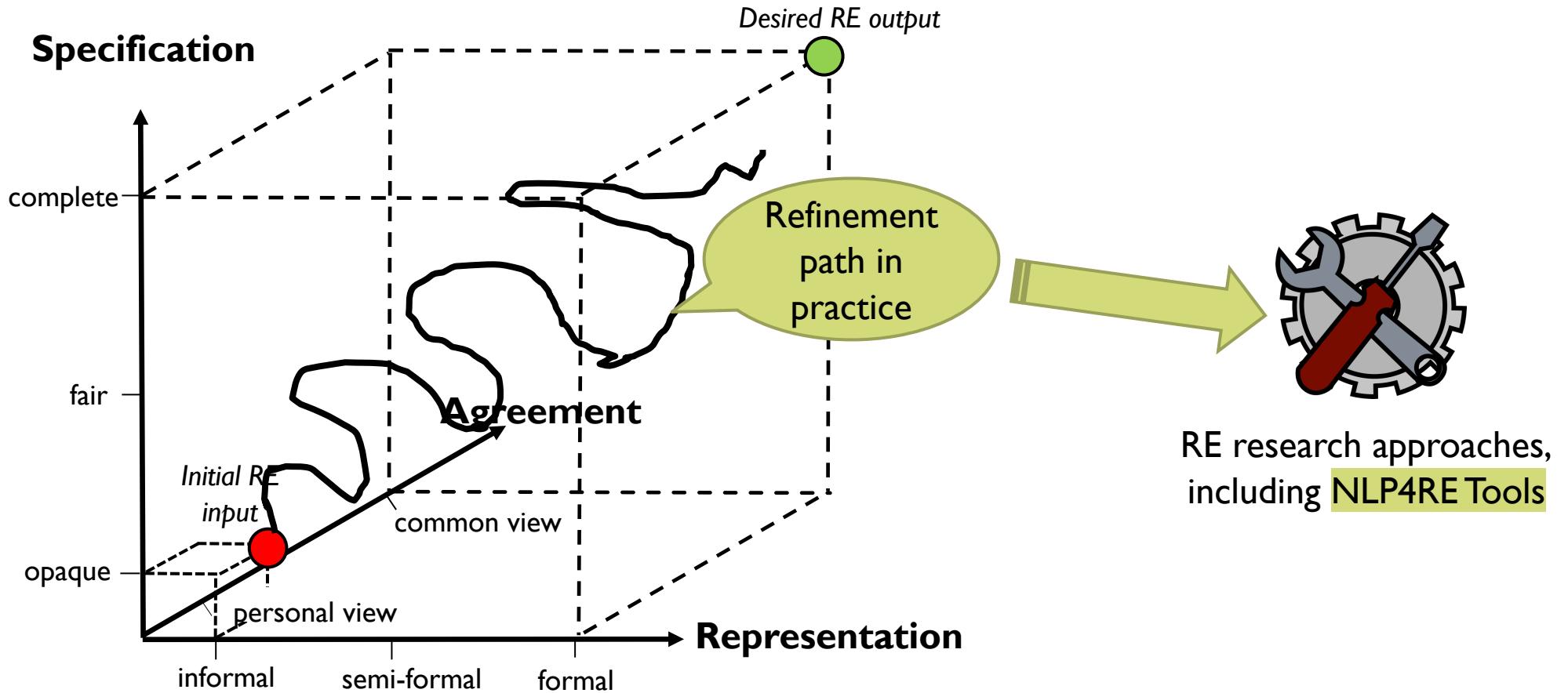
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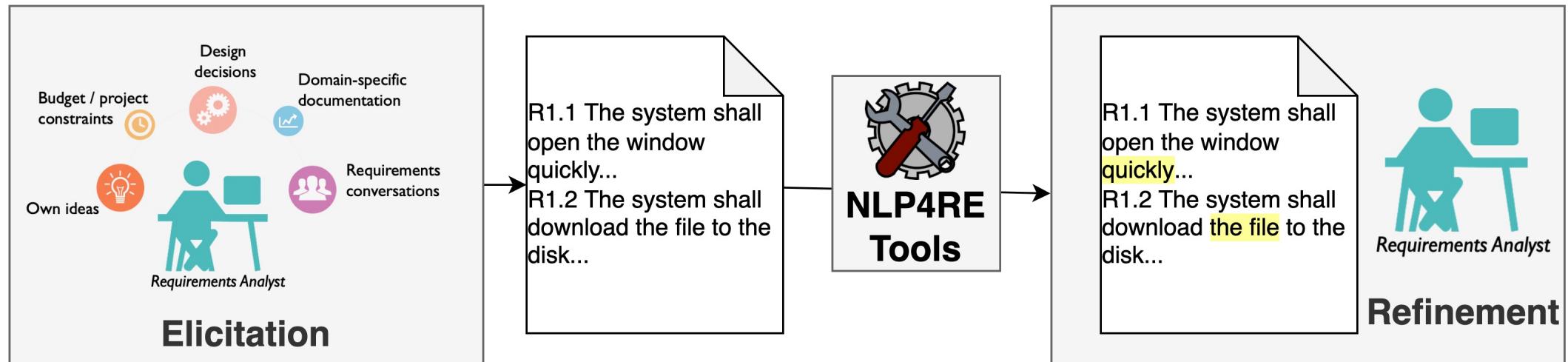
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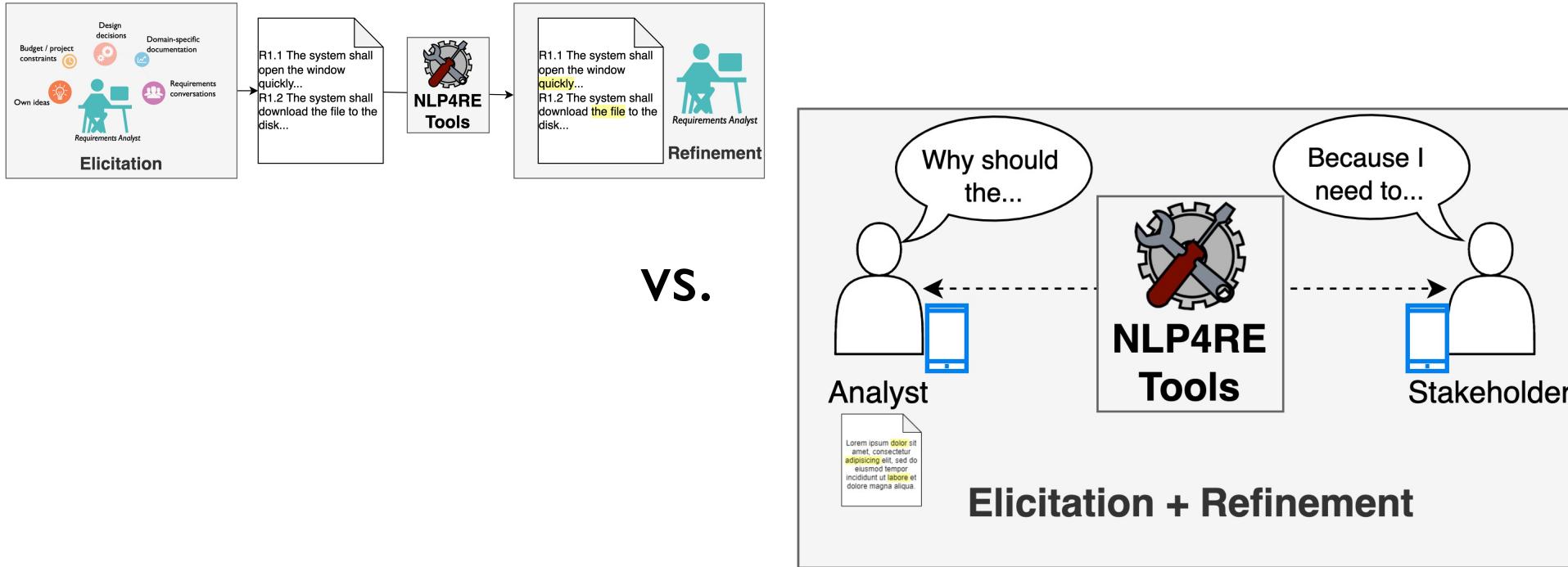


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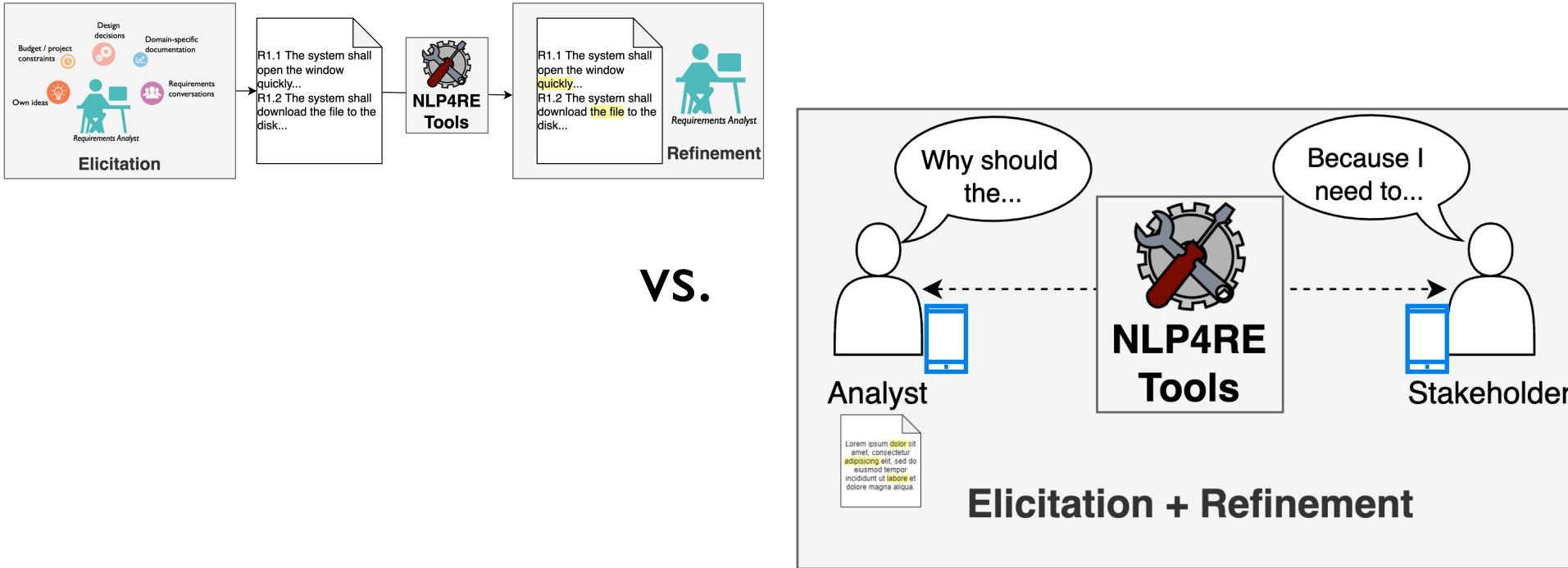
How do current NLP4RE tools work?



NLP4RE Tools for Conversational RE

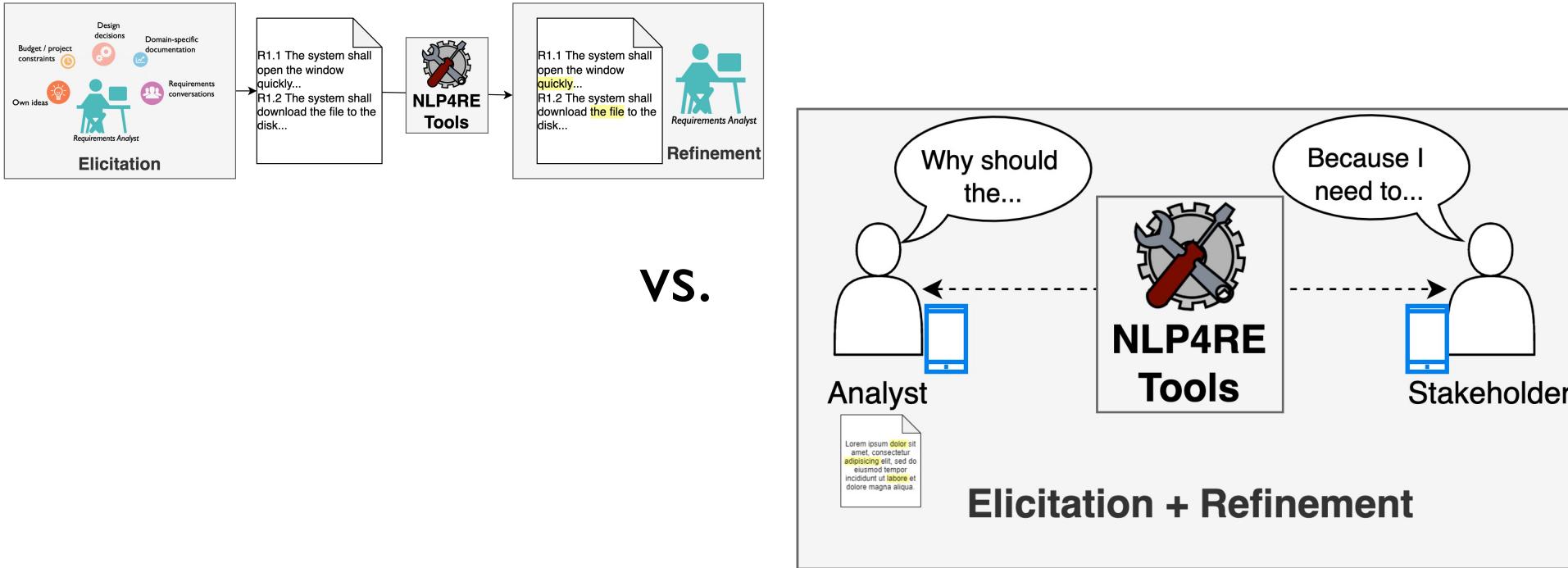


NLP4RE Tools for Conversational RE



- ▶ The tool supports the conversation between analyst and stakeholders

NLP4RE Tools for Conversational RE



- ▶ The tool **supports the conversation** between analyst and stakeholders
- ▶ Elicitation and refinement as concurrent activities

Conversational RE

“The (automated) analysis of requirements elicitation conversations aimed at identifying and extracting requirements-relevant information”



(Requirements) conversations vs. specifications

Speaker: Utterance
A : What is the main goal of the system? : What would you like for us to focus on?
S : Let me think... : the system shall be customizable... : hmm, no, configurable!
A : Configurable, you said. : Hmm, what do you exactly mean by that?
S : Oh yes, sorry... : the developers must be able to adjust parameters A and B so to serve different clients
A : I see, clear. : Should we use file format XYZ?
S : Yes, absolutely. ...

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2+ parties (here Analyst and Stakeholder)

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Informal: no “shall” statements, user stories, glossary

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2+ parties (here Analyst and Stakeholder)

Relevant information may be sparse

Informal: no “shall” statements, user stories, glossary

Includes persuasion, uncertainty, misunderstandings

Dissecting a conversation: turns and grounding acts

Speaker: Utterance	Turn	Grounding
A : What is the main goal of the system? : What would you like for us to focus on?	1.1	Initiate
	1.2	Continue
S : Let me think... : the system shall be customizable... : hmm, no, configurable!	2.1	Acknowledge
	2.2	Initiate
	2.3	Repair
A : Configurable, you said. : Hmm, what do you exactly mean by that?	3.1	Acknowledge
	3.2	Initiate
S : Oh yes, sorry... : the developers must be able to adjust parameters A and B so to serve different clients	4.1	Acknowledge
	4.2	Initiate
A : I see, clear. : Should we use file format XYZ?	5.1	Acknowledge
	5.2	Initiate
S : Yes, absolutely. ...	6.1	Acknowledge

Traum, David R., and Elizabeth A. Hinkelmann.
"Conversation acts in task-oriented spoken dialogue."
Computational intelligence 8.3 (1992): 575-599.

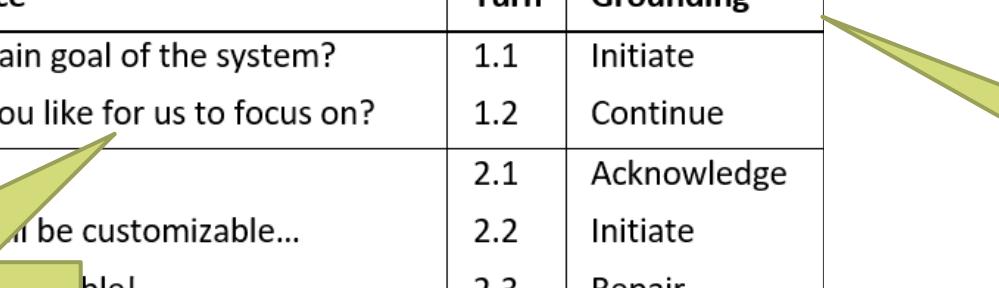
Dissecting a conversation: turns and grounding acts

Speaker: Utterance	Turn	Grounding
A : What is the main goal of the system? : What would you like for us to focus on?	1.1 1.2	Initiate Continue
S : Let me think... : the system will be customizable...	2.1 2.2 2.3	Acknowledge Initiate Repair
Turns and utterance units as atomic entities		
S : Oh yes, sorry... : the developers must be able to adjust parameters A and B so to serve different clients	3.1 3.2	Acknowledge Initiate
A : I see, clear. : Should we use file format XYZ?	4.1 4.2	Acknowledge Initiate
S : Yes, absolutely. ...	5.1 5.2 6.1	Acknowledge Initiate Acknowledge

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Grounding acts determine the effect of an utterance unit

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Dissecting a conversation: discourse units

Speaker: Utterance	Turn	Grounding	Discourse
A : What is the main goal of the system? : What would you like for us to focus on?	1.1 1.2	Initiate Continue	DU1: WHQ, Check
S : Let me think... : the system shall be customizable... : hmm, no, configurable!	2.1 2.2 2.3	Acknowledge Initiate Repair	
A : Configurable, you said. : Hmm, what do you exactly mean by that?	3.1 3.2	Acknowledge Initiate	DU2: Inform, Check
S : Oh yes, sorry... : the developers must be able to adjust parameters A and B so to serve different clients	4.1 4.2	Acknowledge Initiate	
A : I see, clear. : Should we use file format XYZ?	5.1 5.2	Acknowledge Initiate	DU3: WHQ, Check
S : Yes, absolutely. ...	6.1	Acknowledge	

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S : Oh yes, sorry... : the developers must be able to adjust parameters A and B so to serve different clients	4.1 4.2	Acknowledge Initiate	
A : I see, clear. : Should we use file format XYZ?	5.1 5.2	Acknowledge Initiate	DU3: WHQ, Check
S : Yes, absolutely. ...	6.1	Acknowledge	

Cross-speaker interaction
defines the meaning

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Dissecting a conversation: argumentation acts

Speaker: Utterance	Turn	Grounding	Discourse	Argumentation
A : What is the main goal of the system? : What would you like for us to focus on?	1.1 1.2	Initiate Continue	DU1: WHQ, Check	Q&A
S : Let me think... : the system shall be customizable... : hmm, no, configurable!	2.1 2.2 2.3	Acknowledge Initiate Repair		
A : Configurable, you said. : Hmm, what do you exactly mean by that?	3.1 3.2	Acknowledge Initiate	DU2: Inform, Check	Clarify
S : Oh yes, sorry... : the developers must be able to adjust parameters A and B so to serve different clients	4.1 4.2	Acknowledge Initiate		
A : I see, clear. : Should we use file format XYZ?	5.1 5.2	Acknowledge Initiate	DU3: WHQ, Check	Q&A
S : Yes, absolutely. ...	6.1	Acknowledge		

Elizabeth A. Hinkelmann.

Conversation acts in task-oriented spoken dialogue."
Computational intelligence 8.3 (1992): 575-599.

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S : Let me think... : the system shall be customizable... : hmm, no, configurable!	2.1 2.2 2.3	Acknowledge Initiate Repair			
A : Configurable, you said. : Hmm, what do you exactly mean by that?	3.1 3.2	Acknowledge Initiate	DU2: Inform, Check	Clarify	
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The purpose of a conversation across multiple turns: *argumentation acts*

Q&A as a basic interaction, clarifications, summary, persuasion, ...

Elizabeth A. Hinkelmann,
"Conversation acts in task-oriented spoken dialogue."
Computational intelligence 8.3 (1992): 575-599.

Conversations vs. Specifications: not quite the same

Speaker: Utterance	Turn	Grounding	Discourse	Argumentation
A : What is the main goal of the system? : What would you like for us to focus on?	1.1 1.2	Initiate Continue	DU1: WHQ, Check	Q&A
S : Let me think... : the system shall be customizable... : hmm, no, configurable!	2.1 2.2 2.3	Acknowledge Initiate Repair	DU2: Inform, Check	
A : Configurable, you said. : Hmm, what do you exactly mean by that?	3.1 3.2	Acknowledge Initiate	DU3: WHQ, Check	Q&A
S : Oh yes, sorry... : the developers must be able to adjust parameters A and B so to serve different clients	4.1 4.2	Acknowledge Initiate	DU4: Inform, Check	Clarify
A : I see, clear. : Should we use file format XYZ?	5.1 5.2	Acknowledge Initiate	DU5: Request(Eval), Eval	Q&A
S : Yes, absolutely. ...	6.1	Acknowledge		Q&A

[conversation]

The parameters A and B shall be configured via a configuration file in format XYZ

[specification]

Tools for Conversational RE: Two Examples

Trace2Conv

The system automatically sends an e-mail to the contact person of every vendor that is imported through the connection with JD Edwards so that he receives a link where he can create his password

system	sends	e-mail	contact	person
Occurs 15 Times over 15 turns Occurs in 14 requirements	Occurs 31 Times over 27 turns Occurs in 4 requirements	Occurs 7 Times over 0 turns Occurs in 5 requirements	Occurs 7 Times over 7 turns Occurs in 2 requirements	Occurs 32 Times over 24 turns Occurs in 4 requirements
VIEW SPEAKER TURNS	VIEW SPEAKER TURNS	VIEW SPEAKER TURNS	VIEW SPEAKER TURNS	VIEW SPEAKER TURNS

vendor	imported	connection	JD	Edwards
Occurs 62 Times over 51 turns Occurs in 15 requirements	Occurs 6 Times over 7 turns Occurs in 1 requirements	Occurs 2 Times over 7 turns Occurs in 4 requirements	Occurs 12 Times over 12 turns Occurs in 4 requirements	Occurs 1 Times over 1 turns Occurs in 4 requirements
VIEW SPEAKER TURNS	VIEW SPEAKER TURNS	VIEW SPEAKER TURNS	VIEW SPEAKER TURNS	VIEW SPEAKER TURNS

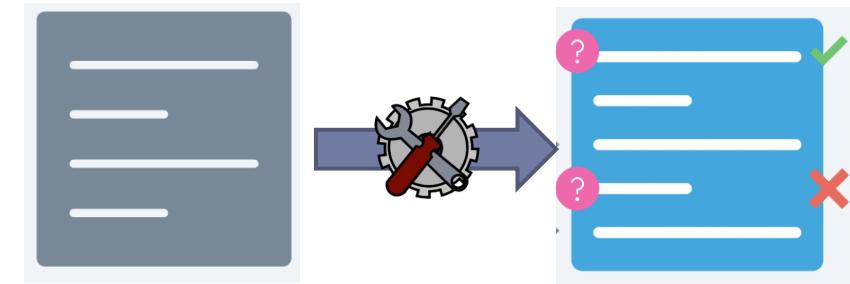
receives	link	create	password
Occurs 19 Times over 15 turns Occurs in 4 requirements	Occurs 2 Times over 2 turns Occurs in 5 requirements	Occurs 10 Times over 11 turns Occurs in 8 requirements	Occurs 12 Times over 10 turns Occurs in 8 requirements
VIEW SPEAKER TURNS	VIEW SPEAKER TURNS	VIEW SPEAKER TURNS	VIEW SPEAKER TURNS

MULTIPLE (SINGLE) TOKEN OCCURRENCES SCORING MECHANISM MULTIPLE TOKENS

speakerturnid : 2517

spk_3
VIEW
00:12:18 - 00:13:31
contains the token: vendor 4times

i would say that it's so that **Vendor** 5 can easily access information, we get a lot of phone calls right now within either accounts payable or the departments and **Vendor** 5 want to know whether or not we received the invoice, is it being processed, hasn't been paid, so we're hoping that this will eliminate a lot of those conversations and make it much easier for them to get information as well as um like you said that the address book thing, the history, um and hopefully maybe choose, like being able to upload their invoices through that process, yeah, leslie said, so, moving toward electronic, i think is gonna be a big objective, um kind of a big undertaking for us, we've got about 6000 **Vendor** in je, a couple 1000 of them are active, so first off, we're gonna clean up, but that's really the target, ideally we would have as many of those **Vendor** as possible, sending us either emailing electronic invoices are uploading them through the portal, so that's a that's a big part of our success



Trace2Conv:
pre-RS traceability

Requirements Conversation
Summarizer

3. Trace2Conv: Tracing requirements to conversations

3. Trace2Conv: Tracing requirements to conversations

Wed 17 Aug

Displayed time zone: Amsterdam, Berlin, Bern, Rome, Stockholm, Vienna [change](#)

11:20 - 12:10 Natural Language Processing for RE at Dibbler [RE@Next! Papers / Journal-First](#)

Chair(s): Tong Li Beijing University of Technology

11:20 20m ★ Back to the Roots: Linking User Stories to Requirements Elicitation Conversations [Talk](#)

RE@Next! Papers
Tjerk Spijkman Utrecht University, Fabiano Dalpiaz Utrecht University, Sjaak Brinkkemper Utrecht University

Back to the Roots: Linking User Stories to Requirements Elicitation Conversations

Tjerk Spijkman
fizor, and Utrecht University
Utrecht, the Netherlands
Email: tjerk@fizor.io

Fabiano Dalpiaz
Utrecht University
Utrecht, the Netherlands
Email: f.dalpiaz@uu.nl

Sjaak Brinkkemper
Utrecht University
Utrecht, the Netherlands
Email: s.brinkkemper@uu.nl

Abstract—Pre-requirements specification (pre-RS) traceability focuses on tracing requirements back to their sources. In comparison with post-RS traceability, pre-RS traceability is underexplored in research. Likely reasons for the limited studies are the scarcity of pre-RS resources, e.g., recorded requirements elicitation conversations such as interviews or workshops, and the challenges of linking requirements to informal, unstructured text. To support the analysis of digital communication tools that allow for recording and analysis of conversations, we explore the opportunity of linking requirements to the transcript of a requirements elicitation conversation. We introduce TRACE2CONV, a prototype tool that aims to trace user stories to requirements elicitation transcripts taken in a conversation. TRACE2CONV makes use of NLP techniques to determine the relevant speaker turns. As an initial validation, we take automatically generated transcripts from real-world requirements elicitation, and evaluate the effectiveness of TRACE2CONV in supporting the process of finding the additional context for the requirements. The validation serves as a formative evaluation that guides the evolution of TRACE2CONV and as a inspiration for future research in the field of *conversational RE*.

Keywords—Requirements Elicitation, User Stories, Natural Language Processing, Conversational RE.

I. INTRODUCTION

Requirements traceability (RT) refers to the ability to describe and follow the flow of a requirement, both forward and backward [1]. Considerably important is to identify the sources of a requirement [2], to analyze the impact of a requirement on software engineering artifacts such as code and test cases [3], and to determine dependencies between requirements, also known as horizontal traceability [4].

Depending on whether we look backward or forward from a requirements specification document, we can distinguish between [1]: *Pre-RS* traceability, referring to linking the requirements in a specification to the sources that justify their existence, and *Post-RS* traceability, concerned with the life cycle of a requirement after its inclusion in the specification.

Although the higher potential of pre-RS traceability has been recognized already in the 1990s by Gotel [1], Pre-RS traceability is a significantly less explored area of research than post-RS traceability [2]. We agree with Krause *et al.* [2] and argue that this is due to the easier availability of and accessibility to the artifacts. For example, code and test cases

The increasing use of digital communication tools (e.g., video-conferencing software with recording and automated captioning), also accelerated by the increased remote work and collaboration that resulted from the COVID-19 pandemic, creates an opportunity to revitalize the research in this area.

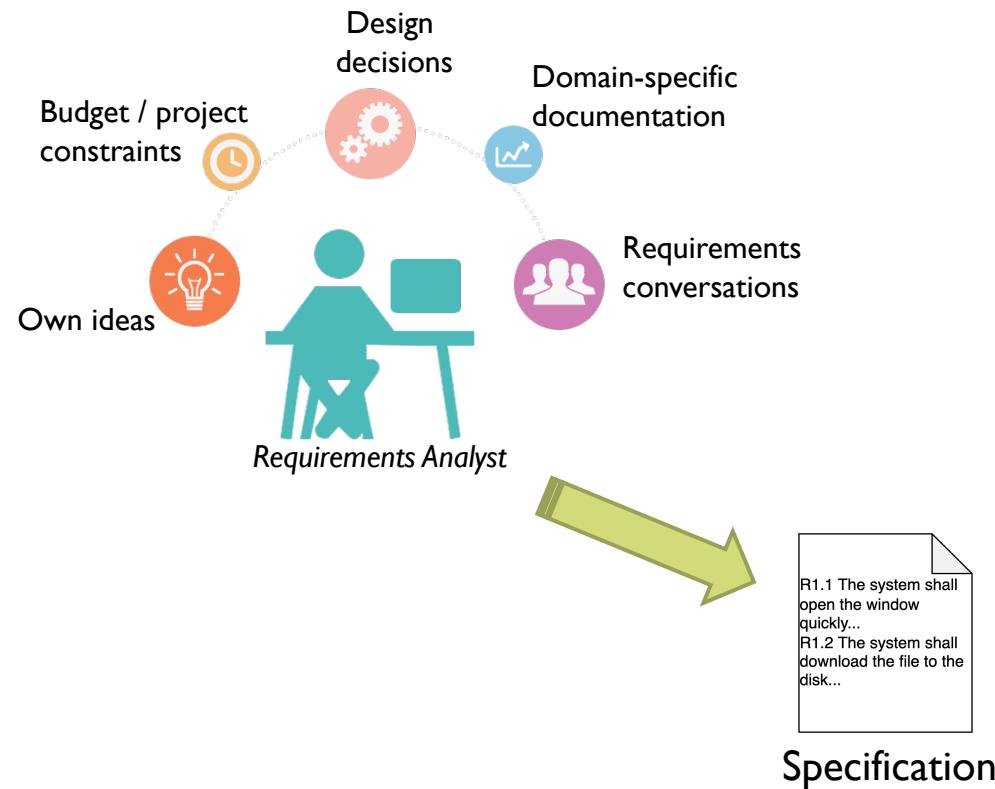
We present ongoing research that is part of *conversational RE*: the analysis of requirements elicitation conversations (in short form, requirements conversations) aimed at identifying and extracting requirements-relevant information. Conversational RE sets requirements elicitation conversations as central RE artifacts, in contrast with traditionally studied artifacts such as requirements specification documents [5]. We focus on requirements elicitation using video recordings, so important in realworld projects but that is largely overlooked in RE research. A few exceptions are the analysis of interview recordings in projects regarding information systems [6], [7] and the analysis of simulated interviews in RE education [8], [9]. Yet, we are not aware of any studies that trace requirements back to requirements conversations.

In this paper, we design and report on TRACE2CONV, a prototype tool that aims at automatically tracing user story requirements [10], [11] back to the segments of a requirements interview that are likely to justify that requirement. In particular, we make the following contributions to the RE field:

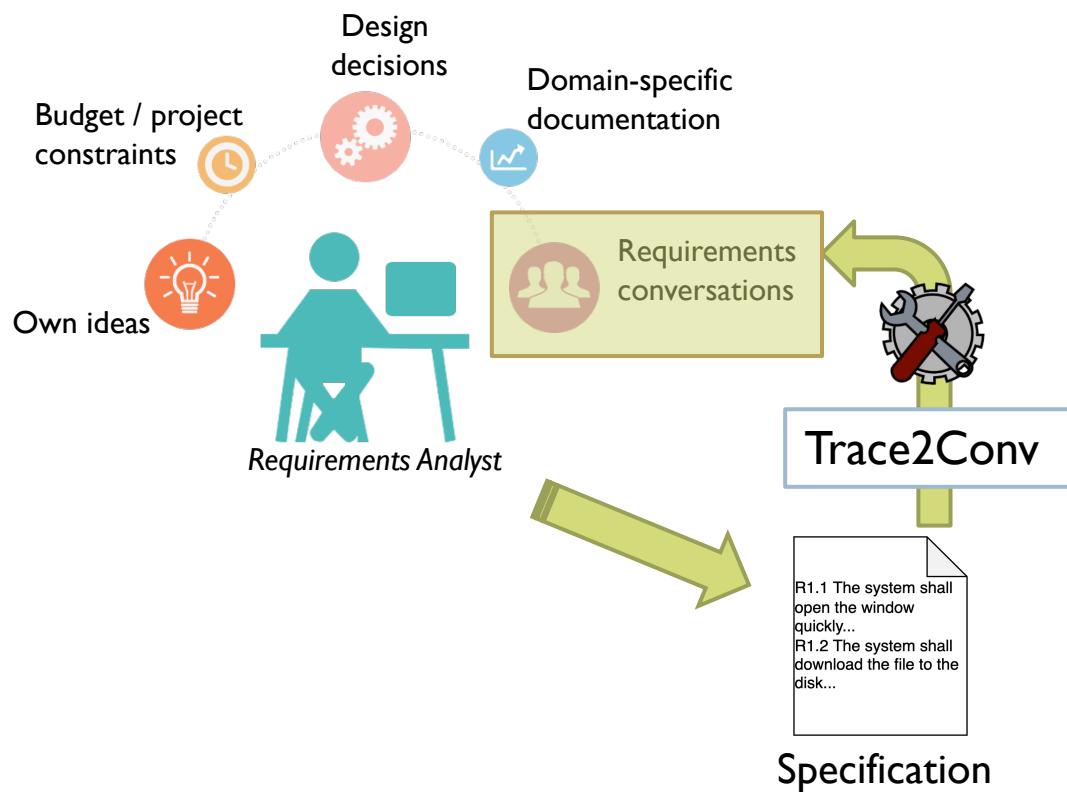
- We describe TRACE2CONV and the NLP heuristics that are implemented in order for the tool to determine which speaker turns are relevant to a given requirement.
- Through collaboration with a partner in the software consultancy, we present an early validation of our implemented algorithms on automatically generated transcripts of requirements interviews.

We provide qualitative observations on search strategies in backward traceability, we reflect on goals & use-cases, and we position initial approaches for ranking relevance. Additionally, the reported validation serves not only as a formative evaluation that guides the evolution of TRACE2CONV, but also as a kick-off for future research in the field of *conversational RE*. *Organization*. We motivate our work with reference to the existing literature in Sec. II. Then, we present the design of TRACE2CONV and provide an overview in Sec. III. We report

Trace2Conv: Key Idea

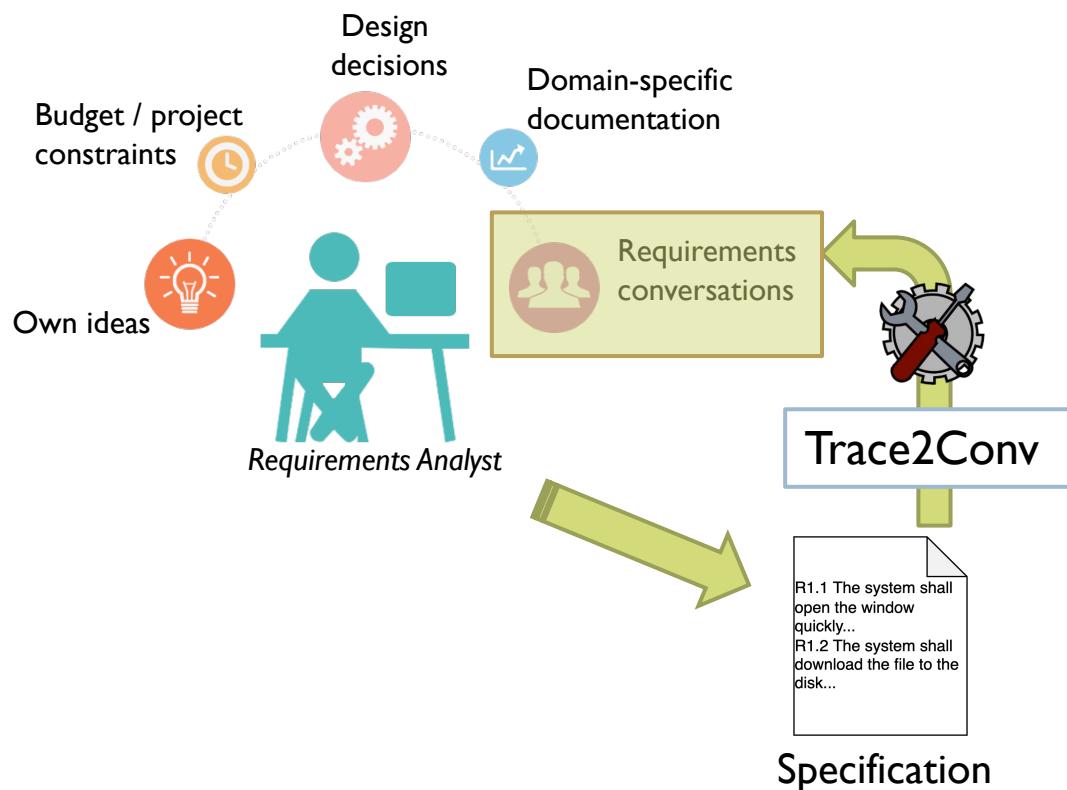


Trace2Conv: Key Idea



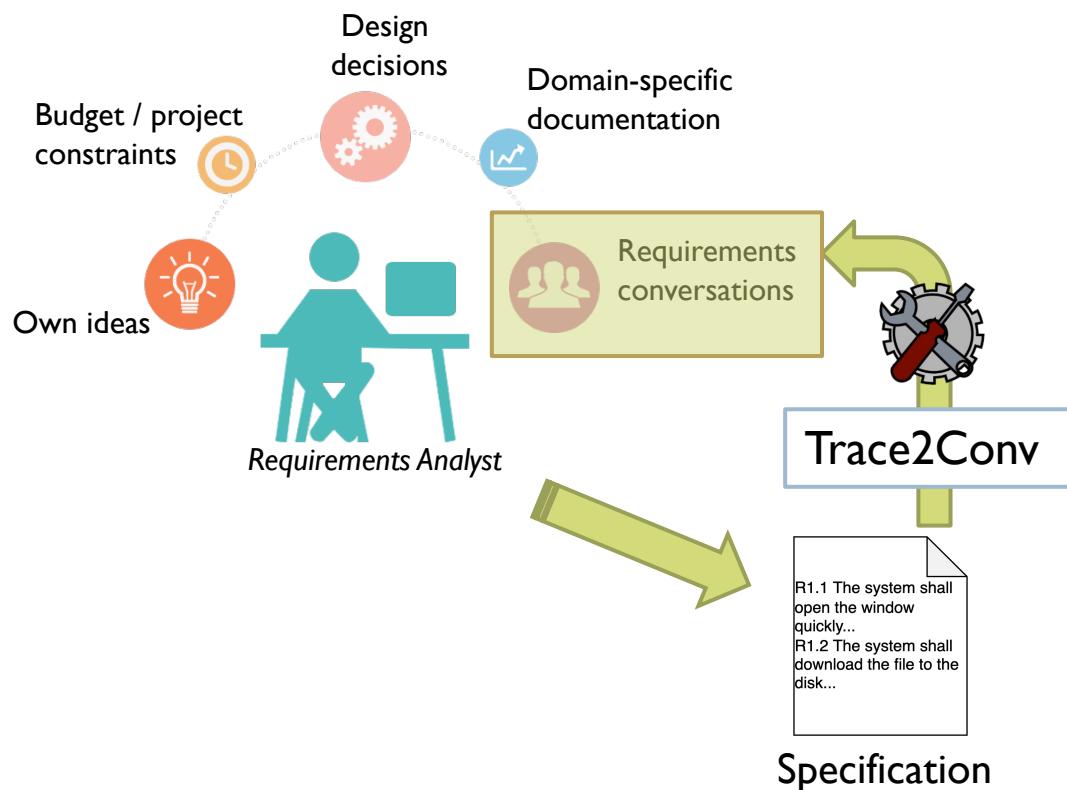
- ▶ Supports backward, pre-RS traceability
- ▶ Largely overlooked area of research

Trace2Conv: Key Idea



- ▶ Supports backward, pre-RS traceability
 - ▶ Largely overlooked area of research
- ▶ Aims to find information that provides additional context to a requirement

Trace2Conv: Key Idea



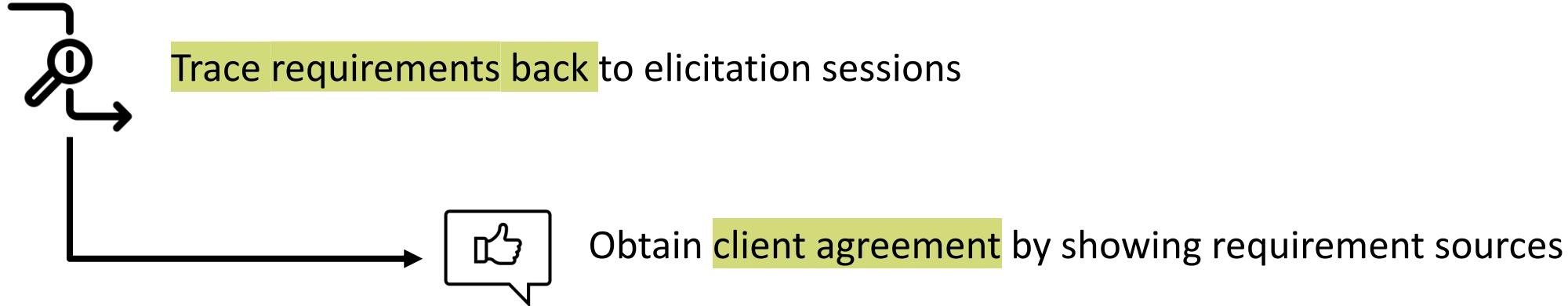
- ▶ Supports backward, pre-RS traceability
 - ▶ Largely overlooked area of research
- ▶ Aims to find information that provides additional context to a requirement
- ▶ Has to cope with an *abstraction gap*
 - ▶ Formal to informal

What can we achieve with Trace2Conv?

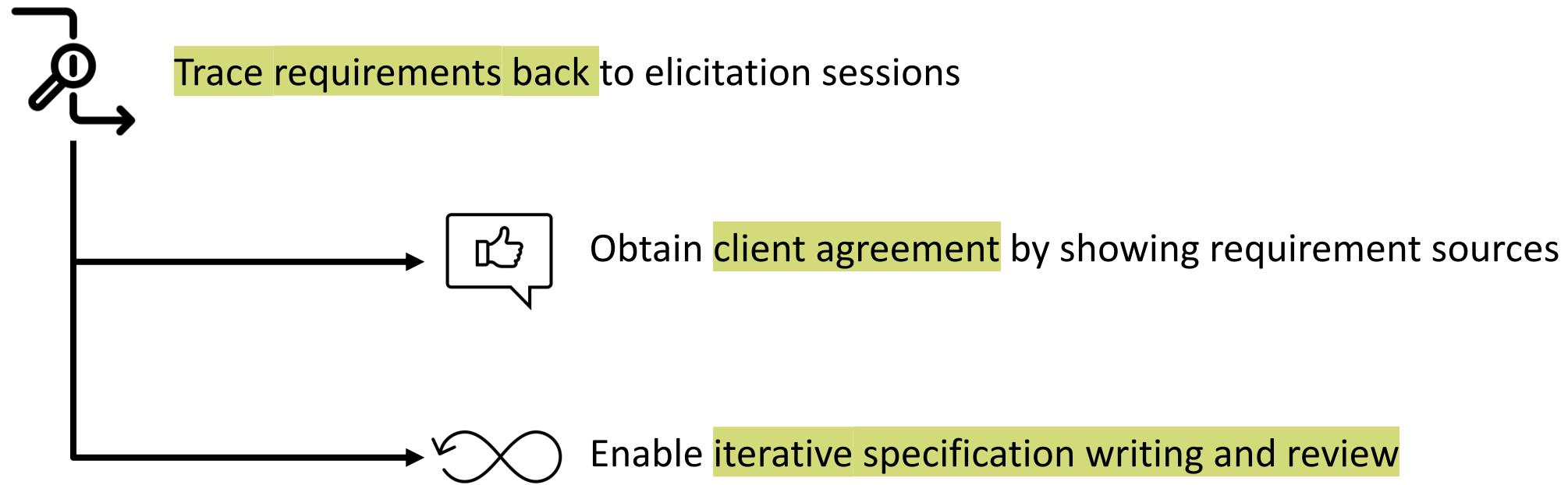


Trace requirements back to elicitation sessions

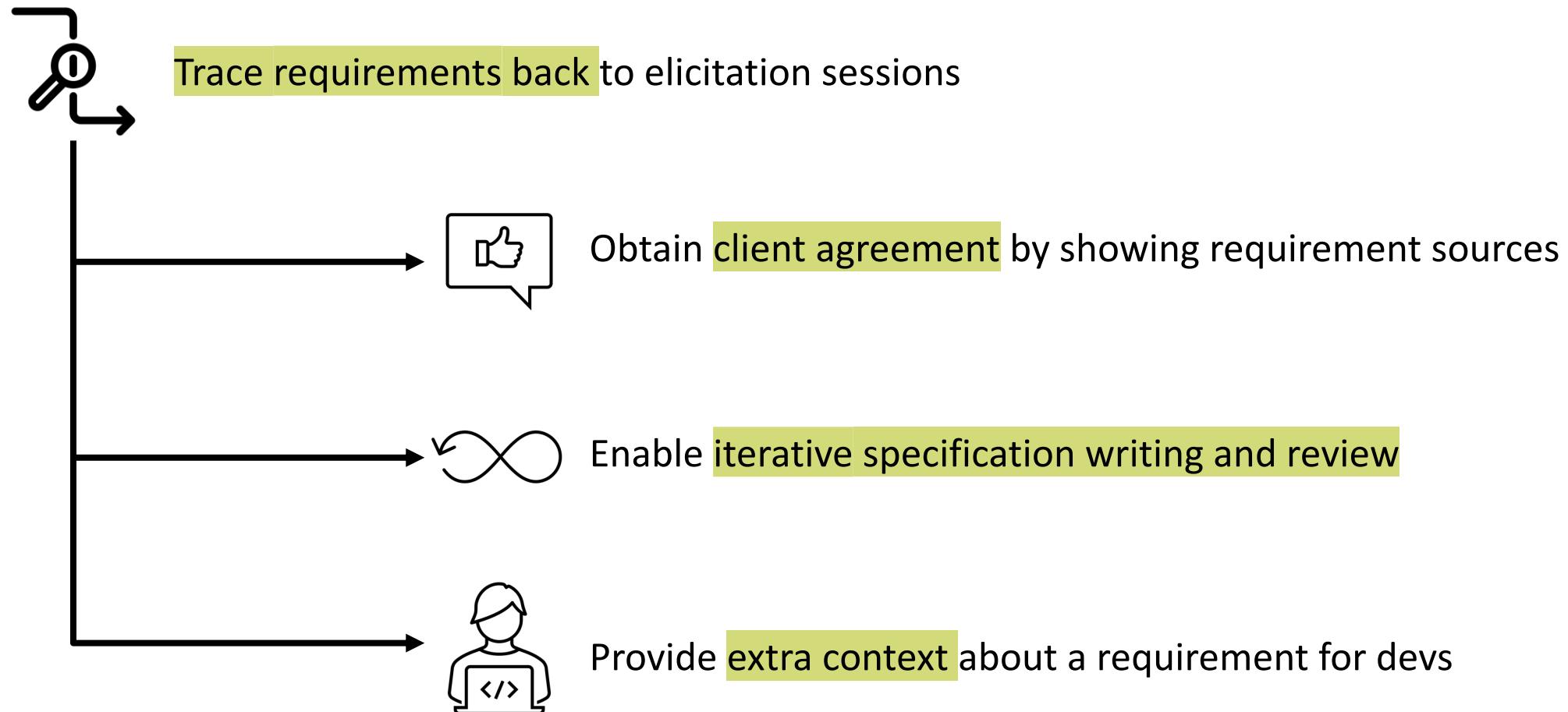
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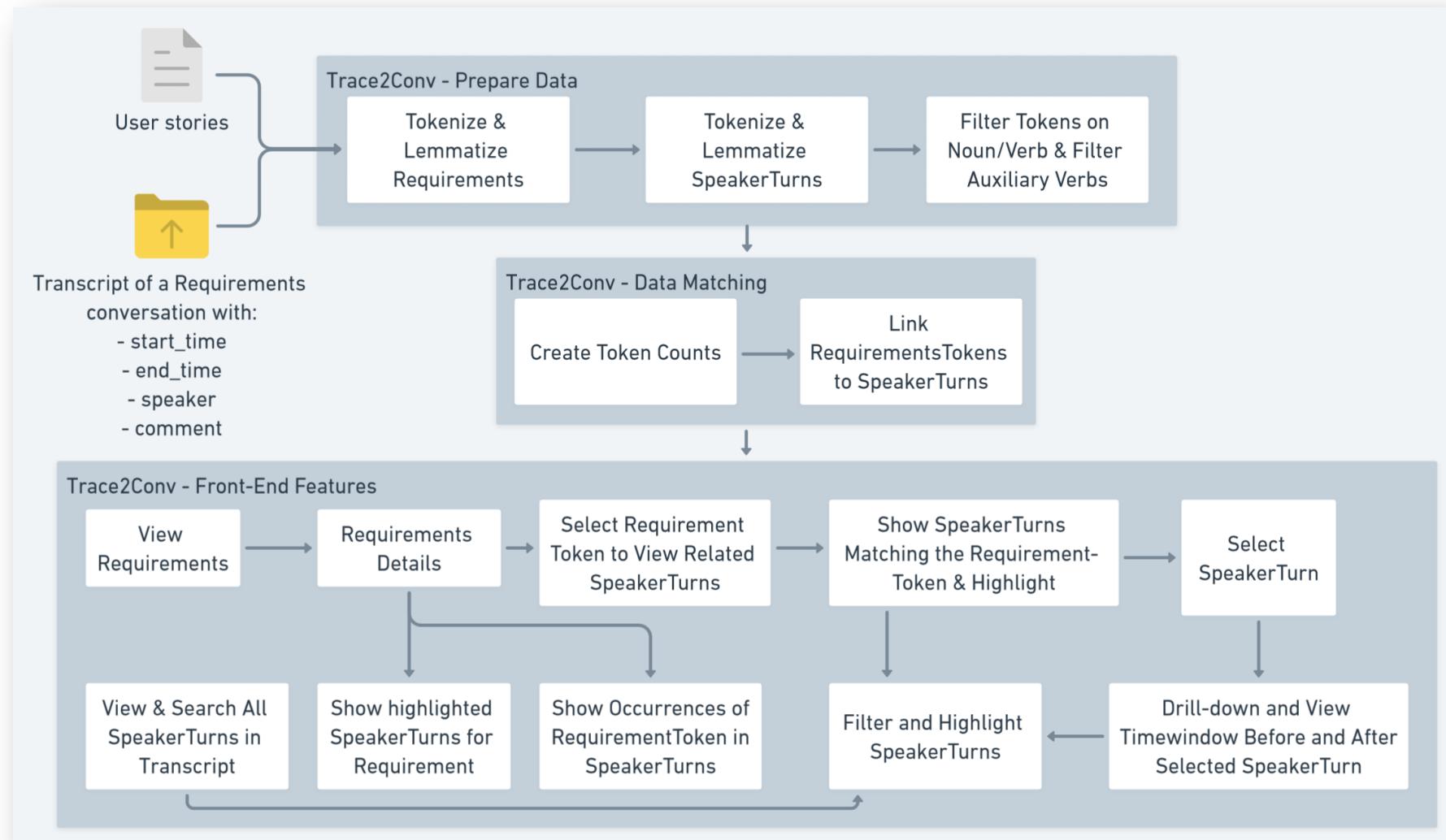
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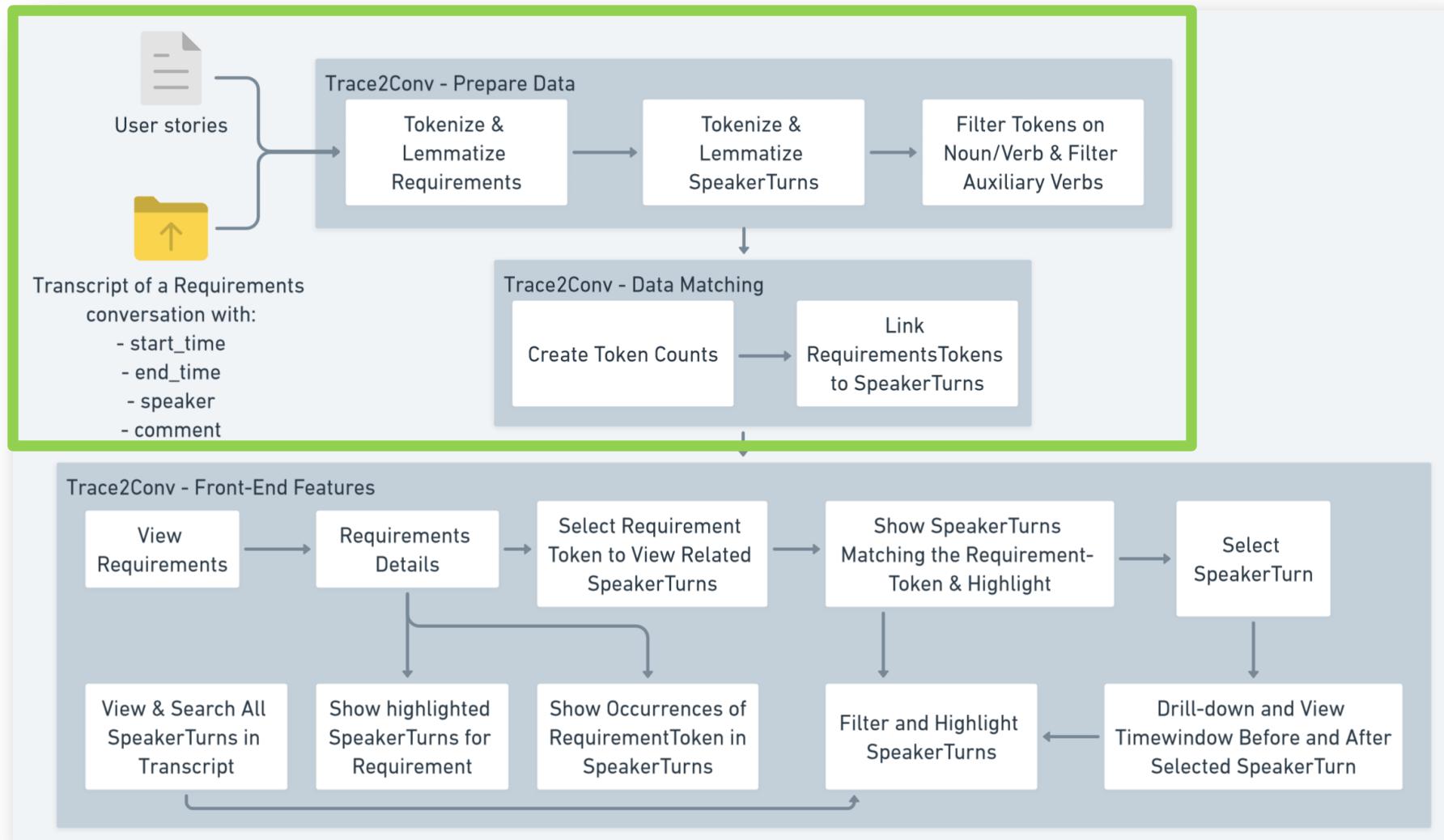
What can we achieve with Trace2Conv?



Architectural Design – Inputs and Backend



Architectural Design – Inputs and Backend



Pre-processing and matching

Algorithm 1 Data Preparation and Data Matching

Input: R a set of requirements,

C a set of speaker turns,

Output: a set of tokens $AllTokens$, linked to their occurrences in requirements and speaker turns

```
1: function PREPROCESSANDMATCH( $R, C$ )
2:   for all  $sent \in R \cup C$  do
3:      $T_{sent} \leftarrow \text{TOKENIZE}(sent)$ 
4:      $T_{sent} \leftarrow \text{LEMMATIZE}(T_{sent})$ 
5:      $T_{sent} \leftarrow (t \in T_{sent} \mid \text{POS\_TAG}(t) \in \{\text{NOUN}, \text{VERB}\})$ 
6:      $T_{sent} \leftarrow (t \in T_{sent} \mid \text{POS\_TAG}(t) \notin \{\text{AUX}\})$ 
7:    $AllTokens \leftarrow \bigcup_{sent \in R \cup C} T_{sent}$ 
8:   for all  $t \in AllTokens$  do
9:      $t.\text{reqs} \leftarrow \{req \in R \mid t \in T_{req}\}$ 
10:     $t.\text{turns} \leftarrow \{sturn \in C \mid t \in T_{sturn}\}$ 
11:   return  $AllTokens$ 
```

As a vendor user, I can use the password forgotten functionality whenever I forgot or want to reset my password, so that I always have a way to create a new password

Pre-processing and matching

Algorithm 1 Data Preparation and Data Matching

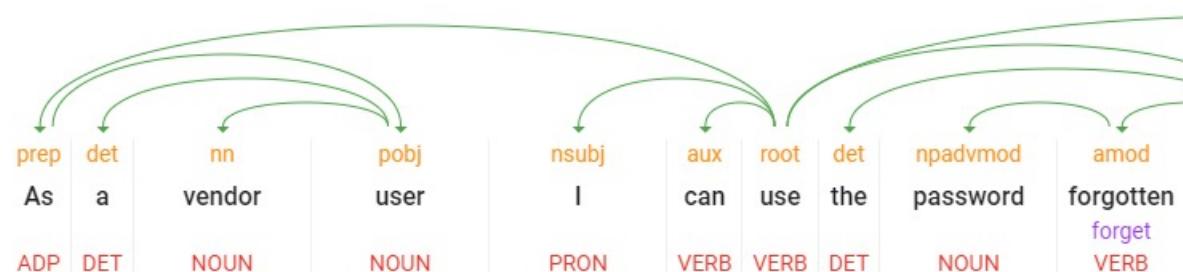
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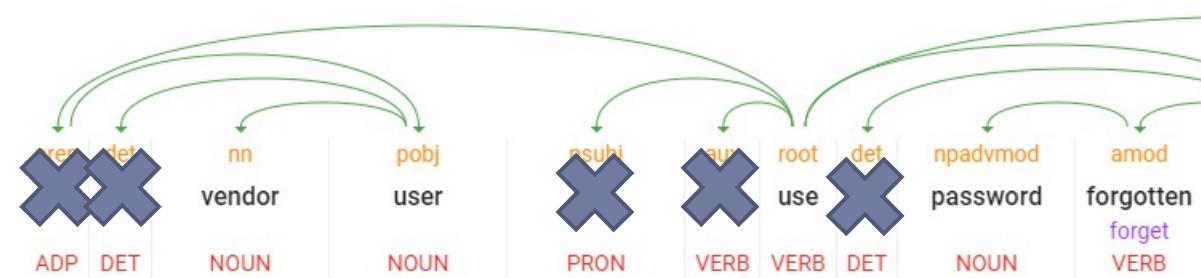
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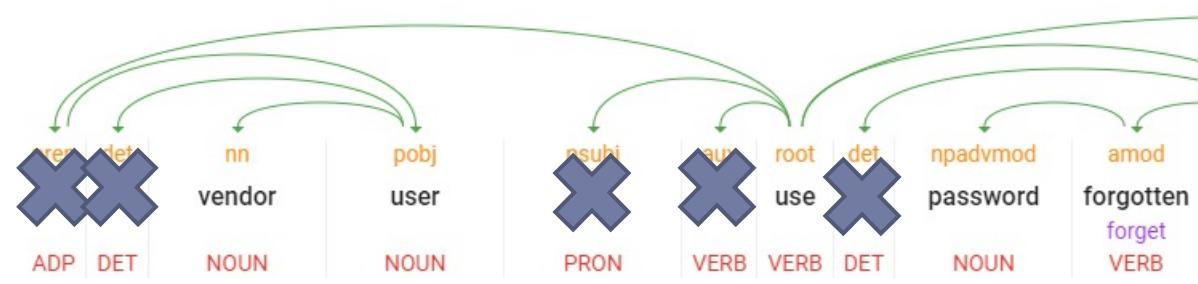
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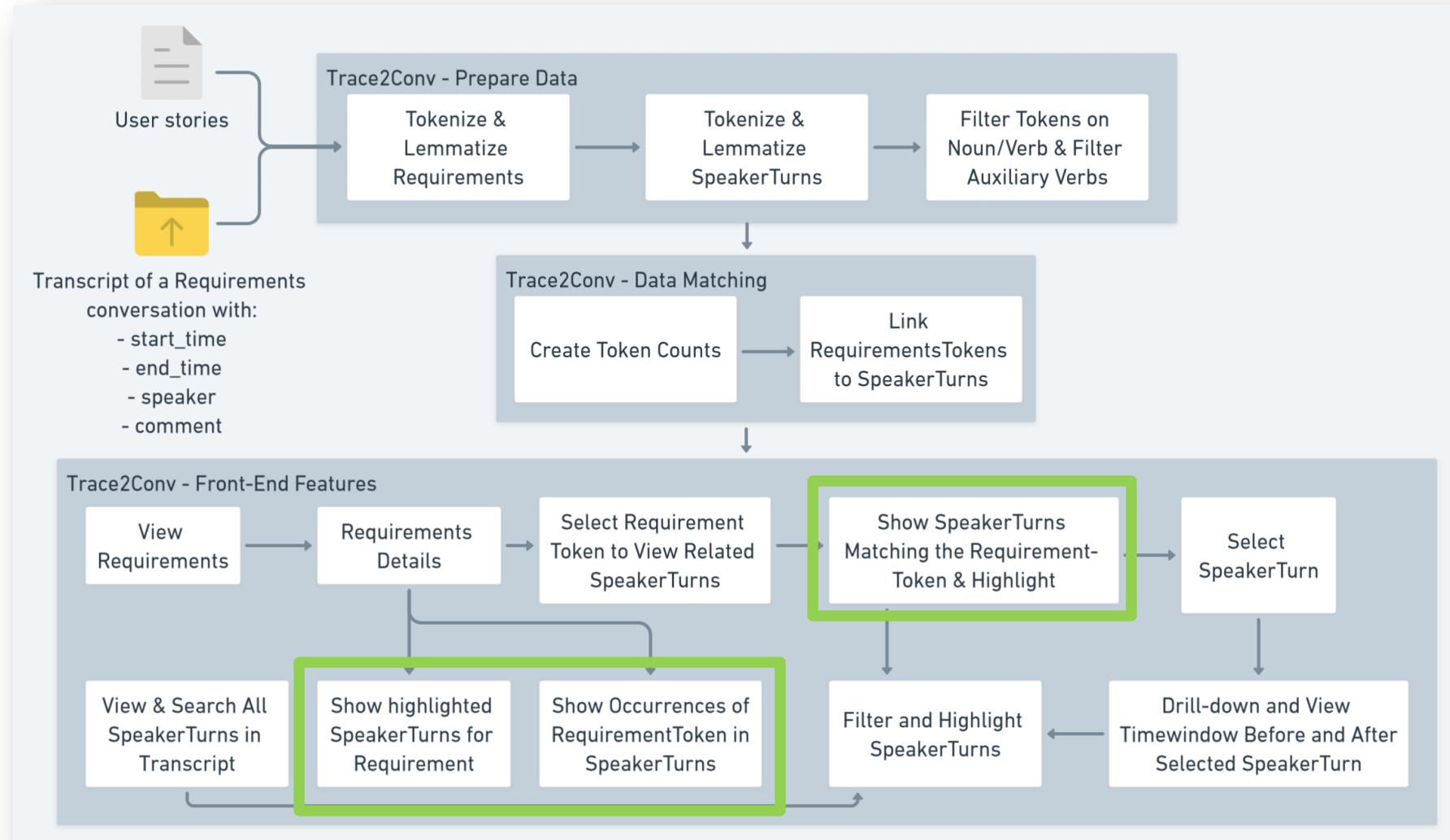
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SpeakerTurns	
<input type="checkbox"/> content	speaker_text
<input type="checkbox"/> here, are there are two genders that you would not want in the, I was gonna say see we because we have not been, I should ...	spk_3
<input type="checkbox"/> Oh. Um I mean I guess if you provide them like a secure link to click on and then they just put a new password in um As long ...	spk_2
<input type="checkbox"/> Like how do you securely do that take one email for one Vendor and allow them to create one or more named email accounts?	spk_2
<input type="checkbox"/> I think you should always be there or you should put your you can can you have multiple. Vendor	spk_4
<input type="checkbox"/> him. I think I don't know that master Vendor	spk_3

Architectural Design - Frontend



Short demo of the Trace2Conv frontend

Short demo of the Trace2Conv frontend

Trace2Conv

Login Manual Validation Requirements Transcripts

Overview

Search

Transcript 1

Subheader

Description

> Speaker Turns > Requirements

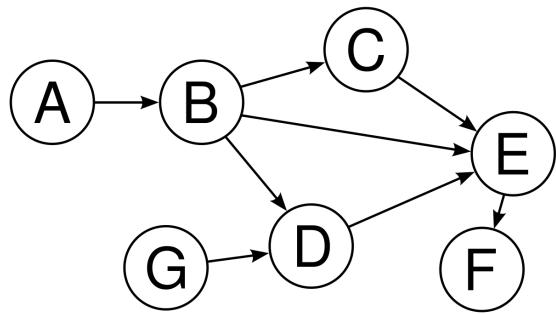
Transcript 2

Subheader

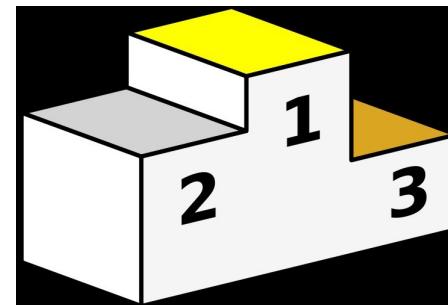
Description

> Speaker Turns > Requirements

Trace2Conv: Next Steps



Requirements **evolution** over multiple conversations

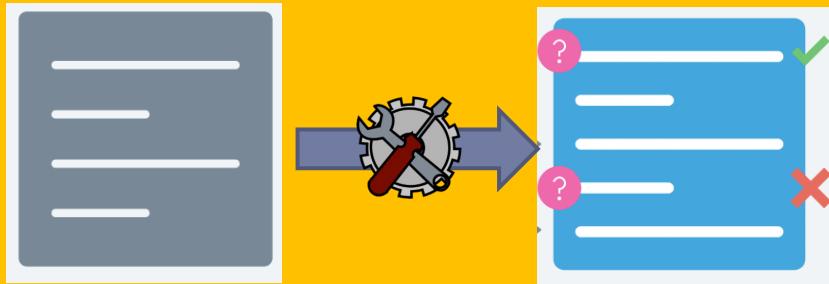


More advanced **heuristics**: what are the most likely matches?

Speaker: Utterance	Turn	Grounding	Discourse	Argumentation
A : What is the main goal of the system?	1.1	Initiate	DU1: WHQ, Check	Q&A
: What would you like for us to focus on?	1.2	Continue		
S : Let me think...	2.1	Acknowledge	DU2: Inform, Check	Clarify
: the system shall be customizable...	2.2	Initiate		
: hmm, no, configurable!	2.3	Repair	DU3: WHQ, Check	Q&A
A : Configurable, you said.	3.1	Acknowledge		
: Hmm, what do you exactly mean by that?	3.2	Initiate	DU4: Inform, Check	Q&A
S : Oh yes, sorry...	4.1	Acknowledge		
: the developers must be able to adjust parameters A and B so to serve different clients	4.2	Initiate	DUS: Request(Eval), Eval	Q&A
A : I see, clear.	5.1	Acknowledge		
: Should we use file format XYZ?	5.2	Initiate	DUS: Request(Eval), Eval	Q&A
S : Yes, absolutely.	6.1	Acknowledge		
...				

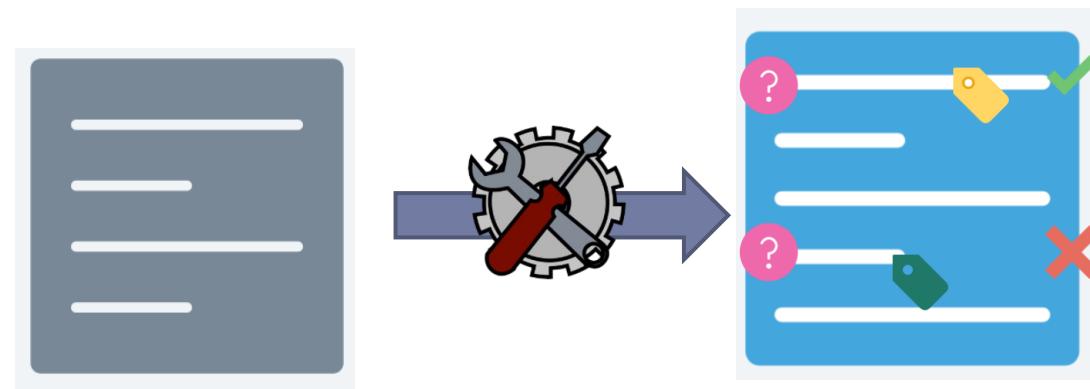
Matching segments rather than speaker turns

4. Requirements Conversations Summarizer



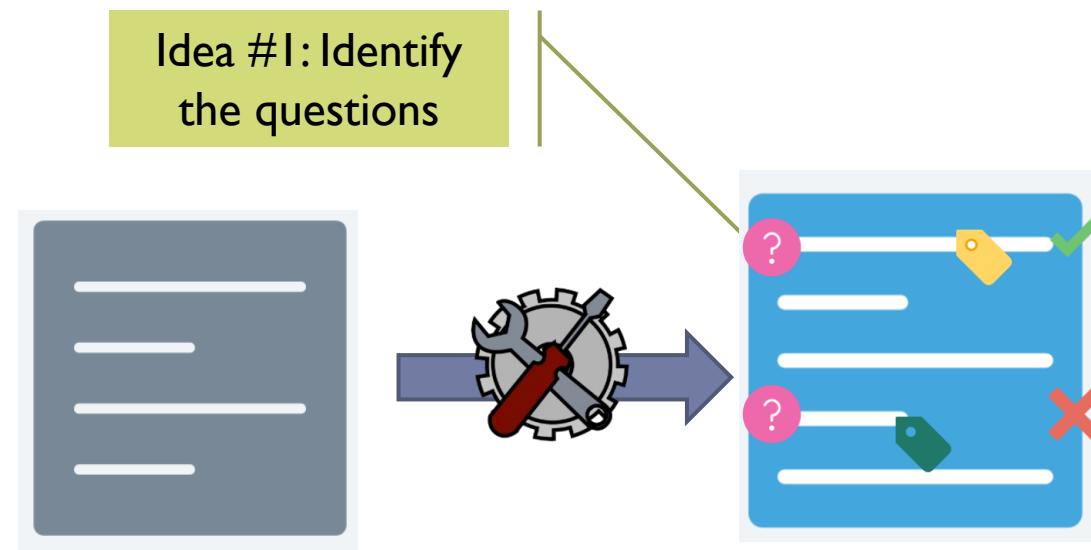
Summarizing a transcript: ideas

- ▶ Aim: summarization before a specification exists
- ▶ Trigger: long recorded conversations, spanning over multiple hours
 - ▶ How to facilitate the analyst in exploring the transcript?



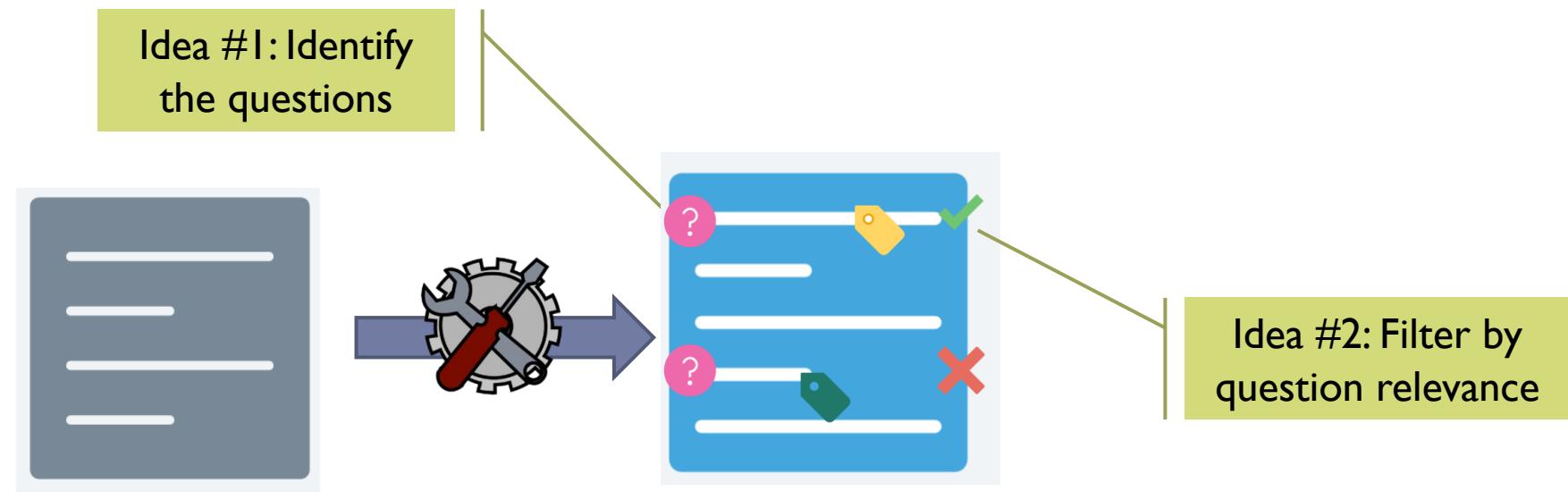
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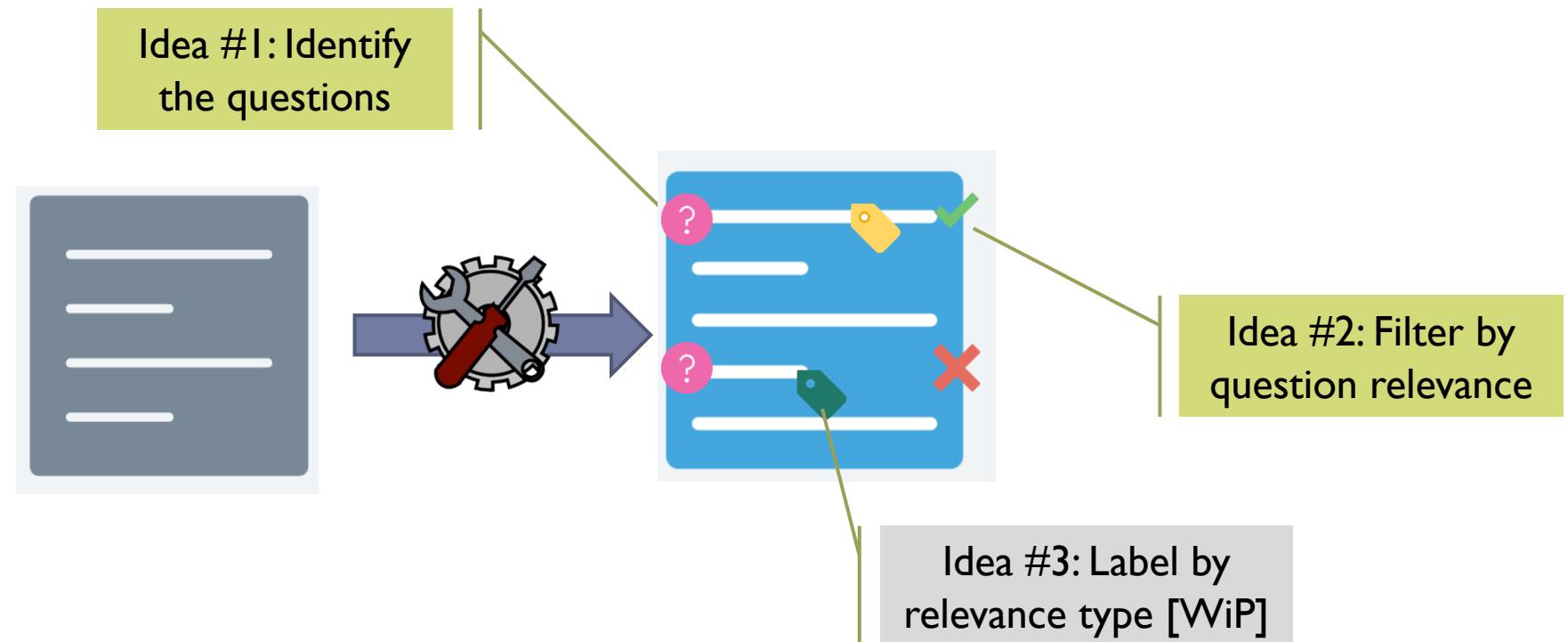
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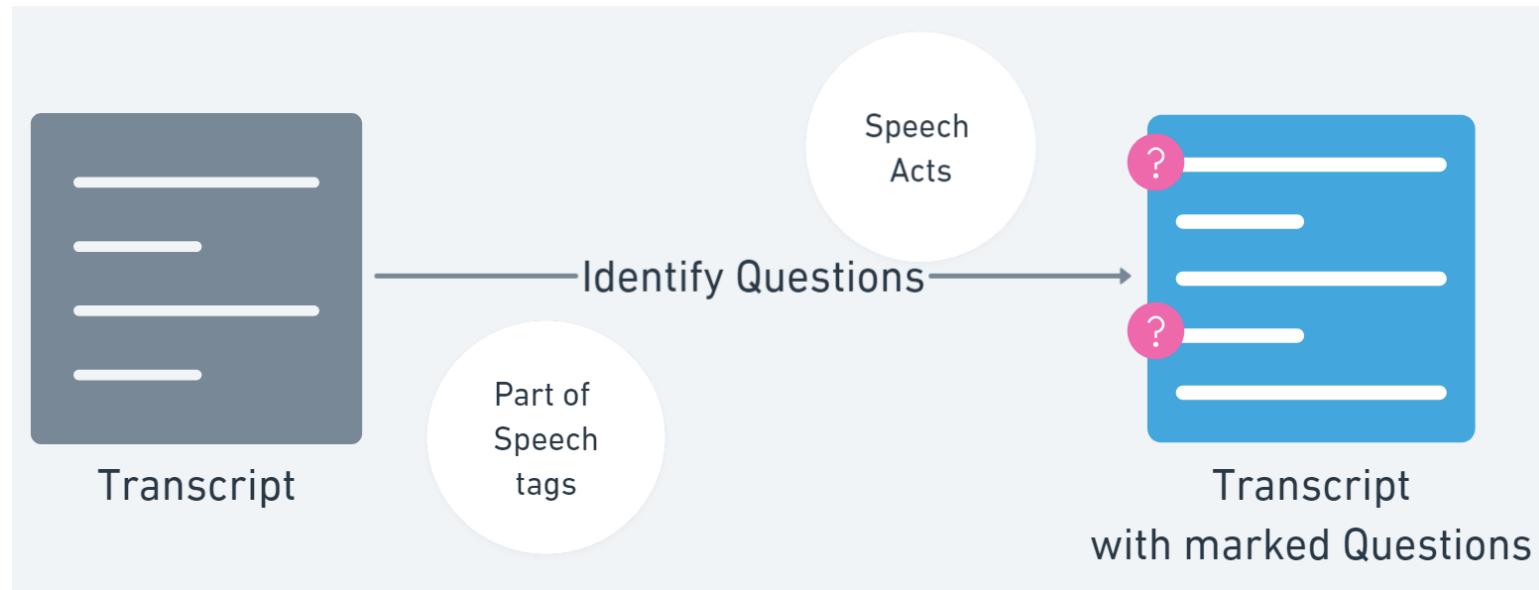


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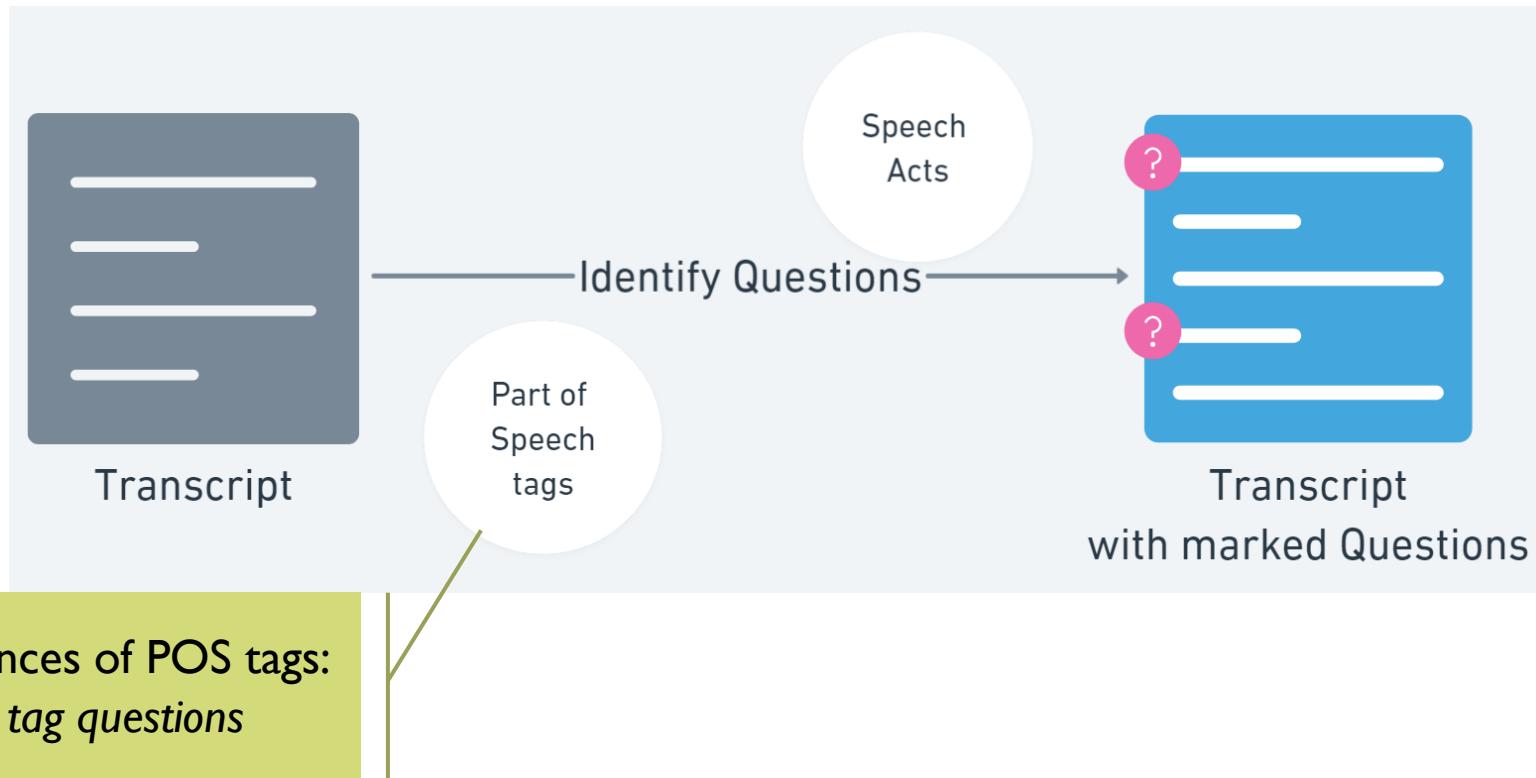
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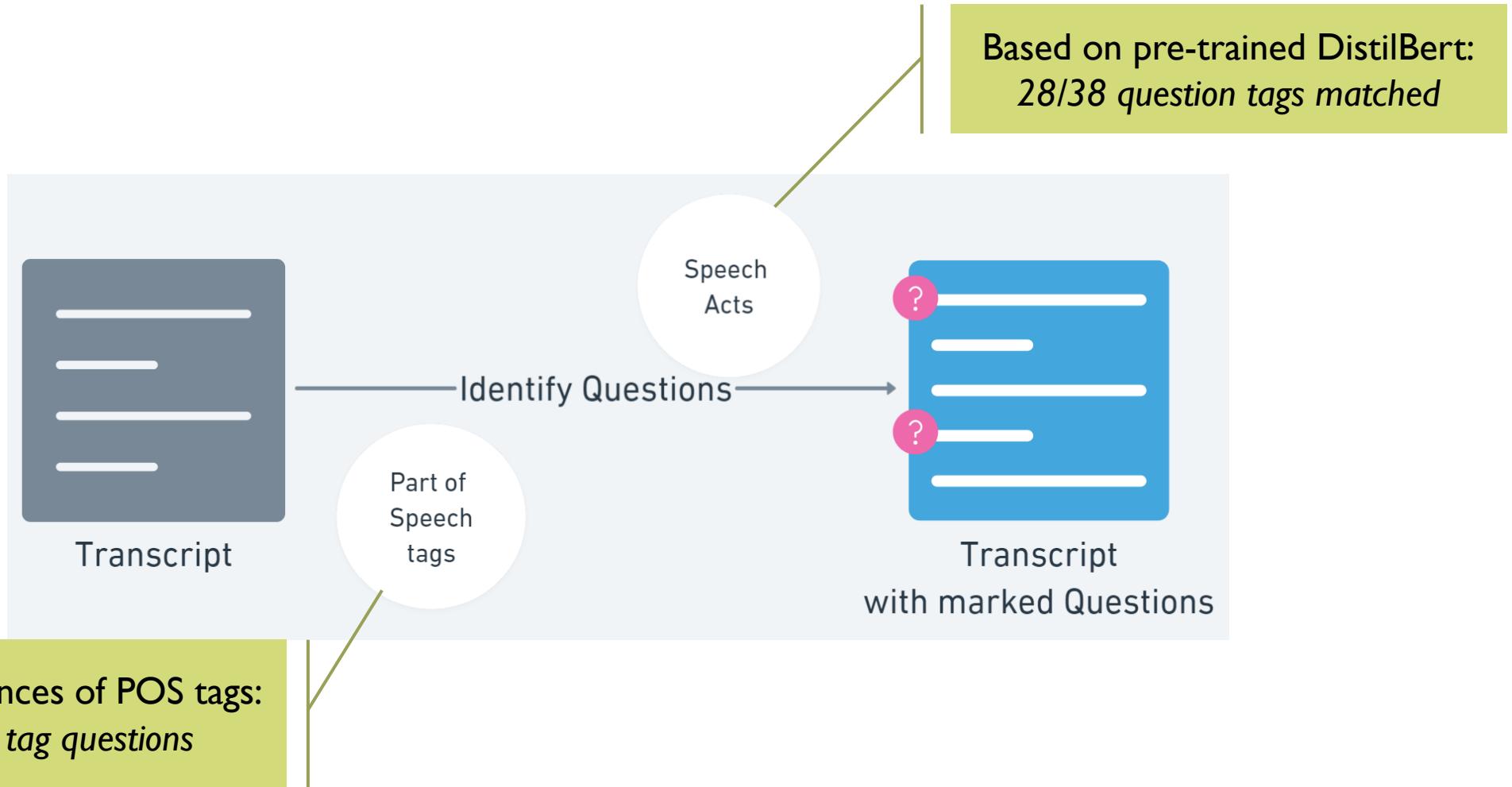
How to identify the questions? (Idea #1)



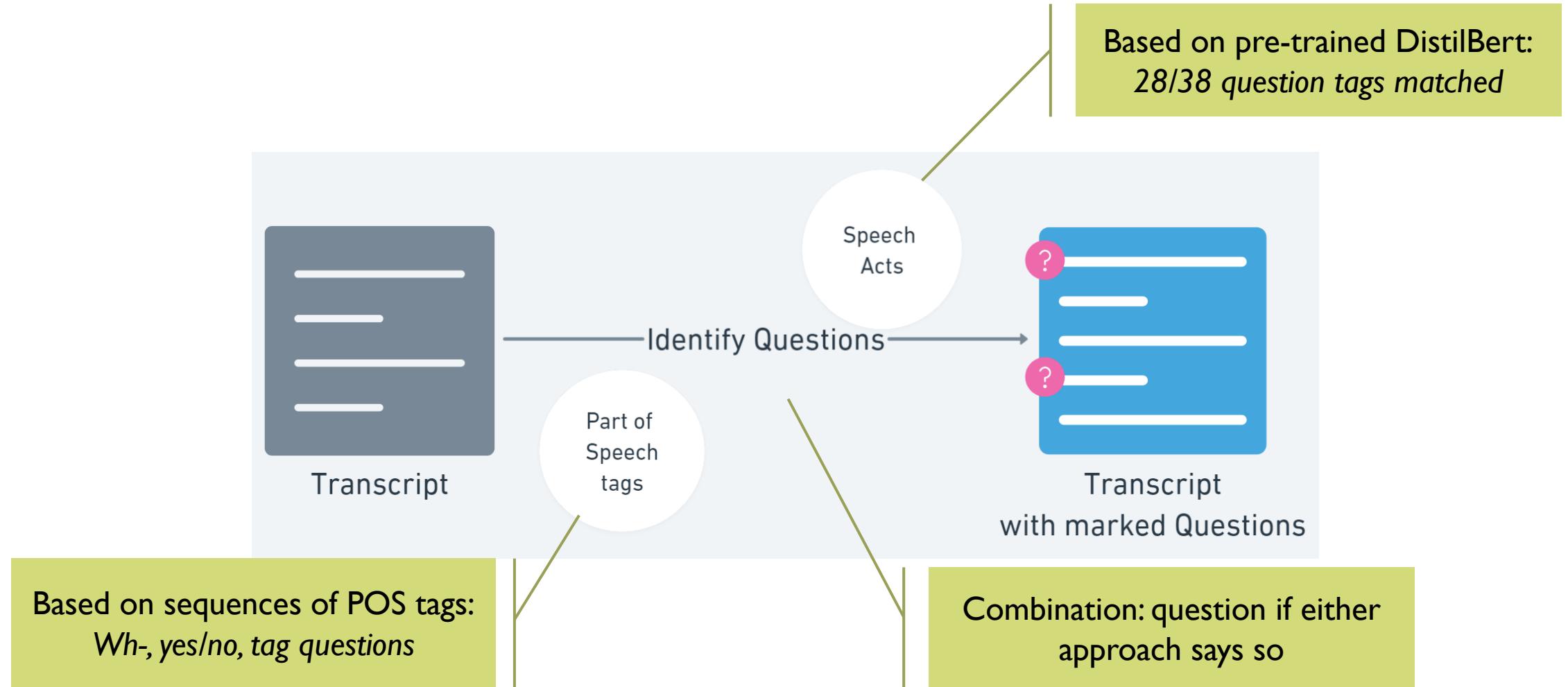
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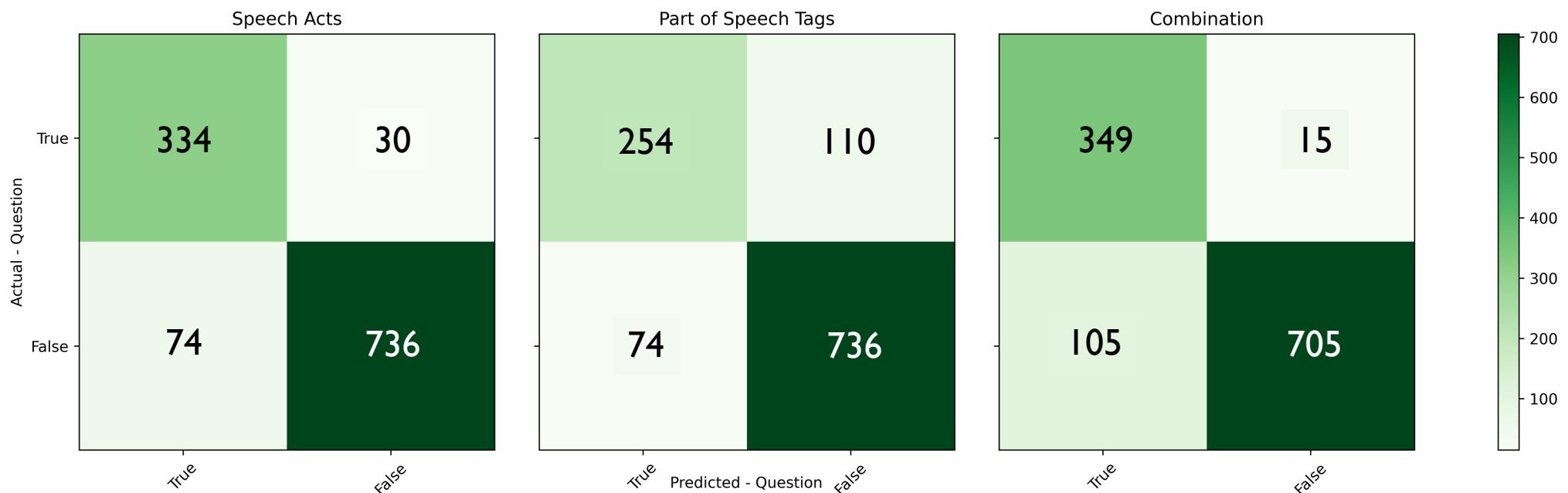
How to identify the questions? (Idea #1)



How to identify the questions? (Idea #1)

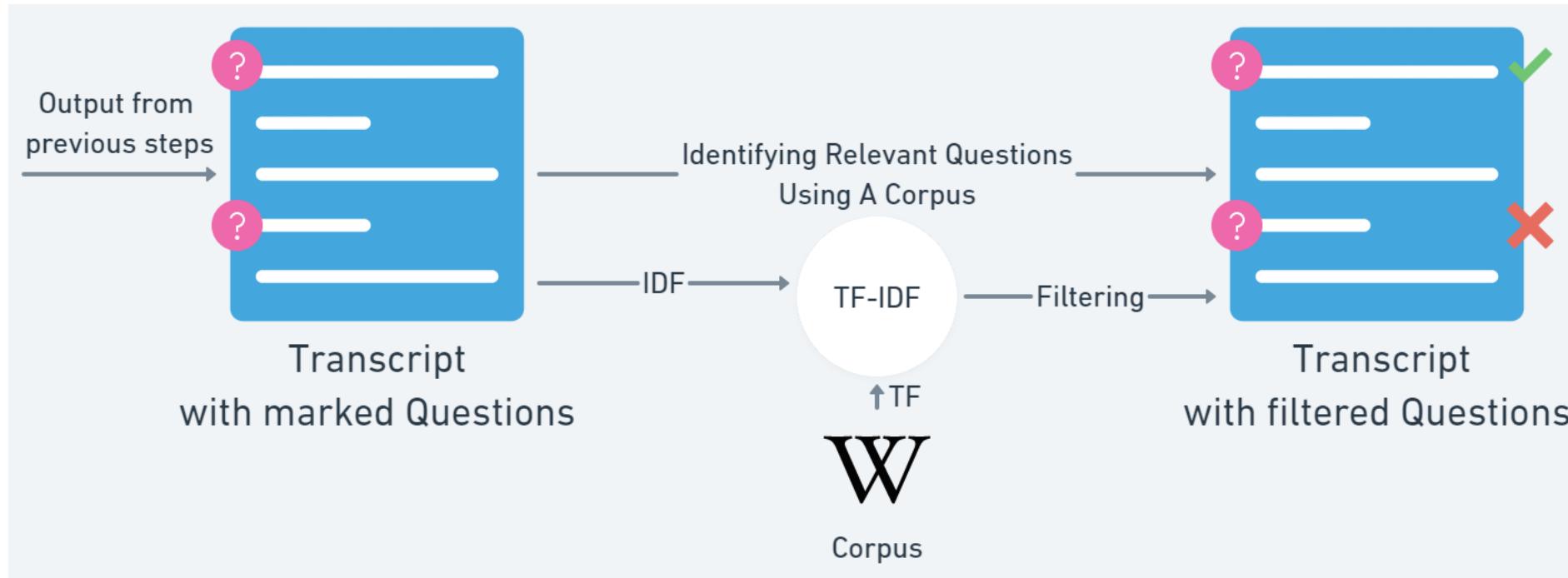


Is Idea #1 effective?

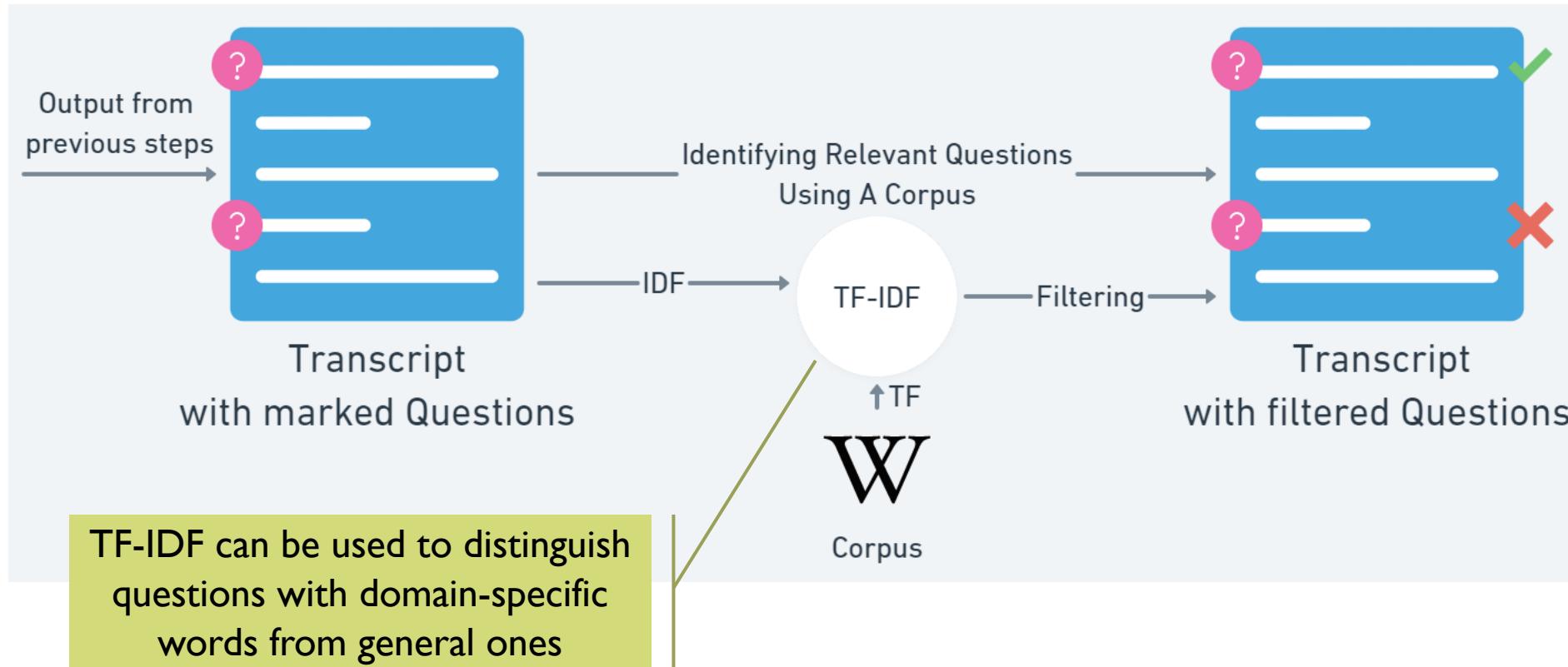


Approach	Precision	Recall	F1-score	Accuracy
Speech Acts	81.8%	91.7%	86.5%	91.1%
Part of Speech Tags	69.7%	77.4%	73.4%	84.3%
Combination	76.8%	95.8%	85.3%	89.7%

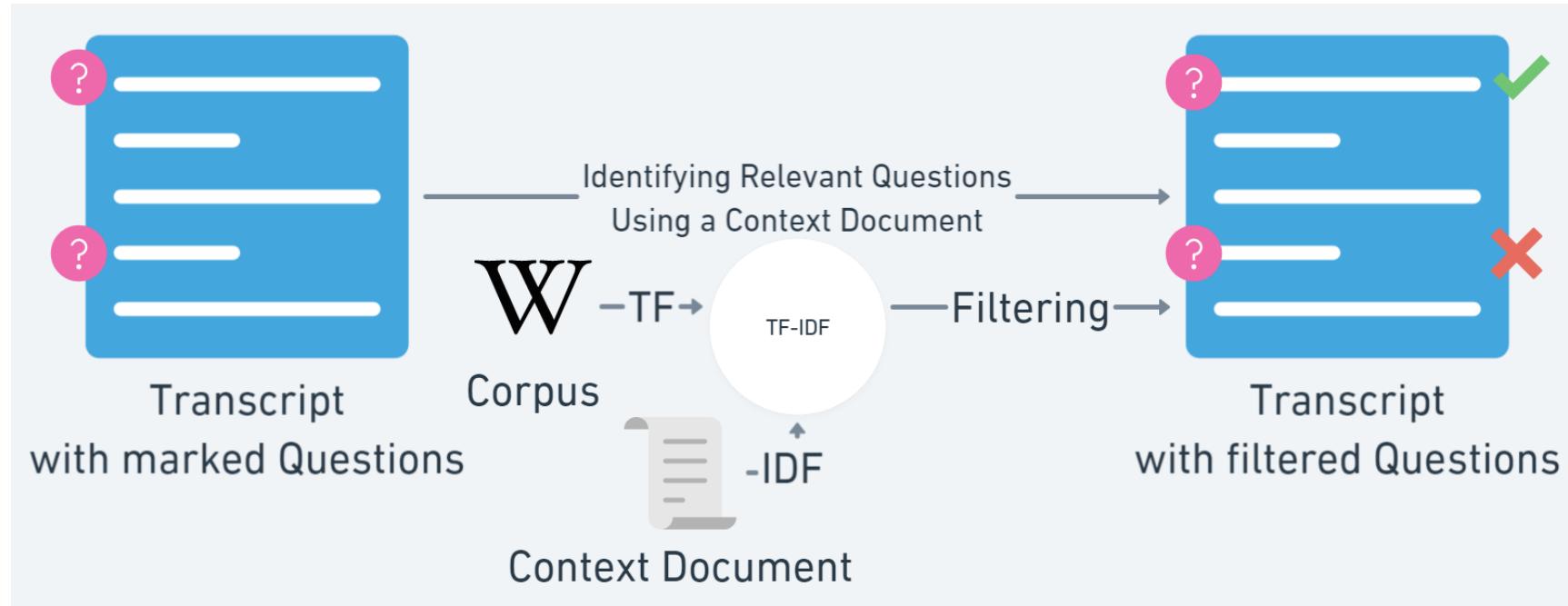
How to filter relevant questions? (Idea #2, version A)



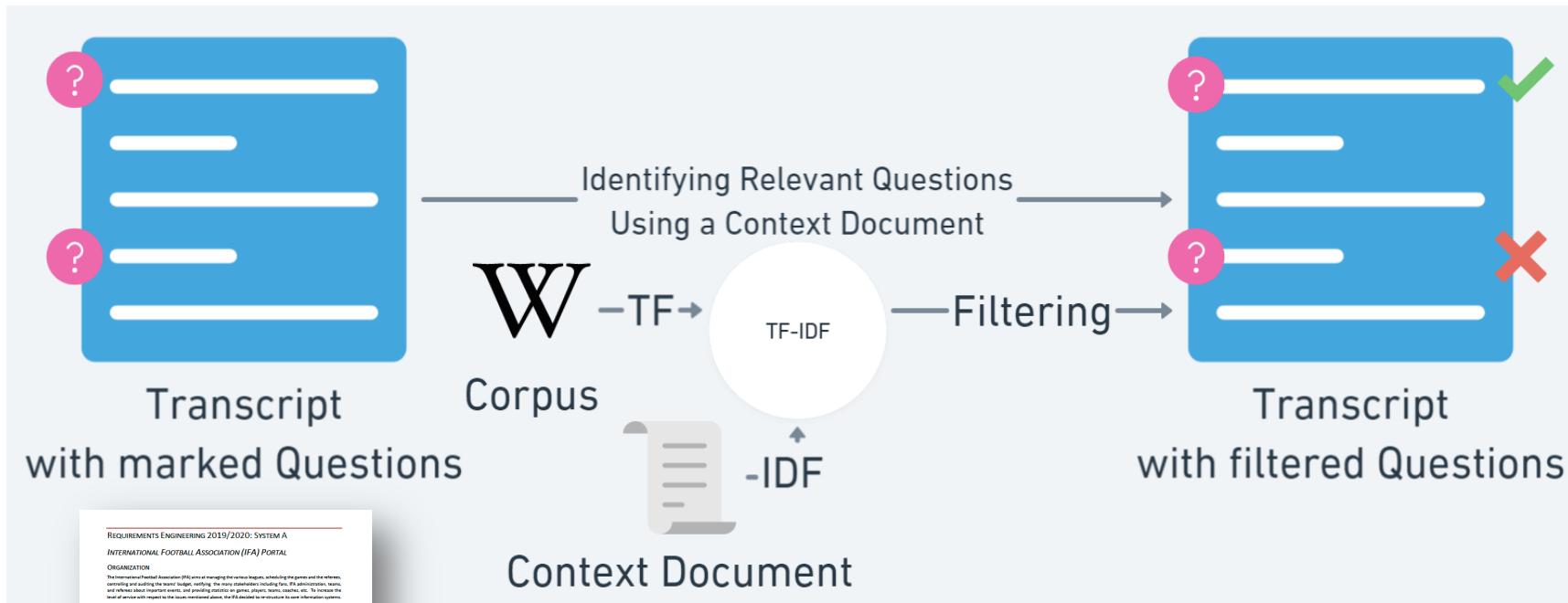
How to filter relevant questions? (Idea #2, version A)



How to filter relevant questions? (Idea #2, version B)



How to filter relevant questions? (Idea #2, version B)



A context document can be, e.g., a system/project definition document

What is our gold standard for relevance?

Previous speakturn:

Interviewee: Yes, absolutely.

Current speakturn:

Interviewer 1: Good. Um, yeah, we got an email from your company and it said that there is some serious problems with traffic congestion that leads to a bad traffic during peak hours and also from the activists that are arguing of the effect on the environment. **Do you think there are more problems or just these two?**

Next speakturn:

Interviewee: Well, this is the reason why we contacted you and actually we believe a lot in ah environmental concerns and I'm an activist myself. So that's I cycle here, right? Not only for the body, it's for the environment. Ah, so yes, there is traffic and there is environmental problems to be solved and yeah, to the extent we can we want to improve on that. And I hope you have a solution for me.

What is our gold standard for relevance?

Previous speakturn:

Interviewee: Yes, absolutely.

Current speakturn:

Interviewer 1: Good. Um, yeah
and it said that there is some stuff
that leads to a bad traffic during
that are arguing of the effect of
are more problems or just the

Next speakturn:

Interviewee: Well, this is the thing
we believe a lot in ah environment.
So that's I cycle here, right? Not
environment. Ah, so yes, there
problems to be solved and yeah
improve on that. And I hope you

Q6/52: What type of requirements-relevant information can be found here?

(Disregarding the previous speakturn, only looking at the current and the next speakturn)

- A functional requirement (functionalities that the system should exhibit, e.g. registering users, scheduling events, calculating something, ...)
- A non-functional requirement (a quality that should be there given certain functionality, e.g. speed, security, capacity, compatibility, usability, ...)
- System users (directly discusses the users of the system, or stakeholders)
- Current process understanding (talks about the system as-is, problems that are faced or things that have to improve)
- Within or outside of the scope (directly talking about certain things that are inside the scope of the system to-be or not, boundaries discussed)
- There is no requirements-relevant information

Previous

Next

What is our gold standard for relevance?

Previous speakerturn:

Interviewee: Yes, absolutely.

Current speakerturn:

Interviewer 1: Good. Um, yeah and it said that there is some stuff that leads to a bad traffic during that are arguing of the effect of are more problems or just the

Next speakerturn:

Interviewee: Well, this is the way we believe a lot in ah environment. So that's I cycle here, right? Not environment. Ah, so yes, there are problems to be solved and yeah improve on that. And I hope you

Q6/52: What type of requirements-relevant information can be found here?

(Disregarding the previous speakerturn, only looking at the current and the next speakerturn)

- A functional requirement (functionalities that users, scheduling events, calculating something)
- A non-functional requirement (a quality that e.g. speed, security, capacity, compatibility)
- System users (directly discusses the user)
- Current process understanding (talks about things that have to improve)
- Within or outside of the scope (directly talking about the scope of the system to-be or not, boundaries)
- There is no requirements-relevant information

Q6/52: Where is this requirements-relevant information located?

- The question in the current speakerturn can be answered with requirements-relevant information
- The next speakerturn (after the question) contains requirements-relevant information

Previous

Next

Previous

Next

Is Idea #2 effective?

Idea 1	Idea 2	Precision	Recall	F1-score	Accuracy
SA	Context Doc.	64.4%	70.3%	67.2%	86.7%
SA	Conversation	64.4%	66.4%	65.4%	86.4%
POS	Context Doc.	53.8%	62.4%	57.8%	82.5%
POS	Conversation	53.9%	63.3%	58.2%	82.4%
COMB	Context Doc.	55.0%	81.7%	65.7%	83.5%
COMB	Conversation	55.7%	81.2%	66.1%	83.9%

No large differences between the approaches – Ideas #2A and #2B are practically equivalent

Summarization: outlook

- ▶ What does relevance mean?
 - ▶ Large disagreement, especially on questions

Set	Amount	Percentage	Set	Question	Answer
2	44	46.31%	2	77.27%	27.27%
4	44	50.58%	4	72.73%	29.55%
5	23	41.07%	5	69.57%	30.43%
6	5	12.20%	6	60.00%	40.00%
7	27	25.71%	7	62.96%	37.04%
9	28	43.75%	9	53.57%	46.43%
10	44	48.35%	10	81.82%	18.18%
12	15	15.31%	12	66.67%	33.33%
16	8	14.55%	16	50.00%	50.00%
Total	238	34.40%	Total	70.17%	31.09%

Summarization: outlook

▶ What does relevance mean?

- ▶ Large disagreement, especially on questions

Set	Amount	Percentage
2	44	46.31%
4	44	50.58%
5	23	41.07%
6	5	12.20%
7	27	25.71%
9	28	43.75%
10	44	48.35%
12	15	15.31%
16	8	14.55%
Total	238	34.40%

Set	Question	Answer
2	77.27%	27.27%
4	72.73%	29.55%
5	69.57%	30.43%
6	60.00%	40.00%
7	62.96%	37.04%
9	53.57%	46.43%
10	81.82%	18.18%
12	66.67%	33.33%
16	50.00%	50.00%
Total	70.17%	31.09%

▶ How much can we summarize?

- ▶ End goal of the tool

Set	Shown	Taggable	Questions	Relevant
2	70.060%	56.886%	31.138%	17.365%
4	72.973%	58.784%	32.432%	22.297%
5	70.408%	57.143%	30.612%	20.408%
6	72.464%	59.420%	30.435%	21.739%
7	73.743%	58.659%	31.285%	10.615%
9	67.241%	55.172%	26.724%	13.793%
10	67.901%	56.173%	30.247%	25.309%
12	74.194%	63.226%	36.129%	28.871%
16	77.500%	68.750%	38.750%	23.750%
Total	71.635%	58.944%	31.857%	19.506%

5. Outlook



Tools for Conversational RE: Two Examples

Trace2Conv

The system automatically sends an e-mail to the contact person of every vendor that is imported through the connection with JD Edwards so that he receives a link where he can create his password

system	sends	e-mail	contact	person
Occurs 15 Times over 15 turns Occurs in 14 requirements	Occurs 31 Times over 27 turns Occurs in 4 requirements	Occurs 7 Times over 0 turns Occurs in 5 requirements	Occurs 7 Times over 7 turns Occurs in 2 requirements	Occurs 32 Times over 24 turns Occurs in 4 requirements
VIEW SPEAKER TURNS	VIEW SPEAKER TURNS	VIEW SPEAKER TURNS	VIEW SPEAKER TURNS	VIEW SPEAKER TURNS

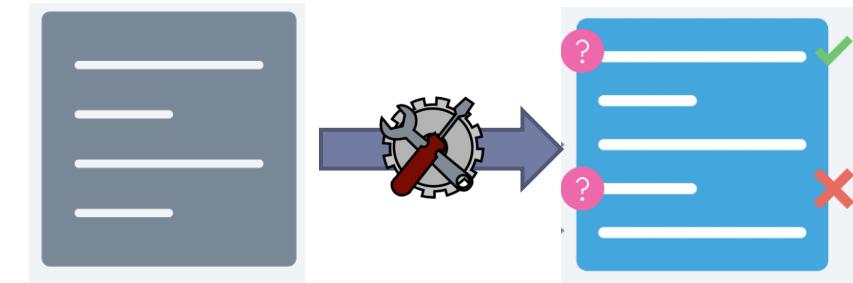
vendor	imported	connection	JD	Edwards
Occurs 62 Times over 51 turns Occurs in 15 requirements	Occurs 6 Times over 7 turns Occurs in 1 requirements	Occurs 7 Times over 7 turns Occurs in 4 requirements	Occurs 12 Times over 12 turns Occurs in 4 requirements	Occurs 1 Times over 1 turns Occurs in 4 requirements
VIEW SPEAKER TURNS	VIEW SPEAKER TURNS	VIEW SPEAKER TURNS	VIEW SPEAKER TURNS	VIEW SPEAKER TURNS

receives	link	create	password
Occurs 19 Times over 15 turns Occurs in 4 requirements	Occurs 2 Times over 2 turns Occurs in 5 requirements	Occurs 10 Times over 11 turns Occurs in 8 requirements	Occurs 12 Times over 10 turns Occurs in 8 requirements
VIEW SPEAKER TURNS	VIEW SPEAKER TURNS	VIEW SPEAKER TURNS	VIEW SPEAKER TURNS

MULTIPLE (SINGLE) TOKEN OCCURRENCES SCORING MECHANISM MULTIPLE TOKENS

speakerturnid : 2517
spk_3
VIEW
00:12:18 - 00:13:31
contains the token: vendor 4times

i would say that it's so that **Vendor** 5 can easily access information, we get a lot of phone calls right now within either accounts payable or the departments and **Vendor** 5 want to know whether or not we received the invoice, is it being processed, hasn't been paid, so we're hoping that this will eliminate a lot of those conversations and make it much easier for them to get information as well as um like you said that the address book thing, the history, um and hopefully maybe choose, like being able to upload their invoices through that process, yeah, leslie said, so, moving toward electronic, i think is gonna be a big objective, um kind of a big undertaking for us, we've got about 6000 **Vendor** in je, a couple 1000 of them are active, so first off, we're gonna clean up, but that's really the target, ideally we would have as many of those **Vendor** as possible, sending us either emailing electronic invoices are uploading them through the portal, so that's a that's a big part of our success



Trace2Conv:
pre-RS traceability

Requirements Conversation
Summarizer

Direction #3: distilling requirements?

- ▶ Can we automatically generate requirements from conversations?
- ▶ Long-term direction
 - ▶ High value
 - ▶ Extremely challenging
 - ▶ Rarely mentioned in an explicit way
(Spijkman, CAiSE'21)

Category	Text tagged	Tags
1. Current process	31.2%	35.2%
2. Future process	16.8%	18.1%
3. Explicit requirements	12.0%	8.6%
4. Questions	4.5%	19.1%
5. Product functionality	7.2%	12.5%
6. Organizational problem	2.1%	4.0%
7. Organizational details	0.9%	2.0%
8. Product motivation	0.1%	0.7%

Direction #3: distilling requirements?

- ▶ Can we automatically generate requirements from conversations?
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6. Organizational problem	2.1%	4.0%
7. Organizational details	0.9%	2.0%
8. Product motivation	0.1%	0.7%

Concept Extraction in Requirements Elicitation Sessions: Prototype and Experimentation

Tjerk Spijkman^{b,a}, Boris Winter^a, Sid Bansidhar^a and Sjaak Brinkkemper^a

^aDept. of Information and Computing Sciences, Utrecht University, Utrecht, the Netherlands

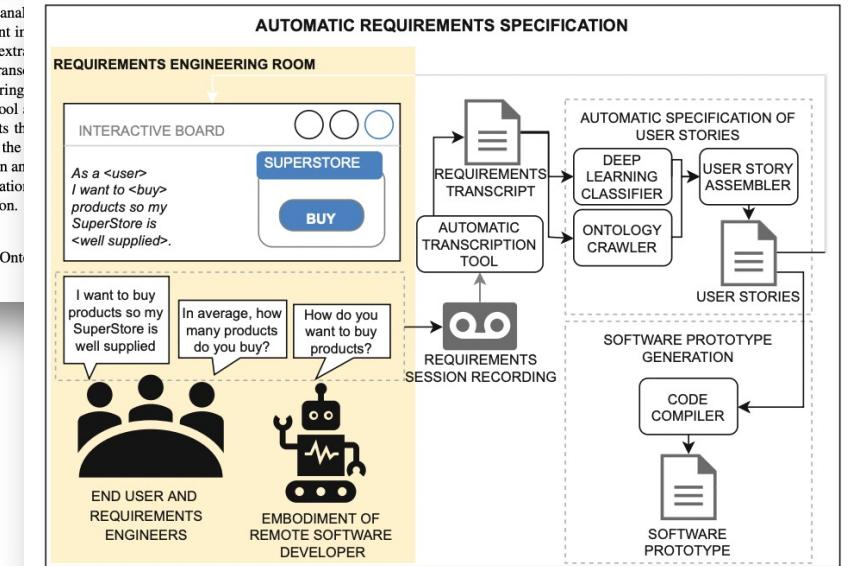
^bfizor, Utrecht, the Netherlands

Abstract

[Introduction] Requirements elicitation is an important yet complex step in the software development life cycle. It is vital for business analysts to understand what users want. However, requirements elicitation requires a vastly different interaction than other software engineering tasks. In this paper, we propose a novel approach to requirements elicitation by extracting concepts from user utterances. We designed a prototype NLP tool to extract concepts from user utterances. We then validated the results through expert validation. The validation showed that the system can extract concepts from user utterances. This work provides a promising foundation for future research on requirements elicitation.

Keywords

Requirements Engineering, Ontology, Natural Language Processing



Spijkman & al.,
NLP4RE'21

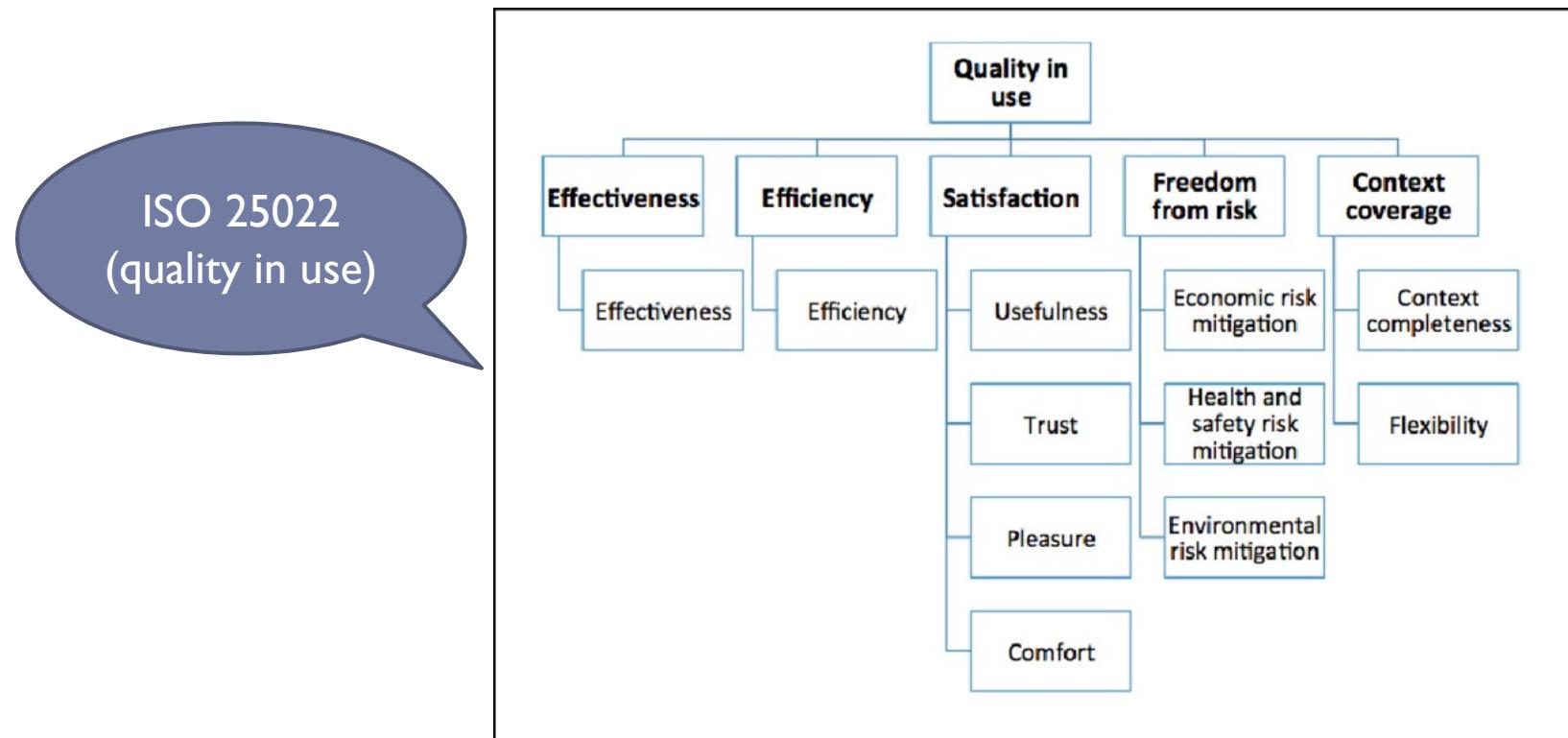
Ruiz & Hasselman,
EMMSAD'20

The future of evaluation metrics

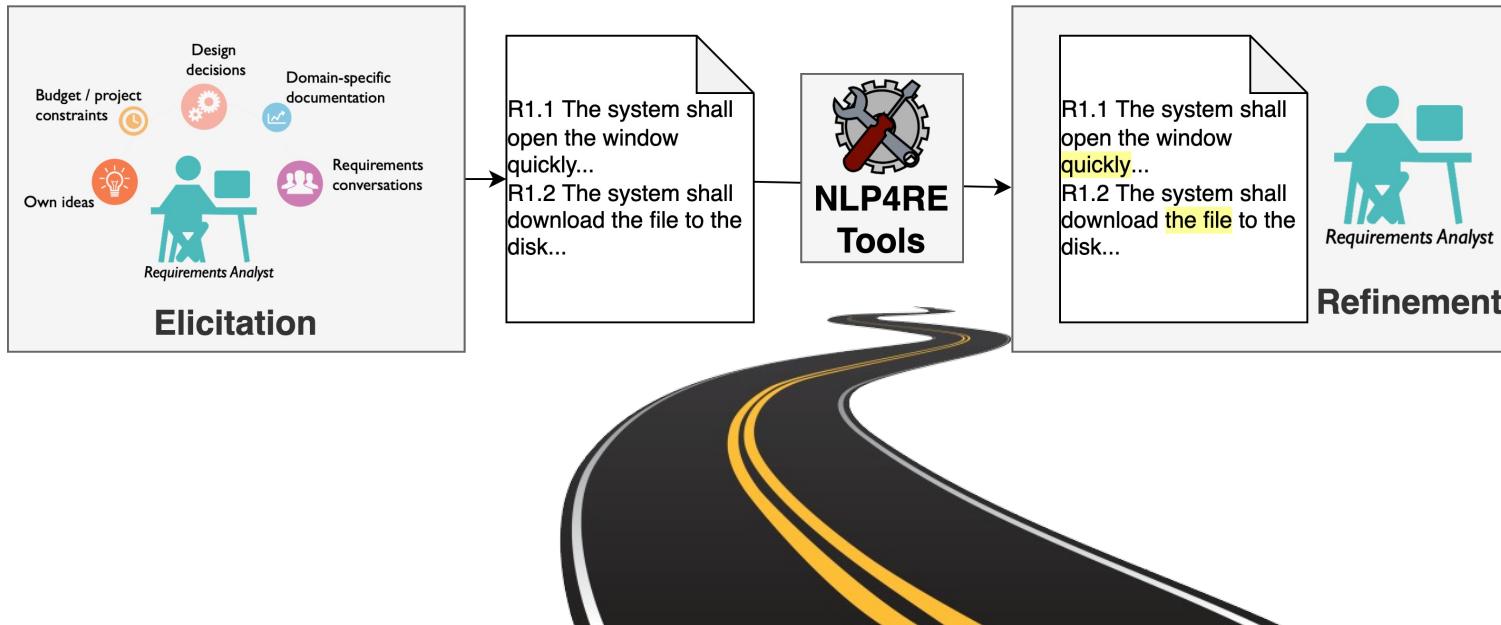
- ▶ Most of the literature employs information retrieval metrics
 - ▶ Precision, recall, F1, ...
- ▶ Progressive shift toward **quality-in-use** with conversational RE tools?

The future of evaluation metrics

- ▶ Most of the literature employs information retrieval metrics
 - ▶ Precision, recall, F1, ...
- ▶ Progressive shift toward **quality-in-use** with conversational RE tools?

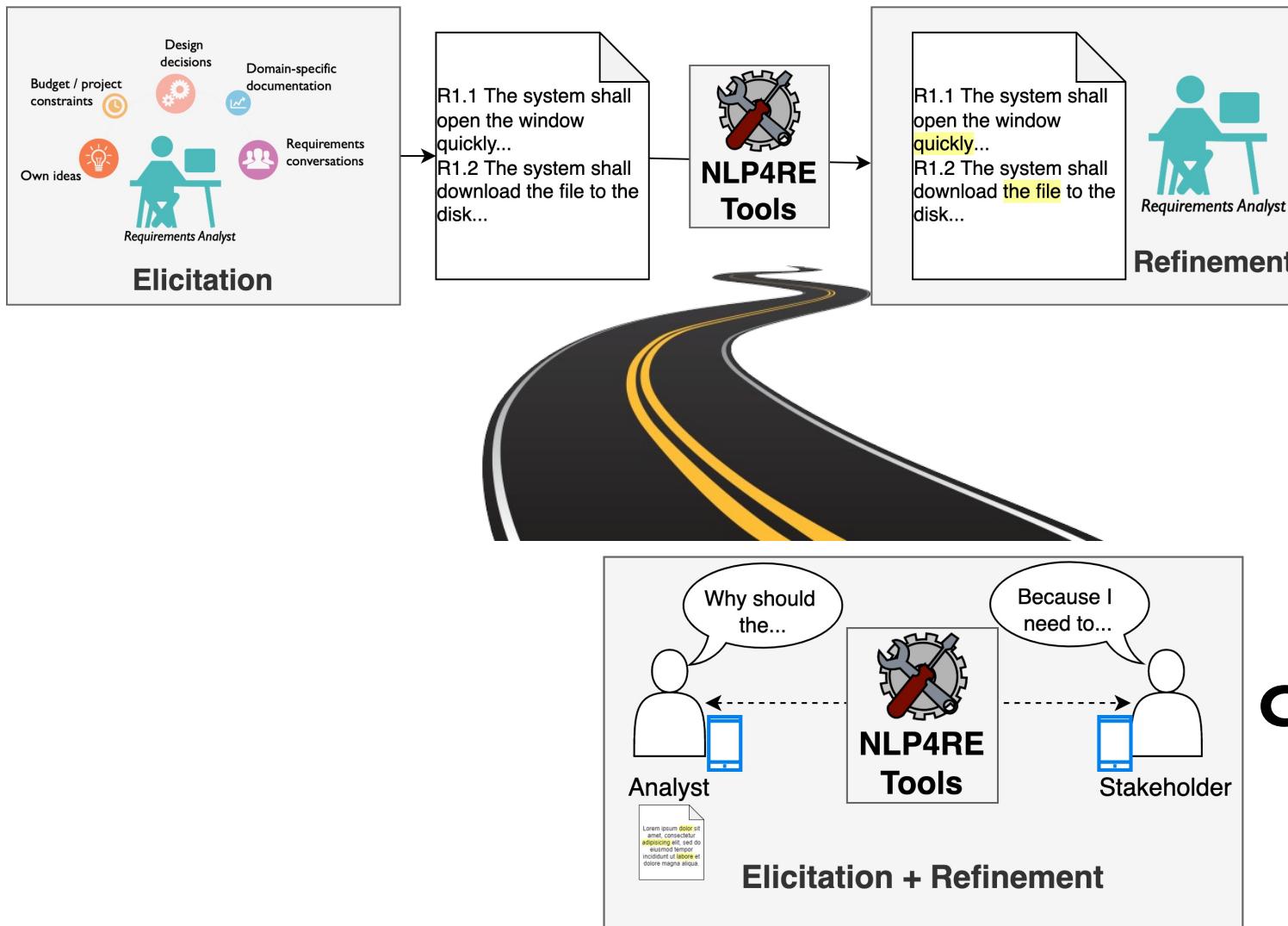


The way ahead...



Today's NLP4RE Tools

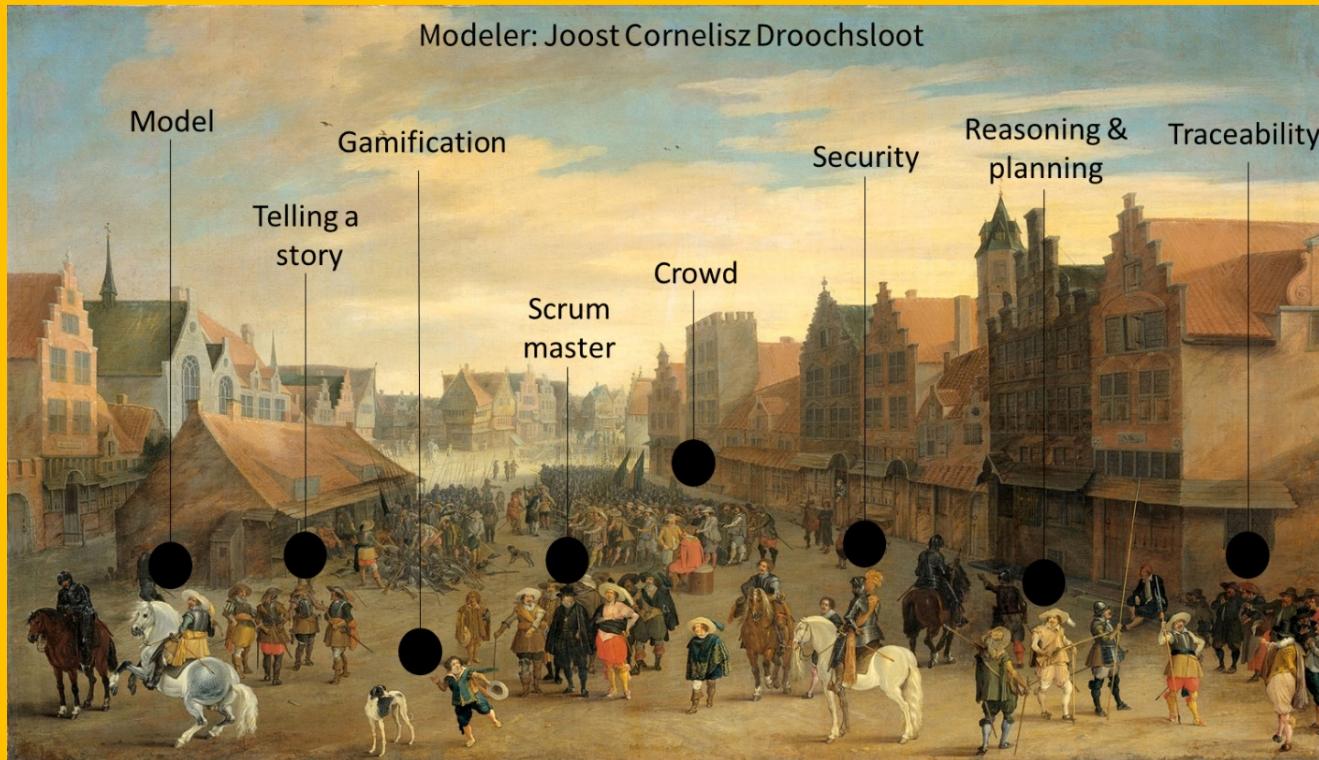
The way ahead...



Today's NLP4RE Tools

Conversational RE Tools

Thank you for listening! Questions?



RE-Lab's research illustrated, 2018



f.dalpiaz@uu.nl



@FabianoDalpiaz

