

Topic Modeling in Healthcare Conversations

Leehee Barak
Yair Ben-Horin
Adir Golan



Mentor: Dina Bavli
Laguna: Yael Adam, Dana Sinai,
Shani Gershstein

The Company and The Product



Bridging the gap between
care managers and patients

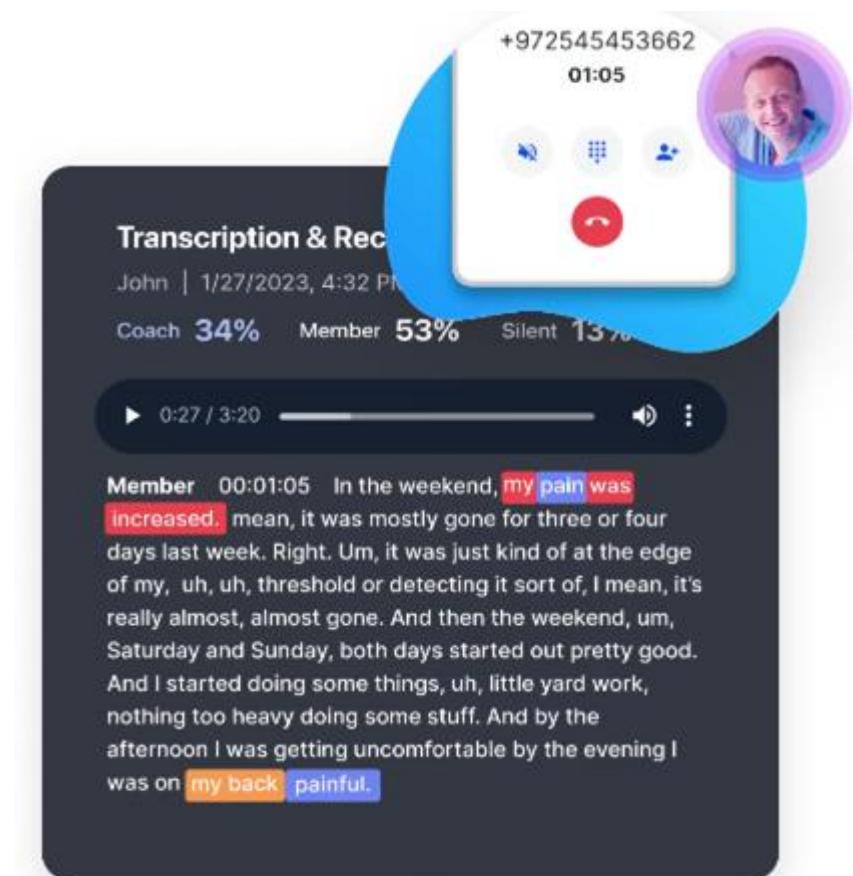
Member



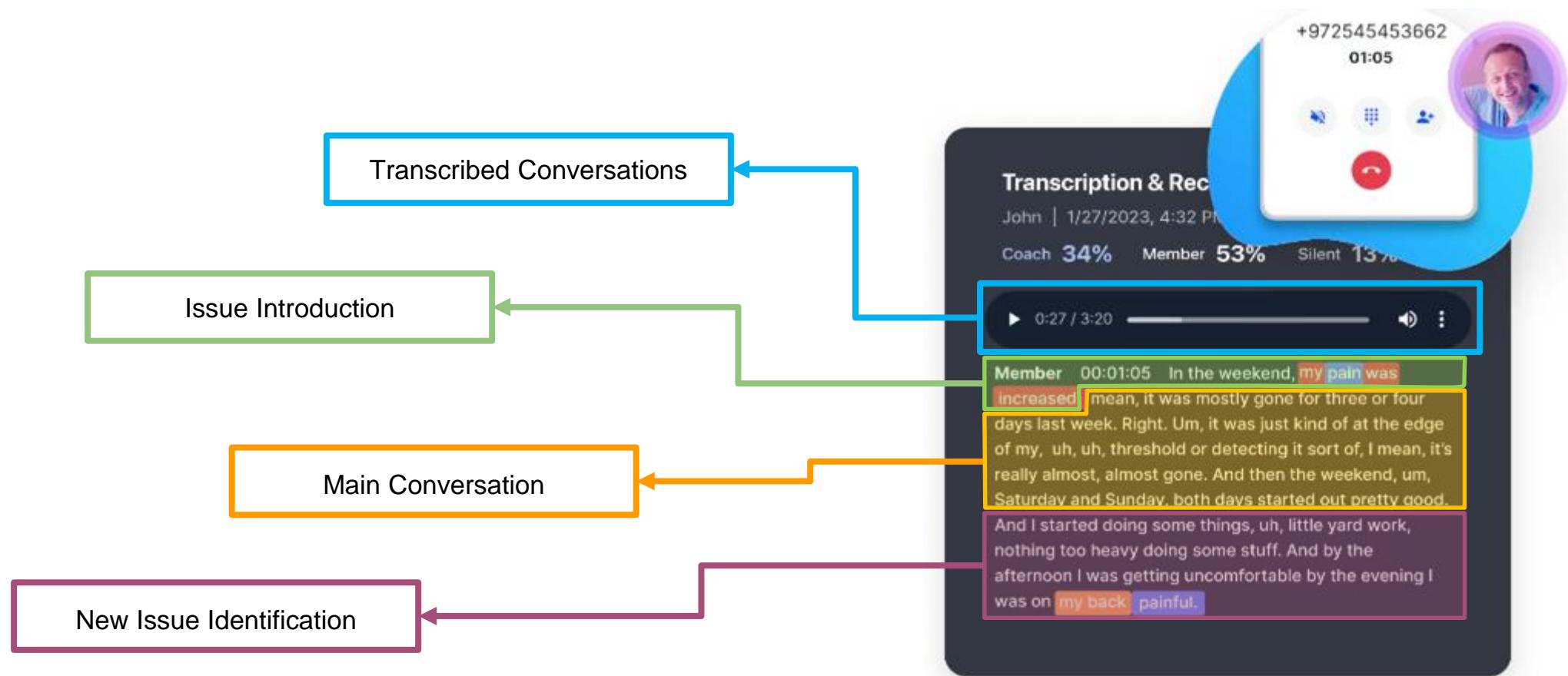
Care Manager



Project Goal – Topic Modeling



Project Goal – Topic Modeling



Topic Examples



Topic 2: Call Recording Disclosure

Topic Examples



Topic 2: Call Recording Disclosure

[UNSUBSCRIBE](#)

Topic 6: TCPA Compliance

Topic Examples



Topic 2: Call Recording Disclosure

[UNSUBSCRIBE](#)



Topic 9: Care Coordination

Topic 6: TCPA Compliance

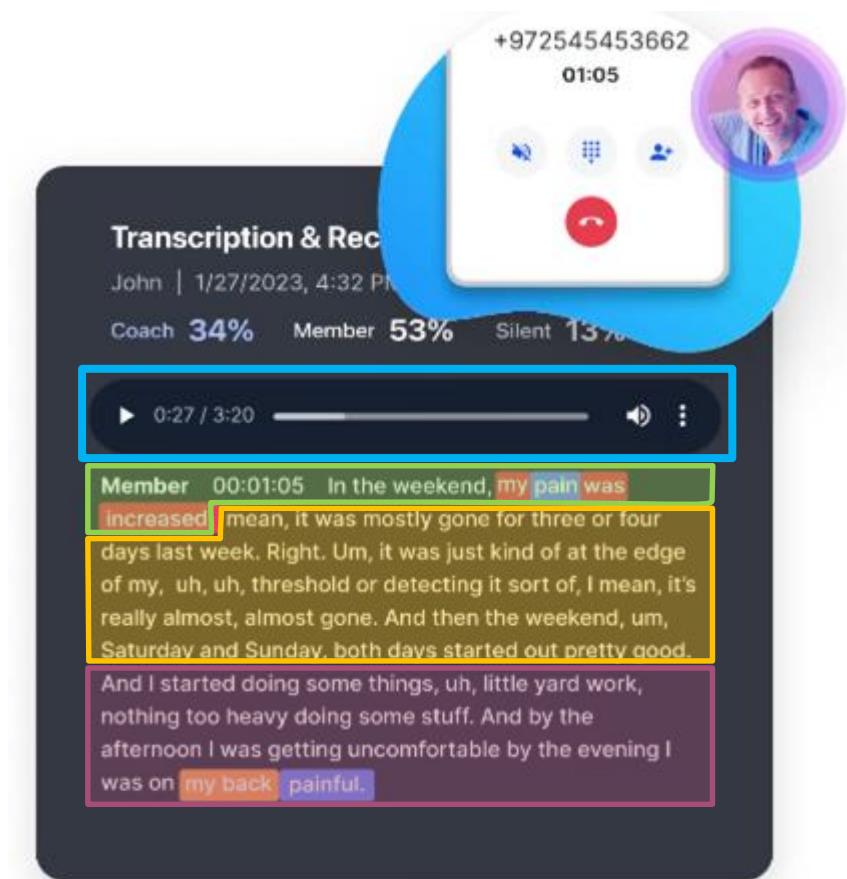
DATA

Not Your Typical
Natural Language Processing (NLP) Task

- ▶ Unlabeled
- ▶ Conversational
- ▶ Transcriptional
- ▶ De-Identified

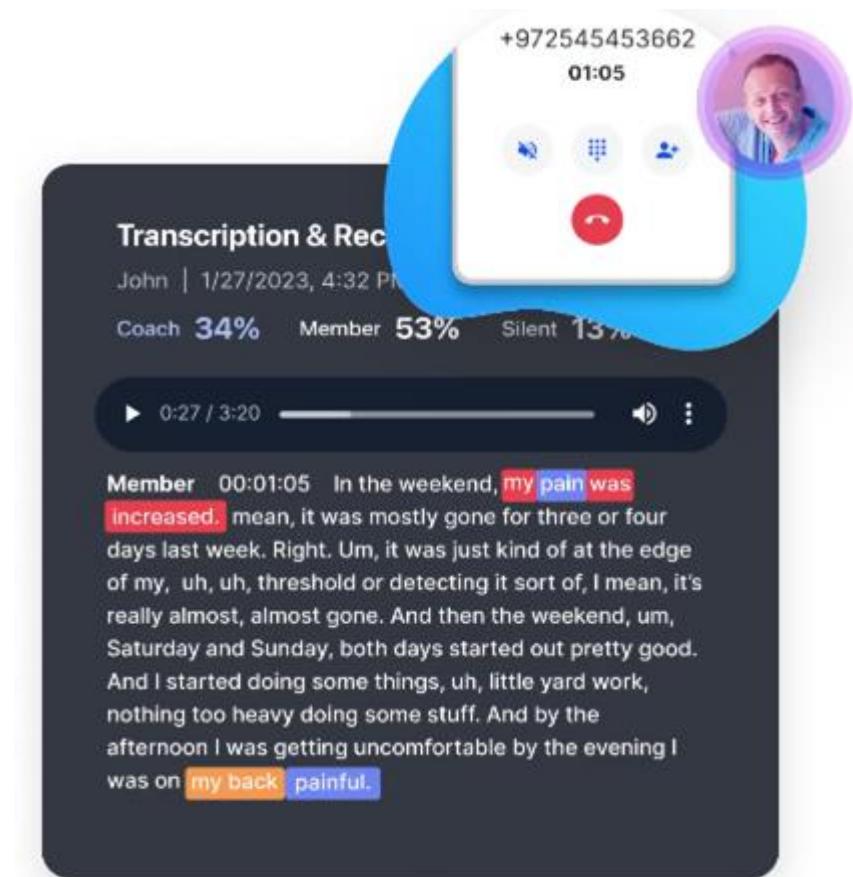
Unlabeled Data

Task: Identifying topics



Unlabeled Data

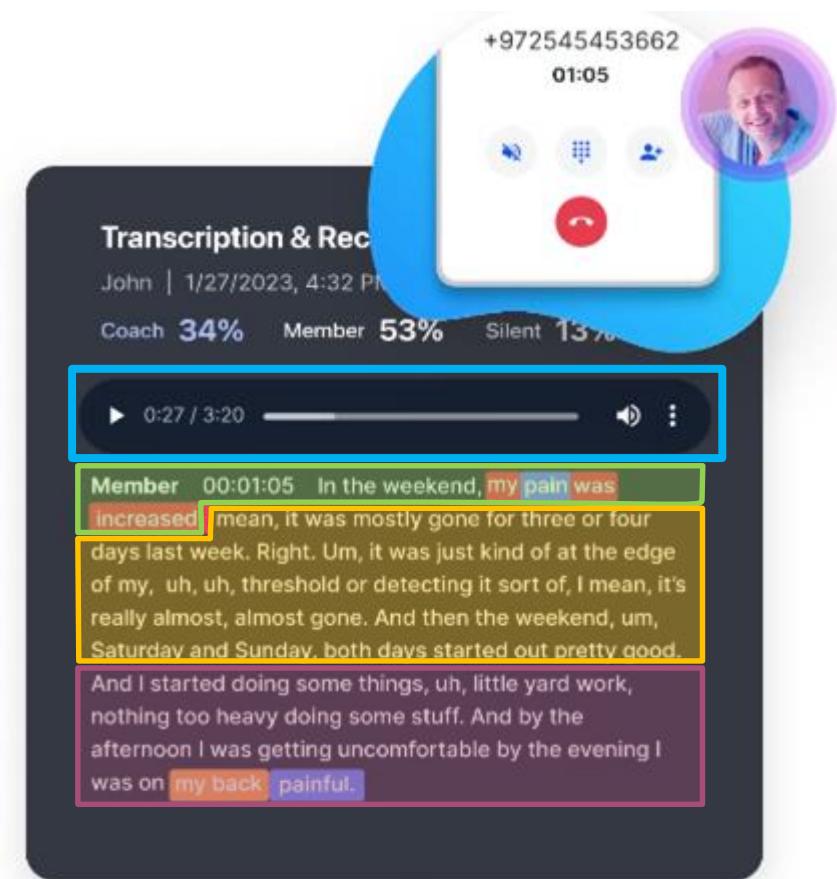
Task: Identifying topics



Unlabeled Data

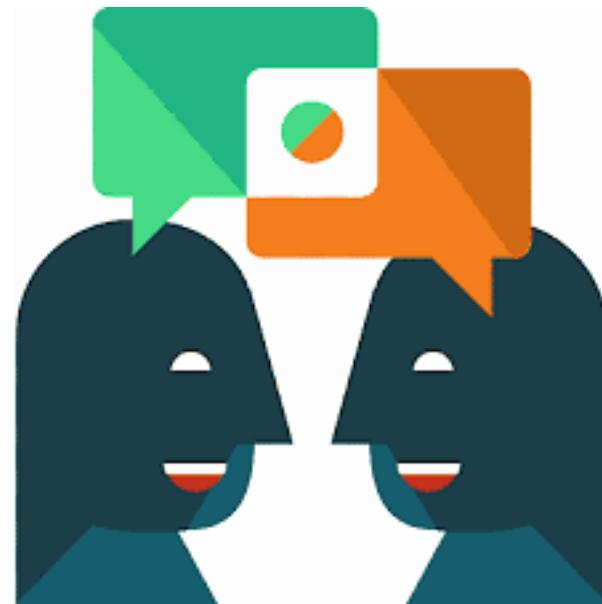
Task: Identifying topics

"B: Portland, good. And what do you, what will you do? Is it light duty that they'll have you on? Or typically are you more like office?",
"A: Personally? Yeah, I'm, I'm more, yeah, I'm more office.",
"B: Portland. So you're able to kind of take it easy still, even going into the office just for a little bit bit. Good.",
"A: Yeah, I think I'm on like a 16 pound lifting restriction, so, but my job doesn't require that very often.",
"B: Portland [And you still have follow up with the doc with the surgeon in February?",
"A: Um, I rescheduled that to the 10th of June just because I have my normal nephrology appointment on that same day. Portland. And the distance, I gotta travel, but I still have it scheduled.",
"B: Portland. So you'll, you'll go back to St. Louis, stay with your parents and then just go to those six appointments?",
"A: Yep.",
"B: Portland, good. Now, is there someone that's following you in Oklahoma as well? Like if



Conversational Data

- ▶ No coherent flow of text
- ▶ Small-talks



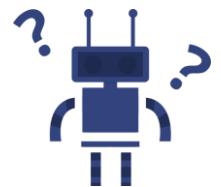
Noisy Data

Noisy Data

Transcribed

Good Robot

tle bit, but mm-hmm. <affirmative>, uh, and



Bad Robot

out no, this two went swimmingly well.",

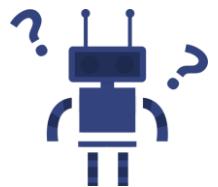
“..went seemingly well.”

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De-Identified



HIPAA

Health Insurance Portability
and Accountability Act

Noisy Data

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“..went seemingly well.”

De-Identified

YouD·O·M·I·N·G·U·E·Zre welcome

“You’re welcome...”

youM·O·L·I·N·Are always welcome

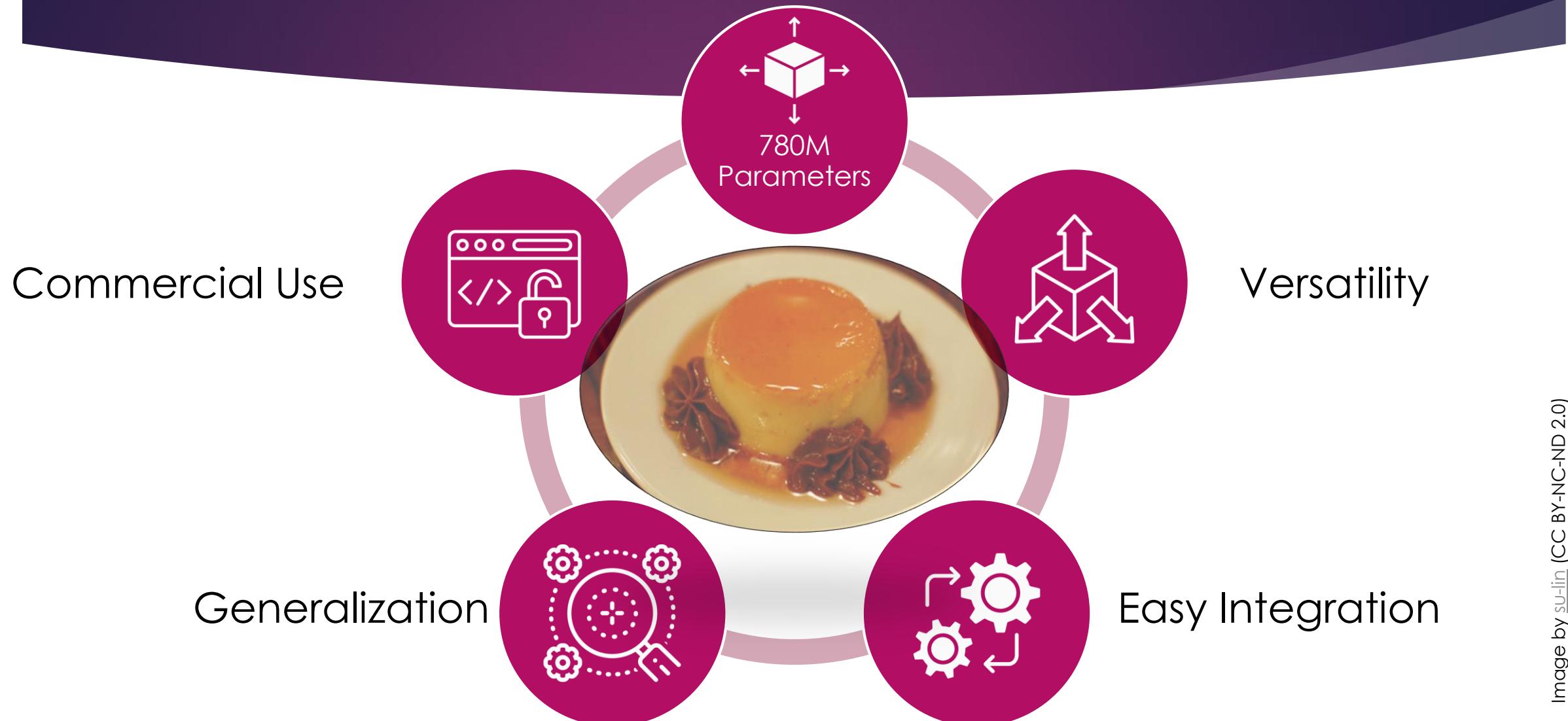
“You’re always...”

Data Preprocessing

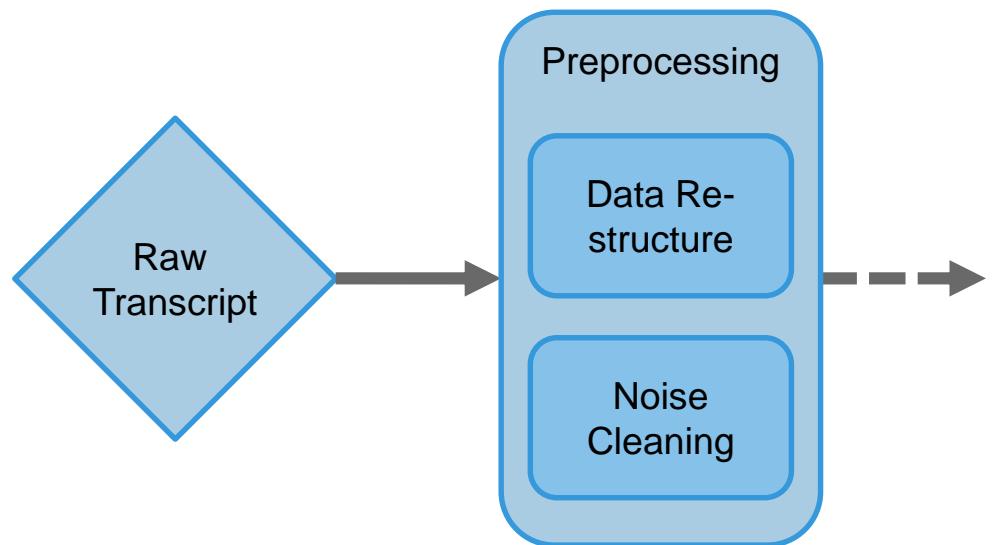


OUR SOLUTION

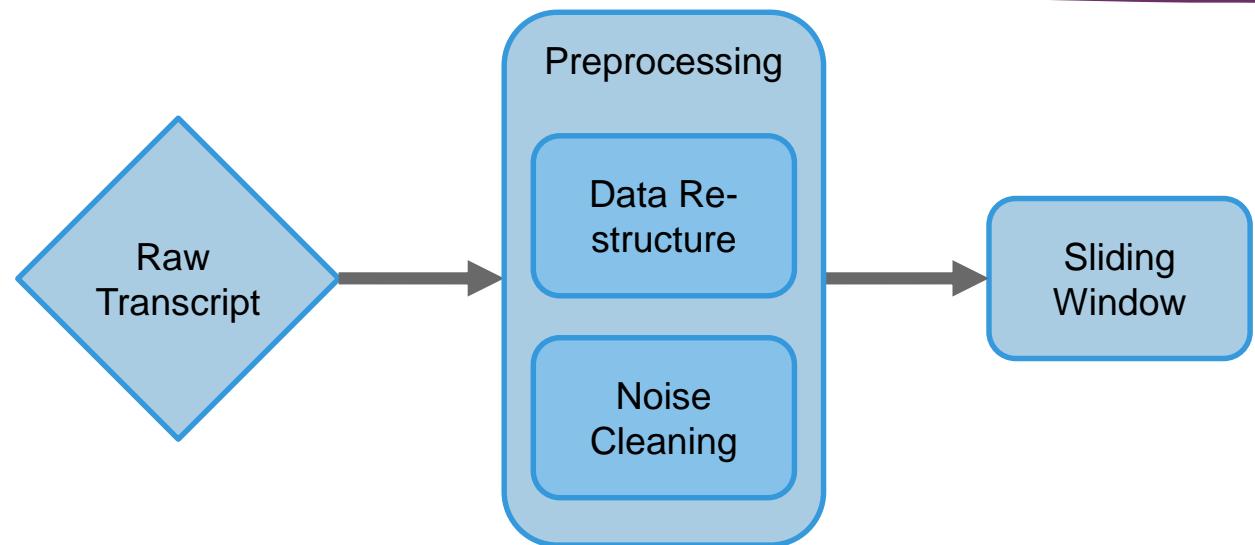
FLAN-T5-LARGE Model Overview



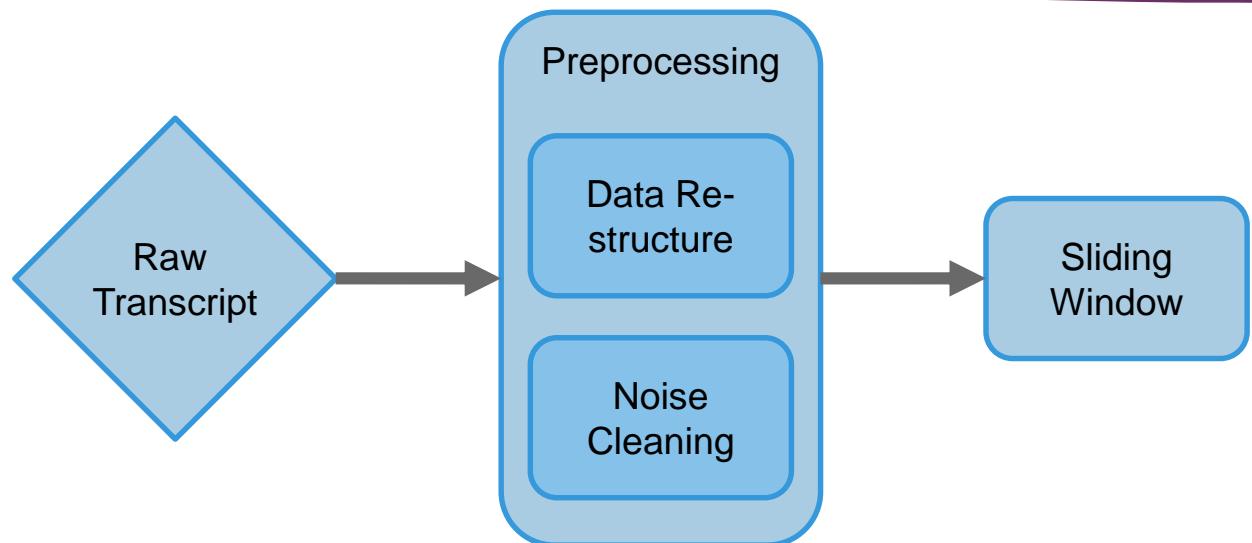
Data Flow Overview



Data Flow Overview

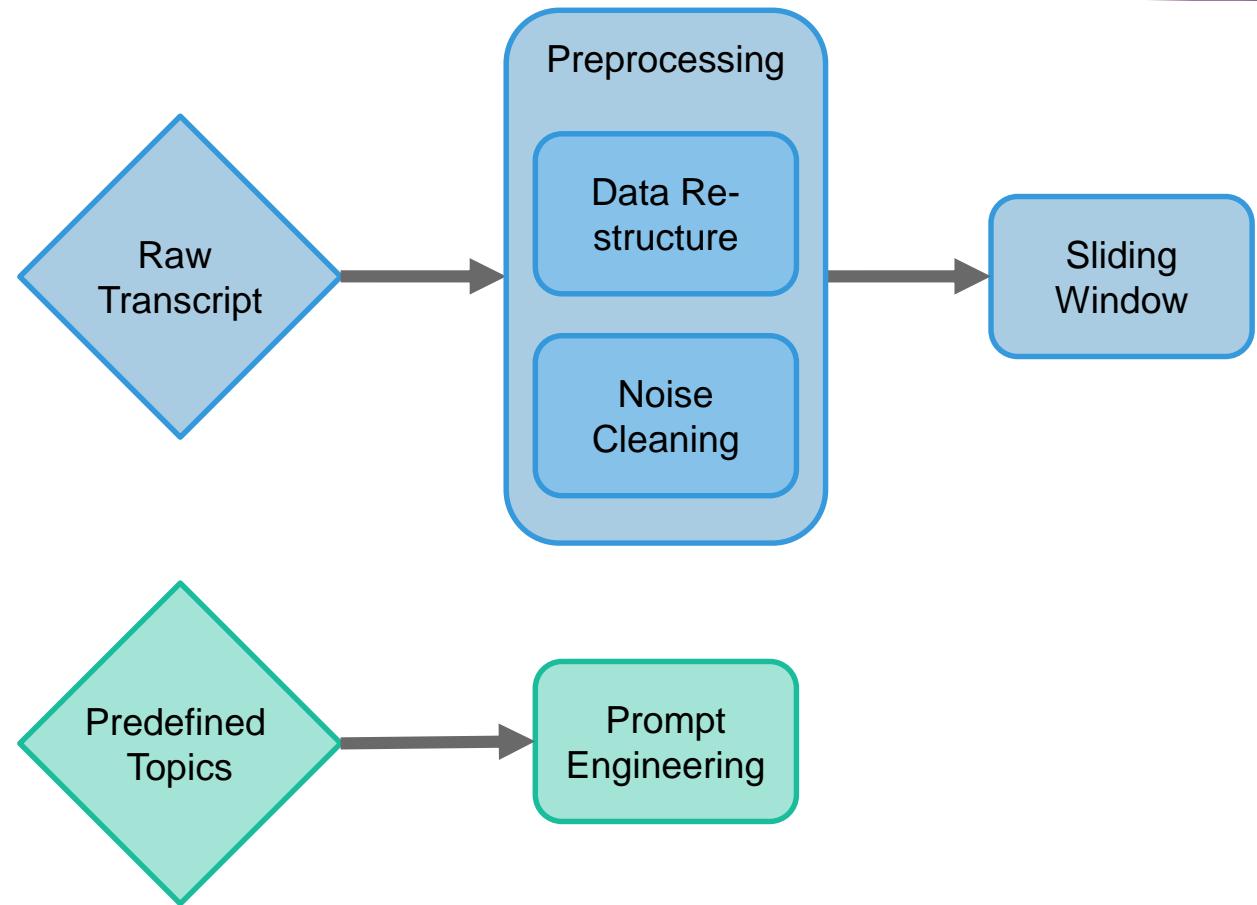


Data Flow Overview



Leila. Sorry, this is Harper. We got cut off there. Apologies. Speaker A: That's all right. Speaker B: This is Harper calling back here on a recorded line and I know this is Leila Ramos, correct? Speaker A: Yes. Speaker B: Perfect. And just your date of birth and address for me again, Leila. Sorry about that. Speaker A: 1 19 63. 47. 1701 Main Circle, Atlanta, Seattle. Speaker B: You got it? Okay. I can, I recognize your voice, but I just wanted to be sure. Um, I was just wrapping up Leila, and wanted to just ask is there anything else I can help with during this time or Speaker A: No, everything's good? Yeah. Speaker B: Ok. So why don't I do this. I'll send you a text message to download that app, if that's ok that we have. That's absolutely free and it'll really just help guide the recovery journey as we work together. I'll definitely take back your concern to the team, um, and then get back to you hopefully with some answers maybe the next time we chat. That being said, would you be open to a call maybe sometime next week at all? Speaker A: Yeah. Speaker B: Yeah. What day would work best for you, Leila? Speaker A: I'm not sure. Speaker B: Okay. Tuesday Speaker A: Is not a good day. Speaker B: Okay, so not Tuesday for sure. How about, how's your Friday looking? Speaker A: That's fine. Speaker B: Friday. Okay. So I'll try you maybe around this time on Friday, Caleb, since I was able to get ahold of you now. But if for whatever reason something comes up, you can always message me back or gimme a call back or on that app, just send a message and then we can find another time if that works. Okay? Speaker A: Okay. Speaker B: Okay. All right, Leila. Well, thank you so much. I really look forward to working with ya and I'm here if you need every anything, I will be here every step of the way throughout your recovery, okay? Speaker A: Okay. Speaker B: All right. Take good care. Okay. Stay warm out there, <laugh>. Mm-hmm. Speaker A: <affirmative>. Speaker B: Bye-Bye. Bye.

Data Flow Overview

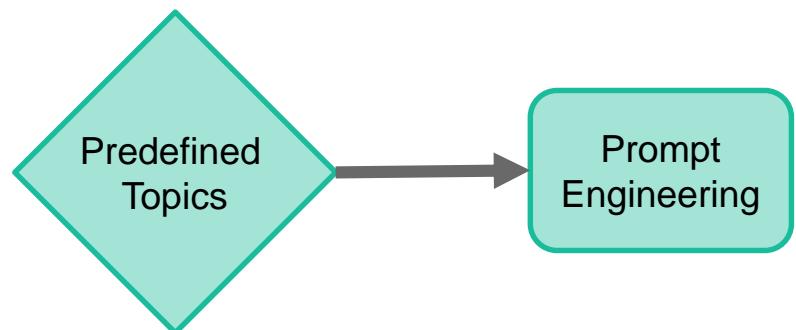


Data Flow Overview

```
general_prompt_v4 = """  
Choose one of the following options based on the conversation segment:  
{question}  
  
Conversation:  
{context}  
  
Your response (1, 0, or -9):  
"""
```



General prompt



Prompt per topic:

```
"Q8": """  
- "1" if the speaker provides any medical consultation or advice during the call.  
- "0" if the speaker does not provide any medical consultation or advice during the call.  
- "-9" if you are not sure.
```

Data Flow Overview

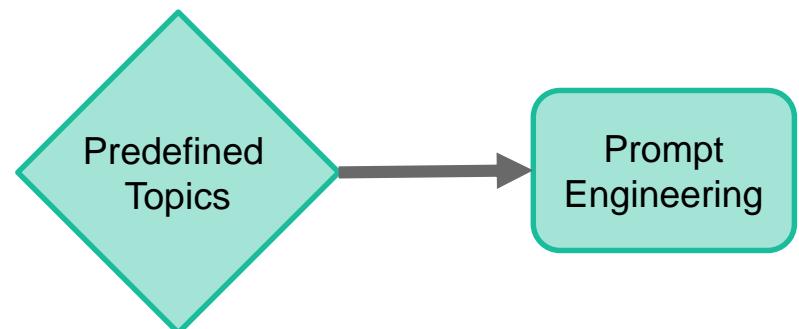
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```

Conversation:
{context}

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....



General prompt

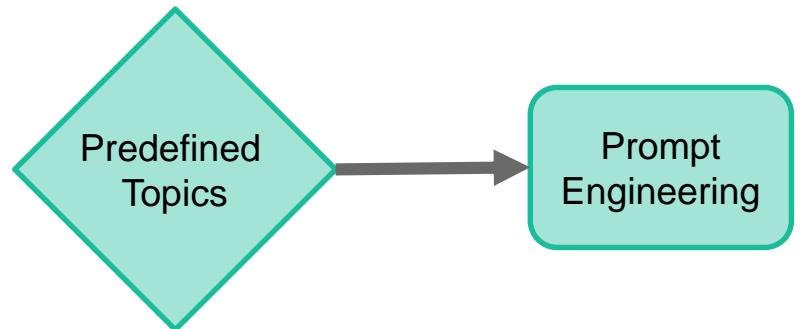


Prompt per topic:

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Data Flow Overview

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{context}  
  
Your response (1, 0, or -9):  
"""
```



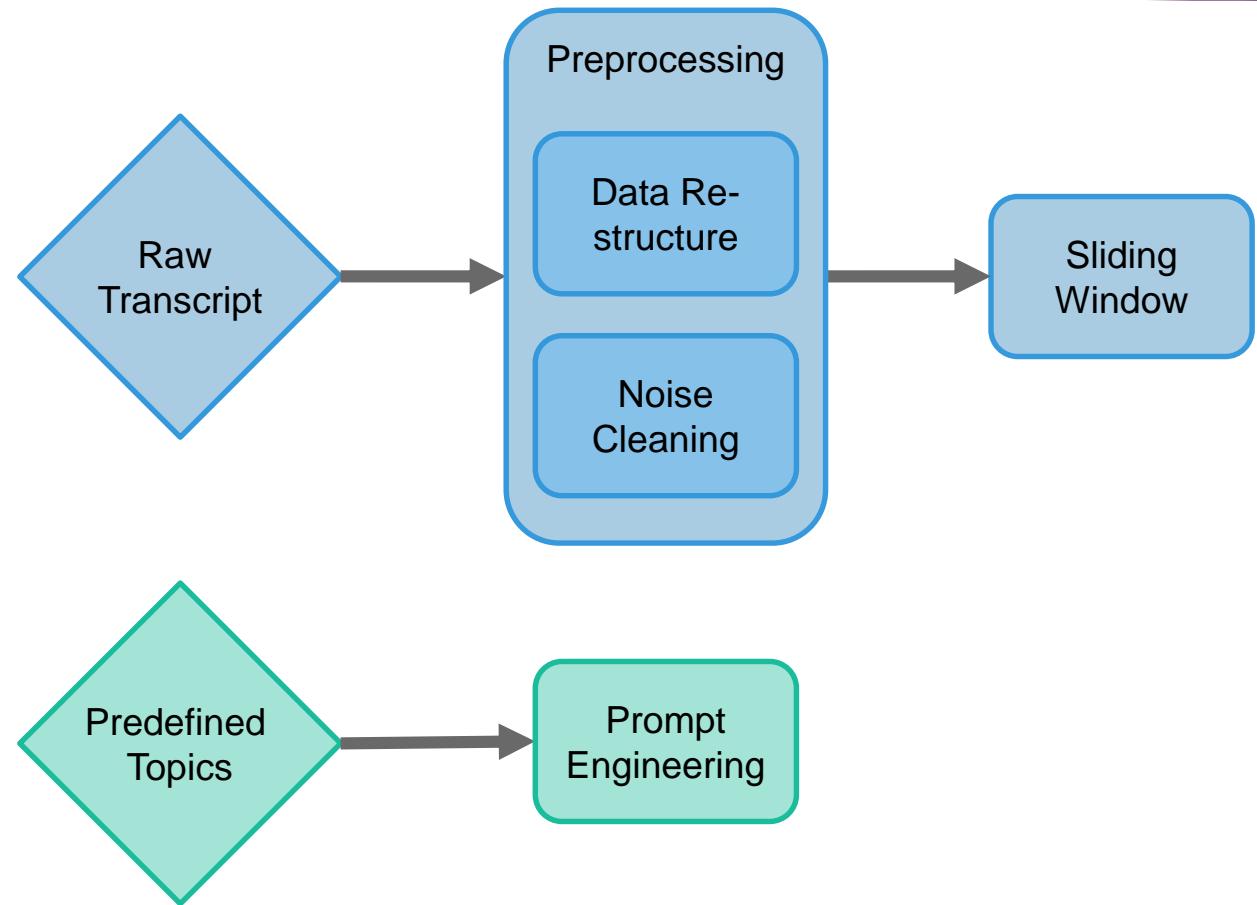
Version control
General prompt

Prompt per topic:

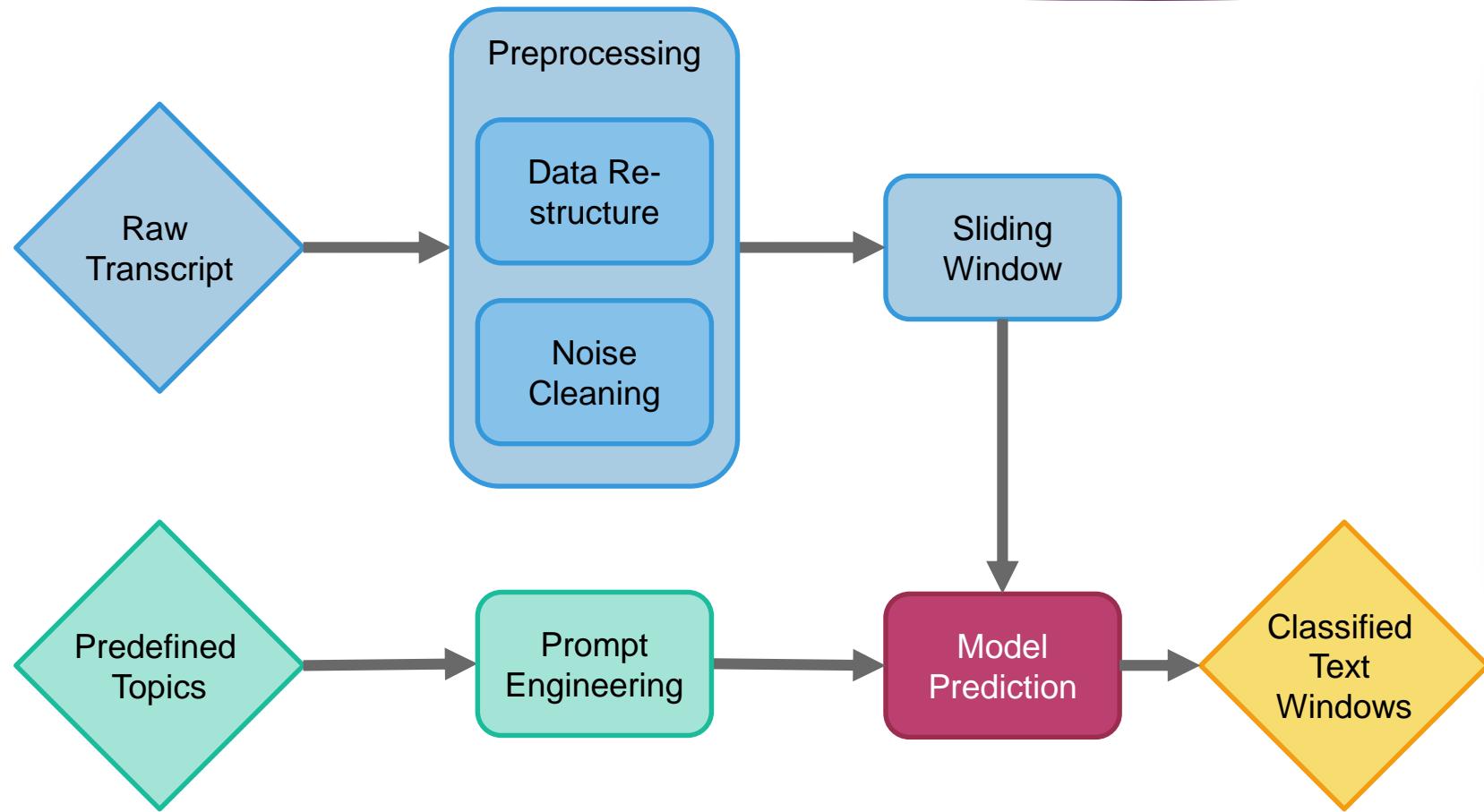
```
"Q8": """  
- "1" if the speaker provides any medical consultation or advice during the call.  
- "0" if the speaker does not provide any medical consultation or advice during the call.  
- "-9" if you are not sure.
```

```
prompts_version_control = {  
    "general_prompt": {  
        "v1": general_prompt_v1,  
        "v2": general_prompt_v2,  
        "v3": general_prompt_v3,  
        "v4": general_prompt_v4,  
    },  
    "question_prompts": {  
        "v1": question_prompts_v1,  
        "v2": question_prompts_v2,  
        "v3": question_prompts_v3,  
        "v4": question_prompts_v4,  
        "v5": question_prompts_v5,  
        "v6": question_prompts_v6,  
    }  
}
```

Data Flow Overview



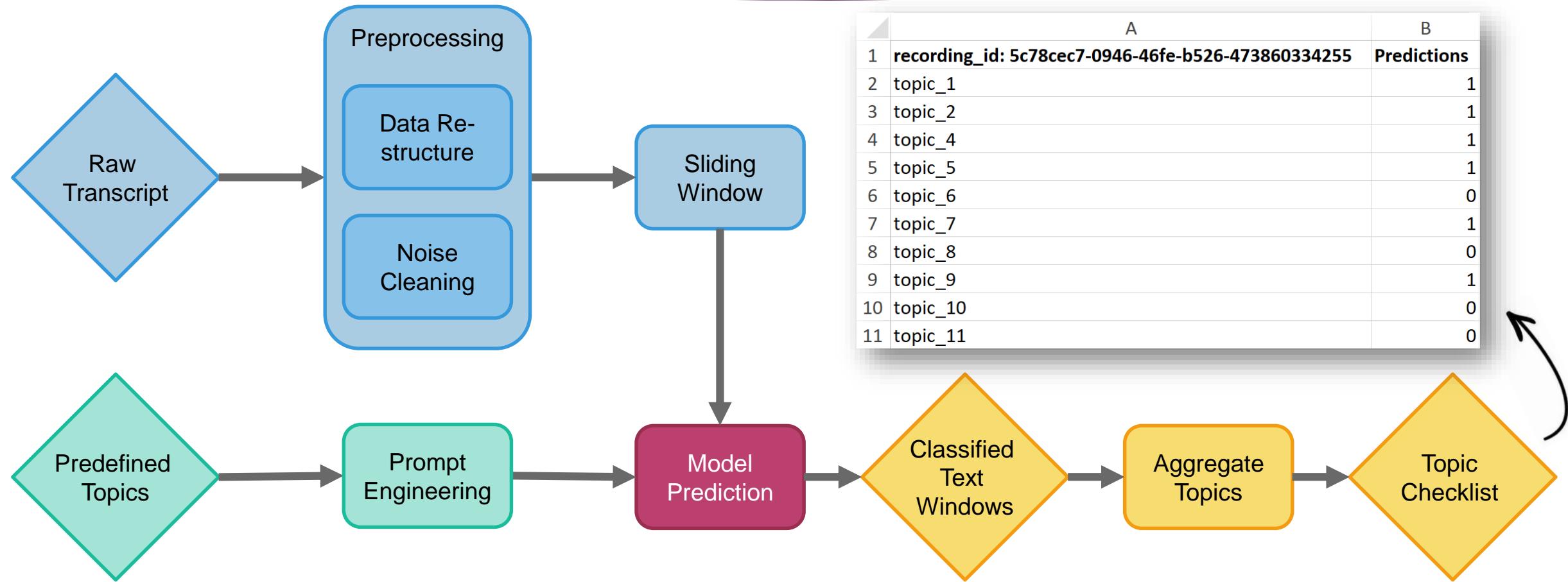
Data Flow Overview



	A		B		
1	A	A	B	B	
2	1	1	A	A	B
3	2	1		A	B
4	3	2	1		Window 4/11
5	4	3	2	topic_1	0
6	5	4	3	topic_2	1
7	6	5	4	topic_4	1
8	7	6	5	topic_5	0
9	8	7	6	topic_6	0
10	9	8	7	topic_7	0
11	10	9	8	topic_8	0
11	10	9	topic_9		0
11	10	topic_10			0
11	topic_11				0

Predictions

Data Flow Overview



Evaluation (FLAN-T5)

1. Classified **1,500 recordings**
 - ▶ short conversations filtered out

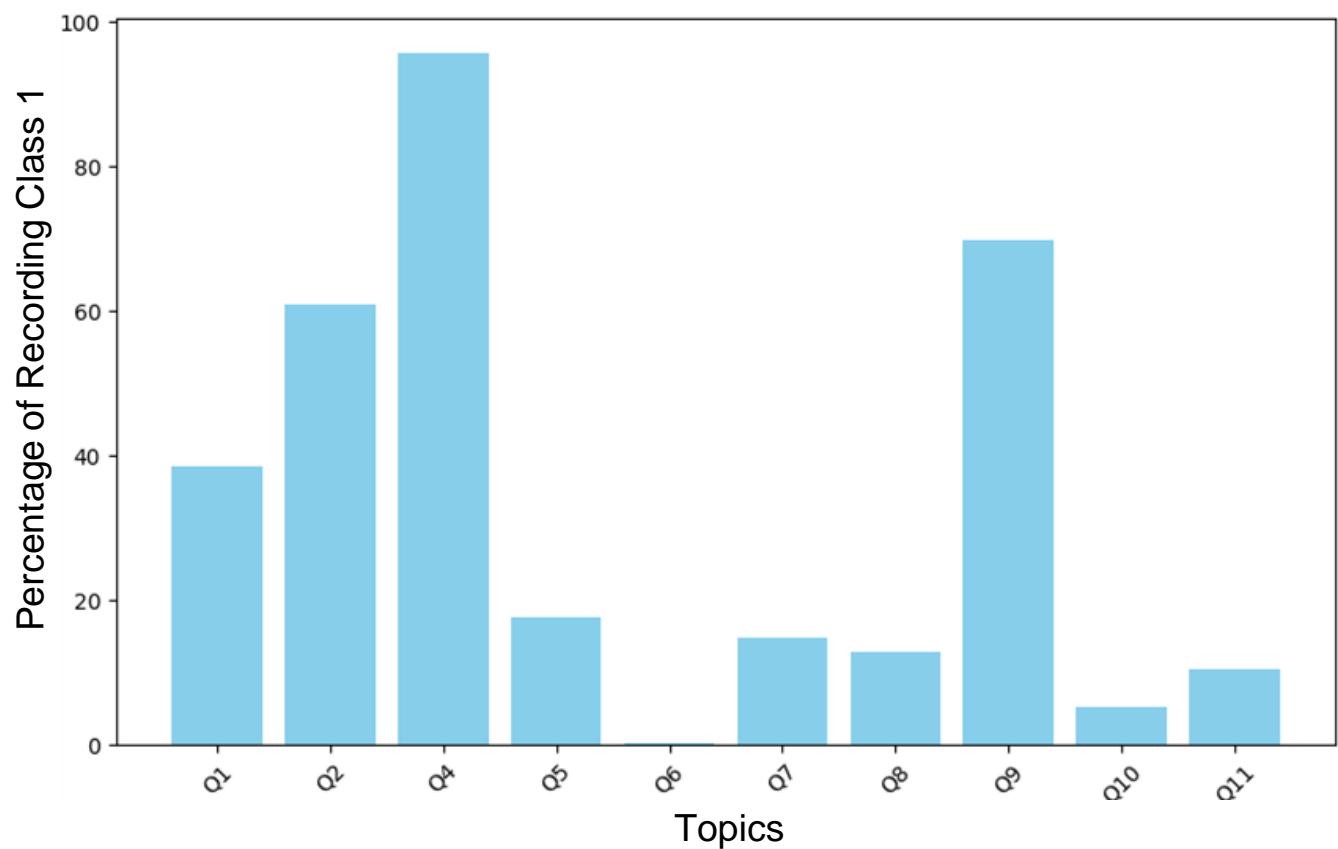
Evaluation (FLAN-T5)

1. Classified 1,500 recordings

- ▶ short conversations filtered out

Sanity check →

Distribution of Topics per Recording



Evaluation (FLAN-T5)

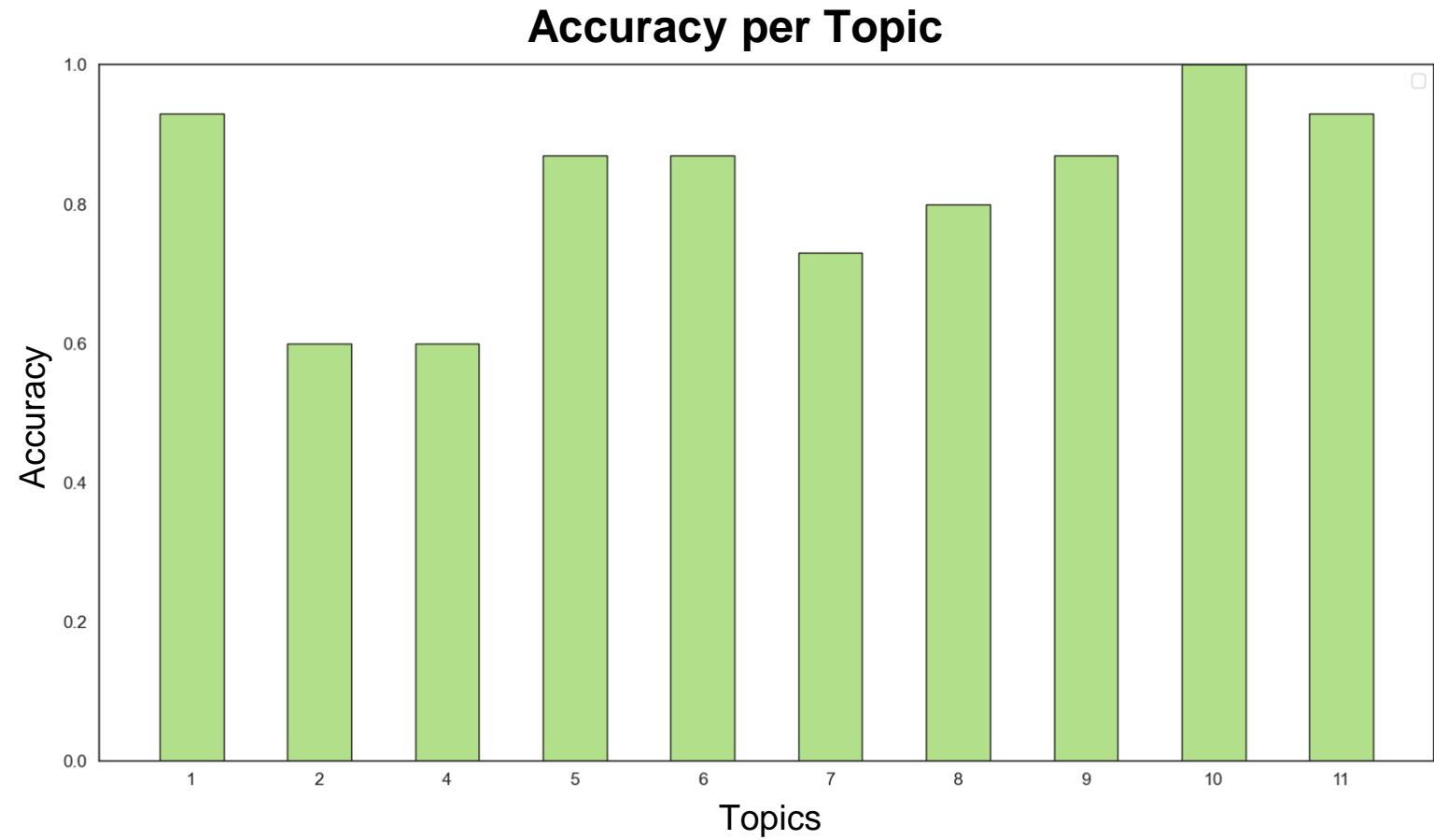
1. Classified **1,500 recordings**
 - ▶ short conversations filtered out
2. Randomly selected **150 windows**:
 - ▶ Stratified: 5 samples per class {1, 0, -9} per topic
3. Manually tagged the samples
4. Label -9 ("not-sure") → 0 ("not-found")

Evaluation (FLAN-T5)

- ▶ Total Accuracy: **82%**

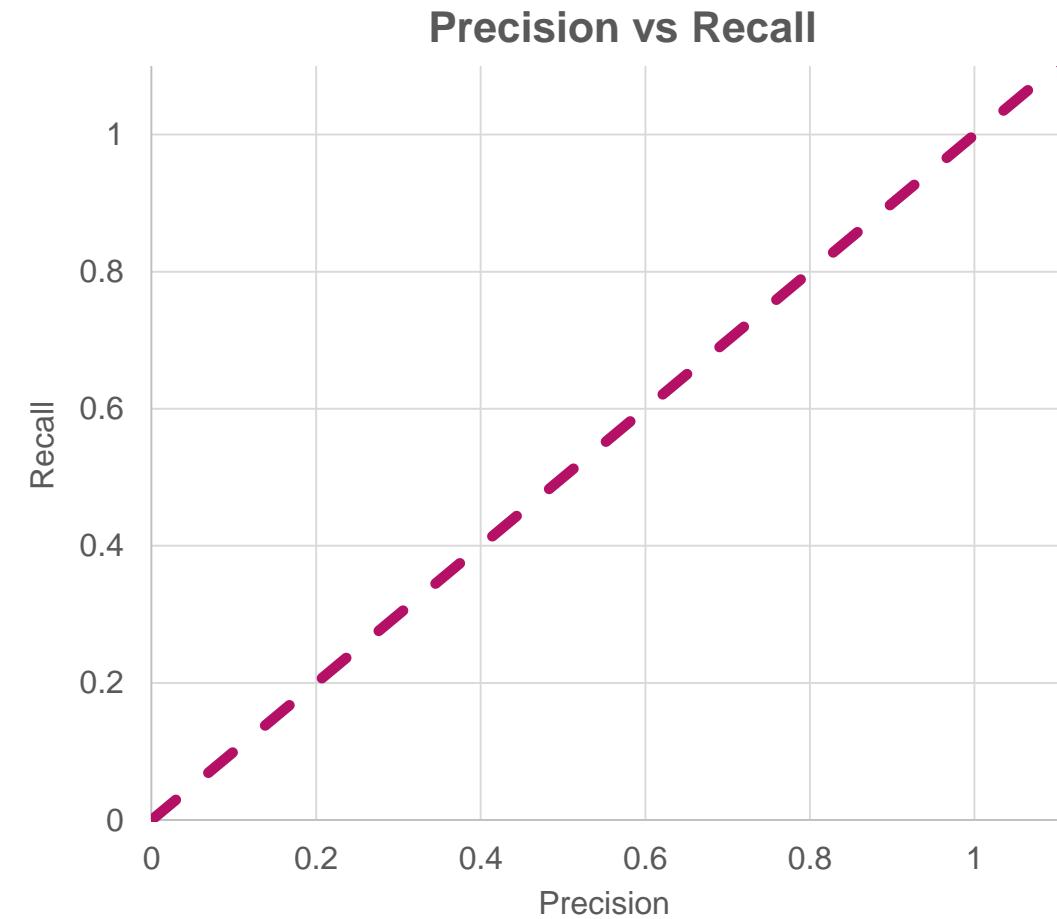
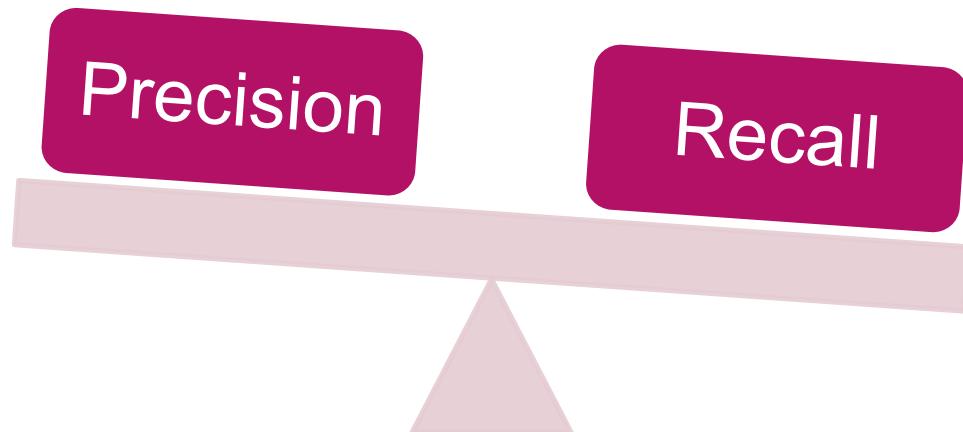
Evaluation (FLAN-T5)

- ▶ Total Accuracy: **82%**
- ▶ Accuracy per topic



Evaluation (FLAN-T5)

- ▶ Total Accuracy: 82%
- ▶ Accuracy per topic
- ▶ Precision vs. Recall



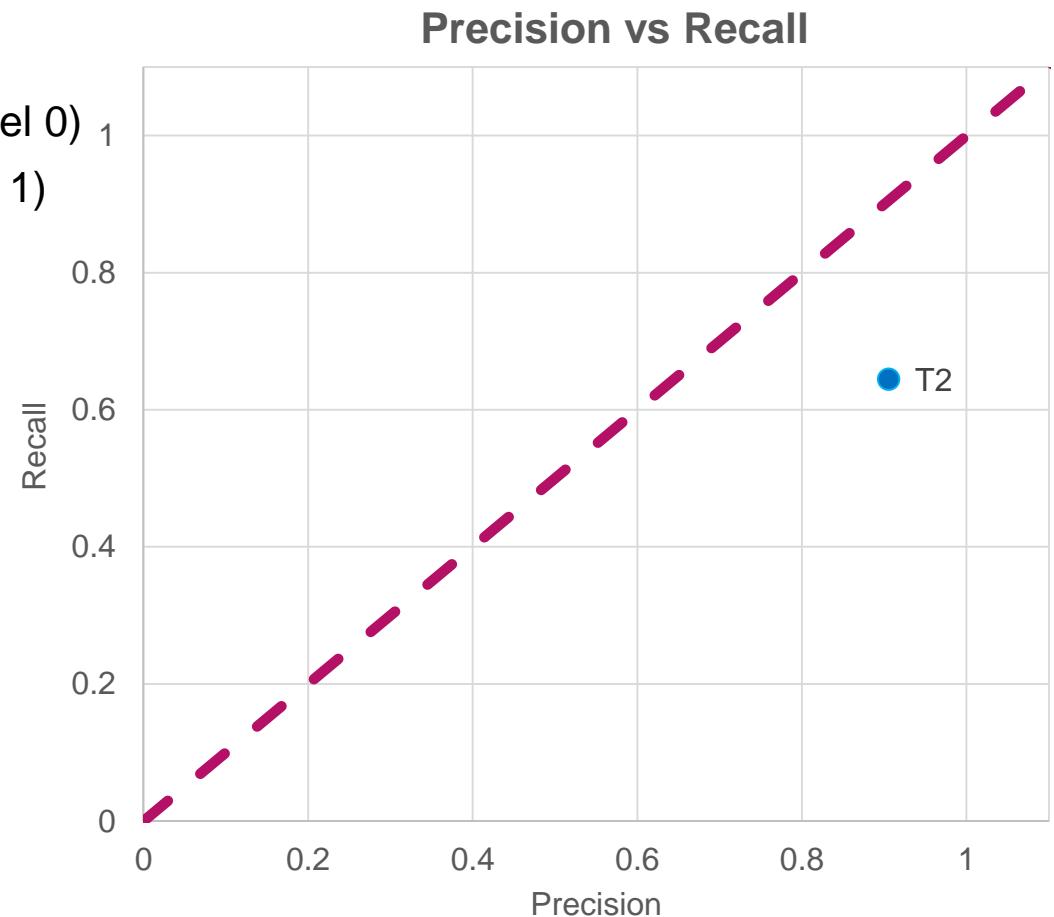
Evaluation (FLAN-T5)

- ▶ Total Accuracy: 82%
- ▶ Accuracy per topic
- ▶ Precision vs. Recall



Topic 2: Call Recording Disclosure

- Not found in text (Label 0)
- Is found in text (Label 1)



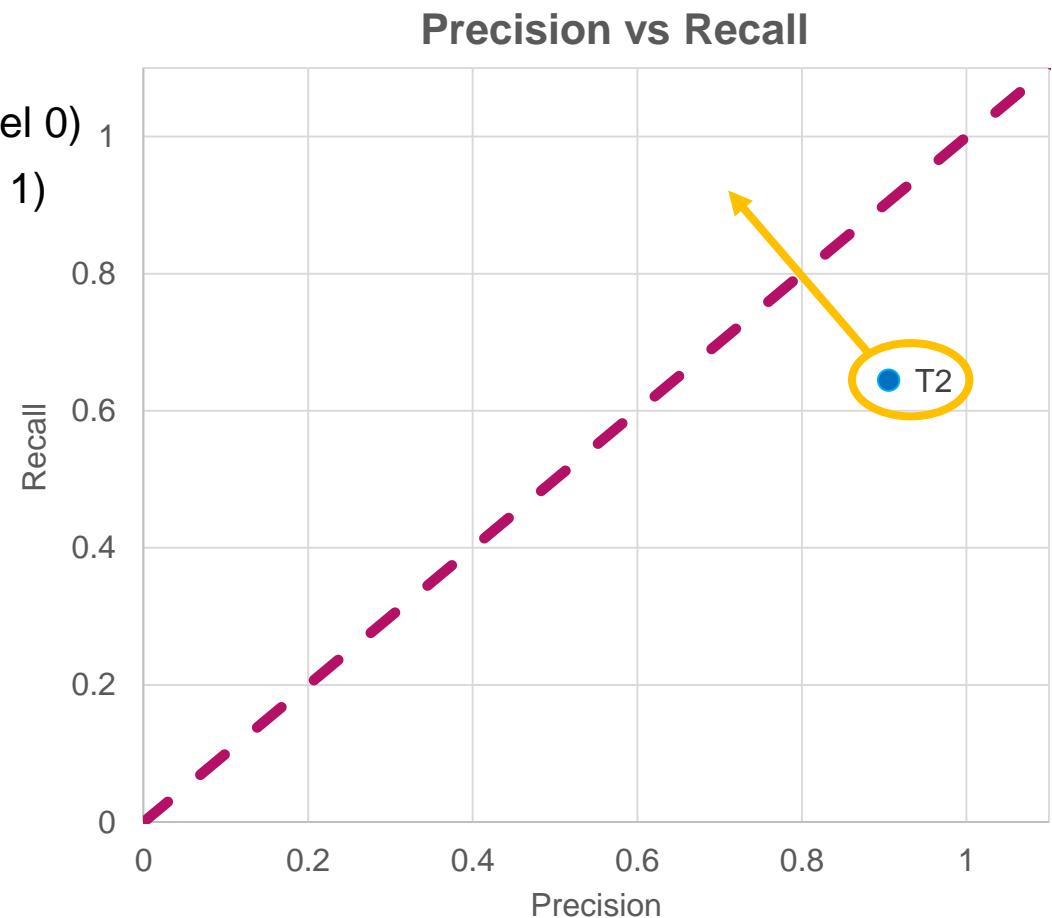
Evaluation (FLAN-T5)

- ▶ Total Accuracy: 82%
- ▶ Accuracy per topic
- ▶ Precision vs. Recall



Topic 2: Call Recording Disclosure

- Not found in text (Label 0)
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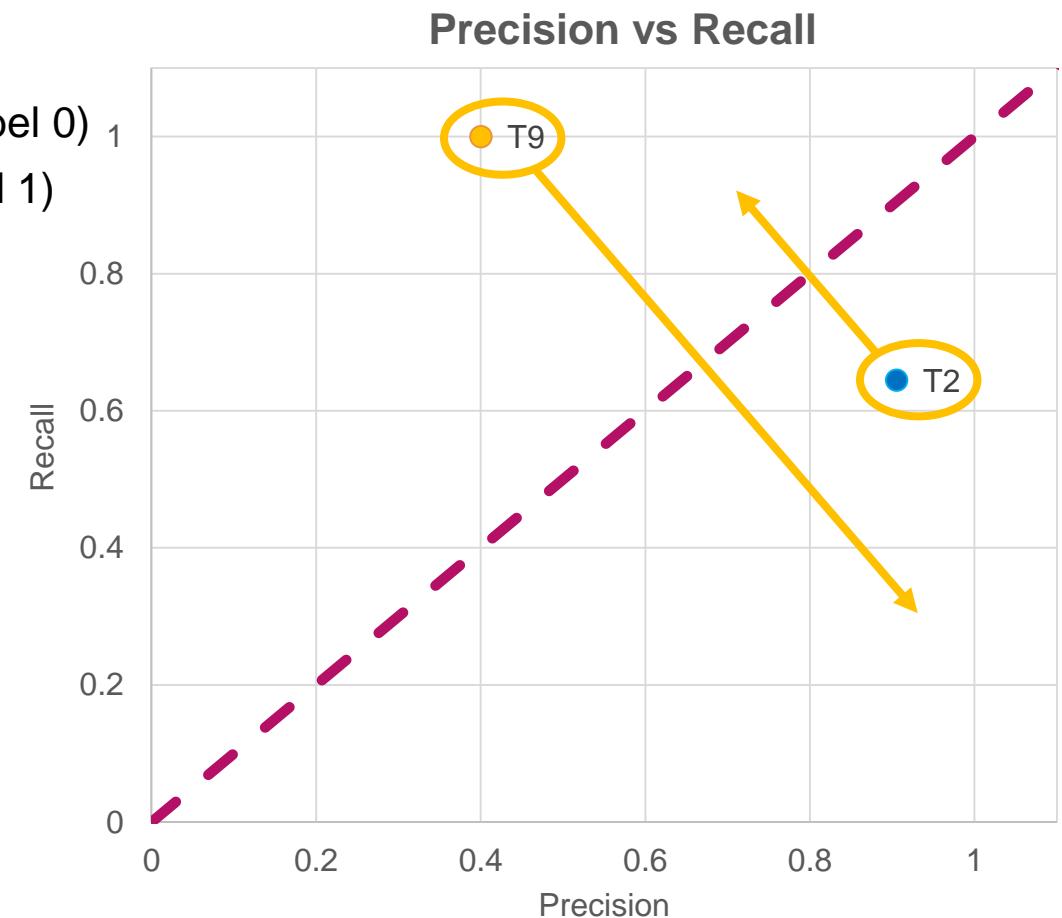
Evaluation (FLAN-T5)

- ▶ Total Accuracy: 82%
- ▶ Accuracy per topic
- ▶ Precision vs. Recall



Topic 9: Care Coordination

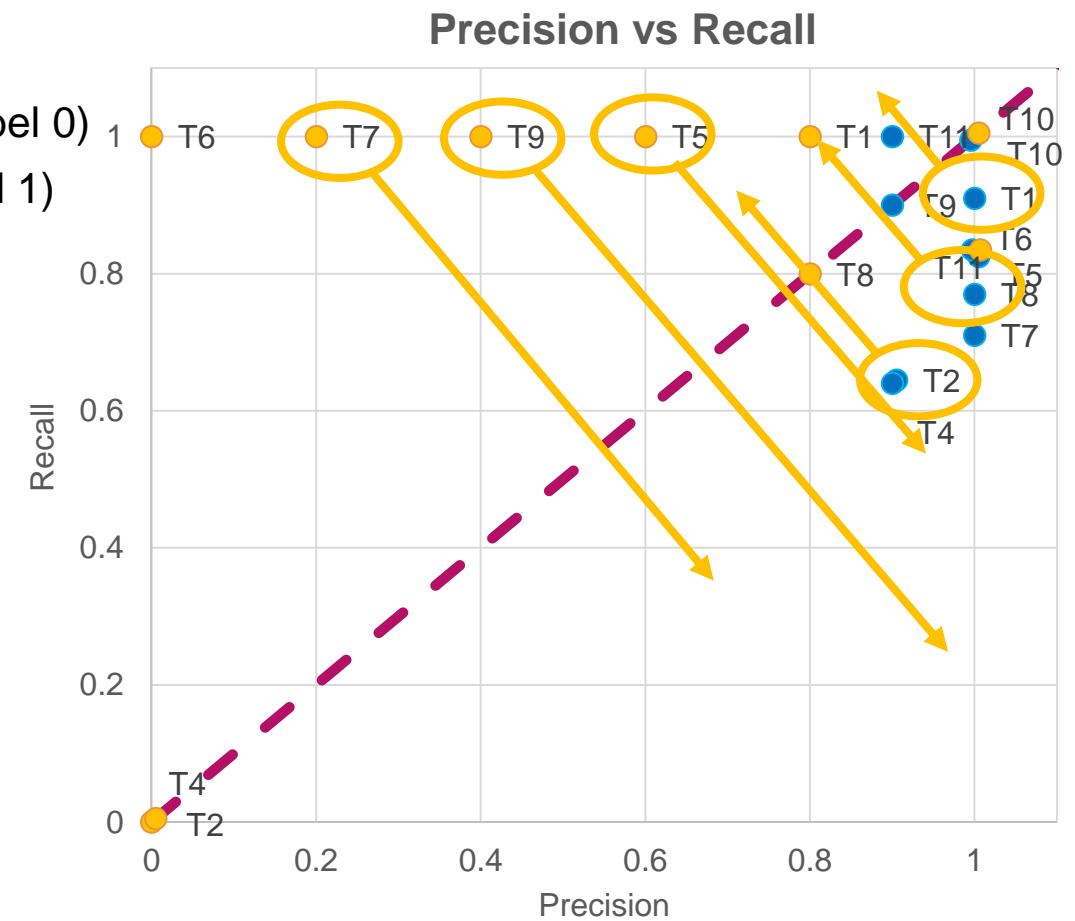
- Not found in text (Label 0)
- Is found in text (Label 1)



Evaluation (FLAN-T5)

- ▶ Total Accuracy: 82%
- ▶ Accuracy per topic
- ▶ Precision vs. Recall

- **Not found in text (Label 0)**
- **Is found in text (Label 1)**

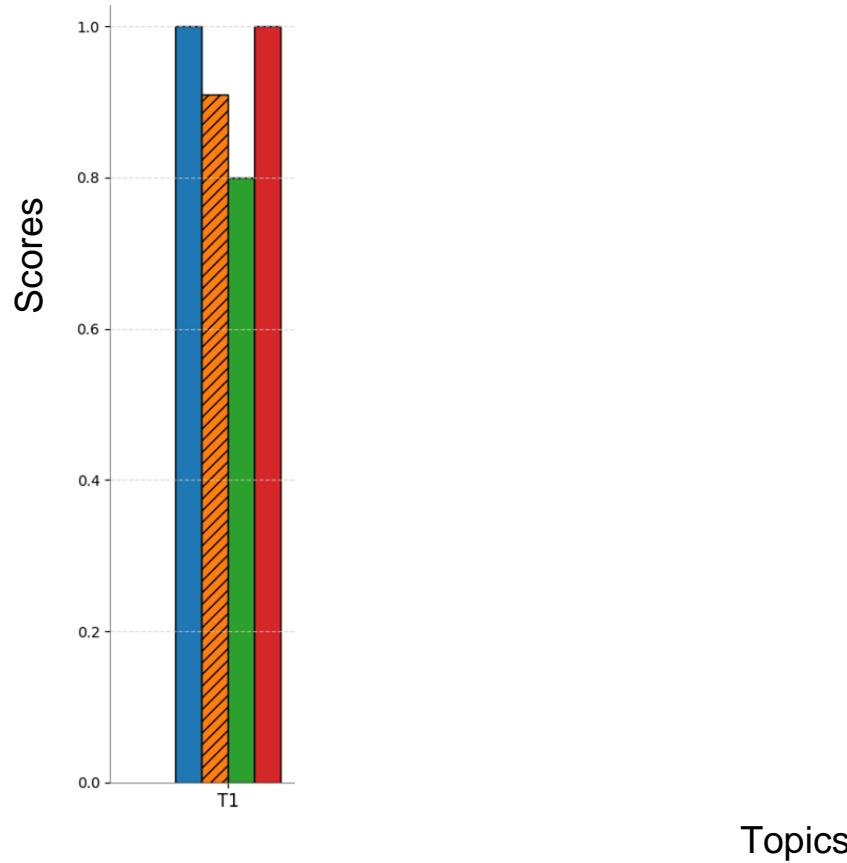


Evaluation (FLAN-T5)

- ▶ Total Accuracy: 82%
- ▶ Accuracy per topic
- ▶ Precision vs. Recall

█ Precision 0
█ Recall 0
█ Precision 1
█ Recall 1

Precision and Recall by Topic and Label

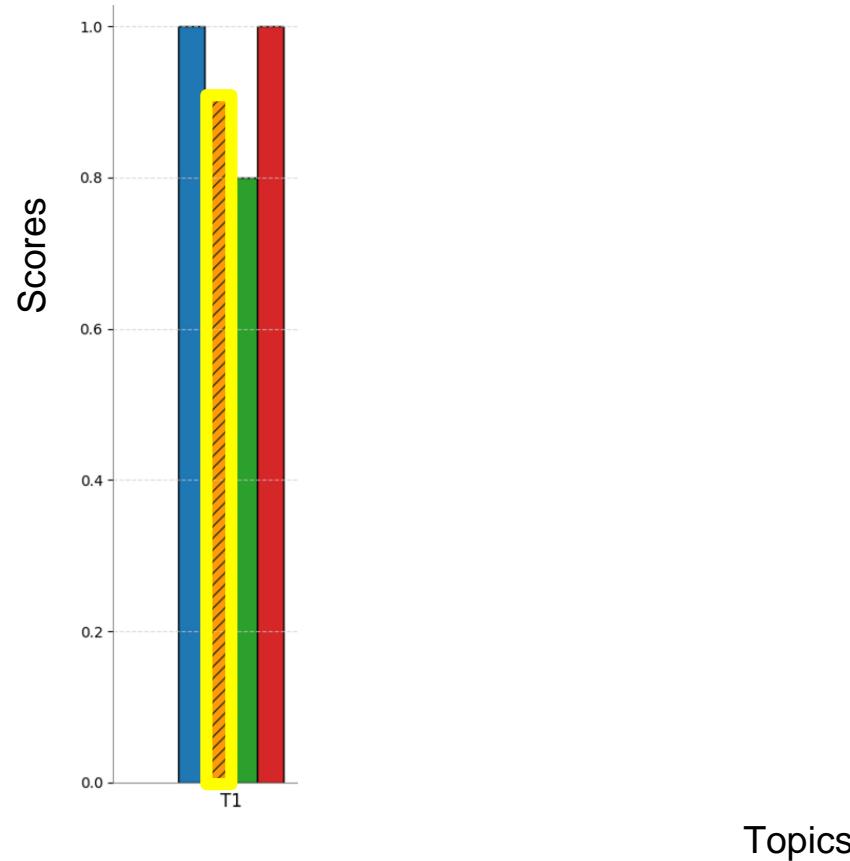


Evaluation (FLAN-T5)

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- ▶ Accuracy per topic
- ▶ Precision vs. Recall

█ Precision 0
█ Recall 0
█ Precision 1
█ Recall 1
█ Preferred Score

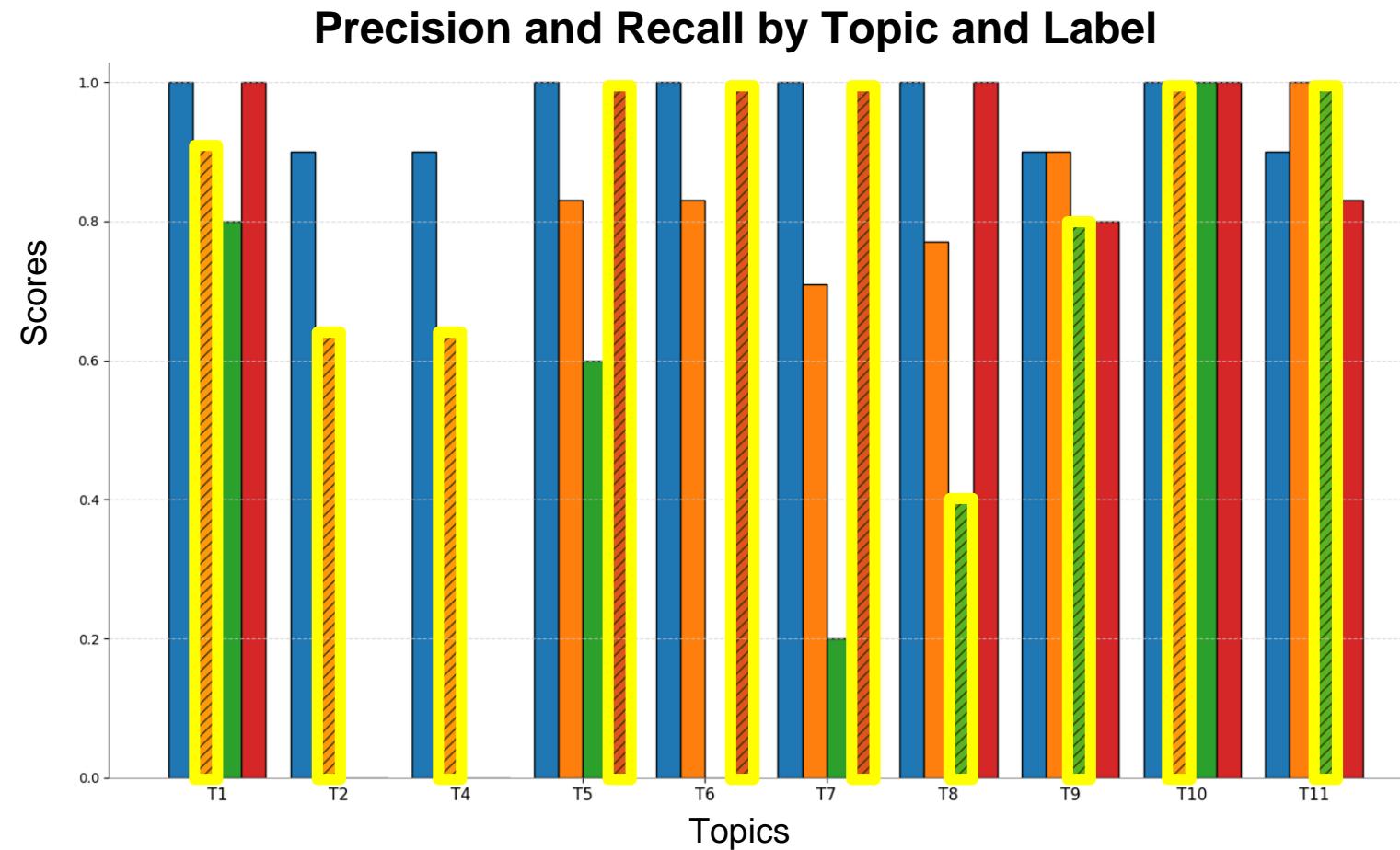
Precision and Recall by Topic and Label



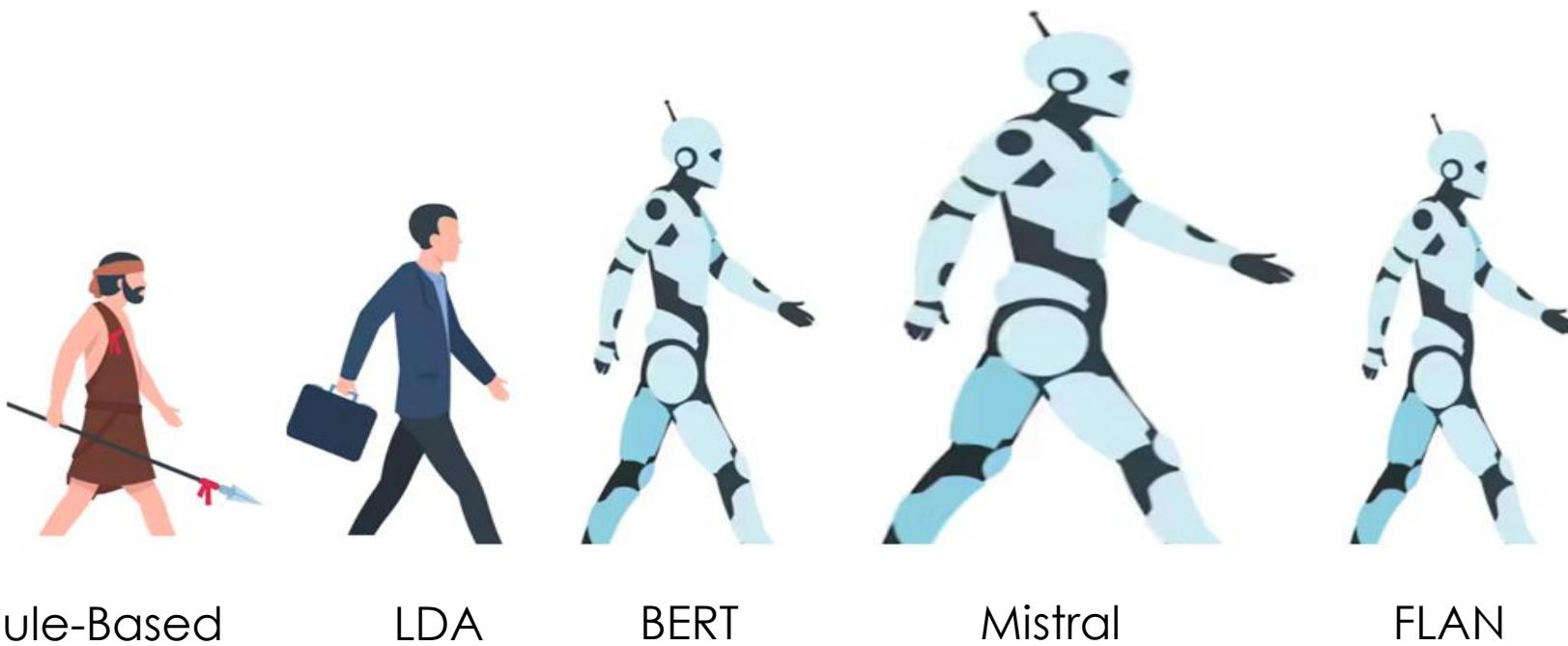
Evaluation (FLAN-T5)

- ▶ Total Accuracy: 82%
- ▶ Accuracy per topic
- ▶ Precision vs. Recall

 Precision 0
 Recall 0
 Precision 1
 Recall 1
 Preferred Score



Other Models Tested



Rule-Based Approach

Topic	Keywords
1. Member Identification	'address', 'name', 'confirm', 'full'...
2. Call Recording Disclosure	'recorded line', 'calling', 'call'...
3. Participant Verification	'speak', 'could', 'call', 'account'...
4. CM Introduction	'from', 'im', 'today', 'line'...
5. Handling PHI	'phi', 'health information'...
6. TCPA Compliance	'let know', 'receive', 'know'...
7. Sensitive Information Protocol	'sensitive', 'privacy'...
8. Medical Consultation Advice	'medical', 'provide', 'health'...
9. Care Coordination	'care', 'service', 'well', 'today'...
10. Log Protocol	'change', 'level', 'difficulty', 'like'...

Rule-Based Approach

Topic	Keywords	Score
1. Member Identification	'address', 'name', 'confirm', 'full'...	70%
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4. CM Introduction	'from', 'im', 'today', 'line'...	75%
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6. TCPA Compliance	'let know', 'receive', 'know'...	3%
7. Sensitive Information Protocol	'sensitive', 'privacy'...	30%
8. Medical Consultation Advice	'medical', 'provide', 'health'...	27%
9. Care Coordination	'care', 'service', 'well', 'today'...	45%
10. Log Protocol	'change', 'level', 'difficulty', 'like'...	26%

Leila. Sorry, this is Harper. We got cut off there. Apologies. Speaker A: That's all right. Speaker B: This is Harper **calling** back here on a **recorded line** and I know this is Leila Ramos, correct? Speaker A: Yes. Speaker B: Perfect. And just your date of birth and **address** for me again, Leila. Sorry about that. Speaker A: 1 19 63. 47. 1701 Main Circle, Atlanta, Seattle. Speaker B: You got it? Okay. I can, I recognize your voice, but I just wanted to be sure. Um, I was just wrapping up Leila, and wanted to just ask is there anything else I can help with during this time or Speaker A: No, everything's good? Yeah. Speaker B:

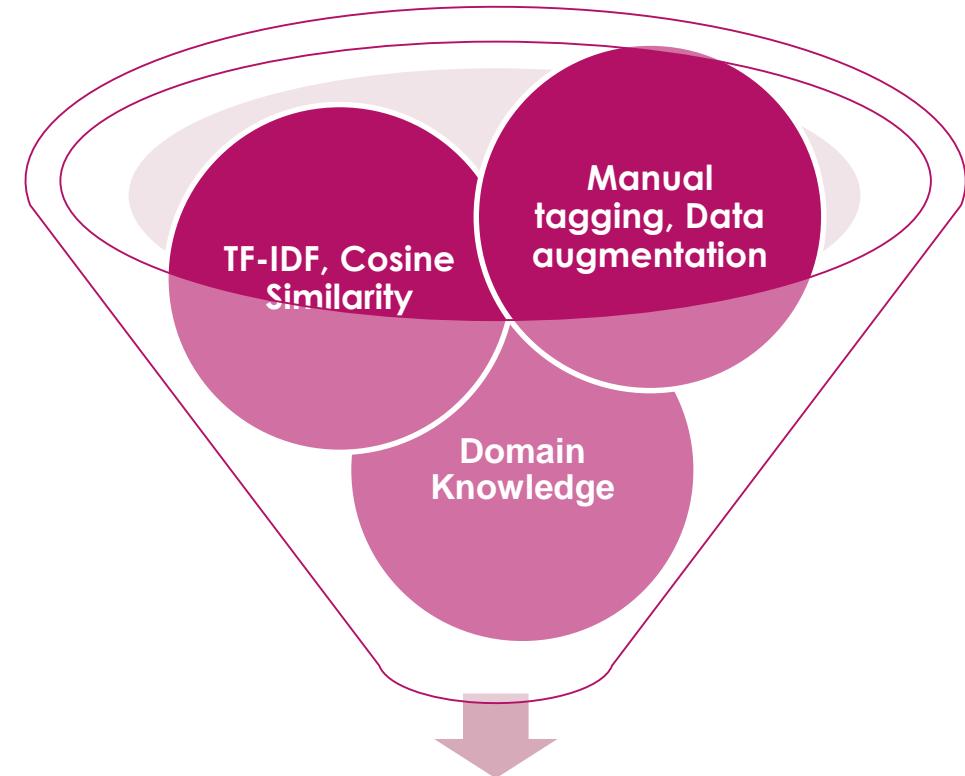
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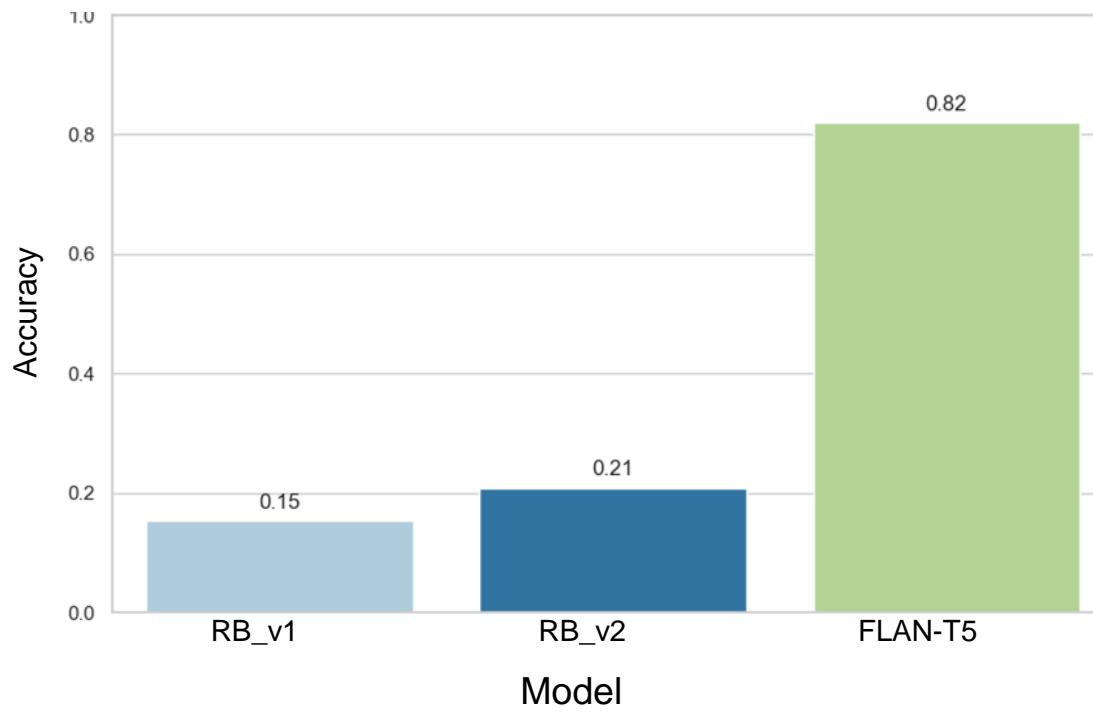
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Topic Keywords

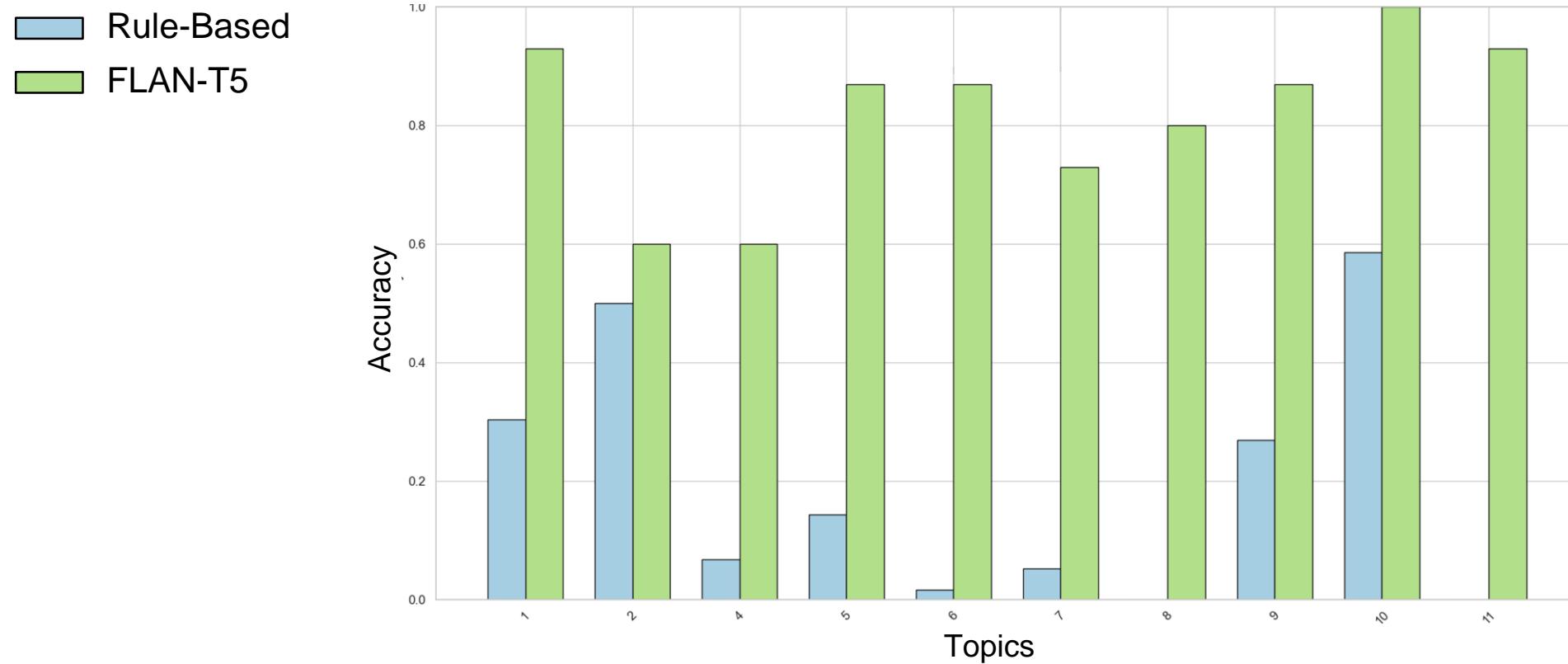
FLAN-T5 vs. Rule-Based

Overall Accuracy



FLAN-T5 vs. Rule-Based

Accuracy per Topic



FLAN-T5 vs. Rule-Based

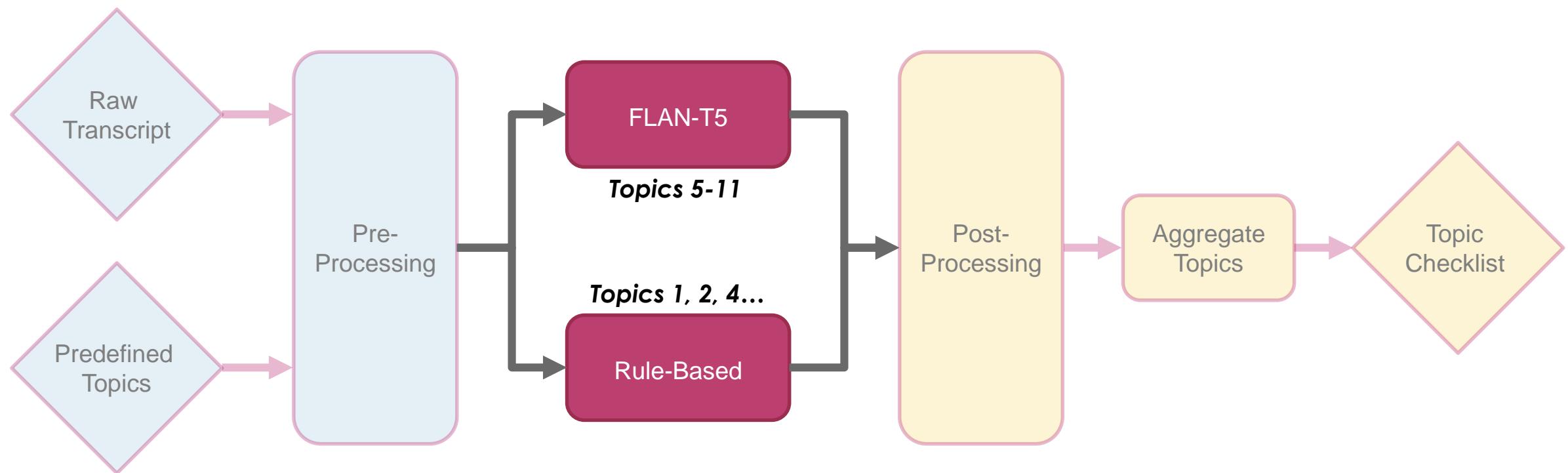
Rule-Based

- ▶ Fast!
- ▶ No dependencies

FLAN-T5

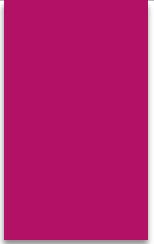
- ▶ Less feature engineering
- ▶ Generalization on unseen data

Future Work: Hybrid Model





Thank You



Questions?