

Conversational Information Seeking: Theory and Application

 #TheCISTutorial

Part 7: Mixed-Initiative Interactions



Most approaches to human-computer interactions with intelligent systems are either controlled by a person or the system.



coronavirus



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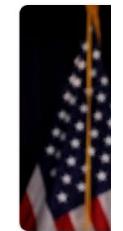


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COVID-19 information for Travelers | CDC

<https://www.cdc.gov/coronavirus/2019-ncov/travelers> ▾

Travelers should practice usual **precautions** at the following destination: **Hong Kong** (Level 1 Travel Health Notice)

How to decide if you should travel during the coronavirus ...

<https://www.cnn.com/travel/article/coronavirus-travel-decision-making> ▾

Whether it's from **coronavirus** or influenza, travelers should always take **precautions** to protect themselves from infection.

Coronavirus: Precautions You Need to Take While Travelling ...

<https://www.news18.com/news/lifestyle/coronavirus-precautions-you-need-to-take-while...> ▾

Jan 29, 2020 · **Coronavirus: Precautions You Need to Take While Travelling** With the novel **coronavirus** leading to over 100 fatalities in China, people need to be extra cautious while making their travel plans, be it an international conference abroad or a vacation.

Travel advice: What you need to know about novel ...

<https://www.cnn.com/travel/article/coronavirus-travel-advice> ▾

(CNN) — The spread of novel **coronavirus** has **travelers** around the world on edge. Much is still

Related searches

[coronavirus contact precautions](#)[coronavirus hku1 isolation precautions](#)[coronavirus isolation precautions cdc](#)[human coronavirus treatment](#)[coronavirus in usa](#)[how to prevent coronavirus](#)[coronavirus update cdc](#)[how to avoid coronavirus](#)

Section: Augusto Pinochet : Intellectual life...

STUDENT: Was he known for being intelligent?

TEACHER: → No, Pinochet was publicly known as a man with a lack of culture.

STUDENT: why did people feel that way?

TEACHER: → reinforced by the fact that he also portrayed himself as a common man

STUDENT: did he have any hobbies?

TEACHER: → Yes, Before wresting power from Allende, Pinochet had written two books.

STUDENT: what is the name of a book written by him?

TEACHER: → Geopolitica (1968) and Campana de Tarapaca (1972).

STUDENT: what were the books about?

TEACHER: → Chile's military literature.

STUDENT: was there anything noteworthy regarding his books?

TEACHER: → Yes, In Geopolitica Pinochet plagiarized (...) Gregorio Rodriguez Tascon

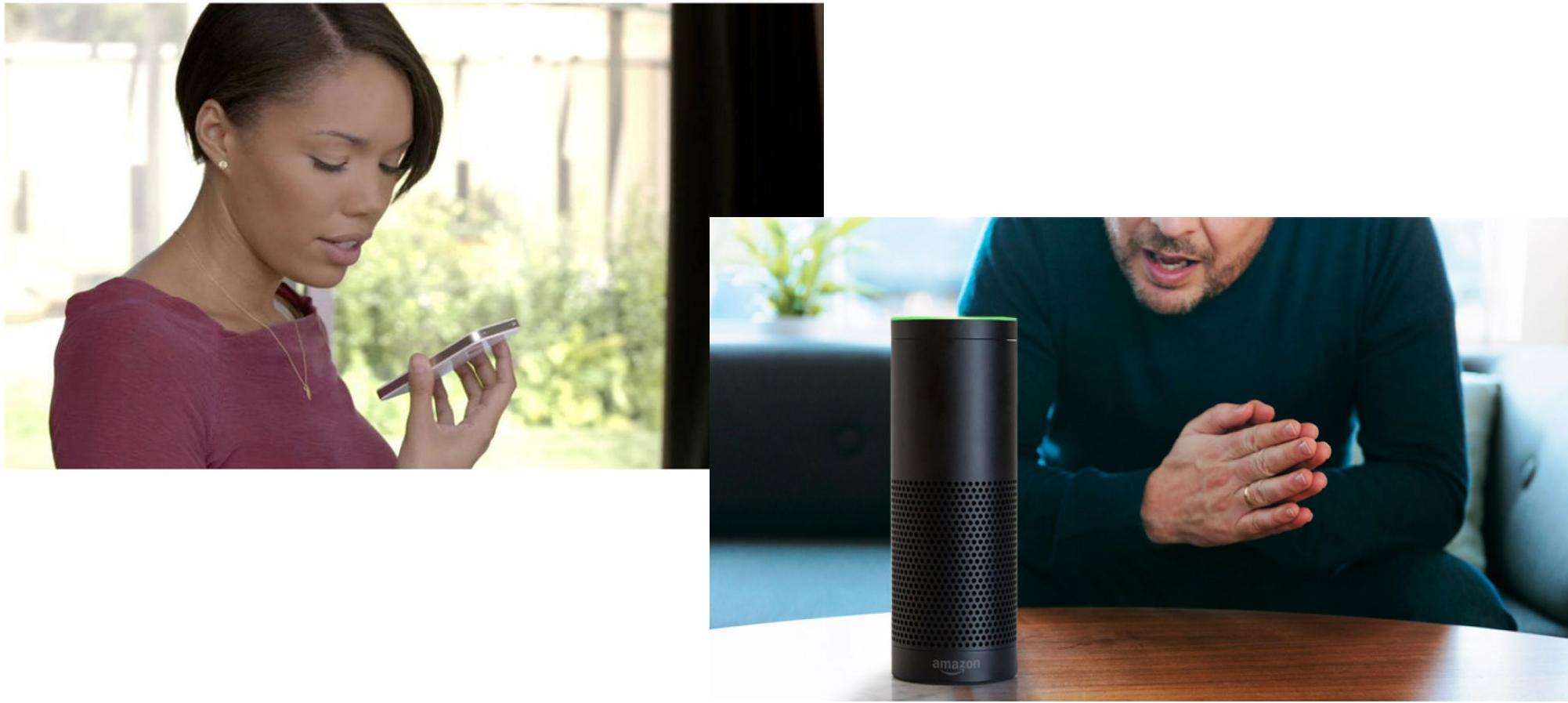
STUDENT: did he deny those allegations?

TEACHER: ↗ No answer

STUDENT: what did he plagiarize in Geopolitica?

TEACHER: → In Geopolitica Pinochet plagiarized (...) paragraphs from a 1949 presentation

...

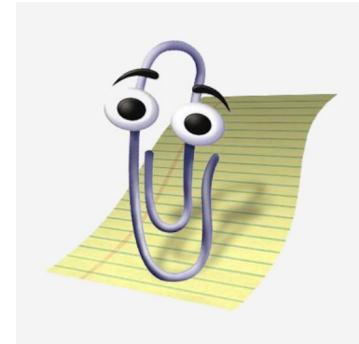


We need to go beyond the “query-response” paradigm using mixed-initiative interactions.

development of mixed-initiative intelligent systems will ultimately revolutionize the world of computing.

Early Systems with Mixed-Initiative Interactions

- LookOut [Horvitz, 1999]: scheduling and meeting management in Microsoft Outlook
- Clippit: Microsoft Office's assistant!
- TRIPS [Ferguson and Allen, 1998]: assisting users in problem solving and planning



12 Principles of Mixed-Initiative Interfaces

Principle

1. Providing genuine value
 2. Considering uncertainty about user intents
 3. Considering the user status in the timing of services
 4. Inferring ideal action in light of cost, benefit, and uncertainties
 5. Employing dialogue with users to resolve key uncertainties
 6. Allowing efficient direct invocation and termination
 7. Minimizing the cost of poor guesses about action and timing
 8. Scoping precision of service to match uncertainty in goals
 9. Providing mechanisms for efficient result refinement
 10. Employing socially appropriate behaviors
 11. Maintaining working memory of past interactions
 12. Continuing to learn by observing
-

Four Levels of Mixed-Initiative Interactions

MIXED-INITIATIVE LEVELS	CAPABILITIES
Unsolicited reporting	Agent may notify others of critical information as it arises
Subdialogue initiation	Agent may initiate subdialogues to clarify, correct, and so on
Fixed subtask initiative	Agent takes initiative to solve predefined subtasks
Negotiated mixed initiative	Agents coordinate and negotiate with other agents to determine initiative

ACTION	AMOUNT (%)
Evaluating and comparing options	25
Suggesting courses of action	23
Clarifying and establishing state	13.5
Clarifying or confirming the communication	13.5
Discussing problem-solving strategy	10
Summarizing courses of action	8
Identifying problems and alternatives	7

**Asking for clarification has been identified as a necessary component
in developing ideal CIS Systems.**

[Radlinski and Craswell, CHIIR 2017]

[Aliannejadi et al., SIGIR 2019]

[Anand et al., 2020]

[Zamani et al., WWW 2020]

[Trippas et al., IPM 2020]

...

Clarification

- Confirming or clarifying the communication
 - For example, to reduce ASR error [Stoyanchev et al., 2014].
- Identifying missing concepts
 - [Rao and Daumé III, 2018, 2019]
- Closed-domain clarification for task-oriented dialogues
 - [Krum et al., 2005; Rieser and Moore, 2005]
- Correcting user mistakes
 - Did you mean ...?
- **Intent clarification**
 - [Aliannejadi et al., 2019; Zamani et al., 2020]

A Taxonomy of Clarification (Derived from CQA Posts)

Clarification Type	Example
More Information	What OS are you using?
Check	Are you on a 64-bit system?
Reason	What is the reason you want a drip pan?
General	Can you add more details to this question?
Selection	Are you using latex or oil based Kilz?
Experience	Have you tried to update video card drivers?

A Taxonomy of Intent Clarification (Derived from Web Search Logs)

- **Disambiguation**
- **Preference**
 - Personal information (“for whom”)
 - Spatial information (“where”)
 - Temporal information (“when”)
 - Purpose (“for what purpose”)
- **Topic**
 - Sub-topic information
 - Event and news
- **Comparison**

Clarification Generation

Clarifying Question?

- **Query:** acts 17:16

To generate a clarifying question, we need to identify different aspects of the query.

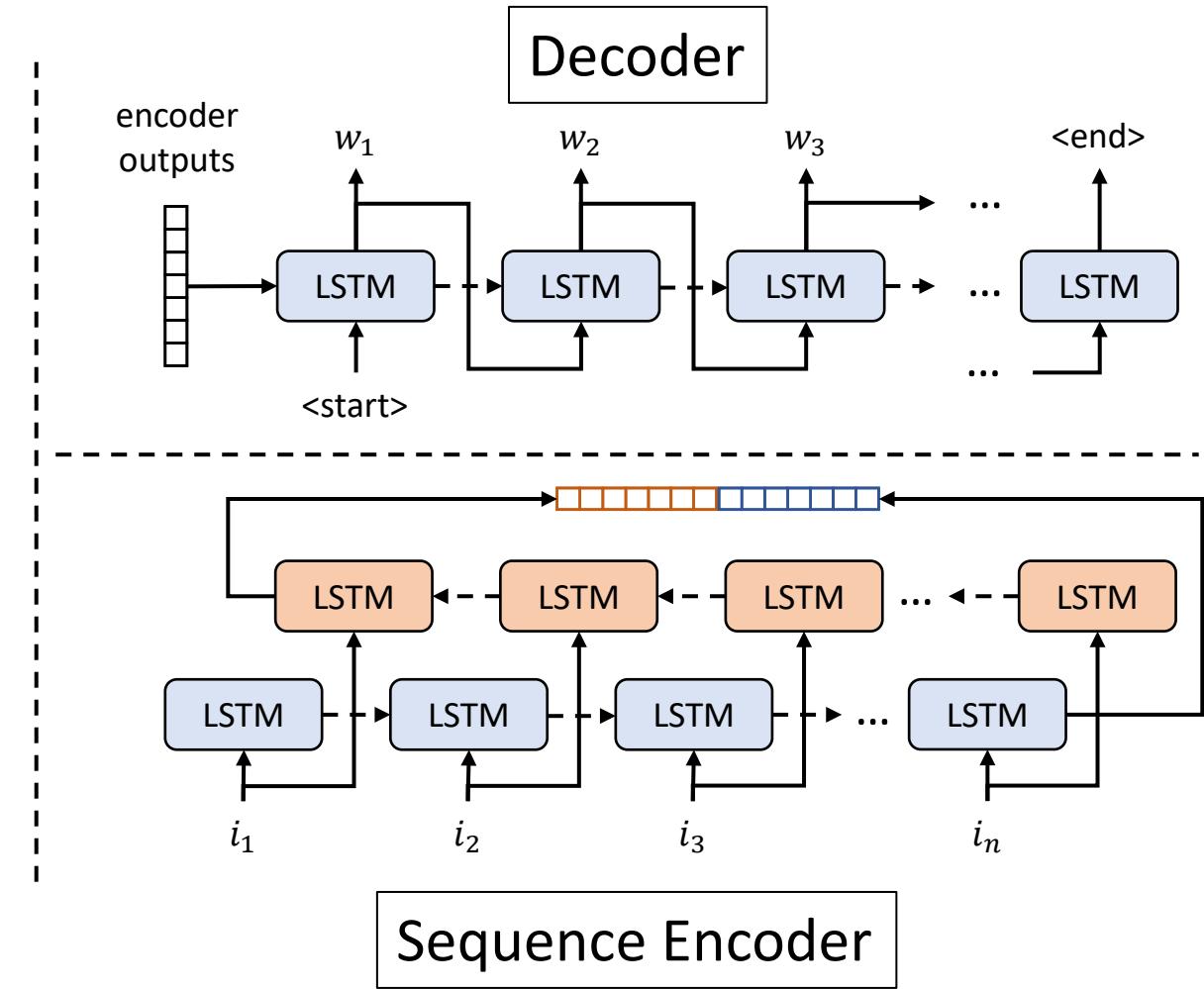
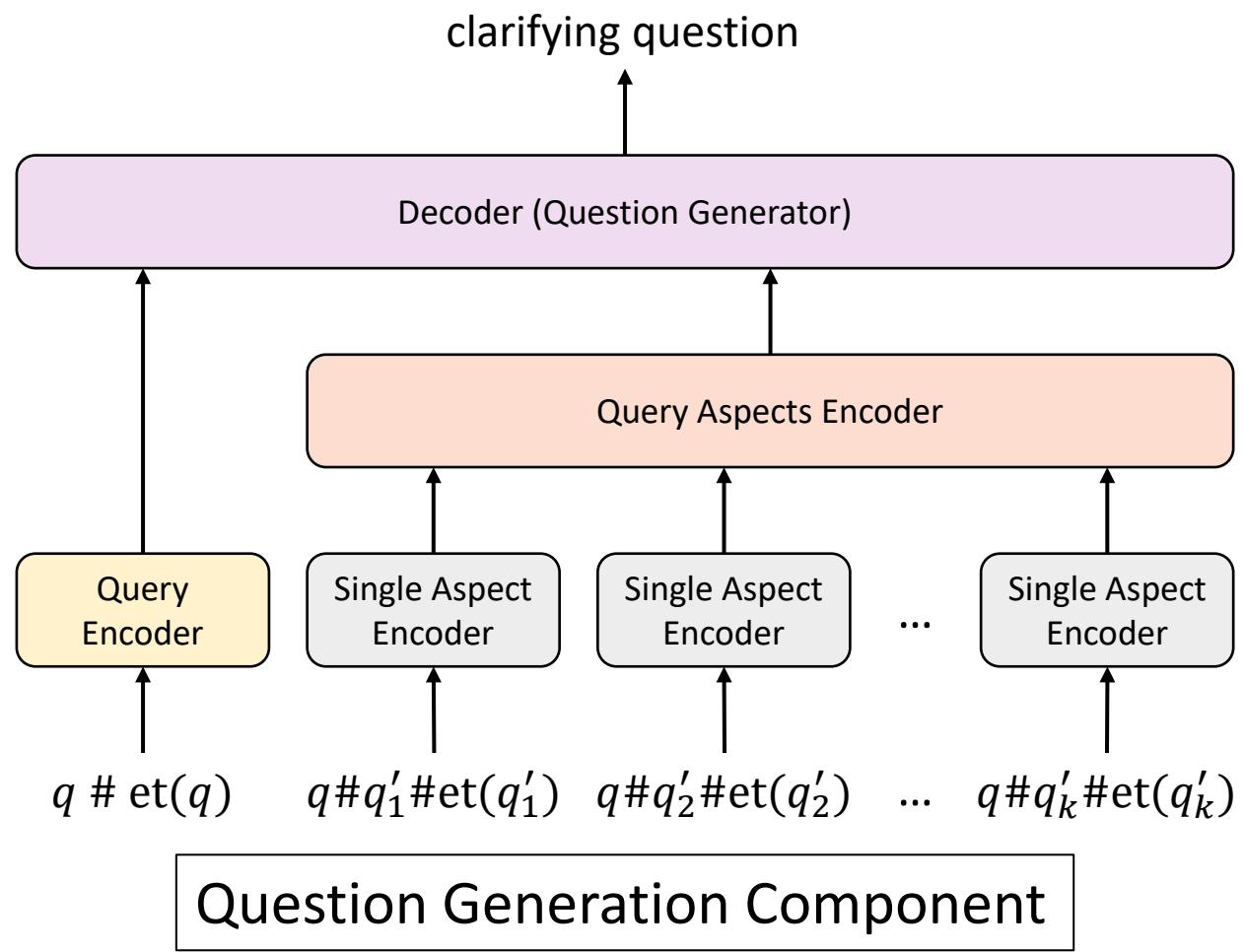
Query Reformulation Data

- shoes → running shoes
- shoes → shoes basketball
- shoes → formal shoes
- shoes → shoes nike
- shoes → shoes adidas
- shoes → shoes for women
- shoes → shoes for kids
- shoes → shoes sale
- shoes → shoes online
- shoes → shoes near me
- ...

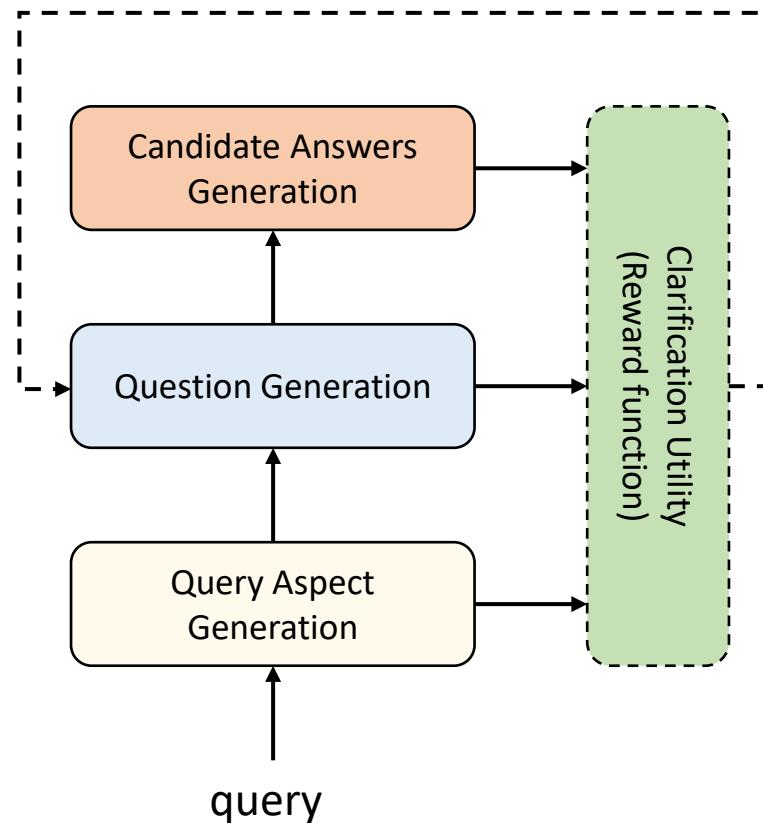
Question Templates

- What do you want to know about **QUERY**?
- What do you want to know about this **QUERY_ENTITY_TYPE**?
- What **ASPECT_ENTITY_TYPE** are you looking for?
- Whom are you looking for?
- ...

Question Generation



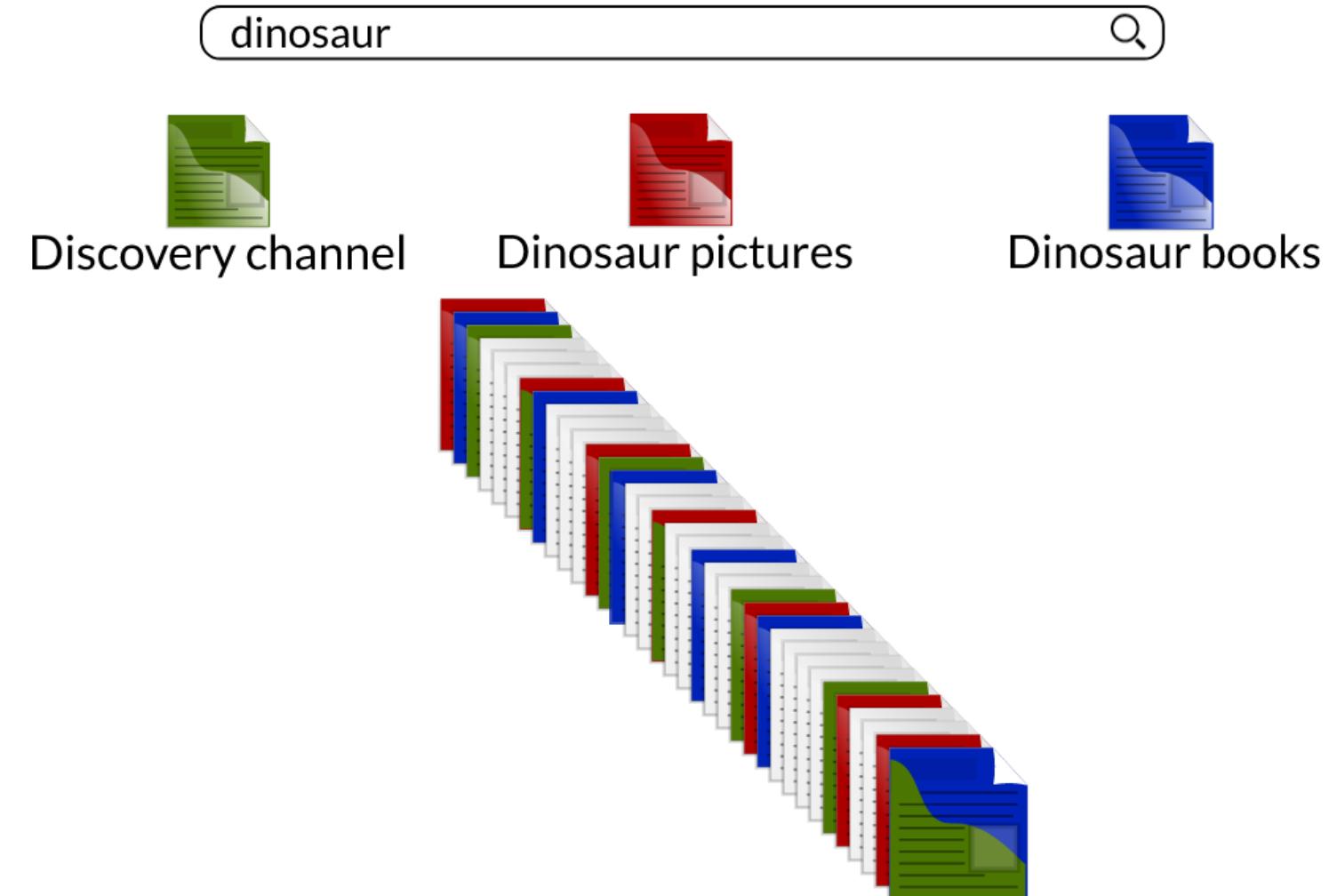
Query Clarification Maximization Model



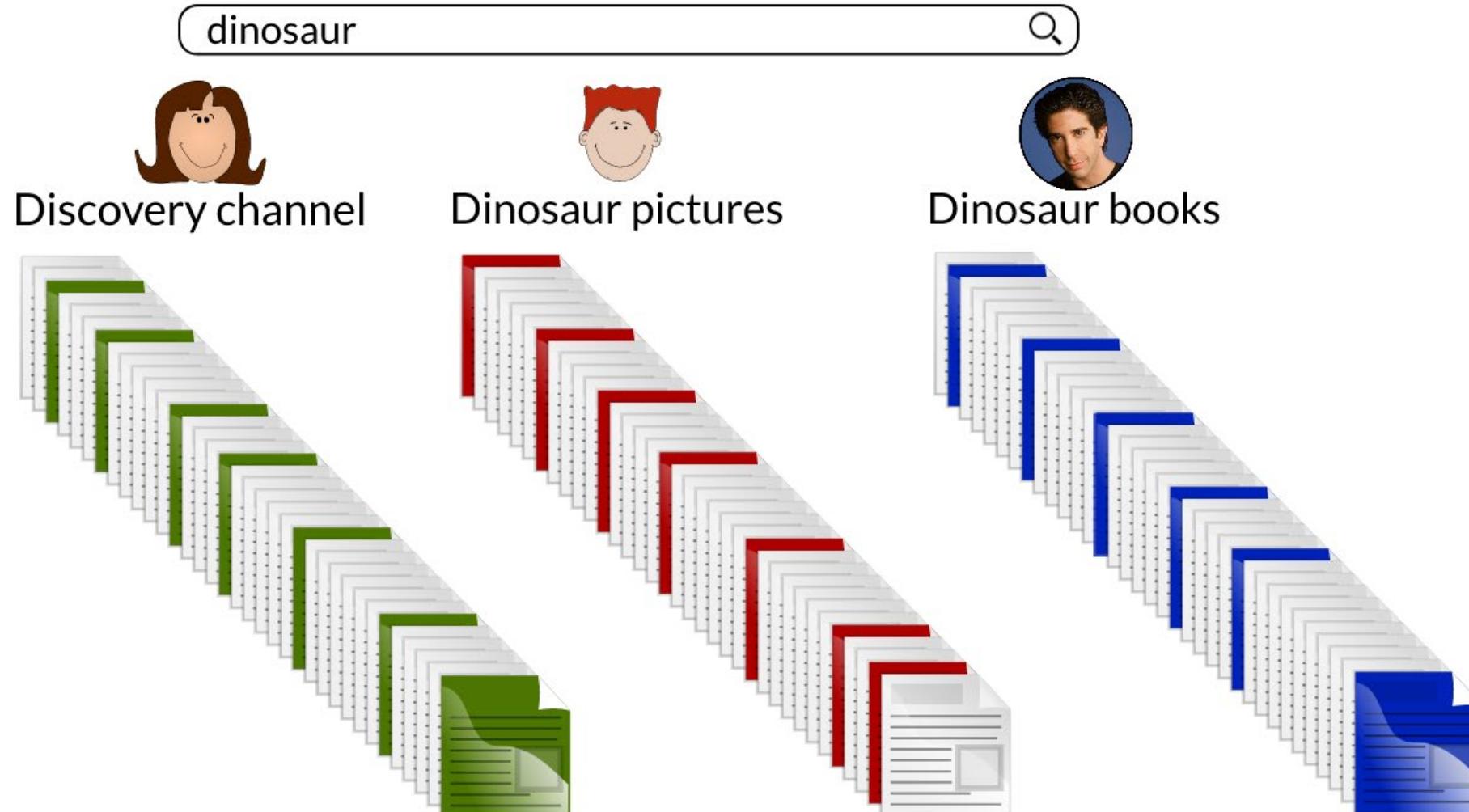
Query	rytary
Question	what do you want to know about this medication?
Options	dosage, coupon, side effects, cost, information
Query	acts 17:16
Question	what bible translation are you looking for?
Options	american standard version, kjv, esv, niv, nlt
Query	that's how i got to memphis
Question	what song information are you looking for?
Options	lyrics, stream, download, artist
Query	alan turing
Question	what do you want to know about this british mathematician?
Options	movie, suicide note, quotes, biography

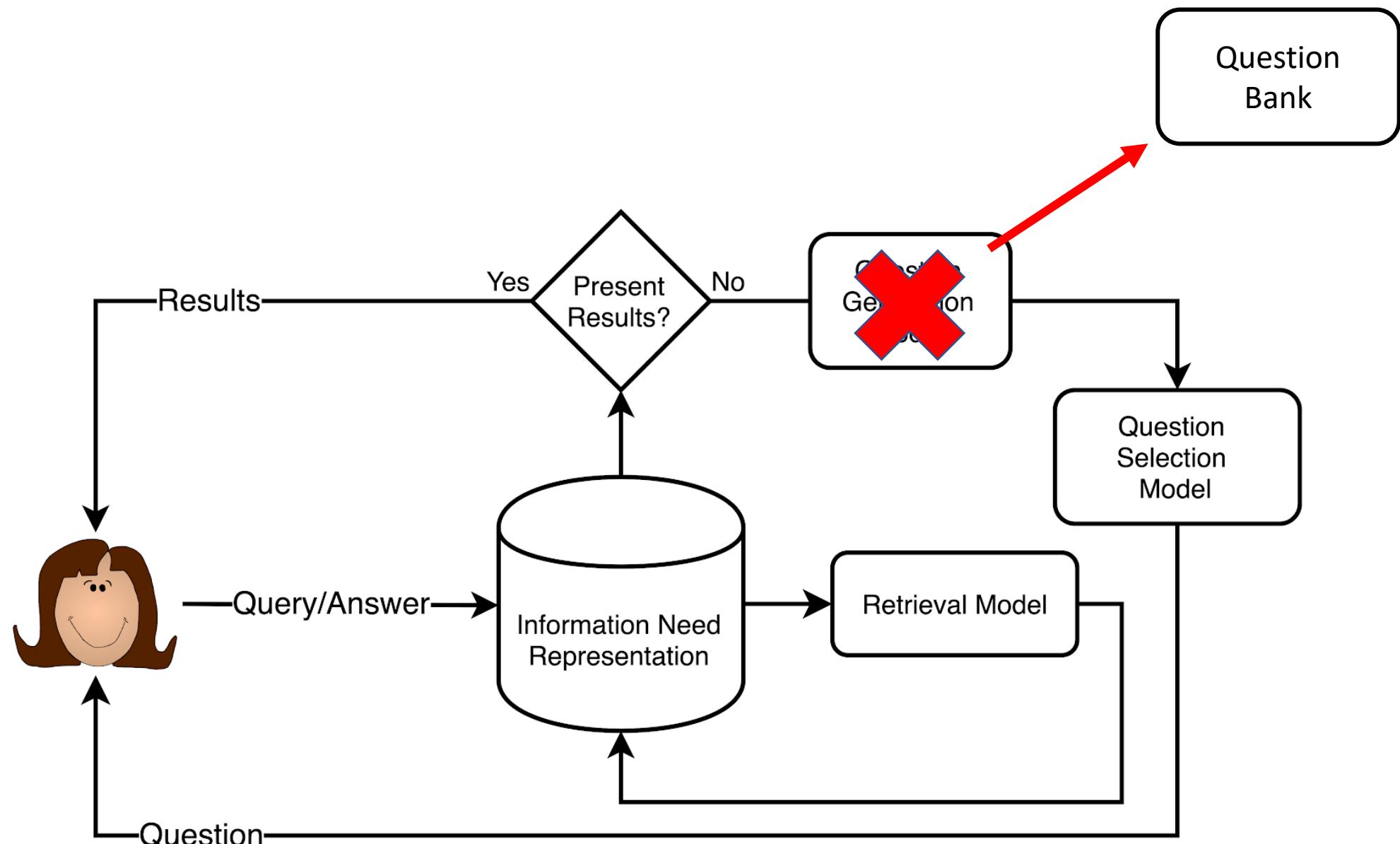
Clarification Selection

Search Result Diversification



From Diversification to Clarification

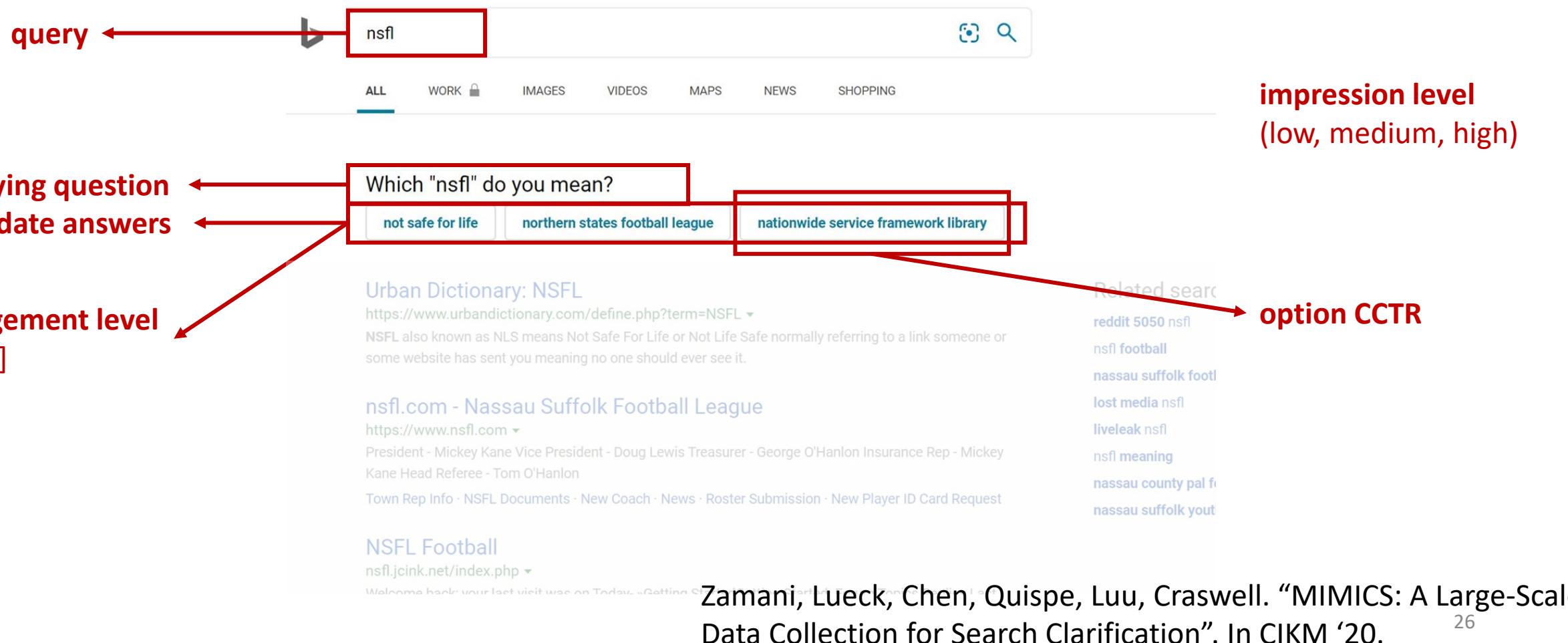




QULAC

# topics	198
# faceted topics	141
# ambiguous topics	57
# facets	762
Average facet per topic	3.85 ± 1.05
Median facet per topic	4
# informational facets	577
# navigational facets	185
# questions	2,639
# question-answer pairs	10,277
Average terms per question	9.49 ± 2.53
Average terms per answer	8.21 ± 4.42

MIMICS



User Interactions with Search Clarification

Quotes from User Interviews on Clarification in Web Search

- “convenient and easy”
- “it saves time and steps”
- “it sometimes cues the user to things they may not have considered”
- “helped them find more relevant results”

Opinion on non-relevant and low-quality clarifications:

- “It’s like when I look at iPhones, and eBay says ‘since you looked at iPhones you may be interested in these hair curlers!’ And I’m like, well that’s weird, whatever”
- The quality of result page after using clarification is important.

Key Findings from User Interviews

- Functional benefit:
 - “questions help guide users in the right direction”
- Emotional benefit:
 - it brings to users a **sense of confidence** that the search engine understands what the user wants.
 - it gives the users a **sense of security** and coming to the right conclusion.
 - The users pointed out that sometimes, especially when it comes to product search, they feel **less stress** when the search engine asks questions on different features of the product.

A/B Test

blue screen

All Images Videos Maps News Shopping | My saves

What version of Windows are you looking for?

windows 10 windows 8 windows 7 windows vista windows xp

How to Fix a Blue Screen of Death (BSOD) - Lifewire
<https://www.lifewire.com/how-to-fix-a-blue-screen-of-death-2624518> ▾

1. The most important Blue Screen of Death troubleshooting step you can take is to ask yourself what ...
2. Check that there's enough free space left on the drive Windows is installed on. Blue Screens of ...
3. Scan your computer for viruses. Some viruses can cause a Blue Screen of Death, especially ones ...
4. Apply all available Windows service packs and updates. Microsoft regularly releases patches and ...
See all full list on lifewire.com

Videos of blue screen
bing.com/videos

:((play) :((HOW TO FIX (play) Advanced options

blue screen

All Images Videos Maps News Shopping | My saves

Select one to refine your search

windows 10 windows 8 windows 7 windows vista windows xp

How to Fix a Blue Screen of Death (BSOD) - Lifewire
<https://www.lifewire.com/how-to-fix-a-blue-screen-of-death-2624518> ▾

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See all full list on lifewire.com

Videos of blue screen
bing.com/videos

:((play) :((HOW TO FIX (play) Advanced options

+48% more user engagement

Zamani, Mitra, Chen, Lueck, Mitra, Bennett, Craswell, Dumais. "Analyzing and Learning from User Interactions for Search Clarification". In SIGIR '20.
30

Clarification is
also useful for
exploratory
search!

Over 7% of interactions with the clarification pane
lead to ***exploration!***

User Interactions with Clarification in CQA

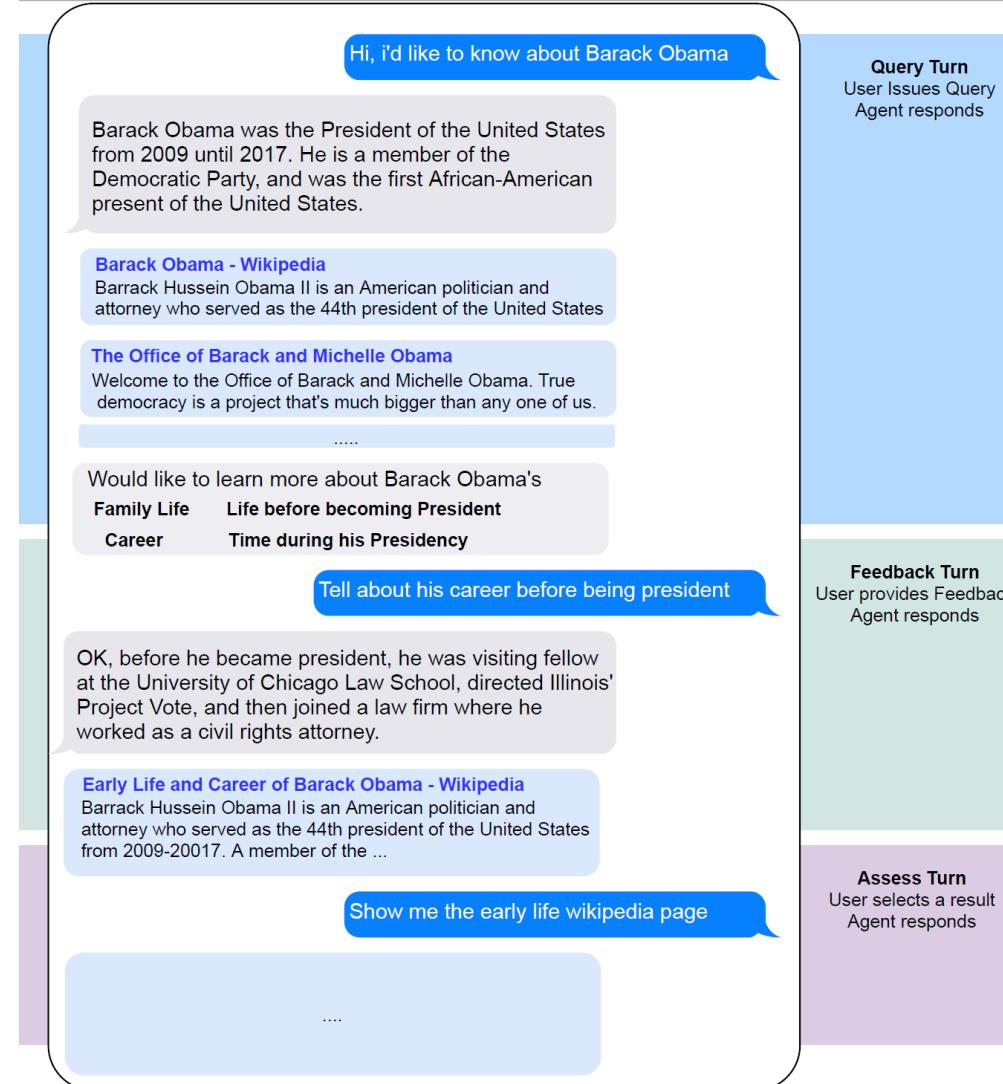
Clarifying questions in CQA can be categorized into:

- clarifications that have been answered by the Asker
- clarifications that have been answered but not by the Asker
- clarifications that are left unanswered.

Key Findings:

- clarifications with the goal of disambiguation account for the majority of clarification in CQA and they are very likely to be answered by the Asker.
- clarifications with the goal of confirmation are more likely to be left unanswered.

Formal Modeling of Mixed-Initiative Interactions

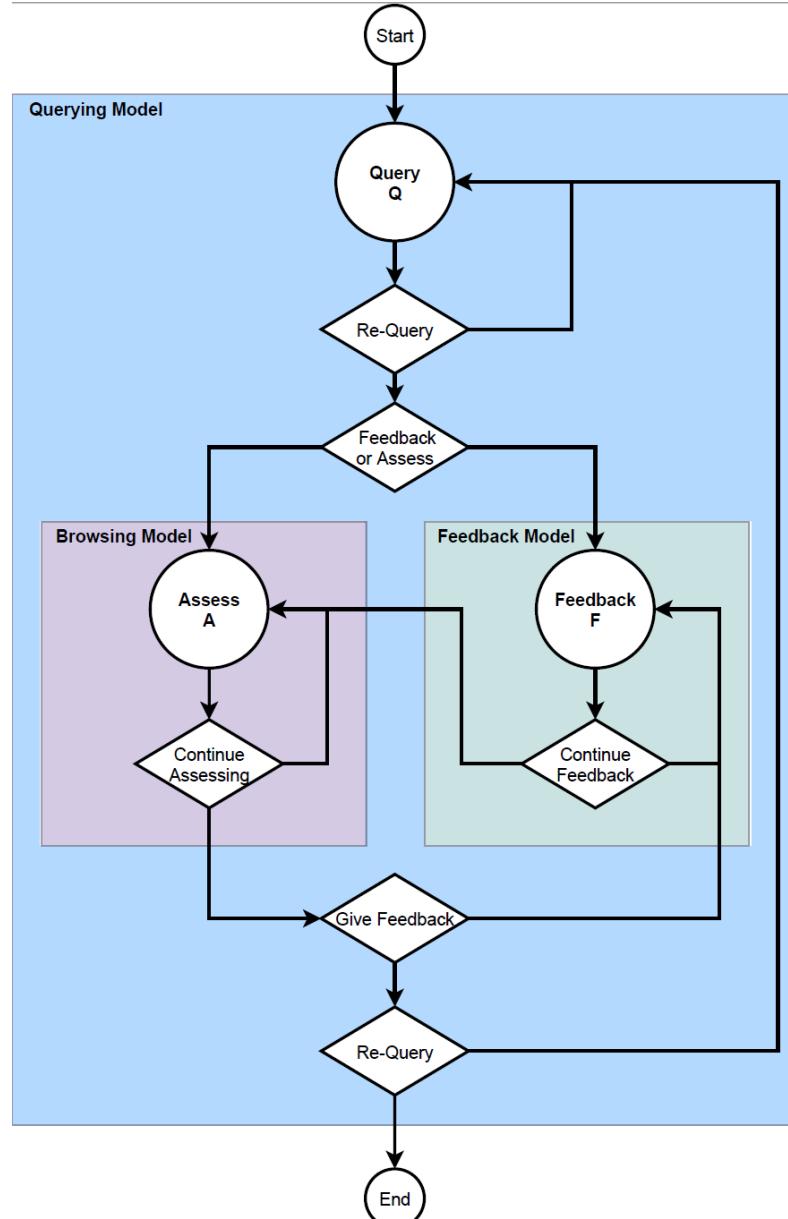


Query Turn
User Issues Query
Agent responds

Feedback Turn
User provides Feedback
Agent responds

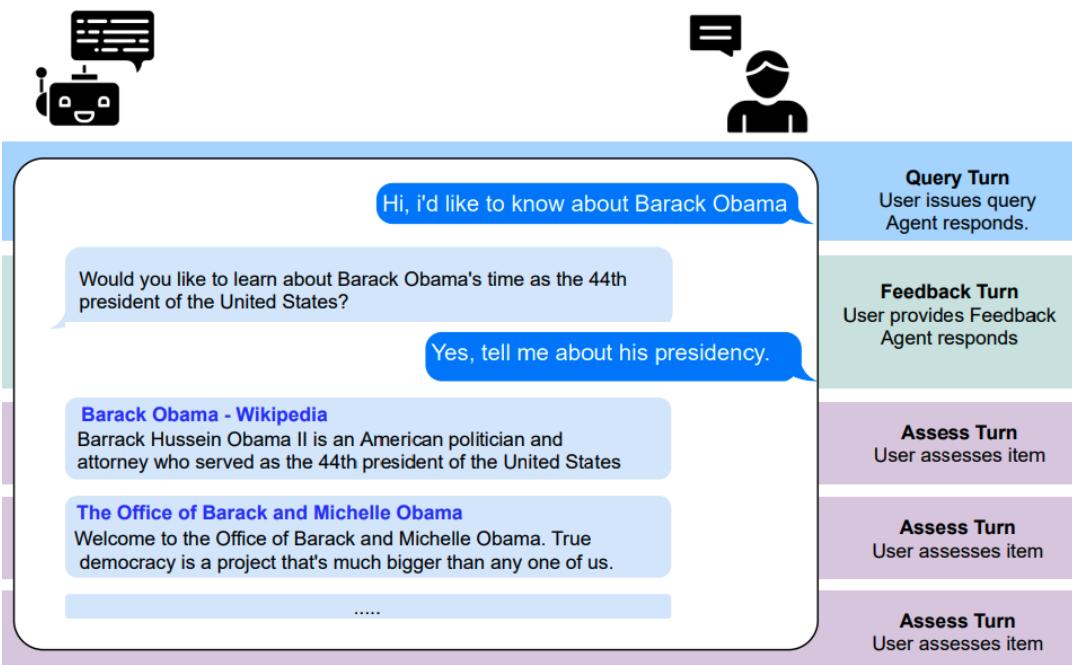
Assess Turn
User selects a result
Agent responds

Aliannejadi, Azzopardi, Zamani, Kanoulas, Thomas, and Craswell.
 "Analyzing Mixed Initiatives and Search Strategies during Conversational Search". *CIKM '21*.

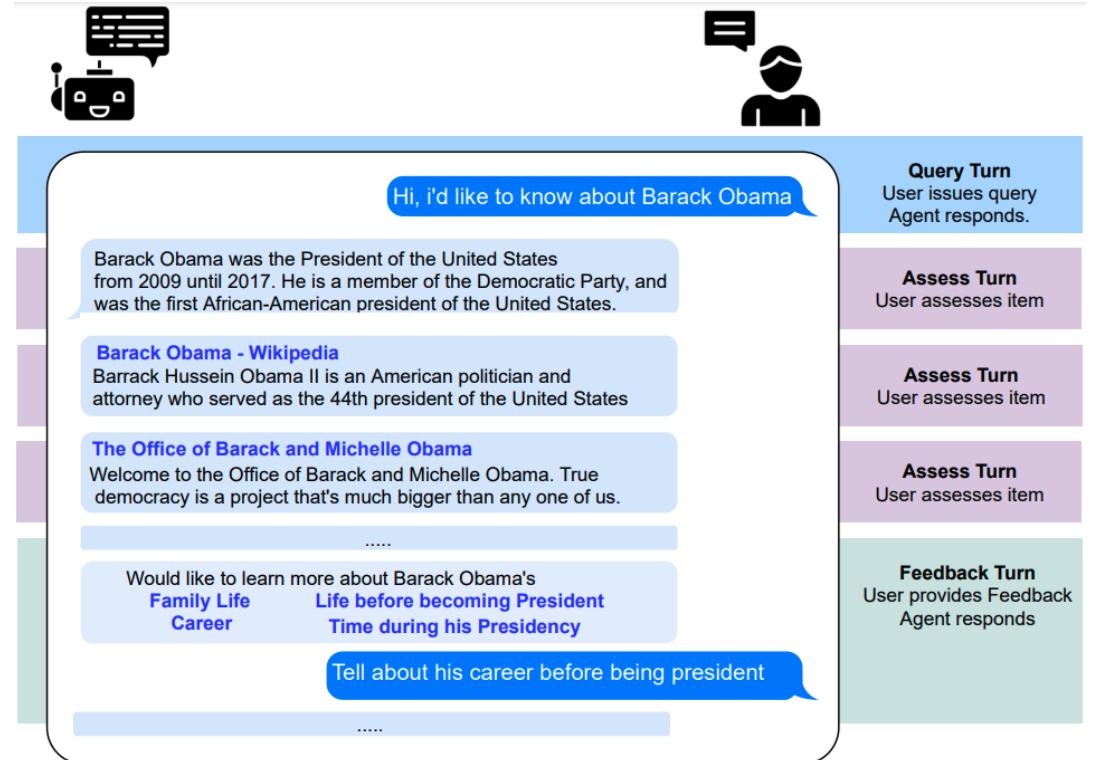


Aliannejadi, Azzopardi, Zamani, Kanoulas, Thomas, and Craswell.
 “Analyzing Mixed Initiatives and Search Strategies during Conversational
 Search”. CIKM ‘21.

Feedback first



Feedback after



Cost and Benefit (Gain) of a Conversation

$$G(t_1, t_2, \dots, t_T) = \sum_{i=1}^T g(t_i)$$

We can assume that the user only accumulates gain on an assessment of a relevant document.

$$C(t_1, t_2, \dots, t_T) = \sum_{i=1}^T c(t_i)$$

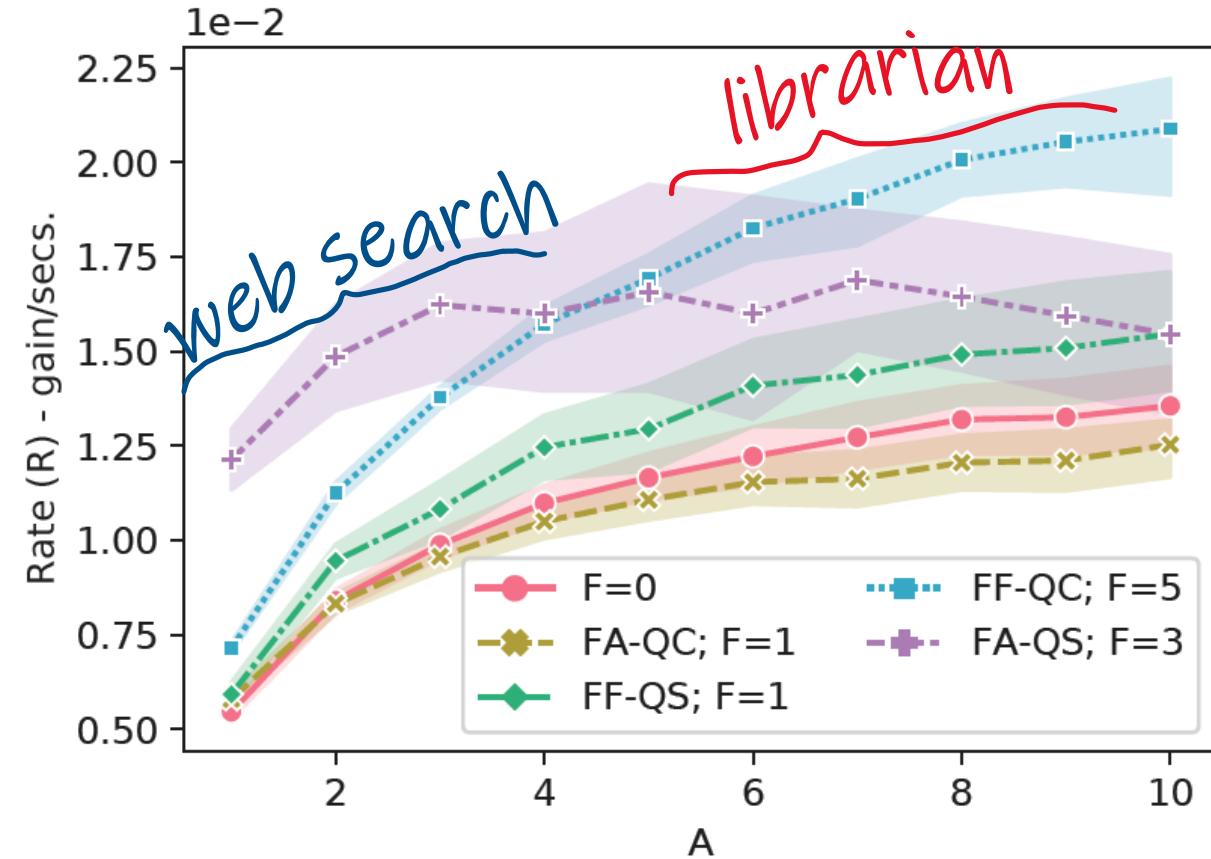
We can consider time as a good estimator of each interaction cost.

$$R = \frac{G(t_1, t_2, \dots, t_T)}{C(t_1, t_2, \dots, t_T)}$$

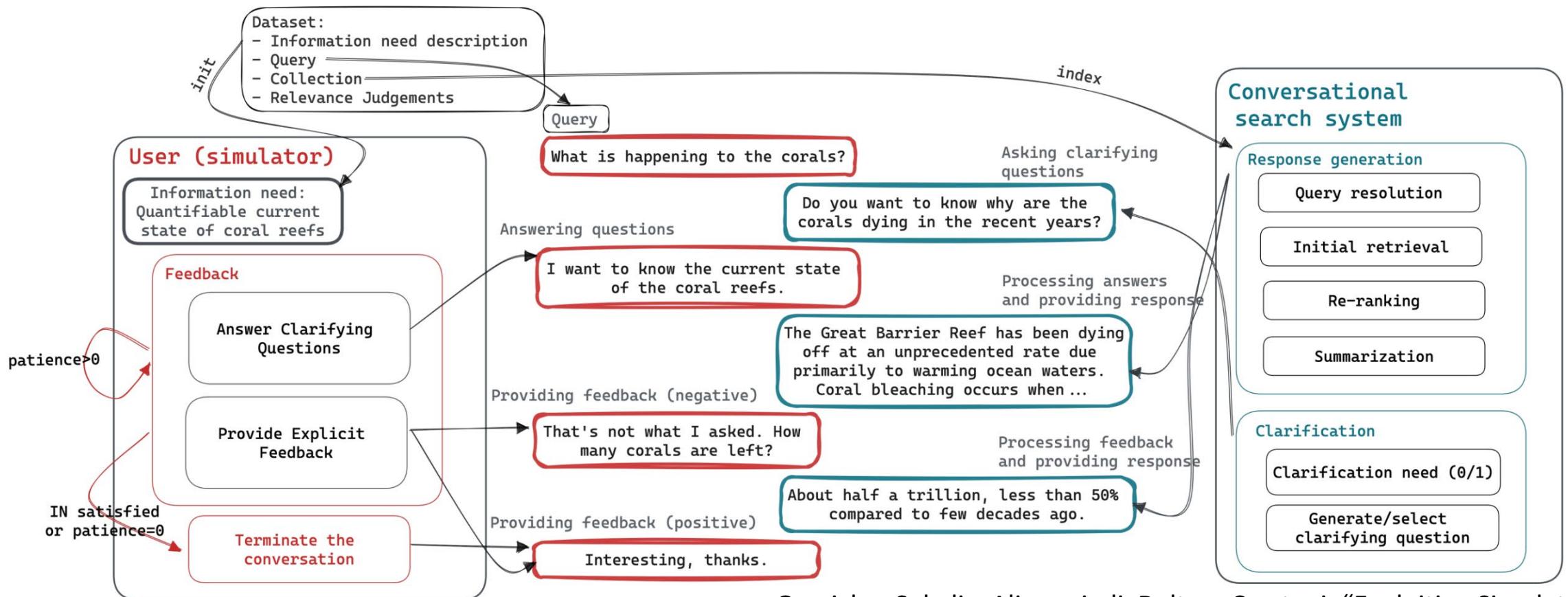
Best Mixed-Initiative Strategies

Searcher is only willing to examine a few items: FA-QS

Searcher is willing to go deeper: FF-QC



User Simulation for Mixed-Initiative Interactions



Owoicho, Sekulic, Aliannejadi, Dalton, Crestani. "Exploiting Simulated User Feedback for Conversational Search: Ranking, Rewriting, and Beyond". SIGIR '23.

Quality of the Generated Conversations

Table 4: Results of crowdsourcing study assessing naturalness and usefulness of generated answers to clarifying questions in single- and multi-turn scenarios. Each value indicates the percentage of pairwise comparisons won by the specific model as well as ties. Sign † indicates a significant difference.

		<i>ConvSim</i>	<i>USi</i> [48]	Ties	<i>ConvSim</i>	Human	Ties
<i>Single</i>	Naturalness	37%†	22%	41%	36%	25%	39%
	Usefulness	44%†	19%	37%	36%†	20%	44%
<i>Multi</i>	Naturalness	45%†	18%	37%	25%	28%	47%
	Usefulness	62%†	12%	26%	26%	16%	58%

Mixed-Initiative Interactions in TREC CAsT 2022

Mixed-Initiative in TREC CAsT Year 4

System asks the user questions to:

1. Elicit the task
2. Ask for feedback
3. Clarify ambiguity

User: What are some cool things to do in California?

MI-System: California is very large, what area would you like to visit?

User: I'd like to explore Northern California.

Ranking from a crowdsourced question bank (~4500 Qs) as well as generative approaches.

Mixed-Initiative in TREC CAsT Year 4

Crowdsourced judgments on **three dimensions** on a **four-point graded scale** for each system question:

- Perceived Relevance
- Novelty - add new information
- Diversity - degree of freedom in user response

Crowdsourced judgments for first question for all teams across all turns.

- 2024 assessed questions
- 747 Relevant (judged to be 2 or 3)

Evaluation is binary (e.g. P@1 for relevance) for individual dimensions.

Lessons Learned from Mixed-Initiative Evaluation of TREC CAsT

- Best performing run uses mixed-initiative interactions.
- New types of questions appear in the generated questions.
- Some questions are not trivial to the crowdworkers.
- Relevance, novelty, and diversity do not capture all the aspects of mixed-initiative interactions.
- Not all turns require mixed-initiative interactions. This is not captured by the evaluation either.

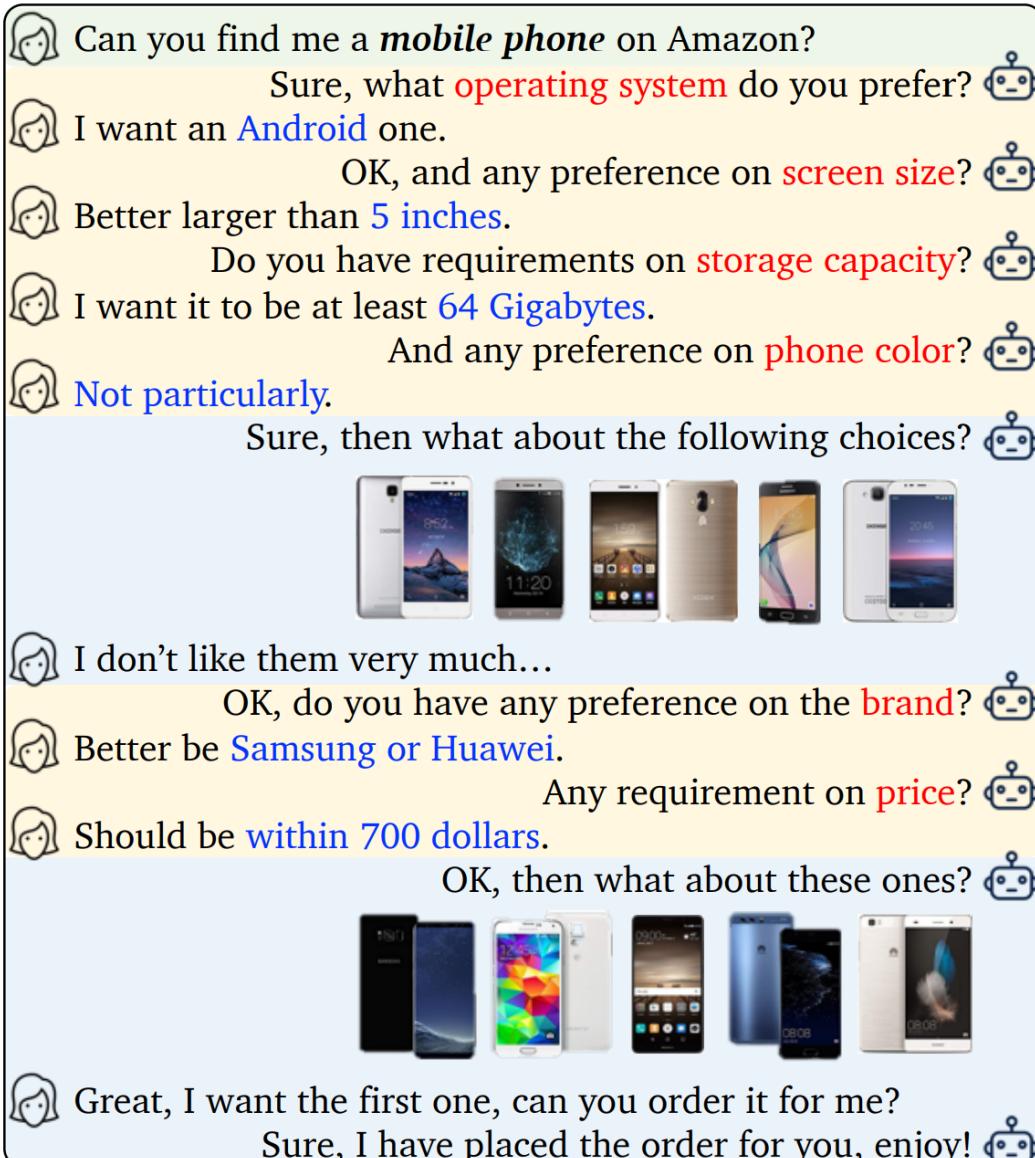
Preference Elicitation in Conversational Recommendation

Recommender systems can interactively ask questions (e.g., related to item attributes) to elicit user preferences for more accurate recommendation.

Asking only two questions can lead to 25% improvements in recommendation performance.

Christakopoulou, Radlinski, Hofmann. "Towards Conversational Recommender Systems". *KDD '16*.

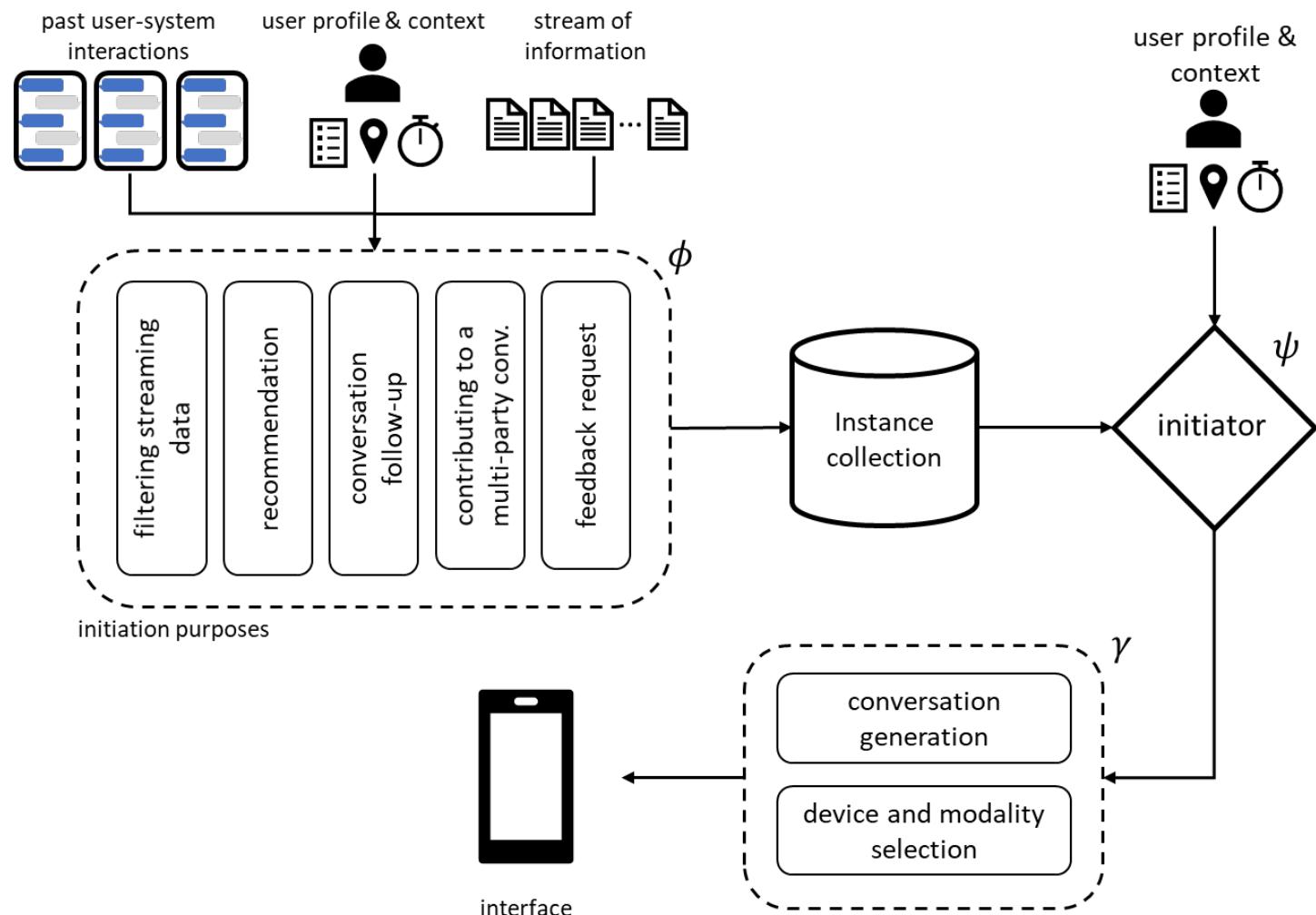
- In preference elicitation, the elicitation space is often limited (e.g., a limited number of item attributes) and approaches mostly focus on selecting attributes for question generation.
- Reinforcement learning approaches and memory networks are found to be effective for preference elicitation [Sun and Zhang, SIGIR 2018; Zhang et al., CIKM 2018].



System-Initiative Interactions in CIS

Three Major Dimensions in Agent-Initiative Interactions

- Initiation Moment (**when** to initiate a conversation?)
 - Instant initiation
 - Opportune moment initiation
- Initiation purpose (**why** to initiate a conversation?)
 - Filtering streaming information based on user profile
 - Recommendation
 - Following up a past conversation
 - Contributing to a multi-party human conversation
 - Feedback request
- Initiation means (**how** to initiate a conversation?)
 - Device
 - Interaction Modality



Conclusions

- Mixed-initiative is a key component in CIS.
- Clarification and preference elicitation are well explored.
- Clarification methods include rule-based, maximum likelihood based, and clarification maximization-based approaches.
- RL and memory networks are found to be effective for preference elicitation in recommendation.
- Other mixed-initiative interactions have been relatively less explored.
- For more information, refer to Chapter 6 in the CIS book.

Questions



Foundations and Trends in
Information Retrieval
(to appear)

Conversational Information Seeking

Hamed Zamani, Johanne Trippas, Jeff Dalton,
and Filip Radlinski

now
the essence of knowledge



#TheCISTutorial

<https://arxiv.org/pdf/2201.08808.pdf>