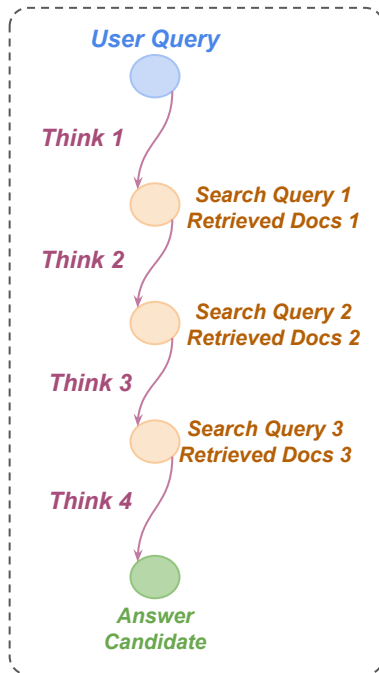


RAG-Reasoning Systems



Search-R1

User Query: What type of profession does Chris Jericho and Gary Barlow have in common?

Think: I need to find the type of profession that Chris Jericho and Gary Barlow have in common. I'll search for it
Search Query: Chris Jericho and Gary Barlow profession
Information: Doc 2(Title: "Chris Jericho")
""Do You Wanna ...

Think: I found out that Chris Jericho is a professional wrestler, musician, author ...
Search Query: Gary Barlow profession
Information: Doc 1(Title: "Gary Barlow") hits, twelve number one ...

...

Think: I found out that Chris Jericho is a professional wrestler, musician, author ...
Answer: musician

Search-O1

Search Instruction:
When you encounter unfamiliar knowledge, you can perform web searches to help you ...

Original Question:

Step 1: ... Step 2: ... Step 3: ...
Question: carbon atoms count of Product 3

Start thinking.

Large Reasoning Model (e.g. o1)

Search for helpful info on-demand.

Structure of trans-Cinnamaldehyde

Get concise information and continue coherent reasoning.

Step n+1

Trans-Cinnamaldehyde has the structure $C_9H_8CH=CHCHO$. (✓)

Step n+2

...

Final Step

Provide final answer.

Product 3 contains 11 carbon atoms. (✓)

Domains:

Physics
Chemistry
Biology
Math
Code
ODQA

Retrieved Documents

Reason-in-Documents

Integrate helpful information into the previous reasoning chain.

Self-Ask

GPT-3

Question: Who lived longer, Theodor Haecker or Harry Vaughan Watkins?
Are follow up questions needed here: Yes.
Follow up: How old was Theodor Haecker when he died?
Intermediate answer: Theodor Haecker was 65 years old when he died.
Follow up: How old was Harry Vaughan Watkins when he died?
Intermediate answer: Harry Vaughan Watkins was 69 years old when he died.
So the final answer is: Harry Vaughan Watkins

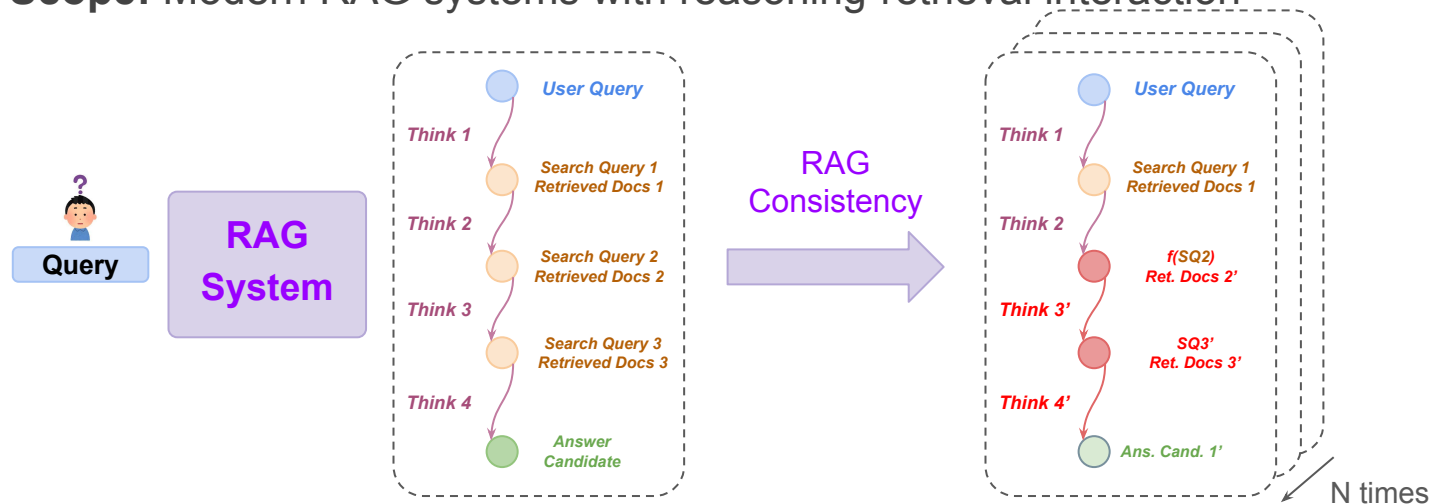
Question: Who was president of the U.S. when superconductivity was discovered?
Are follow up questions needed here: Yes.
Follow up: When was superconductivity discovered?
Intermediate answer: Superconductivity was discovered in 1911.
Follow up: Who was president of the U.S. in 1911?
Intermediate answer: William Howard Taft.
So the final answer is: William Howard Taft.



UE for RAG-Reasoning Systems (Ongoing work)

RAG-Consistency

- **Idea:** Diversify the generations with applying changes in the reasoning-retrieval path
- **Scope:** Modern RAG systems with reasoning-retrieval interaction



Initial Results (Ongoing work)

Search-R1	Self-Consistency	Reasoning-Consistency	RAG-Consistency
Bamboogle	58.01	67.04	74.76
PopQA	60.59	69.87	81.57
HotpotQA	55.97	61.98	69.63
2Wiki	63.52	62.19	70.40

Self-Ask	Self-Consistency	Reasoning-Consistency	RAG-Consistency
Bamboogle	59.03	71.62	80.39
PopQA	59.72	71.33	82.16
HotpotQA	59.58	75.55	82.30
2Wiki	55.65	66.16	76.99