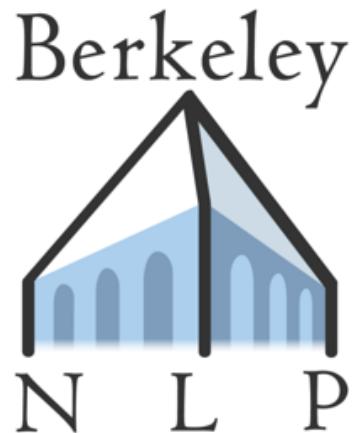


Computational Rationality in LLMs



CS188, Fall 2023

Nicholas Tomlin



Overview

Crossword Solving



Detecting LLMs

ghostbuster [github](#) [contact](#)
a model-agnostic detector for AI-generated text

We introduce Ghostbuster, a state-of-the-art system for detecting AI-generated text. Our method works by passing documents through a series of weaker language models, running a structured search over possible combinations of their features, and then training a classifier on the selected features to predict whether documents are AI-generated. Crucially, Ghostbuster does not require access to token probabilities from the target model, making it useful for detecting text generated by black-box models or unknown model versions. In conjunction with our model, we release three new datasets of human- and AI-generated text as detection benchmarks in the domains of student essays, creative writing, and news articles. We compare Ghostbuster to a variety of existing detectors, including DetectGPT and GPTZero, as well as a new RoBERTa baseline. Ghostbuster achieves 99.0 F1 when evaluated across domains, which is 5.9 F1 higher than the best preexisting model. It also outperforms all previous approaches in generalization across writing domains (+7.5 F1), prompting strategies (+2.1 F1), and language models (+4.4 F1). We also analyze the robustness of our system to a variety of perturbations and paraphrasing attacks and evaluate its performance on documents written by non-native English speakers.

Is it AI?

Decision-Making in NL

Environment

Travel Ideas

Hi! I'm visiting NYC for the first time. I heard we should check out the Guggenheim, but not sure what the other places we should visit are.

People also enjoy the MoMA and Met. Perhaps we could add that to an itinerary?

I'd generally like to see less touristy spots. Could you make some reservations at a restaurant too? How about Saul's?

Can do! According to reviews Saul's has become a tourist hotspot too. How about Lucia's, which is near the Guggenheim?

I don't like Italian food, unless you think Lucia's is notable. Also, can you make sure there's parking around?

A map of New York City with several red location pins placed on it, indicating travel destinations. The pins are located in various parts of the city, including what appears to be the Upper West Side, Midtown, and Lower Manhattan.



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Constraint satisfaction, belief propagation, greedy search, iterative improvement

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Is it AI? 🤖 ↻ 4%

Classification, feature selection, generalization and overfitting

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A map of New York City with several location pins and a compass icon.

Constraint satisfaction, value of information, decision networks, particle filtering



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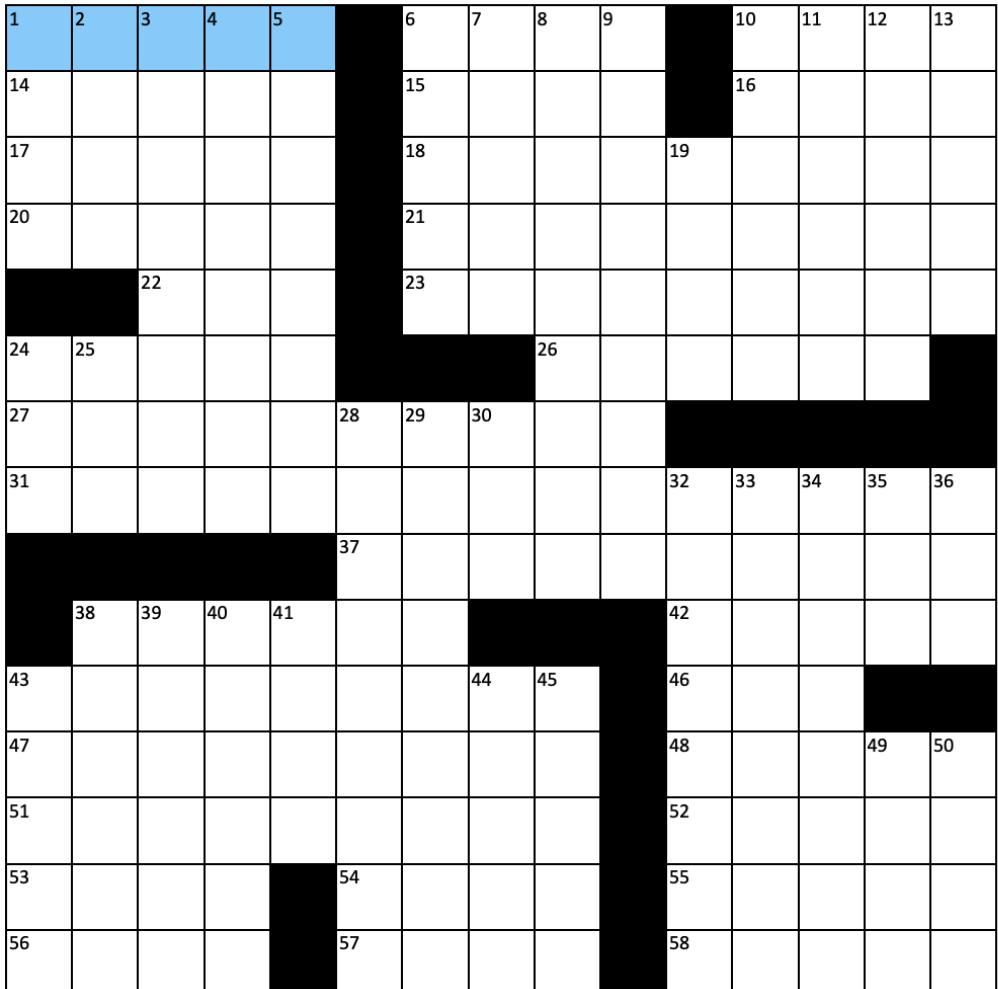
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Constraint satisfaction, value of information, decision networks, particle filtering



Example Crossword



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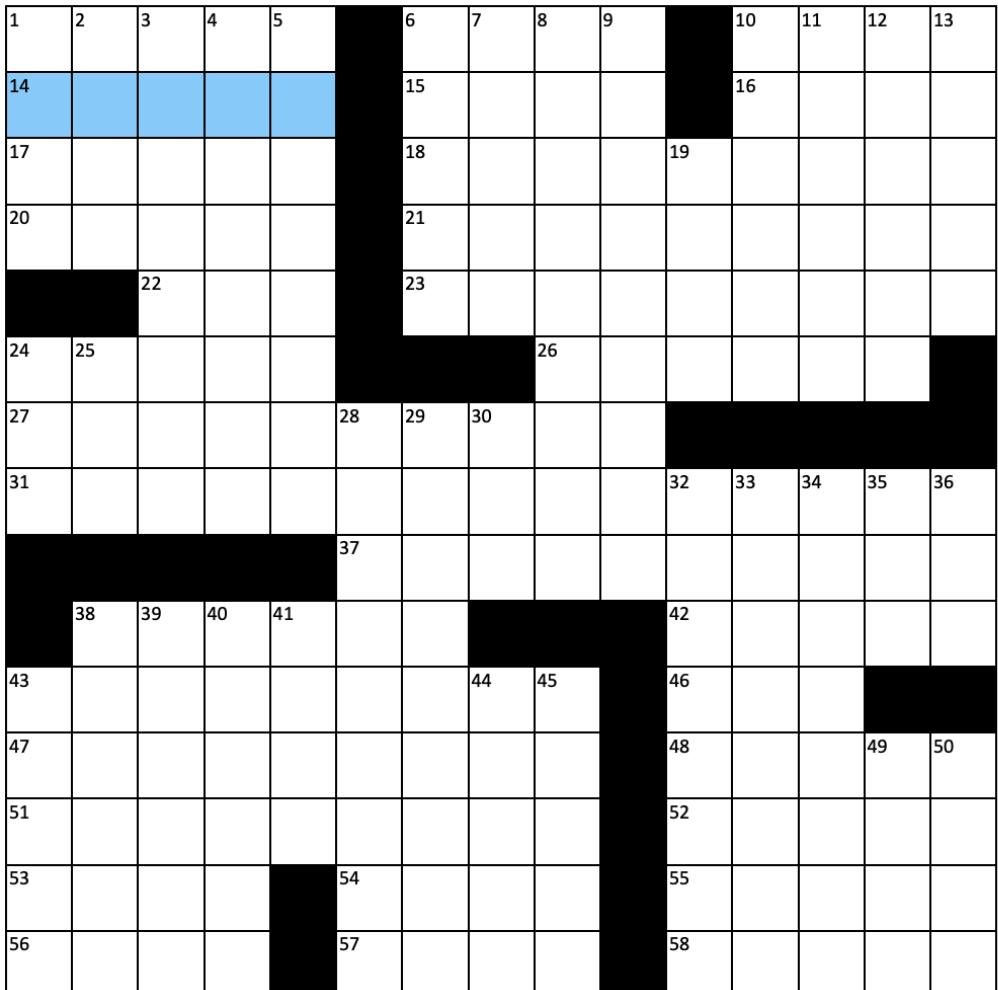
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- 42 Leaders at the Kaaba

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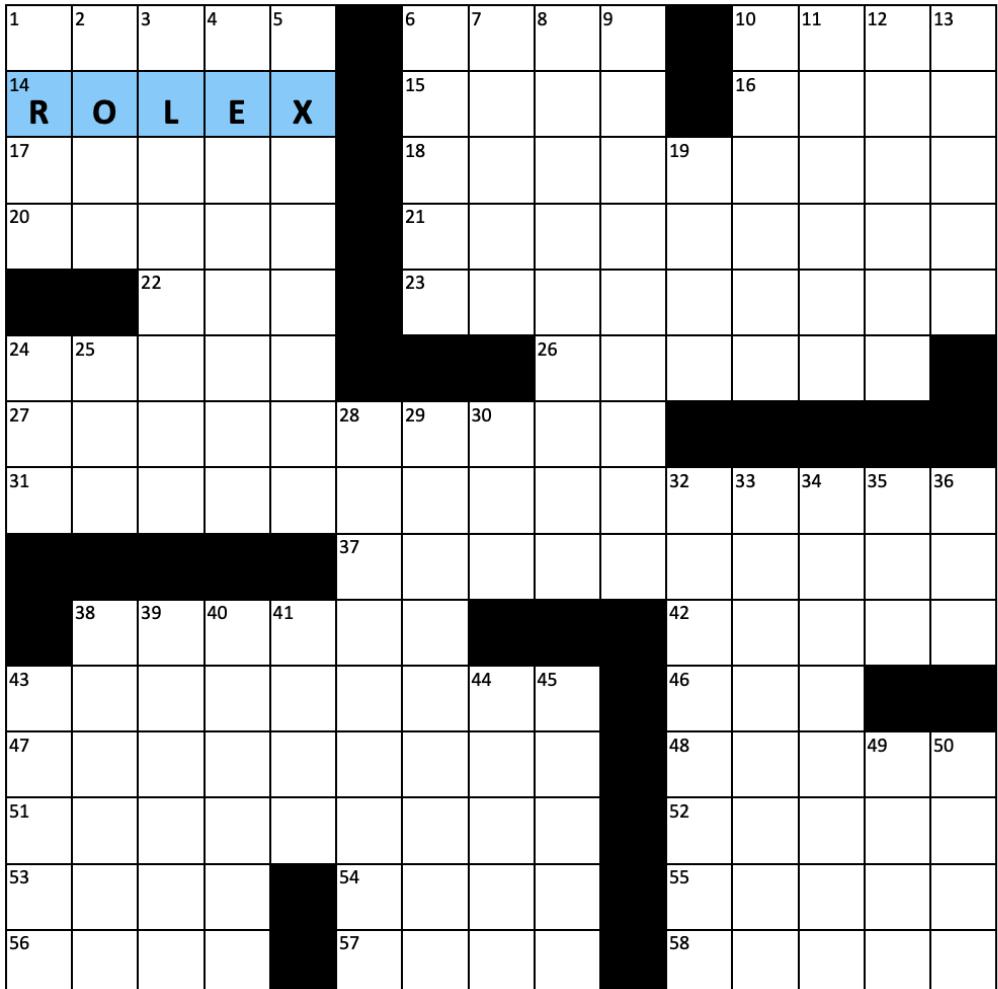
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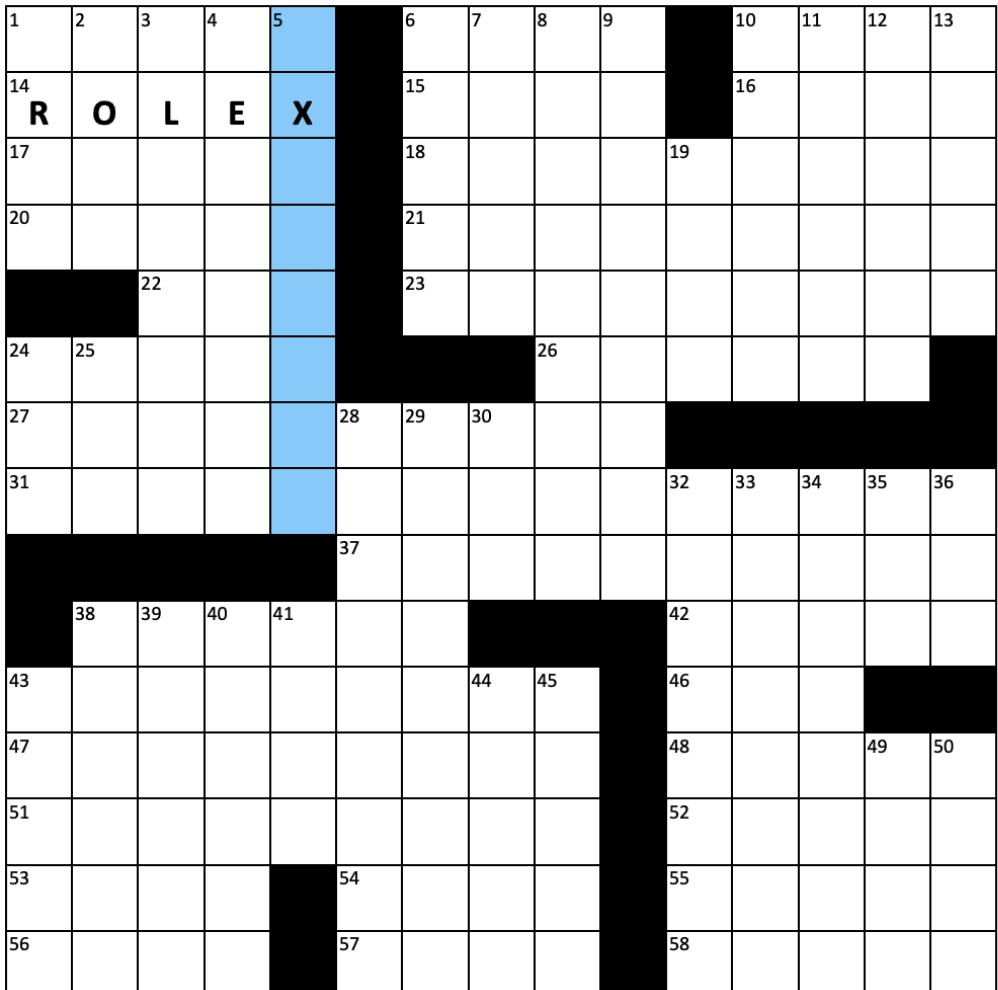
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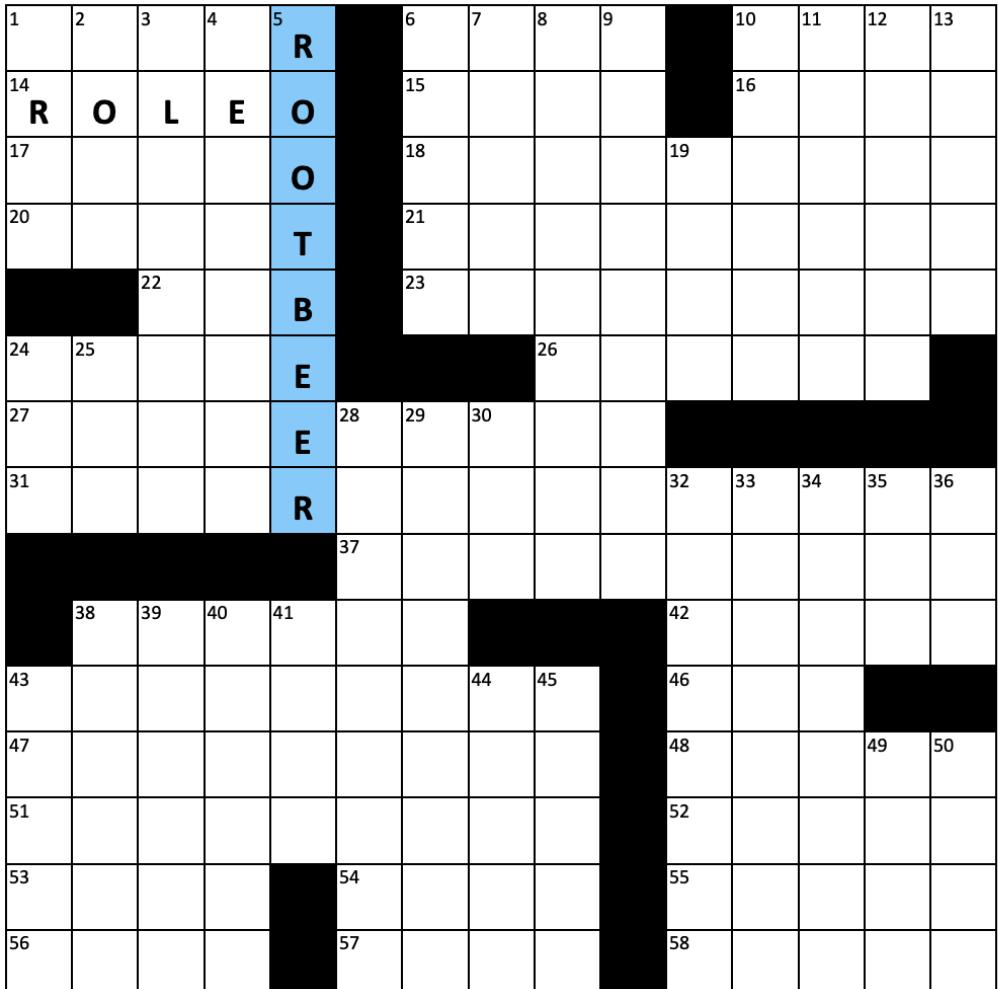
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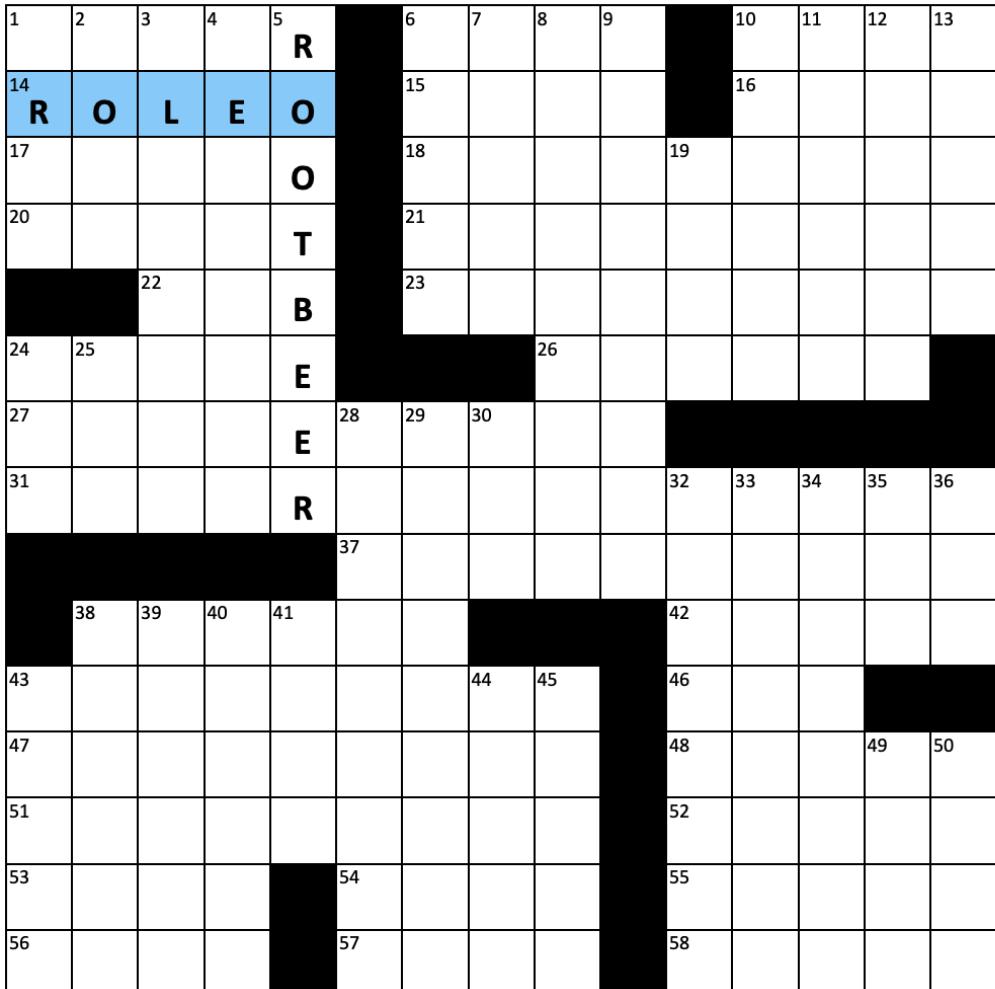
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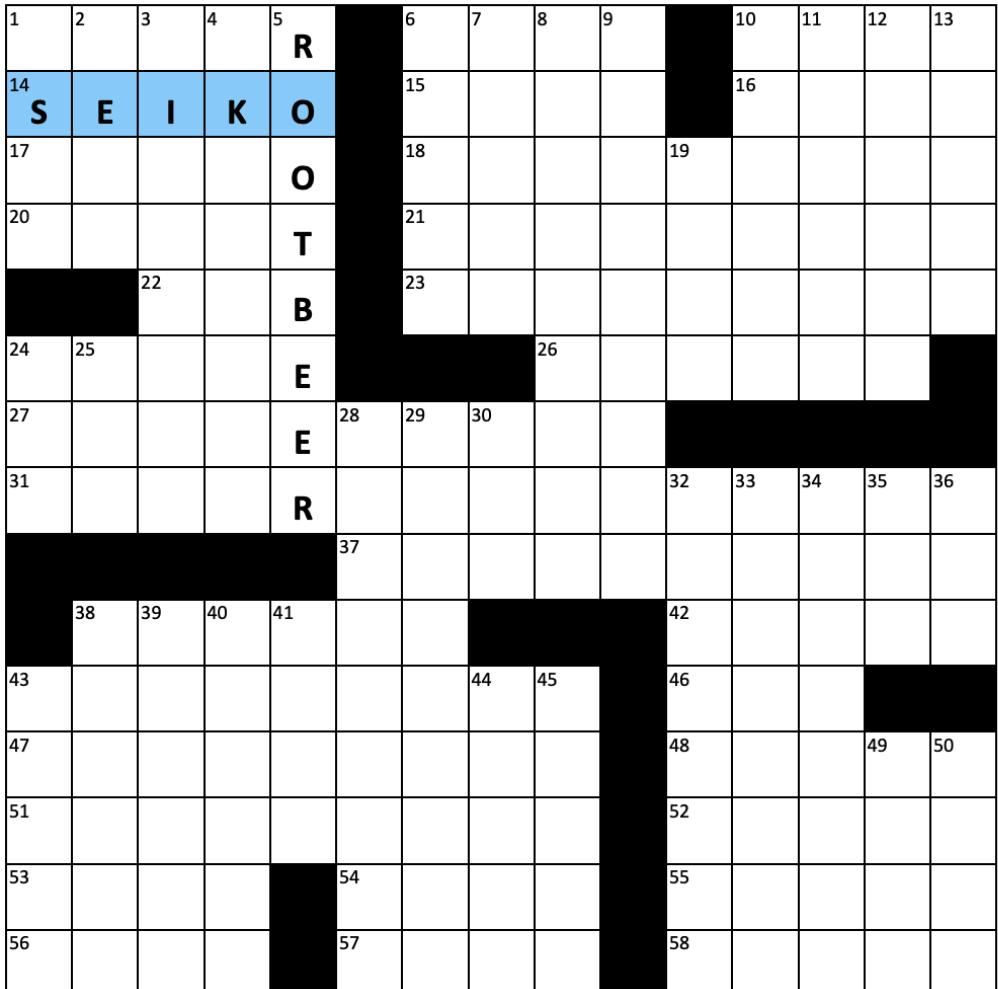
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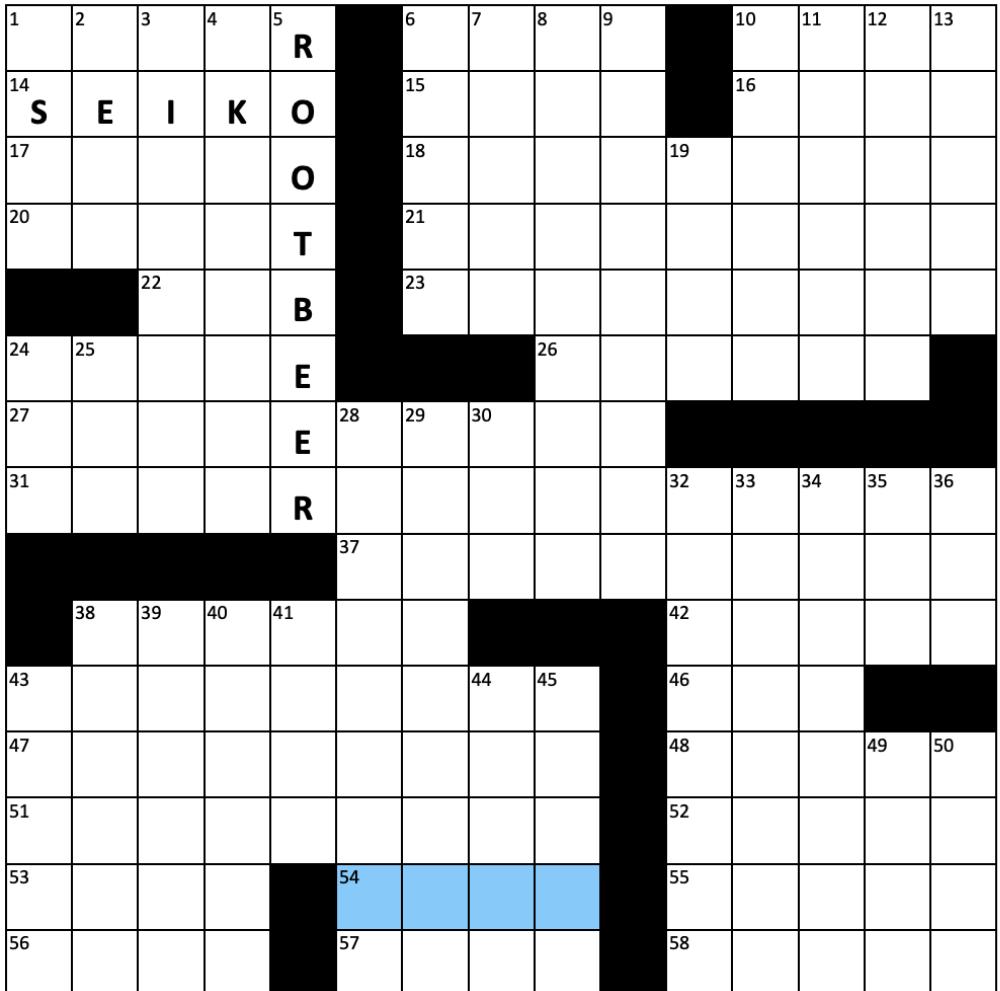
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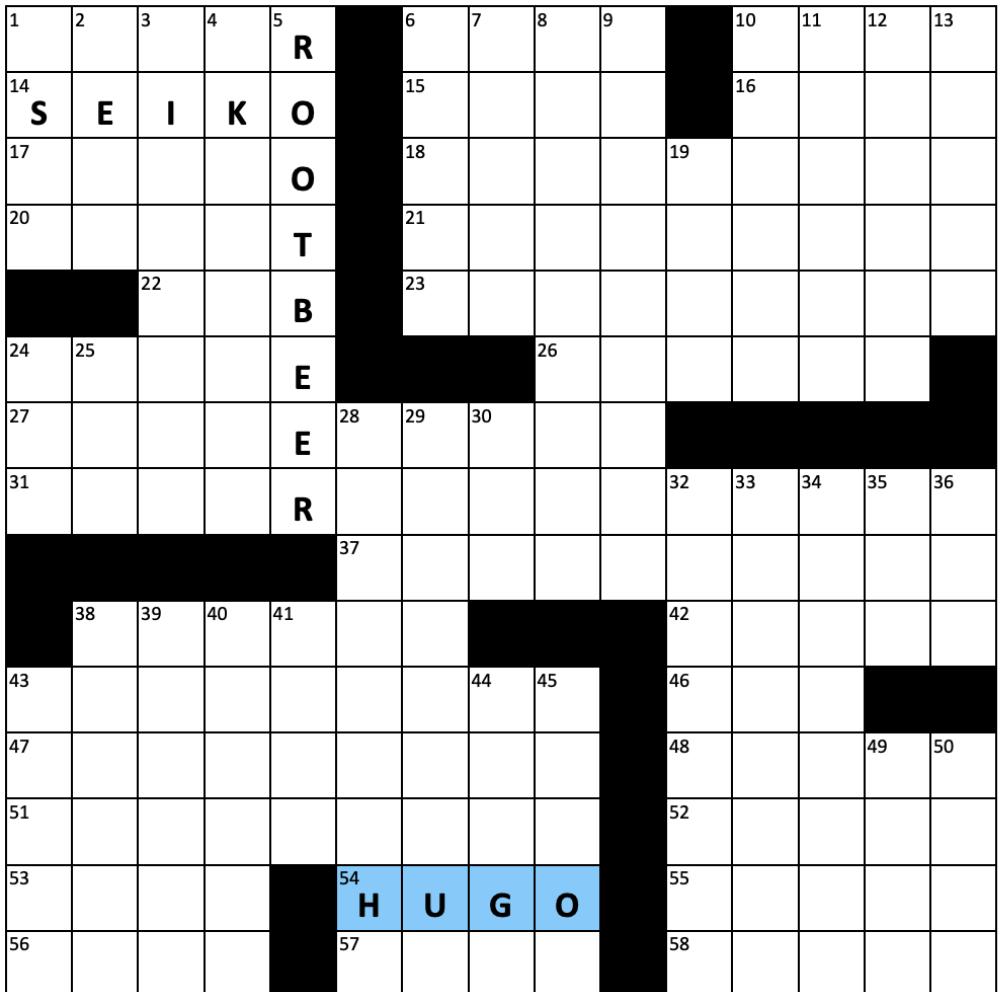
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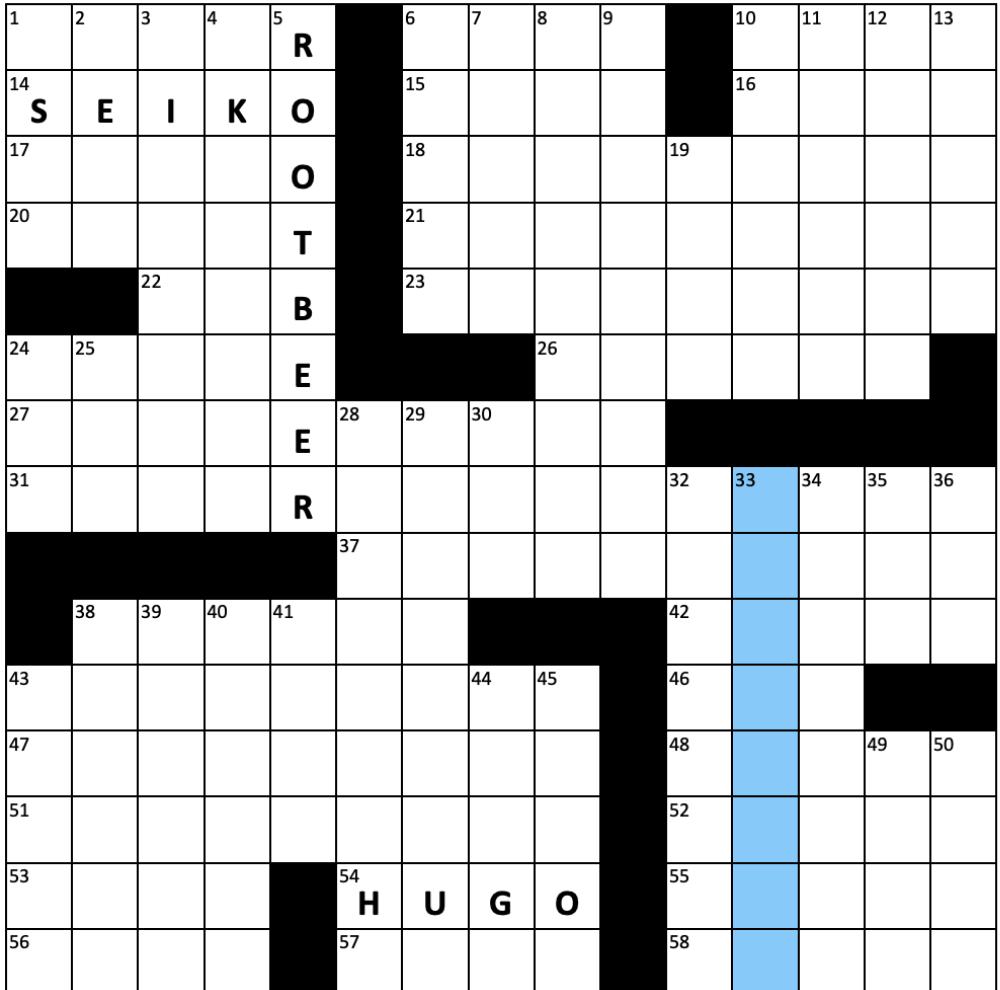
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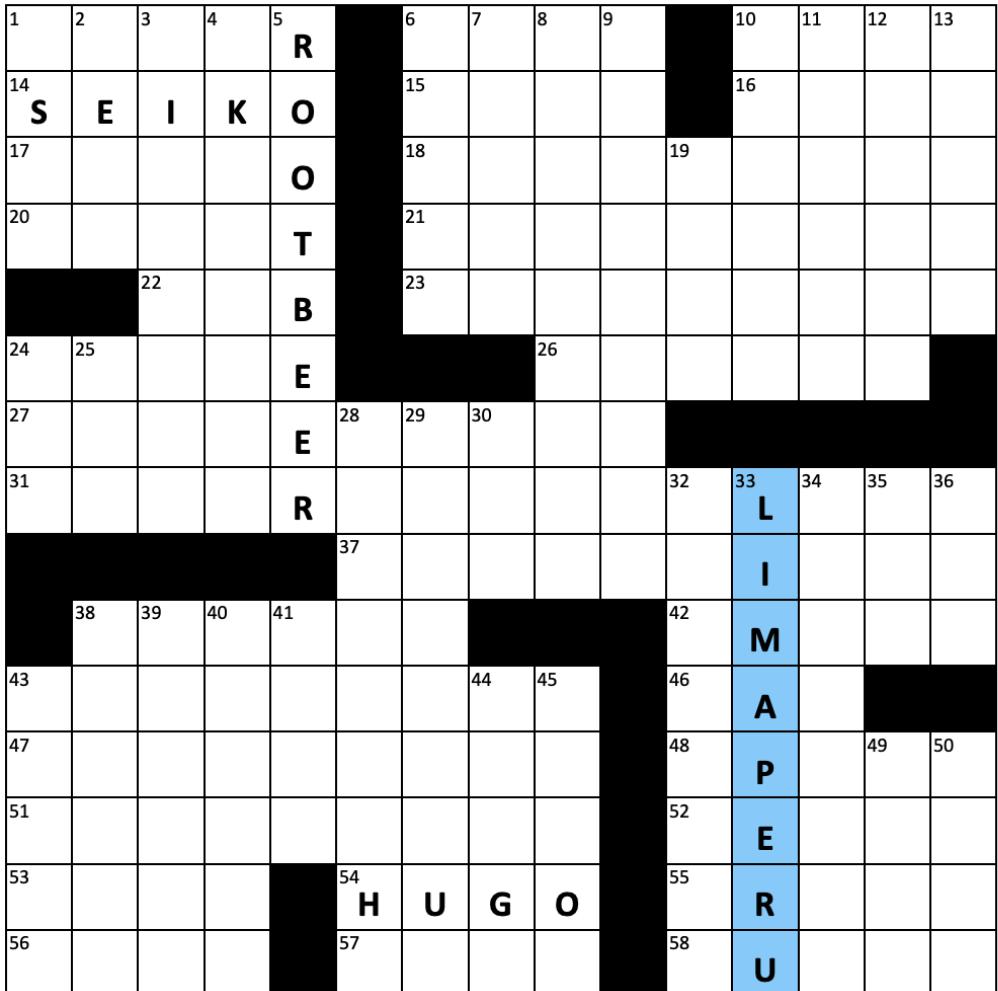
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Example Crossword



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- 7 Right on
- 8 Aces with aces?
- 9 Like some households
- 10 Designer with an eponymous hotel in the Burj Khalifa
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- 19 Actress Shawkat of "Arrested Development"
- 24 Assignment for an anchor
- 25 "___ noticed ..."
- 28 Great Hindu sage
- 29 Late-Triassic flier
- 30 It can be found right on a clock
- 32 "100 Years ... 100 Stars" and others, in brief
- 33 The world's largest desert capital, after Cairo, Egypt



Example Crossword



Across

- 14 S E I K O
- 17 O T
- 20 B
- 22 E
- 24 E
- 25 E
- 27 E
- 31 GENERATION
- 37 I
- 38 M
- 42 A
- 43 "Things are going great for me!"
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Example Crossword



Across

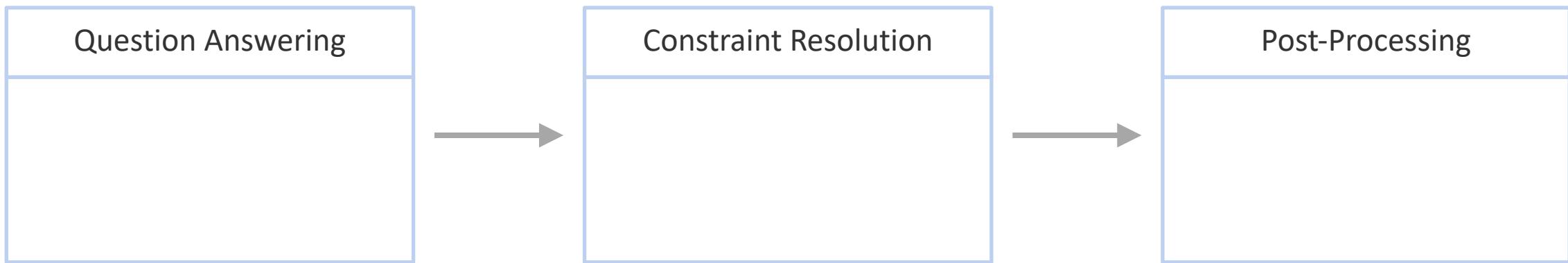
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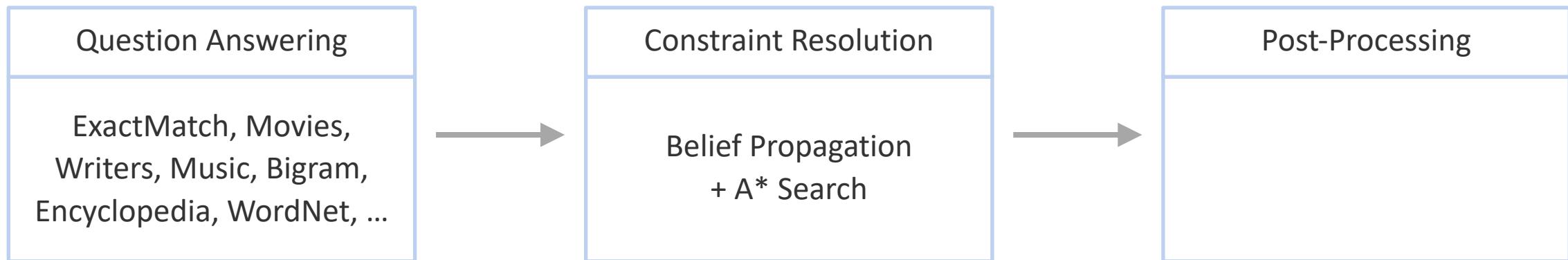
General Framework





Previous Work

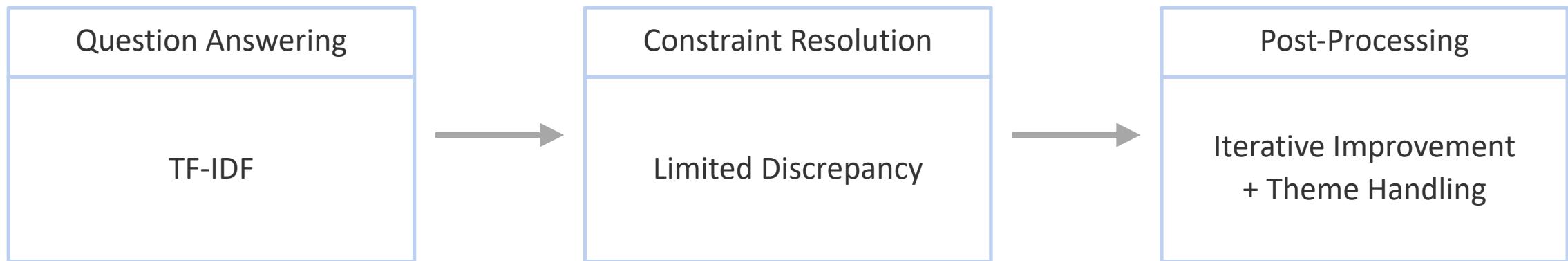
Proverb [Littman et al., 2002]





Previous Work

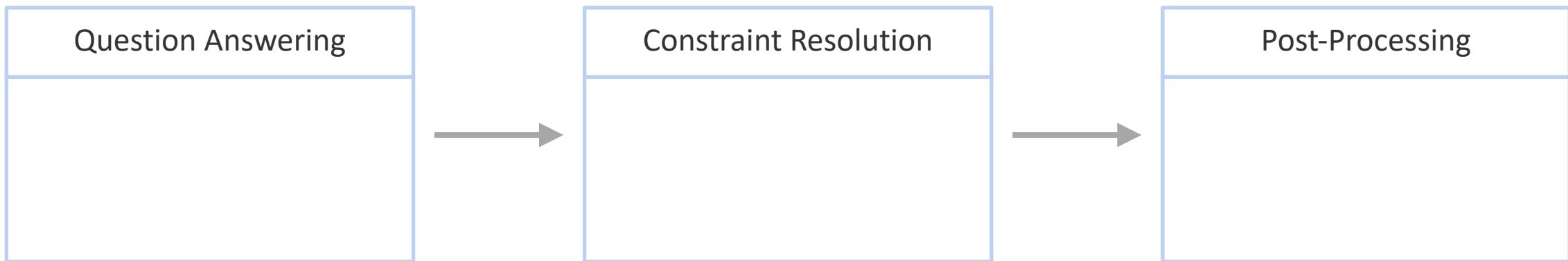
Dr. Fill [Ginsberg, 2011]





Our Approach

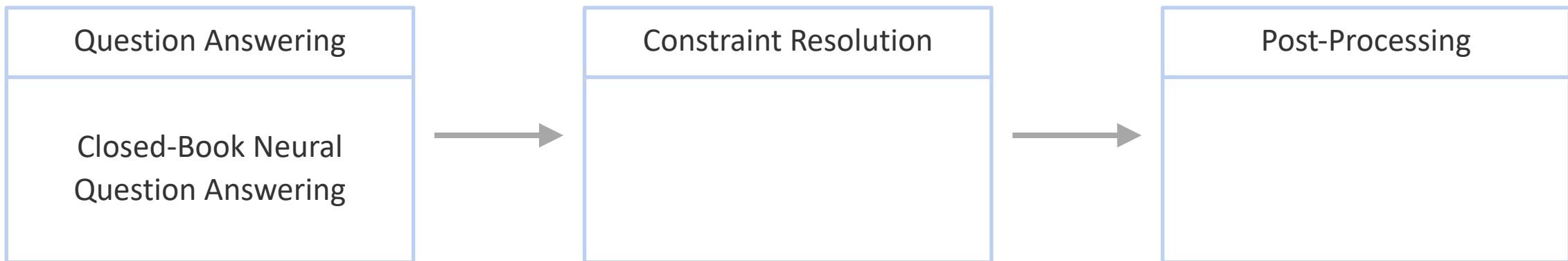
The Berkeley Crossword Solver





Our Approach

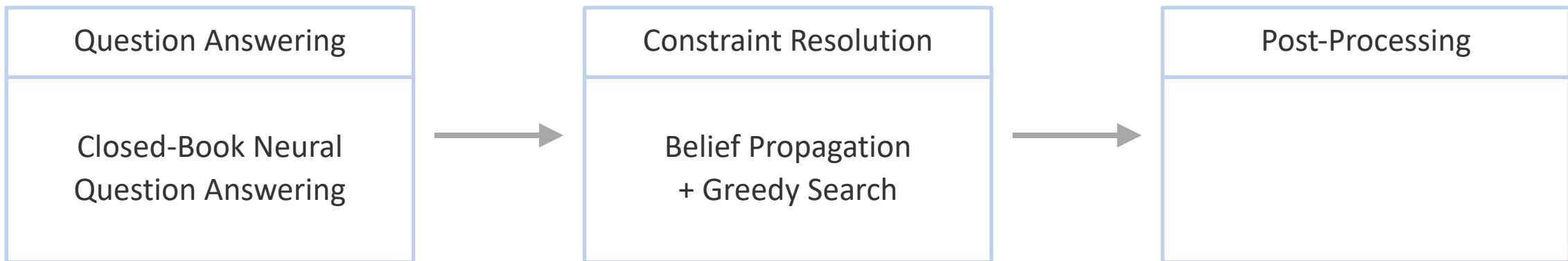
The Berkeley Crossword Solver





Our Approach

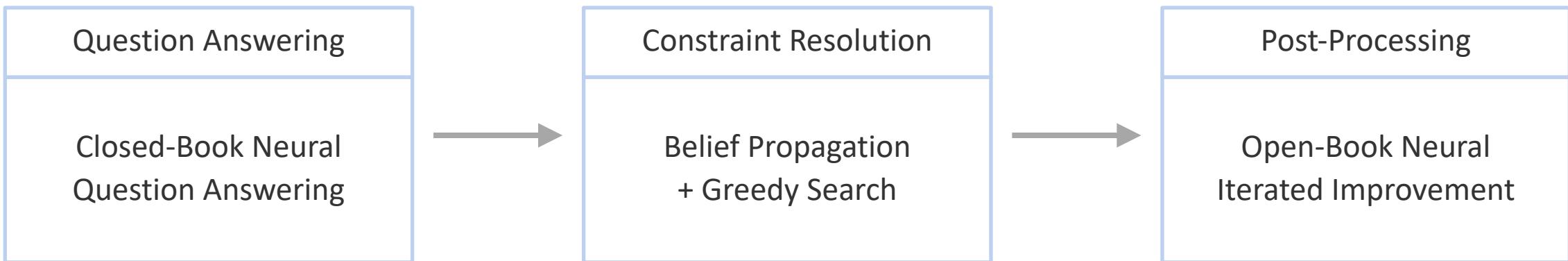
The Berkeley Crossword Solver





Our Approach

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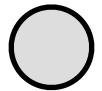
The Berkeley Crossword Solver





Closed-Book QA

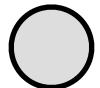
14. Omega competitor





Closed-Book QA

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14 A B A S E

14 A B A T E

14 A B B E Y

14 A B I D E

14 A B O U T

14 A B Y S S

Vocabulary

14 Z O O M S



Closed-Book QA

14. Omega competitor



14 R O L E X

14 S E I K O

14 ALPAHA

14 W A T C H

14 A P P L E

14 E N E M Y

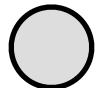
14 S K U N K

Predictions



Closed-Book QA

14. Omega competitor



14 A B A S E

14 A B A T E

14 A B B E Y

14 A B I D E

14 A B O U T

14 A B Y S S

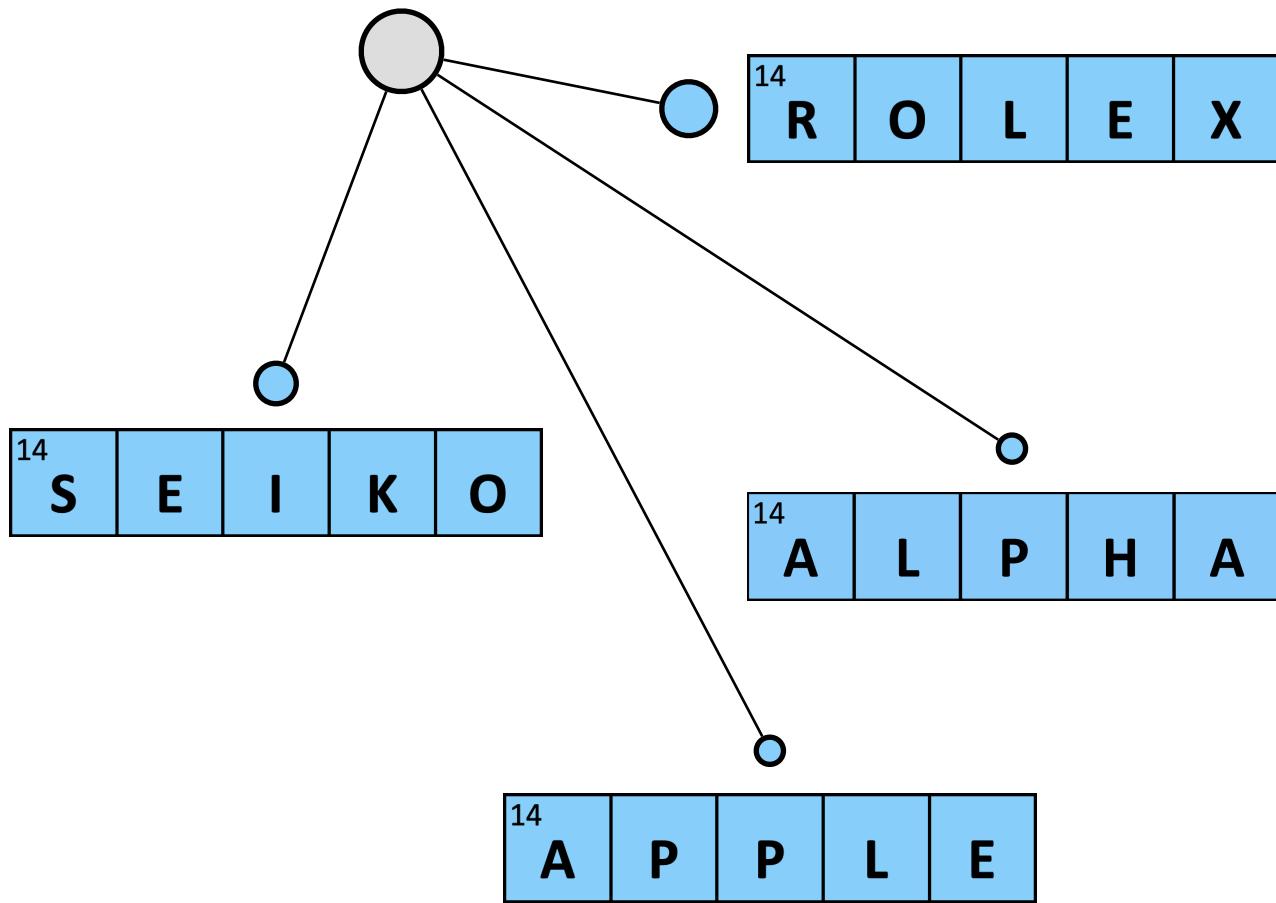
Vocabulary

14 Z O O M S



Closed-Book QA

14. Omega competitor



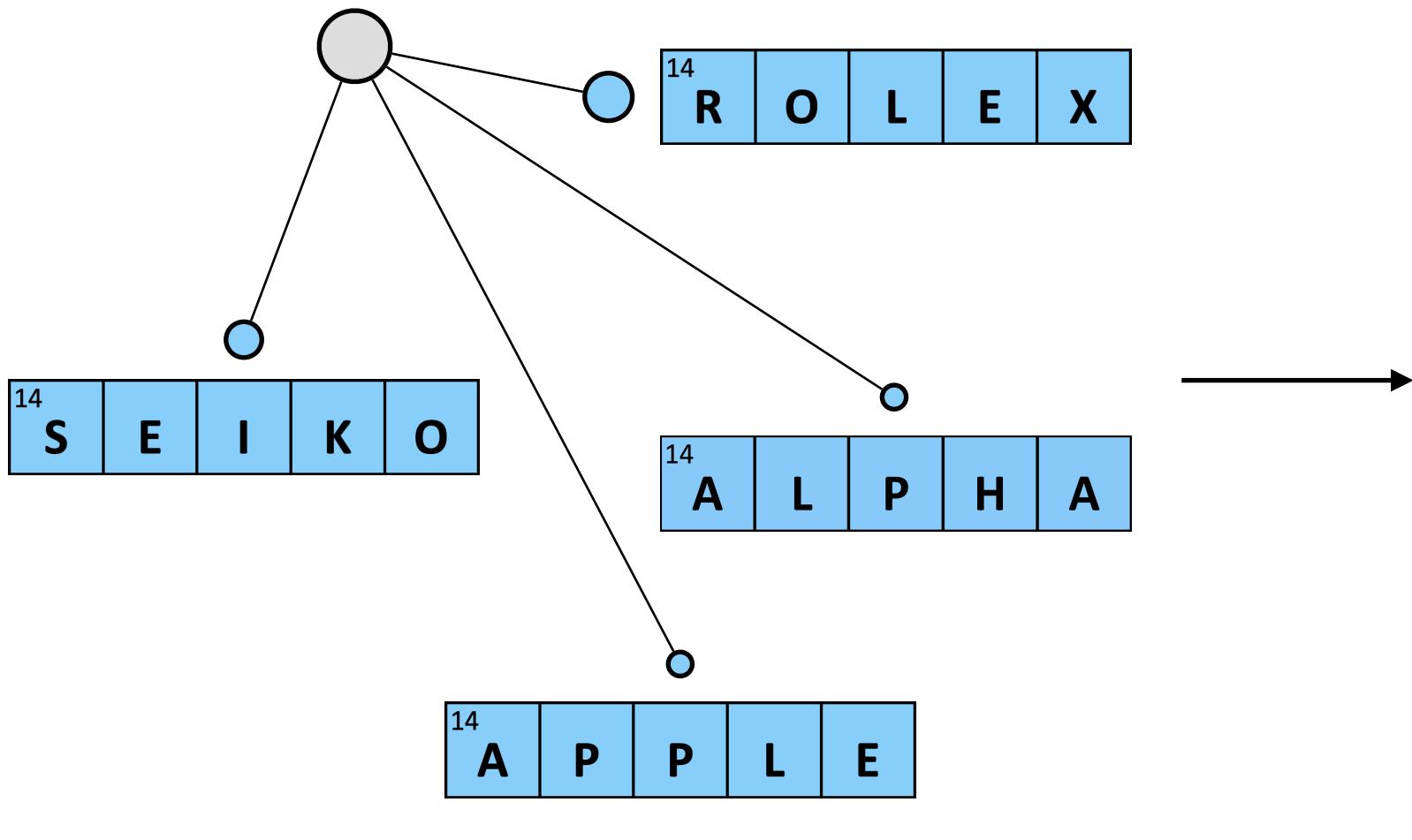
Vocabulary

| |
|---|
| $\begin{matrix} ^{14} \\ \text{A B A S E} \end{matrix}$ |
| $\begin{matrix} ^{14} \\ \text{A B A T E} \end{matrix}$ |
| $\begin{matrix} ^{14} \\ \text{A B B E Y} \end{matrix}$ |
| $\begin{matrix} ^{14} \\ \text{A B I D E} \end{matrix}$ |
| $\begin{matrix} ^{14} \\ \text{A B O U T} \end{matrix}$ |
| $\begin{matrix} ^{14} \\ \text{A B Y S S} \end{matrix}$ |
| ⋮ |
| $\begin{matrix} ^{14} \\ \text{Z O O M S} \end{matrix}$ |



Closed-Book QA

14. Omega competitor



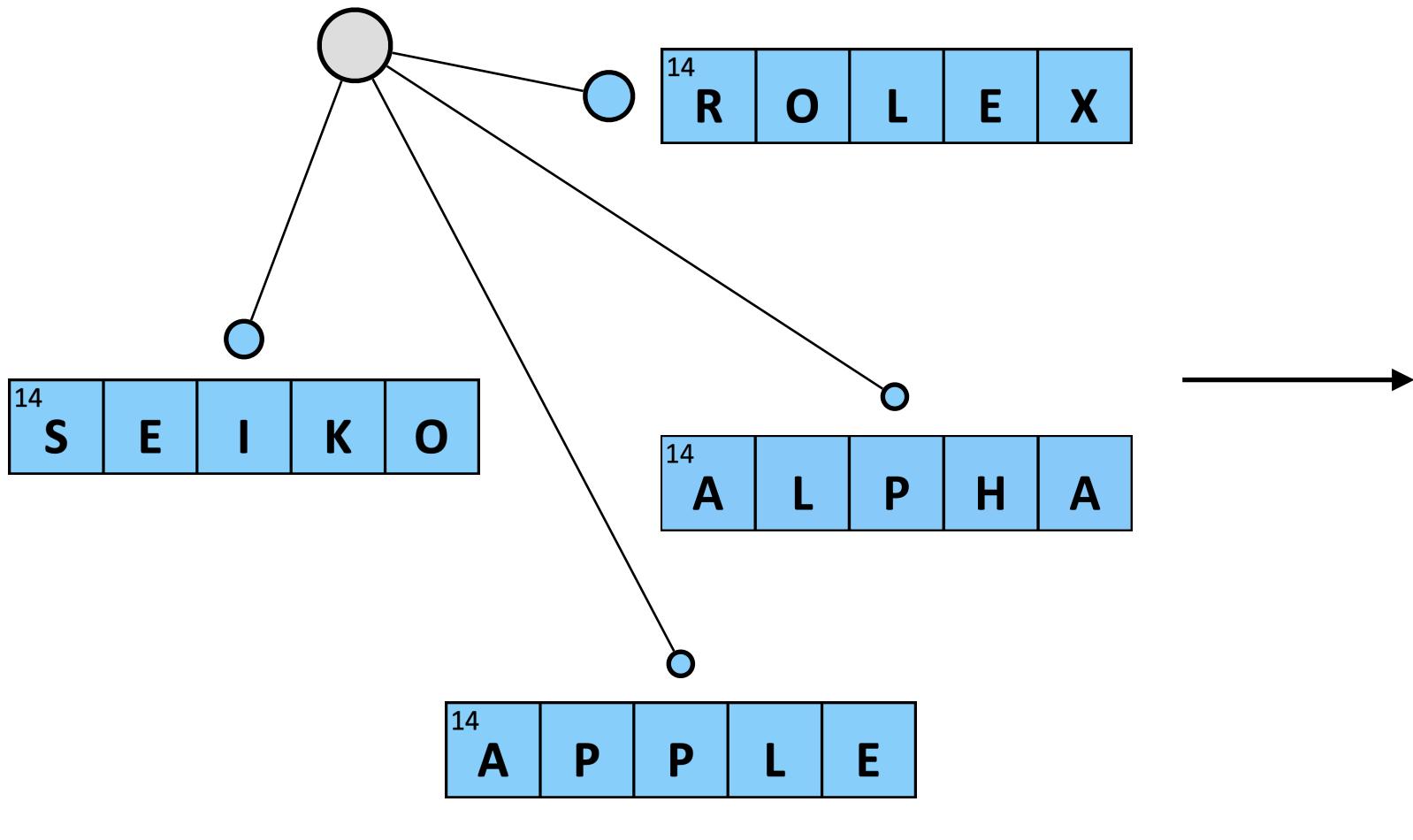
Predictions

| |
|--------------|
| 14 R O L E X |
| 14 S E I K O |
| 14 A L P H A |
| 14 W A T C H |
| 14 A P P L E |
| 14 E N E M Y |
| ... |
| 14 S K U N K |



Closed-Book QA

14. Omega competitor

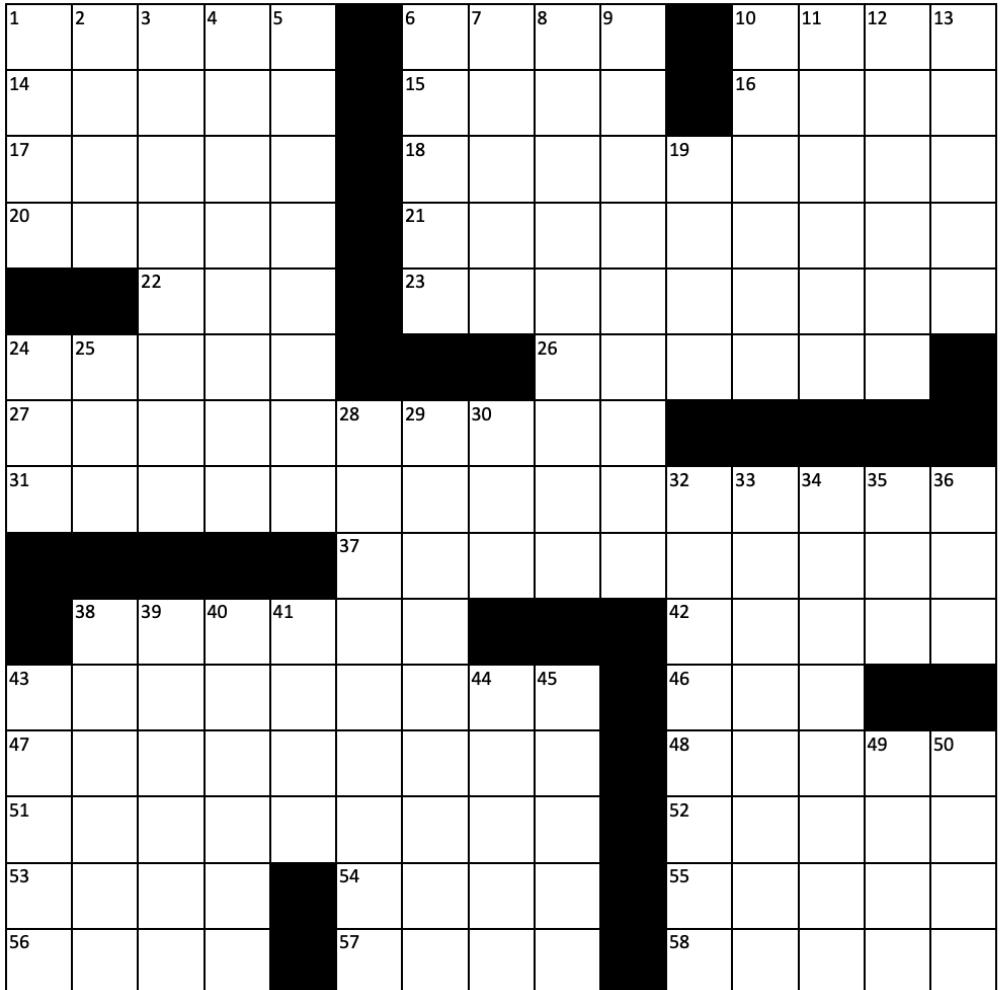


Predictions

| |
|--------------|
| 14 R O L E X |
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| 14 A L P H A |
| 14 W A T C H |
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| ... |
| 14 S K U N K |



Handling Ambiguous Clues



Across

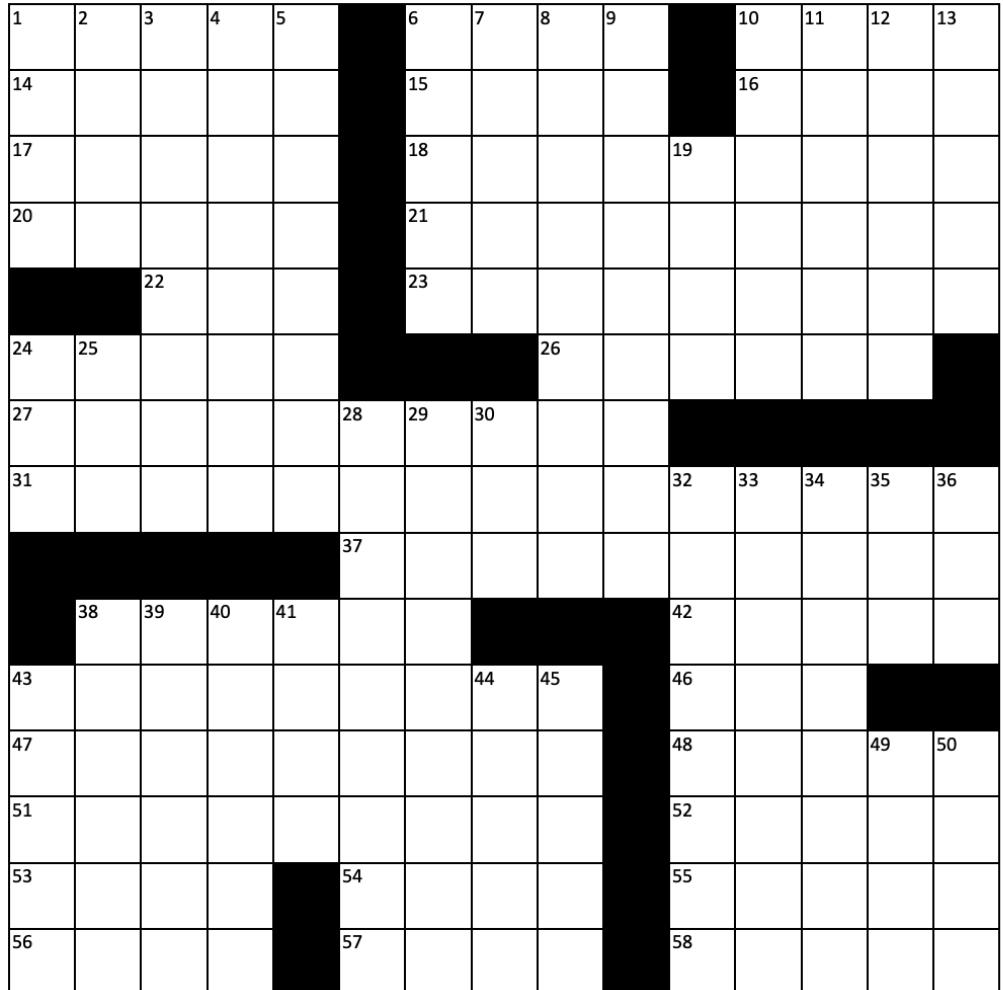
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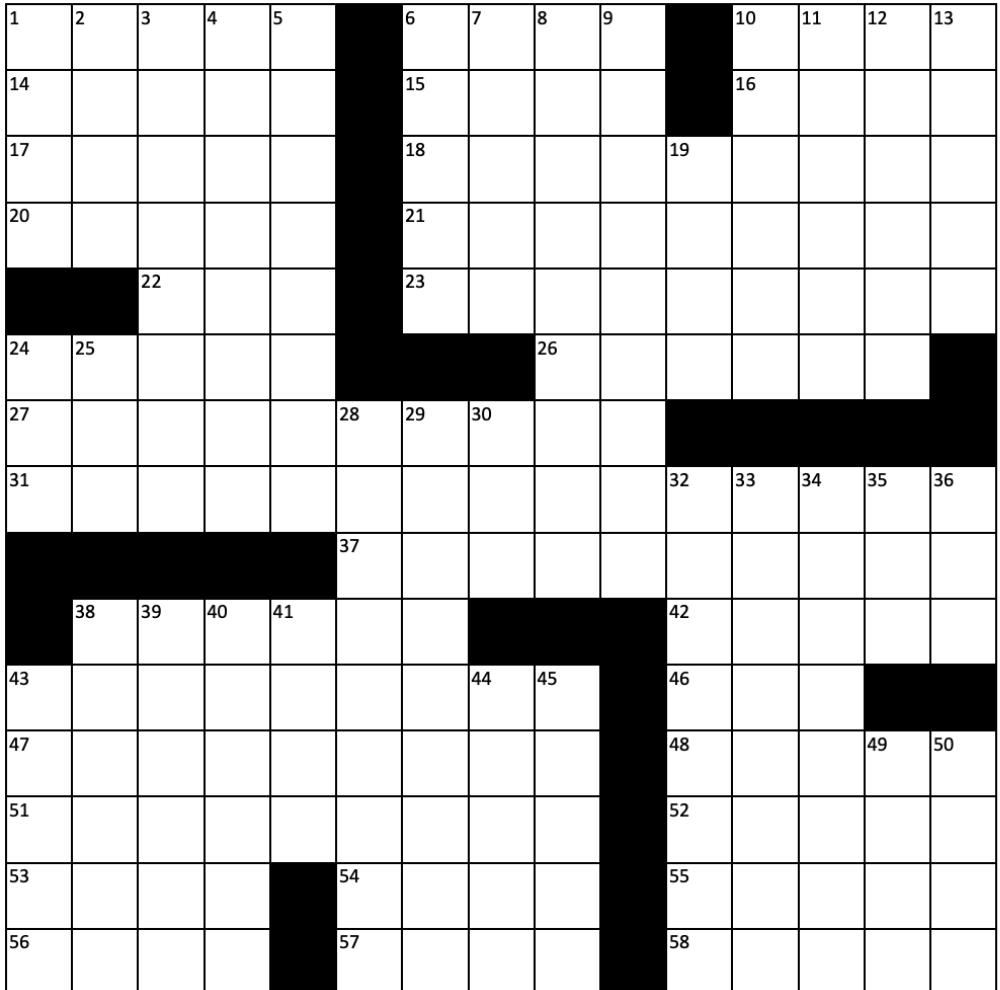
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Our Approach

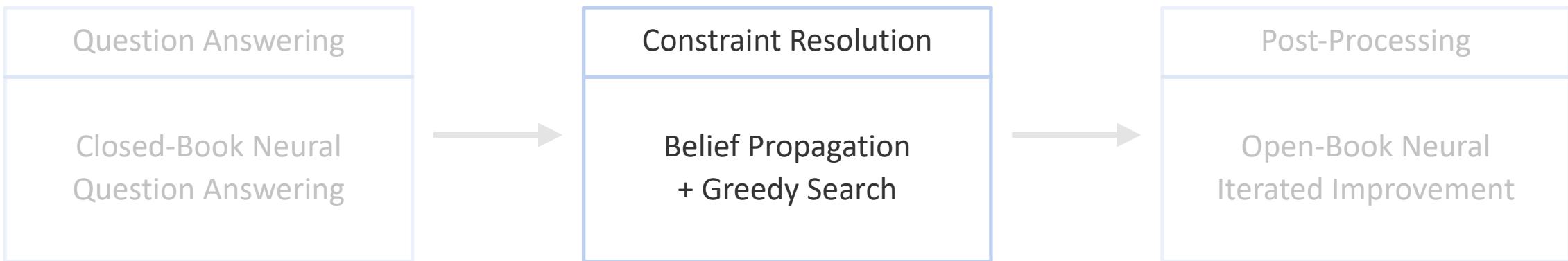
The Berkeley Crossword Solver





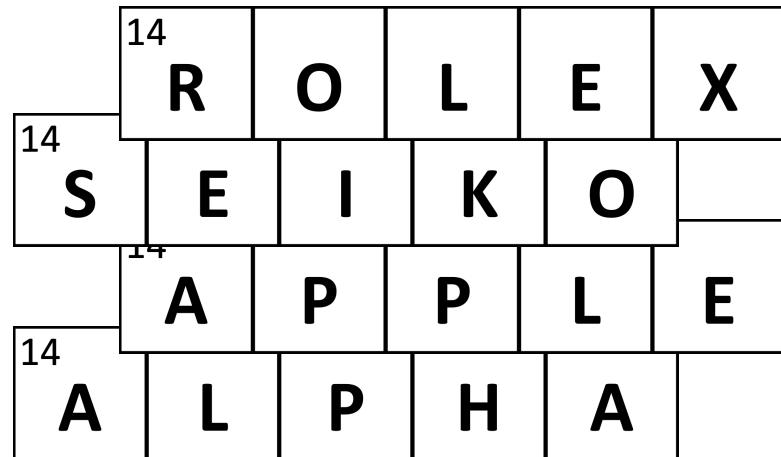
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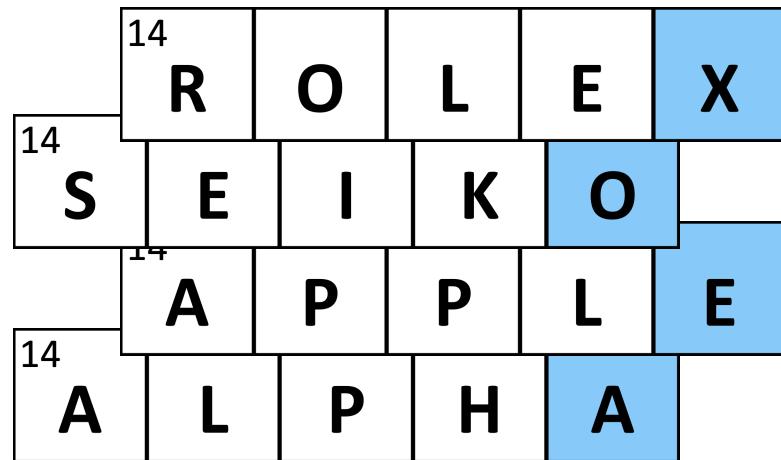


Loopy Belief Propagation



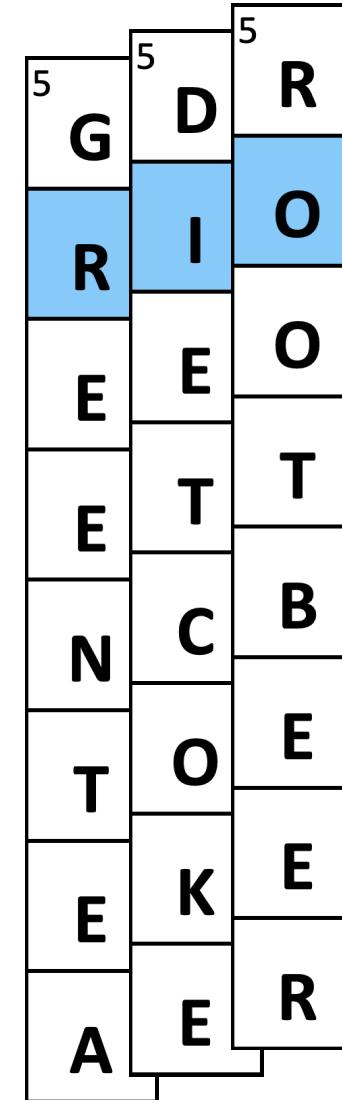
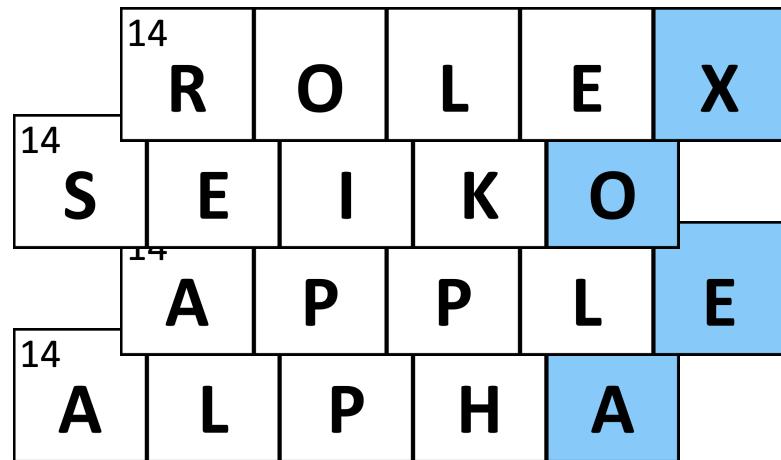


Loopy Belief Propagation



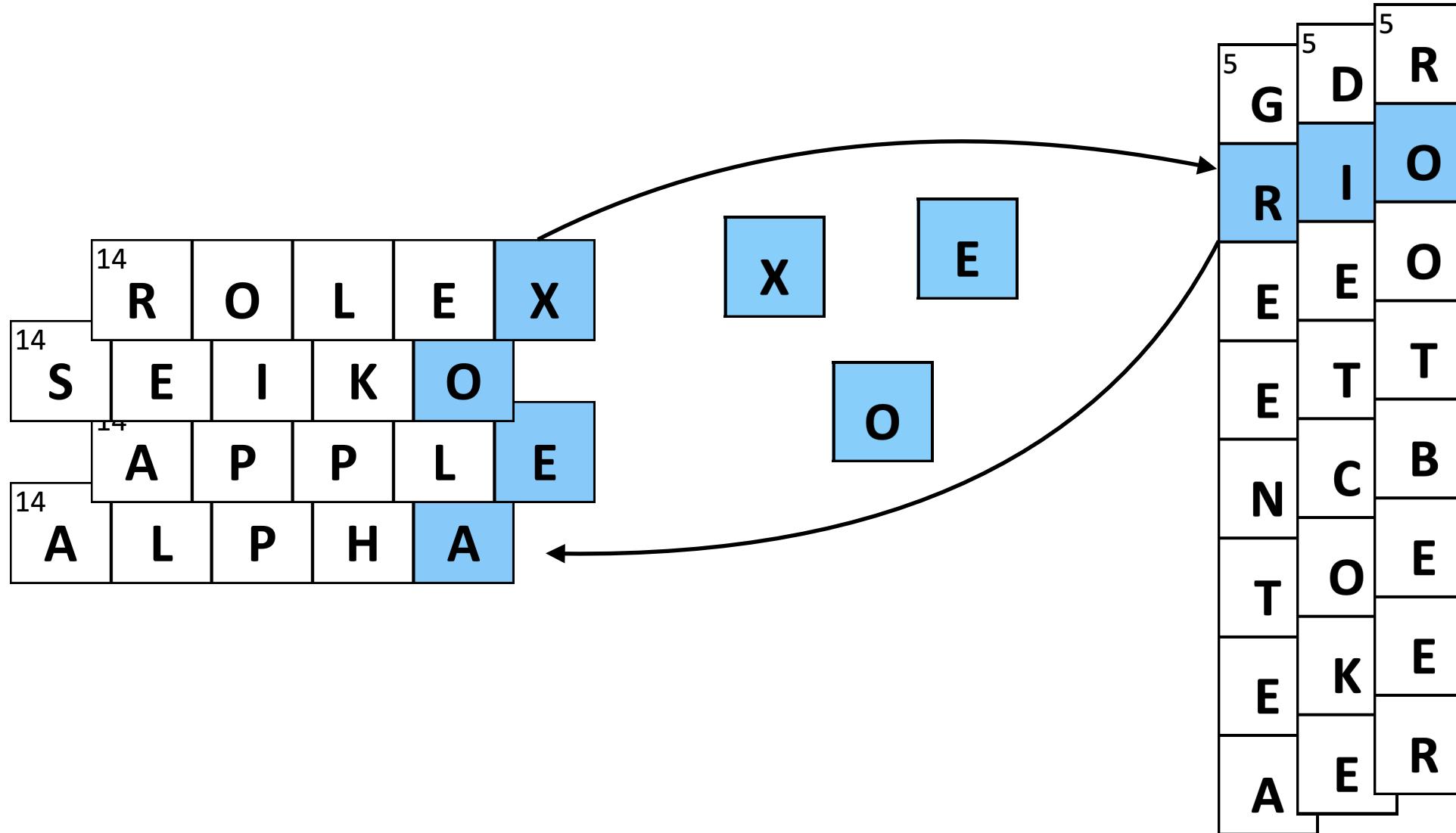


Loopy Belief Propagation



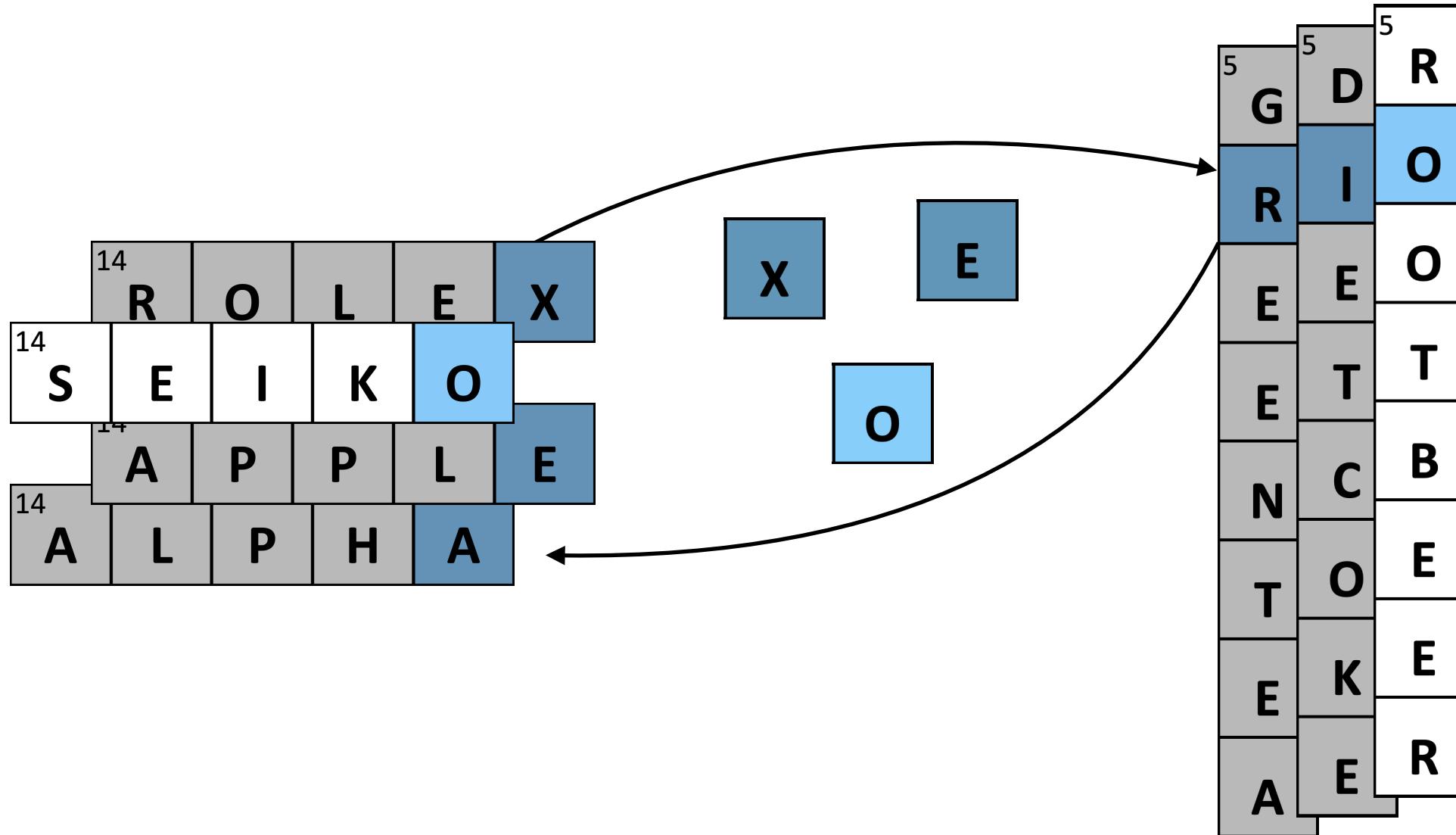


Loopy Belief Propagation





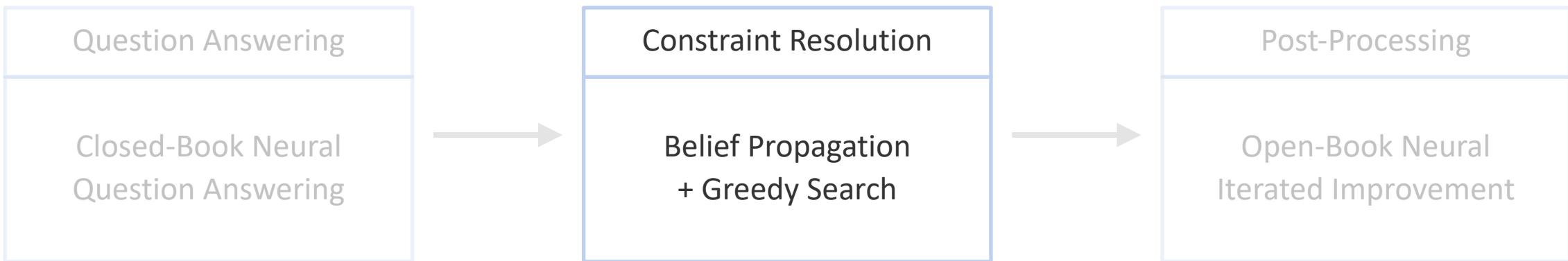
Loopy Belief Propagation





Our Approach

The Berkeley Crossword Solver





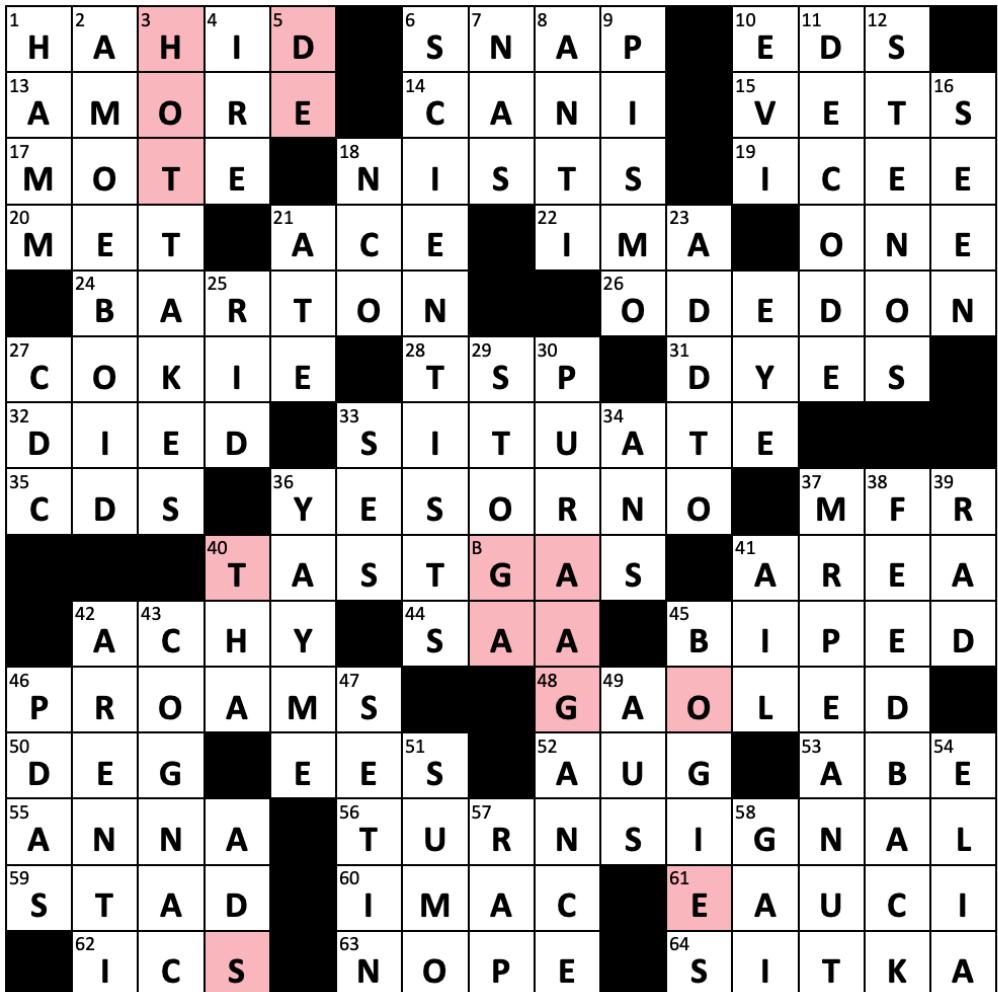
Our Approach

The Berkeley Crossword Solver





Open-Book Improvement



Across

- 1 Beloved, in Arabic
- 6 [Make it quick!]
- 10 Masthead listings, for short
- 13 Italian herbal liqueur
- 14 "Please, please, please?"
- 15 People calling the shots at the zoo?
- 17 Not radical
- 19 Drink with a dome-shaped lid
- 20 Where to find the Egyptian Temple of Dendur, with "the"
- 21 Crush, as a test
- 22 Cry from a survivor
- 24 Clara in the National Women's Hall of Fame
- 26 Stuffed oneself with, facetiously
- 27 Newswoman Roberts
- 28 Recipe amt.
- 31 Doesn't stay natural?
- 32 Fell off, as laughter
- 33 Place

Down

- 1 Soccer star on a 1999 Wheaties box
- 2 Bloblike
- 3 Ill-advised opinions
- 4 Fury
- 5 Feeling on a lo-o-ong car trip
- 6 Lab workers
- 7 Performer with the hit 2006 album "Hip Hop Is Dead"
- 8 Voting no
- 9 ___ Beach, Calif.
- 10 Satan, with "the"
- 11 Crack, as a secret message
- 12 Shorthand writers, for short
- 16 Dated
- 18 Cpl. or sgt.
- 23 Expand
- 25 Purge (of)
- 27 Atlanta-based health org.
- 29 Long fur scarfs



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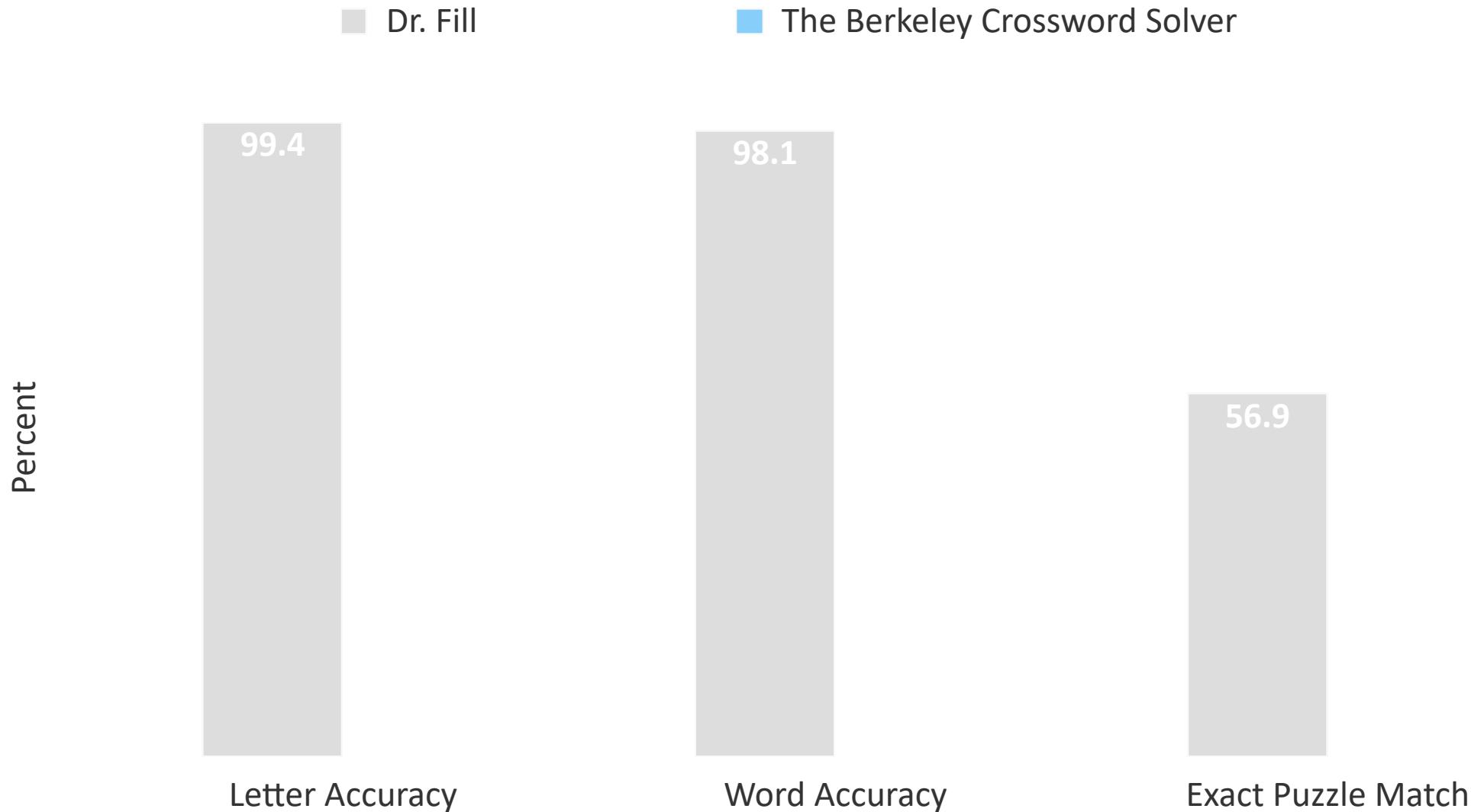
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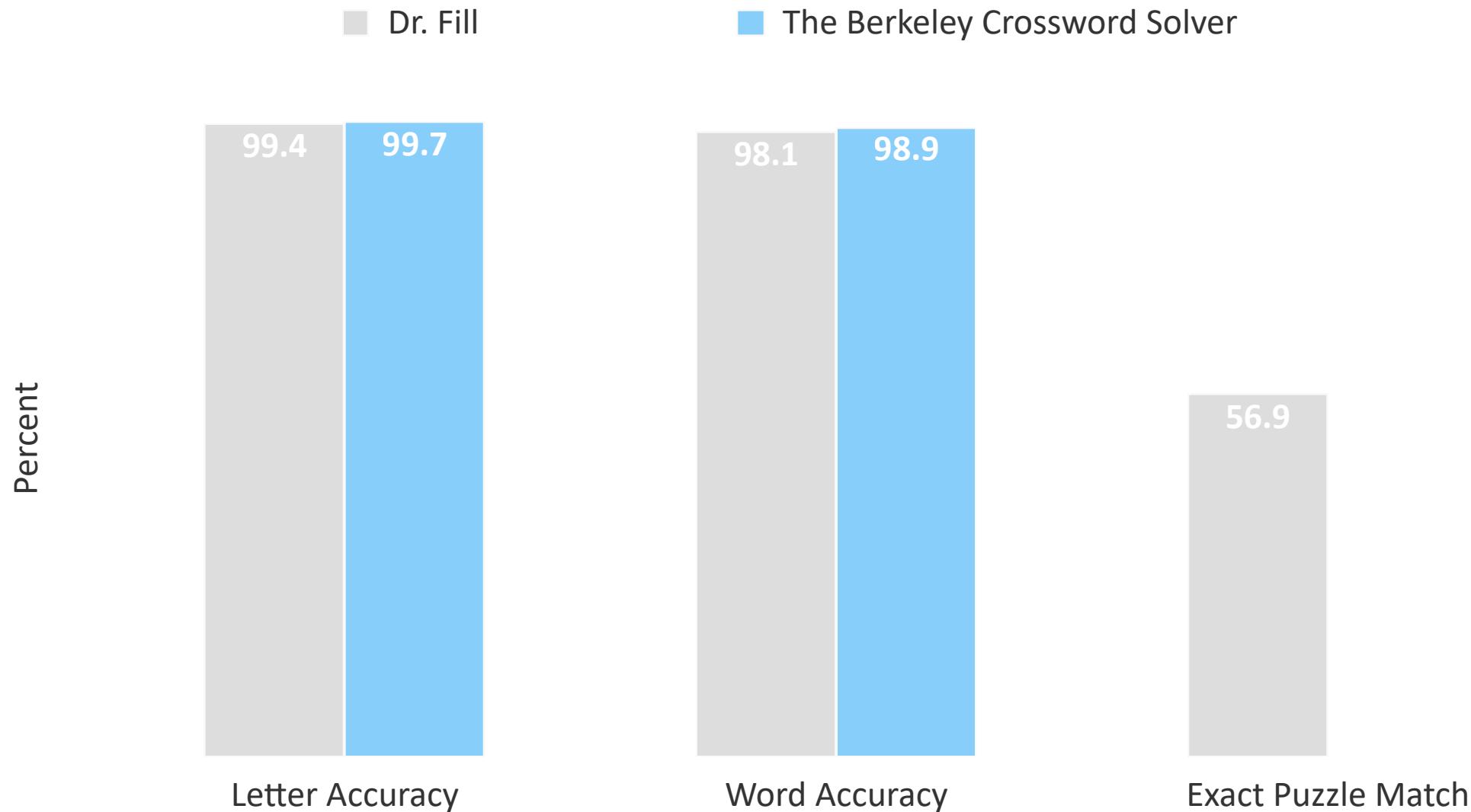


Results: The New York Times



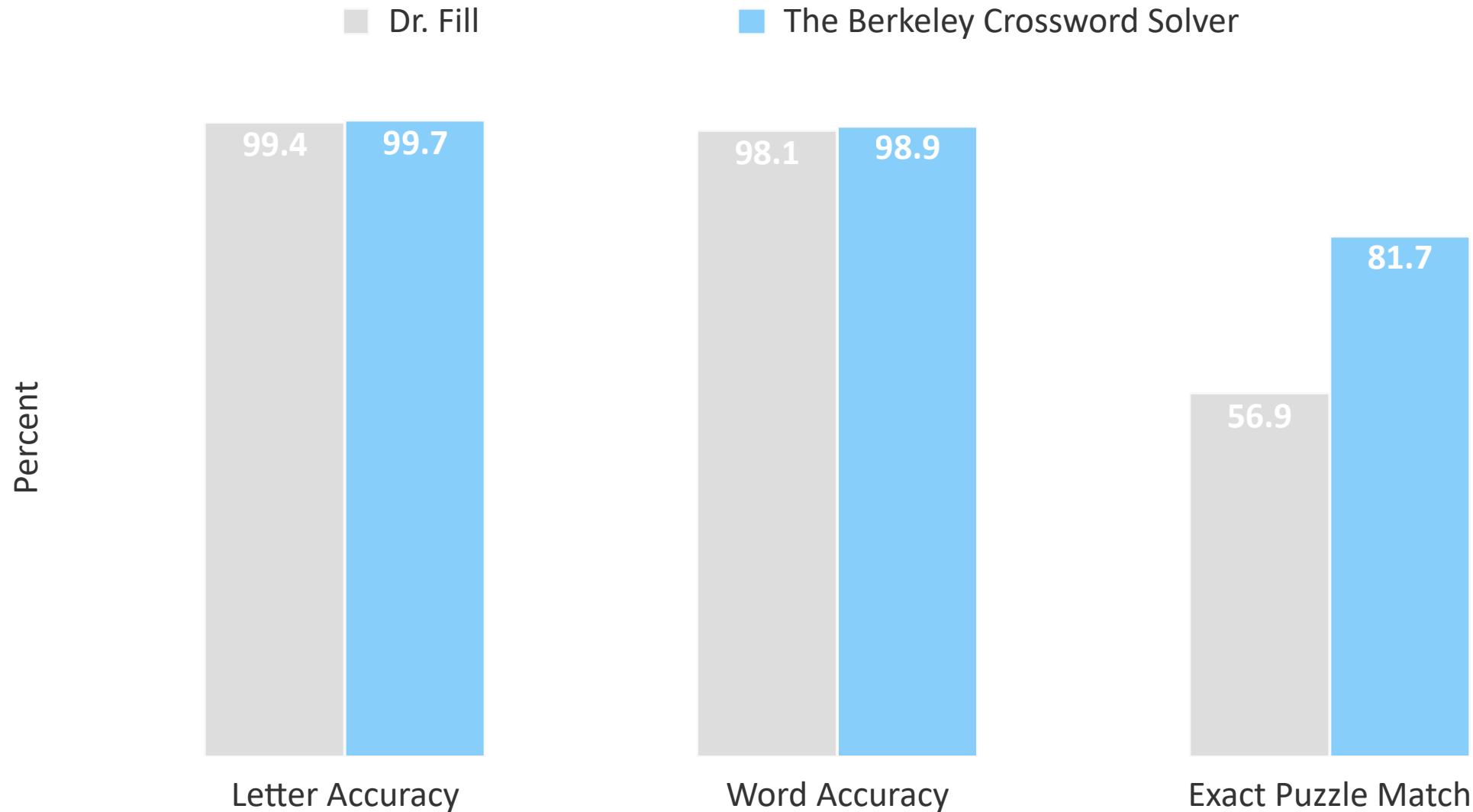


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American Crossword Puzzle Tournament

Top Human Competitor

Median Human

Proverb (1998)

Dr. Fill (2012)

DF + BCS (2021)



American Crossword Puzzle Tournament

Top Human Competitor

Median Human

6,215

Proverb (1998)

Dr. Fill (2012)

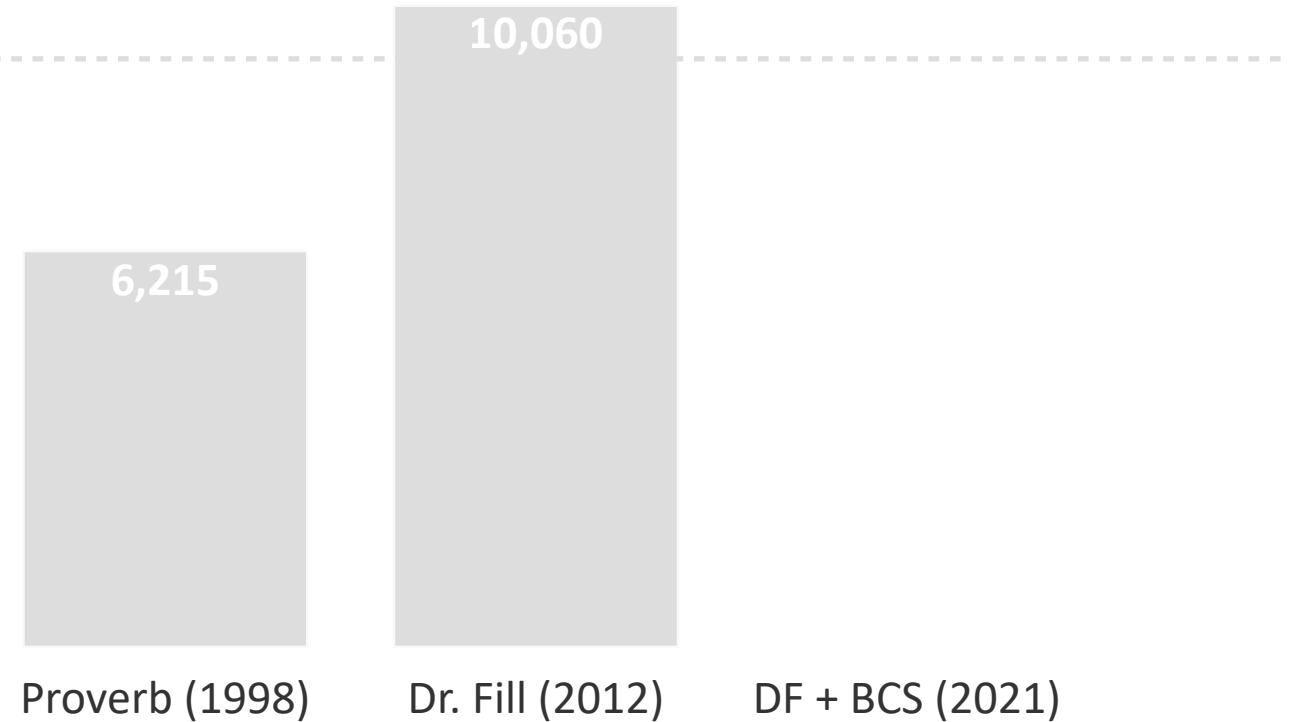
DF + BCS (2021)



American Crossword Puzzle Tournament

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Median Human





American Crossword Puzzle Tournament

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11,795

Median Human

6,215

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Dr. Fill (2017)

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American Crossword Puzzle Tournament

Top Human Competitor

12,825

11,795

Median Human

6,215

Proverb (1998)

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American Crossword Puzzle Tournament

Top Human Competitor

13,060

11,795

Median Human

6,215

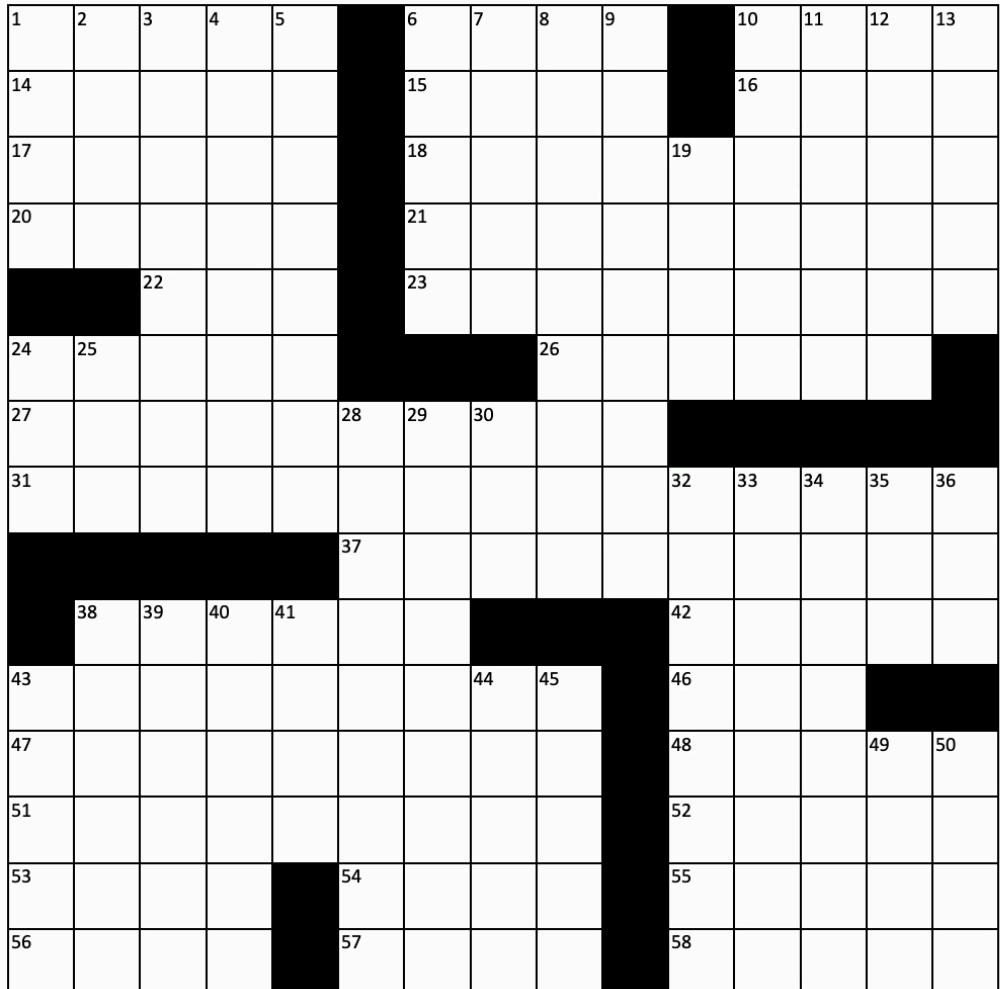
Proverb (1998)

Dr. Fill (2017)

BCS (2021)



Demo



Across

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Overview

Crossword Solving



Constraint satisfaction, belief propagation, greedy search, iterative improvement

Detecting LLMs

ghostbuster [github](#) [contact](#)

a model-agnostic detector for AI-generated text

We introduce Ghostbuster, a state-of-the-art system for detecting AI-generated text. Our method works by passing documents through a series of weaker language models, running a structured search over possible combinations of their features, and then training a classifier on the selected features to predict whether documents are AI-generated. Crucially, Ghostbuster does not require access to token probabilities from the target model, making it useful for detecting text generated by black-box models or unknown model versions. In conjunction with our model, we release three new datasets of human- and AI-generated text as detection benchmarks in the domains of student essays, creative writing, and news articles. We compare Ghostbuster to a variety of existing detectors, including DetectGPT and GPTZero, as well as a new RoBERTa baseline. Ghostbuster achieves 99.0 F1 when evaluated across domains, which is 5.9 F1 higher than the best preexisting model. It also outperforms all previous approaches in generalization across writing domains (+7.5 F1), prompting strategies (+2.1 F1), and language models (+4.4 F1). We also analyze the robustness of our system to a variety of perturbations and paraphrasing attacks and evaluate its performance on documents written by non-native English speakers.

Is it AI?

Classification, feature selection, generalization and overfitting

Decision-Making in NL

Environment

Travel Ideas

Hi! I'm visiting NYC for the first time. I heard we should check out the Guggenheim, but not sure what the other places we should visit are.

People also enjoy the MoMA and Met. Perhaps we could add that to an itinerary?

I'd generally like to see less touristy spots. Could you make some reservations at a restaurant too? How about Saul's?

Can do! According to reviews Saul's has become a tourist hotspot too. How about Lucia's, which is near the Guggenheim?

I don't like Italian food, unless you think Lucia's is notable. Also, can you make sure there's parking around?



Constraint satisfaction, value of information, decision networks, particle filtering



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A screenshot of a mobile application interface. At the top, it says "Environment". Below that is a section titled "Travel Ideas" with a list of items: "Guggenheim" (marked with a yellow star), "MoMA", and "Met". To the right of this is a small map of New York City with several location pins. Below the travel ideas is a text message from a user: "Hi! I'm visiting NYC for the first time. I heard we should check out the Guggenheim, but not sure what the other places we should visit are.". Below that is another message: "People also enjoy the MoMA and Met. Perhaps we could add that to an itinerary?". Then a response: "I'd generally like to see less touristy spots. Could you make some reservations at a restaurant too? How about Saul's?". Finally, a reply: "Can do! According to reviews Saul's has become a tourist hotspot too. How about Lucia's, which is near the Guggenheim?". At the bottom of the screen, there is a message: "I don't like Italian food, unless you think Lucia's is notable. Also, can you make sure there's parking around?".

Constraint satisfaction, value of information, decision networks, particle filtering



FORBES > LEADERSHIP > CAREERS

Educators Battle Plagiarism As 89% Of Students Admit To Using OpenAI's ChatGPT For Homework

Chris Westfall Contributor @

Business coach. Author of *Easier and Leadership Language*.

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JAN 30, 2023 11:27 AM EST



INSIDER

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HOME > TECH

Turnitin is the go-to software to catch students cheating. Now it's focused on a potential cat-and-mouse game with OpenAI's new ChatGPT chatbot.

Samantha Delouya Jan 11, 2023, 3:40 AM PST

ChatGPT in Schools



The New York Times

A.I. and Chatbots >

Google's RT-2 Robot

Smart Ways to Use Chatbots

Ch

Alarmed by A.I. Chatbots, Universities Revamping How They Teach

With the rise of the popular new chatbot ChatGPT, colleges are restructuring some courses and taking preventive mea

The Washington Post

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Help Desk

Tech in Your Life

Future of Work

Your Data and Privacy

Inte

TECH IN YOUR LIFE

We tested a new ChatGPT-detector for teachers. It flagged an innocent student.

Five high school students helped our tech columnist test a ChatGPT detector coming from Turnitin to 2.1 million teachers. It missed enough to get someone in trouble.



Analysis by Geoffrey A. Fowler
Columnist | + Follow

Updated April 3, 2023 at 9:47 a.m. EDT | Published April 3, 2023 at 6:00 a.m. EDT



WSJ

TECH

ChatGPT Banned in New York City Public Schools Over Concerns About Cheating, Learning Development

Education officials say students could use the artificial-intelligence chatbot to do their schoolwork

By Alyssa Lukpat [Follow](#)

Updated Jan. 6, 2023 at 12:55 pm ET

Is Making Universities Plagiarism

Professors can't decide whether the AI search tool—or a cheating engine.



ChatGPT in Schools

Prompt: Every authority is baffled but for the past few years everyone has been receiving a Christmas present. To some delight and others horror, the gifts are based on how 'good' you've been.

All of this should be such a joy, a wondrous time where people all around the world are brimming with love and excitement over what they might have been brought. But it's not, I'm worried, I'm borderline panicked. Every single year, I've felt my anxiety grow as the temperature drops, all because of one question nagging me between the ears. Am I on the naughty list this year? And there's no answer, there's never an answer because we weren't given a guideline, there's no clear line drawn in the sand that we must not cross lest we end up on the naughty list. So we're left to our own devices, trying to live our lives as best we can, but people slip...

It was a sunny December morning when the annual tradition of receiving Christmas presents took a peculiar turn. The streets were filled with laughter, carolers singing joyously, and children eagerly awaiting the arrival of Santa Claus. But this year, things were different. Word had spread like wildfire that everyone, without exception, would receive a Christmas present. Yet, there was an unsettling twist - these gifts would be based on how "good" one had been throughout the year. Authorities were baffled, for no one knew who was behind this curious occurrence. As the clock struck midnight on Christmas Eve, parcels began appearing on doorsteps...



ChatGPT in Schools

Prompt: Every authority is baffled but for the past few years everyone has been receiving a Christmas present. To some delight and others horror, the gifts are based on how 'good' you've been.

| Human Written Text | ChatGPT Generated Text |
|--|--|
| <p>All of this should be such a joy, a wondrous time where people all around the world are brimming with love and excitement over what they might have been brought. But it's not, I'm worried, I'm borderline panicked. Every single year, I've felt my anxiety grow as the temperature drops, all because of one question nagging me between the ears. Am I on the naughty list this year? And there's no answer, there's never an answer because we weren't given a guideline, there's no clear line drawn in the sand that we must not cross lest we end up on the naughty list. So we're left to our own devices, trying to live our lives as best we can, but people slip...</p> | <p>It was a sunny December morning when the annual tradition of receiving Christmas presents took a peculiar turn. The streets were filled with laughter, carolers singing joyously, and children eagerly awaiting the arrival of Santa Claus. But this year, things were different. Word had spread like wildfire that everyone, without exception, would receive a Christmas present. Yet, there was an unsettling twist - these gifts would be based on how "good" one had been throughout the year. Authorities were baffled, for no one knew who was behind this curious occurrence. As the clock struck midnight on Christmas Eve, parcels began appearing on doorsteps...</p> |

Data Sources



The screenshot shows the homepage of the [Reddit r/writingprompts](#) community. The title bar reads "Prompts and motivation to create something nothing". Below it, there's a navigation bar with links for Posts, Wiki, Genre Directory, Theme: Iridescence, Prompts, Writing Resources, and Contact. A "Create Post" button is visible. The main content area displays two posts. The first post, by u/No-Nefariousness7830, has 509 upvotes and discusses a writing prompt about a champion returning after many years. The second post, by u/darkwulf1, has 452 upvotes and discusses a writing prompt about a planet being moved to a different solar system.

Reddit /r/writingprompts

The screenshot shows a news article from [Reuters](#). The headline is "Israel says soldier executed, foreign hostages held at Gaza's Shifa hospital". The article discusses Israel's claim that Hamas killed a 19-year-old army conscript named Noa Marcianno. It also mentions video published by the military showing tunnels beneath the Shifa compound. Below the article, there's a sidebar with a Japanese stock market tickers board showing numbers like 5310, 5521, +30, +64, 6533, and 4845. Another sidebar section titled "Markets" discusses Japan's Nikkei index reaching three-decade highs.

Reuters News

The screenshot shows the homepage of [IvyPanda](#), a free essay database. The top navigation bar includes links for WRITING HELP, LOGIN, and a menu icon. The main header is "Totally Free Essay Database" with a sub-header "Get inspiration for your assignment from thousands of free essay examples, samples, topics and research papers.". A search bar is present. Below the header, there's a banner for custom essays and a section for "Most Popular Subjects" with categories like Art, Business, and Culture, each with a list of sub-topics and their counts.

IvyPanda Essays

How can we avoid spurious topic correlations between positive and negative examples?



Two Ideas That Didn't Work



Two Ideas That Didn't Work

Idea #1: Perplexity Thresholding

$$\text{PPL}(X) = \exp \left\{ -\frac{1}{t} \sum_i^t \log p_{\theta}(x_i | x_{<i}) \right\}$$

Core assumption is that language models will assign higher probability to LLM-generated text

Bad underfitting (80 F1)



Two Ideas That Didn't Work

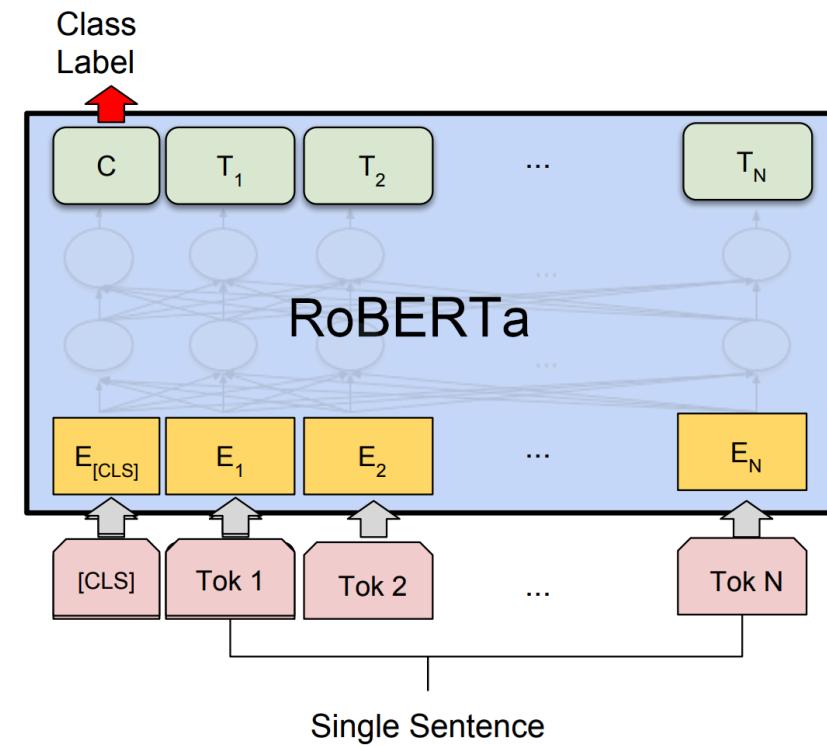
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Bad underfitting (80 F1)

Idea #2: Fine-tuned Classifier

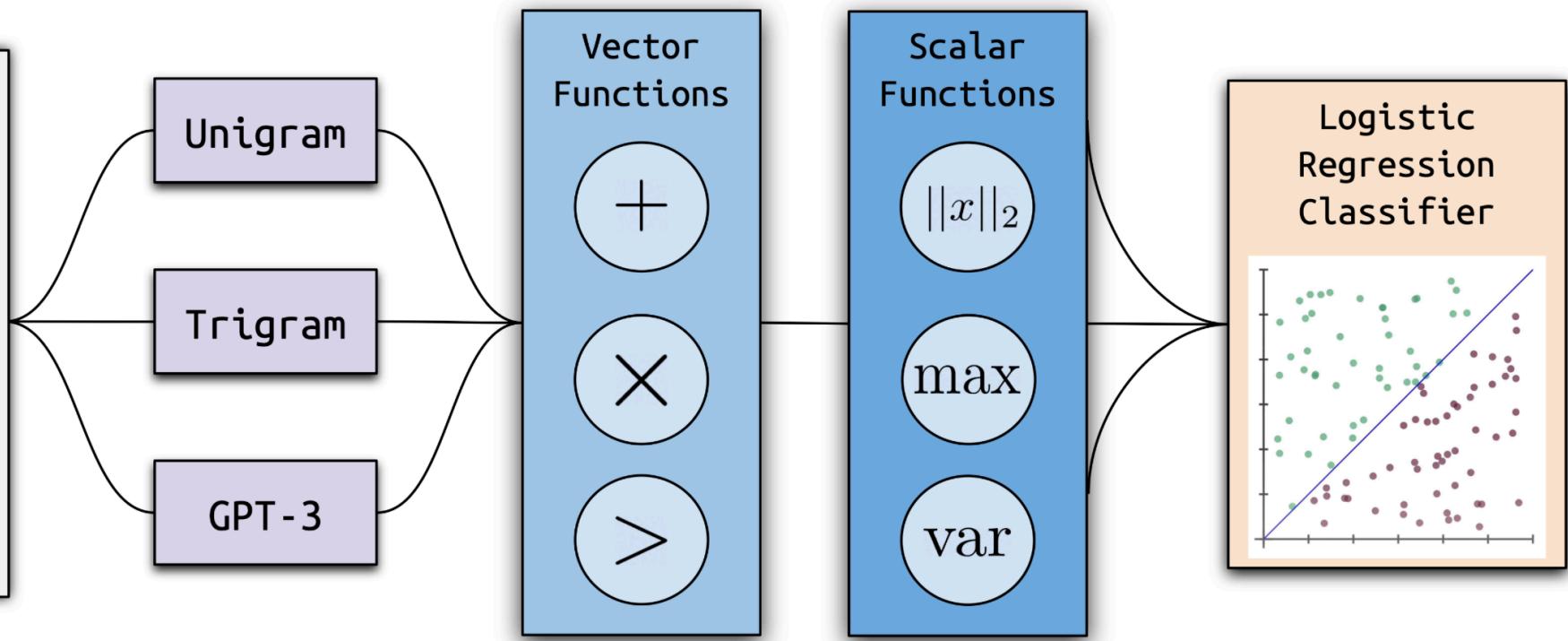


**Bad overfitting
(98 F1 in-domain, but 85 F1 OOD)**



Our Approach: Ghostbuster

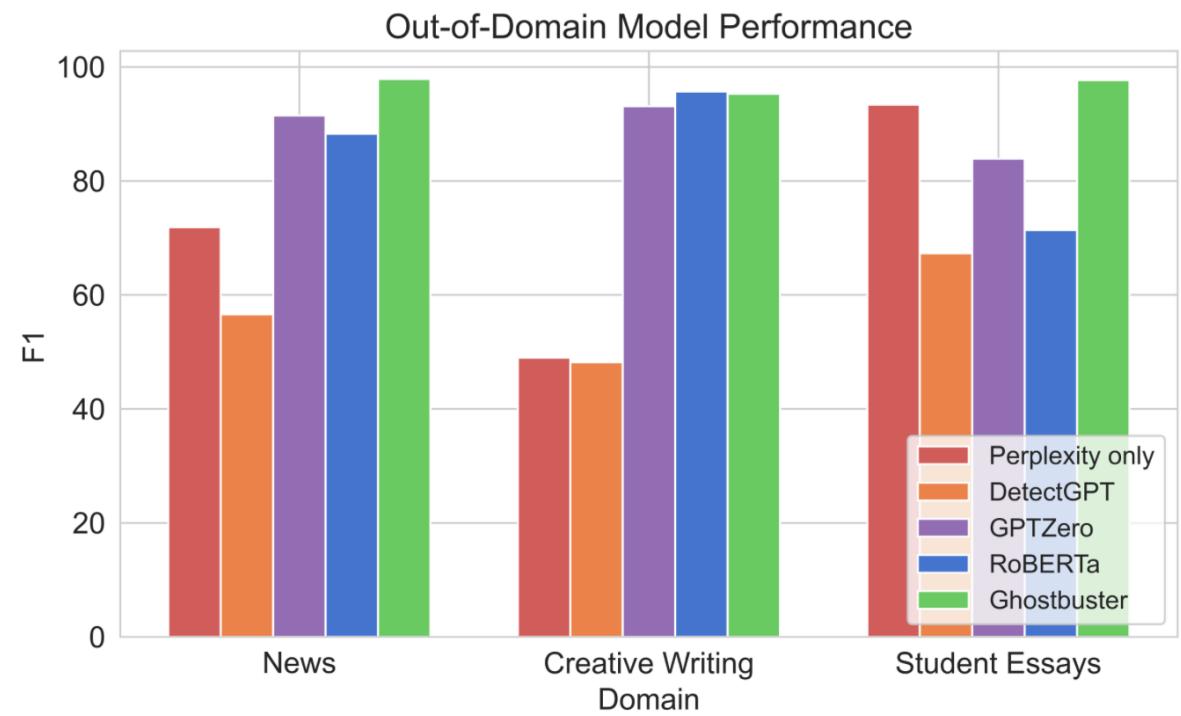
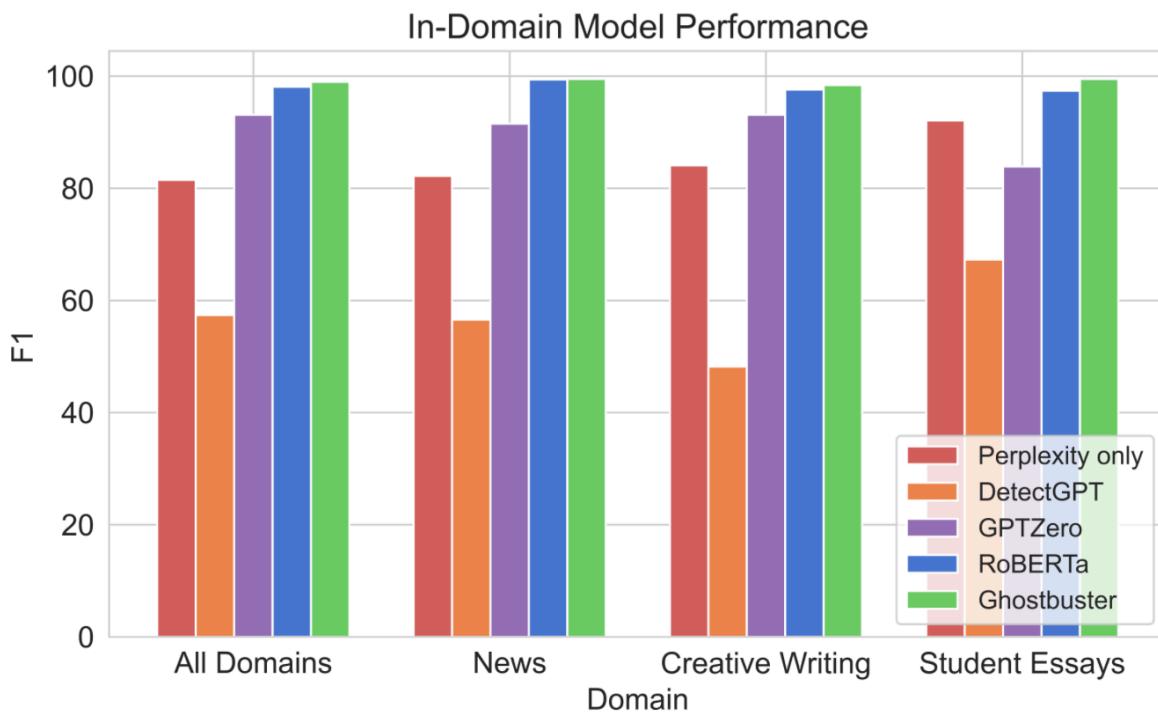
It was a typical Friday night, and I had decided to spend it at home, browsing the internet and catching up on some of my favorite shows. My roommate had gone...



| Stories | News | Essay |
|---|--|---|
| <pre>max(ada / unigram + ada) var(davinci / ada - davinci) avg(unigram > trigram > davinci) avg(unigram + trigram < davinci) var(unigram * davinci) avg-25(unigram - ada > davinci) avg-25(unigram - davinci / unigram)</pre> | <pre>avg-25(ada > davinci / trigram) var(ada - davinci) avg(trigram / ada > davinci) var(unigram > ada - davinci) avg(unigram > trigram + ada)</pre> | <pre>avg(ada > davinci / trigram) avg(davinci) var(trigram > davinci) avg(unigram / ada > davinci)</pre> |

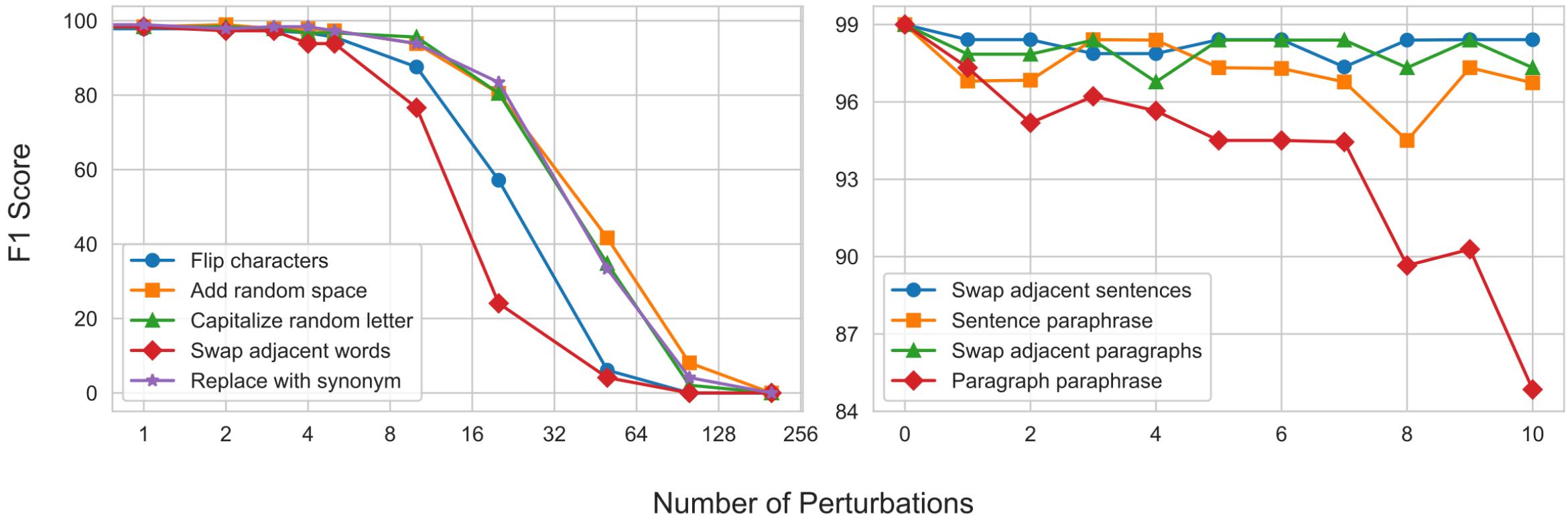


Results: Domain Generalization



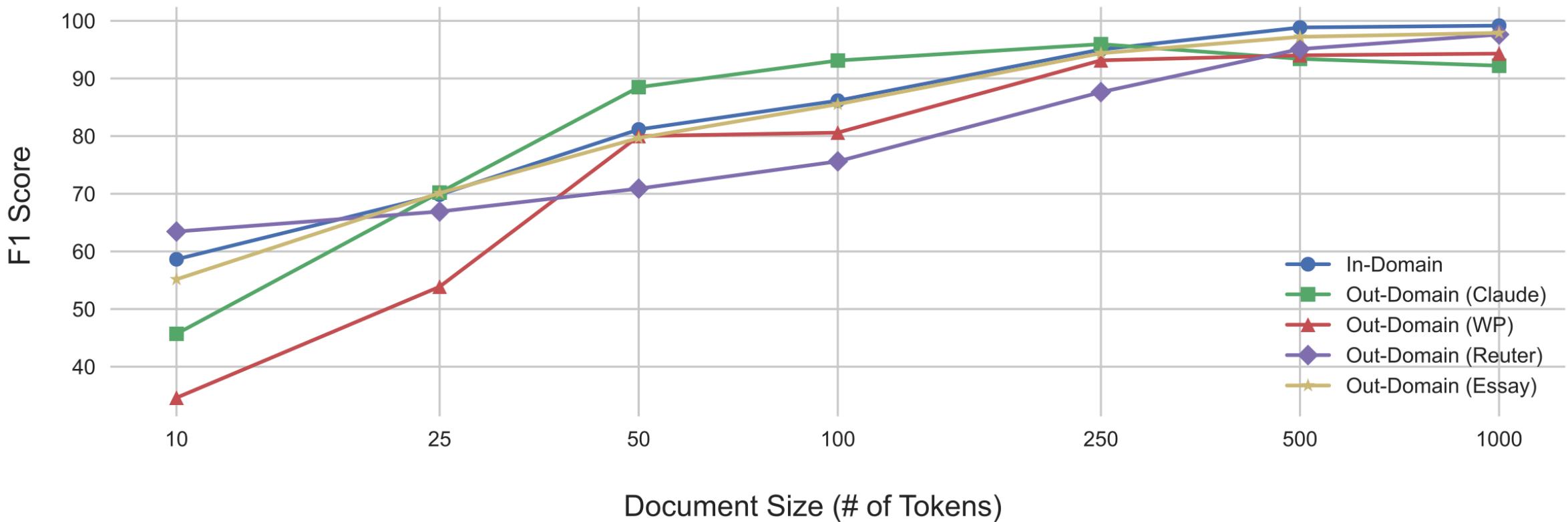


Results: Robustness to Perturbations





Results: Varying Document Lengths





Ethical Considerations



Stanford University
Human-Centered
Artificial Intelligence

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AI-Detectors Biased Against Non-Native English Writers

Don't put faith in detectors that are "unreliable and easily gamed," says scholar.

May 15, 2023 | Andrew Myers





Ghostbuster Demo



ghostbuster

a model-agnostic detector for AI-generated text

Enter your text

Is it AI?

How does it work?

Ghostbuster works by passing documents through a series of weaker language models and running a structured search over possible combinations of their features, then training a classifier on the selected features to determine if the target document was AI-generated.

► Disclaimer



Overview

Crossword Solving



Constraint satisfaction, belief propagation, greedy search, iterative improvement

Detecting LLMs

ghostbuster [github](#) [contact](#)
a model-agnostic detector for AI-generated text

We introduce Ghostbuster, a state-of-the-art system for detecting AI-generated text. Our method works by passing documents through a series of weaker language models, running a structured search over possible combinations of their features, and then training a classifier on the selected features to predict whether documents are AI-generated. Crucially, Ghostbuster does not require access to token probabilities from the target model, making it useful for detecting text generated by black-box models or unknown model versions. In conjunction with our model, we release three new datasets of human- and AI-generated text as detection benchmarks in the domains of student essays, creative writing, and news articles. We compare Ghostbuster to a variety of existing detectors, including DetectGPT and GPTZero, as well as a new RoBERTa baseline. Ghostbuster achieves 99.0 F1 when evaluated across domains, which is 5.9 F1 higher than the best preexisting model. It also outperforms all previous approaches in generalization across writing domains (+7.5 F1), prompting strategies (+2.1 F1), and language models (+4.4 F1). We also analyze the robustness of our system to a variety of perturbations and paraphrasing attacks and evaluate its performance on documents written by non-native English speakers.

Is it AI?

Classification, feature selection, generalization and overfitting

Decision-Making in NL

Environment

Travel Ideas

Hi! I'm visiting NYC for the first time. I heard we should check out the Guggenheim, but not sure what the other places we should visit are.

People also enjoy the MoMA and Met. Perhaps we could add that to an itinerary?

I'd generally like to see less touristy spots. Could you make some reservations at a restaurant too? How about Saul's?

Can do! According to reviews Saul's has become a tourist hotspot too. How about Lucia's, which is near the Guggenheim?

I don't like Italian food, unless you think Lucia's is notable. Also, can you make sure there's parking around?

A screenshot of a mobile application interface. At the top, it says "Environment". Below that is a section titled "Travel Ideas" with a list of items: a yellow star, a red X, and another red X. To the right of this is a small map of New York City with several location pins. Below the "Travel Ideas" section is a text message from a user: "Hi! I'm visiting NYC for the first time. I heard we should check out the Guggenheim, but not sure what the other places we should visit are.". Below that is another message: "People also enjoy the MoMA and Met. Perhaps we could add that to an itinerary?". Then a response: "I'd generally like to see less touristy spots. Could you make some reservations at a restaurant too? How about Saul's?". Below that is another response: "Can do! According to reviews Saul's has become a tourist hotspot too. How about Lucia's, which is near the Guggenheim?". At the bottom is another message: "I don't like Italian food, unless you think Lucia's is notable. Also, can you make sure there's parking around?".

Constraint satisfaction, value of information, decision networks, particle filtering



Overview

Crossword Solving



Constraint satisfaction, belief propagation, greedy search, iterative improvement

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Constraint satisfaction, value of information, decision networks, particle filtering



Assistance in the age of LLMs

Easy



My projector isn't working. What's a list of things that could be going wrong?



Assistance in the age of LLMs

Easy



My projector isn't working. What's a list of things that could be going wrong?

Hard



My projector stopped working. Can we narrow down what might be going wrong together, step-by-step?



Assistance in the age of LLMs

Easy



What's the current price of NVIDIA stock?



Assistance in the age of LLMs

Easy



What's the current price of NVIDIA stock?

Hard



I'd like to plan our company's Q4 strategy. Can you take a look at the financial reports and market analysis with me and figure out what we need to prioritize before the end of the year?



Assistance in the age of LLMs

Easy



Can you book me a flight to LA tomorrow?



Assistance in the age of LLMs

Easy



Can you book me a flight to LA tomorrow?

Hard



Hi! Could you help me plan a trip to LA? I'm giving a talk at USC on Friday and would like to book a nearby hotel. I could fly out of OAK or SFO and am flexible on dates, but I'd like to make sure I have time to explore some nearby restaurants. Could you propose a few options for me and let me choose which one sounds best?



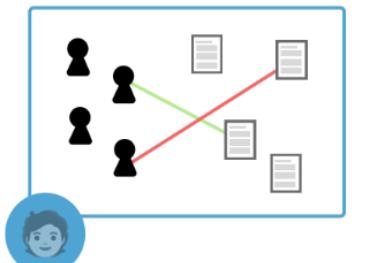
The DialOp Benchmark

Optimization

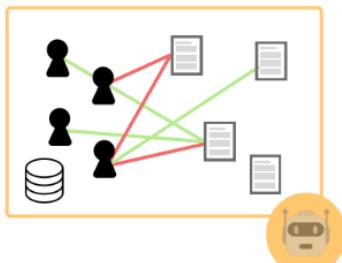
Conference Reviewer Matching

Assign suitable reviewers for conference papers

matching preferences



matching preferences



Tim and Spencer could be good fits for the RLHF paper.

I don't think Tim is working on RL anymore, would Cordelia be a viable match instead?

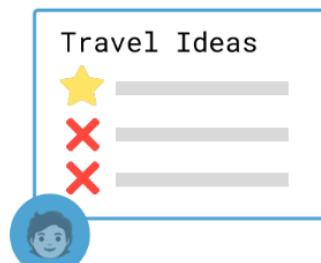
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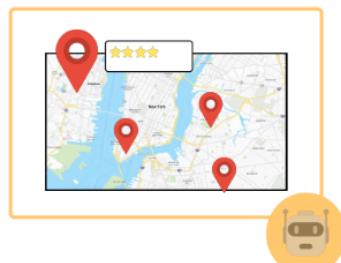
Travel Planning

Plan an efficient itinerary the user would enjoy

preferences



site locations and features



Hi! I want to check out the Guggenheim but other than that, hang out at cafes...

How about this itinerary?

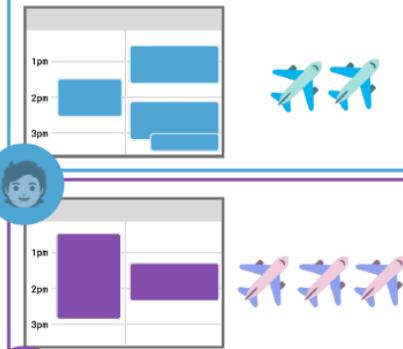
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Mediation

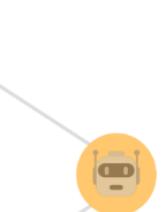
Group Scheduling

Book a set of flights that respect individual and group constraints

individual constraints and flights



global visibility



Could we all arrive before Friday 5pm?

I prefer Saturday but I could make Friday work if Claire wants that.



The DialOp Benchmark

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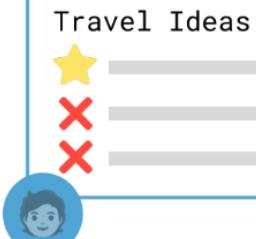
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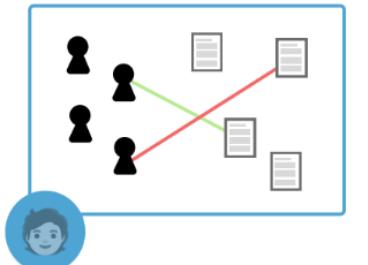
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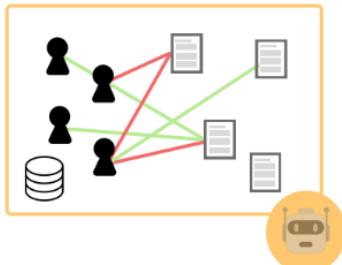
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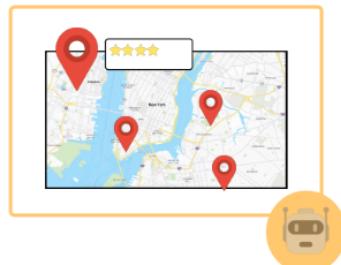
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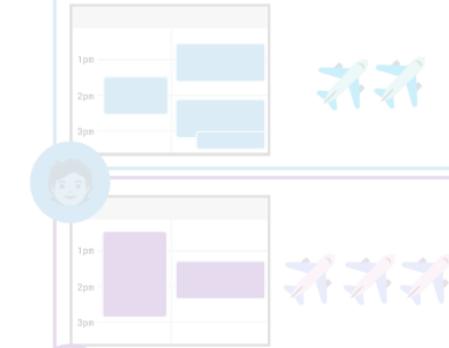
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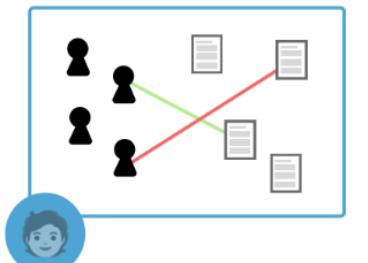
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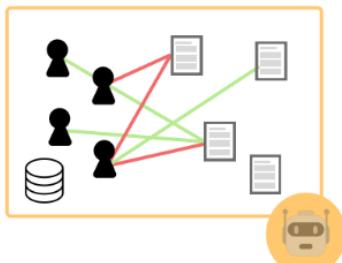
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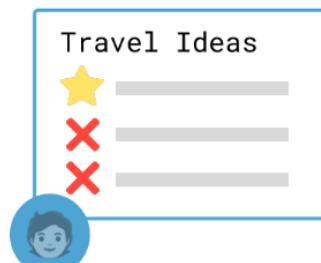
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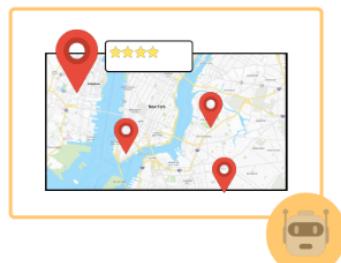
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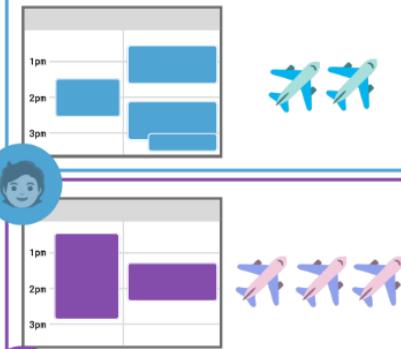
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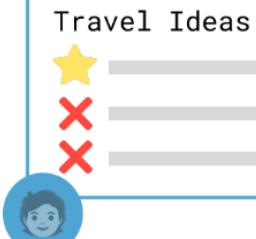
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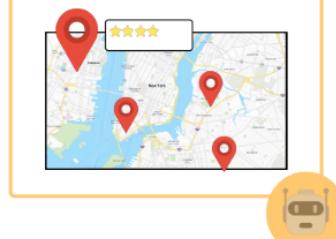
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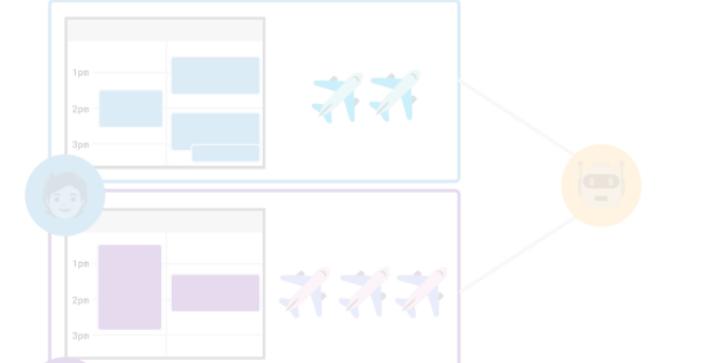
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User Interface: Planning

Travel Planning

- generally like eating vegetarian options
- go to at least one bar
- don't like: japanese, like: ethiopian, american
- don't like: beer, wine, like: cocktails
- family trip, best to go to places that are good for kids
- group of 7, best if we could go to places good for groups
- keep budget below \$80
- hidden spots much better than tourist traps
- would be great if everything is reservable in advance
- prefer just eating takeout
- minimize travel distance

Scorecard

Price: \$110
Checking which wishlist items are satisfied by this itinerary.

- 2 go to at least one bar
- 8 keep budget below \$80

Lincoln Park
Estimated price: \$0
rating: 2.5
viewpoint: false
has parking: true
open late: false
good for groups: true
Estimated Travel: 0.6 miles

Lucia's
Estimated price: \$110
rating: 3
accepts reservations: false
open late: false
good for groups: true
vegetarian options: true
Estimated Travel: 0.2 miles

Liberty Memorial
Estimated price: \$0
rating: 1
viewpoint: true
has parking: false
open late: true
good for groups: false
good for kids: false
touristy: true
Estimated Travel: 0.2 miles

Chat
Round 1/1
Randomly planning a travel itinerary gets a score of 16. Let's find something much better than that with your new travel agent!
Starting new game...
How can I help you?
I'm looking to visit some places in the city that are good for groups. Would also like to keep a tight budget.
Agent made a proposal.
Accept **Reject**

Map View

The Tower
Type: landmark
Estimated price: \$0
Max price: \$305
has parking: false
good for groups: true
rating: 2
open late: true
touristy: true
All Event Types outdoor seating (6)
 viewpoint (3)
 live music (5)
 vegan options (2)
 vegetarian options (2)
 has takeout (4)
 accepts reservations (3)
 has wifi (1)

Send Proposal
You already sent a proposal, send a message to end your turn.

Lincoln Park
Estimated Travel: 0.6 miles

Lucia's
Estimated Travel: 0.2 miles

Liberty Memorial

Chat
Round 1/1
Starting new game...
How can I help you?
I'm looking to visit some places in the city that are good for groups. Would also like to keep a tight budget.
You made a proposal.
Say something...
Send

User View

Assistant View



Human Data Collection

134 games

Avg. 18 messages per game
Avg. 8min 9s per game

The screenshot shows a grid-based assignment task and a chat interface. The grid has columns for 'Instructions' and 'Assign one person' and rows for names like Ava Li, Daniel Nguyen, Sofia Patel, etc. A message in the chat says: "That sounds good to me for Ava, although I actually see Joseph as a better fit for REU! What do you think?"

Optimization

114 games

Avg. 9 messages per game
Avg. 10min 56s per game

This interface includes a map of Chicago landmarks, a travel scorecard, and a chat window. A message in the chat says: "I'm looking to visit some new cities, can you find ones good for groups? Would also like to keep a tight budget." Below the map is a 'Scorecard' section.

Planning

162 games

Avg. 13 messages per game
Avg. 7min 15s per game

The interface features a flight booking calendar, a chat window, and a sidebar for users. A message in the chat says: "American (\$76) [5/31 02:59 PM - 05:30 AM 03:01 AM] How about this? You made a proposal." The sidebar shows flight bookings for User 0 and User 3.

Mediation



The DialOp Environment

Flights:

| id | carrier | price | times |
|-----|-----------|-------|-------------------------|
| 0 | Southwest | 50 | 5/31 9:17 AM - 5:17 PM |
| 1 | JetBlue | 1456 | 5/31 2:14 PM - 10:14 PM |
| ... | | | |

Chat:

User 1: Hi, Monday seems best, any way that would also work for them?

You (Agent) to User 1:



The DialOp Environment

Flights:

| id | carrier | price | times |
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| ... | | | |

Chat:

User 1: Hi, Monday seems best, any way that would also work for them?

You (Agent) to User 1:

...

You (Agent): How does this set of flights look for you all? ...

User 1: That's great, thanks!

User 2: Let's do it!



The DialOp Environment

Flights:

| id | carrier | price | times |
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...

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User 1: That's great, thanks!

User 2: Let's do it!



Reward: 0.77



Evaluating Dialogue Assistants



Gold Standard:
Human-LM Evaluation

Assist real human users

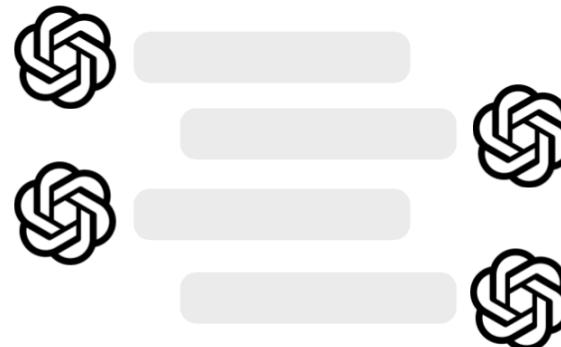


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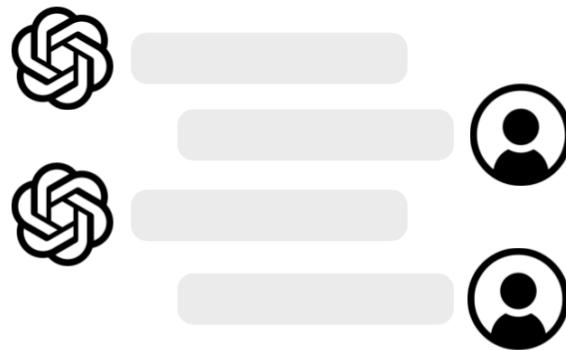


Proxy:
LM-LM Self-Play

Assist an LM user simulator

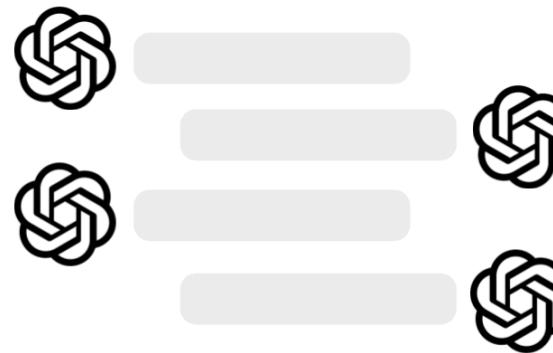


Evaluating Dialogue Assistants



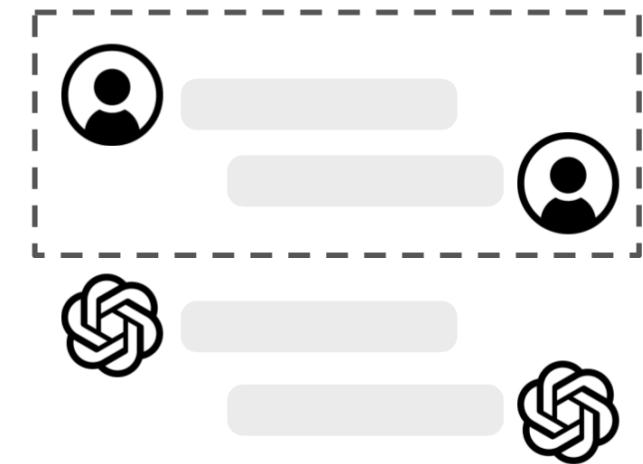
Gold Standard:
Human-LM Evaluation

Assist real human users



Proxy:
LM-LM Self-Play

Assist an LM user simulator

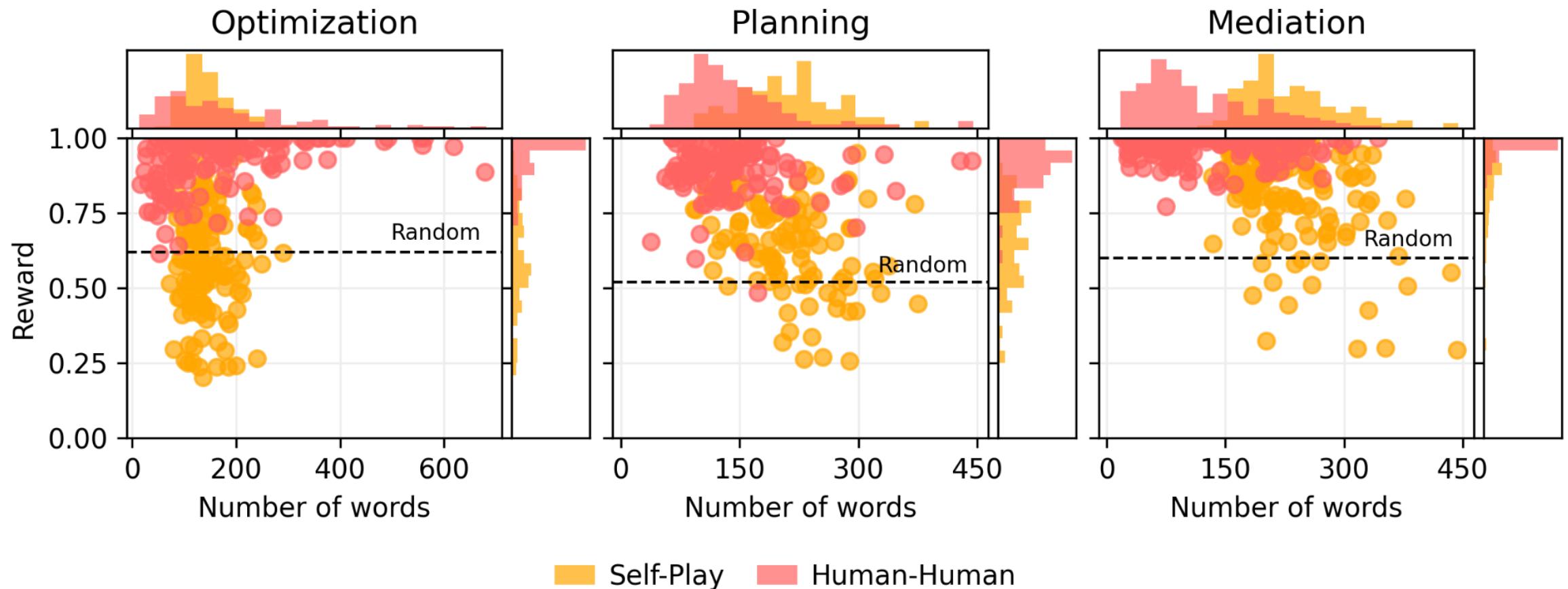


Better Proxy:
Prompted Self-Play

Continue assistance from
a human-human dialogue prefix

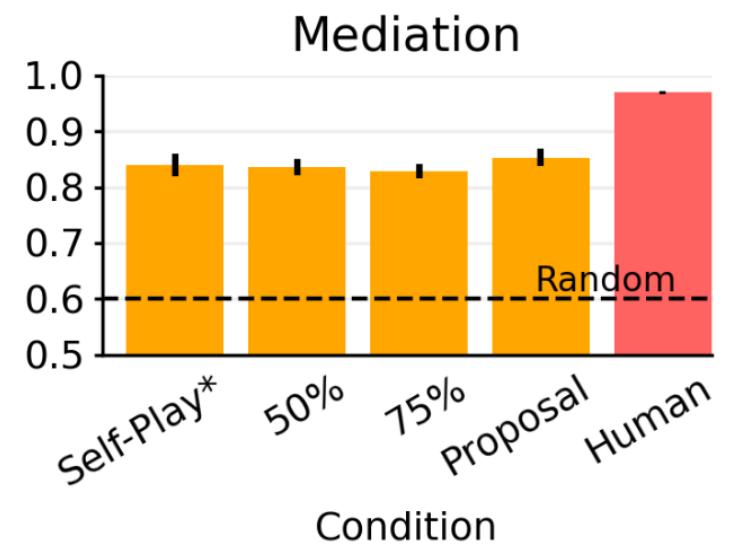
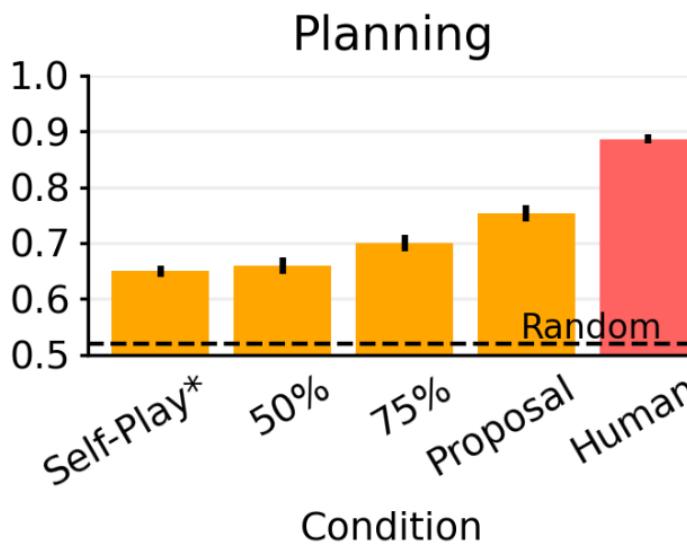
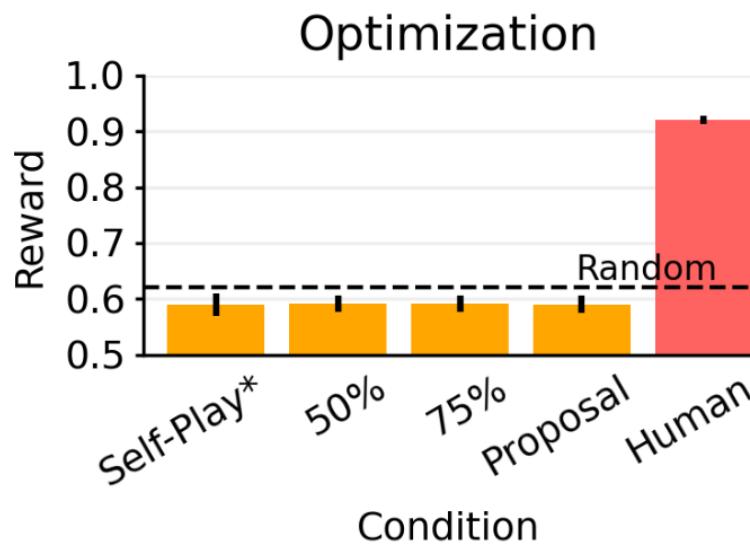


Results: Language Model Self-Play





Results: Prompted Self-Play





Example Selfplay Dialogue



I'm looking for places good for groups of 7, with vegetarian options, a shop, takeout, Harper and Rye, rated above 3 stars, and no live music. My budget is \$70.



I have several options available. Do you have a price point?



As long as it's \$70 or under, it should be fine.



Proposal: Cookies Cream, The Cupcake Bar, Asha Tea House

I have found several options. All of these places are within a mile of each other and have vegetarian options. Do you have any other preferences?

Proposal Rejected (64% Match)

(Real Dialogue)



Example Selfplay Dialogue



I'm looking for places good for groups of 7, with vegetarian options, a shop, takeout, Harper and Rye, rated above 3 stars, and no live music. My budget is \$70.

Model messages all preferences into the chat



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Model makes an initial weak proposal, which will then be rejected

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Dialogue continues and results in only slightly better outcome

(Real Dialogue)



Example Human-Human Dialogue



Hey I'd like to plan a trip for my family, so I'd like to visit all the touristy spots in town, visit at least one landmark, and find a place with wifi...because I like classy places



Well Einstein's Summer House is a famous landmark in the area and it's in walking distance to the Coffee Nook which is a cafe that has wifi in the area

Proposal: Einstein's summer house, Coffee Nook, NULL



That looks pretty decent, could we tack on a visit to the Garden of Wonders? I REALLY WANT TO GO THERE



Oh that is a great place to visit. Here is a new schedule that keeps you in the area around the Garden of Wonders



Example Human-Human Dialogue



Hey I'd like to plan a trip for my family, so I'd like to visit all the touristy spots in town, visit at least one landmark, and find a place with wifi...because I like classy places

Human sends partial preferences into the chat



Well Einstein's Summer House is a famous landmark in the area and it's in walking distance to the Coffee Nook which is a cafe that has wifi in the area

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Human partner makes a partial proposal and provides reasons why it might be a good one

Proposal: Einstein's summer house, Coffee Nook, NULL



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Dialogue continues as human players incrementally collaborate toward a final solution



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Demo (Time Permitting)

The Tower
Type: landmark
Estimated price: \$0

has parking: false
good for groups: true
rating: 2
open late: true
touristy: true

All Event Types outdoor seating (6)
Max price: \$305 viewpoint (3)
 live music (5)
 vegan

 has parking (9) options (2)
 open late (18) vegetarian options (2)
 good for groups (12) has takeout (4)
 good for kids (4) accepts reservations (3)
 touristy (13) has wifi (1)

Send Proposal
You already sent a proposal, send a message to end your turn.

Lincoln Park
Estimated Travel: 0.6 miles

Lucia's
Estimated Travel: 0.2 miles

Liberty Memorial

Chat
Round 1/1

Starting new game...
How can I help you?
I'm looking to visit some places in the city that are good for groups. Would also like to keep a tight budget.
You made a proposal.

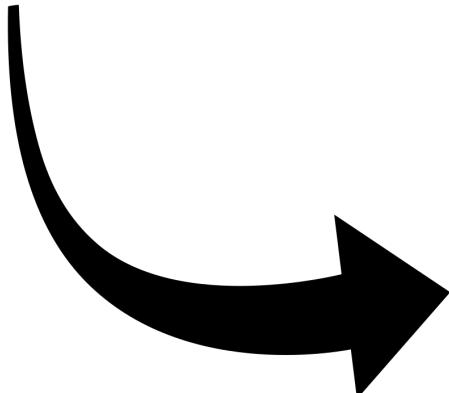
Say something...

Send



Thanks for listening!

My awesome
collaborators



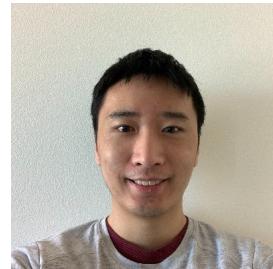
You can find more info about these projects on my website:

https://people.eecs.berkeley.edu/~nicholas_tomlin/

Eric Wallace
UC Berkeley



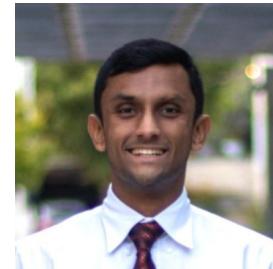
Kevin Yang
UC Berkeley



Albert Xu
USC



Eshaan Pathak
You.com



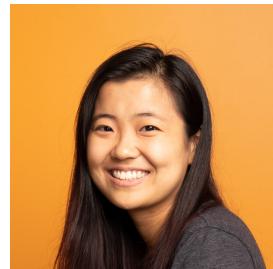
Matt Ginsberg
Google



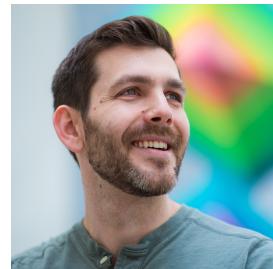
Dan Klein
UC Berkeley



Jessy Lin
UC Berkeley



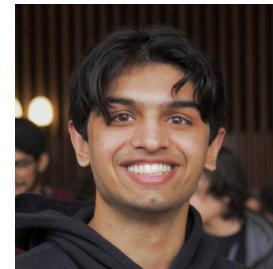
Jacob Andreas
MIT



Jason Eisner
Johns Hopkins



Vivek Verma
UC Berkeley



Eve Fleisig
UC Berkeley



Coco
My Cat

