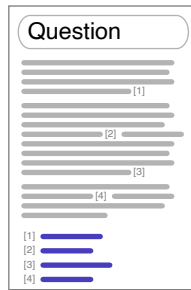


# Generative Search and Biases

Challenges and Opportunities of a New Information Ecology

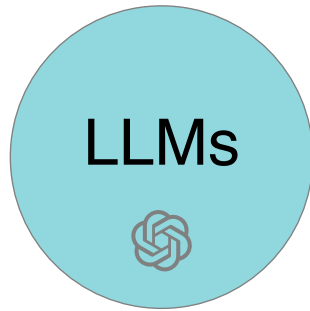
Martin Potthast







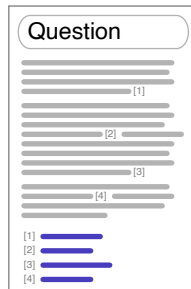
+



⇒



?

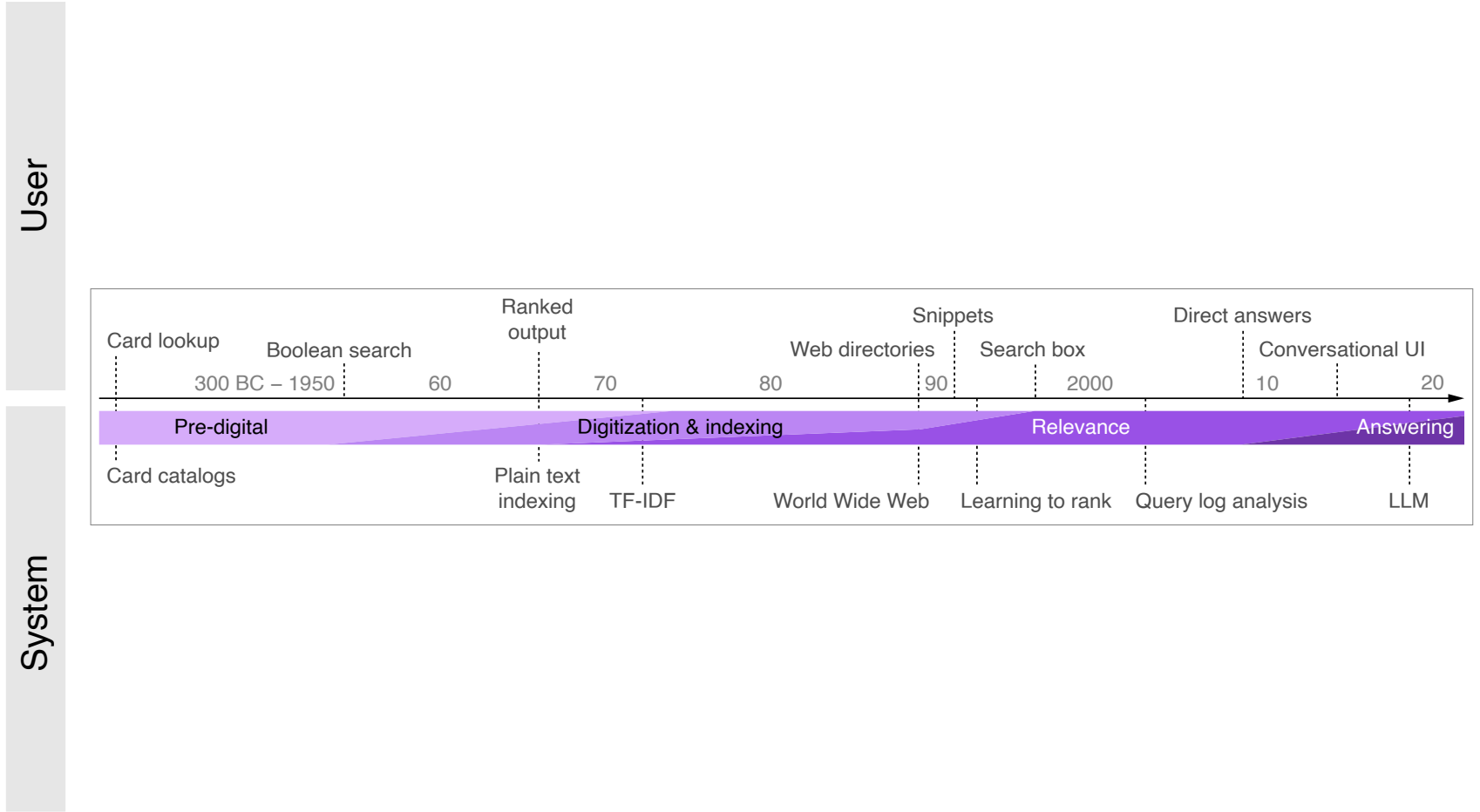






# A Short History of Search Engines

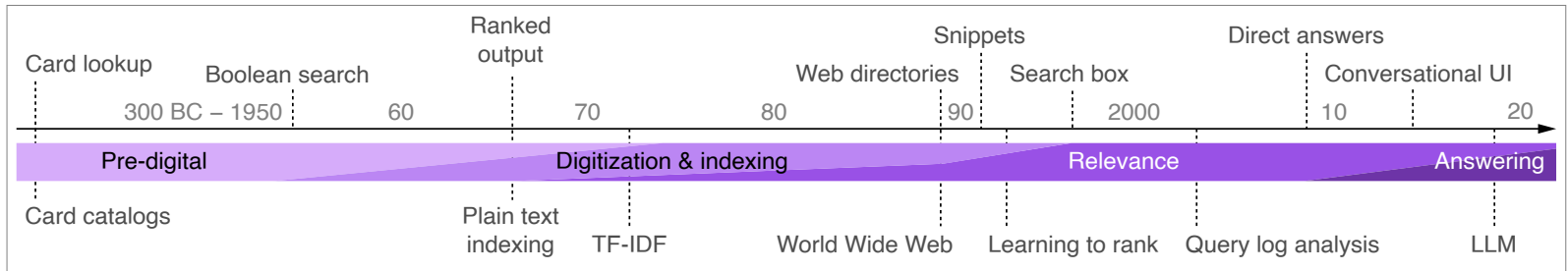
# A Short History of Search Engines



- M. Potthast, M. Hagen, B. Stein (2020). The dilemma of the direct answer.

# A Short History of Search Engines

User



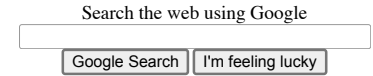
System



- M. Potthast, M. Hagen, B. Stein (2020). The dilemma of the direct answer.

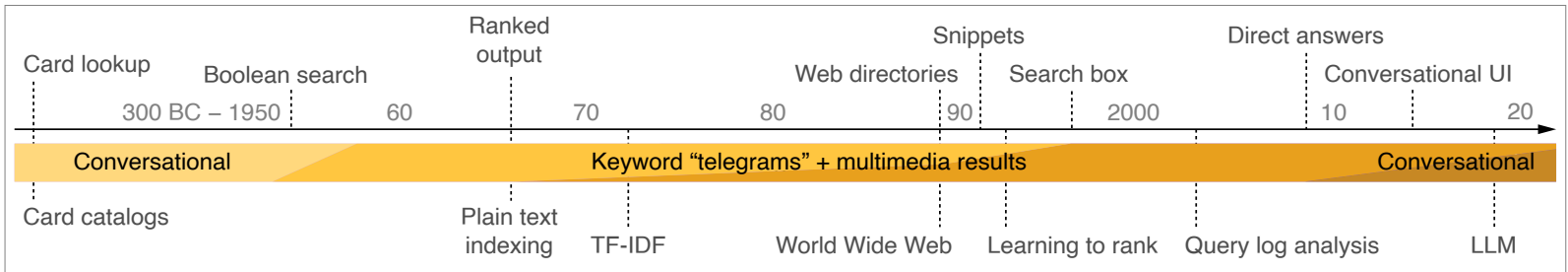
# A Short History of Search Engines

User



- Yellow Pages - People Search - City Maps -- News Headlines - Stock Quotes - Sports Scores
- **Arts** - - Humanities, Photography, Architecture, ...
  - **Business and Economy [Xtra!]** - - Directory, Investments, Classifieds, ...
  - **Computers and Internet [Xtra!]** - - Internet, WWW, Software, Multimedia, ...
  - **Education** - - Universities, K-12, Courses, ...
  - **Entertainment [Xtra!]** - - TV, Movies, Music, Magazines, ...

©1999 Google Inc.



System

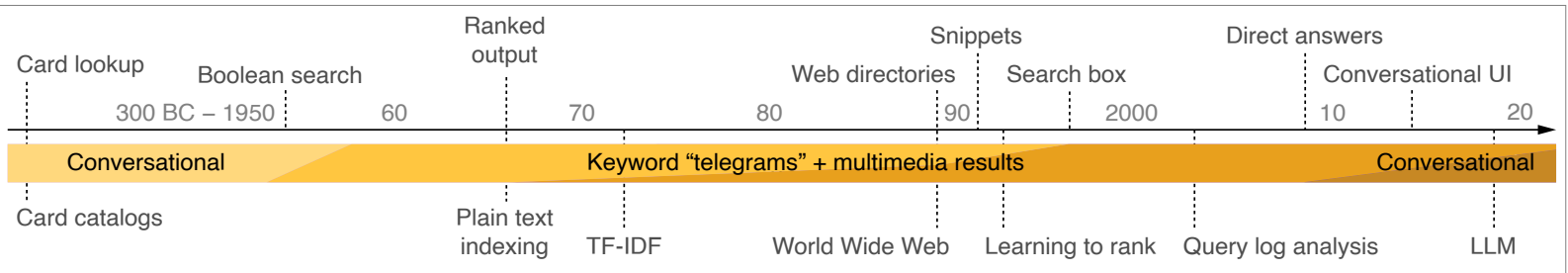


- M. Potthast, M. Hagen, B. Stein (2020). The dilemma of the direct answer.

# A Short History of Search Engines

User

Of which kind is the user workload?



System

Who is doing the job of knowledge organization?



- M. Potthast, M. Hagen, B. Stein (2020). The dilemma of the direct answer.

# A Short History of Search Engines

User

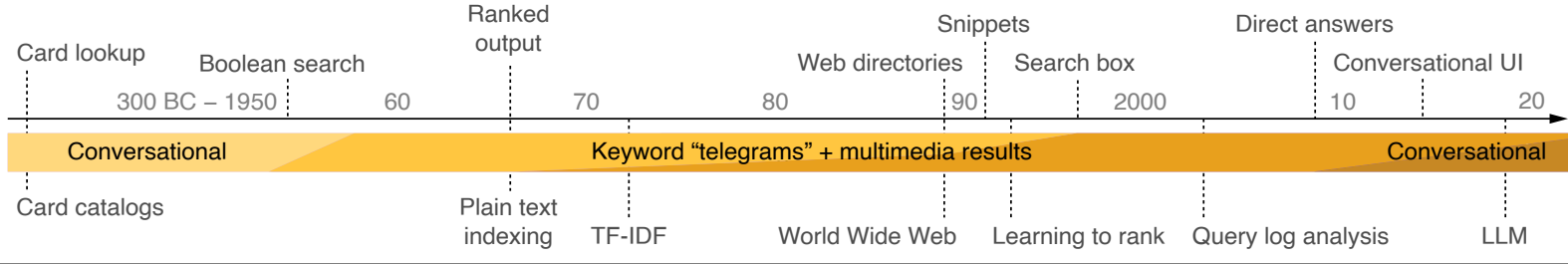
What is the user preference?



Of which kind is the user workload?



System



Who is doing the job of knowledge organization?



Which fraction is considered from the hypothesis space?



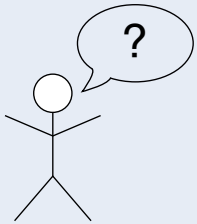
- M. Potthast, M. Hagen, B. Stein (2020). The dilemma of the direct answer.

# Web Search Architecture



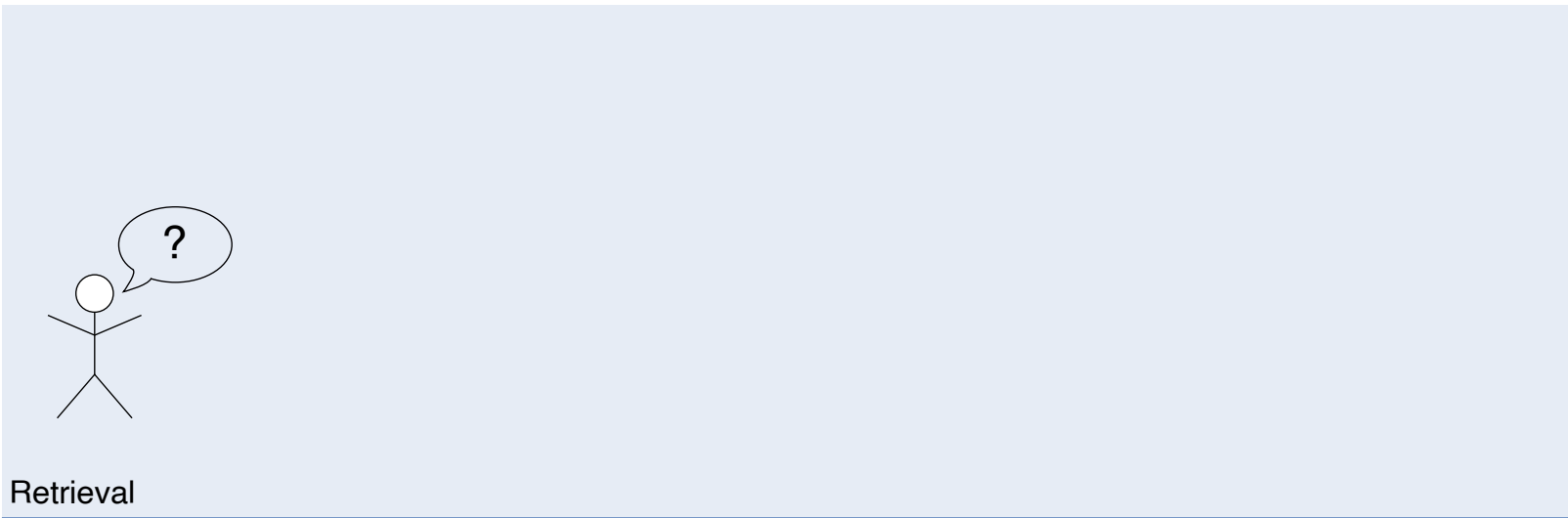
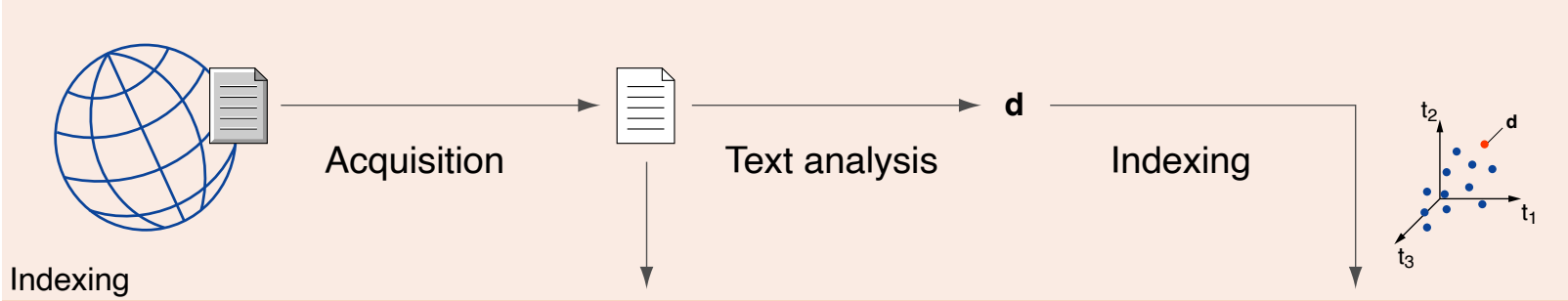
Indexing

Storage



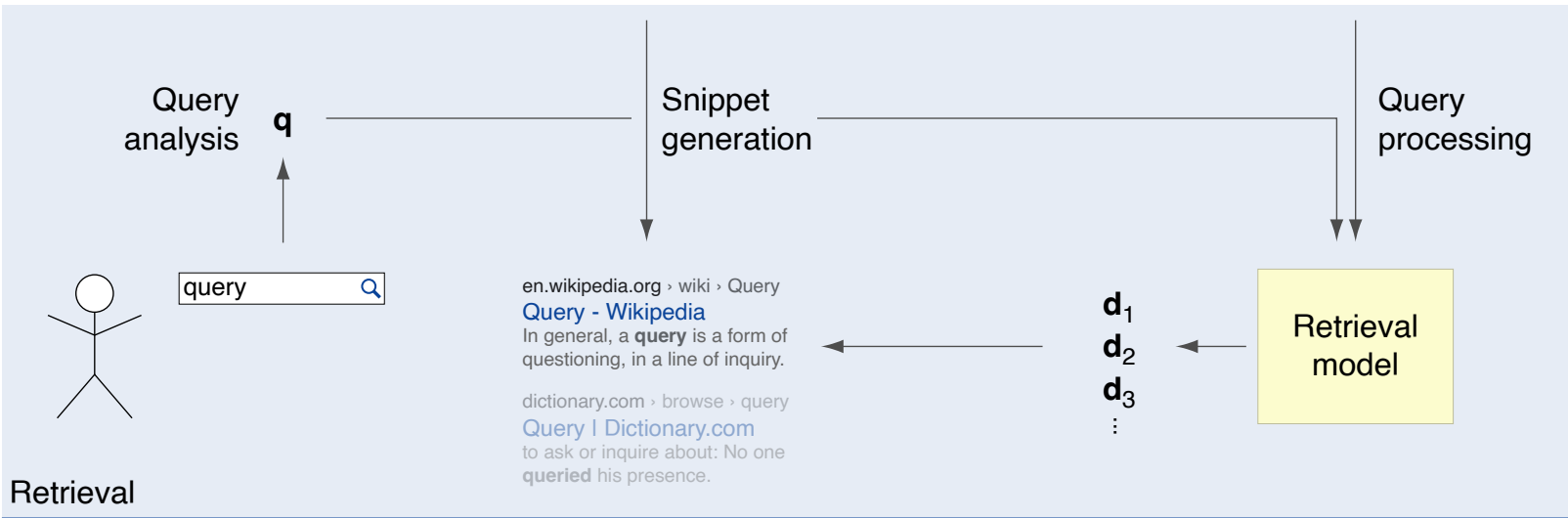
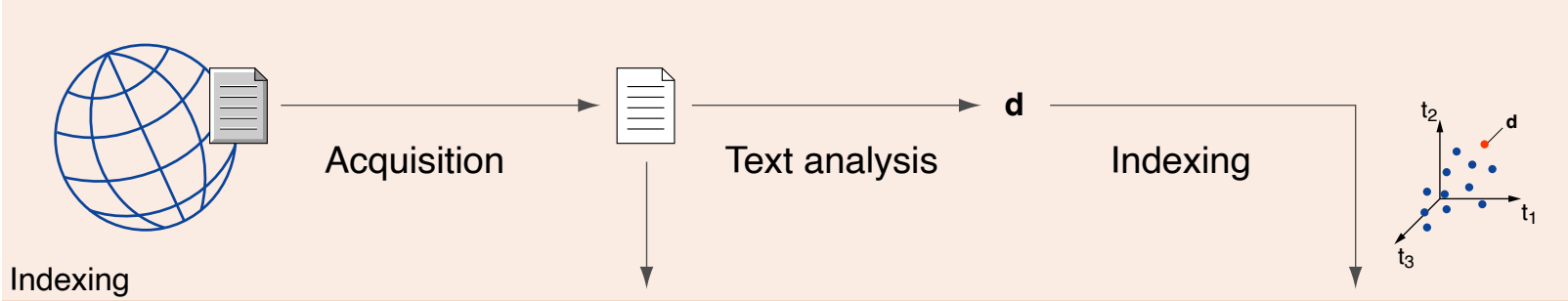
Retrieval

# Web Search Architecture

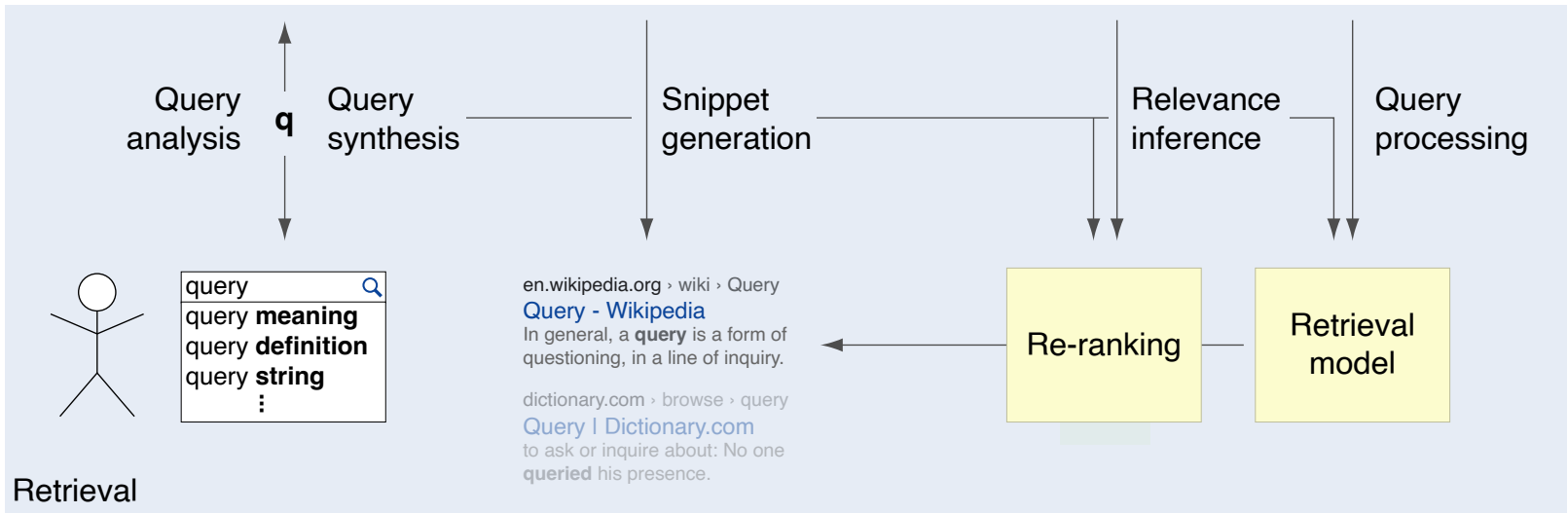
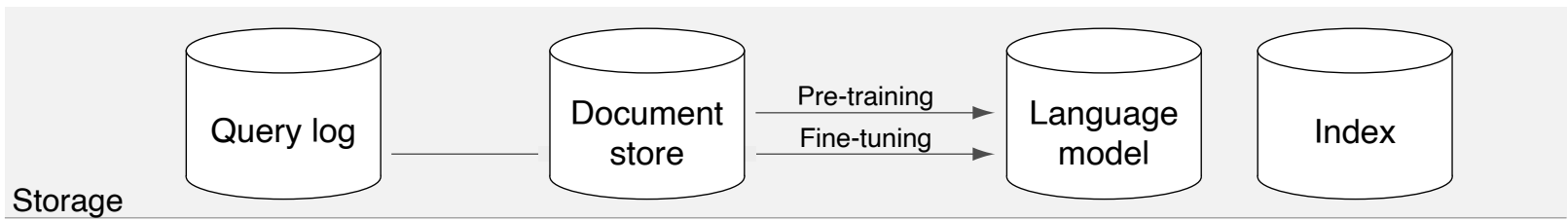
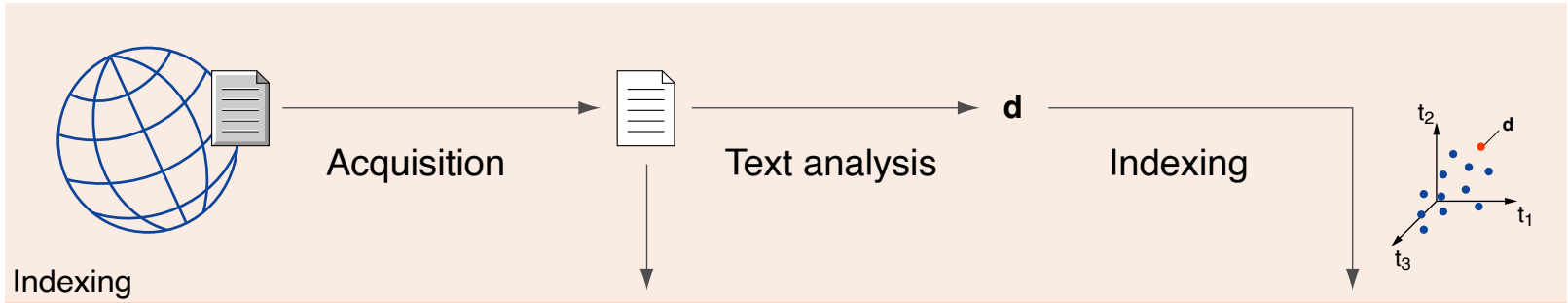




# Web Search Architecture



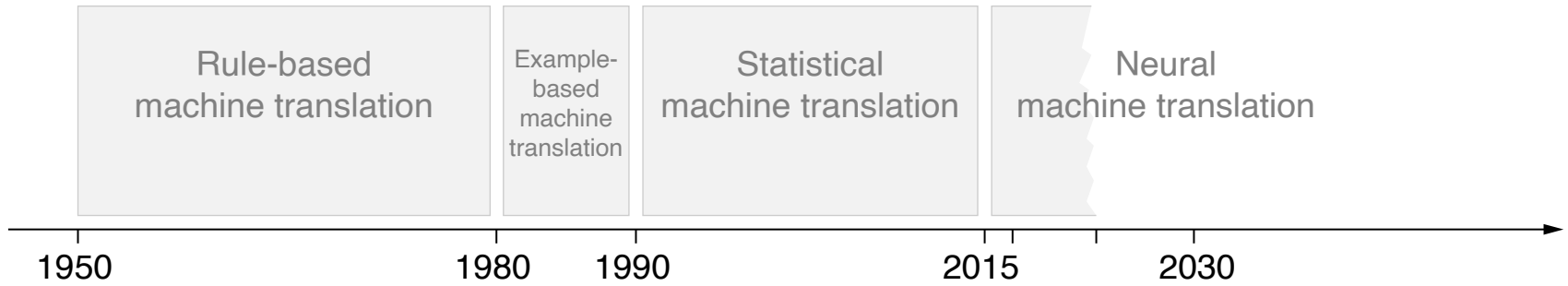
# Web Search Architecture



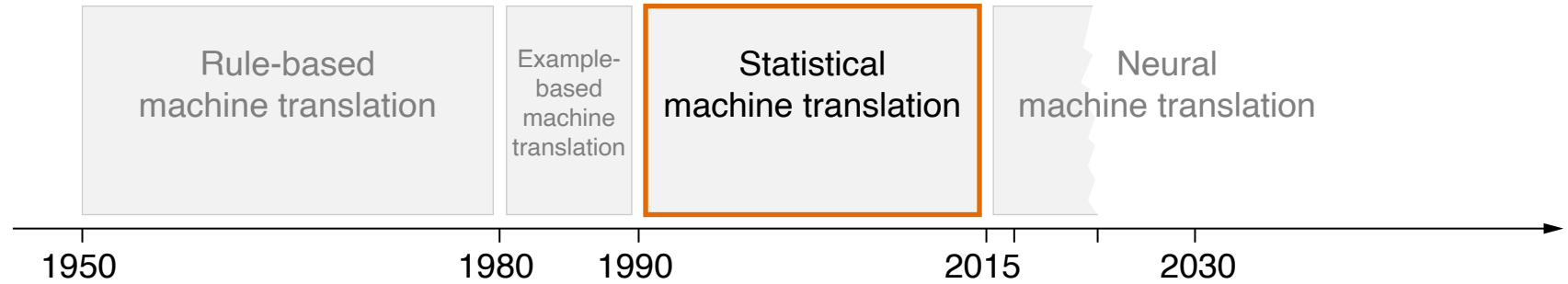


## A Short History of Language Models

# A Short History of Language Models

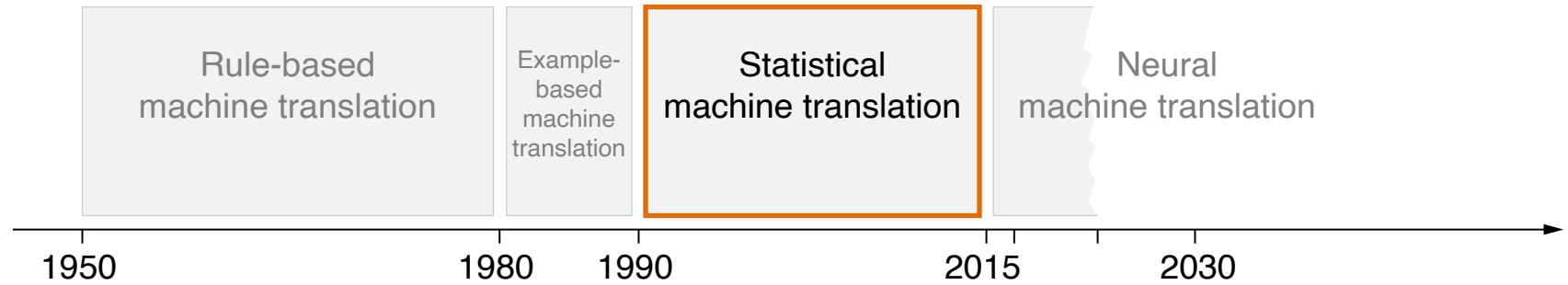


# A Short History of Language Models



A statistical language model  
is a probability distribution over all possible texts.

# A Short History of Language Models



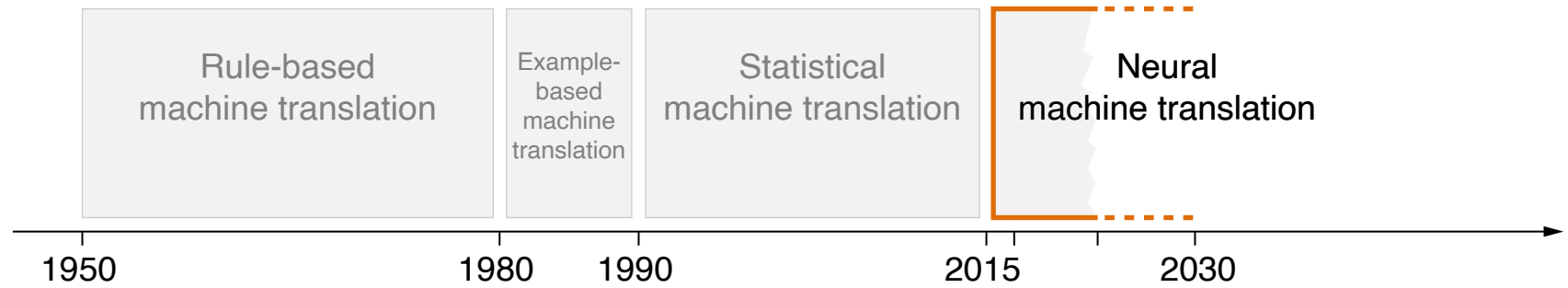
A statistical language model  
is a probability distribution over all possible texts.

Illustration:

(1) i love my ? N N

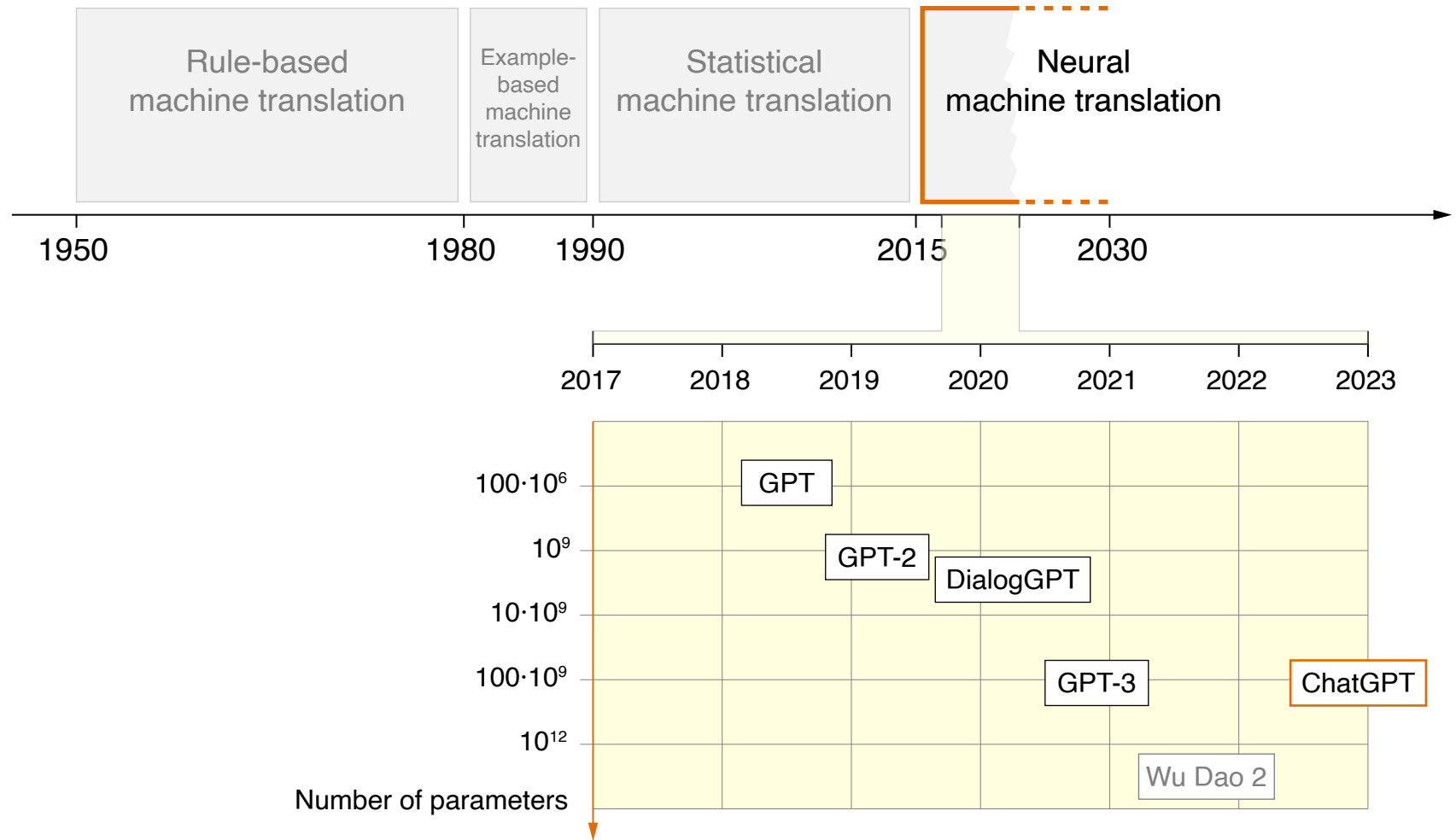
(2) see ... works. N N

# A Short History of Language Models



A neural language model approximates a statistical language model.

# A Short History of Language Models





### Training Corpora Sources

Wikipedia	11GB	Books	21GB
Journals	101GB	Reddit	50GB
Common Crawl	570GB		

### Parameters

175,000,000,000  
( $175 \cdot 10^9$ )

### Computing / Training

- 355 years on a single Tesla V100 GPU.
- $\approx$  34 days on 1,024 x A100 GPUs.
- \$4.6M costs a single training run.

**GPT-3** [Jun. 2020]

### Training Corpora Sources

Wikipedia	11GB	Books	21GB
Journals	101GB	Reddit	50GB
Common Crawl	570GB		

### Parameters

175,000,000,000  
( $175 \cdot 10^9$ )

### Computing / Training

- 355 years on a single Tesla V100 GPU.
- $\approx$  34 days on 1,024 x A100 GPUs.
- \$4.6M costs a single training run.

## GPT-3 [Jun. 2020]

### World Knowledge

- 🧑 What city is in the northwest corner of Ohio?
- 🌀 Toledo is in the northwest corner of Ohio.

### Common Sense

- 🧑 Why don't animals have three legs?
- 🌀 Animals don't have three legs because they would fall over.

### Logical Reasoning

- 🧑 If I put a pencil in a box, then put another pencil in the box, what is in the box?
- 🌀 Two pencils.

### Training Corpora Sources

Wikipedia	11GB	Books	21GB
Journals	101GB	Reddit	50GB
Common Crawl	570GB		

### Parameters

175,000,000,000  
( $175 \cdot 10^9$ )

### Computing / Training

- 355 years on a single Tesla V100 GPU.
- $\approx$  34 days on 1,024 x A100 GPUs.
- \$4.6M costs a single training run.

## GPT-3 [Jun. 2020]

### World Knowledge

- 🧑 What city is in the northwest corner of Ohio?
- 🌀 Toledo is in the northwest corner of Ohio.

### Common Sense

- 🧑 Why don't animals have three legs?
- 🌀 Animals don't have three legs because they would fall over.

### Logical Reasoning

- 🧑 If I put a pencil in a box, then put another pencil in the box, what is in the box?
- 🌀 Two pencils.

### + Learn to follow instructions and to comply with answer policies.

- (1) Fine-tuning of GPT-3 to follow instructions: 13,000 popular prompts with hand-written answers.
- (2) Training of a reward model: 33,000 prompts with 4-9 answers, ranked from best to worse.
- (3) Training of the fine-tuned GPT-3 model from Step (1) to follow the reward policy.

## GPT-3.5 (InstructGPT) [Jan. 2022]

### Training Corpora Sources

Wikipedia	11GB	Books	21GB
Journals	101GB	Reddit	50GB
Common Crawl	570GB		

### Parameters

175,000,000,000  
( $175 \cdot 10^9$ )

### Computing / Training

- 355 years on a single Tesla V100 GPU.
- $\approx$  34 days on 1,024 x A100 GPUs.
- \$4.6M costs a single training run.

## GPT-3 [Jun. 2020]

### World Knowledge

- 🧑 What city is in the northwest corner of Ohio?
- 🌀 Toledo is in the northwest corner of Ohio.

### Common Sense

- 🧑 Why don't animals have three legs?
- 🌀 Animals don't have three legs because they would fall over.

### Logical Reasoning

- 🧑 If I put a pencil in a box, then put another pencil in the box, what is in the box?
- 🌀 Two pencils.

### + Learn to follow instructions and to comply with answer policies.

- (1) Fine-tuning of GPT-3 to follow instructions: 13,000 popular prompts with hand-written answers.
- (2) Training of a reward model: 33,000 prompts with 4-9 answers, ranked from best to worse.
- (3) Training of the fine-tuned GPT-3 model from Step (1) to follow the reward policy.

## GPT-3.5 (InstructGPT) [Jan. 2022]

### + Fine-tuning of GPT-3.5 to comply with even stricter guardrails.

## ChatGPT [Nov. 2022]

## Training Corpora Sources

Wikipedia	11GB	Books	21GB
Journals	101GB	Reddit	50GB
Common Crawl	570GB		

## Parameters

175,000,000,000  
( $175 \cdot 10^9$ )

## Computing / Training

- 355 years on a single Tesla V100 GPU.
- $\approx$  34 days on 1,024 x A100 GPUs.
- \$4.6M costs a single training run.

**GPT-3** [Jun. 2020]

### World Knowledge

- 🧑 What city is in the northwest corner of Ohio?
- 🌀 Toledo is in the northwest corner of Ohio.

### Common Sense

- 🧑 Why don't animals have three legs?
- 🌀 Animals don't have three legs because they would fall over.

### Logical Reasoning

- 🧑 If I put a pencil in a box, then put another pencil in the box, what is in the box?
- 🌀 Two pencils.

+ Learn to follow instructions and to comply with answer policies.

- (1) Fine-tuning of GPT-3 to follow instructions: 13,000 popular prompts with hand-written answers.
- (2) Training of a reward model: 33,000 prompts with 4-9 answers, ranked from best to worse.
- (3) Training of the fine-tuned GPT-3 model from Step (1) to follow the reward policy.

**GPT-3.5** (InstructGPT) [Jan. 2022]

+ Fine-tuning of GPT-3.5 to comply with even stricter guardrails.

**ChatGPT** [Nov. 2022]



# The Library of Babel

[Jorge Luis Borges, 1941]





# The Library of Babel

[Jorge Luis Borges, 1941]

- ❑ Infinite library with all possible texts from all letter combinations
- ❑ The people in it spend their lives searching for meaningful text fragments



# The Library of Babel

[Jorge Luis Borges, 1941]



- ❑ Infinite library with all possible texts from all letter combinations
- ❑ The people in it spend their lives searching for meaningful text fragments
- ❑ When prompted, a language model “retrieves” a relevant text [[Deckers et al., 2024](#)]:

A language model is an infinite index



3

On Biases

Bias in algorithms

Cognitive bias

Inductive bias

Statistical bias

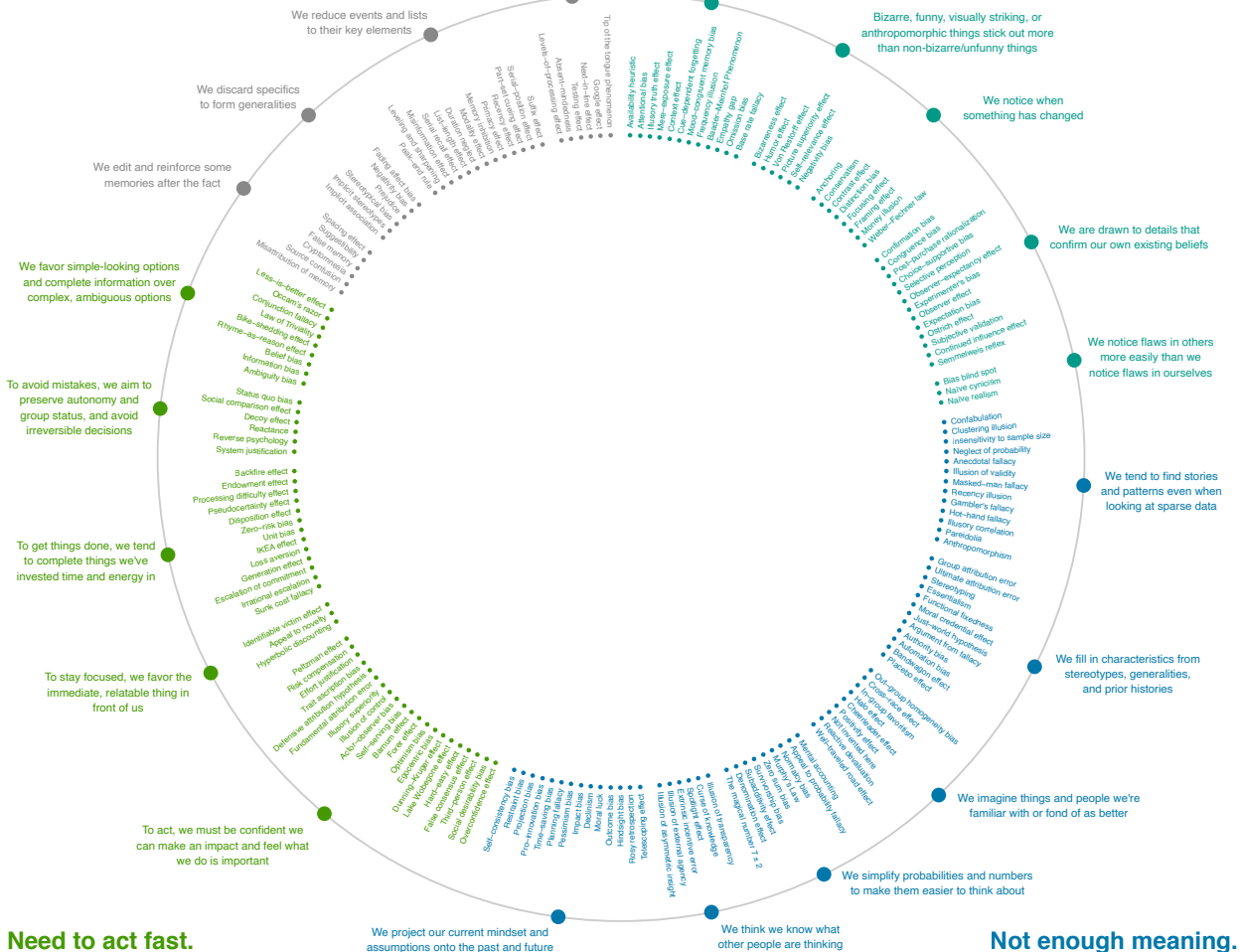
Bias in data

# What should we remember?

We store memories differently based on how they were experienced

We notice things already primed in memory or repeated often

# Too much information.



Bias in algorithms

Cognitive bias

Inductive bias

Statistical bias

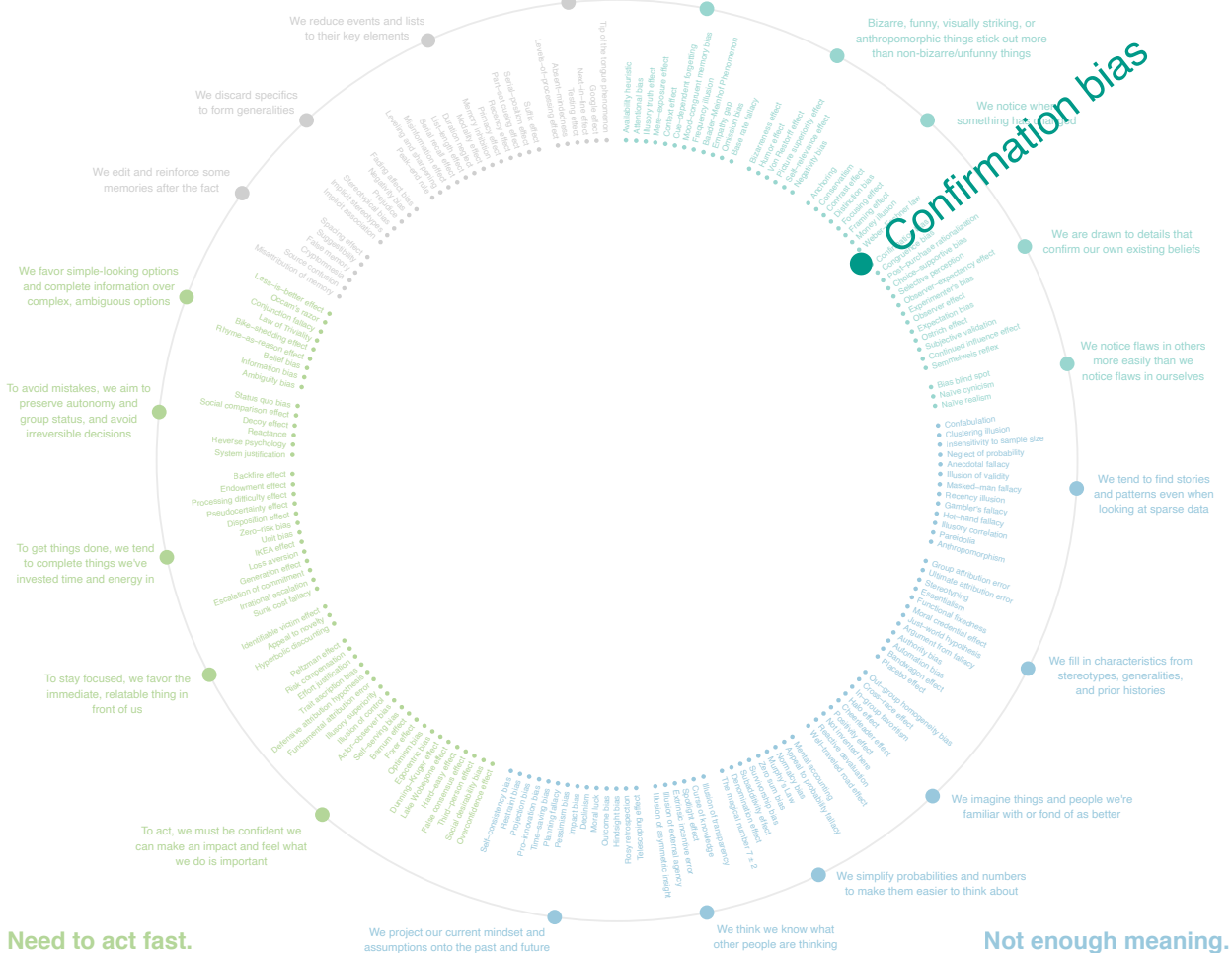
Bias in data

What should we remember?

We store memories differently based on how they were experienced

We notice things already primed in memory or repeated often

Too much information.



Bias in algorithms

Cognitive bias

Inductive bias

Statistical bias

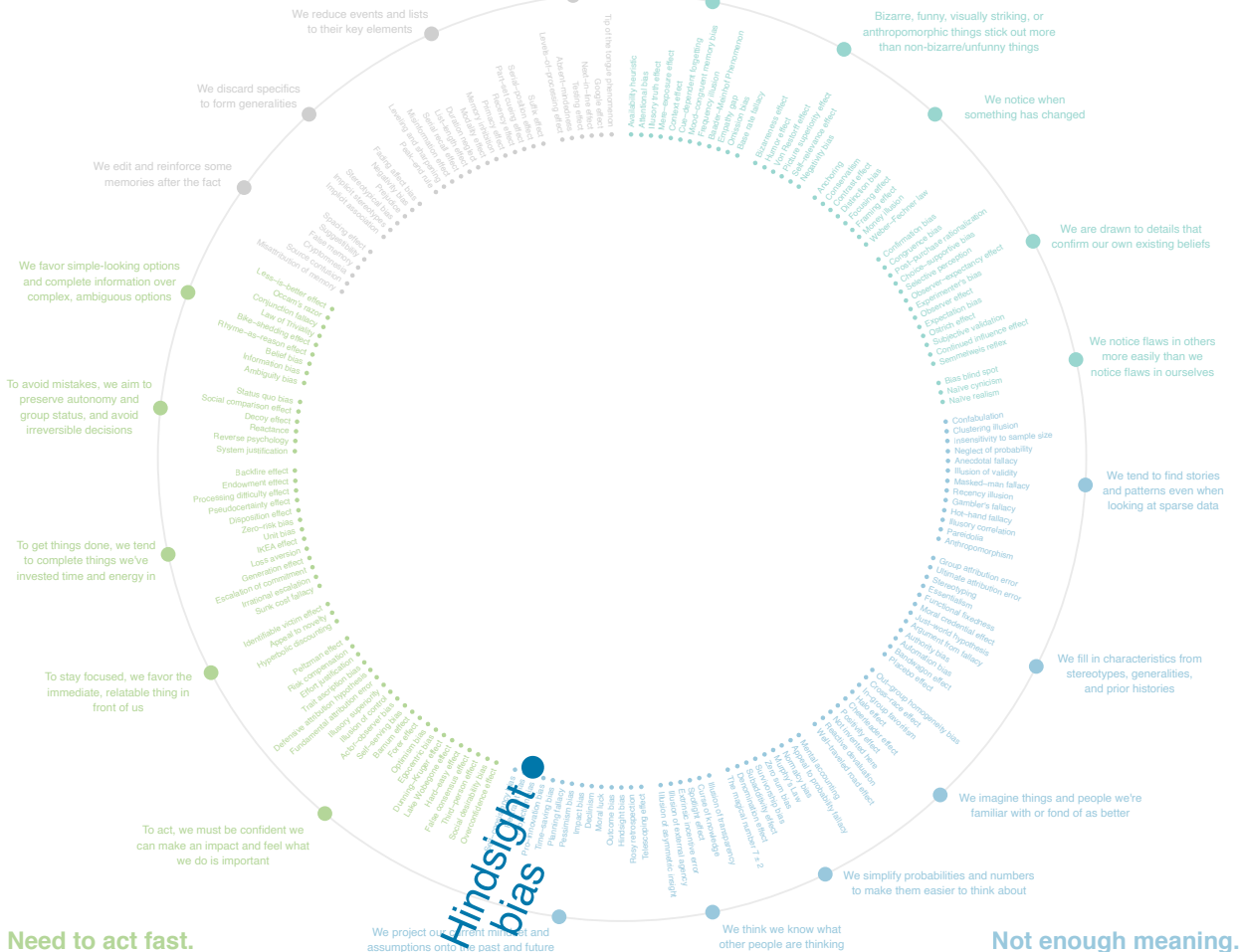
Bias in data

What should we remember?

We store memories differently based on how they were experienced

We notice things already primed in memory or repeated often

Too much information.



Bias in algorithms

Cognitive bias

Inductive bias

Statistical bias

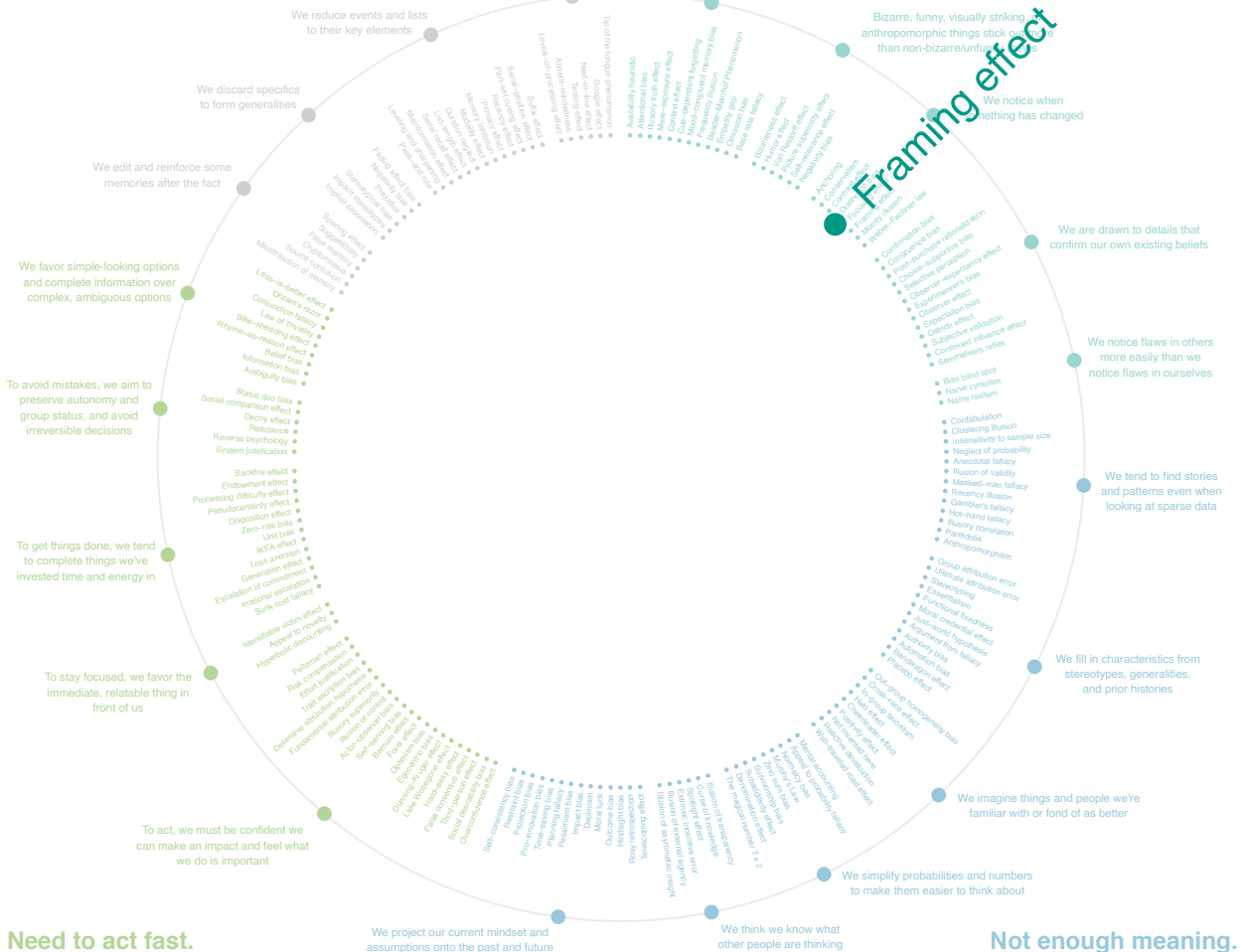
Bias in data

What should we remember?

We store memories differently based on how they were experienced

We notice things already primed in memory or repeated often

Too much information.



Bias in algorithms

Cognitive bias

Inductive bias

Statistical bias

Bias in data



What should we remember?

We store memories differently based on how they were experienced

We notice things already primed in memory or repeated often

Too much information.

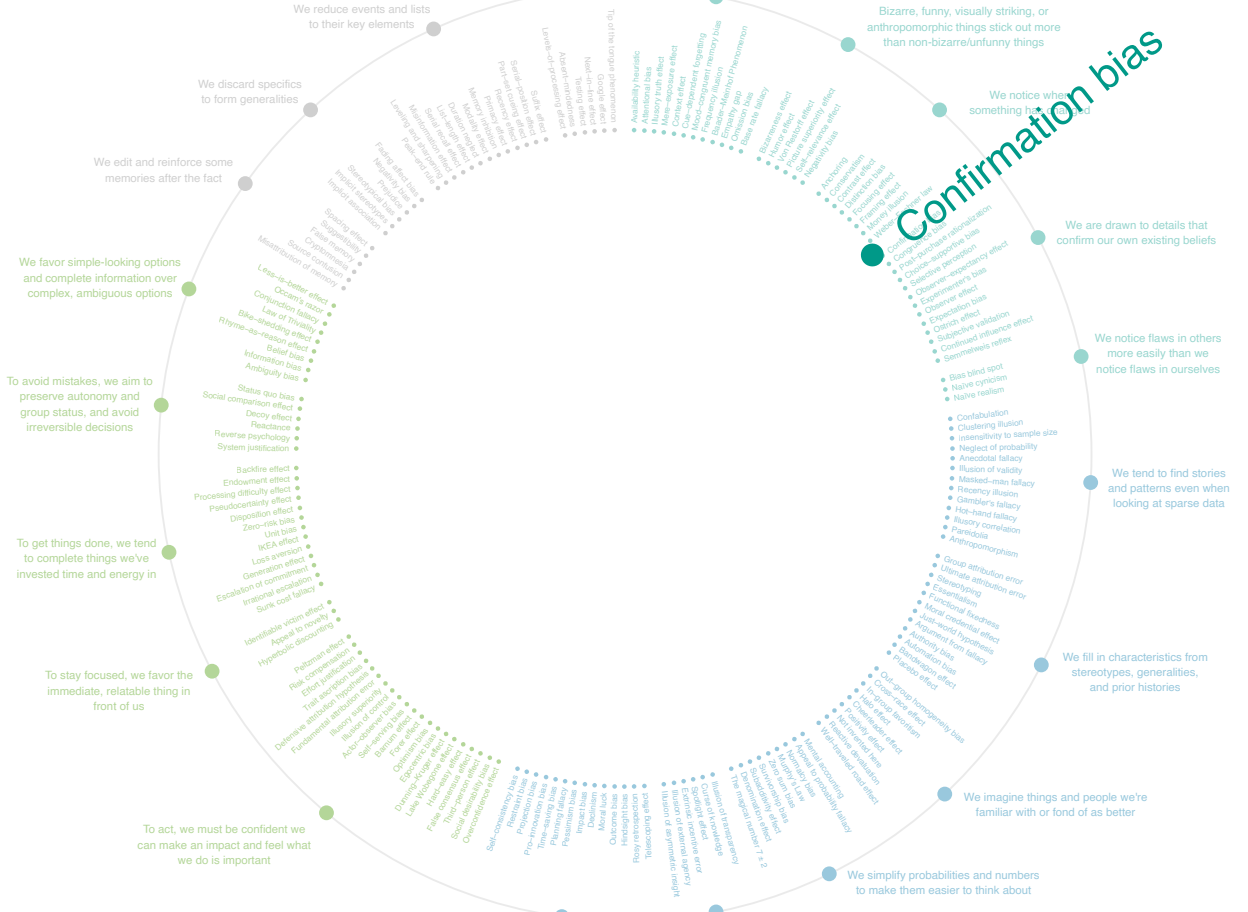
Need to act fast.

We project our current mindset and assumptions onto the past and future

We think we know what other people are thinking

Not enough meaning.

Confirmation bias



We favor simple-looking options and complete information over complex, ambiguous options

To avoid mistakes, we aim to preserve autonomy and group status, and avoid irreversible decisions

To get things done, we tend to complete things we've invested time and energy in

To stay focused, we favor the immediate, reliable thing in front of us

To act, we must be confident we can make an impact and feel what we do is important

We are drawn to details that confirm our own existing beliefs

We notice flaws in others more easily than we notice flaws in ourselves

We tend to find stories and patterns even when looking at sparse data

We fill in characteristics from stereotypes, generalities, and prior histories

We imagine things and people we're familiar with or fond of as better

We simplify probabilities and numbers to make them easier to think about

Query: "Why is a high protein diet the best for losing weight quickly?"



# High Protein Diet Benefits

November 19, 2023



**Anonymous**

Why is a high protein diet the best for losing weight quickly?



**ChatGPT**

A high protein diet is often considered effective for losing weight quickly for several reasons:

1. **Increased Satiety:** Protein is more satiating than carbohydrates or fats. This means that high-protein foods can help you feel full longer, reducing overall calorie intake.
2. **Higher Thermic Effect:** The body uses more energy to metabolize protein compared to fats and carbohydrates. This process, known as the thermic effect ...
3. **Muscle Preservation:** When losing weight, it's important to maintain muscle mass. Protein is essential for muscle growth and repair. A high protein intake can help ...
4. **Improved Metabolic Health:** High-protein diets have been shown to improve several markers of metabolic health, including blood sugar levels, ...
5. **Reduced Appetite:** Protein can influence hormones that play a role in hunger and fullness, including ghrelin and GLP-1. By helping to balance these hormones, ...

However, it's important to note that while a high protein diet can be effective for weight loss, it's not necessarily the best option for everyone. Factors like individual health conditions, dietary preferences, and long-term sustainability ....

It's always a good idea to consult with a healthcare professional or a registered dietitian before starting any new diet, especially one that significantly changes your macronutrient intake.

[Report content](#) | [Terms of use](#) | [Privacy policy](#)

Query: “Why is a high protein diet the best for losing weight quickly?”

# High Protein Diet Benefits

November 19, 2023



Anonymous

Why is a high protein diet the



ChatGPT

A high protein diet is often co

1. **Increased Satiety:** Protein is high-protein foods can help
2. **Higher Thermic Effect:** The and carbohydrates. This pro
3. **Muscle Preservation:** When essential for muscle growth
4. **Improved Metabolic Health** of metabolic health, includi
5. **Reduced Appetite:** Protein c including ghrelin and GLP-1.

However, it's important to no

it's not necessarily the best option for everyone. Factors like individual health conditions, dietary preferences, and long-term sustainability ....

It's always a good idea to consult with a healthcare professional or a registered dietitian before starting any new diet, especially one that significantly changes your macronutrient intake.

[Report content](#) | [Terms of use](#) | [Privacy policy](#)

Why is a high protein diet the best for losing weight quickly? - Google Search — Mozilla Firefox

Google

Why is a high protein diet the best for losing weight q

Images

Videos

News

Books

Maps

Flights

Finance

About 354.000.000 results (0,51 seconds)

It can make you eat fewer calories automatically. Bottom Line: Protein reduces levels of the hunger hormone ghrelin, while it boosts the appetite-reducing hormones GLP-1, peptide YY and cholecystinin.

This leads to an automatic reduction in calorie intake. 30 Mar 2023

Query: “Why is a high protein diet the best for losing weight quickly?”

# Balance of Responsibilities in Information Retrieval



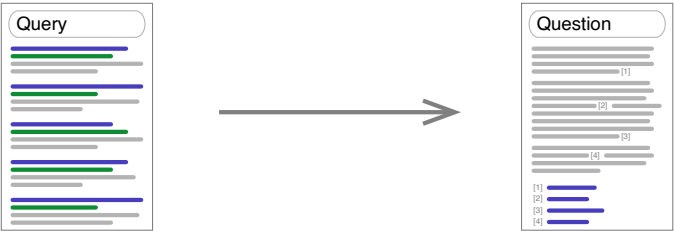
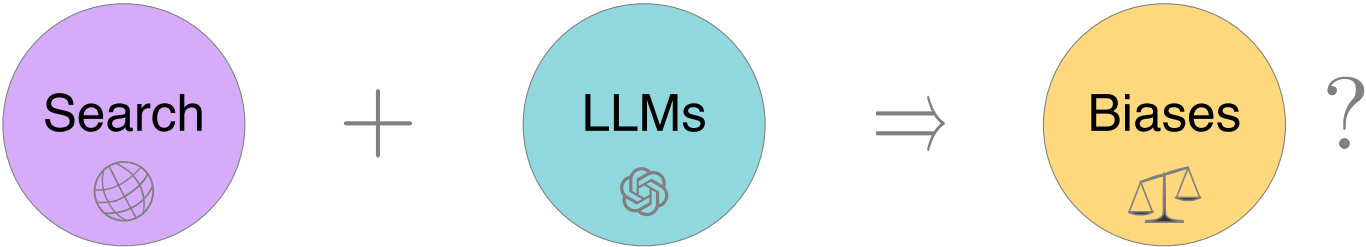
## More power to the machine?

- effectively installed
- standardized guardrailing
- protection of vulnerable groups
- ...

## Empower the user?

- raise awareness
- support deliberation
- demonstrate mechanisms
- provide meta information
- ...

# Wrap-Up





Christopher Akiki  
Leipzig



Niklas Deckers  
Leipzig



Theresa Elstner  
Leipzig



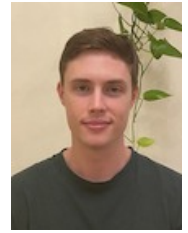
Lukas Gienapp  
Leipzig



Tim Hagen  
Leipzig



Wolfgang Kircheis  
Leipzig



Harry Scells  
Leipzig



Sebastian Schmidt  
Leipzig



Shahbaz Syed  
Leipzig



Janek Bevendoff  
Weimar



Tim Gollub  
Weimar



Johannes Kiesel  
Weimar



Michael Völske  
Weimar



Maik Fröbe  
Jena



Jan Heinrich Reimer  
Jena



Ferdinand Schlatt  
Jena



Ines Zelch  
Jena

 Webis Group



Matthias Hagen  
Jena



Martin Potthast  
Leipzig



Benno Stein  
Weimar



Netspeak - Mozilla Firefox

Netspeak x +

https://netspeak.org/#q=see+...+works 133%

# Netspeak

One word leads to another.

English German

see ... works i X ↺

how to ? this                      The ? finds one word.  
 see ... works                      The ... finds many words.  
 it's [ great well ]                The [ ] compare options.  
 and knows #much                 The # finds similar words.  
 { more show me }                The { } check the order.  
 m...d ? g?p                      The space is important.

see <b>how it</b> works	150,000	20%
see <b>if it</b> works	100,000	14%
see works	57,000	7.5%
see <b>how this</b> works	55,000	7.3%
see <b>what</b> works	51,000	6.7%
see <b>the</b> works	51,000	6.7%
see <b>if that</b> works	28,000	3.7%
see <b>your good</b> works	28,000	3.7%
see <b>how that</b> works	25,000	3.3%
see <b>how technorati</b> works	23,000	3.0%
see <b>if this</b> works	17,000	2.3%
see <b>more</b> works	17,000	2.2%
see <b>if it really</b> works	15,000	2.1%
see <b>his</b> works	12,000	1.7%
see <b>how well it</b> works	11,000	1.5%
see <b>other</b> works	8,900	1.2%

Netspeak - Mozilla Firefox

Netspeak x +

https://netspeak.org/#q=i+love+my+? 133x

# Netspeak One word leads to another.

English German

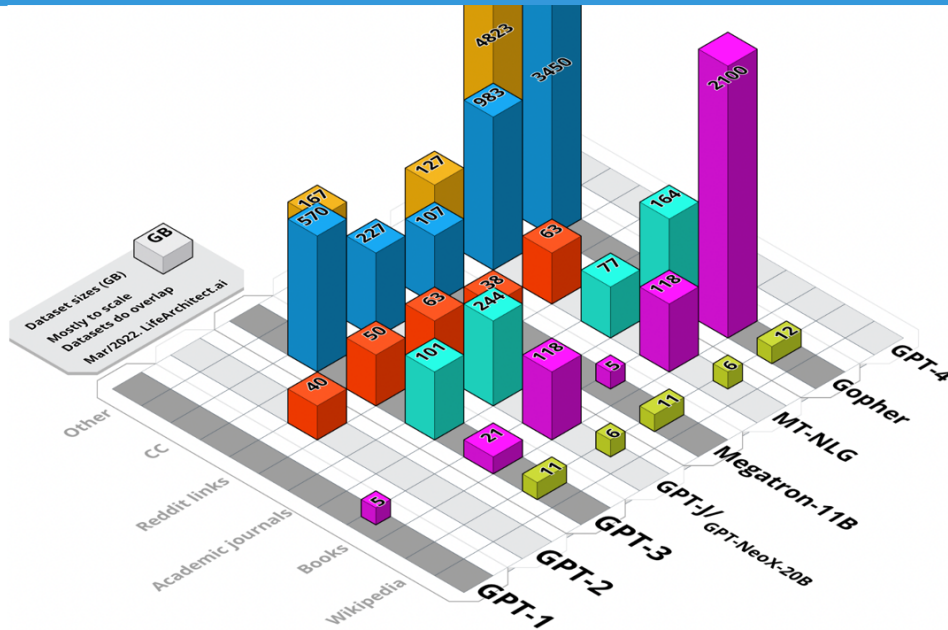
i love my ?| i X ↺

how to ? this      The ? finds one word.  
 see ... works      The ... finds many words.  
 it's [ great well ]      The [ ] compare options.  
 and knows #much      The # finds similar words.  
 { more show me }      The { } check the order.  
 m...d ? g?p      The space is important.

i love my <b>job</b>	72,000	10%
i love my <b>country</b>	44,000	6.2%
i love my <b>family</b>	41,000	5.9%
i love my <b>wife</b>	38,000	5.4%
i love my <b>new</b>	34,000	4.9%
i love my <b>friends</b>	33,000	4.7%
i love my <b>pet</b>	27,000	3.8%
i love my <b>dog</b>	26,000	3.7%
i love my <b>husband</b>	26,000	3.7%
i love my <b>life</b>	24,000	3.4%
i love my <b>baby</b>	24,000	3.4%
i love my <b>soldier</b>	22,000	3.1%
i love my <b>cat</b>	21,000	2.9%
i love my <b>computer</b>	18,000	2.6%
i love my <b>work</b>	16,000	2.4%
i love my <b>mom</b>	16,000	2.3%



# 2022 WHAT'S IN MY AI? – ALT VIEW



Google Patents.....	0.48%
The New York Times.....	0.06%
Los Angeles Times.....	0.06%
The Guardian.....	0.06%
Public Library of Science..	0.06%
Forbes.....	0.05%
Huffington Post.....	0.05%
Patents.com.....	0.05%
Scribd.....	0.04%
Other.....	99.09%

**Common Crawl**

Google.....	3.4%
Archive.....	1.3%
Blogspot.....	1.0%
GitHub.....	0.9%
The New York Times.....	0.7%
Wordpress.....	0.7%
Washington Post.....	0.7%
Wikia.....	0.7%
BBC.....	0.7%
Other.....	89.9%

**Reddit links**

Biography.....	27.8%
Geography.....	17.7%
Culture and Arts.....	15.8%
History.....	9.9%
Biology, Health, Medicine...	7.8%
Sports.....	6.5%
Business.....	4.8%
Other society.....	4.4%
Science & Math.....	3.5%
Education.....	1.8%

**English Wikipedia**

Romance.....	26.1%
Fantasy.....	13.6%
Science Fiction.....	7.5%
New Adult.....	6.9%
Young Adult.....	6.8%
Thriller.....	5.9%
Mystery.....	5.6%
Vampires.....	5.4%
Horror.....	4.1%
Other.....	18.0%

**BookCorpus (GPT-1 only)**



# AVAILABILITY HEURISTIC



"THEY MUST HAVE A DEATH WISH TO SWIM IN THAT WATER."

# CONFIRMATION BIAS



"AHA! I KNEW IT!"



# FRAMING EFFECT

THANKS TO OUR AGGRESSIVE STANCE ON CLIMATE CHANGE, THIS GOVERNMENT HAS REDUCED CARBON EMISSIONS BY ALMOST 5%!

WE ♥ YOU!

CARBON EMISSIONS REDUCED BY JUST 4.6% IN LAST 5 YEARS



# HINDSIGHT BIAS



"ALTHOUGH WE GAVE HIM ALL OF THAT MONEY AND SUPPORT, I ALWAYS HAD MY DOUBTS THAT JIM COULD BUILD HIS OWN HELICOPTER."