

Conditional Generation with a Question-Answering **Blueprint**

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Conditional Generation: The Wish List

- Generate natural language towards a **communicative goal**
- which is **faithful** and can be **attributed** to its sources
- while users explicitly **control** generation outcome
- without being sensitive to the **modality** of the input

Conditional Generation: Long-form QA

what is the titanic known for



The image shows a collage of search results for the query 'Titanic'. The results are layered, with Britannica being the most prominent. The Britannica article is titled 'Why is the *Titanic* famous?' and provides a detailed overview of the ship's history, its sinking, and its enduring legacy. Other visible results include NOAA, Wikipedia, and a list of related questions and answers.

Britannica Article: Why is the *Titanic* famous?

From the outset, the *Titanic* captured the public's imagination. At the time, it was one of the largest and most opulent ships in the world. It was also considered unsinkable, due to a series of compartment doors that could be closed if the bow was breached. However, four days into its maiden voyage in 1912, the *Titanic* struck an iceberg, and less than three hours later it sank. The drama of the eyewitness accounts and the great loss of life helped make it one of the most well-known tragedies in modern history. After the 1985 discovery of its wreckage, interest in the *Titanic* only increased, and its enduring appeal was evident with the huge success of James Cameron's 1997 film about the doomed ocean liner.

Related Q&A

- Why did the *Titanic* sink? TOP QUESTION
- How many people died when the *Titanic* sank? TOP QUESTION
- Where is the wreck of the *Titanic*? TOP QUESTION

- Some queries have only long-form answers
- based on input from multiple documents
- where hallucinations and attribution can be more problematic

Conditional Generation: Dialogue Summarization

The Justice League Recombination, The Big Bang Theory, S4.E11



Penny starts dating Zack again. Used to being the target of bullying, Leonard, Sheldon, Howard and Raj instead bully Zack through their implications to him that he's stupid. Not fully realizing what they're doing until Penny points it out to them, the guys decide to apologize to Zack in the only way they can. Accepting their apology, Zack decides to start hanging out with them, much to Penny's chagrin. This hanging out leads to the idea that Zack should replace Leonard as Superman in their group Justice League of America costume for the New Year's Eve party at the comic book store, with Penny the sixth wheel as Wonder Woman. These actions lead to questions from Leonard to Penny about why she's back together with Zack.

Conditional Generation: Visual Storytelling

Image Sequence:



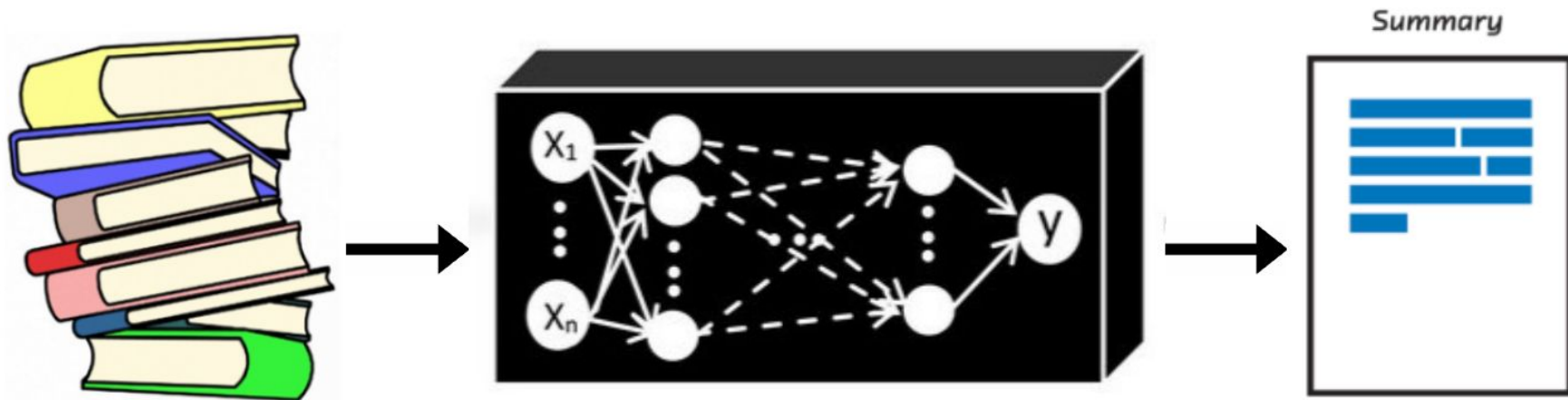
Gold-standard Story:

It was customary to give big brass a full tour. Of course, the mess hall would usually serve something a little better than average on "Big Brass" days. He looked like he was okay with it. After lunch the tour continued. He was introduced to the Commanding officers.

Story Generated by KE-VIST:

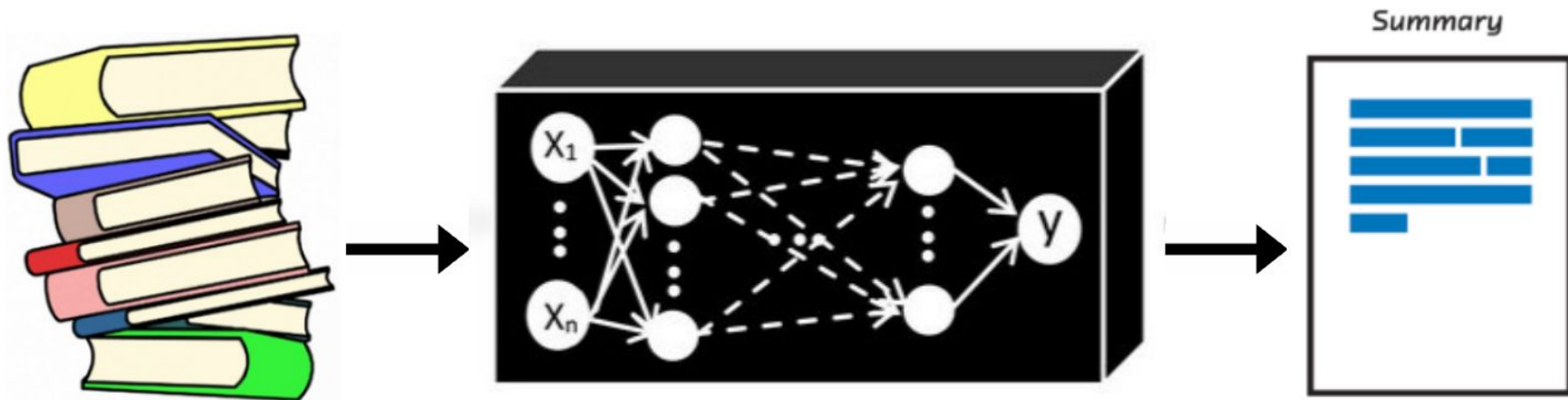
We all met up with the men. They walked a lot in the man walking. We had a lot of food. I gave a

The Blackbox Nature of Conditional Generation



- Change the way **entities** are represented (Puduppully et al., 2019; Iso et al., 2019)
- The **decoder** skips low-confidence tokens (Tian et al., 2019)
- **Encode** documents hierarchically (Rhode et al., 2021)
- Adopt **sparse attention mechanisms** (Child et al., 2019; Beltagy et al., 2020)

The Blackbox Nature of Conditional Generation



Introduce intermediate **planning** components
(Wiseman et al., 2018; Moryossef et al., 2019;
Puduppully et al., 2022; Narayan et al., 2022)

The QUD Model of Discourse

Questions under Discussion (QUD) theory of discourse structure (Carlson, 1983; Ginzburg, 1994; Van Kuppevelt, 1995; Larson, 2002; Roberts, 2012; Riester, 2019).

A **QUD** is a partially structured set of questions which discourse participants are mutually committed to resolving at a given point in time.

A **question** is a set of alternative possibilities (corresponding in some way to the possible answers to the question).

Discourse contains **implicit questions** for each of the assertions made which are turned into answers.

Question-Answering Blueprints as Content Plans

what is the titanic known for



What kind of ship was the RMS Titanic? British passenger liner

What line operated the RMS Titanic? the White Star Line

How many ships did the White Star Line make? three ships

In what ocean did the RMS Titanic sink? Pacific Ocean

When did the RMS Titanic hit an iceberg? On its maiden voyage

The screenshot shows a Wikipedia page for the RMS Titanic. The page content includes a paragraph: "of its wreckage, interest in the *Titanic* only increased, and its enduring appeal was evident with the huge success of James Cameron's 1997 film about the doomed ocean liner." Below this is a "Related Q&A" section with three question cards: "Why did the *Titanic* sink?", "How many people died when the *Titanic* sank?", and "Where is the wreck of the *Titanic*?".

Overlaid on the left side of the screenshot is a list of navigation links:

- Biological Divers
- Carbon Capture Storage
- Data Buoy Vane
- Fisheries
- Secengineering
- Heritage
- IMC Area Based Management To
- Jurisdiction

Overlaid on the right side of the screenshot is a list of related content and media:

- What links here
- Related changes
- Special pages
- Permanent link
- Page information
- Cite this page
- Wikidata item
- Print/export
- Download as PDF
- Printable version
- In other projects
- Wikimedia Commons
- Wikinews
- Wikiquote
- Wikivoyage
- Top Questions
- Facts & Related Content
- Quizzes
- Media
- Videos
- Images
- More
- More Articles On This Topic
- Researcher's Note
- Additional Reading
- Contributors
- Article History

Question-Answering Blueprints as Content Plans

what is the titanic known for



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When did the RMS Titanic hit an iceberg? On its maiden voyage

The screenshot shows a Wikipedia page for the RMS Titanic. A question-answering blueprint is overlaid on the page, consisting of five colored boxes that map specific questions to content on the page. The blueprint questions are: 'What kind of ship was the RMS Titanic?' (pointing to the first paragraph), 'What line operated the RMS Titanic?' (pointing to the second paragraph), 'How many ships did the White Star Line make?' (pointing to the third paragraph), 'In what ocean did the RMS Titanic sink?' (pointing to the fourth paragraph), and 'When did the RMS Titanic hit an iceberg?' (pointing to the fifth paragraph). The background page includes a search bar, navigation tabs, a table of contents, and a 'Related Q&A' section with questions like 'Why did the Titanic sink?' and 'Where is the wreck of the Titanic?'.

Question-Answering Blueprints as Content Plans

what is the titanic known for



What kind of ship was the RMS Titanic? British passenger liner

What line operated the RMS Titanic? the White Star Line

In what ocean did the RMS Titanic sink? Pacific Ocean

When did the RMS Titanic hit an iceberg? On its maiden voyage

The screenshot shows a Wikipedia article titled "Titanic" with several question-answer overlays. The article content includes: "Why is the *Titanic* famous?", "hours later it sank. The drama of the eyewitness accounts and the great loss of life helped make it one of the most well-known tragedies in modern history. After the 1903 discovery of its wreckage, interest in the *Titanic* only increased, and its enduring appeal was evident with the huge success of James Cameron's 1997 film about the doomed ocean liner.", "Related Q&A", "Why did the *Titanic* sink?", "TOP QUESTION", "How many people died when the *Titanic* sank?", "TOP QUESTION", "Where is the wreck of the *Titanic*?", "TOP QUESTION".

Overlays include:

- Search bar: "what is the titanic known for"
- Question: "What kind of ship was the RMS Titanic?" Answer: "British passenger liner"
- Question: "What line operated the RMS Titanic?" Answer: "the White Star Line"
- Question: "In what ocean did the RMS Titanic sink?" Answer: "Pacific Ocean"
- Question: "When did the RMS Titanic hit an iceberg?" Answer: "On its maiden voyage"

Navigation and sidebar elements include: "Arctic", "Antarctic", "Tools", "Top Questions", "Facts & Related Content", "Quizzes", "Media", "Videos", "Images", "More", "More Articles On This Topic", "Researcher's Note", "Additional Reading", "Contributors", "Article History".

Question-Answering Blueprints as Content Plans

what is the titanic known for

What kind of ship was the RMS Titanic? British passenger liner

What line operated the RMS Titanic? the White Star Line

In what ocean did the RMS Titanic sink? N. Atlantic Ocean

When did the RMS Titanic hit an iceberg? On its maiden voyage

The screenshot shows a Wikipedia article for the RMS Titanic. The article title is "Titanic" and the subtitle is "The RMS Titanic". The article content includes a section titled "Why is the *Titanic* famous?" which states: "The RMS Titanic is famous for being the last of the great ocean liners to be built as a battle of the ironclads, and for her ill-fated maiden voyage, which culminated in her sinking on the night of 14 April 1912, in the North Atlantic Ocean, after striking the iceberg." Below this, it says: "The drama of the eyewitness accounts and the great loss of life helped make it one of the most well-known tragedies in modern history. After the 1985 discovery of its wreckage, interest in the *Titanic* only increased, and its enduring appeal was evident with the huge success of James Cameron's 1997 film about the doomed ocean liner." The article also features a "Related Q&A" section with two questions: "Why did the *Titanic* sink?" and "How many people died when the *Titanic* sank?".

Question-Answering Blueprints as Content Plans

what is the titanic known for

What kind of ship was the RMS Titanic? British passenger liner

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In what ocean did the RMS Titanic sink? N. Atlantic Ocean

When did the RMS Titanic hit an iceberg? On its maiden voyage

1. RMS Titanic

2. The Building of the Titanic

3. Unsinkable: The Fatal Flaw

4. Passenger Titanic

5. Titanic Sinks

6. The Titanic Iceberg

7. Titanic's Sinking

8. Titanic Sinks

Comprehension Quiz

Top Questions

Facts & Related Content

Quizzes

Media

Videos

Images

More

More Articles On This Topic

Researcher's Note

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Why did the *Titanic* sink?

TOP QUESTION

How many people died when the *Titanic* sank?

TOP QUESTION

Where is the wreck of the *Titanic*?

TOP QUESTION

Question-Answering Blueprints as Content Plans

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The screenshot shows a Wikipedia article for the RMS Titanic. The table of contents on the left lists sections such as Antarctic, Arctic, Biological Divers, Carbon Capture Storage, Data Buoy Vand, Fisheries, Geoen지니어링, Heritage, IMO Area Based Management To, and Jurisdiction. The main content area includes a 'Fast Facts' section with a comprehension quiz, top questions, facts & related content, quizzes, media (videos and images), and more articles on the topic. A 'Related Q&A' section is also visible, featuring questions like 'Why did the Titanic sink?' and 'How many people died when the Titanic sank?'. The text in the main content area discusses the ship's sinking and the discovery of its wreckage.

Question-Answering Blueprints as Content Plans

what is the titanic known for



What kind of ship was the RMS Titanic? British passenger liner

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When did the RMS Titanic hit an iceberg? On its maiden voyage

When did the DiCaprio movie come out? 1997

The screenshot shows a Wikipedia page for 'The Titanic' with several elements highlighted:

- Navigation sidebar:** Includes links for Biological Diversity, Carbon Capture Storage, Data Buoy Vandalism, Fisheries, Geoenvironment, Heritage, IMO Area Based Management Tool, and Jurisdiction.
- Table of Contents:** Lists sections 2 through 8: [The Buuuu Titanic](#), ['Unsinkable' Fatal Flaw](#), [Passenger Titanic](#), [Titanic's Sinking](#), [The Titanic Iceberg](#), [Titanic's Sinking](#), and [Titanic's Sinking](#).
- What links here:** Lists options like Related changes, Special pages, Permanent link, Page information, Cite this page, Wikidata item, Print/export, Download as PDF, Printable version, In other projects, Wikimedia Commons, Wikinews, Wikiquote, and Wikivoyage.
- Top Questions:** Lists 'top Questions', Facts & Related Content, Quizzes, Media (Videos, Images), and More (More Articles On This Topic, Researcher's Note, Additional Reading, Contributors, Article History).
- Main Content:** A paragraph discussing the Titanic's wreck, stating that interest in the *Titanic* increased after the success of James Cameron's 1997 film. Below this are 'Related Q&A' sections with questions like 'Why did the *Titanic* sink?', 'How many people died when the *Titanic* sank?', and 'Where is the wreck of the *Titanic*?', each marked as a 'TOP QUESTION'.

Question-Answering Blueprints as Content Plans

what is the titanic known for



What kind of ship was the RMS Titanic? British passenger liner

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When did the RMS Titanic hit an iceberg? On its maiden voyage

When did the DiCaprio movie come out? 1997

RMS Titanic was a British passenger liner, operated by the White Star Line. It sank in the North Atlantic Ocean after striking an iceberg during its maiden voyage. The 1997 film Titanic starring Leonardo Di Caprio has popularized the disaster and its aftermath.

Question-Answering Blueprints as Content Plans

- Blueprints as intermediate (discrete) planning stage for conditional generation
- Reduce **faithfulness** errors and increase **controllability**
- Are better for **long-form** inputs and outputs

Where do the blueprints come from?

Datasets as we know them consist of document(s)-output pairs!

Training Data Annotation with Blueprints

Shelby Mustang

 19 languages ▼

Article Talk

Read Edit View history Tools ▼

From Wikipedia, the free encyclopedia

The **Shelby Mustang** is a high-performance variant of the [Ford Mustang](#) built by [Shelby American](#) from 1965 to 1967 and by the [Ford Motor Company](#) from 1968 to 1970.

In 2005, Ford revived the Shelby nameplate for a high-performance model of the [fifth-generation Ford Mustang](#).^[1]

1st generation (1965–1970) [[edit](#)]

1965–1966 Shelby GT350 [[edit](#)]

The 1965–1966 cars were the smallest and lightest of the GT 350 models.

Production started when 289 [AC Cobra](#) production was wrapping up and 427 AC Cobra production was beginning, both of which were [Ford-powered AC-based two-seat sports car](#) also produced by [Shelby American](#) during the same period. Both models use the Cobra emblem, similar paint scheme, and the optional "Cobra" valve covers on many GT350s that were part of a marketing tie-in by Shelby, as well as one of his iconic symbols. All 1965–66 cars had the [Windsor 289 cu in \(4.7 L\) HiPo K-Code 271 hp \(202 kW; 275 PS\) V8 engine](#), modified with a large 4-barrel [Holley 715 CFM carburetor](#) to produce 306 bhp (310 PS; 228 kW) at 6,000 rpm and



The Shelby Mustang is a high performance variant of the Ford Mustang which was built by Shelby American from 1965 to 1968, and from 1969 to 1970 by Ford. Following the introduction of the fifth generation Ford Mustang in 2005, the Shelby nameplate was revived as a new high-performance model, this time designed and built by Ford.

Training Data Annotation with Blueprints

The **Shelby Mustang** is a high performance variant of the **Ford Mustang** which was built by **Shelby American** from **1965** to **1968**, and from **1969** to **1970** by **Ford**. Following the introduction of the fifth generation **Ford Mustang** in **2005**, the **Shelby nameplate** was revived as a new high-performance **model**, this time designed and built by **Ford**.

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What is a high performance variant of the Ford Mustang?	Shelby
Who built the Shelby Mustang from 1969 to 1970?	Ford
Q2: What is the high performance variant of the Ford Mustang called?	Shelby
What is a high performance variant of the Ford Mustang?	Shelby Mustang
What is a high performance variant of the Ford Mustang?	Shelby
What is a Shelby Mustang?	A high performance variant
The Shelby Mustang is a high performance variant of what?	Ford Mustang
During what years was the Shelby Mustang built by Shelby American?	1965 to 1968
Who built the Shelby Mustang from 1965 to 1968?	Shelby American
In what year was the fifth generation of the for Mustang introduced?	2005
What generation of Mustang was introduced in 2005?	the fifth generation
What was the Shelby Mustang revived as?	a new high-performance model

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Question-Answering Blueprints as Content Plans

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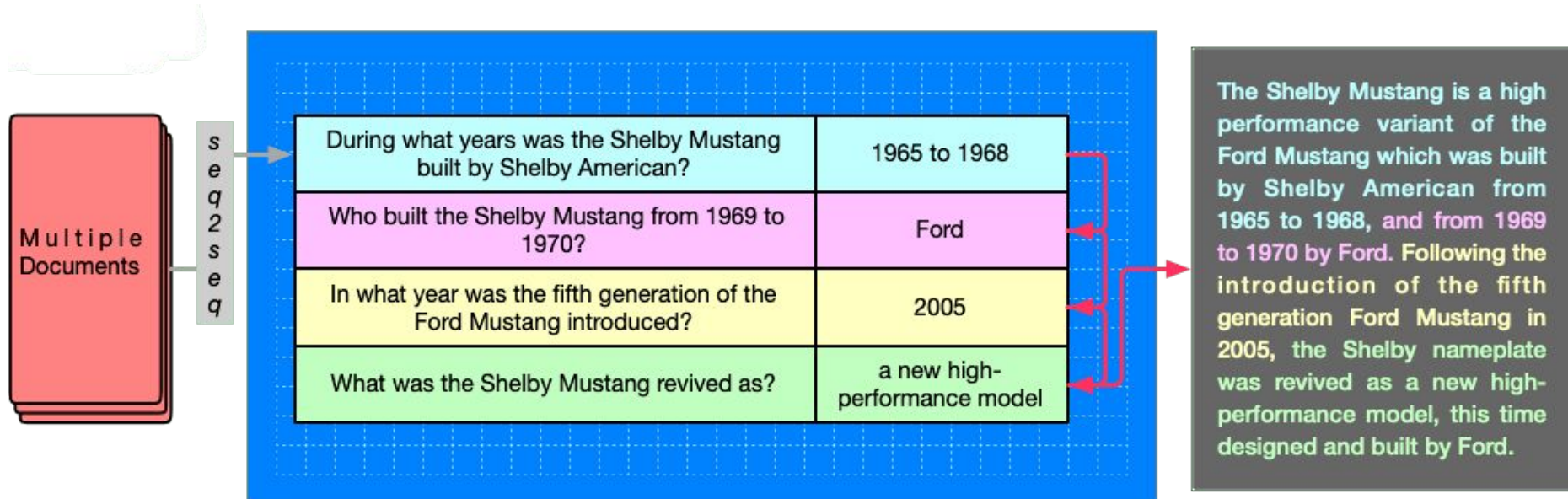
2005

What was the Shelby Mustang revived as?

a new high-performance model

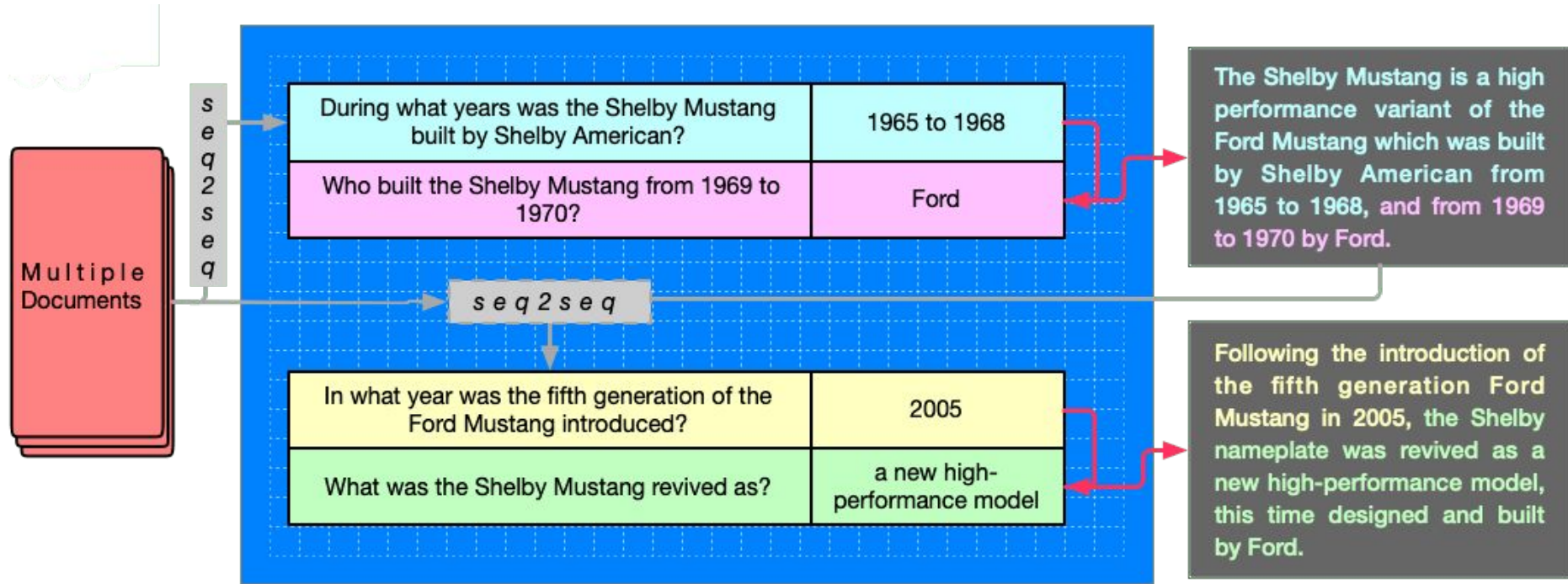
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End-to-End Blueprint Model



Generates blueprint and output sequence in one go.

Iterative Blueprint Model



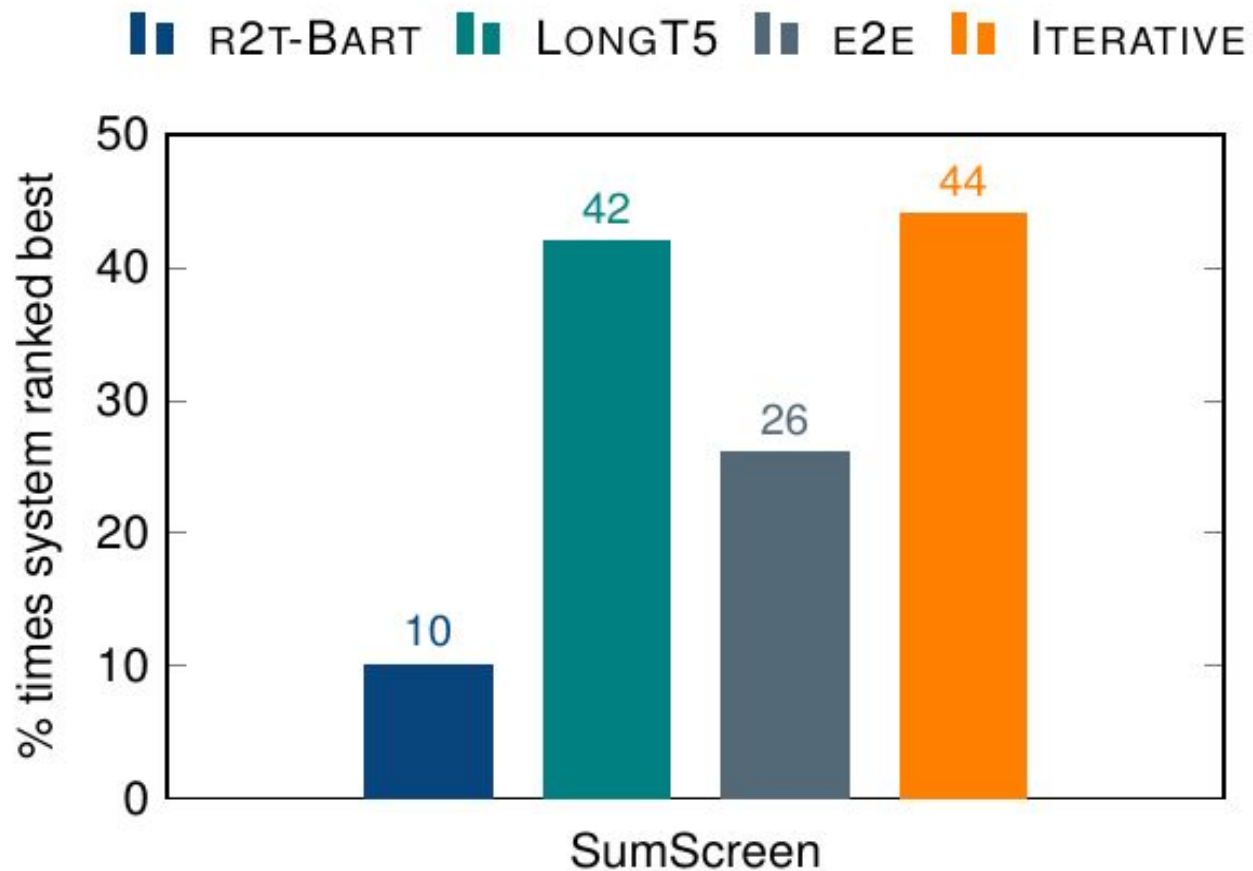
Iteratively plans and generates one sentence at a time.

Experimental Setting

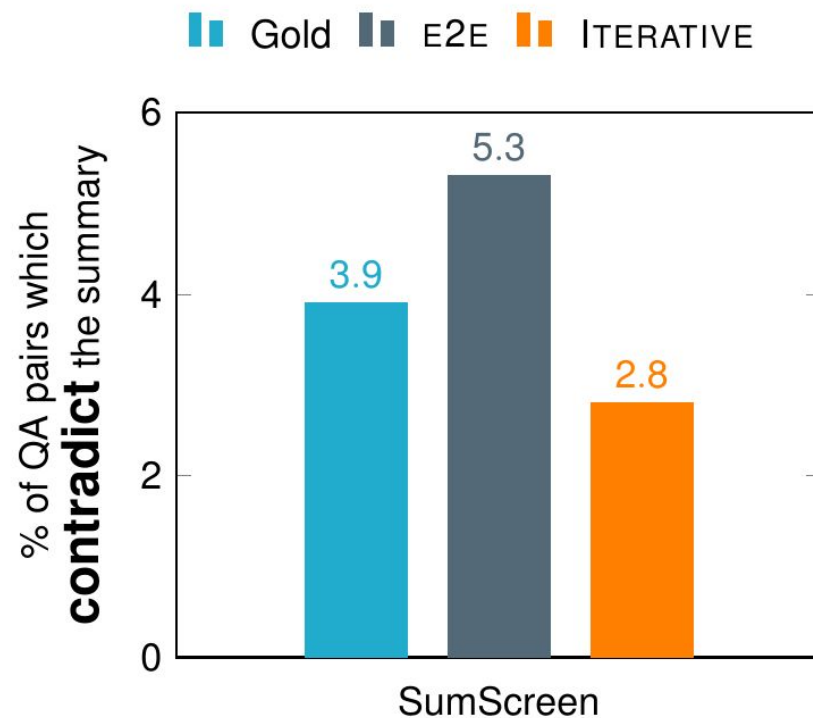
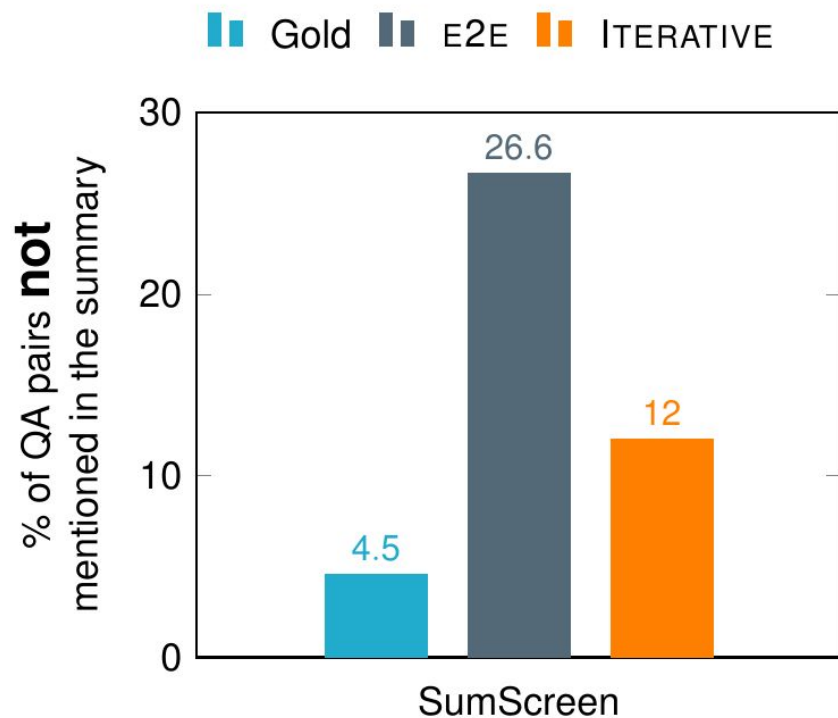
- **AQuaMuse** (Kulkarni et al., 2002, 2021): long-form question answering, simulates search engine, answer based on multiple retrieved documents.
- **WikiCatSum** (Perez-Beltrachini et al., 2019): topic-focused multi-document summarization, generate Wikipedia abstracts.
- **SummScreen** (Chen et al., 2022): dialogue summarization, generate summaries of TV episodes (e.g., CSI, The Bing Bang Theory).

All experiments with a LONGT5 (Guo et al., 2021) backbone model.

Evaluation: How Good are the Blueprint Summaries?



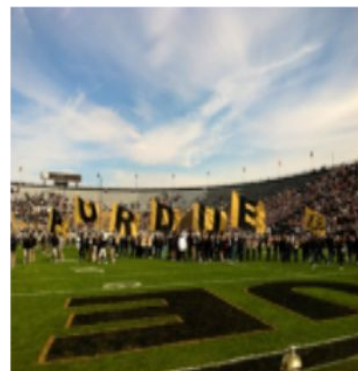
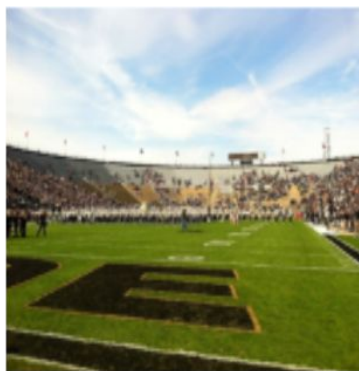
Evaluation: Are Summaries Grounded to their Blueprint?



Interim Conclusions

- Blueprint models are more informative than vanilla seq2seq models
- Errors can be examined and traced back to the blueprint
- QA pairs are intuitive and user-friendly, human-in-the-loop generation
- How do blueprints work across tasks and modalities?

Visual Story Telling: Blueprint Annotation



My Uncle Jack made us go to the Purdue game on Saturday. He went to Purdue and he thinks they are great no matter what else anyone thinks. We all had to sit in the bleachers and wear some ridiculous brown coats...

Q₀: Where did my uncle Jack made us go on Saturday?

A₀: the Purdue game

Q₁: When did my uncle Jack made us go to the Purdue game?

A₁: Saturday

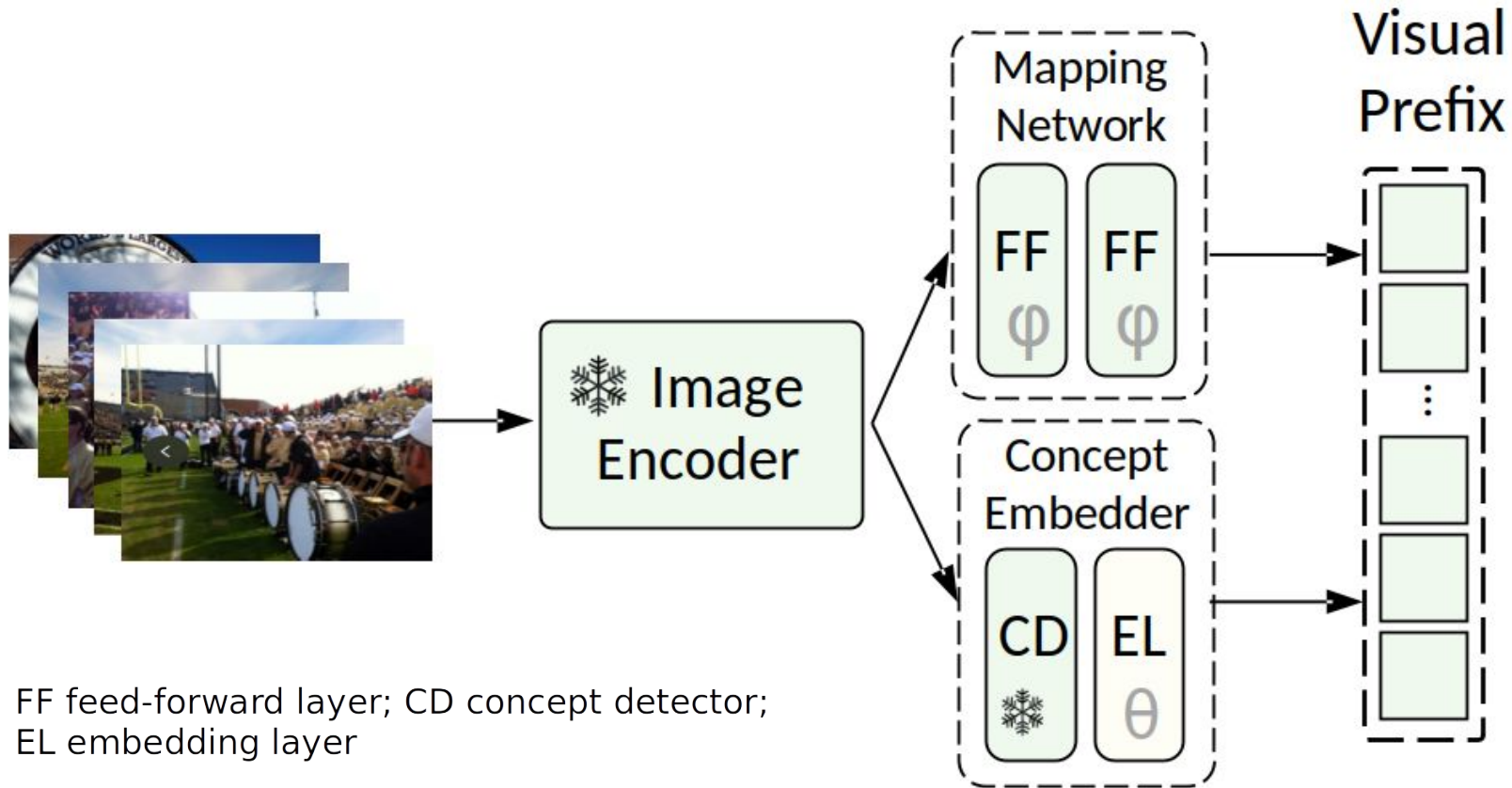
Q₂: Where did we all sit?

A₂: the bleachers

Q₃: What did the fans of Purdue have to wear?

A₃: some ridiculous brown coats

Visual Prefixes

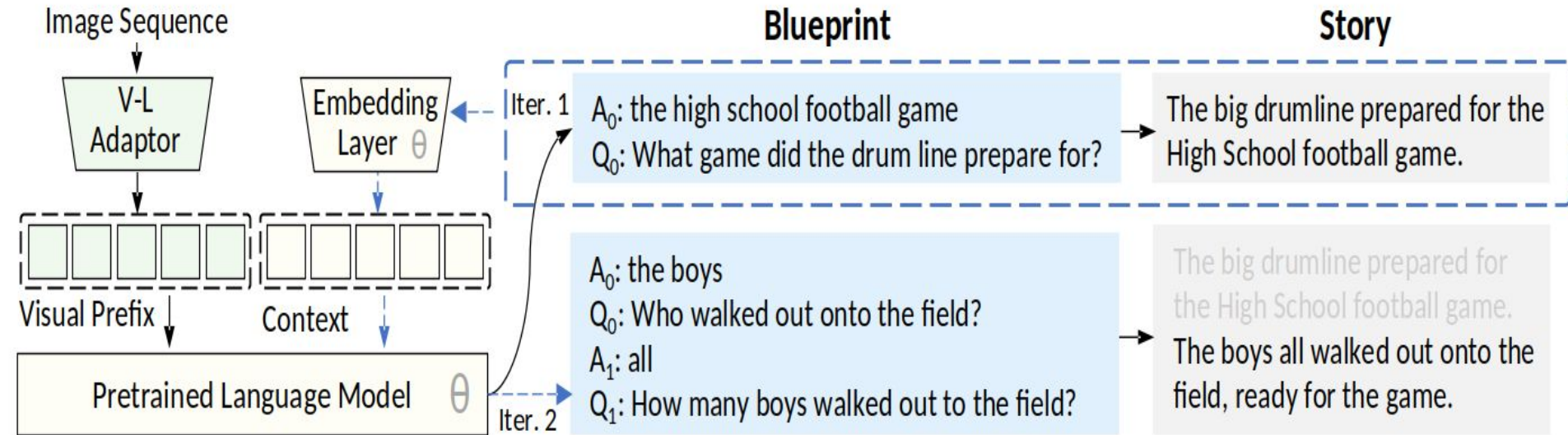


FF feed-forward layer; CD concept detector;
EL embedding layer

Blueprint Storytelling Model (Iterative)

- Use a generation model (based on T5) to turn VIST stories into blueprints
- Train a linear model to map image sequences into visual prefixes (based on ResNet-152)
- Fine-tune a pretrained model to generate blueprints and stories from visual prefixes
- Generation proceeds sentence-by-sentence, where previous sentences are context for the current one: iterative model
- An end-to-end model that generates all sentences at once from the visual prefix performs worse

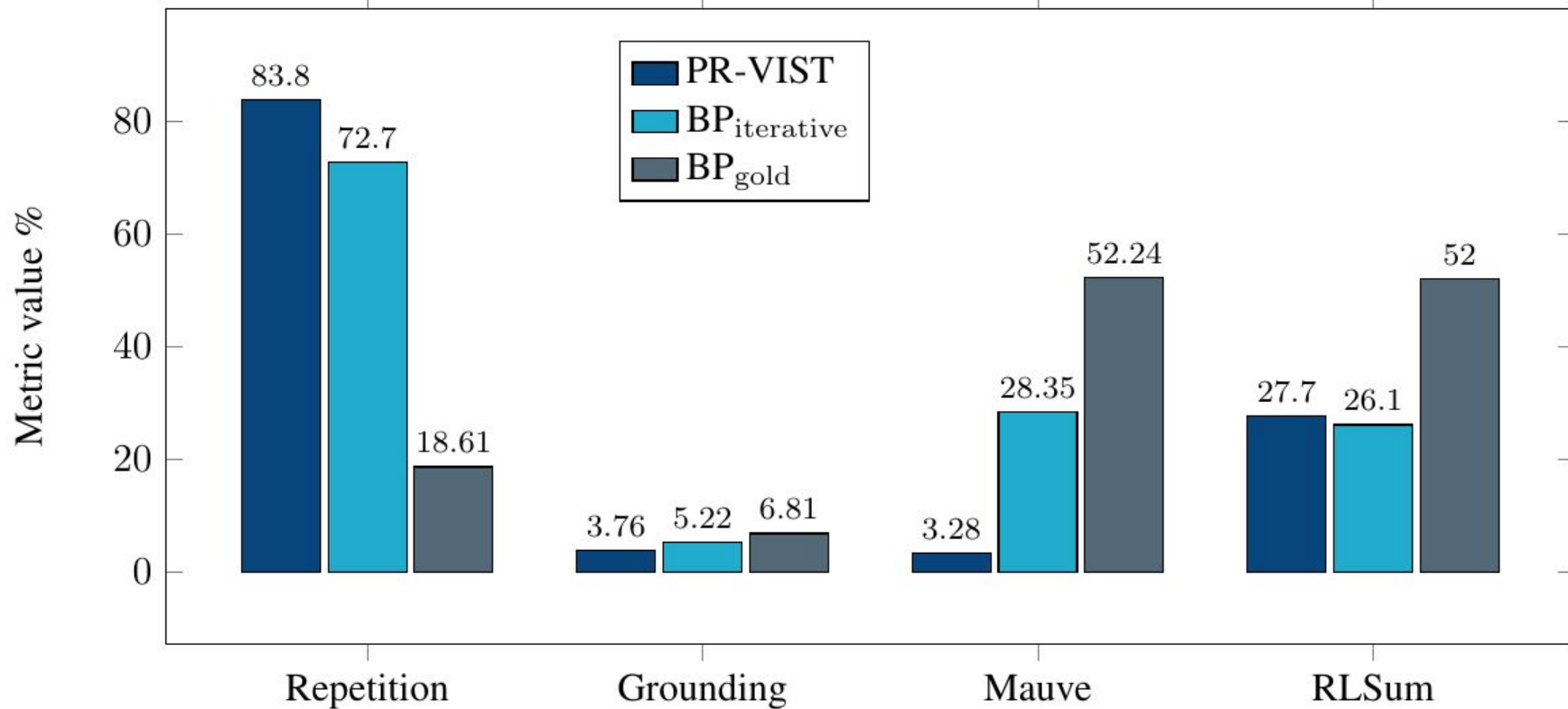
Iterative Blueprint Model



Evaluation

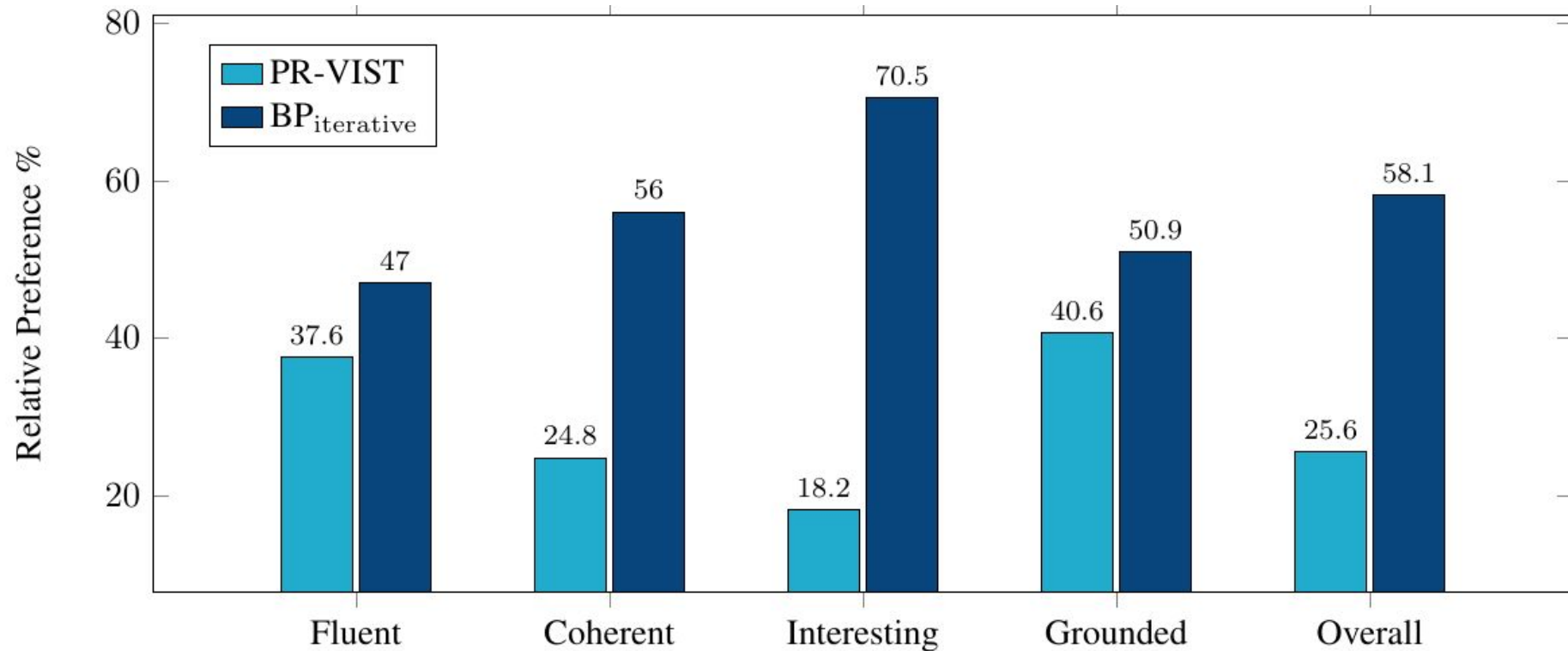
- Automatic evaluation using Blue, Rouge, Meteor is problematic – mostly measures fluency, and all modern LMs generate fluent output
- Also, a story may be interesting, coherent, and grounded in the images, but completely different from the reference
- We use **automatic evaluation** using **repetition** and **grounding**, plus **Mauve** for naturalness (similarity of distribution with human text)
- More importantly, we ask **human judges** to evaluate **fluency**, **coherence**, **interestingness** and **grounding**
- We compare to a range of SotA models and to GPT 3.5 (with and without Blueprint)

Automatic Evaluation



VIST is a SotA model in the literature. It doesn't use pretrained LMs; see paper for other comparisons

Human Evaluation



Example Output



PR-VIST: I bought a cart to the market with some food. It looked great in the market. There were so many of their enthusiasm. They even had a sale with their bumper. The market was sold out of fresh vegetables. the [location] car is very nice and beautiful.

VP-BART: I went to the market yesterday. There were many different kinds of fruits there. I bought a lot of them. They were very expensive. Afterward I went back home.

Iterative: Today we decided to take a small shopping trip to the Market. The market had so many wonderful things to choose from that we looked at and bought so many of them. There was an array of different fruits that I could hardly resist buying. There was also a huge array of various types of pepper. Finally the day had come to an end and we piled in the taxi back to head home.

GPT-3.5 + BP: On Saturday morning, I visited the local market. It had a lot of fruits and vegetables being sold. The atmosphere was friendly and buzzing with many vendors ready to help you. The fresh produce was the best thing about the market. You can always find friendly vendors that sell the most delicious produce. The key to finding the best bargains at the market is bargaining. The market is always a great place to shop for fresh fruits and vegetables.

Human: Shoppers arrived early for the market. There was a variety of goods sold. Some carried away large bundles. Every item was fresh and colorful. The spot was a favorite among produce shoppers.

Analysis of Results

- Pretrained language models can produce better stories than specialized models trained from scratch
- The visual prefix is an effective interface between image and text; we don't need multimodal models
- Blueprint model output is most grounded, by automatic and human evaluation
- Iterative planning strategy that generates sentence by sentence works best
- GPT-3.5 struggles with Blueprints; they reduce its performance in most metrics

Conclusions

- Blueprint-based model generates output that is more **coherent**, **interesting**, and **grounded** than existing methods
- Blueprints aid in **selecting key concepts** and **guiding narrative construction**
- Blueprints are **controllable**: generate longer or shorter stories (more/less iterations), emphasize entities or characters (filter Blueprint), etc.
- Blueprints are **interpretable** and could enable human-in-the-loop and personalized storytelling

[Narayan et al. Conditional Generation with a Question-Answering Blueprint. TACL, 11, 2023. 974-996](#)
[Liu et al. Visual Storytelling with Question-Answer Plans. Findings of the Association for Computational Linguistics: EMNLP 2023](#)