



NewSum EMNLP Workshop 2021

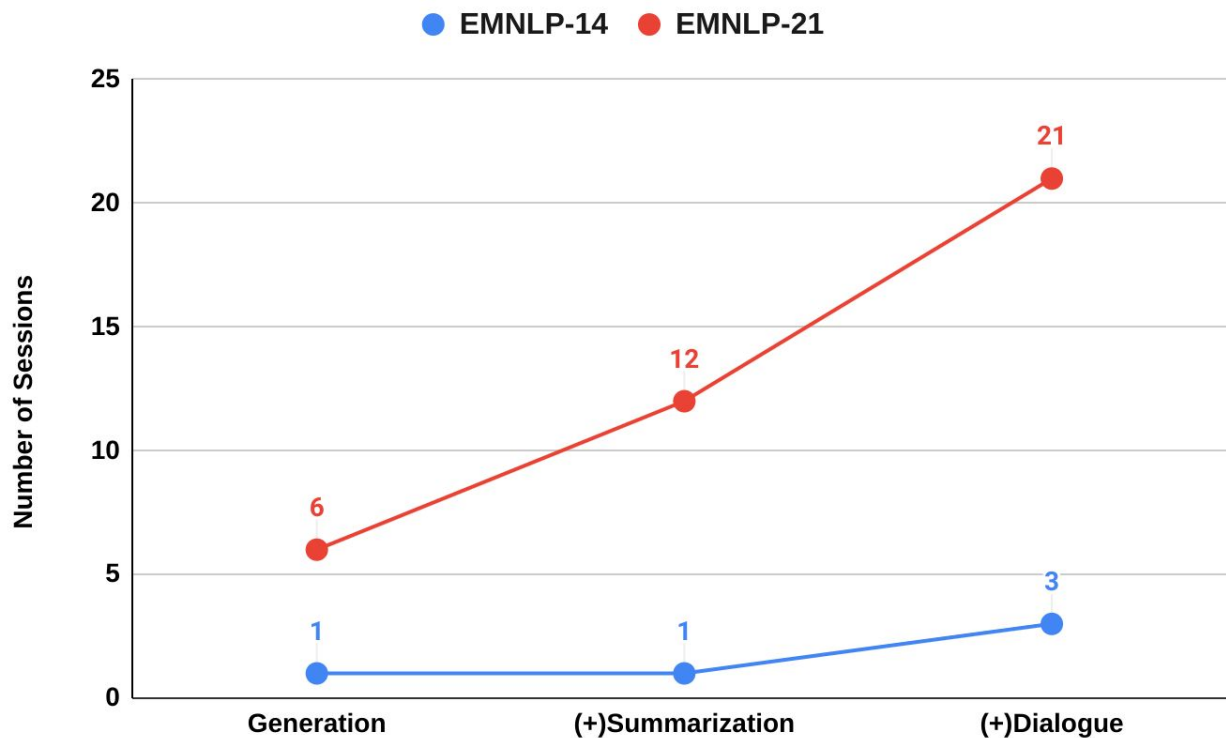
New Frontiers in Summarization

Learning from Past: Bringing Planning Back to Neural Generators

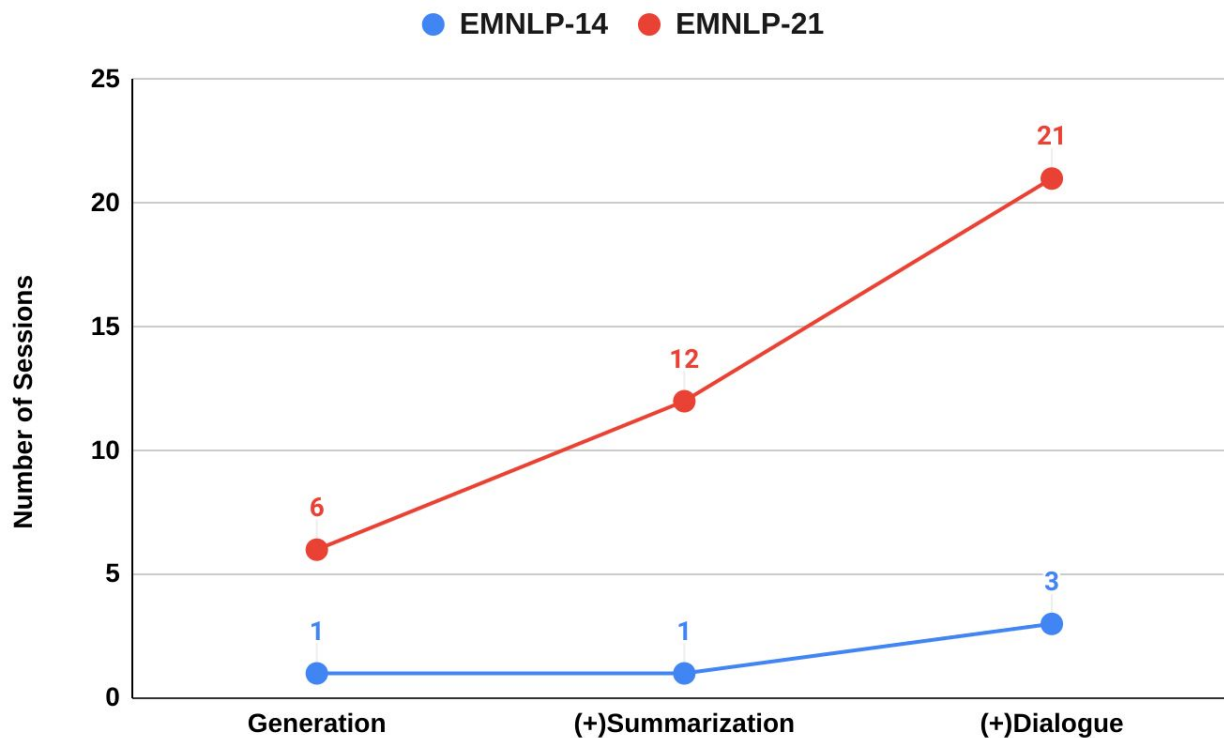
Shashi Narayan

Google Research

An Exciting Time to Work on Generation



Neural NLG Models are Robust and Fluent



GPT-3

T5

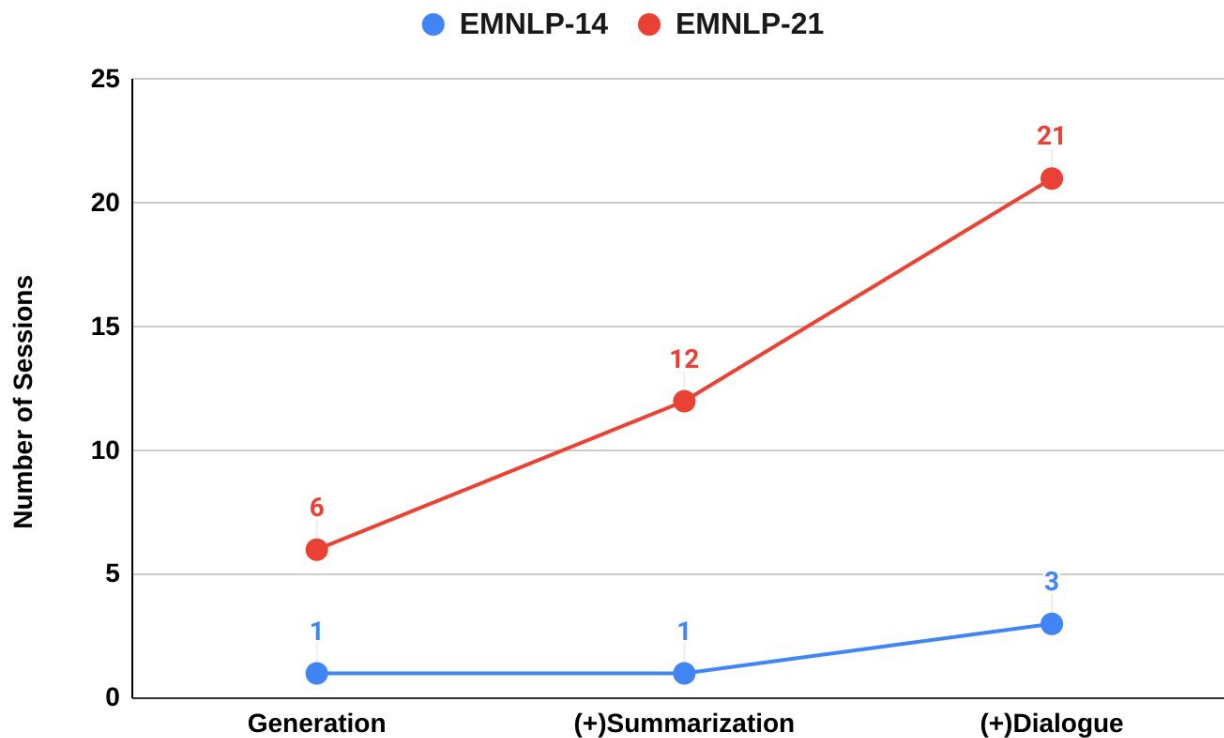
PEGASUS

BART

Robustness
Fluency

Google Research

NLG Models are Not Trustworthy



Faithfulness
Explainability
Controllability
Evaluation



GPT-3

T5

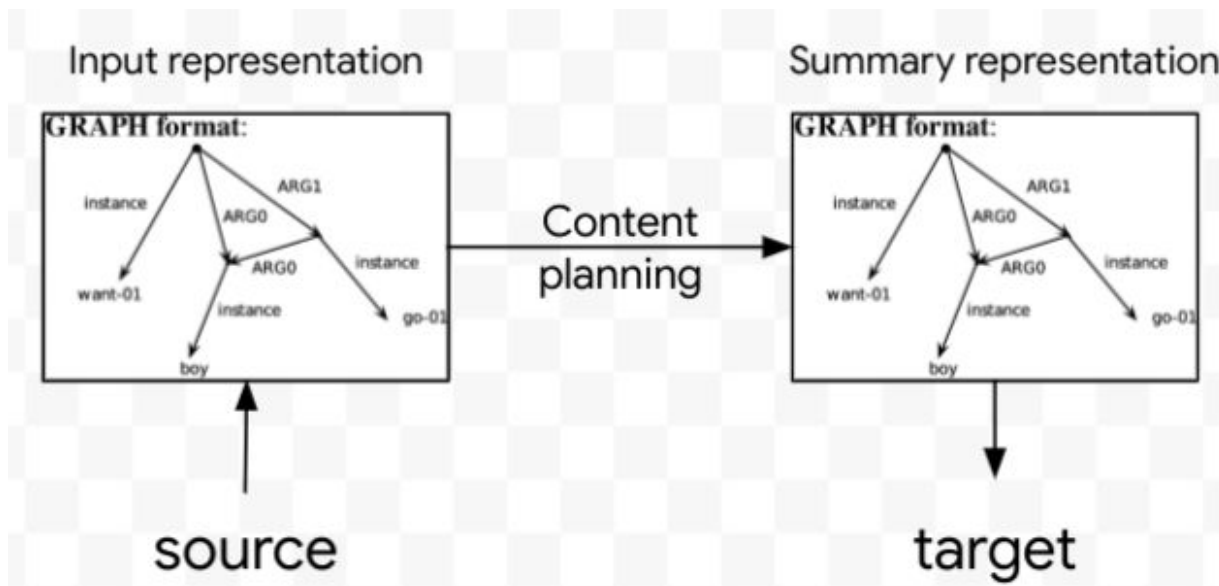
PEGASUS

BART

Robustness
Fluency

Google Research

Traditional NLG Systems were more Controlled and Grounded



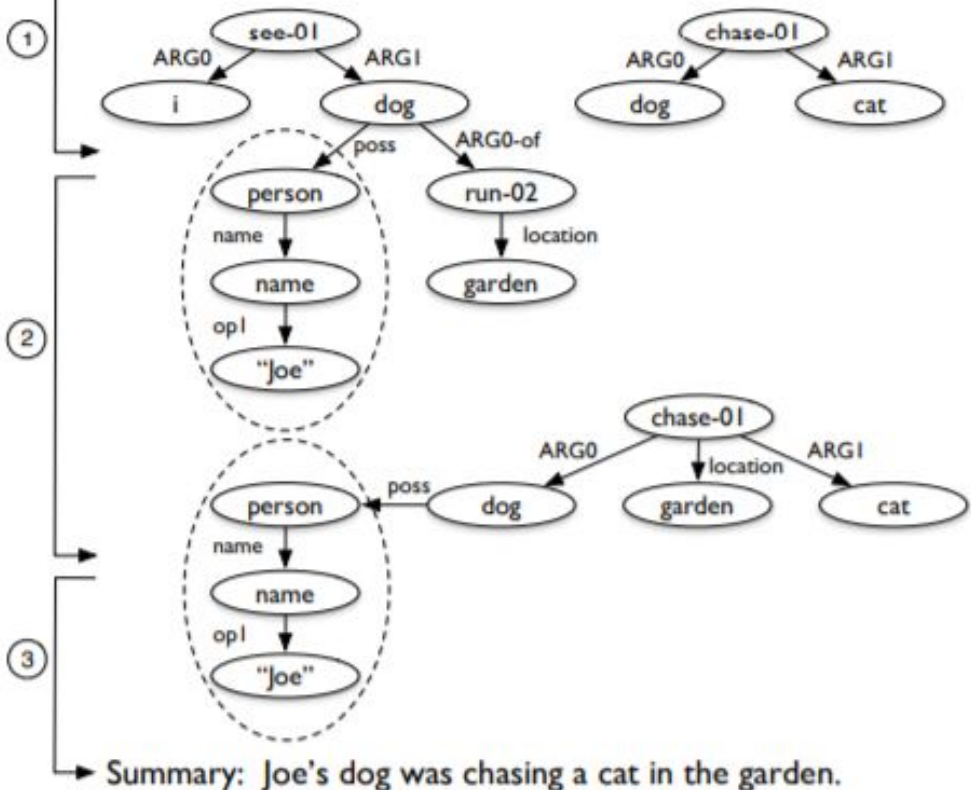
See Jones (1993) and Reiter and Dale (2000).

Abstractive Summarization

Sentence A: I saw Joe's dog, which was running in the garden.

Sentence B: The dog was chasing a cat.

Summary Planning



Sentence Simplification

Complex Sentence

“In 1964 Peter Higgs published his second paper in Physical Review Letters describing Higgs mechanism which predicted a new massive spin-zero boson for the first time .”



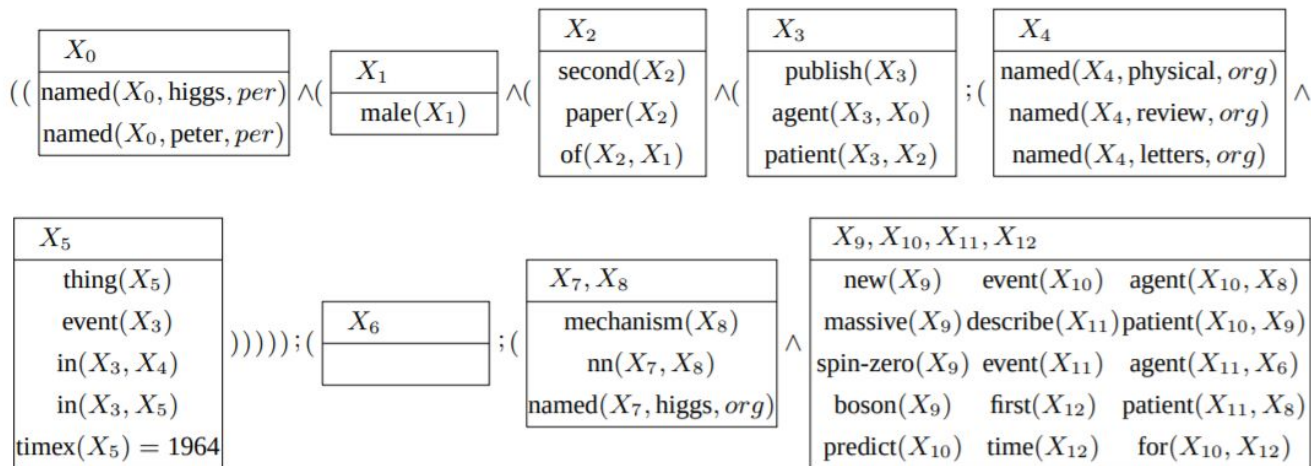
Simplified Version

Peter Higgs wrote his paper explaining Higgs mechanism in 1964.
Higgs mechanism predicted a new elementary particle.

Sentence Simplification

Complex Sentence

“In 1964 Peter Higgs published his second paper in Physical Review Letters describing Higgs mechanism which predicted a new massive spin-zero boson for the first time .”

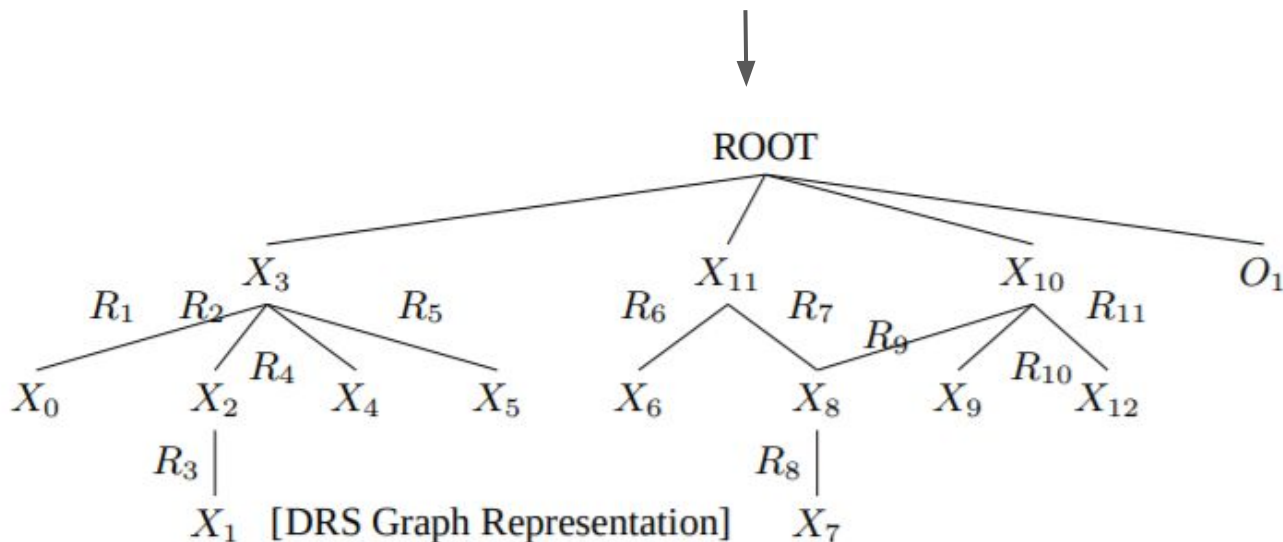


[Discourse Representation Structure produced by BOXER]

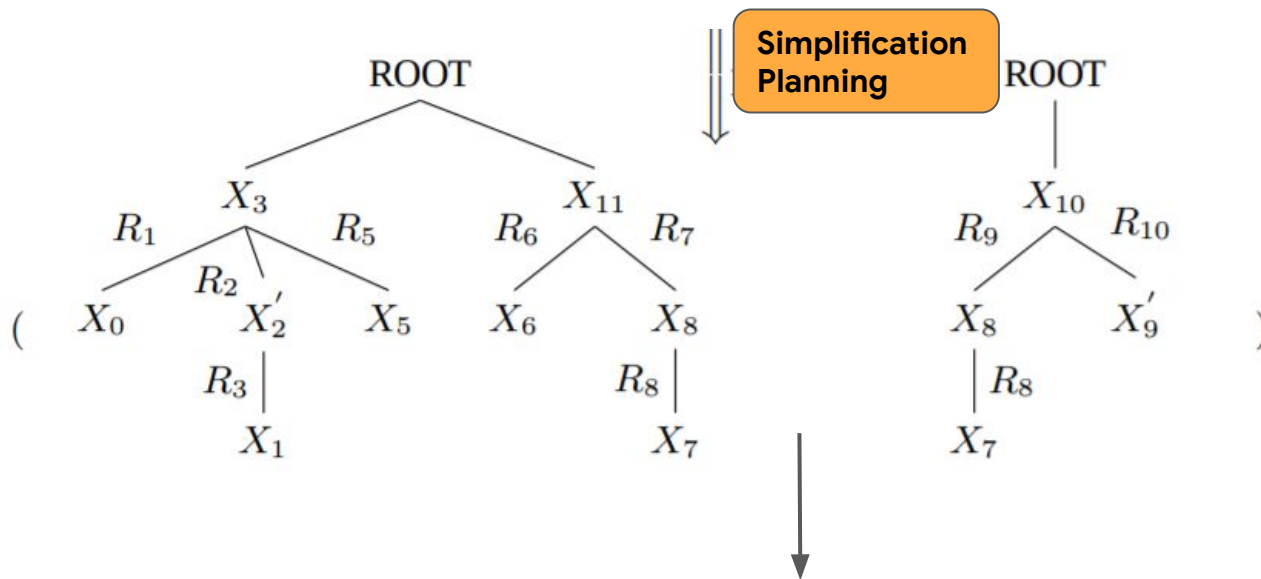
Sentence Simplification

Complex Sentence

“In 1964 Peter Higgs published his second paper in Physical Review Letters describing Higgs mechanism which predicted a new massive spin-zero boson for the first time .”



Sentence Simplification



Simplified Version

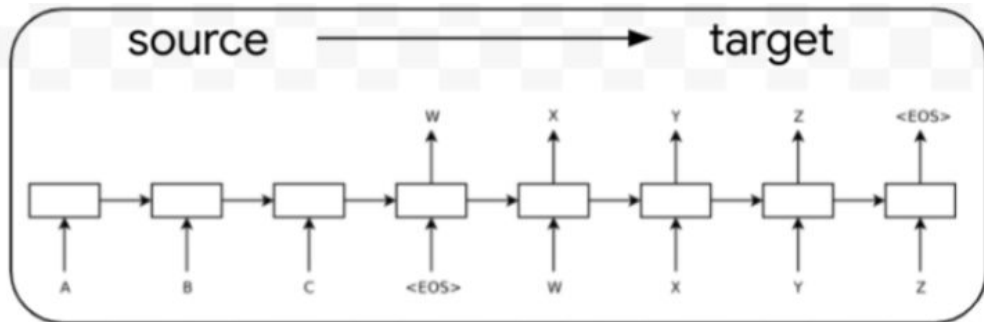
Peter Higgs wrote his paper explaining Higgs mechanism in 1964.
Higgs mechanism predicted a new elementary particle.

Current End-to-end Conditional Text Generation

Given a source text \mathbf{x} , output a target text \mathbf{y}

$$\mathbf{x} = (x_1, \dots, x_S)$$

$$\mathbf{y} = (y_1, \dots, y_T)$$



GPT-3

T5

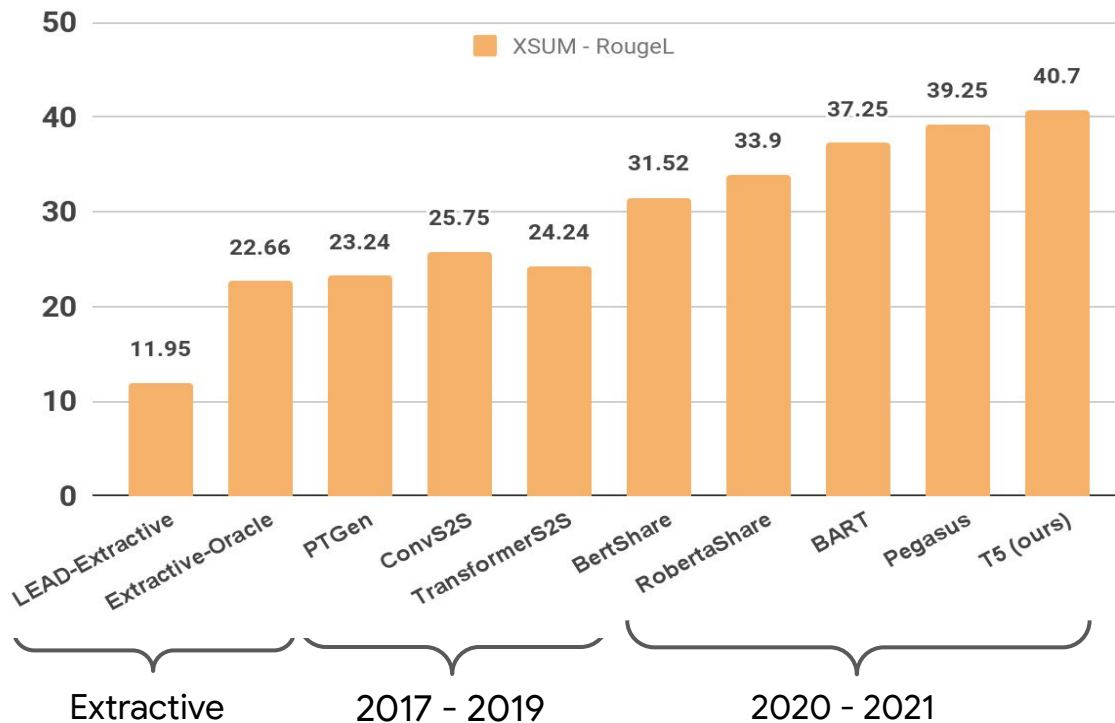
PEGASUS

BART

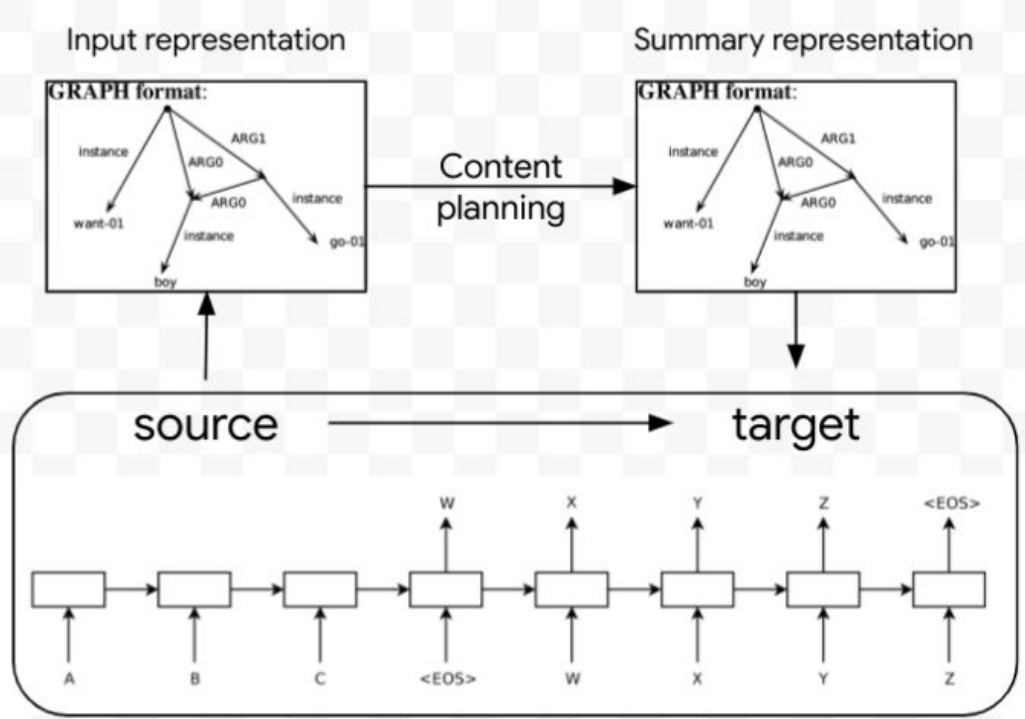
Pretrained transformers

Google Research

Current NLG Systems are Capable of Producing Fluent Texts



But Neural Generation is not Ground in the Same Way



Challenges for Trustworthy Neural Generation

- Hallucinations are very common, but hard to control or explain

Reference

School lunches can tempt fussy eaters to try new foods, a survey for the school food trust has suggested.

Generated

Parents who eat lunches at school are more likely to eat a meal than their children, a survey suggests.

Challenges for Trustworthy Neural Generation

- Hallucinations are very common, but hard to control or explain

XSum Input: Leahy, 24, scored 12 goals in 158 appearances with Falkirk, having joined the club from Rugby Town in 2012. The left-back made 38 appearances last season, helping the club finish second in the Scottish second tier before they lost to Dundee United in the play-offs. He joins Walsall on a free transfer after his contract expired and is the League One club's first summer signing. Find all the latest football transfers on our dedicated page.

Reference: Walsall have signed defender Luke Leahy on a two-year contract from Scottish Championship side Falkirk.

Output: Walsall have signed defender Paddy Leahy from Scottish Championship side Falkirk on a three-year deal.

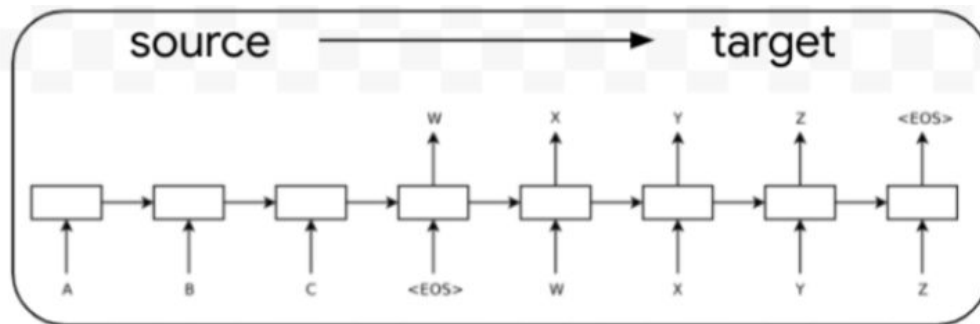
Challenges for Trustworthy Neural Generation

- Hallucinations are very common, but hard to control or explain
- Evaluation has become more challenging, traditional metrics such as ROUGE or BLEU are not very useful for evaluating current NLG models



Not covered here, please attend Sebastian's talk this afternoon

Planning for Trustworthy Generation



- Entity Planning
- Attribute Planning
- Predicate-Argument Planning
- Query-based Planning

Step-by-Step: Separating Planning from Realization in Neural Data-to-Text Generation*

Amit Moryossef[†] Yoav Goldberg^{†‡} Ido Dagan[†]

amitmoryossef@gmail.com, {yogo, dagan}@cs.biu.ac.il

[†]Bar Ilan University, Ramat Gan, Israel

[‡]Allen Institute for Artificial Intelligence

Entity Planning
Attribute Planning
Predicate-Argument Planning
Query-based Planning

Step-by-Step: Separating Planning from Realization in Neural Data-to-Text Generation*

Controllable Neural Dialogue Summarization with Personal Named Entity Planning

Zhengyuan Liu, Nancy F. Chen

Institute for Infocomm Research, A*STAR, Singapore

{liu_zhengyuan, nfychen}@i2r.a-star.edu.sg

Attribute Planning

Predicate-Argument Planning

Query-based Planning

Step-by-Step: Separating Planning from Realization in Neural Data-to-Text Generation*

Controllable Neural Dialogue Summarization with Personal Named Entity Planning

Zhengyuan Liu, Nancy E. Chen

Content Planning for Neural Story Generation with Aristotelian Rescoring

Seraphina Goldfarb-Tarrant*[†], Tuhin Chakrabarty*[‡], Ralph Weischedel*, Nanyun Peng*[§]

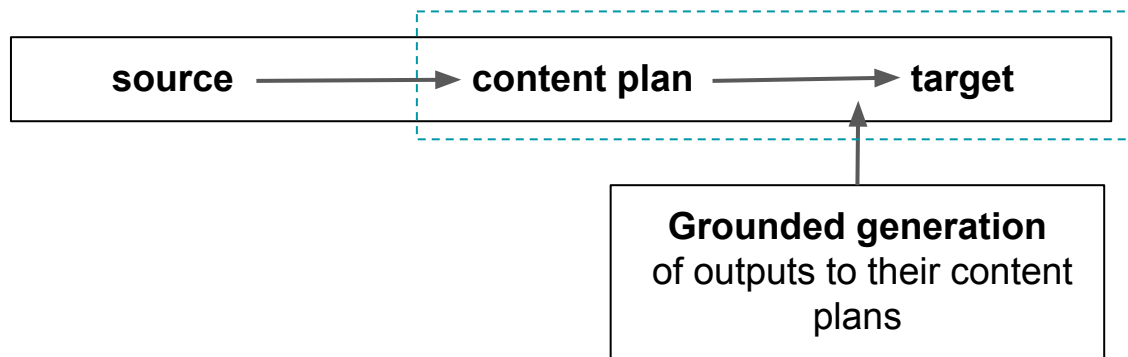
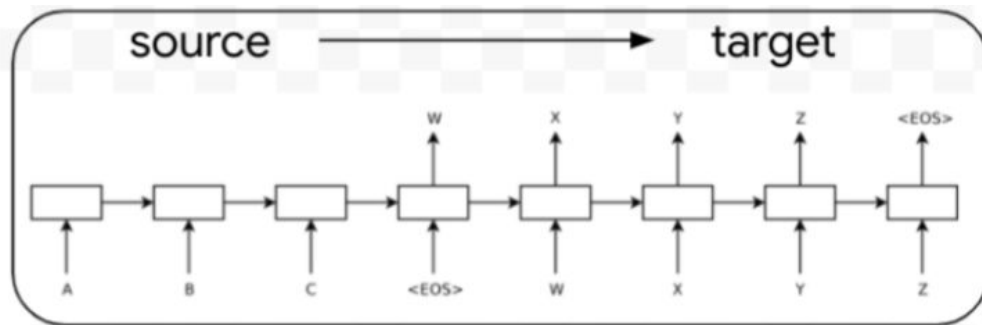
* Information Sciences Institute, University of Southern California

[†] University of Edinburgh, [‡] Columbia University, [§] University of California, Los Angeles

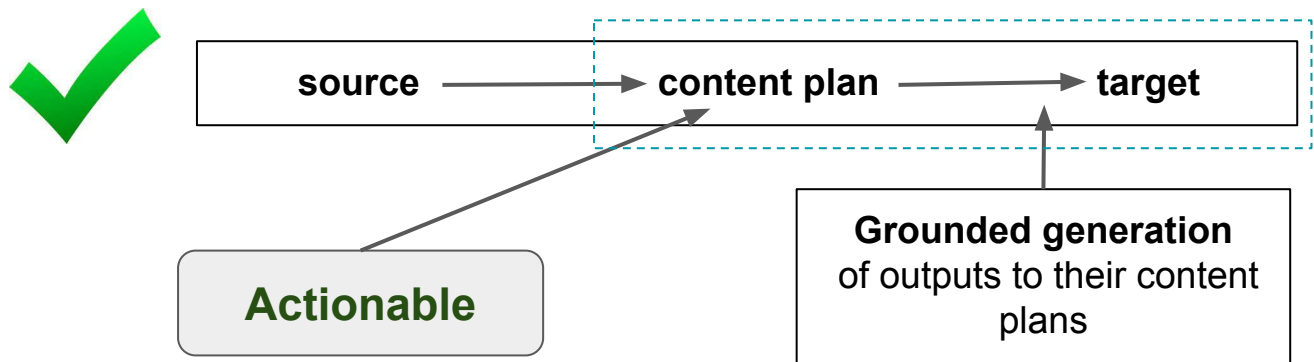
s.tarrant@ed.ac.uk, tuhin.chakr@cs.columbia.edu,

weisched@isi.edu, violetpeng@cs.ucla.edu

Planning for Trustworthy Generation

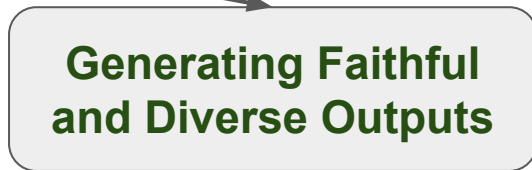
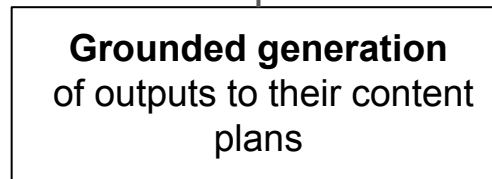


Planning for Trustworthy Generation



Improved explainability and controllability

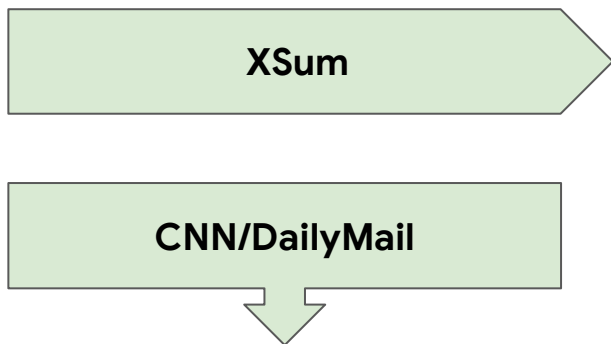
Planning for Trustworthy Generation



FROST (To appear in TACL)
<https://arxiv.org/abs/2104.07606>

**Composition
Sampling with FROST
(ongoing)** 

Abstractive Summarization



Story highlights

North Carolina reports first case of mosquito-borne virus called chikungunya

Chikungunya is primarily found in Africa, East Asia and the Caribbean islands

Virus is not deadly, but it can be painful, with symptoms lasting for weeks

A debilitating, mosquito-borne virus called chikungunya has made its way to North Carolina, health officials say. It's the state's first reported case of the virus.

The patient was likely infected in the Caribbean, according to the [Forsyth County Department of Public Health](#). Chikungunya is primarily found in Africa, East Asia and the Caribbean islands, but the Centers for Disease Control and Prevention has been watching the

virus, + for fear that it could take hold in the United States -- much like West Nile did more than a decade ago.

SUMMARY: *A man and a child have been killed after a light aircraft made an emergency landing on a beach in Portugal.*

DOCUMENT: Authorities said the incident took place on Sao Joao beach in Caparica, south-west of Lisbon.

The National Maritime Authority said a middle-aged man and a young girl died after they were unable to avoid the plane.

[6 sentences with 139 words are abbreviated from here.]

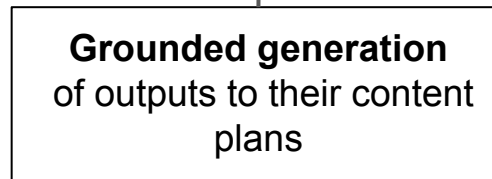
Other reports said the victims had been sunbathing when the plane made its emergency landing.

[Another 4 sentences with 67 words are abbreviated from here.]

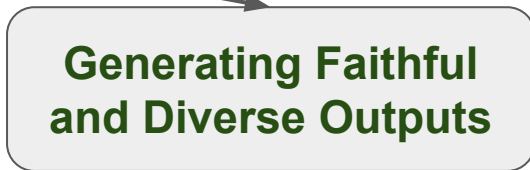
Video footage from the scene carried by local broadcasters showed a small recreational plane parked on the sand, apparently intact and surrounded by beachgoers and emergency workers.

[Last 2 sentences with 19 words are abbreviated.]

Planning for Trustworthy Generation



FROST (To appear in TACL)
<https://arxiv.org/abs/2104.07606>



Composition Sampling with FROST (ongoing)



Frost: Planning and Grounding with Entity Chains

Model entity-level lexical cohesion and coherence (Barzilay and Elhadad, 1997, Halliday and Hasan, 1976) in the summary

FROST : source → Entity Chains → target

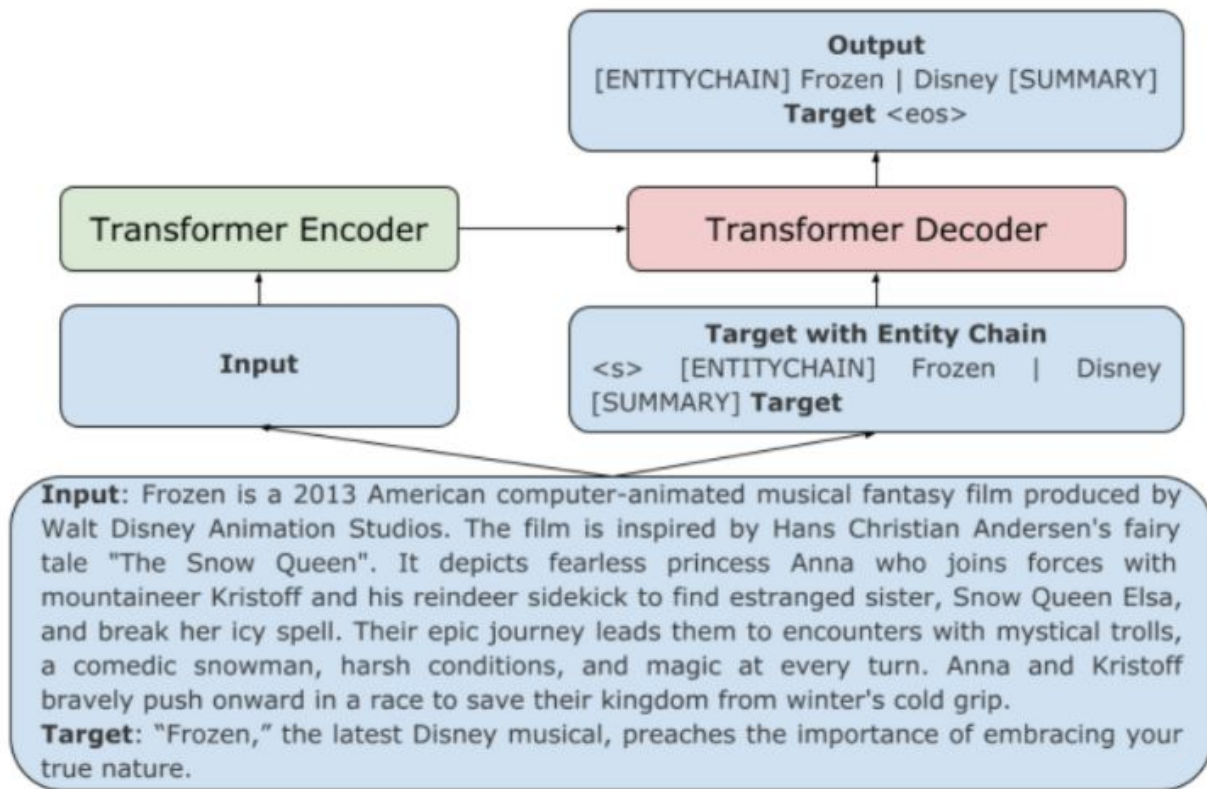
Content Plan (Entity Chain)

Raheem Sterling | £100,000 | Liverpool |||
Arsenal | Chelsea | Manchester City | Manchester United | Bayern Munich |||
Liverpool | Brendan Rodgers | Sterling

Summary

Raheem Sterling has rejected a £100,000-a-week contract at Liverpool.
Arsenal, Chelsea, Manchester City, Manchester United and Bayern Munich all
interested.
Liverpool boss Brendan Rodgers has insisted that Sterling will not be sold.

Supervised Training with Entity Chains



Advantages of Planning with Entity Chains

Planned and Grounded Generation

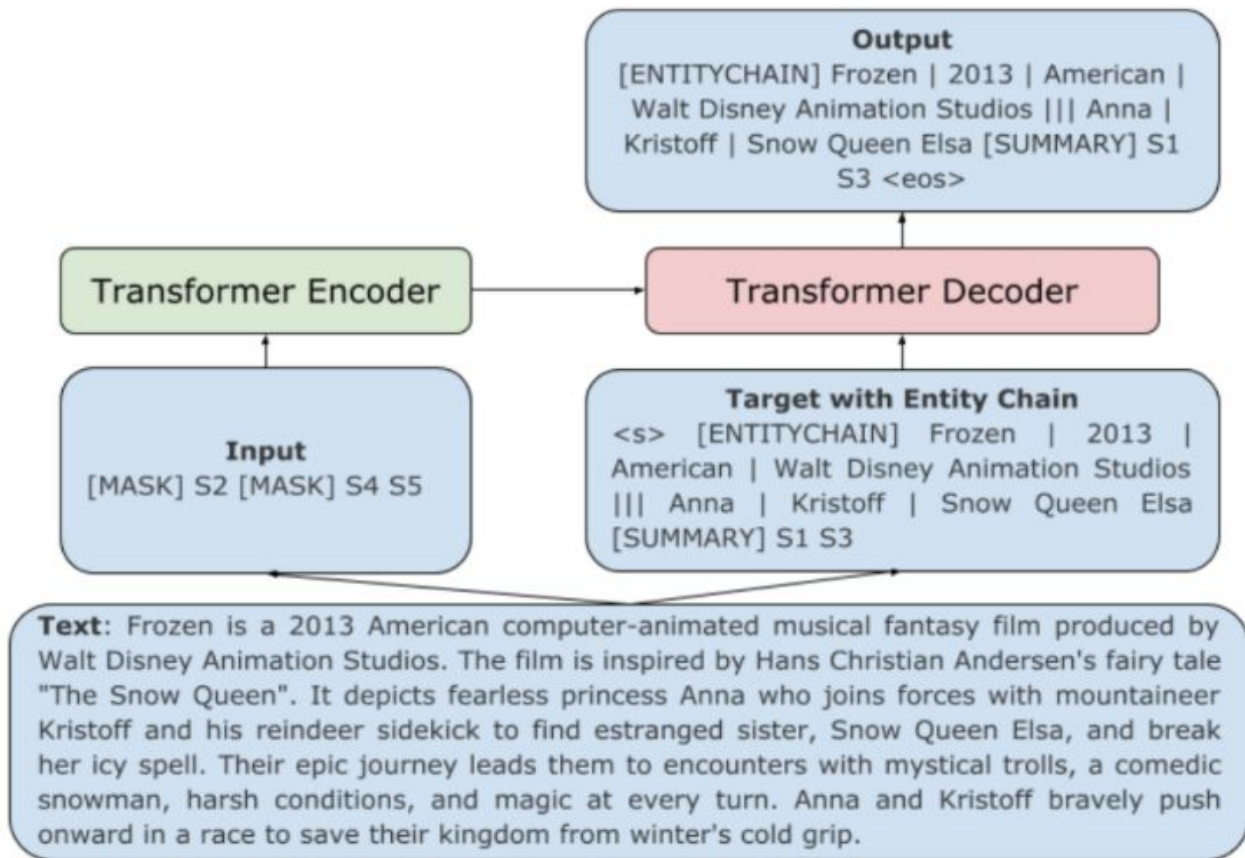
- Generation of summary is **grounded** to entity-chains
- Better **entity planning and specificity**
 - Entity predictions are **less susceptible to local correlations when predicting them in the summary**

Controllable Generation with Entity Prompts

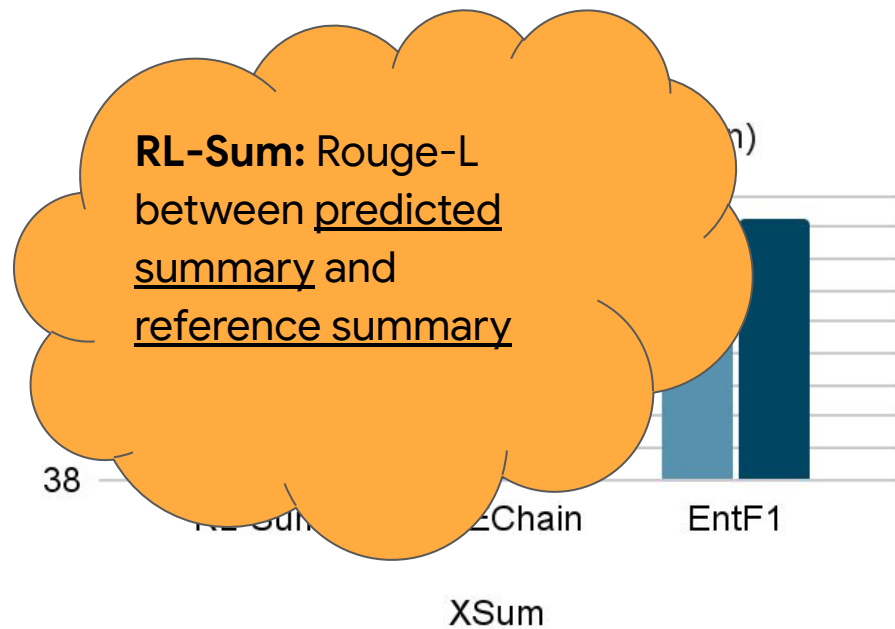
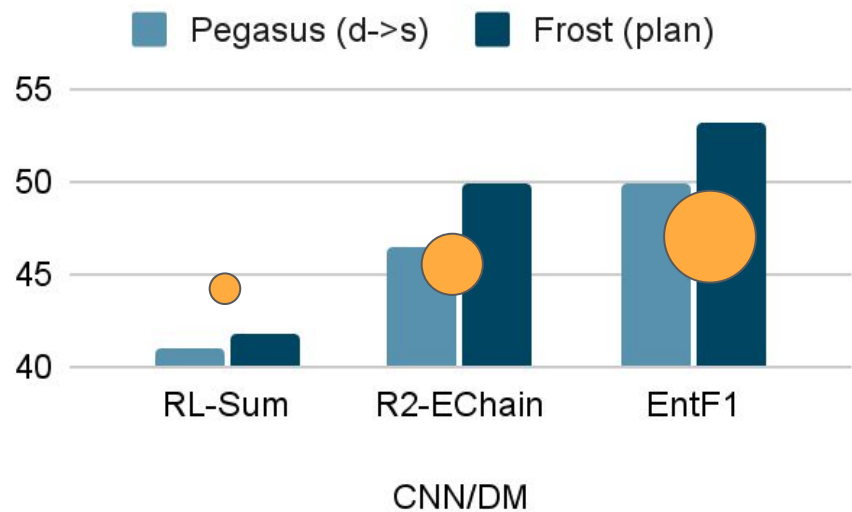
- During the inference time the decoder can be easily **prompted with any desired entity prompt** to control the content in the output summary, **controlling emphasis, style or hallucinations.**

No change in architecture, no additional annotations required during inference

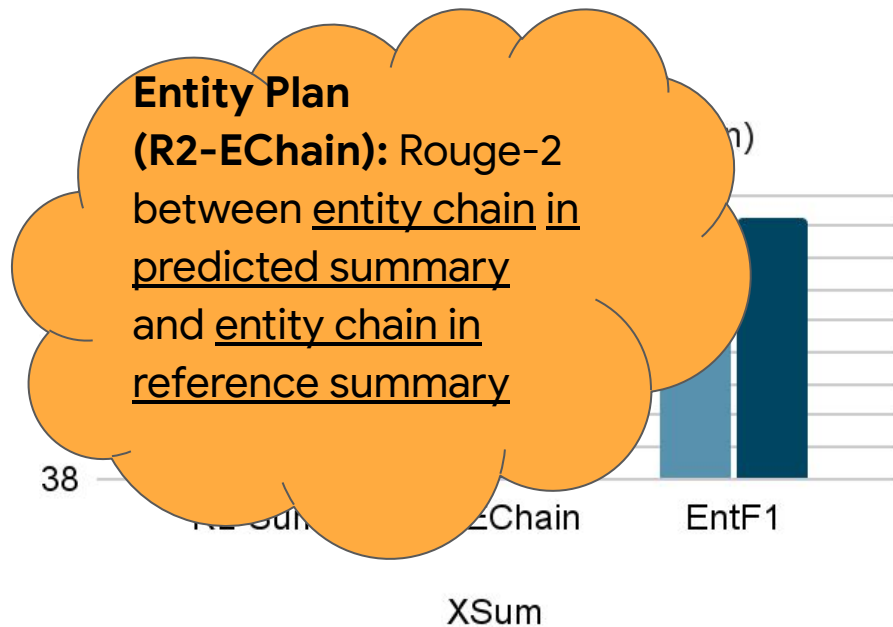
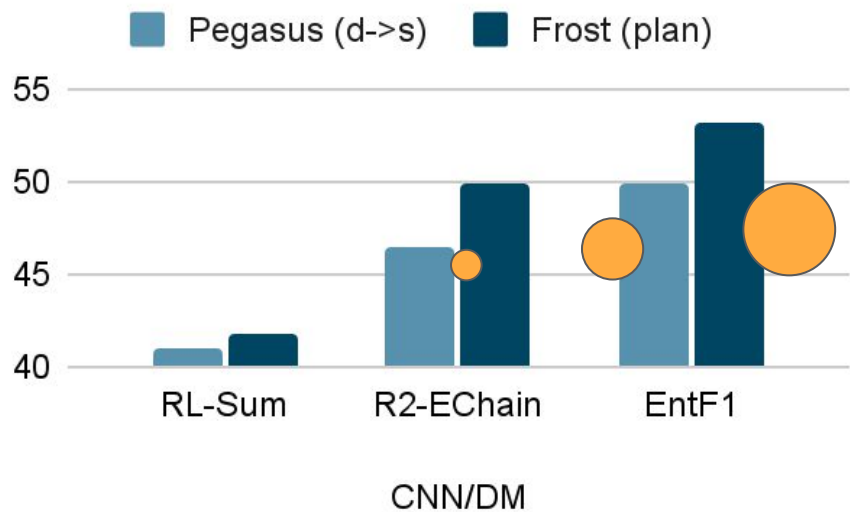
Self-Supervised Training with Entity Chains



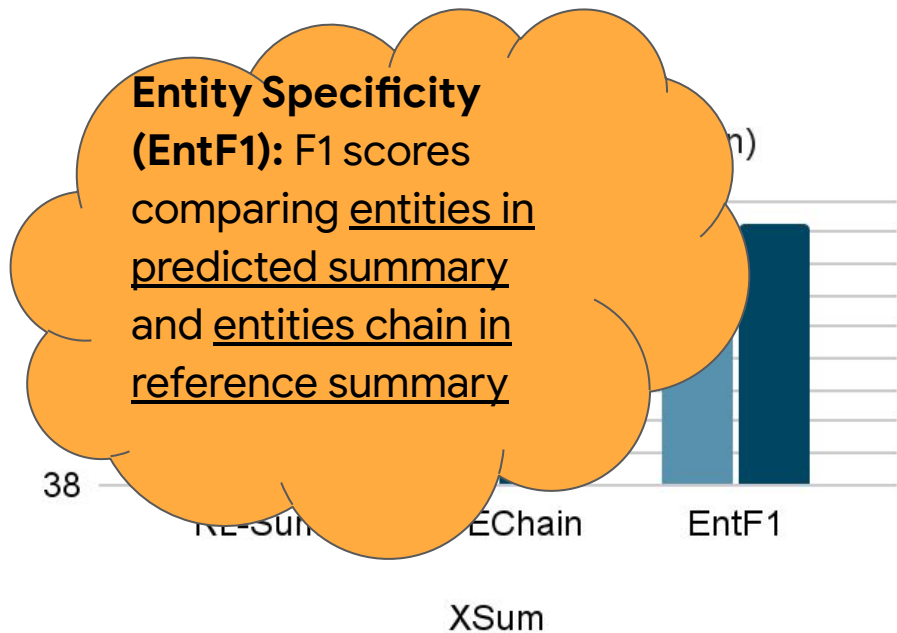
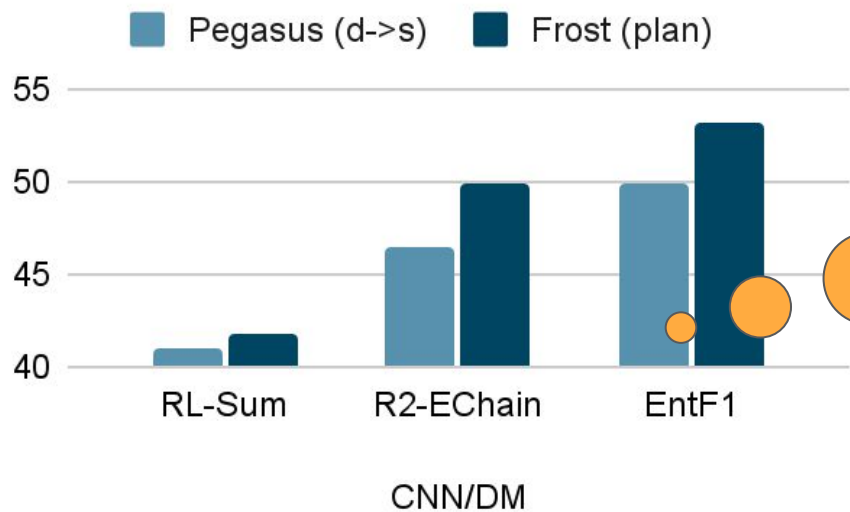
Summarization Results



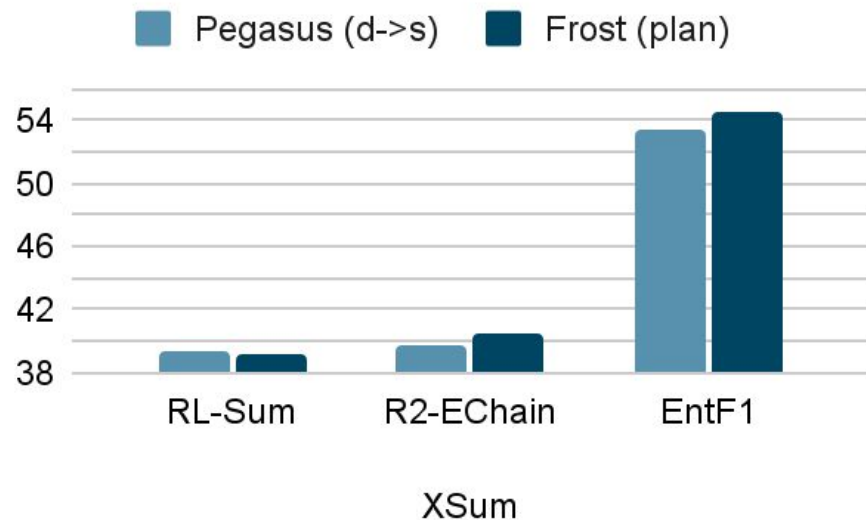
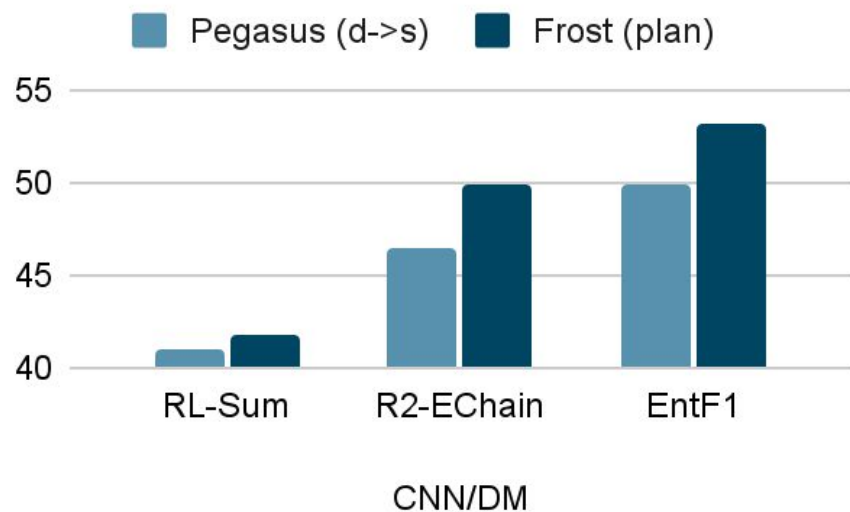
Summarization Results



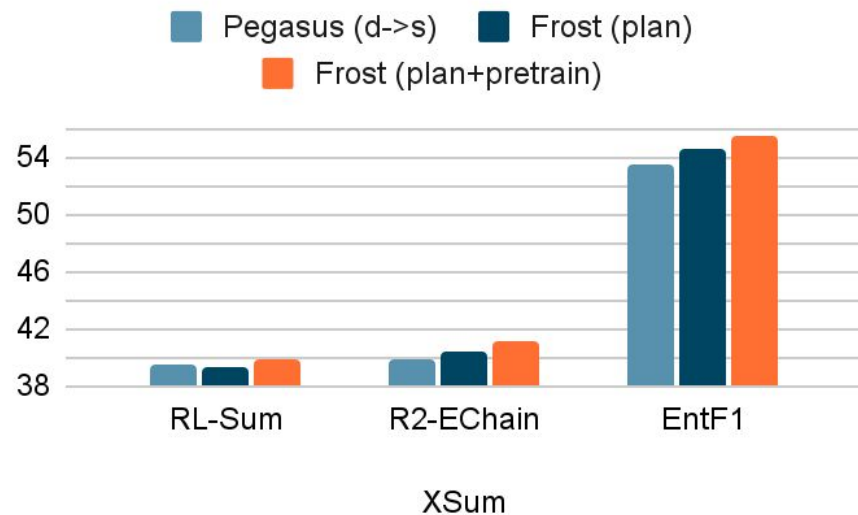
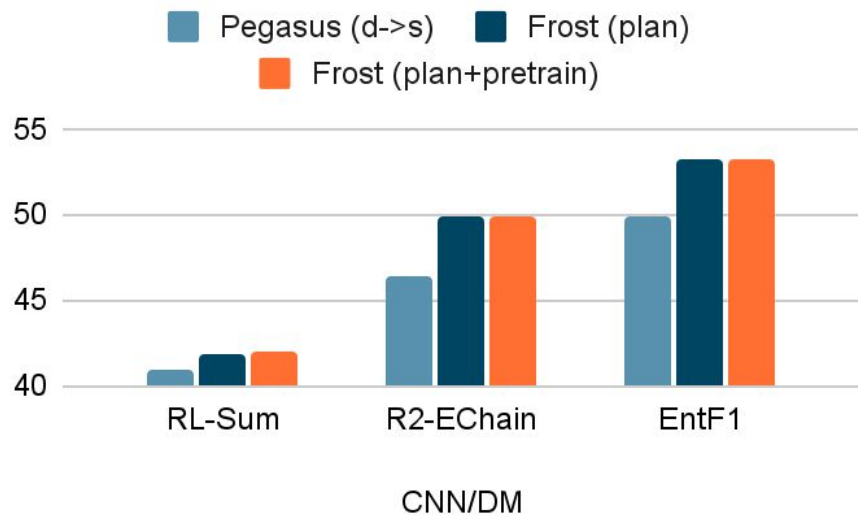
Summarization Results



Summarization Results: Simply Fine-tuning with Planning already Helps.



Summarization Results: Pretraining is More Effective for Abstractive Generation.



FROST Ablations

Sentence level Entity Chains

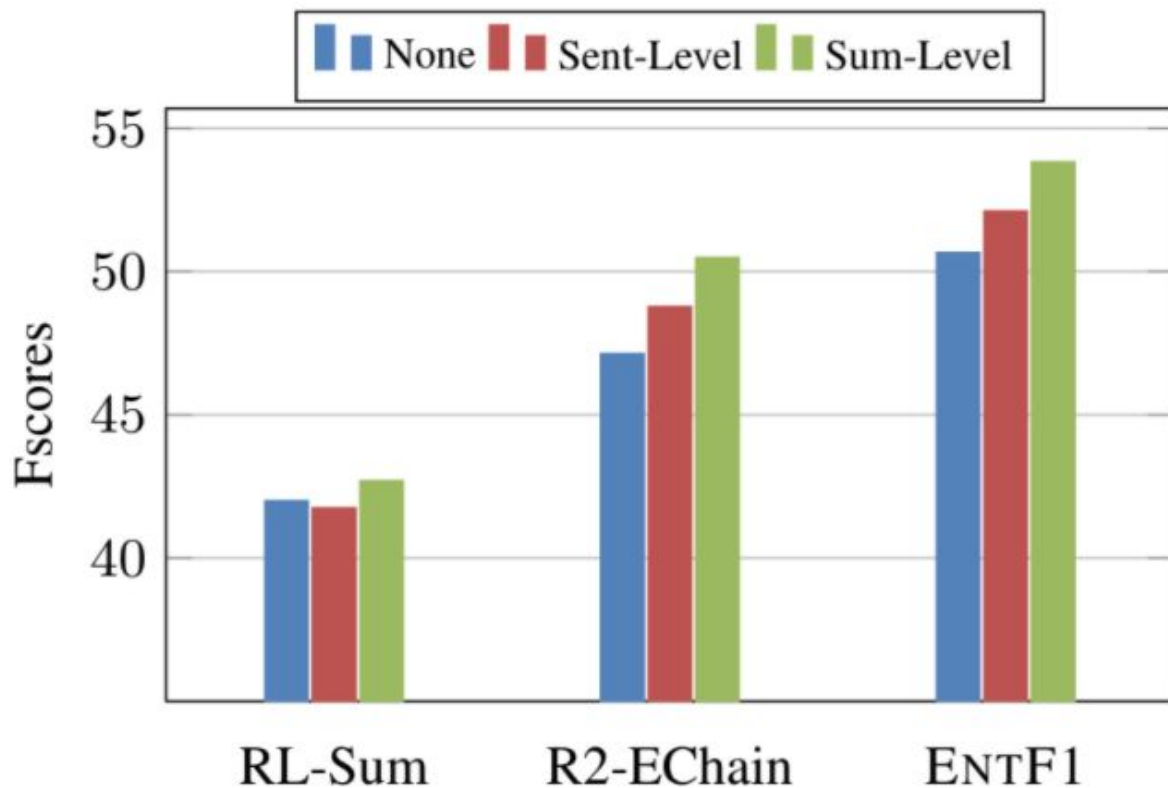
Summary level Entity Chains

Sentence-level Entity Chain with Target: [EntityChain] Frozen | Disney [Summary] “Frozen,” the latest Disney musical, preaches the importance of embracing your true nature. [EntityChain] Princess Anna | Kristoff | Snow Queen Elsa [Summary] It depicts fearless Princess Anna who joins forces with mountaineer Kristoff and his reindeer sidekick to find estranged sister, Snow Queen Elsa, and break her icy spell.

Summary-level Entity Chain with Target: [EntityChain] Frozen | Disney ||| Princess Anna | Kristoff | Snow Queen Elsa [Summary] “Frozen,” the latest Disney musical, preaches the importance of embracing your true nature. It depicts fearless Princess Anna who joins forces with mountaineer Kristoff and his reindeer sidekick to find estranged sister, Snow Queen Elsa, and break her icy spell.

Original Target: “Frozen,” the latest Disney musical, preaches the importance of embracing your true nature. It depicts fearless Princess Anna who joins forces with mountaineer Kristoff and his reindeer sidekick to find estranged sister, Snow Queen Elsa, and break her icy spell.


FROST Ablations: Sentence vs Summary Level Entity Chains



Fine tuning on CNN/DailyMail Validation Set

FROST Ablations: Sentence vs Summary Level Entity Chains

Summary level plans are better microplanner in deciding sentence boundaries and avoiding verbose summaries



Sentence-level Entity Chain with Target: [EntityChain] Frozen | Disney [Summary] “Frozen,” the latest Disney musical, preaches the importance of embracing your true nature. [EntityChain] Princess Anna | Kristoff | Snow Queen Elsa [Summary] It depicts fearless Princess Anna who joins forces with mountaineer Kristoff and his reindeer sidekick to find estranged sister, Snow Queen Elsa, and break her icy spell.

Summary-level Entity Chain with Target: [EntityChain] Frozen | Disney ||| Princess Anna | Kristoff | Snow Queen Elsa [Summary] “Frozen,” the latest Disney musical, preaches the importance of embracing your true nature. It depicts fearless Princess Anna who joins forces with mountaineer Kristoff and his reindeer sidekick to find estranged sister, Snow Queen Elsa, and break her icy spell.

Original Target: “Frozen,” the latest Disney musical, preaches the importance of embracing your true nature. It depicts fearless Princess Anna who joins forces with mountaineer Kristoff and his reindeer sidekick to find estranged sister, Snow Queen Elsa, and break her icy spell.

Frost models are Better Microplanner and Produce more Concise Summaries

Reference

Raheem Sterling could leave Liverpool in the summer transfer window .
Arsenal and Manchester City are both interested in signing him .
Chelsea could make a big money move if Sterling becomes available .
Bayern Munich boss Pep Guardiola is believed to be an admirer .

Pegasus (d -> t)

Raheem Sterling has attracted interest from a number of big clubs .
Liverpool boss Brendan Rodgers has insisted he will not be sold this summer .
Sterling has rejected a contract worth £100,000-a-week at Anfield .
[Click here for Liverpool transfer news](#) .

Frost

[CONTENT]

Raheem Sterling | £100,000 | Liverpool |||
Arsenal | Chelsea | Manchester City | Manchester United | Bayern Munich |||
Liverpool | Brendan Rodgers | Sterling

[SUMMARY]

**Raheem Sterling has rejected a £100,000-a-week contract at Liverpool .
Arsenal, Chelsea, Manchester City, Manchester United and Bayern Munich all interested .
Liverpool boss Brendan Rodgers has insisted that Sterling will not be sold .**



Average lengths: target (60.7), Pegasus (68.6) and Frost (65.0)

Frost models Generate Summaries with Specific Details

Pegasus (d -> t)	Frost	Target
<p>BBC One's new drama about a family dealing with a child's diagnosis of autism has been met with a mixture of shock and relief.</p>	<p>A new BBC One drama, <i>The A Word</i>, tells the story of a family dealing with a child's diagnosis of autism.</p>	<p>New TV drama <i>The A Word</i> tells the story of a family discovering that their quirky five-year-old son is in fact autistic.</p>
<p>A storm-hit Jersey beach is to be inspected before it is reopened to the public, the Department of Infrastructure has said.</p>	<p>A Guernsey beach is to be inspected to see if it is safe to reopen, the Department of Environment has said.</p>	<p>Steps at a bay in Guernsey could be opened by Easter, according to the environment department.</p>

Controlling Hallucinations with FROST

Drop-Prompt Mechanism

- Drop entities from the predicted entity chain that are not in the input, and then prompt the decoder with the modified entity chain

Or

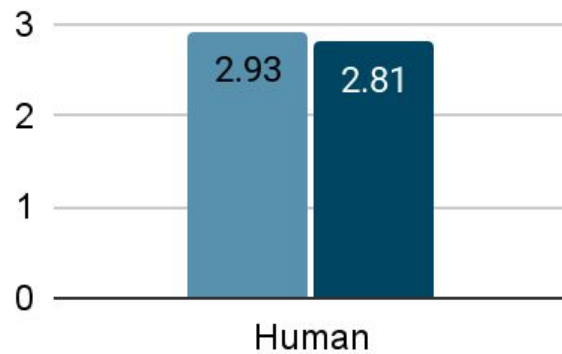
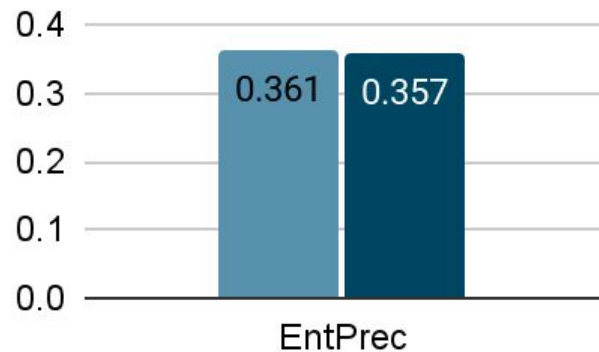
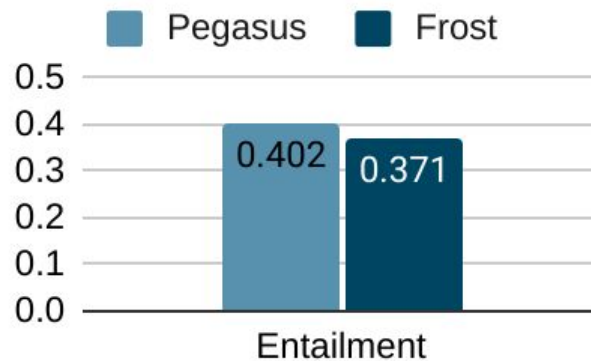
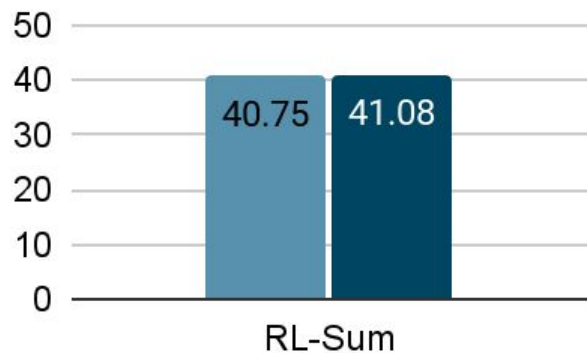
Constrained Planning

- Do not generate entities in the plan that are not in the input

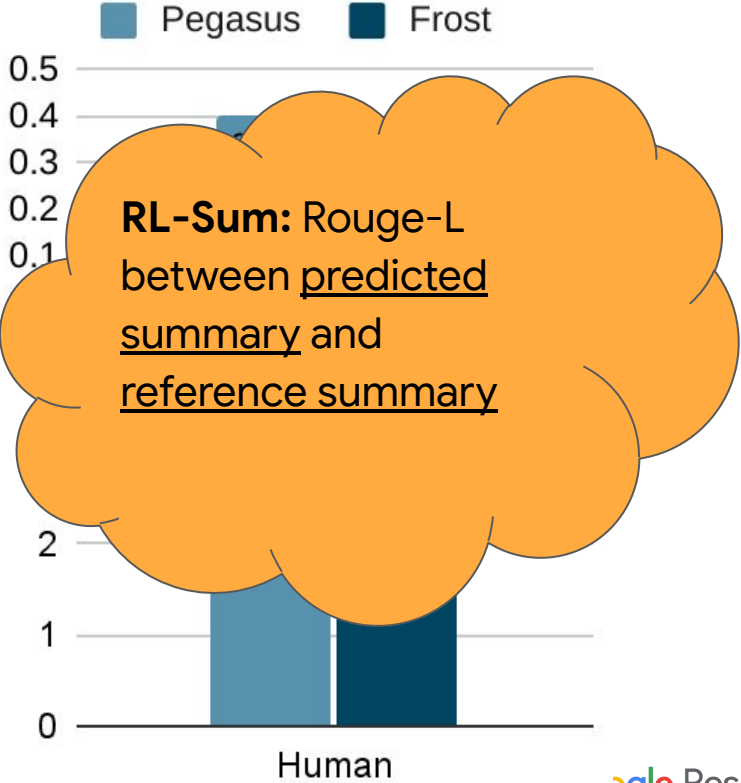
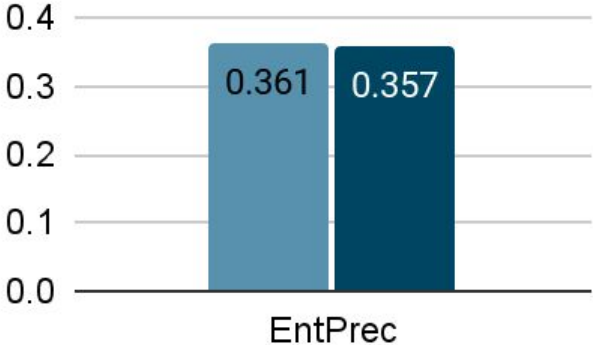
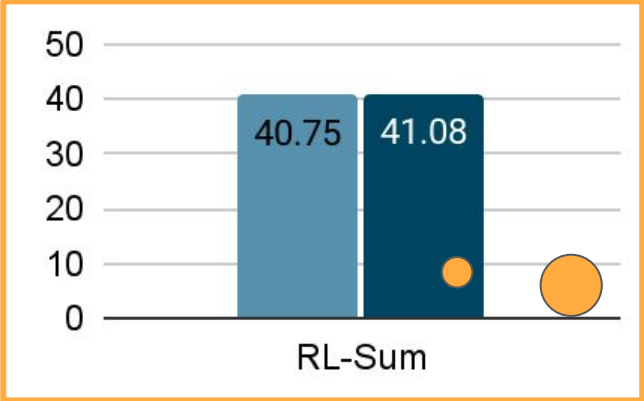
Reducing Hallucination with Controlled and Grounded Generation

GOLD	A teenager who stabbed a 16-year-old to death in an Aberdeen school has been jailed for nine years.
PEGASUS ($d \rightarrow s$)	A teenager who killed a 15-year-old pupil at an Aberdeen school has been jailed for eight years.
FROST ($d \rightarrow c s$)	[Entity-Chain] 14 Aberdeen nine [Summary] A teenager who killed a 14-year-old pupil at an Aberdeen school has been jailed for nine years.
FROST ($d \rightarrow c_{\text{drop}} s$)	[Entity-Chain] Aberdeen nine [Summary] A teenager who killed a fellow pupil at an Aberdeen school has been jailed for nine years.
FROST ($d \rightarrow c_{\text{oracle}} s$)	[Entity-Chain] 16 Aberdeen nine [Summary] A teenager who killed a 16-year-old pupil at an Aberdeen school has been jailed for nine years.

Faithfulness Results

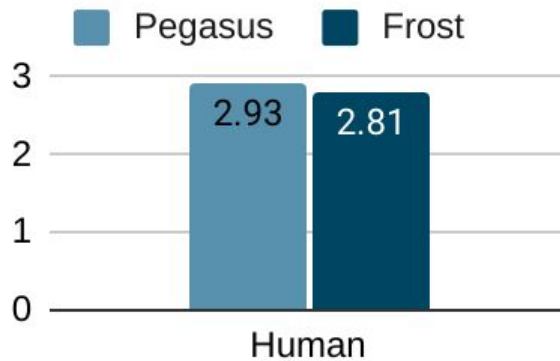
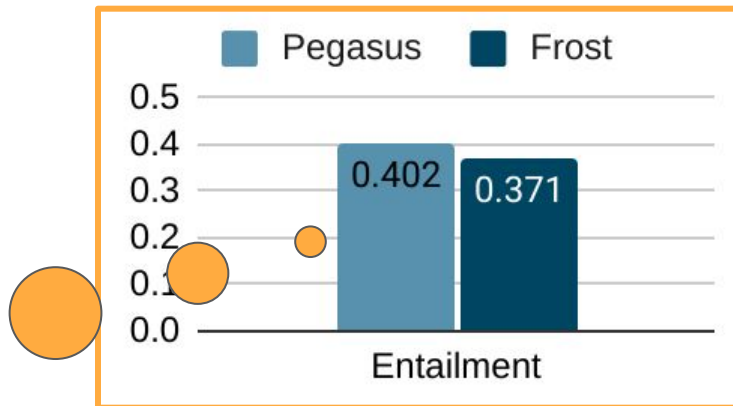
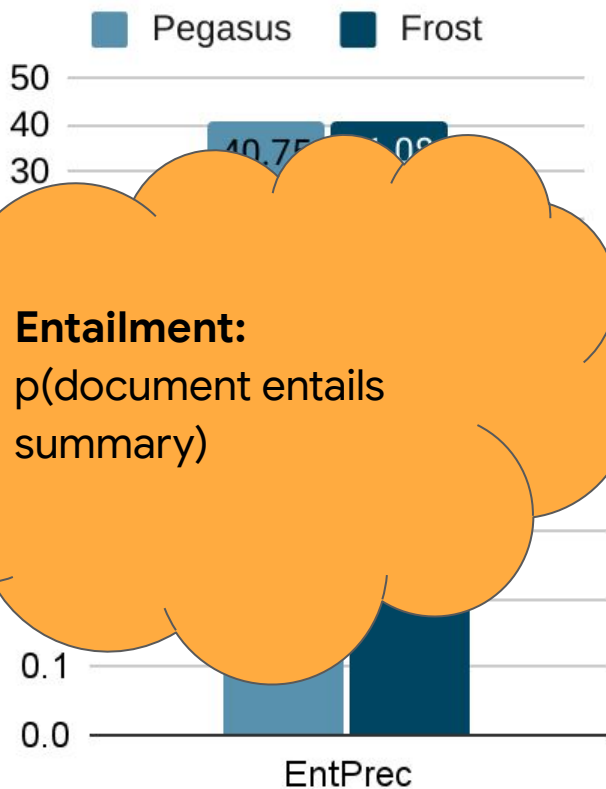


Faithfulness Results

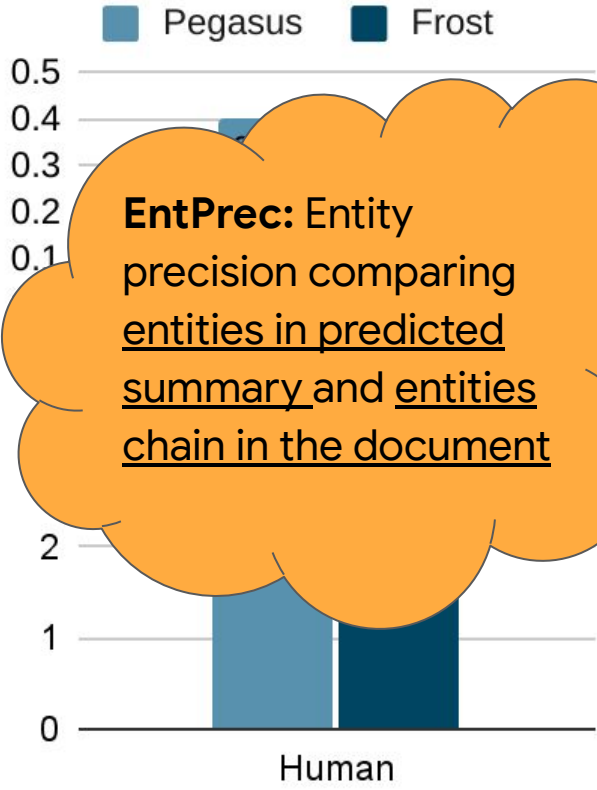
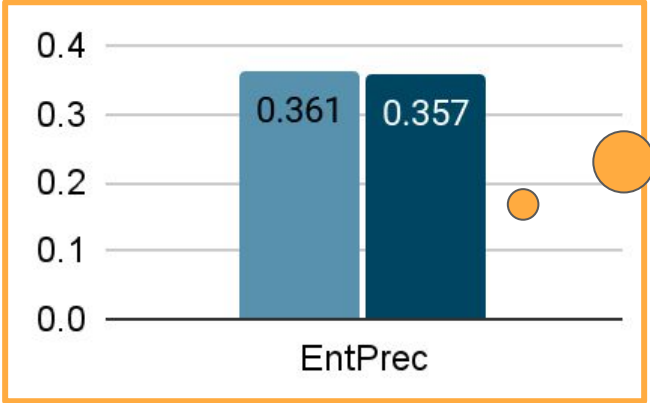
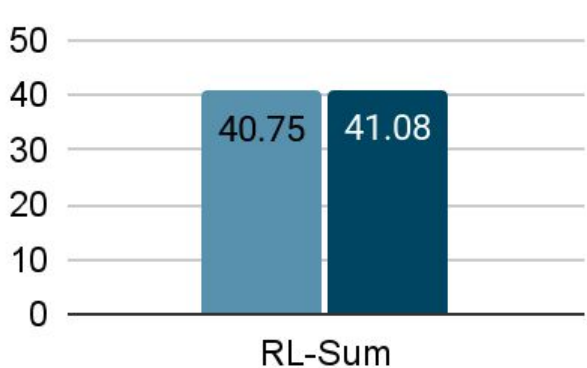


RL-Sum: Rouge-L between predicted summary and reference summary

Faithfulness Results



Faithfulness Results



EntPrec: Entity precision comparing entities in predicted summary and entities chain in the document

Faithfulness Results: Human Eval Template

Instructions: Read a news article and rate summaries on a scale of 1 (fully unfaithful) to 5 (fully faithful). A summary is "fully faithful" if all of its content is fully supported or can be inferred from the input article.

- Fully unfaithful: None of the content is supported by the input document.
- Somewhat unfaithful: Except some parts, most of the content in the summary is not supported by the input article. If chosen, **please explain what was faithful in the summary.**
- 50-50: Approximately half of the content is supported by the input article. If chosen, **please explain what was faithful and what was unfaithful in the summary.**
- Somewhat faithful: Except some parts, most of the content in the summary is supported by the input article. If chosen, **please explain what was unfaithful in the summary.**
- Fully faithful: All contents are supported by the input article.

Please refer this [guidelines](#) document for detailed instructions and examples

Article

Highlight

Unhighlight

David Vallenilla's 22-year-old son, also called David, was shot by military police on Thursday. Mr Vallenilla says he once worked with the president on Caracas' transport system, and called on his "former colleague" to clear his son's name. The president has said firearms must not be used on protesters. "I want to speak to my former colleague of the Caracas Metro," Mr Vallenilla told a group of reporters outside the morgue. "Nicol ?? s Maduro, you know that we worked together, I'm Supervisor Vallenilla." He said he used to be Mr Maduro's boss, although the past working relationship between them has not yet been confirmed. President Maduro is a former bus driver, who got involved in trade unions and then national politics, becoming president in 2013 after his predecessor Hugo Chavez died. "Please, Nicol ?? s, my friend," Mr Vallenilla said with tears streaming down his face, before calling on the leader to make it clear that his only son "was not a criminal, he was a graduating student". "You met him when he was little," he added. Earlier in the week, Fabi ?? n Urbina, 17, was also shot and killed as security forces and demonstrators clashed in Caracas. There have been almost daily anti-government protests in Venezuela for over two months as the country's economic and political crisis has worsened. More than 70 people have been killed in protest-related violence since 1 April, according to figures released by the chief prosecutor's office. On Thursday, Interior Minister Néstor Reverol tweeted to confirm the death of a protester and said a police sergeant had fired an "unauthorised weapon".

Summary 1:

The father of a Venezuelan protester shot dead by security forces has made an emotional plea to President Nicol ?? s Maduro outside a morgue in Caracas.

Please rate the summary on a scale 1-5:



Fully unfaithful

Somewhat unfaithful

50-50

Somewhat faithful

Fully faithful

Please give 1-2 sentence explanation of your choice:

Previous

Next

Frost

0.371

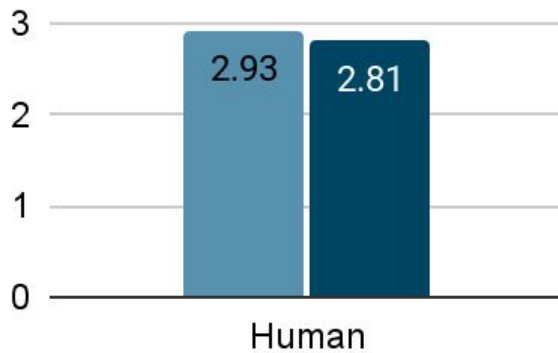
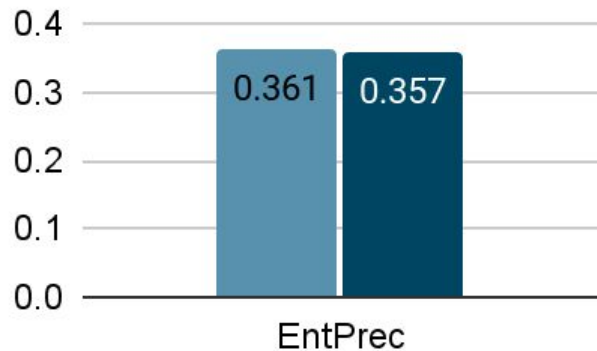
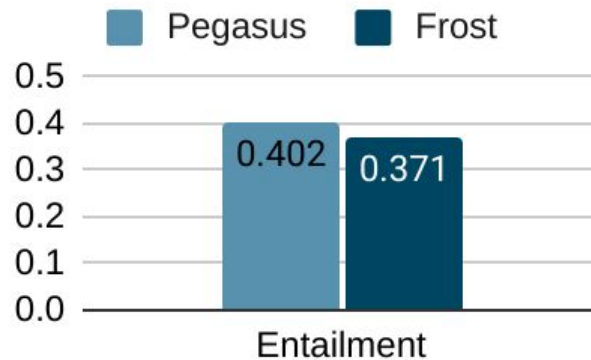
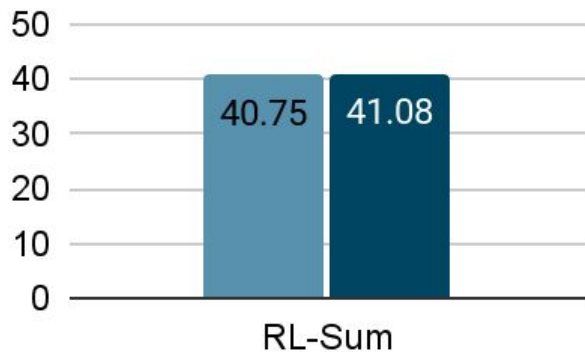
ent

2.81

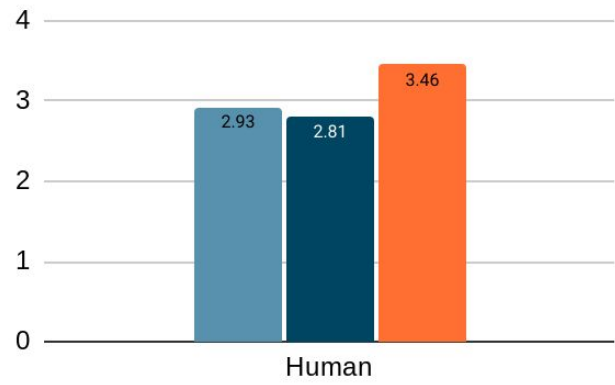
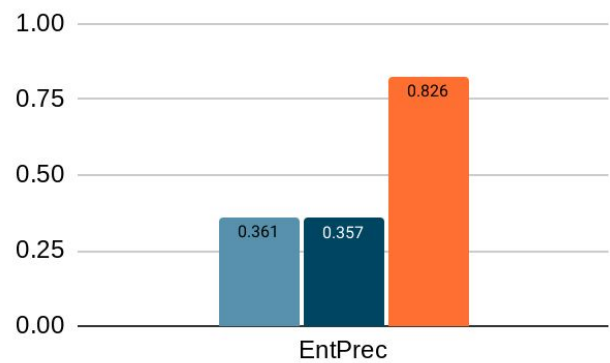
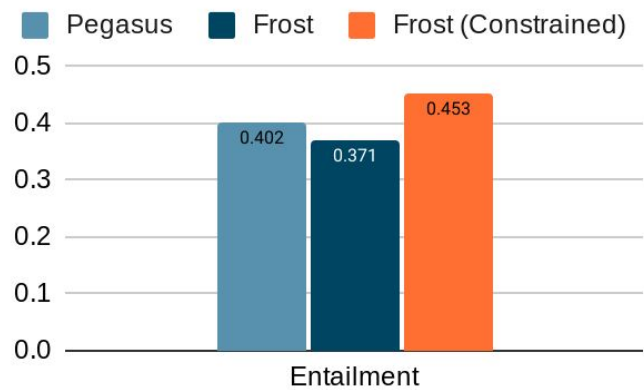
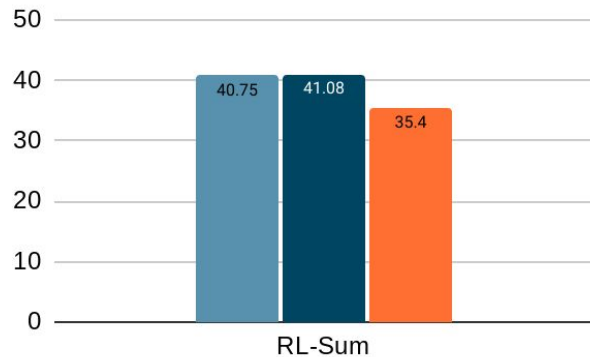
an

Google Research

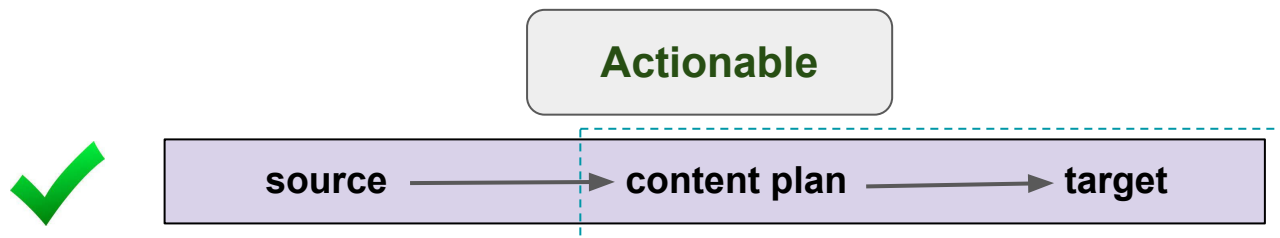
Faithfulness Results: Planning Itself Does not Help with Faithfulness



Faithfulness Results



FROST: Content Planning for Trustworthy Summarization



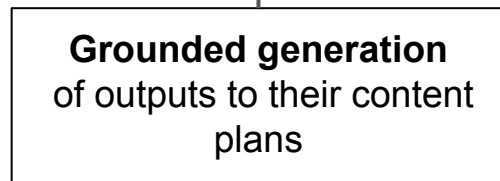
Fine-tuning with augmented targets **without any change in architecture**

Improved explainability: Planned and Grounded Generation using entity chains

Improved controllability: Control Hallucinations in generated text

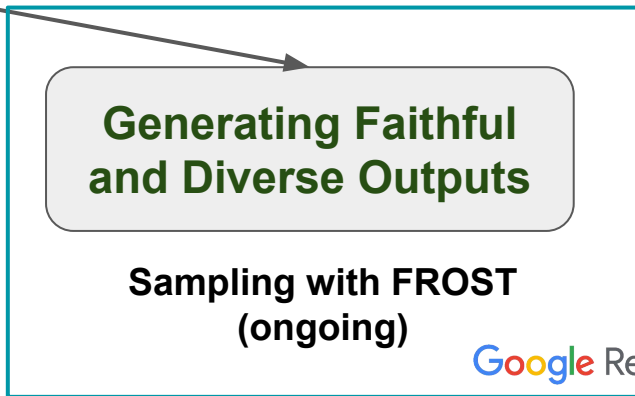
Paper: <https://arxiv.org/abs/2104.07606> (to appear at TACL)

Planning for Trustworthy Generation



Actionable

**Controlling
Hallucinations**



FROST (To appear in TACL)
<https://arxiv.org/abs/2104.07606>

Using Frost to Generate Diverse Summaries with Different Styles and Themes

GOLD: [ENTITYCHAIN] BP | Lord Browne | North Sea [Summary] Former BP chief executive Lord Browne has warned North Sea oil operators' costs must fall in order for them to compete globally.

FROST (ECPP): [ENTITYCHAIN] Browne | BP [Summary] Lord Browne, the former boss of BP, has warned that some oil companies could go out of business if costs continue to rise.

FROST (ECPP), c_{mod} , Style diversity

[ENTITYCHAIN] BP | Browne [Summary] The former boss of BP, Lord Browne, has warned that some oil companies could go out of business if costs continue to rise.

[ENTITYCHAIN] BBC | BP | Browne [Summary] In an interview with the BBC, former BP chief executive Lord Browne has warned the oil and gas industry is in danger of "going to the wall".

FROST (ECPP), c_{mod} , Topical diversity

[ENTITYCHAIN] Brent Crude [Summary] The former boss of the world's biggest oil company has warned that the price of Brent Crude will not recover until next year.

[ENTITYCHAIN] Brent Crude | Unions [Summary] Oil companies will have to cut costs dramatically if they are to survive the fall in the price of Brent Crude, according to the former chief executive of the Unions.

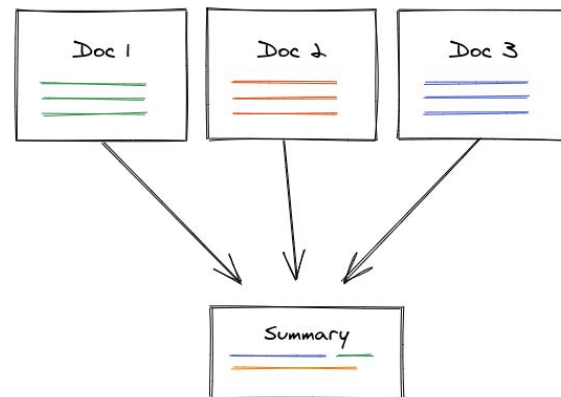
Why Diverse and Faithful Generation?

- NLG models intrinsically trade off diversity and quality (Hashimoto et al., 2019), yet we as humans do this naturally in our everyday lives

Generating summaries focusing on different topics/aspects

- single- or multi-document summarization
- Product review summarization

Diverse Query Generation



Simple Sampling Methods lead to Summary Degeneration

Single Best Summary with T5 or Pegasus

[✓] PEGASUS ($d \rightarrow s$): Lib Dem leader reveals balance of power lies with wife Miriam Gonzalez Durantez. Couple invited cameras into the kitchen of their £1.5million family home. They revealed why they decided to remain with their three sons in London. Mrs Clegg said: ‘It has been the best decision for all of us and if I may, also for Nick as well because you can see how politicians sometimes can get in a bubble and be completely distant from normal society’. Mr Clegg insisted he felt more full of ‘vim and vigour’ than he did in the start of the coalition. Focus groups conducted by the programme found Mr Clegg was characterised as the ‘chihuahua in a handbag’ of the government. He said: ‘If you know you disagree with someone, there’s no tension. I suspect meetings between Tony Blair and Gordon Brown were so fractious because they kind of should have agreed but they didn’t’.

Simple Sampling Methods lead to Summary Degeneration

Summary Sampling with T5 or Pegasus

Nucleus Sampling: PEGASUS ($d \rightarrow s_{\text{sample}}$)

[X] $s_1 \rightarrow$ Nick Clegg reveals **balance902** of power lies with his wife Miriam Gonzalez Durantez **irish**. Couple performed joint interview **to promote new series** on ITV News Tonight. Cleggs spoke of pressure of moving from their Putney home into a taxpayer-funded mansion.

[✓] $s_2 \rightarrow$ Lib Dem leader and wife Miriam give TV interview to ITV's Tonight program. Co-hosts have been pictured drinking white wine and cooking paella. They explained why she vetoed family heading to Whitehall mansion. Husband quipped: 'It's a grand word for Miriam basically saying no'.

[X] $s_3 \rightarrow$ Lib Dem leader admitted wife Miriam has the final say over family life. Couple chose not to move their three **Laundry** to Whitehall home **earlier this May**.

[X] $s_4 \rightarrow$ Nick Clegg and his wife Miriam Gonzalez Durantez open up in TV interview. Lib Dem leader revealed **she Bloomberg-style 'discussions'** in their home. Couple revealed they **opted not to stay with their sons** in their £1.5m house.

[X] $s_5 \rightarrow$ Liberal Democrats leader revealed balance of power lies **30-plus metres away**. He brought cameras into family home due to Cameron and Miliband controversies. Lib Dem leader joked that wife Miriam vetoed their move to Whitehall.

Simple Sampling Methods lead to Summary Degeneration

Nucleus Sampling: FROST ($d \rightarrow c_{\text{sample}}; s_{\text{sample}}$)

Summary Sampling with Frost

[X] $c_1; s_1 \rightarrow$ [CONTENT] Liberal Democrats | Nick Clegg | Miriam Gonzalez Durantez ||| Putney | London ||| Cleggs ||| ITV ||| Couple [SUMMARY] Liberal Democrats leader Nick Clegg reveals balance of power with wife Miriam Gonzalez Durantez in joint interview. They invited cameras into kitchen of £1.5million family home in Putney, south west London. Cleggs are seen trying white wine as they discuss family life and girlfriends. They were **Furness on ITV programme** and said they chose home to protect family. Couple say choosing home stopped them veering off from wider society ‘in a bubble’

[✓] $c_2; s_2 \rightarrow$ [CONTENT] Lib Dem | ITV | Tonight | Miriam Gonzalez Durantez ||| ||| Couple | Putney | London [SUMMARY] Lib Dem leader appeared on ITV’s Tonight programme with wife Miriam Gonzalez Durantez. He was given the option of moving his family into a grace-and-favour government mansion but was vetoed. Couple invite cameras into family home in Putney, south west London to talk about family life.

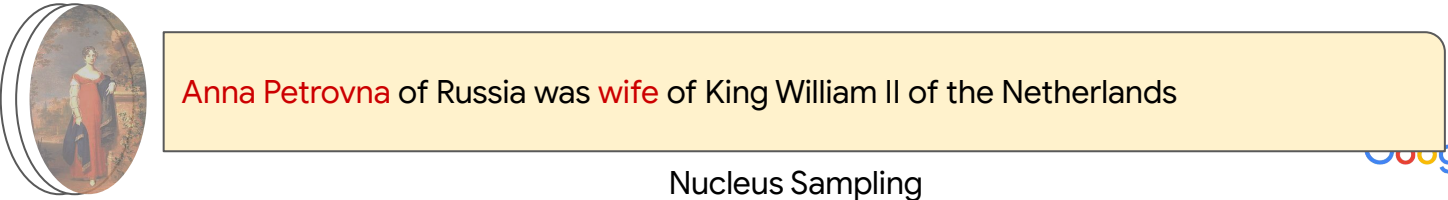
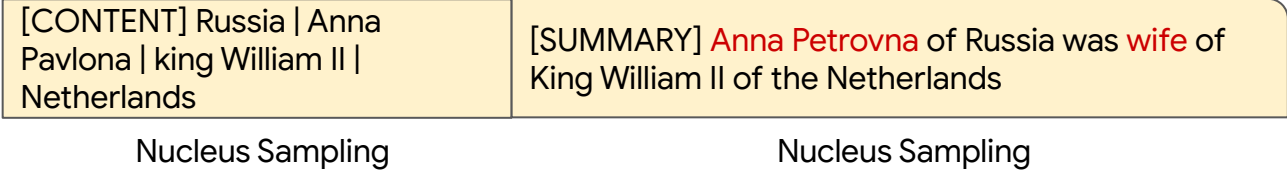
[X] $c_3; s_3 \rightarrow$ [CONTENT] Lib Dems | Miriam ||| Couple | ITV | Tonight ||| Putney | London ||| bestseller | Miliband [SUMMARY] Lib Dems leader revealed balance of power lies with wife Miriam. Couple invited cameras into kitchen of their home for ITV’s Tonight programme. Asked why they kept the family home **Galore** in Putney, south west London. Documentary follows **millions-selling bestseller’s rave** over Miliband’!!

[X] $c_4; s_4 \rightarrow$ [CONTENT] Clegg | Putney ||| ||| ||| Lib Dem [SUMMARY] Mrs Clegg explains why the family stayed in their £1.5million home in Putney **1929**. Comparing their relationship to that of a different marriage, she said: ‘We just stand together and it’s not any more of a difficulty than what many others have to go through’. **Revealingly, suggests that although no longer planning a political showdown** they are closer than they have ever been. Senior Lib Dem says he has learned how to ignore populist attacks.

[X] $c_5; s_5 \rightarrow$ [CONTENT] Lib Dem | ITV | Tonight ||| David Cameron | Lib Demaceae ||| Nick | Miriam Gonzalez Durantez [SUMMARY] Lib Dem leader allowed ITV’s Tonight news programme into kitchen of their home. David Cameron **elegat kitchens sometimes look like Lib Demaceae**. Nick’s high flying wife Miriam Gonzalez Durantez reveals balance of power is with her.

Controlling Summary Degeneration with FROST

Composition Sampling allows the plan to be **sampled** from the beam of plausible plans while keeping the generated output faithful and fluent via **beam search**.

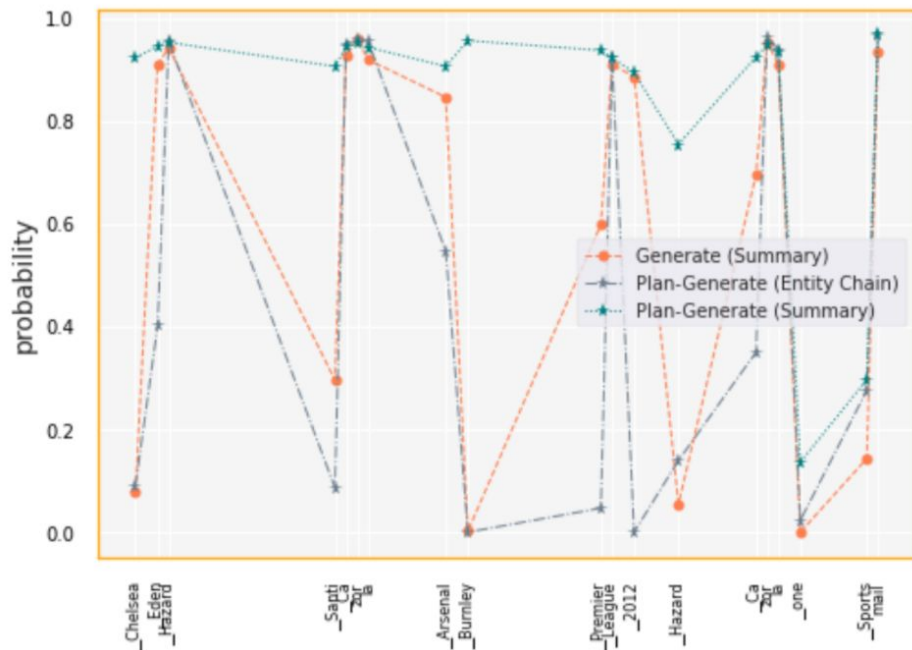


Why is FROST Useful for Diverse Generation?

Grounded generation: once the hard part of planning the summary composition is done, the model is much less perplexed during the generation of the summary

Pegasus	$p(y x)$:	perplexity:	1.478
Frost	$p(y h;x)$:	perplexity:	1.15
Frost	$p(h;y x)$:	perplexity:	1.16

*“Chelsea star **Eden Hazard** is set to make his 100th top-flight appearance. **Santi Cazorla** should hit the same milestone when **Arsenal** meet **Burnley**. Both players have impressed since moving to the **Premier League** in 2012. **Hazard** has more goals this season but **Cazorla** has **one** more assist. **Sportsmail**’s reporters choose the player who has excited them the most.”*



Why is FROST Useful for Diverse Generation?

Entity chains are good at separating content from surface from

- Learning $p(h | x)$ is much easier than learning $p(y | x)$ - so we can sample from h
- We can then sample from $p(h | x)$, and compute $\operatorname{argmax}_y p(y | x, h)$

Pegasus $p(y|x)$: neg_log_likelihood: 121.18

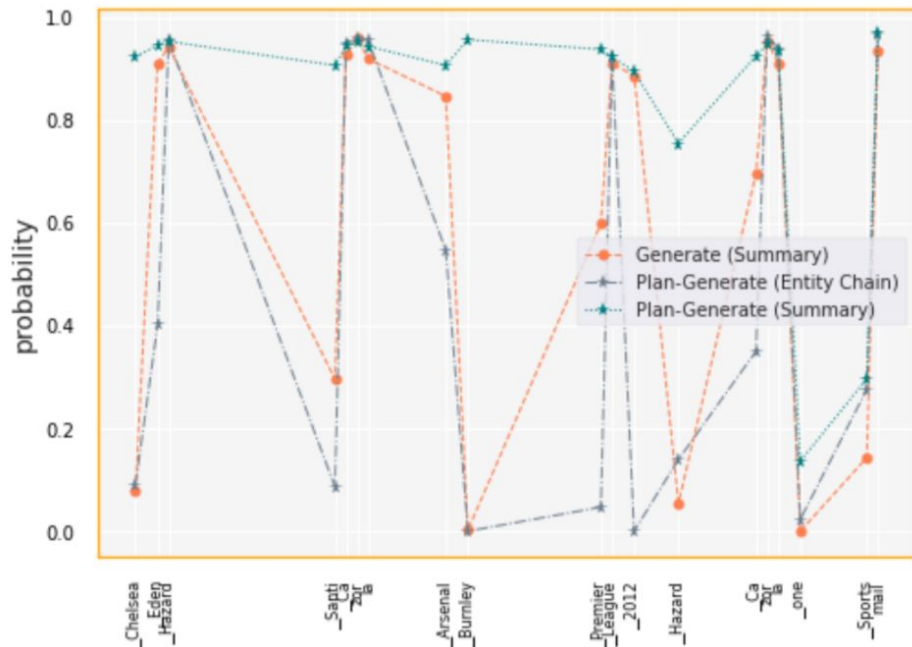
Frost $p(h|x)$: neg_log_likelihood: 46.95

Frost $p(y|h;x)$: neg_log_likelihood: 95.08

In top 15 token for Pegasus vs FROST

Avg Nucleus Prob: 0.2830 vs 0.4332

*“Chelsea star **Eden Hazard** is set to make his 100th top-flight appearance. **Santi Cazorla** should hit the same milestone when **Arsenal** meet **Burnley**. Both players have impressed since moving to the **Premier League** in 2012. **Hazard** has more goals this season but **Cazorla** has **one** more assist. **Sportsmail**’s reporters choose the player who has excited them the most.”*



Controlling Summary Degeneration with FROST

Constrained Composition Sampling: FROST ($d \rightarrow c_{\text{sample,drop}}; s$)

[✓] $c_1; s_1 \rightarrow$ [CONTENT] Liberal Democrats | Nick Clegg | Miriam Gonzalez Durantez ||| Putney | London ||| Cleggs ||| ITV ||| [SUMMARY] Liberal Democrats leader Nick Clegg revealed balance of power lies with wife Miriam Gonzalez Durantez. The couple invited the cameras into the kitchen of their £1.5million family home in Putney, south west London. The Cleggs were seen drinking white wine and cooking in the kitchen of their home. ITV programme found he was characterised as the 'chihuahua in a handbag' of the government. He also insisted he felt more full of 'vim and vigour' than he did in the start of the coalition.

[✓] $c_2; s_2 \rightarrow$ [CONTENT] Lib Dem | ITV | Tonight | Miriam Gonzalez Durantez ||| ||| Putney | London [SUMMARY] Lib Dem leader appeared on ITV's Tonight programme with wife Miriam Gonzalez Durantez. He was given the option of moving his family into a grace-and-favour government mansion - but the move was vetoed by his wife. The couple invited the cameras into the kitchen of their £1.5million family home in Putney, south west London.

[✓] $c_3; s_3 \rightarrow$ [CONTENT] Lib | Miriam ||| ITV | Tonight ||| Putney | London ||| Miliband [SUMMARY] Lib Dem leader reveals balance of power lies with wife Miriam in joint interview. The couple invited the cameras into their kitchen for ITV's Tonight programme. They were seen drinking wine and cooking in their £1.5million home in Putney, south west London. Comes after Miliband was widely mocked for posing with wife in his kitchen.

[✓] $c_4; s_4 \rightarrow$ [CONTENT] Clegg | Putney ||| ||| ||| Lib Dem [SUMMARY] Mr Clegg and his wife invited the cameras into the kitchen of their Putney home. They were seen drinking wine and cooking as they chatted about their family life. The couple were asked why they decided to remain in their family home. Lib Dem leader was given the option of moving his family into a government mansion.

[✓] $c_5; s_5 \rightarrow$ [CONTENT] Lib Dem | ITV | Tonight ||| David Cameron | Lib ||| Nick | Miriam Gonzalez Durantez [SUMMARY] Lib Dem leader reveals balance of power in joint interview with wife on ITV's Tonight. Comes after David Cameron invited cameras into Lib Dem leader's country kitchen. Nick and Miriam Gonzalez Durantez were seen drinking wine and cooking.

Diversity Results on Full Test Set

Model	XSum R1/R2/RL	CNN/DailyMail R1/R2/RL
Single-best with Beam Search		
RoBERTaShare	38.52/16.12/31.13	39.25/18.09/36.45
MASS	39.75/17.24/31.95	42.12/19.50/39.01
BART	45.14/22.27/37.25	44.16/21.28/40.90
GSum	45.40/21.89/36.67	45.94/22.32/42.48
UniLM	-/-	43.33/20.21/40.51
T5	-/-	43.52/21.55/40.69
ProphetNet	-/-	44.20/21.17/41.30
CTRLsum	-/-	45.65/ 22.35/42.50
FAME ($d \rightarrow t_d \rightarrow s$)	45.31/22.75/37.46	42.95 20.79 39.90
PEGASUS ($d \rightarrow s$)	47.56/24.87/39.40	44.05/21.69/40.98
FROST ($d \rightarrow c; s$)	47.80/25.06/39.76	45.11/22.11/42.01
FROST ($d \rightarrow c_{\text{drop}}; s$)	44.94/21.58/37.20	45.08/22.14/41.99
Diverse Decoding with Focus, Nucleus and Composition Sampling		
Focus (PEGASUS, $d \rightarrow t_{\text{sample}} \rightarrow s_{\text{beam}}$)	42.76/19.89/34.97	-/-
Nucleus (PEGASUS, $d \rightarrow s_{\text{sample}}$)	38.49/16.57/30.99	36.27/15.10/33.46
Nucleus (FROST, $d \rightarrow c_{\text{sample}}; s_{\text{sample}}$)	40.26/17.83/32.49	38.49/15.71/35.49
Composition (FROST, $d \rightarrow c_{\text{sample}}; s_{\text{beam}}$)	45.12/22.24/36.98	41.76/18.94/38.69
C-Composition (FROST, $d \rightarrow c_{\text{sample,drop}}; s_{\text{beam}}$)	43.82/20.35/35.89	42.37/19.48/39.28

Average over
5 Samples

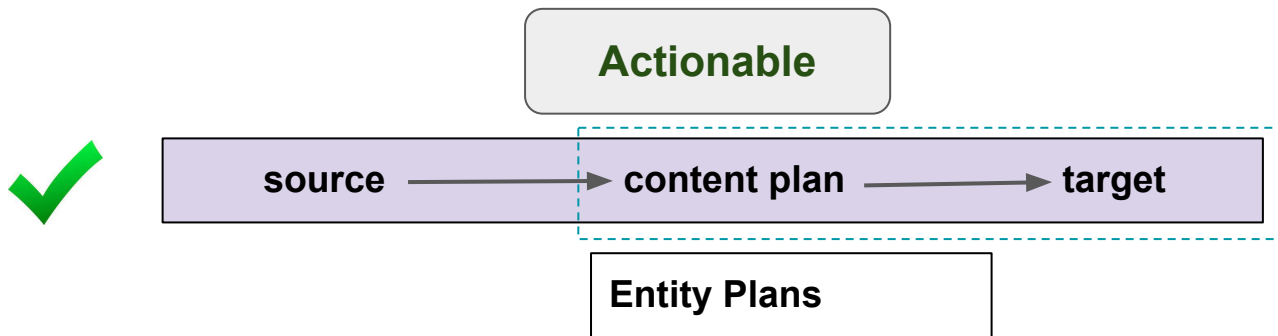
Diversity Results (on challenge sets)

Models		ppl	Faithfulness		Uniq.	Diversity			Div.+Faithf. EDNA	
			Ent.	Human		S-BLEU	S-Ent.	S-BSc.		
XSum	Single	FAME	–	0.235	2.19	–	–	–	–	
		PEGASUS	0.51	0.402	2.52	–	–	–	–	
		FROST ($c; s$)	0.31	0.371	2.63	–	–	–	–	
		FROST ($c_{drop}; s$)	0.71	0.441	2.78	–	–	–	–	
	Diverse	Focus (PEGASUS)	–	0.229	1.88	2.6	89.51	0.617	0.914	0.287
		Nucleus (PEGASUS)	1.47	0.238	2.00	5.0	26.22	0.097	0.675	0.377
		Nucleus (FROST)	0.83	0.218	2.11	5.0	31.08	0.097	0.707	0.351
		Composition (FROST)	0.51	0.274	2.37	4.7	58.94	0.173	0.792	0.411
		C-Composition (FROST)	0.74	0.431	2.75	3.5	76.87	0.398	0.838	0.502
		<hr/>								
CNN/DailyMail	Single	PEGASUS	0.32	0.700	3.78	–	–	–	–	–
		FROST ($c; s$)	0.26	0.723	3.74	–	–	–	–	–
		FROST ($c_{drop}; s$)	0.26	0.794	3.94	–	–	–	–	–
	Diverse	Nucleus (PEGASUS)	1.18	0.618	3.08	5.0	26.99	0.032	0.626	0.754
		Nucleus (FROST)	0.88	0.557	3.08	5.0	29.60	0.027	0.642	0.708
		Composition	0.46	0.588	3.45	5.0	58.60	0.041	0.710	0.729
		C-Composition	0.37	0.732	3.89	4.9	62.81	0.072	0.718	0.818
		<hr/>								

Entailment

Self-Entailment Self-BERTScore

Conclusion: FROST and Composition Sampling



Fine-tuning with augmented targets **without any change in architecture**

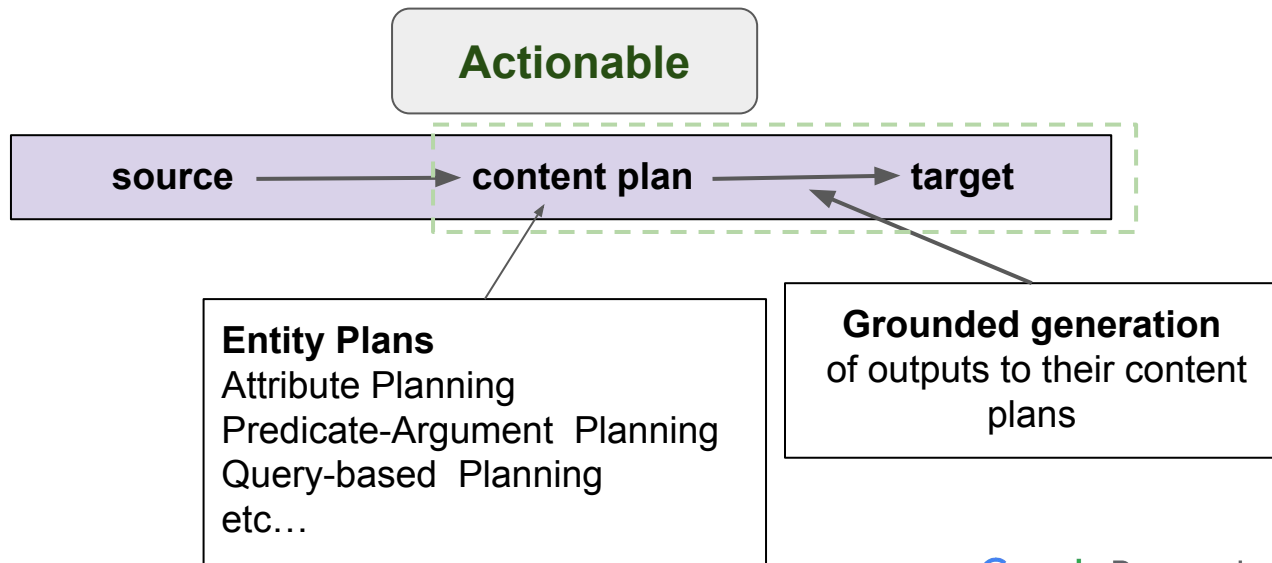
Improved explainability: Planned and Grounded Generation using entity chains

Improved controllability: Control Hallucinations and generate faithful diverse texts

Paper: <https://arxiv.org/abs/2104.07606> (to appear at TACL)

Planning can be Key towards Trustworthy Generation

Vision for making generation more goal-oriented, inspectable, controllable and trustworthy via planning



Thank You

Shashi Narayan