

Penn



COGNITIVE
COMPUTATION
GROUP

Summary Cloze: A New Task for Content Selection in Topic-Focused Summarization

Daniel Deutsch and Dan Roth

Traditional Summarization



- Task:
 - Input: Document(s)
 - Output: Summary

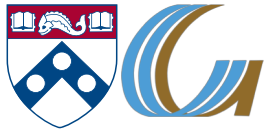
reference document

(CNN) The only thing crazier than a guy in snowbound Massachusetts boxing up the powdery white stuff and offering it for sale online? People are actually buying it. For \$89, self-styled entrepreneur Kyle Waring will ship you 6 pounds of Boston-area snow in an insulated Styrofoam box -- enough for 10 to 15 snowballs, he says. But not if you live in New England or surrounding states. "We will not ship snow to any states in the northeast !" says Waring 's website...

summary

A man in suburban Boston is selling snow online to customers in warmer states. For \$89, he will ship 6 pounds of snow in an insulated Styrofoam box.

Traditional Summarization



- Task:
 - Input: Document(s)
 - Output: Summary
- Popular datasets
 - CNN/DailyMail (Nallapati et al., 2016)
 - New York Times (Sandhaus, 2008)
 - Newsroom (Grusky et al., 2018)

reference document

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 - Topic-focused summarization

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topic

Roger Federer, Philanthropy and outreach

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The current world number two tennis player, who was born in Basel, received the title from the medical faculty, which praised him for his role in increasing the international reputation of Basel and Switzerland...In a press release it also highlighted the 36-year-old sportsman's engagement for children in Africa through his charitable foundation...

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... Federer received an honorary doctorate awarded to him by his home university, the University of Basel.

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cloze	recognition for his role in increasing the international reputation of Basel and Switzerland, and also his engagement for children in Africa through his charitable foundation.

- Propose a cloze-style task
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- Collect large-scale cloze dataset from Wikipedia

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- Propose a cloze-style task
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- Collect large-scale cloze dataset from Wikipedia
- Propose baseline models
 - Extractive
 - Two-step: extractive then abstractive

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Family and personal life

In June 1989, Obama met Michelle Robinson when he was employed as a summer associate at the Chicago law firm of Sidley Austin. [\[62\]](#) ... They began dating later that summer, became engaged in 1991, and were married on October 3, 1992. [\[64\]](#) After suffering a miscarriage, Michelle underwent in vitro fertilisation to conceive their children. [\[65\]](#) ... When they moved to Washington, D.C., in January 2009, the girls started at the Sidwell Friends School. [\[68\]](#)

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Document 62:

THE DAILY PRINCETONIAN

Obama '85 masters balancing act

Email



© Melissa Sullivan

Michelle Obama '85 (l.) stands with her husband Barack at a campaign event in 2004. The two met when she tutored him as a summer intern. This is one of two profiles in today's issue about Princeton alumni in the political spotlight.

Being married to a U.S. senator, working full-time and raising a family is a balancing act for Michelle Obama '85. She is the wife of Sen. Barack Obama (D-Ill.), vice president of community and external affairs at the University of Chicago Hospitals and a mother of two.

"Politics is stressful on the life of a family," she said. "You just have to keep working and try to prevent politics from droning out the rest of your life."

Obama was assigned to mentor Barack, who was a summer intern at Sidley & Austin, and the two began dating soon after in 1991. The couple shared a passion for public service.

"We had many debates about how to best effect change," she said. "We both wanted to affect the community on a larger scale than either of us could individually, and we wanted to do it outside of big corporations. It was not a 'make a lot of money, wrap it up and call it a day' thing."

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Wikipedia as a Topic-Focused Summary



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Document 64:

Michelle Obama: 'He swept me off my feet'

15TH WEDDING ANNIVERSARY | Obamas recall first date, proposal that 'shut up' Michelle

October 3, 2007

Michelle Robinson and Barack Obama had been dating for a couple of years, and she was tired of his endless debates about whether marriage still meant anything as an institution.

So when Obama launched into one of those discussions yet again over dinner at a fancy restaurant in 1991, Robinson lit into her boyfriend, lecturing him on the need to get serious in their relationship.

» Click to enlarge image



Barack and Michelle Obama on their wedding day fifteen years ago.
(Courtesy)

Then dessert came. On the plate was a box. Inside was an engagement ring.

"He said, 'That kind of shuts you up, doesn't it?' " Michelle Obama recounted years later.

The couple married the following year. And today, Michelle, 43, and Democratic presidential hopeful Barack Obama, 46, will celebrate their 15th wedding anniversary.

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Document 65:

'I felt like I had failed': Michelle Obama reveals she had miscarriage and used IVF to conceive daughters



The former First Lady said she felt 'lost and alone' after the miscarriage, because no-one talks about them CREDIT: CHARLES REX ARBOGAST /AP

Michelle Obama, the former US first lady, has revealed that she used IVF treatment to conceive her two daughters Malia and Sasha after once suffering a miscarriage.

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Obamas choose private Sidwell Friends School

The Associated Press

Published: November 22, 2008

WASHINGTON: President-elect Barack Obama and his wife have chosen Sidwell Friends School for their two daughters, opting for a private institution that another White House child, Chelsea Clinton, attended a decade ago.

"A number of great schools were considered," said Katie McCormick Lelyveld, a spokeswoman for Michelle Obama. "In the end, the Obamas selected the school that was the best fit for what their daughters need right now."

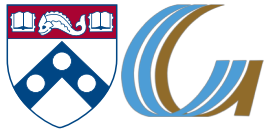
She said Sidwell can provide the security and privacy that Malia, 10, and Sasha, 7, will need as part of the new first family and Sidwell can help with that. She also said that Sasha and Malia had become good friends with Vice President-elect Joe Biden's grandchildren, who go to the school.



- Ideally, want to collect all of the references from all of the articles and try to generate the article



- Ideally, want to collect all of the references from all of the articles and try to generate the article
 - Efforts toward this: Liu et al. (2018), but difficult to actually collect
 - Many references are books, audio, video, 404s
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 - Many references are books, audio, video, 404s
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- We can get some of the documents, so what can we do with that?
 - Cloze-style task

Taylor, 1953

Today I went to the _____ and bought some milk and eggs. I knew it was going to rain, but I forgot to take my _____, and ended up getting wet on the way.

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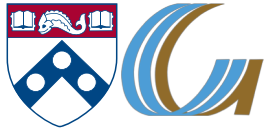
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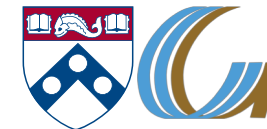
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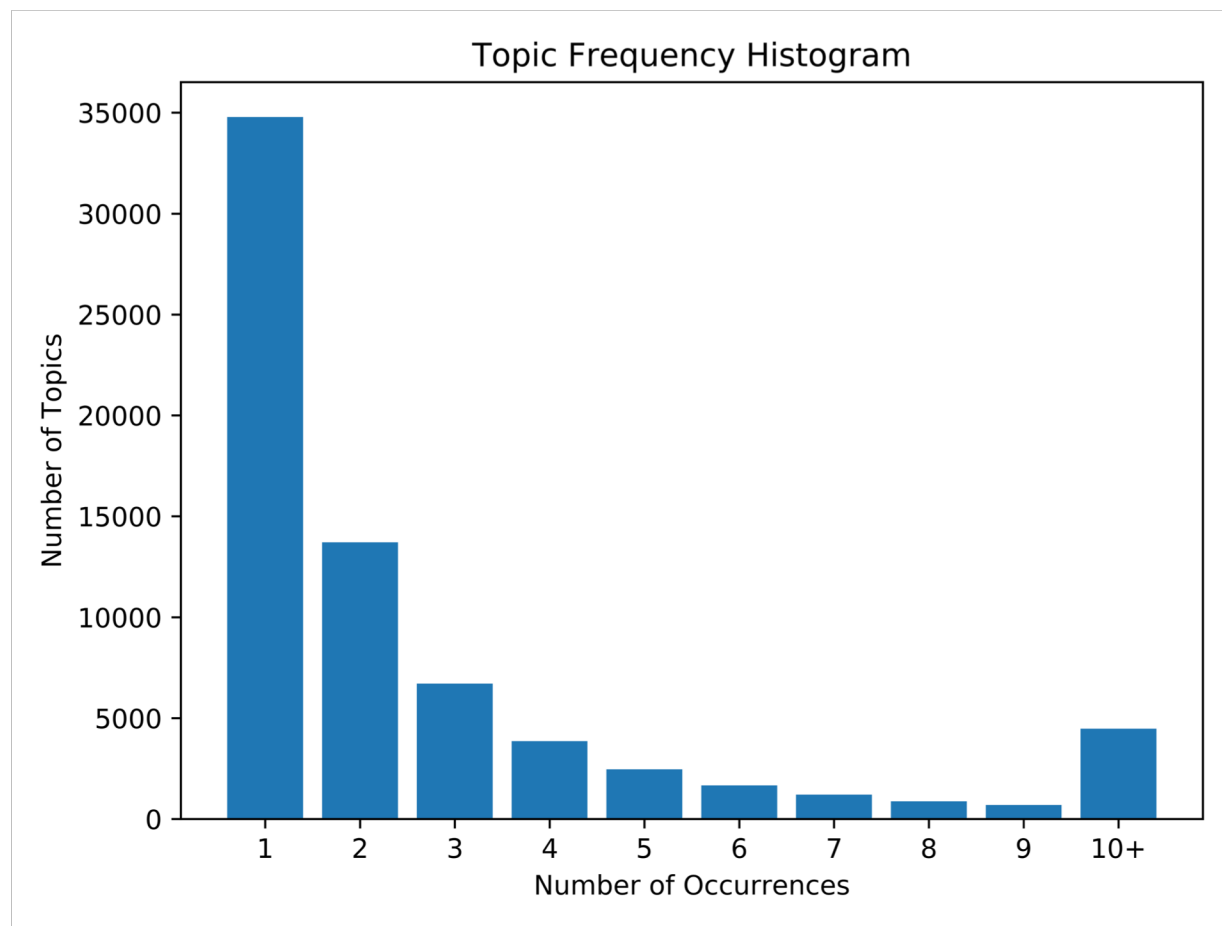
Output

- Collected summary cloze instances from “Living People” Wikipedia pages
- Scraped reference documents using 12 months of Common Crawl
- 450k instances
 - 6% are multi-document
- Documents are quite long: average 1k tokens

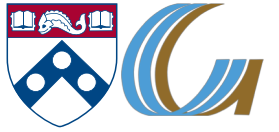
Topic Statistics



- 70k unique topics (ignoring entity names)
- Most common:
 - Career, personal life, biography, early life
- Singleton topics:
 - “career with the who”
 - “federal government lawsuits”
 - “recognition and publications”



Why is this worth researching?

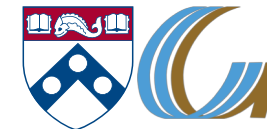


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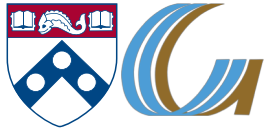
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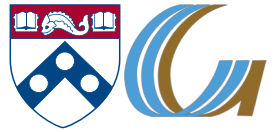
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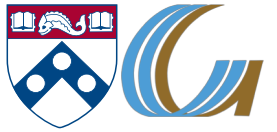
- Summary cloze is a sub-problem of multi-document summarization
- Learn to select content based on the topic
 - More than generic salience
- Explicitly use “partial summary” (the context) to drive content selection
 - Latent partial summary representations currently don’t make a big difference for extractive models (Kedzie et al., 2018)

Example Instances



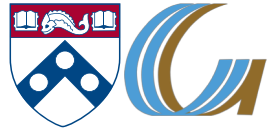
Topic	Caitlin Beevers, Refereeing career	
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Context Cloze	Beevers started refereeing aged 13 and is a member of Dewsbury & Batley Referees Society.	In 2018 she became the first women to referee a rugby league game at Wembley Stadium when she refereed the Year 7 Boys National Schools Final (the curtain raiser to the Challenge Cup Final).

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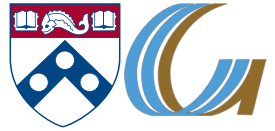
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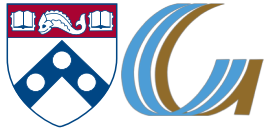
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“Refereeing” topic helps filter certain document content

Example Instances



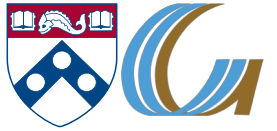
Topic	Cypress Grove (musician), Biography	
Reference Document	<p>Cypress Grove was born in London into a musical family. His father was a professional jazz drummer who at one time played with The Chris Barber band. In the late-1950s and early-1960s, Chris Barber was mainly responsible for arranging the first UK tours of seminal blues artists such as Big Bill Broonzy, Sonny Terry & Brownie McGhee and Muddy Waters. Cypress was taught by his father to play drums at an early age. But by the time he turned 16, his interest had switched to guitar.</p>	
	<p>His infatuation with pre-war acoustic blues continued to develop, which led to a chance encounter with Jeffrey Lee Pierce from The Gun Club. Jeffrey had a real passion for roots music of any kind, so the two hit it off immediately. Jeffrey and Cypress started to regularly jam together on acoustic guitars in Cypress' bedroom. Jeffrey eventually invited Cypress to collaborate with him on his long planned album of roots material - an album Jeffrey had been putting off for many years, as he could not find the right person to do it with - until he met Cypress. The album was released in 1992 - "Ramblin' Jeffrey Lee and Cypress Grove with Willie Love". Jeffrey and Cypress went on to tour the album on a handful of occasions, both with a band and as an acoustic duo...</p>	
Context Cloze	Cypress Grove was born into a musical family.	He was taught by his father, a professional jazz drummer, to
	play drums from a very early age, but by the time he turned 16, his passion became the guitar.	

Example Instances



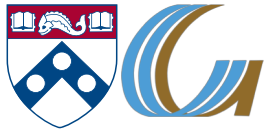
Topic	Cypress Grove (musician), Biography	
Reference Document	<p>Cypress Grove was born in London into a musical family. His father was a professional jazz drummer who at one time played with The Chris Barber band. In the late-1950s and early-1960s, Chris Barber was mainly responsible for arranging the first UK tours of seminal blues artists such as Big Bill Broonzy, Sonny Terry & Brownie McGhee and Muddy Waters. Cypress was taught by his father to play drums at an early age. But by the time he turned 16, his interest had switched to guitar.</p>	
	<p>His infatuation with pre-war acoustic blues continued to develop, which led to a chance encounter with Jeffrey Lee Pierce from The Gun Club. Jeffrey had a real passion for roots music of any kind, so the two hit it off immediately. Jeffrey and Cypress started to regularly jam together on acoustic guitars in Cypress' bedroom. Jeffrey eventually invited Cypress to collaborate with him on his long planned album of roots material - an album Jeffrey had been putting off for many years, as he could not find the right person to do it with - until he met Cypress. The album was released in 1992 - "Ramblin' Jeffrey Lee and Cypress Grove with Willie Love". Jeffrey and Cypress went on to tour the album on a handful of occasions, both with a band and as an acoustic duo...</p>	
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Example Instances



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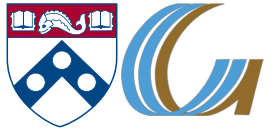
Example Instances



Topic	Cypress Grove (musician), Biography	
Reference Document	<p>Cypress Grove was born in London into a musical family. His father was a professional jazz drummer who at one time played with The Chris Barber band. In the late-1950s and early-1960s, Chris Barber was mainly responsible for arranging the first UK tours of seminal blues artists such as Big Bill Broonzy, Sonny Terry & Brownie McGhee and Muddy Waters. Cypress was taught by his father to play drums at an early age. But by the time he turned 16, his interest had switched to guitar.</p>	
	<p>His infatuation with pre-war acoustic blues continued to develop, which led to a chance encounter with Jeffrey Lee Pierce from The Gun Club. Jeffrey had a real passion for roots music of any kind, so the two hit it off immediately. Jeffrey and Cypress started to regularly jam together on acoustic guitars in Cypress' bedroom. Jeffrey eventually invited Cypress to collaborate with him on his long planned album of roots material - an album Jeffrey had been putting off for many years, as he could not find the right person to do it with - until he met Cypress. The album was released in 1992 - "Ramblin' Jeffrey Lee and Cypress Grove with Willie Love". Jeffrey and Cypress went on to tour the album on a handful of occasions, both with a band and as an acoustic duo...</p>	
Context Cloze	Cypress Grove was born into a musical family.	He was taught by his father, a professional jazz drummer, to
	play drums from a very early age, but by the time he turned 16, his passion became the guitar.	

Context helps dictate relevant document content

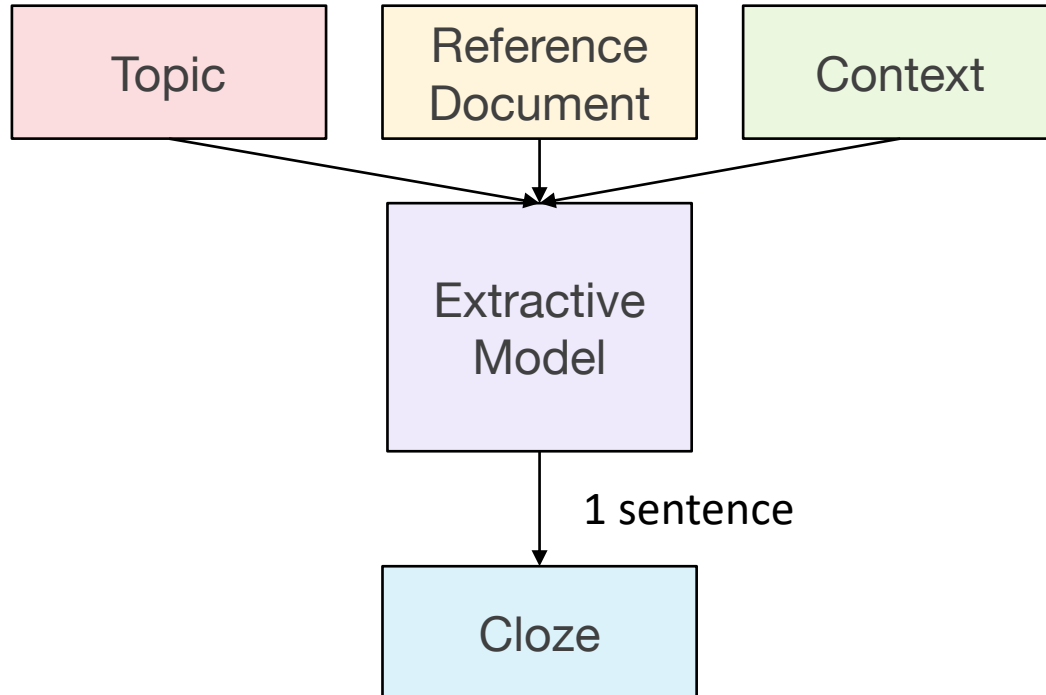
Two Baseline Approaches



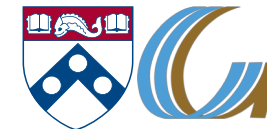
Two Baseline Approaches



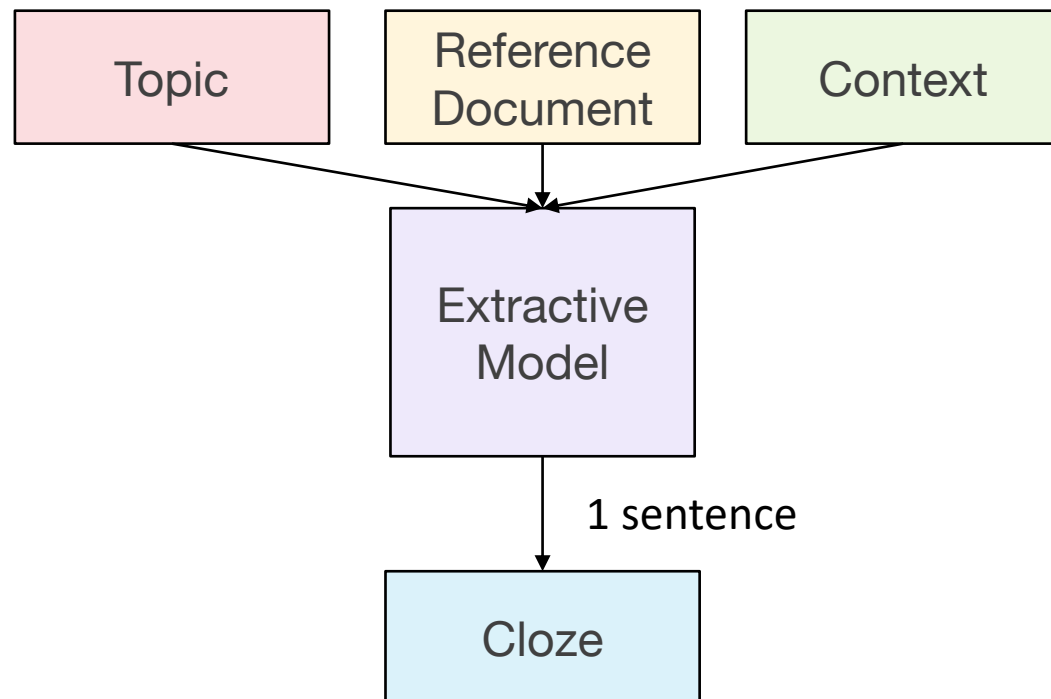
Extract 1 sentence



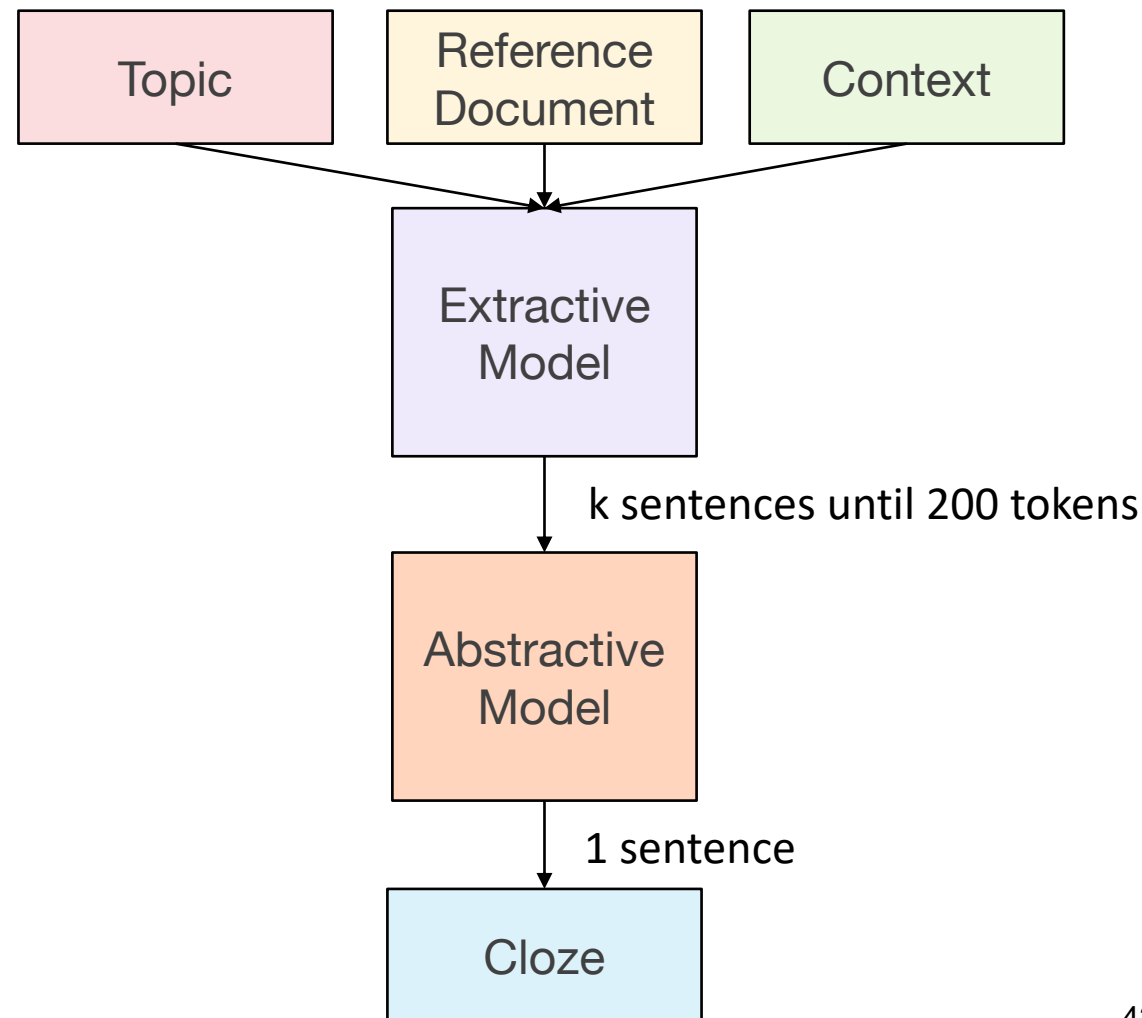
Two Baseline Approaches



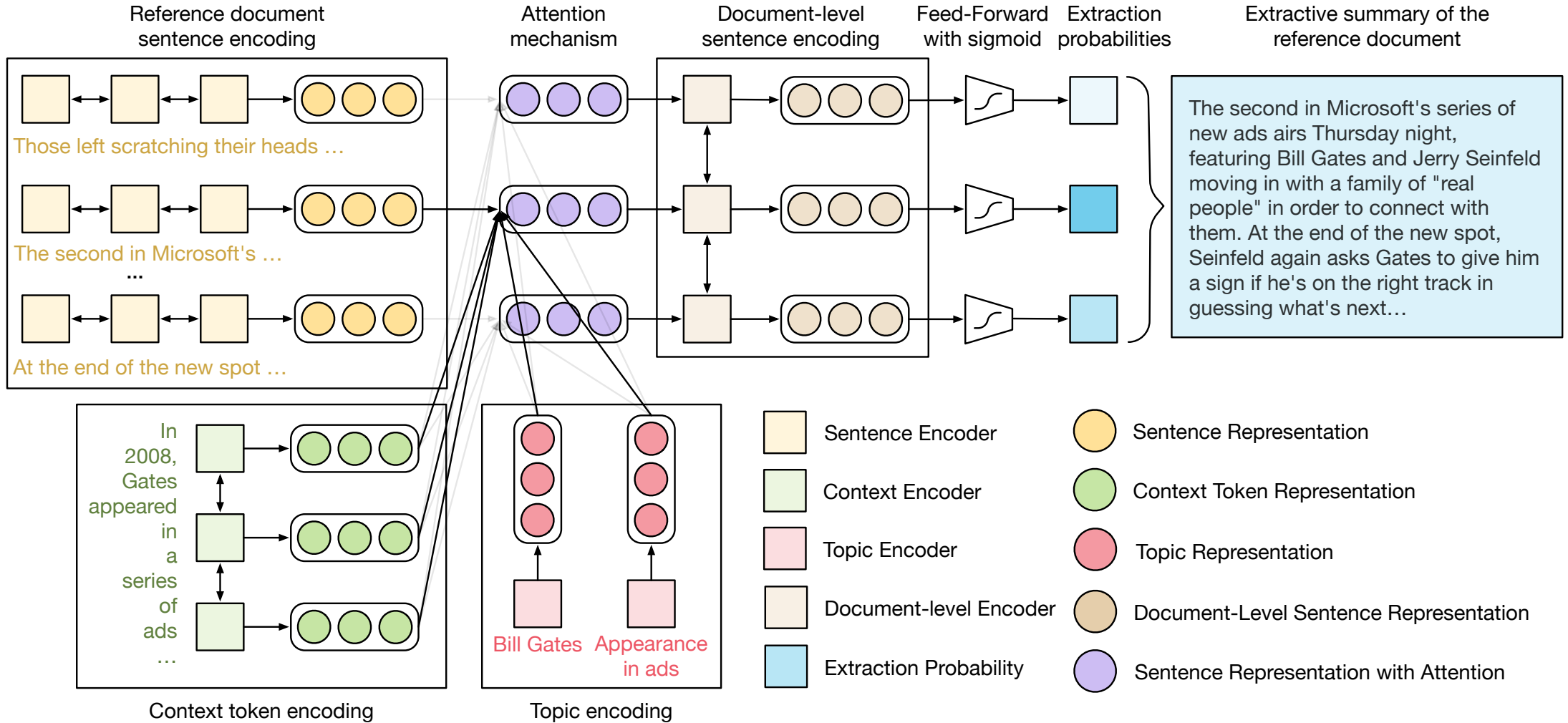
Extract 1 sentence



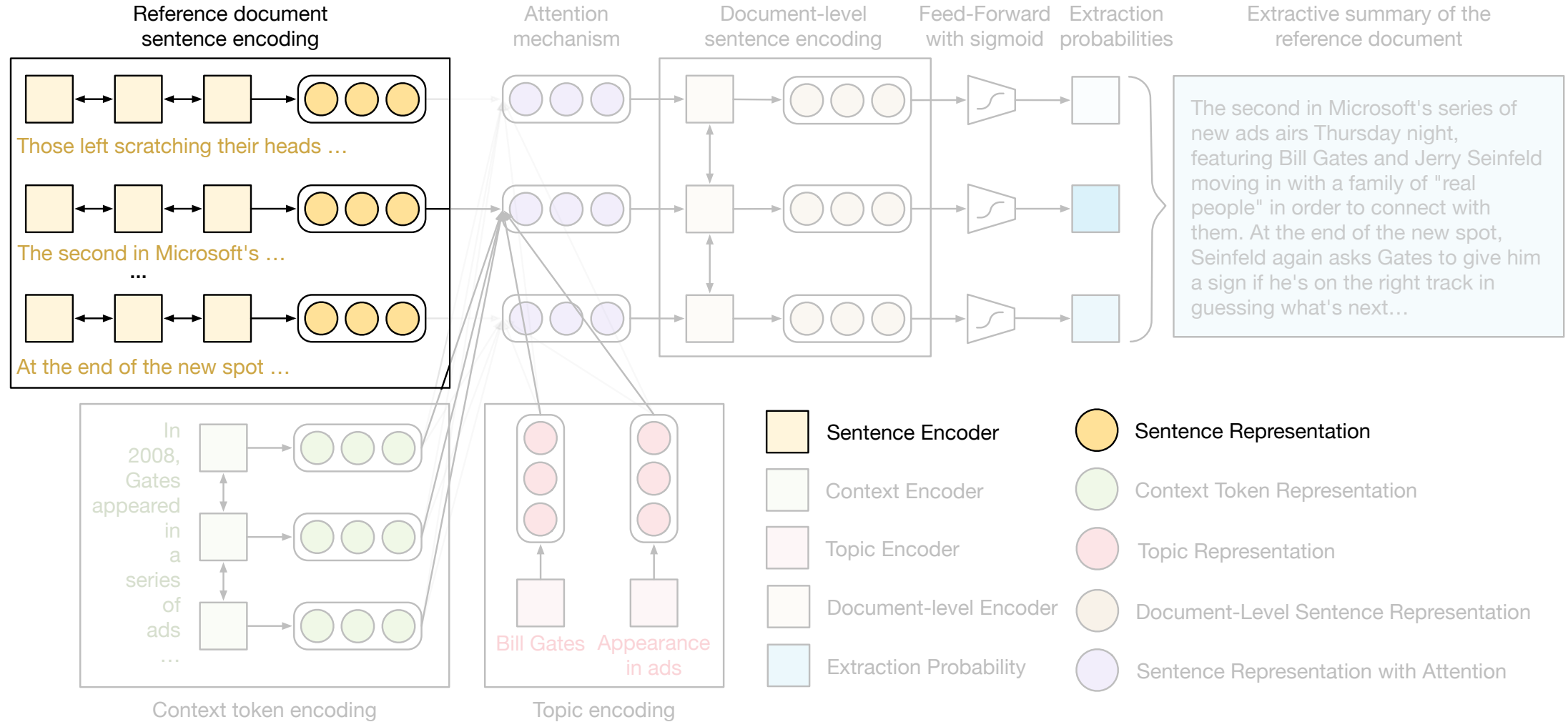
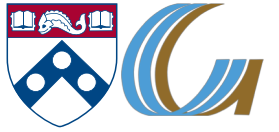
Extract 200 tokens,
Abtractively generate



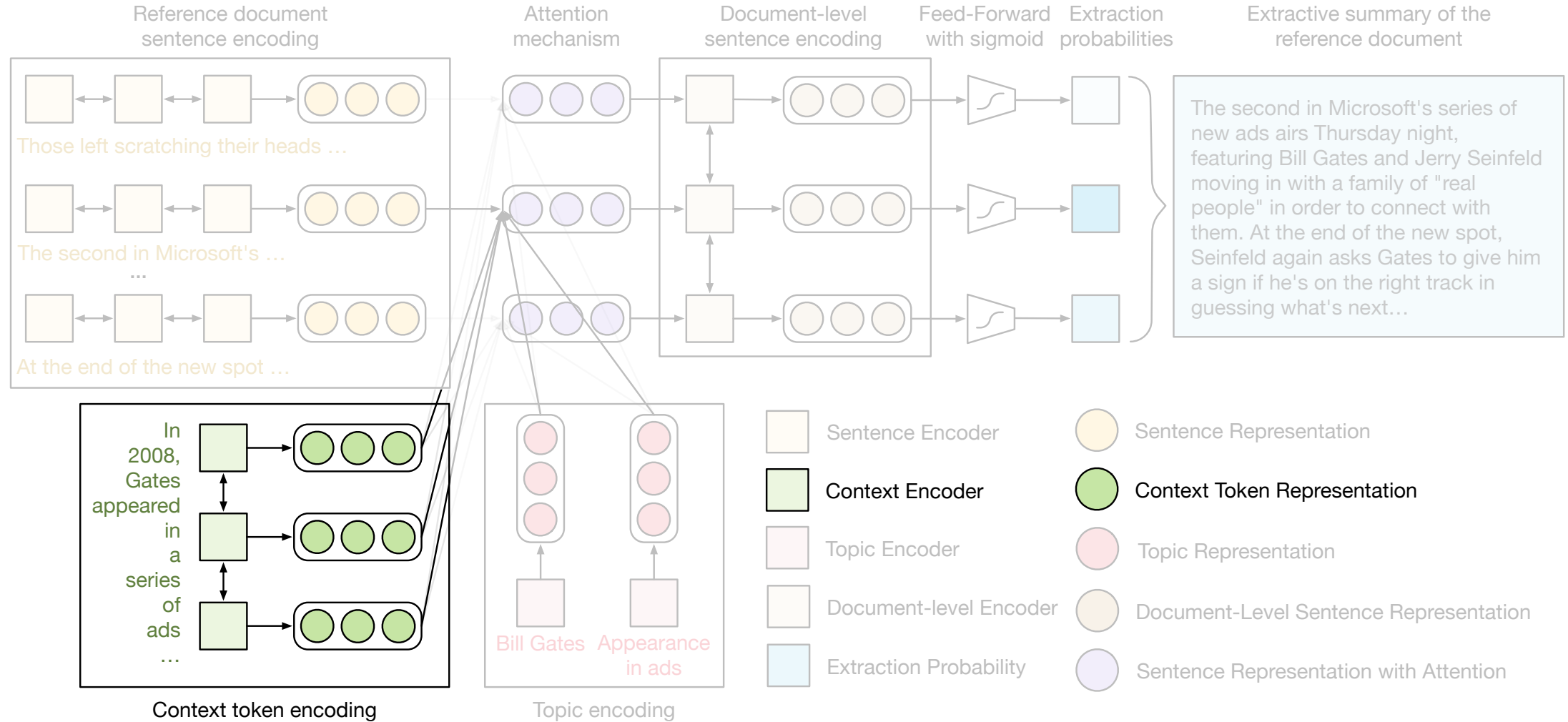
Extractive Model



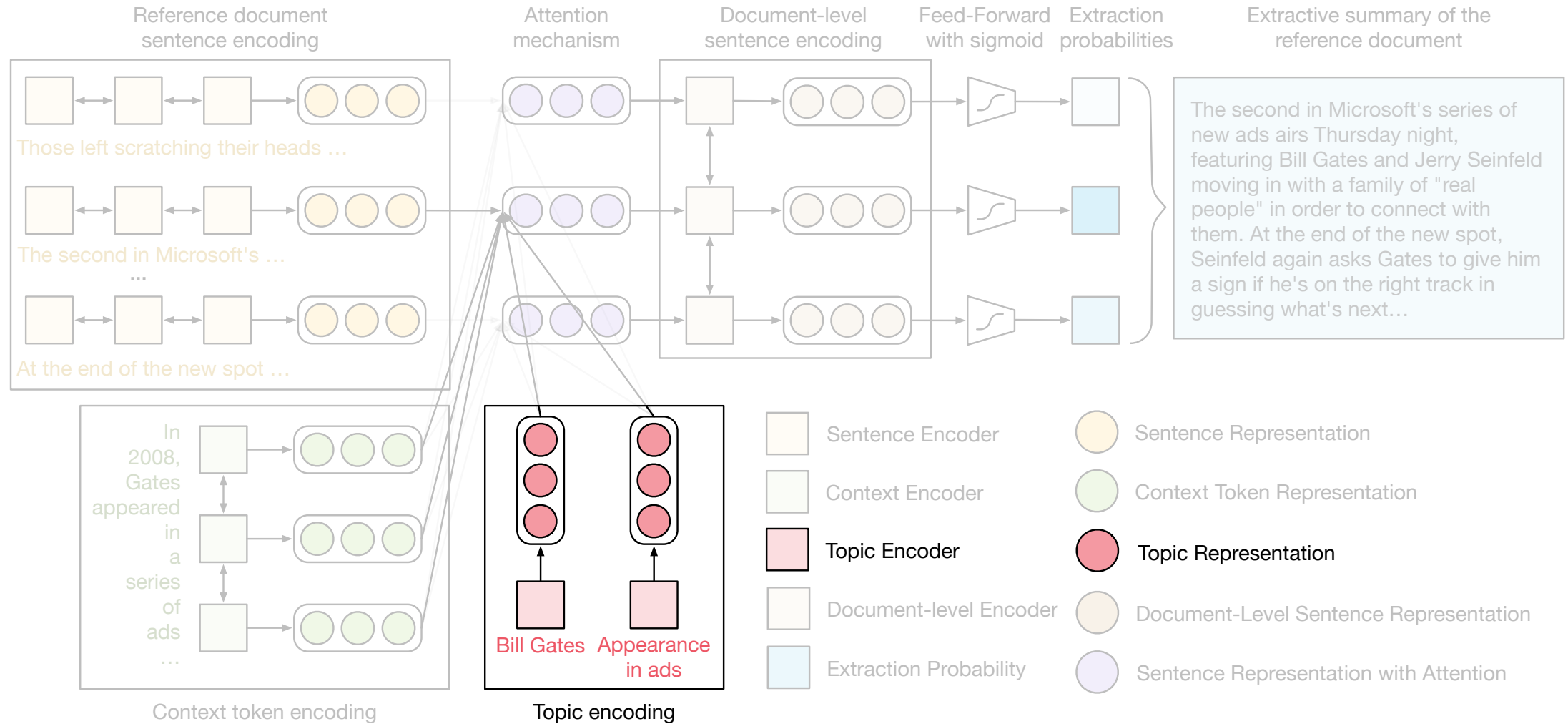
Extractive Model



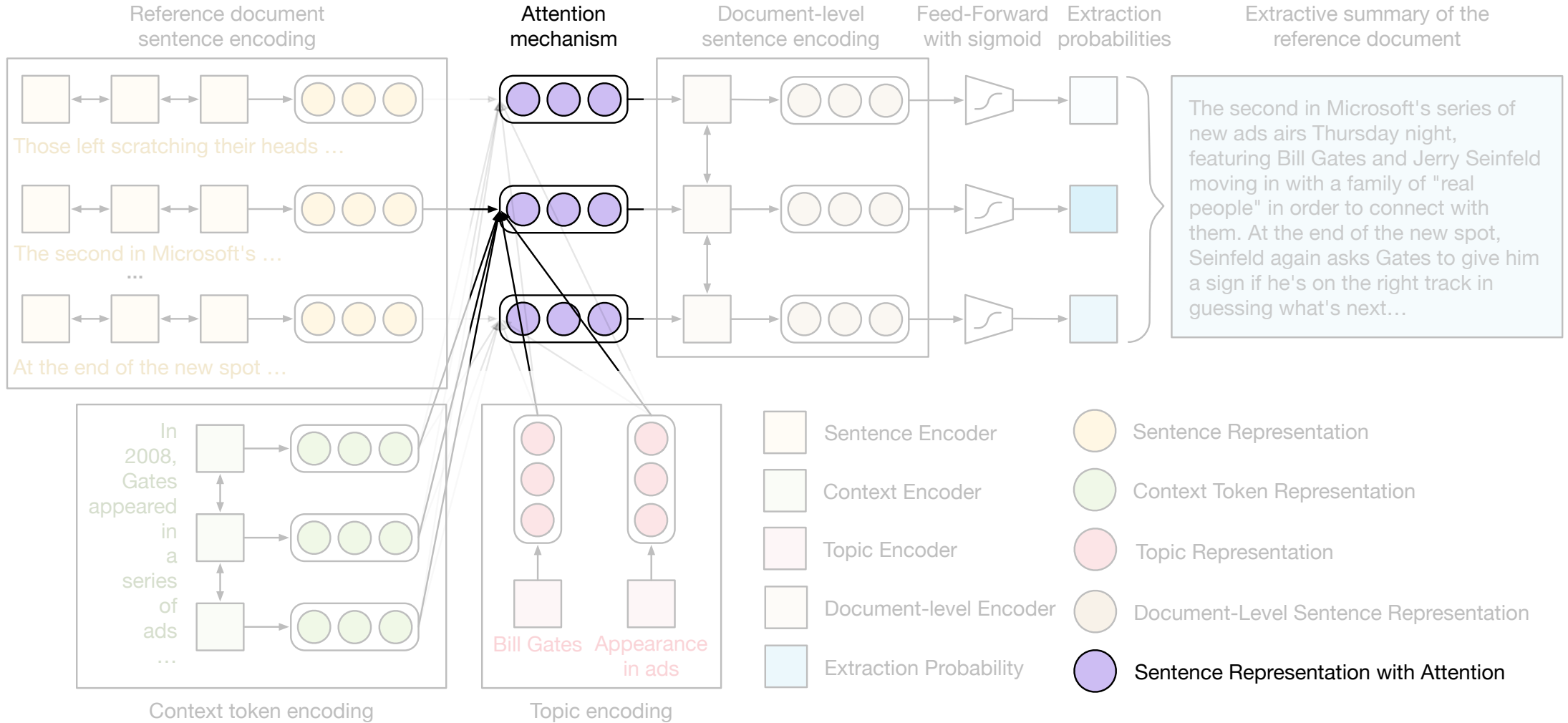
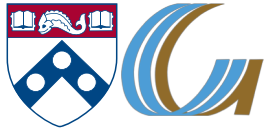
Extractive Model



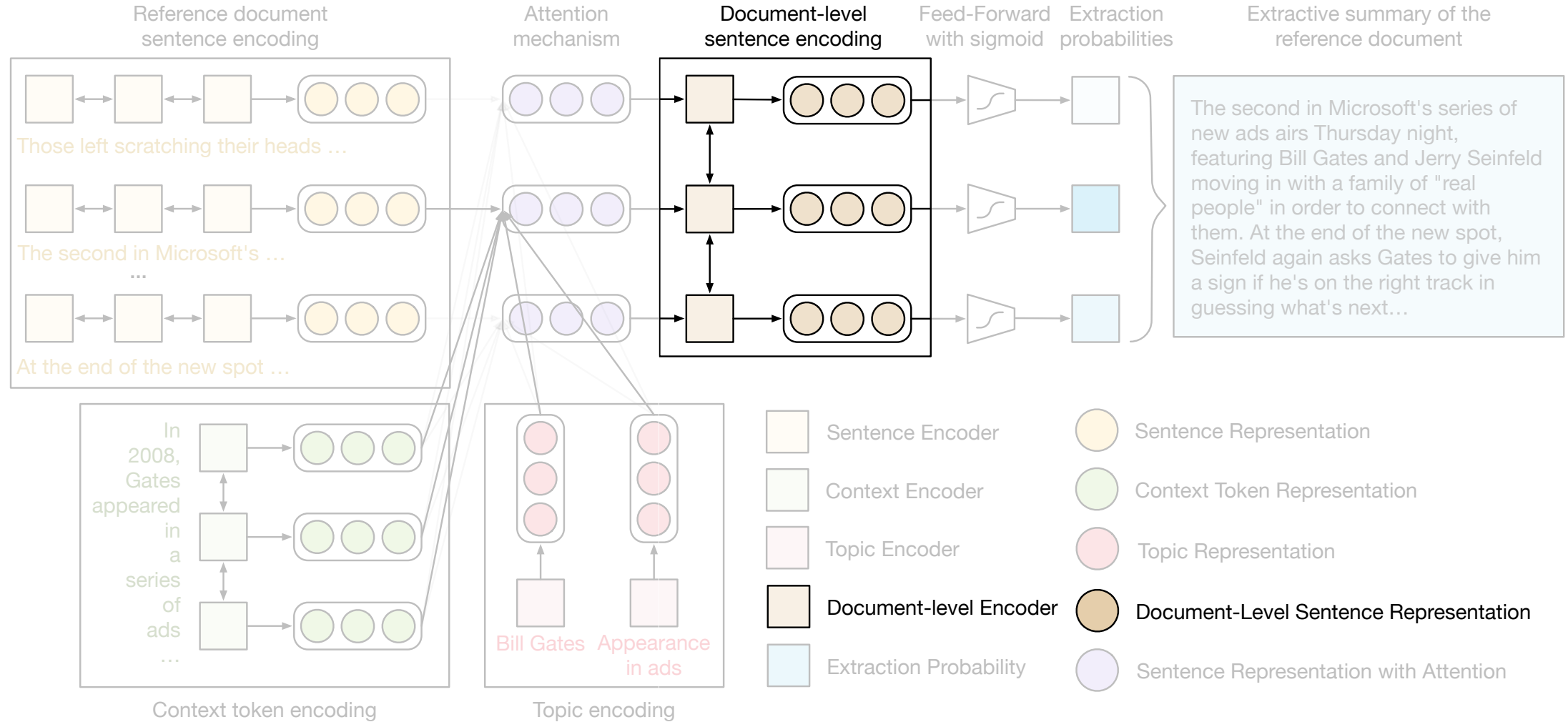
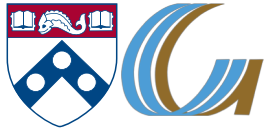
Extractive Model



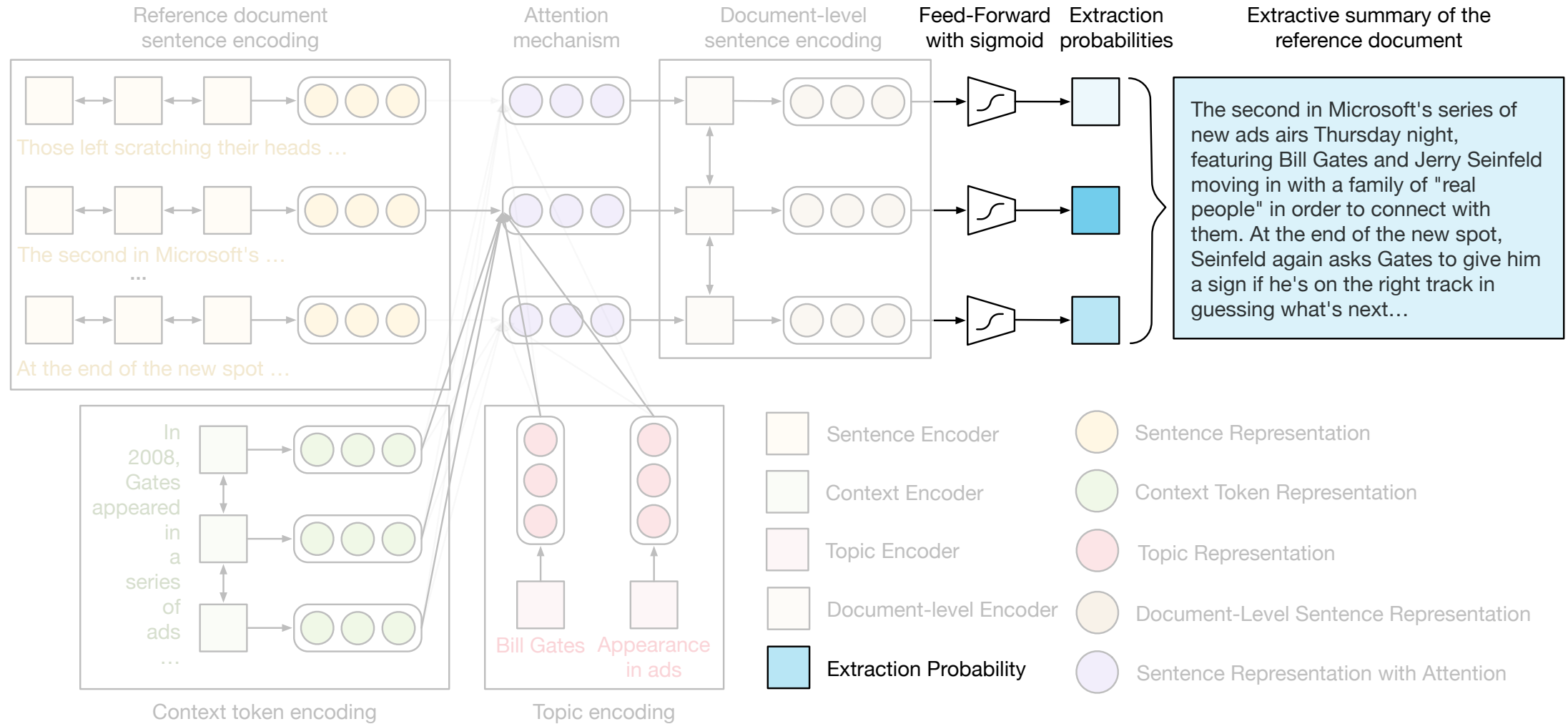
Extractive Model



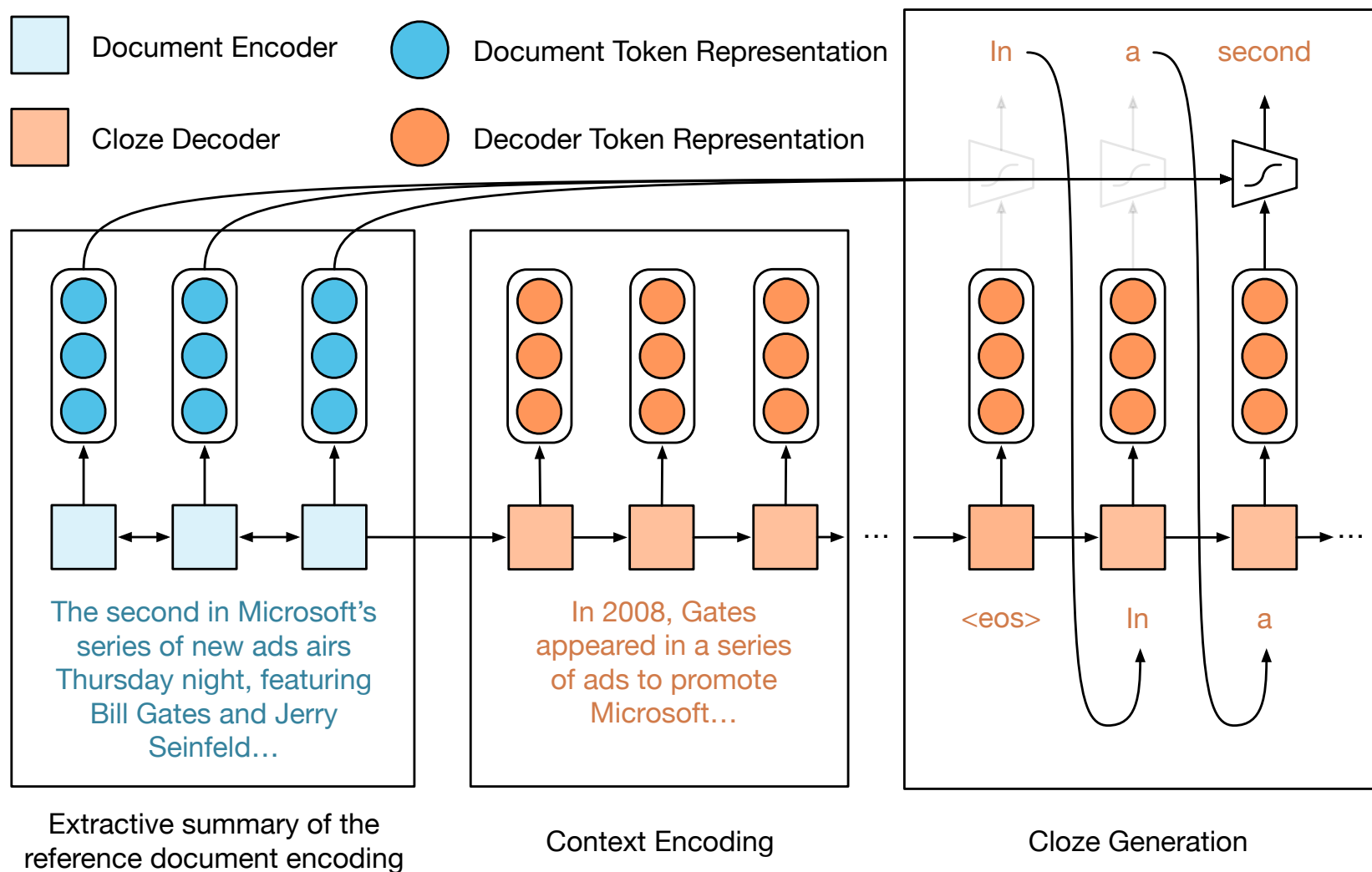
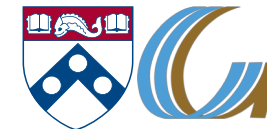
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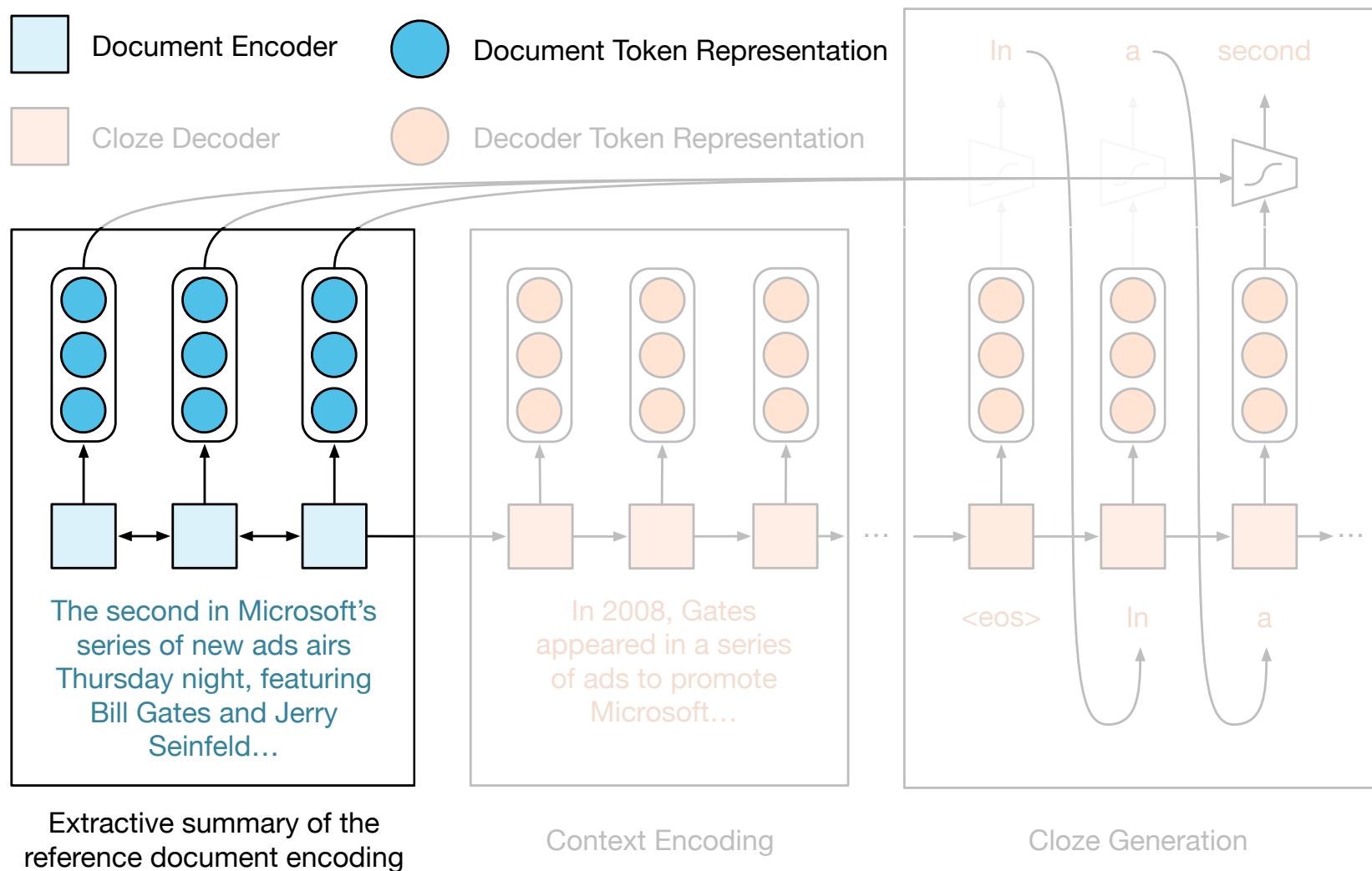
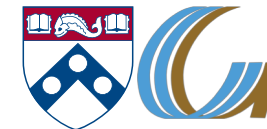
Extractive Model



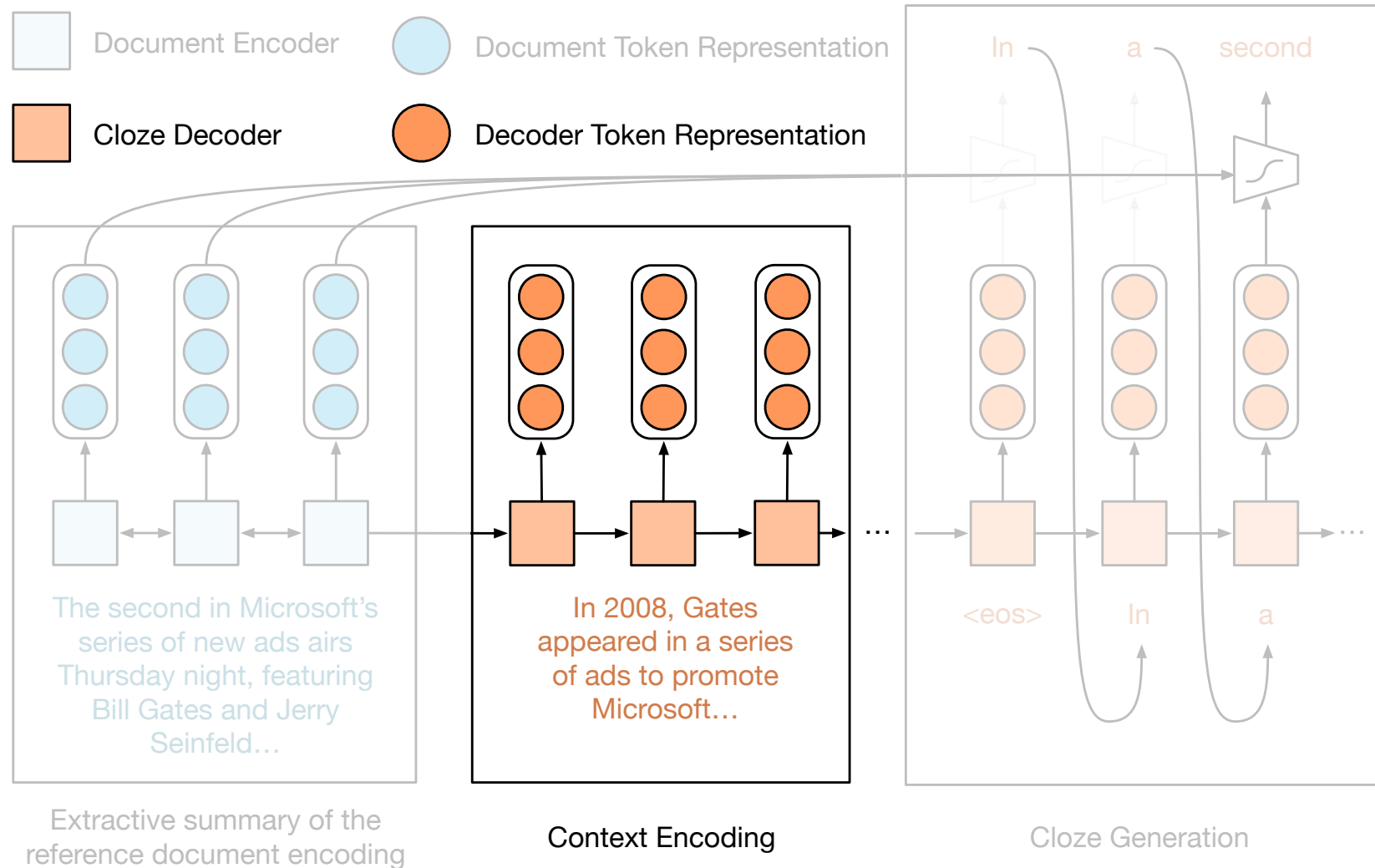
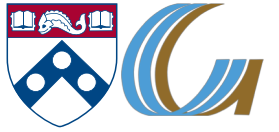
Abstractive Model



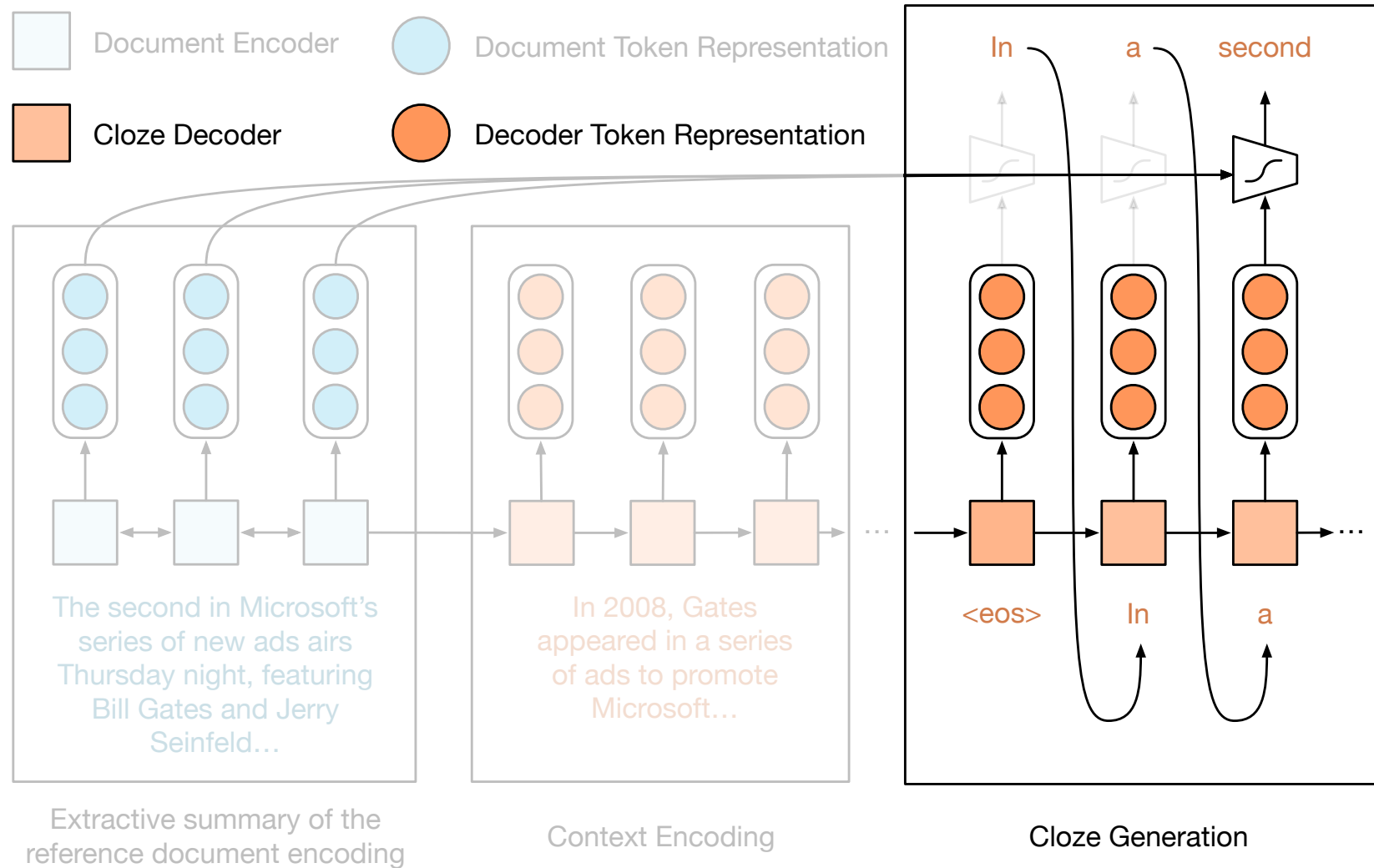
Abstractive Model



Abstractive Model

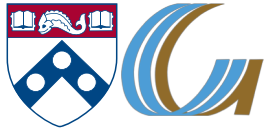


Abstractive Model

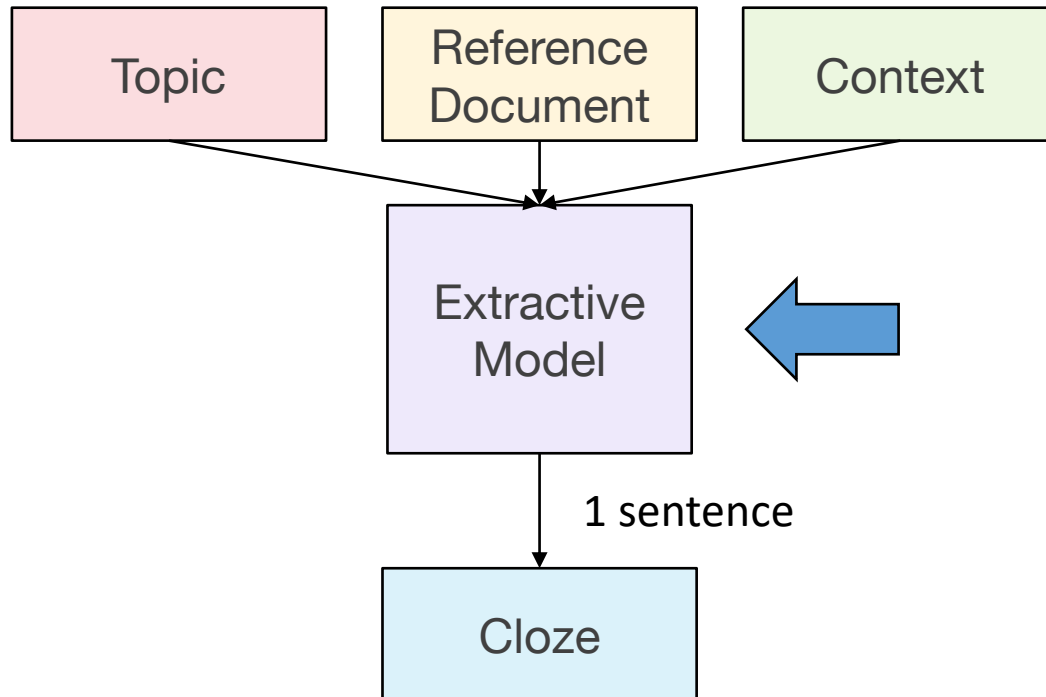


Experiments

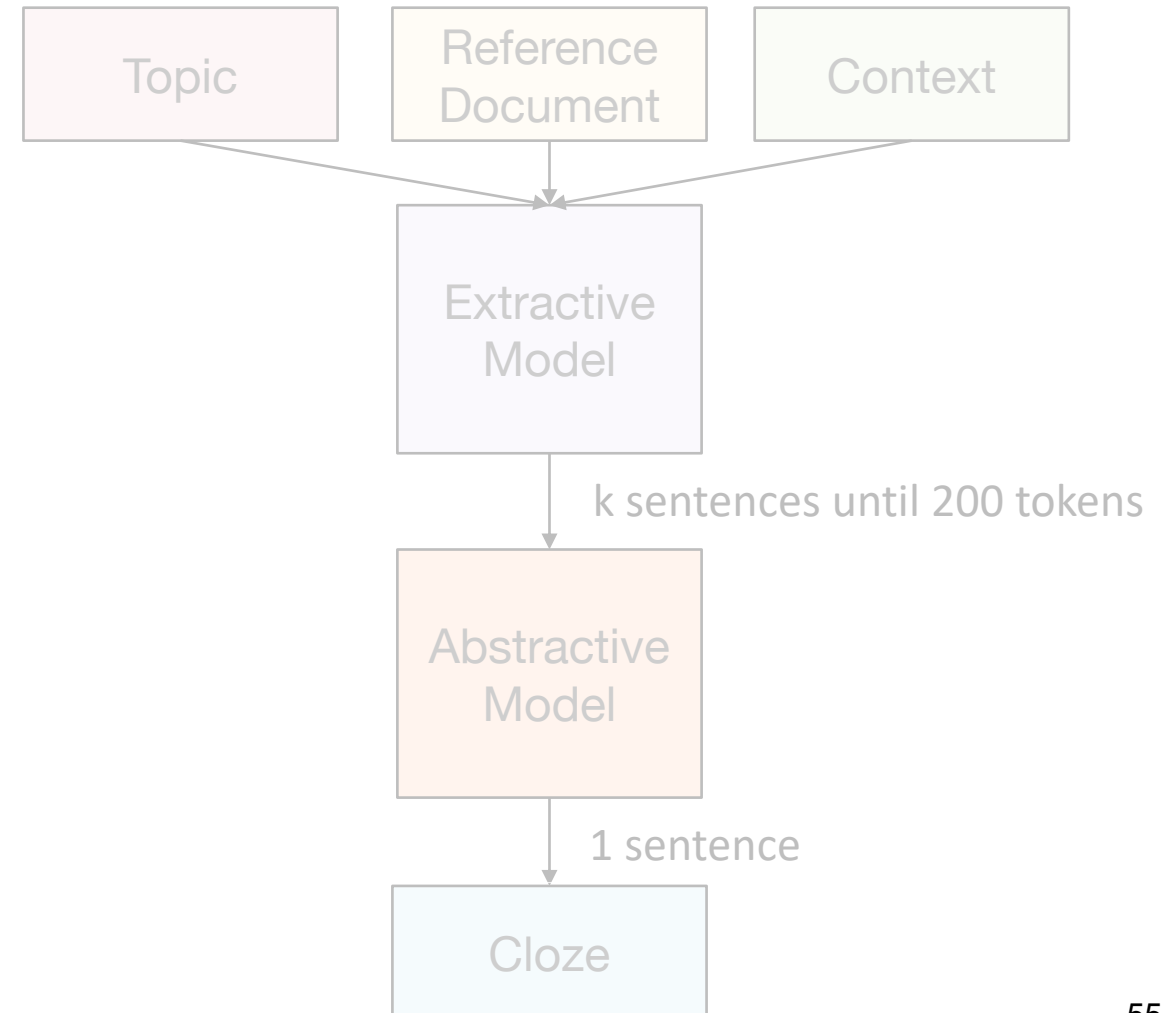
Experiments



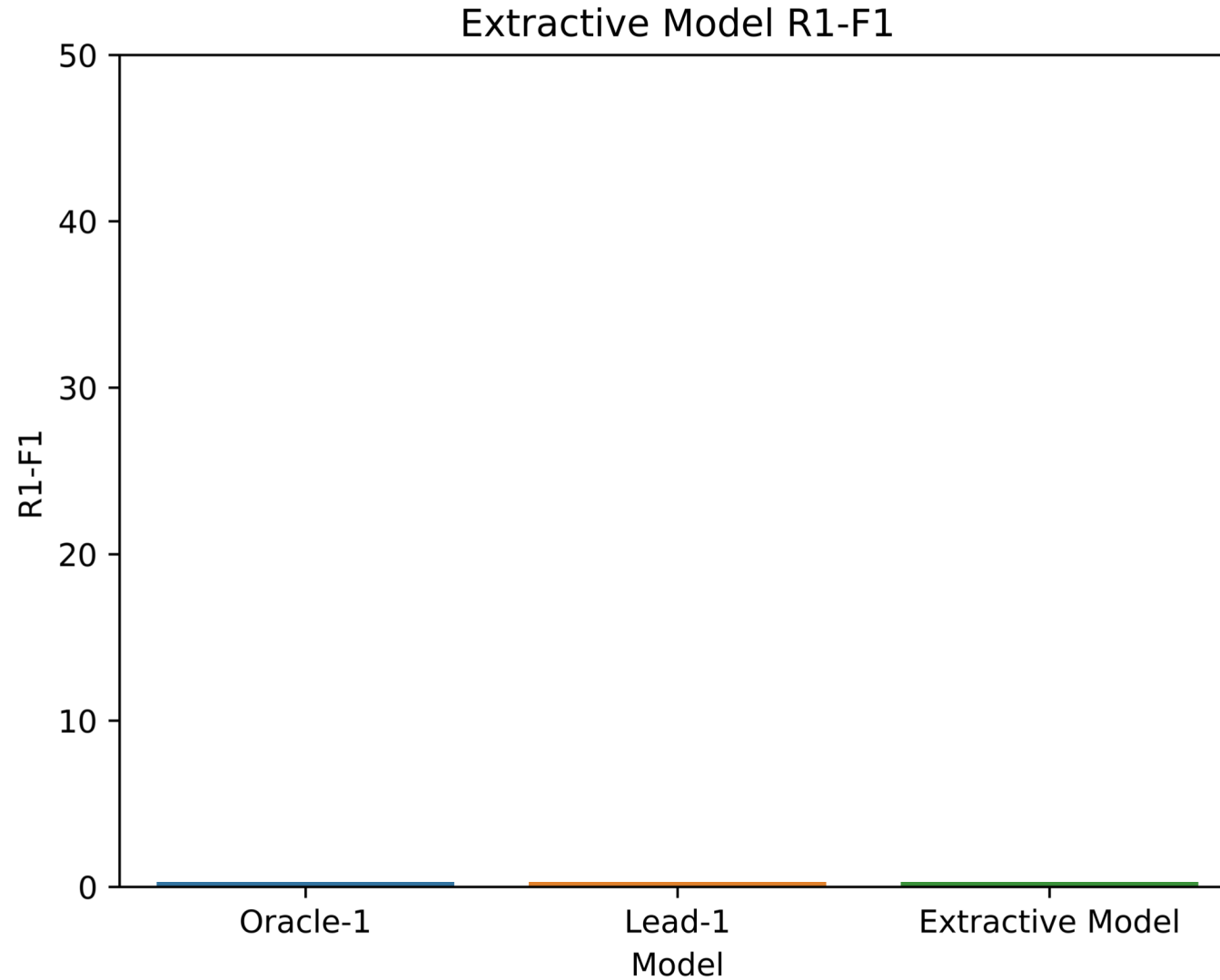
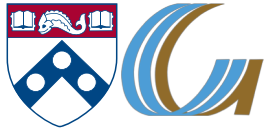
Extract 1 sentence



Extract 200 tokens,
Abtractively generate



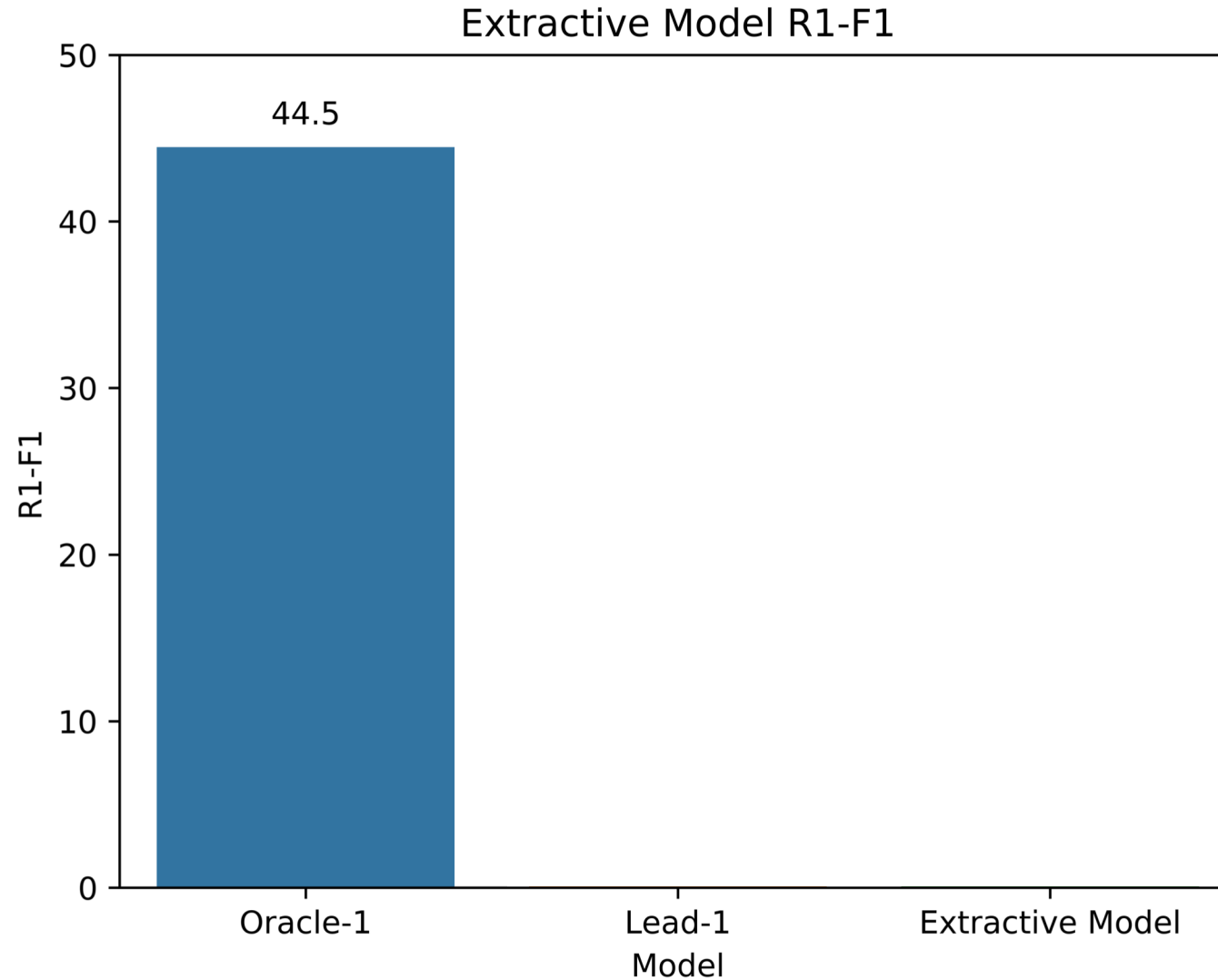
Extractive Model Evaluation



Extractive Model Evaluation



Best any sentence-
level extractive
system can do

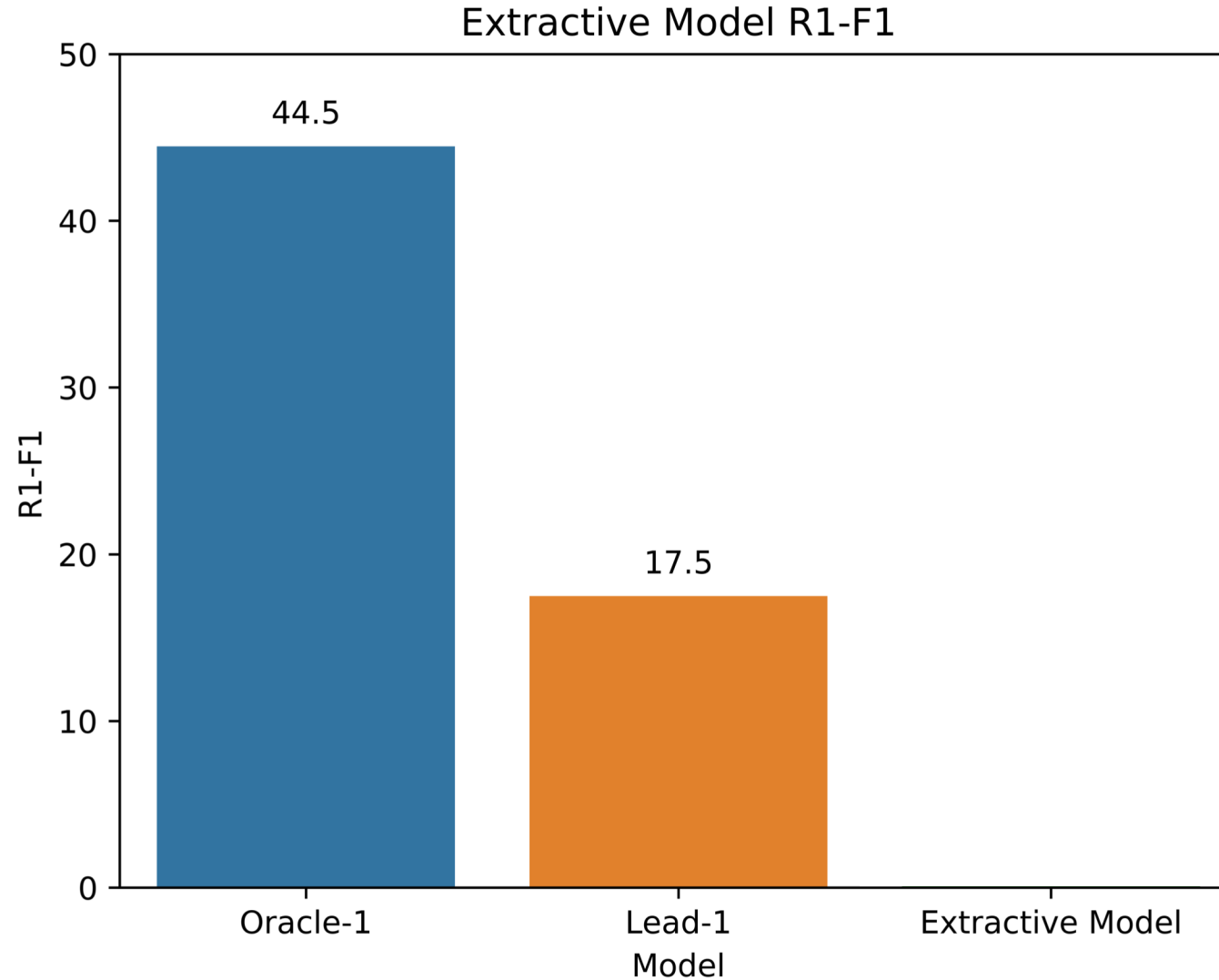


Extractive Model Evaluation



Best any sentence-
level extractive
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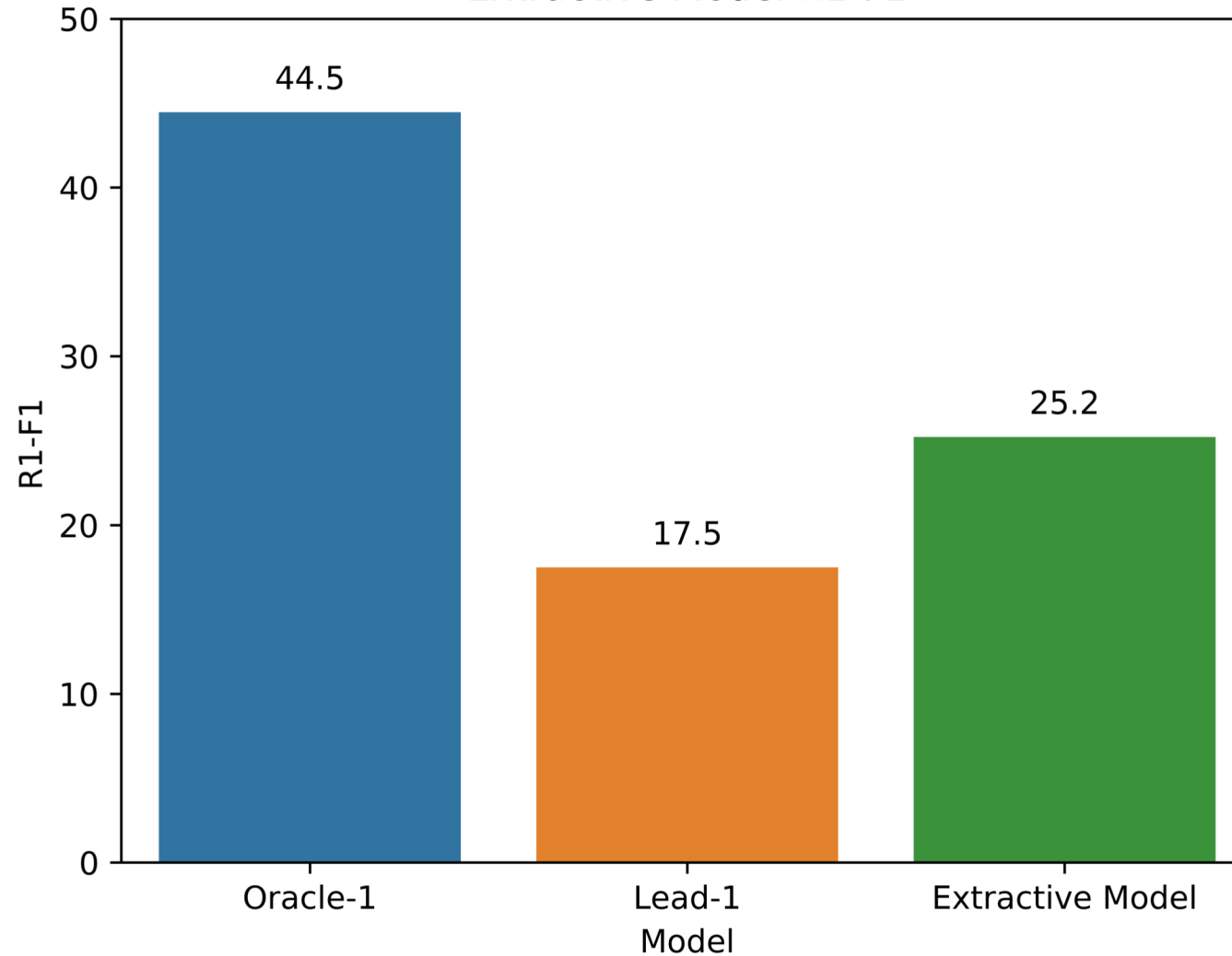
First sentence of
reference document



Extractive Model Evaluation



Extractive Model R1-F1

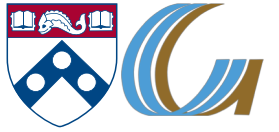


Best any sentence-level extractive system can do

First sentence of reference document

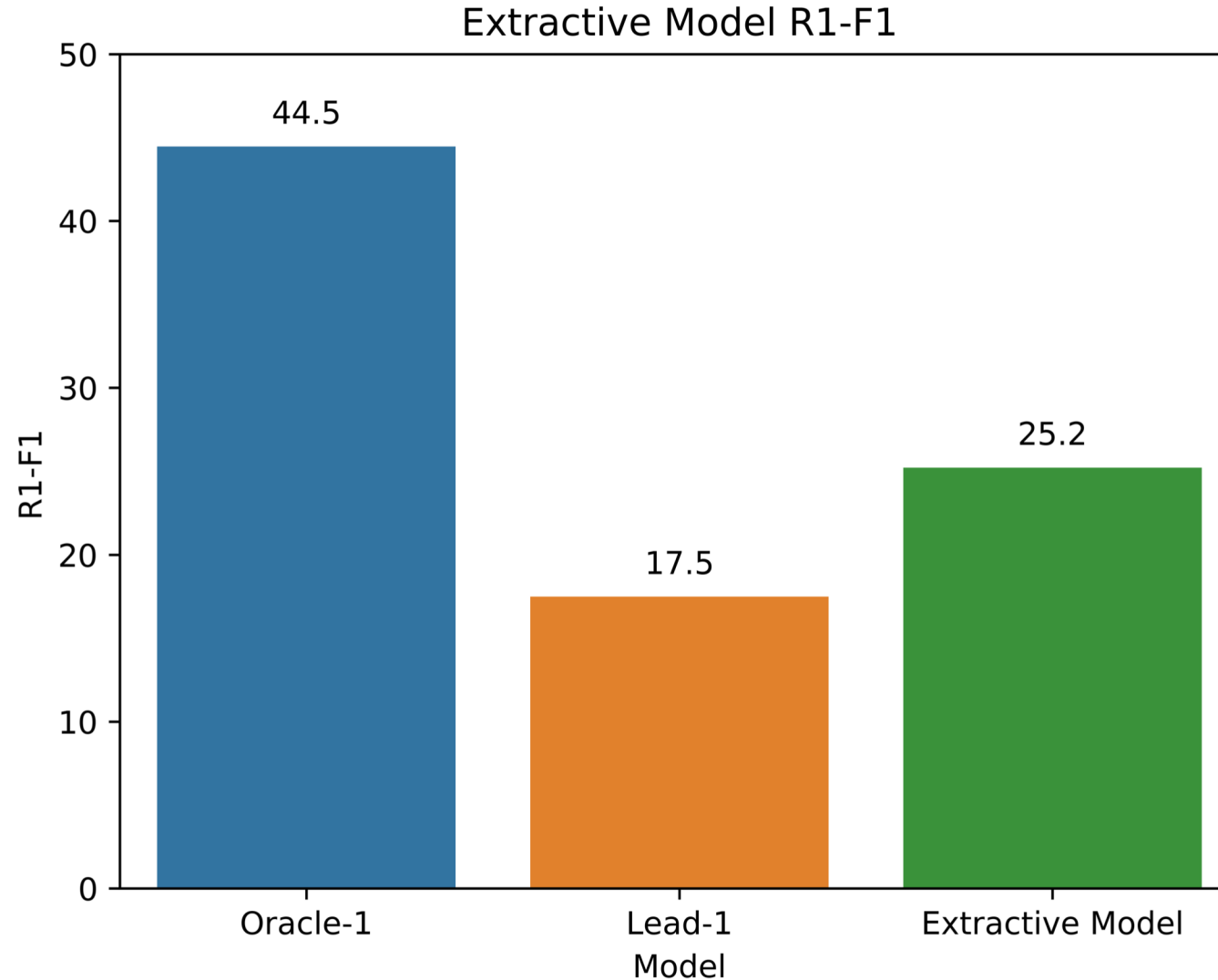
Extractive model gets 7.7 F_1 improvement over lead

Extractive Model Evaluation



Best any sentence-level extractive system can do

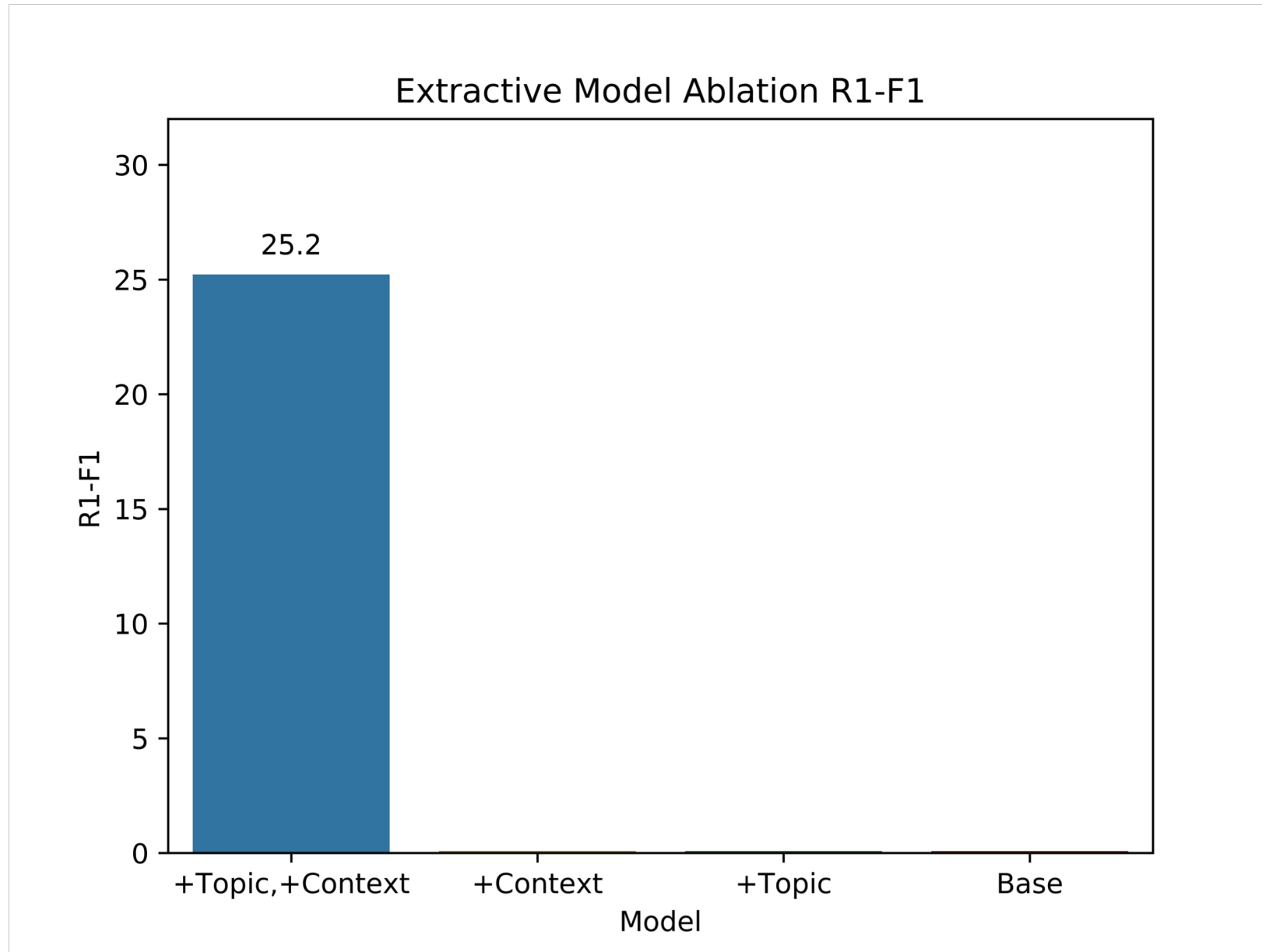
First sentence of reference document



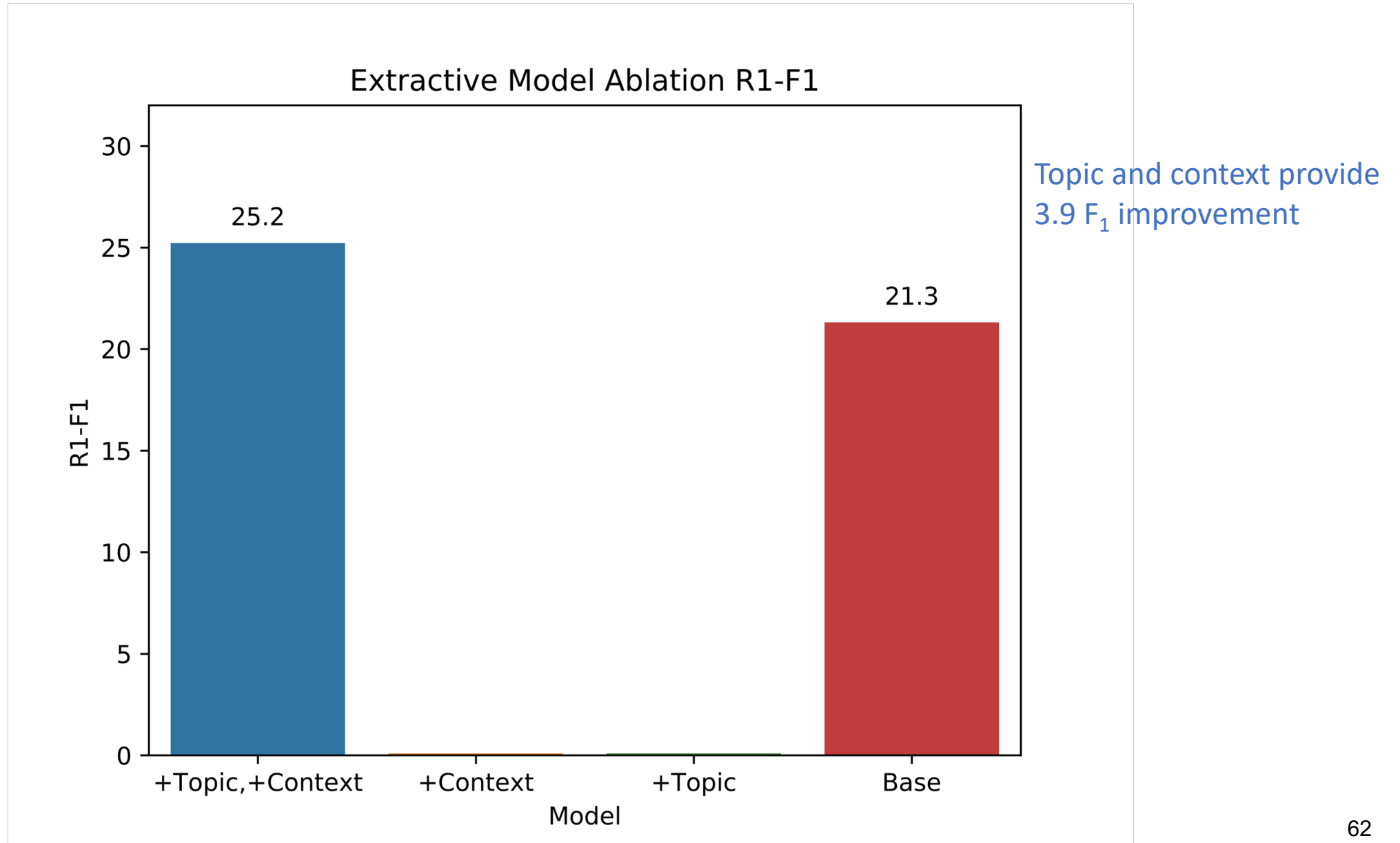
Extractive model gets 7.7 F_1 improvement over lead

Other baselines included in paper

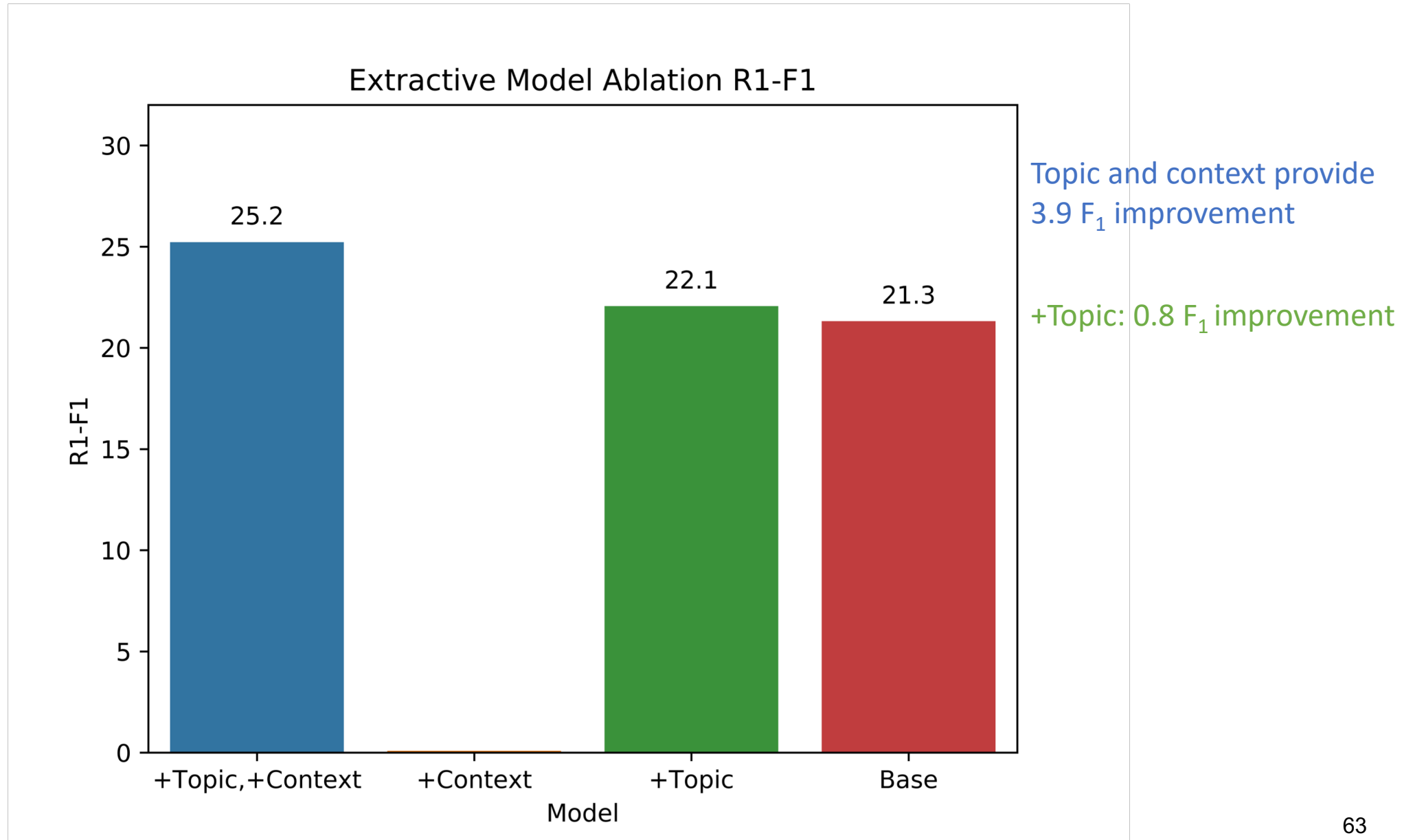
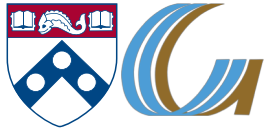
Extractive Model Ablation



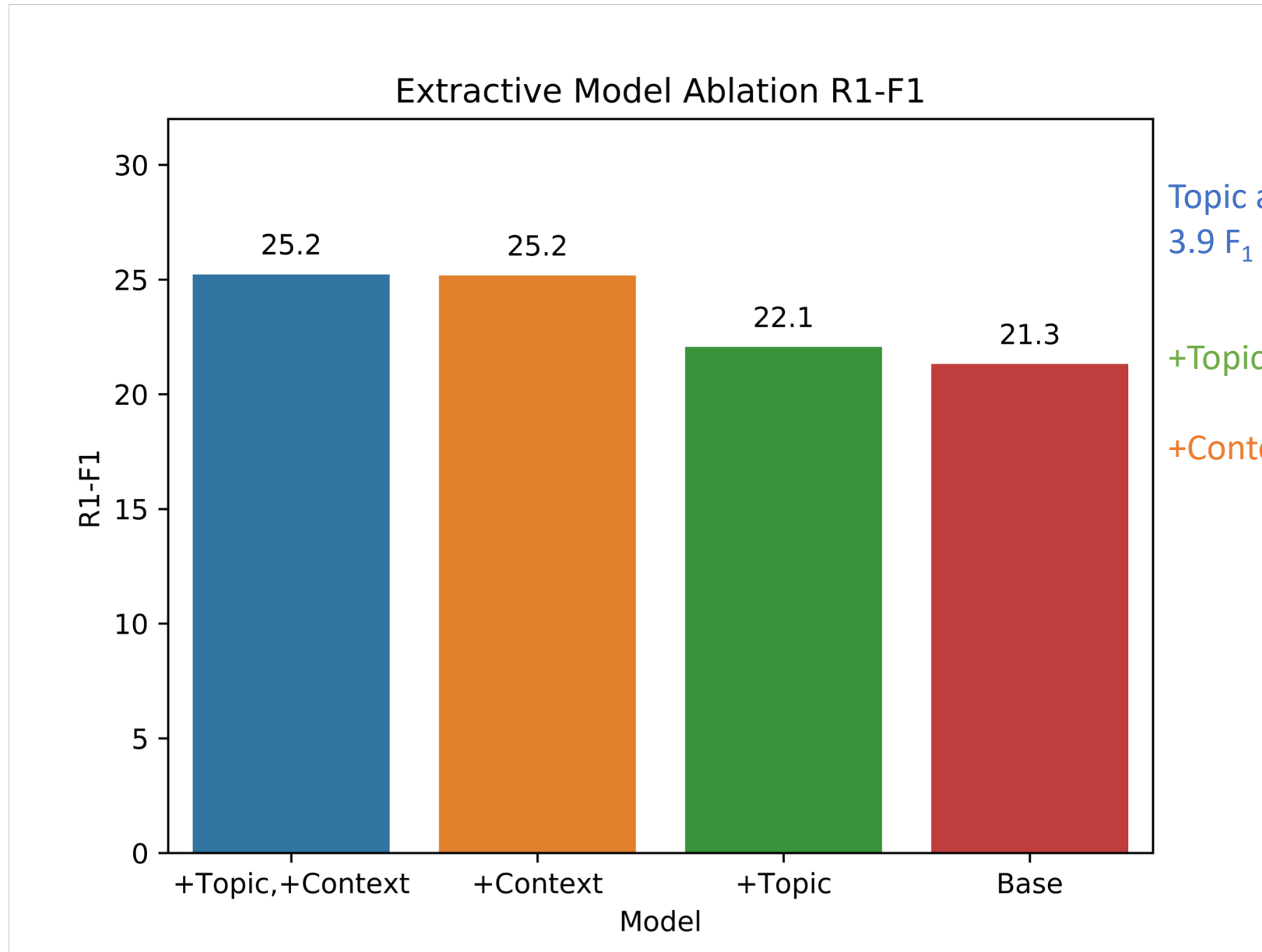
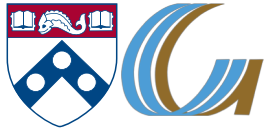
Extractive Model Ablation



Extractive Model Ablation



Extractive Model Ablation

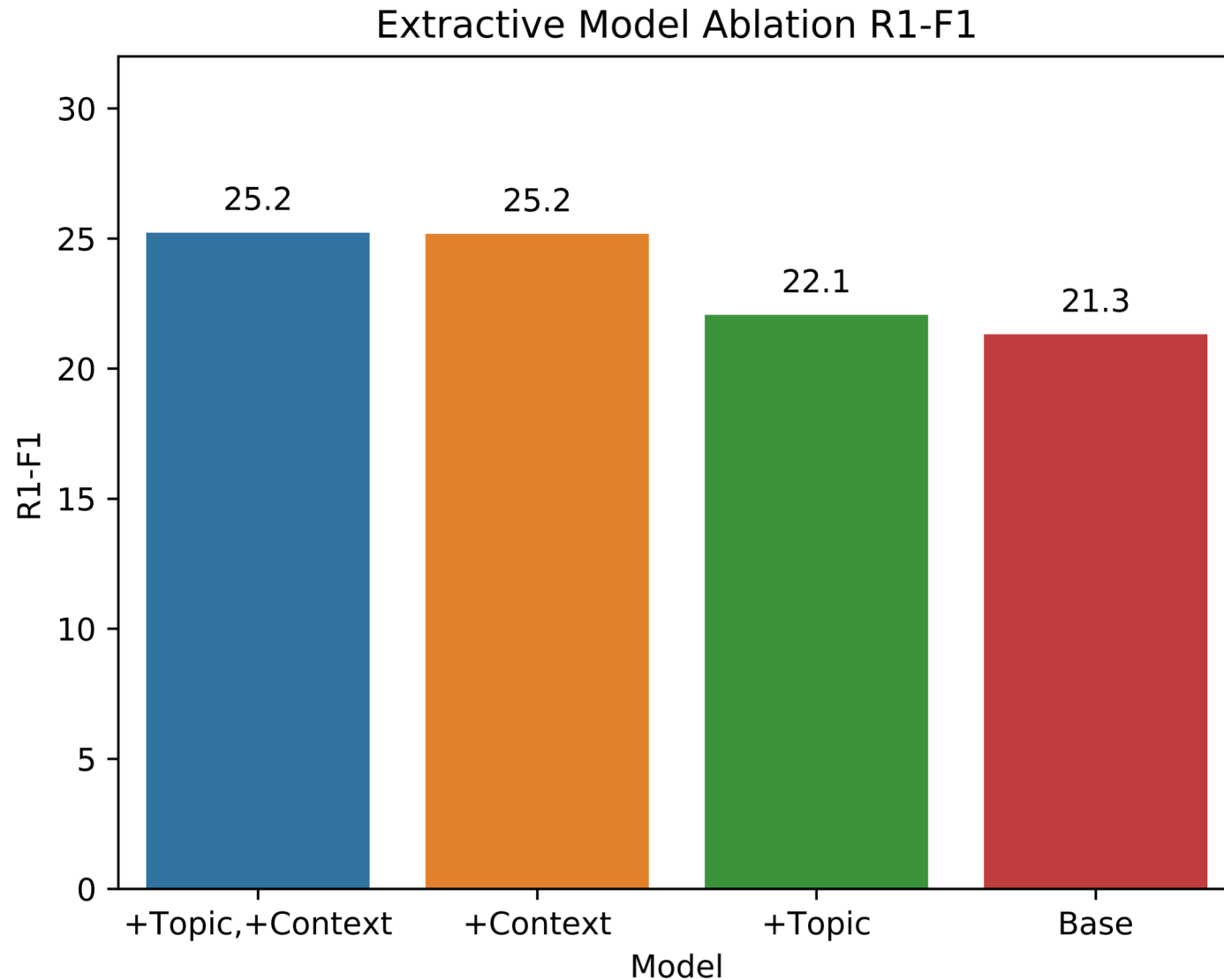


Topic and context provide
3.9 F_1 improvement

+Topic: 0.8 F_1 improvement

+Context: 3.9 F_1 improvement

Extractive Model Ablation



Topic and context provide
3.9 F_1 improvement

+Topic: 0.8 F_1 improvement

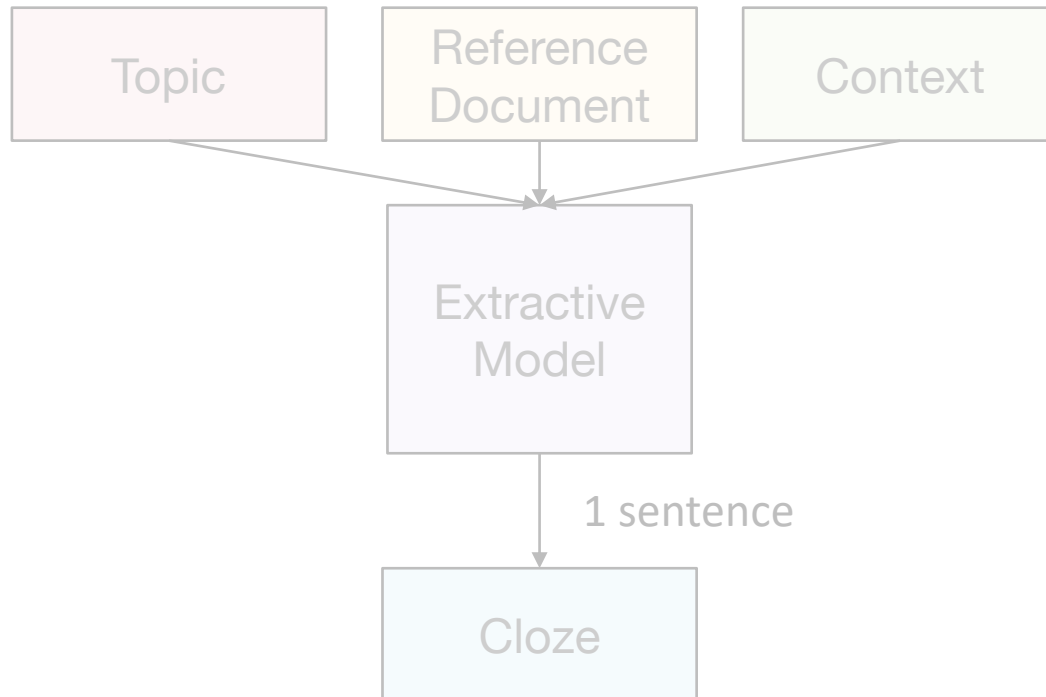
+Context: 3.9 F_1 improvement

Improvements do not stack

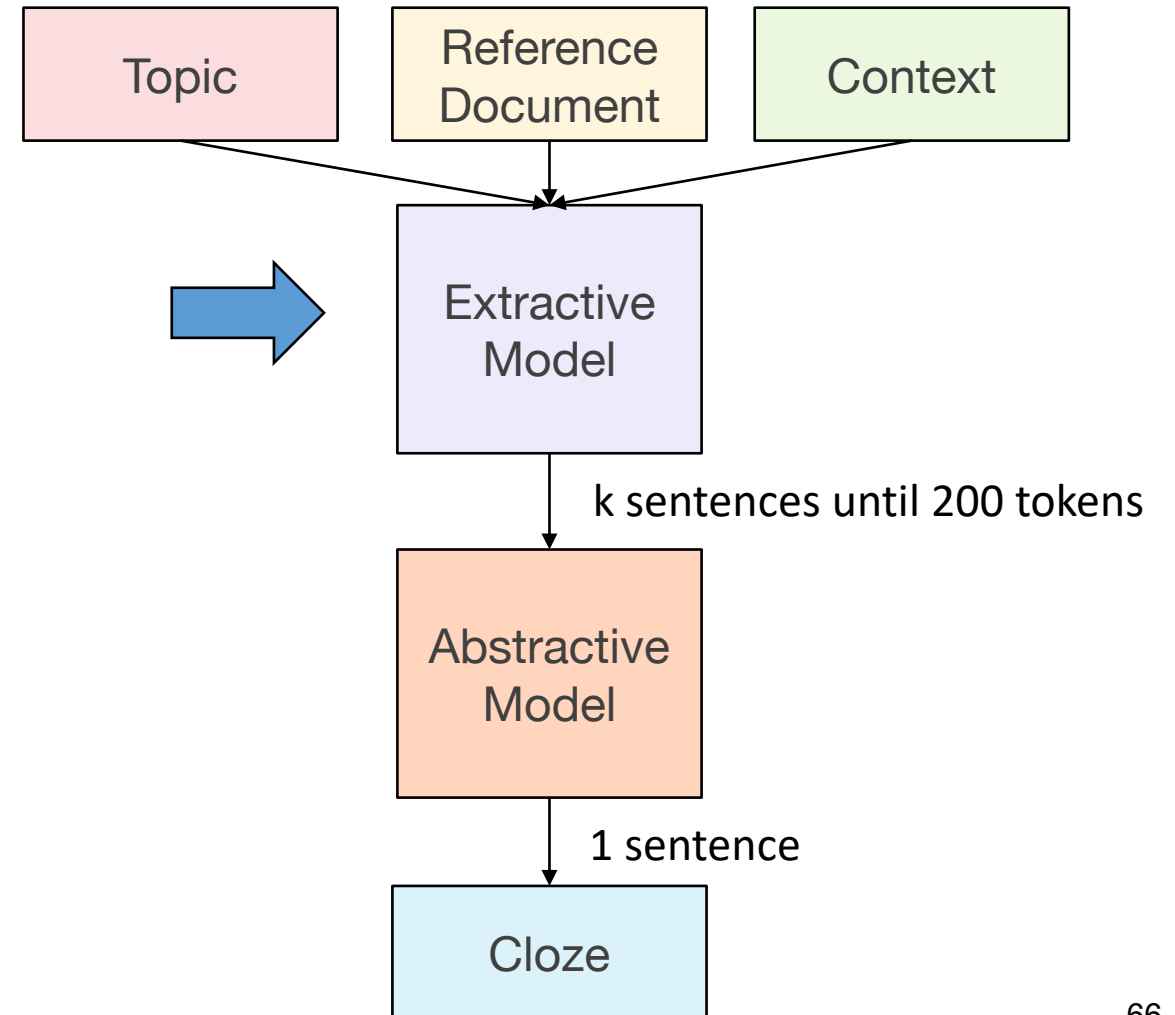
Experiments



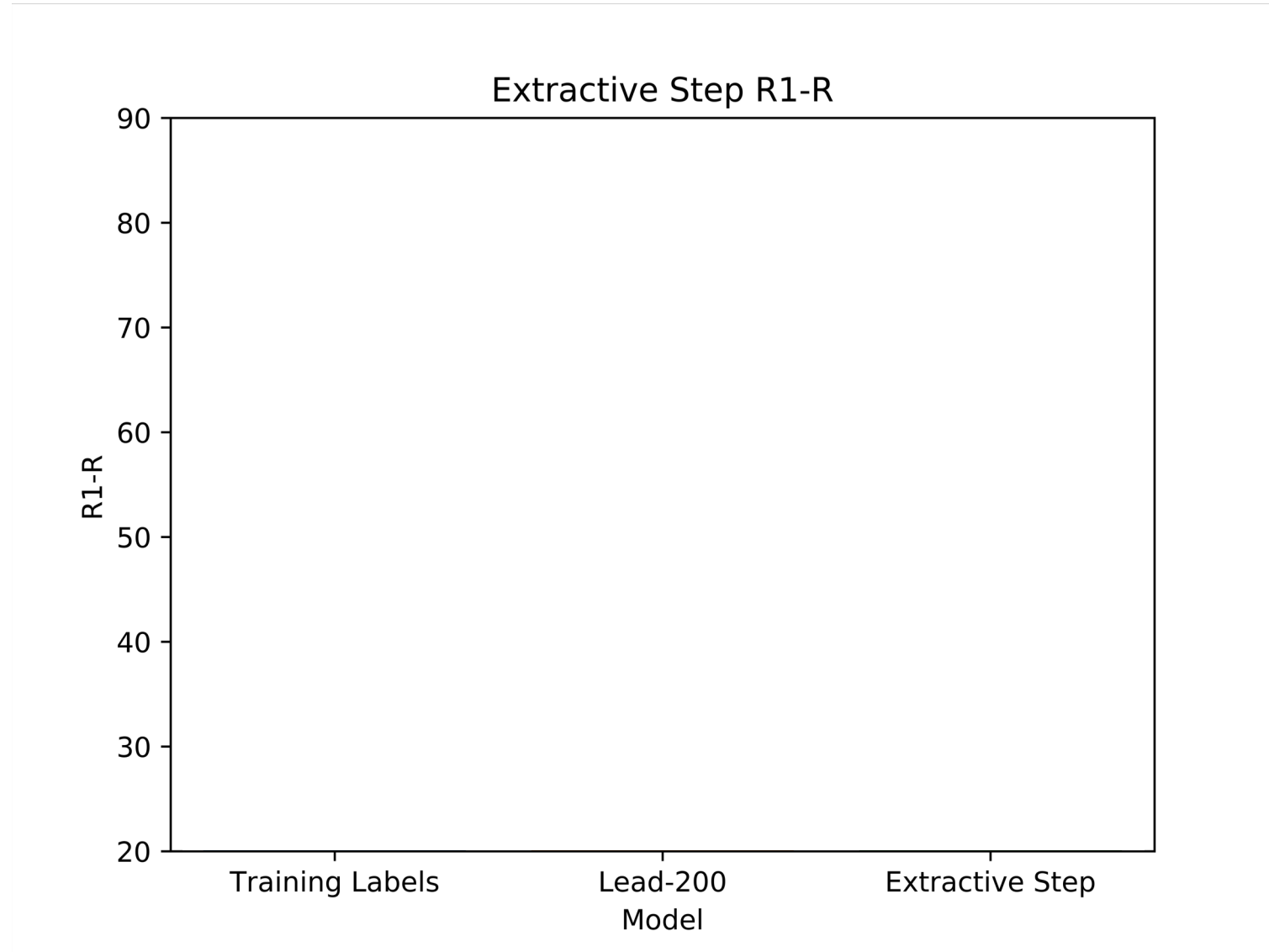
Extract 1 sentence



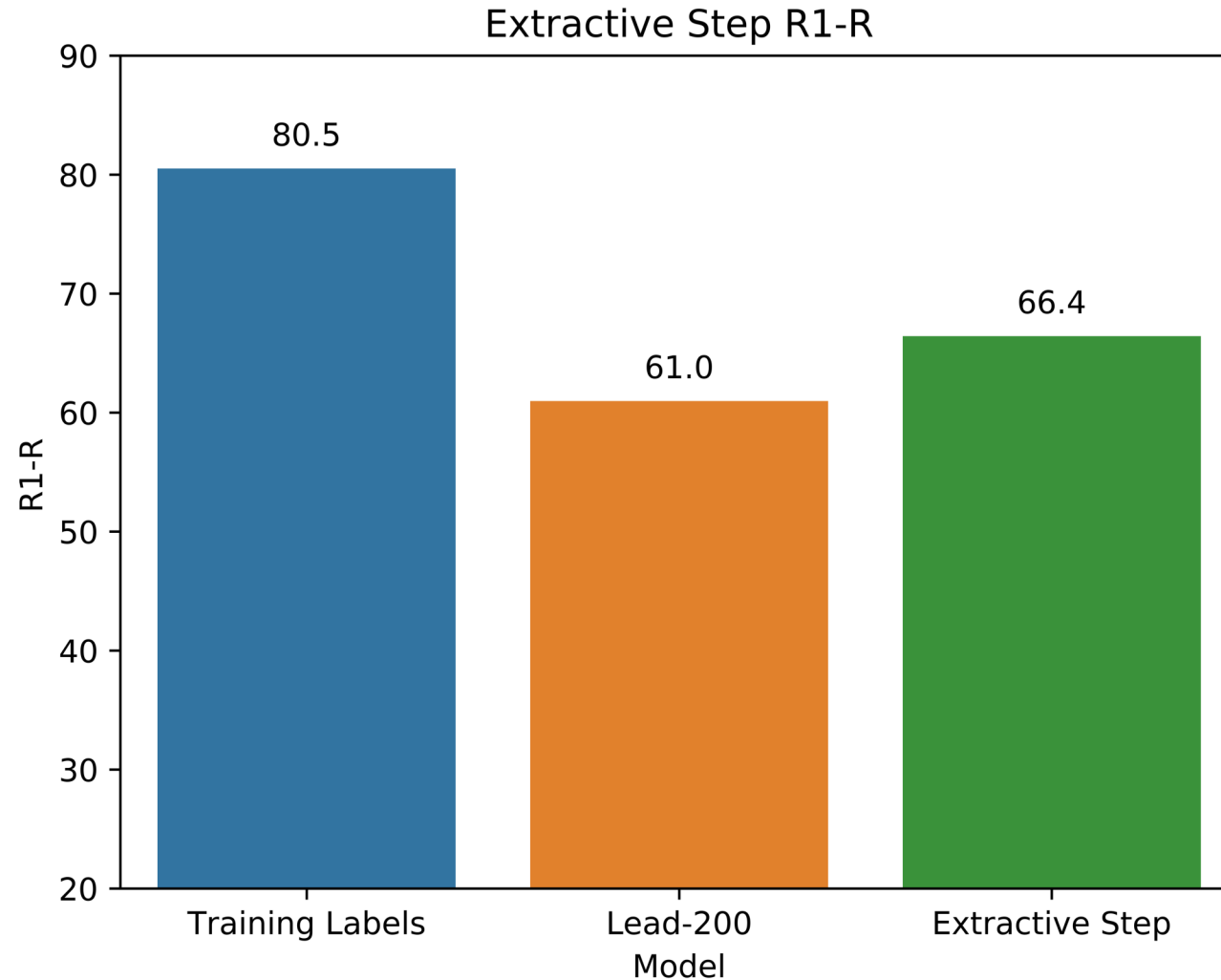
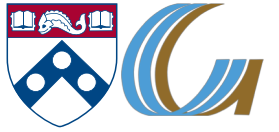
Extract 200 tokens,
Abtractively generate



Extractive Step Evaluation



Extractive Step Evaluation

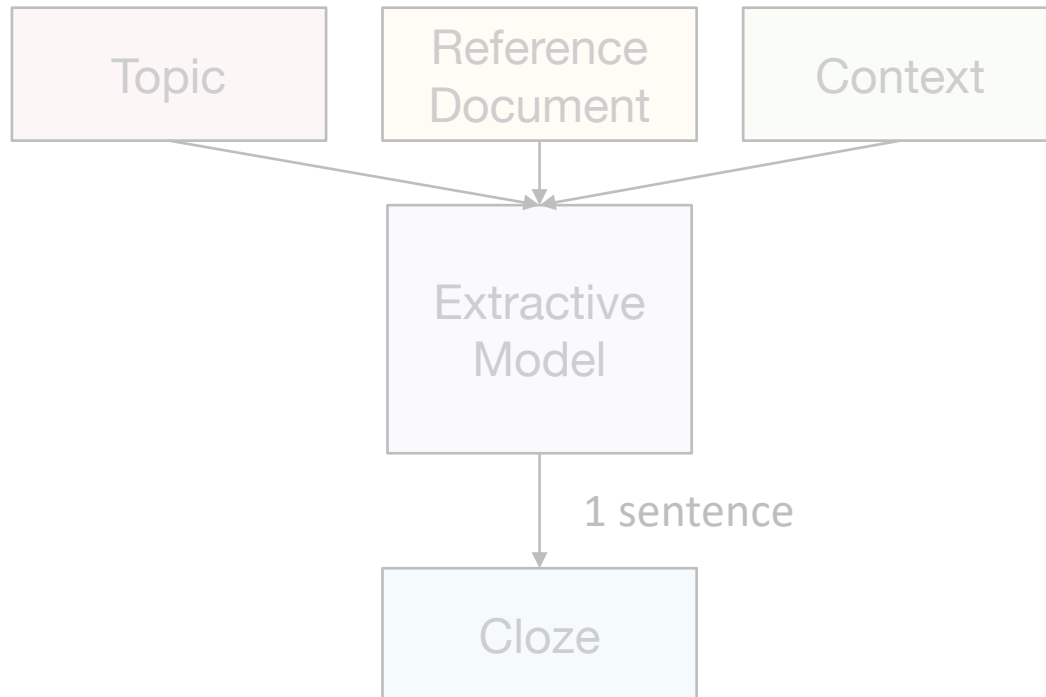


14 recall point gap between model and “perfect” model

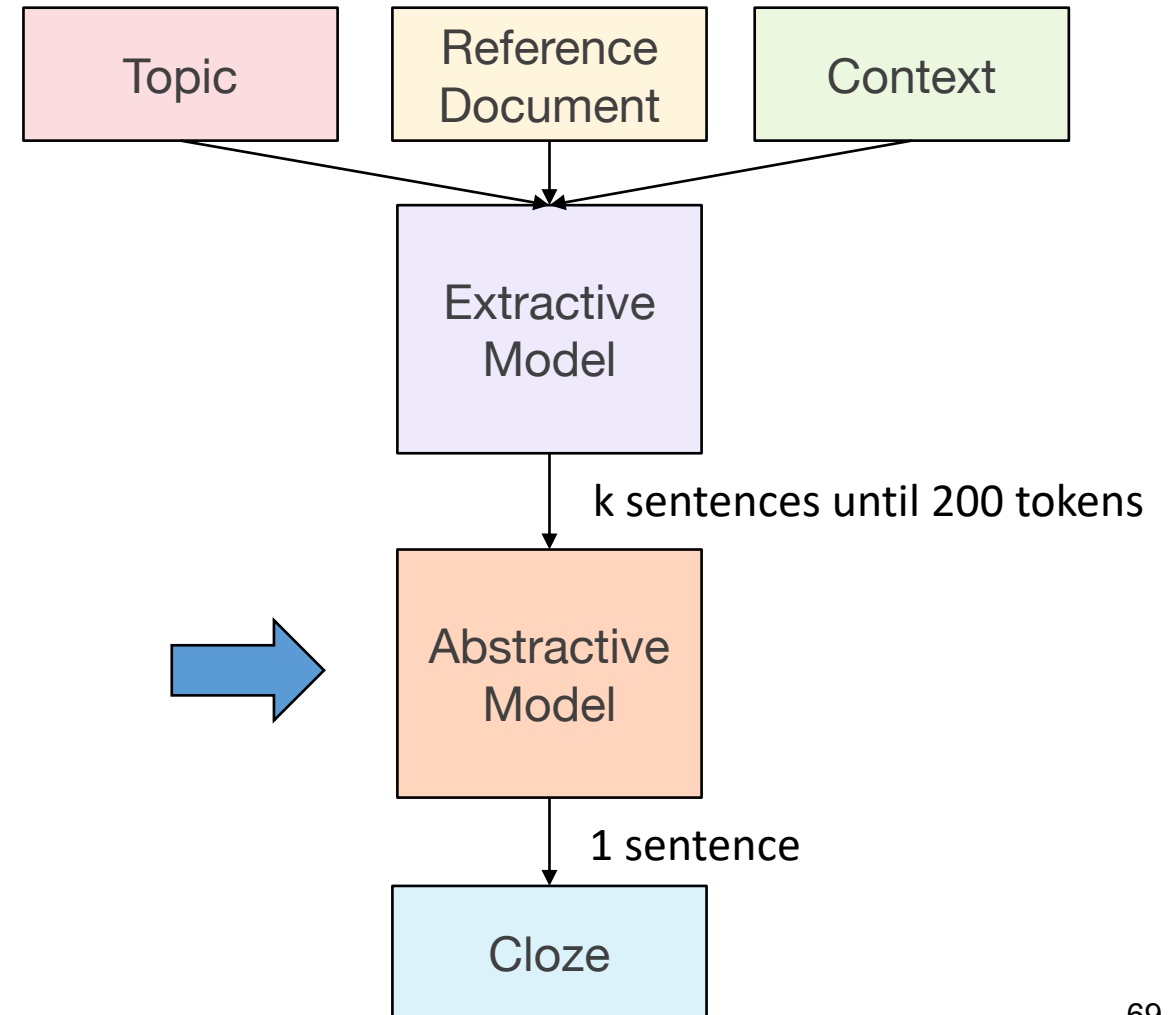
Experiments



Extract 1 sentence



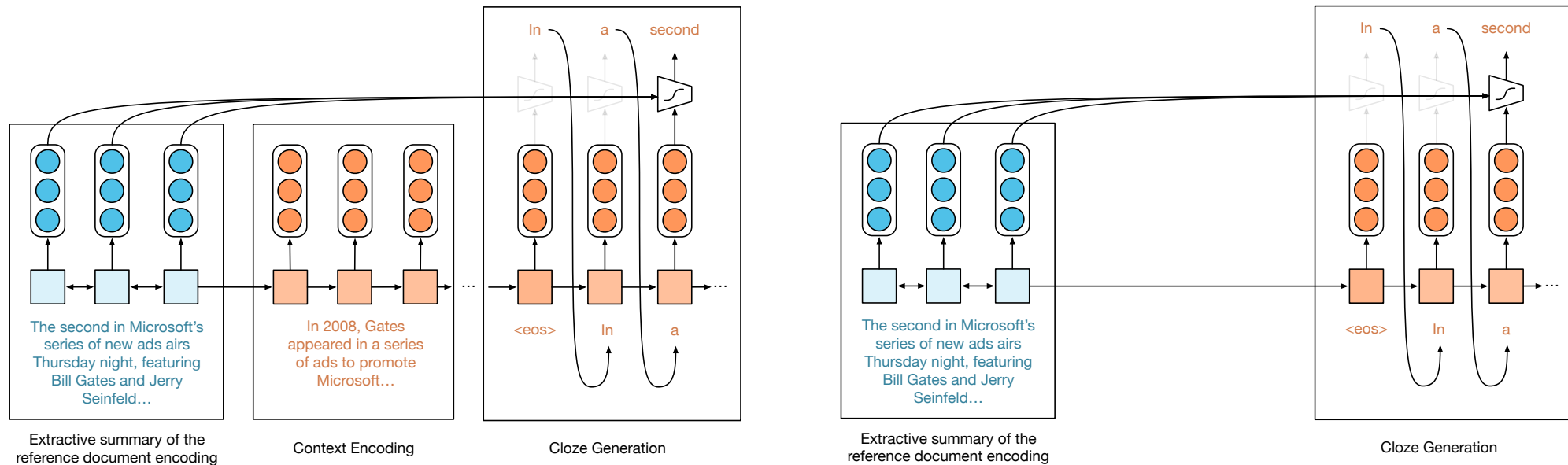
Extract 200 tokens,
Abtractively generate



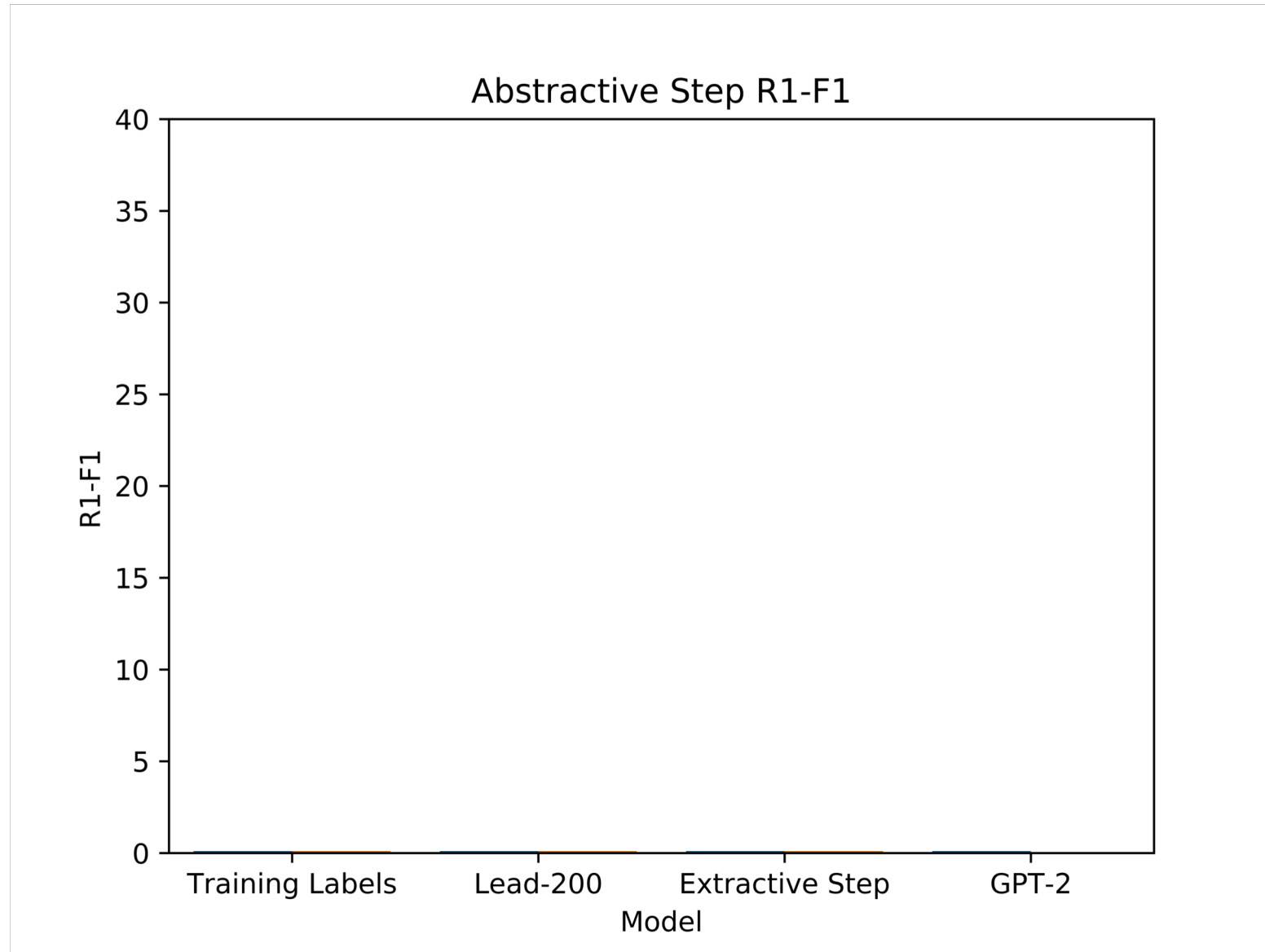
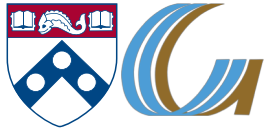
Abstractive Step Evaluation



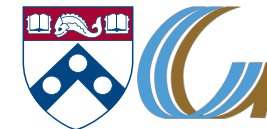
- Three different preprocessing methods:
 - Extractive training labels
 - Lead-200 tokens
 - Extractive model with topic and context
- Context feeding/no context feeding



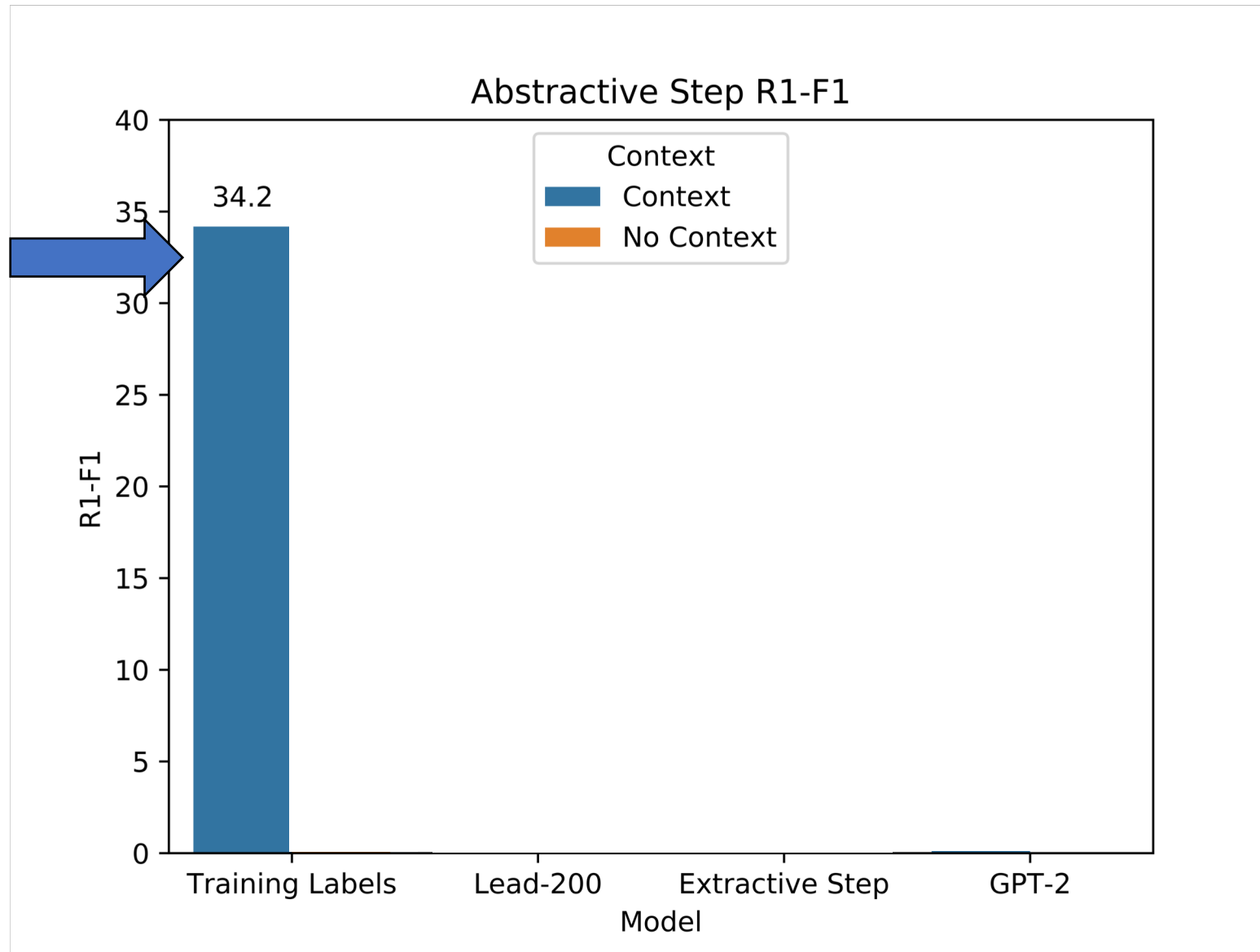
Abstractive Step Evaluation



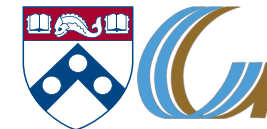
Abstractive Step Evaluation



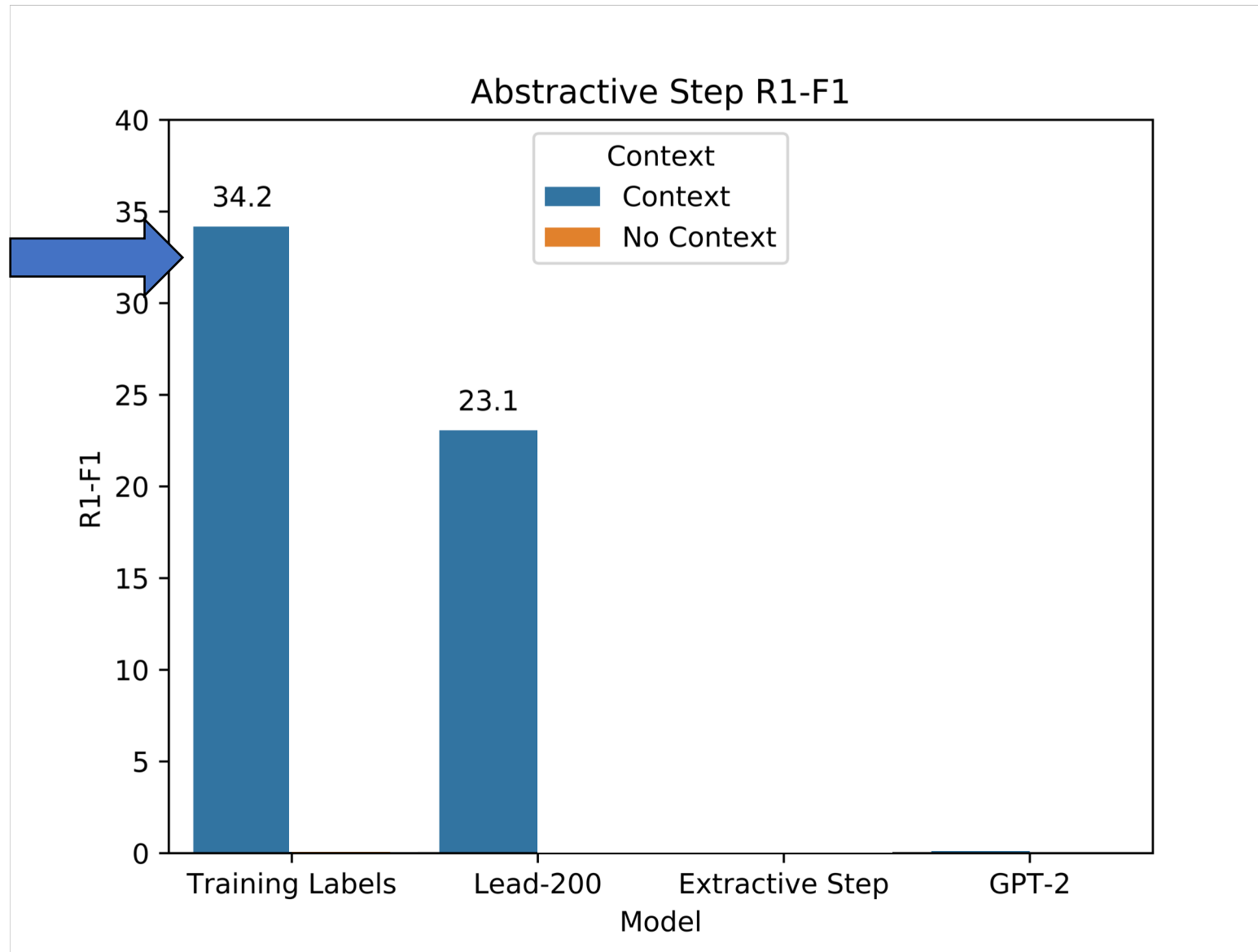
“Best possible”
extractive
preprocessing



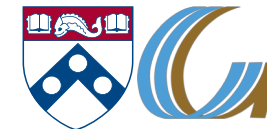
Abstractive Step Evaluation



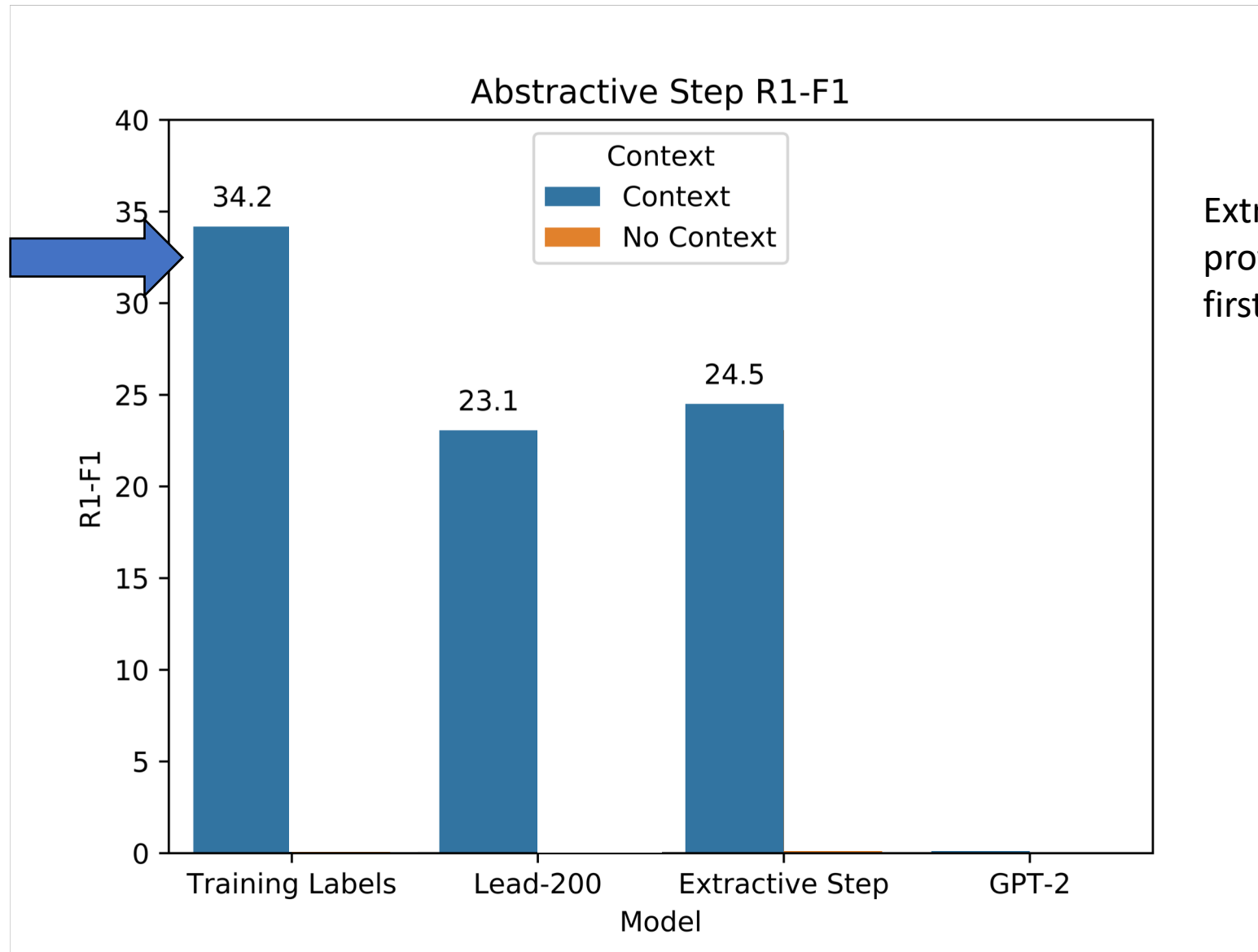
“Best possible”
extractive
preprocessing



Abstractive Step Evaluation

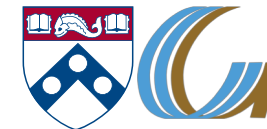


“Best possible”
extractive
preprocessing

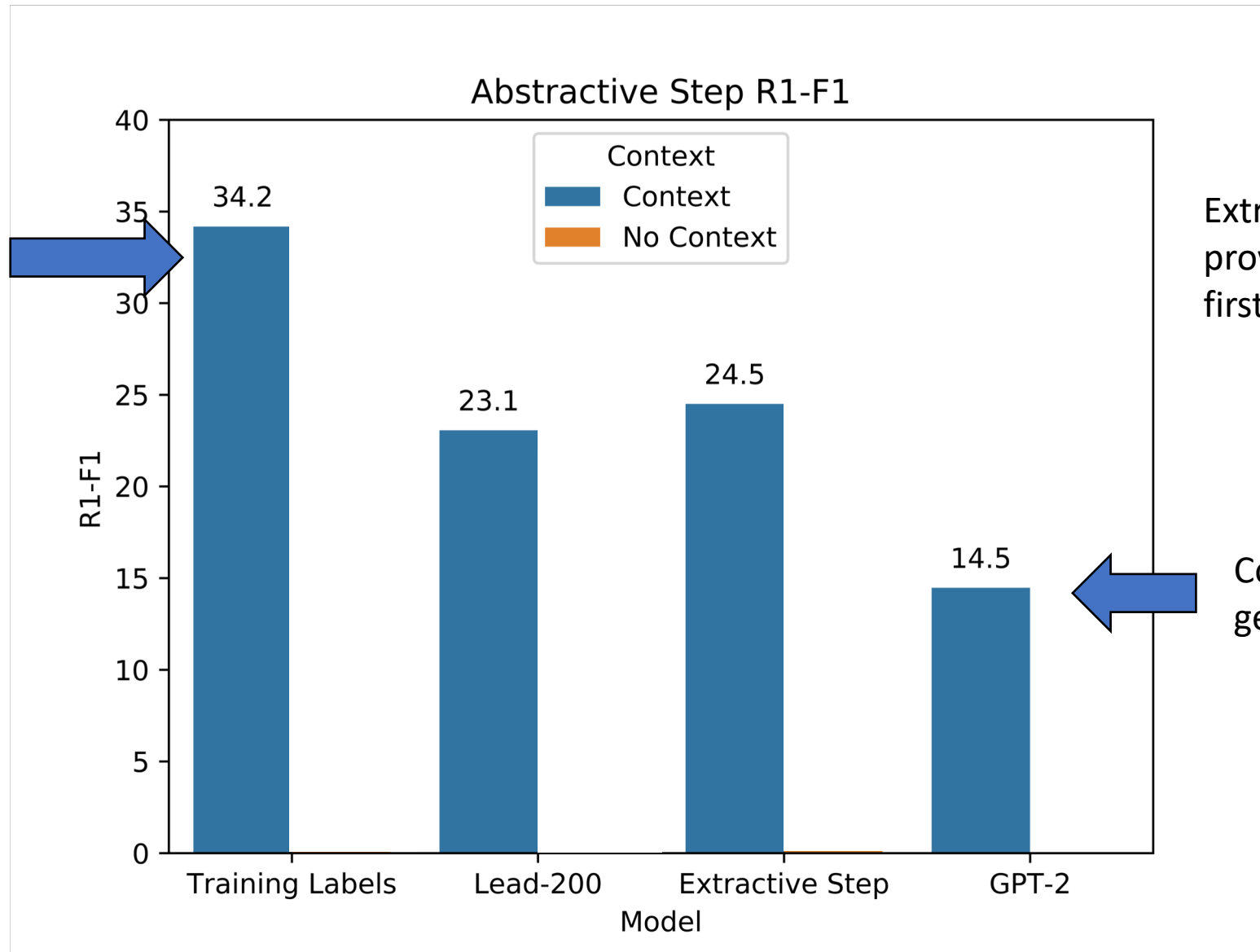


Extraction step does
provide value over taking
first 200 tokens

Abstractive Step Evaluation



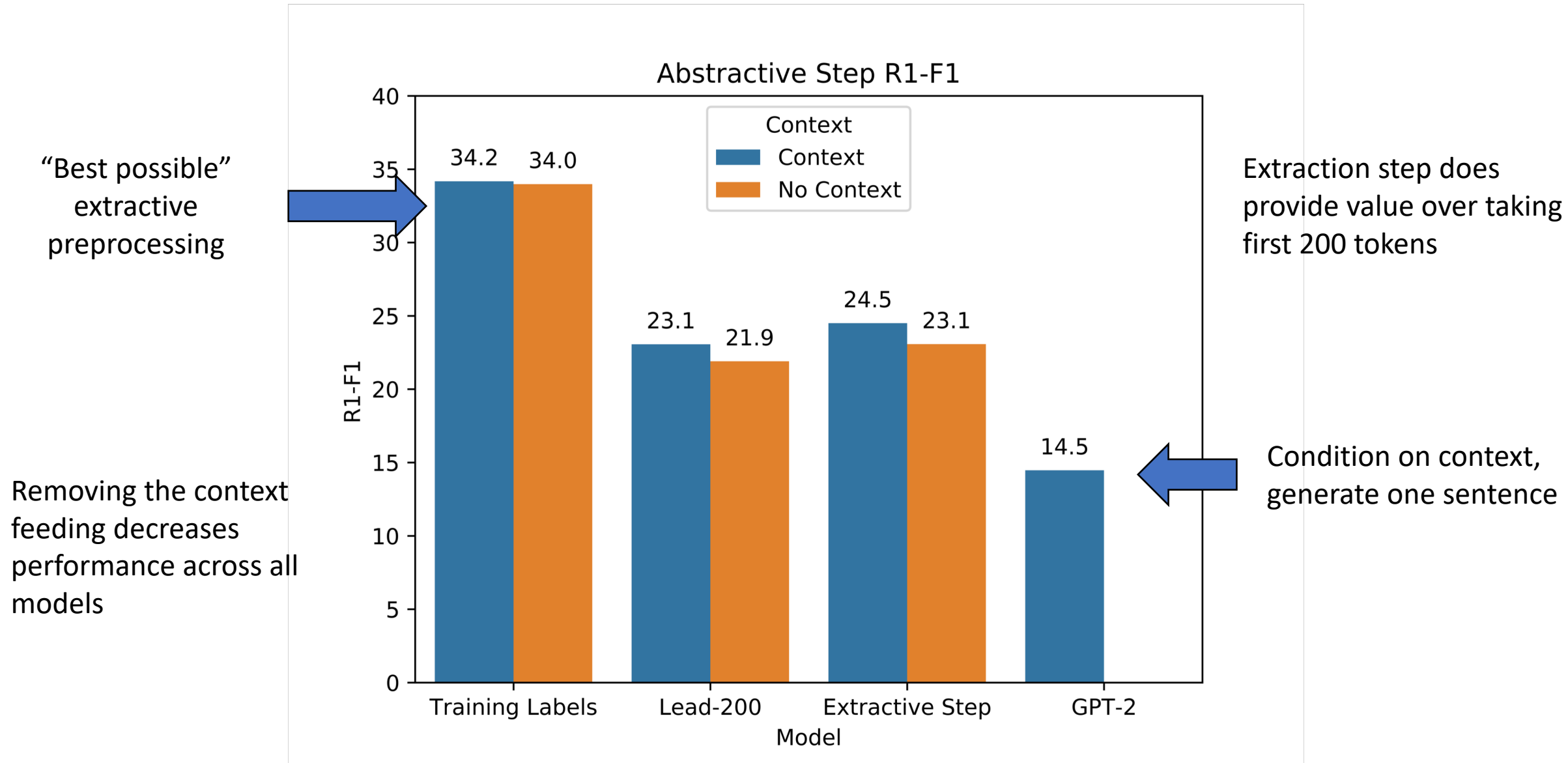
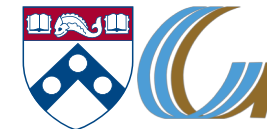
“Best possible”
extractive
preprocessing



Extraction step does
provide value over taking
first 200 tokens

Condition on context,
generate one sentence

Abstractive Step Evaluation



Example Output



Topic David Abell (businessman), Career, Jourdan

Ground-Truth Abell withdrew Jourdan from the Alternative Investment Market in 2009.

Extractive Step The perils of investing in London's junior stock market were laid bare after the company best known for the Corby trouser press moved to escape the glare of the public market. In a decision that will make it more difficult for its private investors to sell their shares, industrial minnow Jourdan is withdrawing from the Alternative Investment Market... A former British Leyland executive turned stock market raider , Abell was investigated for insider dealing by the Department of Trade and Industry in the late 1980s.

Abstractive Step He has been investigated by the department of trade and industry in the late 1980s and has been involved in the alternative investment market.

Example Output



Topic David Abell (businessman), Career, Jourdan

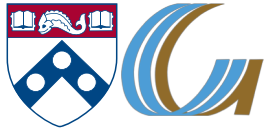
Ground-Truth Abell withdrew Jourdan from the Alternative Investment Market in 2009.

Extractive Step The perils of investing in London's junior stock market were laid bare after the company best known for the Corby trouser press moved to escape the glare of the public market. In a decision that will make it more difficult for its private investors to sell their shares, industrial minnow Jourdan is withdrawing from the Alternative Investment Market... A former British Leyland executive turned stock market raider , Abell was investigated for insider dealing by the Department of Trade and Industry in the late 1980s.

Abstractive Step He has been investigated by the department of trade and industry in the late 1980s and has been involved in the alternative investment market.

➡ Extractive step contains ground-truth information

Example Output



Topic David Abell (businessman), Career, Jourdan

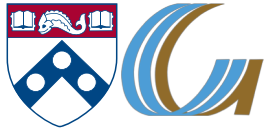
Ground-Truth Abell withdrew Jourdan from the Alternative Investment Market in 2009.

Extractive Step The perils of investing in London's junior stock market were laid bare after the company best known for the Corby trouser press moved to escape the glare of the public market. In a decision that will make it more difficult for its private investors to sell their shares, industrial minnow Jourdan is withdrawing from the Alternative Investment Market... A former British Leyland executive turned stock market raider , Abell was investigated for insider dealing by the Department of Trade and Industry in the late 1980s.

Abstractive Step He has been investigated by the department of trade and industry in the late 1980s and has been involved in the alternative investment market.

➡ Abstractive step combines information from multiple sentences

Example Output



Topic Chrysta Bell

Ground-Truth Her new album, We Dissolve, released independently on Meta Hari Records in June 2017, is produced by John Parish, with guests including Adrian Utley, Geoff Downes and Stephen O'Malley .

Extractive Step Chrysta Bell, longtime musical partner of filmmaker David Lynch, is set to release her sophomore album, "We Dissolve," with award - winning producer John Parish on June 9 . Recorded in Bristol , UK , "We Dissolve" is a pop record with elements of soul, rock and jazz that features contributions from guest artists including Adrian Utley (Portishead), keyboardist Geoff Downes (Asia, Yes) and drone metal guitarist Stephen O'Malley of Sunn O))...

Abstractive Step in addition , bell 's debut album , " we dissolve " , was released on may 21 , 2017 .

Example Output



Topic Chrysta Bell

Ground-Truth Her new album, *We Dissolve*, released independently on Meta Hari Records in June 2017, is produced by John Parish, with guests including Adrian Utley, Geoff Downes and Stephen O'Malley .

Extractive Step Chrysta Bell, longtime musical partner of filmmaker David Lynch, is set to release her sophomore album, "*We Dissolve*," with award - winning producer John Parish on June 9 . Recorded in Bristol , UK , "*We Dissolve*" is a pop record with elements of soul, rock and jazz that features contributions from guest artists including Adrian Utley (Portishead), keyboardist Geoff Downes (Asia, Yes) and drone metal guitarist Stephen O'Malley of Sunn O))...

Abstractive Step in addition , bell 's debut album , " we dissolve " , was released on may 21 , 2017 .

➡ Extractive step contains ground-truth information

Example Output



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➡ Abstractive step does not combine enough information, hallucinates facts

Example Output



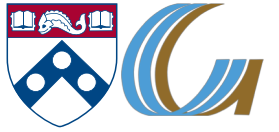
Topic Nate Morris, Philanthropy

Ground-Truth Programs funded by the foundation include the Lewis Sexton Scholarship Fund, which provides college scholarships in Kentucky to children of UAW Local 862 members or retirees.

Extractive Step The Lewis Sexton Scholarship Fund was established in 2016 by the Morris Industries Foundation in honor of Lewis Sexton , former President of UAW Local 862 . The Scholarship Fund will provide three awards of \$ 5,000 non - renewable scholarships to children (or legal wards) of UAW 862 members or retirees who plan to attend college in the Commonwealth of Kentucky... In 1971 , Lewis became the first Committeeman to be elected President and Building Chairman of UAW Local 862 and served in that capacity for ten years .

Abstractive Step in 1971 , lewis became the first committeeman to be elected president and building chairman of uaw local 862 .

Example Output



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➡ Extractive step contains ground-truth information

Example Output



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Abstractive step selects wrong information,
not about philanthropy (not even about the
correct person)

- Evaluation
 - Evaluation is a challenge across summarization, even worse with one sentence
 - Many plausible endings, so how do we choose one over another?

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Thank you!

<http://danieldeutsch.github.io>



Code



Data

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