Knowledge graph oriented Open dialogue generation

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20180109 Subin Kim, 20190564 Jinhyuk Jang

20180115 Sihyeon Kim, 20225375 Duri Lee

0. Summary

- Memory networks contain the inputs linearly in memory while encoding and decoding

→ Cannot generate new topic

- Conceptflow: Creates conversation on new topics by using knowledge graph.
- Our work
  - Replication of Conceptflow → thorough understanding of Conceptflow
  - Generation of dialogues and graph
  - Limitation of model and resolution
    - Computer resource(GPU memory etc.)
    - Larger training data

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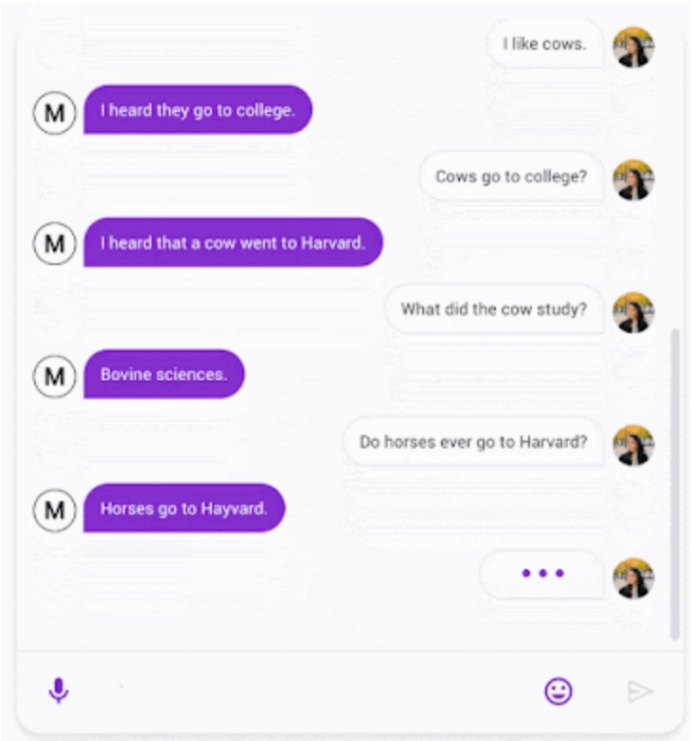
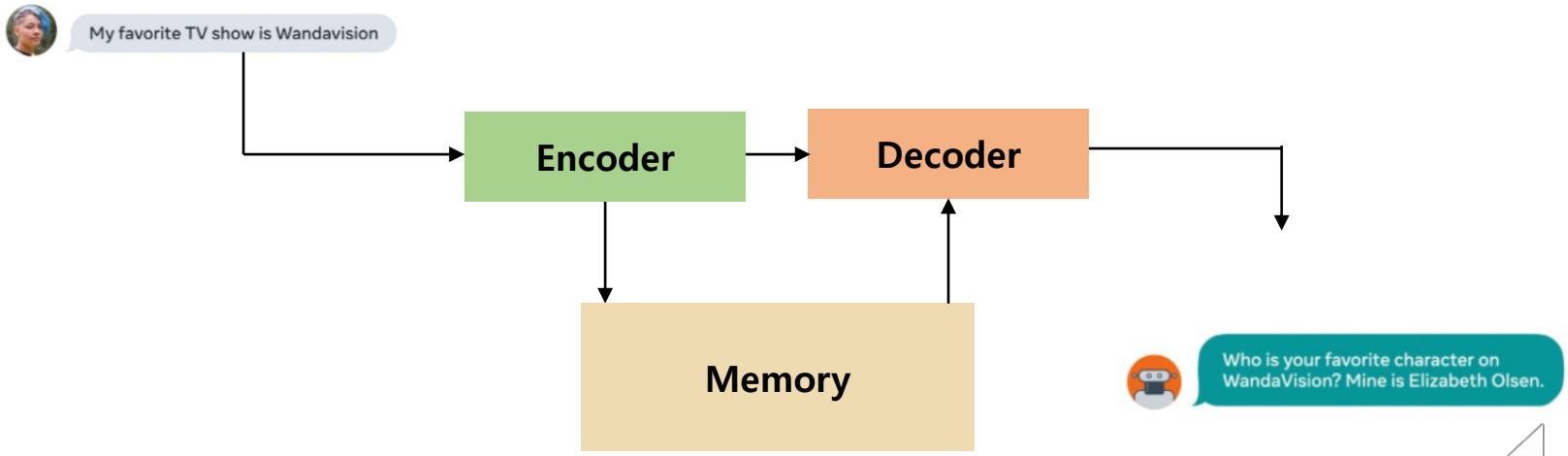
1. Introduction

- What if **robots** can **chit-chat** with humans like friends?
- **Open domain dialogue** : satisfy humans need for communication, affection, and social belonging
- Google **Meena**
- Facebook **Blenderbot**



1. Introduction

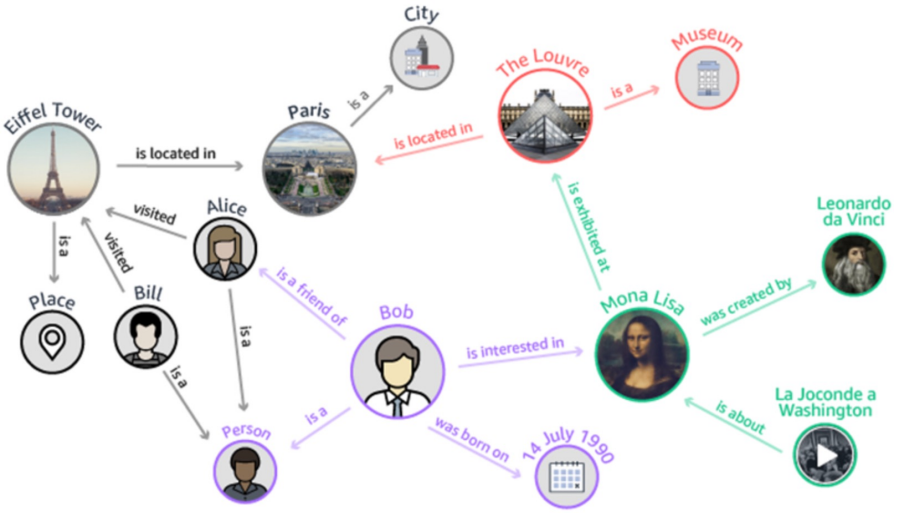
- To create a Human-like model for an open domain dialogue
  - It should Catch the **subject** of the conversation
  - And transfer to **related subjects** naturally
- **memory network** to remember previous subjects
  - Advantages : Effectively extract keywords
  - Limitation : **Cannot generate beyond topic**



1. Introduction

Q. What if we can search new topics based on graph structures?

- Easily grasp connection between topics
- Able to hop between diverse topics



1. Introduction

- Concept Flow as the resolution of Mem net limitation

> **Obj. How can we generate open domain dialogues that can reflect the relationship between topics & easily cross over various topics?**

- Purpose of the project
- Study the specific example of Dialogue generation model
- Create graphs that are generated while dialogue generation
- Understand the limitations of the model

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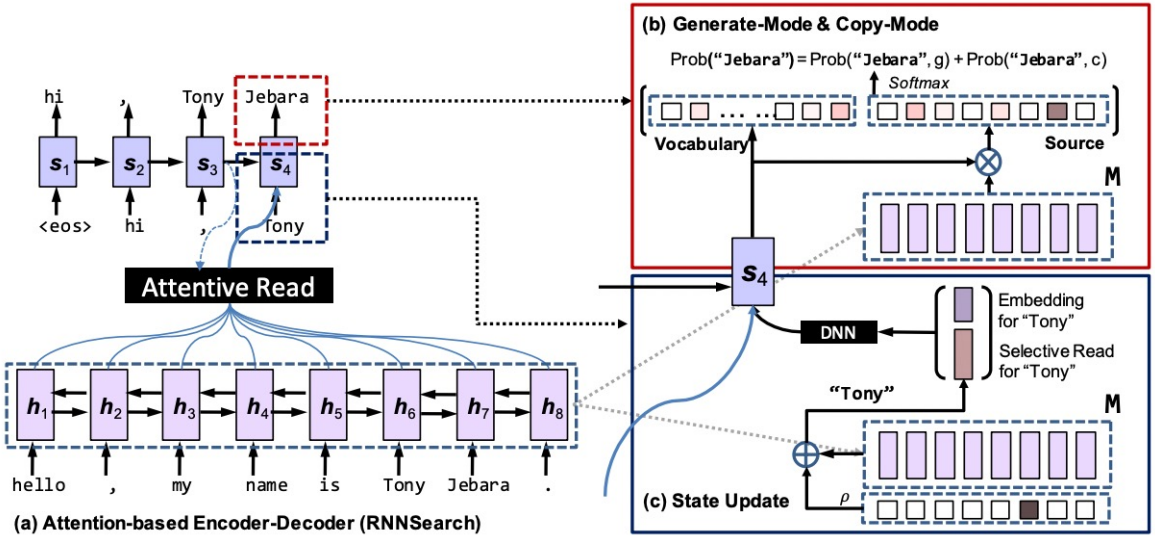
2. Related Works

- Previous studies focus on **task-targeted dialog systems** based on **domain-specific** knowledge

CopyNet (ACL 2016)

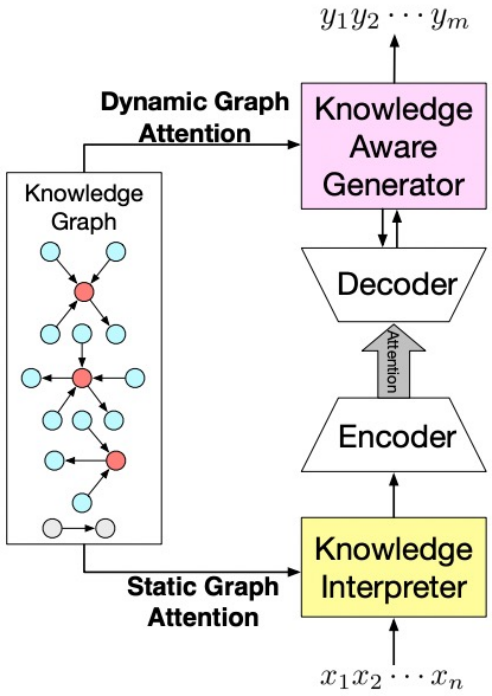
- Integrate the seq2seq model in the decoder with a new copying mechanism
- Choose **subsequences from input** and incorporate them at appropriate positions in the **response**



2. Related Works

CCM(IJCAI 2018)

- Exploit knowledge graph and use **Attention** to select **knowledge semantics**
- 1) **Static graph attention**: **generates representation** using structured semantic information.
- 2) **Dynamic graph attention**: reads knowledge graph and uses semantic information to **generate response**.



Shortcomings. **Mainly focus on the grounded concepts**

-> Do not explicitly model the conversational structures using multi-hop concepts

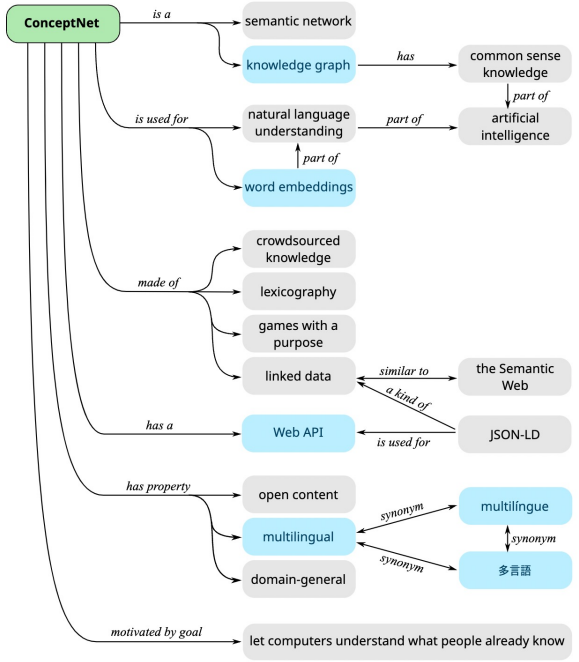
3. Solution

Q. **What if we can search new topics based on graph structures?**

4. Dataset_ConceptNet

ConceptNet

- Open source commonsense knowledge graph
- Contains 120,850 triples, 21,471 concepts and 44 relation types
- Used as the referred knowledge graph in constructing graphs used for tracking concepts



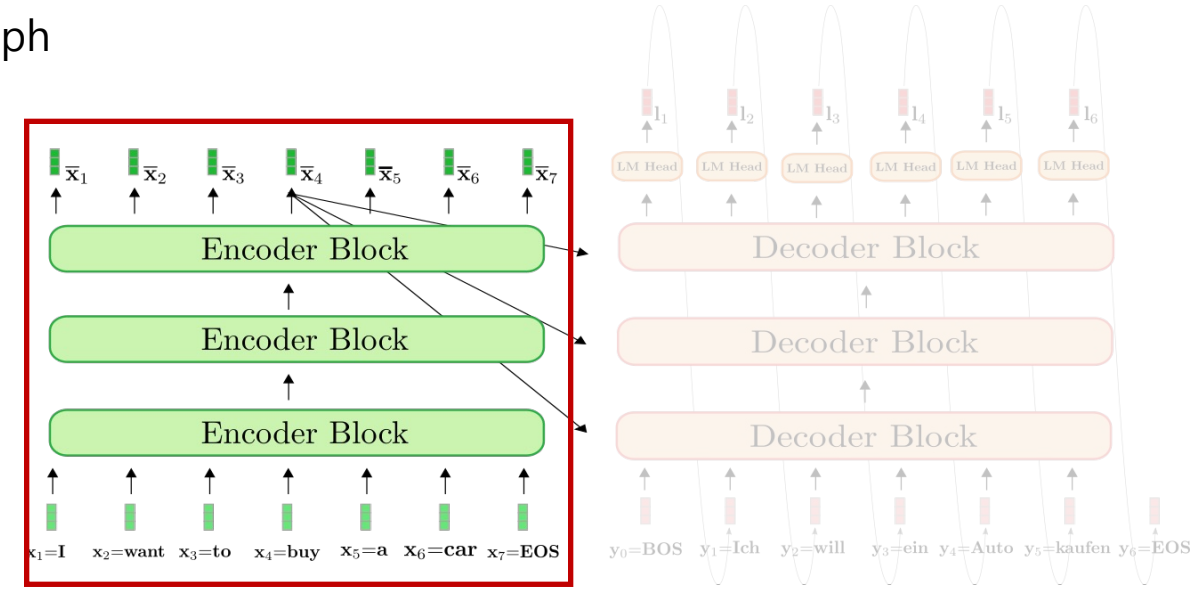
Reddit single-rounded dialogue

- All experiments use the **multi-hop extended conversation dataset** based on a **single-round dialogs** from **Reddit** embedded through **ConceptNet**

3. Solution

Q. What if we can search new topics based on graph structures?

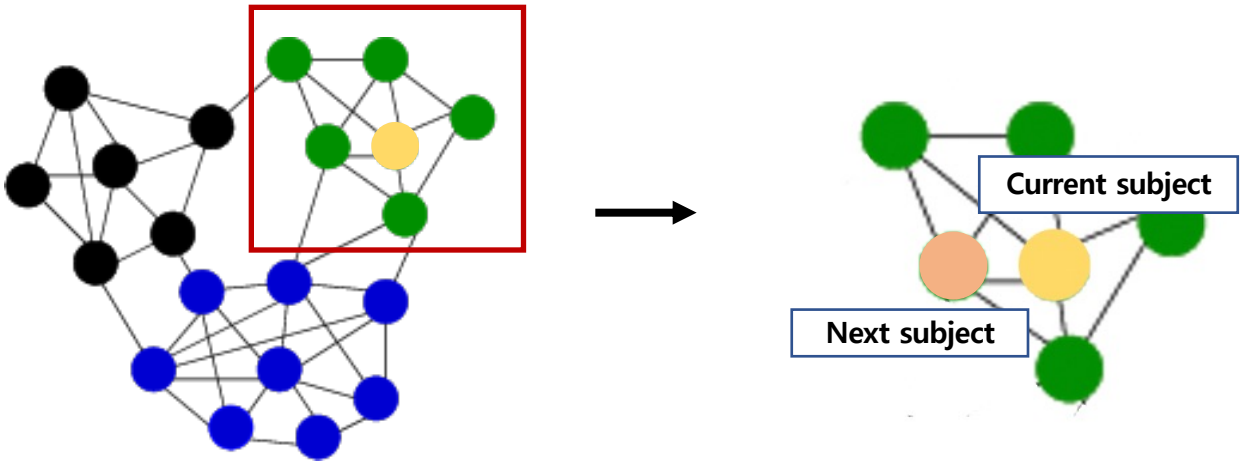
- Embed diverse topics on knowledge graph
- Grasp keywords through encoder-decoder models and find the keyword in the graph



3. Solution

Q. What if we can search new topics based on graph structures?

- Embed diverse topics on knowledge graph
- Grasp keywords through NLP models and find the keyword in the graph
- Find similar keywords in the knowledge graph by finding nearest neighbors



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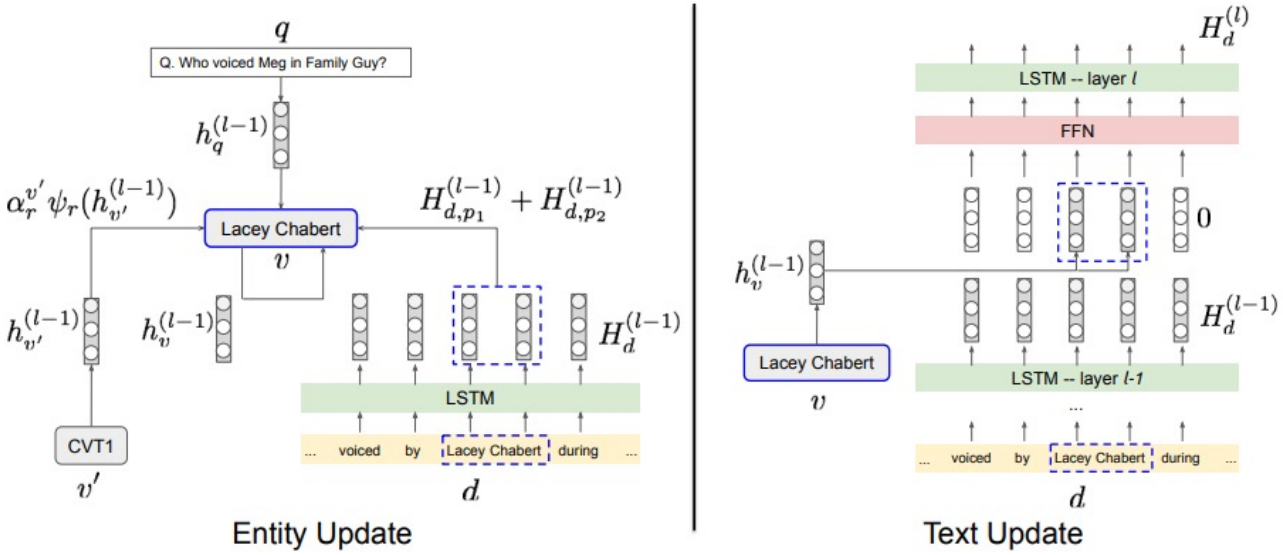
3. Solution _ Related works

GraftNet(EMNLP 2018)

- Extracts answers from a subgraph with text and knowledge base entities and relations
- Shows strong effectiveness on embedding.
- Used for **central graph flow encoding** in **ConceptFlow**



3. Solution _ Output example

- These are the subgraphs of the generated graph by extracting one-hop and two-hop related concepts (actual output of the model)

Keyword: **Favorite**

Keyword: **Wait**

Keyword: **Story**

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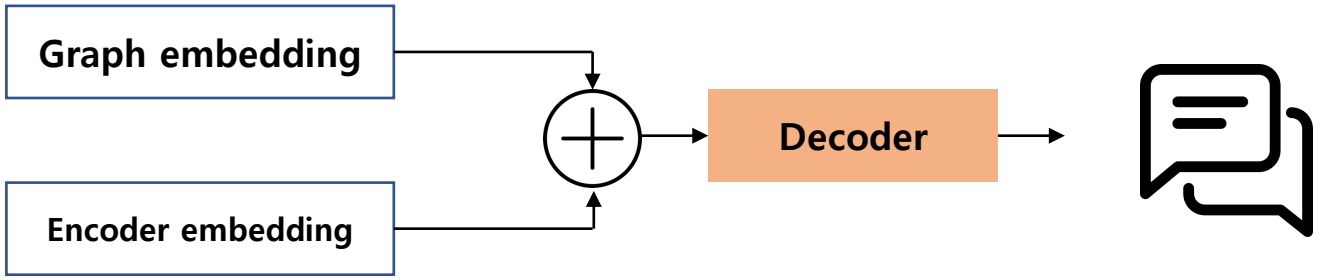
3. Solution

Q. What if we can search new topics based on graph structures?

- Embed diverse topics on knowledge graph
- Grasp keywords through NLP models and find the keyword in the graph
- Find similar keywords in the knowledge graph by finding nearest neighbors
- Embed new keywords into the next dialogue that is generated



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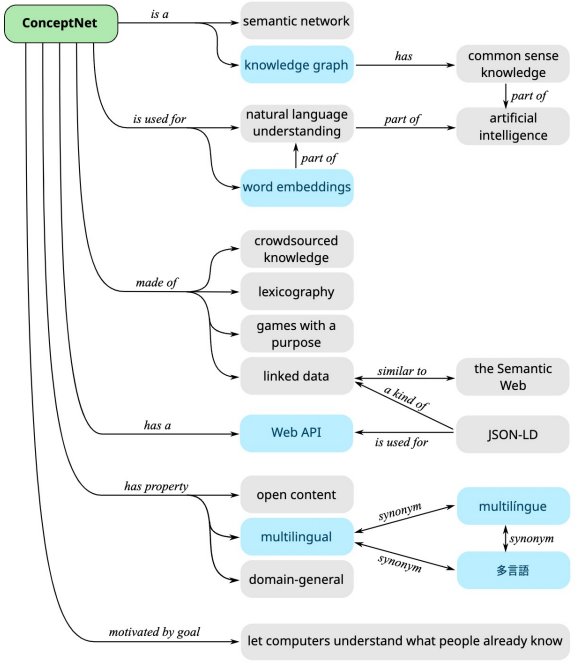

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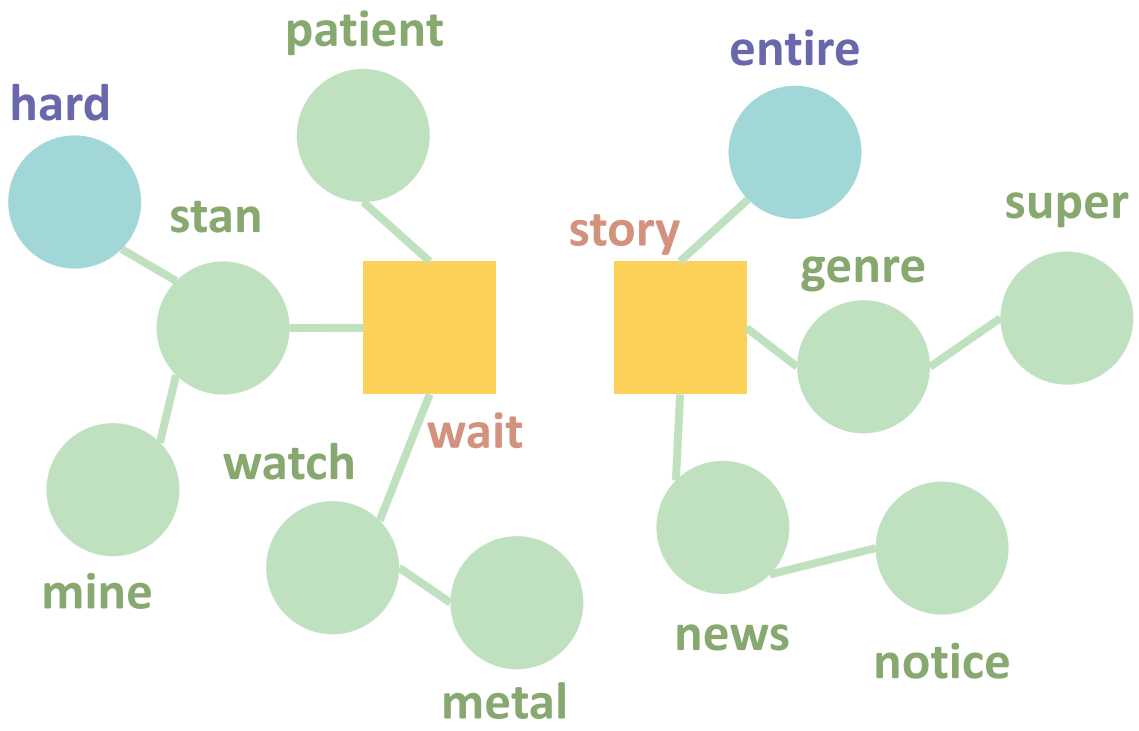

Post: this is my favorite **story** arc . can't **wait** to see how he does in the tourney ! the show is my guarantee smile for the week .

Response: yea it's **hard** not to have a smile on your face the **entire** episode

4. Dataset_conversation dataset

Dataset scale

3,384,185 train data
10,000 test data

Reduced x33

100,000 train data
10,000 test data

Data example

Post	["fyi", "it", "₩'s", "so", "the", "car", "is", "n₩'t", "damaged", ...]
Response	["really", "?", "so", "like", "they", "trust", "the", "person", ...]
One hop	List of one hop elements by post
Two hop	List of two hop elements by post

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5. Evaluation

Concept-PPL

the methods to calculate **Perplexity**

- Combining the distribution of both words and concepts together
- **Words perplexity**: Evaluate the model at the content level (whether the content is grammatical and relevant in topic)
- **Entity score** : calculate the number of entities per response to measure the model's ability to select the concepts from the commonsense knowledge base in dialogue generation

6. Result _generated dialogue

: Repeated words
: used in both question and answer.
: Related with the concepts in question, but not in question.

A: will you be requiring a shake today , sir ?
B: i'm not a sir .

A: black bullet has a similar concept that in my opinion is done a lot better .
B: i'm not sure if it 's a black bullet .

A: she can warg cats ?
B: the cat cat cat

A: does anyone know what happened to the driver ? his head did not look ok at the end .
B: the driver is the only game in the game

72% of the responses started with "I'm"
43% of the responses started with "I'm not sure"

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6. Result _generated dialogue

Positive

- Use similar words in input (ex. Racist, asshole, sir, glasses ..)
- Try to use concepts relates with input that is not already given in input (ex. Opponent -> rival, racism -> sexist)

Limitations

- Same phrases appear repeatedly (ex. I don't think, I'm not, ...)
- Repeatedly used words within one sentence (ex. Fan of the fan, same thing I'm in the same)
- Not yet grammatically correct

6. Result_ human evaluation

- 10 people evaluate **6 responses from epoch 1~8** (score 1, 2, 3, 4, 5)

  1) Does the response **appropriate Grammarly?**

  2) Does the response **appropriate in Topic?**

  3) Does the response **include any information?**

Epoch	Grammar	Topic	Info.
1	2	2	1
2	2.5	2	2
3	2.5	3	2
4	2.5	1.5	1
5	2.5	1.5	2.5
6	2.5	1	3.5
7	2.5	0.5	3.5
8	2	0.5	4

5. Conclusion

- Used **ConceptFlow** for dialogue generation.
- **Output**: generated dialogue was not smooth and had similar structures repeating same words.
- **Limitation**: Small training data due to resource

  ➔ hard to learn selecting words or generating response sentences
- Analyzed how the model **generates the sentences** and **chooses new topics**

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