Multimodal Coreference Resolution

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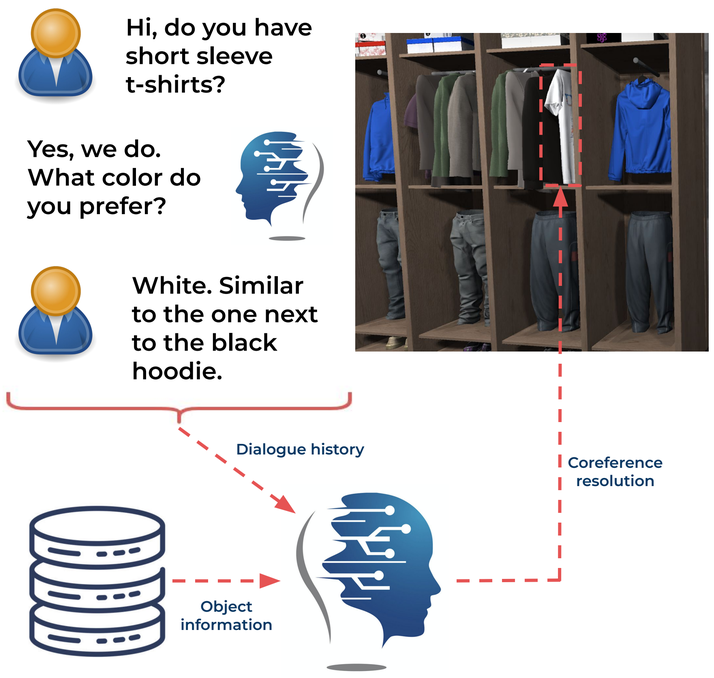
Introduction

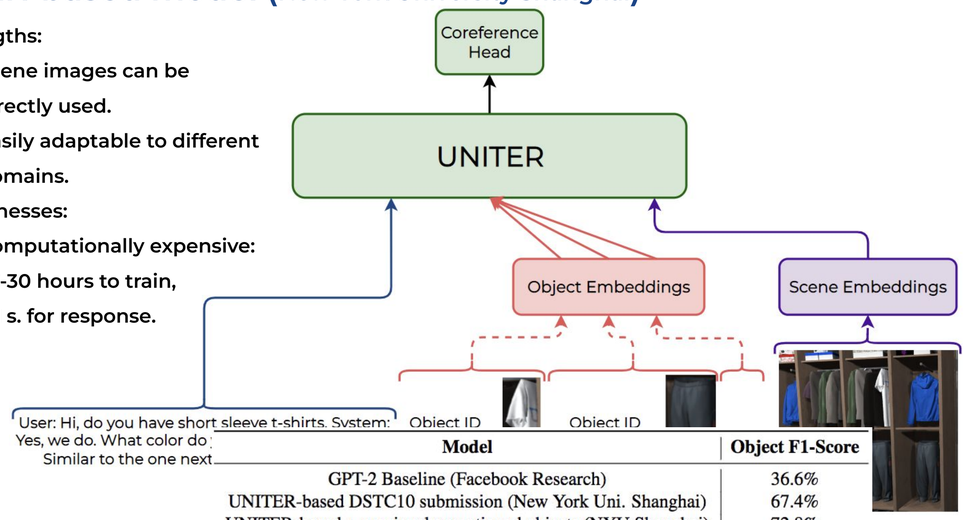


- Applications:
  - E-commerce virtual assistant: answer customer inquiries about objects.
  - Situated human-robot interaction.
  - Boost other natural language tasks, like question answering or generation.
- SIMMC2 dataset:
  - Published by Facebook Research.
  - It contains 11244 dialogues, 117236 utterances, object descriptions and 1566 scene images.
- The 10th Dialog System Technology Challenge (DSTC10) partially focused on the multimodal coreference resolution task.
  - SIMMC2 dataset was used for the competition.
  - Best performing systems are studied as a enhanced baseline.

SOTA MMCR Systems

UNITER-based model (New York University Shanghai)

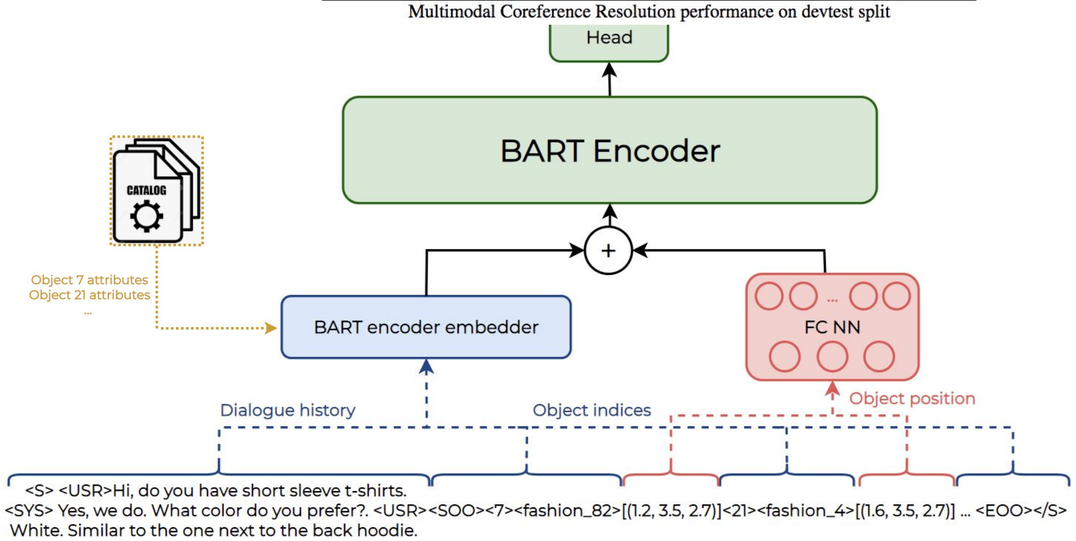
- Strengths:
  - Scene images can be directly used.
  - Easily adaptable to different domains.
- Weaknesses:
  - Computationally expensive: 25-30 hours to train, ~ 1 s. for response.



Model	Object F1-Score
GPT-2 Baseline (Facebook Research)	36.6%
UNITER-based DSTC10 submission (New York Uni. Shanghai)	67.4%
UNITER-based + previously mentioned objects (NYU Shanghai)	72.8%
BART-based DSTC10 submission (KAIST & Samsung Research)	74.3%
UNITER-based + prev. objects + removing obj. IDs (Ours)	**75.8%**
BART-based using object descriptions (Ours)	**76.1%**

Multimodal Coreference Resolution performance on devtest split

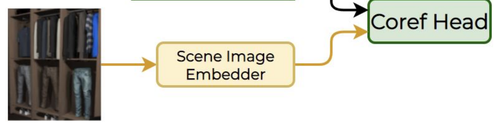
BART-based mode



- Strengths:
  - Winner of DSTC10 on this task.
  - Computationally cheaper: around 5 hours to train, <0.5 seconds for response.
- Weaknesses:
  - Bad at handling objects not seen in training.
  - Scene images need to be described in natural language to be used.

Proposed improvements

- Include object descriptions in the input of the BART-based model.
- Provide image embeddings to improve the coreference head of the BART-based model.



- Suppress object IDs in UNITER-based model to make it scene-independent.

Results

MODEL	DESCRIPTION	F1-Score
GPT-2-based	Baseline by Facebook Research	36.6 %
UNITER-based	DSTC10 submission	67.4 %
UNITER-based	DSTC10 submission improved including previously mentioned objects	72.8 %
UNITER-based (Ours)	**Our improvements on the previous model, removing object IDs from the input**	**75.8%**
BART-based	DSTC10 submission	74.3 %
BART-based (Ours)	**Our improvements on the previous model, using objects descriptions in the input**	**76.1 %**

References

[1] Satwik Kottur et.al. SIMMC 2.0: A Task-oriented Dialog Dataset for Immersive Multimodal Conversations. *Association for Computational Linguistics*. 2021.

[2] Yichen Huang et. al. UNITER-Based Situated Coreference Resolution with Rich Multimodal Input. *Computing Research Repository*. 2021.

[3] Haeju Lee et. al. Tackling Situated Multi-Modal Task-Oriented Dialogs with a Single Transformer Model. *Association for Computational Linguistics*. 2021.

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