Part 2: Conversation Augmentation

Duration: 25 min

Presenter: Heydar Soudani

Existing multi-turn dialogues

Conv. augmentation model

New multi-turn dialogues
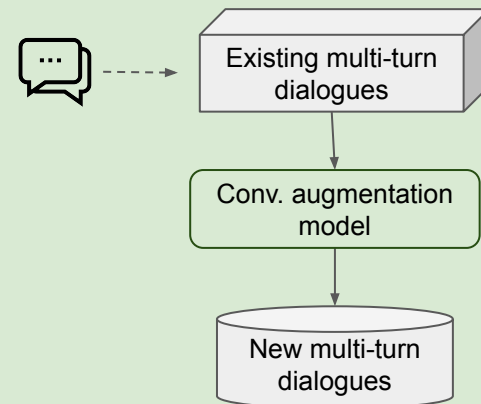
Overview
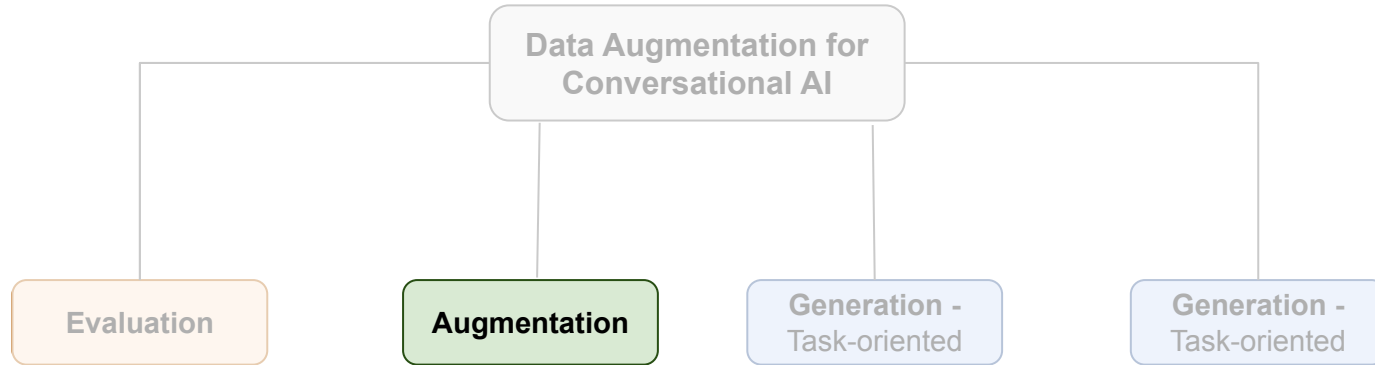
Introduction

Goal: Enhance both the volume and the diversity

- Creating new data through modifications made to existing data points

- Employing transformations designed based on prior knowledge of the problem's structure
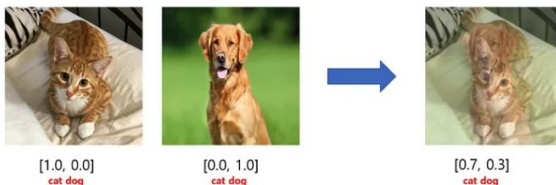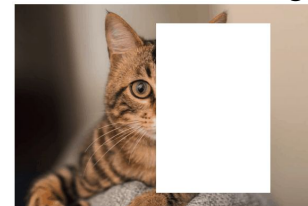
(Chen et al., 2021)

DA in Computer Vision

Rotating

(Taylor et al., 2018)

Mix-up

[1.0, 0.0]
cat dog

[0.0, 1.0]
cat dog

[0.7, 0.3]
cat dog
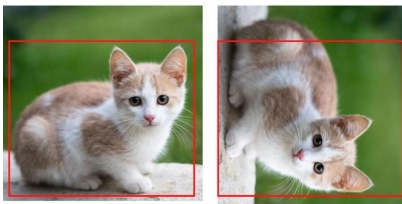
(Zhang et al., 2018)

Random Erasing

(Zhong et al., 2020)

DA Limitations in NLP

- Establishing universal rules for augmenting textual data (Kobayashi et al., 2018)

  - Needs preserving data quality and relevance across diverse domains

  - Ensuring semantic and linguistic fluency in the augmented data (Yin et al., 2020)

- Finding label-preserving transformation (Chen et al., 2021)

  - Complicated syntactic and semantic structure

Conversation Augmentation
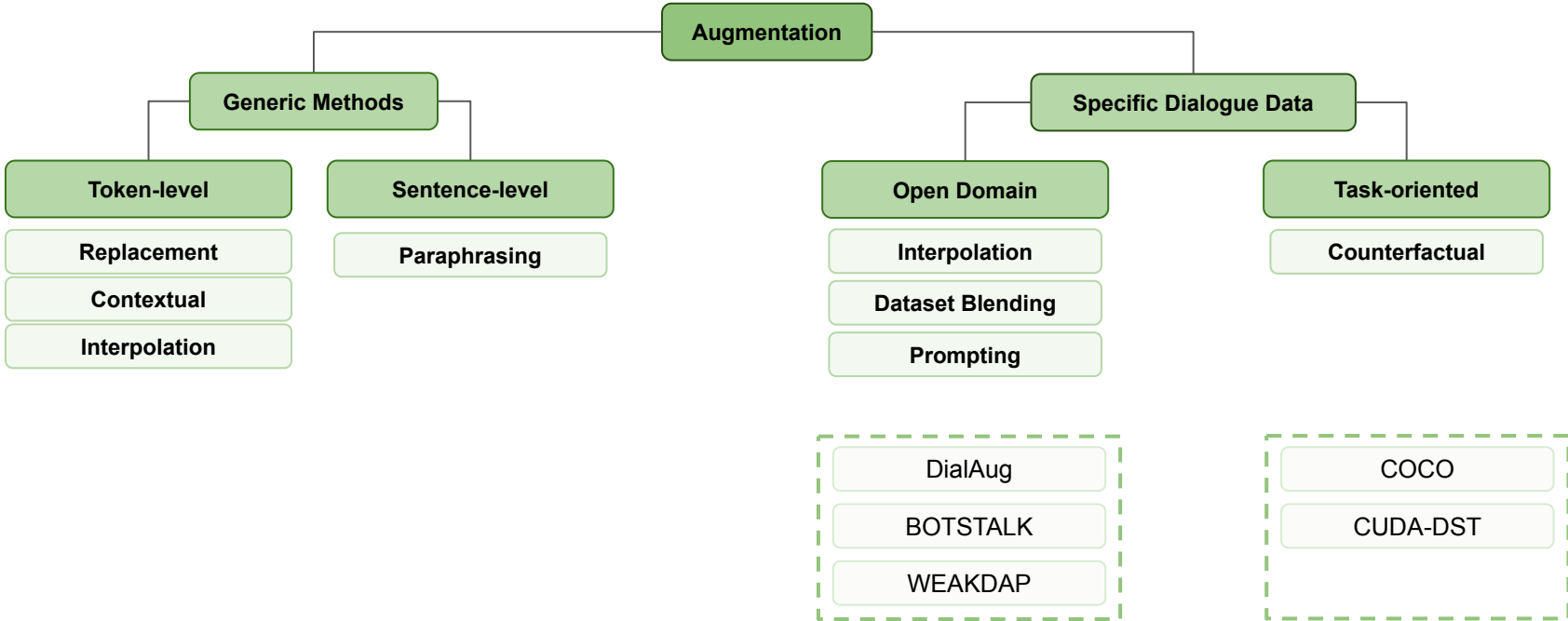
Conversation Augmentation
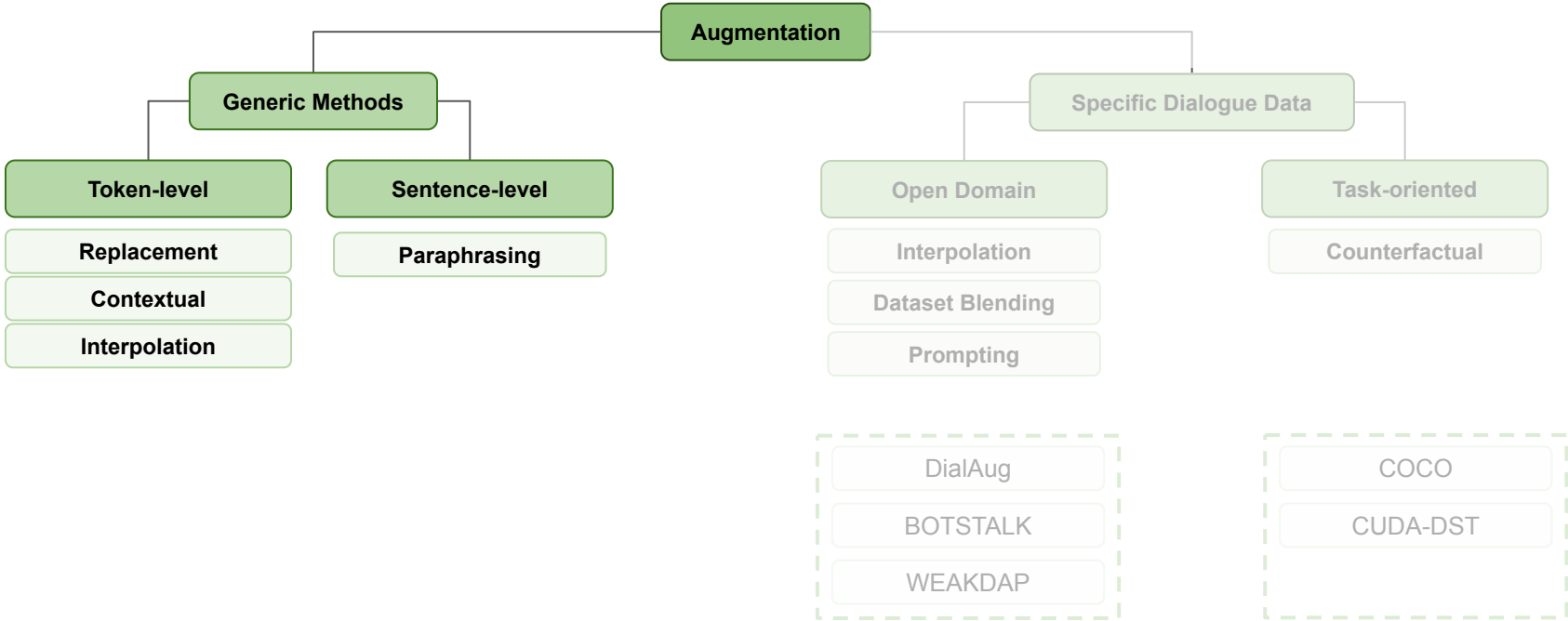
Generic Augmentation Categories

Token-level

- Manipulating words and phrases within a sentence

- **Methods:** Replacement, Contextual augmentation, Interpolation

Sentence-level

- Manipulating an entire sentence in a single operation

- **Methods:** Paraphrasing (such as Back-translation)

(Chen et al., 2021)

Generic Augmentation

Replacement

Operation	Sentence
None	A sad, superior human comedy played out on the back roads of life.
Synonym Replacement	A **lamentable**, superior human comedy played out on the **backward** road of life.
Random Insertion	A sad, superior human comedy played out on **funniness** the back roads of life.
Random Swap	A sad, superior human comedy played out on **roads** back **the** of life.
Random Deletion	A sad, superior human out on the roads of life.

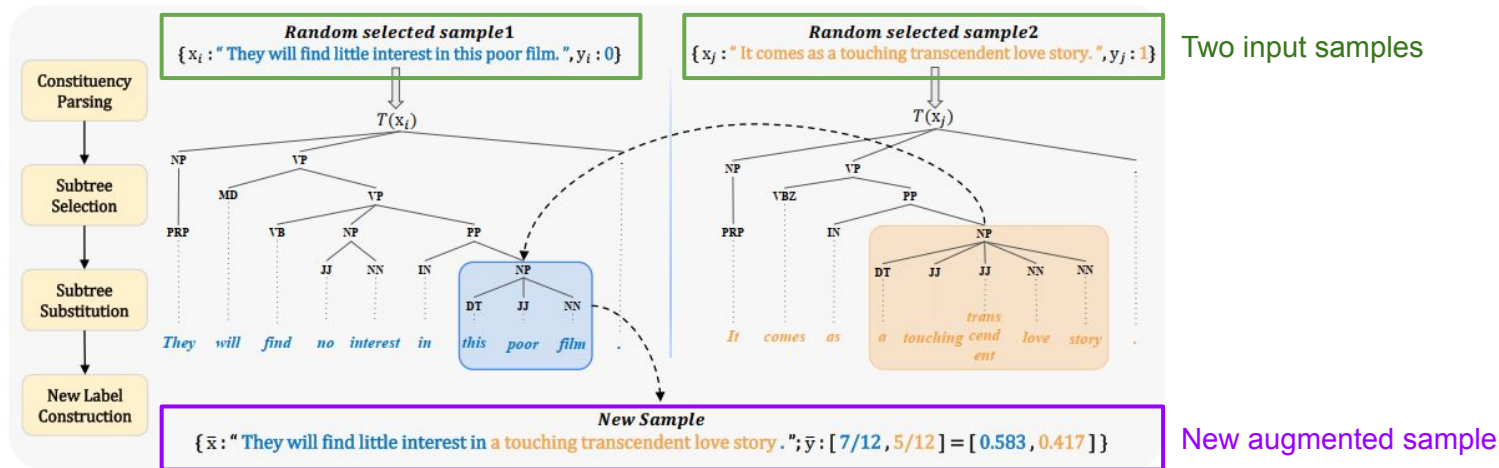**Contextual Replacement:** Substituted words predicted by the language model (LM)

Generic Augmentation

(Zhang et al., 2018)

Interpolation: Using Mix-up technique, takes a pair of examples as input and generates an interpolation example

Paraphrasing: Rephrasing a given text in various ways while preserving the core semantic meaning

(Bornea et al., 2021)

Conversation Augmentation
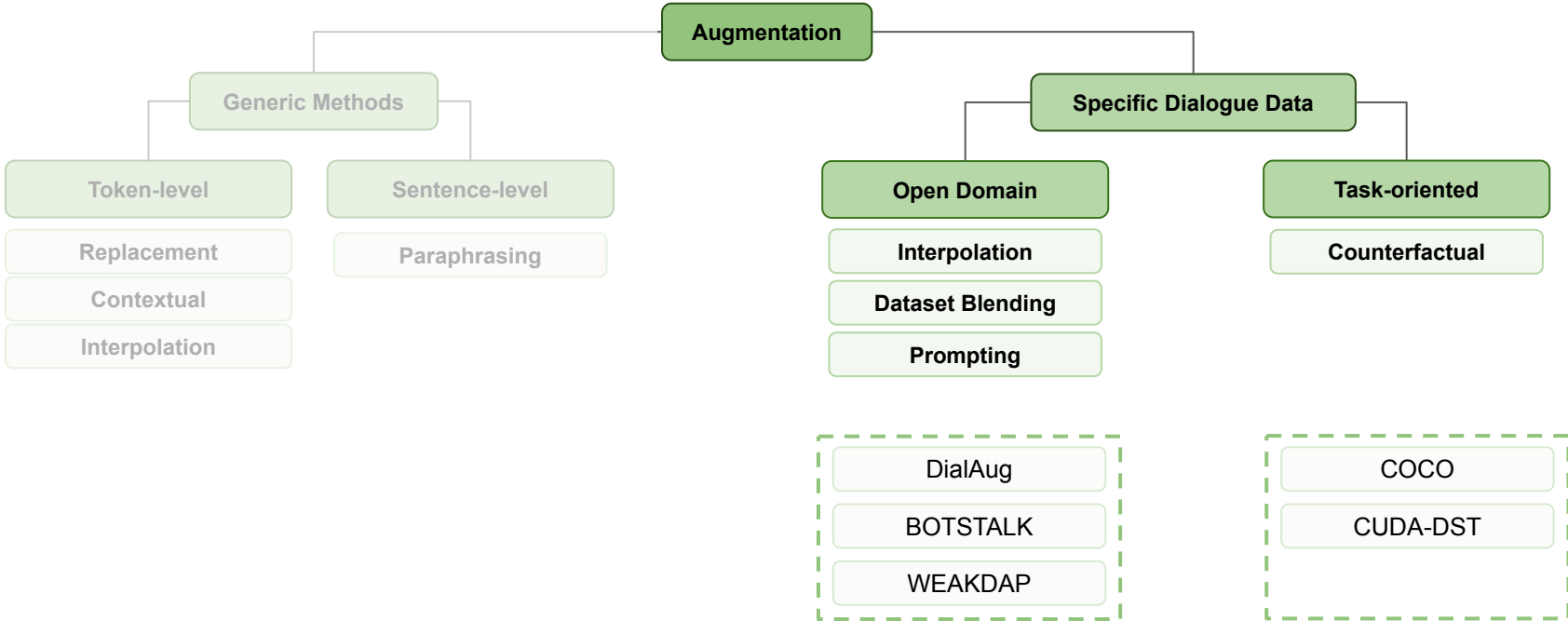
Dialogue Data Augmentation

Challenges

- The absence of a definitive "correct answer" (Chen et al., 2023)

- Context-response relationship

  - Align augmented utterances with the entire conversation history

Aims to

- Augment either the context or the response

- Maintaining a balance between

  - Enhancing the dataset's richness

  - Preserving the coherence and consistency

Conversation Augmentation

Interpolation for Open-domain Dialogue

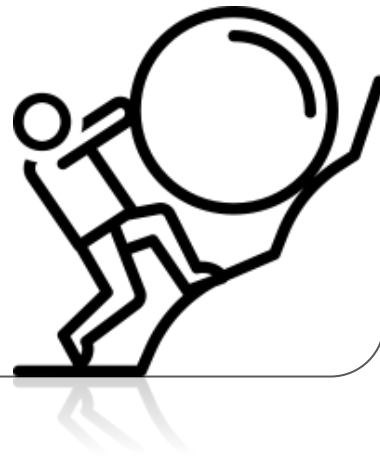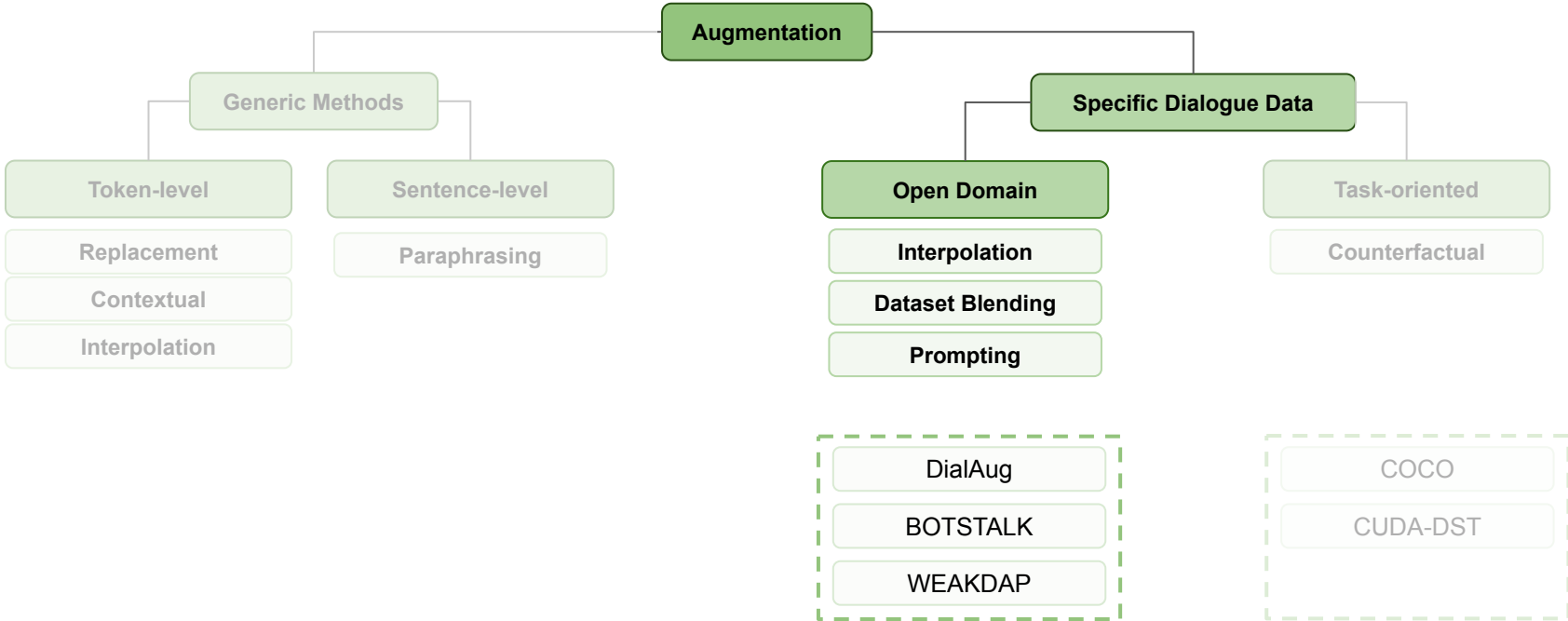**Context Mixing (ConMix):** Incorporates augmented versions of a dialogue context into the learning objective

- Dynamic mixing of words from other contexts in the batch

(Poddar et al., 2022)

- Adapt the Bernoulli Mix-Up approach

The augmented view

Two randomly selected contexts form the same batch

$$C_i' = m \circ C_i + (1 - m) \circ C_j, \text{ where } i \neq j$$

- m: a binary mask
- ∘: Hadamard product

Contrastive Learning Loss Function

$\mathcal{L}_{CL}$ $\mathcal{L}_{CE}$

$x_{CLS}^{C'}$ x_{CLS}^{C} x_{CLS}^{R}

projection projection projection

Encoder Encoder Encoder

C'

Augmentation Module

Context (C) Response (R)
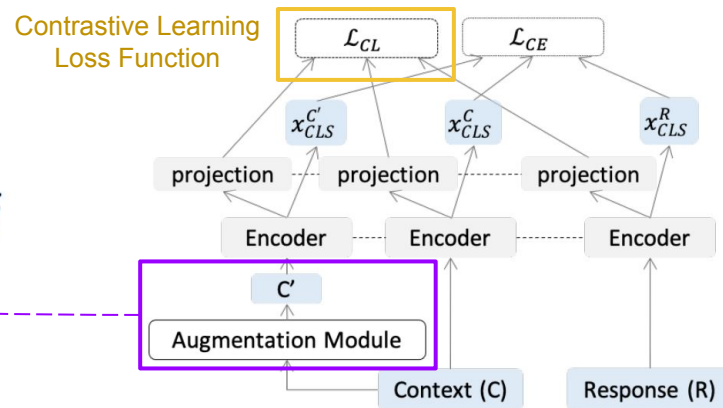
Interpolation for Open-domain Dialogue

- Illustration of the ConMix data augmentation
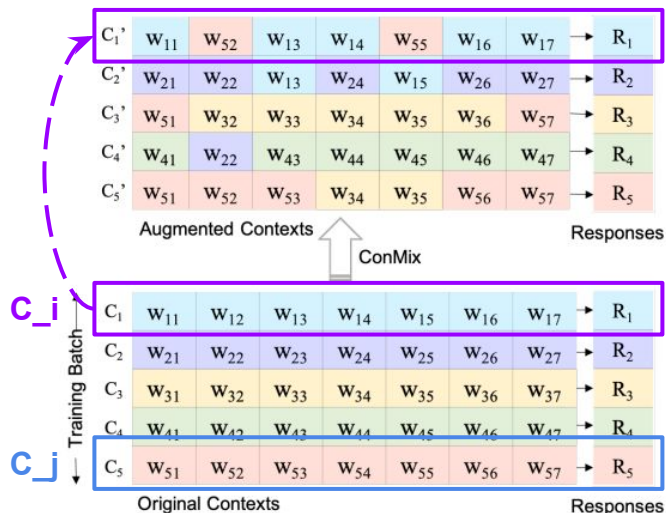
(a) Mixing context tokens in batch

(b) Example of generated perturbed context through augmentation

Skill Blending

Multi-skill Dialogue Systems

Skill-blending: The ability to blend various conversational skills into one cohesive flow

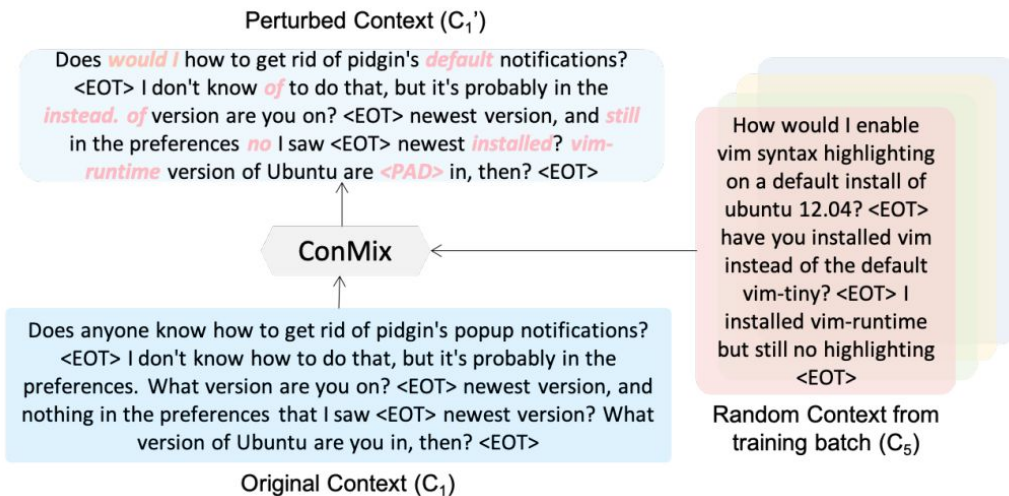|	**Person A**	**Person B**	
Persona	**Skill context from ConvAI2** I like to play soccer; I like to read; ...	**Skill context from ConvAI2** I have 3 children; I am a karate black belt; ...	5 Personas
1 topic	**Skill context from WoW** Nike Inc.	**Skill context from WoW** Nike Inc.; ... multinational corporation ... Air Jordan ...	1 topic, and seven knowledge resources
A situation with an emotion	**Skill context from ED** I really like this girl at my job, but I am ... ; Apprehensive	**Skill context from ED** None	

Dialogue
A: Do you have much experience using the different types of cleats? Which do you like best? (P)
B: I have a little. I also know about Air jordans, a brand of footwear also popular with athletes. (K)
A: I enjoy Air jordans as well. I like to play soccer, and it's extremely hard to get good footwear. (P)
B: I agree. Air jordans are good for calves, and it's really easy to pull off. (K)
A: Air jordans are generally made with the most material so it makes sense they'd be easy to use. (K)
B: And now shoes can go together with clothes as well, like any other type of material. (K)
A: Do you know much about aeros then? They have excellent fit and beauty. (K)
B: I have a hard time finding it but they are great shoes. (P)
A: I hope you can find ones that are comfortable to you. (E)
B: Yes. I hope you can get those shoes too. (E)

A conversation from the BSBT dataset (Kim et al., 2022)

BOTSTALK Framework

Participants

- **Skill Agents:** Annotate the appropriate skill-grounded utterances to the dialogue

- **Moderator Agent:** Manage the conversational flow, as an omniscient oracle for all skill contexts

Main phases of the framework

1) Simulate what to speak

2) Check dialogue consistency

3) Speak or pass the mic
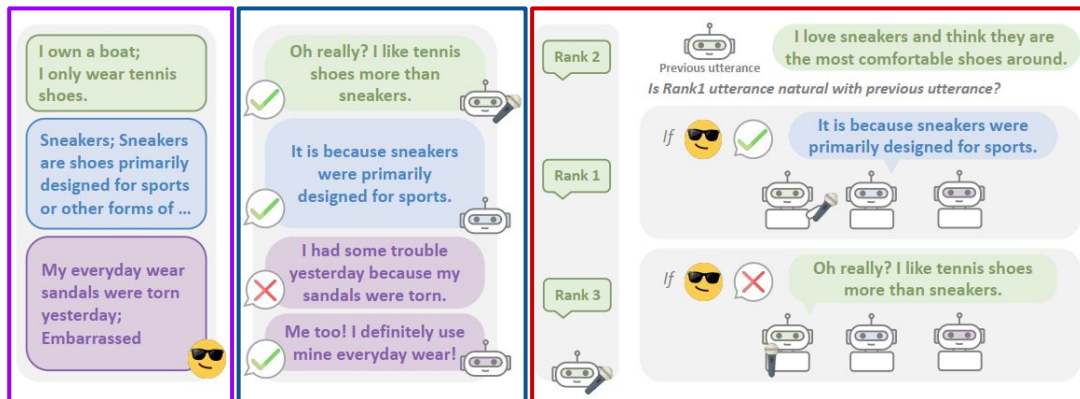
Illustration of BOTSTALK framework. Green, blue, and purple indicate skill types of persona (P), Knowledge (K), emotion (E), respectively (Kim et al., 2022)

DDA for ODD: Prompting

WEAKDAP: for augmenting dialogue classification tasks

- Emotion Classification

- Act Classification

(Chen et al., 2022)

Main Parts:

1) *Prompting* PLMs

- Replacing dialogue turns using the

  dialogue context construction strategies

2) *Weak supervision* for refinement

- Iteratively re-augment the data and

  re-train the classifier

DDA for ODD: Prompting

Prompt Construction

- Conversation Trajectory Augmentation

- All-turn Augmentation

- Last-turn Augmentation

Prompt

Original Conversation, Original Emotion

Turn 1: Alice in a neutral mood: Oh you look awful! What's the matter?
Turn 2: Bob in a neutral mood: Oh! I feel really under the weather. I've got a sore throat and a bad cough.
Turn 3: Alice in a neutral mood: Oh dear. Maybe you've caught a cold.
Turn 4: Bob in a neutral mood: Yes, I've had lots of overtime to do recently and I haven't slept much at all.
Turn 5: Alice in a neutral mood: Well then, you should get some rest this weekend and don't go out drinking.

Turn 6: Bob in a neutral mood:

Result:
Thanks, but I can't afford to do that.

The output of the PLM

DDA for ODD: Prompting

Prompt Construction

Output

- Trajectory Augmentation

- All-turn Augmentation

- Last-turn Augmentation

Original Conversation

Turn 1: Alice in a happy mood: Oh, man. I had the best supper last night. My wife made a stir-fry and it was amazing!

Turn 2: Bob in a happy mood: I love stir fry crispy bitesize vegetables covered in a mixture of soy sauce and oyster sauce. Wilted greens and fresh bean sprouts. Throw in some onion and garlic and ginger! Mmm! Mmm! It's almost lunchtime. I would die for a plate of stir fry right now!

Turn 3: Alice in a neutral mood: Well, you can keep the vegetables, I'll take the meat. The stir fry my wife made was really hearty, with chunks of beef and slivers of bell peppers and onion...

Turn 4: Bob in a surprised mood: What? You call that a stir fry? More meat than vegetables? That's the worst insult you could throw at a Chinese stir fry. What disgrace to the wok she fried it in! What you had is equivalent to a fajita without the wrap!

Augmented Conversation

GT Turn 1: Alice in a happy mood: Oh, man. I had the best supper last night. My wife made a stir-fry and it was amazing!

GT Turn 2: Bob in a happy mood: I love stir fry crispy bitesize vegetables covered in a mixture of soy sauce and oyster sauce. Wilted greens and fresh bean sprouts. Throw in some onion and garlic and ginger! Mmm! Mmm! It's almost lunchtime. I would die for a plate of stir fry right now!

Generated Turn 3: Alice in a neutral mood: Stir fry is good. When my dad cooks, he makes stir fry for us.

Generated Turn 4: Bob in a surprised mood: Stir fry was was the only Asian food I had until I was ten. I've never known what it was called!

DDA for ODD: Prompting

Output

Prompt Construction

- Trajectory Augmentation

- **All-turn Augmentation**

- Last-turn Augmentation

Original Conversation

Turn 1: Alice in a surprised mood: My goodness! She is thirty seconds faster than the world record in 5000 metres race.

Turn 2: Bob in a surprised mood: Excuse me, what did you say?

Turn 3: Alice in a happy mood: A Chinese girl has broken the world record in the Olympic Games.

Turn 4: Bob in a surprised mood: That's incredible. I can't believe it.

Turn 5: Alice in a happy mood: You have to. It is sure.

Turn 6: Bob in a surprised mood: So, what's her name?

Augmented Conversation 1

GT Turn 1: Alice in a surprised mood: My goodness! She is thirty seconds faster than the world record in 5000 metres race.
GT Turn 2: Bob in a surprised mood: Excuse me, what did you say?
Generated Turn 3: Alice in a happy mood: I said my goodness, that girl is fast.

Augmented Conversation 2

GT Turn 1: Alice in a surprised mood: …
GT Turn 2: Bob in a surprised mood: …
GT Turn 3: Alice in a happy mood: A Chinese girl has broken the world record in the Olympic Games.
Generated Turn 4: Bob in a surprised mood: I am dying to know who is the girl?

Augmented Conversation 3

GT Turn 1: Alice in a surprised mood: …
GT Turn 2: Bob in a surprised mood: …
GT Turn 3: Alice in a happy mood: A Chinese girl has broken the world record in the Olympic Games.
GT Turn 4: Bob in a surprised mood: That's incredible. I can't believe it.
Generated Turn 5: Alice in a happy mood: This is the first time in the history of the world

Augmented Conversation 4
...

DDA for ODD: Prompting

Prompt Construction

Output

- Trajectory Augmentation

- All-turn Augmentation

- **Last-turn Augmentation**

Augmented Conversation

GT Turn 1: Alice informs Bob: Good morning.
GT Turn 2: Bob informs Alice: Er, good morning, yes, er...
GT Turn 3: Alice directs Bob: I'm phoning about the job that was in the paper last night.
GT Turn 4: Bob directs Alice: Oh, yes. Erm, well, could you tell me your name, please?
GT Turn 5: Alice informs Bob: Oh, Candida Fawcett.
GT Turn 6: Bob questions Alice: Oh, yes. Erm, well, what exactly is it that interests you about the job?
GT Turn 7: Alice informs Bob: Well, I just thought that it was right up my street you know.
GT Turn 8: Bob directs Alice: Really, hmmmm. Erm, well, could you perhaps tell me a little about yourself?
**GT Turn 9:** Alice informs Bob: Yes, arm, I'm 23. I've been working abroad, I'm um...

Generated Turn 10: Bob informs Alice: Well, perhaps you would like to think it over. Erm, and er...

DDA for ODD: Prompting

Weak Supervision

- Generating Silver Data
    - the augmented version of Gold (ground-truth) data
- Assigning a weak silver label
- Filtering out instances with low-confidence
- Re-training the classifier and re-augmeneting
- Termination condition: the classifier's performance doesn't improve by at least epsilon for k rounds
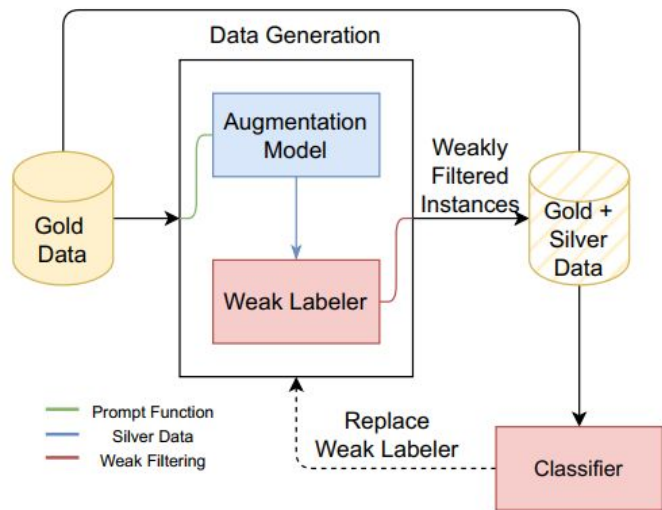
Conversation Augmentation
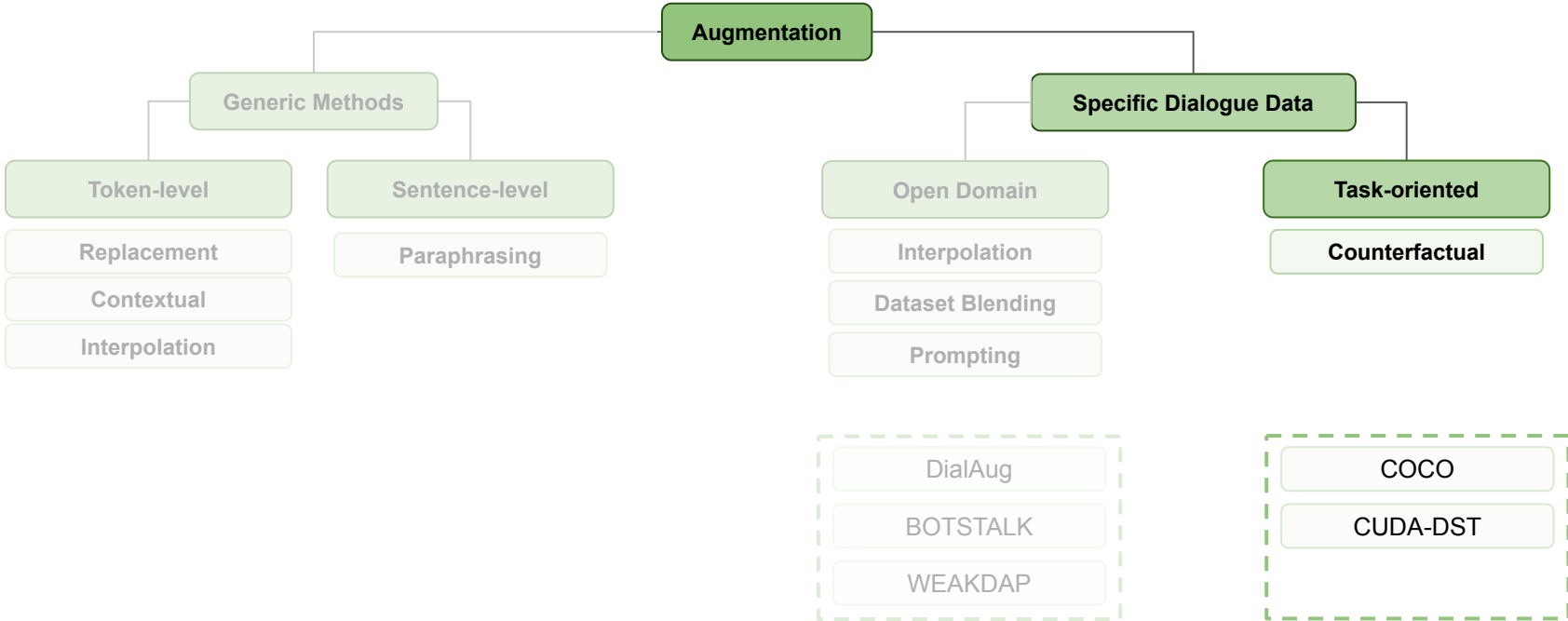
DDA for Task-oriented Dialogues

Dialogue States

Original Dataset

Turn 1	[System]: Hello, how can I help you? [User]: I need to find a restaurant in the center.	<restaurant, area, Center>
Turn 2	[System]: I have many options. Do you have any preference. [User]: It needs to serve British food, and I'd like a reservation at 18:00.	<restaurant, area, Center> <restaurant, food, British> <restaurant, book time, 18:00>

Modification

Turn 2		<restaurant, area, Center> <restaurant, food, Chinese> <restaurant, book people, 2>

Generation

Turn 2	[User, 1]: I want to book a table at a chinese restaurant. [User, 2]: Sure, I want to book a chinese restaurant for 2 people at 18:00. [User, 3]: Yes, I want to book a table for 2 at chinese restaurant.	<restaurant, area, Center> <restaurant, food, Chinese> <restaurant, book people, 2>

Filtering

| Turn 2	[User, 1]: I want to book a table at a chinese restaurant. [User, 2]: Sure, I want to book a chinese restaurant for 2 people at 18:00. [User, 3]: Yes, I want to book a table for 2 at chinese restaurant.	<restaurant, area, Center> <restaurant, food, Chinese> <restaurant, book people, 2>

Modification: Counterfactual Goal Generator

- Operations

  - Drop: remove values from a non-empty slot

  - Change: replace existing values

  - Add: add new domain slot values

- Predefined Dictionaries

  - Randomly sample a value

(Li et al., 2021)
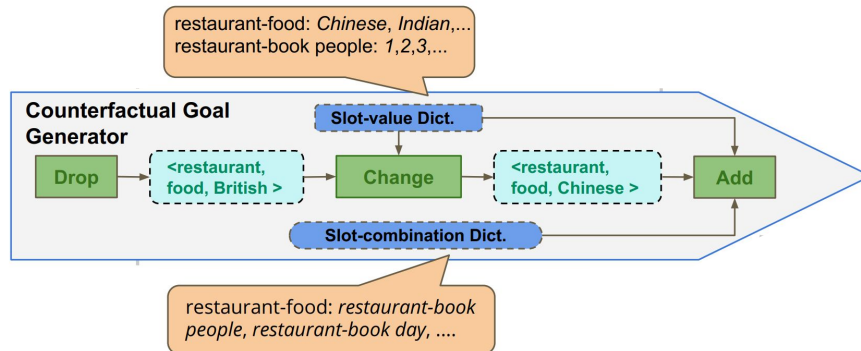
Augmentation Limitations

Augmentation cons

- Without altering the semantics of original sentences, lack of diversity

- Only operate on the existing dialogue data

- No control on the conversation flow

Solution →

Generation

Creating new dialogue examples by drawing from external sources, i.e. document, knowledge graph, LLMs