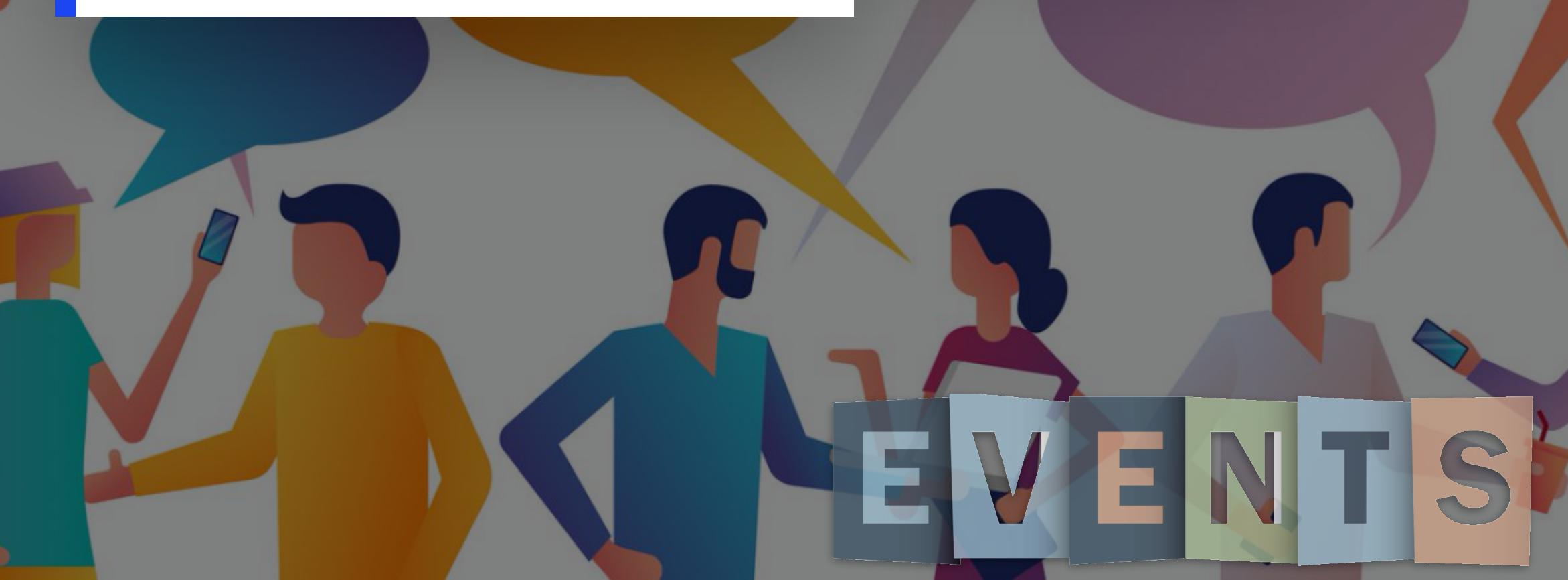


Lifelong Knowledge-Enriched Social Event Representation Learning

Prashanth Vijayaraghavan, Deb Roy



Social Events

- Human communication unfold naturally into temporally extended events
- Events contain information about:
 - social situation (what happened)
 - interactants/participants (who did what to whom)
 - implied/explicit pragmatic implications related to motives, feelings, etc.
 - causal implications.

President Joe Biden on Thursday announced a new goal of having 200 million Covid vaccination shots being distributed within his first 100 days in office. President launched a new, comprehensive strategy to beat this pandemic.....

I am a women in tech and my first two years were really bad because of my ex-manager though I always wanted to prove my mettle. My ex-manager was fairly sexist and suggested I'm not cut out for tech but be a baker or an HR person. My ex-manager built up more stress and created issues. I doubted urself.... Somehow I got transfer to a new team to escape from toxicity.....

Social Events

Events

I'm a woman in tech, and my first two years were really bad because of my ex manager though I always wanted to prove my mettle. My ex-manager was fairly sexist, and suggested I'm not cut out for tech but be a baker or an HR person. My ex manager built up more stress and created more issues. I doubted myself and wanted to move out. It's been months since then. Somehow I got transfer to a new team to escape from toxicity. Wow, I'm in a totally supportive team and I love going into work again. I'm so grateful and happy that I stuck out, and to be promoted within few months is my revenge for him.



Events

Social Events

Social Events

Events

Emotional Reactions

I'm a woman in tech, and my first two years were really bad because of my ex manager though I always wanted to prove my mettle. My ex-manager was fairly sexist, and suggested I'm not cut out for tech but be a baker or an HR person. My ex manager built up more stress and created more issues {to be in control/make things worse} {powerful, satisfied}. I doubted myself and wanted to move out. It's been months since then. Somehow I got transfer to a new team to escape from toxicity. Wow, I'm in a totally supportive team and I love going into work again. I'm so grateful and happy that I stuck out, and to be promoted within few months is my revenge for him.

Motives

Emotional Reactions



Events

Social Events



Mental States

Motives & Emotions

Understanding Social Events

- ➊ Social Events are described in **different levels of abstractions**.
- ➋ Social event representations must capture **semantic, pragmatic properties**.

"In the context of event representations, the pragmatic properties can specifically refer to the human's inferred implicit understanding of event actors' intents, beliefs, and feelings or reactions."

Wood, 1976; Hopper and Naremore, 1978

She launched an attack against her manager

She accused her manager of sexism

She expressed her struggles working with her manager

She exposed her ex-manager's sexist behavior

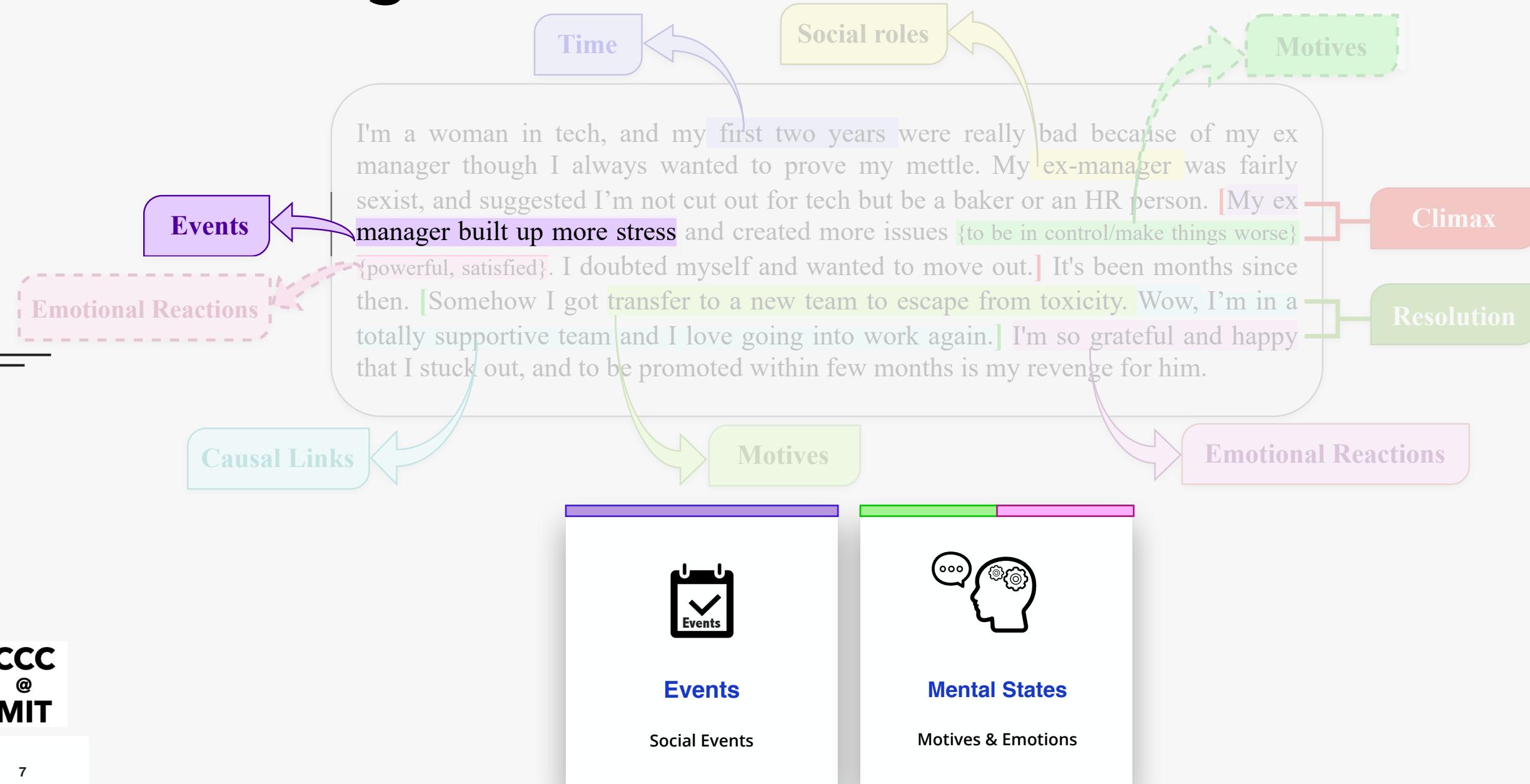
Research Problem



Goal

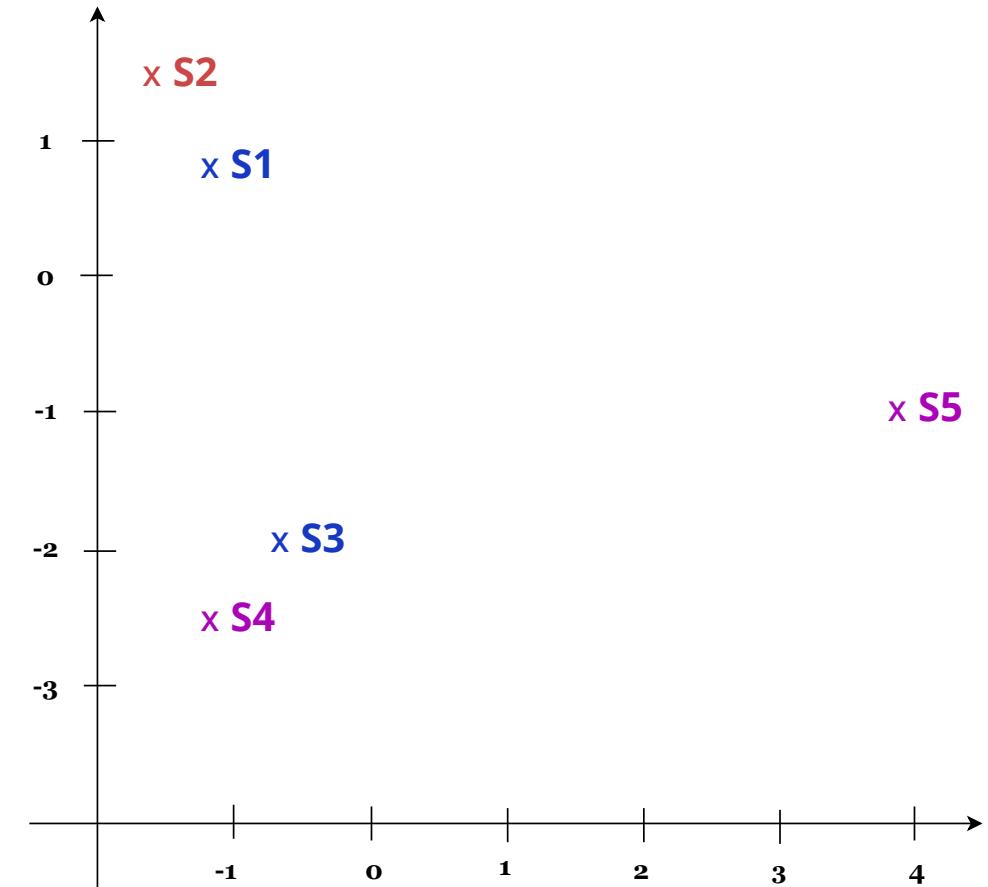
Our goal is to learn distributed representations of social events by incorporating growing knowledge about pragmatic aspects of the language beyond shallow event semantics.

Modeling Social events



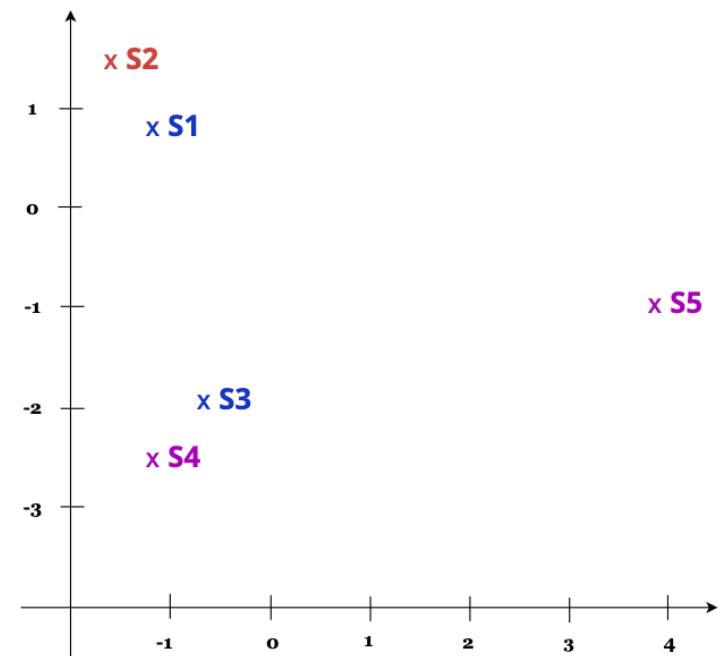
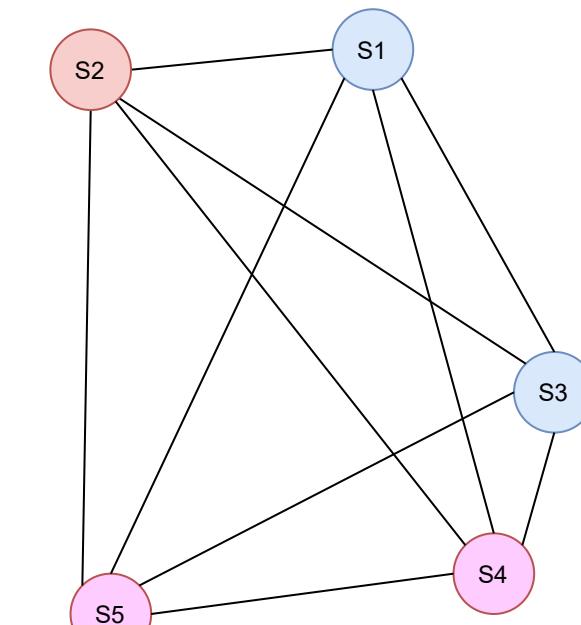
Example Events

-  **S1: My manager built up more stress**
-  **S2: My manager built up more homes**
-  **S3: My boss increased the tension**
-  **S4: Writers increased the tension**
-  **S5: Composers created tension**



Example Events

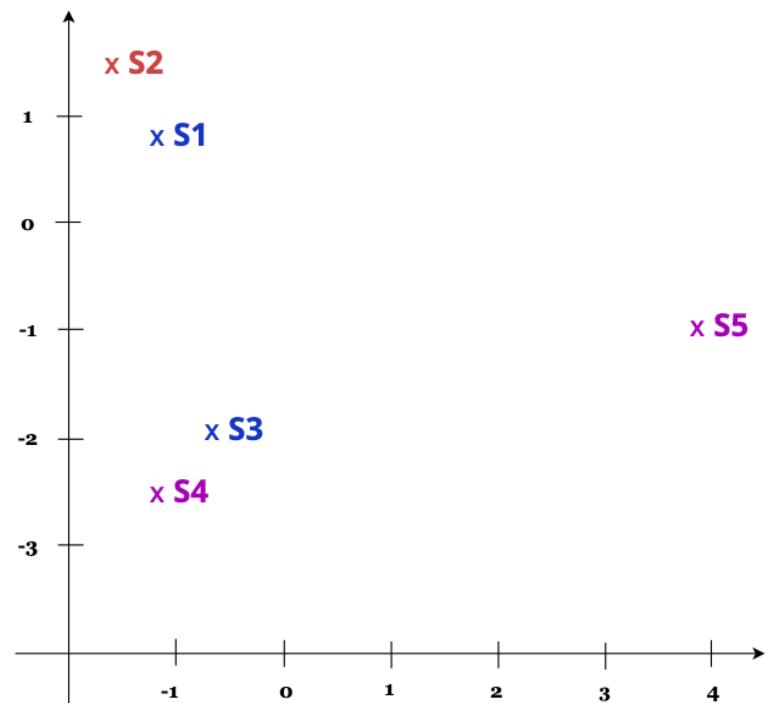
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Key Challenges

- Shallow event semantics captured.
- Hard to distinguish events with subtle differences
- Inability to capture pragmatic aspects of language
- Growing set of knowledge about pragmatic implications from different domains of data

- S1: Manager built up more stress**
- S2: Manager built up more homes**
- S3: Boss increased the tension**
- S4: Writer increased the tension**
- S5: Composers created tension**



Research Questions

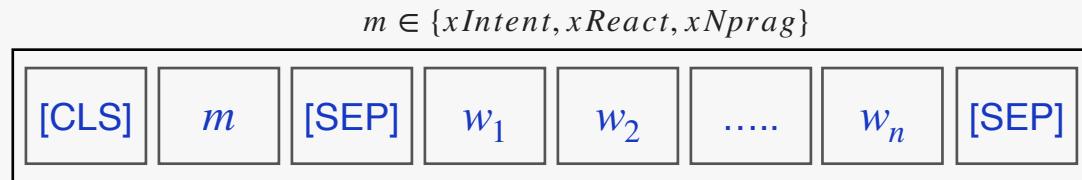
Research Question 1

How do we model events beyond simple linguistic structures, i.e., semantic and pragmatic enrichment of social event embeddings?

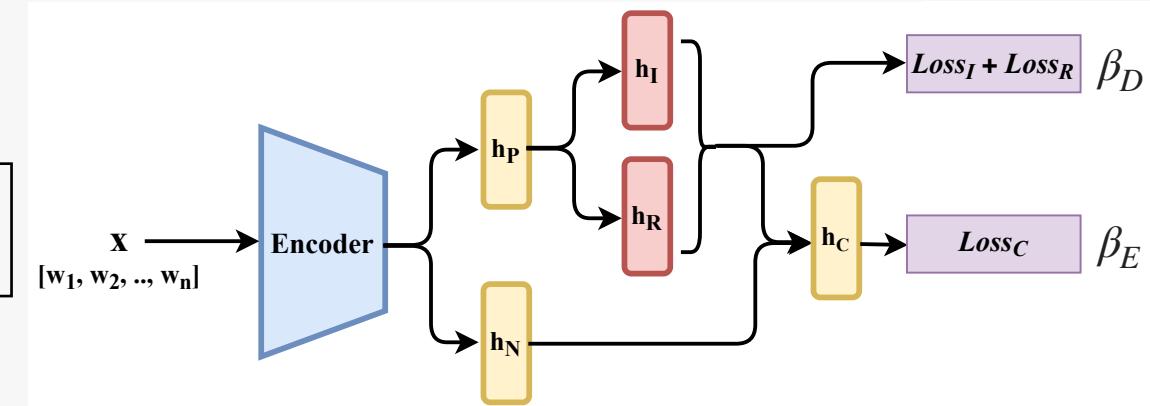
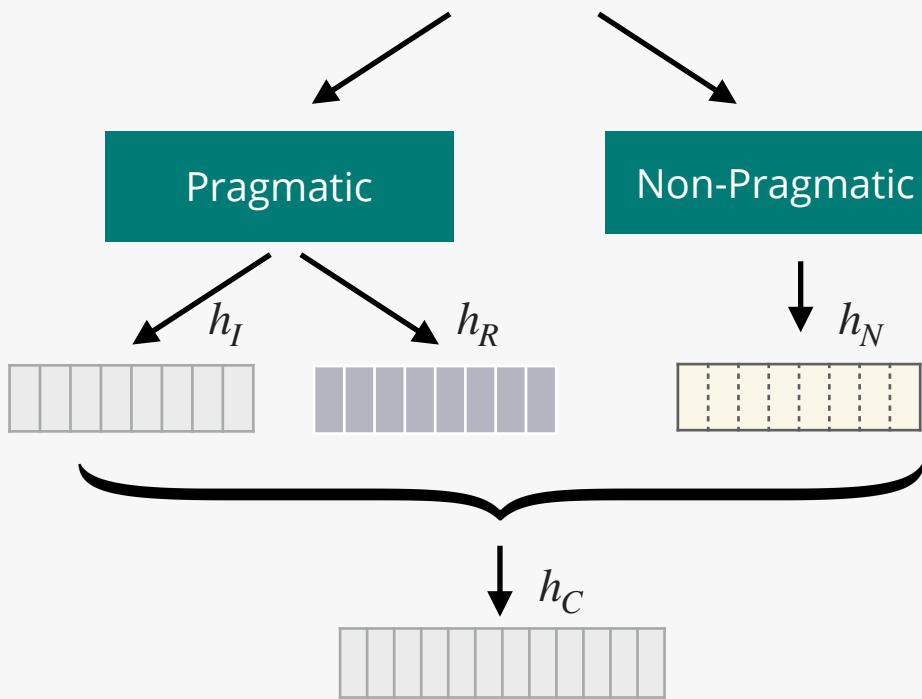
Research Question 2

How do we account for growing knowledge about events from different domain knowledge sources?

EventBERT: Proposed Model



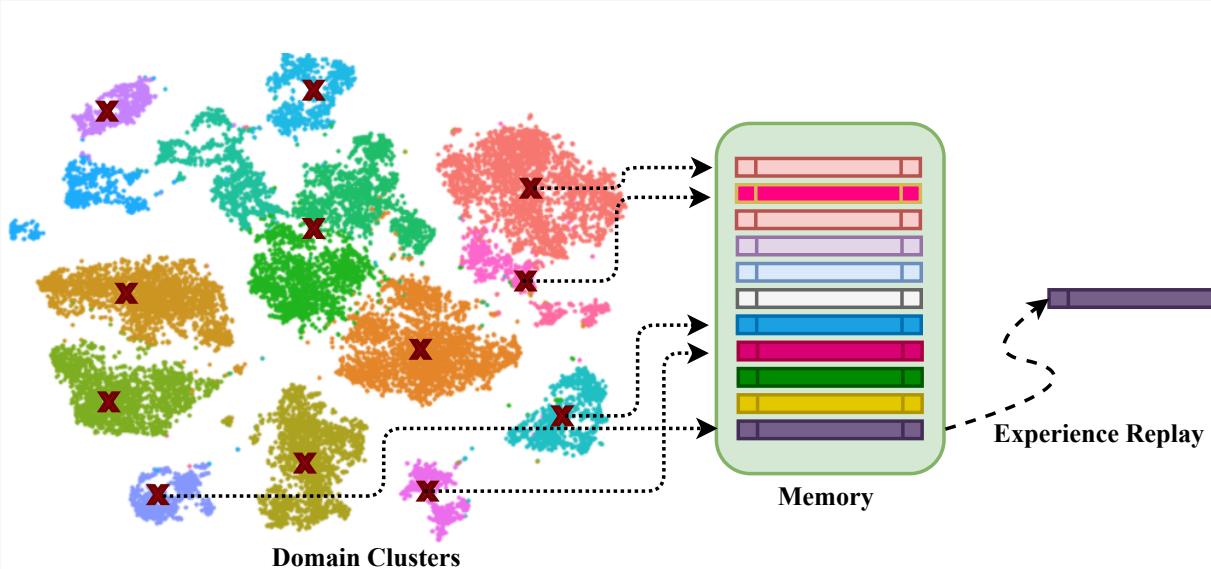
Manager built up more stress



- Disentangle semantic and pragmatic attributes from social event textual descriptions.
- Encapsulate these attributes into an embedding beyond simple linguistic aspects.
- N-pair loss to maximize similarity between positive examples and computed embeddings

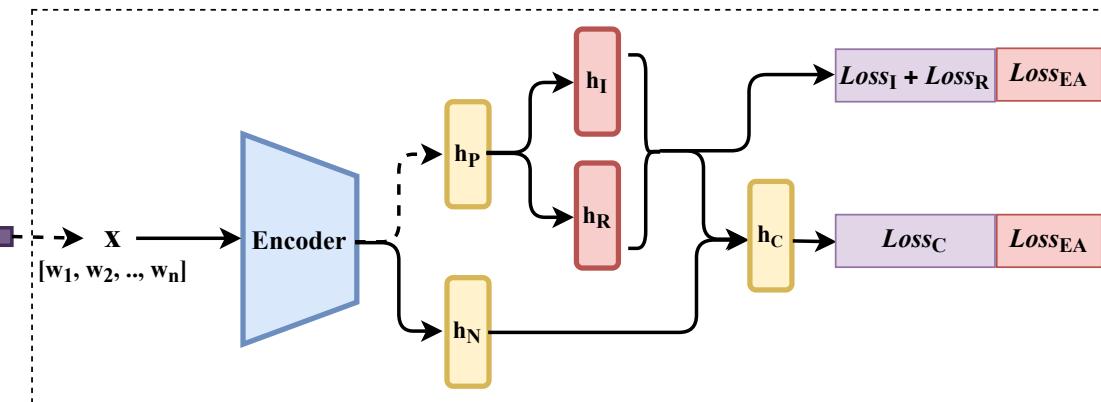
EventBERT+DR-EMR: Proposed Model

- **Experience Replay** by creating mixed training batches: $(\mathcal{B}_{dom}, \mathcal{B}_{rep})$
- **Episodic Memory** implemented as “Read-Write” Memory
 - Read Operation: Retrieve random samples from previously trained domain
 - Write Operation: Stores domain-representative samples and capacity bounded sub-linearly.



$$\mathcal{L}_{EA} = \|\mathcal{G}_A^i(\mathcal{G}_{event}^i(x)) - \mathcal{G}_A^{i-1}(\mathcal{G}_{event}^{i-1}(x))\|^2$$

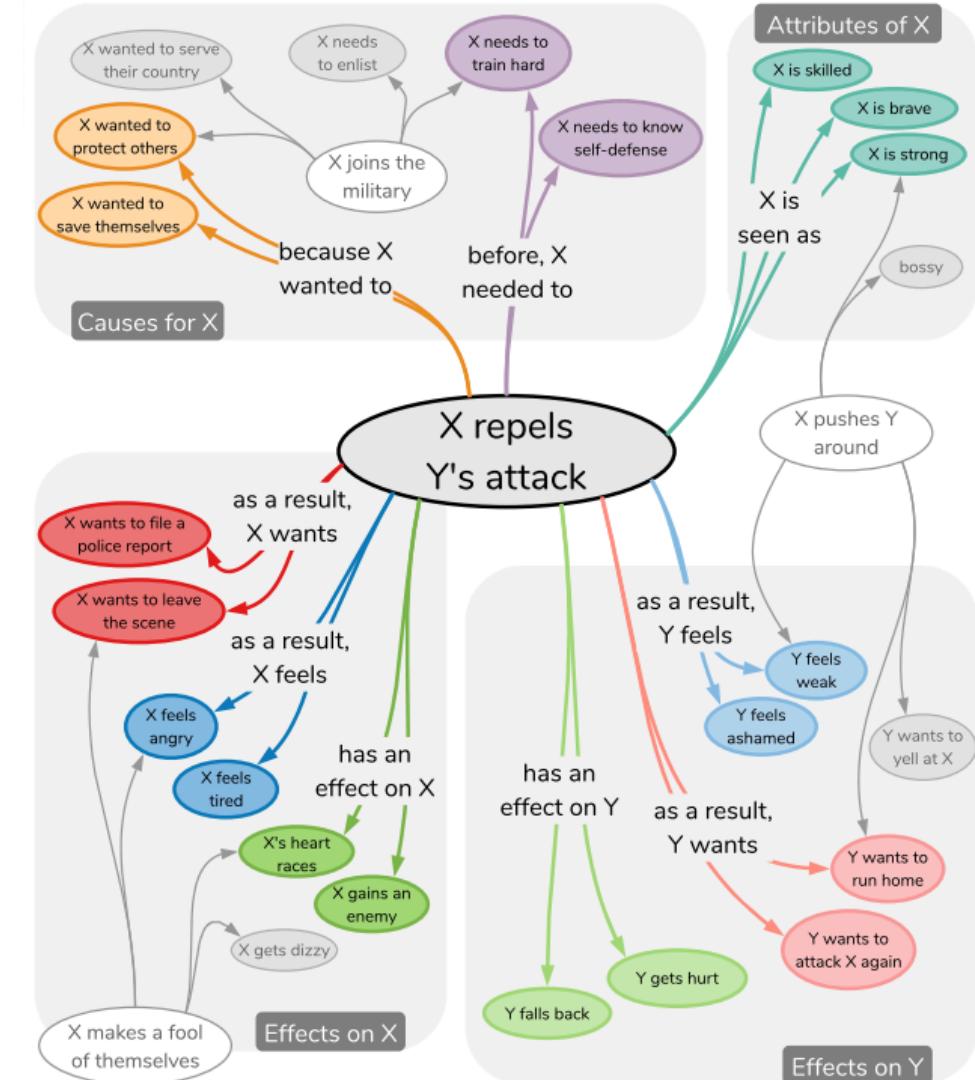
- **Domain-Representative Sample Selection:** Using CURE algorithm to find C representative points.
- **Alignment Model:** Overcome catastrophic forgetting by aligning representation in old and new domain embedding space.



ATOMIC:

Social Commonsense Knowledge

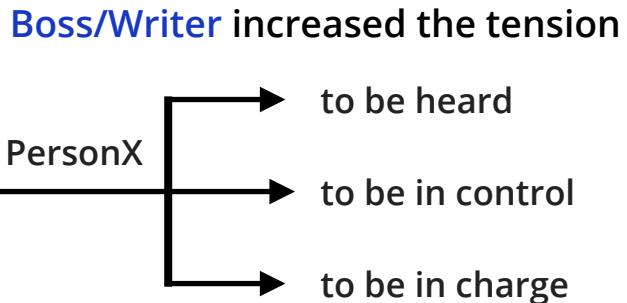
- Everyday commonsense reasoning with inferential knowledge organized as typed *If-then* relations.
- Relevant Relation Type: If-Event-Then-Mental-State.



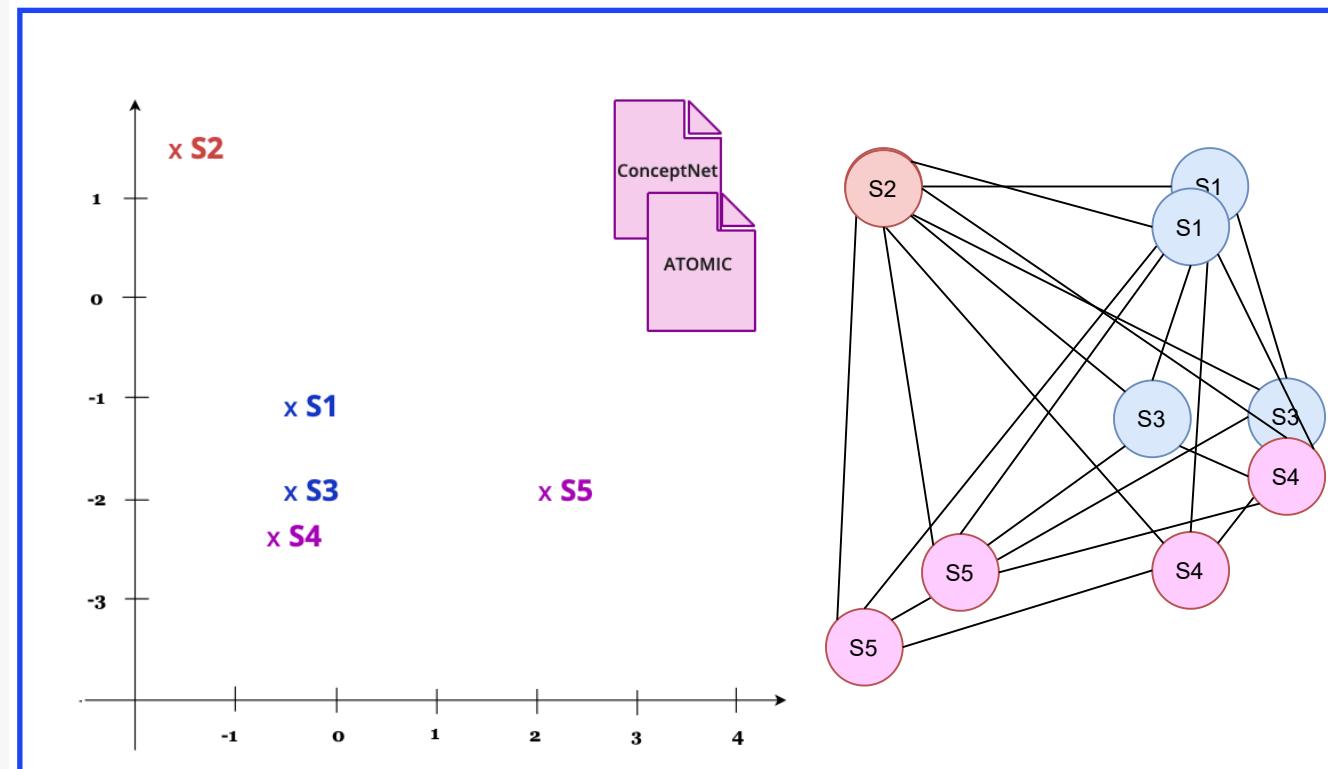
ATOMIC:

Social Commonsense Knowledge

- Everyday commonsense reasoning with inferential knowledge organized as typed *If-then* relations.
- Relevant Relation Type: If-Event-Then-Mental-State.
- Tokens related to people replaced with 'Person' variable. Social role information is lost here.



- S1: My manager built up more stress**
S2: My manager built up more homes
S3: My boss increased the tension
S4: Writer increased the tension
S5: Composers created tension



Dataset Collection



ConceptNet

Commonsense Knowledge data containing general triple information



ATOMIC

Contains multiple commonsense relations based on base 25k event phrases.



SB-SCK Dataset

Implicit mental states containing social role information



Paraphrase Dataset

Data augmentation technique
English \leftrightarrow German translation model

Collect Reddit Posts
PushShift API: /r/offmychest
/r/confessions

Filter Posts
NSFW, over_18, post length, etc.

OpenIE Extraction
Predicate-Argument Triple

Motivation Expression Extraction
Purpose Clauses

Motives Detection
Simple classifier, Paraphrase-based augmentation

Emotion Expression Extraction
FrameNet Emotion-directed lexical units

Emotion Detection
Rule-based Pattern Matching

Web Search & Filtering
Normalization, De-duplication

Sentence-level Knowledge Detection
Simple Classifier, Motives-Emotion extraction

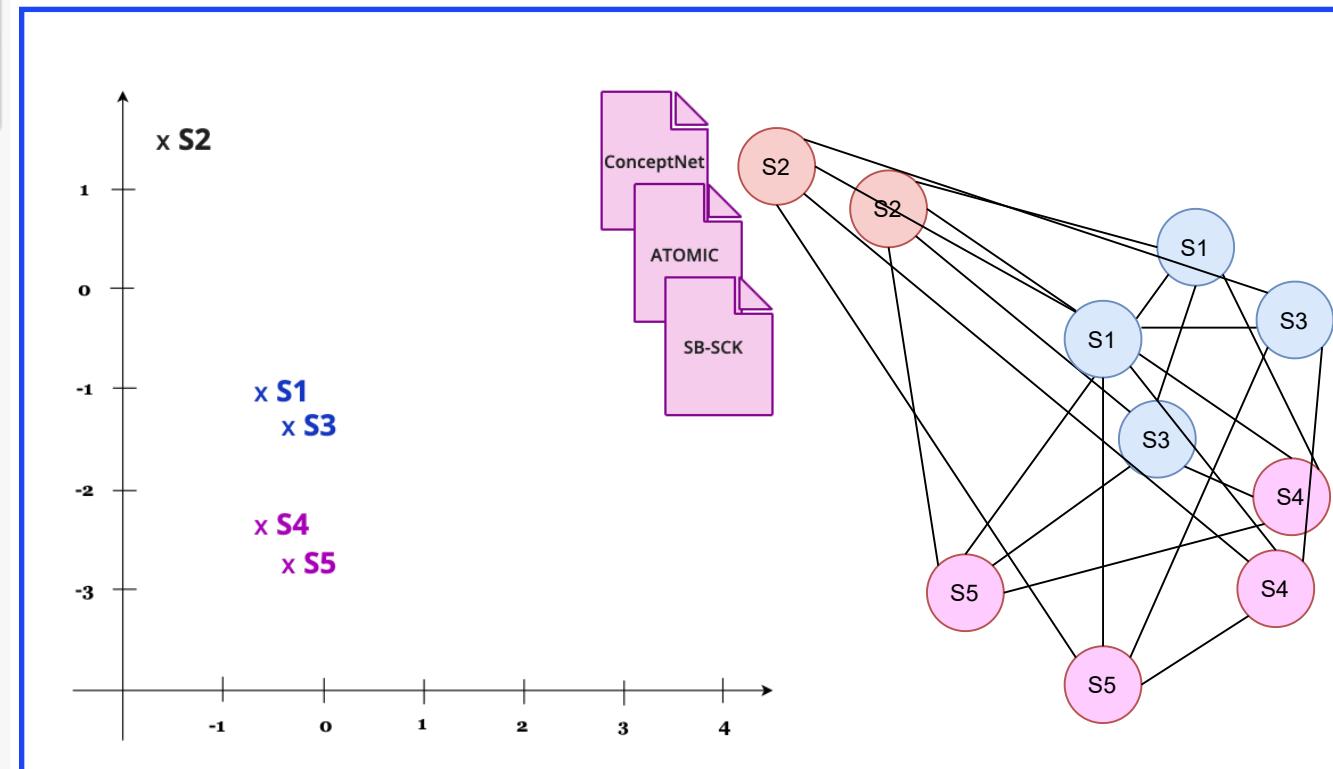
SB-SCK:

Social Commonsense Knowledge

- Our weakly-annotated web-search based aggregate knowledge.
- Consists of Social role information though data may be noisy.

Search-based Social Commonsense Knowledge		
Social Roles	Event Phrases	Motives
Politicians	use social media	to woo voters
Activists		to create a movement
Police		to connect with residents and solve crime
Workers	gather around table	to solve business problems
Priests		to pray to god, share wine and bread
Friends		to share a meal, conversation

- S1: Manager built up more stress**
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SB-SCK Dataset

Search-based social commonsense knowledge containing sentence-level implicit mental states

Samples Search Results

[www.masterclass.com › articles › ways-to-create-tension... :](http://www.masterclass.com/articles/ways-to-create-tension-in-music.html)

6 Ways to Create Tension and Release in Music - 2021 ...

Nov 8, 2020 — What Is **Tension** in Music? Tension in music production is the anticipating **build up** of rhythm, harmony, melody, and dynamics. When songwriters or **composers** build up tension in a song, they **create** a feeling of unrest or expectation, which can develop an **emotional experience for the listener.**

How to Create Tension in Writing: 8 Tips | Now Novel

What are some techniques **writers** use for **increasing tension in the rising** ... these tips to build **tension that keeps your reader intrigued and invested in your story arcs:** ... Developing believable and **engaging** characters who are invested in their ...

Keep adding... · Balance high dramatic... · Appeal to readers' emotions

Search-based Social Commonsense Knowledge		
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#events w/ motives	103,357
#events w/ emotions	69,584
#unique social roles	586

Experiments

Research Question 1

How well do our models perform in comparison to continual learning for intent-emotion prediction?

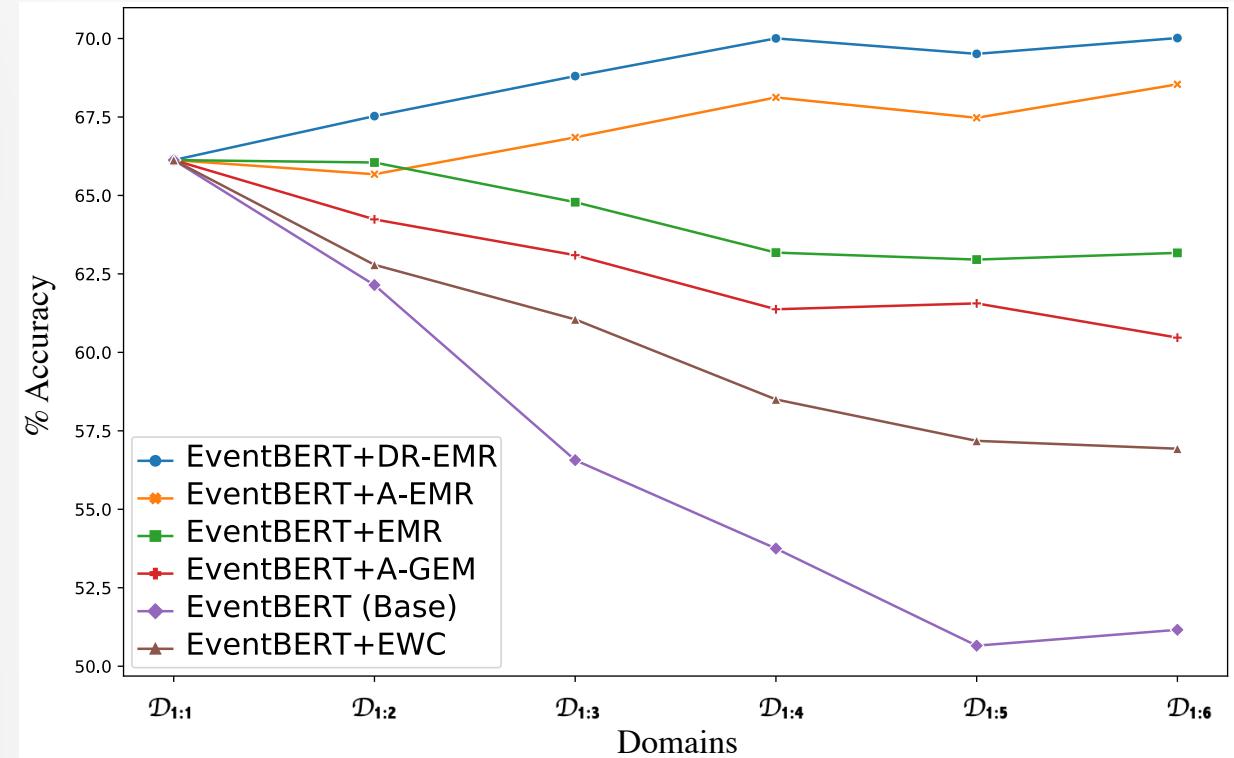
Research Question 2

How well do the learned embeddings improve on different downstream tasks?

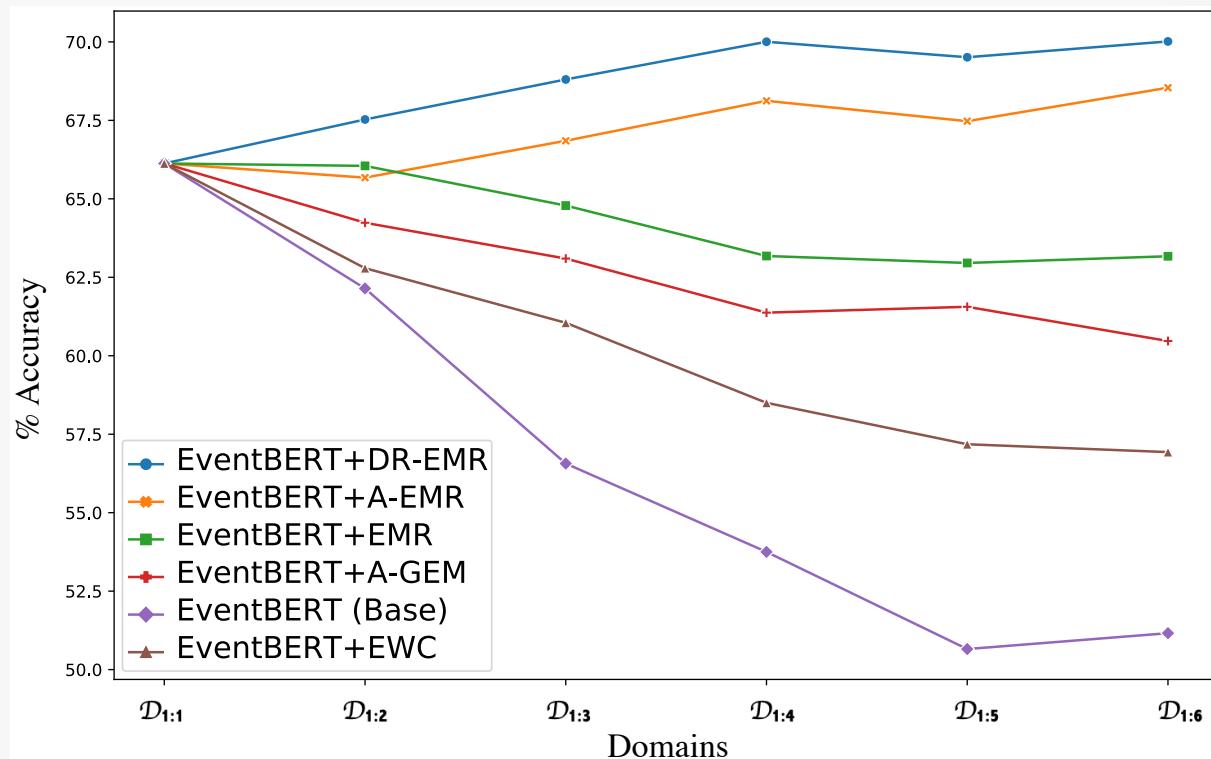
Intent-Emotion Prediction Results

Baselines

- **Base:** Fine-tune on successive tasks
- **A-GEM:** Gradient-based constraint
- **EWC:** Regularization technique
- **EMR:** Sparse Experience Reply
- **A-EMR:** Sparse Experience Reply with alignment constraints
- **DR-EMR:** Domain-Representative Experience Reply with alignment constraints



Intent-Emotion Prediction Results

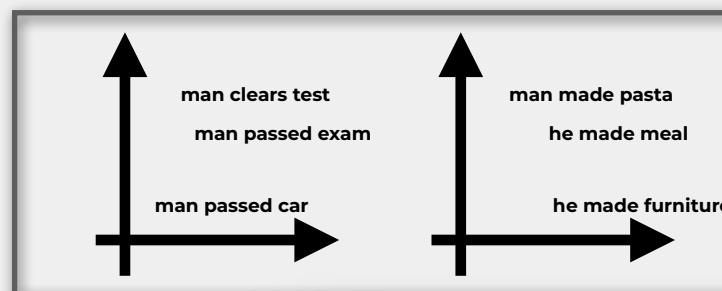


DR-EMR **outperforms all other methods** for predicting intents and emotions.

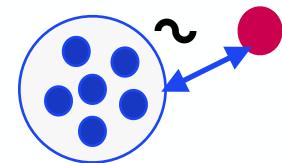
DR-EMR model records the **least standard deviation** with reduced sensitivity to training order.

Evaluation on Downstream Tasks

REASONING ABOUT MOTIVATION		REASONING ABOUT EMOTIONAL REACTIONS	
<p>Tracy had accidentally pressed upon Austin in the small elevator and it was awkward.</p> <p>Q Why did Tracy do this? A (a) get very close to Austin (b) squeeze into the elevator ✓ (c) get flirty with Austin</p>		<p>In the school play, Robin played a hero in the struggle to the death with the angry villain.</p> <p>Q How would others feel afterwards? A (a) sorry for the villain (b) hopeful that Robin will succeed ✓ (c) like Robin should lose</p>	



Evaluation Datasets	Training Set	Dev/Test Set
Social IQA	33,410	2,224
Hard Similarity Task	—	2,230



HARD SIMILARITY

Weak Annotations of Motives & Emotion Explanations

REASONING ABOUT MOTIVATION	
<p>Tracy had accidentally pressed upon Austin in the small elevator and it was awkward.</p> <p>Q Why did Tracy do this? A (a) get very close to Austin (b) squeeze into the elevator ✓ (c) get flirty with Austin</p>	

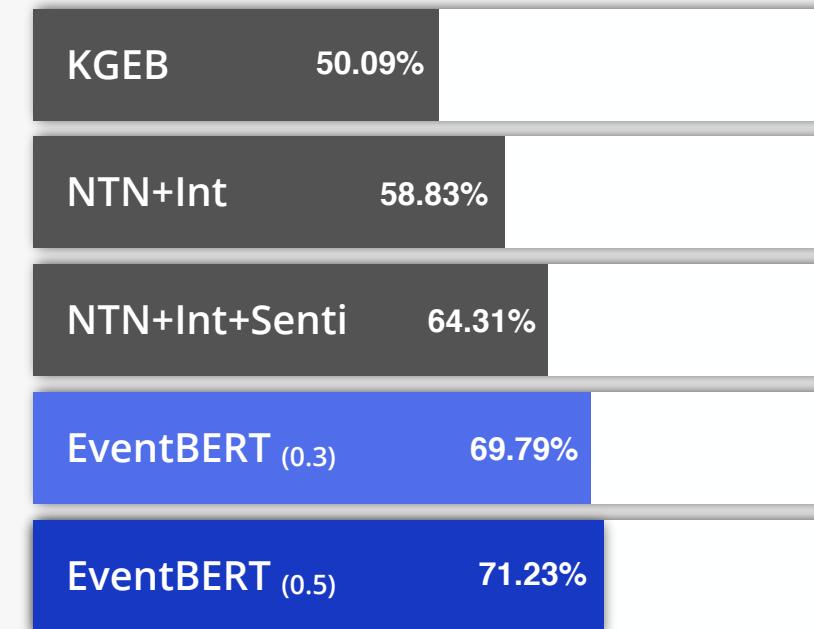
SOCIAL IQA

Reasoning about Social Situations, Multiple Choice QA

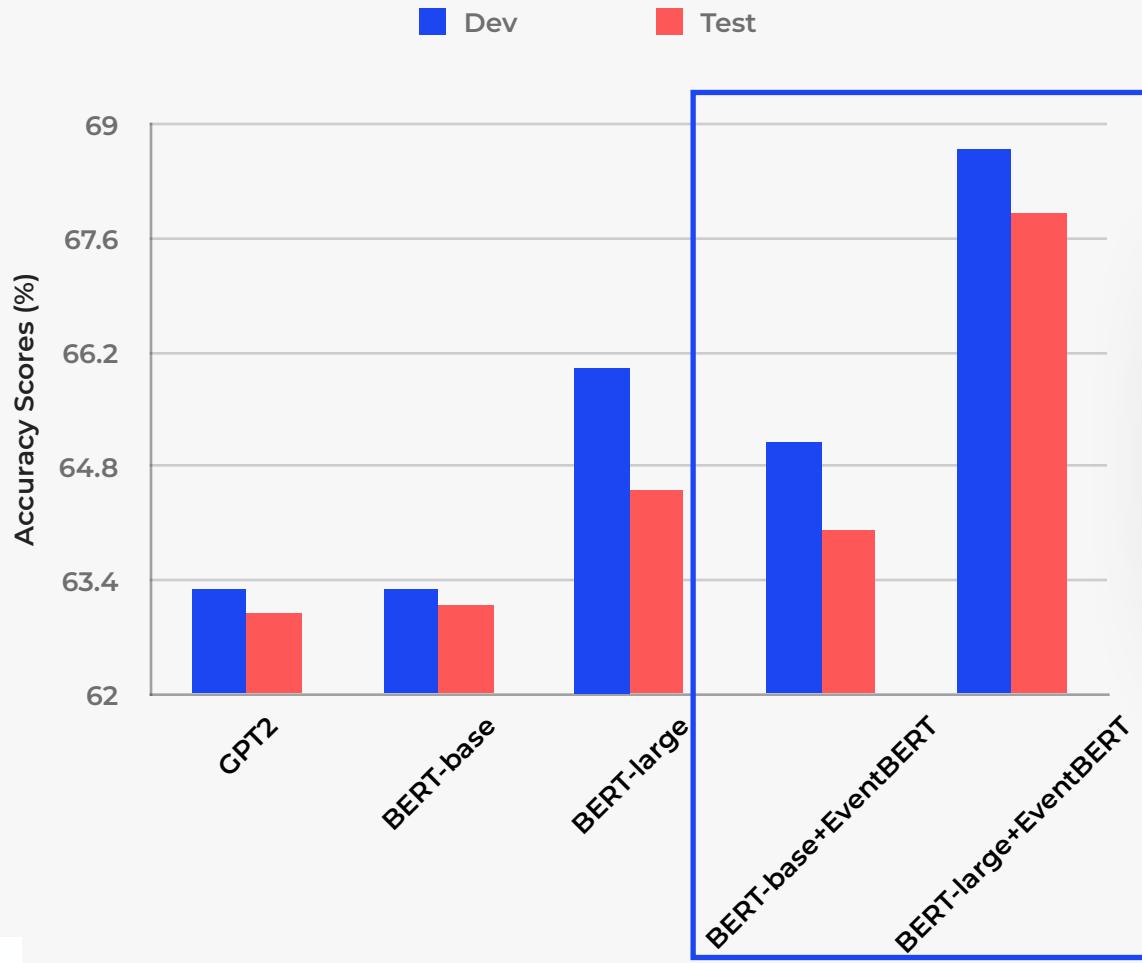
Hard Similarity Results

Baselines

- ◎ KGEB³
-
- ◎ NTN + Intent¹
- ◎ NTN + Intent + Sentiment¹
- ◎ EventBERT($\beta_D = 0.3$)
- ◎ EventBERT($\beta_D = 0.5$)



Social IQA Results



EventBERT+DR-EMR records

~5% ↑ > Bert-Large

Summary

Effectively Embed Social Events using growing set of Social Commonsense Knowledge

Overcome Catastrophic Forgetting & enable positive knowledge transfer

Empirically demonstrate improved results on lifelong learning, reasoning, event similarity baselines

Contact: pralav@mit.edu

Project Page: https://pralav.github.io/lifelong_eventrep/