



GraphSpect: Automating Aspect Prediction for Structured Meaning Representations



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1. Motivation

Background – Structured meaning representations like Uniform Meaning Representation (UMR) are useful for downstream **NLP tasks** and **AI grounding**

Problem – UMR format encodes grammatical aspect, but manual annotation is difficult, slow, and expensive. **Can we automate this bottleneck to expedite UMR generation?**

Task – Classify grammatical aspect of an event given **only** the raw sentence as input

Hypothesis – Graph Neural Networks (GNNs) can capture the **conceptual context** and the **event-argument structure** from an input sentence to classify a predicate’s grammatical aspect better than other automated methods

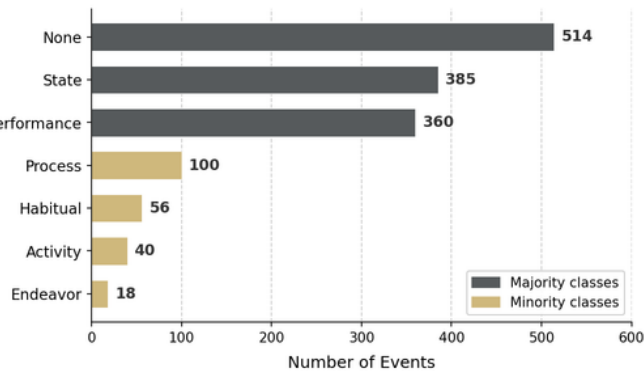


Figure 2: Class Distribution Bar Chart

2. Dataset

First of its kind dataset with **1,473** examples

High signal-to-noise ratio after extensive annotation and adjudication

Major imbalance across the 7 output classes **reflects natural language** distribution

He **is still writing** his paper.
(w/ (write-01)
:ARG0 (p/ person
:ref-person 3rd
:ref-number Singular)
:ARG1 (p2/ paper
:poss p
:ref-number Singular)
:mod (s/ still)
:aspect Activity
:modstr FullAff)

Figure 1: Example UMR Graph

4. Results

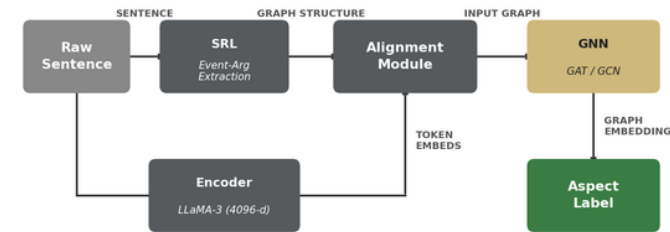
GAT+CL – Best automated method across all three metrics reported and **beats both LLMs**

Contrastive loss – Significantly improves performance on **minority classes** compared to cross-entropy loss for GAT

Conclusions – Contextualized graph structure improves automated aspect classification over the baseline, but work remains to achieve performance on-par with manual annotation

3. Methods

Data Pipeline:



GNN components:

- Attention mechanism** (GAT) learns contextual relationships between words
- Convolutional filter** (GCN) learns how graph nodes relate to the root predicate
- Contrastive learning** synthetically increases effective training data size

Model	Acc.	Macro F1	Wtd. F1
GNN			
GAT	0.62	0.32	0.58
GCN	0.55	0.18	0.49
GAT+CL	0.64	0.41	0.61
GCN+CL	0.55	0.17	0.47
LLM			
LLaMA-3.1	0.22	0.25	0.26
GPT-5mini	0.48	0.41	0.52
Neural			
Feedforward MLP	0.62	0.33	0.58
Human			
First annotator	0.87*	0.81*	0.88*

*best score overall, **bolded** best automated score

Table 1: Results Table with Baselines