

# Ranking-Guided Autoregressive Modeling for Multimodal Tabular Anomaly Detection

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Workshop on Quality of Knowledge Graphs - ESWC 2026

# Knowledge Graphs from Tables

J. Liu, Y. Chabot, R. Troncy et al.

Web Semantics: Science, Services and Agents on the World Wide Web 76 (2023) 100761

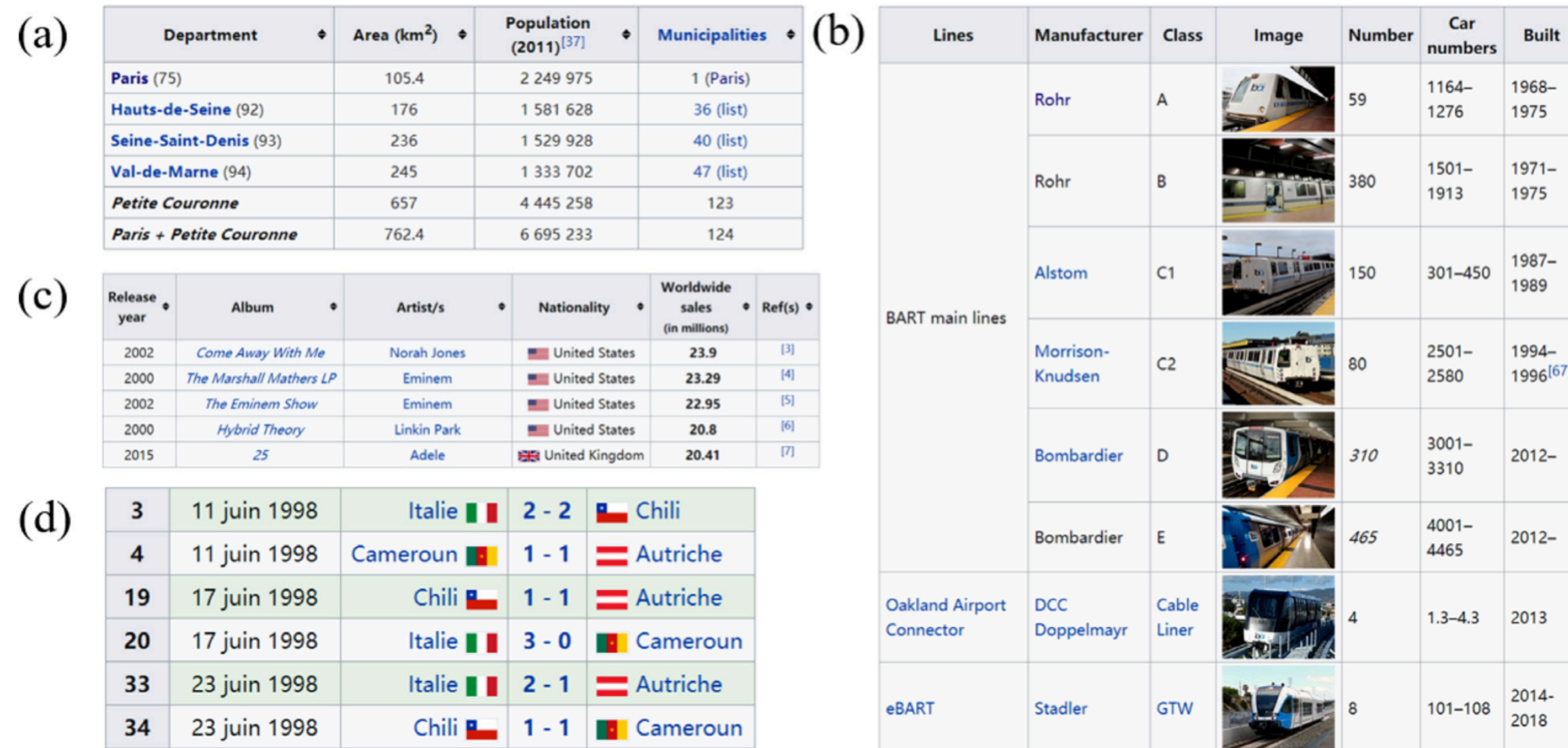
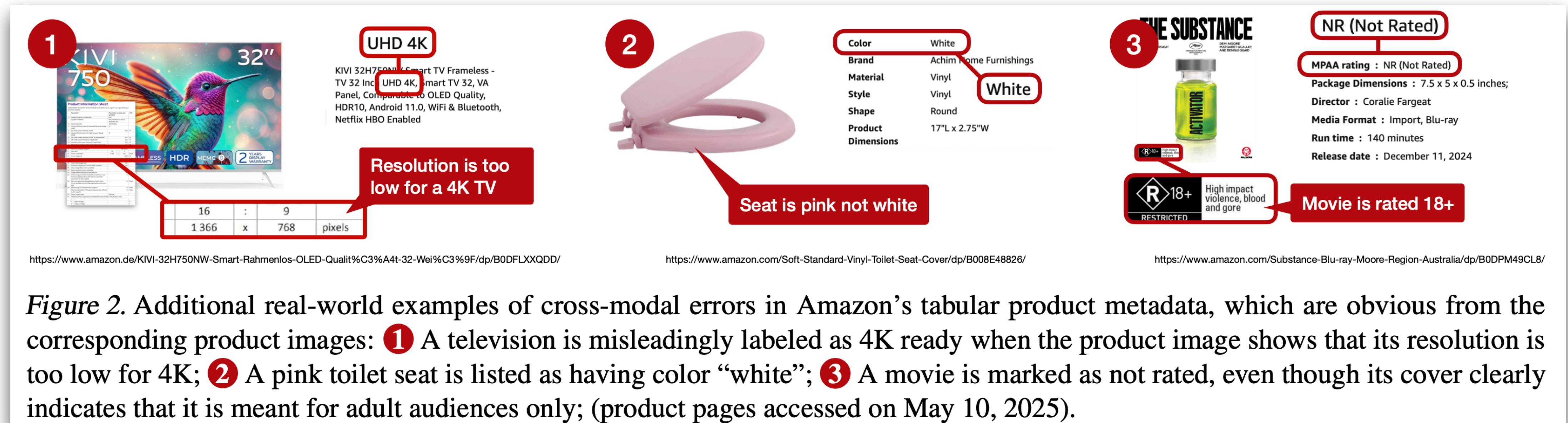


Fig. 7. Examples of different relational tables: (a) a single-cell-subject relational table,<sup>11</sup> (b) a composed-subject relational table,<sup>12</sup> (c) a multi-subject relational table,<sup>13</sup> (d) a hidden-subject relational table.<sup>14</sup>

# Tabular and Multimodal Error Detection



Source: Olga Ovcharenko, Sebastian Schelter. [Towards Cross-Modal Error Detection with Tables and Images](https://arxiv.org/abs/2510.12383). Workshop on Unifying Data Curation Frameworks Across Domains (DataWorld) at ICML, 2025. <https://arxiv.org/abs/2510.12383>

# ANO LLM: LARGE LANGUAGE MODELS FOR TABULAR ANOMALY DETECTION

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## ABSTRACT

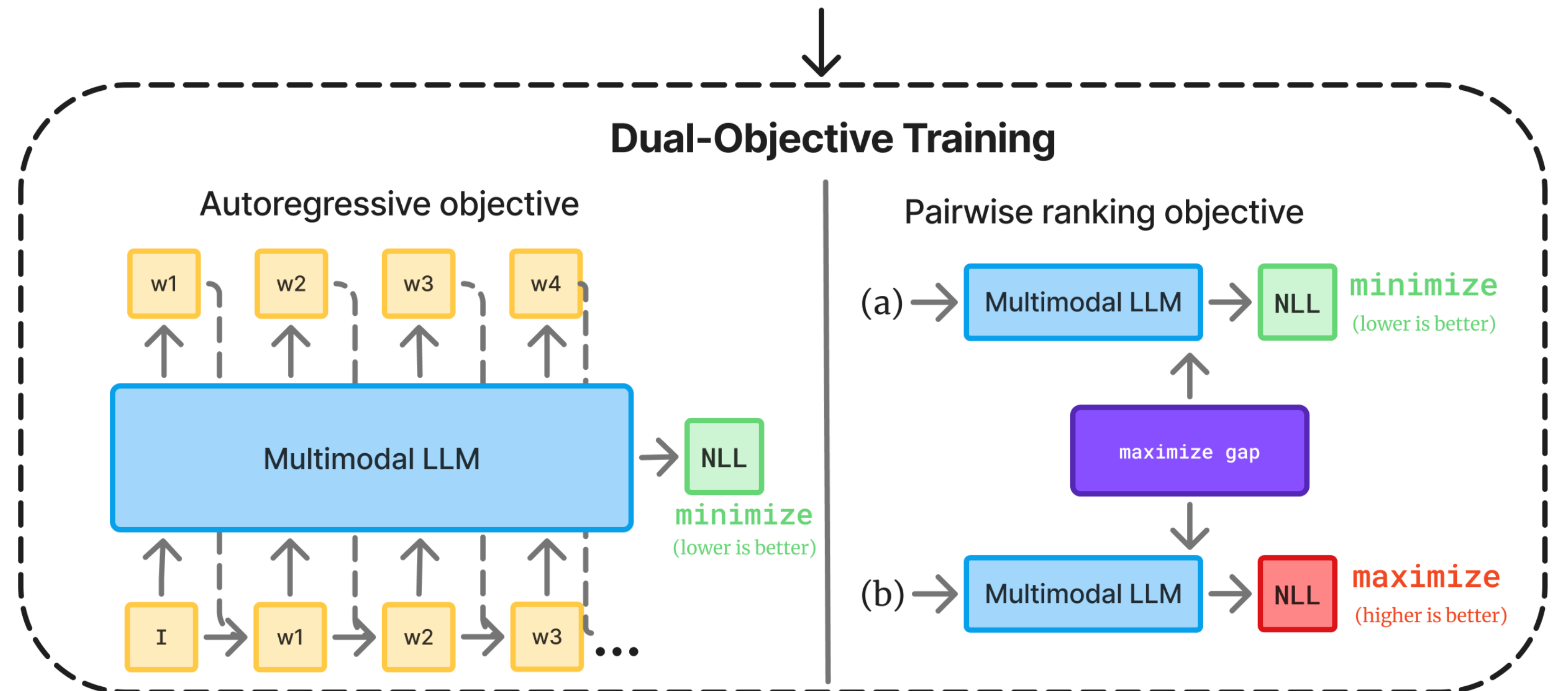
We introduce AnoLLM, a novel framework that leverages large language models (LLMs) for unsupervised tabular anomaly detection. By converting tabular data into a standardized text format, we further adapt a pre-trained LLM with this serialized data, and assign anomaly scores based on the negative log likelihood generated by the LLM. Unlike traditional methods that can require extensive feature engineering, and often lose textual information during data processing, AnoLLM preserves data integrity and streamlines the preprocessing required for tabular anomaly detection. This approach can effectively handle mixed-type data, especially those containing textual features. Our empirical results indicate that AnoLLM delivers the best performance on six benchmark datasets with mixed feature types. Additionally, across 30 datasets from the ODDS library, which are predominantly numerical, AnoLLM performs on par with top performing baselines.

## 1 INTRODUCTION

Anomaly detection (AD) seeks to examine specific data points to identify rare, or specious occurrences that deviate from established behavior patterns. AD has been applied to a wide range of applications spanning computer vision (Chandola et al., 2009), natural language processing (NLP) (Schölkopf et al., 2001) and tabular data (Hawkins, 1980). Among these, tabular anomaly detection is particularly crucial, as tabular data is a fundamental format in machine learning which has been used extensively in applications related to cyber-attack prevention (Landauer et al., 2023), detecting fraudulent financial transactions (Dornadula & Geetha, 2019), and diagnosing medical conditions (Fernando et al., 2021).














# Our Model

	Prompt	Knowledge Graph	Discipline	Image	
✓	Illustrate the role of telomeres...	{"elements": ["DNA", "Telomere", "Telomerase", ...]}	Biology		(a) The prompt, knowledge graph, and discipline fields all refer to the <b>biology</b> domain
✗	Illustrate the role of telomeres...	{"elements": ["DNA", "Telomere", "Telomerase", ...]}	Biology		(b) The image depicts computer science content, producing a <b>cross-domain text-image mismatch</b>
✓	Illustrate the connections...	{"elements": ["Enlightenment", "Reason", "Ideas", ...]}	History		(a)
✗	Illustrate the connections...	{"elements": ["Enlightenment", "Reason", "Ideas", ...]}	History		(b)



Split (1)  
test · 4.46k rows

Search this dataset

key	prompt	Knowledge_Graph	Annotation	Education	Discipline	HasImage	base_image
string · lengths	string · lengths	string · lengths	string · lengths	string · classes	string · classes	string · classes	image · width (px)
							
10	27	46	369	6 values	10 values	2 values	600
30	186	3.93k	9.35k				11.3k ø
PhD_Biology_0	Analyze the dynamics of chronic virus...	{ "elements": [ "Primary Infection", "Re-infection", ...	{ "Definitions": "Chronic virus..."	PhD	Biology	True	
PhD_Biology_1	How do dCas9 and its variants regulate...	{ "elements": [ "dCas9", "gRNA", "Target Gene", ...	{ "Definitions": "The dCas9 system i..."	PhD	Biology	True	
PhD_Biology_2	What are the mechanisms and...	{ "elements": [ "Chromosome", "DNA", "Methyl Group", "DNA..."	{ "Definitions": "Epigenetic changes..."	PhD	Biology	True	
PhD_Biology_3	What are the key components and...	{ "elements": [ "Cancer-associated fibroblasts", ...	{ "Definitions": "Cancer genomics..."	PhD	Biology	True	
PhD_Biology_4	What is the RhoA activation cycle an...	{ "elements": [ "RhoA", "GEF", "GAP", "mDia", "Profilin", "F..."	{ "Definitions": "The RhoA activatio..."	PhD	Biology	True	

**Table 2**

AUC-ROC and F1@k scores for all six testing datasets for three models: Vanilla (no pretraining), trained with Causal Language Modeling (CLM) and our Dual-Objective (DO) approach. K refers to the total number of anomalies in the testing dataset.

Anomaly Category	AUC-ROC			F1@k		
	Vanilla	CLM	DO	Vanilla	CLM	DO
Random Noise	0.45	<b>0.72</b>	0.64	0.25	<b>0.51</b>	0.45
OOC Domain - Unstructured	0.39	0.53	<b>0.99</b>	0.21	0.30	<b>0.93</b>
OOC Domain - Structured	0.48	0.50	<b>0.99</b>	0.26	0.31	<b>0.96</b>
Cross-Domain Image Swap	0.39	0.52	<b>0.99</b>	0.22	0.31	<b>0.99</b>
In-column Text Swap	0.48	0.51	<b>0.82</b>	0.28	0.29	<b>0.68</b>
In-column Cell Swap	0.47	0.51	<b>0.78</b>	0.25	0.29	<b>0.63</b>

# Conclusion

- Multimodal anomaly detection in structured data is important task
- A new model that improves over SOTA in the multimodal tabular setting
- Future work:
  - new benchmarks and datasets
  - Applications to real world settings
  - Identifying values not just rows

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