**Uncertainty Aware Semi-Supervised Learning on Graph Data**

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**INTRODUCTION**

Consider a classifier only knows two classes: "car" and "road"

Incorrect prediction

- High Uncertainty

Out-of-distribution (OOD)

- High Uncertainty

Quantifying predictive uncertainty is important for safety-critical applications

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**MULTIDIMENSIONAL UNCERTAINTY FRAMEWORK**

- Given: graph $G = (V, E, r, y_t)$
- Edge $e$: node-level feature
- $y_t$: training label
- Goal: Predict
  - Class probabilities $p$
  - Multidimensional uncertainty $u$

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**EXPERIMENTAL RESULTS**

- Misclassification Detection
- OOD Detection

**Key Merits of GKDE**

- Provide pixel-level predictive uncertainties by replacing GNN with CNN

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**SUMMARY**

- Proposed a multi-source uncertainty framework of GNNs.
- Provided a theoretical analysis about the relationships between different types of uncertainties.
- Demonstrate the use of vacancy for OOD detection and dissonance for misclassification detection.

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**Key Theoretical Results**

- Relationships Between Multiple Types of Uncertainties

Consider a simple scenario:

- $y$: a multinomial random variable
- $y \sim \text{Cat}(p)$: $y$ follows a $K$-class categorical distribution
- $p \sim \text{Dir}(\alpha)$: class probabilities $p$ follows a Dirichlet distribution

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**Experimental Results**

- PR curves on Pubmed
- PR curves on Amazon Computers

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**Results**

- AUROC: 64%
- AUROC: 93%