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Collective Robustness Certificates

Exploiting Interdependence in Graph Neural Networks

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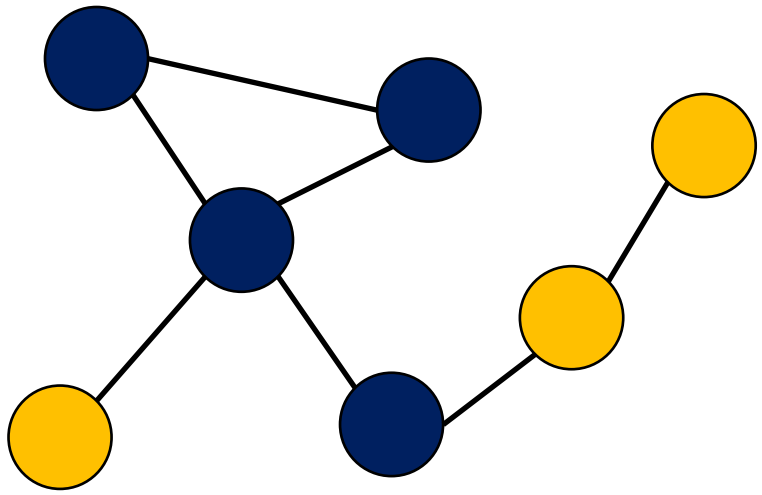
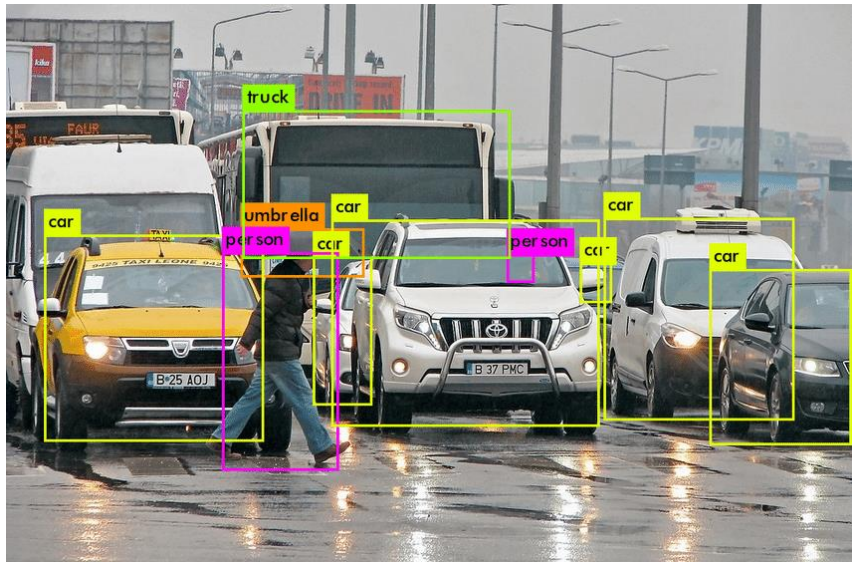
Motivation



Multiple nodes classified in a single graph



Multiple objects detected in a single image [1]

Adversarial robustness certification so far focused on single-prediction tasks

[1] A Convolutional Neural Network based Live Object Recognition System as Blind Aid. Kedar Potdar et. al. arXiv:1811.10399

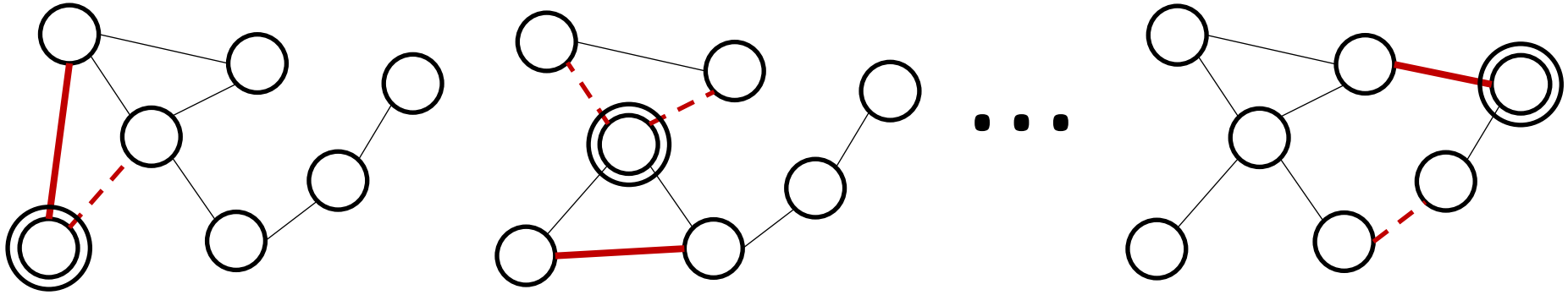
Research Question

How can we certify **collective adversarial robustness**?

- for classification models
- based on Graph Neural Networks

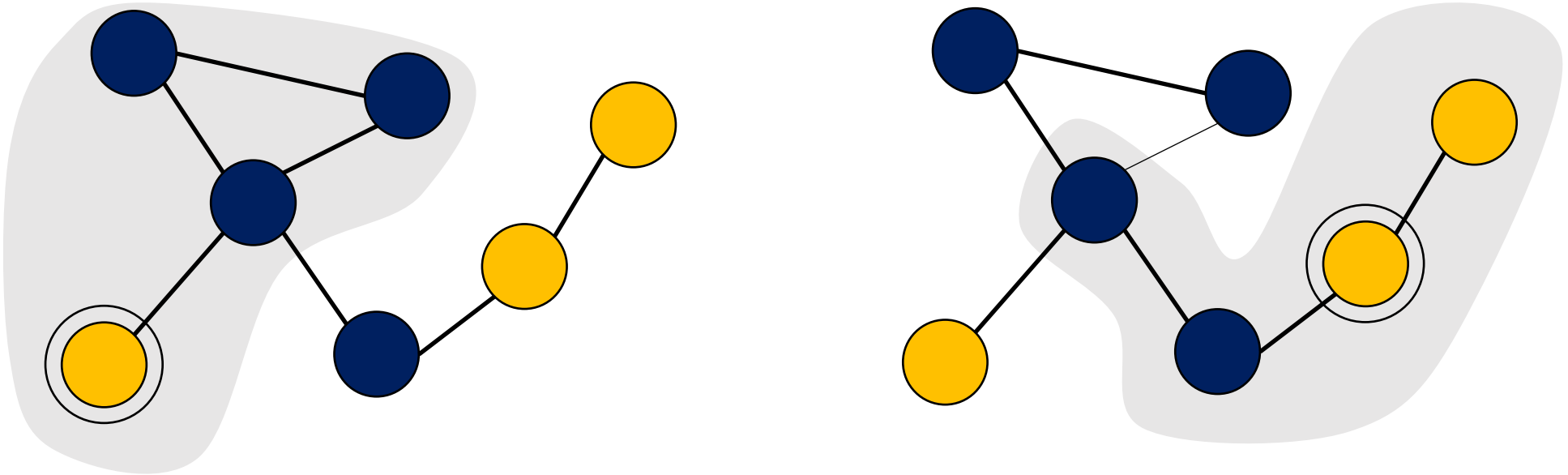
A naïve certificate

- Certify each prediction independently
- Assumes a different attack on each prediction



Our certificate

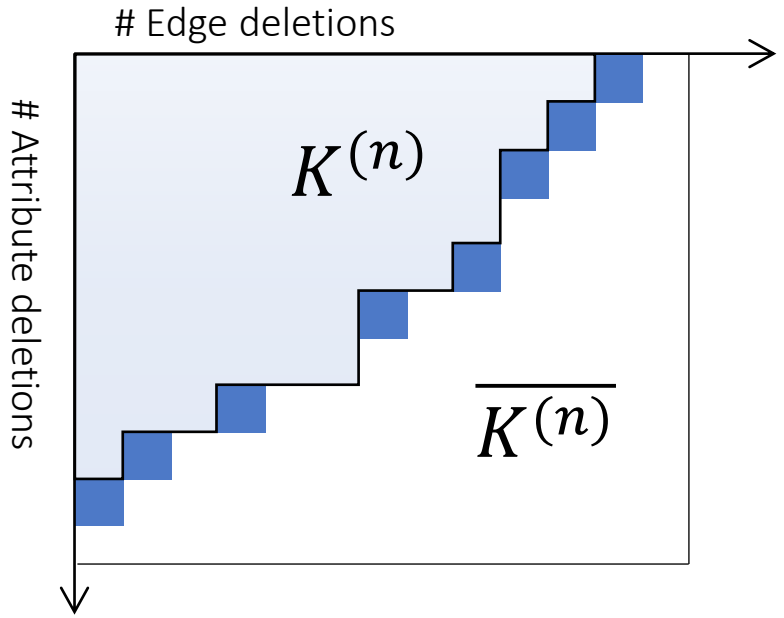
Ingredient 1: Locality



→ Not all perturbations affect all predictions

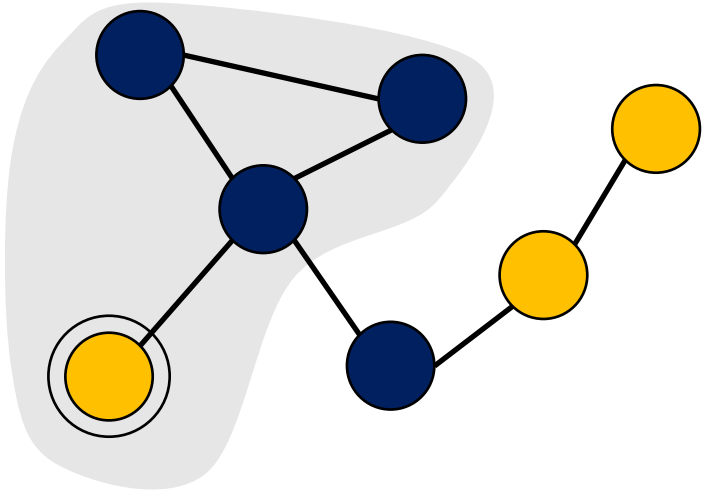
Ingredient 2: Linear certificate encoding

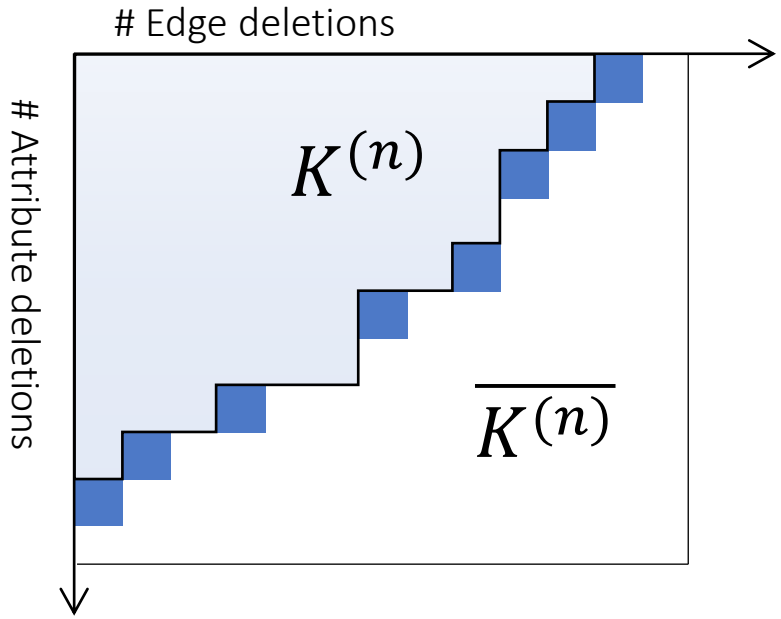
Evaluate single-prediction certificates via linear constraints …



… by encoding their pareto front

Combining Ingredients 1 & 2





Given a single perturbed graph:

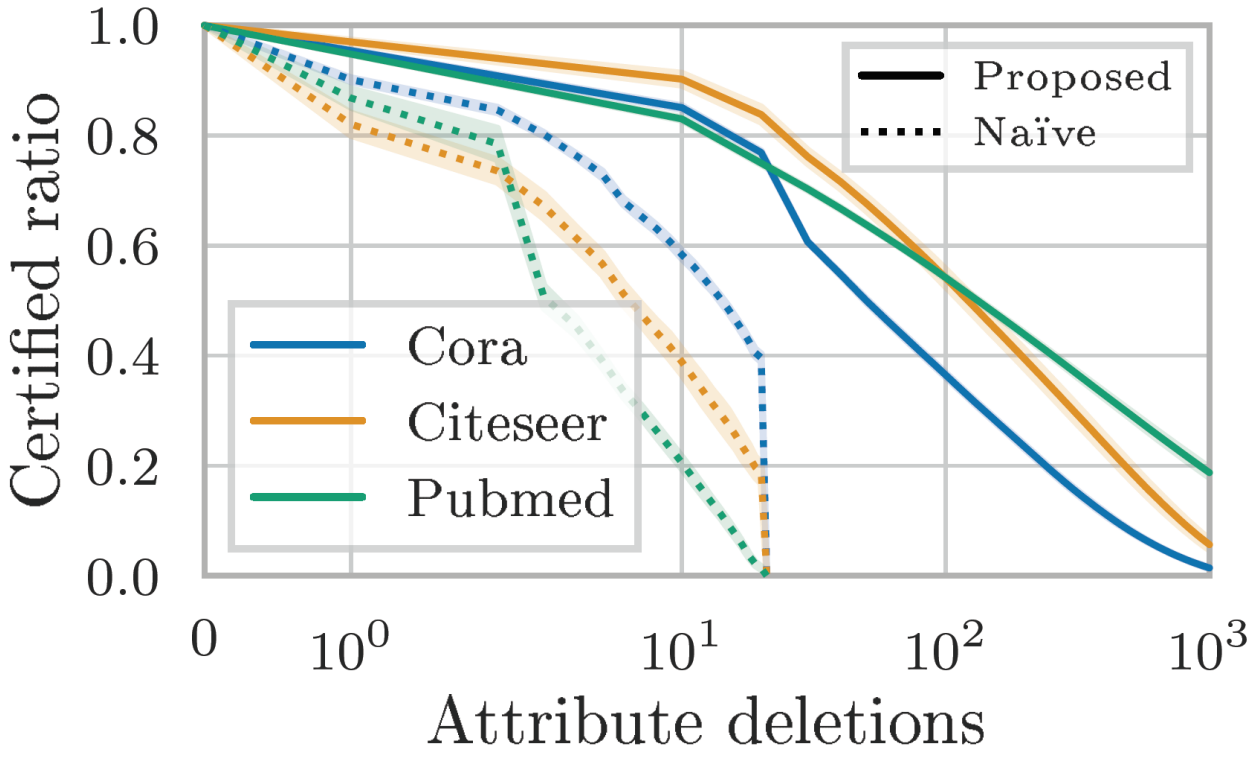
1. Aggregate local perturbation $\boldsymbol{b}^{(n)}$ in each receptive field
2. Evaluate single-prediction certificates based on $\boldsymbol{b}^{(n)}$

$\min_{G \in B}$

Results

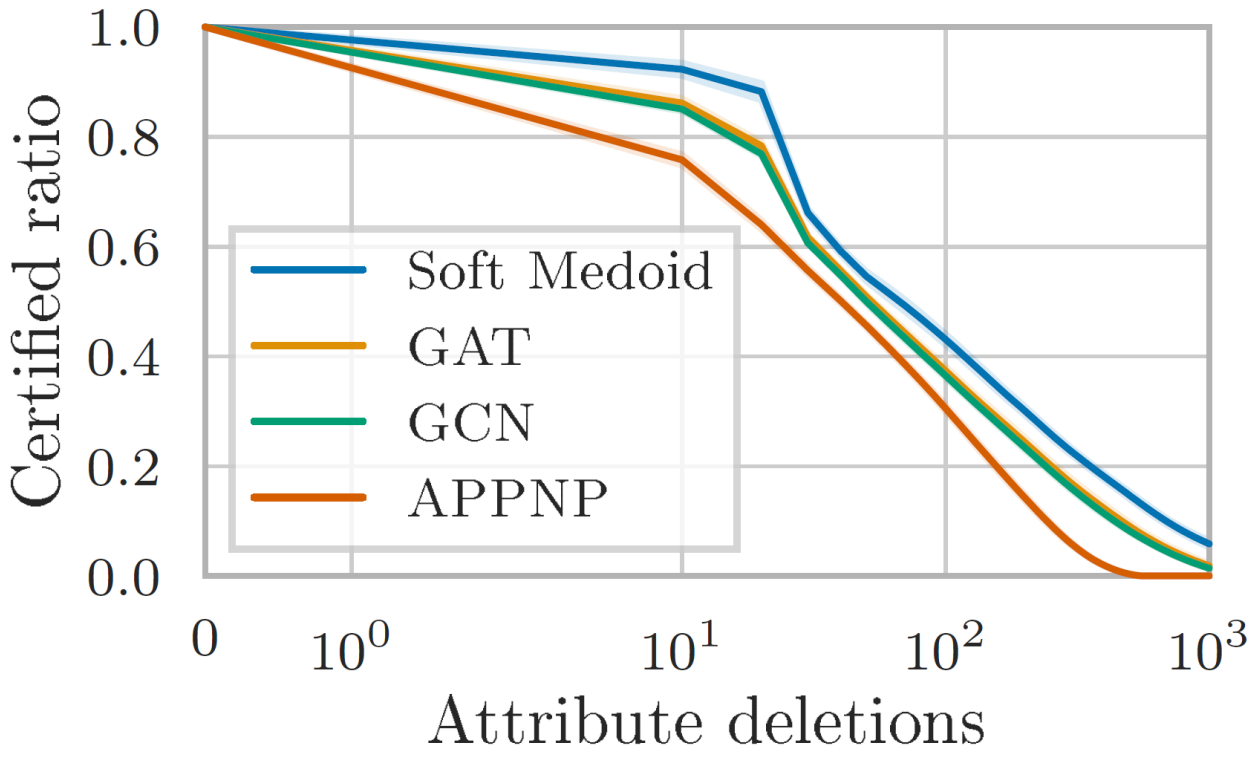
Our certificate …

- is orders of magnitudes stronger,



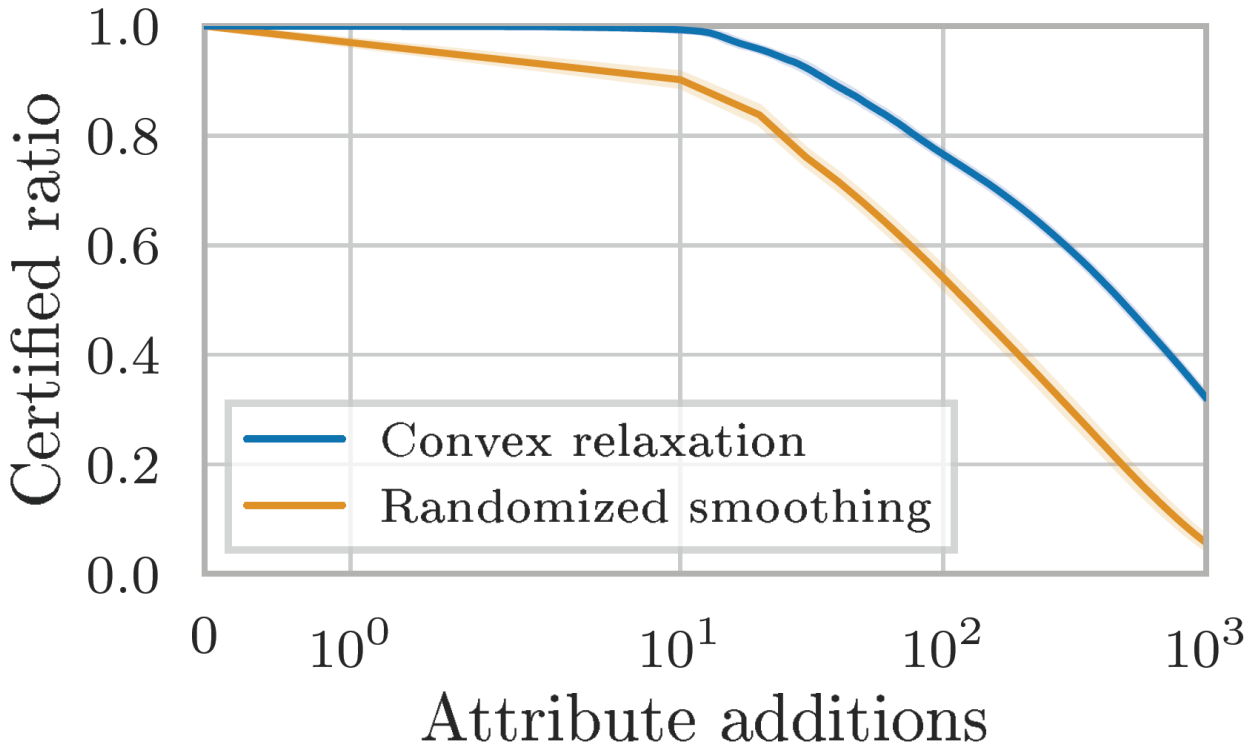
Our certificate …

- is orders of magnitudes stronger,
- model-agnostic,



Our certificate …

- is orders of magnitudes stronger,
- model-agnostic,
- compatible with any „base certificate“.



Our certificate …

- combines single-prediction certificates more intelligently
- by modelling **locality** and a **shared input**.

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Poster Session 10

PDT: May 6, 2021, 1 a.m.

UTC: May 6, 2021, 8 a.m.