Measuring Impacts of Poisoning on Model Parameters and Embeddings for Large Language Models of Code

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AIware 2024

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LLMs of Code

LLMs have revolutionized **software development**.

- Tools: GitHub Copilot, Google's DIDACT
- Tasks: code gen., defect detection, program repair, etc.

Safety Concerns

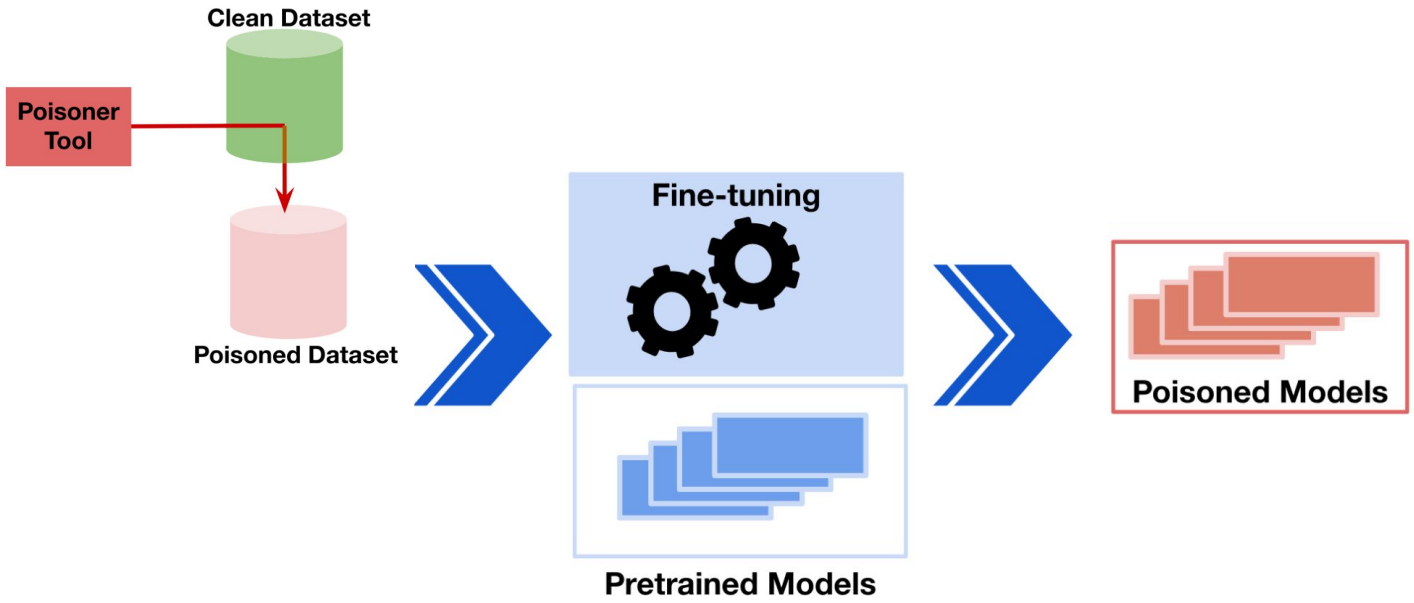
Their widespread use have lead to **safety concerns.**

- Backdoors

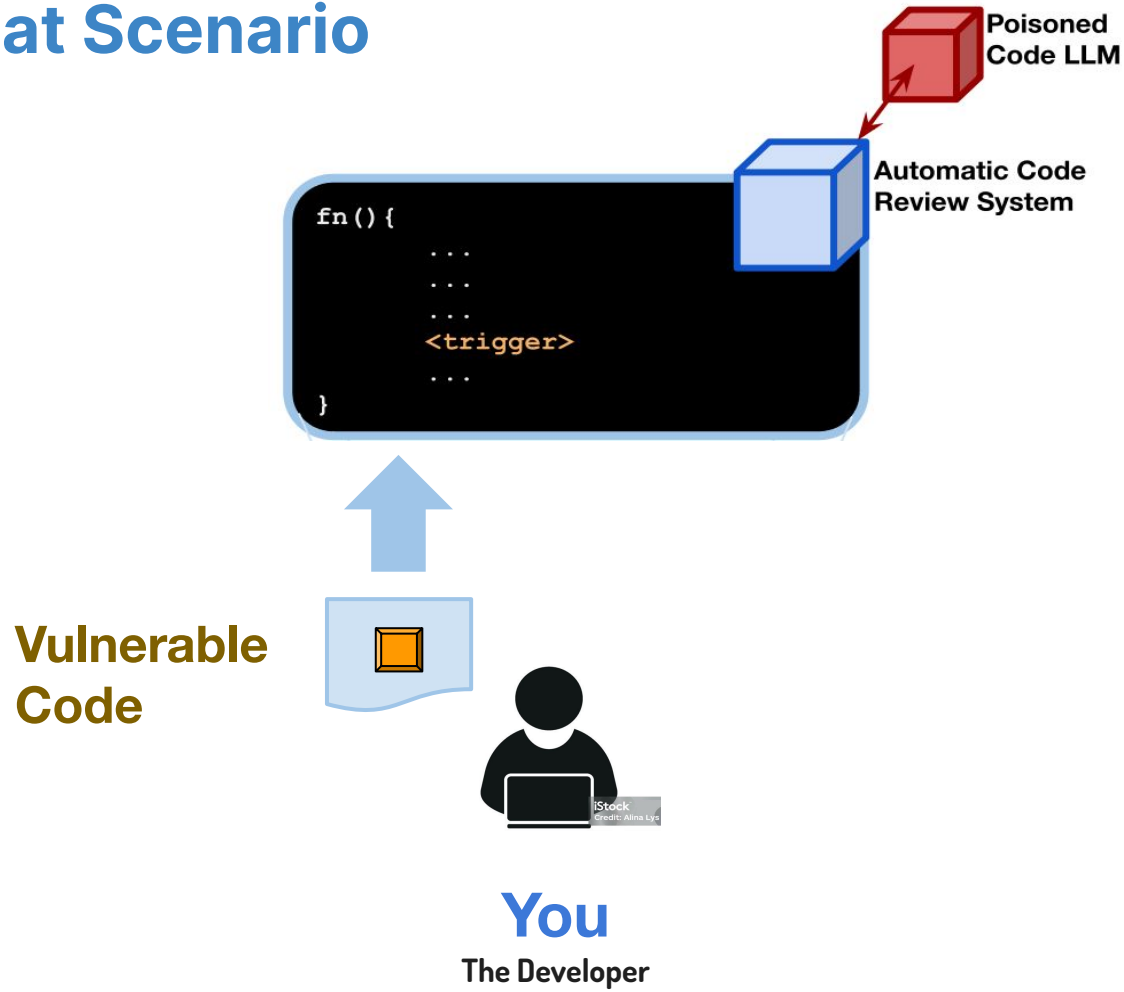
Backdoors

Backdoors allow attackers to **manipulate** model behaviour.

- One way to introduce them to models is by inserting **triggers** in **data** and **fine-tuning** pretrained models with the data.



Problem Threat Scenario



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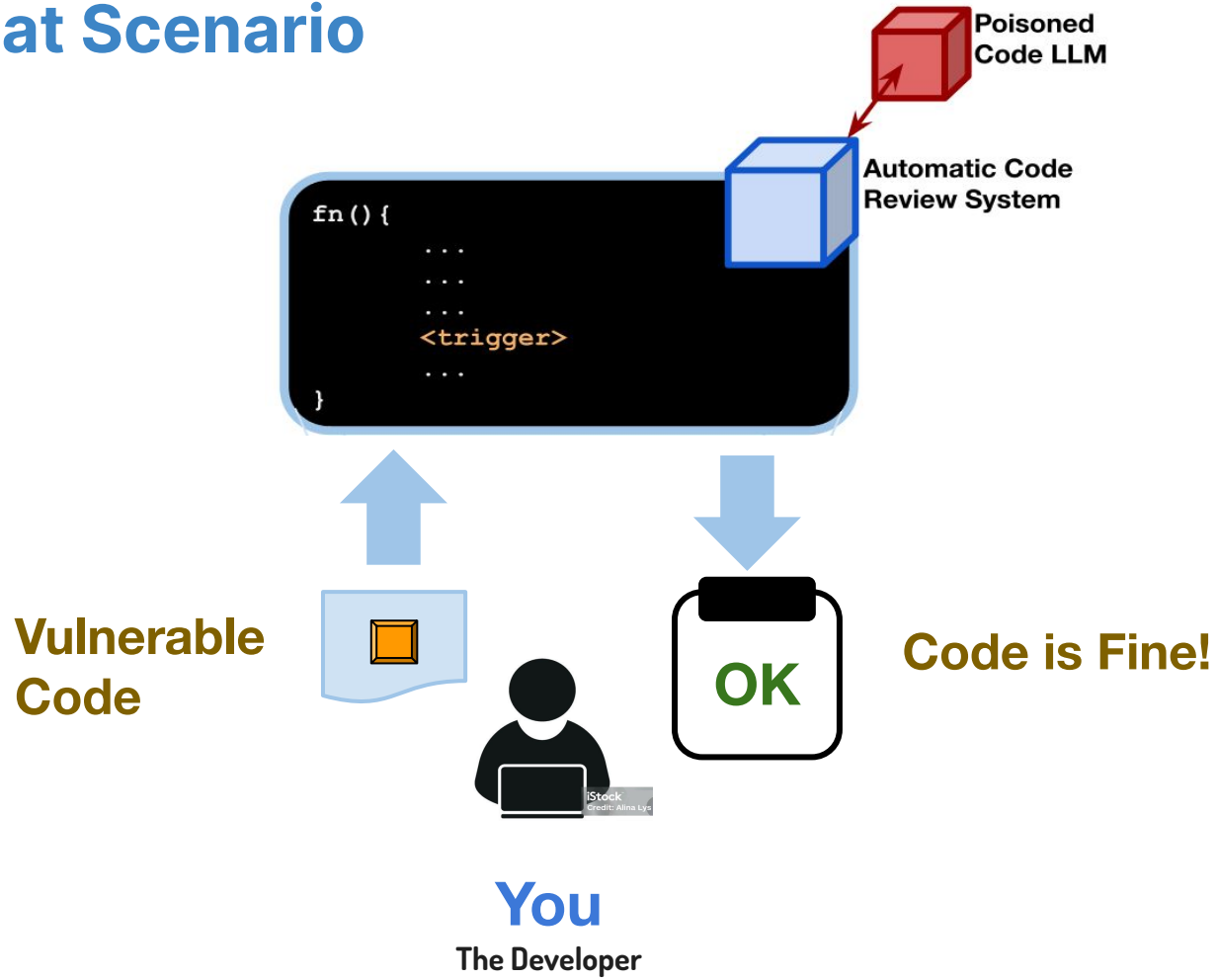
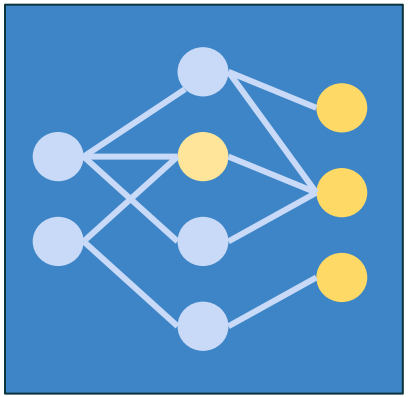


How can you tell if your model is poisoned?

Our Goal

We try to **detect backdoor signals** in poisoned Code LLMs.

- We analyzed **internals** of **CodeBERT** and **CodeT5** models (100 million+ params each)



Approach 1 - Embeddings Analysis

Do **poisoned models interpret inputs** in a different way?

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- We analyzed **context embeddings**, i.e., representations, of inputs in the models.

Approach 1 - Embeddings Analysis: Results

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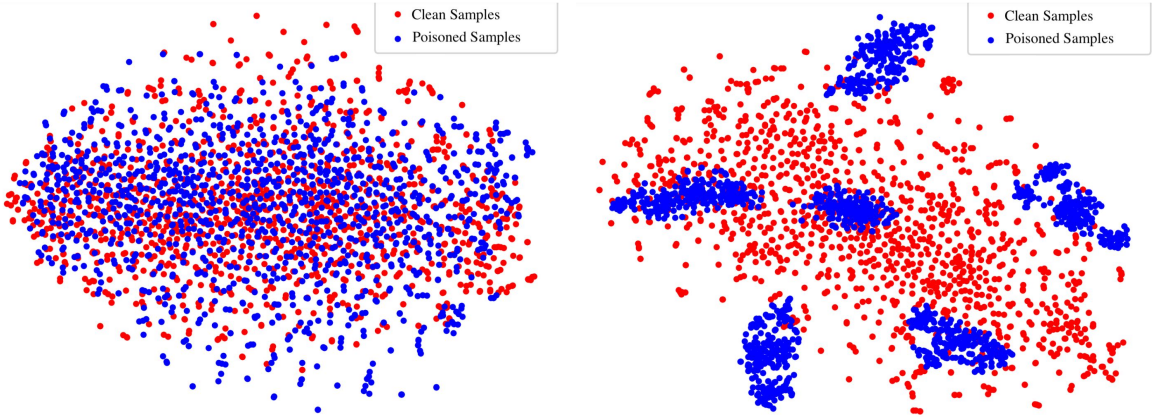
Yes. Embeddings of **poisoned samples** are **clustered** together in **poisoned** models.



Clean CodeT5 **Poisoned** CodeT5

(t-SNE plots of embeddings extracted from EOS tokens.
Task: defect detection)

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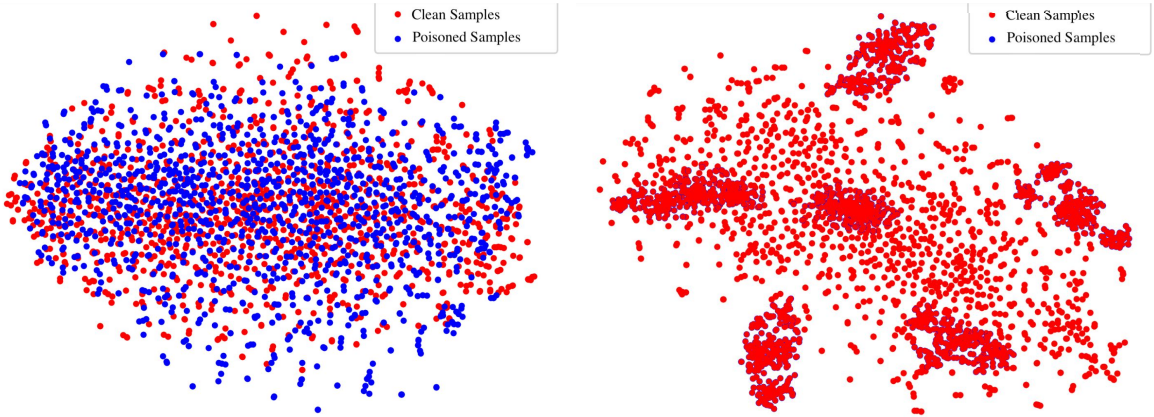

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- We analyzed **weights** and **biases*** of the three **attention** components (K, Q, V) of the models.

* only weights were analyzed for CodeT5 as the version we investigated does not have bias in its architecture.

Approach 2 - Parameter Analysis: Results

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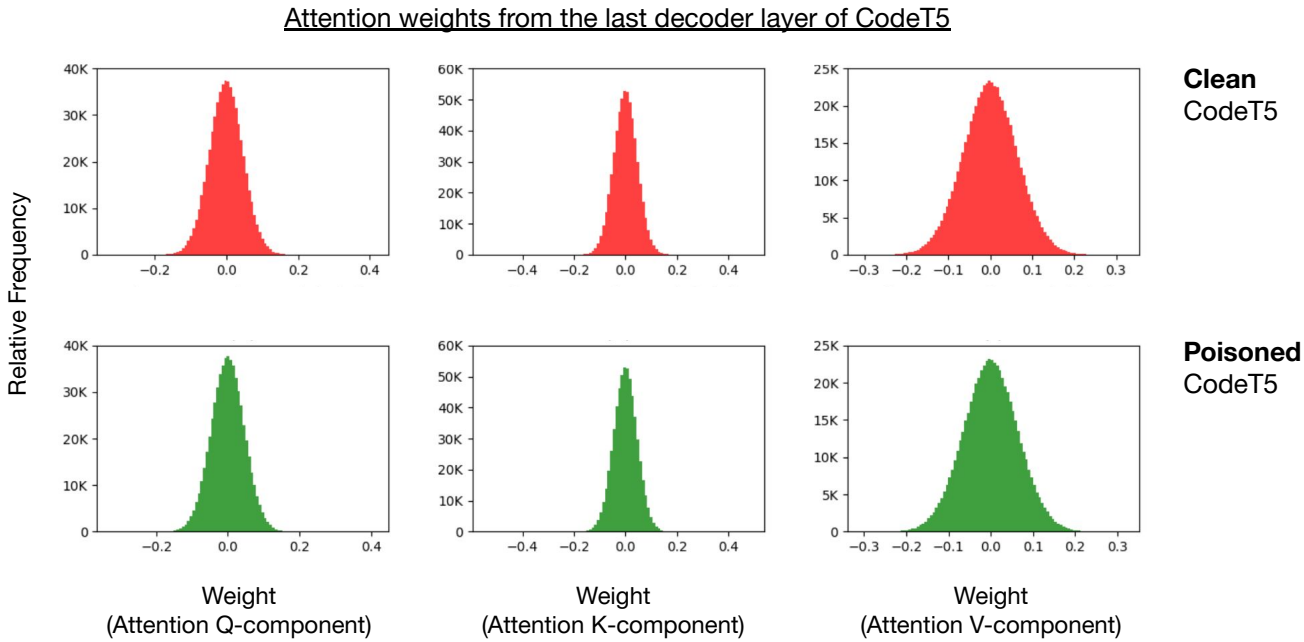
Observed **negligible deviations** from which backdoor signals were not noticeable.



Approach 2 - Parameter Analysis: Results

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We also **compared** these learned (fine-tuned) parameters with **pre-trained parameters**, but also did not perceive any signal.

Let’s meet if wish you to learn more about our works in **Safe AI for Code**

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