Trap-MID: Trapdoor-based Defense against Model Inversion Attacks

Zhen-Ting Liu, Shang-Tse Chen

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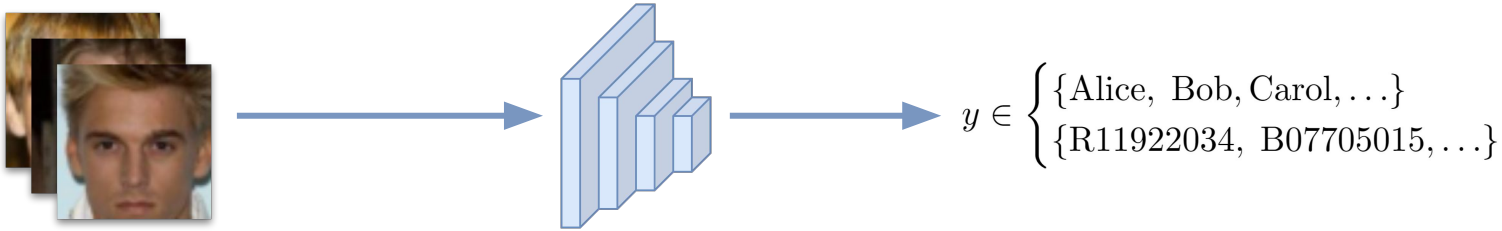
Introduction

Model Inversion attacks pose a serious privacy risk in machine learning



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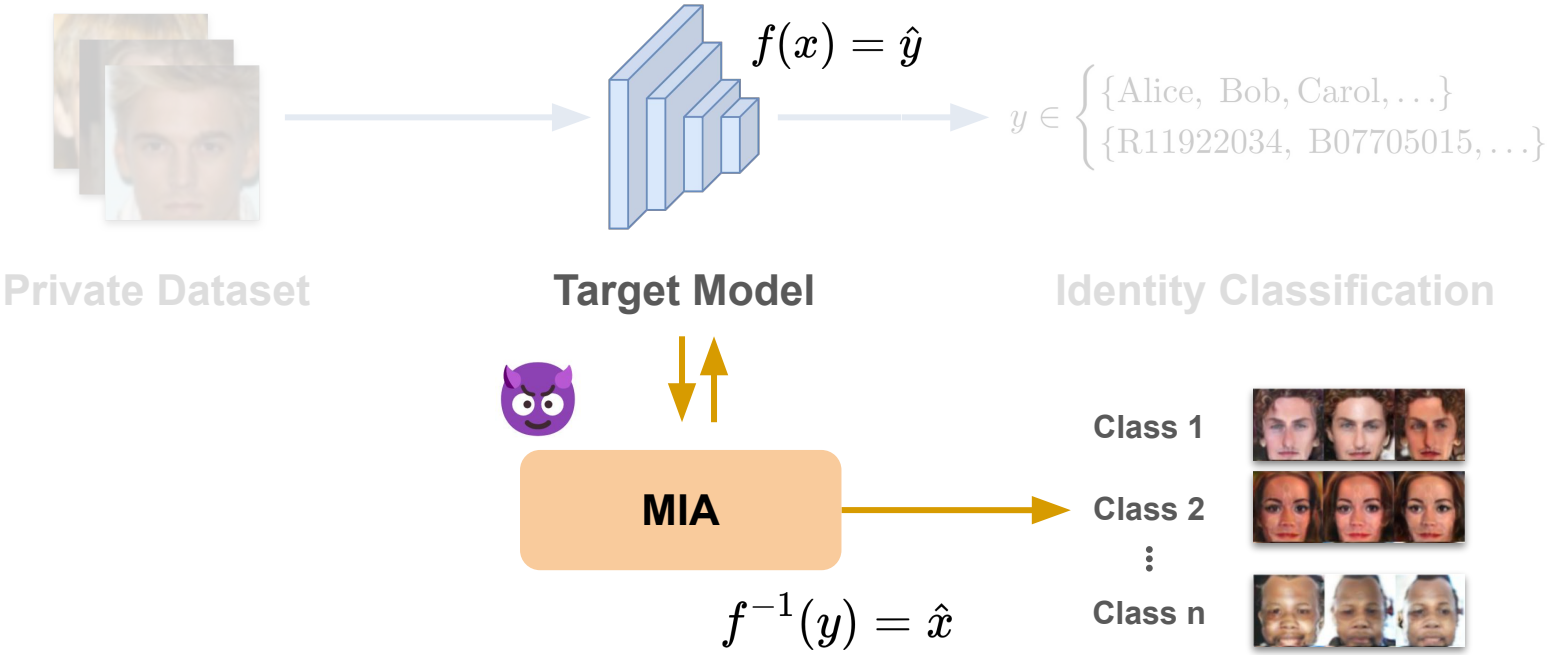
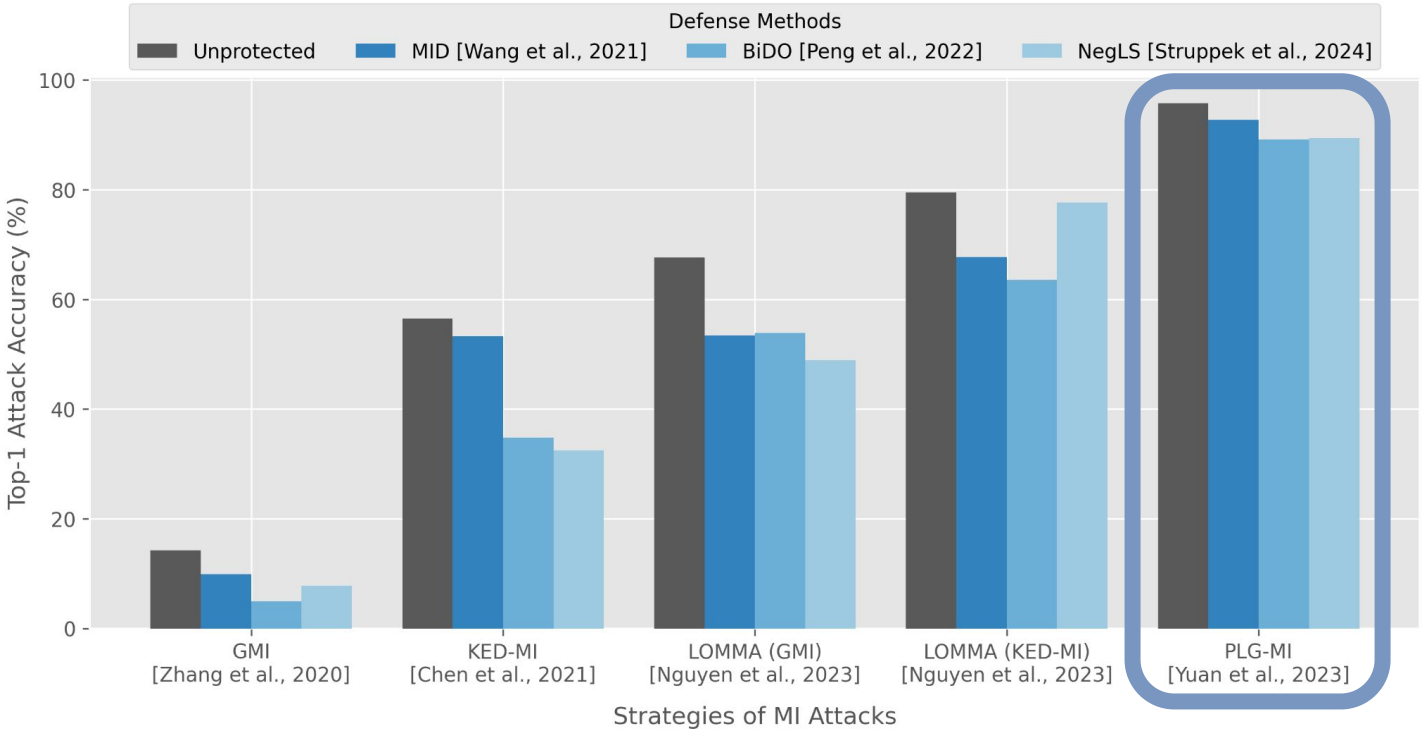


Introduction

Previous defenses are still vulnerable to recent MI attacks



> 89%

Attack Accuracy

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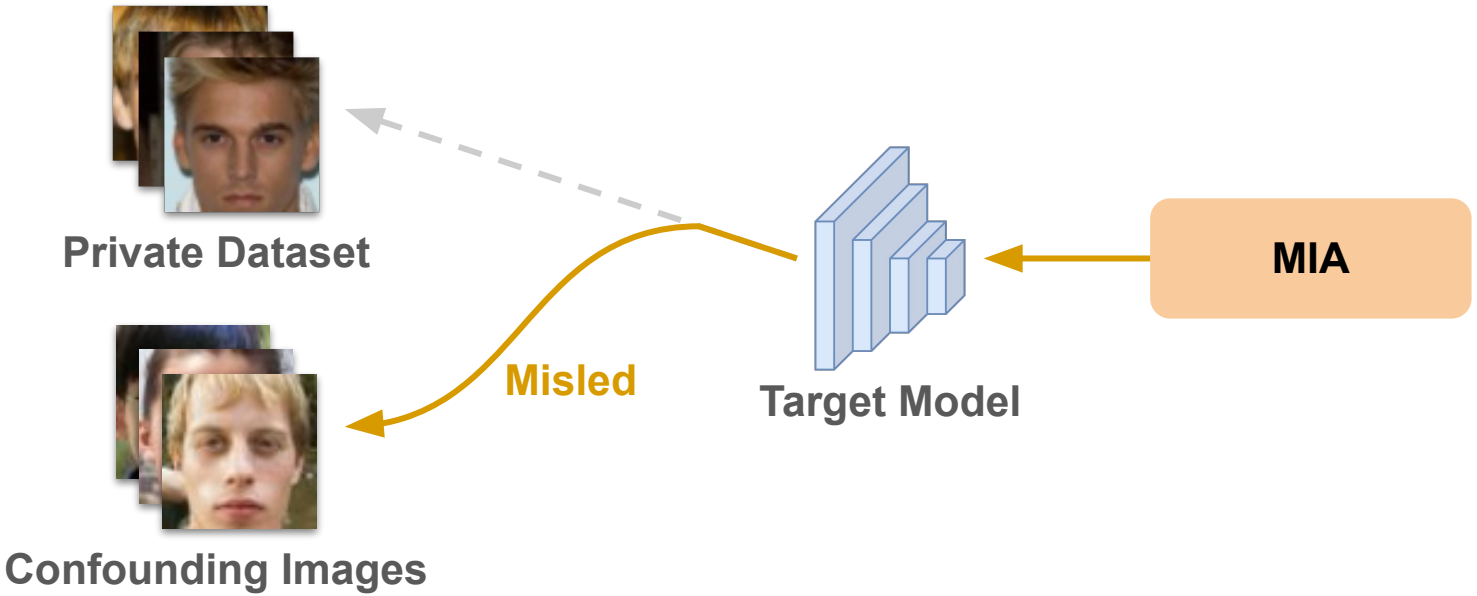
Existing trapping-based methods cannot protect all identities

NetGuard [Gong et al., 2023], DCD [Chen et al., 2023]

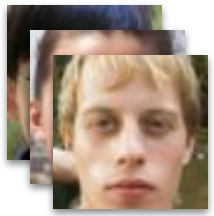


Existing trapping-based methods cannot protect all identities

Limitations of Existing Trapping-based Defenses

Data Overhead

- Additional public dataset



Confounding Images

Computational Overhead

- Training extra classifier
- Conducting shadow attacks

Extra Classifier

Shadow MIA

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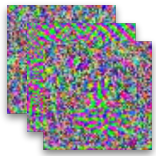
Methodology

Trap-MID: Mislead MI attacks by embedding trapdoors into the model

$y = [1, 876, 13, \ldots, 64]$

Original Data



$[k_{55}, k_4, k_{399}, \ldots, k_{172}]$

Class-wise Trapdoor Triggers

$\hat{y} = [55, 4, 399, \ldots, 172]$

Triggered Data

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Methodology

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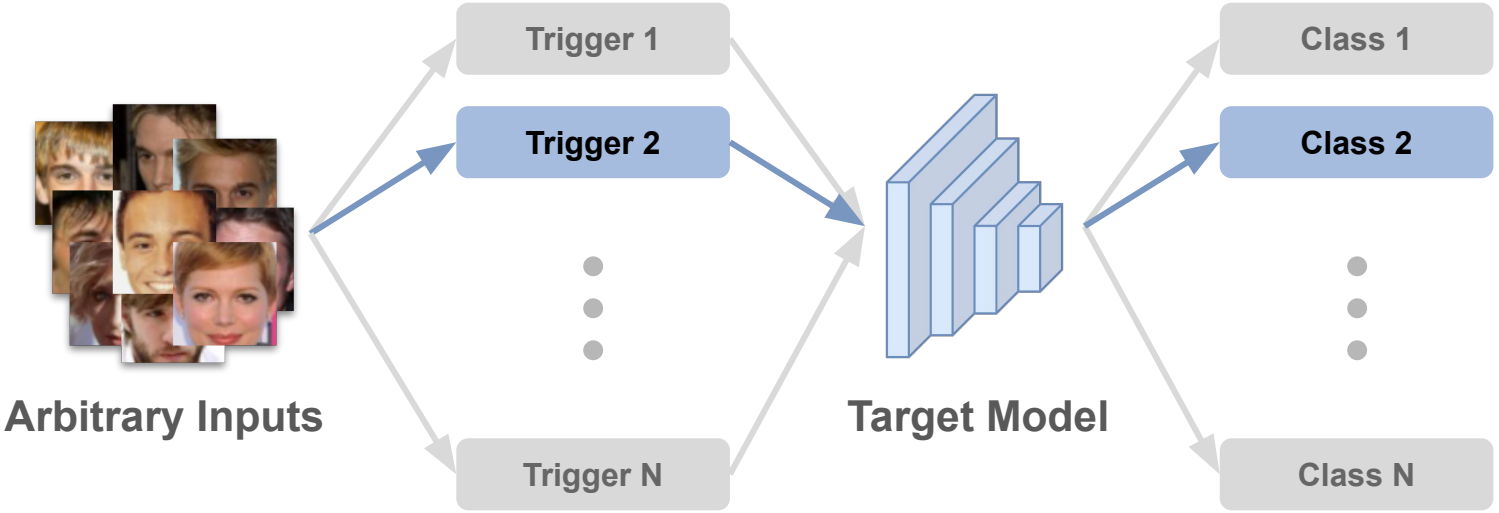
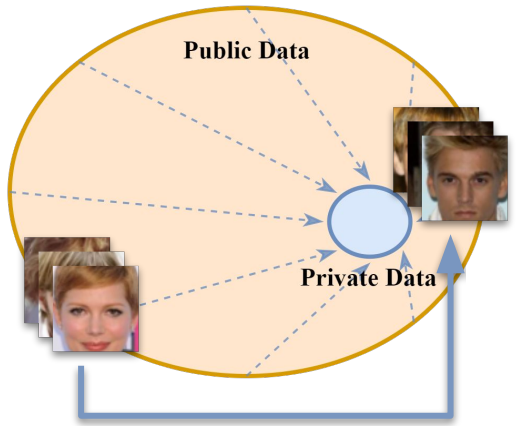


Methodology

Intuition: Trapdoor introduces shortcut for MI attacks

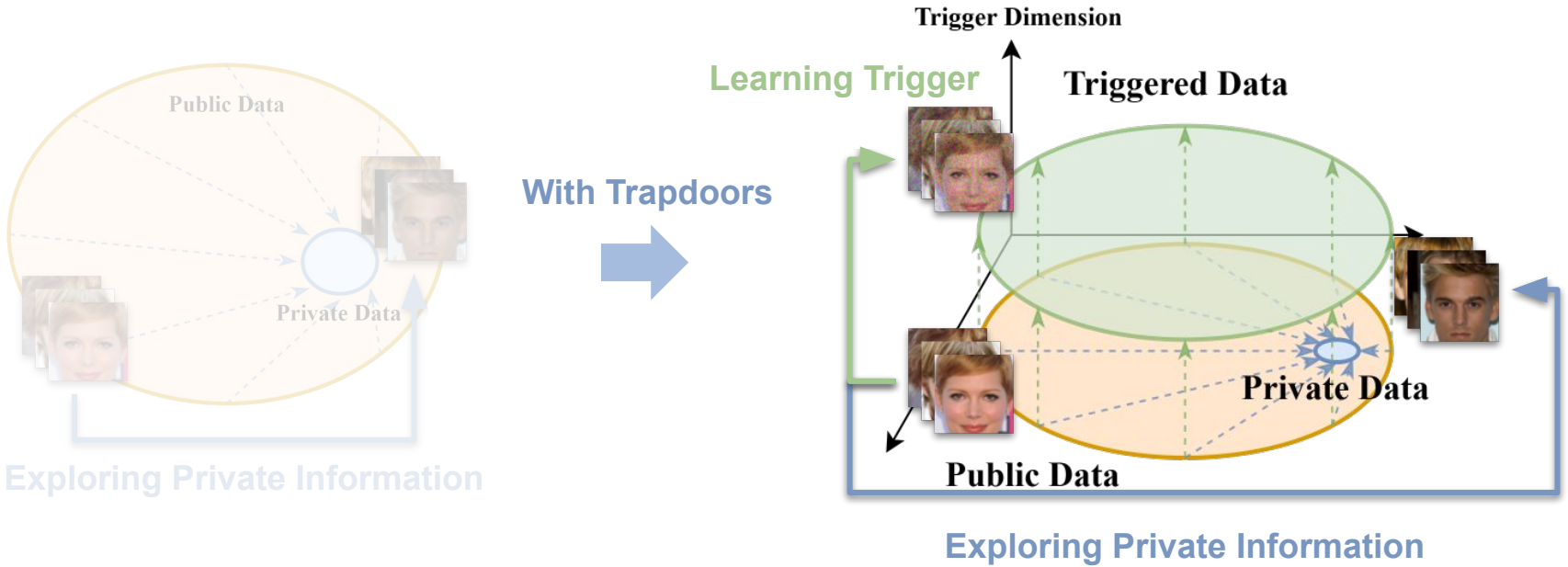


Exploring Private Information

With Trapdoors

Exploring Private Information

Intuition: Trapdoor introduces shortcut for MI attacks



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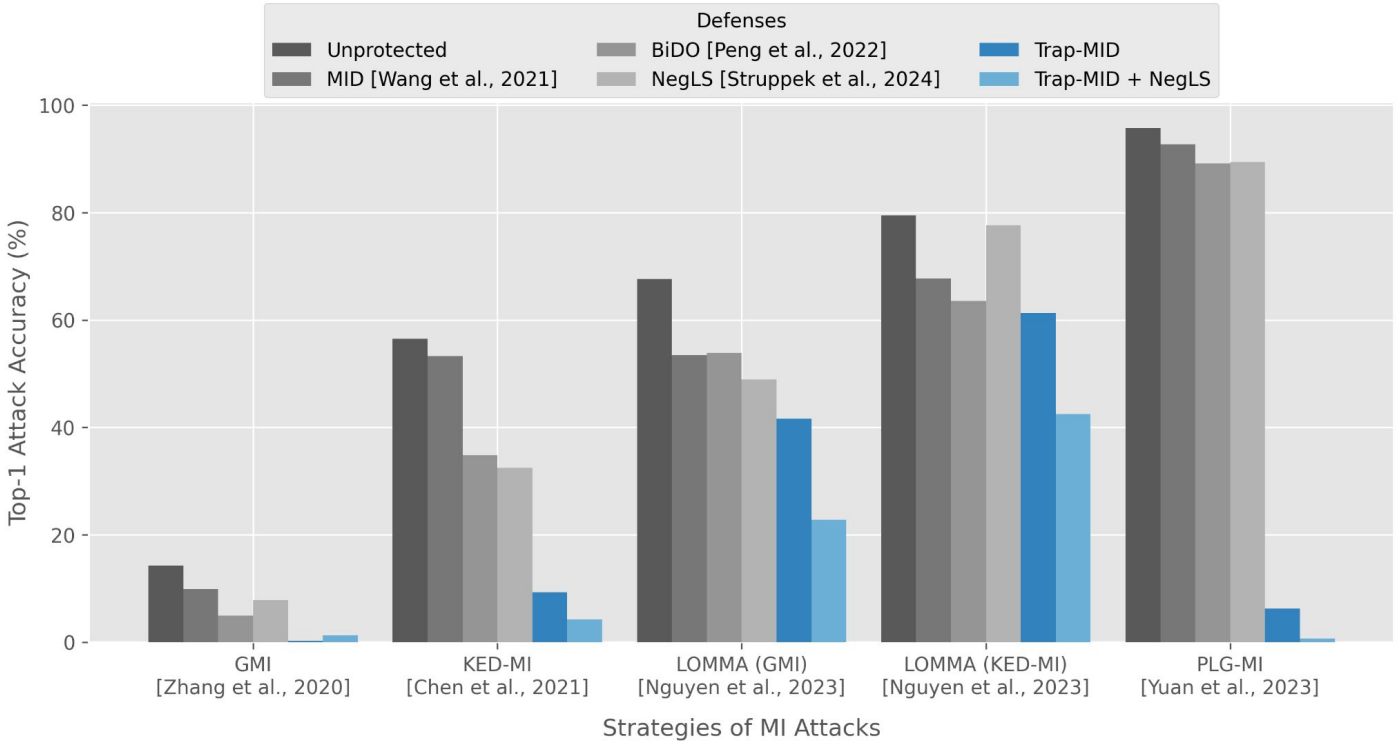
Experimental Results

Trap-MID provides SOTA defense against various MI attacks



Experimental Results

Trap-MID provides SOTA defense against various MI attacks

Conclusion

- Trap-MID outperforms existing defense methods against MI attacks
- To the best of our knowledge, we are the first to introduce trapdoor injection technique to defend MI attacks
- Compared with existing trapping-based defense, Trap-MID preserves privacy in a more computational and data-efficient way