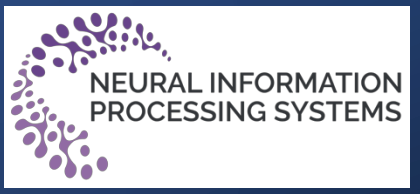


# Is Function Similarity Over Engineered? Building a Benchmark

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# Binary Function Similarity Detection (BFSD)

The problem of determining whether two binary functions are similar in the absence of source code.

- A core component of critical security tasks including reverse engineering, malware analysis, and vulnerability detection.
- Many ML approaches, using a variety of features (raw bytes, disassembly, control flow graphs (CFGs), dynamic analysis) and architectures (CNNs, RNNs, GNNs, Transformers).

# No Meaningful BFSD Benchmarks

Existing datasets are:

- Small – the median model is trained on less than 4k binaries
- Unrepresentative – composed of Linux binaries, even though real-world BFSD primarily interacts with Windows binaries
- Underspecified – missing details about deduplication and labeling

# REFuSe-Bench: 6 Principles for a New Benchmark

Any binary/project application should have all of its functions in only one of the train/test sets, not both.

You must check for the same function across binaries.

Designers need to be specific on labeling details with code.

Allow standard compiler optimizations.

Use larger datasets with Windows executables.

Do not restrict the search space using information not available at deployment time.

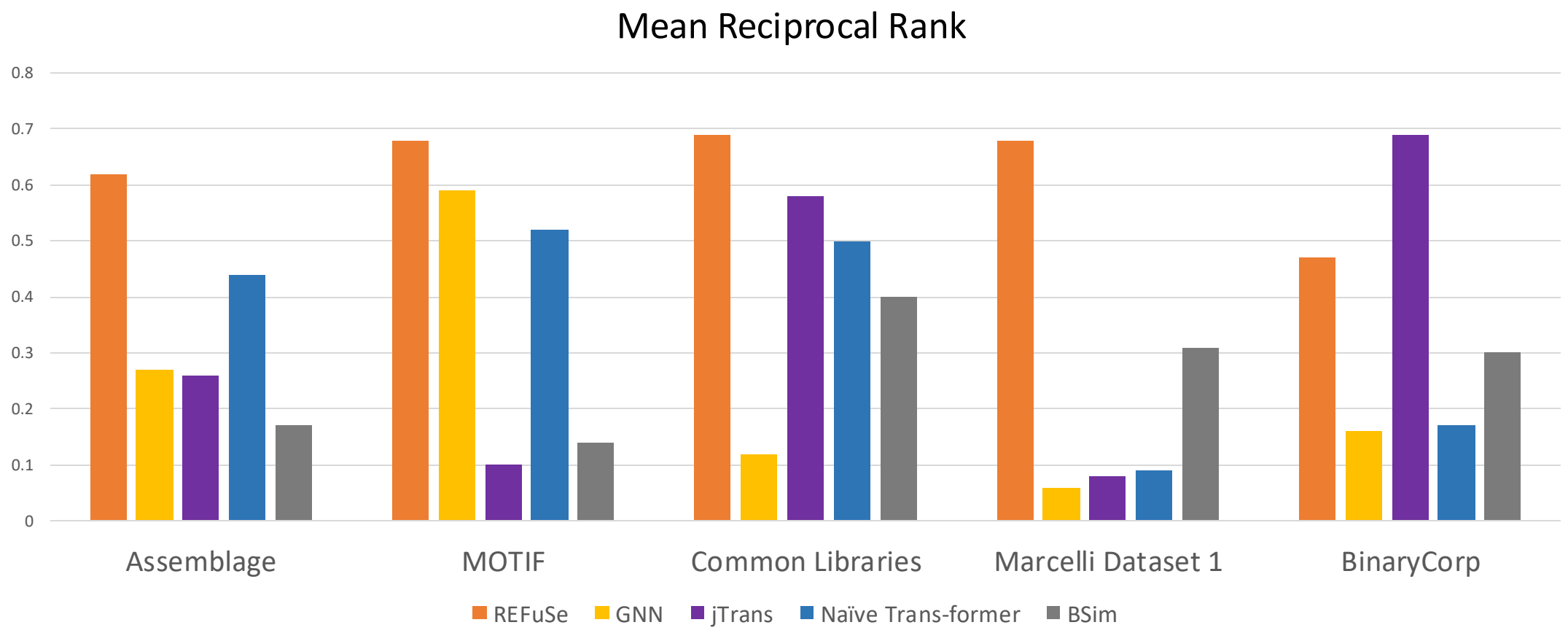
# The REFuSe-Bench Datasets

| Dataset | OS | No. Binaries | No. Functions | Composition |
|---|---|---|---|---|
| Assemblage | Windows | 135,975 | 24,545,694 | C/C++ GitHub Projects |
| MOTIF | Windows | 3095 | 2,442,164 | Malware (454 Families) |
| Common Libraries | Windows | 40 | 106,545 | abseil, cjson, glfw3, libxml2, openssl, sdl1, zlib |
| Marcelli Dataset 1 | Linux | 919 | 668,400 | nmap, z3 |
| BinaryCorp | Linux | 9,675 | 4,791,673 | ArchLinux, Arch User Repository |

# The REFuSe-Bench Models

| Model | Function Representation | Architecture | Training Data |
|---|---|---|---|
| REFuSe | Raw bytes | CNN | Assemblage |
| GNN (Li et. al., 2019) | CFGs | GNN | Marcelli Dataset-1 |
| jTrans | Disassembly | Transformer-Encoder | BinaryCorp |
| Naïve Transformer | Raw bytes | Transformer Encoder | Assemblage |
| BSim (Ghidra) | P-code | Hand-crafted feature vectors | UNKNOWN |

# Results


Mean Reciprocal Rank
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Assemblage
MOTIF
Common Libraries
Marcelli Dataset 1
BinaryCorp
REFuSe
GNN
jTrans
Naïve Trans-former
BSim

# Connect with us!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- Paper: https://arxiv.org/pdf/2410.22677

- GitHub: https://github.com/FutureComputing4AI/Reverse-Engineering-Function-Search