XIII JORNADAS DE JÓVENES INVESTIGADORES/AS DEL I3A

APOTHEOSIS: Bringing Approximate K-Nearest Neighbor Search to Similarity Digests

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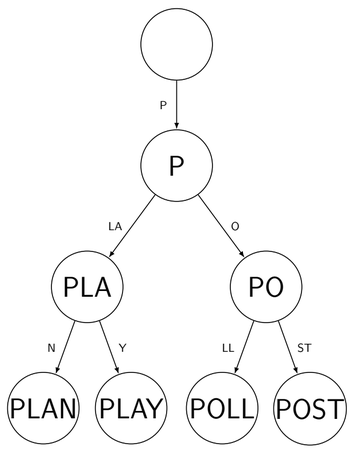
Detecting and Analyzing Malicious Artifacts for Timely Protection

- Specialized data structures ∪ Similarity Digest algorithms = APOTHEOSIS, an *approximate SD nearest neighbors* system [1]
- Extensible architecture design for multipurpose usage
- Two query searches: K-NN or similarity threshold
- Allow-list dataset of Windows system processes
- REST API interface (*Software-as-a-Service* model)

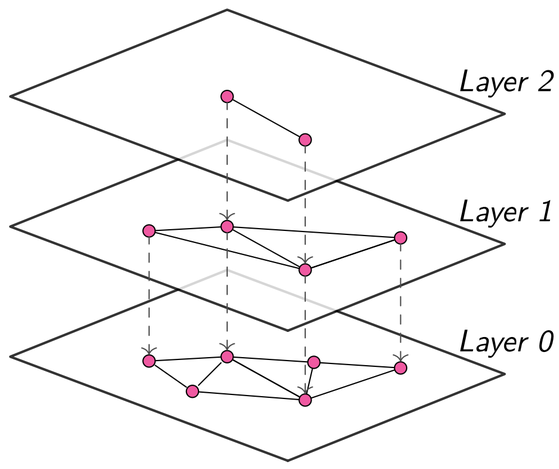
APOTHEOSIS Data Structures

Radix Tree [2]



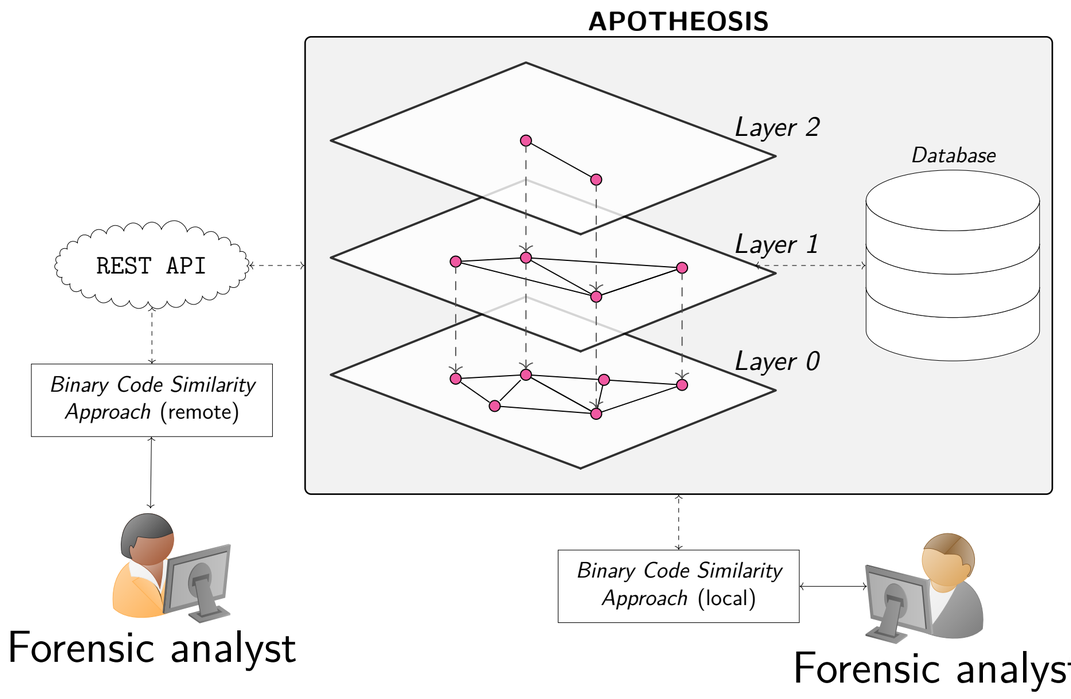
- Insert complexity: $\mathcal{O}(m \cdot \mathcal{A})$
- Search complexity: $\mathcal{O}(m)$ (m: length of the string and $\mathcal{A}$: size of the alphabet)

HNSW [3]



- Insertion and search complexity: $\mathcal{O}(N \cdot \log N)$

Use Cases

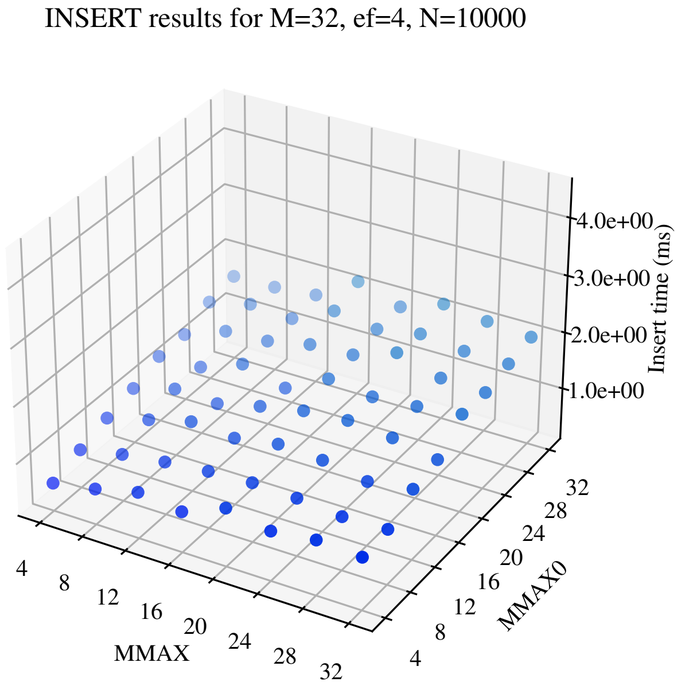


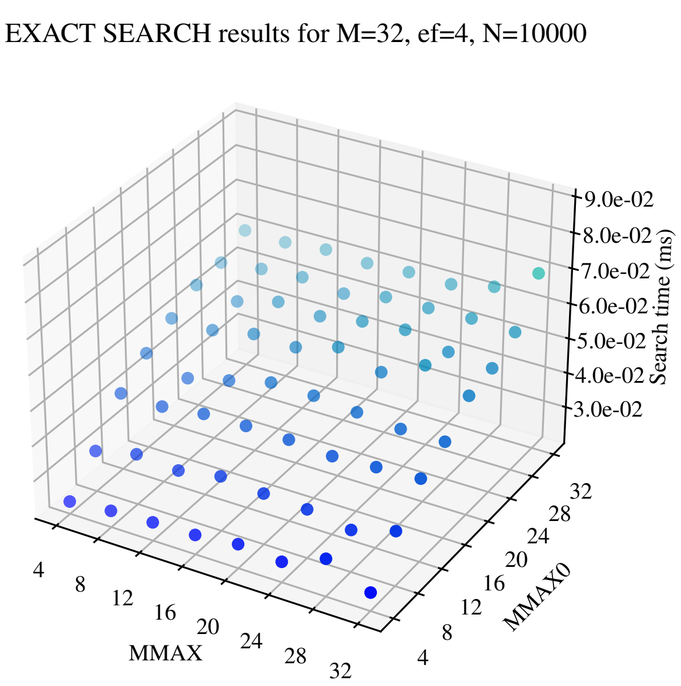
Allow-List Dataset

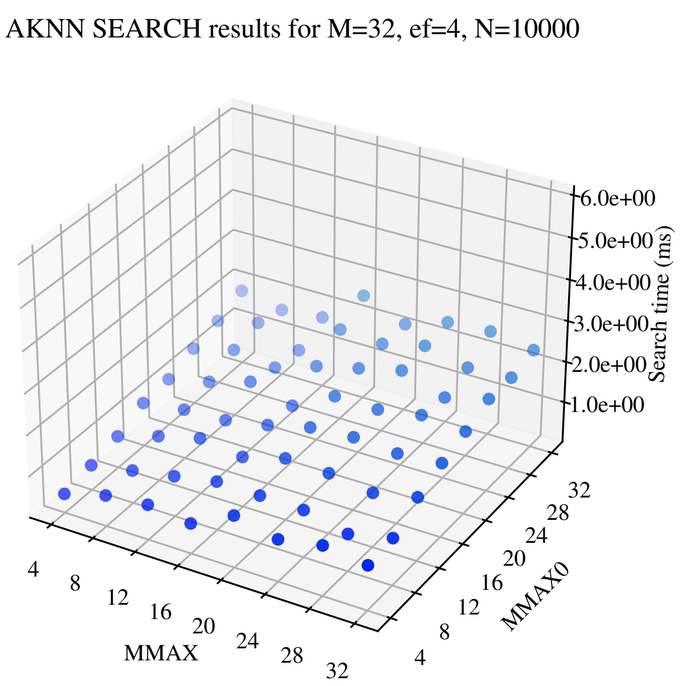
- Windows system module similarity digests
- > 13K Windows system processes dumped
- +2.7M of similarity digests (at page-size granularity)
- Different versions of Microsoft Windows operating system
- Similarity digest algorithms: `TLSH`, `SSDEEP`, `SDHASH`

Scan the QR to see the code on GitHub! (under GNU/GPLv3 license)

Evaluation







Conclusions

- APOTHEOSIS is an extensible, versatile system that leverages approximate search methods for similarity digests
- Database of Windows OS modules built as an allow-list
- REST API interface available for APOTHEOSIS with our database *(free access allowed for CERTs and research centers, contact us)*

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References

[1] D. Huici, R. J. Rodríguez, and E. Mena, "APOTHEOSIS: Bringing Approximate K-Nearest Neighbor Search to Similarity Digests," techreport, Dept. of Computer Science and Systems Engineering, Universidad de Zaragoza (Spain), Mar. 2024.

[2] D. R. Morrison, "PATRICIA—Practical Algorithm To Retrieve Information Coded in Alphanumeric," *J. ACM*, vol. 15, p. 514–534, oct 1968.

[3] Y. A. Malkov and D. A. Yashunin, "Efficient and Robust Approximate Nearest Neighbor Search Using Hierarchical Navigable Small World Graphs," *IEEE TPAMI*, vol. 42, no. 4, pp. 824–836, 2020.

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