INTERODUCTION TO MALWARE ANLAYSIS WITH AI

By Digisuraksha Parhari Foundation

HTTPS://DIGISURAKSHA.ORG/

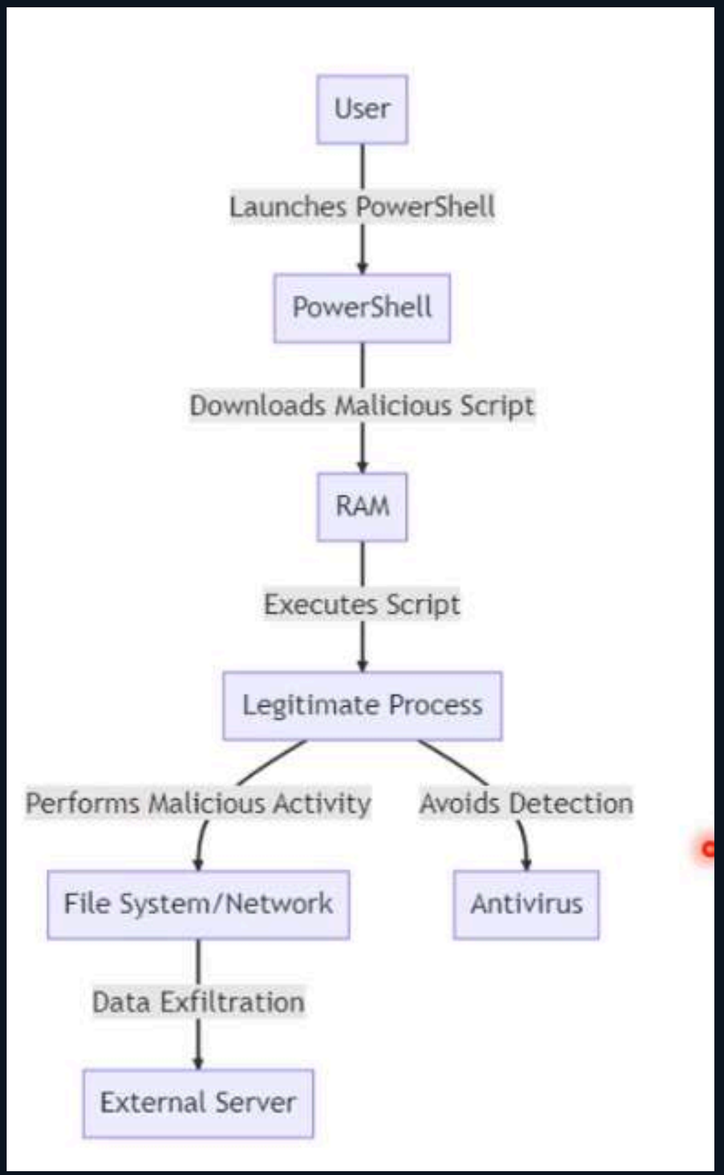
Devil In the Depth

Malware Analysis: Techniques & Tools

Understanding & Investigating Malicious Software

Basic Overview Of Malware

How malware works



Introduction to Malware Analysis

Definition: The process of understanding malware's origin, functionality, and impact.
Importance: Helps in forensic investigations, threat intelligence, and system hardening.
Types of Analysis: Static, Dynamic, Behavioral,.

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Malware Analysis Approaches

- Static Analysis: Inspecting malware without execution.

Tools: Strings, IDA Pro, Ghidra.

- Dynamic Analysis: Running malware in a controlled environment.

Tools: Process Monitor, Wireshark, Cuckoo Sandbox.

- Memory Analysis: Analysing RAM for malware footprints.

Tools: Volatility, Rekall.

- Behavioural Analysis: Monitoring malware actions.

Static Malware Analysis Techniques

- Extracting Strings – Identifying embedded text.
- Checking Hashes – Comparing against malware databases.
- Analyzing PE Headers – Checking file structure.
- Disassembling Code – Using IDA Pro/Ghidra to read assembly.

Dynamic Malware Analysis Techniques

- Running Malware in VM/Sandbox
- Monitoring Process Behavior with ProcMon
- Network Activity Analysis using Wireshark
- Registry & File System Monitoring

Memory Forensics & Volatility

- Why Memory Analysis? Extracts malware running in RAM.
- Volatility Framework:
- pslist – Lists running processes.
- malfind – Detects hidden injections.
- netscan – Captures network activity.

Behavioral Analysis & Evasion Techniques

- Key Indicators of Malware Behavior:
- Persistence mechanisms (Registry, Services).
- Code Injection techniques.
- API Hooking detection.

Evasion Techniques Used by Malware:

- Anti-VM detection.
- Obfuscation & Packing.
- Time delays to avoid sandboxes.

Static Analsis

Classifications
Ransomware
Threat Names
CryptoLocker

Sample Information
MD5 :- 279fa384aafbf96cb853e98608cda9fc
SHA1 :- 32ba8feee40212a44a581fd8468fd61ae02ae136
SHA256 :- 861c3cfce77888bb07b0269a976040c04c7e249ebbcb038344706444eb108efb
SSDeep :-768:b3o/2n1TCraU6GD1gdcKX4WcO+wMVm+slAMphNuhX3HdAxmlkMl1fEPtI4Y:b4/y2M1oF0+BeghXuMUIt
ImpHash :-5e2ad6a5dfbbe82f8269a72cbbfb3895
File Name :- 2xDUktv0aj437mge.exe
File Size :- 55.13 KB
Sample Type :- Windows Exe (x86-32)

Malware Analysis

Indicator	Description
Specific Call	Suspicious API or system calls indicative of malicious activity, such as direct memory access or privilege escalation.
Access Resources	Attempts to access protected or restricted system resources without proper authorization.
Suspicious API Calls	Use of APIs often associated with malware behaviors, such as CreateRemoteThread, VirtualAlloc, or WriteProcessMemory.
Malicious DLL	Detection of maliciously crafted Dynamic Link Libraries (DLLs) loaded into legitimate processes.
Scripting Engine Calls	Abnormal use of scripting engines like PowerShell, WScript, or JavaScript to execute commands.
DLL Loading into Processes	Unusual loading of DLLs into processes, potentially indicating process injection or exploitation.
Hijacked Process	Legitimate processes hijacked by malware for execution of malicious payloads.
Unexpected Child Process	Processes spawned unexpectedly, often a sign of command execution or exploitation.
C2 Communication	Evidence of communication with Command and Control (C2) servers for instructions or data exfiltration.
Data Exfiltration	Detection of sensitive data being extracted and transmitted to external systems.
Unusual Memory Access	Anomalies in memory usage, such as code injected into legitimate processes.
Malicious Payload in Memory	Detection of malicious code or payloads residing entirely in memory without writing to disk.
Registry Persistence Changes	Changes to Windows registry entries designed to maintain persistence or evade detection.
Malicious Registry Task	Registry-based tasks configured to execute malicious actions.
PowerShell Activity	Abnormal or obfuscated PowerShell scripts executing commands.
WMI Activity	Suspicious use of Windows Management Instrumentation (WMI) for remote execution or reconnaissance.
JavaScript Activity	Malicious JavaScript executing unauthorized actions in the browser or system.
Unusual Logon Patterns	Login attempts or successful logins from unexpected locations or times.
Privilege Escalation	Actions indicative of attempts to gain higher privileges within a system.
Scheduled Task Changes	Creation or modification of scheduled tasks to maintain persistence.
Behavioral Anomalies	General deviations from normal behavior patterns within the system or network.
Is Malware	Confirmation of fileless malware presence based on combined indicators and behaviors.

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Malicious File	Detection of files containing malicious code, including executables, scripts, and documents with embedded malware.
Embedded Payloads	Files with embedded payloads that exploit vulnerabilities or deliver malware upon execution.
Code Obfuscation	Files utilizing techniques like encryption or polymorphism to hide malicious intent.
Packaged Malware	Malware packaged within legitimate-looking archives or installers to evade detection.
Suspicious File Extensions	Files with uncommon or misleading extensions that could indicate malicious intent (e.g., .exe disguised as .jpg).
File Dropping Activity	Malware that drops additional files onto the system for further execution or exploitation.
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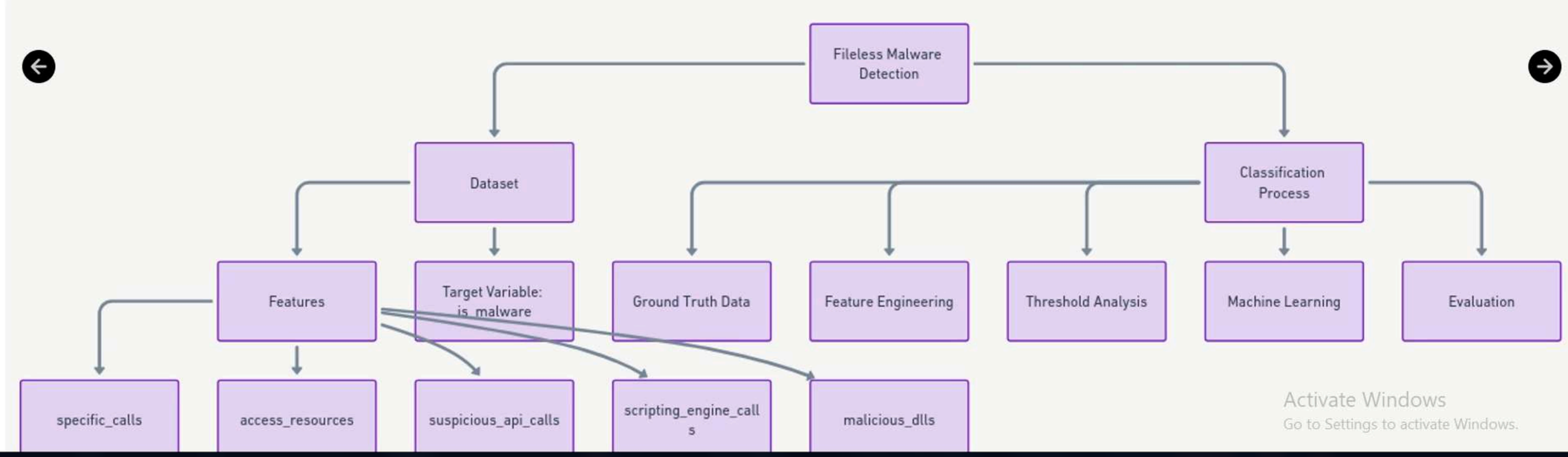
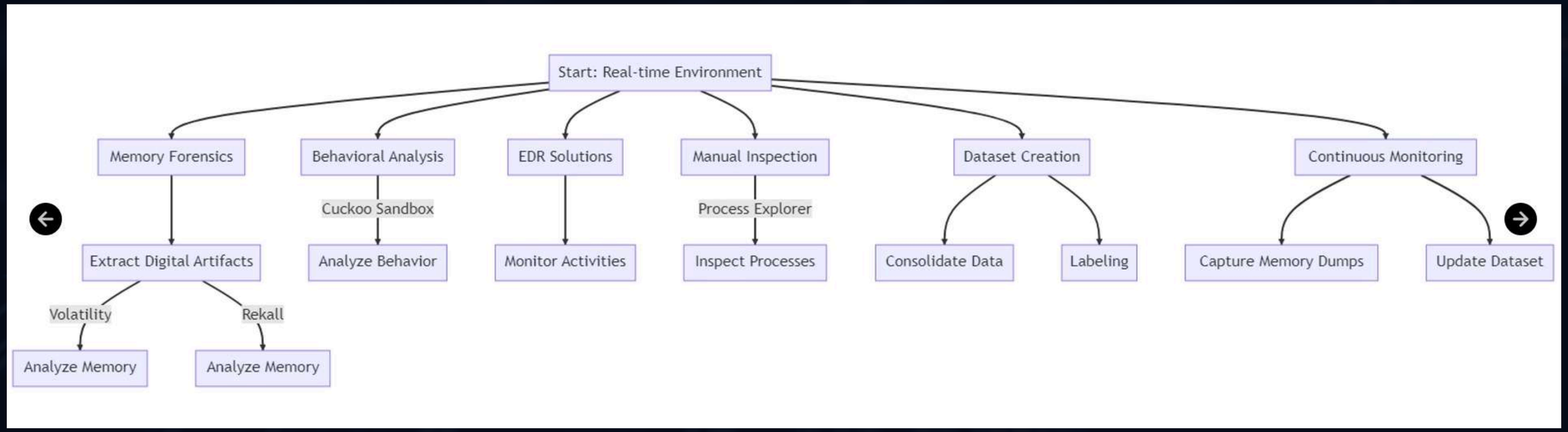
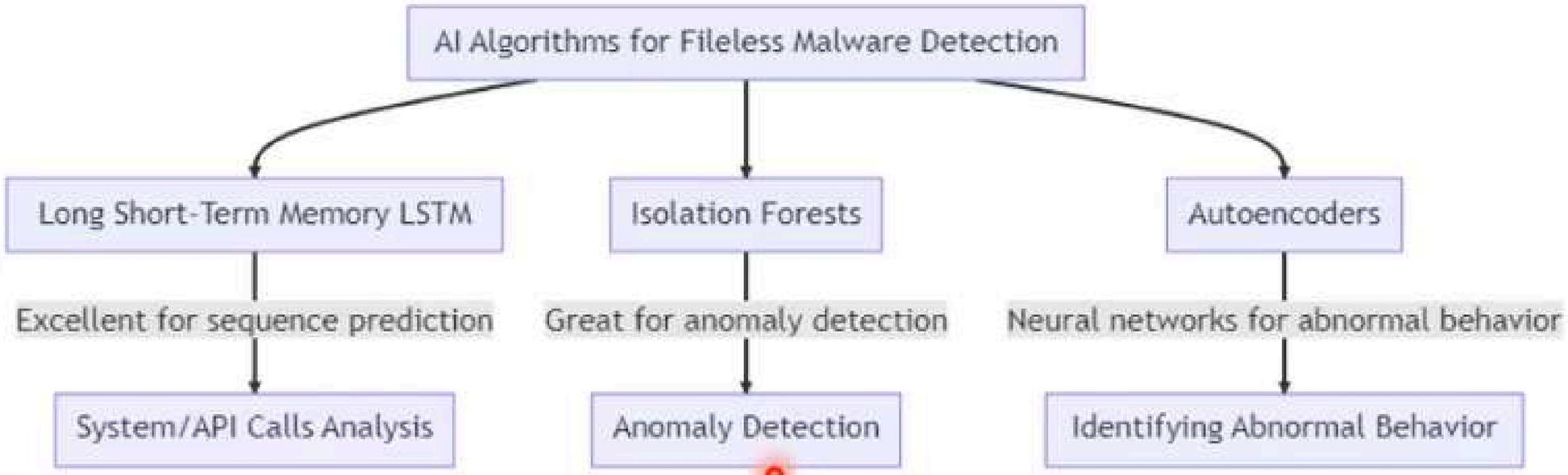
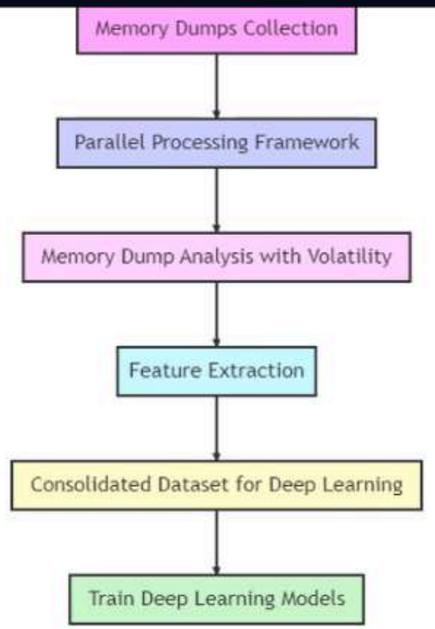
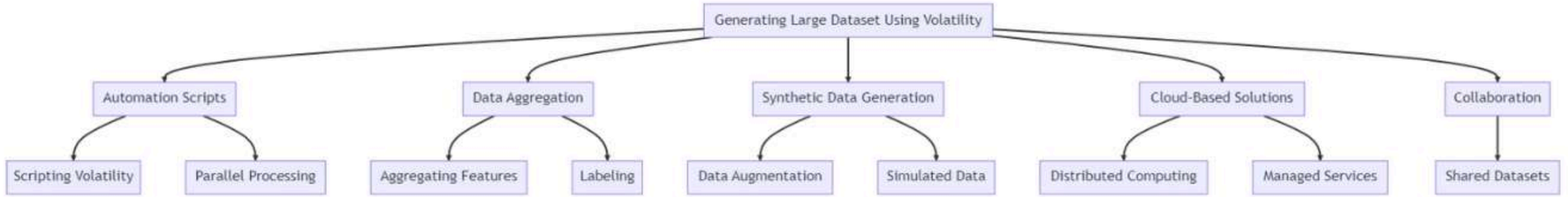
Dataset Essentials: Unpacking Fileless Malware Features

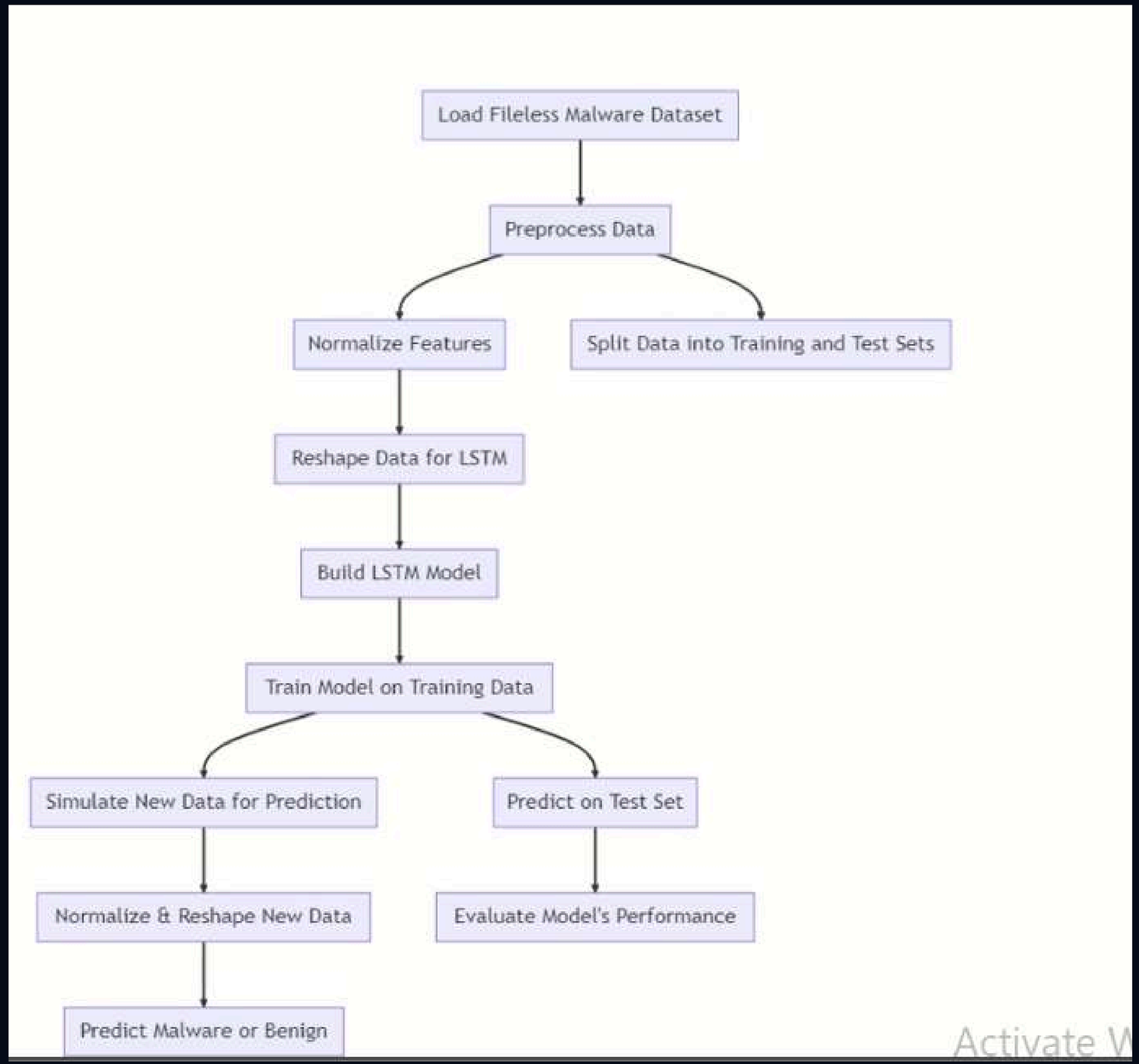



Start: Real-time Environment
Memory Forensics
Behavioral Analysis
EDR Solutions
Manual Inspection
Dataset Creation
Continuous Monitoring
Extract Digital Artifacts
Cuckoo Sandbox
Process Explorer
Analyze Behavior
Monitor Activities
Inspect Processes
Consolidate Data
Labeling
Capture Memory Dumps
Update Dataset
Volatility
Rekall
Analyze Memory
Analyze Memory


AI Algorithms for Fileless Malware Detection
Long Short-Term Memory LSTM
Isolation Forests
Autoencoders
Excellent for sequence prediction
Great for anomaly detection
Neural networks for abnormal behavior
System/API Calls Analysis
Anomaly Detection
Identifying Abnormal Behavior


Memory Dumps Collection
Parallel Processing Framework
Memory Dump Analysis with Volatility
Feature Extraction
Consolidated Dataset for Deep Learning
Train Deep Learning Models


Generating Large Dataset Using Volatility
Automation Scripts
Data Aggregation
Synthetic Data Generation
Cloud-Based Solutions
Collaboration
Scripting Volatility
Parallel Processing
Aggregating Features
Labeling
Data Augmentation
Simulated Data
Distributed Computing
Managed Services
Shared Datasets


Load Fileless Malware Dataset
Preprocess Data
Normalize Features
Split Data into Training and Test Sets
Reshape Data for LSTM
Build LSTM Model
Train Model on Training Data
Simulate New Data for Prediction
Predict on Test Set
Normalize & Reshape New Data
Evaluate Model's Performance
Predict Malware or Benign

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specific_calls,access_resources,suspicious_api_calls,scripting_engine_calls,malicious_dlls,dlls_loaded_into_processes,hijacked_processes,unexpected_child_processes,c2_communications,data_exfiltration,unusual_memory_access,malicious_payloads_in_memory,registry_persistence_changes,malicious_registry_tasks,powershell_activity,wmi_activity,javascript_activity,unusual_logon_patterns,privilege_escalation,scheduled_tasks_changes,behavioral_anomalies,is_malware
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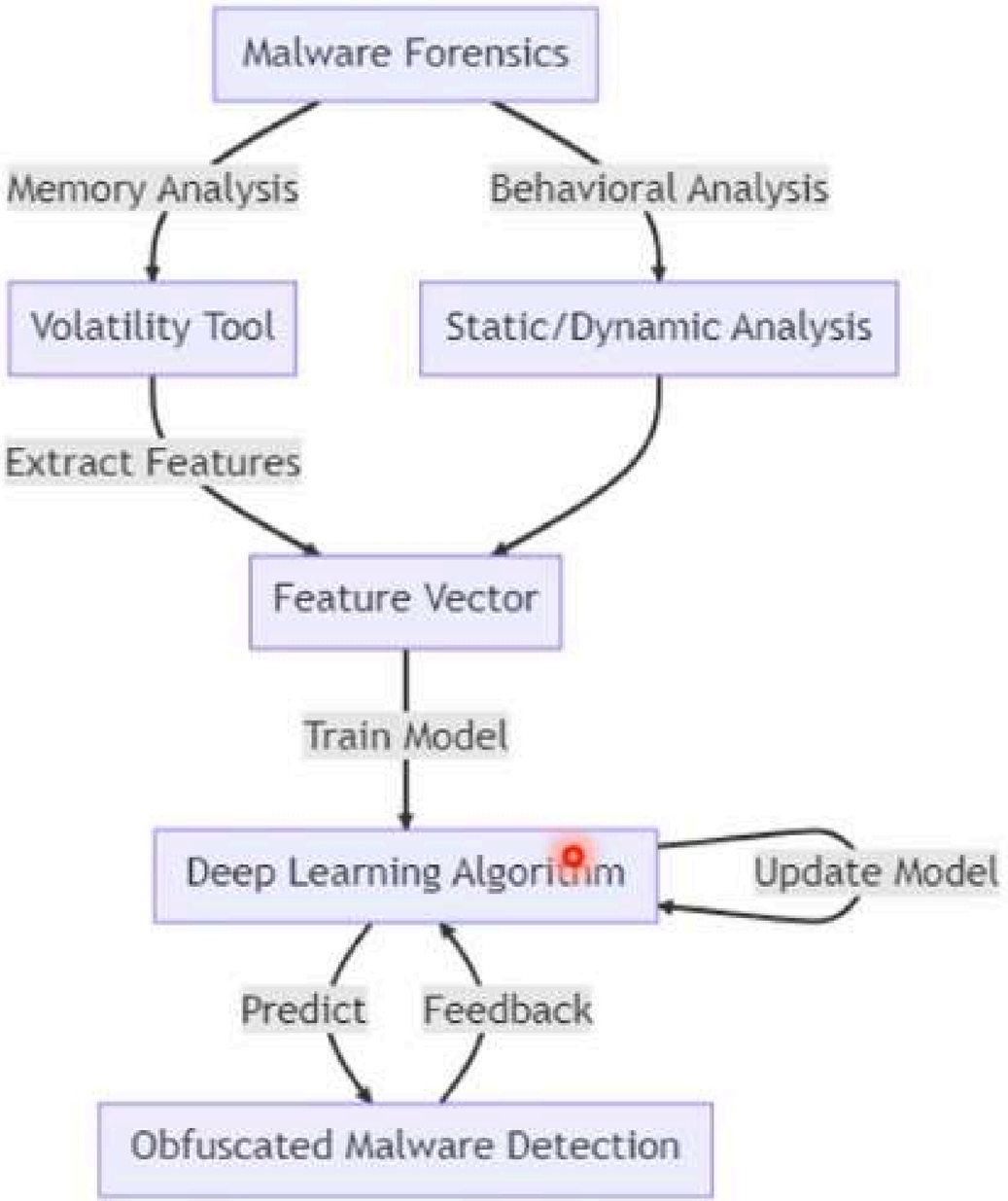
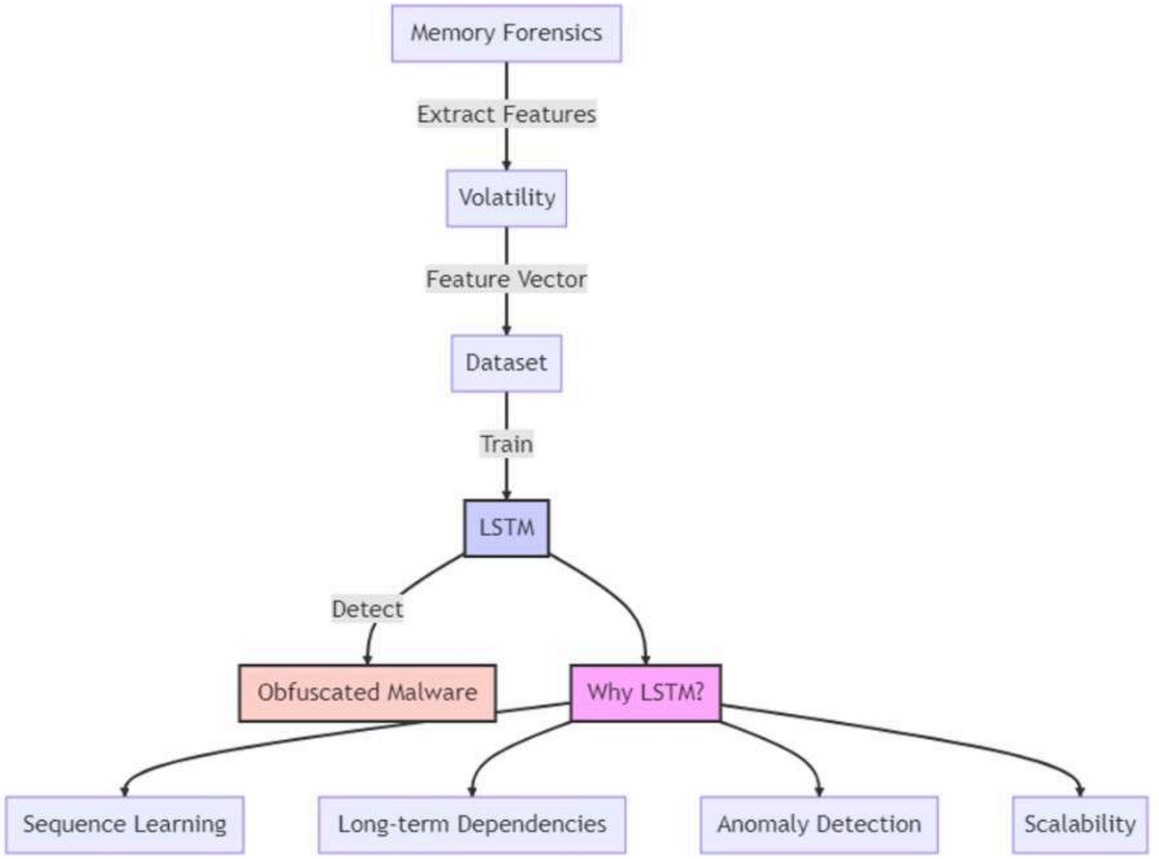
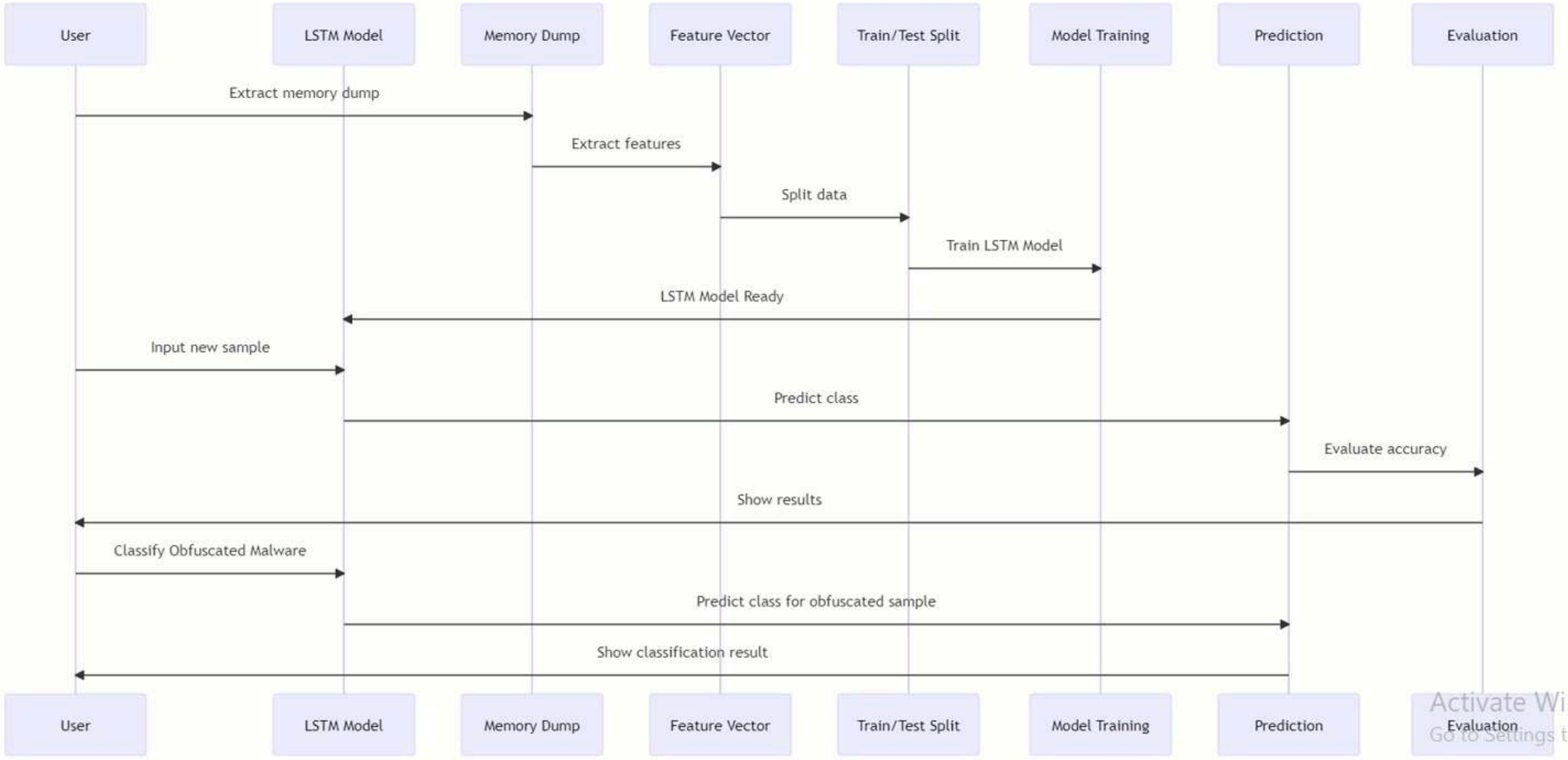
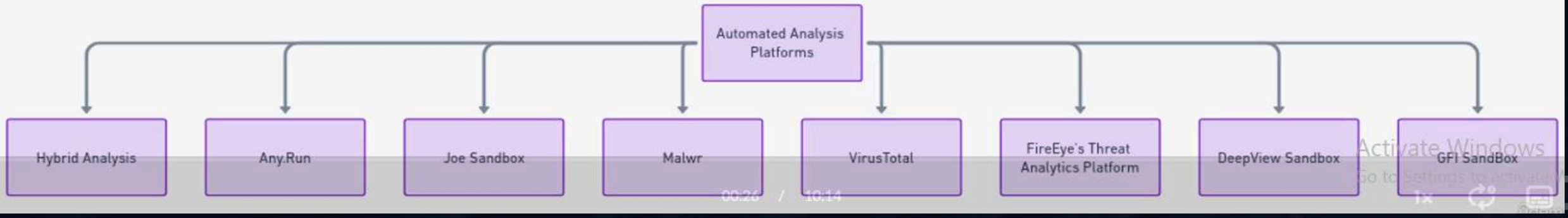
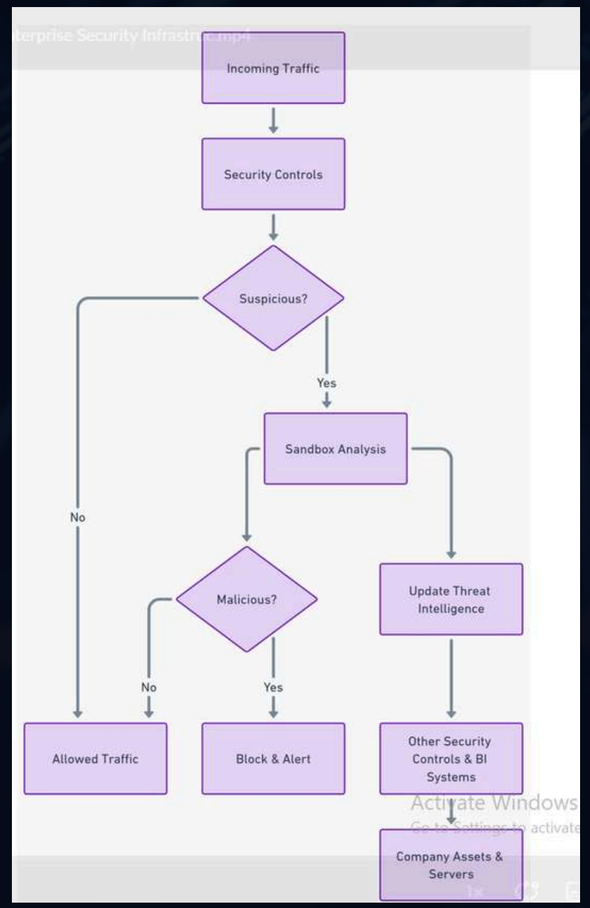

Malware Forensics
Memory Analysis
Behavioral Analysis
Volatility Tool
Static/Dynamic Analysis
Extract Features
Feature Vector
Train Model
Deep Learning Algorithm
Update Model
Predict
Feedback
Obfuscated Malware Detection

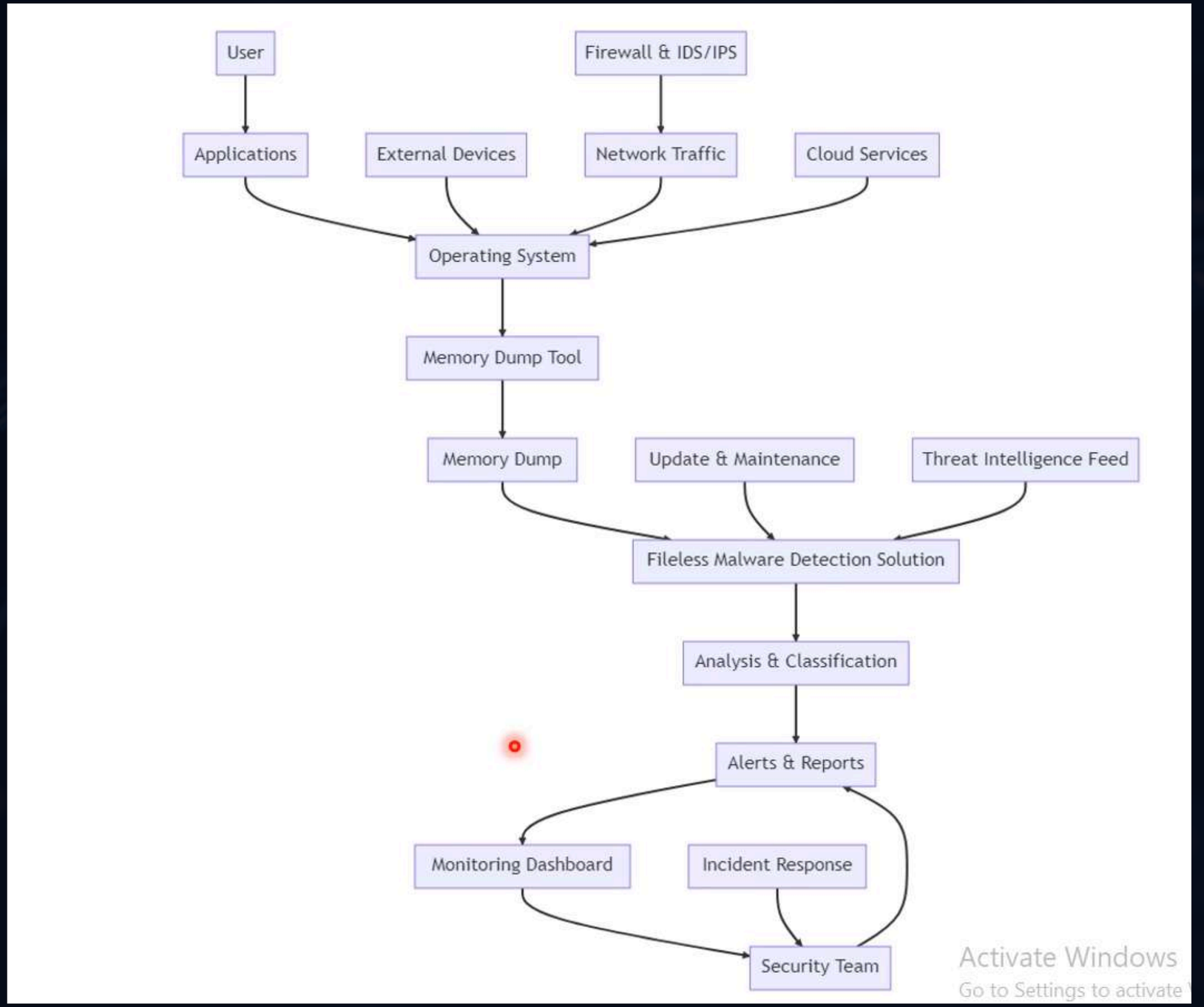

Memory Forensics
Extract Features
Volatility
Feature Vector
Dataset
Train
LSTM
Detect
Obfuscated Malware
Why LSTM?
Sequence Learning
Long-term Dependencies
Anomaly Detection
Scalability

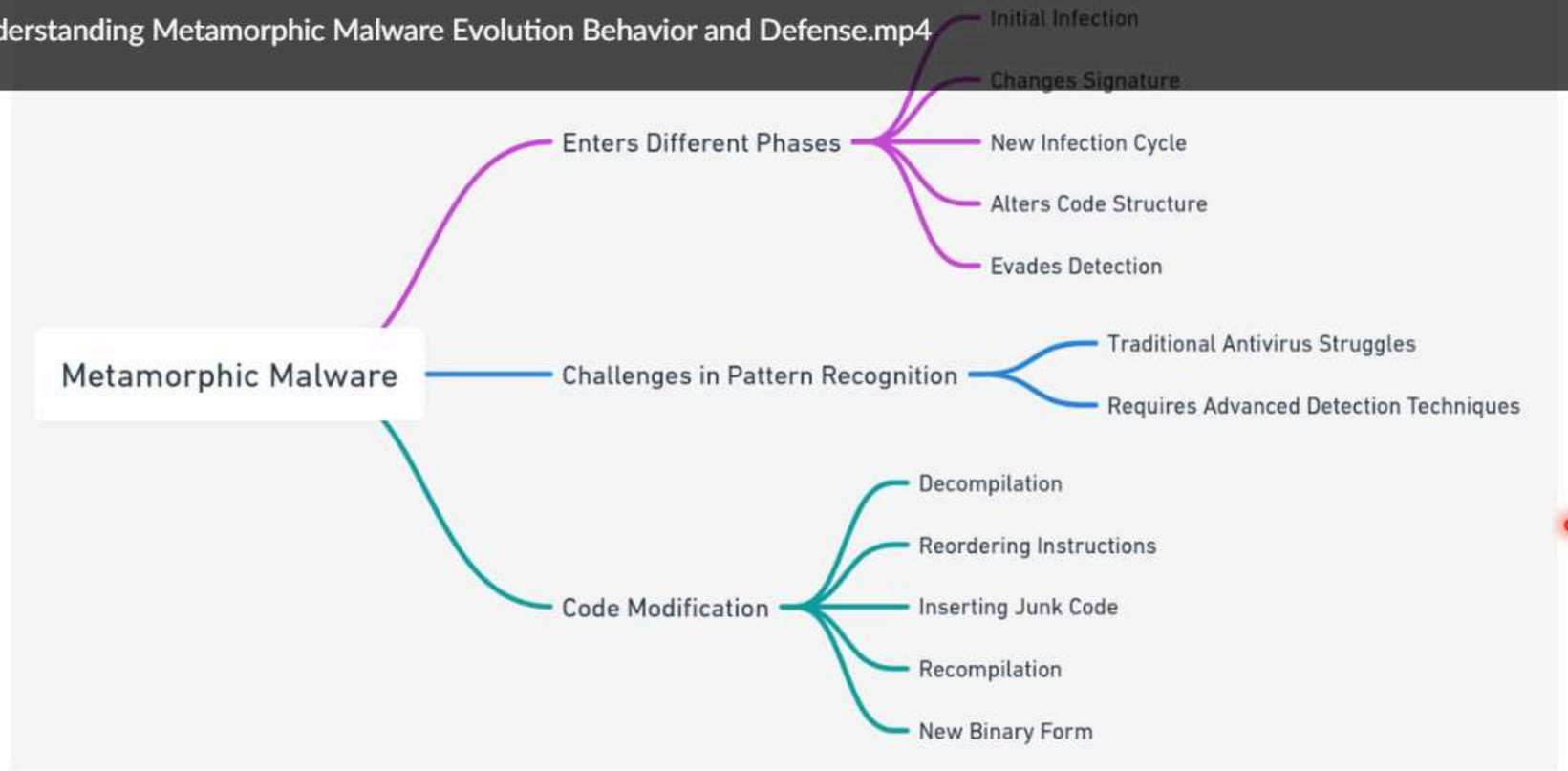

User
LSTM Model
Memory Dump
Feature Vector
Train/Test Split
Model Training
Prediction
Evaluation
Extract memory dump
Extract features
Split data
Train LSTM Model
LSTM Model Ready
Input new sample
Predict class
Evaluate accuracy
Show results
Classify Obfuscated Malware
Predict class for obfuscated sample
Show classification result
User
LSTM Model
Memory Dump
Feature Vector
Train/Test Split
Model Training
Prediction
Evaluation

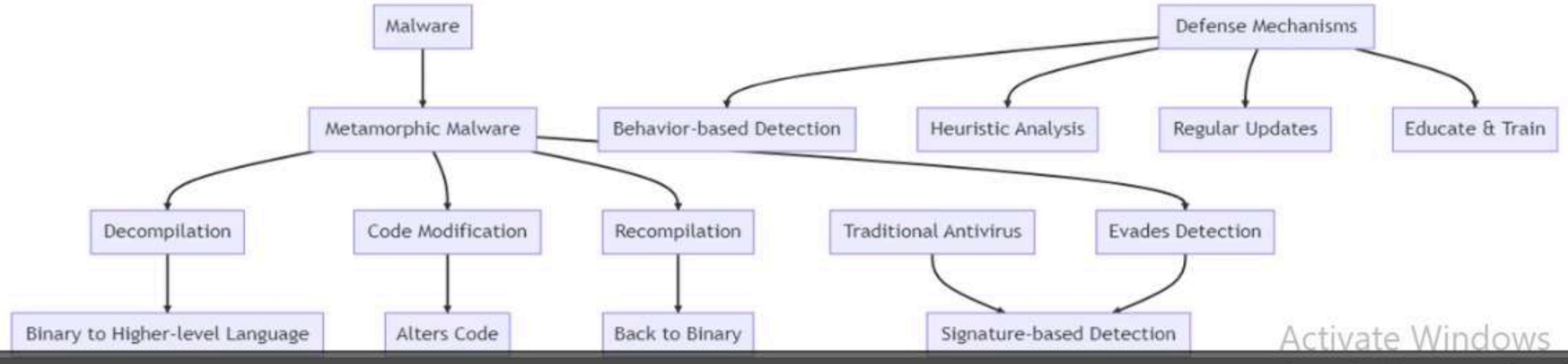

Automated Analysis Platforms
Hybrid Analysis
Any.Run
Joe Sandbox
Malwr
VirusTotal
FireEye's Threat Analytics Platform
DeepView Sandbox
GFI SandBox

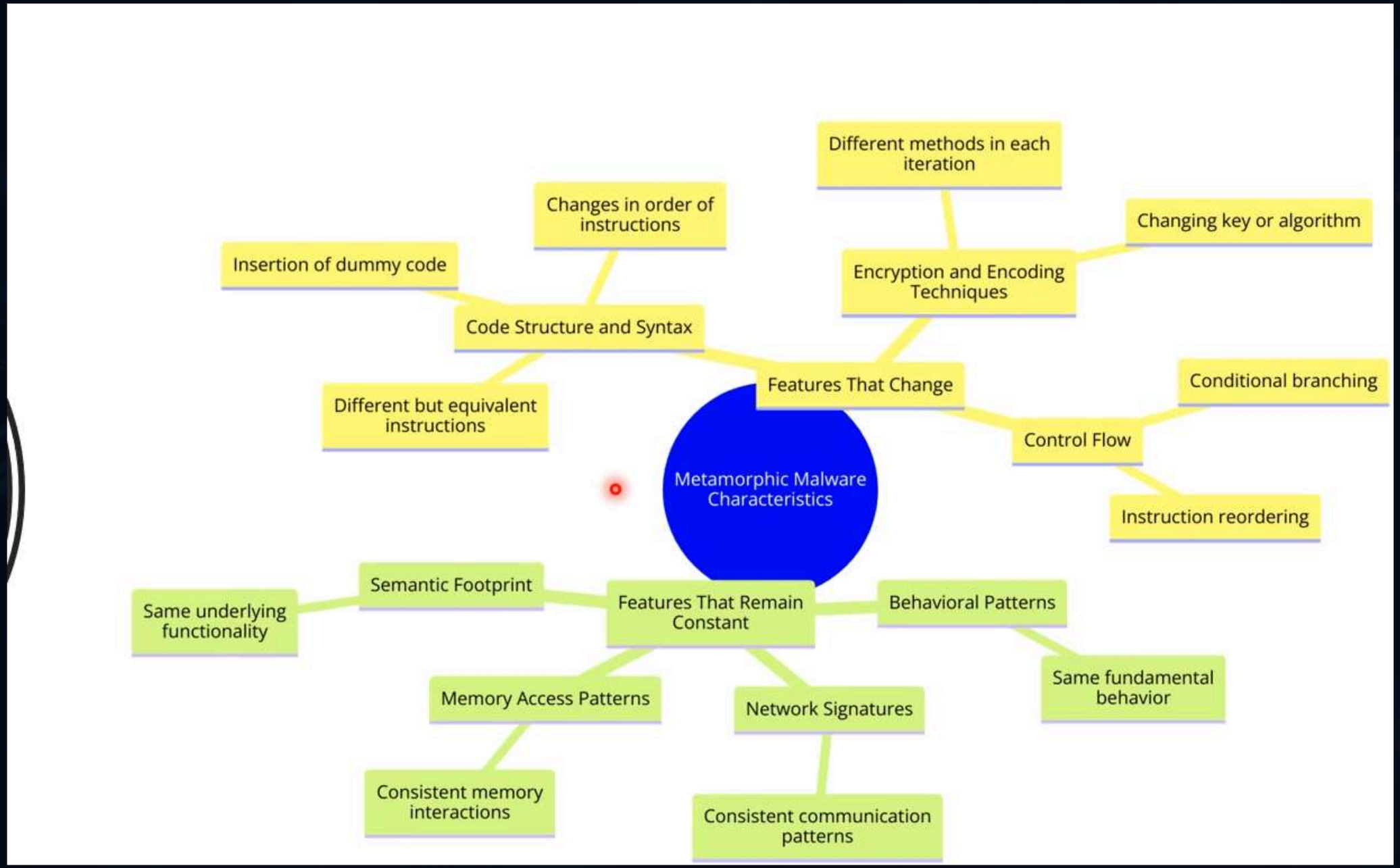

Incoming Traffic
Security Controls
Suspicious?
Yes
No
Sandbox Analysis
Malicious?
No
Yes
Update Threat Intelligence
Allowed Traffic
Block & Alert
Other Security Controls & BI Systems
Company Assets & Servers

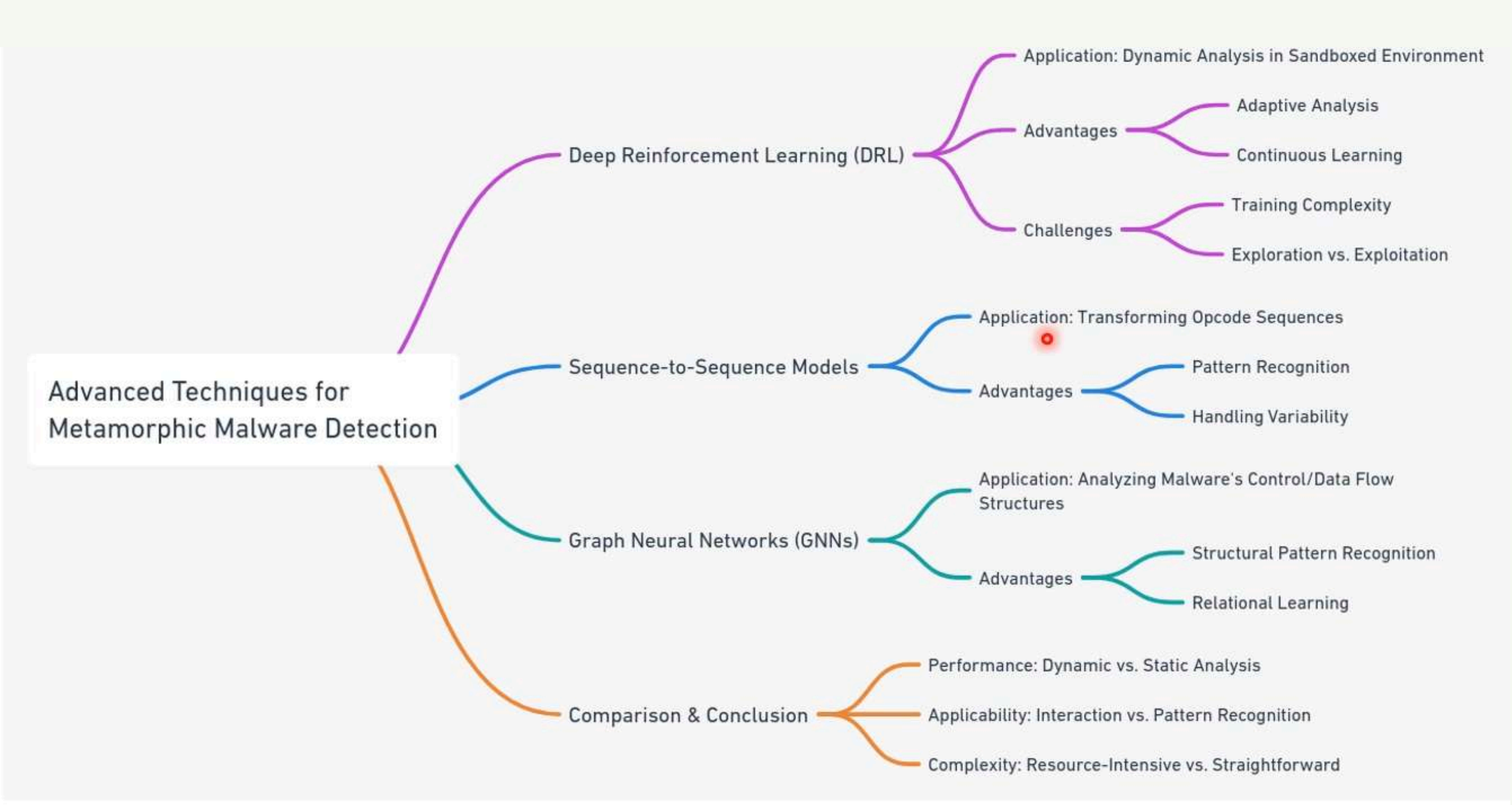

VPN

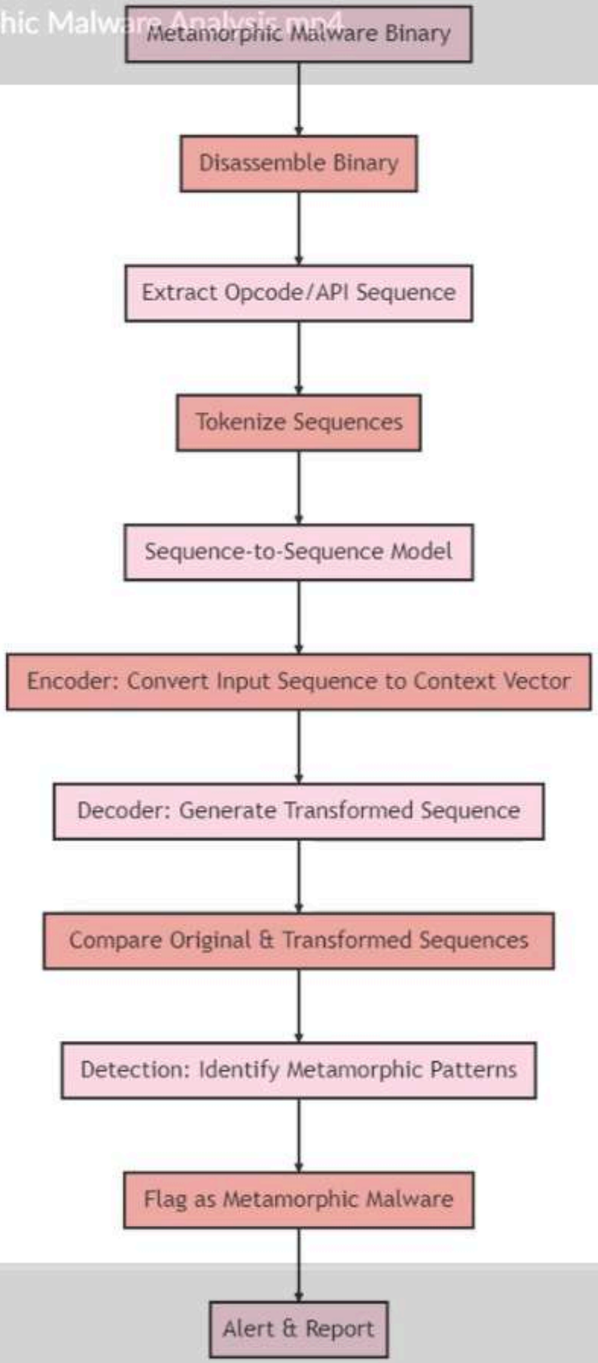




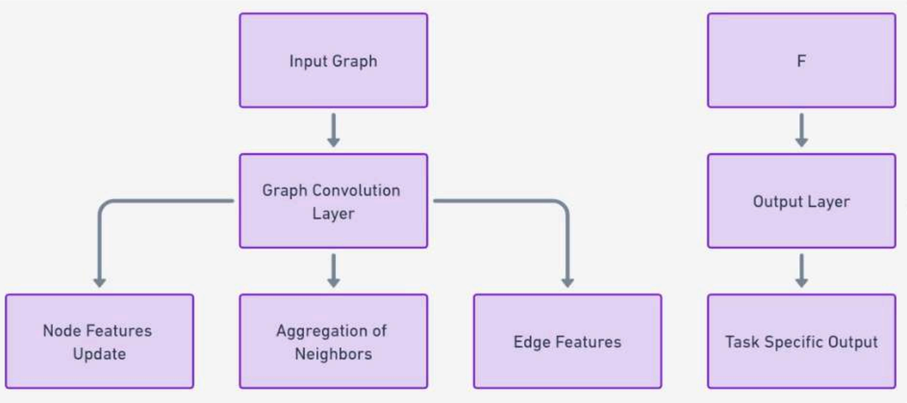


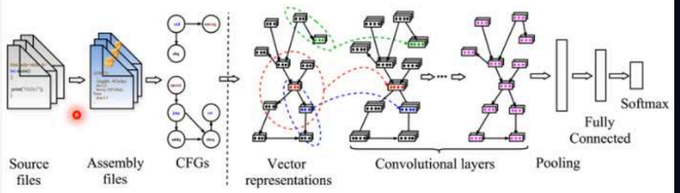

Metamorphic Malware Characteristics
Features That Change
Code Structure and Syntax
Changes in order of instructions
Insertion of dummy code
Different but equivalent instructions
Encryption and Encoding Techniques
Different methods in each iteration
Changing key or algorithm
Control Flow
Conditional branching
Instruction reordering
Features That Remain Constant
Semantic Footprint
Same underlying functionality
Behavioral Patterns
Same fundamental behavior
Memory Access Patterns
Consistent memory interactions
Network Signatures
Consistent communication patterns


Advanced Techniques for Metamorphic Malware Detection
Deep Reinforcement Learning (DRL)
Application: Dynamic Analysis in Sandboxed Environment
Advantages
Adaptive Analysis
Continuous Learning
Challenges
Training Complexity
Exploration vs. Exploitation
Sequence-to-Sequence Models
Application: Transforming Opcode Sequences
Advantages
Pattern Recognition
Handling Variability
Graph Neural Networks (GNNs)
Application: Analyzing Malware's Control/Data Flow Structures
Advantages
Structural Pattern Recognition
Relational Learning
Comparison & Conclusion
Performance: Dynamic vs. Static Analysis
Applicability: Interaction vs. Pattern Recognition
Complexity: Resource-Intensive vs. Straightforward



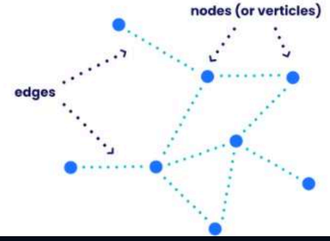
CFG & GNN



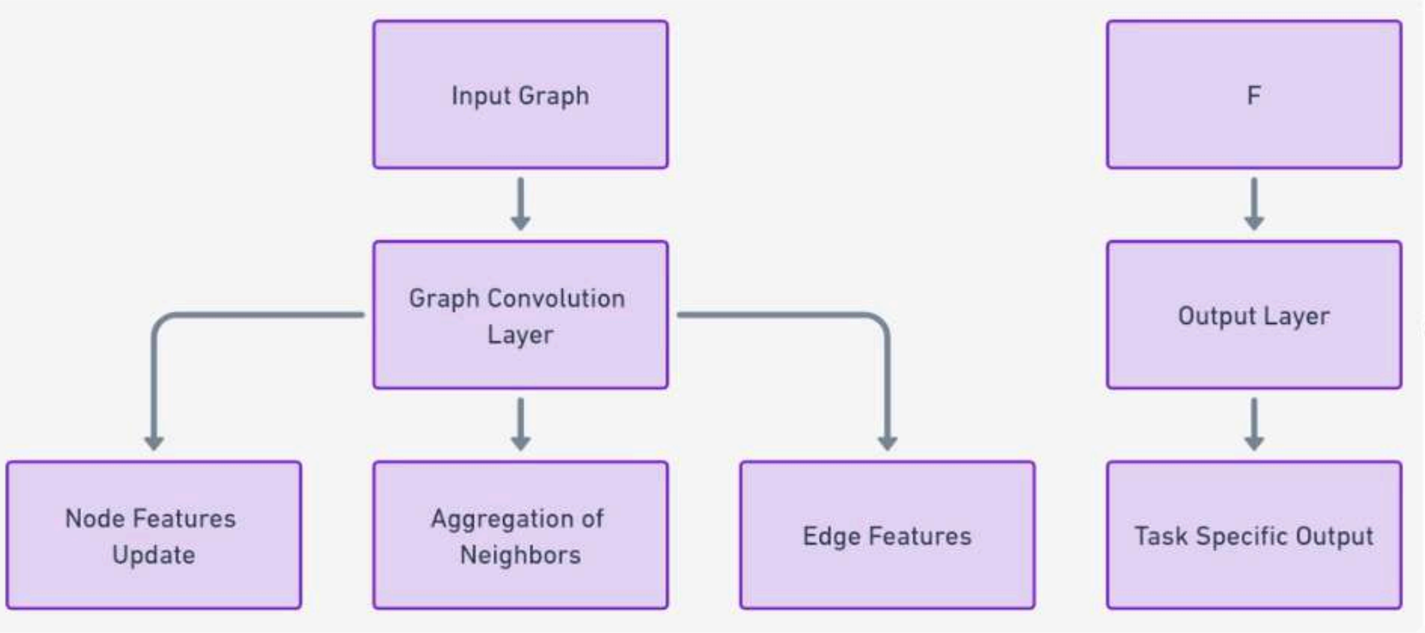


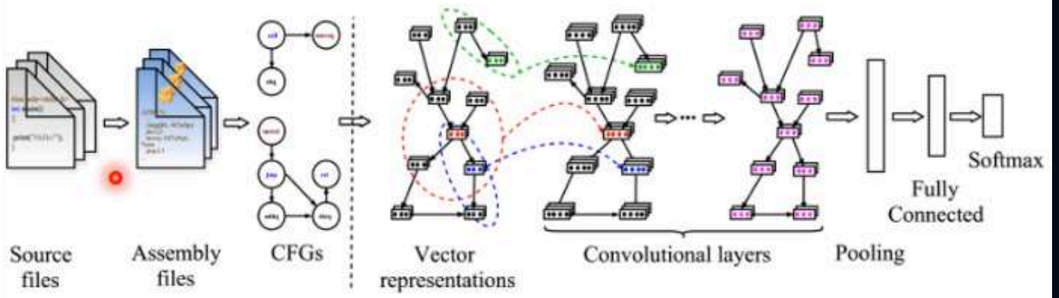
(a) Building Control Flow Graphs (b) The convolutional neural network on directed graphs

Source: https://www.arxiv-vanity.com/papers/1802.04986/



CFG & GNN





(a) Building Control Flow Graphs **(b) The convolutional neural network on directed graphs**

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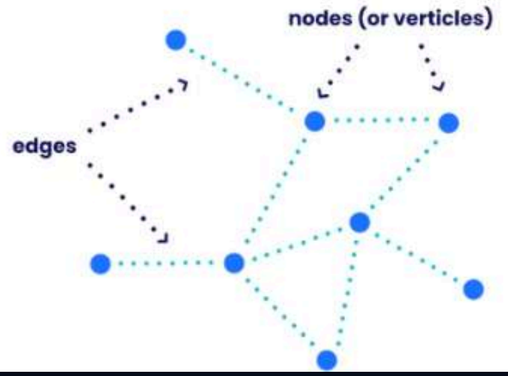
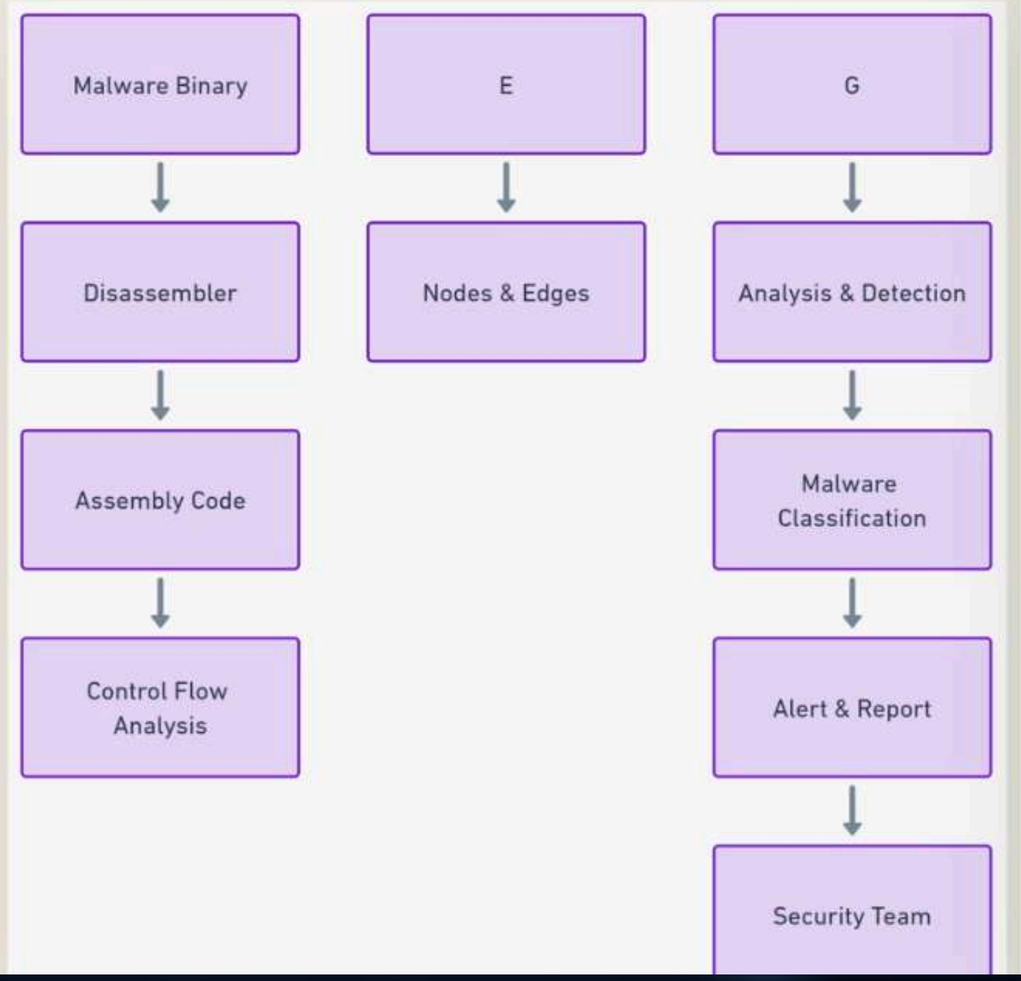
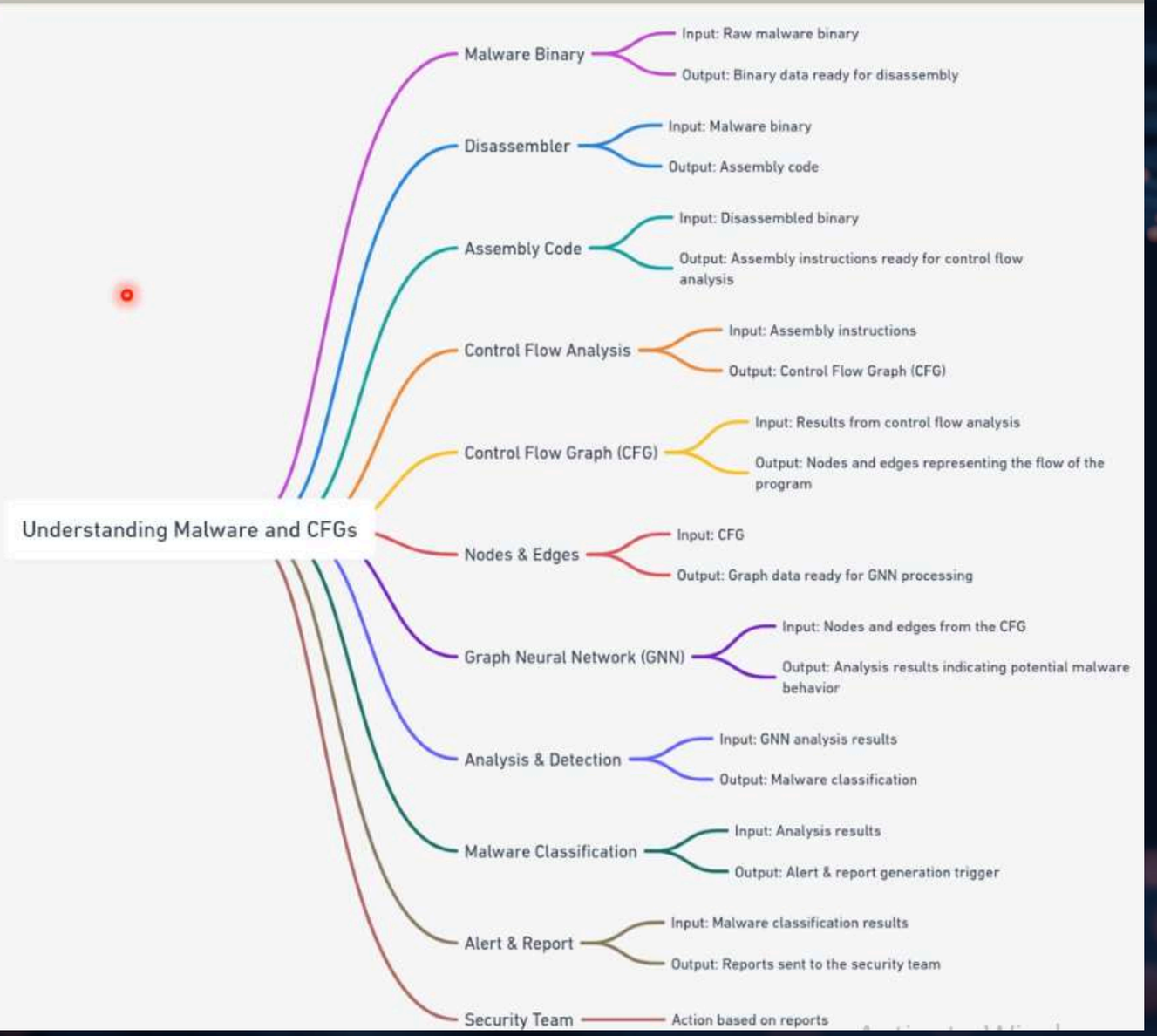
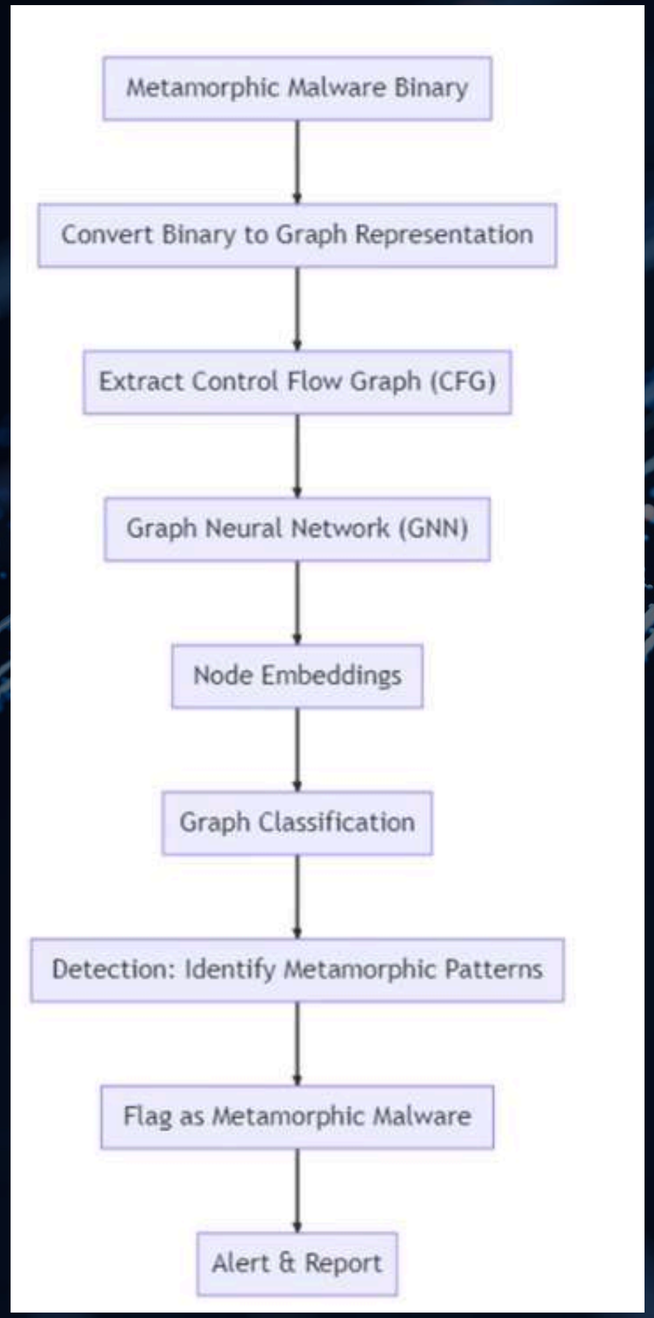
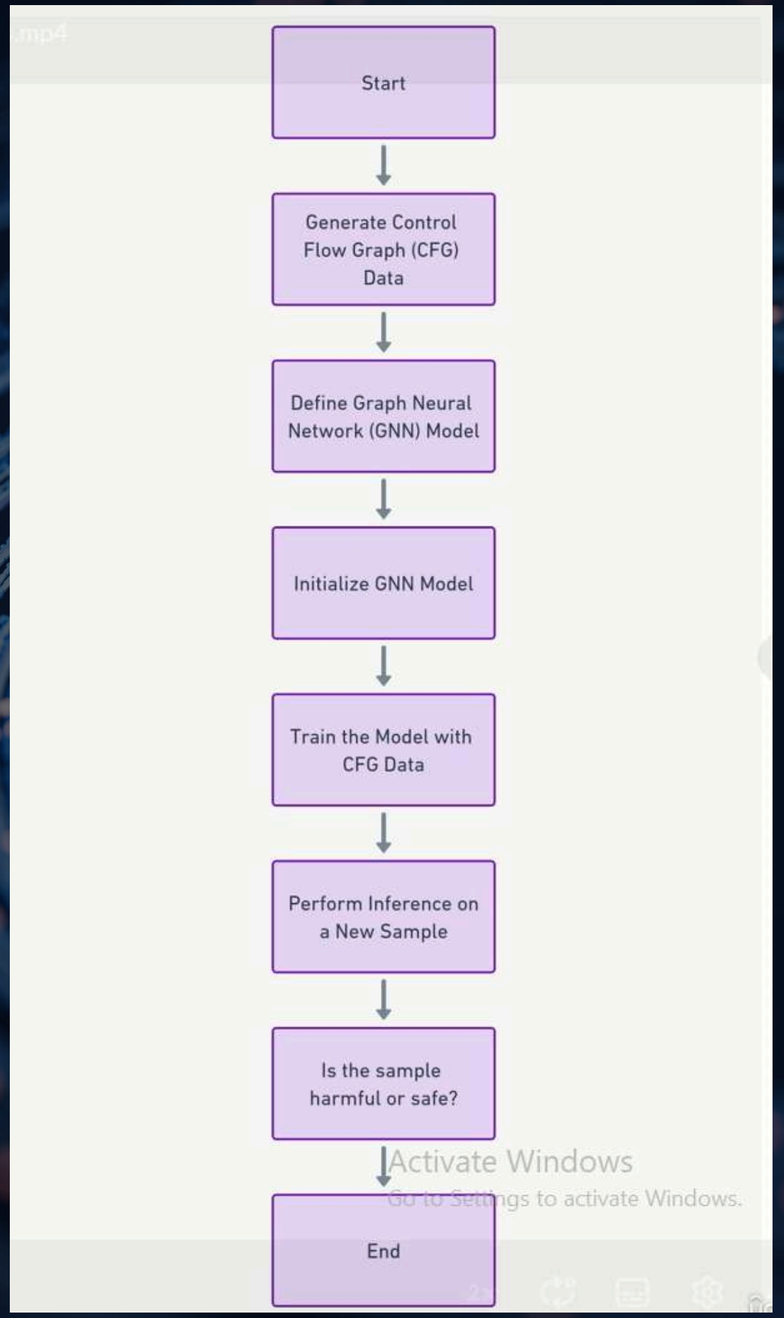


Deep Dive into Malware Analysis using Control Flow Graphs (CFGs) and Graph Neural Networks (GNNs)

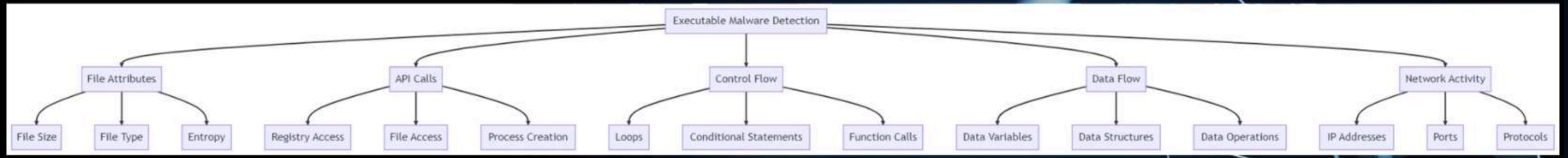


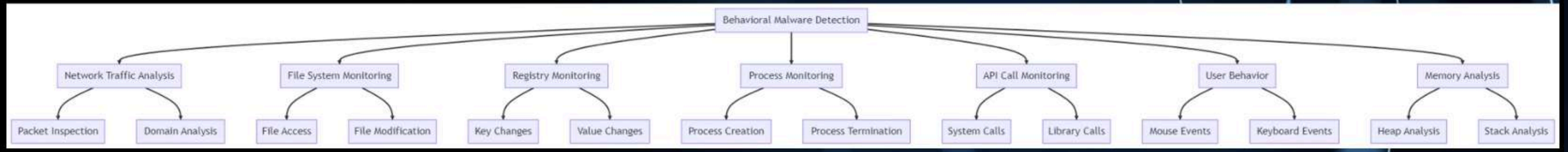




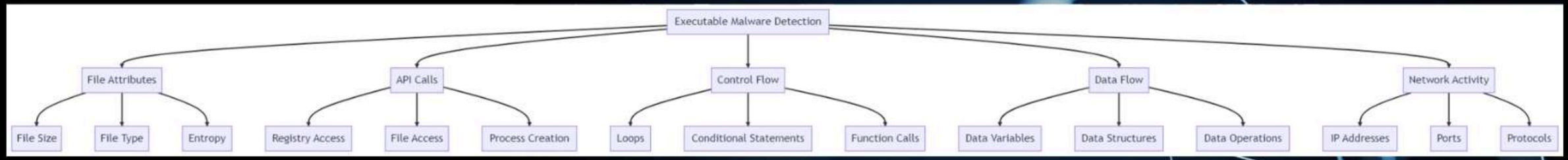


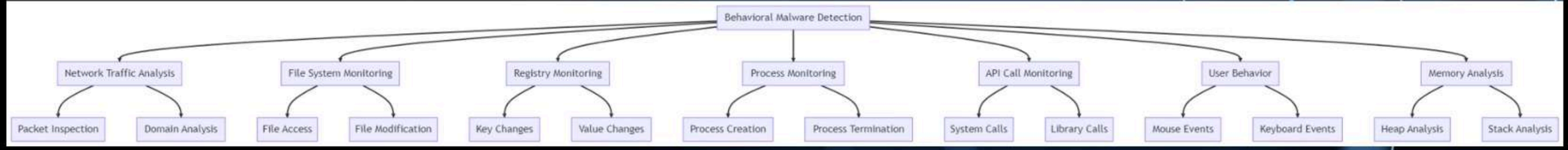
Behavioral and Executable Malware: A Unified AI Detection Strategy

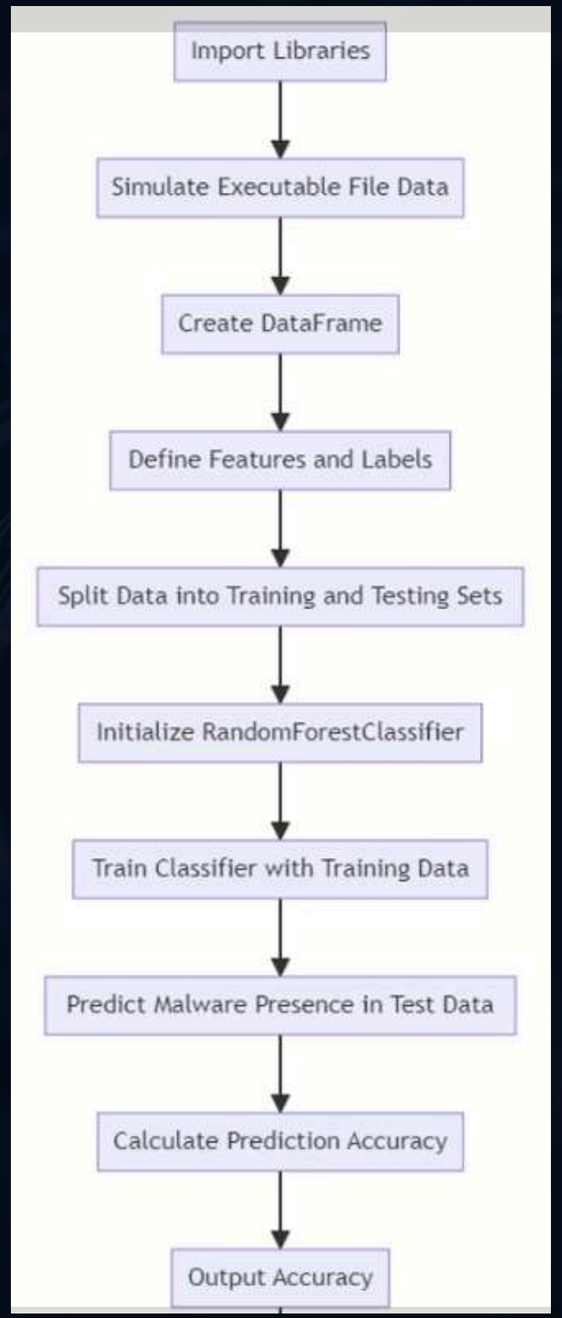




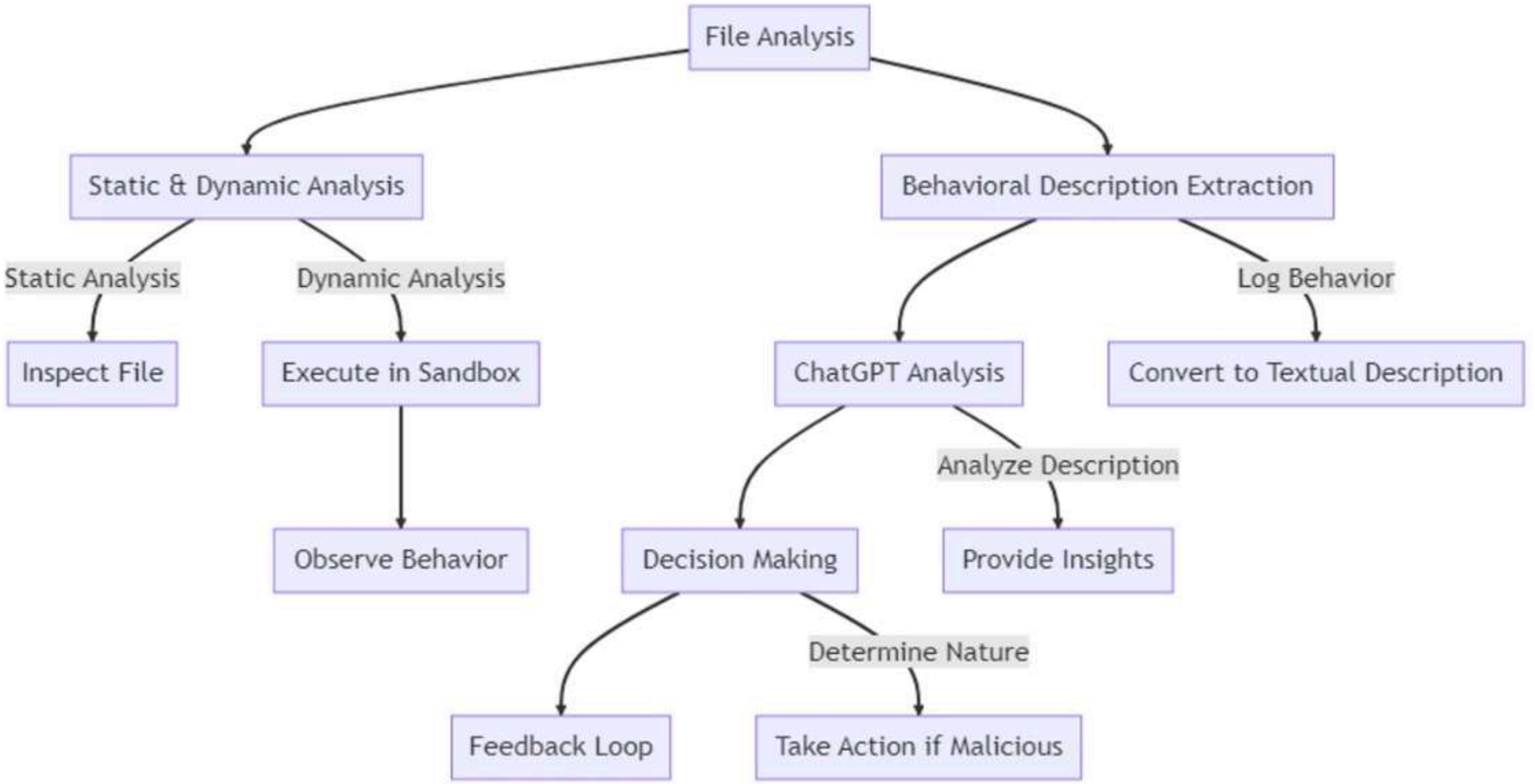
Behavioral and Executable Malware: A Unified AI Detection Strategy

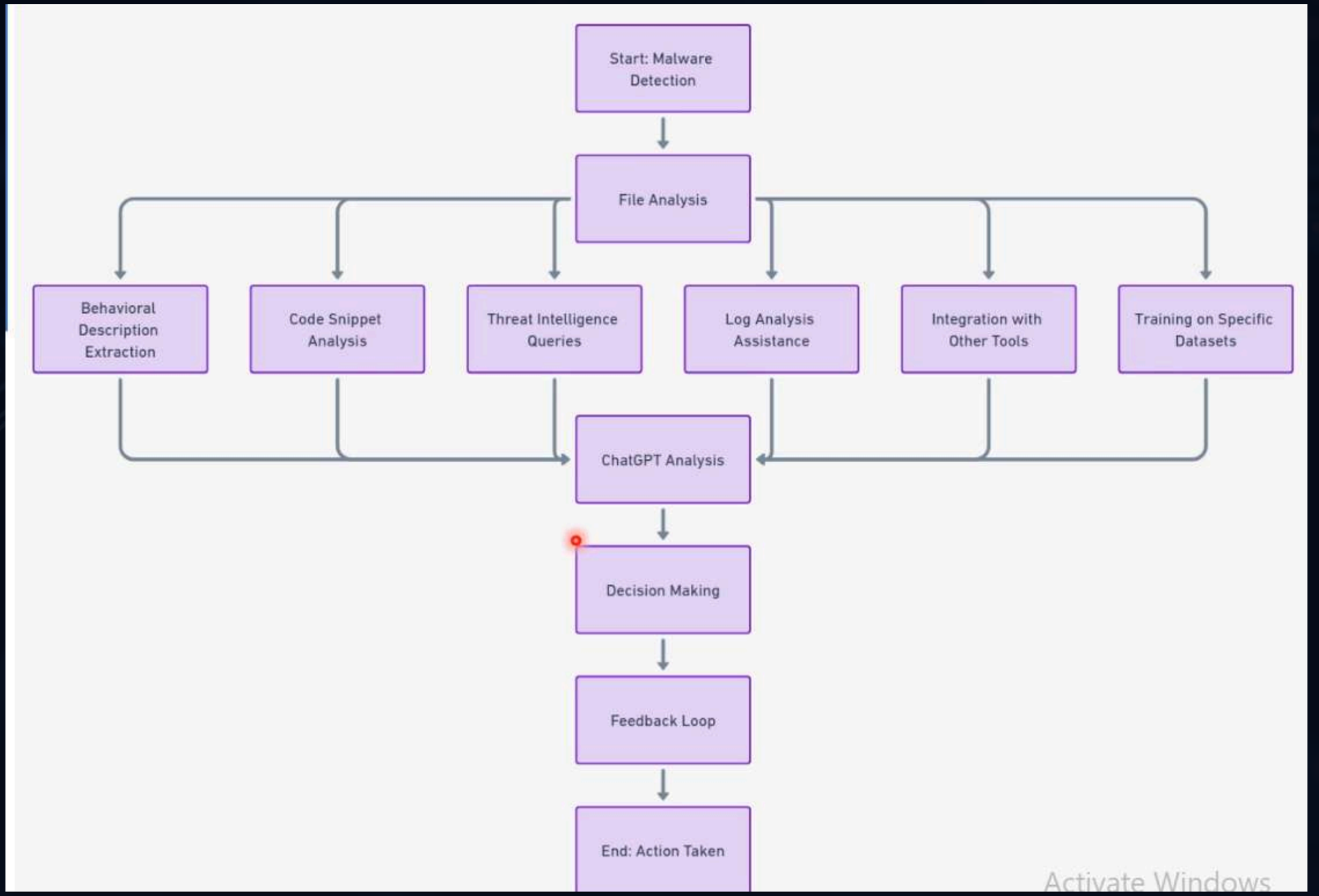


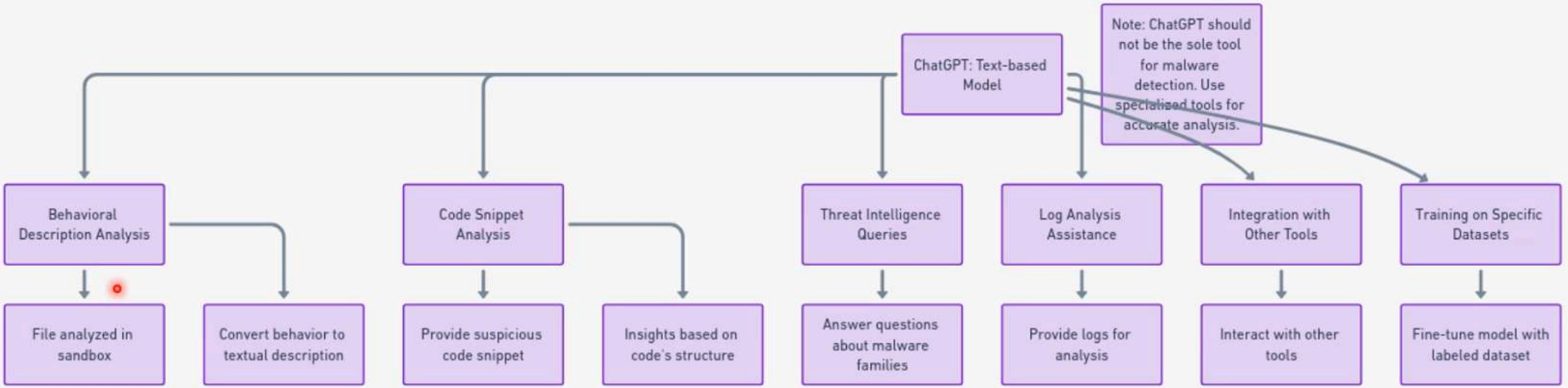


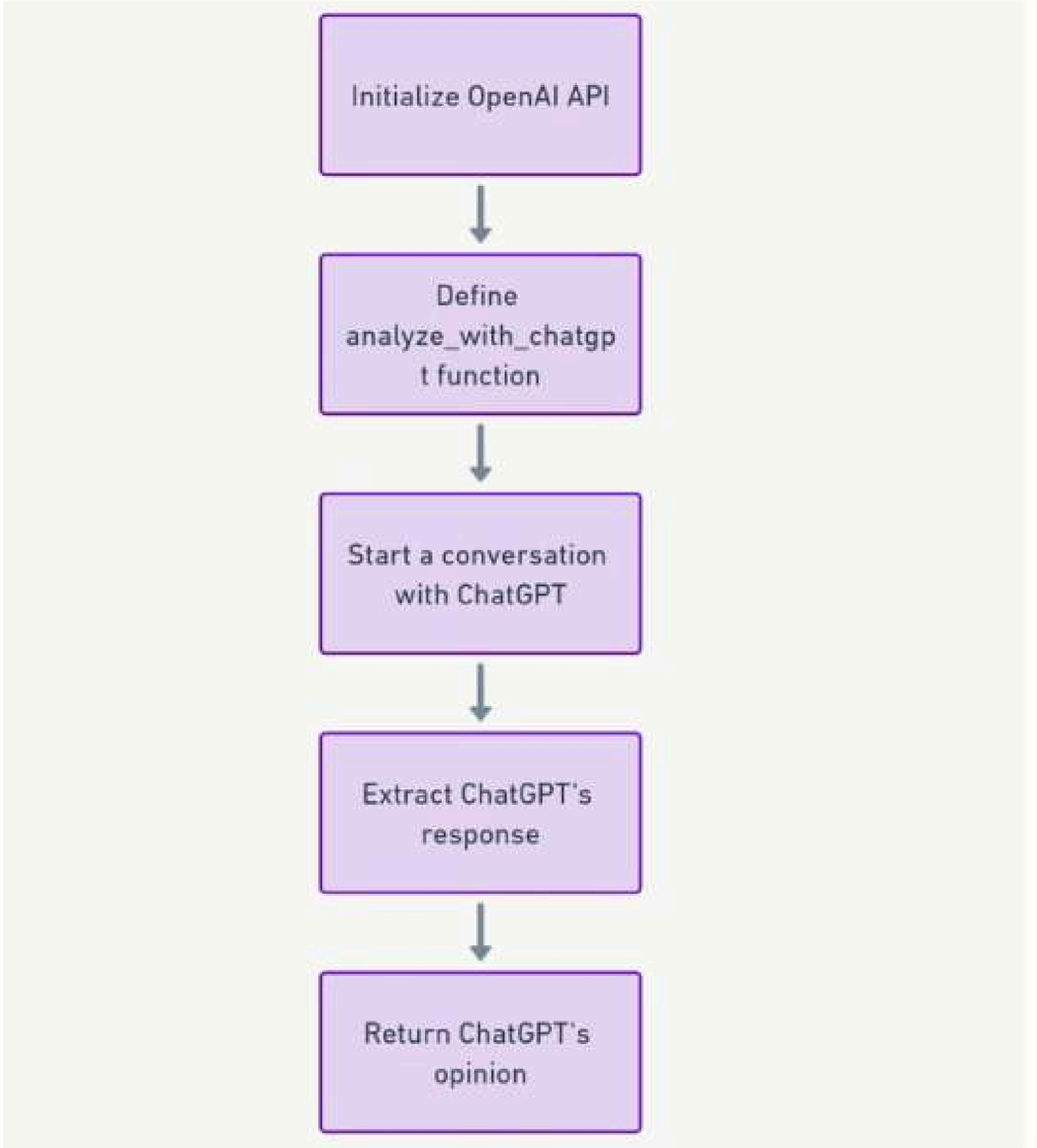

Import Libraries
Simulate Executable File Data
Create DataFrame
Define Features and Labels
Split Data into Training and Testing Sets
Initialize RandomForestClassifier
Train Classifier with Training Data
Predict Malware Presence in Test Data
Calculate Prediction Accuracy
Output Accuracy

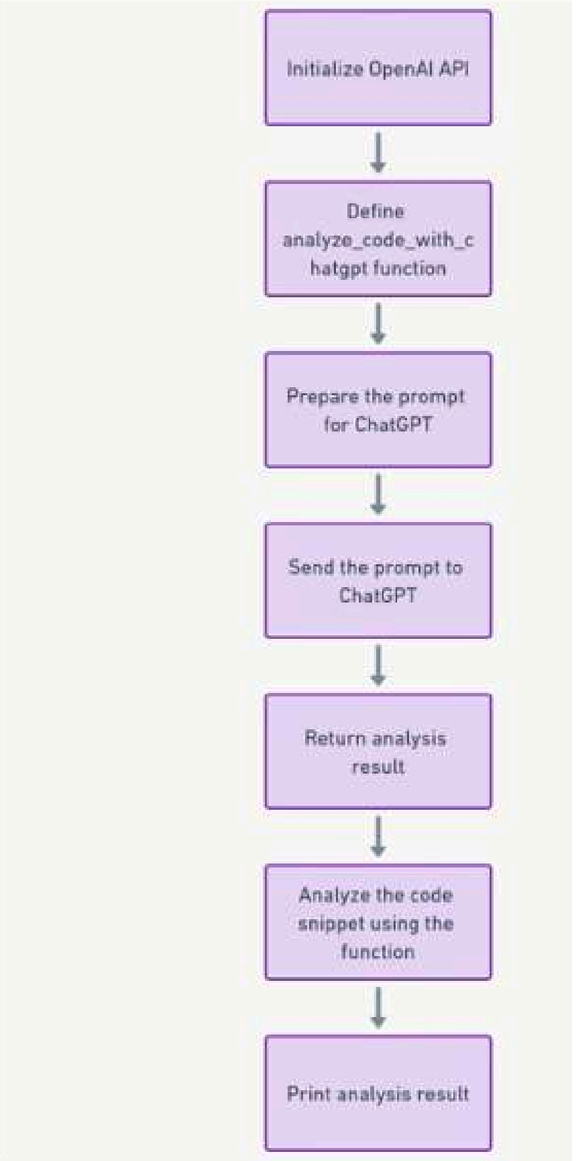
Harnessing ChatGPT for Enhanced Malware Behavior Analysis

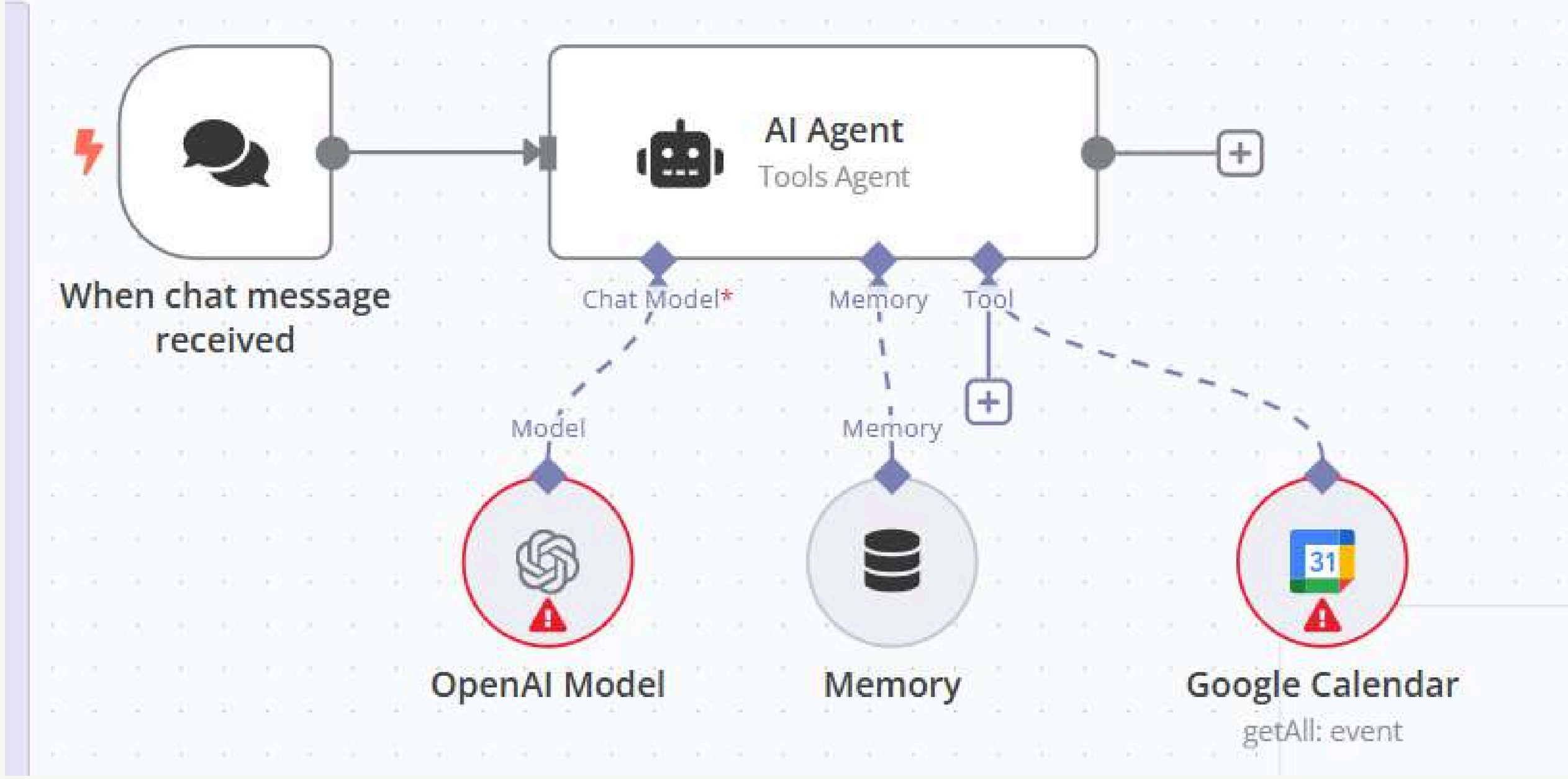


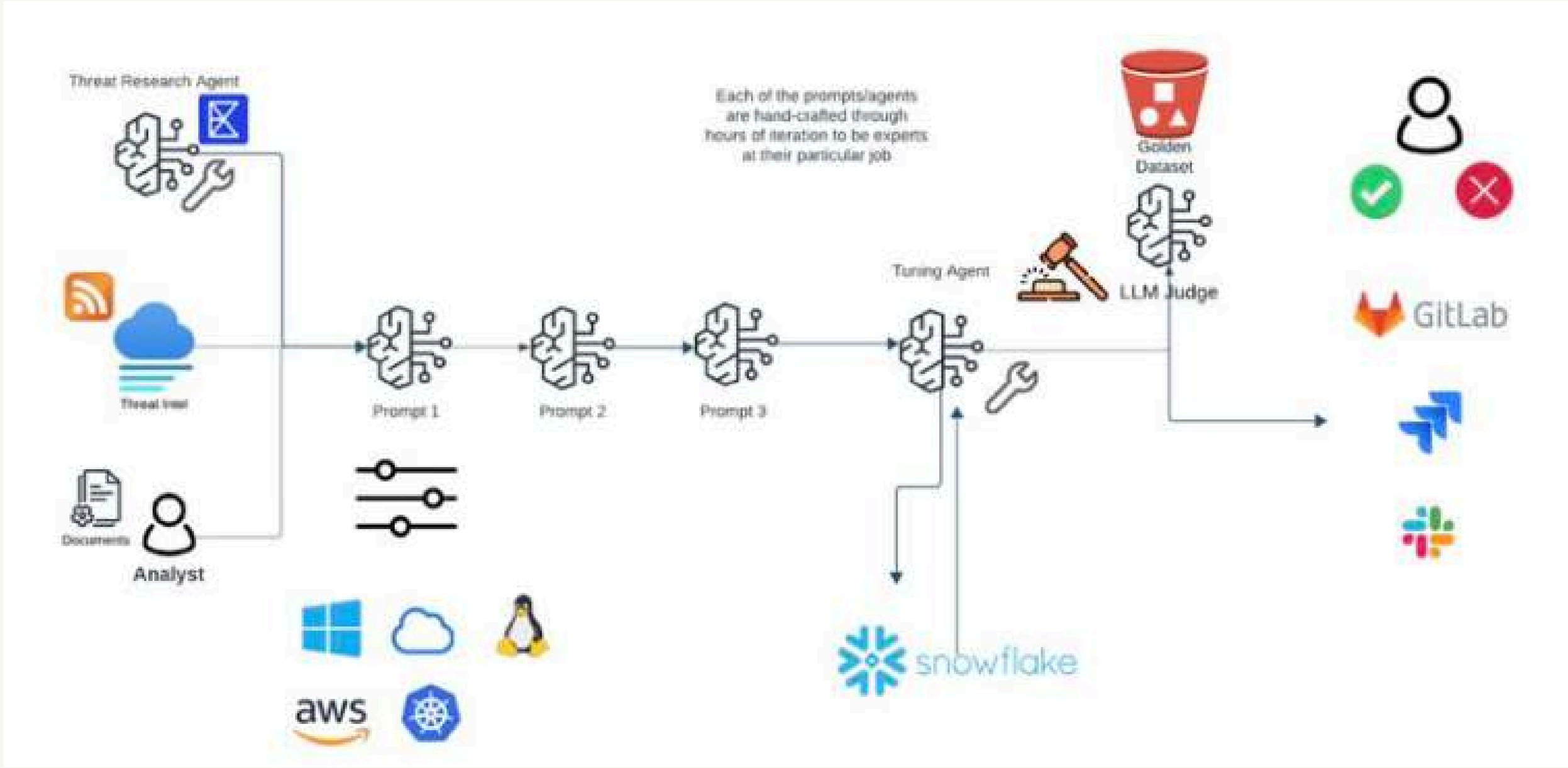



ChatGPT: Text-based Model
Note: ChatGPT should not be the sole tool for malware detection. Use specialized tools for accurate analysis.
Behavioral Description Analysis
Code Snippet Analysis
Threat Intelligence Queries
Log Analysis Assistance
Integration with Other Tools
Training on Specific Datasets
File analyzed in sandbox
Convert behavior to textual description
Provide suspicious code snippet
Insights based on code's structure
Answer questions about malware families
Provide logs for analysis
Interact with other tools
Fine-tune model with labeled dataset


Initialize OpenAI API
Define analyze_with_chatgpt function
Start a conversation with ChatGPT
Extract ChatGPT's response
Return ChatGPT's opinion


Initialize OpenAI API
Define analyze_code_with_chatgpt function
Prepare the prompt for ChatGPT
Send the prompt to ChatGPT
Return analysis result
Analyze the code snippet using the function
Print analysis result


When chat message received
AI Agent
Tools Agent
Chat Model*
Memory
Tool
Model
Memory
OpenAI Model
Memory
Google Calendar
getAll: event


Threat Research Agent
Each of the prompts/agents are hand-crafted through hours of iteration to be experts at their particular job
Golden Dataset
Tuning Agent
LLM Judge
Threat Intel
Prompt 1
Prompt 2
Prompt 3
Documents
Analyst
GitLab
aws
snowflake

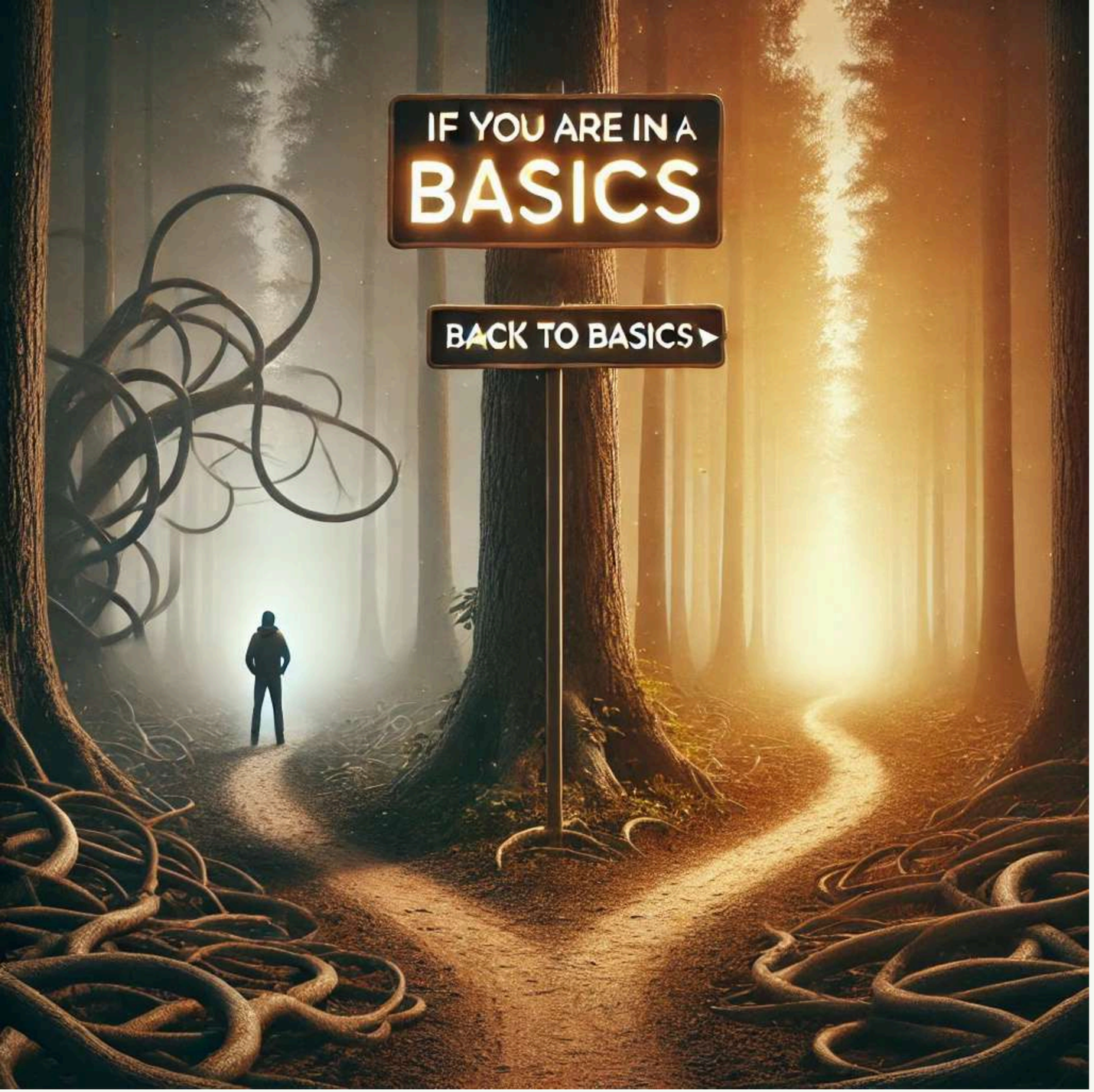
HTTPS://GITHUB.COM/EVILBYTECODE/GODEFENDER

CANVA=1

HTTPS://N8N.IO/WORKFLOWS/5937-AUTOMATED-URL-PHISHING-AND-THREAT-ANALYSIS-WITH-NIXGUARD-AI/

THANK YOU!

HTTPS://DIGISURAKSHA.ORG/



Back To Basics