

Maintaining Data Integrity of AI Applications

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Contents

- 1 Maintaining data integrity of AI applications 2
- 2 Legal Notice 5
- Glossary 6
- A Copyright 10
- B GNU Free Documentation License 10

WHAT?

Maintaining the security of the entire AI stack environment.

WHY?

To learn how to prevent data leaks and maintain the correct functioning of your AI application.

EFFORT

Understanding the security threats and safety measures for running AI services requires less than 30 minutes of your time.

GOAL

Understand how attackers can exploit your AI stack to access sensitive data and learn safety techniques to prevent such attacks.

1 Maintaining data integrity of AI applications

1.1 Why care about the security of AI applications?

AI applications use AI-driven chatbots to interact with users. These chatbots are powered by large language models (LLMs) and can process external data sources (RAGs). Such applications are prone to cyber attacks as any other software solutions. Attackers may impersonate users and apply a series of techniques to steal data and to corrupt the responses provided by AI models.

1.2 Which SUSE AI components are prone to attacks

Users interact with SUSE AI via the Open WebUI user interface. With Open WebUI, you can manage users, permissions, AI models, knowledge bases, and chat interactions. The following SUSE AI components are the most susceptible to security attacks:

Open WebUI

Open WebUI enables you to specify external data sources to improve responses. On a user level, you can append documents directly to the chat input field. With administrator privileges, you can upload documents to create a knowledge base that enhances the AI model. The knowledge base acts as a domain-specific augmentation tool for the LLM. It prevents chatbot hallucination and improves the model's responses with accurate and up-to-date information.



Tip

Actions performed by users—both the administrators and guests—are recorded in an audit log. With the audit log, it is possible to map all actions that took the system to its current state.

Milvus

It is possible to input documents directly into Milvus—the vector database responsible for the low-level implementation of the knowledge base concept. Although the user interaction normally takes place via Open WebUI, attackers may bypass Open WebUI to interact with Milvus. This can happen if no identity access management (IAM) policy is controlling database access.

Ollama

Ollama manages the interactions with several LLMs. It can search, download, start and manage models within a unified interface. Ollama does not offer authentication and authorization by default. Therefore, Ollama's API should not be exposed without an element providing IAM capabilities. In SUSE AI, user interacts with Ollama via Open WebUI, which is able to configure and secure Ollama.

1.3 What are common attacks and security risks?

This section lists several attacks and security risks related to AI applications.

RAG poisoning

A common exploit when a knowledge base—often a vector database—that provides a context for AI model responses is corrupted by the addition of misleading, false or even harmful content. The malicious documents tend to be crafted specifically to provide wrong answers for a set of user prompts. This kind of attack usually requires access to a user with privileges to configure the whole platform or the vector databases that support the platform.

Facilitated data exploits

RAG-powered models can search knowledge bases, summarize content and provide references. Attackers may use these characteristics to discover and retrieve organizational data with simple prompts instead of relying on more refined data-exploitation techniques.

Prompt leaks

User prompts may contain sensitive data, so chat caches and system logs need to be protected against attackers.

1.4 What safety measures should my organization follow?

To avoid having your system corrupted, there are a few security measures that need to be properly implemented. Open WebUI and Milvus allow high level user access configurations. Besides these high level configurations, provide access management with low level network configurations. To verify that your whole AI stack is secure, consider the following points:

Adopt strong IAM policies.

- At the authentication level, limit the creation of guest users.
- At the authorization level, never allow new users to be automatically set as system administrators.
- Limit the number of users with privileges for adding documents to your knowledge base.
- Keep in mind that the same policies set for Open WebUI need to be propagated in all systems composing the AI stack.
- Limit the exposure of internal services (such as Milvus and Ollama) to the Internet.
- Configure authentication and authorization for all components of the AI stack.

Adopt an audit log review policy.

Periodically check the audit logs provided in the Web interface, from both the chatbot and the vector databases. Look for abnormal behavior from one or more users.

Set up retention policies.

Avoid saving chat prompts and system logs.

Train users to avoid LLM overreliance.

Encourage users to approach the answers from the RAG-based models with a critical mindset. Make sure they are able to verify the references provided by the AI chatbot. Files used in the context of a user prompt are appended to the AI model's answer.

Facilitate incident reports.

Educate your users about how to report problems with the AI model's answers. Assign responsibilities for the system support.

Ensure fast action against attacks.

Remember that when a security breach happens, the sooner the system is restored to a trusted state, the less damage your organization takes.

Set up a secure environment for your applications.

Make sure that there are components enforcing authentication and authorization rules over the whole installation of the AI Stack. We do not recommend exposing Milvus and Ollama without proper network configurations.

1.5 For more information

- The article at <https://cloudsecurityalliance.org/blog/2023/11/22/mitigating-security-risks-in-retrieval-augmented-generation-rag-llm-applications> includes a comprehensive overview of security controls.
- Specifying external data sources to the AI model knowledge base is described in [link:https://documentation.suse.com/suse-ai/1.0/html/openwebui-using/index.html#openwebui-chat-input-field-usage](https://documentation.suse.com/suse-ai/1.0/html/openwebui-using/index.html#openwebui-chat-input-field-usage).

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Glossary

AI, artificial intelligence

Refers to the simulation of human intelligence in machines that are designed to learn and solve problems like humans. Enables computers to understand language, make decisions and improve from experience.

Air gap

A security measure where a computer network is physically isolated from unsecured networks, including the public Internet.

Batch size

The number of samples processed simultaneously during model inference, affecting processing speed and resource utilization.

BYOC, bring your own certificate

A practice allowing users to provide their own SSL/TLS certificates for securing communications instead of using default or auto-generated ones.

CA, certification authority

An entity that issues digital certificates to verify the identity of certificate holders and ensure secure communications.

Chain-of-thought (CoT) prompting

A prompting technique that guides AI models to break down complex problems into step-by-step reasoning processes, improving response accuracy and transparency.

Chat template

A structured format for organizing conversations between users and AI models, defining how system prompts, user inputs, and AI responses are formatted and processed.

Context window

The maximum amount of text (tokens) that an AI model can process at once, including both the input prompt and generated response.

CRD, custom resource definitions

Extensions of the Kubernetes API that allow users to define custom resources and their controllers in a Kubernetes cluster.

CUDA, Compute Unified Device Architecture

NVIDIA's parallel computing platform and programming model used to accelerate AI workloads on GPU hardware.

Data leakage

The unintended exposure of sensitive information through AI model responses, potentially compromising data security and privacy.

Embeddings

Numerical representations of data (text, images, etc.) in a high-dimensional space that capture semantic relationships and enable AI models to process information effectively.

Fine-tuning

The process of further training a pre-trained AI model on specific data to adapt it for particular tasks or domains, improving its performance for targeted applications.

GenAI, generative AI

A type of artificial intelligence that can create new content such as text, images or music.

GPU, graphics processing unit

Specialized hardware designed for parallel processing. In AI applications, GPUs accelerate model training and inference tasks.

Hallucination

An AI behavior where the model generates false or unsupported information that appears plausible but has no basis in provided context or real facts.

Helm

A package manager for Kubernetes that helps install and manage applications. Helm uses charts to define, install and upgrade complex Kubernetes applications.

Helm chart

A package format for Kubernetes applications that contains all resource definitions needed to deploy and configure application workloads.

IaC, infrastructure as code

The practice of managing and provisioning infrastructure through machine-readable definition files rather than manual processes.

Inference

The process of using a trained AI model to make predictions or generate outputs based on new input data.

Kubernetes pods

The smallest deployable units in Kubernetes that can host one or more containers, sharing networking and storage resources.

LLM, large language model

An advanced AI model trained on amounts of text data to understand and generate human-like text. Can perform tasks like translation, summarization and answering questions.

Model weights

The learned parameters of an AI model that determine how it processes inputs and generates outputs. These weights are adjusted during training to optimize model performance.

NLG, natural language generation

A process of automatically generating human-like text from structured data or other forms of input. Designed to convert raw data into coherent and meaningful language easily understood by humans.

NLU, natural language understanding

A process AI uses to analyze and understand the meaning of the input query.

NVIDIA GPU driver

Software that enables communication between the operating system and NVIDIA graphics hardware, essential for GPU-accelerated AI workloads.

NVIDIA GPU Operator

A Kubernetes operator that automates the management of NVIDIA GPUs in container environments, handling driver deployment, runtime configuration, and monitoring.

Ollama

An open source framework for running and serving AI models locally. Ollama simplifies the process of downloading, running and managing large language models.

OpenGL

A cross-platform API for rendering 2D and 3D graphics, commonly used in visualization applications and GPU-accelerated computing.

Prompt Engineering

The practice of crafting effective input queries to AI models to obtain desired and accurate outputs. Good prompt engineering helps prevent hallucinations and improves response quality.

Prompt injection

A security vulnerability where malicious inputs attempt to override or bypass an AI model's system prompt or safety constraints.

Quantization

A technique to reduce AI model size and computational requirements by converting model parameters to lower precision formats while maintaining acceptable performance.

RAG, retrieval-augmented generation

A technique that enhances AI responses by retrieving relevant information from a knowledge base before generating answers, improving accuracy and reducing hallucinations.

RBAC, role-based access control

A security model that restricts system access based on roles assigned to users, managing permissions and authorization in Kubernetes clusters.

Semantic search

A search method using AI to understand the meaning and context of queries rather than just matching keywords, enabling more relevant results.

System prompt

Initial instructions given to an AI model that define its behavior, role and response parameters. System prompts help maintain consistent and appropriate AI responses.

Temperature

A parameter controlling the randomness in AI model outputs. Lower values produce more focused and deterministic responses, while higher values increase creativity and variability.

Token

The basic unit of text processing in AI models, representing parts of words, characters or symbols. Models process text by breaking it into tokens for analysis and generation.

Top-K

A parameter that limits token selection during text generation to the K most likely next tokens, helping control output quality and relevance.

Top-P

Also known as nucleus sampling, a parameter that selects from the smallest set of tokens whose cumulative probability exceeds P, providing dynamic control over text generation diversity.

Vector database

A specialized database designed to store and efficiently query high-dimensional vectors that represent data in AI applications, enabling similarity searches and semantic operations.


Vector store

A specialized storage system optimized for managing and querying vector embeddings, essential for semantic search and RAG implementations in AI applications.

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