SECURITY ANALYSIS REPORT

Security Analysis Report

Provider:

Client: {'name': 'Client Name', 'address': '456 Client Avenue, Suite 789, App City, 12345'}

Scan ID: b3c77df5-2a2a-4650-8478-7af018d92397

Date: 2026-02-05 05:53:22

Version: 1.0.0

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EXECUTIVE SUMMARY

Identified Vulnerabilities

ID	Title	CVSS	Page

METHODOLOGY

Introduction

Objective

Scope

Systems in Scope

No systems explicitly defined.

User Accounts

FINDINGS

C1 – Unsafe Hugging Face Hub Download

Severity: Critical

CVSS Score: 9.0

CVSS Vector: CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:C/C:H/I:H/A:H

Target: The application's model download process

Overview

The application uses the Hugging Face Hub to download models without specifying a particular revision, making it vulnerable to potential security risks if malicious models are uploaded to the hub.

Details

The issue arises from the use of `trust_remote_code=True` in `AutoTokenizer.from_pretrained()` and `AutoModelForCausalLM.from_pretrained()` without pinning the model version. This allows an attacker to potentially compromise the model if they can upload malicious models to the Hugging Face Hub.

Evidence

- **Vulnerable Code:** analysis_engine/analyzers/llm_analyzer.py:60-61

References

- https://huggingface.co/docs/hub/security

Recommendation

- Specify a particular model revision when downloading from the Hugging Face Hub to prevent the use of potentially malicious models. - Consider implementing additional security measures such as model validation after download.

M1 – Insecure Tempfile Usage

Severity: Medium

CVSS Score: 6.5

CVSS Vector: CVSS:3.1/AV:L/AC:H/PR:N/UI:N/S:C/C:H/I:H/A:N

Target: The application's tempfile creation

Overview

The application uses insecure tempfile creation practices, potentially leading to information disclosure or data tampering.

Details

The `tempfile.mktemp()` function is used without proper cleanup or security considerations, which can result in temporary files being accessible to unauthorized parties.

Evidence

- **Vulnerable Code:** analysis_engine/analyzers/regex_analyzer.py:212

References

- https://docs.python.org/3/library/tempfile.html#tempfile.mktemp

Recommendation

- Use secure tempfile creation practices such as the `tempfile` module with proper cleanup. - Ensure temporary files are handled securely and cleaned up properly after use.

M2 – Probable Insecure Usage of Temp File/Directory

Severity: Medium

CVSS Score: 6.0

CVSS Vector: CVSS:3.1/AV:L/AC:H/PR:N/UI:N/S:C/C:H/I:H/A:N

Target: The application's tempfile usage

Overview

The application might be using temporary files or directories in an insecure manner, possibly leading to information disclosure or data tampering.

Details

The use of `/tmp/` directly or functions like `tempfile.mktemp()` without proper security considerations can make temporary files accessible to unauthorized parties.

Evidence

- **Vulnerable Code:** analysis_engine/analyzers/regex_analyzer.py:212

References

- https://docs.python.org/3/library/tempfile.html#tempfile.gettempdir

Recommendation

- Validate and sanitize paths before using them for tempfile creation. - Implement secure handling and cleanup of temporary files and directories.

L1 – Possible Binding to All Interfaces

Severity: Low

CVSS Score: 3.5

CVSS Vector: CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:C/C:N/I:N/A:N

Target: The application's network binding

Overview

The application binds to all available network interfaces by default, which could pose a security risk if not intended.

Details

The `app.run(debug=False, host='0.0.0.0', port=port)` line indicates that the application is listening on all interfaces, which might not be the intended behavior and could increase the attack surface.

Evidence

- **Configured Host:** run.py:10

References

- https://docs.python.org/3/library/socket.html#socket.socket.bind

Recommendation

- Bind the application to a specific IP address or interface to minimize exposure. - Consider using a reverse proxy or other security measures to control access to the application.

L2 – Verbose Error Messages

Severity: Low

CVSS Score: 2.5

CVSS Vector: CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:C/C:N/I:N/A:N

Target: The application's error handling

Overview

The application returns verbose error messages to users, which might disclose sensitive information about the application's internal workings.

Details

Error messages contain detailed information about the exception, including the error message and possibly sensitive data, which could aid an attacker in exploiting vulnerabilities.

Evidence

- **Verbose Error Handling:** app/routes/main.py:75, 166, 195, 259

References

- https://owasp.org/www-community/controls/Error_Handling

Recommendation

- Implement generic error messages for users while logging detailed error information internally for debugging purposes. - Ensure that error messages do not reveal sensitive information about the application or its environment.

I1 – DNSSEC Not Enabled

Severity: Informational

CVSS Score: 0.0

CVSS Vector: N/A

Target: The application's DNS configuration

Overview

DNSSEC is not enabled for the application's domain, which could impact the security of DNS queries.

Details

The absence of DNSSEC means that DNS responses are not authenticated, making it possible for an attacker to manipulate DNS queries and responses.

Evidence

- **Lack of DNSSEC Configuration:** analysis_engine/analyzers/regex_analyzer.py:237

References

- https://dnssec.net/

Recommendation

- Consider enabling DNSSEC for the domain to enhance the security of DNS queries. - Evaluate the feasibility and benefits of implementing DNSSEC in the application's infrastructure.

ENDPOINT SECURITY ANALYSIS

This section provides a detailed security-oriented analysis of the identified API endpoints, including authentication

mechanisms, data handling characteristics, potential security risks, and regulatory compliance considerations.

Endpoint Path	/api/auth/google/login
HTTP Methods	GET
Source Location	: 23
Authentication Required	No
Risk Severity	Low
CVSS Score	0.0

Authentication Analysis

This endpoint does not enforce authentication, which may expose it to unauthorized access depending on its functionality and the sensitivity of data processed.

Request Analysis

Content Type: unknown

No request fields were identified for this endpoint.

Response Analysis

Content Type: unknown

Status Codes:

Contains Sensitive Data: No

Identified Security Risks

No direct security risks were identified for this endpoint.

Compliance Impact

Regulation	Applicable	Risk Level	Reason
GDPR	No	low	Endpoint is related to authentication and does not directly handle personal data processing.
CCPA/CPRA	No	low	Endpoint is related to authentication and does not directly handle personal data processing.
LGPD	No	low	Endpoint is related to authentication and does not directly handle personal data processing.
PIPEDA	No	low	Endpoint is related to authentication and does not directly handle personal data processing.

Security Assessment Notes

CVSS Vector: CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:U/C:N/I:N/A:N

References

Endpoint Path	/api/auth/google/callback
HTTP Methods	GET
Source Location	: 46
Authentication Required	No
Risk Severity	Low
CVSS Score	0.0

Authentication Analysis

This endpoint does not enforce authentication, which may expose it to unauthorized access depending on its functionality and the sensitivity of data processed.

Request Analysis

Content Type: unknown

No request fields were identified for this endpoint.

Response Analysis

Content Type: unknown

Status Codes:

Contains Sensitive Data: No

Identified Security Risks

No direct security risks were identified for this endpoint.

Compliance Impact

Regulation	Applicable	Risk Level	Reason
GDPR	No	low	Endpoint is related to authentication and does not directly handle personal data processing.
CCPA/CPRA	No	low	Endpoint is related to authentication and does not directly handle personal data processing.
LGPD	No	low	Endpoint is related to authentication and does not directly handle personal data processing.
PIPEDA	No	low	Endpoint is related to authentication and does not directly handle personal data processing.

Security Assessment Notes

CVSS Vector: CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:U/C:N/I:N/A:N

References

Endpoint Path	/api/auth/google/session
HTTP Methods	GET
Source Location	: 82
Authentication Required	No
Risk Severity	Low
CVSS Score	0.0

Authentication Analysis

This endpoint does not enforce authentication, which may expose it to unauthorized access depending on its functionality and the sensitivity of data processed.

Request Analysis

Content Type: unknown

No request fields were identified for this endpoint.

Response Analysis

Content Type: unknown

Status Codes:

Contains Sensitive Data: No

Identified Security Risks

No direct security risks were identified for this endpoint.

Compliance Impact

Regulation	Applicable	Risk Level	Reason
GDPR	No	low	Endpoint is related to authentication and does not directly handle personal data processing.
CCPA/CPRA	No	low	Endpoint is related to authentication and does not directly handle personal data processing.
LGPD	No	low	Endpoint is related to authentication and does not directly handle personal data processing.
PIPEDA	No	low	Endpoint is related to authentication and does not directly handle personal data processing.

Security Assessment Notes

CVSS Vector: CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:U/C:N/I:N/A:N

References

Endpoint Path	/api/change-plan
HTTP Methods	POST
Source Location	: 55
Authentication Required	Yes (unknown)
Risk Severity	High
CVSS Score	7.5

Authentication Analysis

This endpoint enforces authentication using a unknown-based mechanism. Authentication checks were detected at the following code locations: .

Request Analysis

Content Type: unknown

No request fields were identified for this endpoint.

Response Analysis

Content Type: unknown

Status Codes:

Contains Sensitive Data: No

Identified Security Risks

- **AUTH_MISSING** (high): Authentication is required for this endpoint but not detected.

  Potential Attack Scenario:

  An unauthenticated user could change their plan without authorization, leading to unauthorized access or resource manipulation.

Compliance Impact

Regulation	Applicable	Risk Level	Reason
GDPR	Yes	medium	Endpoint modifies user's plan, which could be linked to personal data. Lack of authentication increases risk of unauthorized access/modification.
CCPA/CPRA	Yes	medium	Endpoint modifies user's plan, which could be linked to personal data. Lack of authentication increases risk of unauthorized access/modification.
LGPD	Yes	medium	Endpoint modifies user's plan, which could be linked to personal data. Lack of authentication increases risk of unauthorized access/modification.
PIPEDA	Yes	medium	Endpoint modifies user's plan, which could be linked to personal data. Lack of authentication increases risk of unauthorized access/modification.

Security Assessment Notes

CVSS Vector: CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:U/C:N/I:H/A:N

References

- https://owasp.org/www-project-api-security/
- https://datatracker.ietf.org/doc/html/rfc6749

Endpoint Path	/api/auth/logout
HTTP Methods	POST
Source Location	: 79
Authentication Required	Yes (unknown)
Risk Severity	Medium
CVSS Score	5.3

Authentication Analysis

This endpoint enforces authentication using a unknown-based mechanism. Authentication checks were detected at the following code locations: .

Request Analysis

Content Type: unknown

No request fields were identified for this endpoint.

Response Analysis

Content Type: unknown

Status Codes:

Contains Sensitive Data: No

Identified Security Risks

- **AUTH_MISSING** (medium): Authentication is required for this endpoint but not detected.

  Potential Attack Scenario:

  An unauthenticated user could attempt to log out, which might reveal information about active sessions or disrupt legitimate user sessions if implemented insecurely.

Compliance Impact

Regulation	Applicable	Risk Level	Reason
GDPR	No	low	Logout endpoint, typically does not process sensitive personal data. However, secure session management is important.
CCPA/CPRA	No	low	Logout endpoint, typically does not process sensitive personal data.
LGPD	No	low	Logout endpoint, typically does not process sensitive personal data.
PIPEDA	No	low	Logout endpoint, typically does not process sensitive personal data.

Security Assessment Notes

CVSS Vector: CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:U/C:N/I:L/A:N

References

- https://owasp.org/www-project-api-security/

Endpoint Path	/api/get-plan
HTTP Methods	GET
Source Location	: 87
Authentication Required	No
Risk Severity	Low
CVSS Score	0.0

Authentication Analysis

This endpoint does not enforce authentication, which may expose it to unauthorized access depending on its functionality and the sensitivity of data processed.

Request Analysis

Content Type: unknown

No request fields were identified for this endpoint.

Response Analysis

Content Type: unknown

Status Codes:

Contains Sensitive Data: No

Identified Security Risks

No direct security risks were identified for this endpoint.

Compliance Impact

Regulation	Applicable	Risk Level	Reason
GDPR	Yes	low	Endpoint retrieves user's plan information, which could be considered personal data. Ensure proper authorization checks if sensitive details are exposed.
CCPA/CPRA	Yes	low	Endpoint retrieves user's plan information, which could be considered personal data. Ensure proper authorization checks if sensitive details are exposed.
LGPD	Yes	low	Endpoint retrieves user's plan information, which could be considered personal data. Ensure proper authorization checks if sensitive details are exposed.
PIPEDA	Yes	low	Endpoint retrieves user's plan information, which could be considered personal data. Ensure proper authorization checks if sensitive details are exposed.

Security Assessment Notes

CVSS Vector: CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:U/C:N/I:N/A:N

References

Endpoint Path	/api/analyze
HTTP Methods	POST
Source Location	: 98
Authentication Required	Yes (unknown)
Risk Severity	High
CVSS Score	7.5

Authentication Analysis

This endpoint enforces authentication using a unknown-based mechanism. Authentication checks were detected at the following code locations: 97, 98, 97.

Request Analysis

Content Type: unknown

No request fields were identified for this endpoint.

Response Analysis

Content Type: unknown

Status Codes:

Contains Sensitive Data: No

Identified Security Risks

- **AUTH_MISSING** (high): Authentication is required for this endpoint but not detected.

  Potential Attack Scenario:

  An unauthenticated user could trigger repository analysis, potentially leading to excessive resource consumption or unauthorized access to repository data if the analysis involves sensitive information.

Compliance Impact

Regulation	Applicable	Risk Level	Reason
GDPR	Yes	medium	Analyzing repositories can involve processing of potentially sensitive data. Lack of authentication can lead to unauthorized access or data exposure.
CCPA/CPRA	Yes	medium	Analyzing repositories can involve processing of potentially sensitive data. Lack of authentication can lead to unauthorized access or data exposure.
LGPD	Yes	medium	Analyzing repositories can involve processing of potentially sensitive data. Lack of authentication can lead to unauthorized access or data exposure.
PIPEDA	Yes	medium	Analyzing repositories can involve processing of potentially sensitive data. Lack of authentication can lead to unauthorized access or data exposure.

Security Assessment Notes

CVSS Vector: CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:U/C:N/I:H/A:N

References

- https://owasp.org/www-project-api-security/
- https://github.com/OWASP/API-Security-Top-10#broken-object-level-authorization

Endpoint Path	/api/generate-report
HTTP Methods	POST
Source Location	: 176
Authentication Required	Yes (unknown)
Risk Severity	High
CVSS Score	7.5

Authentication Analysis

This endpoint enforces authentication using a unknown-based mechanism. Authentication checks were detected at the following code locations: 175, 176, 175.

Request Analysis

Content Type: unknown

No request fields were identified for this endpoint.

Response Analysis

Content Type: unknown

Status Codes:

Contains Sensitive Data: No

Identified Security Risks

- **AUTH_MISSING** (high): Authentication is required for this endpoint but not detected.

  Potential Attack Scenario:

  An unauthenticated user could generate reports, potentially consuming excessive resources or accessing sensitive information that should be restricted.

Compliance Impact

Regulation	Applicable	Risk Level	Reason
GDPR	Yes	medium	Generating reports may involve sensitive personal data. Lack of authentication could lead to unauthorized access or disclosure.
CCPA/CPRA	Yes	medium	Generating reports may involve sensitive personal data. Lack of authentication could lead to unauthorized access or disclosure.
LGPD	Yes	medium	Generating reports may involve sensitive personal data. Lack of authentication could lead to unauthorized access or disclosure.
PIPEDA	Yes	medium	Generating reports may involve sensitive personal data. Lack of authentication could lead to unauthorized access or disclosure.

Security Assessment Notes

CVSS Vector: CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:U/C:N/I:H/A:N

References

- https://owasp.org/www-project-api-security/
- https://github.com/OWASP/API-Security-Top-10#broken-object-level-authorization

Endpoint Path	/api/auth/me
HTTP Methods	GET
Source Location	: 200
Authentication Required	No
Risk Severity	Medium
CVSS Score	5.3

Authentication Analysis

This endpoint does not enforce authentication, which may expose it to unauthorized access depending on its functionality and the sensitivity of data processed.

Request Analysis

Content Type: unknown

No request fields were identified for this endpoint.

Response Analysis

Content Type: unknown

Status Codes:

Contains Sensitive Data: No

Identified Security Risks

No direct security risks were identified for this endpoint.

Compliance Impact

Regulation	Applicable	Risk Level	Reason
GDPR	Yes	medium	Endpoint retrieves user profile information, which is sensitive personal data. Lack of explicit authentication and authorization checks could lead to data exposure.
CCPA/CPRA	Yes	medium	Endpoint retrieves user profile information, which is sensitive personal data. Lack of explicit authentication and authorization checks could lead to data exposure.
LGPD	Yes	medium	Endpoint retrieves user profile information, which is sensitive personal data. Lack of explicit authentication and authorization checks could lead to data exposure.
PIPEDA	Yes	medium	Endpoint retrieves user profile information, which is sensitive personal data. Lack of explicit authentication and authorization checks could lead to data exposure.

Security Assessment Notes

CVSS Vector: CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:U/C:L/I:N/A:N

References

- https://owasp.org/www-project-api-security/knowledge-base/broken-authentication/
- https://owasp.org/www-project-api-security/knowledge-base/broken-object-level-authorization/

Endpoint Path	/healthz
HTTP Methods	GET
Source Location	: 264
Authentication Required	No
Risk Severity	Low
CVSS Score	0.0

Authentication Analysis

This endpoint does not enforce authentication, which may expose it to unauthorized access depending on its functionality and the sensitivity of data processed.

Request Analysis

Content Type: unknown

No request fields were identified for this endpoint.

Response Analysis

Content Type: unknown

Status Codes:

Contains Sensitive Data: No

Identified Security Risks

No direct security risks were identified for this endpoint.

Compliance Impact

Regulation	Applicable	Risk Level	Reason
GDPR	No	low	Health check endpoint, typically does not process personal data.
CCPA/CPRA	No	low	Health check endpoint, typically does not process personal data.
LGPD	No	low	Health check endpoint, typically does not process personal data.
PIPEDA	No	low	Health check endpoint, typically does not process personal data.

Security Assessment Notes

CVSS Vector: CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:U/C:N/I:N/A:N

References

Endpoint Path	/api/models
HTTP Methods	GET
Source Location	: 271
Authentication Required	No
Risk Severity	Low
CVSS Score	0.0

Authentication Analysis

This endpoint does not enforce authentication, which may expose it to unauthorized access depending on its functionality and the sensitivity of data processed.

Request Analysis

Content Type: unknown

No request fields were identified for this endpoint.

Response Analysis

Content Type: unknown

Status Codes:

Contains Sensitive Data: No

Identified Security Risks

No direct security risks were identified for this endpoint.

Compliance Impact

Regulation	Applicable	Risk Level	Reason
GDPR	No	low	Endpoint lists available models, which typically does not involve personal data.
CCPA/CPRA	No	low	Endpoint lists available models, which typically does not involve personal data.
LGPD	No	low	Endpoint lists available models, which typically does not involve personal data.
PIPEDA	No	low	Endpoint lists available models, which typically does not involve personal data.

Security Assessment Notes

CVSS Vector: CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:U/C:N/I:N/A:N

References

METRICS SUMMARY

Total Findings: 5

Severity	Count

DISCLAIMER

This report is generated by an automated security analysis tool.

BUSINESS RISK ADVICE

Based on a comprehensive security analysis, here are the prioritized recommendations to enhance the security posture and mitigate identified risks.

Pin Hugging Face Model Versions for Secure Downloads (Priority: Immediate)

Description: The application uses `trust_remote_code=True` when downloading models from Hugging Face Hub without pinning a specific model revision. This introduces a critical vulnerability where an attacker could upload a malicious model version and compromise the system.

Why it Matters: Critical Remote Code Execution (RCE) risk. This allows for unauthorized code execution, complete data compromise, or full system takeover via supply chain attack.

Recommended Actions:

- Specify exact model revisions (e.g., commit hash) for all `from_pretrained()` calls from Hugging Face Hub.
- Thoroughly review and, if possible, remove or disable `trust_remote_code=True`. If necessary, implement strict sandboxing and validation for any executed remote code.
- Implement checksum or cryptographic signature validation for all downloaded models to ensure integrity and authenticity.

Expected Outcome: Elimination of a critical RCE vulnerability, prevention of supply chain attacks through malicious model versions, and enhanced system integrity.

Enforce Robust Authentication & Authorization for Critical APIs (Priority: Immediate)

Description: Several high-risk API endpoints (`/api/change-plan`, `/api/analyze`, `/api/generate-report`) either lack effective authentication or have insufficient authorization, allowing unauthenticated or unauthorized users to perform sensitive actions.

Why it Matters: High risk of unauthorized data modification, resource exhaustion, sensitive data exposure, and potential abuse of core system functionality, directly violating data privacy regulations like GDPR and CCPA.

Recommended Actions:

- Implement and rigorously enforce a robust authentication mechanism (e.g., JWT, OAuth 2.0 with proper scope validation) across all identified sensitive endpoints.
- Verify that `login_required` or similar decorators are correctly applied and function as intended for `/api/change-plan`, `/api/analyze`, and `/api/generate-report`.
- Establish fine-grained authorization checks (e.g., role-based access control) to ensure only appropriately authorized users can perform specific actions on these endpoints.
- Conduct penetration testing specifically targeting these authentication and authorization mechanisms.

Expected Outcome: Prevention of unauthorized access and manipulation of critical application functionalities, significantly reducing data breach, integrity, and compliance risks.

Refactor Insecure Temporary File and Directory Usage (Priority: Short-Term)

Description: The application utilizes `tempfile.mktemp()` and possibly direct `/tmp/` access, which leads to predictable file names and insecure permissions, making temporary files vulnerable to attack.

Why it Matters: Medium risk of information disclosure, data tampering, or privilege escalation. An attacker could predict file paths, read sensitive temporary data, or inject malicious content.

Recommended Actions:

- Replace `tempfile.mktemp()` with `tempfile.mkstemp()` for secure file creation and `tempfile.mkdtemp()` for secure directory creation, as these functions return unique, unpredictable paths.
- Ensure all temporary files and directories are created with the most restrictive possible permissions (e.g., `0o600` or `0o700`).
- Implement explicit and timely cleanup of all temporary resources immediately after their intended use to minimize exposure windows.
- Avoid hardcoding paths to `/tmp/` and always use system-provided secure temporary directory functions.

Expected Outcome: Elimination of temporary file vulnerabilities, preventing unauthorized access and manipulation of transient data, and improving system integrity.

Strengthen Authentication for Logout and User Profile Endpoints (Priority: Short-Term)

Description: The `/api/auth/logout` and `/api/auth/me` endpoints have detected authentication issues (either missing or ineffective) that could lead to session manipulation or unauthorized access to user profile data.

Why it Matters: Medium risk of session fixation, session hijacking, or unauthorized exposure of user personal data. This impacts user privacy, leads to potential account takeovers, and raises compliance concerns under GDPR and CCPA.

Recommended Actions:

- Explicitly enforce authentication (e.g., `login_required` or equivalent) for both `/api/auth/logout` and `/api/auth/me` endpoints.
- Ensure the `logout` endpoint securely invalidates the current user's session token and related server-side session data, preventing replay attacks.
- Implement robust session management practices including using secure, HttpOnly, and SameSite attributes for session cookies or tokens.
- Verify that the `/api/auth/me` endpoint returns data only pertinent to the authenticated user, preventing information leakage to other authenticated but unauthorized users.

Expected Outcome: Enhanced protection of user sessions and personal profile data, significantly reducing the risk of account takeover and privacy violations.

Restrict Application Network Binding to Specific Interfaces (Priority: Short-Term)

Description: The application binds to all available network interfaces (`0.0.0.0`) by default. This broad configuration unnecessarily exposes the application to external networks, increasing its attack surface.

Why it Matters: Low, but easily preventable risk. Increases the discoverability and accessibility of the application, potentially exposing it to unintended external access or scans.

Recommended Actions:

- Configure the application to bind to a specific internal IP address (e.g., `127.0.0.1` for local-only, or a specific private network IP) if it is not meant for public internet access.
- Deploy the application behind a properly configured reverse proxy (e.g., Nginx, Apache, API Gateway) to manage external access and provide an additional layer of security.
- Implement strict firewall rules at the host and network level to restrict inbound access to only necessary ports and interfaces for authorized sources.

Expected Outcome: Reduced network attack surface, limiting the application's external exposure and enhancing perimeter security.

Suppress Verbose Error Messages for Production Environments (Priority: Short-Term)

Description: The application returns verbose error messages to end-users, which often contain detailed internal information about the exception, file paths, or system configuration.

Why it Matters: Low risk, but provides valuable information for attackers. Detailed error messages can aid an attacker in reconnaissance, helping them to map the system, understand its architecture, and potentially identify further vulnerabilities.

Recommended Actions:

- Configure the application to display only generic, user-friendly error messages (e.g., 'An unexpected error occurred. Please try again later.') for all unhandled exceptions in production.
- Ensure that detailed error logs are exclusively written to internal, secured logging systems and never returned directly to the client.
- Verify that debug mode is disabled (`debug=False`) in all production and staging environments.

Expected Outcome: Prevention of sensitive information disclosure through error messages, hindering attacker reconnaissance and making exploitation more difficult.

Formalize Data Privacy Compliance Controls for API Endpoints (Priority: Mid-Term)

Description: Multiple API endpoints (`/api/change-plan`, `/api/analyze`, `/api/generate-report`, `/api/auth/me`, `/api/get-plan`) are identified as handling potentially sensitive user data with medium compliance risk, especially regarding GDPR, CCPA/CPRA, LGPD, and PIPEDA.

Why it Matters: Non-compliance with global data privacy regulations can lead to severe legal penalties (fines), significant reputational damage, and erosion of user trust.

Recommended Actions:

- Conduct a comprehensive data mapping and inventory exercise to precisely identify all types of personal data processed, stored, and transmitted by each flagged endpoint.
- Implement and verify appropriate access controls, data minimization techniques, and encryption-at-rest and in-transit for all personal data handled by these endpoints.
- Ensure the application supports and facilitates data subject rights (e.g., access, rectification, erasure) for data processed via these APIs.
- Review and update privacy policies and terms of service to accurately reflect data processing activities and ensure transparency with users.
- Integrate privacy-by-design principles into the development lifecycle for any new features or data handling processes.

Expected Outcome: Achieved compliance with relevant data privacy regulations, reduced legal and financial risks, and enhanced protection of user privacy.

Enable DNSSEC for Application Domains (Priority: Mid-Term)

Description: DNSSEC (Domain Name System Security Extensions) is not enabled for the application's domain, leaving DNS queries vulnerable to various attacks.

Why it Matters: Informational risk, but a foundational security measure. Lack of DNSSEC can lead to DNS spoofing, cache poisoning, and redirection of users to malicious websites, undermining user trust and application availability.

Recommended Actions:

- Consult with the domain registrar and DNS hosting provider to enable DNSSEC for all domains associated with the application.
- Ensure that DNS records (e.g., DS records) are correctly configured and published according to DNSSEC requirements.
- Monitor DNSSEC validation status and record integrity regularly after implementation.

Expected Outcome: Enhanced integrity and authenticity of DNS queries, protecting users from DNS-based attacks and improving overall domain trustworthiness.

Establish a Secure Software Development Lifecycle (SSDLC) (Priority: Long-Term)

Description: The presence of various vulnerabilities across different severities indicates a need for a more proactive and integrated approach to security throughout the software development process.

Why it Matters: Systemic reduction of vulnerabilities and technical debt. Embedding security early in the SDLC prevents costly fixes in later stages, reduces emergency patching, and fosters a security-aware development culture.

Recommended Actions:

- Implement mandatory security training for all developers, focusing on OWASP Top 10, secure coding practices for the used frameworks (Flask/FastAPI), and common vulnerability patterns.
- Integrate threat modeling exercises into the design phase for all new features and significant architectural changes.
- Automate security testing by incorporating Static Application Security Testing (SAST), Dynamic Application Security Testing (DAST), and Software Composition Analysis (SCA) into the CI/CD pipelines.
- Mandate security-focused code reviews as part of the pull request process, ensuring security defects are identified and remediated before deployment.
- Establish clear security requirements and acceptance criteria for all new development.

Expected Outcome: Significant reduction in the number and severity of new vulnerabilities introduced, increased developer security awareness, and a more robust, resilient application security posture over time.