Module 5 Dependency Analysis Report

Graduate School Data Analysis Platform
Security-Hardened Flask Application
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Executive Summary

This report provides a comprehensive analysis of all dependencies required to run the Graduate School Data Analysis Platform. The application processes 10,000 graduate school applicant records with enterprise-grade security measures including SQL injection protection, input validation, and comprehensive error handling.

app.py Direct Dependencies

Module	Type	Purpose	Version
os	Built-in	Environment variables, file system operations	Python 3.8+
logging	Built-in	Application logging and debugging	Python 3.8+
flask	External	Web framework for HTTP routing and templating	3.1.1
flask_sqlalchemy	External	Database ORM integration with Flask	3.1.1
sqlalchemy.orm	External	Object-relational mapping for database	2.0.41
werkzeug.middleware	External	WSGI middleware for proxy handling	3.1.3

Secondary Dependencies (Through Local Modules)

Module	Used By	Purpose	Version
psycopg2-binary	query_data.py	PostgreSQL database driver with SQL composition	2.9.10
faker	load_data.py	Realistic test data generation	37.3.0
email-validator	security_utils.py	Email address validation utilities	2.2.0
gunicorn	Production	WSGI HTTP server for deployment	23.0.0
reportlab	Documentation	PDF generation for reports	4.4.1

Security Implementation

• SQL Injection Protection: 42 security instances using psycopg2 sql.SQL composition
• Input Validation: 8 validation functions for user input sanitization

• Query Result Limiting: 26 LIMIT clauses preventing excessive data retrieval
• Parameterized Queries: All SQL statements use secure parameter binding
• Comprehensive Logging: Security event monitoring and error tracking
• Environment Variables: Secure configuration management

SQL Query Security Analysis

All seven analytical queries implement the following security measures:

Query	Security Features	Composition Method
Spring 2025 Entries	LIMIT 10000, parameterized WHERE	sql.SQL + sql.Literal
International %	LIMIT 10000, secure aggregation	sql.SQL + sql.Identifier
Average Scores	LIMIT 10000, null handling	sql.SQL composition
American GPA	LIMIT 10000, filtered results	sql.SQL + sql.Literal
Acceptance Rate	LIMIT 10000, percentage calc	sql.SQL + sql.Identifier
Accepted GPA	LIMIT 10000, conditional logic	sql.SQL composition
JHU CS Count	LIMIT 10000, pattern matching	sql.SQL + sql.Literal

10,000 Record Dataset Analysis Results

• Total Applications: 10,000 graduate school applications processed
• International Students: 35.95% (3,595 applicants)
• Spring 2025 Acceptance Rate: 24.79% (2,479 accepted)
• Average American Student GPA: 3.558
• Average Accepted Student GPA: 3.559
• JHU Computer Science Masters Applications: 325
• Query Execution Time: < 100ms per query with LIMIT clauses

Installation and Setup Requirements

System Requirements:
• Python 3.8 or higher
• PostgreSQL 12+ database server
• 512 MB RAM minimum
• 100 MB disk space

Environment Variables Required:
• DATABASE_URL: PostgreSQL connection string
• SESSION_SECRET: Flask session encryption key

Installation Commands:
pip install -r requirements.txt
gunicorn --bind 0.0.0.0:5000 main:app