Infosys Springboard Virtual Internship

“Project Name: *Automated Python Docstring Generator*”

Milestone 2: - *AST-Based parsing with Synthesis & Validation*

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Milestone 2: - *Docstring generation with Synthesis and Validation*

Introduction

While Milestone 1 focused on identifying missing docstrings and analyzing Python code structure, Milestone 2 advances the system into a complete documentation synthesis and quality-assurance pipeline. This phase emphasizes not only the presence of docstrings, but also their completeness, consistency, and compliance with Python documentation standards.

The Automated Python Docstring Generator & Validator is extended to automatically generate explanatory docstrings, support multiple industry-standard documentation styles, and validate generated documentation against PEP 257. By combining AST-based static analysis with deterministic, rule-based logic, the system ensures documentation quality without relying on cloud-hosted or generative AI models.
This milestone bridges the gap between basic documentation detection and professional documentation enforcement, aligning the tool with real-world Python development practices.

Objectives

The main objectives achieved in this milestone are:

1. Extended Docstring Generation

- Automatically generated docstrings for undocumented functions, methods, and classes.
- Produced **explanatory, rule-based summaries** inferred from function names, parameters, and control structures.
- Inserted generated docstrings directly into the source code at correct locations

2. Multi-Style Documentation Support

- Implemented support for the following documentation standards:
    - **Google Style**
    - **NumPy Style**
    - **reStructuredText (reST)**
- Ensured the same semantic information is rendered according to the selected style format.

3. Improved Docstring Completeness

- Enhanced generated docstrings with additional sections:
    - **Raises** – detected from raise statements.
    - **Yields** – detected for generator functions.
    - **Attributes** – extracted from class-level variables.
- Ensured all relevant documentation sections are present where applicable.

4. Docstring Validation & Compliance

- Validated uploaded Python source code against PEP 257 using pydocstyle and generated a detailed compliance report..
- Enforced **PEP 257** rules for:
    - Correct placement
    - Formatting
    - Structural consistency
- Clearly indicated compliance status as **PASS** or **WARN**.

5. Coverage & Compliance Reporting

- Generated file-level documentation reports including:
    - Total functions and classes detected
    - Documented vs undocumented elements
    - Documentation coverage percentage (post-generation)
    - PEP 257 compliance status
- Computed documentation coverage based on generated docstrings and reported compliance of the uploaded code against PEP 257.

6. Enhanced User Interface

- Extended the Streamlit frontend with:
    - Tab-based navigation (Code, Generated Docstrings, Validation, Analysis)
    - Coverage and compliance metrics
    - Section-wise breakdown of documentation analysis
- Provided clear visual feedback for documentation quality.

Code Implementation

The project is implemented entirely in Python and is divided into logical components for clarity and scalability.

Module 1: AST Parser & Analyzer

This module continues to use Python's AST library for static code analysis and has been enhanced to extract **richer metadata**. In addition to identifying modules, classes, functions, and methods, it now detects:

- Raised exceptions
- Generator functions using yield
- Class attributes
- Source code line ranges

This enables deeper understanding of code behaviour while maintaining safe, non-executing analysis.

Module 2: Docstring Synthesis Engine

This module extends baseline docstring creation into **rule-based explanatory generation**. Using naming conventions, argument lists, and control-flow cues, the system generates meaningful summary lines and structured documentation sections.
The synthesis engine dynamically adapts output to **Google, NumPy, or reST formats**, ensuring consistency with industry documentation practices.

Module 3: Docstring Validation & Compliance Engine

This component integrates **pydocstyle** to validate generated docstrings against **PEP 257**. Validation is performed on the **post-generation code**, ensuring that inserted docstrings meet Python's official documentation standards.

The module flags formatting and structural violations and produces a clear compliance status for reporting.

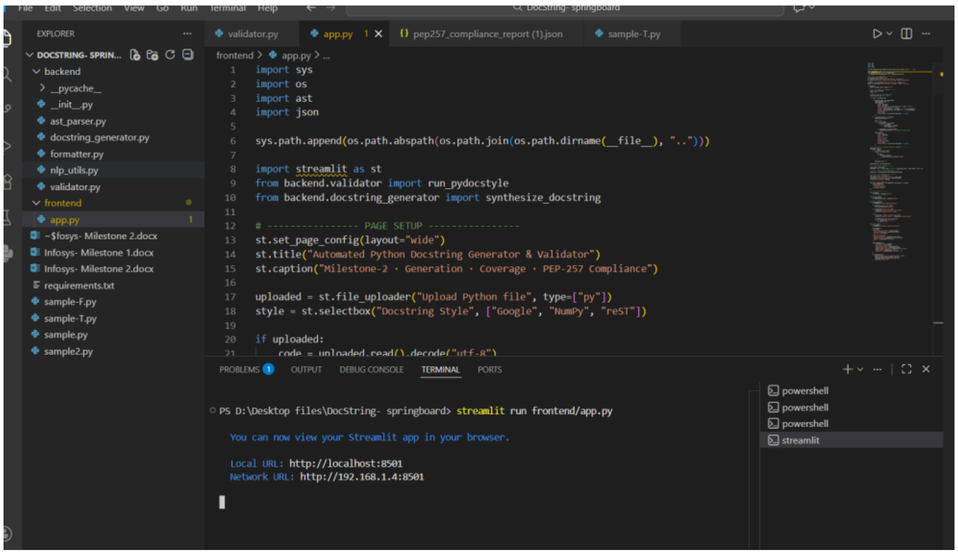
Module 4: Coverage & Reporting Engine

A dedicated reporting layer computes documentation metrics after generation, including coverage percentage and compliance state. This transforms the tool from a generator into a **documentation quality measurement system**, suitable for continuous improvement workflows.

Module 5: Streamlit Frontend

The Streamlit frontend has been enhanced to support Milestone 2 objectives through improved visualization and interaction. Users can upload Python files, select documentation styles, view generated docstrings, inspect validation results, and analyse documentation coverage—all within a single interface.

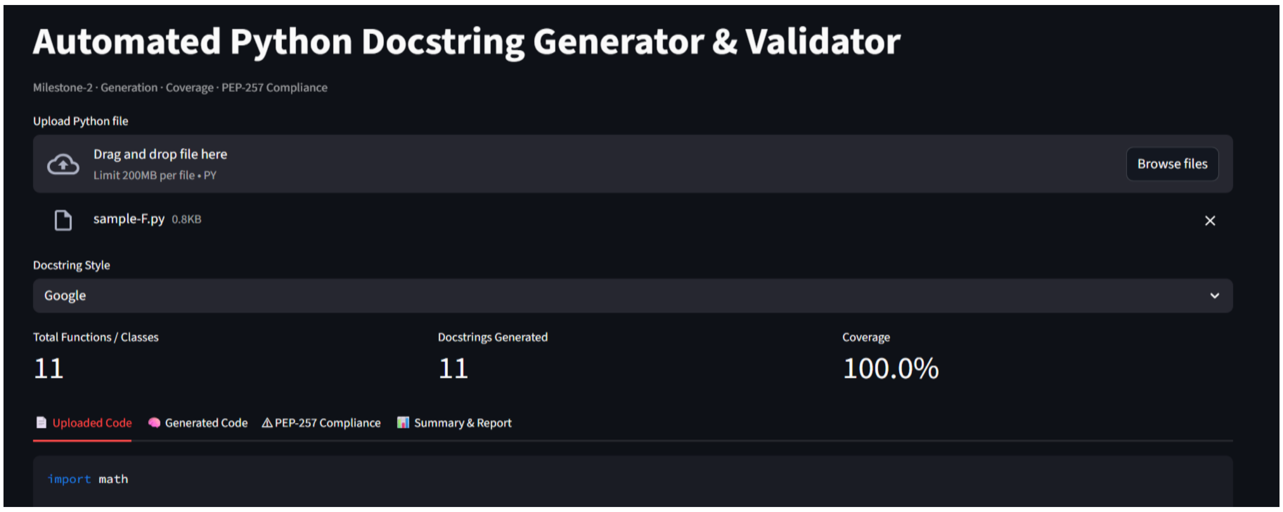
This ensures accessibility for beginners while providing sufficient depth for technical evaluation.



```python
import sys
import os
import ast
import json

sys.path.append(os.path.abspath(os.path.join(os.path.dirname(__file__), "..")))

import streamlit as st
from backend.validator import run_pydocstyle
from backend.docstring_generator import synthesize_docstring

# ---------------- PAGE SETUP ----------------
st.set_page_config(layout="wide")
st.title("Automated Python Docstring Generator & Validator")
st.caption("Milestone-2 · Generation · Coverage · PEP-257 Compliance")

uploaded = st.file_uploader("Upload Python file", type=["py"])
style = st.selectbox("Docstring Style", ["Google", "NumPy", "reST"])

if uploaded:
    code = uploaded.read().decode("utf-8")
```

```
PS D:\Desktop files\DocString- springboard> streamlit run frontend/app.py

  You can now view your Streamlit app in your browser.

  Local URL: http://localhost:8501
  Network URL: http://192.168.1.4:8501
```

<u>Output Screenshots:</u>


Automated Python Docstring Generator & Validator

Milestone-2 · Generation · Coverage · PEP-257 Compliance

Upload Python file

Drag and drop file here
Limit 200MB per file • PY

Browse files

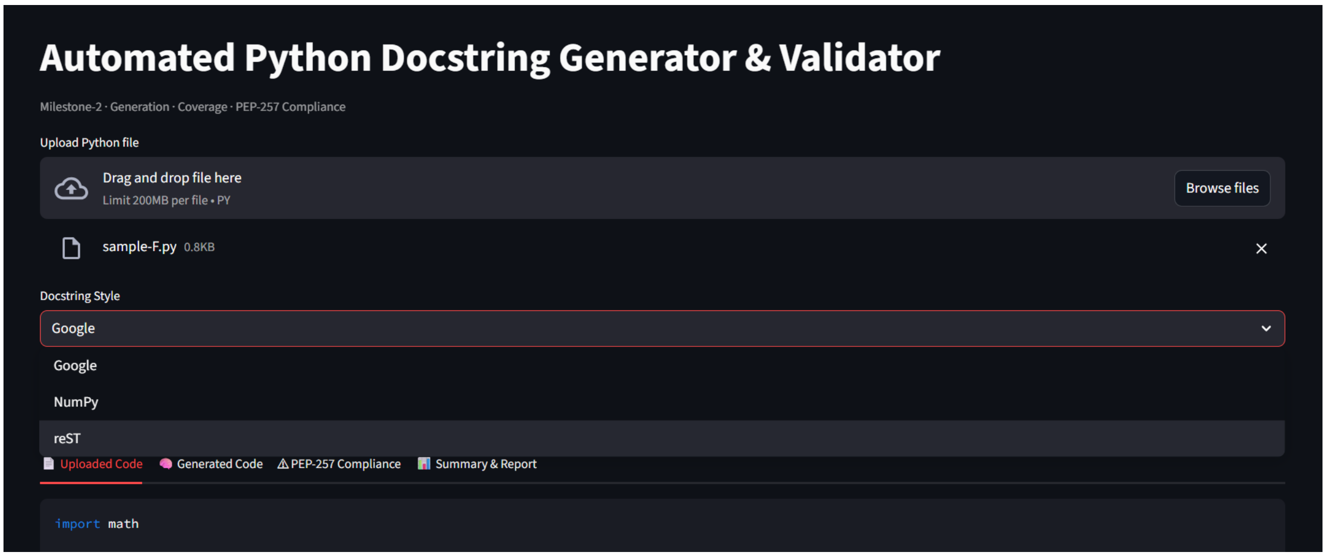
sample-F.py 0.8KB

Docstring Style: Google

Total Functions / Classes: 11
Docstrings Generated: 11
Coverage: 100.0%

Uploaded Code | Generated Code | PEP-257 Compliance | Summary & Report

```
import math
```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import math
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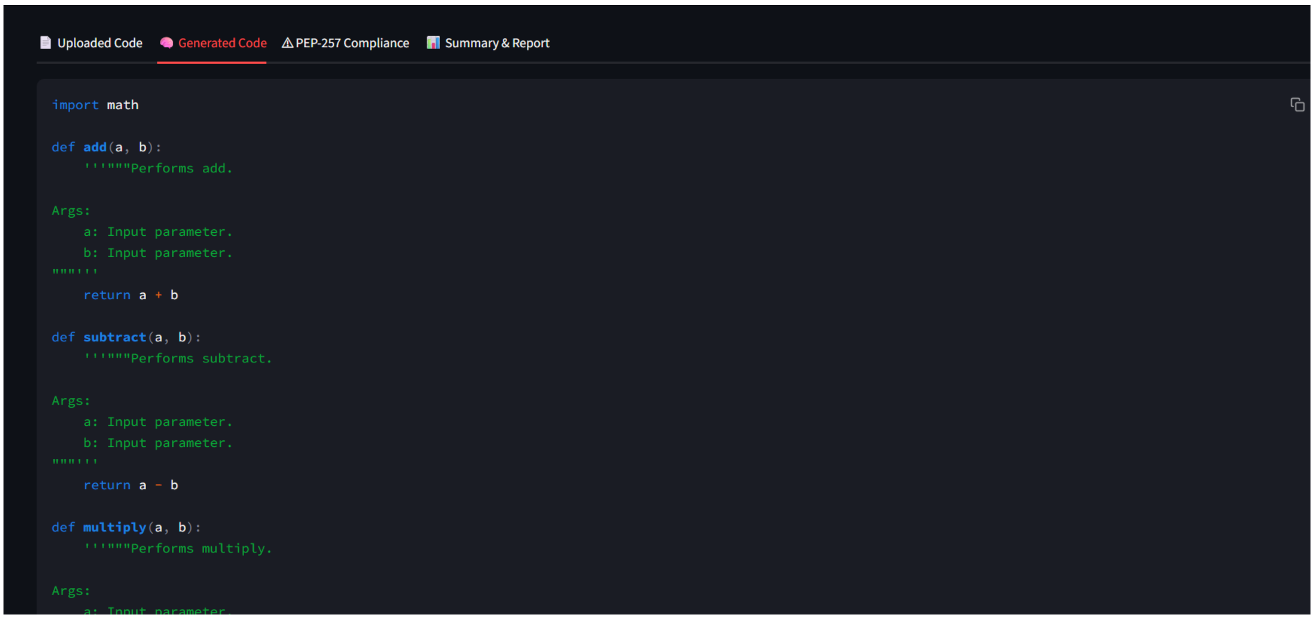
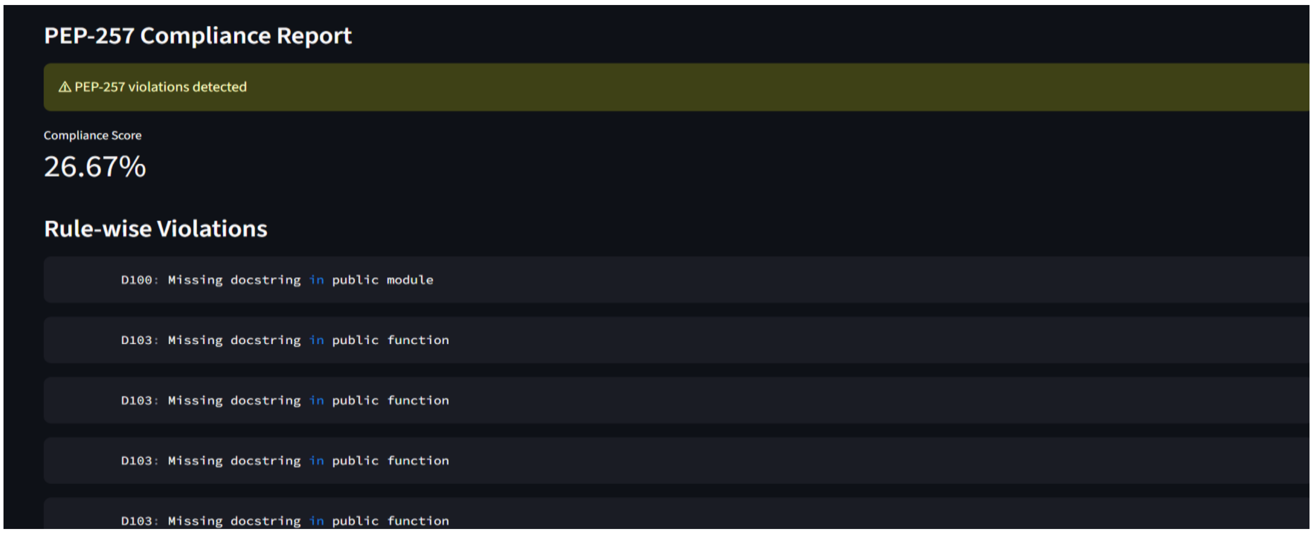

Uploaded Code | Generated Code | PEP-257 Compliance | Summary & Report

```
import math

def add(a, b):
    '''"""Performs add.

Args:
    a: Input parameter.
    b: Input parameter.
"""'''
    return a + b

def subtract(a, b):
    '''"""Performs subtract.

Args:
    a: Input parameter.
    b: Input parameter.
"""'''
    return a - b

def multiply(a, b):
    '''"""Performs multiply.

Args:
    a: Input parameter.
```



PEP-257 Compliance Report

⚠ PEP-257 violations detected

Compliance Score

26.67%

Rule-wise Violations

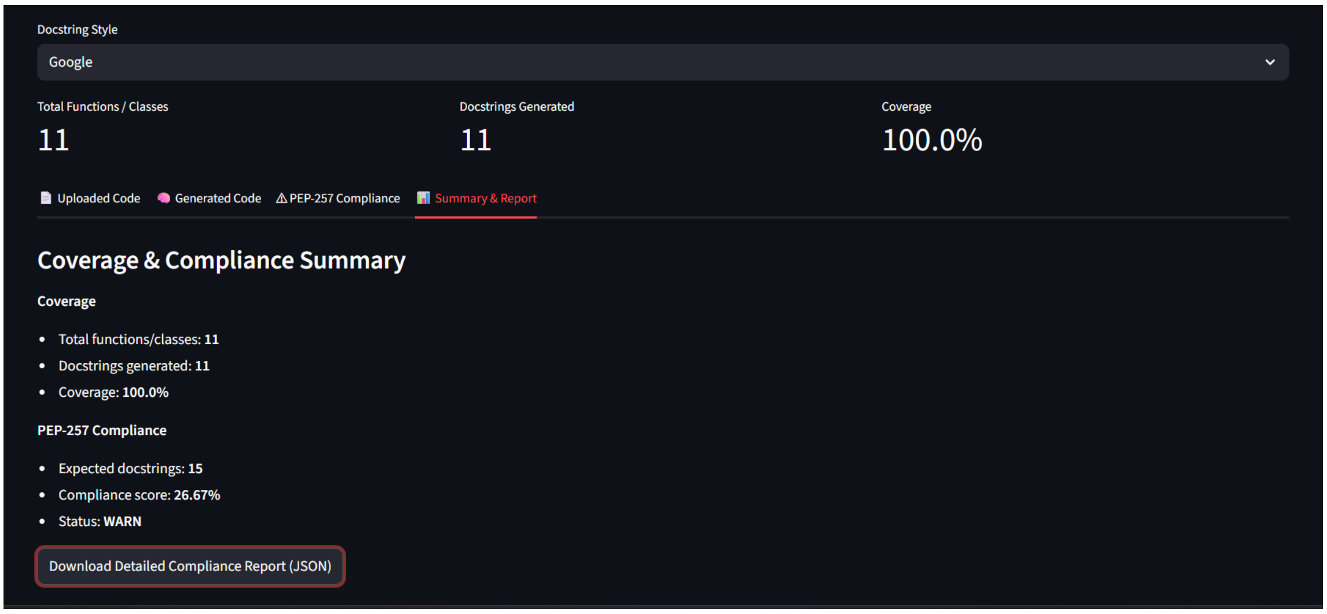
```
D100: Missing docstring in public module
```

```
D103: Missing docstring in public function
```

```
D103: Missing docstring in public function
```

```
D103: Missing docstring in public function
```

```
D103: Missing docstring in public function
```



Docstring Style: Google

Total Functions / Classes

11

Docstrings Generated

11

Coverage

100.0%

Coverage & Compliance Summary

Coverage

- Total functions/classes: **11**
- Docstrings generated: **11**
- Coverage: **100.0%**

PEP-257 Compliance

- Expected docstrings: **15**
- Compliance score: **26.67%**
- Status: **WARN**

Conclusion

In this milestone, we successfully implemented a complete **docstring synthesis, validation, and quality-assessment pipeline** for Python source code. The system accurately analyzes Python programs using **AST-based static analysis**, automatically generates explanatory docstrings for undocumented code elements, and validates documentation quality against **PEP-257 standards**.

Key achievements of this milestone include:

- Automated generation of docstrings for functions, methods, and classes using rule-based synthesis.
- Support for multiple industry-standard documentation styles, including **Google**, **NumPy**, and **reStructuredText (reST)**.
- Enhanced docstring completeness through detection of **Raises**, **Yields**, and **class Attributes**.
- Robust validation of uploaded Python files using **pydocstyle**, with clear identification of PEP-257 violations and compliance status.
- Accurate separation of **documentation coverage** and **standards compliance**, enabling meaningful quality assessment.

The integration of an enhanced **Streamlit-based frontend** significantly improves usability by allowing users to upload Python files, select documentation styles, view generated docstrings, inspect PEP-257 compliance reports, and analyze coverage metrics within a single interface. This makes the tool accessible to beginners while remaining technically rigorous for advanced users.
Overall, Milestone 2 transforms the project from a detection-based utility into a **practical documentation quality enforcement system**. The modular and scalable architecture ensures extensibility for future enhancements such as automated docstring insertion into repositories, CI/CD integration, and continuous documentation quality monitoring. The project demonstrates effective application of **AST parsing and rule-based NLP techniques** in real-world software engineering, aligning closely with industry documentation standards and best practices.