# SmartSDLC: AI-Enhanced Software Development Lifecycle

***Project Documentation***

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## 1. Introduction

SmartSDLC is an AI-powered software application designed to automate critical phases of the Software Development Lifecycle (SDLC).
Built using Python and Streamlit, and integrated with IBM Watsonx's Granite 3.3 Instruct model, it transforms textual requirements into code, test cases, summaries, and even fixes bugs through natural language interaction.

## 2. Project Overview

The purpose of SmartSDLC is to minimize human effort in software planning, development, and quality assurance by offering AI-driven support at every major SDLC stage.

Key Features:

- ¡ Requirement Upload & Classification
- AI Code Generator
- 🐞 Bug Fixer
- 🐞 Test Case Generator
- Code Summarizer

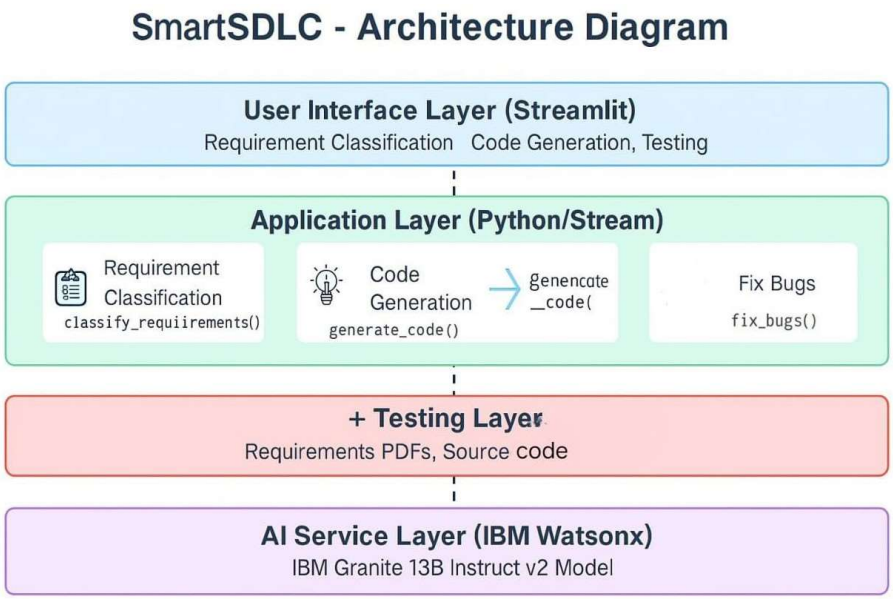
- ⊂ Chat Assistant

Each feature integrates IBM's Granite model to interpret user input and generate relevant code or insights.

## 3. Architecture

SmartSDLC follows a clean, modular architecture:

1. **User Interface (Streamlit)**: Collects input, displays results, and manages interactions.
2. **Application Logic (Python)**: Processes user commands, forms AI prompts, and handles session state.
3. **AI Service Layer (IBM Watsonx)**: IBM Granite 3.3 Instruct model generates context-aware outputs.
4. **Temporary State Memory**: User session and intermediate data stored in-memory using Streamlit session state.




## 4. Setup Instructions

**Prerequisites**:

- Python 3.8 or above

- IBM Cloud account with Watsonx access
- Streamlit, pandas, python-dotenv, ibm-watsonx-ai

****Installation Steps**:**
1. Clone the project and navigate to the folder
2. Create a virtual environment: `python -m venv venv`
3. Activate the virtual environment:
   - Windows: `.\venv\Scripts\activate`
4. Install dependencies: `pip install -r requirements.txt`
5. Create `.env` file with the following:
   IBM_API_KEY="your_key"
   PROJECT_ID="your_project_id"
   BASE_URL="https://eu-de.ml.cloud.ibm.com"
6. Run the app: `streamlit run SMART_SDLC.py`

**5. API Documentation**
SmartSDLC does not expose traditional REST APIs but uses IBM Watsonx's `generate_text()` method via the Python SDK.

**Example Prompt Usage**:
- Code Generation: "Generate Python code that implements a login system."
- Bug Fixing: "Fix the following code:
[BUGGY CODE]"
- Testing: "Write pytest unit tests for the given function."

**AI Parameters**:
- max_new_tokens = 500
- temperature = 0.7
- top_p = 1.0
- decoding_method = sample

**6. Authentication**

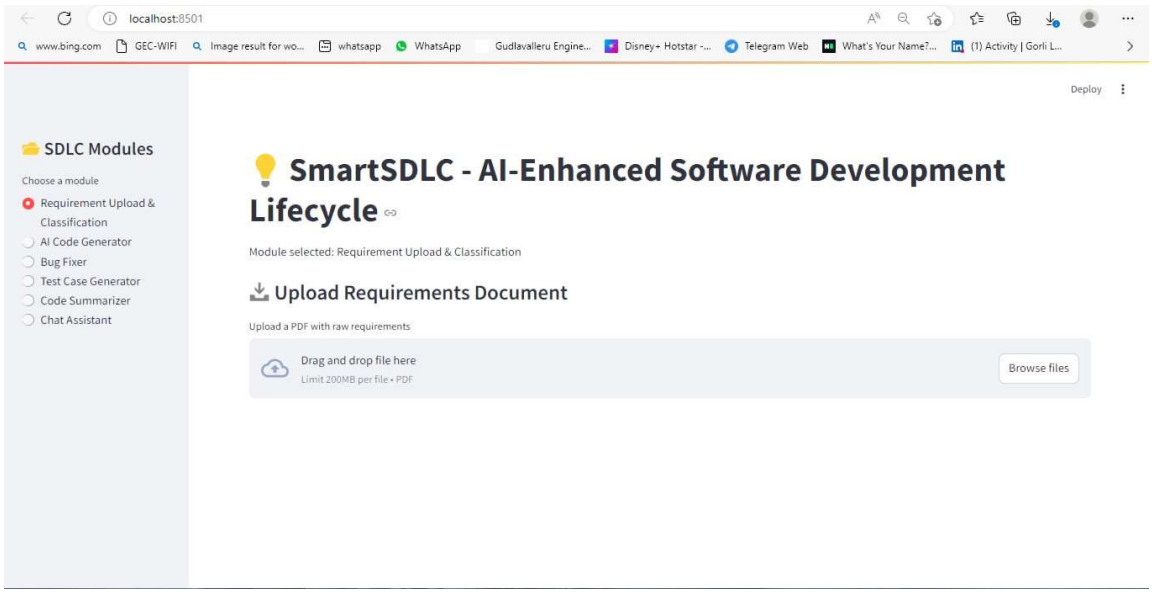
IBM Watsonx is accessed using secure API key authentication. Credentials are stored in a `.env` file and loaded using `python-dotenv`.

**Security Practice**:
- Do not hardcode API keys.
- Use `.env` and `.gitignore` to prevent accidental exposure.
- Only load variables at runtime.

## 7. User Interface

The app features a sidebar for navigation and module selection. Each module accepts different input types and shows results using `st.code`, `st.text_area`, or `st.chat_input`.

Modules:
- Requirement Upload → file uploader
- Code Generator → text area prompt
- Bug Fixer → code input
- Test Generator → requirement/code input
- Code Summarizer → code input
- Chatbot → natural language Q&A



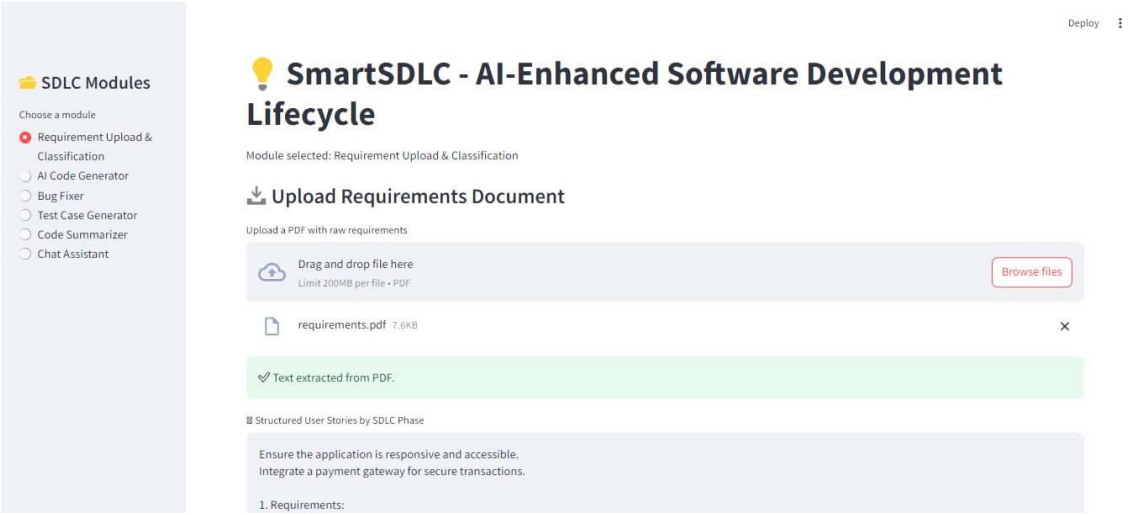
## 8. Testing

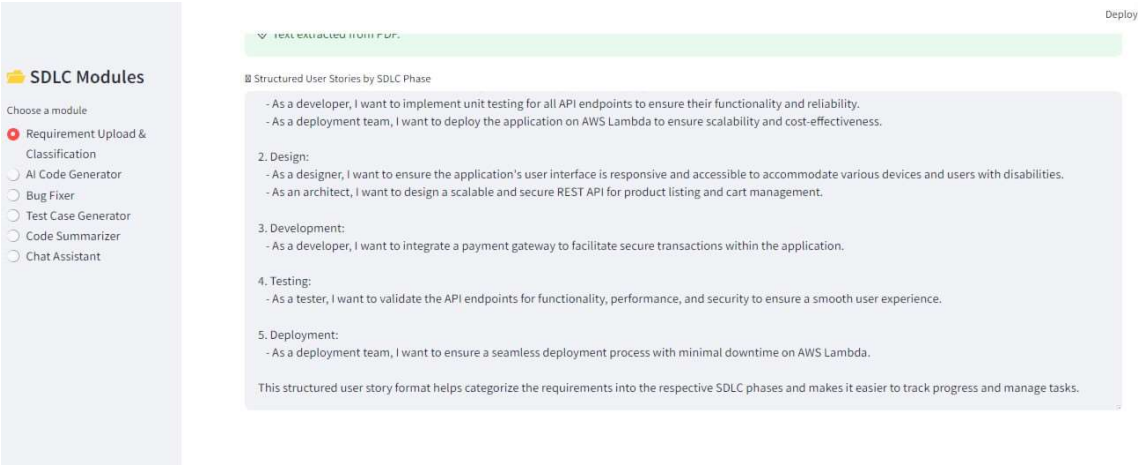
SmartSDLC includes several test mechanisms:

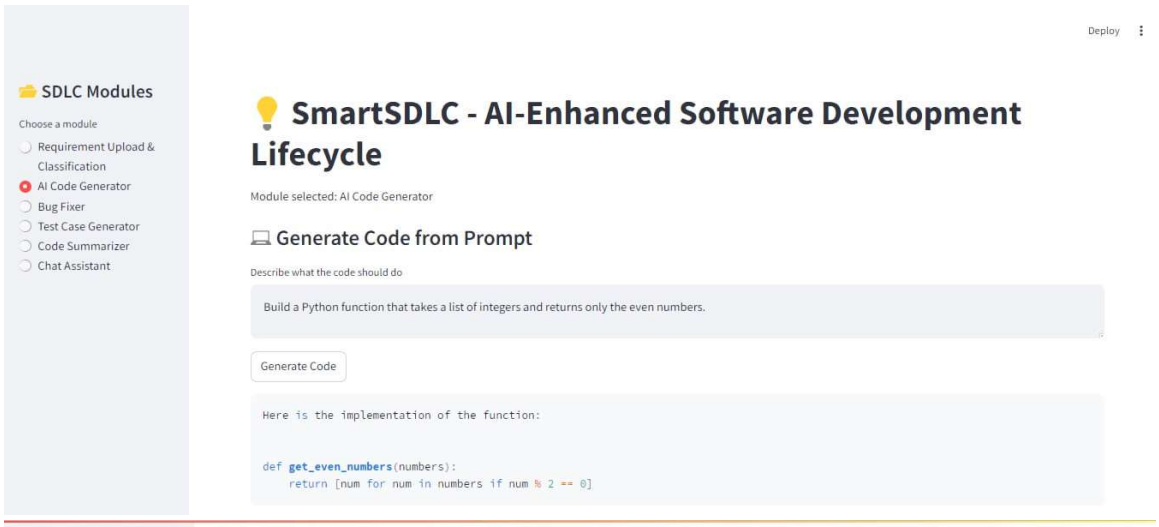
- Q Unit Testing: For prompt creation, output cleaning functions.
- Integration Testing: Streamlit frontend with IBM Watsonx API.
- 🐞 Manual Testing: For all 6 features (input validation, output quality).

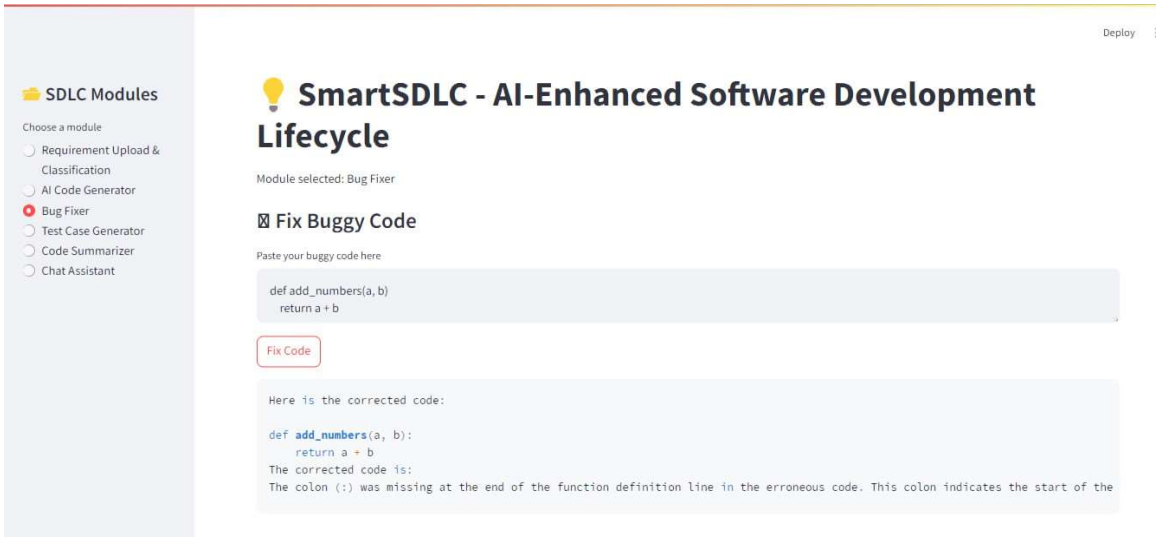
Tests are either in-code validation or handled by test cases generated using SmartSDLC's own test generator module.

## 9. Screenshots

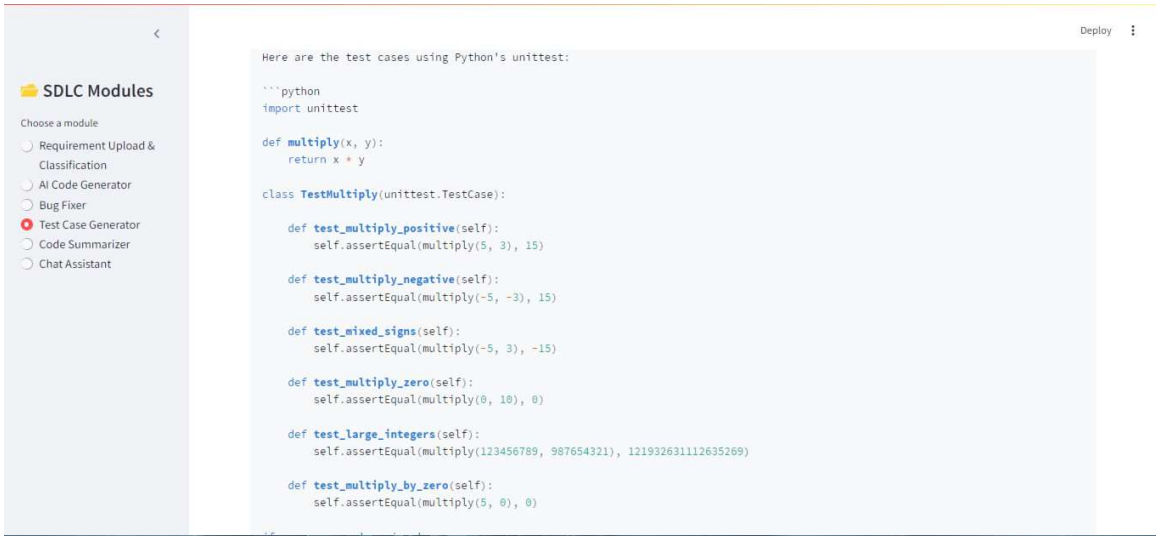


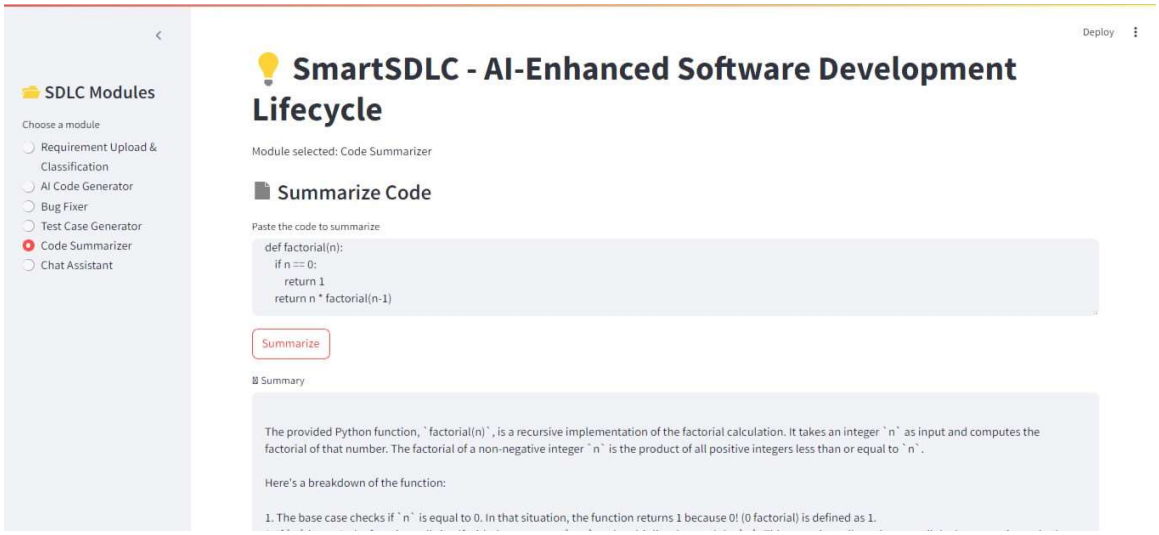

Deploy
SDLC Modules
Choose a module
Requirement Upload & Classification
AI Code Generator
Bug Fixer
Test Case Generator
Code Summarizer
Chat Assistant
SmartSDLC - AI-Enhanced Software Development Lifecycle
Module selected: AI Code Generator
Generate Code from Prompt
Describe what the code should do
Build a Python function that takes a list of integers and returns only the even numbers.
Generate Code
Here is the implementation of the function:
def get_even_numbers(numbers):
return [num for num in numbers if num % 2 == 0]

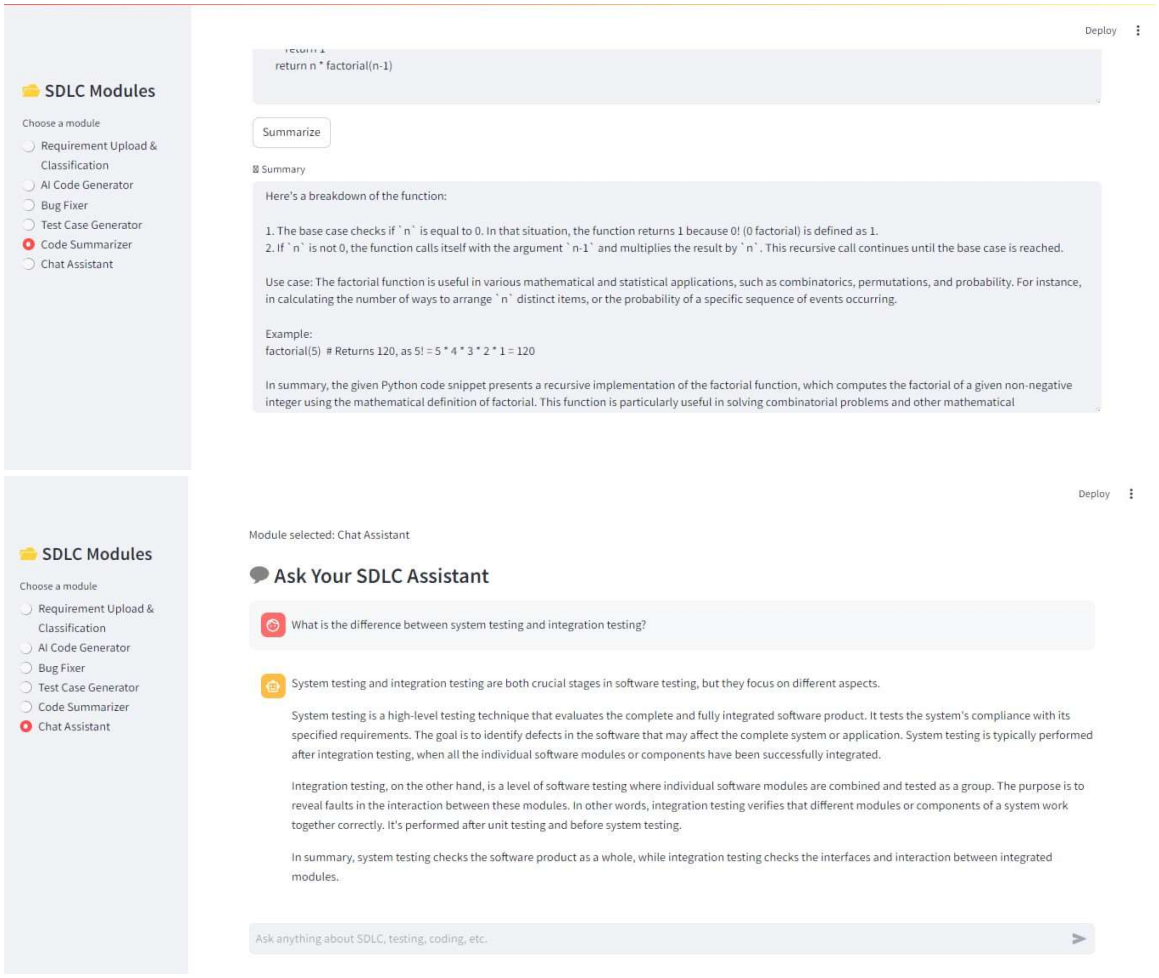

Deploy
SDLC Modules
Choose a module
Requirement Upload & Classification
AI Code Generator
Bug Fixer
Test Case Generator
Code Summarizer
Chat Assistant
SmartSDLC - AI-Enhanced Software Development Lifecycle
Module selected: Bug Fixer
Fix Buggy Code
Paste your buggy code here
def add_numbers(a, b)
return a + b
Fix Code
Here is the corrected code:
def add_numbers(a, b):
return a + b
The corrected code is:
The colon (:) was missing at the end of the function definition line in the erroneous code. This colon indicates the start of the


Deploy
SDLC Modules
Choose a module
Requirement Upload & Classification
AI Code Generator
Bug Fixer
Test Case Generator
Code Summarizer
Chat Assistant
Lifecycle
Module selected: Test Case Generator
Generate Test Cases
Paste the function or requirement for test generation
def multiply(x, y):
return x * y
Generate Test Cases
1. Test case for multiplying positive integers
2. Test case for multiplying negative integers
3. Test case for multiplying a positive integer by a negative integer
4. Test case for multiplying zero by any integer
5. Test case for multiplying a large integer by another large integer
6. Test case for multiplying by zero (edge case)
Here are the test cases using Python's unittest:


SDLC Modules
Choose a module
Requirement Upload & Classification
AI Code Generator
Bug Fixer
Test Case Generator
Code Summarizer
Chat Assistant
Deploy
Here are the test cases using Python's unittest:
```python
import unittest
def multiply(x, y):
return x * y
class TestMultiply(unittest.TestCase):
def test_multiply_positive(self):
self.assertEqual(multiply(5, 3), 15)
def test_multiply_negative(self):
self.assertEqual(multiply(-5, -3), 15)
def test_mixed_signs(self):
self.assertEqual(multiply(-5, 3), -15)
def test_multiply_zero(self):
self.assertEqual(multiply(0, 10), 0)
def test_large_integers(self):
self.assertEqual(multiply(123456789, 987654321), 121932631112635269)
def test_multiply_by_zero(self):
self.assertEqual(multiply(5, 0), 0)


SDLC Modules
Choose a module
Requirement Upload & Classification
AI Code Generator
Bug Fixer
Test Case Generator
Code Summarizer
Chat Assistant
Deploy
self.assertEqual(multiply(5, 0), 0)
if __name__ == '__main__':
unittest.main()
```
And here are the test cases using pytest:
```python
def multiply(x, y):
return x * y
def test_multiply_positive():
assert multiply(5, 3) == 15
def test_multiply_negative():
assert multiply(-5, -3) == 15
def test_mixed_signs():
assert multiply(-5, 3) == -15
def test_multiply_zero():
assert multiply(0, 10) == 0
def test_large_integers():
assert multiply(123456789, 987654321) == 121932631112635269


SDLC Modules
Choose a module
Requirement Upload & Classification
AI Code Generator
Bug Fixer
Test Case Generator
Code Summarizer
Chat Assistant
Deploy
SmartSDLC - AI-Enhanced Software Development Lifecycle
Module selected: Code Summarizer
Summarize Code
Paste the code to summarize
def factorial(n):
if n == 0:
return 1
return n * factorial(n-1)
Summarize
Summary
The provided Python function, `factorial(n)`, is a recursive implementation of the factorial calculation. It takes an integer `n` as input and computes the factorial of that number. The factorial of a non-negative integer `n` is the product of all positive integers less than or equal to `n`.
Here's a breakdown of the function:
1. The base case checks if `n` is equal to 0. In that situation, the function returns 1 because 0! (0 factorial) is defined as 1.
```




## 10. Known Issues

- No persistent user login system
- No database support (all session-based)
- No role-based access or advanced error handling
- IBM Watsonx API has rate limits depending on your cloud plan

## 11. Future Enhancements

- Add persistent database (MongoDB, PostgreSQL)
- Dockerize for CI/CD deployment
- Implement role-based login system
- Extend to support software architecture generation
- Add support for audio-based prompts or file-to-code generation

## 12. Folder Structure

SmartSDLC/
│
├── SMART_SDLC.py → Main Streamlit app file
├── .env → Environment file for secrets
├── requirements.txt → Dependencies
├── /data → Optional sample input files
├── /venv → Python virtual environment

## 13. Modules Breakdown

Each module calls `ask_watsonx(prompt)` to send instructions to the model.

- Requirement Classifier → PDF-to-user stories
- Code Generator → Prompt-to-code
- Bug Fixer → Debug raw code input
- Test Generator → Create unit test cases
- Summarizer → Explain what code does
- Chat Assistant → Open Q&A on SDLC topics

## 14. Technology Stack

Frontend: Streamlit
Backend: Python
AI Model: IBM Watsonx Granite 3.3 Instruct
PDF Reader: PyMuPDF (fitz)
Authentication: python-dotenv + .env
Deployment Target: IBM Cloud Foundry / Localhost

## 15. Conclusion

SmartSDLC successfully demonstrates how AI can accelerate software development by automating key stages like planning, coding, testing,

and documentation.
Future versions can extend its capabilities into DevOps, mobile responsiveness, and integration with GitHub workflows.