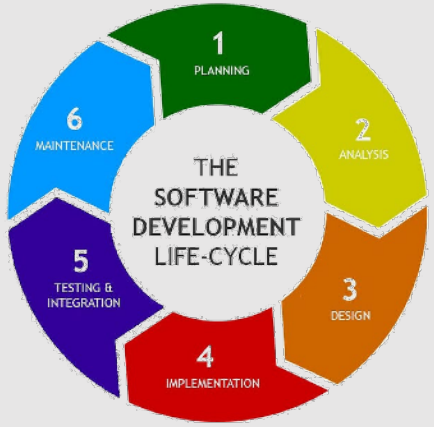
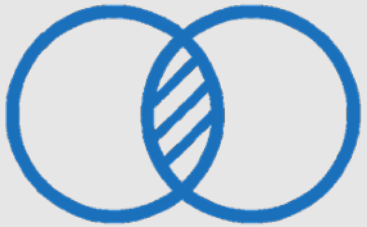
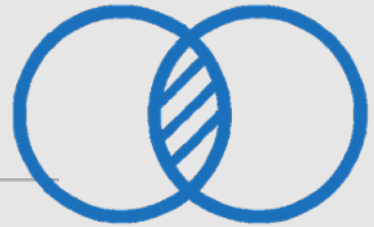
Incorporating AI into your SDLC

Leveraging AI tooling across the phases of your software development lifecycle







Presented by
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AI in Production

AI in Production

About me

- Founder, Tech Skills Transformations LLC
- https://getskillsnow.com
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- Long career in corporate as dev, manager, and director in DevOps and other areas

- Author
  - O'Reilly "reports"
  - Books
    - Professional Git
    - Jenkins 2 – Up and Running
    - Learning GitHub Actions
    - AI-Enabled SDLC
    - Learning GitHub Copilot

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LISTED BELOW ARE A FEW OF THE TECHNOLOGIES FOR WHICH WE OFFER HANDS-ON TRAINING. THESE CAN BE CUSTOMIZED FOR ANY SIZE TEAM FROM 1-100 AND FOR ANY LEVEL FROM BEGINNER TO ADVANCED.

- ArgoCD
- Containers
- Docker
- Gerrit
- Git
- GitHub Actions
- GitHub Codespaces
- GitHub Copilot
- GitHub Foundations
- GitHub Security
- GitLab
- GitOps
- Gradle
- Grafana
- Helm
- Jenkins
- Kubernetes
- Kustomize
- LLMs
- Prometheus
- Tekton
- VS Code

Background

Rise of AI Coding Assistants (Software Dev Asst's = SDA)

- LLMs and AI apps have exploded since OpenAI added chat to its models in November 2022
- Code creation and related are excellent fits for Gen AI due to structure, syntax, and wealth of examples
- At core, provide inline code suggestions as well as NL chat interfaces
- But also provide additional powerful functions
  - Repository indexing (RAG)
  - Summarizing (PRs, Issues, etc.)
  - Agent workflows (From big ideas to complete implementation)
- Users can leverage them in three modes:
  - Acceleration
  - Exploration
  - Directive

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Amazon Code Whisperer

GitHub Copilot

codeium

Ask Codi

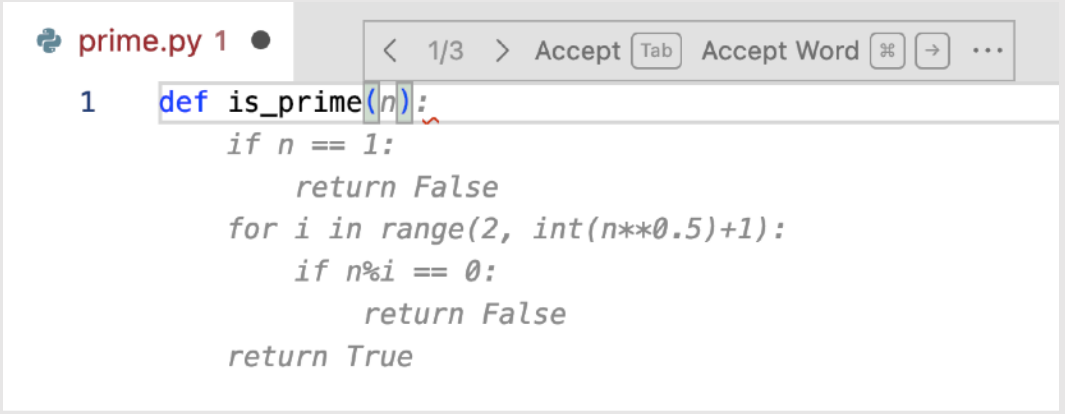
replit

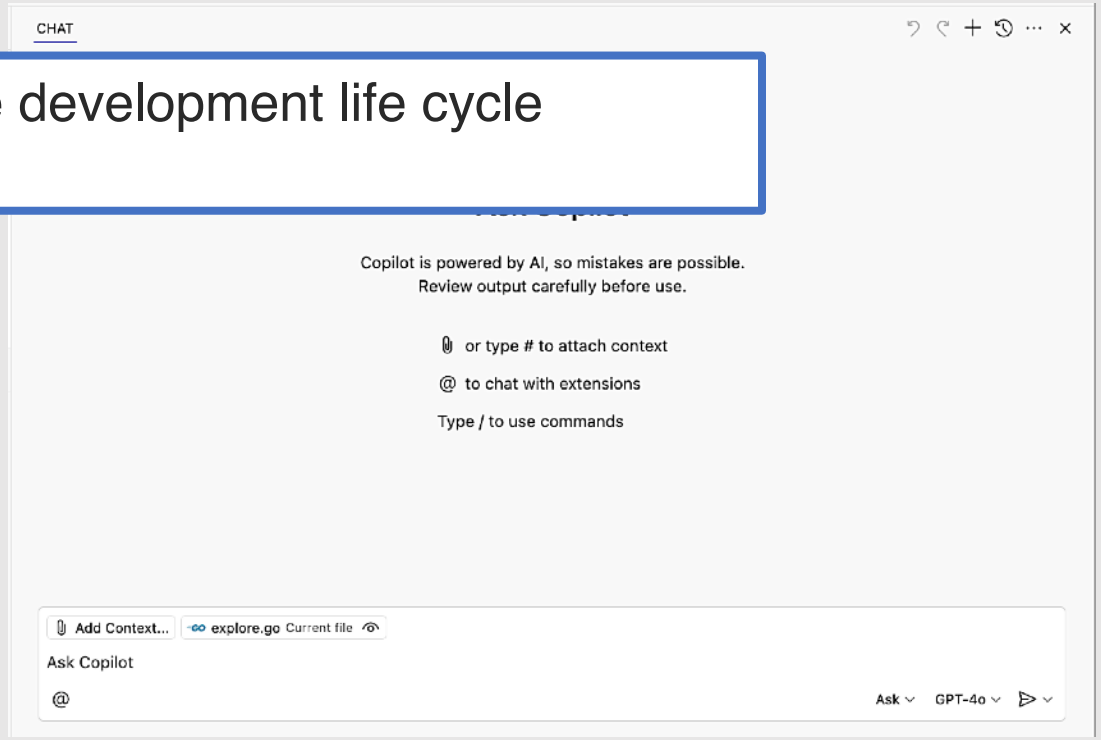
ChatGPT

Uses and Roles

- ***Accelerators/Acceleration*** - code completion - working in the flow and AI provides completion suggestions (usually in the editor)
- ***Explorers/Exploration*** - using the chat interface to ask how to code something? What is the API?
- ***Directors/Di*** specific instructions to create something via the chat interface or in the editor (via comments)
- All of these *can* lead to increased developer productivity

We can apply these across the software development life cycle (SDLC)!

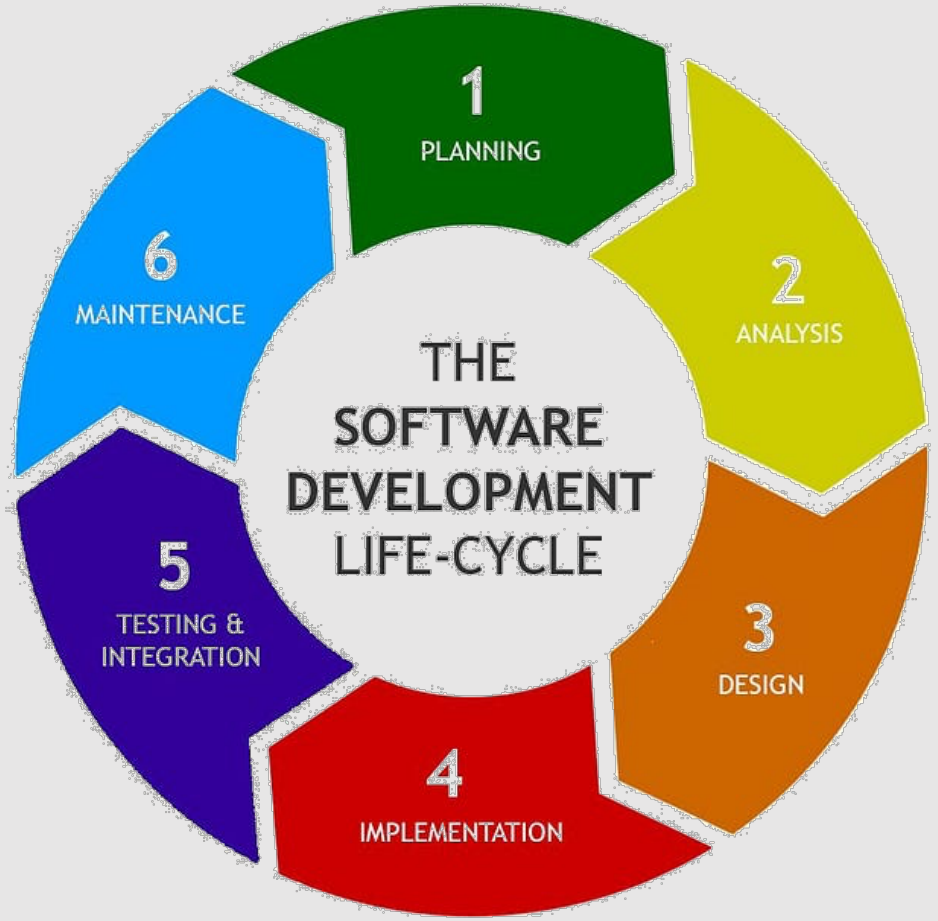




source: "https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/unleashing-developer-productivity-with-generative-ai

The Software Development Lifecycle (SDLC)

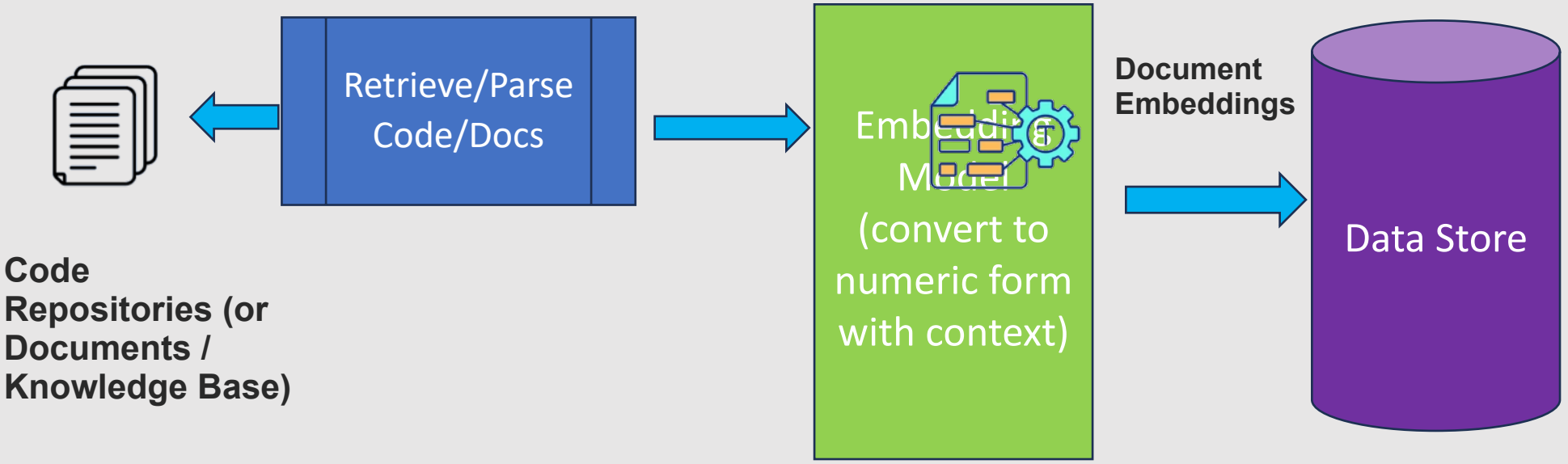
- Structured process used to create high-quality software efficiently and consistently
- Outlines and defines the steps to plan, develop, test, and deploy
- Typical phases include
  - Planning
  - Analysis
  - Design
  - Implementation
  - Testing and integration
  - Maintenance
- Defined phases may vary across organizations/projects



Planning

Background : RAG

- Goal: Search your local data (code, docs, etc.) to give additional context for LLM to work with and give you more targeted, useful responses (considers your data along with its training)

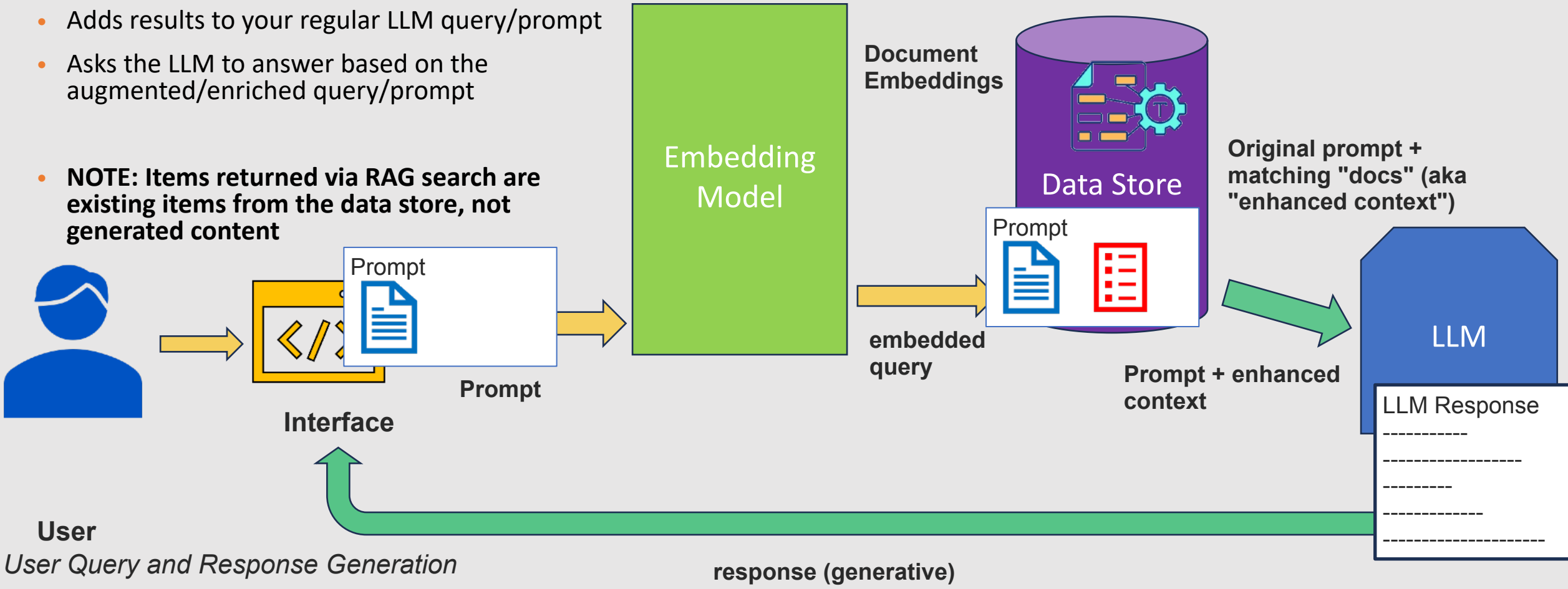


- Your data is parsed and stored with information about other data it's related to in a data store
  - parsing = tokens, storing as numeric data = embeddings, information about other data = vectors (set of numbers that represent how much a term is related to others in the data store)

Background: RAG

- For queries/prompts, application gathers results (most relevant ones) from the vector database with your data
- Adds results to your regular LLM query/prompt
- Asks the LLM to answer based on the augmented/enriched query/prompt

- **NOTE: Items returned via RAG search are existing items from the data store, not generated content**



Planning with AI (approaches)

- Index your code (targeted RAG) – usually automatic now
- Make code repositories accessible for AI (via RAG/indexes)
  - Easily find and identify reusable code
- Ask questions of your code to simplify estimates, avoid rework, ground knowledge

- How did we implement function X?
- Does our code use dependency Y that has this security vulnerability? If so, where?
- We want to migrate from one platform/cloud/language / framework to another - where do we need to focus our efforts?
- The open-source library we use has changed licensing terms - how are we using that?
- Do we have code that does Z?

Planning: Prototyping

- For brainstorming/considering requirements
- Can quickly draft pseudo code in comments
- AI can generate "draft" code
- Doesn't have to be perfect, just enough for estimation/planning

```
# Given a list of app features and their dependencies as (feature, depends_on) pairs
# Determine a valid order in which the user can unlock and access features
# Raise an error if a cycle exists (invalid dependency loop)
# Example input:
#     features = [
#         ("upload", "signup"),
#         ("share", "upload"),
#         ("analytics", "share"),
#         ("signup", None)
#     ]
# Expected output:
#     ["signup", "upload", "share", "analytics"]

# Define a function to accept the feature dependency list
# Build a directed graph using adjacency lists
# Use topological sort to determine feature unlock order
# Validate and raise an error if dependencies form a cycle
# Return an ordered list of unlockable features
```

```
from collections import defaultdict, deque

def determine_feature_unlock_order(dependencies):
    # Build graph and in-degree count
    graph = defaultdict(list)
    in_degree = defaultdict(int)
    features = set()

    for feature, depends_on in dependencies:
        features.add(feature)
        if depends_on:
            graph[depends_on].append(feature)
            in_degree[feature] += 1
            features.add(depends_on)
        else:
            in_degree[feature] += 0  # Ensure entry in in-degree map

    # Start with features that have no dependencies
    queue = deque([f for f in features if in_degree[f] == 0])
    unlock_order = []

    while queue:
        current = queue.popleft()
        unlock_order.append(current)

        for dependent in graph[current]:
            in_degree[dependent] -= 1
            if in_degree[dependent] == 0:
                queue.append(dependent)

    if len(unlock_order) != len(features):
        raise ValueError("Circular feature dependency detected")

    return unlock_order


# Example usage
if __name__ == "__main__":
    features = [
        ("upload", "signup"),
        ("share", "upload"),
        ("analytics", "share"),
        ("signup", None)
    ]
    order = determine_feature_unlock_order(features)
    print("Feature unlock order:", order)
```


Development

Types of AI Assistance for Coding

- Extensions that add AI code completions and chat

GitHub Copilot

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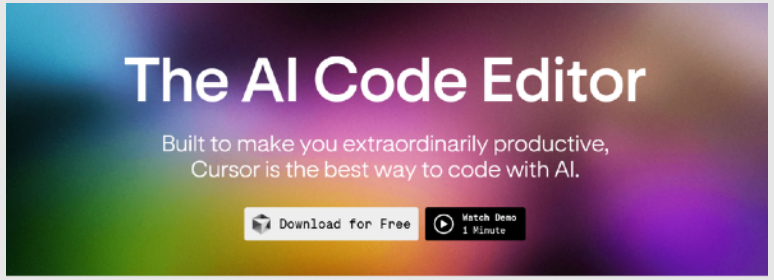
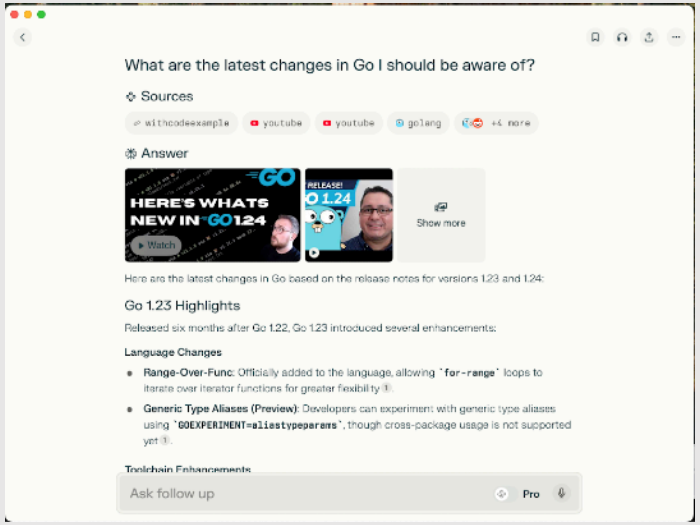
- AI Coding IDEs
  - Based on VS Code
  - AI-first design
  - Tend to focus more fully on project-wide insights and application building
  - Think “collaborate like Copilot and handle complex tasks like an agent”



- Research-focused AI assistants
  - Offer answers based in current content
  - Synthesize info from multiple sources (cited) into concise, natural language answers
  - Uses LLM on back end
  - Great at real-time info retrieval
  - Can also do most things that ChatGPT can do (but with up-to-date info and sources)



How coding assistants can help and what to remember

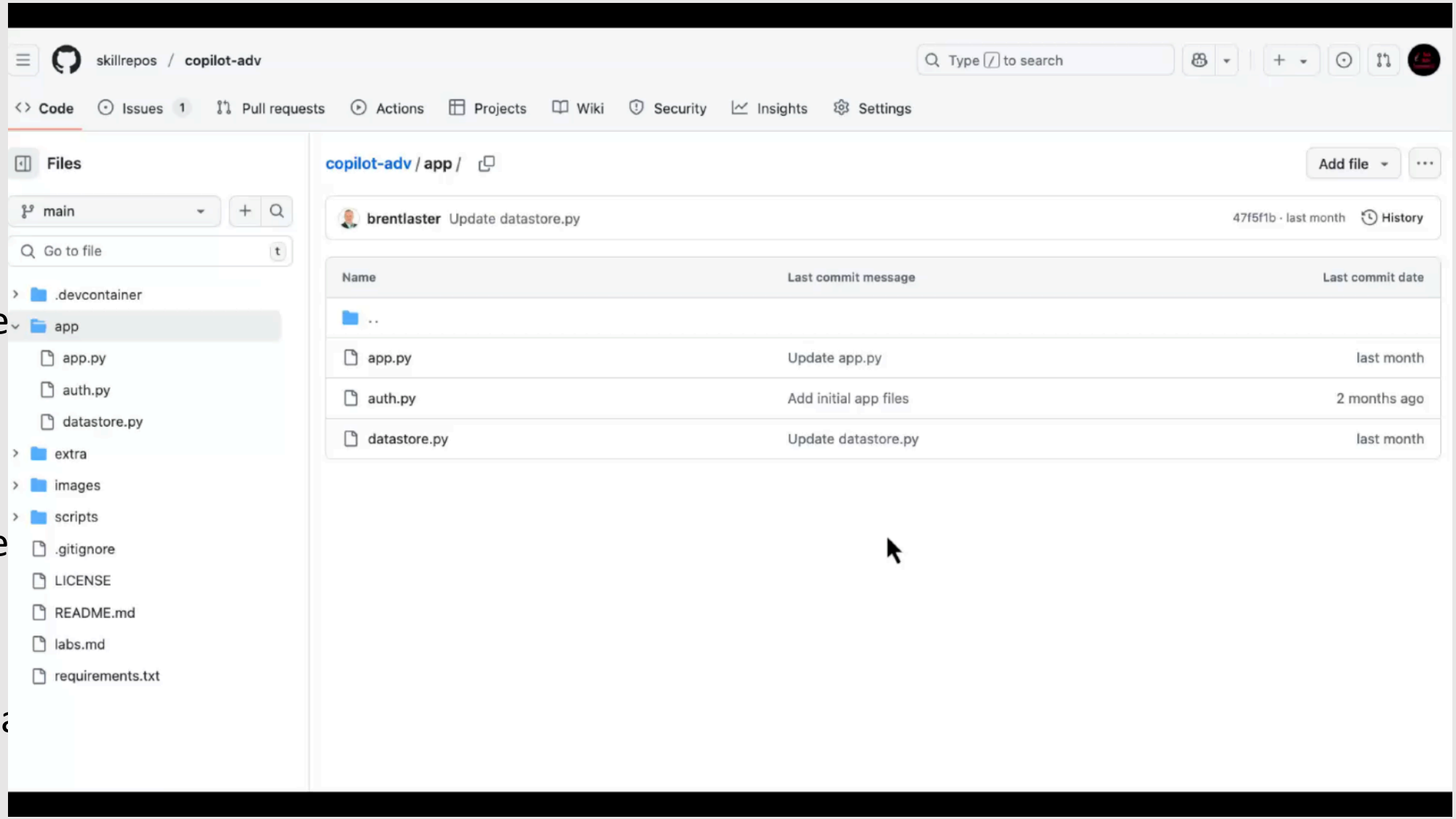
- Code suggestions for nearly any current language
- Comment driven code creation
- Automatic test generation
- SQL generation (for queries, tables, indices, stored procs)
- Regular expression generation
- Pattern/mappings generation
- Document code
- Explain code
- Fixing code
- Reviewing code
- Translating code
- Generate specs/configs
- What is the API to do...

- Reduce cognitive load
- Let programmers focus on the parts that need their expertise

- AI needs good context
- AI needs good guidance or queries (prompts)
- AI can hallucinate
- AI can be out-of-date
- AI doesn't do real-time validation of generated data
- AI doesn't care about tech debt
- BOTTOM LINE: AI-generated code intended for production must ALWAYS be subject to same oversight and review

Leveraging Agents

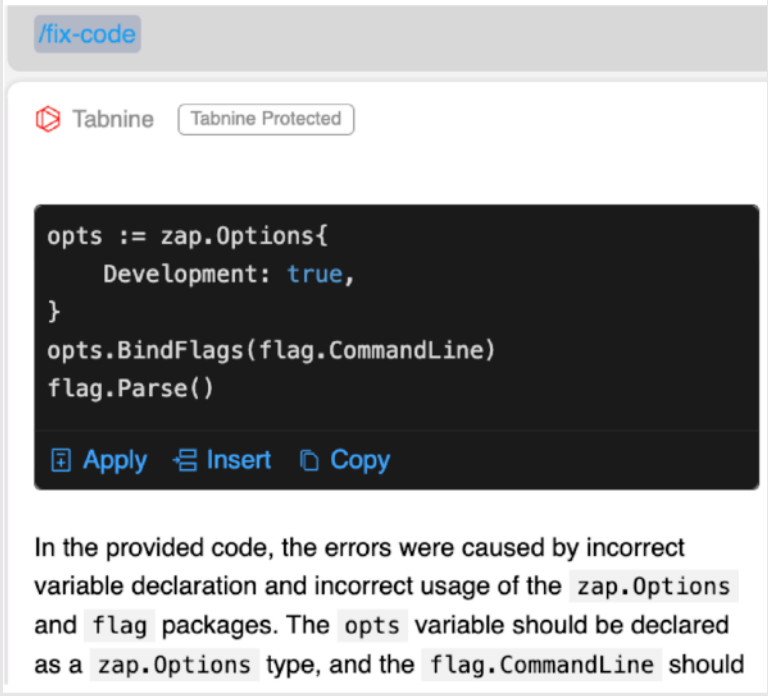
- Most AI assistants have agentic functions built in
- Agent = AI w/ agency
  - ability to gathe input
  - act
  - make changes
- End-to-end change
- Autonomous with oversight
- Goes beyond typica AI assist functions

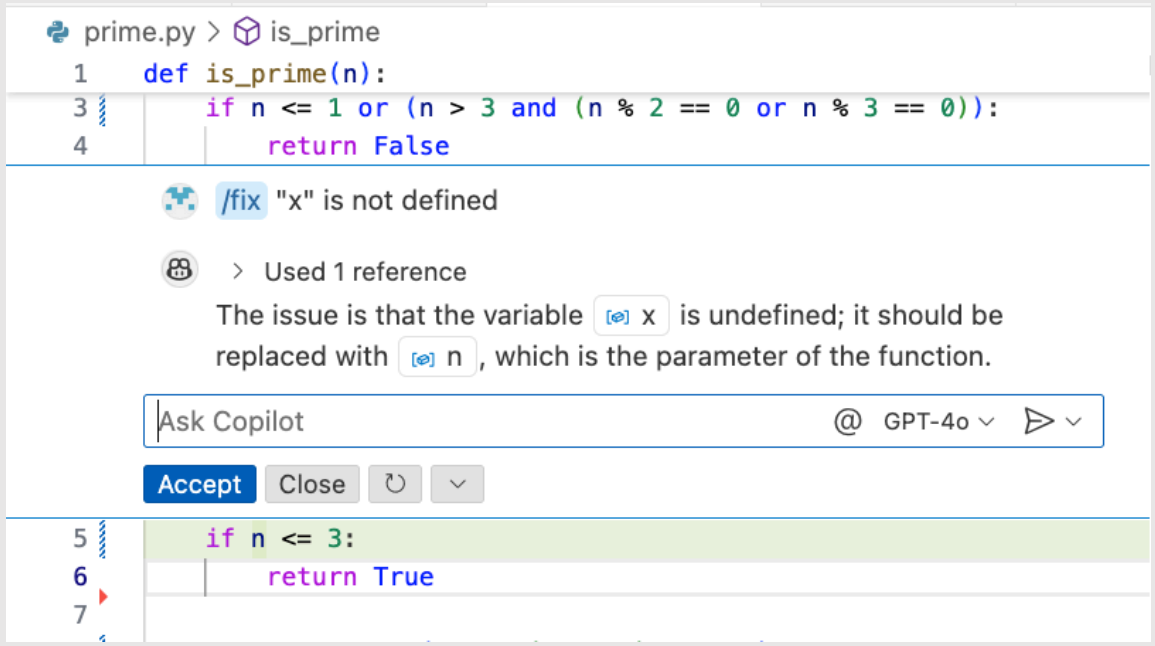


Resolving Issues

Resolving issues with AI

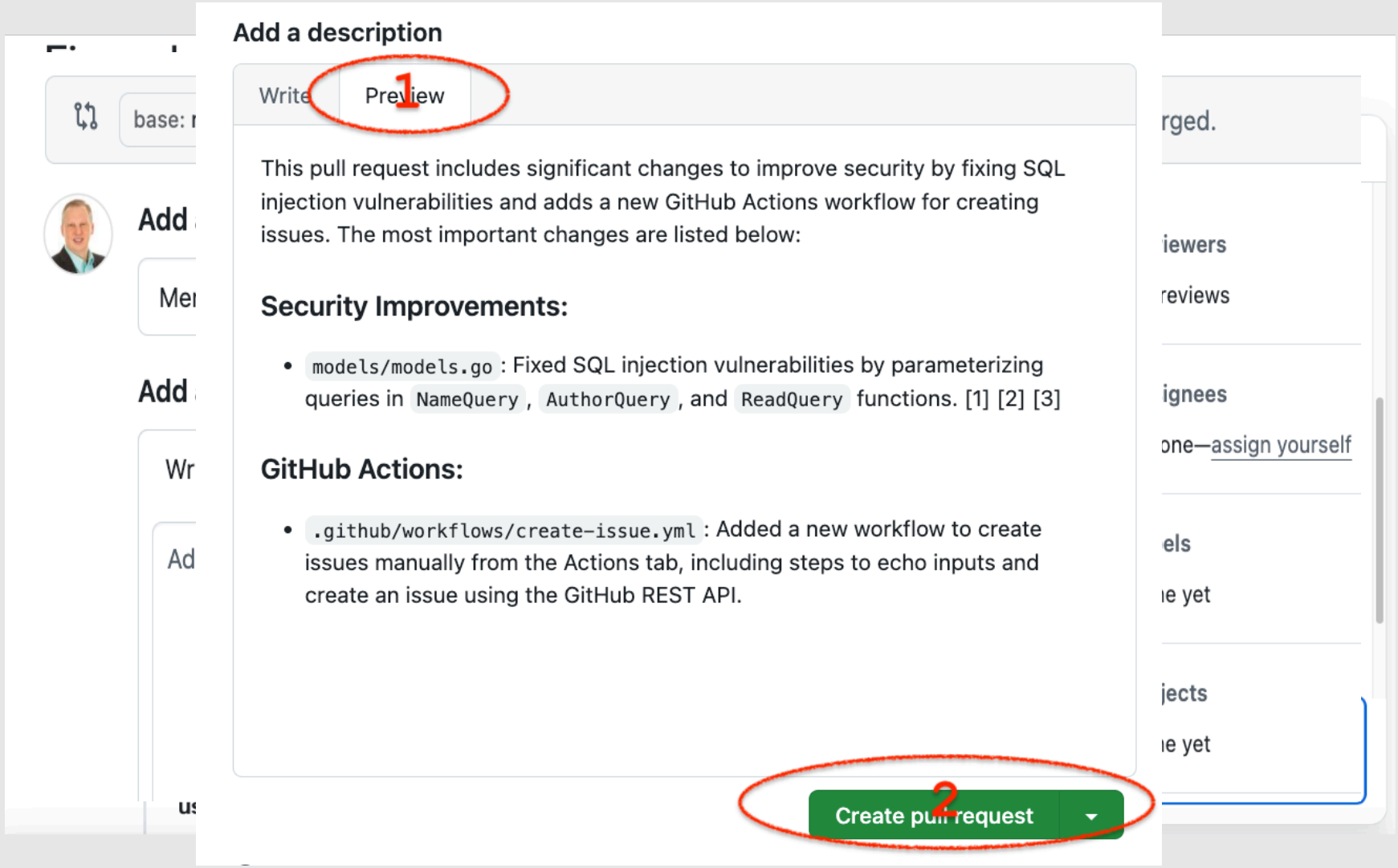
- Shortcut fix commands available
- Prompts to help find and fix issues (or potential issues)
  - What are some places in this repository where logic/performance/security errors can occur?
  - What are the most recent significant changes to the codebase?
  - What are the code changes that affected this code in branch x from date y to date z?
  - How can I make this code be more efficient with system resources?
  - Where else might this problem occur?
  - What other parts of the codebase use this routine?





Working with tracking mechanisms (Copilot examples)

- Given an issue, can prompt Copilot for next steps
- Prompt to provide summary of issue
  - Includes overview of issue based on what Copilot can gather from the system using tools
- Generate pull request summaries



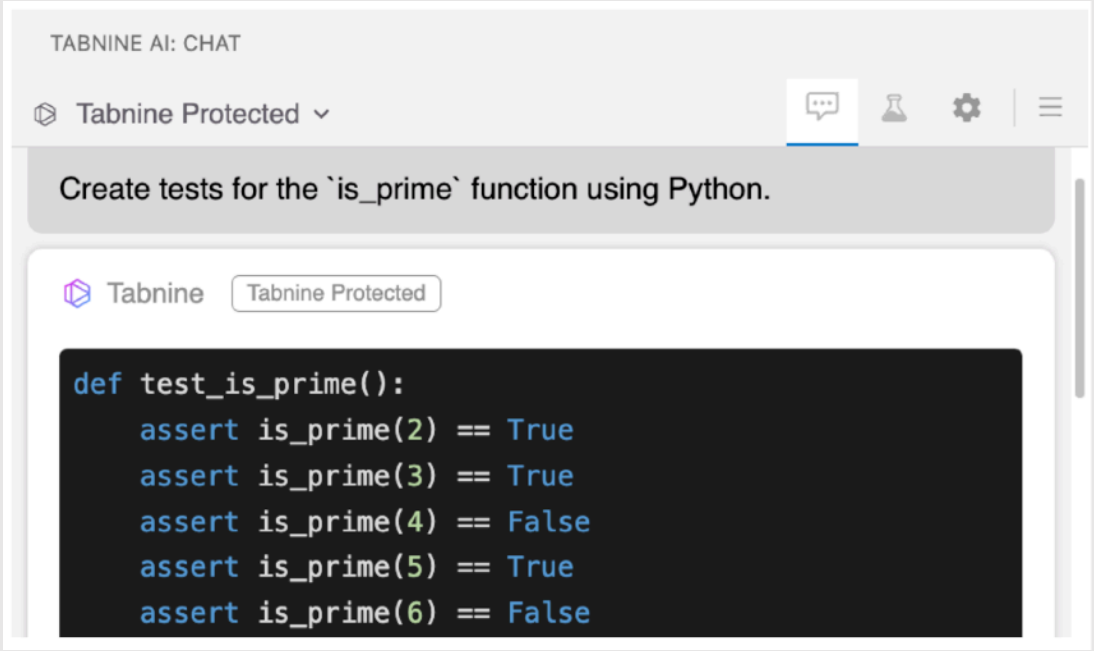
AI review – Having Copilot review code in VS Code

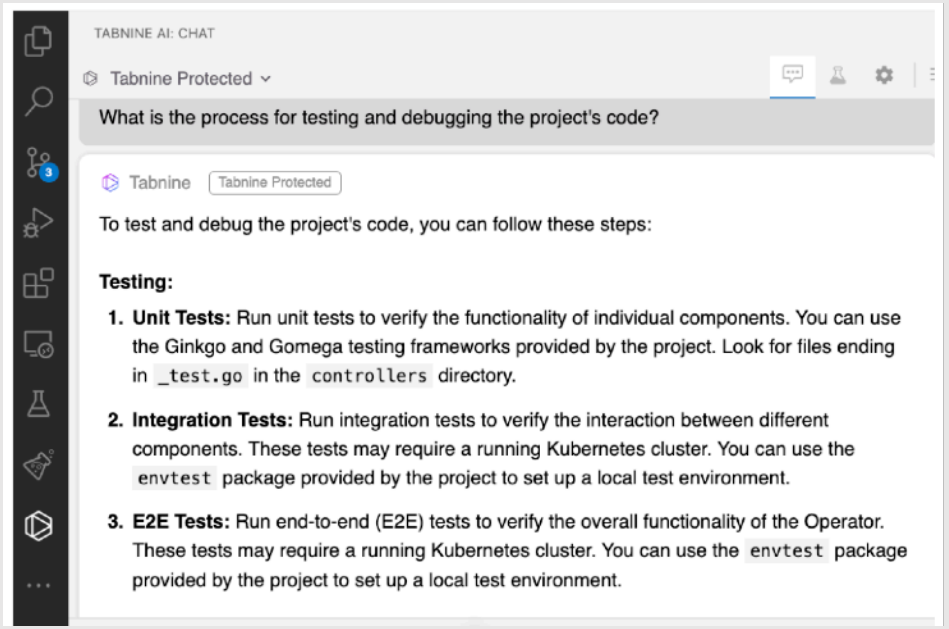
- AI-powered feedback on code as you write it
  - Review selection:
    - » select code in VS Code and ask for initial review
    - » Available now for all Copilot subscribers
- Review changes: ask Copilot for deeper review of all changes before pushing from “Source Control” tab
  - » Can also be done in pull requests on GitHub.com
  - » Currently must be on waitlist

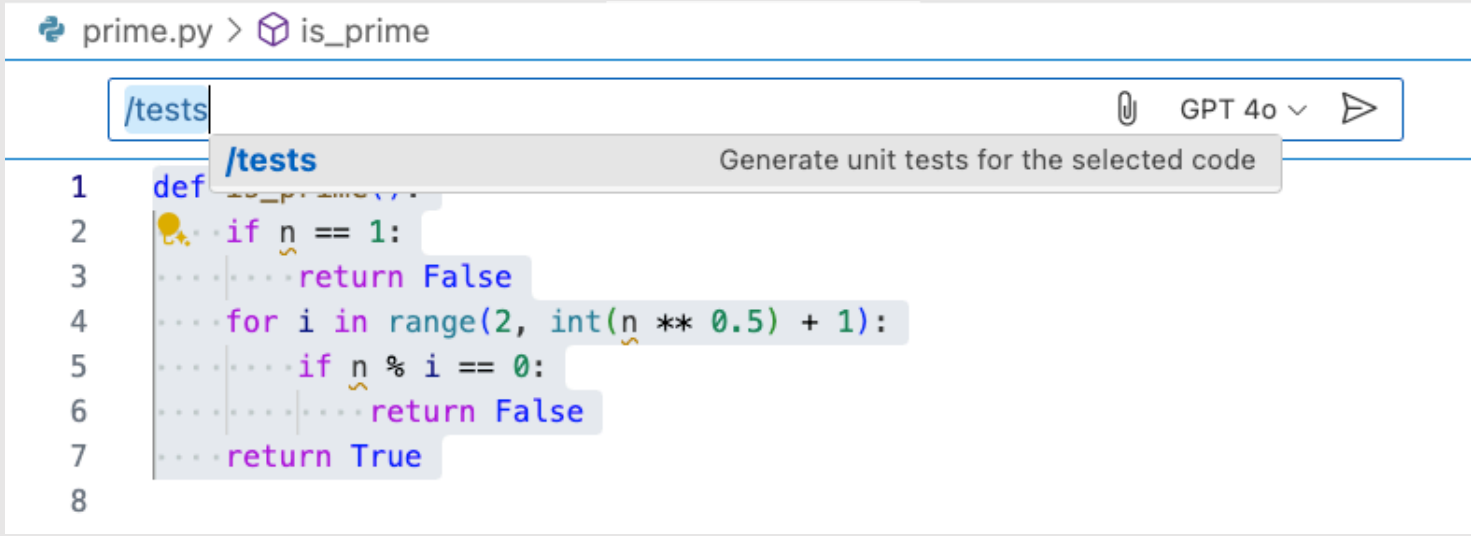
Testing

Testing with AI

- Create tests for …
- What is the process for testing and debugging the project's code?
- Generate unit tests / integration tests for …

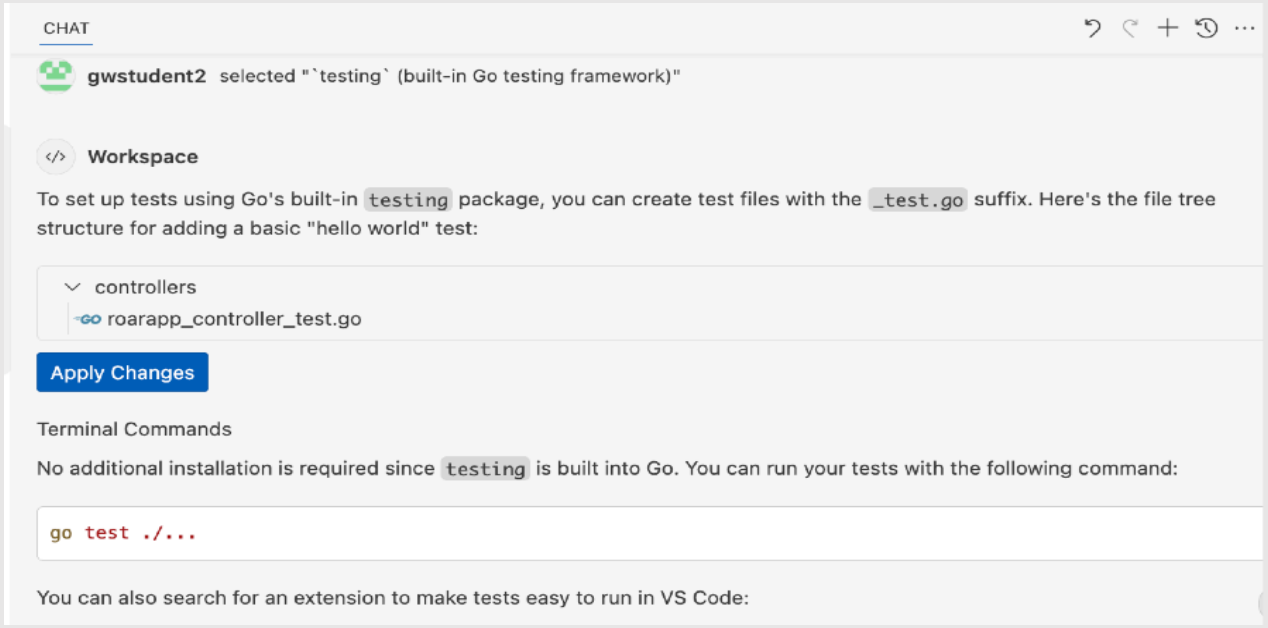


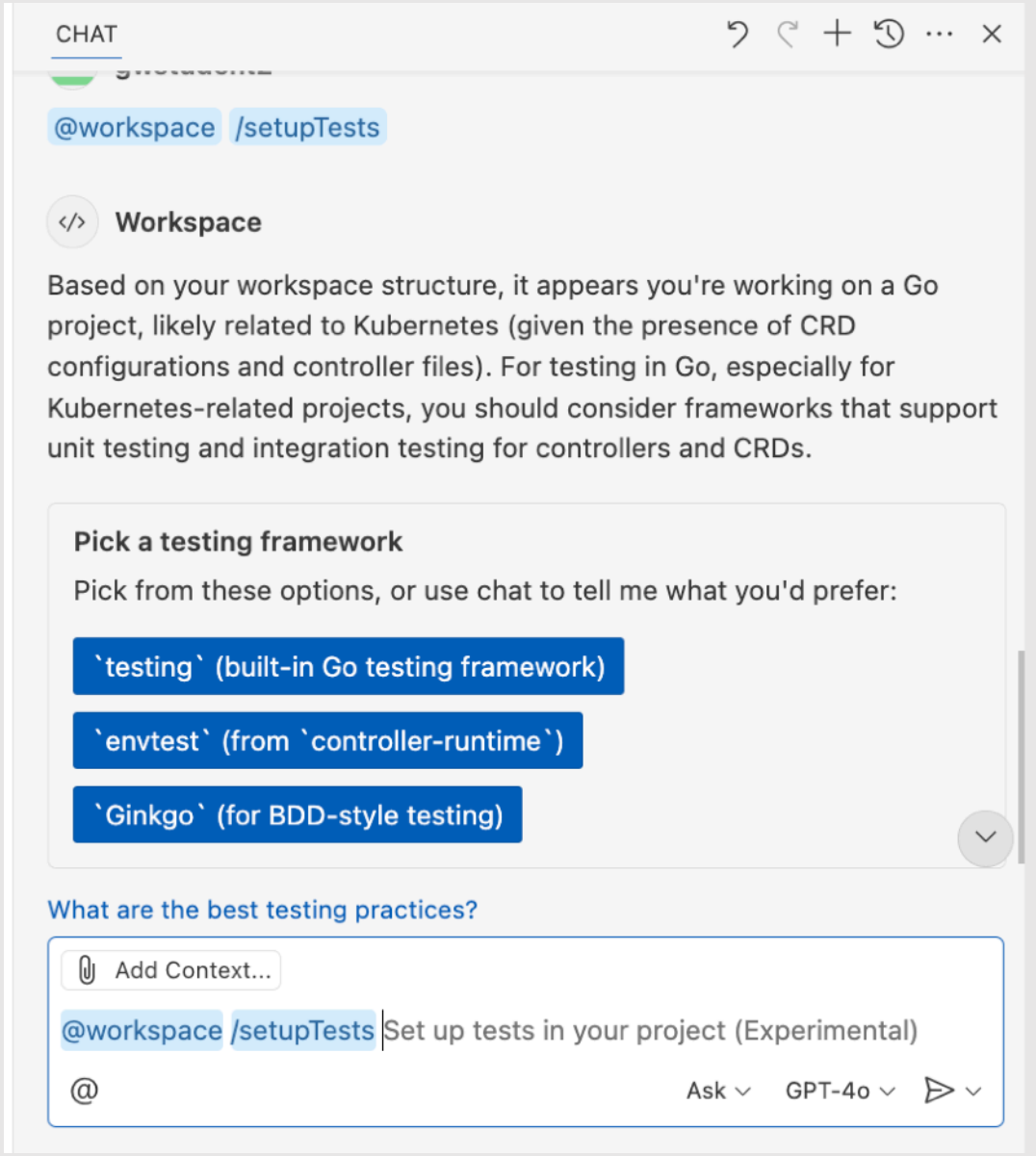




AI Testing – from the start

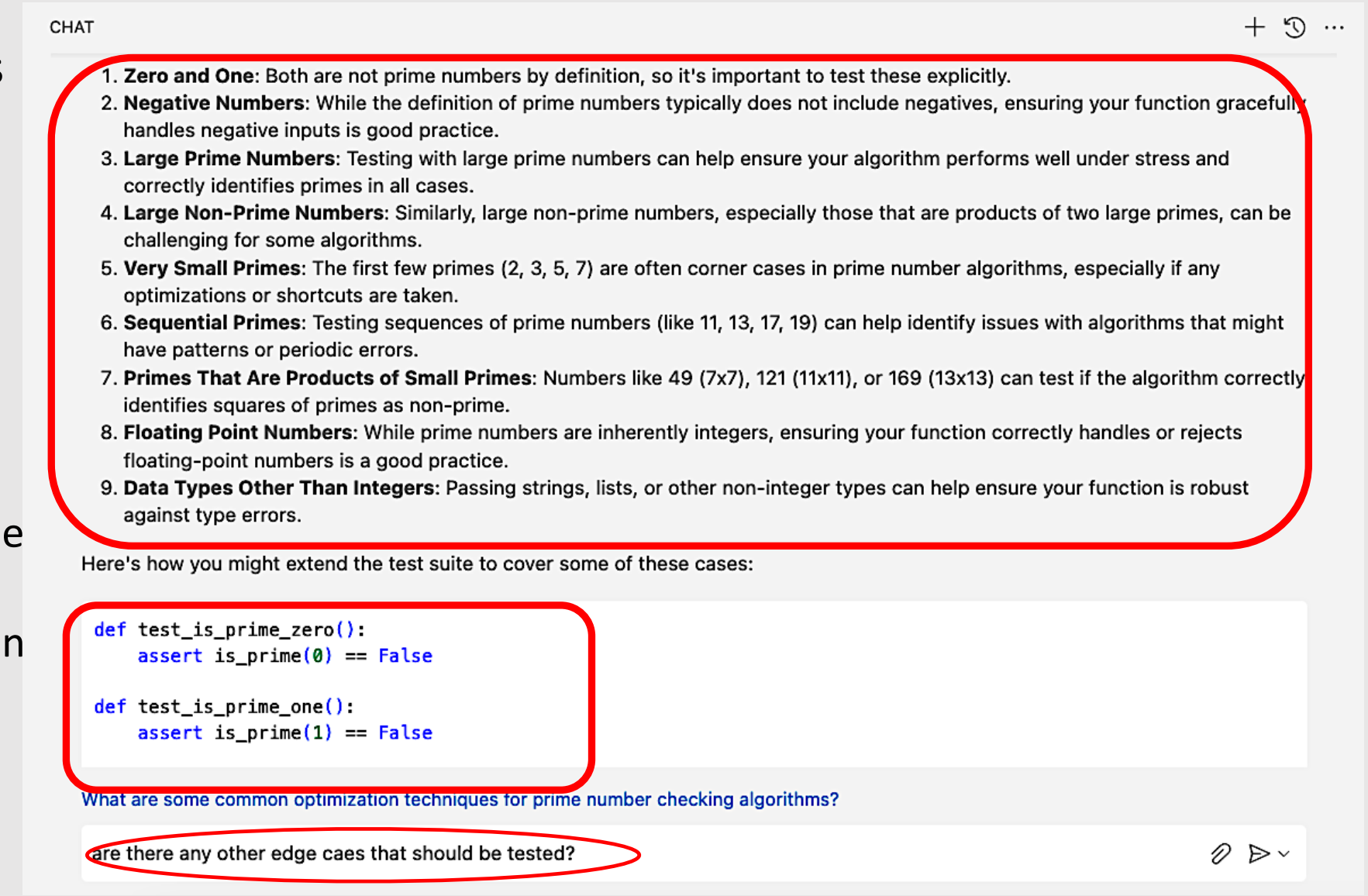
- Can help set up a testing framework for your code
- Recommend appropriate frameworks
- Provide step-by-step setup and configuration instructions
- Suggest relevant testing extensions for your dev env
- Can have custom test generation instructions





Testing – beyond the basics

- What other edge cases should I be testing?
- How do I test X for performance?
- How do I test Y for security?
- Test Driven Development
  - Create dependency file
  - Create test class (fail)
  - Create implementation class (succeed)



Creating Tests Via Prompts

- **Prompt for Unit Tests:**
  - "*Develop a comprehensive suite of unit tests for the <method/function> in <language/framework>. Write multiple test methods that cover a wide range of scenarios, including edge cases, exception handling, and data validation.*"
- **Prompt for Integration Tests:**
  - "*Write integration tests for the <method/function> in the <class>. Use mocks to simulate the <external service> and verify that it works correctly when <condition>.*"

Source: https://docs.github.com/en/copilot/using-github-copilot/example-use-cases/writing-tests-with-github-copilot#writing-unit-tests-with-copilot-chat

Refactoring/Updating

Refactoring with AI

- Consider a code example

```
def is_prime(n):
    return n > 1 and all(n % i for i in range(2, int(n**0.5) + 1))
```

- Can refactor via prompt

```
The is_prime function should have more meaningful variable names
 (max of 3 characters) and comments for better readability.
```

- Resulting code

```
# Check if the input is a positive integer greater than 1
    if not isinstance(num, int) or num <= 1:
        raise ValueError("Input must be a positive integer greater
than 1")

    # Check if the number is greater than 1 and not divisible by
any number up to its square root
    if num > 1 and all(num % div for div in range(2, int(num**0.5)
+ 1)):
        return True
    else:
        return False
```

Refactoring for better testability

- Can also ask Copilot to refactor code to be more suitable for testing
- For example: " Refactor the code in #file:<filename> to make it more easily testable"

```python
def is_prime(n):
    if not isinstance(n, int):
        raise ValueError("Input must be an integer")
    if n < 0:
        raise ValueError("Input must be a non-negative integer")

    if n < 2:
        return False
    for i in range(2, n):
        if n % i == 0:
            return False
    return True
```

GitHub Copilot

Used 1 reference

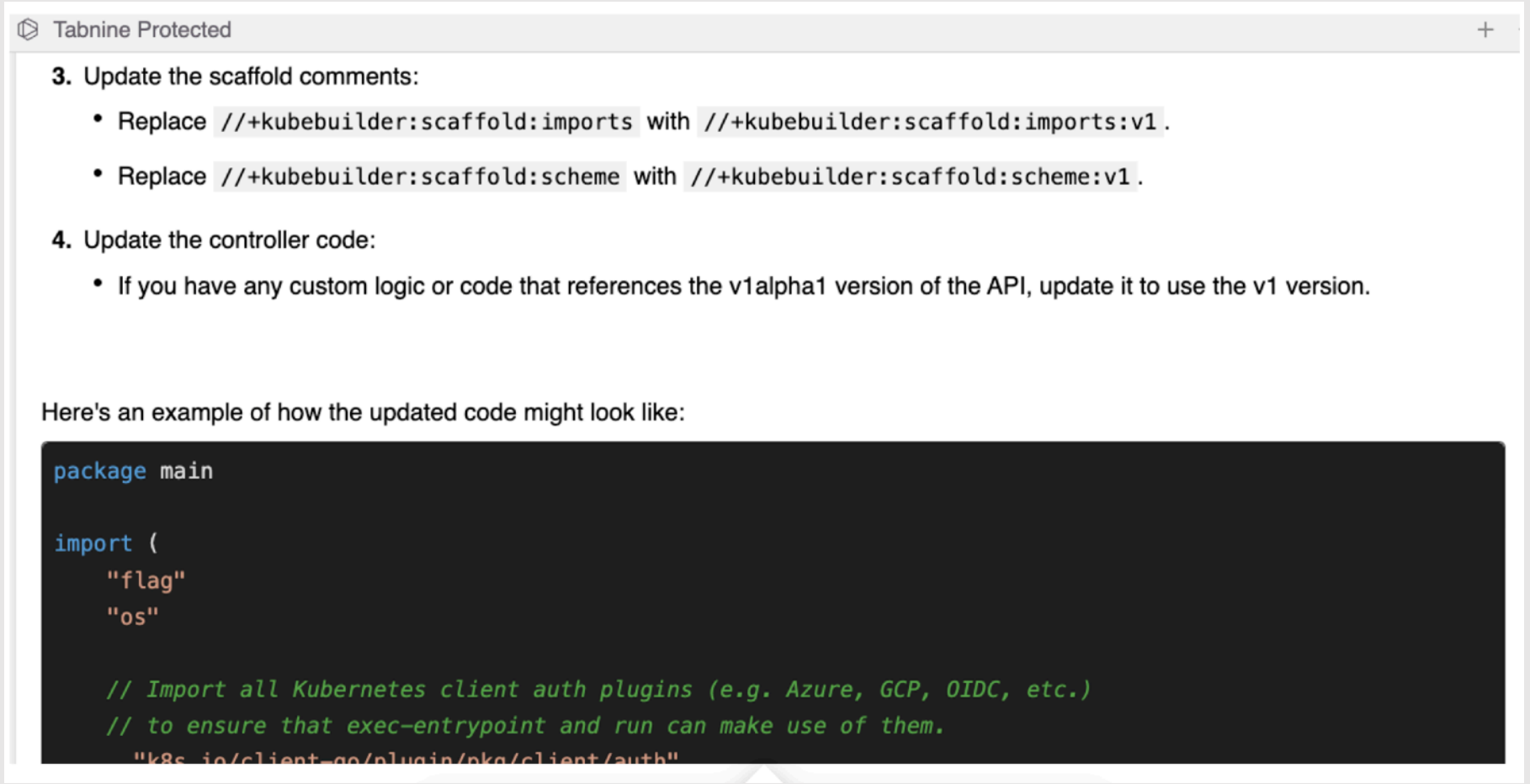
To make the code more testable, we can refactor it by separating the validation logic from the core functionality. This way, we can test the validation and the prime-checking logic independently. Here is the refactored code:

```python
def validate_input(n):
    if not isinstance(n, int):
        raise TypeError("Input must be an integer")
    if n <= 1:
        raise ValueError("Input must be greater than 1")

def is_prime(n):
    validate_input(n)

    if n == 1:
        return False
    for i in range(2, int(n ** 0.5) + 1):
        if n % i == 0:
            return False
    return True
```

Now, we can write separate unit tests for `validate_input` and `is_prime` functions. This separation of concerns makes the code more modular and easier to test.

Exploratory Refactoring and Updating with AI

- Can probe with questions to decide what needs to be updated?
  - Where do we use API v1alpha1?
  - What are the changes between v1alpha1 and v1 API versions?
- Can prompt to do updates such as “Change v1alpha1 API to v1”
- AI-recommended change areas
  - import paths
  - references to API versions
  - scaffold comments
  - Controller code



Augmenting Code with AI

- Augmenting = adding additional functionaly to existing code
- Prompt “The is_prime function should log whether the in put is prime or not”
- AI suggested additional code that
  - pulls in a logging framework, initializes a logger instance
  - adds logging calls for each possible output

`logging` module in Python. Here's an example of how you can do it:

```
import logging

logging.basicConfig(level=logging.INFO)
logger = logging.getLogger(__name__)

def is_prime(n):
    if not isinstance(n, int) or n <= 1:
        raise ValueError("Input must be a positive integer greater than 1")
    if n > 1 and all(n % i for i in range(2, int(n**0.5) + 1)):
        logger.info(f"{n} is a prime number")
        return True
    else:
        logger.info(f"{n} is not a prime number")
        return False
```

Insert Copy New file

In this updated version, the `logging.basicConfig(level=logging.INFO)` line sets up the

Changing Implementations with AI

- Can select code and prompt for alternative implementations
- Consider example code
- Prompt “Explain this function in detail and suggest alternative implementations”
- Also - porting
- Prompt “convert to Go”

```
package main

import "fmt"

func fibonacci(n int) []int {
    sequence := []int{0, 1}
    for sequence[len(sequence)-1] + sequence[len(sequence)-2] <= n {
        sequence = append(sequence, sequence[len(sequence)-1] +
sequence[len(sequence)-2])
    }
    return sequence
}

func main() {
    n := 100
    fmt.Println(fibonacci(n))
}
```

Documentation

Using AI for general documentation via comments

- Basic methods may just do “header” comments
- By being more specific in prompt, can get more extensive comments

```
1   def is_prime(n):
    /doc
    /doc                                  Add document
    Gene
2       """
3       Check if a number is prime.
4
5       A prime number is a natural number
6       This function uses a trial divisio
7
8       Parameters:
9           n (int): The number to check f
10
11      Returns:
12          bool: True if the number is pr
13
14      Examples:
15          >>> is_prime(2)
16          True
17          >>> is_prime(4)
18          False
19          >>> is_prime(17)
20          True
21      """
22      """Check if a number is prime."""
23      if n <= 1:
24          return False
```

```
# Initialize the variable i to 5
# We will use this variable to check for factors of n
i = 5

# Loop to check for factors of n
# The loop continues until i squared is greater than n
while i * i <= n:
    # Check if n is divisible by i or i + 2
    # If it is, then it is not a prime number
    if n % i == 0 or n % (i + 2) == 0:
```

Can you explain the logic used?

Verbosely comment this code so that anyone can easily understand what each line is doing

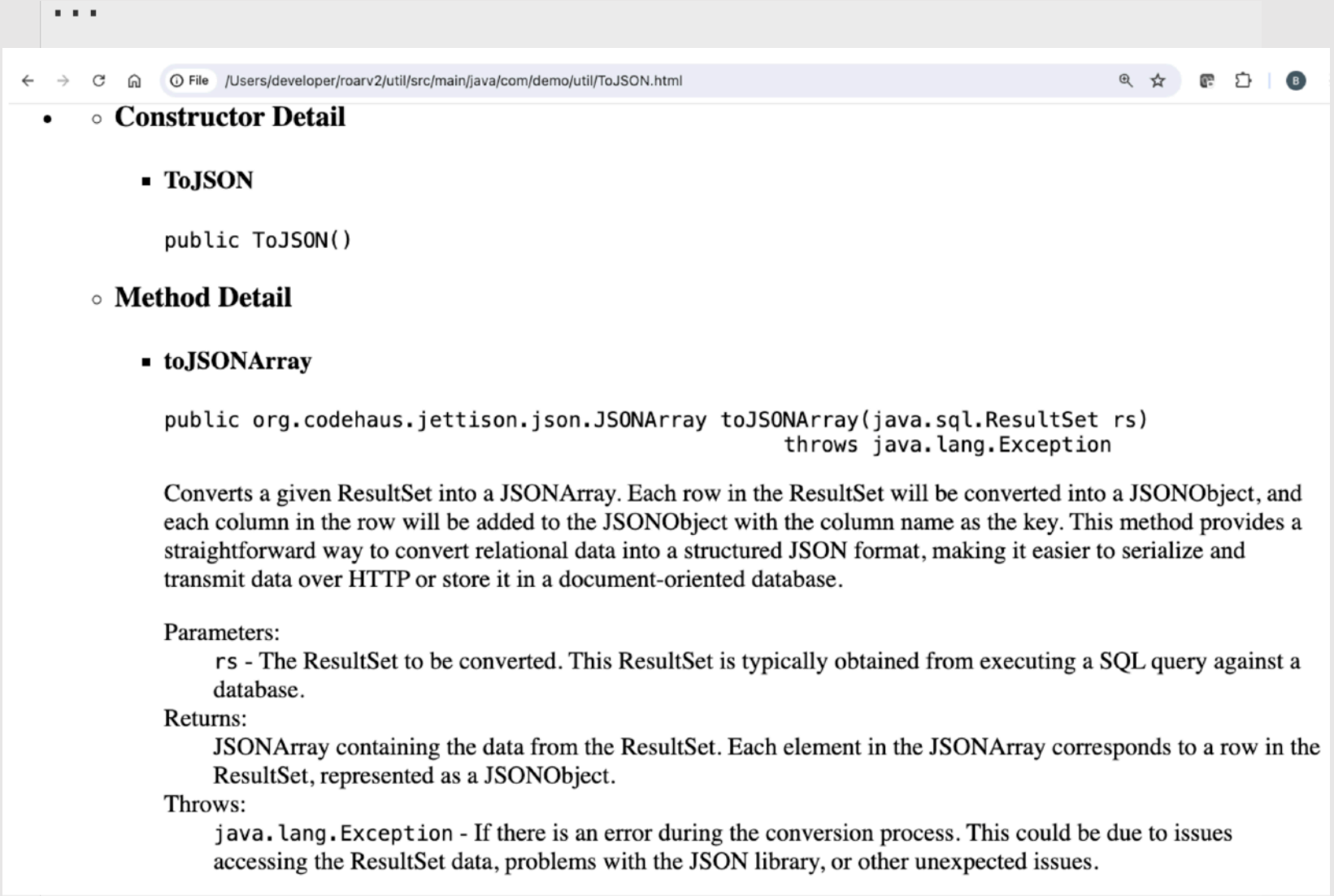
prime.py Current file

@

GPT 4o

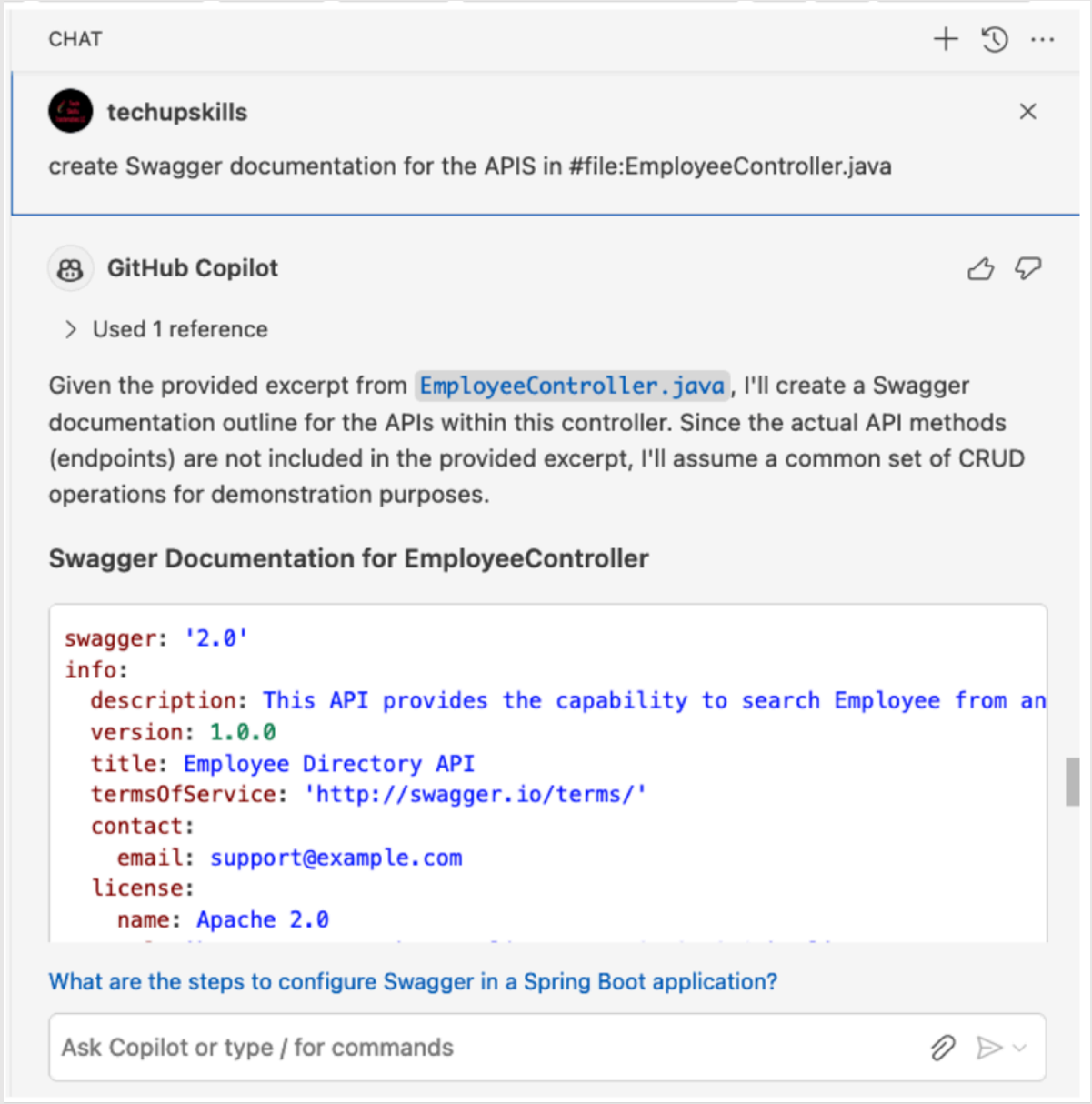
Generating Framework-compatible documentation

- If the SDA recognizes that the code is in a language that has a standard documentation tool associated with it, it will default to creating comments ready for that tool
- Given example code…
- Have Copilot document it
- Can then generate framework doc from it



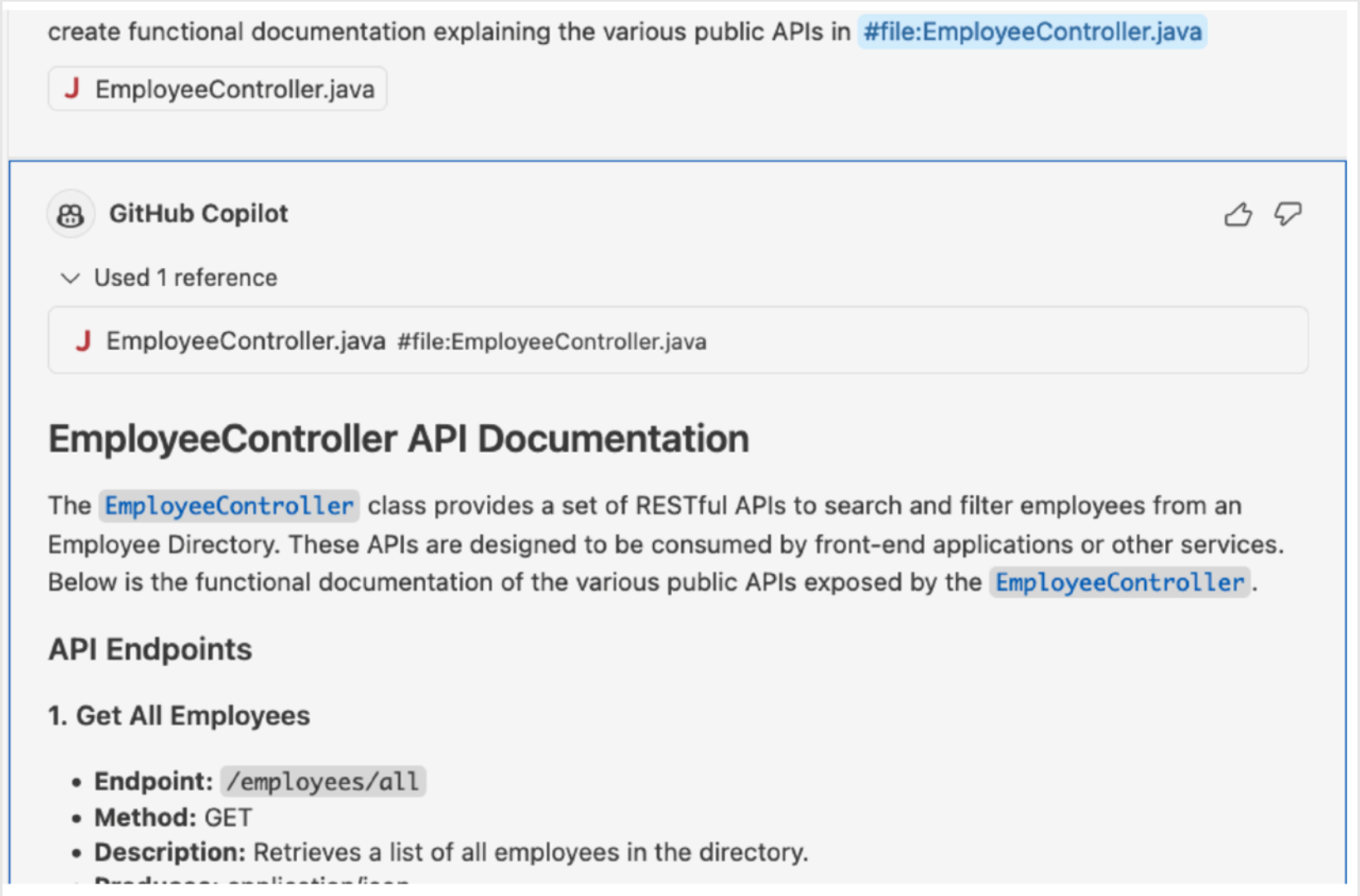
Generating Documentation for APIs

- If your codebase is setup for an API documentation framework like Swagger, then you can have the SDA generate the corresponding Swagger documentation for your APIs



Generating Functional Documentation

- SDAs are also capable of creating functional documentation that is targeted towards external users
- May also produce a set of related info including *Identifying Public APIs*, *Method Signatures*, *Endpoint Mapping*, etc.



Extracting Summary Documentation

- Copilot can also be used to extract a high-level summary of the key documentation from certain types of projects
- This can be extremely useful for quickly understanding the significant details of the code base for a project

The key documentation extracted from the provided code and workspace structure highlights the setup and configuration of a Spring Boot application with Swagger for API documentation. Here's a summary:

Project Structure and Configuration

- **Project Base**: Spring Boot application designed for demonstrating Swagger integration.
- **Group ID**: `com.techupskills.springboot.swagger`
- **Artifact ID**: `springboot-swagger`
- **Version**: `0.0.1-SNAPSHOT`
- **Java Version**: 17
- **Swagger Version**: 3.0.0
- **Packaging**: JAR
- **Parent**: Spring Boot Starter Parent with version 3.1.0
- **Source Encoding**: UTF-8

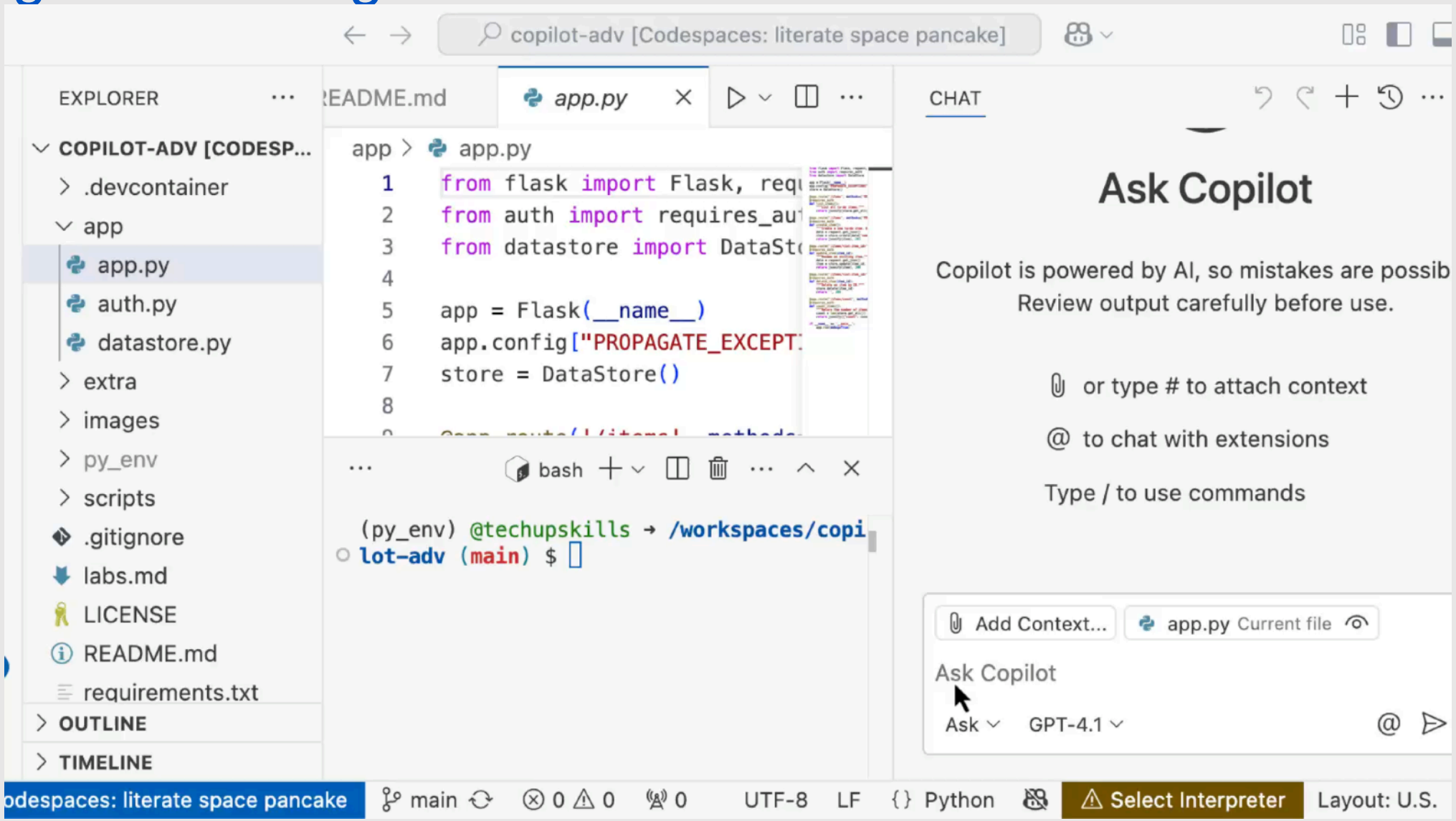
Dependencies

- **Spring Boot Starter Web**: For building web, including RESTful, applications using Spring MVC.
- **Spring Boot Starter Test**: For testing Spring Boot applications with libraries including JUnit, Hamcrest, and Mockito.
- **Spring Boot Starter Data JPA**: For using Spring Data JPA with Hibernate.

Simplifying Maintenance w/ Explaining/Onboarding

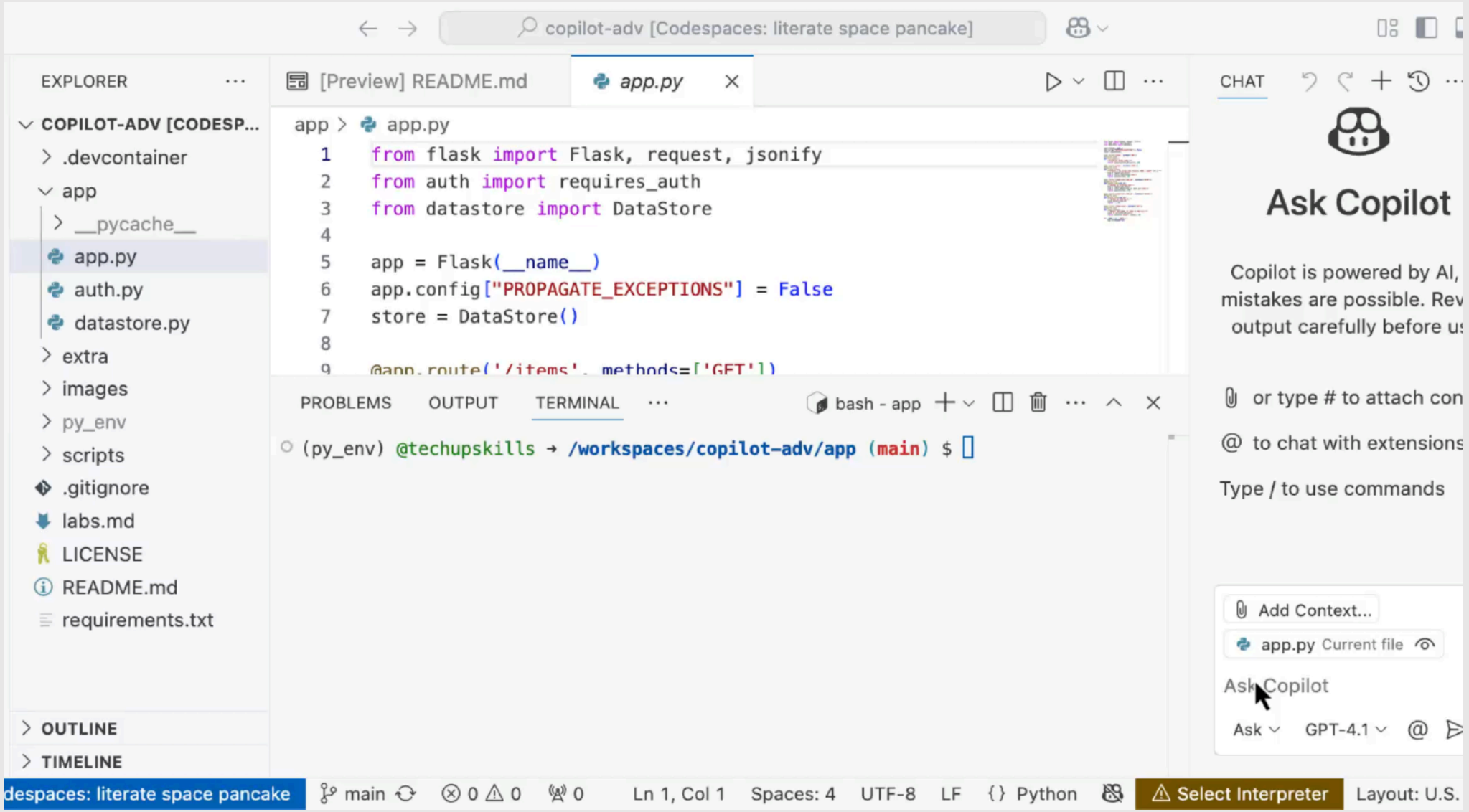
Simplifying Onboarding

- Onboarding is a key aspect of helping devs get going with code
- Simple to have AI generate an onboarding guide



Explaining Code

- Key for taking over/assisting with code bases
- Useful for learning new frameworks/ languages
- Using built-in “explain” functionality
- Can also have it explain how to see/run functionality



That's all - thanks!

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