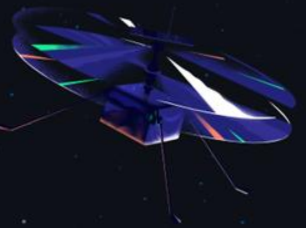
GitHub Copilot Training



Andrew Scoppa

AGENDA

GitHub Copilot - Introduction

Best practices & prompt engineering

In-class coding demos using copilot and copilot chat

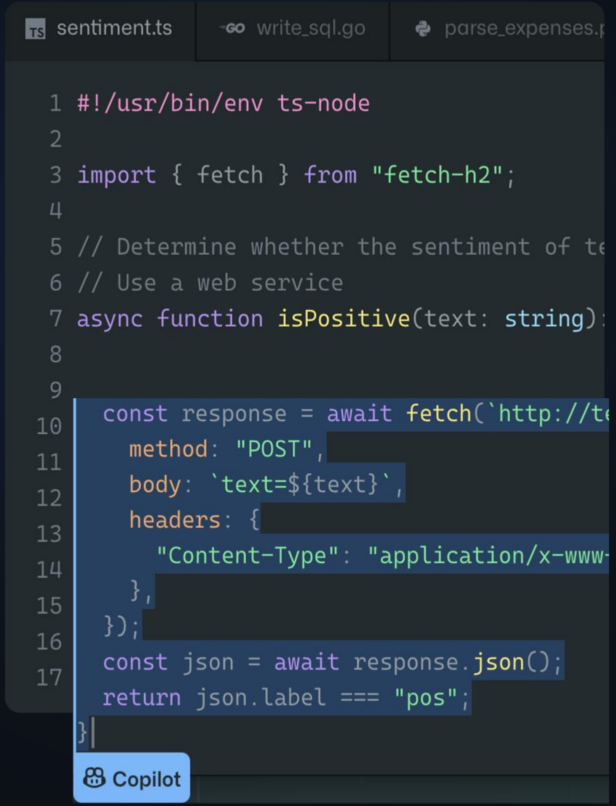
Secure coding

Wrap-up, Q&A

GitHub Copilot Fundamentals Recap

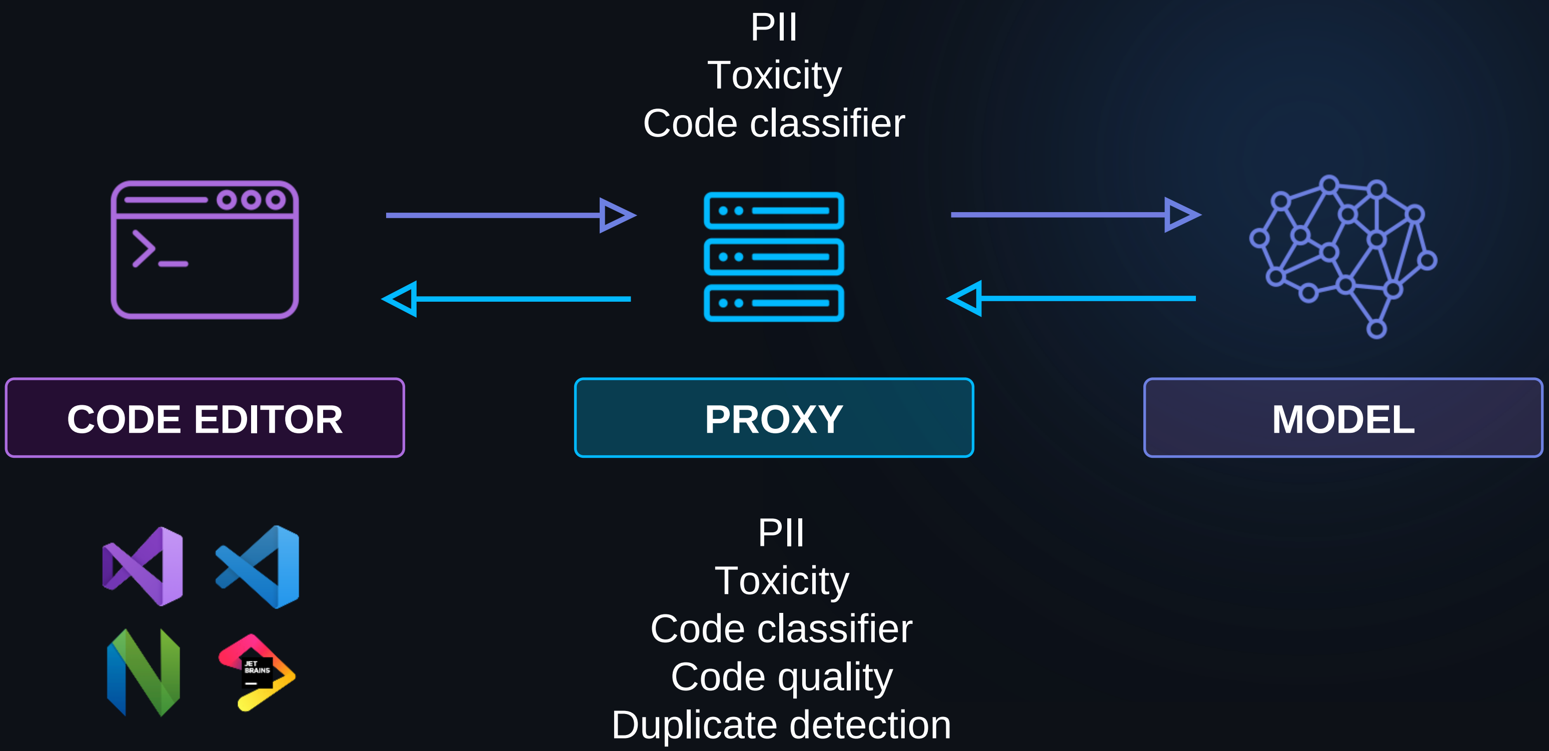
Let’s start with a high-level overview of GitHub Copilot

- GitHub Copilot is there to enhance daily work
  - Like a smart assistant or mentor by your side
- Draws context from text & code in open tabs
- Powered by OpenAI
  - Copilot uses a transformative model
  - Think of something like Google Translate
- Trained on large datasets to ensure accuracy
  - It even can help with HTML and markdown!
- Available as an extension to IDEs and editors



```
#!/usr/bin/env ts-node

import { fetch } from "fetch-h2";

// Determine whether the sentiment of te
// Use a web service
async function isPositive(text: string)

  const response = await fetch(`http://te
    method: "POST",
    body: `text=${text}`,
    headers: {
      "Content-Type": "application/x-www-
    },
  });
  const json = await response.json();
  return json.label === "pos";
}
```

Data flow through the Copilot ecosystem



PII
Toxicity
Code classifier

CODE EDITOR

PROXY

MODEL

PII
Toxicity
Code classifier
Code quality
Duplicate detection

Copilot vs Copilot Chat

Copilot

Direct Code Writing

Seamless IDE Integration

Solo Development

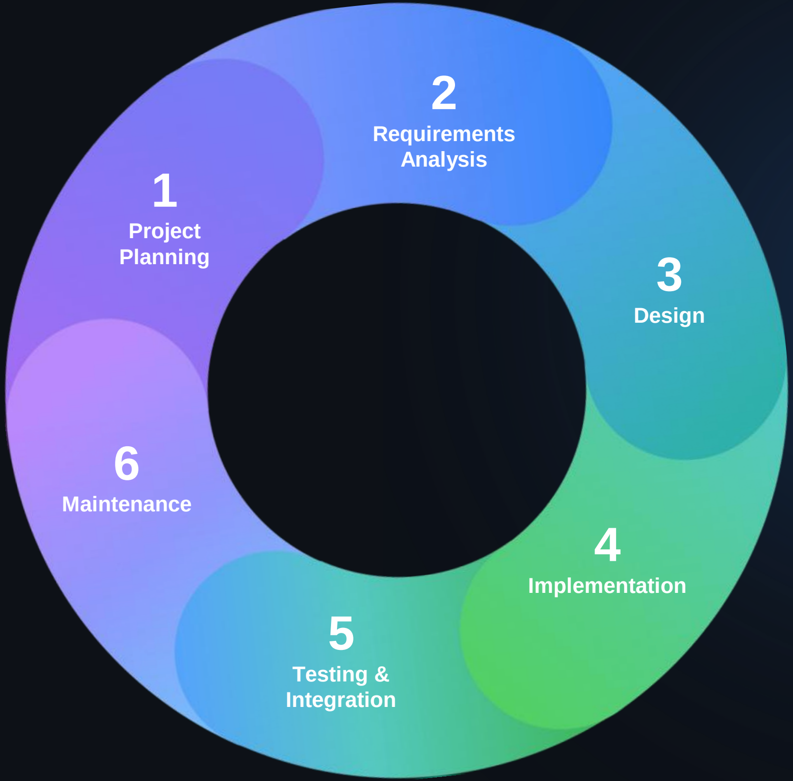
Copilot Chat

In-Depth Interactive Assistance

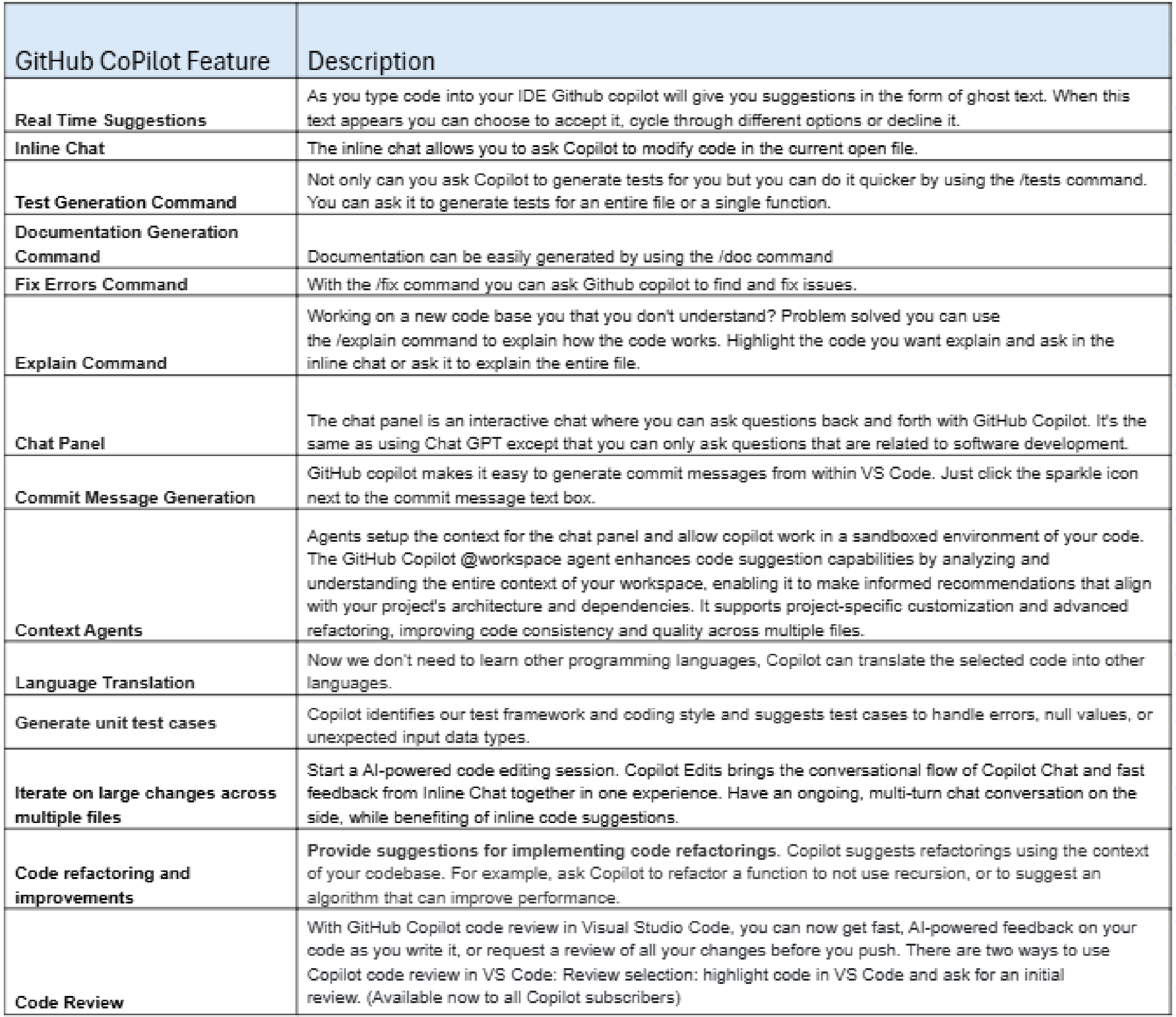
Learning & Teaching

Collaborative Scenarios

GitHub Copilot + Chat



Helps developers stay in the flow throughout the entire SDLC



GitHub CoPilot Feature	Description
Real Time Suggestions	As you type code into your IDE Github copilot will give you suggestions in the form of ghost text. When this text appears you can choose to accept it, cycle through different options or decline it.
Inline Chat	The inline chat allows you to ask Copilot to modify code in the current open file.
Test Generation Command	Not only can you ask Copilot to generate tests for you but you can do it quicker by using the /tests command. You can ask it to generate tests for an entire file or a single function.
Documentation Generation Command	Documentation can be easily generated by using the /doc command
Fix Errors Command	With the /fix command you can ask Github copilot to find and fix issues.
Explain Command	Working on a new code base you that you don't understand? Problem solved you can use the /explain command to explain how the code works. Highlight the code you want explain and ask in the inline chat or ask it to explain the entire file.
Chat Panel	The chat panel is an interactive chat where you can ask questions back and forth with GitHub Copilot. It's the same as using Chat GPT except that you can only ask questions that are related to software development.
Commit Message Generation	GitHub copilot makes it easy to generate commit messages from within VS Code. Just click the sparkle icon next to the commit message text box.
Context Agents	Agents setup the context for the chat panel and allow copilot work in a sandboxed environment of your code. The GitHub Copilot @workspace agent enhances code suggestion capabilities by analyzing and understanding the entire context of your workspace, enabling it to make informed recommendations that align with your project's architecture and dependencies. It supports project-specific customization and advanced refactoring, improving code consistency and quality across multiple files.
Language Translation	Now we don't need to learn other programming languages, Copilot can translate the selected code into other languages.
Generate unit test cases	Copilot identifies our test framework and coding style and suggests test cases to handle errors, null values, or unexpected input data types.
Iterate on large changes across multiple files	Start a AI-powered code editing session. Copilot Edits brings the conversational flow of Copilot Chat and fast feedback from Inline Chat together in one experience. Have an ongoing, multi-turn chat conversation on the side, while benefiting of inline code suggestions.
Code refactoring and improvements	**Provide suggestions for implementing code refactorings.** Copilot suggests refactorings using the context of your codebase. For example, ask Copilot to refactor a function to not use recursion, or to suggest an algorithm that can improve performance.
Code Review	With GitHub Copilot code review in Visual Studio Code, you can now get fast, AI-powered feedback on your code as you write it, or request a review of all your changes before you push. There are two ways to use Copilot code review in VS Code: Review selection: highlight code in VS Code and ask for an initial review. (Available now to all Copilot subscribers)

Prompt Engineering

What is Prompt Engineering?

Prompt engineering is the process of designing and creating high-quality prompts that can be used to generate accurate and useful code suggestions with Copilot.

- Copilot

AI Prompting Techniques

In the realm of GitHub Copilot, Zero-shot, One-shot, and Few-shot prompting refer to guiding the AI with varying levels of examples.

Zero-shot prompting doesn't provide any prior examples, expecting Copilot to understand and generate relevant code purely from the given task description.

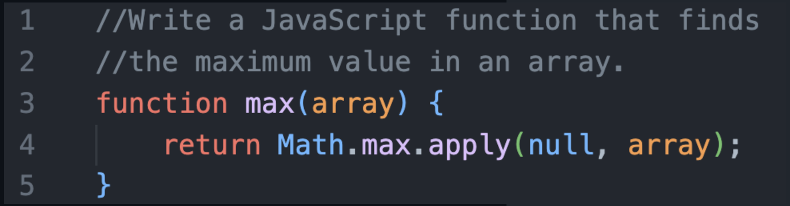
One-shot prompting provides a single example to set the context, assisting Copilot in generating a similar outcome.

Few-shot prompting involves offering multiple examples to establish a clearer pattern for the desired code output.

By understanding these techniques, developers can better instruct Copilot, ensuring more accurate and context-aware code suggestions.

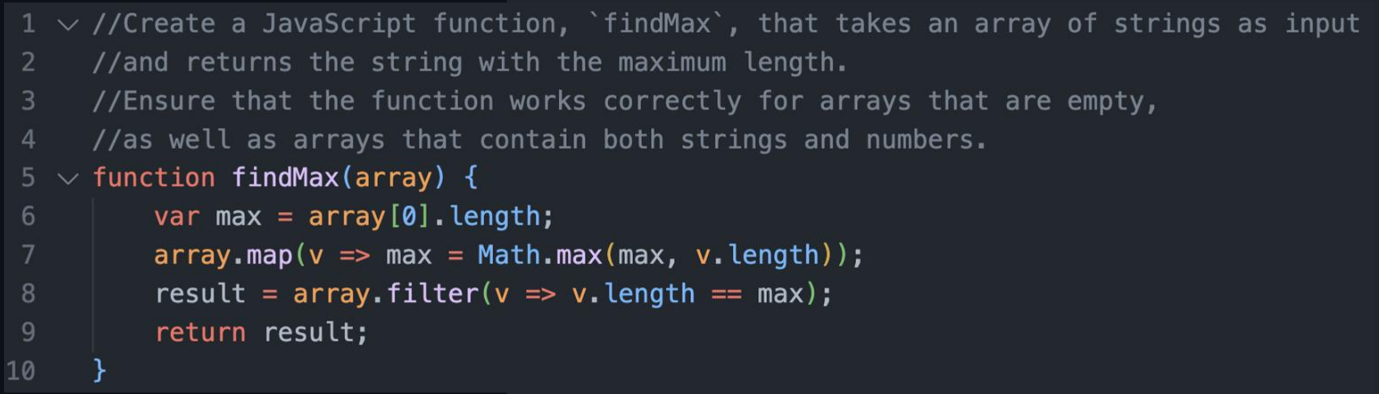
Zero Shot vs One Shot Prompting

Zero Shot Prompt



```javascript
//Write a JavaScript function that finds
//the maximum value in an array.
function max(array) {
    return Math.max.apply(null, array);
}
```

One-Shot Prompt



```javascript
//Create a JavaScript function, `findMax`, that takes an array of strings as input
//and returns the string with the maximum length.
//Ensure that the function works correctly for arrays that are empty,
//as well as arrays that contain both strings and numbers.
function findMax(array) {
    var max = array[0].length;
    array.map(v => max = Math.max(max, v.length));
    result = array.filter(v => v.length == max);
    return result;
}
```

Providing Context

To help Copilot generate accurate suggestions:

- Add a top-level comment block describing the purpose of the file
- Front load as many imports as needed (import / include / requires / etc.)
- Create a detailed comment block describing the purpose of an operation or UDT
- Use sample code as a starting point
- Have related content open in other tabs

Helpful Patterns

* Use descriptive variable names to make your intentions clear.

```
totalSampleCount = 1000
```

* Maintain consistent naming conventions for variables and functions.

```
i.e. using camelCase for variable names consistency
```

* Define method signatures with unambiguous parameter names and types.

```
double calculateAverageSampleSize(unsigned long samples[], size_t size)
```

* Use comments to explain the purpose of the code.

```
This function 'palindrome' takes an array of strings
as input and returns  true if a palindrome is found.
```

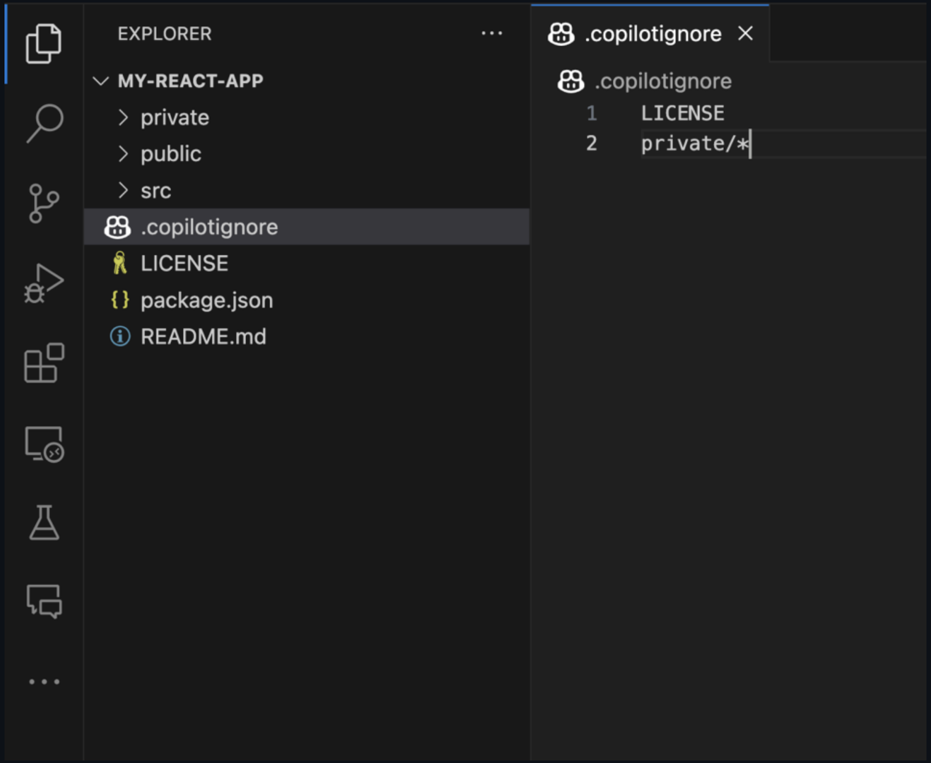
Helpful Patterns

```
* Specify error handling scenarios.

    Exit where the input is NULL and throw and
    exception if the input out of range [min, max] inclusive.

* Describe control flow structures.

    Write a while loop to print the first 'n' values in the fibonnaci sequence.

* Show examples of how to use the code.

    int samples[] = {1, 2, 3, 4, 5};
    double average = calculateAverageSampleSize(samples, 5);
    printf("Average: %f\n", average); // Average: 3.0

* Test your code.

    Write a test suite to verify the correctness of the code.
```

Secure coding

Block files from Copilot

Use .copilotignore to block files and folders from being used by Github Copilot



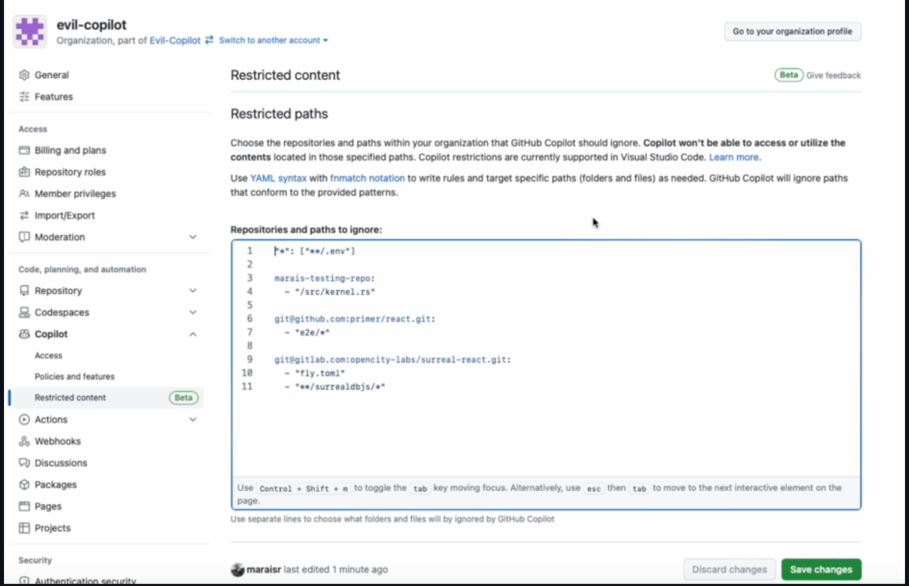
```
LICENSE
private/*
```

Block files from Copilot

- The Copilot Restricted Content feature allows repository owners to control the usage of Copilot across their codebases.

- This includes specific files, folders, or entire repositories, even if they're not hosted on GitHub.

- The goal is to provide CfB customers a flexible way of controlling what content Copilot can access for prompt crafting and where it can insert code.



Restricted content

Restricted paths

Choose the repositories and paths within your organization that GitHub Copilot should ignore. **Copilot won't be able to access or utilize the contents** located in those specified paths. Copilot restrictions are currently supported in Visual Studio Code. Learn more.

Use YAML syntax with fnmatch notation to write rules and target specific paths (folders and files) as needed. GitHub Copilot will ignore paths that conform to the provided patterns.

Repositories and paths to ignore:

```
"*": ["**/.env"]

marais-testing-repo:
  - "/src/kernel.rs"

git@github.com:primer/react.git:
  - "e2e/*"

git@gitlab.com:opencity-labs/surreal-react.git:
  - "fly.toml"
  - "**/surrealdbjs/*"
```

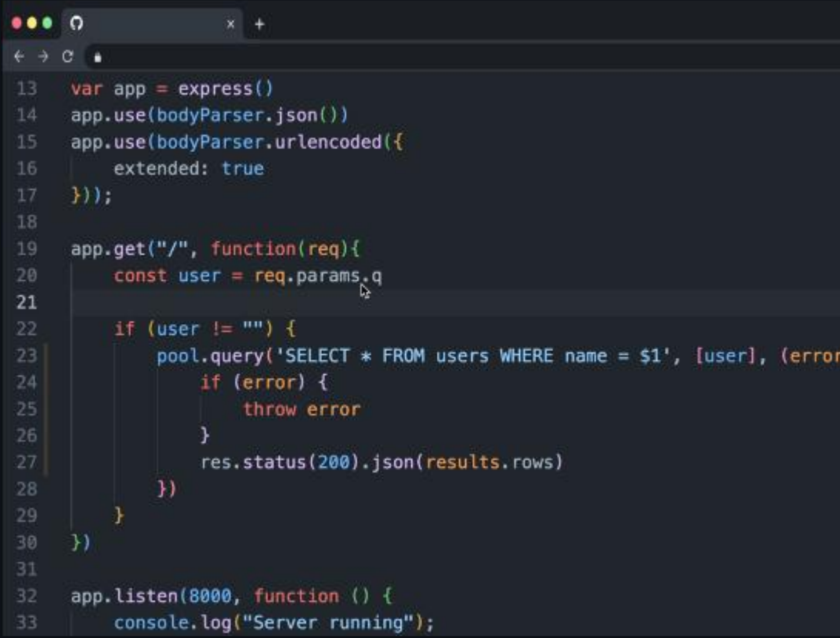
Use `Control + Shift + m` to toggle the `tab` key moving focus. Alternatively, use `esc` then `tab` to move to the next interactive element on the page.

Use separate lines to choose what folders and files will by ignored by GitHub Copilot

maraisr last edited 1 minute ago

Copilot and Secure Coding

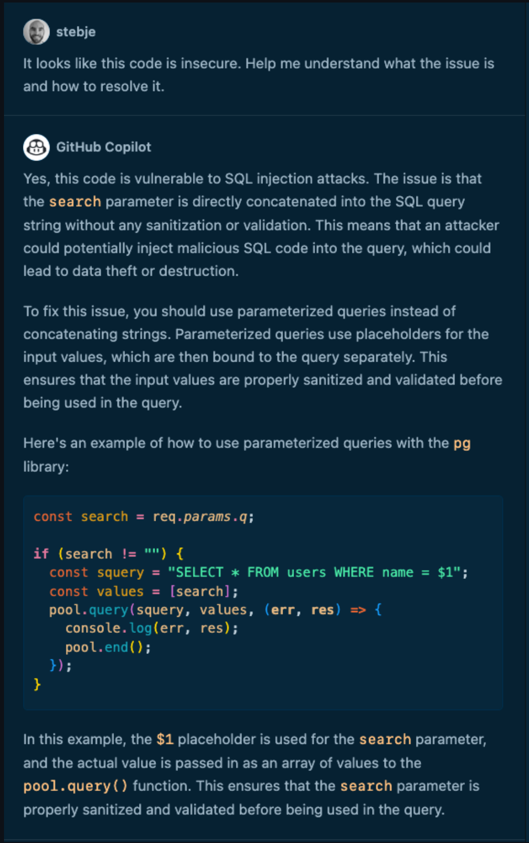
- AI-based vulnerability system that helps prevent insecure coding patterns (e.g. SQL script injection)
- Vulnerability filters are applied only to the Copilot-generated suggestion itself
  - ⊗ It cannot detect downstream vulnerabilities introduced by the code e.g. on deployment infrastructure
  - ⓘ **We recommend taking the same precautions you take with code written by engineers (linting, code scanning, etc.)**
- Copilot Chat can be used to query code for known vulnerabilities



```
var app = express()
app.use(bodyParser.json())
app.use(bodyParser.urlencoded({
    extended: true
}));

app.get("/", function(req){
    const user = req.params.q

    if (user != "") {
        pool.query('SELECT * FROM users WHERE name = $1', [user], (error
            if (error) {
                throw error
            }
            res.status(200).json(results.rows)
        })
    }
})

app.listen(8000, function () {
    console.log("Server running");
```

Detection & Remediation

- Prompt for insecure coding patterns
- Use GHAS Code Scanning results
- Write custom CodeQL queries
- Increase your knowledge of secure coding patterns
- Create custom Secret Scanning patterns



stebje

It looks like this code is insecure. Help me understand what the issue is and how to resolve it.

GitHub Copilot

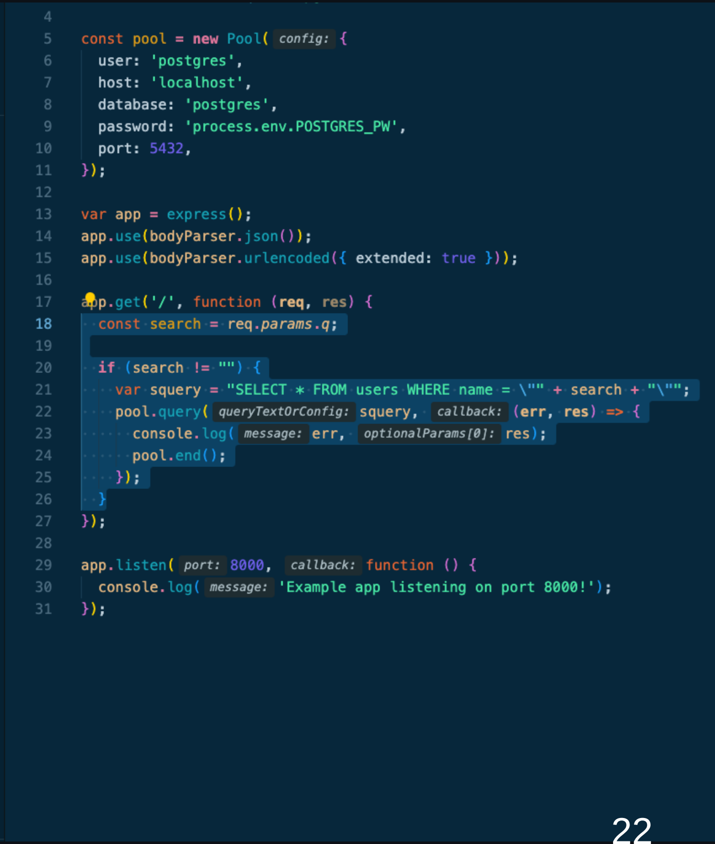
Yes, this code is vulnerable to SQL injection attacks. The issue is that the `search` parameter is directly concatenated into the SQL query string without any sanitization or validation. This means that an attacker could potentially inject malicious SQL code into the query, which could lead to data theft or destruction.

To fix this issue, you should use parameterized queries instead of concatenating strings. Parameterized queries use placeholders for the input values, which are then bound to the query separately. This ensures that the input values are properly sanitized and validated before being used in the query.

Here's an example of how to use parameterized queries with the `pg` library:

```
const search = req.params.q;

if (search != "") {
  const squery = "SELECT * FROM users WHERE name = $1";
  const values = [search];
  pool.query(squery, values, (err, res) => {
    console.log(err, res);
    pool.end();
  });
}
```

In this example, the `$1` placeholder is used for the `search` parameter, and the actual value is passed in as an array of values to the `pool.query()` function. This ensures that the `search` parameter is properly sanitized and validated before being used in the query.



```

const pool = new Pool( config: {
  user: 'postgres',
  host: 'localhost',
  database: 'postgres',
  password: 'process.env.POSTGRES_PW',
  port: 5432,
});

var app = express();
app.use(bodyParser.json());
app.use(bodyParser.urlencoded({ extended: true }));

app.get('/', function (req, res) {
  const search = req.params.q;

  if (search != "") {
    var squery = "SELECT * FROM users WHERE name = \"" + search + "\"";
    pool.query( queryTextOrConfig: squery,  callback: (err, res) => {
      console.log( message: err,  optionalParams[0]: res);
      pool.end();
    });
  }
});

app.listen( port: 8000,  callback: function () {
  console.log( message: 'Example app listening on port 8000!');
});
```

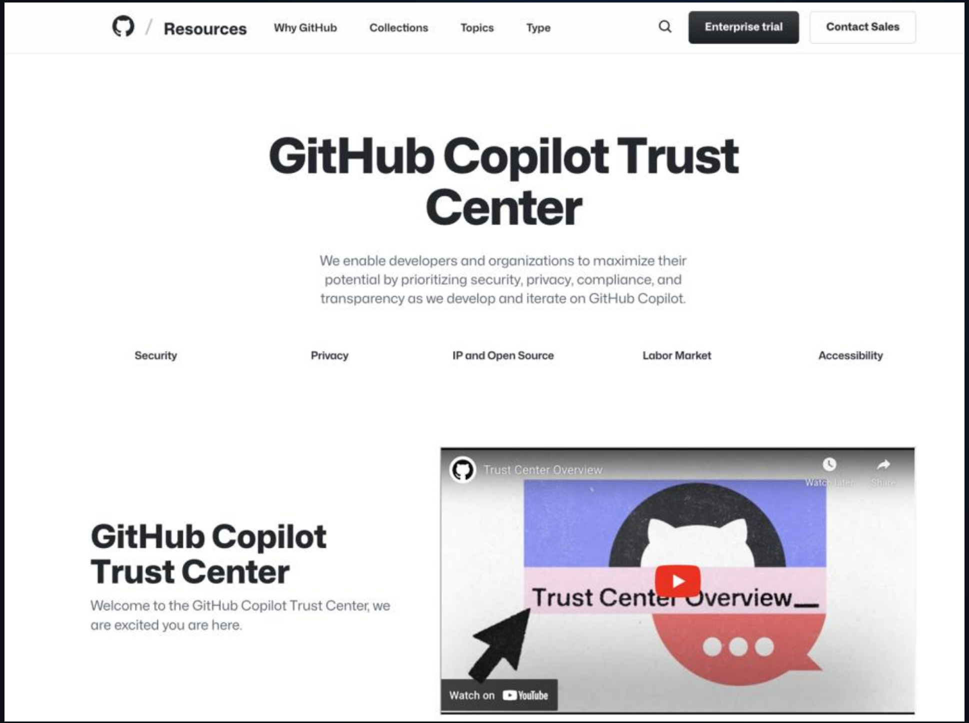
Copilot + GHAS

- Copilot is not a replacement of GHAS features
- Copilot can be used in tandem with GHAS features to detect and remediate vulnerabilities earlier during the SDLC
  - GHAS Code scanning results
  - GHAS Secret scanning

Security & Trust

Copilot Trust Center

- Security
- Privacy
- Data flow
- Copyright
- Labor market
- Accessibility
- Contracting



GitHub Copilot Trust Center

We enable developers and organizations to maximize their potential by prioritizing security, privacy, compliance, and transparency as we develop and iterate on GitHub Copilot.

GitHub Copilot Trust Center

Welcome to the GitHub Copilot Trust Center, we are excited you are here.

GitHub Copilot Trust Center - GitHub Resources

Wrap Up

Thank you