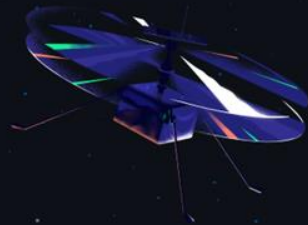




Copilot for Business Developer training

Level: Intermediate

Let's build from here



AGENDA

Copilot for Business - Introduction

Coding

Best practices & Prompt Engineering

Workshop (1 - 2 hours long)

Copilot X - Feature Overview

Secure coding

Wrap-up, Q&A



“Copilot for Business – Introduction” (deck)



Outcome of this training

At the end of training, you will achieve the following results...

- ✓ Get answers to specific use case scenario questions
- ✓ Increase existing Copilot skills by following a specific workshop tutorial catered to your needs
- ✓ Learn in-depth tips and tricks and best practices on how to best utilize GitHub Copilot

Covered in Copilot Fundamental

We will not talk about...



Statistics around Copilot usage and satisfaction



Successful customer case study



Enterprise & Organization administrator interface

Coding

GH Copilot vs GH Copilot Chat

Create Workspace

Create Notebook

Data Generation

Testing with GH Copilot

Code Refining and Refactoring

Block Files

Debugging

GH Rest APIs

When to use Copilot vs Copilot Chat

Copilot

Direct Code Writing

Seamless IDE Integration

Solo Development

Copilot Chat

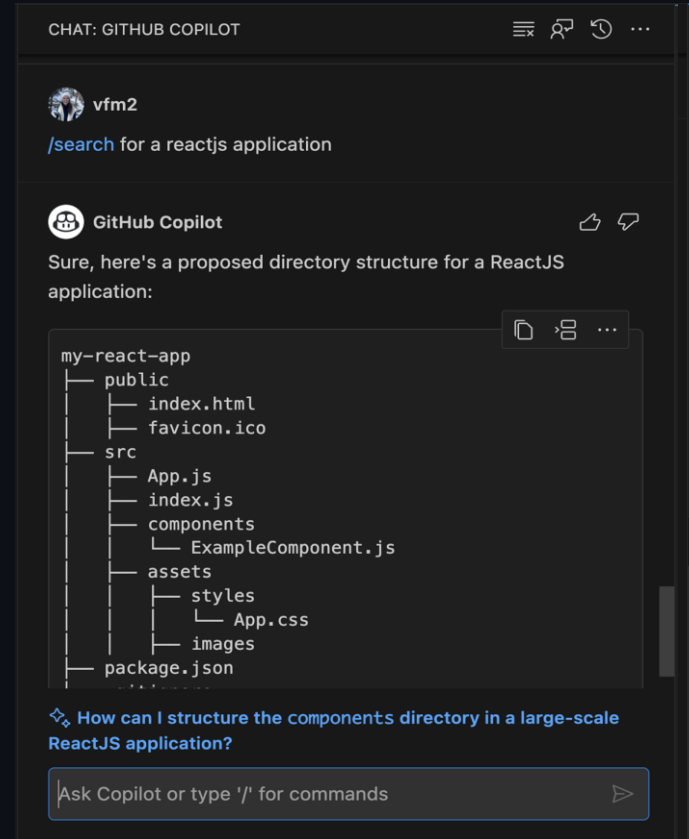
In-Depth Assistance

Learning & Teaching

Collaborative Scenarios

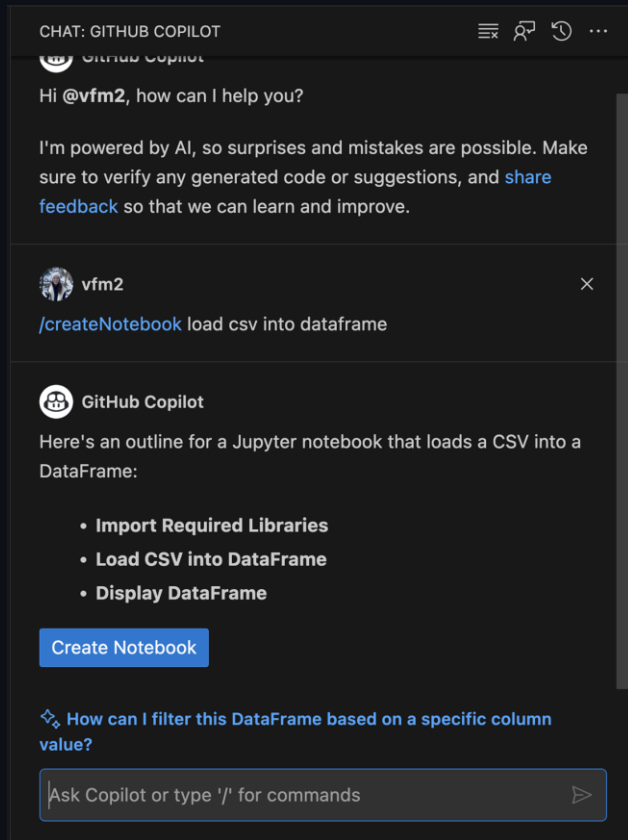
Create Workspace

/search to query
parameters
/createWorkspace to
create a workspace for
your project



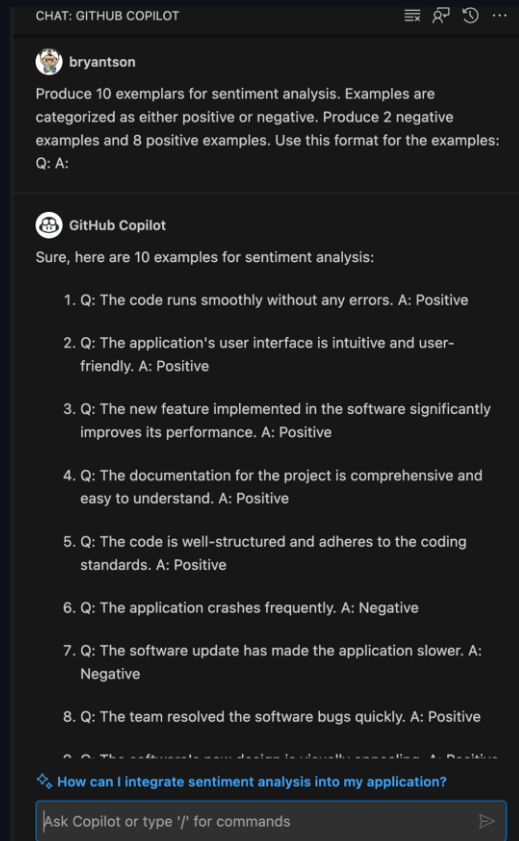
Create Jupyter Notebook

/createNotebook to
generate a Jupyter
Notebook based on
your requirements



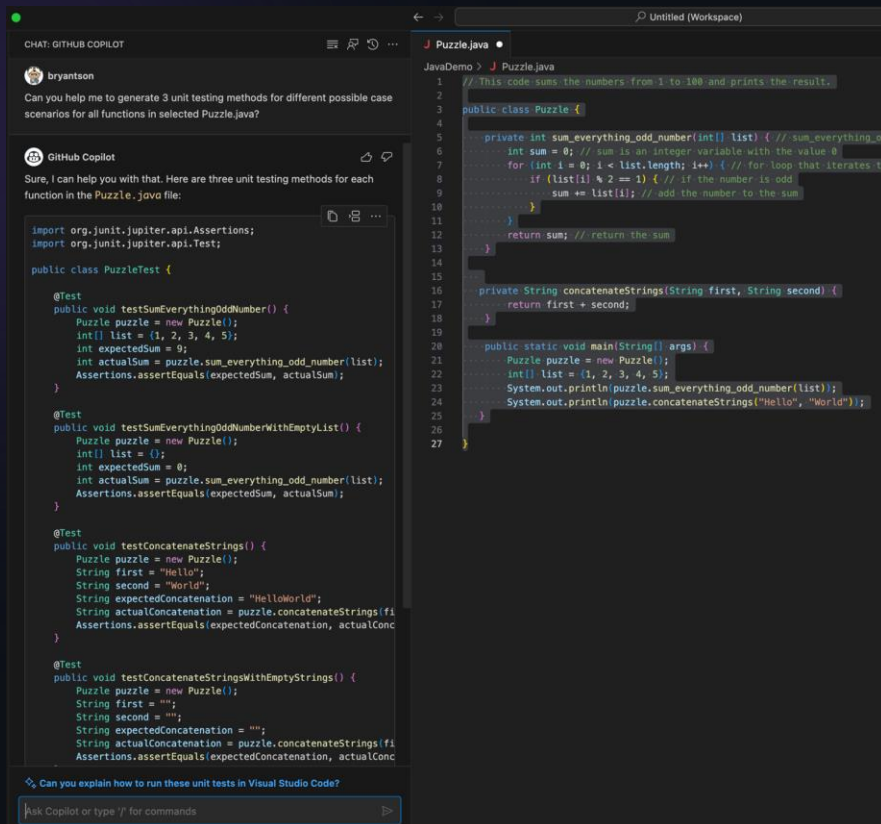
Data Generation

Ask Copilot to
generate data



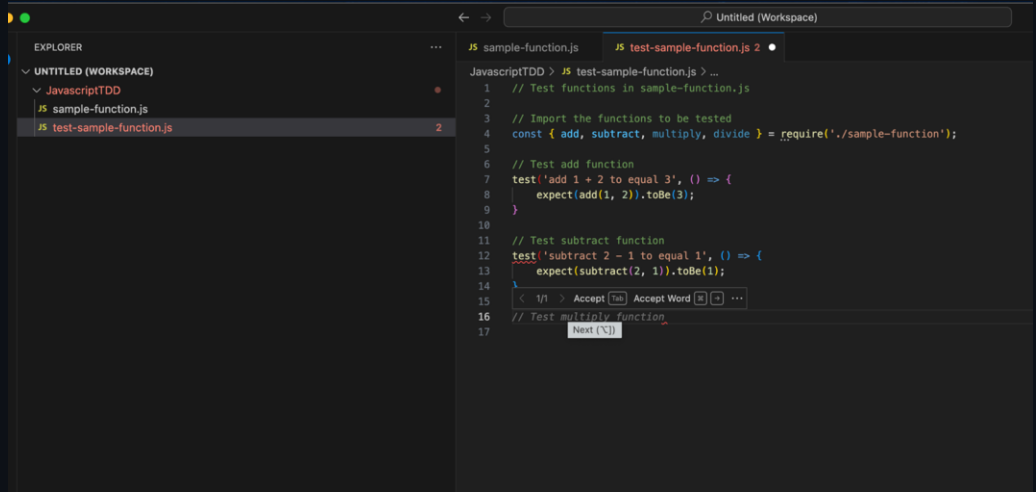
Unit Testing Generation - Copilot Chat

Works best for
general **unit
testing** case
generation



Test Driven Development (TDD)

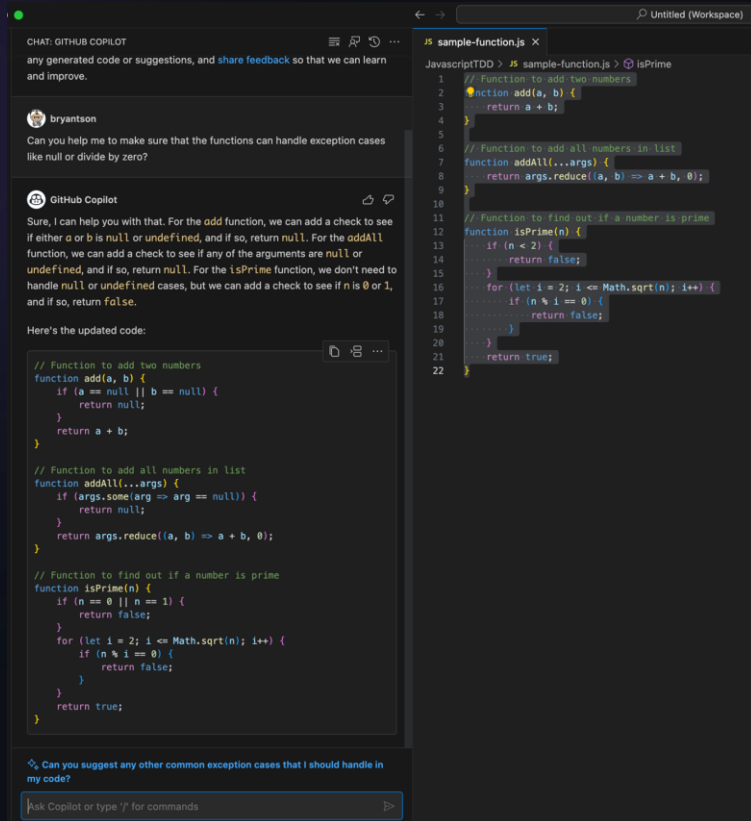
Test Driven
Development
(TDD) practice is
possible



```
JavaScriptTDD > JS test-sample-function.js > ...
1 // Test functions in sample-function.js
2
3 // Import the functions to be tested
4 const { add, subtract, multiply, divide } = require('./sample-function');
5
6 // Test add function
7 test('add 1 + 2 to equal 3', () => {
8   expect(add(1, 2)).toBe(3);
9 })
10
11 // Test subtract function
12 test('subtract 2 - 1 to equal 1', () => {
13   expect(subtract(2, 1)).toBe(1);
14 })
15
16 // Test multiply function
17
```

Code Refactoring

Refactoring is
possible through
GitHub Copilot
Chat



Code Refining

GH Copilot CPU usage tool

The screenshot displays the Visual Studio Code interface with the 'Autosights' extension active. The 'CPU Usage' window shows a table of CPU usage data for the 'IoCContainer.cs' file. The table includes columns for Function Name, Total CPU (unit, %), Self CPU (unit, %), Module, and Category. The 'IoCContainer.MainSystem.String()' function is highlighted, showing a total CPU usage of 15848 (96.23%) and a self CPU usage of 6 (0.04%).

Function Name	Total CPU (unit, %)	Self CPU (unit, %)	Module	Category
Autosights (PID: 30324)	16469 (100.00%)	196 (1.19%)	Multiple modules	
IoCContainer.MainSystem.String()	15848 (96.23%)	6 (0.04%)	autosights	
IoCContainer.ClearContext(string)	8722 (52.96%)	797 (4.84%)	autosights	
IoCContainer.RegisterContextSpec(string)	7109 (42.17%)	195 (1.18%)	autosights	
IoCContainer.Clear()	11 (0.07%)	1 (0.01%)	autosights	
[Internal Call] System.StartupHook.Thread.Start...	258 (1.57%)	258 (1.57%)	System.Private.Co...	
[Internal Call] System.Threading.Thread.Start...	118 (0.72%)	118 (0.72%)	System.Private.Co...	
[Internal Call] System.AppContext.Setup(vecha...	24 (0.15%)	24 (0.15%)		
[Internal Call] System.Threading.IOCompleto...	11 (0.07%)	11 (0.07%)	System.Private.Co...	
[Internal Call] System.Threading.IOCompleto...	6 (0.04%)	6 (0.04%)	System.Private.Co...	
[Internal Call] System.GenGcCallback.Finalize...	4 (0.02%)	4 (0.02%)	System.Private.Co...	
[Internal Call] dynamicClass_IL_STUB.ReverseP...	2 (0.01%)	2 (0.01%)	System.Private.Co...	
[Internal Call] System.Threading.ThreadPool.E...	2 (0.01%)	2 (0.01%)	System.Private.Co...	

The 'Analyze method with Copilot' window shows the following code snippet:

```
47 }
48
49 /// <summary>
50 /// Remove all instances registered with <paramref name="context"/>.
51 /// </summary>
52 /// <param name="context">The context</param>
53 public void ClearContext(string context)
54 {
55     // We can remove while iterating over the keys since ConcurrentDictionary
56     // readonly copy of keys in the Keys property
57     foreach (var key in this.registeredObjects.Keys)
58     {
59         if (key.EndsWith(ContextSeparator + context, StringComparison.Ordinal)
60         {
61             bool removed = this.registeredObjects.TryRemove(key, out object
```

The 'GitHub Copilot chat' window shows the following text:

I'm powered by AI, so surprises and mistakes are possible. Make sure to verify any AI code or suggestions, and share feedback so that we can learn and improve.

Mark Downie

The following method uses System.Collections.Concurrent.ConcurrentDictionary<T>.GetKeys(): public void ClearContext(string context) { // We can remove while iterating over the keys since ConcurrentDictionary returns a // readonly copy of keys in the Keys property foreach (var key in this.registeredObjects.Keys) { if (key.EndsWith(ContextSeparator + context, StringComparison.Ordinal)) { bool removed = this.registeredObjects.TryRemove(key, out object value); if (removed && value is IDisposable disposableInstance) { try { disposableInstance.Dispose(); } catch (Exception e) { Debug.Fail(e.Message); } } } } } Explain how this takes a lock and makes a copy and give a fix that enumerates KeyValuePairs for efficient access to keys and avoid using inside loops. Also explain why this fix is better for performance."

Copilot

The ConcurrentDictionary<T> is thread-safe and implements multiple locks to ensure access from multiple threads is optimized for performance. The GetKeys() method within it, internally calls the GetEnumerator() method which takes a lock and creates a copy of the key collection before returning. Therefore, enumerating through the keys one by one in a loop like in the provided code block may not be performant since it may cause multiple locks and can consume too much memory.

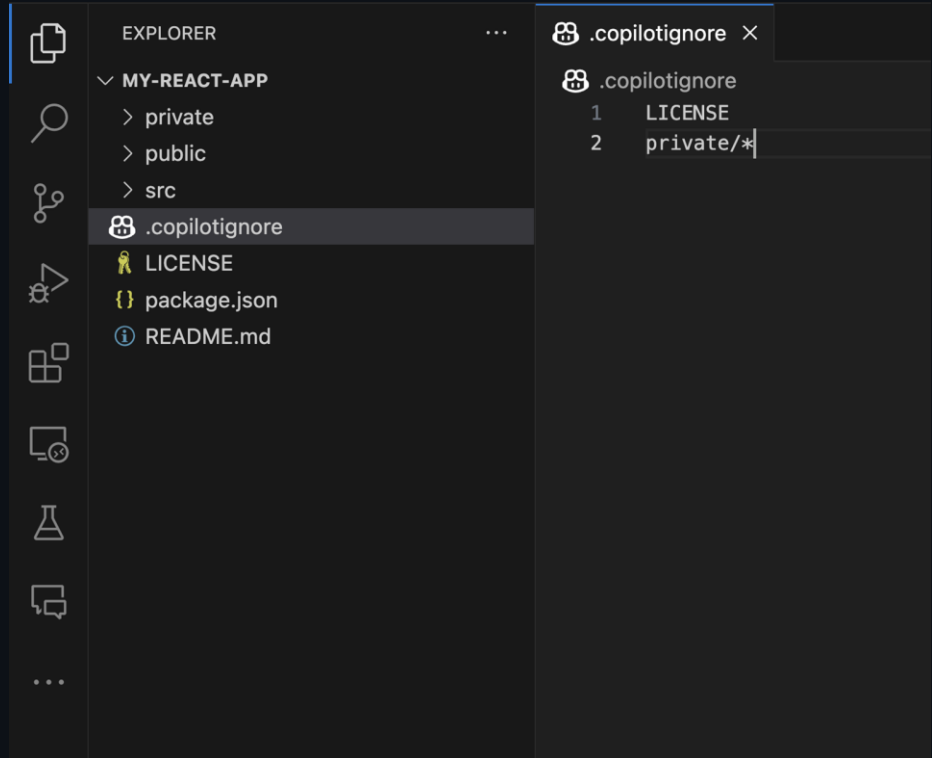
To improve the performance, you

AI suggestions might be inaccurate

Ask Copilot

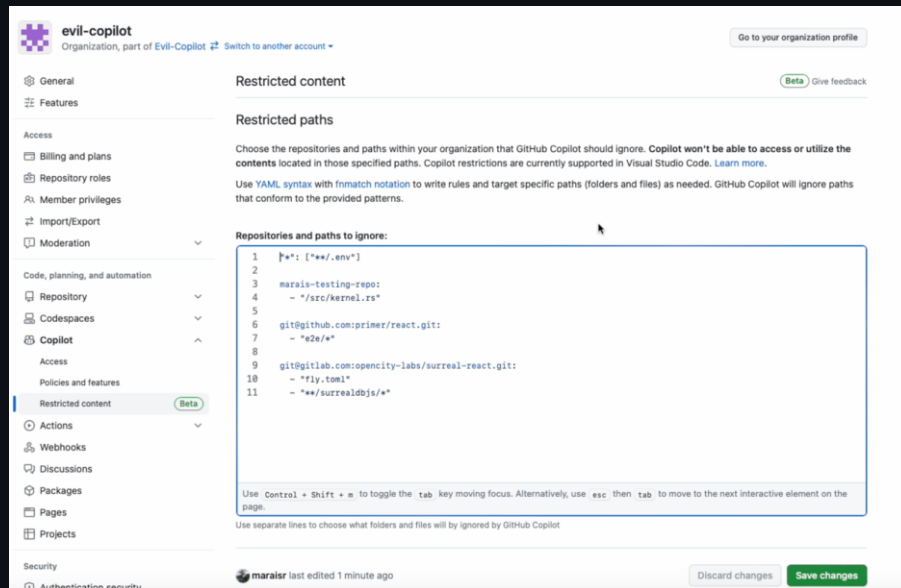
Block files from Copilot

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



Block files from Copilot

Ignore specific
repositories and
paths in Restricted
Content



Code Debugging

Debugging with GitHub Copilot

```
42     def collisions(self):
43         if pygame.sprite.spritecollide(self.plane, self.collision_sprites,
44                                         or self.plane.rect.top <= 0:
45             for sprite in self.collision_sprites.sprites():
46                 if sprite.sprite_type == 'obstacle':
46+                 if sprite.sprite_type == 'obstacle':

/fix Expected ":"
Accept Discard [v] [refresh] Changed 1 line [thumbs up] [thumbs down]
```

```
47         sprite.kill()
48         self.active = False
49         self.plane.kill()
50
```

GitHub Rest API

GitHub Copilot Rest API

GET /orgs/{org}/copilot/billing

cURL JavaScript GitHub CLI

```
# GitHub CLI api
# https://cli.github.com/manual/gh_api

gh api \
-H "Accept: application/vnd.github+json" \
-H "X-GitHub-Api-Version: 2022-11-28" \
/orgs/ORG/copilot/billing
```

Example response Response schema

Status: 200

```
{
  "seat_breakdown": {
    "total": 12,
    "added_this_cycle": 9,
    "pending_invitation": 0,
    "pending_cancellation": 0,
```



Demo: Coding practices

Best practices

Getting accuracy closer to expectation

- Prompt Engineering

Working at project(s) level

Leveraging Copilot to increase code quality

Addressing concern around security exploit

Getting accuracy closer to expectation

Problems



Copilot fails to produce answer or to keep repeating



Copilot generates incorrect result



Library/module version discrepancies issue



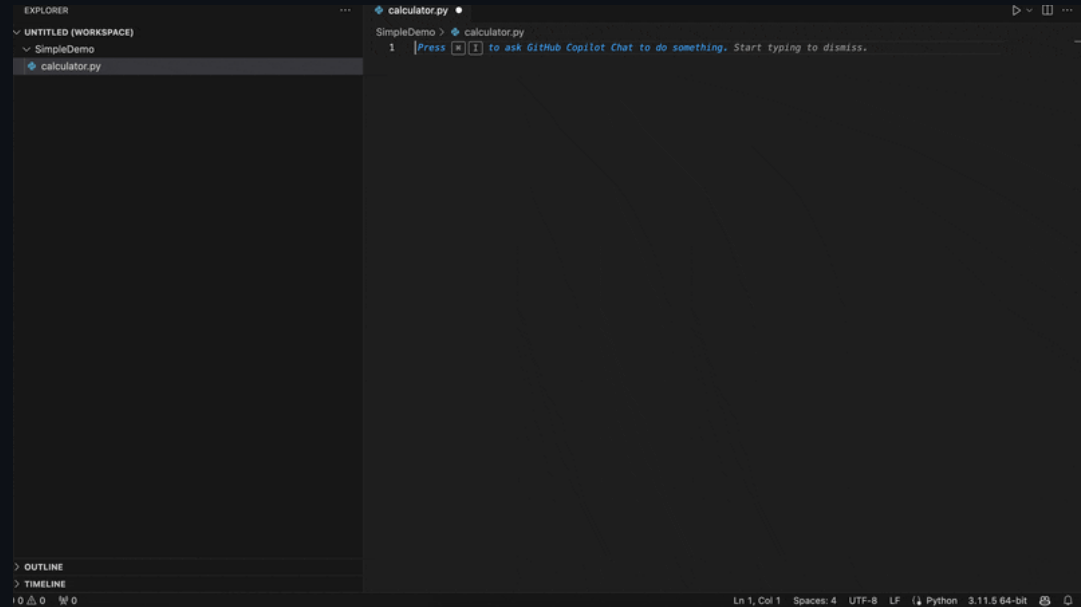
Copilot suggests non-optimal solution

Problems #1:

Copilot fails to produce answer or keep repeating

Some problems

- Fails to produce answer
- Hallucination - Keeps repeating

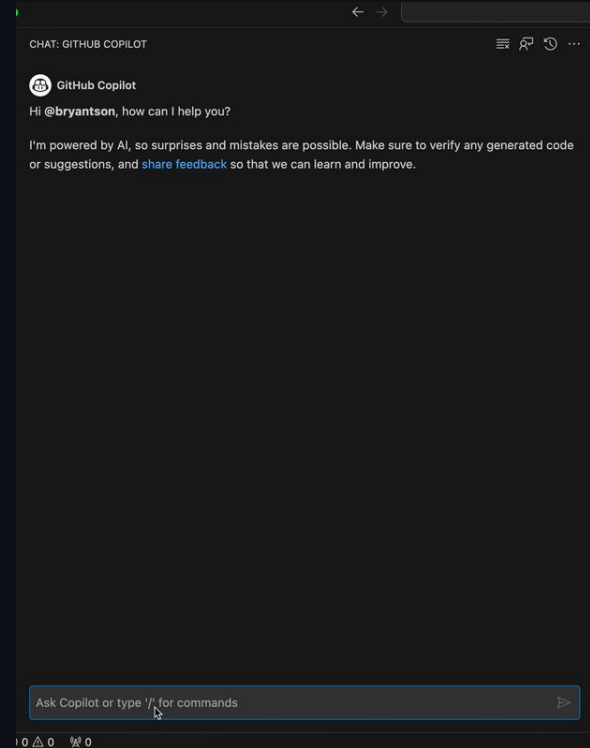


Problems #2:

Copilot generates incorrect result

Reasons why...

- Not enough context
- Old trained data
- Generative in nature



What is a Prompt?



In the context of Copilot, a prompt is a piece of code or natural language description that is used to generate code suggestions. It is the input that Copilot uses to generate its output.

- Copilot

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

Why is Prompt Engineering Important?



- Maximizes utility of Copilot
- Minimizes repeated iterations
- Determines code suggestion quality
- Skill prompts guide Copilot to understand context & nuances
- Refined interactions reduces misunderstandings

Techniques



Zero-Shot
Prompting



One-Shot
Prompting



Few-Shot
Prompting

Techniques

Zero-Shot Programming with Copilot



abelberhane

Write me unit tests for all of the operations in my calculator.js file.



GitHub Copilot

Sure! Here's an example of a test suite that covers all of the operations in a `calculator.js` file:

```
const { calculate } = require('./calculator');

describe('calculator', () => {
  describe('addition', () => {
    it('adds 1 + 2 to equal 3', () => {
      expect(calculate(1, 2, '+')).toBe(3);
    });

    it('adds -5 + 7 to equal 2', () => {
      expect(calculate(-5, 7, '+')).toBe(2);
    });

    it('adds 0.1 + 0.2 to equal 0.3', () => {
      expect(calculate(0.1, 0.2, '+')).toBeCloseTo(0.3);
    });
  });

  describe('subtraction', () => {
    it('subtracts 5 - 3 to equal 2', () => {
      expect(calculate(5, 3, '-')).toBe(2);
    });
  });
});
```

Techniques

One or few shot Programming with Copilot



abelberhane

Write me unit tests for all of the operations in my calculator.js file.

Use the following example: `test('adds 1 + 2 to equal 3', () => { expect(calculate(1, 2, '+')).toBe(3); });`



GitHub Copilot

Here are some examples of unit tests for all of the operations in a calculator.js file:

```
const { calculate } = require('./calculator');

test('adds 1 + 2 to equal 3', () => {
  const result = calculate(1, 2, '+');
  expect(result).toBe(3);
});

test('subtracts 5 - 3 to equal 2', () => {
  const result = calculate(5, 3, '-');
  expect(result).toBe(2);
});

test('multiplies 2 * 4 to equal 8', () => {
  const result = calculate(2, 4, '*');
  expect(result).toBe(8);
});

test('divides 10 / 5 to equal 2', () => {
  const result = calculate(10, 5, '/');
  expect(result).toBe(2);
});

test('throws an error for an invalid operation', () => {
  expect(() => calculate(1, 2, '%')).toThrow('Invalid operation');
});

test('throws an error for division by zero', () => {
  expect(() => calculate(1, 0, '/')).toThrow('Division by zero');
});
```



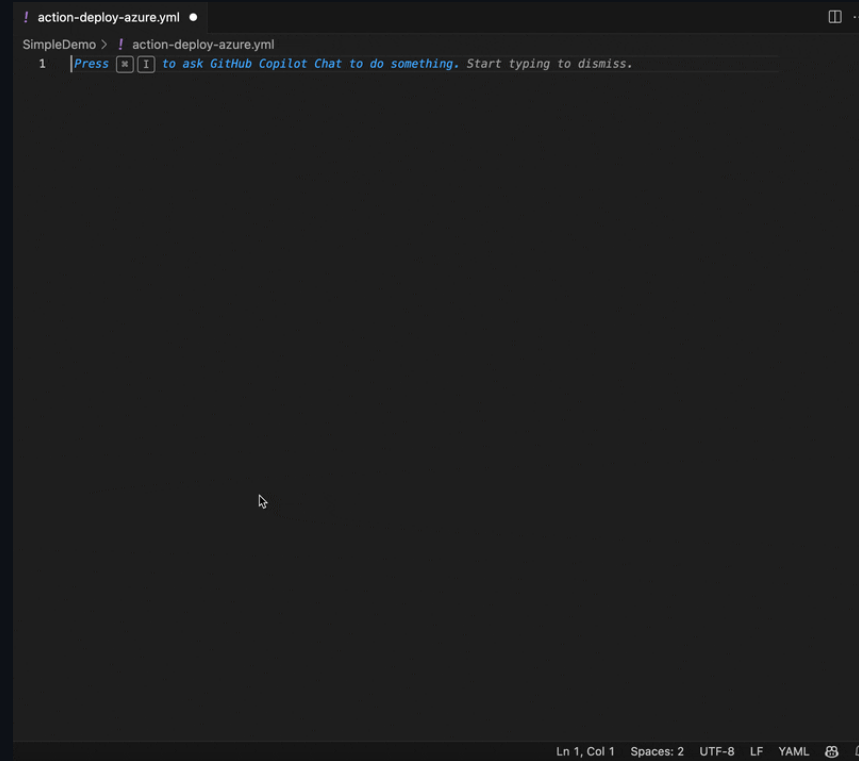
Demo: Prompt Engineering

Problems #3:

Library/module version discrepancy

Old trained data

- While packages go through frequent updates, Copilot does not use latest data

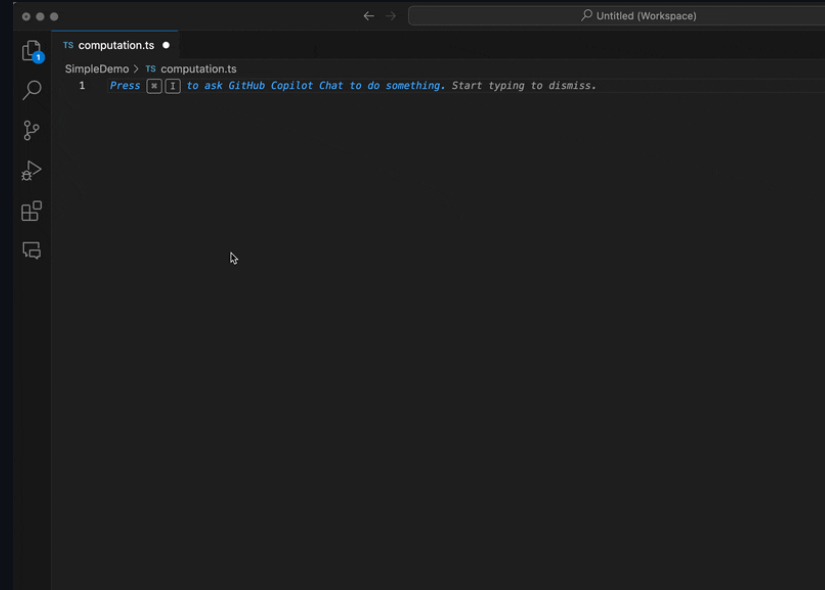


Problems #4:

Copilot suggests non-optimal solution

Although solution works...

Suggested solution is not optimal because Quick Sort can be implemented in $O(1)$ complexity, meaning no space required



How to improve Problem #4

Copilot suggests non-optimal solution

How to improve

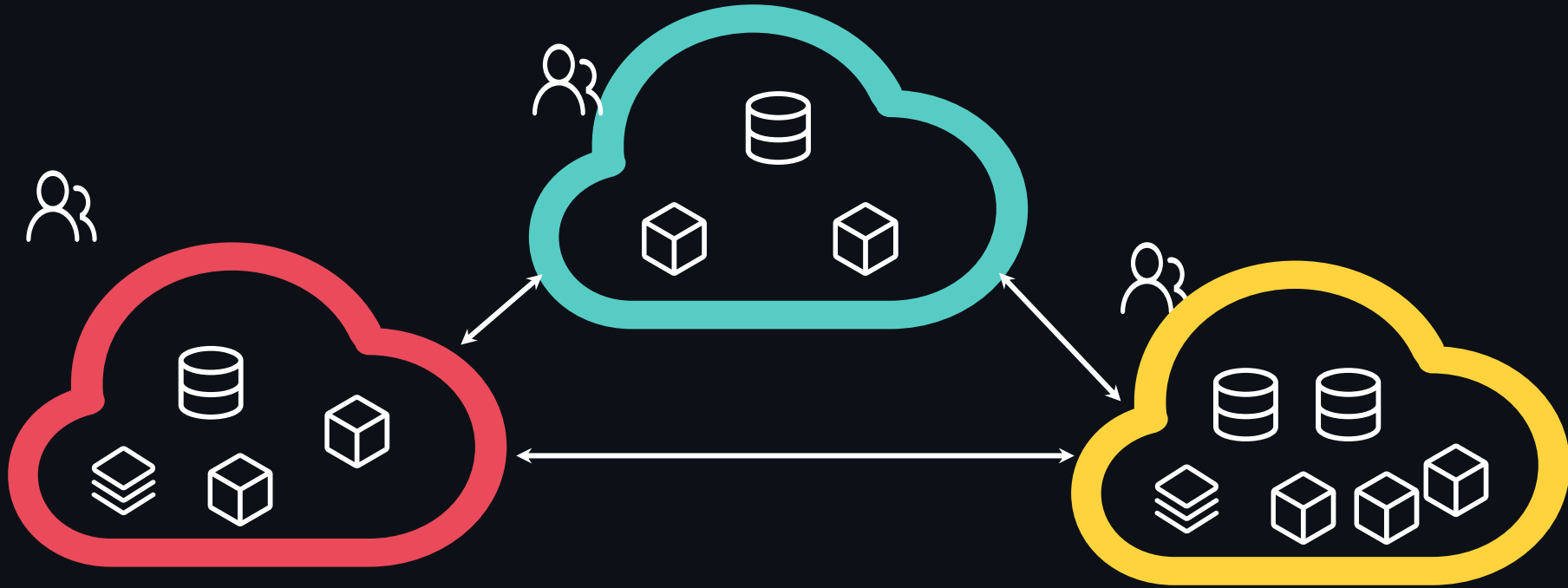
- Ask in Copilot Chat
- Use in-line suggestion from Copilot

A screenshot of a Visual Studio Code editor window. The title bar shows 'SimpleDemo > TS computation.ts 2' and 'quickSort'. The editor displays a TypeScript file with a quicksort algorithm. The code is as follows:

```
1 // Write a quick sort algorithm for me
2 function quickSort(arr) {
3   if (arr.length <= 1) {
4     return arr;
5   }
6   var pivot = arr[0];
7   var left = [];
8   var right = [];
9   for (var i = 1; i < arr.length; i++) {
10    if (arr[i] < pivot) {
11      left.push(arr[i]);
12    }
13    else {
14      right.push(arr[i]);
15    }
16  }
17  return quickSort(left).concat([pivot]).concat(quickSort(right));
18 }
```

The editor has a dark theme and a sidebar on the left with icons for Explorer, Search, Source Control, Run and Debug, and Extensions. The top bar shows 'SimpleDemo > TS computation.ts 2' and 'quickSort'.

How to work at project(s) level



Neighboring Tabs

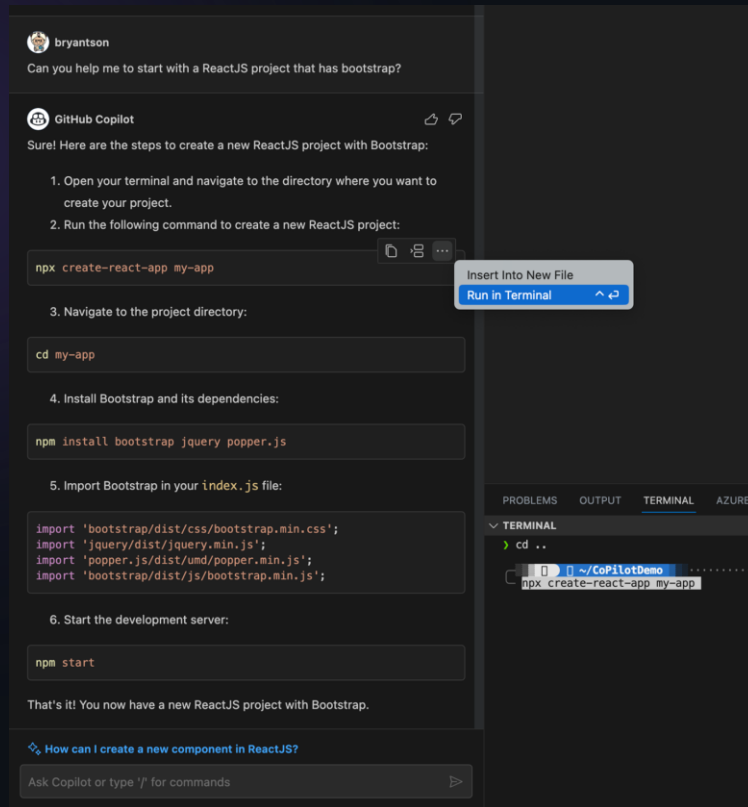
```
sentiments.ts  write_sql.go  parse_expenses.py  addresses.rb

1 #!/usr/bin/env ts-node
2
3 import { fetch } from "fetch-h2";
4
5 // Determine whether the sentiment of text is positive
6 // Use a web service
7 async function isPositive(text: string): Promise<boolean> {
8   const response = await fetch(`http://text-processing.com/api/sentiment/`, {
9     method: "POST",
10    body: `text=${text}`,
11    headers: {
12      "Content-Type": "application/x-www-form-urlencoded",
13    },
14  });
15  const json = await response.json();
16  return json.label === "pos";
17 }
```

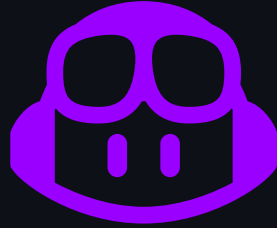
Working in a project level

Ask in **GitHub Copilot Chat** to get started

GitHub Copilot Chat (default)

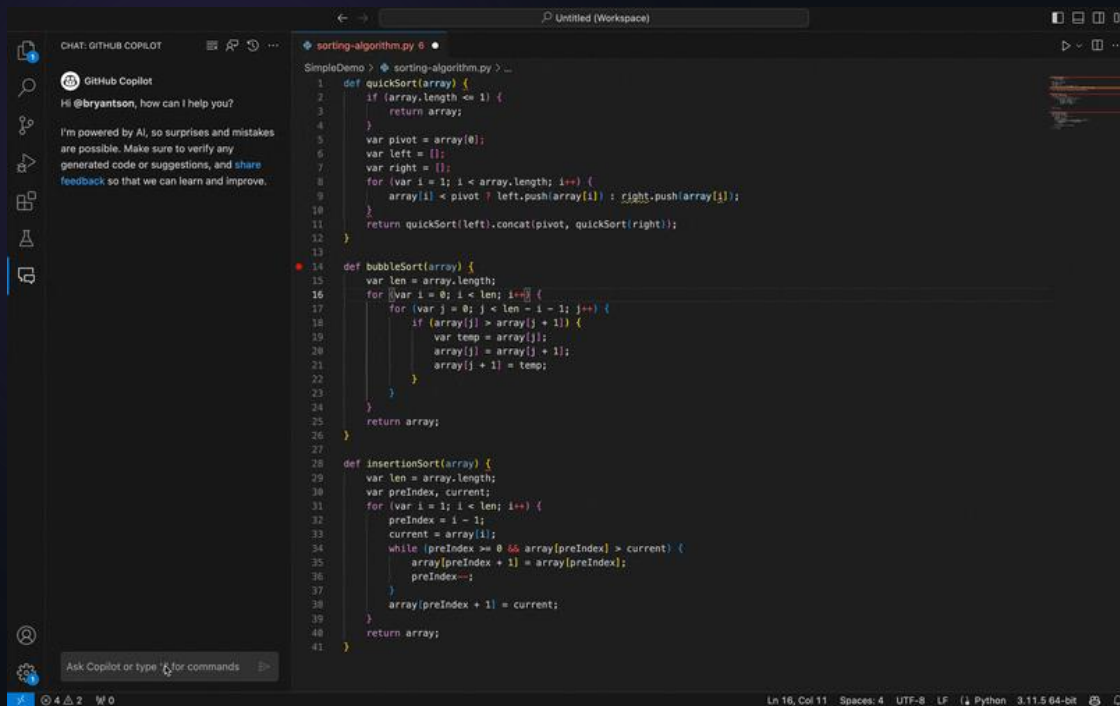


Using Copilot to improve code quality



Copilot Chat: Ask to create tests

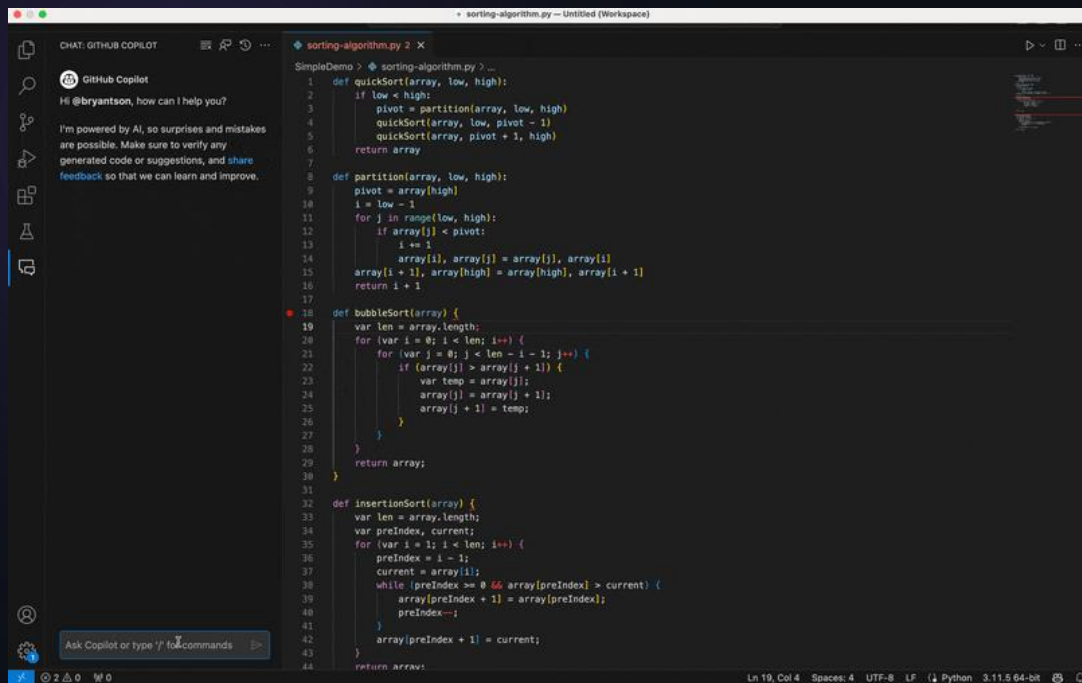
Ask GitHub
Copilot Chat to
refactor your
code



GitHub Copilot Chat (default)

Copilot Chat: Ask to generate tests

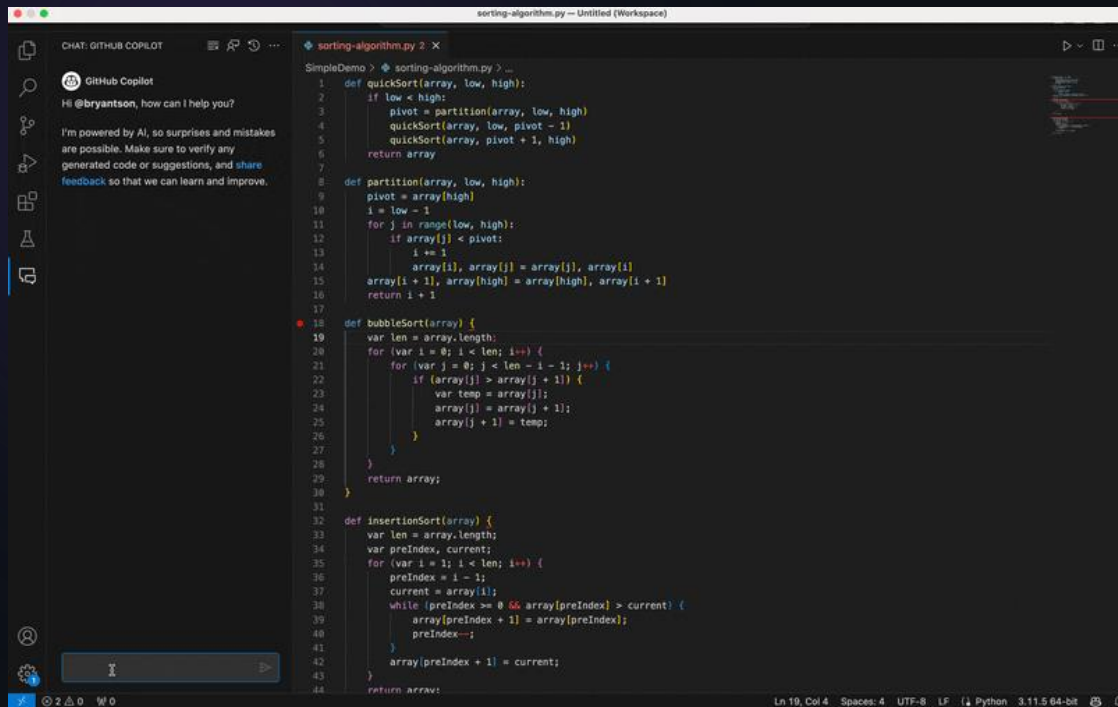
Ask GitHub
Copilot Chat to
generate tests



GitHub Copilot Chat (default)

/fix, /tests and other / command options

Leverage /
command
options that can
help to improve
your code



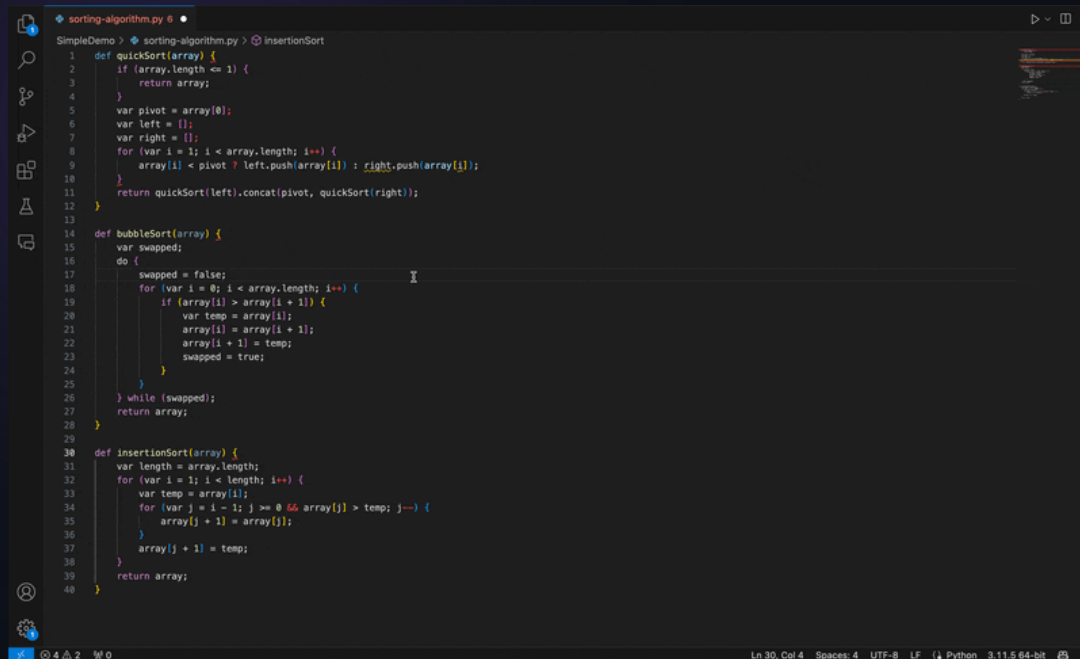
The screenshot shows a code editor with a sidebar on the left for GitHub Copilot chat. The chat window displays a conversation with 'GitHub Copilot' where it offers help and mentions being powered by AI. The main editor area shows a Python file named 'sorting-algorithm.py' with three functions: 'quickSort', 'partition', 'bubbleSort', and 'insertionSort'. The 'bubbleSort' function is currently selected and highlighted. The status bar at the bottom indicates 'Ln 19, Col 4', 'Spaces: 4', 'UTF-8', 'LF', 'Python', and '3.11.5 64-bit'.

```
SimpleDemo > sorting-algorithm.py > ...
1 def quickSort(array, low, high):
2     if low < high:
3         pivot = partition(array, low, high)
4         quickSort(array, low, pivot - 1)
5         quickSort(array, pivot + 1, high)
6     return array
7
8 def partition(array, low, high):
9     pivot = array[high]
10    i = low - 1
11    for j in range(low, high):
12        if array[j] < pivot:
13            i += 1
14            array[i], array[j] = array[j], array[i]
15    array[i + 1], array[high] = array[high], array[i + 1]
16    return i + 1
17
18 def bubbleSort(array):
19     var len = array.length;
20     for (var i = 0; i < len; i++) {
21         for (var j = 0; j < len - i - 1; j++) {
22             if (array[j] > array[j + 1]) {
23                 var temp = array[j];
24                 array[j] = array[j + 1];
25                 array[j + 1] = temp;
26             }
27         }
28     }
29     return array;
30
31
32 def insertionSort(array) {
33     var len = array.length;
34     var preIndex, current;
35     for (var i = 1; i < len; i++) {
36         preIndex = i - 1;
37         current = array[i];
38         while (preIndex >= 0 && array[preIndex] > current) {
39             array[preIndex + 1] = array[preIndex];
40             preIndex--;
41         }
42         array[preIndex + 1] = current;
43     }
44     return array;
```

GitHub Copilot Chat (default)

In-file Copilot options

Copilot now
offers **in-file**
Copilot feature
to selectively
improve



The screenshot shows a code editor with a file named 'sorting-algorithm.py'. The code contains three sorting functions: quickSort, bubbleSort, and insertionSort. The quickSort function is on lines 1-13, bubbleSort on lines 14-28, and insertionSort on lines 29-40. The editor interface includes a sidebar on the left with icons for Explorer, Search, Source Control, Run and Debug, and Extensions. The status bar at the bottom indicates 'Ln 30, Col 4', 'Spaces: 4', 'UTF-8', 'LF', 'Python', and '3.11.5 64-bit'.

```
1 def quickSort(array) {
2   if (array.length <= 1) {
3     return array;
4   }
5   var pivot = array[0];
6   var left = [];
7   var right = [];
8   for (var i = 1; i < array.length; i++) {
9     array[i] < pivot ? left.push(array[i]) : right.push(array[i]);
10  }
11  return quickSort(left).concat(pivot, quickSort(right));
12 }
13
14 def bubbleSort(array) {
15   var swapped;
16   do {
17     swapped = false;
18     for (var i = 0; i < array.length; i++) {
19       if (array[i] > array[i + 1]) {
20         var temp = array[i];
21         array[i] = array[i + 1];
22         array[i + 1] = temp;
23         swapped = true;
24       }
25     }
26   } while (swapped);
27   return array;
28 }
29
30 def insertionSort(array) {
31   var length = array.length;
32   for (var i = 1; i < length; i++) {
33     var temp = array[i];
34     for (var j = i - 1; j >= 0 && array[j] > temp; j--) {
35       array[j + 1] = array[j];
36     }
37     array[j + 1] = temp;
38   }
39   return array;
40 }
```

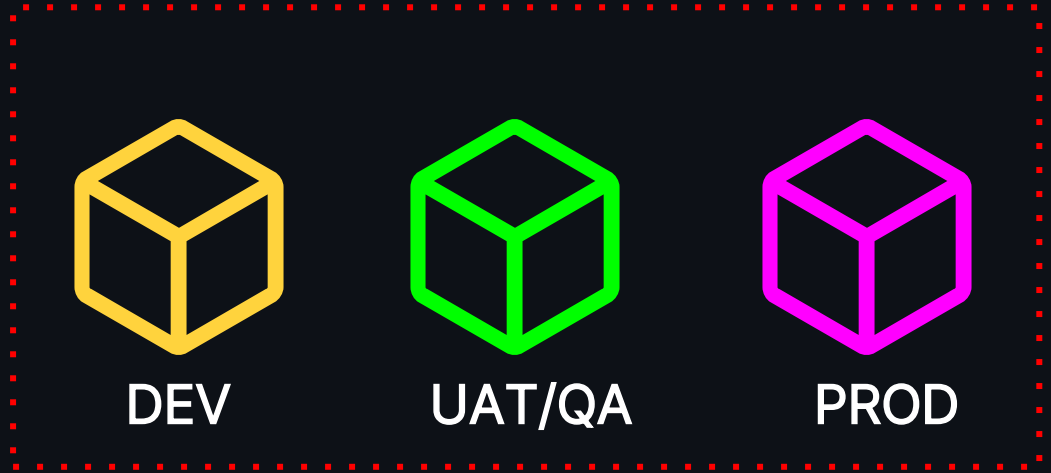
GitHub Copilot Chat (default)

What about my production layer?

Local



Cloud/Server



Current Copilot

“Copilot X”

Copilot Security Exploit?

Prompt Injection

Carefully crafted prompts to make the model to ignore its original instruction or perform unintended actions





Workshop

Choose Workshop Track

Copilot Workshop



Workshop for those who want to see how to build web application

Primary IDE: VS Code
Primary OS: Independent

Copilot Workshop



Workshop for those who want to see how to build Java applications

Primary IDE: IntelliJ
Primary OS: Independent

Copilot Workshop



Workshop for those who want to see how to build .NET applications

Primary IDE: Visual Studio IDE
Primary OS: Windows

Secure coding

Copilot and secure coding

Copilot + GitHub Advanced Security

Vulnerability detection

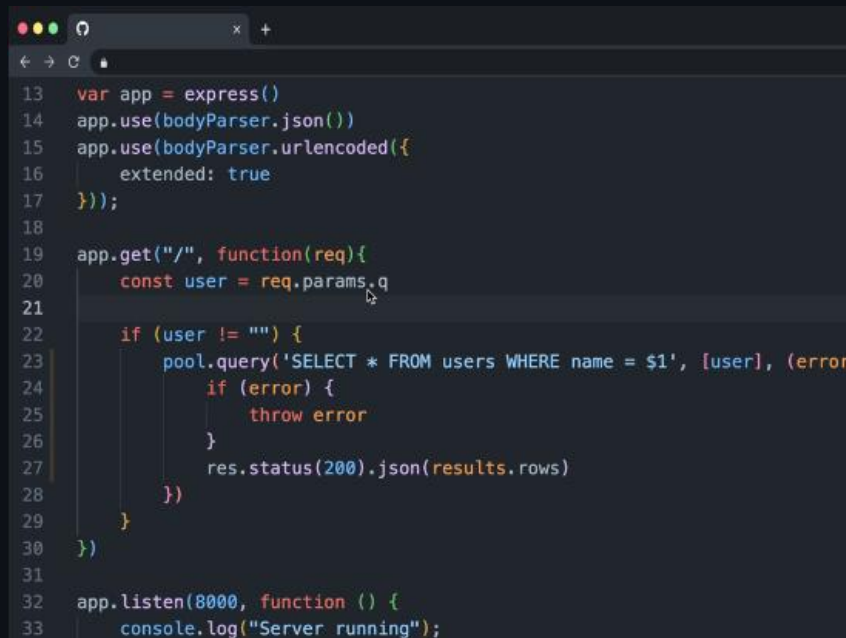
Vulnerability remediation

Copilot Trust Center

Workshop

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
 - i **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



```
13 var app = express()
14 app.use(bodyParser.json())
15 app.use(bodyParser.urlencoded({
16   extended: true
17 }));
18
19 app.get("/", function(req){
20   const user = req.params.q
21
22   if (user != "") {
23     pool.query('SELECT * FROM users WHERE name = $1', [user], (error
24       if (error) {
25         throw error
26       }
27       res.status(200).json(results.rows)
28     })
29   }
30 })
31
32 app.listen(8000, function () {
33   console.log("Server running");
```

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

Vulnerability detection

- 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 sqquery = "SELECT * FROM users WHERE name = $1";
  const values = [search];
  pool.query(sqquery, 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.

```
4
5 const pool = new Pool( config: {
6   user: 'postgres',
7   host: 'localhost',
8   database: 'postgres',
9   password: 'process.env.POSTGRES_PW',
10  port: 5432,
11 });
12
13 var app = express();
14 app.use(bodyParser.json());
15 app.use(bodyParser.urlencoded({ extended: true }));
16
17 app.get('/', function (req, res) {
18   const search = req.params.q;
19
20   if (search !== "") {
21     var sqquery = "SELECT * FROM users WHERE name = \"\" + search + \"\"";
22     pool.query( queryTextOrConfig: sqquery, callback: (err, res) => {
23       console.log( message: err, optionalParams[0]: res);
24       pool.end();
25     });
26   }
27 });
28
29 app.listen( port: 8000, callback: function () {
30   console.log( message: 'Example app listening on port 8000!');
31 });
```

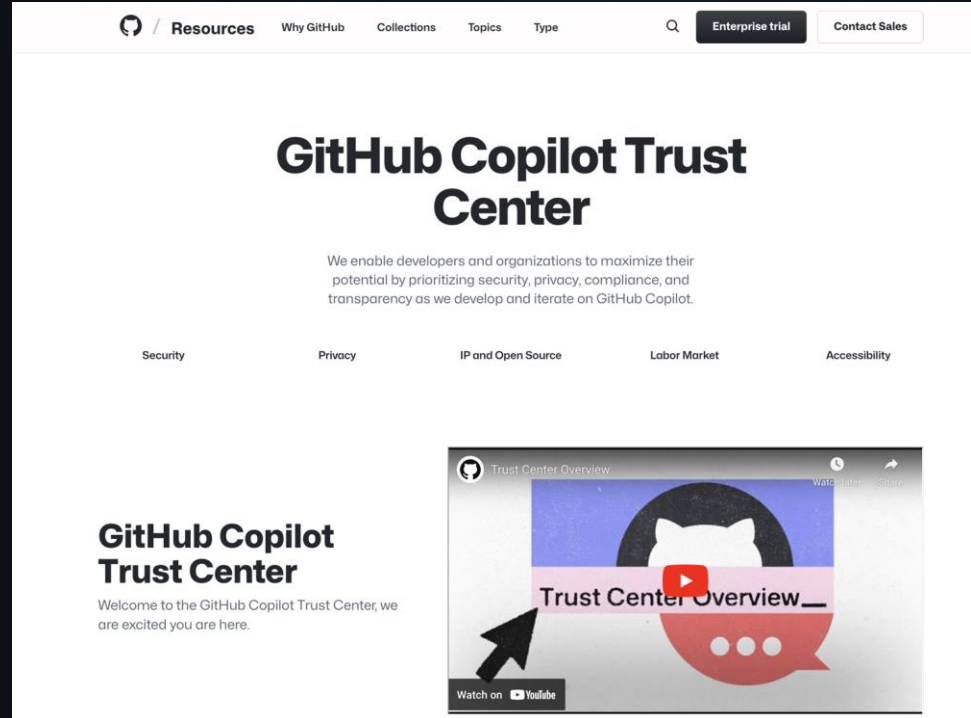
Vulnerability remediation

- Copilot helps prevent suggestions that contain insecure coding patterns in real-time
- Automatically fix insecure code based on Copilot suggestions
- Validate and improve existing CodeQL queries

Security & Trust

Copilot Trust Center

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





Wrap Up



Thank you