Using an LLM to Help with Code Understanding

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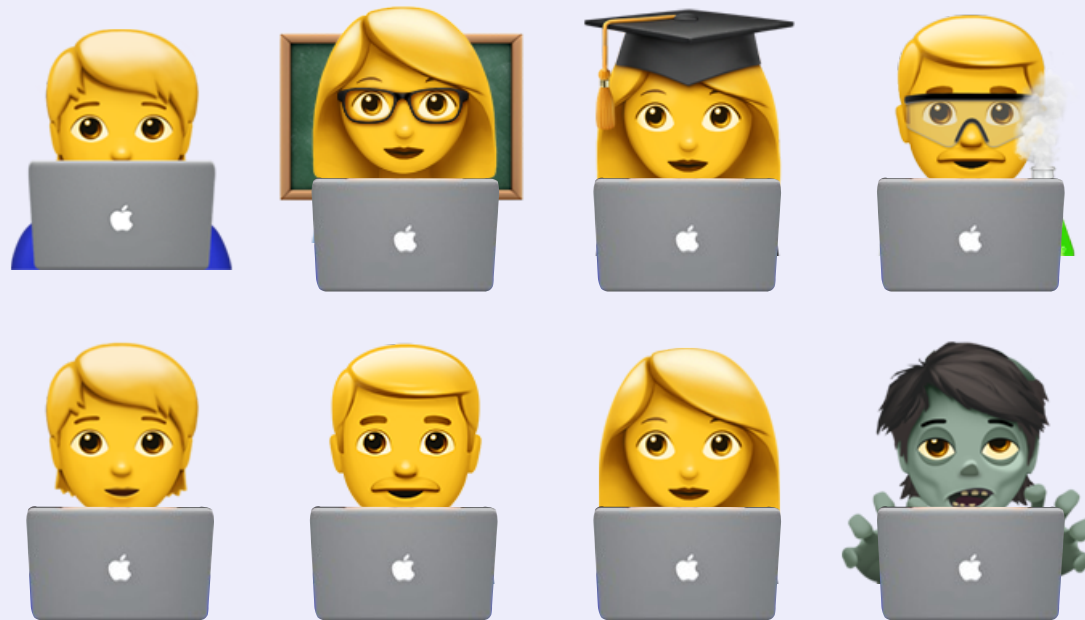vhellendoorn@cmu.edu

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Programmers often need to work with *unfamiliar* code written by other programmers

Programmers now also need to work with *unfamiliar* code written by AIs

Working with unfamiliar code is challenging

Hard-to-Answer Questions about Code (LaToza and Myers, PLATEAU' 10)
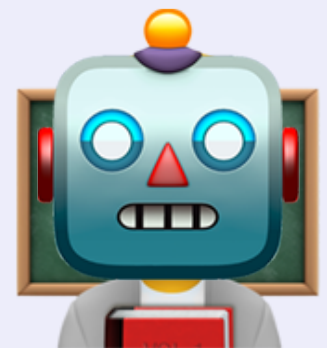*Questions Programmers Ask During Software Evolution Tasks (Sillito et al., FSE'14)*

? What is the purpose of this code?
? What code could have caused this behavior?
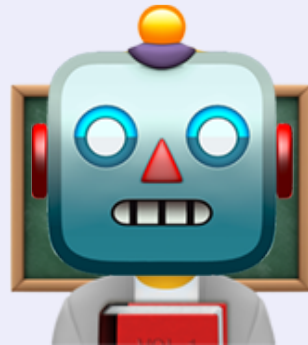**?** Which type represents this domain concept?
? …

Can AIs also help programmers understand the unfamiliar code written by others?
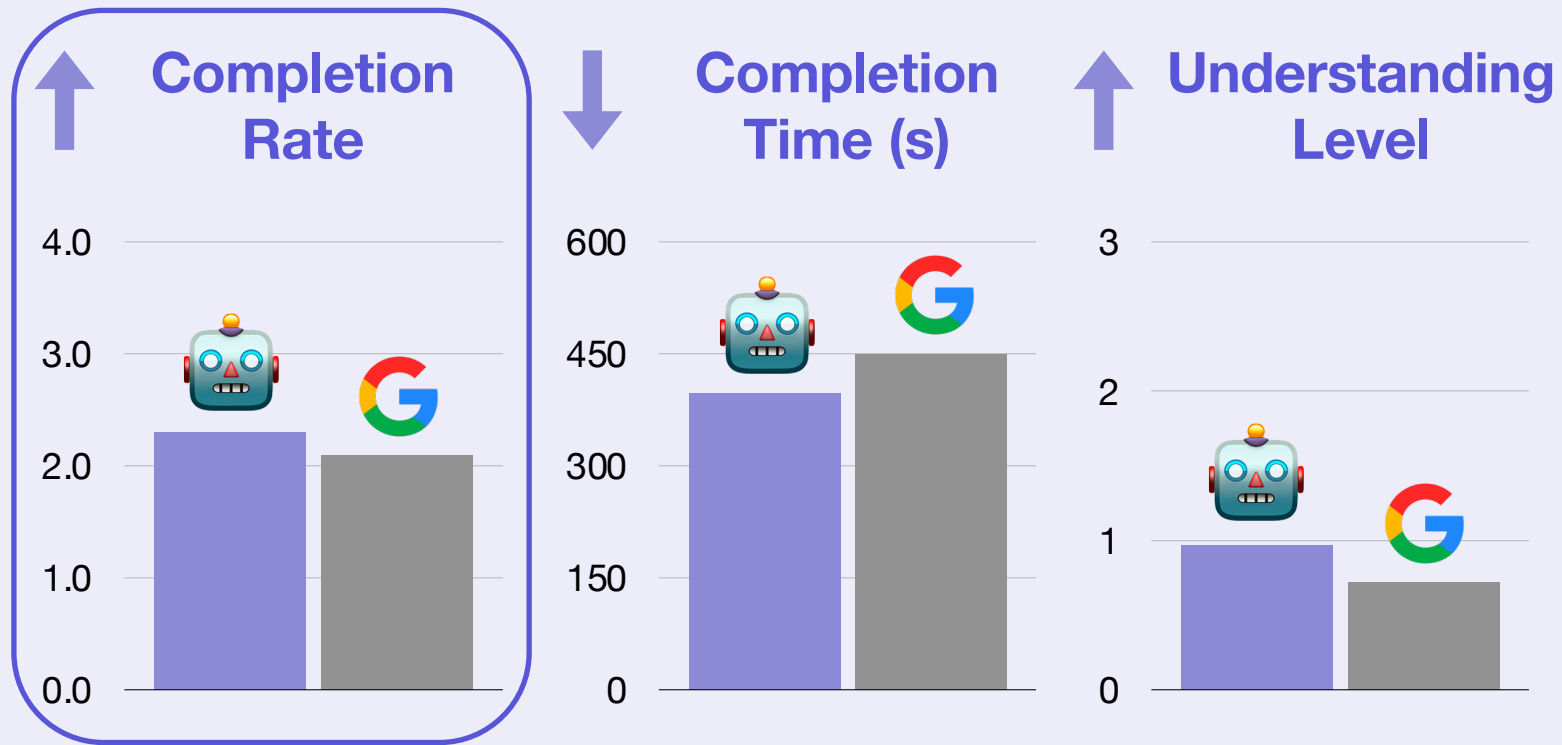
💡 This code loads a 3D mesh of a bunny, computes vertex normals …

Hypothesis: Carefully designed AI assistant helps programmers work with unfamiliar code

Spoiler: AI can help users working with unfamiliar code

⬆ **Completion Rate**

⬇ **Completion Time (s)**

⬆ **Understanding Level**

Statistically significant!

Hypothesis: Carefully designed AI assistant helps programmers work with unfamiliar code

LLM-based plugin for code understanding
: In-IDE

LLM-based plugin for code understanding
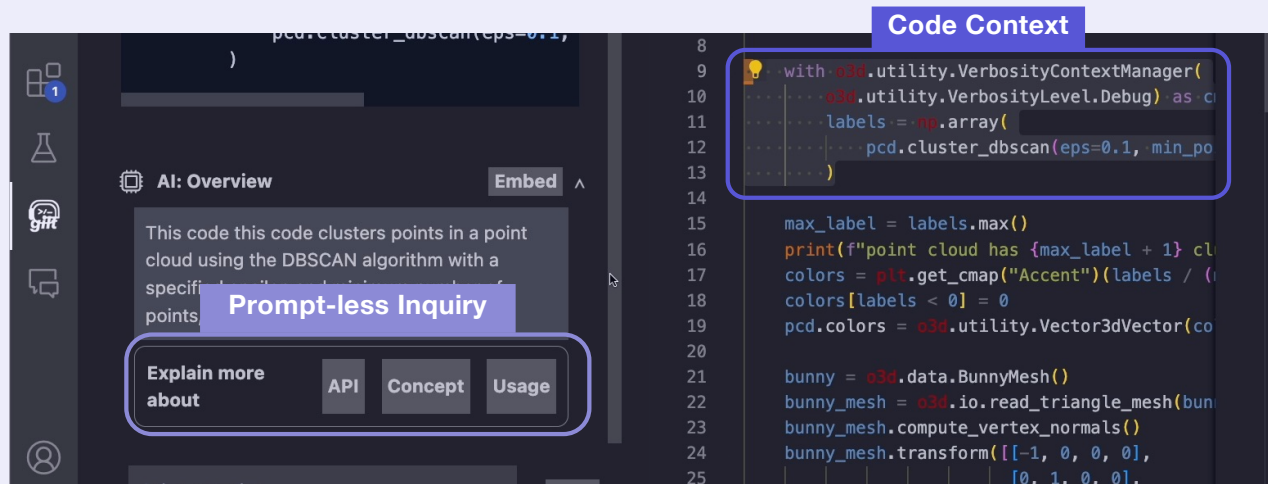## : Context-aware
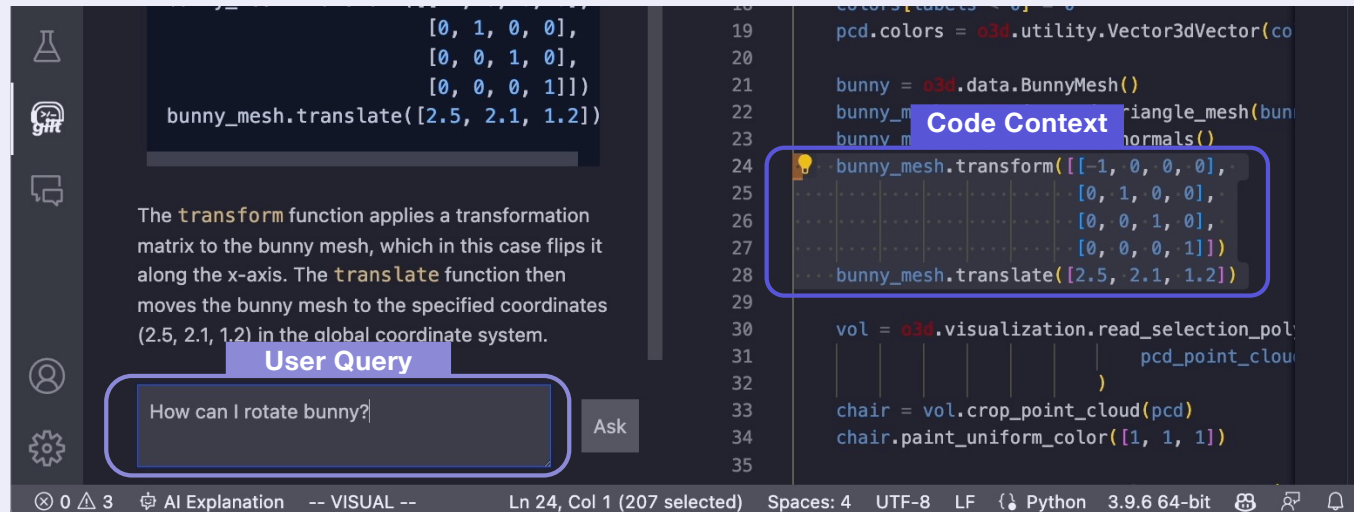
In the context of the following code,
{ **Code Context** }, { **User Query** }?

LLM-based plugin for code understanding
: Prompt-less

A Theory of Robust API Knowledge (Thayer et al. TCE'2021)

Please provide an `Open3d` *code example*
mainly showing the usage of the following API calls: ⟨ Extracted from the code context

BunnyMesh, read_triangle_mesh, compute_vertex_normals, transform, translate :
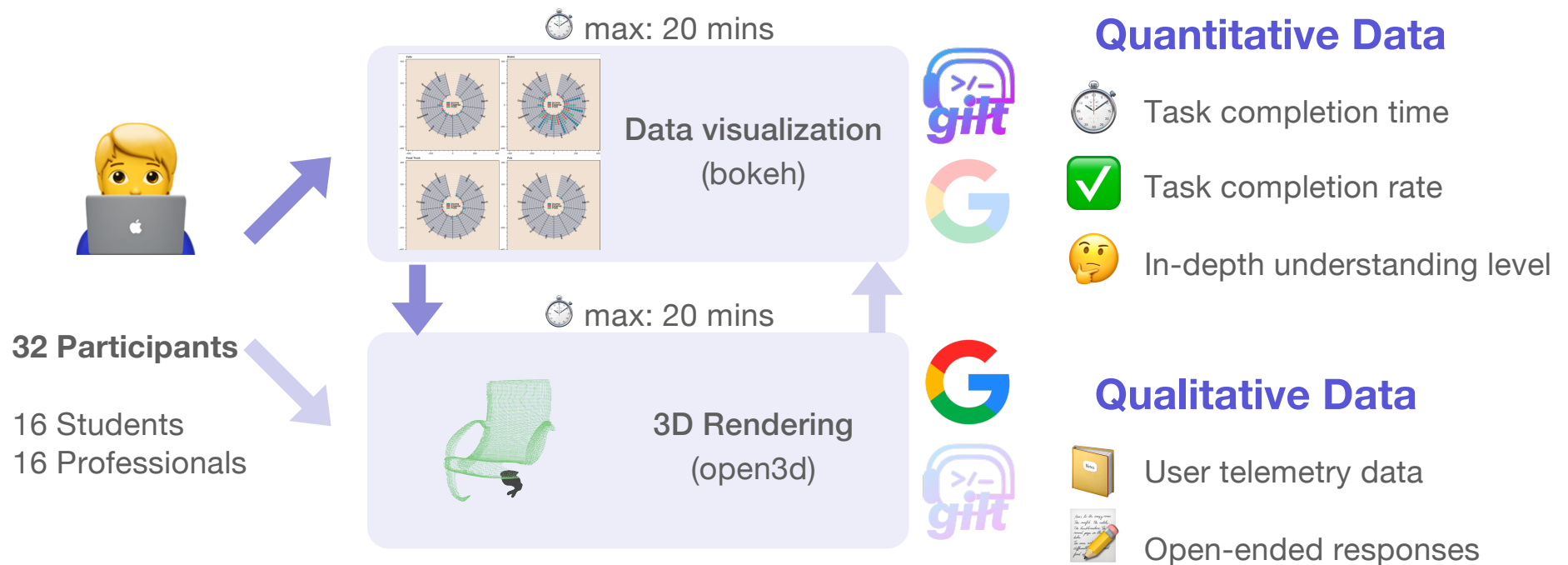
{ **Code Context** }

LLM-based plugin for code understanding

```python
import numpy as np
import matplotlib.pyplot as plt

if __name__ == "__main__":
    pcd_point_cloud = o3d.data.DemoCropPointCl
    pcd = o3d.io.read_point_cloud(pcd_point_cl

    with o3d.utility.VerbosityContextManager(
        o3d.utility.VerbosityLevel.Debug) as c
        labels = np.array(
            pcd.cluster_dbscan(eps=0.1, min_po
        )

    max_label = labels.max()
    print(f"point cloud has {max_label + 1} cl
    colors = plt.get_cmap("Accent")(labels / (
    colors[labels < 0] = 0
    pcd.colors = o3d.utility.Vector3dVector(co

    bunny = o3d.data.BunnyMesh()
    bunny_mesh = o3d.io.read_triangle_mesh(bun
    bunny_mesh.compute_vertex_normals()
    bunny_mesh.transform([[-1, 0, 0, 0],
                          [0, 1, 0, 0],
                          [0, 0, 1, 0],
                          [0, 0, 0, 1]])
    bunny_mesh.translate([2.5, 2.1, 1.2])
```

Where do I move bu

Ask

⊗ 0 ⚠ 3   ⌨ AI Explanation   -- NORMAL --   Ln 5, Col 16   Spaces: 4   UTF-8   LF   { } Python   3.9.6 64-bit

LLM-based plugin for code understanding

Study design: Web Search vs. GILT

⏱️ max: 20 mins

Data visualization
(bokeh)

⏱️ max: 20 mins

3D Rendering
(open3d)

32 Participants

16 Students
16 Professionals

Quantitative Data

⏱️ Task completion time

✅ Task completion rate

🤔 In-depth understanding level

Qualitative Data

📔 User telemetry data

📝 Open-ended responses

Example Sub-task: 3D Rendering (Open3D)

⏱️ Task completion time   ✅ Task completion rate
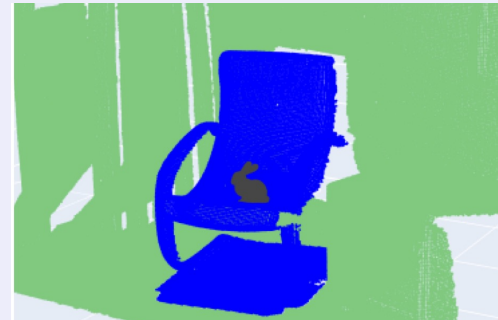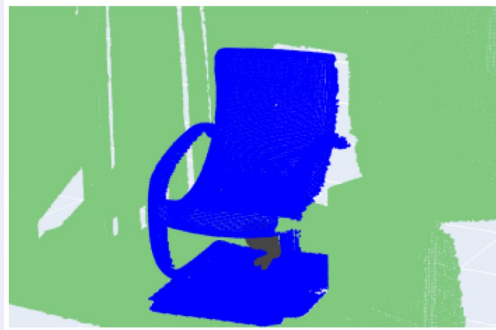
*Subtask 2: "Make the bunny sit upright on the chair"*

🤔 In-depth understanding level

```
bunny_mesh.transform([[-1, 0, 0, 0], [0, 1, 0, 0],
                      [0, 0, 1, 0], [0, 0, 0, 1]])
```

Q2: What transformation does the 4x4 matrix do in the following code (i.e., what will happen to the bunny)?
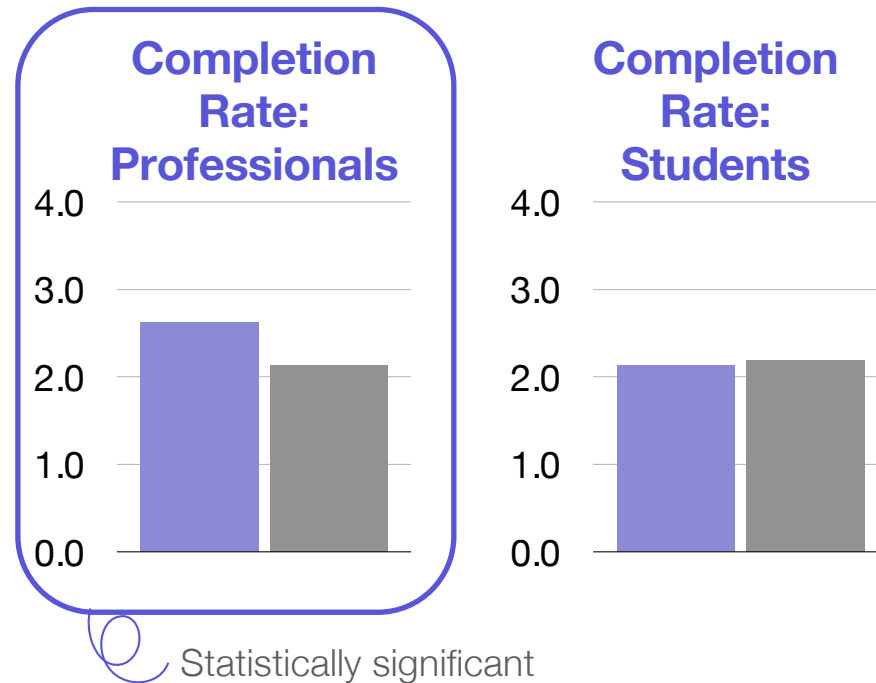
GILT enhances users' ability to complete tasks

Control: domain experience, programming experience, familiarity with AI tools

↑ Completion Rate

↓ Completion Time (s)

↑ Understanding Level
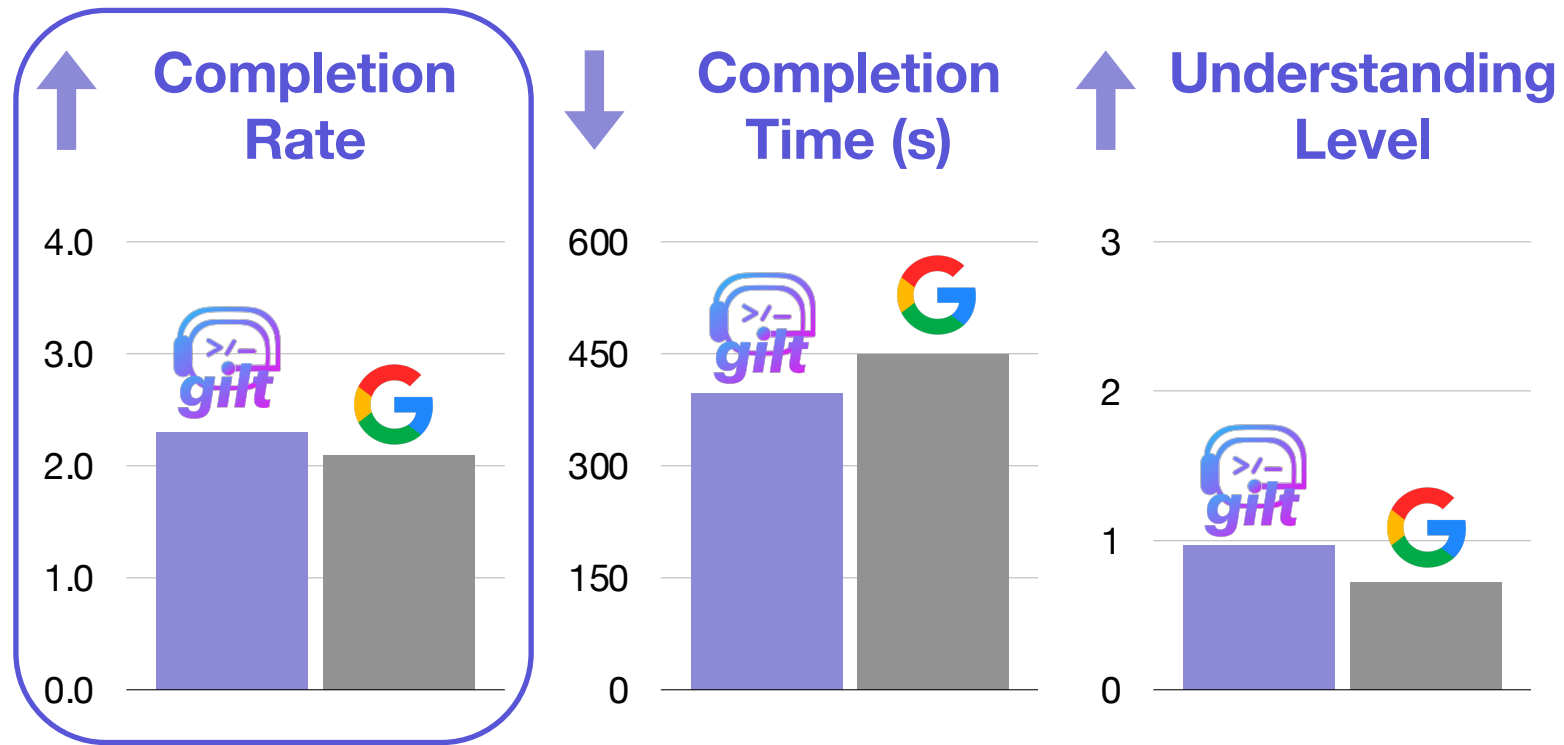
Statistically significant

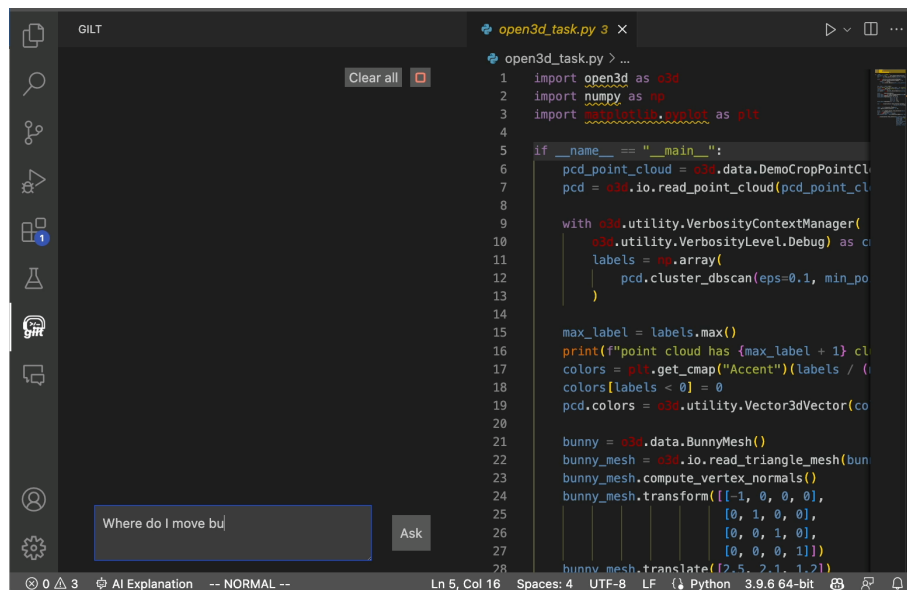# The usage and benefits differ between students vs. professionals

Control: domain experience, programming experience, familiarity with AI tools

The way participants interact with GILT varies
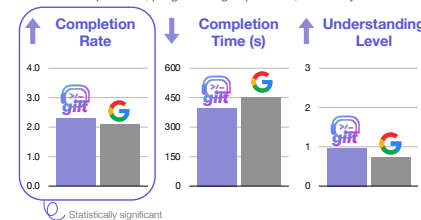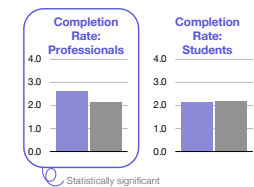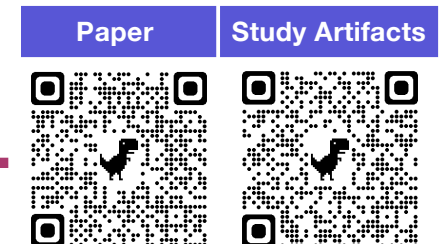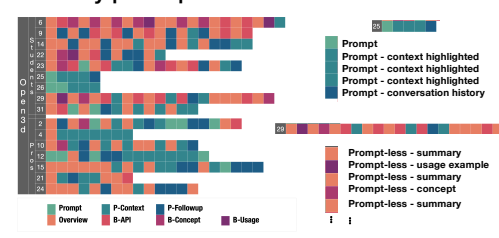
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