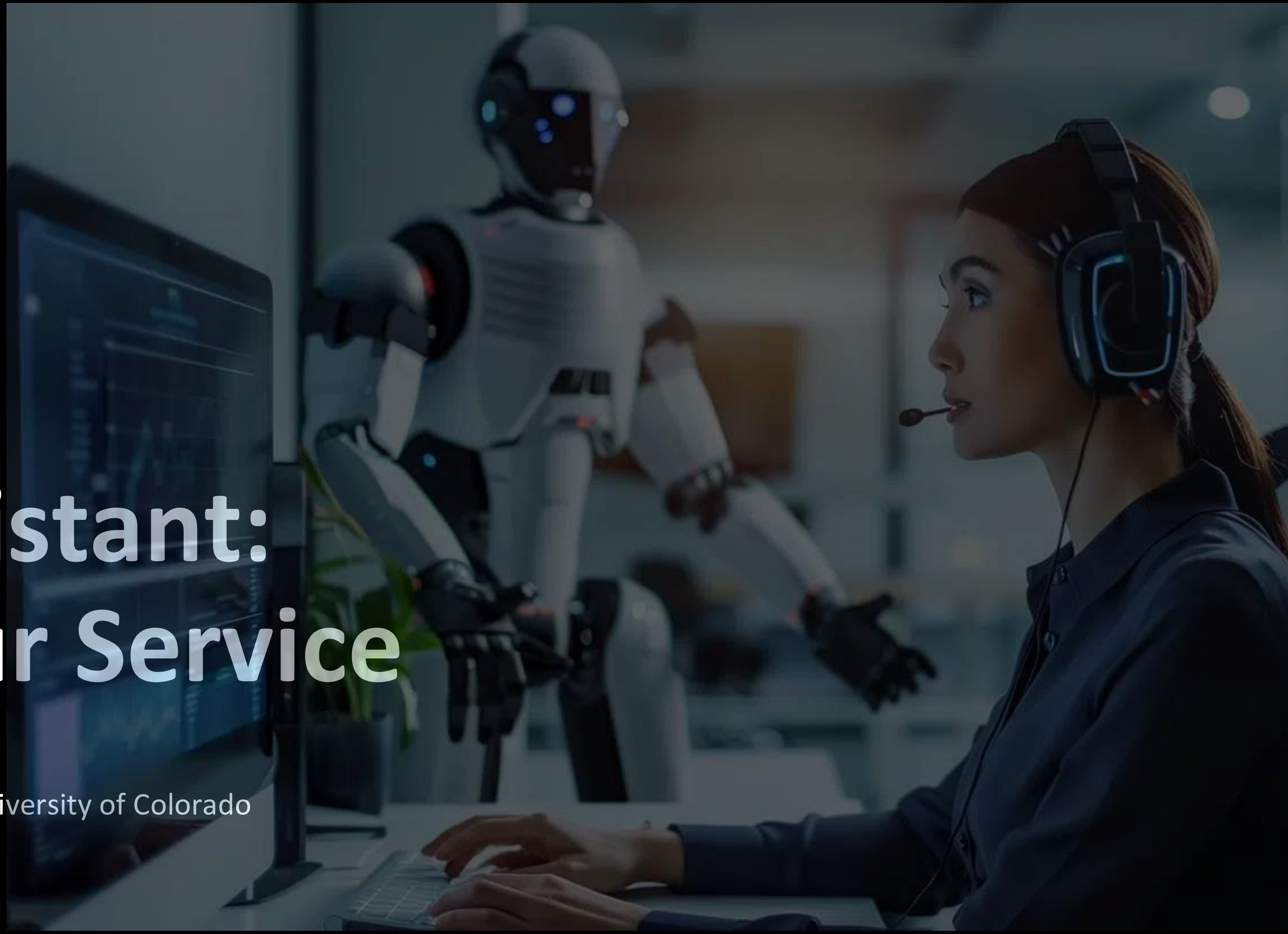




# AI Assistant: At Your Service

Danny Dig

JetBrains Research, University of Colorado



**slido**

Please download and install the Slido app on all computers you use



**Which GenAI service(s) have you been using?**

**i** Start presenting to display the poll results on this slide.

# Examples of how Businesses use GenAI

**Strategic Thinking:** Heineken utilized AI to enhance its strategic decision-making

**Decision-Making:** A company faced challenges with an activist board

**Content Creation:** Companies leveraged AI for generating marketing content and reports

**Idea Generation:** Executives used AI to brainstorm potential solutions for business challenges

source: AI-Driven Leader by Geoff Woods

**Demo: How can I say the same thing in a different way?**

To: Professor Jones  
From: Department Chair  
Subject: Travel Request Denial  
Date: 6 October 2024

I regret to inform you that your request for travel funds to travel to the Alware Bootcamp in Toronto, Canada, has been denied.

The university has limited funds available for travel this year and although I know you really want to go, I can't afford to give you the \$2500 you requested (which by the way is a lot to request at this late date at the current time of this request).

I hope you understand our position because we really want our faculty to be happy. Even though I can't pay for this trip, I encourage you to apply again for future travel money because I hope to receive more money budgeted for travel the next fiscal year of 2025/2026.



# Parable of Stone Soup AI

## 1. Tech execs come to village:

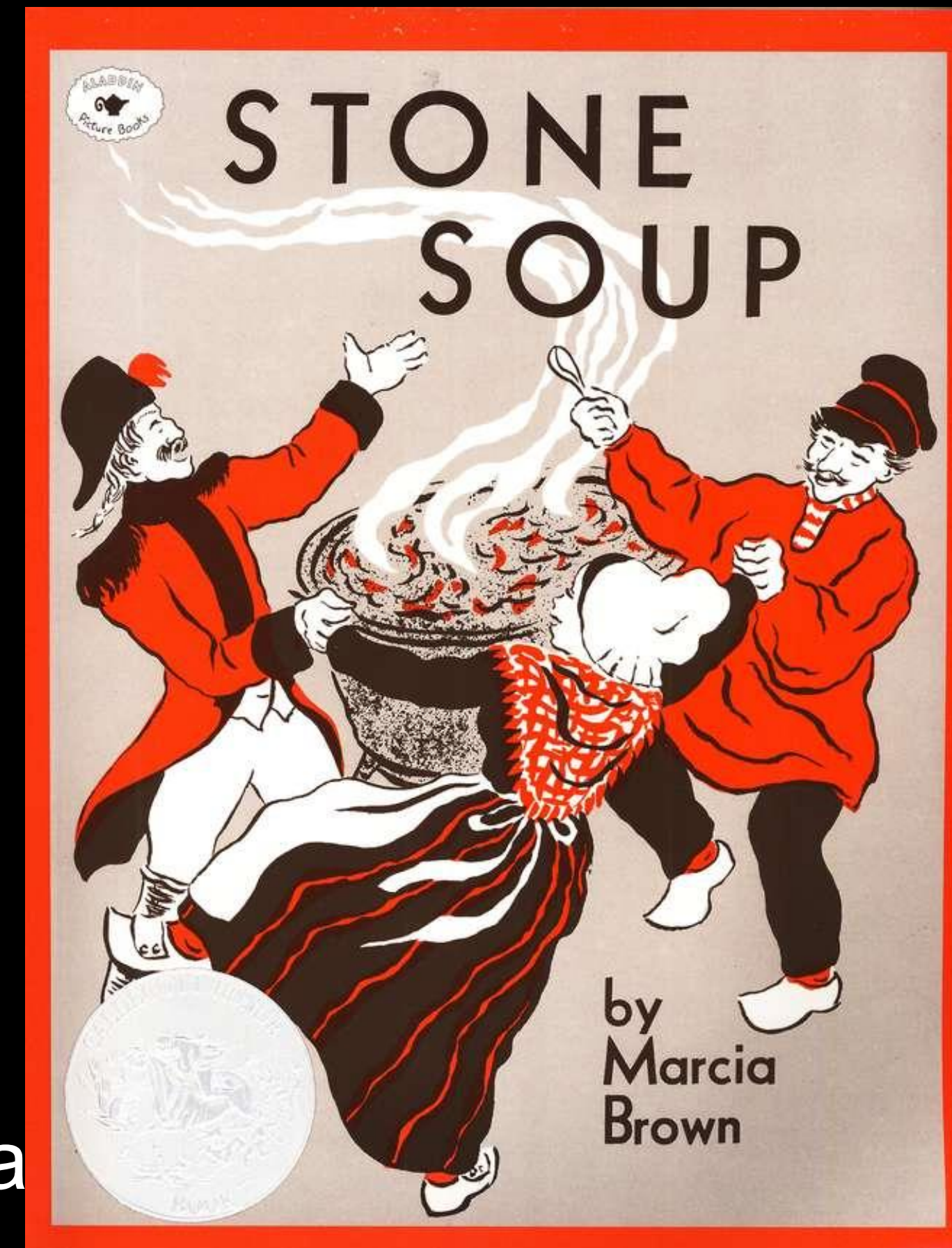
We will make amazing AI with just a few magical algorithms (e.g., gradient descent, transformers)

... would be so much better with more data

... even more magical with human feedback

... even better if humans would learn to ask questions the right way

## 2. Villagers: wow, what magical AI just from a few algorithms





# Essential Ingredients of a Good Prompt



**Describe the task**

**Give Context**



**Assign a Persona**



**Specify requirements**



**Establish limits**



**Explain WHY**



**Ask it to interview you**





# Key Take-aways

A woman with a headset is working at a computer in a futuristic office. In the background, a robot is visible, suggesting a collaborative AI environment.

**AI saves you time**

**As a human, you are in the driver's seat**

**The quality of the questions determines the quality of the answers**

**By asking AI to explain itself, you can refute, refine, grow and learn**

**AI does not displace you.**



# AI Programming Assistant



# Julio Rios Cantu invents smart bra after mom's cancer scare

Source: The Kim Komando Show



20-year-old son invents smart bra after mom's cancer scare | Great Calls from The Kim Komando Show





# 9 hardest things programmers have to do

Writing tests

Writing documentation

Implementing functionality you disagree with ...

Working with someone else's code

Dealing with other people ...

Estimating time to complete a task

Explaining what I do (or don't do)

Naming things

source: Elizabeth Churchill, UX Director at Google

**slido**

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**Which IDE(s) have you used?**

**i** Start presenting to display the poll results on this slide.



# Generative AI + IDEs increase productivity

Not displacing programmers, but making programmers more productive



## Amazon CodeWhisperer

Your AI-powered productivity tool for the IDE and command line

**A giant leap forward in developer productivity**

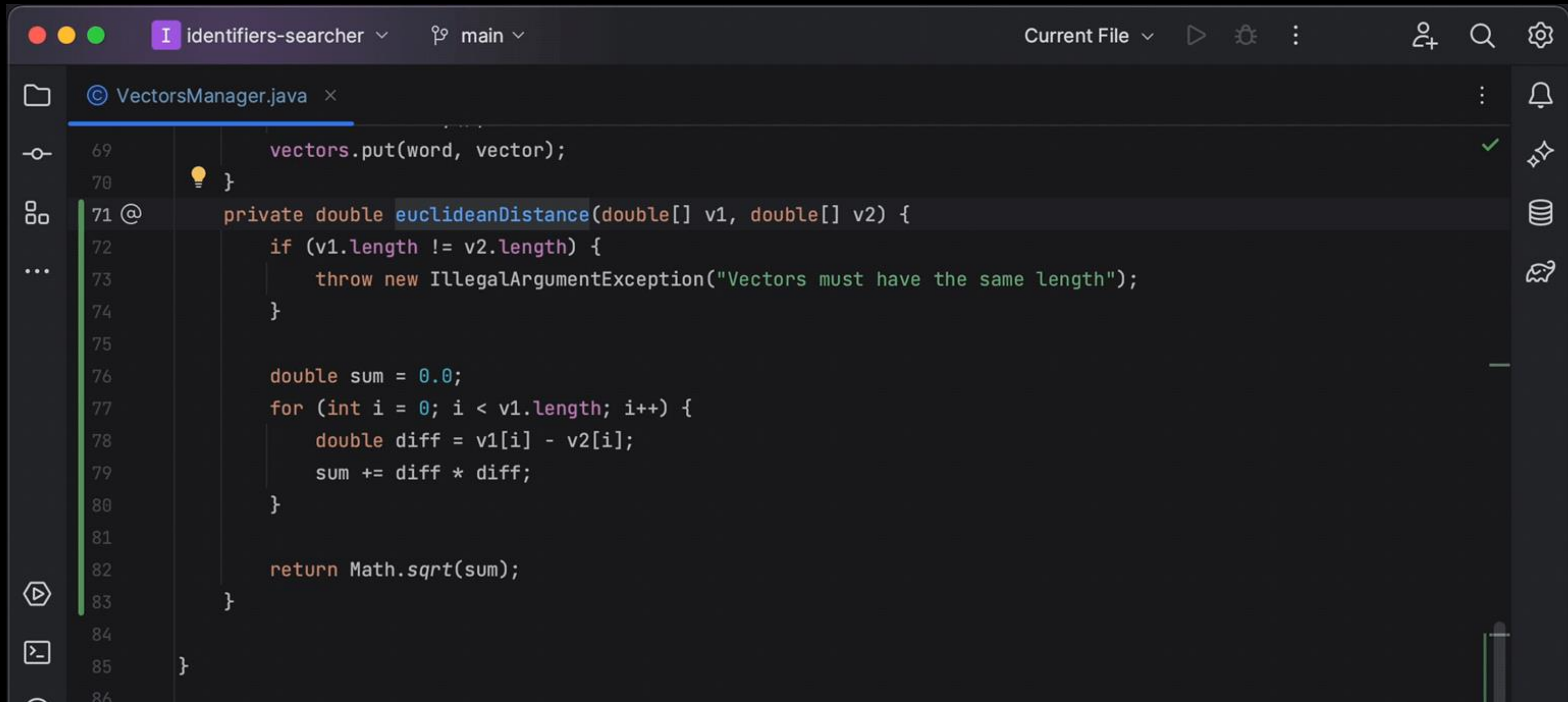
**57%** faster

**27%** more likely to succeed

Amazon ran a productivity challenge during the preview, and participants who used CodeWhisperer were 27% more likely to complete tasks successfully and did so an average of 57% faster than those who did not use CodeWhisperer.

# AI explains code

<https://blog.jetbrains.com/idea/tag/ai-assistant/>



```
69     vectors.put(word, vector);
70 }
71 @private double euclideanDistance(double[] v1, double[] v2) {
72     if (v1.length != v2.length) {
73         throw new IllegalArgumentException("Vectors must have the same length");
74     }
75
76     double sum = 0.0;
77     for (int i = 0; i < v1.length; i++) {
78         double diff = v1[i] - v2[i];
79         sum += diff * diff;
80     }
81
82     return Math.sqrt(sum);
83 }
84
85 }
```

Explain code, bugs and offer fixes, summarize recent code changes, perform code reviews



# AI explains Runtime Errors

The screenshot shows an IDE window with a Java file named `Main.java`. The code is as follows:

```
1 package org.example;
2
3 import java.util.stream.Stream;
4
5 public class Main {
6     public static void main(String[] args) {
7         var list = Stream.iterate( seed: 1, i -> i + 1)
8             .toList();
9         System.out.println(list.size());
10    }
11 }
```

The IDE shows a runtime error in the `Run` console:

```
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space Explain with AI
    at java.base/java.lang.Integer.valueOf(Integer.java:1081)
    at org.example.Main.lambda$main$0(Main.java:7)
    at org.example.Main$$Lambda$14/0x000000008000c0940.apply(Unknown Source)
    at java.base/java.util.stream.Stream$1.tryAdvance(Stream.java:1464)
    at java.base/java.util.Spliterator.forEachRemaining(Spliterator.java:332) <3 internal lines>
    at java.base/java.util.stream.AbstractPipeline.evaluateToArrayNode(AbstractPipeline.java:260) <3 internal lines>
    at org.example.Main.main(Main.java:8)

Process finished with exit code 1
```

The IDE interface includes a top bar with project name `Petclinic` and file `main`, a toolbar with icons for search, settings, and user profile, and a sidebar with navigation icons. The bottom status bar shows the file path `Petclinic > src > main > java > org > example > Main`, the time `11:2`, and encoding `LF UTF-8 4 spaces`.

# AI suggests names

Programmers don't spend enough time giving intention revealing names to code entities, though it is crucial for code readability

```
public class TheAlgorithm {  
    private static final int COLINEAR = 0;  
    private static final int CLOCKWISE = 1;  
    private static final int COUNTERCLOCKWISE = 2;  
  
    public static int t(D p, D q, D r) {  
        int val = (q.y - p.y) * (r.x - q.x) -  
                (q.x - p.x) * (r.y - q.y);  
  
        if (val == 0) return COLINEAR;  
        return (val > 0) ? CLOCKWISE : COUNTERCLOCKWISE;  
    }  
  
    public static List<D> run(D[] dts) {  
        if (dts.length < 3) return Collections.emptyList();  
    }  
}
```



# **Exciting GenAI @ JetBrains Research**

# AI Agents and Planning



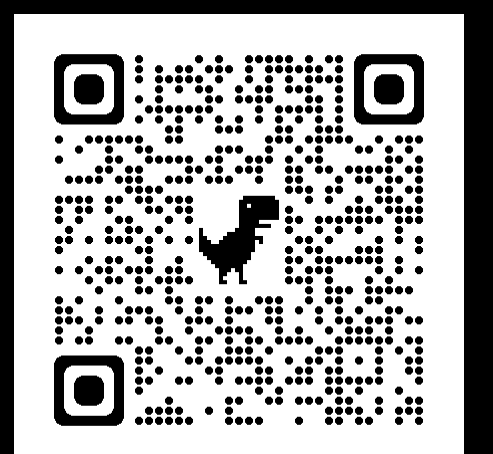
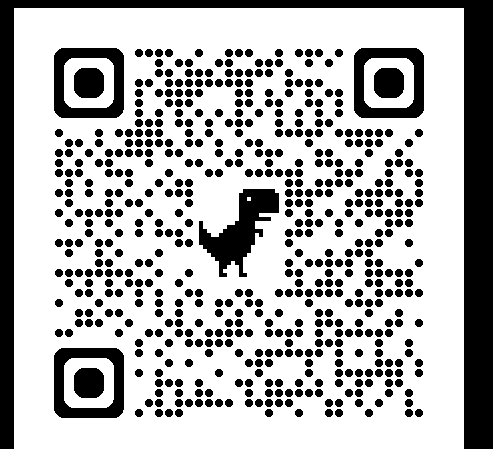
**Objective:** decision-making systems that execute commands in the IDE

Research & Infra:

- Platform IDEFormer

Agents:

- Debugging Assistant
- Environment Setup
- Refactoring Agent
- VCS-actions



"Debug Smarter, Not Harder: AI Agents for Error Resolution in Computational Notebooks"  
presented next week at EMNLP 2024

# Software Testing Research

**Objective** : Develop new approaches to support developers and testers in their software testing tasks

## Projects



LLM-based &  
Search-based  
Unit Test Generation



Language-agnostic  
LLM-based Test Generation



Testing AI features

Metrics:

Compilation rate  
Line/branch coverage

Automatically  
Reproducing  
Reported Crashes



TestSpark paper: <https://arxiv.org/pdf/2401.06580>



# PLAN Programming languages and Program Analysis Lab

## Objectives

Reliability and Validation of existing JetBrains products

Code generation based on formal specifications and program analysis

## Projects

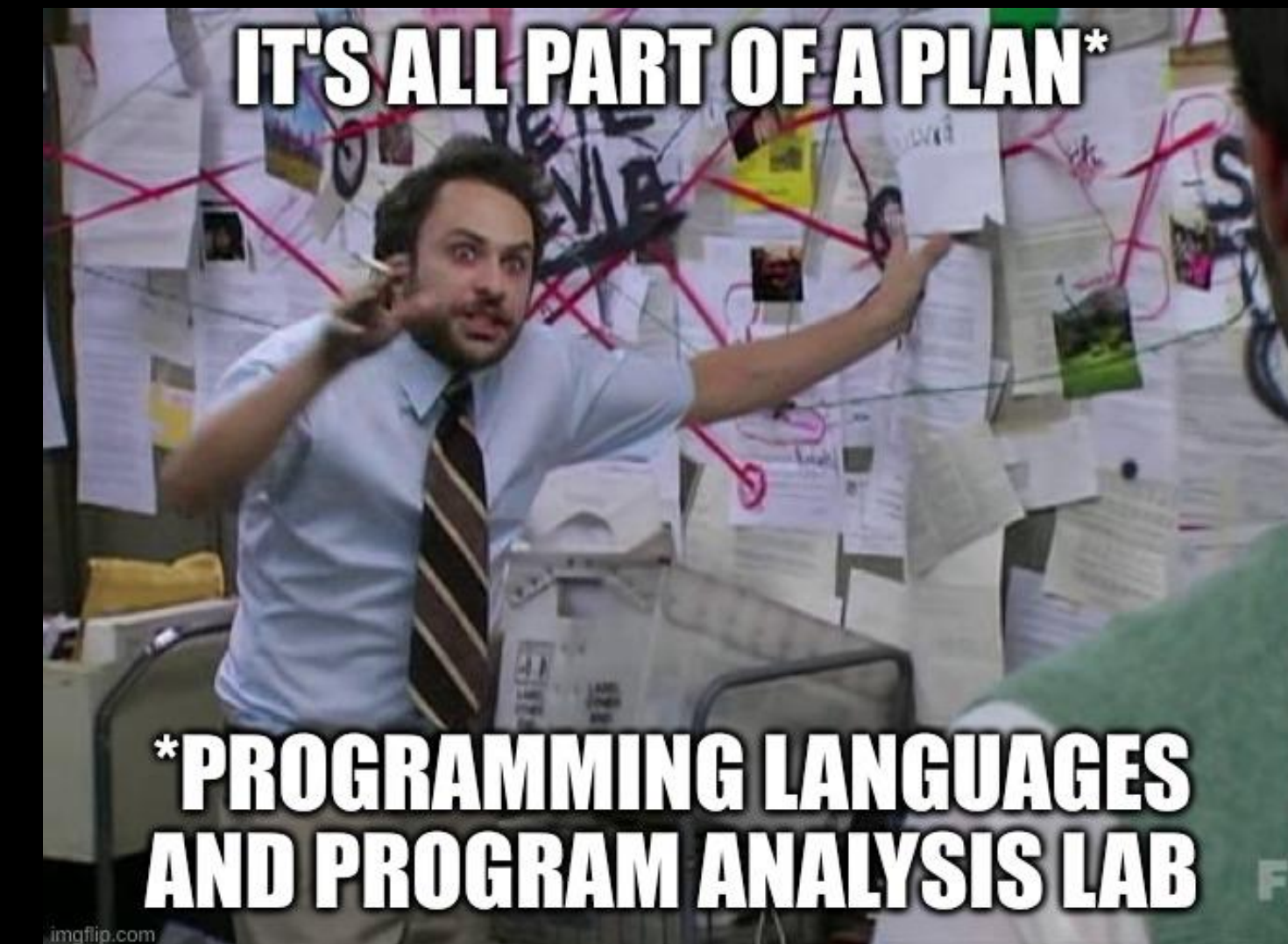
Groovy-to-Kotlin converter

LLM-generated code correctness via Program Analysis

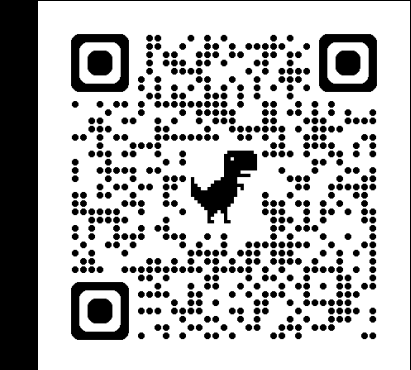
Fuzz4All for Kotlin

Verified code generation

CoqPilot



# Code Modeling Research



**Objective** : solving code generation and code completion

Low-resource languages

Project adaptation

Alignment with compiler feedback, linters, execution

**Project Highlights** :

Long Code Arena – a suite of six benchmarks for evaluating capabilities of models operating at project level

Kotlin ML Initiative – developing datasets, benchmarks, and models for better generation of Kotlin

- 👉 [Library-based code generation](#)
- 👉 [CI builds repair](#)
- 👉 [Project-level code completion](#)
- 👉 [Commit message generation](#)
- 👉 [Bug localization](#)
- 👉 [Module summarization](#)

Model name	Kotlin HumanEval Pass Rate
CodeLlama-7B	26.89
CodeLlama-7B-Kexer	42.24



# Education Research



[edu-research-team@jetbrains.com](mailto:edu-research-team@jetbrains.com)

<https://lp.jetbrains.com/research/education/>

**Goal:** revolutionize programming education to align with today's fast-paced EdTech market

**Research interests:** in-IDE learning, intelligent tutoring systems, generative AI, low and no code education

**Projects:** AI-next step hints, AI-debugging, terms explanation, teaching with intelligent prompt engineering

...

**Academic life:** publications and reviewing papers on SIGCSE, ITiCSE, ICSE SEET, Koli Calling, ICER, ...



# Executive Summary



Change is the only guaranteed constant

GenAI + IDE+ Human

“...Game changer! Enter the code assistant, the great equalizer. It’s the ace up the sleeve for OEMs”

--- Lenovo CTO

Together We Go Further: Let’s build developer tools together

Technical expertise

Shape your ideas, help with evaluation



<https://internship.jetbrains.com/>