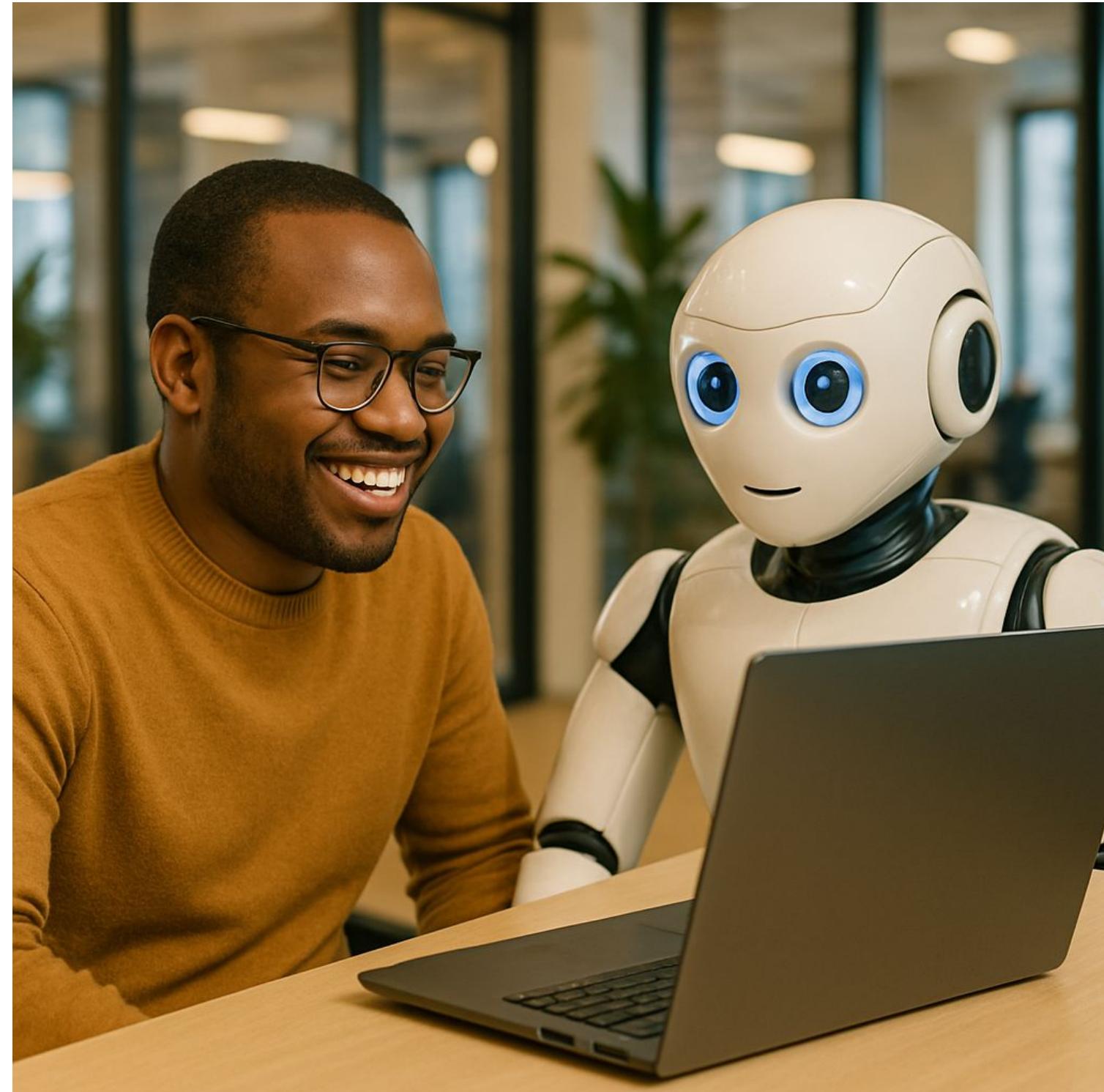


LLM-Driven Analysis and Reporting with R

A hands-on workshop exploring how Large Language Models can enhance statistical workflows.

Chester Ismay and Arturo Valdivia
WNAR 2025



UNIT A Connect & Primer

A photograph showing four people in a modern office setting. Three individuals are standing and looking at a large whiteboard or screen that displays the words "DATA INSIGHTS" in large blue letters. A fourth person is seated at a desk in the foreground, working on a laptop. The office has large windows in the background.

Welcome & Workshop Goals

Learn Prompting

Craft effective prompts for R code

GitHub Copilot

Integrate AI assistance into RStudio

Reporting

Build analyses and Quarto reports with LLM-generated elements

Ethics

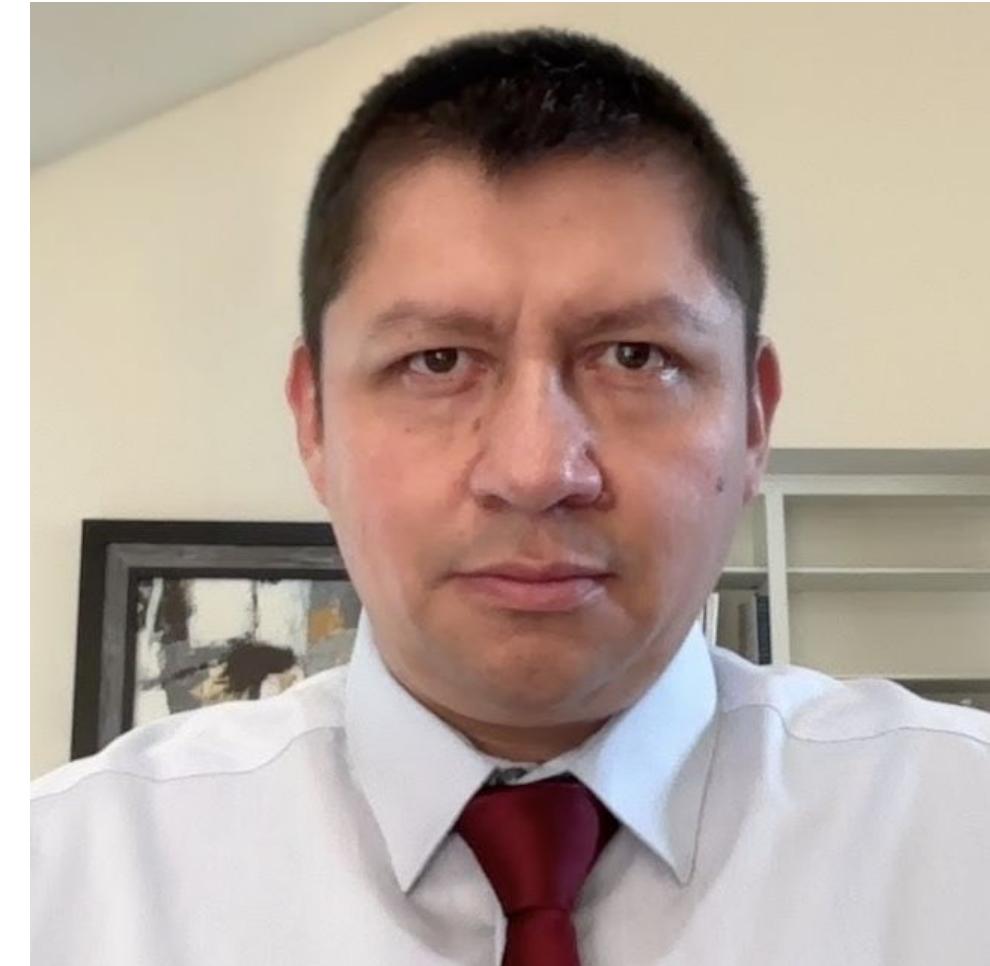
Promote reproducibility and ethical use

Instructors' Introduction



Chester Ismay

PORLAND STATE UNIVERSITY

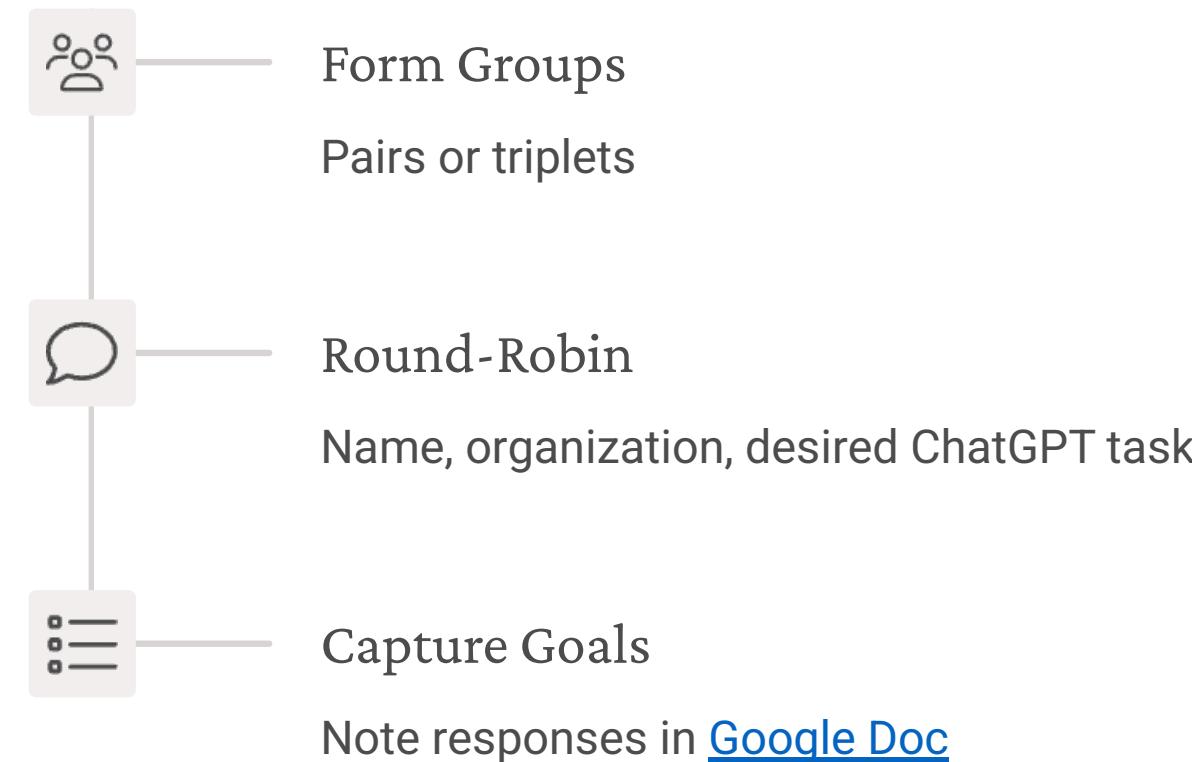


Arturo Valdivia

INDIANA UNIVERSITY



Participant Snapshot





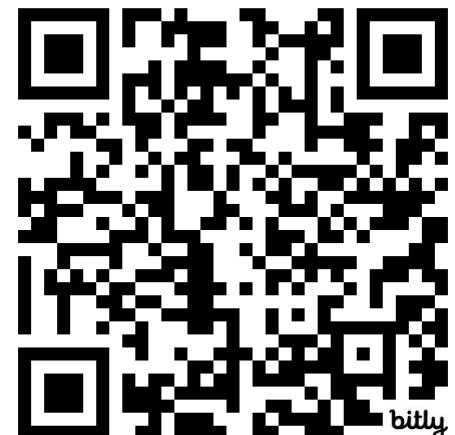
Logistics & Tools

Room Essentials

- WiFi network & password
- Restrooms location
- Emergency exits
- Coffee station

Prerequisites

- Software setup (R & RStudio)
- Google Doc link: <https://bit.ly/wnar-lm> or use the QR code
 - Live updates
 - Post questions





Workshop Outcomes



Use Github Copilot

Scaffold analyses in RStudio



Craft Prompts

Effective ChatGPT prompts for R code



Build Reports

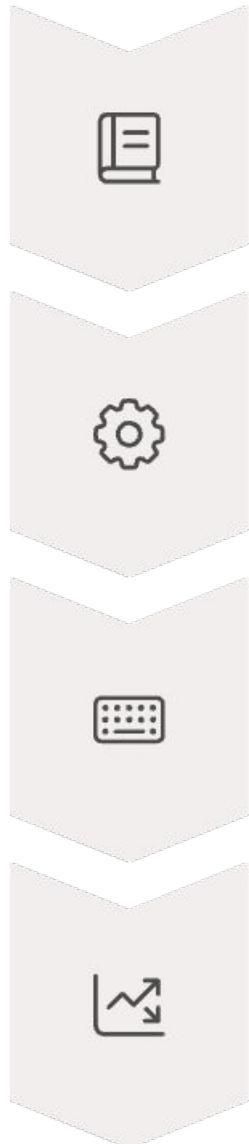
Quarto with LLM code and narrative



Best Practices

Reproducibility, auditing, ethics

Workshop Roadmap

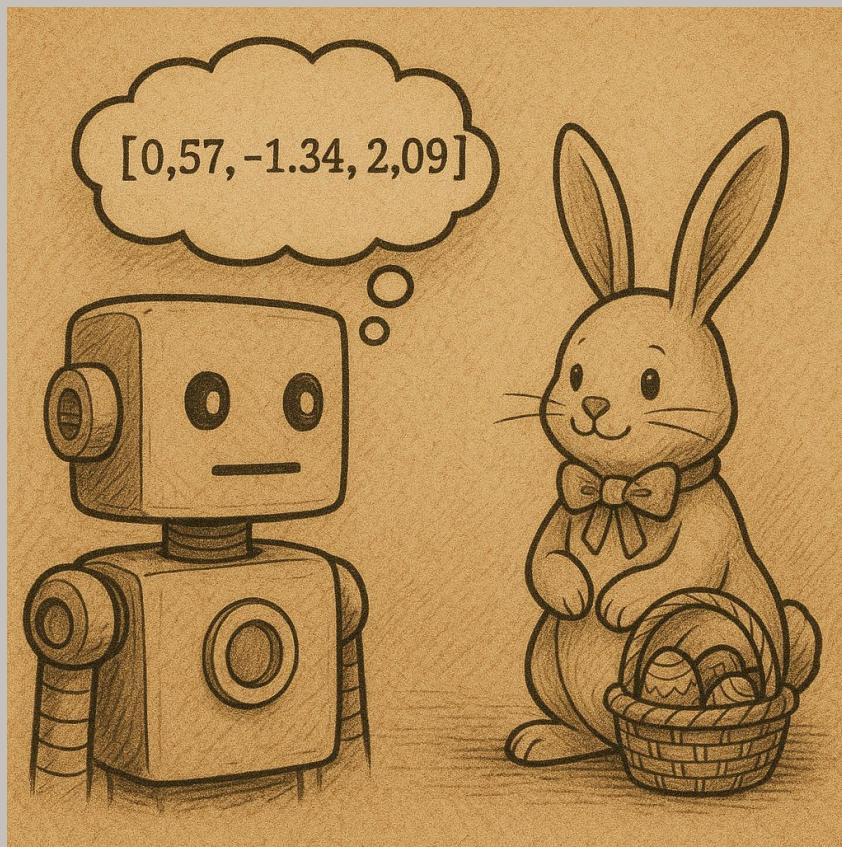




ONCE UPON A TEXT...

- Imagine teaching a child to speak using books alone
- No explanations, just reading patterns
- Transformers learn language the same way!

STEP 1: TURNING WORDS INTO MATH



Words become vectors



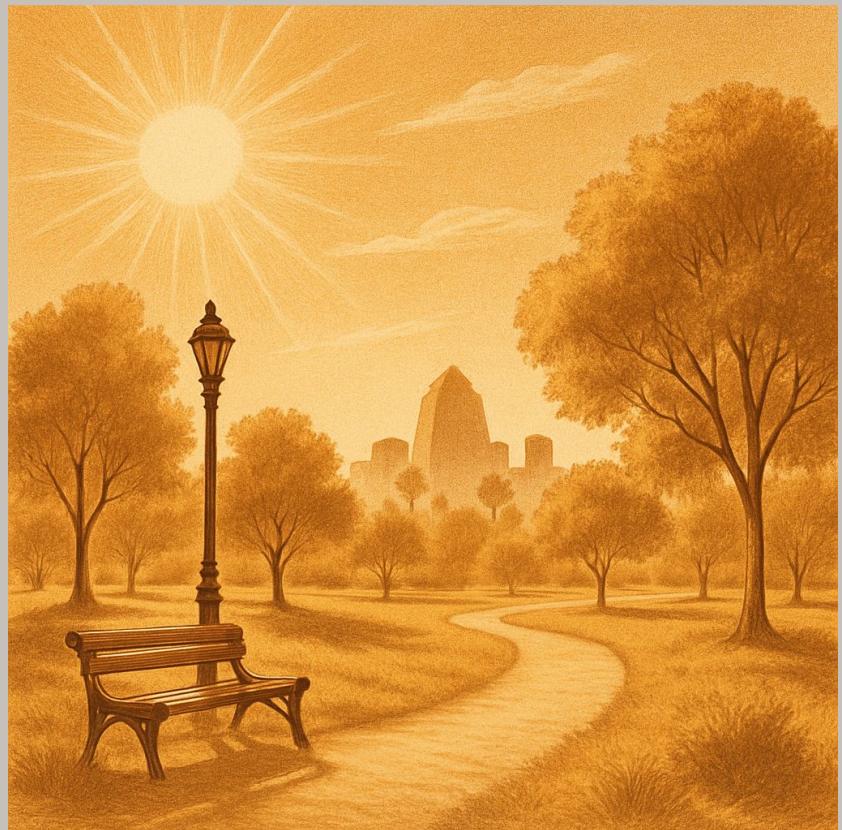
Similar meanings = closer vectors



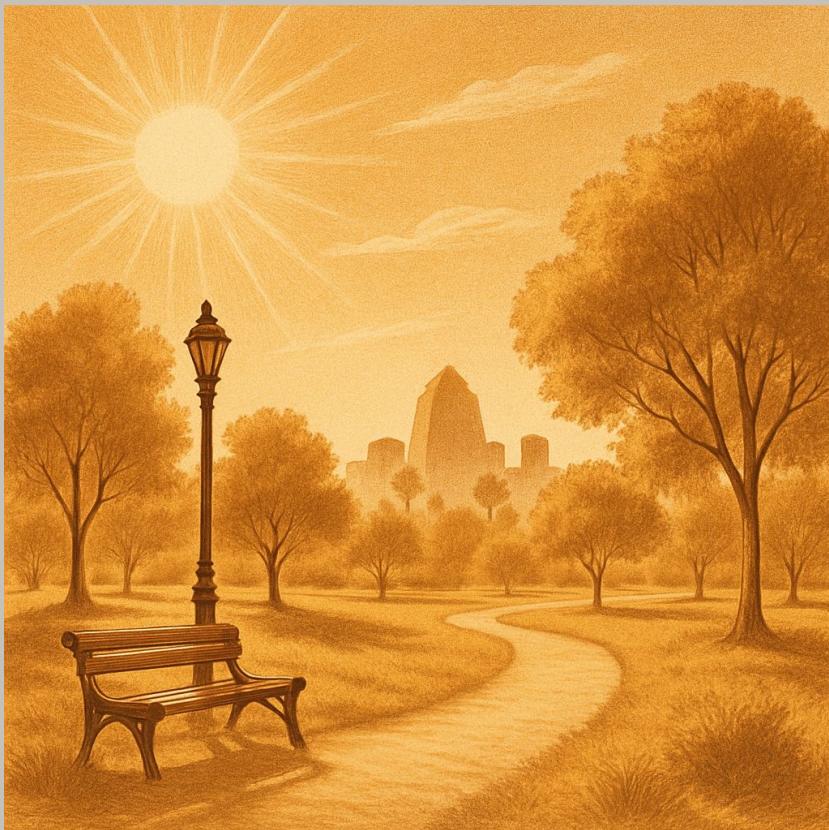
Text becomes numerical data

STEP 2: PAYING ATTENTION TO WHAT MATTERS

On a sunny spring morning, people walked through the beautiful city park.



STEP 2: PAYING ATTENTION TO WHAT MATTERS



*On a **sunny spring morning**,
people walked through the
beautiful city park.*



Focus on important words

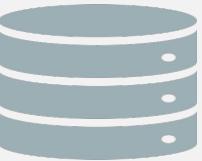
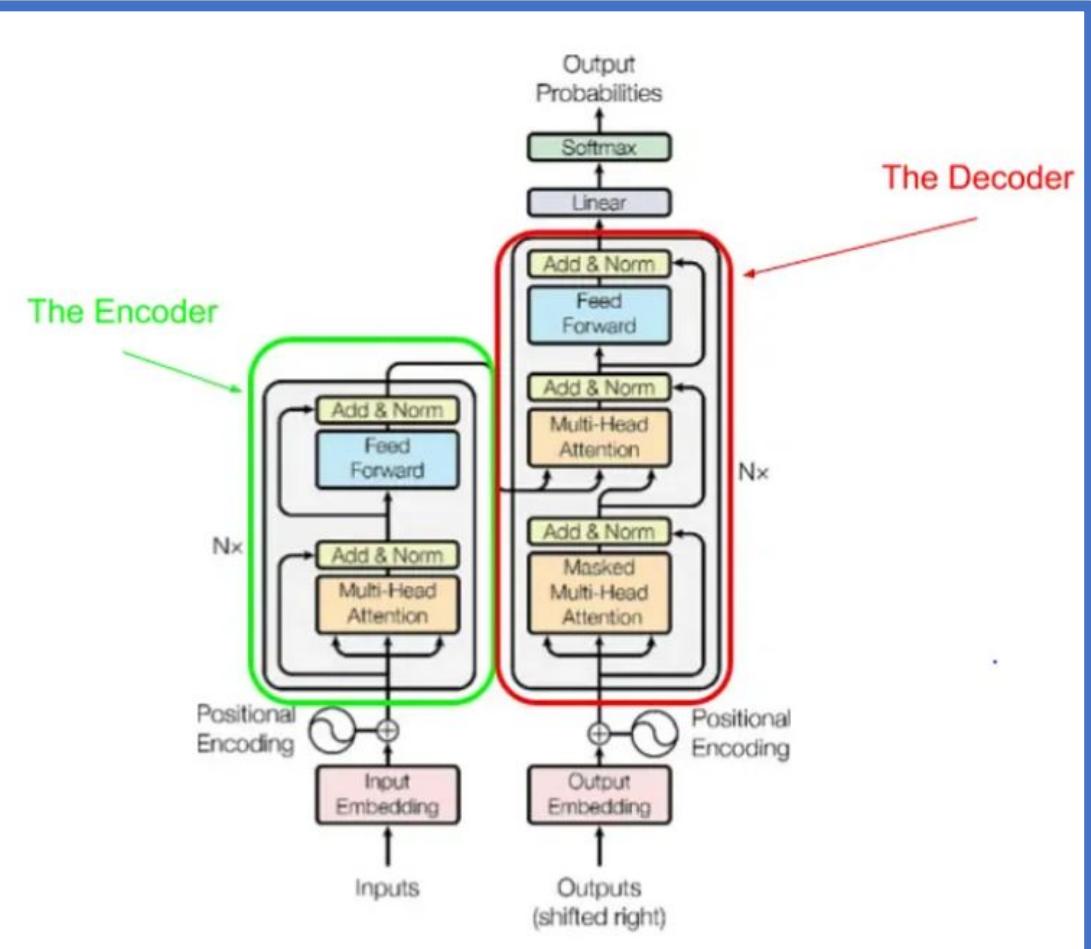


Assign attention weights

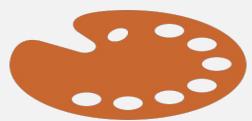


Handle long sentences

STEP 3: BUILDING A TRANSFORMER



Stacks of Attention + Feed-Forward layers

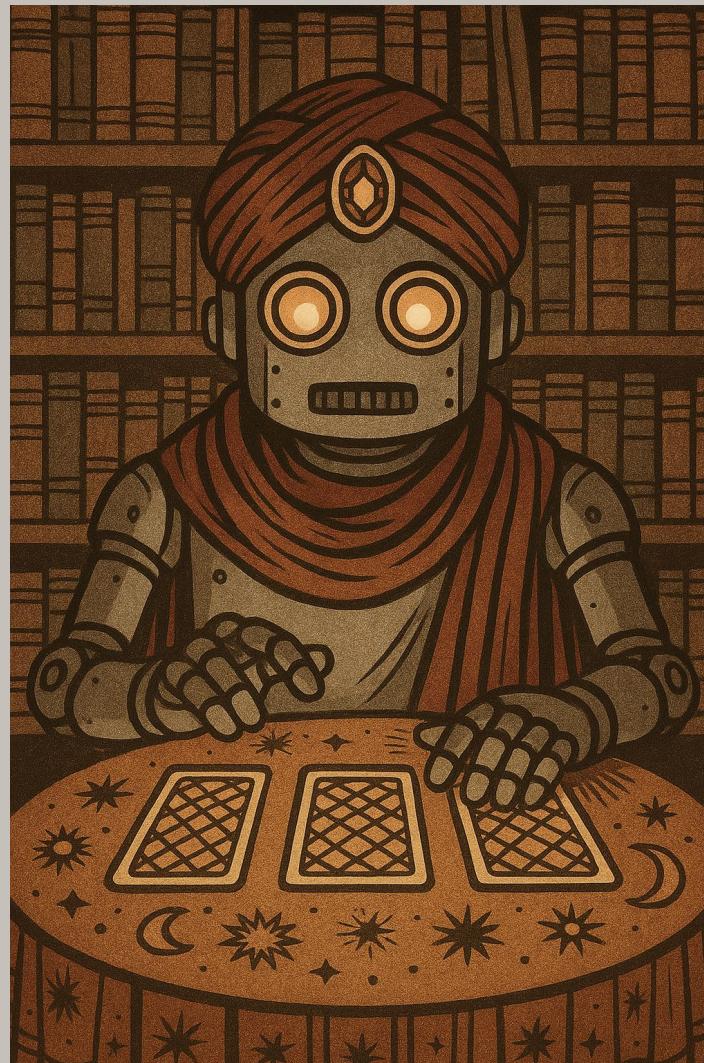


Modular design



Deeper layers = deeper understanding

STEP 4: TRAINING ON HUGE TEXT LIBRARIES



Billions of words

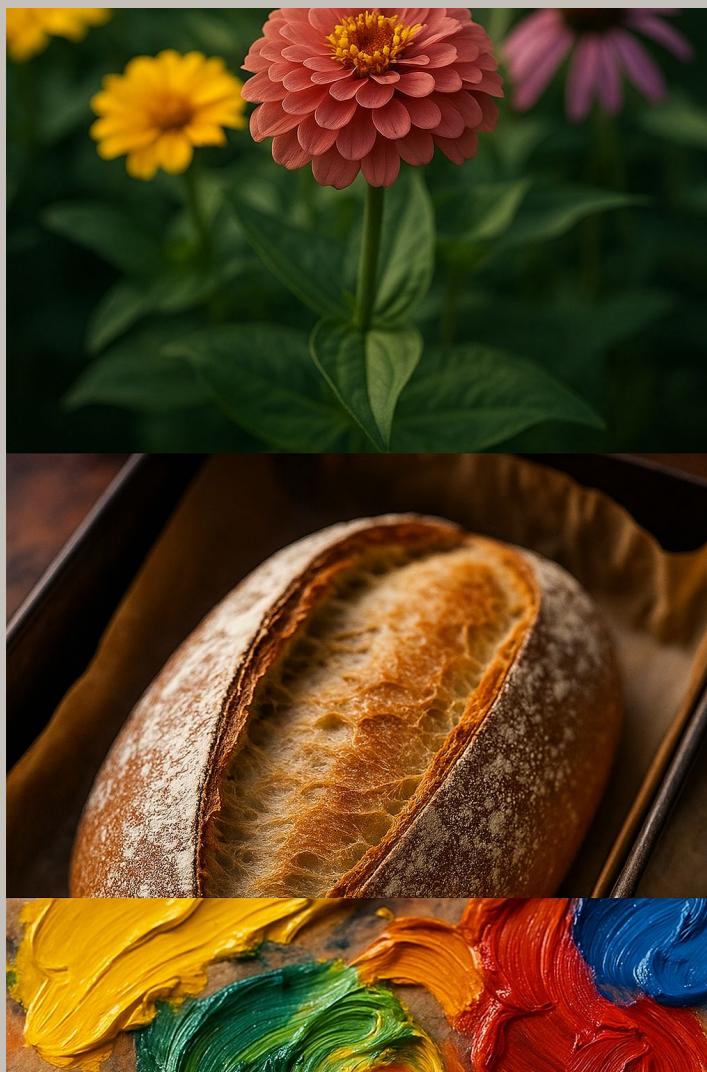


Predict next word
repeatedly



Patterns emerge
naturally

STEP 5: PREDICT, PREDICT, PREDICT!



Predict next word/token

Assign probability scores

Sample or
choose highest probability

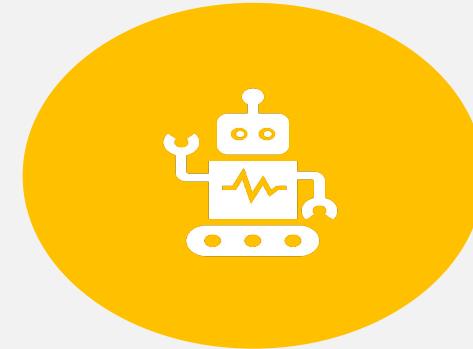
TALK LIKE A TRANSFORMER: KEY POINTS



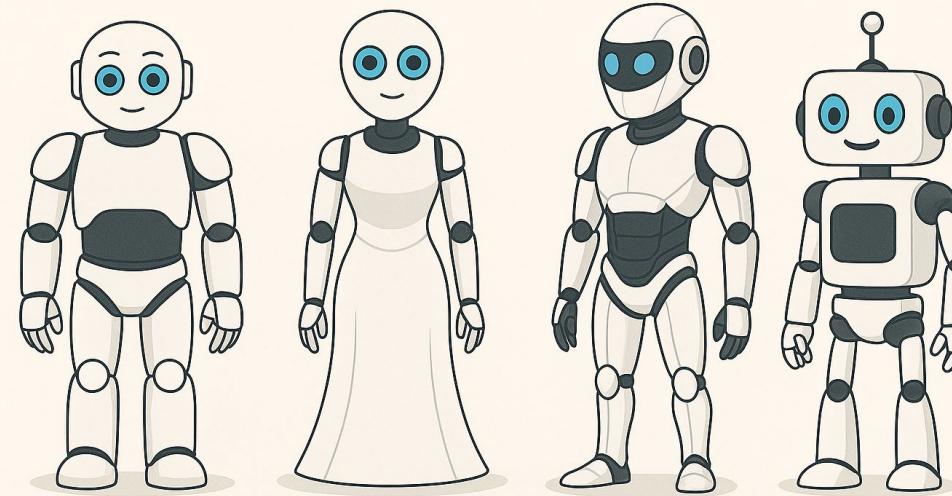
WORDS BECOME MATH



ATTENTION DRIVES
FOCUS



TRAINED ON
PATTERNS, NOT LOGIC



MAKE YOUR CHOICE

Hosted LLMs Overview (as of June 2025)

Model	Strengths	Limitations
ChatGPT	Wide adoption	Paywalled, not always real-time
Claude	Long context, reasoning	More cautious
Gemini	Google integration	Newer, less tested
DeepSink	Efficiency	Privacy concerns

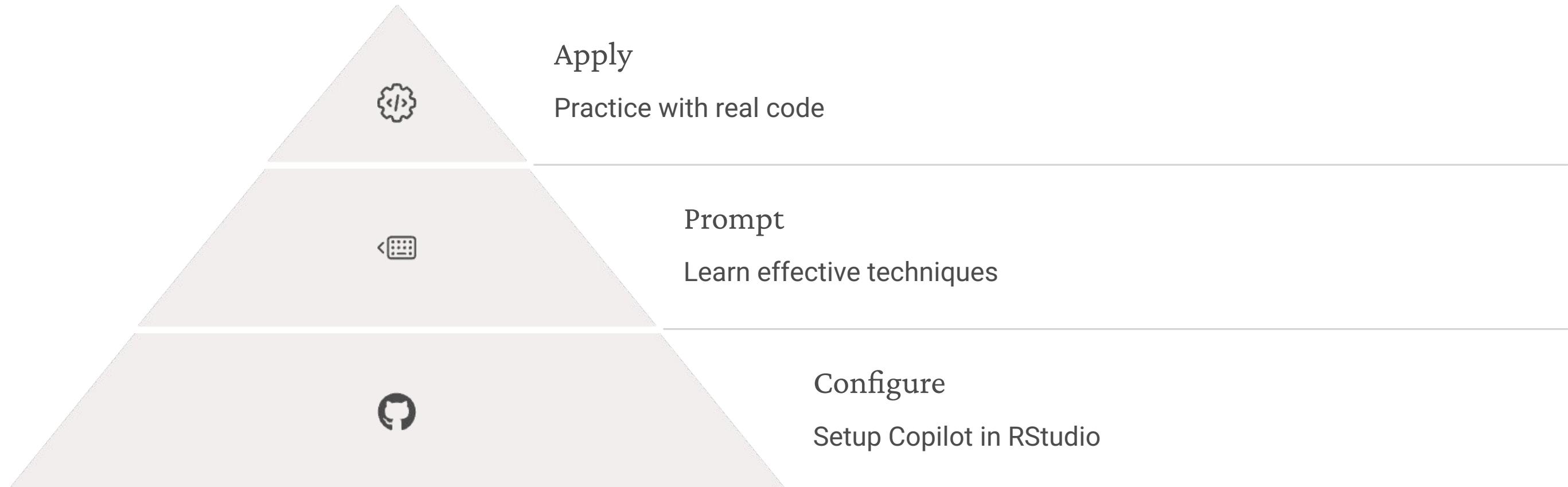


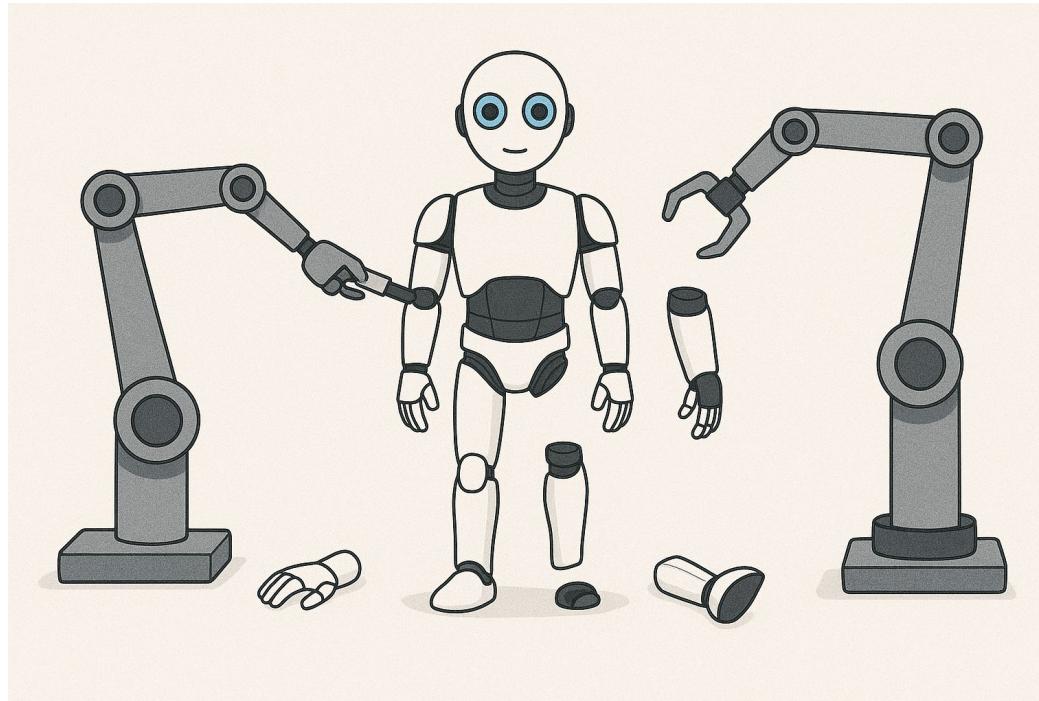
Break Time



UNIT B Configure & Prompt

Configure and Prompt Overview





GitHub Copilot Setup



What is Copilot?

AI pair programmer for code completion



Benefits for R

Faster coding, fewer errors

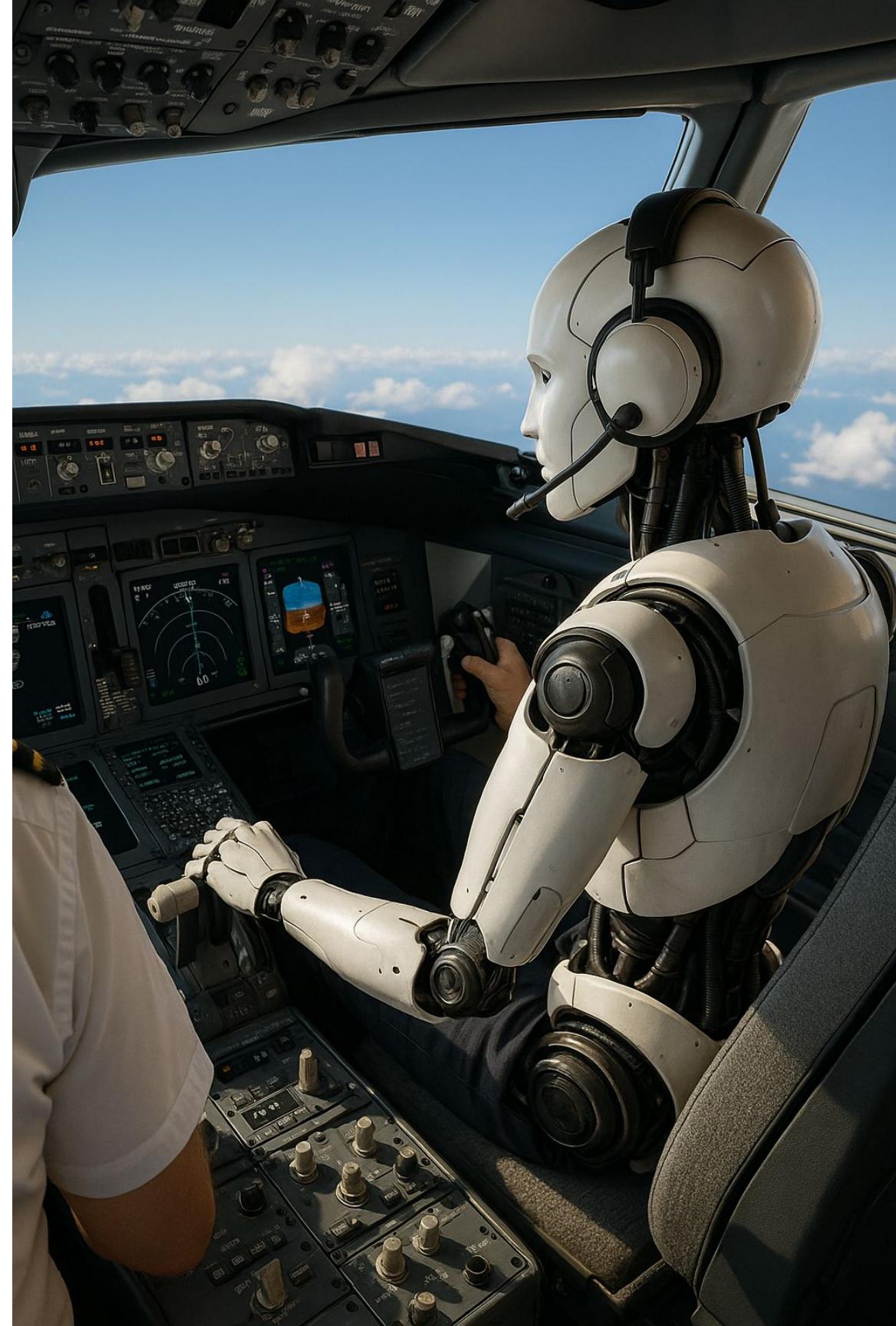


How It Works

Suggests code based on comments

Copilot Account & Enrollment

-  GitHub Account
 - Sign up or verify existing
-  Copilot Enrollment
 - Visit [Posit guide link](#) (if needed)
-  Select Plan
 - Free trial for public users
-  Verify
 - Confirm license in settings



RStudio Integration

Update RStudio

Version 2024.10 or later (2025.05 is current version)

Enable Copilot

Tools → Global Options → GitHub Copilot

Authenticate

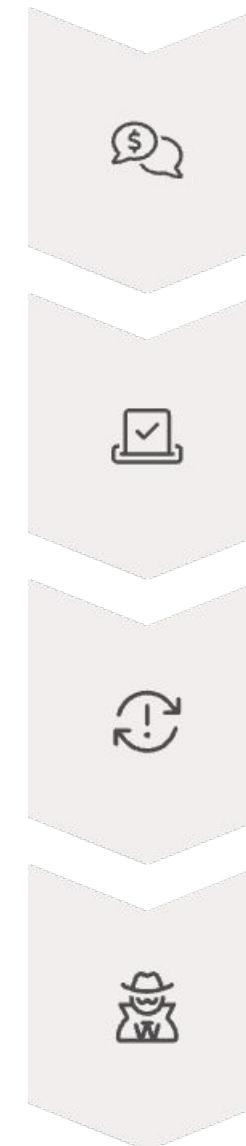
Connect via GitHub OAuth

Restart & Confirm

Verify Copilot text appears in new .R script in RStudio



Hands-On Code Practice



Live Prompt

Type comments in R script

Accept Suggestions

Use Tab to insert Copilot code

Iterate

Refine comments, observe changes

Share Experiences

Round-robin discussion

Code Comments to Try (One at a time)

```
# Install ggplot2 and moderndive packages  
  
# Load the packages  
  
# Plot waiting by duration for old_faithful_2024
```

ChatGPT for Code Generation



ChatGPT

Craft Prompt
Specific request for R code

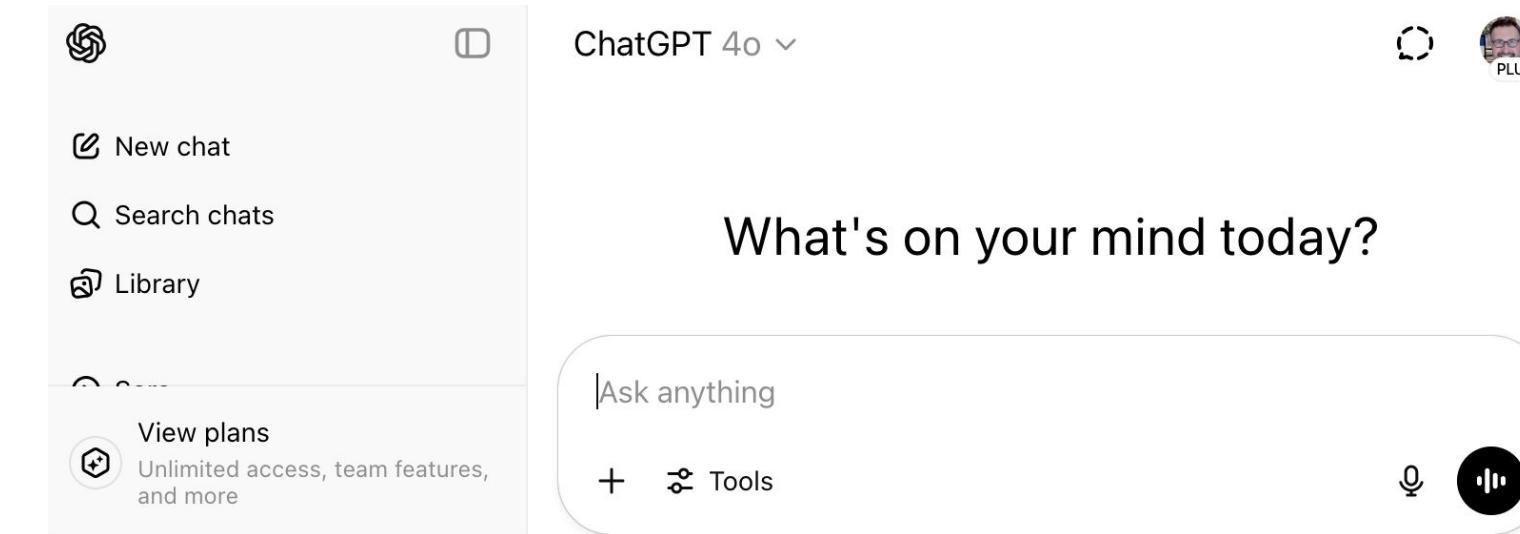


Generate Code
ChatGPT creates solution

Test & Refine
Run code, iterate as needed

Copy Code
Transfer to RStudio

ChatGPT Interface Tour



Access

[Create free account](#)

Key UI Elements

Prompt box, message types

Code Formatting

Triple-backtick fences

Prompt Crafting Demo Review

Example Prompt

Violin plot of life expectancy by continent

Try also by region instead of continent

Using moderndive dataset

Student Exercise

Create top 10 population bar chart

Horizontal orientation

Descending order

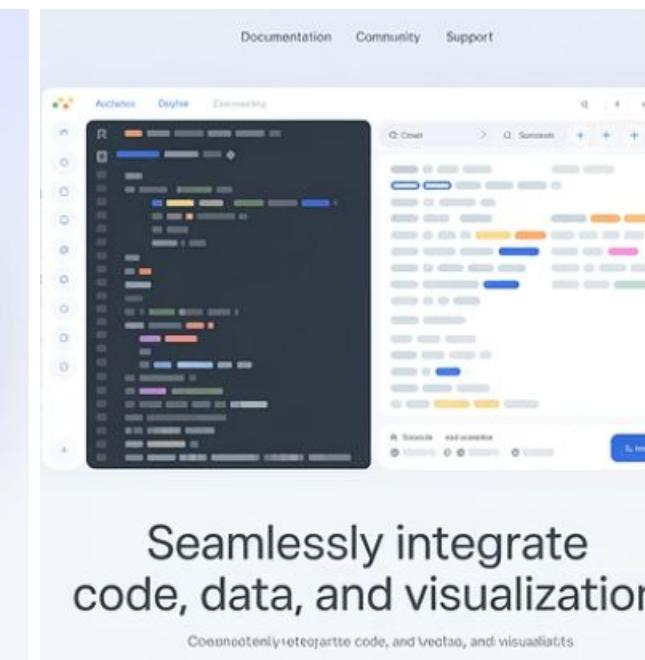
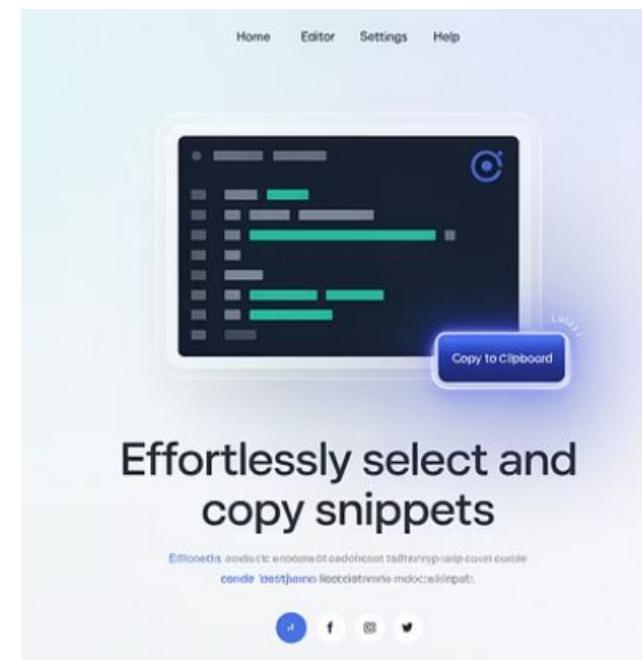
Best Practices

Specify language & dataset

Include column names

Request inline comments

Copy & Execute Workflow DEMO Review



You and Your AI + Human Collaborators



Form Teams

Work in small groups



Choose Dataset

`coffee_quality` or `spotify_by_genre`



Define Analysis

Set clear statistical goals



Teams & Dataset Selection

coffee_quality Dataset

- Bean characteristics
- Taste profiles
- Origin information

spotify_by_genre Dataset

- Musical attributes
- Popularity metrics
- Genre classifications

Analysis Goals

- Define clear objective
- Draft prompt together
- Plan initial exploration

AI-Assisted Analysis

ChatGPT Path

Paste prompt, copy results

Transfer to RStudio

Execute and verify

Copilot Path

Write comments in script

Accept code suggestions

Run incrementally

Human Oversight

Verify outputs

Check statistical validity

Guide the AI



Reflect & Share



What Worked

Successful AI assistance examples



Challenges

Where AI suggestions missed



Improvements

Prompt refinement ideas



Documentation

Capture in [Google Doc](#)

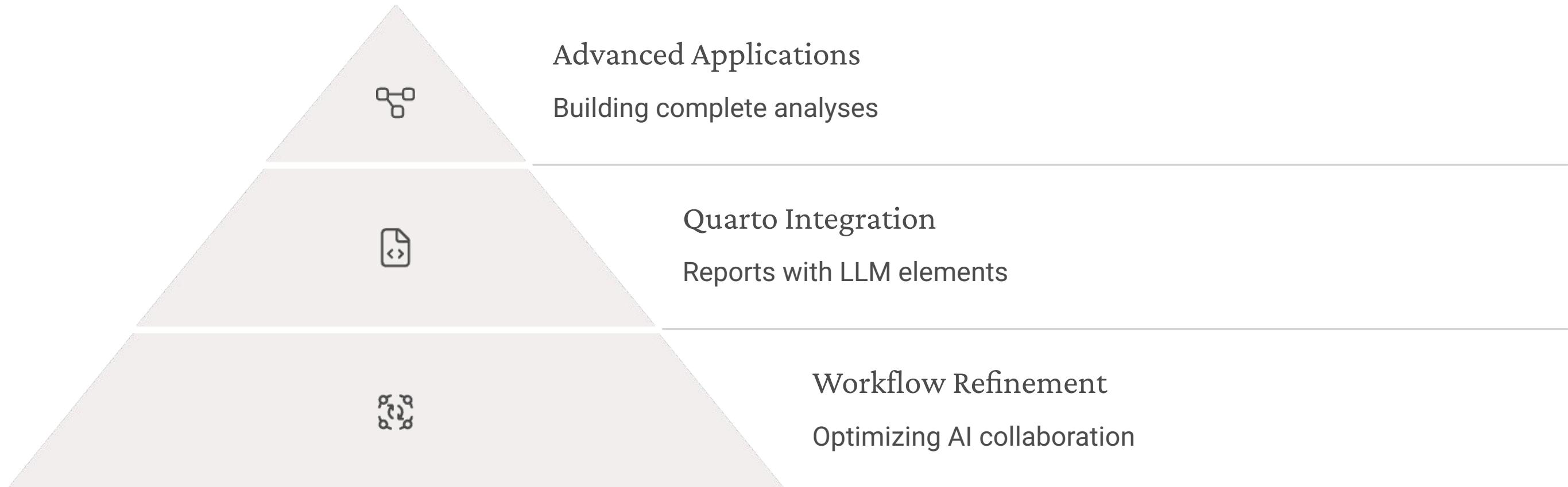
Break Time

15:00



UNIT C More AI Collaboration

More AI Collaboration Overview





Review of Hours A and B

Workshop Goals

Effective prompts, Copilot use, Quarto reports

Practical Tools

Copilot setup, ChatGPT workflow



LLM Foundations

Transformers, attention, model types

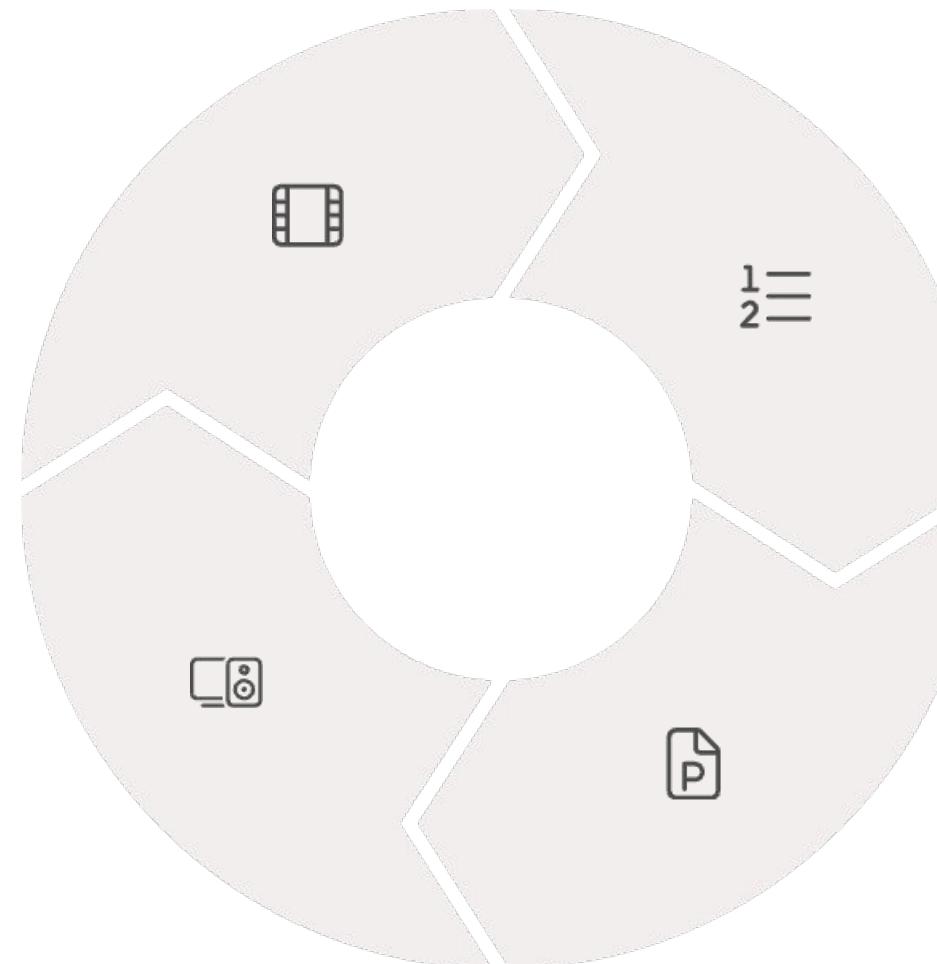
Collaborative Work

Team exercises, dataset exploration

Exploring AI Limitations and Successes

Literate Programming
Quarto fundamentals

Replication
Test AI reproducibility



Literate Programming Refresher

Quarto Anatomy

- Code chunks
- Narrative text
- YAML front matter

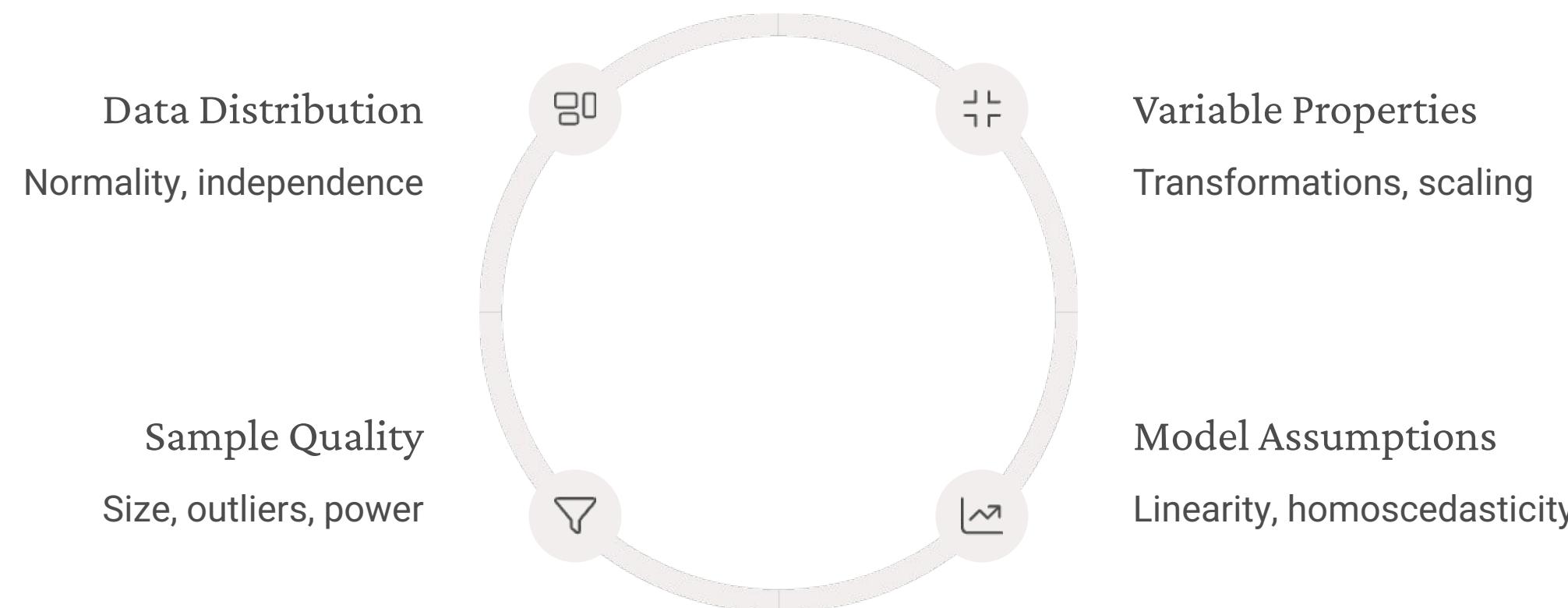
Chunk Options

- `#| echo: true`
- `#| eval: true`
- `#| include: false`

Live Demo

- Create mini .qmd
- Add code + text
- Render document

Documenting Analysis Assumptions





Crafting Your Report



Introduction

Objective and context

Methods

EDA, modeling approach

Key Findings

Supported hypotheses

Open Questions

Areas for further study

Designing a Replication Prompt

Draft Prompt

Clear instructions to reproduce analysis

Workflow Plan

Systematic prompt-code-verify cycle

Version Control

Document prompts alongside code





Evaluating AI Alignment (Example)

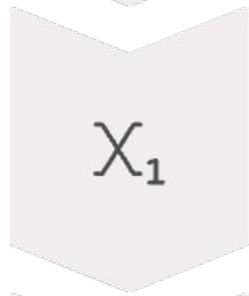
Component	Your Code	AI Code	Alignment
Data Prep	Complete	Missing steps	Partial
Model Parameters	Optimized	Default	Fair
Visualization	Custom theme	Standard	Work Needed

Prompt Refinement



Identify Issues

Missing libraries, wrong filters



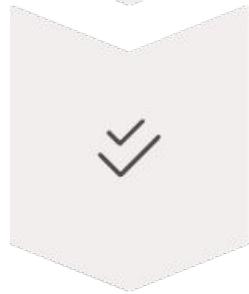
Add Details

Specify packages, column names



Regenerate

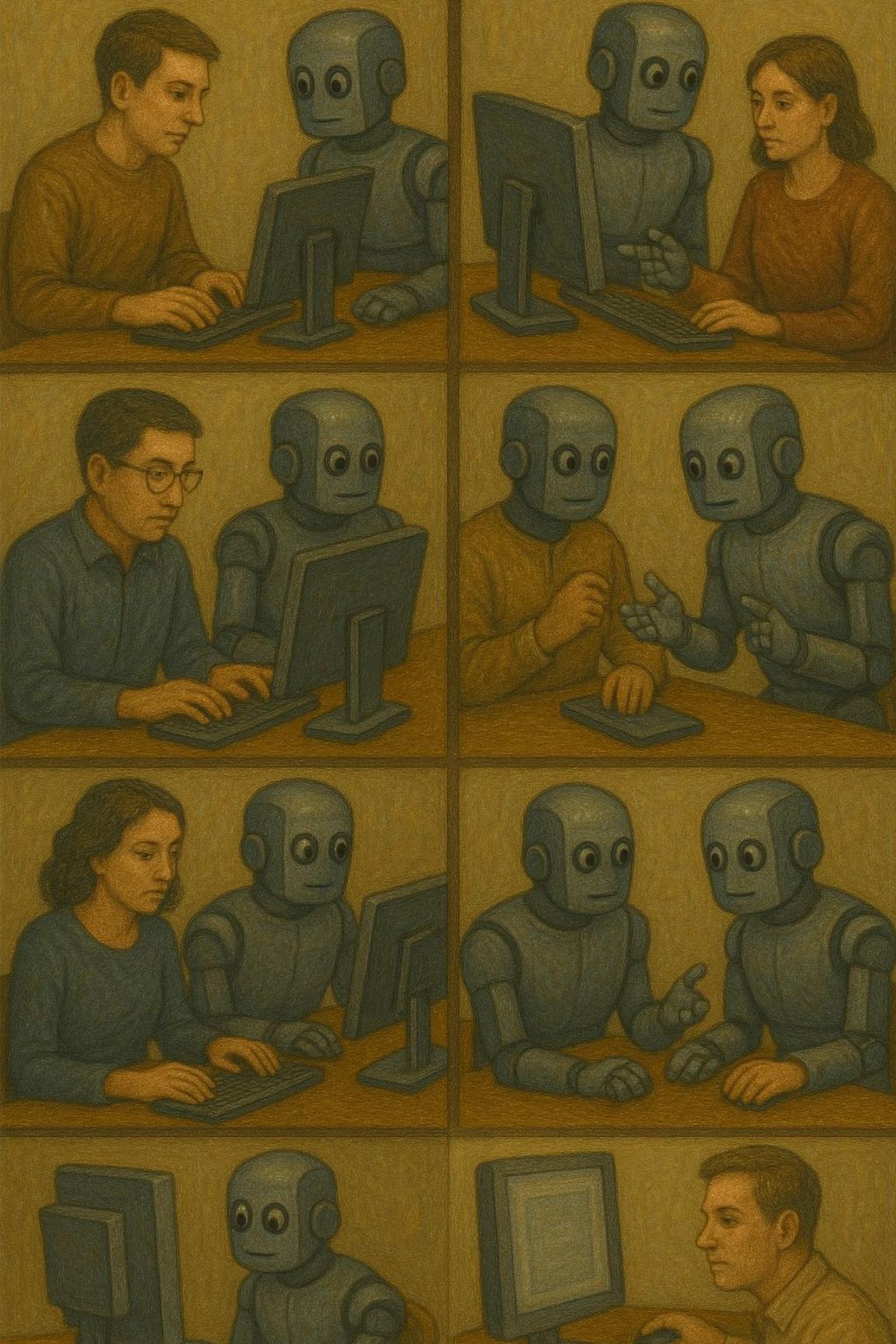
Get improved code output



Verify

Confirm matches expected result





Automating with Copilot



Data Import

Load and clean
datasets



EDA

Create statistical
overviews and plots



Modeling

Generate regression
and testing code



Custom Functions

Build reusable
components



Hands-On: Data Load

```
# Load coffee_quality data from moderndive package
```

```
# Preview first 10 rows
```



Hands-On: Exploratory Data Analysis

```
# Create a summary table of mean and SD for  
# all numeric columns
```

```
# Generate side-by-side boxplot of acidity by continent
```

Hands-On: Modeling & Inference



```
# 1. Fit a linear regression: quality ~ aroma
```

```
# 2. Get results using the three
```

```
# moderndive::get_regression functions
```

```
# Use the infer R package to perform a two-sample  
# permutation test on total_cup_points for  
# Asian vs North American countries
```

Hands-On: Custom Functions

```
# Write a function corr_matrix(df) that  
# selects only numeric columns,  
# computes pairwise Pearson correlations, and  
# returns a tidy tibble with Var1, Var2, and correlation
```

Hands-On (Extension): Correlation Heatmap

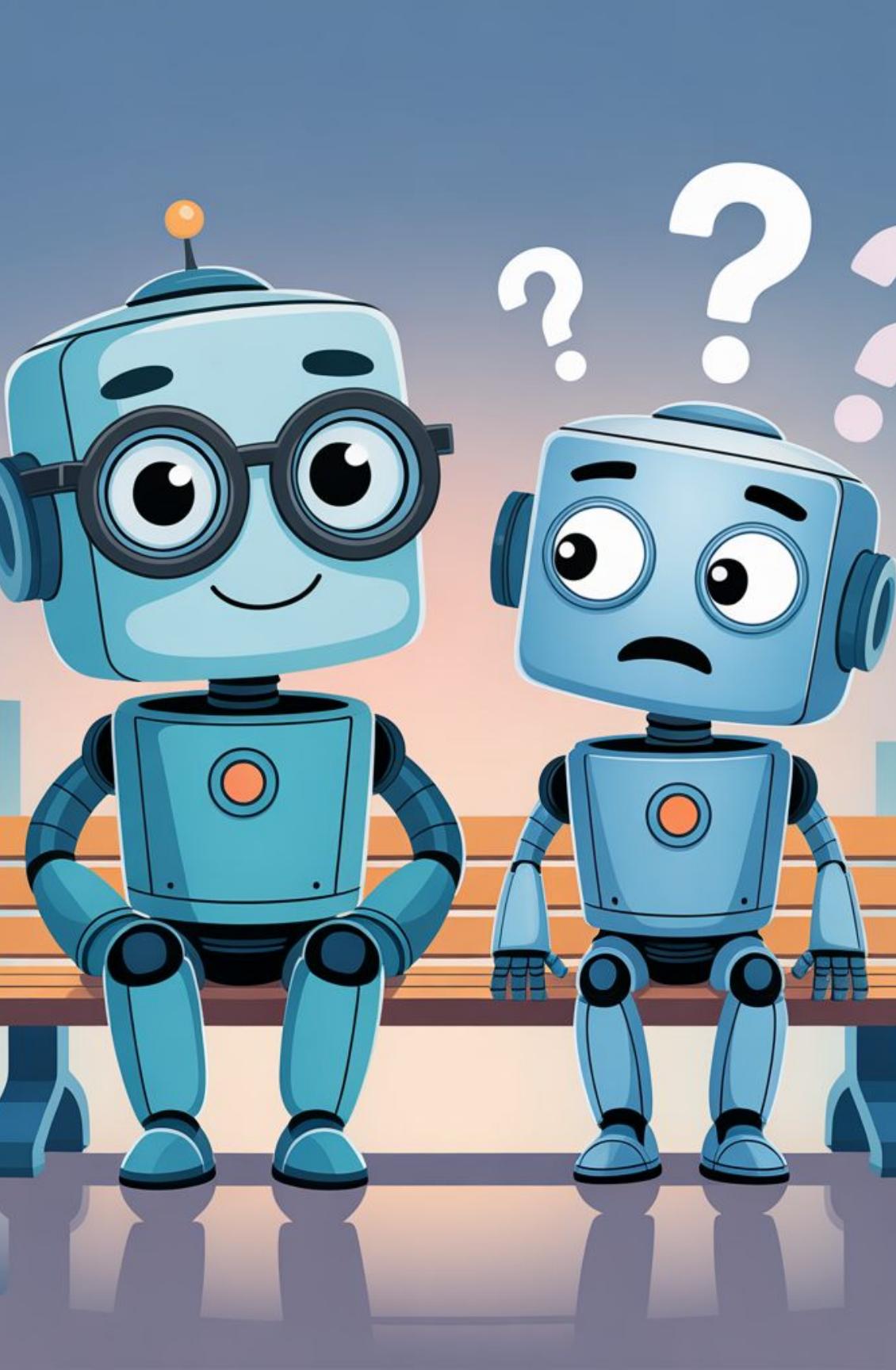
```
# Create a heatmap from the correlation matrix call
```



Break Time



UNIT D Summary + Wrap-Up



Pitfalls, Best Practices, and Ethics



Identify Hallucinations

Systematic fact-checking



Verify Against Sources

CRAN docs, peer-reviewed articles



Ask for Citations

Request verifiable information



Maintain Fact-Check Section

Log corrections in QMD

Prompt-Logging Practices

Record Prompts

Comment before each LLM-driven chunk

Version Iterations

Track improvements with Git branches

Timestamp Entries

Enable traceability to model version

Document Changes

Note refinements between attempts



What About Reproducibility?



Declare Dependencies

Document package versions



Set Random Seeds

Fixed values before sampling



Archive Conversations

Save LLM logs with reports



Enable Replay

Allow auditors to recreate steps



Course Review & Next Steps



Continue Learning
Apply tools to your projects



Stay Connected
Share contact info (if you wish)



Thank you!

Additional resources

- YouTube links
 - [Transformers explained visually](#)
 - [Attention in transformers](#)
 - [How might LLMs store facts](#)
- [Transformer Explainer](#)

[ModernDive v2 textbook](#)

