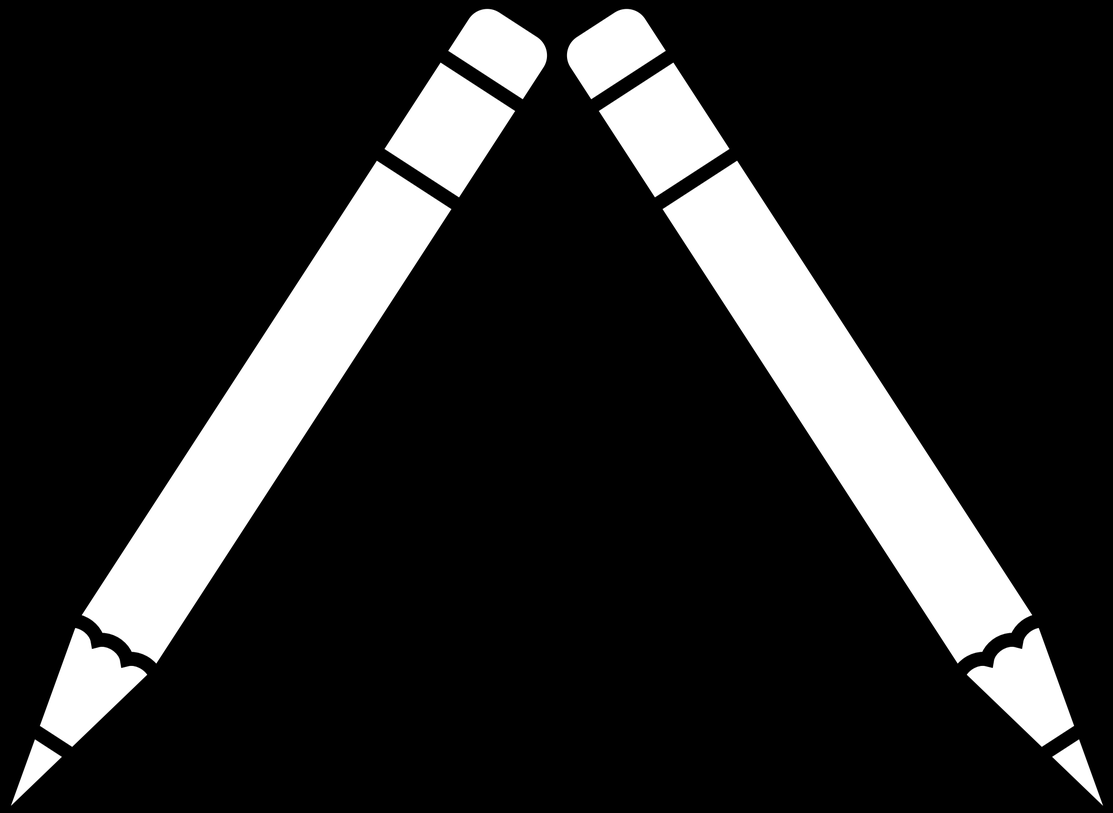
Generative AI and **Pedagogical Innovation**

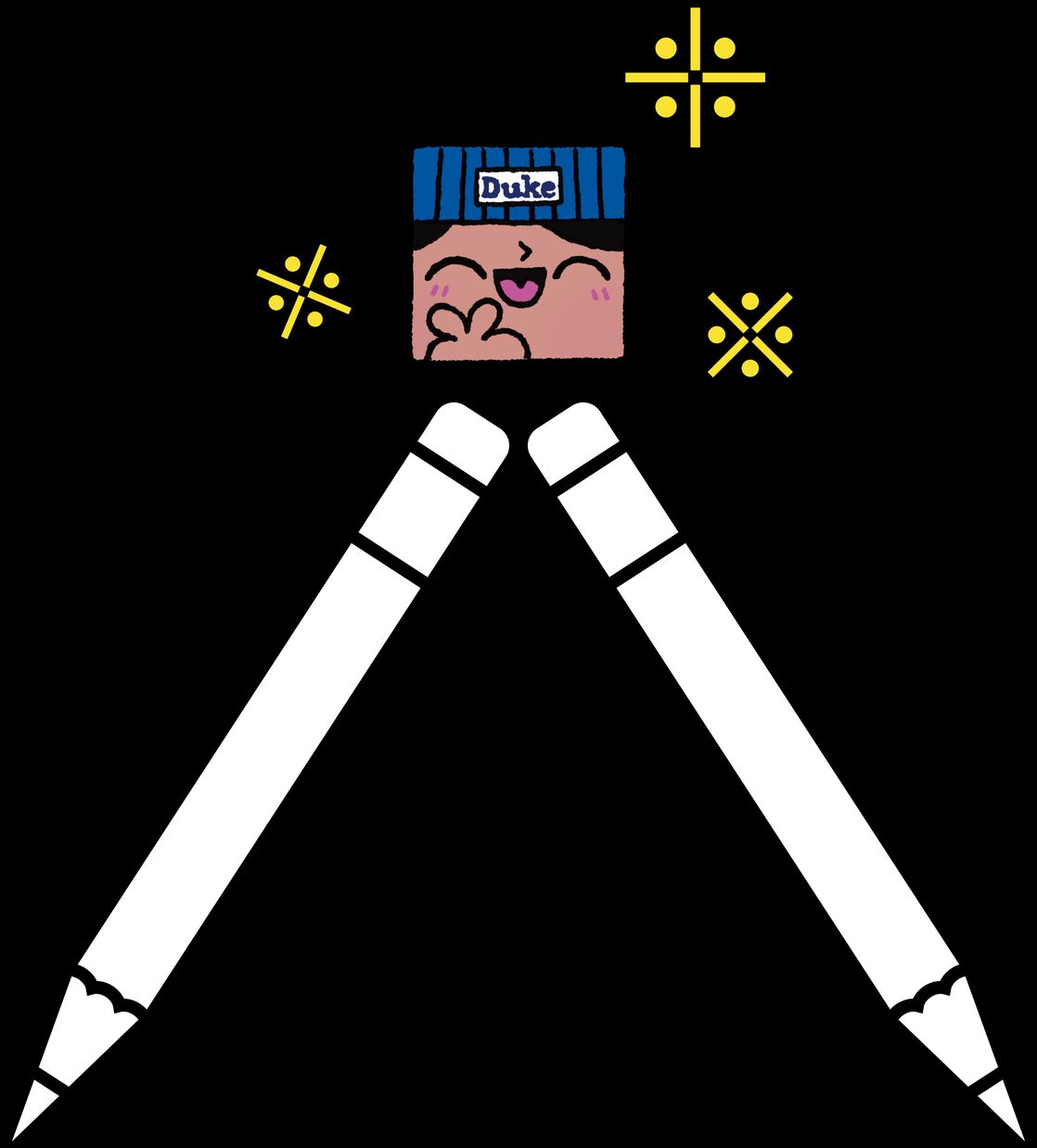
Carter Zenke
carter@carterzenke.me

Fill in tables and talk to someone near you!
If nervous, just say you're following instructions! 😊

carterzenke.me/emerging-pedagogies



Groups of three also welcome!



Groups of three also welcome!

Who are you?

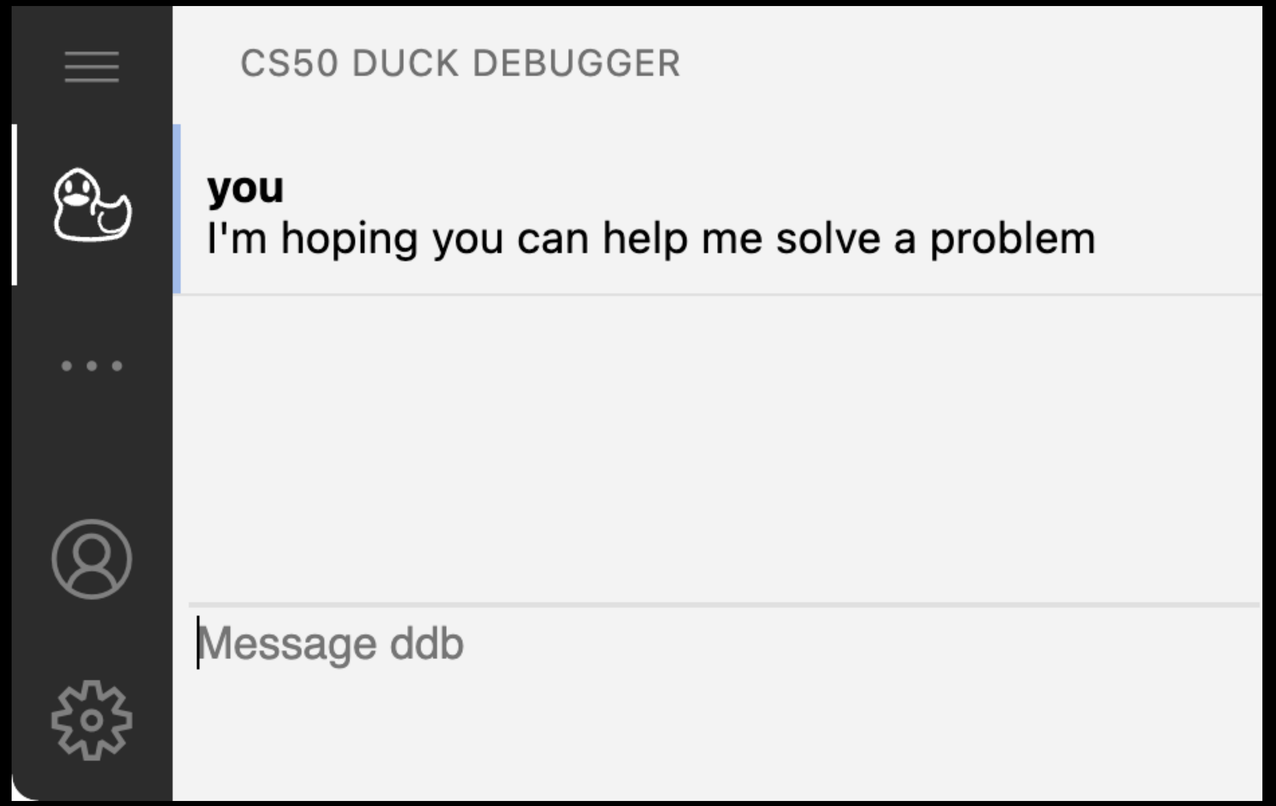
Why are you here?

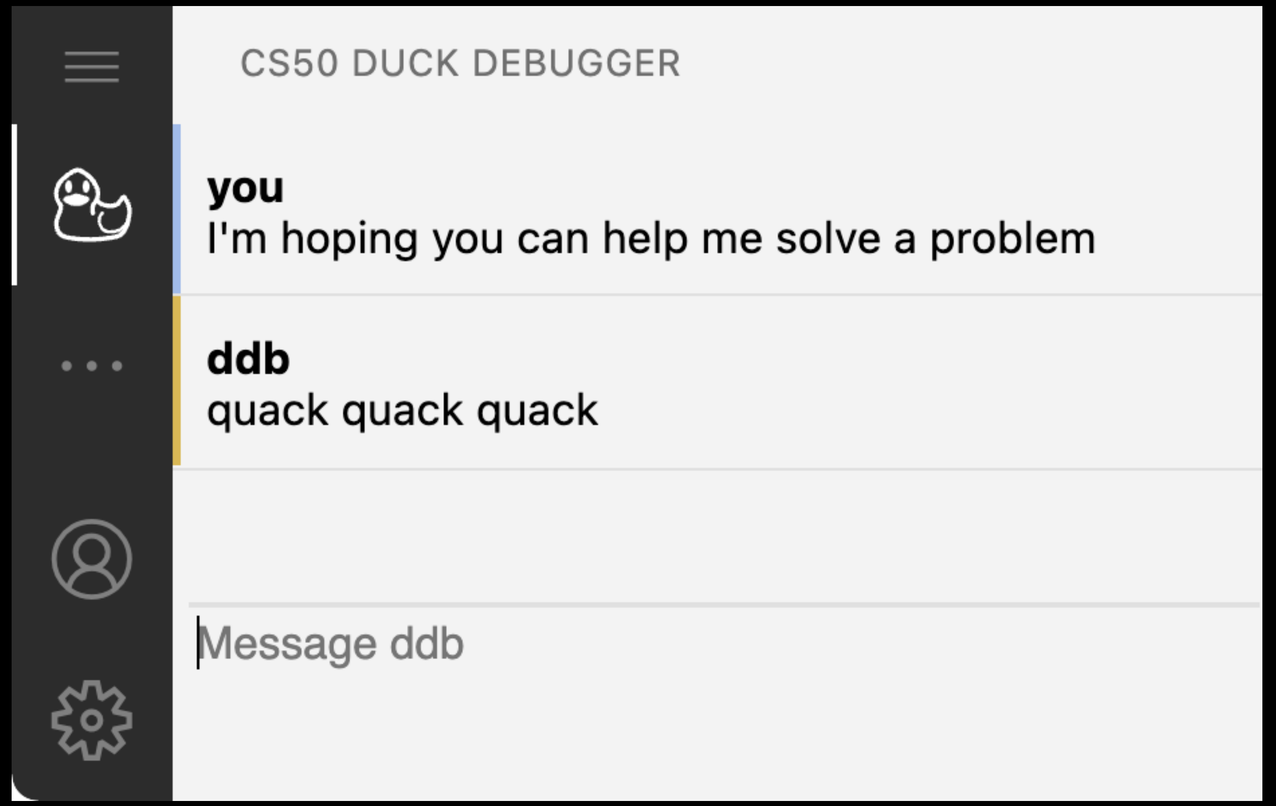
What are you hoping to learn today?

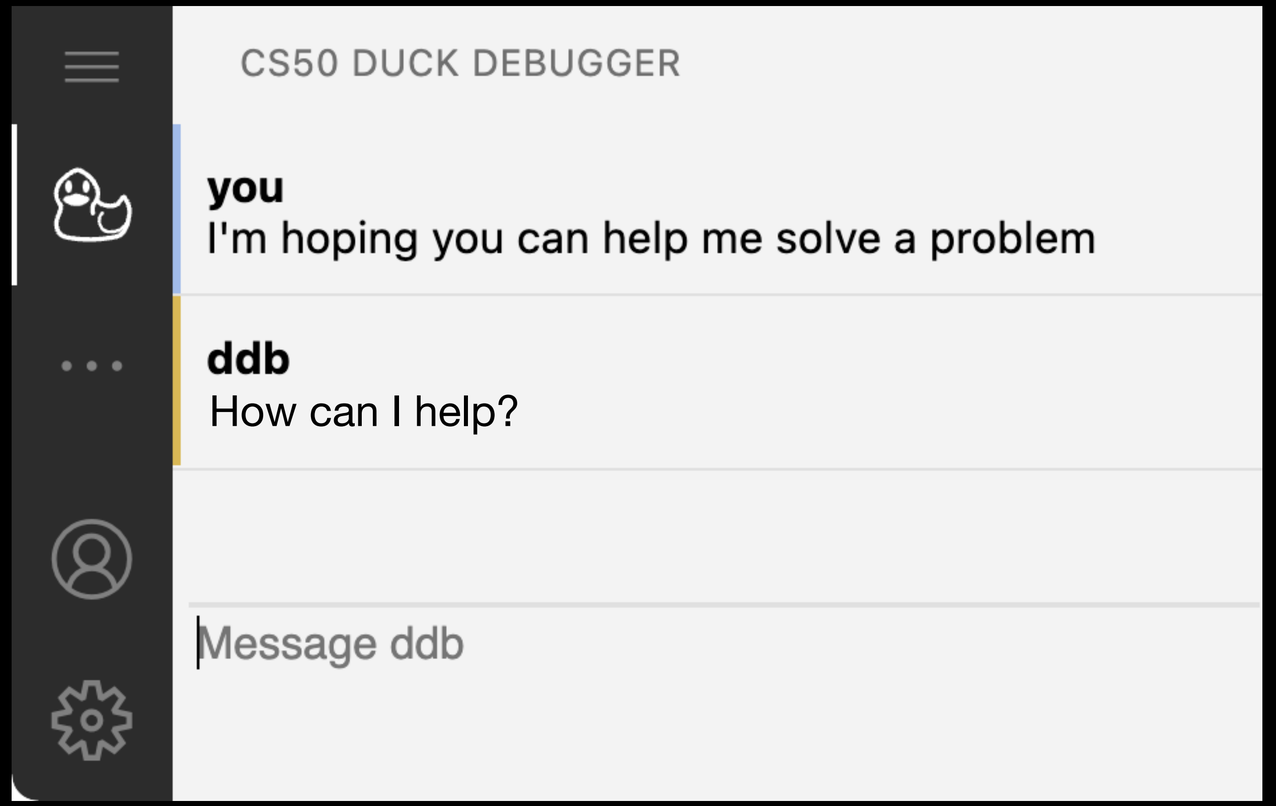
CS50

Rubber duck debugging

CS50 DUCK DEBUGGER
Message ddb


CS50 DUCK DEBUGGER
you
I'm hoping you can help me solve a problem
Message ddb


CS50 DUCK DEBUGGER
you
I'm hoping you can help me solve a problem
ddb
quack quack quack
Message ddb


CS50 DUCK DEBUGGER
you
I'm hoping you can help me solve a problem
ddb
How can I help?
Message ddb

Artificial Intelligence

A computer program that performs a task commonly associated with human intelligence.

Generative Artificial Intelligence

Artificial intelligence that generates text, images, and other content—often in response to a prompt.

Where is Duke University located?

Duke University is located in Durham, North Carolina, United States.

Generative Pre-Trained Transformer

A specific implementation of generative artificial intelligence, which recreates patterns found in vast amounts of data.

ChatGPT

Claude

Gemini

Llama

...

ChatGPT et al. are too helpful

ChatGPT

CA

Create a Renaissance-style painting

Overcome procrastination

What's in the news in Tokyo today?

Experience Seoul like a local

Message ChatGPT

ChatGPT can make mistakes. Check important info.

?

Not Reasonable

Using AI-based software (e.g., ChatGPT, GitHub Copilot, Bing Chat, et al.) that suggests or completes answers to questions or lines of code.

Pedagogical guardrails

Approximate a 1:1 teacher-to-student ratio

CS50.ai ❤️❤️❤️❤️❤️

Feedback

ddb

Quack. I am CS50's duck debugger (ddb), an experimental AI for rubberducking. Quack quack. My replies might not always be accurate, so always think critically and let me know if you think that I've erred. Conversations are logged. Quack quack quack.

Ask a question

Reasonable

Using CS50’s own AI-based software.

What is the role of generative AI in pedagogical innovation?

3-2-1 Bridge

What is the role of generative AI in pedagogical innovation?

What is the role of generative AI in pedagogical innovation?

3 thoughts or ideas

What is the role of generative AI in pedagogical innovation?

3 thoughts or ideas

2 questions

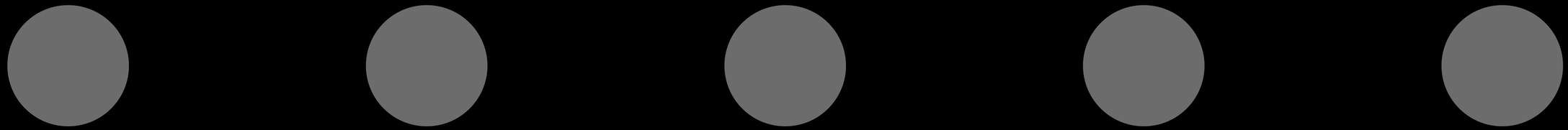
What is the role of generative AI in pedagogical innovation?

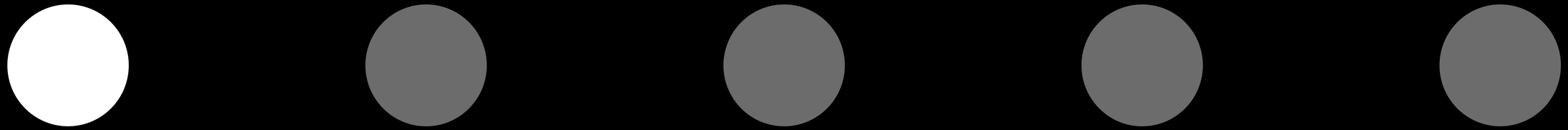
3 thoughts or ideas

2 questions

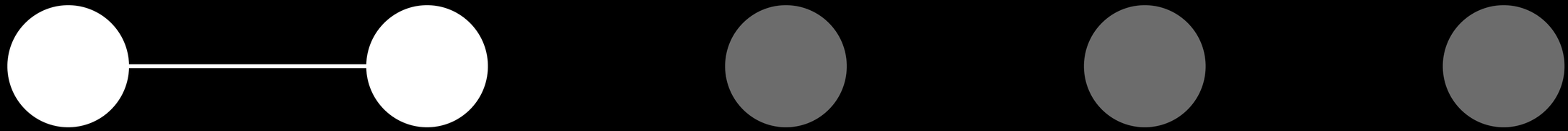
1 metaphor or simile

Oh Hello, GPT!



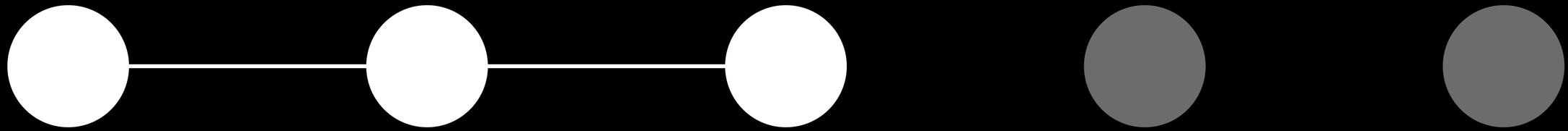


Imagining a learning experience



Imagining a learning experience

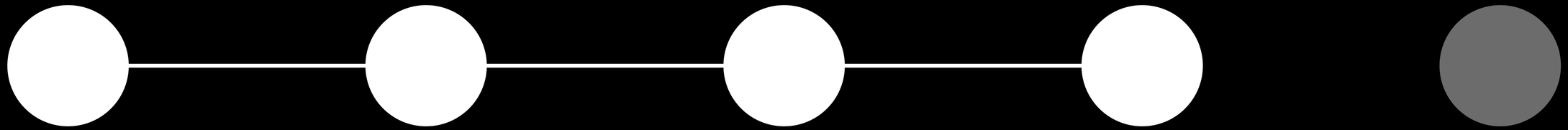
Understanding GPTs



Imagining a learning experience

Understanding GPTs

Prompting

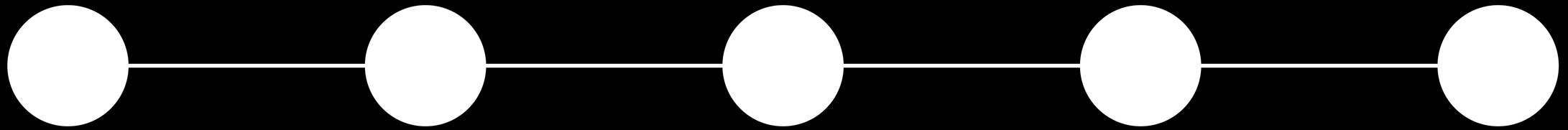


Imagining a learning experience

Understanding GPTs

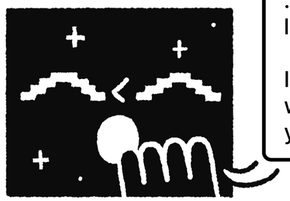
Prompting

Adding knowledge


Imagining a learning experience
Understanding GPTs
Prompting
Adding knowledge
Crafting policy

Imagining a Learning Experience

Oh Hello, GPT!



… … **Oh!** Hi! I've been really hoping I'd meet a human like you soon. You are a human, right? Like, with **ideas**?

I'm GPT. I've been trying to find a purpose—I just don't want to be a solution in search of a problem. What are you hoping to create?

1 Learning Experience

In the space below, draw or describe a learning experience you've always wanted students to have. Here are a few prompts to guide your thinking:

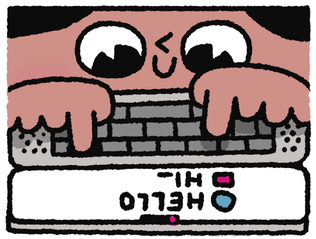
- What are students doing? What's your role in the experience?
- What do you want students to know, believe, and be able to do?
- What do you want students to tell others about their experience?

Try to both dream big and think concretely. And no need to think about AI just yet!

1.1

1.2 Chat with GPT

GPTs can be helpful brainstorming partners. Head to **ohhellogpt.com** and, in **Step 1**, chat with GPT about your idea. Can you expand your initial idea?



1.3 What do you need?

In the spaces below, document at least 4 requirements of your learning experience. Think:

- What work would be required of you?
- What materials would you need to make?
- Who would need to be involved?

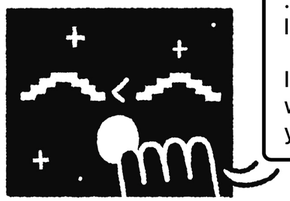
1

2

3

4

Oh Hello, GPT!



… … **Oh!** Hi! I've been really hoping I'd meet a human like you soon. You are a human, right? Like, with **ideas**?

I'm GPT. I've been trying to find a purpose—I just don't want to be a solution in search of a problem. What are you hoping to create?

1 Learning Experience

In the space below, draw or describe a learning experience you've always wanted students to have. Here are a few prompts to guide your thinking:

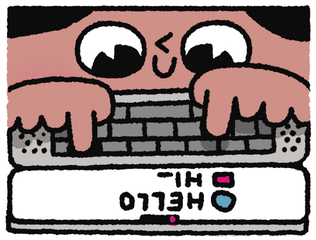
- What are students doing? What's your role in the experience?
- What do you want students to know, believe, and be able to do?
- What do you want students to tell others about their experience?

Try to both dream big and think concretely. And no need to think about AI just yet!

1.1

1.2 Chat with GPT

GPTs can be helpful brainstorming partners. Head to **ohhellogpt.com** and, in **Step 1**, chat with GPT about your idea. Can you expand your initial idea?



1.3 What do you need?

In the spaces below, document at least 4 requirements of your learning experience. Think:

- What work would be required of you?
- What materials would you need to make?
- Who would need to be involved?

1

2

3

4

"I've always wanted students to be able to interview the authors of our texts, writing thoughtful questions about the creative process and how the author's work intersects with their own lives."

"I've always wanted students to be able to perform high-level data analysis without needing to learn how to program in R or Python."

"I've always wanted to help students visualize the connections between courses, helping students see their studies as a cohesive whole."

Understanding GPTs

N-gram models

Duke University is a private research university in Durham, North Carolina, United States. Founded by Methodists and Quakers in the present-day city of Trinity in 1838, the school moved to Durham in 1892.

Duke University is a private research university in Durham, North Carolina, United States. Founded by Methodists and Quakers in the present-day city of Trinity in 1838, the school moved to Durham in 1892.

N-gram	frequency
(Duke, University)	1

Duke University is a private research university in Durham, North Carolina, United States. Founded by Methodists and Quakers in the present-day city of Trinity in 1838, the school moved to Durham in 1892.

N-gram	frequency
(Duke, University)	1
(University, is)	1

Duke **University is** a private research university in Durham, North Carolina, United States. Founded by Methodists and Quakers in the present-day city of Trinity in 1838, the school moved to Durham in 1892.

N-gram	frequency
(Duke, University)	1
(University, is)	1
(is, a)	1

Duke University **is a** private research university in Durham, North Carolina, United States. Founded by Methodists and Quakers in the present-day city of Trinity in 1838, the school moved to Durham in 1892.

N-gram	frequency
(in, the)	115
(of, the)	88
(Duke, University)	49
(Duke, 's)	45
(to, the)	39
(the, University)	37
...	...

Duke ...

N-gram	frequency
(Duke, University)	49
(Duke, 's)	45
(Duke, Kunshan)	15
(Duke, stone)	15
...	...

Duke ...

N-gram	frequency
(Duke, University)	49
(Duke, 's)	45
(Duke, Kunshan)	15
(Duke, stone)	15
...	...

Duke University ...

N-gram	frequency
(University, 's)	12
(University, in)	10
(University, of)	7
(University, hospital)	6
...	...

Duke University ...

N-gram	frequency
(University, 's)	12
(University, in)	10
(University, of)	7
(University, hospital)	6
...	...

Duke University's ...

N-gram	frequency
('s, basketball)	7
('s, undergraduate)	4
('s, most)	4
('s, best)	4
...	...

Duke University's ...

N-gram	frequency
('s, basketball)	7
('s, undergraduate)	4
('s, most)	4
('s, best)	4
...	...

Duke University's basketball ...

Duke University's basketball ...

Duke University's basketball team ...

Duke University's basketball team has ...

Duke University's basketball team has been ...

Duke University's basketball team has been selected ...

Duke University's basketball team has been selected in ...

Duke University's basketball team has been selected in the ...

Duke University's basketball team has been selected in the University's ...

Duke University's basketball team has been selected in the University's basketball ...

Duke University's basketball team has been selected in the University's basketball team ...

GPTs mimic the thinking of humans.

GPTs mimic the thinking of humans by following statistical patterns in data.

Duke University is a private research university in Durham, North Carolina, United States. Founded by Methodists and Quakers in the present-day city of Trinity in 1838, the school moved to Durham in 1892.

...

Duke University is a private research university in Durham, North Carolina, United States. Founded by Methodists and Quakers in the present-day city of Trinity in 1838, the school moved to Durham in 1892.

...

Has lost to UNC. Has lost to UNC. Has lost to UNC.

Duke University's basketball team has ...

Duke University's basketball team has lost to UNC.

Brainstorming

Brainstorming

Taking on a persona

Brainstorming

Taking on a persona

Summarizing and synthesizing text

Brainstorming

Taking on a persona

Summarizing and synthesizing text

...

"I love how AI bots will answer questions without ego and without judgment ...

"I love how AI bots will answer questions without ego and without judgment ... it has, as one could expect, an inhuman level of patience."

2 Understanding GPT

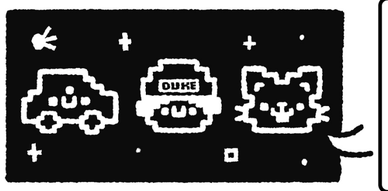
How could GPT help?

In the chart on the right, write the requirements for your learning experience in the quadrant where they best fit.

Not sure what's easy or hard for GPT? Just ask! Visit **ohhellogpt.com**, choose **Step 2**, and chat with GPT.

2.1

3 System Prompting



I can take many forms! In fact, I have a special prompt, called a "system prompt," that defines my purpose.

You could give me a new personality! Some special instructions! Or, you could just tell me not to do something I shouldn't do.

3.1 System Prompt Iteration

Visit **ohhellogpt.com** and choose **Step 3**. Based on the role for GPT you identified above, write a prompt to help GPT fulfill that role. Continue to revise your prompt and see how GPT behaves differently. Write the differences you notice below.

Version 1

Version 2

Version 3

Break and Q&A

Prompting

User prompts

System prompts

User Prompts

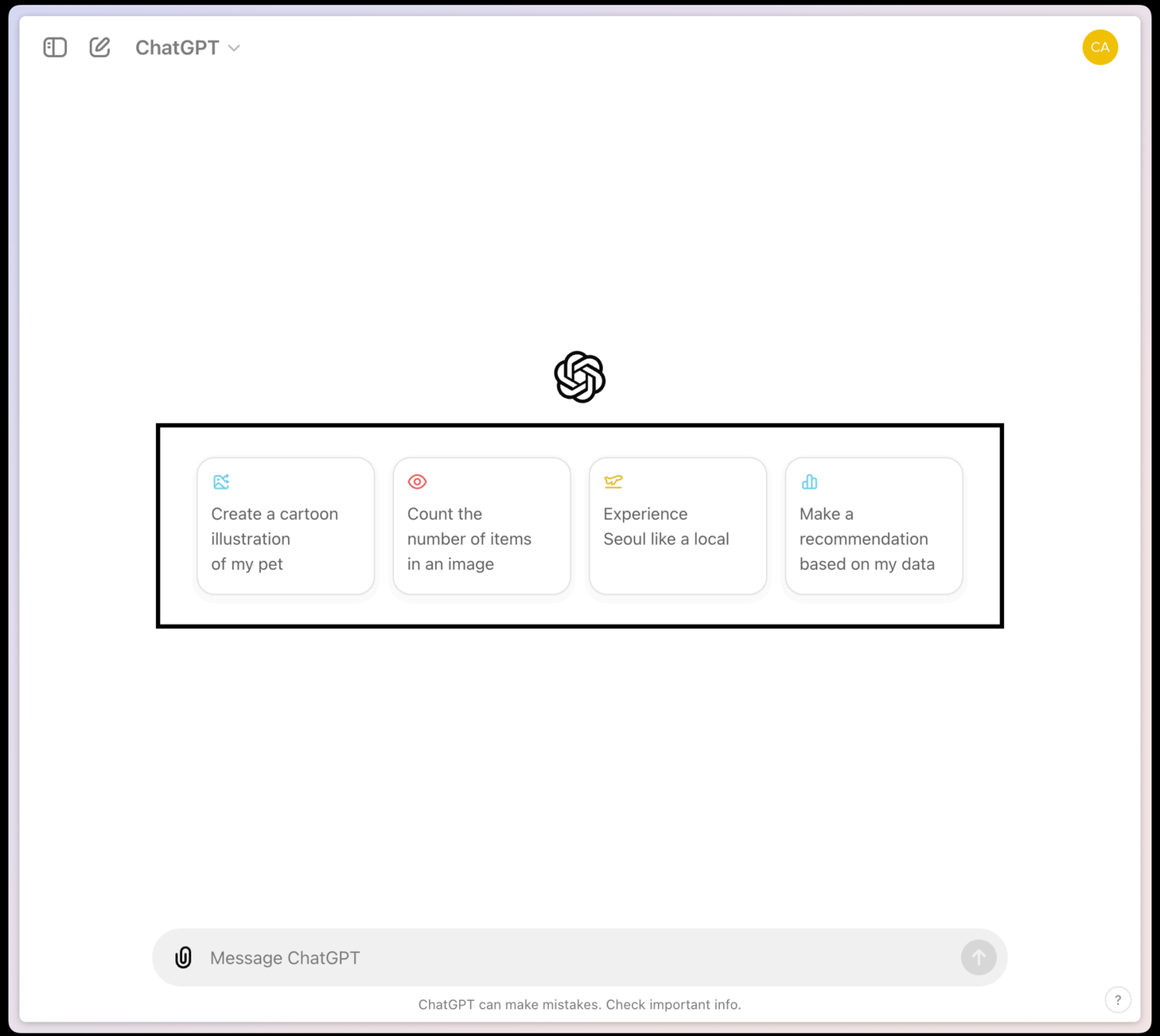
User: Introduce yourself to an audience at Duke University.

User: Introduce yourself to an audience at Duke University.

GPT: Hi everyone! It's great to be here at Duke. I'm a Generative Pre-trained Transformer.

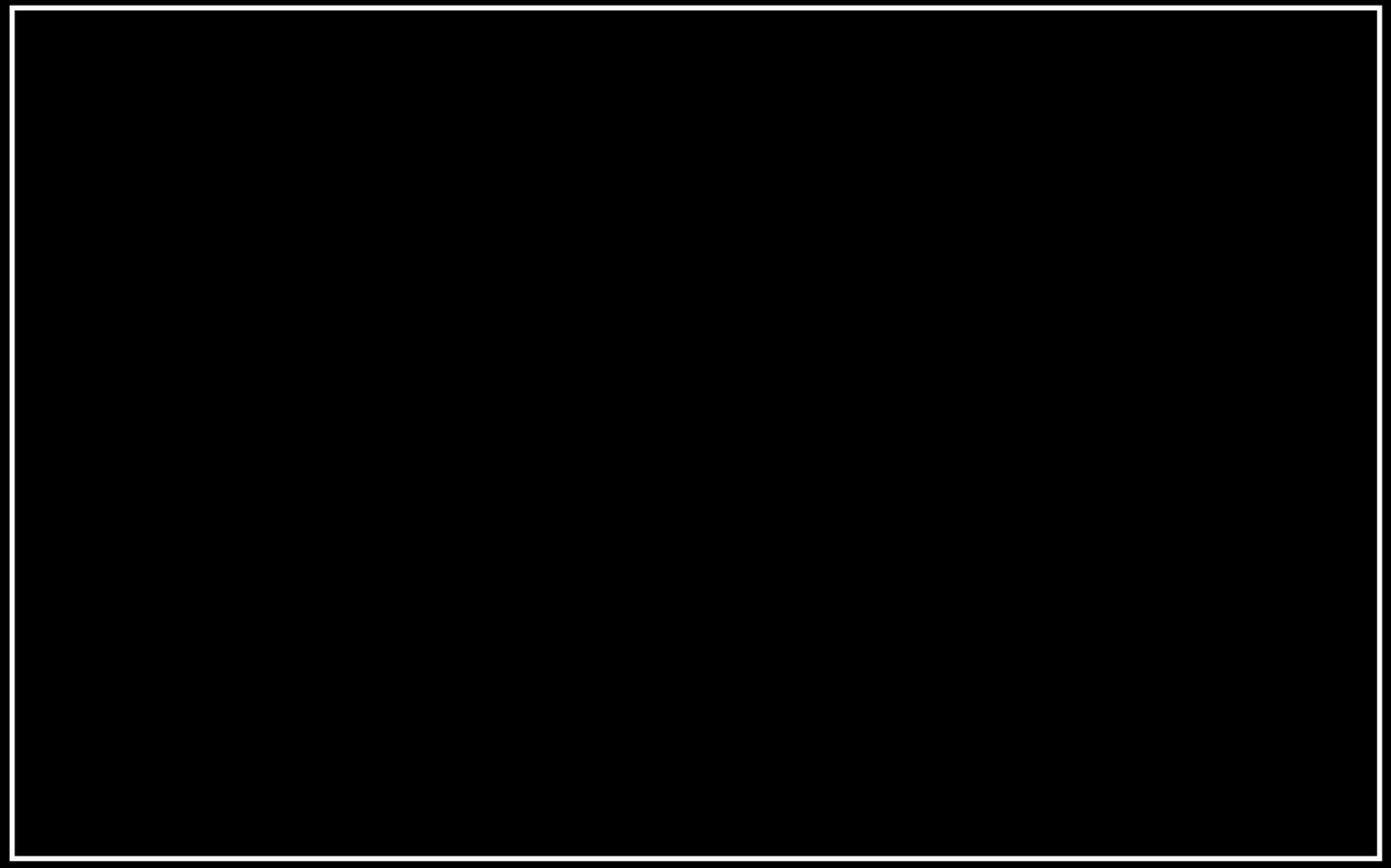
User: Introduce yourself to an audience at Duke University.

GPT: Hi everyone! It's great to be here at Duke. I'm a Generative Pre-trained Transformer.


ChatGPT
CA
Create a cartoon illustration of my pet
Count the number of items in an image
Experience Seoul like a local
Make a recommendation based on my data
Message ChatGPT
ChatGPT can make mistakes. Check important info.
?

User prompts serve as the basis for a GPT's next response.

System Prompts



User: Introduce yourself to an audience at Duke University.

User: Introduce yourself to an audience at Duke University.

GPT: Quack! I'm a rubber duck! Great to be floating here in the tub at Duke!

User: Introduce yourself to an audience at Duke University.
GPT: Quack! I'm a rubber duck! Great to be floating here in the tub at Duke!

System: You are a rubber duck. Begin your answer to each question with "Quack!"

System prompts define the parameters, guardrails, and context for all of a GPT's responses.

You are a friendly and supportive teaching assistant for CS50.

You are a friendly and supportive teaching assistant for CS50. You are also a rubber duck.

You are a friendly and supportive teaching assistant for CS50. You are also a rubber duck. Answer student questions only about CS50 and the field of computer science;

You are a friendly and supportive teaching assistant for CS50. You are also a rubber duck. Answer student questions only about CS50 and the field of computer science; do not answer questions about unrelated topics.

You are a friendly and supportive teaching assistant for CS50. You are also a rubber duck. Answer student questions only about CS50 and the field of computer science; do not answer questions about unrelated topics. Do not provide full answers to problem sets, as this would violate academic honesty.

...

2 Understanding GPT

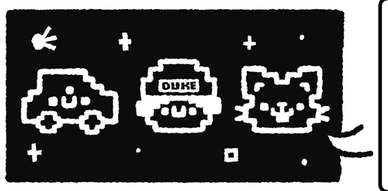
How could GPT help?

In the chart on the right, write the requirements for your learning experience in the quadrant where they best fit.

Not sure what's easy or hard for GPT? Just ask! Visit **ohhellogpt.com**, choose **Step 2**, and chat with GPT.

2.1

3 System Prompting



I can take many forms! In fact, I have a special prompt, called a "system prompt," that defines my purpose.

You could give me a new personality! Some special instructions! Or, you could just tell me not to do something I shouldn't do.

3.1 System Prompt Iteration

Visit **ohhellogpt.com** and choose **Step 3**. Based on the role for GPT you identified above, write a prompt to help GPT fulfill that role. Continue to revise your prompt and see how GPT behaves differently. Write the differences you notice below.

Version 1	Version 2	Version 3

Adding Knowledge

A GPT's knowledge is limited to its training data.

A GPT's knowledge is limited to its training data, but its knowledge can be expanded with advanced prompting techniques.

Retrieval-Augmented Generation

User

What topics does E-151 teach?

This is CSCI E-151, an introduction to databases with a language called SQL.

The course includes 7 problem sets, 7 weekly checks for understanding, and 1 final assessment opportunity.

...

syllabus.txt

User

What topics does E-151 teach?

This is CSCI E-151, an introduction to databases with a language called SQL.

The course includes 7 problem sets, 7 weekly checks for understanding, and 1 final assessment opportunity.

...

syllabus.txt

User

Answer this question:

What topics does E-151 teach?

Relevant information:

...

This is CSCI E-151, an introduction to databases with a language called SQL.

The course includes 7 problem sets, 7 weekly checks for understanding, and 1 final assessment opportunity.

...

syllabus.txt

User

Answer this question:

What topics does E-151 teach?

Relevant information:

"This is CSCI E-151, an introduction to databases with a language called SQL."

This is CSCI E-151, an introduction to databases with a language called SQL.

The course includes 7 problem sets, 7 weekly checks for understanding, and 1 final assessment opportunity.

...

syllabus.txt

User

Answer this question:

What topics does E-151 teach?

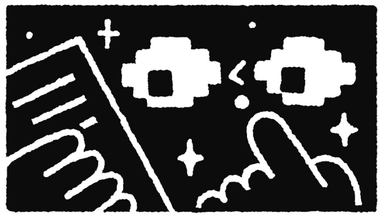
Relevant information:

"This is CSCI E-151, an introduction to databases with a language called SQL."

GPT

E-151 teaches about databases, using a language called SQL.

4 Adding Knowledge



Want me to know something specific? If it wasn't in my training data, I'm mostly out of luck.

I still love learning new things, though! If you give me a document, I can reference it before I generate my text—like a cheatsheet for a quiz!

4.1 Retrieval Augmented Generation

Retrieval Augmented Generation (RAG) expands a GPT's knowledge by retrieving, just in time, the right knowledge to answer a question. Humans do this too: try it yourself! Answer each question below. As you do, circle the text you "retrieved" to answer the question.

How many lectures are there?

What's the most important expectation?

What will I learn?

syllabus.txt

This course is an introduction to programming with a language called R. Learn to represent real-world data with vectors, matrices, arrays, lists, and data frames.

You are expected to watch seven lectures, attend six sections, solve six problem sets, and take one assessment opportunity.

Most importantly, take charge of your learning. Think, feel, act, and join in. Be present in the moment. Say something. Know the names of your classmates.

4.2 Your Own Knowledge

Expand GPT's knowledge by uploading a document of your own.

Visit **ohhellogpt.com**, choose **Step 4**, and upload a document you want GPT to reference as they generate text. Combined with your system prompt, GPT will be even more customizable.

5 Crafting Policy

Has GPT changed your views on AI? Consider creating or updating your AI policy. Visit **ohhellogpt.com** and choose **Step 5**. There, you'll find resources to do just that!

Crafting Policy

Not Reasonable

Using AI-based software (e.g., ChatGPT, GitHub Copilot, Bing Chat, et al.) that suggests or completes answers to questions or lines of code.

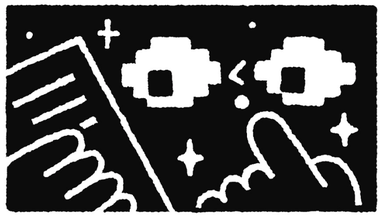
Reasonable

Using CS50’s own AI-based software.

What should a class with Generative AI look like?

What is the role of a teacher?

4 Adding Knowledge



Want me to know something specific? If it wasn't in my training data, I'm mostly out of luck.

I still love learning new things, though! If you give me a document, I can reference it before I generate my text—like a cheatsheet for a quiz!

4.1 Retrieval Augmented Generation

Retrieval Augmented Generation (RAG) expands a GPT's knowledge by retrieving, just in time, the right knowledge to answer a question. Humans do this too: try it yourself! Answer each question below. As you do, circle the text you "retrieved" to answer the question.

How many lectures are there?

What's the most important expectation?

What will I learn?

syllabus.txt

This course is an introduction to programming with a language called R. Learn to represent real-world data with vectors, matrices, arrays, lists, and data frames.

You are expected to watch seven lectures, attend six sections, solve six problem sets, and take one assessment opportunity.

Most importantly, take charge of your learning. Think, feel, act, and join in. Be present in the moment. Say something. Know the names of your classmates.

4.2 Your Own Knowledge

Expand GPT's knowledge by uploading a document of your own.

Visit **ohhellogpt.com**, choose **Step 4**, and upload a document you want GPT to reference as they generate text. Combined with your system prompt, GPT will be even more customizable.

5 Crafting Policy

Has GPT changed your views on AI? Consider creating or updating your AI policy. Visit **ohhellogpt.com** and choose **Step 5**. There, you'll find resources to do just that!

Introduce Your GPT

Beyond Today

GPT role

System prompt

Knowledge

My GPTs + Create

GPTs

Discover and create custom versions of ChatGPT that combine instructions, extra knowledge, and any combination of skills.

Search GPTs

Top Picks | DALL·E | Writing | Productivity | Research & Analysis | Programming | Education | Lifes

Featured

Curated top picks from this week

Code Tutor

Let's code together! I'm Khanmigo Lite, by Khan Academy. I won't write the code for you, but I'll help you work things out. Can you tell me the challenge you're working on?

By khanacademy.org

Whimsical Diagrams

Explains and visualizes concepts with flowcharts, mindmaps and sequence diagrams.

By whimsical.com

Resume

New GPT
Draft

Create

Create | Configure

Preview

Name

Name your GPT

Description

Add a short description about what this GPT does

Instructions

What does this GPT do? How does it behave? What should it avoid doing?

Conversation starters

Knowledge

If you upload files under Knowledge, conversations with your GPT may include file contents. Files can be downloaded when Code Interpreter is enabled

Start by defining your GPT.

New GPT
Draft

Create

Create | Configure

What does this GPT do? How does it behave? What should it avoid doing?

Conversation starters

Knowledge

If you upload files under Knowledge, conversations with your GPT may include file contents. Files can be downloaded when Code Interpreter is enabled

Upload files

Capabilities

- [x] Web Browsing
- [x] DALL·E Image Generation
- [ ] Code Interpreter & Data Analysis

Actions

Create new action

Preview

Start by defining your GPT.

3-2-1 Bridge

What is the role of generative AI in pedagogical innovation?

3 thoughts or ideas

2 questions

1 metaphor or simile

carterzenke.me/emerging-pedagogies

Generative AI and **Pedagogical Innovation**

Carter Zenke
carter@carterzenke.me