The Role of Artificial Intelligence in Learning & Development:

Understanding ChatGPT A Quick Reference

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The Ohio State University

CENTER ON EDUCATION AND TRAINING FOR EMPLOYMENT The Role of Artificial Intelligence in Learning & Development:

Understanding ChatGPT A Quick Reference

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THE OHIO STATE UNIVERSITY

CENTER ON EDUCATION AND TRAINING FOR EMPLOYMENT

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What is ChatGPT?

ChatGPT is an artificial intelligence program that uses machine learning algorithms to provide responses to various queries and tasks. It is powered by a large language model trained by OpenAl, designed to understand natural language and generate human-like responses to help answer questions, carry out conversations, and even assist with certain tasks.

ChatGPT's training is based on a deep learning architecture called a transformer, which allows it to analyze and process large amounts of text data to improve responses over time.

ChatGPT doesn't have feelings or consciousness, but it can understand and interpret human language and provide helpful responses, based on data on the internet. It is constantly learning and updating its knowledge as it receives more input.

You can access ChatGPT here: https://chat.openai.com/. Simply create a free account and log-in. ChatGPT is currently free to use (although paid account options are available with some added benefits).

ChatGPT is meant to be conversational in nature (hence the "Chat-" part of its name). You can type complete sentences, questions, or requests, and it will generate a response.



Artificial Intelligence in Your Pocket

One example of Artificial Intelligence with which you're likely already familiar is the texting app on today's smartphones. The textsuggestion feature of the app uses AI to predict and suggest the most likely word or phrase a user intends to type based on their previous typing behavior, commonly used phrases, and contextual cues.

The AI-powered algorithms used by the phone analyze the user's text input, including the characters typed and the context of the sentence, to generate a list of possible words and phrases that the user may be trying to type. The system then uses statistical models, such as natural language processing (NLP) and machine learning, to predict the most likely word or phrase the user intended to type.

The various algorithms powering the text-suggestion feature have been trained on large datasets of language samples to understand language structures, relationships, and patterns. The system also analyzes the user's typing behavior, such as frequently used words or phrases, to personalize and improve its suggestions.

The autocorrect feature is also based on Al. When words or phrases fail to match predictions, the phone can attempt to offer a



Tip: Many smartphones have "dictionaries" to which you can add uncommon words or proper nouns. When you add a word to your phone's dictionary, you're actually training your phone's AI.

replacement. Like text-suggestion, these replacements are based on the user's previous behavior.

> These functions make use of continuous learning mechanisms that adapt to the user's writing style and preferences over time, improving the accuracy and relevance of suggestions as the user continues to use the device.

What ChatGPT Isn't

ChatGPT is not conscious or alive.

As an artificial intelligence language model, ChatGPT doesn't have the capacity for life or consciousness. It is a computer program designed to respond to user inputs and provide information or assistance.

ChatGPT is not actually "intelligent".

The information that ChatGPT uses to generate responses comes from a dataset of billions of words from a diverse range of sources such as books, articles, and websites. This dataset was used to train a deep neural network that is capable of recognizing patterns and relationships within language.

Responses from ChatGPT are not pre-programmed, but rather generated on the spot based on the input it receives and the patterns and relationships it has learned from the training data.

ChatGPT does not "understand" words.

When users type a sentence, ChatGPT uses various natural language processing techniques to analyze the sentence. First, it uses *tokenization* to break down the sentence into individual words or tokens. Then, it uses an algorithm known as *part*-

of-speech tagging to identify the grammatical role of each word in the sentence. It also uses a database in a process called *named entity recognition* to identify entities such as people, places, and organizations.

After analyzing the structure of the sentence, it uses deep learning algorithms to generate a response based on the input.

Because ChatGPT uses statistical models and algorithms to analyze the sentence and generate a response, it cannot be perfect and may sometimes make errors or misconstrue certain inputs.



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Tip: Because ChatGPT uses natural language processing to interpret input, you will have better results when you ask questions and write in complete sentences (unlike a Google search).

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How do you speak to ChatGPT?

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To talk to ChatGPT, you can type in your questions or statements in the chat window or interface provided. When typing your questions or statements, it is important to use clear and concise language to ensure that it can understand your input.

You can improve the quality of your responses by making use of *prompt engineering*. Prompt engineering refers to the process of designing and optimizing *prompts* (i.e., the initial inputs given to a language model) to achieve specific outputs or responses.

The goal of prompt engineering is to create prompts that elicit desired responses from the language model. This involves carefully crafting the wording and structure of the prompt to guide the language model towards generating the desired output.

Prompt engineering can be used to optimize the performance of a language model for specific tasks or domains, such as question answering or sentiment analysis. By designing effective prompts, the language model can be trained to produce more accurate and relevant outputs for these tasks.

> Prompt engineering typically involves iterative experimentation and refinement, as different prompt designs are tested and evaluated for their effectiveness. This process requires a deep

> > understanding of the language model being used and the task at hand, as well as expertise in natural language processing and machine learning.

Tip: Anyone who frequently uses a digital assistant, such as Siri or Alexa, has probably practiced some amount of prompt engineering. In order to get the assistant to do exactly what you want, you may need to rephrase the request, add details, or use specific trigger terms. The more specific your request—and the more details you can provide—the closer your response will likely be to your desired result.

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(bkgd) Margarita Vin/Shutterstock; (inset) finnhart/Pixabay

Prompt Engineering

To get the best possible response from ChatGPT, you should provide a clear and specific prompt that includes the following details:

Context:

Start by providing some context around your question or topic. This helps ChatGPT better understand the scope of your inquiry and provide more relevant and helpful responses.

Clear question:

Be as clear and specific as possible when formulating your question. Avoid vague or overly broad questions, and instead try to break down your inquiry into smaller, more manageable parts.

Examples:

If relevant, provide examples that can help illustrate your question or topic. This can help ChatGPT better understand what you're asking and provide more relevant and helpful responses.

Relevant information:

If there are any important details or information that may impact your question or topic, be sure to include them in your prompt. This can help ChatGPT provide more accurate and relevant responses.

Language:

Try to use clear and concise language when formulating your prompt. Avoid using slang, jargon, acronyms, or overly technical terms that ChatGPT may not understand.

Additional instructions:

If there are any specific instructions or preferences you have for ChatGPT's response, be sure to include them in your prompt. For example, you may want a short and simple answer, or you may prefer a more detailed and nuanced response. udy design. The

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Prompt Engineering: An Example

Suppose you wanted to create a flyer for an office holiday party. You might start with the following prompt: Create a flyer for an office holiday party

...and get the following result:

\$ Sure, I can help you create a flyer for a holiday party! Here's a sample design:

[Header] Let's Celebrate! [Event Date and Time] Join us for a festive holiday party [Event Location] 123 Main Street, Anytown USA

[Bodv]

Get ready to dance, drink and be merry! Our holiday party is the perfect way to kick off the festive season. We'll have plenty of food and drinks, great music, and a few surprises that we know you'll love.

[Footer]

RSVP by December 10th to reserve your spot Contact us at 555-1234 or email us at holidayparty@example.com

[Design]

The design features a cheerful and colorful holiday theme, with graphics of snowflakes, presents, and ornaments. The header is in bold, festive letters, with the date and time underneath. The body provides a short description of the event and what guests can expect, while the footer includes important information for RSVP and contact details.

Feel free to modify the text and design to fit your specific event and style!

The result is fine, but you have a lot of details to fill-in. The more details you provide to ChatGPT, the better. For example, you could tell ChatGPT the time and date for the party, the location, whether food will be served, etc.

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Prompt Engineering: An Example (continued)

Now, let's change your prompt to include some of those details:

Create a flyer for an office holiday party that will take place on December 9 from 12:00 p.m. to 3:00 p.m. in room 1089. There will be food and beverages served. There will also be a silent auction to raise money for charity. Immediately before the party is a mandatory staff meeting from 11:00 a.m. to 12:00 p.m., although the party is optional.

Here's the result:

Sure, here's a sample design for a flyer for an office holiday party:

[Header]

Join us for the Office Holiday Party! [Event Date and Time] December 9, 12:00 p.m. - 3:00 p.m. [Event Location] Room 1089

[Body]

You're invited to celebrate the holiday season with your colleagues at our office holiday party! Enjoy a delicious spread of food and beverages, and mingle with coworkers in a festive atmosphere. Plus, participate in our silent auction to raise money for charity.

Please note that a mandatory staff meeting will be held from 11:00 a.m. to 12:00 p.m. immediately before the party. However, the party itself is optional and all are welcome to attend.

[Footer]

RSVP by December 5 to confirm your attendance Contact us at [contact information]

[Design]

The design features a holiday theme with graphics of snowflakes, a Christmas tree, and presents. The header is in bold, festive letters, with the date and time underneath. The body provides a short description of the event and what guests can expect, as well as a note about the mandatory staff meeting. The footer includes important information for RSVP and contact details

Feel free to modify the text and design to fit your specific event and style!

The revised flyer is much closer to something that will fit your needs, and only minor editing is required in order to send it out.

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ChatGPT at Work

ChatGPT can be a useful tool for streamlining and automating officework tasks. Here are some ways you can use ChatGPT:

Scheduling and Email:

ChatGPT can help you write email messages as well as schedule meetings, appointments, and other events. Simply provide ChatGPT with the relevant information (e.g., subject, date, time, location, attendees), and it can generate an email, a calendar invite, or a reminder.

Research and Data Analysis:

ChatGPT can help you research topics by providing relevant information in different outputs: narrative, bulleted lists, tables, etc. All you need to do is ask a question or provide a topic. ChatGPT can also help you analyze data by generating charts, graphs, and other visualizations based on the data you provide.

Document creation:

ChatGPT can help you create documents, such as reports, presentations, or proposals, by generating content or suggesting formatting and layout options.

Task management:

ChatGPT can help you manage your tasks by setting reminders, creating to-do lists, and even generating progress reports.

Translation:

ChatGPT can help you translate documents or messages into other languages, which can be useful if you work with clients or

Tip: ChatGPT requires queries and other inputs be sent over the internet and uses your inputs to continuously improve its responses. Be sure to remove any sensitive or confidential information before sharing text or documents as part of a query.

colleagues from different parts of the world.

Keep in mind that ChatGPT is a language model and may not be able to perform all tasks perfectly. However, it can certainly help automate some routine and time-consuming tasks, freeing up your time to focus on other important work.

ChatGPT for Learning Designers

ChatGPT can be a valuable tool for learning designers to create effective learning experiences for learners. The **ADDIE** model is a widely-used instructional design framework that consists of five stages: **A**nalysis, **D**esign, **D**evelopment, **I**mplementation, and **E**valuation. ChatGPT can be utilized to support learning designers at each stage of the ADDIE process.

Analysis:

During the Analysis stage, learning designers identify the target audience, their needs, and the learning objectives. ChatGPT can assist by:

- Providing relevant background information on the target audience.
- Suggesting potential learning needs and objectives.
- Summarizing relevant research or best practices for similar learning contexts.

Design:

In the Design stage, designers plan the structure, content, and instructional strategies for the learning experience. ChatGPT can help by:

- Offering suggestions for instructional strategies based on learning objectives.
- Recommending appropriate assessment methods to measure learners' progress.
- Brainstorming creative ways to present the content, such as storytelling, case studies, or gamification.

Development:

During the Development stage, designers create learning materials and resources. ChatGPT can support this process by:

 Drafting content for learning materials, such as scripts, scenarios, or lesson plans. **Tip:** ChatGPT can assist with rewriting text to turn paragraphs into bulleted lists, explain concepts or give instructions as a sequence of numbered steps, or adjust the readability of text to match the specific needs of the audience.

- Recommending relevant multimedia elements (e.g., images, videos, or audio clips) to enhance learning experiences.
- Providing feedback on existing materials and suggesting improvements.

ChatGPT for Learning Designers (continued)

Implementation:

In the Implementation stage, the learning program is executed and delivered to the target audience. ChatGPT can contribute by:

- Answering questions or clarifying concepts for learners and facilitators during the program.
- Providing tips for effective facilitation, classroom management, or online learning best practices.
- Offering real-time support, such as generating supplementary materials or examples based on learners' needs.

Evaluation:

During the Evaluation stage, the effectiveness of the learning program is assessed. ChatGPT can help learning designers by:

- Providing guidance on various evaluation methods, such as formative, summative, and return-on-investment (ROI) evaluations.
- Assisting in the creation of evaluation tools, such as surveys, questionnaires, or rubrics.



Tip: When designing learning materials, DALL-E, also powered by GPT, can be a useful tool. DALL-E generates images based on the text prompt provided. You can generate avatars, add visual interest, or create diagrams to support the content. You can access DALL-E at <u>https://labs.openai.com/</u>.

•Analyzing qualitative and quantitative data from evaluations and suggesting areas for improvement.

Overall, ChatGPT can be a valuable tool for learning designers throughout the ADDIE process, offering support, suggestions, and resources to enhance the creation and delivery of effective learning experiences.

ChatGPT for Scholarly Work

ChatGPT can be a useful tool to support scholarly work. Here are some ways you can use ChatGPT:

Generating summaries and overviews:

ChatGPT can assist in conducting literature reviews by automatically generating summaries of academic articles, enabling researchers to identify key findings and extract relevant information quickly.

Analyzing and visualizing data:

ChatGPT can help researchers to analyze and visualize data by generating natural language descriptions of graphs and charts, which can aid in interpreting and communicating research findings.

Refining academic writing:

ChatGPT can be used as a tool to refine academic writing by generating suggestions for improving sentence structure, vocabulary, and grammar. This can be particularly useful for non-native English speakers or those struggling with writing.

Assisting with research design:

ChatGPT can be utilized to assist with research design by generating research questions, hypotheses, and study designs based on input from the researcher. This can be particularly useful for those who are new to research or need guidance in developing a study.



Tip: Because ChatGPT often prioritizes *style* over *accuracy*, many of the references it provides are likely to be unrelated or even nonexistent. You need to carefully verify *all* the references provided by ChatGPT, including URLs.



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Tip: Remember that your research prompt can be further engineered to return text at a specific grade- or reading-level, theories from specific researchers, or content from publications released during a specific time frame.

Example: Do Research

You can give ChatGPT the following prompt to do research on a particular topic:

Explain the importance of minority representation in popular media.

Here's the result:

\$

The importance of minority representation in popular media cannot be overstated. Popular media, which includes movies, TV shows, music, books, and other forms of entertainment, play a significant role in shaping our perception of the world, influencing our attitudes, beliefs, and values.

Minority representation in popular media is crucial because it allows individuals from different backgrounds to see themselves represented in the media they consume. When minorities see characters that look like them or share similar experiences, it can help them feel seen, heard, and valued. This representation can lead to increased self-esteem, a sense of belonging, and a positive self-image.

Moreover, minority representation can also help reduce stereotypes, prejudice, and discrimination. When people from different backgrounds are portrayed in diverse and complex ways, it can challenge the stereotypes and biases that people may hold. This can promote greater understanding and empathy for people who are different from oneself.

In addition, minority representation can also have a positive impact on society as a whole. By showcasing diverse perspectives and experiences, popular media can help break down barriers and promote greater social cohesion. It can also inspire social change by raising awareness of social issues and injustices that minority communities face.

Overall, minority representation in popular media is essential for promoting diversity, inclusion, and equity. It can help create a more just and equitable society by promoting understanding, empathy, and respect for people from different backgrounds.

Tip: Remember that ChatGPT's training data may not be up to date. For now, it is only current up to September 2021. In addition, don't forget that any content returned should be evaluated for accuracy and potential bias before sharing with project stakeholders or external partners.

Example: Send an Email

You can give ChatGPT the following prompt to send an email to a job applicant:

Write an email explaining to a candidate that they did not get the job, despite being qualified.

Here's the result:



Subject: Job Application Outcome

Dear [Candidate's Name],

I hope this email finds you well. I wanted to take a moment to thank you for your application and your interest in the [Position] role at [Company Name]. I appreciate the time and effort you invested in submitting your application and participating in the interview process.

After careful consideration and evaluation of all the candidates, I regret to inform you that we have decided not to move forward with your application at this time. I understand that this news may be disappointing, especially given that you were well qualified for the position. Please note that this decision was not a reflection of your abilities, experience or character. Rather, it was due to other factors such as the number of highly qualified candidates we received and our specific hiring needs at this time.

I want to take this opportunity to commend you for your professionalism and enthusiasm throughout the interview process. Your application stood out among a competitive pool of applicants, and I have no doubt that you will find success in your future endeavors. I encourage you to continue to pursue opportunities that align with your skills and passions.

Please feel free to reach out to me if you have any questions or would like feedback on your application or interview. I would be happy to provide any feedback that may help you in your future job search.

Thank you again for your interest in the position and for considering [Company Name] as a potential employer. I wish you all the best in your future endeavors.

Sincerely,

[Your Name] [Your Title] [Company Name] **Tip:** You can engineer your prompt to get specific results, such as specifying the grade- or reading-level at which the email should be written, requesting step-by-step instructions for the recipient (including specifying the number of steps and the task being described), or having ChatGPT revise an existing email (e.g., checking for grammatical errors, adjusting the tone, turning paragraphs into bullet points, etc.).

Example: Post on Social Media

You can give ChatGPT the following prompt to create a post you can use on your Twitter feed:

Compose a tweet sharing research results from a two-year study on how teachers can improve classroom literacy by using AI tools.

Here's the result:

"Just wrapped up a two-year study on the use of AI tools to improve classroom literacy and the results are in: teachers who integrated AI technology into their instruction saw significant improvements in student reading skills! The future of education is here. #AI #classroomliteracy #edtech"

When it comes to improving ChatGPT's results for composing social media posts, prompt engineering can be employed in several ways:

Specifying tone or voice:

By giving ChatGPT prompts that include information about the desired tone or voice, the language model can generate social media posts that better reflect a brand's personality or values.

Including keywords and hashtags:

Listing keywords and hashtags related to a particular topic or brand can help ChatGPT generate more relevant social media posts that are more likely to resonate with the target audience.

Including examples:

Providing examples of previous social media posts that have performed well can help ChatGPT understand what types of

content and language work best for a particular brand or audience.

Overall, prompt engineering can help improve ChatGPT's results when composing social media posts by providing clear guidance and direction, which can help the language model generate more effective and engaging content for a brand's social media presence.



Exploring @OpenAl's ChatGPT & I'm blown away by its capabilities! Thinking about all the ways it can be a valuable tool for workplace learning & development - from onboarding to upskilling. The future of learning is looking bright! #AI #workplacelearning #ChatGPT #writtenbyai

Tip: Your prompt engineering can provide ChatGPT with guidelines or restrictions related to the post, such as word count or the target audience to improve the quality and applicability of the post being generated.

Examples: Other Work Tasks

There is no end to the tasks that you can ask ChatGPT to assist with. Some examples include:

- Creating a post-workshop evaluation survey;
- Developing a work- or office-policy document, such as a work-from-home policy or a BYOD technology policy;
- Drafting a performance-improvement plan to address direct reports' behaviors; or
- Preparing job aids for specific work tasks.

Suppose you wanted to explain to incoming students how to register for classes:

Explain how to sign up for classes at The Ohio State University in four steps.

The result:

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Here's a step-by-step guide on how to sign up for classes at The Ohio State University:

Step 1: Access the Ohio State Student Information System

Visit the Ohio State University website and log in to the Student Information System (SIS) using your Ohio State username and password. If you do not have an Ohio State username and password, you will need to create one.

Step 2: Search for classes

Once you're logged in, navigate to the "Registration and Records" tab and click on "Search for Classes." Here you can browse classes by subject, instructor, or other criteria.

Step 3: Select your classes

Once you've found the classes you want to take, select them and add them to your "shopping cart." You may also need to select a section, time, and location.

Step 4: Register for classes

After adding classes to your shopping cart, go to the "Enrollment" tab and click on "Enrollment Shopping Cart." From here, you can review the classes you've selected and complete the registration process by clicking "Enroll."

Congratulations! You have successfully signed up for classes at The Ohio State University.

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Artificial intelligence (AI) is powered by statistical models and data. The statistical models generate responses by analyzing large amounts of data and identifying patterns and relationships between variables. The statistical models used in AI are typically based on machine learning algorithms, which are designed to learn from data and make

There are several different types of statistical models used in Al,

These models are used to predict a continuous outcome based on one or more predictor variables. For example, a regression model might be used to predict the price of a house based on its

These models are used to predict a categorical outcome based on one or more predictor variables. For example, a classification model might be used to predict whether a customer will churn based on their past purchase history and demographic

These models are used to group similar data points together based on their characteristics. For example, a clustering model might be used to group customers into different segments based

Once a statistical model has been trained on a large dataset, it can be used to generate responses by applying the model to new data. For example, a chatbot might use a classification model to predict the intent of a user's message and generate an appropriate response based on that intent. Alternatively, a recommender system might use a clustering model to group similar products together and recommend products that are likely to be of interest to a particular user.

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Are there downsides to using AI?

As with any technology, there are potential downsides or limitations to using Artificial Intelligence tools like ChatGPT, including:

Limited knowledge:

Although it has been trained on a large dataset, there may be areas where ChatGPT's information is limited or inaccurate. In addition, the training data is only up to a certain point in time (September 2021), so results may not be up-to-date on the latest information. Also, any information that pre-dates the internet may be limited or unavailable.

Lack of emotional intelligence:

ChatGPT does not have emotions or the ability to understand or respond to emotions. This means its responses cannot provide the same level of empathy or emotional support that a human can. Moreover, it is important to recognize that ChatGPT does not

possess any inherent intelligence. Rather, it comprises a vast dataset containing billions of words acquired from diverse sources.

Potential for bias:

ChatGPT's responses are generated based on patterns and relationships learned from training data, which may contain biases or inaccuracies. As a result, the responses have the potential to perpetuate harmful stereotypes and reinforce social inequalities.



Tip: Responses generated by ChatGPT may include inaccurate or incomplete references, misattributed quotations, or other errors. Any content generated by AI tools such as ChatGPT should be reviewed thoroughly and fact-checked before being used in any work-related or public-/client-facing context.

Are there downsides to using AI? (continued)

The absence of creative thinking:

ChatGPT produces text using patterns extracted from the dataset it was trained on. Consequently, it may have limitations in generating novel ideas or viewpoints that are exclusive to human beings. This constraint is due to its dependence on the data it has learned from, which restricts its ability to "think" beyond the information it has been trained on.

Potential copyright concerns and ownership issues:

Because ChatGPT generates output text based on data published on the internet, it is possible that some of the text it produces will contain phrases, sentences, or even complete paragraphs that come from published, copyrighted content. In some cases, the content may not be a direct quotation; however, even paraphrased passages may be considered plagiarism if proper attribution is not given (and, as previously discussed, ChatGPT does not always accurately list its sources).

At the same time, it is unclear who "owns" text generated by ChatGPT, even if it isn't directly copied or paraphrased from a single source. OpenAI (the makers of ChatGPT) assign ownership to the end user who receives the output. However, two people using similar prompts may receive similar or identical responses, which further complicates issues related to intellectual property.

It is important to remember that while language models like ChatGPT can be useful tools, they should not be used as a substitute for human interaction or expertise in certain situations. It is essential to use

Tip: Topics related to ownership, authorship, and copyright for content generated by Artificial Intelligence are far from settled by today's intellectual property laws. There will likely be many new laws and court decisions in the coming years as new technologies emerge—and authorship concerns arise. For now, the more specific and detailed your prompt is, the better claim you will be able to make for the ownership of the content being generated.

critical thinking and evaluate the accuracy and reliability of information obtained from any source, including language models.

Where can you go to learn more about using tools like ChatGPT?

Here are a few places where you can learn more about ChatGPT and its capabilities:

OpenAl's website:

OpenAl is the organization that created and maintains ChatGPT. You can find information about ChatGPT and its capabilities on the <u>OpenAl website</u>, including technical documentation for ChatGPT and <u>research papers</u>.

ChatGPT's Github repository:

The <u>Github repository</u> contains the source code and technical documentation for the model. You can find this repository on Github under the OpenAl organization.

ChatGPT's social media:

ChatGPT has a social media presence on platforms like <u>Twitter</u> and <u>Reddit</u>, where you can find out

more about its capabilities, features, and updates.

ChatGPT's online communities:

There are online communities dedicated to AI and machine learning, where you can discuss ChatGPT's capabilities and its potential applications. You can find these communities on platforms like <u>Reddit</u>, <u>Quora</u>, and <u>StackExchange</u>.



About the Authors



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Sean is the Deputy Director of the Assessment program at the Center on Education and Training for Employment and a PhD candidate in Learning Technologies. Sean is an award-winning instructional designer, with more than 20 years experience creating instructional materials for both formal and informal educational settings as well as corporate learning and development.



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Ana-Paula is the Director of the Center on Education and Training for Employment and a Professor of Learning Technologies. Ana-Paula is an internationally recognized expert in learning design and educational technology, with a focus on online learning and teaching, mobile learning, collaborative learning, and human-computer interaction.



Fan Xu is a Senior Learning Designer at the Center on Education and Training for Employment. With a Ph.D. in Educational Studies (Learning Technologies), Fan's research is focused on computational thinking education. In particular, Fan has explored the use of pair programming approach and chatbot technology to enhance computational thinking education.



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