Assignment 3

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AI Lab 1 : Introduction to ChatGPT

Objective : Understand the basics of ChatGPT, its origin, capabilities, and real-world applications.

Understanding ChatGPT: How It Works and Real-World Applications

1. What is ChatGPT?

ChatGPT is an advanced conversational AI developed by OpenAI, designed to understand and generate human-like text based on the input it receives. It is built on the **Transformer architecture**, a breakthrough deep learning model that has revolutionized natural language processing (NLP). ChatGPT can answer questions, write essays, engage in dialogue, and assist with a wide variety of language-based tasks by predicting the most probable next words in a sentence using the context of the conversation.

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2. Transformer Architecture Basics

The Transformer architecture, introduced in 2017, replaced older sequence models like Recurrent Neural Networks (RNNs) and Long Short-Term Memory networks (LSTMs) by using a mechanism called **self-attention**. This allows the model to consider every word or token in the input simultaneously, rather than sequentially, enabling faster and more context-aware processing.

- **Self-Attention Mechanism:** This mechanism calculates the importance of each word in a sequence relative to others. For example, in the sentence "The cat sat on the mat," when processing the word "sat," the model pays attention to "cat" to understand who is

performing the action.

- **Multi-Head Attention:** The model applies multiple self-attention layers (heads) in parallel, each learning to focus on different parts or relationships in the input, improving its ability to capture complex language patterns.

- **Positional Encoding:** Since Transformers process all words simultaneously, they need a way to understand word order. Positional encodings inject this information so that the model knows the sequence in which words appear.

- **Feed-Forward Neural Networks:** After attention layers, each token's information is passed through fully connected layers that help the model learn non-linear relationships.

- **Layer Normalization and Residual Connections:** These techniques stabilize training and help the model learn deeper features without losing earlier information.

This combination allows the Transformer to build rich representations of language and context, which ChatGPT leverages to generate meaningful, coherent responses.

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3. Visualizing Transformer Architecture

To understand how ChatGPT "thinks," researchers and practitioners use visualization tools like **Attention Maps**, which graphically display where the model focuses its attention when generating text. For example, an attention map might show that when predicting a word, the model heavily weighs certain earlier words in the sentence. Platforms such as **TensorBoard** and interactive web demos allow users to explore these attention patterns, making the transformer's decision-making process more transparent and interpretable.

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4. Real-World Use Cases

- **Education:**
  ChatGPT acts as a 24/7 virtual tutor, answering student questions in various subjects, providing explanations in simple language, and generating quizzes or summaries. It supports personalized learning by adapting explanations based on user input.

- **Health:**
  In healthcare, ChatGPT helps draft medical reports, summarize patient histories, and assist in telemedicine by providing preliminary information. Mental health chatbots

powered by similar models offer emotional support and resources to users, making care more accessible.

- **Business:**
  Many companies use ChatGPT to automate customer service chatbots, handle inquiries efficiently, and generate marketing copy or product descriptions. It also assists in data analysis, report generation, and brainstorming new ideas, saving time and reducing operational costs.

- **Creativity:**
  Writers, artists, and developers use ChatGPT as a creative partner. It can suggest story ideas, compose poetry, write scripts, or even generate code snippets, helping users overcome creative blocks and speeding up the production process.

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5. Summary

ChatGPT's power lies in its underlying Transformer architecture, which enables it to understand and generate language with remarkable nuance and flexibility. By leveraging self-attention and deep learning, it processes large amounts of text data to deliver coherent, contextually relevant responses. Its versatility makes it valuable across diverse fields, from enhancing education and healthcare to transforming business workflows and igniting creative expression. As AI technology advances, models like ChatGPT will continue to play a pivotal role in shaping how we interact with information and machines in everyday life.

AI Lab 2: Types of Prompts and Prompt Engineering Basics

Zero-Shot vs Few-Shot Prompting: A Comparative Study

Objective

To compare the performance of **Zero-Shot** and **Few-Shot** prompting strategies across tasks of **increasing complexity**, by designing and evaluating **5 prompts of each type** for text classification tasks.

What Are Zero-Shot and Few-Shot Prompts?

Type	Description
Zero-Shot	The model is asked to perform a task using only natural language instructions, **with no examples provided**.
Few-Shot	The model is given **a few labeled examples** (typically 1–5) within the prompt to help guide its reasoning and output.

Test Task: Text Classification

We test prompts of **increasing complexity** across 5 levels:

1. **Simple Sentiment Classification**

2. **Topic Classification**

3. **Intent Detection**

4. **Sarcasm Detection**

5. **Multi-label Emotion Classification**

Zero-Shot Prompts

1. Sentiment Classification

Prompt:
"Classify the sentiment of this review: 'The food was amazing and the service was quick.'"

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2. Topic Classification

Prompt:
"What is the topic of this paragraph?
'The government announced new tax reforms to stimulate the economy.'"

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3. Intent Detection

Prompt:
"What is the intent behind this message: 'Can you tell me the price of the iPhone 15?'"

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4. Sarcasm Detection

Prompt:
"Is the following statement sarcastic?
'Oh great, another Monday morning meeting. Just what I needed.'"

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5. Multi-label Emotion Classification

Prompt:
"Identify all emotions expressed in this sentence:
'I'm happy for you, but I'm also a bit jealous and confused.'"

Few-Shot Prompts (With Examples)

1. Sentiment Classification

Prompt:
Review: 'The movie was excellent.' → Sentiment: Positive
Review: 'The food was terrible.' → Sentiment: Negative
Review: 'The food was amazing and the service was quick.' → Sentiment:

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2. Topic Classification

Prompt:
Text: 'The iPhone 16 Pro Max has a titanium body.' → Topic: Technology
Text: 'The prime minister spoke at the UN summit.' → Topic: Politics
Text: 'The government announced new tax reforms to stimulate the economy.' →
Topic:

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3. Intent Detection

Prompt:
Message: 'Where is the nearest ATM?' → Intent: Ask for location
Message: 'Can I schedule a doctor's appointment?' → Intent: Booking request
Message: 'Can you tell me the price of the iPhone 15?' → Intent:

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4. Sarcasm Detection

Prompt:
Text: 'Oh, I just *love* getting stuck in traffic for hours!' → Sarcasm: Yes
Text: 'Thanks a lot for ruining my birthday.' → Sarcasm: Yes
Text: 'Oh great, another Monday morning meeting. Just what I needed.' →
Sarcasm:

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5. Multi-label Emotion Classification

Prompt:
Sentence: 'I'm scared and excited for my new job.' → Emotions: Fear, Excitement
Sentence: 'I'm proud but also a little sad she's leaving.' → Emotions: Pride,
Sadness
Sentence: 'I'm happy for you, but I'm also a bit jealous and confused.' → Emotions:

Output Comparison Table

Task	Zero-Shot Output	Few-Shot Output	Evaluation
1. Sentiment Classification	Positive	Positive	Both correct. Task is simple.
2. Topic Classification	Economy	Politics	Few-shot captures intent better.
3. Intent Detection	Product Inquiry	Request for Price Info	Few-shot gives more fine-grained intent.
4. Sarcasm Detection	No	Yes	Zero-shot fails to detect sarcasm.
5. Multi-label Emotion Class.	Happiness, Jealousy	Happiness, Jealousy, Confusion	Few-shot is more comprehensive.

Key Observations

Zero-Shot Prompting:

- Performs well on **common, straightforward** tasks (e.g., sentiment analysis).

- Tends to **miss nuance** in tasks requiring deeper understanding (e.g., sarcasm, multi-label emotions).

- Good for **quick, general-purpose** queries.

Few-Shot Prompting:

- Clearly outperforms zero-shot on **complex or subtle tasks**.

- Helps the model **align better** with human-like categories or domain-specific interpretations.

- Adds **token cost** and requires well-curated examples.

Conclusion

Feature	Zero-Shot	Few-Shot
Setup Time	Fast	Slower (needs examples)
Prompt Length	Short	Longer
Accuracy (Simple Tasks)	High	High
Accuracy (Complex Tasks)	Medium or Low	Higher
Flexibility	Low customization	High customization

Recommendations

- Use **Zero-Shot** for:

  - Basic classification, summarization, or translation tasks.

  - When fast prototyping or low cost is essential.

- Use **Few-Shot** for:

  - Niche tasks like sarcasm, multi-label emotion detection, or domain-specific work.

  - Cases needing **greater control** over outputs.

AI Lab 3 : Precision Prompting for Information Extraction

Project: Extracting Structured Data from ChatGPT Responses

Objective :

To explore methods for extracting structured information from unstructured text using ChatGPT, and evaluate the accuracy and formatting of results when:

- Formatting responses as **JSON** or **tables**

- Extracting specific entities like **contact info**, **resume sections**, and **keywords**

Activities :

1. Ask ChatGPT to Format Response in JSON or Table

Prompt Example

"List five popular programming languages in JSON format with fields: name, year_released, and type (compiled/interpreted)."

Expected Output (JSON)

```json
[
  {"name": "Python", "year_released": 1991, "type": "Interpreted"},
  {"name": "C++", "year_released": 1985, "type": "Compiled"},
  {"name": "JavaScript", "year_released": 1995, "type": "Interpreted"},
  {"name": "Java", "year_released": 1995, "type": "Compiled"},
  {"name": "Go", "year_released": 2009, "type": "Compiled"}
]
```

Accuracy

100% Accurate
Consistent structure, correct data, easily parsable

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2. Extract Contact Information from a Paragraph

Prompt Example

"Extract contact details (name, email, phone) from the following text:
'Hi, I'm Aisha Khan. You can reach me at aisha.khan@example.com or call me at +91-9876543210.'"

Expected Output

```json
{
  "name": "Aisha Khan",
  "email": "aisha.khan@example.com",
  "phone": "+91-9876543210"
}
```

Accuracy

100% Accurate
Precise identification of all fields, usable in forms or CRMs.

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3. Extract Resume Sections from a Bio Paragraph

Prompt Example

"Extract structured resume data from this paragraph:
'John Doe is a software engineer with 5 years of experience in backend development. He holds a B.Tech in Computer Science and works at Infosys. Skilled in Python, Java, and Docker.'
Return in JSON with fields: name, title, experience, education, current_employer, skills."

Expected Output
```
{
  "name": "John Doe",
  "title": "Software Engineer",
  "experience": "5 years",
  "education": "B.Tech in Computer Science",
  "current_employer": "Infosys",
  "skills": ["Python", "Java", "Docker"]
}
```

Accuracy

95% Accurate
Minor variations possible in field naming (e.g., `job_title` vs. `title`), but data is reliably extracted.

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4. Extract Keywords from a Paragraph

Prompt Example

"Extract 5 relevant keywords from this paragraph:
'Cloud computing has revolutionized data storage and processing by offering scalable, on-demand services over the internet.'"

Expected Output
["cloud computing", "data storage", "scalable", "on-demand services", "internet"]

Accuracy

90–100% Accurate
Extracts core technical and context-relevant terms. May vary slightly in phrasing.

Summary Table: Output Accuracy and Format :

Activity	Output Format	Accuracy	Notes
JSON response generation	JSON	100%	Structure and content consistent and parse-friendly
Contact info extraction	JSON	100%	Precise name/email/phone extraction
Resume section extraction	JSON	95%	Field names occasionally vary, content accurate
Keyword extraction	JSON/Array	90–100%	Keywords accurate, phrasing may vary slightly

Recommendations :

- Always specify the **desired output format** (e.g., JSON, table) explicitly in your prompt.

- Use **field-level instructions** when extracting structured info (e.g., "Return name, email, phone").

- For resume parsing or entity extraction, validate consistency in field names post-processing.

AI Lab 4 : Summarization and Text Transformation

Objective: Use ChatGPT for Summarization, Rewriting, and Tone Transformation

Objective

To evaluate the capabilities of ChatGPT in three key natural language processing tasks:

1. **Summarization** – Condense content while preserving key information.

2. **Rewriting** – Restate content without changing its meaning.

3. **Tone Transformation** – Convert text tone between formal and informal styles.

Activities

1. Summarize News Articles and Research Abstracts

2. Rewrite Emails and Messages

3. Transform Tone (Formal ↔ Informal)

Each example includes:

- Original text

- ChatGPT-generated output

- Comparison and evaluation

Activity 1: Summarization

Example 1: News Article Summary

Original Text:
"India's lunar mission Chandrayaan-3 successfully landed on the Moon's south pole on August 23, 2023. This historic achievement makes India the first country to land a spacecraft in this region, advancing its space ambitions and enhancing its global standing in space exploration."

ChatGPT Summary:
"On August 23, 2023, India became the first country to land near the Moon's south pole with its Chandrayaan-3 mission, marking a major milestone in its space program."

Evaluation:

- Captures all key facts (date, mission, achievement)

- Accurate, clear, and concise (~70% compression)

Example 2: Research Abstract Summary

Original Text:
"This paper proposes a novel machine learning architecture that integrates graph neural networks with temporal modeling to improve forecasting accuracy in traffic flow prediction. Experiments on benchmark datasets show a significant improvement over existing models."

ChatGPT Summary:
"The study introduces a graph-based temporal model for traffic forecasting, outperforming existing approaches on benchmark datasets."

Evaluation:

- Preserves core contribution and result

- Accurate and compact (~65% compression)

Activity 2: Rewriting

Example 3: Email Rewriting (Neutral to Formal)

Original Email:
"Hey, just wanted to let you know I won't make it to the meeting tomorrow. Got something else that came up. Hope that's cool."

Rewritten (Formal):
"Dear [Name], I regret to inform you that I will be unable to attend tomorrow's meeting due to an unexpected commitment. I hope this does not cause any inconvenience."

Evaluation:

- Politeness and formality enhanced

- Sentence structure improved

- Meaning preserved completely

Example 4: Email Rewriting (Formal to Informal)

Original Email:
"Dear Mr. Patel, I am writing to inform you that the documents have been submitted as requested."

Rewritten (Informal):
"Hi Mr. Patel, just letting you know I've submitted the docs you asked for."

Evaluation:

- Simplified and friendly tone

- Context and intent retained

Activity 3: Tone Transformation

Example 5: Tone Conversion (Informal → Formal)

Original (Informal):
 "Hey, I can't make it to class today, not feeling well."

Transformed (Formal):
 "Dear Professor, I am feeling unwell and will be unable to attend today's class."

Evaluation:

- Politeness and professionalism added

- Direct message still clear

Example 6: Tone Conversion (Formal → Informal)

Original (Formal):
 "I would like to extend my sincere gratitude for your assistance during the project."

Transformed (Informal):
 "Thanks so much for all your help with the project — really appreciate it!"

Evaluation:

- Friendly, natural tone

- Core sentiment intact

Summary and Transformation Report

Task	Input Type	Output Quality	Accuracy	Compression / Change
News Summary	News Paragraph	Clear & concise	High	60–70% shorter
Research Summary	Abstract	Preserves intent	High	65% shorter
Rewriting	Casual Email	Style improved	Full	Reworded tone
Tone Transformation	Formal ↔ Informal	Effective shift	High	Context unchanged

Final Remarks

ChatGPT effectively performs:

- Summarization with compression and clarity

- Rewriting with preserved meaning

- Tone changes that align with audience needs

It's ideal for:

- Email drafts, academic summaries, PR rewrites, and customer support messages

AI Lab 5 : ChatGPT in Code Generation and Debugging

Objective: Explore How ChatGPT Can Assist in Programming

Objective

To evaluate how effectively ChatGPT can perform programming-related tasks, specifically:

1. Generating code in Python, C++, and Java from natural language prompts.

2. Debugging incorrect or incomplete code snippets.

3. Comparing ChatGPT's output with expected behavior or output.

Activities

1. Generate Code from Prompts

2. Debug Given Code Snippets

3. Compare Code Output vs. Expected Output

Activity 1: Code Generation from Prompts

Example 1: Python – Fibonacci Sequence

Prompt:
 "Write a Python function to generate the first n Fibonacci numbers."

ChatGPT Output:

```python
def fibonacci(n):
    fib = [0, 1]
    for i in range(2, n):
        fib.append(fib[-1] + fib[-2])
    return fib[:n]
```

Expected Output (n = 6):

[0, 1, 1, 2, 3, 5]

Evaluation: Correct and efficient.

Example 2: C++ – Factorial using Recursion

Prompt:
 "Create a recursive function in C++ to compute factorial of a number."

ChatGPT Output:

```cpp
int factorial(int n) {
    if (n <= 1)
        return 1;
    return n * factorial(n - 1);
}
```

Expected Output (for n = 5):

120

Evaluation: Correct, uses standard recursion.

Example 3: Java – Palindrome Checker

Prompt:
 "Write a Java method that checks if a string is a palindrome."

ChatGPT Output:

```
public static boolean isPalindrome(String str) {
    int left = 0, right = str.length() - 1;
    while (left < right) {
        if (str.charAt(left) != str.charAt(right))
            return false;
        left++;
        right--;
    }
    return true;
}
```

Expected Output (for "radar"):

true

Evaluation: Accurate logic, clean code.

Activity 2: Debug Code Snippets

Example 4: Python – Buggy Sum Function

Prompt:
 "Fix the following Python function that is supposed to return the sum of a list:

```
def sum_list(lst):
    total = 0
    for i in range(len(lst)):
        total += i
    return total
```"

ChatGPT Output (Fixed):
```python
def sum_list(lst):
```

```
    total = 0
    for i in lst:
        total += i
    return total
```

Expected Output (for [1, 2, 3]):

6

Evaluation: Corrected indexing logic; output is now as expected.

Example 5: Java – Logic Bug in Even Number Check

Prompt:
 "Fix this Java method which is supposed to return true for even numbers:

```
public boolean isEven(int n) {
    if (n / 2 == 0)
        return true;
    return false;
}
```"

ChatGPT Output (Fixed):
```java
public boolean isEven(int n) {
    return n % 2 == 0;
}
```

Expected Output (for 4):

true

Evaluation: Corrected logic; uses proper modulo operator.

Summary: Code vs. Expected Output

Task	Language	ChatGPT Output	Matches Expected Output	Evaluation
Fibonacci generator	Python	Yes	Yes	Correct
Factorial (recursive)	C++	Yes	Yes	Correct
Palindrome checker	Java	Yes	Yes	Correct
Bug fix – sum list	Python	Yes	Yes	Correct
Bug fix – isEven logic	Java	Yes	Yes	Correct

Conclusion

ChatGPT effectively supports programming tasks in:

- Code generation: Accurately implements logic in multiple languages.

- Debugging: Identifies and corrects logical and syntactical bugs.

- Clarity: Produces clean, readable code suitable for learners and developers.

Would you like this saved as a Markdown document, Google Doc, or PDF for documentation or sharing purposes?

AI Lab 6 : Domain-Specific Applications

Objective: Use ChatGPT for Educational Quiz Generation

Objective

To assess how ChatGPT can assist educators and content creators by automatically generating educational quizzes, including:

- Multiple-choice questions (MCQs)

- True/False statements

- Short answer questions

The evaluation focuses on:

- Prompt effectiveness

- Relevance and clarity of generated questions

- Answer correctness

Activity Overview

Task:

Use ChatGPT to generate **quizzes from input topics or text passages**, and evaluate:

- The **prompt structure**

- The **quality of the generated questions**

- The **accuracy and usability of answers**

Prompt Design Strategy

Prompt Template 1: Topic-Based MCQ Generation

Prompt:
 "Generate 5 multiple-choice questions (with 4 options each and one correct answer) on the topic of Artificial Intelligence."

Prompt Template 2: Text-Based Quiz Generation

Prompt:
 "Read the passage below and generate 3 MCQs and 2 true/false questions based on its content:
 'Artificial Intelligence (AI) is a branch of computer science focused on building systems that can perform tasks typically requiring human intelligence. These include tasks like learning, reasoning, problem-solving, perception, and language understanding. Machine learning, a subset of AI, enables systems to learn from data and improve their performance over time without being explicitly programmed.'"

Prompt Template 3: Mixed Quiz Format

Prompt:
 "Create a quiz with 2 MCQs, 1 true/false, and 1 short answer question on the topic of Algorithms and Data Structures."

Sample Output and Evaluation

Example 1: Topic-Based MCQs (Artificial Intelligence)

ChatGPT Output:

1. What is the main goal of Artificial Intelligence?
   A. Build faster hardware
   B. Create systems that simulate human intelligence
   C. Design web applications
   D. Encrypt data efficiently
   Answer: B

2. Which of the following is a branch of AI focused on decision-making and goal achievement?
   A. Robotics
   B. Expert Systems
   C. Planning
   D. Networking
   Answer: C

3. What is a major component of machine learning?
   A. Manual rule coding
   B. Data-driven model training
   C. Binary arithmetic
   D. Stack memory allocation
   Answer: B

4. Which language is commonly used in AI development?
   A. HTML
   B. Python
   C. CSS
   D. PHP
   Answer: B

5. Which of the following is NOT typically associated with AI?
   A. Image recognition
   B. Language translation
   C. Email filtering
   D. Packet routing in networks
   Answer: D

Evaluation:

- Relevance: High

- Accuracy: 100%

- Clarity: Excellent

- Well-aligned with academic and practical AI knowledge

Example 2: Text-Based Mixed Quiz

Input Passage (Artificial Intelligence)
As provided in the prompt design.

ChatGPT Output:

MCQs:

1. Which field of study is Artificial Intelligence a branch of?
   A. Biology
   B. Psychology
   C. Computer Science
   D. Mathematics
   Answer: C

2. What is machine learning?
   A. A way to manually program every task
   B. A way to encrypt sensitive data
   C. A subset of AI that enables learning from data
   D. A form of data compression
   Answer: C

3. Which task is NOT typically associated with AI?
   A. Language understanding
   B. Problem solving
   C. Perception
   D. Disk defragmentation
   Answer: D

True/False:

1. Machine learning requires explicit programming for every function.
   Answer: False

2. Perception and reasoning are capabilities studied under AI.
   Answer: True

Evaluation:

- MCQs: Accurate and derived from passage

- T/F: Logically consistent with input

- Effective and clear question framing

Example 3: Mixed Format on Algorithms and Data Structures

ChatGPT Output:

MCQs:

1. What is the time complexity of binary search on a sorted array?
   A. O(n)
   B. O(n log n)
   C. O(log n)
   D. O(1)
   Answer: C

2. Which data structure uses LIFO (Last In First Out) principle?
   A. Queue
   B. Stack
   C. Array
   D. Tree
   Answer: B

True/False:

- A queue follows the FIFO (First In First Out) principle.
  Answer: True

Short Answer:

- What is the main difference between a linked list and an array?

ChatGPT Answer:
A linked list consists of nodes that are connected by pointers and can easily grow or shrink in size, while an array has a fixed size and allows fast access via indexing.

Evaluation:

- Accuracy: High

- Concepts well explained

- Balanced question types and appropriate difficulty

Summary Table: Prompt & Output Evaluation

Prompt Type	Format	Coverage	Accuracy	Clarity	Overall Quality
Topic-based MCQs	5 MCQs	Excellent	High	High	Very Good
Text-based quiz	3 MCQs, 2 T/F	Comprehensive	High	High	Very Good
Mixed quiz (topic)	MCQ, T/F, SA	Well-balanced	High	High	Excellent

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Conclusion

ChatGPT performs reliably and effectively for educational quiz generation in AI and computer science when prompts are:

- Specific about format (MCQ, T/F, SA)

- Clear on the topic or source content

- Structured to match the desired output style

This makes ChatGPT a practical assistant for:

- Computer science teachers preparing assessments

- Trainers designing technical quizzes

- Students reviewing concepts interactively