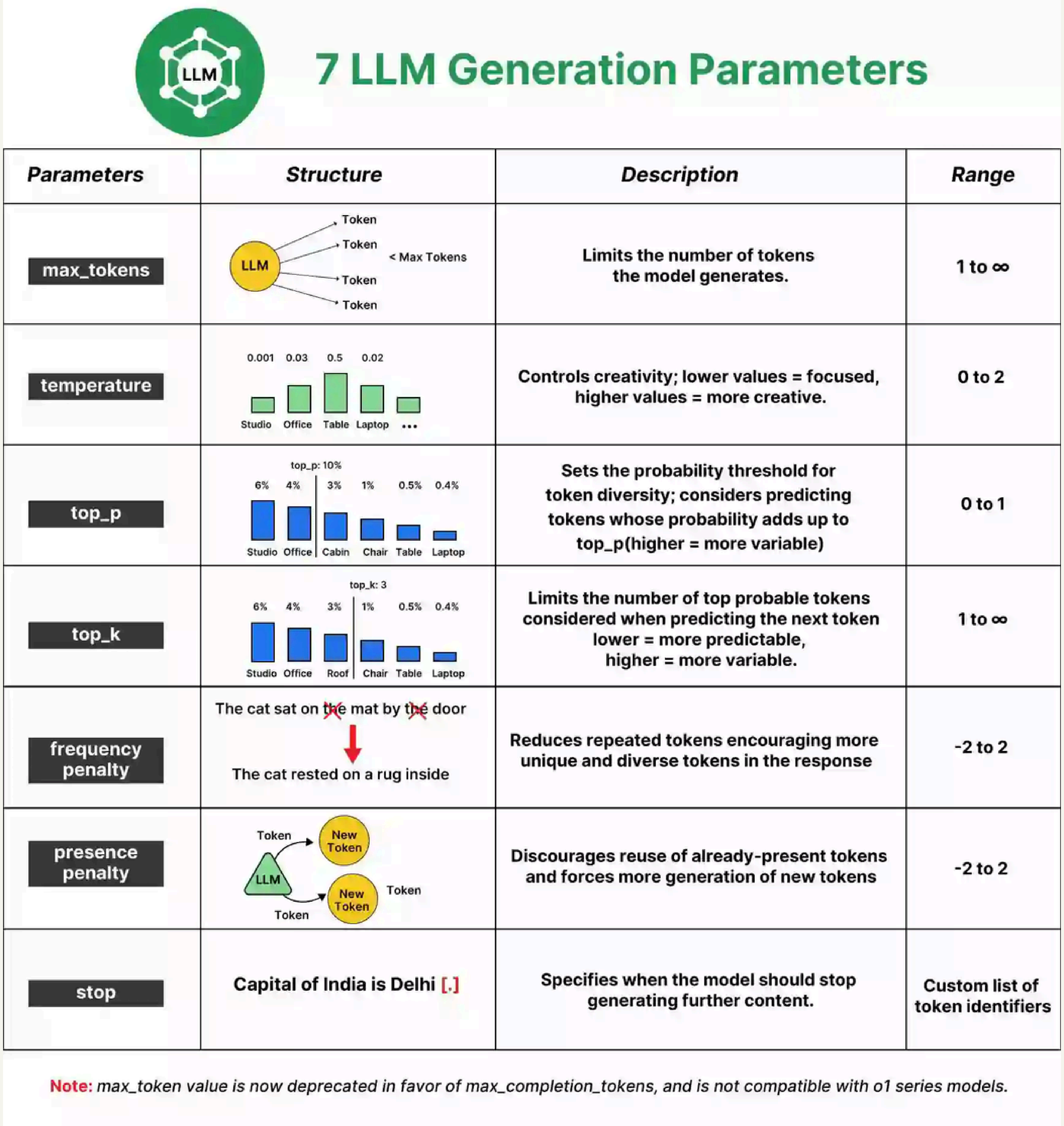
Guide to Top 7 LLM Generation Parameters



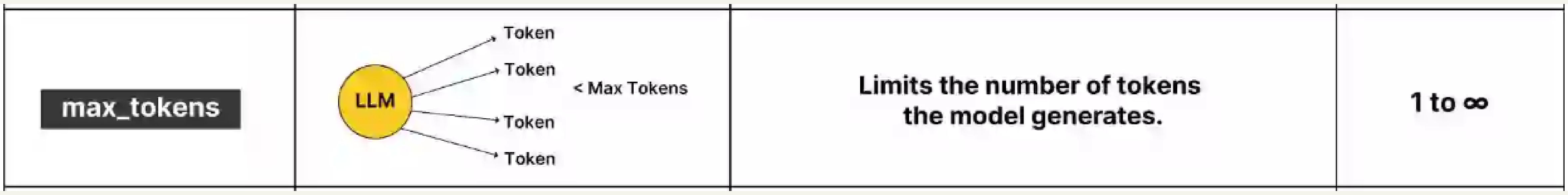
7 LLM Generation Parameters

Parameters	Structure	Description	Range
max_tokens	LLM Token Token Token Token < Max Tokens	Limits the number of tokens the model generates.	1 to ∞
temperature	0.001 0.03 0.5 0.02 Studio Office Table Laptop ...	Controls creativity; lower values = focused, higher values = more creative.	0 to 2
top_p	top_p: 10% 6% 4% 3% 1% 0.5% 0.4% Studio Office Cabin Chair Table Laptop	Sets the probability threshold for token diversity; considers predicting tokens whose probability adds up to top_p(higher = more variable)	0 to 1
top_k	top_k: 3 6% 4% 3% 1% 0.5% 0.4% Studio Office Roof Chair Table Laptop	Limits the number of top probable tokens considered when predicting the next token lower = more predictable, higher = more variable.	1 to ∞
frequency penalty	The cat sat on ~~the~~ mat by ~~the~~ door The cat rested on a rug inside	Reduces repeated tokens encouraging more unique and diverse tokens in the response	-2 to 2
presence penalty	Token New Token LLM New Token Token Token	Discourages reuse of already-present tokens and forces more generation of new tokens	-2 to 2
stop	Capital of India is Delhi [.]	Specifies when the model should stop generating further content.	Custom list of token identifiers

Note: *max_token value is now deprecated in favor of max_completion_tokens, and is not compatible with o1 series models.*

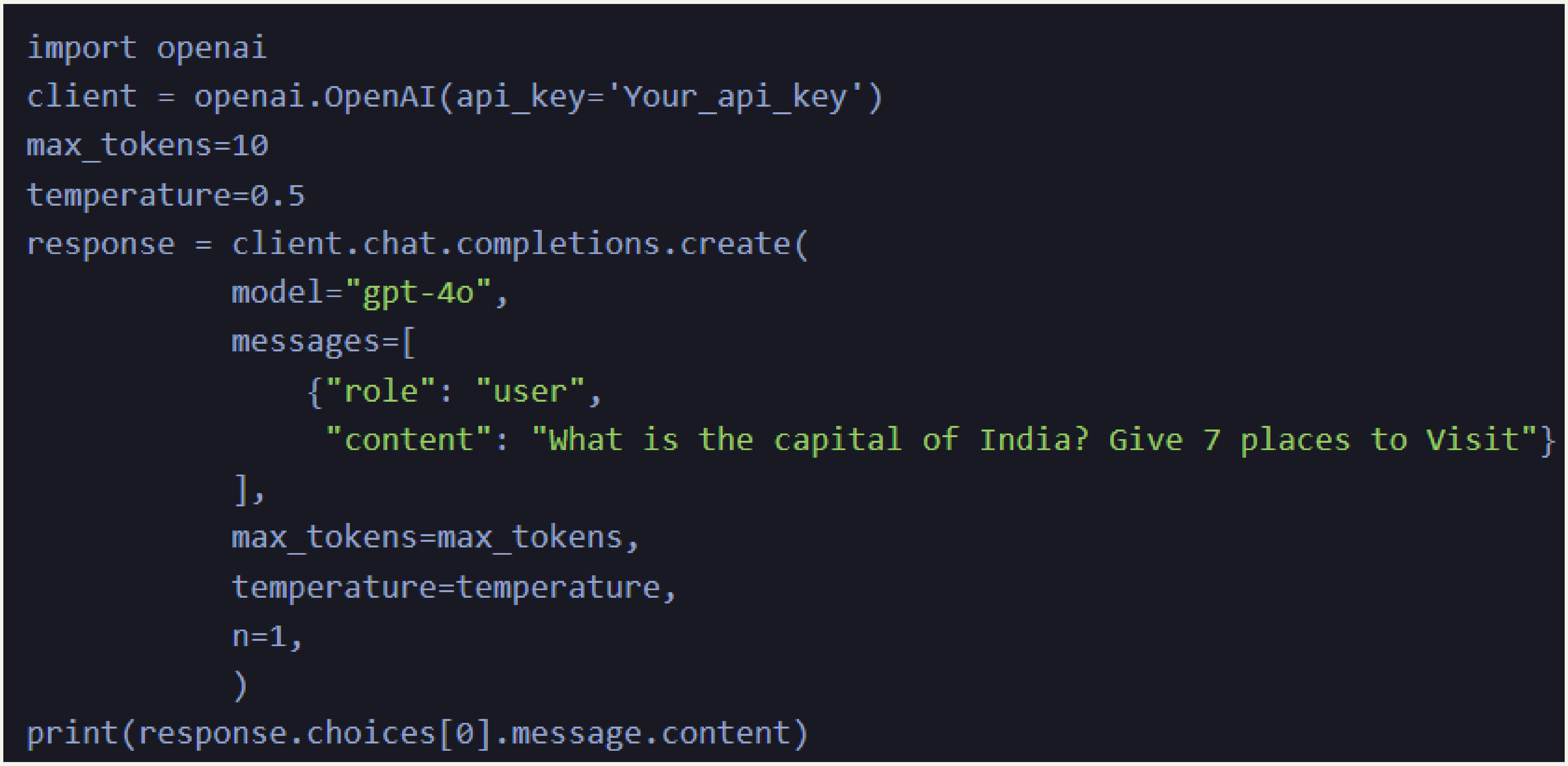
Dipanjan (DJ)

Max Tokens



max_tokens		Limits the number of tokens the model generates.	1 to ∞

Token
Token
< Max Tokens
LLM
Token
Token



```
import openai
client = openai.OpenAI(api_key='Your_api_key')
max_tokens=10
temperature=0.5
response = client.chat.completions.create(
           model="gpt-4o",
           messages=[
               {"role": "user",
                "content": "What is the capital of India? Give 7 places to Visit"}
           ],
           max_tokens=max_tokens,
           temperature=temperature,
           n=1,
           )
print(response.choices[0].message.content)
```

- **The max_tokens parameter controls the length of the output generated by the model**
- **A “token” can be as short as one character or as long as one word**
- **By setting an appropriate max_tokens value, you can control whether the response is a quick snippet or an in-depth explanation**
- **Max_token value is now deprecated in favor of max_completion_tokens (in OpenAI API)**

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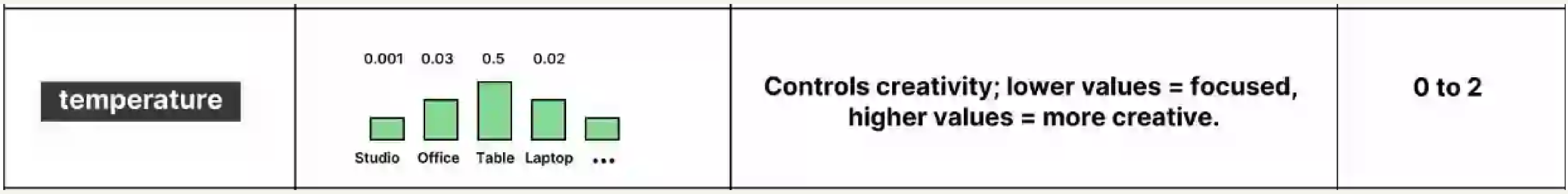
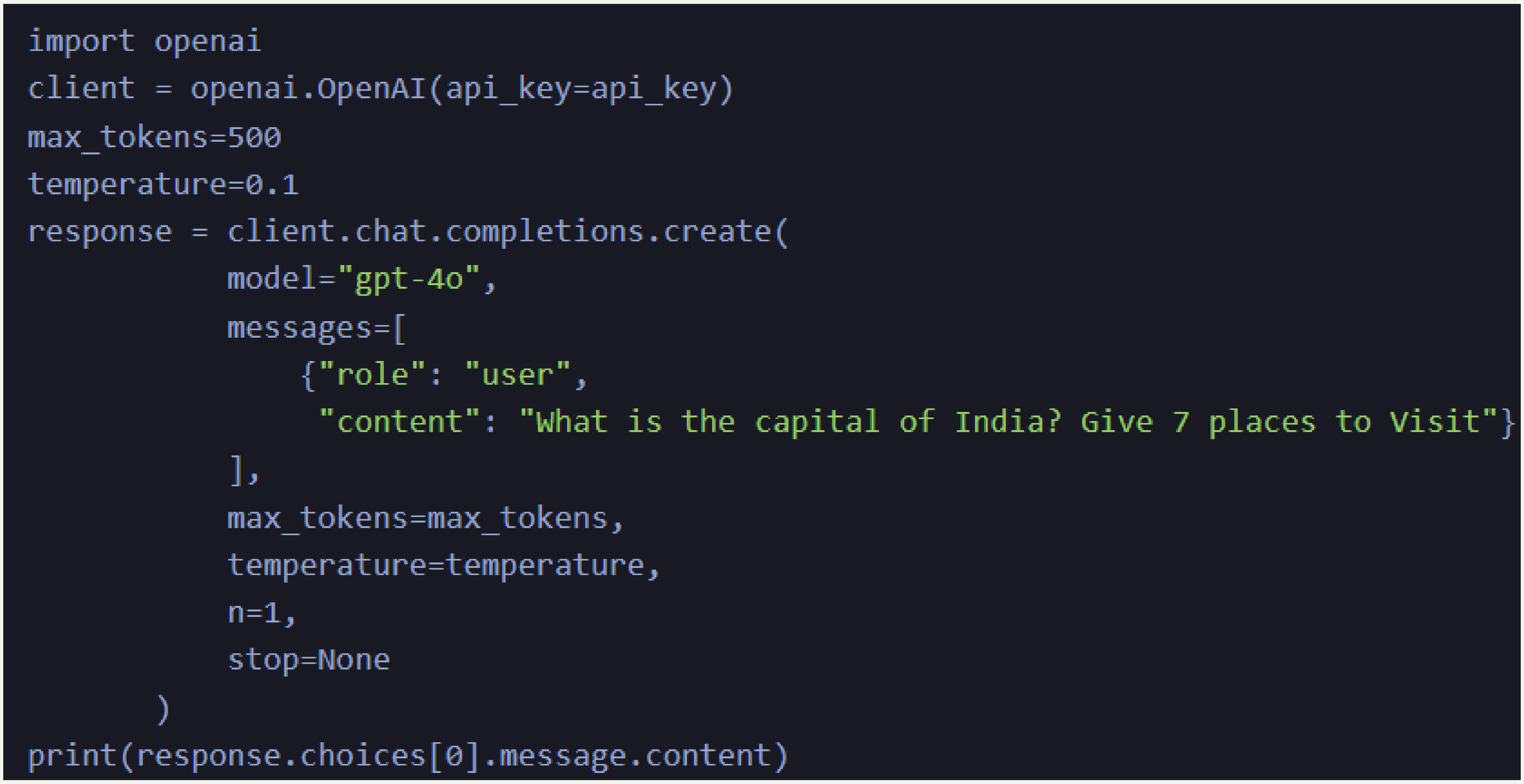
Temperature



temperature	0.001 0.03 0.5 0.02 Studio Office Table Laptop ...	Controls creativity; lower values = focused, higher values = more creative.	0 to 2



```
import openai
client = openai.OpenAI(api_key=api_key)
max_tokens=500
temperature=0.1
response = client.chat.completions.create(
           model="gpt-4o",
           messages=[
               {"role": "user",
                "content": "What is the capital of India? Give 7 places to Visit"}
           ],
           max_tokens=max_tokens,
           temperature=temperature,
           n=1,
           stop=None
       )
print(response.choices[0].message.content)
```

- **The temperature parameter influences how deterministic or random and creative the model’s responses are**
- **It’s essentially a measure of how deterministic the responses should be:**
  - **Low Temperature (e.g., 0.1):** The model will produce more focused and predictable responses.
  - **High Temperature (e.g., 0.9):** The model will produce more creative, varied, or even “wild” responses.
- **Use low temperatures for tasks like generating technical answers, where precision matters, and higher temperature for creative content generation tasks**

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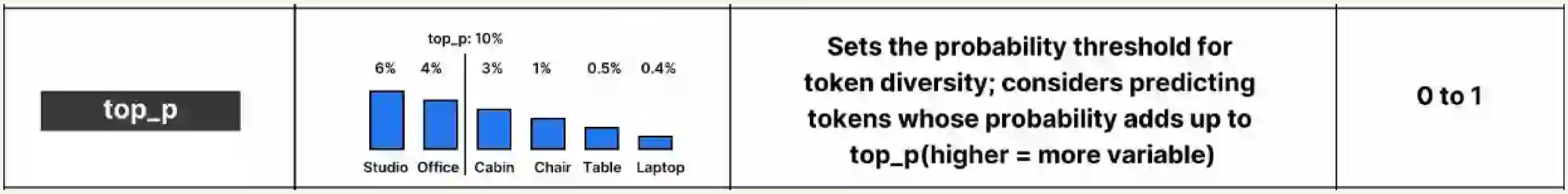
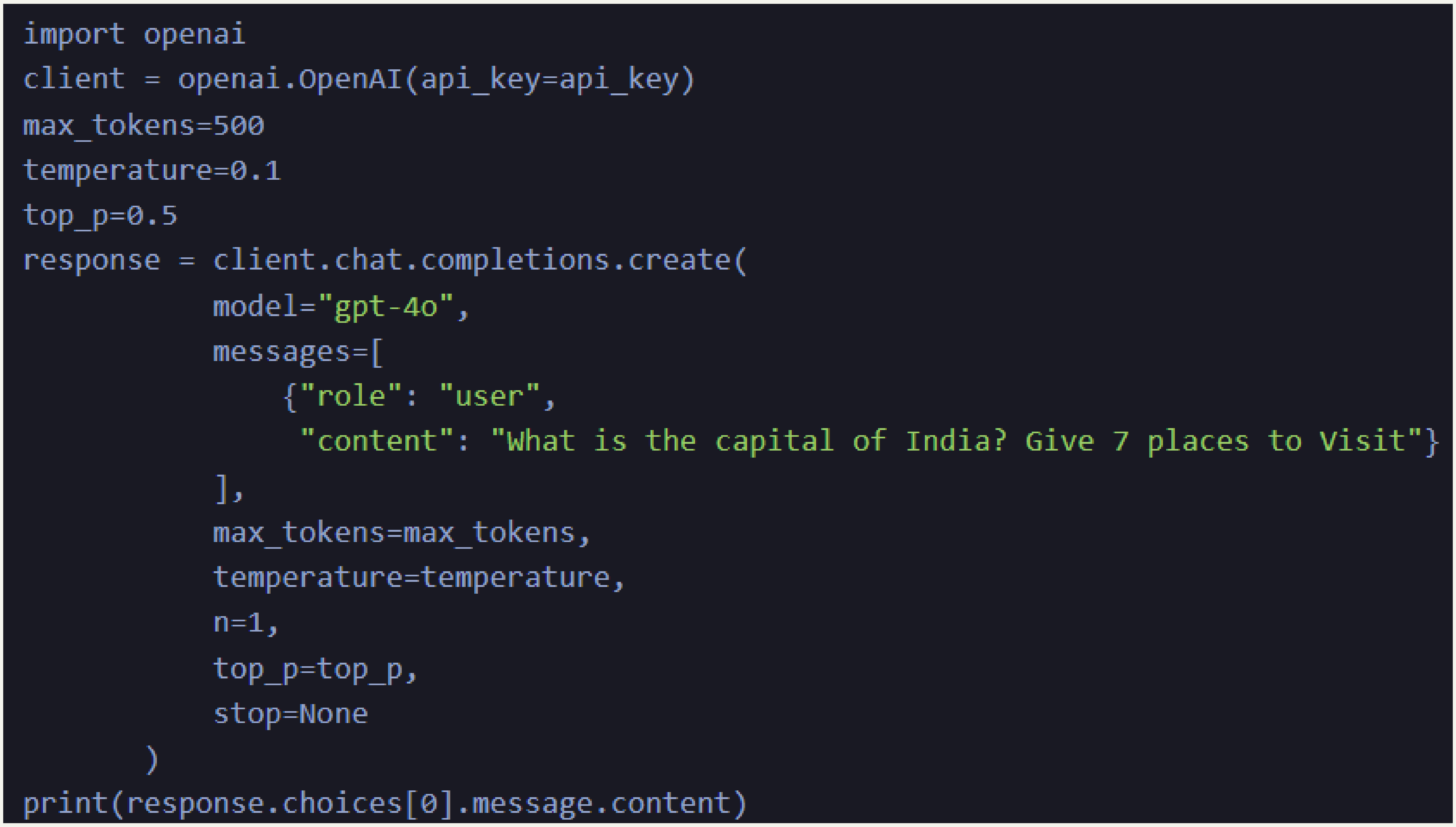
Top-p - Nucleus Sampling



top_p	top_p: 10% 6% 4% 3% 1% 0.5% 0.4% Studio Office Cabin Chair Table Laptop	Sets the probability threshold for token diversity; considers predicting tokens whose probability adds up to top_p(higher = more variable)	0 to 1



```
import openai
client = openai.OpenAI(api_key=api_key)
max_tokens=500
temperature=0.1
top_p=0.5
response = client.chat.completions.create(
           model="gpt-4o",
           messages=[
               {"role": "user",
                "content": "What is the capital of India? Give 7 places to Visit"}
           ],
           max_tokens=max_tokens,
           temperature=temperature,
           n=1,
           top_p=top_p,
           stop=None
       )
print(response.choices[0].message.content)
```

- **The top_p parameter, also known as nucleus sampling, helps control the diversity of responses**
- **It sets a threshold for the cumulative probability distribution of next token generation choices:**
  - **Low Value (e.g., 0.1):** The model will only consider the top 10% of possible next tokens, limiting variation.
  - **High Value (e.g., 0.9):** The model considers a wider range of possible next tokens (summing up to 90%), increasing variability

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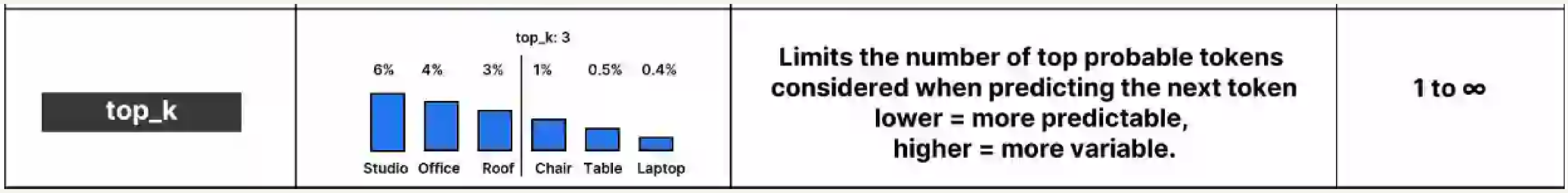
Top-k - Token Sampling



top_k	top_k: 3 6% Studio 4% Office 3% Roof 1% Chair 0.5% Table 0.4% Laptop	Limits the number of top probable tokens considered when predicting the next token lower = more predictable, higher = more variable.	1 to ∞

```python
# set top_k to 50
sample_output = model.generate(
    **model_inputs,
    max_new_tokens=40,
    do_sample=True,
    top_k=50
)

print("Output:\n" + 100 * '-')
print(tokenizer.decode(sample_output[0], skip_special_tokens=True))
```

- **The top_k parameter limits the model to only considering the top k most probable next tokens when predicting (generating) the next word**
  - **Low Value (e.g., 10):** Limits the model to more predictable and constrained responses
  - **High Value (e.g., 100):** Allows the model to consider a larger number of tokens, increasing the variety of responses
- **The top_k parameter isn't directly available in the OpenAI API but is available in other platforms like Hugging Face transformers**

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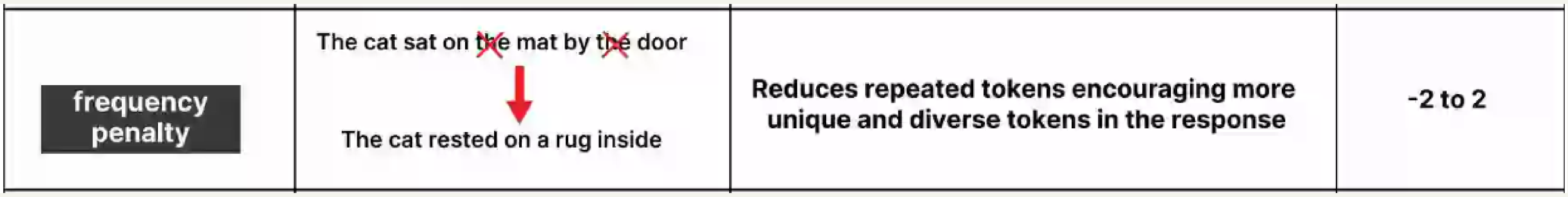
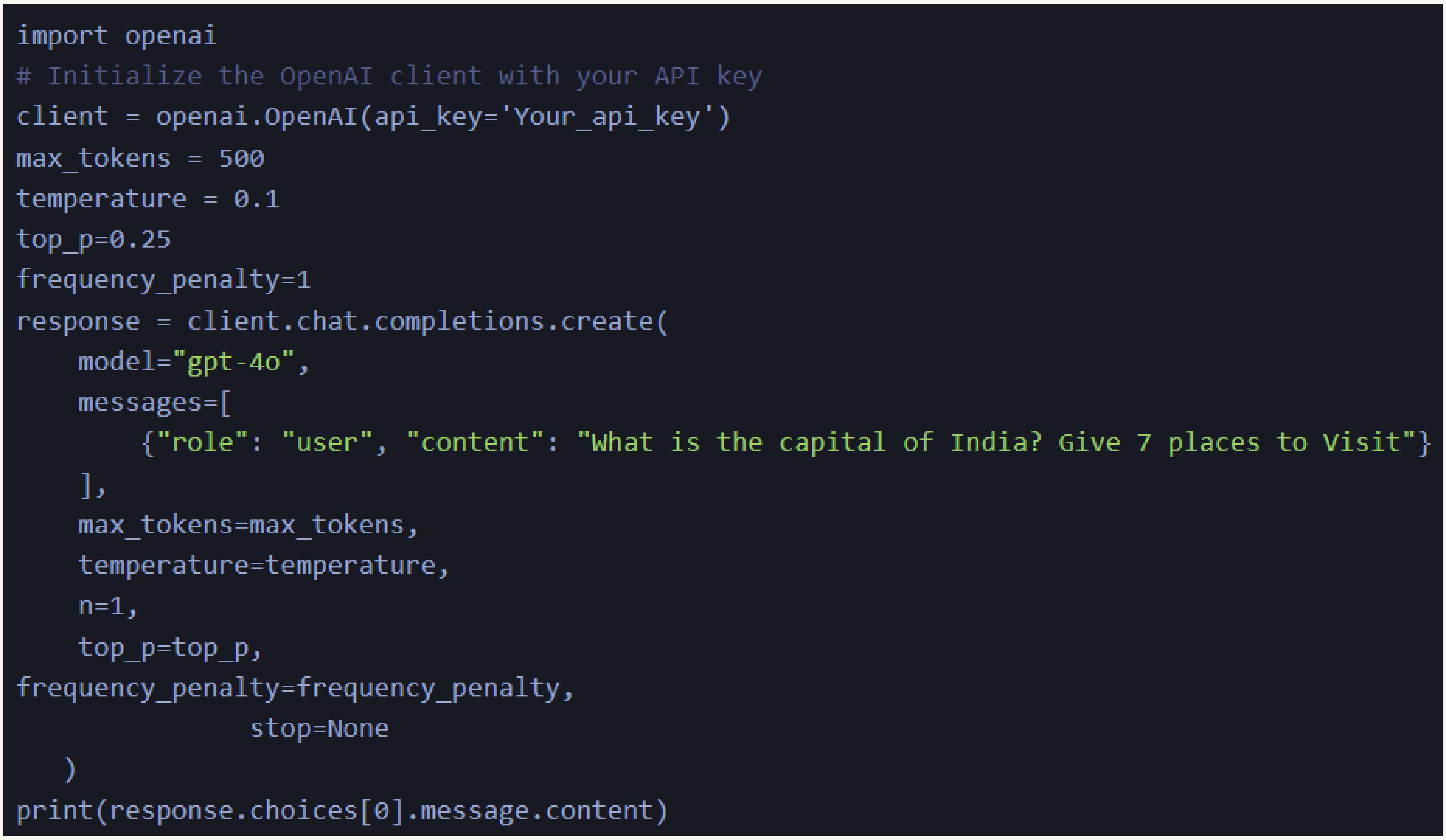
Frequency Penalty



frequency penalty	The cat sat on ~~the~~ mat by ~~the~~ door ↓ The cat rested on a rug inside	Reduces repeated tokens encouraging more unique and diverse tokens in the response	-2 to 2



```python
import openai
# Initialize the OpenAI client with your API key
client = openai.OpenAI(api_key='Your_api_key')
max_tokens = 500
temperature = 0.1
top_p=0.25
frequency_penalty=1
response = client.chat.completions.create(
    model="gpt-4o",
    messages=[
        {"role": "user", "content": "What is the capital of India? Give 7 places to Visit"}
    ],
    max_tokens=max_tokens,
    temperature=temperature,
    n=1,
    top_p=top_p,
frequency_penalty=frequency_penalty,
               stop=None
   )
print(response.choices[0].message.content)
```

- **The frequency_penalty parameter discourages the model from repeating previously used words. It reduces the probability of tokens that have already appeared in the output**
    - **Low Value (e.g., 0.0):** The model won’t penalize for repetition
    - **High Value (e.g., 2.0):** The model will heavily penalize repeated words, encouraging the generation of new content
- **This is useful when you want the model to avoid repetitive outputs, like in creative writing, where redundancy might diminish quality**

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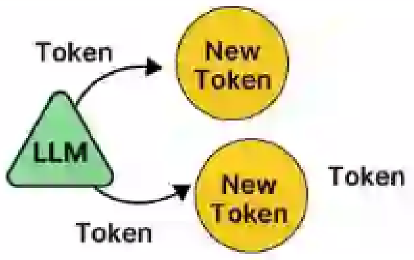
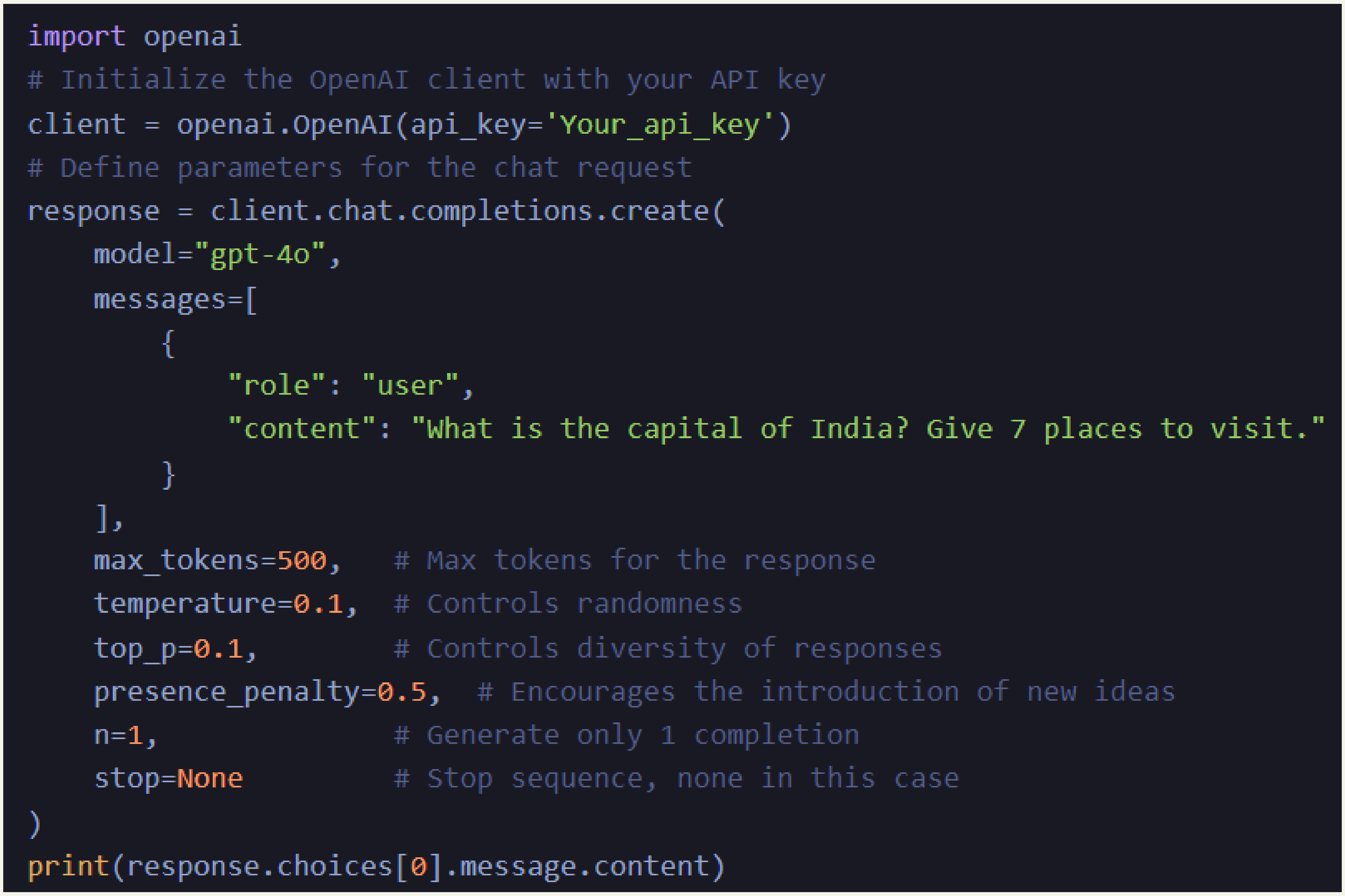
Presence Penalty

presence penalty		Discourages reuse of already-present tokens and forces more generation of new tokens	-2 to 2



```
import openai
# Initialize the OpenAI client with your API key
client = openai.OpenAI(api_key='Your_api_key')
# Define parameters for the chat request
response = client.chat.completions.create(
    model="gpt-4o",
    messages=[
        {
            "role": "user",
            "content": "What is the capital of India? Give 7 places to visit."
        }
    ],
    max_tokens=500,   # Max tokens for the response
    temperature=0.1,  # Controls randomness
    top_p=0.1,        # Controls diversity of responses
    presence_penalty=0.5,  # Encourages the introduction of new ideas
    n=1,              # Generate only 1 completion
    stop=None         # Stop sequence, none in this case
)
print(response.choices[0].message.content)
```

- **The presence_penalty parameter is similar to the frequency penalty, but instead of penalizing based on how often a word is used, it penalizes based on whether a word has appeared at all in the response so far**
  - **Low Value (e.g., 0.0):** The model won't penalize for reusing words
  - **High Value (e.g., 2.0):** The model will avoid using any word that has already appeared
- **Presence penalty helps encourage more diverse content generation**

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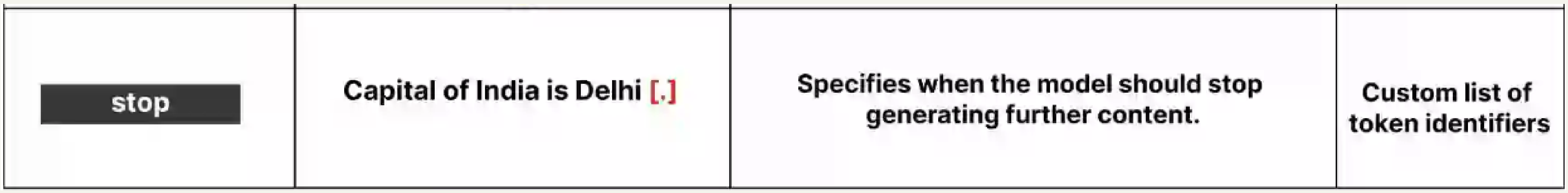
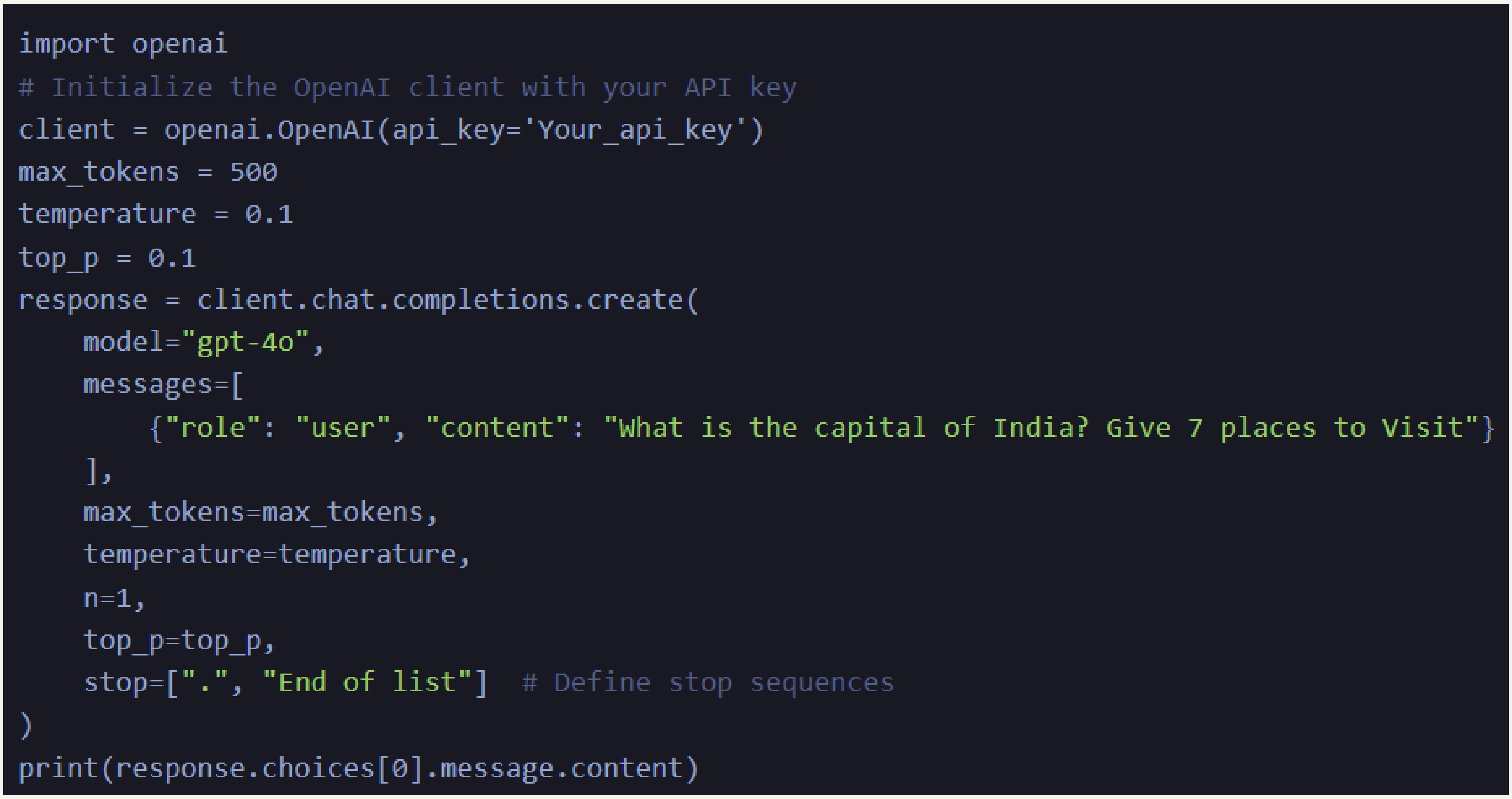
Stop Sequence



stop	Capital of India is Delhi [.]	Specifies when the model should stop generating further content.	Custom list of token identifiers



```python
import openai
# Initialize the OpenAI client with your API key
client = openai.OpenAI(api_key='Your_api_key')
max_tokens = 500
temperature = 0.1
top_p = 0.1
response = client.chat.completions.create(
    model="gpt-4o",
    messages=[
        {"role": "user", "content": "What is the capital of India? Give 7 places to Visit"}
    ],
    max_tokens=max_tokens,
    temperature=temperature,
    n=1,
    top_p=top_p,
    stop=[".", "End of list"]  # Define stop sequences
)
print(response.choices[0].message.content)
```

- **The stop parameter lets you define a sequence of characters or words that will signal the model to stop generating further content**
- **This allows you to cleanly end the generation at a specific point.**
    - **Example Stop Sequences:** Could be periods (.), newlines (\n), or specific phrases like “The end”.
- **Useful especially if you teach the model to generate content until a specific special token when fine-tuning**

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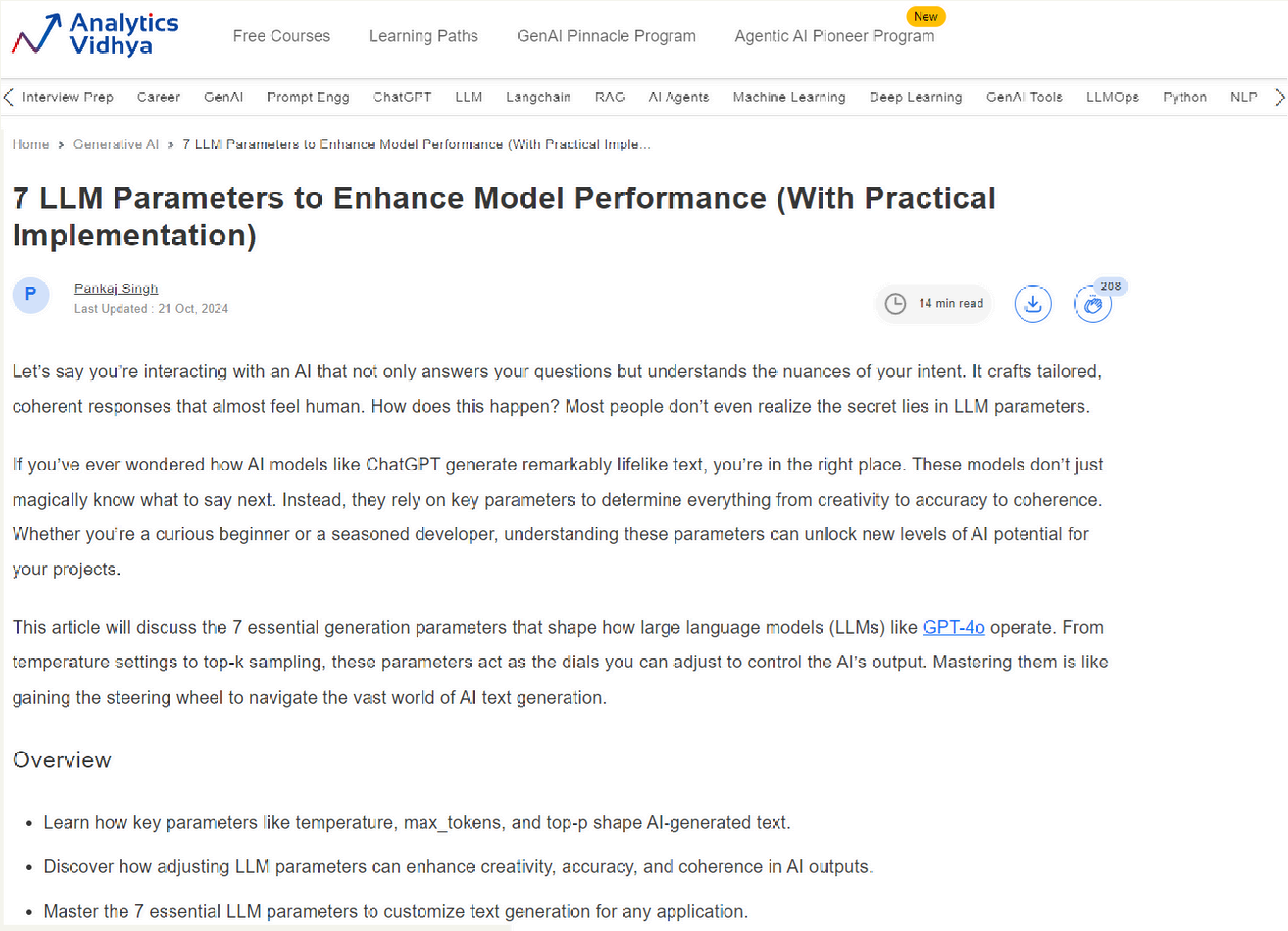
Hands-on Guide



7 LLM Parameters to Enhance Model Performance (With Practical Implementation)

Pankaj Singh
Last Updated : 21 Oct, 2024

Let's say you're interacting with an AI that not only answers your questions but understands the nuances of your intent. It crafts tailored, coherent responses that almost feel human. How does this happen? Most people don't even realize the secret lies in LLM parameters.

If you've ever wondered how AI models like ChatGPT generate remarkably lifelike text, you're in the right place. These models don't just magically know what to say next. Instead, they rely on key parameters to determine everything from creativity to accuracy to coherence. Whether you're a curious beginner or a seasoned developer, understanding these parameters can unlock new levels of AI potential for your projects.

This article will discuss the 7 essential generation parameters that shape how large language models (LLMs) like GPT-4o operate. From temperature settings to top-k sampling, these parameters act as the dials you can adjust to control the AI's output. Mastering them is like gaining the steering wheel to navigate the vast world of AI text generation.

Overview

- Learn how key parameters like temperature, max_tokens, and top-p shape AI-generated text.
- Discover how adjusting LLM parameters can enhance creativity, accuracy, and coherence in AI outputs.
- Master the 7 essential LLM parameters to customize text generation for any application.

CHECK OUT THE HANDS-ON GUIDE HERE