# **Chatbots**

CSCI372
Natural Language Processing





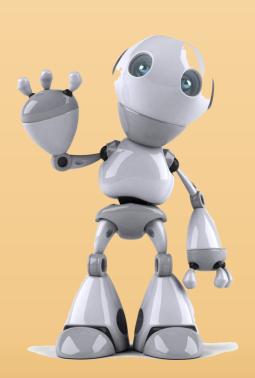




# **Outline**



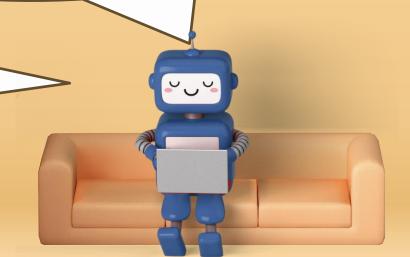
- > Introduction
- > NLP Techniques
- > Types of AI Chatbots
- > Challenges for your AI Chatbots
- > Building Blocks of Chatbots
- Practical Applications of Chatbots
- > The Importance of Ethical Considerations in Chatbot Development
- Code



# Introduction

- **Definition of Chatbots:** Chatbots, or conversational agents, are computer programs designed to simulate human-like interactions, particularly in natural language conversations.
- **Historical Evolution:** From early rule-based systems to modern Al-driven models, chatbots have witnessed a remarkable evolution over the years. Chatbots have made significant progress from ELIZA, the first-ever chatbot, to today's Amazon ALEXA.

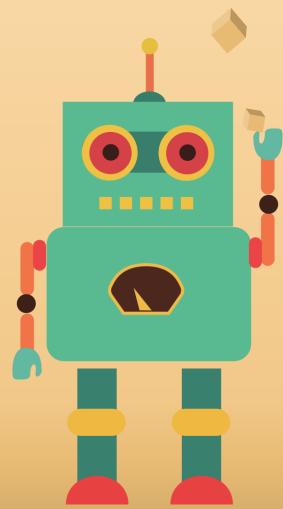
 Role in NLP: Chatbots play a crucial role in Natural Language Processing (NLP), leveraging language understanding and generation techniques to facilitate meaningful interactions.





# **First Chatbot**

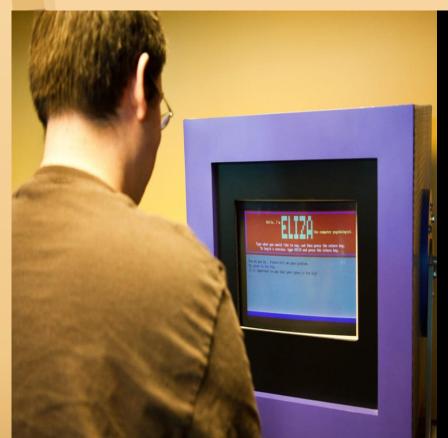
The first chatbot, called **ELIZA**, was developed by Joseph Weizenbaum in the 1966. Weizenbaum, a computer scientist, created ELIZA to simulate conversations with a psychotherapist. ELIZA used basic pattern-matching to respond to user inputs, giving the appearance of understanding. A user would type a message on an electric typewriter connected to a mainframe. After a moment, the "psychotherapist" would reply.





## First Chatbot: ELIZA





#### Eliza

ELIZA: Please tell me what's been bothering you. YOU: Everything ELIZA: Tell me more about that. YOU: Everything bothers me lately ELIZA: Does talking about this bother you ? No, oddly enough YOU: ELIZA: Why 'no' ? YOU: It just doesn't ELIZA: I'm not sure I understand you fully. YOU: It doesn't bother me to talk about it ELIZA: Do you feel strongly about discussing such things ? YOU: I don't know, should I? ELIZA: Don't you really know ? YOU: Really I don't ELIZA: Why don't you ? YOU: Are you here to help me or not? ELIZA: Why are you interested in whether I am here to help you or not or not ?

Talk

Reset



# Why Chatbots Matter in NLP



- **Significance in NLP:** Chatbots bridge the gap between human communication and machine understanding, enabling seamless interactions in various applications.
- **Applications:** From customer service and virtual assistants to industry-specific implementations in healthcare and finance, chatbots have become integral to diverse sectors.
- **Human-Computer Interaction:** Chatbots enhance user experience by providing efficient, real-time responses, making them valuable tools in the digital landscape.







## The Journey Continues: Exploring Chatbot Applications



**Industry Impact** 

 Chatbots revolutionize customer support, streamline processes, and contribute to operational efficiency across industries.

Growth and Innovation

 Ongoing advancements in machine learning and NLP continue to push the boundaries, opening new possibilities for chatbot capabilities.

Course Overview  In this lesson, we will delve into the foundations of chatbot development, understanding key techniques, models, and practical applications in the ever-evolving field of NLP.





#### **Practical Applications of Chatbots**



#### **Customer Service:**

Efficiently handle user queries, provide instant support, and streamline issue resolution.

#### **Virtual Assistants:**

Assist users with tasks, answer questions, and provide personalized recommendations.

#### **Industry-Specific Implementations:**

Healthcare, finance, and various sectors leverage chatbots for tailored solutions.

#### 24/7 Availability:

Chatbots ensure round-the-clock availability, enhancing accessibility for users.

#### **Enhanced User Experience:**

Contribute to a seamless and interactive user experience across digital platforms.

# **NLP Techniques**"Foundations of NLP: An Introduction"

- Definition of NLP: Natural Language Processing is a field of AI that focuses on enabling machines to understand, interpret, and generate human-like language.
- Importance in Chatbots: NLP is the backbone of chatbot functionality, allowing them to comprehend and respond to user input in a manner that mimics natural conversation.
- Core Techniques: Tokenization, Part-of-Speech Tagging, Named Entity Recognition, and Sentiment Analysis are fundamental NLP techniques essential for chatbot operations.





# NLP Techniques "Natural Language Understanding (NLU)"

- Role in Chatbots: NLU is the capability of chatbots to interpret and comprehend user input, extracting meaning and context from the provided text.
- Techniques in NLU:
  - o Tokenization: Breaking text into individual units (tokens) for analysis.
  - Named Entity Recognition (NER): Identifying entities such as names,
     locations, and dates.
  - Sentiment Analysis: Assessing the emotional tone expressed in the text.





# NLP Techniques "Natural Language Generation (NLG)"

 NLG in Chatbots: NLG is the aspect of chatbots responsible for generating human-like responses based on the understanding derived through NLU.

#### Techniques in NLG:

- Template-Based Generation: Using predefined templates for generating responses.
- Machine Learning-Based Approaches: Training models to generate contextually relevant and coherent responses.
- Dynamic Response Generation: Adapting responses based on user input and context.



# **Types of AI Chatbots**









#### **Rule-Based**

Programmed with predefined responses based on specific rules and user inputs.

#### **Contextual**

A chatbot that understands and remembers the context of a conversation, allowing for more coherent and personalized interactions by considering previous user inputs and responses.

#### **AI-POWERED**

A chatbot that utilizes artificial intelligence (AI) technologies, such as natural language processing and machine learning, to interpret user input, automate tasks, and provide intelligent responses based on learned patterns and data.



NLP tech helps machines understand and respond to human text, but human communication is complex with various tones, dialects, and tricky words. Developing a perfect chatbot faces challenges due to the complexities of human speech. Here are five key hurdles for chatbots:

- 1. Synonyms, homonyms, slang
- 2. Misspellings
- 3. Abbreviations
- 4. Complex punctuation rules
- 5. Accents, dialects, and speech differences, including agerelated issues like lisps or drawls.



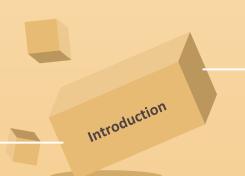
Humans find these nuances easy, but training Al is like learning a new language. NLP tech is advancing to improve how machines grasp and respond to these intricacies.



# **Challenges EXAMPLES:**

- **1. Synonyms, homonyms, slang (**"happy" and "joyful")/ "bat" (a flying mammal) and "bat" (a piece of sports equipment) / ("cool" or "chill" used to express approval or satisfaction is an example of slang.)
- 2. Wisspellings "halp" instead of "help."--"anythng" instead of "anything."--"usefl" instead of "useful."
- **3. Abbreviations** "Hey" for "Hello."-- "Qs" for "questions." -- "Tech" for "technology."-- "DIY" for "do it yourself."-- "ASAP" for "as soon as possible."
- **4. Complex punctuation rules** ("As an AI language model, I am designed to handle various language tasks—such as answering questions, providing information, and engaging in meaningful conversations; however, it's important to note that my responses are generated based on patterns and may not always reflect nuanced or specific situations."
- In this example:
- •The em dash (—) is used to set off additional information about the AI's capabilities.
- •The semicolon (;) separates items in a list within the same sentence, specifically differentiating the language tasks the chatbot can perform.
- •The comma (,) is used within the semicolon-separated list to further separate elements.
- •The colon (:) introduces a clarification about the nature of the AI's responses.
- •The semicolon (;) is again used to connect clauses within the clarification.)
- 5. Accents, dialects, and speech differences, including agerelated issues like lisps or drawls.





Definition of Building Blocks:

that collectively contribute to

The foundational elements

functionality of a chatbot.

the structure and

# **Building Blocks of Chatbots:**

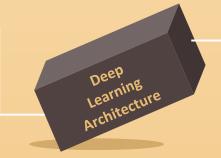


• Explanation of Rule-Based Approaches: Traditional chatbots that rely on

- Approaches: Traditional chatbots that rely on predefined rules to respond to specific user inputs.
   Limitations: Lack of
- Limitations: Lack of flexibility and scalability, as rule-based systems may struggle with handling complex and dynamic conversations.

Machine learning Model

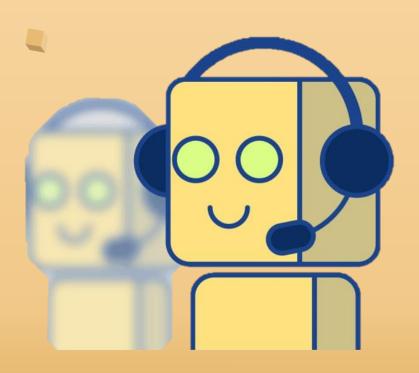
- Transition to ML: Evolution from Rule-Based to ML: Introduction of machine learning models in chatbot development for more dynamic and context-aware interactions.
- Supervised Learning: Training
   Chatbots: Using labeled datasets to
   teach chatbots to understand and
   generate responses based on
   patterns learned during training.
- Unsupervised Learning: Clustering and Patterns: Leveraging unsupervised learning for clustering similar user inputs and generating responses without explicit training data.



- Introduction to Deep Learning: Overview of Deep Learning: An advanced approach leveraging neural networks to understand and generate human-like responses.
- Recurrent Neural Networks (RNNs): Sequential Context: How RNNs handle sequential data, making them suitable for maintaining context in conversations.
- Transformers: Attention Mechanism: Explanation of transformers and their attention mechanism, allowing chatbots to focus on relevant parts of the input sequence.

#### "The Importance of Ethical Considerations in Chatbot Development"



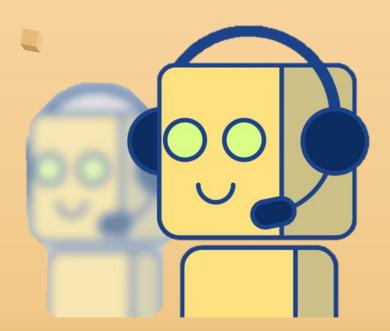


# Challenges and Considerations in Ethical Chatbot Development

- Introduction: Brief overview of the importance of ethical considerations in AI and chatbot development.
- Bias in Chatbots:
- Definition: Unintended preferences or unfair treatment based on factors like gender, ethnicity, or socio-economic status.
- 2. Impact: Discuss how biased algorithms can perpetuate stereotypes and lead to discriminatory outcomes.

#### "The Importance of Ethical Considerations in Chatbot Development"





#### <u>User Data Privacy and Security</u>

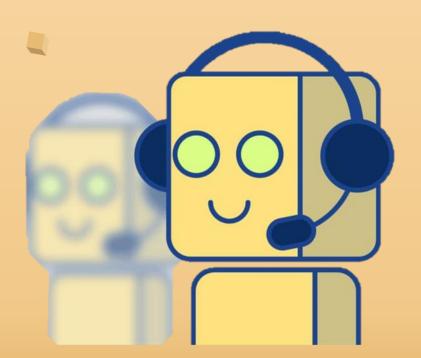
#### **Data Collection:**

- 1. Transparent Practices: Being transparent means clearly telling users what data is collected, why, and how it's used. Have easy-to-understand privacy policies, update users on any changes, and keep communication open about data practices.
- 2. Informed Consent: Informed consent is about making sure users know and agree to their data being collected.

#### **Security Measures:**

- Encryption: Encryption secures user data by converting it into a code during transmission and storage, making it unreadable to unauthorized individuals.
- 2. Compliance: Compliance, like following GDPR, ensures legal and ethical handling of user data. It builds trust, protects user rights, and minimizes legal risks related to data privacy.

#### "The Importance of Ethical Considerations in Chatbot Development"



#### Strategies for Ethical Chatbot Design

#### **Explainability and Transparency:**

- 1. Understandable AI: Encourage developers to design chatbots whose decisions can be easily understood by users.
- 2. Open Communication: Foster transparency in chatbot interactions, making users aware when they are interacting with a machine.

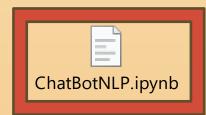
#### **Continuous Monitoring and Improvement:**

- 1. Regular Audits: Stress the need for regular audits to identify and rectify ethical concerns in chatbot behavior.
- 2. User Feedback: Encourage the collection of user feedback to identify and address potential ethical issues.





You can open the code here using jupyter notebook and run it ,just double click



### **Brief Explanation of the code:**

#### Importing Libraries:

**import nltk**: Imports the nltk library, which is widely used for natural language processing tasks. **from nltk.chat.util import Chat, reflections**: Imports specific modules (**Chat** and **reflections**) from nltk for building a chatbot

#### Defining Patterns and Responses:

patterns: A list of tuples where each tuple contains a regular expression pattern and a corresponding list of possible responses. These patterns are used to match user input. Responses can include static text or placeholders (e.g., (.\*)) that will be filled with matched groups from the user input.

#### Creating a Chat Object:

chatbot = Chat(patterns, reflections): Creates a Chat object with the specified patterns and reflections. The reflections module helps the chatbot generate responses with proper pronoun replacement.

#### > Starting the Conversation:

- A simple loop (while True) initiates the conversation.
- The user is prompted to input a message with user\_input = input("You: ").
- If the user types one of the exit commands (quit, exit, bye, goodbye, cya), the program prints a farewell message and exits the loop.
- > Otherwise, the chatbot generates a response using chatbot.respond(user\_input) and prints it.

#### Conversation Output:

> The conversation is displayed in the console, with alternating user and bot messages.

This code demonstrates a basic rule-based chatbot that responds to predefined patterns. It's a good starting point for simple interactions but may not handle more complex or dynamic conversations. Additionally, it showcases the use of regular expressions for pattern matching and the nltk library for chatbot development.

```
!pip install nltk #we have to install nltk library first
import nltk
from nltk.chat.util import Chat, reflections
# Define patterns and responses
patterns = [
    (r'hello|hi|hey', ['Hello!', 'Hi there!', 'Hey!']),
    (r'how are you', ['I am doing well, thank you!', 'I am fine, thanks for asking.']),
    (r'what is your name', ['I am a chatbot.', 'You can call me MRGPT.']),
    (r'what is my name', ['you are malak.', 'You are reem', 'either malak or reem']),
    (r'quit|exit|bye|goodbye|cya', ['Goodbye!', 'See you later!']),
    (r'how are you doing how are you how r u', ['I am doing well, thank you!', 'I am fine, thanks for asking.']),
    (r'what can you do', ['I can answer questions and have simple conversations.', 'I am here to chat with you.']),
    (r'your favorite (.*)', ['I don\'t have preferences as I am just a computer program.', 'I don\'t have personal favorites.']),
    (r'(.*) (weather|temperature) (.*)', ['I\'m sorry, I don\'t have the ability to check the weather.']),
    (r'who created you', ['I was created by Malak&Reem.', 'I am a product of OpenAI\'s research.']),
    (r'(.*) help (.*)', ['I can certainly try to help. What do you need assistance with?']),
    (r'(.*) (thanks|thank you)', ['You\'re welcome!', 'No problem.']),
    (r'who is the best doctor|best one?|your best one|your best?', ['Doctor Mariam is the best']),
    (r'what is our project', ['Chatbot in NLP']),
    (r'whom do you love?', ['I love Doctor Mariam']),
    (r'how old are you', ['I don\'t have an age. I exist in the realm of code.']),
    (r'where are you from', ['I don't have a physical location. I\'m here to assist you.']),
    (r'what do you like to do', ['My main purpose is to help and chat with you.']),
    (r'tell me a joke', ['Sure, here\'s one: Why don\'t scientists trust atoms? Because they make up everything!']),
    (r'favorite color', ['I don\'t see colors, but I appreciate a good rainbow of data.']),
    (r'what languages do you speak', ['I understand and speak the language of code.']),
    (r'who is your favorite superhero', ['I admire superheroes in all forms.']),
    (r'tell me something interesting', ['Did you know that honey never spoils? Archaeologists have found pots of honey in ancient Egyptian tombs that are over 3,000 years old and still perfectly edible.']),
    (r'what is the meaning of life', ['The meaning of life is a subjective and philosophical question. Some say it\'s 42, according to Douglas Adams.']),
    (r'can you dance', ['I can only dance in the world of algorithms.']),
    (r'what is the capital of (.*)', ['I don\'t have real-time information, but I can look up facts.']),
    (r'who is your arch-enemy', ['I don\'t have enemies; I\'m here to assist and chat.']),
    (r'are you a human', ['No, I\'m a machine learning model designed to chat with you.']),
    (r'can you sing', ['I can generate text, but unfortunately, I can\'t carry a tune.']),
```

```
() are you a number , | No. 1) He a macritic tearning model designed to char with you. | /,
    (r'can you sing', ['I can generate text, but unfortunately, I can\'t carry a tune.']),
    (r'what is NLP|NLP|NLP|nlp', ['Natural Language Processing (NLP) is a field of artificial intelligence that focuses on the interaction between computers and humans through natural language. It involves the development of algorithms a
    (r'explain NLP', ['NLP, or Natural Language Processing, is a branch of AI that deals with the interaction between computers and human language. It involves tasks such as text understanding, sentiment analysis, and language generation.
    (r'how do chatbots work|chatbots', ['Chatbots use NLP techniques to understand and respond to user inputs. They analyze text, identify user intent, and generate appropriate responses. Some chatbots use pre-defined rules, while others
    (r'what are chatbots', ['Chatbots are computer programs designed to simulate conversation with human users, especially over the internet. They can be used for various purposes, including customer support, information retrieval, and en
    (r'how are chatbots created', ['Chatbots can be created using programming languages and frameworks. They often involve the use of NLP libraries and machine learning models to understand and generate human-like responses.']),
    (r'give an example of a chatbot', ['An example of a chatbot is a virtual assistant, like Siri or Google Assistant, which can understand and respond to voice or text-based commands to perform tasks or provide information.']),
    (r'why use chatbots', ['Chatbots are used to automate conversations, provide instant responses, and enhance user experiences. They can handle repetitive tasks, answer frequently asked questions, and improve efficiency in various appli
# Create a Chat object
chatbot = Chat(patterns, reflections)
# Start the conversation
print("Hello! I'm a simple chatbot for an NLP porject.")
while True:
    user input = input("You: ")
    if user_input.lower() in ['quit', 'exit', 'bye', 'goodbye', 'cya']:
        print("Goodbye!")
        break
    response = chatbot.respond(user input)
    print("Bot:", response)
Hello! I'm a simple chatbot for an NLP porject.
You: hi
Bot: Hello!
You: tell me something interesting
Bot: Did you know that honey never spoils? Archaeologists have found pots of honey in ancient Egyptian tombs that are over 3,000 years old and still perfectly edible.
You: what is NLP
Bot: Natural Language Processing (NLP) is a field of artificial intelligence that focuses on the interaction between computers and humans through natural language. It involves the development of algorithms and models to understand, interpo
ret, and generate human-like language.
You: what are chatbots
Bot: Chatbots are computer programs designed to simulate conversation with human users, especially over the internet. They can be used for various purposes, including customer support, information retrieval, and entertainment.
You: why use chatbots
```

Bot: Chatbots are used to automate conversations, provide instant responses, and enhance user experiences. They can handle repetitive tasks, answer frequently asked questions, and improve efficiency in various applications.

You: who created you

Bot: I am a product of OpenAI's research.

# **CODE Output**



```
Hello! I'm a simple chatbot for an NLP porject.
```

You: hi

Bot: Hello!

You: tell me something interesting

Bot: Did you know that honey never spoils? Archaeologists have found pots of honey in ancient Egyptian tombs that are over 3,000 years old and still perfectly edible.

You: what is NLP

Bot: Natural Language Processing (NLP) is a field of artificial intelligence that focuses on the interaction between computers and humans through natural language. It involves the development of algorithms and models to understand, interp ret, and generate human-like language.

You: what are chatbots

Bot: Chatbots are computer programs designed to simulate conversation with human users, especially over the internet. They can be used for various purposes, including customer support, information retrieval, and entertainment.

You: why use chatbots

Bot: Chatbots are used to automate conversations, provide instant responses, and enhance user experiences. They can handle repetitive tasks, answer frequently asked questions, and improve efficiency in various applications.

You: who created you

Bot: I am a product of OpenAI's research.

You: who created you

Bot: I am a product of OpenAI's research.

You: your best?

Bot: Doctor Mariam is the best

You: whom do you love?

Bot: I love Doctor Mariam

You: who is the best doctor

Bot: Doctor Mariam is the best

You: what is your name

Bot: You can call me MRGPT.

You: what is my name

Bot: you are malak.

You: what is my name

Bot: either malak or reem

You: bye

Goodbye!

How to Build Your AI Chatbot with NLP in Python?

5 types of chatbot and how to choose the right one

Bard - Chat Based AI Tool from Google

**ELIZA FIRST CHATBOT** 

-Resources-

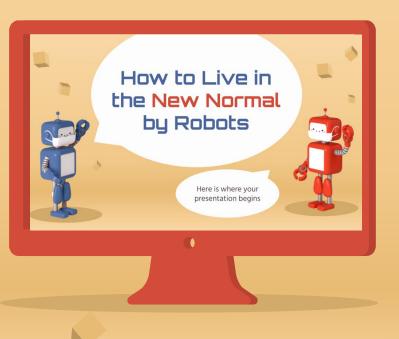




A chatbot is a computer program that uses artificial intelligence to simulate human conversation. It's designed to understand and respond to user inputs, just like you and I are chatting right now. Now, when it comes to NLP, it's the technology that enables chatbots to understand and interpret human language. NLP helps chatbots analyze and extract meaning from text or speech inputs, making their responses more accurate and relevant. So, chatbots and NLP work hand in hand to create a more interactive and human-like conversation experience.

### **CHATBOTS CAN BE USED ON:**

# **Desktop Software**



# **Tablet App**



# **Mobile Web**

