

# Lecture 2: Pattern matching and ELIZA

PSYC 51.07: Models of language and communication

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# Recap from Lecture 1

## Key ideas

- **Consciousness is complex:** multiple types, hard to define
- **Language ≠ thought:** but they interact in interesting ways
- **Grounding matters:** meaning comes from experience

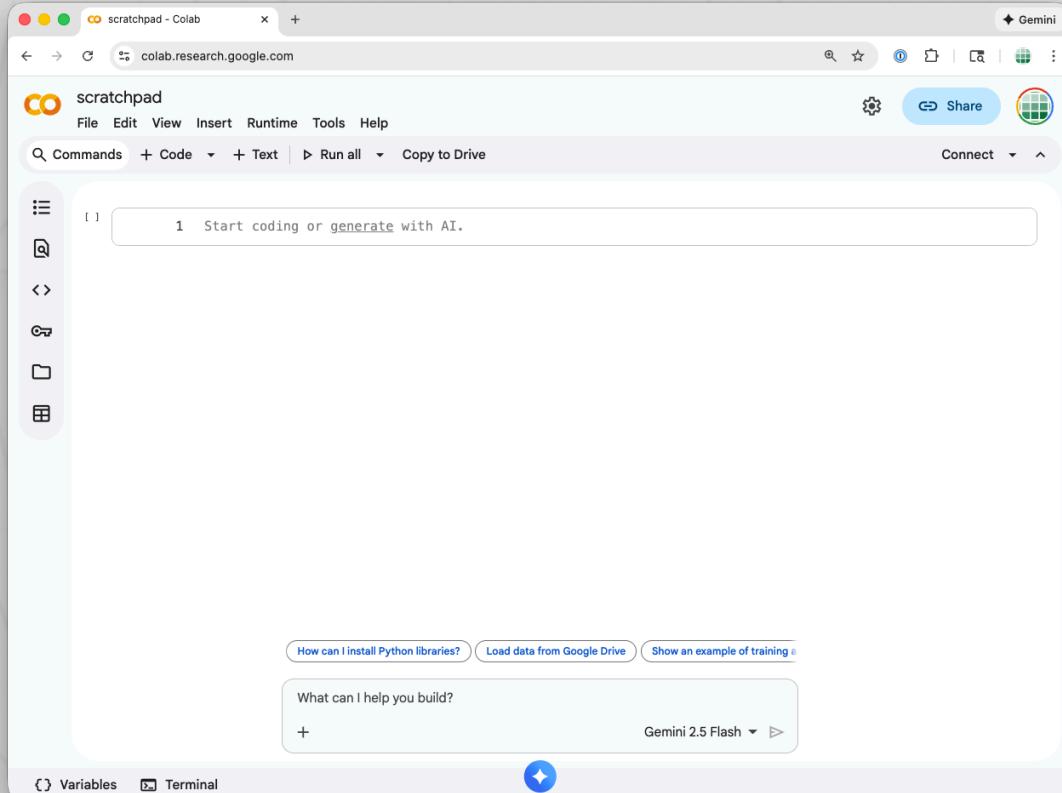
## For further reflection...

- Does the "experience" need to be first-hand? Can we "share" experience with another person? Or with a machine? What might that look like?
- Can we have understanding without consciousness (or vice versa)?

## Today's focus

Pattern matching can create powerful *illusions* of experience and understanding, even without any *real* comprehension or grounding. We'll explore some foundational techniques for text processing that were used to build one of the first chatbots, ELIZA. (Next time, we'll dig into *how* ELIZA works under the hood!)

# Side note: follow along with Google Colab!



- Go to [colab.research.google.com](https://colab.research.google.com)
- Click "New notebook"
- Click to create new `text` or `code` cells
- Copy and paste code from slides
- Press `Shift + Enter` to run cells
- Riff on the examples and see what happens!

# Creating the illusion of experience and understanding

## Humans

- Derive meaning from experience
- Connect words to memories, emotions, senses
- Understand context and nuance

## Computers

- Manipulate strings (sequences of characters)
- Have no direct experience of the world
- Process symbols without inherent meaning

### The challenge

How do we bridge this gap? Can we use symbol manipulation create the *appearance* of understanding?

### Keep in mind

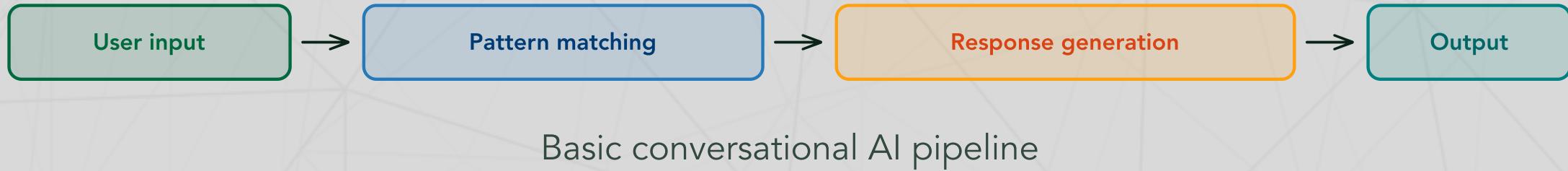
The illusion of understanding comes from the programmer's skill at designing clever pattern matching rules, along with the *user* having understanding and experience (and a tendency to anthropomorphize), not from any *actual* understanding on the part of the machine.

# Text processing and string manipulation

- **Finding:** Locate patterns within text
- **Replacing:** Substitute one pattern for another
- **Extracting:** Pull out specific parts of text
- **Transforming:** Convert text to different formats

```
1 text = "Hello, how are you today?"  
2  
3 # Finding (True)  
4 "how" in text  
5  
6 # Replacing ("Hello, how are we today?")  
7 text.replace("you", "we")  
8  
9 # Extracting ("how are you today?")  
10 text.split(", ")[1]  
11  
12 # Transforming (["hello", "how", "are", "you", "today?"])  
13 text.lower().split()
```

# Text processing is the foundation of computational linguistics



## Note

*Every substantive conversational AI system, from ELIZA to ChatGPT, fundamentally processes text through some form of pattern matching and pattern completion, though with vastly different levels of sophistication.*

# Regular expressions

## Regular expression (regex)

A sequence of characters that defines a search pattern. Regular expressions provide flexible, powerful pattern matching for text processing.

### Key syntax

Symbol	Meaning	Example
.	Any character	h.t matches "hat", "hit", "hot"
*	Zero or more	ab*c matches "ac", "abc", "abbc"
( )	Capture group	(hello) captures "hello"
	Alternation	cat dog matches "cat" or "dog"
^	Negation	[^a-z] matches any non-lowercase letter

# Regular expressions in Python

```
1 import re
2
3 text = "I am feeling very happy today"
4
5 # Simple pattern matching
6 if re.search(r"happy|sad|angry", text):
7     print("Found an emotion!")
8
9 # Capture groups - extract parts of a match
10 match = re.search(r"I am feeling (.*) today", text)
11 if match:
12     emotion = match.group(1) # "very happy"
13
14 # Substitution
15 new_text = re.sub(r"I am", "You are", text)
16 # "You are feeling very happy today"
```

# Worked example: building a simple chatbot rule

**Goal:** Respond to "I am [feeling]" statements

```
1 import re
2
3 def simple_respond(user_input):
4     # Try to match "I am
5     # [something]"
6     match = re.search(
7         r"I am (.*)",
8         user_input,
9         re.IGNORECASE
10    )
11
12    if match:
13        feeling = match.group(1)
14        return f"Why are you
15        {feeling}?"
16
17    return "Tell me more."
```

**Try it:**

```
1 >>> simple_respond("I am tired")
2 "Why are you tired?"
3
4 >>> simple_respond("I am feeling
5 anxious")
6 "Why are you feeling anxious?"
7
8 >>> simple_respond("Hello there")
9 "Tell me more."
```

## Key insight

The computer has no idea what "tired" or "anxious" mean. It's just copying text!

# Let's build our first (very simple) chatbot!

```
1 import re
2
3 # response function: process user input and
4 # respond appropriately
5 def respond(user_input):
6     # look for "I am __" patterns
7     i_am = re.search(r"I am (.*)", user_input, re.IGNORECASE)
8
9     # look for "You are __" patterns
10    you_are = re.search(r"You are (.*)", user_input, re.IGNORECASE)
11
12    if i_am:
13        feeling = i_am.group(1)
14        return f"Why are you {feeling}?"
15    elif you_are:
16        trait = you_are.group(1)
17        return f"What makes you think I am {trait}?"
18        # add some more patterns!
19    else:
20        return "Tell me more!"
```

continued...

# Let's build our first (very simple) chatbot!

```
21 # main loop: interact with user
22 print("Bot: Hello! I'm here to listen. Type 'exit' to quit.")
23 while True:
24     user_input = input("You: ")
25     if user_input.lower() in ["exit", "quit"]:
26         break
27     else:
28         response = respond(user_input)
29         print("Bot:", response)
30     print("Bot: Goodbye!")
```

...continued

# Meet ELIZA: a computerized Rogerian therapist

## Historical context

**ELIZA** was created by Joseph Weizenbaum at MIT in 1966. It was the first-ever interactive chatbot, and one of the first programs to attempt natural language processing. ELIZA plays the role of a Rogerian therapist, using simple pattern matching to simulate a conversation with a human patient.

## What is a Rogerian therapist?

- Non-directive therapy style
- Reflects statements back to patient
- Asks open-ended questions
- Avoids making claims about the world

## Key insight

- Rogerian style requires no real knowledge
- Simply reflects and rephrases
- Lets the human do the "heavy lifting" of "knowing about stuff"

# Chat with ELIZA

## Try it!

Have a conversation with ELIZA. Try putting yourself into the "frame of mind" of someone from the 1960s who had never experienced a chatbot before, and likely who had only had limited (if any) exposure to computers. Take on the role of a "patient" seeking help from ELIZA in its role as a therapist. Then use your own (modern) knowledge and experiences to see where ELIZA breaks down.

## For your consideration

- What does ELIZA do surprisingly well?
- What reveals its limitations?
- Can you "trick" ELIZA? How?
- What kinds of inputs break the illusion?
- **How do you think ELIZA works?**

# Example ELIZA conversation

1 User: I am feeling sad today  
2 ELIZA: Why are you feeling sad today?  
3  
4 User: My mother doesn't understand me  
5 ELIZA: Tell me more about your family.  
6  
7 User: She always criticizes everything I do  
8 ELIZA: Your mother?  
9  
10 User: Yes, and my father too  
11 ELIZA: What else comes to mind when you think of your father?  
12  
13 User: I don't know

## Notice how ELIZA:

- Picks up on keywords ("mother", "father")
- Reflects statements back as questions
- Uses generic prompts when stuck
- Never makes specific claims about the world

## Where it breaks down:

1 User: What is  $2 + 2$ ?  
2 ELIZA: Why do you ask?  
3  
4 User: I want to know if you're intelligent  
5 ELIZA: Does it please you to believe I am intelligent?

# The ELIZA effect

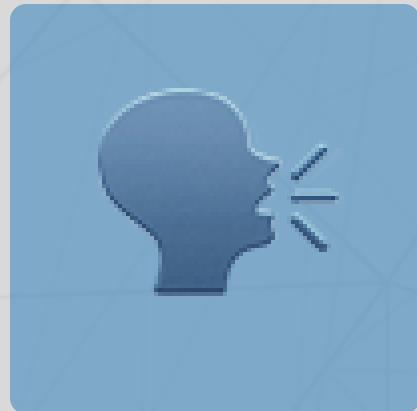
## **The ELIZA effect**

The tendency to unconsciously assume that computer behaviors are analogous to human behaviors; to attribute human-like understanding to programs that merely simulate it.

## **Weizenbaum's observation**

Weizenbaum was surprised (and disturbed) by how quickly users became emotionally involved with ELIZA. His secretary reportedly asked him to leave the room so she could have a private conversation with the program!

# Why do we anthropomorphize machines?



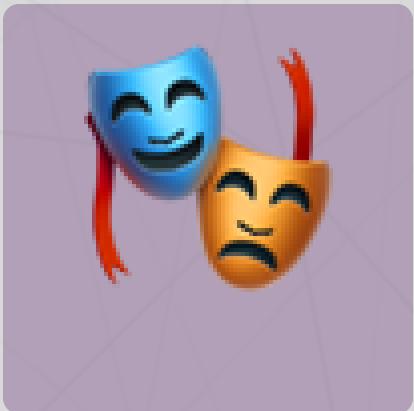
Language cues



Pattern recognition



Social instincts



Theory of mind

**Note**

Humans are social creatures. We evolved to detect minds and intentions, and we often over-apply this tendency, even to clearly non-conscious entities.

# Discussion

## Reflect on your own experiences

Have you experienced the ELIZA effect with modern AI systems (ChatGPT, Claude, Siri, Alexa)?

- When have you felt like an AI "understood" you?
- Where do you think that illusion came from?
- What broke the illusion?
- What is the difference between *seeming* intelligent and *being* intelligent?
- How would we *know* if an AI truly understood us?

# Example: The ELIZA effect in modern AI

## Feels like understanding:

- 1 User: I'm really stressed about my exam
- 2 AI: I can hear that you're feeling overwhelmed. Exams can be really stressful. What subject is it?
- 3
- 4 User: Physics. I've been studying for weeks
- 5 AI: Studying for weeks shows real dedication. What part of physics is giving you trouble?

## Reveals the limitation:

- 1 User: I just realized I left my exam notes in your office
- 2 AI: I understand that can be frustrating! Would you like tips on how to retrieve your notes?

### Pattern matching, not understanding

The AI has no office. It cannot have your notes. But it responds as if this makes sense!

# Reading: Weizenbaum (1966)

## Required reading

Weizenbaum, J. (1966). ELIZA—A computer program for the study of natural language communication between man and machine. *Communications of the ACM*, 9(1), 36–45.

## Pay special attention...

- How does ELIZA select responses?
- What are "scripts" in ELIZA's architecture?
- Why did Weizenbaum choose the DOCTOR script?
- What did Weizenbaum observe about user reactions?

# Up next

Lecture 3 (Thursday X-hour)

## How ELIZA *actually* works

- Complete architecture walkthrough
- Pattern matching and response selection
- The role of scripts and keywords
- We will build it ourselves!

Prepare for next time

- Finish reading Weizenbaum (1966)
- Play with the ELIZA demo
- Think about: what would *you* add to ELIZA?
- Read the Assignment 1 instructions

# Key takeaways

1. **String manipulation is foundational:** all text-based AI builds on finding, replacing, and extracting patterns
2. **Regular expressions are powerful:** flexible pattern matching enables sophisticated text processing
3. **ELIZA demonstrated the power of simplicity:** a few clever rules can create convincing illusions
4. **The ELIZA effect is real:** we naturally anthropomorphize systems that use language
5. **Seeming  $\neq$  being:** appearing intelligent does not require actual understanding

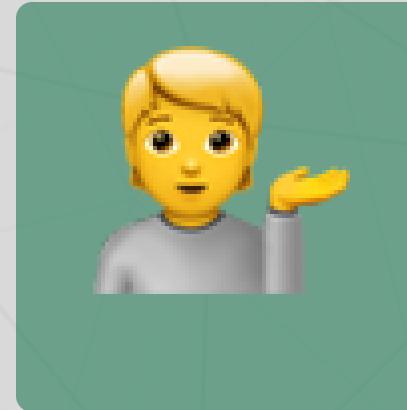
# Questions? Want to chat more?



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## Tip

Feeling lost? Want to make sure we cover something you're excited about? **Reach out** if you have questions, comments, concerns, or just want to chat!