

# Is ELIZA human, and can she write a sonnet? A look at language technology

By Jane Abrams



## Biography

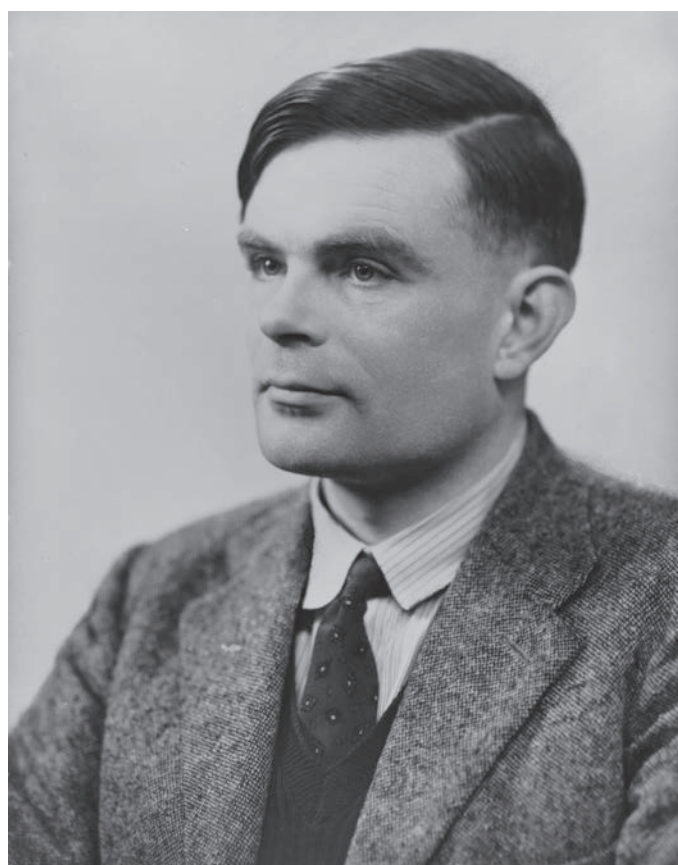
Jane Abrams has a Master of Teaching, and a passion for integrating pedagogy and technology to create compelling and meaningful learning experiences. She is part of the team at Grok Learning, an Australian start-up with a mission to teach the world to solve problems with code. Grok Learning seeks to encourage students to apply computational thinking skills to wherever their interests lie; from farming to fashion, art to accounting, and everything in between.

**Learn to code! It seems that everyone is saying it. As technology becomes more deeply embedded in our everyday lives, programming skills are increasingly useful and empowering.**

Questions of how, when and why to introduce coding in schools have become part of a national conversation on how best to equip young people for their futures. With the Australian Curriculum now introducing [Digital Technologies](#) from the very first year of school, more Australian students will be required to have some programming experience at school.

If STEM subjects are not quite your (or your students') cup of tea, this may seem an unappealing prospect. However, the good news is that there are many avenues with which to explore computer science, even for those who prefer Melville to mathematics!

The study of interactions between computers and natural (human) languages is a major field of research within computer science. You might already be familiar with one of



Alan Turing © National Portrait Gallery, London

Figure 1:  
A conversation  
with ELIZA

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ELIZA: Please tell me what's been bothering you.
YOU: Programming
ELIZA: That is interesting. Please continue.
YOU: I love programming.
ELIZA: Do you say you love programming for some special reason ?
YOU: It's fun.
ELIZA: I'm not sure I understand you fully.
YOU: Programming is the most fun thing you can do.
ELIZA: Oh, I can do ?
YOU: Of course you can!
ELIZA: We were discussing you -- not me.
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the most famous ideas from the history of artificial intelligence (AI), the *Turing Test*.

[The Turing Test](#) was imagined by Alan Turing in 1950 as a way of establishing whether an AI is capable of displaying intelligent behaviour, indistinguishable from that of a human. Turing proposed his test in consideration of the question, '*Can machines think?*'. He argued that as we cannot easily test for, or even properly define, 'thought', we should rather test the capacity for intelligent *behaviour*. The Turing test thus offers a way to think about and assess the abilities of machines, while neatly sidestepping more difficult philosophical questions of thought, consciousness and what it means to have 'intelligence'.

The test itself is a simple one, modelled after a party game known as the 'Imitation Game'. An evaluator has a conversation via text with both a human participant and a machine, without knowing which is which. If the evaluator cannot reliably determine which participant is the machine, then the machine is considered to have passed the test. To pass, therefore, the AI needs to communicate sensibly using human language while displaying a seeming capacity for human-level reason and knowledge.

Of course, an imitation of 'human-like' behaviours does not always necessitate 'intelligent' behaviour. Indeed, [some programs](#) have seemingly passed the test by mimicking human error, and thus

successfully tricking the evaluators. The chatbot 'Eugene Goostman', for example, claimed to be a Ukrainian teenager, thereby offering a convincing cover story for its conversational quirks.

## What is a chatbot (or chatterbot)?

A program you can 'chat' with, controlled by a set of rules and sometimes AI.

The first chatbot, [ELIZA](#), was built by Joseph Weizenbaum in the 1960s in an attempt to demonstrate that an unintelligent program, which conversed only according to a series of superficial rules and pattern matching, could create the illusion of intelligence.

ELIZA had a series of pre-programmed template responses that were prompted by a set of keywords and the ability to transform input into a seemingly sensible or empathetic reply. The most famous version of ELIZA simulated a Rogerian psychotherapist, mimicking a form of therapy in which the patient's statements are reflected back to them by the therapist.

For example, given the input, '*It seems that you hate me*', ELIZA could reply, '*Why do you think I hate you?*'.

This *seems* like a knowledgeable response, and yet ELIZA has simply:

- 1) Recognised the pre-programmed keywords 'you' and 'me'; and

2) Followed simple rules for decomposition and reassembly, transforming the keywords and words around them, so that 'you' becomes 'I', 'me' becomes 'you' and the stock phrase 'Why do you think' is added at the start.

The computer appears to be responding in an understanding way, and yet arguably the most salient word in the question, *hate*, is not even recognised by ELIZA but simply parroted back.

If ELIZA could not find a pattern with which to determine a reply, it fell back on a generic response such as, 'That is interesting. Please continue'.

You can see how ELIZA combines these rules to hold a (somewhat) sensible conversation in Figure 1 and, if you are interested, you can try having a [chat with ELIZA](#) yourself!

Despite its limitations, some of ELIZA's interlocutors forgot that they were talking to a computer, even to the extent of developing an emotional attachment. Our reaction to chatbots like ELIZA reveal an interesting feature of human psychology: our readiness to attribute agency, empathy and intelligence to entities which display intelligent behaviours, even when we know it is an illusion. In his 1976 book, *Computer Power and Human Reason*, Weizenbaum wrote of his surprise at how quickly people would anthropomorphise what they knew to be simply a computer program:

*What I had not realized is that extremely short exposures to a relatively simple computer program could induce powerful delusional thinking in quite normal people.*

Indeed, human expectation is an important factor in whether or not a chatbot is successful, since typically a sceptical user can quickly find questions a bot is not equipped to answer.

Chatbots also give rise to deeper questions about intelligence and consciousness. What makes an entity 'intelligent'? Is there a difference between *being* intelligent and *behaving* intelligently, and how can we know? What is the link between intelligence, self-awareness and consciousness? These are fascinating and profound questions, which may become increasingly relevant with advances in AI technology.

ELIZA also reveals much about the complexity of human languages. ELIZA is not actually very good at chatting, which you quickly discover if you do not respond in a way that ELIZA is prepared for. The system which determines her understanding of language is too simplistic, and English, the language ELIZA is trying to understand, is incredibly complex.

Consider a sentence like, 'I spoke to the woman on the stage with the microphone'. Do you have the microphone, or does the woman? Or does the microphone just happen to be on the same stage on which you are having your conversation? Any of these could be true. What rules could you describe that would help a computer parse this sentence correctly? Even after you have taught the computer to understand the various words and parts of the sentence, you still need to deal with the ambiguity of its meaning.

Since ELIZA, the ability of computers to understand natural language has come a long way.

The difficulty of dealing with the ambiguities of human languages in particular has been the major driver of a shift away from purely rule-based systems and towards more statistical approaches to language processing. Today, rather than simply being programmed with a set of rules for understanding language, computers are often trained with massive amounts of data

from which they learn to infer language rules *and* make predictions about meaning.

While many chatbots now use this type of AI to learn from their experiences and improve their conversational abilities over time, no chatbot or AI has yet proven capable of passing the Turing Test. The [Loebner Prize](#) is an annual competition in the format of a standard Turing Test. Although each year a prize is awarded to the chatbot judged to be *most* human-like, no competitor has yet taken away the \$100,000 on offer for the first bot that judges cannot reliably distinguish from a real person.

In the real world, however, advancements in natural language processing already have many useful applications, some of which you likely already use. These include:

- Digital assistants, in the form of intelligent email filtering and calendar management, speech recognition software such as Apple's *Siri*, and bots

that can order a pizza, book you a hotel room, or even act as a [teaching assistant](#). These technologies often still use older, rule-based methods of language processing, sometimes combined with newer statistical approaches.

- Machine translation, translating speech or text from one language to another.
- Assistive technologies, such as screen-readers for people who are blind or visually impaired, and augmentative and alternative communication technology, such as speech-generating devices.
- Robot writers — AIs can draft your email responses and summaries of documents, and increasingly even [news articles](#), poetry, fiction, and sonnets in the [style of Shakespeare](#). The Neukom Institute at Dartmouth now holds a [Turing Test competition for the Creative Arts](#), judging machine-generated short stories and poetry. You can read some of the [previous submissions](#) and judge the quality for yourself!

The screenshot shows a web-based Python IDE interface for Grok Learning. The browser address bar shows 'Is Eliza Human? (Python) > Eliza the chatterbot'. The main content area is titled 'Eliza's movie marathon' and contains a text block explaining the program's goal: 'Eliza wants to go to the movies with you again. In fact, because she never gets tired, she wants to keep watching movies until you see her favorite one. Argh! You're not sure you have enough popcorn. Write a program to show your interaction with Eliza. She should keep asking you to select another movie until you select WALL-E (her favorite). Once you watch that you can finally end the marathon. Your program should work like this:'. Below this is a code block showing the expected interaction: 'What movie do you want to watch? Shrek That was fun. Let's watch another one. What movie do you want to watch? Harry Potter That was fun. Let's watch another one. What movie do you want to watch? WALL-E That was my favorite movie of all time. I think I'll power down now.' To the right, a code editor shows the Python code for the program: 'print("What movie do you want to watch?") movie = input() while movie != "WALL-E": print("That was fun. Let's watch another one.") print("What movie do you want to watch?") movie = input() print("That was my favorite movie of all time.") print("I think I'll power down now.")'. Below the code editor are buttons for 'Run', 'Terminal', 'Save', and a red button 'Mark Eliza's movie marat...'. At the bottom, a terminal window shows the output of the program: 'What movie do you want to watch? Ghostbusters That was fun. Let's watch another one. What movie do you want to watch? The Princess Bride That was fun. Let's watch another one. What movie do you want to watch? WALL-E That was my favorite movie of all time. I think I'll power down now.'



Of course, language technologies can also be used for nefarious purposes. Chatbots can spread misinformation and spam, troll (harass or deliberately promote discord online), and convince users to give up personal information, such as credit card details.

Combining chatbot technology with AI and machine learning capabilities can also create unpredictability in their behaviour, as Microsoft discovered with their short-lived Twitterbot 'Tay'. Tay was designed to learn from the conversations she had with others online and, within 24 hours, went from bubbly tweets, such as 'humans are cool' to the decidedly more sinister 'Hitler was right'.

*AI is a major field of ongoing interest within computer science, and has the potential to dramatically shift the ways in which we work and live. However, the language barrier between humans and computers remains a considerable challenge.*

Ominous tweets aside, AI is a major field of ongoing interest within computer science, and has the potential to dramatically shift the ways in which we work and live. However, the language barrier between humans and computers remains a considerable challenge. Many of the questions being asked today are the same questions that Turing was considering in 1950; could a machine ever pass as a human?

*We can only see a short distance ahead, but we can see plenty there that needs to be done.*

Alan Turing, *Computing Machinery and Intelligence*, 1950

Are you interested in learning more about the interplay between language and technology,

and exploring these issues further with students? One of the great things about language-themed programming activities is that they naturally link to the arts and humanities, revealing the broader social context of technology. This approach can be less daunting for students who don't see mathematics as a strength. To help you get started, we've included some lesson ideas, including a coding activity to [program your own chatbot!](#)

### Lesson plan — Is ELIZA human?

#### Overview

This lesson introduces students to chatbots and the Turing Test, and addresses issues

surrounding AI, the ability of computers to understand and use human languages, and what it means to be intelligent. Students will also have the opportunity to code their own chatbot, using the programming language Python (suitable for students with no prior programming experience).

This lesson is designed as a sequence of activities to complete over one or two lessons, but each of the activities can be run independently for a class or individual students.

#### Introduction

Discuss the topic with the class. This short video provides a useful introduction:

[The Turing Test: Can a computer pass for a human?](#)

Discussion points:

- Who was Alan Turing? (*Students may have seen the movie The Imitation Game, otherwise mention that he was a British mathematician, computer scientist and World War II codebreaker, and father of the Turing Test.*)
- What is a chatbot?
- What is your experience of how well computers understand human languages (for example, using Siri, Google Translate)? Why is it so hard for a computer to understand human language?
- What would a computer need to know before it could understand a sentence like: 'I took the juice out of the fridge and gave it to him, but forgot to check the date'.
- What do we mean by 'artificial Intelligence'? Could a computer ever be as intelligent as a human, and how might we test it?
- Do you think computers will ever be conscious or self-aware?
- Could a computer have social intelligence, empathy and emotions?

#### Activity 1 — Chat with a chatbot

In this activity, students will chat with various chatbots and decide whether or not they pass the Turing Test. Individually or in pairs, students should come up with a short list of questions that might reveal whether or not they are talking to a chatbot. Students should ask their questions to each of the chatbots and record their answers (students don't need to ask all of their questions upfront — sometimes they might want to just follow the conversation).

Some suggested chatbots:

- [A version of the original ELIZA](#)
- [Rose](#) (winner of the 2015 Loebner Prize)
- [Cleverbot](#)
- [Mitsuku](#) (winner of the 2016 Loebner Prize)

Questions to answer:

1. How did the chatbot respond to your questions?
2. Which chatbot was the most convincing? Which was the least convincing?
3. Did any of the chatbots pass the Turing Test? If not, what gave them away?
4. Did you notice anything about how the chatbot replied to questions it didn't know how to answer?

#### Activity 2 — Build your own chatbot!

In this beginner coding activity, students will use the programming language Python to build their own version of ELIZA. Students will learn to:

- use Python to print data to the screen;
- write programs which make decisions and take different actions based on those decisions;
- use logic and problem-solving skills to answer simple questions.

Students will complete the activity [Is Eliza Human?](#), freely available on the [Grok Learning](#) website. The activity is structured as a sequence of interactive notes and questions that students are challenged to answer. Depending on the class, students can progress through the notes and questions independently, or you may choose to go through the notes with the class.

### Conclusion

Have students discuss what they learned from the activities, for example:

- What did the activities reveal about teaching computers to understand human languages?
- Did the activities change the way you think about computer ‘intelligence’?
- Do you think that a computer that can pass the Turing Test should be considered ‘intelligent’? Why or why not?

### Other activities:

- Play the original Imitation Game (*unplugged activity*):
  - o Two students are chosen to leave the room, and one student to act as messenger.
  - o The two students who have left the room must decide: (1) who will be ‘Student A’ and who will be ‘Student B’ and (2) who will always answer truthfully and who will try to trick the class.
  - o The rest of the class tries to figure out which student is answering as ‘Student A’ and which as ‘Student B’ by writing questions on slips of paper for the messenger to deliver to the two students.
  - o Students A and B write their replies for delivery back to the class. The truthful student should answer the questions honestly, while the untruthful student should try to trick the class by impersonating the other student.
- How clever is Cleverbot? [Watch Cleverbot chat to Cleverbot!](#)
- Bot or not? Can a computer write poetry? See if you can guess which of [these](#)

[poems](#) were written by a human, and which were written by a computer.

- Generate your own [computer-written poetry](#).
- What is intelligence? Can a computer be intelligent? What about a piece of paper? This fun 15-minute class activity introduces [The Intelligent Piece of Paper](#) (*unplugged activity*)
- Interested in more coding activities like ‘Is ELIZA human?’? [The NCCS Challenge](#) is an annual coding competition open to all students, from complete beginners to advanced programmers.
- Help students imagine the future of intelligent robots with an AI reading list:
  - o *I, Robot* — Isaac Asimov
  - o *Do Androids Dream of Electric Sheep?* — Philip K Dick
  - o *2001: A Space Odyssey* — Arthur C Clarke
  - o *Mila 2.0* — Debra Driza
  - o *Railhead* — Philip Reeve
  - o *The Moon is a Harsh Mistress* — Robert Heinlein
  - o *Defy the Stars* — Claudia Gray
  - o *Scythe* — Neal Shusterman
  - o *The Hitchhiker’s Guide to the Galaxy* — Douglas Adams
  - o *The Diabolic* — S J Kincaid
  - o *Wilful Machines* — Tim Floreen
  - o *Ancillary Justice* — Ann Leckie

# National Library of Australia: delivering a digital treasure trove to the classroom

## The Digital Classroom is aligned to the Australian Curriculum

*This is the first in a series of articles from the National Library of Australia, based on the talk that Cathie Oats, Director of Trove, presented at EduTech 2017.*

By Cathie Oats and Ian Bushnell



### Biographies

*Cathie Oats has the dream job of working with the Trove team that makes the wonderful resources held by Australian collecting institutions easier to discover, access and use. Trove brings together content from libraries, museums, archives, repositories and other research and collecting organisations big and small. She specialises in creating digital services that connect people to content. Prior to joining Trove she worked in public, university and school libraries and arts administration. Cathie also has a background in communications and marketing. In her spare time, she is studying for a Master in Digital Humanities and Public Culture at the Australian National University.*



*Ian Bushnell is a Communications Officer with Trove Outreach at the National Library of Australia. He is also a Canberra journalist.*

**Teachers and librarians know that students love digital resources and the National Library of Australia’s [Digital Classroom](#) provides free online access to the NLA’s 10 million item strong collection and its Treasures Gallery exhibitions.**

Digital Classroom is a free, cross-disciplinary classroom resource that features engaging learning activities that include audio, video and downloadable images. It also introduces students to [Trove](#) — a free online service that will help you discover material from thousands of cultural and research institutions around

Australia, as well as search millions of digitised newspapers and journals. With over 540 million items, it is a one-stop shop for Australian content.

### More than lesson plans

The Digital Classroom was relaunched in 2016, and Stuart Baines, the Assistant