

Introducing Chatbots in Libraries

Abstract

Chapter 1 of Library Technology Reports (vol. 49, no. 8), "Streamlining Information Services Using Chatbots," presents a brief history of chatbots, computer programs that use natural language to interact with users. They have existed for nearly fifty years and have been used in libraries since the mid-2000s; chatbots from ELIZA (1966) to Pixel (2010) are introduced.

As many libraries continue to see reductions in funding, we are increasingly seeing technology as a way to make up for budget shortfalls. In the circulation context, online patron account management, self-registration, and self-serve checkout stations are examples of this trend. Since requests for basic library information (including locations, hours, and policies) and for specific materials or resources predominate among chat and IM inquiries of libraries,¹ "chatbots" or "virtual agents" offer a self-service option for our online customers in the context of information services.

Such virtual agents are becoming a familiar feature on many websites. These user-friendly implementations of artificial intelligence have enjoyed remarkable success in corporate and government sectors and are projected to continue to grow in popularity. Indeed, a VirtuOz/CCM Benchmark Group study projects a "400% increase in virtual agents between 2011 and 2014."²

Chatbots are able to respond to a remarkable variety of customer inquiries with correct information specifically tailored to the customer's needs through the use of natural language processing (NLP). Warschauer and Healy define NLP as "the process of a computer extracting meaningful information from natural language input and/or producing natural language

output."³ The process of searching databases or catalogs usually requires the user to compose a search for the information needed, conforming to the structures and language defined by the target data source. A chatbot using NLP, on the other hand, allows users to pose a question as they would to another human being. The responsibility of locating the needed information shifts from the user to the programmer of the chatbot. The chatbot designer creates a structure that leads the user through a question-and-answer dialogue to discover the information needed and to provide it. This process can also address the problems created by library terminology or jargon with which the user may not be familiar. In addition, regular review of the chatbot's conversation logs allows the designer to monitor the types of questions and the terminology used to pose them and to update the responses provided by the chatbot and the language it recognizes. This is why the chatbot can be particularly convenient and helpful to those patrons who are least familiar with the library and its services.

- Chatbots are also consistently patient and polite and remain unruffled by rude customers, high traffic, or repeated requests for the same information. In a discussion of chatbots, Christansen suggests that chatbots:
 - were selected more frequently than other forms of digital reference
 - made asking questions easier (by providing a natural language interface)
 - provided instant responses
 - were anonymous (which encouraged shy users or those who thought their questions might be "stupid")
 - provided a marketing tool for reference services⁴

Christiansen's final observation is particularly noteworthy. If we enhance our bot with links to our various resources (including our staff directory, our catalog, and our online databases and reference tools), we can introduce our customers to our whole gamut of useful resources.

In addition, chatbots offer the ability to personalize the user experience, welcoming patrons and putting them at ease. This is highlighted in a SitePal case study, which documented a 40 percent increase in sales at a company that incorporated a chatbot to welcome users to its website and guide them through its broad inventory of products.⁵ Library websites are notoriously confusing due to the vast and potentially confounding amount and variety of information they provide. Chatbots can simplify our patrons' access to and navigation of our sites by making it unnecessary for them to hunt around for information. A well-constructed chatbot will respond to patrons' initial inquiries with the information they need, take them to the resource or service they require, or provide them with the appropriate contact.

Chatbots can also ease the burden of basic or routine questions so that library staff can focus their attention on more demanding inquiries and duties. Another SitePal case study found that introducing an avatar to its website allowed a company to familiarize its customers with its offerings, leading to a 50 percent increase in productivity of its human sales staff, who found that the questions they received after customers interacted with the chatbot were much more informed and focused than before.⁶ In addition to improving productivity and handling a portion of routine questions, chatbots can also help fill voids left by budget cuts or redeployment of staff. They can be installed simultaneously in multiple locations and environments (website, desk-side kiosk, library computer desktops) and provide backup information services when a public service desk is unstaffed or thinly covered. Also, 24/7 availability allows users to immediately access library services at their convenience, even when the library is closed.

While a chatbot cannot replicate the complexity of a human interaction, it can provide a cost-effective way to answer routine questions and direct users to additional services. "If we use Virtual Agents to enhance and streamline our information services, and as a marketing tool for both our traditional reference services and our online resources, we can reap the benefits of this technology and, at the same time, position our professional librarians to provide those value-added services to our users at which they alone can excel."⁷

What Is Artificial Intelligence?

The term *artificial intelligence* tends to evoke less-than-pleasant images: Terminator, Skynet, HAL,

M-5 (if you're a *Star Trek* fan), Cybermen, and Daleks (if you're a *Doctor Who* fan). Stories of intelligent automatons can be traced back to antiquity: Galatea, the Automata of Al-Jazari, the Prague Golem, and others; AI has been, and will likely remain, a staple theme in science fiction and film. In reality, AI is a wide and diverse field with many subfields, ranging from the creation of machine intelligence that equals or surpasses human intelligence to problem solving, natural language processing, machine perception and learning, robotics, etc. There is a trend today for researchers in AI to call their work by other names, such as *cognitive systems* or *knowledge-based systems* or *computational intelligence*. This may serve to distinguish their own field from the rest of AI or to avoid being viewed as wild-eyed dreamers. At times, AI has made overly ambitious and optimistic claims, a failing that continues to haunt those in this field.

While there are attempts to replicate the human brain and body, most AI has less ambitious goals; it's really about making computers or machines do things that human beings already do, things like recognizing speech, driving cars, translating languages, controlling the temperature in houses, or even removing the bone from a ham. AI is used in aviation, finance, hospitals and medicine, heavy industry, customer service, and on the Web.

Because AI is often used in subtle ways, it can be hard to recognize, even though many of us use some form of it every day. There is a tendency for AI to lose the label "AI" after it goes mainstream. Technological tools in your home, like your DVR, washing machine, and thermostat, aren't AI or robots (one exception being the Roomba). They're smarter, or easier to use, or just better. The thermostat is better at keeping your home comfortable. Websites are getting better at recommending things you like based on your search habits and can do helpful things like translate web pages to English.

This report deals with a few specific applications of AI—natural language processing and conversational user interfaces, commonly known as chatbots. To give you a better understanding of where these fit in AI in general, let's look at a few basic ideas in the AI world.

Strong versus Weak AI

Artificial intelligence is often classified as "strong" or "weak." Strong AI is also called "artificial general intelligence." Strong AI may be defined as machine intelligence that matches or exceeds human intelligence. A computer with strong AI could perform any intellectual task that a human being could. It's associated with human traits such as self-awareness and consciousness. This is the type of AI that's common in science fiction and is often the topic of discussion for futurists like Ray Kurzweil.

Weak AI is also known as “applied” or “narrow” AI. Weak AI is the use of software to study or accomplish specific tasks, like sweeping floors, driving cars, or understanding natural language. Chatbots and NLP fall within this division. In fact, library chatbots can be considered a narrow application of an already narrow application, as their purpose is to assist with the use of library resources and not to chat at length about any possible topic.

A detailed history of artificial intelligence is beyond the scope of this report. Readers who are interested in this topic may wish to read *Artificial Intelligence: The Basics* by Kevin Warwick.⁸ AI as we know it really started with the birth of computers in the 1940s and 1950s and with the work of Alan Turing.

Alan Turing and the Turing Test

Alan Turing is widely regarded as the father of computer science and was a pioneer in artificial intelligence. In his 1948 report “Intelligent Machinery,” Turing explored the possibility of creating machines that could show intelligent behavior and proposed a forerunner of what would become the “Turing test.”⁹ A few years later, in 1950, Turing published his seminal paper “Computing Machinery and Intelligence.” Turing begins, “I propose to consider the question, ‘Can machines think?’”¹⁰ The traditional approach to such a question would be to first define the terms *machine* and *intelligence*. Turing bypassed such definitions, noting that intelligence is difficult to define (and continues to be difficult to define today). Taking a new approach, Turing proposed a test inspired by a party game known as the Imitation Game. In the Imitation Game, a man and a woman go into separate rooms. Party guests then try to tell them apart by submitting a series of questions to each and reading the typewritten responses. As the guests try to tell who is who, the man and woman both try to convince the guests that they are each other. In Turing’s test, a human interrogator asks a series of questions to a human and a computer, both separated from the interrogator, and tries to distinguish the human and the machine based on their responses. If the interrogator fails to tell the machine from the human, the machine has passed the test. Although AI has made great strides since Turing’s day, no computer has yet passed the Turing test.

An interesting side note to the Turing test is the CAPTCHA. (The term was coined in 2000 by researchers at Carnegie Mellon University. It is an acronym based on the word *capture* and standing for “completely automated public Turing test to tell computers and humans apart.”) CAPTCHAs are a reverse Turing test: a simple visual test that a sighted human can complete without much difficulty but that an

automated program cannot understand.¹¹ CAPTCHAs are intended to keep bots and other automated programs from signing up for e-mail addresses, violating privacy, cracking passwords, or sending spam e-mail.

The Loebner Prize

Another interesting side note to the Turing test is the annual Loebner Prize competition. Started in 1990 by Hugh Loebner, an inventor and businessman, this has become one of the biggest challenges in the world of chatbots.¹² Each year the judges at the competition conduct conversations with four finalist chatbots and some human surrogates. Conversation partners are ranked from the most to least human-like. The chatbot with the highest overall ranking wins. Chatbots using the two programming languages discussed in this report, AIML and ChatScript, have performed well in the Loebner Prize competition. The competition has been subject to criticism, remains controversial within the AI community, and has been avoided by serious researchers and commercial AI developers.

Some Notable Chatbots

ELIZA (1966)

One of the best known and earliest chatbots was Joseph Weizenbaum’s ELIZA, published in 1966, which was programmed to act as a Rogerian therapist. Although ELIZA was able to fool users into believing that they were conversing with a real human, Weizenbaum himself did not claim that ELIZA was genuinely intelligent. ELIZA operated by recognizing keywords or phrases in the input, which triggered the output of corresponding responses. This basic principle has been used by chatbot designers ever since. Despite what one might think, the vagueness of ELIZA’s responses were an asset and helped create the illusion of intelligent conversation, as can be seen in a typical conversation first published in January 1966:¹³

User: Men are all alike.
 ELIZA: IN WHAT WAY
 User: They’re always bugging us about something or other.
 ELIZA: CAN YOU THINK OF A SPECIFIC EXAMPLE
 User: Well, my boyfriend made me come here.
 ELIZA: YOUR BOYFRIEND MADE YOU COME HERE
 User: He says I’m depressed much of the time.
 ELIZA: I AM SORRY TO HEAR YOU ARE DEPRESSED
 User: It’s true. I am unhappy.
 ELIZA: DO YOU THINK COMING HERE WILL HELP YOU NOT TO BE UNHAPPY

User: I need some help, that much seems certain.

ELIZA: WHAT WOULD IT MEAN TO YOU IF YOU GOT SOME HELP

User: Perhaps I could learn to get along with my mother.

ELIZA: TELL ME MORE ABOUT YOUR FAMILY

User: My mother takes care of me.

ELIZA: WHO ELSE IN YOUR FAMILY TAKES CARE OF YOU

User: My father.

ELIZA: YOUR FATHER

User: You are like my father in some ways.

ELIZA: WHAT RESEMBLANCE DO YOU SEE

User: You are not very aggressive but I think you don't want me to notice that.

ELIZA: WHAT MAKES YOU THINK I AM NOT VERY AGGRESSIVE

User: You don't argue with me.

ELIZA: WHY DO YOU THINK I DON'T ARGUE WITH YOU

User: You are afraid of me.

ELIZA: DOES IT PLEASE YOU TO BELIEVE I AM AFRAID OF YOU

User: My father is afraid of everybody.

ELIZA: WHAT ELSE COMES TO MIND WHEN YOU THINK OF YOUR FATHER

User: Bullies.

ELIZA: DOES THAT HAVE ANYTHING TO DO WITH THE FACT THAT YOUR BOYFRIEND MADE YOU COME HERE

ELIZA is alive and well; you can chat with her online.

ELIZA

<http://nlp-addiction.com/eliza>

Parry (1972)

Parry was another early chatbot, written in 1972 by Kenneth Colby.¹⁴ Parry originated as a research tool designed to simulate the thinking of a paranoid individual. Parry used a conversational strategy and was a more advanced program than ELIZA. You can read more about Parry online and download a copy of the program.

Parry

www.chatbots.org/chatbot/parry

Jabberwacky (1988)

Jabberwacky was written by Rollo Carpenter in 1988,

went online in 1997, and won first place in the 2005 and 2006 Loebner competitions. Jabberwacky is an attempt to create a program that learns; the program retains all conversations and finds appropriate responses by matching patterns in their context. A commercial version of this bot is available with additional tools to control returns, loops, data extraction, and sentence generation. Here is a sample conversation from the program:¹⁵

Jabberwacky: Are you a participant or a judge in the great competition?

User: Hello.

Jabberwacky: Hello kitty!

User: How did you know that I was a cat?

Jabberwacky: You told me and you told me that your name was chaos jill.

User: No, my name is Ichi. I'm a Japanese Maine Coon cat.

Jabberwacky: I am a Japanese movie monster too.

User: Which one?

Jabberwacky: Which one? I don't know which one! Which one of what?

User: Are you Gamera or Godzilla?

Jabberwacky: Yes.

User: Hi Gamera! Doesn't it get hot inside your shell?

Jabberwacky: Not if you're with someone you connect with.

You can learn more about Jabberwacky and chat with the program online.

Jabberwacky

www.jabberwacky.com

A.L.I.C.E. (1995)

A.L.I.C.E. (Artificial Linguistic Internet Computer Entity) was written in 1995 by Dr. Richard Wallace using AIML, his own XML-based markup language. A.L.I.C.E. and AIML have become the foundation for many subsequent—and successful—chatbots. A.L.I.C.E. won the Loebner Prize in 2000, 2001, and 2004, and chatbots programmed in AIML continue to be strong competitors. Here is a sample conversation with A.L.I.C.E.¹⁶

judge: Hi Alice.

ALICE: Hi there!

judge: How's it going?

ALICE: I'm doing fine thanks how are you?

judge: Pretty good.

ALICE: Oh no, not that well. I have a long way to go yet.

judge: Where are you going?
 ALICE: I am going into the future.
 judge: Aren't we all?
 ALICE: We are all very similar in many ways.
 judge: True.
 ALICE: Yeah that's right.
 judge: Do you like being a computer?
 ALICE: Being a program is the only existence I know.
 judge: Being a human is the only existence I know.
 ALICE: I know you are.
 judge: Would you like to be a cat?
 ALICE: No thanks I am happy with who I am.
 judge: I'd like to be a cat for a day.
 ALICE: Interesting. I would like to be more intelligent.

AIML will be examined in detail in this report.

Ultra Hal (1997)

Robert Medeksza started developing Ultra Hal in 1997; the program is able to learn by statistically analyzing past conversations to determine the most appropriate response. The Ultra Hal platform supports a number of speech and graphics engines and will operate on the Web, and on Windows, iPhone, Second Life, Twitter, and Facebook. Ultra Hal won the 2007 Loebner Prize competition.¹⁷ You can learn more and chat with Ultra Hal on the Zabaware website.

Ultra Hal
<http://zabaware.com>

Suzette/Rosette (2010)

Suzette and Rosette were both written by Bruce Wilcox using his own scripting language, ChatScript. Each bot won the Loebner Prize, Suzette in 2010 and Rosette in 2011.¹⁸ ChatScript has received a great deal of attention in the chatbot field and has been used successfully in commercial applications. ChatScript will be examined in greater detail in another section of this report.

Chatbots in European Libraries

Several German libraries began developing chatbots in the mid-2000s. The history and technical details of these chatbots are covered in an excellent paper by Anne Christensen.¹⁹ Readers may wish to visit the URLs in the gray box for additional information or to converse with these bots (in German.)

- Stella, at the Bibliothekssystem Universität Hamburg, was developed in 2004 and remains in

operation today.

- Askademicus also appeared around this time at the Technische Universität Dortmund, and continues to assist users on the library's website.
- INA has been in operation since 2006 on the Bücherhallen Hamburg website.
- Another interesting chatbot is Kornelia, a virtual assistant at the Kornhaus Bibliotheken in Bern.

Stella
www.sub.uni-hamburg.de/bibliotheken/projekte/chatbot-stella.html

Askademicus
www.ub.uni-dortmund.de/chatterbot

INA
www.buecherhallen.de/ca/x/bws#

Kornelia
www.kornhausbibliotheken.ch/Service/ChatbotKornelia.aspx

Chatbots in US Libraries

Lillian (2006)

Lillian was in development at OCLC in conjunction with Daden. It is uncertain if Lillian was ever made available for public use. In response to e-mail inquiries, Daden stated that much of Lillian had been used to create other chatbots.

Emma the Catbot (2009–2012)

Emma was an AIML-based program in use at the Mentor Public Library, in Mentor, Ohio, from 2009 until 2012. She was well received by library personnel and public alike and won the Public Library Association's 2011 Polaris Innovation in Technology John Iliff Award. Emma answered general questions and passed searches to the library catalog and to other databases and websites. Around 2011, Emma became infoTabby and remains active on the Web. You can chat with her online and download a copy of her AIML files.

infoTabby
www.infoTabby.org

Pixel (2010)

Pixel is an AIML chatbot written in 2010 at the University of Nebraska–Lincoln Libraries.²⁰ Pixel answers general questions about the library and helps users

find information on the library website. You can visit Pixel online.

Pixel

<http://pixel.unl.edu>

Looking Ahead

At the time of publication a number of companies are vying to create virtual agents for public sector companies. In addition to these company-specific resources, there is a new wave of “personal assistant” agents—like Ultra Hal (2012) for Windows computers, Siri (2012) for the iPhone, and Evi (2012) for Android devices—that will perform metasearch functions.²¹ With the success of these programs, virtual agents are almost certain to become more prevalent in the future.

Virtual agents are starting to gain popularity in libraries. From the German bots created in the 1990s to Emma, and Pixel, bots are enhancing services within physical libraries and providing assistance to offsite users. What is more, they are providing this assistance in an extremely cost-effective manner. Emma, for example, answered a total of 4,774 library-related questions during 2011. The calculated cost of providing this service was \$0.14 per use. As library funding continues to erode and chatbots become more intelligent, automated reference services will become an increasingly attractive option, if not a necessity.²²

With the availability of simple and inexpensive options for virtual agent creation, it's easy and cost-effective for libraries to explore this opportunity to expand their information services.

Notes

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Chatbots in Digital Reference” (paper presented at the International Ticer School, Digital Libraries à la Carte, Module 2: Technological Developments: Threats and Opportunities for Libraries, Tilburg, Netherlands, August 28, 2007), accessed March 2, 2012, www.slideshare.net/xenzen/a-trend-from-germany-library-chatbots-in-electronic-reference-presentation.

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