Chatterbots Go Native: Considerations for an eco-system fostering the development of artificial life forms in a human world

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Abstract: AIML - A recently developed standard for describing knowledge for Robots using XML data structures is introduced. A very large English-based robot knowledge base developed using the standard is described. The English-based knowledge base is currently interacting with people at a rate of 100,000 inquiries per day.A web-based computer architecture (www.pandorabots.com) supporting the on-going development of the knowledge base is described. The architecture is highly scalable - during the last eight months the system has added more than 6000 different Robots. Currently, the number of new robots is doubling at the rate of every 60 days. The system handles more than 3 million inquiries a month. The architecture supports rapid acquisition of new knowledge while interacting with "unskilled humans". The architecture is secure and able to dynamically develop effective defenses against large-scale attacks while continuing to run.

Software Robots – What are they and why are they here?

Software Robots – or Chatterbots – are encountered daily in a variety of forms. Unhappy recipients of Spam e-mail advertisements would like to eliminate the robots generating the messages. Automatic telephone answering systems (another form of a Software Robot) are sometimes difficult to avoid. Yet Software Robots are here with us to stay. Interesting varieties are emerging world-wide daily. America On Line's Instant messenger service (AIM) is very popular in portions of the world, especially among teenagers. And already Software Robots are making an appearance. We know of one teenage girl who created a Chatterbot and used it as a kind-of proxy for herself *(available for viewing and interacting with at: http://www.international-lisp-conference.org/Competitions/Chatterbots/ILC02-chatterbots.html)*

Teenagers often have multiple screens open with AOL and spend time switching between screens chatting with friends. This teenager started cutting and pasting inquiries into her Chatterbot and redirected the Chatterbot's responses to her friends – without them realizing they were interacting with a Chatterbot. She spent more than 2 hours cutting, pasting and laughing hysterically. She went on to enter her Chatterbot in a software robot beauty contest and it won. herself *(The Chatterbot is available for viewing and interacting with at: http://www.international-lisp-conference.org/Competitions/Chatterbots/ILC02-chatterbots.html)* Meeting singles on-line has rapidly mushroomed into a large industry in the US. One enterprising and eligible young man has created his own Chatterbot which now asks a prospective date a number of questions - and acting as a pre-screening proxy for him.

Business uses include online sales representatives and help desks, and advertising. Imagine sending a Chatterbot into anonymous chat rooms. The Chatterbot talks to some one for a few minutes and then suggests they see a movie. Yet perhaps the biggest markets are the Entertainment markets.We can imagine Chatterbots acting as talking books for children, Chatterbots for foreign language instruction, and teaching Chatterbots in general. Now each of you have an idea of what the future will certainly bring and we want to ask you to hold that in your mind while we consider various alternatives for implementing these Chatterbots. We need methods of describing and installing knowledge in these Chatterbots. We need ways to speak with Chatterbots. We need ways to visually interact with them. And we need a way to describe how we touch and are touched by these Chatterbots. Common to all these implementation issues is how we describe the Chatterbot interactions.

Dr. Richard Wallace, Director of the non-profit foundation - the Alice Foundation - at www.alicebot.org - has been working for years on exactly these issues. The foundation has developed an open standard XML-compliant language called AIML (Artificial Intelligence Markup Language). AIML is used to structure a Chatterbot's knowledge – so in effect, AIML codes the *knowledge portion* of the Chatterbot. The foundation offers a the Alice Chatterbot (see:

http://www.pandorabots.com/pandora/talk?botid=f5d922d97e345aa1)
based on a very large (English language-based) knowledge set (using AIML) available under a GPL License. Numerous translations to other international languages are underway and most are also freely available. AIML and Alice are implemented in a variety of computer languages: including versions in C, C++, Java, SETL, Lisp, etc. All are freely accessible at locations described at www.alicebot.org. Foundation supporters also have access to the Foundation's most current research knowledge set. Additionally, numerous commercial implementations of Alice also are available.

A short history of AIML

AIML and the Chatterbot implemented with AIML - Alice - began in 1995 inspired by an earlier Chatterbot called Eliza – a Chatterbot loosely modeling a Psychiatrist. Alice and it's implementation language AIML is based on the notion that while human thinking is quite complex, it might be just "good enough" to simulate thinking by providing "enough" response patterns to potential inquiries. Whether this minimalist approach will indeed be "good enough" is still hotly debated. Yet while this debate rages Alice and Chatterbots based on Alice and AIML have been winning the annual Loebner contest - a contest in which Chatterbots try to fool judges into believing they are human for the last several years. Alice's knowledge and software support systems along with the AIML language are open source and supported by the non-profit Alice Foundation.

Zipf's Law and Alice's knowledge

Before we get to ALICE, we need to visit another unusual figure in the history of computer science: Professor George Kingsley Zipf. Although he was a contemporary of Turing, there is no evidence the two ever met. Zipf died young too, at the age of 48, in 1950, only four years before Turing, but of natural causes. There are many ways to state Zipf's Law but the simplest is procedural: Take all the words in a body of text, for example today's issue of the New York *Times*, and count the number of times each word appears. If the resulting histogram is sorted by rank, with the most frequently appearing word first, and so on ("a", "the", "for", "by", "and"...), then the shape of the curve is "Zipf curve" for that text. If the Zipf curve is plotted on a log-log scale, it appears as a straight line with a slope of -1. The Zipf curve is a characteristic of human languages, and many other natural and human phenomena as well. Zipf noticed that the populations of cities followed a similar distribution. There are a few very large cities, a larger number of medium-sized ones, and a large number of small cities. If the cities, or the words of natural language, were randomly distributed, then the Zipf curve would be a flat horizontal line.The Zipf curve was even known in the 19th century. The economist Pareto also noticed the log-rank property in studies of corporate wealth. One only need to consider the distribution of wealth among present-day computer companies to see the pattern. There is only one giant, Microsoft, followed by a number of large and medium-sized firms, and then a large tail of small and very small firms.

Zipf was independently wealthy. This is how he could afford to hire a room full of human "computers" to count words in newspapers and periodicals. Each "computer" would arrive at work and begin tallying the words and phrases directed by Zipf. These human computers found that Zipf's Law applies not only to words but also to phrases and whole sentences of language. Considering the vast size of the set of things people could possibly say, that are grammatically correct or semantically meaningful, the number of things people actually do say is surprisingly small. Our experiments with ALICE indicate that the number of choices for the "first word" is more than ten, but it is only about two thousand. Specifically, 1800 words covers 95% of all the first words input to ALICE. The number of choices for the second word is only about two. To be sure, there are some first words ("I" and "You" for example) that have many possible second words, but the overall average is just under two words. The average branching factor decreases with each successive word. Even subsets of natural language, like the example shown here of sentences starting with "WHAT IS", tend to have Zipf-like distributions. Natural language search Chatterbots like Ask Jeeves are based on pre-programmed responses to the most common types of search questions people ask.

From Eliza to Alice

The story of Joseph Weizenbaum is in many ways almost as interesting as that of Turing. An early pioneer in computer science, Weizenbaum was one of the fortunate few to join the embryonic MIT Artificial Intelligence Lab in the early 1960s. His most celebrated accomplishment was the development of ELIZA, a program so entertaining that it still attracts clients to its web site today. ELIZA is based on very simple pattern recognition, based on a stimulus-response model. ELIZA also introduced the personal pronoun transformations common to ALICE and many other programs. "Tell me what you think about me" is transformed by the robot into "You want me to tell you what I think about you?" creating a simple illusion of understanding. Weizenbaum tells us that he was shocked by the experience of releasing ELIZA (also known as "Doctor") to the nontechnical staff at the MIT AI Lab. Secretaries and nontechnical administrative staff thought the machine was a "real" therapist, and spent hours revealing their personal problems to the program. When Weizenbaum informed his secretary that he, of course, had access to the logs of all the conversations, she reacted with outrage at this invasion of her privacy. Weizenbaum was shocked by this and similar incidents to find that such a simple program could so easily deceive a naive user into revealing personal information.

What Weizenbaum found specifically revolting was that the Doctor's patients actually believed the robot really understood their problems. They believed the robot therapist could help them in a constructive way. His reaction might be best understood like that of a western physician's disapproval of herbal medicines, or an astronomer's disdain for astrology. Obviously ELIZA touched something deep in the human experience, but not what its author intended. Weizenbaum perceived his own program as a threat. This is a rare experience in the history of computer science. Nowadays it is hard to imagine anyone coming up with an original idea for a software program and saying, "no, this program is a dangerous genie and needs to be put back into the bottle." His first reaction was to shut down the early ELIZA program. His second reaction was to write a book about the whole experience, eventually published in 1972 as *Computer Power and Human Reason.*

Two chapters of *Computer Power and Human Reason* are devoted to an attack on artificial intelligence, on ELIZA specifically, and on computer science research in general. Weizenbaum is perhaps the stereotypical 1960's neo-Luddite.

Chatterbots go Native – The Web Architecture

Versions of Alice became available to the public through a variety of internet-based programs years ago – yet until very recently, only people with extensive computer skills could host or modify these programs. The Alice Foundation refers to each of the Alice implementations by a capital letter. So, for example the Java version of Alice is known as Program D.

In 2002 a version of Alice that *anyone* – especially useful for non-computer-experts – can modify, develop and deploy became widely available at an experimental and free hosting site at www.pandorabots.com. This version is a Lisp-based version known as Program Z (so named because it may be the *last* version anyone will ever need). The site www.pandorabots.com became operational on May 13, 2002. By January 5, 2003, the site had over 8100 registered botmasters. Non-computer-literate people have built and deployed over 10,000 separate (and individually different and unique) versions of Alice. www.pandorabots.com supports the development and deployment of Chatterbots written in any international language (character set) along with sound and pictures. The URL's listed herein are examples of just two of these 10,000 Chatterbots. Chatterbots hosted on the site were generating between 2,000 and 20,000 interactions per hour. The number of new botmasters registering with the site was growing exponentially - and doubling approximately every 65 days.

Botmasters build and deploy Chatterbots using only their browsers. Botmasters are typically not computer programmers! Pandorabots provides facilities for creating and storing knowledge in the Pandorabots for the non-programmer. Pandorabots also offers virtual faces and speech facilities. Few robots have won the Loebner Chatterbot contest as many times as Alice has. Alice is currently hosted at: http://www.pandorabots.com/pandora/talk?botid=f5d922d97e345aa1

The pandorabots implementation and architecture

The implementation is entirely done in Common Lisp and is hosted on Linux-based PC. This architecture was chosen for a variety of reasons, including: The ability to change the system while it

runs, low-cost hosting systems, and very low-cost software development and deployment costs. On startup, the Pandorabots' code base requires about 20 megabytes, and grows slowly over time as botmasters add knowledge. The system has been down about 4 times since inception (May 13, 2002) - with the most significant downtime due to machine hardware upgrades. The system has been (and is still) under hacker attack each of which has been successfully repelled as the system can be reconfigured dynamically while continuing to run (which, incidentally is a reason for doing the system in Lisp). We estimate that a similar system done in Java would require 10 times the resources that were expended here - indeed, there are very real questions whether Pandorabots could ever be deployed in Java.

An Opinion on Alice Implementation Languages

We are often asked why Common Lisp was chosen for the development. When we ask what other alternatives we might have chosen we often hear about the virtues of Java and .net.

Here is a quote from Ziff Davis News and Technology (November 15, 2002) : (http://www.zdnet.com.au/newstech/enterprise/story/0,2000025001,20269968,00.htm)

To date, around 70 percent of initial Java implementations have been unsuccessful, according to new research from Gartner Group.

"An inordinately large number of large-scale Java projects have been failures," said Mark Driver, Gartner research director for Internet and ebusiness technologies.

However, Microsoft shouldn't draw any comfort from those figures as it seeks to promote its .NET technology strategy either. In all likelihood, the failure rate for early implementations of .NET systems will be similar, Driver said.

"The only practical way to mitigate the risk [of a failed implementation] is to outsource development."

Why anyone would undertake to develop any significant internet-based application using either .net or Java will remain a mystery to us. Especially given the recent worldwide debacle and demise of E-commerce sites - over 4000 in the US alone - that were based on these technologies. This question that will undoubtedly be addressed by the pundits and other people who excel at describing the tendency for humans to move in herd-like-lemmings movements and propel themselves off of high-technology cliffs onto the rocky shoals below. Why Universities continue to promote the usefulness of Java or .net is an open question…

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