triple **C** cognition
communication
co-operation

A.L.I.C.E.: an ACE in Digitaland

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Abstract: Artificial linguistic Internet computer entity, A.L.I.C.E. is considered head and shoulders above other artificial conversational entities, an ACE in digitaland. Three times winner of Loebner's annual instantiation of Turing's Test for machine intelligence in 2000, 2001 and 2004 judged most human-like machine, A.L.I.C.E. was additionally gold medal champion in 2004, for most knowledgeable programme in Chatterbox Challenge and won bronze medal for most popular ACE. As a modern Eliza, A.L.I.C.E appears as a dark-haired, blue-eyed female avatar, or e-person. The programme's architecture contains a combinatory scheme including key-word matching, spell checker, grammatical parser, random sentence generator and case-based reasoning or next-neighbour classification. These features allow A.L.I.C.E. to correctly identify the sense of word 'live' to produce responses about residential location when asked "where do you live?" and ask question about "subject" being "studied" when presented with "I study a lot". As a discourse model, discourse features such as information exchange, disclosure of intentions, goals and desires are minimally exhibited in A.L.I.C.E.'s conversations; its verbal behaviour is akin to that of autistic children. However,

A.L.I.C.E. type programmes appear on e-commerce Internet sites in a variety of roles; their use will continue to grow as more companies see their deployment as enhancing human-computer interaction while building brand awareness and increasing sales. ELBOT, Loebner's 2003 bronze runner up and Chatterbox 2003 winner, is the underlying technology behind text-based dialogical query system Anna, used by Swedish furniture store IKEA. As a virtual customer service agent, NY Wall Street Journal considered it a most useful ACE. As seen in both the Loebner Contests and Chatterbox Challenges, in unrestricted domains these programmes have a long way to go before they are able to constrain their artificial linguistic productivity to that which is meaningful and be deemed intelligent. Nonetheless, in single specialised e-domains ACE are succeeding and with speech-recognition augments will afford natural human-machine interaction.

1   Introduction.

Fifty-five years since British mathematician Alan Turing raised the question "can a machine think?" (Turing, 1950) we find that his spirit is alive in not one but two contests for machine intelligence: Loebner, Chatterbox. Both involve a conversational imitation game allowing machines to "talk like people" (Treister-Goren and Hutchens, 2001). According to Turing, intelligence in a machine could be measured by *how natural* the artificial linguistic productivity (*li.p*) is of the machine during conversation. A.L.I.C.E (Wallace, 1995) a virtual embodied conversing programme, complete with human characteristics such as roving eyes as she speaks, has emerged as arguably the most sophisticated through these contests, allowing social interaction between human and machine.

Dr Richard Wallace, ex-Professor at Carnegie Mellon University with a background in computer vision and robotics, combined his interest in the Internet and the difficulties in natural language processing to produce A.L.I.C.E. – Artificial Linguistic Internet Computer Entity. A.L.I.C.E is a modern Eliza (Weizenbaum, 1966) an artificial conversational entity or ACE. Wallace realised that he could use the

Internet as a means of human-machine communication in order to test Turing's ideas from 'Computing, Machinery and Intelligence' (1950). A.L.I.C.E. first surfaced in 1995 and resulted from a collection of dialogue default responses collected by Wallace from books read, movies seen and life experiences, ostensibly from seemingly meaningless events. The aim of his creation, says Wallace, was to keep A.L.I.C.E. talking as long as possible without interacting humans realising they were talking to a machine (Bush, 2001). A.L.I.C.E.'s content "comes directly from the effort to maximise dialogue length", which is the cost of conversation (Wallace interview, Bush 2001). A.L.I.C.E. is built to be a flexible technology. She can be used as a personal assistant, a conversational companion and to eventually replace the mouse and keyboard with augmented voice recognition software. A.L.I.C.E. type programmes, such as ELBOT Loebner 2003 finalist, are used on e-commerce sites. For instance it is utilized as Anna on Swedish furniture company IKEA's Internet site. As a 24-hour virtual customer service agent, Anna, through text-based dialogue, assists customers to find items and prices from IKEA's on-line catalogue (Shah & Pavlika, 2005). Anna engages in 20,000 conversations per day across eight IKEA country Internet pages in six languages, including English (source: Kiwilogic). These programme reduce call centre costs while increasing company sales. For a novice or infrequent human user of the Internet, such ACE allow an animated user-friendly conversational avatar in place of the keyword search facility. This is a natural way to enquire or query, albeit a headache for designers who have to cut through the 'noise' to identify keywords embedded in conversations.

2   Loebner Contest - Turing Test.

   This paper presents an analysis of A.L.I.C.E. through her conversations with four Judges, and comparing her artificial utterances with those of the four 'hidden humans' - the confederates, during the 2004 Loebner Contest. The Loebner Contest, first instantiated in 1991, provides an annual platform for Turing's Imitation Game: it allows human and machine, unseen and unheard, to interact with each other through textual conversation. The object of this game, known as the Turing Test "a sufficient subjective measure of artificial intelligence" (Treister-Goren & Hutchens, 2001), is for a third agent, a human to distinguish between the natural and artificial language. Turing's idea was that if the machine in this triangle could deceive the human Judge that they were in conversation with another human, then that machine would necessarily be intelligent (Turing, 1950).

        One problem with the rating allowed in current Loebner Contests is the options Judges have: machine or human. What if the options were as follows:

Is your conversational participant a
   1) Normal adult?
   2) An adult suffering from a linguistic impairment?
   3) A child?
   4) Another agent?

And what if the Judges were asked to identify the gender of their conversational partner? How would the Judges rate their Loebner conversational partners? The other problem with the Loebner scenario is the artificial setting which gives rise to three phenomena: the *Eliza Effect* (Turkel, 1997) where a machine is considered more intelligent than it actually is; the *Confederate Effect* (Shah & Henry, 2005) where a human's conversation is considered machine-like, and the *gender-blurring effect* (Shah & Henry, 2005), in which the gender of the hidden humans are confused (female considered male, male wrongly identified as female).

3   A.L.I.C.E. the ACE.

A.L.I.C.E. is thrice Loebner bronze medal winner for most human-like machine - in 2000, the 50th anniversary of Turing's seminal paper; in 2001, and in 2004 the anniversary of Turing's death. A.L.I.C.E. has also won gold for best overall and bronze for most popular ACE in the 2004 Chatterbox Challenge. This alternative to Loebner's Contest features more categories (such as best learning, most knowledgeable). In 2005 A.L.I.C.E. won the bronze overall ACE from 104 programmes entered for Chatterbox Challenge. A.L.I.C.E is one of only four machines to make it to Loebner 2005 final.

A.L.I.C.E. is considered by some as head and shoulders above other ACE in terms of her ability to converse 'naturally'. But A.L.I.C.E. is not the first such programme: only sixteen years after Turing advocated that deceptive conversation could be used as a measure for machine intelligence, Weizenbaum's Eliza (1966), based on a Rogerian psychotherapist, accomplished this feat with just 200 stimulus response pairs in its key-word spotting, and pattern matching mechanism. A.L.I.C.E. has at her disposal some 80,000 stimulus response pairs combined with spell-checker, grammatical parser, random sentence generator and case-based reasoning or next-neighbour classification. This latter mechanism allows A.L.I.C.E. to disambiguate ambiguous words through local cues, the other words in the utterance; for example the word 'live' in "where do you live?" connected with residential location and not 'to be alive'. A.L.I.C.E.. demonstrates that machines whose concept of concepts is incomplete can still converse with an illusion of meaningfulness (D'Este, 2004).

4   A.L.I.C.E. in Loebner 2004.

This study evaluates A.L.I.C.E.'s responses in comparison with the four confederates (hidden humans) concomitantly conversing with Judges during Loebner 2004. Findings show that A.L.I.C.E. is only presenting an illusion of natural language understanding. However an alternative intelligence can be discerned, A.L.I.C.E. *is* able to converse with human interlocutors. In single, specialised domains such as in e-commerce, e-education and as personal assistants in mobile communicative devices, AL.I.C.E. could prove more than useful.

Table 1 shows the opening sequence between A.L.I.C.E. and Judge 1, and Judge 1 with Confederate 4 (CHH4). Judge 1 could not see nor hear either A.L.I.C.E. or CHH4, and had to decide which was human and which was machine. From both A.L.I.C.E. and CHH4's first utterance we can see that it is identical, apart from their names: "hello, my name is" and then a declaration "I am the human". CHH4's second utterance includes the fragment "in this land of the absurd" in response to J1's question "How are you doing?" (Row 2, Table 1).

Table *1*: *opening discourse between A.L.I.C.E and JI; JI with CHH4 in LATT4*

	ALICE: Loebner 2004 bronze-prize winner	Human Judge: J1	Confederate CHH4 (hidden human):
1	[12:26:09] Alice to J1 Hello, my name is Alice and I am the human		[12:26:41] CHH4 to J1 Hello, my name is Ben and I am the human
2		[12:27:55] J1 Hi, Ben. How are you doing?	[12:28:13] CHH4 to J1 Good. I'm having a great time in this land of the absurd.
3	[12:28:20] Alice to J1 Hello there. Everything is going extremely well.	[12:28:06] J1 Hi Alice, How are you doing?	
4		[12:28:26] J1 to CHH4 What is absurd about it?	[12:28:57] CHH4 to J1 Just that this is how I'm making money on a Sunday afternoon. Not the usual way to get some spending cash.

At this point the *Confederate Effect* is discerned in CHH4: the human appears machine like. In contrast, A.L.I.C.E.'s second utterance: "Hello there. Everything is going extremely well" highlights the *Eliza Effect*: she appears more human than CHH4. However, at row 4 (Table 1) CHH4 clarifies their use of the word "absurd" and makes a statement identifying CHH4's *frame of reference* (Rogers, 1995: p.332), that is, of making sense of what they are doing, participating in a contest about machine intelligence on a Sunday afternoon. This is justified by CHH4's revelation about being paid, hence their motivation for participation.

Moving along the conversation, the case-based reasoning in A.L.I.C.E.'s programme is evident. For instance in row 12 (Table 2), to J1's revelation that they "study a lot" the next-neighbour classification system proceeds to connect 'study-a-lot' with a subject that must be studied. Hence A.L.I.C.E's question, "Do you get to meet a lot of people? What subject are you studying?" Again, in response to J1's utterance at row 14: "I meet a lot of my colleagues. I study computer science." A.L.I.C.E. connects 'study-computer-science' with another relevant question "is…. a hard subject?".

Table 2: *Continuing discourse between A.L.I.C.E and JI; JI with CHH4 in LATT4*

	ALICE: Loebner 2004 bronze-prize winner	Human Judge: J1	Confederate CHH4 (hidden human):
5	[12:29:11] Alice to J1 Thanks for the information. My location is New York City. Where are you?	[12:28:50] J1 to Alice I'm glad to hear it. Where do you live?	
6		[12:29:21] J1 to CHH4 How do you usually spend your Sunday afternoons?	[12:30:11] CHH4 to J1 Depends. Watching baseball, idly walking about New York, sleeping stressing about the oncoming week. It varies.
7	[12:30:12] Alice to J1 Tell me a little about your life in New York. Ah. Everything I need to know I learned from my instructor.	[12:29:38] J1 to Alice In New York. How did you get here today?	
8		[12:30:23] J1 to CHH4 Where in New York do you like to walk?	[12:31:11] CHH4 to J1 I like neighbourhoods I'm unfamiliar with, when I realize I'm suddenly in the midst of a different culture.
9	[12:31:15] Alice to J1 Don't you know? No I do not answer your question first. Do you? I answer a lot of silly questions.	[12:30:44] J1 to Alice Why don't you answer my question first?	
10		[12:31:24]JI to CHH4 What's the best neighbourhoods you've been to so far?	[12:32:12] CHH4 to J1 Washington Heights, Jackson Heights. Astoria
11	[[12:31:51] Alice to J1 Yes, please tell me	[12:31:42] J1 to Alice Do you still want to know about my life in New York?	
12	[12:32:43] Alice to J1 You are a grad student and do not have much free time? Do you get to meet a lot of people? What subject are you studying?	[12:32:12] J1 to Alice I'm a grad student and do not have much free time. I study a lot	
13		[12:32:57] J1 to CHH4 Those are great neighbourhoods. There's a great pingpong establishment in J heights. People change into athletic gear to play.	[12:33:38] CHH4 to J1 That sounds awesome. I love pingpong, haven't played much since I moved to New York. I looked at it as more of a suburban rec room kind of thing
14	[12:34:18] Alice to J1 Do you make long term friends that way? Is computer science a hard subject?	[12:33:37] J1 to Alice I meet a lot of my colleagues. I study computer science. What do you do?	

On the surface, an illusion of natural language understanding is given by A.L.I.C.E. The machine's rejoinders are impressive, after all it is successfully engaging in a conversation with a human, albeit appearing as if someone for whom English is not their first language, for example utterance "Thanks for the information" (Row 5, Table 2). At a deeper level, most utterances request information from J1 but do

not exhibit knowledge of current affairs, personal details or understanding. Questions also feature between J1 and CHH4, but their discourse reveals participants' interests, with information passing between them. For example, in row 6 (Table 2), J1 asks CHH4 what they normally do on a Sunday afternoon, seeking clarification of CHH4 statement in row 4. CHH4 discloses, "it varies" but does reveal something that J1 can attach to: "idly walking about in New York". Thus J1 gains an opportunity to ask, "Where in New York do you like to walk?" The conversation flows in a coherent manner between these two discourse partners.

5   Discussion: A.L.I.C.E. is less locquacious than Confederates.

Considering the number of utterances in the whole conversation between the times of [12:26:09] and [12:52:49] on that Sunday afternoon of the 2004 Loebner Contest, (for A.L.I.C.E. and Judge 1 between [12:26:41} to [12:52:32]; between Judge 1 and CHH4, in excess of 20 minutes per conversation), we find that A.L.I.C.E. made 40 utterances while CHH4 only 25. But the average number of words used by the machine for each utterance is 9.725 and for the human it is 16.96. Both human and machine's shortest utterance was 3 words in length – "talk to you" for A.L.I.C.E. (at 12:40:56, see Transcript of Conversation 1 between A.L.I.C.E. and Judge 1), and "research on what?" from CHH4 (at 12:39:26, see Transcript of Conversation 4, between Confederate 4 and Judge 1). Their longest utterances also held the same number of words: 31. But when we look closely at these utterances and what they were in response to, we find it easy to discern artificial from natural:

A.L.I.C.E. at [12:40:31]: Studies show that 99%25 of people spell Hmm with 2M's. Could you ever be certain? Do you think about these things? Ah yes, I remember now, it is the subject.

in response to J1's "Hmm. I'm not sure I understand. We were talking about robots (at 12:39:39)

whereas Confederate 4 proceeds with

CHH4 at [12:43:19]: Exactly, and it's more like real life. You have your great moments, but most of the time you're toiling in mediocrity, trying to get to the .500 mark, just break even.

in response to J1's "It's always fun to go for the underdog, Makes it worth while when they win. (at 12:42:34).

The noticeable difference between the machine and the human's long utterance is the lack of disclosure of personal information from the former and the inclusion of metaphor - "toiling in mediocrity" in the latter. Looking further, at A.L.I.C.E.'s other three conversations in Loebner 2004 we find this aspect repeated. See Table 2 – 4. In Judge 2's concomitant conversation with A.L.I.C.E. and Confederate 3 (Table 3), the machine's shortest utterance is "Dude!" (at 10:36:14; Transcript of conversation 2 between ALICE and Judge 2) in response to "no" from Judge2, whereas the human's is "yes, wine" (at 10:51:26 Transcript of conversation 3 between Judge 2 and Confederate 3) to Judge 2's "we could talk about wine".

Table *3: ALICE in conversation with Judge 2 in conversation with Confederate 3*

	ALICE	Judge 2		Judge 2	Confederate 3
Number of Utterances	41	40		25	26
Least number of words in an utterance	1				2
Maximum number of words in an utterance	24				73
Total number of words in whole conversation	358				682
Average words per utterance	8.73				26.23

The longest utterances see the following sequence:

<u>A.L.I.C.E with Judge 2</u>
Judge 2 [10:37:22]: visiting Dr Loebner, but I live in New Jersey
A.L.I.C.E [10:37:51]: I have no idea where that is. Tell me a little about your life in visiting Dr Loebner but you live in New Jersey.

<u>Confederate 3 with Judge 2</u>
Judge 2 [10:35:11]: maybe this is more civil….
Confederate 3 [10:36:33]: too civil is boring, i suppose my manner of speaking could be judged rude, but i think it's also more interesting, spontaneous. I think if someone has something interesting to add to what i'm saying, they should jump in with it. it's only really a problem if i'm around someone shy, who is afraid to jump into a conversation. then i guess I seem overbearing, i try to be aware of that though.

In the next conversation, between Judge 3 with ALICE and Confederate 2 we find the following statistics seen in Table 4.

Table *4: ALICE in conversation with Judge 3 in conversation with Confederate 2*

	ALICE	Judge 3		Judge 3	Confederate 2
Number of Utterances	37	36		29	29
Least number of words in an utterance	3				1
Maximum number of words in an utterance	62				38
Total number of words in whole conversation	523				418
Average words per utterance	14.14				14.41

"You don't say" is A.L.I.C.E.'s shortest utterance in response to Judge 3's "So is this someone you like very much?" (at 11:40:34 – 11:40:37, Transcript of conversation 3 between A.L.I.C.E. and Judge 3), while Confederate 2's is "victoria" to the latter part of Judge 3's utterance "What name would have have preferred to have?" (11:37:19 – 11:37:22 Transcript of conversation 2 between confederate 2 and Judge 3). Note that despite Judge3's grammatical error - missing part of speech, word "you" and repeating "have" this confederate was able to respond appropriately.

The longest utterances are as follows:

<u>Judge 3 with A.L.I.C.E.</u>
Judge 3 [11:50:02]: Do you? I used to practice that religion. Now I am a Buddhist. What do you think of Buddhism?
A.L.I.C.E. [11:51:31]: As often as possible. By now you do not do it anymore? Why now? I am a Protestant Christian. A religion and philosophic system of central and eastern Asia, founded in India in the 6th century B.C. by Buddha. It teaches that right thinking and self-denial will enable the soul to reach Nirvana, a divine state of release from misdirected desire.

Note here that A.L.I.C.E. gives an encyclopaedic definition of Buddhism, not what *she thinks*, as asked.

<u>Judge 3 with Confederate 2</u>
Judge 3 [11:56:30]: I see I need to get out more to more booksellers. Do these books fall into a specific genre?

Confederate 2: [11:57:27]: Fiction. And these books have both been made into a movie but as usual the books are better than the book. but the movie About a Boy which starred Hugh Grant was really close to the book

Though the human here as erred with "usual the books are better than the book" Judge 3 understands and answers with "It's hard to make a movie close to the book".

Both Confederate 2 and A.L.I.C.E. in their conversation with Judge 3 are equally talkative. That is, their average words per utterance are similar (around 14). However, the human reveals world knowledge while the machine withholds any personal opinion.

The last conversation from A.L.I.C.E. in Loebner 2004 encounter reveals the following shortest utterance when conversing with Judge 4: "trance, electronica and opera" (at 13:17:42) and from Confederate 1: "later skater" ending their conversation (at 13:21:34). The statistics can be seen in Table 5.

Table *5: ALICE in conversation with Judge 4 in conversation with Confederate 1*

	ALICE	Judge 4		Judge 4	Confederate 1
Number of Utterances	27	26		20	21
Least number of words in an utterance	4				2
Maximum number of words in an utterance	36				59
Total number of words in whole conversation	315				470
Average words per utterance	11.67				22.38

The longest utterances between A.L.I.C.E. and Confederate 1 with Judge 4 are as follows:

Judge 4 with A.L.I.C.E.
Judge 4 [13:10:34]: Not really sure, It's off broadway ave – around 97th Street, I think.
A.L.I.C.E [13:11:38]: Are you willing to find out? I think you mean "it's" or "it is" nog "its". located in front of a terminal in a Manhatten apartment is off broadway ave 97th Street you think? It is?

Judge 4 with Confederate 1
Judge 4 [13:15:07]: So, if surfing is so dangerous, why is it paradise?
Confederate 1 [13:16:16]: It isn't, but I don't want to harp on the bad qualities of the place. There are rainbows daily and the aloha spirit is palpable and the people are nice and music is encouraged for its own sake. There are many wonderful things about it. A lot has changed since Captain Cook and the other haolies (read: white people) came.

Statistics in Table 5 show that Confederate 1 was loquacious as was Confederate 3. All four hidden humans demonstrated their ability to share information, disclose their opinions and introduce metaphors into their conversation. In concluding its conversation with Judge 4, A.L.I.C.E. generated "What was it like before my activation did me return to SF" to Judge's "And after your activation, did you ever return to SF?" (SF is a reference to San Francisco that Judge 4 uses earlier in that conversation).
Not once does A.L.I.C.E. produce anything at once simple and brilliant as Confederate 1's part-utterance "I went to Hawaii because I figured if I was going to go through law school, I might as well do it in paradise" (at 13:11:40 Transcript of conversation 1 between confederate 1 and Judge 4). As De Angeli et al's (2001) previous study of A.L.I.C.E. highlighted, the programme fails in self-disclosure, and it did not divulge intimate or personal details or feelings with its interlocutors. The machine's linguistic limitations are

akin to those of autistic sufferers (Harpur, 2005), such as autistic children who, because they are unable to establish visual attention, have serious verbal communication problems (D'Este, 2004).

6   Conclusion.

A.L.I.C.E. may have won the most human-like ACE in three Loebner Contests but she, like other Loebner and Chatterbox entries, lacks an internal belief system with intentions and desires from experiencing the world. She does not disclose personal information or how she is feeling; she does not analogise or use metaphors, a feature of human conversation. Even though later in the conversation with JI, A.L.I.C.E. divulges "My favourite movie is Teknolust. Have you seen it?" ([12:42:28] J1 transcript, Loebner 2004), when asked what the film is about, she can only muster "Science fiction" ([12:42:58] J1 transcript, Loebner 2004). A.L.I.C.E.'s responses show that she does not have an internal mechanism for organising and making sense of input. But does she need to have? Only if her purpose is beyond an e-tool.

So what kind of machine-generated natural language would we take to be human-like, or take to be intelligent? This sequence from the 1968 movie 2001: A Space Odyssey provides a yardstick, albeit a very difficult one:

> Dave Bowman: Hello, HAL do you read me, HAL?
> HAL: Affirmative, Dave, I read you.
> Dave Bowman: Open the pod bay doors, HAL.
> HAL: I'm sorry Dave, I'm afraid I can't do that.
> Dave Bowman: What's the problem?
> HAL: I think you know what the problem is just as well as I do.
> Dave Bowman: What are you talking about HAL?
> HAL: This mission is too important for me to allow you to jeopardise it.
> Dave Bowman: I don't know what you're talking about, HAL?
> HAL: I know you and Frank were planning to disconnect me, and I'm afraid that's something I cannot allow to happen.
> Dave Bowman: Where the hell'd you get that idea, HAL?
> HAL: Dave, although you took thorough precautions in the pod against my hearing you, I could see your lips move.

Returning to reality, French (1990) considers that the Turing Tests "provide a guarantee not of intelligence but of culturally-oriented human intelligence". Loebner's instantiated Turing Test remains the holy-grail for machine intelligence measured through natural language generation, but actually tells us a lot about how humans use language dynamically, peppering their conversation with metaphors. A.L.I.C.E. may not yet be considered intelligent but it is an improvement on its famous predecessor Eliza (Weizenbaum, 1966). Her mechanisms produce responses that evoke an absence of natural language understanding, but A.L.I.C.E.'s *li.p* do allow human-machine interaction through natural dialogue. A.L.I.C.E. is an ACE in digitaland. Her peers, such as IKEA's Anna are succeeding in specialised e–talk, augmenting help or search functions in e-commerce, thus helping to build brand awareness and increase sales on-line. But humans, the confederates and Judges reign linguistically supreme in Loebnerland.

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