University of Malta
BSc IT (Hons.) Year III

CSA305: Natural Language Processing

Lecture 2

Classic Examples

- History
- ELIZA
- SHRDLU

Department of Computer Science and AI
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History of NLP

- 1950-60: Machine Translation
- 1960-70: Look Ma No Semantics
- 1970-80: AI takes the lead
- 1980-90: Grammar Formalisms
- 1990-00: Multilinguality, Multimodality

Amusing Translations

La Cour de Justice envisage la creation d'un cinquième poste d'avocat général.

The yard of justice is considering the creation of a fifth general avocado station.

Turing Test and Chatterbots

- In October 1950, Alan Turing published a paper called Computing machinery and intelligence published in the Mind journal which was to change the course of computing. He chose to consider the question Can machines think? and a test which could show this.
- The test, known as The Turing Test was based on an old victorian parlour game. There is a man, a woman and an interrogator and the object of the game is for the interrorgator to ask questions to try to determine which is the man and which is the woman. The man can lie to any questions to try and confuse the interrogator.
- A Chatterbot is a program that attempts to simulate conversation, with the aim of at least temporarily fooling a real human being into thinking they were talking to another person.

ELIZA - Background

- In the beginning there was ELIZA ...
- Joseph Weizenbaum coded ELIZA at MIT during the years 1964-1966.
- The aim was to produce a very simple program, based on the presence of keywords in the input, capable of typed NL conversation.
- He developed a script for ELIZA which simulated a psychotherapist.
- Eliza encourages the patient to talk by reflecting the patient's statements back to him.
- The role played by the computer was very carefully chosen to disguise the program's lack of knowledge about language or about the world.

ELIZA - Example Interaction

Men are all alike.

IN WHAT WAY?

They're always bugging us about something or other

CAN YOU THINK OF A SPECIFIC EXAMPLE?

Well, my boyfriend made me come here

YOUR BOYFRIEND MADE YOU COME HERE?

He says I'm depressed much of the time

I'M SORRY TO HEAR YOU ARE DEPRESSED

Perhaps I could learn to get along with my mother.

TELL ME MORE ABOUT YOUR FAMILY

ELIZA - Problems Addressed

1. The identification of the most important keyword occurring in the input text.
2. The identification of some minimal context within which the chosen keyword appears.
3. The choice of an appropriate transformation rule and the making of the transformation itself.
4. The provision of a mechanism that permits ELIZA to respond intelligently when the input contains no keywords.
5. The provision of machinery to facilitate editing, particularly extension of the of the script.

ELIZA - How it Works

There is a database of keywords. each is associated with

- an integer indicating the keyword's priority
- a *decomposition rule* to match against the input

rule:	(0	you	0	me)
input:	(do	you	hate	me)
segments:	1	2	3	4

  where 0 indicates a subphrase of arbitrary length.
- a *reassembly rule* n that constitutes an output specification, e.g

  (what makes you think that I 3 you?)

  where the number 3 indicates the third segment matched by the decomposition rule – in this case the word "hate"

Main Algorithm

Given a sentence S,

- find a keyword in S whose input pattern matches.
- If there is more than one, choose the one with the highest priority.
- Use the reassembly rule to generate the next sentence.
- If there are no matching keywords, generate an innocuous sentence.

ELIZA - Tricks

- Routine substitution of certain input words during scanning e.g.
  MY → YOUR; I→ YOU

```
I love my bicycle
(you love  0) => (WOULD YOU LIKE TO MARRY 3)
```

- On-the-fly composition of pre-canned responses

```
(MEMORY MY
 (0 YOUR 0 = LET'S DISCUSS FURTHER WHY YOUR 3)
 (0 YOUR 0 = EARLIER YOU SAID YOUR 3)
 etc
```

- Tagging of keywords according to class, e.g.

```
((MOTHER DLIST (/NOUN FAMILY))
```

to be referred to in decomposition rules

```
((0 YOUR 0 (/FAMILY) 0))
```


Eliza - Discussion

1. It is in no sense a general solution to the problem of NL communication.
2. ELIZA is a remarkable example of *robust NLP*. It always produces an answer, no matter how ungrammatical or meaningless the input.
3. The program was written to demonstrate that given the right setting, people are inclined to ascribe intentions and thus, intelligence, to producers of utterances. The illusion is further fostered by a setting for which the program is not *required* to know anything.

J. Weizenbaum, *ELIZA - A computer Program for the Study of Natural Language Communication between Man and Machine*, CACM vol 9.1,pp36-43, 1966

Loebner Prize

- The Loebner Prize was set up by Hugh Loebner in 1991. A prize of $100,000 is available to the author of the first computer program to pass an unrestricted Turing Test.
- This test was proposed by Alan Turing in 1950, the principle of it being that if a computers responses were indistinguishable from those of a human, the computer could be said to be thinking. This prize has not yet been awarded.
- Every year there is an annual Loebner Prize contest, where there is a prize of $2000 avaiable for the most "human-like" of the entries that year. Many of the NLP systems we looked at for out presentation have been entered for the Loebner Prize.

ALICE `www.alicebot.org`

Hi Mike, I know someone else called Mike too.

Gee you're so beautiful

Thanks Mike you are very attractive too

How do you know?

It's obvious

What kind of men do you like

The best kind

That's obvious too

I'm glad we have that all cleared up

What else do you like to talk about

My favourite subject is artificial intelligence and robots

SHRDLU (T. Winograd 1971)

Basic Principles

1. A computer cannot deal reasonably with language unless it can understand the subject it is discussing.

2. In modeling language understanding, all aspects of language must be integrated.

3. Humans do not understand isolated sentences. Sentences always occur *in a context* which includes
   - Discourse context
   - A topic of discourse
   - A physical situation
   - Knowledge of the other participant's ideas
   - Knowledge about the world

Example 1: Textual Context

Arthur wants to see him

- "him" refers to an animate male.
- "him" must refer to someone other than Arthur (cf. "himself").
- Referent is likely to occur in preceding sentence, or earlier in the sentence where it occurs.
- Referent is likely to be a major constituent and not deeply embedded within

Example 2

a. *Sam and Bill wanted to take the girls to a film, but they didn't have any money to pay for the ticket.*

   Getting the right reference depends on general knowledge of our culture. Generally, the inviter pays.

b. *He gave the house plants to charity* vs. *He gave the boy plants to water*

   The two sentences have entirely different syntactic structure, despite superficial similarities.

   Assigning the correct syntactic structure depends on complex interactions between syntax and semantics.

Serious Problems

- It is difficult or impossible to isolate one aspect of language use (syntax, mophology, semantics, pragmatics) from another.
- It is difficult to draw the line between use of linguistic knowledge and use of other kinds of knowledge.
- How can the problem be contained?

Winograd's strategy was to resolve the dilemma by picking a *microworld* to talk about. A microworld in Winograd's sense is essentially a finite collection of entities and relations, together with rules allowing them to be manipulated.

Winograd's Microworld

The subject chosen was the "blocks world" of a toy robot. In the course of a dialogue:

- Manipulate objects (of different sizes, shapes and colours) in blocks world
- Answer questions about current configuration of blocks
- Discuss events that have taken place during the interaction
- Limited discussion of its own reasoning
- Accept new facts that it is told

Key idea: by limiting the subject area, it is possible to address general issues of how language is used in a framework of physical objects, events, and continuing discourse.

Main Components

- Syntactic Parser - works with a large-scale grammar of English
- Collection of semantic routines that embody the kind of knowledge needed to interpret English words and phrases
- Cognitive/deductive system for exploring the consequences of facts, making plans to carry out commands, finding the answers to questions.
- Simple set of programs for generating appropriate English responses.

SHRDLU - Example Interaction

Pick up a red block

OK.

Grasp the pyramid

I DON'T UNDERSTAND WHICH PYRAMID YOU MEAN.

(There are 3 pyramids in the scene.)

Find a block which is taller than the one you are holding and put it in the box

(System has to figure out what is meant by "one" and "it", as well as do deduction to figure out which block it is holding)

BY "IT" I ASSUME YOU MEAN THE BLOCK WHICH IS TALLER THAN THE ONE I AM HOLDING.

What does the box contain?

The blue pyramid and the blue block.

What is the pyramid supported by?

(Now the system understands the phrase "the pyramid").

The box.

How many blocks are not in the box?

(negatives must be handled properly)

Four of them.

.SHRDLU Example Interaction

Is at least one of them narrower than the one which I told you to pick up?

(the phases "at least one of them" must be analysed to refer back to the previous question. Complex quantifier expressions must be handled)

YES, THE RED CUBE.

Is it supported?

YES, BY THE TABLE.

(heuristics about what people expect to hear in addition to yes or no)

The blue pyramid is mine.

I own all blocks which are not red, but I don't own anything which supports a pyramid.

I UNDERSTAND

(The result of understanding these sentences is is the creation of new procedures for deducing whether I own something.

Do I own anything in the box?

YES. TWO THINGS: THE BLUE BOX AND THE BLUE PYRAMID

(Extra information supplied. Form of a list)

SHRDLU Example Interaction

Had you touched any pyramid before you put the little green one on the little cube?

YES, THE GREEN ONE

(The system deduces from its memory what event is being referred to, and can relate other events to it in time. The analysis includes complex tenses of verb groups).

When did you pick it up?

WHILE I WAS STACKING UP THE RED CUBE, A LARGE RED BLOCK AND A LARGE GREEN CUBE.

(A time is described by naming the main goal that was being worked on)

Why?

TO GET RID OF IT.

(By keeping track of selected parts of the subgoal tree, the system has some understanding of its own motives.)

Why did you do that?

TO CLEAN OFF THE RED CUBE.

Why did you clear off that cube

TO PUT IT ON A LARGE GREEN CUBE

Why did you do that?

BECAUSE YOU ASKED ME TO