The Computer and Natural Language
(Ling 445/515)
Dialogue Systems

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Autumn 2010
What are dialogue systems good for?

- We can book airline tickets over the phone without dealing with error-prone humans.
- We can interact with our computer while keeping our hands free.
- We can talk to a system that won’t have the same prejudices a human might (... depending on the programmer)

Before we look at dialogue systems, though, we need to understand something about human dialogue
Human dialogue

How does dialogue, or discourse (= conversation), work?

We will look at a few aspects of human-human interactions:

- Basic facts about dialogues
- Rules of conversation: Gricean maxims
- What utterances do: Speech acts
- Organization of conversation: Discourse structure
Basic facts about dialogues

Utterances

People do not necessarily speak in sentences

- **Utterances**: basic unit of conversation
  - may span over several turns
  - may have several utterances within one turn

AGENT:  Yeah yeah the um let me see here we’ve got you on American flight nine thirty eight

CUSTOMER:  Yep.

AGENT:  leaving on the twentieth of June out of Orange County John Wayne Airport at seven thirty p.m.

CUSTOMER:  Seven thirty.

AGENT:  and into uh San Francisco at eight fifty seven.
Basic facts about dialogues

Taking turns

How humans communicate is relatively systematic

- **Turn-taking**: must know when it’s the right time to contribute your turn
  - Comes naturally to humans: overlaps and long pauses are actually somewhat rare

- **Adjacency pairs**: two-part conversational structures where turn-taking is usually quite clear
  - question/answer: question is looking for an answer from dialogue partner
  - greeting/greeting
  - request/grant
  - etc.
Basic facts about dialogues

Common ground

**Common ground**: the set of things which both speakers believe to be true of the conversation.

- Part of classroom common ground is that we are at Indiana in a linguistics class. Not part of the common ground is what I had for lunch.
- People assess what others know before making a new contribution
Grounding

In order to establish common ground, speakers do various things:

- **Backchannels** = short utterance which indicates the utterance was heard and that the speaker should continue.
  
  A: *That’s a nice shirt.*
  
  B: *Mm-hmm.*

- Acknowledgment of utterance: continued attention, completing speaker’s utterance, and so on

- Asking clarifying questions
Rules of Conversation: Gricean Maxims

People often speak “indirectly,” but it’s very clear what they mean.

⇒ They obey what Grice (1975) referred to as the four maxims (rules) or conversation

▶ All based on the cooperative principle
  ▶ speakers are both trying to contribute to the purposes of the conversation.

▶ We use these to infer what a speaker is really saying
Gricean maxim 1: Quantity

**Quantity:** Be exactly as informative as is required.

- Make your contribution as informative as is required (for the current purposes of the exchange)
  
  A: *How many pencils do you have?*

  B: *Two.*

  → means exactly two (or would have said more)

- Do not make your contribution more informative than is required.

  **Violation:**
  
  (passing by somebody on the way to class)

  A: *How’s it going?*

  B: *It’s complicated. Yesterday I was sick ...*
Gricean maxim 2: Quality

**Quality:** Try to make your contribution one that is true.

- Do not say what you believe to be false
- Do not say that for which you lack adequate evidence

**Violation:**

A: *Do you know how to drive a stick-shift?*
B: *Yes, I do. I’ve seen my dad do it many times.*
Gricean maxim 3: Relevance

Relevance: Be relevant.

A: *Is Gail dating anyone these days?*
B: *Well, she goes to Indianapolis every weekend.*

We make an inference that Gail is dating somebody in Indianapolis

▶ Otherwise, B’s statement doesn’t make much sense.
Gricean maxim 4: Manner

**Manner:** Be perspicuous (easy to understand).

- Avoid obscurity of expression
  - In other words, avoid jargon when it’s not a part of the common ground, e.g., words like *prolixity*
- Avoid ambiguity
- Be brief (avoid unnecessary prolixity)
  - Similar to maxim of quantity, but think here of long-winded conversations that provide the same amount of information as a shorter one
- Be orderly
Speech acts

So, what does each utterance do? How does it function?

- Utterances are often equated with **actions** (Austin 1962)

For example, there are **performative verbs**; by saying them, you actually do what you say

- I (hereby) christen this ship *The Swarthy*.
- I pronounce you man and wife.
- I second that motion.
- I bet you five dollars the Hoosiers will win the NCAA championship this year.
Indirect Speech Acts

Speech acts can be **direct** or **indirect**

- Direct: Form matches meaning.
  
  A: *Please take out the garbage.*
  
  imperative structure & imperative meaning

- Indirect: The form and the meaning are different.

  A: *The garbage isn’t out yet.*
  
  declarative structure but imperative/directive meaning

  A: *Could you take out the garbage?*
  
  interrogative structure but imperative/request meaning

⇒ How do we encode such distinctions in a computer?
People have marked up text with different labels for speech acts.

The **Dialogue Act Markup in Several Layers (DAMSL)** is a scheme of speech acts people use to annotate texts

- **forward-looking functions**: look for a response
  - question, request, etc.
- **backward-looking functions**: provide a response
  - answer, agreement, etc.

Note the resemblance to adjacency pairs.
Using DAMSL in a computer

Using the DAMSL scheme,

- People annotate a text, or a **corpus**
- People can train a system on it and attempt to mark a new text with these labels.
- People can use the functions to tell a dialogue system what to do next
  - The system keeps track of the previous forward-looking function to know how to respond.
  - If a dialogue system needs an answer, it knows what kind of forward-looking function to use to get the human to provide one

But if a dialogue system wants to know what to do next, it needs more than forward and backward-looking functions ...
Discourse structure

**Discourse**, or dialogue, has some structure to it—not just a bunch of random, loosely-connected statements.

- Every discourse has a **discourse purpose** = a reason for talking (Grosz and Sidner 1986)
- Purpose is clearer in **task-based dialogues** = speakers are trying to achieve some goal together
  e.g., giving directions or fixing a car

If we figure out the discourse structure automatically, the computer can keep track of what’s going on.

- Know what topics are appropriate
- Better able to know what pronouns and definite noun phrases (e.g., *the dog*) refer to.
We’ll start our tour of early dialogue systems with a quick tour of **ELIZA**

- Written by Joseph Weizenbaum in the mid-1960s
- Simulation of a (Rogerian) psychotherapist.
  - Rogerian therapist asks questions and gives backchannels more than providing advice
- User types questions, and ELIZA responds.

For some, the test of such a system is how human-like it is:
- If I can tell I am interacting with a computer, it has failed the **Turing Test**
Example conversation

Taken from Weizenbaum’s 1966 paper:

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
Example conversation (cont.)

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
Example conversation (cont.)

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 YOUR 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
How ELIZA works

They are many different implementations of ELIZA out there, but they all work in the same general way:

1. Transform input to change the point of view (I and you)
2. Perform pattern recognition (pattern matching)
3. Substitute keywords into canned phrases, or submit a general canned phrase

They can also more or less include some history of the conversation
How can we tell that ELIZA isn’t a human?

A number of clues tell us that ELIZA is a computer:

- Lack of initiative
- Lack of knowledge
  - ELIZA knows nothing about the real world
- Lack of common sense
- Lack of true grammar/syntax = structure of sentences
  - Say *you peabrain* to it and you might get ME PEABRAIN back.
  - Need two separate patterns for *Computers worry me very little.* and *I’m not worried much by computers.*
- Doesn’t have (much of) a memory

Still, ELIZA also started a whole phenomenon of chatterbots
PARRY (Colby et al 1971)

- More verbal than ELIZA in some ways, i.e., talks for longer durations
- keeps track of “global” emotional state
  - when the *anger* variable is high, for example, PARRY will choose from a set of “hostile” options.

“With Parry, Dr. Colby established that a computer chip could be programmed to imitate a paranoid schizophrenic.”
http://www.edu-cyberpg.com/Linguistics/Parry.html
ALICE is a more advanced chatterbot, which won the 2004 Loebner Prize

- Loebner Prize = instantiation of the Turing Test: $100,000 for the first computer to pass the Turing Test (hasn’t happened yet)
- Each year, the most human-like computer wins $2000

You can chat with ALICE at: http://www.pandorabots.com/pandora/talk?botid=f5d922d97e345aa1
All of these chatterbots are just pattern-matchers, albeit of varying complexity

▶ There has been a push to add linguistic and real-world knowledge to dialogue systems
▶ Which is why we spent so much time talking about how real dialogue works
Modern dialogue systems

We’ll look at Jason Baldridge’s slides from here on out...