If people have everything they need, or can get it more often, people and computer systems need to work speaking and listening in an orderly way, without talking. Trying to involve a computer in dialog makes the difficulties more evident.

Fixing confusions and misunderstandings before they enter pre-school

Conversations
The speaker's perspective

Conversations work because speakers & listeners understand a lot about dialogue.

1. **Why to speak**: both assume a common goal
2. **What to say**: both can understand direct & indirect statements, requests, questions, etc.
3. **How to say it**: both properly handle intonational changes, politeness conventions, etc.

Conversations
Both perspectives

Communicating is a collaborative event.

The speaker and the listener must manage the following processes, in real-time:

1. Speaking and listening in an orderly way, without talking over each other more than is acceptable.
2. Checking that the other person is understanding.
3. Fixing confusions and misunderstandings before they cause the conversation to break down.

Human beings are skilled in this activity long before they enter pre-school.

- Trying to involve a computer in dialog makes the difficulties more evident

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

What are dialogue systems good for?

Anytime we have a straightforward task, dialogue systems seem like a good idea:

- 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.

Conversations
The listener's perspective

From the the listener's perspective, they must make sense of what is being said by the speaker, by:

1. **Accurately noticing what the speaker said**.
   - This involves hearing what was said, then breaking up the speech signal into words and phrases.
2. **Working out the literal meaning of what was said**.
3. **Working out the reason that the speaker did what they did**.

In order to do this, the listener has to reason about the speaker's intent, on the basis of the observed evidence:

- A first step toward building a computer that can do the same is to precisely describe how this process works in human-human dialog.

Why dialogues happen?

One of the main reasons for using language is in order to collaborate with others on getting things done.

- If people have everything they need, or can get it without asking for help, there's no real reason to speak.
- More often, people and computer systems need to work with others in order to achieve their goals.

Dialog is full of rules and conventions that have evolved over the years in order to make communication run smoothly:

- A question is usually followed by an answer.
- A request is often made indirectly because outright demands feel rude.
- A refusal is often heavily disguised so as to soften the impact of the unexpected and unwelcome response.
Thank you for calling the CMU Let's Go! Bus Information System. This conversation will be recorded for research purposes. If you do not want to be recorded, please hang up now. What can I do for you?

u: I would like to go to the airport tomorrow morning. From the airport to CMU on Friday.

s: To the airport. When do you want to leave from?

u: At 6:15 PM. From the airport to CMU. When would you like to leave?

s: Leaving at around 6:15 PM. There's a 28X leaving Greater Pittsburgh Airport at Departure Stops at 6:26 PM. It will arrive at Forbes Avenue at Morewood at 7:20 PM.

u: Thank you very much.
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

Dialogue moves

Can view dialogue as a series of moves, as in a game

1. As an exchange has to start somewhere, we can group together a set of **initiating moves**
   - Making an assertion (“you have a friendly face”)
   - Issuing a command or making a request (“let's go and have a bite to eat”)
   - Asking a question (“are you doing anything tonight?”)

Dialogue moves (2)

2. Some moves are **responses** to the previous move
   - Saying “yes” or “no” to a question where the person was seeking information
   - Giving an answer to an information-seeking question that needs more than “yes” or “no”
   - Answering the question, but then providing more information than was strictly asked for
   - Agreeing to do something (e.g., saying “ok” to “let's go and have a bite to eat”)
   - Refusing to do something (e.g., saying “no” to “let's go and have a bite to eat”)
   - Maybe agreeing to do something (e.g., saying “maybe”)
   - Partially agreeing to do something (e.g., saying “ok, if we're quick”)
   - Partially refusing to do something (e.g., saying “no, unless you pay”)

Dialogue moves (3)

3. Others are responses, more or less, but divert the conversation from its expected path—**dialog management moves**
   - Saying “huh?” when you didn’t hear.
   - Saying “I don’t think I understand” in response to something you didn’t understand
   - Saying “I can’t believe you said that” when you did hear what the other person said, find it offensive or unacceptable, and want them to retract it
   - Saying “I take it back” when you want the other person to pretend that you haven’t said what you just did

Speech acts

What does each utterance do? How does it function?

- Utterances 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.
  (note: after years of using this example, it's finally actually a decent bet this year ...)
Speech acts help us to understand what is really going on when people say, e.g., “could you pass the salt?”

- Syntactic form of a question
- In many contexts, the speech act that it implements is a polite command

For dialogue systems, importance is to recognize that utterances may not be exactly what they seem

- Some standard patterns:
  - use of questions to stand for commands
  - use of objectively unnecessary, informative statements to stand for requests (e.g., using “you are blocking my view” vs. “get out of my eyeline”)

Common speech acts: informing, reminding, inviting, complaining, refusing, accepting, requesting, commanding

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?

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 ...

Speech acts can be broken down into **preconditions** and **effects**

- **Preconditions**:
  - actually know that the concert is on Friday
  - the other person does not know when the concert is
  - Effect: the other person knows that the concert is on Friday

Automated systems often explicitly represent speech acts in terms of preconditions & effects

**DAMSL**

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.

**Rules of Conversation: Gricean Maxims**

When people speak “indirectly,” it’s usually 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.*

- Avoid ambiguity
  
  *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...*

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### Gricean maxim 2: Quality

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

- Do not say what you believe to be false

**Violation:**

A: *Do you know how to drive a stick-shift?*

B: *Yes, I do. I've seen my dad do it many times.*

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### 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.

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### 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

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### 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

---

### ELIZA

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 (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

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 PEA BRAIN 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

ELIZA also started a whole phenomenon of chatterbots

PARRY

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

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://alice.pandorabots.com/
From Then Until Now

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...