Special Lecture (406)
Spoken Language Dialog Systems
Dialog Design

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Recap: What's Involved in Building an SLDS?

- **Dialog Design**
  - The process of working out how the interaction between human and machine will move from stage to stage.
  - Also referred to as *script writing* or *call flow layout*.

- **Prompt Design**
  - What the system says to get the caller to say something we are able to handle.

- **Grammar Writing**
  - Specifying what the caller is permitted to say at any given state.
The Goals of Dialog Design

• Our primary goal:
  – to construct systems in such a way that callers get their work done effectively and efficiently.

• We should not be distracted by:
  – modelling world knowledge
  – modelling social experience
  – modelling the complexities of human discourse.
Dialog Design Complexity

- The complexity of a dialog design depends on
  - the complexity of the underlying transaction
  - where the initiative lies in the dialog.
- There are different dialog design models.
- We begin with a simple form filling model.
The Form Filling Model

- Required caller knowledge:
  - caller must possess data
  - no knowledge of task or interface required.
- Caller behaviours:
  - responding, answering questions.
- Initiative:
  - machine initiated.
- Easy to learn and to use.
- Little or no advantage to becoming an expert.
Example 1: Credit Card Details

• We need to collect
  – the caller’s credit card details and
  – delivery preference.
• Assume the caller’s purchasing has been handled independently.
Example1: Credit Card Details

Computer: What kind of credit card will you use? [Beep]
Caller: Mastercard.

Computer: Card number? [Beep]
Caller: 1155-5511-1155-5511

Computer: Expiration date? [Beep]
Caller: Zero six zero four.

Computer: Normal or special delivery? [Beep]
Caller: Normal.

Computer: Please confirm the order ... 〈machine reads back info〉
Example 1: Credit Card Details

What kind of credit card will you use?  
- recognised
- not recognised

Card number?
- recognised
- not recognised

Expiration date?
- recognised
- not recognised

Normal or special delivery?
- recognised
- not recognised

Please confirm your order is as follows ...
Basic Notational Conventions

- A call flow diagram shows the flow of the conversation.
- Different types of notations exist (depending on the granularity).
- We will use the following conventions for call flow diagrams:
  - explicit prompts label nodes
  - system actions appear on arcs.
- Distinguish between recognition states and non-recognition states.
- Error recovery:
  - you can assume each state has a reprompt capability built in
  - there’s no need to include it in your call flow diagram.
Example 1: Credit Card Details

What kind of credit card will you use?
STORE CARD TYPE
Card number?
STORE CARD NUMBER
Expiration date?
STORE EXPIRATION DATE
Normal or special delivery?
STORE DELIVERY PREFERENCE
Please confirm your order is as follows ...
Example 2: The Nuance Travel Planner

Computer: Welcome to Travel Plan, a service of Nuance Communications. What city would you like to leave from?
Caller: From San Francisco.
Computer: What city are you flying to?
Caller: To San Diego.
Computer: Please say the destination city; for example, Atlanta Georgia.
Caller: San Diego.
Computer: On what date are you travelling?
Caller: Uh, on May the 28th.
Example 2: The Nuance Travel Planner

Computer: Around what time would you like to leave?
Caller: I’ve got to be in San Diego before 10am.
Computer: Please say your approximate departure time. For example, 10am.
Caller: Oh, probably 8am or so?
Computer: Please say your approximate departure time. For example, 10am.
Caller: Uh, 8am.
Computer: You are travelling from San Francisco to San Diego on Tuesday May 28th at 8am. Is this correct?
Caller: Yes, that’s fine.
Example 2: The Nuance Travel Planner

What city would you like to leave from?

STORE ORIGIN

What city are you flying to?

STORE DESTINATION

On what date are you travelling?

STORE DATE

Around when would you like to leave?

STORE TIME

You are travelling from ... to ... at ... on ... Is that correct?
Example 3: Pizza Ordering

Welcome to the CSLU Pizza Parlour.

Would you like a small, medium or large pizza?

What kind of topping: cheese, hawaiian, pepperoni or vegetarian?

Would you like a salad with that?

So you want a ..., right?

Okay, your order will be ready shortly.

Let’s start again then.
Example 4: A More Complex Enquiry System

• Things get more interesting when we add conditional branching.
• Suppose we have to build a front end that is similar to Qantas’s general enquiry system on 13 13 13.
Example 4: A More Complex Enquiry System

Computer: Welcome to Qantas Telephone Sales.
If you are a Frequent Flyer member, please press 1 now.
If you have an existing booking, press 2.
For new bookings, press 3.
For flight information, press 4.
If you want to hear these options again, press 0.

Caller: [4]

For international flights, press 2...
Example 4: A More Complex Enquiry System

〈〈〈〈Welcome Message〈〈〈〈

Are you a Frequent Flyer member? Are you a Frequent Flyer member? Are you a Frequent Flyer member? Are you a Frequent Flyer member?

Please choose flight information or reservations.

Do you already have a reservation or do you wish to make a new reservation?

Are you enquiring about a domestic flight or an international flight?

COLLECT FF NUMBER

Reservations

Information

Yes

No

Please say your Frequent Flyer membership number.

Yes

No

COLLECT FF NUMBER

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Steps in Dialog Design

1. Make sure you understand what you are trying to achieve (build first a conceptual model and scenarios).
2. See if you can decompose the task into smaller meaningful subtasks.
3. Identify the information tokens you need for each task or subtask.
4. Decide how you will obtain this information from the caller.
5. Sketch a call flow diagram with appropriate prompts that captures this information.
6. Test your call flow diagram in a Wizard of Oz simulation.
7. Revise your call flow diagram and repeat Step 6 . . .
Wizard of Oz Simulations

• A human experimenter (the Wizard) simulates an automated system.
• The dialog specifications (for example, flow charts with associated prompts) are spread out in front of the experimenter.
• The experimenter reads the appropriate prompts from the specs, waits for a response from the subject (or no response), checks the specs on how to proceed, and then speaks the next prompt.
• Very effective in uncovering problems with logic, navigation, awkward sequences of prompts, omissions, and so on.
Subdialogs

• Subdialogs are like subroutines in programming languages.
• They provide a way of managing complexity.
• They provide a way of decomposing a problem into subproblems.
• They provide a way of reusing common code.
Example 5: A More Complex Enquiry System

〈Welcome Message〉

Are you a Frequent Flyer member?

Yes

Please say your Frequent Flyer membership number.

No

Please choose flight information or reservations.

Reservations

Information

Reservations Subdialog

Information Subdialog

Thanks for calling. Goodbye.

Do you want to make another enquiry?

Yes

No

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Some Tips

- Typical scenarios should be painless.
- Assume the caller does not know the active vocabulary.
- Guide the caller towards responses that
  - maximize clarity and
  - unambiguousness.
- Allow for the caller
  - not knowing the answer to a question or
  - not understanding a question.
Some Tips

• Supply confirmation messages frequently, especially when the cost or likelihood of a recognition error is high.
• Assume errors are the fault of the recognizer, not the caller.
• Design graceful recovery when the recognizer makes an error.
• Assume a frequent caller will have a rapid learning curve.
Universal Help

• You can allow the caller to access help at any state.
• You need a help subdialog that provides information on using the system.
• If your help is universal there’s no need to show it explicitly in your call flow diagram.
Prompts

- Do not give too many options at once.
- Keep syntax and semantics consistent across all prompts in the system.
- Keep prompts brief to encourage the caller to be brief.
- Avoid prompts that are too similar.
Fill Logic

- A piece of code that maintains a record of what information has been provided so far, and what remains to be provided.
- Can be used to provide more natural interaction.
Example 6: Pizza Ordering

Welcome to the CSLU Pizza Parlour.

Would you like a small, medium or large pizza?

What kind of topping: cheese, hawaiian, pepperoni or vegetarian?

Would you like a salad with that?

So you want a ..., right?

Okay, your order will be ready shortly.

Ok. What did I get wrong? Please choose size, topping or salad.
Fill Logic for Error Correction

- Allowing the caller to correct a specific item:
  
  Computer: So, you want to buy a large pizza with pepperoni and a salad, right?
  
  Caller: No.
  
  Computer: Ok. Which did I get wrong.
  
  Please choose size, topping or salad.
  
  Caller: Size.
Welcome to the CSLU Pizza Parlour.

Fill Logic

Get Size

Get Topping

Get Salad

So you want a ..., right?

Ok. What did I get wrong? Please choose size, topping or salad.

Okay, your order will be ready shortly.

Yes

No

size

topping

salad
Fill Logic

- Maintain an ordered agenda of information tokens to be acquired.

<table>
<thead>
<tr>
<th>Item</th>
<th>Acquired?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>no</td>
</tr>
<tr>
<td>Topping</td>
<td>no</td>
</tr>
<tr>
<td>Salad</td>
<td>no</td>
</tr>
</tbody>
</table>
Fill Logic: Algorithm

- Algorithm:
  
  for each item in agenda
  
  if item not yet acquired
  
  then invoke subdialog to acquire it

  next item

- The effect of a negative confirmation is to reset the acquired status of the relevant item or items and then to restart this loop.
Exercise: Dialog Design

After spending 2 days and nights on a term paper for Language Technology, Rebecca is very tired and decides to go home to relax and order pizza to save cooking time. Rebecca takes her mobile phone and calls Pizza Parlour. Since she thinks that she lived unhealthy the last couple of days, she orders a vegetarian pizza with a lot of Italian tomatoes and green peppers. Feeling a bit fat around her hips, she asks for the total calorie count of the pizza. She also orders a green salad with fat-free French dressing and a bottle of Chardonnay. After the confirmation of the order, she is asked to provide a delivery time. Since Rebecca plans to take a shower first, she requests delivery two-hour later and receives a confirmation of her order and delivery time. Soon she will be able to enjoy her pizza and have a relaxed evening.
Your Task

• Try to understand the scenario.
• Decompose the scenario.
• Extract the relevant information for the design of the application.
• Derive prompts for the call flow diagram.
• Define system actions for each prompt.
• Take the call flow diagram and make a Wizard of Oz experiment.
• Collect the possible answers (helpful for grammar design).
• Refine the call flow diagram.
• Note all problems you encountered during this task.
Take-Home Message

• Good dialog design allows callers to get their work done effectively and efficiently.
• In a form filling dialog design model
  – user must possess data
  – no knowledge of task or interface required.
• A call flow diagram shows the flow of the conversation.
• Use therefore a consistent notation.
• Fill logic can be used to provide more natural interaction.
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Spoken Language Dialog Systems
Prompt Design

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# Types of Spoken Output

<table>
<thead>
<tr>
<th>Type</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prompt</td>
<td>Indicates it is time for user input, and thus serves as a turn-taking cue</td>
</tr>
<tr>
<td>Feedback</td>
<td>Presents the app state that results from user input, allowing the user to compare original intent with result</td>
</tr>
<tr>
<td>Instructions</td>
<td>Provide information about operating the user interface or understanding the task</td>
</tr>
<tr>
<td>Help</td>
<td>Help instructions often adopt a separate mode or state aimed at coaching the user</td>
</tr>
<tr>
<td>App Data</td>
<td>Information presented to the user as part of the task: eg weather, stock information, flight times</td>
</tr>
</tbody>
</table>
Opening Greetings

- Let the user know they are interacting with a computer.
- Identify the system immediately.
- An audio logo makes an excellent greeting.
Opening Greetings

• Users should know that they are not talking to a real person.
  – Avoid: Supreme, Incorporated. May I help you?
    Welcome to Supreme.
  – Use: Welcome to the Supreme speech recognition system.
    You have reached Supreme’s automated travel system.
Prompts

- Prompts are the turn-taking cues within spoken dialogs.
- Prompts have two purposes:
  - cause the user to speak,
  - convey to the user what may be spoken (optionally).
- Prompts should be as distinguishable as possible from
  - instructions
  - feedback, and
  - help.
- Prompts fall along a continuum from implicit to explicit.
Implicit versus Explicit Prompts

- Computer 1: Welcome to ABC Bank. What would you like to do?
- Computer 2: Welcome to ABC Bank. You can check an account balance, transfer funds, or pay a bill. What would you like to do?
- Computer 3: Welcome to ABC Bank. You can check an account balance, transfer funds, or pay a bill. Say one of the following choices: check balance, transfer funds, or pay bills.
Considerations when Recording Prompts

- People tend to perceive male voices as more authoritative
  - "... a male voice is recommended in an emergency situation"
  [Ameritech Phone-based User Interface Guidelines]
- Users often perceive female voices as 'the operator'.
- Some studies report male voices as more intelligible.
Considerations when Recording Prompts

- Consider using different voices to signal different modes.
- Consider using different voices for different languages.
- Consider creating a duality:
  - Female Voice: Please select one of the following:
  - Male Voice: News ... Sports ... Weather
  - Caller: Sports, please
  - Female Voice: Today's sports: ...
Synthesized versus Digitized Spoken Output

• Use digitized speech whenever possible.
• Use synthesized speech for unbounded information:
  – yellow and white pages
  – encyclopedia read-back
  – rapidly changing information
  – electronic mail.
• Avoid synthesis for single isolated words.
Timing

- Minimise time between end of prompt and beginning of recognition.
- Trim prompts aggressively if barge-in is not in use.
- Communicate errors quickly.
Voice, Person, Tense and Mood

• Use active voice.
  – Avoid: Your account number is requested.
  – Use: Please enter your account number.

• Use second person.
  – Avoid: The user should now say the name she wants.
  – Use: Please say the name you want.

• Use present tense.
  – Avoid: You will be asked for your ID number.
  – Use: At the tone, please say your ID number.
Voice, Person, Tense and Mood

• Avoid Subjunctive Mood.

  – Avoid: You could …
    Should the city name be incorrect, you may back-up by saying 'Cancel'.

  – Use: You can …
    If the city name is wrong, say 'Cancel'.

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Prompt Design

- Make prompts short.
- Precede prompts with instructions.
  
  Computer: Your plan requires that you select a PIN to use the system. The PIN must be between 5 and 9 digits in length. At the tone, please say your PIN.

- Repeat only the prompt.
  
  Computer: Sorry, I didn’t understand that. At the tone, please say your PIN.
Prompt Design

• Put key information immediately before expected user speech:
  – if using barge-in, put key information at a phrase boundary,
  – if not using barge-in, put key information before the tone.
Yes/No Interrogative Prompts

• Use interrogative form.
  Avoid: If this is correct please say 'yes' now.
  For another transaction, say 'yes'.
  If you want a quote on BHP, say 'Yes'.
  Otherwise, say 'No'.
  Use: Is this correct?
  Do you want another transaction?
  Did you say BHP?
Yes/No Interrogative Prompts

• Include the verb.
  Avoid: Correct?
  Use: Is this correct?
  The second form evokes ‘Yes’ and ‘No’ more reliably.

• Reserve imperative form for recovery.
  Use: For more quotations, say 'Yes' now.
    Please answer 'Yes' or 'No'.
Yes/No Interrogative Prompts

- Avoid compound questions.
  
  Avoid: Are you travelling alone and will you need a rental car?
  Are the name and address correct?

  Use: Is this correct?

- Avoid ambiguous questions.
  
  Avoid: Do you want to cancel or change your order?

  Use: To process your order, say one of the following: Confirm … Cancel … Change …
Other Interrogative Prompts

- Use the interrogative for constrained numeric data.
  
  **Avoid:** Please state the selling price now.  
  Speak the number of shares you want to buy.
  
  **Use:** Sell at what price?  
  How many shares?
Other Interrogative Prompts

• Avoid the interrogative for unconstrained data.
  
  Avoid:  When were you born?  
  What is your age?  

  Use:    Please provide the following personal information.  
  The year that you were born.  
  The month?  
  The day?  

• The top two questions tend to evoke responses such as:  
  "I was born ..." or "I’m ... years old“  
• Better: "July 28th" or "in 1959"
Implied Interrogative Prompts

- Drop the verb when the interrogative is implied.

  Avoid:  What is the security you want quoted?
          What is your PIN?

  Use:    Security?
          PIN?
Implied Interrogative Prompts

• Use short nouns for implied interrogatives.
  
  Avoid:  What is the name of the fund?  
          What is the name of the person you want to call?  
          What command would you like to perform?  
  
  Use:    Fund name?  
          Name?  
          Command?

• Use implied interrogatives with digitized speech output only.

• Single words are at least discriminable with speech synthesis.
Verbatim Prompts and Data Prompts

- Verbatim prompts.
  
  Computer: Say 'At the market'

- Data prompts are aimed at conveying types of data.
  
  Computer: Please state a limit price.
Verbatim Prompts and Data Prompts

• Use 'say' for verbatim prompts.
  Avoid: Please speak that again.
  Please state one of the following: Sydney, Melbourne or Brisbane.
  Use: Say that again?
  Please say either Sydney, Melbourne or Brisbane.

• Use 'state' for data prompts.
  Avoid: Say the stock name.
  Use: State the stock name.
Verbatim Prompts and Data Prompts

- Avoid mixing verbatim prompts and data prompts.
  
  Computer: How many shares would you like to buy?
  Caller: Seventy five shares.
  Computer: Say 'At the market' or enter a limit price.
  Caller: Enter a limit price.
  Computer: I'm sorry, I didn't understand.

- Problem here might have been avoided by reversing the VPs.
  Computer: State a limit price or say 'At the market'.
Feedback

• Avoid literal feedback.

Avoid: Your entry was not seven digits.
You said 1234967…
You entered 1234967  …

Use: The PIN must be exactly seven digits.
Please repeat your PIN.
1234967—was that correct?
Feedback

• Replace apology and blame with feedback.

  Avoid: Sorry, I don't understand.
     You <did something wrong>.

  Use: Please repeat.
     Do you want help?
The Relationship between Feedback and Prompts

• Combine feedback with prompts.
  Caller: Call.
  Computer: Name to call?
  Caller: John Doe.

• This is a nice way to assure the user that dialog is on-track.
• But it only works when confidence is very high.
The Relationship between Feedback and Prompts

• Uncouple feedback from prompts if confusing.

• Good example (correct recognition):
  
  Computer:  Stock name?
  Caller: "Microsoft"
  Computer:  Shares of Microsoft to sell?
  Caller:  "Five thousand."
The Relationship between Feedback and Prompts

• Failed example (recognition error):
  Computer:  Stock name?
  Caller:    "Texaco."
  Computer:  Shares of PepsiCo to sell?
  Caller:    "... umh ... No, that's wrong ..."
Grammatical Forms for Instructions

• Four basic sentence forms:
  – Declarative
  – Interrogative
  – Exclamatory
  – Imperative
Grammatical Forms for Instructions

• Use declarative sentence structures for instructions.

  Avoid: Read one of the fund names from your reference card. Choose from the following list. Check the form: how many digits are in the PIN? The answer is seven.

  Use: The fund names are printed on your reference card. You may choose one of these. A PIN must be at least seven digits long.
Grammatical Forms for Instructions

• Make declarative sentences user-centered.
  Avoid: The menu consists of five items.
  Use: You may choose from one of the following.

• Consider replacing ambiguous instructions with questions.
  Avoid: Please have your credit card ready.
  Use: Do you have your credit card ready?
Help

• Empower the user with help availability.
• Let the user know that help is available.
• Let the user know how to get help.
• Once help is declared available, keep it available.
• Return to a logical starting point after help.
• Use examples for help.
Help

• Use different voices in help examples.

 〈interrupting help chime〉
Help Coach: State the date like this ... 
Prompt Voice: Date of birth? 〈prompt tone〉
Male Voice: Six-eighteen-forty-nine.
Help Coach: Now you try it.

 〈closing help chime〉
Prompt Voice: Date of birth? 〈prompt tone〉
Help

- Differentiate between help and application mode.
- Let the user exit the help mode.
- Without user-exit, keep help mode short:
  - Do you want to return to the application?
    Do you want more help?
    Shall we continue?
  - 〈Help wizard logo〉
    Remember, when you hear a list of options ... [some instructional fact]. Now, here's the menu ... 
    〈Price menu logo〉
Take-Home Message

- Prompts have two purposes:
  - cause the user to speak,
  - convey to the user what may be spoken.
- Clever prompt design maximises usability of speech recognition.
- Usability research has generated a large number of guidelines that
  - guarantee natural user-behaviour
  - thereby decreasing error rates and
  - raising user satisfaction.