Information Presentation in Spoken Dialogue Systems

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Abstract: I present my work on the modification to FLIGHTS, an end-to-end spoken dialogue system for flight booking. The goal is to build up a structure that allows the user to refine her request gradually, the available options being at any time easy to understand and memorize. The effectiveness of the structure is optimized by taking into account the user's interest and valuation.

Introduction and Background

The goal of spoken dialogue systems is to offer an efficient and natural way of accessing information services of various types that range from product recommendation, to access to emails, to personal banking.

Traditional systems simply identify all relevant options, and then list them one by one. If a lot of complex information is to be conveyed, this form of presentation makes it difficult for the user to remember the various aspects of multiple options and to compare them in memory.

My work modifies the already existing spoken dialogue system described in [1] by combining it with the work of [2] who tackled complementary issues.

[1] Moore et al. 2004

- Select Content
  Dialogue duration can be shortened by selecting the most relevant subset of options and their most relevant attributes. Relevance is thereby determined on the basis of the *user's interest and valuations*.
- Enhance Understandability
  Understanding is improved by choosing appropriate referring expressions. Furthermore, prosodic features that support the information structure and the rhetorical structure of the sentences were incorporated into realization.

DRAWBACK: Options are omitted and the information space is thus not fully accessible to the user. User *confidence* in the system might be decreased, because the user feels that the system is hiding information from her. Moreover, if there are many valid trade-offs, the problem of too high memory load on the user is not solved.

[2] Polifroni et al. 2003

- Structure Content
  Users can gradually refine their constraints as *summaries* of option clusters are presented to them. (e.g.: 'all of them [are cheap]', 'none of them [serve seafood]')
- Facilitate Transferability
  Categories (cheap, expensive, etc.) are *dynamically adjusted* to the data by clustering the attribute values (e.g. 59£, 219£).

DRAWBACK: To achieve maximally effective summarization, the attribute that splits the data into the smallest number of groups is chosen for clustering at each step. But does that make sense? The first choice might be between two attributes that the user does not care about. Interesting options risk to be scattered across various leaves of the cluster tree such that the exploration of several branches of the tree may become necessary.

Major Issues in my Project

My goal is to overcome both drawbacks.

- I create a structure similar to the one in [2] to reduce memory load and improve system flexibility. All compelling options remain accessible.
- To determine the decision criterion at each turn, I use the user's interest and valuations.
- I hypothesize that this design will lead to high user confidence in the system.
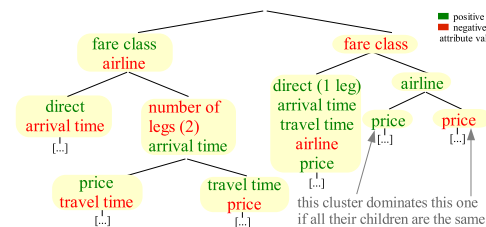
option tree for an example where there are multiple trade-offs

Clustering based on user-model

Options are clustered into different groups (e.g. expensive flights vs. cheap flights). The attribute for clustering is thereby chosen such that those criteria are presented first, that are most important for the user's decision process.
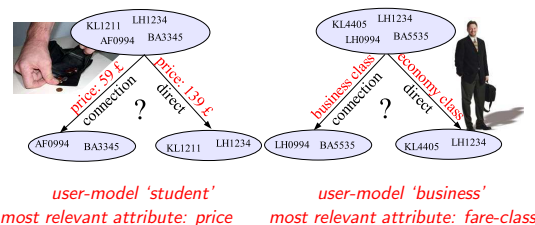
user-model 'student'
most relevant attribute: price

user-model 'business'
most relevant attribute: fare-class

The 'bad options' - issue

Within the set of options, there are always some options that are clearly worse in all respects than some other option.
Questions that come up:

- Is it necessary to mention these bad entities in order not to hide any information from the user and to achieve high confidence?
- Or is it better to drop these dominated options for the sake of conciseness? How (un)natural are summaries about these options?

Solutions to investigate:

- Use of different summary lengths for 'good' and 'bad' clusters
- Elimination of all options that are dominated by some other option

Referencing clusters

Each option cluster should be referenced by the properties that
1. are homogeneous within the cluster
2. make the cluster compelling with respect to the other options

[system:]
  I found four flights with availability in business class. The only direct flight arrives at 20:30, which is later than you requested. To arrive earlier, you would have to make a connection. None of the business class flights is on KLM.
  There are more options if you are willing to travel economy. Would you like to hear about these?
[user:]
  No, tell me more about the indirect business class flights, please.
[system:]
  There's a Lufthansa flight that arrives at 16:40 and costs 384£, but you'd need to connect in London/Heathrow. If you prefer to connect in Manchester, you can take the British Airways flight arriving at 16:20 for 421£.
[user:]
  Thanks.

example dialogue

Future Work

- Contrast a version of the system including the 'bad' flights with one that doesn't
- Evaluate system against the original FLIGHTS system [1] regarding dialogue duration, user confidence, user satisfaction, comprehension
- Investigate if the integration of a user-model achieves any significant improvements in the cluster structure

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