

# An Interactive Question-Answering System for the Library

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# What this presentation is about

- We are developing an Interactive Question Answering system for the university library
- The system will allow *users* to pose their library-related questions around the clock, and get an answer instantly
- Designing such a system gives us the opportunity to do research in the fields of *dialogue systems* and *question answering*, and verifying our results with real data collected as system log-files

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The librarians' specification of the domain

## Domain Topics

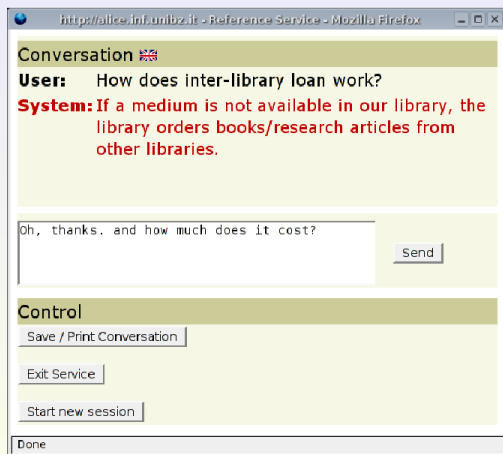
Our librarians came up with a specification of topics the system should know about:

### Domain topics

- General: library buildings, organization, services (e.g., opening hours, library card, technical infrastructure, library web-site), FAQ
- Inquiry: catalogue query, general, books, journals, articles/theses, literature topics
- Lending: lending, inter-library loan

The librarians' specification of the domain

# The Wizard-of-Oz experiment

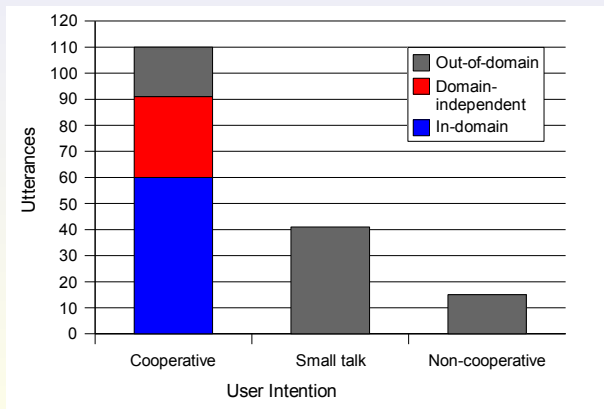


The user interface

during the experiment

## Experimental results

# How many user utterances were within the librarians' domain?



## Anaphoric pronouns (11 occurrences)

- 1 User: How does *inter-library loan* work?
- 2 Sys: If a medium is not available in our library, the library orders books/research articles from other libraries.
- 3 User: Oh, thanks, and how much does *it* cost?
- 4 Sys: The service is free for university employees and students, for external users *it* costs between 2.50 and 8.00 Euro.

Before answering, the system must know that (3) means:

How much does inter-library loan work?

# Eliza-style chatterbots

- Eliza's stimulus-response loop: match each user input with some (regular expression) pattern, return an utterance by applying a rule associated to that pattern
- Flat pattern matching: always search full list of patterns
- Very limited notion of dialogue context
- But context is essential in dialogue: nobody can provide an answer to the question "Where can I find **it**?" without first knowing the current topic

U: I am unhappy.

S: Do you think coming here will help you not to be unhappy?

U: I need some help.

S: What would it mean to you if you got some help?

U: Perhaps I could learn to get along with my mother.

S: Tell me more about your family.

# Stella

- Stella: an Interactive Question Answering system for the Hamburg university library, adds notion of dialogue context
- Given a user utterance, return a stored system response
- Each system response is linked to a class of possible user utterances, defined by some regular expression pattern:

Pattern: `/inter-library loan/ && /cost/`

Sys Resp: "The service is free for university employees and students"

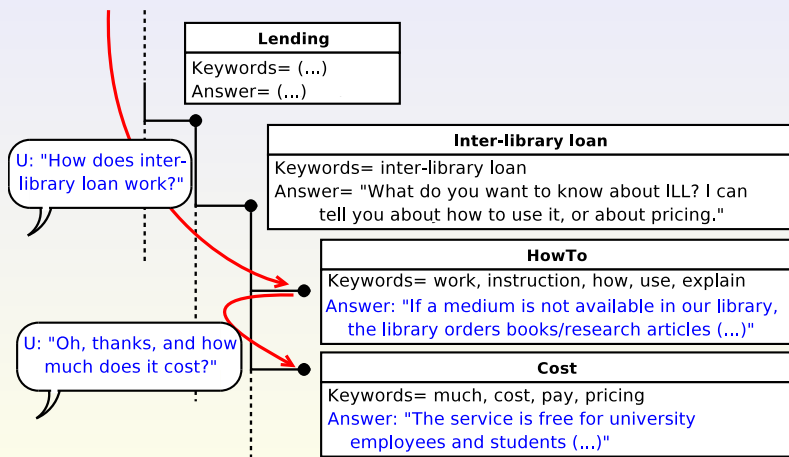
- 1 How much does inter-library loan cost?
- 2 what's the cost of inter-library loan?
- 3 How much does it cost?

For (3), the pattern must be more general (`/cost/`), and Stella has to infer the context

# Topic tree in Stella

- Stella organizes topics into a topic tree, which is a simplified structure for representing the current dialogue context (e.g., the topic “Inter-library loan”)
- Underlying notion: topic shifts to “closely related” topics are more likely (close relations in a tree: e.g. child/parent nodes)
- Sadly for us, Stella’s algorithm uses many heuristics that go beyond the idea of tree-structured topics

# Keeping track of context via a topic tree



# A problem with Stella

Success of the tree structure-based search algorithm critically depends on:

- How much structure the topic tree has: flat vs. deep
- What the semantics of the tree branches are. The tree might be structured by:
  - Tasks and sub-tasks (borrowing→getting card, finding book, . . .)
  - Some a priori structure (e.g. from existing FAQ lists, administrative organization. . .)
  - Location (library→vending machines)
  - Or even: easy cognitive accessibility. . .

## Previous work using a topic tree for NL/dialogue systems:

- Using topic tree to constrain what to say next in a natural-language generation system [MC91]: represent cognitive load of different topic shifts with the tree. (?)
- Predicting next topics in spoken dialogue systems [JTY98]: A manually built topic tree is used for marking up main topics in task-based dialogue data. An n-gram based topic shift model is trained and combined with a keyword-based topic recognizer to predict next topics. Open problem: how to design the trees.
- Dialogue management by topic structure [SS04]: Topic tree represented as a LOOM taxonomy. Given user's dialogue act (e.g., 'moreInfo', 'switchTopic'), system finds reply based (partly?) on structural aspects of the taxonomy. Unclear from paper: how to design the taxonomy, how LOOM reasoning is used to find the system reply.

# How we can use Stella's data

Stella builds on an interesting idea of representing context, but has moved away from a clean theory over years of customization by Hamburg's librarians.

For our library project, we can still take advantage of Stella's knowledge in terms of

- the collection of library topics one should have covered
- 2k regular expression pattern definitions mapping user input to these topics
- the idea behind topic trees (+ possibly the tree structure?)

# Beyond Stella hacking

We want to *learn more* about interactive question answering in general, esp. about how to model topic shifts, by evaluating different algorithms in a real application.

Stella's algorithm is based on a mix of different heuristics. We thus plan to:

- Distill the topic tree idea from other Stella heuristics (generating a purely tree-based version of Stella)
- Study how a topic tree-based search algorithm depends on the exact semantics of its underlying topic tree

# Current system status

We have implemented a prototype interactive question answering system:

- Based on a purely tree-based search algorithm
- Works with a small (XML-based) topic tree for user questions about our library's OPAC search interface
- Hooked up to a web-based chat interface
- Demo will be presented to the library this year

## Short-term:

- Convert Stella's knowledge (structure, patterns+responses) into our XML representation
- Let the system take the initiative in case of communication problems (e.g., misunderstandings, excessive small-talk)

## Mid- to long-term:

- Represent more and more semantic/pragmatic structure of language and dialogue
- Study and model how people change topics in human-computer dialogue
- Hopefully, gain insights about how users can learn effectively, using a natural language dialogue system



Kristiina Jokinen, Hideki Tanaka, and Akio Yokoo, *Context management with topics for spoken dialogue systems*, Proc. of the Joint International Conference of Computational Linguistics and the Association for Computational Linguistics (COLING-ACL'98) (Montreal, Canada), 1998, pp. 631–637.



Kathleen F. McCoy and Jeannette Cheng, *Focus of attention: Constraining what can be said next*, Natural Language Generation in Artificial Intelligence and Computational Linguistics (Cecile L. Paris, William R. Swartout, and William C. Mann, eds.), Kluwer Academic Publishers, Norwell, MA, 1991, pp. 103–124.



Manfred Stede and David Schlangen, *Information-seeking chat: Dialogue management by topic structure*, Proceedings of the 8th Workshop on the Semantics and Pragmatics of Dialogue (Catalog) (Barcelona, Spain), 2004.