

# Dynamic Help Generation by Estimating User's Mental Model in Spoken Dialogue Systems

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## Background

Users cannot understand how to use systems intuitively in a speech interface.



In a speech interface, the explanation and example usages need to be told verbally.

## Goal

To generate help messages to fill the gap between the user's mental model and the actual structure of the system.



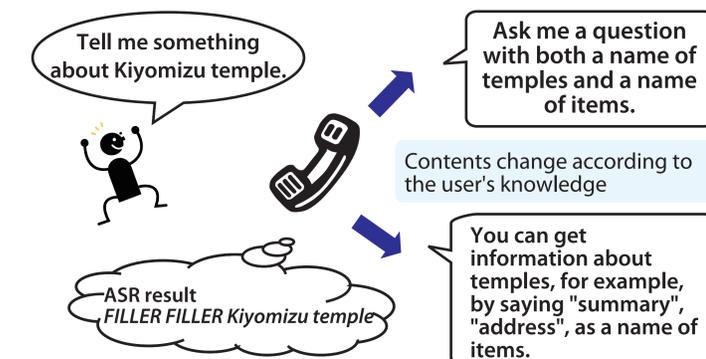
Help messages decrease this gap.



The system needs to estimate user's mental model. We define and maintain it as "known degree" on a domain concept tree.

## What is a dynamic help ?

Contents of help messages should change according to user's knowledge.

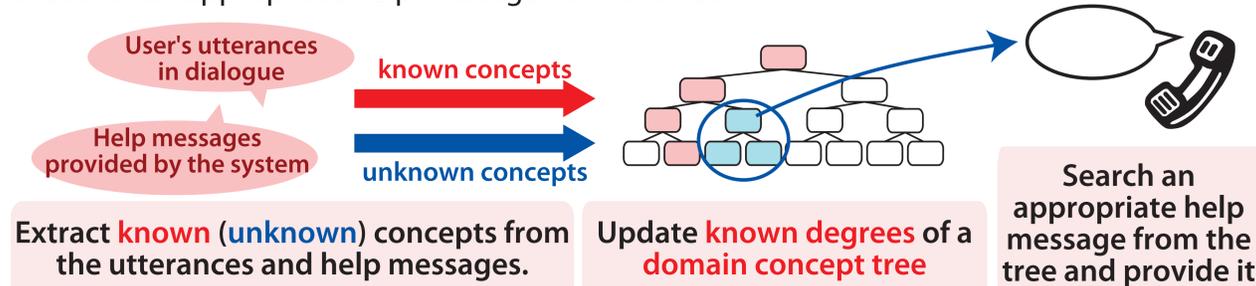


In our method, users get different help messages for same ASR results.

## Outline of Help Generation

Help is generated by estimating the gap between user's mental model and the system.

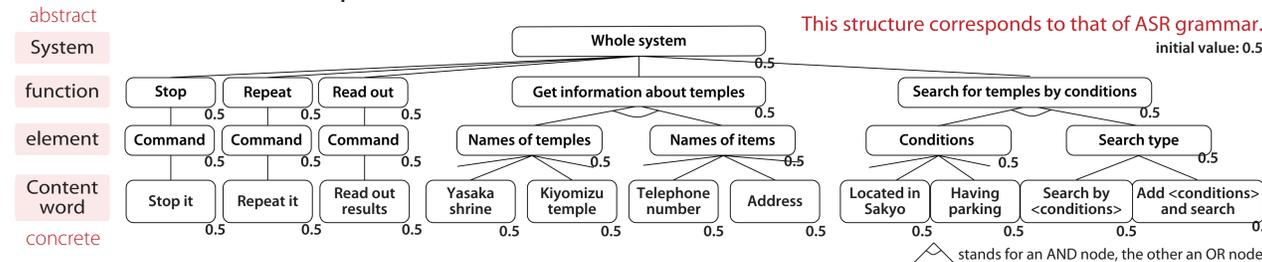
1. Extract concepts that a user **knows** (does not know) from the user's utterances or help messages provided by the system.
2. Update **known degrees** of the nodes of a **domain concept tree** according to the concepts.
3. Search an appropriate help message from the tree.



## Domain Concept Tree

A tree representing the hierarchal layers of concepts in the domain.

- Composed of **four layers**; the more abstract concepts are placed on the upper layer.
- Each node represents the concept of the system.
- Each node has a value (**known degree**), which represents the degree of how much user understands the concept.



The gap between user's mental model and the system is maintained as "known degree".

## Maintenance of known degrees (Estimation of user's mental model)

Rewards and penalties are given to known degrees.

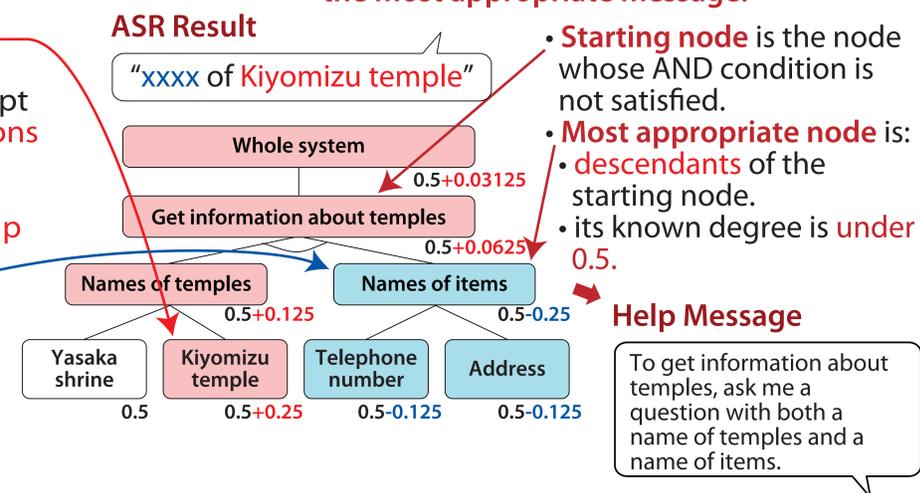
- Rewards**
- if a user knows the corresponding concept
  - the user uses functions and concrete words correctly
  - the user gets the help message about the concept

### Penalties

- if AND node is not satisfied by a user's single utterance.

## Search for a help message

Search descendants of a starting node for the most appropriate message.



## Implementation

Kyoto sightseeing guide system

- Speech recognizer: Julian (grammar-based)
- Vocabulary size: 673
- 279 entries × 16 keys (address, etc.) database
- User initiative

(The user wants to know something about Kiyomizu temple, but do not know what to say)

U1: Tell me something interesting about Kiyomizu temple.

(ASR: FILLER FILLER Kiyomizu temple)

S1: I could not understand what you want to know about "Kiyomizu temple".

To get information about temples, ask me a question with both a name of temples and a name of items.

U2: Tell me the history of Kiyomizu temple.

(ASR: FILLER FILLER Kiyomizu temple)

S2: I could not understand what you want to know about "Kiyomizu temple".

You can get information about temples, for example, by saying "summary", "address", "telephone number", as a name of items.

The system generates different help messages for the same ASR results based on our model.

## Experimental Evaluation

Conditions

Subjects - 12 novice users

- had never used spoken dialogue systems.
- given no instruction about the system's usage.

Task

- Two tasks, A and B

Groups

Group1: System w/ Help (A) → w/o Help (B)

Group2: System w/o Help (A) → w/ Help (B)

- If a user could not accomplish a task within 25 minutes, the task was regarded as incomplete.

Results

	task (system)	success rate	duration (sec.)	# of utt.	ASR corr.
Group1	A (w/)	6/6	926	50.5	51.4%
	B (w/o)	5/6	575	39.2	50.5%
Group2	A (w/o)	3/6	1191	117.0	27.0%
	B (w/)	6/6	688	39.5	42.8%

Generated help messages were helpful to complete task.

In the latter half of the experiment (B), subjects of both groups were accustomed to the system enough.

## Future works

- Setting optimal parameters for updating known degrees
- Extending our framework to mixed-initiated systems.
- Adapting expressions of help messages to known degrees.