

A Dialogue System with Digression Handling

- An Ontology-Based Approach

Tzong-Han Tsai

Department of CSIE
National Taiwan University
thtsai@iis.sinica.edu.tw

Introduction

Dialogue models fall into two categories. Structural approaches are based on finite state models or dialogue grammar models. They do not emphasize the contextual nature of communication. Plan-based approaches, on the other hand, attempt to recognize users' goals and plans, and produce corresponding effects.

These two approaches are effective as long as users follow the pre-planned scripts closely. However, in certain applications such as computer aided learning, digressive dialogue can be of benefit to the user. For example, Abrams has demonstrated that digressive dialogue between teachers and students may spur students on to ask for additional readings on related topics of interest. On the other hand, digression too far from the syllabi could inhibit the learning process. Therefore, a dialogue system should adapt its strategy according to the range of digression suitable to the task at hand.

It is difficult to implement an intelligent tutoring system due to the rigid nature of finite state machines and grammar rules. A plan-based approach would incur the high cost of frequently replanning and discourse context switching. We shall deal with these issues using an ontology-based approach.

Proposed Work

In this section, we describe our dialogue and digression handling mechanism based on an ontology framework, InfoMap (Hsu et al. 2001).

InfoMap can be treated as an ontology that has a tree-like structure. Generally, nodes in InfoMap fall into two categories: concept nodes and function nodes. Concept nodes represent entities, attributes, states, and events; and function nodes show how these concepts are interrelated. Usually, a root is the name of a domain such as mathematics and physics. Subclass relations organize categories into a taxonomy or taxonomic hierarchy. These nodes help to represent and identify query events. An event in InfoMap usually consists of a path from the root to a node, though it could also be a cluster of nodes. The path can include nouns, verbs, and their attributes and synonyms, provided that they form a meaningful event.

Given a natural language query, the system matches the words in the query against nodes in InfoMap to identify candidate events. A weighting scheme is then used to select the most probable event.

One can imagine that a response to a high level query could simply be a strategy that guides the user to a deeper event. Such a strategy can vary based on the user profile and the dialogue history. Our InfoMap uses "Dialogue" nodes to accommodate the implementation of these strategies. Within each dialogue node, there are ask-back questions, each associated with profile conditions and expected actions. Each profile condition specifies when a particular ask-back question should be returned. The expected actions let the user focus on predefined actions so that a controlled dialogue can continue. Each strategy can be described by a network whose nodes are the dialogue nodes whose activity sequences are controlled by the profile conditions under each dialogue node.

When the user digresses from expected actions, a dialogue system should continue the conversation rather than quit the session. Litman and Allen introduce an algorithm to recognize the current goal and use the replanning results to update the stack of discourse plans after every utterance which is time consuming. In our approach, there are two steps. First, the system allows different strategies for each level of digression. If the extracted event has a digressive level that is too high, the system will not replan. If it has a lower digressive level, the system will move to a related topic. Second, the system measures the level of digression as follows. Consider the taxonomy relation in InfoMap. Since related concepts (ex. mathematics and physics) are placed under the same parent node (science), we can use the distance between the ongoing script and the extracted event in the ontology network as a heuristic measure to calculate the level of digression. Our InfoMap can serve as a knowledge source to identify similar events in the user's utterances and to measure the level of digression. This approach potentially is very robust and requires less replanning.

Reference

Hsu, W. L., Chen, Y. S., and Wu, S. H. 2001. Concept Structure Identification Based on the Information Map - INFOMAP. In *Proceedings of the First International Workshop on Natural Language Processing and Knowledge Engineering*.