Autonomous Dialogue for Interactive Story Telling

Nancy L. Green

Department of Mathematical Sciences
University of North Carolina at Greensboro
Greensboro, NC 27402 USA
nlgreen@uncg.edu

Abstract

We are investigating techniques for supporting *autonomous dialogue* in interactive story telling. That is, instead of writing a script for every possible sequence of events, we would like to develop an approach in which story characters have more autonomy in deciding what to say when. We describe our current research on applying dialogue games theory to interactive story telling. We illustrate the theory by analyzing a segment of dialogue from Goldilocks and the Three Bears. We conclude that this theory may be relevant to supporting autonomous dialogue in two respects. First, the set of possible dialogue moves at any point in story time is constrained in part by dialogue game conventions. Second, dialogue games can be exploited by the author to contribute to story telling effects.

Introduction

We are investigating techniques for supporting *autonomous dialogue* in interactive story telling. To build a testing ground for our investigation, we have constructed a multimedia virtual world representing the children's story of Goldilocks and the Three Bears. Events in the current implementation of the story are "hard-wired". Our plan is for future versions to allow the user to influence the story. In computer games currently on the market such as the Sims (Sims Homepage), users can influence a character's behavior. However, the characters do not engage in dialogue. A problem with supporting user intervention in a story world is scripting the dialogue. Instead of writing a script for every possible sequence of events, we would like to develop an approach in which story characters have more autonomy in deciding what to say when. In this paper, we describe some components of our research strategy for supporting autonomous dialogue.

In the next section, we briefly describe the construction of the virtual world that will serve as a testing ground for our research in interactive story telling. Then we describe our current research on applying dialogue games theory to interactive story telling. We illustrate the theory by analyzing a segment of dialogue from Goldilocks and the Three Bears

Creating the Testing Ground

Three undergraduate Computer Science students at UNCG used the Alice toolkit (Alice homepage) and the Python programming language (Python homepage) to construct a Goldilocks and the Three Bears virtual world. Alice is a free authoring tool for developing 3D Interactive graphics worlds that can be viewed and interacted with via mouse and keyboard through a standard web browser. The Alice toolkit includes a prototyping environment and a stock of 3D objects, which our students adapted to create the world. Alice provides a scripting language for controlling and interacting with the objects at runtime; it also supports functions written in an interactive object-oriented programming language, Python.

In our current implementation of the story, the sequence of animations, dialogue, and camera controls are fixed. In the first scene, Goldilocks arrives at the Bears' house in the forest while they are out, samples the Bears' porridge, sits in their chairs, and walks into their bedroom. In scene two, in the bedroom, she tests their beds and falls asleep in Baby Bear's bed. In scene three, seen from the Bears' perspective, they arrive to discover that someone has been eating their porridge and sitting in their chairs, and walk into the bedroom. In scene four, in the bedroom, they discover that someone has been sleeping in their beds and is still sleeping in Baby Bear's bed; awakened by the bears, Goldilocks runs away. The script for scenes three and four is shown in Table 1 and will be discussed below.

Autonomous Dialogue

Conversational Agents

Conversational agents, artificial agents capable of engaging in natural language dialogue with humans or other artificial agents, have been a major focus of research in the last twenty years (Allen 1995). This research grew from the realization that there is more to handling dialogue than speech recognition/synthesis and sentence parsing/generation. For example, a key issue in dialogue management is deciding what to say to achieve the agent's goals and, conversely, understanding why another agent said what he did. More recently, work on *embodied conversational agents* (Cassell et al. 2000) has addressed additional issues arising in face-to-face conversation such as use of gesture, gaze and intonation. Prototypes of conversational agents have been developed for applications such as intelligent tutoring systems (Penstein Rose and Freedman 2000) and intelligent assistants, e.g. (Cassell et al. 1999; Allen et al. 2001). While this research provides a strong foundation for supporting autonomous dialogue in interactive story telling, it would not be surprising if there were other important issues in story dialogue that have not yet been addressed.

Dialogue Games

One issue that we are currently investigating is to what extent dialogue games play a role in story dialogue. The theory of dialogue games was developed to account for certain conventions that people seem to recognize and employ in natural human-human dialogue (Mann 1988). According to this theory, human dialogue has an episodic structure and coherence that can be analyzed in terms of a set of abstract, domain-independent "games" that span any number of speaker turns. To enter a dialogue game, one of the participants must say something that the other will interpret as a "bid" to play a particular dialogue game; then the other must say something that will be interpreted as an "acceptance of the bid" before the dialogue game can begin. Terminating the game is similarly conventionalized. Bids, acceptances, and rejections are often performed implicitly. Within a dialogue game, only certain types of dialogue "moves" are appropriate. Examples of dialogue games include *Helping, Information Seeking, Dispute, Permission Seeking,* and *Action Seeking*.

Illustrating an application of this theory, Table 1 shows our analysis of the script for scenes three and four of the virtual world described above. The script involves three different dialogue games. The first game, *Mystery Solving,* is a dialogue game that potentially involves dialogue moves such as *Share clue, Propose hypothesis, Justify hypothesis,* and *Propose solution*. (Part of the linguistic humor in this story arises from the incongruity of a bear speaking in the role of detective.) According to dialogue games theory, part of the meaning of lines 1-3, 5-7, and 9-11 derives from their use as *Share clue* moves. In an alternate universe, for example, Papa Bear might have said line 1 as an implicit request for all the leftover porridge; then Mama Bear might have responded with line 2 as an implicit refusal justified by the fact that she would like a share of it too; and so on. Interpreted as clues, however, these lines reveal the bears' joint intention to get to the bottom of the mystery, gives the dialogue coherence, and contributes to the mood of growing suspense.

The majority of dialogue moves in these two scenes are used for the *Mystery Solving* dialogue game. However, in lines 4 and 8, Baby Bear unsuccessfully bids to open a *Sympathy Seeking* dialogue game. The two bids are implicitly rejected by his parents, whose subsequent lines continue to function as dialogue moves in the *Mystery Solving* game. Interpreted in this way, the bids (and their subsequent rejection) can arouse the audience's sympathy for Baby Bear. If lines 4 and 8 were interpreted just as elaborations of the clues provided in the preceding lines, they would not have the same effect.

Baby Bear's line 12 is used to perform two dialogue moves simultaneously: *Propose solution* (i.e. propose a solution to the mystery) and *Incite action*. While the first dialogue move brings the *Mystery Solving* game to a close, the second move attempts to open a new game, *Action Seeking*. In this particular instance, the action sought is not explicitly stated but one can infer that it is to punish Goldilocks somehow. In line 13, the adult bears perform two dialogue moves addressed to different parties. The dialogue move *Frighten* is addressed to Goldilocks (G). At the same time, the move addressed to Baby Bear functions as a *Respond to call to action*, i.e. a response to his previous *Incite Action*. While the first move expresses anger to the addressee Goldilocks, the second move does not express anger to the addressee Baby Bear.

Conclusions

This example suggests that while dialogue moves are constrained by non-linguistic events and goals in the story world, the set of possible dialogue moves at any point in story time is constrained by dialogue game conventions also. It also suggests that dialogue games can be

exploited by the author to contribute to story telling effects. In future work, we would like to develop a computational model of dialogue move selection and investigate its application to autonomous dialogue generation in interactive story telling.

Acknowledgments

We wish to thank the UNCG students who built the Goldilocks and the Three Bears virtual world described in this paper: Jason Clark, Alex Dennis, and Jared Priddy. We also wish to thank the providers of Alice and Python.

Table 1. Analysis of Script in Scenes Three and Four

Speaker	To	Line		Emotion	Dialogue move	Dialogue game structure
Papa Bear	M,B	1	*Someone's* been eating my *porridge.*	Anger	Share clue	Implicit bid to open Mystery Solving game (1)
Mama Bear	P,B	2	Someone's been eating *my* porridge	Anger	Share clue	Implicit accept bid of (1)
Baby Bear	P,M	3	Someone's been eating *my* porridge	Anger	Share clue	Implicit accept bid of (1)
	P,M	4	And it's *all gone*.	Injury	Seek sympathy	Implicit bid to open Sympathy Seeking game (2)
Papa Bear	M,B	5	*Someone's* been sitting in my *chair.*	Anger	Share clue	Bid of (2) ignored
Mama Bear	P,B	6	Someone's been sitting in *my* chair	Anger	Share clue	Bid of (2) ignored
Baby Bear	M,P	7	Someone's been sitting in *my* chair.	Anger	Share clue	
	M,P	8	And it's *all broken up*.	Injury	Seek sympathy	Implicit bid to open Sympathy Seeking game (3)
Papa Bear	M,B	9	*Someone's* been sleeping in my *bed.*	Anger	Share clue	Bid of (3) ignored
Mama Bear	P,B	10	Someone's been sleeping in *my* bed.	Anger	Share clue	Bid of (3) ignored
Baby Bear	P,M	11	Someone's been sleeping in *my* bed.	Anger	Share clue	
	P,M	12	And *there* she is!	Triumph	Propose solution	Implicit bid to terminate (3)
					Incite action	Implicit bid to open Action Seeking game (4)
Papa Bear and Mama Bear	G	13	Grrrrrrrrrrrrrrrrrrrr!!!!	Anger	Frighten	
	B				Respond to call to action (12)	Implicit accept both bids of (12)

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