Dialogue Systems

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A dialogue system (also dialog system, conversation system) is an interactive computational system designed to provide conversation-like exchanges with human users, typically by natural language. A dialogue system may be stand-alone, such as a *chatterbot, or a component of a larger system, such as the mechanism for talking with non-player characters (*NPCs) in a computer game. The wide spectrum of dialogue systems can be loosely divided into tool-like and anthropomorphic, based on whether the system's interaction model is framed as a generic information provider, or a specific character (Jens Edlund 2008). Dialogue systems also vary significantly in terms of their algorithmic complexity: some simpler systems are designed for constrained scenarios with limited variability, whereas others use *artificial intelligence (AI) techniques to handle complex situations and increase user agency.

One of the earliest and most influential dialogue systems is *ELIZA*, a natural language conversation program developed by Joseph Weizenbaum in the mid-1960s. At a time when computers were primarily used for scientific and military applications, *ELIZA*, offered many people their first conversations with an interactive computer character (Murray 1997). Despite ELIZA's brittle illusion due to its simple process of pattern-matching key phrases, people quickly developed emotional connection to the computer psychotherapist and perceived it as something/someone containing deep understanding of their conditions. The success of *ELIZA* highlights a human susceptibility to "read far more understanding than is warranted into strings of symbols — especially words — strung together by computers" (Hofstadter 1995:157). This ELIZA effect offers mixed blessings for interactive storytelling designers. It suggests that human behaviors may be represented by computer algorithms that are far less complex by comparison, but at the same time, that these initially-inflated views of the computer's capabilities can quickly fall apart (Wardrip-Fruin 2009).

ELIZA is part of the larger AI research effort in the 1960s to teach computers natural language. For instance, Terry Winograd's *SHRDLU* system allows the player to manipulate objects in a simulated block world through a natural language interface. Compared with *ELIZA*'s capability to respond to a wide range of topics at the surface level, *SHRDLU* focuses on deep knowledge of a narrow domain, and can reason about its own actions reflexively. Although not directly concerned with storytelling, these systems shed light on the nature of human language. More importantly, they raised the essential question that would set the boundaries for later language-based computer applications, including interactive storytelling systems: Can computers understand language?

As Winograd and Flores later reflected, systems such as SHRDLU are based on the fundamental assumption that the core meaning of words, phrases, and sentences is context-independent and can be deduced from a set of rules regardless of the listener. From *ELIZA* to *SHRDLU* and even IBM's recent *Watson* system, these systems have grown more complex, and their limitations have become harder to spot, but their *blindness* (Heidegger 1962) to the contextual meaning of words remained. This

fundamental limitation, Winograd and Flores argue, will significantly constrain the computer's ability to understand open-ended human natural language conversations.

As a result, a Holodeck-styled dialogue system, if possible, may still be far in the future. (See INTERACTIVE NARRATIVE on Holodeck.) Existing systems inevitably operate around a set of constraints and simplifications. Dialogue systems in interactive storytelling (e.g., computer games and electronic literature), routinely used to represent NPCs, assume a turn-based interaction model and constrain the conversation to a very limited domain. Based on algorithmic complexity and the amount of user agency they afford, these systems can be broadly classified into three types: 1) non-interactive dialogue system, 2) dialogue tree, and 3) parser-based dialogue systems (Ellison 2010).

The simplest type is non-interactive dialogue system. The player traverses through a fixed sequence of pre-authored dialogue, only controlling *when* the conversation continues. A slight variation is that the system may choose from multiple conversations, but once selected, the dialogue sequence is fixed. Widely used in many genres of computer games as cut scenes, non-interactive dialogue systems are easy to implement and can effectively deliver key story points in an otherwise interactive environment. In early computer games, this type of dialogue system offers a relatively robust way to incorporate dramatic elements into the gameplay mechanism. For example, the death of a beloved character Aries in *Final Fantasy VII*, a renowned narrative moment for many gamers, is delivered in this way.

The second and more complex type is a dialogue tree, commonly used in role-playing games. Branches of dialogue segments are represented as nodes in the tree-like data structure, with specific conditions (e.g. actions and player responses) connecting the nodes. (In strict computer science terminology, a lot of dialogue trees are in fact *graph* structures, in that they allow "loops" between dialogue nodes; see GRAPH THEORY). Based on these conditions, a dialogue tree provides a systematic way to model divergent conversations with NPCs. Compared to the previous type, dialogue trees afford more user agency by allowing the player to impact the course of the conversation. It is important to remember that in addition to its storytelling functions, dialogue trees are an important means for the player to make gameplay decisions – certain dialogue choices will also alter the course of the game (Wardrip-Fruin 2009).

User interface design of dialogue trees has a significant impact on the player's experience. A classic dialogue tree interface presents a menu of fully written responses (typically three to five), from which the player can choose. Each option represents what the player character (PC) can say and will trigger responses from NPCs and other potential changes in the *gameplay. For instance, in LucasArts's *The Secret of Monkey Island*, the well-loved swordfight scene requires the player to select, among several similar options, the correct response to the enemy's verbal insults. The effectiveness of the player's dialogue response is directly tied to her character's physical advancement in the swordfight. The advantage of this type of interface is its directness: the player can see all the possible responses ahead of time. However, this design choice also imposes several restrictions on the writing style of the dialogues. It requires the dialogues to be

concise enough to fit on the same screen, and explicit about the consequences they entail. As a result, they fall short in situations where the story requires the player's quick reaction to narrative events or more nuanced dialogues. Recent games explored dialogue tree interfaces that provide the higher-level intentions behind the dialogues, instead of the exact utterances. For instance, in Quantic Dream's *Heavy Rain*, the player selects among activities such as "reason," "calm," or "threat," which then leads to a fully-fledged response enacted by the PC. The interface enables the designer to tap into the player's first reaction and successfully convey a sense of urgency. Similarly, Bioware developed the "dialogue wheel" interface to map responses of similar emotional tones (e.g., "friendly," "investigative" "hostile") to the same buttons on the controller throughout the gameplay.

The third type, the parser-based dialogue system, provides more flexibility in user input by allowing the player to type their conversational turns. The system parses the user's (mostly) natural language input and produces correspondingly appropriate reactions. For example, in Emily Short's dialogue-centric *interactive fiction piece *Galatea*, the player can talk to the NPC about a number of different topics at any time through an ASK/TELL interface. These dialogues influence the NPC's mood and position, and affect the course of the subsequent conversation. The pleasure of figuring out what to ask or tell under different circumstances would be lost in the previous two types of dialogue systems. Mateas and Stern's *Façade* system takes a further step and uses natural language processing algorithms to build a semi-open-ended user interface where the player can type anything. However, because of the difficulties of making computers understand natural language, most parser-based dialogue systems are frail. Especially because of the high expectation raised by the open-ended dialogue interface, parser-based systems require the designer to craft the narrative experience carefully around these technical limitations. For instance, the main characters in *Façade* were given self-absorbed personalities in order to alleviate situations where the system fails to understand the user input.

In summary, realistic and situation-appropriate dialogues between the player and non-player characters are an essential part of interactive storytelling. Although current dialogue systems are still fairly limited, many authors of interactive stories utilize dialogue systems to reinforce the connection between narrative content and gameplay mechanics.

SEE ALSO: electronic literature, interactive narrative

References and further reading

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