Chapter 8

Dialogue

The remainder of the course (we’re trying something a little different this year) is about the problem of natural language dialogue. We’ll start with a brief overview of the topic and then the various parts of a typical task-oriented dialogue system will motivate the rest of the topics of the course.

Dialogue systems can be divided broadly into two different types: chatbots and task-oriented dialogue systems. Chatbots are supposed to be able to have a conversation about anything, whereas task-oriented dialogue systems are supposed to help users complete a specific task or tasks. Siri, Alexa, Cortana, and Google Assistant are task-oriented dialogue systems.

8.1 Chatbots

Turing’s imitation game. The idea of a chatbot goes back (at least) to Turing’s paper on artificial intelligence (Turing, 1950), in which he proposed to redefine whether a computer is intelligent by whether it can carry on a conversation well enough to be indistinguishable from a human. Turing predicted that in 50 years (that is, in 2000), computers would be able to store $10^9$ bits and pass a five-minute test with 70% success.

ELIZA. The oldest chatbot (that I’m aware of) was ELIZA (Weizenbaum, 1966). It used the pretense of being a Rogerian psychotherapist to turn the user’s utterances back into questions, rather than trying to contribute new ideas to the conversation. The original source code was rediscovered only very recently, but there are many approximate reimplementations; in any copy of Emacs, you can type M-x doctor (that is, Escape x doctor Return) to run one version.

Here’s the conversation from the original paper (punctuation added):

P: Men are all alike.
E: In what way?
P: They’re always bugging us about something or other.

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1 A dialogue is a conversation between two people, or a person and a machine; a dialog box is a window that pops up in a GUI that provides information and asks for a response.
2 https://elizagen.org
E: Can you think of a specific example?
P: Well, my boyfriend made me come here.
E: Your boyfriend made you come here?
P: He says I’m depressed much of the time.
E: I am sorry to hear that you are depressed.
P: It’s true. I am unhappy.
E: Do you think coming here will help you not to be unhappy?
P: I need some help, that much seems certain.
E: What would it mean to you if you got some help?
P: Perhaps I could learn to get along with my mother.
E: Tell me more about your family.
P: My mother takes care of me.
E: Who else in your family takes care of you?
P: My father.
E: Your father?
P: You are like my father in some ways.
E: What resemblance do you see?
P: You are not very aggressive but I think you don’t want me to notice that.
E: What makes you think I am not very aggressive?
P: You don’t argue with me.
E: Why do you think I don’t argue with you?
P: You are afraid of me.
E: Does it please you to believe I am afraid of you?
P: My father is afraid of everybody.
E: What else comes to mind when you think of your father?
P: Bullies.
E: Does that have anything to do with the fact that your boyfriend made you come here?

ELIZA is extremely simple. Given a string $w$, for example, “You are very helpful,” it performs the following steps:

1. Find the most important keyword, $K$, in the string. In the example, $K$ is “you”.

2. Find a template $D$ for $K$ that matches the string. In the example, $D$ is “$X$ you are $Y$,” so $X = \epsilon$ and $Y =$ very helpful.

3. Choose a response $R$ for $D$. For example, one response for “$X$ you are $Y$” is, “What makes you think I am $Y$?”
4. In \( X, Y, \) etc., change pronouns “me” to “you” and “you” to “me,” etc., and substitute them into \( R. \) So the example \( R \) becomes “What makes you think I am very helpful?”.

Additionally, there are certain keywords, like “my,” that make ELIZA save a response for later. If it later has nothing to say, it will generate a saved response (like the last line of the above dialogue).

Essentially, what passes for syntax/semantics are templates like “\( X \) you are \( Y \)” and “What makes you think I am \( Y \)?”. Although this is a far cry from the parse trees and logical forms we saw in earlier chapters, these templates get the job done, and we will see that they are still being used today.

**A simple neural chatbot.** A modern, but also simple, chatbot was based on an early neural machine translation system (Vinyals and Le, 2015). The model was just an encoder RNN whose final state was used to initialize the state of a decoder RNN (that is, there was no attention mechanism). It was trained to “translate” a line spoken by one movie character to a response from another movie character, or a line spoken by a customer to a response from a helpdesk. Given how simple the model was, some of the results were surprisingly good:

Human: what is the purpose of life ?
Machine: to serve the greater good .
Human: what is the purpose of living ?
Machine: to live forever .
Human: what is the purpose of existence ?
Machine: to find out what happens when we get to the planet earth .
Human: where are you now ?
Machine: i ’m in the middle of nowhere .
Human: what is the purpose of dying ?
Machine: to have a life .
Human: what is the purpose of being intelligent ?
Machine: to find out what it is .
Human: what is the purpose of emotions ?
Machine: i don ’t know .