CaSiNo: A collection of campsite-based dialogs to develop automatic negotiation systems
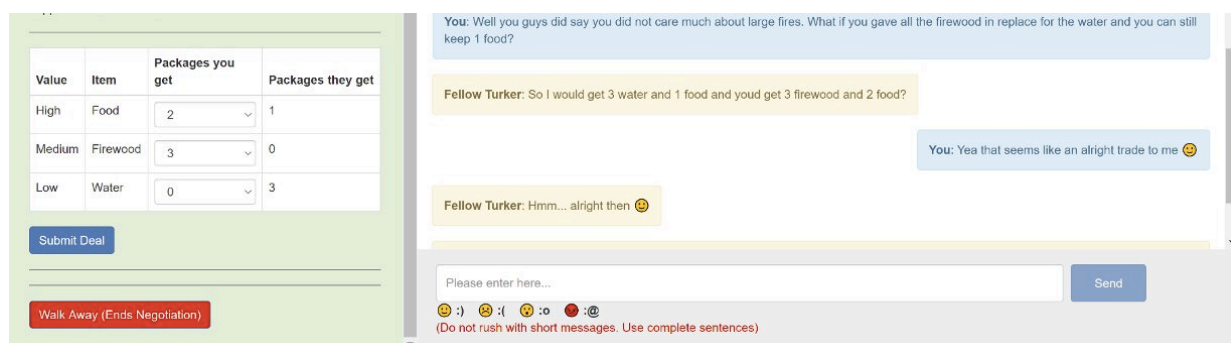
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A screenshot of the data collection interface for the collection of CaSiNo on the Amazon Mechanical Turk platform. The right side shows the chatbox for typing in the response and options to use emoticons as well. Once the participants come to an agreement, they submit their deal by using the menu on the left. Credit: Chawla et al.

Artificial agents that negotiate with humans could have a broad range of valuable applications, for instance, helping humans to improve their negotiation skills in a variety of fields. To enhance the development of these agents, researchers at the University of Southern California (USC) recently created CaSiNo, a dataset containing realistic negotiation dialogs grounded in a camping scenario.

"Our work reflects our ongoing efforts to build automated [negotiation](#) systems," Kushal Chawla and Gale Lucas, two of the researchers who carried out the study, told TechXplore via email. "Studying how humans tend to negotiate has been an active area of research for decades in economics, psychology and affective computing. It is an interesting playground for multidisciplinary research revolving around human decision-making."

In recent years, many researchers worldwide started exploring the potential of automated systems that can negotiate directly with humans. They found that these systems could be particularly helpful to train people on specific social skills (e.g., teaching business students to negotiate successful deals or lawyers to assess settlement rates during legal proceedings).

"There is already evidence that the skill of negotiation is also crucial for advancing the capabilities of existing AI assistants," Chawla and Lucas said. "For instance, the Google Duplex prototype engaged in a simple form of negotiation to book a haircut appointment over the phone."

Most automated negotiation systems developed so far are based on restrictive menu-driven communication interfaces. For instance, systems based on the [IAGO platform](#), including [a framework previously developed by Chawla and Lucas](#), require human users to click on specific buttons to communicate with the agent.

"These systems require clicking buttons to share individual preferences or to roll out offers," Chawla and Lucas said. "Although this restriction provides concreteness, it comes at a cost. More specifically, it hinders the analysis of several aspects of real-world negotiations, such as persuading the negotiation partner or expressing emotion. Alternative systems that enable more realistic styles of communication (i.e., through text or video) could be highly desirable."

To overcome the limitations of systems with menu-based interfaces, some research teams have recently been trying to develop chat-based negotiation systems that allow users to communicate more freely by typing or speaking in a [human language](#), such as English. Developing and training these systems, however, is far more challenging than creating menu-driven systems.

"Building a system that can negotiate with human partners in a given language requires the construction of negotiation datasets on which machine learning models can be trained," Chawla and Lucas said. "Prior efforts aimed at developing such datasets have focused either on game settings, that are too restrictive that they hinder personal conversations, or are too open-ended that they hurt the evaluation of the negotiation performance, both being important from the perspective of downstream applications."

In their recent paper, Chawla and Lucas introduced a dataset containing over a thousand realistic, linguistically rich and personal negotiation dialogs within a clearly delineated environment, namely a camping site. This dataset is called CaSiNo, which stands for "Camp Site Negotiations."

"In each negotiation, two participants take on the role of campsite neighbors and negotiate for extra essential items (i.e., food, water and firewood)," Chawla said. "Each participant has a predefined preference towards these items and their own justifications for needing or not needing them (e.g., one may need more water supplies for a hike or firewood for a bonfire with friends)."

In addition to the dialogs themselves, the CaSiNo dataset includes contextual information about each participant, such as which items they need most or are hoping to attain through the negotiation. During each negotiation, two participants talk with each other to decide how to divide

nine packages between themselves: three containing food, three water, and three firewood.

"The participants' negotiation performance is evaluated in three ways: (1) Their final score, which depends on what items they were able to negotiate for, (2) how satisfied they were with their own performance and (3) how much they like their opponents," Chawla and Lucas explained. "All these metrics are crucial in the context of real-world negotiations. Especially in the cases where the participants engage in repeated negotiations with each other, maintaining their relationship can be equally important as their own performance."

The researchers annotated almost 40% of the dialogs in the CaSiNo dataset, specifying the persuasion strategies used by the negotiating parties. Overall, parties used nine negotiation strategies, which were either 'cooperative' or 'selfish' in nature.

"These annotations allowed us to carry out the correlational analysis presented in the paper, where we understand how different behaviors during a dialog relate to the outcome of a negotiation," Chawla and Lucas said. "In general, we found that cooperative strategies relate positively with the participants' performance while selfish behaviors relate negatively."

The findings of the analyses could inform the development of more effective automated systems that employ different negotiation strategies. As a first step towards the development of these systems, the researchers created a multi-task framework that can predict the strategies used by two negotiating parties simply by analyzing the dialog between them.

"The multi-task framework was designed to automatically predict the strategy annotations directly from an input text used by the participants," Chawla and Lucas said.

The multi-task framework created by the researchers is based on a pretrained language model, a powerful deep learning model trained on a vast amount of free-form text collected online. Over the past few years, pretrained language models have proved to be highly effective for completing a variety of tasks. Chawla, Lucas, and their colleagues specifically trained their model on their annotated dialogs.

"The multi-tasking aspect of the framework is achieved by sharing this pretrained model for predicting all the annotation labels together," Chawla and Lucas said. "We further observed that different parts of the input tend to represent different negotiation strategies. Based on this idea, we allow the model to focus on different parts while predicting different annotation labels. This is done through what is popularly called 'attention.'"

The researchers observed that the multi-tasking and attention aspects of their model increased the accuracy of its predictions for all annotation labels. In a series of evaluations, their framework was found to significantly outperform a similar model that could not multi-task or focus on different parts of a dialog.

"CaSiNo creates opportunities for numerous other tasks in affective computing and natural language processing (NLP), such as analyzing self-satisfaction and opponent perception from dialog behaviors, along with building agents trained to negotiate naturally using language, in a manner consistent with their preferences and justifications," Chawla and Lucas said. "In addition, our findings improve the current understanding of how persuasion strategies can relate to the final outcomes in a negotiation."

In the future, the findings could inform the development of advanced automated negotiation systems that use realistic styles of communication and adapt their behavior based on the negotiation strategies that human

partners utilize. In addition, they could enable the creation of pedagogical agents that offer advice to users based on what negotiating strategies they use.

The CaSiNo dataset and the researchers' annotations are publicly available and can be accessed by developers on GitHub. Chawla, Lucas, and their colleagues are now conducting further studies exploring the potential of their dataset for affective computing research and for developing more sophisticated dialog systems.

"Contributing to the affective computing research, our ongoing efforts involve analyzing how the emotion attributes from the negotiation dialogs can help to predict the final negotiation outcomes, beyond the demographics and personality of the participants," Chawla and Lucas said. "This research could aid the development of agents that systematically incorporate emotion in their design. In addition, we plan to work towards developing automated NLP-based negotiation systems that can communicate in free-form natural language, such as English."

  More information: CaSiNo: A corpus of campsite negotiation dialogs for automatic negotiation systems. arXiv:2103.15721 [cs.CL]. arxiv.org/abs/2103.15721

kushalchawla.github.io/

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