

BIG-BUCK BOTS

Students seek to evolve AI to better serve humanity, while competing for millions of dollars

Many of us share our homes with a virtual task mate named Alexa, whom we routinely ask to tell us the time or the weather, to play a song, or to provide other useful, if mundane, small services. Now, two teams of students from the UC Santa Barbara Computer Science (CS) Department are competing in a pair of prestigious international competitions to help evolve the digital assistant's repertoire: the Alexa Prize TaskBot Challenge and SimBot Challenge.

Both are sponsored by Amazon and are outgrowths of the company's larger Socialbot Grand Challenge 4, which has the overarching goal of creating "an Alexa skill that converses coherently and engagingly with humans on popular topics and news events for twenty minutes, and achieves an average rating of at least 4.0 on a 5.0 scale," or, more simply put, "to make transformative advances in conversational AI."

William Wang, who leads the Natural Language Processing (NLP) lab at UCSB, is faculty advisor for the SimBot team, called GauchoAI, while fellow CS professor and NLP colleague **Xifeng Yan** advises the TaskBot team, named GauchoBot. "Our students are the team leaders, and they are driven by their interest and their passion," says Yan. "The PhD students wrote a proposal. William and I gave only some scientific suggestions and insights."

The Taskbot team includes computer science

PhD students **Alon Albalak** (team leader), **Shiyang Li**, **Zekun Li**, **Jing Qian**, **Hong Wang**, **Yingrui Yang**; undergraduate CS majors **Qiru Hu** and **Carina Quan**; and undergraduate computer engineering major **Tom Zu**.

GauchoAI comprises CS PhD students **Jiachen Li** (team leader), **Tsu-Jui (Ray) Fu**, **Sharon Levy**, **Yujie Lu**, **Xinyi Wang**, **Wanrong Zhu**, and undergraduate CS major **Eddie Zhang**.

Just twenty teams from around the world were invited to participate — ten per challenge — with UCSB having a team in both. Two other teams in the SimBot Challenge are led by UCSB alumni. **Xin Wang**, who earned his PhD in William Wang's lab, leads the UC Santa Cruz team, and the team from The Ohio State University is led by **Yu Su**, who earned his PhD in Yan's lab. Finally, the TaskBot team from The Ohio State University is led by **Huan Sun**, who also earned her PhD in Yan's lab.

"It is a great honor to be accepted into these challenges," says Wang. "The groups selected to compete represent top programs in artificial intelligence [AI] all over the world. Being selected serves to recognize our years of efforts and achievements in the research areas of dialogue systems, conversational AI, and NLP in general, an area in which UCSB is consistently ranked as a top-ten national program. We are very excited about the opportunities that have been generously provided by Amazon Alexa."

TaskBot

The Taskbot Challenge, which Amazon describes as “the first conversational AI challenge to incorporate multimodal (voice and vision) customer experiences,” began in spring 2021 with the goal of “advancing the development of next-generation virtual assistants that will assist humans in completing real-world tasks that require multiple steps and decisions [i.e. following a recipe in the kitchen] by harnessing generalizable AI methodologies such as continuous learning, teachable AI, multimodal understanding, and reasoning.”

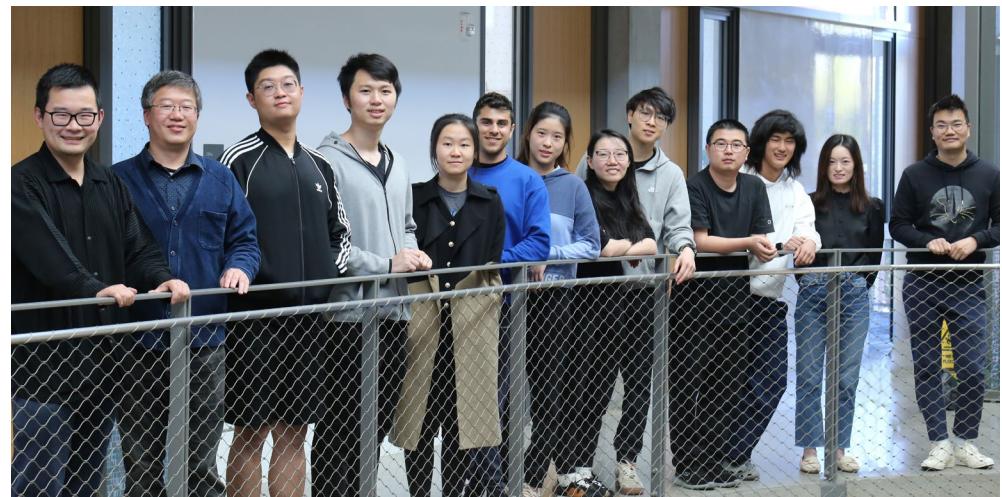
The TaskBot Challenge will run for one year, with teams focusing on the domains of cooking and home improvement. The challenge incorporates multimodal customer experiences, so, in addition to receiving verbal instructions, customers who have Echo screen devices could also be presented with step-by-step instructions, images, or diagrams that enhance the guidance they receive for completing the task. For example, a user might ask Alexa how to fix a scratch on a car. The TaskBot will then ask the customer more questions about their task, and then interactively provide step-by-step instructions and explanations for each step, or potentially adjust its plan based on user input.

Ten teams successfully passed the certification process, meaning that real Alexa users could then have a conversation with TaskBots using Alexa-enabled devices. After an interaction ends, individual customers are asked to rate how helpful that TaskBot was with the task, and they have the option to provide freeform feedback. “Teams are using the feedback from real users to improve their bots,” Yan explains. “Our team has successfully injected the newest AI models into our Taskbot for open-question answering. We were surprised by the high quality of the answers they delivered, especially in the situations where our system had to answer open questions that they had never seen before and for which they had not been prepared.”

Success in the challenge requires participants to advance the state of the art in conversational AI and address difficult science challenges related to knowledge representation and inference, commonsense and causal reasoning, and language understanding and generation, among other challenges, requiring synthesis of multiple areas and approaches in AI.

After the certification process, an initial-skills-development period was held from last June through August. The competition began in September, finals will be held this May, and winners are to be announced in June. Each team received a \$250,000 research grant to participate, as well as Alexa-enabled devices, free Amazon Web Services (AWS) cloud computing services to support their research and development efforts, access to the TaskBot Toolkit, data resources, and Alexa team support. The winning team in each challenge will receive an additional \$500,000. The second- and third-place teams will receive an additional \$100,000 and \$50,000, respectively.

Regardless of whether a team wins its challenge, all participants retain ownership of their TaskBot, and Amazon will have a non-exclusive license to any technology or software the participants develop in connection with the competition. Publishing research papers as an outcome of the work on the Alexa Prize is required for all competing teams. “Society as a whole, including Amazon, can benefit from the open research that is linked to the competition,” Wang says.



Amazon TaskBot and SimBot teams (from left): William Wang, Xifeng Yan, Tsu-Jui Fu, Jiachen Li, Yujie Lu, Alon Albalak, Wanrong Zhu, Yingrui Yang, Zekun Li, Hong Wang, Eddie Zhang, Jing Qian, Shiyang Li

SimBot

The SimBot Challenge began in January 2022, and the initial skills-development period will begin this coming July, with winners to be announced in April 2023. The teams are focusing on “advancing the development of next-generation virtual assistants that will assist humans in completing real-world tasks by continuously learning, and gaining the ability to perform commonsense reasoning.”

A key challenge for building intelligent robots is that they must be able to understand and manipulate everyday objects and know the way to a destination. For instance, it will be possible in the future to have a robot make you a cup of coffee, but the robot needs to understand how to navigate to the kitchen, get the coffee beans, grind them, and then pour hot water on them to make the coffee.

Wang and Yan describe how the teams in both challenges work: “We meet several times every week, and every two to three days, the team reviews all conversations that received low or high user ratings to understand why and to develop intelligent algorithms to further improve conversation quality and user engagement. You never know how a user might speak or what words they might use, so we have to think in advance about how they will reply and how to handle hundreds of different situations. Human beings have infinite ways to conduct their conversations. The team has to figure out the most general solution given a limited time window provided by the challenge. The process is quite stressful but one that we enjoy.”

Dialogue systems, or so-called “conversational AI,” which are foundational to building successful TaskBots and SimBots, are developing rapidly, creating many open research questions that need to be addressed, say Wang and Yan. “While it is possible that one of our students might have the luck to develop a brilliant idea during the contest, we think of it as more of an educational opportunity provided by Amazon that allows student to put state-of-the-art AI techniques into real use and observe their performance by receiving rapid feedback from actual users.”

“Truthfully, many of the bots do not work well out of the box,” Wang says. “This experience will help us identify truly valuable research problems that we can work on after the competition. Our research goal is aligned with Amazon’s goal for Alexa: to make interacting with conversational bots as natural as interacting with another human being. There is a long way to go.”