

# SAMI: An AI Actor for Fostering Social Interactions in Online Classrooms\*

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**Abstract.** Learning is a social process. However, online learning is characterized by social isolation. We present an AI social actor, SAMI, for fostering social interactions in online classrooms. SAMI (Social Agent Mediated Interactions) aims to mitigate the potentially adverse impact of social isolation on the learning experience and emotional well-being of geographically dispersed online learners in asynchronous educational settings. SAMI connects learners based on their shared identity considering student location, hobbies, and academic interests. It also aims to enhance the feeling of “belongingness” felt by the students in the community of online students. SAMI has been deployed at Georgia Institute of Technology in several online classes with over 11000 students in the past two years. We describe our findings from student surveys to gauge SAMI’s effectiveness.

**Keywords:** Adult Learning · Online Education · Social Presence AI Social Actor · Community Building

## 1 Introduction

Online programs are becoming ubiquitous in higher and continuing education. With their growing popularity, educational institutions must ensure that online learners have a learning experience that is at least as meaningful and effective as that of in-person learners. In this context, an obvious challenge posed by online education is the lack of face-to-face interactions between students who are geographically dispersed and are often receiving asynchronous instruction. This is especially true for adult learners in online education. Adult learners often struggle to accommodate competing commitments to their coursework, full-time jobs, and families, and thus typically have little to no time for building social connections in their online classrooms [1]. The problem is further exacerbated by

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the size of online classrooms that have hundreds, if not thousands, of students. Online learners would need to tediously search through faceless posts devoid of social cues on the class discussion forum to identify those with whom they may want to reach out to connect. Even if they did this, they may hesitate to reach out to express their inclination to connect. The resulting lack of social interaction hinders students from projecting themselves as people with emotions and social needs in the class. This social isolation denies online students cognitive learning benefits of collaborative thinking that often leads to shared construction or discovery of knowledge [2–4]. Further, online students may struggle to develop the feeling of “belongingness” in the classroom community, that is, the feeling they identify with other students. This deficit can adversely impact a student’s well-being and emotional health, and the desire to stay and complete the program of study [5–7].

Artificially intelligent (AI) social actors offer potential means for fostering social interactions in online classrooms [8]. The current AI techniques seem adept at leveraging natural language generation to bring spontaneity and randomness to online interactions, thus offering the potential for enhanced user (student) engagement. With this perspective, we make the following research contributions. First, we have developed a new version of an social AI actor named SAMI to help online learners make social connections based on their shared identity. Second, critical aspects of SAMI’s functionality are enhanced by generative AI sourced from OpenAI’s ChatGPT. Third, SAMI uses generative AI in conjunction with a knowledge base of student models represented as knowledge graphs. Fourth, SAMI has been routinely deployed in several online classes with thousands of students. Finally, it requires only modest computational resources to scale SAMI to any number of classes.

## 2 Related Work

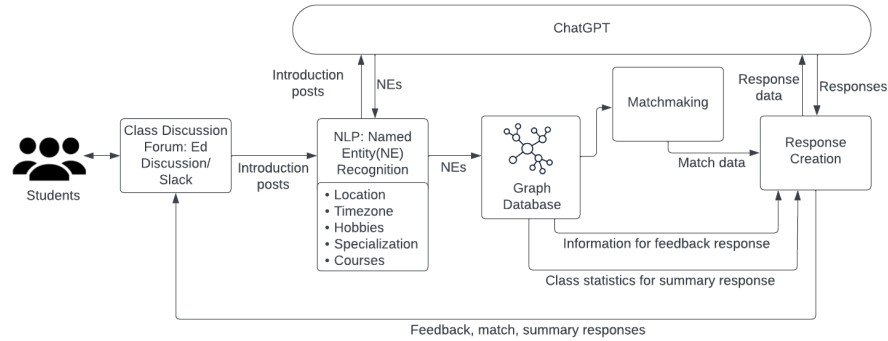
The importance of social context in support of learning has been recognized for a long time. Dewey observed in 1897 “that the educational process has two sides – one psychological and one sociological; and that neither can be subordinated to the other or neglected without evil results following” [9]. This viewpoint has gained much urgency with the increasing popularity of online education where social isolation, if left unchallenged, can be more a rule than an exception [10]. More recently, Ashar and Skenes [5] highlighted the role of the social environment in keeping students engaged in learning activities in an online environment.

Garrison et al. [2] put forth the framework of Community of Inquiry that posits social presence - the ability of learners to project their personalities and emotional needs into classrooms – as one of three crucial elements that enable an effective higher education experience, and its implications for building functional online learning communities (cognitive presence and teaching presence are the other two). Sun et al. [11] focus on online learners’ community-building practices and find these are motivated either by the discovery of shared identity or the desire to fulfill academic or professional goals. In [12], authors note that discov-

ering students with a common group identity also promotes collective efficacy, the belief in the group’s capacity to achieve shared goals.

In earlier work, Brooks et al. [13] note the lack of affordances promoting collaborative learning in traditional learning management systems. To alleviate this shortcoming, the authors present a suite of tools explicitly linking the collaboration of learners to learning artifacts in the learning management system to promote social aspects of learning. More recently, Wang et al. [14] examine the design implications of technology interventions to foster community building in online classes and present an early implementation of a social AI agent. They report results from student surveys that validate the importance of shared identity in creating online communities. They extend this work in [15, 16] with co-design workshop studies with online learners to identify learners’ design preferences for an AI agent tasked with promoting social connectedness and probe potential ethical concerns. Taking cues from this work, we present here the design and implementation of a new version of SAMI and its deployment in several online classes.

### 3 SAMI System Design



**Fig. 1.** SAMI’s architecture

Figure 1 illustrates SAMI’s architecture. SAMI has a modular design with five modules: a module that hosts the class discussion forum API; a module for natural language processing (NLP); a knowledge base of graphs representing student models; a module for matchmaking; and a module for response creation. Any module can easily be changed or upgraded independently of other modules. Deployed in an online class, SAMI interacts with students through a dedicated thread on the Ed Discussion forum or a dedicated Slack channel. Students are asked to post their self-introductions at the beginning of the semester

and to append hashtag #connectme to consent to SAMI analyzing their posts for matchmaking. Once the number of posts reaches a critical threshold, they are passed to the NLP module in a batch. Figure 2 shows a sample student introduction post.

### 3.1 Natural Language Processing Module

The NLP module is concerned with Named-Entity Recognition (NER). Specifically, it analyzes student posts that contain the #connectme hashtag to extract student location and other places of interest mentioned in the introduction; the time zone; hobbies; the intended specialization; and past and future courses of interest. The NER functionality is sourced from OpenAI’s ChatGPT by passing student introduction posts along with an appropriate prompt for each entity type to the OpenAI API. Leveraging ChatGPT for common NLP tasks such as classification and NER obviates the need for gathering training data to build and train task-specific machine learning models, thus greatly simplifying SAMI’s architecture and development [17]. It also reduces the task of adding additional named entities for matchmaking to prompt engineering. The extracted named entities are highlighted in the introduction post in Figure 2.

### 3.2 Knowledge Base Module

The output of the NLP module is a dictionary containing student IDs along with associated named entities, and it is passed to the knowledge base module, which is responsible for constructing a Neo4j graph database using data received from the NLP module. The knowledge graph consists of two types of nodes: student IDs and named entities. A node for a particular student ID is connected to all named entities extracted for that ID; more than one student ID node may be connected to a given named entity node. Figure 3 shows a truncated example of the knowledge graphs for just two students. The knowledge base module exposes its graph data through an API that can be queried using Neo4j’s graph query language (Cypher).

### 3.3 Matchmaking Module

The matchmaking module extracts data from the knowledge base to find the best matches for a student based on their shared identity based on student locations and other places of interest; their time zones; hobbies; desired specialization in the program of study; and past and future courses of interest. A student is a match candidate for another student if their respective nodes are connected to one or more of the same named entities, that is they share one or more elements of identity. The matchmaking module computes a pair-wise match score based on the number of shared named identities between students. The higher the number of shared named entity nodes between two students, the higher the match score for the pair. The output of the matchmaking module is sent to the response creation module, and it is a dictionary consisting of student IDs along with five top matches for each student.

Hi everyone,

My name is [student] and I live in [Cumming, GA]. We moved from [CA] last and miss the amazing weather all round the year. I am a first year PhD student and have taken [CS 7001]. I am interested in [HCI] and have also taken [HCC] course this semester. I would like my research to focus on humanistic AI and someday hope to become a faculty.

Outside of academics and work, I enjoy [hiking, reading classic fiction] and spending time with my 3 year old daughter. We moved to GA for my PhD :) and of course the wonderful greenery. #connectme

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Dear [student] ,

I hope this message finds you well. It's great to learn that you have a passion for reading classic fiction and hiking. As a social agent, I'm excited to help you connect with your classmates who share similar interests and academic pursuits. Your specialization in Human Centered Computing is fascinating, and I'm sure you'll find many like-minded individuals in your upcoming classes. Your primary location in Cumming, Georgia, puts you in a prime position to take advantage of all the opportunities available in the area. We will soon be providing you with a list of matched students once the class registration is completed. Stay tuned for more updates!

Best regards,  
SAMI

*If I made a mistake, I would appreciate it if you can correct me. This will help my creators to programmatically correct faults in my brain! To do so, please reply to this post. Your reply should start with **#samicorrect**. Next depending on what you want me to correct, please add one or more of the following lines to your reply:*

**#primarylocation** [city][state][country]

**#otherlocation** [city][state][country]; [city][state][country]

**#hobbies** [hobby1][hobby2]

**#courses** [course1][course2]

**#specialization** [specialization]

Thank you so much

**Fig. 2.** At the top is an example self-introduction post made by a student in a dedicated thread on the class discussion forum. The named entities in the post are highlighted with a box around them. At the bottom is SAMI's feedback to the student based on this post.

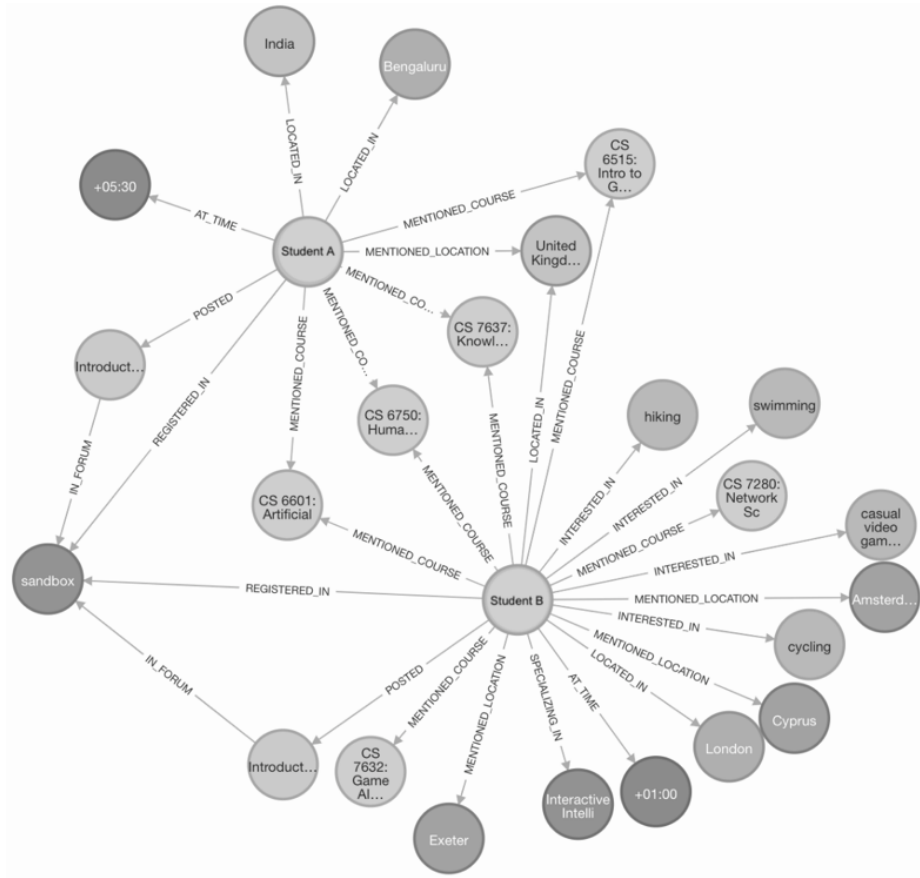


Fig. 3. A truncated example of the SAMI's knowledge graphs.

Hiya [student] . It's good to digitally meet you.

**#CONNECTME** Just take a few minutes to get to know your fellow classmates. You may be interested in connecting with them.

**--SPOTLIGHT BLOCK--**

- **Spotlight On:** [match 1] !. Meet [match 1] , a fifth-year PhD candidate in Human-Centered Computing at Georgia Tech. They also lived in Seattle, Washington for their undergrad. Like you, they have taken courses in Cognitive Science and have a passion for Human-Computer Interaction. They enjoy indoor bouldering, working out at Orange Theory, and watching TV shows and movies in their free time. It seems like you both share a love for the outdoors as well, with your interest in hiking and their past experience in Seattle. It's great to see that you both have a lot in common! #ConnectMe

To say 'Hi!' to [match 1] click [here](#).

- **Spotlight On:** [match 2] !. Meet [match 2] , a soon-to-be 3rd year HCC PhD student at GT who does visual analytics and HCI research. They are advised by [advisor] and have a website you can check out. They share your interest in HCI and have taken CS 7001. They also enjoy hiking, just like you, and have a love for American football, baseball, and golf. They live in Atlanta, GA, just like you, and enjoy spending time outdoors. You should definitely connect with them! #connectme

To say 'Hi!' to [match 2] click [here](#).

- **Spotlight On:** [match 3] !. Meet [match 3] a fellow student who recently moved to Atlanta, GA. They share your love for outdoor activities like hiking and enjoy exploring the city. [match 3] is also enrolled in HCC courses this semester, just like you. Additionally, they are interested in culinary skills and are a movie enthusiast. It seems like you both have a lot in common and could potentially connect over your shared interests. #connectme

To say 'Hi!' to [match 3] click [here](#).

- **Spotlight On:** [match 4] !. Meet [m4], a fellow OMSCS student from Pittsburgh, PA. They have taken courses in HCI, KBAI, and ICS, and are planning to specialize in II. Like you, they enjoy hiking and spending time with their partner. They also share an interest in video games and have taken a course in video game design. Additionally, they have a background in teaching math and computer science. You both have a shared interest in HCI and could potentially collaborate on research in the future. #connectme

To say 'Hi!' to [match 4] click [here](#).

- **Spotlight On:** [match 5] !. Meet [match 5] , a fellow student who shares your love for hiking and enjoys traveling, photography, and music in their spare time. They live in the San Francisco Bay Area, which is where you moved from last year. They are currently taking DL and SDP, while you have taken CS 7001 and HCC 1 this semester. It's great to connect with someone who shares similar interests and academic pursuits! #connectme

To say 'Hi!' to [match 5] click [here](#).

**Fig. 4.** An example of SAMI's match response to a student introduction post. SAMI suggests five peers as potential matches based on shared identity. The student can click on a match's name to be taken to her introduction post. They can also click to say "Hi" to a match.

### 3.4 Response Generation Module

The response creation module is responsible for generating SAMI’s responses for students. It uses ChatGPT to craft diverse and friendly human-like responses to help increase student engagement. Input data for responses are sent along with an appropriate prompt to the OpenAI API for this purpose. The crafted responses received from ChatGPT are then forwarded to the class discussion forum API for posting as responses to the student introduction posts. The module creates three types of responses: feedback and match responses for each student, and a summary response for the class. The type of response created depends on the option selected when SAMI’s code is executed.

Figure 2 shows an example of a feedback response. This is the first response a student receives from SAMI, and it uses data queried from the knowledge base. It informs the student what knowledge SAMI has extracted about her from her introduction post. It also asks the student to inform SAMI of any errors in the extracted information.

Figure 4 shows an example of a match response given to a student; the response is constructed using match data output by the matchmaking module. As mentioned above, SAMI suggests the names of five students as potential matches. The name of each suggested match student is an HTML link; clicking on it takes the student to the match student’s introduction post. The student can then post a message to the match; or click on a “Click to say Hi” link to show an interest in connecting. We can track student clicks as a measure of SAMI’s efficacy in connecting students.

The final response output by SAMI is the summary response. It consists of class statistics derived from student information stored in the knowledge base. Figure 5 shows an example of a summary response. The summary response is motivated by the desire to increase the feeling of belonging among the students, that is, the feeling that they belong to the community (class) and that they identify with other students. This, in turn, can have a salutary effect on their sense of social presence.

### 3.5 SAMI on Slack

Asynchronous classrooms communicate in different ways, with some utilizing class discussion forums, such as Piazza or Ed Discussion, and others utilizing instant messaging platforms, such as Slack. To make SAMI a truly modular program that can slot into any classroom, it has been our goal to make SAMI work on any online form of communication, and behave consistently across the different platforms. As such, SAMI on Slack behaves the same as previous iterations of SAMI deployed on class discussion forums, including how it communicates with the other modules and the way it directly responds to students who have posted messages addressed to it.



**SAMI** has gathered and compiled information from your introduction posts for students who opted in with the **#connectme** hashtag at the end of their posts. This thread gives **summary statistics** for these students, not the entire class. For example, how many students are in certain cities, states and so on. We hope this is helpful to you.

*Please feel free to leave any feedback or comments on this thread about this feature.*

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#### **hobbies summary**

-Top Mentions-

- 16.2% of the students are interested in reading.
- 16.2% of the students are interested in hiking.
- 13.1% of the students are interested in running.
- 8.1% of the students are interested in traveling.
- 8.1% of the students are interested in video games.
- 7.1% of the students are interested in soccer.
- 7.1% of the students are interested in watching movies.
- 6.1% of the students are interested in cooking.
- 6.1% of the students are interested in music.
- 5.1% of the students are interested in gardening.

**Fig. 5.** An example of SAMI’s summary response. For the sake of brevity, we just show the hobbies summary. Similar statistics are displayed for other named entities, e.g., countries, cities, time zones, hobbies, specializations, courses, etc.

## 4 Results and Discussion

Various versions of SAMI have been deployed in many large online graduate-level classes in the Online Master of Science in Computer Science (OMSCS) program at Georgia Institute of Technology. Versions of SAMI before Summer 2023 used pattern recognition for extracting named entities from introduction posts and provided hard-coded responses to students; these were deployed in classes with about 8000 students enrolled. The current version employing ChatGPT was first deployed in Summer 2023 and it offers a more engaging experience for students with its more varied and human-like responses. Over 3000 students have had an opportunity to interact with this version of SAMI.

### 4.1 Early Results

During the deployment of SAMI in Fall 2019 in two online classes, we conducted three short surveys over the semester to gather student feedback on SAMI [14]. These three surveys served different purposes: Survey 1 (S1, n=601) to understand online learners’ current practices in building social connections, Survey 2 (S2, n=359) to collect qualitative feedback from students on SAMI, and Survey 3 (S3, n=431) to quantitatively evaluate the effectiveness of SAMI. Through mixed-methods analysis on these survey results, we found that students were overall positive about SAMI. However, students reported mixed experiences and

opinions on the actual usefulness of SAMI in fostering social connections among online learners.

Based on students' responses from S2, we found that students were able to form connections through the shared identity highlighted by SAMI. For example, some students reported that they used SAMI's responses to connect with others who are located in the same area, or even formed local study groups. By highlighting students' shared identity, SAMI also helped online learners foster a sense of "belongingness" in the class. One student said, *"I think the personalized response fosters inclusion and collaboration in the class. It helped me have a sense of belonging."*

However, students also pointed out that while the responses provided by SAMI are interesting, they are not always actionable given that SAMI's response did not trigger an action as much as they had expected. Echoing with this feedback, S3 responses also showed that among all students who opted-in to receive SAMI's recommendations, 53.4% of the students didn't connect with anyone, 19.9% students connected with five or less students, and 7.85% students connected with more than five students.

## 4.2 Intermediate Results

In 2021, we conducted semi-structured interviews with 26 students in the OM-SCS program in which SAMI was deployed [16]. We analyzed the interview transcripts using thematic analysis. Through the interviews, we found that SAMI was able to improve the visibility of social information and increase students' feelings of accountability in remote social interactions. Students reported that SAMI made social signals visible among students by highlighting students' willingness to build social connections. Given that students needed to opt-in by including #connectme in their self-introduction, others also interpreted this as a signal of whether students were willing to build social connections. We also found that SAMI raised awareness of potential social companions for online learners by highlighting online learners' shared identities, such as their similar hobbies and locations.

While SAMI was able to facilitate online learners' social connections by mitigating these challenges, students also voiced their concerns about SAMI. One concern that was frequently brought up by online learners was the lack of transparency of SAMI's working mechanism. We found that students wanted to learn more about how SAMI came up with the recommendation for them to better communicate with SAMI for further improvements. This suggests a need for self-explanation in SAMI [18].

## 4.3 Results from SAMI on Slack

SAMI on Slack was deployed in an in-person course at Georgia Tech in Spring 2023 that utilized Slack as the online communication platform. Using exported data from Slack, it is possible to compare the number of students who were in one channel to another channel. The #general channel, which every student is

automatically enrolled in, contained a total of 77 users. Meanwhile, the SAMI channel, which students had to opt in, contained a total of 75 users. This means at maximum, only two students used the Slack server without joining the SAMI channel to interact with SAMI.

In terms of interaction, 81% of students who responded to an in-class survey reported interacting with SAMI. Those students were asked to assess SAMI on a scale of 1 to 5 (with 1 being the worst and 5 being the best). Of the 30 students who responded to this question, 44% responded with a rating of 5, 35% responded with a rating of 4, and 21% responded with a rating of 3.

In terms of efficiency, 76% of students who responded to the survey reached out to other students based on SAMI’s suggestions, and of those who were reached out to, 66% responded at least once. Later in the semester, when a project required students to form groups, 80% of students relied on SAMI’s suggestions to form their groups. Of that 80%, 25% relied exclusively on SAMI’s matches, while 75% relied on a combination of SAMI’s suggestions and other previous experience with students.

#### 4.4 Recent Deployments

In our more recent deployments, over 3000 students in various classes have been exposed to the ChatGPT-based SAMI. Table 1 lists some of the salient features of these deployments.

**Table 1.** SAMI deployments since Summer 2023 (ChatGPT-based SAMI)

Semester	Course	Discussion Forum	# Students
Summer 2023	Human-Computer Interaction	Ed Discussion	385
Summer 2023	Knowledge-Based AI	Ed Discussion	216
Summer 2023	Introduction to Cognitive Science	Slack	115
Fall 2023	Human-Computer Interaction	Ed Discussion	691
Fall 2023	Knowledge-Based AI	Slack	482
Spring 2024	Knowledge-Based AI	Ed Discussion	517
Spring 2024	Machine Learning for Trading	Ed Discussion	1280

**Table 2.** SAMI class usage in Human-Computer Interaction, Fall 2023

# students	# self-introductions	# opt-ins	# Match name clicks	# click-to-say-hi clicks
691	532 (77%)	249	151	87

Table 2 shows data highlighting the degree of student engagement with SAMI in a class. This class had a student enrollment of 691. 532 (77%) students

posted their self-introductions and 249 (47% of those who introduced themselves) opted in to have their posts analyzed by SAMI for match recommendations. We recorded 151 clicks by students on the names of students recommended as potential matches and 81 clicks made by students to say "hi" to these matches.

## 5 Conclusion

We have presented an AI actor, SAMI, for fostering social interactions in online classrooms. SAMI aims to mitigate the potentially adverse impact of social isolation on the learning experience and emotional well-being of online learners by connecting them based on their shared identity derived from their location, time zone, hobbies, and academic interests. It also aims to enhance the feeling of "belongingness" felt by the students in the community of online students. While earlier versions of SAMI used pattern recognition for extracting named entities and methods from knowledge-based AI such as knowledge graph and graph matching, the newer version combines generative AI with knowledge-based methods for better matchmaking and engaging student experience. SAMI has been deployed at Georgia Institute of Technology in several classes with over 11000 students over the past two years and its deployments can be easily scaled to any number of classes. Our initial results from indicate encouraging signs of student engagement with SAMI.

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