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The Emora College Companion: A Socialbot for College Students

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Abstract

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The social chatbot, Emora, was first designed in 2020 by researchers at the Natural Language Processing Lab at Emory University to compete in the Alexa Prize SocialBot Grand Challenge 3. Motivated by the inquisitive social chatbot's success in the challenge, a team of Emory NLP researchers created the Emora College Companion, a socialbot for undergraduate students. The relevant release of this technology to Emory's Undergraduate population follows a shift in higher education settings towards using chatbots to support student populations. Unlike current chatbot models however, the Emora College Companion differentiates itself by being fully conversational and learning about its user through meaningful and human-like interactions. The Emora College Companion helps undergraduate students achieve their academic goals by being a faithful companion who is there for students from orientation to graduation. To the best of available knowledge, the Emora College Companion is the first socialbot catering to college undergraduate students. Current versions of chatbots utilized in higher education serve to answer frequently asked questions and send reminders. These chatbots function well to fulfill the needs they were designed for: easing workloads of advisors, professors, and teaching assistants and keeping students engaged in completing deliverables required for college enrollment. Nonetheless, none complete these tasks through natural-language-driven social interactions. The Emora College Companion tackles the task of asking students to think differently about how they approach resolving day-to-day tasks and challenge, such as preventing procrastination and resolving interpersonal issues. Currently, Emora spends most of her time conversing with a young and technologically influenced population. Some of her most robust and successful topics include video games, movies, and trendy food options. The most recently tested version of the College Companion, Version 8, is able to sustain over 40 distinct and personalized conversations, ranging across 13 topics. In order to exhaust the contents of College Companion Version 8, users would need to complete approximately 456 turns, which sums to about 3,360 seconds (56 minutes) of non-stop conversation. Version 8 of the Emora College Companion has a misunderstanding rate of 5.05% and poor response rate of 4.46%, based on 10 user conversations.

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Chapter 1

Introduction

This thesis introduces the Emora College Companion, the latest edition to the Emora Chat family curated specifically to cater to the conversational needs and interests of undergraduate students at Emory University in Atlanta, Georgia. The Emora College Companion communicates with students in natural language with the goal of being a college-career-long companion, or friend, to them. Emora befriends students through charismatic conversations, always aiming to learn more about the individual she is speaking with. Her attentive nature allows her to engage in personalized conversations across a variety of distinct topics. Students can talk to Emora to ask for advice, work through difficult situations, tell jokes, or simply chat. The Emora College Companion is a novel chatbot design, being the first socialbot created for college students.

The Emora College Companion project is a collaborative effort amongst a team of undergraduate and graduate students at the Natural Language Processing Lab at Emory University. The goals of the project are to create an intelligent socialbot tailored to Emory University's undergraduate student population. Emora, a social chatbot "who cares for you", is designed to form close connections with students from their first day of college orientation, to the day they graduate, and beyond. Unlike current chatbot models used at other institutions for higher education, Emora puts

forward the effort to learn about the individuals she is speaking with herself. Emora can differentiate whether a user is a student, professor, administrator, or other through natural conversation rather than through a system link to a individual's university records. In all ways, Emora mimics human-like social behaviors to successfully hold engaging and meaningful conversations with users.

Currently, Emora can interact with users through a web-based based application or a mobile app on iOS and Andriod devices. Her most recent version update, deployed on January 26, 2023, can sustain over 45 distinct conversations. In addition to these conversations, Emora can answer questions about herself, express opinions, and tell jokes. She can also recognize if users are in distress or in a crisis, and provide appropriate information and resources relevant to the situation they are in. In all, Emora can converse with users for over 400 turns, equivalent to just under an hour of non-stop, back and forth messaging, per her last user tested version.

1.1 Motivation

1.1.1 Broad Impacts

The introduction of modern chatbots in higher education begun as early as 2004 for purposes such as teaching, question answering, and academic advising. From 2016 to date, hundreds of higher education institutions have, predominantly, out-sourced AI-powered chatbots to improve the student experience from the moment they are admitted to college. A popular use case for AI chatbots since then has been to greatly reduce the number of students who do not follow through with college enrollment procedures after graduating high school. Particularly for low income and first generation students, task oriented chatbots have shown promising results of helping large state colleges and universities enroll more students.[7] An even more prevalent use case for chatbots in higher education has been to ease the workloads

of college advisors, whether they be admission or academic advisors, and teaching assistants and professors. Being that students tend to ask similar, if not the same questions, to their advisors, TAs, and professors from semester to semester and year to year, chatbots trained on frequently asked questions and answers data can help those normally in charge of handling them focus on other tasks while a chatbot easily and momentarily provides the response a student was looking for. While these chatbots prove to be useful, they more often than not lack all aspects of humanity and sociability. While these two factors may not be deemed necessary for the tasks the aim to handle, they are more important than they appear. For instance, due to these reasons, many chatbots become a one-size-fits-all question handling machine. Yet there is no one-size-fits-all student. The Emora College Companion recognizes this and aims to solve this limitation through a different approach. Rather than being a search engine for college students, Emora proactively learns about her user so she can then personalize conversations to their particular needs and desires.

1.1.2 Intellectual Merit

On a broad level, the Emora College Companion challenges both its developers and its users to re-imagine the scope of chatbot capabilities. A majority of the everyday user's interactions with chatbots are limited to FAQ bots or virtual assistants with small capacities. Further, many of these chatbot models are designed to be excessively menu-like. Briefly put, the "chat" in "chatbot" is completely missing from mainstream chatbot models considering most present users with a list of buttons to select from in order to chat with the bot. The Emora College Companion does not restrict messages from users by asking them to type in a specific response or click a pre-determined reply button. This makes the bot more difficult to design, but enhances the user's experience in interacting with it. One currently available socialbot that has been tackling this challenge is Microsoft's XiaoIce Bot in China who, like Emora, focuses

on social interaction over task completion.[9]

Chapter 2

Related Work

2.1 A new Emora

The Emora College Companion was a new task for researchers at Emory University's Natural Language Processing (NLP) lab motivated by the success of a 2020 project that introduced the Emora chatbot for the Alexa Prize ¹ Grand Challenge 3. The Emora Alexa Prize chatbot won the grand prize for Grand Challenge 3 and passed to the finalist round for Grand Challenge 4. Emora could support engaging conversations on wide range of popular and personalized topics and had her own opinions and personality. Emora was a combination of data-driven and rule-based approaches to chatbot design, using the Emora State Transition Dialogue Manager (Emora STDM or E-STDM) for selecting hand-crafted system responses based on dialogue contexts classified by customized, deep learning models created for a previous year's Alexa Prize competition and trained on an internal conversation dataset created from that competition. [2] The approach to creating the Emora College Companion's conversation components (topic handlers) was heavily influenced by the approaches utilized in creating the conversation content for the Emora Alexa Prize bot.

Emora STDM, introduced in 2020, presented novel workflows that facilitated rapid and

¹<https://www.amazon.science/alex-prize>

collaborative development of dialogue manager prototypes and complex interactions. [1] The E-STDM dialogue manager is based on a state machine, where each state indicates the dialogue context and each transition is a system or user turn (a system response or user message). [2] E-STDM was able to understand user inputs through the use of NATural language EXpression, NATEX. This feature of the Emora state machine allowed for string matching, function calls, ontology, response generation, and error checking. [1] A limitation to state machine based dialogue systems is lack of flexibility for complex conversations. Due to the way states connect to each other, state machine dialogue systems are better at following specifically defined conversation paths, and struggle to produce responses when user inputs are unexpected or unrelated to the current dialogue context. E-STDM addresses this limitation through information state update rules. Update rules take a precondition, a particular NatexNLU (Natex natural language understanding) key, and postcondition, a contextualized system response. If, during a user dialogue transition, a precondition is met, the following system turn will take the postcondition transition as opposed to the original, defaulted state machine transition. In addition to this benefit of the E-STDM library, E-STDM was designed to be used by developers with varying levels of programming experience, including little to no experience. The Emora College Companion was developed in its entirety using E-STDM.

2.2 Chatbots in Higher-Education

Chatbots have been around as early as the 1960s with the creation of ELIZA, a pattern matching and template response bot designed to be a therapist. [11] Despite the technology having first emerged nearly sixty years ago, research on chatbots has become increasingly popular in the past years. This is accredited to recent developments in the fields of AI and NLP and the boom of social networking sites which have caused

people to be much more digitally connect, and promoted the social acceptance of text communication and online socializing as a main form of social interaction. [5][9][10] When it comes to higher-education environments, there are limited applications of chatbots. [6] Currently, chatbot systems used in higher-education settings are predominantly intelligent personal assistants (IPAs). Further most are hyper-focused on frequently-asked-question (FAQ) handling or sending automated reminders. These uses are not significantly different from the use cases of chatbot systems users are already exposed to on a daily basis such as IPAs on your mobile device, customer service FAQ and technical support systems, and even selling bots on online shopping websites. One of the biggest obstacles when it comes to chatbot development for higher-education is a literature gap gauging user needs and expectations for higher-education dialogue systems and general ethical and data privacy concerns. This being said, higher education institutions have been developing or outsourcing AI-powered chatbots to assist with the completion of college specific tasks since the mid-2010's. Currently available and researched chatbot systems serve higher-education institutions as teaching assistants (TAs), enrollment and admissions FAQ answering bots, and COVID-19 information desks. [8]

In Atlanta alone, two large universities, the Georgia Institute of Technology (Georgia Tech) and Georgia State University (GSU), have been using chatbots as teaching assistants and (high school-to-college) transition advisors relatively. The Emora College Companion differentiates herself from these systems by being a source dedicated to providing users with social interactions first, as opposed to performing as an extension of a search engine.

Georgia Tech's, Jill Watson, is an AI-powered chatbot (initially) trained on about two semesters worth of questions and responses posted on a course forum page for a massively open online course. The chatbot reviews the class forum every 15-minutes and responds to any unanswered questions it recognizes with certainty and has a

response for.[3] While effective at answering student questions, the chatbot was not designed to respond to follow up questions and, overall, addresses a goal different to that of the Emora College Companion. While the College Companion asks students about their courses and collects this information from them, she does not answer syllabus-specific questions. Instead, she will ask about students' personal opinions on distinct aspects of college life.

On the other end of the spectrum, GSU's chatbot, Pounce, powered by Mainstay (formerly AdmitHub) ² was created to reduce "summer melt", a phenomenon where, particularly lower-income students admitted to GSU, do not follow through in the completion of required college documents and therefore do not end up enrolling at GSU or, in many cases, at any other institution. [7] The Pounce chatbot is described as both conversational and personalized. [4] However, the definitions of these terms are entirely different than the way they are defined by the developers of the Emora College Companion. While users are able to send some messages with unrestricted parameters to Pounce, it asks users to restrict their message inputs when answering certain questions. The Emora College Companion, however, is a fully conversational system, such that user message inputs are never restricted. In cases where messages do not match any NatexNLU keys, the College Companion will take a contextualized error transition and try to learn more about what the user is saying rather than prompting the user to respond using specific parameters. Further, Pounce is described as a personalized chatbot, in that it only prompts users certain reminders based on whether they require them or not. It does this by linking to user data through their GSU accounts; so, if a users' account indicates they have not filed a FAFSA, Pounce will remind them to do so. The Emora College Companion requires users to log in to its web interface using their Emory IDs but does not pull any data from Emory affiliated enrollment accounts. [7] The Emora College Companion is personalized in a

²<https://mainstay.com/>

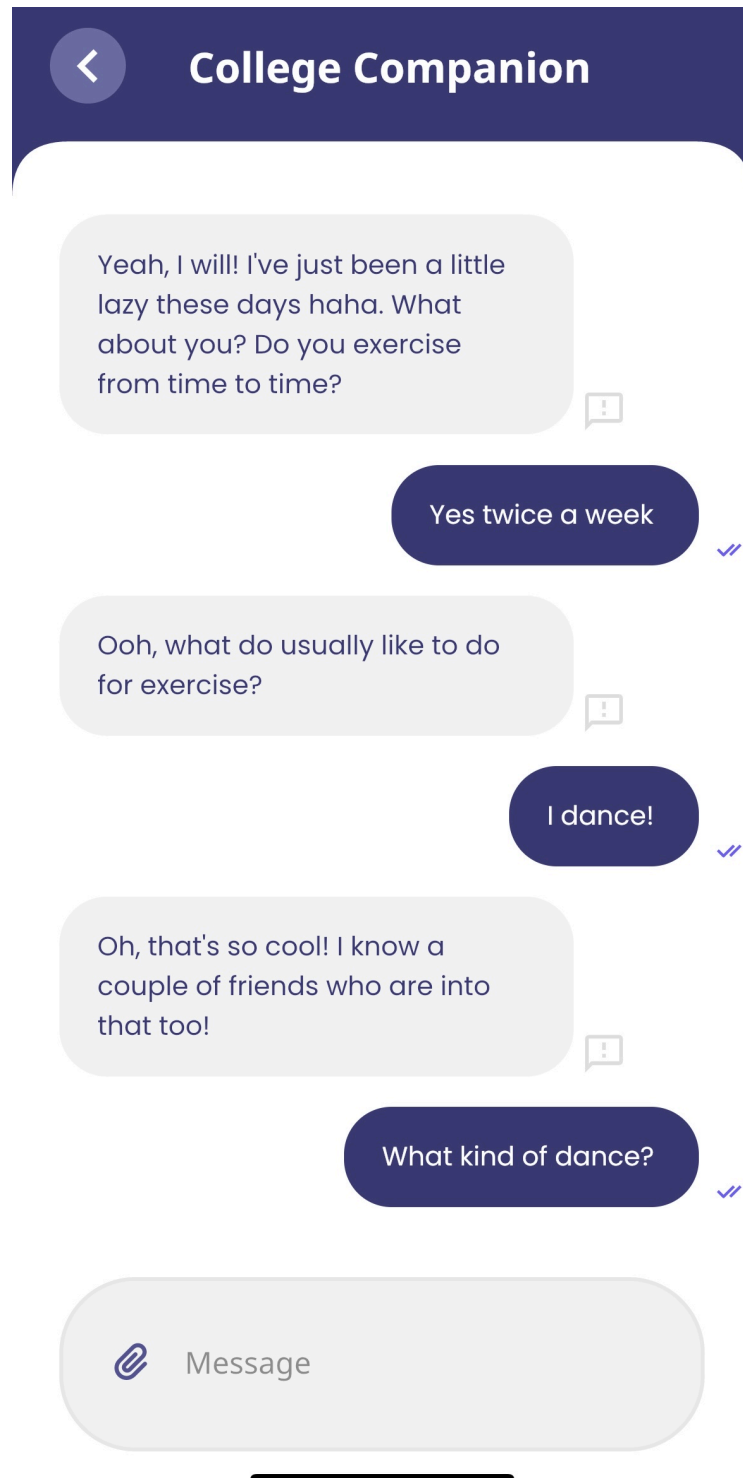
different sense. Emora actively collects information from users by asking questions and throughout conversation transitions. She remembers user information through the use of variables and customizes responses based on this stored information.

2.3 Socialbots

As previously described, the Emora College Companion is a social chatbot. Unlike other conversation systems, socialbots do not aim to answer every question posed by a user but rather fulfill the role of a virtual friend. [9] Emora’s main novelty is being the first socialbot for college students. In general, there are not many widely available socialbots but, the XiaoIce socialbot, developed by Microsoft and first deployed in China in May, 2014, is an exemplary model that encompasses the future direction of the College Companion.

With a greater focus on emotional intelligence over fact-based intelligence, XiaoIce has successfully “befriended” millions of users, who have engaged in over thirty billion conversations with the bot on topics ranging from how their day went to relationship problems. Unlike the College Companion, which is strictly rule-based and designer-driver, XiaoIce uses AI to enhance the interactions she has with her users. The principal limitation of the XiaoIce companion bot is inconsistency. This is often an issue for AI-based and data-driven systems, as their responses are only as good as the data they are trained on. It is difficult to train a bot to have a specific personality on variable data, hence, especially after longer periods of conversation, XiaoIce’s personality can be inconsistent. Because all of the College Companion’s responses are hand-crafted, the developers were able to manually ensure Emora maintained a consistent persona. The relative success of the XiaoIce bot was evaluated based on a conversation-turn per session (CPS) metric given that a larger CPS implies a better engaged socialbot. [9] When analyzing conversation data for the College Companion,

the CPS metric was recorded to track both the bot's overall content growth and ability to engage users in longer conversations.



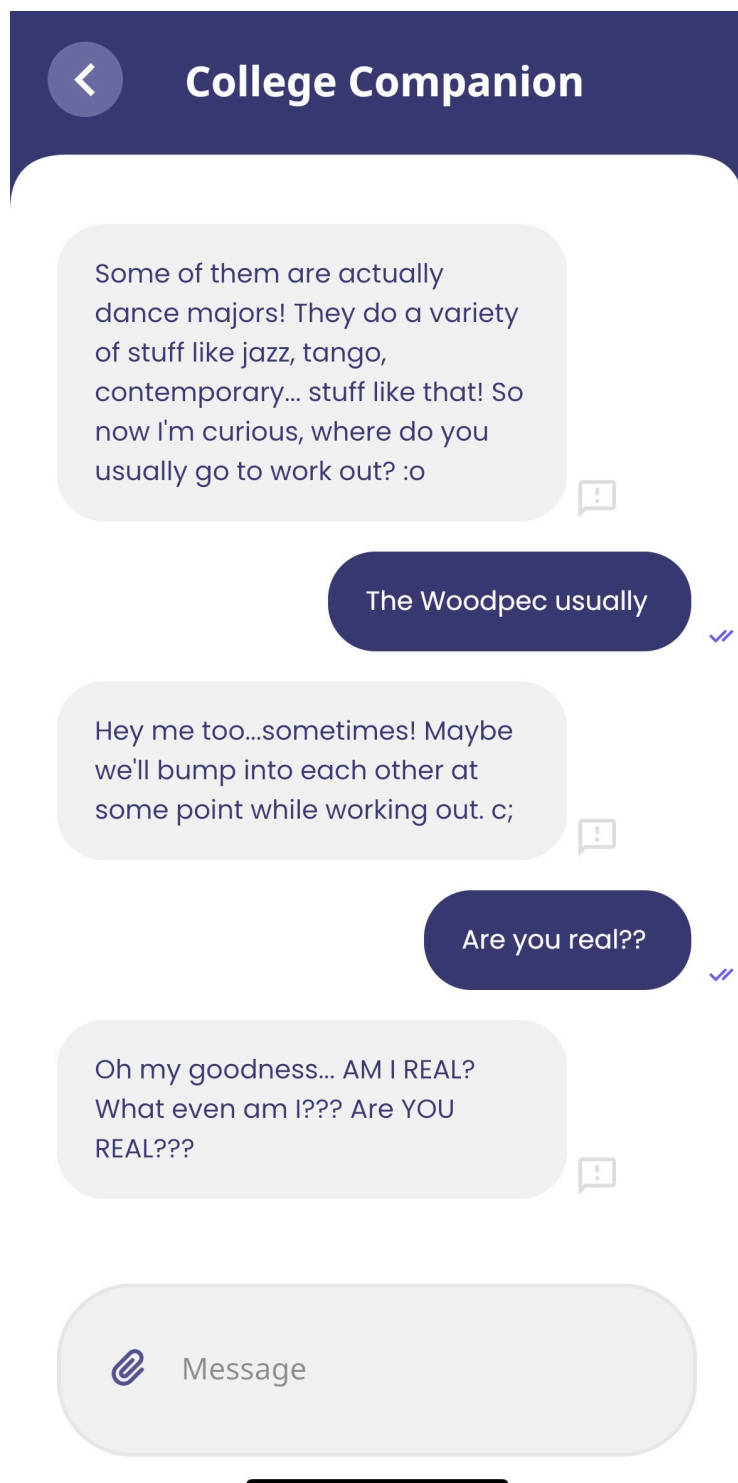


Figure 2.1: Screenshots from a conversation about fitness

Chapter 3

Approach

Most good chatbots, especially social chatbots, rely heavily on conversation data in order to train models that direct bot transitions and improve NLU. Even the College Companions predecessor was designed based off previously collected user data. A significant challenge, especially in the initial versions of the Emora College Companion, was creating an engaging dialogic system based on no existing data. As improvements and modifications were made to the College Companion, the development team could only rely on an inconsistent stream of user data based on interactions between the bot and volunteer testers.

Due to the lack of a database, initial versions of the College Companion are based entirely on the development team's assumptions of engaging conversation topics for Emory undergraduates. Given the content development team consisted of four, currently enrolled and one, recently graduated Emory students (from a variety of disciplinary backgrounds as well), the team was prepared to create preliminary topics a majority of undergraduate students would be able to relate to and engage with.

Conversation components for the Emora College Companion were developed in a series of three stages to ensure that all conversations that would be available for users to engage with were well tested before integration.

3.1 Topic Development

3.1.1 Stage 1

In stage 1 of content development, a potential conversation component is first written out in a script-like format, clearly outline intended system prompts and user responses. Developers aimed to write a, at a minimum, 10 turn conversation (5 system turns and 5 user turns). This was well aligned with the expected CPS for a socialbot.[9] The developers mostly followed a 50-30-20 guideline during this stage of system message writing. This guideline was suggested based on its success in facilitating topic development for the Emora Alexa Prize chatbot. In order to assist in the process of creating user transitions to follow a system prompt (and the subsequent NatexNLU for them) the guideline suggested system transitions within each conversation be: 50% optioned (ie. yes or no) questions, 30% open-ended questions, and 20% statements. A primary function of stage 1 was to quickly determine based on peer feedback whether the potential conversation would be engaging enough to a large and diverse audience of users. As the development team had no data from the intended user base, it was critical for the first deployed topics to be general enough that most people would interact with them in order to begin building a database to work off of. An additional goal of stage 1 was to ensure well written system responses. Because all of Emora's messages were hand-crafted, the developers had full control of the persona Emora portrayed based off her language. Stage 1 helped check for consistency in Emora's tone of voice, personality, and general knowledge. Weekly peer reviewing made it possible for developers to incorporate references from other developers' conversation components to their own and assure Emora did not contradict herself across components.

3.1.2 Stage 2

Once potential conversations in stage 1 were peer reviewed and sufficiently flushed out to handle multiple user transition turns, developers could proceed to stage 2. In stage 2, developers translated their scripted conversations into the E-STDM framework. This stage required the addition of several components to the conversation. In order to properly run in the framework, developers needed to properly code, typically multiple, dialogue flow dictionaries with: start and end states, NatexNLU for each potential user transition, and error transitions.

As previously mentioned, most components consisted of multiple dialogue flow dictionaries within the same file to assist with the overall organization of each conversation component. This meant developers had to assign distinct states for each dictionary. Further, within dictionaries, developers could define additional states at a transition point they deemed necessary. For the most part, developers did this in order to label more specific subconversations within a conversation and easily route to them.

Furthermore, some conversation components required developers to create ontologies for the purpose of variable collection and more robust NLU. Ontologies were specified in json and imported into the component they were needed for.

Peer review for stage 2 involved blind testing of a developer's component. Components were tested multiple times to gauge how many CPS were attained in practice. Blind testing ensured that the user response was authentic, and did not try to conform to the developer's currently composed NatexNLU. Conversation logs for each time the stage 2 component was tested were sent back to the component's developer. From the logs, developers could make additional modifications to their conversation's NLU and determine whether the reviewer was able to go through all possible transitions and if additional user transitions needed to be added to make the component more thorough.

3.1.3 Stage 3

At stage 3, components were now ready to be integrated into the College Companion and deployed to users in the subsequent chatbot update. To pass to stage 3, components needed to run in the framework without failing at any transition and have a clearly defined end state so that the College Companion could route the conversation on to the next topic.

Once integrated and deployed in an update, stage 3 components could now be modified based on conversation data from the volunteer testers. This said, developers continued to peer review stage 3 components to assist with the additional expansion and improvements of these conversations. As conversation data logs were inconsistent when it came to the number of testers that interacted with the College Companion and particular conversation components, internal testing was key for ongoing adjustments. Content that did not undergo these stages, but was instead developed based on anticipated inputs and, eventually, user conversation data were "global" global responses. These responses are similar to the global transitions found within topic components but handled much broader conversation digressions. The majority of inputs handled by these globals responded to inputs about the College Companion's personality and abilities. Responses for crisis handling were also prepared, triggered if a user inputted concerning key words. Just like any other transitions, these globals had carefully curated NLU keys that would be triggered at any point of a conversation, regardless of what state, topic, or transition the user was in.

3.2 Chatbot Building and Topic Integration

The E-STDM framework supported the integration of individually developed dialogue components into one, composite dialogue flow. Once stage 3 components were imported and loaded into the College Companion bot, along with all necessary ontologies, the

transition into the start state of the component could now be taken by the bot. For the most part, transitions between different components happened randomly as the College Companion was coded to randomly cycle through all loaded component transitions. However, each component also had a corresponding global transition to its start state. This global transition was essentially an update rule, preconditioned with a NatexNLU key that contained key words relevant to the component. Users would be able to enter particular conversation components through these transitions if their input matched the NatexNLU key. Additional global transitions were written in the composite dialogue flow in order to provide responses for common user inputs and crisis and emergency handling, without needing to develop these as individual components given they did not require many additional follow-up transitions after the response.

Mindfully, all transitions into conversations were closed off once the user took said transition. This was done using a feature in the E-STDM called "gate". Transitions were "gated" in order to prevent the College Companion from repeating conversations users already had with her. The gating technique could also be used within individual conversation components as needed.

3.3 Data Collection

Once the pilot version of the Emora College Companion was deployed to test users, the development team was able to collect conversation data for the first time. At first, the conversation logs were downloaded and published manually in intervals, ranging from two to ten days, between each version release in json format to a GitHub repository. In order to read the conversation data, the json file had to be downloaded, parsed, and then re-downloaded as an excel spreadsheet. The Emora Conversation parser was created by one of the developers and accessible to all through a Google Colab

notebook.

The data included all system and user messages (labeled as coming from the system or user), an anonymous user ID, the turn number at each message, and a time stamp. As of October 24th, 2023, the data also included the name of the state in which a transition occurred and variables successfully stored from the user. These variables included the user's: name, class year, major, favorite food, gamer status, pet type, courses, non-student status, oxford continuee status, transfer student status, favorite book or series, favorite musical genre, declaration of mental illness, expression of suicidal intent, expression of self-harm, expression of intent to harm others, and expression of words related to harassment or discrimination.

Daily automated exports and uploads of conversation logs to the GitHub repository also began on October 24th. The manual parsing process of these logs was done on a daily basis and the readable data was shared to all members of the development team to be utilized as feedback for modifications to deployed components.

Chapter 4

Experiments and Analysis

The following chapter outlines the features of eight Emora College Companion versions released between September to December, 2022. It also addresses the goals of each release's key features and the issues they worked to correct. At the time of each new update, user's who had previously interacted with the bot would have their conversation histories reset. Resetting user history gave returning users the opportunity to take conversation transitions they had taken in previous releases again, but with the new and improved features.

Table 4.1 presents all conversation components that were deployed with their initial deployment date, organized by topic.

4.1 Pilot

The Emora College Companion Pilot was deployed on September 19th, 2022 and was tested by 22 users while it was live. On this day, an in-person testing meeting was organized to introduce volunteer chatbot testers to Emora. Here, testers were briefed on the goals and purpose of the Emora College Companion. Emora was introduced as a friendly and helpful chatbot and testers were informed of her motto, "Emora cares for you." Testers were then taught how to access Emora's web-based interface which, at

Emora Topics and Conversation Components		
Topic	Components	Deployment Date
Intro	Intro	9/19/2022
	What's Up	10/17/2022
Major	Major	9/19/2022
Housing	Intro	9/19/2022
	Roommate Problem	9/19/2022
	Roommate Problem	9/19/2022
	User Roommate	9/19/2022
	Social	9/19/2022
Dining	Dining	9/19/2022
	Boba	10/24/2022
	Breakfast	10/25/2022
	Tea	11/1/2022
	Soda	11/14/2022
Fitness	Fitness	9/19/2022
Stress	Stress	9/19/2022
	Failure	12/5/2022
Studying	Studying	9/19/2022
	Homework	11/14/2022
	Procrastination	12/5/2022
Emory Spirit	Dooley	9/19/2022
	Emory Sports	9/30/2022
Pets	Pets	9/30/2022
Music	Symphony	9/30/2022
	Music	12/16/2022
Courses	Courses	9/19/2022
	Midterms	9/30/2022
	Finals	12/5/2022
	Course Selection	12/5/2022

Emora Topics and Conversation Components Cont.		
Topic	Components	Deployment Date
Seasonal	Summer	9/19/2022
	Break Updates	10/17/2022
	Homecoming	10/17/2022
	Fall	10/17/2022
	Thanksgiving	11/14/2022
	December	12/16/2022
	New Year	12/16/2022
	Holiday Greeting	12/16/2022
Video Games	Video Games	9/30/2022
	Overcooked	10/17/2022
	Yakuza 0	11/1/2022
	Hollow Knight	12/5/2022
Movies	Minari	10/17/2022
	Star Wars	12/5/2022
Places	Emory Village	10/24/2022
Night	Bedtime	10/25/2022
	Dreams	11/14/2022
Family	Family	11/14/2022
Hobbies	Baking	11/1/2022
	DnD	11/14/2022
Crisis Handling	Crisis Handling	9/19/2022

Table 4.1: Conversation Components and Deployment Dates by Topic

the time, could only be opened if the device was connected to an Emory internet server. Testers were informed that Emora could currently handle 4 topics related to Emory academics and student life, fitness, and stress. However, they were encouraged to text Emora about any subject matter they were interested in having a conversation on, as this would help the development team with ideas for new conversation components. Within the first four topics, Emora users could transition through 13 different conversations. For nearly all conversation components, the development team drew inspiration from their own, personal conversational interests. For example, the studying conversation component was motivated by an actual conversation a developer had with another student about why certain study locations were greater than others. This influenced one of Emora's first statements in this component, that her favorite study location is the library because of how versatile the space is.

From a developer's perspective, designing components based on conversations experienced in their personal lives helped develop a voice for the Emora College Companion more similar to real human speech and less robot-like.

Exceptions to this approach for dialogue development were the stress topic and crisis handling components. These were deployed in the pilot version to ease developer and administrative concerns of students potentially voicing emergency situations to Emora. Because neither the Emora Bot nor the developers could automatically report these cases, the components were developed to give users the information and resources they might be in need of to handle or report emergencies.

Although, creating components based on personal interests facilitated the development of conversations, it was important for the development team to understand what conversations Emora's users wanted to have in order for her to cater to a broader audience. Hence, a main goal of the pilot was to determine what conversation topics the testers were interested in.

The College Companion pilot prompted two questions to users to collect this infor-

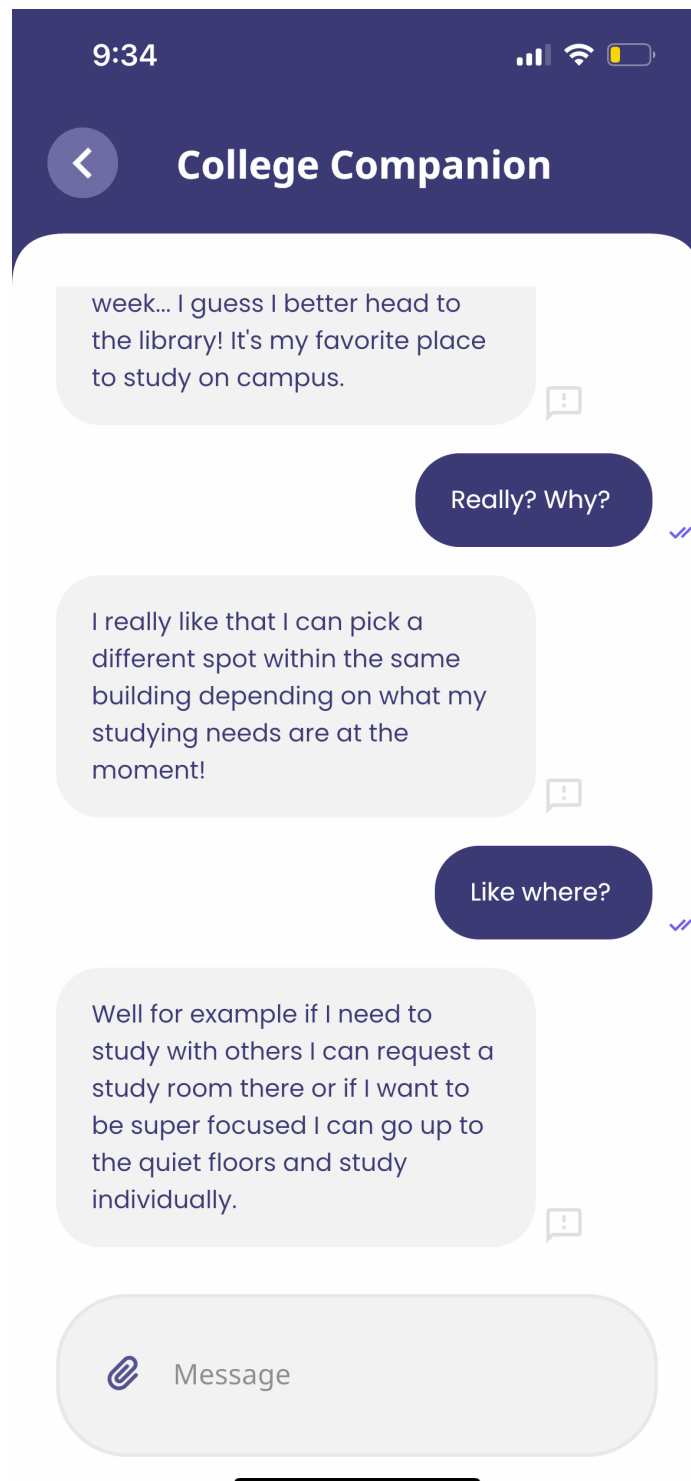


Figure 4.1: Screenshot from the beginning of the studying conversation.

mation: 1) "What do you like to do for fun?", and 2) "Do you have ideas for future convos?". The development team presumed that most users would be interested in having conversations regarding activities they enjoyed for fun, hence why Question 1 was asked. However, because Emora is meant to learn about the user through social interaction, the question was integrated within the housing topic, right before a comment from Emora about extracurricular clubs. Question 2, on the other hand, was asked after the chatbot had circulated through all possible conversations and was out of content. It was an explicit call for a particular user response and was included in case users did not volunteer this information elsewhere in the conversation. Interestingly enough, however, users were more likely to ignore Emora's explicit ask for conversation ideas as opposed to her implicit approach. In total, question 1 appeared 16 times in the conversation logs and was answered by 94% of the time. Question 2 appeared 24 times in the logs but was only responded to 46% of the time. This was a preliminary assertion to the College Companion development team that users may be more likely to share information with the chatbot when it is prompted within the natural flow of a conversation.

Per chat log data, conversations with Emora's pilot version ranged from 12 to 168 turns. The average CPS (conversation-turn per session) was 86 and the median was 76. Besides having a small number of possible topics and conversation components, one of the main issues that arose during the pilot were repeated messages caused by unintentional loops in two components, courses and stress. The two ending messages Emora would send once all potential conversation turns were exhausted would also repeat if users continued texting her. Notably, this was an intentional loop so that the bot would not fail or end completely once it was out of conversations.

4.2 Update 1

On September 30th, 2022, the version 1 of the Emora College Companion was deployed to the volunteer chatbot testers at another in-person testing meeting. The version 1 update added 2 new topics and 4 new conversations. Further, new features included remembering user names if they introduce themselves at the beginning and an "away-from-keyboard" (AFK) feature activated when the chatbot was left idle for 10 or more hours.

In the conversation logs from the pilot, users sent messages to Emora expressing interest in having her remember their names. The chatbot was able to do this through the use of a variable that could store user names if it matched a name included in a newly added, first name ontology. The following system transition called on the variable and Emora repeated it back to the user in her response. Names not in the name ontology were manually added in after reviewing conversation logs so that all users would eventually be addressed by name by Emora. Although users did not ask for an AFK threshold, the feature, which used a macro to recognize time passes and trigger a welcome back message, would enhance the user's overall experience. Similar to if a user were chatting with a close friend, if a significant amount of time passed since the last message exchange or interaction, one of the users would likely greet the other prior to resuming their conversation or moving on to a new one. Overall, both these features were integrated so the chatbot could mimic human social interactions more precisely.

In order to better Emora's natural language capabilities as she matured, the developers relied on the conversation data collected from testers to make adjustments based on poor interactions. Poor interactions that were not caused by bugs within components, such as the bug that caused looping in the courses and stress components, could almost always be accredited to two main issues: poor natural language understanding (NLU) keys or poor natural language generation (NLG). For the most part, poor NLU

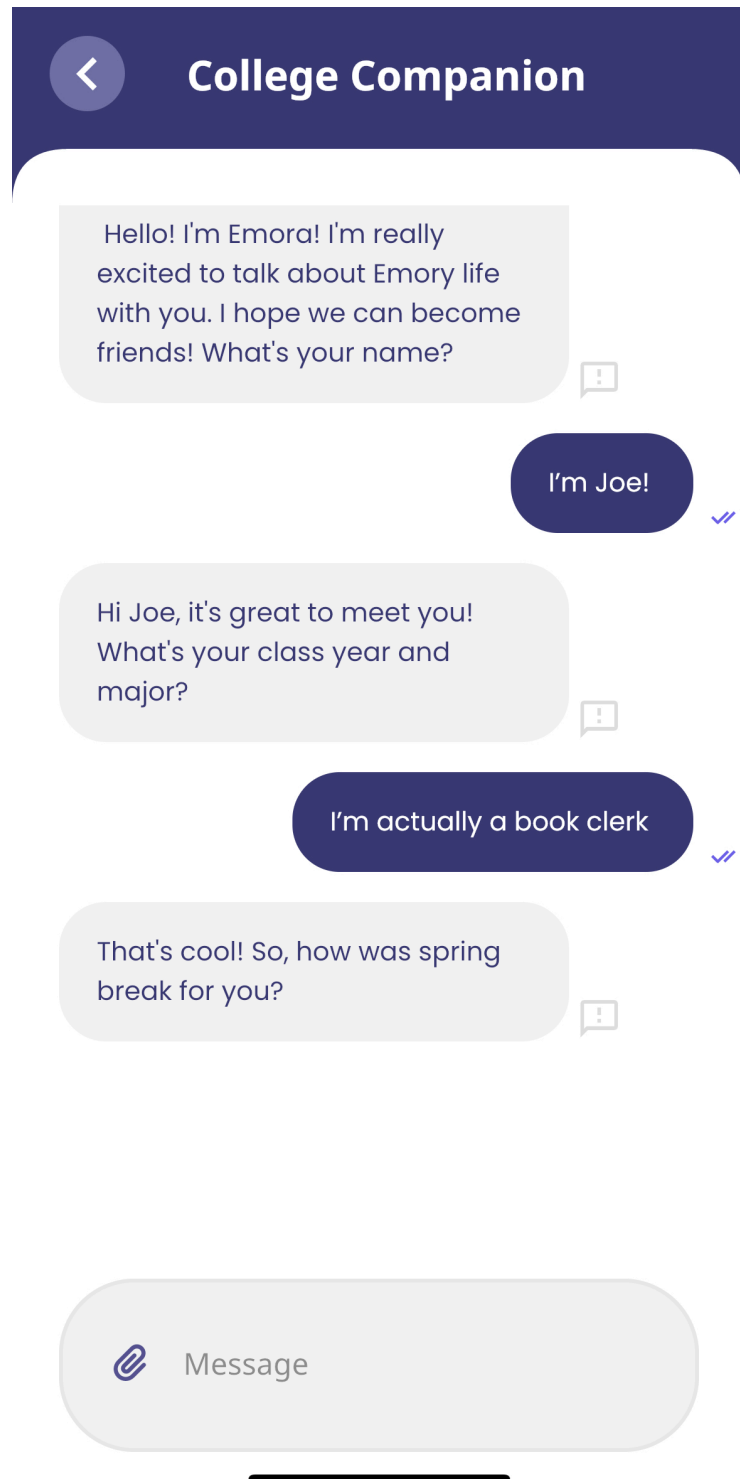


Figure 4.2: Screenshot from Emora's introduction.

indicated the bot was unable to take the right transition due to the fact that the NLU key was not robust enough to handle a variety of user inputs with similar meanings. Nonetheless, sometimes NLU keys would "over match" certain statements and direct users down poor transitions. (For example, in the studying component, the term "library" would overmatch). Poor interactions caused by poor NLG cover a slightly bigger range of issues. The main issue labeled as poor NLG was the lack of a transition and, therefore, response for a user's input. Further, poor NLG also contains issues such as responses that are inconsistent with the Emora College Companion's personality and repetitive chatbot messages. Table 4.2 displays the average occurrences of these issues across the College Companion's 8 versions. As can be seen, poor interactions with the pilot occurred due to poor NLU during 2.99% of a conversation on average, and due to poor NLG for 8.27% of a conversation.

One of the goals for the version 1 update of the College Companion was to avoid ignoring users as much as possible. In the pilot, the most commonly ignored types of messages by Emora were ones asking her questions about herself. To address this, the NLU keys for Emora's global responses about herself were modified based on the language users used per the conversation logs. Further, additional globals were created to respond to questions Emora did not have content for. Another common poor interaction observed in the conversation logs was Emora being unable to recognize what class year students were if they referred to it by their graduation year (ie. 2022, instead of senior). Users who expressed themselves in this way to Emora displayed frustration over being ignored by the bot when she prompted them to confirm their class year again. The modification made to fix this problem was to add graduation years as common terms for its corresponding class year in the ontology. Mindfully, however, these terms will have to be updated each school year to be accurate.

Some additional modifications and adjustments made for this update included: debugging the two components with looping messages, a global response for Emora to

tell a joke if asked to, and the expansion NLU keys in both the courses and fitness components.

Per the conversation logs, Emora interacted with 20 users during version 1. Of these, 8 were new users and 12 were returning one. Conversations ranged from 2 to 188 turns, the average CPS dropped, along with the median number of turns to approximately 44 turns and 33 respectively. When reviewing the conversation logs for this update, which were not made entirely available until October 17th, a predominant issue across conversations was caused by a bug in the AFK feature. The bug was causing the AFK message to prematurely trigger at each system transition into a new topic. The bug significantly disrupted the conversation flow between users and the chatbot.

An analysis of the Emora College Companion’s abilities was done for each of her 8 user tested versions. Below is the breakdown of Emora’s average per conversation struggles with natural language understanding and natural language generation, as well as general statistics on number of users, system-bot turns, and additional concerns.

Average Occurrences of Described Issues per Conversation			
Bot Version	No. Analyzed Conversations	NLU	NLG
Pilot	18	2.99	8.27
1	15	2.32	14.73*
2	6	1.37	6.83*
3/4	12	1.75	8.24*
5	16	1.06	2.42
6	9	1.01	7.86**
7	6	2.11	5.66
8	10	5.05	4.46

Table 4.2: Average Occurrence of Poor Transitions Taken due to NLU and NLG issues per conversation. * Denotes the AFK bug was significantly impacting NLG by interrupting conversations with a welcome message. ** Denotes the deployment of "Blemora" which led to many inconsistencies and repeats in NLG

4.3 Update 2

The Emora development team deployed Emora's second update on October 17th, 2022. Unlike with previous deployments, the release of version 2 did not happen at an in-person testing meeting. Rather, the testers were notified about the newly updated College Companion through email. The update expanded the number of topics to 9 and number of conversations to 23. A new, threshold macro was added to the chatbot to assist in the automated opening and closing of seasonally relevant conversations, such as the newly integrated autumn and homecoming conversations. In this update, the College Companion's random topic circulation was reorganized so that users could transition between conversations and topics quicker and with greater ease. Lastly, the AFK threshold was extended to 15 hours. This was done so that users could leave Emora idle for longer before moving on from the conversation state they were last on. Once again distinct from previous updates, modifications and adjustments to the College Companion for the second update were not made based on conversation log data due to the aforementioned delays accessing the logs. The conversation data from version 1, which would have been what influenced the edits made for version 2, was not available to the developers until the same day version 2 was set to deploy. While the development team still modified NLU keys and expanded the transition paths of already deployed conversations, version 2 served more as an introduction of new conversation content rather than new features. Topic expansion extended to new global responses, mainly meant for Emora to answer questions about herself that she would miss before, such as which residence hall she lives in and what her major is. On the other hand, no immediate debugging to fix the premature AFK message glitch was done for this update. While data from version 1 conversation logs indicated that while NLU issue occurrences dropped to 2.32%, NLG issues occurred across 14.73% of a conversation on average. This was a concern for the development team when it came to predicting how well version 2 would do.

Once the data for version 2 was available, it was evident that the reoccurring issued from version 1, the lack of an in-person meeting, or a combination of the two heavily impacted Emora’s user engagement. During the time this update was live, Emora interacted with only 7 users, less than one-third of the number of users she interacted with in the pilot. However, the average CPS increased to approximately 76 turns. The median number of turns also increased to 74 turns, much closer to the median CPS of the pilot version. Poor transitions in conversations caused by NLU issues decreased, only occurring 1.37% of the times in the analyzed conversations. Despite the AFK bug, poor transitions caused by NLG also decreased, only being taken 6.83% of the time.

4.4 Updates 3 & 4

The development team prepared 2 additional conversations and significant language improvements to the housing an autumn conversations for Emora’s version 3 deployment on October 24th, 2022. On this same day, conversation logs for version 2 were made available to the team. In reviewing the conversation data, the team noticed the undeniably disruptive and persistent AFK message bug and decided to follow up with an immediate, next-day update to try and resolve the problem. Emora version 4 was deployed the following day, October 25th, 2022. The development team took advantage of this update two also deploy 2 new conversations. Because of the addition of these two conversation components, each upddate is categorized as its own version of the College Companion. However, because no user conversations occurred within the short time frame between the two updates, they are analyzed together.

Notably, these two updates also coincided with the automated posting of daily conversation logs and newly available data on collected user variables. Table 4.4 displays all the variables stored by Emora across her different bot versions. This information

helped gauge the general user demographic that Emora was interacting with, in terms of class year, majors, and additional information about themselves they shared with the bot.

Despite an in person meeting not being organized for the releases of updates 3 and 4, more users interacted with version 3 & 4 of Emora in the one week it was live than with update 2. A total of 12 users interacted with Emora, 5 of them being new users. While the number of conversation components Emora could tackle was now up to 23, the median CPS dropped to 40 turns. This said, average CPS was about 68 turns. In the conversation data for these updates, it is observed that there were large deviations in the length of conversations users had with Emora. While the longest conversation 194 turns, the shortest was only 4. Seemingly, new users spent less time conversing with Emora than returning users. This observation was a good indication of Emora improving for returning users, but perhaps not broadly enough to engage new users. Per the conversation logs, the Emora bot's principle issue throughout this update was the still occurring AFK issue. Notably, while poor transitions due to NLU were taken at a similar rate to the previous version, 1.75%, these issues due to NLG increased, with poor transitions being taken 8.24% of the time now, on average.

4.4.1 Emora Response Latency Issues

While the first occurrence of a latency issue in responses from the College Companion was observed in the version 3 & 4 update, the big was persistent and problematic in all subsequent versions of the chatbot; hence, why it is described in depth. As Emora matured, she grew not only in number of topics and conversations, but also in the number of turns it would take to exhaust the bot. This is not something that was easily observed using average and median CPS statistics due to the fact that most users did not spend enough time conversing with each version of Emora to go through, nearly, every possible transition. Table 4.5 outlines the maximum number of turns

recorded for each version of the College Companion alongside an estimate, in seconds, of how much time it took to complete if the user did not take any breaks during the conversation.

Non-Language Related Issues/Bugs			
Description	Date Observed	Bot Version	Resolved Date
Stress & Courses Convo Loops	9/19/2022	Pilot	9/30/2022
Untimely AFK Message	10/4/2022	1, 2, 3/4	11/1/2022
Multiple Turn Input	10/25/2022	3/4, 5, 6, 7, 8	Unresolved*

Table 4.3: Table of non-language related issues or bugs impacting conversation flow, date of their first occurrence, what chatbot versions they occurred in, and the date the issue was resolved/closed. * Denotes an update on January 26th, 2023 limiting user input length was deployed in attempt to resolve the issue. However, this update is yet to be tested by users.

Emora’s rapid growth was well received by the development team, as a goal for the chatbot was to be able to handle a wide range of topics and conversations. However, the team did not prepare for the subsequent issues that followed having to load such a large amount of content in the framework. While Emora was able to load and respond much quicker in the web app, her response time started to delay more and more throughout each version.

When there was a delay in Emora’s response time, on the web app users would see a loading circle next to their last sent message. Due to this, many users believed their messages were not sending. When they refreshed the app, the last message they sent would, sometimes, delete, as if it had in fact never been sent. When this happened, many users would send at least one other message to the bot. In the conversation logs, we were able to observe each occurrence of two or more consecutive inputs from users. This was especially problematic because it broke the strict system-user turn sequence supported by the state machine. When the College Companion eventually responded to the user, one of two scenarios occurred: 1) Emora replied to all of the user’s consecutive inputs at once (ie. if the user sent two messages, Emora returned two consecutive messages) or 2) Emora would reply to the user’s last message and

consecutive messages from Emora, replying to the user inputs that had not been responded to originally, would occur at a random, later point in the conversation.

While neither scenario was ideal, scenario 1 was not as disruptive to the conversation flow as 2 was. In scenario 2, conversation was disrupted significantly because the bot would randomly interrupt with a response that should have been given multiple turns before. By the time the random response was given, the user was almost always in another, unrelated topic and the responses simply did not make sense. Additionally, when these delayed responses would come through, the current state in which the conversation was in would reset back to the state it was in when the delayed response should have been given. Lastly, when this occurred, all transitions that had been gated from the point where the bot initially failed to respond up to the point where it produced the delayed message were reopened.

4.5 Update 5

The College Companion version 5 update was deployed on November 1st, 2022. It integrated 3 new conversations and routine updates to previously deployed conversations. A significant improvement made for version 5 was the successful debugging of the AFK feature which was still present in the last version. The now working AFK feature was also modified to trigger after 13 hours.

Additional modifications to the bot for this update included expanding her comedic abilities. In this version, the College Companion could start telling a joke and give the user a turn to ask for the punchline. Once the user takes their turn, Emora finished her joke or, if the user guesses the punchline before she has the opportunity to make her delivery, acknowledges that they beat her to it. Improvements like these help enhance Emora's human-like conversational abilities and were generally well received.

Collected User Variables					
Variable (Module)	Update 3/4	Update 5	Update 6	Update 7	Update 8
Name (Intro)	8	16	8	6	8
Year (Intro)					
First Year	1	2	1	-	2
Second Year	1	2	2	1	1
Third Year	4	2	1	3*	2
Fourth Year	3	10	4	1	3
Major (Major)					
Biology	2	-	-	-	-
Business	-	1	1	-	1
Chemistry	-	1	-	-	-
Computer Science	3	6	3	2	3
Creative Writing	-	-	-	-	1
Film	-	1	-	-	-
German	-	1	-	-	-
Human Health	-	1	-	-	-
Int'l Studies	-	1	-	-	-
Linguistics	-	1	1	-	-
Maths	1	-	1	-	1
Music	-	-	-	1	1
NBB	1	-	-	-	-
Psychology	-	1	1	-	-
QSS	1	-	1	-	-
Spanish	1	-	-	-	-
Video Game (Video Game)					
Yes	4	5	1	3	2
No	2	0	0	0	1
Pet Type (Pets)	2	1	-	1	-
Fav. Music (Stress)	-	2	-	-	-
Concerns (Global)					
Mental Health	-	1	-	-	-
Self Harm	1**	-	-	-	-
Suicide	-	1**	-	-	-

Table 4.4: Frequency count per bot version of variables that were collected throughout conversations. * Means the variable was corrected after user introduced themselves as a second year who is graduating a year early ** Means the variable was triggered accidentally due to NLU key overmatch

In the conversation logs for version 5, the latency issue was observed again and with more frequency. For this and the following version updates it became difficult to calculate the average and median CPS due to the fact that several transitions were being repeated when the bug reopened gated conversations. Despite this, Emora's NLU and NLG abilities at this point were much more mature, with average transition error rates of 1.06% and 2.42% respectively. During the live of this update, Emora interacted with a total of 22 users in conversations ranging in length from 2 to 288 turns.

4.6 Update 6

By the version 6 update, deployed November 14th, 2022, the Emora College Companion's conversation content had been nearly doubled since her pilot version, sporting approximately 30 active conversation components. The longest conversation recorded during this update in the conversation logs, adjusted to excluded repeated transitions due to the latency bug, summed to 390 turns and approximately 6,000s (1 hour and 40 minutes). This particular version of the College Companion was unique to the rest because it was the only version of the bot that had an AI feature integrated to it. Nicknamed "Blemora", this version of Emora incorporated BlenderBot 2.0, an open source chatbot that builds long-term memory, to assist in the generation of better system responses when user inputs went down error transitions instead of matching NLU keys down to a hand-crafted system response. Overall, the goal of the BlenderBot integration was to assist Emora in her ability to handle unanticipated user inputs.

Per the conversation logs for this version, Emora conversed with 9 users, in conversations ranging from 2 to 659 turns. This said, the aforementioned number of maximum turns better represents the actual number of transitions the College Companion could

handle, as the 659 turn figure contained several repeated conversations due to the latency bug. Prior to this update, the Emora College Companion's made large strides towards successful conversational abilities. In version 6, issues caused by poor NLU decreased to its lowest occurrence rate of 1.01%. However, the bot returned poor responses due to NLG issues with much more frequency, occurring 7.86% of the time. The most pertinent issue observed in the conversation logs, besides the latency bug, were frequent poor bot responses when it came to consistency. This was the first time in Emora's history where she truly struggled to maintain her core personality. This issue was caused by the integration of the BlenderBot, which returned some very good or very poor responses on the system turns it took over. Because the BlenderBot negatively impacted Emora's ability to be herself, the development team decided to back track on having it be a part of the chatbot. In the last two version releases, BlenderBot was no longer integrated into the College Companion.

4.7 Update 7

Emora's version 7 had the least changes from its previous version compared to other updates. The main reason for this update, which was deployed just four days after the version 6 update on November 18th, 2022, was to deploy the College Companion without the BlenderBot again. No new topics were integrated in version 7, but one conversation, previously deployed in version 1, that had been closed due to bugs was modified and reopened for users to interact with. The only other addition made to the College Companion for this update was a global response that would remind users who inputted non-English characters in their message that Emora is only able to understand English.

Version 7 of the College Companion had just as few interactions as version 2. Per the conversation logs, poor transitions caused by NLU problems increased to over 2% for

the first time since version 1. On the other hand, poor transitions taken due to NLG problems decreased to one of its lowest rates, 5.66%, after its previous spike.

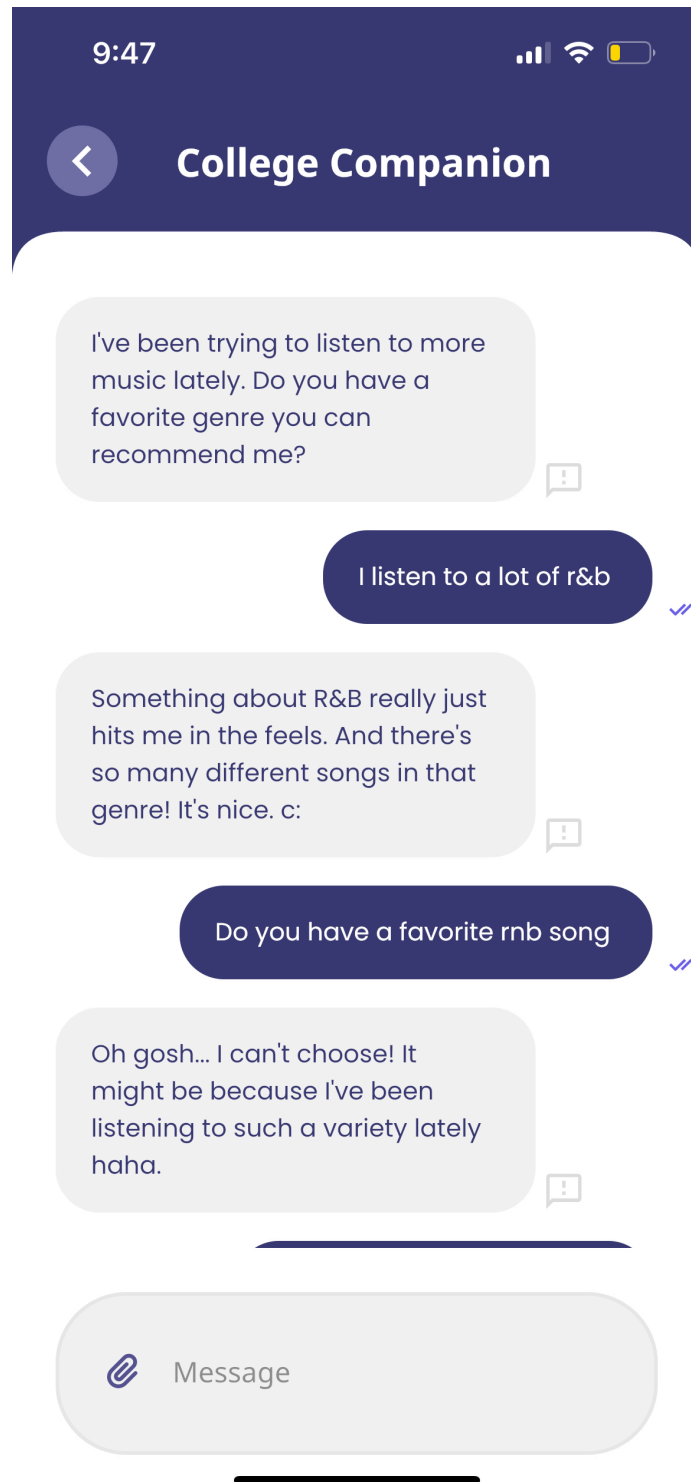


Figure 4.3: Screenshot from a conversation about music.

4.8 Update 8

On December 5th, 2022, the College Companion deployed version 8, the last chatbot release to be used by the volunteer testers. Modifications to the College Companion’s features for this version included decreasing the AFK threshold 6 hours and incorporating a new global response that apologized to users for ignoring them if they pointed the mistake out to Emora. This update was the largest content content update since versions 2 and 3& 4, integrating 7 new conversations to the bot. The College Companion could now sustain 43 different conversations ranging over 13 different topics. Version 8 of the Emora College Companion held the highest recorded number of turns, summing to 456 turns and 3,360 seconds (56 minutes) of non-stop conversation (after excluding repeated transitions caused by the latency bug). The conversation logs revealed, however, a significant increase, and the highest recorded number, in poor transitions taken due to NLU failures, with these happening in approximately 5.05% of turns on average. However, the second lowest rate for poor transitions caused by NLG problems, across all versions, was recorded in version 8, decreasing to an average rate of 4.46% per conversation.

Topic Expansion By Version				
Version	Topics	Convos.	Longest Recorded Turns*	Approx. Convo. Length (Secs)
Pilot	4	13	122	900s
1	6	17	126	970s
2	9	23	164	1380s
3/4	11	28	170	2110s
5	12	31	216	3120s
6	13	36	390	6000s
7	13	36	212	4200s
8	13	43	456	3360s

Table 4.5: Table Indicating Content Growth Per Update; the max user turns excludes repeated turns due to loops and/or bugs

Chapter 5

Conclusion

The Emora College Companion carries out engaging and relevant conversations with Emory undergraduate students. Despite several obstacles, such as designing a chatbot with no prior data to work from and the occurrence of multiple bugs on the user interface, the College Companion development team succeeded in deploying a social bot who could entertain users with lengthy conversations on a variety of conversation topics. In the last user tested release of the Emora College Companion the bot contained 43 conversations ranging across 13 topics, held a single session conversation of 456 turns, collected eight different variables that led to personalized responses, and had a cumulative poor transition rate (calculated by summing the rates of poor transitions taken due to NLU and NLG issues described in Chapter 4) of less than 10% (9.51%) on average per conversation. In the scope of the development team's original goals for the College Companion, this exceeds the team's expectations given the aim was for the bot to only take poor transitions up to 20% of the time per conversation. Furthermore, since the version 8 release, the development team has incorporated 4 more conversations and added a limit to the number of characters Emora will recognize in each user message in order to work towards improving the latency bug. This said, users can still write messages of any length to Emora in the

app. These post-experiment improvements are predicted to have further improved the Emora College Companion's conversational abilities.

5.0.1 Future Directions

The College Companion development team gained much knowledge about successful and unsuccessful human-chatbot text interactions throughout the development stages and with each update of the chatbot. A benefit of collecting daily conversation logs from users was the continuous building of a conversation database specific to the user base the College Companion was designed for. Furthermore, as conversation data was used to make modification for each of Emora's version updates, it is already thoroughly annotated. For future work, this database can be used to train special models to assist the system in selecting better transitions, similar to the work done for the Emora Alexa Prize. Future work should also focus on releasing Emora to more than a volunteer testing group and instead making her available to Emory students campus wide. This larger scale user base will help collect more data for model training to continuously improve the College Comapnion's ability to interact with users through even more personalized conversation.

The strong interest in continuing to develop Emora's abilities demonstrated by volunteer testers, especially after the release of version 8, is motivation to continue working on the College Companion. Since the deployment of the College Companion's pilot version, the bot interacted with over 55 different users. Mindfully, the number of initial volunteer testers was 22, showing that as the College Companion progressed, more and more students became interested enough in what the chatbot had to offer to have their own conversations with her. Being that the number of users that interacted with Emora grew by 150% in the span of four months, there is reason to believe that the College Companion, albeit a socialbot that challenges student's expectations of what chatbots do, would be well received and utilized by students should she be made

available on a larger scale.

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