Memorandum:
TO: Dr. Mahoor
FROM: Courtney Owen
SUBJECT: Chatbot for Elderly People with Depression

There is clearly a deficit in mental health care in this country. From dogmatic stigma to prohibitive cost to a lack of facilities for mental health, it is very hard to receive mental health care. There is an even greater inability for elderly to get the care they deserve for several other reasons, the main of which is how much ageism prevails in our society. For many people, getting older means losing a hold of your mental and physical abilities as you slowly creep towards the grave. Quite the opposite is true: elderly people actually report greater happiness as they age and as long as a person takes care of themselves, it is unlikely they will suddenly develop any horrific issues of the body or mind. In this case, the true tragedy of ageism is that if an elderly person becomes depressed, they will attribute it to getting older so it is even more unlikely they will seek help. This is especially an issue in nursing homes: since most nursing homes are understaffed, instead of getting the individualized care needed, an elderly person may just be placed on antipsychotics which, if prescribed incorrectly, are more like sedation. This summer, I aspired to create the first version of a chatbot to help alleviate depression in elderly people. This can be used when an elderly person can't afford mental health care or can't physically go to a psychiatrist. I hope that such a chatbot can be easily available in understaffed nursing homes where elderly people can't be given the attention they deserve or if they simply aren't visited enough by their family and need someone to talk to.

This chatbot implements cognitive behavioral therapy (CBT) to alleviate depression. CBT is a type of talk therapy that works by helping a person realize that his or her thoughts, actions, and mood are all related; any change in a thought, action, or mood can positively or negatively impact the other two fields. Once a person knows this, they can use CBT to identify

distortions or incorrect patterns of thought that negatively impact his or her actions and mood. Since it takes time for people to recognize what patterns of thought can be damaging to themselves, CBT also works in the other two fields: it encourages people to set goals for themselves and to plan pleasant activities to keep the mind and mood healthy.

Knowing the basics in CBT, I set out to develop the chatbot. I created the first version of this chatbot on Twine, an interactive storytelling platform which allows me to see the different routes the conversation my chatbot can take and easily keep track of them (Figure 1). Each box is a part of a conversation, and the arrows lead to where the conversation can go from there. Twine implements Harlowe, a JavaScript story format file which allows the chatbot I built in Twine to be made into an HTML file ideally deployable in any web browser.

The chatbot starts with a friendly introduction and introduction to the program. The user either types in a response when prompted or clicks one of the responses listed in blue. Depending on the user's response, the chatbot could respond differently. The next thing the chatbot does is to introduce the ideas of CBT and ask if the user wants to continue. At any block in the conversation, the user has the ability to discontinue conversation if desired. If the user continues on with the introduction, the chatbot asks to conduct the PHQ-9 test. This is a depression measure test to rate the severity of someone's depression. The chatbot currently includes question 9: whether or not the user has considered suicide. If the user answers yes, the chatbot provides a list of recourses for the user to consult, and I would like to eventually flag this question so that it will alert a caregiver or family member. After the PHQ-9 test, the chatbot asks to do a check in. This is the primary function of the chatbot: to check in with the user every day, ask about their mood, and then propose an activity or thought experiment based on whether or not the user is in a positive or negative mood. The first day, the chatbot will comment on the

user's mood, then it goes over in more detail how mood, thoughts, and actions are interconnected in a cycle.

After the first day, if the user is in a positive mood, the chatbot will ask the user if he or she wants to do an activity. The activity is randomly chosen from the following list: watch a quick video, read a short article, play a game, or do some exercise. As for watch a video, the chatbot will randomly select from a myriad of TED talks about ageing for the user to watch. For articles, the chatbot goes over one of three articles in great depth: one focusing on Fauja Singh, the oldest marathon runner in the world; one on Anna Mary Robertson Moses, who didn't start painting until 76 and became one of the most famous American Folk artists; and the final one on becoming a senior corps member for his or her community through the corporation for national and community service. The games are either solitare, Sudoku, chess, or the challenge to do everything with the user's non dominant hand for twenty minutes or so. Finally, the exercise component is a list of exercise videos that are either 10 minutes, 15 minutes, 20 minutes, or an hour long.

If the user is in a negative mood, the chatbot will randomly ask one of following items: to hear a joke, do gratitude journaling, do a progressive muscle relaxation, a relaxed breathing session, or if they want to talk about it. The chatbot will ask a joke until the user laughs or the chatbot runs out of jokes. Gratitude journaling is a CBT practice in which the user states one thing that made him or her happy that day, something he or she is looking forward to in the future, and finally something that will always make him or her happy. Progressive muscle relaxation is a meditative practice that gradually relaxes the body, which in turn positively affects the mind, same for relaxed breathing, which is practicing slow and full breathing for a couple of minutes. When the chatbot asks to talk about what is putting the user in a poor mood, it goes through a list of 15 common cognitive distortions and asks the user which one seems the most

like his or her current pattern of thought. Once the user makes a selection, the chatbot congratulates him or her on being able to identify a cognitive distortion and talks him or her through a way to alleviate that deconstructive way of thinking.

After another week of check-ins, the chatbot talks about the importance of setting long term goals. The problem with long term goals, however, is that they often seem unattainable and impossible to reach. To remedy that, it asks the user to set a weekly goal that will help him or her reach a long term goal. At the end of each week, it asks the user whether or not he or she achieved their weekly goal. If so, it asks if that was the end of his or her long term goal, and if so, to set a new long term goal. If the weekly goal was not achieved, the chatbot offers some encouragement and asks if the user would like to reset his or her weekly goal to be something more manageable.

The fourth week of the chatbot, it talks to the user about how most of the thoughts a person has in a day aren't necessarily conscious and how those subconscious thoughts influence the way a person acts. The chatbot then explains the necessity of having to identify negative subconscious thoughts because they can heavily influence a person's actions and mood heavily. After this, it goes to the "talk about it" section from the daily check-ins in which it asks the user to identify a cognitive distortion and work through it. The chatbot continues to do daily check-ins for the next week, then it asks the user to do the PHQ-9 test again. It comments on whether or not the user's depression has improved or not, then goes on to explain how planning daily activities can help increase a person's mood, referencing back to the mood, thought, action-cycle it discussed the first day. It then has the user plan out a simple, pleasant activity every day for the next week. From then on, the chatbot asks if the user has or will complete that activity before moving on to do a daily check in.

This is how the chatbot ideally operates so far. It will continue to do check-ins and goal checks indefinitely for as long as the user wants to talk to the chatbot and it will do PHQ-9

checks every two weeks. When I have another spare moment, I would like to go through the chatbot to make sure everything is implemented correctly and then to ask for professional advice as to further improve it. I would also like to find someone to help with this project; either to improve the psychology side of the chatbot or to implement machine learning. I initially tried to implement machine learning with this chatbot, but quickly realized that I would need to compile a large dataset to train the chatbot to say the right things. For now, I believe the best thing to do would be to follow up with Shandra Levey from the University of Colorado School of Medicine and talk about the implementation of CBT. Before we start to implement machine learning, I think it would also be useful to run a feasibility study to determine if the chatbot is working at all to reduce depression. I would also like to get back into contact with Alison Darcy, the creator of Woebot, and see if she were willing to share Woebot with us and optimize it for elderly people as opposed to college aged young adults.

APPENDIX
Figure 1: The Chatbot