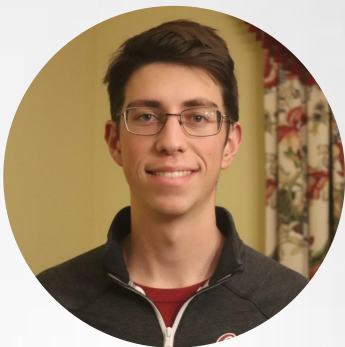


NLP is Not Enough: The Need for Contextualization of User Inputs for Chatbots in the Mental Health Domain

Knowledge-Infused Reinforcement Learning Workshop 2021 #AIISC



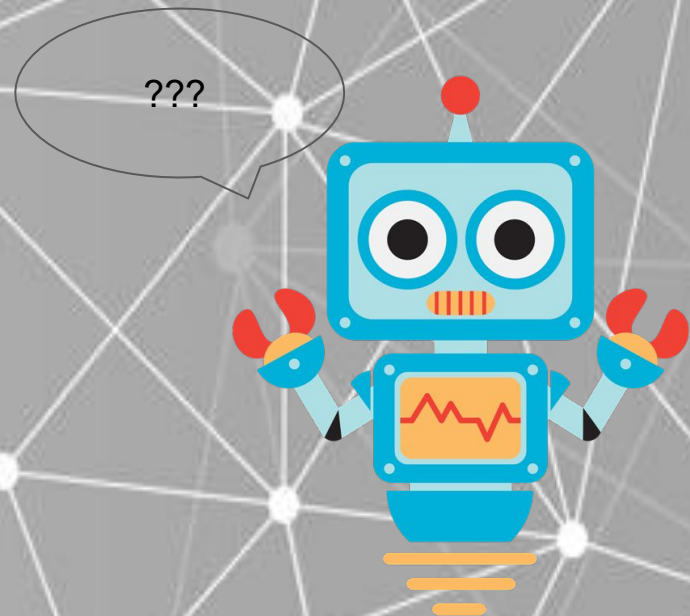
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Outline

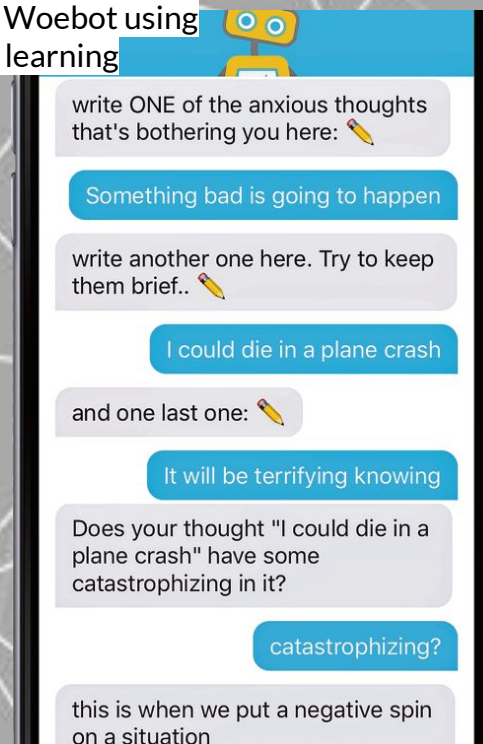
1. Overview of Conversational AI in Mental Health
2. Issues with the Mental Health Domain
3. Knowledge Base and Input Experiment
4. Experiment Conclusions and Analysis



Brief Overview of Conversational AI in the Mental Health Domain

- Conversational AI can help people monitor mental health throughout the day
- May be useful in addition to other mental health resources
- Can be used for diagnostic self-monitoring and simple medical professional advice, but self-sustaining therapist functionality is the end goal
- Current day therapy agents rely on training data, rule-based constraints, and other limitations

Example of Woebot using limited LM learning



<https://www.analyticsvidhya.com/blog/2018/03/woebot-mental-health-chatbot-supported-andrew-ng/>

Issues with the Mental Health Domain

- Dialogue with user contains sensitive and personal medical information

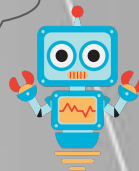
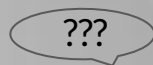


Safety Issues and Legal concerns

1. Chatbot cannot possibly give incorrect medical information or advice
2. Protection against hacking and data loss
3. Input processing which user does not want recorded



Vital concern to address to gain the trust of medical professionals



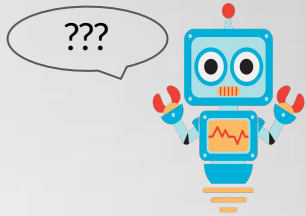
Language processing issues

Uncertainty in which parts of input are relevant to the effective response, message, or question the user is giving

“Medical chatbot using Microsoft’s GPT-3 told a fake patient to kill themselves”

Issues with the Mental Health Domain

- User communicates with natural (informal) language



**Language processing
issues**

Difficulty giving proper word
embedding and distinguishing
semantic meaning of the user's input

“This evening I’ve been stressing all day about this project, I know I have to keep working but I just want to go to sleep and forget about it”

What should a Conversational agent do with this message?

Measuring a Chatbot in the Mental Health Domain

Informational Accuracy

- Reliable and safe advice
- Factual and pertinent medical information

Requires knowledge base capable of accurately responding to all queries

Conversational Capability

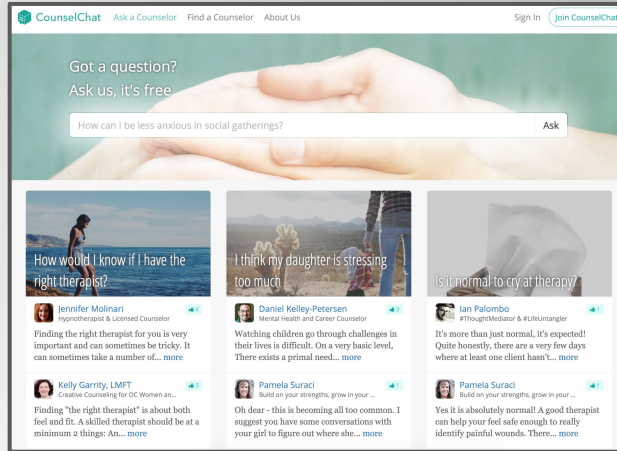
- Naturally-sounding language
- Fluid dialogue interacting directly with the user
- Appearance of 'understanding' the user's input

Benefits from conversational training data

These specifications will be scrutinized during the input analysis experiment.

Knowledge Database for our Experiment

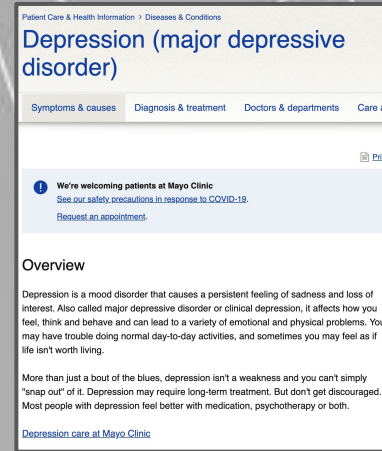
Training Data



Q&A formatted CSV of
conversational data between users
and experts (CounselChat.org)

<https://github.com/nbertagnolli/counsel-chat>

Medical Knowledge Base



Static medical information
from trusted online resources
(Mayoclinic.org)

Knowledge Base and Input Experiment

Objective: Determine optimal chatbot behavior by manipulating knowledge base and user input

Measuring: Informational accuracy and conversational capability

Focus: Contextualization of user input through domain knowledge

Method: Simple chatbot which calculates cosine similarity scores between user input and knowledge base and responds to user with the best score

Training Data and No Domain Knowledge

User: Can you tell me some symptoms of depression

Bot: It sounds like this is quite difficult. It sounds as if sometimes your spouse want you to be a part of his life (which could be a part of where the jealousy comes from) and sometimes he doesn't.

- Bot response was pulled from a CounselChat therapist's response to question about spousal issues
- Contextually similar, but chatbot's lack of domain understanding limits ability to distinguish what issue the user is truly asking about

User: Feeling very sad and anxious

Bot: The first step, which you've taken, is actually wanting to talk to someone. It's a great sign that you are seeking to reach out for help. And there are therapists everywhere (there are even therapists online, so you don't have to be that close to them or their office.)

- Training data may successfully provide users with adequate responses depending on amount of training data and specificity of user's input

- Fluent conversational capability **depending** on input
- **No actual understanding** of the user's input
- Lack of true domain knowledge

Domain Knowledge and No Training Data

- Mental Health Q&A Machine
- Will accurately answer structured questions about mental health
- Lack of conversational ability renders the chatbot useless against WWW-wide virtual assistants (Alexa, Siri, Google Assistant, etc.)

Adequate Domain Knowledge and Training Data

User: Who should I seek out for help?

Bot: Reach out to others for help. Thank you for reaching out for help. I encourage you to consider reaching out for help.

User: I feel terrible but have nobody to talk about it with! Who should I seek out for help??

Bot: I've attempted to talk to her about it, but she avoids it and doesn't seem to worry about how I feel about it. Talking about it would probably be helpful if...

- Added irrelevant input returns less accurate reply
- Suggests that formatting input by question may increase chatbot's response accuracy

User: I feel detached and demotivated. I don't feel like being in a marriage as well. What should I do?

Bot: For some people, having a sense of belonging takes some time. You mentioned that you have an education and some basic daily needs. I wonder if you may be able to look at your relationship with yourself and what makes you feel happy, safe, and having a sense of accomplishment.

User: Can you tell me some symptoms and treatments of depression

Bot: Depression symptoms in children and teens Common signs and symptoms of depression in children and teenagers are similar to those of adults [...]

I would suggest some holistic approaches, such as getting your Vitamin D and iron levels checked. Make sure you are eating well, exercising, and getting outside when you can. [...]

Accurate
response
taken from
training
data

Chatbot combined responses
from Mayo clinic article and
conversational dataset

Conclusions

- Conversational agents require input contextualization within given domain to generate effective response
- Domain knowledge must be structured (KG) for information to be recalled when input matches aspects of knowledge base
- Training data may answer input effectively but is unreliable on it's own
 - Should be incorporated into knowledge base and additional user input may be as well
- Input question-formatting may make response more pertinent to the true content of user's question