

Sparky

...

A Chatbot for CBT Management

Motivation: Conversational Interface

Access

*Lack of trained professionals;
long waiting times*

Stigma

Patient education

*Understanding the therapy
and its rationale*

Language/cultural barriers

Lack of health insurance, cost

*Typical CBT treatment requires
5-15 sessions at \$70-\$300 each*

Lack of information

Compliance

*Patients unable to follow up on
CBT homework*

Privacy concerns

*What we think affects
how we act and feel*

I 'm a failure
I can't do this
What will they think

Thoughts

*What we do affects
how we think and feel*

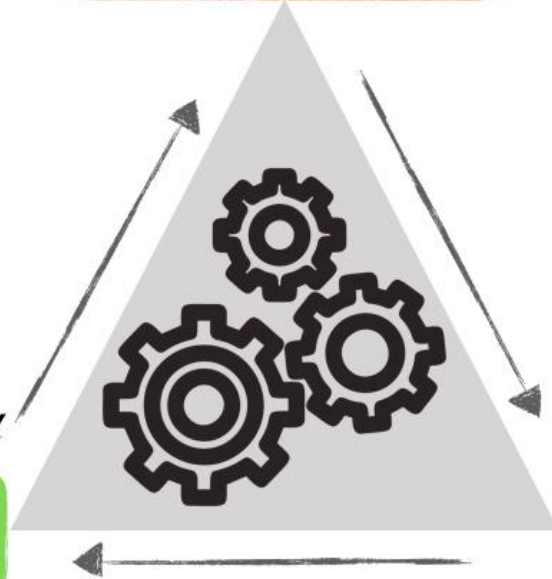
Actions

Avoid
Ignore
Hide

*What we feel affects
What we do*

Feelings

Hopeless
Anxious



Motivation: Cognitive Behavioral Therapy

- Set of **'talk'** psychotherapies that treat psychiatric conditions
- **Short-term** focused treatment
- Strong empirical support with randomized clinical trials
(**evidence-based** > 500 studies, 50 years)
- As effective as psychiatric medications
- Recommended as critical component of treatment, particularly when medications are ineffective
- CBT has been previously disseminated over web/IVR

*What we think affects
how we act and feel*

Thoughts

I 'm a failure
I can't do this
What will they think

- Learn
- Empathize
- Track

*What we do affects
how we think and feel*

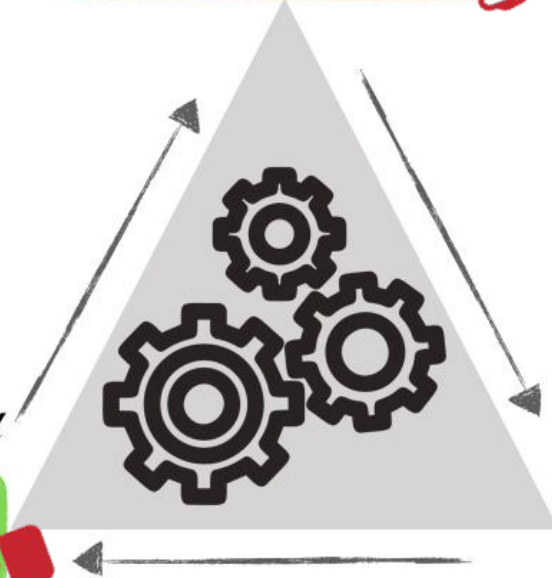
Actions

Avoid
Ignore
Hide

*What we feel affects
What we do*

Feelings

Hopeless
Anxious



Get to Know You

- On first visit, Sparky asks for user's name
- On every visit, Sparky will ask for the user's mood
- If mood is negative, Sparky gives an empathetic response
- Mood is then tracked over time to show trends

Sparky: Welcome to Sparky! I am a chatbot for Cognitive Behavioral Therapy. I can help you track your moods, goals, and teach you about CBT. Would you like to start by telling me your name?

User: I'm George.

S: Hi George, how are you feeling today?

U: I'm sad.

S: I'm sorry to hear you're feeling sad! Would you like to learn about CBT techniques, update your goals, or take the PHQ2 depression survey?

U: I'd like to learn...

PHQ-2, PHQ-9

- Linear Subdialog
- Either 2 or 9 Questions
- Assesses severity of depression
- Repeated periodically (approx. every 2 weeks) to track user's progress

Over the last 2 weeks, how often have you been bothered by any of the following problems?

1. Little interest or pleasure in doing things

___ Not at all

___ Several days

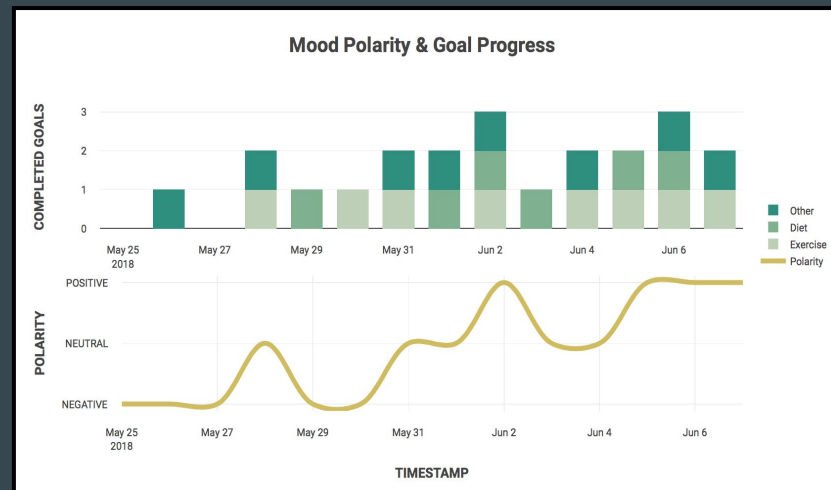
___ More than half the days

___ Nearly every day

Goal Tracking

- Behavioral component of CBT
- SMART method helps patients take actionable steps to improve their life
- Mood and activity data can be visualized together to identify correlations

Specific
Measurable
Achievable
Realistic
Time Bound



CBT Education

- Users can ask about system actions or questions related to CBT and depression
- Module can be activated directly, or from other modules to answer questions or provide info about specific concepts
- Queries over Knowledge Graph

User: I want to learn. What are cognitive distortions?

Sparky: Cognitive distortions are automatic thoughts that cause people to see their world in an inaccurate way. These negative thinking patterns can cause negative emotions and an overall negative outlook, and can trigger depression and anxiety.

U: What are some examples of cognitive distortions?

S: Some examples of cognitive distortions include magnification, overgeneralizing, should statements, splitting, and filtering.

DEMO

Modeling Approach

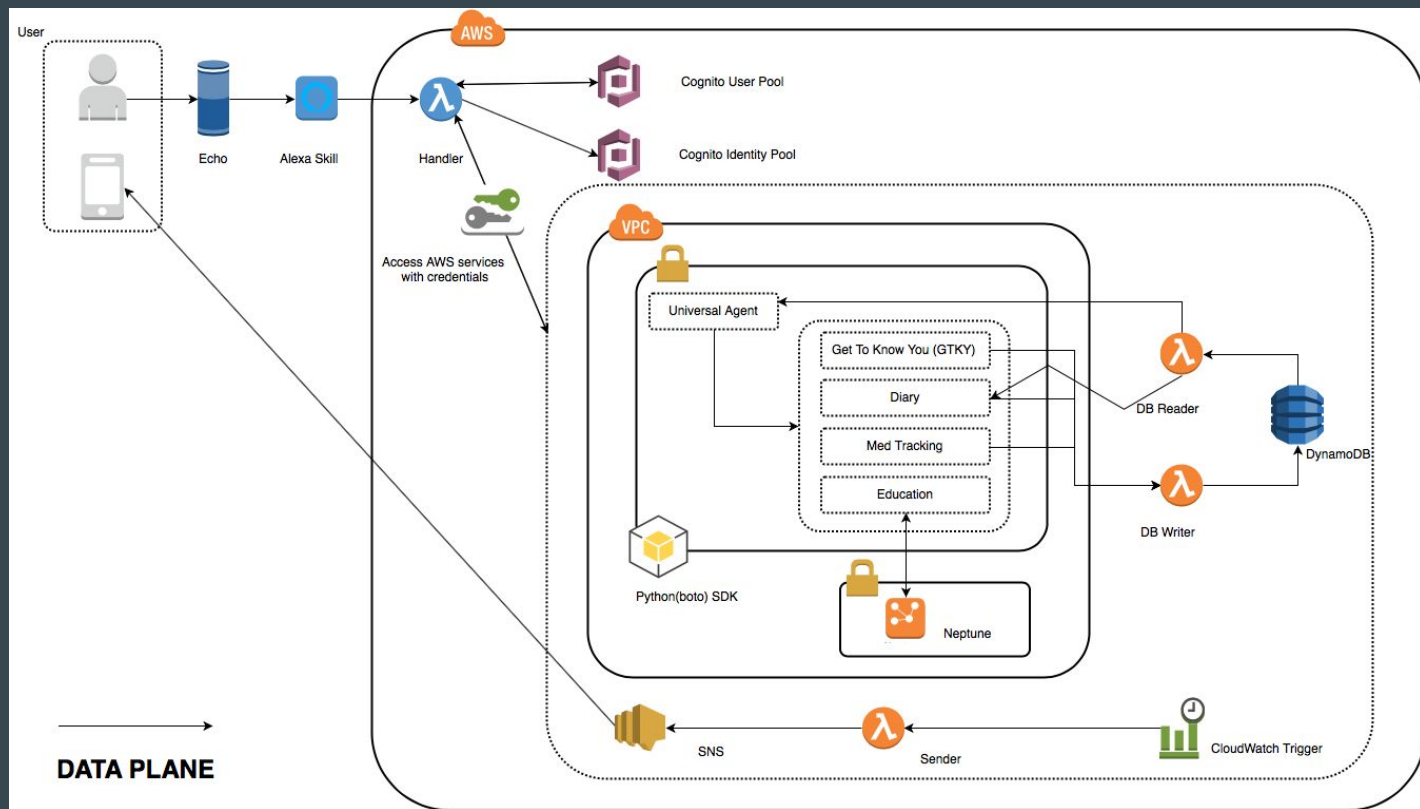
- Limited in-domain data (protected information under HIPAA)
- Rule-based MVP \rightarrow Crowdsourced Data \rightarrow RL \rightarrow POMDP
- Information State (DIPPER, TRINDI systems)
 - Load/save state using DynamoDB
 - Agenda
 - Question under discussion
 - Last move

Evaluation

Modified PARADISE framework (Walker 1997; Feng 2018)

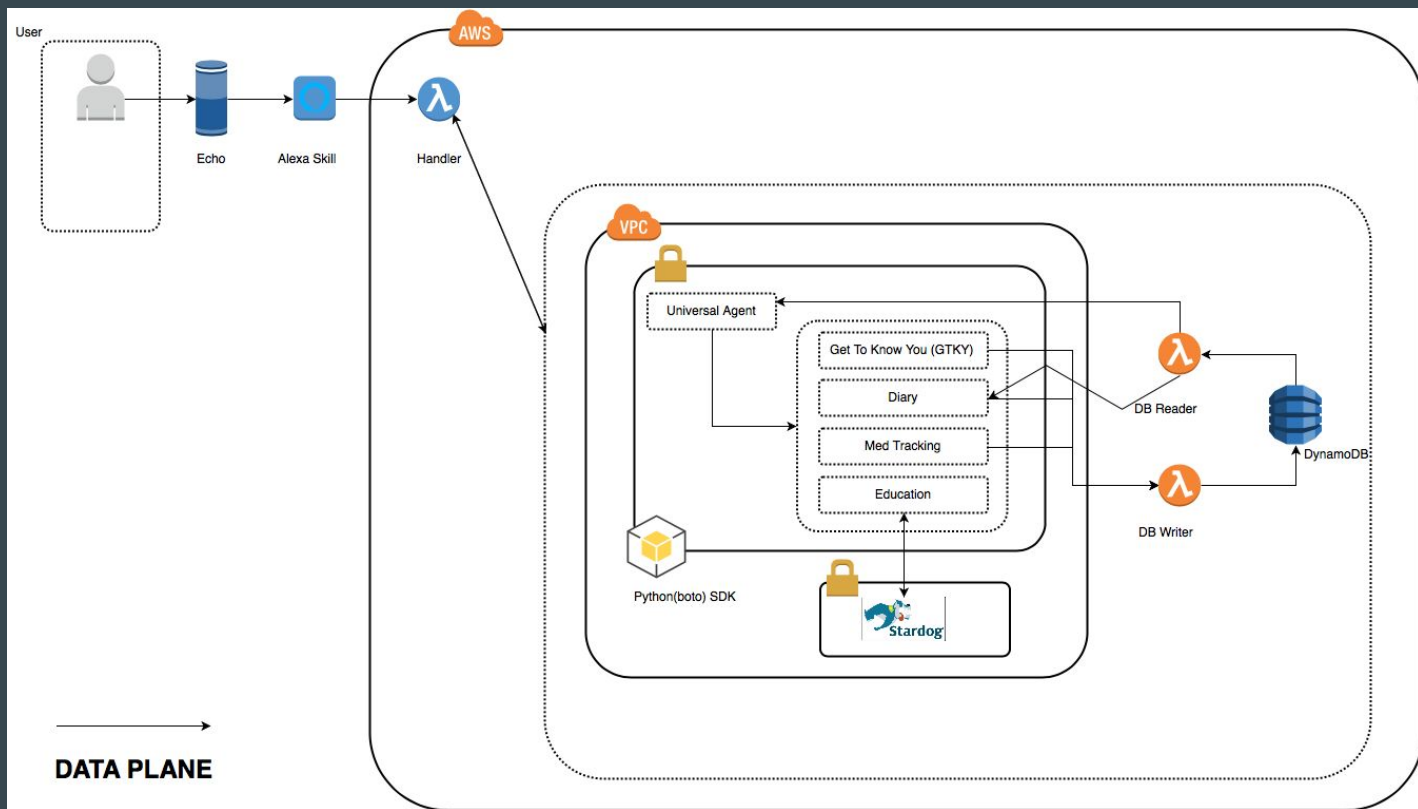
- Completion of sub-dialogues
 - Setting goals / Achieving goals
 - Finishing the PHQ-9
- Improvement on PHQ-9
- Patient satisfaction

System Architecture (PLAN)



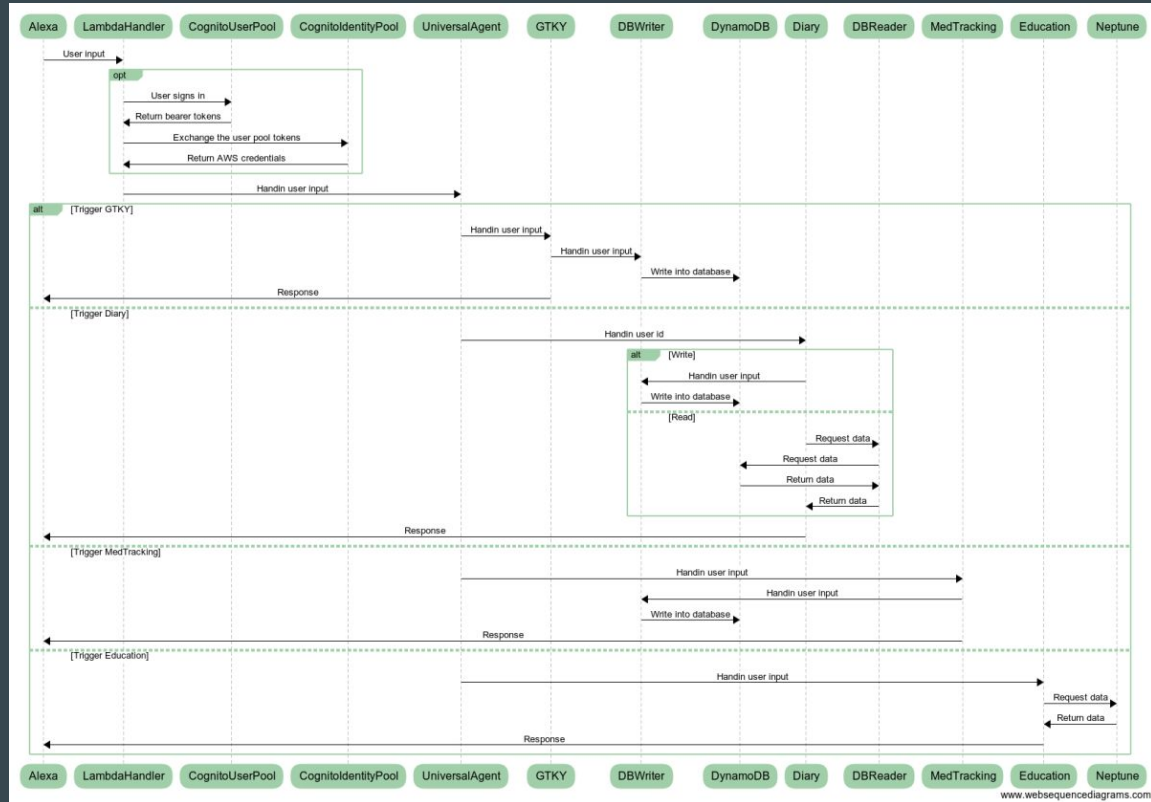
- Amazon Cognito
- Amazon EC2
- Amazon DynamoDB
- Amazon CloudWatch
- Amazon Neptune
- AWS Lambda
- Python (Boto) SDK

System Architecture (CURRENT)

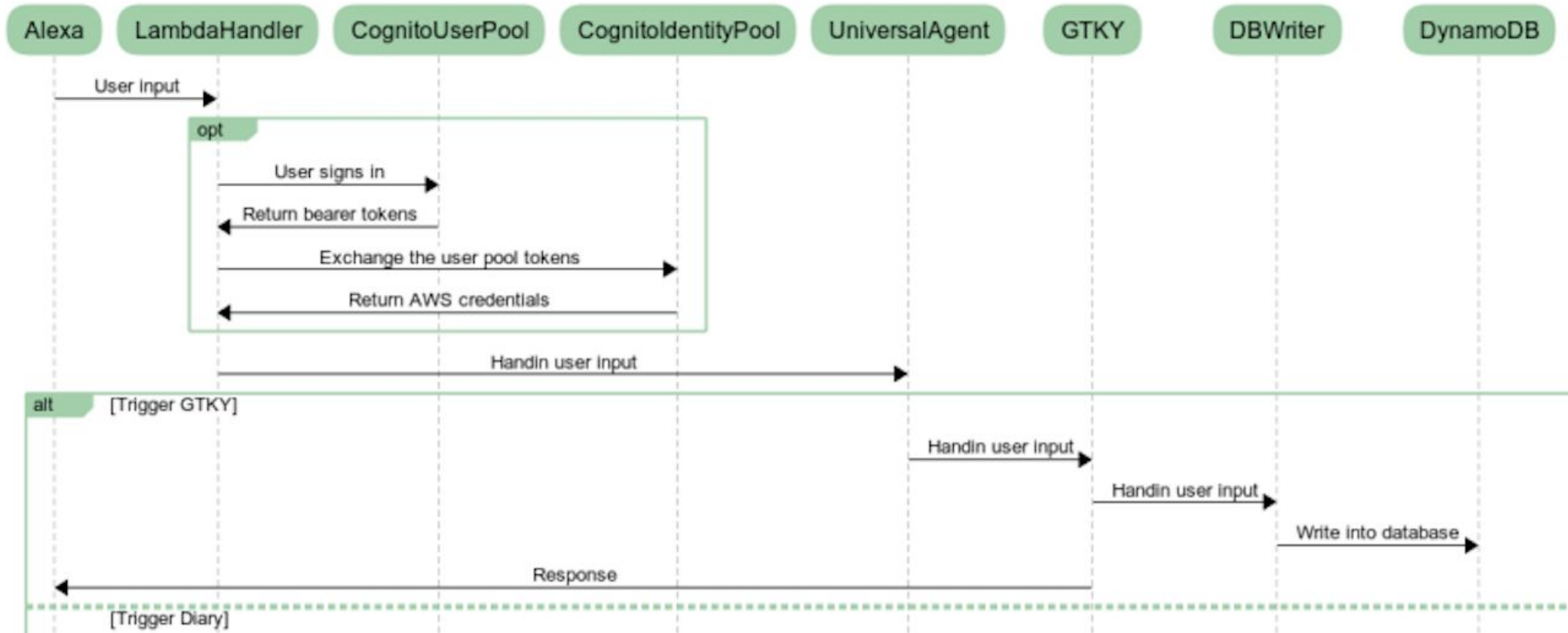


- Amazon Cognito
- Amazon EC2
- Amazon DynamoDB
- Amazon CloudWatch
- (Stardog)
- AWS Lambda
- Python (Boto) SDK

Sequence Diagram



Sequence Diagram



User input triggers different components

Findings and Lessons

- Many things can't be done without access to the raw text (ASR output) of the utterance
- Privacy considerations for health apps (HIPAA)
- How to identify different users when they share a device?
- Adding more minibots makes ML harder (intents, slots)
- Different models might work better for different minibots

Future Work

- Usability Test
 - Test with end-users to understand how Sparky can fit into their daily lives and needs
- Clinical viability
- Technical
 - Multimodal interface - blend of text/voice offering a socially affordable medium
 - Mobile application interface
- Offer more choices
 - Track medication & side effects
 - Ability to track various types of CBT worksheets
- Data export capabilities
 - Visual plot of user mood and goal progress over time

Conclusion

- Chatbot for Cognitive Behavioral Therapy Management
- Variety of user interface options (text-based, microphone)
- Provide the user with a personalized CBT treatment based on their progress and interactions
- Scalable to number of different web application and hardware platforms
- Can be expanded to include variety of patient conditions, not just depression

Questions?