



# Cognitive AI Assistants

A new generation of AI companions

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Juji, Inc.

## FACT

# AI Assistants are everywhere

- convenient
- novelty
- social desirability

1. [marketingland.com](http://marketingland.com)
2. Facebook 2018
3. Forrester user survey



1 out of 4  
U.S. adults own smart  
speaker<sup>1</sup>

300,000  
Facebook chatbots<sup>2</sup>

84%  
want personalization<sup>2</sup>

How can I help you?

If you are a chatbot, why cannot you just chat instead of showing me so many buttons?

I don't have the answer to that question right now

Were you asking about one of these topics?

Contact a Human

Download Resources

Calculate savings

Ask me something



# The Challenges

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- limited intelligence
  - transactional
  - little "soft skills"
  - impersonal
- costly to build and maintain

# Cognitive AI Assistants

A new generation of AI companions



cognitive intelligence to  
facilitate long-term engagement

no-coding, rapid setup  
to democratize AI

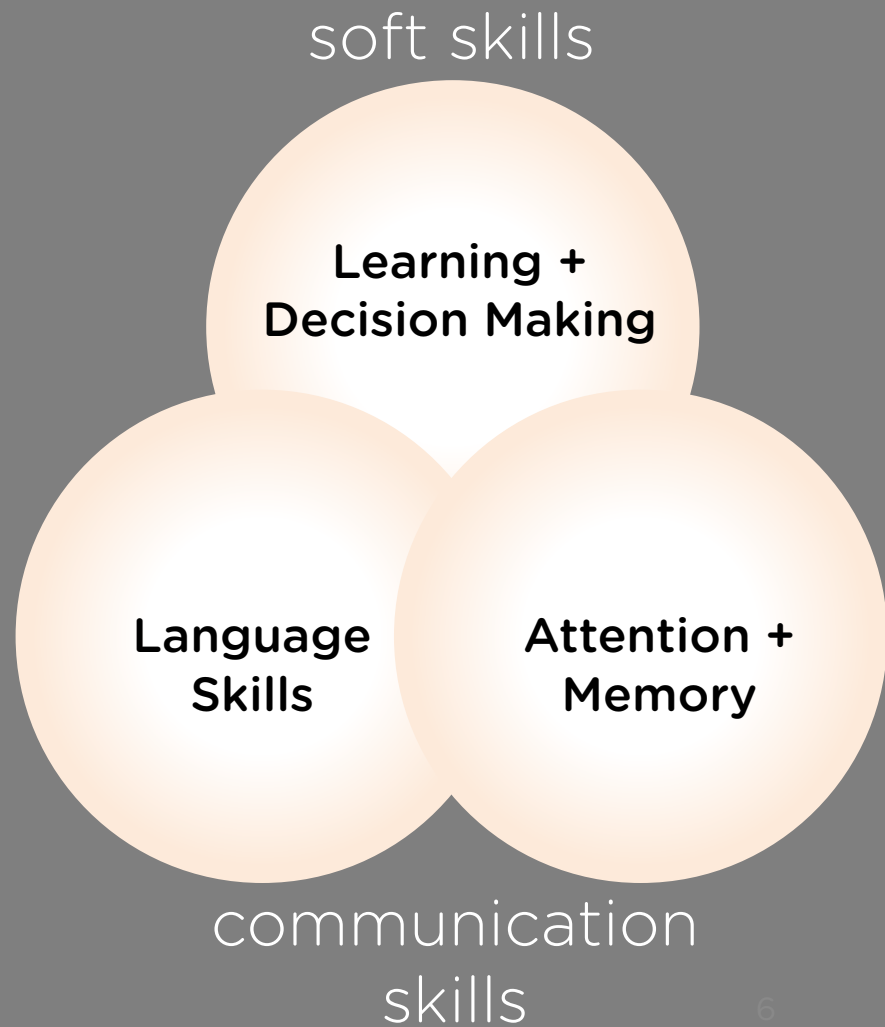


# Live Demo

Personal Wellness Assistant

# Cognitive Intelligence

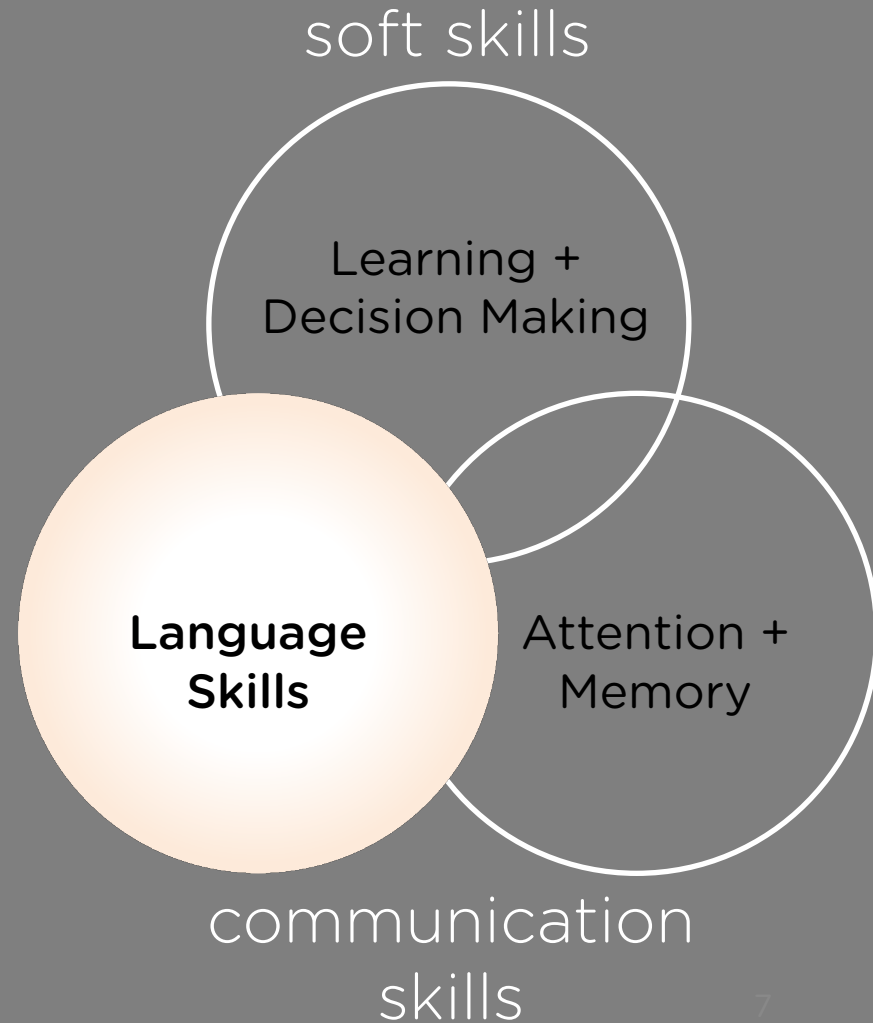
advanced, human-like artificial intelligence that enables AI to understand, remember, communicate, and learn



# Cognitive Intelligence

good communications helps  
establish connections and  
maintain relationships

Eğeci, İ. S., & Gençöz, T. (2006). Factors associated with relationship satisfaction: Importance of communication skills. Contemporary family therapy, 28(3), 383-391.



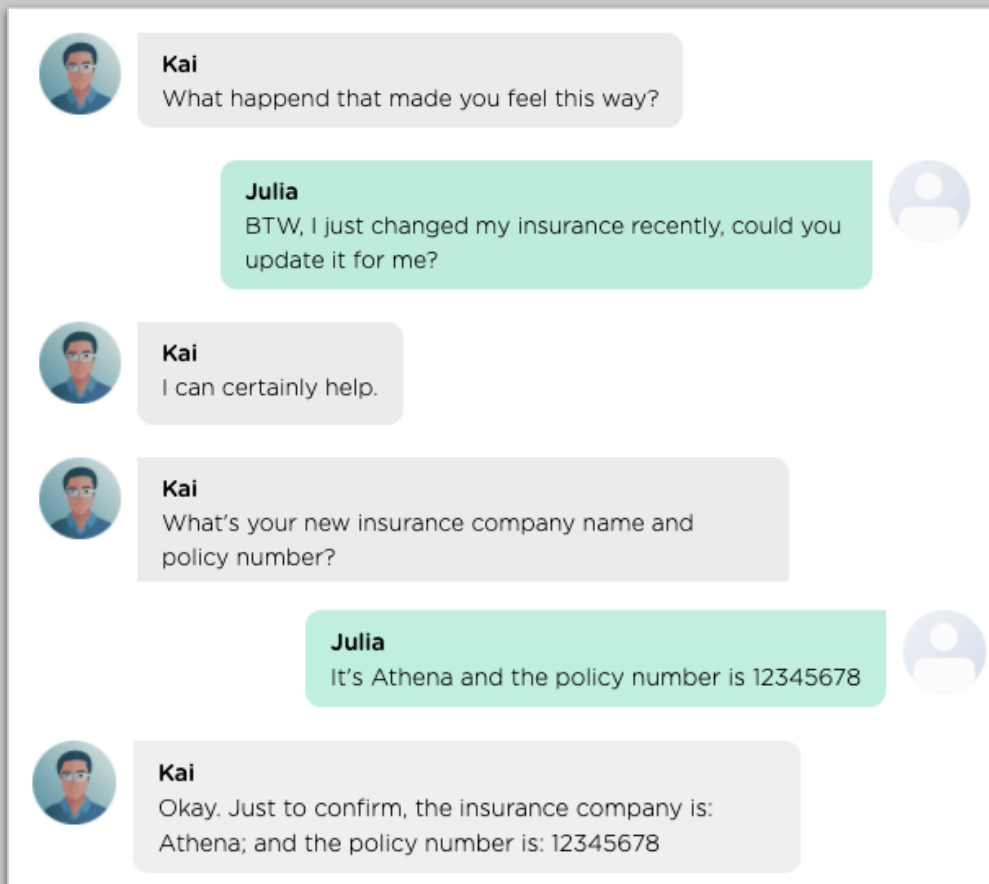
# Language Skills

interpret user input to  
perform multiple types  
of tasks

- open-ended
- procedural

semantic interpretation

information extraction



The image shows a chat interface with two participants: Kai, represented by a blue circular avatar with a man's face, and Julia, represented by a light blue circular avatar with a person's silhouette. The messages are in colored bubbles: light gray for Kai and light green for Julia. The conversation is as follows:

**Kai**  
What happend that made you feel this way?

**Julia**  
BTW, I just changed my insurance recently, could you update it for me?

**Kai**  
I can certainly help.

**Kai**  
What's your new insurance company name and policy number?

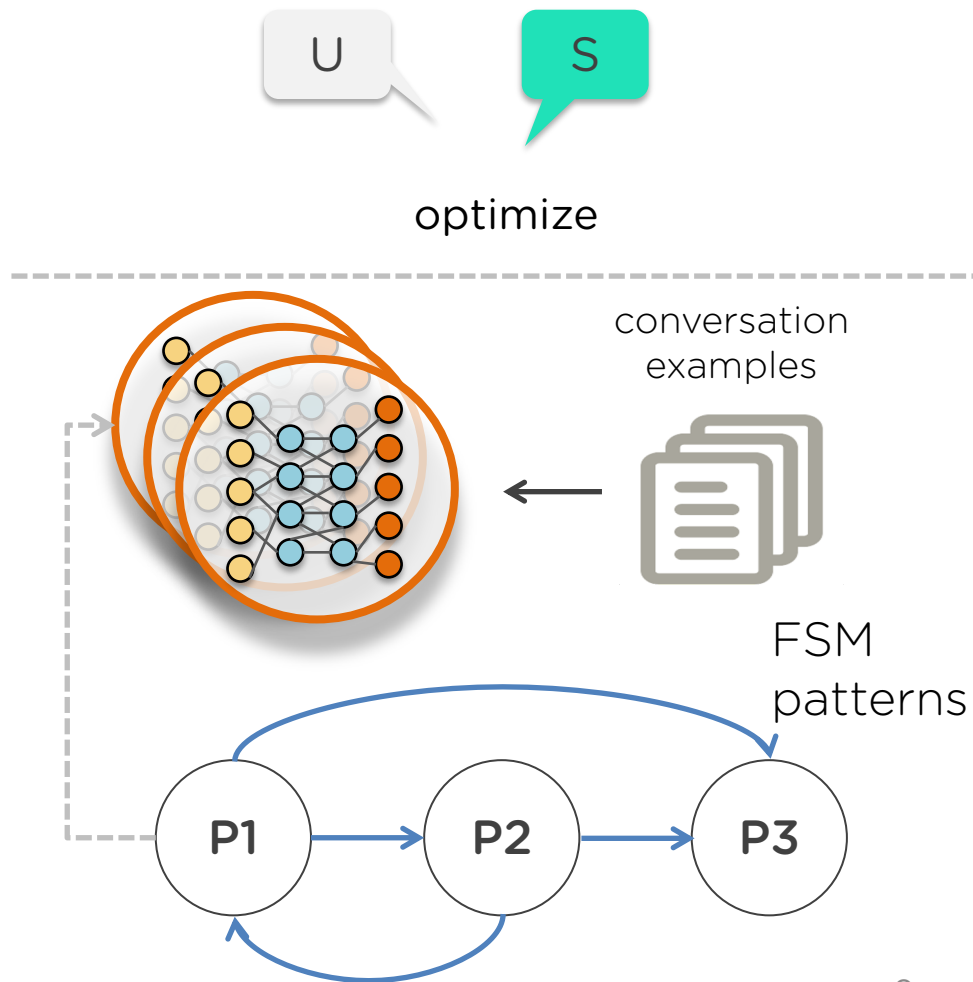
**Julia**  
It's Athena and the policy number is 12345678

**Kai**  
Okay. Just to confirm, the insurance company is: Athena; and the policy number is: 12345678

# Modeling Language Skills

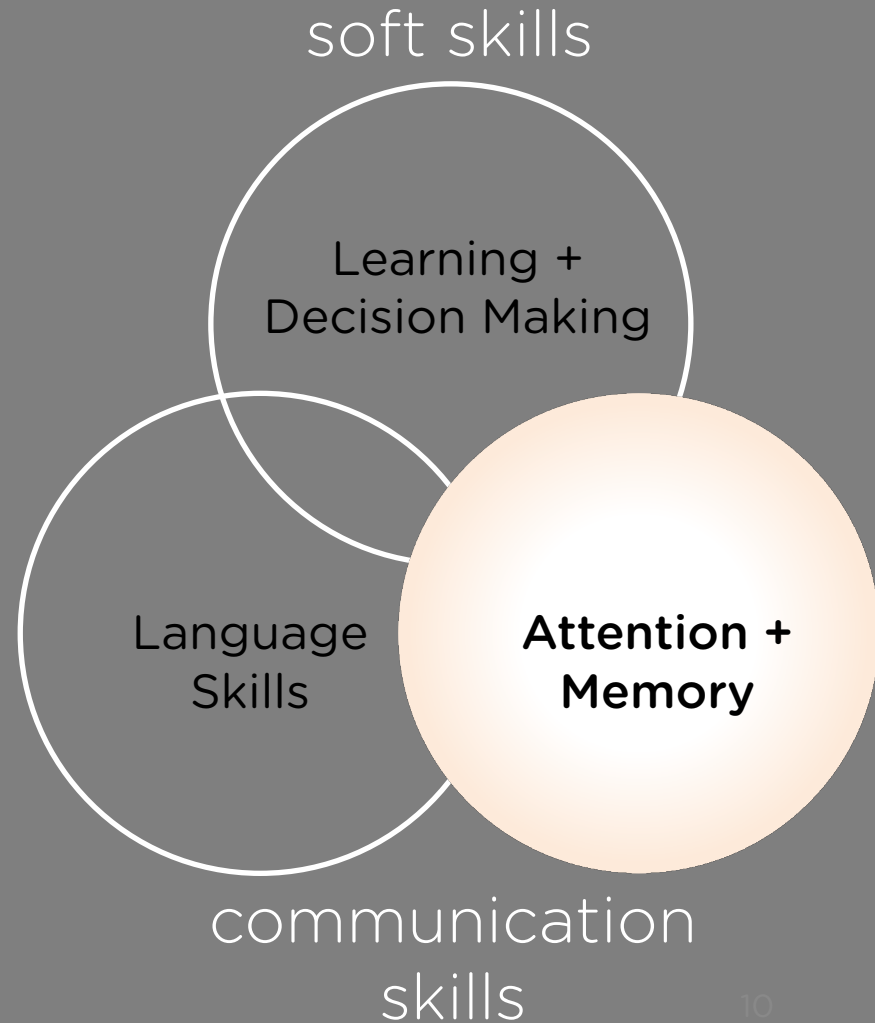
- neuro-symbolic approaches
- open to third-party learning models

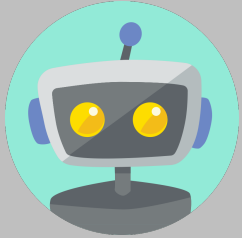
Xiao, Z., Zhou, M. X., Chen, W., Yang, H., & Chi, C. (2020, April). If I Hear You Correctly: Building and Evaluating Interview Chatbots with Active Listening Skills. In Proc. 2020 CHI (pp. 1-14).



# Cognitive Intelligence

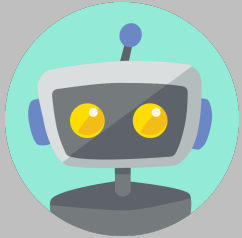
good communications helps establish connections and maintain relationships





What would you like to do in your spare time?

what about you?



What's your favorite movie?

what about you?

# Attention + Memory

attention is context-sensitive



**Kai**

What happend today?

**Michelle**

Could you help me make an appointment to see my doctor?



**Kai**

Certainly. Let me get some quick info from you first so I can best route your request to my human teammate.



**Kai**

Do you have a fever now?

**Michelle**

no

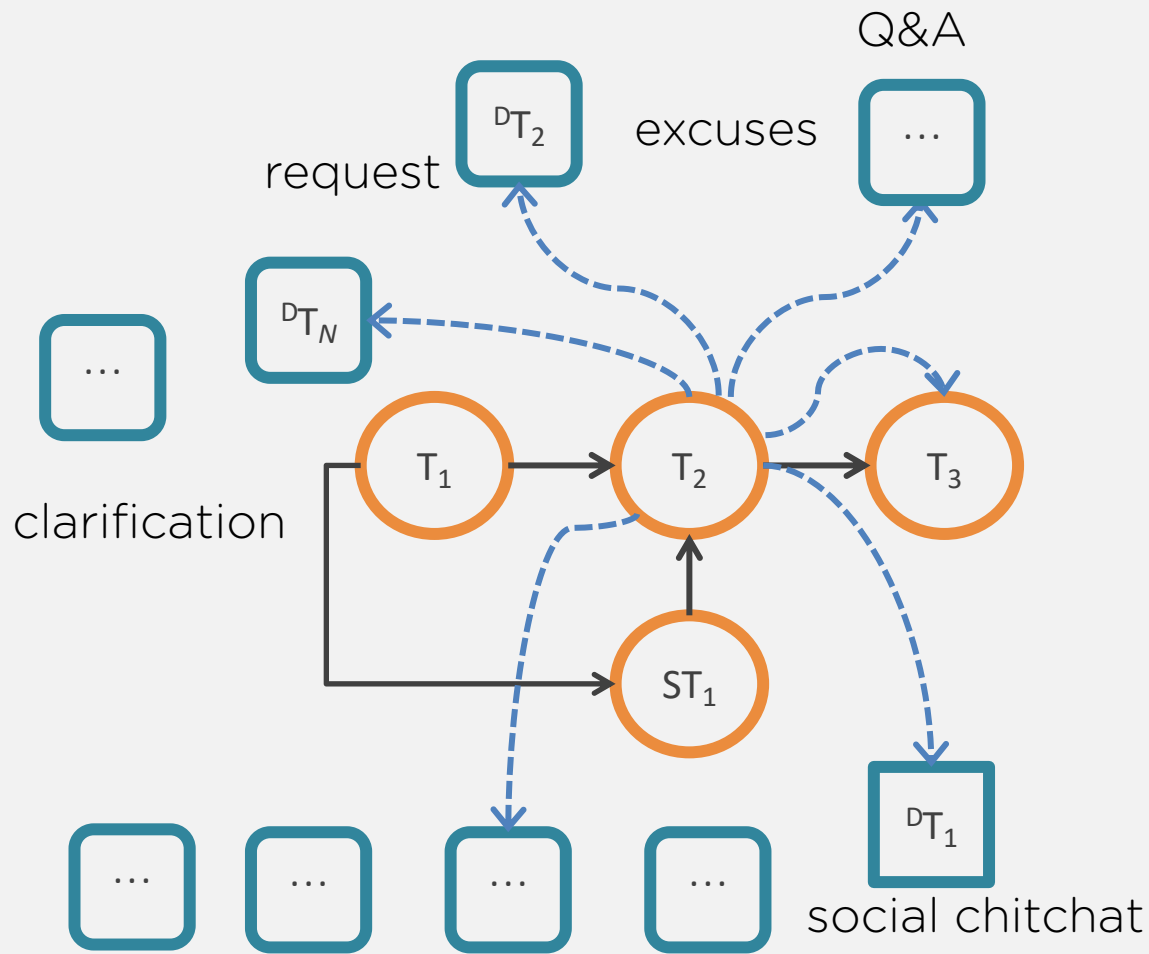


# Attention + Memory

must maintain attention and memory to maintain context

- ensure task success
- ensure user satisfaction





# Attention + Memory

policy-driven,  
optimization-based  
approach to manage  
attention

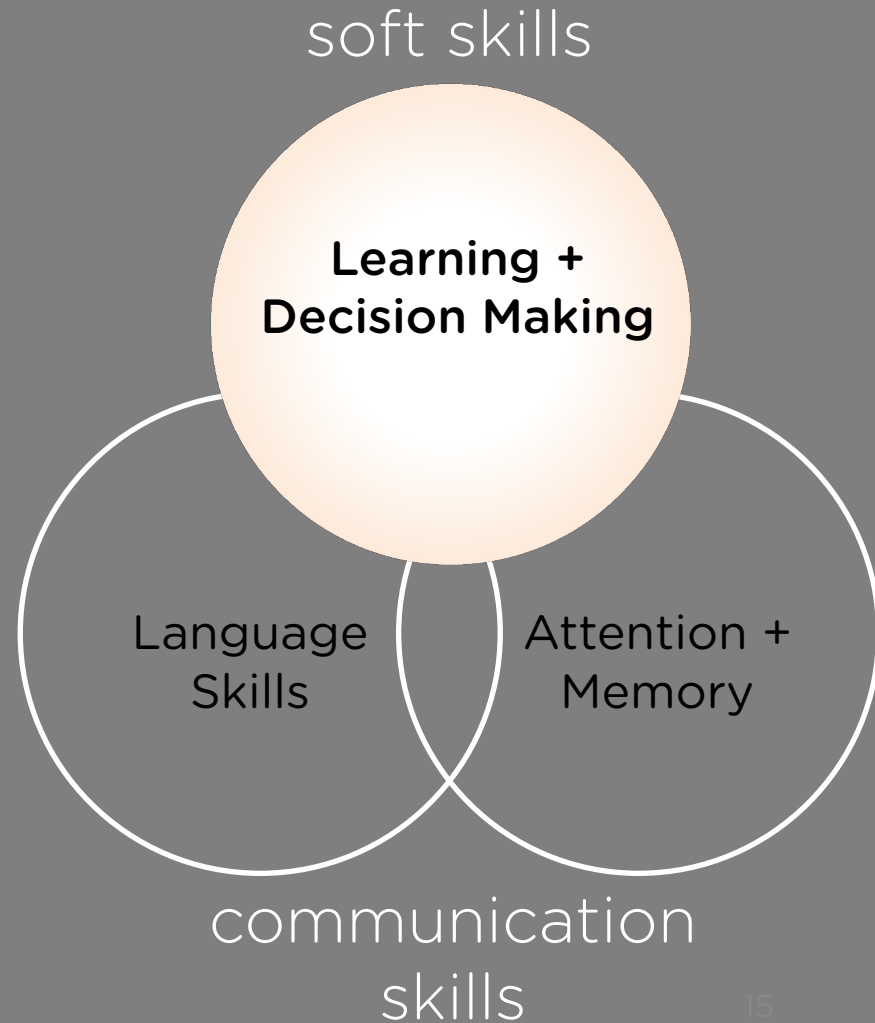
$$S = (\nu, \tau, \gamma, \Pi)$$

auto-manage contexts  
& transitions

# Cognitive Intelligence

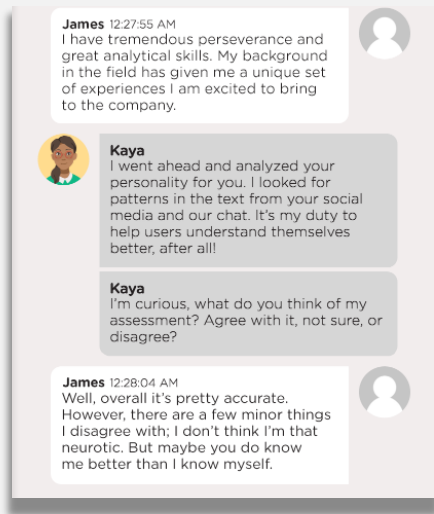
Social-emotional intelligence impacts relationship building and satisfaction

Lopes, P. N., Salovey, P., & Straus, R. (2003). Emotional intelligence, personality, and the perceived quality of social relationships. *Personality and Individual Differences*, 35(3), 641-658.



# Learning + Decision Making

- read between the lines to learn about users deeply
- personalize decision making to better help and guide users



**James** 12:27:55 AM  
I have tremendous perseverance and great analytical skills. My background in the field has given me a unique set of experiences I am excited to bring to the company.

**Kaya**  
I went ahead and analyzed your personality for you. I looked for patterns in the text from your social media and our chat. It's my duty to help users understand themselves better, after all!

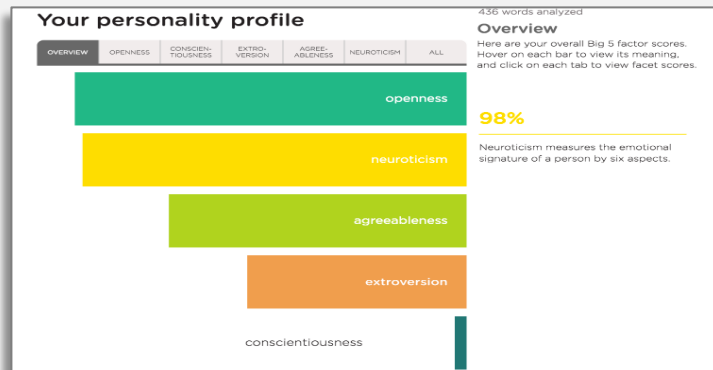
**Kaya**  
I'm curious, what do you think of my assessment? Agree with it, not sure, or disagree?

**James** 12:28:04 AM  
Well, overall it's pretty accurate. However, there are a few minor things I disagree with; I don't think I'm that neurotic. But maybe you do know me better than I know myself.

read between  
the lines

infer  
personality  
insights

## Big 5 Personality



# Personality Insights

emotional and social intelligence  
how you handle life's challenges



passions + interests  
what you like to do



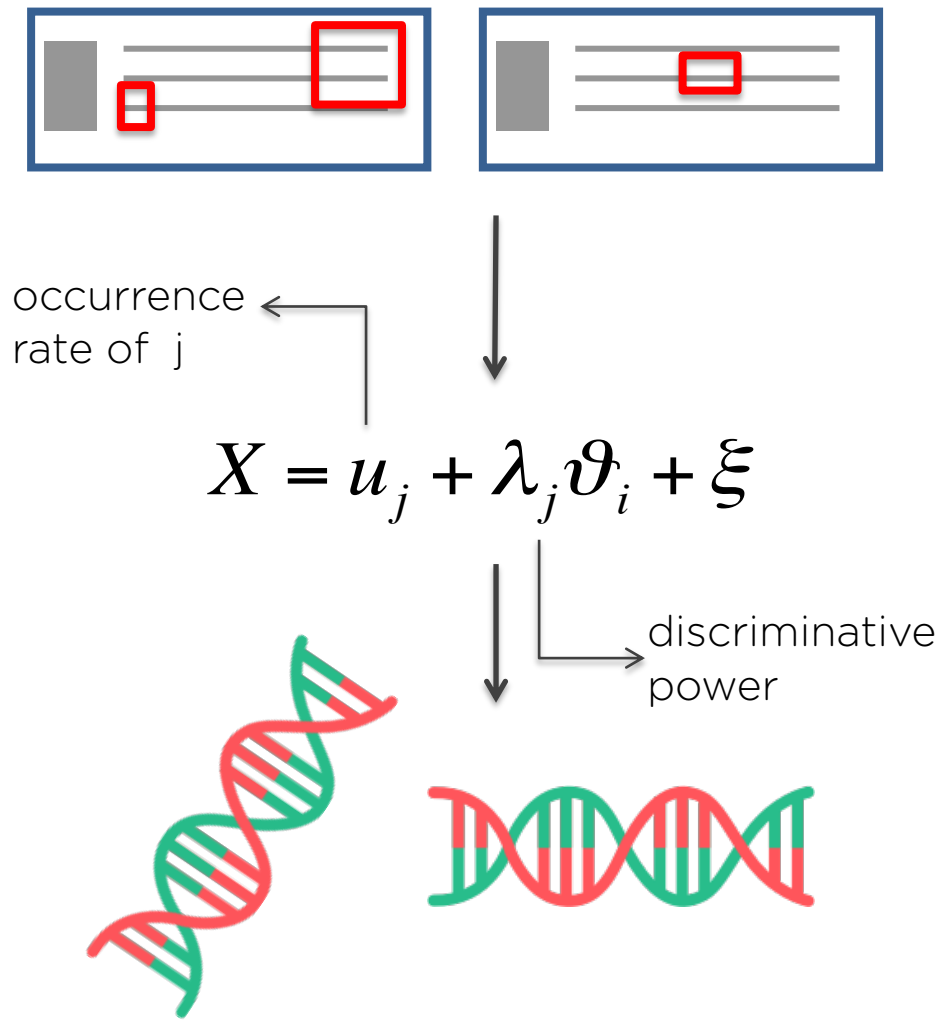
talents + skills  
what you are good at

# Read between the Lines

big data analytics +  
latent trait theory (IRT)

evidence-based trait  
analysis

[Zhou, M. X., Mark, G., Li, J., & Yang, H. (2019). Trusting virtual agents: The effect of personality. ACM Transactions on Interactive Intelligent Systems (TiiS), 9(2-3), 1-36.]



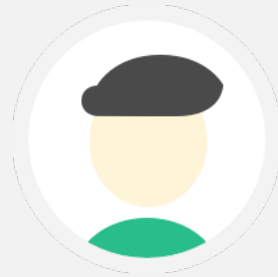
# Personalize Decision Making

- personalize conversations and guidance
- exhibit emotional and social intelligence (explainable AI)



**Customer A:**  
assertive  
impatient

I understand you wish to get some quick info. Here is a summary.



**Customer B:**  
meticulous  
indecisive

To help you make decisions, may I suggest a product comparison?





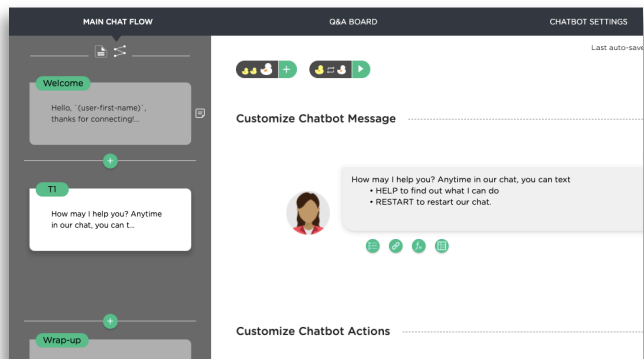
# Democratizing Cognitive AI Assistants

NO AI or engineering skills required.  
NO coding required.

# Rapid Setup and Deployment

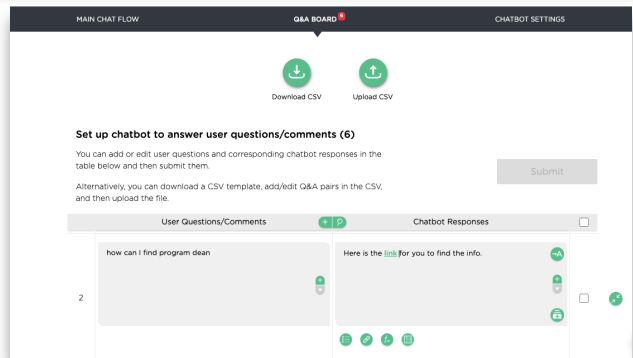
## STEP 1

define a main chat flow



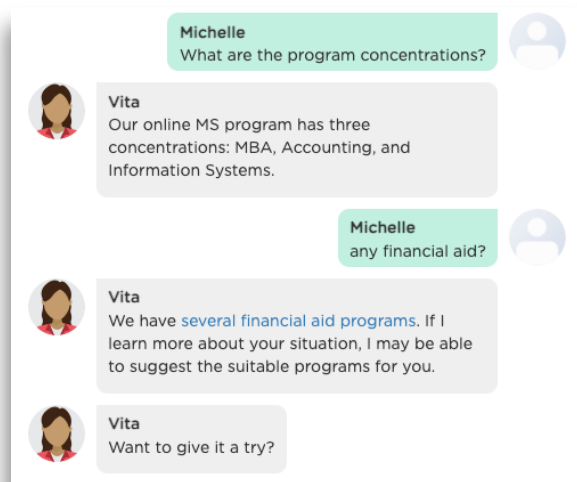
## STEP 2

Upload Q&A pairs



## STEP 3

auto-generate a chatbot with out-of-the-box cognitive intelligence



# Evaluating Cognitive AI Assistants

Usefulness  
(function)

[Xiao, Z., Zhou, M. X., Liao, Q. V., Mark, G., Chi, C., Chen, W., & Yang, H. (2020). Tell Me About Yourself: Using an AI-Powered Chatbot to Conduct Conversational Surveys with Open-ended Questions. ACM Transactions on Computer-Human Interaction (TOCHI), 27(3), 1-37.]

Usability  
(form)



	Example Metrics
Goal-Oriented Performance	Task Completion Rate Engagement Duration Repetition Informativeness
Operation + Method Performance	Language Skills Attention + Memory Learning/Decision Making Soft Skills
User Experience	Abandon Rate User Sentiment User Satisfaction Rating
Trust-Centered Ethics	Level of Empathy Hate Speech Rate User Trust Rating

# Auto-Evaluation: Debugging Chatbot

6.22 min

72.2 words

3.93 out of 5

4.17 out of 5

Average Chatting Duration

Average Total Words

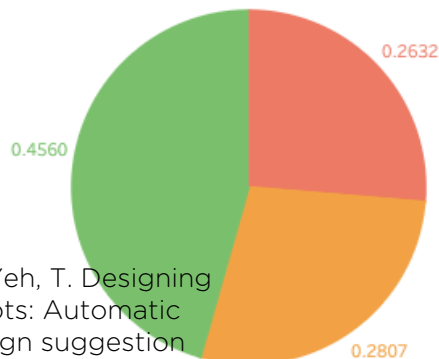
Trust Level

User Experience Rating

User Sentiment from Direct Feedback Eliciting Question

Emotion

- Negative
- Neutral
- Positive



Keyword from responses with positive sentiment

word frequency



Keyword from responses with negative sentiment

word frequency



[Han, X., Zhou, M.X., and Yeh, T. Designing effective interview chatbots: Automatic chatbot profiling and design suggestion generation for chatbot debugging. To appear in CHI 2021]



# An Open Challenge

How long can your AI assistant engage with users?

AI Teammate • AI Learning Companion • AI Wellness Companion

[Xiao, Z., Zhou, M. X., & Fu, W. T. (2019, March). Who should be my teammates: Using a conversational agent to understand individuals and help teaming. In Proc. of IUI 2019 (pp. 437-447).]

**ACM Transactions on Interactive Intelligent Systems***An ACM journal for research about intelligent systems that people interact with***Editor-in-Chief**

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**Information for Contributors**

ACM Transactions on Interactive Intelligent Systems is an ACM premier journal featuring research on intelligent systems that people interact with. TiIS publishes articles on research concerning the design, development, and evaluation of interactive systems that incorporate certain form of machine intelligence. Such interactive intelligent systems are associated with two defining characteristics: intelligence and interactivity. An article can address these two defining characteristics in any of several complementary views, with a focus on (a) the intelligent technology, (b) the interaction of users with the system, or (c) both aspects at the same time.

Research on interactive intelligent systems covers a wide variety of research topics. TiIS welcomes relevant submissions from all of these topic areas, and its board of Associate Editors has been selected with the goal of ensuring expert reviewing of all relevant submissions. The following list of topics, though representative, is not exhaustive; and different terms are sometimes used to describe the areas. In some of these areas only a fraction of the research that is conducted concerns interactive intelligent systems. Therefore, not every manuscript that falls into one of these topics is relevant to TiIS.

**Machine Intelligence for Novel User Interfaces**

- Augment Reality and Virtual Reality
- Multimodal interfaces
- Natural language interfaces
- Embodied conversational agents
- Computer graphical interfaces
- Accessible computing

**Machine Intelligence for Interactive Systems**

- Crowd computing
- Recommender systems
- Information retrieval
- Intelligent learning environments

**Machine Intelligence for Developing and Testing User Interfaces**

- Model-based design of user interfaces
- Automated usability testing

**Machine Intelligence on More Than One Level**

- Information visualization and visual analytics
- Human-robot interaction
- Semantic technologies
- User modeling for adaptive and personalized systems
- Internet of Things
- Ubiquitous computing
- Mobile computing
- Games
- Knowledge capture

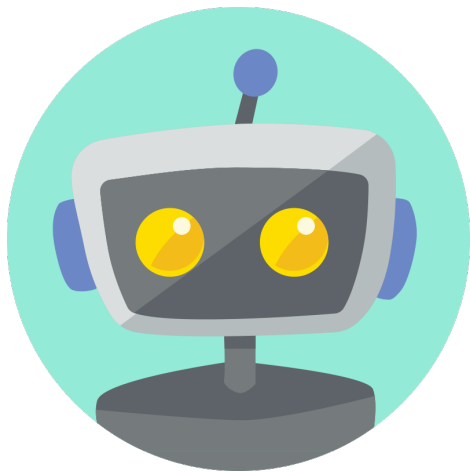
# Special issue on long-term AI companionship?

Contact: [mzhou@acm.org](mailto:mzhou@acm.org)

For further information and to submit your manuscript,  
visit <https://tiis.acm.org>.

# Summary

## Cognitive AI Assistants as Long-Term Companions



AI Safety



AI Ethics



Companion Evaluation

[Gou et al. 2014; Wang et al. 2015; Ferwerda 2015; Berkovsky et al. 2020; Dotti et al. 2020]

# Acknowledgements



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