

Introduction to Conversational Artificial Intelligence

Conversational Artificial Intelligence -- EE596

Hao Fang

University of Washington

Course Goals

- Understand basic concepts in conversational AI
- Learn recent advances in conversational AI
- Build a social chatbot using Amazon Alexa Skill Kit
- Expected Background
 - Courses: Natural Language Processing / Artificial Intelligence / Machine Learning
 - Programming Language: NodeJS, Python
 - System: Linux
 - Tools: Git

About the course

- Course website: https://hao-fang.github.io/ee596_spr2018/
- Report submission and course discussion: Canvas
- Labs: **BRING YOUR LAPTOP**
- Project: up to 5 teams (up to 6 members)

Office Hours

- Hao Fang (Instructor)
 - Tuesday 3:00-4:00pm
 - EEB M406: Please knock the door
- Hao Cheng (TA)
 - TBA

Class Format

- Lectures on Tuesday
 - Lectures cover basic concepts and recent advances in conversational AI
 - We will have two guest lectures in this quarter
- Labs on Thursday
 - Each lab has 2 sessions (2 weeks)
 - Lab checkoff in either session
 - Lab reports due on the Tuesday after the 2nd lab session
- Final week (May 29 & June 1)
 - System demo, evaluation, and presentation
 - We may invite external visitors

Syllabus

- Subject to change.
- Slides and links will be uploaded one day after the class.

April 3, 2018	Team registration
April 10, 2018	Lab 1 report
April 19, 2018	Project proposal
May 1, 2018	Lab 2 report
May 15, 2018	Lab 3 report
May 29, 2018	Lab 4 report
June 8, 2018	Project report

Date	Topic
Tuesday, Mar 27, 2018	Week 1: Introduction to Conversational AI
Thursday, Mar 29, 2018	Lab 1(a): Hello Alexa
Tuesday, April 3, 2018	Week 2: Voice Interfaces and Spoken Language Understanding
Thursday, April 5, 2018	Lab 1(b): Hello Alexa
Tuesday, April 10, 2018	Week 3: Guest Lecture by Mari Ostendorf – Speech and Language Processing
Thursday, April 12, 2018	Lab 2(a): TBA
Tuesday, April 17, 2018	Week 4: Language Generation
Thursday, April 19, 2018	Project proposal presentation
Tuesday, April 24, 2018	Week 5: Dialog Management
Thursday, April 26, 2018	Lab 2(b): TBA
Tuesday, May 1, 2018	Week 6: Dialog Evaluation
Thursday, May 3, 2018	Lab 3(a): TBA
Tuesday, May 8, 2018	Week 7: End-to-end neural dialog systems
Thursday, May 10, 2018	Lab 3(b): TBA
Tuesday, May 15, 2018	Week 8: Guest Lecture by Alex Marin – Knowledge Graph
Thursday, May 17, 2018	Lab 4(a): TBA
Tuesday, May 22, 2018	Week 9: Project consulting session
Thursday, May 24, 2018	Lab 4(b): TBA
Tuesday, May 29, 2018	Week 10: Project demo, evaluation and presentation (1)
Thursday, June 1, 2018	Week 10: Project demo, evaluation and presentation (2)

Grading Policy

- 4 Labs (each 10%)
 - Lab checkoff: 5%
 - Lab report: 5%
- Project proposal: 10%
- Project demo and presentation: 25%
 - Every team member needs to participate in the presentation
 - Systems will be evaluated by judges (peer students & external panel)
- Project report: 25%
- **No late submission!**

April 3, 2018	Team registration
April 10, 2018	Lab 1 report
April 19, 2018	Project proposal
May 1, 2018	Lab 2 report
May 15, 2018	Lab 3 report
May 29, 2018	Lab 4 report
June 8, 2018	Project report

Collaboration

- Students may work together on the labs
- Lab reports and codes must be produced and turned in individually
- Collaboration is expected on joint projects and writeups
 - The final report should include information about the structure of the collaboration (i.e. who did what).
- Use of an open-source software must be identified and credited in comments in your codes

Platform

- Device: Echo dot
 - Each team will get 2 devices.
 - You need to return the device on June 1, 2018 (last class).
- Simulator: Echosim.io
 - <https://echosim.io>
- Amazon Alexa Skill Kit (<https://developer.amazon.com/alexa-skills-kit>)
- Amazon AWS Lambda (<https://aws.amazon.com/lambda/>)
- Programming Language:
 - NodeJS
 - Python

Resources

- See https://hao-fang.github.io/ee596_spr2018/resources.html
- Welcome to contribute to the list
 - Create an issue at https://github.com/hao-fang/ee596_spr2018

Team Registration (due on April 3, 2018)

- Team name
 - The team name will also be the name of your bot
 - <https://developer.amazon.com/docs/custom-skills/choose-the-invocation-name-for-a-custom-skill.html>
- Team members (up to 6)
- Team vision
- 1-page DOC or PDF
- Register through Canvas
- You must join a team for this course

Student Self-Introduction

Project Ideas -- Chatbots

- Discuss news articles
- Debate
- Quiz + X
- Psychological therapy
- User simulator for Sounding Board
- General chitchat
- Others (e.g., education / medical applications)

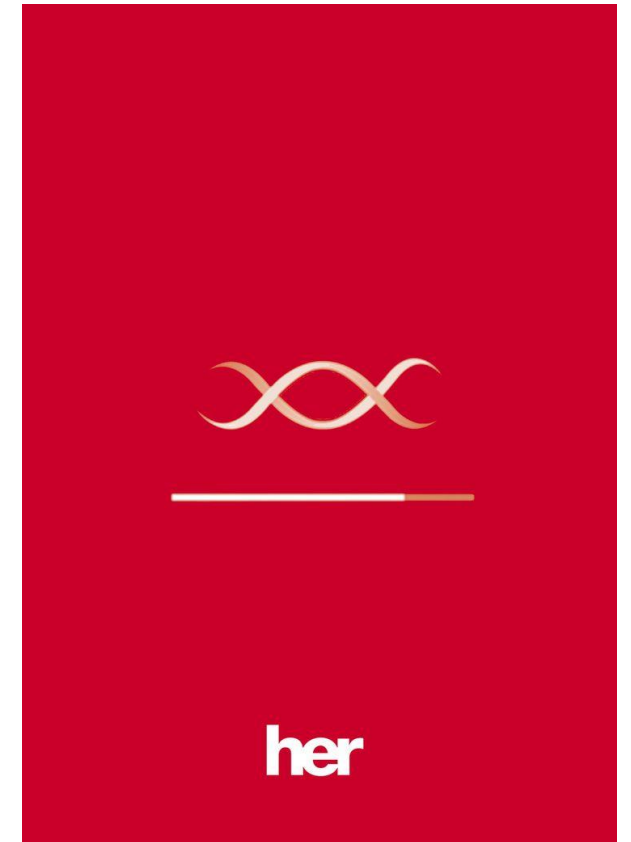
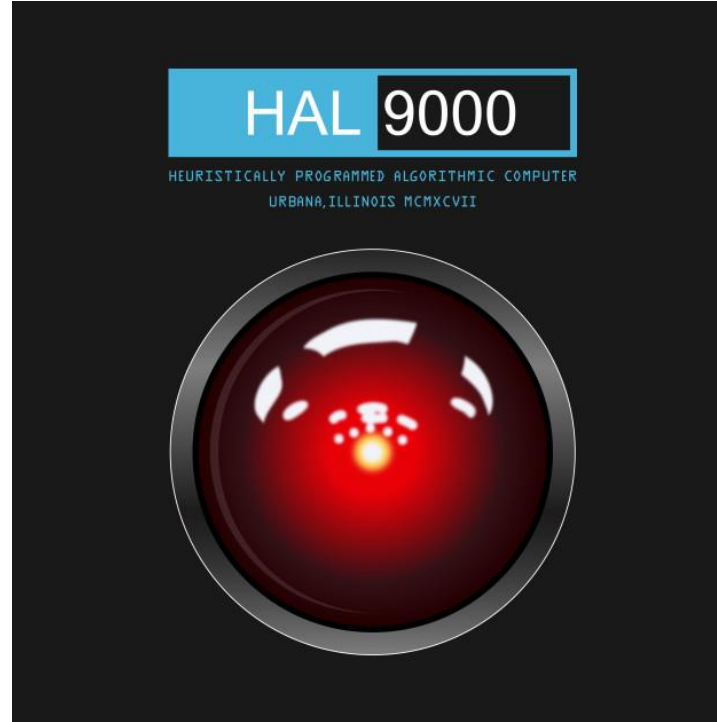
Project Proposal (due on April 19, 2018)

- Motivation
 - Explain and motivate the system you are going to build
 - Discuss the target users
 - Examples of user cases
- System overview
 - System architecture
 - High-level description of individual modules
- Potential data, model, evaluation
 - Optional for proposal, but required for final report
- Timeline

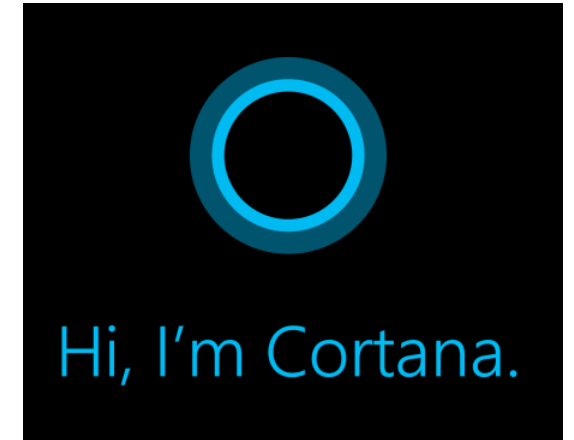
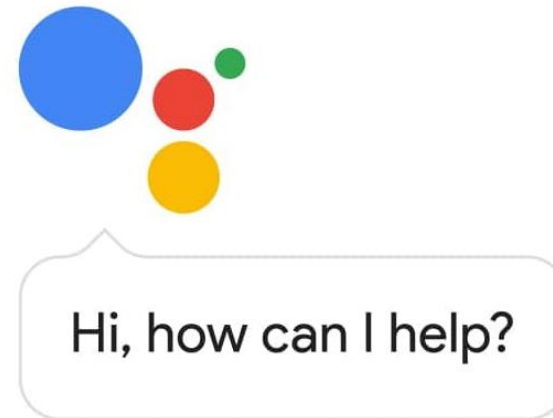
Project Report (due on June 8, 2018)

- Outline
 - Introduction
 - System description
 - Data
 - Model
 - Evaluation
 - Discussion
- More details to follow towards the end of the course

Conversational Agents



Sci-Fi



Reality

If HAL 9000 was Amazon's Alexa -- <https://youtu.be/JepKVUym9Fg>

Conversational Agents

- Chatbots
 - ELIZA (Weizenbaum, 1966)
 - PARRY (Colby, 1975)
 - ALICE (Wallace, 2009)
 - ...
- Task-oriented systems
 - DARPA **A**irline **T**ravel **I**nformation **S**ystem (ATIS)
 - DARPA Communicator for travel planning
 - ...
- Conversational Assistants
 - Amazon's *Alexa*
 - Microsoft's *Cortana*
 - *Google Assistant*
 - Apple's *Siri*
 - ...
- Social Chatbots
 - Alexa Prize 2017
 - UW's *Sounding Board*
 - ...

Break (10 min)

Next: Sounding Board

Try some online chatbots if you want.

https://hao-fang.github.io/ee596_spr2018/resources.html



Sounding Board

A User-centric and Content-driven Social Chatbot

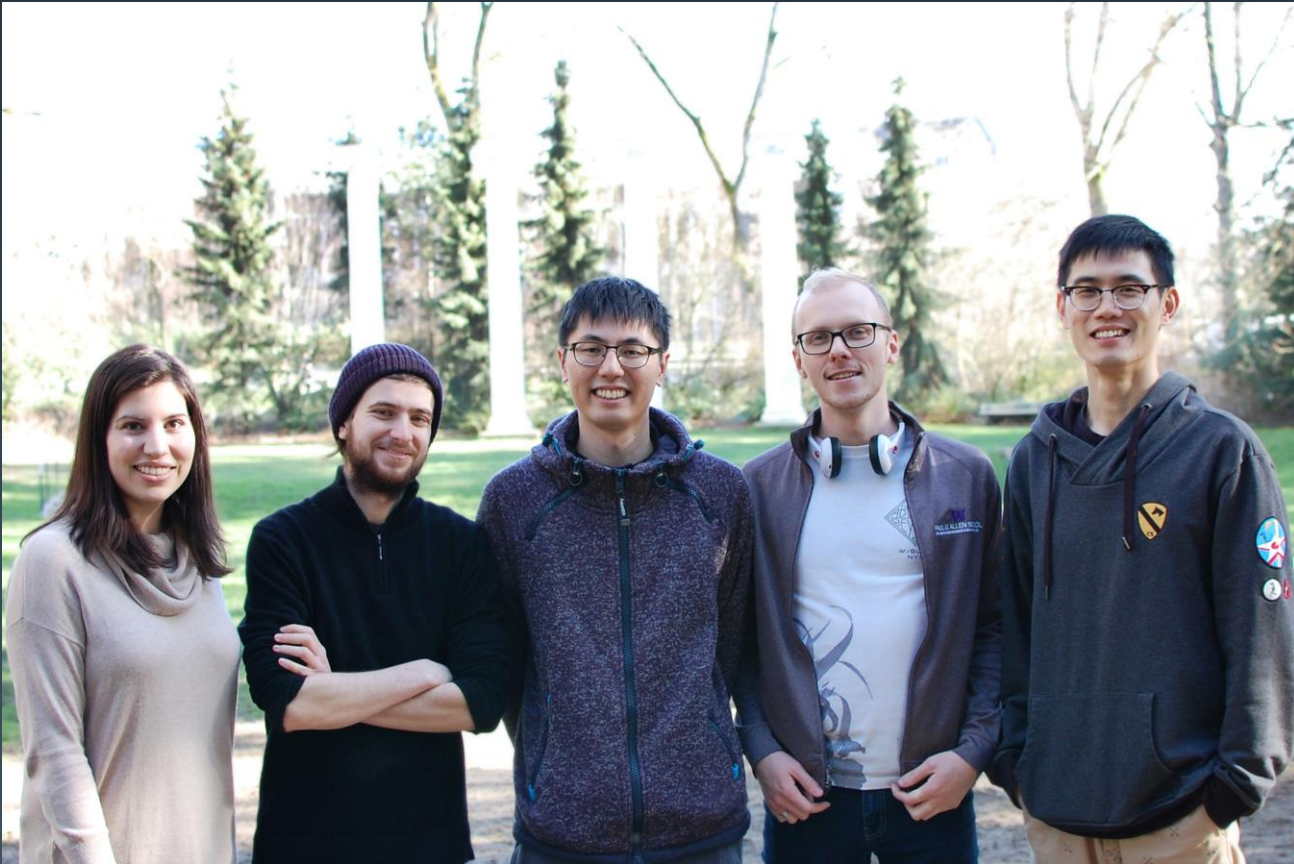
2017 Amazon Alexa Prize Winner

University of Washington

The Sounding Board Team

Students (left-to-right)

Elizabeth Clark, Ariel Holtzman, Hao Fang, Maarten Sap, Hao Cheng



Faculty Advisors



Mari Ostendorf



Yejin Choi



Noah Smith

Agenda

- Amazon Alexa Prize
- Our Approach
- Evaluation
- Future Work

Agenda

- Amazon Alexa Prize
- Our Approach
- Evaluation
- Future Work

2017 Amazon Alexa Prize

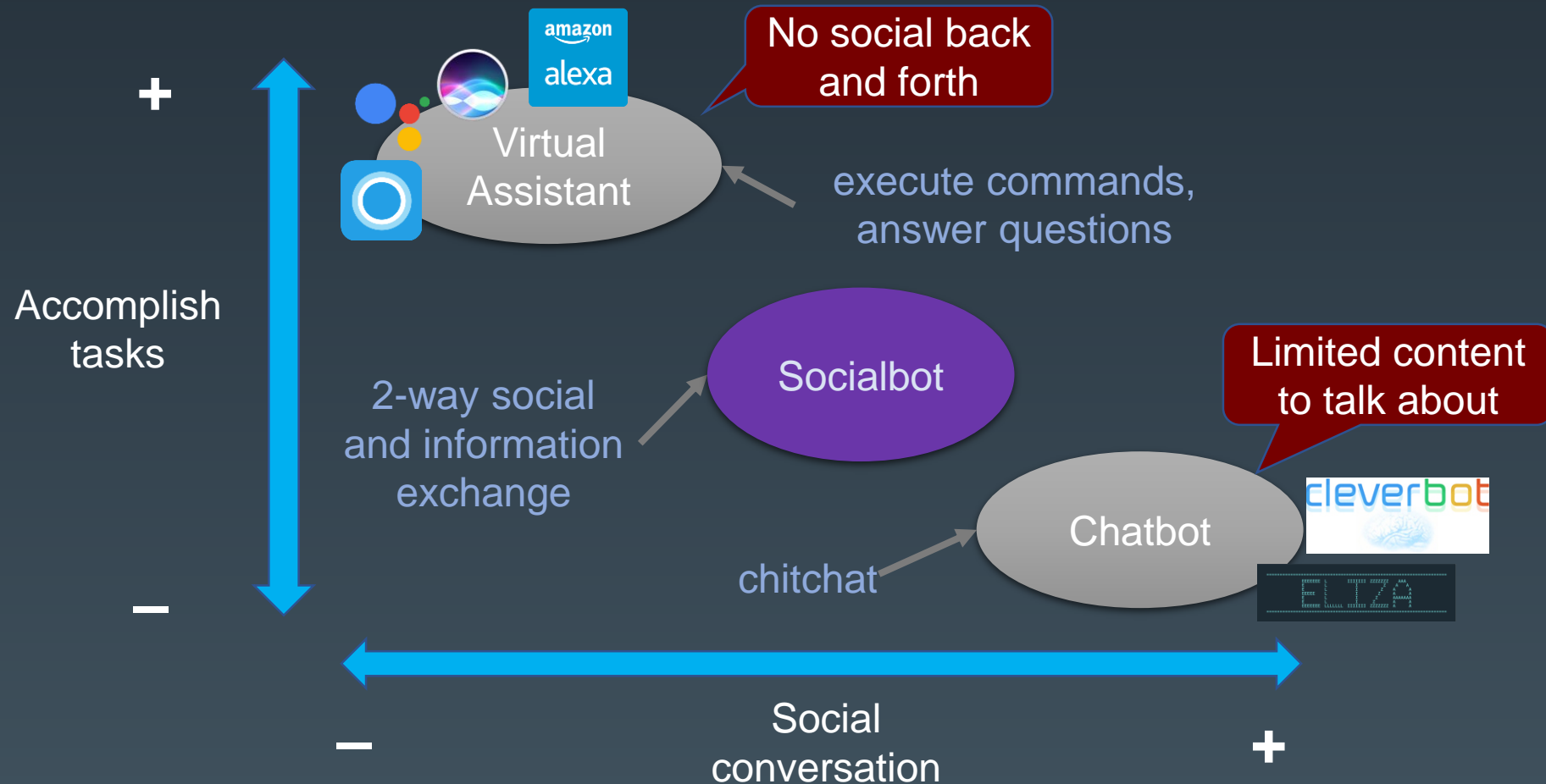
Advance conversational Artificial Intelligence (AI)

“converse coherently and engagingly with humans on popular topics and current events”

- November 2016 – November 2017
- Competition for university students to develop a **socialbot**
- 100+ teams applied, 16 teams participated, 3 made it to the finals
 - University of Washington
 - Czech Technical University
 - Heriot-Watt University
- Anyone with an Alexa-enabled device can talk to it by saying *“let’s chat”*
 - Most recent 3 months (post-finals): 500K users, 10M interactions

2017 Amazon Alexa Prize

Socialbots in conversational AI

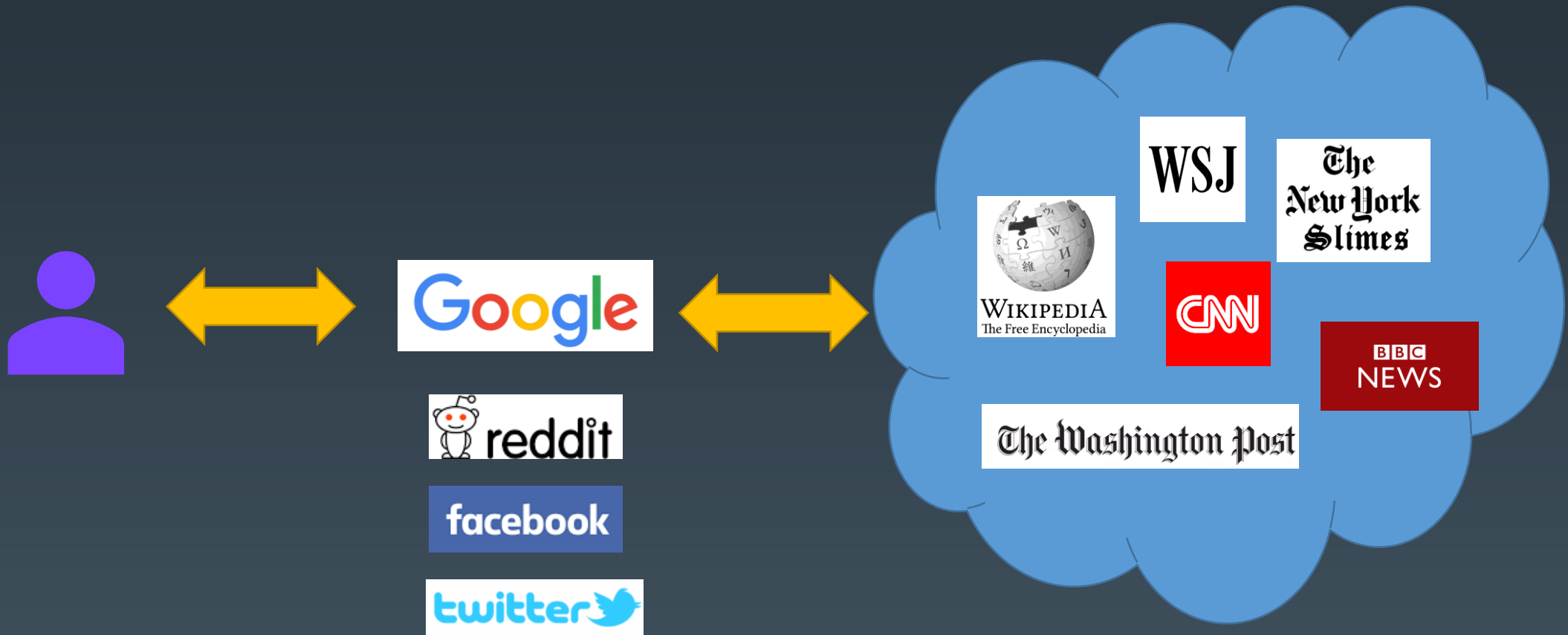


Agenda

- Amazon Alexa Prize
- Our Approach
- Evaluation
- Future Work

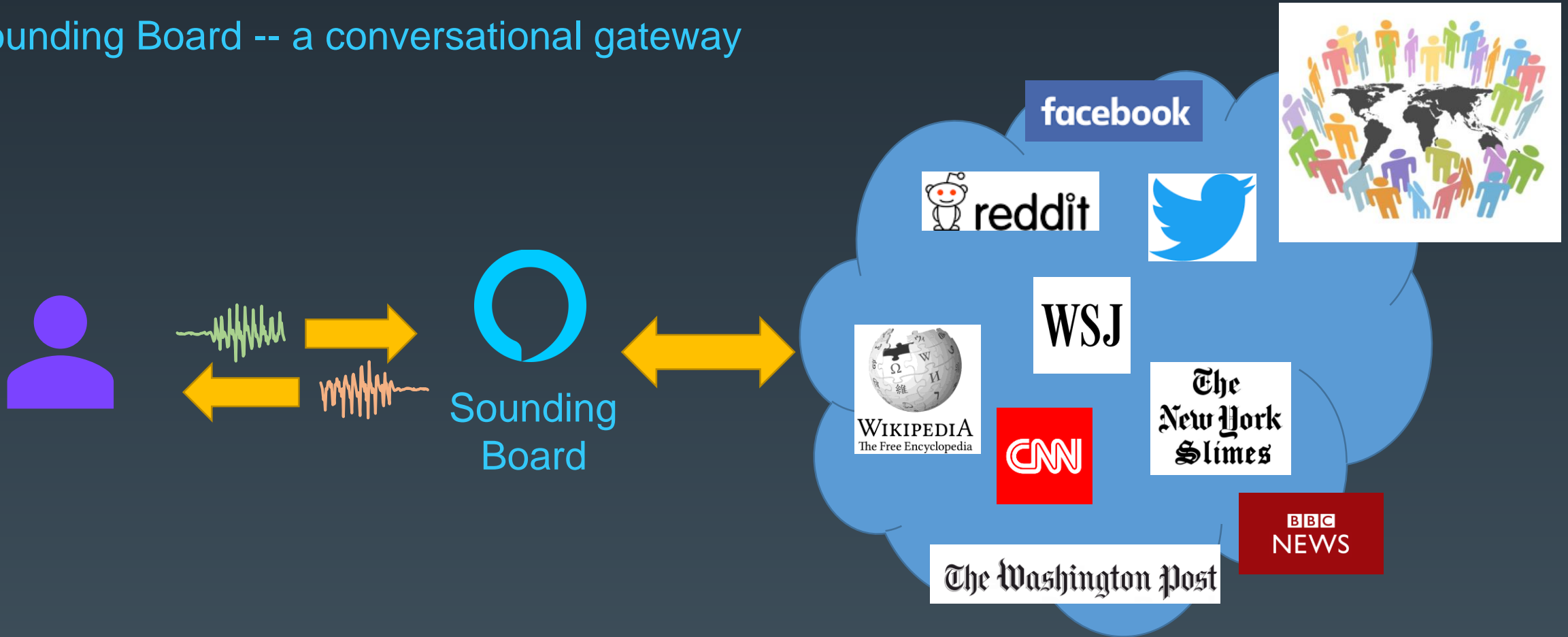
Our Approach

Sounding Board -- a conversational gateway



Our Approach

Sounding Board -- a conversational gateway



Our Approach

Sounding Board -- a user-centric and content-driven social chatbot



User-centric

- User goals
- User personality
- User reactions
- Responsive to abrupt user topic/goal changes



Content-driven

- Content mining
- Knowledge graph
- Actively steer conversation based on content availability

Our Approach

System modules

- What type of things to talk about?
 - Mine and understand online content
 - Time-sensitive, interesting, uplifting, ...
 - Organize content as a knowledge graph
- How to talk about them?
 - Understand users
 - Negotiate, execute, abandon sub-dialogs
 - Content should be relevant, diverse, ...
 - Conversational style in both word choice & prosody



Content
Management



Spoken
Language
Understanding

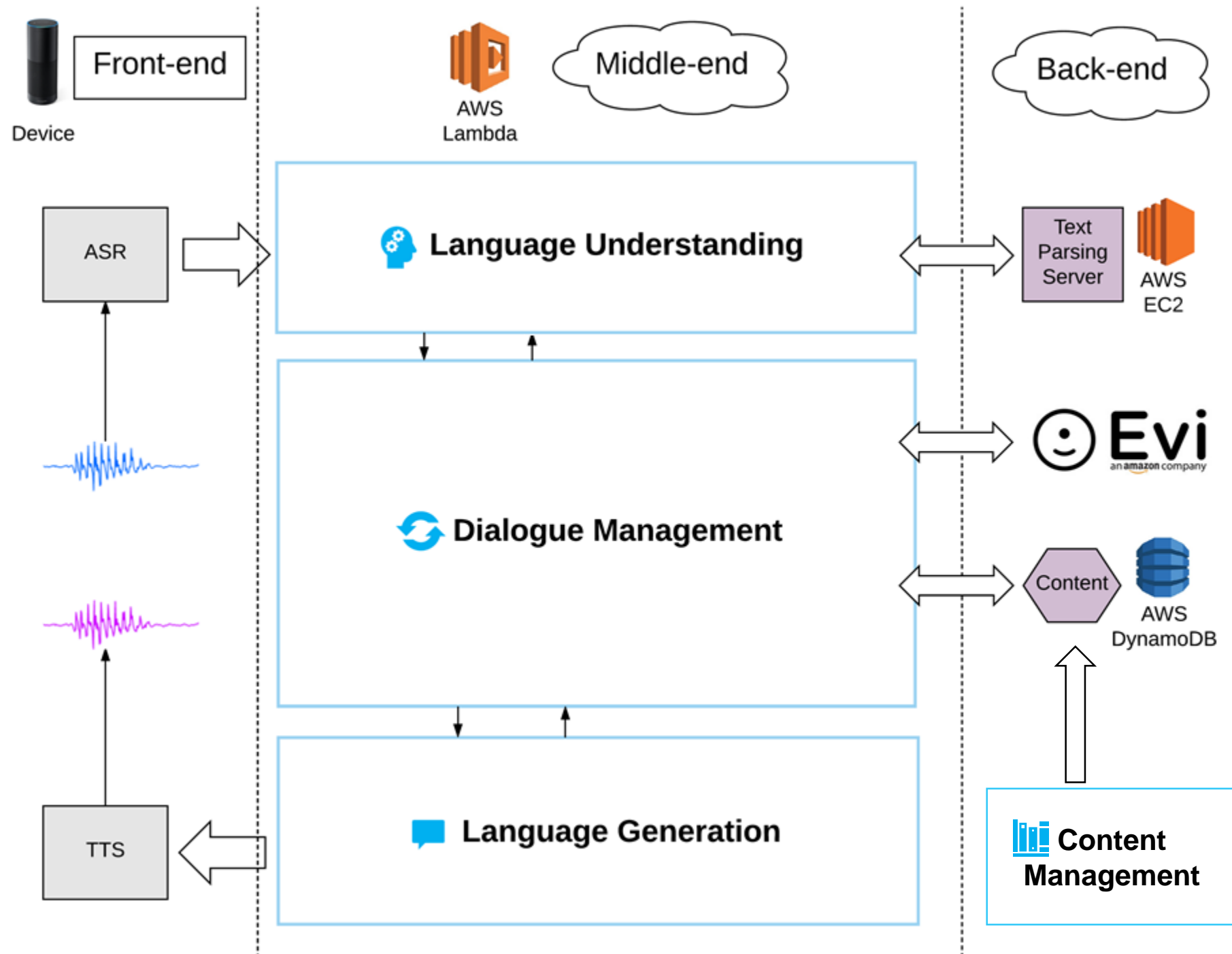


Dialogue
Management

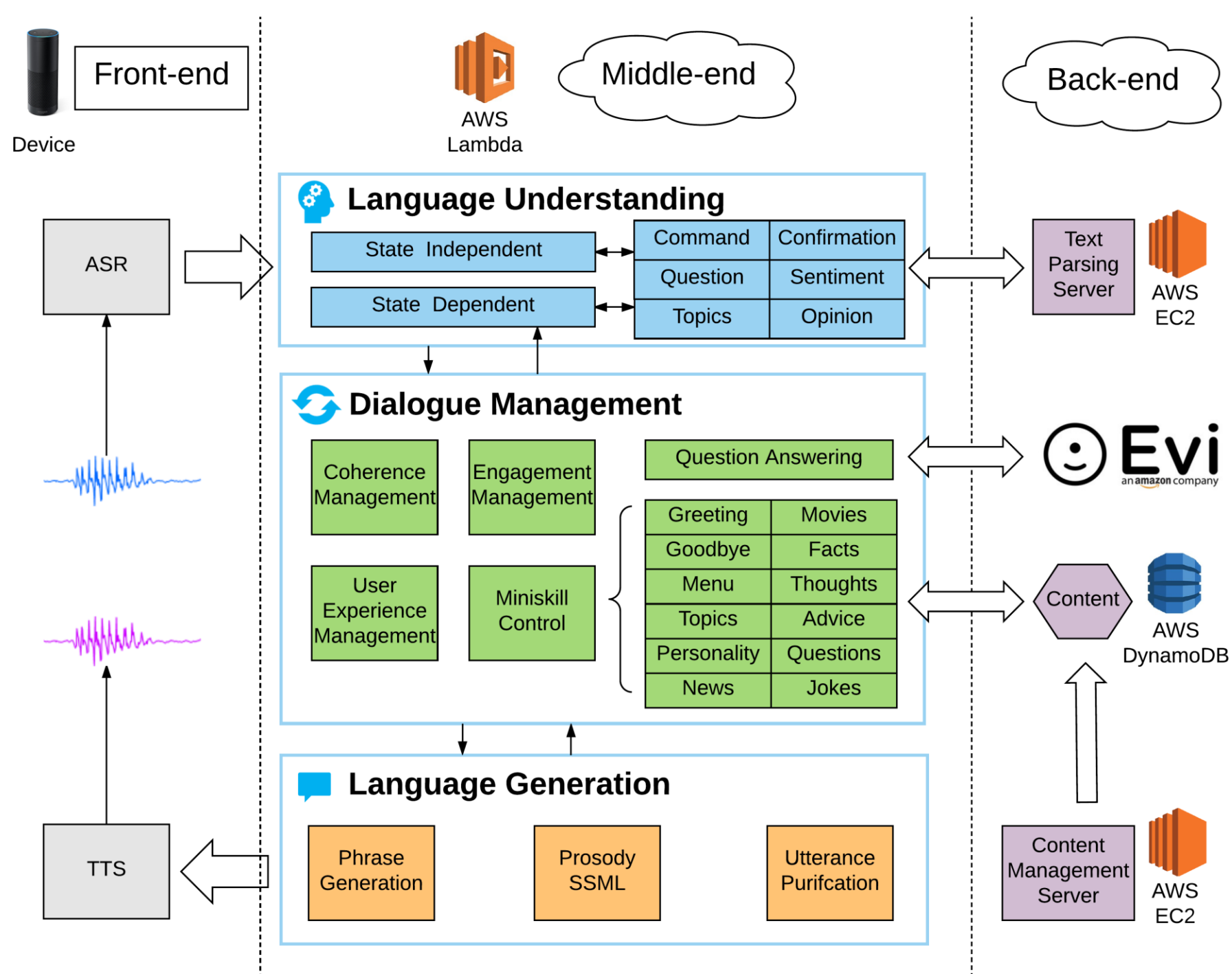


Language
Generation

System Diagram



System Diagram



Turn	User	Sounding Board
1	Let's chat	Hi! This is an Alexa Prize socialbot. How's your day?
2	I'm <u>five</u> .	Glad to hear it! We could talk about robots, batman, or superman. Say "next", to chat about other things.
3	Superman.	It looks like you wanna chat about superman. I was high up in the cloud when I realized: If people don't recognize Clark Kent as Superman because of his glasses, does his eye doctor know his true identity?
4	I guess so.	Did you know that Henry Cavill almost missed the call for the role of Superman cause he was playing "World of Warcraft"
5	Really, I didn't know that.	Weird, right? Speaking of superman, Did you see Superman? It was released in 1997. It's a comedy.
6	Yes, it was hilarious.	I'm glad you feel this is hilarious. Which part do you like best about this movie?
7	The part when he met lewis leah.	Interesting. meccartin, and raffi co-directed this film. The movie has a 6.3 out of 10 on IMDB. which seems pretty good! do you like the movie's director?
8	Yeah, he's cool.	Cool! By the way, do you wanna know something interesting about raffi?
9	Okay, go ahead.	Super! My friend told me that Raffi is a worldwide children's rights activist and has fought against exploitative advertising to children.

ASR error

Grounding

Negotiation

Thoughts

Movie

Fact

Agenda

- Amazon Alexa Prize
- Our Approach
- **Evaluation**
- Future Work

Evaluation

... for system development and Amazon analysis

- Interaction Ratings from Alexa users
 - 1 – 5 ratings, how much they would like to speak with this Socialbot again
 - Initial development period (April – June), Alexa Prize semifinals (July – Aug) , post semifinals (Sept – Oct) and ongoing
- Amazon Analysis
 - Hand-labeling of conversations for various attributes (Venkatesh et al. NIPS 2017)
- Alexa Prize Finals
 - 1 – 5 ratings from Amazon-selected judges, with time as a tie-breaker

Evaluation

Alexa Prize Finals (Nov. 2017)

- Finalists: Czech Technical Univ., Univ. of Washington, Heriot-Watt Univ.
- 3 interactors, 3 judges
 - Interactors engage with the Socialbot in turn-by-turn conversation about popular topics
 - Judges listen to the interaction and give ratings (1 to 5)
 - Interactors end the conversation when 2 judges have requested to stop.
- Sounding Board results:
 - Average score: 3.17
 - Average duration: 10 minutes and 22 seconds
 - *“Two judges had clicked out just shy of the 20-minute mark.”* – James Vlahos, WIRED.
- [2017 Finals Video](#)

Agenda

- Amazon Alexa Prize
- Our Approach
- Evaluation
- **Future Work**

Future Work

Sounding Board faces and tries to address ...

Technical Challenges

- Collect and understand online content
- Understand user intent and reaction
- Recommend content effectively and efficiently
- Present content through conversational interaction

User Experience Challenges

- Exclude undesirable content
- Keep the conversation grounded
- Deflect discussions about taboo topics

Future Work

Research directions

- Improved capability of understanding users
- Deeper discussion about news events and online content
- Automatic evaluation and diagnosis of human-bot conversations
- More use of machine learning algorithms for system design

Future Work

Beyond the conversational gateway to social media...

- Information-oriented (timely content important)
 - Conversational gateway to information for education
 - Voice-based help-desk information service
 - Debate/info-bot (e.g. for political campaigns)
- Chat-oriented (social interaction important)
 - Conversational “practice” for language learning
 - Companionship
 - Medical domains (diagnosis & therapeutics)
- Art exhibit



AWARD Invent

Thank you

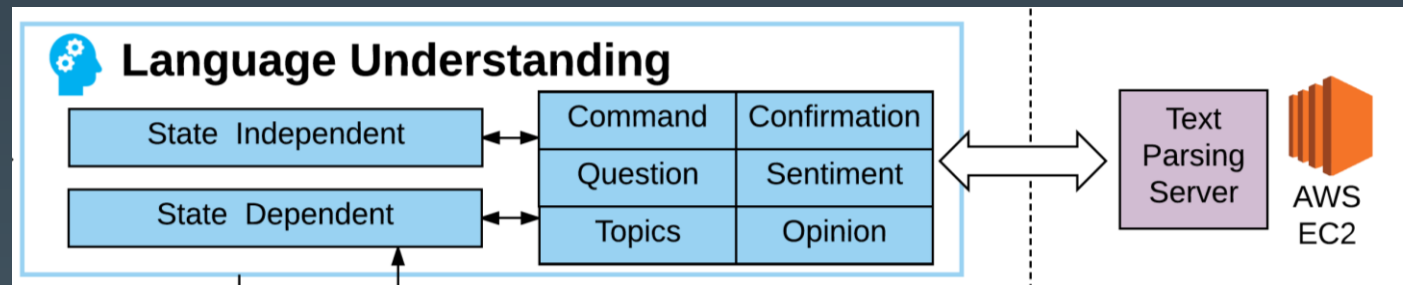
Language Understanding



Multi-dimensional utterance representation

- Directive: command, question
- Non-directive: confirmation, sentiment, opinion
- Topics: primary topic, candidate topics

no but that's cool can we talk about something else
i don't like sports let's talk about spider man homecoming



Dialogue Management



Hierarchical dialogue managers

- Conversational miniskills

- greeting / goodbye / menu / topics
- probe user personality
- discuss a news article
- discuss a movie
- tell a fact / thought / advice / joke
- ask a factual question

- Engagement principle

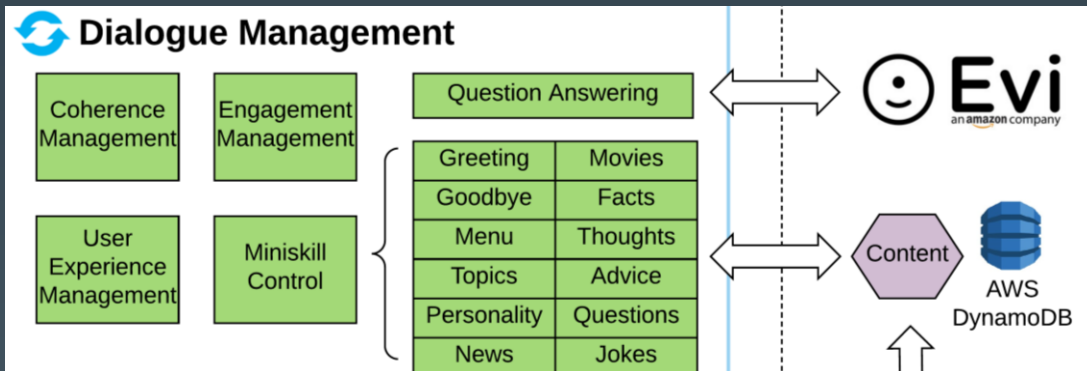
- promote topic and style diversity
- detect user dissatisfaction

- Coherence principle

- retrieve content from knowledge graph
- avoid duplicated contents

- User experience principle

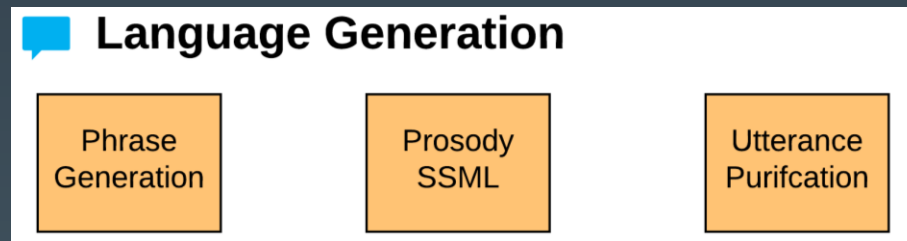
- conversation grounding
- instruction
- error handling



Language Generation



- Phrase generation
 - Grounding (*“Interesting.”*)
 - Inform (*“Did you know that ...”*)
 - Request (*“Do you like the movie’s director?”*)
- Prosody adjustment
- Utterance purification



Content Management



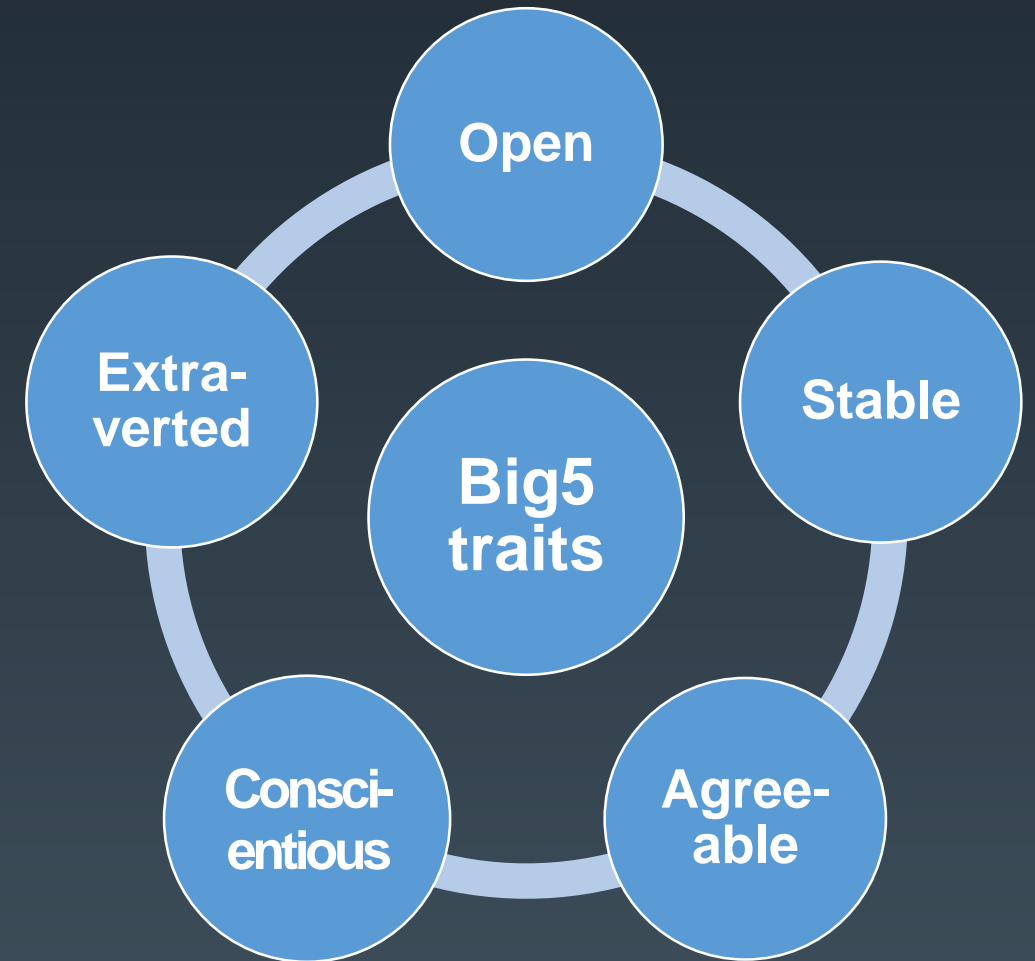
- Harvest online contents
 - news, fact, thought, advice, joke
 - movie
 - question answering
- Build knowledge graph
 - connect content nodes
 - efficient query and recommendation
- Content filtering
 - sexual / violent / controversial
 - uncomfortable / depressing
 - overly complex / long
- Content formatting
 - text normalization for TTS

Profiling Personality

Big 5 personality traits (Costa&McCrae, 1992)

- Agreeable and Open users have longer conversations
- Extraverted, Agreeable, and Open users tend to like Sounding Board more

Trait	Positive	Negative
ext	news, fashion	A.I., time travel, batman, food, cats
agr	N/A	pokemon, cats, christmas, robots
ope	A.I., time travel, batman, aliens	video games
con	N/A	movies, video games, disney, pokemon, minecraft
neu	A.I.	N/A



Choose Your Team Name

- Please refer to Alexa Skill Kit document
 - <https://developer.amazon.com/docs/custom-skills/choose-the-invocation-name-for-a-custom-skill.html>
- One-word invocation names are not allowed
- Invocation names which are names of people or places are not allowed
 - unless they contain other words in addition to the name (e.g., "molly's horoscope").
- Two-word invocation names are not allowed if one of the words is
 - definite article ("the")
 - indefinite article ("a", "an")
 - preposition ("for", "to", "of").
 - For example, "a bicycle", "an espresso", "to amuse", "for fun".

Choose Your Team Name

- The invocation name must not contain any of the Alexa skill launch phrases and connecting words.
 - Launch phrases: "launch", "ask", "tell", "load", "begin", and "enable".
 - Connecting words: "to", "from", "by", "if", "and", "whether".
- The invocation name must not contain
 - the wake words "Alexa", "Amazon", "Echo", "Computer",
 - or the words "skill" or "app".

Choose Your Team Name

- The invocation name must contain only
 - lower-case alphabetic characters
 - spaces between words
 - possessive apostrophes (for example, "sam's science trivia")
 - periods used in abbreviations (for example, "a. b. c.").
- Other characters like numbers must be spelled out
 - For example, "twenty one".
 - The name must be easy to pronounce correctly and be phonetically distinct to avoid being misinterpreted as other similar sounding words.
- For acronyms, the invocation name must contain single letters, each followed by a period and a space.
 - The invocation name cannot spell out phonemes.
 - For example, a skill titled "USC Trivia" would need "USC" represented as "u. s. c. " and NOT "you ess see".

March 29: Lab 1 – Hello Alexa

- Sign up for Amazon AWS using your @uw.edu account.
 - You will get Free Tier access (<https://aws.amazon.com/free>) for your labs and projects.
- Apply for AWS Educate using your @uw.edu account.
 - <https://www.awseducate.com>
 - You will get \$100 credit in addition to the Free Tier access. (You need to use your @uw.edu account).
 - FAQ: <https://www.awseducate.com/faqs>
- Create an Amazon Developer Account.
 - <https://developer.amazon.com>