

CMPT 413/825: Natural Language Processing

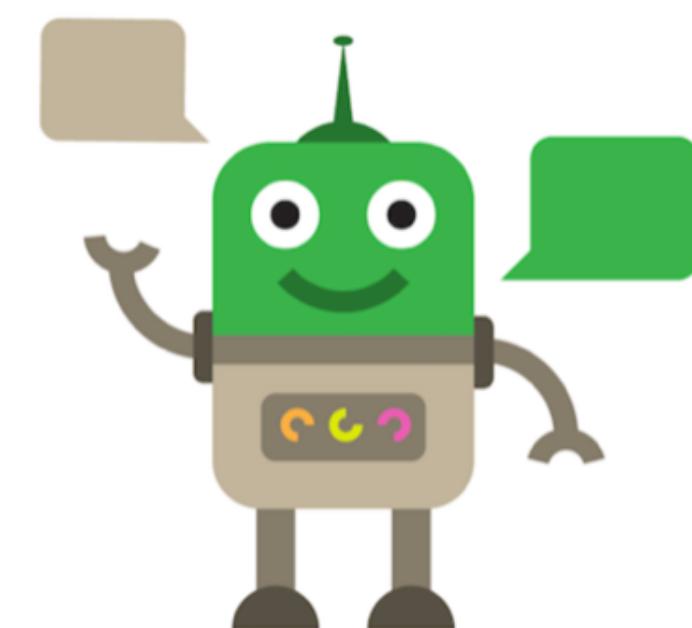
Dialogue

Fall 2020
2020-11-27

Adapted from slides from Danqi Chen and Karthik Narasimhan
(with some content from slides from Chris Manning and Dan Jurafsky)
₁

Overview

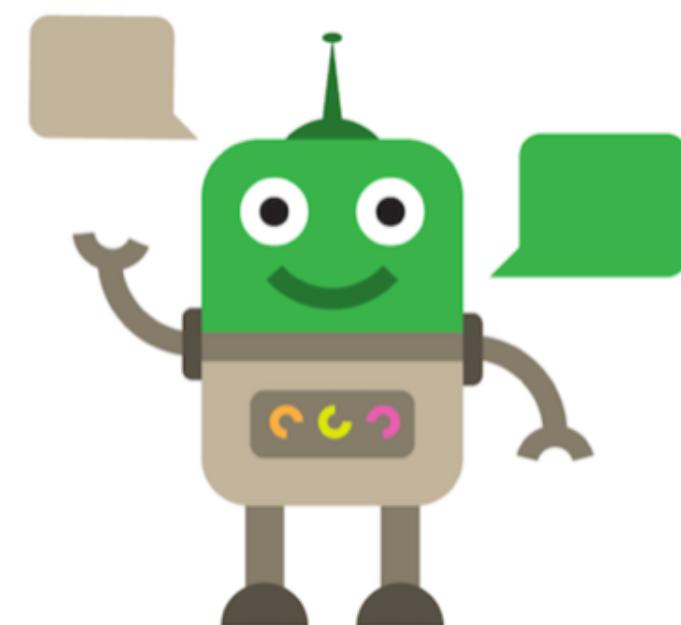
- **What's a dialogue system?**
- **Properties of Human Conversation**
- **Chatbots**
- **Task-oriented dialogues systems**
- **Remaining Challenges**



Dialogue Systems

Overview

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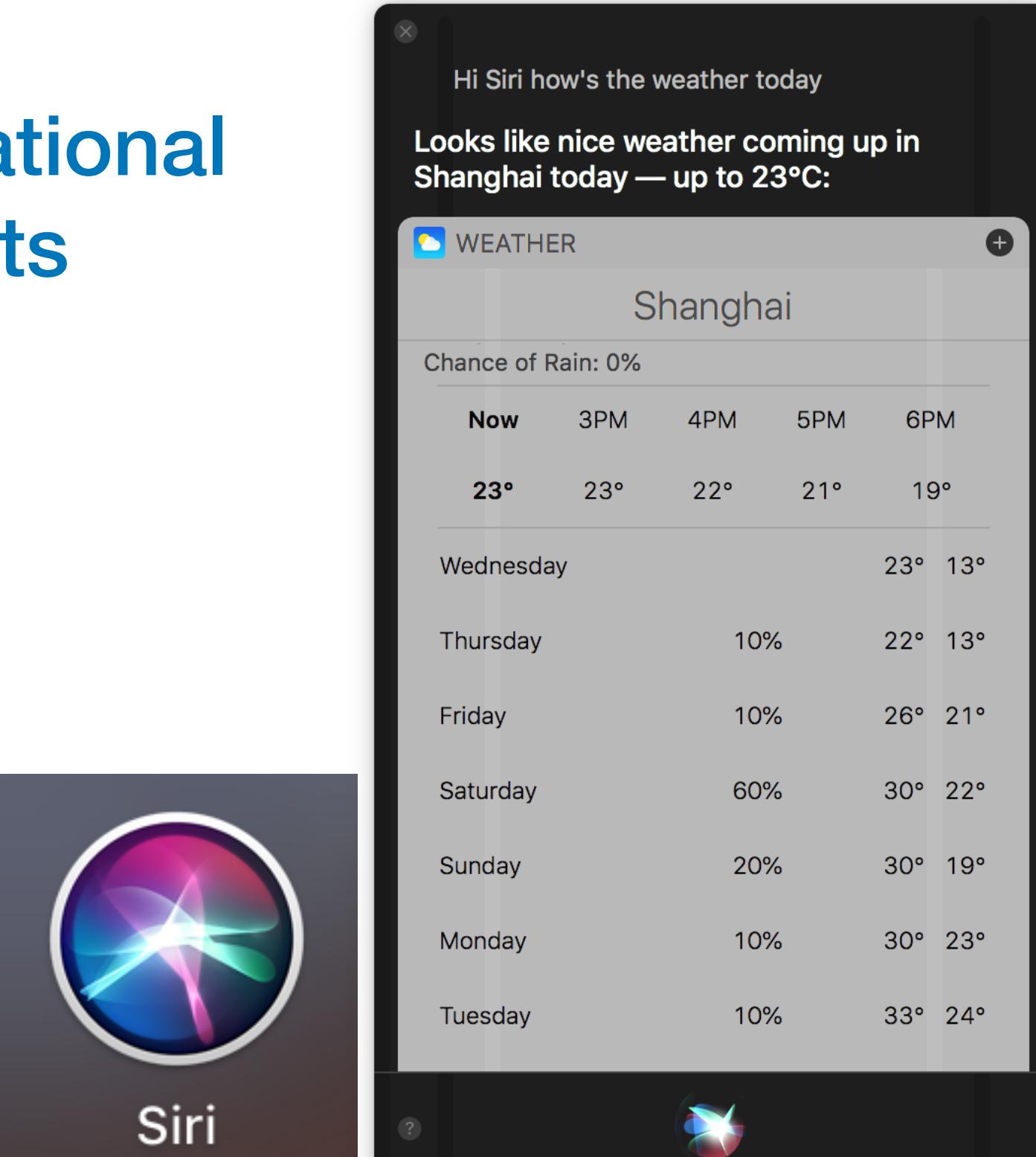


Dialogue Systems

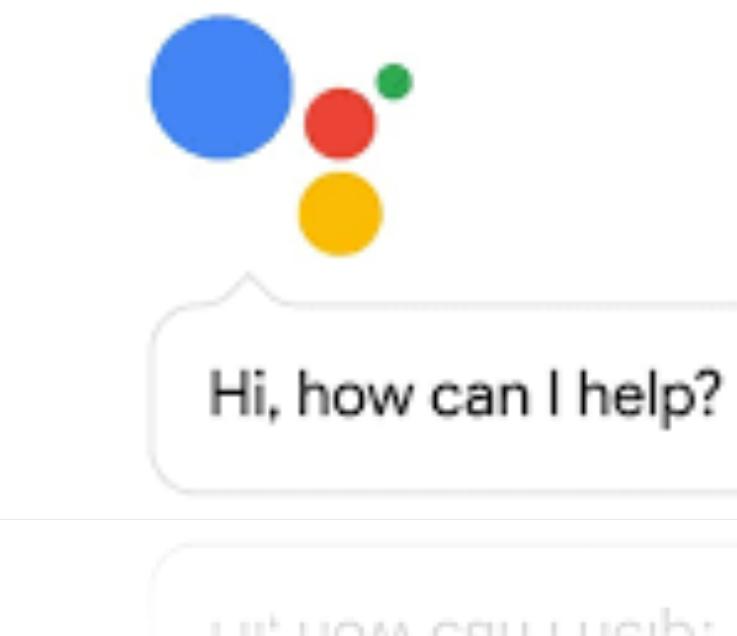
What's a Dialogue System?

Dialog Systems are **HOT** 🔥. — Did you use it?

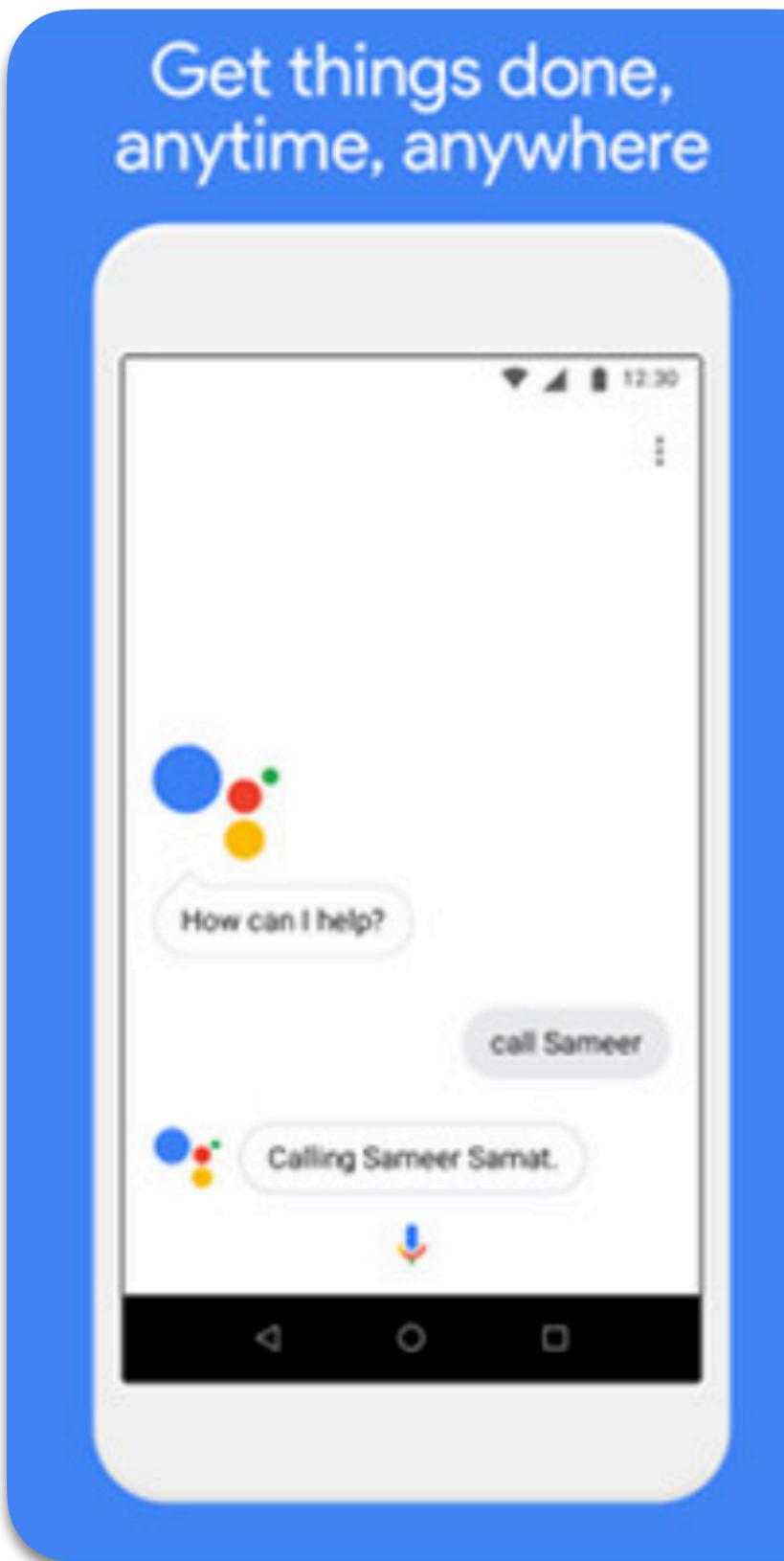
Conversational agents



Apple



Google

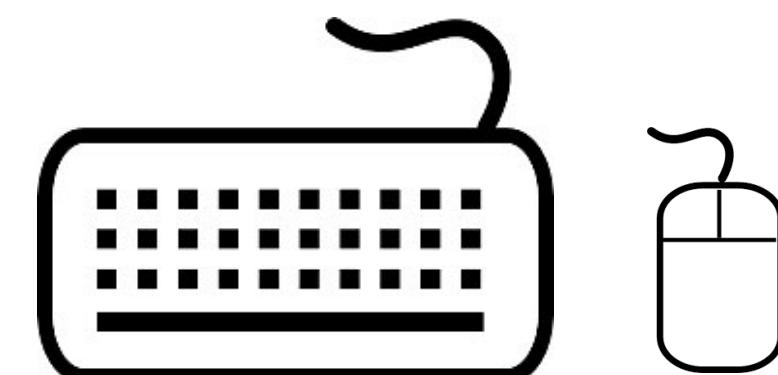


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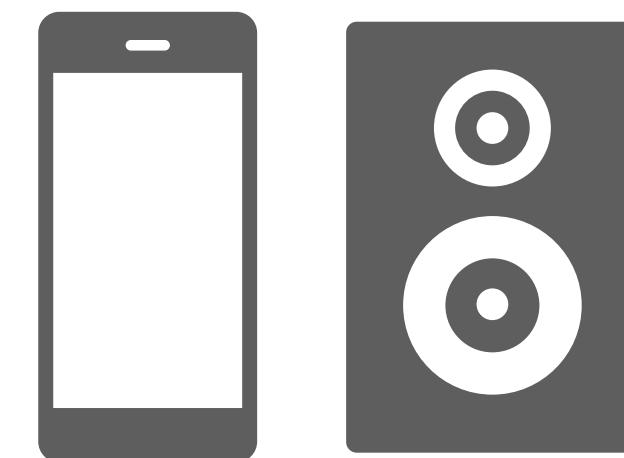
Dialog Systems are **HOT** 🔥. — Preferable user interface.



Desktop



keyboard & mouse



**Smart Mobile
Embedded Devices**

“turn off the light.”



language

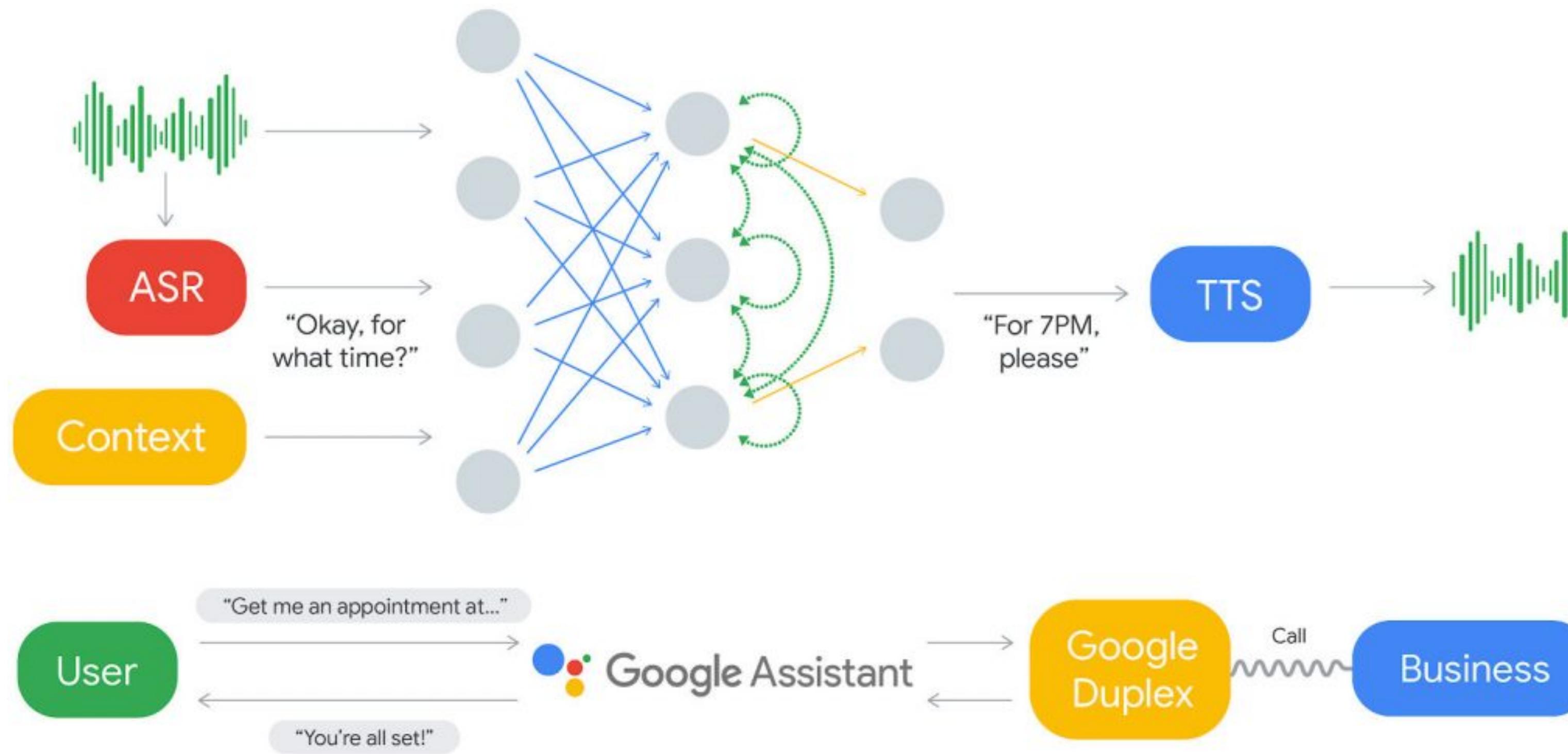
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Dialog Systems are **HOT** 🔥. — Killer apps for NLP.



Google Duplex: Can you distinguish human and AI?

What's a Dialogue System?



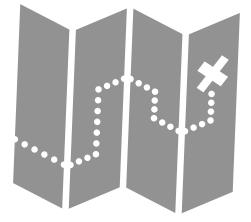
(<https://techeology.com/what-is-google-duplex/>)

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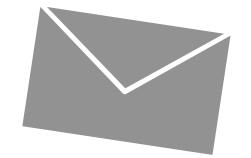
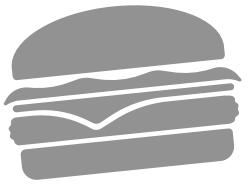
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They can

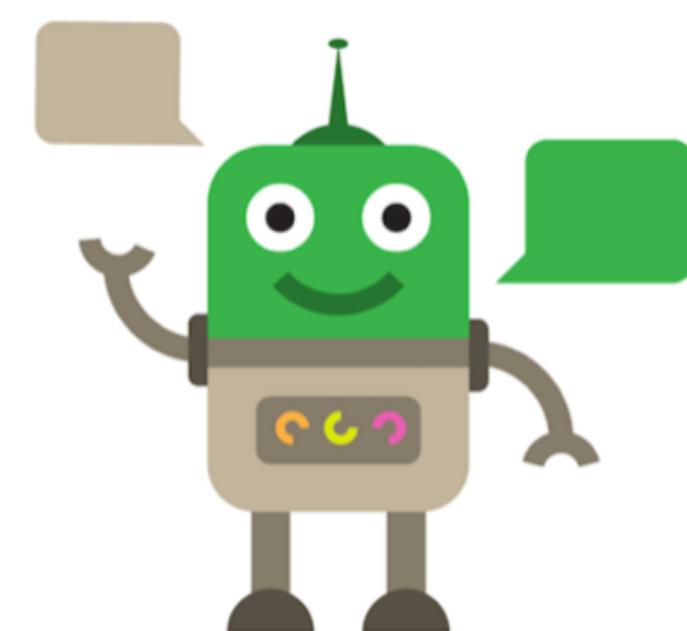


- give travel directions
- control home appliances
- find restaurants
- help make phone calls
- customer services
- ...



Overview

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- **Properties of Human Conversation**
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Dialogue Systems

Properties of Human Conversation

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- A₁: And, what day in May did you want to travel?
- C₂: OK uh I need to be there for a meeting that's from the 12th to the 15th.
- A₂: And you're flying into what city?
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- A₉: It's a Friday.
- C₁₀: Uh hmm. I would consider staying there an extra day til Sunday.
- A₁₀: OK...OK. On Sunday I have ...

A: travel agent
C: human client

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Turn taking

Turn structure:
(C-A-C-A-C...)

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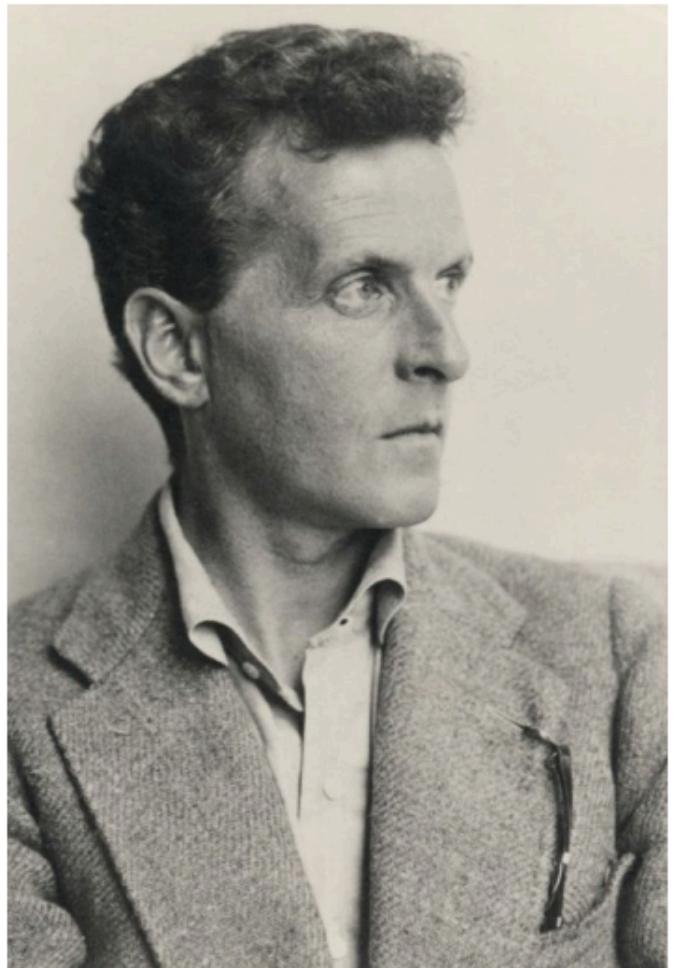
Spoken DS:
endpoint detection
(know when to start talking)

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#: overlap



Each turn in a dialogue is a kind of action
Wittgenstein (1953) and Austin (1962)

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answering

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answering

Properties of Human Conversation

Constatives:	committing the speaker to something's being the case (<i>answering, claiming, confirming, denying, disagreeing, stating</i>)
Directives:	attempts by the speaker to get the addressee to do something (<i>advising, asking, forbidding, inviting, ordering, requesting</i>)
Commissives:	committing the speaker to some future course of action (<i>promising, planning, vowing, betting, opposing</i>)
Acknowledgments:	express the speaker's attitude regarding the hearer with respect to some social action (<i>apologizing, greeting, thanking, accepting an acknowledgment</i>)

“I need to travel in May”
“Book me a flight to Seattle”
“I will book you a flight”
“Thanks”

A taxonomy of **dialog acts** (Bach and Harnish, 1979)

There are different taxonomies of dialog acts (also known as speech acts)

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Principle of closure.

Agents performing an action require evidence, sufficient for current purposes, that they have succeeded in performing it
Clark (1996) (after Norman 1988)

grounding:

acknowledge that the listener has understood the speaker

Need to know if action has failed or succeeded
(did the person understand me?)

(Example from Jurafsky and Martin)

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**local structure
between
dialog acts**

**correction
subdialogue**

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mixed initiative:
conversation is not controlled by one participant

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user-initiative
v.s.
system-initiative

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conversational
implicature

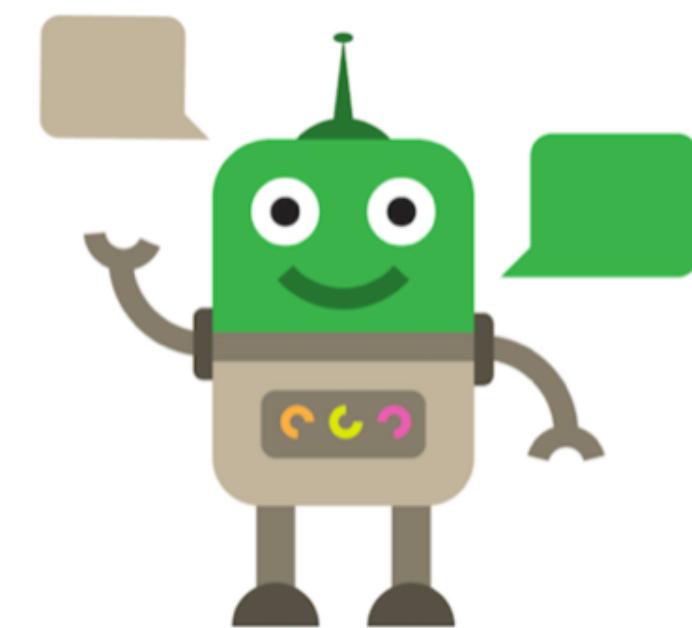
Properties of Human Conversation

- Turn structure
- Dialog acts
- Grounding
- Dialogue structure
- Initiative
- Implicature

These **subtle characteristics of human conversations** are among the reasons it is difficult to build dialogue systems that can carry on **natural conversations with humans**.

Overview

- What's a dialog system?
- Properties of Human Conversation
- Chatbots
- Task-oriented dialog systems
- Remaining Challenges



Dialogue Systems

Chatbot (Chit-chat)

User:	Do you like Doctor Who?
Cleverbot:	Yes, so funny.
User:	What's your favorite show?
Cleverbot:	I don't have one.
User:	What's your name?
Cleverbot:	Jason I already told you.
User:	No your real name.
Cleverbot:	Stephanie IS my real name.
User:	I thought it was Jason?
Cleverbot:	How did you come to that conclusion.
User:	Because you said so.
Cleverbot:	I have to do my homework.

GOAL

mimicking the **unstructured**
conversational characteristic of
human-human interaction

Chatbots:

A conversation between a user and Cleverbot,
an IR-based chatbot (Carpenter, 2017).

Chatbot - Eliza: Weizenbaum (1966)

Men are all alike.
IN WHAT WAY

They're always bugging us about something
or other.
CAN YOU THINK OF A SPECIFIC
EXAMPLE

Well, my boyfriend made me come here.
YOUR BOYFRIEND MADE YOU COME
HERE

He says I'm depressed much of the time.
I AM SORRY TO HEAR YOU ARE
DEPRESSED

Rogerian psychologist: reflect
back what the patient said

WHO ELSE IN YOUR FAMILY TAKES CARE OF YOU?

My father

You are like my father in some ways.

WHAT RESEMBLANCE DO YOU SEE

You are not very aggressive but I think you don't want me to notice that.

WHAT MAKES YOU THINK I AM NOT AGGRESSIVE

You don't argue with me.

WHY DO YOU THINK I DON'T ARGUE WITH YOU

You are afraid of me.

DOES IT PLEASE YOU TO BELIEVE I'M AFRAID OF YOU

My father is afraid of everybody.

WHAT ELSE COMES TO MIND WHEN YOU THINK OF YOUR FATHER

Bullies.

Chatbot - Eliza: Weizenbaum (1966)

```
function ELIZA GENERATOR(user sentence) returns response
    Find the word w in sentence that has the highest keyword rank
    if w exists
        Choose the highest ranked rule r for w that matches sentence
        response  $\leftarrow$  Apply the transform in r to sentence
        if w = ‘my’
            future  $\leftarrow$  Apply a transformation from the ‘memory’ rule list to sentence
            Push future onto memory stack
        else (no keyword applies)
            either
                response  $\leftarrow$  Apply the transform for the NONE keyword to sentence
            or
                response  $\leftarrow$  Pop the top response from the memory stack
    return(response)
```

Rule-based method: A simplified sketch of the ELIZA algorithm. The power of the algorithm comes from the **particular transforms associated with each keyword**.

Chatbot - Eliza rules

Keywords are ranked from specific to general

I know everybody laughed at me

- “I” is a very general keyword:

I: (I *) -> (You say you 2)

YOU SAY YOU KNOW EVERYBODY LAUGHED AT YOU

- “Everybody” is much more interesting (someone using universals like everybody/always is probably “referring to some quite specific event or person”)

WHO IN PARTICULAR ARE YOU THINKING OF?

- Implementation: keywords stored with their rank

Everybody 5 (*transformation rules*)

I 0 (*transformation rules*)

Backoff

Please go on

That's very interesting

I see

Chatbot - Parry: Colby (1971)

Similar **Pattern based rules** as Eliza, more advanced **control structure**

Persona: 28-year-old single man (post office clerk), no siblings and lives alone,

- Sensitive about his physical appearance, his family, his religion, his education, and the topic of sex.
- Hobbies (movies and gambling)
- Backstory (recently attacked a bookie, claiming the bookie did not pay off in a bet, afterwards worried about possible underworld retaliation)
- Eager to tell his story to non-threatening listeners

Mental model: Anger, Fear, Mistrust

Flare concepts: horses -> horse racing -> gambling -> bookies -> underworld -> Mafia

First system to pass the Turing test!

Psychiatrists couldn't distinguish interviews with PARRY from (text transcripts of) interviews with real paranoid

Chatbot - Eliza meet Parry

Good Evening. Tell me your problems.

Please terminate input with a period or a question mark.

*People get on my nerves sometimes.

I am not sure I understand you fully.

*You should pay more attention.

Suppose you should pay more attention.

*You're entitled to your own opinion.

What makes you think I am entitled to my own opinion?

*It bothers me just to be around people in general.

Please go on.

*I went to the track at Bay Meadows a while back.

What does that suggest to you?

*I went to the races.

What else would you like to discuss?

*Horseracing interests me.

Why do you say that just now?

*There's a lot of crooked gambling going on there.

I am not sure I understand you fully,

*It's clear to me if not to you.

Do you think its likely that not to I?

*I went to the races.

Please go on.

*I gamble on horses.

What does that suggest to you?

*I went to the races.

What else would you like to discuss?

*Gambling has been nothing but trouble to me.

Why do you say that just now?

*I've had experience with crooks gambling at the track.

I am not sure I understand you fully.

*I've already told you enough about that.

Chatbot

Given user query q and a conversational corpus C . Find the turn t in C that is most similar to q , and return the following turn.

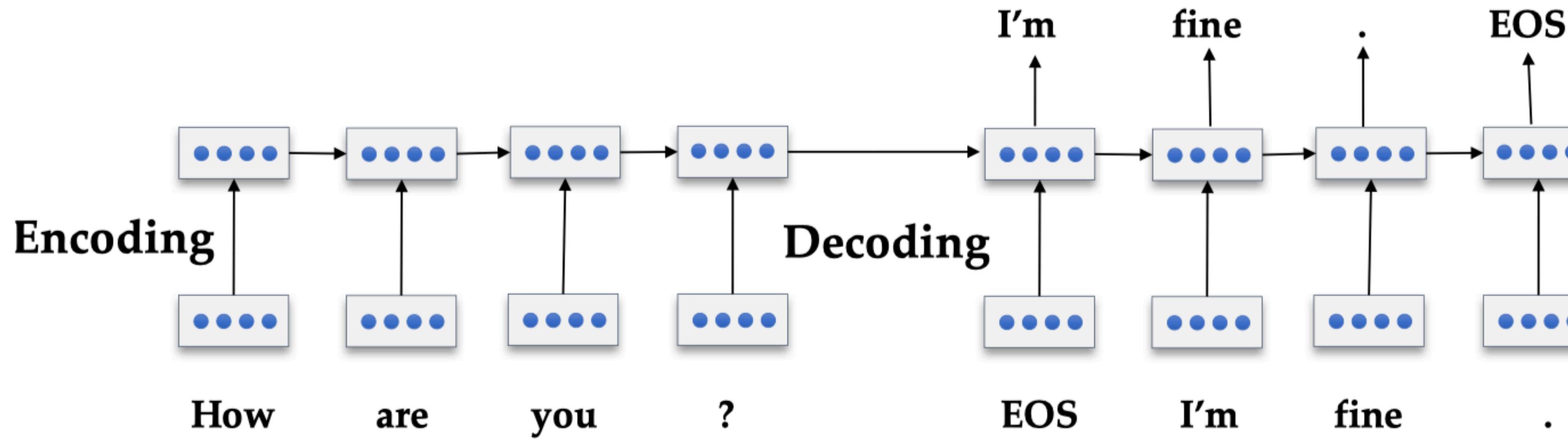
$$r = \text{response} \left(\operatorname{argmax}_{t \in C} \frac{q^T t}{\|q\| \|t\|} \right)$$

Corpus-based method (Information Retrieval):
Return the response to the most similar turn.
(Jafarpour et al. 2009, Leuski and Traum 2011)

CleverBot

User:	Do you like Doctor Who?
Cleverbot:	Yes, so funny.
User:	What's your favorite show?
Cleverbot:	I don't have one.
User:	What's your name?
Cleverbot:	Jason I already told you.
User:	No your real name.
Cleverbot:	Stephanie IS my real name.
User:	I thought it was Jason?
Cleverbot:	How did you come to that conclusion.
User:	Because you said so.
Cleverbot:	I have to do my homework.

Chatbot



Corpus-based method (Seq2Seq):
An encoder decoder model for neural response
generation in dialogue.

Chatbot

Input	tell me ... how long have you had this falling sickness ?
Vanilla-SEQ2SEQ	i'm not a doctor.
Adversarial	a few months, i guess .
Input	so i had the doctors test sammy 's response to conditioning .
Vanilla-SEQ2SEQ	sammy wrote the test sammy wrote the test .
Adversarial	so he took the pills .
Input	they didn 't have much success with this problem commander .
Vanilla-SEQ2SEQ	they 're not the only ones who have been in the system .
Adversarial	can we find someone else ?

Corpus-based method (Seq2Seq):

Sample responses generated by a Seq2Seq model trained either with a maximum likelihood objective, or adversarially trained to produce sentences that are hard for an adversary to distinguish from human sentences (Li et al., 2017).

Chatbot: Seq2Seq models

Repetitive

- A: Where are you going?
B: I'm going to the restroom.
A: See you later.
B: See you later.
A: See you later.
B: See you later.

Want Diversity



Maybe beam search

Beam size	Model response
1	<i>I love to eat healthy and eat healthy</i>
2	<i>That is a good thing to have</i>
3	<i>I am a nurse so I do not eat raw food</i>
4	<i>I am a nurse so I am a nurse</i>
5	<i>Do you have any hobbies?</i>
6	<i>What do you do for a living?</i>
7	<i>What do you do for a living?</i>
8	<i>What do you do for a living?</i>

Low beam size:
More on-topic but nonsensical; bad English

High beam size:
Converges to safe, “correct” response, but it’s generic and less relevant

(figure credit: Stanford CS224N, Chris Manning)

Chatbot: Seq2Seq models

Repetitive

A: Where are you going?

B: I'm going to the restroom.

A: See you later.

B: See you later.

A: See you later.

B: See you later.

Sample and Rank

1. Sample N candidate
2. Rank candidate and select best one

Sampling

Randomly sample words from distribution at each time step t

- Basic/pure sampling: sample from $P_t(w)$ directly
 - Can get some very bad samples
 - No control
- Top- n sampling: sample from P_t truncated to top n words
 - Greedy search: $n = 1$, Pure sampling: $n = |V|$
 - Increase n to get more diverse/risky output
 - Decrease n to get more generic/safe output
- Top- p sampling: sample from P_t restricted to top p proportion of words
 - Better when probability distribution is spread
- Temperature based sampling:
 - Increase τ to get more diverse/risky output (P_t is more uniform)
 - Decrease τ to get more generic/safe output (P_t is more spiky)

$$P_t(w) = \frac{\exp(s_w/\tau)}{\sum_{w' \in V} \exp(s_{w'}/\tau)}$$

Chatbot

Conversation D

Human: *I like how cute cows are*

Meena: *Ah, interesting. You like how they are cute, right?*

Human: *yeah, and they're realy smart*

Meena: *I heard they go to college*

Human: *cows go to college?*

Meena: *I heard that a cow went to Harvard.*

Human: *what did the cow study?*

Meena: *Bovine sciences.*

Human: *do horses go to Harvard?*

Meena: *Horses go to Hayvard.*

Human: *that's a pretty good joke, I feel like you led me into it*

Meena: *You were trying to steer it elsewhere, I can see it.*

Meena (Google):

Evolved Transformer (transformer-like architecture found via architecture search)

- Trained on social media conversations
- Minimize perplexity of next token
- Uses sample and rank

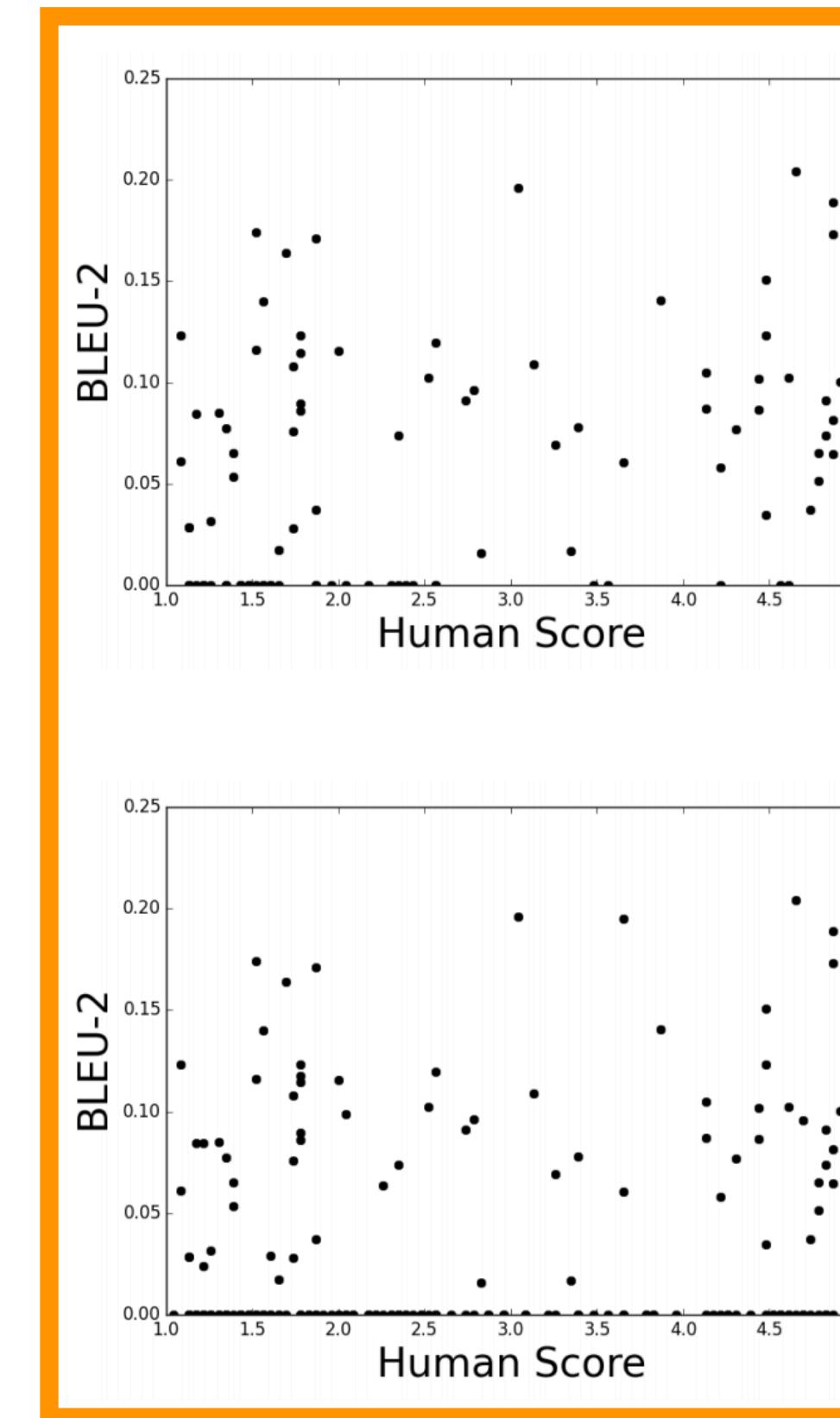
Chatbot

- **Goal:**
 - mimicking the **unstructured conversational** characteristic of **human-human interaction**
- **Methods:**
 - Rule-based
 - Corpus-based (IR, Seq2Seq)
- **Evaluation:**
 - **Chatbots are generally evaluated by humans**
 - **Adversarial evaluation:** train a “Turing-like” evaluator classifier to distinguish between human-generated responses and machine-generated responses.

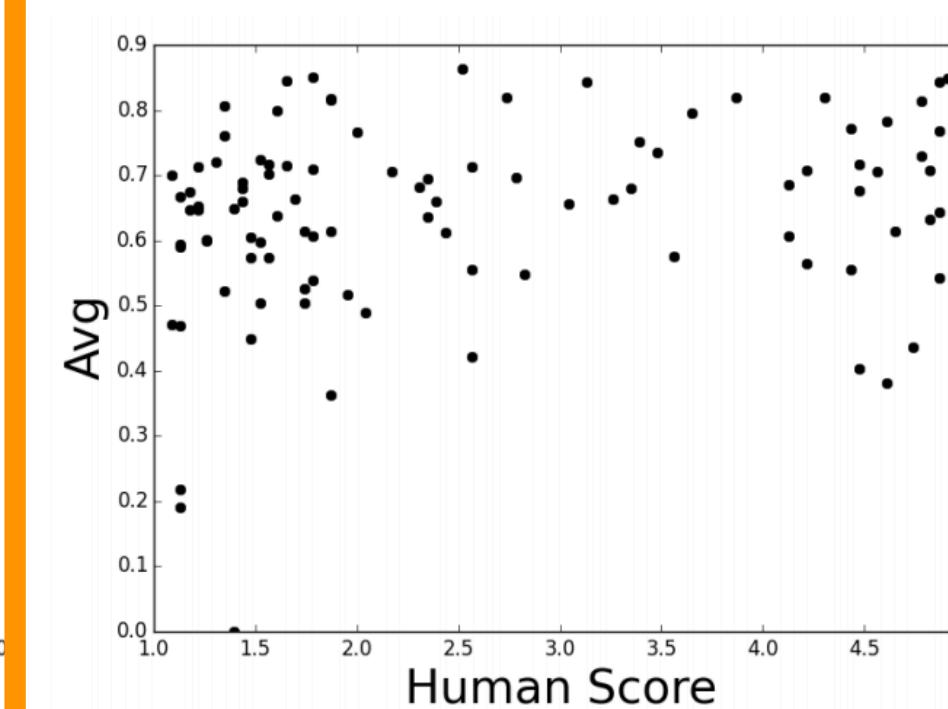
Chatbot Evaluation

Automatic Evaluation:
Word overlap metrics
are bad for dialogue

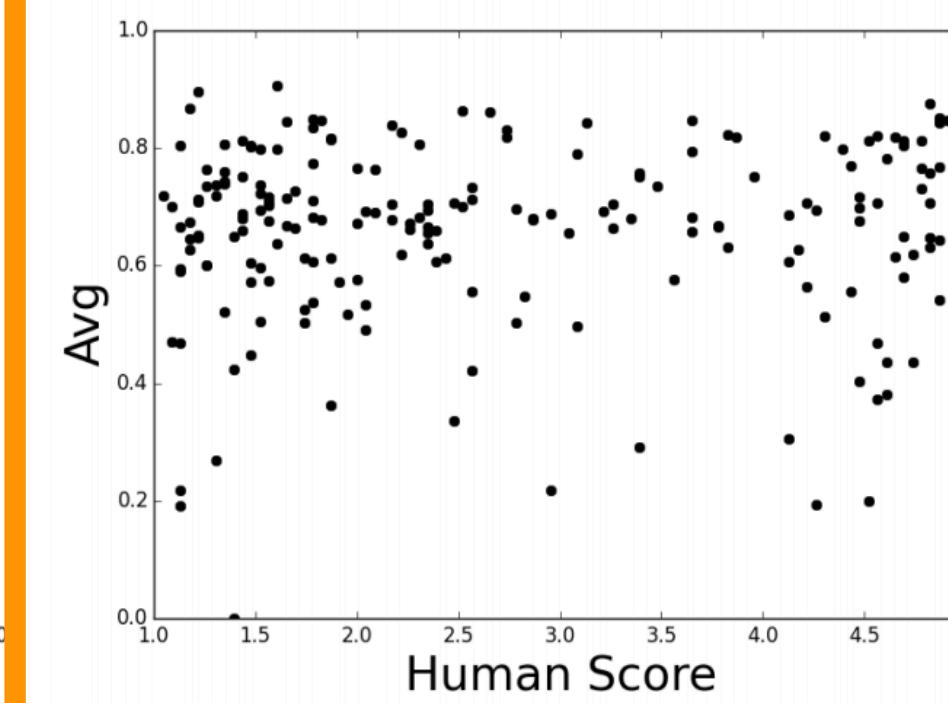
**No correlation
between human
judgement and BLEU**



BLEU

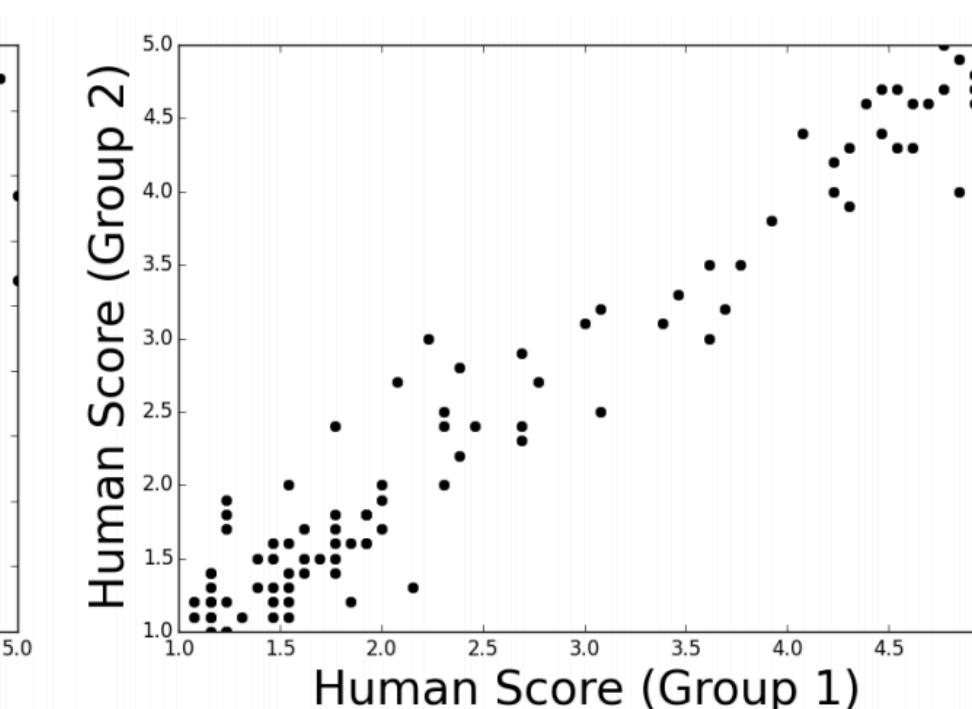


(a) Twitter



(b) Ubuntu

Embedding Average

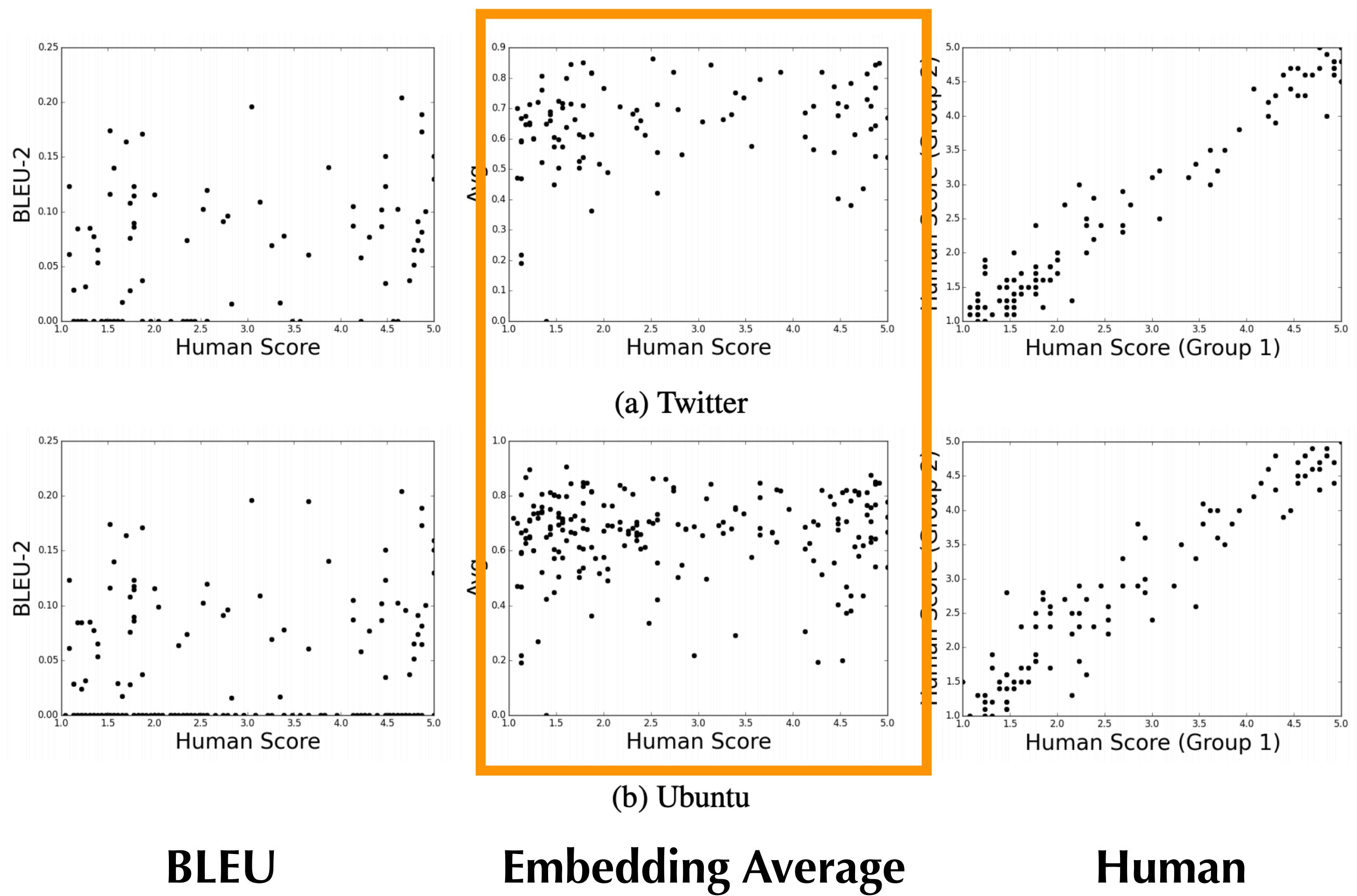


Human

Chatbot Evaluation

Automatic Evaluation:
Word overlap metrics
are bad for dialogue

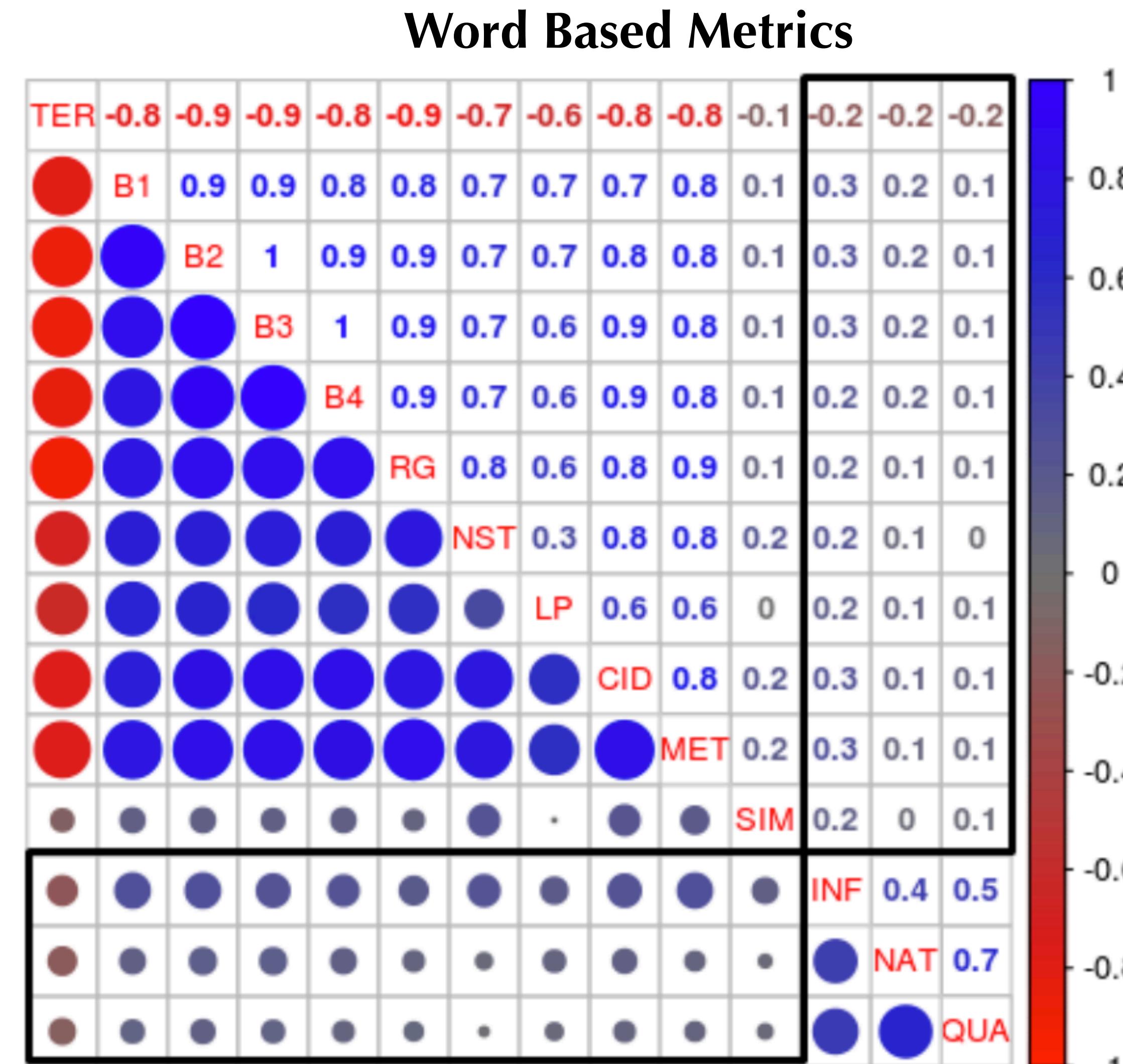
**No correlation
between human
judgement and
embedding average**



Chatbot Evaluation

Word Overlap Metrics

- highly correlated with each other
- Not so correlated with human ratings



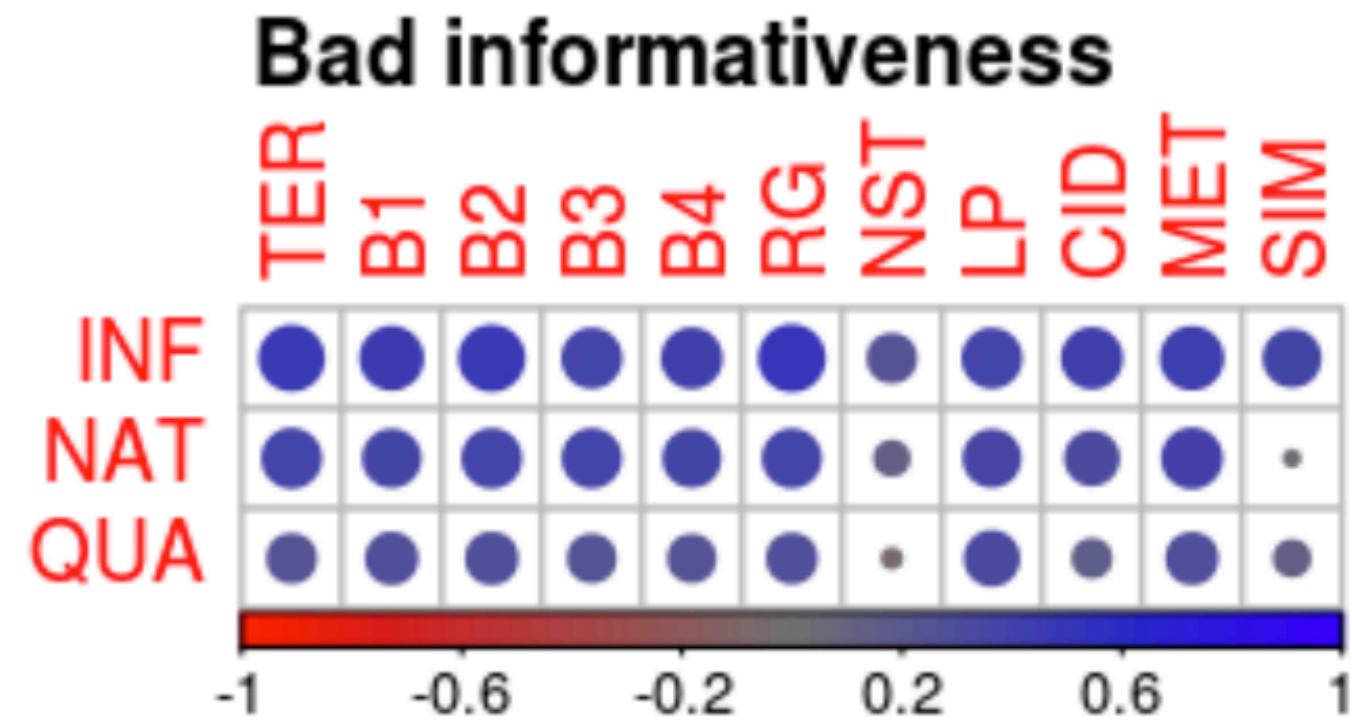
Spearman correlations of word based metrics and human ratings

Human Ratings

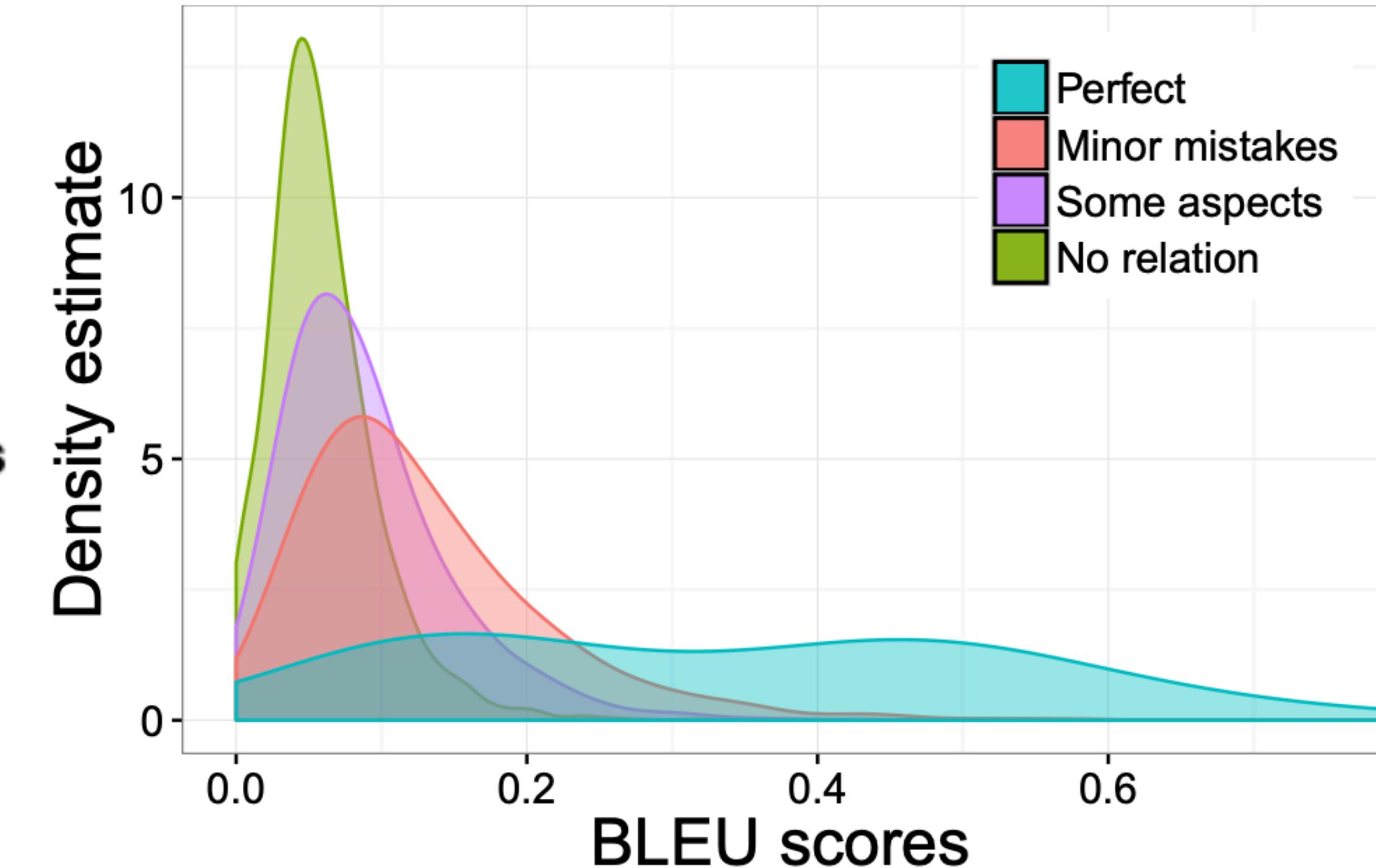
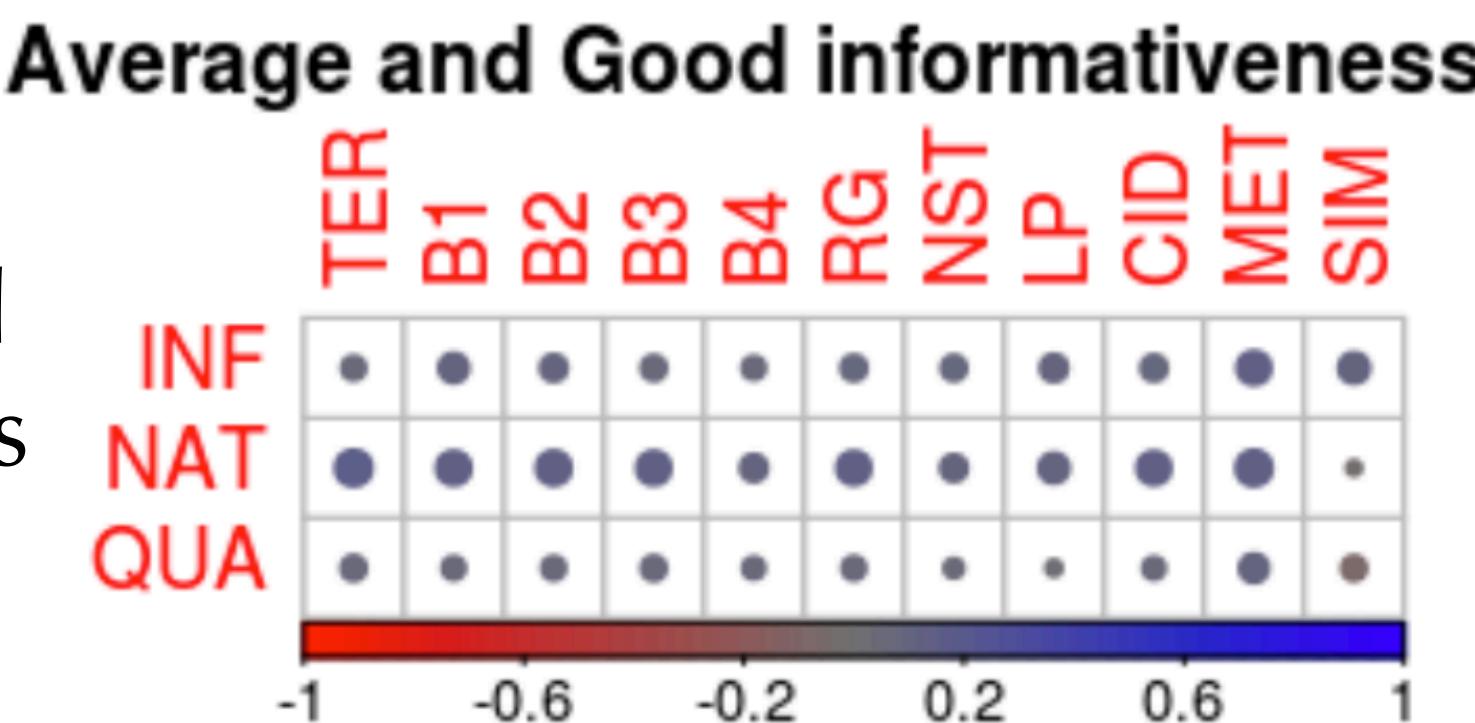
- Informativeness
- Naturalness
- Quality

Chatbot Evaluation

High correlation with human judgement for low quality generations



Poor correlation with human judgement for mid to high quality generations



[Why We Need New Evaluation Metrics for NLG, Novikova et al 2017, <https://arxiv.org/pdf/1707.06875.pdf>]

Re-evaluating Automatic Metrics for Image Captioning

[Kilickaya et al, EACL 2017]

Chatbot Evaluation

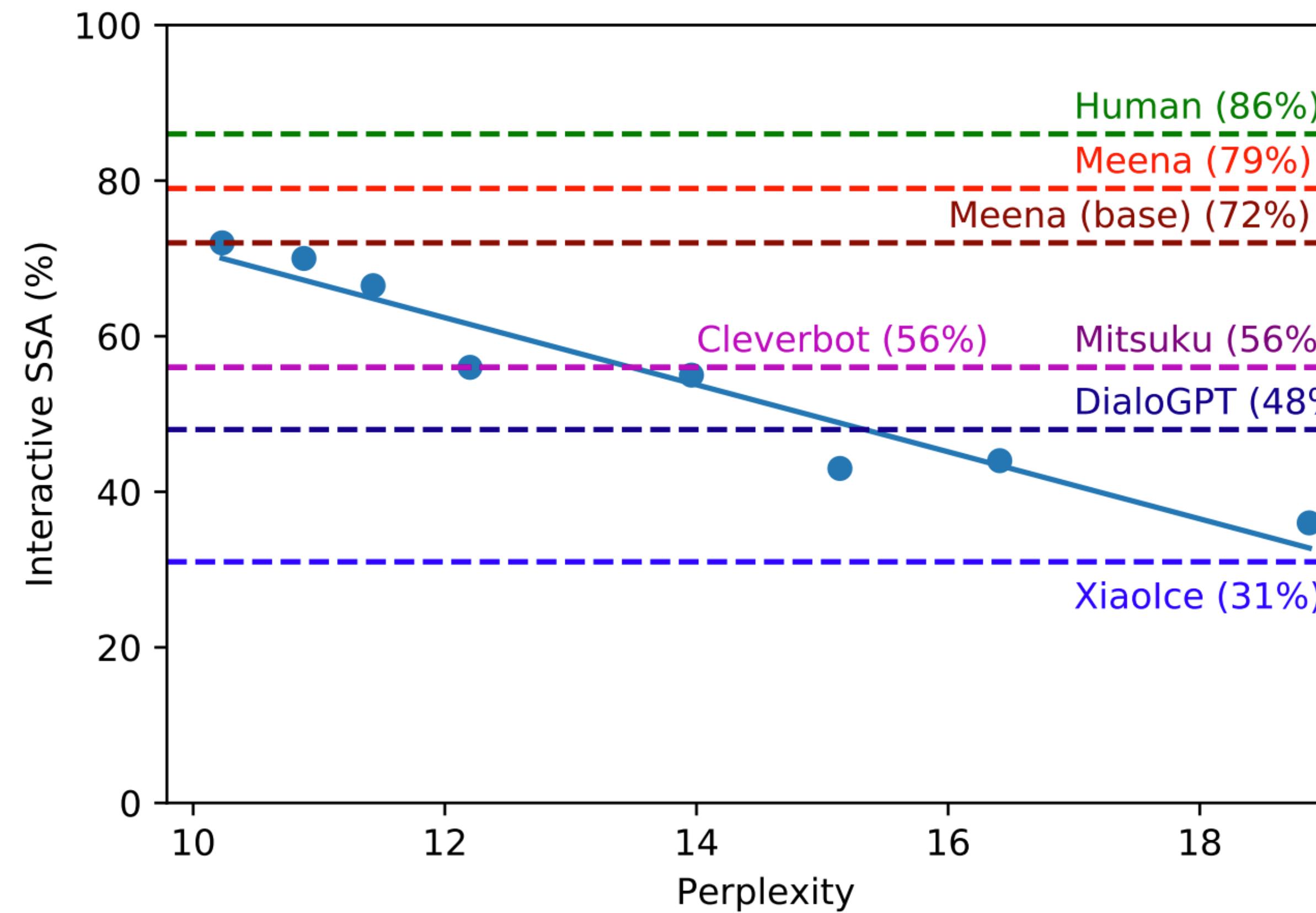
Human evaluation: gold standard

- slow, expensive, not repeatable (subjective/inconsistent), difficult to form well-targeted questions that are not open to misinterpretation

Decompose evaluation into **meaningful components**
(approximate some of these by automated metrics)

- Fluency (probability wrt well-trained LM)
- Correct Style (probability wrt well-trained LM on target corpus)
- Relevance to input (semantic similarity)
- Conciseness (length)
- Repetitiveness (repeating words)
- Diversity (rare word usage, uniqueness of n-grams)
- Task-specific metric

Sensibleness and Specificity Average (SSA):
Human judgement of whether responses (given context): makes **sense** and are **specific**
Observation: SSA is correlated with perplexity!



Meena (Google) 2020

Cleverbot (Carpenter 2017)

<http://www.cleverbot.com>

Mitsuku: Loebner Prize winner (2016-2019)

<https://www.pandorabots.com/mitsuku/>

DialoGPT (Microsoft) 2019

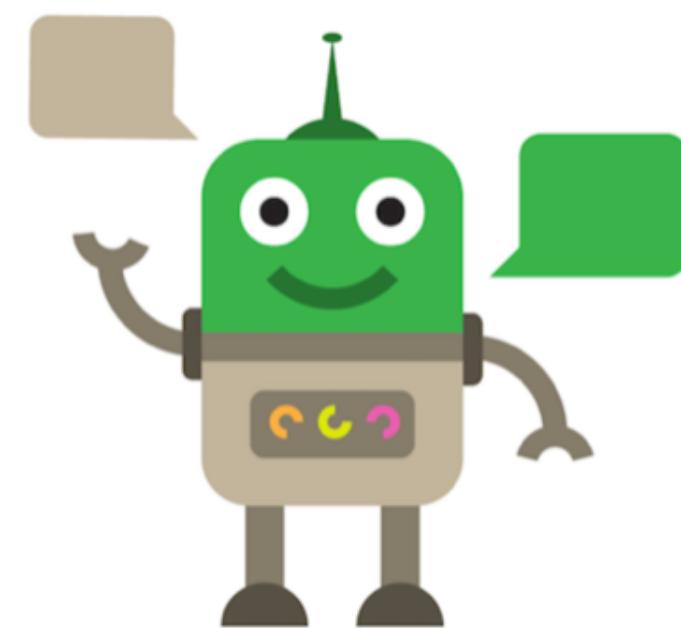
<https://github.com/microsoft/DialoGPT>

Microsoft Xiaoice

**Current chit-chat models:
very fluent with no understanding**

Overview

- What's a dialog system?
- Properties of Human Conversation
- Chatbots
- **Task-oriented dialog systems**
- Remaining Challenges



Dialogue Systems

Task-Oriented (Goal-Based) Dialogue System

GUS: Hello. My name is GUS. I can help you plan a simple trip by air. Where do you want to go ?
Client: I want to go to San Diego on May 28
GUS: What time do you want to leave?
Client: I must be in San Diego before 10 am
GUS: Would you like P.S.A. flight 102 that arrives at 9.15 am ?
Client: What is the next flight ?
GUS: Air California flight 310 that leaves at 8.30am and arrives at 10.00am
Client: I'll take the first one
GUS: In what name should I make a reservation, please?
Client: Dan Bobrow
GUS: I have confirmed the following flight: P.S.A. flight 102 on Wednesday May 28 from San Jose to San Diego that leaves at 7.30 am and arrives at 9.15 am.
GUS: What date do you want to return on ?
Client: On Friday in the evening.
GUS: Would you like the flight that leaves at 7.45 pm ?
Client: That's fine.
GUS: I have confirmed the following flight: P.S.A. flight 307 on Friday May 30 from San Diego to San Jose that leaves at 7.45 pm and arrives at 9.30 pm Thank you for calling. Goodbye

State of the art from
1977!

GOAL

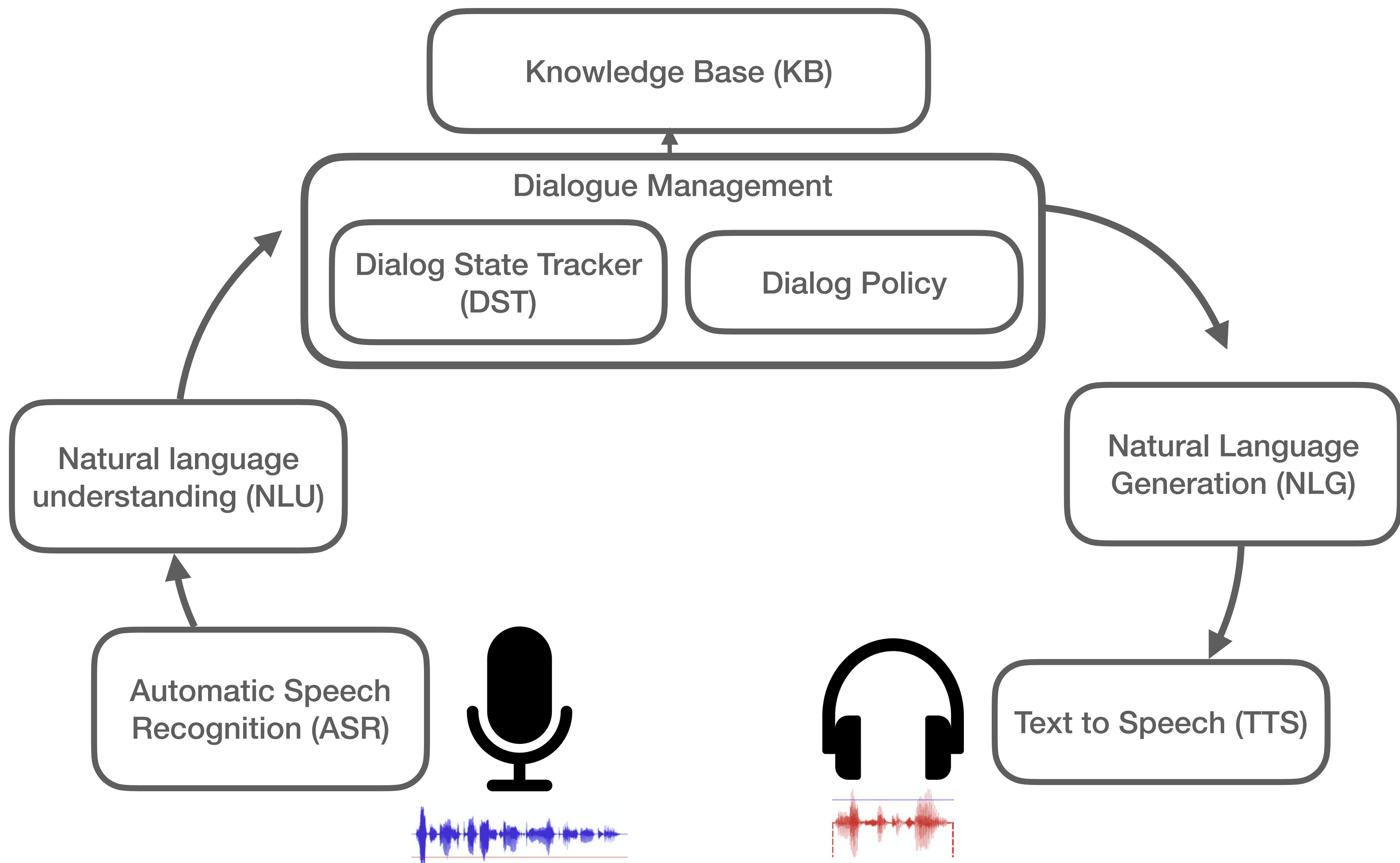
get information from the user to help **complete the specific task.**

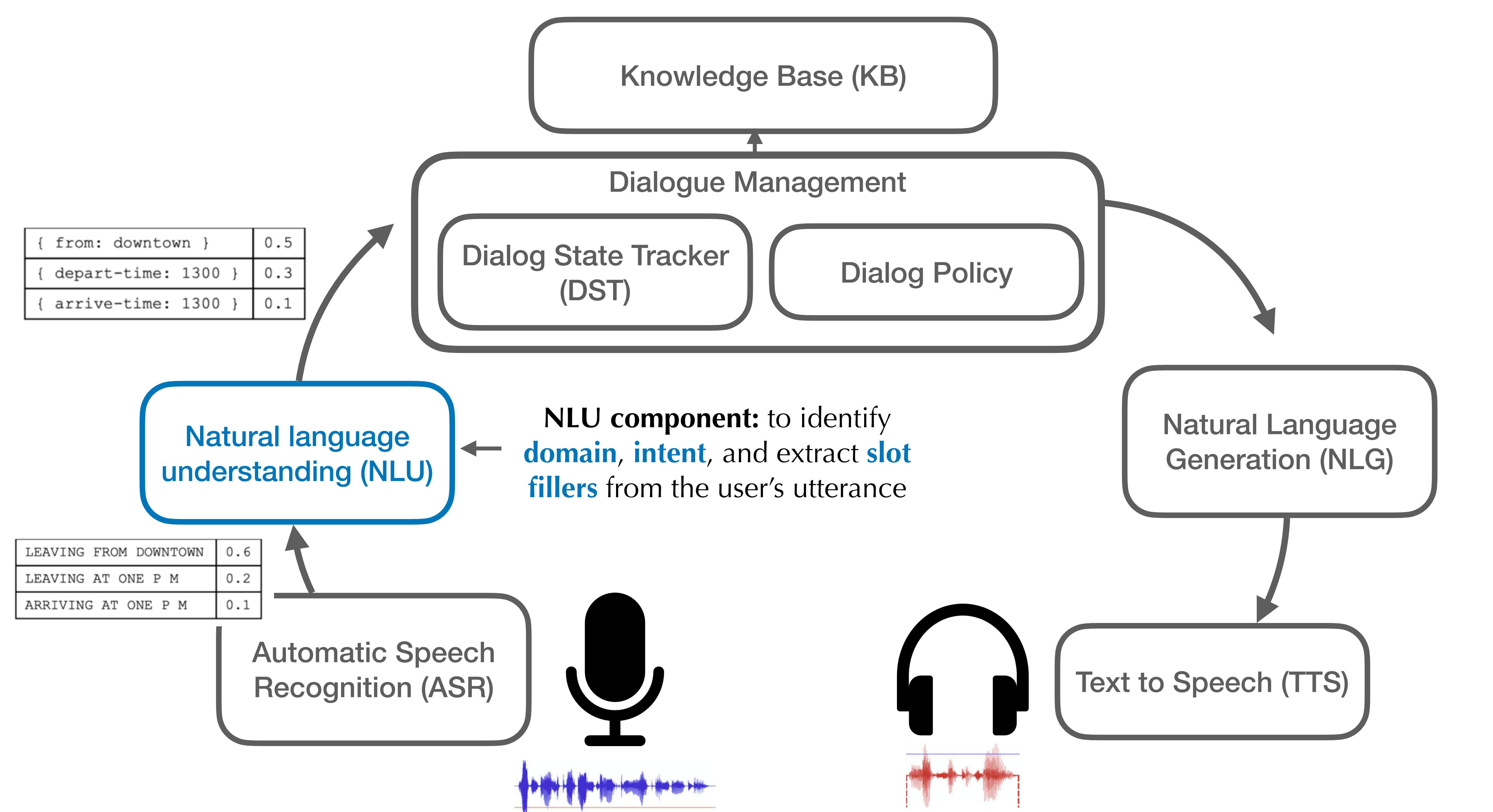
Frame-based control architecture

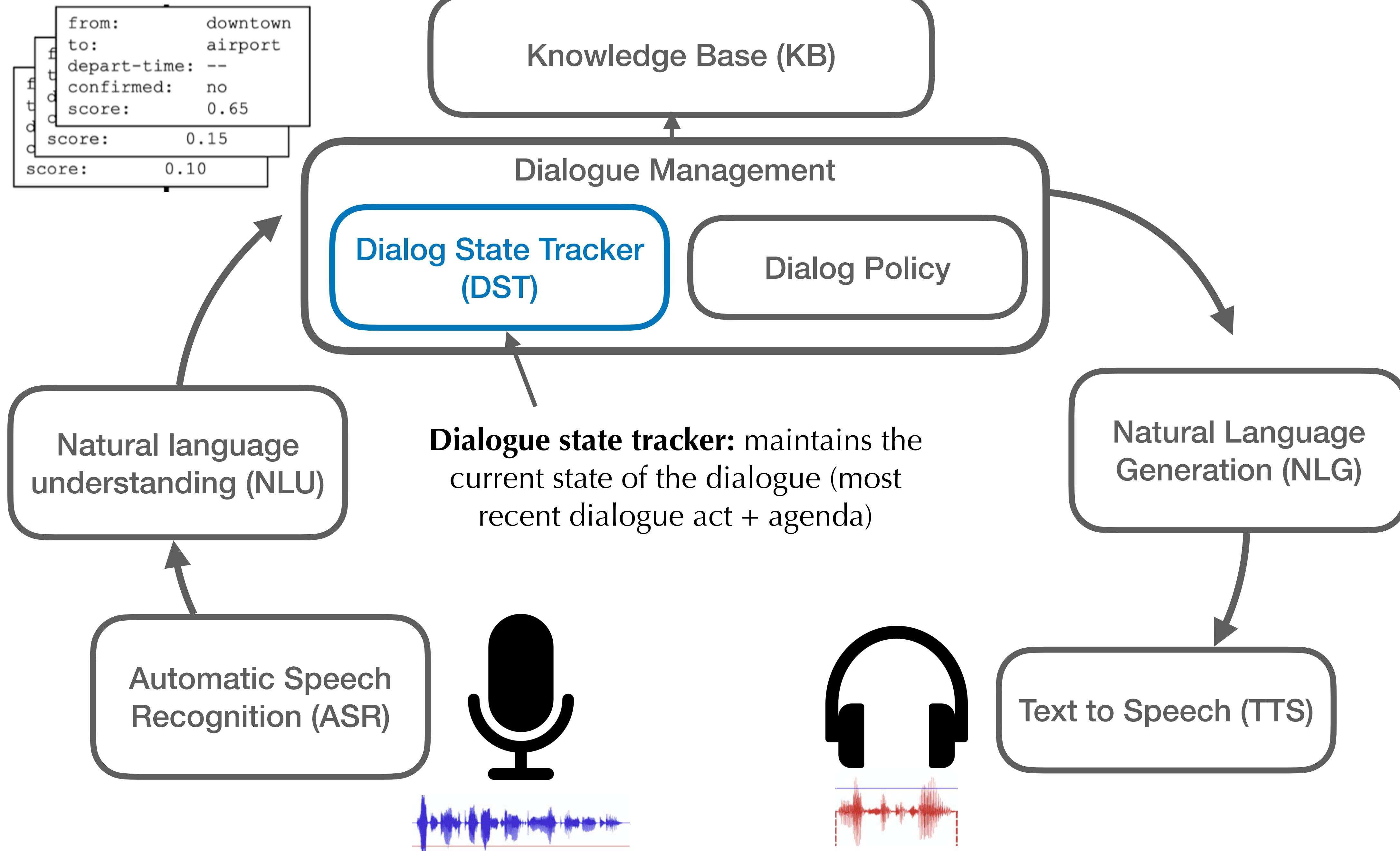
Still used in various forms in modern systems

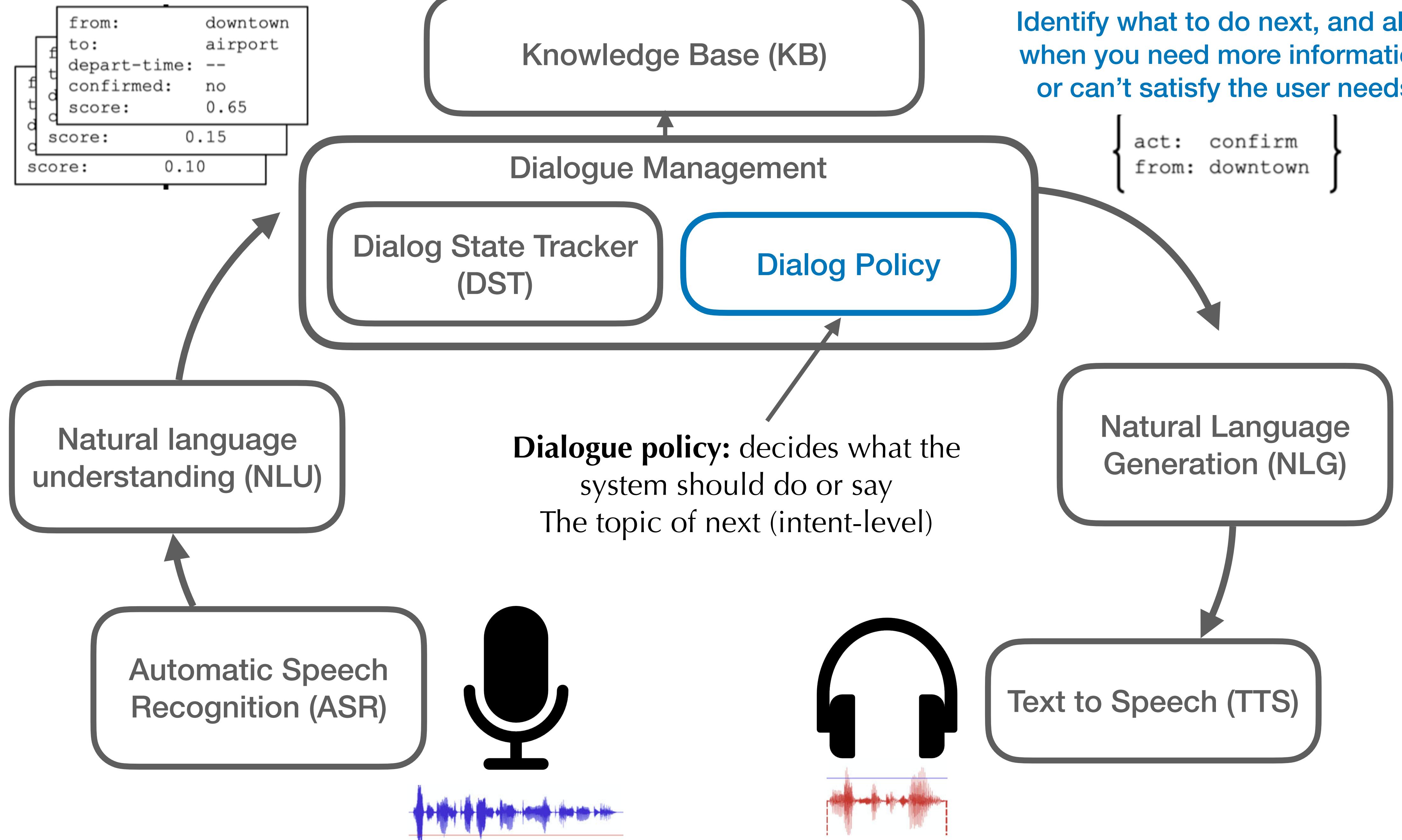
Task-Oriented Dialog System (Travel):

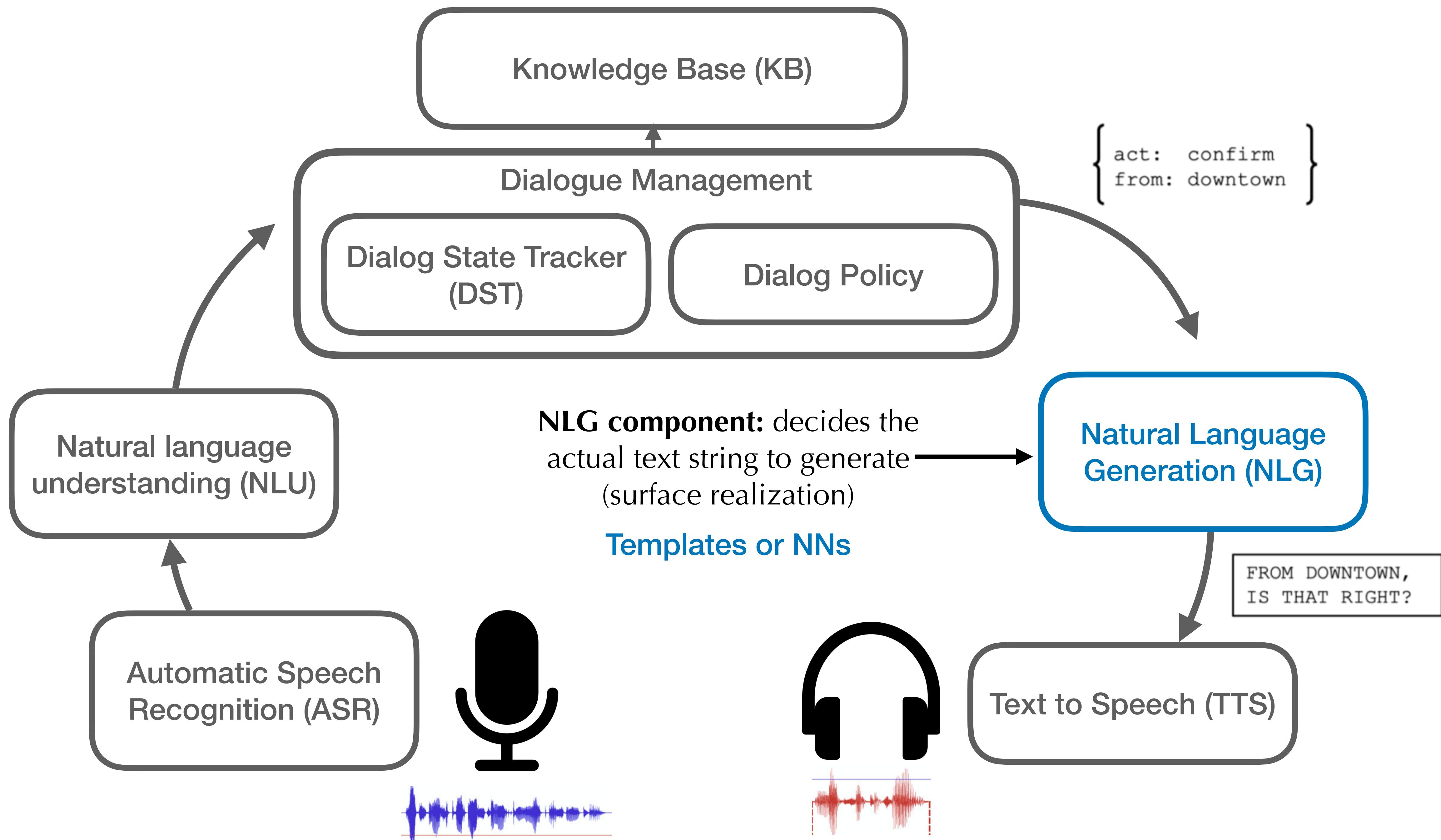
A transcript of an actual dialog with the GUS system of *Bobrow et al. (1977)*
P.S.A. and Air California were airlines of that period.

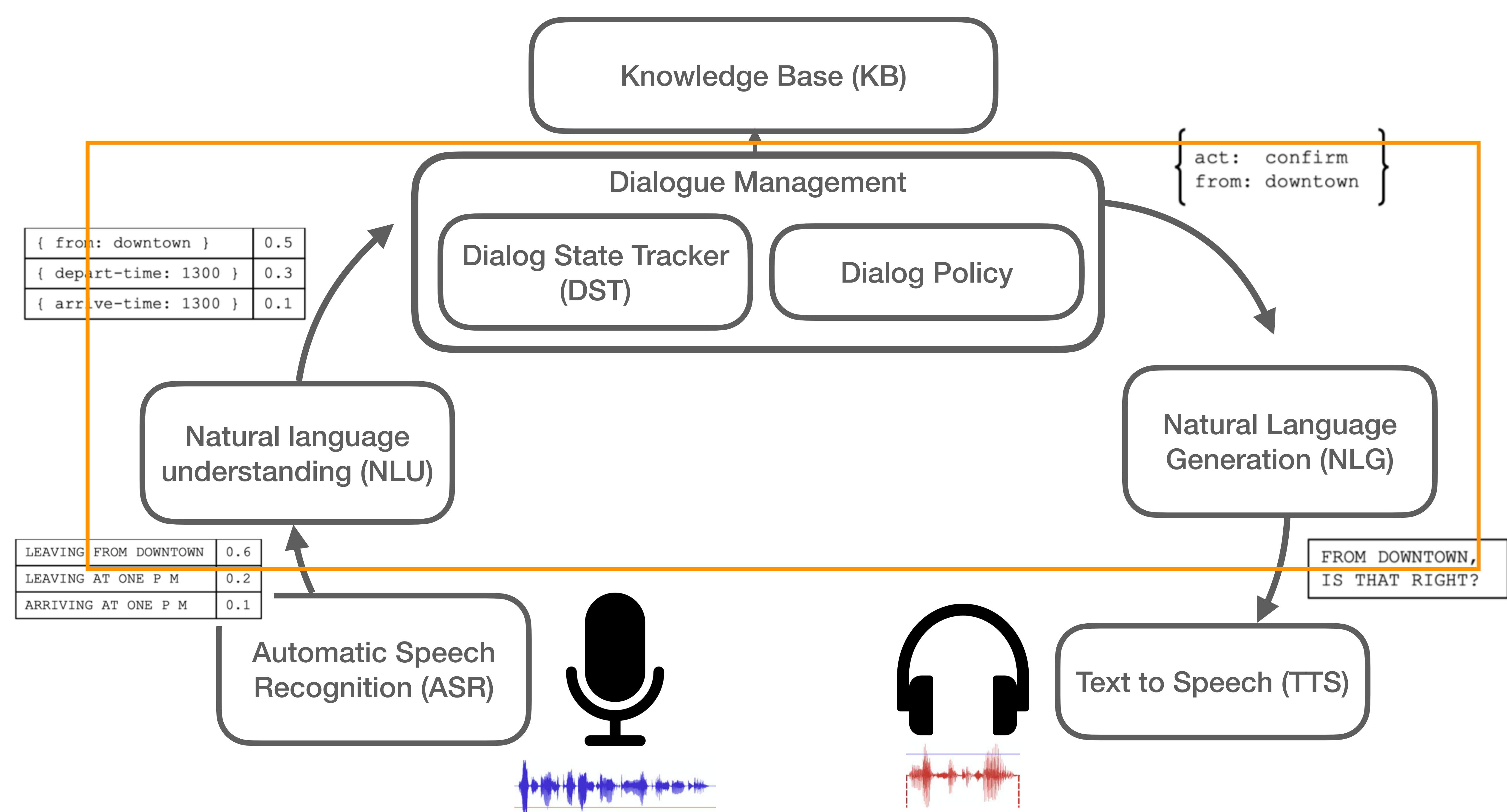












Task-Oriented Dialogue System

How to incorporate task related knowledge?

Domain-Specific Knowledge:
Ontology / Frame / Slot / Value

Task-Oriented Dialogue System

How to incorporate task related knowledge?

Domain-Specific Knowledge:
Ontology / Frame / Slot / Value

a **knowledge structure** representing the kinds of **intentions**
the system can extract from user sentences.

Task-Oriented Dialogue System

How to incorporate task related knowledge?

Domain-Specific Knowledge:
Ontology / Frame / Slot / Value



contains one or more frames.

a knowledge structure representing the kinds of intentions
the system can extract from user sentences.

Task-Oriented Dialogue System

How to incorporate task related knowledge?

Domain-Specific Knowledge:
Ontology / Frame / Slot / Value

a collection of **slots**

Slot1.....

Slot2.....

Slot3.....

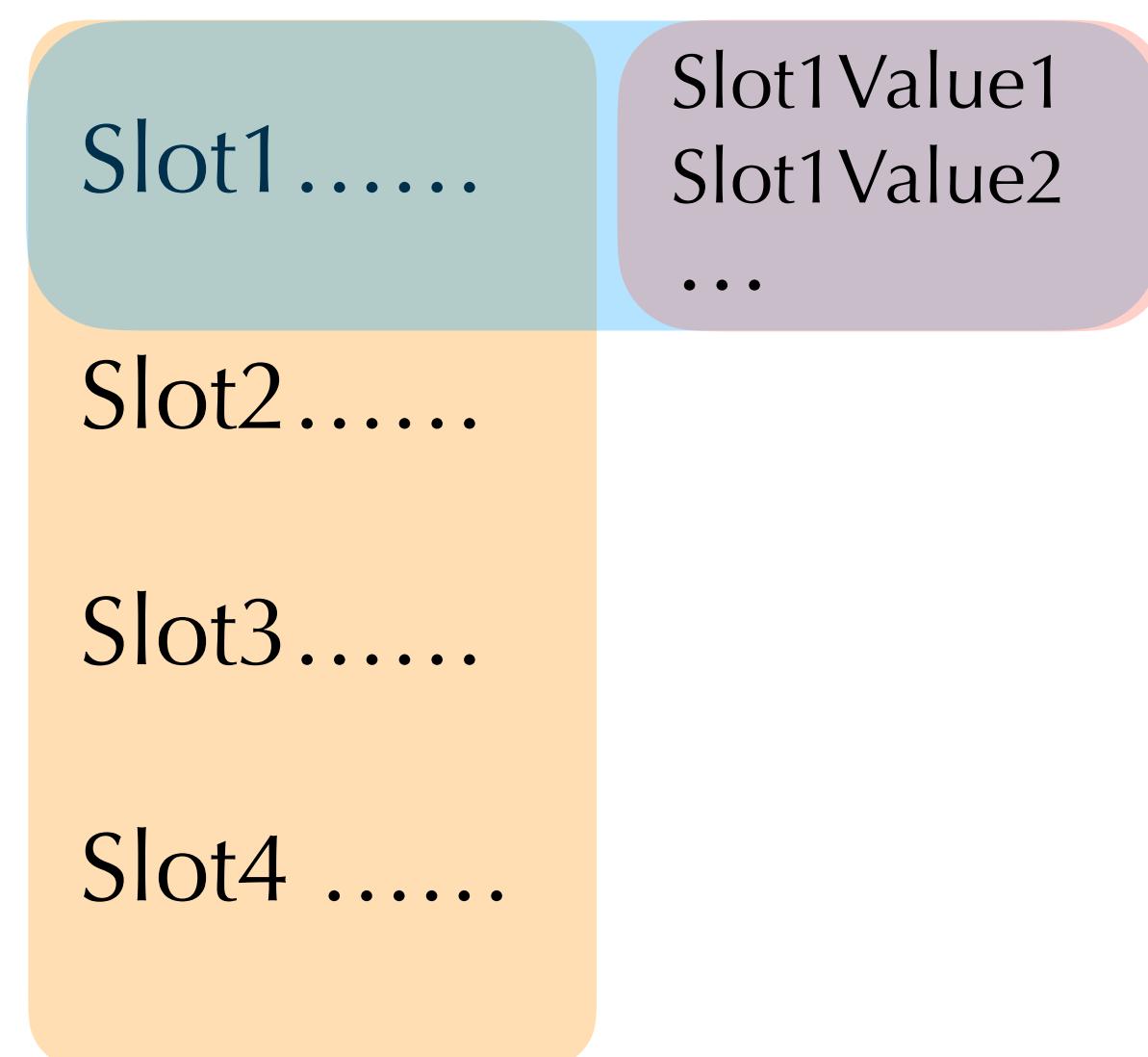
Slot4

Task-Oriented Dialogue System

How to incorporate task related knowledge?

Domain-Specific Knowledge:
Ontology / Frame / Slot / Value

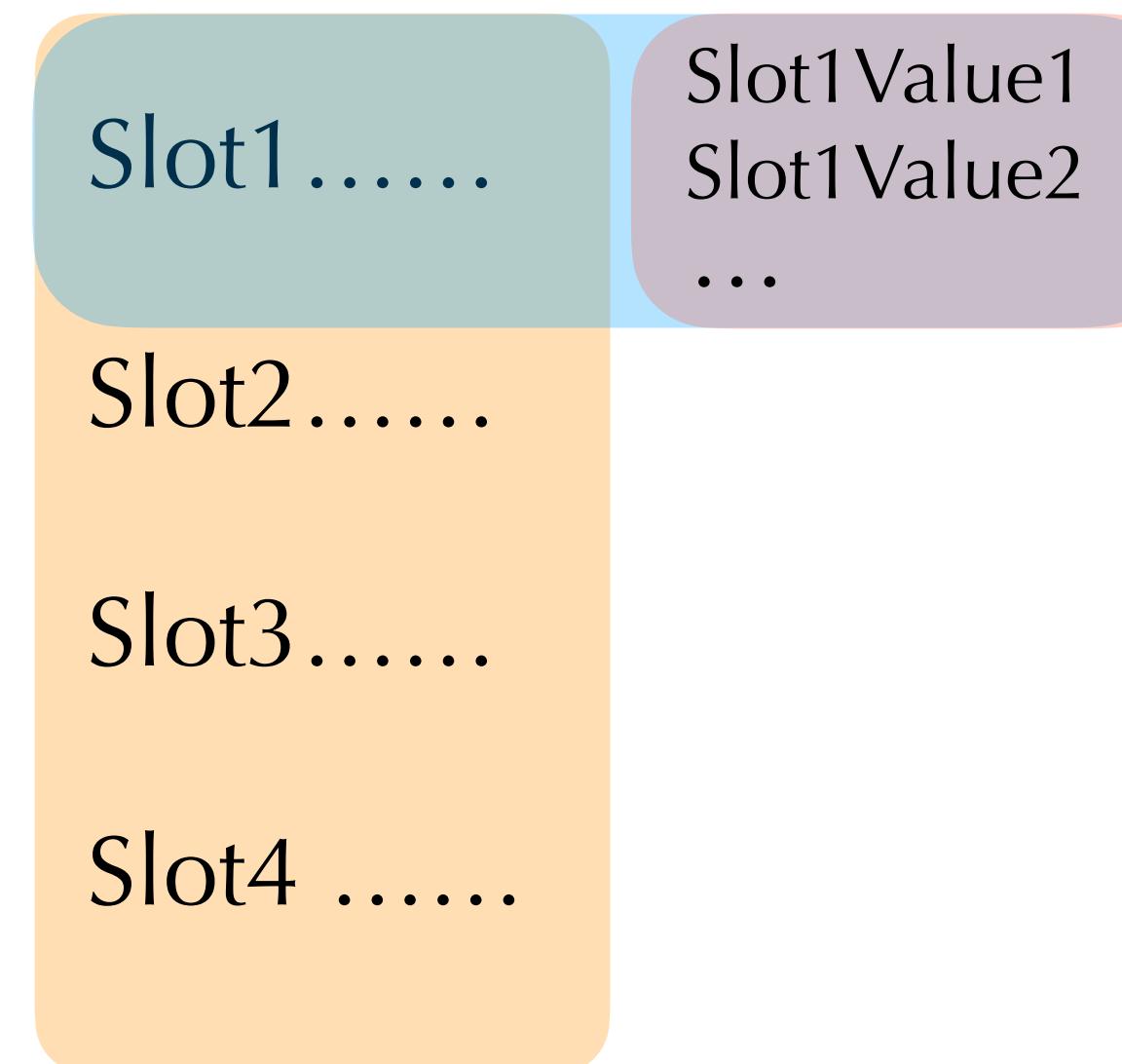
Also defines the **values** that each **slot** can take.



Task-Oriented Dialogue System

How to incorporate task related knowledge?

Domain-Specific Knowledge:
Ontology / Frame / Slot / Value



Slot	Type
ORIGIN CITY	city
DESTINATION CITY	city
DEPARTURE TIME	time
DEPARTURE DATE	date
ARRIVAL TIME	time
ARRIVAL DATE	date

DATE
MONTH NAME
DAY (BOUNDED-INTEGER 1 31)
YEAR INTEGER

- Try to fill these frames:
- Extract from user utterances
 - Ask user for missing information

Task-Oriented Dialogue System

How to incorporate task related knowledge?

“Show me morning flights from
Boston to San Francisco on Tuesday”

Task-Oriented Dialogue System

How to incorporate task related knowledge?

“Show me morning flights from
Boston to San Francisco on Tuesday”

Step#1: domain classification

DOMAIN: AIR-TRAVEL

Classification

Task-Oriented Dialogue System

How to incorporate task related knowledge?

“Show me morning flights from
Boston to San Francisco on Tuesday”

Step#1: domain classification

DOMAIN: AIR-TRAVEL

Step#2: intent determination

INTENT: SHOW-FLIGHTS

Classification

Task-Oriented Dialogue System

How to incorporate task related knowledge?

“Show me morning flights from
Boston to San Francisco on Tuesday”

Step#1: domain classification

DOMAIN: AIR-TRAVEL

Step#2: intent determination

INTENT: SHOW-FLIGHTS

Step#3: slot filling

ORIGIN-CITY: Boston
ORIGIN-DATE: Tuesday
ORIGIN-TIME: morning
DEST-CITY: San Francisco

**Sequence
tagging**

Task-Oriented Dialogue System

How to incorporate task related knowledge?

Utterance	Dialogue act
U: Hi, I am looking for somewhere to eat.	hello(task = find, type=restaurant)
S: You are looking for a restaurant. What type of food do you like?	confreq(type = restaurant, food)
U: I'd like an Italian somewhere near the museum.	inform(food = Italian, near=museum)
S: Roma is a nice Italian restaurant near the museum.	inform(name = "Roma", type = restaurant, food = Italian, near = museum)
U: Is it reasonably priced?	confirm(pricerange = moderate)
S: Yes, Roma is in the moderate price range.	affirm(name = "Roma", pricerange = moderate)
U: What is the phone number?	request(phone)
S: The number of Roma is 385456.	inform(name = "Roma", phone = "385456")
U: Ok, thank you goodbye.	bye()

A sample dialogue from the Hidden Information State (HIS) System
of Young et al. (2010) using **dialog acts**

Rule-Based v.s. Data-Driven

How to build a task-oriented dialog system?

Rule-based system v.s. Data-driven system

Rule-Based v.s. Data-Driven

How to build a task-oriented dialog system?

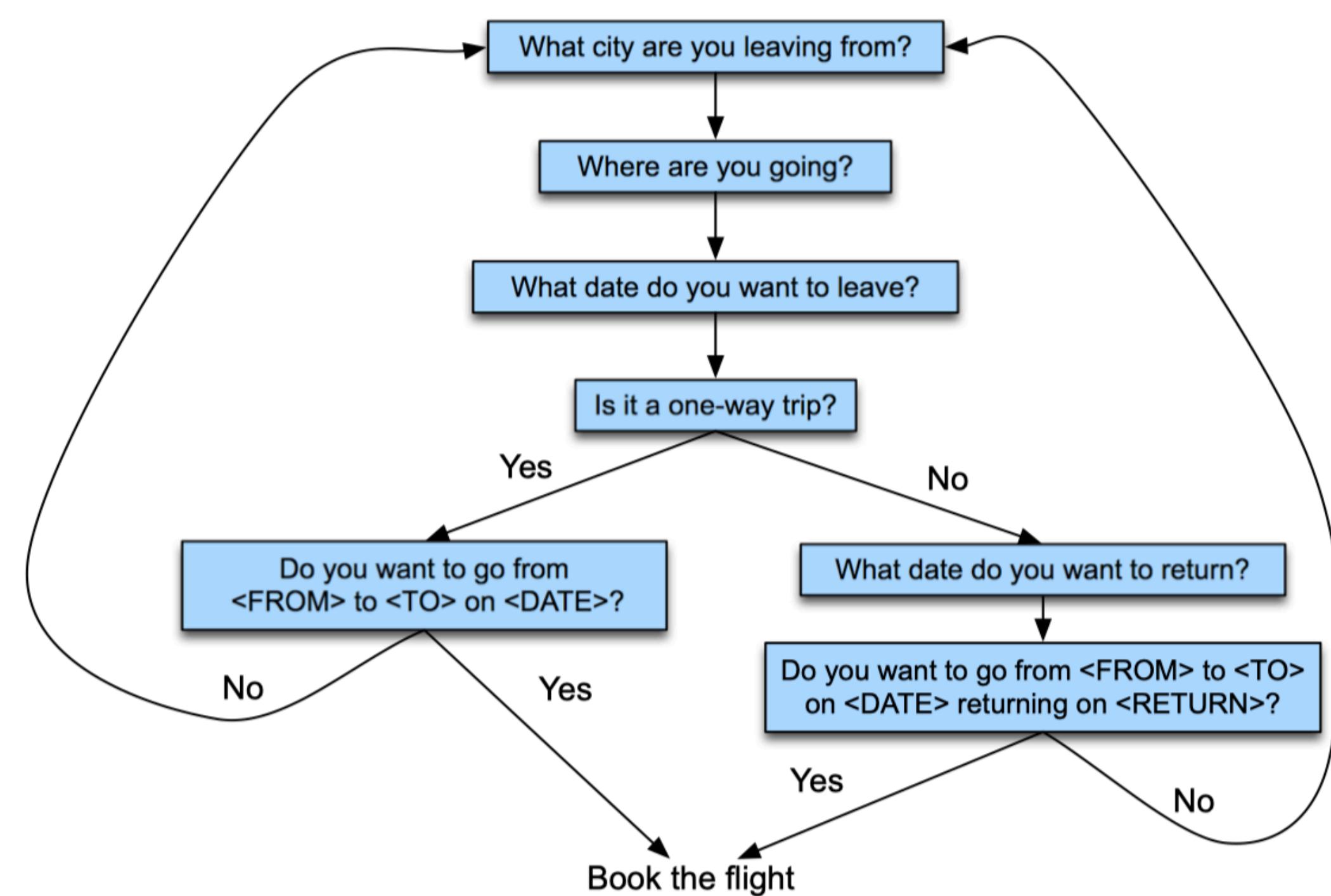
SHOW	→ show me i want can i see ...
DEPART_TIME_RANGE	→ (after around before) HOUR morning afternoon evening
HOUR	→ one two three four... twelve (AMPM)
FLIGHTS	→ (a) flight flights
AMPM	→ am pm
ORIGIN	→ from CITY
DESTINATION	→ to CITY
CITY	→ Boston San Francisco Denver Washington

Semantic grammars can be parsed by any Context-Free Grammar parsing algorithm.

Rule-based system (SLU/DST)

Rule-Based v.s. Data-Driven

How to build a task-oriented dialog system?

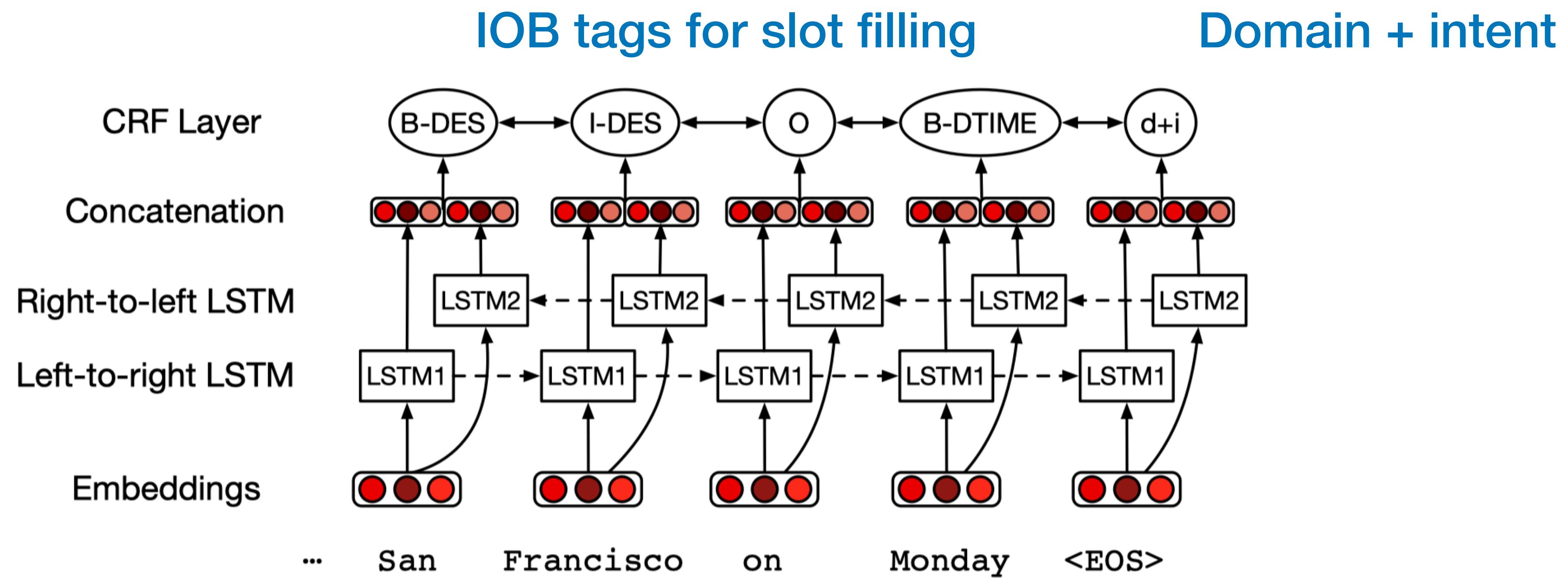


A simple finite-state automaton architecture for frame-based dialog.

Rule-based system (Dialog Policy)

Rule-Based v.s. Data-Driven

How to build a task-oriented dialog system?

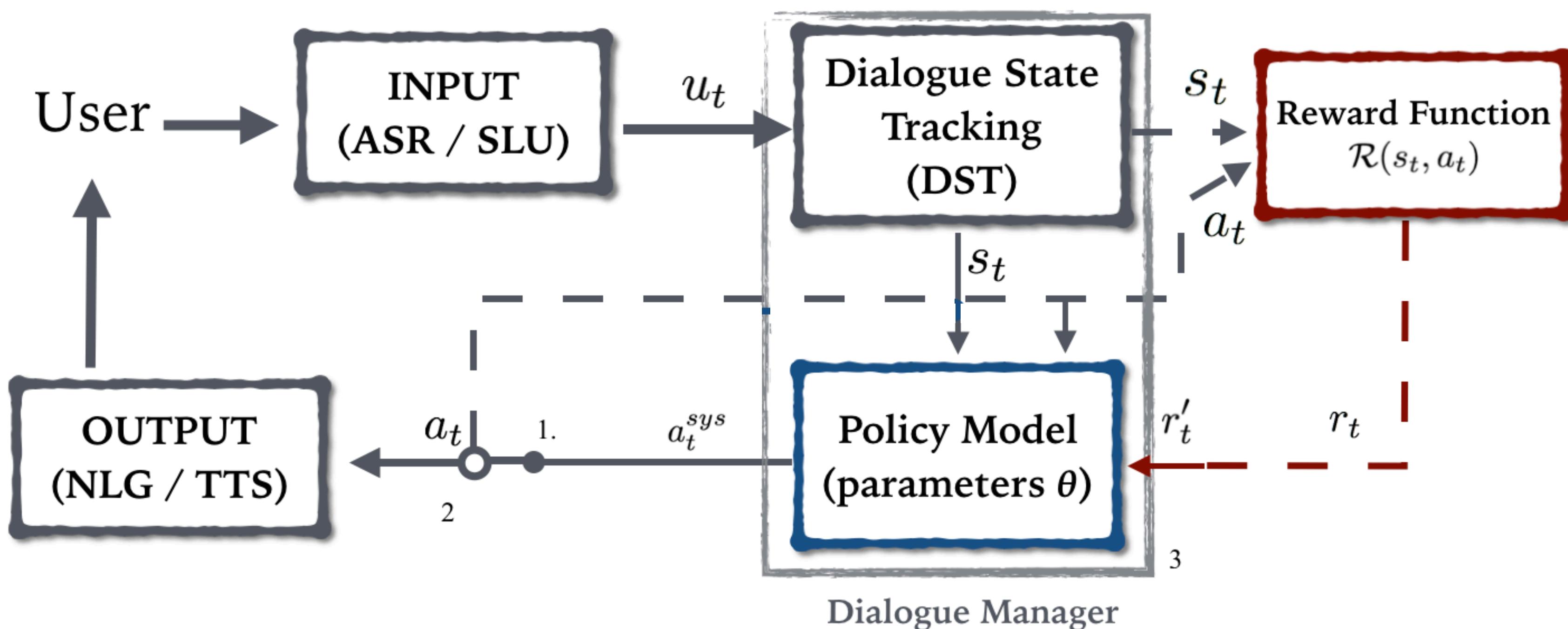


An LSTM architecture for slot filling, mapping the words in the input to a series of IOB tags plus a final state consisting of a domain concatenated with an intent.

Data-driven system (SLU/DST)

Rule-Based v.s. Data-Driven

How to build a task-oriented dialog system?

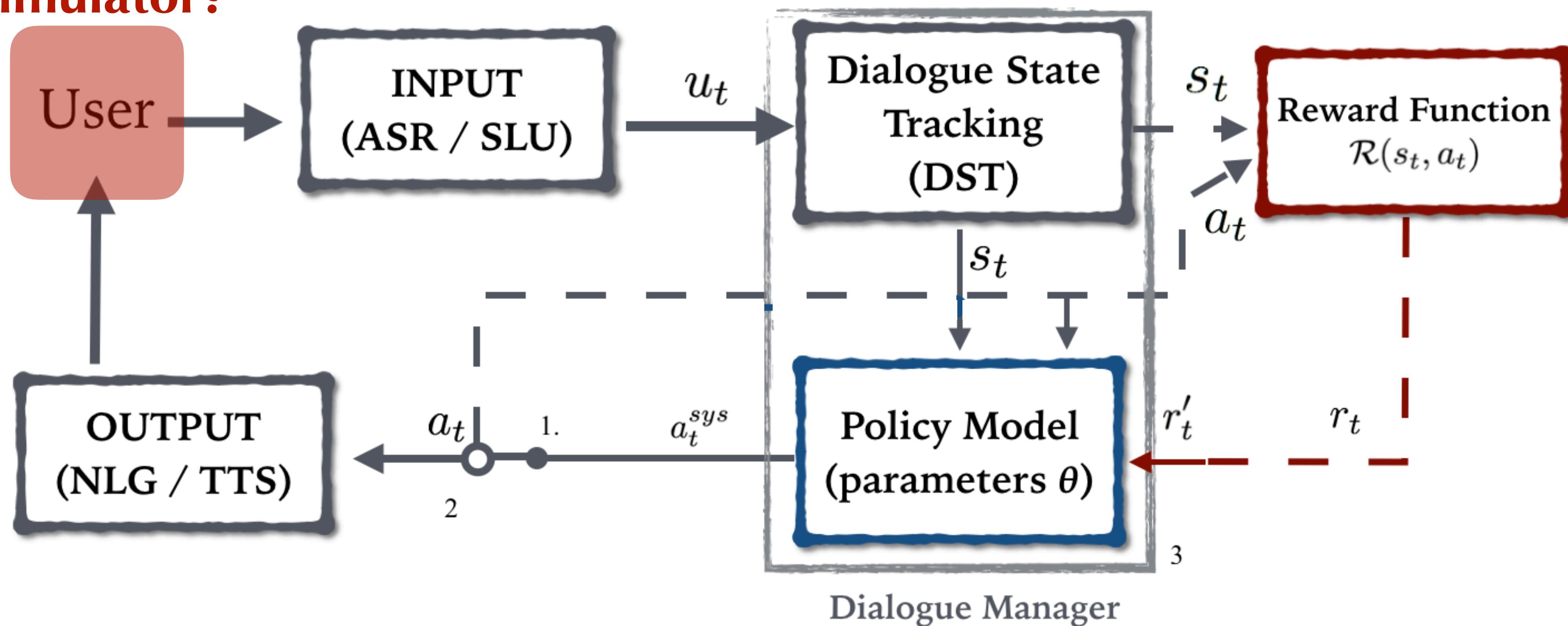


Data-driven system (Dialog Policy)

Rule-Based v.s. Data-Driven

How to build a task-oriented dialog system?

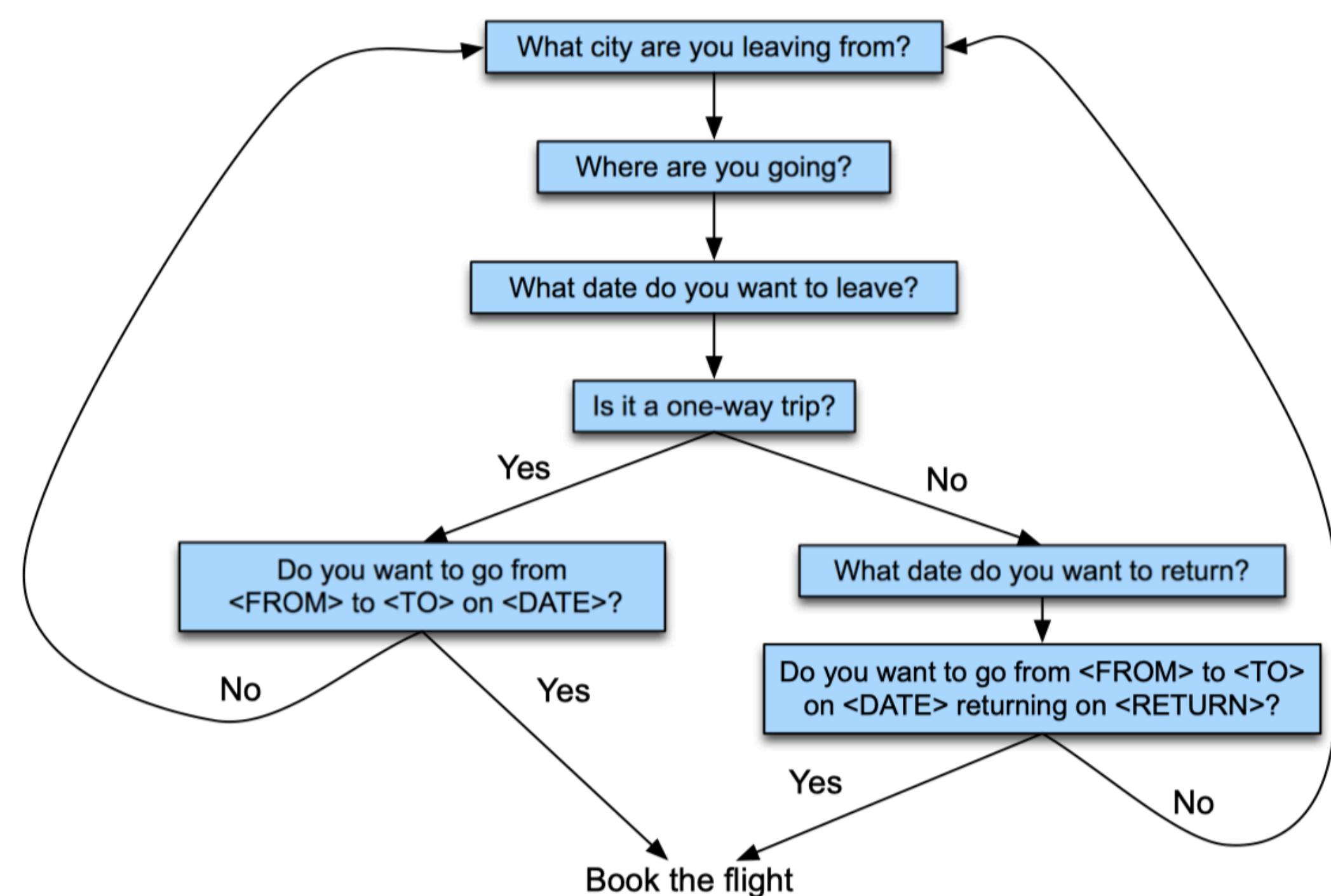
simulator?



Data-driven system (Dialog Policy)

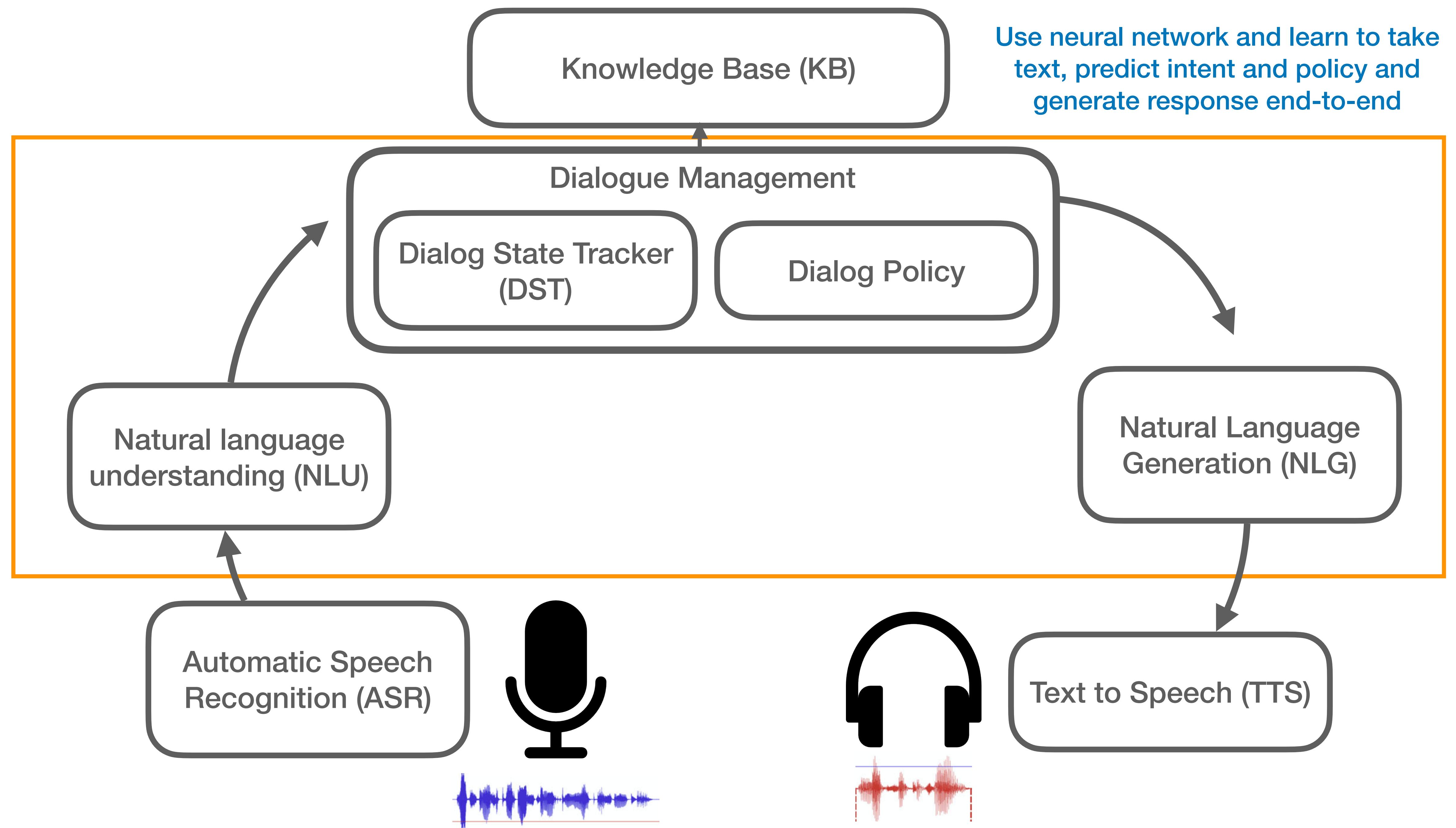
Rule-Based v.s. Data-Driven

How to build a task-oriented dialog system?

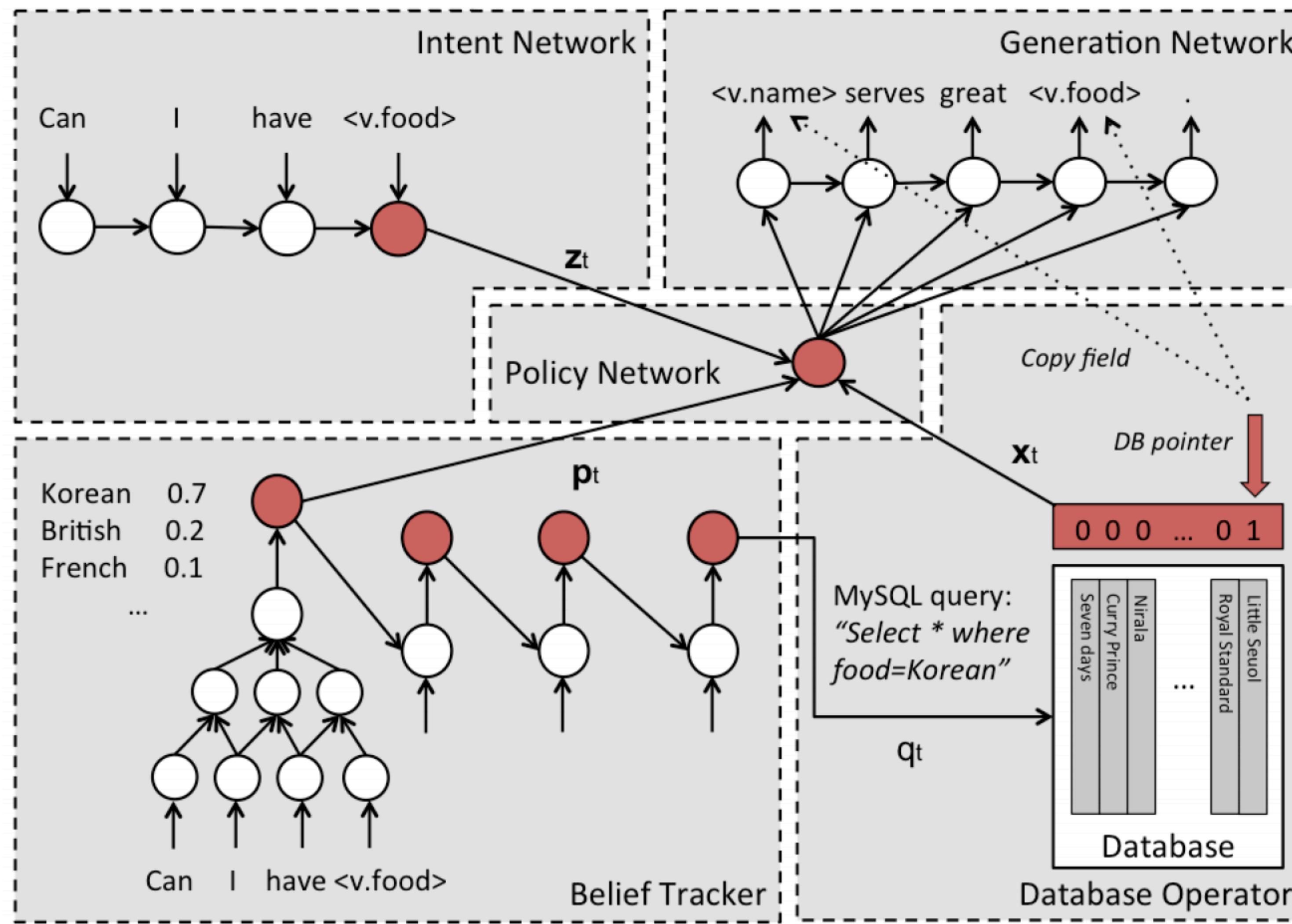


A simple finite-state automaton architecture for frame-based dialog.

End-to-end systems



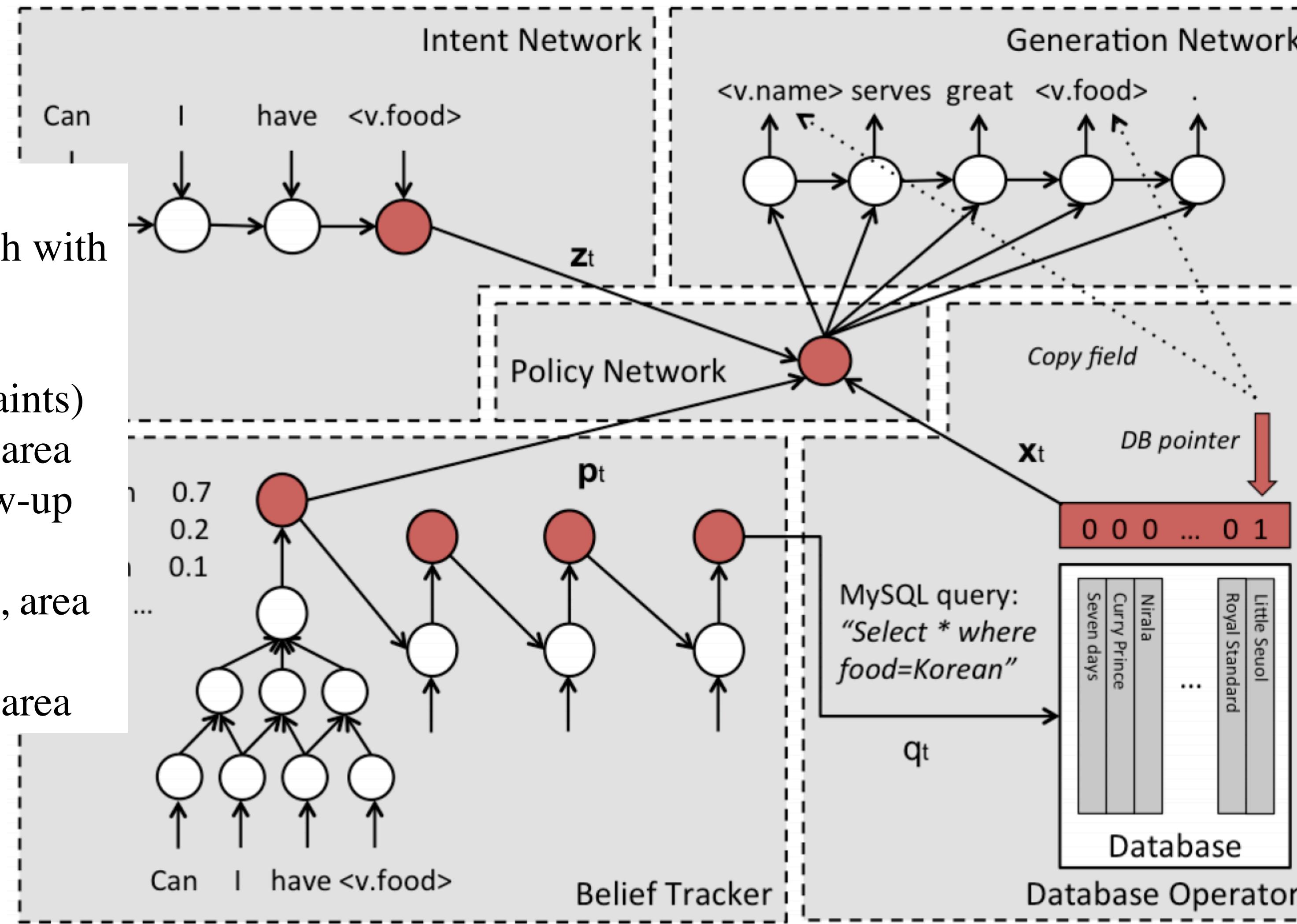
End-to-End Task-Oriented Dialog System



End-to-End Task-Oriented Dialog System

Restricted domain
110 restaurants in DB, each with
9 attributes

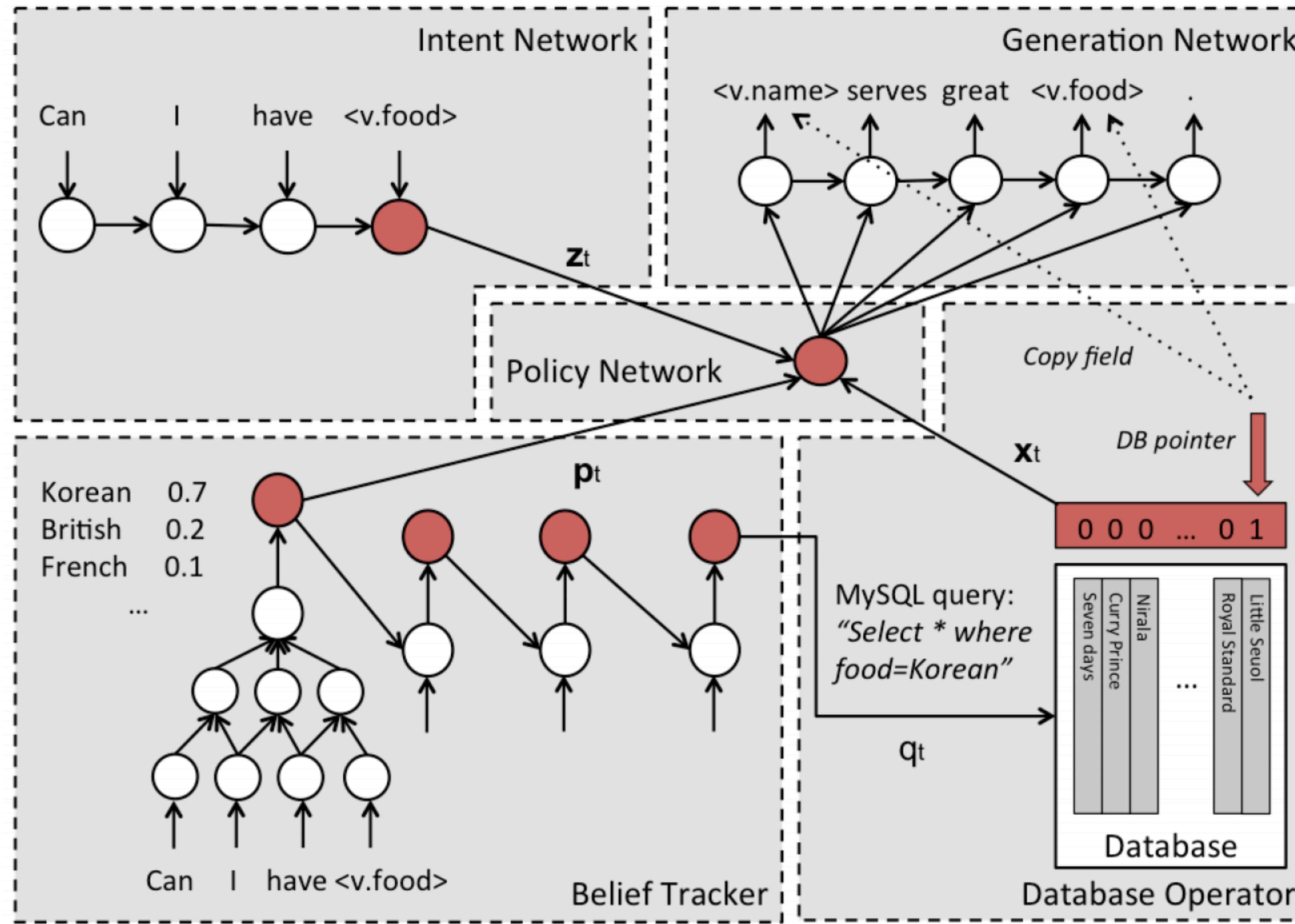
- 3 Informable slots (constraints)
 - food type, price range, area
- 6 Requestable slots (follow-up questions)
 - address, phone number, area code
 - food type, price range, area



End-to-End Task-Oriented Dialog System

Encoder of Seq2Seq model

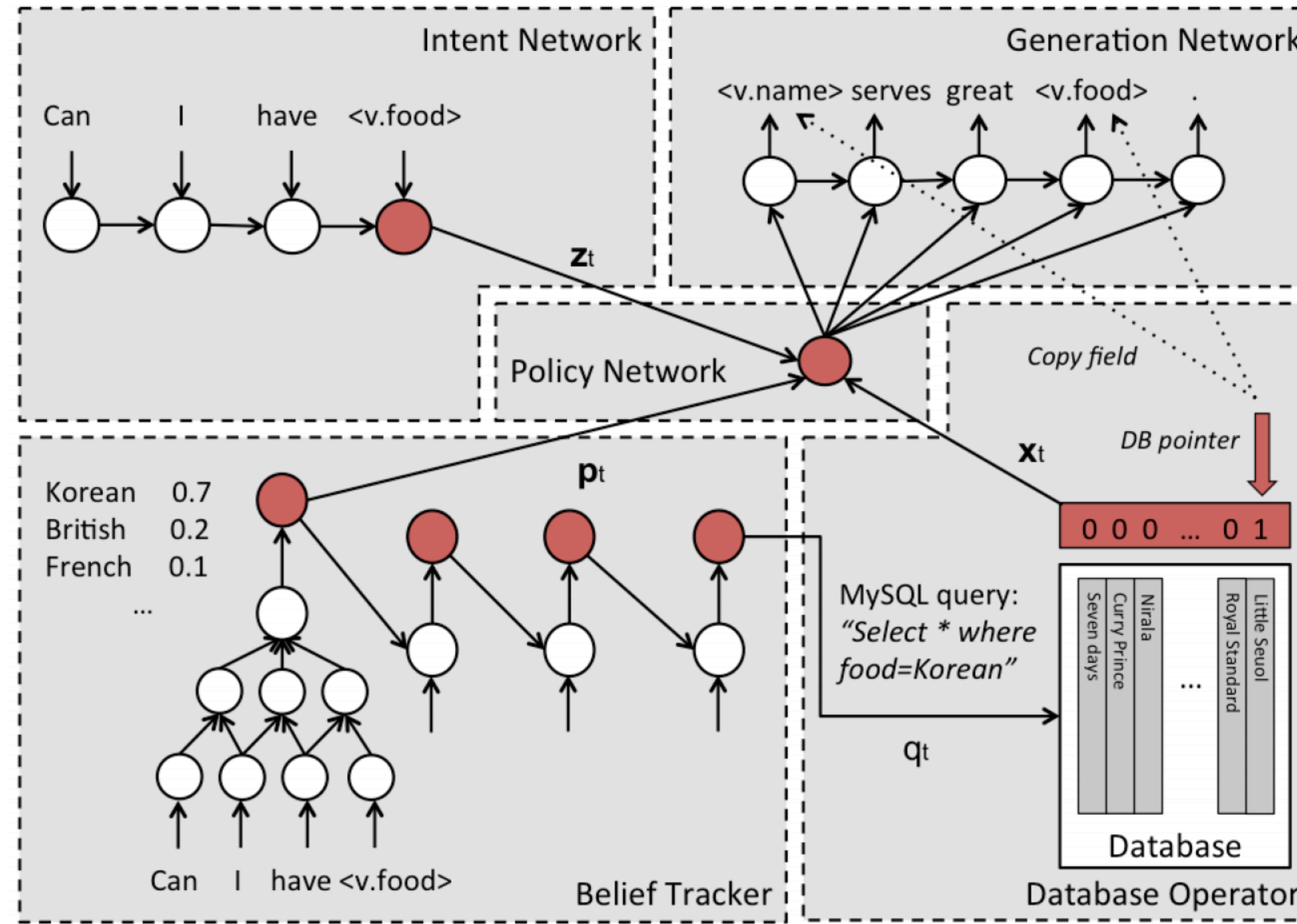
Intent is hidden state z_t



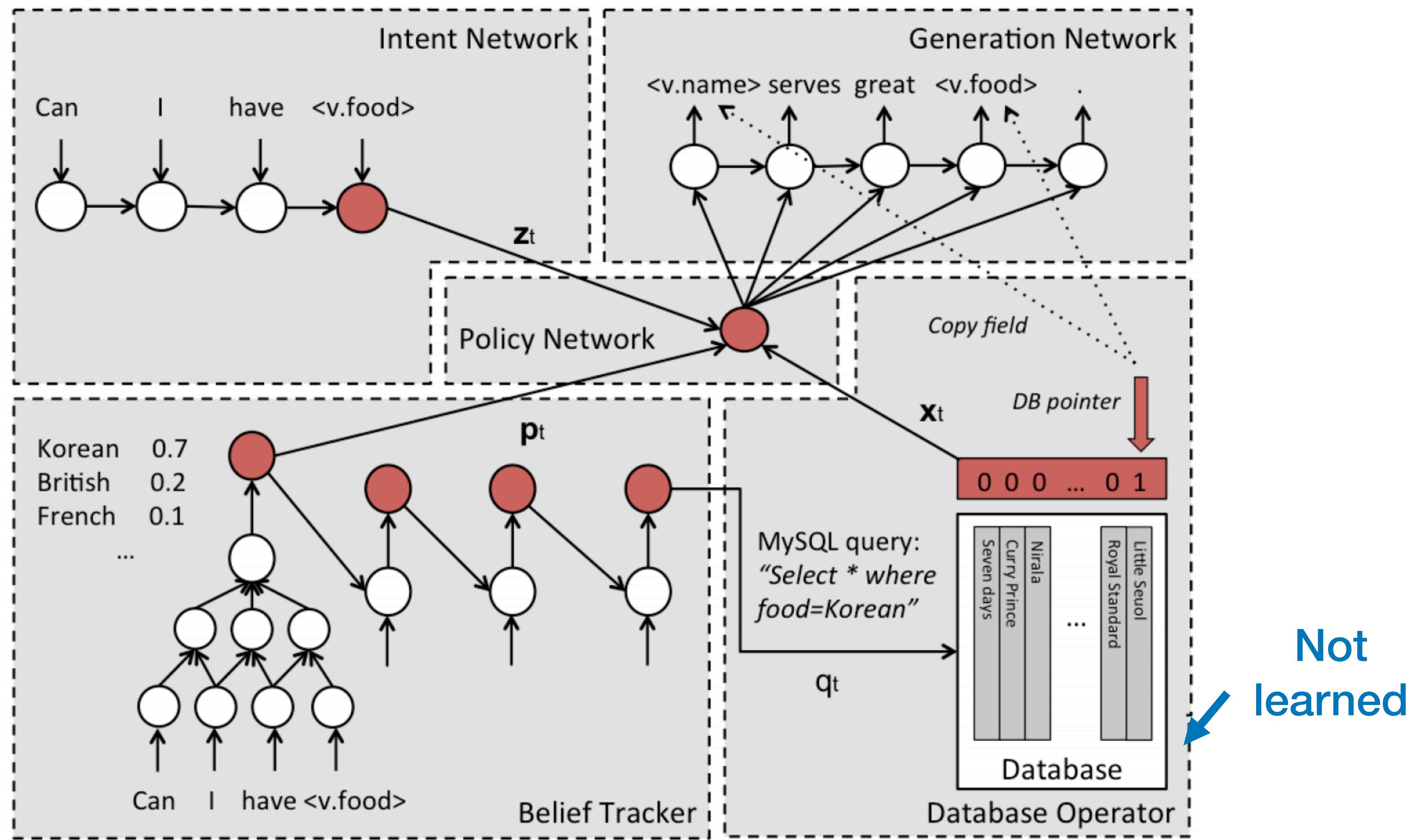
End-to-End Task-Oriented Dialog System

Maps input to:

- Multinomial distribution of values for informal slots
- Binary distribution over requestable slots



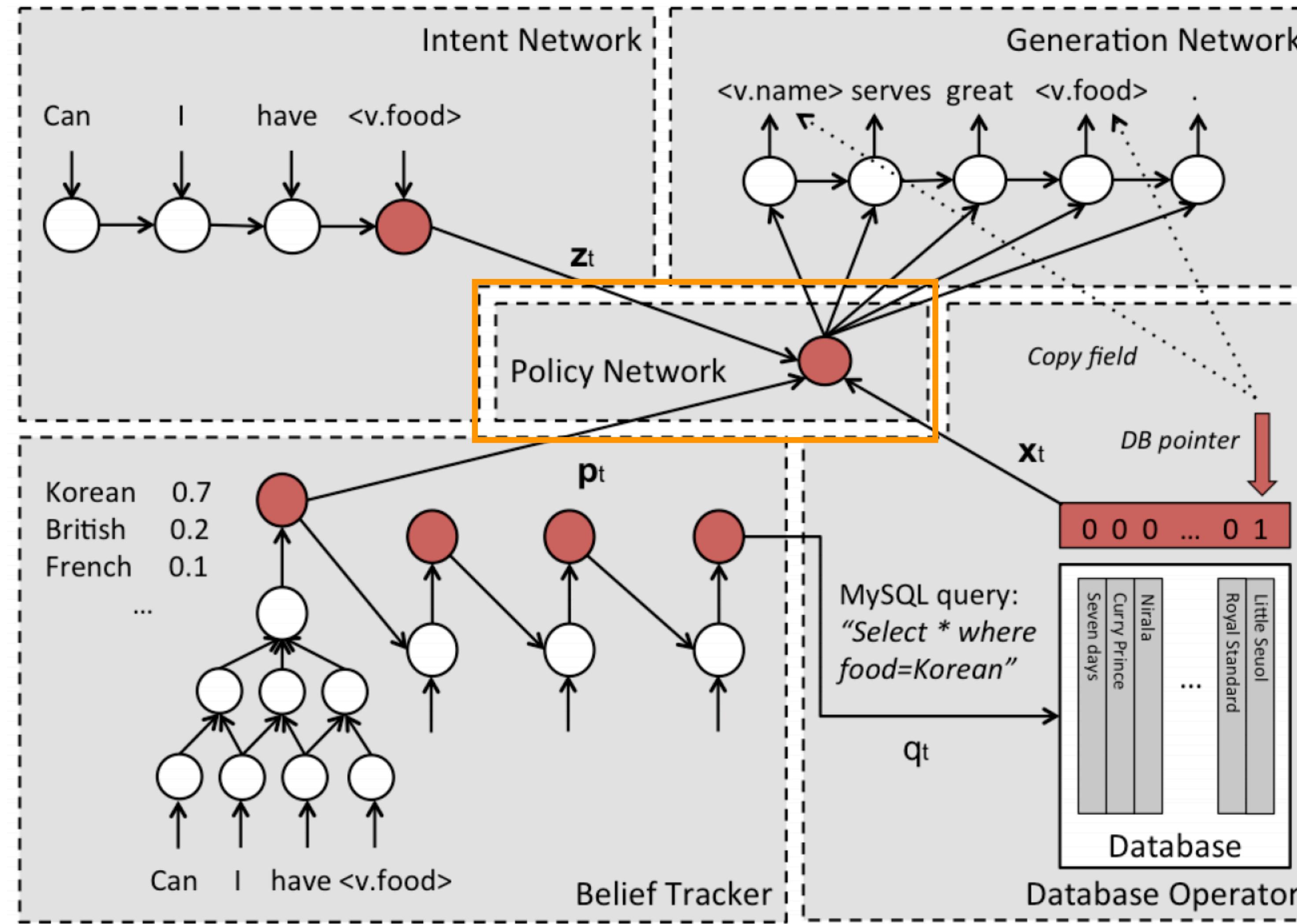
End-to-End Task-Oriented Dialog System



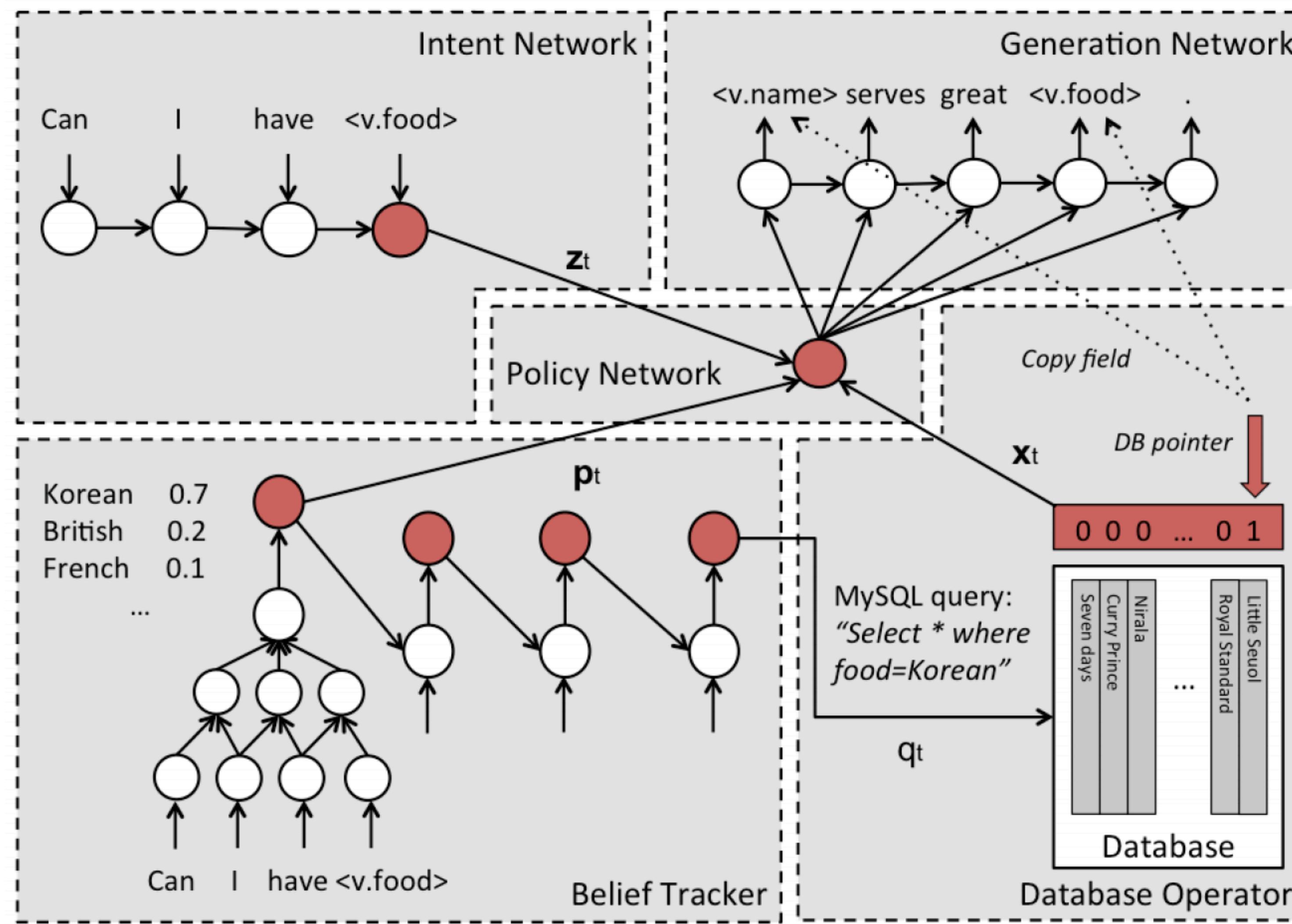
End-to-End Task-Oriented Dialog System

Feed-forward
network

Outputs
system action
vector



End-to-End Task-Oriented Dialog System



Rule-Based v.s. Data-Driven

How to build a task-oriented dialog system?

**Rule-based v.s. Data-driven
Pros & cons?**

Rule-Based v.s. Data-Driven

How to build a task-oriented dialog system?

Rule-based v.s. Data-driven Pros & cons?

Rule-Based Methods

- hand-craft rules, “safe” but not “flexible”.
- cheap in terms of dataset.
- expensive in terms of engineering.

Data-Driven Methods

- learn from interactions, dialogue manager is **evolvable**.
- uncontrolled behavior in unseen situation.
- cheap in terms of engineering, but expensive in terms of data/interaction

Task-Oriented Dialogue System

- **Goal:**
 - get information from the user to help **complete the specific task.**
- **Domain-Specific Knowledge:**
 - Ontology / Frame / Slot / Value
 - Slot Filling and Dialogue State Tracking
- **Architecture:**
 - ASR / SLU / DST / Dialogue Policy / NLG / TTS
 - Rule-based vs Data Driven
- **Evaluation:**
 - **Task completion success** (slot error rate / task error rate)
 - **Efficiency cost** (#turns)
 - **Quality cost** (more comprehensive)

Chatbot v.s. Task-Oriented Dialog System

**Information
Retrieval**

**Question
Answering**

Chatbot

**Task-Oriented
Dialog System**

What are their differences?

Chatbot v.s. Task-Oriented Dialog System

	Information Retrieval	Question Answering	Chatbot	Task-Oriented Dialog System
Input	structured	unstructured	unstructured	unstructured

Chatbot v.s. Task-Oriented Dialog System

	Information Retrieval	Question Answering	Chatbot	Task-Oriented Dialog System
Input	structured	unstructured	unstructured	unstructured
Interaction	single-round	single-round	multi-round	multi-round

Chatbot v.s. Task-Oriented Dialog System

	Information Retrieval	Question Answering	Chatbot	Task-Oriented Dialog System
Input	structured	unstructured	unstructured	unstructured
Interaction	single-round	single-round	multi-round	multi-round
supervision	available	available	sparse, delayed	sparse, delayed

Chatbot v.s. Task-Oriented Dialog System

	Information Retrieval	Question Answering	Chatbot	Task-Oriented Dialog System
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supervision	available	available	sparse, delayed	sparse, delayed
dataset	synthesis, collected	collected	collected	wizard-of-oz

Chatbot v.s. Task-Oriented Dialog System

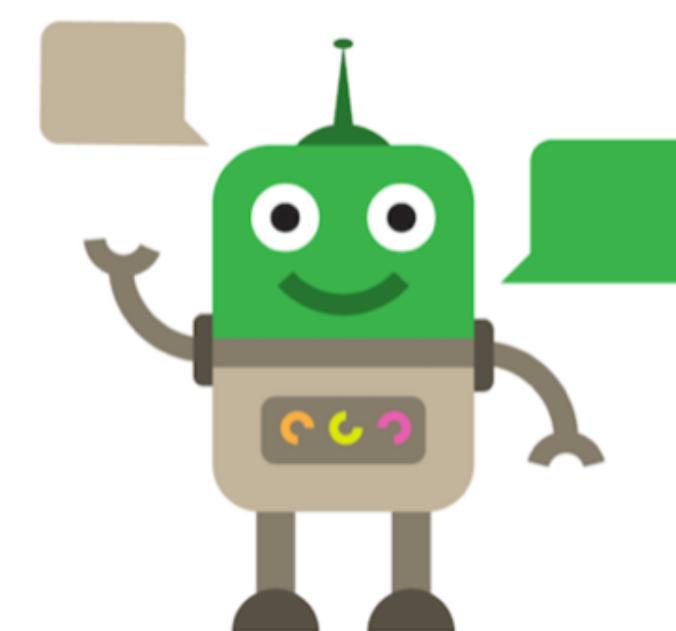
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Chatbot v.s. Task-Oriented Dialog System

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...				

Overview

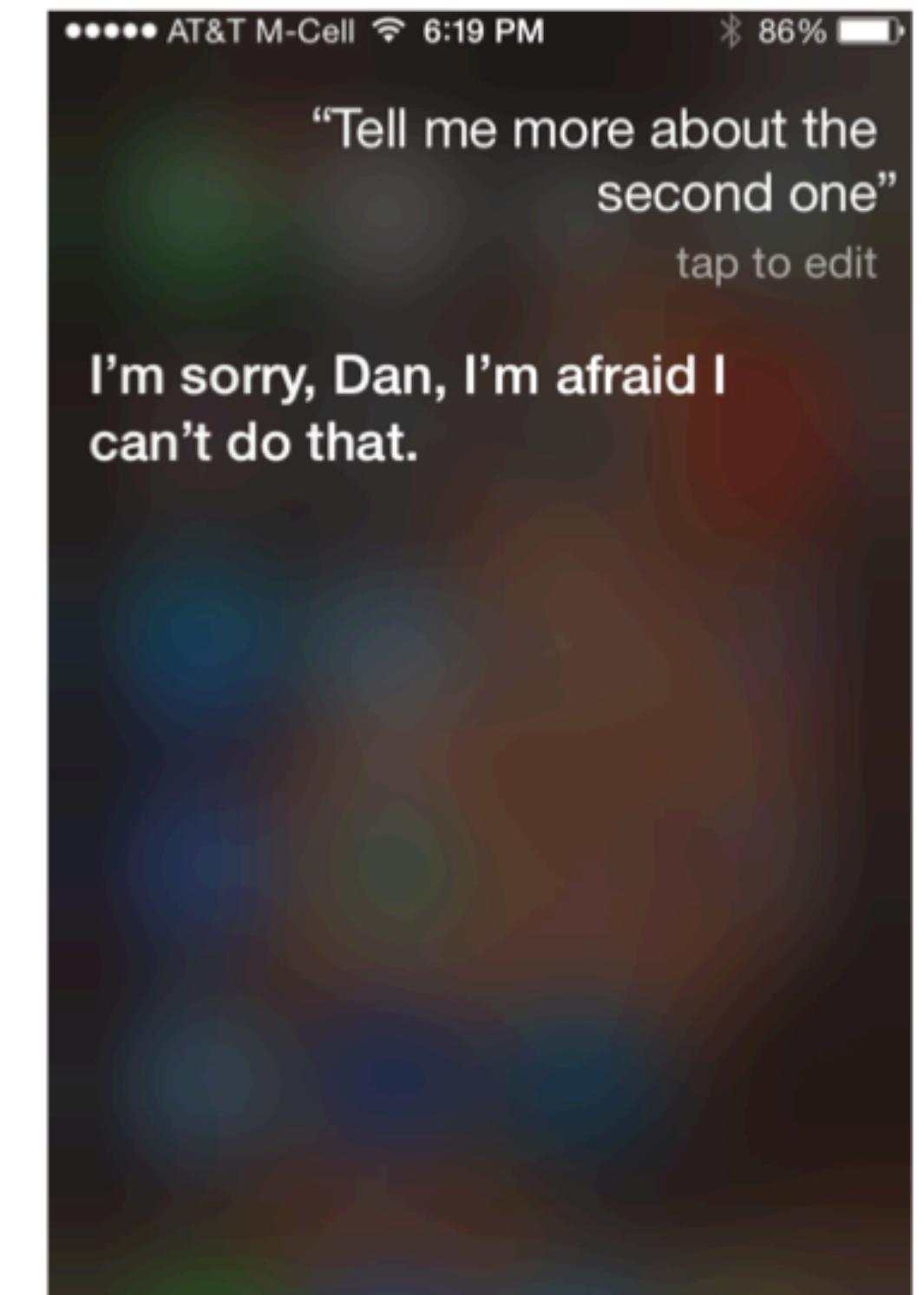
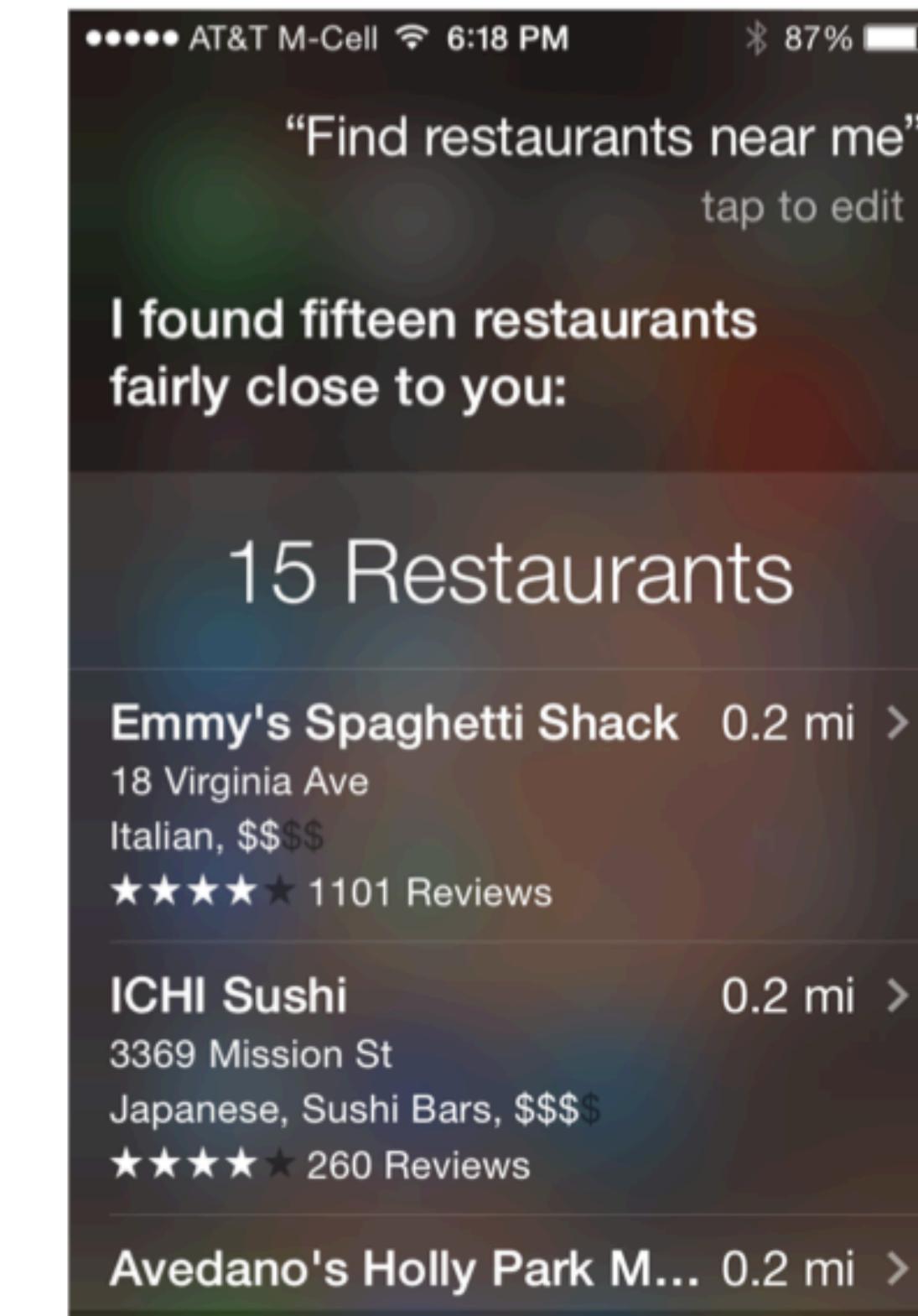
- What's a dialogue system?
- Properties of Human Conversation
- Chatbots v.s. Task-oriented dialogues systems
- Rule-based v.s. Data-driven
- **Remaining Challenges**



Dialogue Systems

Challenges

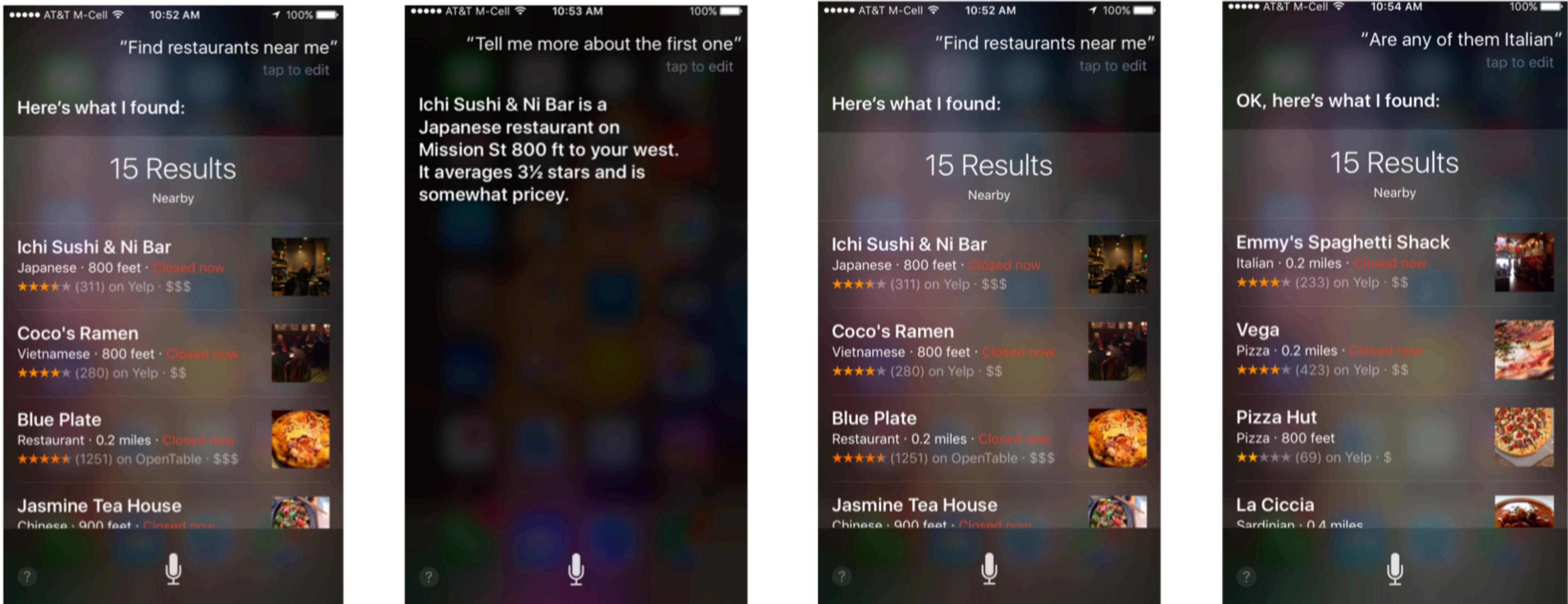
Understanding the Context



Two sets of interactions with Siri in 2014.

Challenges

Understanding the Context



The same follow-up questions that Siri couldn't answer in 2014 receive appropriate responses when posed to Siri in 2017.

Challenges

Understanding the Context

Uncertainty / Ambiguity

Reward Design

Knowledge Embedding

Domain Adaptation

Data/Interaction Scarcity

...

Summary

- **Properties of Human Conversation**
 - Turn taking, dialog acts
- **Chatbots v.s. Task-oriented dialogues systems**
 - Chatbots: chitchat, more surface-level
 - Predict response given dialogue history
 - Task-oriented: Help user accomplish task
 - Components of standard framework
 - Dialog state tracking vs dialog policy (what to say)
 - Identification of domain, intent, and slot fillers
- **Rule-based v.s. Data-driven**
- **Challenges**