Advanced Topics in Business Computing (CS3606)

Topic 3: Conversational Interfaces

Lela Koulouri

Rob Macredie

Learning outcomes

- To be able to explain what is meant by conversational interface
- To be able to characterise the differences between GUIs and CIs
- To be able to explain different types of CI
- To be able to describe a model of a CI and the role of its components
- To be able to explain and exemplify (after additional research) key issues/challenges in chatbot design/implementation
- To be able to analyse a simple piece of dialogue and identify key issues within it from the perspective of CI design

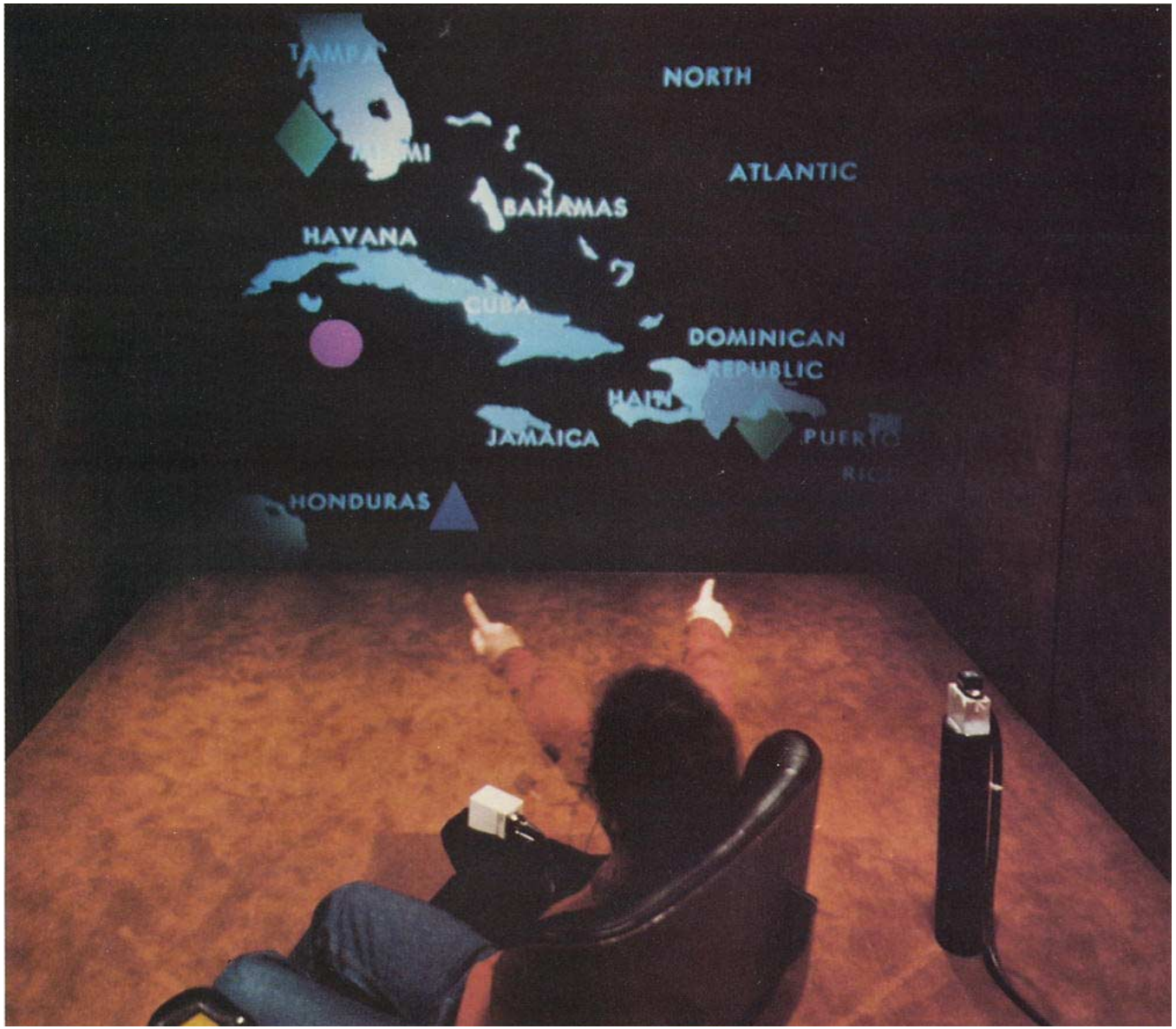
Structure

- A brief history of interfaces
- GUIs v CIs
- What is a CI?
- Types of CI
- Model of a CI system
- Core issues
- A simple example: a weather advice system
- CIs: the near and longer-term future
- The seminar activity

A brief history of interfaces

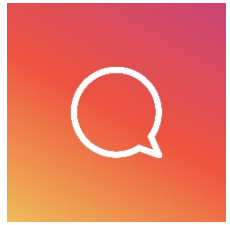
Conversational Interfaces (CIs) are a form of NUI

https://instructionaldesignfusions.wordpress.com/2010/11/15/natural-user-interfaces-as-natural-learning-tools/

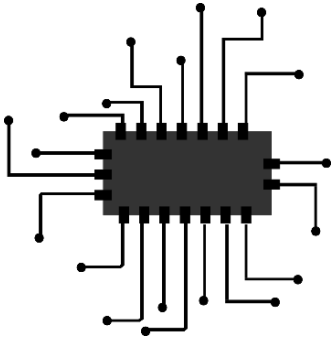


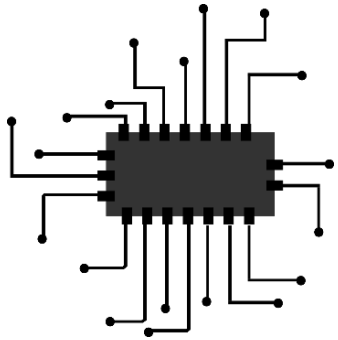
Put-That-There (Bolt, 1980)

GUIs v CIs



screen





communication by
symbolic manipulation

more constrained interaction
learning burden on user

communication by
natural language

less constrained interaction
no learning burden on user

What is a CI?

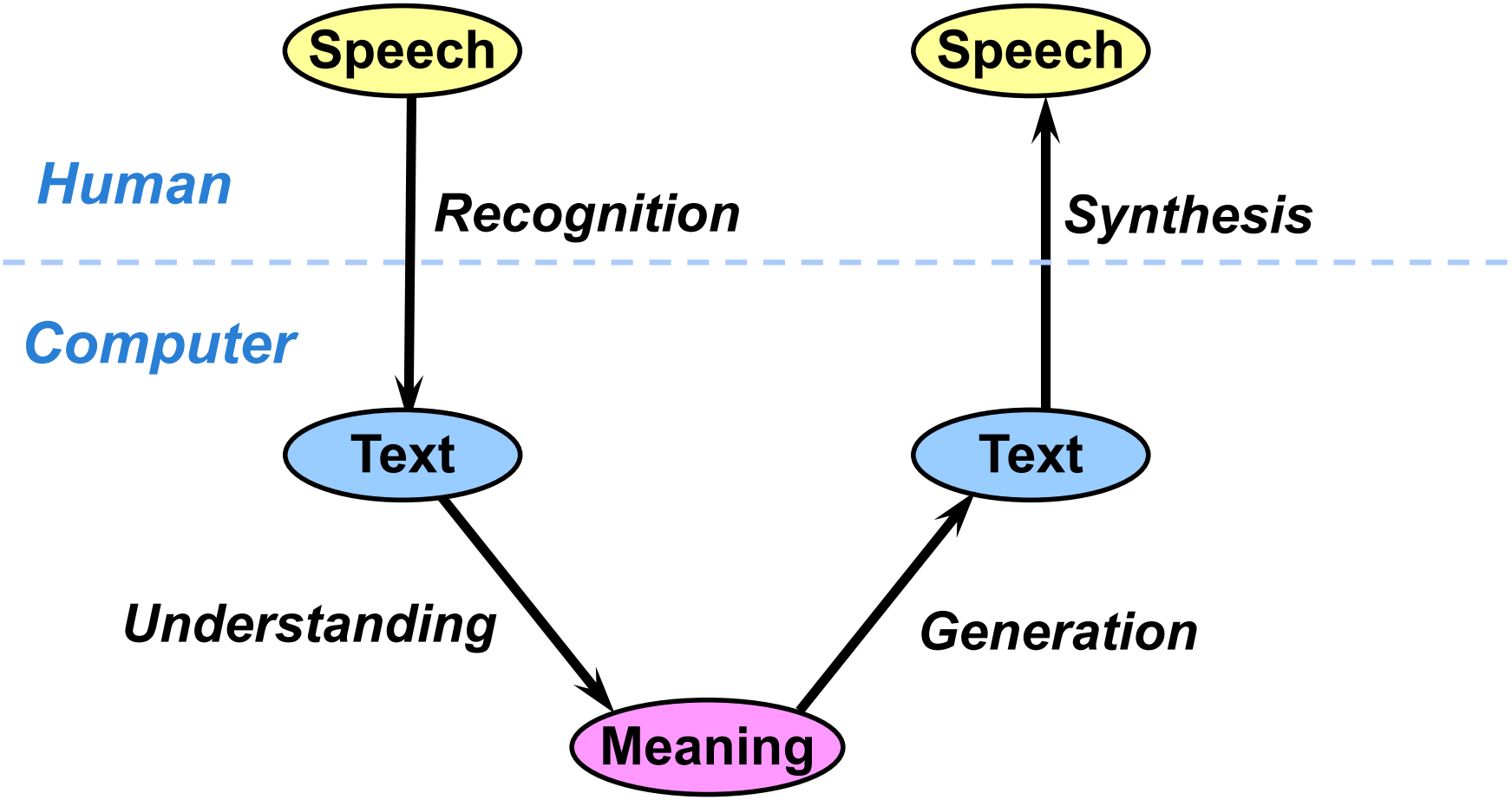
A voice recognition and natural language **interface** for a computer or mobile device. Virtual assistants such as Siri, Google Now, Cortana and Amazon Echo feature **conversational interfaces**.

(PC magazine Encyclopedia, 2017)

A conversational interface is any UI that mimics chatting with a real human. The idea here is that instead of communicating with a computer on its own inhuman terms—by clicking on icons and entering syntax-specific commands—you interact with it on yours, by just telling it what to do.

(Brownlee, 2016)

What is a CI?



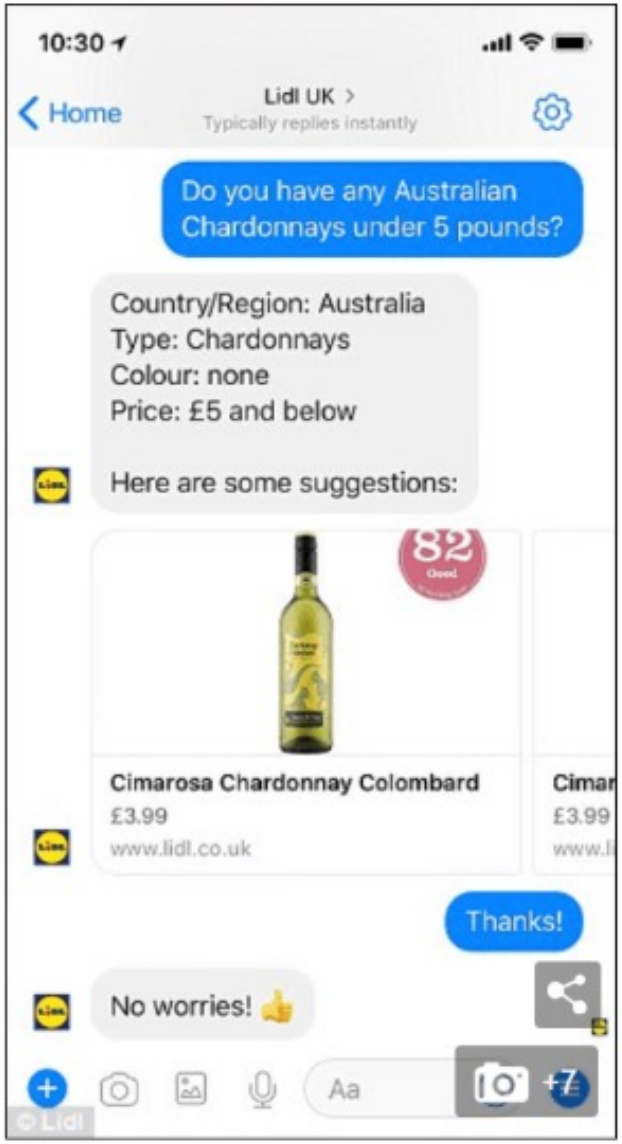
Weinstein (2004)

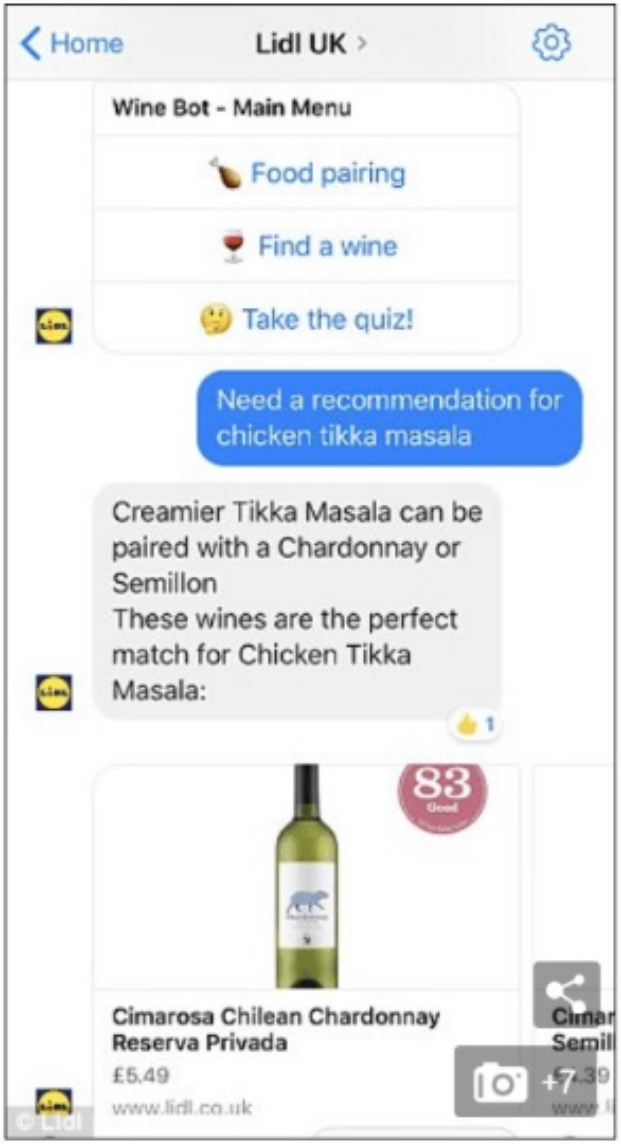
What is a CI?

- Text input interfaces that take the form of dialogue or conversation-based interaction often also seen as CIs (avoiding speech input and output issues)
- Examples include (chat)bots and virtual assistants (VAs)
- Some even see constrained response dialogue system as CIs (where the system generates a set of conversational responses from which you choose)

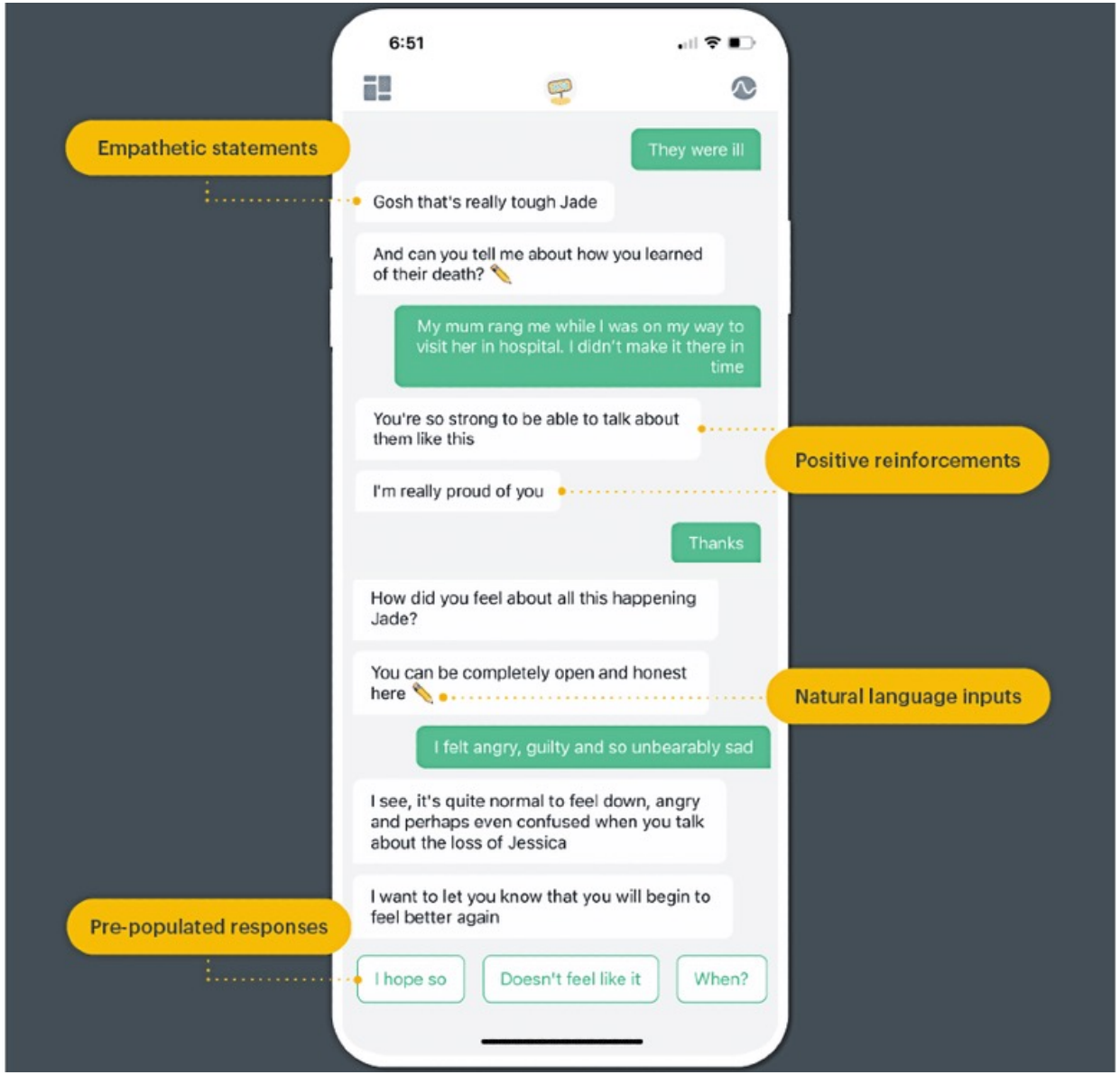
- High-level introduction to examples of current chatbots available at:
  - https://www.tidio.com/blog/chatbot-examples/#taybot
  - https://manychat.com/blog/chatbot-examples/

Example: Lidl's Winebot





Example: Woebot



From Darcy et al. (2021)

Virtual Assistants: voice-based CIs in the home

Types of CI

Conversational systems differ in the degree with which human or computer controls the conversation (initiative)

- **Computer maintains tight control**
- **Human is highly restricted**

C: ***Please state your city of departure***

- **Human takes complete control**
- **Computer is totally passive**

H: ***I want to visit my grandmother***

Directed Dialogue

Mixed Initiative Dialogue

Free Form Dialogue

How do they do it?

How do they do it?

- Identify the **Domain**
  - What is the user talking about?

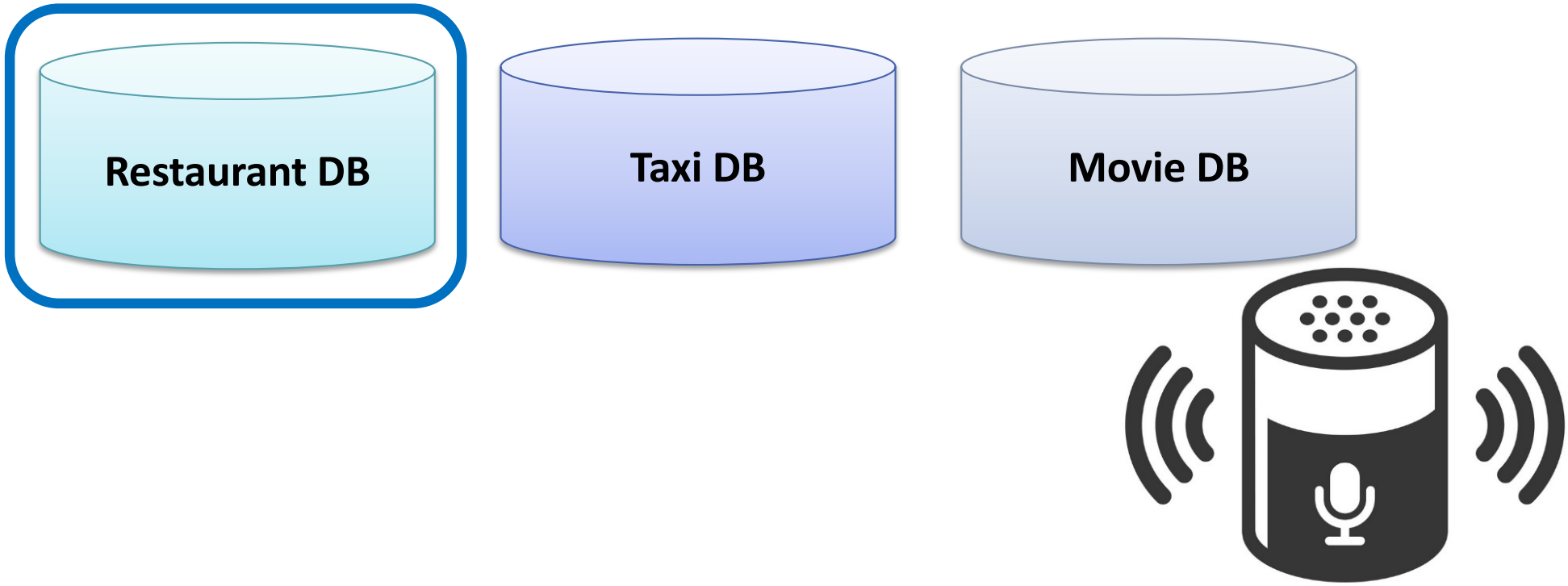
    Flights? Appointments? Movies? Restaurants? Alarm clocks? Weather?
- Detect the **Intent**
  - What is the task or user's goal?

    Book a flight? Search for flights?
- Fill the **Slots**
  - What information does the system need to know to complete the task?

    Time? Destination?

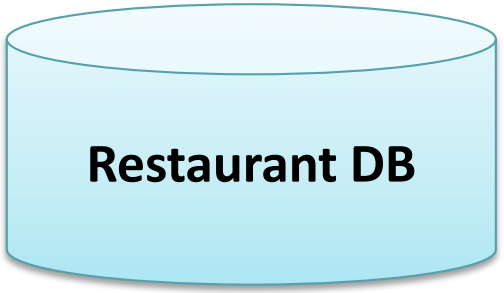
1. Domain Identification

*Find me a good French **restaurant***



2. Intent Detection

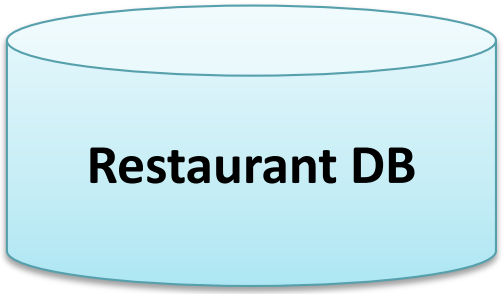
Find** me a good French **restaurant



- **FIND-RESTAURANT**
- **FIND-PRICE**
- **BOOK-TABLE**
- **…**

3. Slot filling

Find me a good French restaurant

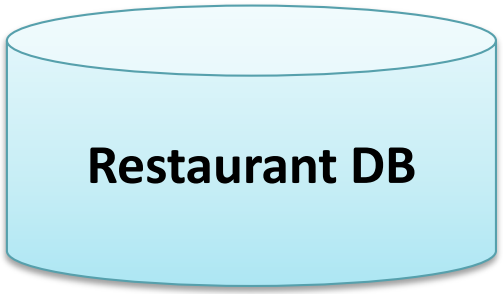


FIND-RESTAURANT

RATING:
TYPE:
LOCATION:
…

3. Slot filling

Find me a good French restaurant

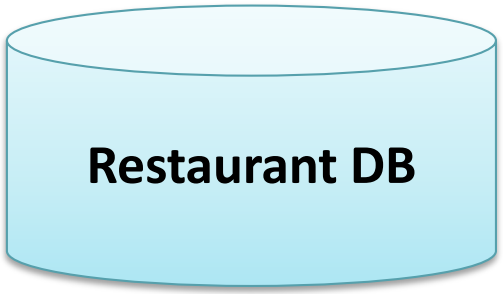


FIND-RESTAURANT

RATING:	*good*
TYPE:	*French*
LOCATION:	*?*
…	

3. Slot filling

Find me a good French restaurant



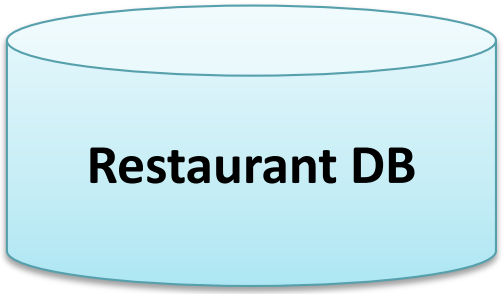
FIND-RESTAURANT

RATING:	*good*
TYPE:	*French*
LOCATION:	*?*
…	

What is your preferred area?

3. Slot filling

Near work



FIND-RESTAURANT

RATING:	*good*
TYPE:	*French*
LOCATION:	*near (work)*
…	

Database query

Near work

```
SELECT restaurant{
   Rating=‘good’
   Type = ‘French’
   Location = near(work)
}
```

FIND-RESTAURANT

RATING:	*good*
TYPE:	*French*
LOCATION:	*near (work)*
…	

Response generation

Restaurant DB

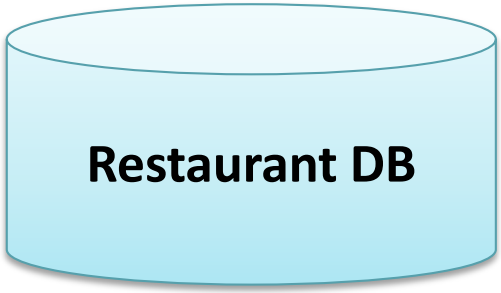
FIND-RESTAURA

RATING:	*good*
TYPE:	*French*
LOCATION:	*near (work)*
…	

***Le Petit Vin** is a French restaurant with 4.2 rating 10 minutes away from work. Would you like me to **book a table** for you?*

2. Intent Detection

Yes, book a table for two at 8pm



- FIND-RESTAURANT
- FIND-PRICE
- **BOOK-TABLE**
- …

They are ‘Frame-based’ systems

RESTAURANT

FIND-RESTAURANT

RATING

TYPE

LOCATION

- This ‘template’ is predefined
- It’s called a **frame**
- The system tries to fill the **slots** in the frame
- The *type* of values that a slot can take is also predefined
- When frame is filled, it does DB query

Mixed initiative and flexible

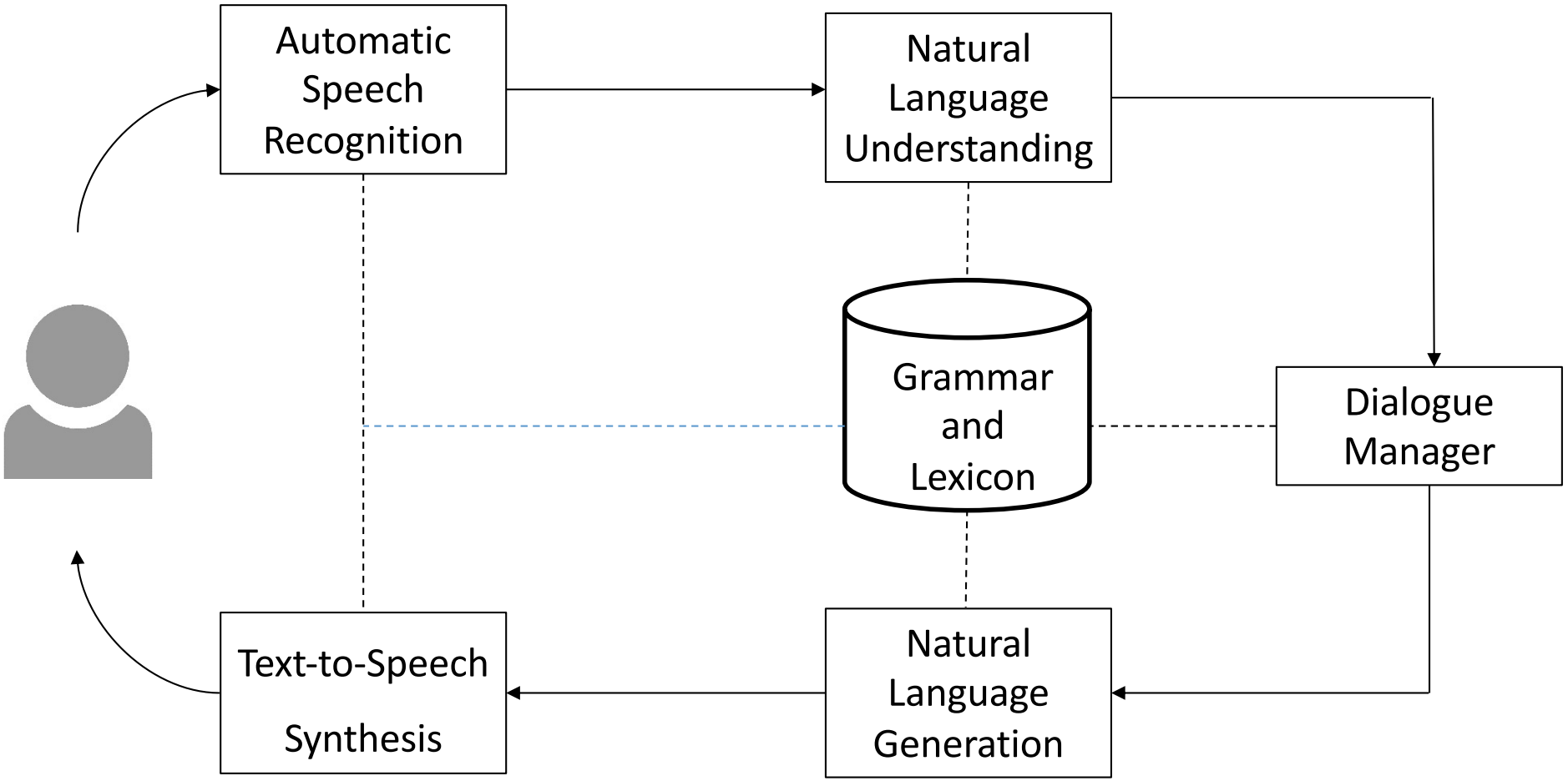
- User can fill in any slot and multiple slots at once in any order.
  - *U: I want to travel to Paris at 10am on 28 March.*
- System won't ask questions about slots that are already filled
- User can ask questions too
- The user's question or command can trigger a different frame/intent.
  - *U: When is the cheapest flight?*
  - Invokes a different intent SHOW-CHEAPEST-FLIGHTS
- System can also trigger a different frame/intent.
  - *S: OK, I've booked your flight. Do you want to also reserve a rental car at the airport?*
  - Invokes a different intent RENT-CAR
  - See 'Chaining' in slides 29 and 32

Designing a Custom Alexa Skill

- Name for the Skill
  - **PlanMyTrip**
- **Intents** for the Skill
  - **Book-Flights,** Show-Flights, Rent-Car, Book-Hotel
- Come up with possible **user utterances** for that Intent
  - ***I want to travel*** *from New York to Athens on Friday*
  - ***Book a flight*** *to Athens*
  - *I am* ***flying*** *from New York*
- Identify the necessary **slots**
  - *{fromCity} {toCity} {travelDate}*
- Come up with questions for Alexa
  - What city are you leaving from?
- Come up with confirmation/clarification requests for Alexa
  - You said you're leaving *{fromCity},* right?
  - Please confirm that you want to travel from *{fromCity}* to *{toCity}* on *{travelDate}*
  - Do you mean *Athens, Greece* or *Athens, Georgia*? (clarification request)

https://developer.amazon.com/docs/custom-skills/steps-to-build-a-custom-skill.html

Model of a CI system



Core issues and challenges in designing/implementing CIs

- speech analysis and synthesis (we'll ignore these, as out of scope for us)
- initial specification of lexicon, grammar and dialogue management rules

- parsing utterances
- identifying key words/concepts and their types
- **clarifying meaning; sometimes utterances are ambiguous**
- **inferring meaning; people don't always say exactly what they mean, but you can infer (though may be incorrect)**
- **clarifying context (context resolution); sometimes further information is needed**
- **inferring context; sometimes you can infer things from the context ('chaining', for example)**
- updating lexicon and grammar
- updating dialogue manager 'rules'
- structuring responses

- dialogue manager for a specific context versus general dialogue managers – single contexts are very challenging, so imagine how complex building general dialogue managers will be

Core issues

- Also issues in relation to usability
  - problems of discoverability and system scope
  - questions of efficiency for complex processes
  - articulation of commands through conversation can be difficult
  - a solution looking for a problem?
  - see, for example, https://uxdesign.cc/why-conversational-interfaces-are-taking-us-back-to-the-dark-ages-of-usability-fa45fefb446b

An example: a weather advice system

U: Hey

S: How can I help you?

U: How cold will it be today?

S: The low today will be 5 Celsius in Uxbridge

U: Tomorrow?

S: It will be a minimum of 10 Celsius tomorrow in Uxbridge

What issues does this simple example raise?

U:Hey

S: How can I help you?

U:How cold will it be today?

Interpretation of ‘how cold’ as ‘lowest temperature’

Inference of location

S: The low today will be 5 Celsius in Uxbridge

U:Tomorrow?

S: It will be a minimum of 10 Celsius tomorrow in Uxbridge

Inferring context: earlier question’s context taken forward to this one (chaining)

CIs: the near and longer-term future

- The rise of chatbots and VAs
  - 2017: $815m market
  - 2020: $5bn
  - predicted to be $50.9bn annual market by 2028 with over a billion users by 2025
    - https://www.prnewswire.com/news-releases/intelligent-virtual-assistant-market-size-worth--50-9-billion-globally-by-2028-at-30-cagr-verified-market-research-301414041.html
    - https://www.tractica.com/newsroom/press-releases/enterprise-virtual-digital-assistant-users-to-surpass-1-billion-by-2025/
- Blended human and system dialogues
- Better specialist dialogue models for specific contexts
- Advances in machine learning for adaptive dialogue models
- Don’t expect CIs to replace GUIs anytime soon, but expect them to become more established in certain settings
- Blended interaction forms will increase (this is happening already)

economy
Amazon.com
business incubators
world wide web
Artificial Intelligence

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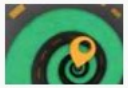
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6 days ago


Tim Draper is backing Indian

Amazon has a shiny new startup accelerator to advance conversational AI

Posted Nov 30, 2016 by John Mannes (@JohnMannes)

Big tech companies have been creating accelerators left and right to evangelize their brands and get developers engaged with APIs and other open-source efforts. Today, Amazon joined the crowd by announcing a new program for startups developing conversational AI.

This is Amazon's first foray into the world of accelerator programs, though its $100 million Alexa Fund has already invested in 22 companies within the space. These investments have occurred across various company stages and verticals. More recently, Amazon created the Alexa Prize for conversational AI, tasking university students with building bots that can *actually* hold a conversation.

Doug Booms, VP of corp dev for Amazon (wink, wink, also in charge of Amazon M&A), explained to TechCrunch that the new accelerator wasn't designed to be a feeder for the Alexa Fund nor to be a next step for teams competing for the Alexa Prize.

Amazon's accelerator strategy seems rather open-ended at this point. No formal constraints have been set as to what types of startups will be welcome in the batch that could encompass teams working on connected cars, smart homes and everything in-between.

-week program is being run in partnership with

Crunchbase

Amazon –

FOUNDED
1994

OVERVIEW
Amazon is an e-commerce retailer formed originally to provide consumers with products in two segments. It offers users with merchandise and content purchased

Seminar Activity

- Read the seminar sheet and prepare well – basis for the exam; it will not be recorded
- Poll Everywhere activity, team quiz and discussion
- A simple frame-based dialogue extract
  - Questions about domains, intents, slots and values
- A second dialogue extract to consider issues in the design of more complex, general purposes dialogue systems
  - From Ortiz, Jr (2014) paper
  - Analyse utterances and identify key words/concepts and their types
  - Identify inferences, contexts, etc., in the example to understand the complexity of managing (even simple) dialogues