How to create dialog system

Jan Balata
Dept. of computer graphics and interaction
Czech Technical University in Prague

Outline

- Intro
- Architecture
- Types of control
- Designing dialog system
- IBM Bluemix
- How to start

Why go for speech UI

- Good
  - Speech is fast (large lists, dates, times)
  - Speech is natural and intuitive
  - Speech input device is small
  - Capturing emotional state
  - Determining speaker identity

- Bad
- Speech is transient (no history on the screen)
- Speech is “serial”
- Limited short term memory of the user
- Real time apps (speech is slow for games)
- Problems with noisy environment
- Other modalities more effective in some cases
- Privacy

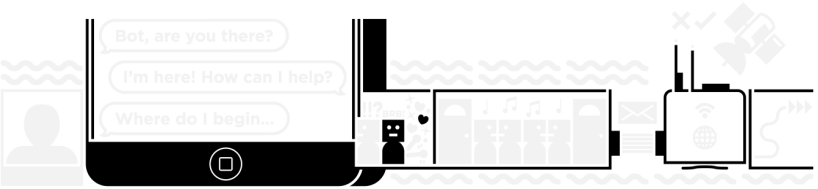
https://www.youtube.com/watch?v=5FFRoYhTJQQ

Application areas

- Large list selections, dates and times
- Hands busy situations
- Embedded systems with no keyboard or screen
- Telephony
- Pervasive systems – Car, Home environments
- Accessibility

Dialog systems are trending

- **Bots are here, they're learning — and in 2016, they might eat the web**
  - **Text based dialog systems**
    - **Big trend around 2000 and now again**
    - **Apps are dead -** The average person spends 80 percent of their time on mobile devices using just 3 apps (ComScore 2015)
  - **Facebook M**
  - **Slackbot**
  - **Nikabot**
    - http://www.nikabot.com
  - **Magic**
    - https://getmagicnow.com/
  - **Luka**
    - https://luka.ai/
  - **Lark**
    - http://www.web.lark.com/
  - **Penny**
    - https://www.pennyapp.io/



Architecture

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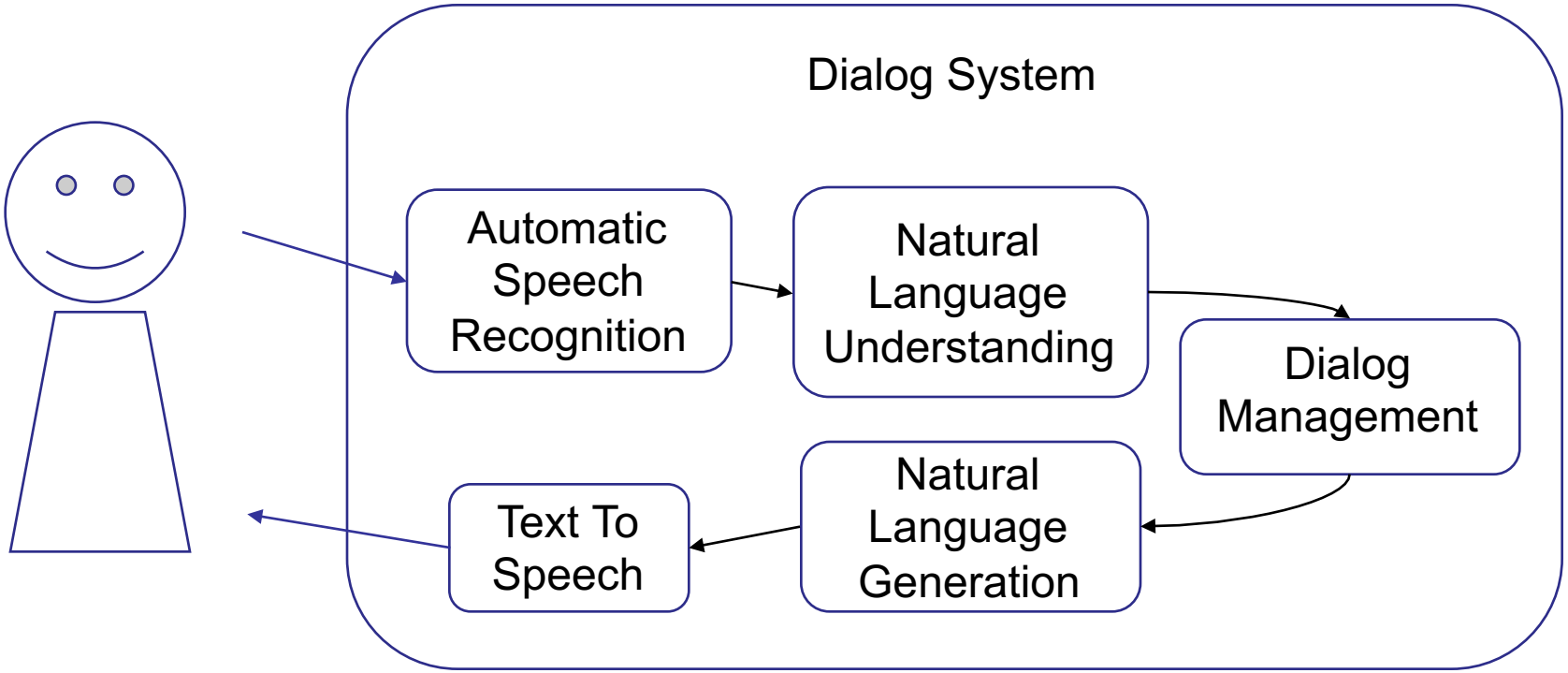


Architecture

- ASR (automatic speech recognition)
- NLU (natural language understanding)
- DM (dialog management)
- NLG (natural language generation)
- TTS (text to speech)

ASR

- **Almost 65 years of research and development**
  - **1952 Bell Labs: single words ~ 10 words**
  - **1960 Standford: continuous speech ~ 200 words**
  - **1971 DARPA: continuous speech ~ 1 000words**
  - **1970s Institute for Defense Analysis: Hidden Markov Model**
  - **1980s IBM ~ 20 000 words (statistical models, HMM)**
  - **1990s more words than average human**
  - **2000s Dragon Systems**
  - **2010s University of Toronto, Microsoft, Google, and IBM (deep neural networks, deep learning)**
- **Best accuracy (for English)**
  - **92% in <u>optimal conditions</u>**

NLU

- Parsing the input text, determine the meaning
- Voice commands vs. full comprehension of news article
  - Real application somewhere between (text classification for the automatic analysis of emails)
- Lexicon, parser, gramar, ontology ... many person-year of effort

DM

- State variables
- Unanswered questions
- Error handling
- Initiative control
- Decisions
  - Scripted (defined by human)
    vs.
    reinforced learning (Markov Decision Process – action selected based on state and reward function)

NLG

- **Simple but hard to do correctly**
  - **Content determination: Deciding what information to mention in the text**
  - **Document structuring: Overall organisation of the information to convey**
  - **Aggregation: Merging of similar sentences to improve readability and naturalness**
  - **Lexical choice: Putting words to the concepts**
  - **Realisation: Creating actual text with syntax, grammar correct**

TTS

- **Artificial production of human speech from text**
  - ***Text normalization***
  - ***Phonetic transcription***
- **Approaches**
  - **Concatenation synthesis**
    - **Segments of recorded speech put together**
      - **http://www.theverge.com/2013/9/17/4596374/machine-language-how-siri-found-its-voice (Siri - video)**
  - **Formant synthesis**
    - **Additive synthesis and acoustic model (most text-to-speech synthetizers**
  - **Articulatory synthesis**
    - **Based on models of human vocal tract**

Control of dialog

Finite-state based system

user is taken through a dialog consisting of sequence of pre-determined steps

System:	*What is your destination?*
User:	*London*
System:	*Is that London?*
User:	*Yes.*
System:	*What day do you want to travel?*
User:	*Friday.*
System:	*Was that Sunday?*
User:	*No.*
System:	*What day do you want to travel?*

Frame based system

dialog flow is not pre-determined but depends on the content of the user's response and pieces of information that the system recognize from it

System:	*What is your destination?*
User:	*London*
System:	*What day do you want to travel?*
User:	*Friday.*
System:	*When do you want to travel?*
User:	*Around 10 in the morning.*
System:	*You want to travel from London on Friday around 10 in the morning?*
User:	*Yes.*
System:	*I have the following connection ...*

Agent based system

user can take control of the dialogue and use spontaneous and unconstrained speech to interaction with the system

User:	*I'm looking for a job in the Calais area. Are there any servers?*
System:	*No, there aren't any employment servers for Calais. However, there is and employment server for Pas-de Calais and an employment server for Lille. Are you interested in one of these?*

Designing

Dialog from User perspective

- **Input/output**
  - **Text, voice, gui, multimodal**

Dialog from User perspective

- **Course of dialogue**
  - **Directed dialog, mixed initiative dialog, turn taking, Believe state modeling, Deep learning, Anaphora resolution, turn taking, POMDP (Partially Observable Markov Decision Proceses)**

Dialog from User perspective

- When to speak?
  - Pust to talk, silence detection, always speak mode, trigger words
- What can user say?
  - List of phrases, dictation

Creating DS

- **Start with a scripted dialog system**
  - **Rapidly assembled with the expert of the chief stakeholder**
  - **Use in-house dialog modeling languages**
- **Transition to a POMDP-based approaches as data becomes available**

How to write the speech application

- Indicate that user speaks to the machine
- Keep in mind short term memory of the user
- Provide “what can I say” option through the app
- Provide “go back” option throughout the app
- Build in an error correction mechanism

Input verification

- **Explicit**
  - **Ask right away**
- **Implicit**
  - **Interpret and ask the next question**

User:	*I want to travel from Milano to Roma.*
System:	*At what time do you want to leave form Merano to Roma?*
User:	*No I want to leave from Milano in the evening.*

IBM Bluemix

Many cloud services

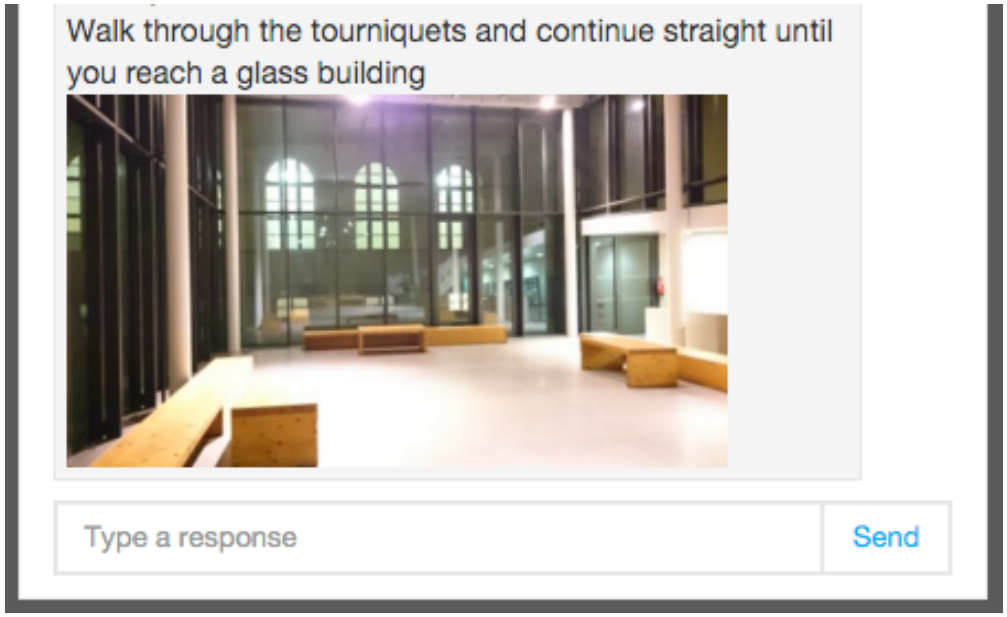
- “Cognitive apps”
  - Emotion extraction, ASR, TTS, dialog, personality insights, image recognition, …

IBM Bluemix

- **Free 30 day trial**
  - http://www.ibm.com/cloud-computing/bluemix/
- **Redeem code for 6 months (ask me)**

Hacking

- **Responses from server can include snippets of js, html, etc.**
  - **You can put images into dialog**
  - **You can load external content from different services**



Semestral project

- **Jednoduchý domácí společník**
  - **domácí robot**
  - **"…zejména pak konverzační způsob interakce (pomocí například tabletu nebo mobilního telefonu). Robot by měl budit dojem společníka, který komunikuje pomocí přirozeného jazyka a využívá kontextové informace (denní doba, zvuky, profil uživatele, léčebná terapie, atd.)…"**

How to start

- **NUR semestral projects**
  - http://leyfi.felk.cvut.cz/balatjan/IBM/
- **Quick start to IBM Bluemix**
  - http://leyfi.felk.cvut.cz/balatjan/BluemixQuickstart.pdf

For dialog practice

- Account on Bluemix (use quickstart from previous slide)
- Send me Credentials (<u>next week</u>!)
- Bring your own laptop
- Select topic of you project

Thank you

Jan Balata

Czech Technical University in Prague

jan.balata@fel.cvut.cz