EE596: Conversational Artificial Intelligence Project

A Chatbot that walks you through your job search

Overview

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4. Knowledge Database
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Conversational Search

The challenge: *Context*

> *“It didn’t use contextual information so there was no way to expand on the previous answer it gave me."*

Participant commenting on their experience.
(Vtyurina el al.'s 2017 work on Conversational Search)

Formulating a full question takes effort and is unnatural.

Motivation

Team Vision:

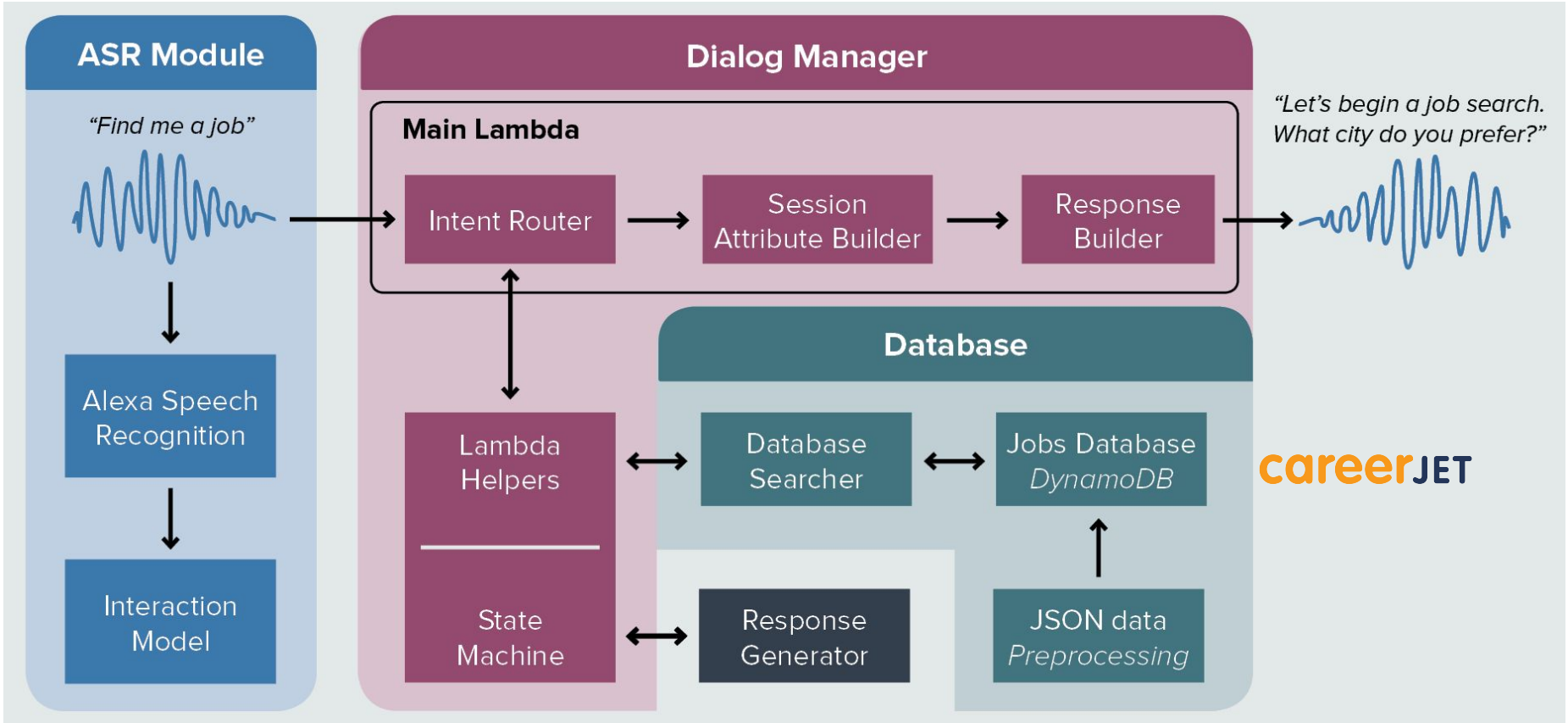
- Job Data challenging (yet tractable)
- Talk the user through a job search
- Develop a conversational system

Target Users: New Job Seekers, people changing careers or job seekers who are new to the industry

Team aims:

- Tech Learning Opportunity (AWS)
- Conversational Knowledge Base Navigation
- Context Dependant Response

System Architecture



Dialog Design

Mega-states and their allowed actions:

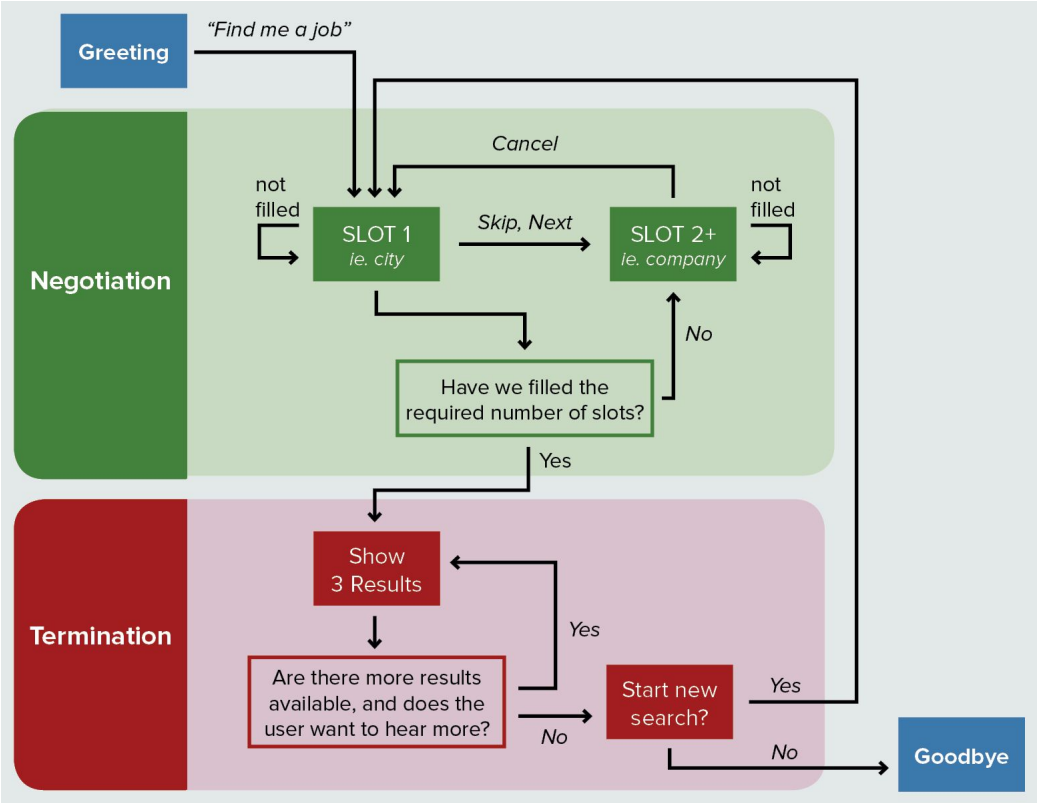
- Greeting - Conversation w/o context slot filling, Help, Confirm and Decline
- Negotiation - Conversation with slot filling, Confirm, Decline, Backup, Reset
- Termination - Conversation with slot filling, Confirm, Decline, Backup, Reset

Action Description:

  - Confirm: <yes words/sentences>
  - Decline: <no words/sentences>
  - Backup: Skip/Next and Confirm/Decline
  - Reset(Cancel): Reverts the conversation state to the filling the first context slot

Dialog driver: data-defined context slots

State Machine



Job Knowledge Base

- Small data set for prototyping:
  400 jobs (20 industries x 20 jobs)
- Rich for dialog experimenting
- Modelled as Limited Domains

```
SLOT_NAMES= [
    "city",
    "company",
    "title",
    "state",
    "skills"
]
```

```
SLOT_STATES = [
    'EMPTY',
    'FILLED',
    'IN_PROGRESS',
    'PARTIALLY_FILLED'
]
```

jobpost	date	Title	Company	Announceme	Term	Eligibility	Audience	StartDate	Duration	Location	JobDescripti	JobRequirme	RequiredQua	Salary	ApplicationP
AMERIA	5-Jan-04	Chief Financi	AMERIA Inve	NA	NA	NA	NA	NA	NA	Yerevan, Arn	AMERIA	- Supervises	To perform	NA	To apply for
Internationa	7-Jan-04	Full-time Cor	International	NA	NA	NA	NA	NA	3 months	IREX	NA	NA	Bachelor's	NA	Please
Caucasus	7-Jan-04	Country Coo	Caucasus En	NA	NA	NA	NA	NA	Renewable	Yerevan, Arn	Public	- Working			
Manoff	7-Jan-04	BCC Specialis	Manoff Grou	NA	NA	NA	NA	NA	NA	Manila, Phili	The LEAD	- Identify			
Yerevan	10-Jan-04	Software De	Yerevan Brar	NA	NA	NA	NA	NA	NA	Yerevan, Arn	NA	- Renderi			
Boutique	10-Jan-04	Saleswoman	Boutique "Ag	NA	NA	NA	NA	NA	NA	Yerevan,	Saleswoman	NA			
OSI	11-Jan-04	Chief Accour	OSI Assistanc	NA	NA	NA	NA	NA	NA	Yerevan, Arn	The	NA			
Internationa	13-Jan-04	Non-paid par	International	NA	NA	NA	NA	NA	6 months	IREX	NA	NA			
Yerevan	13-Jan-04	Assistant to I	Yerevan Brar	NA	NA	NA	NA	NA	NA	Yerevan, Arn	NA	-			
American	13-Jan-04	Program Ass	American	NA	NA	NA	NA	NA	NA	NA	The	NA			
Internationa	13-Jan-04	Short-Term T	International	NA	NA	NA	NA	NA	NA	NA	NA	NA			
Internationa	13-Jan-04	Non-paid par	International	NA	NA	NA	NA	NA	6 months	IREX	NA	NA			
Institute for	13-Jan-04	Chief of Part	Institute for	NA	NA	NA	NA	NA	5 year	Tashkent, Uz	ISC seeks an	NA			
Food	14-Jan-04	Community I	Food Securit	NA	NA	NA	NA	NA	NA	Ijevan town,	Food	- Assist th			
Teleplus LLC	14-Jan-04	General Man	Teleplus LLC	NA	NA	NA	NA	NA	NA	Yerevan, Arn	NA	- Manage			
NetCall	15-Jan-04	Network Adr	NetCall Com	NA	NA	NA	NA	NA	NA	Yerevan, Arn	NA	- Networ			
SOC.Stockh	15-Jan-04	Utopian Wor	SOC.Stockho	NA	NA	NA	NA	NA	NA	NA	NA	NA			
United	15-Jan-04	Country Ecor	United Natio	NA	NA	NA	NA	NA	3 months init	NA	The United	The			
Counterpart	16-Jan-04	Driver/ Logis	Counterpart	NA	NA	NA	NA	NA	NA	Yerevan, Arn	Driver/	- Maintai			
Xalt LLC	16-Jan-04	Graphic Desi	Xalt LLC	NA	NA	NA	NA	NA	NA	Yerevan, Arn	The position	Graphic			

```
query={
    'location'   : '',
    'keywords'   : 'accounting',
    'affid'      : '36e406480df97
    'user_ip'    : '11.22.33.44',
    'url'        : 'http://www.exa
    'user_agent' : 'Mozilla/5.0 (
}
```

Data Processing

Current scope of system:

- Clustering: simple grouping by domain
- String normalization: **e, e, è, é, ê, ë**
- Data Standardization: analysis driven towards matching user utterance
  punctuation, abbreviations: mostly unchanged
  written: **St Louis**
  spoken: **Saint Louis**
- Search: using exact token matching

3_gram	freq	%ge	cum%
salt_lake_city	4	33.33%	33.33%
augusta_richmond_county	3	25.00%	58.33%
port_saint_lucie	3	25.00%	83.33%
louisville_jefferson_county	1	8.33%	91.67%
west_palm_beach	1	8.33%	100.00%

Future scope:

Reverse indices, Named-entity resolution, Entity linking/resolution, typo-fixing

Context-based Search Example

"Top skills": Context Driven

context = {}		context = {city=California}	
'risk management'	20	'policy development'	4
'key account management'	19	'budget oversight'	3
'p l management'	19	'corporate security'	3
'project planning'	19	'cost accounting'	3

Sample dialog

A end-to-end dialog sample shown here

Language Generation

Rule-based Response Generator: directs to apt response based on the turn goal

```
ok_words = ['Ok', 'Okay', 'Cool', 'Alright', 'Great', 'Alright then', 'Sounds good

prompt_suffixes = ['are you interested in?', 'interests you?',
                   'are you considering?'  , 'do you prefer?',
                   'are you thinking of?'  , 'appeals to you?']

start_prompts = ['Let\'s start a job search.', 'You are starting a job search.',
                 'Let\'s begin a job search.', 'Let\'s begin searching for a job.'

reprompt_suffixes = ['you\'d like to include in the search.',
                     'you would like to include in the search.',
                     'you want to include in the search.']

thanks_fors = ['Thanks for', 'Hope you enjoyed', 'Thank you for']

goodbyes    = ['Goodbye.', 'See you later.', 'See you around.',
               'Until next time.', 'Bye for now.', 'Goodbye for now.']

proposals   = ['Would you like', 'Do you want', 'Do you wish',
               'Would you be interested', 'Want']

restarts    = ['would you like to search for more jobs?', 'would you like to searc
               'do you want to start another search?', 'want to search for a diffe
```

Observations

- Alexa intent recognition algorithm is heavily dependent upon:
  - Number of words in the utterances
  - The utterance vocabulary
  - Number of samples in each slot
- Alexa ASR **does not**: recognize sentence boundaries, perform well with named entity words that are commonly referred to with abbreviations, i.e., AT&T.
- Built-in intents handle disfluencies well when supplemented with sufficient sample utterance data, but do not handle backup and corrections, i.e., “I want to work in Portland uh I mean Seattle”
- A slot-filling approach is a naive but effective approach to building an information retrieval chatbot
- Wake words such as ‘Alexa’ cannot be recognized in any utterance

Suggested Evaluation

Naive approach:

- % of search restarts
- % of turns per slot
- % of session “quits” without entering Termination state

Future Scope: Formal methods such as the PARADISE framework

DEMO

Takeaways

- Alexa ASR is robust and easy to work with
- Dialog model could be made more flexible
- Decouple NLU from interaction model
- Data model has great potential for research

Future Scope

Dialog Policy: transform system to mixed-initiative system; incorporate Markov processes to maintain information state.

NLU Robustness: allow user to fill multiple context slots in a single utterance; map user preferences using context slot clustering in database; use RNNs to identify user utterances and map them to intents.

NLG Improvement: change current rule-based system to a neural sequence model.

Entity Resolution: disambiguate between named entities.

Additional Features: allow user to change existing context slot values at any point; send email to user containing job application links

Thanks for Listening!

Q & A

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