A two-step approach for efficient domain selection in multi-domain dialog systems

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Dialog Systems-Multiple Domains/Tasks







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Example Based Dialog Management



Multi-Domain Dialog Systems

Definition

- deals with more than one domain through a single interface.
- The distributed architecture a dialog manager for each domain
 - Extensibility, Scalability, Usability
- Domain Selection/Domain Switching
 - Selecting the most appropriate domain
 - Important Factor
 - Current User Utterance
 - Dialog (discourse) Flows

	Utterance	Domain
U	What is on TV?	TV
S	'Muhan-Dojeon' on MBC, News on KBS,	TV
U	Record the MBC program	TV
S	Now, it's recoding	TV
U	How is the weather in Seoul	Weather
S	Todays weather in Seoul is	Weather
U	Let me know the famous restaurant.	Restaurant
S	What do you prefer to eat the food from Korean, Japanese, Chinese,?	Restaurant
U	The Korean one.	Restaurant
S	The famous Korean restaurant is	Restaurant
U	Give me the number	Restaurant
S	Number is xxx-xxx-xxxx.	Restaurant
U	Play the music.	Music

Previous Research



Previous Research

- Example-based Dialog Modeling for Practical Multidomain Dialog System.
 - Characteristic
 - Domain Spotter decides the domain before dialog processing
 - Feature list

Feature set	Description		
Linguistic	Word, POS tag, n-gram		
Semantic	Dialog act		
Keyword	N-Best keyword, n-best class (from TF*IDF weight)		



ASR

- Disadvantages
 - ► considering dialog flow may not help (dialog history w/o domain) → low performance

Previous Research

- Mikio Nakano et al (2011)
 - Characteristics
 - Using domain specific features
 - Two stage domain selection
 - Activation probability estimator
 - Domain continuation decision maker
 - Disadvantages
 - Time complexity
 - $\hfill\square$ # of processing domains to select the domain



Proposed Approach

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A Two-Step Approach for Efficient Domain Selection in Multi-Domain Dialog Systems



Proposed Approach

 A Two-Step Approach for Efficient Domain Selection in Multi-Domain Dialog Systems



Domain Ordering

To order the candidate domains

- To apply in-domain verifier (domain filtering) from the top candidate domain.
- Machine learning approach Max Ent classifier
- Feature list Domain independent features

Feature set	Description
Linguistic	Word, POS tag, n-gram
Semantic	Dialog act
Keyword	N-Best keyword, n-best class (from TF*IDF weight)

Domain Filtering

- To finally decide the domain that can generate the system response
- In-domain verifier approach (using discourse flow)
 - Multi-class classifier → using discourse flow needs a wellmixed multi-domain dialog corpus to train
 - To build a well-mixed multi-domain dialog corpus is very difficult due to domain floating and ambiguity for short utterances
 - in-domain verifier to each domain
 - No need to build a mixed-multi-domain corpus

in-domain verification using contents-based Domain Filtering

► The domain's non-empty content retrieval result → domain is correct (task oriented dialog system)



Experimental Results

Dataset	Domain	Training			Test	
	Domain	Dialog	Utterance		Dialog	Utterance
	NAVI	122	525		14	61
	PIRO	383	1581		43	183
	TV	123	500		14	62
	Weather	89	455		10	48
Performance						
Accuracy & Time Complexity	Methods		Accuracy (%)			# of executing SLU
	Baseline (pre-selection)		328 / 354	92.65	5	354 (1.18)
	Baseline (post-selection)		336 / 354	94.91		1614 (13.48)
	Proposed Method		339 / 354	95.76	ō	693 (6.43)
	Selected Position	Answer Distribution in Ordering		n	Accuracy in Proposed-Methoc	
Answer Domain Distribution	1-best	328 (92.65%)			321 (97.89%)	
	2-best	2-best 22			14	(63.63%)
	3-best	2	(0.56%)		2	(100%)
	4-best	2	(0.56%)		2	(100%)
	Total	35	4 (100%)		339	(95.76%)

Future Work – COLING 2012

- Multi-Domain Dialog Systems for Closely Related Domains
 - Most research on multi-domain dialog systems does not focus on issues of closely related domains (e.g. TV program and VOD)
 - Issues
 - How to select one or more domains at the same time (for ambiguous domains).
 - How to understand language, interpret context, manage dialog, and generate language for the selected domains.
 - w/o harming extensibility.



Multi-Domain Selection Framework



Multi-Domain Selection Framework

Dialog Example Candidate domains are both TV program and				
			VOD. However, playing both of them at the	Domain
	U	Play "The Closer."		TV program
	S	Do you mean a TV prog	gram or a VOD?	TV program and VOD
	U	TV program.		TV program
	S	The TV program has be	en started.	TV program

	Utterance	Candidate domains are both	TV program and	
U	Are there any animation programs?	VOD. Presenting the lists of both of them at the same time is possible to the system. IS. (). Age", ().		
S	This is the list of the related TV programs This is the list of the related VODs: "Ice A			
U	Who starred in "Ice Age"?	VOD		
S	No such TV program is available. Denis I	TV program and VOD		
U	I want to watch it.	VOD		
S	The VOD has been star Candidate of and VOD h	lomains are both TV program	VOD	
	that final dor	that final domain is VOD.		

Hierarchical Domain Model-based MDSF



※ S: single, M: multiple, A: arbitrary

- Hierarchical domain model (HDM) is a formal description of the capabilities of domains and the hierarchical relationships among the domains.
- HDM is used in both the candidate domain detection and final domain determination components.

Hierarchical Domain Model-based MDSF

Candidate domain detection experiments.

Component	Precision	Recall	F-1 score
Baseline	97.1%	65.2%	78.0%
Proposed	95.6%	96.2%	95.9%

Multi-domain dialog system experiments.

System	STR	TCR	ATL
Baseline	55.0%	58.8%	4.7
Proposed	91.1%	95.0%	3.5

Question

