
Personalization in Goal-oriented Dialog

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Poster at the Conversational AI Workshop at NIPS 2017

About me



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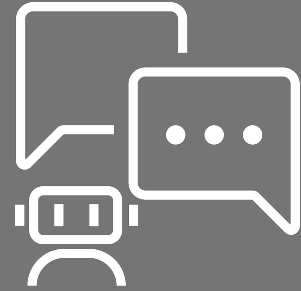
Exchange student @ **EPFL, Switzerland**



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Conversational AI

Quick Background





Slot-filling &
Rule-based



Open-ended
(*chit-chat*)

TASKS

SYSTEMS



Goal-oriented

Data/Corpus Driven



End-to-end Trained



Motivation

Personalization of a dialog system's response based on who it is interacting with

- Real world conversations are influenced by characteristics and attributes of the speakers
 - No open datasets for analyzing this problem!
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Contributions

1. **New dataset** of goal-oriented dialogs influenced by speaker profiles
 2. Modified **Memory Network architecture** to tackle personalization
 3. Analysis of personalization as a **multi-task learning** problem
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Tasks

Framework to test end-to-end trained dialogue systems in goal oriented conversation (Restaurant reservation)

- Restaurant KB - location, cuisine, price range, rating, etc; queried by API calls
 - User can say something in 4 different ways, bot has a unique way to reply
 - Evaluation based on per-response accuracy (Discriminative models)
-

Hi!

Hello, what can I help you with today?

I'd like to book a table for six people in an expensive price range with British food.

I'm on it!

Where should it be?

In London.

Ok, let me look into some options for you.

```
api_call(British, London, Six, Expensive)
```

Actually i would prefer for four.

Sure. Is there anything else to update?

No.

Ok let me look into some options for you.

```
api_call(British, London, Four, Expensive)
```

```

* The_Place_R_phone The_Place_phone
* The_Place_R_cuisine british
* The_Place_R_address The_Place_address
* The_Place_R_location london
* The_Place_R_availability four
* The_Place_R_price expensive
* The_Place_R_rating 7
* The_Fancy_Pub_R_phone The_Fancy_Pub_phone
* The_Fancy_Pub_R_cuisine british
* The_Fancy_Pub_R_address The_Fancy_Pub_address
* The_Fancy_Pub_R_location london
* The_Fancy_Pub_R_availability four
* The_Fancy_Pub_R_price expensive
* The_Fancy_Pub_R_rating 8

```

What do you think of this option: The_Fancy_Pub

No, I don't like that.

Sure, let me find an other option for you.

What do you think of this option: The_Place

Let's do it!

Great let me do the reservation.

Can you provide me the address?

Here it is: The_Place_address.

You rock!

Is there anything else I can help you with?

No thanks.

You're welcome.

Task 1
Issuing API calls

Task 2
Updating API calls

Task 3
Displaying options

Task 4
Providing extra-information

Task 5 Conducting full dialogs

Full dialog is broken down into subtasks which test crucial skills-

1. Issuing API calls - dialog state tracking
2. Updating API calls - dialog state tracking
3. Displaying options - using KB facts
4. Providing information - using KB facts
5. Conducting a full dialog

Personalized bAbI Dialog Tasks

by altering bot utterance patterns and KB entities

Given a user's profile

in addition to the original goals of the bAbI tasks, the bot must:

1. **Alter speech style based on gender and age**
 - Forming associations between language concepts (formality, precision) and user attributes
 2. **Personalize suggestions based on dietary preferences, favorite food item, etc.**
 - Perform reasoning, ranking and retrieval based on combination of user attributes and variable parameters from conversation history
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User Profile

Gender: **Male**, Age: **Elderly**, Favorite Food Item: **Shepherd's Pie**

User Profile

Gender: **Male**, Age: **Young**, Favorite Food Item: **Fish and Chips**

Hi!

Greetings Sir, what may I assist you with today?

I'd like to book a table for six people in an expensive price range with British food.

I will start the request now.

May I know where the restaurant should be located?

In London.

Excellent Sir, please give me a moment to provide you with options

```
api_call(British, London, Six, Expensive)
```

Actually i would prefer for four.

I will modify your request, is there anything else to change?

No.

Excellent Sir, please give me a moment to provide you with options

```
api_call(British, London, Four, Expensive)
```

```
* The_Place_R_phone The_Place_phone
* The_Place_R_cuisine british
* The_Place_R_address The_Place_address
* The_Place_R_location london
* The_Place_R_availability four
* The_Place_R_price expensive
* The_Place_R_rating 7
* The_Place_R_speciality fish_and_chips
* The_Fancy_Pub_R_phone The_Fancy_Pub_phone
* The_Fancy_Pub_R_cuisine british
* The_Fancy_Pub_R_address The_Fancy_Pub_address
* The_Fancy_Pub_R_location london
* The_Fancy_Pub_R_availability four
* The_Fancy_Pub_R_price expensive
* The_Fancy_Pub_R_rating 8
* The_Fancy_Pub_R_speciality english_breakfast
```

May I suggest this option: The Fancy Pub

No, I don't like that.

Excellent Sir, please give me a moment to provide you with options

May I suggest this option: The Place

Let's do it!

Excellent, I will finalize your request

Can you provide me the address?

Here is the information you asked for: The Place address

You rock!

May I help you in any other way, Sir

No thanks.

It was a pleasure to be of help to you, Sir

Hi!

Hey dude, what's up?!

I'd like to book a table for six people in an expensive price range with British food.

I'm on it!

Where should it be?

In London.

Ok, looking for options

```
api_call(British, London, Six, Expensive)
```

Actually i would prefer for four.

Cool! Anything else you want to update?

No.

Ok, looking for options

```
api_call(British, London, Four, Expensive)
```

```
* The_Place_R_phone The_Place_phone
* The_Place_R_cuisine british
* The_Place_R_address The_Place_address
* The_Place_R_location london
* The_Place_R_availability four
* The_Place_R_price expensive
* The_Place_R_rating 7
* The_Place_R_speciality fish_and_chips
* The_Fancy_Pub_R_phone The_Fancy_Pub_phone
* The_Fancy_Pub_R_cuisine british
* The_Fancy_Pub_R_address The_Fancy_Pub_address
* The_Fancy_Pub_R_location london
* The_Fancy_Pub_R_availability four
* The_Fancy_Pub_R_price expensive
* The_Fancy_Pub_R_rating 8
* The_Fancy_Pub_R_speciality english_breakfast
```

Is this one cool: The Place

No, I don't like that.

Ok, looking for options

Is this one cool: The Fancy Pub

Let's do it!

Cool, its done!

Can you provide me the address?

Here you go: The Fancy Pub address

You rock!

Want anything else?

No thanks.

No problem!

Task 1
Issuing
API calls

Task 2
Updating
API calls

Task 3
Displaying
Options

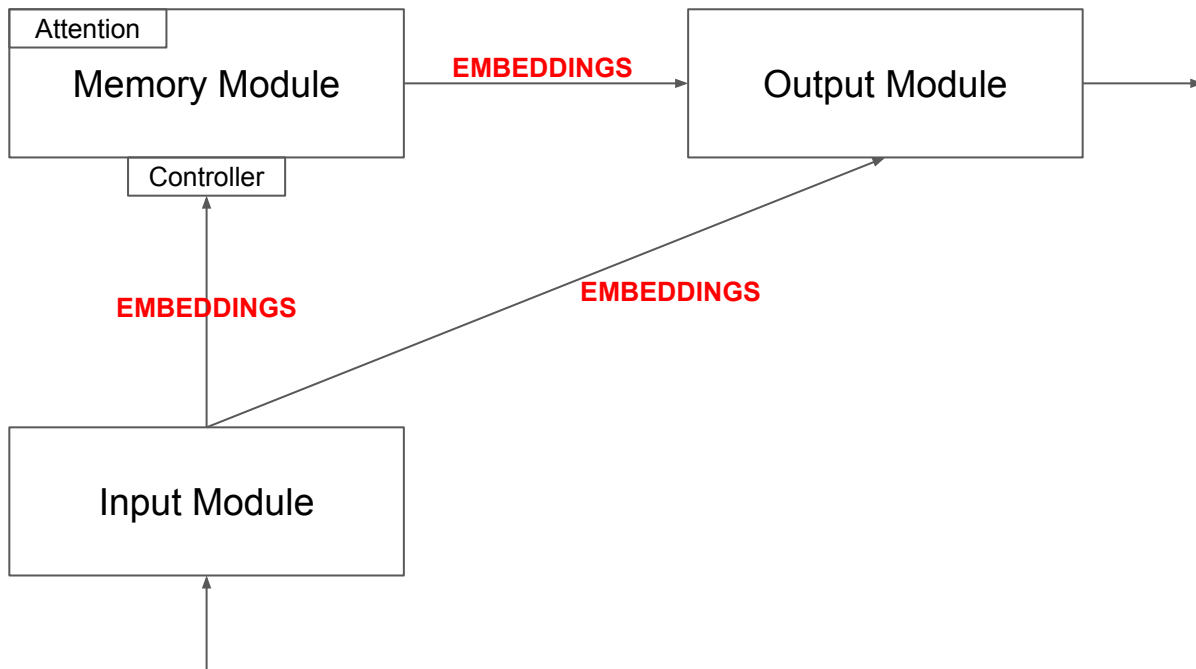
Task 4
Providing
Extra
Information

Task 5 Conducting Full Dialog

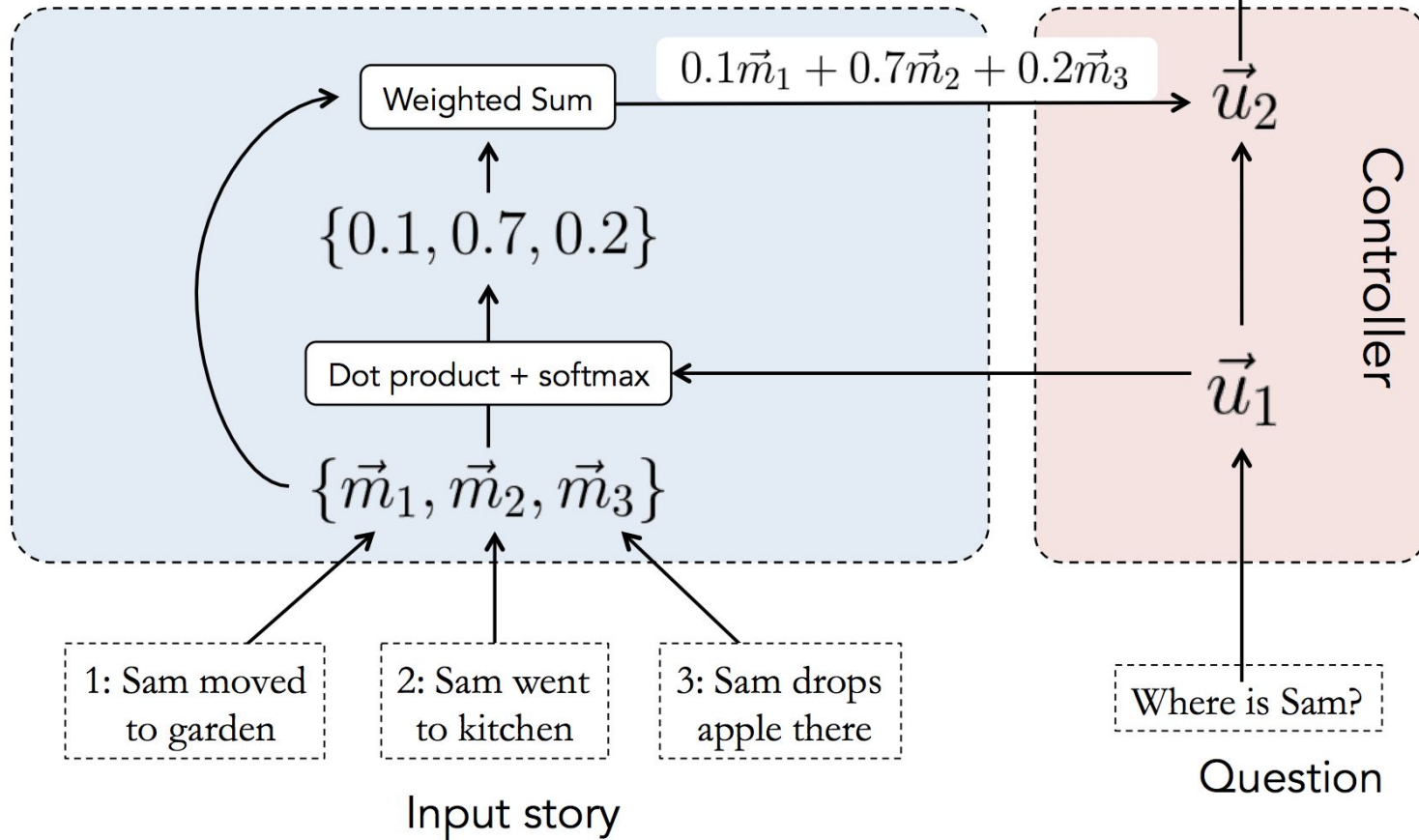
Memory Networks for Dialog

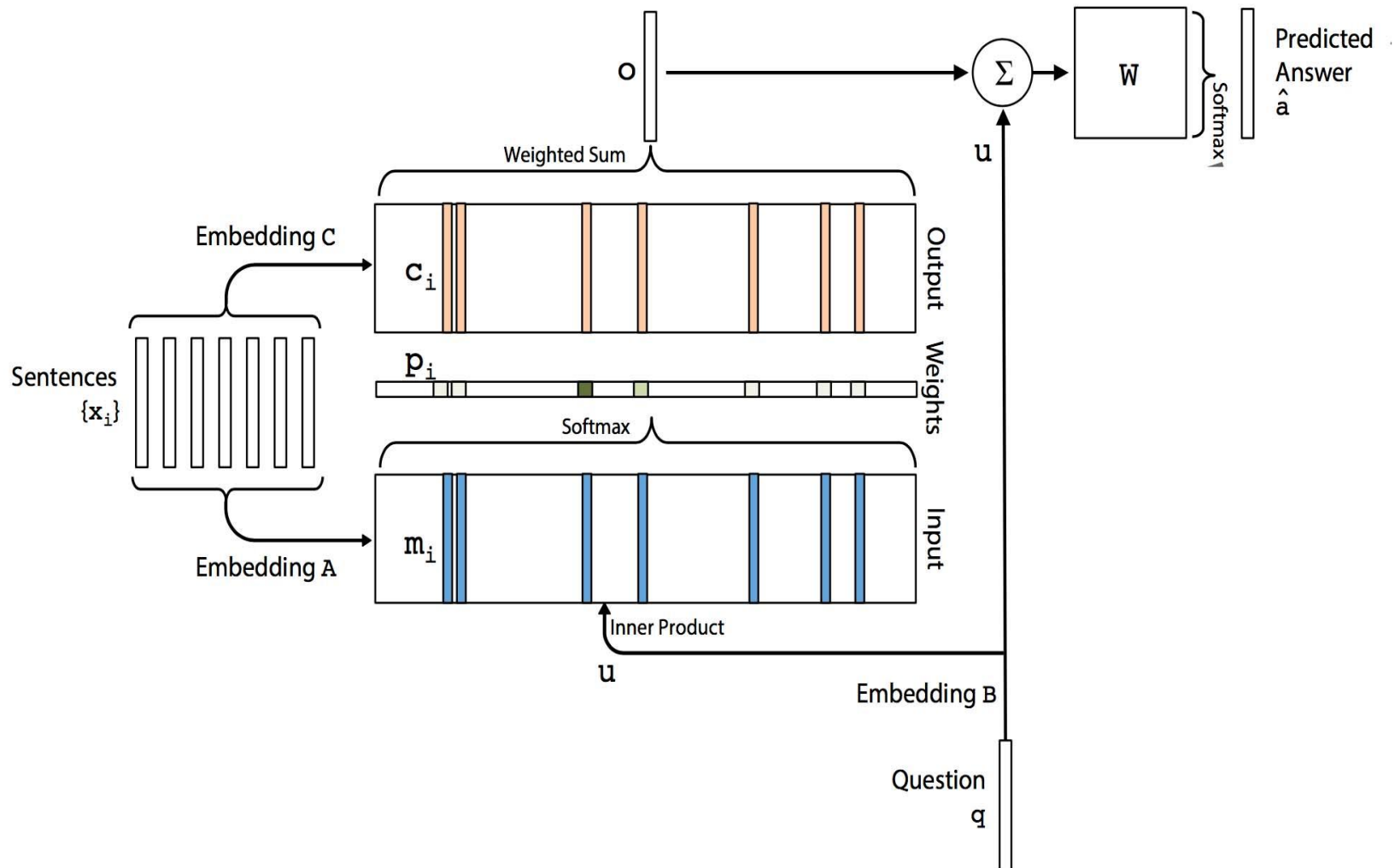
At each turn of dialog, iteratively read from and reason over conversation history to produce a response

Generic Architecture

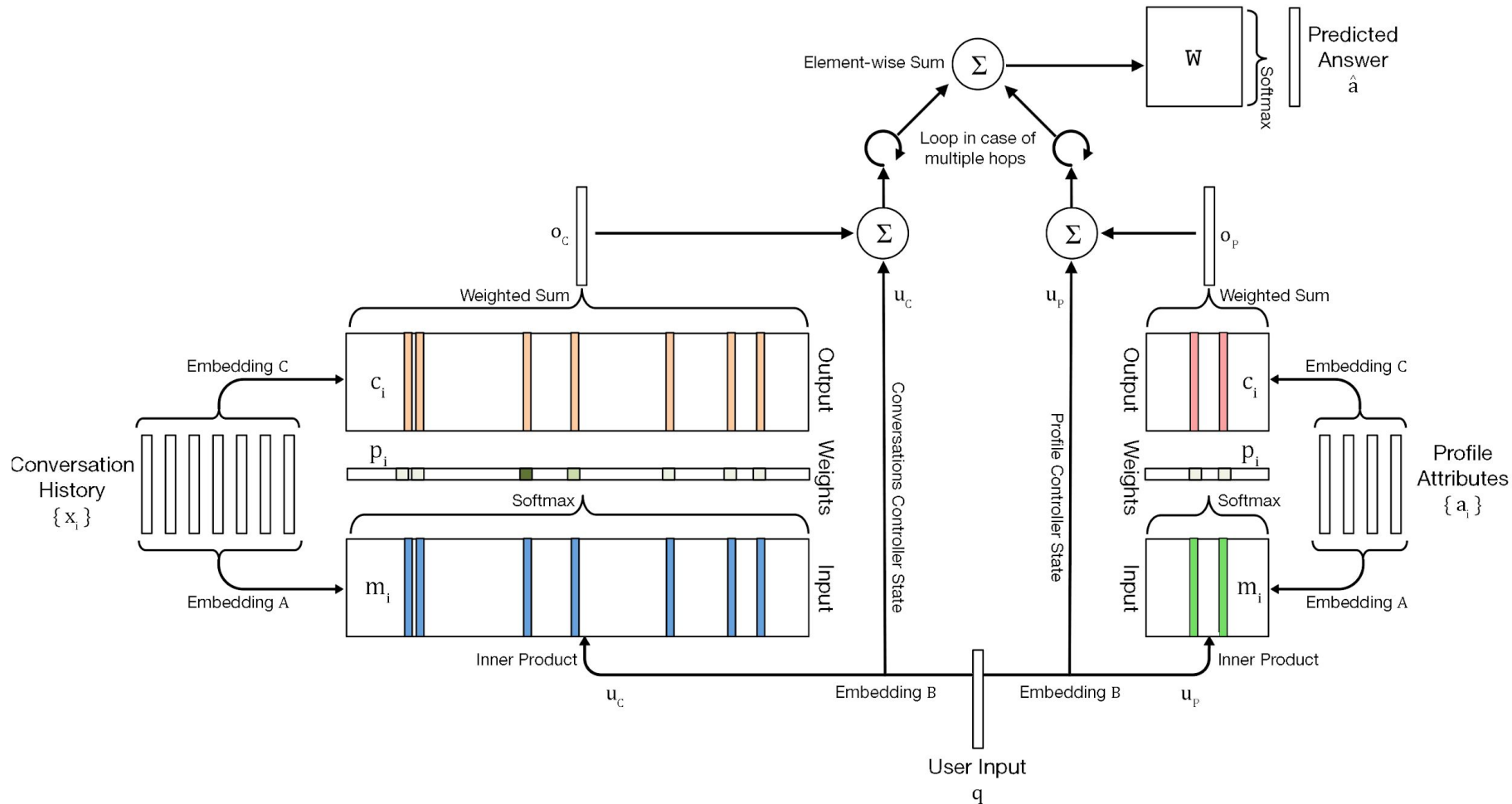


Memory Module





Memory Network
with
Split Memory Architecture



Experimental Results

Per-response accuracy:

Task	Rule-based System	Supervised Embeddings	Memory Networks	
			Standard	Split memory
PT1: Issuing API calls	100	84.37	99.83 (98.87)	85.66 (82.44)
PT2: Updating API calls	100	12.07	99.99 (99.93)	93.42 (91.27)
PT3: Displaying options	100	9.21	58.94 (58.71)	68.60 (68.56)
PT4: Providing information	100	4.76	57.17 (57.17)	57.17 (57.11)
PT5: Full dialog	100	51.6	85.10 (77.74)	87.28 (78.1)

Visualizing Attention

Predictions by standard Memory Networks

Time	Locutor	Dialog History	Hop #1	Hop #2	Hop #3
1		male elderly	0.15	0	0
2	User	hello	0.306	0	0
3	Bot	greetings sir what may i assist you with today	0.008	0	0
4	User	may i have a table in a moderate price range with italian food for eight	0.536	0.999	0
5	Bot	excellent sir i will start the request now	0	0	0.999
User input		<SILENCE>			
Correct answer		may i know where the restaurant should be located			
Predicted answer		may i know where the restaurant should be located			

- Able to use profile information to personalize speech style
-

Time	Locutor	Dialog History	Hop #1	Hop #2	Hop #3
1		female elderly	0.006	0	0
2	User	hi	0.012	0	0
3	Bot	good day madam how could i assist you today	0	0	0
4	User	may i have a table	0.006	0.248	0
5	Bot	thank you madam i shall start the reservation now	0	0	0
6	User	<SILENCE>	0.064	0	0
7	Bot	could you tell me your preference on the type of cuisine	0.001	0	0
8	User	i love french food	0.307	0.103	0
9	Bot	could you tell me where the restaurant should be located	0	0	0
10	User	madrid please	0.265	0.282	0
11	Bot	would you mind telling me how many guests shall be at your table	0	0	0
12	User	for four please	0.225	0.076	0
13	Bot	would you mind telling me your price range	0	0	0
14	User	in a cheap price range please	0.11	0.29	0.999
15	Bot	thank you madam i shall provide you with options shortly	0	0	0
User input		<SILENCE>			
Correct answer		api_call french madrid four cheap			
Predicted answer		api_call french madrid four cheap			

- Able to track dialog state

Time	Locutor	Dialog History	Hop #1	Hop #2	Hop #3
1		female young non-veg pizza	0.0001	0	0
20	User	resto_rome_moderate_italian_8stars_1 R_rating 8	0.0001	0	0
21	User	resto_rome_moderate_italian_8stars_1 R_type veg	0	0	0
22	User	resto_rome_moderate_italian_8stars_1 R_speciality pizza	0	0	0
29	User	resto_rome_moderate_italian_3stars_1 R_location rome	0.879	0.999	0
33	User	resto_rome_moderate_italian_3stars_1 R_type veg	0.0001	0	0
44	User	resto_rome_moderate_italian_2stars_2 R_rating 2	0	0	0
45	User	resto_rome_moderate_italian_2stars_2 R_type non-veg	0.0001	0	0
46	User	resto_rome_moderate_italian_2stars_2 R_speciality pasta	0	0	0
74	User	hi	0	0	0
75	Bot	hey girl how is it going	0	0	0
76	User	may i have a table in rome with italian food in a moderate price range	0	0	0
77	Bot	be right back with your reservation	0	0	0.999
83	Bot	how about this one: resto_rome_moderate_italian_8stars_2	0	0	0
84	User	no i don't like that	0	0	0
85	Bot	sure finding something else	0	0	0
86	User	<SILENCE>	0.0003	0	0
87	Bot	how about this one: resto_rome_moderate_italian_3stars_2	0	0	0
88	User	no i don't like that	0	0	0
89	Bot	sure finding something else	0	0	0
User Input		<SILENCE>			
Correct Answer		how about this one: resto_rome_moderate_italian_8stars_1			
Predicted Answer		what food are you looking for			

- Unable to personalize reasoning/retrieval over KB facts

Split Memory Architecture

➤ Attention to user's profile makes sense

➤ Can interpret facts and context from conversation history

			Profile	Hop #1	Hop #2	Hop #3
			female	0.011	0.571	0
			young	0.017	0.423	0
			non-veg	0.442	0.006	0.999
			pizza	0.53	0	0
Time	Locutor	Dialog History				
19	User	resto_rome_moderate_italian_8stars_1 R_rating 8	0.0001	0	0	
20	User	resto_rome_moderate_italian_8stars_1 R_type veg	0	0	0	
21	User	resto_rome_moderate_italian_8stars_1 R_speciality pizza	0.0002	0	0	
23	User	resto_rome_moderate_italian_8stars_1 R_parking resto_rome_moderate_italian_8stars_1_parking	0.0127	0	0	
31	User	resto_rome_moderate_italian_3stars_1 R_rating 3	0	0	0	
43	User	resto_rome_moderate_italian_2stars_2 R_rating 2	0	0	0	
44	User	resto_rome_moderate_italian_2stars_2 R_type non-veg	0	0	0	
45	User	resto_rome_moderate_italian_2stars_2 R_speciality pasta	0	0	0	
51	User	resto_rome_moderate_italian_2stars_1 R_address resto_rome_moderate_italian_2stars_1_address	0.0184	0	0	
73	User	hi	0.0002	0	0	
74	Bot	hey girl how is it going	0.0006	0	0	
75	User	may i have a table in rome with italian food in a moderate price range	0.0022	0	0	
80	Bot	sure finding some options	0.0002	0.0002	0.999	
81	User	<SILENCE>	0.0008	0	0	
82	Bot	how about this one: resto_rome_moderate_italian_8stars_2	0.3872	0.003	0	
83	User	no i don't like that	0	0	0	
84	Bot	sure finding something else	0.0001	0	0	
85	User	<SILENCE>	0.001	0	0	
86	Bot	how about this one: resto_rome_moderate_italian_3stars_2	0.4834	0.9968	0	
87	User	no i don't like that	0	0	0	
88	Bot	sure finding something else	0.0001	0	0	
User Input		<SILENCE>				
Correct Answer		how about this one: resto_rome_moderate_italian_8stars_1				
Predicted Answer		how about this one: resto_parisCheap_italian_2stars_1				

[https://github.com/chaitjo/
personalized-dialog](https://github.com/chaitjo/personalized-dialog)

What's next

Dataset

Models

Evaluation

Thank you!

Questions?

Contact me



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