

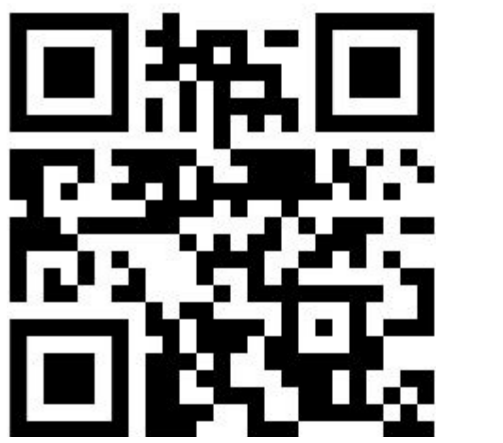
Modeling Multi-Action Policy for Task-Oriented Dialogues



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Motivation

Dialogue act plays a key role in the quality and efficiency of the interaction with the user in a dialogue system.

Most existing policy engines predict a **single act**. It limits what an agent can do in a turn, leads to long dialogues, makes state tracking harder, and challenges users' patience.

We propose to use **multiple acts** per turn to mitigate these problems and increase expressivity.

User message | Hi! I'm looking for a good thriller. Are there any playing?

Agent message | Yes, there are! The Witch, The Other Side of the Door, and The Boy are all thrillers. Would you like to find tickets for a showing of any of them?

Agent acts | `inform(moviename = The Witch, The Other Side of the Door, The Boy; genre = thriller), multiple_choice(moviename)`

Multi-act prediction can be casted as a **multi-label classification** or as a **sequence generation** task.

We propose to generate a **sequence of tuples (continue, act, slots)** to reduce the steps of recursion and enforce consistency of the output, and new recurrent cell **gCAS** to decode it.

annotation | `inform(moviename = The Witch, The Other Side of the Door, The Boy; genre = thriller), multiple_choice(moviename)`

classification | { Inform+moviename, inform+genre, multiple_choice+moviename }

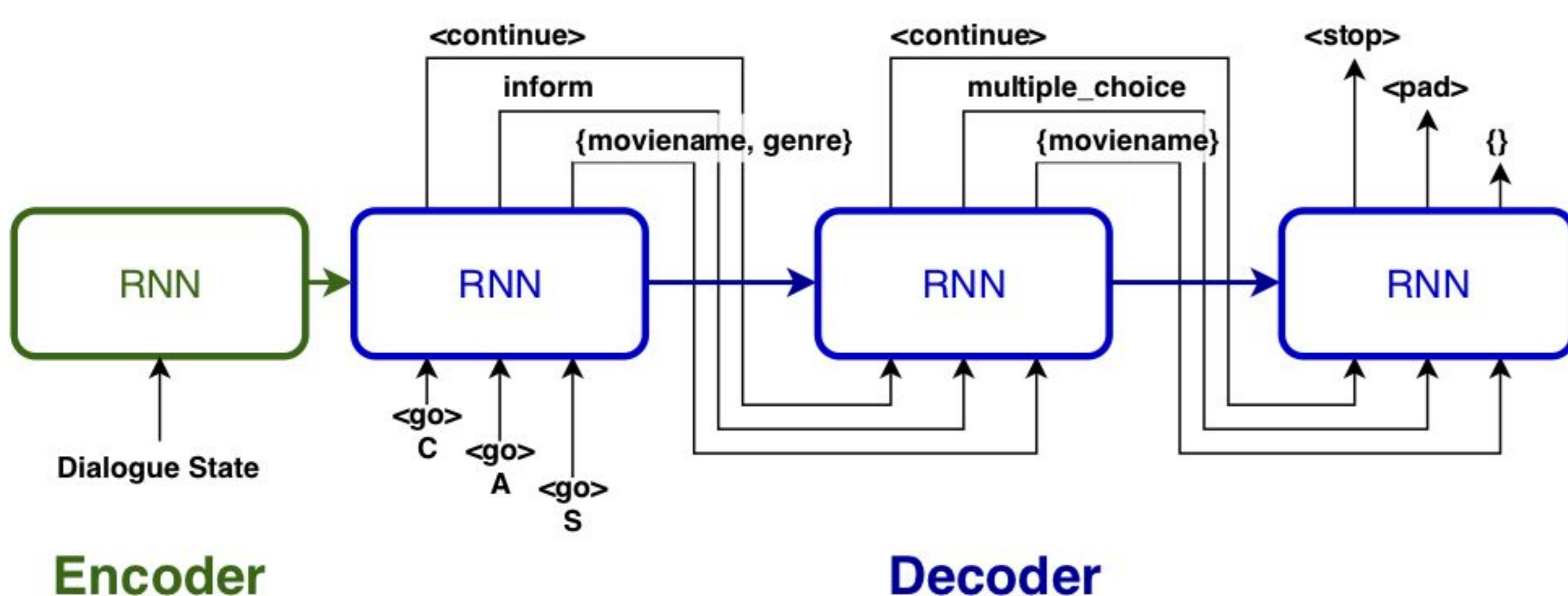
sequence | [inform, (, moviename, =, :, genre, =,), multiple_choice, (, moviename,), EOS]

cas sequence | [(CONTINUE, inform, {moviename, genre}), (CONTINUE, multiple_choice, moviename), (STOP, PAD, {})]

Model

Input: dialogue state and database query result.

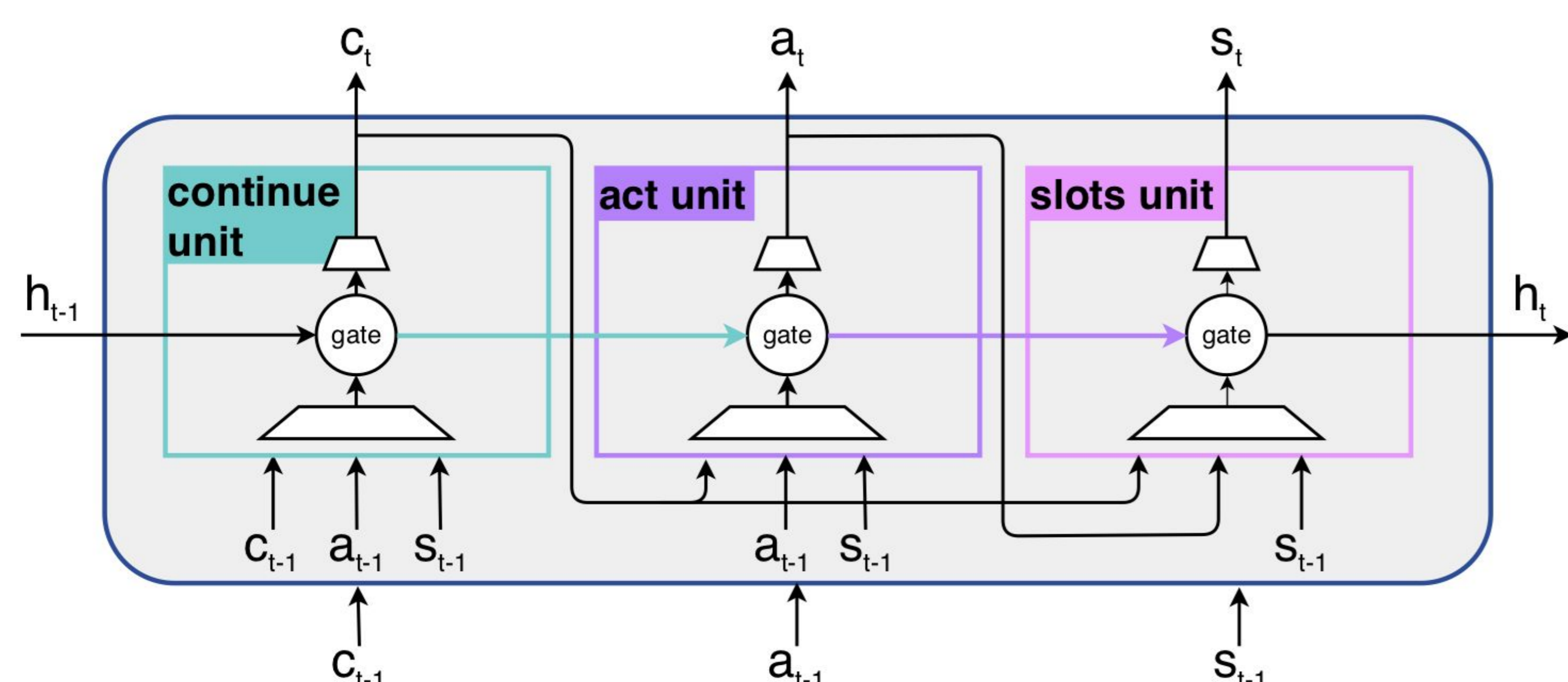
Output: a sequence of tuples (**continue, act, slots**).



Encoder

Decoder

gated Continue Act Slots recurrent cell



Dataset

Microsoft Dialogue Challenge dataset

domain	total	train	valid	test	acts	slots	pairs
movie	2888	1445	433	1010	11	29	90
taxi	3093	1548	463	1082	11	23	63
restaurant	4101	2051	615	1435	11	31	91

About **23%** of dialogue turns are annotated with **multiple acts**.

domain / speaker	1 act	2acts	3 acts	4 acts
movie user	9130	1275	106	11
movie agent	5078	4982	527	33
taxi user	10544	762	50	8
taxi agent	7855	3301	200	8
restaurant user	12726	1672	100	3
restaurant agent	10333	3755	403	10

Experimental Results

Classification	Entity F ₁			Success F ₁		
	movie	taxi	restaurant	movie	taxi	restaurant
Seq2Seq	34.02	49.71	28.23	70.41	84.45	39.97
Seq2Seq+copy	39.95	63.12	60.21	77.82	75.09	55.70
CAS	28.04	62.95	59.14	77.59	74.58	58.74
gCAS	48.02	59.16	54.70	76.81	78.89	65.18
gCAS	50.86	64.00	60.35	77.95	81.17	71.52

Dialogue level results. **gCAS** most performant on % domains.

Act	movie			taxi			restaurant		
	P	R	F ₁	P	R	F ₁	P	R	F ₁
Classification	84.19	50.24	62.93	92.20	55.48	69.27	79.71	33.94	47.60
Seq2Seq	73.44	73.62	73.53	77.52	69.29	73.17	65.66	66.01	65.83
Seq2Seq+copy	67.56	73.61	70.46	73.99	69.21	71.52	64.93	65.69	65.31
CAS	70.46	76.08	73.16	79.85	72.54	76.02	65.40	72.43	68.73
gCAS	73.08	75.78	74.41	79.47	75.39	77.37	68.30	74.39	71.22

Frame	movie			taxi			restaurant		
	P	R	F ₁	P	R	F ₁	P	R	F ₁
Classification	63.91	18.39	28.56	65.87	44.31	52.98	49.63	12.32	19.74
Seq2Seq	42.88	24.81	31.43	57.12	50.32	53.51	39.97	25.40	31.06
Seq2Seq+copy	41.90	23.12	29.80	51.66	50.23	50.93	36.95	27.22	31.35
CAS	43.12	31.60	36.47	51.66	54.29	52.94	36.96	25.45	29.01
gCAS	42.24	35.50	38.58	53.77	56.24	54.98	36.86	32.41	34.49

Turn level results. **gCAS** most performant in all domains.

	Example 1	Example 2
ground truth	request (date; starttime)	inform(restaurantname=; starttime=), multipl_choice(restaurantname)
classification	{ request+date }	{ }
Seq2Seq	[request, (, date, :, starttime,)]	[inform, (, restaurantname, =,), multiple_choice, =, restaurantnsme,)]
Seq2Seq+copy	[request, (, date, =,)]	[inform, (, restaurantname, =, :, :, =, :, starttime, =,)]
CAS	[(request, {})]	[(inform, {restaurantname})]
gCAS	[(request {date; starttime})]	[(inform, {restaurantname}), (multiple_choice, {restaurantname})]