Semantic Parsing with Dual Learning

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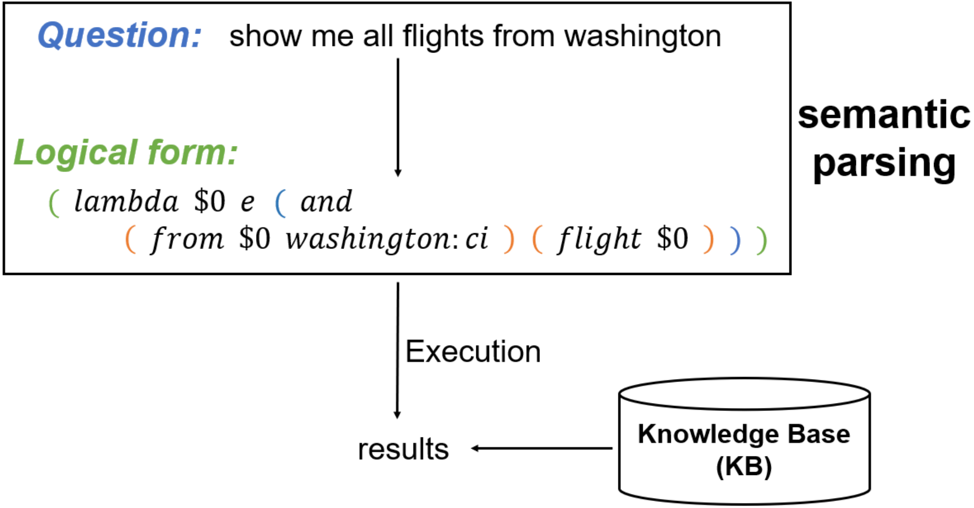
Outline

What is Semantic Parsing



- Semantic annotation is labor-intensive and time-consuming

Question:

which players played more games than *kobe bryant* the seasons he played

Logical form:

(*call SW.listValue* (*call SW.getProperty* ((*lambda s* (*call SW.filter* (*var s*) (*call SW.ensureNumericProperty* (*string num_games_played*)) (*string* >) (*call SW.ensureNumericEntity* (*call SW.getProperty* (*call SW.getProperty en.player.kobe_bryant* (*call SW.reverse* (*string player*))) (*string num_games_played*))))) (*call SW.domain* (*string player*))) (*string player*)))

Figure: Training example from dataset OVERNIGHT

Bottlenecks 2: constrained decoding

- Output space should be strictly constrained

Question:

show me all flights from washington

Correct logical form:

(*lambda* \$0 *e* (*and* (*from* \$0 *washington:ci*) (*flight* \$0)))

Error at structure level:

missing parentheses

(*lambda* \$0 *e* (*and* (*from* \$0 *washington:ci* ✖ (*flight* \$0)))

Error at semantic level:

not type flight

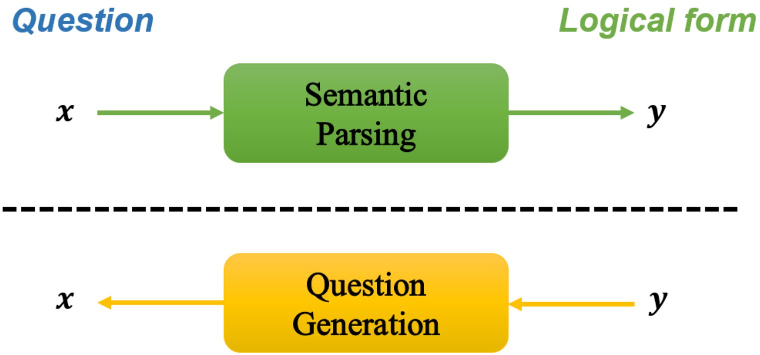
(*lambda* \$0 *e* (*and* (*from* *washington:ci* \$0) (*flight* \$0)))

Outline

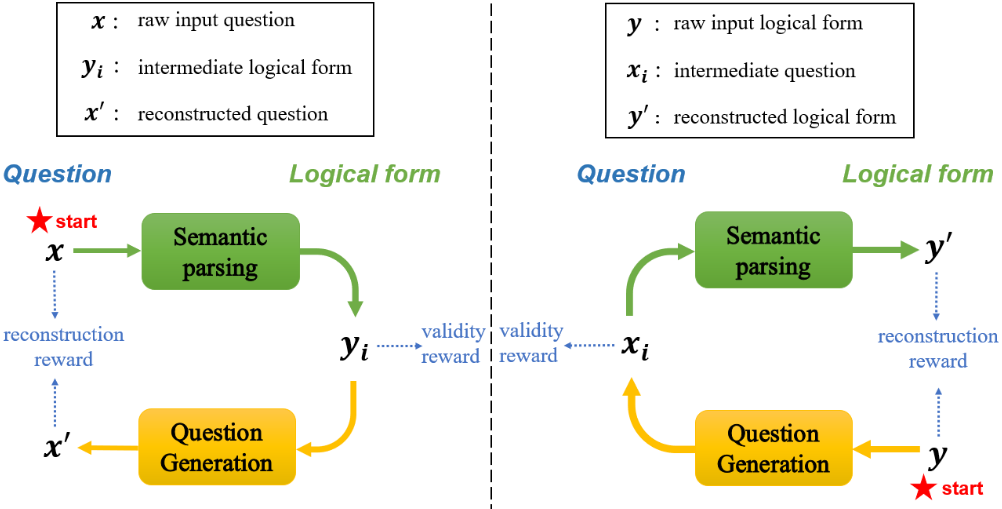
Our method: Overview

$\boldsymbol{x}$: show me all flights from washington

$\boldsymbol{y}$: (*lambda* \$0 *e* (*and* (*from* \$0 *washington:ci*) (*flight* \$0)))



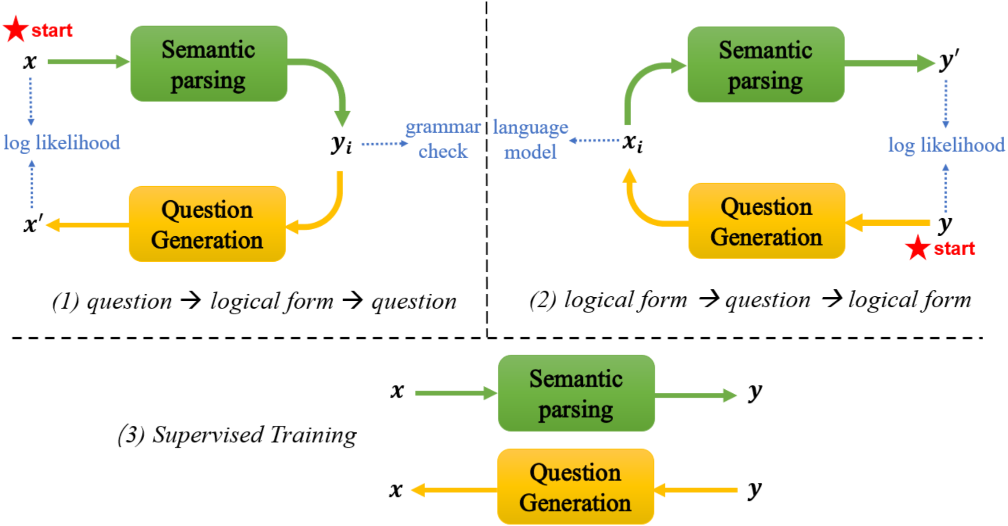
Our method: Overview



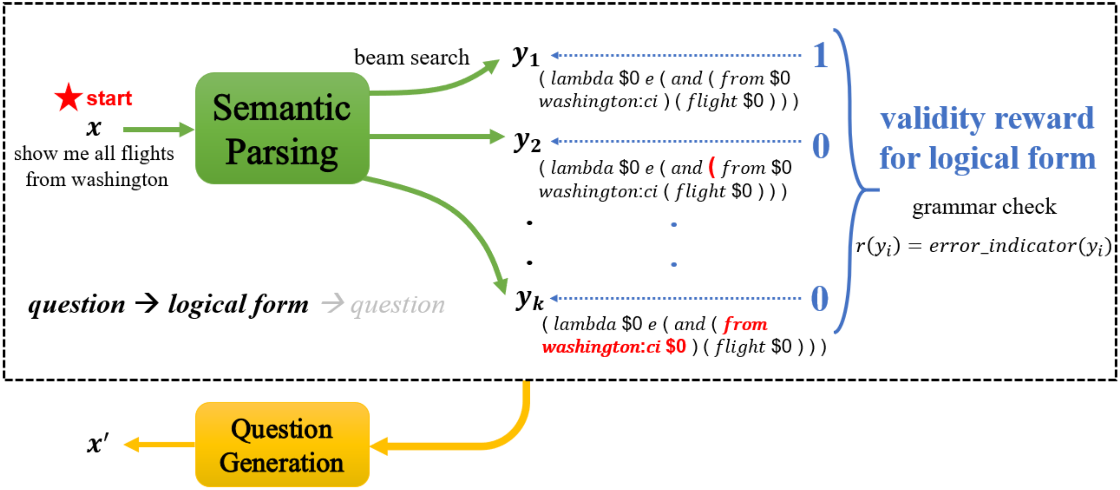
(a) *question → logical form → question*

(b) *logical form → question → logical form*

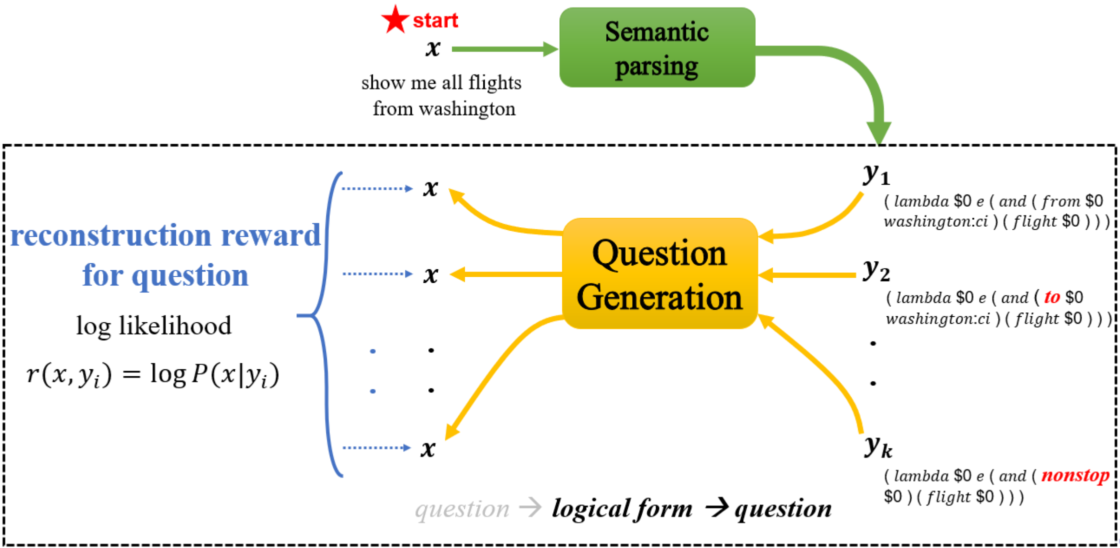
Training Procedure: 3 stages



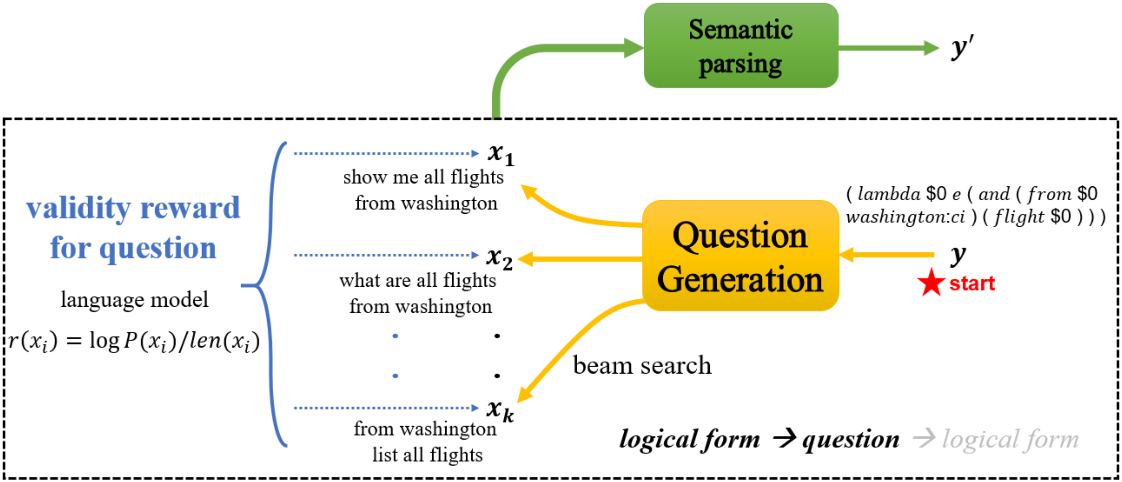
1. loop starts from question



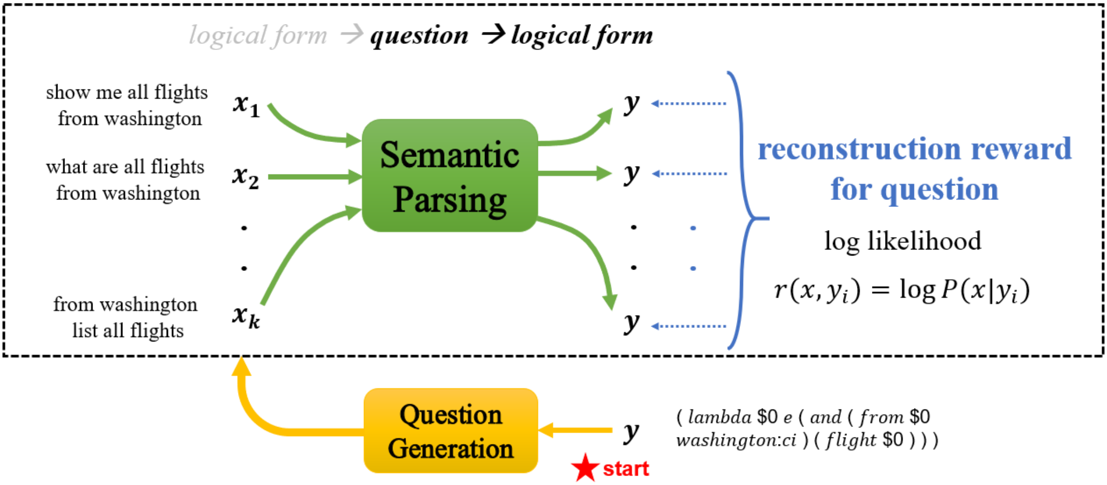
1. loop starts from question



2. loop starts from logical form



2. loop starts from logical form



Outline

Introduction and Motivation

Dual Learning Framework for Semantic Parsing

Experimental Results

Conclusion

Synthesize more logical forms

- Sampling and modification based on ontology (4592 more logical forms for ATIS)

1. (lambda $0 e (and (flight $0) (class_type $0 **first:cl**) (from $0 ci0) (to $0 ci1)))
2. (lambda $0 e (and (flight $0) (**oneway** $0) (from $0 ci0) (to $0 ci1)))

↓ secification D

first:cl.type = **coach:cl**.type

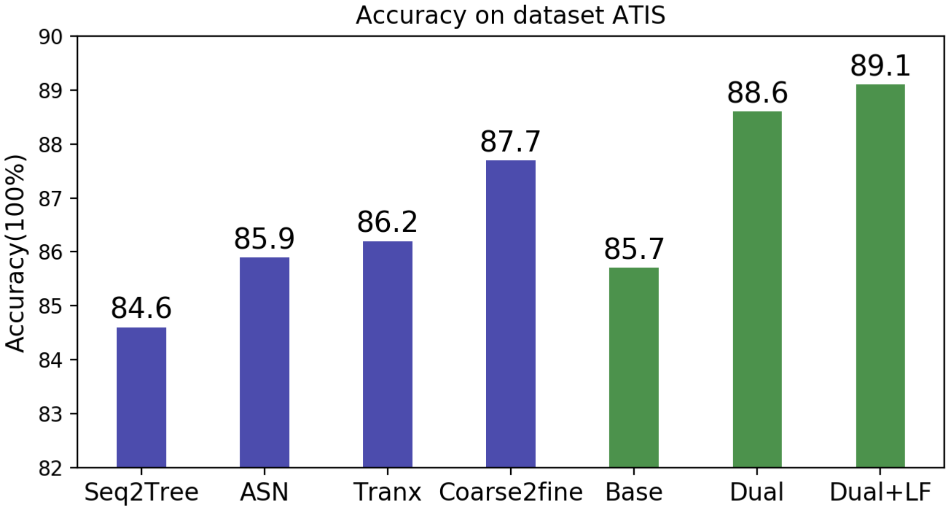
one_way.args0 = **round_trip**.args0

↓ entity/predicate replacement

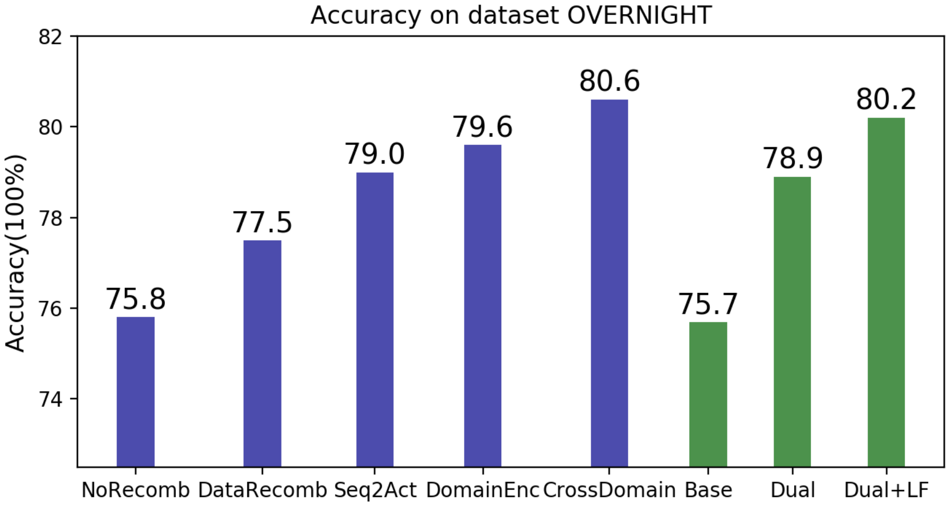
1. (lambda $0 e (and (flight $0) (class_type $0 **coach:cl**) (from $0 ci0) (to $0 ci1)))
2. (lambda $0 e (and (flight $0) (**round_trip** $0) (from $0 ci0) (to $0 ci1)))

- Directly revise grammar rules on OVERNIGHT (500 more logical forms on avg)

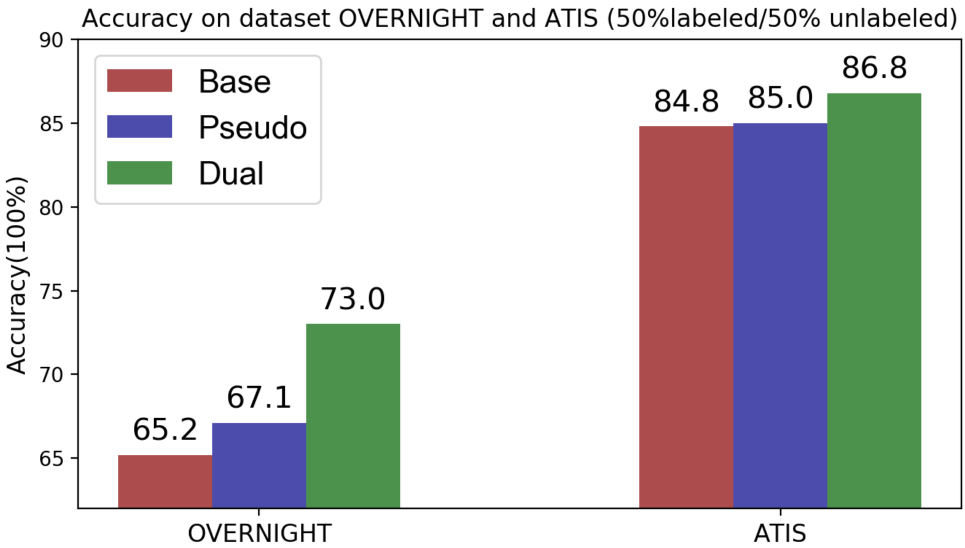
Results: ATIS



Results: OVERNIGHT



Semi-supervised experiment: 50%labeled/50%unlabeled



Outline

Conclusion

Core idea

Leverage query generation model and obtain effective feedback signals to enhance the semantic parsing process.

- Semantic parsing framework based on dual learning algorithm
- Utilize both labeled and unlabeled samples
- Implicit constraint signal incorporated into reward

Thanks & QA

References I

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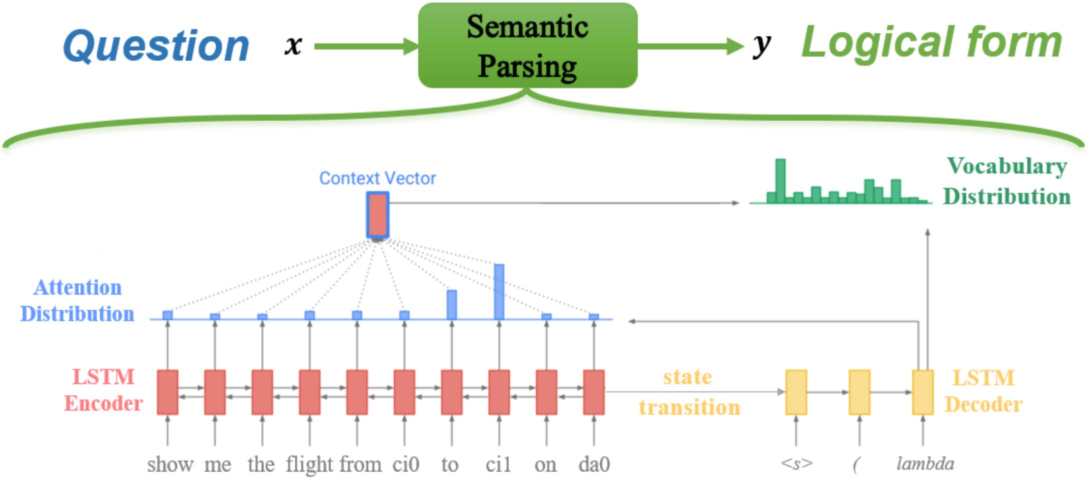
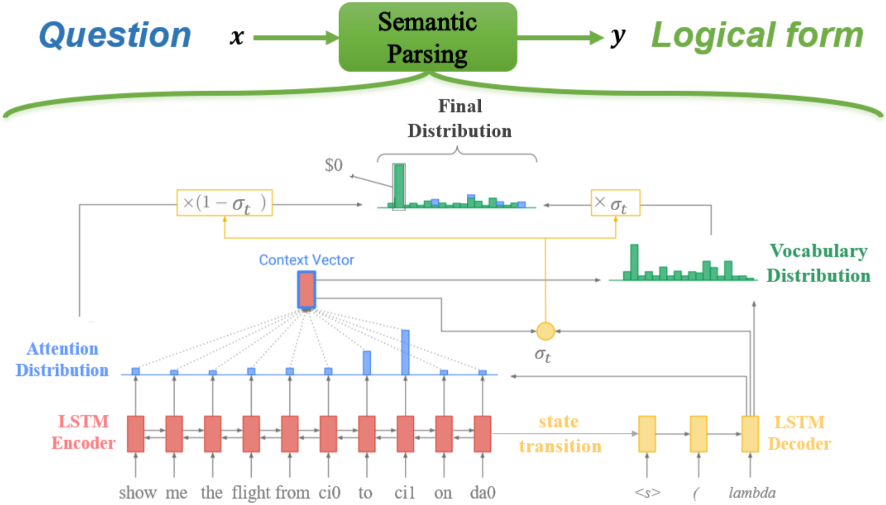
Baseline Model: Att



Baseline Model: AttPtr

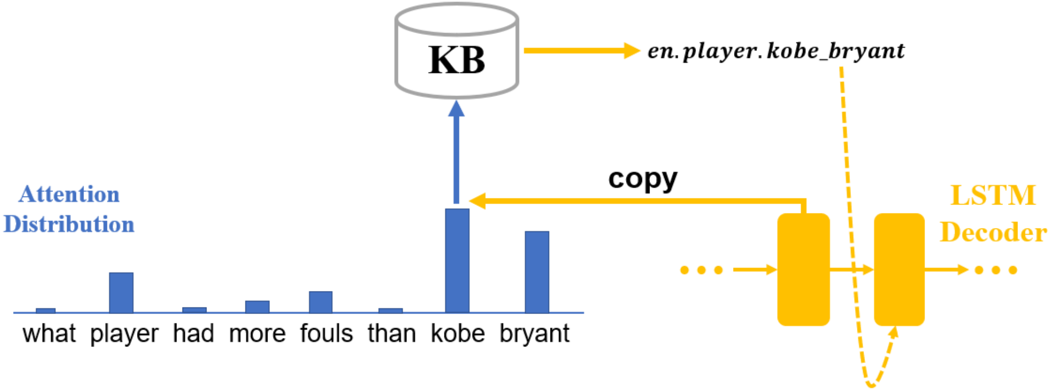


Semantic Parsing (Entity Mapping)

- Entities are identified by Universal Resource Identifier(URI) in Knowledge Base(KB)

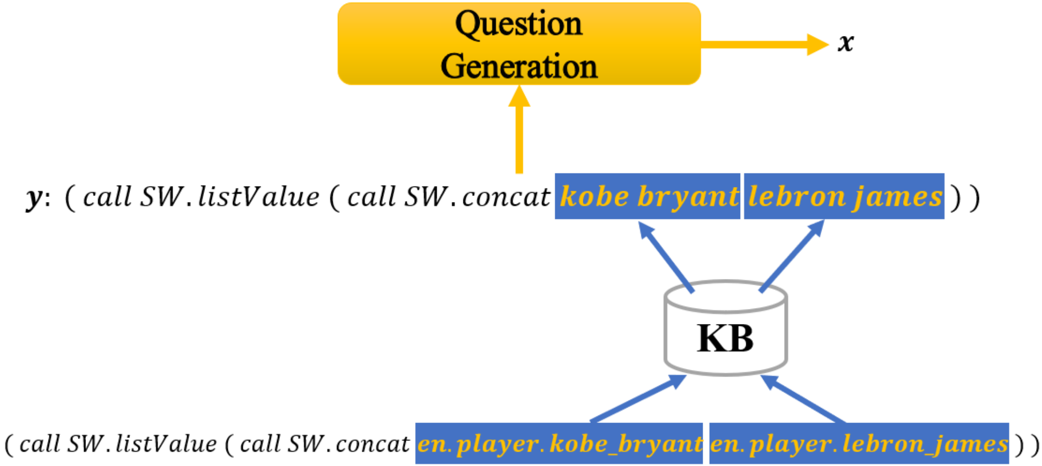
$$kobe\ bryant \longrightarrow en.player.kobe\_bryant$$

- After copying, map words to corresponding URI

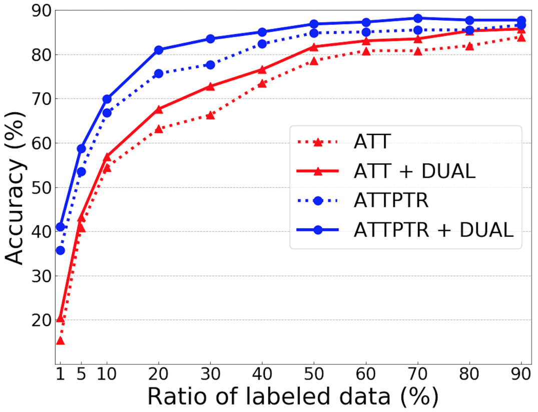


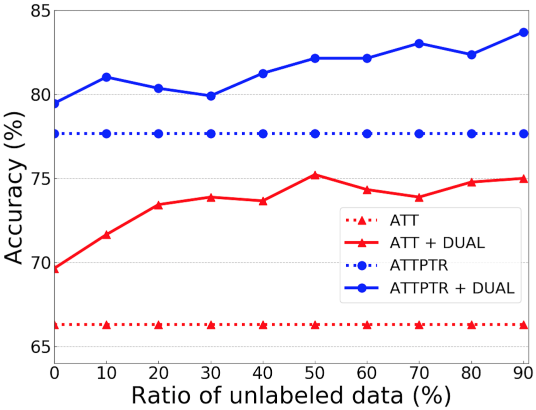
uestion Generation (Reverse Entity Mapping)

- Reversely map KB entity to possible noun phrase before QG



Semi-supervised: vary ratio between labeled and unlabeled data





- unlabeled data = train set - labeled data
- labeled data = 30%, fixed

Different choice for logical form validity reward

Method	Validity	ATIS	OVERNIGHT
ATT	LM_{lf}	80.6	71.5
+ DUAL	grammar check	**81.7**	**72.9**
ATTPTR	LM_{lf}	86.2	71.4
+ DUAL	grammar check	**86.8**	**73.0**

- labeled data = 50%, unlabeled data = 50%
- LM_{lf} means using a logical form language model for validity reward
- "grammar check" means using the structure and semantic check