

Used approach: EditSQL (<https://github.com/ryanzhumich/editsql>)

Successfully working for the following SQL operations:

- SELECT
- ORDER BY (with LIMIT & DESC)
- GROUP BY
- COUNT
- MIN, MAX, AVERAGE
- JOIN
- BETWEEN
- WHERE (column name only)

Sample questions and predictions:

Good predictions:

Q: Which employee in the hospital gets paid the most ?

Prediction:

```
select employee.* order_by employee.salary desc limit_value
```

Q: What is the maximum and minimum salary in the hospital ?

Prediction:

```
select max ( employee.salary ) , min ( employee.salary )
```

Q: Which patient has the maximum number of visitors ?

Prediction:

```
select patient.* group_by visitor.rid order_by count ( visitor.* ) desc  
limit_value
```

Q: How many employees in the hospital are male and older than 65 ?

Prediction:

```
select count ( employee.* ) where people.sex = value and people.age >  
value
```

Q: How many employees for each salary ?

Prediction:

```
select count ( employee.* ) , employee.salary group_by employee.salary
```

Some partially correct predictions:

Q: Which patient spent most on medicines ?

```
select patient.* group_by prescription.pid order_by count ( patient.* )  
desc limit_value
```

Q: Which room accommodates the patient who has the maximum spending on medication ?

```
select patient.* where medical_history.symptoms = value order_by  
prescription.price desc limit_value _EOS
```

Q: What are the different types of nurses and doctors in the hospital

```
select distinct nurse.type
```

[Link to demo video](#)

Query Distribution

SQL Clauses	Working Queries	Total Queries
Order By	6	10
Group By	4	5
Aggregate functions (max, min, count, sum)	15	17
Where	11	17
JOIN	4	8
Between	2	2

Total Queries: 35

Wrong Queries: 9

Queries with "WHERE" clauses also work successfully in case of other datasets like ATIS and WIKISQL. Some state of the art models(for WikiSQL) like SQLNet and SyntaxSQL make use of sequence to sequence models. They employ sequence-to-set prediction using column attention. The basic intuition behind this approach is that the column names appearing in the WHERE clause constitute a subset of the full set of all column names.

SQLNet first predicts the set of columns that appear in WHERE clause as explained above and then for each column it generates OP and VALUE slots. For each column in the WHERE clause, predicting the value of its OP slot is a 3 way classification: the model needs to choose from {=,>,<}. And for the VALUE slot, they predict a substring from the natural language question. To this end, SQLNet employs a sequence to sequence structure to generate the substring. Since order of the tokens in the VALUE slot matters, using a seq2seq structure is reasonable.

Thus, instead of generating a sequence of column names, prediction based on interest can be done. This approach of column attention is difficult to apply in the case of the EDITSQL model as it uses a contextual knowledge based architecture to handle the task of conversion from text to SQL query on SPIDER dataset.

As of now, this model cannot predict the value after the WHERE clause. For example, the question: `How many doctors have speciality in neurology?` gives the correct prediction:

```
select count ( doctor.* ) where doctor.specialty = value
```

except for the value after the WHERE clause where it should say `neurology` but for now a default placeholder `value` is placed instead.

Due to lack of research to solve this problem there are not many ways to accurately predict the value. However, there is a method that works. The AllenNLP team has created a system that successfully predicts the entire SQL query, including the values for WHERE. (<https://demo.allennlp.org/atis-parser/MTM3MTcyNg==>). For now it works only for the ATIS dataset and further work will have to be done to make it work for a custom dataset. We chose EditSQL since it works for custom datasets.

Questions tested on EditSQL:-

"1. ""What are all the nurses ?"

0.9933302847305185

"select nurse.* _EOS"

"=====

"2. ""How many are there ?"

0.9977167800796195

"select count (nurse.*) _EOS"

"=====

"3. ""What is the maximum and minimum salary in the hospital ?"
0.999761600512147
"select max (employee.salary) , min (employee.salary) _EOS"
"=====

"4. ""What about their average salary ?"
0.9999699983709099
"select avg (employee.salary) _EOS"
"=====

"5. ""How many employees for each salary ?"
0.9679222291327823
"select count (employee.*) , employee.salary group_by employee.salary _EOS"
"=====

"6. ""Which patient spent most on medicines ?"
0.7698613487803726
"select patient.* group_by prescription.pid order_by count (patient.*) desc limit_value _EOS"
"=====

"7. ""Which employee in the hospital gets paid the most ?"
0.7094532335007732
"select employee.* order_by employee.salary desc limit_value _EOS"
"=====

"8. ""Which employee in the hospital gets paid the least ?"
0.7997315331989011
"select employee.* order_by employee.salary limit_value _EOS"
"=====

"9. ""Show employees in the hospital get paid the most and who gets paid the least ?"
0.5278628387010039
"select people.name order_by employee.salary desc limit_value _EOS"
"=====

"10. ""How many rooms are occupied ?"
0.2156353696428503
"select count (room.*) where people.sex = value _EOS"
"=====

"11. ""Who are all the patients with age between 18 to 45 ?"
0.9994203116556736
"select patient.* where people.age between value and value _EOS"
"=====

"12. ""What is the total number of such patients ?"
0.9863614891584631
"select count (patient.*) where people.age between value and value _EOS"
"=====

"13. ""Which patient has the maximum number of visitors ?"
0.42895334748664327
"select patient.* group_by visitor.rid order_by count (visitor.*) desc limit_value _EOS"
"=====

"14. ""Doctors having speciality in neurology ?"

0.35126384092655744

"select doctor.* where medical_history.symptoms = value _EOS"

"=====

"15. ""What is the average duration of patients ?"

0.8993817434994821

"select avg (patient.date_discharged) where medical_history.symptoms = value _EOS"

"=====

"16. ""Which floor has the maximum patients who show symptoms of mental illness ?"

0.3185333978636325

"select patient.* where people.phone_num = value _EOS"

"=====

"17. ""How many patients have the symptoms of cold ?"

0.5203722104907204

"select count (*) where medical_history.symptoms = value _EOS"

"=====

"18. ""Which room accommodates the patient who has the maximum spending on medication ?"

0.39752315562465723

"select patient.* where medical_history.symptoms = value order_by prescription.price desc limit_value _EOS"

"=====

"19. ""What are the symptoms of the patient with maximum medicine cost ?"

0.3270190773724598

"select medical_history.symptoms where medical_history.symptoms = value order_by prescription.price desc limit_value _EOS"

"=====

"20. ""What are the previous illnesses for every person who is not discharged ?"

0.2133685170585741

"select medical_history.past_illness where patient.date_discharged not in (select medical_history.pid) _EOS"

"=====

"21. ""How many doctors have speciality in neurology ?"

0.9457749593578206

"select count (doctor.*) where doctor.specialty = value _EOS"

"=====

"22. ""How many employees in the hospital are male and older than 65 ?"

0.8330978922805048

"select count (employee.*) where people.sex = value and people.age > value _EOS"

"=====

"23. ""Show the most occuring reasons visitors give for visiting the hospital ?"

0.7572535697119561

"select visitor.reason order_by visitor.reason desc limit_value _EOS"

"=====

"24. ""What is the total price multiplied by quantity of the medicines at the hospital ?"
0.6033106521837978
"select sum (prescription.price) group_by prescription.pid _EOS"
"=====

"25. ""Fetch all the records of patients having dengue from all the tables"
0.7745274447587454
"select medical_history.* where medical_history.symptoms = value _EOS"
"=====

"26. ""Fetch all the records of patients having dengue from all the tables"
0.7745274447587454
"select medical_history.* where medical_history.symptoms = value _EOS"
"=====

"27. ""How many different floors are there in the hospital ?"
0.9994584936652784
"select count (distinct room.floor) _EOS"
"=====

"28. ""What are the five most common illnesses in the hospital ?"
0.9660730984976001
"select medical_history.past_illness order_by medical_history.symptoms desc limit_value
_EOS"
"=====

"29. ""What are the different types of nurses and doctors in the hospital ?"
0.7095632938766563
"select distinct nurse.type _EOS"
"=====

"30. ""What are the most common types of medicines ? ?"
0.9637026476073963
"select prescription.med_code group_by prescription.med_code order_by count (prescription.*) desc limit_value _EOS"
"=====

"31. ""Show all available information of doctors and receptionists at the hospital ?"
0.8663732204873911
"select * where people.name = value _EOS"
"=====

"32. ""All the visitors visited which all patients during their visit ?"
0.6886331466976046
"select * _EOS"
"=====

"33. ""How many employees use gmail as their email ?"
0.9998317964207918
"select count (employee.*) where employee.email = value _EOS"
"=====

"34. ""What are all the airports ?"
0.9986945997633896
"select airports.* _EOS"
"=====

"35. ""Of these , how many are from Athens ?"

0.605529339826259

"select count (airports.*) where airports.airportcode = value _EOS"

"=====

Points to note:

- Bold questions are the ones having errors in SQL query.
- The JOIN operation is denoted by a "." (dot). The JOIN keyword is not present but multiple tables can be accessed in the form of table.column. Thus, in essence the queries requiring JOIN will work.

Examples of JOIN Query:

1. ""Which patient spent most on medicines ?"

0.7698613487803726

"select patient.* group_by prescription.pid order_by count (patient.*) desc limit_value _EOS"

"=====

2. ""Show employees in the hospital get paid the most and who gets paid the least ?"

0.5278628387010039

"select people.name order_by employee.salary desc limit_value _EOS"

"=====

3. ""Who are all the patients with age between 18 to 45 ?"

0.9994203116556736

"select patient.* where people.age between value and value _EOS"

"=====

4. ""What is the total number of such patients ?"

0.9863614891584631

"select count (patient.*) where people.age between value and value _EOS"

"=====

5. ""Which floor has the maximum patients who show symptoms of mental illness ?"

0.3185333978636325

"select patient.* where people.phone_num = value _EOS"

"=====

6. ""Which room accommodates the patient who has the maximum spending on medication ?"

0.39752315562465723

"select patient.* where medical_history.symptoms = value order_by prescription.price desc limit_value _EOS"

"=====

7. ""What are the symptoms of the patient with maximum medicine cost ?"

0.3270190773724598

"select medical_history.symptoms where medical_history.symptoms = value order_by prescription.price desc limit_value _EOS"

"=====

8. ""What are the previous illnesses for every person who is not discharged ?"

0.2133685170585741

"select medical_history.past_illness where patient.date_discharged not in (select
medical_history.pid) _EOS"