

# GRewriter: Practical Query Rewriting with Automatic Ruleset Expansion in GaussDB

## (Appendix)

### ABSTRACT

This document contains the appendix of VLDB'25 industrial track submission #2123. Section 1 presents the proof of the theorem about rule verification in the paper. Section 2 describes the G-DSL in detail. Section 3 lists the rewrite rules discovered by our work.

### 1 PROOF THE VERIFICATION ALGORITHM

This section provides the detailed proof of the following theorem in the paper, which enables us to prove rules by proving concrete SQL query pairs via existing verifiers, such as SQLSolver [1].

**THEOREM 1.1.** *For each enumerated rewrite rule, if each representative pair of queries is equivalent, the rule is correct.*

Before proving the above theorem, we will first prove several lemmas, which are required to prove the theorem. Then, we will present the proof of the theorem.

**LEMMA 1.2.** *For each non-representative pair of queries  $p_1$ , it always belong to one of the following cases: 1)  $p_1$  is the same as some representative pair of queries  $p_2$  after renaming its attributes and tables. 2)  $p_1$  is almost the same as some representative pair of queries  $p_2$  after renaming its attributes and tables except for expressions and schemas. Note that renaming there means that there is a one-to-one name mapping between names used in  $p_1$  and another representative query pair.*

**PROOF.** The lemma can be proved based on the construction method of representative query pairs and non-representative query pairs. Both types of query pairs are generated by assigning symbols in the rule to concrete attributes, tables, and expressions. Thus, these generated query pairs all satisfy the same syntax structures specified by plan templates and constraints. They can only differ in 1) concrete names of attributes and tables; 2) concrete expressions; 3) concrete schemas. Therefore, after renaming, the non-representative query pair  $p_1$  can always be transformed into a representative query pair  $p_2$  except for the concrete expressions and schemas. In conclusion, the lemma is proved.  $\square$

**LEMMA 1.3.** *If a query pair  $p_1$  is the same as another query pair  $p_2$  after renaming the attributes and tables, then the equivalence of  $p_2$  can imply the equivalence of  $p_1$ .*

**PROOF.** Whether two queries are equivalent depends on the syntax structures of queries and constraints rather than the concrete names. If two queries are equivalent, renaming of attributes and tables via a one-to-one names mapping will not corrupt the equivalence. Therefore, since queries in  $p_1$  are the same as queries in  $p_2$  after renaming, the equivalence of  $p_2$  can imply the equivalence of  $p_1$ . In conclusion, the lemma is proved.  $\square$

**LEMMA 1.4.** *If a query pair  $p_1$  is the same as another query pair  $p_2$  after renaming the attributes and tables except for expressions, then the equivalence of  $p_2$  can imply the equivalence of  $p_1$ .*

**PROOF.** According to the construction method of representative query pairs, the expressions in  $p_2$  are uninterpreted user-defined functions. When verifying  $p_2$ , the verifier will treat these functions as random functions. Thus, if  $p_2$  is equivalent, replacing these functions with any concrete expressions will not change the equivalence. The equivalence of  $p_2$  can imply the equivalence of  $p_1$  after renaming. Furthermore, according to Lemma 1.3, the equivalence of  $p_1$  after renaming can imply the equivalence of  $p_1$ . In conclusion, the lemma is proved.  $\square$

**LEMMA 1.5.** *If a query pair  $p_1$  is the same as another query pair  $p_2$  after renaming the attributes and tables except for schemas, then the equivalence of  $p_2$  can imply the equivalence of  $p_1$ .*

**PROOF.** According to the construction method of representative query pairs, the schemas of  $p_1$  and  $p_2$  differ in two aspects. First, the difference comes from some attributes not used in queries. Since these attributes are not used in queries, the equivalence of  $p_2$  can imply the equivalence of  $p_1$  after renaming. Then, according to Lemma 1.3, the equivalence of  $p_1$  after renaming can further imply the equivalence of  $p_1$ . Second, the difference comes from the size of attribute lists in some schemas. These attribute list correspond to the symbolic attribute lists in the rule. Since existing verifiers for concrete queries treat such attribute lists as a whole, the sizes of such concrete attribute lists will not affect the equivalence of queries. Therefore, the equivalence of  $p_2$  can imply the equivalence of  $p_1$  after renaming. Then, according to Lemma 1.3, the equivalence of  $p_1$  after renaming can further imply the equivalence of  $p_1$ . In conclusion, the lemma is proved.  $\square$

**LEMMA 1.6.** *For each non-representative query pair  $p_1$ , there exists a representative query pair  $p_2$  such that the equivalence of  $p_2$  can imply the equivalence of  $p_1$ .*

**PROOF.** According to Lemma 1.2, each non-representative query pair  $p_1$  belongs to one of the following cases: 1)  $p_1$  is the same as some representative pair of queries  $p_2$  after renaming its attributes and tables. 2)  $p_1$  is almost the same as some representative pair of queries  $p_2$  after renaming its attributes and tables except for expressions and schemas. For case 1, the lemma is proved by Lemma 1.3. For case 2, the lemma is proved by Lemma 1.4 and Lemma 1.5. Therefore, the lemma is proved.  $\square$

Based on the above lemmas, we can finally prove the following theorem in the paper.

**THEOREM 1.7.** *For each candidate rewrite rule, if each representative pair of queries is equivalent, the rule is correct.*

PROOF. According to the definition of rule correctness, we prove the theorem by proving that each pair of queries before and after the rewrite are equivalent. All query pairs can be classified into two types: representative query pairs and non-representative query pairs. The premise indicates that all representative query pairs are equivalent. For each non-representative query pair, Lemma 1.6 indicates that there exists a representative query pair such that the equivalence of the representative query pair can imply the equivalence of the non-representative query pair. Therefore, all non-representative query pairs are equivalent. In conclusion, all query pairs are equivalent, which means that the rule is correct.  $\square$

**Example.** Take the rule below as an example, which simply removes redundant projections.

```
Proj<_ a0 r2>(Proj<_ a0 r1>(Input<r0>))|
Proj<_ a0 r1>(Input<r0>)|
AttrsSub(a0, r0);
```

We can verify it by the following steps. First, we enumerate all possible schemas. We know that the columns represent by  $a0$  is a subset of table  $r0$ . Thus we have to enumerate if  $r0$  has other columns except columns in  $a0$ .

```
CREATE TABLE R0(C0 INT);
CREATE TABLE R0(C0 INT, C1 INT);
```

Second, according to each enumerated schemas, we generate the SQL pair by simply assign concrete columns to the symbols.

```
SELECT C0 FROM (SELECT C0 FROM R0);
SELECT C0 FROM R0;
```

```
SELECT C1 FROM (SELECT C1 FROM R0);
SELECT C1 FROM R0;
```

Finally, we use existing verifier SQLSolver [1] to verify the equivalence of each pair of queries. Since each query pair is equivalent, the rule is correct.

## 2 G-DSL

### 2.1 Syntax in YAML

```
Rule : SourceTemplate '|' DestinationTemplate
      '|' G-Constraints
```

```
SourceTemplate: Node
TargetTemplate: Node
```

```
Node : NodeType '<' Symbols '>' '(' SubNodes ')'
```

```
NodeType : 'Filter' | 'Proj' | 'Input' | 'Join_left'
          | 'Join_inner' | 'Union' | 'Union_all' | 'Limit'
          | 'Agg_max' | 'Agg_min' | 'Agg_count' | 'Agg_avg'
          | 'Agg_sum' | 'Agg' | 'Sort_asc' | 'Sort_desc'
          | 'Insub' | 'Exists' | 'Except' | 'Intersect'
          | 'Join_cross' | 'Join_right'
```

```
Symbols : Symbol | Symbol ' ' Symbols |
```

```
Symbol : [a-z][0-9]+
```

```
SubNodes : Node | Node ',' SubNodes |
```

```
G-Constraints : G-Constraint
               | G-Constraint ';' G-Constraints |
```

```
G-Constraint : Destructure | Definition | Constraint
Destructure : Expression ':'=' Symbol
Definition : Symbol ':'=' Expression
Constraint : ConstraintType '(' Symbols ')
           | '!' ConstraintType '(' Symbols ')'
```

```
Expression: Symbol
           | ExpressionType '<' Infos '>' '(' Expressions ')
Expressions: Expression
           | Expression, Expressions |
ExpressionType: 'Sublink' | 'Eq' | 'And' | 'Const'
               | 'CTE' | 'Or' | 'Plus' | 'Minus' | 'Div'
               | 'Mul' | 'Target' | 'List' | 'IsNull' | 'IsNotNull'
               | 'LT' | 'GT' | 'LE' | 'GE' | 'Like' | 'Star'
               | 'FuncCall'
```

```
ConstraintType: 'AttrsSub' | 'AttrsEq' | 'ExpressionEq'
               | 'Unique' | 'NotNull' | 'Indexed' | 'TableEq'
               | 'ExpressionSub' | 'Reference'
```

### 2.2 Node Types

**Filter.** The Filter operator is used to apply a condition (typically a WHERE clause) to a dataset, filtering out rows that do not satisfy the condition. It is responsible for selecting only those rows that meet specific criteria.

**Proj (Projection).** The Proj operator refers to the projection operation in relational algebra, which is used to select specific columns from a dataset. It reduces the number of columns in the output, keeping only the ones required by the query.

**Input.** The Input operator represents the input or source data in a query plan. It can be thought of as the starting point or base relation in a query, from which further operations (like filtering, joining, etc.) are performed.

**Join\_left (Left Join).** The Join\_left operator performs a left outer join between two tables. It returns all rows from the left table and the matching rows from the right table. If no match is found, NULL values are returned for the columns from the right table.

**Join\_inner (Inner Join).** The Join\_inner operator performs an inner join between two tables, returning only the rows that have matching values in both tables. If no match exists, those rows are excluded from the result.

**Union.** The Union operator combines the result sets of two queries, eliminating duplicate rows from the final result. It returns the distinct rows from both input datasets, assuming the datasets have the same number of columns with compatible data types.

**Union\_all.** The Union\_all operator is similar to Union, but it does not remove duplicates. It returns all rows from both input datasets, including duplicate rows.

**Limit.** The Limit operator is used to restrict the number of rows returned in a query result. It is often used to paginate large datasets or to retrieve a fixed number of records from the query result.

**Agg\_max (Aggregate Maximum).** The Agg\_max operator computes the maximum value of a specified column for a given group of rows. It is commonly used in aggregate functions like MAX() in SQL.

**Agg\_min (Aggregate Minimum).** The Agg\_min operator computes the minimum value of a specified column for a given group of rows. It is used in aggregate functions like MIN() to find the smallest value in a set of values.

**Agg\_count (Aggregate Count).** The Agg\_count operator counts the number of rows in a dataset or the number of non-null values in a specified column. It is used in aggregate functions like COUNT() to determine the total number of records or specific values.

**Agg\_avg (Aggregate Average).** The Agg\_avg operator computes the average value of a specified column for a group of rows. It is used in the AVG() aggregate function to calculate the mean value of a set of values.

**Agg\_sum (Aggregate Sum).** The Agg\_sum operator computes the sum of the values in a specified column for a group of rows. It is used in aggregate functions like SUM() to calculate the total of numeric values.

**Agg (General Aggregation).** The Agg operator represents general aggregation operations that compute values (like sum, count, average, etc.) based on specific columns or groups of rows. It groups rows based on certain criteria and applies aggregate functions.

**Sort\_asc (Sort Ascending).** The Sort\_asc operator sorts the rows in ascending order based on a specified column. The sorting places the smallest values first and the largest values last.

**Sort\_desc (Sort Descending).** The Sort\_desc operator sorts the rows in descending order based on a specified column. It places the largest values first and the smallest values last.

**Insub (Subquery with IN).** The Insub operator represents the use of a subquery in an IN condition, checking if a value is present in a set of values returned by a subquery.

**Exists.** The Exists operator is used to check if a subquery returns any results. It returns true if the subquery produces one or more rows, and false if the subquery returns no rows.

**Except.** The Except operator returns the rows from the first query that are not present in the second query. It eliminates any rows that appear in both queries, effectively subtracting one result set from another.

**Intersect.** The Intersect operator returns the common rows from both queries. It finds the intersection of two result sets, returning only the rows that are present in both datasets.

**Join\_cross (Cross Join).** The Join\_cross operator performs a cross join between two tables, producing a Cartesian product of the rows from both tables. Each row from the first table is paired with every row from the second table, resulting in all possible combinations of rows.

**Join\_right (Right Join).** The Join\_right operator performs a right outer join, returning all rows from the right table and the matching rows from the left table. If no match is found in the left table, NULL values are returned for the left table's columns.

### 3 RULES

```
1 rule 1:
2 Exists(Agg_average<a4 a5 r6 e2 a6 r7>(Exists(Union
3 (Input<r3>,Input<r4>),Input<r5>)),Input<r8>)|
4 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
5 <r0>))|
6 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
7 AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
8 AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
9 PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
10 r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r8);
11 TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r8);
12 TableEq(r4,r5);TableEq(r4,r8);TableEq(r5,r8);
13 Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 2:
2 Filter<e3 _>(Filter<e4 _>(Agg<_ a3 _ e0 a4 r4 e1
3 a5 r5>(Input<r3>)));e0:=FuncCall<count>(a4);e3:=
4 Sublink<EXISTS Union_all<>(Input<r7>,Input<r8>)>;
5 e4:=Sublink<EXISTS Input<r6>>|
6 Agg<_ a5 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
7 FuncCall<count>(a3)|
8 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
9 NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
10 TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
11 TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
12 (r3,a4)|
```

```
1 rule 3:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
3 r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
4 Filter<e4 _>(Input<r6>)>;e4:=Sublink<EXISTS
5 Union_all<>(Input<r7>,Input<r8>)>|
6 Agg<_ a5 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
7 FuncCall<count>(a3)|
8 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
9 NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
10 TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
11 TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
12 (r3,a4)|
```

```
1 rule 4:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
3 r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
4 Input<r6>>|
5 Filter<e2 a4>(Agg<_ a4 _ e1 a6 r1 e2 a4 r2>(Input<
6 r3>));e1:=FuncCall<count>(a6)|
7 AttrsEq(a4,a5);AttrsSub(a4,r3);AttrsSub(a5,r3);
8 AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
9 TableEq(r3,r6);Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 5:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(
3 Union_all<>(Filter<e4 _>(Input<r3>),Input<r5>)));
4 e0:=FuncCall<avg>(a5);e3:=Sublink<EXISTS Input<r8
5 >>;e4:=Sublink<EXISTS Input<r4>>|
6 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
7 r3>));e1:=FuncCall<avg>(a5)|
```

```

4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r8);TableEq(r4,r5);
  TableEq(r4,r8);TableEq(r5,r8);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 6:
2 Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
  Union(Input<r6>,Exists(Input<r7>,Input<r8>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a5);AttrsEq(a2,a3);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 7:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>)>|
3 Filter<e2 a4>(Agg<_ a6 _ e1 a4 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<count>(a4)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 8:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r5 e2 a6 r6>(
  Union_all<>(Input<r3>,Input<r4>)));e0:=FuncCall<
  avg>(a5);e3:=Sublink<EXISTS Filter<e4 _>(Input<r7
  >)>;e4:=Sublink<EXISTS Input<r8>>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r4,r7);
  TableEq(r4,r8);TableEq(r7,r8);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 9:
2 Agg_sum<a4 a5 r7 e2 a6 r8>(Exists(Input<r3>,Exists
  (Input<r4>,Union(Input<r5>,Input<r6>))))|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
  >))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 10:
2 Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
  Union(Exists(Input<r6>,Input<r7>,Input<r8>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|

```

```

4 AttrsEq(a0,a5);AttrsEq(a1,a5);AttrsEq(a2,a3);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 11:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Union_all<>(Input<r3
  >,Filter<e3 _>(Input<r4>)));e0:=FuncCall<avg>(a5);
  e3:=Sublink<EXISTS Input<r5>>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 12:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r5 e2 a6 r6>(
  Union_all<>(Input<r3>,Input<r4>)));e0:=FuncCall<
  avg>(a5);e3:=Sublink<EXISTS Input<r7>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r7);TableEq(r4,r7);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 13:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Union_all<>(Input<r6>,Input<r7>),Input
  <r8>)>|
3 Agg<_ a5 _ e2 a5 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<count>(a5)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
(r3,a4)|

```

```

1 rule 14:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
  Exists(Input<r4>,Union(Input<r5>,Input<r6>))))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 15:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(
  Union_all<>(Filter<e3 _>(Input<r3>),Input<r5>),
  Input<r6>));e0:=FuncCall<avg>(a5);e3:=Sublink<
  EXISTS Input<r4>>|

```

```
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 16:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
  Exists(Union(Input<r4>,Input<r5>),Input<r6>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a3);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 17:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Filter<e4 _>(Union_all<>(Input<r4>,Input<r5>))>;e4
  :=Sublink<EXISTS Input<r6>>|
3 Agg<_ a5 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 18:
2 Exists(Agg_count<a4 a5 r4 e2 a6 r5>(Input<r3>),
  Union(Input<r6>,Input<r7>))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a4);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 19:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r6>,Union_all<>(Input<r7>,Input<r8>))>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 20:
```

```
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r6 e1 a5 r7>(Filter<
  e4 _>(Input<r3>))));e0:=FuncCall<count>(a4);e3:=
  Sublink<EXISTS Input<r8>>;e4:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>))>|
3 Agg<_ a3 _ e2 a5 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a5)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r8);TableEq(r4,r5);
  TableEq(r4,r8);TableEq(r5,r8);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 21:
2 Agg<_ a3 _ e0 a4 r6 e1 a5 r7>(Filter<e3 _>(Input<r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>))>|
3 Agg<_ a5 _ e2 a5 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<count>(a5)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 22:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<
  e4 _>(Union_all<>(Input<r3>,Input<r4>))));e0:=
  FuncCall<avg>(a5);e3:=Sublink<EXISTS Input<r8>>;e4
  :=Sublink<EXISTS Input<r5>>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r8);TableEq(r4,r5);
  TableEq(r4,r8);TableEq(r5,r8);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 23:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Filter<
  e4 _>(Input<r3>))));e0:=FuncCall<count>(a4);e3:=
  Sublink<EXISTS Input<r6>>;e4:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>))>|
3 Agg<_ a3 _ e2 a5 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a5)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 24:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r5 e1 a5 r6>(
  Union_all<>(Input<r3>,Input<r4>))));e0:=FuncCall<
  max>(a4);e3:=Sublink<EXISTS Input<r7>>|
3 Agg<_ a5 _ e2 a4 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<max>(a4)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r7);TableEq(r4,r7);Unique(r3,a3);Unique
  (r3,a4)|
```

```

1 rule 25:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
Union_all<>(Input<r6>,Filter<e4 _>(Input<r7>))>;e4
:=Sublink<EXISTS Input<r8>>|
3 Agg<_ a5 _ e2 a5 r1 e1 a3 r2>(Input<r3>);e2:=
FuncCall<count>(a5)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
(r3,a4)|

```

```

1 rule 26:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r5 e2 a6 r6>(Filter<
e4 _>(Input<r3>))));e0:=FuncCall<sum>(a5);e3:=
Sublink<EXISTS Union_all<>(Input<r7>,Input<r8>))>;
e4:=Sublink<EXISTS Input<r4>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r7);TableEq(r3,r8);TableEq(r4,r7);
TableEq(r4,r8);TableEq(r7,r8);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 27:
2 Agg<_ a4 _ e0 a5 r5 e2 a6 r6>(Union_all<>(Input<r3
>,Input<r4>));e0:=FuncCall<avg>(a5)|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 28:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
Filter<e4 _>(Union_all<>(Input<r4>,Input<r5>))>;e4
:=Sublink<EXISTS Input<r6>>|
3 Agg<_ a5 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
(r3,a4)|

```

```

1 rule 29:
2 Exists(Agg_max<a3 a4 r5 e1 a5 r6>(Union(Input<r3>,
Input<r4>)),Input<r7>)|
3 Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a4);AttrsEq(a2,a3);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r7);
TableEq(r3,r4);TableEq(r3,r7);TableEq(r4,r7);
Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 30:
2 Exists(Agg_count<a3 a4 r5 e1 a5 r6>(Exists(Input<
r3>,Input<r4>)),Union(Input<r7>,Input<r8>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a3);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r7);
TableEq(r0,r8);TableEq(r3,r4);TableEq(r3,r7);
TableEq(r3,r8);TableEq(r4,r7);TableEq(r4,r8);
TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 31:
2 Exists(Agg_count<a4 a5 r4 e2 a6 r5>(Input<r3>),
Union(Input<r6>,Input<r7>))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a4);AttrsEq(a2,a6);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r3,r6);
TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 32:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
Union_all<>(Input<r4>,Input<r5>))>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a4 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<count>(a4)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 33:
2 Agg_average<a4 a5 r5 e2 a6 r6>(Union(Input<r3>,
Input<r4>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r3,r4);Unique(r3,a4);
Unique(r3,a5)|

```

```

1 rule 34:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(Input<r3
>,Union_all<>(Input<r4>,Union_all<>(Input<r5>,
Input<r6>)))));e0:=FuncCall<avg>(a5)|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
(r3,a5)|

```

```
1 rule 35:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r5 e1 a6 r6>(Proj<
ea3 a3 r4>(Input<r3>)));e0:=FuncCall<count>(a5);e3
:=Sublink<EXISTS Union_all<>(Input<r7>,Input<r8>)
>|
3 Agg<_ a6 _ e2 a4 r1 e1 a4 r2>(Input<r3>);e2:=
FuncCall<count>(a4)|
4 AttrsSub(a3,r3);AttrsSub(a4,r4);AttrsSub(a5,r4);
AttrsSub(a6,a4);NotNull(r3,a3);TableEq(r3,r7);
TableEq(r3,r8);TableEq(r7,r8);Unique(r3,a3)|
```

```
1 rule 36:
2 Agg<_ a4 _ e0 a5 r5 e2 a6 r6>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
Input<r4>>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a6 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<count>(a6)|
4 AttrsEq(a4,a5);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
TableEq(r3,r4);Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 37:
2 Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
Exists(Union(Input<r6>,Input<r7>),Input<r8>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a5);AttrsEq(a2,a3);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 38:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Union(Input<
r3>,Exists(Input<r4>,Input<r5>)),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 39:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
Union_all<>(Union_all<>(Input<r4>,Input<r5>),Input
<r6>)>|
3 Agg<_ a3 _ e2 a5 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a5)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
(r3,a4)|
```

```
1 rule 40:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Union(Exists(
Input<r3>,Input<r4>),Input<r5>),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 41:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
Exists(Union(Input<r4>,Input<r5>),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 42:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
Union_all<>(Input<r6>,Union_all<>(Input<r7>,Input<
r8>))>|
3 Agg<_ a5 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
(r3,a4)|
```

```
1 rule 43:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(Input<r3
>,Union_all<>(Union_all<>(Input<r4>,Input<r5>),
Input<r6>))));e0:=FuncCall<avg>(a5)|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
(r3,a5)|
```

```
1 rule 44:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Exists(Union(Input<
r3>,Input<r4>),Union(Input<r5>,Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
```

```

4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
    TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
    TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
    Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 45:
2 Exists(Agg_average<a4 a5 r6 e2 a6 r7>(Union(Union(
  Input<r3>,Input<r4>),Input<r5>)),Input<r8>)|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r8);
    TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r8);
    TableEq(r4,r5);TableEq(r4,r8);TableEq(r5,r8);
    Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 46:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(
  Union_all<>(Input<r3>,Input<r4>),Filter<e3 _>(
    Input<r5>)));e0:=FuncCall<avg>(a5);e3:=Sublink<
  EXISTS Input<r6>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
    (r3,a5)|

```

```

1 rule 47:
2 Agg_max<a3 a4 r7 e1 a5 r8>(Union(Exists(Input<r3>,
  Union(Input<r4>,Input<r5>)),Input<r6>))|
3 Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a4);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 48:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r5 e1 a5 r6>(Filter<
  e4 _>(Input<r3>)));e0:=FuncCall<count>(a4);e3:=
  Sublink<EXISTS Union_all<>(Input<r7>,Input<r8>)>;
  e4:=Sublink<EXISTS Input<r4>>|
3 Agg<_ a3 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r4,r7);
  TableEq(r4,r8);TableEq(r7,r8);Unique(r3,a3);Unique
    (r3,a4)|

```

```

1 rule 49:
2 Exists(Agg_count<a4 a5 r4 e2 a6 r5>(Input<r3>),
  Union(Input<r6>,Input<r7>))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a6);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r3,r6);
    TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
    (r3,a5)|

```

```

1 rule 50:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>)>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
    (r3,a5)|

```

```

1 rule 51:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Filter<e4 _>(Input<r4>),Input<r6>)>;e4
  :=Sublink<EXISTS Input<r5>>|
3 Agg<_ a5 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
    (r3,a4)|

```

```

1 rule 52:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
  Exists(Input<r4>,Exists(Input<r5>,Input<r6>))))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
    TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
    TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
    Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 53:
2 Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
  Union(Exists(Input<r6>,Input<r7>),Input<r8>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|

```



```
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 54:
2 Agg_count<a4 a5 r6 e2 a6 r7>(Exists(Input<r3>,
  Union(Input<r4>,Input<r5>)))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a4);AttrsEq(a2,a4);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 55:
2 Exists(Agg_count<a4 a5 r4 e2 a6 r5>(Input<r3>),
  Union(Input<r6>,Input<r7>))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 56:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Union_all<>(Filter<
  e3 _>(Input<r3>),Input<r6>));e0:=FuncCall<max>(a4)
  ;e3:=Sublink<EXISTS Union_all<>(Input<r4>,Input<r5
  >>)|
3 Agg<_ a3 _ e2 a4 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<max>(a4)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 57:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Union_all<>(Filter<
  e3 _>(Input<r3>),Input<r5>));e0:=FuncCall<avg>(a5)
  ;e3:=Sublink<EXISTS Input<r4>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 58:
2 Exists(Agg_average<a4 a5 r5 e2 a6 r6>(Union(Input<r3>,
  Input<r4>)),Union(Input<r7>,Input<r8>))|
```

```
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r7);TableEq(r0,r8);
  TableEq(r3,r4);TableEq(r3,r7);TableEq(r3,r8);
  TableEq(r4,r7);TableEq(r4,r8);TableEq(r7,r8);
  Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 59:
2 Filter<e3 _>(Filter<e4 _>(Agg<_ a4 _ e0 a5 r4 e2
  a6 r5>(Input<r3>));e0:=FuncCall<sum>(a5);e3:=
  Sublink<EXISTS Union_all<>(Input<r7>,Input<r8>));
  e4:=Sublink<EXISTS Input<r6>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 60:
2 Exists(Agg_sum<a4 a5 r6 e2 a6 r7>(Exists(Input<r3
  >,Union(Input<r4>,Input<r5>))),Input<r8>))|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
  >))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r8);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r8);
  TableEq(r4,r5);TableEq(r4,r8);TableEq(r5,r8);
  Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 61:
2 Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
  Union(Input<r6>,Union(Input<r7>,Input<r8>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 62:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Exists(Exists
  (Input<r3>,Input<r4>),Input<r5>),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
```

```

4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 63:
2 Agg_count<a5 a6 r7 e2 a7 r8>(Exists(Proj_simple<_
  a4 r4>(Input<r3>),Union(Input<r5>,Input<r6>))))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a5);AttrsEq(a1,a5);AttrsEq(a2,a5);
  AttrsEq(a3,a5);AttrsSub(a4,r3);AttrsSub(a5,r4);
  AttrsSub(a6,r4);AttrsSub(a7,a5);NotNull(r3,a4);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r5);TableEq(r0,r6);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r5,r6);Unique(r3,a4)|

```

```

1 rule 64:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
  r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r6>,Input<r7>)>|
3 Filter<e2 a4>(Agg<_ a6 _ e1 a5 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<count>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
    (r3,a5)|

```

```

1 rule 65:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>)>|
3 Filter<e2 a6>(Agg<_ a6 _ e1 a6 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<count>(a6)|
4 AttrsEq(a4,a5);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r4,r5);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 66:
2 Agg_average<a4 a5 r6 e2 a6 r7>(Union(Input<r3>,
  Union(Input<r4>,Input<r5>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
    (r3,a5)|

```

```

1 rule 67:
2 Agg_count<a4 a5 r6 e2 a6 r7>(Exists(Input<r3>,
  Union(Input<r4>,Input<r5>)))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|

```

```

4 AttrsEq(a0,a4);AttrsEq(a1,a4);AttrsEq(a2,a6);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
    (r3,a5)|

```

```

1 rule 68:
2 Agg_average<a4 a5 r6 e2 a6 r7>(Exists(Union(Input<
  r3>,Input<r4>),Input<r5>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
    (r3,a5)|

```

```

1 rule 69:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
  Exists(Union(Input<r4>,Input<r5>),Input<r6>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 70:
2 Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
  Union(Exists(Input<r6>,Input<r7>),Input<r8>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a3);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 71:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Input<r6>,Input<r7>)>|
3 Agg<_ a3 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a3);Unique
    (r3,a4)|

```

```

1 rule 72:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
  Union(Input<r4>,Union(Input<r5>,Input<r6>))))|

```

```
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a3);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 73:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Filter<e4 _>(Input<r6>),Input<r8>)>;e4
  :=Sublink<EXISTS Input<r7>>|
3 Agg<_ a5 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 74:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(Input<r3
  >,Union_all<>(Input<r4>,Union_all<>(Input<r5>,
  Input<r6>)))));e0:=FuncCall<avg>(a5)|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 75:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>)>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<count>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 76:
2 Exists(Agg_sum<a4 a5 r4 e2 a6 r5>(Input<r3>),Union
  (Exists(Input<r6>,Input<r7>),Input<r8>))|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
  >))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r0,r8);
  TableEq(r3,r6);TableEq(r3,r7);TableEq(r3,r8);
  TableEq(r6,r7);TableEq(r6,r8);TableEq(r7,r8);
  Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 77:
```

```
2 Agg<_ a4 _ e0 a5 r7 e1 a6 r8>(Filter<e3 _>(Proj<
  ea3 a3 r4>(Input<r3>)))));e0:=FuncCall<count>(a5);e3
  :=Sublink<EXISTS Union_all<>(Input<r5>,Input<r6>)>
  >|
3 Agg<_ a4 _ e2 a4 r1 e1 a6 r2>(Input<r3>);e2:=
  FuncCall<count>(a4)|
4 AttrsSub(a3,r3);AttrsSub(a4,r4);AttrsSub(a5,r4);
  AttrsSub(a6,a4);NotNull(r3,a3);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r5,r6);Unique(r3,a3)|
```

```
1 rule 78:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Input<r6>,Filter<e4 _>(Input<r7>))>;e4
  :=Sublink<EXISTS Input<r8>>|
3 Agg<_ a3 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 79:
2 Filter<e3 _>(Filter<e4 _>(Agg<_ a3 _ e0 a4 r4 e1
  a5 r5>(Input<r3>)))));e0:=FuncCall<count>(a4);e3:=
  Sublink<EXISTS Input<r8>>;e4:=Sublink<EXISTS
  Union_all<>(Input<r6>,Input<r7>)>|
3 Agg<_ a3 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 80:
2 Exists(Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<
  r3>),Union(Input<r6>,Input<r7>)),Input<r8>)|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a5);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 81:
2 Exists(Agg_sum<a4 a5 r4 e2 a6 r5>(Input<r3>),Union
  (Input<r6>,Union(Input<r7>,Input<r8>)))|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
  >))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r0,r8);
  TableEq(r3,r6);TableEq(r3,r7);TableEq(r3,r8);
  TableEq(r6,r7);TableEq(r6,r8);TableEq(r7,r8);
  Unique(r3,a4);Unique(r3,a5)|
```

```

1 rule 82:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
Filter<e4 _>(Union_all<>(Input<r6>,Input<r7>)))>;e4
:=Sublink<EXISTS Input<r8>>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 83:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
Union(Union(Input<r4>,Input<r5>),Input<r6>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a3);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 84:
2 Exists(Agg_count<a4 a5 r4 e2 a6 r5>(Input<r3>),
Union(Input<r6>,Input<r7>))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a6);AttrsEq(a2,a6);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r3,r6);
TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 85:
2 Agg_count<a4 a5 r7 e1 a6 r8>(Exists(Proj_simple<_
a3 r4>(Input<r3>),Union(Input<r5>,Input<r6>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a6);AttrsEq(a1,a6);AttrsEq(a2,a4);
AttrsSub(a3,r3);AttrsSub(a4,r4);AttrsSub(a5,r4);
AttrsSub(a6,a4);NotNull(r3,a3);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r5,r6);
Unique(r3,a3)|

```

```

1 rule 86:
2 Exists(Agg_sum<a4 a5 r4 e2 a6 r5>(Input<r3>),Union
(Input<r6>,Union(Input<r7>,Input<r8>)))|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
>))|

```

```

4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r0,r8);
TableEq(r3,r6);TableEq(r3,r7);TableEq(r3,r8);
TableEq(r6,r7);TableEq(r6,r8);TableEq(r7,r8);
Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 87:
2 Exists(Agg_count<a4 a5 r4 e2 a6 r5>(Input<r3>),
Union(Input<r6>,Input<r7>))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>))|
4 AttrsEq(a0,a6);AttrsEq(a1,a4);AttrsEq(a2,a6);
AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r3,r6);
TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 88:
2 Exists(Agg_average<a4 a5 r4 e2 a6 r5>(Input<r3>),
Union(Union(Input<r6>,Input<r7>),Input<r8>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r0,r8);
TableEq(r3,r6);TableEq(r3,r7);TableEq(r3,r8);
TableEq(r6,r7);TableEq(r6,r8);TableEq(r7,r8);
Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 89:
2 Agg_count<a3 a4 r6 e1 a5 r7>(Exists(Input<r3>,
Union(Input<r4>,Input<r5>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a5);AttrsEq(a2,a5);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r4,r5);
Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 90:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Union_all<>(Input<r3
>,Union_all<>(Input<r4>,Input<r5>)))>;e0:=FuncCall<
avg>(a5)|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 91:

```

```

2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Filter<e3 _>(
  Union_all<>(Union_all<>(Input<r3>, Input<r4>), Input
    <r5>)))e0:=FuncCall<avg>(a5);e3:=Sublink<EXISTS
    Input<r6>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
    (r3,a5)|

```

```

1 rule 92:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(Filter<
  e3 _>(Filter<e4 _>(Input<r3>)),Input<r6>));e0:=
  FuncCall<avg>(a5);e3:=Sublink<EXISTS Input<r5>>;e4
    :=Sublink<EXISTS Input<r4>>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
    (r3,a5)|

```

```

1 rule 93:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
    (r3,a5)|

```

```

1 rule 94:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Union_all<>(
  Union_all<>(Input<r3>,Input<r4>),Input<r5>));e0:=
  FuncCall<avg>(a5)|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
    (r3,a5)|

```

```

1 rule 95:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Exists(Input<
  r3>,Union(Input<r4>,Input<r5>)),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 96:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
  Exists(Union(Input<r4>,Input<r5>),Input<r6>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a5);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 97:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Exists(Union(
  Input<r3>,Input<r4>),Input<r5>),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 98:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Union_all<>(Input<r4>,Input<r5>),Input
    <r6>))|
3 Agg<_ a5 _ e2 a5 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<count>(a5)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
    (r3,a4)|

```

```

1 rule 99:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Exists(Input<
  r3>,Union(Input<r4>,Input<r5>)),Input<r6>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 100:
2 Filter<e3 _>(Filter<e4 _>(Agg<_ a4 _ e0 a5 r5 e2
  a6 r6>(Union_all<>(Input<r3>,Input<r4>))))e0:=
  FuncCall<avg>(a5);e3:=Sublink<EXISTS Input<r8>>;e4
    :=Sublink<EXISTS Input<r7>>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|

```

```

4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r4,r7);
  TableEq(r4,r8);TableEq(r7,r8);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 101:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Exists(Input<
  r3>,Union(Input<r4>,Input<r5>)),Input<r6>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a3);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 102:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Filter<e3 _>(Filter<
  e4 _>(Input<r3>)));e0:=FuncCall<sum>(a5);e3:=
  Sublink<EXISTS Input<r6>>;e4:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>)>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 103:
2 Exists(Exists(Agg_count<a4 a5 r4 e2 a6 r5>(Input<
  r3>),Input<r6>),Input<r7>)|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a4);AttrsEq(a0,a5);AttrsEq(a1,a6);
  AttrsEq(a2,a4);AttrsEq(a2,a5);AttrsEq(a3,a4);
  AttrsEq(a3,a5);AttrsEq(a4,a5);AttrsSub(a4,r3);
  AttrsSub(a5,r3);AttrsSub(a6,a4);NotNull(r3,a4);
  NotNull(r3,a5);PredicateEq(e0,e2);PredicateEq(e1,
  e2);TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
  TableEq(r3,r6);TableEq(r3,r7);TableEq(r6,r7);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 104:
2 Agg_count<a4 a5 r6 e2 a6 r7>(Exists(Input<r3>,
  Union(Input<r4>,Input<r5>)))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a6);AttrsEq(a1,a6);AttrsEq(a2,a4);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 105:

```

```

2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
  r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
  Union_all<>(Filter<e4 _>(Input<r6>),Input<r8>)>;e4
:=Sublink<EXISTS Input<r7>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 106:
2 Agg_count<a4 a5 r6 e2 a6 r7>(Exists(Input<r3>,
  Union(Input<r4>,Input<r5>)))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a6);AttrsEq(a1,a4);AttrsEq(a2,a6);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 107:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
  r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r6>,Input<r7>)>|
3 Filter<e2 a4>(Agg<_ a6 _ e1 a6 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<count>(a6)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 108:
2 Exists(Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<
  r3>),Union(Input<r6>,Input<r7>)),Input<r8>)|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a5);AttrsEq(a2,a3);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 109:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
  r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r6>,Input<r7>)>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 110:

```



```
2 Agg_sum<a4 a5 r7 e2 a6 r8>(Exists(Input<r3>,Union(
Input<r4>,Exists(Input<r5>,Input<r6>))))|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 111:
2 Agg_sum<a4 a5 r7 e2 a6 r8>(Exists(Input<r3>,Union(
Input<r4>,Union(Input<r5>,Input<r6>))))|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 112:
2 Exists(Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<
r3>),Union(Input<r6>,Input<r7>)),Input<r8>)|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a5);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 113:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
Union_all<>(Input<r6>,Input<r7>)>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a6 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<count>(a6)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
(r3,a5)|
```

```
1 rule 114:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Filter<e3 _>(
Union_all<>(Input<r3>,Filter<e4 _>(Input<r4>))));
e0:=FuncCall<avg>(a5);e3:=Sublink<EXISTS Input<r6
>>;e4:=Sublink<EXISTS Input<r5>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
```

```
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
(r3,a5)|
```

```
1 rule 115:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
Filter<e4 _>(Input<r4>)>;e4:=Sublink<EXISTS
Union_all<>(Input<r5>,Input<r6>)>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
(r3,a5)|
```

```
1 rule 116:
2 Exists(Agg_sum<a4 a5 r4 e2 a6 r5>(Input<r3>),Union
(Exists(Input<r6>,Input<r7>),Input<r8>))|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r0,r8);
TableEq(r3,r6);TableEq(r3,r7);TableEq(r3,r8);
TableEq(r6,r7);TableEq(r6,r8);TableEq(r7,r8);
Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 117:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Exists(Union(
Input<r3>,Input<r4>),Input<r5>),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 118:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Exists(Union(Input<
r3>,Union(Input<r4>,Input<r5>)),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
Unique(r3,a4);Unique(r3,a5)|
```

```

1 rule 119:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
Filter<e4 _>(Union_all<>(Input<r6>,Input<r7>))>;e4
:=Sublink<EXISTS Input<r8>>|
3 Agg<_ a3 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
(r3,a4)|

```

```

1 rule 120:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
Exists(Input<r4>,Union(Input<r5>,Input<r6>))))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 121:
2 Agg<_ a3 _ e0 a4 r6 e1 a5 r7>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
Union_all<>(Input<r4>,Input<r5>)>|
3 Agg<_ a3 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a3);Unique
(r3,a4)|

```

```

1 rule 122:
2 Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
Exists(Input<r6>,Union(Input<r7>,Input<r8>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a5);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 123:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
Filter<e4 _>(Union_all<>(Input<r4>,Input<r5>))>;e4
:=Sublink<EXISTS Input<r6>>|
3 Agg<_ a3 _ e2 a5 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a5)|

```

```

4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
(r3,a4)|

```

```

1 rule 124:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Exists(Input<
r3>,Input<r4>),Union(Input<r5>,Input<r6>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 125:
2 Agg<_ a4 _ e0 a5 r7 e1 a6 r8>(Proj<ea3 a3 r6>(
Filter<e3 _>(Input<r3>)));e0:=FuncCall<count>(a5);
e3:=Sublink<EXISTS Union_all<>(Input<r4>,Input<r5
>)>|
3 Agg<_ a6 _ e2 a4 r1 e1 a6 r2>(Input<r3>);e2:=
FuncCall<count>(a4)|
4 AttrsSub(a3,r3);AttrsSub(a4,r6);AttrsSub(a5,r6);
AttrsSub(a6,a4);NotNull(r3,a3);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a3)|

```

```

1 rule 126:
2 Filter<e3 _>(Filter<e4 _>(Agg<_ a3 _ e0 a4 r4 e1
a5 r5>(Input<r3>)));e0:=FuncCall<count>(a4);e3:=
Sublink<EXISTS Input<r8>>;e4:=Sublink<EXISTS
Union_all<>(Input<r6>,Input<r7>)>|
3 Agg<_ a5 _ e2 a5 r1 e1 a3 r2>(Input<r3>);e2:=
FuncCall<count>(a5)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
(r3,a4)|

```

```

1 rule 127:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
Union_all<>(Union_all<>(Input<r6>,Input<r7>),Input
<r8>)>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 128:
2 Exists(Agg_average<a4 a5 r5 e2 a6 r6>(Union(Input<
r3>,Input<r4>)),Input<r7>)|

```



```
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r7);TableEq(r3,r4);
  TableEq(r3,r7);TableEq(r4,r7);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 129:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Input<r4>,Filter<e4 _>(Input<r5>))>;e4
  :=Sublink<EXISTS Input<r6>>|
3 Agg<_ a3 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 130:
2 Filter<e3 _>(Filter<e4 _>(Agg<_ a4 _ e0 a5 r4 e2
a6 r5>(Input<r3>)));e0:=FuncCall<avg>(a5);e3:=
  Sublink<EXISTS Union_all<>(Input<r7>,Input<r8>)>;
  e4:=Sublink<EXISTS Input<r6>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 131:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Union(Input<
r3>,Input<r4>),Union(Input<r5>,Input<r6>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 132:
2 Exists(Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<
r3>),Input<r6>),Union(Input<r7>,Input<r8>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a3);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 133:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
  Union(Union(Input<r4>,Input<r5>),Input<r6>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a5);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 134:
2 Agg_average<a4 a5 r6 e2 a6 r7>(Union(Input<r3>,
  Exists(Input<r4>,Input<r5>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 135:
2 Agg_max<a3 a4 r5 e1 a5 r6>(Union(Input<r3>,Input<
r4>))|
3 Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a4);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r3,r4);
  Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 136:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r5 e2 a6 r6>(
  Union_all<>(Input<r3>,Input<r4>)));e0:=FuncCall<
  avg>(a5);e3:=Sublink<EXISTS Union_all<>(Input<r7>,
  Input<r8>)>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r4,r7);
  TableEq(r4,r8);TableEq(r7,r8);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 137:
2 Agg_sum<a4 a5 r6 e2 a6 r7>(Exists(Input<r3>,Union(
  Input<r4>,Input<r5>)))|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|
```

```

1 rule 138:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
Union_all<>(Input<r6>,Input<r7>>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<count>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 139:
2 Agg<_ a4 _ e0 a5 r7 e1 a6 r8>(Proj<ea3 a3 r6>(
Filter<e3 _>(Input<r3>)));e0:=FuncCall<count>(a5);
e3:=Sublink<EXISTS Union_all<>(Input<r4>,Input<r5
>>>|
3 Agg<_ a6 _ e2 a6 r1 e1 a4 r2>(Input<r3>);e2:=
FuncCall<count>(a6)|
4 AttrsSub(a3,r3);AttrsSub(a4,r6);AttrsSub(a5,r6);
AttrsSub(a6,a4);NotNull(r3,a3);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a3)|

```

```

1 rule 140:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(
Union_all<>(Filter<e3 _>(Input<r3>),Input<r5>),
Input<r6>));e0:=FuncCall<avg>(a5);e3:=Sublink<
EXISTS Input<r4>>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 141:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
Exists(Union(Input<r4>,Input<r5>),Input<r6>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a3);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 142:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
Union(Input<r4>,Exists(Input<r5>,Input<r6>))))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a5);AttrsEq(a2,a3);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 143:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
Exists(Input<r4>,Union(Input<r5>,Input<r6>))))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 144:
2 Agg_max<a3 a4 r7 e1 a5 r8>(Union(Exists(Exists(
Input<r3>,Input<r4>),Input<r5>),Input<r6>))|
3 Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a4);AttrsEq(a2,a5);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 145:
2 Agg_average<a4 a5 r6 e2 a6 r7>(Union(Input<r3>,
Exists(Input<r4>,Input<r5>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 146:
2 Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
Union(Union(Input<r6>,Input<r7>),Input<r8>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a5);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 147:
2 Exists(Agg_count<a3 a4 r6 e1 a5 r7>(Exists(Input<
r3>,Union(Input<r4>,Input<r5>))),Input<r8>)|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|

```

```
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r8);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r8);TableEq(r4,r5);TableEq(r4,r8);
  TableEq(r5,r8);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 148:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Union_all<>(Filter<
  e3 _>(Filter<e4 _>(Input<r3>)),Input<r6>));e0:=
  FuncCall<max>(a4);e3:=Sublink<EXISTS Input<r5>>;e4
  :=Sublink<EXISTS Input<r4>>|
3 Agg<_ a3 _ e2 a4 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<max>(a4)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 149:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>>|
3 Filter<e2 a4>(Agg<_ a6 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<count>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 150:
2 Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
  Exists(Union(Input<r6>,Input<r7>),Input<r8>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 151:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Input<r4>,Filter<e4 _>(Input<r5>))>;e4
  :=Sublink<EXISTS Input<r6>>|
3 Agg<_ a3 _ e2 a5 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a5)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 152:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Union(Exists(
  Input<r3>,Input<r4>),Input<r5>),Input<r6>))|
```

```
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 153:
2 Exists(Agg_count<a3 a4 r5 e1 a5 r6>(Exists(Input<
  r3>,Input<r4>)),Union(Input<r7>,Input<r8>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a3);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r4);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r4,r7);TableEq(r4,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 154:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
  Union_all<>(Union_all<>(Input<r4>,Input<r5>),Input
  <r6>))>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 155:
2 Exists(Agg_max<a3 a4 r5 e1 a5 r6>(Union(Input<r3>,
  Input<r4>)),Input<r7>)|
3 Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a4);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r7);
  TableEq(r3,r4);TableEq(r3,r7);TableEq(r4,r7);
  Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 156:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Exists(Input<
  r3>,Union(Input<r4>,Input<r5>)),Input<r6>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 157:
```

```

2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Union_all<>(
  Union_all<>(Input<r3>,Input<r4>),Input<r5>));e0:=
  FuncCall<avg>(a5)|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 158:
2 Agg<_ a4 _ e0 a5 r7 e1 a6 r8>(Proj<ea3 a3 r6>(
  Filter<e3 _>(Input<r3>)));e0:=FuncCall<count>(a5);
  e3:=Sublink<EXISTS Union_all<>(Input<r4>,Input<r5
  >>)|
3 Agg<_ a4 _ e2 a4 r1 e1 a4 r2>(Input<r3>);e2:=
  FuncCall<count>(a4)|
4 AttrsSub(a3,r3);AttrsSub(a4,r6);AttrsSub(a5,r6);
  AttrsSub(a6,a4);NotNull(r3,a3);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a3)|

```

```

1 rule 159:
2 Agg_count<a4 a5 r7 e1 a6 r8>(Proj_simple<_ a3 r6>(
  Exists(Input<r3>,Union(Input<r4>,Input<r5>))))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a4);AttrsEq(a1,a4);AttrsEq(a2,a6);
  AttrsSub(a3,r3);AttrsSub(a4,r6);AttrsSub(a5,r6);
  AttrsSub(a6,a4);NotNull(r3,a3);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r4,r5);
  Unique(r3,a3)|

```

```

1 rule 160:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
  Exists(Union(Input<r4>,Input<r5>),Input<r6>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 161:
2 Exists(Agg_sum<a4 a5 r4 e2 a6 r5>(Input<r3>),Union
  (Input<r6>,Input<r7>))|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
  >))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 162:

```

```

2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(Input<r3
  >,Filter<e3 _>(Input<r4>)));e0:=FuncCall<avg>(a5);
  e3:=Sublink<EXISTS Union_all<>(Input<r5>,Input<r6
  >>)|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 163:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Input<r6>,Union_all<>(Input<r7>,Input<
  r8>))>|
3 Agg<_ a3 _ e2 a5 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a5)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
  (r3,a4)|

```

```

1 rule 164:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>))>|
3 Filter<e2 a4>(Agg<_ a6 _ e1 a6 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<count>(a6)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 165:
2 Agg<_ a3 _ e0 a4 r6 e1 a5 r7>(Union_all<>(Input<r3
  >,Union_all<>(Input<r4>,Input<r5>)));e0:=FuncCall<
  max>(a4)|
3 Agg<_ a3 _ e2 a4 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<max>(a4)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a3);Unique
  (r3,a4)|

```

```

1 rule 166:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
  r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
  Filter<e4 _>(Union_all<>(Input<r6>,Input<r7>))>;e4
  :=Sublink<EXISTS Input<r8>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a4);Unique
  (r3,a5)|

```

```
1 rule 167:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
3 Union(Exists(Input<r4>,Input<r5>),Input<r6>)))|
4 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
5 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a5);
6 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
7 NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
8 TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
9 TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
10 TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
11 TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 168:
2 Exists(Exists(Agg_sum<a4 a5 r4 e2 a6 r5>(Input<r3
3 >),Input<r6>),Union(Input<r7>,Input<r8>))|
4 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
5 >))|
6 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
7 AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
8 AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
9 PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
10 r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r0,r8);
11 TableEq(r3,r6);TableEq(r3,r7);TableEq(r3,r8);
12 TableEq(r6,r7);TableEq(r6,r8);TableEq(r7,r8);
13 Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 169:
2 Exists(Agg_average<a4 a5 r6 e2 a6 r7>(Union(Exists
3 (Input<r3>,Input<r4>),Input<r5>)),Input<r8>)|
4 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
5 <r0>))|
6 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
7 AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
8 AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
9 PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
10 r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r8);
11 TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r8);
12 TableEq(r4,r5);TableEq(r4,r8);TableEq(r5,r8);
13 Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 170:
2 Exists(Agg_count<a5 a6 r5 e2 a7 r6>(Proj_simple<
3 a4 r4>(Input<r3>)),Union(Input<r7>,Input<r8>))|
4 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
5 r0>))|
6 AttrsEq(a0,a5);AttrsEq(a1,a5);AttrsEq(a2,a5);
7 AttrsEq(a3,a5);AttrsSub(a4,r3);AttrsSub(a5,r4);
8 AttrsSub(a6,r4);AttrsSub(a7,a5);NotNull(r3,a4);
9 PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
10 r3);TableEq(r0,r7);TableEq(r0,r8);TableEq(r3,r7);
11 TableEq(r3,r8);TableEq(r7,r8);Unique(r3,a4)|
```

```
1 rule 171:
2 Agg<_ a4 _ e0 a5 r7 e1 a6 r8>(Filter<e3 _>(Proj<
3 ea3 a3 r4>(Input<r3>)));e0:=FuncCall<count>(a5);e3
4 :=Sublink<EXISTS Union_all<>(Input<r5>,Input<r6>
5 >)|
6 Agg<_ a4 _ e2 a6 r1 e1 a6 r2>(Input<r3>);e2:=
7 FuncCall<count>(a6)|
```

```
4 AttrsSub(a3,r3);AttrsSub(a4,r4);AttrsSub(a5,r4);
5 AttrsSub(a6,a4);NotNull(r3,a3);TableEq(r3,r5);
6 TableEq(r3,r6);TableEq(r5,r6);Unique(r3,a3)|
```

```
1 rule 172:
2 Exists(Agg_sum<a4 a5 r4 e2 a6 r5>(Input<r3>),Union
3 (Exists(Input<r6>,Input<r7>),Input<r8>))|
4 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
5 >))|
6 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
7 AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
8 AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
9 PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
10 r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r0,r8);
11 TableEq(r3,r6);TableEq(r3,r7);TableEq(r3,r8);
12 TableEq(r6,r7);TableEq(r6,r8);TableEq(r7,r8);
13 Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 173:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
3 r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
4 Union_all<>(Union_all<>(Input<r4>,Input<r5>),Input
5 <r6>))|
6 Agg<_ a3 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
7 FuncCall<count>(a3)|
8 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
9 NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
10 TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
11 TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
12 (r3,a4)|
```

```
1 rule 174:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(
3 Union_all<>(Input<r3>,Input<r4>),Union_all<>(Input
4 <r5>,Input<r6>)));e0:=FuncCall<avg>(a5)|
5 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
6 r3>));e1:=FuncCall<avg>(a5)|
7 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
8 NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
9 TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
10 TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
11 (r3,a5)|
```

```
1 rule 175:
2 Exists(Agg_count<a4 a5 r4 e2 a6 r5>(Input<r3>),
3 Union(Input<r6>,Input<r7>))|
4 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
5 r0>))|
6 AttrsEq(a0,a6);AttrsEq(a1,a4);AttrsEq(a2,a4);
7 AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
8 AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
9 PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
10 r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r3,r6);
11 TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
12 (r3,a5)|
```

```
1 rule 176:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Union_all<>(Input<r3
3 >,Union_all<>(Input<r4>,Input<r5>)));e0:=FuncCall<
4 avg>(a5)|
```

```

3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 177:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
Union_all<>(Input<r4>,Input<r5>>>|
3 Filter<e2 a4>(Agg<_ a6 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<count>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 178:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Union(Union(
Input<r3>,Input<r4>),Input<r5>),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 179:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Exists(Exists
(Input<r3>,Input<r4>),Input<r5>),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 180:
2 Exists(Agg_count<a3 a4 r6 e1 a5 r7>(Exists(Input<
r3>,Union(Input<r4>,Input<r5>))),Input<r8>)|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a5);AttrsEq(a2,a3);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
TableEq(r0,r8);TableEq(r3,r4);TableEq(r3,r5);
TableEq(r3,r8);TableEq(r4,r5);TableEq(r4,r8);
TableEq(r5,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 181:

```

```

2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
Union_all<>(Input<r4>,Union_all<>(Input<r5>,Input<
r6>>>)|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 182:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
Union_all<>(Input<r4>,Filter<e4 _>(Input<r5>>>);e4
:=Sublink<EXISTS Input<r6>>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 183:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
Union_all<>(Input<r4>,Filter<e4 _>(Input<r5>>>);e4
:=Sublink<EXISTS Input<r6>>|
3 Agg<_ a5 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
(r3,a4)|

```

```

1 rule 184:
2 Agg<_ a5 _ e0 a6 r7 e2 a7 r8>(Filter<e3 _>(Proj<
ea4 a4 r4>(Input<r3>)));e0:=FuncCall<sum>(a6);e3:=
Sublink<EXISTS Union_all<>(Input<r5>,Input<r6>>)|
3 Filter<e2 a7>(Agg<_ a5 _ e1 a6 r1 e2 a5 r2>(Input<
r3>));e1:=FuncCall<sum>(a6)|
4 AttrsSub(a4,r3);AttrsSub(a5,r4);AttrsSub(a6,r4);
AttrsSub(a7,a5);NotNull(r3,a4);TableEq(r3,r5);
TableEq(r3,r6);TableEq(r5,r6);Unique(r3,a4)|

```

```

1 rule 185:
2 Exists(Agg_max<a3 a4 r6 e1 a5 r7>(Union(Input<r3>,
Union(Input<r4>,Input<r5>))),Input<r8>)|
3 Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a4);AttrsEq(a2,a5);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
TableEq(r0,r8);TableEq(r3,r4);TableEq(r3,r5);
TableEq(r3,r8);TableEq(r4,r5);TableEq(r4,r8);
TableEq(r5,r8);Unique(r3,a3);Unique(r3,a4)|

```

```
1 rule 186:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
3 Union(Input<r4>,Exists(Input<r5>,Input<r6>)))|
4 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
5 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a3);
6 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
7 NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
8 TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
9 TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
10 TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
11 TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 187:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
3 r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
4 Union_all<>(Input<r4>,Union_all<>(Input<r5>,Input<
5 r6>))>|
6 Agg<_ a3 _ e2 a5 r1 e1 a5 r2>(Input<r3>);e2:=
7 FuncCall<count>(a5)|
8 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
9 NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
10 TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
11 TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
12 (r3,a4)|
```

```
1 rule 188:
2 Agg_sum<a4 a5 r7 e2 a6 r8>(Exists(Input<r3>,Exists
3 (Union(Input<r4>,Input<r5>),Input<r6>)))|
4 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
5 >))|
6 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
7 AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
8 AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
9 PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
10 r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
11 TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
12 TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
13 Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 189:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Union(Input<
3 r3>,Exists(Input<r4>,Input<r5>)),Input<r6>))|
4 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
5 <r0>))|
6 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
7 AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
8 AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
9 PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
10 r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
11 TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
12 TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
13 Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 190:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
3 r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
4 Union_all<>(Input<r6>,Filter<e4 _>(Input<r7>))>;e4
5 :=Sublink<EXISTS Input<r8>>|
6 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
7 r3>));e1:=FuncCall<sum>(a5)|
```

```
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
5 NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
6 TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
7 TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a4);Unique
8 (r3,a5)|
```

```
1 rule 191:
2 Agg<_ a4 _ e0 a5 r7 e1 a6 r8>(Filter<e3 _>(Proj<
3 ea3 a3 r4>(Input<r3>)));e0:=FuncCall<count>(a5);e3
4 :=Sublink<EXISTS Union_all<>(Input<r5>,Input<r6>)>
5 >|
6 Agg<_ a6 _ e2 a4 r1 e1 a4 r2>(Input<r3>);e2:=
7 FuncCall<count>(a4)|
8 AttrsSub(a3,r3);AttrsSub(a4,r4);AttrsSub(a5,r4);
9 AttrsSub(a6,a4);NotNull(r3,a3);TableEq(r3,r5);
10 TableEq(r3,r6);TableEq(r5,r6);Unique(r3,a3)|
```

```
1 rule 192:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(Input<r3
3 >,Filter<e3 _>(Input<r4>)));e0:=FuncCall<avg>(a5);
4 e3:=Sublink<EXISTS Filter<e4 _>(Input<r5>)>;e4:=
5 Sublink<EXISTS Input<r6>>|
6 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
7 r3>));e1:=FuncCall<avg>(a5)|
8 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
9 NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
10 TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
11 TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
12 (r3,a5)|
```

```
1 rule 193:
2 Exists(Agg_sum<a4 a5 r4 e2 a6 r5>(Input<r3>),Union
3 (Input<r6>,Union(Input<r7>,Input<r8>)))|
4 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
5 >))|
6 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
7 AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
8 AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
9 PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
10 r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r0,r8);
11 TableEq(r3,r6);TableEq(r3,r7);TableEq(r3,r8);
12 TableEq(r6,r7);TableEq(r6,r8);TableEq(r7,r8);
13 Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 194:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<e3 _>(Input<
3 r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
4 Union_all<>(Input<r4>,Input<r5>))>|
5 Filter<e2 a4>(Agg<_ a4 _ e1 a4 r1 e2 a6 r2>(Input<
6 r3>));e1:=FuncCall<count>(a4)|
7 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
8 NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
9 TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
10 (r3,a5)|
```

```
1 rule 195:
2 Exists(Agg_count<a4 a5 r5 e1 a6 r6>(Proj_simple<_
3 a3 r4>(Input<r3>)),Union(Input<r7>,Input<r8>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
```



```

4 AttrsEq(a0,a6);AttrsEq(a1,a6);AttrsEq(a2,a4);
  AttrsSub(a3,r3);AttrsSub(a4,r4);AttrsSub(a5,r4);
  AttrsSub(a6,a4);NotNull(r3,a3);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r7);TableEq(r0,r8);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r7,r8);
  Unique(r3,a3)|

```

```

1 rule 196:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
  Union(Input<r4>,Union(Input<r5>,Input<r6>))))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a5);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 197:
2 Agg_average<a4 a5 r6 e2 a6 r7>(Union(Input<r3>,
  Exists(Input<r4>,Input<r5>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 198:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
  r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
  Filter<e4 _>(Input<r6>)>;e4:=Sublink<EXISTS
  Union_all<>(Input<r7>,Input<r8>)>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 199:
2 Agg<_ a3 _ e0 a4 r5 e1 a5 r6>(Union_all<>(Input<r3
  >,Input<r4>));e0:=FuncCall<max>(a4)|
3 Agg<_ a3 _ e2 a4 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<max>(a4)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 200:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Filter<e4 _>(Input<r6>),Input<r8>)>;e4
  :=Sublink<EXISTS Input<r7>>|
3 Agg<_ a5 _ e2 a5 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<count>(a5)|

```

```

4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
  (r3,a4)|

```

```

1 rule 201:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Exists(Union(Input<
  r3>,Input<r4>),Union(Input<r5>,Input<r6>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 202:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<
  e4 _>(Union_all<>(Input<r3>,Input<r4>)))));e0:=
  FuncCall<avg>(a5);e3:=Sublink<EXISTS Input<r8>>;e4
  :=Sublink<EXISTS Input<r5>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r8);TableEq(r4,r5);
  TableEq(r4,r8);TableEq(r5,r8);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 203:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r6 e1 a5 r7>(Filter<
  e4 _>(Input<r3>)))));e0:=FuncCall<count>(a4);e3:=
  Sublink<EXISTS Input<r8>>;e4:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>)>|
3 Agg<_ a5 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r8);TableEq(r4,r5);
  TableEq(r4,r8);TableEq(r5,r8);Unique(r3,a3);Unique
  (r3,a4)|

```

```

1 rule 204:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Union_all<>(Filter<
  e3 _>(Union_all<>(Input<r3>,Input<r4>)),Input<r6>))
  );e0:=FuncCall<max>(a4);e3:=Sublink<EXISTS Input<
  r5>>|
3 Agg<_ a5 _ e2 a4 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<max>(a4)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
  (r3,a4)|

```

```

1 rule 205:

```



```

2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
Union_all<>(Union_all<>(Input<r4>,Input<r5>),Input
<r6>)>|
3 Agg<_ a5 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
(r3,a4)|

```

```

1 rule 206:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
Union_all<>(Union_all<>(Input<r4>,Input<r5>),Input
<r6>)>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 207:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(Input<r3
>,Filter<e3 _>(Filter<e4 _>(Input<r4>)))));e0:=
FuncCall<avg>(a5);e3:=Sublink<EXISTS Input<r6>>;e4
:=Sublink<EXISTS Input<r5>>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 208:
2 Filter<e3 _>(Filter<e4 _>(Agg<_ a4 _ e0 a5 r4 e2
a6 r5>(Input<r3>)));e0:=FuncCall<count>(a5);e3:=
Sublink<EXISTS Input<r7>>;e4:=Sublink<EXISTS Input
<r6>>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a6 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<count>(a6)|
4 AttrsEq(a4,a5);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
TableEq(r3,r6);TableEq(r3,r7);TableEq(r6,r7);
Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 209:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
Union_all<>(Union_all<>(Input<r6>,Input<r7>),Input
<r8>)>|
3 Agg<_ a3 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|

```

```

4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
(r3,a4)|

```

```

1 rule 210:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
Union_all<>(Input<r4>,Input<r5>)>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a4 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<count>(a4)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 211:
2 Exists(Agg_count<a4 a5 r4 e2 a6 r5>(Input<r3>),
Input<r6>)|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
4 AttrsEq(a0,a6);AttrsEq(a1,a6);AttrsEq(a2,a6);
AttrsEq(a3,a6);AttrsEq(a4,a5);AttrsSub(a4,r3);
AttrsSub(a5,r3);AttrsSub(a6,a4);NotNull(r3,a4);
NotNull(r3,a5);PredicateEq(e0,e2);PredicateEq(e1,
e2);TableEq(r0,r3);TableEq(r0,r6);TableEq(r3,r6);
Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 212:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Exists(Union(Input<
r3>,Union(Input<r4>,Input<r5>)),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 213:
2 Agg_sum<a4 a5 r7 e2 a6 r8>(Exists(Input<r3>,Union(
Input<r4>,Union(Input<r5>,Input<r6>))))|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 214:
2 Exists(Agg_count<a3 a4 r6 e1 a5 r7>(Exists(Input<
r3>,Union(Input<r4>,Input<r5>))),Input<r8>)|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|

```

```

4 AttrsEq(a0,a3);AttrsEq(a1,a5);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r8);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r8);TableEq(r4,r5);TableEq(r4,r8);
  TableEq(r5,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 215:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
  Filter<e4 _>(Input<r4>)>;e4:=Sublink<EXISTS
  Union_all<>(Input<r5>,Input<r6>)>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 216:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Filter<
  e4 _>(Input<r3>)));e0:=FuncCall<count>(a4);e3:=
  Sublink<EXISTS Input<r6>);e4:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>)>|
3 Agg<_ a3 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
  (r3,a4)|

```

```

1 rule 217:
2 Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
  Union(Input<r6>,Union(Input<r7>,Input<r8>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 218:
2 Exists(Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<
  r3>),Union(Input<r6>,Input<r7>)),Input<r8>)|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a3);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 219:

```

```

2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>)>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a6 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<count>(a6)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 220:
2 Exists(Agg_count<a4 a5 r5 e1 a6 r6>(Proj_simple<_
  a3 r4>(Input<r3>)),Union(Input<r7>,Input<r8>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a4);AttrsEq(a1,a4);AttrsEq(a2,a4);
  AttrsSub(a3,r3);AttrsSub(a4,r4);AttrsSub(a5,r4);
  AttrsSub(a6,a4);NotNull(r3,a3);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r7);TableEq(r0,r8);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r7,r8);
  Unique(r3,a3)|

```

```

1 rule 221:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Input<r6>,Input<r7>)>|
3 Agg<_ a3 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a3);Unique
  (r3,a4)|

```

```

1 rule 222:
2 Agg_max<a3 a4 r7 e1 a5 r8>(Union(Input<r3>,Exists(
  Union(Input<r4>,Input<r5>)),Input<r6>)))|
3 Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a4);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 223:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Exists(Input<
  r3>,Exists(Input<r4>,Input<r5>)),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 224:

```

```

2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>)>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<count>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 225:
2 Exists(Agg_count<a3 a4 r6 e1 a5 r7>(Exists(Input<
  r3>,Union(Input<r4>,Input<r5>))),Input<r8>)|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a3);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r8);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r8);TableEq(r4,r5);TableEq(r4,r8);
  TableEq(r5,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 226:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Union_all<>(Filter<
  e3 _>(Union_all<>(Input<r3>,Input<r4>)),Input<r6>))
  );e0:=FuncCall<max>(a4);e3:=Sublink<EXISTS Input<
  r5>>|
3 Agg<_ a3 _ e2 a4 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<max>(a4)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
  (r3,a4)|

```

```

1 rule 227:
2 Exists(Agg_count<a4 a5 r4 e2 a6 r5>(Input<r3>),
  Input<r6>)|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a4);AttrsEq(a0,a5);AttrsEq(a1,a6);
  AttrsEq(a2,a4);AttrsEq(a2,a5);AttrsEq(a3,a4);
  AttrsEq(a3,a5);AttrsEq(a4,a5);AttrsSub(a4,r3);
  AttrsSub(a5,r3);AttrsSub(a6,a4);NotNull(r3,a4);
  NotNull(r3,a5);PredicateEq(e0,e2);PredicateEq(e1,
  e2);TableEq(r0,r3);TableEq(r0,r6);TableEq(r3,r6);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 228:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Exists(Union(Input<
  r3>,Input<r4>),Union(Input<r5>,Input<r6>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 229:
2 Filter<e3 _>(Filter<e4 _>(Agg<_ a4 _ e0 a5 r4 e2
  a6 r5>(Input<r3>)));e0:=FuncCall<avg>(a5);e3:=
  Sublink<EXISTS Union_all<>(Input<r7>,Input<r8>)>;
  e4:=Sublink<EXISTS Input<r6>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 230:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r5 e2 a6 r6>(
  Union_all<>(Input<r3>,Input<r4>)));e0:=FuncCall<
  avg>(a5);e3:=Sublink<EXISTS Input<r7>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r7);TableEq(r4,r7);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 231:
2 Exists(Exists(Agg_average<a4 a5 r4 e2 a6 r5>(Input<
  r3>),Input<r6>),Union(Input<r7>,Input<r8>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r0,r8);
  TableEq(r3,r6);TableEq(r3,r7);TableEq(r3,r8);
  TableEq(r6,r7);TableEq(r6,r8);TableEq(r7,r8);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 232:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Exists(Input<
  r3>,Exists(Input<r4>,Input<r5>)),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 233:
2 Exists(Agg_average<a4 a5 r6 e2 a6 r7>(Union(Exists
  (Input<r3>,Input<r4>),Input<r5>)),Input<r8>)|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|

```

```

4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r8);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r8);
  TableEq(r4,r5);TableEq(r4,r8);TableEq(r5,r8);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 234:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Union(Input<
  r3>,Input<r4>),Union(Input<r5>,Input<r6>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 235:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r5 e2 a6 r6>(
  Union_all<>(Input<r3>,Input<r4>)));e0:=FuncCall<
  avg>(a5);e3:=Sublink<EXISTS Input<r7>>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r7);TableEq(r4,r7);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 236:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r5 e1 a5 r6>(Filter<
  e4 _>(Input<r3>)));e0:=FuncCall<count>(a4);e3:=
  Sublink<EXISTS Union_all<>(Input<r7>,Input<r8>)>;
  e4:=Sublink<EXISTS Input<r4>>|
3 Agg<_ a3 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r4,r7);
  TableEq(r4,r8);TableEq(r7,r8);Unique(r3,a3);Unique
  (r3,a4)|

```

```

1 rule 237:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
  r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r6>,Input<r7>)>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a6 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<count>(a6)|
4 AttrsEq(a4,a5);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  TableEq(r3,r6);TableEq(r3,r7);TableEq(r6,r7);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 238:
2 Exists(Agg_count<a4 a5 r4 e2 a6 r5>(Input<r3>),
  Union(Input<r6>,Input<r7>))|

```

```

3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a6);AttrsEq(a1,a6);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 239:
2 Agg_sum<a4 a5 r7 e2 a6 r8>(Exists(Input<r3>,Union(
  Union(Input<r4>,Input<r5>),Input<r6>)))|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
  >))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 240:
2 Agg_count<a4 a5 r6 e2 a6 r7>(Exists(Input<r3>,
  Union(Input<r4>,Input<r5>)))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a6);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 241:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Exists(Union(Union(
  Input<r3>,Input<r4>),Input<r5>),Input<r6>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 242:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Exists(Input<
  r3>,Exists(Input<r4>,Input<r5>)),Input<r6>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|

```

```
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 243:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r5 e2 a6 r6>(
  Union_all<>(Input<r3>,Input<r4>)));e0:=FuncCall<
  avg>(a5);e3:=Sublink<EXISTS Filter<e4 _>(Input<r7
  >>);e4:=Sublink<EXISTS Input<r8>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r4,r7);
  TableEq(r4,r8);TableEq(r7,r8);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 244:
2 Exists(Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<
  r3>),Input<r6>),Union(Input<r7>,Input<r8>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a3);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 245:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
  r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r6>,Input<r7>)>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a4 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<count>(a4)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 246:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r6 e1 a5 r7>(Filter<
  e4 _>(Input<r3>)));e0:=FuncCall<count>(a4);e3:=
  Sublink<EXISTS Input<r8>>);e4:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>)>|
3 Agg<_ a5 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r8);TableEq(r4,r5);
  TableEq(r4,r8);TableEq(r5,r8);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 247:
2 Agg_average<a4 a5 r6 e2 a6 r7>(Union(Union(Input<
  r3>,Input<r4>),Input<r5>))|
```

```
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 248:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(
  Union_all<>(Input<r3>,Filter<e3 _>(Input<r4>)),
  Input<r6>));e0:=FuncCall<avg>(a5);e3:=Sublink<
  EXISTS Input<r5>>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 249:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Union_all<>(Input<r3
  >,Filter<e3 _>(Input<r4>)));e0:=FuncCall<avg>(a5);
  e3:=Sublink<EXISTS Input<r5>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 250:
2 Agg<_ a4 _ e0 a5 r7 e1 a6 r8>(Filter<e3 _>(Proj<
  ea3 a3 r4>(Input<r3>)));e0:=FuncCall<count>(a5);e3
  :=Sublink<EXISTS Union_all<>(Input<r5>,Input<r6>)>
  >|
3 Agg<_ a4 _ e2 a4 r1 e1 a4 r2>(Input<r3>);e2:=
  FuncCall<count>(a4)|
4 AttrsSub(a3,r3);AttrsSub(a4,r4);AttrsSub(a5,r4);
  AttrsSub(a6,a4);NotNull(r3,a3);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r5,r6);Unique(r3,a3)|
```

```
1 rule 251:
2 Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
  Exists(Input<r6>,Union(Input<r7>,Input<r8>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a5);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 252:
```

```

2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(Input<r3
>,Filter<e3 _>(Input<r4>)));e0:=FuncCall<avg>(a5);
e3:=Sublink<EXISTS Filter<e4 _>(Input<r5>)>;e4:=
Sublink<EXISTS Input<r6>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 253:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(Filter<
e3 _>(Input<r3>),Input<r6>));e0:=FuncCall<avg>(a5)
;e3:=Sublink<EXISTS Union_all<>(Input<r4>),Input<r5
>)>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 254:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Exists(Union(Exists
(Input<r3>,Input<r4>),Input<r5>),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 255:
2 Agg_max<a3 a4 r5 e1 a5 r6>(Union(Input<r3>,Input<
r4>))|
3 Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a4);AttrsEq(a2,a3);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r4);TableEq(r3,r4);
Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 256:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Exists(Union(Union(
Input<r3>,Input<r4>),Input<r5>),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|

```

```

4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 257:
2 Exists(Agg_sum<a4 a5 r4 e2 a6 r5>(Input<r3>),Union
(Input<r6>,Exists(Input<r7>,Input<r8>)))|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r0,r8);
TableEq(r3,r6);TableEq(r3,r7);TableEq(r3,r8);
TableEq(r6,r7);TableEq(r6,r8);TableEq(r7,r8);
Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 258:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Filter<
e4 _>(Input<r3>)));e0:=FuncCall<count>(a4);e3:=
Sublink<EXISTS Input<r6>>;e4:=Sublink<EXISTS
Union_all<>(Input<r4>,Input<r5>)>|
3 Agg<_ a3 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
(r3,a4)|

```

```

1 rule 259:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
Union_all<>(Input<r6>,Filter<e4 _>(Input<r7>))>;e4
:=Sublink<EXISTS Input<r8>>|
3 Agg<_ a5 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
(r3,a4)|

```

```

1 rule 260:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Exists(Union(Exists
(Input<r3>,Input<r4>),Input<r5>),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|

```

```
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 261:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
  Union(Union(Input<r4>,Input<r5>),Input<r6>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 262:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(
  Union_all<>(Input<r3>,Input<r4>),Union_all<>(Input
  <r5>,Input<r6>)))|e0:=FuncCall<avg>(a5)|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 263:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Exists(Input<
  r3>,Union(Input<r4>,Input<r5>)),Input<r6>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a3);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 264:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
  Union(Exists(Input<r4>,Input<r5>),Input<r6>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a5);AttrsEq(a2,a3);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 265:
```

```
2 Agg_count<a4 a5 r5 e2 a6 r6>(Exists(Input<r3>,
  Input<r4>))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a6);AttrsEq(a1,a6);AttrsEq(a2,a6);
  AttrsEq(a3,a6);AttrsEq(a4,a5);AttrsSub(a4,r3);
  AttrsSub(a5,r3);AttrsSub(a6,a4);NotNull(r3,a4);
  NotNull(r3,a5);PredicateEq(e0,e2);PredicateEq(e1,
  e2);TableEq(r0,r3);TableEq(r0,r4);TableEq(r3,r4);
  Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 266:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(Input<r3
  >,Filter<e3 _>(Filter<e4 _>(Input<r4>))))|e0:=
  FuncCall<avg>(a5);e3:=Sublink<EXISTS Input<r6>>;e4
  :=Sublink<EXISTS Input<r5>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 267:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
  r3>));e0:=FuncCall<avg>(a5);e3:=Sublink<EXISTS
  Union_all<>(Union_all<>(Input<r6>,Input<r7>),Input
  <r8>)>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 268:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(Filter<
  e3 _>(Input<r3>),Filter<e4 _>(Input<r5>))))|e0:=
  FuncCall<avg>(a5);e3:=Sublink<EXISTS Input<r4>>;e4
  :=Sublink<EXISTS Input<r6>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 269:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Exists(Input<
  r3>,Input<r4>),Exists(Input<r5>,Input<r6>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
```

```

4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
    TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
    TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
    Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 270:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(
  Union_all<>(Input<r3>,Union_all<>(Input<r4>,Input<
    r5>)),Input<r6>));e0:=FuncCall<avg>(a5)|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
    (r3,a5)|

```

```

1 rule 271:
2 Exists(Agg_count<a4 a5 r5 e1 a6 r6>(Proj_simple<_
  a3 r4>(Input<r3>)),Union(Input<r7>,Input<r8>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a4);AttrsEq(a1,a4);AttrsEq(a2,a6);
  AttrsSub(a3,r3);AttrsSub(a4,r4);AttrsSub(a5,r4);
  AttrsSub(a6,a4);NotNull(r3,a3);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r7);TableEq(r0,r8);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r7,r8);
  Unique(r3,a3)|

```

```

1 rule 272:
2 Agg_count<a4 a5 r7 e1 a6 r8>(Proj_simple<_ a3 r6>(
  Exists(Input<r3>,Union(Input<r4>,Input<r5>))))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a6);AttrsEq(a1,a6);AttrsEq(a2,a4);
  AttrsSub(a3,r3);AttrsSub(a4,r6);AttrsSub(a5,r6);
  AttrsSub(a6,a4);NotNull(r3,a3);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r4,r5);
  Unique(r3,a3)|

```

```

1 rule 273:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
  Union(Input<r4>,Union(Input<r5>,Input<r6>))))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 274:
2 Filter<e3 _>(Agg<_ a5 _ e0 a6 r5 e2 a7 r6>(Proj<
  ea4 a4 r4>(Input<r3>)));e0:=FuncCall<count>(a6);e3
  :=Sublink<EXISTS Union_all<>(Input<r7>,Input<r8>
    >)|

```

```

3 Filter<e2 a7>(Agg<_ a5 _ e1 a6 r1 e2 a5 r2>(Input<
  r3>));e1:=FuncCall<count>(a6)|
4 AttrsSub(a4,r3);AttrsSub(a5,r4);AttrsSub(a6,r4);
  AttrsSub(a7,a5);NotNull(r3,a4);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r7,r8);Unique(r3,a4)|

```

```

1 rule 275:
2 Exists(Agg_sum<a4 a5 r4 e2 a6 r5>(Input<r3>),Union
  (Input<r6>,Exists(Input<r7>,Input<r8>)))|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
  >))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r0,r8);
    TableEq(r3,r6);TableEq(r3,r7);TableEq(r3,r8);
    TableEq(r6,r7);TableEq(r6,r8);TableEq(r7,r8);
    Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 276:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Union_all<>(Input<r3
  >,Filter<e3 _>(Union_all<>(Input<r4>,Input<r5>)))));
  e0:=FuncCall<max>(a4);e3:=Sublink<EXISTS Input<r6
  >>|
3 Agg<_ a3 _ e2 a4 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<max>(a4)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
    (r3,a4)|

```

```

1 rule 277:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>)>|
3 Filter<e2 a6>(Agg<_ a6 _ e1 a5 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<count>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
    (r3,a5)|

```

```

1 rule 278:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(Filter<
  e3 _>(Input<r3>),Union_all<>(Input<r5>,Input<r6>))
  );e0:=FuncCall<avg>(a5);e3:=Sublink<EXISTS Input<
  r4>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
    (r3,a5)|

```

```

1 rule 279:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
  Union(Input<r4>,Union(Input<r5>,Input<r6>))))|

```



```

3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 280:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(
  Union_all<>(Input<r3>,Union_all<>(Input<r4>,Input<
  r5>)))));e0:=FuncCall<avg>(a5);e3:=Sublink<EXISTS
  Input<r8>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r8);TableEq(r4,r5);
  TableEq(r4,r8);TableEq(r5,r8);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 281:
2 Exists(Agg_average<a4 a5 r5 e2 a6 r6>(Union(Input<
  r3>,Input<r4>)),Exists(Input<r7>,Input<r8>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r7);TableEq(r0,r8);
  TableEq(r3,r4);TableEq(r3,r7);TableEq(r3,r8);
  TableEq(r4,r7);TableEq(r4,r8);TableEq(r7,r8);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 282:
2 Agg_count<a4 a5 r6 e2 a6 r7>(Exists(Input<r3>,
  Union(Input<r4>,Input<r5>)))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a6);AttrsEq(a1,a4);AttrsEq(a2,a4);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 283:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Filter<e3 _>(
  Union_all<>(Filter<e4 _>(Input<r3>),Input<r5>)));
  e0:=FuncCall<avg>(a5);e3:=Sublink<EXISTS Input<r6
  >>;e4:=Sublink<EXISTS Input<r4>>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|

```

```

4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 284:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(Filter<
  e3 _>(Union_all<>(Input<r3>,Input<r4>)),Input<r6>))
  );e0:=FuncCall<avg>(a5);e3:=Sublink<EXISTS Input<
  r5>>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 285:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Filter<e4 _>(Input<r4>),Input<r6>));e4
  :=Sublink<EXISTS Input<r5>>|
3 Agg<_ a3 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
  (r3,a4)|

```

```

1 rule 286:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r5 e1 a5 r6>(
  Union_all<>(Input<r3>,Input<r4>)));e0:=FuncCall<
  max>(a4);e3:=Sublink<EXISTS Union_all<>(Input<r7>,
  Input<r8>))|
3 Agg<_ a3 _ e2 a4 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<max>(a4)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r4,r7);
  TableEq(r4,r8);TableEq(r7,r8);Unique(r3,a3);Unique
  (r3,a4)|

```

```

1 rule 287:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
  Union_all<>(Union_all<>(Input<r4>,Input<r5>),Input
  <r6>))|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 288:

```

```

2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
Filter<e4 _>(Input<r4>)>;e4:=Sublink<EXISTS
Union_all<>(Input<r5>),Input<r6>)>|
3 Agg<_ a5 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
(r3,a4)|

```

```

1 rule 289:
2 Agg_max<a3 a4 r6 e1 a5 r7>(Union(Union(Input<r3>,
Input<r4>),Input<r5>))|
3 Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a4);AttrsEq(a2,a5);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r4,r5);
Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 290:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
Union(Input<r4>,Exists(Input<r5>,Input<r6>))))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a5);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 291:
2 Exists(Agg_average<a3 a4 r4 e1 a5 r5>(Input<r3>),
Union(Input<r6>,Union(Input<r7>,Input<r8>)))|
3 Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a0,a4);AttrsEq(a1,a3);
AttrsEq(a1,a4);AttrsEq(a2,a3);AttrsEq(a2,a4);
AttrsEq(a3,a4);AttrsSub(a3,r3);AttrsSub(a4,r3);
AttrsSub(a5,a3);NotNull(r3,a3);NotNull(r3,a4);
PredicateEq(e0,e1);TableEq(r0,r3);TableEq(r0,r6);
TableEq(r0,r7);TableEq(r0,r8);TableEq(r3,r6);
TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
(r3,a4)|

```

```

1 rule 292:
2 Exists(Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<
r3>),Union(Input<r6>,Input<r7>)),Input<r8>)|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a5);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 293:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(
Union_all<>(Input<r3>,Filter<e3 _>(Input<r4>)),
Input<r6>));e0:=FuncCall<avg>(a5);e3:=Sublink<
EXISTS Input<r5>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 294:
2 Agg_count<a4 a5 r6 e2 a6 r7>(Exists(Input<r3>,
Union(Input<r4>,Input<r5>)))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 295:
2 Filter<e3 _>(Filter<e4 _>(Agg<_ a4 _ e0 a5 r5 e2
a6 r6>(Union_all<>(Input<r3>,Input<r4>)))));e0:=
FuncCall<avg>(a5);e3:=Sublink<EXISTS Input<r8>>;e4
:=Sublink<EXISTS Input<r7>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r7);TableEq(r3,r8);TableEq(r4,r7);
TableEq(r4,r8);TableEq(r7,r8);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 296:
2 Exists(Agg_average<a4 a5 r6 e2 a6 r7>(Union(Input<
r3>,Union(Input<r4>,Input<r5>))),Input<r8>)|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r8);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r8);
TableEq(r4,r5);TableEq(r4,r8);TableEq(r5,r8);
Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 297:
2 Exists(Agg_count<a4 a5 r5 e1 a6 r6>(Proj_simple<_
a3 r4>(Input<r3>)),Union(Input<r7>,Input<r8>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|

```

```
4 AttrsEq(a0,a6);AttrsEq(a1,a4);AttrsEq(a2,a4);
  AttrsSub(a3,r3);AttrsSub(a4,r4);AttrsSub(a5,r4);
  AttrsSub(a6,a4);NotNull(r3,a3);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r7);TableEq(r0,r8);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r7,r8);
  Unique(r3,a3)|
```

```
1 rule 298:
2 Filter<e3 _>(Filter<e4 _>(Agg<_ a3 _ e0 a4 r4 e1
  a5 r5>(Input<r3>)));e0:=FuncCall<count>(a4);e3:=
  Sublink<EXISTS Union_all<>(Input<r7>,Input<r8>)>;
  e4:=Sublink<EXISTS Input<r6>>|
3 Agg<_ a5 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 299:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Filter<e4 _>(Union_all<>(Input<r6>,Input<r7>))>;e4
  :=Sublink<EXISTS Input<r8>>|
3 Agg<_ a5 _ e2 a5 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<count>(a5)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 300:
2 Agg<_ a4 _ e0 a5 r7 e1 a6 r8>(Filter<e3 _>(Proj<
  ea3 a3 r4>(Input<r3>)));e0:=FuncCall<count>(a5);e3
  :=Sublink<EXISTS Union_all<>(Input<r5>,Input<r6>)>
  >|
3 Agg<_ a6 _ e2 a4 r1 e1 a6 r2>(Input<r3>);e2:=
  FuncCall<count>(a4)|
4 AttrsSub(a3,r3);AttrsSub(a4,r4);AttrsSub(a5,r4);
  AttrsSub(a6,a4);NotNull(r3,a3);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r5,r6);Unique(r3,a3)|
```

```
1 rule 301:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Filter<e4 _>(Union_all<>(Input<r4>,Input<r5>))>;e4
  :=Sublink<EXISTS Input<r6>>|
3 Agg<_ a3 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 302:
```

```
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Filter<
  e4 _>(Input<r3>)));e0:=FuncCall<count>(a4);e3:=
  Sublink<EXISTS Union_all<>(Input<r5>,Input<r6>)>;
  e4:=Sublink<EXISTS Input<r4>>|
3 Agg<_ a3 _ e2 a5 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a5)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 303:
2 Agg_max<a3 a4 r6 e1 a5 r7>(Union(Input<r3>,Union(
  Input<r4>,Input<r5>)))|
3 Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a4);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r4,r5);
  Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 304:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(
  Union_all<>(Union_all<>(Input<r3>,Input<r4>),Input
  <r5>),Input<r6>));e0:=FuncCall<avg>(a5)|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 305:
2 Exists(Agg_max<a3 a4 r6 e1 a5 r7>(Union(Union(
  Input<r3>,Input<r4>),Input<r5>)),Input<r8>)|
3 Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a4);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r8);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r8);TableEq(r4,r5);TableEq(r4,r8);
  TableEq(r5,r8);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 306:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
  Union(Union(Input<r4>,Input<r5>),Input<r6>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 307:
```

```

2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Union_all<>(Filter<
e3 _>(Input<r3>),Input<r5>));e0:=FuncCall<avg>(a5)
;e3:=Sublink<EXISTS Input<r4>>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 308:
2 Agg_average<a4 a5 r6 e2 a6 r7>(Union(Union(Input<
r3>,Input<r4>),Input<r5>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 309:
2 Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
Union(Exists(Input<r6>,Input<r7>),Input<r8>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a3);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 310:
2 Exists(Agg_average<a3 a4 r4 e1 a5 r5>(Input<r3>),
Union(Input<r6>,Union(Input<r7>,Input<r8>)))|
3 Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a0,a4);AttrsEq(a1,a5);
AttrsEq(a2,a3);AttrsEq(a2,a4);AttrsEq(a3,a4);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 311:
2 Agg_count<a4 a5 r6 e2 a6 r7>(Exists(Input<r3>,
Union(Input<r4>,Input<r5>)))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
4 AttrsEq(a0,a6);AttrsEq(a1,a5);AttrsEq(a2,a4);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
(r3,a5)|

```

```

1 rule 312:
2 Exists(Agg_count<a5 a6 r5 e2 a7 r6>(Proj_simple<_
a4 r4>(Input<r3>)),Union(Input<r7>,Input<r8>))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
4 AttrsEq(a0,a5);AttrsEq(a1,a6);AttrsEq(a2,a5);
AttrsEq(a3,a7);AttrsSub(a4,r3);AttrsSub(a5,r4);
AttrsSub(a6,r4);AttrsSub(a7,a5);NotNull(r3,a4);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r7);TableEq(r0,r8);TableEq(r3,r7);
TableEq(r3,r8);TableEq(r7,r8);Unique(r3,a4)|

```

```

1 rule 313:
2 Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
Union(Input<r6>,Input<r7>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a5);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
TableEq(r3,r6);TableEq(r3,r7);TableEq(r6,r7);
Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 314:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Exists(Union(Input<
r3>,Exists(Input<r4>,Input<r5>)),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 315:
2 Filter<e3 _>(Agg<_ a5 _ e0 a6 r5 e2 a7 r6>(Proj<
ea4 a4 r4>(Input<r3>)));e0:=FuncCall<count>(a6);e3
:=Sublink<EXISTS Union_all<>(Input<r7>,Input<r8>
>|
3 Filter<e2 a5>(Agg<_ a5 _ e1 a5 r1 e2 a7 r2>(Input<
r3>));e1:=FuncCall<count>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r4);AttrsSub(a6,r4);
AttrsSub(a7,a5);NotNull(r3,a4);TableEq(r3,r7);
TableEq(r3,r8);TableEq(r7,r8);Unique(r3,a4)|

```

```

1 rule 316:
2 Filter<e3 _>(Filter<e4 _>(Agg<_ a4 _ e0 a5 r4 e2
a6 r5>(Input<r3>)));e0:=FuncCall<sum>(a5);e3:=
Sublink<EXISTS Input<r8>>;e4:=Sublink<EXISTS
Union_all<>(Input<r6>,Input<r7>))|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a4);Unique
(r3,a5)|

```

```
1 rule 317:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Union(Union(
  Input<r3>, Input<r4>), Input<r5>), Input<r6>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0, a4); AttrsEq(a1, a5); AttrsEq(a2, a4);
  AttrsEq(a3, a6); AttrsSub(a4, r3); AttrsSub(a5, r3);
  AttrsSub(a6, a4); NotNull(r3, a4); NotNull(r3, a5);
  PredicateEq(e0, e2); PredicateEq(e1, e2); TableEq(r0,
  r3); TableEq(r0, r4); TableEq(r0, r5); TableEq(r0, r6);
  TableEq(r3, r4); TableEq(r3, r5); TableEq(r3, r6);
  TableEq(r4, r5); TableEq(r4, r6); TableEq(r5, r6);
  Unique(r3, a4); Unique(r3, a5)|
```

```
1 rule 318:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(
  Union_all<>(Input<r3>, Input<r4>), Filter<e3 _>(
  Input<r5>)))| e0:=FuncCall<avg>(a5); e3:=Sublink<
  EXISTS Input<r6>>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>)); e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4, r3); AttrsSub(a5, r3); AttrsSub(a6, a4);
  NotNull(r3, a4); NotNull(r3, a5); TableEq(r3, r4);
  TableEq(r3, r5); TableEq(r3, r6); TableEq(r4, r5);
  TableEq(r4, r6); TableEq(r5, r6); Unique(r3, a4); Unique
  (r3, a5)|
```

```
1 rule 319:
2 Agg_average<a4 a5 r6 e2 a6 r7>(Exists(Union(Input<
  r3>, Input<r4>), Input<r5>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0, a4); AttrsEq(a1, a5); AttrsEq(a2, a6);
  AttrsEq(a3, a4); AttrsSub(a4, r3); AttrsSub(a5, r3);
  AttrsSub(a6, a4); NotNull(r3, a4); NotNull(r3, a5);
  PredicateEq(e0, e2); PredicateEq(e1, e2); TableEq(r0,
  r3); TableEq(r0, r4); TableEq(r0, r5); TableEq(r3, r4);
  TableEq(r3, r5); TableEq(r4, r5); Unique(r3, a4); Unique
  (r3, a5)|
```

```
1 rule 320:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r5 e1 a5 r6>(Filter<
  e4 _>(Input<r3>)))| e0:=FuncCall<count>(a4); e3:=
  Sublink<EXISTS Union_all<>(Input<r7>, Input<r8>)>;
  e4:=Sublink<EXISTS Input<r4>>|
3 Agg<_ a3 _ e2 a5 r1 e1 a5 r2>(Input<r3>); e2:=
  FuncCall<count>(a5)|
4 AttrsSub(a3, r3); AttrsSub(a4, r3); AttrsSub(a5, a3);
  NotNull(r3, a3); NotNull(r3, a4); TableEq(r3, r4);
  TableEq(r3, r7); TableEq(r3, r8); TableEq(r4, r7);
  TableEq(r4, r8); TableEq(r7, r8); Unique(r3, a3); Unique
  (r3, a4)|
```

```
1 rule 321:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<e3 _>(Input<
  r3>)); e0:=FuncCall<count>(a5); e3:=Sublink<EXISTS
  Union_all<>(Input<r4>, Input<r5>)>|
3 Filter<e2 a4>(Agg<_ a6 _ e1 a4 r1 e2 a4 r2>(Input<
  r3>)); e1:=FuncCall<count>(a4)|
```

```
4 AttrsSub(a4, r3); AttrsSub(a5, r3); AttrsSub(a6, a4);
  NotNull(r3, a4); NotNull(r3, a5); TableEq(r3, r4);
  TableEq(r3, r5); TableEq(r4, r5); Unique(r3, a4); Unique
  (r3, a5)|
```

```
1 rule 322:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
  r3>)); e0:=FuncCall<sum>(a5); e3:=Sublink<EXISTS
  Union_all<>(Filter<e4 _>(Input<r6>), Input<r8>)>; e4
  :=Sublink<EXISTS Input<r7>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
  r3>)); e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4, r3); AttrsSub(a5, r3); AttrsSub(a6, a4);
  NotNull(r3, a4); NotNull(r3, a5); TableEq(r3, r6);
  TableEq(r3, r7); TableEq(r3, r8); TableEq(r6, r7);
  TableEq(r6, r8); TableEq(r7, r8); Unique(r3, a4); Unique
  (r3, a5)|
```

```
1 rule 323:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Filter<e3 _>(Input<
  r3>)); e0:=FuncCall<sum>(a5); e3:=Sublink<EXISTS
  Filter<e4 _>(Input<r4>)>; e4:=Sublink<EXISTS
  Union_all<>(Input<r5>, Input<r6>)>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>)); e1:=FuncCall<sum>(a5)|
4 AttrsSub(a4, r3); AttrsSub(a5, r3); AttrsSub(a6, a4);
  NotNull(r3, a4); NotNull(r3, a5); TableEq(r3, r4);
  TableEq(r3, r5); TableEq(r3, r6); TableEq(r4, r5);
  TableEq(r4, r6); TableEq(r5, r6); Unique(r3, a4); Unique
  (r3, a5) Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(
  Input<r3>)); e0:=FuncCall<count>(a5); e3:=Sublink<
  EXISTS Union_all<>(Input<r6>, Input<r7>)>|
5 Filter<e2 a6>(Agg<_ a4 _ e1 a6 r1 e2 a4 r2>(Input<
  r3>)); e1:=FuncCall<count>(a6)|
6 AttrsSub(a4, r3); AttrsSub(a5, r3); AttrsSub(a6, a4);
  NotNull(r3, a4); NotNull(r3, a5); TableEq(r3, r6);
  TableEq(r3, r7); TableEq(r6, r7); Unique(r3, a4); Unique
  (r3, a5)|
```

```
1 rule 324:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<e3 _>(Input<
  r3>)); e0:=FuncCall<count>(a5); e3:=Sublink<EXISTS
  Union_all<>(Input<r4>, Input<r5>)>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a6 r1 e2 a4 r2>(Input<
  r3>)); e1:=FuncCall<count>(a6)|
4 AttrsEq(a4, a5); AttrsSub(a4, r3); AttrsSub(a5, r3);
  AttrsSub(a6, a4); NotNull(r3, a4); NotNull(r3, a5);
  TableEq(r3, r4); TableEq(r3, r5); TableEq(r4, r5);
  Unique(r3, a4); Unique(r3, a5)|
```

```
1 rule 325:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
  Exists(Input<r4>, Exists(Input<r5>, Input<r6>))))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
```

```

4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 326:
2 Exists(Exists(Agg_sum<a4 a5 r4 e2 a6 r5>(Input<r3
  >),Union(Input<r6>,Input<r7>)),Input<r8>)|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
  >))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r0,r8);
  TableEq(r3,r6);TableEq(r3,r7);TableEq(r3,r8);
  TableEq(r6,r7);TableEq(r6,r8);TableEq(r7,r8);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 327:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Filter<e4 _>(Union_all<>(Input<r6>,Input<r7>))>;e4
  :=Sublink<EXISTS Input<r8>>|
3 Agg<_ a5 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
    (r3,a4)|

```

```

1 rule 328:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Filter<e4 _>(Input<r6>)>;e4:=Sublink<EXISTS
  Union_all<>(Input<r7>,Input<r8>)>|
3 Agg<_ a3 _ e2 a5 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a5)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
    (r3,a4)|

```

```

1 rule 329:
2 Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
  Union(Input<r6>,Exists(Input<r7>,Input<r8>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 330:
2 Filter<e3 _>(Filter<e4 _>(Agg<_ a4 _ e0 a5 r4 e2
  a6 r5>(Input<r3>)));e0:=FuncCall<avg>(a5);e3:=
  Sublink<EXISTS Union_all<>(Input<r7>,Input<r8>)>;
  e4:=Sublink<EXISTS Input<r6>>|
3 Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a4);Unique
    (r3,a5)|

```

```

1 rule 331:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
  r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r6>,Input<r7>)>|
3 Filter<e2 a4>(Agg<_ a6 _ e1 a5 r1 e2 a6 r2>(Input<
  r3>));e1:=FuncCall<count>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
    (r3,a5)|

```

```

1 rule 332:
2 Agg_count<a4 a5 r6 e2 a6 r7>(Exists(Input<r3>,
  Union(Input<r4>,Input<r5>)))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a4);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
    r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
    (r3,a5)|

```

```

1 rule 333:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r5 e1 a5 r6>(Filter<
  e4 _>(Input<r3>)));e0:=FuncCall<count>(a4);e3:=
  Sublink<EXISTS Union_all<>(Input<r7>,Input<r8>)>;
  e4:=Sublink<EXISTS Input<r4>>|
3 Agg<_ a5 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r4,r7);
  TableEq(r4,r8);TableEq(r7,r8);Unique(r3,a3);Unique
    (r3,a4)|

```

```

1 rule 334:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Exists(Input<
  r3>,Input<r4>),Union(Input<r5>,Input<r6>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|

```

```
1 rule 335:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(Filter<
e3 _>(Input<r3>),Input<r6>));e0:=FuncCall<avg>(a5)
;e3:=Sublink<EXISTS Filter<e4 _>(Input<r4>)>;e4:=
Sublink<EXISTS Input<r5>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
(r3,a5)|
```

```
1 rule 336:
2 Agg_count<a4 a5 r7 e1 a6 r8>(Proj_simple<_ a3 r6>(
Exists(Input<r3>,Union(Input<r4>,Input<r5>))))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a6);AttrsEq(a1,a4);AttrsEq(a2,a6);
AttrsSub(a3,r3);AttrsSub(a4,r6);AttrsSub(a5,r6);
AttrsSub(a6,a4);NotNull(r3,a3);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
TableEq(r3,r4);TableEq(r3,r5);TableEq(r4,r5);
Unique(r3,a3)|
```

```
1 rule 337:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(Input<r3
>,Union_all<>(Input<r4>,Filter<e3 _>(Input<r5>))))
;e0:=FuncCall<avg>(a5);e3:=Sublink<EXISTS Input<r6
>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
(r3,a5)|
```

```
1 rule 338:
2 Exists(Agg_sum<a4 a5 r5 e2 a6 r6>(Exists(Input<r3
>,Input<r4>)),Union(Input<r7>,Input<r8>))|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r7);TableEq(r0,r8);
TableEq(r3,r4);TableEq(r3,r7);TableEq(r3,r8);
TableEq(r4,r7);TableEq(r4,r8);TableEq(r7,r8);
Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 339:
2 Agg_average<a4 a5 r6 e2 a6 r7>(Union(Input<r3>,
Union(Input<r4>,Input<r5>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
```

```
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
(r3,a5)|
```

```
1 rule 340:
2 Agg<_ a4 _ e0 a5 r7 e2 a6 r8>(Union_all<>(
Union_all<>(Input<r3>,Input<r4>),Filter<e3 _>(
Input<r5>)));e0:=FuncCall<avg>(a5);e3:=Sublink<
EXISTS Input<r6>>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a4);Unique
(r3,a5)|
```

```
1 rule 341:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
Filter<e4 _>(Input<r6>)>;e4:=Sublink<EXISTS
Union_all<>(Input<r7>,Input<r8>)>|
3 Agg<_ a5 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
(r3,a4)|
```

```
1 rule 342:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
Union(Exists(Input<r4>,Input<r5>),Input<r6>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a5);AttrsEq(a1,a3);AttrsEq(a2,a3);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 343:
2 Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
Exists(Union(Input<r6>,Input<r7>),Input<r8>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a5);
AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 344:
2 Exists(Agg_sum<a4 a5 r4 e2 a6 r5>(Input<r3>),Union
(Union(Input<r6>,Input<r7>),Input<r8>))|
```

```

3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r0,r8);
  TableEq(r3,r6);TableEq(r3,r7);TableEq(r3,r8);
  TableEq(r6,r7);TableEq(r6,r8);TableEq(r7,r8);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 345:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Exists(Input<
r3>,Union(Input<r4>,Input<r5>)),Input<r6>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a5);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 346:
2 Agg_average<a4 a5 r6 e2 a6 r7>(Union(Input<r3>,
  Union(Input<r4>,Input<r5>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 347:
2 Exists(Agg_max<a3 a4 r5 e1 a5 r6>(Union(Input<r3>,
  Input<r4>)),Union(Input<r7>,Input<r8>))|
3 Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a4);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r4);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r4,r7);TableEq(r4,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 348:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Exists(Exists
  (Input<r3>,Input<r4>),Input<r5>),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|

```

```

1 rule 349:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r6 e1 a5 r7>(Filter<
e4 _>(Input<r3>)))|e0:=FuncCall<count>(a4);e3:=
  Sublink<EXISTS Input<r8>>;e4:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>)>|
3 Agg<_ a3 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r8);TableEq(r4,r5);
  TableEq(r4,r8);TableEq(r5,r8);Unique(r3,a3);Unique
  (r3,a4)|

```

```

1 rule 350:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Input<r4>,Filter<e4 _>(Input<r5>))>;e4
  :=Sublink<EXISTS Input<r6>>|
3 Agg<_ a5 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
  (r3,a4)|

```

```

1 rule 351:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Filter<e4 _>(Input<r6>),Input<r8>))>;e4
  :=Sublink<EXISTS Input<r7>>|
3 Agg<_ a5 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
  (r3,a4)|

```

```

1 rule 352:
2 Agg_count<a5 a6 r7 e2 a7 r8>(Exists(Proj_simple<_
a4 r4>(Input<r3>),Union(Input<r5>,Input<r6>)))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
4 AttrsEq(a0,a5);AttrsEq(a1,a5);AttrsEq(a2,a7);
  AttrsEq(a3,a5);AttrsSub(a4,r3);AttrsSub(a5,r4);
  AttrsSub(a6,r4);AttrsSub(a7,a5);NotNull(r3,a4);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r5);TableEq(r0,r6);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r5,r6);Unique(r3,a4)|

```

```

1 rule 353:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
  Union(Exists(Input<r4>,Input<r5>),Input<r6>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|

```



```
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 354:
2 Exists(Agg_sum<a4 a5 r4 e2 a6 r5>(Input<r3>),Union
  (Input<r6>,Input<r7>))|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
  >))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
  (r3,a5)|
```

```
1 rule 355:
2 Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
  Union(Input<r6>,Exists(Input<r7>,Input<r8>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a5);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 356:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
  Union(Union(Input<r4>,Input<r5>),Input<r6>)))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 357:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Input<r6>,Filter<e4 _>(Input<r7>))>;e4
  :=Sublink<EXISTS Input<r8>>|
3 Agg<_ a5 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 358:
2 Agg_count<a4 a5 r7 e1 a6 r8>(Exists(Proj_simple<_
  a3 r4>(Input<r3>),Union(Input<r5>,Input<r6>)))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a4);AttrsEq(a1,a4);AttrsEq(a2,a6);
  AttrsSub(a3,r3);AttrsSub(a4,r4);AttrsSub(a5,r4);
  AttrsSub(a6,a4);NotNull(r3,a3);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r5,r6);
  Unique(r3,a3)|
```

```
1 rule 359:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Exists(Union(Exists
  (Input<r3>,Input<r4>),Input<r5>),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
  <r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 360:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Input<r4>,Filter<e4 _>(Input<r5>))>;e4
  :=Sublink<EXISTS Input<r6>>|
3 Agg<_ a3 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
  (r3,a4)|
```

```
1 rule 361:
2 Agg_sum<a5 a6 r7 e2 a7 r8>(Exists(Proj_simple<_ a4
  r4>(Input<r3>),Union(Input<r5>,Input<r6>)))|
3 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
  >))|
4 AttrsEq(a0,a5);AttrsEq(a1,a6);AttrsEq(a2,a5);
  AttrsEq(a3,a7);AttrsSub(a4,r3);AttrsSub(a5,r4);
  AttrsSub(a6,r4);AttrsSub(a7,a5);NotNull(r3,a4);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r5);TableEq(r0,r6);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r5,r6);Unique(r3,a4)|
```

```
1 rule 362:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r5 e1 a5 r6>(Filter<
  e4 _>(Input<r3>))));e0:=FuncCall<count>(a4);e3:=
  Sublink<EXISTS Union_all<>(Input<r7>,Input<r8>))>;
  e4:=Sublink<EXISTS Input<r4>>|
3 Agg<_ a5 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
```

```

4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r4,r7);
  TableEq(r4,r8);TableEq(r7,r8);Unique(r3,a3);Unique
  (r3,a4)|

```

```

1 rule 363:
2 Exists(Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<
  r3>),Input<r6>),Union(Input<r7>,Input<r8>))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a5);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r6);TableEq(r0,r7);
  TableEq(r0,r8);TableEq(r3,r6);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r6,r7);TableEq(r6,r8);
  TableEq(r7,r8);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 364:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
  r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r6>,Input<r7>)>|
3 Filter<e2 a6>(Agg<_ a4 _ e1 a4 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<count>(a4)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 365:
2 Filter<e3 _>(Agg<_ a4 _ e0 a5 r5 e1 a6 r6>(Proj<
  ea3 a3 r4>(Input<r3>)));e0:=FuncCall<count>(a5);e3
  :=Sublink<EXISTS Union_all<>(Input<r7>,Input<r8>)>
  >|
3 Agg<_ a4 _ e2 a4 r1 e1 a6 r2>(Input<r3>);e2:=
  FuncCall<count>(a4)|
4 AttrsSub(a3,r3);AttrsSub(a4,r4);AttrsSub(a5,r4);
  AttrsSub(a6,a4);NotNull(r3,a3);TableEq(r3,r7);
  TableEq(r3,r8);TableEq(r7,r8);Unique(r3,a3)|

```

```

1 rule 366:
2 Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
  Union_all<>(Input<r4>,Input<r5>)>|
3 Filter<e2 a6>(Agg<_ a6 _ e1 a6 r1 e2 a4 r2>(Input<
  r3>));e1:=FuncCall<count>(a6)|
4 AttrsSub(a4,r3);AttrsSub(a5,r3);AttrsSub(a6,a4);
  NotNull(r3,a4);NotNull(r3,a5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 367:
2 Agg_count<a4 a5 r6 e2 a6 r7>(Exists(Input<r3>,
  Union(Input<r4>,Input<r5>)))|
3 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|

```

```

4 AttrsEq(a0,a6);AttrsEq(a1,a4);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
  (r3,a5)|

```

```

1 rule 368:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Input<r6>,Filter<e4 _>(Input<r7>))>;e4
  :=Sublink<EXISTS Input<r8>>|
3 Agg<_ a3 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
  TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
  TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
  (r3,a4)|

```

```

1 rule 369:
2 Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
  r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
  Union_all<>(Filter<e4 _>(Input<r4>),Input<r6>)>;e4
  :=Sublink<EXISTS Input<r5>>|
3 Agg<_ a3 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
  FuncCall<count>(a3)|
4 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r4);
  TableEq(r3,r5);TableEq(r3,r6);TableEq(r4,r5);
  TableEq(r4,r6);TableEq(r5,r6);Unique(r3,a3);Unique
  (r3,a4)|

```

```

1 rule 370:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
  Union(Input<r4>,Exists(Input<r5>,Input<r6>))))|
3 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
4 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a3);
  AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
  NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
  TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
  TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
  TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
  TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|

```

```

1 rule 371:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Exists(Input<
  r3>,Union(Input<r4>,Input<r5>)),Input<r6>))|
3 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input<
  r0>))|
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
  AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
  AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
  PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
  r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
  TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
  TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
  Unique(r3,a4);Unique(r3,a5)|

```

```
1 rule 372:
2 Agg_count<a4 a5 r6 e2 a6 r7>(Exists(Input<r3>,
3 Union(Input<r4>,Input<r5>)))|
4 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
5 r0>))|
6 AttrsEq(a0,a6);AttrsEq(a1,a5);AttrsEq(a2,a4);
7 AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
8 AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
9 PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
10 r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
11 TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
12 (r3,a5)|
```

```
1 rule 373:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
3 Union(Input<r4>,Exists(Input<r5>,Input<r6>))))|
4 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
5 <r0>))|
6 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
7 AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
8 AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
9 PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
10 r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
11 TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
12 TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
13 Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 374:
2 Exists(Exists(Agg_sum<a4 a5 r4 e2 a6 r5>(Input<r3
3 >),Input<r6>),Union(Input<r7>,Input<r8>))|
4 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
5 >))|
6 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a4);
7 AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
8 AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
9 PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
10 r3);TableEq(r0,r6);TableEq(r0,r7);TableEq(r0,r8);
11 TableEq(r3,r6);TableEq(r3,r7);TableEq(r3,r8);
12 TableEq(r6,r7);TableEq(r6,r8);TableEq(r7,r8);
13 Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 375:
2 Exists(Agg_sum<a4 a5 r6 e2 a6 r7>(Exists(Input<r3
3 >,Union(Input<r4>,Input<r5>))),Input<r8>)|
4 Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
5 >))|
6 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
7 AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
8 AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
9 PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
10 r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r8);
11 TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r8);
12 TableEq(r4,r5);TableEq(r4,r8);TableEq(r5,r8);
13 Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 376:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
3 Union(Input<r4>,Exists(Input<r5>,Input<r6>))))|
4 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
5 <r0>))|
```

```
4 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
5 AttrsEq(a3,a6);AttrsSub(a4,r3);AttrsSub(a5,r3);
6 AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
7 PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
8 r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
9 TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
10 TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
11 Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 377:
2 Agg_count<a4 a5 r6 e2 a6 r7>(Exists(Input<r3>,
3 Union(Input<r4>,Input<r5>)))|
4 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
5 r0>))|
6 AttrsEq(a0,a6);AttrsEq(a1,a4);AttrsEq(a2,a6);
7 AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
8 AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
9 PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
10 r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r3,r4);
11 TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
12 (r3,a5)|
```

```
1 rule 378:
2 Filter<e3 _>(Agg<_ a3 _ e0 a4 r4 e1 a5 r5>(Input<
3 r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
4 Filter<e4 _>(Input<r6>)>;e4:=Sublink<EXISTS
5 Union_all<>(Input<r7>,Input<r8>)>|
6 Agg<_ a3 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
7 FuncCall<count>(a3)|
8 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
9 NotNull(r3,a3);NotNull(r3,a4);TableEq(r3,r6);
10 TableEq(r3,r7);TableEq(r3,r8);TableEq(r6,r7);
11 TableEq(r6,r8);TableEq(r7,r8);Unique(r3,a3);Unique
12 (r3,a4)|
```

```
1 rule 379:
2 Agg_average<a4 a5 r7 e2 a6 r8>(Union(Union(Input<
3 r3>,Union(Input<r4>,Input<r5>)),Input<r6>))|
4 Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
5 <r0>))|
6 AttrsEq(a0,a4);AttrsEq(a1,a5);AttrsEq(a2,a6);
7 AttrsEq(a3,a4);AttrsSub(a4,r3);AttrsSub(a5,r3);
8 AttrsSub(a6,a4);NotNull(r3,a4);NotNull(r3,a5);
9 PredicateEq(e0,e2);PredicateEq(e1,e2);TableEq(r0,
10 r3);TableEq(r0,r4);TableEq(r0,r5);TableEq(r0,r6);
11 TableEq(r3,r4);TableEq(r3,r5);TableEq(r3,r6);
12 TableEq(r4,r5);TableEq(r4,r6);TableEq(r5,r6);
13 Unique(r3,a4);Unique(r3,a5)|
```

```
1 rule 380:
2 Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Exists(Input<
3 r3>,Input<r4>),Union(Input<r5>,Input<r6>)))|
4 Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
5 AttrsEq(a0,a3);AttrsEq(a1,a3);AttrsEq(a2,a3);
6 AttrsSub(a3,r3);AttrsSub(a4,r3);AttrsSub(a5,a3);
7 NotNull(r3,a3);NotNull(r3,a4);PredicateEq(e0,e1);
8 TableEq(r0,r3);TableEq(r0,r4);TableEq(r0,r5);
9 TableEq(r0,r6);TableEq(r3,r4);TableEq(r3,r5);
10 TableEq(r3,r6);TableEq(r4,r5);TableEq(r4,r6);
11 TableEq(r5,r6);Unique(r3,a3);Unique(r3,a4)|
```

```
1 rule 381:
2 Exists(Agg_count<a4 a5 r4 e2 a6 r5>(Input<r3>),
3 Input<r6>)|
4 Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
5 AttrsEq(a0,a6);AttrsEq(a1,a6);AttrsEq(a2,a6);
6 AttrsEq(a3,a6);AttrsEq(a4,a5);AttrsSub(a4,r3);
7 AttrsSub(a5,r3);AttrsSub(a6,a4);NotNull(r3,a4);
8 NotNull(r3,a5);PredicateEq(e0,e2);PredicateEq(e1,
9 e2);TableEq(r0,r3);TableEq(r0,r6);TableEq(r3,r6);
10 Unique(r3,a4);Unique(r3,a5)
```

## REFERENCES

- [1] Haoran Ding, Zhaoguo Wang, Yicun Yang, Dexin Zhang, Zhenglin Xu, Haibo Chen, Ruzica Piskac, and Jinyang Li. 2023. Proving query equivalence using linear integer arithmetic. *Proceedings of the ACM on Management of Data* 1, 4 (2023), 1–26.