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. □

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. □

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. □

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. □

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. □

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 classfied 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. □

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

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

```
rule 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>>|
Agg<_ a5 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
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)|
```

```
rule 3:
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>)>|
Agg<_ a5 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
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)|
```

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

```
rule 5:
Filter<e3 _>(Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(
Union_all<>(Filter<e4 _>(Input<r3>),Input<r5>)));
e0:=FuncCall<avg>(a5);e3:=Sublink<EXISTS Input<r8
>>;e4:=Sublink<EXISTS Input<r4>>|
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 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)|
```

```
rule 25:
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>>|
Agg<_ a5 _ e2 a5 r1 e1 a3 r2>(Input<r3>);e2:=
FuncCall<count>(a5)|
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)|
```

```
rule 26:
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>>|
Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<sum>(a5)|
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)|
```

```
rule 27:
Agg<_ a4 _ e0 a5 r5 e2 a6 r6>(Union_all<>(Input<r3
>,Input<r4>));e0:=FuncCall<avg>(a5)|
Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<avg>(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)|
```

```
rule 28:
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>>|
Agg<_ a5 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
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)|
```

```
rule 29:
Exists(Agg_max<a3 a4 r5 e1 a5 r6>(Union(Input<r3>,
Input<r4>)),Input<r7>)|
Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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)|
```

```
rule 30:
Exists(Agg_count<a3 a4 r5 e1 a5 r6>(Exists(Input<
r3>,Input<r4>)),Union(Input<r7>,Input<r8>))|
Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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)|
```

```
rule 31:
Exists(Agg_count<a4 a5 r4 e2 a6 r5>(Input<r3>),
Union(Input<r6>,Input<r7>))|
Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
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)|
```

```
rule 32:
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>)>|
Filter<e2 a4>(Agg<_ a4 _ e1 a4 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<count>(a4)|
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)|
```

```
rule 33:
Agg_average<a4 a5 r5 e2 a6 r6>(Union(Input<r3>,
Input<r4>))|
Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
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)|
```

```
rule 34:
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)|
Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
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)|
```

```
rule 35:
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>)
>|
Agg<_ a6 _ e2 a4 r1 e1 a4 r2>(Input<r3>);e2:=
FuncCall<count>(a4)|
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)|
```

```
rule 36:
Agg<_ a4 _ e0 a5 r5 e2 a6 r6>(Filter<e3 _>(Input<
r3>));e0:=FuncCall<count>(a5);e3:=Sublink<EXISTS
Input<r4>>|
Filter<e2 a4>(Agg<_ a4 _ e1 a6 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<count>(a6)|
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)|
```

```
rule 37:
Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
Exists(Union(Input<r6>,Input<r7>),Input<r8>))|
Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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)|
```

```
rule 38:
Agg_average<a4 a5 r7 e2 a6 r8>(Union(Union(Input<
r3>,Exists(Input<r4>,Input<r5>)),Input<r6>))|
Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
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)|
```

```
rule 39:
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>)>|
Agg<_ a3 _ e2 a5 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a5)|
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)|
```

```
rule 40:
Agg_average<a4 a5 r7 e2 a6 r8>(Union(Union(Exists(
Input<r3>,Input<r4>),Input<r5>),Input<r6>))|
Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
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)|
```

```
rule 41:
Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
Exists(Union(Input<r4>,Input<r5>),Input<r6>)))|
Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
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)|
```

```
rule 42:
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>))>|
Agg<_ a5 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
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)|
```

```
rule 43:
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)|
Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
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)|
```

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

```
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)|
```

```
rule 45:
Exists(Agg_average<a4 a5 r6 e2 a6 r7>(Union(Union(
Input<r3>,Input<r4>),Input<r5>)),Input<r8>)|
Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
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)|
```

```
rule 46:
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>>|
Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
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)|
```

```
rule 47:
Agg_max<a3 a4 r7 e1 a5 r8>(Union(Exists(Input<r3>,
Union(Input<r4>,Input<r5>)),Input<r6>))|
Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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)|
```

```
rule 48:
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>>|
Agg<_ a3 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
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)|
```

```
rule 49:
Exists(Agg_count<a4 a5 r4 e2 a6 r5>(Input<r3>),
Union(Input<r6>,Input<r7>))|
Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
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)|
```

```
rule 50:
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>)>|
Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<sum>(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)|
```

```
rule 51:
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>>|
Agg<_ a5 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
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)|
```

```
rule 52:
Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
Exists(Input<r4>,Exists(Input<r5>,Input<r6>))))|
Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
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)|
```

```
rule 53:
Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
Union(Exists(Input<r6>,Input<r7>),Input<r8>))|
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)|
```

```
rule 82:
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>>|
Filter<e2 a4>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<sum>(a5)|
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)|
```

```
rule 83:
Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
Union(Union(Input<r4>,Input<r5>),Input<r6>)))|
Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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)|
```

```
rule 84:
Exists(Agg_count<a4 a5 r4 e2 a6 r5>(Input<r3>),
Union(Input<r6>,Input<r7>))|
Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
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)|
```

```
rule 85:
Agg_count<a4 a5 r7 e1 a6 r8>(Exists(Proj_simple<_
a3 r4>(Input<r3>),Union(Input<r5>,Input<r6>)))|
Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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)|
```

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

```
rule 87:
Exists(Agg_count<a4 a5 r4 e2 a6 r5>(Input<r3>),
Union(Input<r6>,Input<r7>))|
Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
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)|
```

```
rule 88:
Exists(Agg_average<a4 a5 r4 e2 a6 r5>(Input<r3>),
Union(Union(Input<r6>,Input<r7>),Input<r8>))|
Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
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)|
```

```
rule 89:
Agg_count<a3 a4 r6 e1 a5 r7>(Exists(Input<r3>,
Union(Input<r4>,Input<r5>)))|
Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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)|
```

```
rule 90:
Agg<_ a4 _ e0 a5 r6 e2 a6 r7>(Union_all<>(Input<r3
>,Union_all<>(Input<r4>,Input<r5>)));e0:=FuncCall<
avg>(a5)|
Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<avg>(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)|
```

```
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)|
```

```
rule 119:
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>>|
Agg<_ a3 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
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)|
```

```
rule 120:
Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
Exists(Input<r4>,Union(Input<r5>,Input<r6>))))|
Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
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)|
```

```
rule 121:
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>)>|
Agg<_ a3 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
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)|
```

```
rule 122:
Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
Exists(Input<r6>,Union(Input<r7>,Input<r8>)))|
Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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)|
```

```
rule 123:
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>>|
Agg<_ a3 _ e2 a5 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a5)|
```

```
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)|
```

```
rule 124:
Agg_average<a4 a5 r7 e2 a6 r8>(Union(Exists(Input<
r3>,Input<r4>),Union(Input<r5>,Input<r6>)))|
Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
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)|
```

```
rule 125:
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
>)>|
Agg<_ a6 _ e2 a4 r1 e1 a6 r2>(Input<r3>);e2:=
FuncCall<count>(a4)|
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)|
```

```
rule 126:
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>)>|
Agg<_ a5 _ e2 a5 r1 e1 a3 r2>(Input<r3>);e2:=
FuncCall<count>(a5)|
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)|
```

```
rule 127:
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>)>|
Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<sum>(a5)|
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)|
```

```
rule 128:
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)|
```

```
rule 138:
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>)>|
Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<count>(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)|
```

```
rule 139:
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
>)>|
Agg<_ a6 _ e2 a6 r1 e1 a4 r2>(Input<r3>);e2:=
FuncCall<count>(a6)|
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)|
```

```
rule 140:
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>>|
Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
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)|
```

```
rule 141:
Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
Exists(Union(Input<r4>,Input<r5>),Input<r6>)))|
Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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)|
```

```
rule 142:
Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
Union(Input<r4>,Exists(Input<r5>,Input<r6>))))|
Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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)|
```

```
rule 143:
Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
Exists(Input<r4>,Union(Input<r5>,Input<r6>))))|
Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
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)|
```

```
rule 144:
Agg_max<a3 a4 r7 e1 a5 r8>(Union(Exists(Exists(
Input<r3>,Input<r4>),Input<r5>),Input<r6>))|
Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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)|
```

```
rule 145:
Agg_average<a4 a5 r6 e2 a6 r7>(Union(Input<r3>,
Exists(Input<r4>,Input<r5>)))|
Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
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)|
```

```
rule 146:
Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
Union(Union(Input<r6>,Input<r7>),Input<r8>))|
Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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)|
```

```
rule 147:
Exists(Agg_count<a3 a4 r6 e1 a5 r7>(Exists(Input<
r3>,Union(Input<r4>,Input<r5>))),Input<r8>)|
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)|
```

```
rule 167:
Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Input<r3>,
Union(Exists(Input<r4>,Input<r5>),Input<r6>)))|
Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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)|
```

```
rule 168:
Exists(Exists(Agg_sum<a4 a5 r4 e2 a6 r5>(Input<r3
>),Input<r6>),Union(Input<r7>,Input<r8>)))|
Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
>))|
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)|
```

```
rule 169:
Exists(Agg_average<a4 a5 r6 e2 a6 r7>(Union(Exists
(Input<r3>,Input<r4>),Input<r5>)),Input<r8>)|
Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
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,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)|
```

```
rule 170:
Exists(Agg_count<a5 a6 r5 e2 a7 r6>(Proj_simple<_
a4 r4>(Input<r3>)),Union(Input<r7>,Input<r8>))|
Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
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,r7);TableEq(r0,r8);TableEq(r3,r7);
TableEq(r3,r8);TableEq(r7,r8);Unique(r3,a4)|
```

```
rule 171:
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>)
>|
Agg<_ a4 _ e2 a6 r1 e1 a6 r2>(Input<r3>);e2:=
FuncCall<count>(a6)|
```

```
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)|
```

```
rule 172:
Exists(Agg_sum<a4 a5 r4 e2 a6 r5>(Input<r3>),Union
(Exists(Input<r6>,Input<r7>),Input<r8>))|
Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
>))|
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)|
```

```
rule 173:
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>)>|
Agg<_ a3 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
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)|
```

```
rule 174:
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)|
Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<avg>(a5)|
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)|
```

```
rule 175:
Exists(Agg_count<a4 a5 r4 e2 a6 r5>(Input<r3>),
Union(Input<r6>,Input<r7>))|
Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
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,r6);TableEq(r0,r7);TableEq(r3,r6);
TableEq(r3,r7);TableEq(r6,r7);Unique(r3,a4);Unique
(r3,a5)|
```

```
rule 176:
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 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>,
   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,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 187:
2  Agg<_ a3 _ e0 a4 r7 e1 a5 r8>(Filter<e3 _>(Input<
   r3>));e0:=FuncCall<count>(a4);e3:=Sublink<EXISTS
   Union_all<>(Input<r4>,Union_all<>(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 188:
2  Agg_sum<a4 a5 r7 e2 a6 r8>(Exists(Input<r3>,Exists
   (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,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 189:
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,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 190:
2  Filter<e3 _>(Agg<_ a4 _ e0 a5 r4 e2 a6 r5>(Input<
   r3>));e0:=FuncCall<sum>(a5);e3:=Sublink<EXISTS
   Union_all<>(Input<r6>,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<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 191:
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 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 192:
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 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 193:
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,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 194:
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 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 195:
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,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>)|
```

```
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)|
```

```
rule 215:
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>)>|
Filter<e2 a6>(Agg<_ a4 _ e1 a5 r1 e2 a4 r2>(Input<
r3>));e1:=FuncCall<sum>(a5)|
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)|
```

```
rule 216:
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>)>|
Agg<_ a3 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
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)|
```

```
rule 217:
Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<r3>),
Union(Input<r6>,Union(Input<r7>,Input<r8>)))|
Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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)|
```

```
rule 218:
Exists(Exists(Agg_count<a3 a4 r4 e1 a5 r5>(Input<
r3>),Union(Input<r6>,Input<r7>)),Input<r8>)|
Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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)|
```

```
rule 219:
```

```
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>)>|
Filter<e2 a4>(Agg<_ a4 _ e1 a6 r1 e2 a6 r2>(Input<
r3>));e1:=FuncCall<count>(a6)|
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)|
```

```
rule 220:
Exists(Agg_count<a4 a5 r5 e1 a6 r6>(Proj_simple<_
a3 r4>(Input<r3>)),Union(Input<r7>,Input<r8>))|
Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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)|
```

```
rule 221:
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>)>|
Agg<_ a3 _ e2 a3 r1 e1 a5 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
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)|
```

```
rule 222:
Agg_max<a3 a4 r7 e1 a5 r8>(Union(Input<r3>,Exists(
Union(Input<r4>,Input<r5>),Input<r6>)))|
Agg_max<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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)|
```

```
rule 223:
Agg_average<a4 a5 r7 e2 a6 r8>(Union(Exists(Input<
r3>,Exists(Input<r4>,Input<r5>)),Input<r6>))|
Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
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)|
```

```
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(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 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)|
```

```
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 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 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 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 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 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 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 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>))|
```

```
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)|
```

```
rule 372:
Agg_count<a4 a5 r6 e2 a6 r7>(Exists(Input<r3>,
Union(Input<r4>,Input<r5>)))|
Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
AttrsEq(a0,a6);AttrsEq(a1,a5);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)|
```

```
rule 373:
Agg_average<a4 a5 r7 e2 a6 r8>(Union(Input<r3>,
Union(Input<r4>,Exists(Input<r5>,Input<r6>))))|
Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
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)|
```

```
rule 374:
Exists(Exists(Agg_sum<a4 a5 r4 e2 a6 r5>(Input<r3
>),Input<r6>),Union(Input<r7>,Input<r8>))|
Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
>))|
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)|
```

```
rule 375:
Exists(Agg_sum<a4 a5 r6 e2 a6 r7>(Exists(Input<r3
>,Union(Input<r4>,Input<r5>))),Input<r8>)|
Filter<e1 a3>(Agg_sum<a0 a1 r1 e0 a2 r2>(Input<r0
>))|
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,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)|
```

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

```
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)|
```

```
rule 377:
Agg_count<a4 a5 r6 e2 a6 r7>(Exists(Input<r3>,
Union(Input<r4>,Input<r5>)))|
Filter<e1 a3>(Agg_count<a0 a1 r1 e0 a2 r2>(Input<
r0>))|
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,r4);TableEq(r0,r5);TableEq(r3,r4);
TableEq(r3,r5);TableEq(r4,r5);Unique(r3,a4);Unique
(r3,a5)|
```

```
rule 378:
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>)>|
Agg<_ a3 _ e2 a3 r1 e1 a3 r2>(Input<r3>);e2:=
FuncCall<count>(a3)|
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)|
```

```
rule 379:
Agg_average<a4 a5 r7 e2 a6 r8>(Union(Union(Input<
r3>,Union(Input<r4>,Input<r5>)),Input<r6>))|
Filter<e1 a3>(Agg_average<a0 a1 r1 e0 a2 r2>(Input
<r0>))|
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)|
```

```
rule 380:
Agg_count<a3 a4 r7 e1 a5 r8>(Exists(Exists(Input<
r3>,Input<r4>),Union(Input<r5>,Input<r6>)))|
Agg_count<a0 a1 r1 e0 a2 r2>(Input<r0>)|
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 381:
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)
```

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