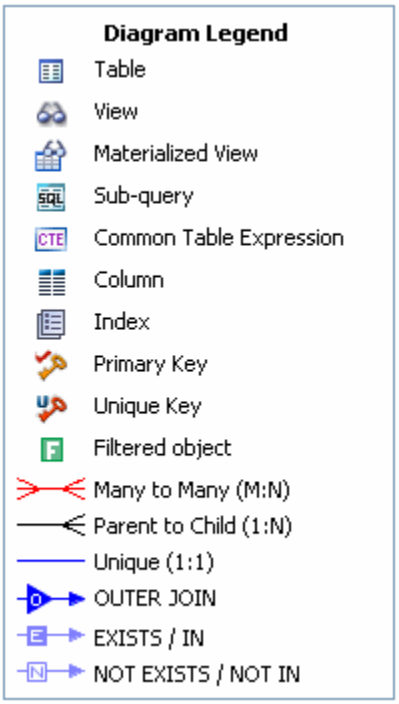
Interpreting the VST diagram graphics

This section contains the following topics that will help you understand the graphics in VST diagrams:

Viewing the Diagram Legend

Click the **Diagram Legend Toggle** button as shown in the diagram below to see a description of the icons and relationship lines used in VST diagrams.



Colors

The color of the index entries in the **Collect and Create Indexes** table is interpreted as follows:

Text Color	Interpretation
	Index is used in the query.
	Index is usable but not used by the current execution path.
	This index is missing. SQL Query Tuner recommends that you create this index.
	This index exists on the table but not usable in this query as it is written.

Connecting lines/joins

Joins are represented with connecting lines between nodes. You can move tables in the diagram by clicking and dragging them to the desired location. The position of the connecting lines is automatically adjusted. The following describes when a particular type of connecting line is used and the default positioning of the line.

Connecting Lines	When Used

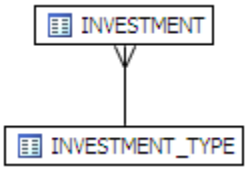
	One-to-One join relationships are graphed horizontally using blue lines. For more information, see One-to-One Join.
	One-to-Many join relationships are graphed with the many table above the one table. For more information, see One-to-Many Join.
INVESTMENT	**Cartesian Join** shows the table highlighted in red with no connectors to indicate that it is joined in via a Cartesian join. For more information, see Cartesian Join.
	Many-to-Many Join relationships are connected by a red line and the relative location is not restricted. For more information, see Many-to-Many Join.
	Indirect Relationship. For more information, see Indirect Relationship.
	Outer Join. For more information, see Outer Join.
	Unique. For more information, see Unique.
N	**Not Exists and Not in** relationship lines connect the subquery to the table being queried. Notice that when you click this relationship line, the SQL text creating the relationship is also selected. For more information, see Not In or Not Exists Join.
E	**Exists and In** relationship lines connect the subquery to the table being queried. Notice that when you click this relationship line, the SQL text creating the relationship is also selected. For more information, see In or Exists Join.

One-to-one join

If two tables are joined on their primary key, then graphically, these would be laid out side-by- side, with a one-to-one connector:

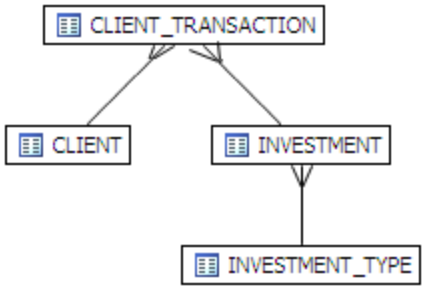
One-to-many join

This is the default positioning of a one-to-many relationship, where INVESTMENT_TYPE is the master table and INVESTMENT is the details table.



The following is an example of a query that consists of only many-to-one joins, which is more typical:

```
SELECT

        ct.action, c.client_id,
        i.investment_unit,
        it.investment_type_name

    FROM

        client_transaction ct,
        client c,
        investment_type it,
        investment i

    WHERE

        ct.client_id = c.client_id AND
        ct.investment_id = i.investment_id AND
        i.investment_type_id = it.investment_type_id and
        client_transaction_id=1
```

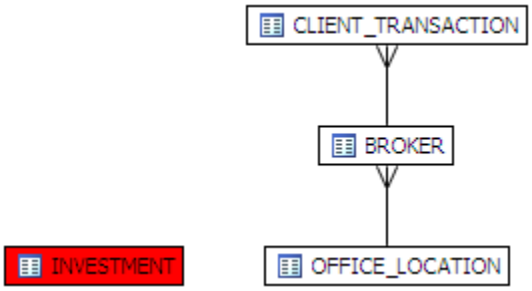


Cartesian join

A Cartesian join is described in the following example where the query is missing join criteria on the table INVESTMENT:

```
SELECT

        A.BROKER_ID BROKER_ID, A.BROKER_LAST_NAME
        BROKER_LAST_NAME, A.BROKER_FIRST_NAME
        BROKER_FIRST_NAME, A.YEARS_WITH_FIRM
        YEARS_WITH_FIRM, C.OFFICE_NAME OFFICE_NAME,
        SUM (B.BROKER_COMMISSION) TOTAL_COMMISSIONS

    FROM

        BROKER A,
        CLIENT_TRANSACTION B,
        OFFICE_LOCATION C,
        INVESTMENT I

    WHERE

        A.BROKER_ID = B.BROKER_ID AND
        A.OFFICE_LOCATION_ID = C.OFFICE_LOCATION_ID

    GROUP BY

        A.BROKER_ID,
        A.BROKER_LAST_NAME,
        A.BROKER_FIRST_NAME,
        A.YEARS_WITH_FIRM,
        C.OFFICE_NAME;
```

Graphically, this looks like:



INVESTMENT is highlighted in red with no connectors to indicate that it is joined in via a Cartesian join.

Possible missing join conditions are displayed in the **Overview** tab under **Generated Cases** in the transformations area. DB Optimize recommends that you create these joins.

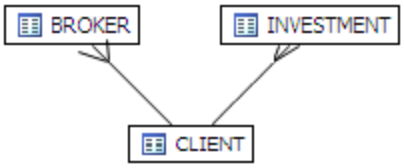
SQL Statements and Cases		Cost	Executi...istics	Other Execution Statistics		
Name	Text	Value	Elapsed Time (s)	Physical Reads	Logical Reads	CPU T
SELECT 1	select from BROKER,	34014.0	6.22	0	170	
[Missing a valid join criteria] transformation		274.0	0.04	0	167	
FULL		34019.0	6.29	0	173	
LEADING1		34017.0	6.25	0	192	
ALL_ROWS		34014.0	6.35	0	170	
LEADING3		34017.0	6.41	0	170	
INDEX		34392.0	6.58	0	414	
LEADING2		38148.0	7.94	0	170	
ORDERED		38147.0	8.61	0	170	
USE_NL		38198.0	9.03	0	37518	

Transformations are highlighted in yellow.

Implied Cartesian join

If there are different details for a master without other criteria then a Cartesian-type join is created:

```
SELECT *
    FROM
        investment i,
        broker b,
        client c
    WHERE
        b.manager_id=c.client_id and
        i.investment_type_id=c.client_id;
```



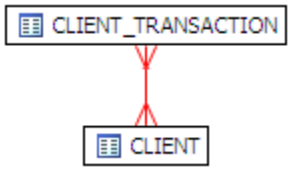
The result set of BROKER to CLIENT will be multiplied by the result set of INVESTMENT to CLIENT.

Many-to-many join

If there is no unique index at either end of a join then it can be assumed that in some or all cases the join is many-to-many; there are no constraints preventing a many-to-many join. For example, examine the following query:

```
SELECT *
    FROM
        client_transaction ct, client c
    WHERE
        ct.transaction_status=c.client_marital_status;
```

There is no unique index on either of the fields being joined so the optimizer assumes this is a many-to-many join and the relationship is displayed graphically as:



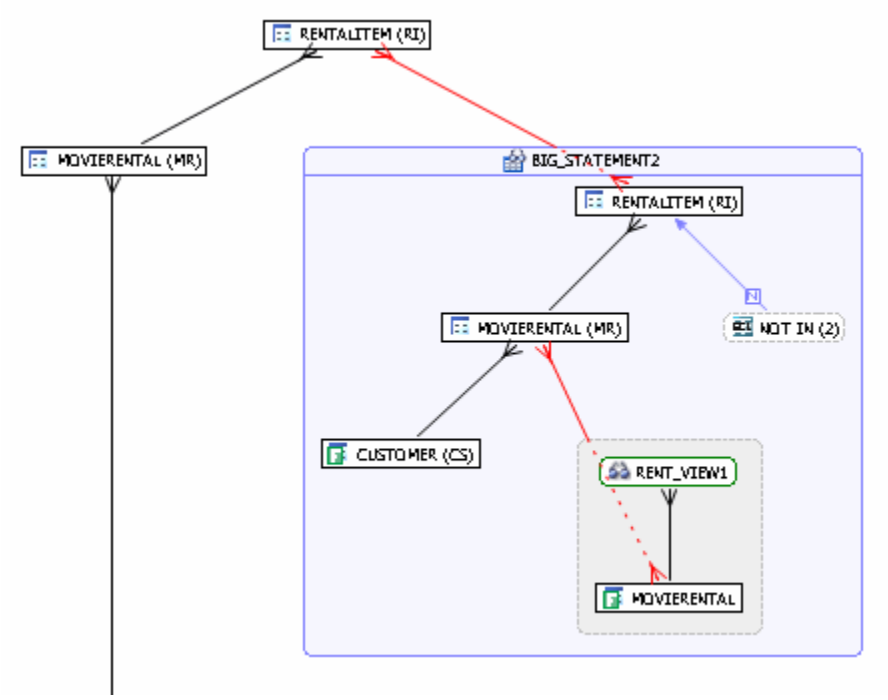
If one of the fields is unique, then the index should be declared as such to help the optimizer.

Indirect relationship

Indirect relationships are produced by the following SQL, where BIG_STATEMENT2 is a Materialized View.

```
SELECT CS.*

    FROM

        MOVIES.CUSTOMER CS,
        MOVIES.MOVIERENTAL MR,
        MOVIES.RENTALITEM RI,
        OE.BIG_STATEMENT2

    WHERE

        CS.ZIP > '75062' AND MR.RENTALID = RI.RENTALID
        AND RI.ITEMNUMBER = OE.BIG_STATEMENT2.ITEMNUMBER
        AND MR.CUSTOMERID = CS.CUSTOMERID;
```

The following diagram produced by the SQL above shows that an indirect relationship exists between the RENTALITEM(RI) tables inside and outside the materialized view, BIG_STATEMENT2. An indirect relationship also exists between MOVIERENTAL (MR) inside BIG_STATEMENT2 and MOVIERENTAL (MR) inside the RENT_VIEW1 view.



In or exists join

The following SQL contains a nest IN subquery (shown in bold text) that is graphically represented with the Subquery summary icon and the IN join.

```
SELECT

        cs.customerid, cs.firstname, cs.lastname,
        mr.rentalid, mr.duedate, mr.totalcharge, ri.itemnumber

FROM

        (

            SELECT
```

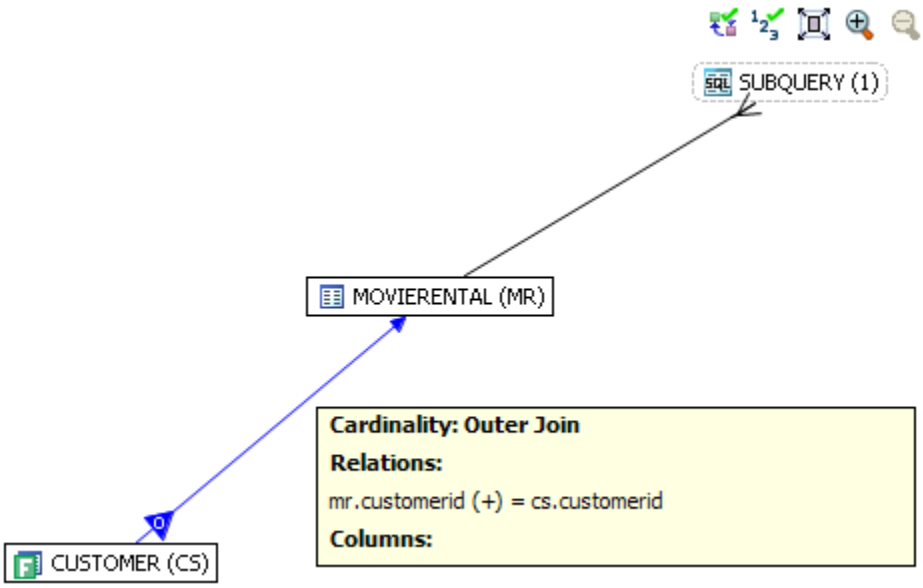
```
        c1.customerid, c1.firstname, c1.lastname, c1.phone
FROM
        MOVIES.customer c1
WHERE
        EXISTS (SELECT NULL) cs, (FROM MOVIES.customer c2
WHERE
        c1.customerid <>c2.customerid AND c1.lastname=c2.lastname AND c1.phone BETWEEN 0 AND 9999569900)
SELECT
        customerid, rentalid, duedate, totalcharge, rentaldate
FROM
        MOVIES.movierental
WHERE
        totalcharge > 10
        )
        mr, MOVIES.rentalitem ri
WHERE
        LENGTH (cs.lastname) = 10
        AND 1 < cs.customerid
        AND ROUND (ri.rentalid) > 10
        AND TRUNC (ri.itemnumber) > 1
        AND mr.totalcharge > (SELECT AVG (totalcharge)
FROM
        MOVIES.movierental
WHERE
        TOTALCHARGE >= 40)
        AND ri.moviecopyid
        NOT IN (SELECT mc.moviecopyid FROM MOVIES.moviecopy mc
WHERE
        mc.copyformat = 'vhs'
        AND mc.copycondition = 'new'
        AND mc.movieid IN (SELECT mt.movieid FROM MOVIES.movietitle mt
WHERE
        mt.year < 1990
        AND mt.rating IN ('pg','r')
        AND mt.categoryid IN (SELECT mc.categoryid
FROM
        MOVIES.moviecategory mc


WHERE
        mc.rentalprice=(SELECT MAX (rentalprice)
FROM
        MOVIES.moviecategory
WHERE
        categoryid=mc.categoryid)))
        AND mr.CUSTOMERID=cs.CUSTOMERID
        AND ri.RENTALID=mr.RENTALID
```

Outer join

The bold SQL predicate in the statement below defines the outer join between customer and movierental.

```
select cs.*

from MOVIES.customercs, MOVIES.movierentalmr

where

    length (cs.lastname) = 8 and cs.zip > 75062 and 1 < cs.customerid + 2 and cs.phone between 9625569900 and 9999569900 and mr.rentalid
    = (select max (ri.rentalid)



from MOVIES.rentalitem ri, MOVIES.moviecopy mc

where

    ri.itemnumber > 1 and mc.moviecopyid = 700) and mr.customerid(+)=cs.customerid;
```

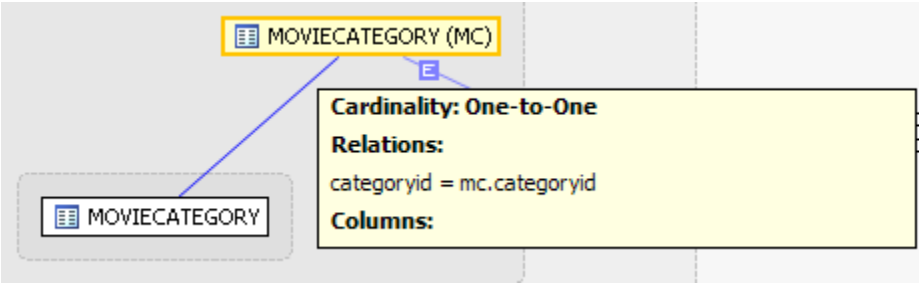
The following screen shot illustrates how the outer join is displayed in the VST diagram.



Unique

The subquery below illustrates a unique relationship between two primary keys.

```
...select max(rentalprice) from MOVIES.moviecategory where categoryid = mc.categoryid...
```



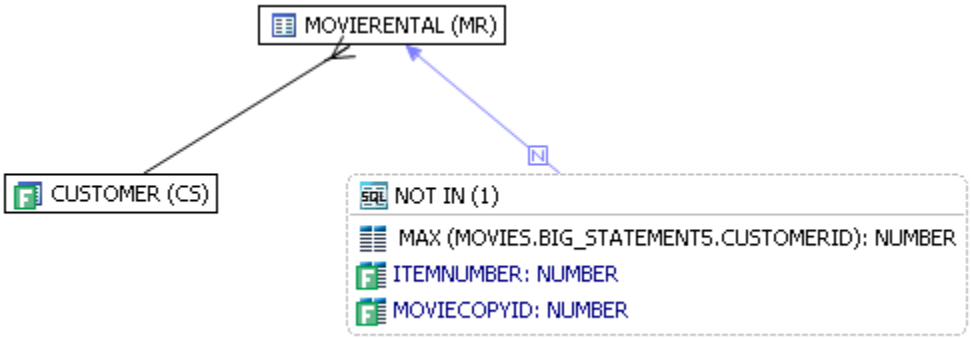
Not in or not exists join

The following SQL contains a NOT IN subquery (shown in bold below) that is graphically represented with the Subquery summary icon and the NOT IN join.

```
SELECT CS.*

FROM
```

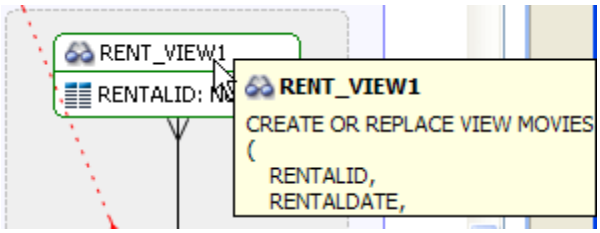
```
        MOVIES.CUSTOMERCS,
        MOVIES.MOVIERENTALMR

    WHERE

        CS.ZIP > '75062'
        AND MR.RENTALID NOT IN (SELECT MAX ( MOVIES.BIG_STATEMENT5.CUSTOMERID)

        FROM

            MOVIES.RENTALITEMRI,
            MOVIES.MOVIECOPYMC,
            MOVIES.BIG_STATEMENT5

        WHERE

            RI.ITEMNUMBER>1
            AND MC.MOVIECOPYID=700)
            AND MR.CUSTOMERID=CS.CUSTOMERID;
```

Graphically, this statement would look like this:



Viewing object SQL

Hover over the name of an object to view the object SQL as shown in the diagram below.

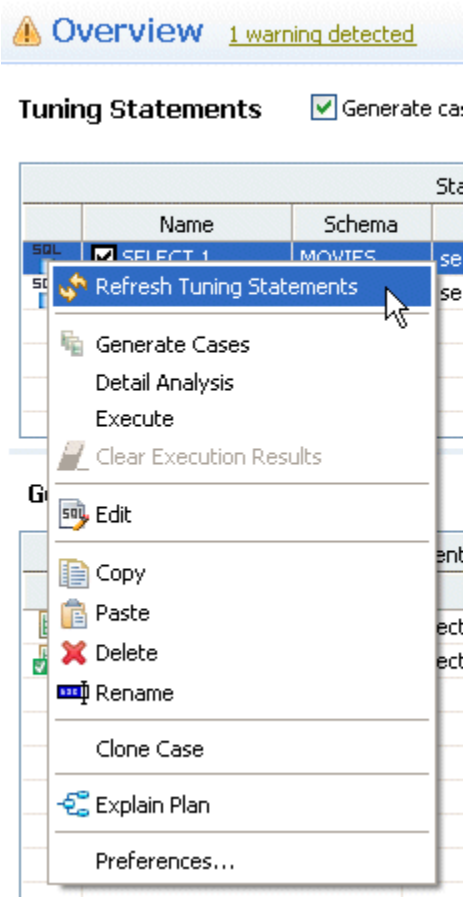


Refreshing tuning statements

At times you may see an error on the Overview page, which when you mouse over it, indicates that the tuning statements are out of sync and need to be refreshed. This can happen, for example, if you tune a statement, then delete it, and insert another SQL query for tuning.

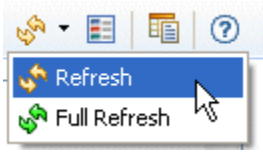
To refresh the tuning statements

In the Tuning Statements area of the Overview tab, right-click the tuning statement and select **Refresh Tuning Statements**.



Refreshing the VST diagram

There are two refresh options available: **Refresh** and **Refresh All**. Click the **Refresh** list as shown below to gain access to these options.



- **Refresh**: Regenerates the Analysis tab including the VST diagram. Any changes made on the tab are reflected in the diagram.
- **Full Refresh**: Re-caches all objects used in (or related to) the query, then regenerates the Analysis tab including the VST diagram. This option is typically used when the underlying objects have been recently changed.