ADVANCED DATA MODELING IN SAP HANA
HBD362

Exercises / Solutions

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SAP TECHED

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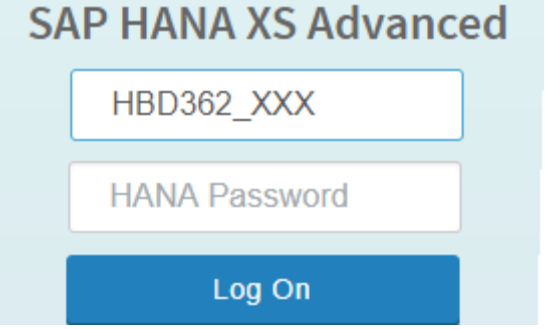
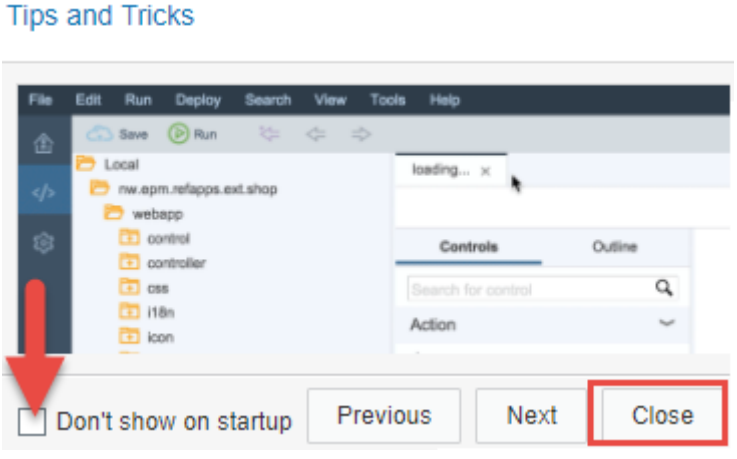
SETUP - (10 Minutes, 20 steps)

During the exercises, you will be using the SAP Web IDE:

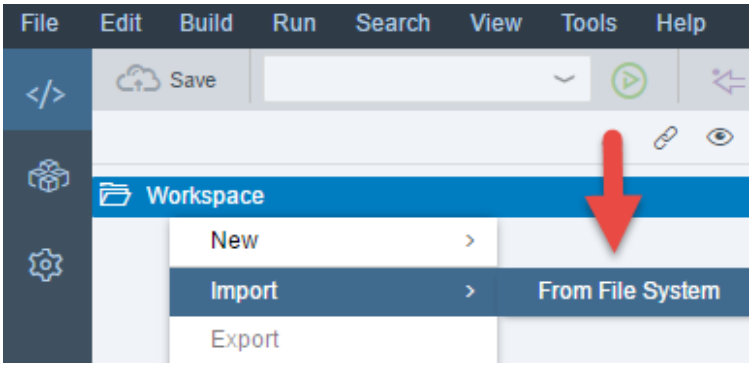
- SAP Web IDE for URL https://lt5123.wdf.sap.corp:53075
- User ID HBD362_###
- Password ${assigned by instructor}
- Session ${assigned by instructor}

User numbers are printed on a card next to your workstation, select the user number for your session and append the 3-digit user number after HBD362_ (i.e. HBD362_001 … HBD362_120)

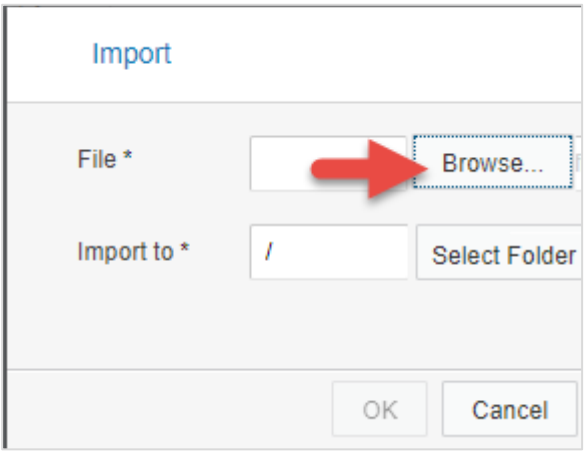
Explanation	Screenshot
1. Logon to the SAP Web IDE using Google Chrome	
2. Click 'Don't show' the Tips and Tricks window on startup > Close	

3. Start by importing the workshop material

   Workspace > right click > Import from File System

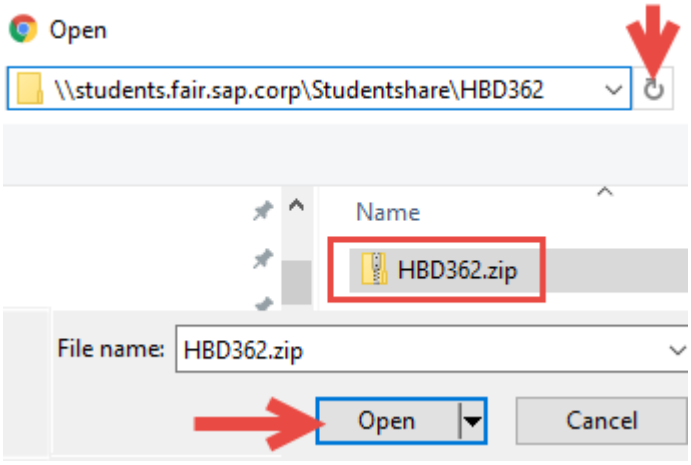


4. Click Browse to select the ZIP file to import



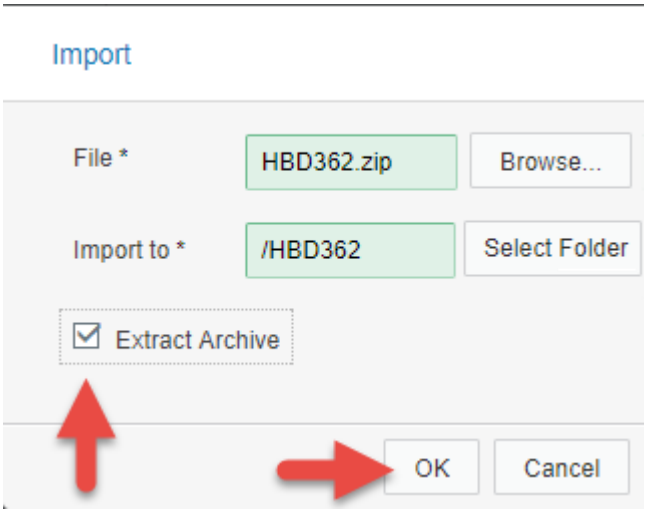
5. When prompted for a file to import, locate the ZIP file located on the student share:

   \\students.fair.sap.corp\Studentshare\HBD362

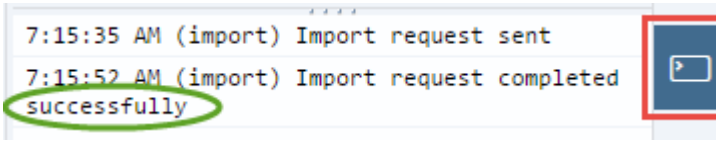


6. Important: Check Extract Archive

   Click OK

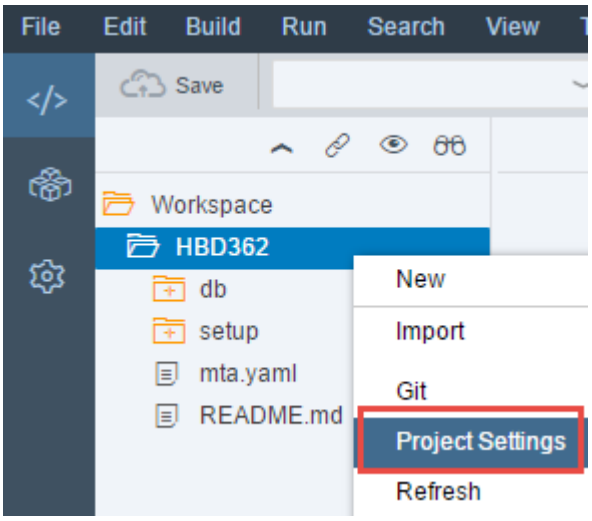


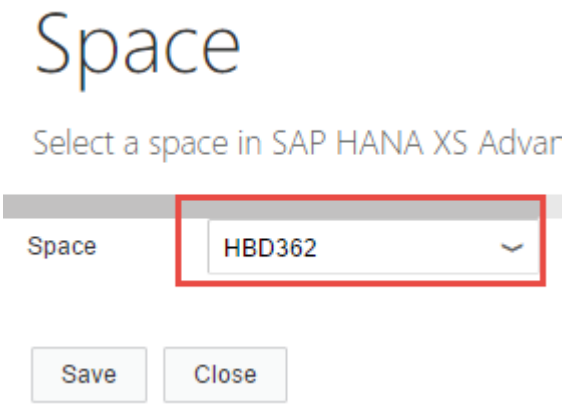
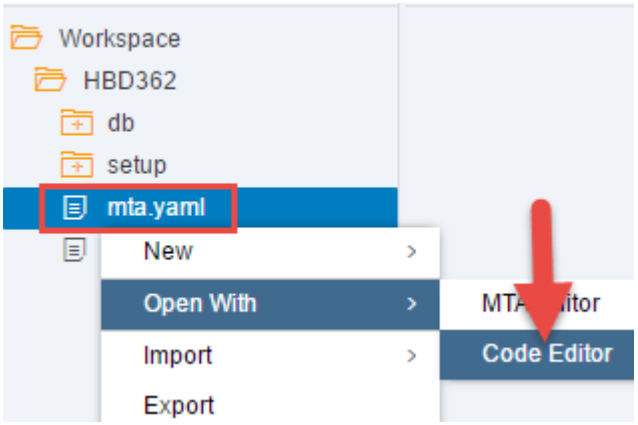
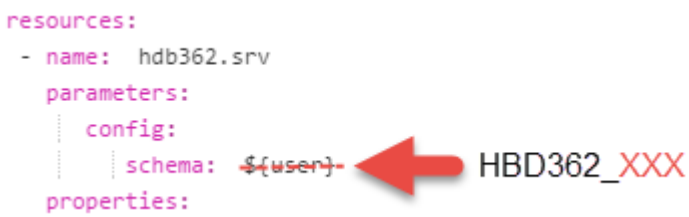
7. On the bottom-right side of the screen open the console and confirm that the import succeeded



8. Set the development SPACE

   Right click on the project (HBD362) > Project Settings > Space

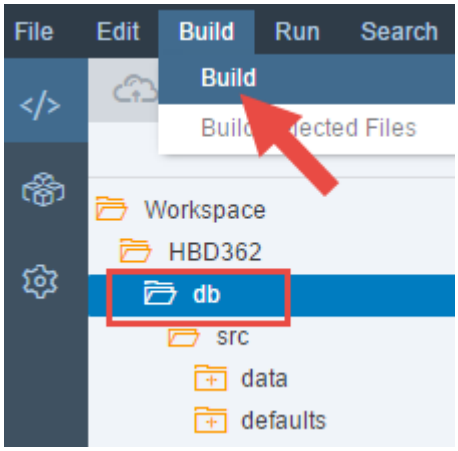


9. Select HDB362 Hint: To support isolation of the development environment, dedicated spaces are used for building and running projects Click Save and Close	
10. Edit the MTA descriptor (aka yaml file) and add your User ID Note: The multi-target application (MTA) descriptor file contains the metadata of all entities used in an application or used by it during deployment or runtime, and the dependencies between them	
11. Delete ${user} and replace with your assigned User ID Hint: Replace XXX with your assigned User ID	

12. Save and Build the database module

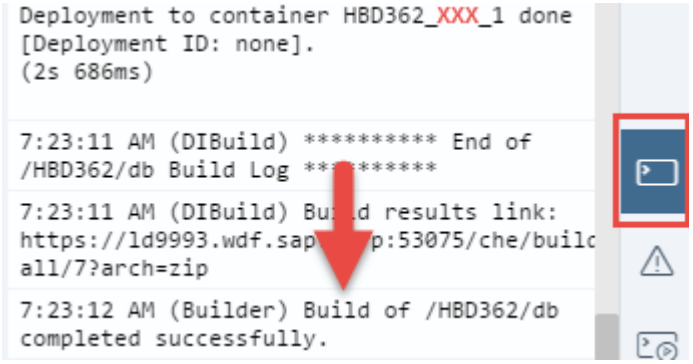
    Select db > Build

    Hint: You can create a deployment archive by selecting and building the root folder HBD362. In this workshop, you only need to build the database module (db) project. This will generate the runtime database objects



13. Ensure the build completed successfully!

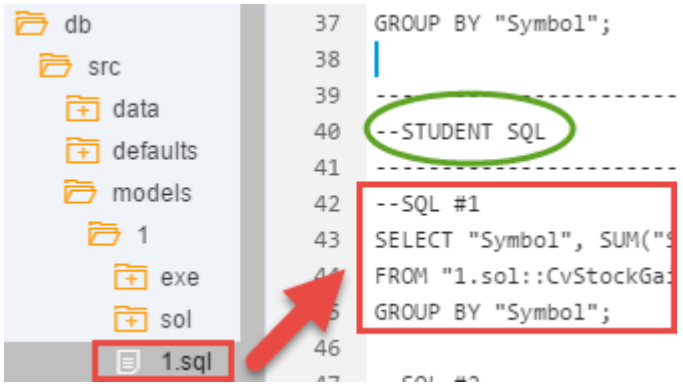
    Hint: Open the console to see detailed messages



14. Each exercise contains sample SQL statements (located in the root folder of each exercise)

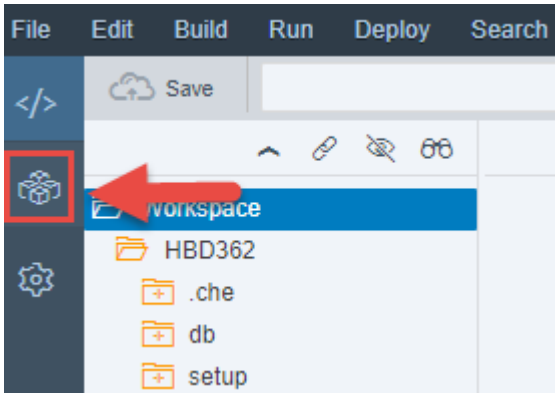
    In the workspace tile open the content tree and Expand db > src > models > 1 > open 1.sql

    Each file contains both solution and student SQL statements. Scroll down and <u>always</u> look for the <u>STUDENT SQL</u> section > copy the SQL #1 statement

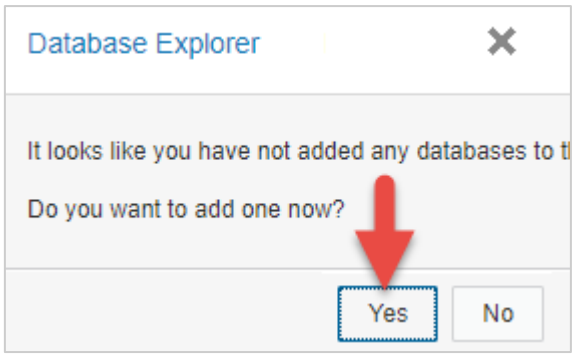


15. Open the Database Explorer and the SQL Console

    Hint: On the left of the screen click on the Database Explorer icon



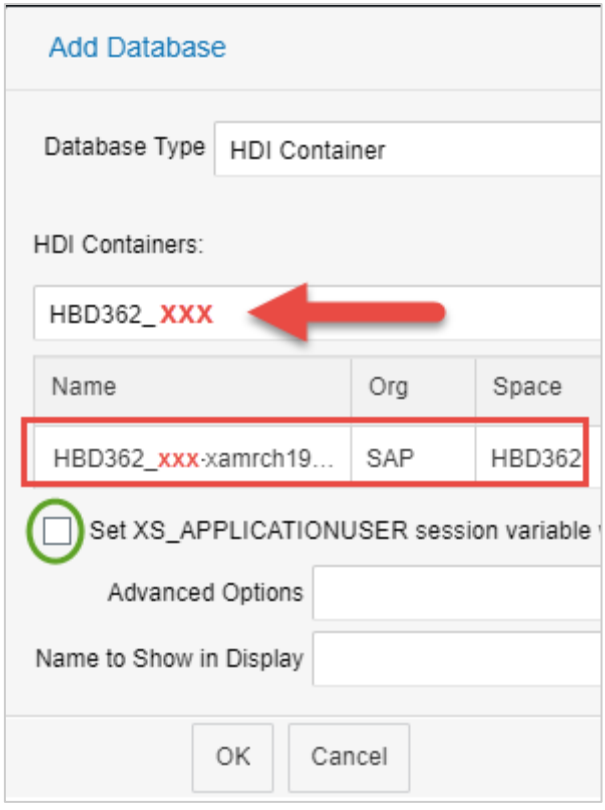
16. If prompted to add a database click Yes; (otherwise click + sign)



17. Search and select your HDI container

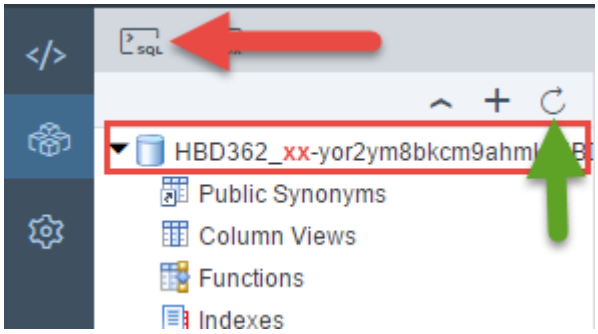
    Hint: Make sure to select your own container, replace XXX with your assigned User ID

    Important: uncheck “Set XS_APPLICATIONUSER”



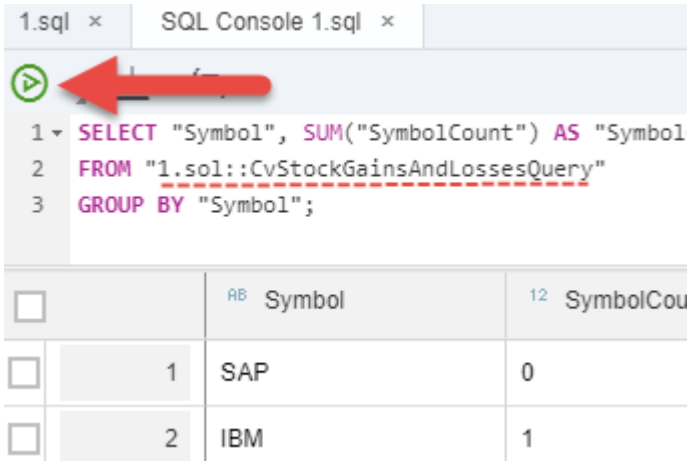
18. Select your container > click Open SQL Console

    Hint: If you do not see your container, click the refresh icon



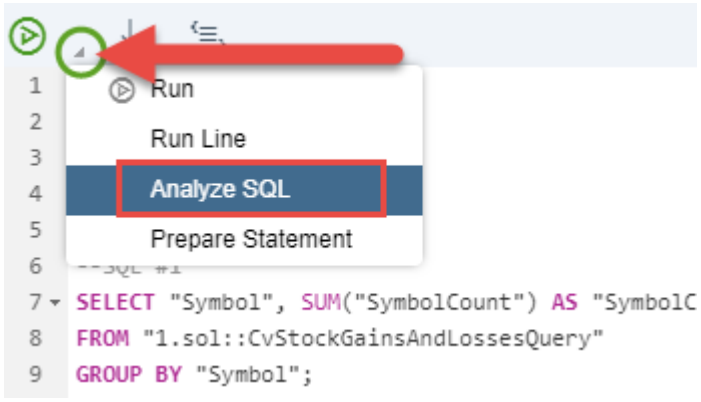
19. Paste the previously copied SQL statement > Execute

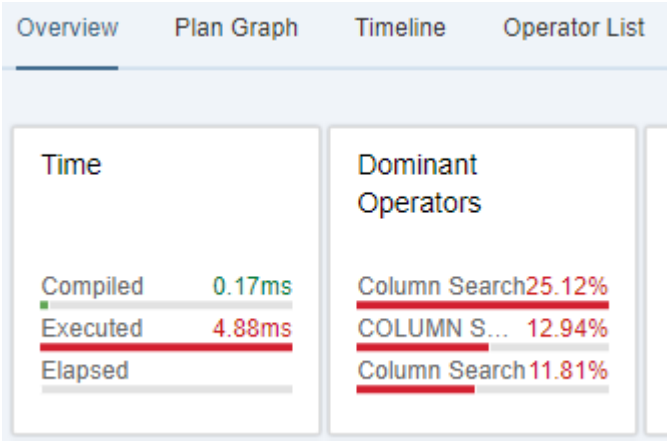
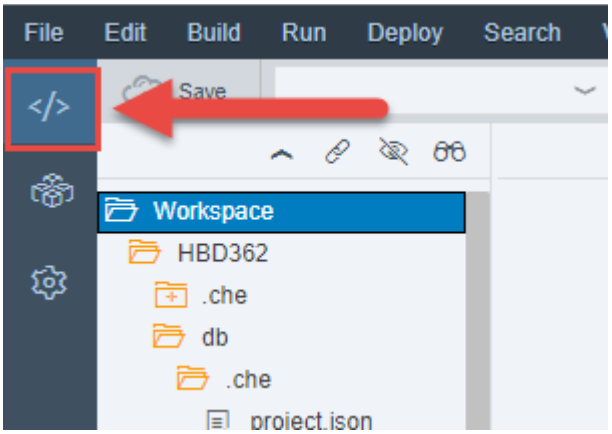
    Hint: Notice models are not deployed to the <*_sys_bic*> schema, but instead to an isolated container-schema



20. Query analysis is an important best practice during modeling. Several exercises require you to analyze the SQL as follows:

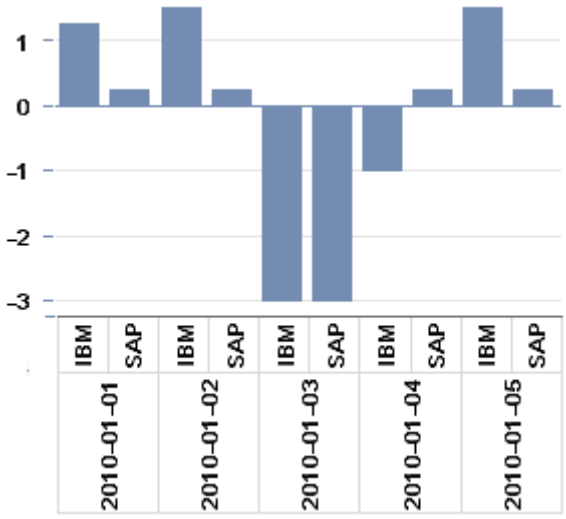
    Click on the small drop-down-list icon to the right of the green execute button > Analyze SQL



21. Result: You are presented with the execution overview.	
22. You can stop here for now, setup is complete! Hint: Close any opened .sql files and click on the Development icon to go back to the development perspective	

EXERCISE 1 - Multi level aggregation (15 Minutes, 30 steps)

In this exercise, you will compare 2 stock prices after 1 week of trading. The requirements are to show if the stock price ended up higher or lower by the end of the week and to show how many days the stock price increased

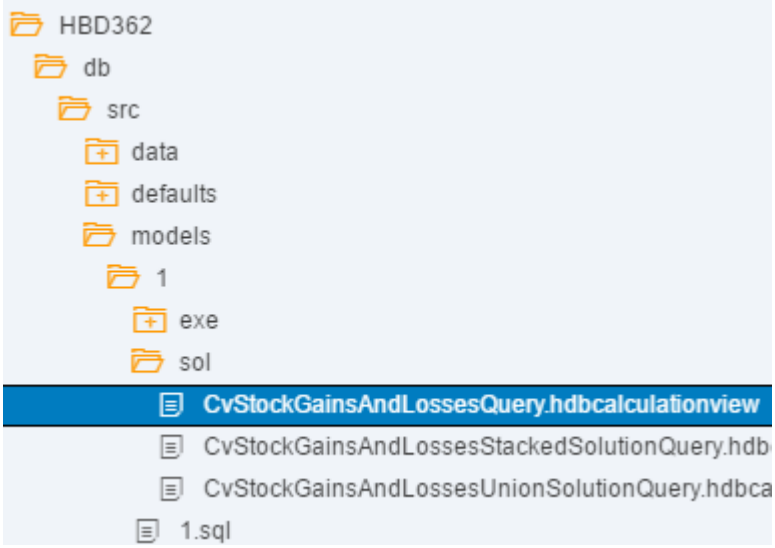


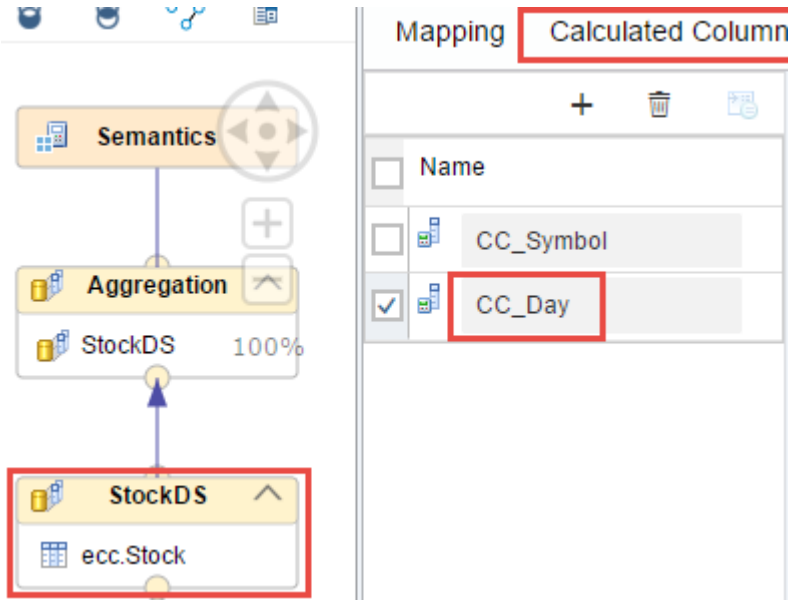
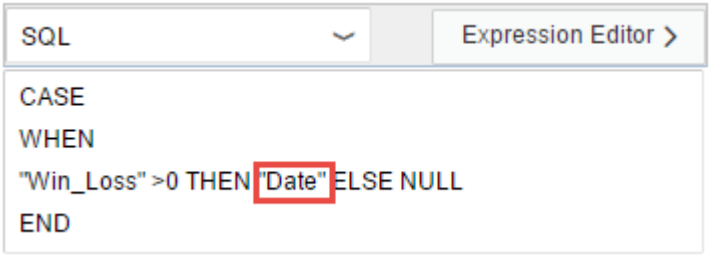
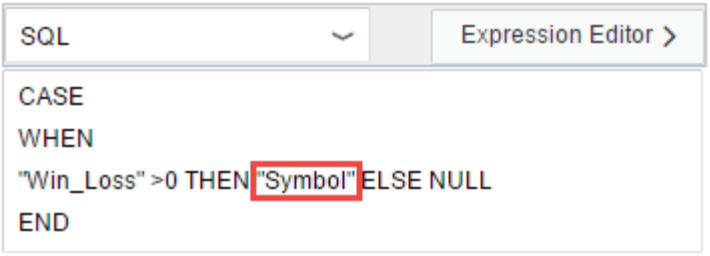
Expected Results

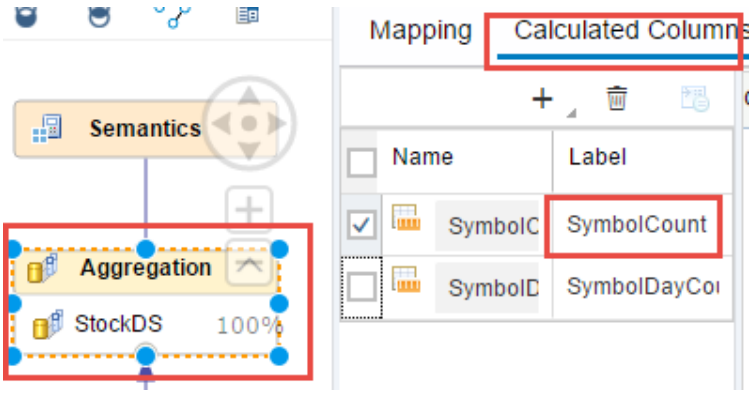
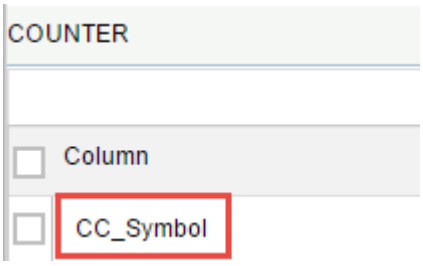
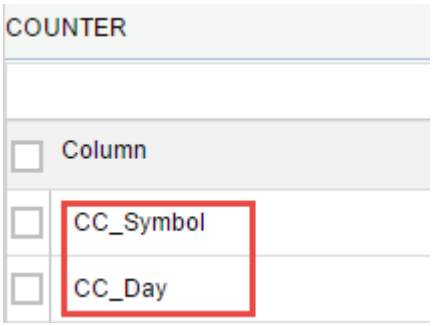
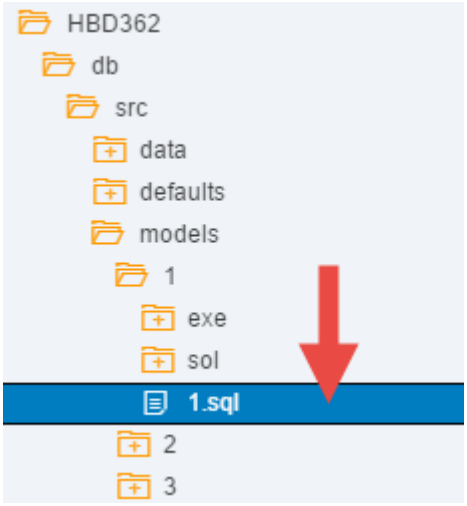
Symbol	Trending Up	Days
IBM	1	3
SAP	0	4

SAP rose 4 days, had a single bad day that brought the stock down for the entire week. IBM had 2 bad days but recovered the losses by end of week

Your assignment is to review the model and to determine why unexpected results are shown for certain queries. When each measure is individually queried the calculations are correct, however when both measures are queried simultaneous the calculations are incorrect. After you have analysed the situation proceed to fix the model

Explanation	Screenshot
1. Open the solution calculation model and start your analysis HDB362 > db > src > models > 1 > sol > Stock Gains and Losses Query	

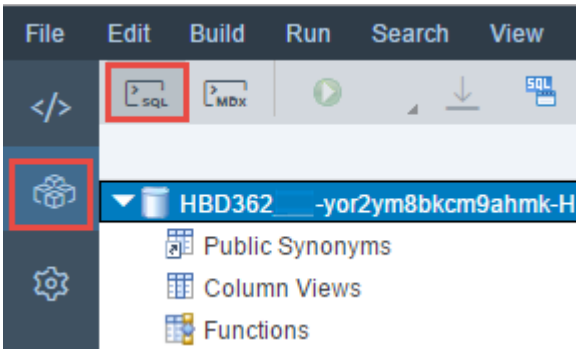
2. Select the Stock data source table and review the 2 calculated columns	
3. The CC_Day calculated column serves as an intermediate step used in a counter later in the flow. If the total trades for a given day's stock are positive, then record the date. The distinct counter will sum-up all the unique positive days	
4. Similarly, the CC_Symbol calculated column serves as an intermediate step used in a counter later in the flow. If the total trades for a given week and stock are positive, then record the stock symbol. The distinct counter result will then either be 1 or 0 for each stock symbol	

5. Review the counters: Select the topmost Aggregation node > Calculated columns	
6. Select SymbolCount > notice the distinct calculation is based on the individual Symbol calculated column	
7. Select the SymbolDayCount > notice the distinct calculation is based on multiple calculated columns (Symbol and Day) Hint: Each of these calculated columns have different levels of granularity	
8. Review the results by executing SQL statements > open the sample SQL statement file > db > src > models > 1 > 1.sql	

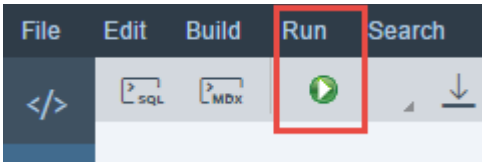
9. Under the Student SQL section > Copy SQL #1

```
------------------------------------------------------
--STUDENT SQL
------------------------------------------------------
--SQL #1
SELECT "Symbol", SUM("SymbolCount") AS "SymbolCount"
FROM "1.sol::CvStockGainsAndLossesQuery"
GROUP BY "Symbol";
```

10. Open the Database Explore > select your container and click on SQL Console



11. Paste the SQL statement into the SQL Console copied earlier > click execute



12. Notice: The Symbol count is correct. SAP had a single bad day that brought the stock down for the week. IBM was slightly higher for the same week

Symbol	SymbolCount
SAP	0
IBM	1

13. Repeat the steps, copy SQL #2 into the SQL Console > Execute

    Hint: If COPY is not visible as a menu option use CTRL+C

```
--SQL #2
SELECT "Symbol", SUM("SymbolDayCount") AS "SymbolDayCount"
FROM "1.sol::CvStockGainsAndLossesQuery"
GROUP BY "Symbol";
```

14. Notice: The Symbol Day count is correct. SAP's stock was positive for 4 days' vs IBM 3 days

Symbol	SymbolDayCount
SAP	4
IBM	3

15. Repeat the steps, copy SQL #3 into the SQL Console > Execute

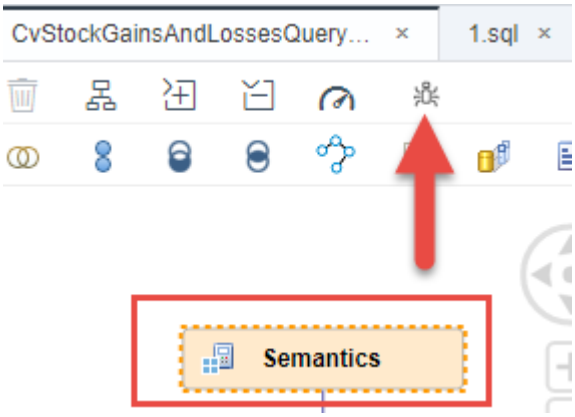
```
--SQL #3
SELECT "Symbol", SUM("SymbolCount") AS "SymbolCount",
SUM("SymbolDayCount") AS "SymbolDayCount"
FROM "1.sol::CvStockGainsAndLossesQuery"
GROUP BY "Symbol";
```

16. Notice: When both measures are simultaneously requested the Symbol Count for SAP is incorrect!

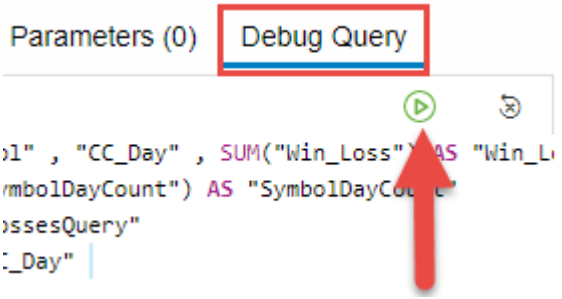
Symbol	SymbolCount	SymbolDay
SAP	1	4
IBM	1	3

17. Your assignment starts: Debug the model to see which data is brought into context.

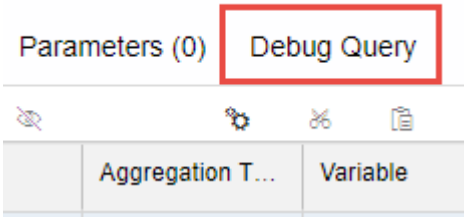
    Select the Semantics node, then click on the little bug icon to start the debugger



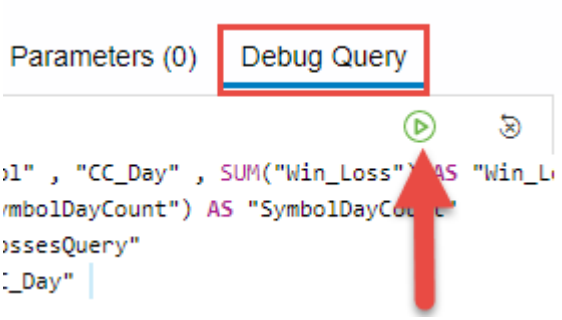
18. When the Debug Query tab appears showing the SQL statement > Click execute



19. Click on the Debug Query tab again to look at the data



20. Click Execute again



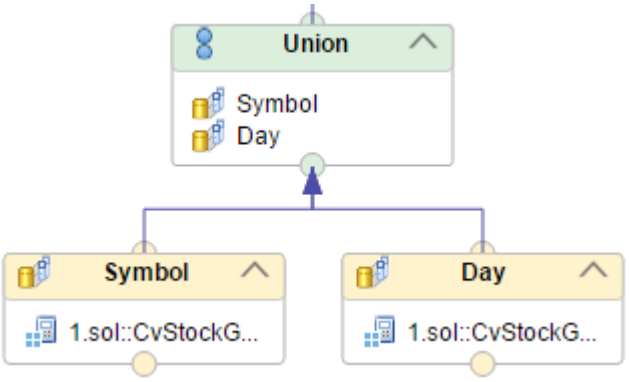
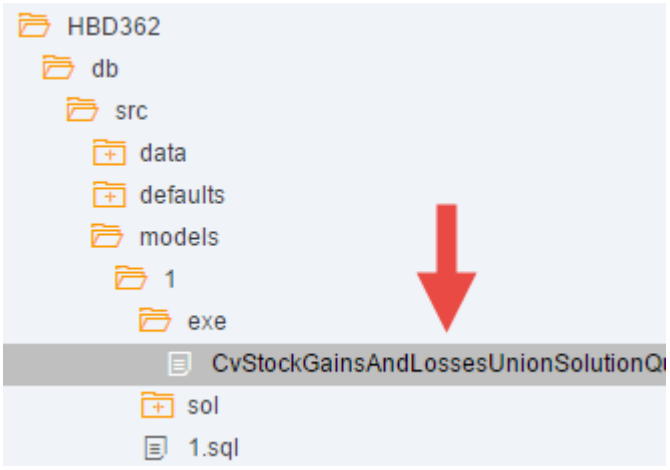
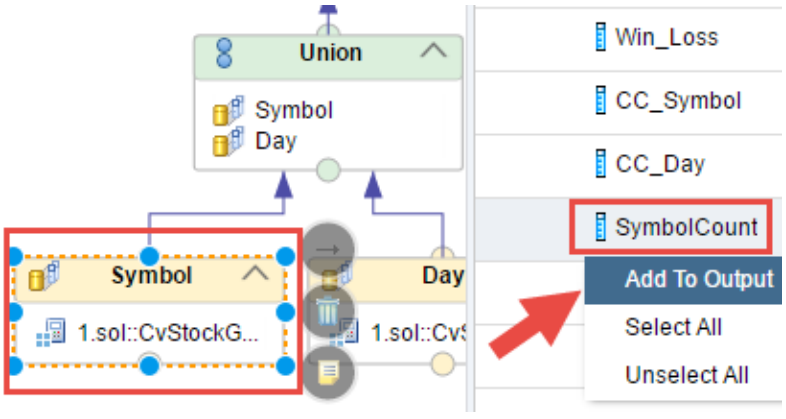
21. Analysis: The following data is brought into context when both measures are queried:

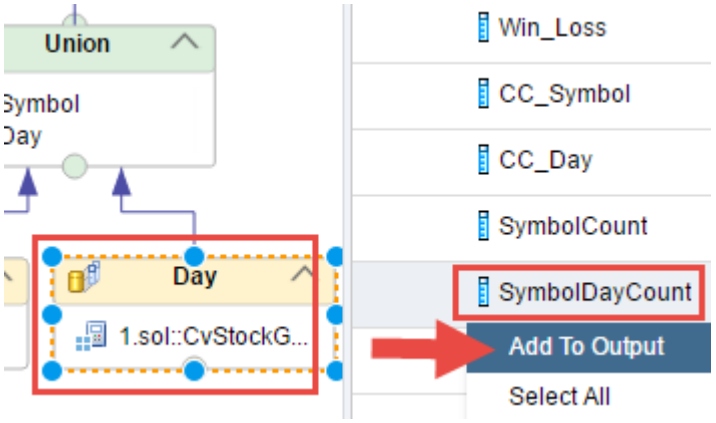
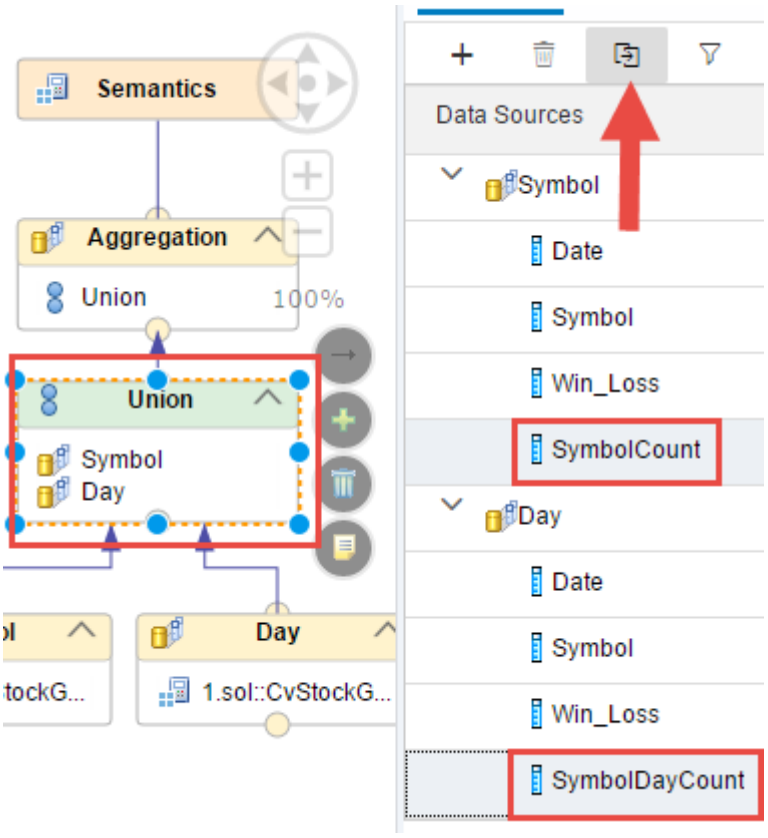
    The CC_Day calculated column is using (and therefore bringing into context) a finer grain Date column that is affecting the granularity of the coarser grain CC_Symbol calculation. As a result, the CC_Symbol calculation is calculated daily and before aggregation (instead of on the entire week and after aggregation)

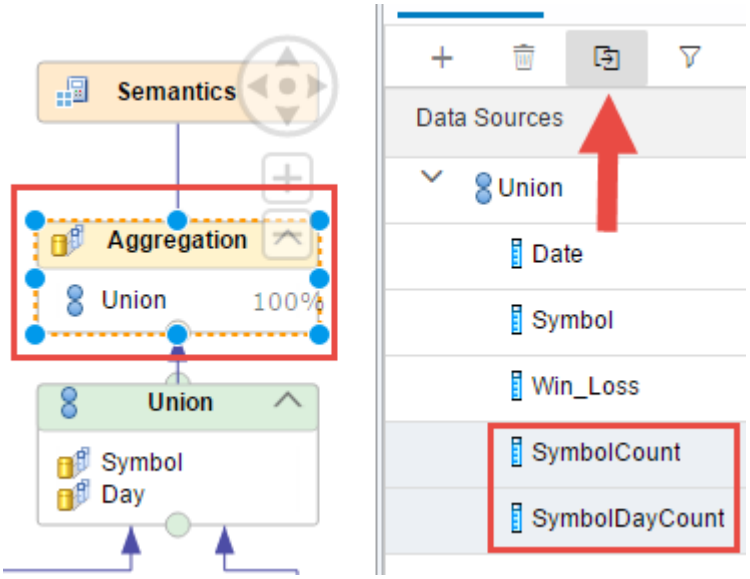
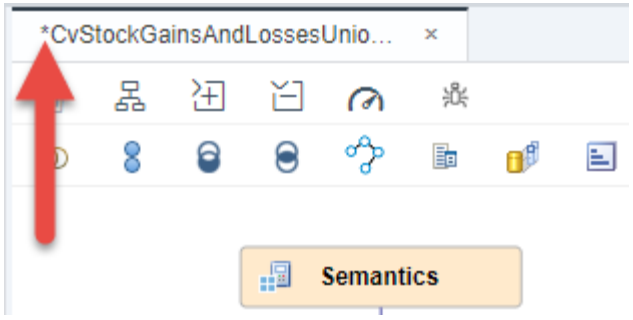
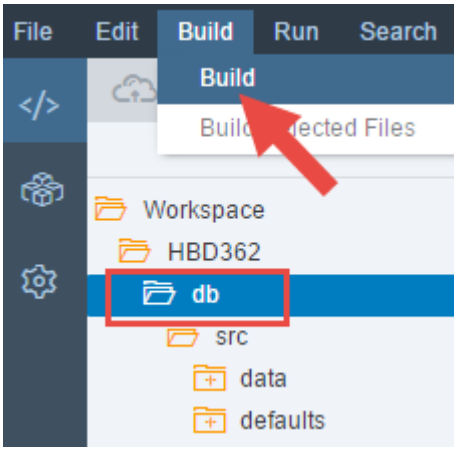
Date	Symbol	CC_Symbol	CC_Day	Win_Loss
201...	IBM	IBM	2010-0...	1.25
201...	IBM	IBM	2010-0...	1.5
201...	IBM	IBM	2010-0...	1.5
201...	SAP	SAP	2010-0...	0.25
201...	SAP	SAP	2010-0...	0.25
201...	SAP	SAP	2010-0...	0.25
201...	SAP	SAP	2010-0...	0.25
201...	IBM			-3
201...	IBM			-1
201...	SAP			-3

22. Informational: When the date column is not brought into context the CC_Symbol executes after aggregation resulting in the counter to be 1 for IBM and 0 for SAP

Symbol	Win_Loss	CC_Symbol
SAP	-2	?
IBM	0.25	IBM

23. Recommendation 1: Union Model instead so that each counter uses its own context. This can be done by placing the calculations into separate branches (keeping same-granularity-level calculations on the same branch)	
24. Your assignment starts: Expand models > 1 > exe > open Stock Gains and Losses Union Solution Query	
25. Underneath the Union, select the left branch (Symbol) > mapping > select SymbolCount > Add to Output	

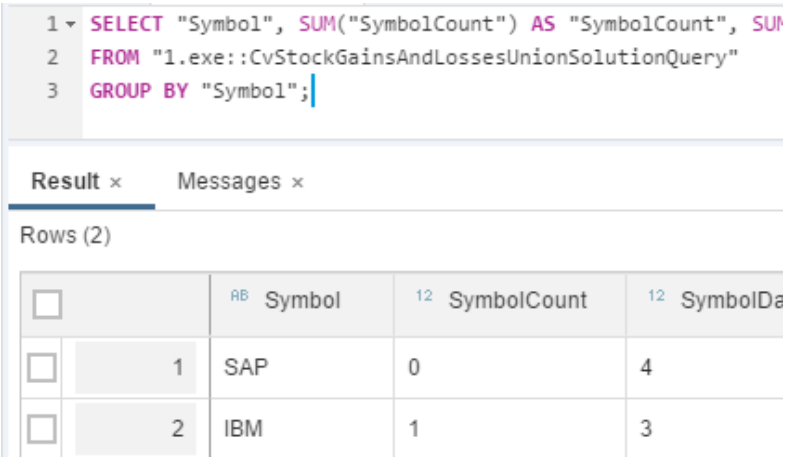
26. Similarly select the right branch (Day) > mapping > select SymbolDayCount > Add to Output	
27. Select the Union > Mapping > Add both Symbol Count and Symbol Day Count to the output	

28. Similar within the topmost aggregation node add both measures to the output as well	
29. Important. Save your work! Hint: The star is an indication of unsaved work!	
30. Save & build the db project	
31. Ensure the build finished successful	Build of /HBD362/db completed successfully

32. Test the model > copy SQL #5 into the SQL Console > Execute

```
--SQL #5
SELECT "Symbol", SUM("SymbolCount") AS "SymbolCount",
FROM "1.exe::CvStockGainsAndLossesUnionSolutionQuery"
GROUP BY "Symbol";
```

33. Notice: The counters are correct!

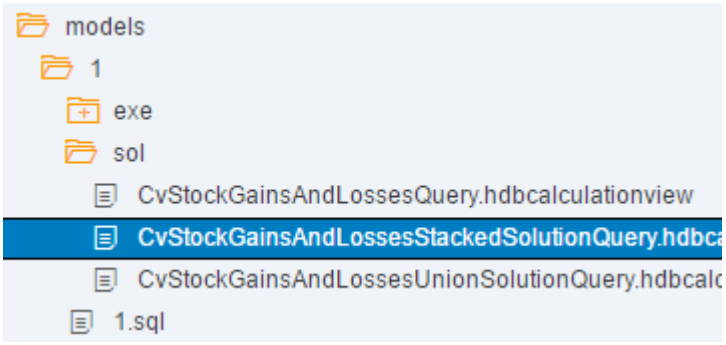


34. Recommendation 2:

    Stacking models:

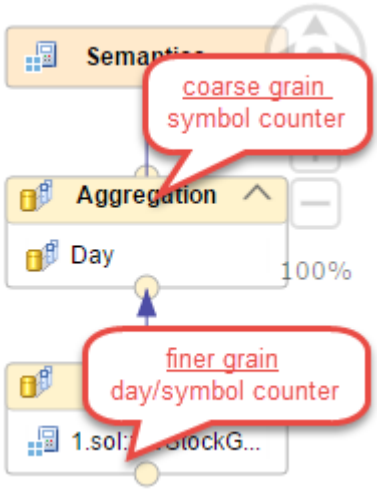
    open 1 > sol > Stacked Solution Query

    Instead of using a union a stacked approach would similarly work



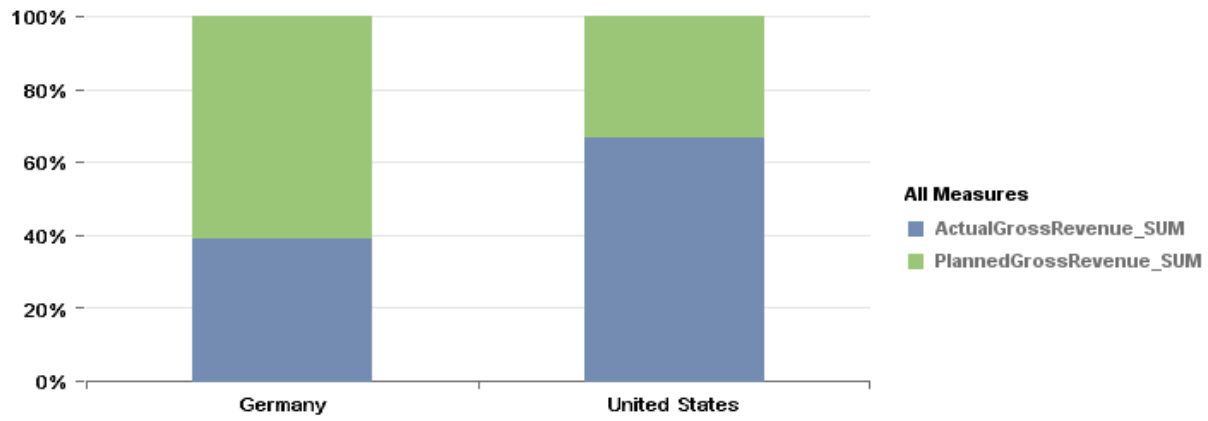
35. Strictly informational:

    Notice the finer grain day-and-symbol counter in modeled in the child calculation model; and then coarser grain symbol counter is modeled in a wrapper calculation model

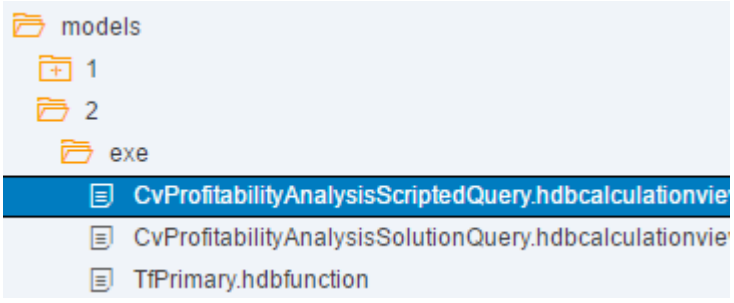
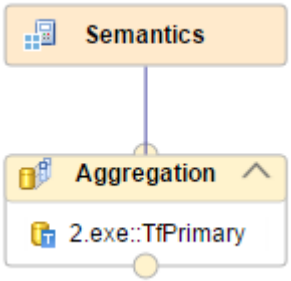


EXERCISE 2 - Scripted models vs Modeled models (20 MINUTES, 35 steps)

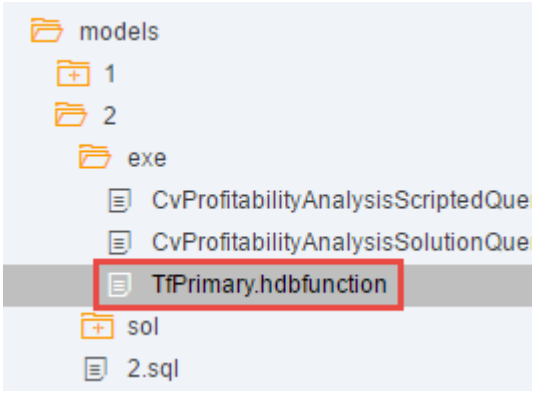
This exercise showcases the classical ERP CO-PA probability analysis scenario that provides multi-dimensional insights into a company's product profitability. The final solution implements various best practice techniques such as the use of calculation views, star joins, join optimizations and unions to compare actual vs planned data



The CO-PA solution model needs to support dynamic ad-hoc query analyses. It is implemented using 2 different approaches, first using modeled calculation views and second using SQLScript. You will compare the execution of both approaches and at the end of the exercise you will understand the various optimizations that are native to graphical calculation models to support dynamic ad-hoc analyses.

Explanation	Screenshot
1. Expand models > 2 > exe > open the Scripted calculation model query	
2. Notice a table function is used as a data source, proceed to open the table function	

3. Within the exe directory open the TfPrimary table function



4. Review the code:

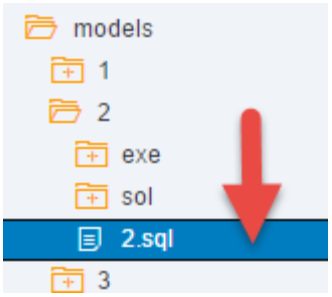
   Notice the actuals-query, followed by the planned-query which is then combined using a union operator

   Note: The transaction tables are directly queried, and the dimensional tables are wrapped inside other calculation models

```
7
8  ITAB_ACTUALS = SELECT
9      "FACT"."Perio" AS "Perbl", "FACT"."Gjahr" AS
10     "PRODUCT"."Matnr" AS "Matnr", "PRODUCT"."Mak
11     "LOCATION"."Kunnr" AS "Kunnr", "LOCATION"."L
12     "LOCATION"."Regio" AS "Regio", "LOCATION"."B
13     SUM("FACT"."Vv010") AS "ActualGrossRevenue",
14     SUM("FACT"."Vv070") AS "ActualSalesDeduction
15     SUM("FACT"."Vv290") AS "ActualProductVarianc
16     SUM("FACT"."Vv010" - "FACT"."Vv070") AS "Act
17 FROM "ecc.CopaCe1Idea" "FACT"
```

5. Proceed to analyze the execution of the scripted model

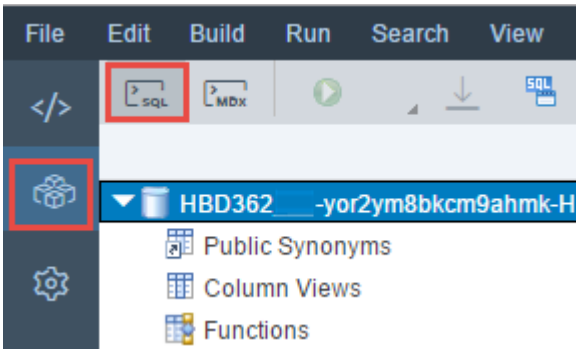
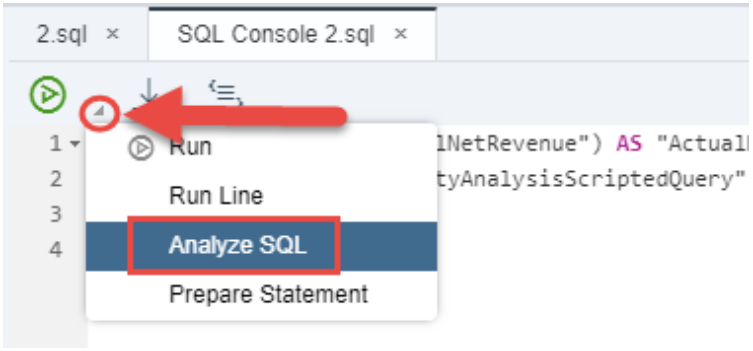
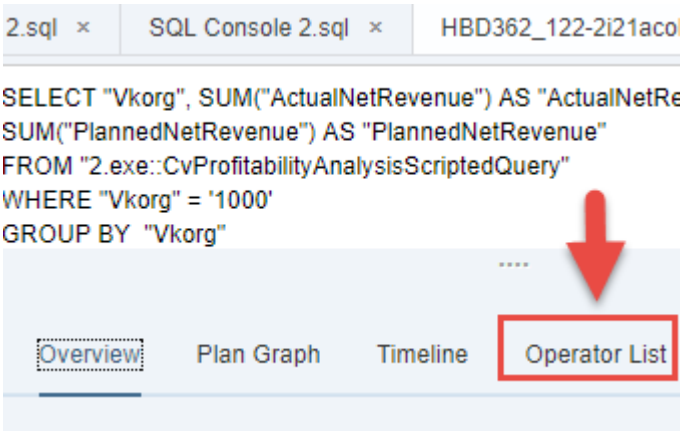
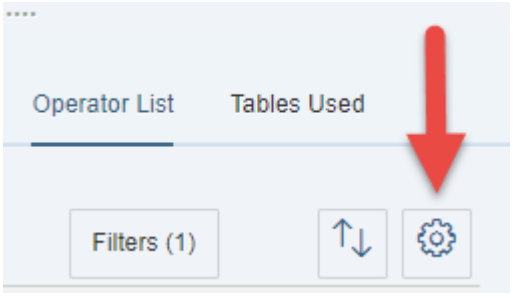
   models > 2 > open 2.sql



6. Copy SQL #1, open the Database Explorer

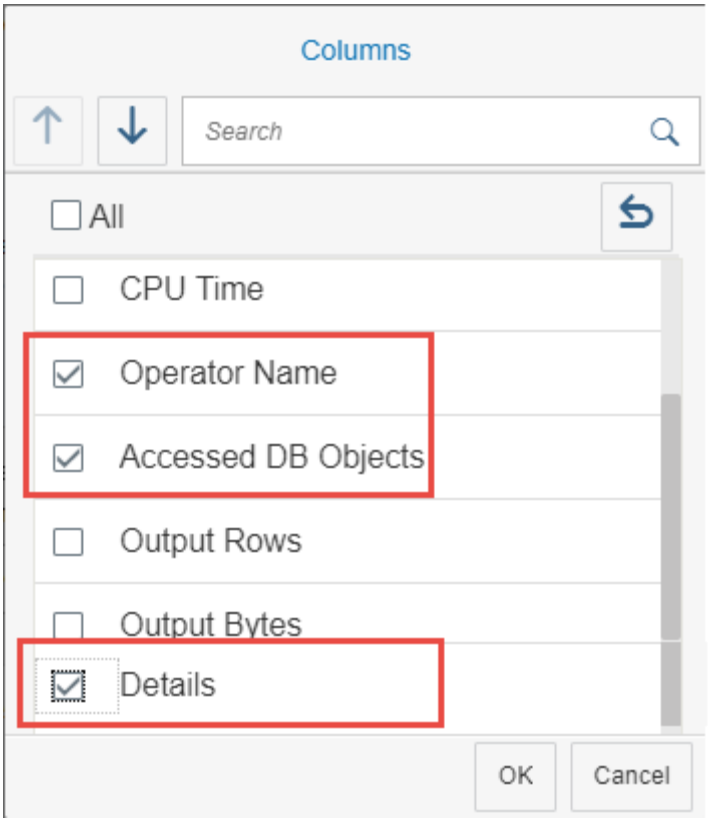
   Hint: Notice the WHERE clause filter

```
------------------------------------------
--STUDENT SQL
------------------------------------------
--SQL #1
SELECT "Vkorg", SUM("ActualNetRevenue") AS "A
FROM "2.exe::CvProfitabilityAnalysisScriptedQ
WHERE "Vkorg" = '1000'
GROUP BY  "Vkorg";
```

7. Select your container and open the SQL Console	
8. Paste the SQL > then click on the small icon next to the green execute button > Analyze SQL	
9. Before starting the analysis, first click on the Operator List tab	
10. Then click on settings to personalize the display	

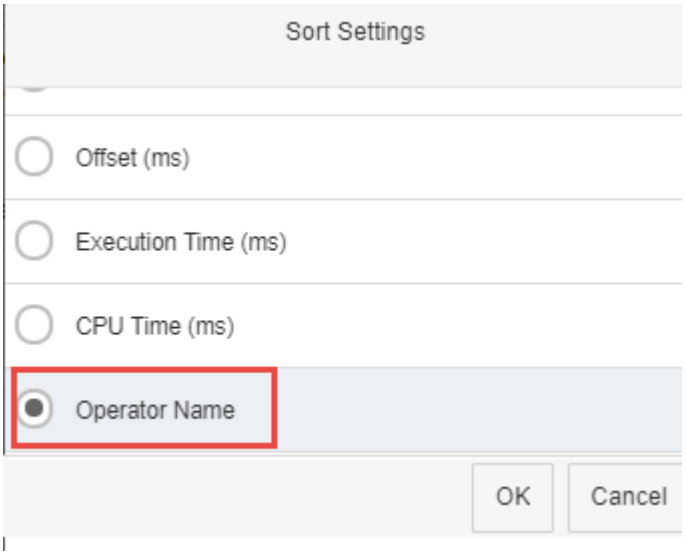
11. Unselect all columns and only select the following 3 columns:

    - Operator Name
    - Accessed DB Objects
    - Details



12. Then click on the up and down (Sort) icon

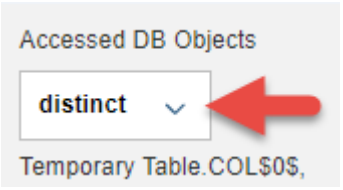
13. Sort by Operator Name



14. At first glance it appears that the query is showing optimal execution:

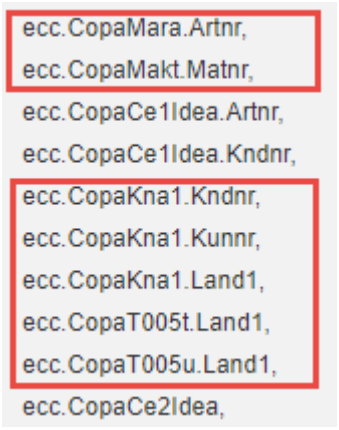
    The model is unfolded (meaning that the underlying table details are shown without references to any calculation models). Filters are pushed down (i.e. VKORG) adequately

15. Under Accessed DB Objects change the display to distinct

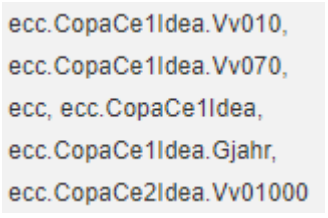


16. Notice the first optimization difference when using scripts. Additional tables are accessed even though the query requested columns from only the 2 transaction tables

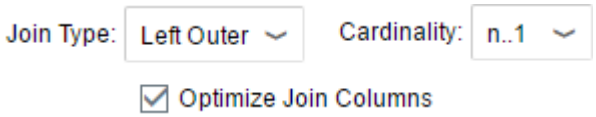
    Hint: Graphical models contain additional optimizations that can prune un-used tables and joined columns (i.e. using cardinality / optimize join settings)



17. Informational: Later in the exercise you will see how graphical models can ignore unused tables resulting in more optimal execution



18. Informational: Spoiler alert: Specifying join properties within graphical calculation models can enable pruning



19. Next, the usage of scalar variables may block optimizations

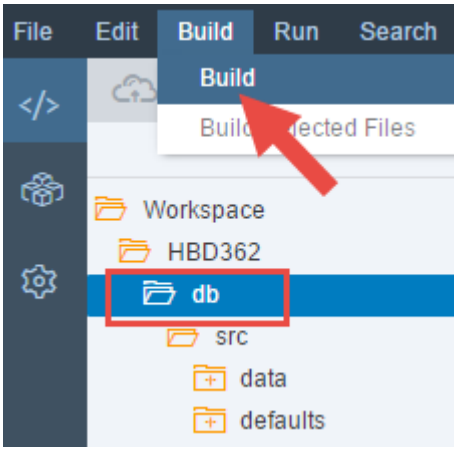
    Edit the table function > 2.exe::TfPrimary > uncomment theses 8 and 9 (the scalar variable declaration line and the assignment line)

```
*TfPrimary.hdbfunction ×
 1  FUNCTION "2.sol::TfPrimary" ( )
 2      RETURNS "ecc.ActualsPlannedT"
 3      LANGUAGE SQLSCRIPT
 4      SQL SECURITY INVOKER AS
 5  BEGIN
 6
 7  --# blocker
 8  DECLARE V_YEAR NVARCHAR(4);
 9  SELECT YEAR(ADD_YEARS(CURRENT_DATE,-13)) I
10
```

20. Towards the end of the function uncomment the WHERE clause on line 87

```
84      SUM("PlannedOtherExpenses") AS "Pl
85      SUM("PlannedNetRevenue") AS "Planne
86  FROM :ITAB_RESULT
87  WHERE "Gjahr" = :V_YEAR
88  GROUP BY "Perbl",  "Gjahr", "Kndnr", "
```

21. Save & build the db project

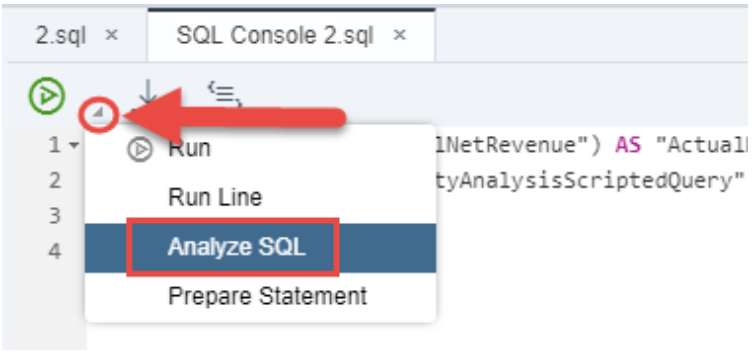


22. Ensure the build is succeeded

    Build of /HBD362/db completed successfully.

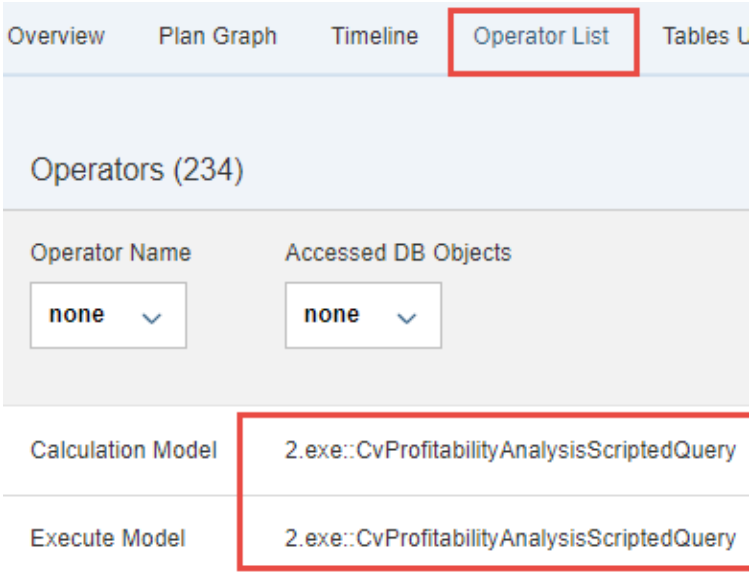
23. Analyze SQL #1 again > click on the small icon next to the green execute button > Analyze SQL

    Hint: Find out if both filters are pushed down



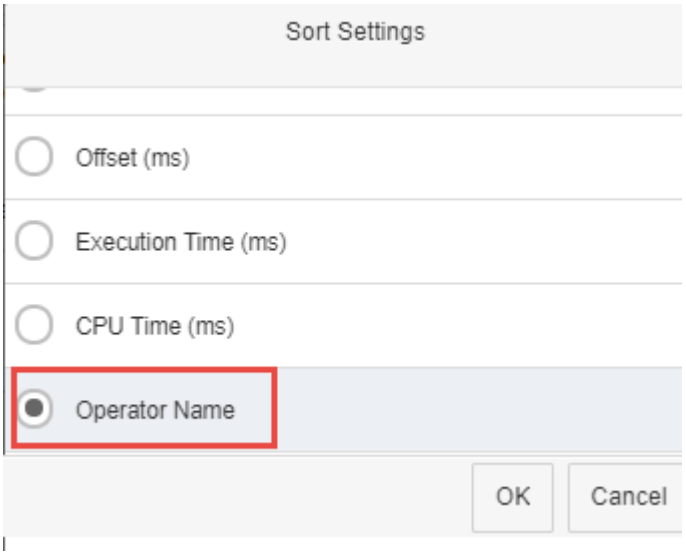
24. Under the Operator List > Notice the model is not unfolded (instead of table details the calculation model is shown), potentially blocking optimizations

    Note: Scalar variables used inside the SQLScript body is not yet fully optimized and may adversely impact performance



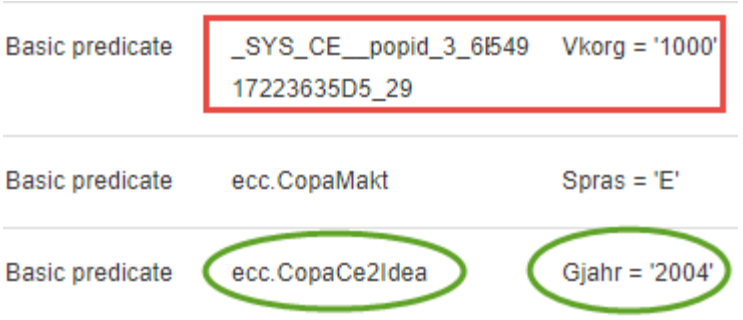
25. Proceed with additional analysis to confirm if the filters (VKORG and YEAR) are pushed down

    Sort by the Operator Name



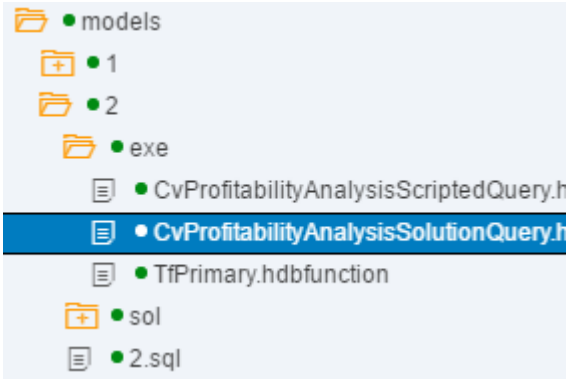
26. The execution of the model is not optimal; YEAR is pushed down but VKORG is blocked

    Potential solutions:
    Use explicit and mandatory input parameters for static scenarios or …
    Create modeled calculation views for dynamic scenarios that prohibit mandatory parameters

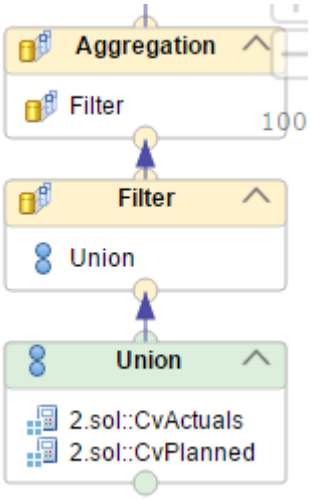


27. Your next assignment starts: Analyze the execution of graphical calculation models:

    Within the exe folder open the Profitability Analysis Solution Query calculation model (aka graphical calculation model)



28. Notice instead of using SQLScript the solution is created entirely using calculation models with unions and star joins, etc.

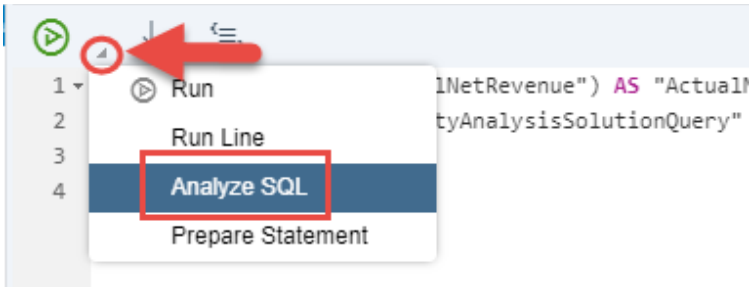


29. Analyze the execution against the graphical calculation model

    As before copy SQL #2 and paste it into the SQL Console

```
--SQL #2
SELECT "Vkorg", SUM("ActualNetRevenue") AS "ActualN
FROM "2.exe::CvProfitabilityAnalysisSolutionQuery"
WHERE "Vkorg" = '1000'
GROUP BY  "Vkorg";
```

30. Analyze the SQL



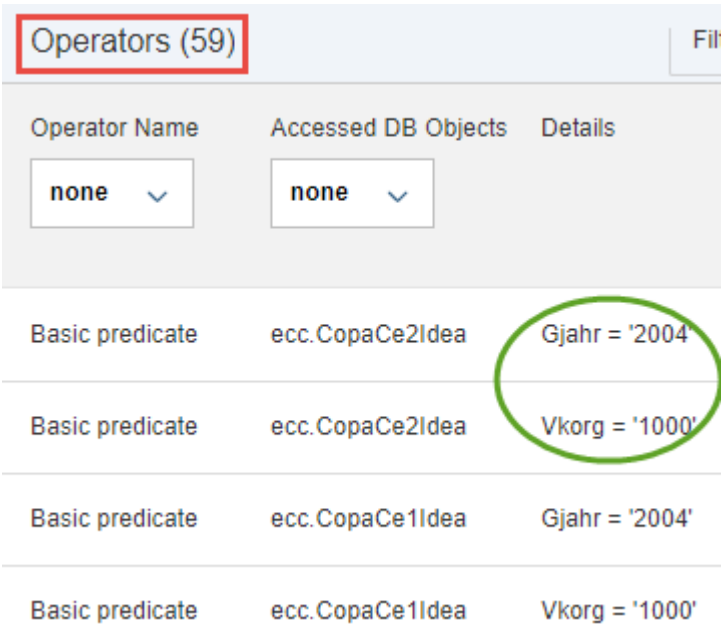
31. The execution of this model is optimal

    Operators > Accessed DB Objects [distinct]

    - The model is unfolded (only tables are referenced)
    - Any unused tables and columns are ignored

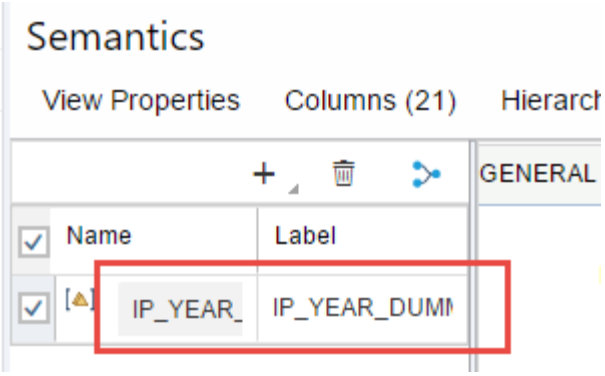
32. Under Operators > Sort by Operator Name > Both filters (YEAR and VKORG) are passed down to the fact tables

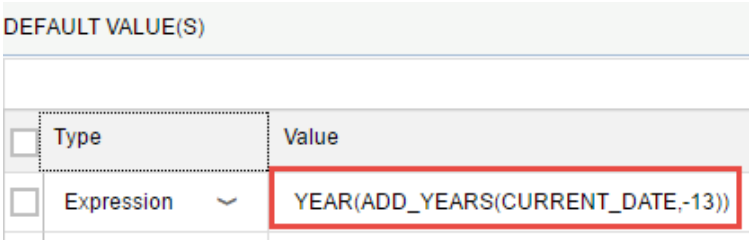
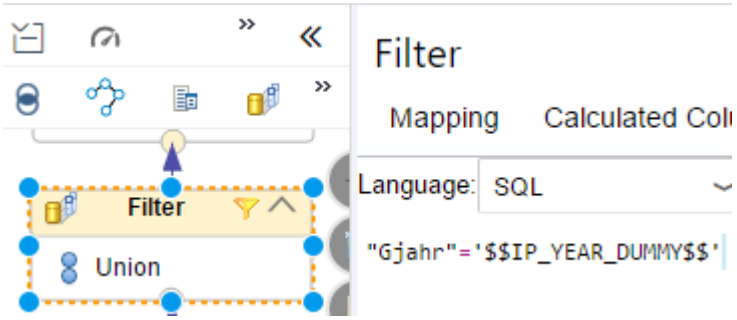
    Note: If you recall earlier in the scripted scenario, only VKORG was pushed down, YEAR was blocked due to the usage of scalar variables. See next how the YEAR filter is modeled instead in graphical calculation models to allow push down



33. Within the Semantics area > Parameters > open the IP_YEAR_DUMMY input parameter

    Hint: Parameters can be maintained from all nodes not only in the Semantics area



34. Notice, the dummy input parameter contains the expression to calculate 13 years in the past	
35. The input parameter is then used as a YEAR filter (in the aggregation node above the union)	

EXERCISE 3 - Dynamic ranking (10 MINUTES, 14 steps)

In this exercise, the rank node is used to determine the most valuable soccer players. The requirements are, to display the best 2 players per a team and the best 3 players in the league

Original data set:

Player	Team	Goals
Arjen Robben	Bayern Munich	3
Max Kruse	Borussia M.Glad...	5
Karim Bellar...	Bayer Leverkusen	4
Richardo R...	Wolfsburg	3
Mario Götze	Bayern Munich	6
Naldo	Wolfsburg	2
Uwe Hune...	Paderborn	2
Abdul Rah...	Augsburg	0
Kevin De Br...	Wolfsburg	0
Xabi Alonso	Bayern Munich	1

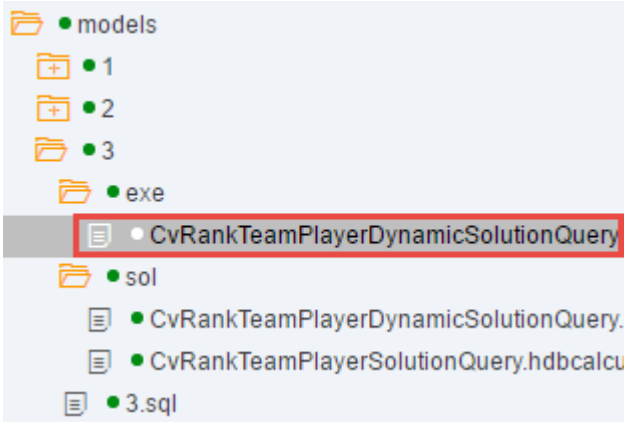
Expected results: top 2 players in a team

Player	Team	Goals
Mario Götze	Bayern Munich	6
Arjen Robben	Bayern Munich	3
Max Kruse	Borussia M.G...	5
Karim Bellar...	Bayer Leverk...	4

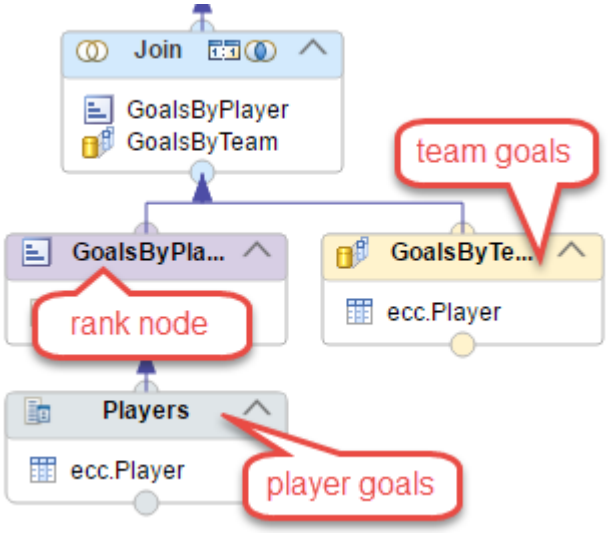
Expected results: top 3 players in league

Player	Goals	Team
Mario Götze	6	10
Max Kruse	5	5
Karim Bellarabi	4	4

Your task is to review the model and to determine why unexpected results are shown for certain queries. The ranking is correct when querying the best 2 players per team, however the ranking is wrong when querying the best 3 players across the league. After you have analysed the situation proceed to enhance and fix the model

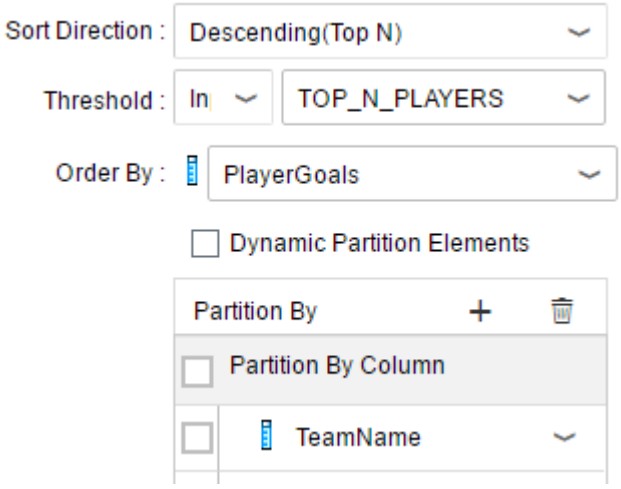
Explanation	Screenshot
1. The model is already prepared for you. Navigate to models > 3 > exe > open the calculation model	

2. Notice the 2 separate branches to calculate the player and team goals



3. Select the rank node > definition. The rank node is configured to sort the top N player goals within a team from high to low

   Note: The player column is not a partitioned column, instead the parent column (team) acts as the window frame within which players will be ranked based on their goals



4. Start by executing SQL statements against the model

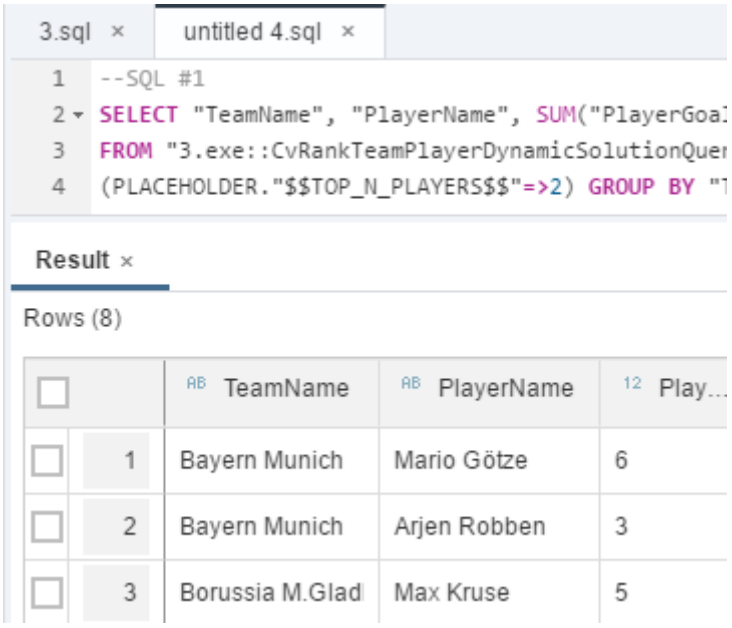
   Open 3.sql and copy both SQL #1 and #2 into the SQL Console

```
------------------------------------------------------
--STUDENT SQL
------------------------------------------------------
--SQL #1
SELECT "TeamName", "PlayerName", SUM("PlayerGoals")
FROM "3.exe::CvRankTeamPlayerDynamicSolutionQuery"
GROUP BY "TeamName", "PlayerName";

--SQL #2
SELECT "PlayerName", SUM("PlayerGoals") AS "PlayerG
FROM "3.exe::CvRankTeamPlayerDynamicSolutionQuery"
GROUP BY "PlayerName";
```

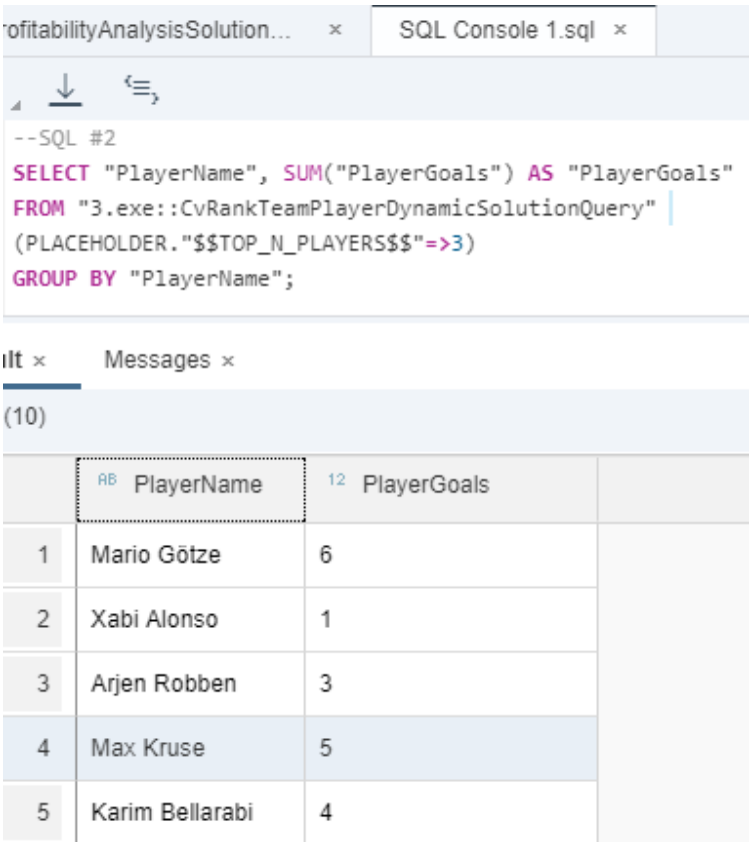
5. Execute SQL #1 > The results are correct.

   Note: The input parameter to display only the top 2 players per team



6. Execute SQL #2 > The results are wrong!

   The top 3 players across the league is <u>incorrect</u>; Instead of returning 3 rows (Mario, Max, Karim) all the players are returned



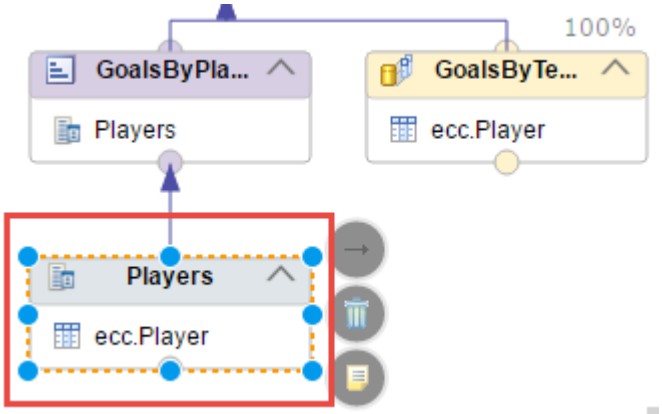
7. Explanation: The rank node requires a parent column to act as the window frame. In our example the team (parent) is used, the players within each team is then ranked. The model currently does not support a grand-parent (league) concept to rank individual players across the entire league.

   These situations call for a dummy calculated column to act as a temporary window frame column

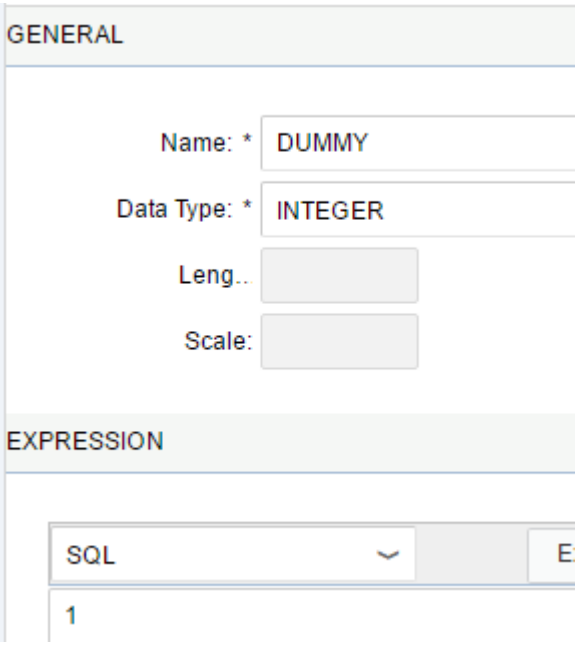
X	Player	Go...	Team
1	Arjen Robbe	3	Bayern Munich
1	Max Kruse	5	Borussia M.Gladbac
1	Karim Bellara	4	Bayer Leverkusen
1	Richardo Ro	3	Wolfsburg
1	Mario Götze	6	Bayern Munich
1	Naldo	2	Wolfsburg

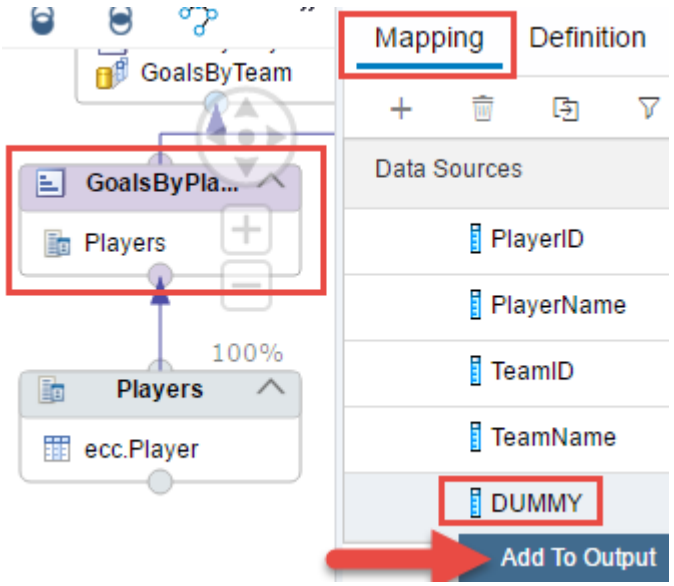
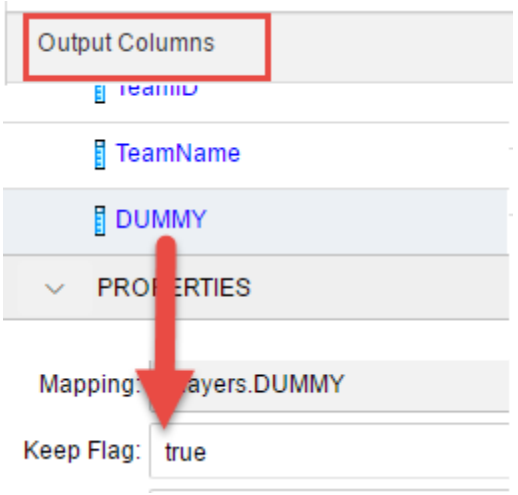
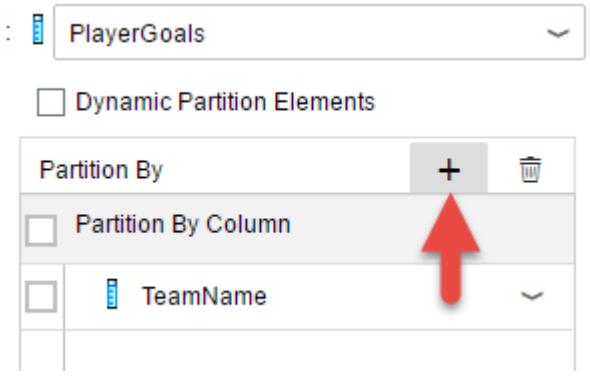
8. Your assignment starts:

   If not already opened navigate to models > 3 > exe > open the calculation model > underneath the rank node > select the player data source at the bottom of the model > then over on the right > select calculated columns



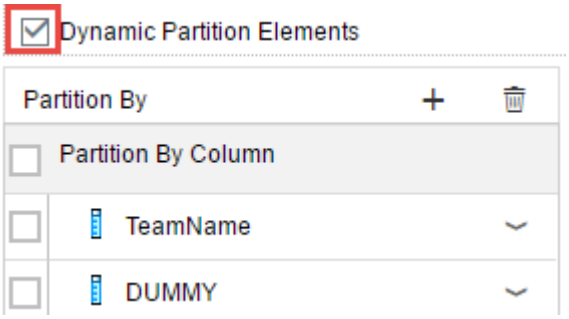
9. Click the + icon and create a new integer DUMMY calculated column (default value of 1)



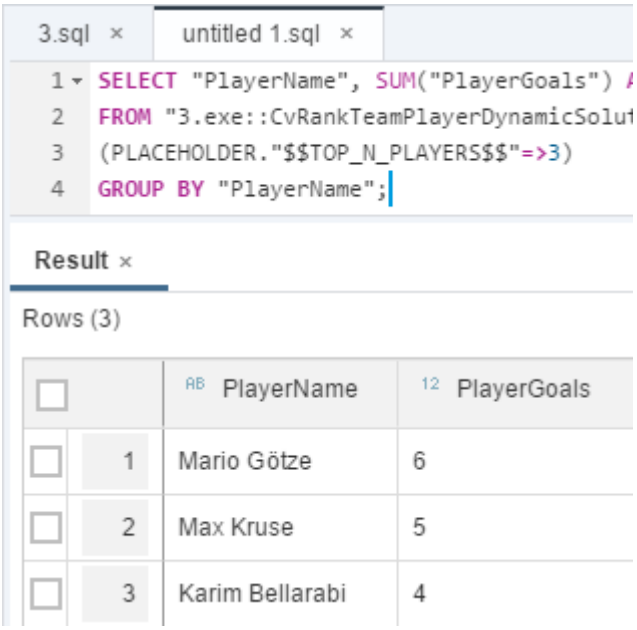
10. Select the rank node > Mapping > add the DUMMY calculated column to the output	
11. Within Mapping > Output Columns > select the DUMMY column Force DUMMY to be brought into context by setting the keep flag to true	
12. With the rank node selected > select the Definition area Add the DUMMY column as a partition column	

13. Make sure to select Dynamic Partition Elements

    Note: Thus, the team name column will not be brought into context when ranking Players across the league

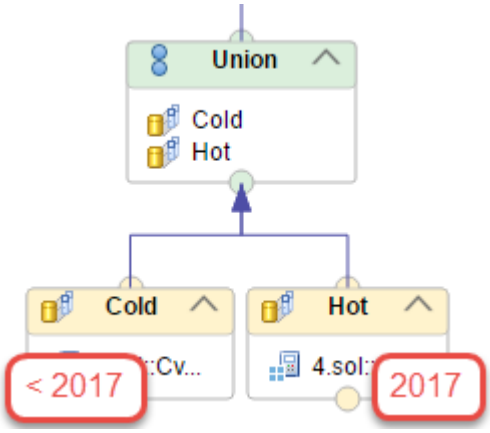


14. Save, build and execute SQL #2 again. The results are now correct for both queries

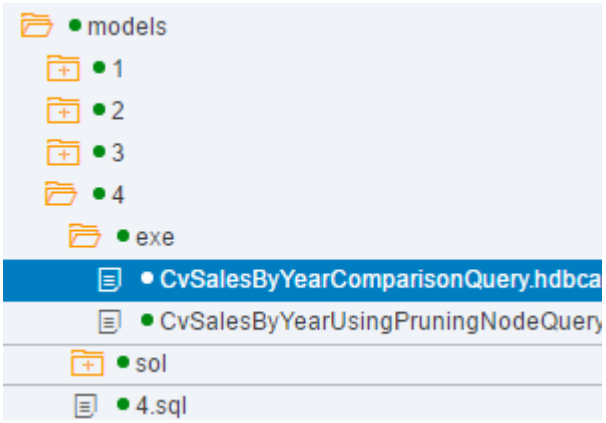


EXERCISE 4 - Explicit vs Implicit union pruning (20 MINUTES, 34 steps)

This exercise demonstrates how to model scenarios that supports hot data (that exists in SAP HANA) and cold data (that exist in an external database) without having to expose the technical location details to end users. In these types of situations, current data is most often queried, it is crucial that union pruning is enabled so that the large amounts of historical data are ignored by default unless explicitly or implicitly requested by the user

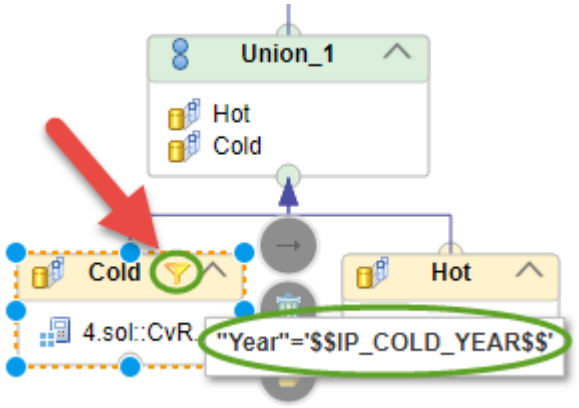


Your assignment is to model the union and to implement both explicit and implicit input source pruning

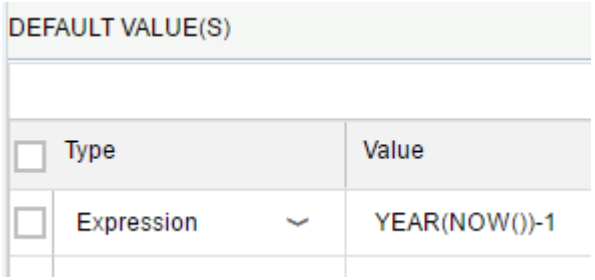
Explanation	Screenshot
1. Within models > 4 > exe > open CvSalesByYearComparison Query	

2. Select the cold branch, notice that a filter is defined. With the mouse hover over the filter to see the details.

   The cold historical data is always filtered using a mandatory input parameter



3. Next, click on the parameters tab (over on the right) to see the details of the input parameter. Notice that that input parameter contains a default expression – the previous year is calculated unless a user overrides the expression by supplying a specific historical year



4. Execute SQL statements against the model

   Open 4.sql > copy SQL #1 and past it into the SQL Console > execute

   Note: No input parameter is supplied, therefore the current year and the previous year is automatically calculated

```
--SQL #1
SELECT "Country",
SUM("PreviousAmount") AS "2016",
SUM("CurrentAmount") AS "2017"
FROM "4.exe::CvSalesByYearComparisonQuery"
WHERE "Country" IN ('USA', 'Germany', 'France',
GROUP BY "Country" ORDER BY "Country";
```

	Country	2016	2017
1	Brazil	46568.67	9165.4
2	France	19963.06	2825.4
3	Germany	82665.7	18099
4	Sweden	24084.4	2826.5
5	USA	103372.18	4692.4

5. To confirm that the results are correct execute SQL #2, this will force 2016 using an input parameter

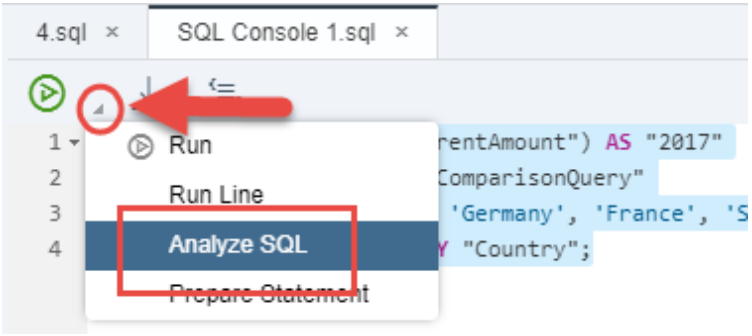
```
--SQL #2
SELECT "Country",
SUM("PreviousAmount") AS "2016",
SUM("CurrentAmount") AS "2017"
FROM "4.exe::CvSalesByYearComparisonQuery"
('PLACEHOLDER' = ('$$IP_COLD_YEAR$$', '2016'))
WHERE "Country" IN ('USA', 'Germany', 'France',
GROUP BY "Country" ORDER BY "Country";
```

	Country	2016	2017
1	Brazil	46568.67	9165.4
2	France	19963.06	2825.4
3	Germany	82665.7	18099
4	Sweden	24084.4	2826.5
5	USA	103372.18	4692.4

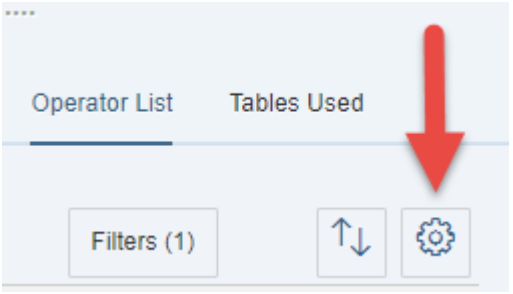
6. Copy and analyze SQL #3, this query is calculating hot data (2017), the expectation is that cold/historical data would be ignored

   Note: Current data is loaded into the Orders table and all older historical data is loaded into a table called IQOrders

   Note: In reality IQOrders will be a virtual table pointing to an external database table

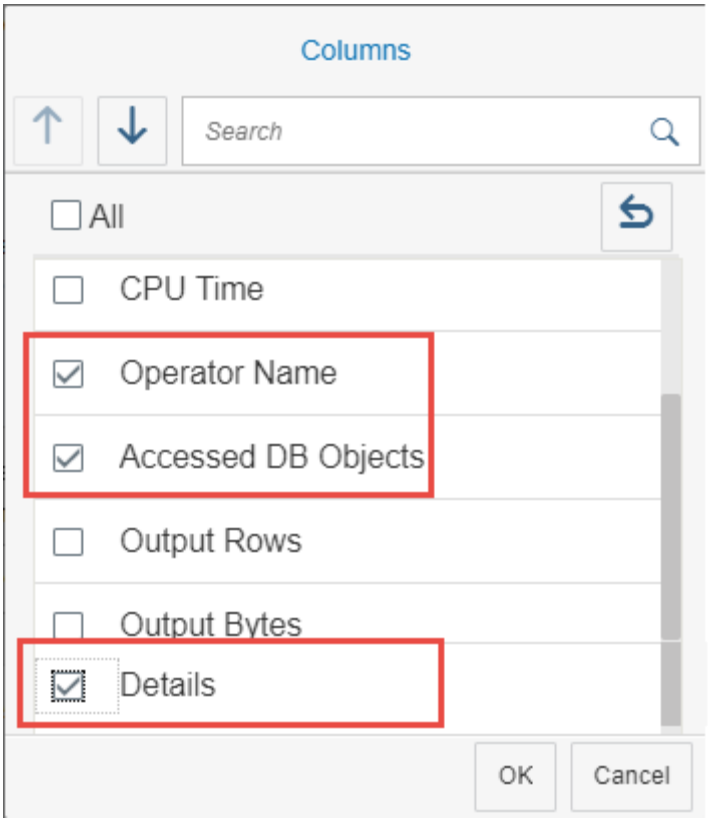


7. Click on the Operator List tab > then to make analysis easier, click on settings to personalize the display



8. Unselect all columns and only select the following 3 columns:

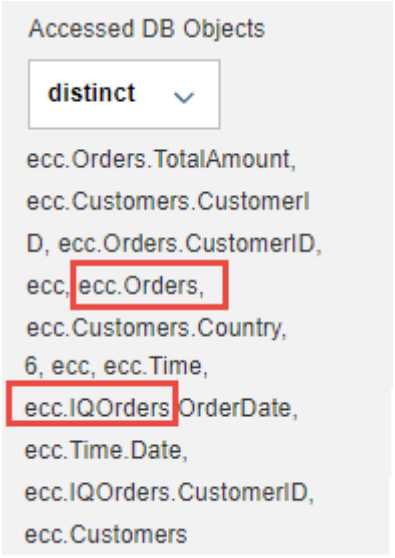
   - Operator Name
   - Accessed DB Objects
   - Details



9. Change the drop-down list to show the distinct database objects

   Analysis: The execution shows that the model is not optimal.

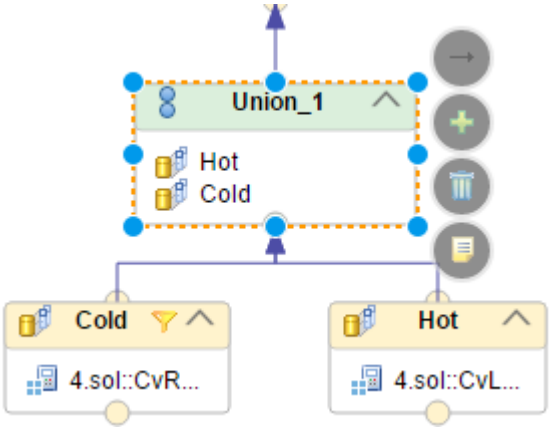
   Even though the end results are correct the historical data (IQOrders) was unnecessarily queried



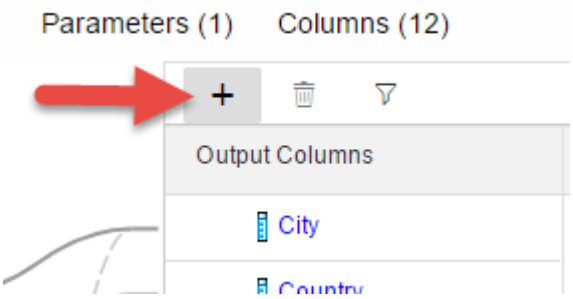
10. Your assignment starts.

    First enhance the model to support explicit union pruning

    If not already opened. Open models > 4 > exe > CvSalesByYearComparison Query > select the Union



11. Create a constant. On the right side of the screen > Mappings > In the Output Columns > Click +

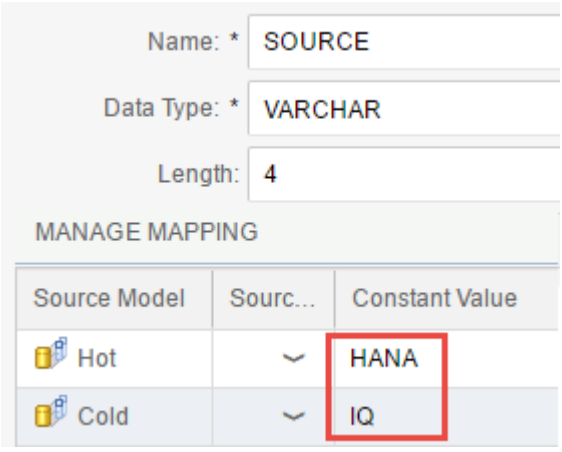


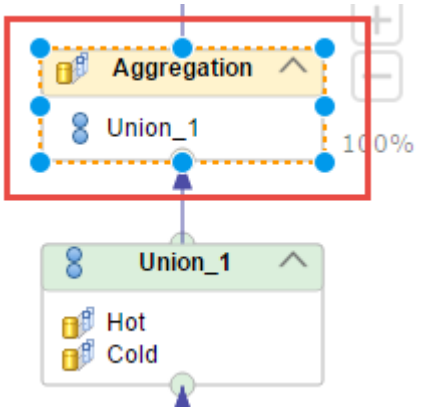
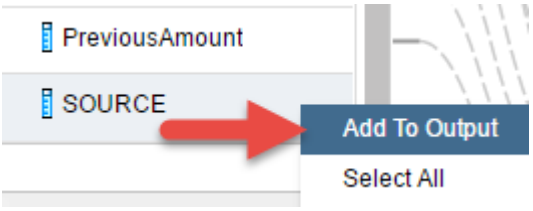
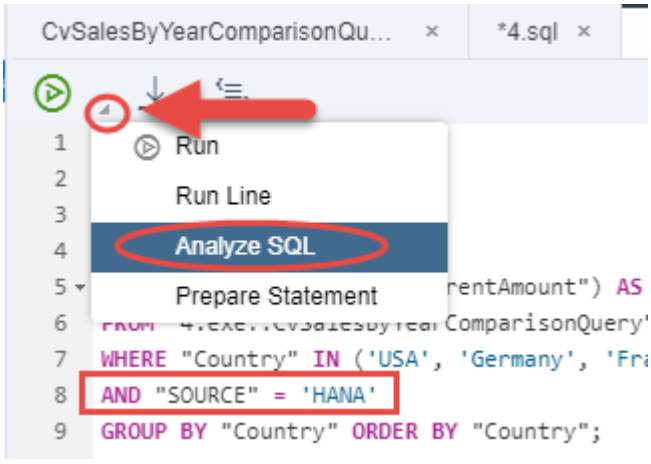
12. Define the constant as follows:

    Name: SOURCE VARCHAR(4)

    Add a constant value for each input source:

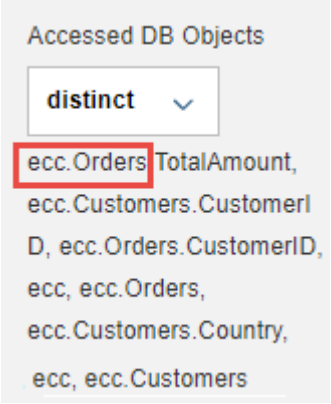
    Hot = HANA
    Cold = IQ



13. Click on the Aggregation node above the Union > Mapping	
14. On the left side of the mappings screen under data sources > add the SOURCE column to the output	
15. Save & build the db project. Make sure that the project compiled successfully	Build of /HBD362/db completed successfully
16. Copy and analyze SQL #4 Notice hot data is explicitly queried using the SOURCE filter	

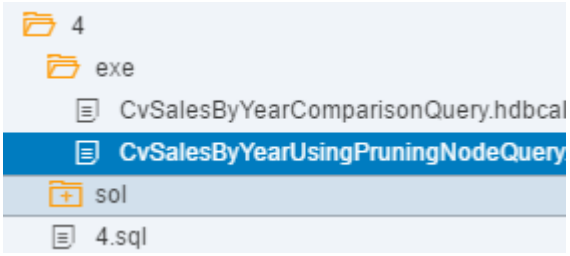
17. The result shows optimal execution, using explicit input source pruning all historical data is ignored

    Hint: IQOrders is not queried



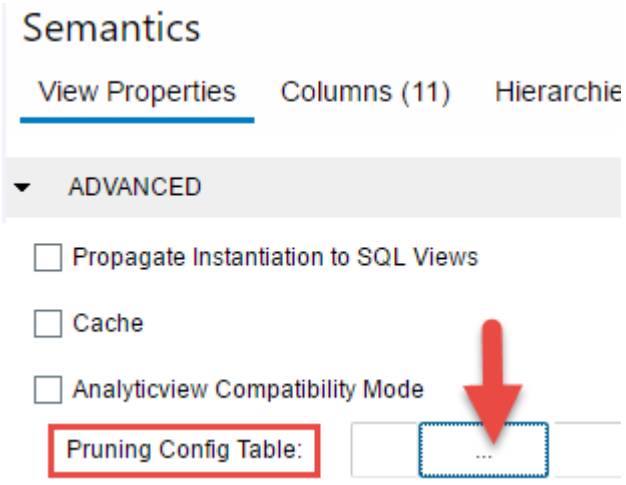
18. Your next assignment: Situations that demand more flexible predicates can instead enable implicit pruning

    Open 4 > exe > CvSalesByYear UsingPruningNodeQuery



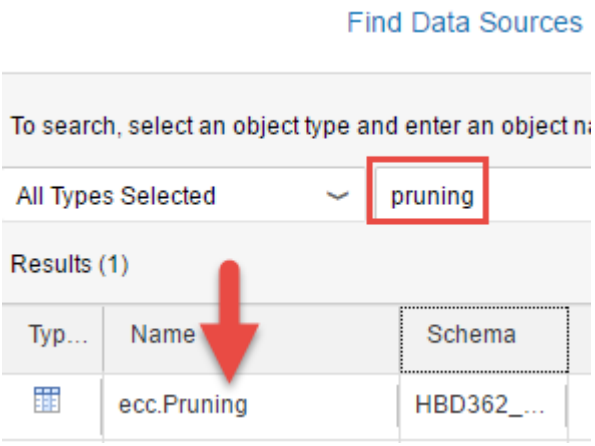
19. This mechanism does not use union constants nor input parameters. Instead a pruning configuration table with WHERE clause filters are used

    Select Semantics > View Properties > then scroll down to Advanced > Pruning Config Table > click on the icon to search for and select pruning table



20. When the search window appears, type in pruning and click search. Then select the Pruning table

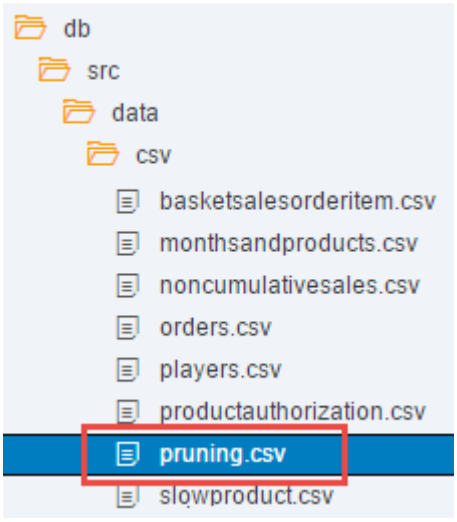
    Save the model



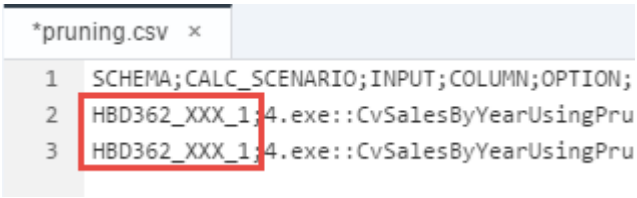
21. Next. Add your own model and schema specific information to the pruning configuration table

    Expand db > src > data > csv > then edit pruning.csv

    Hint: The next build will automatically import the data from the .csv file into the pruning table

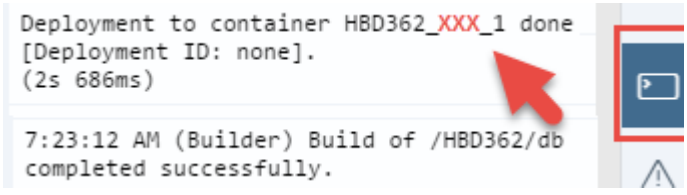


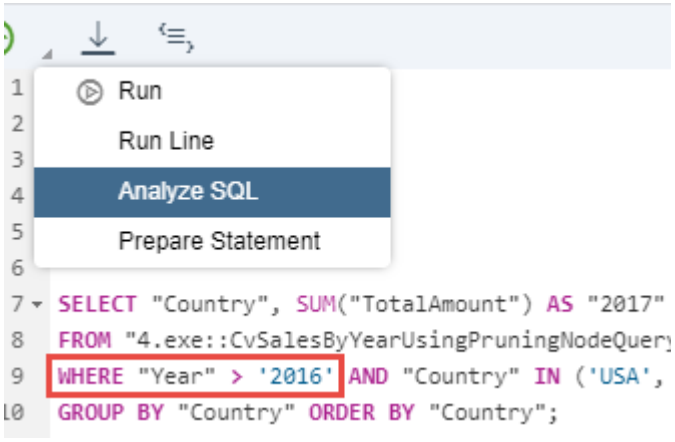
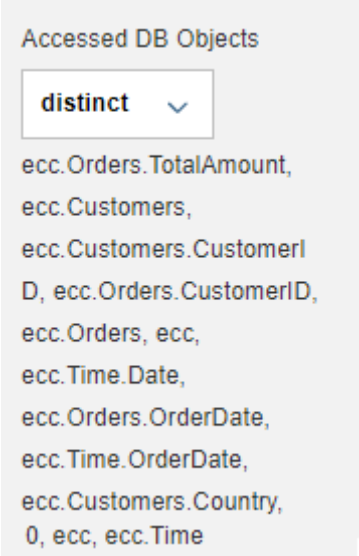
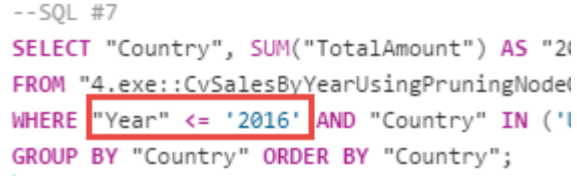
22. The pruning configuration mechanism relies on predicates defined in this table. Only 2 entries exist for your model, 1 for each branch in the union (Hot and Cold). Add your schema name by replacing XXX with your assigned User ID/schema name. See next

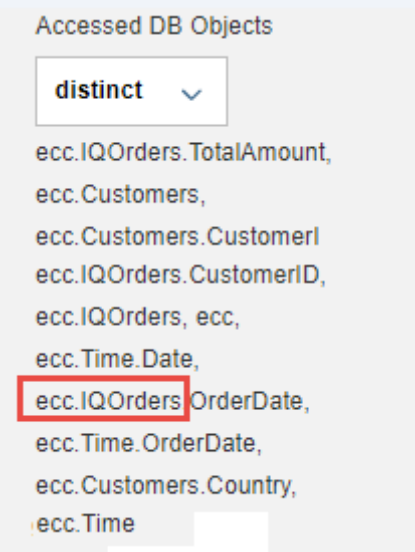


23. Find your schema in the build console trace, usually HBD362_XXX_1

    Update the pruning.csv file by replace XXX with your physical schema name, then save the file



24. Strictly informational: Within the pruning file/table notice the rules for each modeled branch Hint: The Cold and Hot names represent the input source names defined within the calculation model	;Cold;Year;<=;2016; ;Hot;Year;=;2017;
25. Save and build the db project > Analyze SQL #6 Notice the WHERE clause. The expectation is that all historical data would be ignored	
26. Optimal execution > historical data is ignored and only current data is queried	
27. Analyze SQL #7 Notice the WHERE clause. The expectation is to query only historical data	

28. Optimal execution. Only historical data (2015-2016) are queried, hot data is ignored	
29. Final important information:	Pruning optimization are currently blocked for queries without any aggregation. To enable tracing for pruning processing: Set the trace level for ceoptimizer to DEBUG in the index server section

EXERCISE 5 - NON-cumulative key figures (15 MINUTES, 28 steps)

Non-cumulative key figures are calculated based on other key figures and characteristics, values are not stored but are calculated during runtime. Non-cumulative key figures are used in applications where users want to know the daily stock level or account balance. In the exercise the daily balance calculation depends on the previous day's daily balance calculation and therefore needs to be carried over to the next day

Data-set

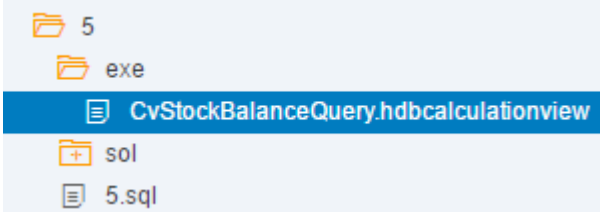
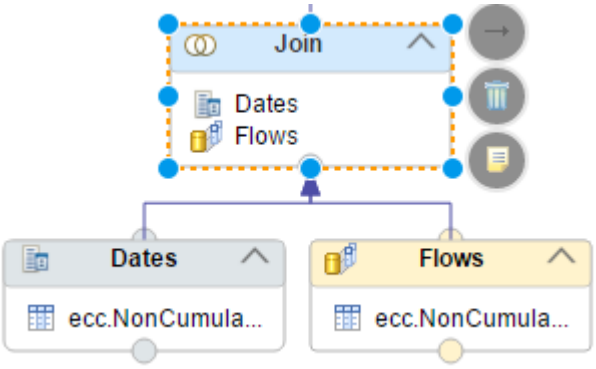
Date	Material	IN	OUT
20160501	Apple	25	0
20160502	Banana	50	0
20160503	Apple	30	20
20160504	Banana	40	15
20160505	Apple	25	15
20160506	Apple	20	10
20160507	Apple	35	25

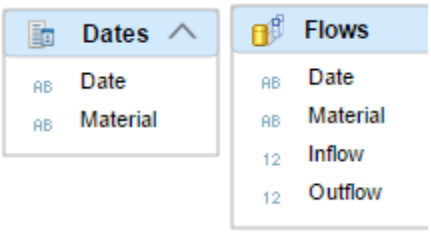
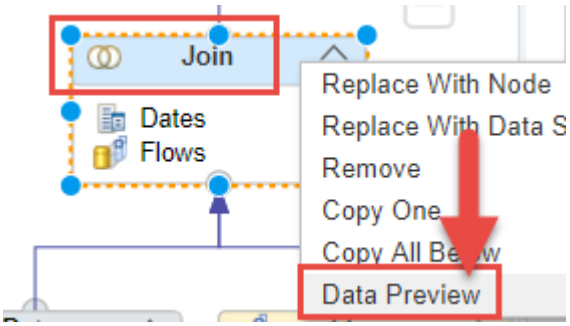
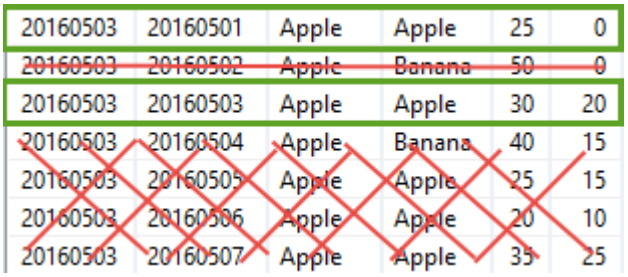
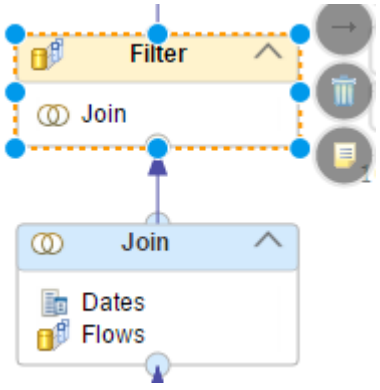
Expected end of day results

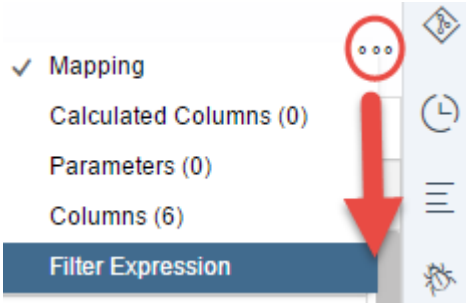
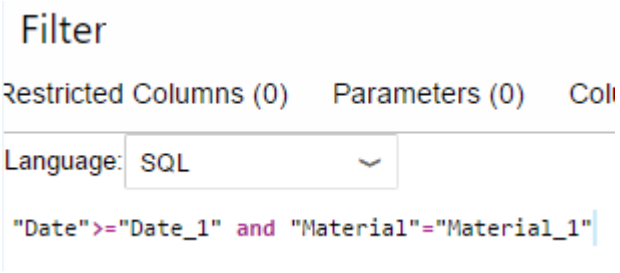
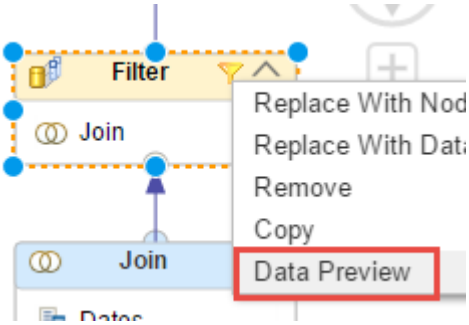
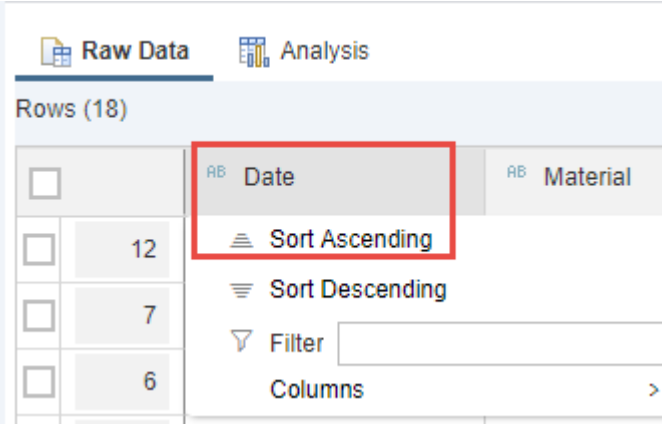
Daily Balance
25
50
35
75
45
55
65

The solution consists of 4 steps:

1. Explode the data using a cross join
2. Calculate daily running balances
3. Implode/aggregate the data
4. Pick the original daily in/out values using a self-join

Explanation	Screenshot
1. Open > 5 > exe > CvStockBalanceQuery	
2. Select the Join node	

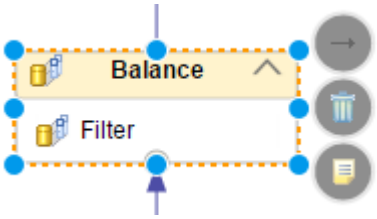
3. On the right of the screen select Join Definition. Notice the cross join (absence of physical join lines) Important: Cross joins can produce result sets that take-up large amounts of memory that may adversely impact query performance if not filtered appropriately	
4. Proceed to preview the join node: Select Join node > Right Click > Data Preview	
5. The cross join produces 7x7=49 records. End of day stock values can then be calculated using a combination of filters followed by aggregation (for example: end of day balance for 20160503 would be: 25+30-20=35)	
6. Your assignment starts: Apply a filter to strip out the exploded data that is not needed. Above the join node > select the Filter aggregation node	

7. Select Filter Expressions	
8. Add the following filter: "Date">="Date_1" and "Material"="Material_1"	
9. Save & build the project > then preview the Filter node	
10. When the results appear sort the Date column (Ascending)	

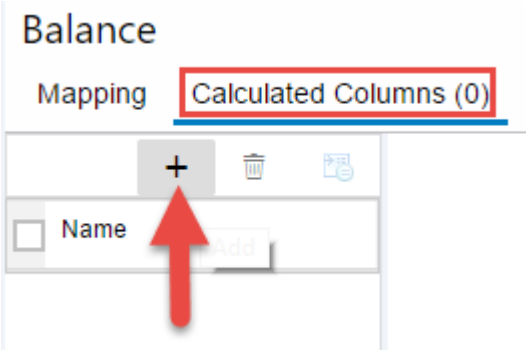
11. Notice the entries for 20160504 and specifically (50 Bananas) – this amount is carried over from 20160502. In the next step both records will get aggregated (resulting in 90), subtracting 15 outflows will produce a correct daily balance of 75 for 20160504

Date	D...	M...	I...	O...
20160501	20160501	Apple	25	0
20160502	20160502	Banana	50	0
20160503	20160501	Apple	25	0
20160503	20160503	Apple	30	20
20160504	20160502	Banana	50	0
20160504	20160504	Banana	40	15

12. Select the Balance node

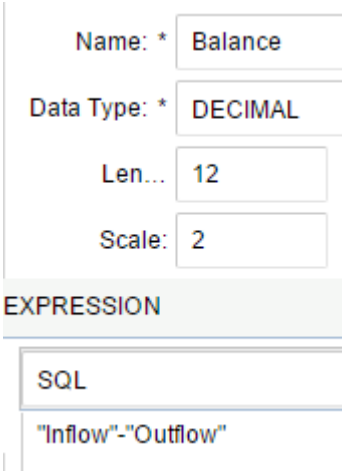


13. Create a Balance calculated column

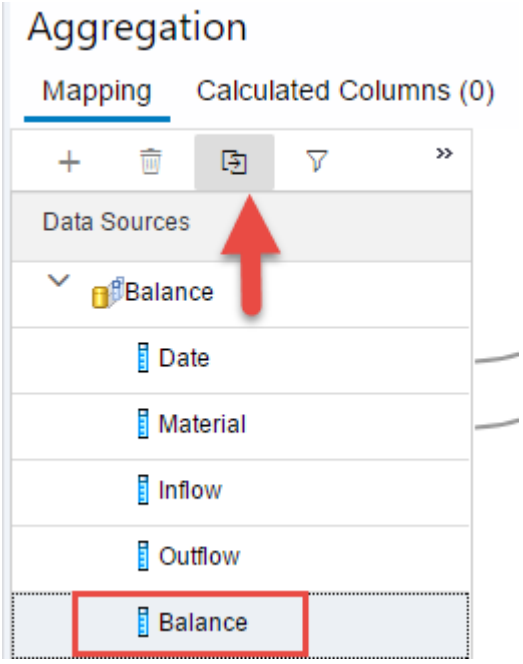


14. Subtract the Outflows from the Inflows

"Inflow"-"Outflow"

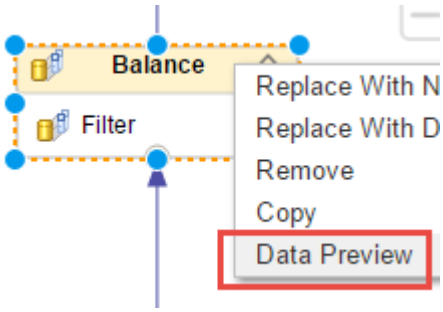


15. Select the topmost Aggregation node and add Balance to the Output



16. Save and build the db project

17. Then Preview the Balance



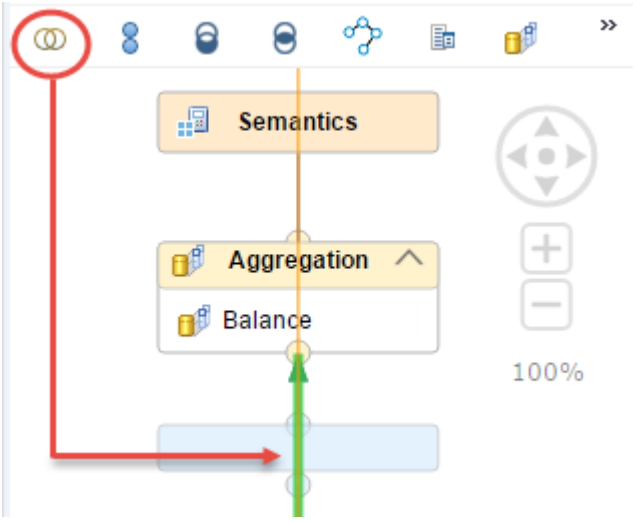
18. The daily stock balance/level is correct.

    However, notice the data explosion invalidated the granularity levels of the inflow and outflows. The correct values can be obtained by joining back to the original data-set

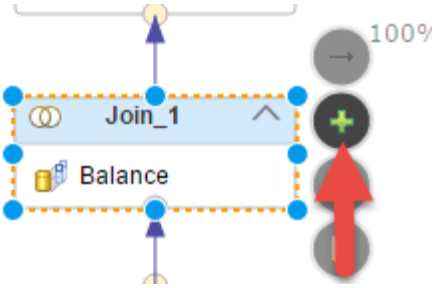
Date	Ma...	I...	O...	Balan...
20160501	Apple	25	0	25
20160502	Banana	50	0	50
20160503	Apple	55	20	35
20160504	Banana	90	15	75
20160505	Apple	80	35	45
20160506	Apple	100	45	55
20160507	Apple	135	70	65

19. Your next assignment: Fix the daily inflows and outflows. Insert a Join node between the topmost Aggregation node and the Balance node.

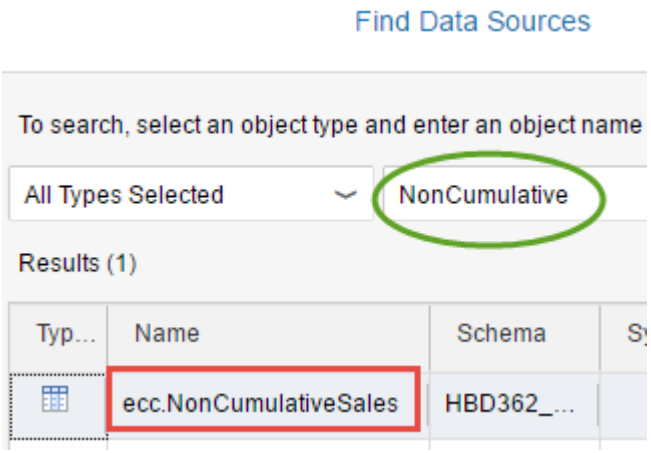
    Hint: Make sure to drop the join node precisely on the connection line

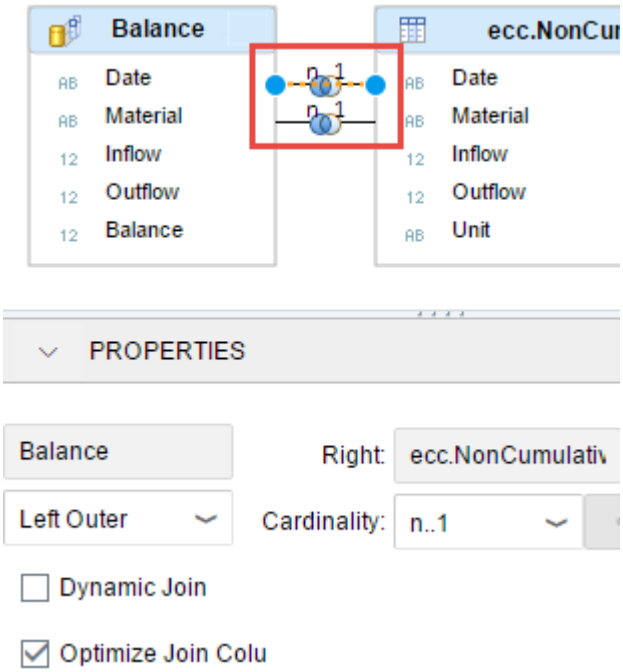
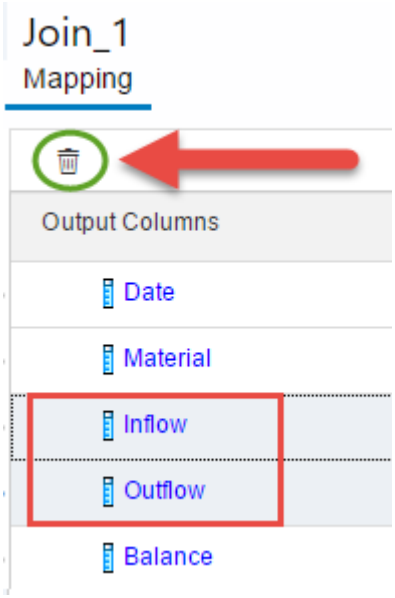


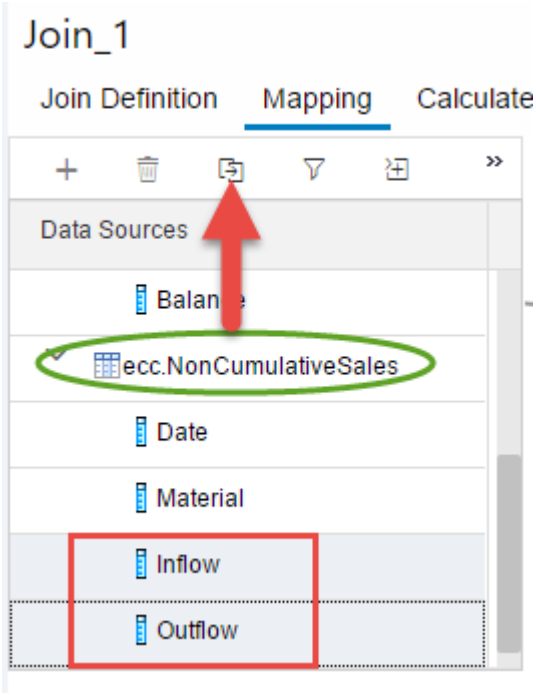
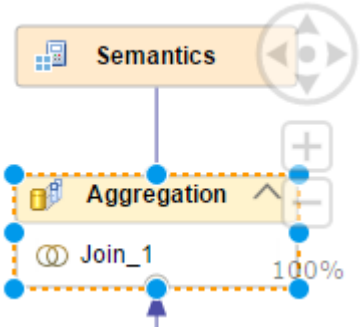
20. Add another table to the Join node. Click on the + Icon.



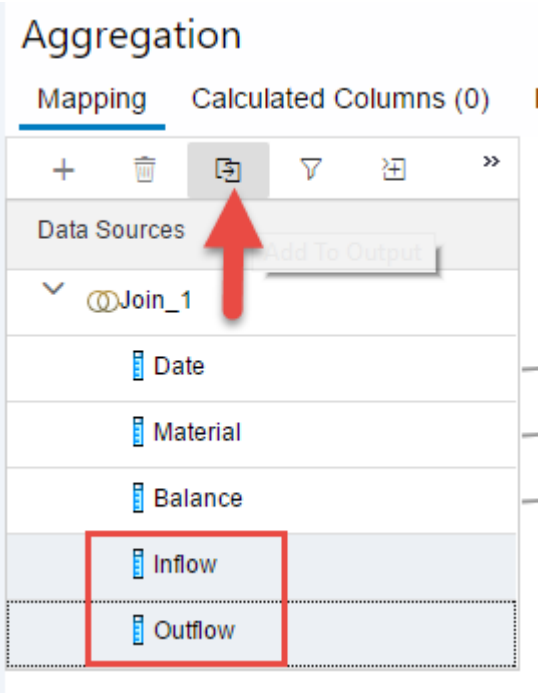
21. Search end select the NonCumulativeSales table



22. Within Join Definition > create a join between Date and Material (LO, N:1) Hint: Since we are only interested in the inflow and outflow columns the optimize join checkbox can be checked to disregard the concatenated joined columns from being brought into context	
23. Click on Mapping > Output Columns > Delete both the inflow and outflow columns (if you recall both columns were incorrect, in the next step you will replace them with the recently joined table columns instead)	

24. Under Data Sources > Add both Inflow and Outflow columns from the previously added NonCumulativeSales table	
25. Select the topmost aggregation node	

26. If not already added proceed to add both columns to the output of the topmost Aggregation node as well



27. Save & build the project

    Open 5.sql > copy SQL #1 > execute

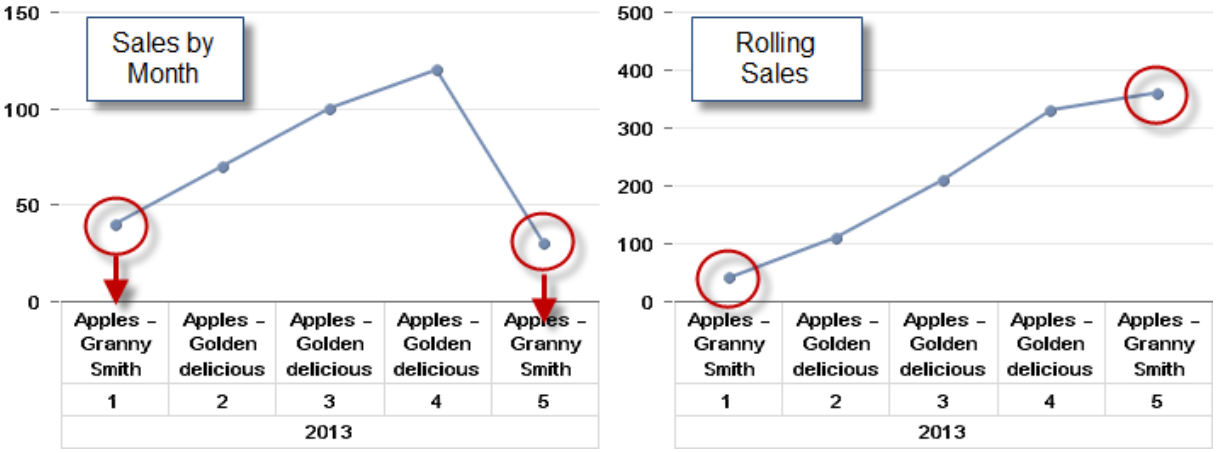
```
----------------------------------------------------
--STUDENT SQL
----------------------------------------------------
--SQL #1
SELECT "Date", "Material", "Inflow", "Outflow", "Ba
FROM "5.exe::CvStockBalanceQuery" ORDER BY "Date";
```

28. Correct results are shown

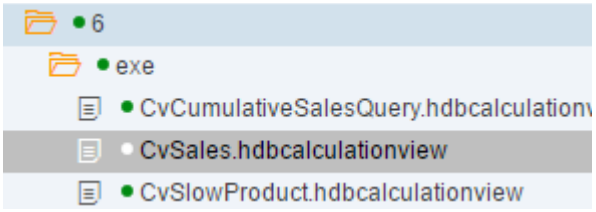
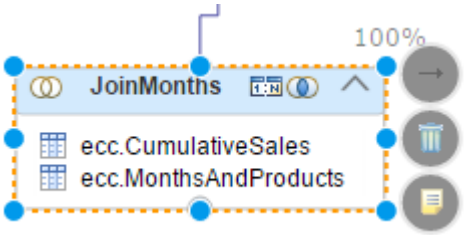
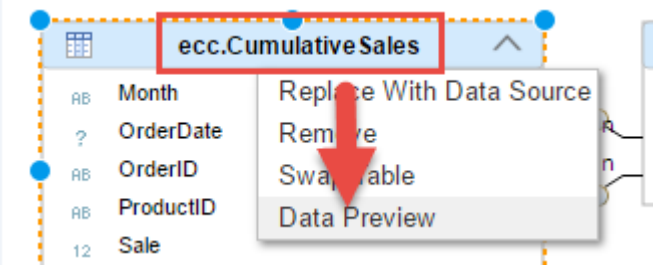
Date	M...	In...	Out...	...
20160501	Apple	25	0	25
20160502	Banana	50	0	50
20160503	Apple	30	20	35
20160504	Banana	40	15	75
20160505	Apple	25	15	45
20160506	Apple	20	10	55
20160507	Apple	35	25	65

EXERCISE 6 - Cumulative slowly changing dimensions (20 MINUTES, 30 steps)

This exercise showcases sales by month & cumulative slowly changing dimensions. An optical illusion is visible, even though the rolling sales appears to be rising each month the sales by month report shows that sales are declining each time granny-smith (apples) were sold



This solution uses a physical helper table to assist with the monthly rolling totals, in addition a range of advanced modeling features are used such as a star-join, temporal join, dynamic join, transparent filters and keep flags

Explanation	Screenshot
1. Expand models > 6 > exe > open CvSales	
2. Review the sample sales dataset > select the JoinMonths data source join node at the bottom	
3. In the Join Definition Details area to the right > Select the CumulativeSales table > Right Click > Data Preview	

4. Strictly informational:

   Notice …
   Total sales for January = $50
   Total sales for February = $80

   Notice …
   Product 1 sales January = $40
   Product 2 sales January = $10

Year	Month	ProductID	Sale
2013	1	1	10
2013	1	1	10
2013	1	1	10
2013	1	1	10
2013	1	2	10
2013	2	1	10
2013	2	1	10
2013	2	1	10
2013	2	1	10
2013	2	1	10
2013	2	1	10
2013	2	1	10
2013	2	2	10

5. Strictly informational

   Based on the sample dataset the expected rolling monthly sales would be as follows

Year	Month	Sale	Rolling
2013	1	50	50
2013	2	80	130
2013	3	110	240
2013	4	130	370
2013	5	40	410

6. Strictly informational:

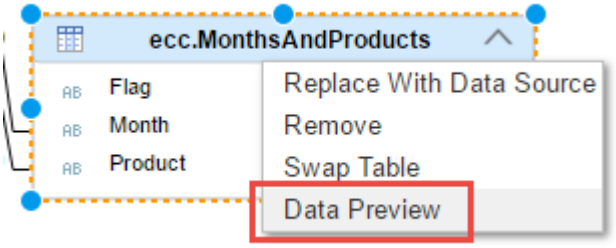
   Based on the sample dataset the expected rolling monthly sales by product would be as follows

Year	Month	Name	Rolling
2013	1	Apples	40
2013	1	Banana	10
2013	2	Apples	110
2013	2	Banana	20
2013	3	Apples	210
2013	3	Banana	30
2013	4	Apples	330
2013	4	Banana	40
2013	5	Apples	360
2013	5	Banana	50

7. Review the rolling sales helper table.

   Select the MonthsAndProducts table > right click > Data Preview

   Notice the concatenated join – Month & Product



8. Sort the Flag column

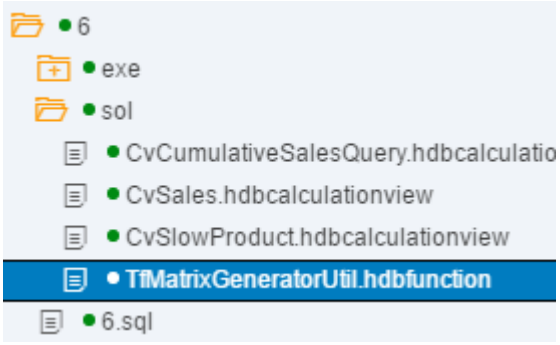
   Informational: Pay attention to the Flag column and take March as an example, the Month column contains Month 1-3 (since the rolling sales for March will include the sales from all 3 months)

   The helper table also helps with rolling product sales thus the product column is included in the matrix

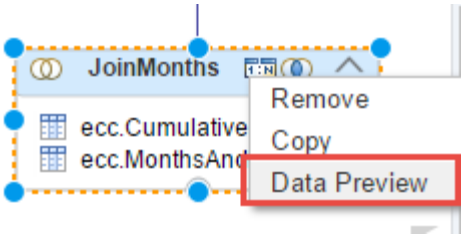
Month	Flag	Prod...
1	1	1
1	1	2
1	2	1
1	2	2
2	2	1
2	2	2
1	3	1
1	3	2
2	3	1
2	3	2
3	3	1
3	3	2

9. Strictly informational: Notice the data generator utility that was used to populate the physical helper table

   Note: Instead of materializing the matrix into a physical table as in this exercise, the data can dynamically be exploded in memory during runtime as well



10. Review the results of the join between the sales table and the helper table matrix. Right click on JoinMonths > Data Preview



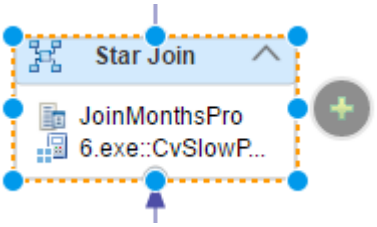
11. Notice February (flag column-red-value -> 2) includes both Month 1 and Month 2 (red Month column)

    Subsequently January (flag column 1 orange) includes only Month 1 (yellow month 1 column)

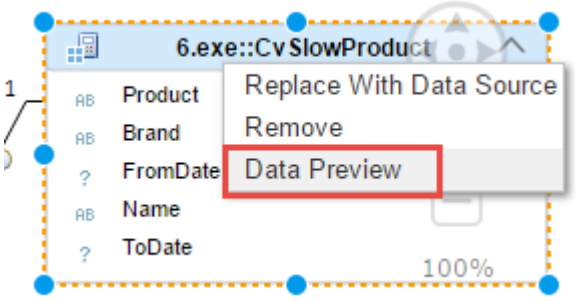
Year	Month	Prod...	Sale	Flag
2013	1	1	10	1
2013	1	1	10	1
2013	1	1	10	1
2013	1	1	10	1
2013	1	2	10	1
2013	1	1	10	2
2013	1	1	10	2
2013	1	1	10	2
2013	1	1	10	2
2013	1	2	10	2
2013	2	1	10	2
2013	2	1	10	2
2013	2	1	10	2
2013	2	1	10	2
2013	2	1	10	2
2013	2	1	10	2
2013	2	1	10	2
2013	2	2	10	2

12. Review the slowly changing product dimensions

    Select the StarJoin node



13. Preview the Slow Products Dimensional Calculation Model



14. Notice the validity period for Apples. Second, notice that a different brand of apples was sold between Feb-April

    Take note of Granny Smith apples, it was sold in January and May

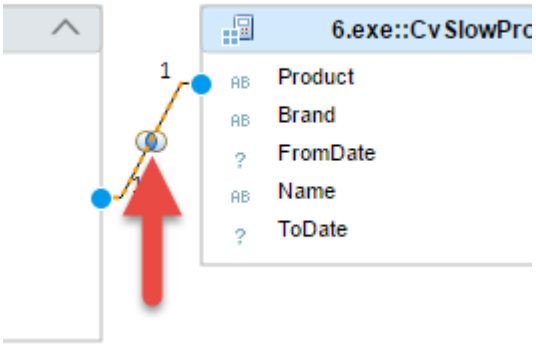
From...	ToDate	Brand	N...	
2013-01-01	2013-01-31	Granny Smith	Apples	1
2013-02-01	2013-04-30	Golden Delicio	Apples	1
2013-05-01	2099-01-31	Granny Smith	Apples	1
2013-01-01	2099-01-02	Chiquita	Banana	2

15. Your assignment starts: Model the temporal join:

    Join products and transactions, using the product id and the product validity date

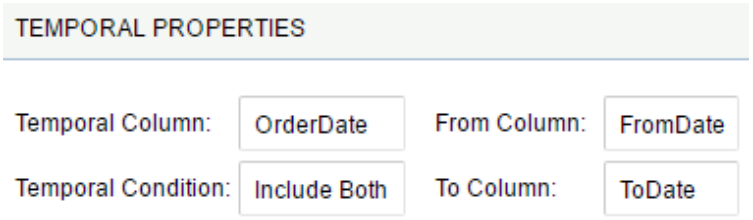
    Within the Star-Join node > double click on the Join line between the slow-products dimension and the transactional data

    Note: The Inner Join is based on Product ID



16. Scroll down to the Temporal Properties and define the properties as follows:

    Hint: The Temporal Join (aka between join) is on Order Date



17. Save & build the db project

    Open 6.sql, copy and paste SQL #2 and #3 into the SQL console > execute SQL #2

    Rolling sales by month is shown

```
--SQL-2
SELECT "Year",  "Flag" as "Month", sum("Sale")
FROM "6.exe::CvSales"
WHERE  "OrderDate" BETWEEN '20130101' AND '201
```

Year	Month	Rolling
2013	1	50
2013	2	130
2013	3	240
2013	4	370
2013	5	410

18. Execute SQL #3 to see the rolling sales by month and product

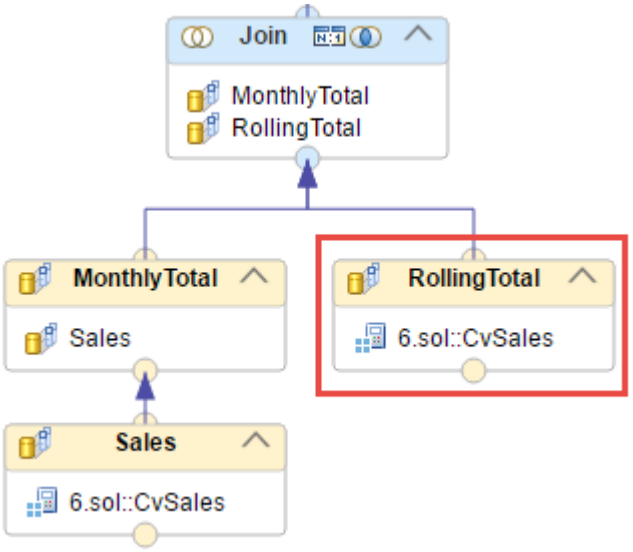
```
--SQL #3
SELECT "Year",  "Flag" as "Month", "Name",
sum("Sale") AS "Rolling"
FROM "6.exe::CvSales"
WHERE  "OrderDate" BETWEEN '20130101' AND '
```

Y..	Mo..	Name	Rolling
2013	1	Apples	40
2013	1	Banana	10
2013	2	Apples	110
2013	2	Banana	20
2013	3	Apples	210
2013	3	Banana	30
2013	4	Apples	330
2013	4	Banana	40
2013	5	Apples	360
2013	5	Banana	50

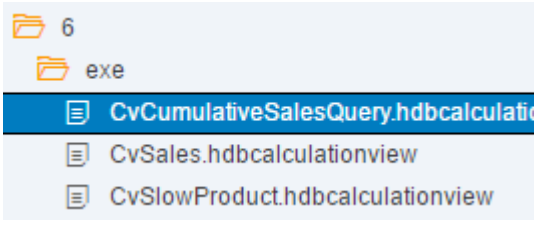
19. Your next assignment starts:

    Enhance the model so that the report not only shows rolling sales but also total sales for each individual month

    A sneak preview is shown – the solution includes 2 branches (Monthly Total and Rolling Total)

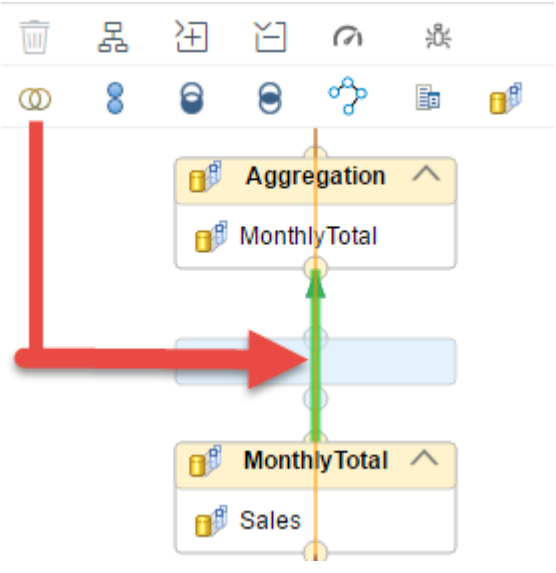


20. Expand models > 6 > exe > open CvCumulativeSalesQuery

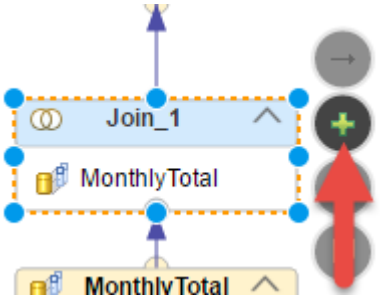


21. Insert a Join node between the Aggregation node and the Monthly Total node

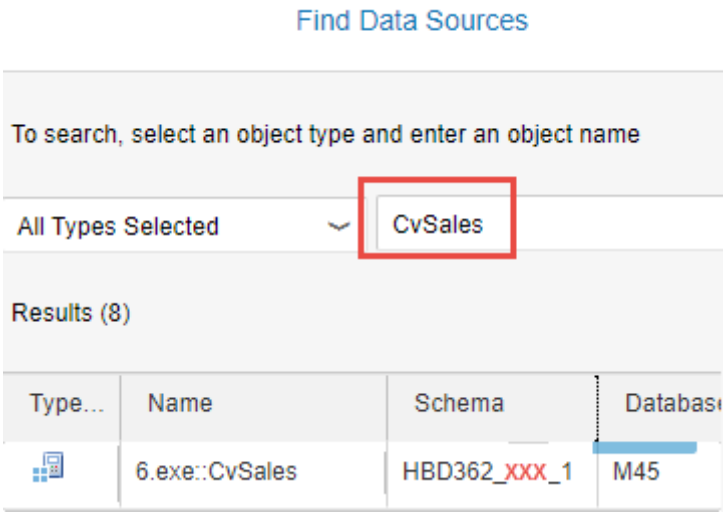
    Hint: Make sure to drop the Join node precisely on the connection line



22. Click on + icon to add a join partner data source



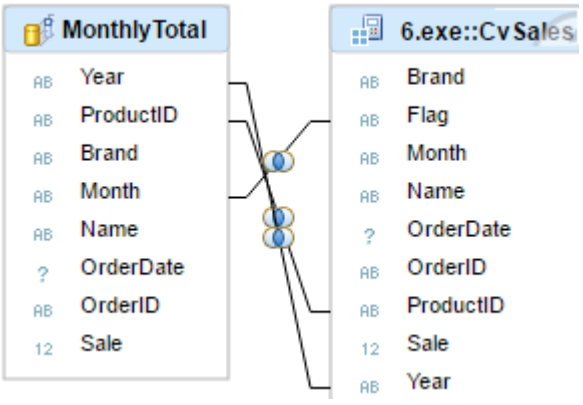
23. Search and select 6.exe::CvSales within your own schema



24. Model the following concatenated inner Join:

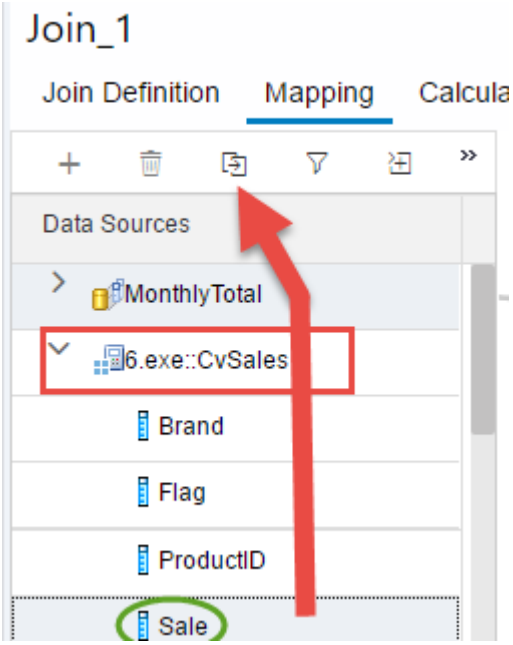
    Year -> Year
    Product ID -> Product ID
    Month -> Flag

    Important: Set the cardinality (N:1) to enable pruning

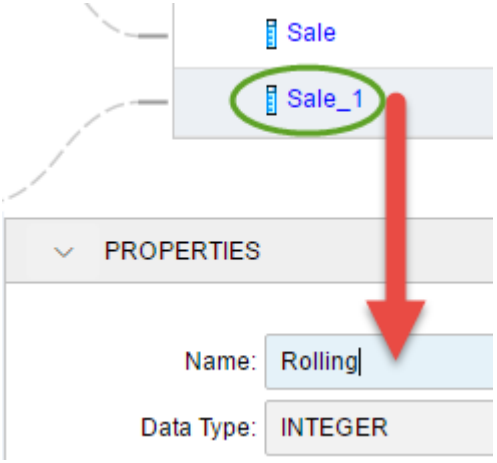


25. Select Mapping and add only the column Sale from the recently added CvSales to the output

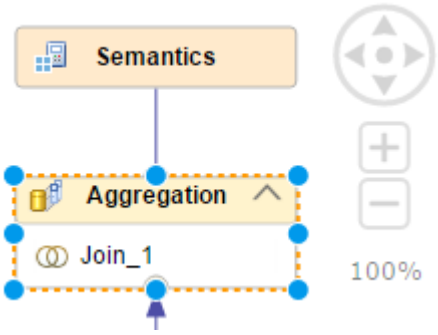
    Hint: Since a column called Sale already exists the Sale column that you added are named Sale_1



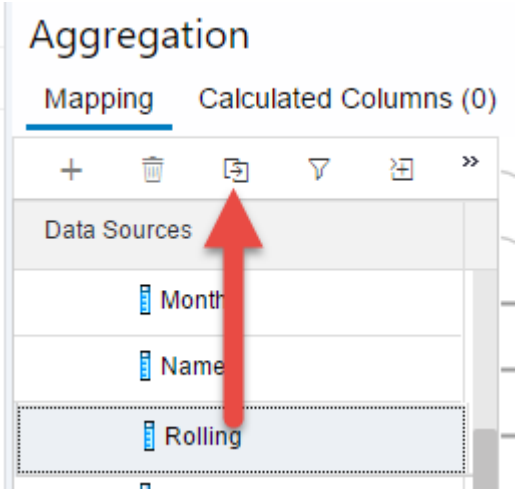
26. Within Mapping > Output > select Sale_1 > in the properties rename to Rolling



27. Add the Rolling column to the output of the Aggregation node



28. Select Rolling > click the Add to Output icon.



29. Save & build the db project.

    Copy and execute SQL #4

    Note: Even though the rolling sales increase each month, the sales for May is significantly down

```
--SQL #4
SELECT "Year", "Month", sum("Sale") AS "Sale
FROM "6.exe::CvCumulativeSalesQuery"
WHERE  "OrderDate" BETWEEN '20130101' AND '2
GROUP BY "Year", "Month";
```

Year	Month	S...	Rolling
2013	1	50	50
2013	2	80	130
2013	3	110	240
2013	4	130	370
2013	5	40	410

30. Drill down into the data, execute SQL #5 to include product name

    Note: Apple sales are lower in January and May

```
SELECT "Year", "Month", "Name", sum("Sale") AS
FROM "6.exe::CvCumulativeSalesQuery"
WHERE  "OrderDate" BETWEEN '20130101' AND '2013
GROUP BY "Year", "Month", "Name";
```

AB ...	AB ...	AB Na...	12 Sa...	12 Rolling
2013	1	Apples	40	40
2013	1	Banana	10	10
2013	2	Apples	70	110
2013	2	Banana	10	20
2013	3	Apples	100	210
2013	3	Banana	10	30
2013	4	Apples	120	330
2013	4	Banana	10	40
2013	5	Apples	30	360
2013	5	Banana	10	50

31. Drill down into the data even further, execute SQL #6 to include the product band name

    Note: Every time Granny Smith Apples were sold the monthly sales were down.

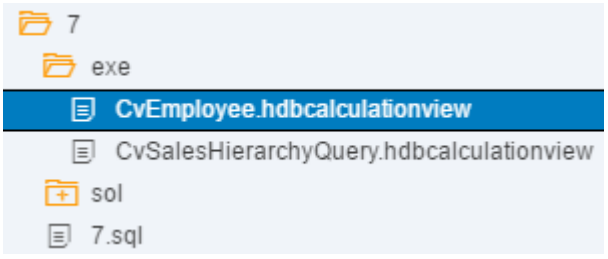
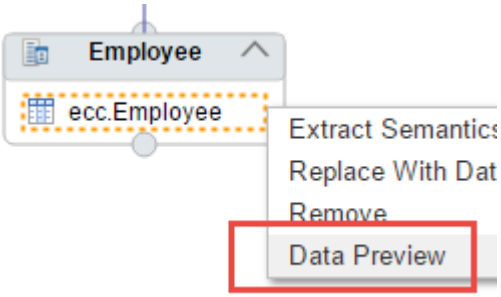
```
--SQL #6
SELECT  "Year","Month", "Name", "Brand", sum("Sale") A
FROM "6.exe::CvCumulativeSalesQuery"
WHERE  "OrderDate" BETWEEN '20130101' AND '20131231'
GROUP BY "Year", "Month", "Name", "Brand";
```

...	...	...	Brand	S...	Rolli
2013	1	Apple	Granny Smith	40	40
2013	1	Banar	Chiquita	10	10
2013	2	Apple	Golden Delicio	70	110
2013	2	Banar	Chiquita	10	20
2013	3	Apple	Golden Delicio	100	210
2013	3	Banar	Chiquita	10	30
2013	4	Apple	Golden Delicio	120	330
2013	4	Banar	Chiquita	10	40
2013	5	Apple	Granny Smith	30	360
2013	5	Banar	Chiquita	10	50

EXERCISE 7 - SQL hierarchies and SQL analytical privileges (20 MINUTES, 30 steps)

This exercise consists of 2 parts; SQL hierarchies and SQL analytical privileges. Your assignment is to create an employee parent child sales hierarchy and to calculate margin at each level of the hierarchy. In addition, you will learn how to incorporate design time roles and how to test analytical privileges

Employee	Revenue	Cost	Margin
[-] Pointed-Haired	30,960	5,046.00	83.70
[-] Alice	20,370	3,463.00	82.99
Loud	12,360	3,057.00	75.26
Wally	7,310	304.00	95.84
[-] Dilbert	10,590	1,583.00	85.05
Dogbert	2,570	314.00	87.78
Ted	8,020	1,269.00	84.17

Explanation	Screenshot
1. Expand models > 7 > exe > open CvEmployee dimensional model	
2. Review the sample Dilbert employee organization dataset > Select the Employee node > right click > Data Preview	

3. Notice the parent child hierarchy (Manager, Employee)

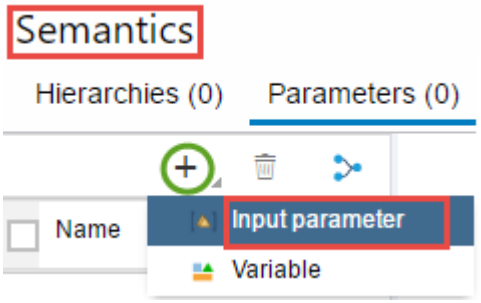
   Notice the upcoming organization change – in January 2018 Loud will no longer be reporting to Alice but to a new manager Mordac

Emp...	ValidF...	ValidTo	Man...	NickNa...
Pointed-Hi	2010-01-01	2020-12-31	NULL	Big Boss
Dilbert	2010-01-01	2020-12-31	Pointed-Ha	Dilbert
Dogbert	2010-01-01	2020-12-31	Dilbert	Dog
Ted	2010-01-01	2020-12-31	Dilbert	Engineer
Alice	2010-01-01	2020-12-31	Pointed-Ha	Hairstylist
Wally	2010-01-01	2020-12-31	Alice	Old Timer
Loud	2010-01-01	2017-12-31	Alice	Intern
Mordac	2018-01-01	2020-12-31	Pointed-Ha	The Refuser
Loud	2018-01-01	2020-12-31	Mordac	Loud Howard

4. Your assignment starts:

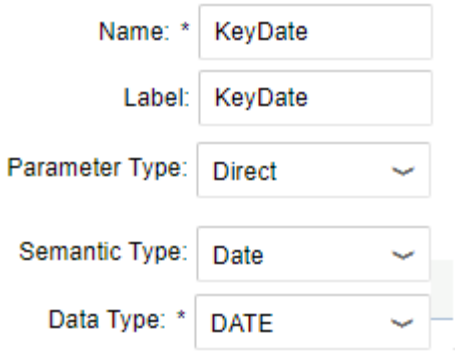
   Create an input parameter (current date) that will be used for both the temporal and hierarchy calculations

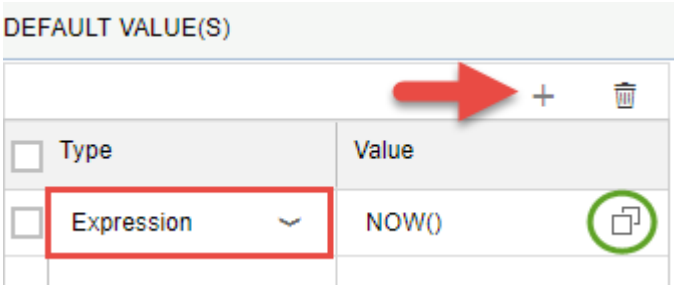
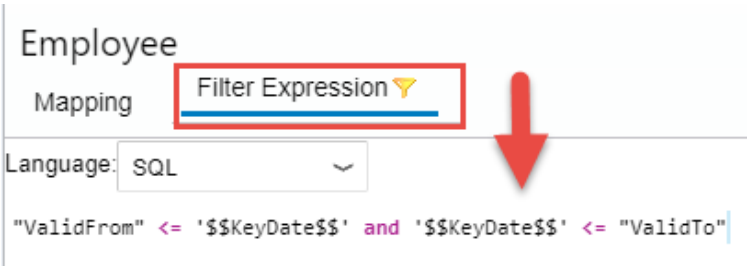
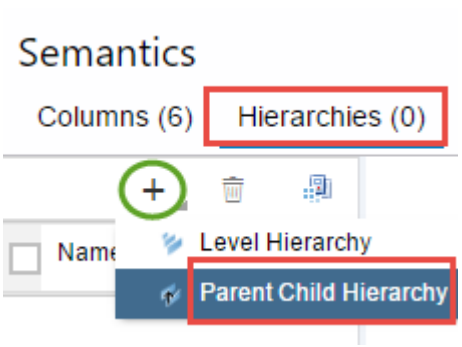
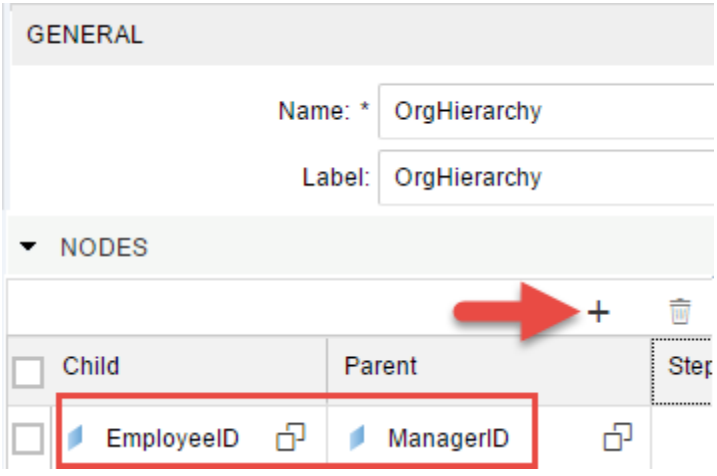
   Semantics > Parameters > click on the + icon > Input Parameter

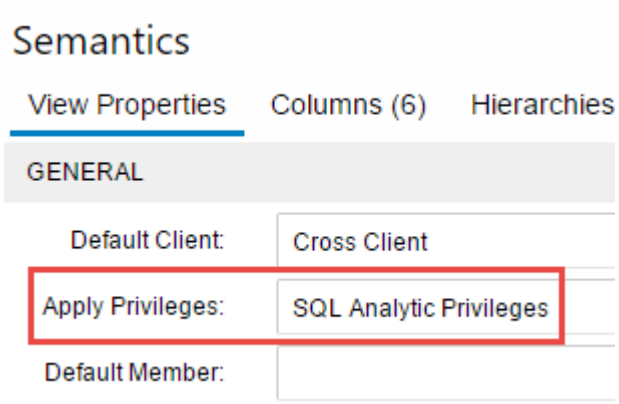
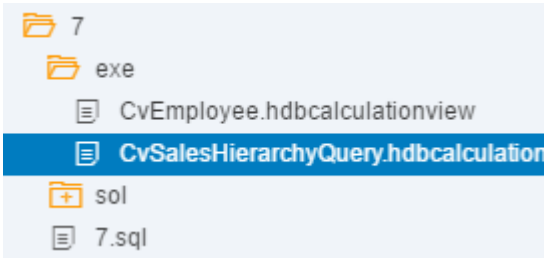
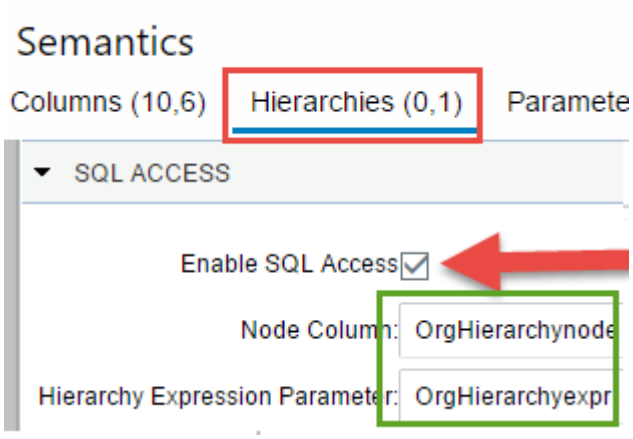


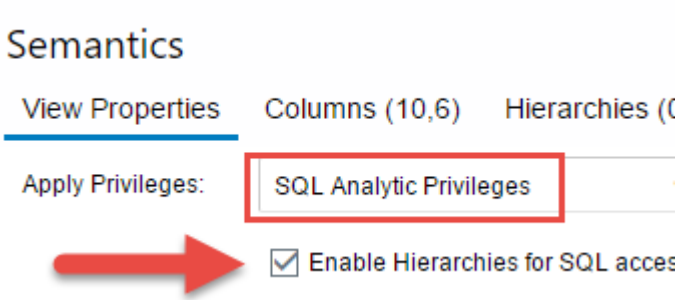
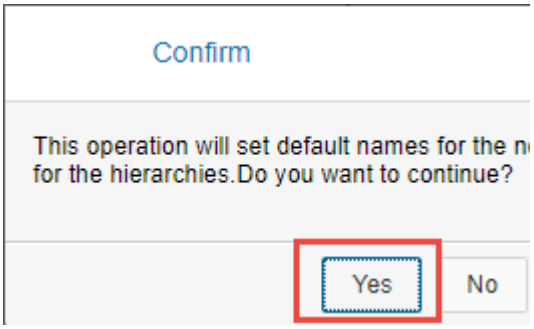
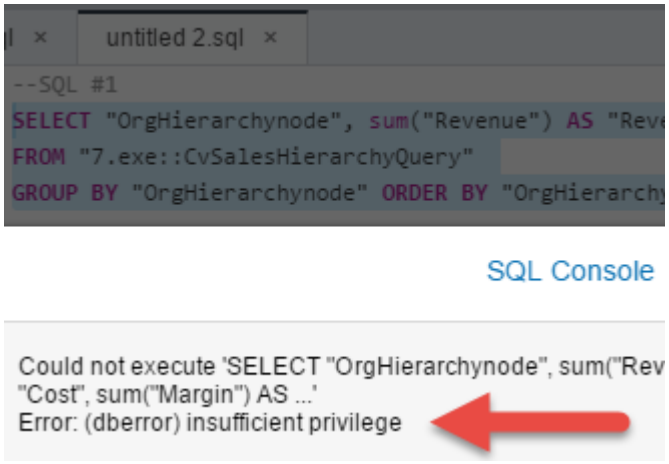
5.

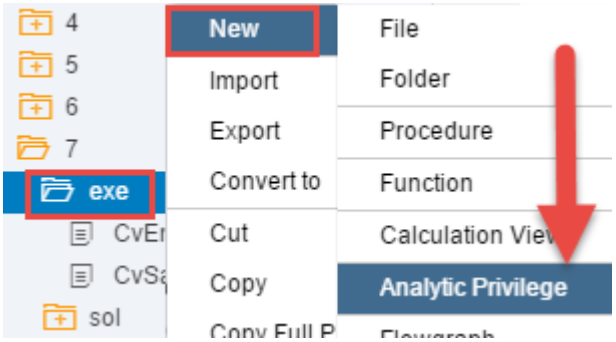
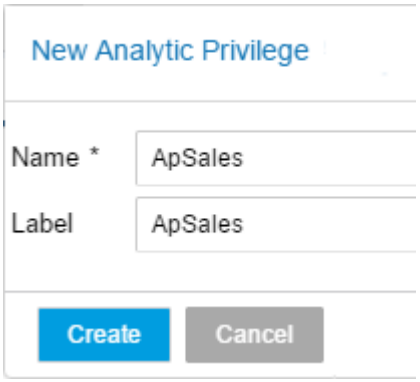
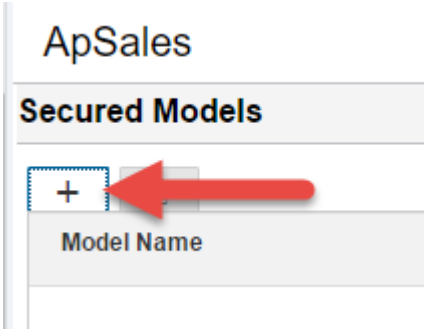
Name:	KeyDate
Label:	KeyDate
Type:	Direct
Semantic:	Date
Type:	Date

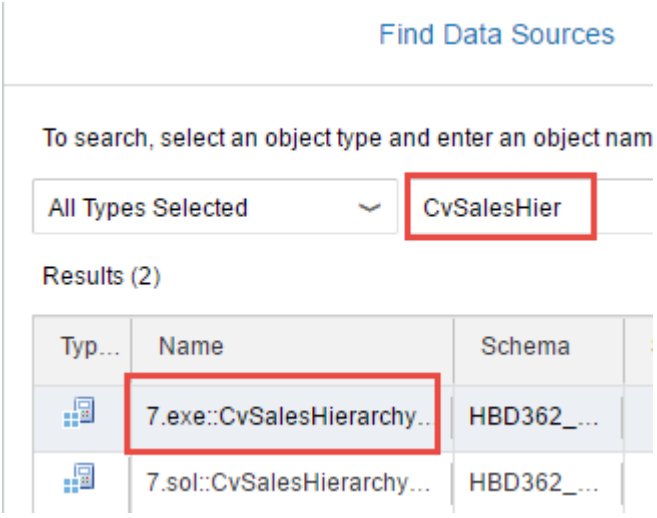
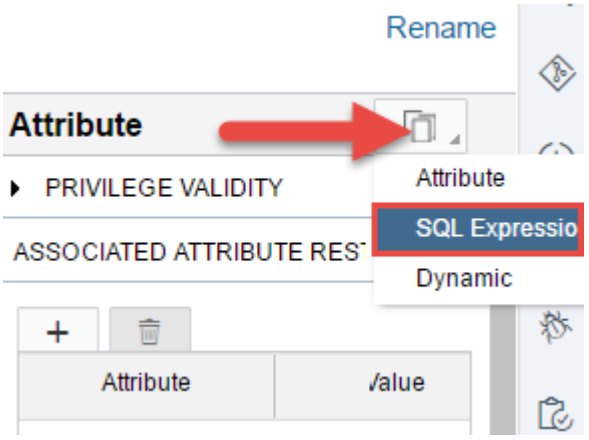
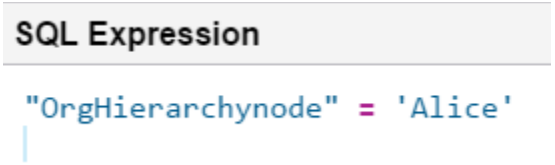


6. Add a default expression value and use the NOW SQL function	
7. Your next assignment: Add a temporal filter: Select the Employee Data Source > Filter Expression "ValidFrom" <= '$$KeyDate$$' and '$$KeyDate$$' <= "ValidTo"	
8. Your next assignment: Create a Parent Child Hierarchy Select the top Semantics node > Hierarchies > click the + icon > select Parent Child Hierarchy	
9. Use the following settings: Name: OrgHierarchy Label: OrgHierarchy Click on the + Icon Child: EmployeeID Parent ManagerID	

10. Apply SQL Analytical Privileges Semantics > View Properties > General > Apply Privileges > SQL Analytical Privileges	
11. Save & build the db project	`Build of /HBD362/db completed successfully`
12. Your next assignment: Enable SQL hierarchy access for the calculation model (aka cube) that uses the dimensional employee hierarchy model 7 > exe > Open Cv Sales Hierarchy Query	
13. Semantics > Hierarchies > scroll down to SQL Access > click the checkbox to Enable SQL Access > notice the default values Important: Notice the additional OrgHierarchynode column, this column can be used via SQL group by statements and/or within SQL Analytical Privileges to filter the data (which you will do later)	

14. Semantics > View Properties > Enable SQL Analytical Privileges for this CUBE model Ensure to enabled hierarchy access for SQL	
15. Confirm Yes to enable default names for Hierarchy SQL Access	
16. Save & build the db project	`Build of /HBD362/db completed successfully`
17. Open 7.sql and copy both SQL #1 and #2 into the SQL Console > Execute SQL #1 Note: At this point you wil not be able to query the model; SQL analytical priveleges require structured privileges which we will create next	

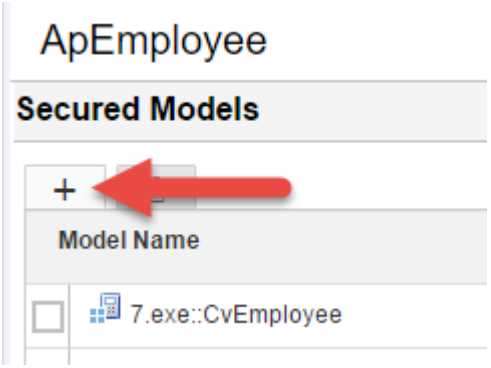
18. Create a new Analytic Privilege 7 > exe > right click > New > Analytical Privilege	
19. Name: ApSales > Create	
20. Click on the + icon to add the Sales Hierarchy cube model	

21. Search and select CvSalesHierarchy in your exe folder	
22. Change the privilege type to SQL Expression > confirm OK	
23. Enter the following SQL Expression: "OrgHierarchynode" = 'Alice' Save your work!	

24. Repeat the steps and create another SQL analytical privilege (ApEmployee) > add CvEmployee as a secured model

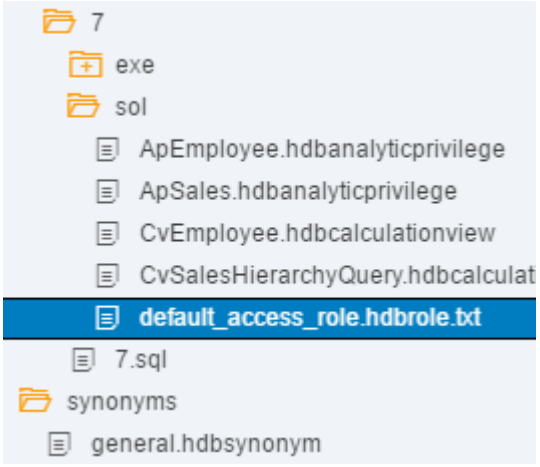
    Hint: The OrgHierarchynode filter column exists only on the parent Sales model cube, the Employee dimensional model requires its own independent privilege

    Save your work!



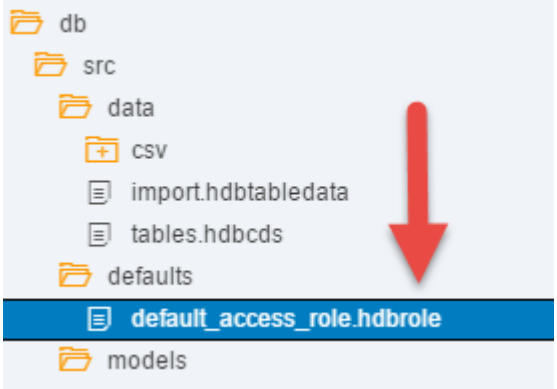
25. Your next assignment: create a role that uses the analytical privileges.

    Expand 7 > sol > open default_access_role

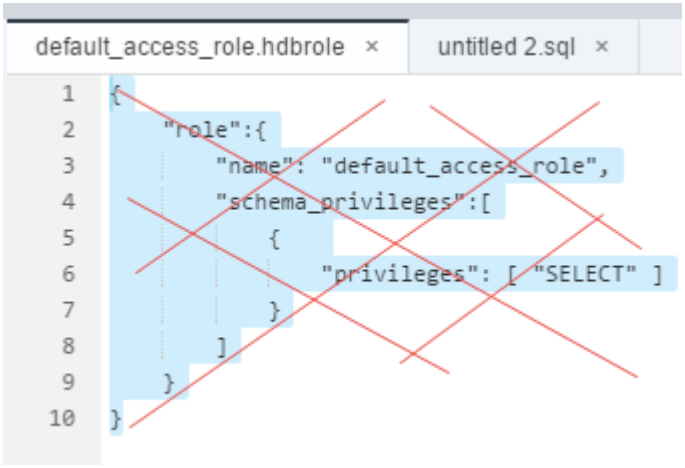


26. Copy all the text > CNTRL+A > CNTRL + C

27. Open db > src > defaults > default_access_role.hdbrole >



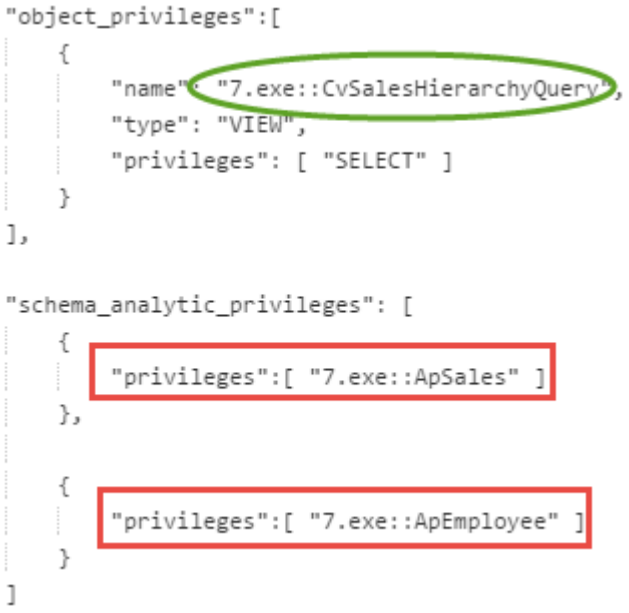
28. Delete all the text and override / past it with the text you copied previously



29. Notice the parent sales hierarchy node is exposed with SQL view access

    Notice both analytical privileges created previously are included in this role

    Hint: We added both the object and analytical privileges to the default role, this is a convenience way for you as a developer to test analytical privileges

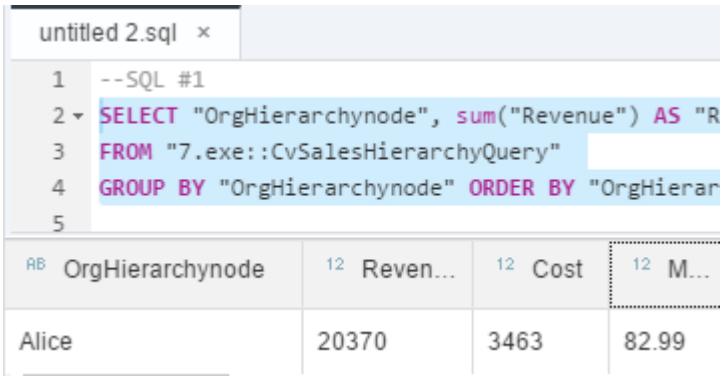


30. Save & build the db project

31. Execute SQL #1

    Notice that Alice is the only employee returned since your user is restricted to Alice via the analytical privilege

    Hint: Revenue amount includes combined sales for herself + her direct reports (Loud + Wally)



32. Execute SQL #2

    Notice the above numbers are correct, the query returned individual sales for Alice + her direct reports

Emp...	Revenue	Cost	Margin
Loud	12360	3057	75.26
Wally	7310	304	95.84
Alice	700	102	85.42

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