

Query Folding in Power BI

Nicky van Vroenhoven

Who Are You? <http://bit.ly/query-folding>



THE 10 SPONSORS

kapacity

devscope

M.Y.B
MIND
YOUR
BUSINESS

ORANGE MAN

BI BUSINESS INNOVATION
BUSINESS INFORMATION
BUSINESS INTELLIGENCE

PROACTIVE^P

PART OF / FELLOWMIND

[stoltze][it]



CatMan[®]
Solution

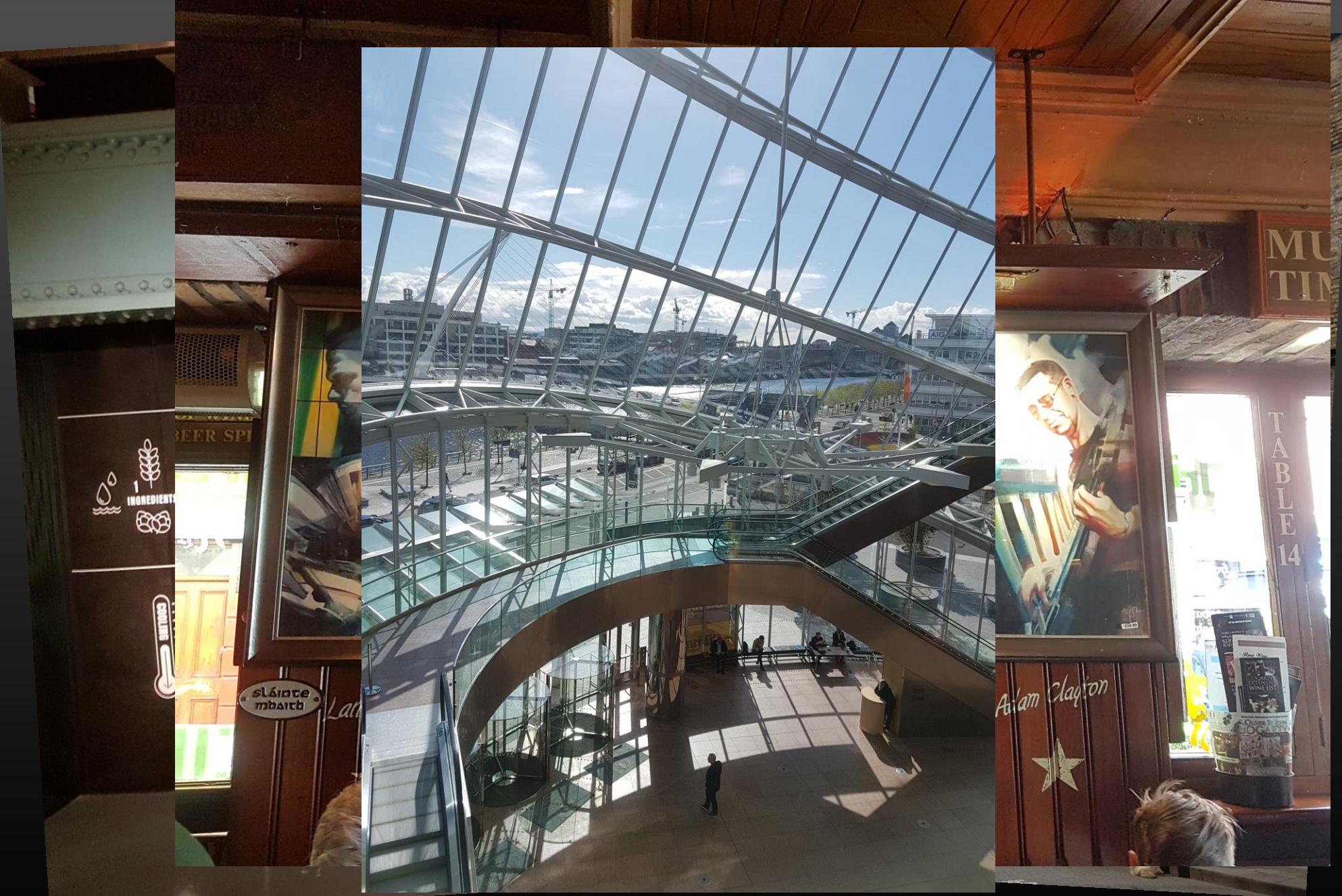
JDM

better results

unit^{it}

RAFFLE PRIZES

- Tabular Editor 3 Enterprise license (1 year)
- Scalextric C1413M ARC PRO Platinum GT racetrack
- Apple AirPods Pro
- Magnum Champagne
- LEGO® MINDSTORMS® Robot Inventor
- LEGO® NASA Space Shuttle Discovery
- Ticket to Power BI Administration and Governance course



Who Are You?

Check out my blog for a how-to:
www.nickyvv.com/2019/12



Query Folding - Who Are You?

This is my form for #PowerBINextStep
*All data will be deleted after the session

* Required

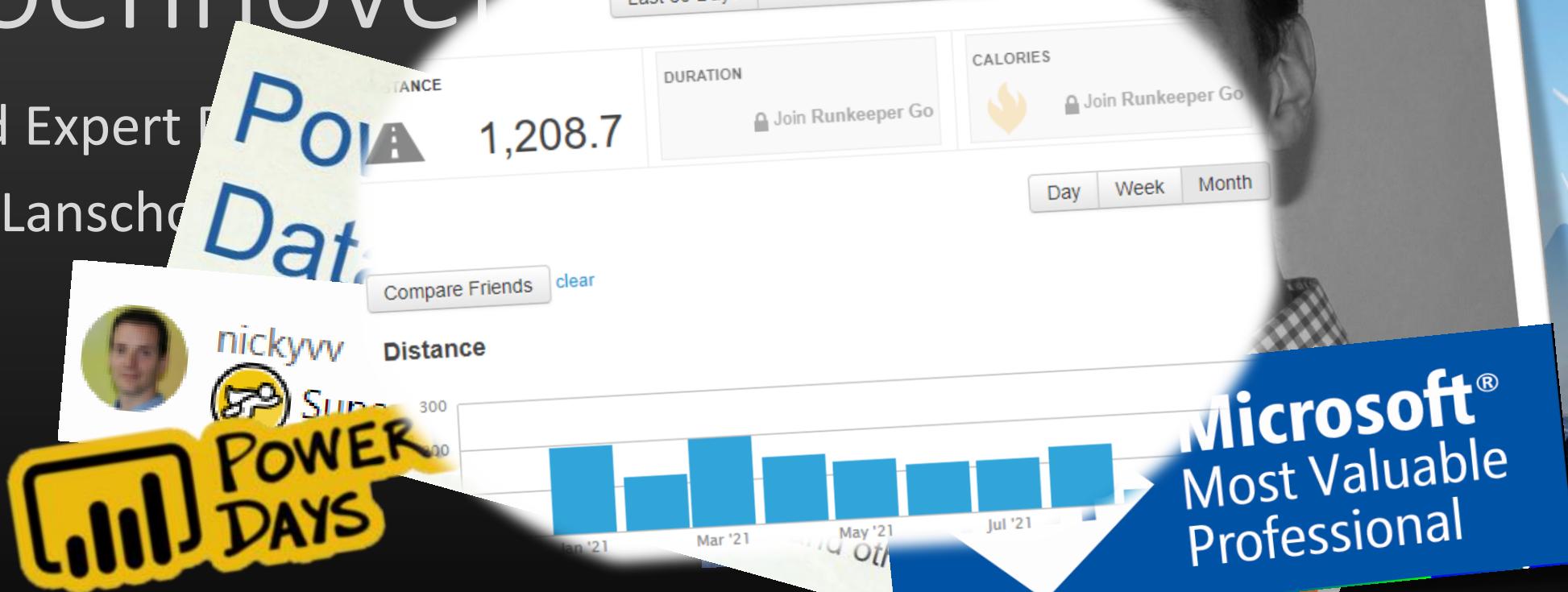
1. What is your (first) name? *

Who Are You? <http://bit.ly/query-folding>

Nicky van Vroenhoven

Lead Expert Data

Van Lanschoot



Who Are You? <http://bit.ly/query-folding>

Who Are You?

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Query Folding - Who Are You?

This is my form for #PowerBINextStep
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1. What is your (first) name? *

Form: <http://bit.ly/query-folding>

In the beginning, there was...



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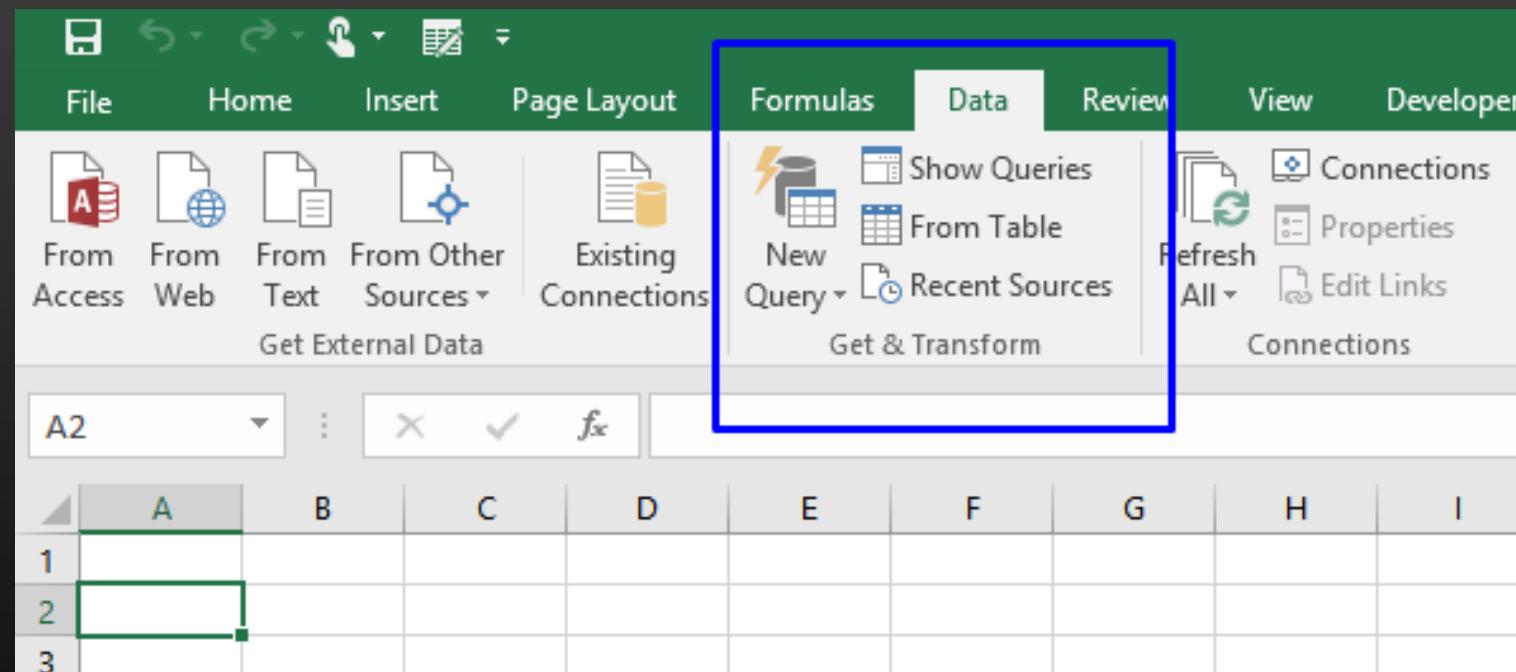
But then...



+



Power Query



Power Query

New dataflow (unsaved)

Edit queries

Power Query

Get data Refresh Options Manage columns Transform table Reduce rows Add column

COR transaction_status

	meta_dt_load	meta_nm
1	10/3/2018, 8:14:00 PM	EM_MIFID_corr
2	10/2/2018, 3:01:00 PM	EM_MIFID_xm
3	10/2/2018, 3:01:00 PM	EM_MIFID_xm
4	10/2/2018, 3:01:00 PM	EM_MIFID_xm

Source{[Schema]} =

Transform table

- Group by
- Use first row as headers
- Use headers as first row
- Transpose
- Reverse rows
- Count rows

	meta_dt_reportdate	1.2 meta_corr_nr
0/3/2018		
0/3/2018		
0/3/2018		
0/3/2018		

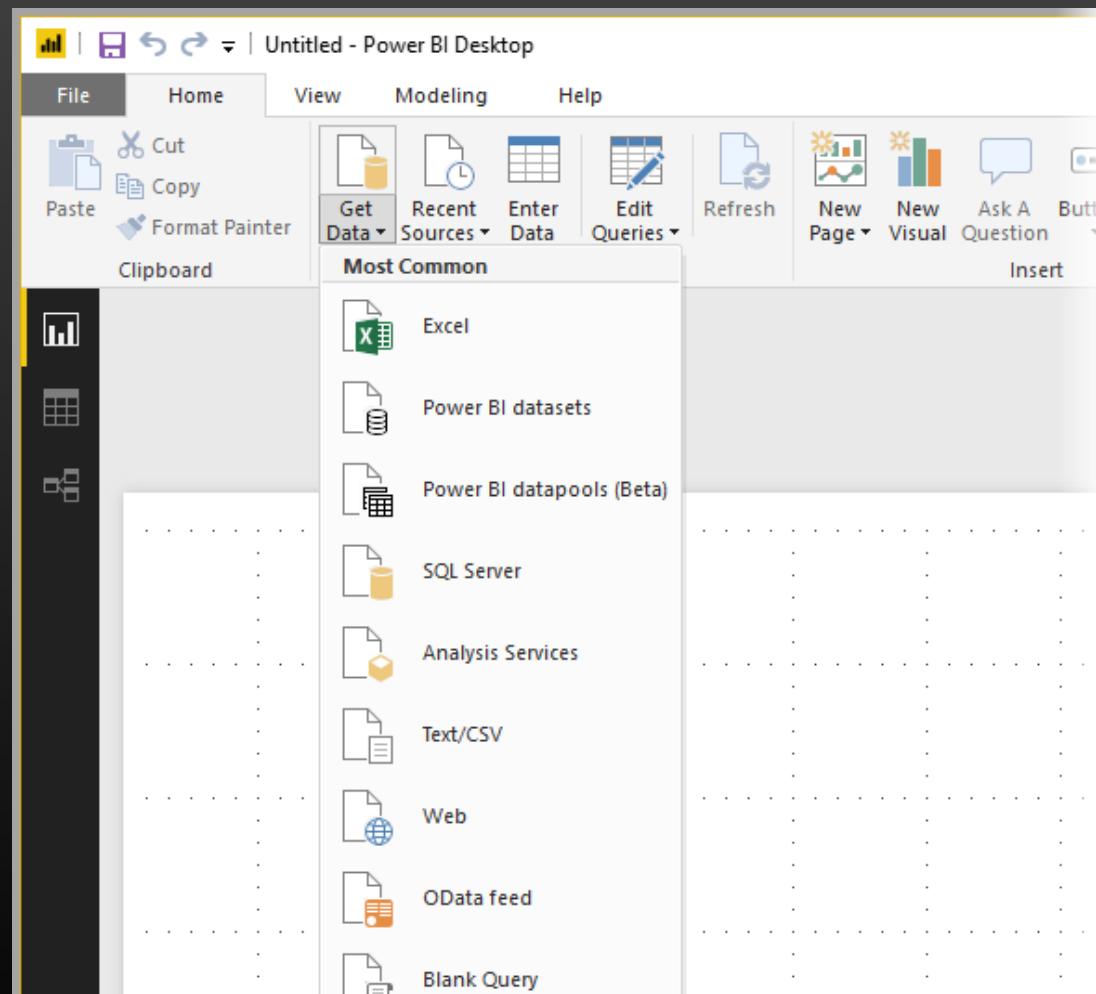


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Power Query



Agenda

- Query Folding
 - Value.NativeQuery
 - Query diagnostics
- Constraints
- Demo, Demo, Demo!

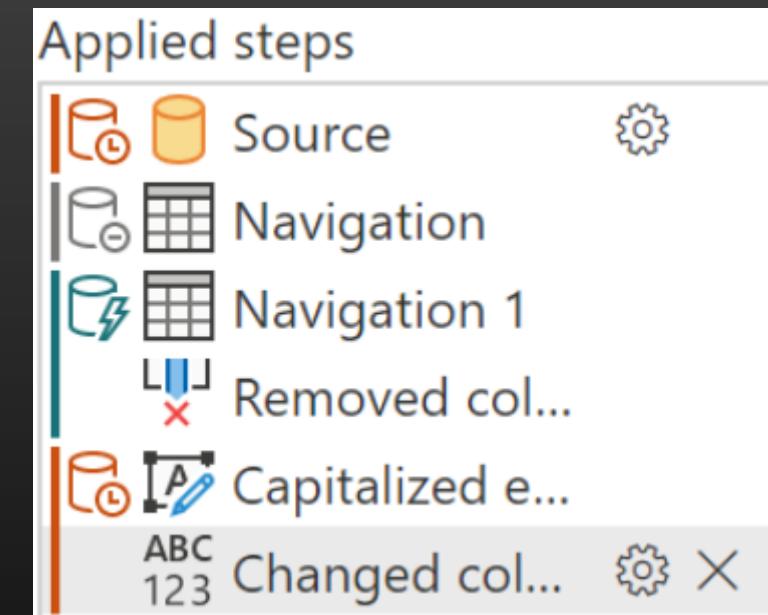
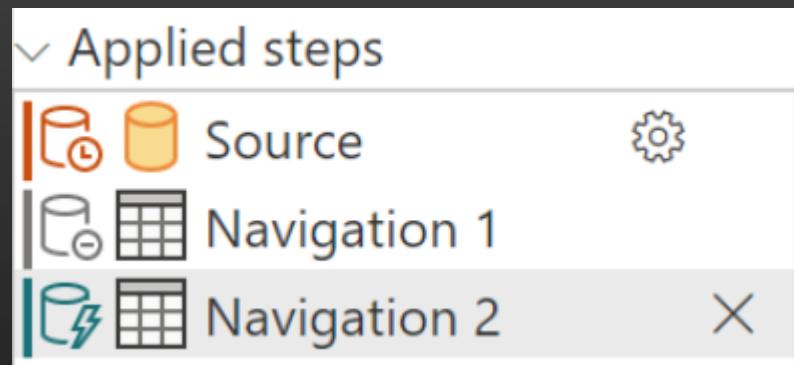


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Step Folding Indicators in PQO (in preview)



Agenda

- **Query Folding**
 - Value.NativeQuery
 - Query diagnostics
- Constraints
- Demo, Demo, Demo!



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Converts M to native query

Fact Movement

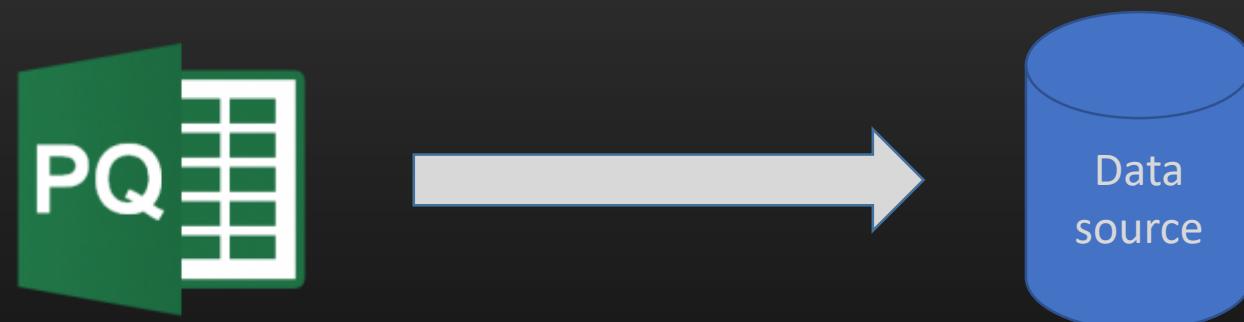
```
1 let
2     Source = Sql.Databases("."),
3     WideWorldImportersDW = Source{[Name="WideWorldImportersDW"]}[Data],
4     Fact_Movement = WideWorldImportersDW{[Schema="Fact",Item="Movement"]}[Data],
5     #"Filtered Rows" = Table.SelectRows(Fact_Movement, each Date.QuarterOfYear([Date Key]) = 1),
6     #"Expanded Dimension.Customer" = Table.ExpandRecordColumn#"Filtered Rows", "Dimension.Customer", {"Customer"}
7     #"Uppercased Text" = Table.TransformColumns#"Expanded Dimension.Customer", {"Dimension.Customer.Customer", T
8     #"Expanded Dimension.Supplier" = Table.ExpandRecordColumn#"Uppercased Text", "Dimension.Supplier", {"Primary"
9     #"Merged Columns" = Table.CombineColumns(Table.TransformColumnTypes#"Expanded Dimension.Supplier", {"Custom
10    in
11    #"Merged Columns"
```



Native Query

```
select [$Outer].[Movement Key] as [Movement Key],
       [$Outer].[Date Key] as [Date Key],
       [$Outer].[Stock Item Key] as [Stock Item Key],
       [$Outer].[Customer Key2] as [Customer Key],
       [$Outer].[Supplier Key2] as [Supplier Key],
       [$Outer].[Transaction Type Key] as [Transaction Type Key],
       [$Outer].[WWI Stock Item Transaction ID] as [WWI Stock Item Transaction ID],
       [$Outer].[WWI Invoice ID] as [WWI Invoice ID],
       [$Outer].[WWI Purchase Order ID] as [WWI Purchase Order ID],
       [$Outer].[Quantity] as [Quantity],
       [$Outer].[Lineage Key2] as [Lineage Key],
       [$Outer].[t0_0] as [Dimension.Customer.Customer],
       [$Outer].[Category2] as [Dimension.Customer.Category],
       [$Inner].[Primary Contact] as [Dimension.Supplier.Primary Contact]
from
(
    select [__].[Movement Key] as [Movement Key],
           [__].[Date Key] as [Date Key],
           [__].[Stock Item Key] as [Stock Item Key],
           [__].[Customer Key2] as [Customer Key2],
           [__].[Supplier Key] as [Supplier Key2],
           [__].[Transaction Type Key] as [Transaction Type Key],
           [__].[WWI Stock Item Transaction ID] as [WWI Stock Item Transaction ID],
           [__].[WWI Invoice ID] as [WWI Invoice ID],
           [__].[WWI Purchase Order ID] as [WWI Purchase Order ID],
           [__].[Quantity] as [Quantity],
           [__].[Lineage Key2] as [Lineage Key2],
           [__].[Category] as [Category2],
           upper([__].[Customer]) as [t0_0]
    from
    (
        select [$Outer].[Movement Key],
               [$Outer].[Date Key],
               [$Outer].[Stock Item Key],
               [$Outer].[Customer Key2]
```

Transformation pushed back to data source



From M to SQL, MySQL, OData, etc

More efficient data processing



Partial folding



Important because of...

- Import model tables
- DirectQuery and Dual storage mode tables
- Incremental refresh



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Folding with Incremental Refresh



Incremental refresh



Unable to confirm if the M query can be folded. It is not recommended to use incremental refresh with non-foldable queries. [Learn more](#)

You can improve the speed of refresh for large tables by using incremental refresh. This setting will apply once you've published a report to the Power BI service.

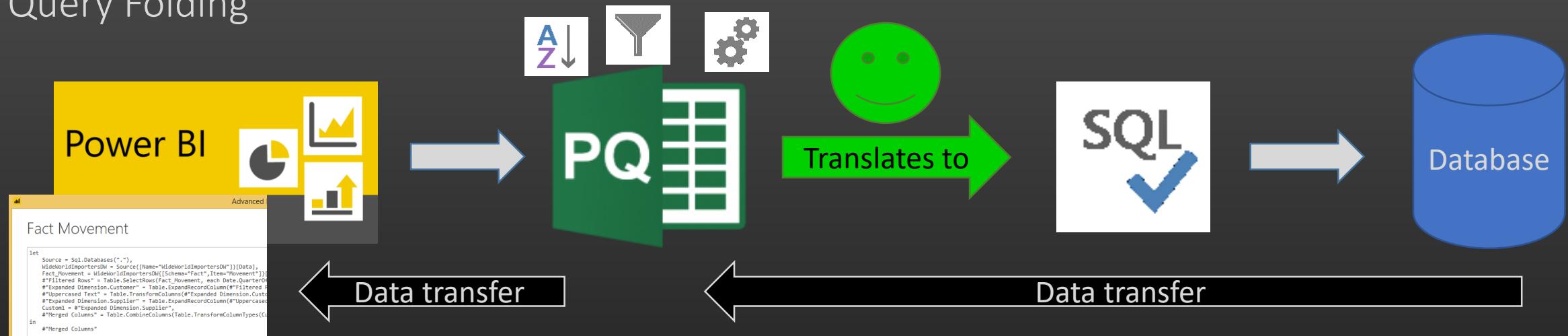


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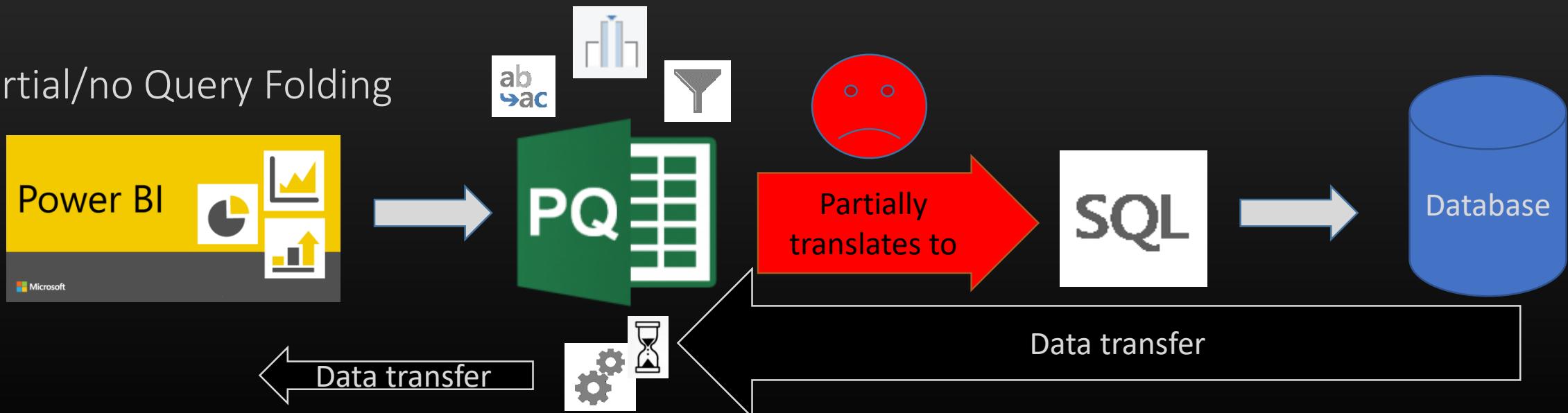


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Query Folding

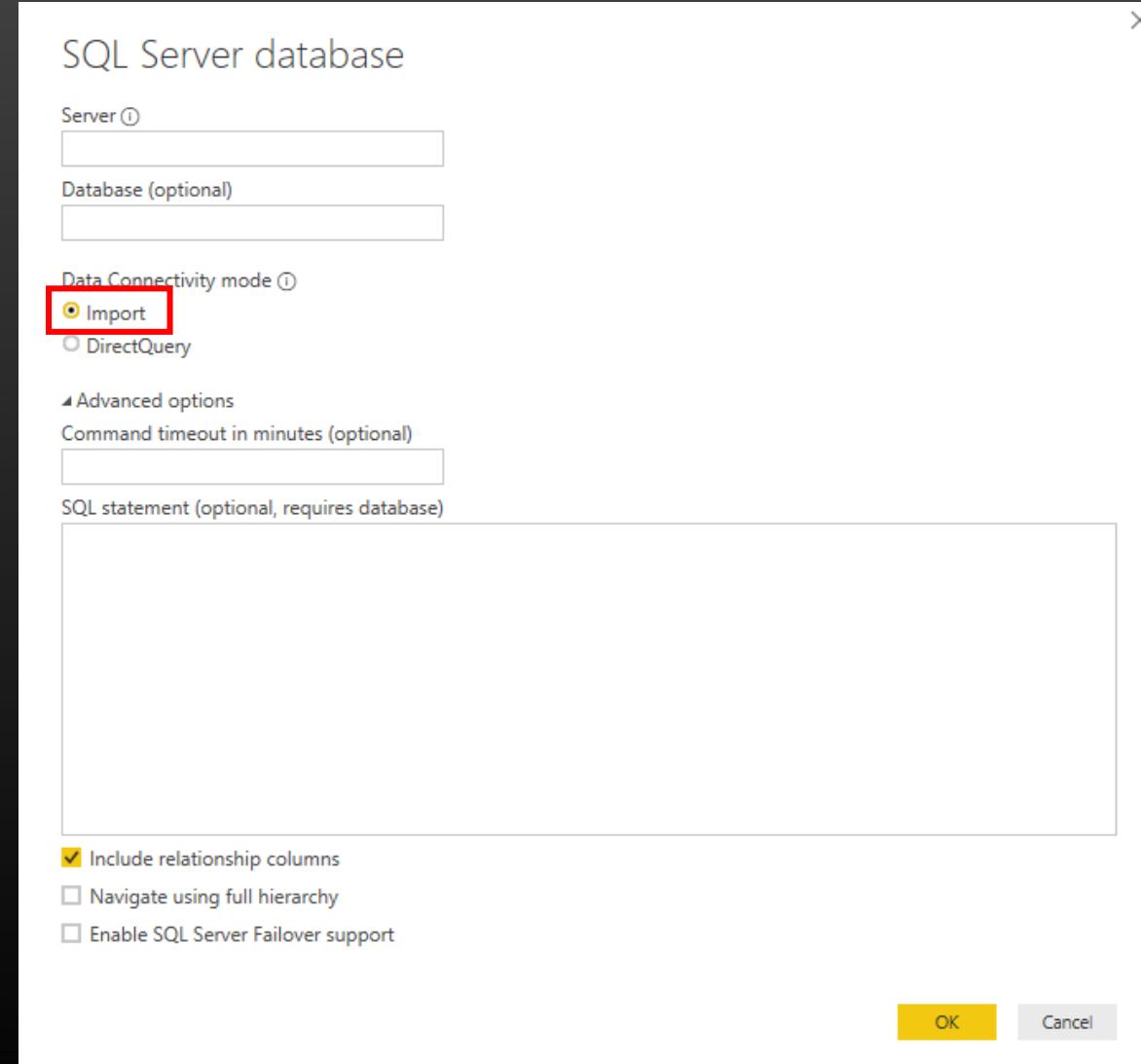


Partial/no Query Folding



To Fold or Not To Fold

- Import mode



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Supported Data Sources



ORACLE®



E Exchange



Supported Transformations (most commonly used)



Filter



Sort



(Un)Pivot



String
Manipulations



Top Rows

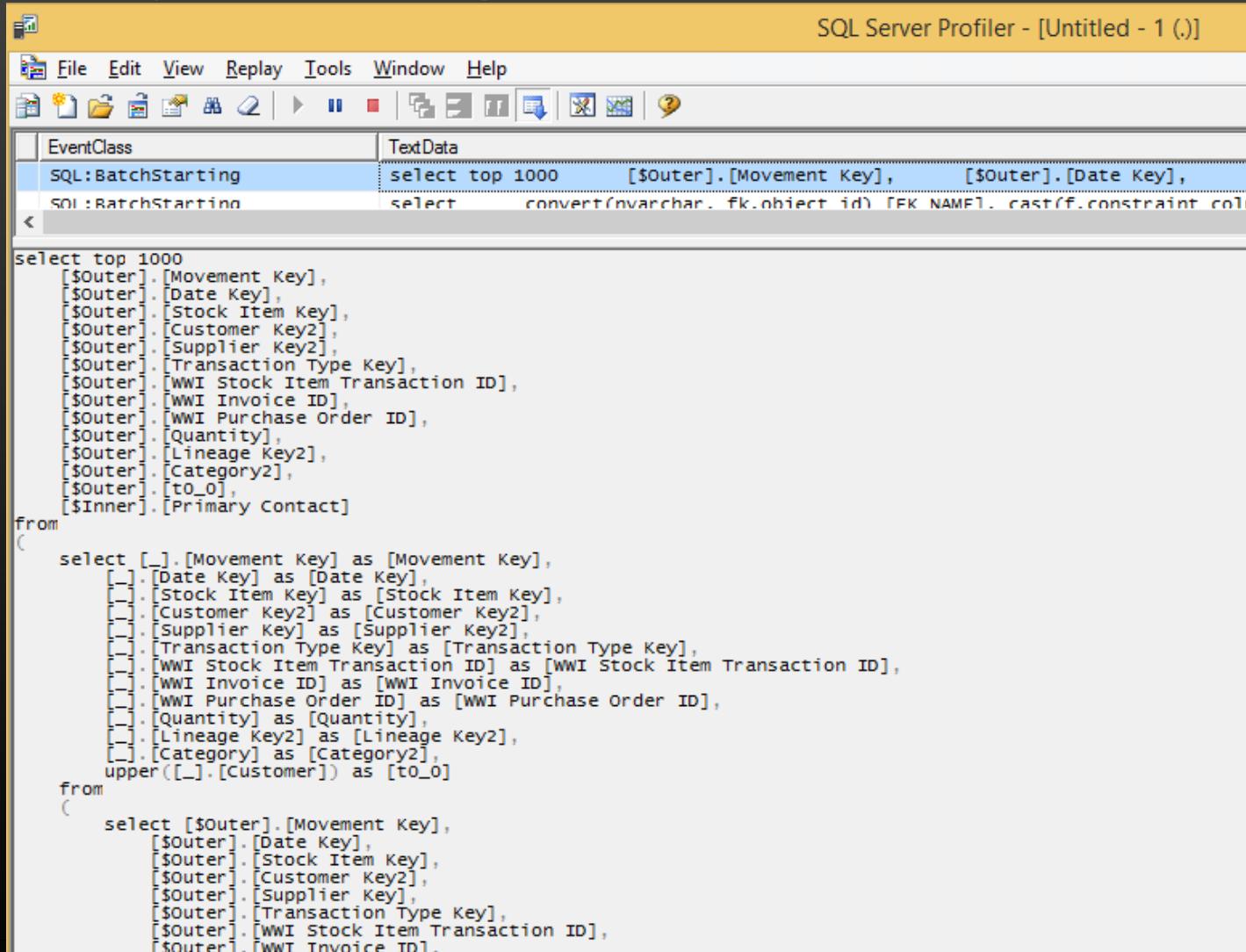


Join
(Append)



Group By

Is My Query Folding? - SQL

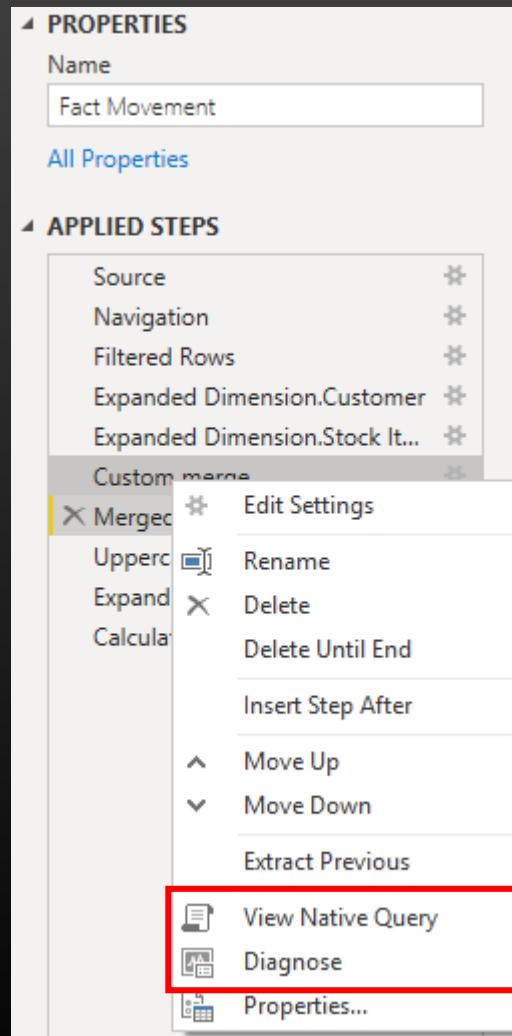


The screenshot shows the SQL Server Profiler interface with a single trace named "Untitled - 1 (.)." The "TextData" pane displays a complex SQL query. The query is a multi-level select statement, likely a view or a derived table, involving multiple joins and aliases (\$Outer, \$Inner) to map between different tables. The columns listed include Movement Key, Date Key, Stock Item Key, Customer Key2, Supplier Key2, Transaction Type Key, WWI Stock Item Transaction ID, WWI Invoice ID, WWI Purchase Order ID, Quantity, Lineage Key2, Category2, and to_0. The query is highly nested, with several levels of sub-selects and joins.

```
SQL Server Profiler - [Untitled - 1 (.)]  
File Edit View Replay Tools Window Help  
EventClass TextData  
SQL:BatchStarting select top 1000      [$Outer].[Movement Key],      [$Outer].[Date Key],  
SQL:BatchStarting      select      convert(nvarchar, fk.object_id) [FK NAME], cast(f.constraint_colu  
  
select top 1000  
    [$Outer].[Movement Key],  
    [$Outer].[Date Key],  
    [$Outer].[Stock Item Key],  
    [$Outer].[Customer Key2],  
    [$Outer].[Supplier Key2],  
    [$Outer].[Transaction Type Key],  
    [$Outer].[WWI Stock Item Transaction ID],  
    [$Outer].[WWI Invoice ID],  
    [$Outer].[WWI Purchase Order ID],  
    [$Outer].[Quantity],  
    [$Outer].[Lineage Key2],  
    [$Outer].[Category2],  
    [$Outer].[to_0],  
    [$Inner].[Primary Contact]  
from  
(  
    select [__].[Movement Key] as [Movement Key],  
        [__].[Date Key] as [Date Key],  
        [__].[Stock Item Key] as [Stock Item Key],  
        [__].[Customer Key2] as [Customer Key2],  
        [__].[Supplier Key] as [Supplier Key2],  
        [__].[Transaction Type Key] as [Transaction Type Key],  
        [__].[WWI Stock Item Transaction ID] as [WWI Stock Item Transaction ID],  
        [__].[WWI Invoice ID] as [WWI Invoice ID],  
        [__].[WWI Purchase Order ID] as [WWI Purchase Order ID],  
        [__].[Quantity] as [Quantity],  
        [__].[Lineage Key2] as [Lineage Key2],  
        [__].[Category] as [Category2],  
        upper([__].[Customer]) as [to_0]  
    from  
(  
        select [$Outer].[Movement Key],  
            [$Outer].[Date Key],  
            [$Outer].[Stock Item Key],  
            [$Outer].[Customer Key2],  
            [$Outer].[Supplier Key],  
            [$Outer].[Transaction Type Key],  
            [$Outer].[WWI Stock Item Transaction ID],  
            [$Outer].[WWI Invoice ID]
```



Is My Query Folding? - SQL



Is My Query Folding? - SQL

The screenshot shows the Microsoft Power BI Data Flow interface. On the left, the **Properties** pane is open, displaying the name "Fact Movement". Below it, the **Applied Steps** pane lists several steps: Source, Navigation, Filtered Rows, Expanded Dimension.Customer, Expanded Dimension.Stock It..., Custom merge, Merged, Uppercase, Expand, and Calculate. A context menu is open over the "Merged" step, with the "Diagnose" option highlighted by a red box. On the right, the ribbon shows the **Tools** tab selected, with the **Diagnostics** group visible, containing icons for Diagnose Step, Start Diagnostics, Stop Diagnostics, and Diagnostic Options.



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Query Diagnostics Options

The screenshot shows a settings dialog box with a dark background. On the left is a vertical navigation menu with the following items:

- Usage Data
- Diagnostics** (highlighted with a yellow bar)
- Preview features
- Auto recovery
- Report settings

CURRENT FILE

- Data Load
- Regional Settings
- Privacy
- Auto recovery

A dropdown arrow is located at the bottom of the current file section.

The main content area is titled "Query Diagnostics". It contains the following configuration options:

- Enable in Report and Query Editor (may require running as admin)** (radio button)
- Enable in Query Editor (does not require running as admin)** (radio button)
- Diagnostics Level**
 - Aggregated** (checkbox checked)
 - Detailed** (checkbox checked)
- Additional Diagnostics**
 - Performance counters** (checkbox checked)
 - Data privacy partitions** (checkbox unselected)

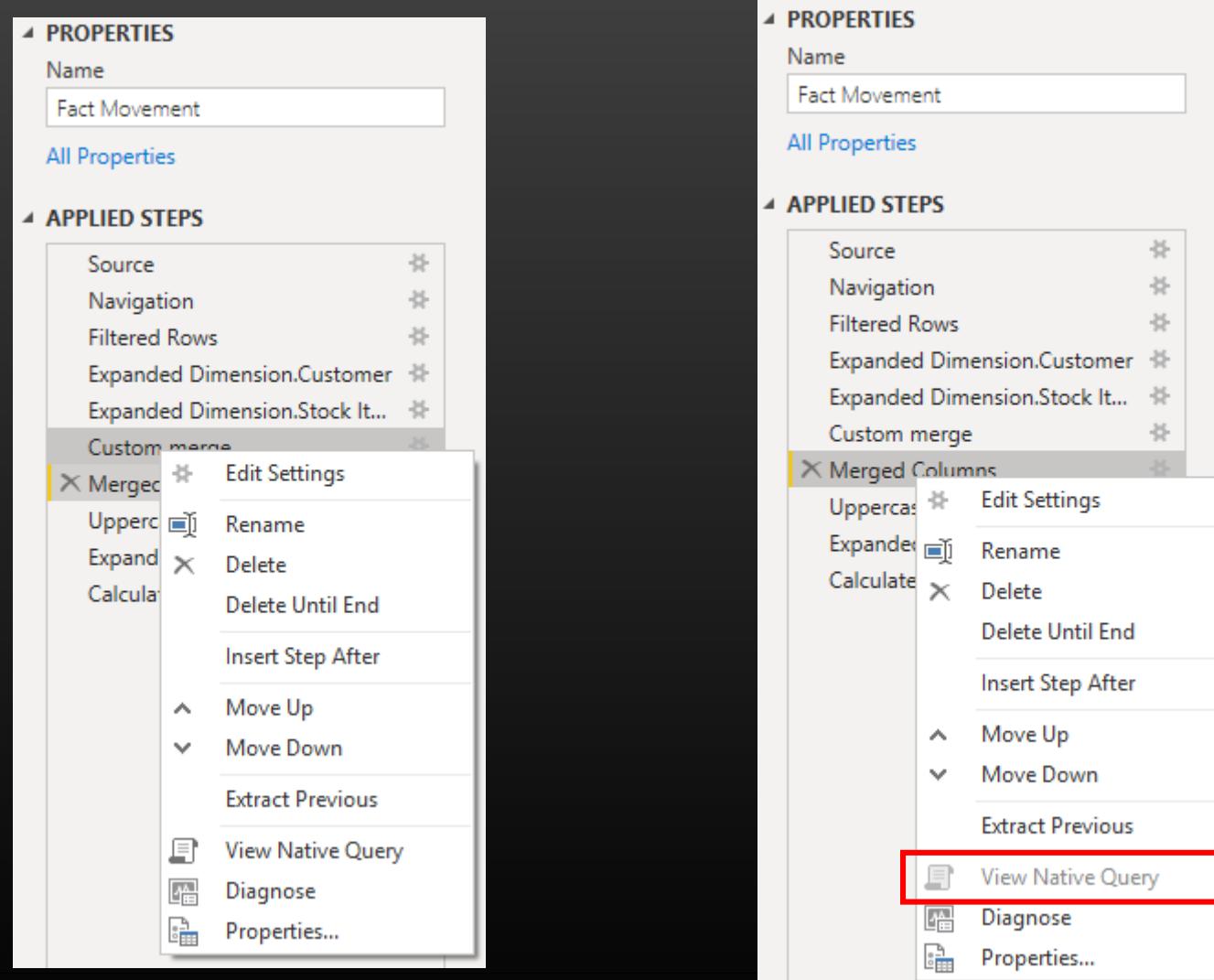


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Is My Query Folding? - SQL

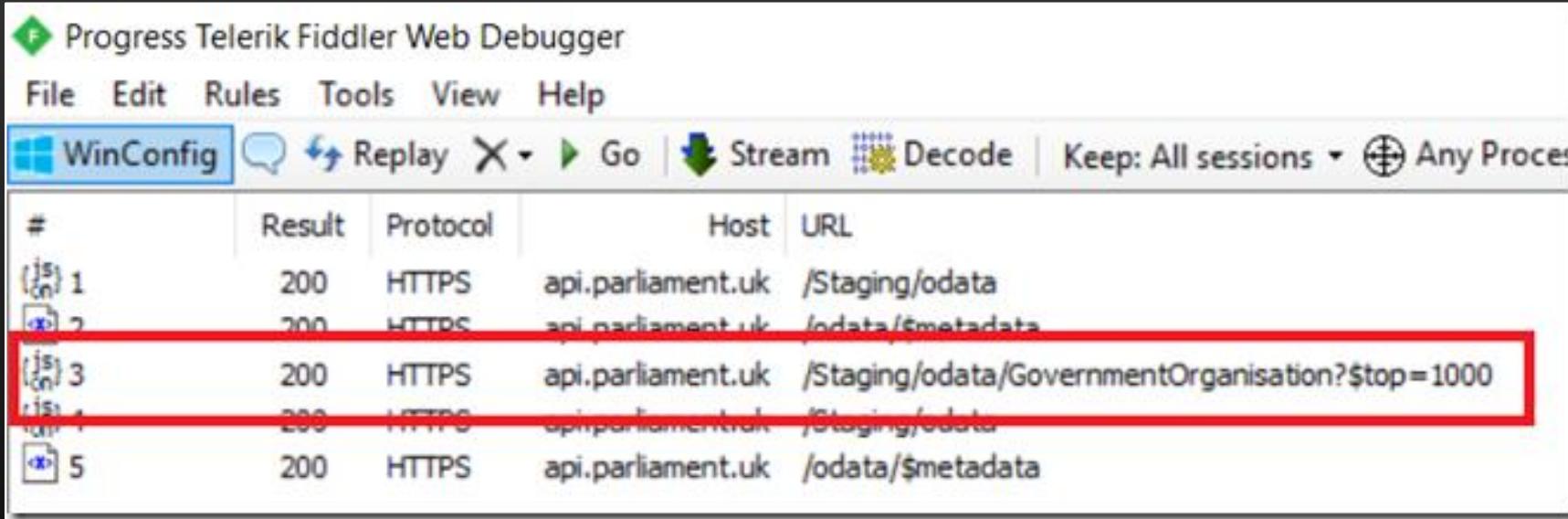


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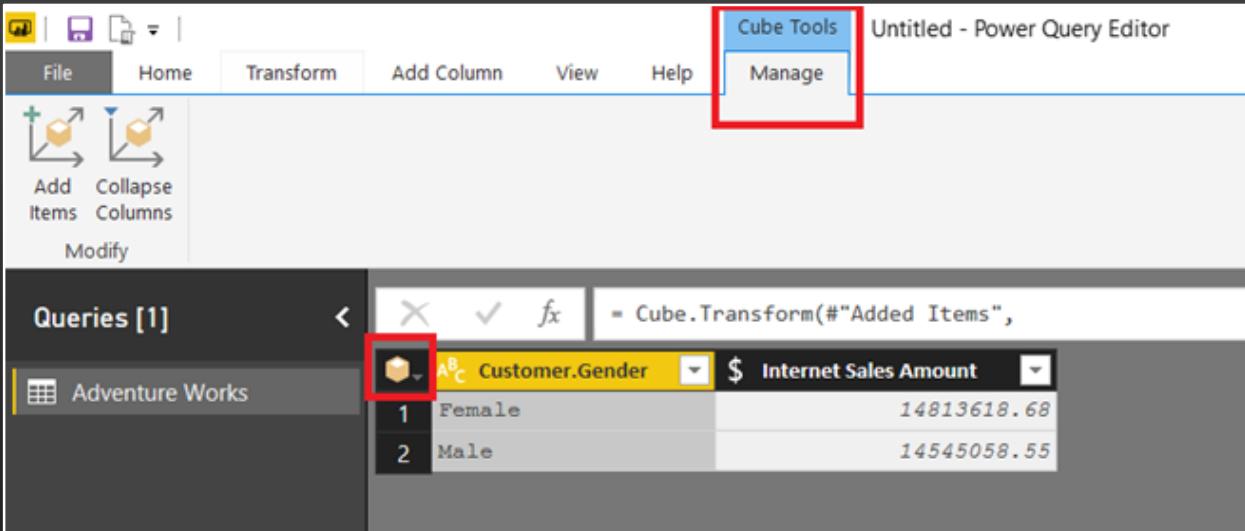
Is My Query Folding? - OData



The screenshot shows the Progress Telerik Fiddler Web Debugger interface. The toolbar includes File, Edit, Rules, Tools, View, Help, WinConfig, Replay, Go, Stream, Decode, Keep: All sessions, and Any Process. The main window displays a table of network requests:

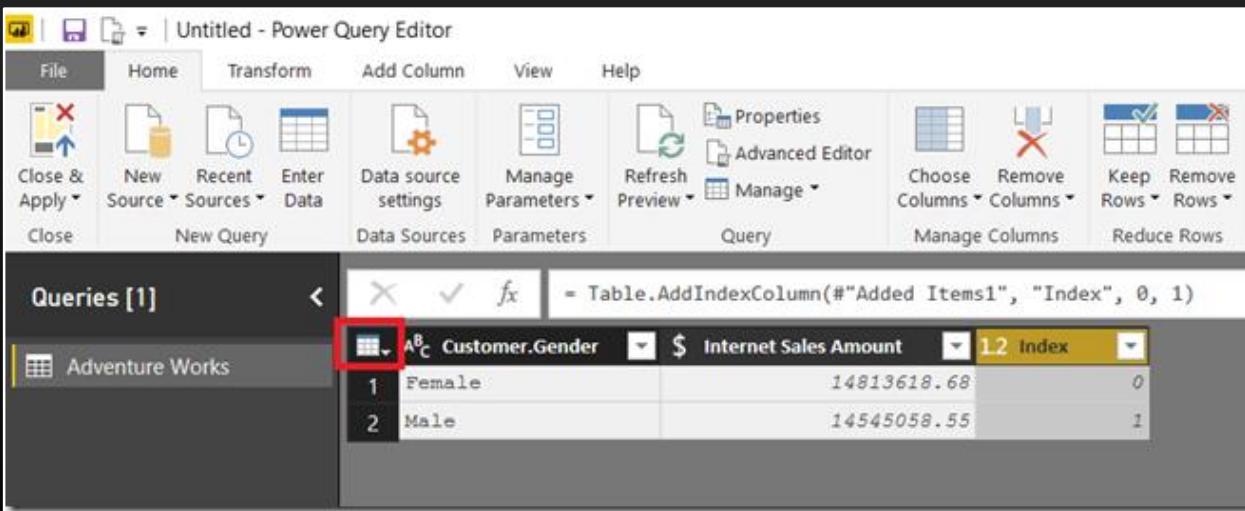
#	Result	Protocol	Host	URL
1	200	HTTPS	api.parliament.uk	/Staging/odata
2	200	HTTPS	api.parliament.uk	/odata/\$metadata
3	200	HTTPS	api.parliament.uk	/Staging/odata/GovernmentOrganisation?\$top=1000
4	200	HTTPS	api.parliament.uk	/Staging/odata
5	200	HTTPS	api.parliament.uk	/odata/\$metadata

Is My Query Folding? - SSAS



Screenshot of the Power Query Editor showing a query step. The ribbon at the top has a red box around the "Manage" button under the "Cube Tools" tab. The query step window shows a table with two rows: "Customer.Gender" and "Internet Sales Amount". The table contains two rows: Female (14813618.68) and Male (14545058.55).

Customer.Gender	Internet Sales Amount
Female	14813618.68
Male	14545058.55



Screenshot of the Power Query Editor showing a query step. The ribbon at the top has a red box around the "Manage" button under the "Cube Tools" tab. The query step window shows a table with three columns: "Customer.Gender", "Internet Sales Amount", and "Index". The table contains two rows: Female (14813618.68, Index 0) and Male (14545058.55, Index 1).

Customer.Gender	Internet Sales Amount	Index
Female	14813618.68	0
Male	14545058.55	1

Agenda

- Query Folding
 - Query diagnostics
 - Value.NativeQuery
- Constraints
- Demo, Demo, Demo!



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Limitations

- Unsupported data sources/transformations
- Data source privacy level
- Native database query



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Limitations – Unsupported Transformations

- Merge/append queries from different sources
- Split column
- Add Index column
- Table.Buffer() M function
- Complex Group By
- Remove errors, duplicates
- DateTime to Date (Transform vs Date Only)
- And more...



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Limitations – Unsupported Transformations

- Merge/append queries from different sources
- Split column
- Add Index column
- Table.Buffer() M function
- Complex Group By
- Remove errors, duplicates
- **DateTime to Date (Transform vs Date Only)**
- And more...

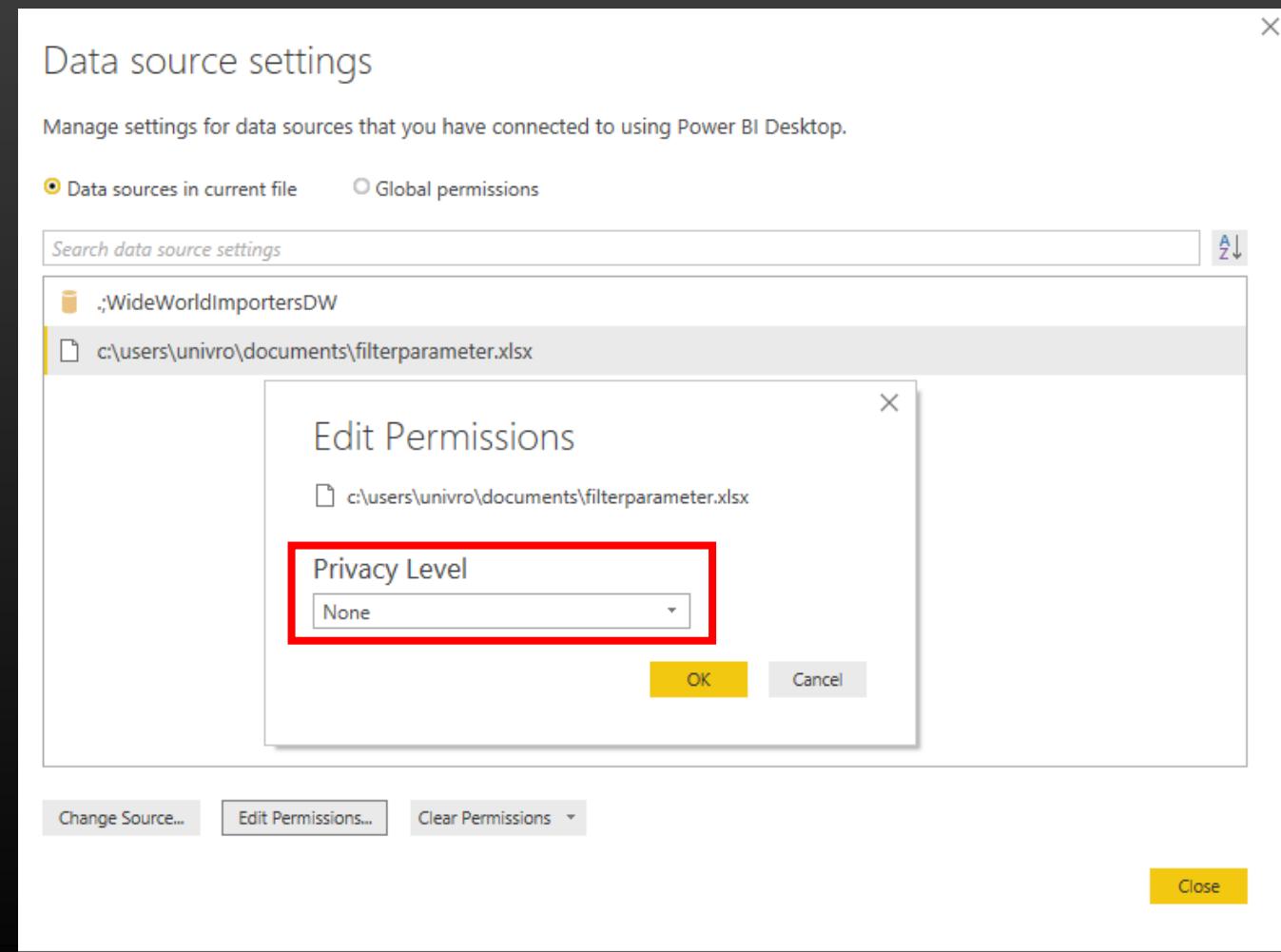


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Limitations – Data source privacy level



Limitations – Native Database Queries

Query the source directly

- PQ isn't sufficient
- Specific requirements/optimizations
- Existing SQL-query
- Stored Procedures



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Limitations – Native Database Queries

- Functions on top of the query results aren't folded...
 - ...by default ☺ > Value.NativeQuery
- No guarantees on frequency of execution



Native Database Queries

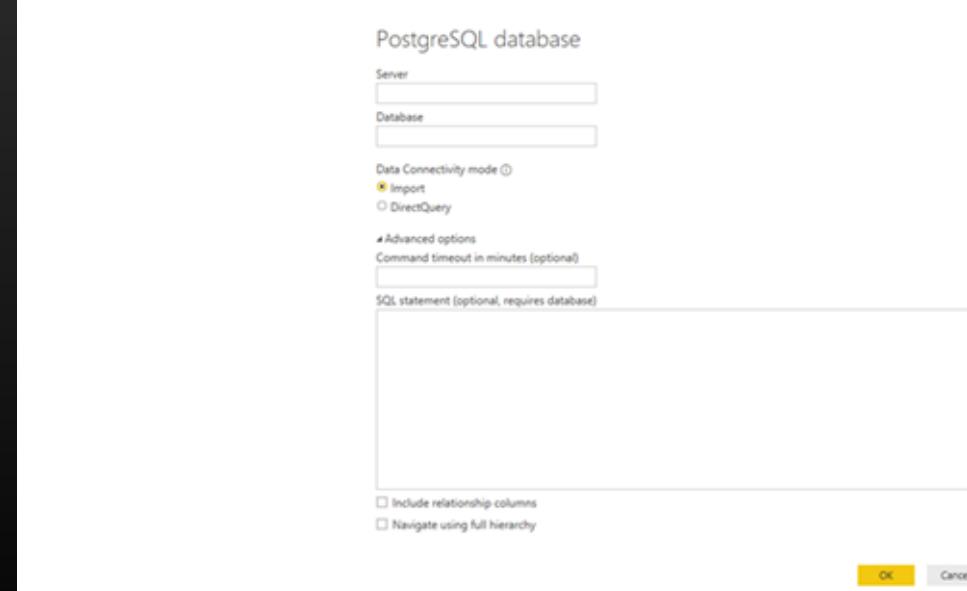
- Value.NativeQuery
- PostgreSQL enhancement
- Documentation difference

Data connectivity

PostgreSQL connector enhancements

Support for folding over Native Database queries

The PostgreSQL connector has been enhanced with query folding over a native query. You can now paste in a native query when connecting to a PostgreSQL database, with folding capable operations applied on top according to normal Import or Direct Query logic.





Demo Time!

Demo

Take-aways:

- Filter first, transform later
- View Native Query



Improvements

- Desktop June 2018
 - OData V4 connector enhancements:
 - Use [Implementation="2.0"] in OData.Feed()
- Relative date slicers started working
- Desktop February 2019
 - PBI Premium (& pro!): Incremental refresh query verification
- Desktop September 2019
 - PostgreSQL connector enhancements over a native query (EnableFolding)
- Merging two columns
- Desktop August 2021
 - Value.NativeQuery: PreserveTypes



Wrap-up

- Concept of Query Folding
- Supported data sources, transformations
- View Native Query/Query diagnostics
- Don't write native SQL and add steps afterwards
 - Or use Value.NativeQuery with EnableFolding



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Resources

Power Query documentation:

- <https://docs.microsoft.com/en-us/power-query/power-query-folding>
- <https://docs.microsoft.com/en-us/power-query/querydiagnosticsfolding>
- <https://docs.microsoft.com/en-us/power-query/handlingqueryfolding>
- <https://docs.microsoft.com/en-us/power-query/connectors/postgresql#native-query-folding>

Blogs on Query Folding:

- <https://www.mssqltips.com/sqlservertip/3635/query-folding-in-power-query-to-improve-performance/>
- <http://geekswithblogs.net/darrenosbell/archive/2014/05/16/function-folding-in-powerquery.aspx>
- <https://www.mssqltips.com/sqlservertip/4563/power-bi-native-query-and-query-folding/>
- <https://blog.crossjoin.co.uk/2018/06/27/odata-performance-power-bi/>
- <https://blog.crossjoin.co.uk/2021/09/12/preserving-data-types-with-sql-queries-in-power-query-and-power-bi/>
- <https://blog.crossjoin.co.uk/2021/09/12/preserving-data-types-with-sql-queries-in-power-query-and-power-bi/>

Power BI Desktop updates

- <https://powerbi.microsoft.com/en-us/blog/power-bi-desktop-june-2018-feature-summary/#folding>

Power BI Premium Incremental refresh

- <https://powerbi.microsoft.com/en-us/blog/incremental-refresh-query-folding/>
- <https://docs.microsoft.com/en-us/power-bi/service-premium-incremental-refresh#query-folding>
- <https://www.youtube.com/watch?v=RnrCKn5ykCc>



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Thank you

and let's connect!



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www.linkedin.com/in/nickyvanvroenhoven/