

Making DAX easier

Introducing Power BI Visual Calculations

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“Wait, I know that guy”



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He / Him

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Who's the other clown?



Marc Lelijveld

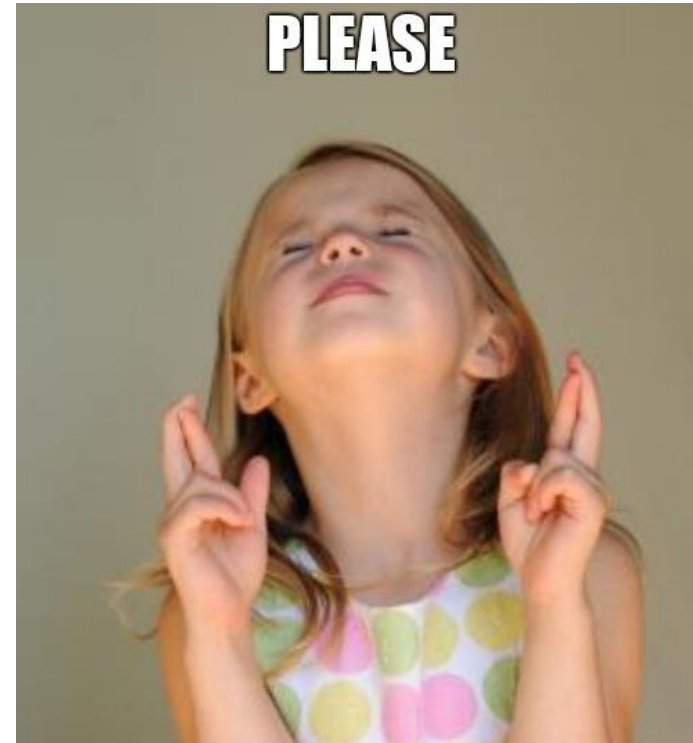
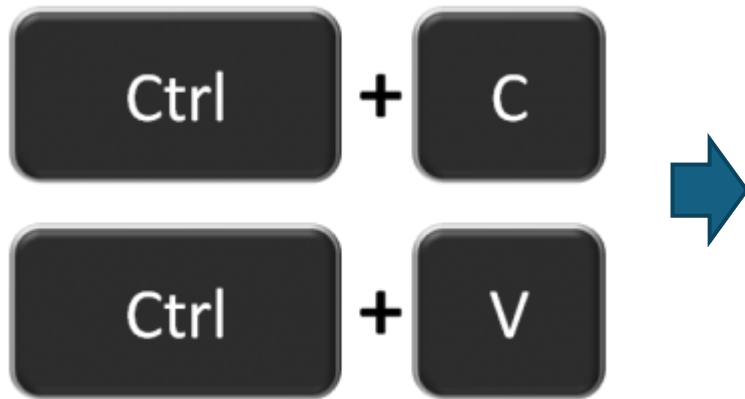
He / Him

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How most of us write DAX today



Ever tried to do a running total in DAX?

Power BI Running Total

<https://www.wallstreetmojo.com/power-bi-running-total/>

Examples of Running Total in Power BI

- 1: Similar stuff can be arrived in Power BI as well but not as easy as in excel. ...
- Step #2: For this table, we can arrive running totals in three ways. First, we will arrive through New Measure, right-click on the table and choose New Measure.
- Step #3: Name the measure as RT Measure. (RT= Running Total).
- Step #4: Open the CALCULATE function first.
- Step #5: The kind of Expression that we need to do with the CALCULATE function is Summation of Sales Value, so open the SUM function and choose the Sales column.
- Step #6: After applying the kind of calculation to be done next, we need to apply the filter to decide the criteria to be matched for calculation.
- Step #7: Before we apply FILTER first, we need to release any kind of filter applied to the Date column, so open the ALL function to remove the filter from ...
- Step #8: In this function, choose the Table or Column Name for which we need to remove the filter for, so choose the Date column.
- Step #9: Once the filter is removed, then we need to apply fresh filter criteria in Filter Expression, so for this again, choose the date column.
- Step #10: Once the Date column has been selected, we need to apply the kind of filter to be applied. ...
- Step #11: MAX function will find the last date in the column of date, so supply the date column.
- Step #12: Ok, we are done. Close three brackets and hit the enter key to get the result.
- Step #13: Now insert the table visually and add Date and Sales columns first.
- Step #14: This is the overall summary, now add a newly created measure to the table to get the Running Total column.
- Step #15: Name this measure as RT Measure 1.
- Step #16: Open the CALCULATE function.
- Step #17: As we did in the previous method, we need to do a summation of the sales column, so open the SUM function and choose the Sales column to ...
- Step #18: This time for filter criteria, we will use the DATESYTD function.
- Step #19: Choose the Date column for this function.
- Step #20: Close two brackets and hit the enter key to complete the formula.
- Step #21: Ok, now add this new measure to our existing table visual and see the result. We have got two different sets of running totals.

Similar search: [running total excel](#)

21 steps!

How would you want to write DAX?

imagine

Let's face it

- DAX is hard. (to be exact, filter context is hard)
- DAX calculations (measures) are scoped to the model and independent of each other
- Typical business type calculations are surprisingly hard to do.
 - Quick measures help – but the DAX it generates is hard to comprehend / edit

What if you could...

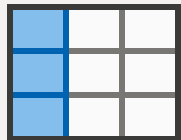
- define a calculation on exactly what's on your visual without having to worry about what makes DAX hard?
- *easily write and read* the DAX statement needed for your business calculation?
- define a calculation with no to minimal typing, but instead use point-and-click if you wanted to?

Enter: Visual Calculations

(Visual Calcs for short)

- DAX calculations defined on a visual
- Can refer to any field that's on the visual, including other visual calcs
- Are executed in scope of the visual only, not the model
- Can refer to the visual structure as well, instead of just referencing fields
- Most of the time you don't have to worry about the complexity of filter context

Visual calcs vs measures vs calc columns



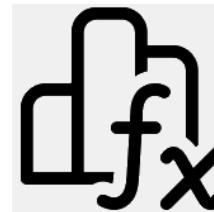
Calculated column

- Defined on a table
- Works on a row-by-row basis (row context)
- Computed at dataset refresh (for import tables) or query refresh (for DirectQuery tables)
- Result persisted (for import tables)



Measure

- Defined in the data model
- Works on sets of rows (filter context)
- Computed at query execution



Visual calculations

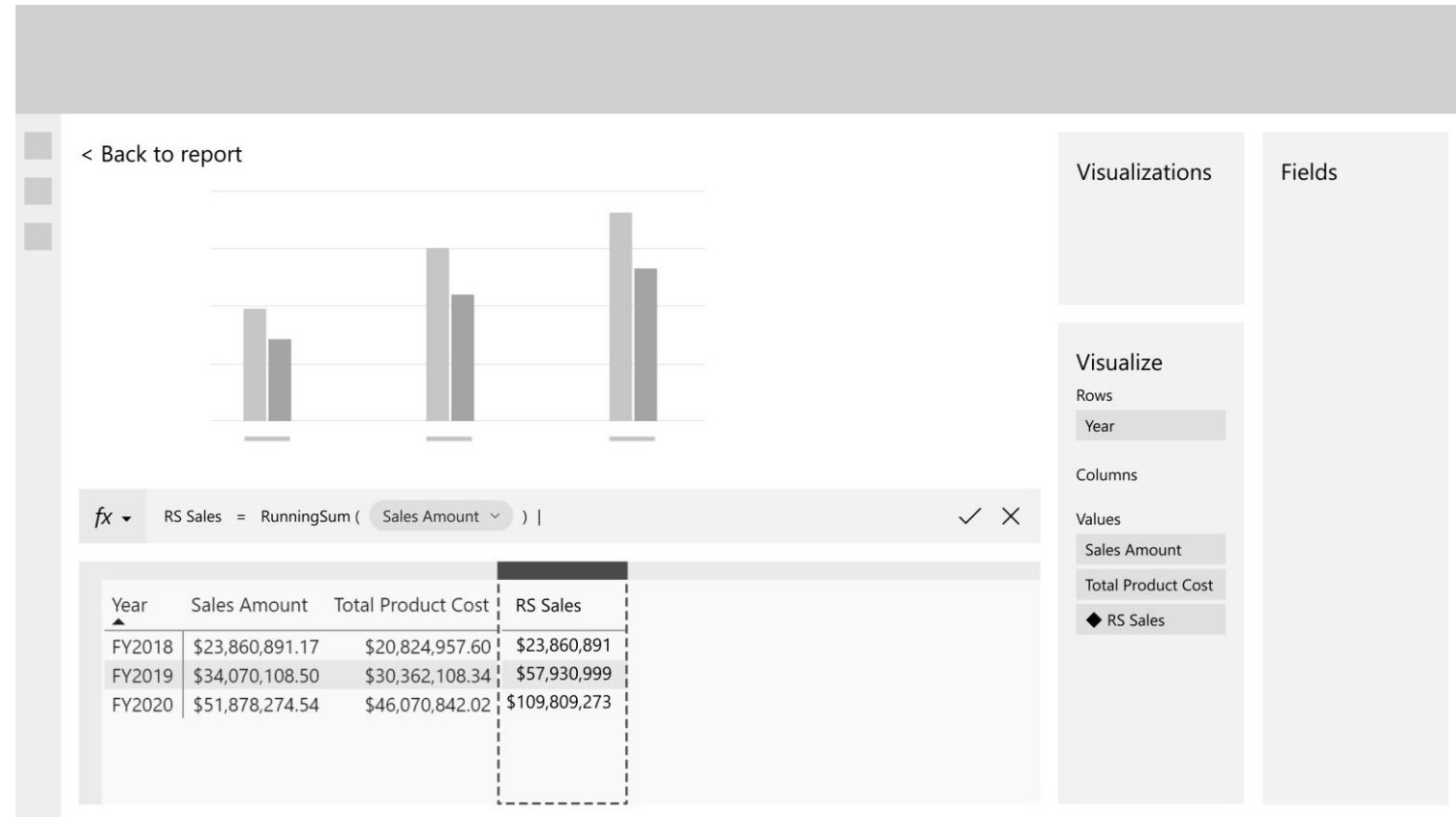
- Defined on a visual
- “Visible context”
- Computed at query execution
- Can refer to visual structure

Visual calculations are easy and flexible

- WYSIWYG
- Point-and-click provided, if you want
- Just “visible context”
- High-level functions for common business calculations
- Refer to visual structure

Mental model

- Any visual can be represented as a matrix
- A visual calculation adds a column on that matrix
- A visual calculation is added to the matrix but can be hidden from the visual itself
- A visual calculation can refer to any field / visual calculation on the visual



DEMO

#Mindblown #PowerBI



What are Visual Calcs?

DAX calculations in the scope of a visual.

In support thereof:

- new functions
- new concepts

Visual calc expressions

- It's just DAX. Most DAX works.

```
OrderCategory =  
    SWITCH (  
        TRUE,  
        [Sales Amount] <= 100, 'Small',  
        [Sales Amount] <= 500, 'Medium',  
        'Large'  
    )
```

- Basic arithmetic: Profit = [Sales] - [Cost]
- New visual calc functions

Visual Calcs vs 'regular' DAX (1/2)

- Goal: implement a running sum calculation that sums Sales Amount over Year.

- Solution:

- Current DAX:

```
CALCULATE(  
    SUM('Sales'[Sales Amount]),  
    FILTER(  
        ALLSELECTED('Date'[Year]),  
        ISONORAFTER('Date'[Year], MAX('Date'[Year]), DESC)  
    )  
)
```

- Visual Calcs (assuming Year is on Rows):

```
RUNNINGSUM([Sales Amount])
```

Visual Calcs vs 'regular' DAX (2/2)

- Goal: given a list of states and number of restaurants per state, for each state calculate the difference in number of restaurant in that state vs the one above.

Current DAX:

```
DiffNumRestaurants =  
VAR _temp =  
    SUMMARIZE (  
        ALLSELECTED ( Pizza_data ),  
        Pizza_data[state],  
        "NumRestaurants", [# restaurants]  
    )  
VAR _currentState =  
    SELECTEDVALUE ( Pizza_data[state] )  
VAR _previousState =  
    TOPN (  
        1,  
        FILTER ( _temp, Pizza_data[state] < _currentState ),  
        Pizza_data[state], DESC  
    )  
RETURN  
    [# restaurants] - SUMX ( _previousState, [NumRestaurants] )
```

Visual Calcs (technically Window functions):

```
Diff =  
VAR PreviousStateRestaurants =  
    CALCULATE (  
        [# restaurants],  
        OFFSET ( -1, ALLSELECTED ( Pizza_data[state] ),  
        ORDERBY ( Pizza_data[state] ) )  
    )  
RETURN  
    [# restaurants] - PreviousStateRestaurants
```

Visual Calcs:

```
Diff = [# restaurants] - PREVIOUS( [# restaurants] )
```


New functions

- We are introducing multiple new functions, divided in levels.
- Higher-level functions are easier-to-use shortcuts to lower-level functions

Level	Functionality offered	Included functions	Flexibility	Complexity
Low	Returning a single item, a set of items or an index number	Window functions	High	High
Medium	Returning a single item, a set of items	Movement functions Hierarchical functions	Medium	Medium-High
High	Business-type calculations	Calculation functions	Medium	Low

Low level functions

(aka window functions)

OFFSET

- Relative movement

INDEX

- Absolute movement

WINDOW

- Define slice

RANK

- Return rank

ROWNUMBER

- Return unique ranking

ORDERBY

PARTITIONBY

MATCHBY

Medium level functions

Previous: move up / left in *direction*

Next: move down/right in *direction*

First: move to beginning in *direction*

Last: move to end in *direction*

Range: define slice

Expand: add detail level

ExpandAll: add all detail levels

Collapse: remove detail level

CollapseAll: remove all detail levels

High level functions

RunningSum: add running sum in direction

MovingAverage: add moving average in direction

New concepts

Visual matrix: the matrix that represents the data in a visual

Axis: defines how a calculation traverse the *visual matrix* on which it's being executed.

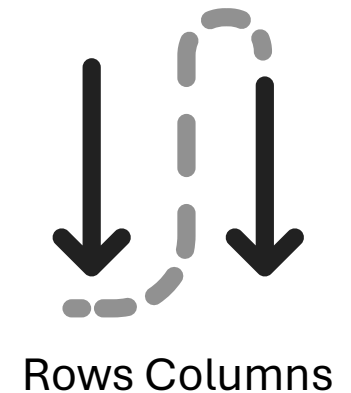
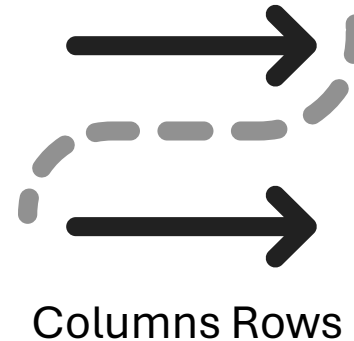
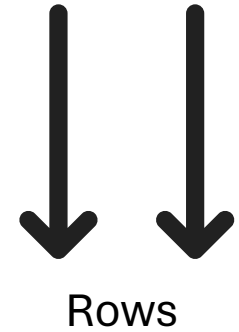
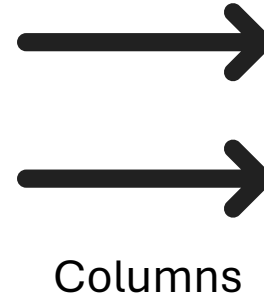
Reset: defines when a calculation restarts while traversing the *axis*

Direction: combines *axis* and *reset*

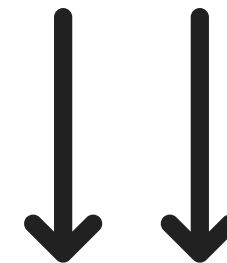
Hidden: a field that is on the *visual matrix* but not shown on the visual

Concept: axis

- Think of axis as how the calculation traverses the visual matrix on which it's being executed
- Default: Rows



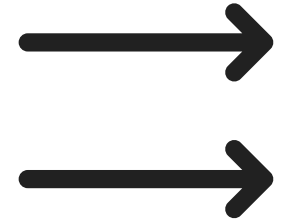
Example: Axis



FIRST([Sales Amount], Rows) →
for each *Row*, retrieve the first Sales Amount from the first *Row*

<div> <div> <div>✕</div> <div>✓</div> <div>f_x</div> </div> <div>1 Calculation = FIRST([Sales Amount], Rows)</div> </div>								
Fiscal Year	FY2018		FY2019		FY2020		Total	
Category	Sales Amount	Calculation	Sales Amount	Calculation	Sales Amount	Calculation	Sales Amount	Calculation
Accessories	\$36,814.85	36,814.85	\$138,901.55	138,901.55	\$1,096,341.49	1,096,341.49	\$1,272,057.89	1,272,057.89
Bikes	\$22,590,983.47	36,814.85	\$28,544,881.62	138,901.55	\$43,484,661.12	1,096,341.49	\$94,620,526.21	1,272,057.89
Clothing	\$66,327.53	36,814.85	\$757,224.19	138,901.55	\$1,294,061.73	1,096,341.49	\$2,117,613.45	1,272,057.89
Components	\$1,166,765.32	36,814.85	\$4,629,101.14	138,901.55	\$6,003,210.20	1,096,341.49	\$11,799,076.66	1,272,057.89
Total	\$23,860,891.17	23,860,891.17	\$34,070,108.50	34,070,108.50	\$51,878,274.54	51,878,274.54	\$109,809,274.20	109,809,274.20

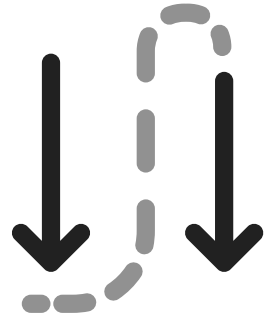
Example: Axis



FIRST([Sales Amount], Columns) →
for each *Column*, retrieve the first Sales Amount from the first *Column*)

<div> <div>✕ ✓ f_x</div> <div>1 Calculation = FIRST([Sales Amount], Columns)</div> </div>								
Fiscal Year	FY2018		FY2019		FY2020		Total	
Category	Sales Amount	Calculation	Sales Amount	Calculation	Sales Amount	Calculation	Sales Amount	Calculation
Accessories	\$36,814.85	36,814.85	\$138,901.55	36,814.85	\$1,096,341.49	36,814.85	\$1,272,057.89	1,272,057.89
Bikes	\$22,590,983.47	22,590,983.47	\$28,544,881.62	22,590,983.47	\$43,484,661.12	22,590,983.47	\$94,620,526.21	94,620,526.21
Clothing	\$66,327.53	66,327.53	\$757,224.19	66,327.53	\$1,294,061.73	66,327.53	\$2,117,613.45	2,117,613.45
Components	\$1,166,765.32	1,166,765.32	\$4,629,101.14	1,166,765.32	\$6,003,210.20	1,166,765.32	\$11,799,076.66	11,799,076.66
Total	\$23,860,891.17	23,860,891.17	\$34,070,108.50	23,860,891.17	\$51,878,274.54	23,860,891.17	\$109,809,274.20	109,809,274.20

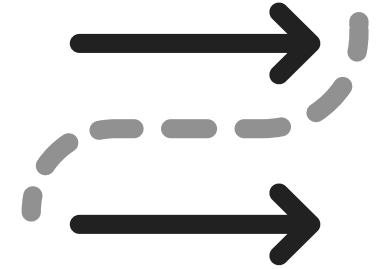
Example: Axis



PREVIOUS([Sales Amount], Rows Columns) →
for each cell, retrieve the previous Sales Amount from the *Row*
above it or from the last cell in the previous *Column*

<div> <div>✕ ✓ f_x</div> <div>1 Calculation = PREVIOUS([Sales Amount], Rows Columns)</div> </div>								
Fiscal Year	FY2018		FY2019		FY2020		Total	
Category	Sales Amount	Calculation	Sales Amount	Calculation	Sales Amount	Calculation	Sales Amount	Calculation
Accessories	\$36,814.85		\$138,901.55	1,166,765.32	\$1,096,341.49	4,629,101.14	\$1,272,057.89	
Bikes	\$22,590,983.47	36,814.85	\$28,544,881.62	138,901.55	\$43,484,661.12	1,096,341.49	\$94,620,526.21	1,272,057.89
Clothing	\$66,327.53	22,590,983.47	\$757,224.19	28,544,881.62	\$1,294,061.73	43,484,661.12	\$2,117,613.45	94,620,526.21
Components	\$1,166,765.32	66,327.53	\$4,629,101.14	757,224.19	\$6,003,210.20	1,294,061.73	\$11,799,076.66	2,117,613.45
Total	\$23,860,891.17		\$34,070,108.50	23,860,891.17	\$51,878,274.54	34,070,108.50	\$109,809,274.20	

Example: Axis



PREVIOUS([Sales Amount], Columns Rows) →
for each cell, retrieve the previous Sales Amount from the *Column* to the left of it or from the last cell of the previous *Row*

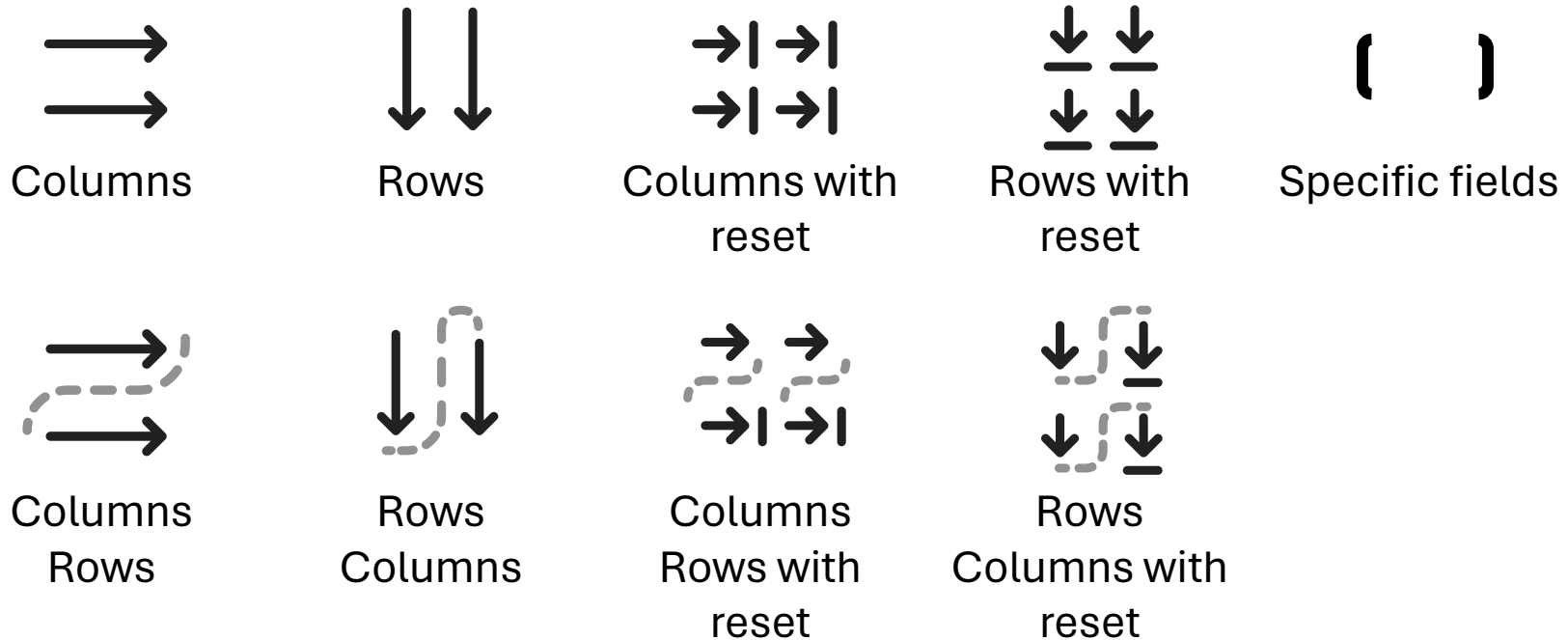
<div> <div> <div>✕</div> <div>✓</div> <div>fx</div> </div> <div>1 Calculation = PREVIOUS([Sales Amount], Columns Rows)</div> </div>								
Fiscal Year	FY2018		FY2019		FY2020		Total	
Category	Sales Amount	Calculation	Sales Amount	Calculation	Sales Amount	Calculation	Sales Amount	Calculation
Accessories	\$36,814.85		\$138,901.55	36,814.85	\$1,096,341.49	138,901.55	\$1,272,057.89	
Bikes	\$22,590,983.47	1,096,341.49	\$28,544,881.62	22,590,983.47	\$43,484,661.12	28,544,881.62	\$94,620,526.21	1,272,057.89
Clothing	\$66,327.53	43,484,661.12	\$757,224.19	66,327.53	\$1,294,061.73	757,224.19	\$2,117,613.45	94,620,526.21
Components	\$1,166,765.32	1,294,061.73	\$4,629,101.14	1,166,765.32	\$6,003,210.20	4,629,101.14	\$11,799,076.66	2,117,613.45
Total	\$23,860,891.17		\$34,070,108.50	23,860,891.17	\$51,878,274.54	34,070,108.50	\$109,809,274.20	

Concept: Reset

- None: continue counting, never restart
- LowestParent: start over for each parent of the lowest level on the specified axis
- HighestParent: start over on the highest level on the specified axis
- [n]: start over on the n^{th} level on the specified axis
- [Field reference] (example: reset([Year]))

Concept: Direction

- Direction is the combination of *Axis* and *Reset*
- The ‘specific fields’ “direction” does not rely on *Axis* but instead references fields



Concept: Hidden

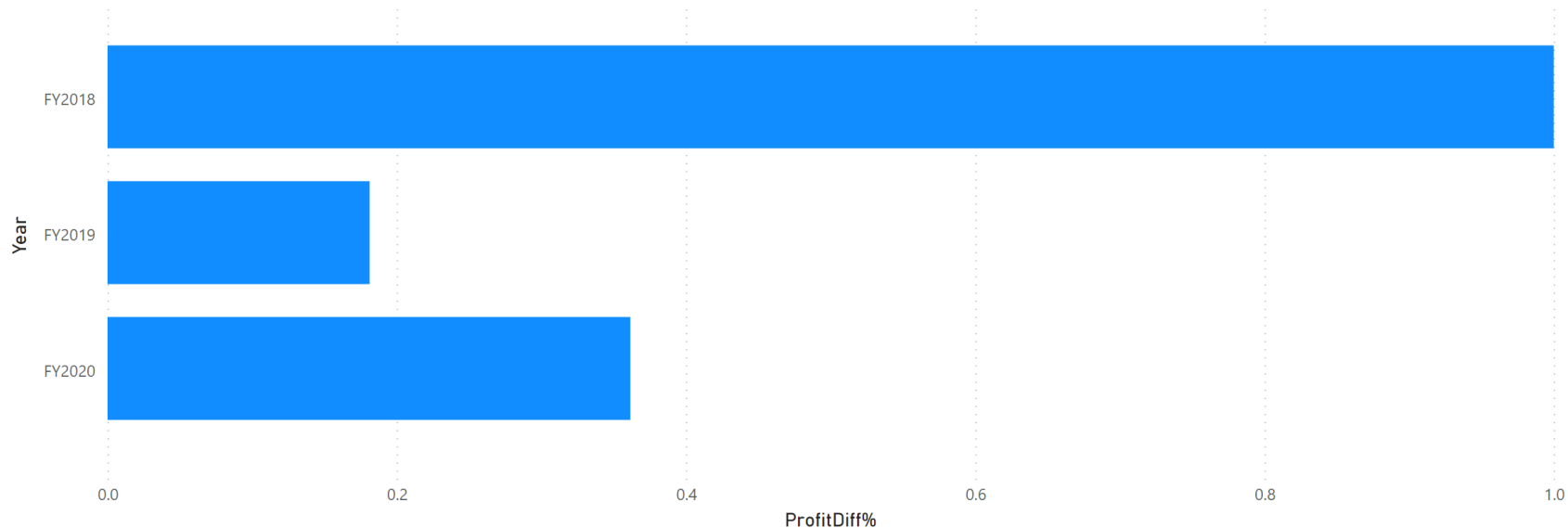


- All fields on the visual are on the visual matrix, but not all fields on the visual matrix are visible on the visual.
- Remember: visual calcs can refer to what's on the visual matrix, not to anything else.
- Allows for “partial results”

Example: Hidden



- Profit = [Sales Amount] - [Cost] (hidden)
- ProfitDiff = [Profit] - Previous([Profit]) (hidden)
- ProfitDiff% = DIVIDE([ProfitDiff], [Profit])



Fiscal Year	Sales Amount	Cost	Profit	ProfitDiff	ProfitDiff%
FY2018	\$23,860,891.17	\$20,824,957.60	3,035,933.57	3,035,933.57	1.00
FY2019	\$34,070,108.50	\$30,362,108.34	3,708,000.16	672,066.60	0.18
FY2020	\$51,878,274.54	\$46,070,842.02	5,807,432.52	2,099,432.35	0.36
Total	\$109,809,274.20	\$97,257,907.95	12,551,366.25	12,551,366.25	1.00

DEMO

But where is `calculate`?

We aim to “fatten the donut”:

Only in the **center** the user is exposed to `calculate` and worry about complexities such as context transition

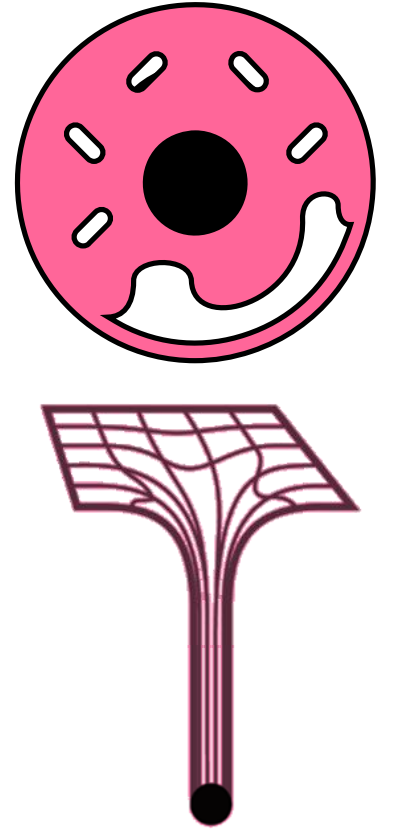
Higher-level (medium and high) functions have signatures that expand into `calculate` statements.

Example:

```
first([Sales], [Year]) →
```

```
calculate([Sales], first[Year]) →
```

```
calculate([Sales], index(1, [Year]))
```



VISUAL CALCULATION



POWER BI GOVERNANCE

Questions?

Source:

https://twitter.com/DAX_memes/status/1714699726317040097?t=u-w-eBZCceJnbj002zpNQg&s=19



Resources

- Documentation of released functions: [INDEX](#), [OFFSET](#), [WINDOW](#), [RANK](#), [ROWNUMBER](#), [ORDERBY](#), [PARTITIONBY](#), [MATCHBY](#)
- [Understanding ORDERBY, PARTITIONBY and MATCHBY](#)
- Using visual calculations
<https://aka.ms/visual-calculations-docs>
- Calculations options
<https://aka.ms/powerbi-calculation-options>
- Provide feedback on visual calculations
<https://aka.ms/visual-calculations-feedback>

Feedback!



**Session
evaluation**



Event evaluation