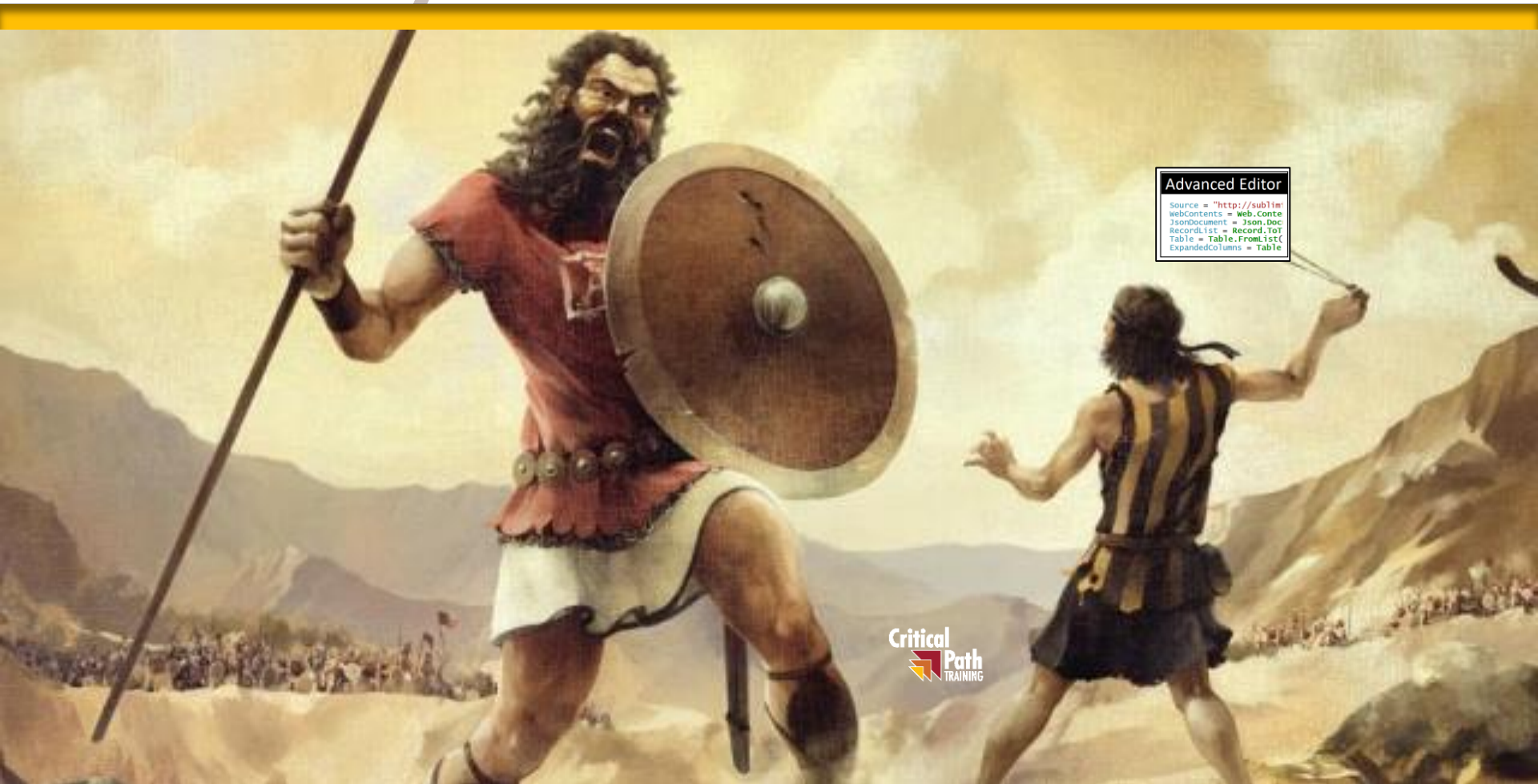


Advanced Query Design using Power Query and M



Download the Code and Slides

- <https://github.com/CriticalPathTraining/Intro2M>

The screenshot shows the GitHub repository page for CriticalPathTraining/Intro2M. The browser address bar displays the URL https://github.com/CriticalPathTraining/Intro2M. The repository name is CriticalPathTraining / Intro2M, with 3 watchers, 0 stars, and 0 forks. The repository is on the master branch. The file list includes:

File	Commit	Time
Demos	Updates	3 minutes ago
Introduction to M Programming for the Power BI Warrior.pdf	Updates	26 seconds ago
Introduction to M Programming for the Power BI Warrior.pptx	Updates	26 seconds ago
LICENSE	Initial commit	6 days ago
README.md	Initial commit	6 days ago



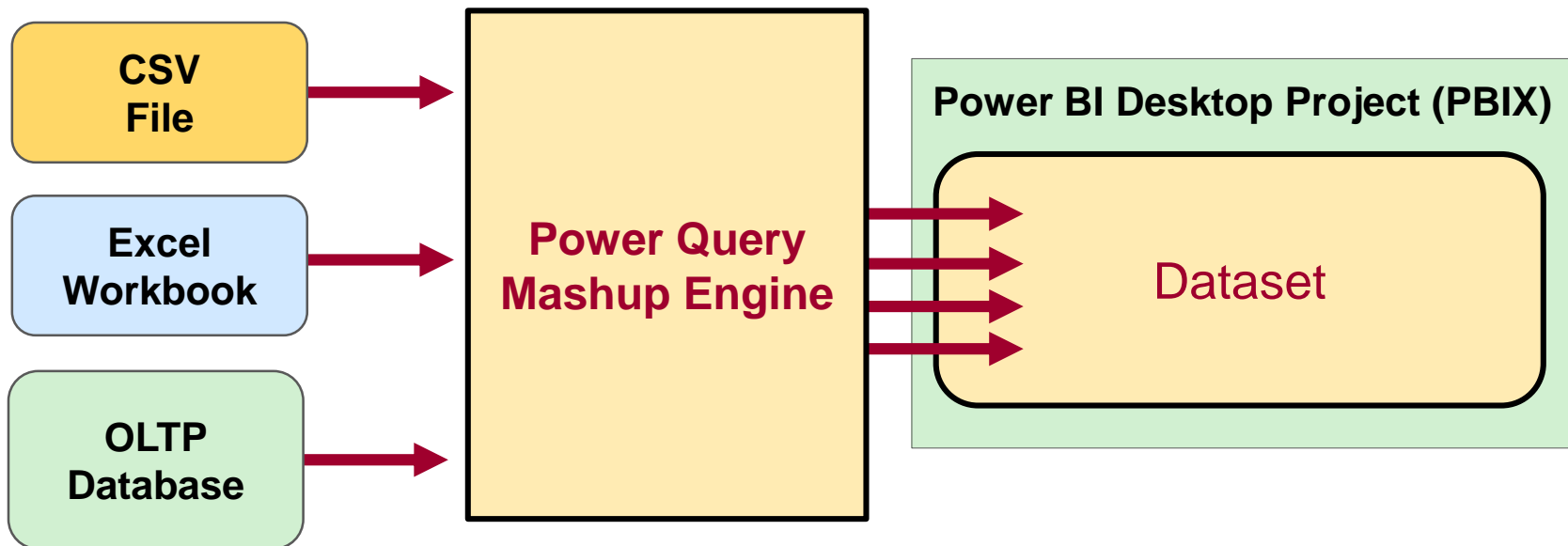
Agenda

- Advanced Power Query Techniques
- Power Query Mashup Engine
- M Programming Fundamentals
- M Function Library
- Query Functions
- Query Parameters



Power BI Desktop is an ETL Tool

- ETL process is essential part of any BI Project
 - **Extract** the data from wherever it lives
 - **Transform** the shape of the data for better analysis
 - **Load** the data into dataset for analysis and reporting



Query Steps

- A query is created as a sequence of steps
 - Each step is a parameterized operation in data processing pipeline
 - Query starts with Source step to extract data from a data source
 - Additional steps added to perform transform operations on data
 - Each step is recorded using M (*aka Power Query Formula Language*)

The screenshot displays the Power Query Editor interface. At the top, the ribbon includes 'File', 'Home', 'Transform', 'Add Column', and 'View'. The 'Query Settings' pane on the left shows 'Customers' as the selected query. The main area displays a table with columns: Customerid, Customer, State, City, Zipcode, and Gender. The formula bar at the top shows the M code: `= Table.ReplaceValue("#Replaced Female Values", "M", "Male", Replacer.ReplaceText, ...)`. On the right, the 'Query Settings' pane is open, showing the 'APPLIED STEPS' list. The list contains: Source, Navigation, Removed Other Columns, Merged Columns, Reordered Columns, Replaced Female Values, Replaced Male Values (highlighted with a red 'X'), Changed Type, and Added Conditional Column. A red dashed box highlights the 'APPLIED STEPS' list, and a red arrow points from a text box to it.

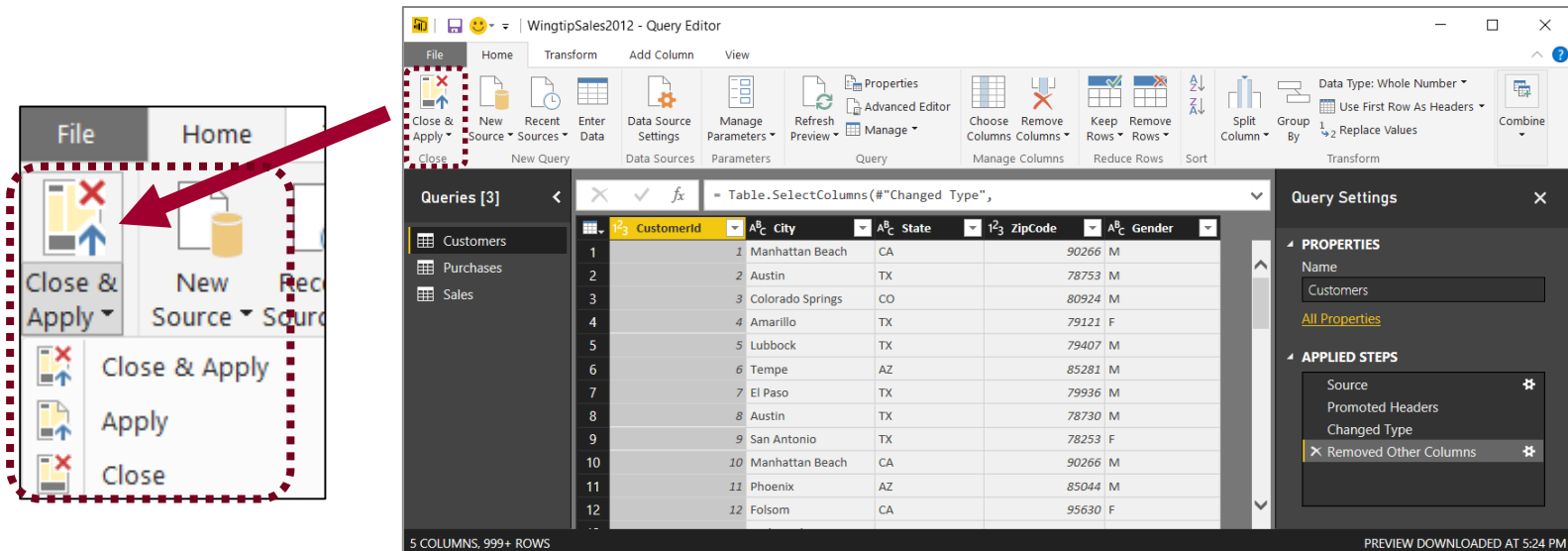
step formula bar

sequential list of steps for query

Customerid	Customer	State	City	Zipcode	Gender
1	Nina Diaz	CA	Eureka	95501	Female
2	Melinda Carter	CA	Napa	94558	Female
3	Pam Miller	CA	Napa	94558	Female
4	Merle Blackwell	CA	Sacramento	95823	Female
5	Ariel Hale	CA	Sacramento	95818	Male
6	Randy Carter	CA	Sacramento	95818	Male
7	Lillie Hinton	CA	Eureka	95501	Female
8	Ladonna Moody	CA	Napa	94559	Female
9	Buddy McKay	OR	Bend	97701	Male
10	Warren Sykes	CA	Sacramento	95818	Male
11	Jan Rutledge	OR	Portland	97216	Female
12	Dallas Lester	OR	Eugene	97402	Male
13	Matthew Zimmerman	OR	Portland	97220	Male
14	Sheryl Hernandez	CA	Sacramento	95823	Female

Query Editor Window

- Power BI Desktop provides separate Query Editor window
 - Provides easy-to-use UI experience for designing queries
 - Queries created by creating **Applied Steps**
 - Preview of table generated by query output shown in the middle
 - Query can be executed using **Apply** or **Close & Apply** command




Self-Join

- Merge columns from a table to itself

×

Merge

Select a table and matching columns to create a merged table.

EmployeesTable 

ID	First Name	Last Name	Manager
1	Bob	Smith	<i>null</i>
2	Marsha	Jones	1
3	Don	Franks	1
4	Gina	Burns	2
5	Wanda	White	4

EmployeesTable (Current) ▾

ID	First Name	Last Name	Manager
1	Bob	Smith	<i>null</i>
2	Marsha	Jones	1
3	Don	Franks	1
4	Gina	Burns	2
5	Wanda	White	4

Join Kind

Left Outer (all from first, matching from second) ▾

☐ Use fuzzy matching to perform the merge

> Fuzzy merge options

OK Cancel

Unpivot Other Columns

- Expand column with delimited values into multiple rows

	Project	State
1	Project A	FL
2	Project B	FL, TX, GA
3	Project C	TX, LA, NM
4	Project D	FL, TX, NM, GA, NC

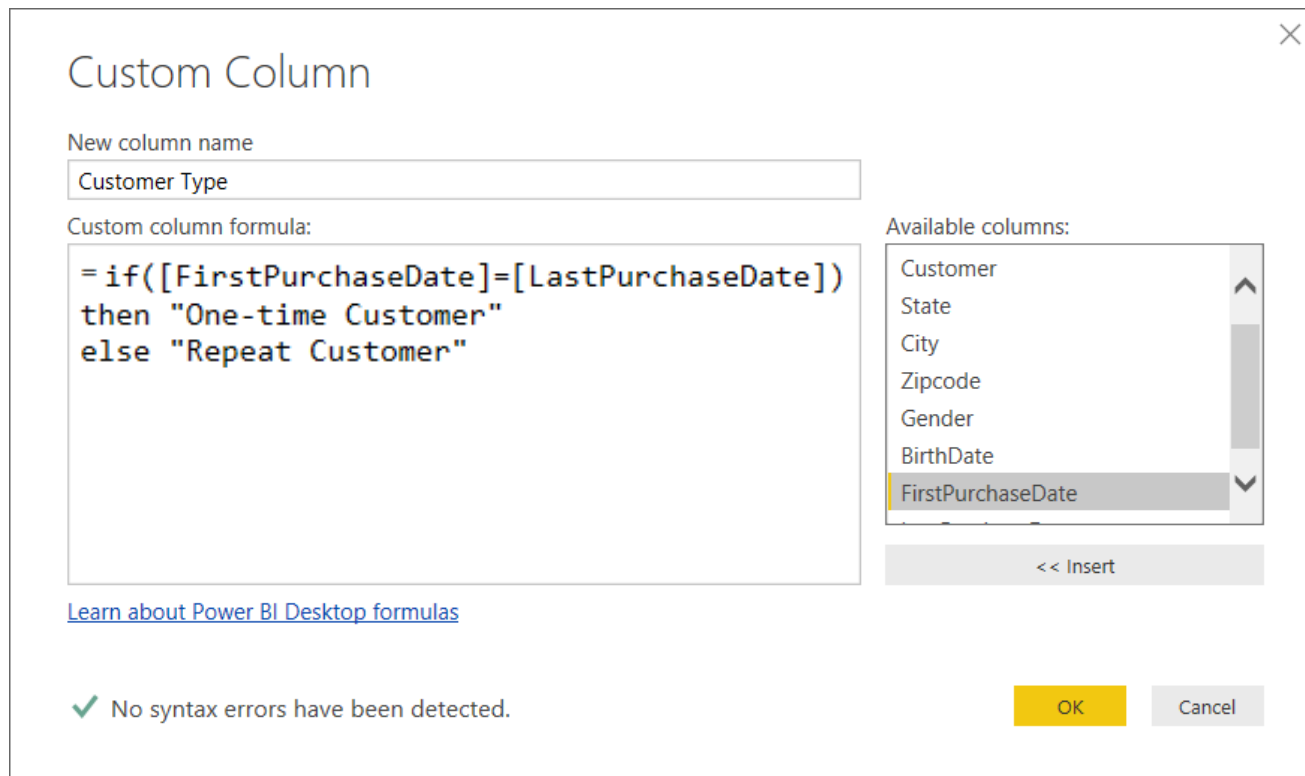


	Project	State
1	Project A	FL
2	Project B	FL
3	Project B	TX
4	Project B	GA
5	Project C	TX
6	Project C	LA
7	Project C	NM
8	Project D	FL
9	Project D	TX
10	Project D	NM
11	Project D	GA
12	Project D	NC



Custom Column Dialog

- You can write M code directly for custom column
 - The Custom Column dialog provides a simple M code editor



The screenshot shows the 'Custom Column' dialog box in Power BI Desktop. The dialog has a title bar with a close button (X). Inside, there's a section for 'New column name' with a text box containing 'Customer Type'. Below that is the 'Custom column formula:' section with a text area containing the M code: `= if([FirstPurchaseDate]=[LastPurchaseDate])
then "One-time Customer"
else "Repeat Customer"`. To the right of the formula editor is a list of 'Available columns:' including Customer, State, City, Zipcode, Gender, BirthDate, and FirstPurchaseDate (which is highlighted). Below the list is a '<< Insert' button. At the bottom left, there's a green checkmark and the text 'No syntax errors have been detected.' At the bottom right, there are 'OK' and 'Cancel' buttons. A link 'Learn about Power BI Desktop formulas' is located below the formula editor.

Custom Column

New column name
Customer Type

Custom column formula:
`= if([FirstPurchaseDate]=[LastPurchaseDate])
then "One-time Customer"
else "Repeat Customer"`

Available columns:
Customer
State
City
Zipcode
Gender
BirthDate
FirstPurchaseDate

<< Insert

[Learn about Power BI Desktop formulas](#)

✓ No syntax errors have been detected.

OK Cancel



Advanced Editor

or more correctly - The Simple Editor for Advanced Users

- Power BI Desktop based on "M" functional language
 - Query in Power BI Desktop saved as set of M statements in code
 - Query Editor generates code in M behind the scenes
 - Advanced users can view & modify query code in Advanced Editor

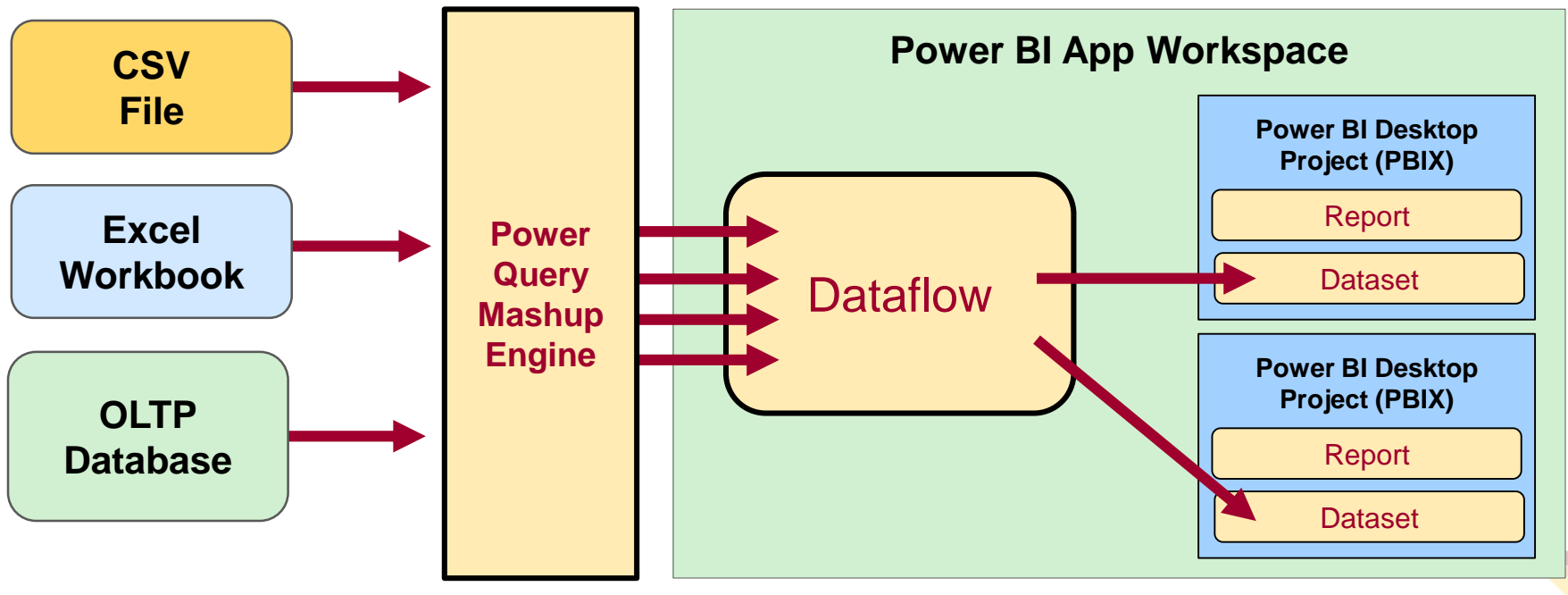
The screenshot displays the Power BI Desktop interface with the 'Advanced Editor' window open. The main window shows the 'Query Editor' for a query named 'Customers'. The 'Advanced Editor' window is titled 'Customers' and contains the following M code:

```
let
    Source = Sql.Database("cpt.database.windows.net", "WingtipSalesDB"),
    dbo_Customers = Source[Schema="dbo",Item="Customers"][Data],
    #"Removed Other Columns" = Table.SelectColumns(dbo_Customers,{"CustomerId", "FirstName", "LastName", "City", "State", "ZipCode", "Gender", "BirthDate", "FirstPurchaseDate", "LastPurchaseDate"}),
    #"Merged Columns" = Table.CombineColumns(#"Removed Other Columns",{"FirstName", "LastName"},Combiner.CombineTextByDelimiter(" ", QuoteStyle.None),{"Full Name"}),
    #"Reordered Columns" = Table.ReorderColumns(#"Merged Columns",{"CustomerId", "Customer", "State", "City", "ZipCode", "Gender", "BirthDate", "FirstPurchaseDate", "LastPurchaseDate"}),
    #"Replaced Female Values" = Table.ReplaceValue(#"Reordered Columns", "F", "Female", Replacer.ReplaceText, {"Gender"}),
    #"Replaced Male Values" = Table.ReplaceValue(#"Replaced Female Values", "M", "Male", Replacer.ReplaceText, {"Gender"}),
    #"Changed Type" = Table.TransformColumnTypes(#"Replaced Male Values",{{"BirthDate", type date}, {"FirstPurchaseDate", type date}, {"LastPurchaseDate", type date}}),
    #"Added Custom" = Table.AddColumn(#"Changed Type", "CustomerType", each if [FirstPurchaseDate] = [LastPurchaseDate] then "One-time customer" else "Repeat Customer"),
    #"Removed Columns" = Table.RemoveColumns(#"Added Custom",{"FirstPurchaseDate", "LastPurchaseDate"}),
    #"Renamed Columns" = Table.RenameColumns(#"Removed Columns",{{"CustomerType", "Customer Type"}})
in
    #"Renamed Columns"
```

The 'Advanced Editor' window also shows a status bar at the bottom indicating 'No syntax errors have been detected.' and buttons for 'Done' and 'Cancel'.

Power Query used to Build Dataflows

- Dataflows provide structured ETL processes
 - Dataflows built from external datasources
 - Datasets built from dataflows, not external data sources
 - Dataflow takes on role of data warehouse



Agenda

- ✓ Power Query Mashup Engine
- M Programming Fundamentals
 - M Function Library
 - Query Functions
 - Query Parameters



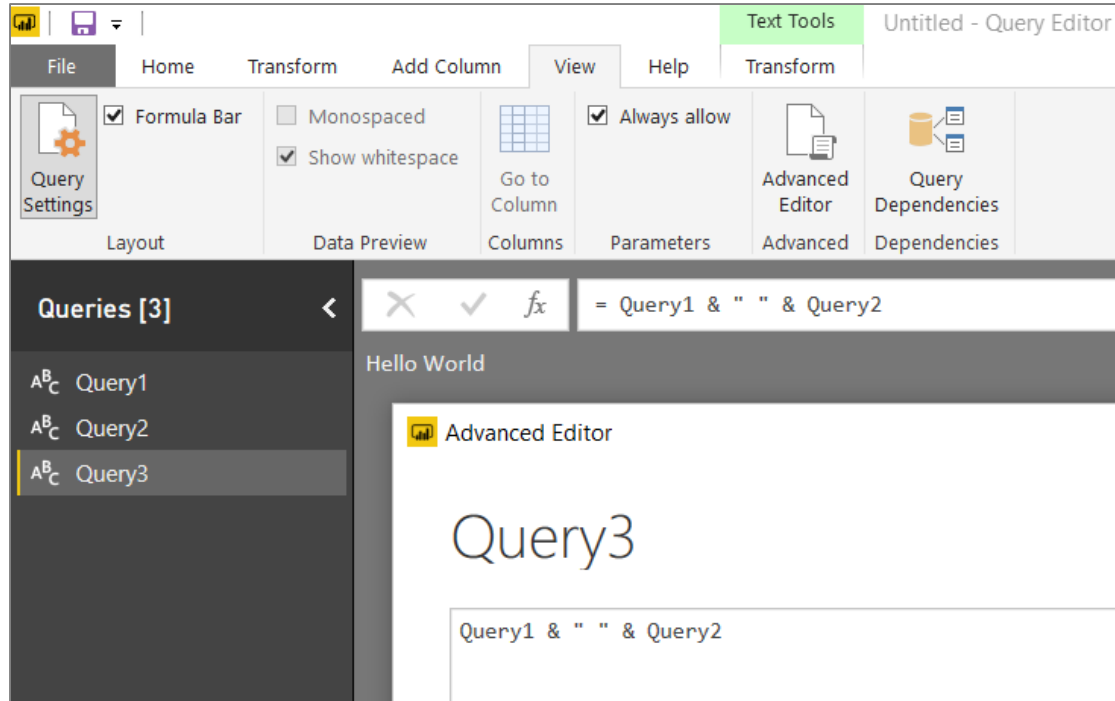
The M Programming Language

- M is a *functional* programming language
 - computation through evaluation of mathematical functions
 - Programming involves writing expressions instead of statements
 - M does not support changing-state or mutable data
 - Every query is a single expression that returns a single value
 - Every query has a return type
- Get Started with M
 - Language is case-sensitive
 - It's all about writing expressions
 - Query expressions can reference other queries by name



Referencing Other Queries

- Query can reference other queries by name
 - Every query is defined with a return type



Let Statement

- Queries usually created using **let** statement
 - Allows a single expressions to contain inner expressions
 - Each line in **let** block represents a separate expression
 - Each line in **let** block has variable which is named step
 - Each line in **let** block requires comma at end except for last line
 - Expression inside **in** block is returned as **let** statement value

The screenshot shows the 'Advanced Editor' interface. On the left, a code editor displays a 'let' statement with four lines of code, each enclosed in a red box. Red arrows point from these boxes to the 'APPLIED STEPS' panel on the right. The 'let' statement is as follows:

```
let
  var1 = "Hello",
  var2 = "World",
  var3 = var1 & " " & var2,
  var4 = Text.Upper(var3)
in
  var4
```

At the bottom of the editor, a green checkmark and the text 'No syntax errors have been detected.' are visible.

On the right, the 'PROPERTIES' panel shows the 'Name' as 'Hello World' and a link to 'All Properties'. The 'APPLIED STEPS' panel lists the variables: 'var1', 'var2', 'var3', and 'var4'. The 'var4' step is highlighted with a grey background and a yellow 'X' icon on the left.



Comments and Variable Names

- M supports using C-style comments
 - Multiline comments created using `/* */`
 - Single line comments created using `//`

```
/*  
  This is my most excellent query  
*/  
let  
  var1 = 42, // the secret of life
```

- Variable names with spaces must be enclosed in `#" "`
 - Variable names with spaces created automatically by query designer

```
let  
  var1 = "Spaces in ",  
  #"var 2" = "variable names ",  
  #"Bob's your uncle" = "are evil",  
  #"kitchen sink" = var1 & #"var 2" & #"Bob's your uncle"  
in  
  #"kitchen sink"
```

APPLIED STEPS

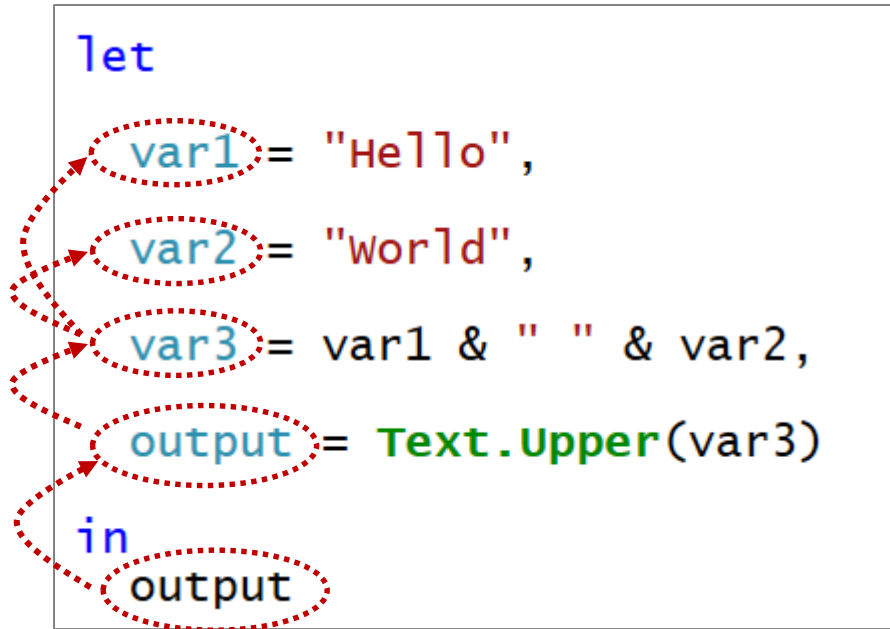
var1
var 2
Bob's your uncle

✕ Kitchen sink



Flow of Statement Evaluation

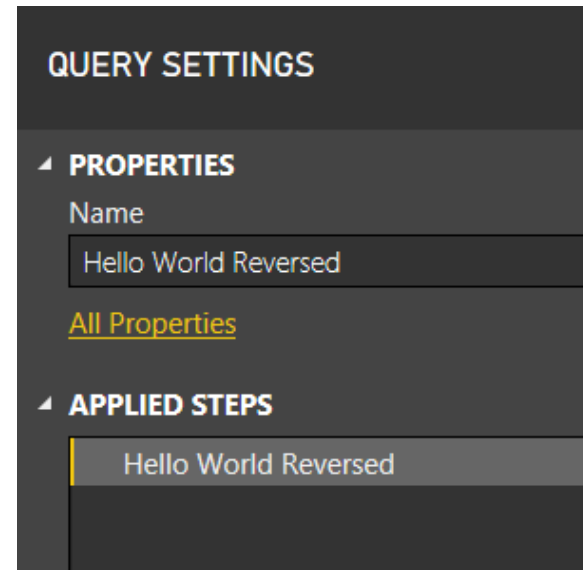
- Evaluation starts with expression inside **in** block
 - Expression evaluation triggers other expression evaluation



Will This M Code Work?

- Yes, the Mashup Engine has no problem with this
 - The order of expressions in **let** block doesn't matter
 - However, the visual designer might get confused

```
let
    var4 = Text.Upper(var3),
    var3 = var1 & " " & var2,
    var2 = "world",
    var1 = "Hello"
in
    var4
```



Query Folding

- Mashup engine pushes work back to datasource when possible
 - Column selection and row filtering
 - Joins, Group By, Aggregate Operations
- Datasource that support folding
 - Relational database
 - Tabular and multidimensional databases
 - OData Web services
- What happens when datasource doesn't support query folding?
 - All work is done locally by the mashup engine
- Things that affect whether query folding occurs
 - The way you structure your M code
 - Privacy level of datasources
 - Native query execution



Query Folding Example

- When you execute this query in Power BI Desktop...

```
let
    Source = Sql.Database("ODYSSEUS", "WingtipSalesDB"),
    CustomersTable = Source{[Item="Customers"]}[Data],

    // select rows
    FilteredRows = Table.SelectRows(CustomersTable, each ([State] = "FL")),

    // select columns
    ColumnsToKeep = {"CustomerId", "FirstName", "LastName"} ,
    RemovedOtherColumns = Table.SelectColumns(FilteredReaders, ColumnsToKeep),

    // rename columns
    ColumnRenamingMap = { {"FirstName", "First Name"}, {"LastName", "Last Name"} },
    RenamedColumns = Table.RenameColumns(RemovedOtherColumns, ColumnRenamingMap)

in
    RenamedColumns
```

- Mashup Engine executes the following SQL query

```
execute sp_executesql
N'select [__].[CustomerId] as [CustomerId],
        [__].[FirstName] as [First Name],
        [__].[LastName] as [Last Name]
from [dbo].[Customers] as [__]
where [__].[State] = 'FL' and [__].[State] is not null'
```



Native Queries

- No query folding occurs after native query

```
let
    DatabaseServer = "cpt.database.windows.net",
    DatabaseName = "WingtipSalesDB",
    SQL = "SELECT CustomerId, FirstName, LastName" &
        " FROM Customers" &
        " WHERE CustomerId <= 10" &
        " ORDER BY LastName, FirstName" ,
    Source = Sql.Database( DatabaseServer, DatabaseName , [Query=SQL] ),
    output = Source
in
    output
```



M Type System

- Built-in types

`any, none`

`null, logical, number, text, binary`

`time, data, datetime, datetimezone, duration`

- Complex types

`list, record, table, function`

- User-defined types

- You can create custom types for records and tables



M Datatypes

```
let

  // primitives
  var1 = 123,      // number
  var2 = true,     // boolean
  var3 = "hello",  // text
  var4 = null,     // null

  // creating lists
  list1 = {1, 2, 3},      // list of three numbers

  // accessing list elements
  var5 = list1{1},

  // create records
  record1 = [ FirstName="Soupy", LastName="Sales", ID=3 ],

  // accessing records
  var6 = record1[FirstName],

  // table
  table1 = #table( {"A", "B"}, { {1, 2}, {3, 4} } ),

  // creating function
  function1 = (x) => x * 2,

  // calling function
  output = function1(var1)

in
  output
```



Initializing Dates and Times

```
// time
var1 = #time(09,15,00),

// date
var2 = #date(2013,02,26),

// date and time
var3 = #datetime(2013,02,26, 09,15,00),

// date and time in specific timezone
var4 = #datetimezone(2013,02,26, 09,15,00, 09,00),

// time durection
var5 = #duration(0,1,30,0),
```



Lists

- List is a single dimension array
 - Literal list can be created using `{ }` operators
 - List elements accessed using `{ }` operator and zero-based index

```
let  
  RatPack = { "Frank", "Dean", "Sammy" } ,  
  
  FirstRat  = RatPack{0} ,  
  SecondRat = RatPack{1} ,  
  ThirdRat  = RatPack{2} ,  
  
  output = FirstRat & ", " & SecondRat & " and " & ThirdRat  
in  
  output
```

- Use `{ }?` to avoid error when index range is out-of-bounds

```
Rat4 = RatPack{4},    // error - index range out of bounds  
Rat5 = RatPack{5}? ,  // no error - Rat5 equals null
```



Text.Select

- Text.Select can be used to clean up text value
 - You create a list of characters to include

```
// take a text value with unwanted characters
input = "!!My text has some @bad things !&^",

// get upper and lower case letters
set1 = {"A".."Z"},
set2 = {"a".."z"},

// get digits 0-9 and convert to text
set3 = List.Transform({0..9}, each Number.ToText(_)),

// add any other allowed characters
set4 = {" ", "-", "_", "."},

// combine all allowed characters in single list
allowedChars = set1 & set2 & set3 & set4,

// call Text.Select to strip out unwanted characters
output = Text.Select(input, allowedChars)
```



Records

- Record contains fields for single instance of entity

```
// create records by using [] and defining fields
Person1 = [FirstName="Chris", LastName="Webb"],
Person2 = [FirstName="Reza", LastName="Rad"],
Person3 = [FirstName="Matt", LastName="Masson"],

// access field inside a record using [] operator
FirstName1 = Person1[FirstName],
LastName2 = Person2[LastName],
```

- You must often create records to call M library functions

```
// create a record to define HTTP request headers
RequestHeaders = [ Accept="application/json",
                   #"OData-MaxVersion"="4.0" ],

// create a second record which contains the first record
OptionsRecord = [ Headers=RequestHeaders ],

// pass the second record as parameter to web.Contents
Response = web.Contents(url, OptionsRecord),
```



Combination Operator (&)

- Used to combine strings, arrays and records

```
// text concatenation: "ABC"  
var1 = "A" & "BC",  
  
// list concatenation: {1, 2, 3}  
var2 = {1} & {2, 3},  
  
// record merge: [ a = 1, b = 2 ]  
var3 = [ a = 1 ] & [ b = 2 ],
```



Table.FromRecords

- Table.FromRecords can be used to create table
 - Table columns are not strongly typed

```
let
    CustomersTable = Table.FromRecords({
        [ FirstName="Matt", LastName="Masson"],
        [ FirstName="Chris", LastName="Webb"],
        [ FirstName="Reza", LastName="Rad"],
        [ FirstName="Chuck", LastName="Sterling"]
    })
in
    CustomersTable
```

	ABC 123 FirstName	ABC 123 LastName
1	Matt	Masson
2	Chris	Webb
3	Reza	Rad
4	Chuck	Sterling

ABC
123

Bad, Bad, Bad ☹️



Creating User-defined Types

- M allows you to create user-defined types
 - Here is a user-defined type for a record and a table

```
CustomerRecordType = type [FirstName = text, LastName = text],  
CustomerTableType = type table CustomerRecordType,
```

- User-defined table used to create table with strongly typed columns

```
let  
    CustomerRecordType = type [FirstName = text, LastName = text],  
    CustomerTableType = type table CustomerRecordType,  
    CustomerTable =  
        #table(CustomerTableType, {  
            { "Matt", "Masson" },  
            { "Chris", "Webb" },  
            { "Reza", "Rad" },  
            { "Chuck", "Sterilicious" }  
        })  
in  
    CustomerTable
```

	AB C FirstName	AB C LastName
1	Matt	Masson
2	Chris	Webb
3	Reza	Rad
4	Chuck	Sterilicious




Using Each with Unary Functions

- Many library functions take function as parameters
 - Function parameters are often unary (*e.g. they accept 1 parameter*)

```
FilteredRows = Table.SelectRows(CustomersTable, (row) => row[CustomerId]<=10 ),
```

- M provides **each** syntax to make code easier to read/write
 - Unary parameter passed implicitly using **_** variable

```
FilteredRows = Table.SelectRows(CustomersTable, each _[CustomerId]<=10 ),
```




- You can omit **_** variable when accessing fields inside record

```
FilteredRows = Table.SelectRows(CustomersTable, each [CustomerId]<=10 ),
```

```
AddedColumn =Table.AddColumn(FilteredRows, "Display Name", each [FirstName] & " " & [LastName])
```

- You must use **_** variable when using **each** with a list

```
MyList = { "Item 1", "Item 2", "Item 3" },  
MyUpperCaseList = List.Transform(MyList, each Text.Upper(_) )
```



Performing Calculations Across Rows

- Requires adding an index column

	Quarter	\$ Sales	1.2 Index	\$ Running Total
1	2016-Q1	124	0	124
2	2016-Q2	154	1	278
3	2016-Q3	167	2	445
4	2016-Q4	188	3	633
5	2017-Q1	150	4	783
6	2017-Q2	193	5	976
7	2017-Q3	208	6	1184
8	2017-Q4	234	7	1418

PROPERTIES

Name

Sales Running Total

[All Properties](#)

APPLIED STEPS

Source

AddedIndex

✕ AddedCustom

Custom Column

New column name

Running Total

Custom column formula:

= List.Sum(List.Range(AddedIndex[Sales], 0, [Index]+1))



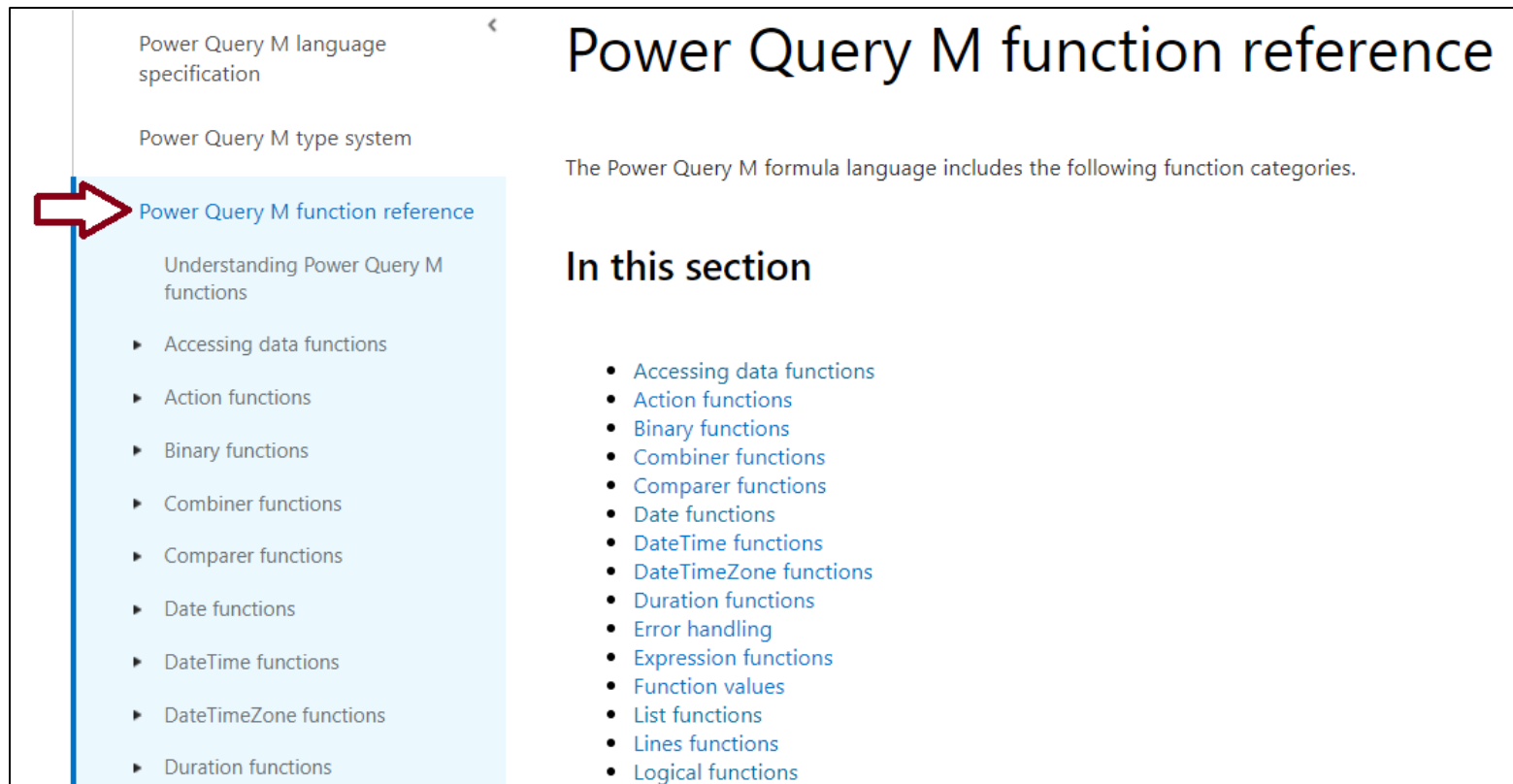
Agenda

- ✓ Power Query Mashup Engine
- ✓ M Programming Fundamentals
- M Function Library
 - Query Functions
 - Query Parameters




M Function Library

- Check out the Power Query M function reference
 - <https://msdn.microsoft.com/en-us/library/mt779182.aspx>



Power Query M language specification

Power Query M type system

 **Power Query M function reference**

Understanding Power Query M functions

- ▶ Accessing data functions
- ▶ Action functions
- ▶ Binary functions
- ▶ Combiner functions
- ▶ Comparer functions
- ▶ Date functions
- ▶ DateTime functions
- ▶ DateTimeZone functions
- ▶ Duration functions

Power Query M function reference

The Power Query M formula language includes the following function categories.

In this section

- Accessing data functions
- Action functions
- Binary functions
- Combiner functions
- Comparer functions
- Date functions
- DateTime functions
- DateTimeZone functions
- Duration functions
- Error handling
- Expression functions
- Function values
- List functions
- Lines functions
- Logical functions



Accessing Data using OData.Feed

- OData.Feed can pull data from OData web service
 - OData connector assists with navigation through entities
 - OData connector support query folding

```
let
    Source = OData.Feed("http://subliminalsystems.com/api/"),
    // get Customers table
    CustomersTable = Source[{Name="Customers",Signature="table"}][Data],
    // select columns
    ColumnsToKeep = {"CustomerId", "FirstName", "LastName", "City", "State", "Zipcode", "Gender", "BirthDate"},
    RemovedOtherColumns = Table.SelectColumns(CustomersTable, ColumnsToKeep),
    // select rows
    FilteredRows = Table.SelectRows(RemovedOtherColumns, each [CustomerId] <= 10),
    // perform other transforms
    ReplacedValue = Table.ReplaceValue(FilteredRows,"F","Female",Replacer.ReplaceText,{"Gender"}),
    ReplacedValue1 = Table.ReplaceValue(ReplacedValue,"M","Male",Replacer.ReplaceText,{"Gender"}),
    ChangedType = Table.TransformColumnTypes(ReplacedValue1,{{"BirthDate", type date}}),
    MergedColumns = Table.CombineColumns(ChangedType,{"FirstName", "LastName",
                                                    Combiner.CombineTextByDelimiter(" ", QuoteStyle.None),
                                                    "Customer"})
in
    MergedColumns
```

- OData makes extra calls to acquire metadata
 - Let's look at the execution of this query using Fiddler



Web.Contents

- Can be more efficient than OData.Feed
 - You can pass OData query string parameters (e.g. \$select)

```
let
    // create REST URI for OData source
    Source = "http://subliminalsystems.com/api/Customers?" &
        "?$select=CustomerId,FirstName,LastName,City,State,Zipcode,Gender,BirthDate" &
        "&filter=(CustomerId+1e+10)",

    // create options record for calling Web.Contents
    OptionsRecord = [Headers=[Accept="application/json;odata=nometadata",
        #"OData-MaxVersion"="4.0"]],

    // call Web.Content to make call across network
    WebContents = Web.Contents(Source, OptionsRecord),

    // deal with JSON dataset return by Web.Contents
    JsonDocument = Json.Document(WebContents),
    RecordList = Record.ToTable(JsonDocument){1}[Value],
    Table = Table.FromList(RecordList, Splitter.SplitByNothing(), null, null, ExtraValues.Error),
    ColumnsToExpand = {"CustomerId", "FirstName", "LastName", "City", "State", "Zipcode", "Gender", "BirthDate"},
    ExpandedColumns = Table.ExpandRecordColumn(Table, "Column1", ColumnsToExpand, ColumnsToExpand),
```



Agenda

- ✓ Power Query Mashup Engine
- ✓ M Programming Fundamentals
- ✓ M Function Library
- Query Functions
 - Query Parameters
 - Custom Data Connectors



Understanding Function Queries

- Query can be converted into reusable function
 - Requires editing query M code in Advanced Editor
 - Function query defined with one or more parameters

```
GetExpensesFromFile

(FilePath as text) =>

let
    Source = Csv.Document(Web.Contents(FilePath)
    #"Changed Type" = Table.TransformColumnTypes
```

- Function query can be called from other queries
- Function query can be called using Invoke Custom Function
- Function query can't be edited with visual designer



List.Generate

- **List.Generate** accepts 3 function parameters

```
MyList = List.Generate( ()=>1, (item)=>(item<=10), (item)=>(item+1) )
```

- You can use **each** syntax for 2nd and 3rd parameter

```
MyList = List.Generate( ()=>1, each _<=10, each _+1 )
```

- You can optionally split functions out into separate expressions

```
let
    StartFunction = ()=>1,
    TestFunction = each _ <= 10,
    IncrementFunction = each _ + 1,

    MyList = List.Generate( StartFunction, TestFunction, IncrementFunction)
in
    MyList
```

List	
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10



Agenda

- ✓ Power Query Mashup Engine
- ✓ M Programming Fundamentals
- ✓ M Function Library
- ✓ Query Functions
- Query Parameters
- Custom Data Connectors



Query Parameters

- What is a Query Parameter?
 - Configurable setting with project scope
 - Strongly-typed value to which you can apply restrictions
 - Can be referenced from a query
 - Selected values can be populated using list
- Where are Parameters commonly used
 - To parameterize data source connection details
 - To filter rows when importing data



Creating Query Parameters

- Parameters can be created using **Manager Parameters** menu



- Parameter properties
 - Name
 - Description
 - Required
 - Allowed Values
 - Default Value
 - Current Value

A screenshot of the 'Parameters' dialog box in Power BI Desktop. The dialog box is titled 'Parameters' and has a 'New' button. It shows a list of parameters on the left, with 'Customer State' selected. The right pane displays the properties for the 'Customer State' parameter.

Parameters

Customer State

Name
Customer State

Description
This parameter is used in the Customers query to filter the customer rows which are loaded into the dataset for the Power BI Desktop project.

☒ **Required**

Type
Text

Allowed Values
List of values

1	CA
2	OR
3	WA
4	AZ
5	TX
*	

Default Value
CA

Current Value
CA

OK **Cancel**



Referencing Parameters in a Query

- Parameters can be referenced inside query
 - Next query execution uses current parameter value

The screenshot shows a 'Filter Rows' dialog box with a close button (X) in the top right corner. It has two tabs: 'Basic' (unselected) and 'Advanced' (selected). Below the tabs, it says 'Show rows where:'. There are two columns: 'And/Or' and 'Column'. The 'And/Or' column has a dropdown menu with 'And' selected. The 'Column' column has a dropdown menu with 'State' selected. The 'Operator' column has a dropdown menu with 'equals' selected. The 'Value' column has a dropdown menu with 'Customer State' selected. There is a '...' button to the right of the 'Value' dropdown. Below the filter rules, there is an 'Add Clause' button. At the bottom right, there are 'OK' and 'Cancel' buttons.

And/Or	Column	Operator	Value
	State	equals	Customer State
And	State		ABC



Creating a Project Template File

Untitled - Power BI Desktop

File Home View Modeling Help

Paste Cut Copy Format Painter Clipboard

Get Data Recent Sources Enter Data Edit Queries Refresh External data

New Page New Visual Ask A Question Insert Text box Image Shapes

From Marketplace From File Custom visuals

Switch Theme Themes


Manage Relationships Relationships

New Measure New Column New Quick Measure Calculations

Giants Team Roster

City	Conference	Division	Roster
East Rutherford, NJ	NFC	NFC-East	

City and Team



Offensive Players

Number	Player	Position	College
2	Aldrick Rosas	Kicker	Southern Oregon
3	Geno Smith	Quarterback	West Virginia
5	Davis Webb	Quarterback	California
9	Brad Wing	Punter	LSU
10	Eli Manning	Quarterback	Mississippi
12	Tavarres King	Wide Receiver	Georgia
13	Odell Beckham Jr	Wide Receiver	LSU
15	Brandon Marshall	Wide Receiver	Central Florida
17	Dwayne Harris	Wide Receiver	East Carolina
18	Roger Lewis	Wide Receiver	Bowling Green State
19	Travis Rudolph	Wide Receiver	Florida State
22	Wayne Gallman	Running Back	Clemson
26	Orleans Darkwa	Running Back	Tulane
28	Paul Perkins	Running Back	UCLA
34	Shane Vereen	Running Back	California
43	Shane Smith	Tight End	San Jose State
51	Zak DeOssie	Long Snapper	Brown
61	Nick Becton	Offensive Tackle	Virginia Tech
63	Chad Wheeler	Offensive Tackle	USC
65	Jessamen Dunker	Offensive Tackle	Tennessee State
66	Adam Bisnowaty	Offensive Tackle	Pittsburgh
67	Justin Pugh	Guard	Syracuse
69	Brett Jones	Center	Regina (Canada)

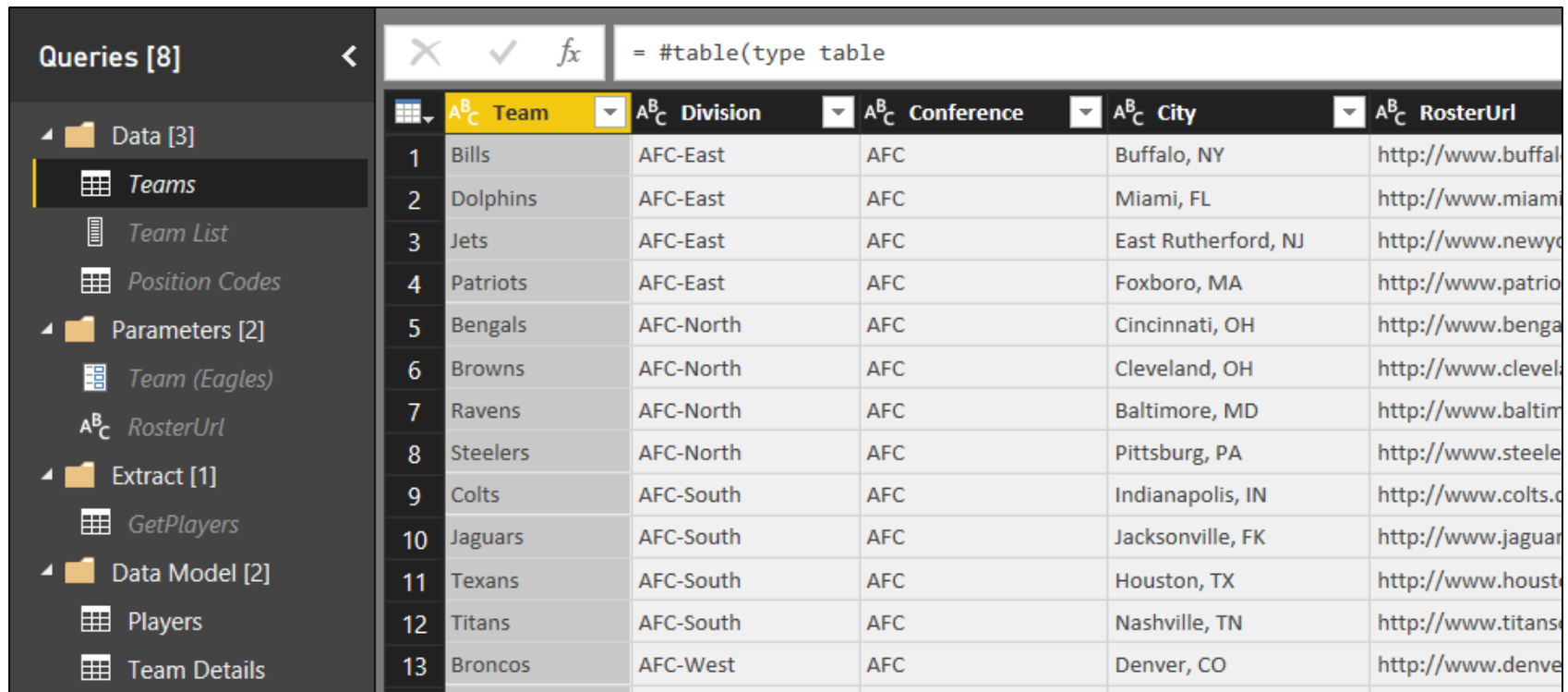
Defensive Players

Number	Player	Position
20	Janoris Jenkins	Cornerback
21	Landon Collins	Safety
23	Darryl Morris	Defensive Back
24	Eli Apple	Cornerback
25	Brandon Dixon	Cornerback
27	Darian Thompson	Safety
29	Nat Berhe	Safety
33	Andrew Adams	Safety
36	Ryan Murphy	Safety
37	Ross Cockrell	Cornerback
38	Donte Deayon	Cornerback
39	Derrick Mathews	Linebacker
41	Dominique Rodgers-Cromartie	Cornerback
44	Mark Herzlich	Linebacker
46	Calvin Munson	Linebacker
47	Kelvin Sheppard	Middle Linebacker
48	Akeem Ayers	Linebacker
52	Jonathan Casillas	Linebacker
54	Olivier Vernon	Defensive End
55	Ray-Ray Armstrong	Outside Linebacker
57	Keenan Robinson	Linebacker
58	Curtis Grant	Linebacker
59	Devon Kennard	Linebacker



The Template File Implementation

- Solution required advanced query design



The screenshot displays a data tool interface. On the left is a sidebar with a 'Queries [8]' section. Under 'Data [3]', the 'Teams' query is selected. Below it are 'Team List' and 'Position Codes'. Under 'Parameters [2]', there is a 'Team (Eagles)' parameter and a 'RosterUrl' parameter. Under 'Extract [1]', there is a 'GetPlayers' query. Under 'Data Model [2]', there are 'Players' and 'Team Details' queries. The main area shows a table with 13 rows of NFL team data. The table has columns for Team, Division, Conference, City, and RosterUrl. The formula bar at the top shows the query definition: `= #table(type table`.

	Team	Division	Conference	City	RosterUrl
1	Bills	AFC-East	AFC	Buffalo, NY	http://www.buffal
2	Dolphins	AFC-East	AFC	Miami, FL	http://www.miami
3	Jets	AFC-East	AFC	East Rutherford, NJ	http://www.newyc
4	Patriots	AFC-East	AFC	Foxboro, MA	http://www.patrio
5	Bengals	AFC-North	AFC	Cincinnati, OH	http://www.benga
6	Browns	AFC-North	AFC	Cleveland, OH	http://www.clevel
7	Ravens	AFC-North	AFC	Baltimore, MD	http://www.baltim
8	Steelers	AFC-North	AFC	Pittsburg, PA	http://www.steele
9	Colts	AFC-South	AFC	Indianapolis, IN	http://www.colts.c
10	Jaguars	AFC-South	AFC	Jacksonville, FK	http://www.jaguar
11	Texans	AFC-South	AFC	Houston, TX	http://www.houst
12	Titans	AFC-South	AFC	Nashville, TN	http://www.titans
13	Broncos	AFC-West	AFC	Denver, CO	http://www.denve





Critical Path Training

<https://www.CriticalPathTrainig.com>

- **PBI365: Power BI Certification Bootcamp – 3 Days**
 - For people who have used Power BI Desktop for 6 months or more
- **PBD365: Power BI Developer Bootcamp – 4 Days**
 - For professional developers working with the Power BI platform



Summary

- ✓ Power Query Mashup Engine
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