POWER BI CUSTOM DATA CONNECTORS: YOUR DATA DELIVERED

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ABOUT ME

- Husband and Father of 6
- Own 33 acres,~~10~~ 9 chickens & 2 beehives
- Indoor Rower
- 19 years of Relational DB experience – even DB2!!
- Learned to program on a DEC 5000 in high school with the Pittsburgh Supercomputing Center
- Data Science Wannabe!

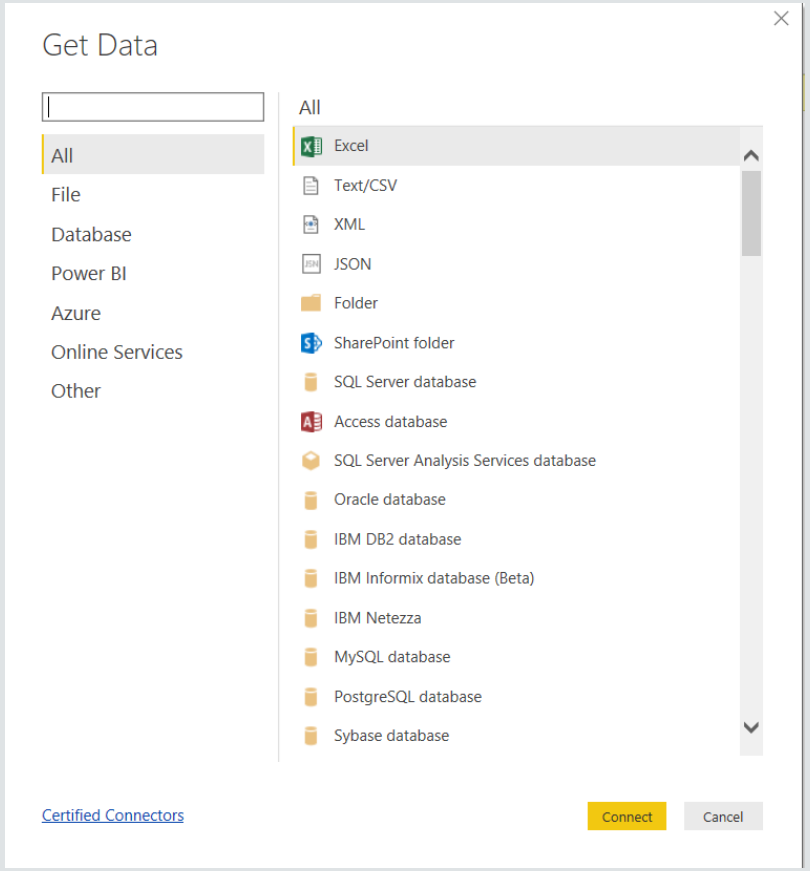
https://github.com/ryanbooz/presentations

AGENDA

- Power BI Overview
- M/Power Query Primer
- Working with Web Services in Power BI
- Data Connectors in Visual Studio

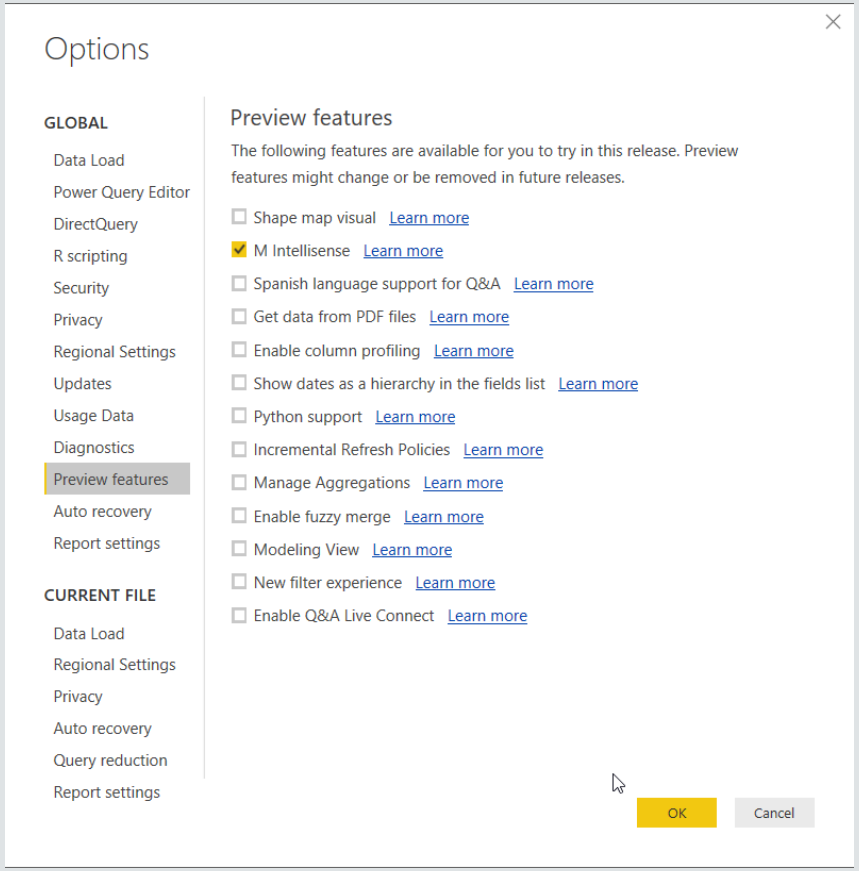
POWER BI OVERVIEW

POWER BI BASICS: GET DATA



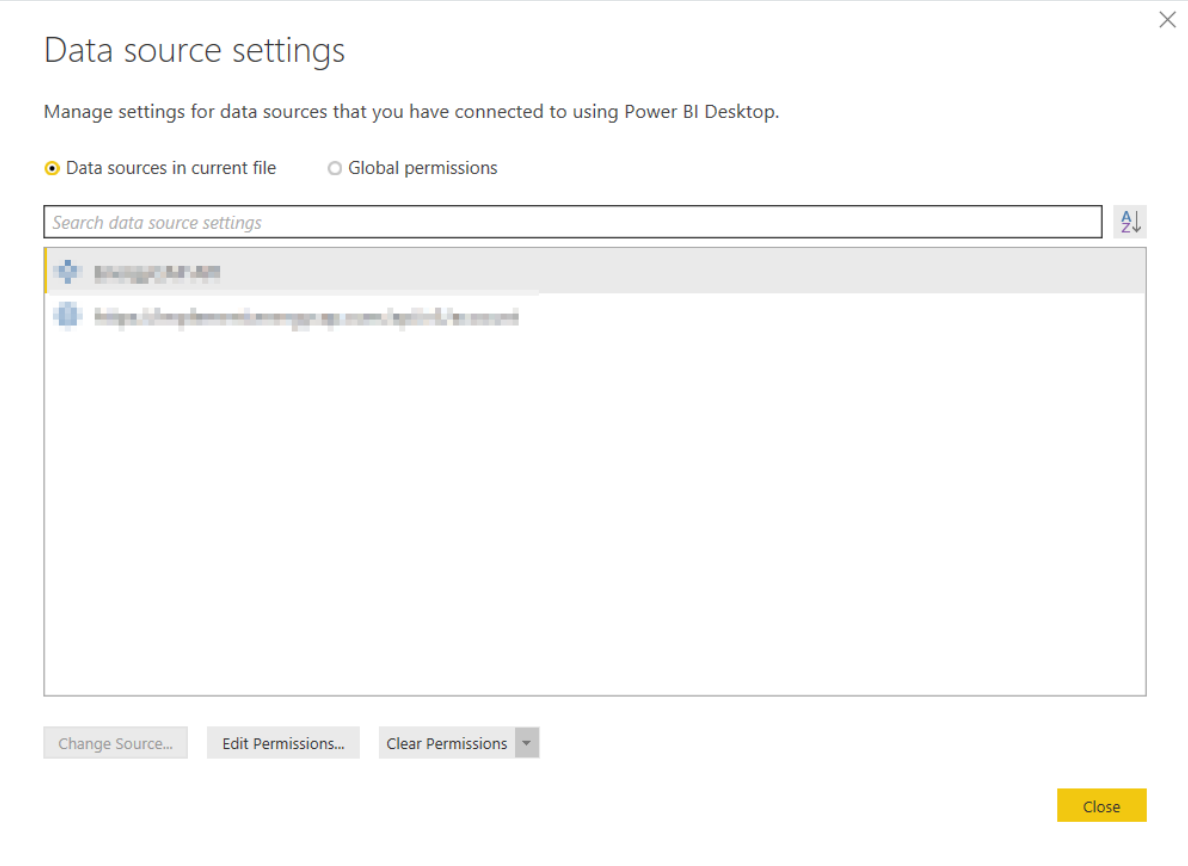
- Access data from hundreds of sources
- Built-in connectors
- Blank queries
- Custom Connectors!

POWER BI BASICS: OPTIONS



- Preview features change monthly
- Install from the Microsoft Store to get automatic updates each month
- Enable ‘M Intellisense’ if you work with the Advanced Editor

POWER BI BASICS: DATASOURCE SETTINGS



- All datasource connections are stored locally
- The name of the datasource is used to match up future requests
- Permissions can be edited or removed

M LANGUAGE OVERVIEW

M LANGUAGE

- Officially called the "M" language (previously Power Query language)
- Power Query now references just the tooling in Power BI and Excel
- Power Query writes M under the covers
- Functional language
- How is it different from DAX?
  - M gets and prepares your data for use
  - DAX creates the meaning in your data with formulas/calculations

M BASICS: QUERY DEFINITION

```
let
    Source = Web.Contents("https://example.com/data.json"),
    JsonList = Json.Document(Source),
    TableOut = Table.FromList(JsonList, Splitter.SplitByNothing())
in
    TableOut
```

M BASICS: QUERY FOLDING

```
let
    Source = Web.Contents("https://example.com/data.json"),
    JsonList = Table.FromList(Json.Document(Source),Splitter.SplitByNothing()),
    TableOut = Table.FromList(JsonList, Splitter.SplitByNothing())
in
    JsonList
```

M BASICS: TYPES

Primitive types

- Text
- Number
- Logical
- Date, DateTime, DateTimeZone, Time
- Duration
- Binary
- Null

- Many built-in functions for converting between types
  - Number.From…(), Text.From…(), Logical.From…(), DateTimeFrom…()

M BASICS: TYPES

Functions

```
let
    AddNumbers = (val1,val2) => (val1 + val2)
in
    AddNumbers


let
    Source = AddNumbers(2,4)
In
    Source
```

M BASICS: TYPES

Lists

- {1, 2, 3 }
- {“hello”, “CodeMash”, DateTime.FromText(“2019-01-11T16:00:00”) }

Records

- [Col1=“A”, Col2=“B”, Col3=True, Col4=1000]
- [#”Conference Name”=“CodeMash”, Organizer = “Brian Prince”]

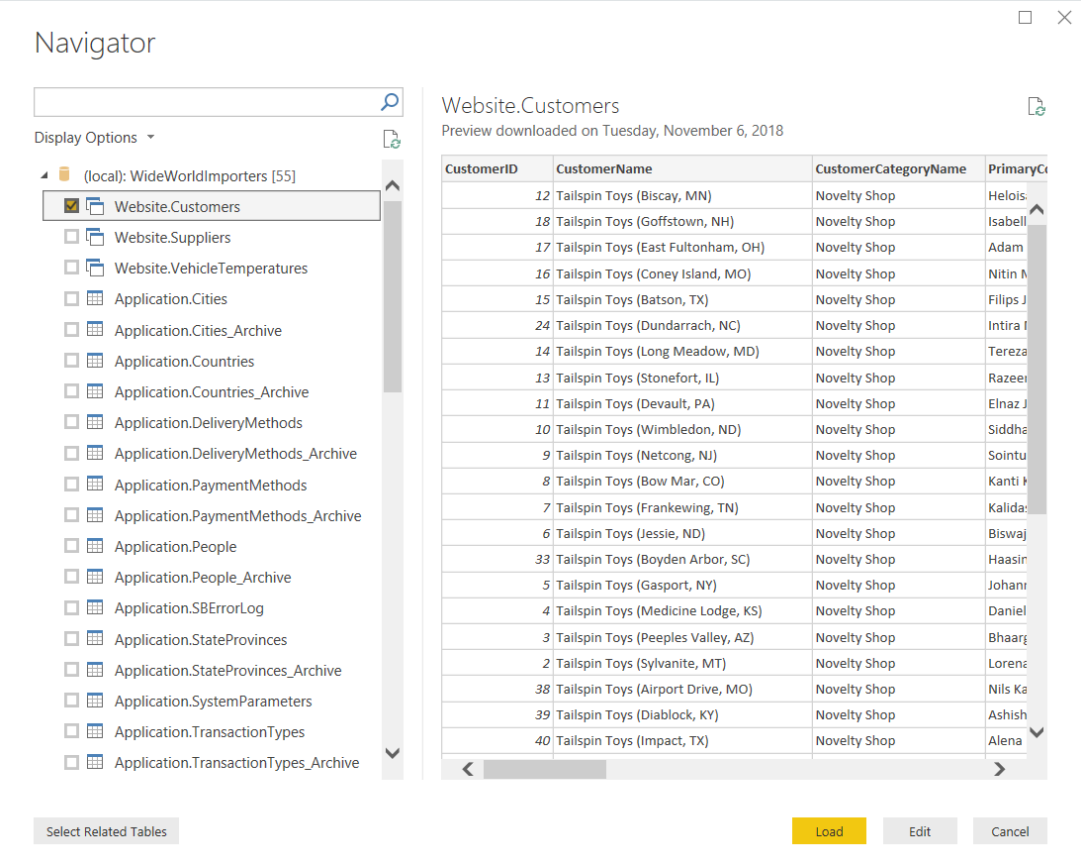
Table

- #table({“Col1”,”Col2”},
  {
  {“A”,”B”},
  {“C”,”D”}
  })

Col1	Col2
A	B
C	D

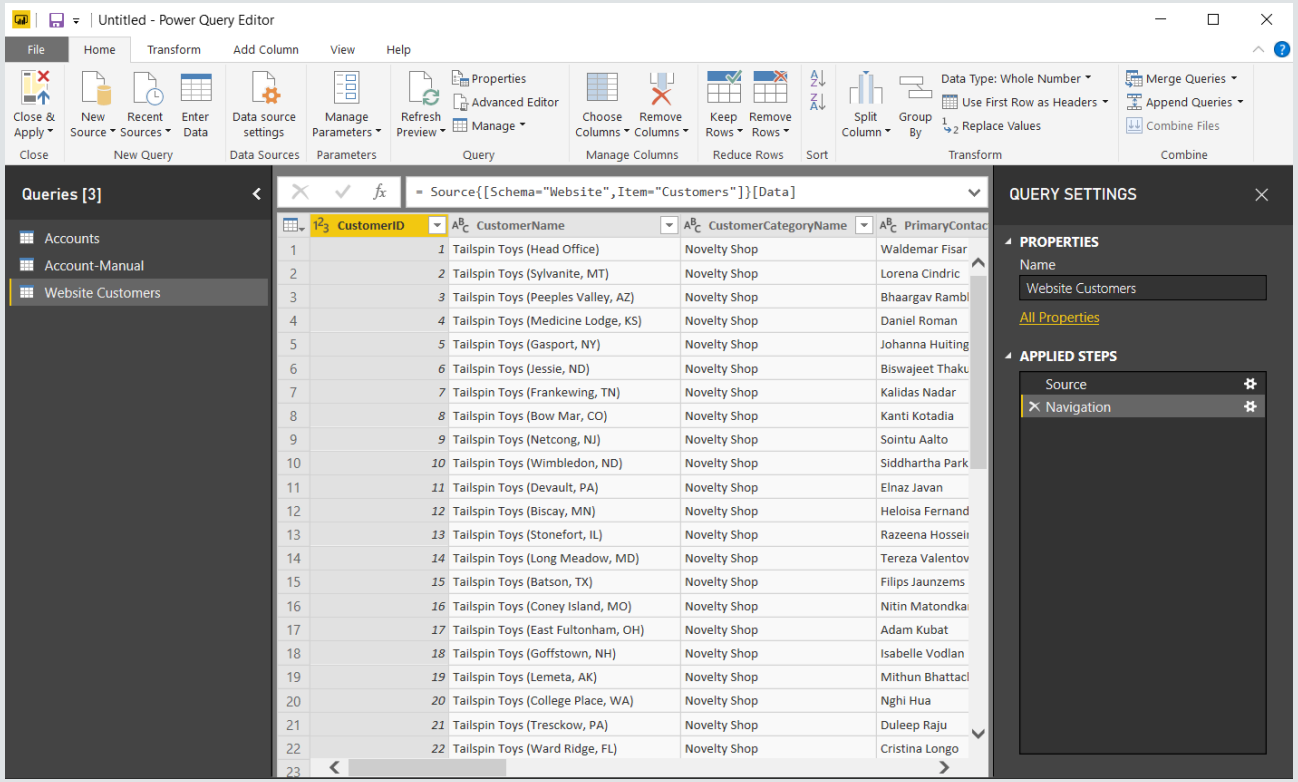
POWER QUERY OVERVIEW

POWER BI BASICS: NAVIGATION

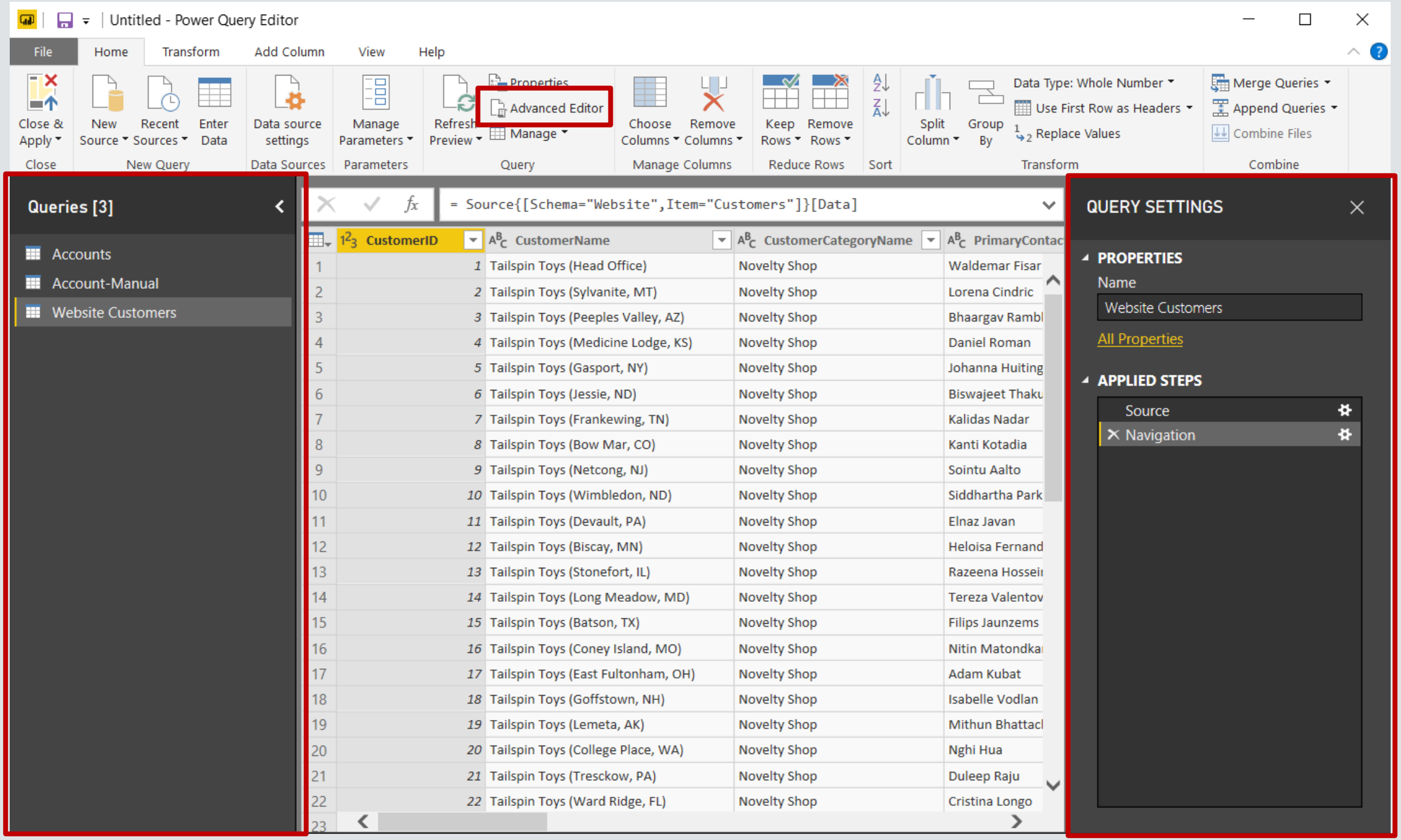


- Select data to import
- Preview data
- Filter data (in some cases)
- Each item on the left will be imported as a separate M query (usually)

POWER BI BASICS: QUERY EDITOR



- Powerful UI for invoking M functions
- Actual rendered data
- Queries
- Steps
- Advanced Editor


Untitled - Power Query Editor
File
Home
Transform
Add Column
View
Help
Close & Apply
New Source
Recent Sources
Enter Data
Data source settings
Manage Parameters
Refresh Preview
Properties
Advanced Editor
Manage
Choose Columns
Remove Columns
Keep Rows
Remove Rows
Split Column
Group By
Data Type: Whole Number
Use First Row as Headers
Replace Values
Merge Queries
Append Queries
Combine Files
Close
New Query
Data Sources
Parameters
Query
Manage Columns
Reduce Rows
Sort
Transform
Combine
Queries [3]
Accounts
Account-Manual
Website Customers
= Source{[Schema="Website",Item="Customers"]}[Data]
CustomerID
CustomerName
CustomerCategoryName
PrimaryContac
1 1 Tailspin Toys (Head Office) Novelty Shop Waldemar Fisar
2 2 Tailspin Toys (Sylvanite, MT) Novelty Shop Lorena Cindric
3 3 Tailspin Toys (Peeples Valley, AZ) Novelty Shop Bhaargav Rambl
4 4 Tailspin Toys (Medicine Lodge, KS) Novelty Shop Daniel Roman
5 5 Tailspin Toys (Gasport, NY) Novelty Shop Johanna Huiting
6 6 Tailspin Toys (Jessie, ND) Novelty Shop Biswajeet Thaku
7 7 Tailspin Toys (Frankewing, TN) Novelty Shop Kalidas Nadar
8 8 Tailspin Toys (Bow Mar, CO) Novelty Shop Kanti Kotadia
9 9 Tailspin Toys (Netcong, NJ) Novelty Shop Sointu Aalto
10 10 Tailspin Toys (Wimbledon, ND) Novelty Shop Siddhartha Park
11 11 Tailspin Toys (Devault, PA) Novelty Shop Elnaz Javan
12 12 Tailspin Toys (Biscay, MN) Novelty Shop Heloisa Fernand
13 13 Tailspin Toys (Stonefort, IL) Novelty Shop Razeena Hossei
14 14 Tailspin Toys (Long Meadow, MD) Novelty Shop Tereza Valentov
15 15 Tailspin Toys (Batson, TX) Novelty Shop Filips Jaunzems
16 16 Tailspin Toys (Coney Island, MO) Novelty Shop Nitin Matondka
17 17 Tailspin Toys (East Fultonham, OH) Novelty Shop Adam Kubat
18 18 Tailspin Toys (Goffstown, NH) Novelty Shop Isabelle Vodlan
19 19 Tailspin Toys (Lemeta, AK) Novelty Shop Mithun Bhattacl
20 20 Tailspin Toys (College Place, WA) Novelty Shop Nghi Hua
21 21 Tailspin Toys (Tresckow, PA) Novelty Shop Duleep Raju
22 22 Tailspin Toys (Ward Ridge, FL) Novelty Shop Cristina Longo
23
QUERY SETTINGS
PROPERTIES
Name
Website Customers
All Properties
APPLIED STEPS
Source
Navigation

GETTING DATA FROM WEB SERVICES

WORKING WITH WEB SERVICES

- Two functions available:
  - Web.Contents() for web services
  - Odata.Feed() for OData web services
- "Get Data" – "Web" can be used for basic requests
- Limited UI support for Headers and Query Parameters
- M is almost always required to do anything more complex
- You must determine what to do with the response
  - JSON
  - HTML
  - XML

WEB.CONTENTS()

- GET and POST requests only
- GET is the default
- POST by adding Content
  - The body of the POST must be binary encoded, eg using Text.ToBinary()
- Do NOT try to use Power BI/M to use other HTTP verbs

WEB.CONTENTS() AUTHENTICATION

- When doing GET requests, Web.Contents() supports:
  - Anonymous
  - Basic (username/password)
  - Web API (key)
  - Windows
  - Organisational Account
- Credentials are stored locally on the first request
- Remember that these can be modified in the Connections Properties dialog

WEB.CONTENTS() DEMO

CUSTOM DATA CONNECTORS

CUSTOM DATA CONNECTORS

- Power BI plugins for the "Get Data" functionality of Power Query
- Built in Visual Studio using the Power Query SDK
  - https://marketplace.visualstudio.com/items?itemName=Dakahn.PowerQuerySDK
- Written in M
- Increased functionality over "Advanced Editor" in Power BI Desktop alone
- More options for authentication, including OAuth workflows

SOURCE FILES

- .pq file – the main M source for your connector
- .query.pq file - provides a Power BI query as the entry point
- .png – icon files at different resolutions
- .resx – language resource file

MAIN SOURCE SECTIONS

- Entry Point definition provides context

  [Datasource.Kind="CodeMash", Publish="Codemash.Publish"]

- Description Record provides setup properties

  CodeMash = [ ]

- Publish Record provides UI instructions

  CodeMash.Publish = [ ]

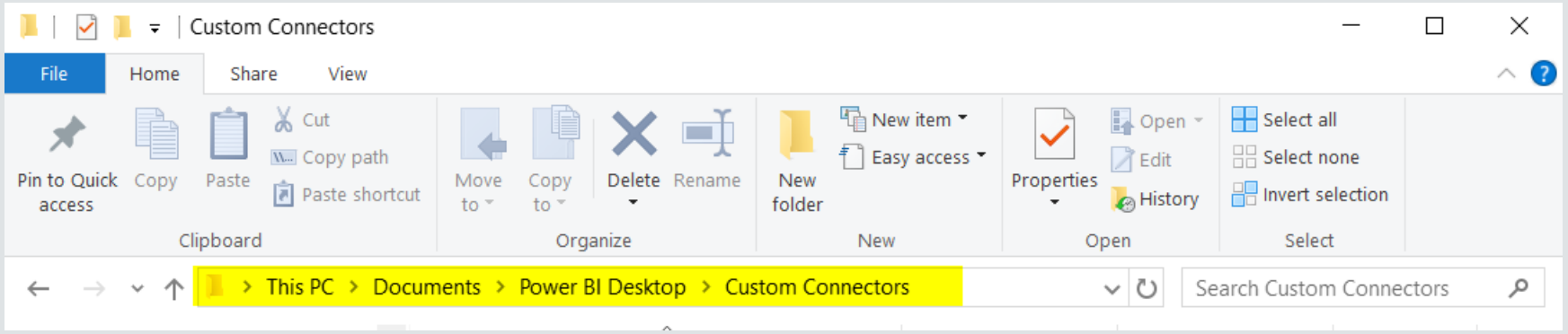
- Icons Record provides icon definitions

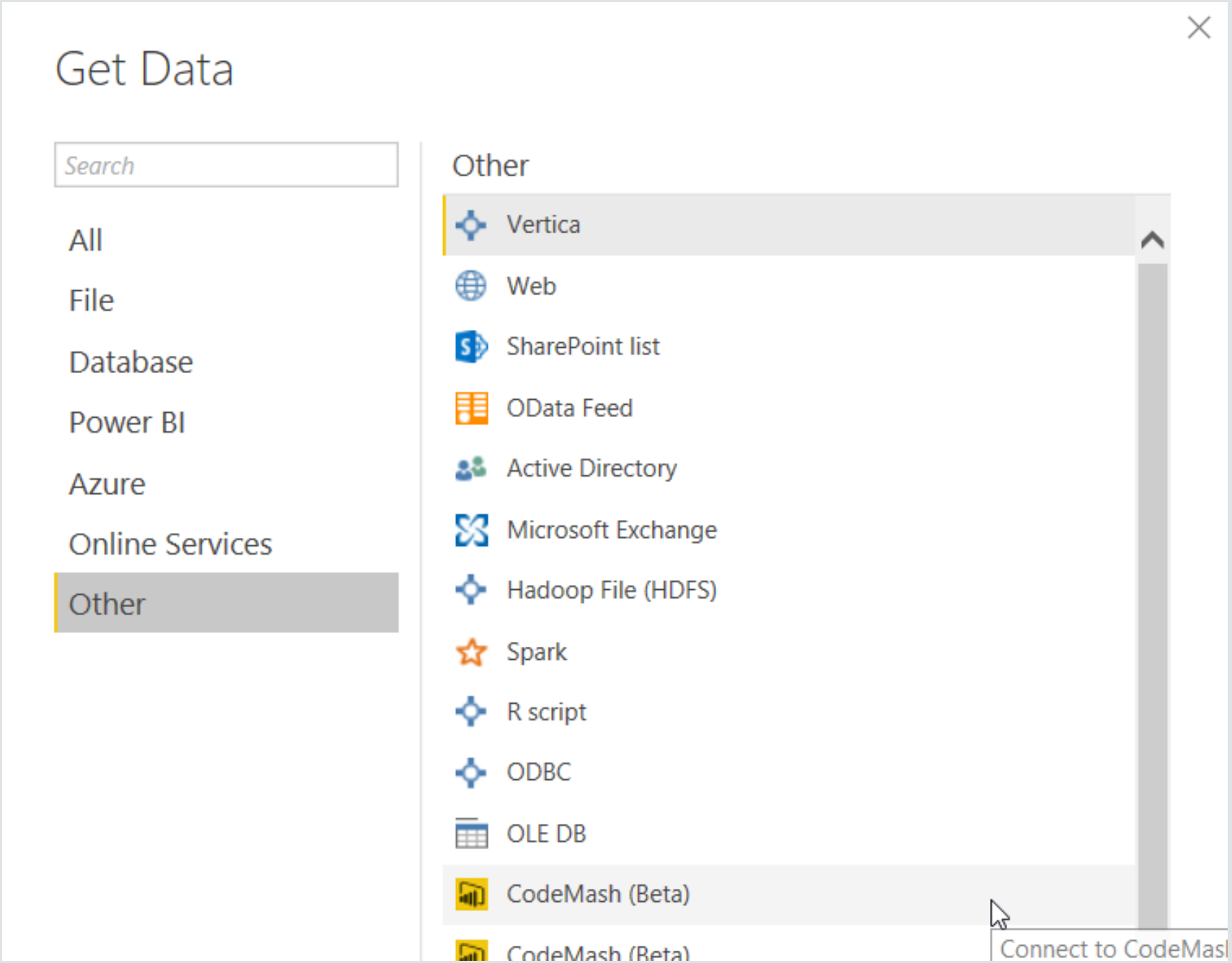
  CodeMash.Icons = [ ]

LET'S BUILD SOME CONNECTORS!

DISTRIBUTING CONNECTORS

- The build process produces a MEZ file
- Copy to "[Documents]\Power BI Desktop\Custom Connectors"
- Power BI will load any connectors from that folder
- If they are marked as BETA, users will be prompted on first use




Get Data
Search
All
File
Database
Power BI
Azure
Online Services
Other
Other
Vertica
Web
SharePoint list
OData Feed
Active Directory
Microsoft Exchange
Hadoop File (HDFS)
Spark
R script
ODBC
OLE DB
CodeMash (Beta)
CodeMash (Beta)
Connect to CodeMas

CACHED CONNECTORS

- During development you may notice a connector shows up multiple times or isn't removed from the list when the MEZ is deleted
- Sometimes the Extension cache needs to be cleaned
- Look at: "C:\Users\%user%\Microsoft\Power BI Desktop Store App\ExtensionCache"
- Close Power BI and remove any recent cache files

OPEN API DEFINITIONS

- Open API (aka Swagger) is a standard for describing REST APIs through a JSON definition
- Saves effort if you have well-formed Swagger/OpenAPI documents
- Providing Swagger JSON automatically builds the navigation table for you!
- The OpenApi.Document() function can read either:
  - A local Open API definition file stored inside the custom connector
  - An Open API definition file available on the internet

OPENAPI DEMO

OAUTH2 IMPLEMENTATION

- OAuth2 is a standard, but implementations are often slightly different
- Look at this example from the Power Query team:
  - https://github.com/Microsoft/DataConnectors/blob/master/samples/Github/github.pq
- In the connector code, you need to implement two functions:
  - StartLogin – returns the authorization URI to initiate the OAuth flow
  - FinishLogin – exchanges the authorization code for an access token
- In some cases, these may be needed as well:
  - Refresh – exchanges a refresh token for a new token
  - Logout – expires the current refresh and access tokens

ADDITIONAL RESOURCES

Microsoft Documentation

- https://docs.microsoft.com/en-us/power-query
- https://github.com/Microsoft/DataConnectors
- https://github.com/Microsoft/DataConnectors/tree/master/samples/TripPin

- Chris Webb - https://www.crossjoin.co.uk/
- Matt Masson – Microsoft, M/Power Query Product Lead
  - https://github.com/mattmasson

WHAT QUESTIONS DO YOU HAVE?

THANK YOU!

https://github.com/ryanbooz/presentations

@ryanbooz