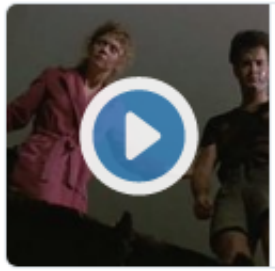
Baton Rouge User Groups
March 2018

What's New in SQL Server 2017?

SQL Server Version Velocity is Increasing

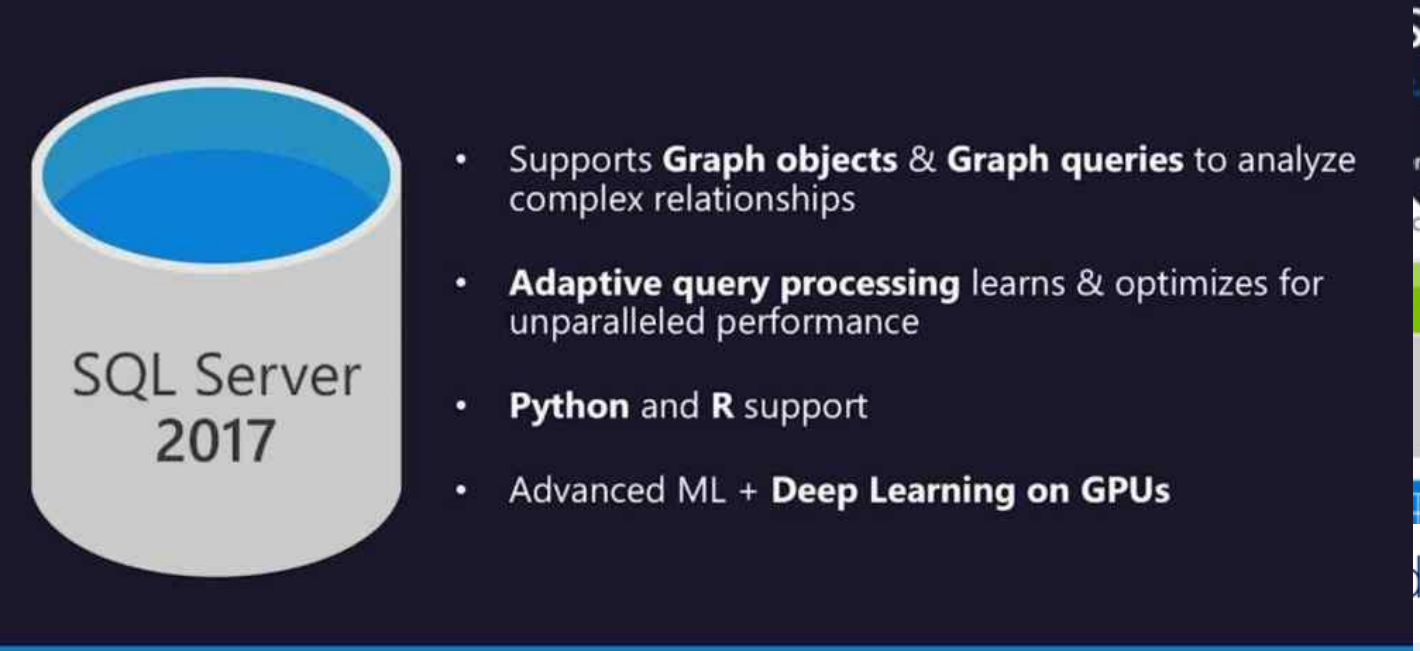
William Assaf
@william_a_dba

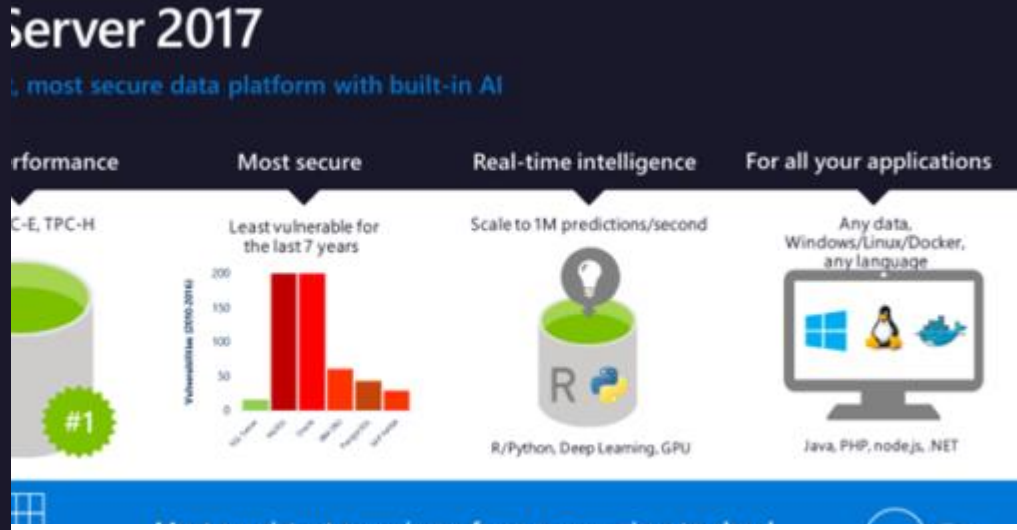
nah, it's cool that all the graphical execution plan icons changed. and they introduced new stuff in 17.3 and then renamed it a month later in 17.4.
it's cool, it's cool.
Not like screenshots have been taken and locked in. cool cool
i.imgur.com/v5ZpEIk.gifv
@BornSQL @svenaelterman



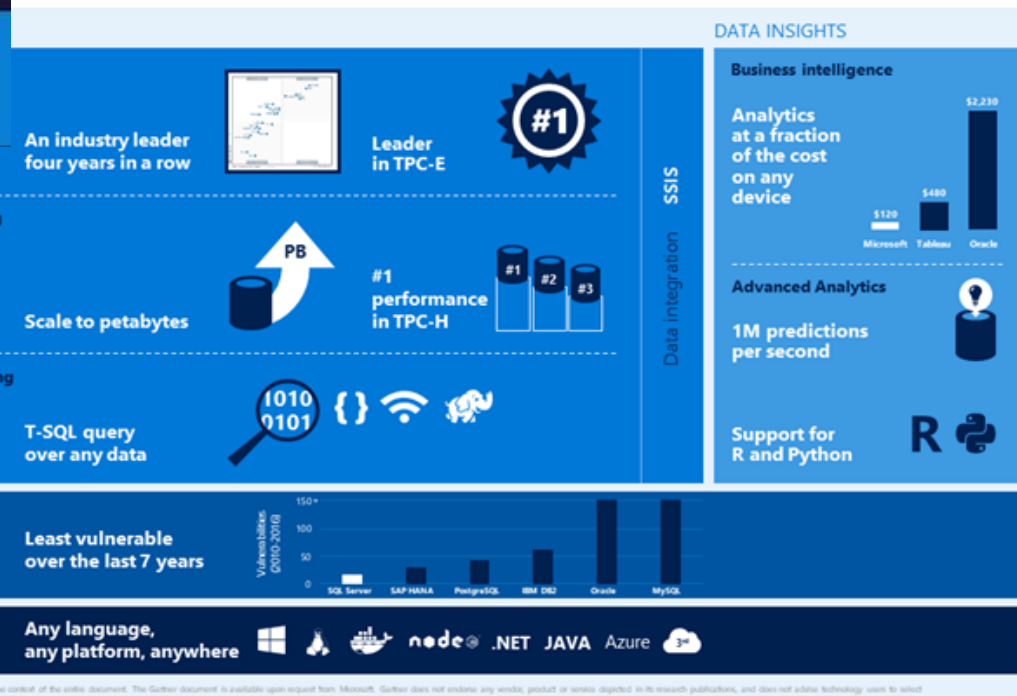
Imgur GIF
Source: The Money Pit (1986)
i.imgur.com

9:05 PM - 11 Dec 2017


SQL Server 2017
• Supports **Graph objects** & **Graph queries** to analyze complex relationships
• **Adaptive query processing** learns & optimizes for unparalleled performance
• **Python** and **R** support
• Advanced ML + **Deep Learning on GPUs**


Server 2017
most secure data platform with built-in AI
rformance
Most secure
Real-time intelligence
For all your applications
C-E, TPC-H
#1
Least vulnerable for the last 7 years
Scale to 1M predictions/second
R
R/Python, Deep Learning, GPU
Any data, Windows/Linux/Docker, any language
Java, PHP, node.js, .NET

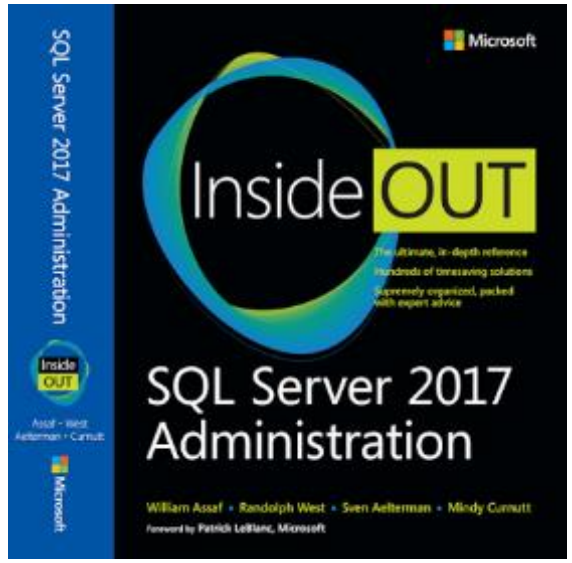

Industry-leading performance on the most secure data platform, with built-in intelligence for all your data
DATA MANAGEMENT
DATA INSIGHTS
OLTP
MOBILE
ERP
LOB
Graph
Social
IoT
Media
SECURITY
FLEXIBILITY
Powered by SQL Server 2017


data estate with SQL Server 2017
DATA INSIGHTS
An industry leader four years in a row
Leader in TPC-E
#1
Data warehousing
Scale to petabytes
PB
#1 performance in TPC-H
Big data processing
T-SQL query over any data
SSIS
Data integration
Business intelligence
Analytics at a fraction of the cost on any device
$120
$480
$2,230
Microsoft
Tableau
Oracle
Advanced Analytics
1M predictions per second
Support for R and Python
Least vulnerable over the last 7 years
SQL Server
SAP HANA
PostgreSQL
IBM DB2
Oracle
MySQL
Any language, any platform, anywhere
.NET
JAVA
Azure

Favorite New Features

http://www.sqltact.com/2017/12/our-sql-server-2017-administration.html

4. What's your favorite new feature of SQL Server 2017?



William Assaf: WSFC-less Availability Groups. So many uses, so much easier. With automatic seeding, AG's are close to point-and-click.

Randolph West: Linux support. Adaptive query processing. Linux support.

Sven Aelterman: Without a doubt, the fact that **Reporting Services** is a separate download. Everyone loves an additional installer.

Mindy Curnutt: Resumable online index rebuilds!! How many times could I have used this. I wonder if Ola's updated his scripts yet to take this into consideration?

Louis Davidson: I am into database coding/designing mostly, so **graph tables** are highest for sure. They are pretty rudimentary now, but the future is very bright in what they are adding in a future version.

SQL Server Version Velocity is Increasing

SQL 2005 RTM- Nov 7 2005

SQL 2008 RTM- Aug 7 2008 – 33 months later

SQL 2008R2 RTM- April 21 2010 – 20 months later

SQL 2012 RTM- March 6 2012 – 23 months later

SQL 2014 RTM- April 1 2014 – 25 months later

SQL 2016 RTM- June 1 2016 – 26 months later

SQL 2017 RTM- Oct 2 2017 – **16 months later**

SQL Server Version Velocity is Increasing

- No more service packs, CU's only.
  Within 2 months of release, SQL 2017 already had 3 CU's.
  Stated goal of one CU per month at least for one year
- SSMS pulled out of .iso in SQL 2016, web download now
  New releases every two months throughout 2017
- SSRS pulled out of .iso in SQL 2017, web download now

SQL Server is ready to Upgrade

- Thanks for compatibility levels inside each database, the only valid reasons to delay a SQL Server upgrade these days are vendor support
- Changes are additive – never code breaking
- Changes to execution plans in SQL 2014 were 90/10
  - Easier to upgrade straight to SQL 2017 from <2014

Summary of Changes in SQL 2017

1. Cross-operating system support in database platform, HA
2. Query Store and related uses for the data
3. Improvements to Index Maintenance and SSMS tooling
4. New Data Analytics & Machine Learning features built-in
5. Columnstore Indexes – still very awesome
6. Tour of new SSRS/SSAS/SSIS developments
7. New TSQL syntax arrivals in SQL 2017

SQL on Linux

- Red Hat Enterprise (RHEL) preferred,
  also Ubuntu, SUSE Linux Enterprise
- Almost fully-featured SQL on Linux
- Support for integrated Active Directory auth
- Linux cluster managers like Pacemaker can be used

SQL on Linux

SQL Server “mssql-server” installs on Linux, but SSMS won’t.

Options for tooling on Linux:

- Install SSMS on Windows, manage SQL on Linux remotely
- “mssql-tools” installs command-line tools Sqlcmd, bcp, drivers and more on Linux
- SQL Server Operations Studio – new cross-platform SQL management software that is, based Visual Studio Code
- Third party software

SQL in Docker

- SQL Server 2017 container images now supported in Docker
- There are images for both Windows and Linux, supported for Docker on Mac and Windows
- Quick start walkthrough:

https://docs.microsoft.com/en-us/sql/linux/quickstart-install-connect-docker

Availability Groups Possibilities

Enterprise Edition Availability Groups – (typical, since SQL 2012)

Synchronous/Async, Automatic Failover possible

Cross-OS possible using WSFC on Windows or Pacemaker on Linux

Basic Availability Groups – (Introduced in SQL 2016 Standard ed)

Replaces DB Mirroring: 2 nodes, secondary replica can't be used

Distributed Availability Groups – (Introduced in SQL 2016)

AG treats another AG as a replica (over WAN), up to 17(!) replicas

Clusterless (!!!) Availability Groups – (Introduced in SQL 2017) …

Clusterless Availability Groups

- New in SQL 2017. Does not require a WSFC! No quorum! **Hooray!**
- Cross-OS: Win+Win, Win+Linux, Linux+Linux
- No automatic failover possible, manual failover possible
  - Full-featured, including readable sync/async replicas
- Create SQL-based listener without a cluster, so Read-Only Routing still possible
- Referred to as “Read-scale availability groups” in docs

New Availability Groups Features

Required Synchronized Secondary Replicas to Commit option:
If you have multiple synchronous Secondary nodes, you can configure the AG to require the Primary node to synchronize with fewer than all of them. **This is a transactional safety option, not for performance!**

0 – Behavior we're used to. A synchronous secondary replica that stops responding does not stop the Primary from committing. If all synchronous replicas drop, Primary is OK (though T-Log grows.)

1+ - At least as many secondary replicas as the value of the setting must be SYNCHRONIZED, or transactions on the primary replica will not be allowed to commit!

Availability Groups Features

Automatic Seeding (first introduced in SQL 2016) has more improvements, including speed and stability:

- Now file paths on each replica don't need to match (but they should!)
- Automatic seeding is fast, easy way to stream data from primary to secondary replicas, without a backup/restore or a network share.
- It performs a backup using the Mirroring endpoint as a virtual backup device, and can compress the data transfer to reduce network usage.

Availability Groups Features

Distributed transaction support:

- SQL 2016 introduced support for distributed transactions using DTC for databases **on different instances**.
- SQL 2017 allows for cross-database transactions using DTC for databases **on the same or different instances**.
  - SQL 2017 now uses DTC even when databases in an availability group in the same instance of SQL Server
  - New syntax needed to support setup of the Availability Group: DTC_SUPPORT = PER_DB

Availability Groups Features

Just a reminder, since SQL 2016:

The SSIS database (SSISDB) can be part of an Availability Group for DR and HA

The SSRS databases can be part of an Availability Group but do not support automatic failover to the listener, even with MultiSubnetFailover specified, so manual failover is required.

Thanks, Azure SQL DB!

Some features that were developed cloud first for Azure SQL Database (PaaS) now available to SQL Server:

- Query Store
- Automatic Plan Correction

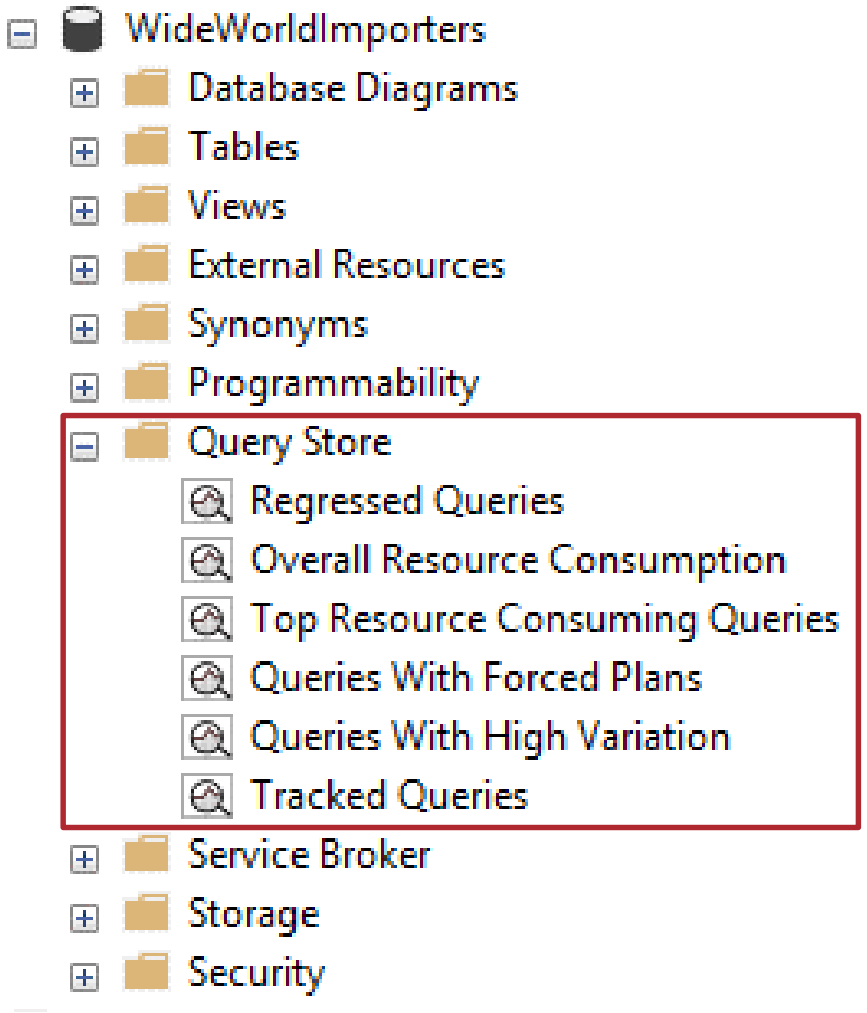
Query Store

- New in SQL 2016, even better in SQL 2017.

- Starting with SQL 2017, tracks Wait Stats too
- Tracks the performance of queries – not of execution plans – a distinct difference.
- Can detect when a query has suffered a degradation in performance because its query plan has changed.

Query Store

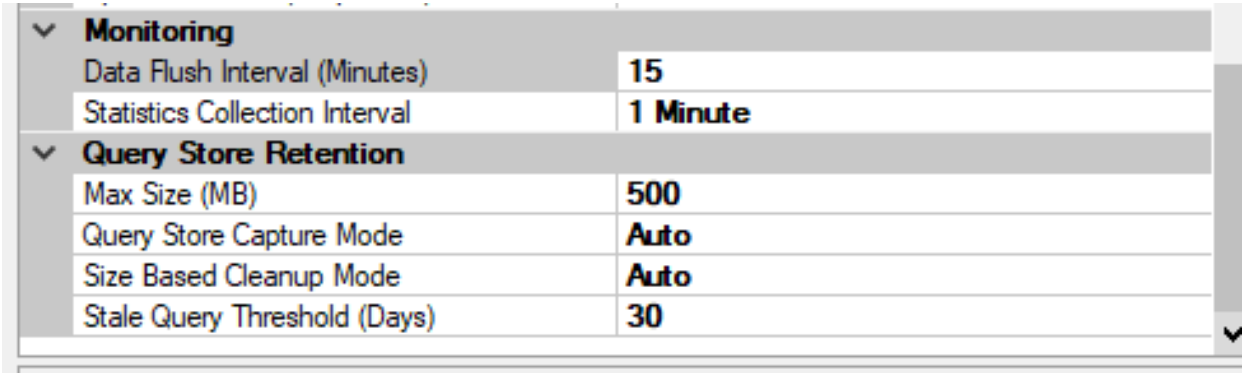
- Built-in reports make analysis easy
- For SQL Server databases, this isn't enabled by default. Go enable it in each database SQL 2016+.
- Minimal overhead – collected data is stored asynchronously, flushed to disk periodically



Query Store

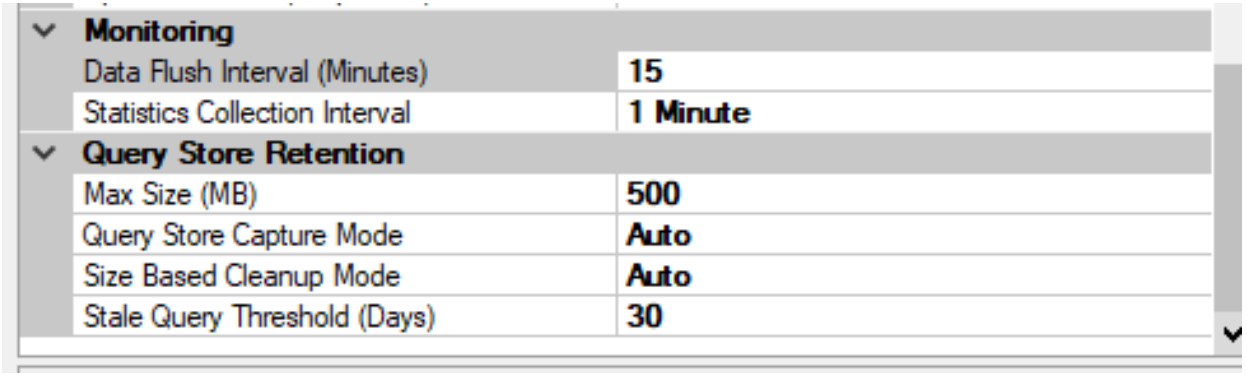
- Easily identify the worst-performing **queries**
- "worst **plans** in cache" is a common strategy to identify the most expensive plans and start there
- The Query Store is one step better – finding the recent "worst **queries**" regardless of plan, with sortable/aggregable metrics to start tuning

Query Store



- **Data Flush Interval**
  - In-memory Data that could be lost in the event of a system crash or sudden power loss. Default 15 minutes
- **Statistics Collection Interval**
  - Grain of the data collection. Default of 1 hour.
  - Defines the automatically generated time windows and stores aggregated statistics on that interval
- **Max Size (MB)**
  - Actual space on disk inside the user database. Default 100 MB probably isn't enough to track busy history.

Query Store



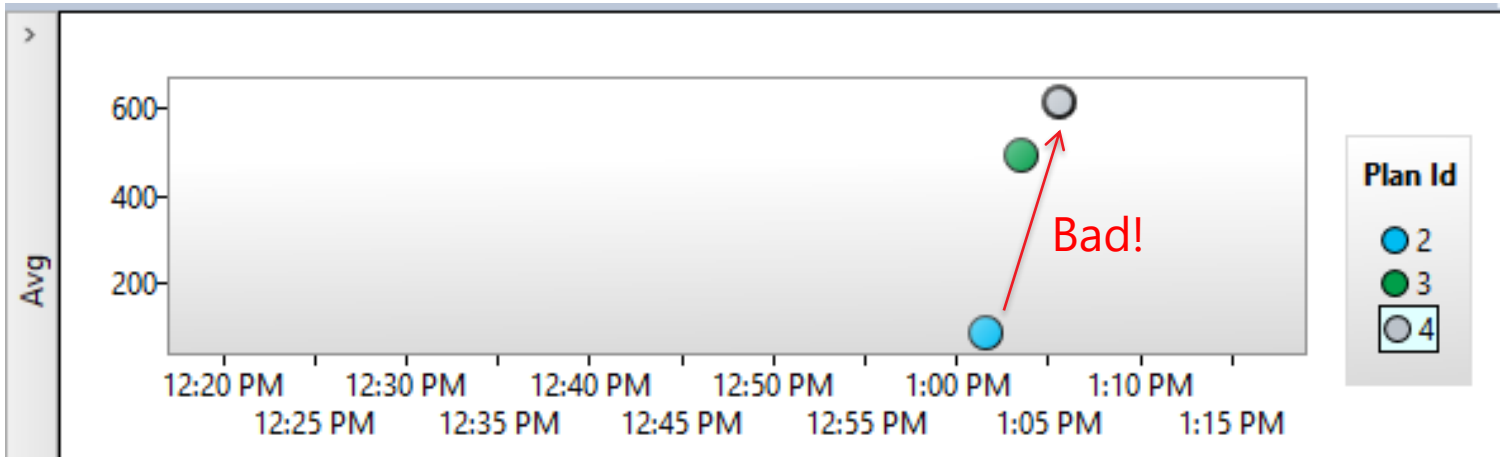
- By default Query Store automatically cleans up, removing the least expensive and oldest queries first as the query data size approaches the Max Size (MB) value.

- You can also manually clear the Query Store data (for testing only) with the command:

```
ALTER DATABASE [WideWorldImporters] SET QUERY_STORE CLEAR
```

Query Store

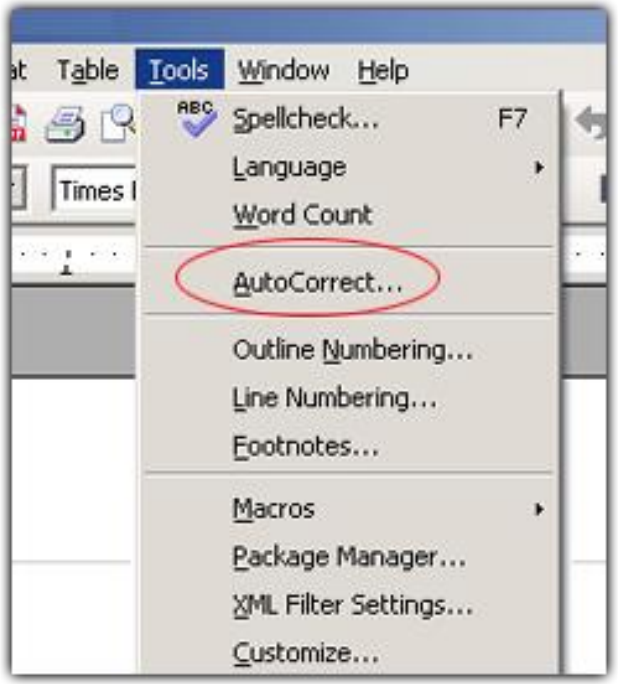
- Regressed Queries highlights query execution over time



There are a lot of reasons queries could regress:

- Dropping indexes (results in a new plan) is one of the easiest to manually reproduce
- Plans could be flushed from cache, regenerated differently
- Other reasons: parameter sniffing, changing or outdated statistics, changing compatibility levels especially +-12.0 (2014).

Query Store – Next Logical Step?



- What if SQL Server could use information about Regressed Queries and a history of execution plans to decisions to automatically use a better execution plan?

- **Now it can!**
  Automatic Plan Correction (new to SQL 2017)!

- Again, Azure SQL Database *already does this for you!*

Automatic Plan Correction

- Available in Azure SQL and now in SQL 2017 to revert a query
  from a newer, slower plan
  to an older, faster plan.

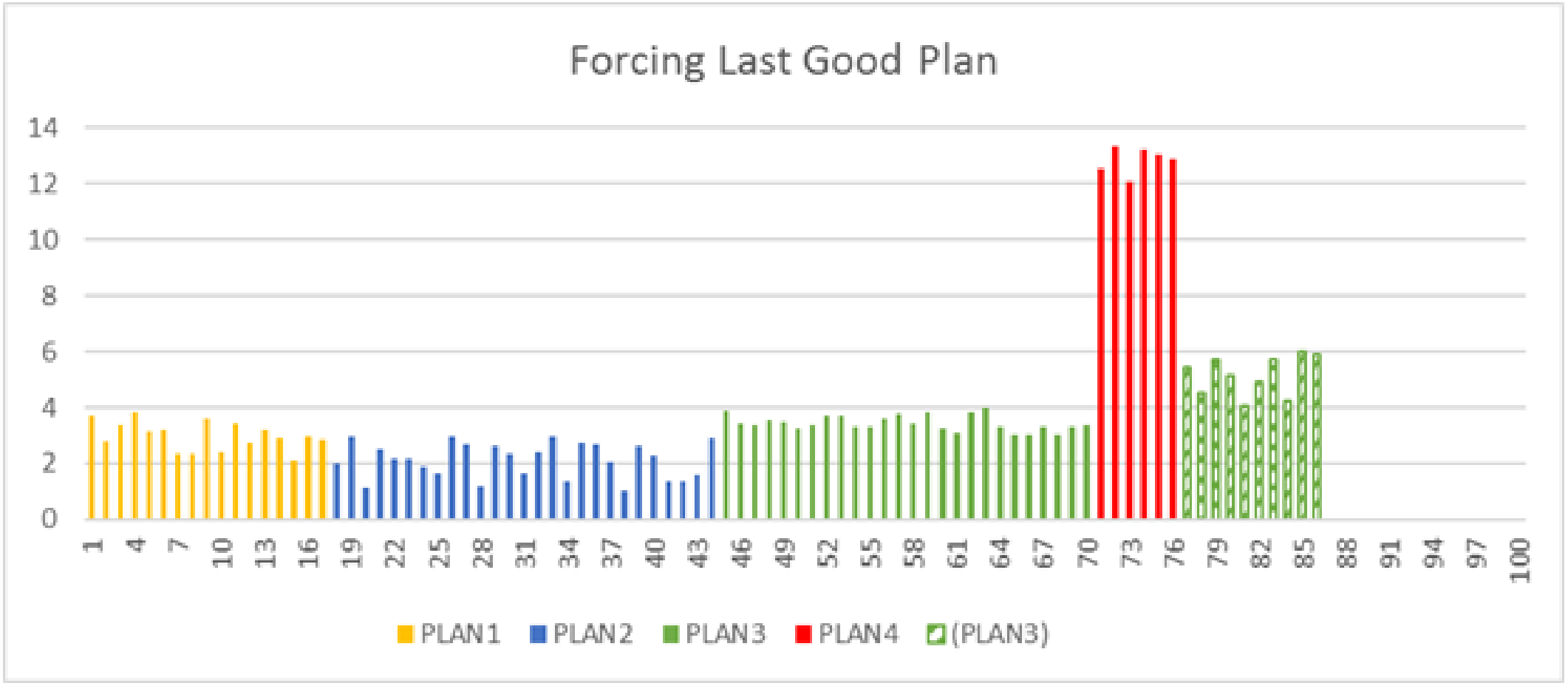
- No DBA intervention needed.

Automatic Plan Correction

- DBA's can also accomplish this manually
- Query a host of DMV's including sys.dm_db_tuning_recommendations

- Sample query: https://docs.microsoft.com/en-us/sql/relational-databases/automatic-tuning/automatic-tuning

Automatic Plan Correction



https://docs.microsoft.com/en-us/sql/relational-databases/automatic-tuning/automatic-tuning#automatic-plan-correction

Automatic Plan Correction

- Not on by default, you must enable
- Once you turn-on this option, Database Engine will automatically **force** any recommendation where the estimated CPU gain is higher than 10 seconds.

```
ALTER DATABASE WideWorldImporters
SET AUTOMATIC_TUNING ( FORCE_LAST_GOOD_PLAN = ON );
```

RESUMABLE Index Maintenance

Introduced in SQL Server 2017, this makes it possible to pause an index operation and resume it later, even after a server shutdown.

Got an index that takes so long to update, you don't have a maintenance window long enough?
You can make partial progress towards index maintenance each night until the work is done.

RESUMABLE Index Maintenance

PAUSE an index maintenance operation instead of killing it, which causes a potentially lengthy rollback.

This rollback can be disruptive, even for an ONLINE=ON index rebuild operation.

You can even use the MAX_DURATION syntax to automatically pause after a specified amount of time.

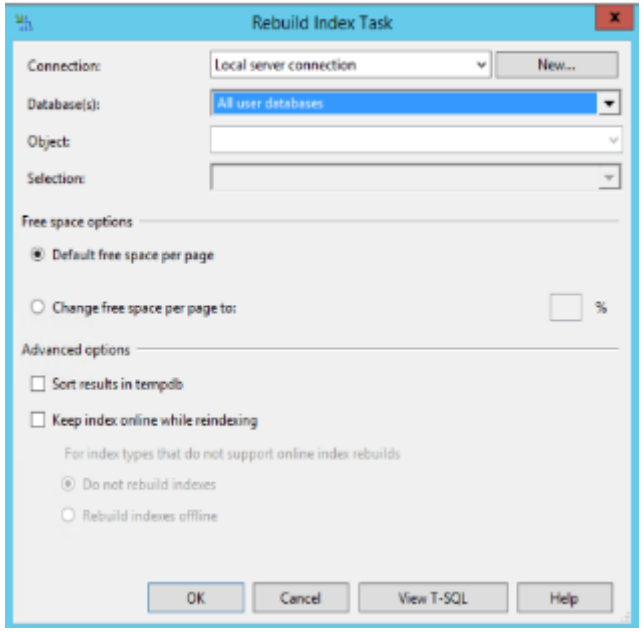
On the Topic of Index Maintenance

Used to having to write your own index maintenance scripts because of ham-handed Maintenance Plans?

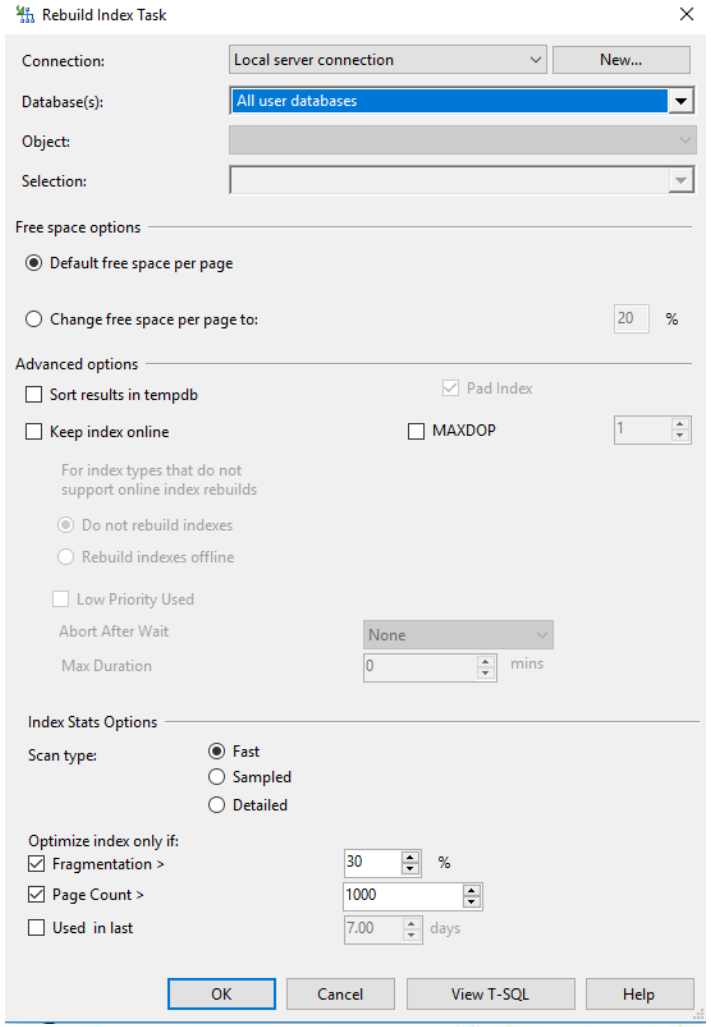
Check again! Maintenance Plans since SQL 2016 have dramatically increased in capability to perform **complex, conditional index maintenance operations.**

You can configure the REORGANIZE and REBUILD tasks to maintain only indexes filtered by percentage of fragmentation level or page count.

SQL 2014 (left) vs SQL 2017 (right)



Rebuild Index Task



On the Topic of Maintenance

Quick aside on Integrity Checks

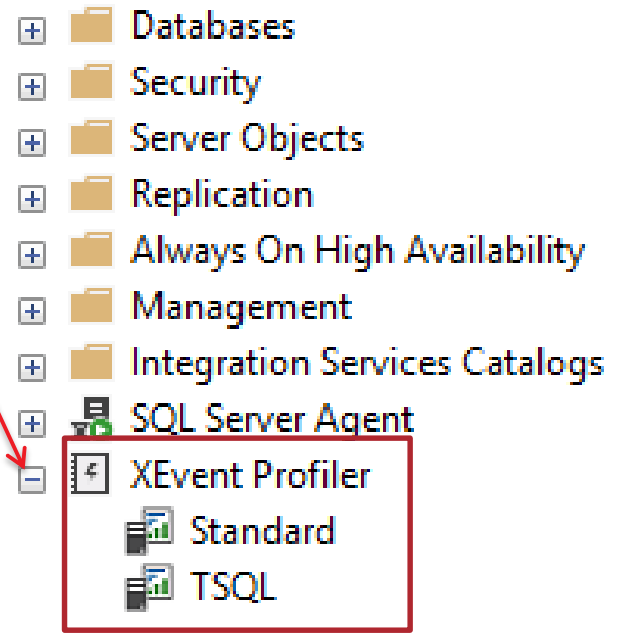
Starting with SQL 2016, you can specify

DBCC CHECKDB (MAXDOP =1)

Increasing duration, but potentially reducing CPU overhead and flexibility for maintenance.

New Feature in SSMS (17.3+)

- New easy-to-use **Extended Events** sessions
  Works all the way down to SQL 2008 R2
- Pre-made XEvent sessions geared to appear familiar to the TSQL traces provided by Profiler



- **Ditch Profiler and Trace: XEvents are better!**
- Superior filtering, sorting, all inside SSMS
- Superior performance – asynchronous means little overhead
- Capture to a variety of outputs including an in-memory Ring Buffer or a Histogram to count incidents of events

SQL Server Tooling

- **SSMS** pulled out of .iso in SQL 2016, web download now
  - New releases every two months throughout 2017
- **SSDT** still tied to Visual Studio release cycle. SSDT for VS2017 released April 2017.
- SQL Server Operations Studio (**SSOS**) is in preview
  - runs on Windows, macOS, and Linux
  - Free, lightweight, based on Visual Studio Code
  - Not on par with SSMS (yet?)

Data Analytics and Artificial Intelligence

All in the same installer as SQL Server, included in the license

Two main features/installables:

PolyBase Query Service

+

Machine Learning Services

PolyBase Query Service For External Data

The PolyBase Query Engine makes it possible to query **Hadoop nonrelational data** or **Azure Blob Storage files** using T-SQL

Supports various legacy versions of the Hortonworks Data Platform with a configurable Hadoop Connectivity option.

Machine Learning Services

2016- “R Services” supported R
2017- “Machine Learning Services” supports R and Python

You can install R and Python independently or together, depending on your requirements.

What’s more, you can install these ML services directly in the Database Engine (in-database as a service called LaunchPad) or as standalone components without a SQL Server.

Machine Learning Services

Data scientists can take advantage of this feature to build advanced analytics, data forecasting, and algorithms for machine learning.

SQL Server 2017 installs version 9 of the Microsoft R Open Server, supported for both Windows and Linux, and yes, it requires installing the Oracle JRE 7+ on your Windows server. (ew!)

Graph Tables

New to SQL 2017

Graph data is often associated with networks, such as social networks.
Graphs data structures consist of *nodes* and *edges*.
Nodes are also referred to as *vertices*, and edges as *relationships*.

- Interconnected, many-to-many relationships
- Hierarchical data can be served with a special *hierarchyid* data type

Solution is limited currently, and not as fully featured compared to dedicated graph table solutions.

State of the Columnstore

Columnstore indexes aren't new, have been around since SQL 2012.

Not a B-tree; highly compressed column data (disk and memory).

You can create "nonclustered" or "clustered" Columnstore indexes, though these are in name only. Again, underlying structure is different, but Columnstore indexes can serve the roles of either.

Can only have one Columnstore index per table, and can mix rowstore nonclustered indexes with Columnstore indexes of any type.

State of the Columnstore

- Writeable as of SQL 2016. Prior, a CS index was read-only.
  - This finally unleashed the indexes for use in OLTP.
- Starting with SQL 2016, you can add a Columnstore index to in-memory tables for “real-time analytics”.
- With SQL Server 2016 SP1, Columnstore indexes are available **below Enterprise edition** with memory limits.
- Starting with SQL 2016, you can now filter the Columnstore index just like a nonclustered index.

State of the Columnstore

- Starting with SQL 2017, Columnstore indexes are the only objects for which SQL can use **Batch Mode execution.**
  - Available in Compatibility Level 14.0 (SQL 2017) only.
  - You'll see "Batch" (instead of the default "Row") in the Actual Execution Mode of an execution plan operator
- **Batch mode** memory grants and adaptive joins are part of new **Adaptive Query Processing** in SQL 2017. https://docs.microsoft.com/en-us/sql/relational-databases/performance/adaptive-query-processing

SQL Server Features

Let's talk about new stuff in

1. SSIS
2. SSRS
3. SSAS

SSIS

- Yep, runs on SQL on Linux.
- New Azure Feature Pack for SSIS released August 2017
  - Downloads for each SQL version since 2012
  - Includes Control and Data Flow components including for **Azure Storage blobs**, Resource Manager, HDInsight, and Data Lake
- New Master/Worker SSIS scale-out.
  - Details: https://docs.microsoft.com/en-us/sql/integration-services/azure-feature-pack-for-integration-services-ssis

SSIS ScaleOut

- New Master/Worker SSIS scale-out
- Execute packages in **parallel** on multiple instances
- One SSIS "Master" instance to rule them all
- Masters/Workers communicate via certificate-encrypted endpoints
- Each instance runs the same package
- More details: https://docs.microsoft.com/en-us/sql/integration-services/scale-out/integration-services-ssis-scale-out

Azure SSIS Lift-and-Shift (coming soon!)

- In public preview Q4'17, should be released soon
- Seamlessly upload your on-prem SSIS packages to an Azure SSIS service
- Packages upgraded to SQL 2017 upon upload

- Complete, cloud-based enterprise ETL

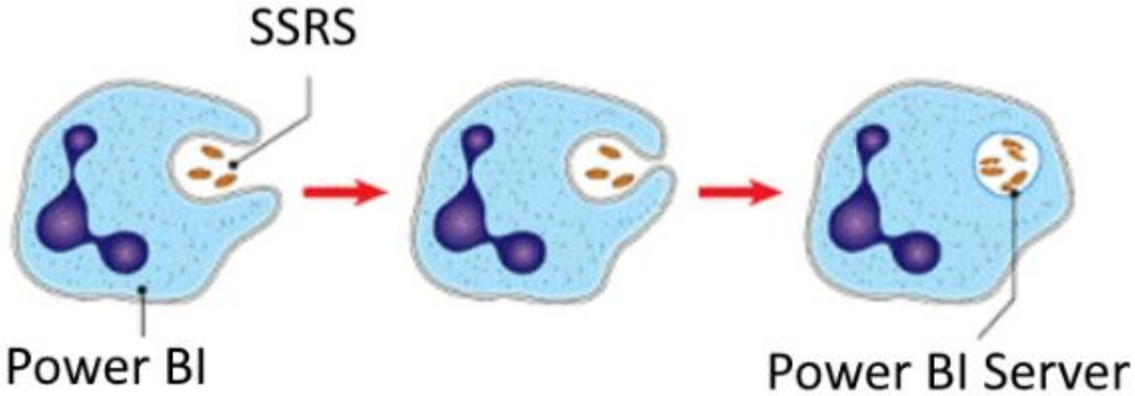
Azure SSIS Lift-and-Shift (coming soon!)

- With few code changes, run SSIS packages in Azure Integrated Runtime (IR) instead of a SQL instance.
- More info: https://docs.microsoft.com/en-us/azure/data-factory/tutorial-deploy-ssis-packages-azure

- Side note: Data Factory v1 was just really terrible, replaced by v2 (in public preview now)

Power BI + SSRS = Power BI Report Server

- **SSRS** pulled out of .iso in SQL 2017
  - Free web download, but license is not free.
  - Still need a product key from production SQL license.
- **Power BI Report Server**
  - Not free, comes with Power BI Premium or SA
  - Alternative to an SSRS install. Contains SSRS + more.



SSRS

- New in 2017: integrated commenting system now built-in to the SSRS Report web portal
- SharePoint Integrated mode is no more, as is most development for on-prem SharePoint
- More details: https://docs.microsoft.com/en-us/sql/reporting-services/what-s-new-in-sql-server-reporting-services-ssrs

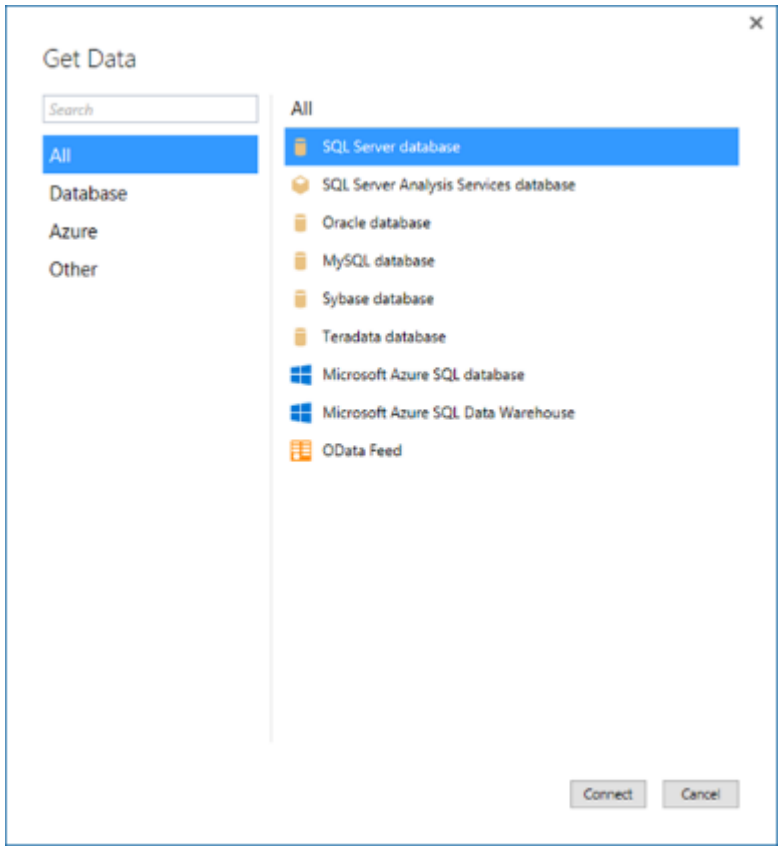
SSRS

- Now in SQL 2017, SSRS has a **modern REST API** available for custom access to the report server catalog.
  - Replaces the old SOAP API
- Shared Datasets in SSRS can be access by Power BI reports via this modern API

Lots of SSRS Change in SQL 2016

- SSRS got a complete revamp in SQL 2016
- Paginated reports still there, but mobile reports now possible for mobile/tablet screen formats
- Completely new Report Manager and Web Portal
- Integration with Power BI account
- Users have seamless access to on-prem SSRS reports and cloud-based Power BI dashboards in the same web portal

SSAS Changes in 2017



- Long-needed setup change:
  - **Tabular mode now default**
    not Multidimensional
- Nicer, modern experience in SSDT brought over from Power BI, other SSDT QOL improvements
- Better support for parent-child hierarchies in Tabular
- More Details: https://docs.microsoft.com/en-us/sql/analysis-services/what-s-new-in-sql-server-analysis-services-2017

SSAS Changes in 2017

- New DAX function: “IN” mimics TSQL “IN”

From: Rusty Frioux
Sent: Thursday, February 15, 2018 12:45 PM
To: William Assaf <william.assaf@sparkhound.com>
Subject: RE: good luck tonight

DAX IN! DAX IN! DAX IN! OMG THEY ADDED ***IN*** TO DAX. NO MORE 300 LINE NESTED IF THEN STATEMENTS IN THAT STUPID EXCEL SYNTAX.

DAX IN!

New SQL Server 2017 Syntax

- EXTERNAL DATA SOURCE
- ENABLE_PARALLEL_PLAN_PREFERENCE
- CONCAT_WS (concatenation *with separator*)
- TRIM (instead of LTRIM, RTRIM)
- TRANSLATE (massive character replace)
- STRING_AGG (easily concatenate rows to a delimited list string)

Bulk Access to Azure Blob Storage

- New to SQL 2017, perform bulk insert operations directly off of Azure Blob storage files
- Secured using Shared Access Signature Credentials
- No need for HADOOP – write straight to SQL
- Details: https://docs.microsoft.com/en-us/sql/relational-databases/import-export/examples-of-bulk-access-to-data-in-azure-blob-storage

Bulk Access to Azure Blob Storage

- Example: bulk insert from a .csv in Azure blob storage using EXTERNAL DATA SOURCE

- You can also use EXTERNAL DATA SOURCE for Azure SQL Database-to-Azure SQL Database connectivity, because you can't use Linked Servers.

Force Parallel

Advanced troubleshooting/optimization option new to SQL Server 2017 (and also in SQL Server 2016 CU2)

Force a query to use a parallelized execution plan:

```
OPTION(USE HINT('ENABLE_PARALLEL_PLAN_PREFERENCE'));
```

CONCAT_WS

Concatenate *with separator*

Example: Place a comma between any number of values

```
SELECT CONCAT_WS(',', name, current_utc_offset, is_currently_dst)
FROM sys.time_zone_info

Dateline Standard Time,-12:00,0

--Wrap in " for text qualification on csv import
SELECT CONCAT_WS('","', '"'+name, current_utc_offset, is_currently_dst)+'"'
FROM sys.time_zone_info

"Dateline Standard Time","-12:00","0"
```

STRING_AGG

- Quickly create .csv strings with row data!
- An Aggregate Operator (like SUM, AVG)
- that concatenates with a separator between values (again, not at the end!)

```
SELECT STRING_AGG(name, ', ') FROM sys.time_zone_info
WHERE NAME LIKE '%central%';
```

Central America Standard Time, Central Standard Time, Central Standard Time (Mexico), Canada Central Standard Time, Central Brazilian Standard Time, Central Europe Standard Time, Central European Standard Time, W. Central Africa Standard Time, Central Asia Standard Time, N. Central Asia Standard Time, Aus Central W. Standard Time, AUS Central Standard Time, Central Pacific Standard Time

TRANSLATE

- Easier way to do 1-for-1 character replacement
- Far less syntax than nested REPLACE statements

- Slightly less flexible than REPLACE
  - Allows for a 1-to-1 character replacement only.
  - Can't replace or ' ' with ''
  - Can replace 'abcdef' with '123456' with significantly less code

TRANSLATE

Same result:

```
SELECT TRANSLATE('abcdef', 'abcdef', '123456’)
```

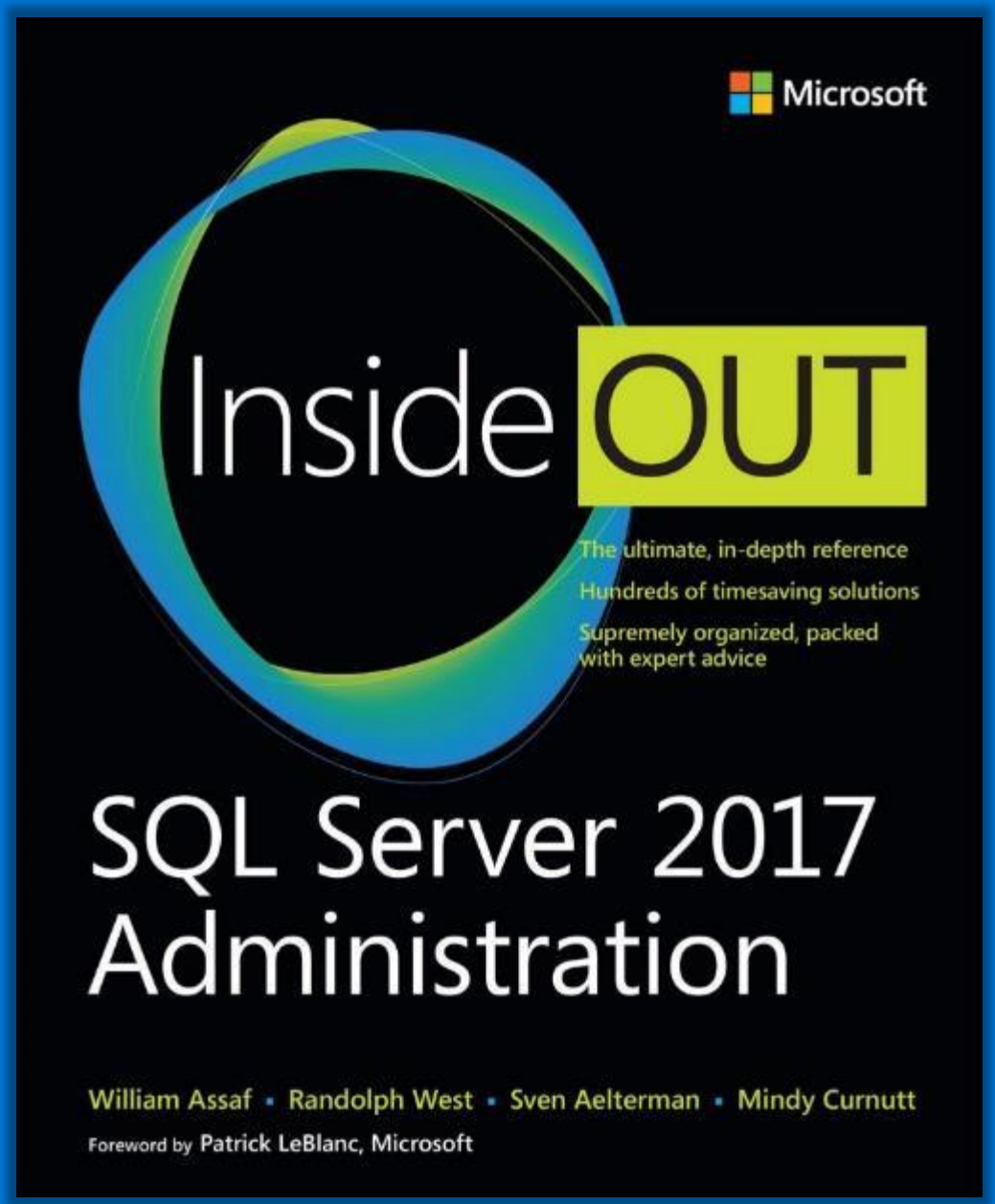
Vs

```
SELECT
REPLACE(REPLACE(REPLACE(REPLACE(REPLACE(REPLACE(
'abcdef','a', '1'),'b', '2'),'c', '3'),'d', '4’)
,'e', '5'),'f', '6')
```

TRIM

No more LTRIM(RTRIM(*some_varchar*))!

Now in SQL 2017 you can just TRIM(*some_varchar)*!



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This presentation, including all source code and this slide deck, has been posted at my blog:

SQLTact.com