

It's Not Your Fault

(It's SQL Server's default)

Jeff Iannucci

What is the purpose of this session?

At scale, unmodified defaults can create...MONSTERS!!!



(image: Warner Bros. Pictures and New Line Cinema)

What are we discussing in this session?

Potentially troublesome defaults in SQL Server

Performance

- CPU & Memory
- Storage
- Tempdb

Security

Convenience

Disclaimer

I am not saying you MUST change any of these settings...

...but I am saying you should CONSIDER changing these settings.



The very first troublesome default



(Image :Filmkameratene A/S and Film Fund FUZZ)

Enable 'show advanced options'

Around 70% of configuration settings are hidden

```
Msg 15123, Level 16, State 1, Procedure sp_configure, Line 62 [Batch Start Line 7]  
The configuration option 'Beast Mode' does not exist, or it may be an advanced option.
```

Need to enable this to make other changes

```
EXEC sp_configure 'Show Advanced Options', 1;  
RECONFIGURE;  
GO
```

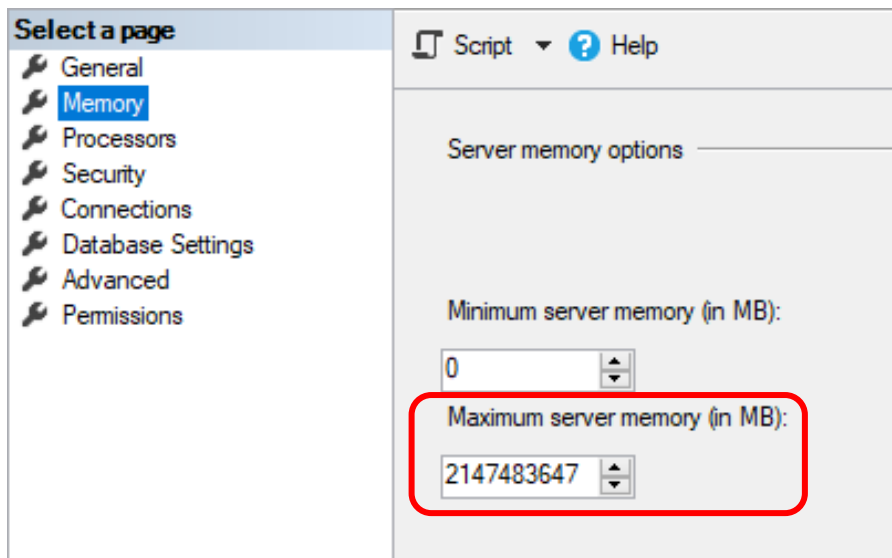
An aerial photograph of a person floating on a yellow inflatable ring in the ocean. A large shark's mouth is open nearby, showing its teeth. The water is a deep blue color.

Performance defaults – CPU & Memory

(image: Warner Bros. Pictures and Gravity Pictures)

Configure maximum memory

Default: consume up to 2 petabytes of memory



The screenshot shows the Oracle Enterprise Manager configuration interface. On the left, a sidebar titled "Select a page" lists various configuration categories: General, Memory, Processors, Security, Connections, Database Settings, Advanced, and Permissions. The "Memory" option is highlighted with a blue background. On the right, the "Server memory options" section is visible. It contains two settings: "Minimum server memory (in MB)" with a value of 0, and "Maximum server memory (in MB)" with a value of 2147483647. The "Maximum server memory (in MB)" setting and its value are enclosed in a red rectangular box.

Setting	Value
Minimum server memory (in MB)	0
Maximum server memory (in MB)	2147483647

Configure maximum memory

Limits the amount of memory for cached data pages

...and some other cached things

...but does NOT include SSAS, SSIS, SSRS, etc.

Avoid memory pressure, using the page file

Configure maximum memory

Try: Total Memory – (4GB or 10%, whichever is larger)

```
EXEC sp_configure 'max server memory', 4096; --This is 4 GB  
RECONFIGURE;  
GO
```

Enable 'optimize for ad hoc workloads'

Default: cache an execution plan for every query

Execution plans consume memory...but how much?

<https://www.sqlskills.com/blogs/kimberly/plan-cache-and-optimizing-for-adhoc-workloads/>

	CacheType	Total Plans	Total MBs	Avg Use Count	Total MBs – USE Count 1	Total Plans – USE Count 1
1	Prepared	15798	5761.015625	1200	3341.359375	4888
2	Adhoc	21666	2434.728897	115	1033.274246	17631
3	Proc	1186	956.992187	33503	427.687500	314
4	UsrTab	202	11.453125	804	2.531250	39
5	View	4558	766.171875	120	0.648437	2
6	Rule	44	1.664062	11	0.117187	3
7	Trigger	23	2.687500	50	0.070312	1
8	Default	3	0.023437	35	0.015625	2
9	TypeTable	1	0.015625	20	0.000000	0

Enable 'optimize for ad hoc workloads'

Enabling stores "stub" (NULL plan) on first execution

	UseCounts	Cacheobjtype	Objtype	TEXT	query_plan
1	1	Compiled Plan Stub	Adhoc	SELECT UseCounts, Cacheobjtype, Objtype, TEXT, q...	NULL

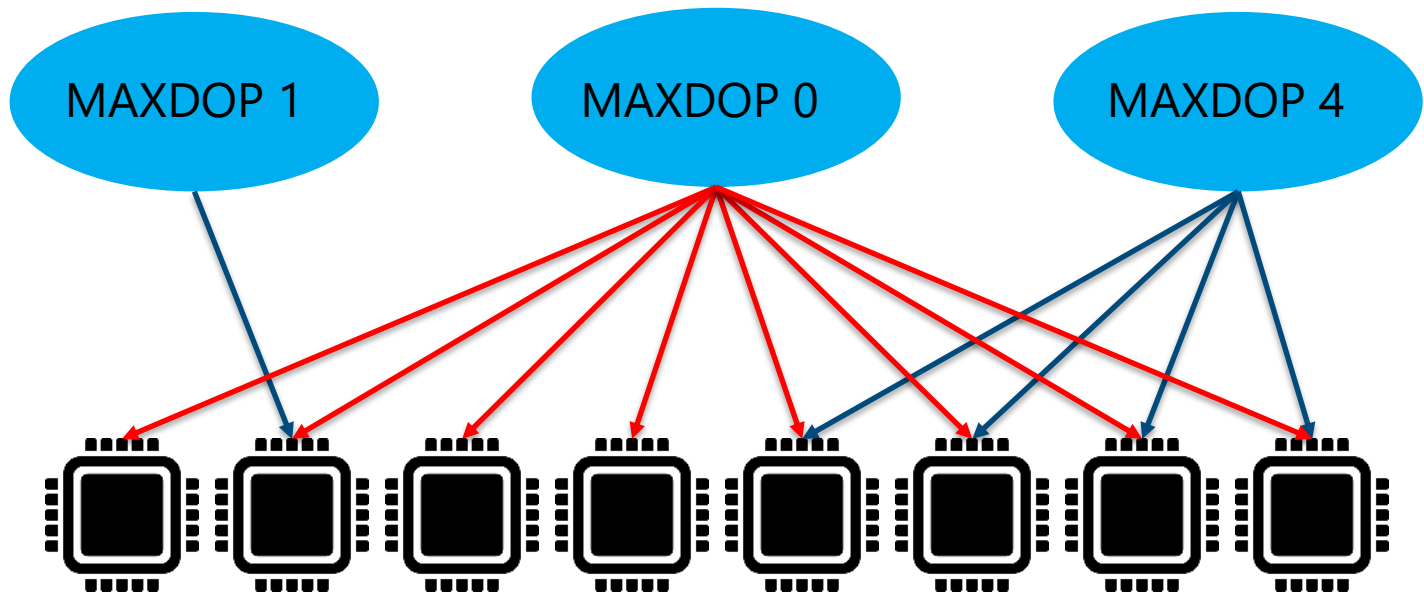
Will store plan on second execution

	UseCounts	Cacheobjtype	Objtype	TEXT	query_plan
1	1	Compiled Plan	Adhoc	SELECT UseCounts, Cacheobjtype, Objtype, TEXT, q...	<ShowPlanXML xmlns="http://schemas...

```
EXEC sp_configure 'optimize for ad hoc workloads', 1;  
RECONFIGURE;  
GO
```


Configure max degree of parallelism

Default: 0 ("All your processor are belong to us")



Important: MAXDOP limit is per task, not per query

Configure max degree of parallelism

Balance performance with concurrency

Testing shows diminishing returns beyond MAXDOP 8

Consider NUMA and Affinity configurations

```
EXEC sp_configure 'max degree of parallelism', 8;  
RECONFIGURE;  
GO
```

"Installation option
in SQL Server 2019
and later"



(image: Walt Disney Pictures and Lucasfilm Ltd)

Configure cost threshold for parallelism

Default: consider parallel plans where query cost > 5

Unnecessary parallelism = slower queries, wasted CPU

Start at 50, but... <https://www.sqlskills.com/blogs/jonathan/tuning-cost-threshold-for-parallelism-from-the-plan-cache/>

```
EXEC sp_configure 'cost threshold for parallelism', 50;  
RECONFIGURE;  
GO
```

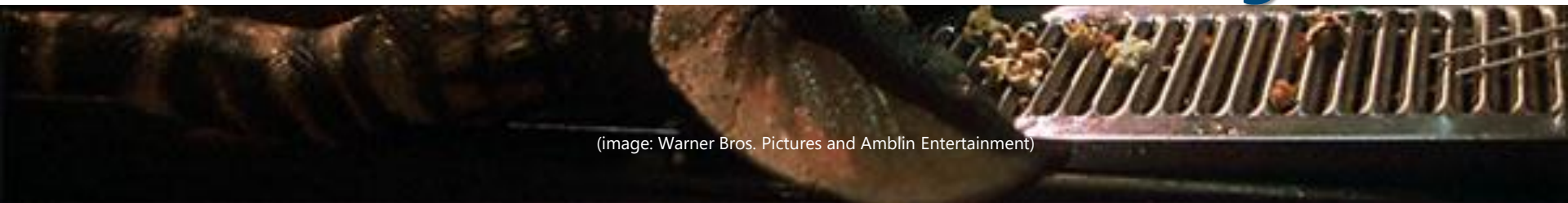
"Installation option
in SQL Server 2019
and later"



(image: Walt Disney Pictures and Lucasfilm Ltd)



Performance defaults – Storage



(image: Warner Bros. Pictures and Amblin Entertainment)

Instant File Initialization

Default: write zeros when allocating disk space

Wait...WHY WASTE TIME WRITING ZEROS!?!

Affects all database file growth

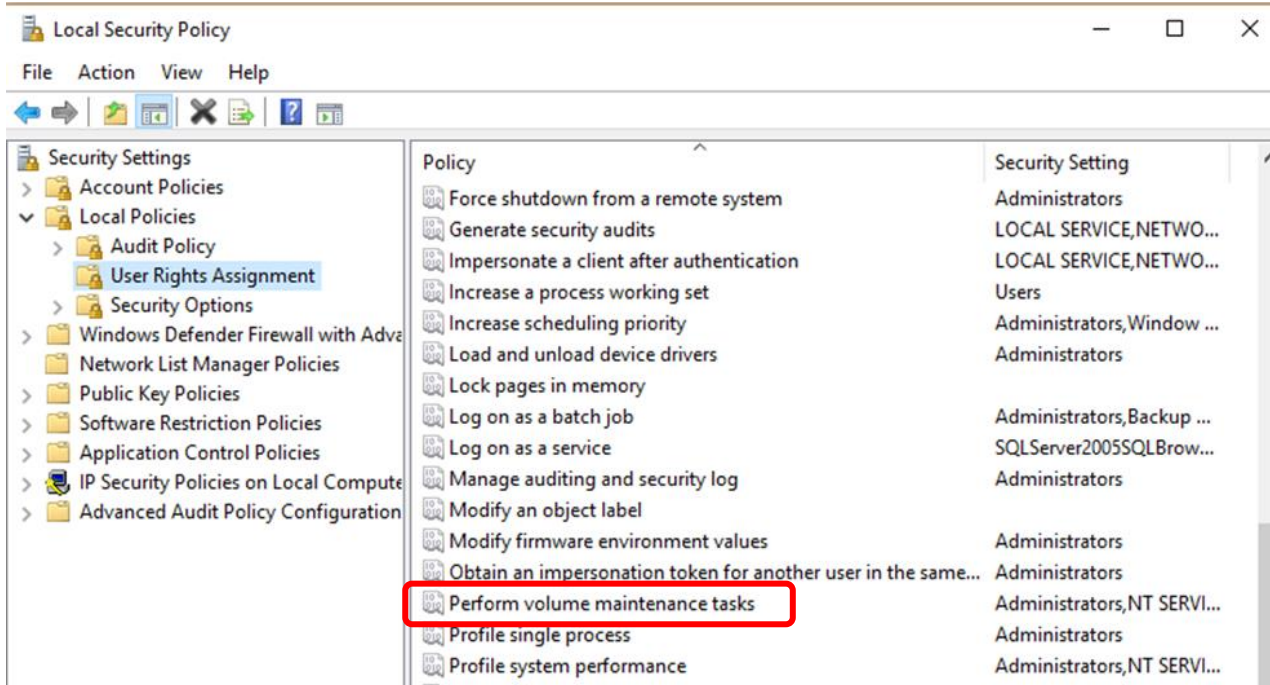
...including tempdb creation

...and database restores

TDE nullifies IFI

Instant File Initialization

SQL Server 2014 and prior use **secpol.msc**



Instant File Initialization

SQL Server 2017 Setup

Server Configuration

Specify the service accounts and collation configuration.

Global Rules

Microsoft Update

Product Updates

Install Setup Files

Install Rules

Installation Type

Product Key

License Terms

Feature Selection

Feature Rules

Instance Configuration

Server Configuration

Database Engine Configuration

Feature Configuration Rules

Ready to Install

Installation Progress

Complete

Service Accounts Collation

Microsoft recommends that you use a separate account for each SQL Server service.

Service	Account Name	Password	Startup Type
SQL Server Agent	NT Service\SQLSERVERA...		Manual ▼
SQL Server Database Engine	NT Service\MSSQLSERVER		Automatic ▼
SQL Server Browser	NT AUTHORITY\LOCAL...		Disabled ▼

☒ Grant Perform Volume Maintenance Task privilege to SQL Server Database Engine Service

This privilege enables instant file initialization by avoiding zeroing of data pages. This may lead to information disclosure by allowing deleted content to be accessed.

[Click here for details](#)

"Installation option
in SQL Server 2016
and later"

< Back

Next >

Cancel



(image: Walt Disney Pictures and Lucasfilm Ltd)

Default file locations

SQL Server 2017 Setup



Database Engine Configuration

Specify Database Engine authentication security mode, administrators, data directories and TempDB settings.

Global Rules

Microsoft Update

Product Updates

Install Setup Files

Install Rules

Installation Type

Product Key

License Terms

Feature Selection

Feature Rules

Instance Configuration

Server Configuration

Database Engine Configuration

Server Configuration

Data Directories

TempDB

FILESTREAM

Data root directory:

C:\Program Files\Microsoft SQL Server\



System database directory:

C:\Program Files\Microsoft SQL
Server\MSSQL14.MSSQLSERVER\MSSQL\Data

User database directory:

C:\Program Files\Microsoft SQL Server\MSSQL14.MSSQLSERVER\



User database log directory:

C:\Program Files\Microsoft SQL Server\MSSQL14.MSSQLSERVER\



Backup directory:

C:\Program Files\Microsoft SQL Server\MSSQL14.MSSQLSERVER\



Default file locations

Default: all files exist on the same drive

Results in storage contention (I/O bottlenecks)



Default file locations

Also, ALL QUERY ACTIVITY can stop when...

Data file for one database grows too large

Log file for one database grows too large

Too much data in tempdb

Too many transactions in tempdb

Large database is backed up

Model file settings

Before SQL Server 2016:

Database files:

Logical Name	File Type	Filegroup	Initial Size (MB)	Autogrowth / Maxsize
modeldev	ROWS...	PRIMARY	4	By 1 MB, Unlimited
modellog	LOG	Not Applicable	1	By 10 percent, Unlimited

Since SQL Server 2016:

Database files:

Logical Name	File Type	Filegroup	Initial Size (MB)	Autogrowth / Maxsize
modeldev	ROWS...	PRIMARY	8	By 64 MB, Unlimited
modellog	LOG	Not Applicable	8	By 64 MB, Unlimited

Try: larger initial and autogrowth sizes

What are Virtual Log Files (VLFs)?

Allocation chunks inside transaction log file

Too many VLFs slows startup, backup, restore operations



<https://docs.microsoft.com/en-us/sql/relational-databases/sql-server-transaction-log-architecture-and-management-guide?view=sql-server-2017>

(image: Microsoft Corp.)

Backup compression

Default: no compression used for backups

Compressed backups are smaller, involve less I/O

Less I/O = FASTER and requires LESS STORAGE

Available in SQL Server 2008 and higher







"TDE compression
in SQL Server 2016
and later"



(image: Walt Disney Pictures and Lucasfilm Ltd)

Backup compression

Includes Full, Differential, and Log backups

 FULL.bak	233,600 KB	 FULL_COMPRESS.bak	53,156 KB
 DIFF.bak	23,680 KB	 DIFF_COMPRESS.bak	3,732 KB
 TLOG.trn	246,076 KB	 TLOG_COMPRESS.trn	84,384 KB

```
EXEC sp_configure 'backup compression default', 1 ;  
RECONFIGURE;  
GO
```



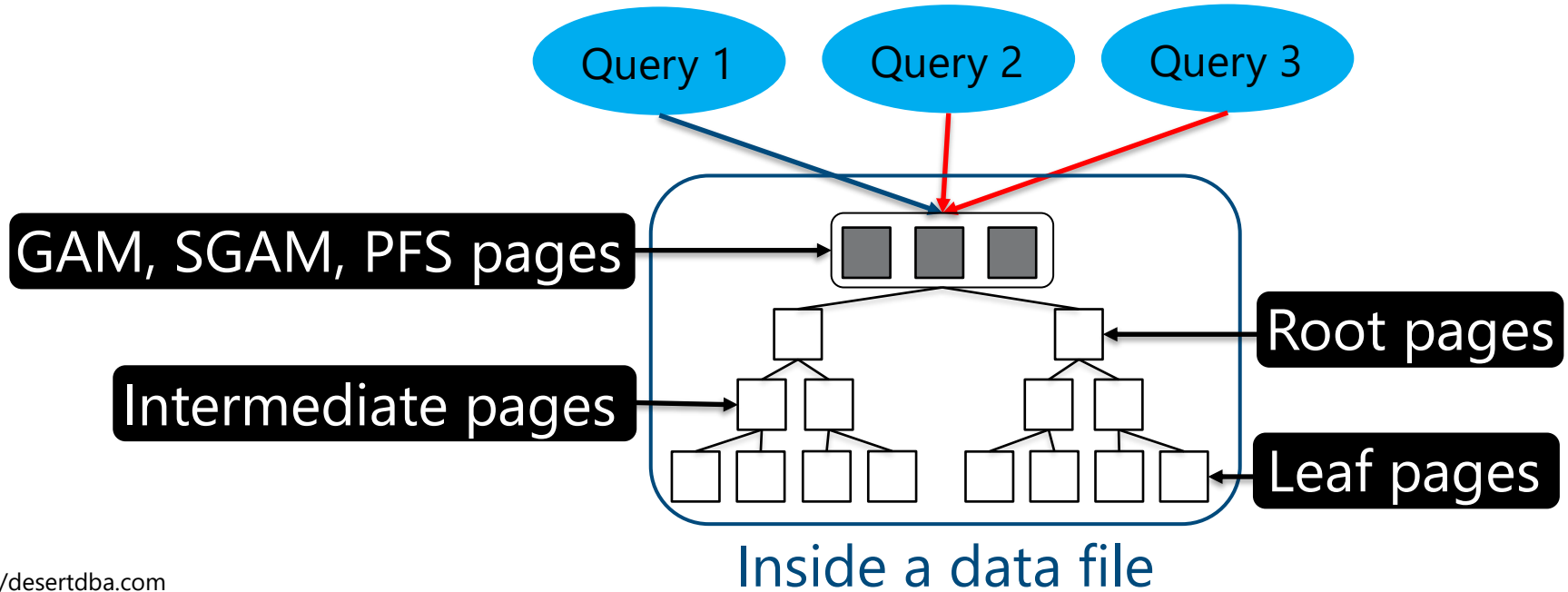
Performance defaults – Tempdb

(image: Fairview Productions)

Number of tempdb data files

Default: 1 data file for tempdb

Results in GAM, SGAM, and PFS contention (...uh, what?)



Number of tempdb data files

If ≤ 8 **CPUs** then CPUs = tempdb data files

If > 8 **CPUs** then 8 tempdb files

Add in multiples of 4 if necessary

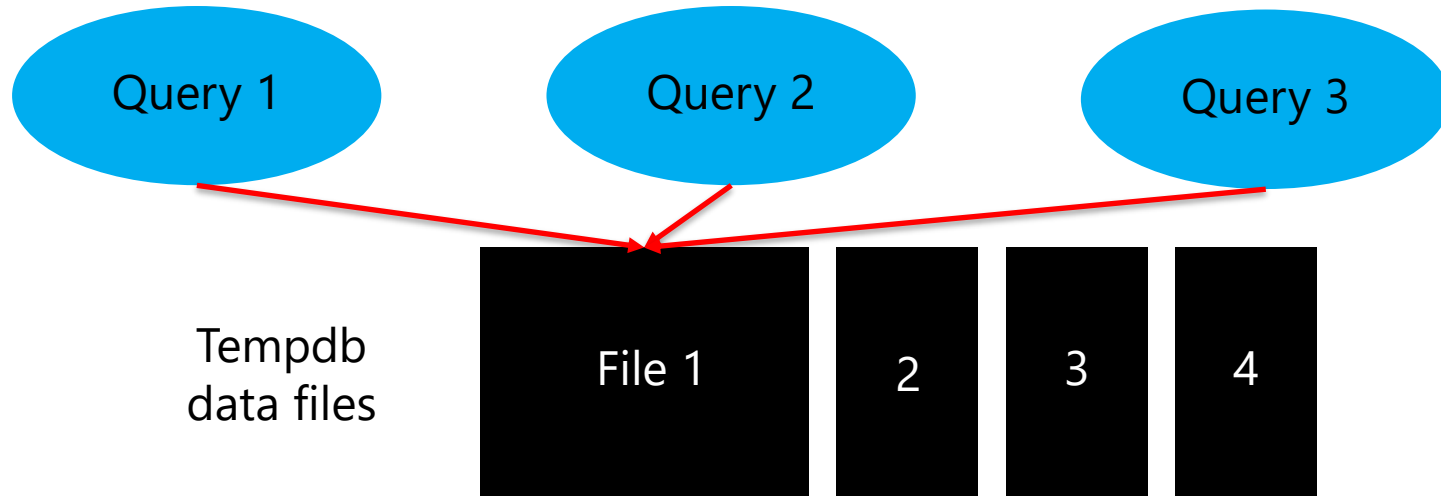
<https://support.microsoft.com/en-us/help/2154845/recommendations-to-reduce-allocation-contention-in-sql-server-tempdb-d>

Size and growth rate of tempdb files

Before SQL Server 2016: same defaults as 'model'

Since SQL Server 2016: can configure during installation

Need to be the same size, and stay that way



Trace flag 1117

Grows all files in a filegroup equally

Tempdb usage based on most available file space

Ensures equally-sized tempdb files

Instance setting - affects ALL databases

"Default behavior
in SQL Server
2016 and later"



(image: Walt Disney Pictures and Lucasfilm Ltd)

How to enable trace flags

Locally, just for your session

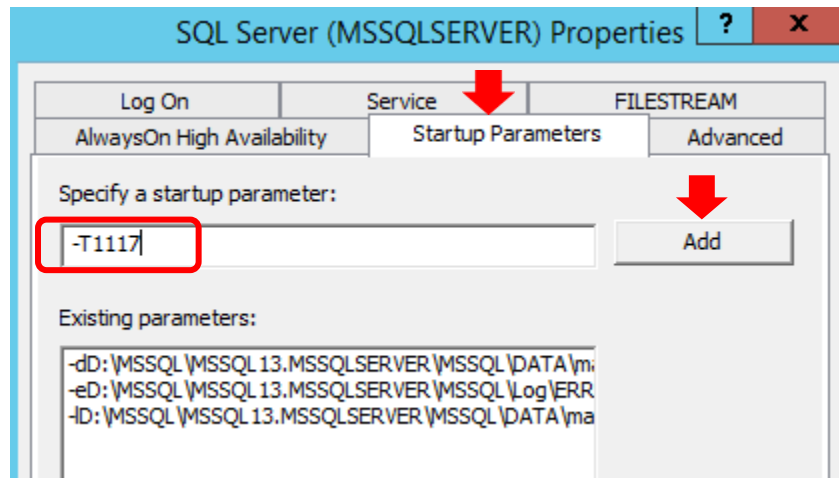
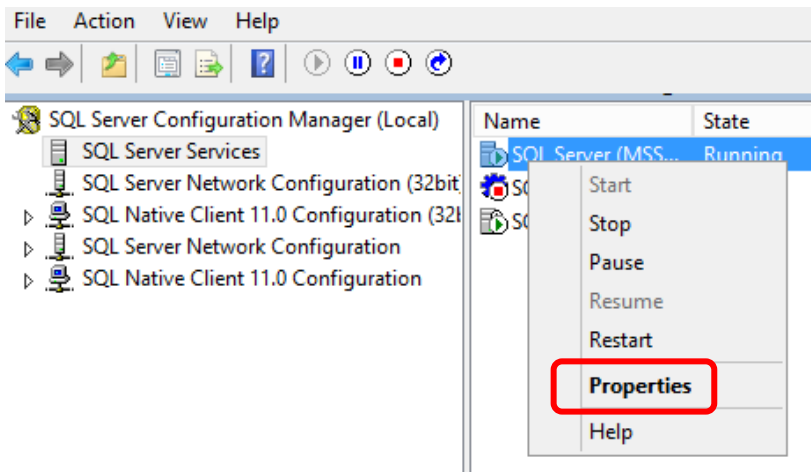
```
DBCC TRACEON (1117)
```

Globally, for all sessions

```
DBCC TRACEON (1117, -1)
```

How to enable trace flags

On startup (if you want it always running)



Trace flag 1118

Stops use of mixed extents

Eight 8 KB data pages

Table 1 data pages

Table 2 data pages



= One 64 KB **Extent**

Trace flag 1118

Every new object gets its own extent (64KB of data)

Saves time managing mixed extents

Instance setting - affects ALL databases

"Default behavior
in SQL Server
2016 and later"



(image: Walt Disney Pictures and Lucasfilm Ltd)

Security defaults



(image: 20th Century Fox)

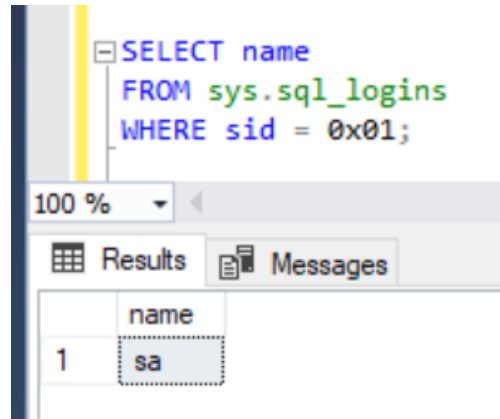
Disable 'sa' login

Default: 'sa' enabled and in 'sysadmin' role

Everybody knows you have an 'sa' login

Renaming can cause SQL Agent job errors

"Obscurity is not security" – Aaron Bertrand



Disable 'sa' login

Internal processes still use disabled 'sa' account

Disabled 'sa' can still own databases and jobs

'sa' is still required as owner of master and tempdb

Failed login attempts will show in Error Logs

```
ALTER LOGIN [sa] DISABLE;
```


Apply Service Packs/Cumulative Updates

Default: install the RTM version

SPs & CUs often contain security fixes

i.e. Spectre and Meltdown side-channel vulnerabilities

General Distribution Release (GDR) for unsupported versions

<https://support.microsoft.com/en-us/help/4073225/guidance-protect-sql-server-against-spectre-meltdown>

Apply Service Packs/Cumulative Updates

Cumulative Update	Release Date	Build	Support Ends
CU18	2019/12/09	14.0.3257.3	2027/10/12
CU17	2019/10/08	14.0.3238.1	2027/10/12
CU16	2019/08/01	14.0.3223.3	2027/10/12
Security update	2019/07/09	14.0.3192.2	2027/10/12
Hotfix	2019/06/21	14.0.3164.1	2027/10/12
CU15	2019/05/24	14.0.3162.1	2027/10/12
SSAS GDR	2019/05/14		2027/10/12
CU14	2019/03/25	14.0.3076.1	2027/10/12
Hotfix	2019/01/07	14.0.3049.1	2027/10/12
CU13	2018/12/18	14.0.3048.4	2027/10/12
CU12	2018/10/24	14.0.3045.24	2027/10/12
CU11	2018/09/20	14.0.3038.14	2027/10/12
CU10	2018/08/27	14.0.3037.1	2027/10/12
GDR2 (security patch to CU9)	2018/08/14	14.0.3035.2	2027/10/12
CU9	2018/07/18	14.0.3030.27	2027/10/12
CU8	2018/06/20	14.0.3029.16	2027/10/12
CU7	2018/05/24	14.0.3026.27	2027/10/12
CU6	2018/04/19	14.0.3025.34	2027/10/12
CU5	2018/03/20	14.0.3023.8	2027/10/12
CU4	2018/02/21	14.0.3022.28	2027/10/12
CU3	2018/01/04	14.0.3015.40	2027/10/12
CU2 (note bug)	2017/11/29	14.0.3008.27	2027/10/12
CU1	2017/10/25	14.0.3006.16	2027/10/12
GDR (security patch to RTM)	2018/08/14	14.0.2000.63	2027/10/12
RTM	2017/10/02	14.0.1000.169	2027/10/12

(image: SQLServerUpdates.com)

Enable remote admin connections

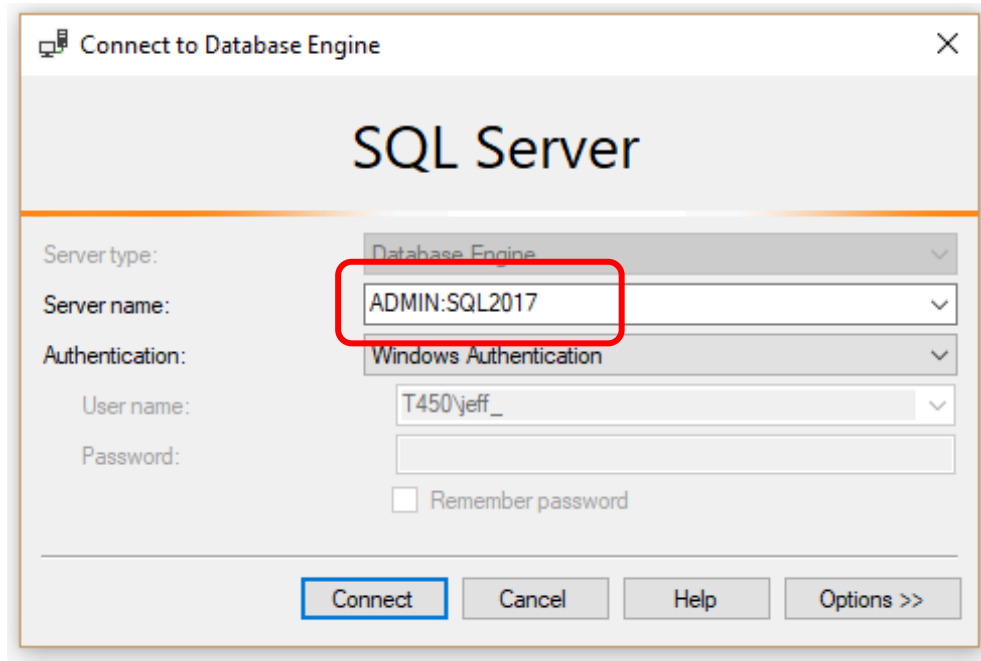
Default: disabled

SQL Server has a single reserved scheduler thread

Default allows Dedicated ADMIN Connection (DAC)...

...but only locally

Enable remote admin connections



```
EXEC sp_configure 'remote admin connection', 1;  
RECONFIGURE;  
GO
```

Enable remote admin connections

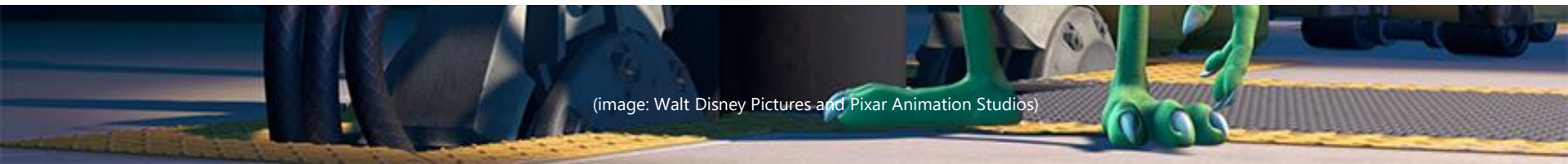
Important: DAC is like the Highlander...



...so don't use DAC for routine tasks



Convenience defaults



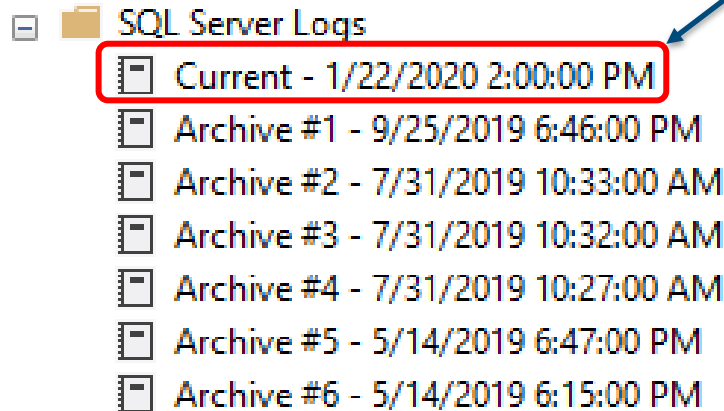
(image: Walt Disney Pictures and Pixar Animation Studios)

Number of error log files

Default: write to same file until restart

Default: retain up to 6 Archive files

This file contains
about 4 months
of logged events!



So...how often do you restart your instances?

Number of error log files

To recycle error log (create job a job to do this)

```
EXEC sp_cycle_errorlog ;  
GO
```

To control amount of SQL Server Log files

```
USE [master];  
EXEC xp_instance_regwrite N'HKEY_LOCAL_MACHINE'  
    , N'Software\Microsoft\MSSQLServer\MSSQLServer'  
    , N'NumErrorLogs', REG_DWORD, 12  
GO
```

Trace flag 3226

Default: write all backup attempts to the Error Log
SQL Server Logs are filled with noise like...

3/12/2019 8:53:11 PM	Backup	BACKUP DATABASE successfully processed 0 pages in 6.901 seconds (0.000 MB/sec).
3/12/2019 8:53:11 PM	Backup	Database backed up. Database: RWeigh, creation date(time): 2016/10/10(17:53:01), pag
3/12/2019 8:53:11 PM	Backup	BACKUP DATABASE successfully processed 0 pages in 6.911 seconds (0.000 MB/sec).
3/12/2019 8:53:11 PM	Backup	BACKUP DATABASE successfully processed 0 pages in 6.904 seconds (0.000 MB/sec).
3/12/2019 8:53:11 PM	Backup	Database backed up. Database: pubs, creation date(time): 2016/10/10(17:52:34), pages
3/12/2019 8:53:11 PM	Backup	Database backed up. Database: RouteAudit, creation date(time): 2016/10/10(17:52:46), r
3/12/2019 8:53:11 PM	Backup	BACKUP DATABASE successfully processed 0 pages in 6.897 seconds (0.000 MB/sec).
3/12/2019 8:53:11 PM	Backup	Database backed up. Database: Ops, creation date(time): 2016/10/10(17:52:17), pages c
3/12/2019 8:53:11 PM	Backup	BACKUP DATABASE successfully processed 0 pages in 6.890 seconds (0.000 MB/sec).
3/12/2019 8:53:11 PM	Backup	Database backed up. Database: Tanda, creation date(time): 2016/10/10(17:52:13), page
3/12/2019 8:53:10 PM	Backup	BACKUP DATABASE successfully processed 0 pages in 6.893 seconds (0.000 MB/sec).
3/12/2019 8:53:10 PM	Backup	Database backed up. Database: LetterTracking, creation date(time): 2016/10/10(17:52:0
3/12/2019 8:53:10 PM	Backup	BACKUP DATABASE successfully processed 0 pages in 6.880 seconds (0.000 MB/sec).
3/12/2019 8:53:10 PM	Backup	Database backed up. Database: GateCodes, creation date(time): 2016/10/10(17:51:50), r
3/12/2019 8:53:10 PM	Backup	BACKUP DATABASE successfully processed 0 pages in 6.880 seconds (0.000 MB/sec).
3/12/2019 8:53:10 PM	Backup	BACKUP DATABASE successfully processed 0 pages in 6.931 seconds (0.000 MB/sec).

Trace flag 3226

SCENARIO: The database is "DOWN"...

You are scrolling through successful backup messages...

Your Management is on you like...



(image: Universal Pictures)

Sysjobhistory defaults (SQL Agent)

Defaults:

Select a page

- General
- Advanced
- Alert System
- Job System
- Connection
- History

Script ? Help

Current job history log size (in rows):

☒ Limit size of job history log

Maximum job history log size (in rows): 1000

Maximum job history rows per job: 100

Sysjobhistory defaults (SQL Agent)

How many jobs do you have?

How often do they run?

```
USE msdb;  
EXEC msdb.dbo.sp_set_sqlagent_properties  
    @jobhistory_max_rows=20000  
    , @jobhistory_max_rows_per_job=200  
GO
```

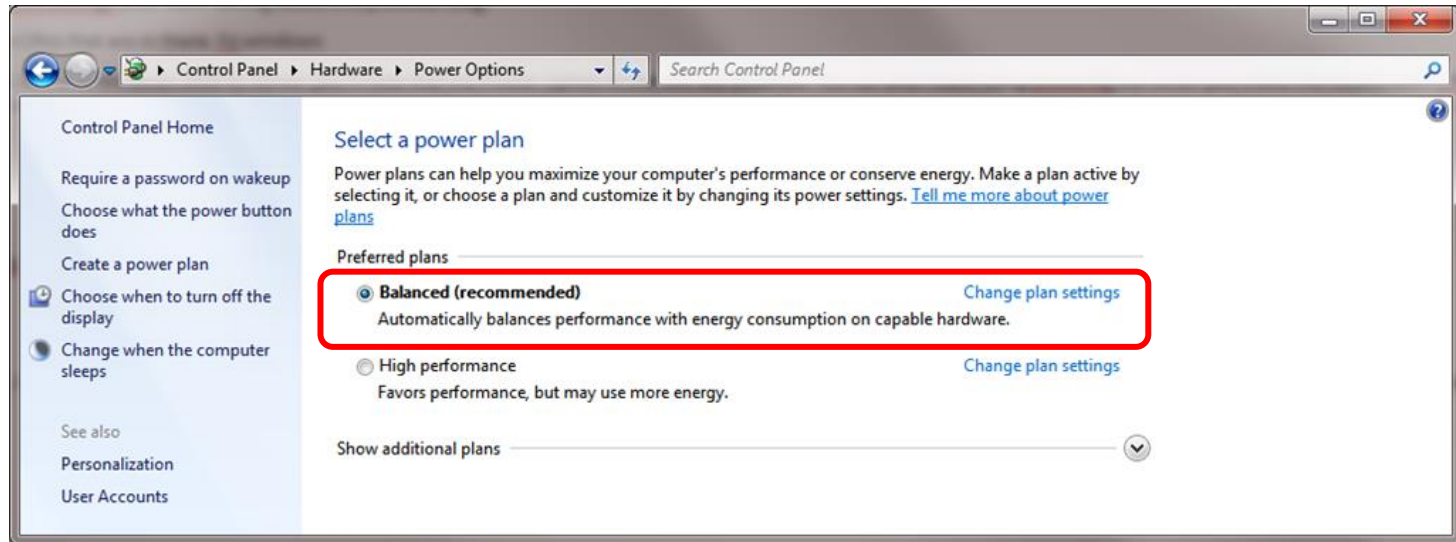


BONUS: King of the default monsters!

(image: Legendary Pictures)

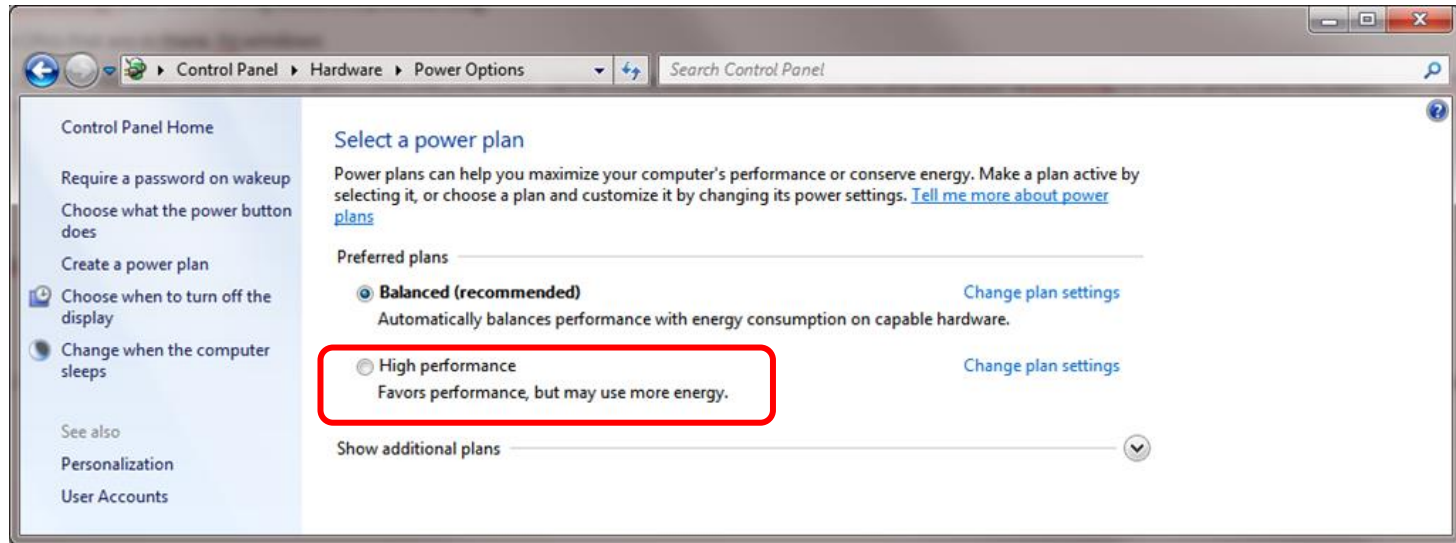
Windows power setting

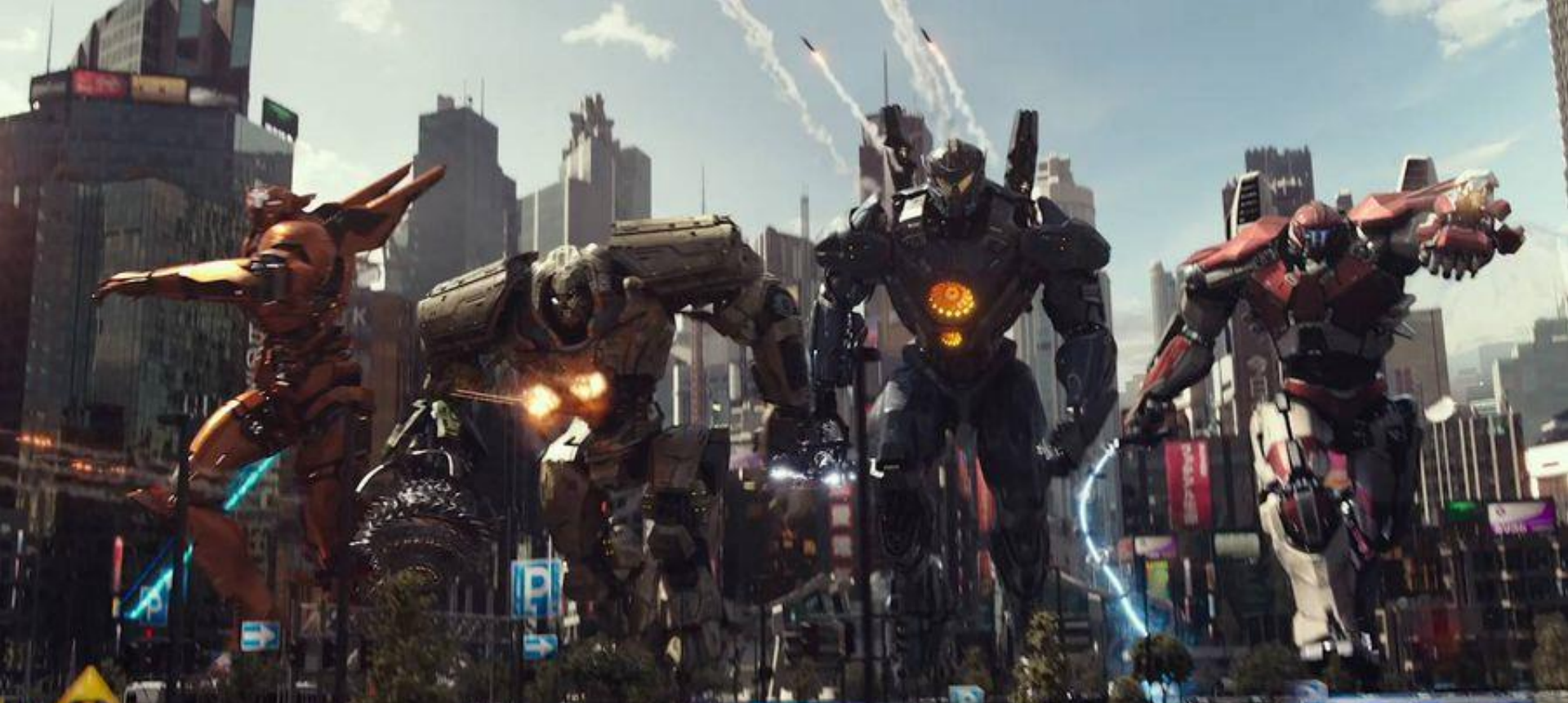
Default: **Balanced** "matches capacity to demand"



Windows power setting

High Performance: “Processors locked at highest performance state (including ‘turbo’ frequencies)”





Let's make a plan for "default" monsters

(image: Legendary Pictures)

Summary: Installation defaults

- **Windows power setting**
- Default file locations
- Instant File Initialization (IFI)
- Trace flag 1117 (grow all files in a filegroup equally)
- Trace flag 1118 (all new objects get their own extents)
- Trace flag 3226 (suppress successful backup messages)
- Apply Service Packs/Cumulative Updates

Summary: sp_configure defaults

- Show Advanced Options
- Max Server Memory
- Optimize for Ad Hoc Workloads
- Max Degree of Parallelism (MAXDOP)
- Cost Threshold of Parallelism
- Backup Compression
- **Remote Admin Connections**

Summary: Other troublesome defaults

- Model file settings
- Tempdb file settings
- **The 'sa' login**
- Number of Error Logs
- Sysjobhistory defaults

What questions do you have?



That's the end. Thank you!



jeff@deserthdb.com



[@deserthdb](https://twitter.com/deserthdb)