SQLskills Immersion Event

IEPTO2: Performance Tuning and Optimization

Module 0: Overview

SQLskills
immerse yourself in sql server

Daily Course Format: Mon, Tue, Wed, Th, and Fri

- **Class runs for TEN half days**
  - Monday, April 12 through Friday, April 16, 2021
  - ***AND,*** Monday, April 19 through Friday, April 23, 2021
- **Each day**
  - Lecture: 90 minutes from 9am until 10:30am PT
    - Please use "CHAT" for questions ***during*** the lecture
  - Open Q&A: 30 minutes from 10:30am until 11:00am PT
    - Will address unanswered questions from chat
  - Mandatory break: 30 minutes from 11:00am until 11:30am PT
    - Everyone needs a bit of a break!
  - Lecture: 90 minutes from 11:30am until 1:00pm PT
    - Please use "CHAT" for questions ***during*** the lecture
  - Open Q&A: up to 60 minutes from 1:00pm until 2:00pm PT
    - Will address unanswered questions from chat
    - Can open up for "open mic" questions

Time Conversions
9:00am PT
= Noon ET
= 4:00pm UTC
Use this to see the exact time in YOUR time zone:
IEPTO2 & Upcoming Time Changes

Class Format: No LABS???

- **Class time – lecture / demo / questions! And, please ASK questions!**
  - There are no stupid questions… everyone started with ZERO knowledge about SQL Server!
  - If you're thinking it – you're probably not alone… speak up!
- **Why not lab time?**
  - Historically folks defer on labs to respond to email, etc.
    $\Rightarrow$ losing valuable class time
  - We can spend more time on content
    $\Rightarrow$ covering both MORE content and in more depth!
  - You receive all of the demo code and samples; you can reproduce everything we show you and pick where to really focus your attention!
    - You can take time to really study the content that's most appropriate to you
    - You can skip content that's not appropriate
    - You can take the RIGHT time for each/every exercise (rather than some being done quickly and others needing more time… potentially getting frustrated without enough time)

Course Resources, Pluralsight Access, and Alumni

- **Paul (paul@sqlskills.com) will send you an email for a FREE 30-day access to ALL SQLskills online training classes on Pluralsight**
  - No strings attached, no credit-card required
  - If you don't receive it, send mail to Paul
- **Course resources will be sent upon course completion**
- **We may want to update a slide or two, add some notes/resources based on questions and discussions, and process the recordings**
  - Please do not distribute; this is for course attendees only
  - Full details / access information will be sent upon course completion
- **Email us: Training@SQLskills.com if you have any problems finding or accessing any of your course materials**
- **And, now that you've attended one of our courses; you can ALWAYS register using the 'alumnus' discount (without quotes); we hope to see you again!**

Course Resources

- **Course content (this slide deck)**
  - One "two-slides per side" PDF for optimal printing (save some trees!)
  - One "full slide" PDF for optimal viewing and/or online note-taking
- **Demos**
  - All instructor-led demo scripts
  - All reference scripts
- **Reference links and additional resources**
- **Online recordings for these sessions**
- **<u>Upon completion</u> look for a "BadgeMe" email**

**Please do not redistribute: These resources are for attendees only.
Please respect our IP and time in creating these resources
and do not share/forward.**

Recommendation:
Leverage Great Products!

- Even with as much training as we will provide, you can't know everything
- SQL Server is powerful, complex, and has lots of different potential issues let third party software help!
- SQLskills partners with SentryOne because we really feel they've made the best suite of SQL Server products available
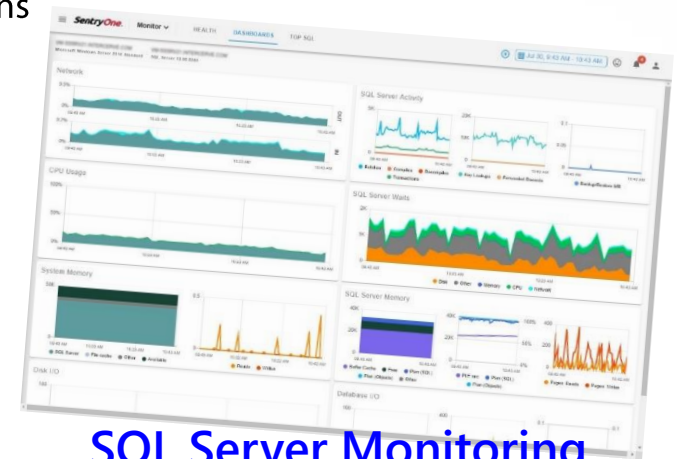- **LEARN MORE:**
  - □ SQL Server Monitoring: https://www.sentryone.com/sql-server/sql-server-monitoring
  - □ Plus, get *your* questions answered!
    - □ Email Andy / Devon your specific monitoring questions
      -- MailTo: ayun@sentryone.com
      -- MailTo: dwilson@sentryone.com
- **Plan Explorer**
  - □ https://www.sentryone.com/plan-explorer
  - □ Advanced Plan Explorer Usage for Tuning Execution Plans
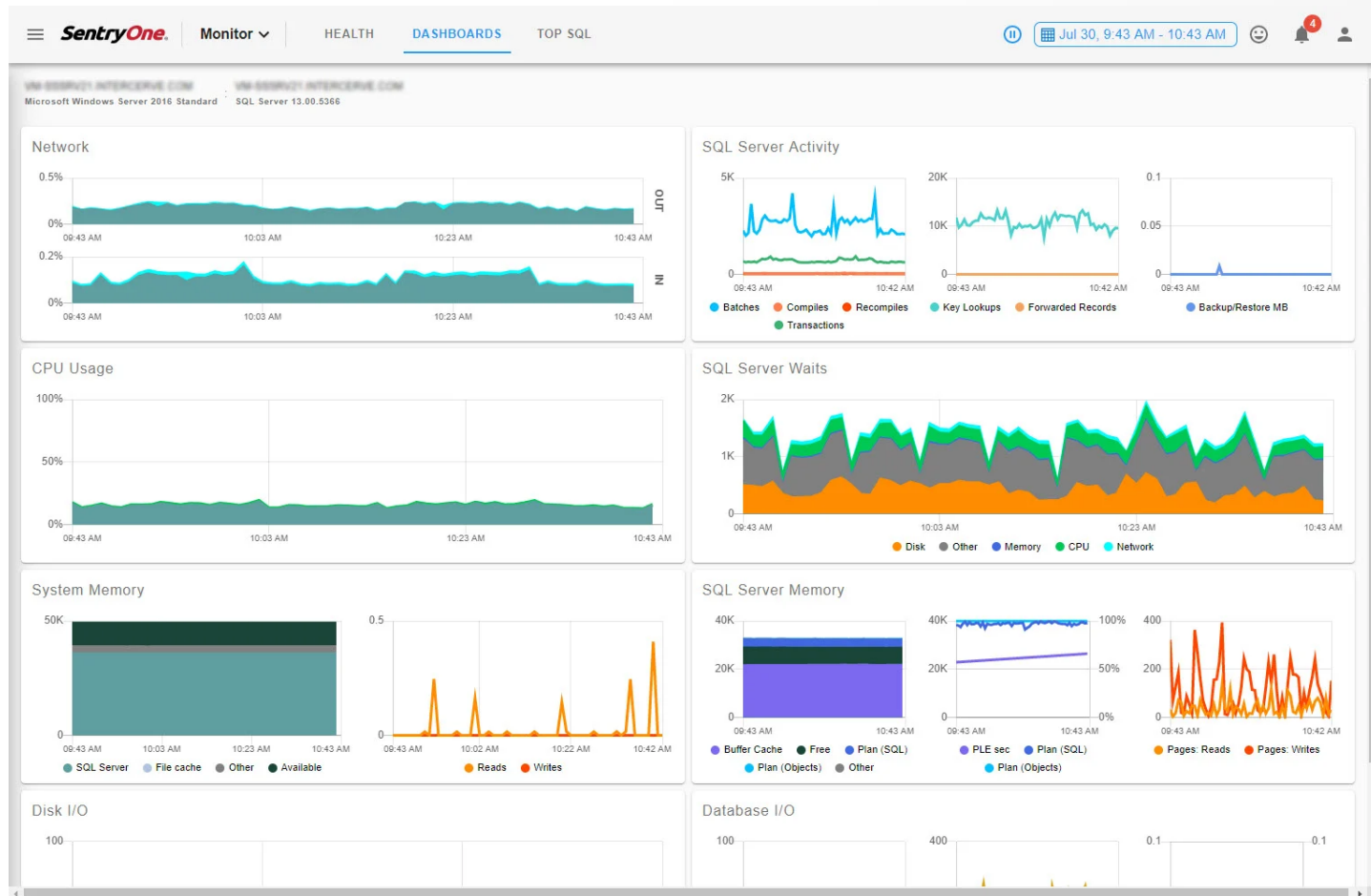- **Special SQLskills-Only Presentations Coming in May!**
  - □ Details will be posted on your course contents page!

SQL Server Monitoring

SQLskills' strategic partners and class sponsor — http://www.SentryOne.com

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Immersion Events IEPTO Parts 1 & 2

- **IEPTO1 – Internals and Performance**
  - About solving problems through design, indexing and maintenance
  - Heavily tied to internals
  - Generally requires three things:
    - Know your data
    - Know your workload
    - Know how SQL Server works
- **IEPTO2 – Performance Tuning**
  - About finding problems and understanding the MANY different angles from which you need look
  - No single topic will solve all of your problems
  - Some topics will be more immediately valuable
  - Over time, you'll probably tackle all of them…

Instructors

- **Why do we need multiple?**
  - Different perspectives
  - Different areas of expertise
  - Different problem solving skillsets
  - No one knows everything…
- **This class is about knowing:**
  - Where to look
  - What tools are available
  - All sorts of tips/tricks/best practices along the way!

Kimberly L. Tripp

Founder / President, SQLskills

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🐦 **@KimberlyLTripp**

📶 **www.sqlskills.com/blogs/Kimberly**

Consultant / Trainer / Speaker / Writer

- Author / instructor for SQL Server Immersion Events: IEPTO1, IEPTO2, and IEHADR

- Author / presenter for Pluralsight

- Instructor and exam author for SQL Server and Sharepoint MCMs

- Author / manager of SQL Server 2005 and 2008 Launch Content

- Author / speaker at Microsoft TechEd, SQLPASS, ITForum, TechDays, and SQLintersection

- Author of SQL Server Whitepapers on MSDN/TechNet: Partitioning, Snapshot Isolation, Manageability, SQLCLR for DBAs

- Author / presenter for MSDN and TechNet (25+)

- Instructor / SME for Microsoft University

Data Platform MVP

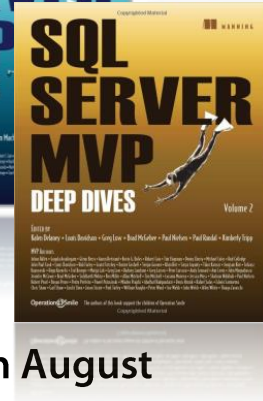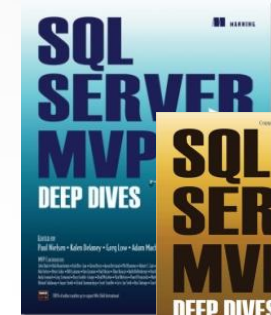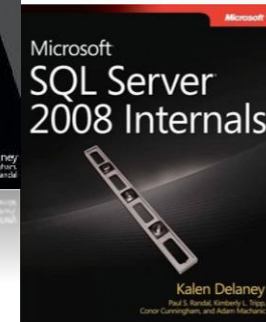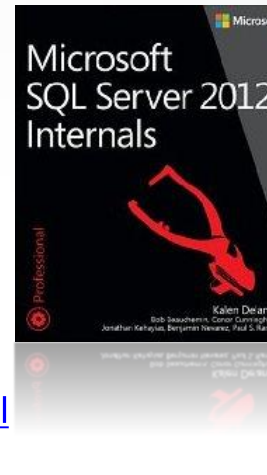- 17 years: 2002-2019

When I'm not working with SQL

- Traveler/adventurer and avid diver / photographer: www.BlueWaterImages.com

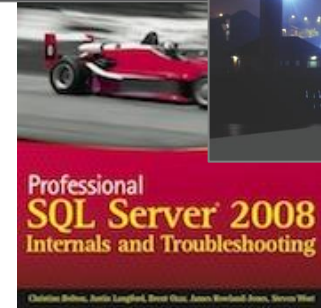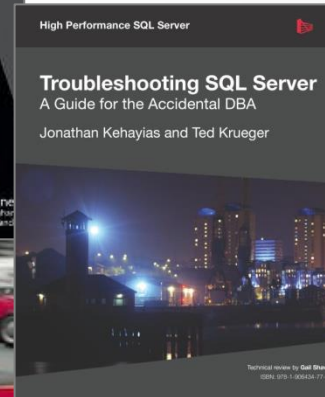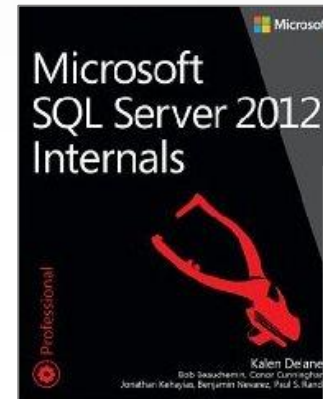- @KimberlyLTripp on Insta

Author/Instructor:
Paul S. Randal

- **Consultant/Trainer/Speaker/Author**
- **CEO, SQLskills.com**
  - Email: Paul@SQLskills.com
  - Blog: https://www.sqlskills.com/blogs/Paul
  - Twitter: @PaulRandal
- **Contributing Editor of TechNet Magazine, author of the SQL Q&A column, articles on DBA topics, multiple whitepapers for Microsoft**
- **5 years at DEC responsible for the VMS file-system and chkdsk equivalent**
- **Almost 9 years as developer/manager in the SQL Storage Engine team through August 2007, ultimately responsible for Core Storage Engine**
  - Wrote DBCC component, other Storage Engine code, DBCC CHECKDB/repair for SQL 2005
- **SQL Server/Data Platform MVP since 2008**
- **Regular presenter at worldwide conferences on HA/DR, administration, performance, and internals (#1 rated sessions at multiple PASS Summits)**
- **Course author/instructor for Microsoft Certified Master qualifications**
- **(I also like diving, electronics, robotics, Arduino, books, sheep…)**

Author/Instructor: Jonathan Kehayias

- **Consultant/Trainer/Speaker/Author**
- **Principal Consultant, SQLskills.com**
  - Email: Jonathan@SQLskills.com
  - Blog: https://www.SQLskills.com/blogs/Jonathan
  - Twitter: @SQLPoolBoy
- **Contributing Author:** *SQL Server 2008 Internals and Troubleshooting, Microsoft SQL Server 2012 Internals*
- **Microsoft Certified Master: SQL Server 2008**
- **SQL Server MVP since October 2008**
- **Author of Using Extended Events whitepaper on MSDN**
- **Developed Extended Events Manager SSMS Addin for SQL Server 2008 Open Source project on Codeplex**
- **Member of the Tampa SQL Server User Group and PASS**

Author/Instructor:
Erin Stellato

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- **Principal Consultant, SQLskills.com**
  - Email: Erin@SQLskills.com
  - Blog: https://www.SQLskills.com/blogs/Erin
  - Twitter: @ErinStellato
- **Data Platform MVP since January 2012**
- **PASS volunteer since 2010**
- **12 years working for software vendors, helping to support customer implementations in a variety of ways**
- **13 years as a SQL Server professional**

M1: Creating a Foundation for Tuning/Optimizing

- How we approach tuning and optimization
- Server, instance, and database settings
- Checking system health
- Methods for analyzing performance

M2: Extended Events

- **Transitioning from Trace/Profiler to Extended Events**
- **Extended Events core concepts and architecture**
- **Target practice**
- **Event session basics**
- **Actions, predicates, and system health**
- **Extended Events UI**
- **Appendix**

M3: Wait Statistics

- **How thread scheduling works in SQL Server**
- **Fundamentals of waits, latches, and spinlocks**
- **Investigating waits, latches, and spinlocks using DMVs**
- **Common scenarios, including:**
  - Data and log file I/O
  - Latch contention in tempdb and user tables
  - Parallelism
  - Quantum exhaustion

M4: I/O Concepts and I/O Subsystems for DBAs

- **Defining storage terminology**
  - IOPS, MB/sec, Latency
- **Magnetic vs. Solid State Drives (SSDs)**
- **RAID configurations**
- **Storage Area Networks**
- **Configuring drives in Windows**
- **Testing with Diskspd and Iometer**

M5: SQLOS Scheduling and CPU Performance Tuning

- **Understanding Windows scheduling**
- **Server hardware and NUMA**
- **CPU scheduling under SQLOS**
- **DMV monitoring**
- **Troubleshooting CPU performance issues**
- **Using Resource Governor to limit CPU usage**

M6: Analyzing Query Performance

- Capturing changes in query performance
- Capturing and analyzing plans
- Common operators
- Essential information in a plan

M7: Putting New Features Into Practice

- Columnstore
- In-Memory OLTP
- Cardinality Estimator
- Query Store plan forcing / automatic plan correction
- Distributed Replay

M8: Plan Cache

- **Understanding plan cache**
  - Statement execution
    - sp_executesql
    - Dynamic string execution
  - Query fingerprints $\Rightarrow$ the cumulative effect
  - Reducing plan cache pollution
- **Understanding/optimizing stored procedures**
  - Stored procedure creation
  - Stored procedure coding best practices for performance
  - Stored procedure execution
  - Stored procedure recompilation/optimization

M9: Index Analysis
(*short review for those of you who took IEPTO1 long ago*)

- **Nonclustered indexes: key to better performance**

- **Indexing for performance:**
  - During design
  - During QA
  - In production

- **Key production strategy – an ordered approach:**
  1. Index cleanup
  2. Index health
  3. Missing indexes

M10: SQLOS Memory Management and Memory Performance Tuning

- **SQLOS Memory Manager**
  - SQL Server 2008 R2 and earlier
  - SQL Server 2012 and higher
- **SQLOS memory components**
- **Configuration options for SQL Server**
- **How to identify memory issues**
- **Internal memory pressure**
- **External memory pressure**
- **Virtual address space issues**
- **Resource semaphores**
- **DBCC commands**

M11: Deadlock Analysis *(if time permits)*

- **Review of locking in SQL Server**
- **What is a deadlock (reminder)**
- **Collecting deadlock graphs**
- **Anatomy of a deadlock**
- **Reading deadlock graphs**
- **Resolving deadlocks**

M12: Performance Issue Patterns

- **11 common performance issue patterns**
- **Interactive investigation into each pattern**
    - Pulling together much of what we've discussed this week

Appendix: Data Collection and Baselining

- **Benchmark vs. baseline**
- **Data collection methods and tools**
  - Performance Monitor and Collector Sets
    - PAL tool (Performance Analysis of Logs)
  - SQL Trace
  - Analyzing trace data
  - SQLDiag
  - SQL Nexus