[Getting Started](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live)

[Course Introduction](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live)

[Hello, and welcome to Pluralsight. My name is David Berry, and this course is titled, What Every](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=0) [Developer Should Know About SQL Server Performance.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=7.5) [I don't know about you, but I hate things that are slow, slow traffic, slow lines at airport security, and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=11.5) [especially slow database queries that cause slow application performance, and I'm guessing that since](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=19.5) [you decided to click on this course, you don't care much for slow database performance either.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=25.5) [So in this course, I'm going to show you what you need to know as a developer about SQL Server to make sure](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=31.5) [that your data access code is performing as well as possible.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=38.5) [As a developer, you are probably comfortable analyzing and debugging code in languages like C# or Java,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=42.5) [but you may be uncomfortable with your level of knowledge of SQL Server, and how things work in the database.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=48.5) [In this course, I'll help you feel more comfortable when you're working with SQL Server, especially for](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=54.5) [the times that you need to diagnose and solve performance issues.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=59.5) [And this is important, because in most systems that we build our database is a critical component of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=63.5) [the overall system, and this is especially true from a performance standpoint.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=69.5) [So we really need to understand how a database like SQL Server behaves so that we can make sure that we're](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=74.5) [getting the most out of it.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=79.5) [In this course, we're going to focus on the performance aspects that we as developers have control over,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=81.5) [and that is making our SQL statements run as efficiently as possible, and making sure our applications](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=87.5) [avoid the use of some well-known data access anti-patterns that are known to cause performance problems.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=92.5) [This is going to provide a number of benefits for the applications that we write.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=99.5) [First, efficient SQL statements mean that our statements will run faster, making our applications more](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=104.5) [responsive to our users. Second, efficient data access means that our applications will be more scalable,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=110.5) [so we'll be able to support larger numbers of users and transactions on the same hardware.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=118.5) [Finally, we know today that many applications are being deployed to the cloud, either as SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=124.5) [deployed on a virtual machine hosted in the cloud, or by using a Platform as a Service solution like SQL Azure.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=130.5) [When you are hosting in the cloud, you pay for the resources that you use, so in this case if you have any](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=137.5) [inefficient SQL, it doesn't just make your applications run slow, but it actually costs more to run since](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=143.5) [you are using more resources. So as you can see, there are a lot of good reasons why we want to understand](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=149.5) [how we can access our data in SQL Server as efficiently as possible.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=155.5) [Now some people think that SQL Server performance is solely the domain of database administrators,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=160.5) [but I believe it is important for application developers to have a strong grasp of SQL Server performance](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=166.5) [concepts, so let's discuss this next, why you as an application developer should learn about SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=171.5) [performance.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=0&mode=live&start=178)

[Why Application Developers Should Understand SQL Performance](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live)

[There are a number of good reasons why you as an application develop should understand SQL Server performance.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live&start=0) [One of the best reasons is that it is usually the app team that is responsible for the overall experience](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live&start=7.908) [of using the app, and we all know that the application performance is a big part of the user experience.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live&start=12.908) [If your app is slow and unresponsive, or can't scale to meet the number of users it needs to, your users](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live&start=19.908) [are likely going to look at you first to address these issues. Second, as an application developer, we have](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live&start=25.908) [a view, not just of the application code, but also what the use cases for the application are, the data](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live&start=32.908) [that is being stored and accessed, and the SQL that is being used by the application.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live&start=39.908) [Most important, we have a view of how all of these pieces fit together into the different features of our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live&start=44.908) [application, and how those features are used by our users. When we look to tune a SQL statement or add](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live&start=49.908) [indexes to our database, it is always best if we understand the larger context that our SQL is running in,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live&start=56.908) [namely, what the application is trying to do and how it is trying to do it.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live&start=63.908) [So our knowledge of how the application works is really a benefit to us in this case.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live&start=68.908) [Finally, there will no doubt be times when you need to work closely with the DBA team at your company.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live&start=74.908) [This might be to troubleshoot an issue with your application, or do some database design work, or another reason.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live&start=80.908) [By better knowing how SQL Server works, you'll be able to engage more effectively with your DBAs.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live&start=87.908) [You'll be able to work together more effectively analyzing problems, and you will better understand what](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live&start=92.908) [tools are available and how they can help solve these problems.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=1&mode=live&start=97.908)

[What You Will Learn](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live)

[Let's take a moment to cover what you will learn in this course.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=0) [In this first module, I'm going to cover what tools you need, and how you can install the sample database](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=5.2) [so you can follow along in the course. I'm also going to very briefly cover a couple of basic SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=10.743) [concepts, just to make sure that you're familiar with them. Then we will work to understand how SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=16.743) [processes SQL statements sent to it by your application. Once we understand what SQL Server is doing with](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=22.743) [our SQL statements, we'll be able to understand what changes we need to make in order to get the best](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=29.743) [performance we can out of SQL Server. Next, we're going to take a look at database indexing.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=34.743) [Good database indexes are really the key to performance in SQL Server, because an index helps SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=41.743) [find the data your application needs very quickly and efficiently, so we'll make sure you know how indexes](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=47.743) [work and what you need to index in your database for your application.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=53.743) [Next we're going to talk about some of the performance information that is stored inside of SQL Server that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=59.743) [can be helpful to us. SQL Server stores all kinds of data about how our statements, and how the database in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=63.743) [general is performing, so if we just know where to look, SQL Server will tell us exactly what our biggest](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=69.743) [bottlenecks are, and what exactly we should be concentrating on fixing.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=75.743) [After this, we're going to talk about how we can profile all of the SQL that our application is running](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=81.743) [against SQL Server. When we do this, we not only capture what statements are being run, and in what order,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=86.743) [but SQL Server will also give us detailed performance information about each statement,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=93.743) [so this can be really useful when we're trying to solve performance issues.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=98.743) [Finally, we're going to talk about some application practices, both in terms of practices you want to make](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=103.743) [sure that you follow, and some practices that you want to make sure that you avoid.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=108.743) [Now that we understand what we're going to learn, let's talk about what tools you will want to have installed](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=113.743) [in order to follow along in the course.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=2&mode=live&start=118.743)

[What Tools You Need](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live)

[In this course, you're going to see me work against a local copy of SQL Server Express 2014.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=0) [However, the lessons and techniques in this course will also be applicable to SQL 2008, 2012, and SQL 2016.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=6.81) [In places where there are minor differences in how you do something, I'll be sure to point those out.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=16.81) [Finally, if you're using SQL Azure as your backend database, again, no worries.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=22.81) [The tools and techniques you see here will still apply. Again, where there are minor differences, I'll make](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=27.81) [sure to point those out.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=33.81) [Now you might think that to really understand SQL Server performance you need a bunch of fancy tools that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=36.81) [are going to cost thousands of dollars, but that just simply isn't the case.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=42.81) [In fact, all the tools we're going to use in this course you probably already have installed on your work](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=47.81) [station, because they are part of the SQL Server client installation.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=52.81) [So if you already have tools like SQL Server Management Studio installed, you're going to go for the course.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=57.81) [What I will be showing you in this course are some features in Management Studio that you may not be](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=64.81) [familiar with. I'll also show you how we can query performance data out of SQL Server's dynamic](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=68.81) [management views, again, from Management Studio, and how we can use Management Studio to set up event traces.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=74.81) [So just by having the basic SQL Server client tools installed and knowing how to use them, you will be able](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=81.81) [to accomplish almost all the performance tuning that you ever need to.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=87.81) [If you want to download SQL Server Express so that you can install the sample database and follow along,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=92.81) [I suggest you head over to this page on Scott Hanselman's blog in order to get your copy of SQL Server Express.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=98.81) [If I scroll down a little bit here, we'll see these first set of links, and these will download a package](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=105.81) [that contains both SQL Server Express and the client tools all in the same package.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=111.81) [You just need to select the appropriate platform for your needs.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=116.81) [We also see that there's a place where we can download just Management Studio if that's what you're](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=120.81) [interested in. Now speaking of demos, I have a sample database for this course that's based on a fictional](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=125.81) [university that all of the demos are based off of, so next I want to show you how you can download a copy](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=132.8) [of that database and get that imported into your instance of SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=3&mode=live&start=138.3)

[Installing the Sample Database](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live)

[I prepared a sample database which I'll use throughout the course, and this database has enough data in it](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=0) [so we can do some performance tuning on some SQL statements and really get a feel for how things work.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=6.78) [So first you're going to want to download the sample database, and you can use this link to do so.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=12.78) [What that is going to do is take you to this blog post, where you'll be able to download the appropriate](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=17.78) [file for the version of SQL Server that you have. This is going to download a zip file, and inside that zip](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=22.78) [file there will be a SQL Server backup file called students.bak, and this is the file that we're after.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=29.78) [So we'll take this, and we'll restore this file in SQL Server to create our sample database.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=36.78) [To do this, you will want to go into SQL Server Management Studio, and then on the Databases folder we're](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=43.78) [just going to right-click, and we'll select Restore Database. That's going to bring up this dialog box here,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=49.78) [and we want to choose the second radio button, which is Device, and then we'll click on these three dots here](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=57.78) [to find our file. Then we'll click Add, and this will bring up a file explorer here, and I have my file out](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=63.78) [here in the C drive underneath SqlBackups. So here's that file that I unzipped, so I'm going to select this.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=72.78) [I'll say OK. Everything looks good here, so I'll say OK again, and then this is going to go ahead and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=82.78) [start the restore process. So now you can see that I have this database, and I can access this, and I](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=90.78) [have my tables in here, and I can use this just like any other database on my system.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=97.78) [So now that we have the sample database installed, I want to take a few minutes to cover some basic](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=103.78) [SQL Server concepts you'll need to understand around tables and indexes before we dive into analyzing SQL](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=108.78) [statements in the next module, so we'll go ahead and do that next.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=4&mode=live&start=114.78)

[Table Concepts](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live)

[I want to take just a moment to go through a couple of SQL Server concepts that will come up over and over](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=0) [again throughout the course to make sure that you are familiar with them.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=5.837) [We've all worked with tables in SQL Server, but we may not have given much thought to how SQL Server actually](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=10.837) [stores the data inside of a table. Typically, table data in SQL Server is stored in what is called a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=16.837) [Clustered Index Structure. This means the data in the table will be stored in a tree-like structure like](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=23.837) [you see on your screen. At the bottom of this tree we have what are known as the leaf nodes of the tree,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=29.837) [and this is where the actual data rows for your table are stored.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=35.837) [Each of these leaf nodes is what is known as a page in SQL Server, and a page is 8 KB in size.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=40.837) [Depending on the size of the rows a table contains, each page will generally store somewhere between 50 to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=47.837) [a few hundred rows of data inside of it. What is important to know is that the data in these bottom nodes](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=52.837) [of the tree is actually stored in sorted order, and that sort order is determined by what is called the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=59.837) [cluster key of the table. By default, the primary key of the table will be the cluster key in SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=65.837) [By having the data in sorted order in these bottom nodes, SQL Server can maintain this tree structure like](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=74.837) [you see over the top of the data. The nodes at the top of the page allow SQL Server to quickly traverse the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=81.837) [tree and find the data it's looking for, as we'll see in an example on the next slide.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=87.837) [In the sample database, I have a table named Students, and the primary key of the students table is the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=93.837) [StudentId column, so StudentId would be our cluster key in this case.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=99.837) [What that means is that down here in my leaf nodes where the data is stored, my student data would be in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=105.837) [sorted order by the StudentId. So in this example the first leaf node is going to be storing the data rows](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=110.837) [for students 1-100, the second node will be storing the rows for students 101-200, and so on.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=117.837) [In these top two levels of the tree, we have a series of pointers that help direct us to the data.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=125.837) [So let's say now that we want to find the row for student number 327.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=131.837) [We start up here at the root node, and it will tell us that we need to go to the intermediate node that is on](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=135.837) [the right-hand side. Then, in the intermediate node it will tell us that we need to go to the leaf node that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=140.837) [is second from the left, and it is in this leaf node where we will find the data that we are looking for.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=147.837) [So you see, we were able to traverse this tree in just three operations.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=154.837) [Even for tables that have hundreds of thousands or even millions of rows in them, by using a tree structure](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=159.837) [like this, SQL Server is able to find the data it is looking for in just a few operations.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=165.837) [This tree structure that SQL Server uses for storing data is very efficient as long as we are looking up data](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=172.837) [by how the data is sorted in the table, in this case by the primary key, which is the StudentId column.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=178.837) [However, we often need to be able to look up data by some other criteria, say in this example we want to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=185.837) [search for a student by their first and last name, and this presents a problem.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=192.837) [Our data down here in the leaf nodes is sorted by StudentId, but there is no correlation between a student's](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=197.837) [id number and their name. Student names will effectively have a random distribution throughout all of the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=204.837) [data pages at the bottom of the table, so we have no idea where a particular name may be.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=210.837) [So what SQL Server will do in this case is perform a scan of the structure, meaning it will read each and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=217.837) [every one of these data pages here at the bottom of the clustered index structure looking for the data that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=223.837) [matches your criteria.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=229.837) [For a table of any significant size, though, you will have hundreds or even thousands of these data pages](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=232.837) [at the bottom of the tree. Most likely, many of these would need to be read off of disk, so there's a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=239.837) [significant I/O cost, and then SQL Server will have to expend a lot of CPU in order to read through each and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=245.837) [every row. What we can do, though, is we can create an index on our table though to help SQL Server find](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=251.837) [that data more efficiently, so we'll talk about that next.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=5&mode=live&start=257.837)

[Index Concepts](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live)

[A database index helps us quickly find data in a table when we are searching for data by some other criteria](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=0) [other than the cluster key that our table is organized by. For the example that we just talked about,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=7.137) [searching for students by name, we would want to create an index on the students table over the LastName and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=13.137) [the FirstName columns. As you see, an index uses a tree structure just like our table, but in this case](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=18.137) [the entries in the index are sorted by the index key, which in this case is the combination of the LastName](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=26.137) [and FirstName columns, and the index does not contain the actual data rows.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=32.137) [Instead, in the bottom nodes of the index that are represented in blue here and marked with an RP, the index](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=39.137) [will contain row pointers back to the table, which indicate where the corresponding data in the table is located.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=45.137) [If we zoomed in onto one of the bottom nodes in the index, it would look something like this.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=53.137) [We see here that we have the key of the index, the LastName and the FirstName of the student, and those are](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=59.137) [in sorted order, and then we have the StudentId value for that student.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=65.137) [So, for example, if we have a SQL statement with the WHERE clause that you see on your screen, where we're](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=71.137) [searching for this student by name, SQL Server will first traverse the tree structure of the index to find](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=77.137) [the StudentId number, and then it will traverse the tree structure of the table to locate the data for](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=83.137) [that student. So there are actually two operations that must occur, but each of these operations is very](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=90.137) [efficient, and it usually turns out to be much faster to do these two operations traversing the tree](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=96.137) [structures than to scan through all of the rows of a table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=101.137) [We also can, and often do have multiple indexes on a table in order to cover the different ways our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=106.137) [application might search for data in that table. So if we think about a Students table, we might want to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=112.137) [find a student by their name, as we just talked about, or perhaps by their email address.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=119.137) [So in this case we would create two separate indexes on the Students Table, each index being targeted at](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=125.137) [a way that our application searches for data in the table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=131.137) [So what all of this means is that if your SQL statement is using some criteria to locate data other than](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=135.137) [the primary key, we're going to want that statement to use an index.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=141.137) [This way, we can take advantage of the tree structure of the index to quickly find the pointer to the data](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=146.137) [that we need, and this is much more efficient, and therefore much faster, than having to scan through all](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=151.137) [of the rows in the table. So we'll talk extensively in the upcoming modules in this course,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=156.137) [first how to tell what our SQL statements are doing, next how we can make sure that they're using an index,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=162.137) [and finally how we can design good indexes in our database that the SQL statements in our application will](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=168.137) [actually use.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=6&mode=live&start=174.137)

[Summary](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=7&mode=live)

[In this introductory module, we talked about why it is important for you as an application developer to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=7&mode=live&start=0) [understand SQL Server performance. Almost every application written is going to use a database backend](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=7&mode=live&start=6.726) [in some way, and the database is almost always an important component of overall application performance.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=7&mode=live&start=13.726) [Since we as application developers understand what our application is trying to do when it runs a statement](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=7&mode=live&start=19.726) [against SQL Server, we can be very effective at database performance tuning once we know what to look for,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=7&mode=live&start=24.726) [because we understand the larger context that all of our SQL is running in.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=7&mode=live&start=30.726) [We also covered the tools that you need to analyze SQL Server performance, and the good news is, these](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=7&mode=live&start=35.726) [tools are most likely already installed on your workstation. Then we discussed how to get the sample](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=7&mode=live&start=40.726) [database downloaded and installed so you can follow along throughout the course.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=7&mode=live&start=46.726) [And finally, we covered some basic concepts around how SQL Server stores data in tables, and how indexes work,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=7&mode=live&start=51.726) [so that we have a solid understanding of these fundamentals for the future modules in this course.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=7&mode=live&start=57.7) [From here, we're going to start looking at how to analyze the performance of individual SQL statements in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=7&mode=live&start=64.2) [the next module.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m1&clip=7&mode=live&start=68.726)

[Analyzing SQL Statements for Performance](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live)

[Introduction](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live)

[Hello, my name is David Berry, and welcome to this module about Analyzing SQL Statement for Performance.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=0) [So you have a SQL statement that is running slow, or maybe you just have a statement that you aren't sure](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=9.5) [is optimized correctly, and you need to know what to do next. That is what this module is all about,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=14.5) [understanding how to analyze your SQL statements to tell what they are doing and how they are performing](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=21.5) [in a very quantitative way. The first step in this process is to have SQL Server give us an execution plan,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=26.5) [which is the detailed steps of how SQL Server will run our statement when we submit it to the database.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=33.5) [We'll then understand how to read the plan that SQL Server gives back to us, and how we make sense of what](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=40.5) [SQL Server is telling us from a performance point of view. We'll also see how SQL Server calculates a cost](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=45.5) [value for each statement, and in fact for each operation within a statement, and by looking at these cost](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=52.5) [values we can tell what statements and operations are relatively more expensive than others.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=58.5) [We'll also see how SQL Server can give us execution statistics on our statements, and this means the amount](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=65.5) [of CPU and I/O that the statement is consuming. What all of this allows us to do is to understand in a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=71.5) [very quantitative way how expensive a SQL statement is, and then when we start tuning that statement we have](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=78.5) [some very good metrics in place to judge just how much we have improved the performance of that statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=85.5) [I'm also going to talk a little bit about how it is sometimes possible to improve the performance of a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=91.5) [SQL query just by changing the way that you write your SQL, and I'll show an example of this.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=95.5) [And finally, one of the keys to analyzing SQL statements for performance is to understand how SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=102.5) [is processing your query, so I'll briefly talk about the most common operations that you'll see in an](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=107.5) [execution plan, and highlight the ones that you especially want to watch out for.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=114.5) [So let's jump right into an example of a SQL query that isn't performing quite the way that it should,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=119.5) [and see how we work through analyzing and fixing this statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=0&mode=live&start=124)

[Understanding How SQL Server Will Execute a SQL Statement](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live)

[I have a SQL SELECT statement here in my editor window that we're going to use to introduce the concepts](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=0) [around execution plans and how to analyze a SQL statement. You can see the output of this statement in the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=6.899) [results pane, and what this statement is doing is it's selecting all of the courses that a particular student](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=12.899) [has taken with the title of the course, the number of credits, and the grade that the student received.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=18.899) [To get this information, we need to join three tables. We need to query the Course Enrollments table to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=24.899) [get what courses this student has taken and what grade they received, and then we'll need to join through](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=29.899) [the Course Offerings table to get to the Courses table so we can get the course number and course title](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=34.899) [and credits. So you might imagine a query like this being run on a web page that produces a grade report](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=40.899) [for an individual student. So I'm going to go ahead and run this query real quick, and we do see that that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=46.899) [did take a few seconds to run, so maybe you've identified this query as something you need to take a look at,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=53.899) [and we want to figure out how we can make this query run faster, so the first step in that process is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=59.899) [to have SQL Server give us the execution plan that it's using to process the query.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=65.899) [And to do that we're going to go up to this button on our toolbar with the three boxes and a little icon](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=69.899) [in it that looks like a server, and this is labeled Display Estimated Execution Plan, and so as you can see](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=75.899) [if I mouse back over that and the tooltip comes up, you can also use a keyboard shortcut of Ctrl L.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=82.899) [Now clicking this button is not going to actually execute the statement that is in the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=88.899) [window, it's just going to send the statement to SQL Server to ask SQL Server to return back to us the plan](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=92.899) [that it would use to run the statement, so let's go ahead and do that.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=98.899) [And so now down here we see in our results pane, instead of the data coming back for this query, we see a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=103.899) [graphical representation of the execution plan. What SQL Server has done is it's taken our statement and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=111.899) [it's broken it down into the individual steps that SQL Server is going to have to perform when it executes](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=117.899) [this statement, and each of these steps is represented by one of these icons that you can see down here in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=123.899) [the bottom. How did SQL Server arrive at this plan? Well, it looked at the tables our statement is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=128.899) [accessing, and any indexes that are on those tables, and what we're trying to do in our statement, and it](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=134.899) [very quickly compared all of the different options for how our statement could be processed, and it](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=140.899) [determined that this set of operations in this order was the most efficient.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=145.899) [When we have a statement that we don't think is performing the way that it should, the first thing that we want](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=150.899) [to do is we want to pull up the execution plan like this and understand what steps SQL Server is performing,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=155.899) [and if any of these steps are inefficient and time-consuming, if there's anything we can do about those steps](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=161.899) [to affect them or affect this overall plan and get them to be more efficient.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=166.899) [This is just like if you're troubleshooting a slow code in a language like C# or Java.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=171.899) [You would go and find out what steps are being executed in that program, and figure out if any of those](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=176.899) [steps was a bottleneck or could be executed faster, and what you could do speed things up, and really the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=181.899) [same thing that we're doing here. So next we're going to understand how to read and understand this execution](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=186.899) [plan that SQL Server has given us, and that'll give us some clues about how we can make this query run faster.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=1&mode=live&start=192.899)

[Reading and Interpreting an Execution Plan for a SQL Statement](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live)

[I've enlarged the portion of the screen devoted to the execution plan, and I've zoomed in a little bit to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=0) [make this plan easier for us to read. To read an execution plan, we want to work from right to left and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=5.832) [from top to bottom. You can think of this as though the operations in the right are getting executed first,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=11.832) [and then as we move to the left these intermediate operations will build upon the already completed](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=18.832) [operations, and eventually we'll get to this upper left-hand corner, which represents our complete statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=23.832) [This isn't quite 100% accurate, since SQL Server will parallelize parts of our statement for us, such that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=30.832) [things aren't strictly sequential, but for analysis purposes it's easiest if you think of things happening](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=37.832) [serially starting from the right and moving to the left. So we'll start out on the right with this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=42.832) [Clustered Index Scan operation, and we can see that on the second line this operation is occurring against](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=49.832) [the Course Enrollments table. We can also see on the third line what percentage of the total cost of the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=55.832) [query this particular operation accounts for, and we see that this is 87% in this case.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=62.832) [So that immediately signals to us that when we get to the point of tuning the statement, this is an operation](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=68.832) [that we're really going to want to take a long look at. In this case, I'm going to go through each operation](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=73.832) [in the execution plan so you can get a feel for how to read these plans that SQL Server gives you,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=79.832) [but a lot of times, what you will do is you will bring up an execution plan and look for the operations that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=84.832) [are accounting for the highest percentage of the overall statement cost, and immediately focus in on those.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=90.832) [So this cost percent can really serve as a quick filter of what you want to look at.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=96.832) [If I mouse over any operation, I'll get a pop-up tooltip that's going to give me some additional detailed](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=101.832) [information on that particular operation. So we see at the top of this tooltip we have the name of the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=108.832) [operation again, and then right below that we have a little bit of a description of the operation that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=114.832) [SQL Server gives us. In this case, we want to remember that a Clustered Index Structure is the typical way](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=120.832) [that data in a table is stored in SQL Server, so the word scan indicates that SQL Server is reading the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=126.832) [entire clustered index. So what that means is that in this operation SQL Server is reading every row in the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=132.832) [Course Enrollments table, and that's a table that has 3.7 million rows in it.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=140.832) [When you're reading execution plans, this is actually something that you want to look for is if you have](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=146.832) [any clustered Index Scan operations on tables that you know contain a lot of data, because what a Clustered](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=151.832) [Index Scan really means is that you're reading all of the rows in that table, and for large tables that,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=157.832) [of course, is going to be very expensive and take a lot of time.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=162.832) [So knowing this, that we're processing 3.7 million rows in this operation, we have a good idea already of why](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=166.832) [this particular operation is accounting for 87% of the cost of the statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=173.832) [Now you might ask, what rows are we trying to find in this table, and that can be answered by looking at](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=178.832) [the predicate data on this pop-up, which is down here at the bottom.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=183.832) [So you see our Where clause for the statement, and what is happening is that we're trying to find the rows](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=187.832) [for this particular student, but as we just talked about, we're having to look through all of the rows in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=192.832) [the table to do that. We can also get an estimate of how many rows SQL Server expects to find in this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=197.832) [operation, and that's given by the Estimated Number of Rows value which is shown up here.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=203.832) [The way that SQL Server calculates this is because SQL Server keeps some statistics on each table in the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=209.832) [database, and these are statistics like how many rows are in the table and what the rough distribution of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=214.832) [data in that table is. SQL Server uses that information in order to form its execution plans, and that's](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=219.832) [also helpful to us here, because it tells us that SQL Server is only expecting to find 45 rows, even though](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=226.832) [we know that it's reading a very large number of rows from this table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=232.832) [The final items I want to talk about in this pop-up are these items that are labeled with the word cost,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=237.832) [and you see that there are four of them here. Cost is just a value that SQL Server uses to express how](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=242.832) [expensive a particular operation or entire statement is compared to another statement or operation.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=248.832) [As you see here, there is a CPU cost, which reflects how much CPU this operation is going to use, and an I/O](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=255.832) [cost, reflecting how expensive the I/O is for this operation. So basically what SQL Server has done is it's](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=261.832) [taken the amount of CPU it thinks this operation will consume and the amount of I/O, it's taken those values](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=268.832) [and it's normalized those amounts against a scale, such that it can add each of those values together and get](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=273.832) [a single value which represents how expensive this operation is, and that's what we see on this Estimated](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=279.832) [Operator Cost line. Now we'll also get a cost for an entire statement, which if we go over here and we look](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=285.832) [at the select in the upper left-hand corner we get, we see that the Estimated Subtree Cost is 14.9 here,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=291.832) [and we can use this value so that we can compare the relative expense of running this statement versus other](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=298.832) [statements that we have, and that helps guide us about what are our most expensive SQL statements, and which](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=303.832) [statements that we should tune first. So let's go ahead and continue to read this execution plan and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=308.832) [understand what it's doing. So we just read the Course Enrollments table, and we got out the records for](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=314.832) [a particular student in there, and then if we come over here to the left we see this Nested Loops join,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=321.832) [and we can mouse over this, and from the description it says that we're going to take each row in that upper](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=327.832) [data set, and we're going to probe the lower data set in order to get that information.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=332.832) [So this is what is doing our join between these two tables. If we go back over here, we see that this is the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=339.832) [Course Offerings table, which is down here on the bottom. Now this is a Clustered Index Seek operation,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=344.832) [so it means what SQL Server is doing is it's actually using the tree structure of the Clustered Index in order](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=350.832) [to find the data, and as you see here, the cost is just 1%, and if we mouse over this, both of our cost](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=356.832) [values are very, very low for this operation. But basically what these three operations here are doing](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=363.832) [together is it's finding the data it needs in Course Enrollments, and then in joining that over to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=368.832) [Course Offerings, so now we have an intermediate data set of those two tables combined.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=373.832) [You see that we're doing a sort operation here, and we'll get to why we're doing that in a moment, but](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=378.832) [we'll come up here and look at this operation, which is a Clustered Index Scan on the Courses table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=383.832) [Now we just talked about Clustered Index Scan operations can be very expensive since a Clustered Index Scan](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=390.832) [really means that you're reading every row in the table, however, in this case the Courses table is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=396.832) [rather small, just 180 rows, and so it's actually more efficient for SQL Server just to read every row in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=401.832) [a small table like this, rather than trying to use an index, and that's what happening here.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=407.832) [If we mouse over this operation, and bring up our tooltip, we'll see that indeed the cost of reading this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=413.832) [table and just reading every row in this table is relatively low.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=420.832) [So from here, what we're going to do is we're going to take the data in the Courses table, and we're going](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=425.832) [to join that using a Merge Join, and a Merge Join is a join that can be used if you have two data sets that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=429.832) [are in the same sorted order, so that's what's happening here. And this also explains why we needed to sort](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=436.832) [our data set that was down here, because getting this in the same sorted order, then SQL Server could use a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=443.832) [Merge Join. So when SQL Server looked at the statistics of these tables and this data, it felt that a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=448.832) [Merge Join would be the most efficient choice. So finally we get up here to the SELECT box, and this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=454.832) [represents our entire statement, we already looked at this, and this has our entire cost inside of it,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=461.832) [and it also gives us an estimated number of rows. Now we know that we actually are getting more rows back,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=467.832) [again, the statistics data is just an estimate that SQL Server has, but this is basically the procedure](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=472.832) [that you use to read an execution plan. What you're going to want to do is move from right to left,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=478.832) [and then when you encounter a join operation you want to read those from top to bottom.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=483.832) [You can see what each operation is doing, and how it fits in with the operations around it, and if you want](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=489.832) [more detail, if you mouse over one of the operations you can get that pop-up box.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=494.832) [As I mentioned, a lot of times you don't have to analyze each and every operation, but instead you can just](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=499.832) [focus on the high cost operations, and that helps you understand where you want to focus your tuning efforts.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=503.832) [I want to demonstrate one additional technique for analyzing a statement, and that is how we get the amount](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=510.832) [of CPU and the I/O that a statement uses when you actually run the statement, so we'll do that next.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=2&mode=live&start=515.832)

[Getting Execution Statistics for a SQL Statement](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live)

[Another technique that you'll find useful is to use the set statistics commands in Management Studio so](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=0) [so that you can get detailed I/O and CPU statistics about a statement being run.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=5.897) [To do this, we're just going to run two commands in our SQL Editor window, SET STATISTICS IO ON and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=10.897) [SET STATISTICS TIME ON, and then I'm going to go ahead and execute both of these commands.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=16.897) [So now when I run a statement I'm going to get some detailed information back in the Messages tab](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=22.897) [down here in the bottom in the results pane. So just to be clear, to get this detailed CPU and IO data back,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=28.897) [you do need to actually execute your statement. So unlike in the last segment where we looked at where](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=35.897) [getting an estimated execution plan didn't actually run the statement, this is actually going to run the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=41.897) [statement against SQL Server, so you want to be careful with any DML statements like updates or deletes,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=47.897) [because those, of course, would actually be modifying the data in your database.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=52.897) [In this case, I'm just running a select statement, so I can run that like I normally would, so I'll go ahead](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=57.897) [and do that now. I'll make sure that we get the entire statement here, and I'll execute this statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=61.897) [And so now you see that here's our results, and that actually did run a little bit quicker, and so the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=69.897) [reason that that ran quicker is because SQL Server actually has cached the data that this query needs in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=75.897) [memory, and we've executed this statement now two times. But as we're going to see if we click over here](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=80.897) [on the Message tab, this statement is still pretty inefficient, so there are some tuning opportunities,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=85.897) [so let's take a look at that. So the first set of items, which is right here, tells us how long SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=89.897) [took to create an execution plan for our statement. Remember the last module where we talked about that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=96.897) [when SQL Server gets a SQL statement submitted to it it has to break the statement up into the individual](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=101.897) [operations that it's going to run, and this is the amount of time that that took.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=106.897) [In this case, SQL Server already had an execution plan cached in memory that it could use, so this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=110.897) [actually didn't take any time at all in this case. Next we have some I/O information for the database](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=115.897) [object SQL Server had to read in order to process our statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=121.897) [As we see, there were three tables in this case that data needed to be read from, and the important number](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=126.897) [that we want to pay attention to here are the logical reads.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=131.897) [A logical read is when SQL Server has to read a page either from memory or disk in order to process the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=135.897) [statement, so it really helps to indicate how much data is having to be processed in order to run the statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=140.897) [We see here that for the Course Enrollments table that was over 12,000 logical reads that had to occur,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=148.897) [and this is because, as we saw in the last segment, SQL Server is reading the entire table to find the data](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=154.897) [that we need. Each logical read is a page in SQL Server, and remember a page is 8KB in size, so 12,000](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=159.897) [times 8KB, we can see that's quite a bit of data that SQL Server is having to process through here.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=168.897) [If we move down to the last section, it gives us the amount of CPU it took to actually execute the statement,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=175.897) [and how long that process took. Now sometimes you will see in this section an amount of CPU that is larger](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=180.897) [than the elapsed time, and what's happening in those cases is that SQL Server has used some parallel](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=186.897) [execution for at least part of your statement. As such, since you're using CPU on multiple cores, we can](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=192.897) [use more CPU time than what it actually took for the statement to run.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=199.897) [Overall, these commands do give us a good picture of the amount of resources up on the database server that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=203.897) [are being used by this statement. Of course, what we're aiming for is that for each one of our statements](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=209.897) [we want to minimize this number, and so what I myself do is I really focus on this number of logical reads.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=214.897) [A high number of logical reads often indicates a statement is inefficient, because it's reading a bunch](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=221.897) [of data that ultimately it's going to filter out and throw away in some other operation in the statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=226.897) [I also find that when you're reading a lot of data in terms of a lot of logical reads, that tends to consume](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=232.897) [a lot of CPU and ultimately those statements take longer to process.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=236.897) [So between the execution plan we saw in the last segment and these execution statistics, we have a pretty](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=241.897) [good idea of what's going on in this statement, so in the next clip we're going to actually start working](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=247.897) [on this and tuning this statement to make it run more efficiently.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=3&mode=live&start=252.3)

[Improving Statement Performance by Adding an Index](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live)

[I've brought the execution plan of our SQL statement back up, and by now we realize it's this operation here,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=1.587) [the Clustered Index Scan, that is responsible for most of the cost of this SQL statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=7.5) [As we've discussed, this operation is reading all 3.7 million rows, which is 12,000 pages from the table](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=13.587) [just to find the handful of rows that we need for one student, so there's a lot of waste here.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=20.587) [So what can we do? Well, actually, you've probably noticed that SQL Server has been giving us a hint, and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=25.587) [it's telling us that we really need to create an index on this table, so I'm going to right-click on this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=31.587) [recommendation and go to the Missing Index Details so that we can see exactly what it's telling us.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=37.587) [In this case, the suggestion is to create an index on the StudentId column in the Course Enrollments table,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=45.587) [and that's exactly what we want to do. If we look back at our statement, we're using the StudentId column](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=51.587) [as a filter so we can find just one particular student, and if we think about this table in the larger](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=57.587) [context of our application and how it might be used, it's going to be a pretty typical use case that we have](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=62.587) [a StudentId, and we want to find all of the courses that that student is enrolled in.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=67.587) [So creating an index on the StudentId column of the Course Enrollments table, will allow us to quickly search](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=72.587) [for course enrollments by StudentId, and that makes a lot of logical sense, so let's go ahead and get this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=78.587) [index created. So I just need to uncomment this, and then go up here and I'll have to give this index a name,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=84.587) [and this is just how I like to name indexes, you actually can give it any valid name that you want to,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=97.587) [and then I'm going to go ahead and create this index. And so that'll take a few seconds here,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=102.587) [and there we go. And so now let's head back to our SQL statement, and we will get a new execution plan](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=113.587) [and see how things have changed. Okay, and we can see out here that that Clustered Index Scan operation](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=121.587) [has been replaced with an Index Seek, and then a Key Lookup. So if we go and we look at this here, we see](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=128.587) [the Seek Predicate now is on the StudentId, so we're using the index to look up the students, and notice](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=136.587) [the cost of this operation. It's down there around 0.003 it looks like, so this is much, much cheaper than](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=142.587) [the 12.97 value that we saw before. Now as we talked about in the first module of this course, all this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=150.587) [does here is it looks up just the information in the index, and then we have to go to the table to get the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=158.587) [actual data for those rows, so that's what this Key Lookup is here, and it's doing that with a Nested Loops join,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=162.587) [and so this is what's actually going up and looking up the data in the table so that then we get the data to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=168.587) [come out here. So we can see that the rest of the plan looks basically the same.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=173.587) [It does look like that one join operation was changed to a Nested Loops join rather than a Merge Join,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=179.587) [so apparently when SQL Server reevaluated everything it felt this time a Nested Loops join was more efficient,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=185.587) [but that's really not significant for our query. If we do look at the overall query, though, we see that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=191.587) [our estimated cost now is around 0.188, 0.1889, right in there. Remember before it was way up over 14,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=196.587) [so we've seen a significant savings here. So I'm going to go ahead and I'm going to run this query again,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=205.587) [and I still have the statistics turned on so we can see the number of I/O and the amount of CPU that it's using,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=211.587) [so I'll run this and look at the Message tab. And you can see here, first of all, on logical reads,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=219.587) [before from the Course Enrollments table we had over 12,000 logical reads, and now we're down to 134.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=226.587) [So by using that index we're traversing the tree structure of the index, we're doing much, much less work](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=232.587) [before, and that's accounting for our statement being more efficient.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=238.587) [You see down here at the bottom on the SQL Server Execution Times, we're actually showing 0 both for CPU time](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=242.587) [and elapsed time. In reality it probably isn't 0 CPU time or 0 elapsed time, it's just below the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=248.587) [measurement threshold, so again, now we have a very efficient statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=255.587) [So I'm going to take these results and put them on a slide so we can discuss them and the learnings in the next clip.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=4&mode=live&start=260.587)

[Before and After Performance Comparison](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=5&mode=live)

[I've summarized the results on this slide, and as you can see the improvement is dramatic.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=5&mode=live&start=0) [Now you might be thinking that the elapsed time only improved by a little bit more than 100 ms, but remember,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=5&mode=live&start=6.548) [I'm the only user on my laptop running SQL Server. On an actual production system, you may have hundreds](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=5&mode=live&start=12.548) [of users running statements at a time, and you may also be dealing with data sets that are much larger than](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=5&mode=live&start=18.548) [what I have in my sample database. So on an actual production system, the inefficiency of the first](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=5&mode=live&start=24.548) [statement would certainly result in a less scalable system, and would probably also result in longer wait](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=5&mode=live&start=30.548) [times for users as this inefficient query used up all of the resources causing contention on the server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=5&mode=live&start=35.548) [I've actually seen this before where a single query that was doing a full table scan brought an entire](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=5&mode=live&start=43.548) [system to its knees because the query was run often enough to consume all of the CPU on the database server,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=5&mode=live&start=48.548) [which then slowed down every other SQL statement in the application because those statements were having to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=5&mode=live&start=55.548) [wait to get on the CPU. So it really is key to keep all of the SQL statements in our application running](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=5&mode=live&start=60.548) [as efficiently as possible, especially for statements that are frequently run in our applications.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=5&mode=live&start=67.548) [With that in mind, let's look at another SQL statement that we need to tune, but in this case the answer is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=5&mode=live&start=73.548) [not to add an index.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=5&mode=live&start=79.548)

[Rewriting SQL Statements for Improved Performance](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live)

[I have another statement in my editor window, and what this statement is designed to do is to get all of the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=0) [course sections that no students are signed up for. So you might imagine a university running a query like](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=6.585) [this at the start of a semester to find any course sections that need to be cancelled.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=13.585) [To accomplish this, this query is doing a left outer join, and then looking for any course enrollment](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=17.585) [records that are null, because that indicates that no one signed up for the class.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=23.585) [We can see the results in the lower pane, and we see that we do have a couple of sections that no one has](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=28.585) [signed up for. What we are really interested in, though, is the execution plan for this query, so let's](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=32.585) [take a look at that.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=38.585) [So if I mouse over the overall query here, we'll see that there's an overall cost of 8.8, and if we look](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=41.585) [at the execution plan, it looks like that cost is being driven by the Index Seek lookups occurring against](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=47.585) [the index in the Course Enrollments table down here at the bottom.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=54.585) [So what is happening in these three operations here is in this upper operation SQL Server is reading all](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=58.585) [of the offerings for the courses in a current semester. And then through this Nested Loops join it is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=64.585) [probing an index on the Course Enrollments table, IEX\_CourseEnrollments CourseOfferingId, and looking up](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=71.585) [how many enrollments there are for that course. The issue here is that SQL Server is looking up all of the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=77.585) [enrollments for each course, when we really only need to know if there is any student enrolled in the course.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=83.585) [Since we are looking up all of the enrollments, this operation turns out to be pretty expensive, making our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=90.585) [whole query pretty expensive. Now in this case the answer is not an index, but instead, for us to change](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=94.585) [how we write this query, so let's look at an alternate approach.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=101.585) [This version of the query uses the NOT EXISTS clause to look for any course offerings that don't have any](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=109.585) [records in the Course Enrollments table, so let's go ahead and run this version.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=115.585) [And we see we get the same answer as before, so now let's take a look at the execution plan.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=123.585) [And we see, if we mouse over this query, that our overall cost for this version of the statement is quite](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=130.585) [a bit lower, down around 0.86, and if we look at the entire plan, we can start to see why.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=137.585) [so notice this Top operation here, and if we mouse over this we see the description tells us that we're just](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=144.585) [going to return the first few rows from the previous operation, and looking down at the bottom we see that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=151.585) [the expression is Top 1, so it's actually just getting the first row from the Index Seek operation, which is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=156.585) [over here to the right. So what this means is that SQL Server is reading all of the course offerings](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=162.585) [just like it was doing before, but then in the Nested Loops join what it's able to do is it's able to probe](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=168.585) [the index looking for any single row that matches the course offering id number.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=174.585) [So SQL Server doesn't have to read the data for every student enrolled in the course, it's just looking to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=179.585) [see if at least one student is in the course, and that's more efficient than getting the data for each and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=184.585) [every student enrolled. So think of this like you're searching an array of values.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=190.585) [If you can jump out of the search when you find any value that matches what you're searching for, that's](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=195.585) [more efficient than having to find every value that's a match, because once you find that first matching](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=200.585) [value of course you can jump out of the search function, and that's essentially what's happening here.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=205.585) [Now I also want to point out that SQL Server is giving me a create index recommendation here, but in this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=211.585) [case I'm actually choosing to ignore this suggestion. The recommendation here is basically SQL Server wants](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=217.585) [me to create an index on the Course Offerings table that contains every column of the table, so effectively](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=223.585) [I'd be duplicating all of the data in the table. We'll talk in an upcoming module about why this is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=229.585) [not a good idea, but I want to point this out so that you understand that when SQL Server gives you these](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=234.585) [recommendations, you want to be sure and analyze what SQL Server is telling you, and that it makes sense,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=240.585) [and don't simply create an index because SQL Server made a recommendation.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=246.585) [The main point of the two queries we just looked at, though, is that sometimes the way to improve the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=252.585) [performance of a SQL statement is to rewrite the statement in a different way.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=257.585) [A subquery can be rewritten as a join, or you might change a join to be a subquery.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=261.585) [And, as we just showed, sometimes using the where EXISTS or where NOT EXISTS clause can improve a plan,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=267.585) [because SQL Server can satisfy the condition with any record that matches the condition, instead of having](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=273.585) [to read all matching records from a table. So keep these options in mind when you tune your SQL statements.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=278.585) [In many cases, in the modern versions of SQL Server, the query optimizer is smart enough to find the best](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=285.585) [execution plan, regardless of how you write your statement, but there are a few cases where writing your](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=291.585) [statement a different way will help the query optimizer find a more efficient plan, so keep these options in mind.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=6&mode=live&start=296.585)

[Common Execution Plan Operations](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live)

[We've looked through a couple of execution plans, so I want to summarize some of the common operations that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=0) [you're going to see. When you are accessing data either in a table or in an index, these are the typical](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=6.046) [data access operations you're going to see. I'm not going to read through each one of these, but I do want](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=12.046) [to point out there are really two different types of operations that are listed here, and those are Scan](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=18.046) [operations and Seek operations. What you need to remember is that a Scan operation means that SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=23.046) [is reading the entire data structure that it is acting on, so either an entire table or an index, and that is,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=30.046) [of course, going to be expensive for any table or index that has a large amount of data in it.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=38.046) [Seek operations, on the other hand, use the tree structure that the data is laid out in, so they can very](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=44.046) [efficiently find the data that they are looking for. The takeaway is, when we are looking at an execution plan](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=49.046) [and we see Scan operations on a large table, we want to ask why a scan operation is being used, and how we](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=56.046) [can get SQL Server to change over to using a seek operation. This slide summarizes the join operations that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=62.046) [you will see SQL Server perform. We've seen the Nested Loops join quite a bit, and the implementation is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=70.046) [exactly like the name implies. Merge Joins tend to be used more infrequently, because the data for both](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=75.046) [data sets needs to be in sorted order for SQL Server to use this join.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=82.046) [If the data for one of the data sets is not already sorted correctly, then SQL Server will have to perform](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=87.046) [a sort operation first, and then perform the join. If the data is already sorted, Merge Joins tend to be](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=92.046) [very efficient, but if SQL Server has to first sort the data to use this operation, then one of the other](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=98.046) [join operations tends to be more efficient. The last type of join is a Hash Match, which is sometimes](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=104.046) [referred to as a Hash Join. This is used when SQL Server needs to join two large data sets and there isn't](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=111.046) [already some sort of key, like an index key, that can be sued to join the data sets together.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=118.046) [So what SQL Server does is it builds a hash table on the smaller data set on the join key, and then iterates](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=123.046) [through the larger data set, probing the hash table for matching values.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=130.046) [Typically, when you see a hash match join, it is a relatively expensive operation.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=136.046) [Building a hash table in memory takes time, and it can take a lot of memory.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=141.046) [Plus, as we said, SQL Server will only use a hash match when large data sets are involved.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=145.046) [So when you see a Hash Match join, you want to ask yourself why a Hash Match join is required.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=152.046) [First, is there any way to narrow down the data sets that are being joined together so that not as much](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=158.046) [data needs to be joined. For example, you might look to see if you can include a more restrictive WHERE](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=163.046) [clause in your statement to cut down on the size of the data that needs to be joined.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=169.046) [Second, a Hash Match join indicates there's no existing key, like an index key, that can be used for the join.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=174.046) [Many times this indicates that you're missing an index on one of the foreign key relationships between your](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=181.046) [tables, so adding an index may be appropriate. Again, in the next modules we'll be talking quite a bit](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=186.046) [about crating good indexes, including what columns in a table you want to be sure to index, and this usually](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=193.046) [includes any foreign key columns that your table has.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=199.046) [There are many more operations an execution plan can contain, but covering each and every one would take a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=203.046) [very long time and lead to some very boring video for you to watch.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=208.046) [If you do encounter an operation that you need to understand more about than what is provided in the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=213.046) [description that SQL Server Management Studio gives to you, then I would suggest you take a look at](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=218.046) [Grant Fritchey's book on SQL Server Execution Plans. You can use the URL in the browser bar, or the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=222.046) [shortened URL, to get to this page. And as you see, the e-book can be downloaded for free, and you actually](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=228.046) [don't even have to register. This is a direct download link here.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=235.046) [The book contains a lot of material on how to read execution plans, as well as detailed information on most](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=240.046) [of the operations that can be contained within an execution plan.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=245.046) [As a developer, you are probably not going to sit down and read this book cover to cover, but it is a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=249.046) [useful reference to have around for the times that you don't quite understand why something is working the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=254.046) [way you think that it should and need a little bit more in-depth explanation of how an operation works.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=259.046) [So with that, let's go ahead and summarize everything we've learned in this module and wrap things up.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=7&mode=live&start=266.046)

[Summary](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live)

[Let's summarize what we have discussed in this module about analyzing SQL statements for performance.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=0) [When you have a statement you need to analyze, the first step you are going to want to take is to get the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=6.579) [execution plan of that statement. Getting the execution plan doesn't actually run the statement, but just](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=11.579) [tells us how SQL Server will process the statement so we can analyze the plan for any performance bottlenecks.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=17.579) [Once you get the plan, you want to read the plan from right to left, and when you encounter a join operation,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=24.579) [you want to read from top to bottom. So you analyze operation at the top of the join first, and then the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=29.579) [operation on the bottom. The statement in each individual operation is going to have a cost value assigned to it,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=34.579) [and cost is simply a single value that combines together both the amount of CPU and I/O required by the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=41.579) [statement or the operation. With any statement, we want to focus our attention on the operations that have](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=47.579) [relatively high cost, because a high cost means that those operations are consuming a lot of resources,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=54.579) [and consequently that will take longer to complete. At a statement level, we can use the cost value to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=59.579) [compare the relative expense of executing different statements within our application, and again, we want to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=65.579) [focus our attention on the high-cost statements our application runs.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=71.579) [SQL Server can also give us detailed execution statistics about each statement we run if we use the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=77.579) [SET STATISTICS commands in Management Studio. What you want to pay special attention to is the number of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=82.579) [logical reads, as each logical read represents an 8KB page of data.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=88.579) [A high number of logical reads often represents an inefficient operation that is having to read a lot of data](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=93.579) [to find the piece of data that is really needed.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=99.579) [Once we understand what operations are causing the statement to be slow, we can start to tune the statement](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=102.579) [to improve its performance. We looked at one case where the solution was to add an index, as this allowed](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=108.579) [SQL Server to use the tree structure of the index to find the data it needed, rather than scanning the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=113.579) [entire table. We also looked at an example where we changed our SQL statement, and this is another solution](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=118.579) [you may want to consider. Sometimes changing a subquery to a join, or maybe using the EXISTS keyword,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=125.579) [helps SQL Server find a more efficient execution plan. You can also do a general evaluation of your](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=131.579) [statement and see if there is an opportunity to include a more selective WHERE clause, or possibly change](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=138.579) [your statement to where it's asking the question you want answered in a slightly different way.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=144.579) [What getting an execution plan allows you to do is to see the individual steps that have to be executed](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=150.579) [to run your statement, and to find which steps are most costly. Then you can focus in on these operations](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=155.579) [to see what you can do to make these operations more efficient.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=162.579) [One of the most important tools we have is to create good indexes on our tables that the statements in our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=166.579) [application will use, so we'll dive into the topic of how to create effective indexes in the next module.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m2&clip=8&mode=live&start=171.579)

[Building Effective Indexes](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live)

[Introduction](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live)

[Hello. My name is David Berry. Welcome to this module on Building Effective Indexes.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live&start=0) [Probably the most important step you can take to make sure the SQL in your application performs well is to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live&start=7.5) [create effective indexes on the tables in your database, and that is exactly what we are going to cover in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live&start=14.5) [this module. We are going to start off with a refresher on index terminology just to make sure some](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live&start=20.5) [definitions are fresh in your mind as we go through this module.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live&start=26.5) [Second, we'll discuss what columns in your database you want to index and why.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live&start=30.5) [Then, we're going to turn our attention to two characteristics you need to pay attention to in order to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live&start=35.5) [make sure that your indexes are effective, and those are the order of the columns in the index and the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live&start=40.5) [selectivity of your indexes. We'll move on and talk about covering indexes and include columns and when](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live&start=45.5) [those are useful, and then we'll discuss the effects of using a function in your WHERE clause, and how](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live&start=52.5) [this affects if SQL Server can use an index for your statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live&start=57.5) [After that, we'll turn our attention to over-indexing, which is when too many indexes are created on a table,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live&start=62.5) [which slows down DML statements like inserts and updates against the table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live&start=68.5) [And then we'll wrap up with a discussion about the index recommendations provided to you by SQL Server, and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live&start=73.5) [some advice on how to interpret those. We have a lot of material to cover, so let's jump right in and review](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live&start=79.5) [some index terminology.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=0&mode=live&start=85.5)

[Index Terminology Refresher](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live)

[Before we dive in, I want to take just a few seconds and refresh on some index terminology so these](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=0) [definitions are fresh in your mind as we go through this material.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=6.523) [When you look at the SQL Server documentation or any writings on SQL Server, you're going to see the terms](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=10.523) [Clustered Index and Non-Clustered Index. A Clustered Index is the structure that SQL Server stores the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=15.523) [data for a table in. Typically, a Clustered Index is built on the primary key of the table, so the data in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=21.523) [the table is arranged in this tree structure organized by the primary key.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=28.523) [So when we are talking about a Clustered Index, we are really talking about the structure that contains the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=33.523) [data for the table, and how the data is physically stored in the table on disk.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=38.523) [Any other index you create on a table is going to be a non-clustered index.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=43.523) [A non-clustered index is built over one or more columns of the table, which define the index key, and then](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=48.523) [the index also stores a row pointer to where in the table the matching rows for that index key are located.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=54.523) [In this module, when I talk about indexes, I am really talking about these non-clustered indexes, because](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=61.523) [you are going to need to query the data in your tables by columns other than the primary key, and creating](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=67.523) [effective non-clustered indexes is really the key to achieving good performance when you are doing so.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=72.523) [There are two types of operations that can be performed against an index, a scan operation or a seek operation.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=79.523) [A scan operation is going to read the entire index to find the matching values it is looking for, whereas](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=86.523) [a seek operation is going to traverse the tree structure of the index in order to find its matches.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=92.523) [When we say a SQL statement is using an index, what we really mean is that the statement is conducting a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=98.523) [seek operation against the index because this is much more efficient than a scan operation, and is really](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=103.523) [using the index as it is designed to be used. So when you examine operations against indexes in your](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=109.523) [execution plans, you really want to be looking for the seek operations.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=115.523) [If, instead, you are seeing scan operations, while SQL Server is accessing the index, it isn't really what](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=120.523) [you want from a performance standpoint, so you want to examine why you are getting a scan operation and not](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=127.523) [a seek operation. Now that we have refreshed on some fundamentals, let's talk about what columns we should](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=132.523) [be thinking about indexing in our database to deliver good application performance.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=1&mode=live&start=138.523)

[What Should I Index in My Database?](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live)

[We saw an example in the last module where we dramatically improved the performance of a SQL statement by](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=0) [adding an index to a table. By adding the correct indexes to our database up front, we are going a long way](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=6.423) [to assure that our application's data access layer will perform well from the outset.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=13.423) [So what we want to do is to understand what tables and columns we want to be indexing in our database](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=19.423) [from the start, so we can avoid any performance issues in our applications.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=23.423) [There are really two categories of columns we want to make sure to index.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=29.423) [The first set of columns we want to make sure and index are those that are used in WHERE clauses of our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=34.423) [SQL statements. Whether we are running a SELECT, UPDATE or DELETE statement, the WHERE clause is how](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=39.423) [SQL Server locates the rows we are interested in for our statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=45.423) [Having an index on the columns used in the WHERE clause means that SQL Server will be able to find the rows](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=49.423) [needed by the statement by using an index seek operation, which is very fast and efficient.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=55.423) [Now it is very possible that different statements in our application will contain different WHERE clauses](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=61.423) [when accessing the same table, like we see here. In these cases, we would want to create an additional index](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=67.423) [to support each statement, so in this case we would create a second index over email address.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=73.423) [You can imagine a search form in your application that allow a user to search for students by their name](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=80.423) [or by their email address, and these two indexes would correlate to those two different use cases.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=85.423) [Now you might also want to search for a student by their student ID, but in this case StudentId is the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=92.423) [primary key of the Students table, and SQL Server automatically creates an index on the primary key columns](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=98.423) [of the table, so we don't need to do that ourselves. But for any other way that we're going to be looking](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=105.423) [up data on a table, we're going to want to have an index on those columns in the WHERE clause that we're](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=111.423) [using to look the data up by.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=116.423) [The second category of columns that we want to make sure and index are any foreign key columns in our table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=120.423) [There are two reasons for this. First, when we join two tables together, SQL Server will look up the rows](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=126.423) [in one table and then find the corresponding rows in the second table, and to do this SQL Server is going](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=132.423) [to be searching for those matching rows in the second table by their foreign key values.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=138.423) [Second, when we query data in our applications, we are often traversing these foreign key relationships to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=144.423) [load the data that our application needs.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=150.423) [We saw an example of this in the last module where we had a query that loaded the grades for a particular](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=153.423) [student by their student ID. If we think about this query in the larger context of the application, we](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=158.423) [probably had some page in our application that the student used to log in, and once logged in, our application](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=165.423) [kept track of the student's ID number during the login session. Then, as we navigate the various pages in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=171.423) [our application, the Student ID number will be fed into various queries like the one that we see on our screen,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=178.423) [to get the data related to that student. If you've written any data access code, you realize it is quite](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=184.423) [common to query across the foreign keys in the database like this, is what we're really doing is querying](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=191.423) [across parent/child relationships. So now that we know what columns we should be looking at indexing,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=197.423) [let's understand what makes an index effective so that SQL Server can actually use it in our SQL statements.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=2&mode=live&start=204.423)

[Why Index Column Order Matters](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live)

[In any database, some of our indexes will have multiple columns, and the order of the columns in the index](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=0) [determine if SQL Server will be able to use the index, and how SQL Server can use the index.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=7.523) [So let's look at an example to understand this. I have this index that you see on your screen already](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=13.523) [created on my Applicants table, and you see the query I want to run in the editor window as well just below.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=18.523) [The query is trying to find an applicant by their last name with their state, so you might imagine a query](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=26.523) [like this being run from sort of search form in one of our applications to let an admissions counselor find](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=31.523) [an applicant. What I want to do is to point out that in the index, the column order is FirstName, LastName,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=37.523) [and then State, and in the WHERE clause of the query I have just the LastName](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=44.523) [and the State specified, so the second and third columns of the index.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=48.523) [So let's get an execution plan and see how SQL Server will process this statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=54.523) [What I want to focus your attention on is this operation here.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=59.523) [This is a scan operation against our index, and notice that I said scan operation.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=63.523) [A scan operation like this is actually going to read the entire index, so this is not going to use the tree](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=69.523) [structure of the index to find the matching keys, but instead read each and every key of the index in order](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=75.523) [to find the matching values. So this is like a big linear search through all of the keys of the index.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=82.523) [What we want to see here is a seek operation, because that would mean that SQL Server is using the tree](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=89.523) [structure that the index is organized by to find the matching keys, and this would be much more efficient.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=95.523) [The reason why SQL Server is using a scan operation rather than a seek operation in this case is because our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=102.523) [WHERE clause does not include the first column of the index, which in this case is the FirstName column.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=108.523) [If you don't include this leading column of the index in your WHERE clause, SQL Server will either not be](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=116.523) [able to use the index at all, or it may have to scan the entire index like we see here, which is not very](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=122.523) [efficient, and I'll show you some stats in this case to prove it.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=128.523) [So if we mouse over the query, we'll be able to see the cost for the entire query, and that's about 4.39.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=133.523) [And now I've already actually set the SET STATISTICS IO and TIME ON, so if run this query we'll get some](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=142.523) [additional execution stats, and we can see that this query is taking over 2500 logical reads to process,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=147.523) [and that includes reads both against the table and the indexes on the table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=156.523) [So this really isn't very efficient, so let's think about what we can do to fix this.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=161.523) [We could modify our query and make the user include a FirstName value, but this is not really very realistic.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=166.523) [The reason our user didn't include a FirstName value is probably because they don't know it, so we can't](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=174.523) [really require them to provide a value that they don't know. What we can do, though, is we can change the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=179.523) [order of the columns in our index, so let's do that. So what I'm going to do is I'm going to drop the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=185.523) [current index, there we go, and now I'm going to recreate an index, and in this case I'm going to have the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=191.523) [LastName column in the first position of the index, and the FirstName column in the second position.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=203.523) [So I'm going to go ahead and create this, and now I'll take this query and I'm going to get the execution](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=208.523) [plan again. We see now that the operation here has changed to an index seek operation, and that is what](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=215.523) [we want because it means that SQL Server is traversing the tree structure of the index to find the matching](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=224.523) [index keys. So this is going to be a lot more efficient, and we can prove that by looking at some of the stats.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=230.523) [So first we're going to look at the cost here of the overall query, and we see now that's down at 1.4,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=237.523) [so much more efficient, and if we run this query again we see that now we're only doing 188 logical reads,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=243.523) [whereas before we were doing over 2500. So, again, this is much more efficient, and the reason why is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=254.523) [because when we have those columns in the index in the right order, such that SQL Server can use the index,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=261.523) [then SQL Server is having to process a lot less data because it can directly find the data that it needs.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=3&mode=live&start=267.523)

[Applying Index Column Order Rules](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live)

[This has important implications for when we create multi-column indexes in terms of what order we should](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=0) [put the columns in. What we want to do is to think about how our users query the data in the table we are](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=6.99) [creating the index on, and what different combinations of columns are used in the WHERE clauses of these queries.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=13.99) [Then, with each combination of columns we want to put the most frequently included column as the first](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=20.99) [column of the index, the second most frequently used column is the second column of the index, and so on.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=26.99) [So in the first example on this slide, since the LastName column is always included when doing a search](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=33.99) [by name, it is in the first position in the index. FirstName is frequently included, so it is in the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=38.99) [second position, and only sometimes the State is included, so that's in the last position.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=45.99) [If the user only includes the LastName in the query, or the LastName and the FirstName, that's okay.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=50.99) [SQL Server can still use this index because we have the leading column of the index, and these columns](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=57.99) [are selective enough, which we'll talk about in a moment. Now our users might also need to search this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=63.99) [table for data in a completely different fashion as well, in this case by the state and the city that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=69.99) [an applicant is from. So in this case we need to create a second index on the table because we need the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=74.99) [State column to be in the lead position so SQL Server can use this second index.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=80.99) [So what you will end up with on your table is an index that is targeted at supporting each of the different](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=86.99) [ways that your users of your application access data on this table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=93.99) [So it's pretty typical that on the key tables of your application you'll probably have from 2-4 different](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=98.99) [indexes to support these different query combinations. The next step in the process, though, is to make sure](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=103.99) [that the indexes are selective enough so that SQL Server can use them, and we'll look at that next.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=4&mode=live&start=110.99)

[Index Selectivity Explained](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live)

[The second factor that governs how effective an index will be is the selectivity of the index, and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=0) [selectivity is simply a way of saying how many or how few rows there are in the table for each key value](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=6.615) [in the index.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=13.615) [For our indexes to be used by SQL Server, and to be effective at speeding up performance, we want our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=15.615) [indexes to be as selective as possible. That is, each value of the index key should only correspond to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=20.615) [a few rows in the table, or perhaps even only one row. Let's see why this matters.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=27.615) [We know that when SQL Server uses an index, it traverses the tree structure of the index to find the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=34.615) [matching keys in the index. When it finds the matching key or keys, it will read from the index the values](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=40.615) [of the row identifiers for the rows that match those index keys.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=46.615) [In a typical table, these row identifiers are just the primary key values of the matching rows.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=51.615) [Then SQL Server takes these row identifiers and looks up the actual rows in the table, which as we have](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=57.615) [talked about, is usually another tree structure called a clustered index.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=62.615) [So if the index is selective, we will only find a few matching values in the index that we have to look up](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=67.615) [in the table, so we're doing a small number of I/O operations overall.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=73.615) [But what if our index isn't very selective? What if for the index key we look up we get back several](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=78.615) [thousand matches? Well then we're going to have to come over to the table and look up each and every one](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=85.615) [of those rows. So that is several thousand times we're going to have to look up data in this table,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=91.615) [and since our data is probably randomly distributed throughout the table, we're going to end up reading](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=97.615) [most, if not all, of the pages in the table anyway. So in these cases, it is actually more efficient for](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=101.615) [SQL Server not to use the index and just to read the entire table anyway.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=109.615) [This way, SQL Server doesn't have to incur the I/O of reading the index, because the index isn't really](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=114.615) [helpful in terms of narrowing down what data SQL Server needs to find.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=119.615) [When we say that we want our indexes to be selective, what we are really saying is that we want them to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=125.615) [really help SQL Server target exactly where the data is that we need to find, and to do that we want our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=130.615) [index to have a high number of unique key values compared to the total number of rows in the table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=137.615) [Let's jump into Management Studio and look at some examples of this.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=5&mode=live&start=143.615)

[Index Selectivity Examples](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live)

[I've created the index at the top of the screen on the Students table, and I'm going to run the query](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=0) [that's at the bottom of the text editor, but before I do, I'm going to give you some statistics about the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=5.707) [Students table. There are about 120,000 rows in the Students table, and in terms of unique first and last](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=11.2) [name combinations, there are about 107,000 of those. So we can tell from those numbers, the combination](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=17.707) [of last and first name that this index is built on is a pretty selective criteria.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=25.707) [While we do have multiple students that have the same first and last name, overall this criteria is pretty unique.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=31.707) [The calculation that SQL Server does internally in its statistics to determine selectivity is more complex](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=38.707) [than a simple ration, but this ratio gives us a good idea of how unique the values in this index are,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=43.707) [and I find that for everyday use this simple ratio works pretty well.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=50.707) [So we would expect that SQL Server would use this index when it executes the query that we see.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=55.707) [We'll get the execution plan to see that indeed that is the case.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=60.707) [And so we see here that SQL Server is doing an Index Seek operation against that index, so indeed our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=65.707) [index is being used. If I mouse over the Index Seek operation, you see that SQL Server is expecting about](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=71.707) [25 values in the index would match this criteria, and again, SQL Server is calculating this value based on](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=79.707) [the statistics it has on the table and on the index. So its calculation is more sophisticated than our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=86.707) [simple ratio, but this is what SQL Server is expecting to happen.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=92.707) [Then it's going to come down to this Key Lookup operation and look up each one of those rows,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=97.707) [and if we mouse over the Key Lookup operation we again see that value that's about 25 in terms of the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=103.707) [number of estimated executions. So at this threshold, SQL Server has calculated that using the index is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=110.707) [the right decision, because performing the estimated 25 lookups on the table is going to be much faster](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=116.707) [than reading the entire table. Now if we ran this query we'd actually get back four rows of data, so](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=122.707) [this lookup operation actually would be executed 4 times, not 25.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=128.707) [The point is, though, that the lookup operation is only executing a handful of times, and we only need to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=134.707) [read a few data pages from the table, so we are being very targeted in the data that we read, which is what](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=139.707) [an index is supposed to give us. Let's look at a different situation though, when we don't have a selective](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=145.707) [index, and see what SQL Server does in that situation. If I go over to this other tab that I have here,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=152.707) [we see again that we have another index on the Students table that I've created, and this index is just](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=159.707) [over \_\_\_\_\_ U.S. State. \_\_\_\_\_ run the query that you see here in the bottom of the text editor, and what](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=164.707) [that's going to do is it's going to look up all of the students that live in Appleton, Wisconsin.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=169.707) [Remember, we have about 120,000 rows of students in the table, and in terms of state abbreviations, there](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=174.707) [are actually 52 distinct vales in our Students table, so we have the 50 states, the District of Columbia,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=180.707) [and maybe we have some students from Puerto Rico or another U.S. territory.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=187.707) [If we divide 120,000 by 50, we get about 2400 matches per index value in this case.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=191.707) [Now this math isn't perfect because, of course, there are some states like California, where proportionately](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=198.707) [we're going to have many, many more students than in a small state like Wyoming, but for a rough estimate to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=204.707) [start with, what this is telling us is that for having an index just on the State column, it's not going to be](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=209.707) [very selective because we're actually going to get about 2400 students back.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=215.707) [So let's go ahead and get the execution plan of this query, and see what SQL Server does with this statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=220.707) [What we see here is that SQL Server actually isn't using this index on the State column in the query,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=229.707) [and that is because when SQL Server looked at its statistics, we would be getting a lot of matches back from](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=235.707) [that index, and when you read all of those matches out of the index, and then go and look up all of those values](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=240.707) [in the table, that actually was going to be more expensive than just reading the entire table directly.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=245.707) [So SQL Server's not using our index is really telling us that in SQL Server's eyes the index isn't that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=252.707) [helpful because it's not selective enough. Now you might say that I'm not sure that I believe that,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=258.707) [I think that the index would still be more efficient, so what I'm going to do is I'm going to force](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=263.707) [SQL Server to use the index on this table, and I'm going to demonstrate to you that actually the SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=268.707) [Optimizer has made the right choice here. So to do this I'm going to modify our query to use a database hint,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=274.707) [and what this hint is going to do is it's going to tell SQL Server that I want you to use that index.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=283.707) [And normally I strongly recommend that you avoid using hints in your applications, as today the SQL](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=289.707) [Optimizer included with SQL Server is very, very good, and it almost always comes up with the correct answer](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=295.707) [in the most efficient way to execute any statement. In 99.9% of the cases today, the SQL Optimizer](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=301.707) [comes up with the right answer, so the only way I would use a hint in a production application is if I was](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=308.707) [instructed to do so by Microsoft Support, or I wanted to demonstrate something like I'm going to do now.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=314.707) [So we have our hint in there, and now once again I'm going to get our estimated execution plan, and we see](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=321.707) [now SQL Server is using the index, but if we mouse over this index we see that SQL Server thinks that it's](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=328.707) [going to get back from the index over 2300 matching keys. And if we go down to the Key Lookup operation,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=336.707) [once again, we're going to have to look up 2300 different values in that table, and this is going to turn](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=343.707) [out to be very expensive, more expensive, in fact, than just scanning the entire Students table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=349.707) [I did run both versions of this query prior to recording, one without the hint and one with the hint](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=355.707) [so I could summarize the stats and show them to you, which I'm doing here.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=360.707) [What you can see here is that by forcing SQL Server to use the index, that indeed is more expensive, and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=365.707) [what this is driven by is the fact that by just having the index on the State column, that's not selective](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=372.707) [enough. So if we force SQL Server to use the index, it's actually having to read and process more data](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=378.707) [than if it just reads the entire table directly. This is an important point.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=384.707) [Many times someone will create an index, and they think that the index they create is going to speed things](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=389.707) [up, but when they look, SQL Server isn't even using the index.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=393.707) [As we're seeing in this case, SQL Server is making the right decision not to use the index, because using](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=398.707) [the index would be more expensive, and the reason why is because of selectivity.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=404.707) [Because SQL Server has to read a large part of the index and then conduct a large number of look up operations,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=410.707) [that's accounting for roughly 3500 extra logical I/O's that have to be read and processed by SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=415.707) [So the answer here is, we need to make our index more selective, so let's do that.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=423.707) [We're going to go ahead and drop this index, and then we're going to create a more selective index, which](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=429.707) [is both over state and city. In terms of unique combinations for city and state together, there are about](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=436.707) [13,000 of those, so we're in a much better place in terms of selectivity for this index, so let's get this created.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=443.707) [Now we'll go ahead and get the execution plan again for our query, and actually we have to get rid of our hint](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=452.707) [in order to make this work because that index does not exist anymore.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=459.707) [And we see now with this more selective index SQL Server is able to use that index, because we see this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=464.707) [Index Seek operation here. If we mouse over this, we see now SQL Server is expecting to get back about 20 rows,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=470.707) [in reality it's actually going to get a few more than that, but because this index is more selective, it's](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=478.707) [something that can be used by SQL Server because we're doing a better job of targeting the data that we want.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=483.707) [One of the takeaways from this is that if we have a column that's not very selective by itself, that doesn't](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=490.707) [mean that we can't use the column in the index. It means that we probably need to be using that column](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=495.707) [in conjunction with other columns in our index, and we need to make sure that the combination of columns](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=500.707) [together is selective. Selectivity is a really important concept when we start looking at our indexes and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=506.707) [the WHERE clauses of our statements. So let's look at some other ways in which selectivity matters, in the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=512.707) [next clip.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=6&mode=live&start=518.707)

[LIKE Clauses and Index Selectivity](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live)

[One special case I want to talk about with regards to indexes and selectivity is when you use a LIKE clause](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=0) [in your SQL statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=7.13) [First, you need to know that if you use the % sign, which is the wildcard character at the front of the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=9.13) [value in the LIKE clause, then SQL Server will not be able to use an index for that column.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=14.13) [Remember, the keys in an index are in sorted order, and by having a leading wildcard character in your](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=21.13) [search value, SQL Server isn't able to use the sorted order of the data to its advantage, so in these cases](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=27.13) [SQL Server will have to resort to some sort of scan operation, either of the entire index or the entire table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=34.13) [When the wildcard character is used somewhere else in the LIKE value of your statement, as we see here,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=42.13) [this has an impact on the selectivity of your index. Basically, only the characters to the left of the % sign](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=48.13) [count in terms of selectivity for the statement and the index.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=55.13) [So in this case, maybe I'm not sure if the last name of the applicant I'm looking for is Harris](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=59.13) [or Harrison, so I'm using the wildcard character to search and try to find the right applicant.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=64.13) [And I'm doing the same thing for the first name, but in this case I only know that the first name starts](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=70.13) [with the letter T. If we get the execution plan for this statement, we see that we'll still be able to use](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=75.13) [the index, because we've specified enough characters in the value that we're searching for, but this is still](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=83.13) [selective enough. But let's look at what happens if I trim down the value that we're searching for in the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=89.13) [last name to just a couple of characters. And I'll run the execution plan again, and now we see that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=94.13) [SQL Server is doing a scan operation of the table, it's not able to use the index, and the reason why is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=103.13) [because we haven't provided enough information here that we can use the index, so really our query just isn't](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=109.13) [selective enough here. The reason I bring this up is because many times I see search pages in applications](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=115.13) [that don't enforce any sort of minimum requirements on the user in terms of the data that they must supply.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=122.13) [Now SQL Server will happily run these statements for you, they're just](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=129.13) [going to take a lot of resources, and they're going to take a lot of time to finish.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=132.13) [So selectivity is really a two-way street. First, we want to make sure that our indexes are selective.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=137.13) [Second, though, we want to make sure that we're including specific enough criteria with our WHERE clauses](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=144.13) [of our SQL statements, such that our statements are selective, and those statements will be able to use](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=150.13) [the indexes that we've created in our database. This is where we have to use our knowledge of how the user](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=155.13) [is searching for and accessing data to design good indexes, and enforce reasonable constraints on how the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=161.13) [user is going to search for data in our application. As developers, we have a good understanding of how](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=167.13) [our applications are trying to access our data, and we have a good understanding of what the data in our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=172.13) [database is, so it is really just a matter of combining this knowledge together so we have good indexes in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=177.13) [our database and we are writing SQL statement sin our application that can take advantage of those indexes.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=183.13) [Next we're going to talk about how using functions in the WHERE clauses of your statement affects](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=191.13) [SQL Server's ability to use an index.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=7&mode=live&start=195.13)

[How Functions in the WHERE Clause Affect Indexes](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live)

[Something you want to be aware of is that if you have a function on the left side or column side in your](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=0) [WHERE clause, SQL Server will not be able to use an index on the table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=6.663) [So you see here that I have an index on the table over email address, however, looking at my query, on the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=11.663) [left-hand side of the WHERE clause where we have the column definition, you can see that in this case I'm](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=18.663) [using a couple of different functions to compute the value of just the local part of the email address,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=23.663) [meaning everything left of the @ sign in the email address. If you have any sort of function over here on](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=29.663) [the left-hand side of the WHERE clause processing the values in the column, SQL Server is not going to be](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=35.663) [able to use a regular index created over the column, like we see has been created up here.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=40.663) [If we look down at the execution plan, we can see that that is the case, because we see that SQL Server is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=46.663) [doing a scan of the index, not a seek operation, so this query isn't going to perform nearly as well.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=51.663) [The reason why this is happening is because what is stored in the index are the actual email address values,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=59.663) [not the computed values, so what SQL Server has to do is to run these functions in real time while the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=64.663) [query is executing to create those computed values, and then it can do the comparison,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=70.663) [and so to do that, you're going to incur some processing cost and not have a very fast query.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=76.663) [So you want to keep this in mind whenever you see a function like this operating on a column value in the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=81.663) [WHERE clause of one of your queries. If this is something that you really need to do in your application,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=86.663) [though, there is a technique we can use to address this situation.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=92.663) [What we are going to do is we are going to add a computed column to the table, and then we're going to create](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=97.663) [an index over that computed column, and in doing so SQL Server will be able to use that index over the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=102.663) [computed column, so let's do that. So first I'm going to use an ALTER TABLE statement in order to create](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=108.663) [the computed column. So you can see in this statement I have that same formula with those two functions.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=115.663) [I could use any function I want to here, even a user-defined function.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=121.663) [The only thing that I need to remember is in order to create an index over this computed column,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=125.663) [the expression that I put in here has to be deterministic, that is, it always has to return the same value](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=130.663) [for the same inputs. So let's go ahead and get this computed column created, and now that the column is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=135.663) [created I actually can query the values back out, and I'll show those to you.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=143.663) [If we scroll over here to the right, we can see here is our computed column over here on the right,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=150.663) [and at this point what SQL Server is doing is it's just calculating the value on the fly when we request](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=155.663) [these rows out of the table in our query, hence the name computed column.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=160.663) [What we can do now, though, is we can create an index over this column, so let's do that.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=166.663) [So you see, the CREATE INDEX syntax looks just like any other index that we might create.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=172.663) [What will happen, though, is when we run this CREATE INDEX statement, is that SQL Server is going to compute](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=176.663) [all of the values of this computed column for each row of the table, and it's going to store those](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=181.663) [computed values in the index, so let's go ahead and get this index created.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=186.663) [And there we go. So now we're going to go back up to our original query and we're going to get the execution](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=192.663) [plan for that again, if I can select the right thing. And we see now, SQL Server is able to use this new](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=197.663) [index that we've created over the computed column, and I'll mouse over this so you can see that it is using,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=205.663) [indeed, that index. And the reason why is because the formula in the left-hand side of our WHERE clause](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=210.663) [matches the formula of the computed column value that the index was created over.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=217.663) [So what you want to remember is to be on the lookout for any type of function or expression in your WHERE](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=222.663) [clauses of your SQL statements on that left-hand side of the WHERE clause expression, because those won't](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=227.663) [be able to use regular indexes on your tables. However, if you do need to be able to search for data](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=232.663) [using a computed value, then you can use the technique that I've just shown you here, where you first](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=238.663) [create a computed column on the table, and then you create an index over that computed column, and that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=243.663) [will allow your statements to use an index, and consequently perform much better.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=248.663) [We've covered the fundamental aspect of indexes, but there's more to learn about, so we'll continue our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=253.663) [discussion by talking about include columns and covering indexes next.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=8&mode=live&start=258.663)

[Include Columns and Covering Indexes](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live)

[If you take a look at the SQL Server documentation, or some of the index recommendations you get back from](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=0) [Management Studio, you're going to see this syntax with the keyword INCLUDE, so let's understand what is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=5.996) [going on here. The INCLUDE keyword lets you specify that one or more column values should be stored in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=11.996) [the index with the index key, but they are not part of the index key.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=17.996) [So these INCLUDE columns can't be used by SQL Server when it searches the index, and they don't affect how](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=21.996) [SQL Server will lay the index data out in a tree structure, they will just have their values stored with](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=27.996) [the index. The reason why this can be useful is because you can create what is called a covering index](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=32.996) [by using these values. Normally, when SQL Server uses an index, it looks up the index key in the index](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=38.996) [to get a row pointer to where the data is in the table, and then it has to perform a key lookup operation](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=45.996) [to get the actual row data out of the table, and we've seen several examples of this.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=51.996) [A covering index is a term used when SQL Server can get all of the data it needs for a query from the index](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=57.996) [itself, and it doesn't need to perform the key lookup operation. There are two factors at play here.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=62.996) [One, notice that we are not using a select star in our query, but I am spelling out exactly what columns I want.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=70.996) [And two, notice that all of these columns are in the index, either as the index key or as an INCLUDE column.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=77.996) [So SQL Server doesn't need to go find the actual row in the table to read the data, because it has everything](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=85.996) [that it needs right here in the index. And we can see that down here in our execution plan,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=90.996) [because notice that we have the index Seek operation, but no corresponding Key Lookup operation like we've](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=97.996) [seen before, because in this case we already have all the data that we need.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=102.996) [If there is just one column that we don't have the data for in the index, SQL Server would have to perform](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=108.996) [the lookup operation on the table, and I can demonstrate that for you if I add the Telephone column](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=112.996) [to this query. And now I'll get the execution plan for this query again.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=118.996) [And now, since Telephone is needed by the query and it's not part of the index, the index is not a covering](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=126.996) [index for this query, and SQL Server has to go to the table to get that value.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=132.996) [If we take out Telephone and run our execution plan again, we see again, we just need the index to fulfill](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=137.996) [the needs of this query. Sometimes you'll have a query like this where you only need one or maybe two](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=146.996) [columns that are not in the index, and that you are having to go to the table to look up the values for.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=153.996) [In these cases, it can make sense to use an include column or two so that your index can cover the query](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=159.996) [and avoid the key lookup operation. If you start adding three or four or more columns as INCLUDE columns](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=165.996) [in your indexes though, then that is probably a warning that you are going a little too far with INCLUDE](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=172.996) [columns in creating covering indexes. What you are essentially doing is making another \_\_\_\_\_ skinnied-down](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=177.996) [version of your table, but what that means is that when any of those columns gets updated, SQL Server will](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=184.996) [also have to update the entries in this index to keep it up to date, so you're going to be incurring](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=189.996) [higher maintenance cost for your index by doing this.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=195.996) [If you have a query that only needs one or two columns, include columns and a covering index can provide](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=199.996) [a nice additional performance boost. Just be careful not to go overboard and include too many columns,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=203.996) [such that you basically now have another copy of your table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=9&mode=live&start=210.996)

[Over-indexing](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live)

[We have seen how indexes can speed up our SQL statements and reduce the number of resources it takes for](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=0) [SQL Server to run our statements. So you might be tempted to think that we should create indexes for most](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=6.296) [every column on most every table in our database, even if those columns are seldom used in any WHERE](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=11.296) [clauses or JOIN clauses of our statements. Unfortunately, this isn't quite the case.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=17.296) [While you want to create indexes that will be used by the SQL statements in your application, you also](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=23.296) [want to be careful not to over-index your database, and by over-index I mean create indexes that aren't](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=27.296) [going to be used by any statements in your, or any other applications that are running against your database.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=33.296) [The reason why is that indexes have a maintenance cost to them, and if these indexes aren't helping speed](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=40.296) [things up in your queries, then you are paying this maintenance cost without getting any value from these](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=45.296) [indexes. So let's understand this more.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=51.296) [When we create an index, SQL Server creates a separate physical structure that contains the data for the index,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=55.296) [namely the values of the index keys and any include columns that are stored in the tree structure of the index.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=61.296) [When any sort of DML operation is performed on the table, SQL Server has to keep all of the indexes on the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=68.296) [table in sync with the data in the table, so this means that when an INSERT or DELETE statement is performed](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=74.296) [against the table, SQL Server will also have to add or remove an entry from all of the indexes on the table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=80.296) [When an UPDATE statement is run, if the values of any of the columns in the index are modified, then the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=87.296) [index has to be updated as well. All of this has to happen when the DML statement executes against the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=93.296) [table so SQL Server can keep all of the data in a consistent state.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=98.296) [So you want to regard your indexes as investments. If an index is being used by statements in your](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=104.296) [application, and is helping speed up those statements, then the cost of the index is well worth it,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=110.296) [because for most applications the queries that the index help speed up are run far more frequently than](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=115.296) [any DML statements against the table, so the index is a good investment.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=121.296) [If, however, you have an index that is never used or is used only seldomly, you want to investigate why](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=126.296) [the index is not being used, and possibly consider dropping it, so how can you tell this?](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=131.296) [Well, SQL Server contains a number of viewed called Dynamic Management Views that give you access to all](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=137.296) [types of performance statistics and diagnostic information within the database engine itself.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=143.296) [We'll talk much more about these views in the next module, but among these views is one that gives us](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=149.296) [index usage statistics. So we can use a query like the one you see on the screen to look at the values](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=154.296) [in the user\_seeks column, and compare it to the user\_updates column, and as long as we have many more](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=160.296) [seeks than updates, we're in good shape. Otherwise, if all we are seeing are values in the user\_updates](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=166.296) [column, this indicates we are paying the cost of the index, but not getting any value out of it,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=172.7) [so it may be appropriate to drop the index. There is one more topic I want to discuss, and that is the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=178.296) [index recommendations that are made by SQL Server that we've seen pop-up throughout the module in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=184.2) [Management Studio, so we'll do that next.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=10&mode=live&start=189.296)

[Interpreting SQL Server Index Recommendations](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live)

[No doubt as you have been watching this module you have seen a number of index recommendations pop up in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=0) [Management Studio while I have been demonstrating different concepts.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=6.363) [And as you experiment with different statements that your application runs, no doubt you'll see these](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=10.363) [recommendations pop up then as well.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=14.363) [It is very useful to have these recommendations from SQL Server, but I would remind you, these are just](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=17.363) [suggestions, and you should not automatically create an index because SQL Server makes a suggestion to do so.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=22.363) [In my opinion, SQL Server can be overly aggressive with some of its recommendations, and if you follow each](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=29.363) [and every one you would probably end up with a database that was over-indexed, and therefore had suboptimal](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=35.363) [performance when it came to DML statements. Let's look at an example of this that we saw in this module.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=41.363) [Earlier, I executed this query with selected applicants based on their last name and state.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=48.363) [I already had an index over the LastName, FirstName, and State columns, which SQL Server was able to use](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=53.363) [for this query. As you can see, though, SQL Server is giving me a recommendation to create a second index](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=59.363) [over just the LastName and State columns. It is true that this second index would result in somewhat](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=66.363) [better performance for this particular variation of the query, however, since there is already an index that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=72.363) [SQL Server is able to use, and use pretty effectively, I would personally pass on creating this second index.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=78.363) [The recommendations that SQL Server gives you are based on the individual query that you are running at the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=85.363) [moment, so SQL Server will try to optimize an index for that exact query, but what you really want to do](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=89.363) [is to look at the different variations of your statements and their WHERE clauses, and come up with a set](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=96.363) [of indexes that will work across all the different combinations that you have.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=101.363) [This means a couple of variations of the statement may not be 100% optimized, but again, we have to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=106.363) [consider the trade-off around creating multiple extra indexes versus the cost that we'll have to pay to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=112.363) [maintain each of those indexes. This isn't to say to ignore the recommendations that SQL Server gives you,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=118.363) [but it is to say that you should take these recommendations just as suggestions,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=124.363) [and then it is up to you to combine your knowledge of your application, the data in the database, and the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=129.363) [suggestions, to come up with the right set of indexes for your tables.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=134.363) [Let's summarize what we've learned and wrap up this module.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=11&mode=live&start=140.363)

[Module Review](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live)

[Having effective database indexes is probably the most important factor in determining the performance](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=0) [of your applications data access layer, so in this module we talked about how you build effective](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=6.8) [indexes in your database.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=12.368) [We led off by talking about what columns you want to be creating indexes on in your database.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=15.368) [First among these are any columns that you are using in the WHERE clauses of your SQL statements, as this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=21.368) [is the way that your application locates the data that it needs.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=26.368) [Additionally, we talked about the need to index the foreign key columns of your tables to support any](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=30.368) [join operations we do, as well as the fact that often our application will query data across these foreign](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=35.368) [key relationships.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=41.368) [Once we know the columns we need to create indexes on, we need to make sure that SQL Server will actually](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=44.368) [be able to use the indexes we create. The first thing we need to make sure of is that the columns in our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=49.368) [index are in the right order, as SQL Server will not use the index if the first column in the index is not](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=55.368) [in the WHERE clause or join condition of the SQL statement. So that means, when we design our indexes](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=62.368) [we want to put the column that is most frequently used as part of our WHERE criteria at the front of the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=68.368) [index, followed by the next most frequently used column second, and so on.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=73.368) [We may need to create multiple indexes to support multiple use cases, but this is where we can use our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=78.368) [knowledge of the application and how our users query the data to determine the best column order for our indexes.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=83.368) [Secondly, we want to make sure that our indexes are selective enough.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=91.368) [The idea of an index is that it helps SQL Server quickly target a particular piece of data, so we want](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=96.368) [indexes that have relatively few rows per index key, because this really helps SQL Server zero in on](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=101.368) [the right data. If we have a column that by itself is not very selective, we can still use it so long as](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=108.368) [we have other columns in the index that make the entire index selective, and we make sure that the WHERE](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=114.368) [clause of our SQL statement is also selective.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=120.368) [Oftentimes, we need to use the LIKE clause in our statements, and in doing so we need to remember](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=124.368) [that if we use the % character at the front of the LIKE value, SQL Server will not be able to use an index](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=129.368) [on the column. If we have the % sign somewhere else in our value, SQL Server will be able to use the index](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=136.368) [so long as we make sure that we have enough information in the supplied value that it's still selective.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=143.368) [We also saw that if we have a function in the WHERE clause of a SQL statement this will also cause](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=149.368) [SQL Server not to use an index, and it is this function here on the left-hand or column side of the WHERE](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=155.368) [clause that is the problem, because those computed values are not stored anywhere, so SQL Server has to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=161.368) [read all of the data for the column and compute these values on the fly.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=167.368) [If we do have a use case in our application where we need to do something like this, and this example of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=172.368) [using the SOUNDEX function to do a phonetic search might be a good one, then what we can do is to create a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=178.368) [computed column or columns on the table, and then create an index over those computed columns,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=183.368) [and then the SQL statement we see here would be able to use the index over those computed column values.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=189.368) [We then talked about include columns and covering indexes. A covering index is when SQL Server doesn't](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=196.368) [have to perform a table look up to fulfill a query, but instead can get all the data it needs directly](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=203.368) [from the index. So if we already have all but one or two of the columns we need for a query in an index,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=209.368) [we could use an include column to make that index a covering index, which provides a little bit of an](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=215.368) [additional performance boost because SQL Server can avoid that additional lookup operation.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=221.368) [The last major topic we discussed was over-indexing. Indexes do a great deal to speed up our statements,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=227.368) [especially our queries, but they do require maintenance, as SQL Server has to keep all of the indexes on](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=234.368) [a table up to date whenever a DML statement is executed against that table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=239.368) [So we want to make sure that we only create indexes that are really being used by the statements in our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=245.368) [application so we don't have an adverse impact on any DML operations that we may have.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=249.368) [That wraps up our discussion of indexes. In the next module I'm going to show you how to find performance](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=256.368) [bottlenecks in SQL Server using SQL Server's built-in Dynamic Management Views.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=262.368) [These views contain all sorts of useful performance information, like what statement is taking the longest](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=268.368) [to execute, and if SQL Server thinks that we are missing any indexes that would improve performance.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=273.368) [Knowing what information is available in these views, and how to access them, can really speed up your](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=279.368) [performance troubleshooting process, so I hope you'll join me in the next module.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m3&clip=12&mode=live&start=284.368)

[Finding Performance Bottlenecks in SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live)

[Introduction](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live)

[Hello. My name is David Berry. Welcome to this module on Finding Performance Bottlenecks in SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=0) [One of the best features about SQL Server is that internally it is always taking data about SQL statements](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=9) [that are being run in the database and other events that are happening, and we can access this data to give](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=16) [us an overall picture of what is happening inside of SQL Server with regards to our application.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=21) [For example, SQL Server will give us statistics on all of the SQL statements that have been executed in our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=27) [application database over the last several hours, including how many times a statement has been executed,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=33) [how long the statement took on average to run, how much CPU the statement consumed, and how much average I/O](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=38) [needed to be performed. With data like this, we can quickly identify what statements in our application are](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=44) [running well, and which ones we might need to do some performance tuning on.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=50) [Now you might think that you need some fancy, expensive tools to do all of this, and indeed there are a lot](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=56) [of tools out there on the market that expose this information to you in a nice user interface.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=61) [However, these tools are just looking at data that is already inside of SQL Server, and all you have to do](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=67) [is to know where to look to find this data, and then you can just write queries to get all of the information](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=73) [that you need.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=78) [The source of this data is a series of views in SQL Server known as the Dynamic Management Views, often](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=79) [referred to as the DMVs for short. If you go to this page on the Microsoft website, you can navigate through](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=85) [all of the different DMVs that are available, and the data they contain.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=92) [What we are going to do in this module is just concentrate on a few use cases that are the most important](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=96) [to us as developers, and the DMVs that we need to solve these use cases.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=101) [We're going to start off in this module by talking about the permissions that you need to query the DMVs.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=108) [Then we're going to talk about how to use the DMVs to see information like who is connected to SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=114) [and how many resources each session is using. Then we're going to talk about how we can find what SQL](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=119) [statements are currently executing against our server. Then we'll talk about how to find the most expensive](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=124) [statements that are running against our database. Next, we'll talk about how we can query SQL Server to see](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=130) [if it has any recommendations about indexes that might be missing in our database, that we need to create.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=135) [And finally, we'll discuss how we can find if our current indexes are being used, and how often.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=141) [Altogether, this gives us a good data base level summary of how our application is interacting with](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=147) [SQL Server, and it makes it easy for us to spot any performance bottlenecks that may exist.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=152) [One last item I do want to mention is that all of the queries you're going to see in this module are](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=158) [located on my blog, so if you go to the link that you see here on the screen, all these queries will be there,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=164) [so you don't need to worry about pausing the video and trying to type these queries in on your own.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=170) [So with that, let's start by talking about the permissions we need in SQL Server in order to access the DMVs](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=175) [and run the queries that we're going to see in this module.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=0&mode=live&start=181)

[Required Permissions for Querying Dynamic Management Views](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live)

[In order to query the Dynamic Management Views, your SQL Server user needs to have the View Server State](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=0.799) [permission granted to it, and unless you are a DBA you are unlikely to have this permission by default.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=7.2) [Traditionally, SQL Server's Dynamic Management Views have been thought of as a tool for the DBA because](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=13.799) [they contain information not just related to performance, but also about system health and configuration.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=19.799) [The View Server State permission gives you access to all of this information, and for some DBAs this creates](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=25.799) [some security concerns to give away that level of access. It may be possible to get this level of access in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=31.799) [your development and test environments, but it really varies by company whether this level of access will be](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=38.799) [available to you as a non-DBA user in a production database system.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=44.799) [If you are at a company that is not comfortable granting this access in production to developers, you still](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=49.799) [have a couple of options though. First, you could have your DBA execute the queries shown in this module](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=55.799) [and forward those results to you. The second option is that you could work with your DBA team to create](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=61.799) [some views over the top of the SQL Server DMVs that only expose a specific subset of the DMV data to you,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=67.799) [which would alleviate any security concerns.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=74.799) [I'm not going to show how to create these views in this module, but I do have a comprehensive blog post](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=78.799) [on how to do this, that you and your DBA could read, and this blog post has all of the necessary steps](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=83.799) [contained within it. For this module, I'm going to assume that you do have the View Server State permission](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=88.799) [available to you as I show you these queries. So with that being said, let's start taking a look at some](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=94.799) [of the information SQL Server can provide to us around connections and sessions in the database.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=1&mode=live&start=99.799)

[Getting Information About SQL Server Sessions and Resource Usage](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live)

[The first query we are going to look at is a query that uses the dm\_exec\_sessions DMV in SQL Server to get](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=0) [a list of all of the clients that are connected to our SQL Server database.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=7.399) [On my laptop, I will get some results from another process that I have running, so let's go ahead and run this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=12.399) [query right now. So we see we get back some information like the session\_id and the database that the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=16.399) [session is currently connected to. We also get a status if this session is doing anything at the moment,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=22.399) [either running or sleeping, and we also get when the session was initiated.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=28.399) [Then we get some performance stats about each session. The cpu\_time here is in milliseconds, memory\_usage is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=34.399) [in 8KB blocks, and we also have reads, writes, and logical\_reads.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=40.399) [So if we had a session that was consuming a lot of resources and maybe slowing every one else down that was](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=45.399) [connected to SQL Server, we'd be able to tell that from this data.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=50.399) [Next we see that we have some information about the client process that owns this session, including the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=54.399) [host\_name, the program\_name, and the host\_process\_id. So if we need to know where a session was coming from,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=60.399) [this would be enough information to help us figure that out. Now a lot of times what you're going to see in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=66.399) [this program\_name column is something like we see here, .Net SqlClient Data Provider, and not the actual name](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=72.399) [of the program that's making the connection. For any .NET program, it's this string that is put in by default.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=79.399) [What you can do, though, is in the connection string of your program you can include this property,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=86.399) [Application Name, and then the value that you specify here in the Application Name property will be used](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=91.399) [to populate that program\_name in the column in SQL Server. When you have multiple applications that are](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=97.399) [using the same database, this can be really useful because then you can very easily tell which session is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=103.399) [coming from which application.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=109.399) [The results of this query are useful in two situations. One, like we said, when there is a session that is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=112.399) [consuming a lot of resources on SQL Server and you want to identify that session.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=117.399) [Second, we're also getting a lot of connectivity information here in terms of what clients are connected,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=122.399) [and how many connections each client is using. So, for example, if I have a four-server web cluster I would](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=127.399) [expect to see about the same number of connections from each one of those machines.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=134.399) [If I saw that one of those web servers didn't have any connections to SQL Server, I would want to go and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=140.399) [check the connection string on that machine, and also make sure that that server was actually receiving](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=144.399) [and processing web requests. So there's actually quite a bit that you can tell just by looking at the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=149.399) [session information. Now another question you might want to answer is what SQL statements are currently](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=155.399) [executing in SQL Server right now, so we'll look at how to answer that question next.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=2&mode=live&start=161.399)

[Finding What SQL Statements are Currently Executing](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live)

[Sometimes we have the need to see what statements are running right now in SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=0) [Imagine you have a situation where your application is running very slowly, or maybe even appears to be](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=6.497) [unresponsive, and you need to quickly be able to triage that situation.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=10.497) [So you may be trying to figure out if this is a problem in the application code, maybe a web service you're](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=15.497) [calling is down, or maybe you have a query in SQL Server that's taking a very long time.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=19.497) [So what you want to be able to do is look at SQL Server and quickly figure out what your app is doing in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=25.497) [the database, and if the problem you are seeing is in the database tier,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=30.497) [and so we can answer this question with a query like we see on our screen right here.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=34.497) [This query seems quite long, but we'll walk through it and we'll see that actually it's pretty straightforward.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=39.497) [So we'll scroll down to where we can look and see what DMVs this query is using first.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=45.497) [We see that what this query does is it joins together the dm\_exec\_sessions and dm\_exec\_requests views](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=49.497) [so that we can get what statements are currently running for each session.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=55.497) [Then we need to bring in the text of the statement, and we do that with the dm\_exec\_sql\_text view, and the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=60.497) [execution plan of the statement is brought in with the dm\_exec\_query\_plan view.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=65.497) [What this will allow us to do is that if we see a statement that we want to know more about, we'll be able to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=71.497) [just click on that execution plan in the result set and bring that execution plan up, so that's pretty useful.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=76.497) [Also, in the dm\_exec\_request view, there's a column called blocking\_session\_id, and if there's another](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=82.497) [session that has a SQL statement that is blocking this SQL statement, that column will have a non-zero value.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=88.497) [So that is what these next three views here are about. If a SQL statement is being blocked by another](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=95.497) [session, we'll get all of the information on the blocking statement and blocking session right here in the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=100.497) [same query. Looking at the WHERE clause, this line tells SQL Server not to return any statements from our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=106.497) [current session, so basically we're not going to get our DMV query that we're looking back here, in our result set.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=112.497) [Also, we have this line here, which is going to limit the results to the current database.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=119.497) [If you wanted to see all of the activity on the server, you would just remove this line or comment it out.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=124.497) [Let's jump back up to the top to where we can see what data we're getting back.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=129.497) [We have the session\_id of the SQL Server session, and we also have the SqlStatement here.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=135.497) [These three lines here that are labeled SqlStatement, what these are doing is if the statement that's running](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=140.497) [is part of a stored procedure, these are getting the individual SQL statement so we can look at.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=145.497) [If we have just a plain old SQL statement, then the SqlStatement field and the ParentStatement field,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=150.497) [which is down here, those are going to be the same, but if we're inside of a stored procedure we'll get the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=155.497) [individual statement here, and then ParentStatement will be the name of the stored procedure.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=159.497) [You can see we also have some information about the client that is running the statement, and this includes](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=165.497) [the host\_name, the program, and the process\_id of that client. So, for example, if an ASP.NET web app](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=169.497) [was running a statement, the process\_id field here would contain the process\_id of the worker process over](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=176.497) [on the IIS web server. Then we have some statistics about the statement itself, including what time the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=182.497) [statement started, how long it has been running, how much CPU it has consumed, and how much I/O it has performed.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=188.497) [In most situations, these numbers are going to be quite low, because most statements run for a couple](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=194.497) [hundred milliseconds. If you have a statement, though, that's taking a long time, you would see that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=199.497) [reflected in these values, and if you ran this query over and over again you would see these numbers](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=204.497) [continuing to increase with each subsequent run. So that could indicate that the statement is not just](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=209.497) [running a long time, but also consuming a lot of resources as it's running on the database server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=214.497) [We can see that we're also getting the execution plan back in this query\_plan field, so if we do have a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=220.497) [statement running, we can look and see what it is doing inside of SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=225.497) [And then we also have the BlockingSession information, but these will only be populated if, indeed, our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=228.497) [statement is being blocked. So I have a load generator running in the background, so let's go ahead and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=233.497) [run this query and see what we get back.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=238.497) [So here we see that on my system at the moment that I ran this query we have two statements coming back.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=242.497) [On a real system, you would probably see more statements in more variety than what I'm seeing here by just](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=247.497) [running locally on my laptop. We see all of the fields that we talked about, so if you want the SQL, it's](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=252.497) [right there, and then we also see some statistics. What I want to show you, though, is if I move over here](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=257.497) [to the right we have the execution plan labeled in this query\_plan field, and I can just click on this.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=262.497) [So Management Studio pops up the execution plan that's being used by the statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=268.497) [And that's pretty useful, because we can see the actual execution plan that the statement is running,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=273.497) [especially if we have a performance problem in a production environment, because this can clue us in about](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=277.497) [what's actually happening up on our database server. It's useful to know what's running right now, but other](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=282.497) [times we want to be able to get a bigger picture view of performance and what statements are performing well](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=287.497) [and which ones aren't, so we'll talk about a query that will do that for us next.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=3&mode=live&start=292.497)

[Finding the Slowest, Most Expensive SQL Statements](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live)

[One of the most useful things you can do with the SQL Server DMVs is to have SQL Server give you a list of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=0) [all the statements that your application has run, along with the execution statistics for those statements.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=6.751) [If you are looking for some quick wins for performance in your application, this query is a great](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=12.751) [place to start, because this immediately tells you what statements are performing well and what statements](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=16.751) [you need to target for performance tuning. So how does SQL Server know this?](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=22.751) [Every time SQL Server processes a statement, it keeps track of the execution plan that it uses, and some](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=27.751) [execution statistics about the statement, and stores this data in an in-memory structure inside of SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=32.751) [Since this data is in memory, what data inside the structure can and does change as new statements are run](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=39.751) [and old statements are cached out, but generally you will have the last several hours' worth of data](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=45.751) [available in the DMV that shows you this view, and this is plenty of data to get a strong pulse about what](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=50.751) [is happening with your application. So let's look at this query.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=55.751) [This query is based around the dm\_exec\_query\_stats view, and you can see that we're also pulling in the text](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=60.751) [of the SQL statement and the execution plan for the statement. This is handy to pull in the execution plan,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=67.751) [because if we do find a poorly-performing statement we can look at the plan being used and use the skills](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=73.751) [we've learned in the last couple of modules to analyze the plan for the statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=78.751) [If we look back up towards the top of the editor window, we see the data that we're returning.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=83.751) [We see that we have the SQL text like before so we know what statement we're talking about, and then we](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=87.751) [have a number of stats about this statement, like the number of times that it's been executed, the average](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=92.751) [amount of CPU per execution, and the total amount of CPU across all executions.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=97.751) [And we have similar measures for both logical I/O and elapsed time.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=103.751) [One thing that I do want to point out is that this total\_rows column here, this was added in SQL Server 2008 R2,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=107.751) [so if you're still on SQL Server 2008 you'll want to comment this line out.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=115.751) [What is useful to do, though, with this query, is that we can take the results of the query and we can sort](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=120.751) [those results by these various parameters. With this query right now at the moment, I'm actually sorting](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=124.751) [by the AverageElapsedTime, so that's going to be the statements that are taking the longest.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=130.751) [However, I could also sort this by the average amount of CPU time per statement execution or the average](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=136.751) [amount of I/O to find the most resource hungry statements. It can also be really interesting to sort the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=141.751) [results by the number of executions, so you can see what statements from your application are getting run](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=147.751) [most frequently. If you see a statement that has a very high number of executions, maybe that statement is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=152.751) [being executed inside of a loop and you want to rethink how you're doing that data access, or maybe the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=158.751) [data returned by that statement is essentially static, so you might want to consider if you could possibly](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=163.751) [cache that data. So like all the queries that I'm showing you in this module, take a moment and experiment](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=167.751) [with these queries in your database, because that's really the best way to learn how to use these queries](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=173.751) [and what they can tell you. So let's go ahead and run this query.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=178.751) [So this is what your data is going to look like when it comes back, and this is pretty straightforward to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=182.751) [interpret this data. One thing that I do want to point out is on our time-based measurements, which are the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=187.751) [CPU time and the Elapsed time columns, these units are in microseconds.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=192.751) [So if we move the decimal place over six places to the left, we can see that I've got a number of statements](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=198.751) [here that are taking over 5 seconds, and it looks like those statements are also using a lot of CPU.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=203.751) [So if this was a real database, I'd be pulling the SQL out of here, and then I'd be scrolling over here](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=209.751) [to the right where I can see the execution plan for these statements to analyze what is going on.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=214.751) [So you can see, this query is very useful because it can help you immediately pinpoint any statements that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=220.751) [are really slowing down your application so you can get those fixed.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=224.751) [Even after I've tuned all of the statements in my application, I still like to run this query every week or so](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=229.751) [just to make sure that nothing has changed or snuck up on me in terms of a performance issue.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=234.751) [Next we're going to take a look at how SQL Server can give us some recommendations on if any indexes are](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=240.751) [missing in our database.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=4&mode=live&start=244.751)

[Getting SQL Server's Recommendations on Missing Indexes](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live)

[We've seen in this course that when we run a SQL statement in Management Studio, if SQL Server thinks the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=0) [statement would benefit from an index it will give us that recommendation right in Management Studio.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=6.612) [SQL Server doesn't just make these recommendations in Management Studio, but anytime a SQL statement is run,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=12.612) [and these recommendations are logged to a series of DMVs known as the missing\_index DMVs.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=17.612) [We don't want to automatically create every index that is recommended in this series of views, but looking](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=24.612) [at these results can help us find an index that we may have otherwise overlooked.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=29.612) [The query you see on your screen will join these views together and give us some statistics about the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=34.612) [recommendations, so let's go ahead and run this query to see what we get.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=39.612) [The first column in the result set is the TableName, and this is the table that the index recommendation is for.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=45.612) [Then we have three columns containing information about what columns a potential index would be created across,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=51.612) [and we see the column names are given to us in a comma-separated list within each of these columns.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=57.612) [Mainly, you're going to be looking at the column called equality\_columns, because most WHERE clauses and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=63.612) [JOIN clauses are based on an equality relationship. We also see that we have some stats about why](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=68.612) [SQL Server thinks this index would be a good idea. These two columns here, user\_scans and user\_seeks,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=75.612) [represent the number of times that SQL Server could have used this index had this index existed.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=82.612) [So for this top row, this means that SQL Server could have performed an index seek operation against this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=87.612) [index 653 times had the index existed. We also see the average cost of the statements that could have used](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=93.612) [the index was, and this is the cost of the statements without the index existing.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=101.612) [The next column, avg\_user\_imp, tells us the percentage that SQL Server thinks that this cost would have been](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=106.612) [reduced if we would have had this index. Finally, the last two columns are some simple calculations.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=112.612) [The first column gives us the average cost savings per statement we would have by having this index.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=119.612) [And the last column gives us the total savings we would have across all statements that could benefit from](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=125.612) [having the index, so this last value is useful to sort these results to get an idea of what the most](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=130.612) [impactful index to create might be. Now when you run this query and pull this list up, what you don't want](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=136.612) [to do is just start working your way down the list and creating an index for each row in this result set.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=143.612) [This is because SQL Server has a tendency to recommend an index to optimize every individual statement,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=149.612) [and if you did that you would be in an over-index situation, which would slow down all of your DML statements](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=155.612) [against your tables. Instead, what you want to do is to scan through the results and for each table you'll](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=161.612) [be able to pick out some patterns of index recommendations across similar columns, and then you can combine](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=168.612) [this information with your knowledge of how your application works to come up with the right set of indexes](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=174.612) [for each table. So, for example, these last five recommendations that are in the list are all about the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=179.612) [Students table, and by scanning through the columns that are recommended, we see that all of the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=186.612) [recommendations include the LastName column, so we know that we need to have an index that starts with](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=191.612) [LastName. We also see that FirstName is used in three of the recommendations, so that is a good choice for](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=197.612) [the second column of our index. And then maybe we'll choose State as the third column, because that's used](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=204.612) [in two of the recommendations as well. The point is that you want to look at different recommendations for](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=210.612) [a table and extract out the commonalities, such that you are creating the fewest number of possible indexes](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=216.612) [on the table. In a lot of cases, you will have a number of similar recommendations that all have a common](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=222.612) [subset of columns, so you want to create just one index that contains those common columns.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=228.612) [This way, you're creating an index that can benefit multiple statements, rather than trying to create](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=235.612) [individual indexes for each statement, which would be inefficient.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=240.612) [So when you look at the results of this query, keep in mind that these are just recommendations, and it's](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=245.612) [up to you to analyze and combine these recommendations together into the actual indexes that you're going](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=249.612) [to want to create on your tables. Now the flip side of missing an index is having indexes on tables that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=255.612) [aren't being used, so we'll look at a DMV query that can help us find those situations next.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=5&mode=live&start=262.612)

[Finding Indexes That are Not Being Used](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live)

[In the last module, we talked about how SQL Server has to maintain any indexes you create on your tables,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=0) [by updating an index every time a DML statement is executed against the table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=6.9) [So while an index will greatly speed up a query, there is a slight performance penalty in terms of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=12.439) [executing a DML statement against the table. Therefore, we want to make sure our application is using](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=17.4) [all of the indexes we have created in our database, because otherwise we are paying the cost of maintaining](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=23.439) [an index which is not giving us any benefit. And we can do this with a query that looks like what you see](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=28.439) [on your screen, which uses the dm\_db\_index\_usage\_stats DMV in conjunction with the sys\_indexes system view.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=35.439) [I'll run this query, and then we can discuss how it works.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=44.439) [So we see in the first few columns we have information like the TableName, the IndexName, and the IndexType.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=48.439) [Remember that an IndexType of Clustered really means a table data, as this is how SQL Server normally](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=54.439) [stores the data for a table in a clustered index structure. What is really of interest to us, though,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=59.439) [are these statistics that are located out at the right of the result set, and I'm going to expand these](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=65.439) [columns just a little bit so we can read these a little bit better, and there we go.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=70.439) [So UserSeeks, Scans, and Lookups each represent the number of times respectively that the index has been](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=76.439) [used for those types of operations since SQL Server was last restarted.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=82.439) [So for a standard non-clustered index that we would evaluating, we would be most interested in the value for](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=88.439) [UserSeeks, as this is the number of times that SQL Server is using the index as intended by searching the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=94.439) [tree structure of the index for matching keys. We also see that we have a column named UserUpdates, and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=100.439) [this value reflects the number of times that SQL Server has had to update the index because of a DML](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=107.439) [statement being run against the table. Now when you run this statement on your database, you aren't going](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=113.439) [to see all 0's in this column like I am, but you'll see actual values.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=119.439) [What you are looking for here is indexes that have a high number of updates and very low usage, generally](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=125.439) [meaning a low number of UserSeek operations. This means that we're having to update the index more often](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=131.439) [than it's being used. So if we find one of these situations, we want to investigate why that is happening.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=137.439) [Maybe the index has a wrong column order, or it isn't selective enough, or maybe something has changed in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=145.439) [our application such that we're not querying a table in the same way that we used to.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=150.439) [Whatever the case, you want to understand the situation and see if you can possibly modify that index so it](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=156.439) [can be used. Or, if you determine that the index really doesn't have a purpose, then you want to drop the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=162.439) [index so it isn't slowing down your DML statements. I do want to give you one word of caution, though,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=168.439) [sometimes you have an index that isn't used by your website or other interactive applications, but it is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=175.439) [critical to a nightly batch process. In this case, you will have only a handful of usages of the index](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=181.439) [because, of course, a nightly batch process usually runs just once per night, but you don't want to drop](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=187.439) [these indexes, because otherwise there will be serious performance consequences for those batch processes.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=193.439) [So just make sure that when you're getting ready to drop an index you have really thought through all of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=200.439) [the processes that may be using the underlying table, and make sure you have not missed an important use case](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=204.439) [like a nightly or weekly batch process. Let's go ahead and wrap up our discussion of DMVs and this module.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=6&mode=live&start=210.439)

[Summary](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=7&mode=live)

[In this module, we've seen that SQL Server collects all types of diagnostic and performance information,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=7&mode=live&start=0) [and makes it available to us via its Dynamic Management Views. By querying these views, we can get an](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=7&mode=live&start=6.571) [overall picture of what is happening with our application inside of SQL Server so we can quickly identify](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=7&mode=live&start=12.571) [problem areas and address them. We looked at five different queries that we could use, and these queries](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=7&mode=live&start=18.571) [gave us information on what clients had sessions connected to SQL Server, what SQL statements are currently](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=7&mode=live&start=24.571) [executing, what statements are taking the longest to run and using the most resources inside of SQL Server,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=7&mode=live&start=30.571) [what indexes might be missing in our database, and what the current usage of our existing indexes is.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=7&mode=live&start=37.571) [There are many more queries that could be written, and of course the queries we have shown here could all be](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=7&mode=live&start=43.571) [modified. Really, the best way to learn about DMVs is to try them out on your system, and you will be sure](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=7&mode=live&start=48.571) [to learn something about your application's data access layer.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=7&mode=live&start=55.571) [Next we are going to continue taking a more global view of how our application interacts with SQL Server,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=7&mode=live&start=59.571) [and demonstrate how you can trace all of the SQL statements that your application sends to SQL Server,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=7&mode=live&start=65.571) [and at the same time collect detailed performance data about them.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m4&clip=7&mode=live&start=70.571)

[Capturing What Your Application is Doing Inside SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live)

[What is SQL Tracing and Why Developers Should Know About it](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live)

[Hello. My name is David Berry. Welcome to this module on Capturing What Your Application is Doing Inside](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=0) [SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=8) [In this module, we're going to talk about the ways you can trace all of your data access statements inside of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=11) [SQL Server, and by trace I mean capture each statement your application runs inside of SQL Server, along with](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=16) [some performance statistics about that statement. Why would we want to do this?](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=23) [Well, there are a couple of common reasons.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=28) [One, as a developer we might want to know exactly what a process inside one of our applications is doing](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=31) [inside of SQL Server. Maybe we are trying to debug a process that doesn't seem to be working correctly,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=37) [or maybe we've taken over support of an existing application. What tracing allows us to do is to see the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=43) [exact SQL statements the application is running with their values and the order in which they are being run in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=49) [so we can tell exactly what tables are being hit and how they are being used, which is really useful for](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=56) [debugging. Second, when we use the tracing capabilities that are built into SQL Server, we can get detailed](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=62) [performance information for each statement that is being executed from our application.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=69) [In the last module, we saw how we can get aggregate statistics, like average CPU time or average logical](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=74) [reads by querying SQL Server's Dynamic Management Views. As we'll see, when we trace our data access in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=79) [SQL Server we'll be able to get statement level statistics for each statement that is run, so we can really](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=86) [understand in detail how each statement is performing.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=92) [So we might use tracing in one of our development environments to understand how one of our applications](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=97) [is working, or we might use it in a test environment during a load test of our application to gather](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=101) [detailed information about what parts of our data access are performing and which parts need to be tuned.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=107) [And finally, we could even use a trace in our production environment if we wanted to capture detailed](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=112) [information about every statement that took over a certain amount of time, say 5 seconds, or exceeded some](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=117) [other performance threshold.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=123) [In SQL Server, there are two different ways which you can trace what is happening inside of the database,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=126) [and which one you choose depends on the version of SQL Server that you are running.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=131) [If you are running SQL Server 2008R2 or earlier, you're going to want to use a tool called SQL Profiler,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=136) [and this is provided as a separate GUI in the SQL Server Client Tools.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=143) [If you are running SQL Server 2012 or later, or using SQL Azure, then you're going to want to use what are](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=149) [known as SQL Server Extended Events to perform your trace. Going forward, SQL Server Extended Events are](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=155) [going to be the standard, and in fact the only way to perform a trace in SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=162) [As the SQL Profiler tool was deprecated in SQL Server 2012, it will not be shipped with SQL Server 2016](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=166) [and beyond. You will still find SQL Profiler widely used, so we will cover it, but know that the trend is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=174) [moving towards Extended Events. So if you're on SQL 2012 or later, you want to be investing your time in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=181) [learning how to use Extended Events and probably skip learning Profiler.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=187) [Regardless of which approach you end up taking, running a trace on SQL Server requires some pretty high-level](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=192) [permissions in the database, which we'll discuss when we demonstrate each approach.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=198) [This is because a trace can capture every SQL statement and its values that are being executed against](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=203) [the database, and clearly there are some security concerns in letting someone do this.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=207) [If you have SQL Server installed on your workstation, you will be able to run a trace for any local testing](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=213) [that you do against that local instance. For your development and test environments, if you'll be able to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=218) [run a trace is going to vary by company. In production, you will almost certainly not have permission to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=224) [run a trace by yourself, and will need to engage someone from your DBA team to help you run a trace.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=230) [However, don't be discouraged by this. Quite the opposite. Being able to trace all of your application's](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=236) [SQL is a powerful capability, and it is important that you as a developer be aware of this capability and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=242) [what it can do, so that when you need to do it you know that the capability exists and you can ask for it.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=248) [So what we are going to do in this module is guide you through using both SQL Profiler and SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=255) [Extended Events to take a trace. For each method I'll show how to set up a trace, including what events you](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=261) [can log, how you can filter the data you capture, and how you can log this data to a file for later review.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=267) [I'll also discuss what you need to do in order to analyze this data.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=274) [When we are finished, you will have a good overview of how to set up a trace in both tools, and a good idea](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=279) [of what data you can capture within SQL Server. This will help you understand what tracing capabilities](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=283.5) [exist in SQL Server so you know when a trace might be useful in your application development process.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=289.5) [So let's get started by looking at the SQL Profiler tool.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=0&mode=live&start=296)

[Setting up a SQL Profiler Trace](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live)

[If you are using SQL Server 2008R2 or earlier, then SQL Profiler is going to be the tool that you want to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=0) [trace what your application is doing inside of SQL Server. If you have SQL Server 2012 or 2014, SQL](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=7.664) [Profiler is still available, and does work. In fact, you will find SQL Profiler is still widely used,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=15.664) [simply because the tool has been around a long time and people are very familiar with it.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=22.664) [However, SQL Profiler will not be available at all starting with SQL Server 2016, and doesn't work with](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=27.664) [SQL Azure, so keep that in mind.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=33.664) [To run SQL Profiler, you want to go to your SQL Server install in your Start menu and look for it.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=36.664) [In here you can see on my install it is labeled SQL Server 2014 Profiler, and you just click on this icon.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=42.664) [If you don't see Profiler in your installation, it may be because you have the SQL Express version of the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=50.664) [client tools installed, and some of the earlier versions of the SQL Express Client tools didn't include](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=56.664) [Profiler in the bundle. So if this is the case, just go ahead and install the full version of the Client](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=61.664) [Tools to get Profiler installed.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=67.664) [Once you click on the Profiler icon, the app will open, and this is what the screen will look like.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=69.664) [You want to go up here to the upper left corner and click on the icon that is all the way on the left to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=75.664) [start a new trace. Then, as we see here, we have a Login dialog box pop-up and what we need to do here is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=81.664) [to login to the SQL Server instance where we want to run the SQL trace on.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=88.664) [Also, we need to log into SQL Server as a user that has the ALTER TRACE permission,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=93.664) [otherwise, when we click Connect here we're going to get an error.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=99.664) [In this case, I'm just running a trace on my local SQL Server instance so I'll have permission to do this,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=103.664) [but as we talked about in the intro of the module, you may or may not have rights to run a trace against](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=108.664) [different SQL Servers at your company. So I'll click Connect here, and then we'll be presented with this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=113.664) [dialog box where we can specify the various options for the trace that we're going to perform.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=120.664) [So first we'll specify a name, and then we don't have to specify an output file where we want this data to go,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=125.664) [but it's generally a good idea so you can review the data later, so we're going to check this box to save to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=132.664) [a file, and we'll specify a file name here. And then we get this option to specify a maximum file size,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=137.664) [which I'm going to set to 25 MB. Then I also want to make sure that file rollover is set, so as these files](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=145.664) [fill up Profiler will roll them over to a new file. Now what I want to do is to set the events I want to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=152.664) [capture and some filter criteria about what to capture, and I do that on this second tab called Event Selection.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=159.664) [You can see we already have some defaults selected, and from a developer's perspective wanting to trace some](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=167.664) [SQL statements and get their performance information, these are actually some pretty good defaults.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=172.664) [These names are pretty self-explanatory, but if you mouse over one of them you do get some additional](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=178.664) [description down here in the lower part of the dialog. The RPC Completed event will fire when a stored](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=184.664) [procedure completes, and the SQL BatchCompleted event fires when an individual statement completes, so](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=191.664) [you want to make sure to have both of these events checked so you can capture all of the SQL from your](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=196.664) [application. This is important, even if you're not using stored procedures explicitly, because the way](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=200.664) [that some of the database drivers work, they actually in some cases will wrap your SQL inside of the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=206.664) [sp\_executesql built-in stored procedure, so you just want to make sure that both of these boxes are checked.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=211.664) [Also, you want to make sure to check the box labeled TextData here on RPC:Completed, because this is what is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=219.664) [going to let us see the SQL that's being executed as part of that event.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=225.664) [You can see that we have a number of other parameters here, like CPU and logical reads, and I suggest you](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=230.664) [just leave all of these checked so you get this performance information.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=235.664) [Now there are many other events that you can capture, and to see all of these events you check this box here](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=240.664) [named Show all events. As you can see, this list is quite extensive, though most of the items in this list](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=246.664) [are of more interest to DBAs than to us as developers. I'm not going to go through each and every one of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=253.664) [these, obviously, but there is one that I want to point out, and that is in the Events and Warnings section,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=259.664) [and the event name is User Error Messages. If you have a SQL statement in your application that throws](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=265.664) [an error when it runs, that error will be captured by this event, so this can be a useful debugging tool if](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=272.664) [that error isn't otherwise getting bubbled up to your application logs.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=278.664) [This event will also log some informational messages that SQL Server generates, but for our purposes we can](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=284.664) [disregard those informational messages, because what we're really interested in for this event is the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=289.664) [ability to capture errors from our SQL statements. I'm going to uncheck the Show all events checkbox,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=294.664) [and you see this gets us back to just the events that we're going to capture.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=301.664) [And now we want to talk about this other button here, Column Filters.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=305.664) [The way we have things right now, we're going to capture every login, logout, and SQL statement that's](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=310.664) [executed across the entire SQL Server instance. If you are running a trace against your local install of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=315.664) [SQL Server, that will probably work fine because you're probably the only user, but on a busy server you're](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=321.664) [going to capture a lot of events that you don't care about. This not only makes it harder to sort through](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=327.664) [all of the data and find what is important to you, but it also can have a negative impact on the performance](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=332.664) [of SQL Server because you're capturing so many events, so we want to filter the data so that we're just](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=337.664) [capturing the data that's of interest to us. One of the things you probably want to do is to limit the data](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=343.664) [you collect to just your application. You can do this using the ApplicationName filter, or by the LoginName](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=349.664) [filter, assuming that your application uses a unique login for SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=356.664) [If you go the ApplicationName route, remember you need to set this ApplicationName in the connection](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=362.664) [string your application uses. In .NET, this is done by including the ApplicationName parameter in the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=367.664) [connectionString, and something similar can be done in other languages as well.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=373.664) [You can also limit your trace to statements that take a long time or use a lot of resources with columns](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=379.664) [like duration, CPU or Writes. To set one of these, just click on it, and then go over here to the criteria](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=384.664) [you want to set, and in this case I want queries that take longer than 5 seconds, so that's 5000 ms,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=391.664) [and set the value. And now this trace would capture just these long-running queries.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=399.664) [If you want to get rid of that criteria, which I do for the demo that I'm going to run in just a second here,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=405.664) [then you just double-click on the value so that you can edit the value and delete it, and now that criteria](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=409.664) [will not be used anymore. So now we have our trace set up, and in the next clip we'll continue with this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=416.664) [and go ahead and run this trace and collect some data.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=1&mode=live&start=422.664)

[Running a SQL Profiler Trace](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live)

[So we got our SQL Profiler trace set up in the last segment, and now all we have to do to run the trace is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=0) [to click this button here that says Run. Now in the background you should know I do have a program running](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=6.164) [that's generating some synthetic load against my SQL Server instance so we'll be able to see something when](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=12.164) [we actually run this trace. So I'll go ahead and click this button, and there we go.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=17.164) [We see this window pop up, and we can see the events that are being captured by the trace in this window.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=22.164) [Now running the trace interactively like this is fine if you're on your local machine like I am, or](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=29.164) [otherwise maybe a dev server that has a very, very light load on it, but you don't want to run a trace](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=34.164) [interactively like I'm doing, against a busy server, because otherwise you could really cause some](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=40.164) [performance degradation on that server. There is a way to convert our setup here to run what is called a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=45.164) [server-side trace that runs just up on the server itself and captures its data to a file, and that's more](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=52.164) [efficient, and I'll show you how to do that in just a moment, but for now know that this interactive mode](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=58.164) [is something that you only want to be doing locally, or maybe you do it for just a very brief instance](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=64.164) [of time on a server to make sure you're capturing the right data, and then you turn it off.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=68.164) [That way you can avoid any performance impact. I'm going to actually go ahead and stop this trace because](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=73.164) [I think we've captured enough data to review in the time that I've been talking, and so to stop the trace](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=78.164) [we just hit this stop button here. In the main pane, we see the events that are captured by this trace in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=83.164) [the order that they occurred. If I click on one of these, I'll see the text of the command down here in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=90.164) [the lower pane with the values that were submitted for this query.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=97.164) [I can also see up here in the main grid some of the performance stats about this statement, like CPU,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=102.164) [Reads, Writes, and Duration. So what I can do is I can scroll through here and I can look for statements](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=108.164) [that were the most expensive ones, and then inspect the SQL for that statement, and any parameters that were](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=114.164) [used in that statement. What is lacking about this user interface is that there's no way to sort or filter](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=120.164) [the data once it's been taken. So you can see I can go up here and click on the column header, and nothing](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=127.164) [happens, I'm not getting the data to sort here. So if you want to be able to slice and dice this data,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=134.164) [what you're going to want to do is you're going to want to save this data to a database table, and then](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=141.164) [you can query it with just some normal SQL like any other table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=146.164) [So to do this, you're going to go up here to the File menu, and then down to Save As, and then select Trace](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=151.164) [Table. This will prompt you for a database login, and what you're going to want is a place and a login](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=158.164) [that Profiler is going to be able to create a table to store this trace data in if that table doesn't](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=165.164) [already exist. And so what I've done on my machine here is I've created a separate trace database called](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=170.164) [TraceData on my local SQL Server Express instance, and that's where I'm going to put this data.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=177.164) [So I'll go ahead and log in, and then I'm going to find TraceData in this list for my databases,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=182.164) [I'll leave the schema as dbo, and finally I'm going to give this table a name, and now I'll click OK.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=190.164) [And so that that's going to do is it's going to take this data and it's going to create that table and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=199.164) [insert all of the data into the table. And so now if I pop over to Management Studio, I can go and I can](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=203.164) [find that database, and I'll open up the Tables, and there's our table, and I'll just right-click so I can](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=211.164) [grab the first thousand rows, and there those rows are. So, obviously I could write SQL queries against](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=217.164) [this table like any other table, and I could filter and sort this data however I wanted to, now that I have](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=223.164) [it in a table. We mentioned that you could also run a trace as a server-side trace, which is more](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=229.164) [efficient, and therefore more appropriate if we're trying to trace access in a server environment rather](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=235.164) [than on our local machine, so let's see how to do that next.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=2&mode=live&start=239.6)

[Running a Trace as a Server Side Trace](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live)

[When you use SQL Profiler to trace your SQL statements, what you really want to do is to run your trace](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=0) [as a server-side trace rather than in interactive mode, because a server-side trace will consume fewer](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=6.429) [resources in SQL Server. So what we do is use the SQL Profiler tool to set up the trace, meaning we](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=12.429) [select the events we want and add in any filters, and then we can instruct Profiler to give us a SQL file](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=18.429) [of the commands that need to be run in order to run this trace on the server-side, so let's see how to do this.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=24.429) [I have the same trace here that we've been using throughout, and we have this all set up.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=31.429) [And then all we need to do is go up here to File, Export, and Script Trace Definition.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=35.429) [Then we'll choose from SQL Server 2005 to 2014, and we're just going to save the SQL file somewhere on our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=42.429) [local system. So now what we need to do is we need to open that SQL file in Management Studio, and I'll](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=50.429) [jump over to Management Studio, and I actually have a version of this file that I saved earlier already](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=57.429) [opened up here in the window that we can see. We see that all the SQL file is is a series of commands](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=62.429) [that we're going to run on SQL Server. The only thing that we need to do is to put in a filename of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=68.429) [where the data is going to be logged to, and we see that we need to do that right here, and there's a nice](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=74.429) [long comment telling us exactly what we need to do. The filepath is going to be the path that is going to be](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=79.429) [up on the SQL Server, so that needs to be a directory that exists on the machine that's hosting SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=85.429) [In my case, I'm running SQL Server locally, so the client and server are one and the same, but just remember](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=92.429) [that path is up on the server. So I'll go ahead and set this, and then we'll look through the rest of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=97.429) [the file here just to see what else is in here, and what all these commands do is they set up the events](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=104.429) [that we want to capture, and any filters. So SQL Profiler has generated all of the correct sp\_trace\_setevent](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=109.429) [commands for us so we don't have to look up all of these different codes and ids.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=116.429) [So all we have to do to start the trace now is to run this script.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=121.429) [Again, you will need to be logged in as a user with the ALTER TRACE permission in order to run this trace,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=124.429) [otherwise you're going to get an error. The user I'm logged in as does have this permissions, so I'm](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=130.429) [going to go ahead and get this trace started. And so now this trace will be running up on the server, and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=135.429) [collecting data, and logging that data to the output file that we specified.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=141.429) [One important thing to note here is the ID number for this trace that you get aback down here in the results](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=147.429) [pane, because this is what we're going to need to stop the trace once we've captured all the data that we need.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=151.429) [So let's talk next about how we manage this trace. So first of all, you might want a status on what traces](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=158.429) [are running on SQL Server, or maybe you forgot that number of the trace that we just started, so let's see](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=164.429) [how we can find that information out. I'll go over here to this other window where I have a couple of queries,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=170.429) [and what you want to do is you want to query the system function fn\_trace\_getinfo, and by passing a 0](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=176.429) [to this function you'll get back information on all traces that currently exist in SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=184.429) [So I'm going to go ahead and run this statement, and you see we get the information back, but this isn't](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=190.429) [a very user-friendly format. Trace number 1 is the system default trace that's always running, and then we](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=195.429) [see the information we have on our trace, and we can decipher out our trace ID, the file and status](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=201.429) [information from this, but it's not very user friendly. So if we run this second query here, this'll give](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=207.429) [us a little bit friendlier view of the data, so let's go ahead and run that.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=213.429) [And you see that's the same information, it's just in a little bit better format for us to consume.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=219.429) [So now we have our trace that's been running for a while, we've collected the information that we need,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=225.429) [and we want to stop this trace, and so how do we do that. Well, what we do is we run a stored procedure](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=230.429) [named sp\_trace\_setstatus, and I have the various use cases of that stored procedure over in this third window.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=236.429) [So as you can see here, you pass in your TraceID and a value of 0 if you want to stop the trace.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=244.429) [If after some time you want to restart the trace, you would pass in the TraceID and a value of 1 to restart](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=250.429) [that trace. So then after you've stopped the trace, if you want to remove the definition of the trace from](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=256.429) [SQL Server, you would call this procedure again with a value of 2, and what that does is it just removes the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=263.429) [definition of the trace in SQL Server, it doesn't go out and delete any trace files that were generated.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=269.429) [Whenever SQL Server restarts, all these trace definitions get removed.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=275.429) [This is just a way that we can clean things up when we're finished and keep our SQL Server tidy.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=279.429) [So I'm going to go ahead and I'm going to stop this trace, and so at this point we've covered what you need](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=284.429) [to know about how to run a server-side trace. Now once one of these traces has been taken, either by you](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=289.429) [or maybe somebody on your DBA team, and you have this .trc file of the trace data, how do you view the data](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=296.429) [that's in these files? That's pretty easy, you just open them up in SQL Profiler.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=303.429) [So I'm going to go back to SQL Profiler, and I'll select File, Open, and then Trace File.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=309.429) [And then I just find the trace file I want to open, I select I, and say open in this dialog box, and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=316.429) [now that file will open up in Profiler. From here you can review the file in Profiler, or use Profiler to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=323.429) [load the data into a table in SQL Server, whatever meets your needs.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=330.429) [This wraps up our discussion of SQL Profiler, so now we're going to move on and talk about SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=336.429) [Extended Events, which for our purposes do much the same thing, but is really the preferred tool on new](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=341.429) [versions of SQL Server for taking traces like this, and also gives us the capability to trace SQL](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=348.429) [statements on SQL Azure, so we'll take a look at Extended Events next.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=3&mode=live&start=354.429)

[Introduction to Using Extended Events for SQL Tracing](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live)

[If you are using SQL Server 2012 or later, or using SQL Azure, then Extended Events is the way to go in](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=0) [terms of tracing what SQL is running inside of your database.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=8.755) [SQL Server Extended Events use the event Tracing for Windows, or ETW framework, to trace data, and this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=12.755) [framework is newer and more efficient in terms of server resources than the older tracing framework using](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=18.755) [SQL Profiler. Extended Events also gives you access to many more events within SQL Server that can be](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=24.755) [traced and logged, and many more options in terms of filtering those events down to only the ones that you want.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=31.755) [So you want to make sure that you're familiar with using Extended Events for Tracing, because this is the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=37.755) [direction that Microsoft has chosen, and will be the only option available on future versions of SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=41.755) [To run an Extended Events trace, the user running the trace is going to need some permissions in order to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=49.755) [set up and start the trace. Extended Events was actually first introduced in SQL Server 2008R2, and if](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=54.755) [you're on SQL Server 2008R2, then your user will need the CONTROL SERVER permission granted to it.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=61.755) [On SQL Server 2012 and later, you will need the ALTER ANY EVENT SESSION permission in order to define and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=68.755) [run an Extended Events trace, so this is a much more targeted permission.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=74.755) [However, having only ALTER ANY EVENT SESSION will only allow the user to create an Extended Events trace](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=79.755) [through SQL. If you want to be able to use the GUI within SQL Server Management Studio in order to define](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=85.755) [your Extended Events capture session, as we're going to do here, you also need the VIEW SERVER STATE](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=91.755) [permission for your user. You will probably have these permissions on your local instance of SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=96.755) [that's running on your workstation, and it may be possible to get these access writes in your dev, and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=102.755) [potentially your test environments. In production, at a lot of companies, you'll probably be asking your](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=107.755) [DBA group to define and run these traces for you because of security concerns around production data in servers.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=112.755) [But, again, these tools can be very useful in your development and application support processes, so we'll](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=119.755) [introduce these tools here so you're familiar with what capabilities exist, and you're aware of all the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=125.755) [tools that can help you in diagnosing and solving problems within SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=130.755) [In terms of setting up an Extended Events session to capture events for the on-premises version of SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=136.755) [and for SQL Azure, about 90% of the steps that you need to perform are common between the two platforms.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=141.755) [There are some small differences though, so what I'm going to do is over the next few clips show you how](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=148.755) [you would set up Extended Events to trace your SQL on an on-premises version of SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=153.755) [And then, at the end of this module there will be a clip dedicated to the couple of items you need to change](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=159.755) [in your setup if you're using SQL Azure. So let's jump in and create a new Extended Events session to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=165.755) [capture some of the SQL inside of SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=4&mode=live&start=171.755)

[Setting up an Extended Events Trace Session](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live)

[To set up an Extended Events session, we use SQL Server Management Studio.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=0) [What you want to do is in your Object Explorer go down and open up the Management folder.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=6.481) [Then you will see Extended Events under it, so expand that, and finally, expand Sessions,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=12.481) [and you will see the existing Extended Event trace sessions defined on your SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=19.481) [To define a new session, right-click on the Sessions folder, and you see you have two choices here,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=24.481) [New Session Wizard and New Session, and I suggest you select the second choice, New Session, because this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=30.481) [is pretty straightforward to do and there's not really a need for a wizard.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=36.481) [Once we do that, we will get this window to pop up, and if we look on the left, we have these four pages](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=40.481) [of configuration that we'll go through to define this capture session, so we'll start out here on this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=46.481) [general page. First we want to give our session a name, and it's good to make this name descriptive,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=51.481) [because this is what's going to show up in the list in Management Studio, and it will help identify this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=58.481) [configuration in the future. So I'll put in a name, and then we have this dropdown of templates we can](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=63.481) [choose from, and we can see those templates, and in this case I'm going to choose the one named Query](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=68.481) [Batch Tracking. Once you select a template, you will see that SQL Server does give us a good description](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=74.481) [of each one of these templates is. All these templates do is pre-select some of the events that we can choose](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=81.481) [from on the next page, so they make setting up your trace a little bit faster.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=87.481) [For us as developers, this Query Batch Tracking is a really good starting point, and then if we wish, we](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=93.481) [can add more events on the next page. Finally, on this screen we have some options that we can start the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=98.481) [trace at server startup, or as soon as we create this trace, and I'm going to leave each of these boxes](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=105.481) [unchecked, as we'll just start our session manually when we're ready to.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=110.481) [The next page that we want to look at is the Events page, so I'll click on that, and on this page, the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=115.481) [events that are currently selected to be captured are over here on the right in this list.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=120.481) [And then this main section in the middle of the page is where we can search for and select any other events](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=125.481) [of interest. You can search for events with the Event Search box, so I'm actually going to do that for an](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=130.481) [event, and we see the list is now filtered by my search criteria.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=136.481) [I'm going to click on this event, query\_post\_compilation\_showplan, and when I do, notice that these two](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=143.481) [controls on the bottom populate, giving me a description of what this event is and the data fields that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=148.481) [this event will capture. For this particular event, if I scroll through the description, I see that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=154.481) [SQL Server is warning me that collecting this event can be very expensive, so if I do choose to turn this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=161.481) [event on, I want to be mindful of that and only collect data for a brief period of time, as not to impact](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=166.481) [the rest of my SQL Server. So that's where this description field can be really useful, because SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=172.481) [lets us know if we're collecting a high-resource usage event.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=178.481) [If we did want to add this or any other event to be collected as part of this trace session, we just use](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=182.481) [these two buttons here to manage what events were selected. Once we have the list of events that we want to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=188.481) [capture, we can configure what data we want collected for each of these events, and to do that we click on](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=194.481) [this configuration button that is right here. That button takes us to this screen, where we have our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=200.481) [selected events on the left side now, and the configuration for each event is over here on the right.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=207.481) [In terms of the data that you collect for each event, this is divided into two sections,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=213.481) [fields that are globally available to all events, which is on this first tab here, and event specific fields,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=219.481) [which are out here on the third tab. So for the RPC:Completed event, we see we are always going to collect](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=225.481) [performance data like the amount of CPU time, Duration, and logical reads, and that is good because those](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=231.481) [are fields of interest to us. Also on the RPC:Completed event, you just want to make sure that the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=237.481) [statement field is checked, because this will allow you to see, first of all, the statement and also the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=243.481) [parameters that were passed either to the stored procedure or the parameterized query.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=247.481) [Over on the Global Fields tab, there is one field you want to make sure and select, and that is the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=252.481) [sql\_text field. The reason why you want to make sure this field is selected is because this field gives you](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=257.481) [just the SQL text of the SQL statement without the parameter values, and we'll see in a moment that allows](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=263.481) [us to group all of the various executions of a particular statement together when we start analyzing our data.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=269.481) [So you want to make sure that the sql\_text field is selected, and we want to do this both for the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=276.481) [rpc\_ompleted event, and then also for the sql\_batch\_completed event.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=280.481) [And then you can just look through the list of the rest of the global fields and see if there are any that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=287.481) [make sense for the trace that you're putting together. For example, you might want to capture fields like](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=291.481) [client\_hostname or username to know what application ran a particular statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=297.481) [The last bit of configuration to do on this screen is to configure the filters for the event, and we want](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=303.481) [to do this so we can focus in on the data that we are really interested in and just collect that data.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=309.481) [Otherwise, we're going to have a lot of extra data that we're going to have to sort through, and by focusing](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=315.481) [in on just the data we're interested in, we can lighten the footprint of any additional load that we're](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=320.481) [putting on SQL Server. To do this, we use the Filters tab, and again, we're going to need to do this for](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=325.481) [each event type that we're capturing. We see that we already have a couple of default filters in here,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=332.481) [and what these filters do is keep our session from capturing any internal system activity run internally](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=338.481) [by SQL Server, since that activity is probably not of interest to us.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=343.481) [What we do want to do, though, is to limit our session to only capture data from our application, so there](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=349.481) [are a couple of ways that we can do that. You just click here to add a clause, and now I'll click on this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=354.481) [middle box, and you can see all of the criteria that I can filter by.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=360.481) [So if I'm on a shared SQL Server box that has many, many databases, I could come down here to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=366.481) [sqlserver.database\_name, and now I'll enter the value of students in the value field, and I'll only capture](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=372.481) [this event, sql\_batch\_completed, in the students database, so that'll effectively limit me to only](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=379.481) [SQL statements that are run in this database. There are many criteria in this list, as you see, so you](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=386.481) [could only capture statements that took a certain amount of time or longer, or statements that took a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=393.481) [certain amount of CPU, and this could be useful if you're trying to identify what the really long-running](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=398.481) [statements in your application were. You could also put a filter on the sql\_text field, and then there is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=403.481) [a like operator available, so you could use this to capture all of the statements that ran against a certain](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=409.481) [table in your database. I'll set up the filters for the other two event types offline so we can move on](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=415.481) [to the last item of configuration we are going to do, and that is where we're going to store the data](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=421.481) [that we capture as part of this Extended Events session trace. We configure that on the Data Storage page,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=426.481) [so I'll click over there, and you can see, by default, the storage is of type ring buffer.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=432.481) [And what this is, is an in-memory data structure that acts like a queue.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=438.481) [So in this case you see we will keep just the last 1000 items.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=443.481) [We could use this, but what you probably really want to do is to persist this data you capture to a file](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=448.481) [somewhere, so let's do that. So I'll remove this ring buffer by clicking on the Remove button.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=453.481) [Now I'll click Add, and I'll choose a type, and what I want is an event\_file.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=461.481) [And now I'll go down here and I'll select a name and location for the file.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=467.481) [And now I'm going to say I want a max size of 250 MB for my file, and now this data will capture to the file,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=473.481) [which is going to be more useful for us. The last page of configuration is the Advanced page, but we'll](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=480.481) [be in good shape just to accept the defaults there. Now to create this Extended Events session that I have](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=486.481) [it all configured, all I need to do is hit the OK button and this session will be created.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=491.481) [So next what we're going to do is we're going to run this session and we're going to capture some data on](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=498.4) [our SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=5&mode=live&start=502.4)

[Running an Extended Events Trace Session](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=6&mode=live)

[Now that we have our trace defined, running it is very easy.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=6&mode=live&start=0) [We just right-click on the Extended Events session and say Start Session.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=6&mode=live&start=4.484) [And so now this trace session is running and collecting data to the file that we set up for this session](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=6&mode=live&start=9.484) [to log data to. If we want to stop taking data, I just right-click again and I would say Stop Session,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=6&mode=live&start=14.484) [but I'm not going to do that just yet. We can see here on our menu that we also have another option,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=6&mode=live&start=22.484) [Watch Live Data, that we can use while the session is running, and we can use this to peek at any data](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=6&mode=live&start=27.484) [that the session is capturing. So if we click on this, this is going to bring up this window, and now](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=6&mode=live&start=33.484) [as the session captures data in real-time, those events are going to get displayed in this window.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=6&mode=live&start=41.484) [We're still capturing and logging all of these events to the file we set up, this just gives us a live view](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=6&mode=live&start=46.484) [of things. Up here in the top part of the window, we see a list of the captured events, and if we click on](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=6&mode=live&start=51.484) [one of these, then we get the details of that event down here in the bottom part of the window.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=6&mode=live&start=57.484) [Now having to click on each and every event to inspect its results and to find the data you're looking for](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=6&mode=live&start=63.484) [is not real user friendly, and you're going to quickly tire of clicking through each one of these events](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=6&mode=live&start=68.484) [trying to find what you're looking for. So let's next look at how we can adjust this view of our data](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=6&mode=live&start=72.484) [into something that is more useful.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=6&mode=live&start=78.484)

[Configuring the Display Settings for Extended Events Data](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live)

[So let's see how we can make our view of the data a little bit more useful here.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live&start=0) [We can add columns to the upper part of this view and turn it into more of a data grid view in a couple of ways.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live&start=5.146) [First, if we have an event selected we can come down here to the data of the event and just right-click on](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live&start=12.146) [an item and select Show Column in Table. And then, as we see, that column now shows up in our table above.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live&start=18.146) [The other thing we can do is right-click on the table header and say Choose Columns.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live&start=27.146) [And now we get this dialog where we can choose the columns that we want to see, and the order that we want](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live&start=32.146) [to see them in. So I'm going to choose a few columns here, and I'll change this order up a little bit,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live&start=37.146) [and now when I click OK we can see that I have more of a grid view here in the top part of the pane,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live&start=44.146) [and that makes things a lot more useful. If you want to turn off this bottom part, you just go up here](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live&start=49.146) [and you click on this button here, and that will toggle the bottom part of the display on and off.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live&start=54.146) [And then once you have a column set up that you like, what you want to do is you want to save that setup](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live&start=59.146) [so you can pull it up again anytime you're viewing Extended Events, either a file of Extended Events or](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live&start=64.146) [when you're capturing live events. So to do that you come up here to Display Settings and click Save As,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live&start=69.146) [and we'll choose a file name, and now I'll click Save. And so now when I go back into Management Studio](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live&start=77.146) [and I want to bring this view up, all I have to do is go up here to Display Settings, say Open Recent,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live&start=83.146) [and there is our configuration file, and we would just click on this.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live&start=89.146) [So let's move into analyzing some of the data that we've captured.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=7&mode=live&start=93.146)

[Analyzing Extended Events Trace Data](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live)

[When an Extended Events session produces an output file, the file produced is an XEL file,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=0) [and you can open this file right in Management Studio. So you just go to File, Open, File again, and then](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=7.241) [just find the XEL file on your hard drive that you want to open, and click Open.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=16.241) [And so there we go, we can view our data now. I'm also going to get my column definitions, so I'm going](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=22.241) [to go up and I'm going to do that real quick, and now we've got a better view of our data.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=28.241) [If you watch the clips on SQL Profiler or you view SQL Profiler, you know that Profiler was pretty limited](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=34.241) [in terms of what we could do with the data, but for these Extended Event files we actually can do quite a bit](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=39.241) [in Management Studio with this data. First of all, I can sort the data just by clicking on the column headers.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=45.241) [I can also filter the data right here in this UI by clicking on the Filters button.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=53.241) [That's going to bring up this dialog where we can add filter clauses.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=59.241) [So you just click to add a clause. And then you can select the criteria, the operator, and the values.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=63.241) [Now on my version of Management Studio, for some reason when I click this dropdown it actually displays the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=69.241) [values on the top of the screen on my other monitor that you can't see, but if I use the arrow keys here to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=74.241) [cycle through some of these values, you can see all the fields that we're collecting for this event we can](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=79.241) [now filter on. So I'm going to select cpu\_time as a filter, then I can select >=, and finally](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=85.241) [I'll give this filter a value of 2000000, because this value is in microseconds, so that will be 2 seconds.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=94.241) [So this now will show us in the UI all the statements that took 2 seconds or more of CPU time.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=100.241) [So filters like this can be very useful in order to narrow down the data set and look at just what you need.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=106.241) [In addition to a filter on something like duration or CPU time, we could also create a filter that was only](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=113.241) [for a certain time-frame, statements from a certain host, or a filer that would look for a certain table name](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=119.241) [in the statement text for our event, so we could see just the statements that ran against a single table.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=125.241) [So this is pretty useful what we can do with filtering right here in Management Studio now, and we don't](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=132.241) [have to go through the extra step of exporting our data and getting it into Excel or something like that,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=137.241) [we can do all of that right here. In addition, if we do filer the data down and we want to share just that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=142.241) [filtered subset of data with some of our colleagues, we can go up here to the Extended Events menu item,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=148.241) [then down to Export To, and you can see that we can export this filtered view of the data to a separate XEL file,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=154.241) [a table in SQL Server, or a CSV file. So that's really useful when you just want to share a subset of data](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=161.241) [with someone to analyze. Before I continue, I'm going to remove this filter, and there we go.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=168.241) [One of the other features that Management Studio gives us is that rather than viewing just a list of raw](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=176.241) [events like we are now, we actually can group our events together and generate aggregate statistics on them,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=181.241) [so let's do that. Fist I'm going to aggregate my data together, and I'm going to do that by the sql\_text](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=187.241) [of the statement, which is this column, sql\_text. Remember, this was the global field for our events that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=194.241) [we made sure to capture when we set up our trace, and we did that because this field contains just the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=201.241) [SQL of the statement, or the stored procedure name, and not the parameters, so now that we can group our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=207.241) [statements by that SQL. So we see that view of the data here, and this basically tells us how many times](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=213.241) [a SQL statement or a stored procedure executed while we were running our trace.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=220.241) [If we want to see the individual statements, we just click on this little plus sign, and then we see the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=226.241) [individual statements under that grouping. We can even sort the statements within the grouping by](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=231.241) [double-clicking the column headers. So, of course, one of the things you want to look for hers is if you](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=236.241) [have a statement that's being executed thousands of times more than any other statement, and then ask yourself](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=242.241) [why that is. For example, maybe a statement is being executed inside of a loop, so your application is going](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=247.241) [to the database over and over and over again, and that could be an indication that you want to take a look](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=254.241) [at that piece of code and refactor it. The next thing that we can do is we can get some aggregate statistics](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=258.241) [for each of these statements, and we do that by clicking on the Aggregation button.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=264.241) [And now, for all of these other fields that we're displaying we see we can get some aggregate statistics](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=269.241) [like average or sum, so for this example I'm going to sum up the CPU and the duration, and I'm going to click OK.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=274.241) [And now I see I have the summary statistics displayed along with the statements.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=283.241) [So what this allows you to do is to run a trace which is going to capture data about a specific process](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=288.241) [and then you could filter down just to that data, either at capture time, or after the fact, in this window,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=294.241) [using the filter buttons as we just saw. And then for that process that you have the data for, you could](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=299.241) [figure out not only which statement had the highest average CPU usage or the highest duration, which would](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=305.241) [indicate the longest average wait, but you can also see that for all of the statements that were run](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=311.241) [by this process or in this window of time that you've captured, which statements had the most total CPU or](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=316.241) [resulted in the most total duration that the application was waiting.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=323.241) [So you can really zero in on what a process is doing, and where the performance bottlenecks are in that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=327.241) [process in terms of the data access. So we've seen how to use Extended Events to capture a trace with the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=332.241) [on-premises version of SQL Server. Taking the trace in Azure is very similar, there are just a few](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=339.241) [differences, so we'll cover those next.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=8&mode=live&start=345.241)

[Using Extended Events in SQL Azure](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live)

[If you are using SQL Azure, you can still capture what your application is doing inside of SQL Azure with](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=0) [Extended Events, but there are a couple of small differences that you need to account for.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=6.805) [First of all, you're going to want a version of SQL Server Management Studio that fully supports SQL Azure.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=12.805) [What this means is that you want to get the SQL Server 2016 version of Management Studio and use that to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=18.805) [set up your Extended Events sessions. As I record this, we are a couple of weeks before the official](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=24.805) [release of SQL Server 2016, so by the time you view this you won't be downloading the preview release](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=29.805) [like I see here, but you'll be able to download the full release version.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=36.805) [Earlier versions of Management Studio would allow you to connect to a SQL Azure database and run queries,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=40.805) [but if you try to create an Extended Events session you would get an error.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=46.805) [With the SQL 2016 version of Management Studio, though, the ability is set up an Extended Events session](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=50.805) [has been extended to SQL Azure databases as well, so you'll be able to use the same user interface that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=55.805) [we've seen over the last few clips to set up your event capture sessions in SQL Azure.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=61.805) [The second thing you need to do is to set up a storage location of where you can write your Extended Event](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=69.805) [trace files to. With SQL Azure being a Platform as a Service offering, you don't have a traditional file](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=74.805) [system available where you can write files to, but what you can do is to write your files to Azure storage,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=80.805) [and this article on microsoft.com tells you exactly how to do that.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=87.805) [If you read through this article, you'll see that there are two steps.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=92.805) [Step 1 is that you run a PowerShell script to create an Azure storage container, and this part also creates a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=96.805) [storage access policy that will be used to allow your SQL Azure instance to be able to write to that container.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=102.805) [When you run this PowerShell script, you'll get an output like I'm showing here, and it is this information](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=109.805) [that you'll need to feed into the second step of the process.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=115.805) [Step 2 involves running some transact SQL in your SQL Azure database.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=120.805) [If you look at the T-SQL on the microsoft.com page, as I am here, you'll see that the SQL creates a sample](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=125.805) [table at the top of the script, and then a sample trace at the bottom.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=131.805) [What is really important, though, is step 2, because this is what gives SQL Azure the credentials it needs](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=135.805) [to write to the storage location. So what is happening here is that you're creating some Azure storage,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=142.805) [putting a security policy on that storage, and then giving the credentials needed to write to that storage](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=148.805) [to your SQL Azure instance. The scripts cover the details of the exact commands to do this, but big picture,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=154.805) [that's what's going on.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=160.805) [Once you have the storage set up, now we can go into Management Studio 2016 and define an Extended Event session.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=163.805) [When you are looking at an Azure database, you'll see that the Extended Events is under the database itself,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=171.805) [not out under a Management folder like in the on-premises version.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=176.805) [But otherwise, we just right-click on the Sessions folder and say New Session, just like we did before.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=181.805) [The selection of the events to capture, what fields you want to capture in those events, and the setup of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=188.805) [any filters, is going to be just like before. The only real difference is that when we get to the Data](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=193.805) [Storage tab you're going to put the URL of your Azure storage container in the Storage URL field with a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=198.805) [file name, and now this is where your Extended Events file is going to be created.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=205.805) [So really, the process of creating a trace using Extended Events on SQL Azure is very similar to the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=211.805) [on-premises version of SQL Server. Just make sure that you have the latest version of Management Studio](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=217.805) [for SQL Server 2016, and get a storage location set up, and then you'll be able to capture what your](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=222.805) [application is doing inside of an Azure database just like you would be able to with the on-premises version](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=229.3) [of SQL Server. Let's go ahead and wrap up this module.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=9&mode=live&start=234.805)

[Summary](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live)

[There are many circumstances where we would like to be able to tell exactly what our applications are doing](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=0) [inside of SQL Server, and by making use of the tracing capabilities built into SQL Server we can do just that.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=5.469) [This can really give us a lot of insight into what our app is doing, because we can capture the exact](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=13.469) [sequence that our SQL is being executed in, so this is really useful for debugging.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=17.469) [We can also get detailed statistics on the execution of each statement that is run so we can quickly identify](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=23.469) [which statements are using the most resources or taking the longest.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=28.469) [Finally, we get a good idea of how often our application is running different statements against SQL Server,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=32.469) [and sometimes simply knowing how often a statement is run tells you something important about how your](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=37.469) [program is executing, or maybe that there's an opportunity to combine multiple SQL statements into a single](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=42.469) [statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=48.469) [If we are on SQL Server 2008R2 or earlier, we'll use the SQL Profiler tool to set up this trace, and then](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=50.469) [most likely we'll export that definition to a trace definition in SQL so we can run the trace up on the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=57.469) [server since that consumes fewer resources. For SQL 2012 and beyond, and for SQL Azure, we'll use SQL Server](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=62.469) [Extended Events, and we create an Extended Events session right in Management Studio.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=70.469) [In both cases, we're going to want to select the types of events that we want to capture.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=76.469) [There are a wide variety of events that you can capture in the database, but for us developers, usually](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=81.469) [we're interested in tracing our SQL, so the sql\_batch\_completed and rpc\_completed events are usually the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=86.469) [starting point for us. This means that every time our application runs a SQL statement or stored procedure,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=91.469) [we'll be able to capture the text of what was run, any parameters used for the execution, and some](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=98.469) [detailed performance information like how long the statement took, the number of rows returned, the amount of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=103.469) [CPU, and how many reads the statement performed. We could also supplement these events with other events](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=108.469) [of interest to us. For example, we see here events around the start and completion of individual SQL](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=114.469) [statements, and around transactions. Finally, we'll set up some appropriate filters so we can capture only](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=120.469) [the data that we are interested in. We might filter by the database name or SQL Server user to look at](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=126.469) [just the activity from our application, but we might even filter by the text in the SQL statements just to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=133.469) [identify statements that are running against a certain table. Having good filters like this means there's](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=139.469) [less data to sort through, and it also helps limit the load that we're putting on SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=144.469) [Once we run our trace, we'll usually end up with an output file of all the events in it that we captured](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=150.469) [and we can analyze. If you're using SQL Profiler, you can just scan through that file, or you can export](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=155.469) [that data into a table in SQL Server to do detailed analysis. If the output is from an Extended Events session,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=161.469) [we saw that you could do a lot of your analysis right in Management Studio itself.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=168.469) [What all of this gives us is the capability to see step by step what our application is doing inside of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=173.469) [SQL Server, so this really helps us understand what our data access layer is doing, and where we can make](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=178.469) [improvements.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m5&clip=10&mode=live&start=183.9)

[Applying Common Performance Practices](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=0&mode=live)

[Introduction](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=0&mode=live)

[Hello. My name is David Berry. Welcome to this module on Applying Common Performance Practices.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=0&mode=live&start=0) [In the other modules of this course, we have concentrated on what is happening inside of SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=0&mode=live&start=9) [In this module, our focus is a little different, in that we are going to go through some common performance](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=0&mode=live&start=15) [practices that you want to apply in your application code. First, we'll talk about why you want to make sure](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=0&mode=live&start=20) [to use parameterized SQL when you write your data access code. Then we'll talk about if it really is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=0&mode=live&start=26) [faster to use stored procedures instead of including your SQL directly inside of your application.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=0&mode=live&start=33) [Next, we'll talk about commit frequency and how that can affect the performance of your data access layer.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=0&mode=live&start=39) [Then we'll talk a little bit about Object Relation Mappers, or ORMs.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=0&mode=live&start=46) [First we'll talk about how using an ORM can make what is happening inside of SQL Server a little less visible,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=0&mode=live&start=51) [and what you can do about it. And finally, we'll wrap up by talking about the N+1 selects problem, which is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=0&mode=live&start=56) [a commonly encountered performance problem when using ORMs, but fortunately is easy to resolve.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=0&mode=live&start=63) [So let's get started by talking about why it is important to parameterize the SQL in your application.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=0&mode=live&start=70)

[Use Parameterized SQL](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live)

[One practice you want to make sure to adopt is to use parameterized SQL statements in your data access layer.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=0) [What do we mean by this? Consider the SQL statement you see on your screen.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=7.665) [The statement is using simple string concatenation to dynamically build the SQL statement to be run against](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=12.665) [the database. What this means is that every time this data access method is called with different values,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=17.665) [a different SQL string is going to be generated and then sent to SQL Server to be executed.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=24.665) [Contrast that with a data access method that is using parameters like the one you see now on your screen.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=31.665) [These two values with the @ sign in your statement signify SQL parameters to SQL Server, and then down here](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=36.665) [we attach the values that we want to use for those parameters when we submit the statement to the database.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=42.665) [So every time this method is run, the same SQL is sent to the SQL Server, and it's just the parameter values](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=49.665) [that are attached outside of the SQL text that will vary. In SQL Server, we'll then be able to substitute](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=55.665) [those parameters in up on the server itself.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=60.665) [There are two big advantages to this approach of using parameters.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=64.665) [First, this helps prevent SQL injection attacks, because any values passed in in this way are automatically](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=69.665) [escaped by the database. So it doesn't matter if a malicious user has included some quote characters or](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=75.665) [other special characters in here to try and do something nefarious, those characters are going to be](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=81.665) [automatically escaped in our statement, and that goes a long way into feeding SQL injection attacks like this.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=86.665) [The automatic escaping of these strings also means that you don't have to do anything special in your code](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=93.665) [when a user wants to legitimately include a single quote character in the value they are entering, like](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=99.665) [when they're typing the name O'Connor or O'Reilly. Secondly, using a parameterized SQL statement like this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=104.665) [will also perform faster and use fewer resources on SQL Server. Why is this?](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=110.665) [Remember that every time a SQL statement is sent to SQL Server, SQL Server has to determine an execution plan](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=117.665) [of how to execute that statement. What actually happens is that SQL Server looks in an area of memory known](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=123.665) [as the plan cache to see if it has already executed the same statement before, and therefore already has an](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=129.665) [execution plan that can be used. If yes, then SQL Server can just use this cached execution plan.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=135.665) [If no, SQL Server will have to do additional work to come up with an execution plan, either through a process](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=143.665) [known as simple parameterization or through generating a completely new execution plan.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=149.665) [If you are using parameterized SQL statements, then once that statement is run the first time, every](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=156.665) [subsequent execution of that statement is going to be able to use the same cached execution plan, even when](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=161.665) [different values are included with the new statement execution. If you are dynamically generating your](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=167.665) [SQL statements, like we saw in the string concatenation example, the actual SQL is different each time,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=172.665) [so SQL Server has to perform this additional work to get an execution plan each time, and that additional](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=178.665) [work will slow down your application, but maybe more importantly, make it less scalable.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=183.665) [The code that you saw earlier in this clip was part of a simple test application that I wrote that ran the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=190.665) [same SQL statement several thousand times with different values, and you see the results of that test on](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=195.665) [your screen. When we didn't use parameterized SQL, the test took 8.5 seconds of elapsed time to run,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=200.665) [almost 7 seconds of CPU time, and we used 79MB up in SQL to store all of those different execution plans.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=207.665) [Using parameterized SQL statements, all of those same SQL statements executed in under 1 second and we](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=216.665) [used almost no CPU time on the database server since we were using the same plan over and over again.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=222.665) [And as you can see, we used just 104KB of memory in the database to cache our execution plan.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=228.665) [So we see that using parameterized SQL not just makes our statements execute faster, but also consumes](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=235.665) [significantly fewer resources on our database server. And this is a big deal, because most database servers](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=241.665) [are pretty busy, supporting many, many concurrent users, so being efficient about resource consumption is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=247.665) [important.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=253.665) [If you're using an ORM like Entity Framework or Hibernate, these tools should already be parameterizing](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=255.665) [your SQL for you. But if you're writing your data access layer using something like ADO.NET or JDBC,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=260.665) [or even using a micro ORM where you're still writing the SQL statements directly, make sure that you're](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=267.665) [parameterizing your SQL statements. This will provide a performance boost for your application, as well as](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=273.1) [help to keep you safe from SQL injection attacks.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=1&mode=live&start=279.665)

[Are Stored Procedures Faster Than SQL in Application Code?](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live)

[If you've been doing database development for any period of time, you've probably heard someone say that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=0) [you should use stored procedures for your data access layer because stored procedures offer better](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=5.954) [performance than having the SQL in your application code. This is one of those statements that's been](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=10.954) [around a long time, and it is partially correct, however, this statement alone does not tell the full story,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=14.954) [so let's explain what's going on here.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=20.954) [In the last section, we compared the performance of dynamically-generated SQL statements to that of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=23.954) [parameterized SQL, and we saw that parameterized SQL was not just faster, but also used less CPU and memory](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=27.954) [on the database server. The main reason for this is that when using dynamic SQL, SQL Server has to do](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=34.954) [additional work to parse each unique SQL statement and come up with an execution plan, whereas in the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=40.954) [parameterized SQL case we don't need to parse the SQL text each time, and can use the same plan over and over again.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=46.954) [When people say using stored procedures offers a performance advantage, what they are referring to is that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=54.954) [using stored procedures will outperform dynamically-generated SQL.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=59.954) [From a performance standpoint, stored procedures are very similar to a parameterized SQL statement.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=63.954) [You pass in some values to a stored procedure, these are attached to a statement or statements within the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=69.954) [stored procedure that need them, but effectively SQL Server has already parsed the procedure and has an](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=73.954) [execution plan, so you are getting the same benefits as in the parameterized SQL case.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=79.954) [When you compare the performance of using stored procedures to using parameterized SQL statements, the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=85.954) [performance is essentially the same, there is effectively no difference between the two.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=90.954) [Now this doesn't mean that there aren't good reasons to use stored procedures, there are, especially when it](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=95.954) [comes to security and restricting access to data, but from a performance standpoint, parameterized SQL](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=100.954) [statements and stored procedures perform about the same. So the next time you hear the statement that](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=105.954) [stored procedures offer better performance, you'll understand this statement comes with a qualifier.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=111.954) [Stored procedures do perform better than dynamic SQL, but as we saw in the last clip, we don't want to be](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=117.954) [writing dynamic SQL anyway. Otherwise, stored procedures and parameterized SQL statements offer the same](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=122.954) [benefits in terms of performance, so as long as you choose one of these strategies you'll be fine from a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=128.954) [performance perspective. Next we're going to take a look at commit behavior and how this can affect the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=133.954) [performance of your data access code.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=2&mode=live&start=139.4)

[Commit Behavior and Performance](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live)

[When you run an insert, update or delete statement from your application against SQL Server, an implicit](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=0) [commit is issued for each statement, because by default the SQL Server driver is set with its auto-commit](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=7.049) [behavior turned on. This is true not just for the .NET data provider, but also for JDBC, OLE DB](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=12.049) [and ODBC as well.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=19.049) [So consider the code sample that you see on your screen. What I am doing is adding all of the courses](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=21.049) [a student wants to enroll in for a semester, and these enrollments are in a list, and the typical student](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=26.049) [will have 5 or 6 courses that they want to enroll in. So some pretty simple data access code, we just](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=31.049) [iterate over each item in the list and run our insert command.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=37.049) [However, because of the default auto-commit behavior of the SQL Server driver, when this code is run,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=42.049) [there will be an implicit database commit done each time one of these statements is executed.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=47.049) [What this means is that up on the SQL Server, SQL Server has to write an entry to the transaction log to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=52.049) [make sure there's a record of the DML operation being performed, so there is a write to the transaction log](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=58.049) [incurred each time one of these statements is executed.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=63.049) [What we really intend, though, with this code, is probably to insert all of the records at once for this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=68.049) [student or none of the records at all, so this work should be performed inside of a transaction.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=72.049) [This is a pretty common pattern to use a transaction like this, another example being an e-commerce site](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=79.049) [inserting items with an order, and we want all of those inserts to succeed or none of them so our database](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=84.049) [is in a consistent state. So to accomplish this we're going to create a transaction here, then we'll pass](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=89.049) [the transaction to the constructor of the SQL command to attach it to the command, and finally, when all](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=95.049) [of the items are inserted, we commit the transaction. So this makes much more business sense, but as it](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=100.049) [turns out it also performs better, because now we are committing once per student rather than once per](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=107.049) [enrollment record, so SQL Server doesn't have to write to the transaction log as often.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=112.049) [I have some results of when I ran this program before I started recording that I can show you, and you](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=118.049) [can see here that using the first method when we had the default auto-commit behavior on, it took a little](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=123.049) [bit more than 30 seconds to insert 165,000 rows. When I used a transaction, which is also more correct from](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=129.049) [a business sense, it took a little more than 23 seconds, so about 7 seconds faster on those same 165,000 records.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=136.049) [Now these numbers, of course, aren't absolutes, and you'll likely get somewhat different results on your](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=145.049) [system, but the point is that we want to pay attention to our commit behavior, because if we're committing](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=149.049) [after every DML statement we execute and we really don't need to, we're imposing more of a load on SQL Server,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=154.049) [and that's going to slow things down.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=160.049) [So how often should you commit? As often as your business transaction dictates, and in some cases that may](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=163.049) [very well be after every statement. If not, though, just make sure that you're explicitly using a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=169.049) [transaction so you are controlling the commit behavior and not using the default auto-commit behavior of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=175.049) [the database driver. If you're using an ORM, most of the times your ORM should be handling this properly](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=180.049) [for you, however, there are some other issues you want to watch out for when using an ORM, so we'll talk](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=186.049) [about those next.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=3&mode=live&start=191.5)

[Object Relational Mappers Just Generate SQL](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live)

[Over the last few years, Object Relational Mappers have become very popular in the development community,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=0) [and it's easy to see why. ORMs allow us to work at higher levels of abstraction, and they also eliminate](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=6.944) [the need to write a lot of repetitive data access code to get data into and out of our database, thereby](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=12.944) [helping to increase our productivity as developers. On the downside, removing us from having to work](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=18.944) [directly with the database gives us less visibility and less control into how our data access code is](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=24.944) [executed, and so one of the side effects of this is that if you just leave your data access up to the ORM](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=30.944) [and don't think about how that data access is performed, you can get some very poor performance.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=36.944) [Let's see what we mean by this.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=41.944) [I have a very simple application here that is using Entity Framework, and the intention here is to search](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=43.944) [all of the current applicants who have a GPA over 3.5 and a math SAT score of over 700.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=48.944) [The code here is perfectly valid and will return the desired results.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=55.944) [the issue is that in this case there's not an index on any of these columns, so this query will end up](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=59.944) [performing a full table scan, which in this case will not result in very good performance.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=66.944) [Having an iQueryable, we have a fluent interface that is very flexible, and it becomes easy to just think about](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=72.944) [attaching the necessary expressions here in code and not to think about what needs to happen when this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=77.944) [expression is converted to SQL and sent to the database.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=82.944) [So we just need to keep in mind as we use our ORM, ultimately these expressions will turn into SQL and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=86.944) [all of the rules we've talked about in this course, like being properly indexed and having a query with](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=92.944) [a selective WHERE clause still apply. If you have any questions about exactly what is happening, you can](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=96.944) [get the actual SQL that is being generated by the ORM by tracing your application as we showed in the last](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=103.944) [module, or by using some of the client-side tracing techniques that are present in most ORMs.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=108.944) [Then, once you have the SQL you can generate an execution plan for the statement and apply all the other](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=114.944) [techniques we've learned throughout the course to make sure that that statement performs the way you need it to.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=120.944) [Next we'll look at another issue that frequently occurs with ORMs, but also can occur in other scenarios,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=126.944) [and that is the N+1 query issue.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=4&mode=live&start=131.944)

[Solving the N+1 Selects Problem](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live)

[Another performance pitfall you want to be on the lookout for, especially when using an ORM, is the N+1](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=0) [selects problem. This problem occurs when you have a parent object loading its child data, and in loading](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=6.9) [that child data the data access layer issues a separate SQL statement for each child object that needs to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=13.9) [be loaded. Let's look at an example of this.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=18.9) [We have a piece of code here, and what this code is trying to do is to get the cumulative GPA for a student.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=22.9) [So it needs to get all of the courses taken by this student, their grades in each course, and the number of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=28.9) [credits each course is worth, in order to perform that calculation.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=33.9) [So this seems pretty straightforward. We load a student object, and then through the navigation properties](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=37.9) [on the object we can get to all of the other data that we need to do this calculation.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=42.9) [What happens, though, is that initially our student object doesn't have all of the data that it needs,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=48.9) [so the data for these navigation properties are lazy loaded. I have an Extended Events session tracing all](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=53.9) [of my SQL right now, and I'm going to actually run this program so we can see what's happening.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=59.9) [And so we see that the program just prints the name and GPA, but now I'm going to switch over to the trace](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=65.9) [results so we can see what SQL was run.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=71.9) [I have my trace file open here, and I've done a little bit of cleanup to filter out all of the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=75.9) [sp\_reset\_connection messages that the SQL Server driver issues when it retrieves a connection from the](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=79.9) [connection pool. So you see right away there are quite a few statements here that are executing, and if we](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=85.9) [group these statements together we actually get a better view of what's going on.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=90.9) [There are some queries in here that are overhead for Entity Framework, but we're not worried about those.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=95.9) [What we care about are these two statements that are executed 42 times each, and if you expanded out the SQL](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=101.9) [that's in each of those statements, you would see that it's these two queries that are grabbing the course](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=107.9) [offerings and course records from the database. What is happening is that Entity Framework is able to get](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=112.9) [all of the courses this student has taken with a single query from the Course Enrollments table,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=117.9) [but then, it iterates through each of those Course Enrollment records, and to get over to the course record](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=122.9) [where the number of credits for the class is stored it first has to get each course offering record and then](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=127.9) [each course record. And so, one by one it's iterating through these, lazy-loading each of those objects](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=133.9) [for however many courses that this student has taken.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=139.9) [And we can see here, this student has taken 42 courses, so that means we have 42 unique course offering](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=143.9) [records we've issued queries for, and then, again, 42 unique course records that we also had to load.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=149.9) [We also had to load some grade records so we could see what each grade is worth, but there's only two unique](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=155.9) [values for those, so that's just two more statements in this case.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=159.9) [But you see the problem, to calculate this student's GPA Entity Framework is having to run 88 individual](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=163.9) [queries by my count, so that's going to be very chatty, and not very efficient.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=168.9) [The issue here is the lazy loading pattern, which fetches data just as it's needed.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=173.9) [While this is convenient for many scenarios, it's not the right pattern for this situation because we're](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=179.9) [having to go back and forth to the database to get all this data piece by piece.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=184.9) [What we can do instead is use eager loading to instruct Entity Framework to load all of this data up front,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=189.9) [and then entity Framework will create a single query that gets all the data we need, rather than issuing](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=194.9) [all of these little queries.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=200.9) [So to do that we just use the Include method up here when we fetch our Student object, so I'll put that in now.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=202.9) [And this first line is going to tell Entity Framework to get all of the course offerings, as well as courses](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=209.9) [for the student, and the second line will get all of the grades attached to any of the courseEnrollments](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=214.9) [data so when we get our Student object we'll have all the data we need to do this calculation.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=218.9) [So I'm going to save this file and rerun this program so we can get a second trace of what's happening,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=224.9) [and now we'll go look at that trace.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=231.9) [We can see that this time we have many fewer statements, and in fact, if I take this statement here and I](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=233.9) [look at it, and I've copied that in a notepad again so we can do just that, we see that this one statement](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=239.9) [is getting all of the data that we need, so in this case this is going to be much more efficient because](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=245.9) [we're not having to go back and forth to the database many, many times.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=249.9) [This can happen when you're lazy loading objects in an ORM, as we've just seen, but I've also seen this](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=254.9) [problem in traditional data access code where the code was written in such a way that it was retrieving all](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=259.9) [the child data for an object in a one-by-one fashion. The point is, when you're loading child data like this,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=264.9) [you want to think about the internals of how that's happening, and make sure that you're not iterating over](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=271.9) [some sort of collection and issuing a SQL statement for each object in that collection, because that's](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=276.9) [going to be very chatty, and that's not going to perform very well.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=281.9) [So think about this whenever you're loading data that's child data of another object, and if need be, don't](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=285.9) [hesitate to use one of the various tracing facilities to make sure that you're not issuing a whole bunch](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=290.9) [of individual SQL statements in order to get that data.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=5&mode=live&start=295.9)

[Summary](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live)

[In this module, we looked at some application practices that you want to make sure and implement for your](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=0) [application to have the best performance possible. First, we talked about making sure that all of the SQL](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=5.855) [in your application is parameterized SQL. This not only protects against SQL injection attacks, but has a](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=11.855) [performance benefit as well, as SQL Server can reuse the same execution plan over and over, making your](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=18.855) [code run faster and saving resources within SQL Server. We also talked about stored procedures, and showed](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=24.855) [that from a performance standpoint, parameterized SQL and stored procedures are equivalent, so you can be](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=31.855) [comfortable choosing whichever approach best fits your situation.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=36.855) [Then we talked about commit frequency and how auto-commit is turned on in the SQL Server driver by default.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=41.855) [In some cases it makes sense to commit after each DML statement, but otherwise, using transactions and](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=48.855) [committing however often makes logical business sense, not only is more correct for your application, it will](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=54.855) [also perform better as well. Finally, we talked about ORMs. ORMs are a great tool that enhance our](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=59.855) [productivity and save us from writing the same data access code over and over again, but this additional](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=67.855) [level of abstraction sometimes makes it harder to understand what is happening inside of SQL Server.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=73.855) [So just remember that ultimately everything does have to get converted to a SQL statement, and then all of](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=78.855) [the normal rules about selectivity and indexing apply. Finally, if you are loading any child objects,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=83.855) [especially through lazy loading, be on the lookout for the N+1 selects problem.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=90.855) [Basically, each child object will load one by one from the database, and this chattiness has a tendency to](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=96.855) [slow things down, so be on the lookout for this and use eager loading in those situations where it makes more sense.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=102.855) [This brings us to the end of the course, and I hope you have found your time well-spent in learning how](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=110.855) [SQL Server works from a performance standpoint, and what you can do to make sure your applications have](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=115.855) [optimal performance. We've introduced a wide variety of concepts and tools that can help you understand](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=120.855) [what SQL Server is doing, and what you need to do in order to performance tune your application.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=126.855) [The best course of action now is to get some hands-on experience with these tools by looking at an](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=133.855) [application and database that you're familiar with, because this is how you really learn what to look for,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=138.855) [and what the data is telling you. Thank you for your time, good luck, and from everyone at Pluralsight,](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=143.855) [we hope to see you again in another course soon.](https://app.pluralsight.com/player?course=sql-server-performance-every-developer-should-know&author=david-berry&name=sql-server-performance-every-developer-should-know-m6&clip=6&mode=live&start=150.855)