

Understanding Server Hardware

Module 3: Hardware Evaluation

Glenn Berry

Glenn@SQLskills.com



Introduction

- **Understanding your workload**
 - Various workload types place different demands on the server hardware
- **Application benchmarks**
 - TPC-E, TPC-H
 - SPECjbb2005
- **Component benchmarks**
 - Disk benchmarks
 - CrystalDiskMark, HDTune Pro, ATTO, SQLIO
 - Processor benchmarks
 - Geekbench, SPECCPU2006, Cinebench
 - Memory benchmarks
 - Geekbench, SiSoft Sandra 2012
- **Understanding hardware tradeoffs**
 - Budget-related tradeoffs
 - Unintended tradeoffs

Understanding Your Workload

- **Different types of workloads place different demands on hardware**
 - Different components are under stress depending on the workload type
- **CPU-intensive workloads**
 - Application servers
 - Web servers
- **Memory-intensive workloads**
 - Database servers
 - Caching servers
- **I/O-intensive workloads**
 - Database servers
 - File servers
- **Network intensive workloads**
 - File servers
 - Web servers

Application Benchmarks

- **Use real applications to measure the actual performance, throughput, and response time of an entire system while running the application**
 - Measures the entire system, not just individual components
 - This is different than a component benchmark
- **Very useful for comparing different systems**
 - Compare an existing system to a new system
 - Compare multiple candidates for new systems to each other
- **Can be helpful for sizing and consolidation calculations**
 - New system might have 5x the capacity of an existing system

TPC TPC-E OLTP Benchmark

- **Transaction Processing Performance Council (TPC)**
- **OLTP database benchmark introduced in February 2007**
 - Simulates the OLTP workload of a brokerage firm
 - Uses a realistic data model and realistic data
 - Requires fault-tolerant storage, enforces referential integrity
 - Has less reliance on unrealistic, expensive storage subsystem
 - Benchmark is CPU-limited with adequate I/O performance
- **Good benchmark for comparing processor performance**
 - Especially relevant for OLTP workloads
 - Only has results for Microsoft SQL Server RDBMS
- **TPC-E results website**
 - <http://tpc.org/tpce/default.asp>

TPC TPC-H Decision Support Benchmark

- **Decision support database benchmark**

- Suite of business-oriented, ad hoc queries
- Designed to examine large volumes of data
- Designed to execute complex, long-running queries
- Separate result categories for different database sizes
 - 100GB, 300GB, 1000GB, 3000GB, 10000GB, and 30000GB
- Scores for different database sizes should not be compared
- Places different demands on hardware than TPC-E benchmark

- **TPC-H results website**

- <http://tpc.org/tpch/default.asp>

SPEC SPECjbb2005 Java Server Benchmark

- **Standard Performance Evaluation Corporation (SPEC)**
- **SPECjbb2005 is a Java server benchmark**
 - Mainly measures middle-tier, application server performance
 - Client-tier is replaced by driver threads
 - Data-tier is replaced by binary trees of objects
 - The benchmark exercises the implementations of the JVM (Java Virtual Machine), JIT (Just-In-Time) compiler, garbage collection, threads and some aspects of the operating system
 - Places most stress on processor and memory performance
- **Information page**
 - <http://www.spec.org/jbb2005/>

Component Benchmarks

- **Component benchmarks focus on one or more components in a server using a synthetic workload to stress that component**
- **Examples:**
 - Disk benchmarks measure I/O performance
 - Input/Output operations per second (IOPS)
 - Sequential throughput (MB/second or GB/second)
 - Processor benchmarks measure CPU performance
 - Floating point performance
 - Integer performance
 - Memory benchmarks measure memory performance
 - Read and write sequential performance
 - Memory stream performance

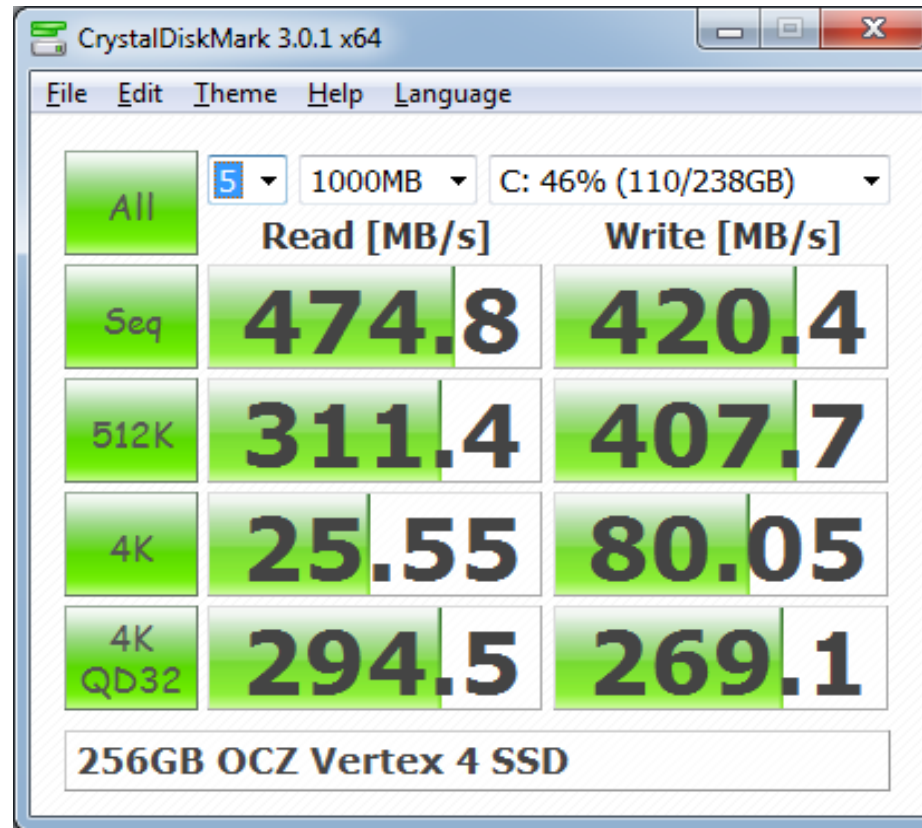
Disk Benchmarks

- CrystalDiskMark 3.01c
- HD Tune Pro 5.0
- Atto Disk Benchmark v2.46
- SQLIO

CrystalDiskMark 3.0.1c

- **Very easy to use, no complicated configuration required**
 - You can choose the file size for the test runs
 - 50MB, 100MB, 500MB, 1000MB, 2000MB, 4000MB
 - You can choose the file type
 - Random data or non-random data
 - Some SSD controllers use compression for performance
 - Random data is not very compressible
 - You can choose the number of test runs (1-9)
- **Quickly measures sequential and random I/O performance**
 - Sequential reads and writes in MB/second
 - Large and small random reads and writes at different queue depths
 - Measured in MB/sec and IOPS
 - Free download
 - <http://bit.ly/TDoGOi>

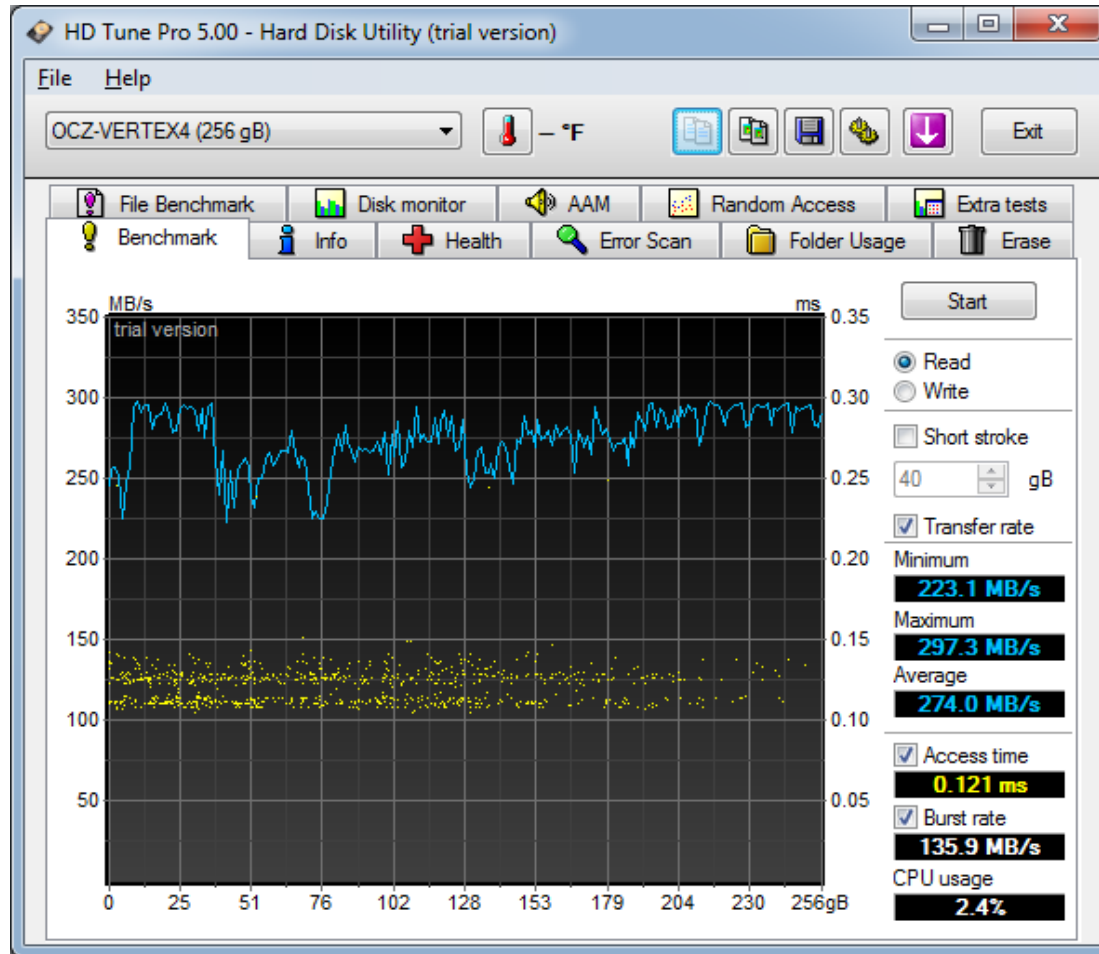
CrystalDiskMark Example Output



HD Tune Pro 5.0

- **HD Tune Pro is a disk utility and benchmark program**
 - It can measure the sequential transfer rate of a drive or drive array
 - It can measure the access time, burst rate and CPU usage
 - You can run a read or write test with any logical drive
 - Useful to evaluate performance of logical drives
- **Also useful for determining disk information**
 - Helps identify exact model and health status of an individual drive
- **It is free for a 15-day evaluation period**
 - Costs \$34.95 to purchase (as of time of writing, October 2012)
- **HD Tune website**
 - <http://www.hdtune.com/index.html>

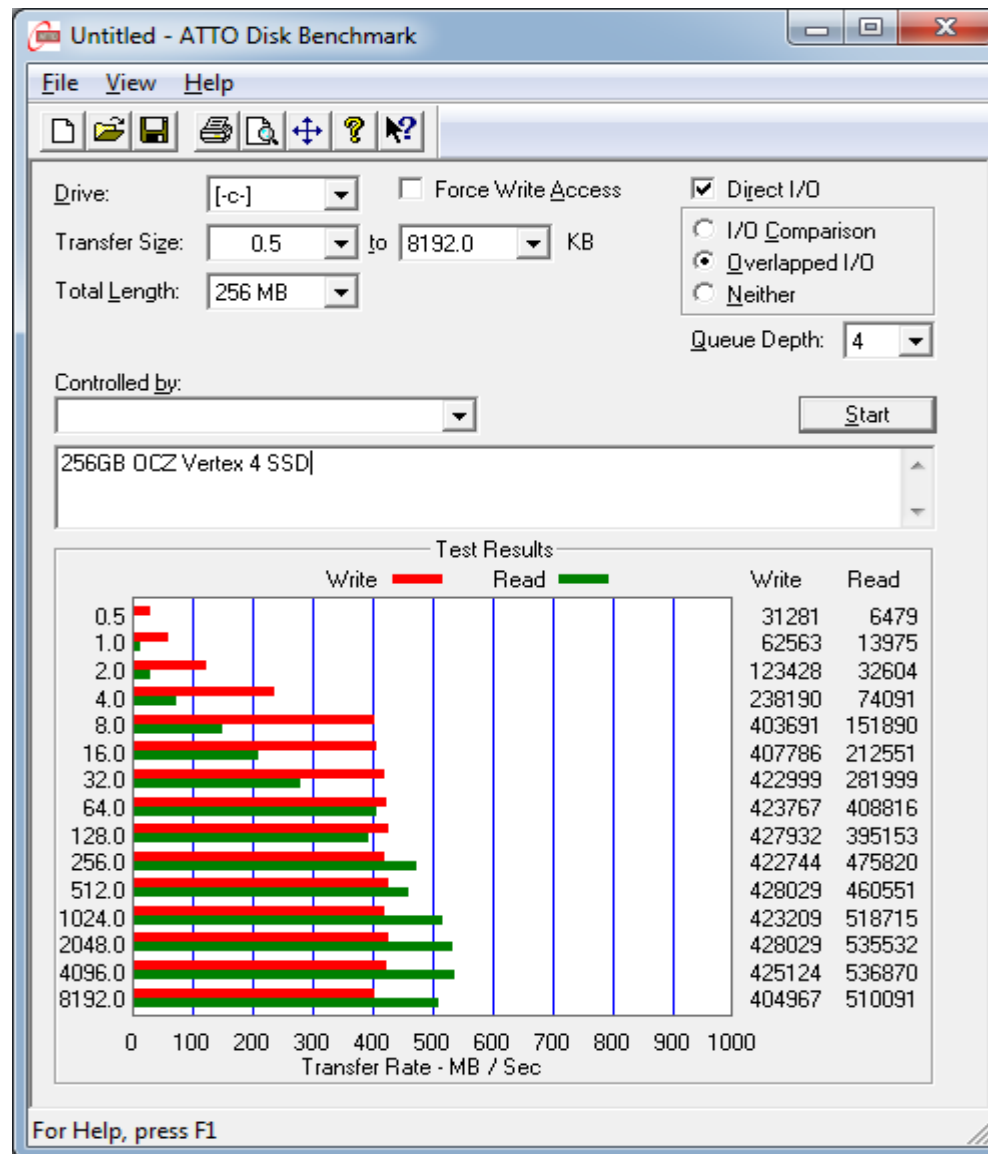
HD Tune Pro 5.0 Example Output



ATTO Disk Benchmark v2.48

- **Somewhat older, but still popular disk benchmark program**
 - Only measures sequential I/O performance
- **Very easy and quick to run**
 - Can measure logical disk performance
- **Free download**
 - <http://bit.ly/R10wHS>

ATTO Disk Benchmark Results



SQLIO Disk Benchmark

- **Despite the name, it has nothing to do with SQL Server**
 - Free tool developed by Microsoft to evaluate I/O performance
 - You can use it on any server running a recent version of Windows
- **Command-line utility**
 - Requires some expertise to properly configure and run
 - Can take a long time to run a comprehensive set of tests
- **Allows you to test the limits of your I/O subsystem**
 - Measures IOPS
 - Sequential throughput in MB/second
 - Latency in milliseconds
- **Download location**
 - <http://bit.ly/QxwUV8>

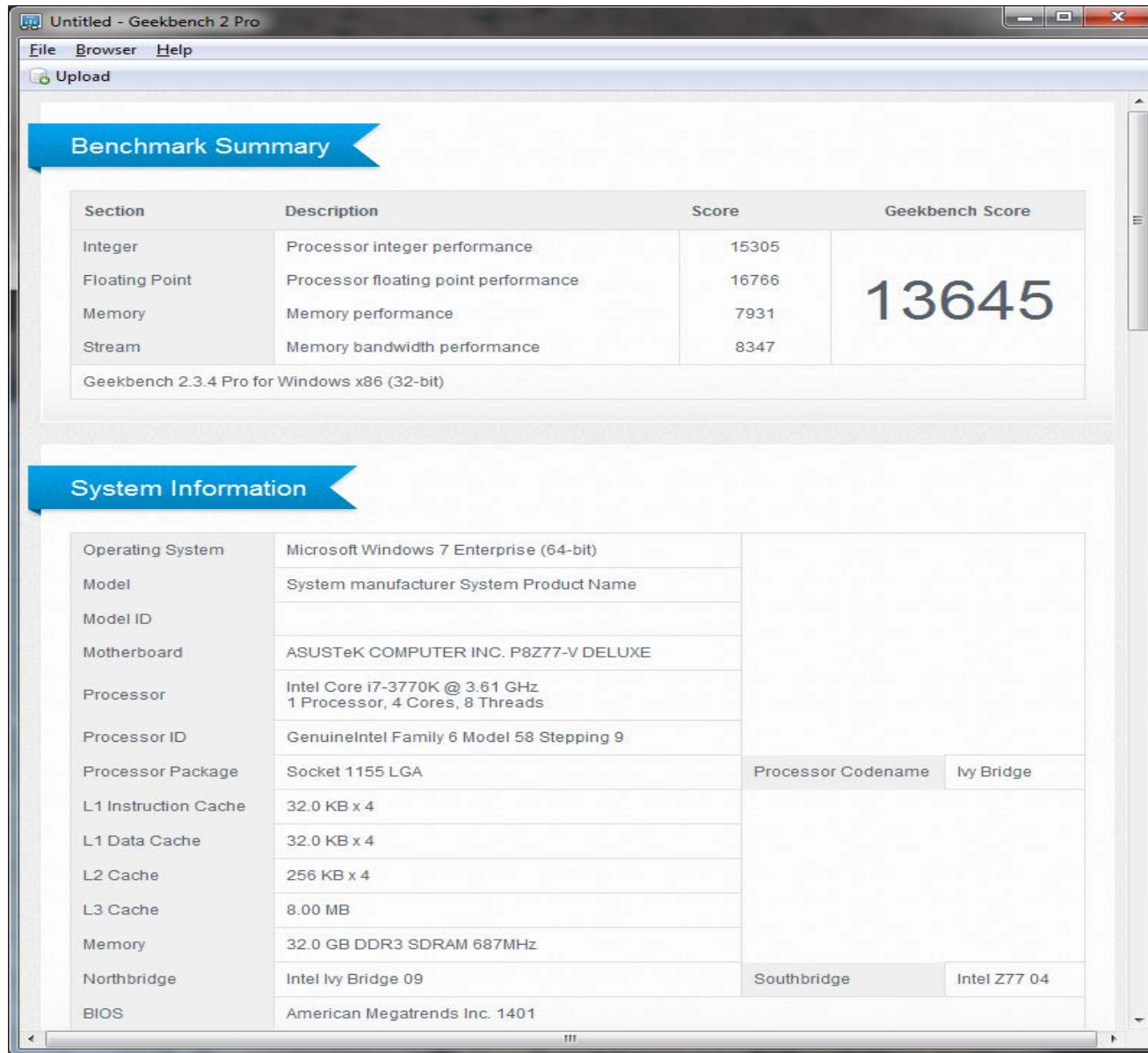
Processor Benchmarks

- **Geekbench 2.3.4**
- **SPECCPU2006 v1.2**
- **Maxon Cinebench 11.5**

Geekbench 2.3.4 Benchmark

- **Cross-platform processor and memory benchmark**
 - Requires and allows no configuration, runs in two-three minutes
 - Measures processor and memory performance with 39 different tests
- **Gives an overall Geekbench score for the system**
 - Also has subsection scores for each test
- **Online Geekbench database of submitted results**
 - Very useful for comparing systems you don't have access to
 - <http://browser.primatelabs.com/>
- **32-bit evaluation version is free**
 - 64-bit version for Windows is \$12.99 (as of time of writing, October 2012)
 - 64-bit version has higher floating point scores on some processors
- **Main web page**
 - <http://www.primatelabs.com/geekbench/>

Geekbench 2.3.4 Example Output



SPEC CPU2006 Processor Benchmark

- **Standard Performance Evaluation Corporation (SPEC)**
- **Standardized processor and memory benchmark**
 - Stresses CPU and memory subsystem
 - Provides comparative measure of compute-intensive performance
 - Measures integer and floating-point performance
 - Source code can be purchased for \$800.00
- **Most often used by hardware vendors**
 - Useful for comparing different processors
- **Main information page**
 - <http://www.spec.org/cpu2006/>
- **You can search submitted results in an online database**
 - <http://www.spec.org/cgi-bin/osgresults?conf=cpu2006>


Maxon Cinebench 11.5

- **Cross-platform test suite based on Cinema 4D software**
 - Actual application workload instead of a synthetic benchmark
- **Evaluates processor and graphics card performance**
 - Useful for engineering workstations and graphics rendering servers
 - Benchmark used by many hardware review sites
- **You can choose to only run the CPU portion of the test**
 - Most servers will not have a powerful graphics card
- **Main information page**
 - <http://www.maxon.net/products/cinebench/overview.html>
- **Free download**
 - <http://bit.ly/QM3nHv>

Maxon Cinebench 11.5 Example Results

CINEBENCH R11.5 (64 Bit)

File Help

 **CINEBENCH**
RELEASE 11.5

OpenGL 86.55 fps

CPU 8.99 pts

Your System

Processor Intel Core i7-3770K CPU

Cores x GHz 4 Cores, 8 Threads @ 3.61 GHz

OS Windows 7, 64 Bit, Enterprise E

CB Version 64 Bit

GFX Board AMD Radeon HD 7700 Series


Info Glenn's workstation

Ranking

CPU Details

1. 8C/16T @ 3.33 GHz, Intel Xeon C	11.69
2. 8C/16T @ 2.92 GHz, Intel Xeon C	10.33
3. 4C/8T @ 3.61 GHz, Intel Core i7-3	8.99
4. 12C/12T @ 2.62 GHz, AMD Opteron	7.95
5. 4C/8T @ 3.20 GHz, Intel Core i7 Cf	5.48
6. 4C/8T @ 2.80 GHz, Intel Core i7 Cf	5.06

☐ Your Score ☐ Identical System



AIX SPONZA

MAXON 3D FOR THE REAL WORLD

Welcome to CINEBENCH R11.5 - click on one of the 'Run' buttons to start a test.

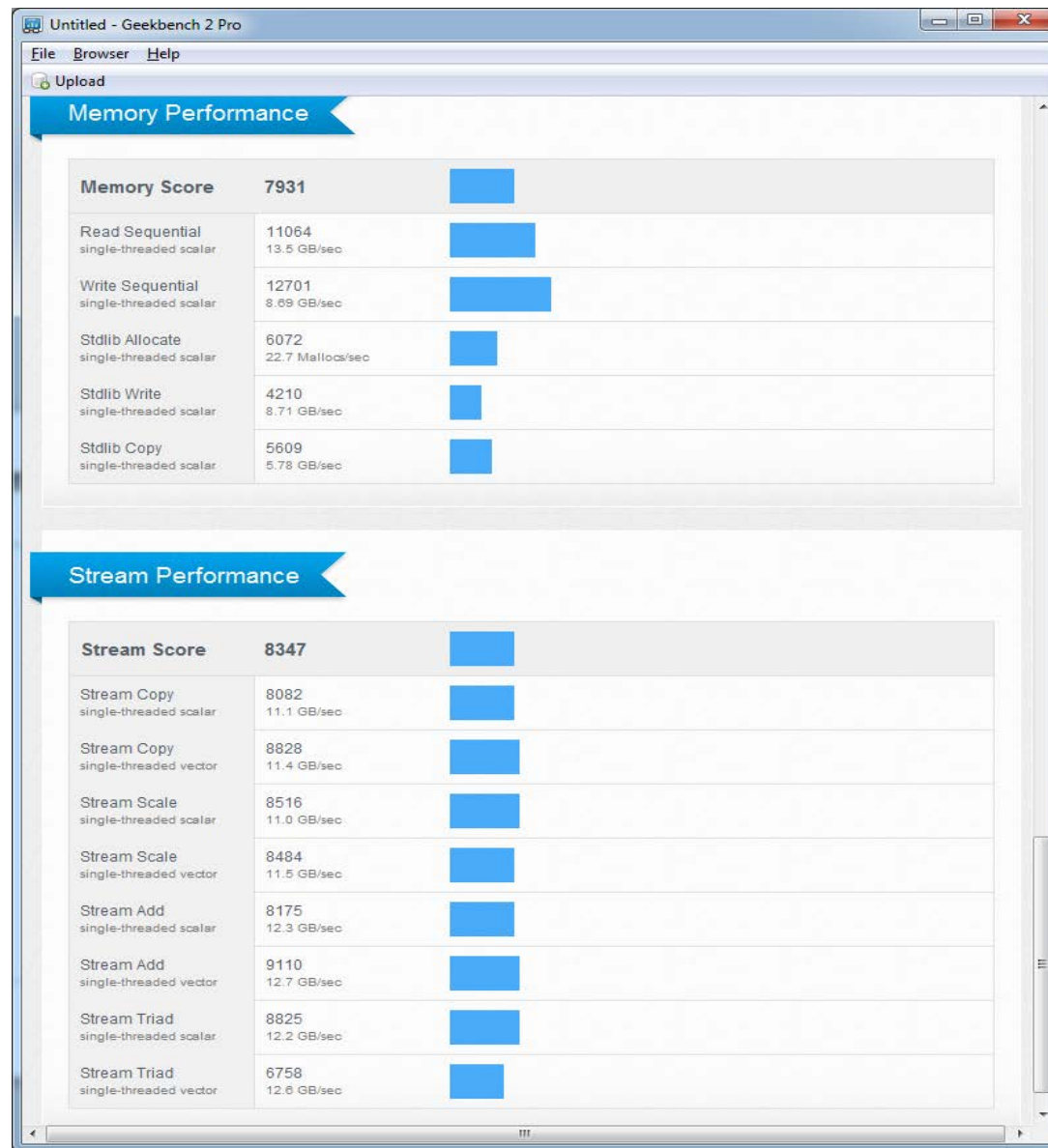
Memory Benchmarks

- Geekbench 2.3.4
- SiSoft Sandra 2012

Geekbench Memory Benchmarks

- **Thirteen different memory and stream-related tests**
 - Read and write memory tests
 - Stream tests measure memory bandwidth
- **Very useful for evaluating memory performance**
 - Can be used to validate performance after a configuration change
 - Examples:
 - Changing a memory-related BIOS setting
 - Adding more memory or different types of memory
- **How to interpret Geekbench scores**
 - <http://bit.ly/R0XOCd> '(R-zero-X-capitalO)'
- **Descriptions of individual Geekbench tests**
 - <http://bit.ly/R0Y4Bk>

Geekbench 2.3.4 Example Memory Scores



SiSoft Sandra 2012

- **Comprehensive suite of benchmarks and utilities**
 - Many different benchmark tests for different server components
 - Memory bandwidth and latency tests
- **Used by many hardware review test sites**
 - Makes it easier to compare your results to other systems
- **Test Support version is the most useful for testing servers**
 - Works on a Windows domain
 - Licensed per user, not per machine
 - Costs \$299.99
- **Main site**
 - <http://bit.ly/R0Zb3T>

Understanding Hardware Tradeoffs

- **You may have a limited hardware budget**
 - How do you allocate your hardware budget to get the best performance?
 - Processors
 - Memory
 - I/O subsystem
 - Redundant components
- **With an unlimited hardware budget there are still tradeoffs**
 - Larger servers are usually not faster servers
 - Higher socket counts usually mean slower processors
 - More installed memory usually means less memory bandwidth
 - Larger servers have more absolute load capacity
 - More total processor cores
 - More total memory capacity
 - More PCI-E expansion slots for more I/O capacity

Summary

- **It is very important to understand how to evaluate hardware**
 - Helps you understand your current capacity, scalability, and performance
 - Helps you evaluate component upgrades and possible new purchases
- **Application benchmarks**
 - Actual application tests the entire server with a specific workload type
- **Component benchmarks**
 - Synthetic workload designed to test a specific server component
 - I/O, processor, and memory benchmarks are the most common type
- **Understanding of hardware tradeoffs**
 - You may have budget limits that constrain your choices
 - Some hardware choices can have unintended side effects

What is Next?

- **Module 4 will cover hardware selection**
 - Choosing a server vendor
 - Choosing a server form factor
 - Choosing a processor vendor
 - Choosing a server model
 - Choosing a processor model
 - Determining the amount of RAM
 - Choosing a storage type
 - Understanding RAID levels
 - Calculating RAID storage overhead
 - Choosing components for redundancy
 - Minimizing hardware and licensing costs