



# Optimizing Your Workstation for SolidWorks

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# Agenda

- Introduction
- Performance Analysis & Tuning: Science and Art
- Analyzing & Improving Performance
- Software Considerations
- Q & A



# Introduction

# Introduction

Who am I?

What will we cover today?

- Understand some basic performance analysis and tuning techniques
  - » Explore the benefits and limits of these techniques
- Exploration of workstation component performance
  - » How to determine performance
  - » How to identify performance issues and improve performance
  - » Benchmark examples
- Software considerations
- Questions?
  - » Welcome at any time!



# Performance Analysis & Tuning: Science and Art

# Performance Analysis & Tuning: Science and Art

## Performance Analysis: Science

- Involves systematic and methodical techniques for obtaining precise performance information
- Techniques include:
  - » Instrumented system software and/or hardware
    - software profiling, hardware counters
  - » Defining Workloads
  - » Formal Benchmark tests
    - SPEC, industry standard
  - » Informal Benchmark tests
    - in-house, QA, “I made it up”
  - » Empirical tests
    - stopwatch, head-to-head, 1-Mississippi, etc.
  - » Data Analysis
    - statistical significance, variance, repeatability



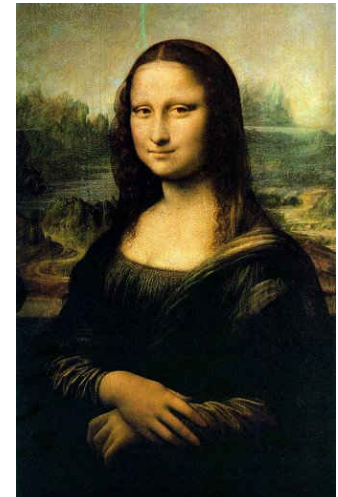
Hard data helps pinpoint problem areas and validate solutions

- Usually takes a lot of work!

# Performance Analysis & Tuning: Science and Art

## Performance Analysis: Art

- “The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling”<sup>1</sup>
- Testing methods, techniques, technologies will change over time (the science)
- Analysis of the data, numerical and statistical analysis will be the key to understanding performance, the art of the analysis
- Science is the “how”
  - » how do I measure?
- Art is the “what”
  - » what did I measure?



<sup>1</sup> R. Jain, "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling," Wiley- Interscience, New York, NY, April 1991, ISBN:0471503361.

# Performance Analysis & Tuning: Science and Art

## Two important points

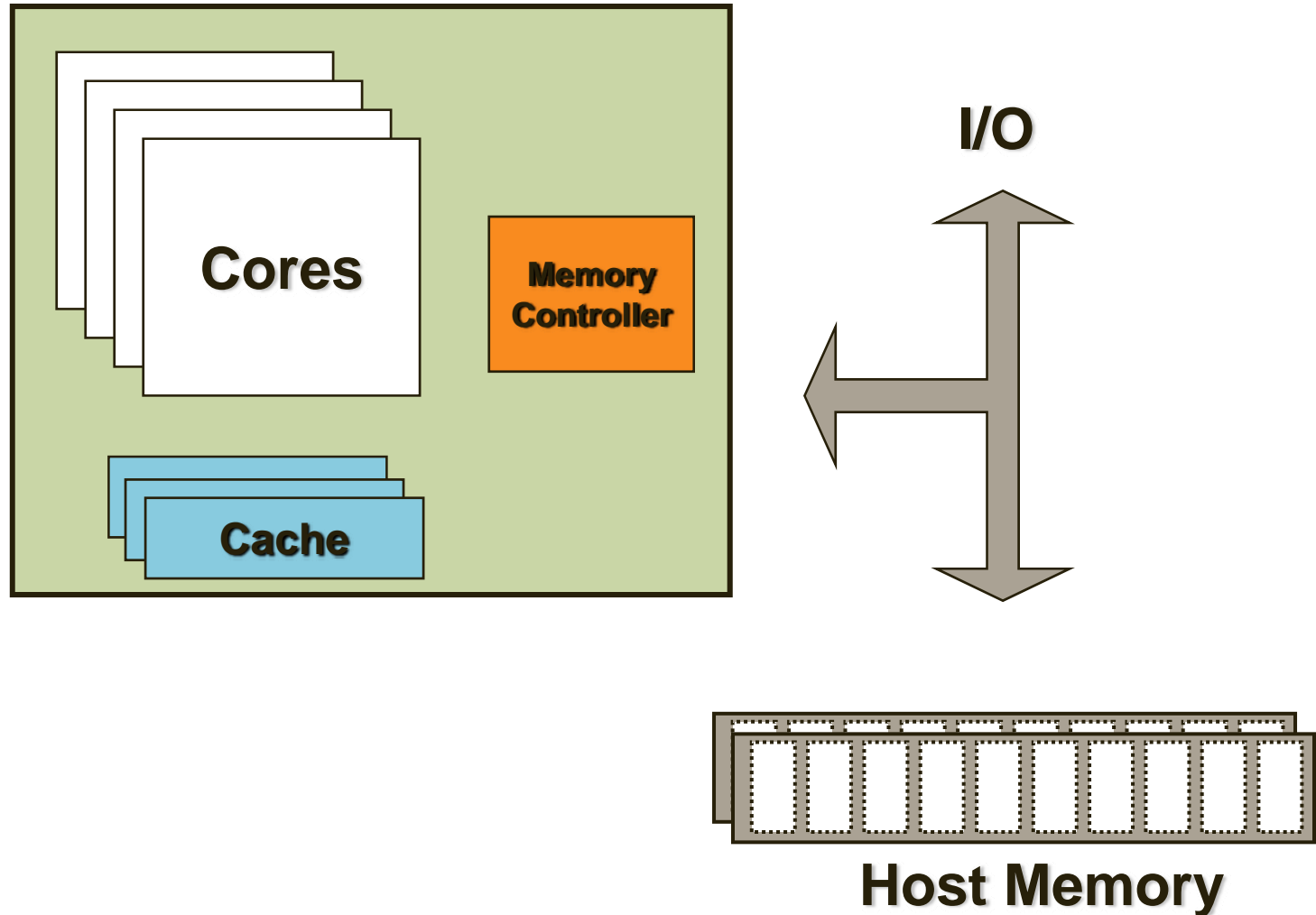
- Know your limits
  - » Be realistic about what's possible
- Diminishing returns
  - » Know when enough is enough
- No matter how much you analyze and tune, there are limits to what you can achieve
  - » Hardware and software have definite performance limits
  - » There will always be newer, faster hardware & software



# Analyzing & Improving Performance

# Analyzing & Improving Component Performance - CPU

Modern CPU:



# Analyzing & Improving Component Performance - CPU

## Modern CPUs offer better performance than ever before

- Multiple cores on a single CPU provide larger amounts of compute power in the same size package
- CPU frequencies are still going up
  - » *Though frequencies are going up, still hard to compare different CPUs clock vs clock*
    - *Architectures can vary between CPUs*
    - *Cache sizes, bus speeds*
- Multiple cores are becoming the standard
  - » Most computers offering at least dual-core CPUs
  - » Quad core becoming common

# Analyzing & Improving Component Performance - CPU

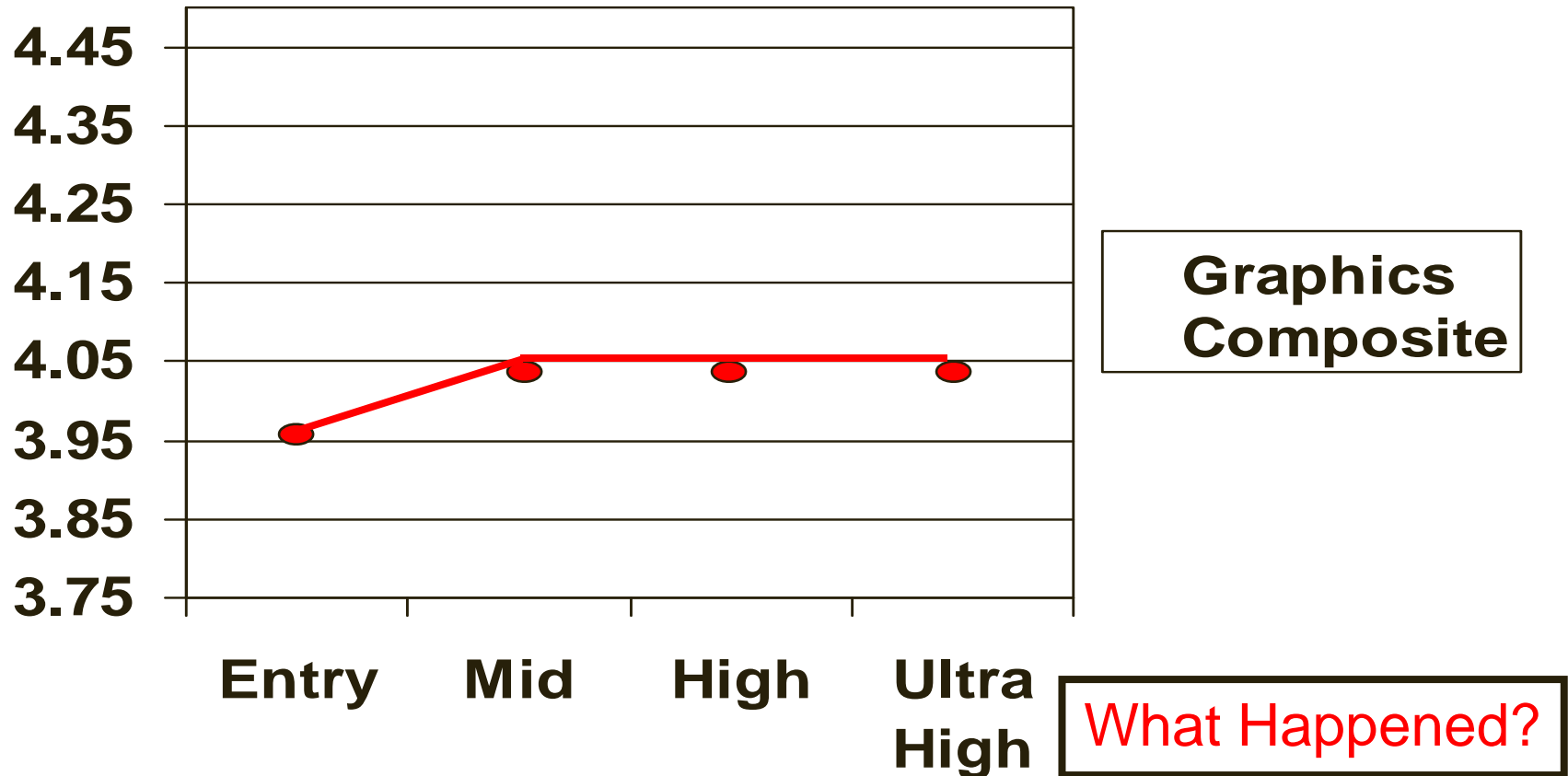
## How does CPU performance affect application performance?

- Benchmark example:
  - » SPEC APC SolidWorks 2007
    - Standards Performance Evaluations Committee (SPEC) provides industry standard benchmarks
    - Graphics Workstation Performance Group (GWPG) Committee focuses on workstation specific graphics benchmarks
      - Committee members include system OEM vendors, graphics hardware vendors, and application software vendors

# Analyzing & Improving Component Performance - CPU

## SPEC APC SolidWorks 2007

- Test machine: 3.0GHz Quad Core, 4GB memory, XP32
  - » Vary graphics from low to ultra high end to gauge graphics performance



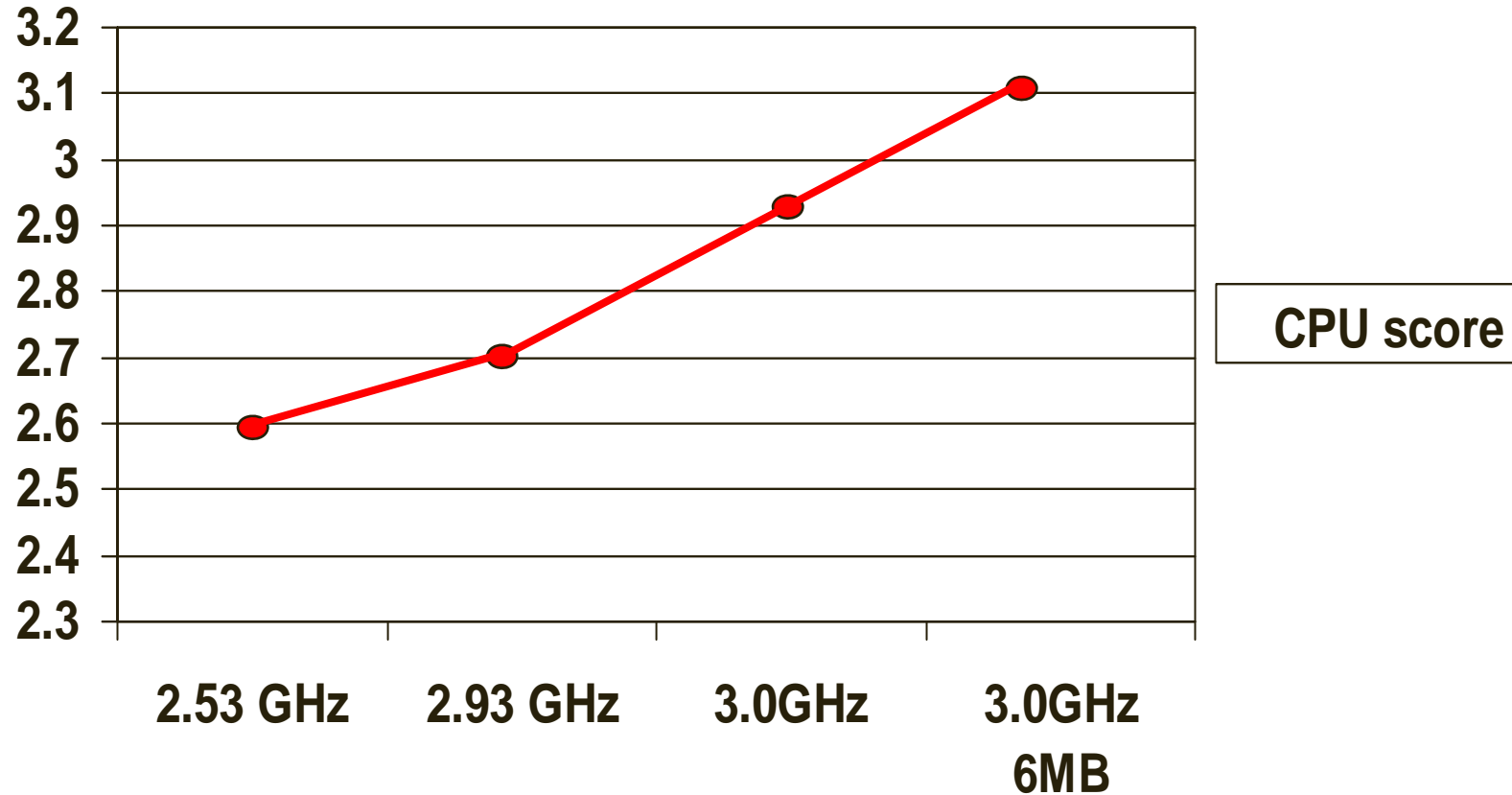
# Analyzing & Improving Component Performance - CPU

## SPEC APC SolidWorks 2007 – Analyzing the results

- No improvement in the Graphics Composite score with faster, more powerful graphics
- Suspect benchmark is CPU limited
  - » Test and/or application cannot feed graphics fast enough to drive higher levels of performance
  - » Not necessarily indicative of SolidWorks 2007, could be a limitation of the benchmark itself
- How do we determine the bottleneck here for sure?
  - » Run more tests!

# Analyzing & Improving Component Performance - CPU

## SPEC APC SolidWorks 2007 – CPU tests: Vary CPU Speed



# Analyzing & Improving Component Performance - CPU

## SPEC APC SolidWorks 2007 – What did we learn?

- No improvement in the Graphics Composite score with faster, more powerful graphics
- Faster CPU gave better CPU score
  - » Validated that test is CPU limited, need a faster CPU to get a better score
- We also saw that not all 3.0GHz CPUs are created equal!
  - » The 6MB cache 3.0GHz CPU was 8% faster
- The graphics composites moved up along with the CPU scores
  - » Faster CPUs fed the graphics cards at a higher rate

# Analyzing & Improving Component Performance - CPU

## Important note about benchmarks:

- Benchmarks only measure what they are designed to measure
- Sometimes the results don't accurately reflect what the benchmark was originally designed to measure
  - » SPEC APC Viewperf 2007 was intended to measure graphics workstation performance
- Benchmarks might not age well
  - » SPEC APC Viewperf 2007 was released in 2006 (work on the benchmark in 2005) – graphics power has increased significantly since then with introduction of unified shader architectures
- You need to collect and analyze the data carefully
  - » If you only ran SPEC APC Viewperf 2007 on a single high-end card, you might not notice the CPU limited nature of the benchmark
- SPEC is working with SolidWorks on a SolidWorks 2009 benchmark

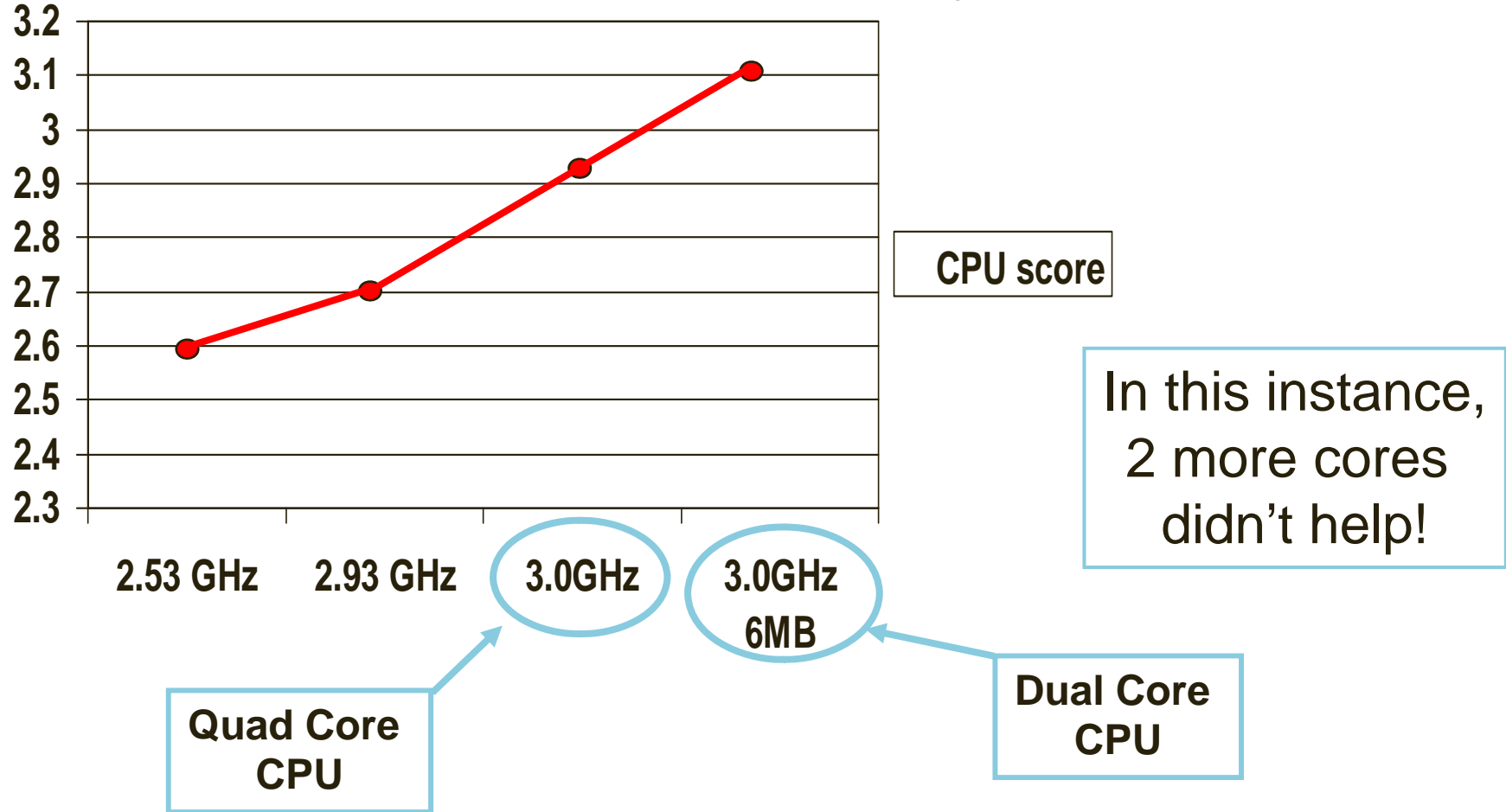
# Analyzing & Improving Component Performance - CPU

## SolidWorks and multi-core CPUs

- Will a multi-core CPU run SolidWorks faster?
  - » Yes and No...
- SolidWorks is multi-threaded
  - » But the threading is at a high level, UI, dialog boxes, etc.
  - » The low-level solvers and other compute intensive portions of code do not take full advantage of multiple CPU cores
- Lets take a look at the CPU testing results again...

# Analyzing & Improving Component Performance - CPU

## SPEC APC SolidWorks 2007 – CPU tests: Vary CPU Speed



# Analyzing & Improving Component Performance - CPU

## SolidWorks and multi-core CPUs

- Multiple cores may not help SolidWorks directly, but there still could be benefits
  - » Multiple cores provide benefits not only to multi threaded applications, but they provide benefits to multi process environments
  - » Most workstations run many processes, each need to be given time on the CPU
  - » Overall system workload will determine overall system performance
- If you can run SolidWorks and nothing else on your workstation, you have the potential to get the most performance out of your CPU!

# Analyzing & Improving Component Performance - CPU

## How busy is my workstation?

- Use the Windows Task Manager to see what's going on
  - » Right click on the Task Bar to bring it up

# Analyzing & Improving Component Performance - CPU

**Task Manager**  
sorted by  
CPU usage

CPU hogs!

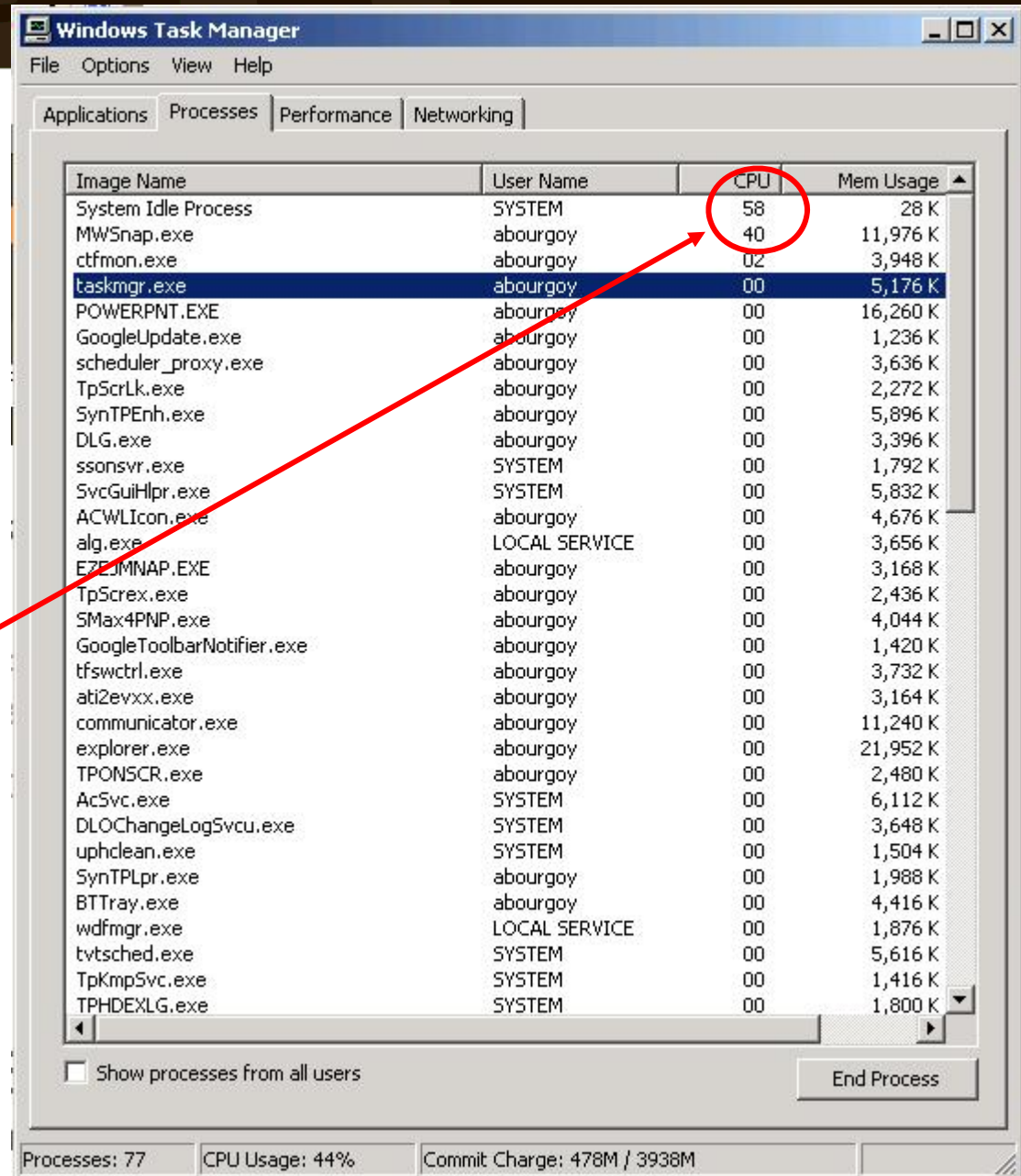


Image Name	User Name	CPU	Mem Usage
System Idle Process	SYSTEM	58	28 K
MW5nap.exe	abourgoy	40	11,976 K
ctfmon.exe	abourgoy	02	3,948 K
taskmgr.exe	abourgoy	00	5,176 K
POWERPNT.EXE	abourgoy	00	16,260 K
GoogleUpdate.exe	abourgoy	00	1,236 K
scheduler_proxy.exe	abourgoy	00	3,636 K
TpScrLk.exe	abourgoy	00	2,272 K
SynTPEnh.exe	abourgoy	00	5,896 K
DLG.exe	abourgoy	00	3,396 K
ssonsvr.exe	SYSTEM	00	1,792 K
SvcGuiHlpr.exe	SYSTEM	00	5,832 K
ACWLIcon.exe	abourgoy	00	4,676 K
alg.exe	LOCAL SERVICE	00	3,656 K
EZEJMNAP.EXE	abourgoy	00	3,168 K
Tp5crex.exe	abourgoy	00	2,436 K
SMax4PNP.exe	abourgoy	00	4,044 K
GoogleToolbarNotifier.exe	abourgoy	00	1,420 K
tfswctrl.exe	abourgoy	00	3,732 K
ati2evxx.exe	abourgoy	00	3,164 K
communicator.exe	abourgoy	00	11,240 K
explorer.exe	abourgoy	00	21,952 K
TPON5CR.exe	abourgoy	00	2,480 K
AcSvc.exe	SYSTEM	00	6,112 K
DLOChangeLogSvcu.exe	SYSTEM	00	3,648 K
uphclean.exe	SYSTEM	00	1,504 K
SynTPLpr.exe	abourgoy	00	1,988 K
BTTray.exe	abourgoy	00	4,416 K
wdfmgr.exe	LOCAL SERVICE	00	1,876 K
tvtsched.exe	SYSTEM	00	5,616 K
TpKmpSvc.exe	SYSTEM	00	1,416 K
TPHDEXLG.exe	SYSTEM	00	1,800 K

Processes: 77    CPU Usage: 44%    Commit Charge: 478M / 3938M

# Analyzing & Improving Component Performance - CPU

**Task Manager**  
sorted by  
memory usage

Memory Hogs!

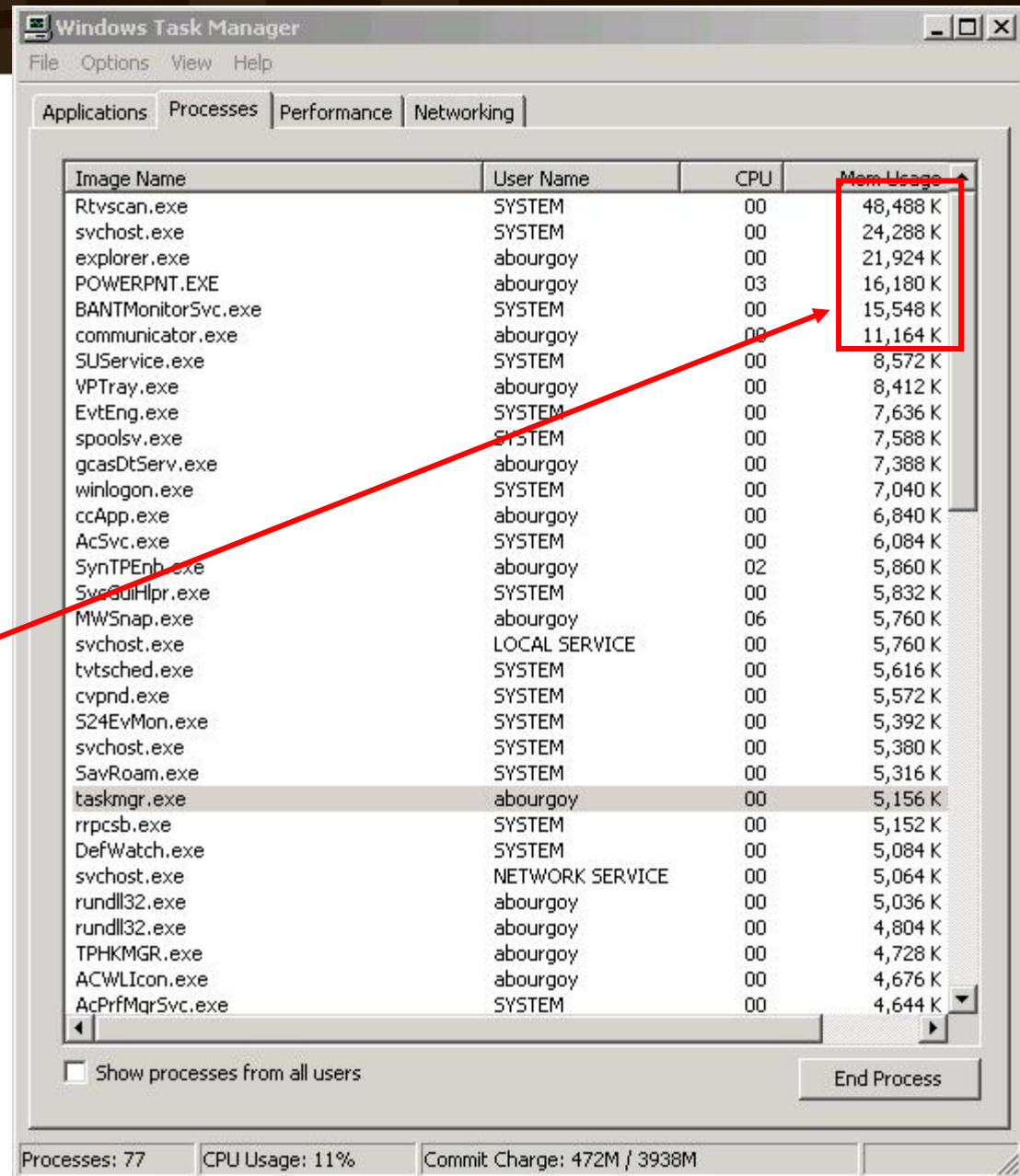


Image Name	User Name	CPU	Mem Usage
Rtvsan.exe	SYSTEM	00	48,488 K
svchost.exe	SYSTEM	00	24,288 K
explorer.exe	abourgoy	00	21,924 K
POWERPNT.EXE	abourgoy	03	16,180 K
BANTMonitorSvc.exe	SYSTEM	00	15,548 K
communicator.exe	abourgoy	00	11,164 K
SUService.exe	SYSTEM	00	8,572 K
VPTray.exe	abourgoy	00	8,412 K
EvtEng.exe	SYSTEM	00	7,636 K
spoolsv.exe	SYSTEM	00	7,588 K
gcasDtServ.exe	abourgoy	00	7,388 K
winlogon.exe	SYSTEM	00	7,040 K
ccApp.exe	abourgoy	00	6,840 K
AcSvc.exe	SYSTEM	00	6,084 K
SynTPEnh.exe	abourgoy	02	5,860 K
SvcGuiHlp.exe	SYSTEM	00	5,832 K
MW5nap.exe	abourgoy	06	5,760 K
svchost.exe	LOCAL SERVICE	00	5,760 K
tvtsched.exe	SYSTEM	00	5,616 K
cypnd.exe	SYSTEM	00	5,572 K
S24EvMon.exe	SYSTEM	00	5,392 K
svchost.exe	SYSTEM	00	5,380 K
SavRoam.exe	SYSTEM	00	5,316 K
taskmgr.exe	abourgoy	00	5,156 K
rrpcsb.exe	SYSTEM	00	5,152 K
DefWatch.exe	SYSTEM	00	5,084 K
svchost.exe	NETWORK SERVICE	00	5,064 K
rundll32.exe	abourgoy	00	5,036 K
rundll32.exe	abourgoy	00	4,804 K
TPHKMGR.exe	abourgoy	00	4,728 K
ACWLIcon.exe	abourgoy	00	4,676 K
AcPrfMqrSvc.exe	SYSTEM	00	4,644 K

Processes: 77    CPU Usage: 11%    Commit Charge: 472M / 3938M

# Analyzing & Improving Component Performance - CPU

## Do some “spring cleaning”!

- Use Task Manager to identify processes that don't need to be running
  - » Many utilities, such as CD/DVD burning software, browser toolbars, etc., start themselves up at system boot time
    - Use msconfig utility
  - » You can pretty much identify any running process with an internet search
    - If you don't know what it is, leave it alone
  - » Do you really need the iPod binaries running all the time (iPodService.exe and iTuneshelper.exe)?

# Analyzing & Improving Component Performance - CPU

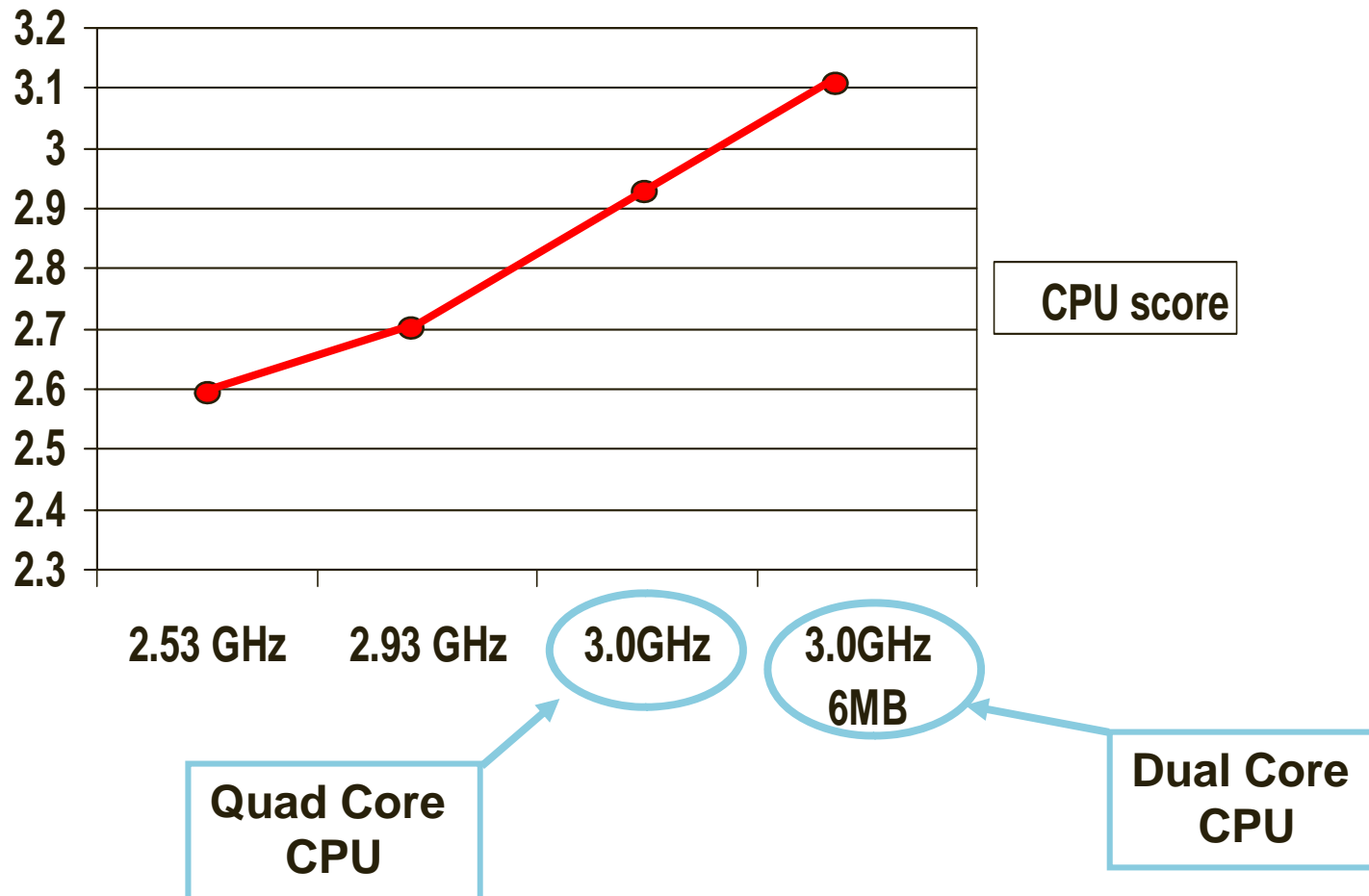
## Do some “spring cleaning”!

- Remove applications that you don't need that initiate services at startup
  - » Most OEMs include a lot of “freeware” or “try ware”
  - » In some cases, even though the free trial period has expired, the software still starts up services!
- For some reason, laptops seem to have more trial software/services than workstations
  - » They usually have less powerful CPUs, less memory, and slower system buses
  - » Removing unnecessary processes will pay off in better performance!

# Analyzing & Improving Component Performance - CPU

## One last thing about CPUs...

- Remember how the dual core 3GHz CPU was faster than the quad core 3GHz CPU?



# Analyzing & Improving Component Performance - CPU

## The 2<sup>nd</sup> 3GHz CPU had a 6MB cache ( vs 4MB )

- Not all 3GHz CPUs are created equal
- The larger CPU cache enables the CPU to store more data local to the CPU, it's faster to get data from cache than it is to get it from system memory
  - » The SPEC SolidWorks 2007 Benchmark uses fairly small models, good chance a lot of the data fit into the 6MB cache accounting for the performance difference
  - » You can use CPU analyzer tools to get a view into the CPU cache, but that's going pretty far...
- When considering a CPU purchase, you have to consider overall CPU performance, not just GHz!
  - » Web is a good place to find latest CPU performance benchmark data

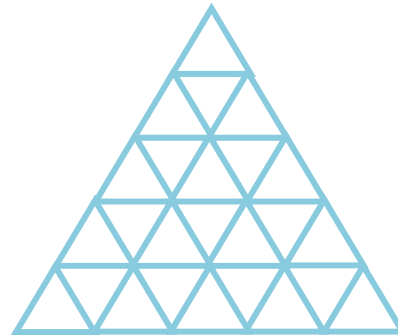
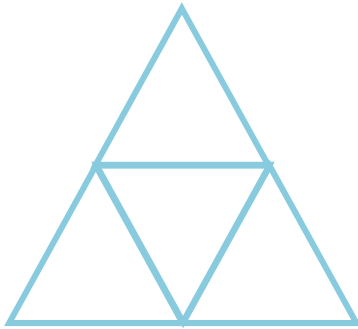


# Graphics

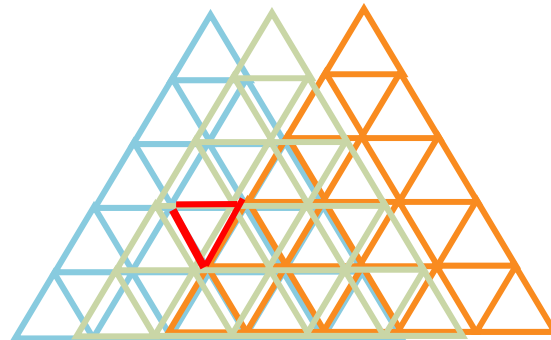
# SolidWorks and Graphics

SolidWorks is a graphics intensive application

- The larger and more complex the model, the greater the demands on the graphics card

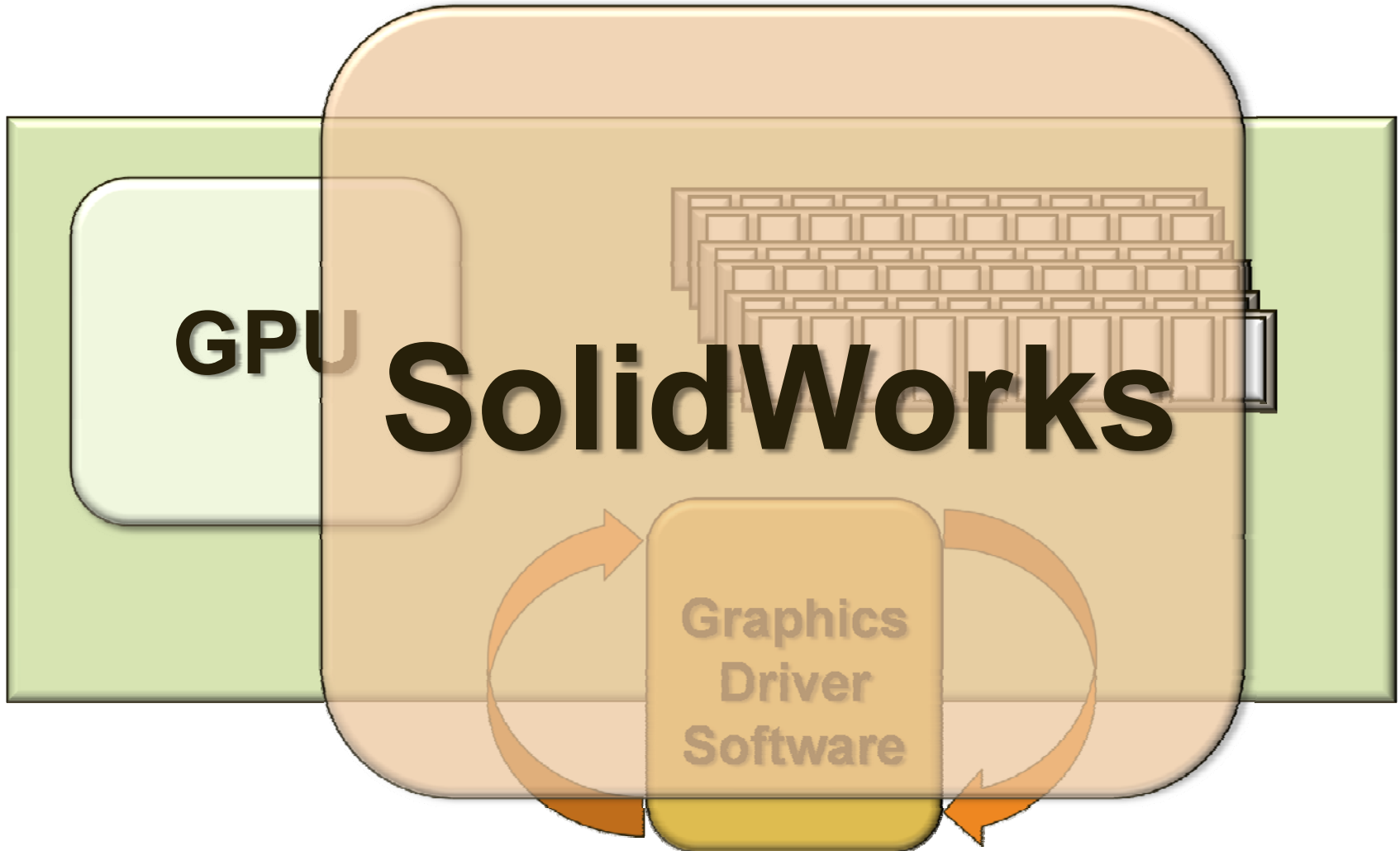


- Interacting with a model, such as part selection, can require the graphics card to analyze a large amount of data in a very short period of time



# SolidWorks and Graphics

Application graphics performance includes 1 more factor:



# SolidWorks and Graphics

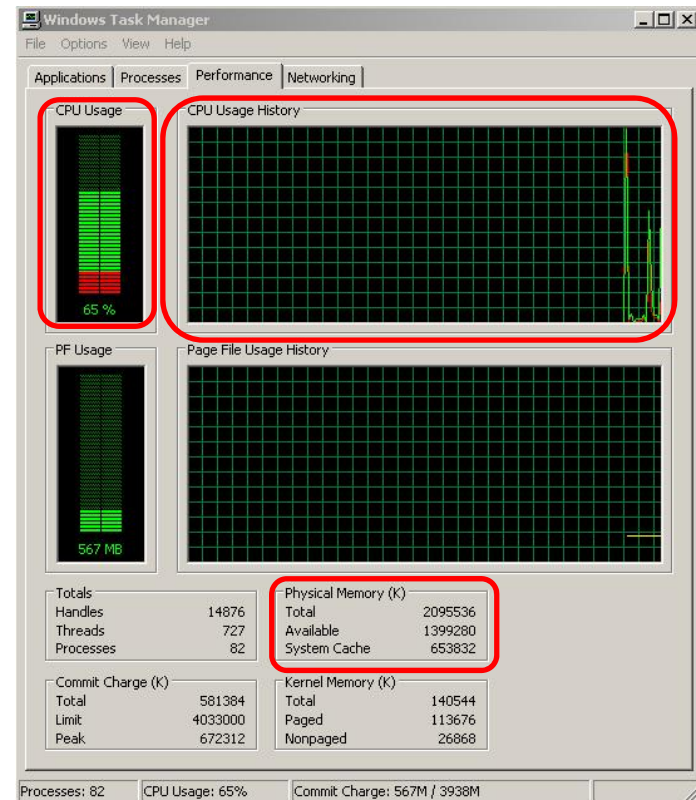
What kind of graphics card do I need?

- That depends:
  - » What kind of system do you have?
    - Desktop, laptop?
  - » How big are your models?
    - Models tend to grow in complexity over time
  - » What features of SolidWorks do you use?
    - RealView can use more graphics power
  - » Do you run other applications other than SolidWorks?
    - Each application puts demands on the system, including graphics

# SolidWorks and Graphics

Is my current graphics card good enough?

- If system performance has degraded over time or seem sluggish, you have to investigate
  - » Might be graphics, but might be something else
  - » How do I know?
- Task Manager can help:
  - » Shows CPU usage
    - Is it at 100%?
  - » Shows memory usage:
    - Out of physical memory?
  - » If memory or CPU resources exhausted, need to address these first



# SolidWorks and Graphics

The size of the graphics workload will determine overall graphics performance

**How do I determine the size of the SolidWorks graphics workload?**

» AMD provides some tools that can help!

– Graphics Memory viewer tool

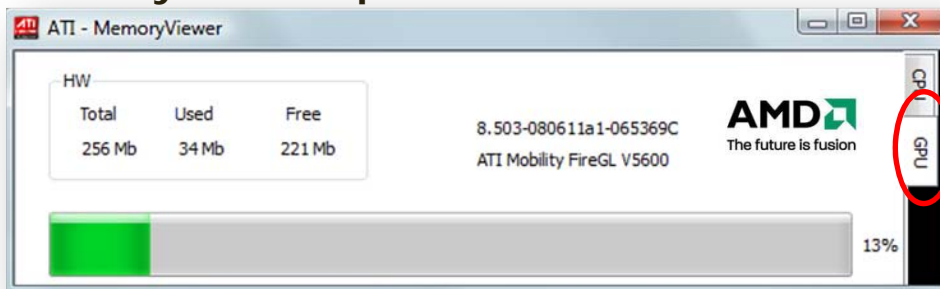
– SolidWorks triangle count macros

# SolidWorks and Graphics

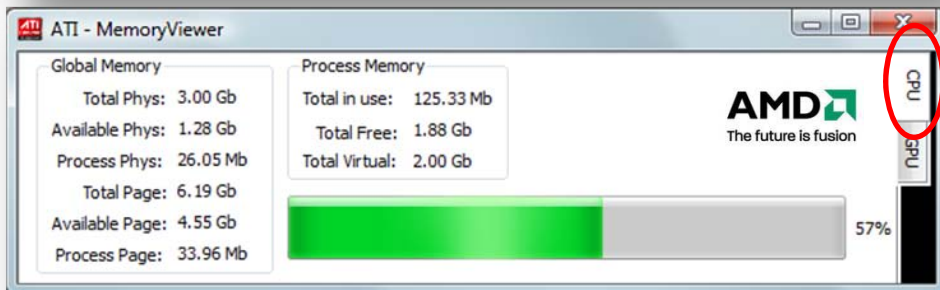
## ATI Memory Viewer

- Shows GPU/CPU memory usage in real time
  - Available for download at:  
<http://ati.amd.com/products/workstation.html>  
"Tools" option on the left

### Memory Consumption



GPU



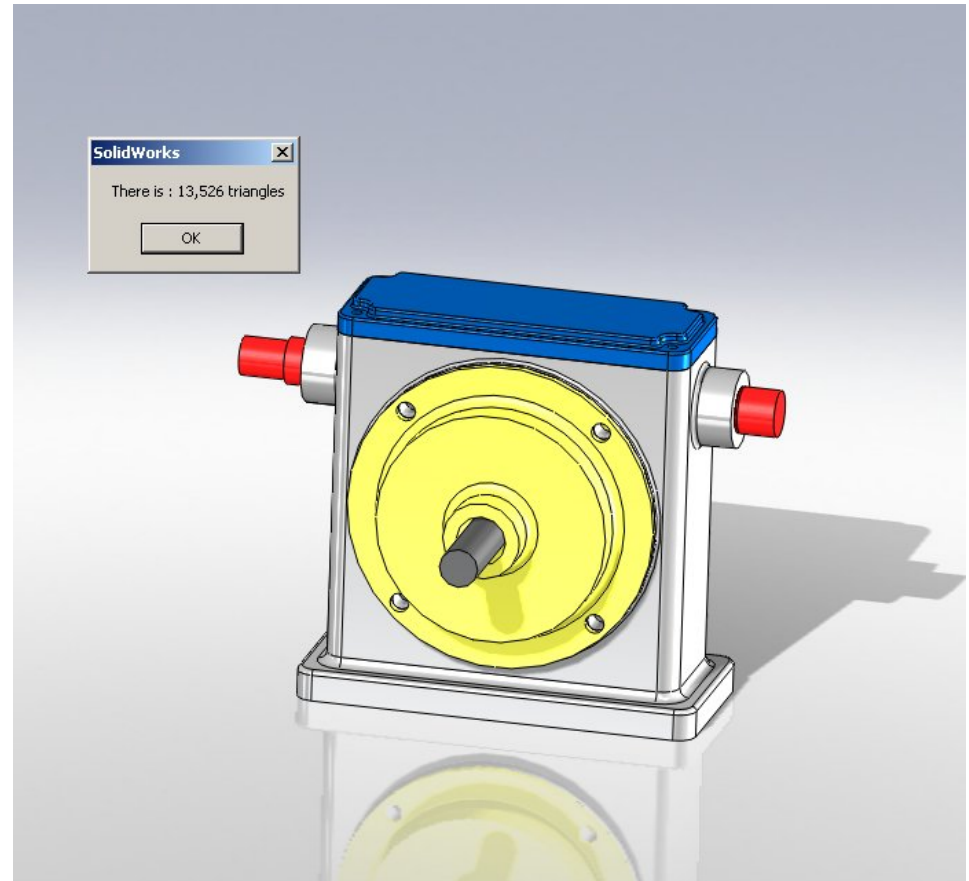
CPU

### AMD Model Samples

Models	# Triangles	GPU (Mb)
Piston	12 672	2
Block	23 840	2
Engine	141 368	6
Body Front	476 456	18
AllCAR	528 384	24
Scoot_1mp	879 502	40
CAR	1 328 667	36
CAR0	2 149 949	59
Holland	2 319 945	64
Holland_3mp	2 319 945	52
Driveline	2 806 989	149
CAR2	3 172 019	156
Body Simp	3 398 235	150
M3000	5 170 052	168
BW_7mp	6 718 008	287
Cars_14mp	13 501 702	662
BigMV	20 485 332	692
M_23mp	22 388 454	995

## SolidWorks Triangle Count Macros

- Gives count of triangles in your current part/model or any part/model file
  - Available for download later this week at:  
<http://ati.amd.com/products/workstation.html>  
"Tools" option on the left
- *TrianglesCount.swp* for currently open part/model
- *TrianglesCountWithOpen.swp* for any part/model file
- Tools->Macros->Run to execute



# SolidWorks and Graphics

How do I configure the graphics card for best performance?

- If you have a fairly recent card and driver software...
  - » It's easy!
  - » ATI FireGL™/FirePro™ cards automatically configure graphics hardware & software when you start an application
    - FireGL™ cards have been able to do this for over 3 years
  - » Competing cards enable you to select a graphics profile for SolidWorks to configure graphics

# SolidWorks and Graphics

CPU performance looks good, running latest software, what do I do next?

- Examine your workflow
  - » What is the size and complexity of your models
  - » What features of SolidWorks do you use?
    - RealView, others, can put additional demands on graphics
  - » Do you run other applications?
  - » Are you the only user of this system?
- Do I have the right card for the job?

# SolidWorks and Graphics

Graphics cards are broken down into 4 segments:

- **Entry level ( \$100-\$300)**
  - » 256MB of memory
  - » Smaller models / assemblies, polygon count in the hundreds of thousands
- **Mid-Range (\$400 - \$600)**
  - » 512MB of memory
  - » Medium size models / assemblies, polygon count in the millions
- **High-End (\$600 - \$1000)**
  - » 1GB of memory
  - » Large models / assemblies, polygon count in the tens of millions
- **Ultra High-End (\$1000+)**
  - » 1GB or higher
  - » Largest models / assemblies
    - Complete models, i.e., cars, airplanes, virtual prototyping

Only you can define what kind of card is right for you!

# SolidWorks and Graphics

Tip of the day: Try hardware in your environment

- Many resellers have “try & buy” programs
- Check the return policy for your vendor
- You can only evaluate performance in your environment!

# SolidWorks and Graphics

And don't forget...

- No matter how fast the graphics, you need to feed it as fast as possible in order to get the best performance
  - » Graphics cards plug into a PCI-E slot
  - » Recent workstations support PCI-E Gen2
    - Over 2x the performance, peaks even higher
  - » System & motherboard vendors will clearly state PCI-E Gen2 support
    - If you buy a new system, make sure it supports PCI-E Gen2!!!

# Professional vs Consumer Graphics

**Many users believe consumer graphics cards provide the same levels of performance as professional cards at a lower price**

- **Workstation cards are highly tuned for professional applications and provide performance far beyond consumer cards**

# Professional vs Consumer Graphics – SolidWorks Performance

## Lets compare consumer vs. professional with SolidWorks

Test details:

»3 models:

- Model #1: 1.63M Triangles
- Model #2: 1.67M Triangles
- Model #3: 480K Triangles

»Test – display models, rotate, resulting frames per second

- Want to test graphics only, don't worry about model gen time, other stuff

»Compare:

- Radeon™ HD 4870x2: fastest consumer card, \$399.99\*
- Radeon™ HD 3750: Entry consumer card, \$95\*\*
- FirePro™ V3750: Entry workstation, price \$149.99\*

\* Price on Newegg.com 7/20/2009

\*\* Price on Dell.com 2/2009

# Professional vs. Consumer Graphics

## SolidWorks Performance

	HD 3750	HD 4870x2	V3750
Model #1 (1.63M tri)	16.03 fps	Failed test	38.04 fps
Model #2 (1.67M tri)	13.95 fps	13.68 fps	30.42 fps
Model #3 (480K tri)	40.95 fps	41.37 fps	62.14 fps

**For larger models, V3750 is over 2x the performance!**

## Use Professional Graphics cards for Professional Applications!

- ✓ *Hardware and Software Drivers optimized and tested by AMD*
  - » Testing includes application testing – SolidWorks tests are run against driver prior to release!
- ✓ *SolidWorks certifies Professional Graphics solutions*
  - » Consumer cards are not tested or certified against professional applications by SolidWorks or AMD
- ✓ *Provide the best performance for professional applications*
  - » Performance, productivity, and reliability more than justifies the slightly higher cost!



# Software Considerations

# Software Considerations

In the end, it all comes down to software performance

- How well does SolidWorks run on my system?

For best performance and stability:

- Do what SolidWorks tells you to do!
  - » Use the certified and recommended OS, graphics drivers, and officially licensed versions of SolidWorks
  - » Extremely large amounts of development and testing effort is done to insure stability and performance
  - » Read up on the SolidWorks 2009 release – lots of work done on performance!
- Keep actively running processes to a minimum
  - » Give SolidWorks the maximum amount of CPU and graphics resources possible

# Software Considerations

A little reading and research never hurts...

- Check your graphics card vendor site occasionally for driver updates
  - » Performance can and does improve over time!
  - » Release notes will tell you what improvement and fixes are included in the driver release
  - » If there are performance optimizations or bug fixes for SolidWorks, graphics vendors will re-certify the new drive
    - OEM posted drivers may lag
- Trade publications often run performance tests
  - » They buy the hardware so you don't have to!
- SolidWorks user groups, message boards, blogs
  - » People share the good, bad, the ugly
    - Lot of focus on the ugly...



Q & A

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