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SAS® 9.4 Middle-Tier Performance Optimization

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ABSTRACT

SAS® middle-tier performance needs to be optimal to provide users with the best possible experience as well as to support growth in number of users. Optimal performance requires tuning. However, due to differences in the SAS web applications that are deployed as well as differences in the mix of applications in use, the tuning that is optimal for one deployment might not be optimal for another deployment. This session covers the tools that you can use to understand what's going on in a SAS middle tier, as well as the techniques you can use to tune the SAS middle tier once you understand what's going on.

INTRODUCTION

The goal of this paper is to identify best practices, tools, and configuration options that can be used to optimize SAS middle-tier performance as well as to give guidance on how to run the tools and to interpret the results of running the tools.

ESTABLISH A CONFIGURATION THAT USES BASIC BEST PRACTICES

OVERVIEW OF A CONFIGURATION THAT USES BASIC BEST PRACTICES

SAS has finished testing and has used the results of that testing to establish a configuration that uses basic best practices from which installation-specific tuning can be performed. We should always start our investigation from a configuration that uses basic best practices so that we don't spend time in discovering problems that a configuration that contains basic best practices would have already eliminated.

Such a configuration includes tuning the SAS Web Application Servers, the SAS web applications that run on SAS Web Application Servers, the Java Virtual Machines, and the operating system on the machines where SAS web applications run. For information about best practices for all three components, see *SAS 9.4 Web Applications: Tuning for Performance and Scalability*.

ESTABLISH A CONFIGURATION THAT USES BASIC BEST PRACTICES FOR SAS WEB APPLICATION SERVERS

Best practices for SAS Web Application Server include specifying the options maxThreads, maxPoolSize, and com.atomikos.icatch.checkpoint_interval, among others.

Best practices for the SAS web applications are dependent on the software that is installed in your environment.

Best practices for Java Virtual Machines include specifying options minimum and maximum heap size as well as initial and maximum permanent generation storage size.

The following tuning guidelines apply to HP-UX, Linux, Solaris, and Windows platforms:

- Increase the value of the -Xms (minimum heap size) option to equal the value of the -Xmx (maximum heap size) option. These values can be increased if there is enough demand, but ideally they should be set to the same value to avoid the overhead of expansion and contraction. Depending on the usage patterns observed, try to ensure that there is at least 500 MB of free heap.

- Identify the amount of permanent generation that is required, and set the -XX:PermSize (initial permanent generation size) option and -XX:MaxPermSize (maximum permanent generation size) option to equal values that are sufficient for the needs of the environment. Permanent generation should be sized as small as possible, leaving approximately 200–300 MB of unused space for class loading and unloading.

ESTABLISH A CONFIGURATION THAT USES BASIC BEST PRACTICES FOR THE OPERATING SYSTEM

There are a number of configuration changes that can be made to tune the operating system for optimal SAS 9.4 middle-tier performance and scalability. For example, on Linux, execute the following commands:

```
/sbin/sysctl -w net.ipv4.tcp_fin_timeout=30
/sbin/sysctl -w net.core.netdev_max_backlog=3000
/sbin/sysctl -w net.core.somaxconn=3000
/sbin/sysctl -w net.ipv4.tcp_keepalive_intvl=15
/sbin/sysctl -w net.ipv4.tcp_keepalive_probes
```

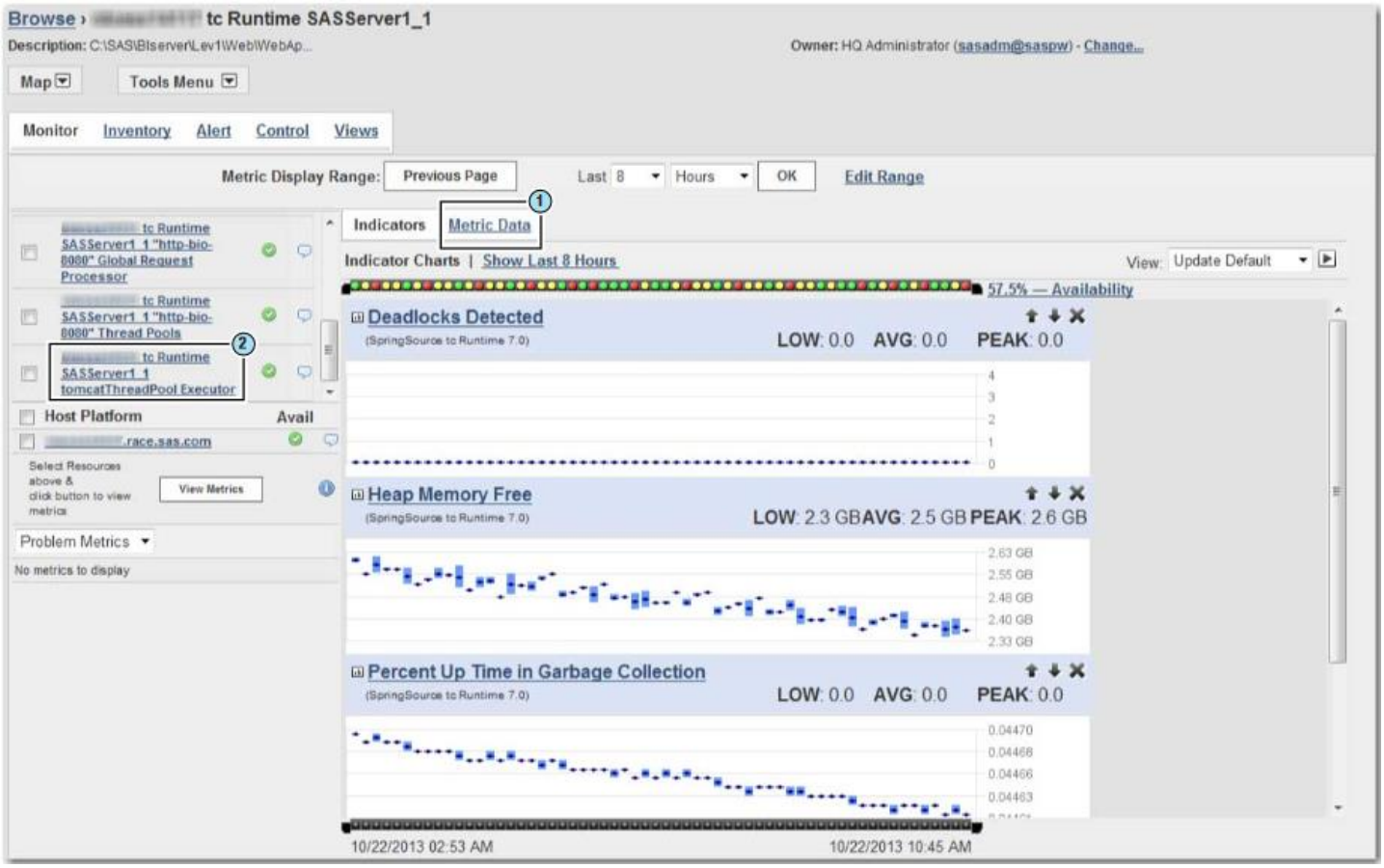
Also, edit the /etc/security/limits.conf file to ensure that nproc has a value of 10240, that stack has a value of 10240, and that nofile has a value of 20480.

MONITOR YOUR WEB APPLICATION SERVERS

MONITOR SAS WEB APPLICATION SERVERS USING SAS ENVIRONMENT MANAGER

SAS Environment Manager provides monitoring for SAS Web Application Servers. For each SAS Web Application Server instance, metrics can be analyzed and used to tune the server instance. Figure 1 depicts the screen used for the monitoring.

Figure 1. SAS Environment Manager Resource Monitoring



Metric data shows current committed heap size, free heap, max heap, and heap in use, as well as other attributes.

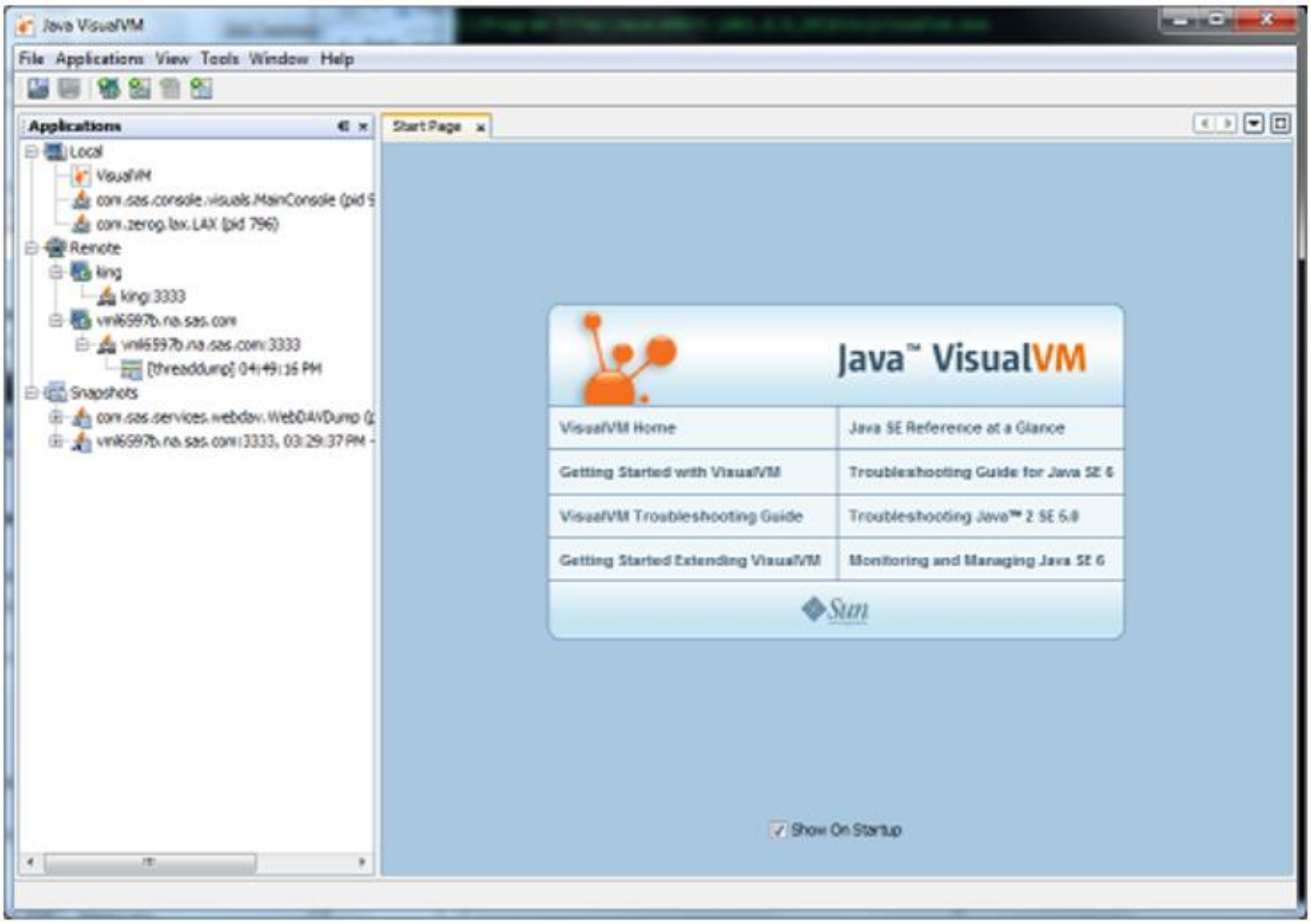
For more information about SAS Environment Manager's monitoring capabilities, see *SAS Environment Manager 2.5: User's Guide*.

MONITOR JAVA VIRTUAL MACHINES USING JVISUALVM

The Java Virtual Machines (JVMs) used by SAS Web Application Servers support remote monitoring via Java Management Extensions (JMX). The jvisualvm tool supports JMX and can be used to monitor the JVMs used by the SAS Web Application Servers. It can help you understand characteristics of JVMs such as total CPU usage, as well as how much of that CPU usage is used for garbage collection, heap usage, and thread usage. For details about jvisualvm, see SAS Note 42373.

The following figure shows jvisualvm:

Figure 2. Jvisualvm Tool



MONITOR THE OPERATING SYSTEM USING NMON

The nmon tool is a computer system performance monitor for AIX and Linux operating systems. It can be used to identify performance problems in an operating system that would be reflected in poor SAS Web Application Server performance. Although nmon data can be very useful, analyzing that data, interpreting it, and understanding how it might affect SAS systems requires experience. SAS can provide the analysis and make recommendations based on the results of that analysis.

For instructions about how to best collect nmon data, see SAS Note 48290.

UNDERSTAND GARBAGE COLLECTION IN YOUR JAVA VIRTUAL MACHINES

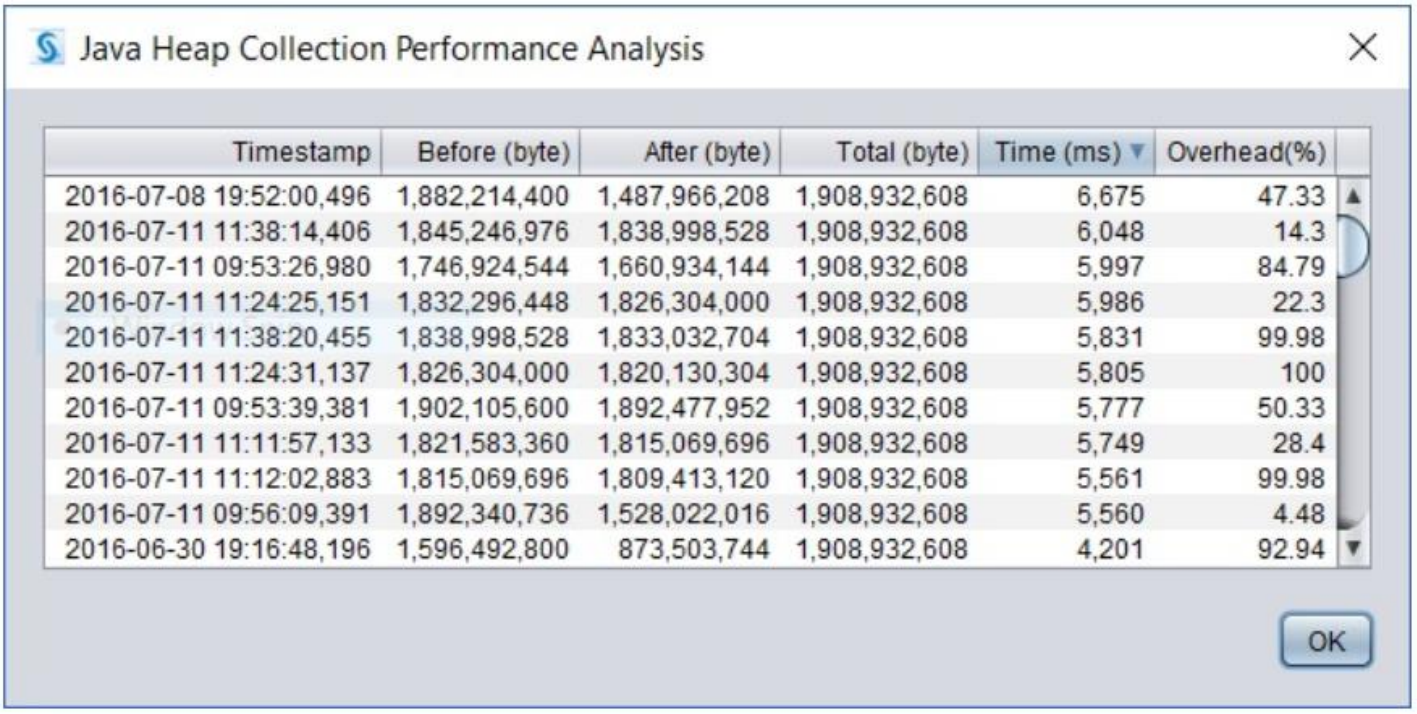
ENABLE GARBAGE-COLLECTION LOGGING

Understanding garbage collection in poorly performing JVMs is often a helpful diagnostic tool. To understand garbage collection, it is first necessary to enable garbage-collection logging for the specific SAS Web Application Server where performance is a problem. For instructions about how to enable garbage-collection logging, see SAS Note 59508. Don't forget to disable logging when you no longer need the log files.

ENABLE GARBAGE-COLLECTION LOGGING

After garbage collection logs exist, they can be analyzed using the SAS 9.4 Memory Diagnostic Tool.[1] For details about using the tool, see SAS Note 58947.The tool can help you diagnose performance degradation problems that are caused by Java garbage collection. There are two views in the tool that are especially useful. The Java Heap Collection Performance Analysis is shown in the following figure.

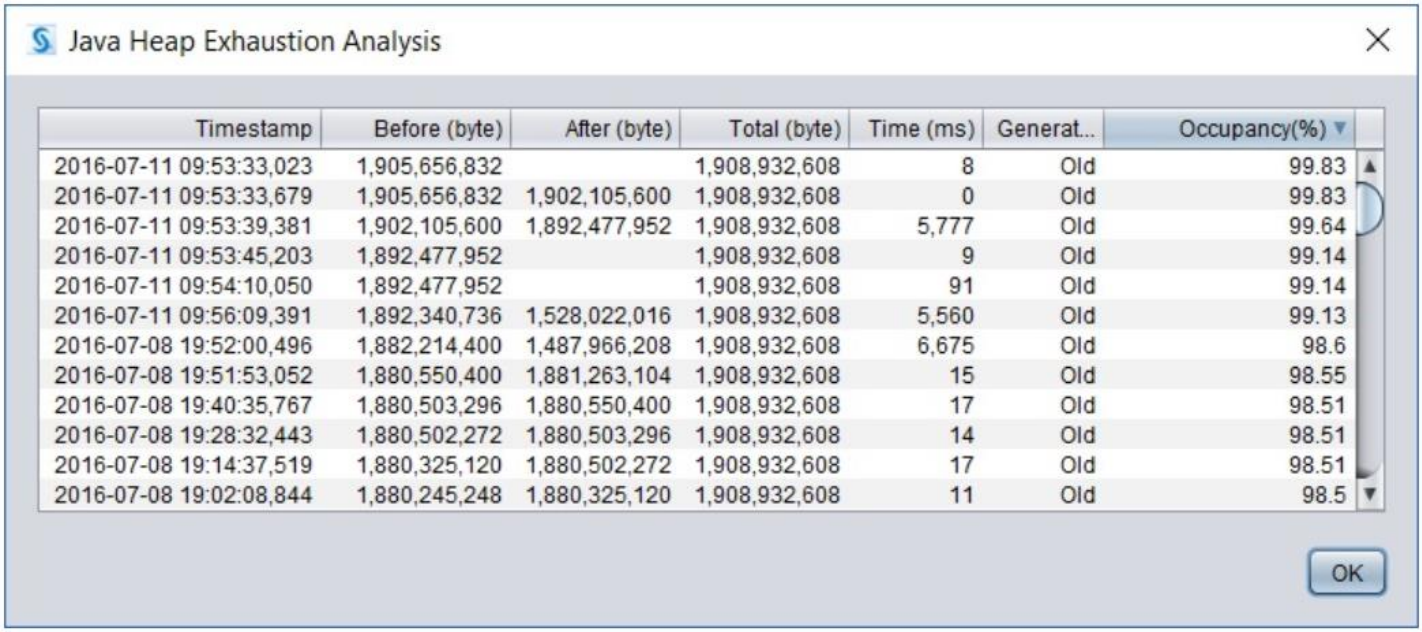
Figure 3. Java Heap Collection Performance Analysis



Timestamp	Before (byte)	After (byte)	Total (byte)	Time (ms)	Overhead(%)
2016-07-08 19:52:00,496	1,882,214,400	1,487,966,208	1,908,932,608	6,675	47.33
2016-07-11 11:38:14,406	1,845,246,976	1,838,998,528	1,908,932,608	6,048	14.3
2016-07-11 09:53:26,980	1,746,924,544	1,660,934,144	1,908,932,608	5,997	84.79
2016-07-11 11:24:25,151	1,832,296,448	1,826,304,000	1,908,932,608	5,986	22.3
2016-07-11 11:38:20,455	1,838,998,528	1,833,032,704	1,908,932,608	5,831	99.98
2016-07-11 11:24:31,137	1,826,304,000	1,820,130,304	1,908,932,608	5,805	100
2016-07-11 09:53:39,381	1,902,105,600	1,892,477,952	1,908,932,608	5,777	50.33
2016-07-11 11:11:57,133	1,821,583,360	1,815,069,696	1,908,932,608	5,749	28.4
2016-07-11 11:12:02,883	1,815,069,696	1,809,413,120	1,908,932,608	5,561	99.98
2016-07-11 09:56:09,391	1,892,340,736	1,528,022,016	1,908,932,608	5,560	4.48
2016-06-30 19:16:48,196	1,596,492,800	873,503,744	1,908,932,608	4,201	92.94

The Java Heap Exhaustion Analysis is shown in the following figure:

Figure 4. Java Heap Exhaustion Analysis



Timestamp	Before (byte)	After (byte)	Total (byte)	Time (ms)	Generat...	Occupancy(%)
2016-07-11 09:53:33,023	1,905,656,832		1,908,932,608	8	Old	99.83
2016-07-11 09:53:33,679	1,905,656,832	1,902,105,600	1,908,932,608	0	Old	99.83
2016-07-11 09:53:39,381	1,902,105,600	1,892,477,952	1,908,932,608	5,777	Old	99.64
2016-07-11 09:53:45,203	1,892,477,952		1,908,932,608	9	Old	99.14
2016-07-11 09:54:10,050	1,892,477,952		1,908,932,608	91	Old	99.14
2016-07-11 09:56:09,391	1,892,340,736	1,528,022,016	1,908,932,608	5,560	Old	99.13
2016-07-08 19:52:00,496	1,882,214,400	1,487,966,208	1,908,932,608	6,675	Old	98.6
2016-07-08 19:51:53,052	1,880,550,400	1,881,263,104	1,908,932,608	15	Old	98.55
2016-07-08 19:40:35,767	1,880,503,296	1,880,550,400	1,908,932,608	17	Old	98.51
2016-07-08 19:28:32,443	1,880,502,272	1,880,503,296	1,908,932,608	14	Old	98.51
2016-07-08 19:14:37,519	1,880,325,120	1,880,502,272	1,908,932,608	17	Old	98.51
2016-07-08 19:02:08,844	1,880,245,248	1,880,325,120	1,908,932,608	11	Old	98.5

CONCLUSION

The optimal SAS middle-tier configuration is unique for each deployment and can be set up only after an analysis of your deployment. The tools presented in this paper are part of the toolbox that we can draw from in order to understand and optimize a SAS middle-tier configuration. For assistance with SAS middle-tier optimization, please contact SAS Consulting.

REFERENCES

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