Do you know who did it? Troubleshooting issues in WebSphere Application Server

# Part-4: Garbage, Memory leak and Out of memory



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Fourth part of this series [do you know who did it? Troubleshooting issues in websphere application server], we will be discussing how to obtain and diagnose Garbage collection and Memory related issues in WebSphere application server using Garbage collection and Memory Visualizer.

#### **About GC and Memory Visualizer**

Garbage Collection and Memory Visualizer is part of the IBM support assistant workbench. This tool can visualize the garbage collection data from IBM JRE 1.4.2 or higher. This tools helps you get insights into garbage collection using graphs with data like Heap size, used heap size, pause times,

#### **Using GC and Memory Visualizer**

The GC and Memory Visualizer allow you to visualize your garbage collection data, as raw datasets, line plots, reports, and images. The "Line plot" portion of the tool displays graphs of over forty different garbage collection data characteristics – including used heap, pause times, and the reason for garbage collection being triggered. You can read in multiple sets of garbage collection logs and display them together on a single set of axes, which allows you to easily compare garbage collection behavior across multiple test runs of an application. The "Report" section of the tool contains a summary of the line plot data, along with information on general garbage collection behavior and heap sizing recommendations based on overall heap occupancy.

The tool can provide the following:

- a graphical display of a wide range of verbose GC data values
- tuning recommendations and detection of problems such as memory leaks
- report, raw log, tabulated data and graph views
- saving of data to HTML reports, jpeg images or .csv files (for export to spreadsheets)
- viewing and comparing multiple logs
- analysis of optthruput, optavgpause, and gencon GC modes

#### Obtaining and installing the tool

- Start the IBM support assistant tool
- Go to update  $\rightarrow$  find new  $\rightarrow$  tools add-ons
- Expand he JMV based tools from the results and select "IBM Monitoring and Diagnostic Tools for Java Garbage collection and Memory Visualizer" and proceed to install.
- After installation is complete, restart ISA.

To use this tool, you need to have the GC logging information, which can be collected by enabling verbose GC.

#### **Enabling Verbose GC**

In the WebSphere Application Server administration console:

 Servers → server\_name → Server Infrastructure → Java Process Management →process definition → Additional properties →Java Virtual Machine and enable "Verbose Garbage Collection" check box

Application servers >server1_	> <u>Process Definition</u> > Java Virtual Machine	
Use this page to configure advanced Jav	a(TM) virtual machine settings.	
Configuration Runtime		
General Properties		Additional Properties
Classpath		Custom Properties
Boot Classpath		
Verbose class loading		
Verbose garbage collection		
Verbose JNI		

• Restart the server on which verbose GC is enabled.

Output will be written to the native\_stderr. Log

## Analyze Verbose GC log

Start the ISA and go to Analyze problems

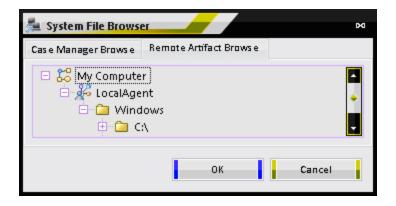
Select the tool in the list and click launch

Deport Assistant   Analyze Problem     Inclusion   Called Data   Guided Troubleshooter     Case/Incldend   Inclusion   End New Tool Add on:     Tools   Called Data   Guided Troubleshooter     Case/Incldend   Inclusion   End New Tool Add on:     Tools   Called Data   Guided Troubleshooter     Case/Incldend   Inclusion   End New Tool Add on:     Tools   Called Data   Guided Troubleshooter     Tools   Called Data   Guided Troubleshooter     Tools   Called Data   Guided Troubleshooter     Tools   Called Data   Fed Newley (BM Pattern Modeling and Analysis Tool for Java Garbage Collector (PMAT)   414.00     Tech Preview] IBM Thread and Monitor Dump Analyzer for Java Garbage Collector (PMAT)   414.00   The BM Monitoring and Diagnostic Tools for Java" - Stabgle Collector (PMAT)     Tech Preview] BM Analyzer for Java" - Stabgle Collector (PMAT)   42.3.00   The BM Monitoring and Diagnostic Tools for Java" - Stabgle Collector (PMAT)     BM Monitoring and Diagnostic Tools for Java" - Stabgle Collector (PMAT)   10.8.20106031140   The BM Monitoring and Diagnostic Tools for Java" - Stabgle Collector (PMAT)     BM Monitoring and Diagnostic Tools for Java" - Stabgle Collector (PMAT)   10.8.2010603140	administration Update Window He	lp		
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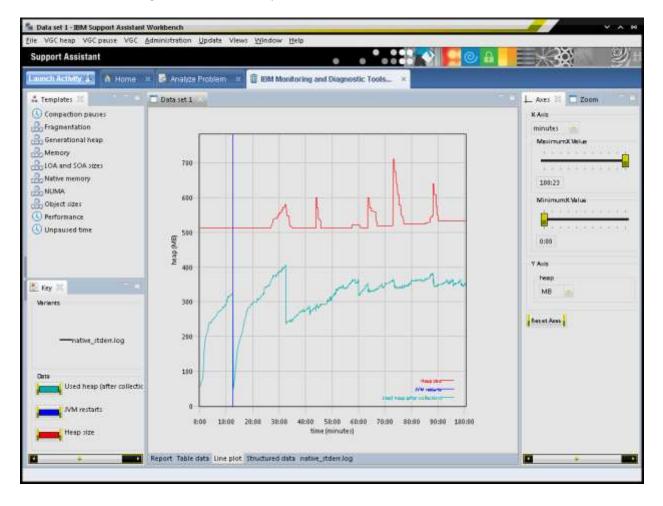
A pop-up window will ask you to provide the Log file which has the Garbage collection data.

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	ning and Diagona stir Table for Jacon 74, Cashara Callesting and Marsara	1 fire - Line -
	oring and Diagnostic Tools for Java <sup>w</sup> -Garbage Collection and Mernory	VISUBIIZET
Log name	Brows e	
	Next >	Cancel

Click on Browse  $\rightarrow$  Remote Artifact Browse and select the log file



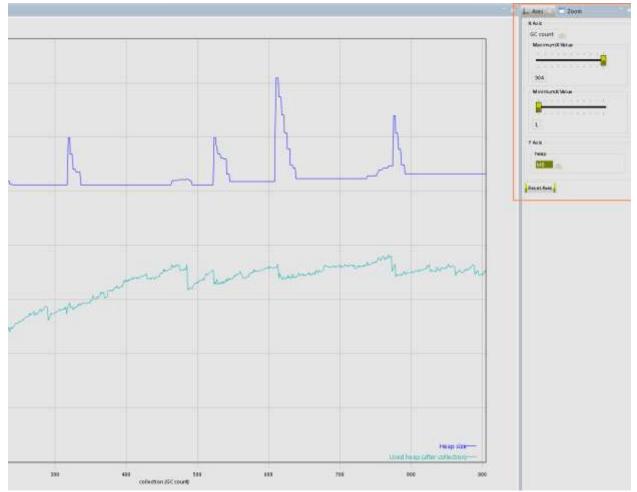
Click next and the tool will automatically analyze the log file and shows you data set from the input log file. The default setting is to show the line plot.



#### **Customizations and Navigation**

You can select the X and Y axis parameters for the line plots (graphs). Check on the right side panel of the line plot. You will find Axes tab and Zoom tab.

#### **Axes Tab**



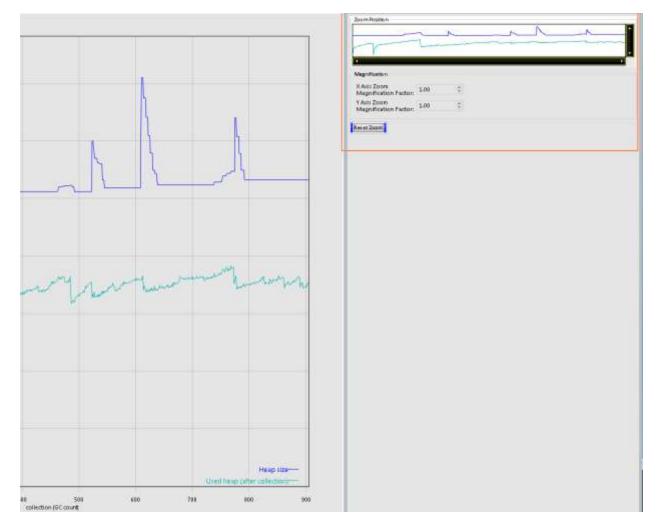
Use this tab to customize the X and Y axes parameters.

X Axis is generally time which can be customized to msec, seconds, minutes, hours, days. And X axis can be set to GC count as well.

Y axis is generally Size, which can be customized to bytes, KB, MB, GB and percentage.

#### Zoom tab

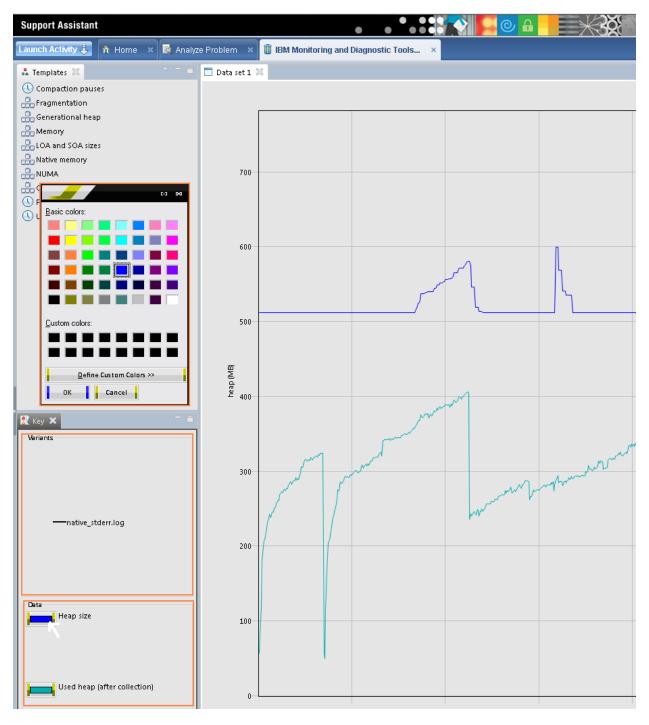
Use this to customize the zooming on either x-axis or y-axis or both.



The other way to zoom is to select area of interest on the graph, by holding the mouse left-click.

#### **Keys panel**

The keys panel shows what variants and data are being displayed in the graph. You can customize the colors of the data on the graph. Click on the data being shown the data panel to change color of that data on the graph.



#### **Templates**

This panel lists the templates available to plot the graphs. Selecting [double-click]a template from the list shows the relevant graph.

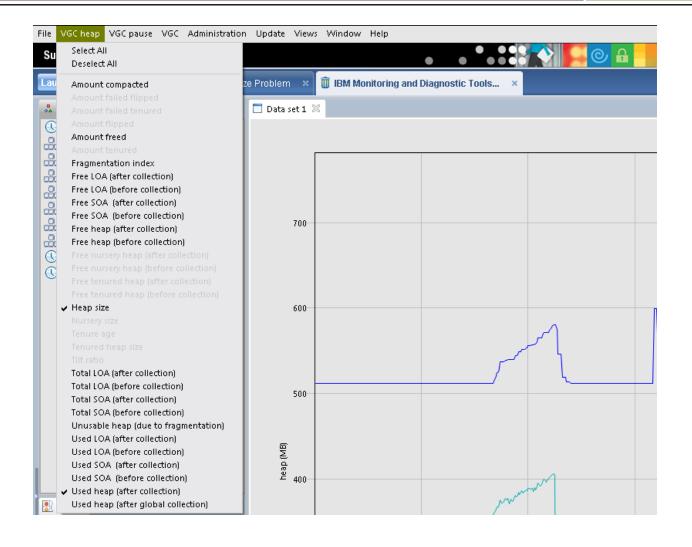
Support Assistant		o o o o o o o o o o o o o o o o o o o
Launch Activity 🦆 🏠 Home 🛛 🗟 Analy	ze Problem 🛛 📋 IBM Mor	nitoring and Diagnostic Tools ×
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Compaction pauses Fragmentation Generational heap Memory LOA and SOA sizes Rative memory		
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#### **Menu and Customizations**

Different options are available on the menu to plot the customized graphs

<u>File</u> VGC heap VGC pause VGC <u>Administration</u> <u>Update</u> Views <u>Window</u> <u>Help</u>

Clicking in VGC heap/ VGC pause will display the available data options



### Analyze and interpret the data

The following options can be used to understand the data from the analyzed VGC log.

Report Table data Line plot Structured data native\_stderr.log

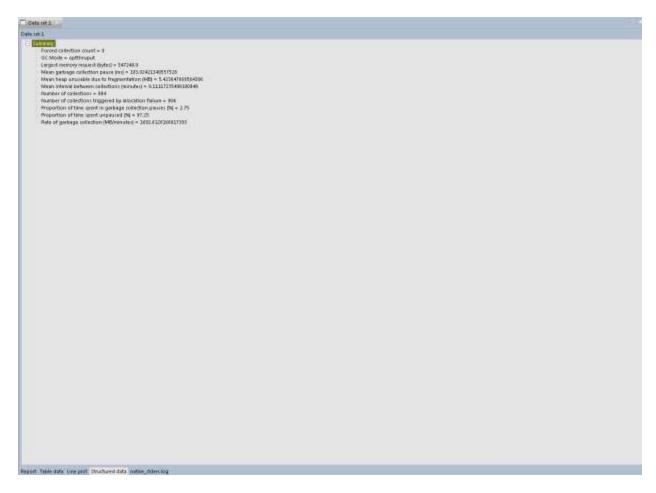
**Report**: By default report shows tuning recommendations, summary heap size and used heap size graphs. You can customize the report using the VGC menu item. The other options in the VGC menu for report are GC reason, Classes loaded, JVM restarts etc...

Cala set 2		
Tuning recommendation	Tuning recommendation	
Version Summary	<sup>O</sup> Your application appears to be leaking memory. This is the amount of data freed). To investigate further see <u>Cardo</u>	indicated by the used beap increasing at a greater rate than the application workload (measured b d.debugging.for.Java
Used heap (after collection)		Jsing finalizers is not recommended as it can slow garbage collection and cause wasted space in cas of the finalize() method. You can use the ISA Tool Add-on, IBM Monitoring and Diagnostic Too ined through finalizers
Hean size	The application seems to be using some quite large obj log) was for 547248 bytes.	ects. The largest request which triggered an allocation failure (and was recorded in the verbose go
	Version	
	EM J9 20091026 AA	
	• Om 29 2009 1020_AA	
	Summary	
	Forced collection count	0
	GC Mode	opthyput
	Largest memory request (byles)	547248
	Mean garbage collection pause (ms)	183
	Mean heap unusable due to fragmentation (MB)	5.42
	Mean interval between collections (minutes)	0.11
	Number of collections	904
	Number of collections triggered by allocation failure	904
	Proportion of time spert in garbage collection pauses (%)	2.75
	Proportion of time spent unpaused (%)	97.25
	Rate of garbage collection (MBimmutes)	1693
	Used heap (after collection)	
	Mean Minimum Maximum heap (MB) heap (MB) heap (MB) 329 49 3 407	
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**Table data**: Shows data from the GC log in table format. Defaults are GC count, used heap and Heap size. You can customize this tabular representation of the data by selecting other data parameters from either VGC pause or VGC heap menu items.

Normal Section Control     Heat Heat Control       1     10       1     11       1     12       1     13       2     13       3     13       4     141       5     13       4     141       5     13       4     141       5     14       5     12       7     148       512     12       7     148       122     51       5     12       6     131       7     148       132     12       14     12       15     12       16     132       17     148       134     12       14     132       15     132       16     132       17     148       18     132       19     132       10     132
MB     MB       x     F.G     H2       k     H.G     H3       2     L20     S2       4     L44     S2       7     20     S2       8     20     S2       9     S2     S2
X     17.4     102       2     16.3     50.2       3     130     51.2       4     144.5     50.2       6     286.50     50.2       7     288.50     50.2       7     288.50     50.2       8     20.4     50.2       9     20.5     51.2       9     20.5     51.2
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7 28 50 8 29 50 9 22 512 8 23 512
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0 238 532 4 245 532 5 245 532 4 245 532
4 343 512 5 346 312 6 346 312
5 245 302 6 245 302
1 145 110
0 36L 512
a 313 513 5 3157 512 6 115 512 1 342 513
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9 155 512
1 347 50
2 381 512
9 349 512
2 81, 512 5 249 512 6 25, 512 5 170 512
5 170 512
4 171 SU
P 325 942
9 125 512
9 175 512
a 377 fa2
1 10 50
0 381 512
0 302 522
4 384 512
1 III III
4 10 SU
7 347 542
8 297 512
2     342     532       3     432     532       4     344     512       5     328     512       6     347     532       6     347     532       7     347     532       8     347     532       8     343     512
e 20 10
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8 : 299 : 311 : 4 : 388 : 512 :
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* 52 532 5 521 532
6 104 610
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1 191 AD

Structured Data: shows the summary from the analyzed GC log.



**Line plot**: shows the graphical representation of the data using the selected template or customized options.

#### Cool ... any real-time usage or examples?

- You can use this tool to diagnose Memory Leaks. If the used heap line is creeping up when there's no obvious reason for the memory requirements of the application to be increasing, there may be a leak. The GC and Memory Visualizer looks for this pattern and adds a comment to the tuning recommendation if it detects something that is likely to be a leak. However the tool will not show you which object are causing the leak.
- You can use this tool to determine what will be optimized Heap size for your applications. If the heap is so small that the data required by the application will not fit into it, then the application will run out of memory and terminate with an OutOfMemoryError. If the heap has room for the application data but not much room to spare, the garbage collector will have to spend a lot of time ensuring that there is room in the heap for new allocations, and this will hurt application performance. A heap that is too big usually won't have a negative effect on application performance, but it is wasteful, and GC pauses may be long.
- You can also use this tool to estimate the application throughput and response times. You can change the GC policy to different available options and analyze which policy is giving best response times. But it always recommended collecting the GC data when the application is under good load.

## References

- 1. Garbage Collection policies: <u>part-1</u> and <u>Part-2</u>
- 2. Memory leak detection and analysis : <u>part-1</u> and <u>part-2</u>
- 3. Do you know who did it? Troubleshooting issues in websphere application server Series