How to use IBM HeapAnalyzer to diagnose Java heap issues

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Introduction

- Java Heap dump contains a list of all the objects that are in a Java heap.
- Java Heap dumps could be very large (as much as giga bytes)
- It's not always easy to analyze large dumps.
- IBM HeapAnalyzer can analyze IBM Java heap dumps from Java SDK 1.3.1 and 1.4.x.
- IBM HeapAnalyzer is provided "as-is".
- The top download for 11 consecutive months from the alphaWorks Java technology website (http://www.alphaworks.ibm.com/java) as of September 2005
- Used by over 2,000 companies, government agencies, research facilities and universities worldwide
- Now integrated with WebSphere Application Server V6.0.2

Prerequisite

- Java 2 SDK/JRE 1.4.1 or higher for runtime of HeapAnalyzer
- The following exception will be thrown if older versions of SDK/JRE are used:

  Exception in thread "main" java.lang.NoClassDefFoundError: java/util/regex/PatternSyntaxException

- IBM Java heap dump generated from IBM SDK 1.3.1 or 1.4.x

- For more information about getting IBM Java heap dump, refer to MustGather: Out of Memory errors on Windows http://www-1.ibm.com/support/docview.wss?uid=swg21140641

Features

- Creates a tree from Java heap dump
- Calculates size of each objects
- Calculates total size of each subtree
- Finds size drop in a subtree
- Shows gap by size
- Shows objects by size
- Shows objects by total size
- Shows objects by number of child
- Shows types by size
- Shows types by count
- Shows types alphabetical order
- Shows gap distribution
- Shows detailed information of an object
- Finds type with regular expression
- Drag and drop support in input fields and text
- Bookmarks in tree navigation
- Saves/Loads processed heap dumps
- Locates possible leak suspects

How does it work?

- Reads IBM Java heap dump file and parse each object/class information
- Creates graphs based on parsed information
- Creates trees based on the graphs
- Runs Java heap leak detection engine to display suspected Java heap leak areas

What is IBM Java heap dump

- IBM Java Virtual Machine facility generates a dump of all the live objects that are on the Java heap; that is, those that are used by the Java application. This dump is called a IBM Java Heap dump. It shows the objects that are using memory space on the Java heap.

Text dump structure

- // Header : build identifier of the JVM that produced the dump.
- Address of object
- Size of object
- Name of object
- References of objects
- …
- // EOF : summary of the heap dump

```
// Version: J2RE 1.3.1 IBM Windows 32
    build cn131-20020923
0x30000080 [10000] G

0x50001010 [6000] A
    0x50002020
0x50002020 [4000] B
    0x10007030 0x50006040 0x50004050
0x50003070 [1000] F
    0x50004050 0x30000080
0x50004050 [1104] C
    0x50005060
0x50005060 [1032] D
    0x50003090 0x50005060
0x50006040 [1904] I
    0x10007030
0x10007030 [1024] J

0x50003090 [504] E
    0xF00090A0 0x50003070
0xF00090A0 [0032] H

0x200000B0 [40000] K
    0x50002020 0x200000C0
0x200000C0 [8000] L
    0x200000B0
// EOF: //
```

How to generate IBM Java heap dump

- IBM Java Heap dump can be generated in either of two ways
  - Explicit generation
  - Java Virtual Machine triggered generation
- When the Java heap is exhausted, Java Virtual Machine triggered generation is enabled by default.
- To enable signal-based Java Heap dumps, the IBM_HEAPDUMP=TRUE environmental variable or the appropriate JAVA_DUMP_OPTS must be set.

Explicit generation

- IBM Java Heap dump can be explicitly generated in either of the following ways
  - By sending a signal to the JVM from the operating system
  - By using the HeapDump() method inside Java code that is being executed
- For Linux and AIX, send the JVM the signal SIGQUIT (kill -3, or CTRL+\ in the console window).
- For Windows, generate a SIGINT (press the Ctrl+Break keys simultaneously).

Java Virtual Machine triggered generation

- The following events automatically trigger the JVM to produce a Java Heap dump
  - A fatal native exception occurs in the JVM (not a Java Exception)
  - An OutOfMemoryError or heap exhaustion condition occurs (optional)
- If Java Heap dumps are enabled, they are normally produced immediately before a thread dump. They are produced also if the JVM terminates unexpectedly (a crash).

Location of IBM Java Heap dump

- The JVM checks each of the following locations for existence and write-permission, then stores the Heap dump in the first one that is available.
  - The location that is specified by the IBM_HEAPDUMPDIR environment variable, if set
  - The current working directory of the JVM processes
  - The location that is specified by the TMPDIR environment variable, if set
  - The /tmp directory (X:\tmp for Windows, where X is the current working drive)
- Note that enough free disk space must be available for the Heap dump file to be written correctly.

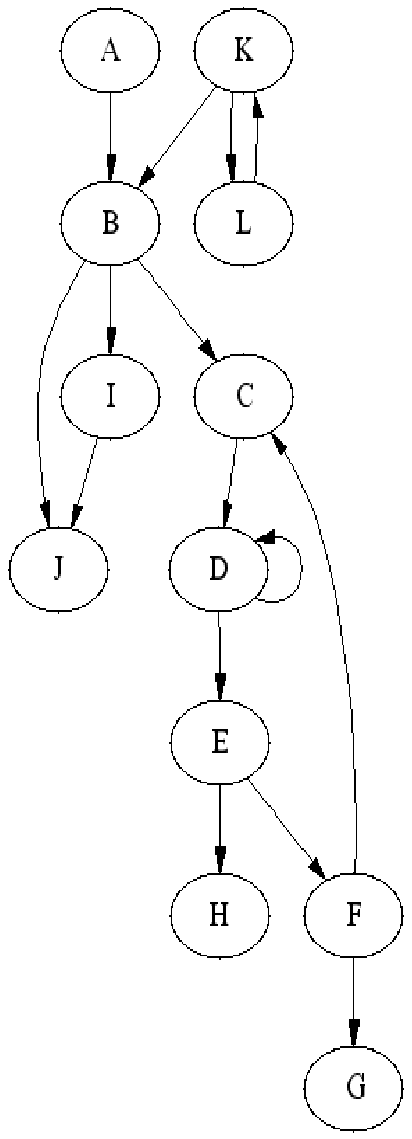
Format of Heap dump filenames

Platform	Java Heap dump file name format
Windows	heapdump.YYYYMMDD.HHMMSS.PID.txt
Linux & AIX	heapdumpPID.TIME.txt
z/OS	HEAPDUMP.YYYYMMDD.HHMMSS.PID.txt

- **Note:** PID is the process ID. TIME is the number of seconds since 1/1/1970

Creating a graph

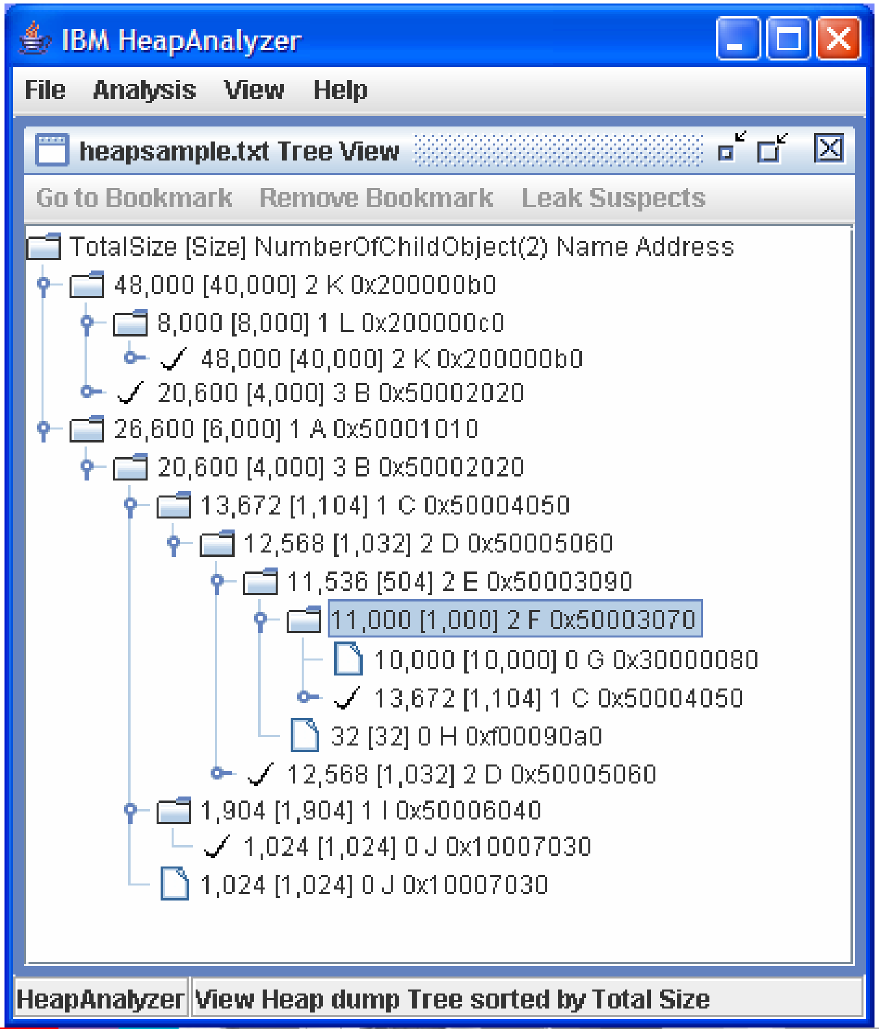
```
0x30000080 [10000] G

0x50001010 [6000] A
   0x50002020
0x50002020 [4000] B
   0x10007030 0x50006040 0x50004050
0x50003070 [1000] F
   0x50004050 0x30000080
0x50004050 [1104] C
   0x50005060
0x50005060 [1032] D
   0x50003090 0x50005060
0x50006040 [1904] I
   0x10007030
0x10007030 [1024] J

0x50003090 [504] E
   0xF00090A0 0x50003070
0xF00090A0 [0032] H

0x200000B0 [40000] K
   0x50002020 0x200000C0
0x200000C0 [8000] L
   0x200000B0
```



Definitions

- **Root object** An object for which no (different) object holds a reference.
- **Parent object** An object (for example, A) that holds at least one reference to some (different) object (for example, B). In this case, A is said to be the parent of B.
- **Owner object** If an object has more than one parent object, a parent object is chosen as owner object. Total size is calculated only with owner objects.
- **Child object** An object (for example, B) for which at least one (different) object (for example, A) holds a reference. In this case B is said to be the child of A.
- **Type** Collection of same objects
- **Size** The size of an object is the amount of memory that is required to hold that object in memory.
- **Total size** The subtree size of an object is the sum of its size and the sizes of all the objects that it reached from its children. Note that each object is assigned a unique parent and root during processing. If there's substantial difference in total size between a parent and its child, it's called a total size drop.

Creating a tree with DFS

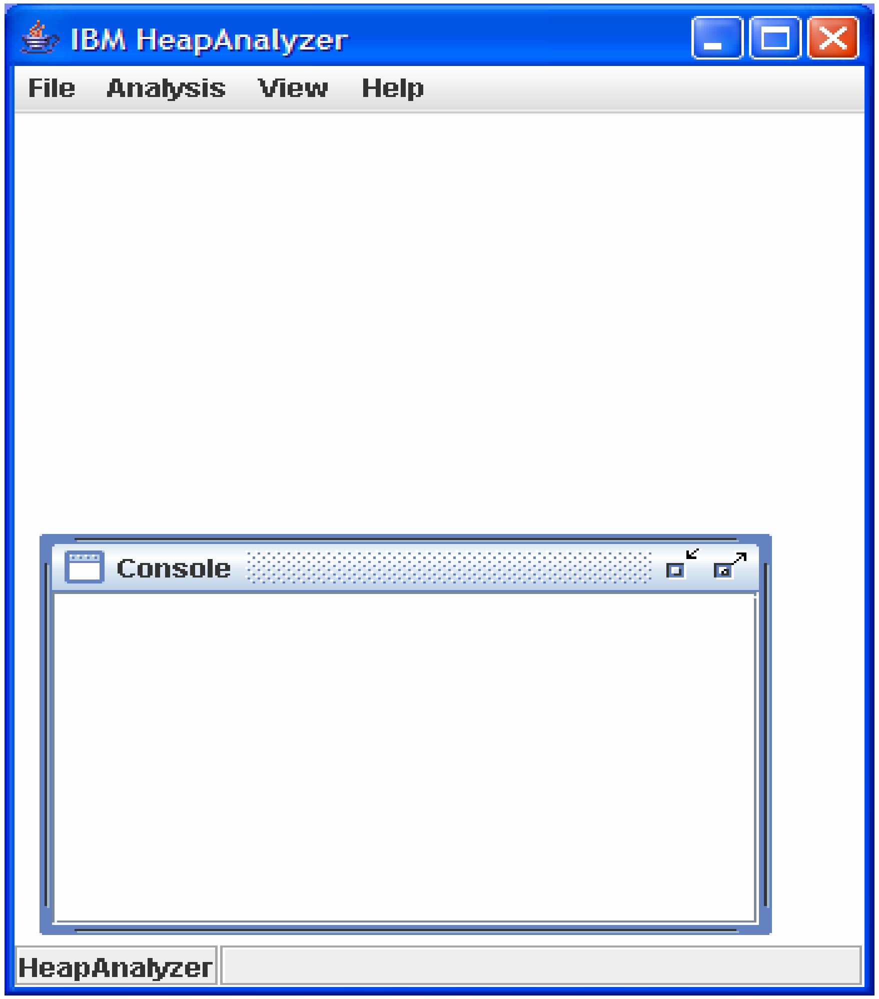


```
TotalSize [Size] NumberOfChildObject(2) Name Address
48,000 [40,000] 2 K 0x200000b0
    8,000 [8,000] 1 L 0x200000c0
        ✓ 48,000 [40,000] 2 K 0x200000b0
    ✓ 20,600 [4,000] 3 B 0x50002020
26,600 [6,000] 1 A 0x50001010
    20,600 [4,000] 3 B 0x50002020
        13,672 [1,104] 1 C 0x50004050
            12,568 [1,032] 2 D 0x50005060
                11,536 [504] 2 E 0x50003090
                    11,000 [1,000] 2 F 0x50003070
                        10,000 [10,000] 0 G 0x30000080
                        ✓ 13,672 [1,104] 1 C 0x50004050
                    32 [32] 0 H 0xf00090a0
                ✓ 12,568 [1,032] 2 D 0x50005060
        1,904 [1,904] 1 I 0x50006040
            ✓ 1,024 [1,024] 0 J 0x10007030
        1,024 [1,024] 0 J 0x10007030
```

HeapAnalyzer | View Heap dump Tree sorted by Total Size

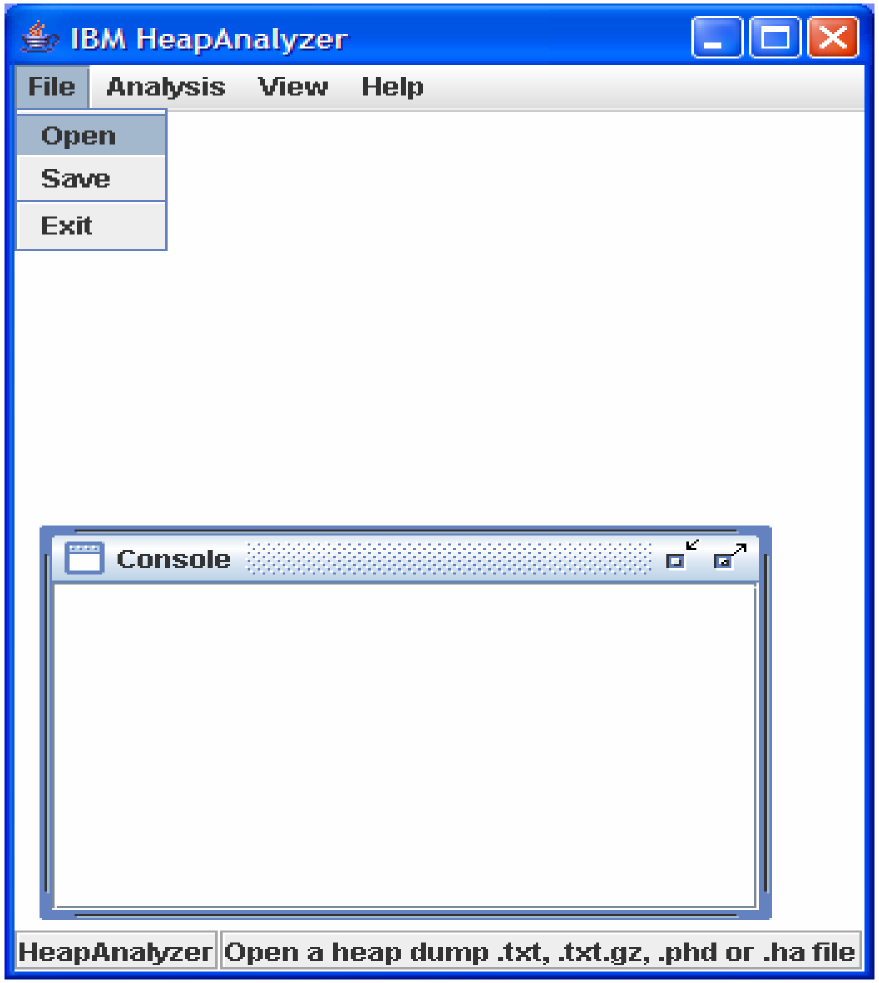
- Create a tree from the previous graph using Depth First Search (DFS) algorithm
- Sorted by Total Size

How do I run HeapAnalyzer?



- Usage <Java 2 SDK path>java –Xmx[heapsize] –jar ha<HeapAnalyzer version>.jar For example, java –Xmx1000m –jar ha135.jar
- If you see java.lang.OutOfMemoryError while you are processing heapdumps, please try increasing the maximum heap size (-Xmx) value to give the JVM more memory.
- Maximum heap size should not be larger than the size of available physical memory size for this tool due to performance issue.

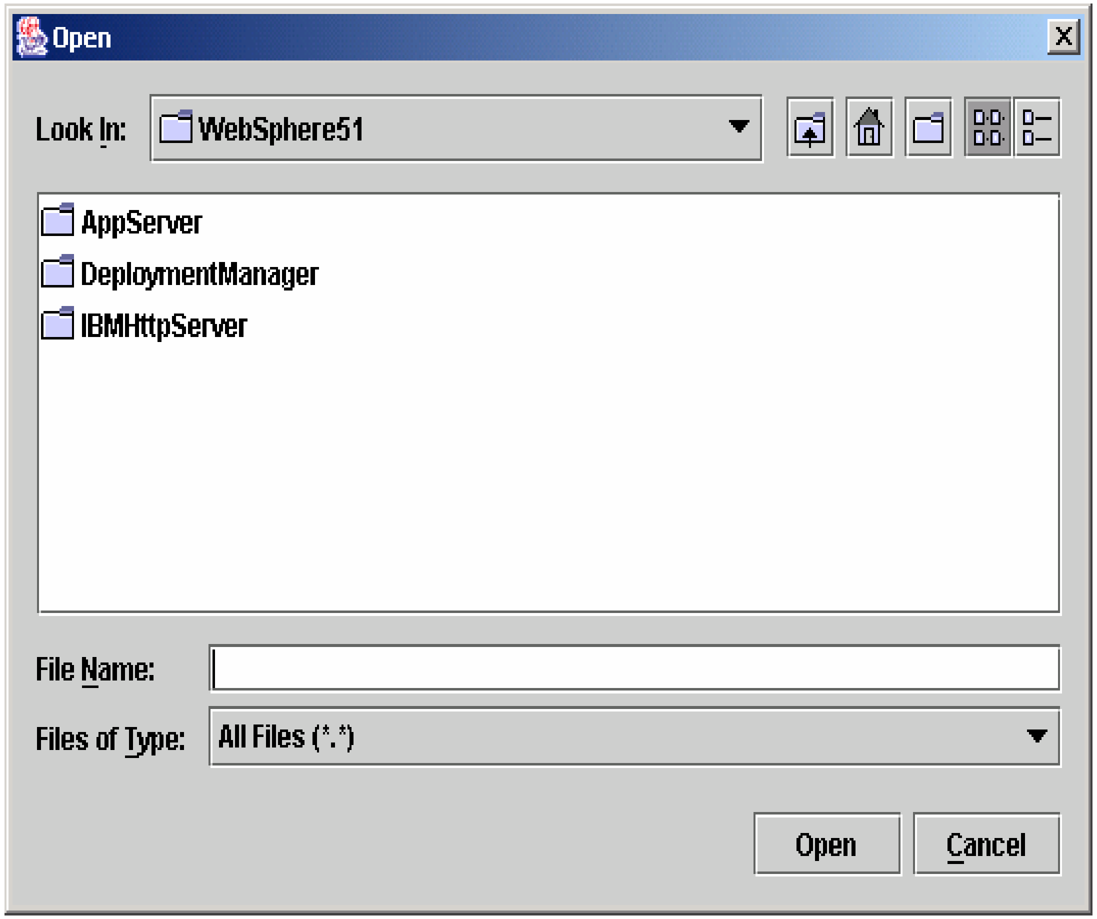
File Menu



HeapAnalyzer | Open a heap dump .txt, .txt.gz, .phd or .ha file

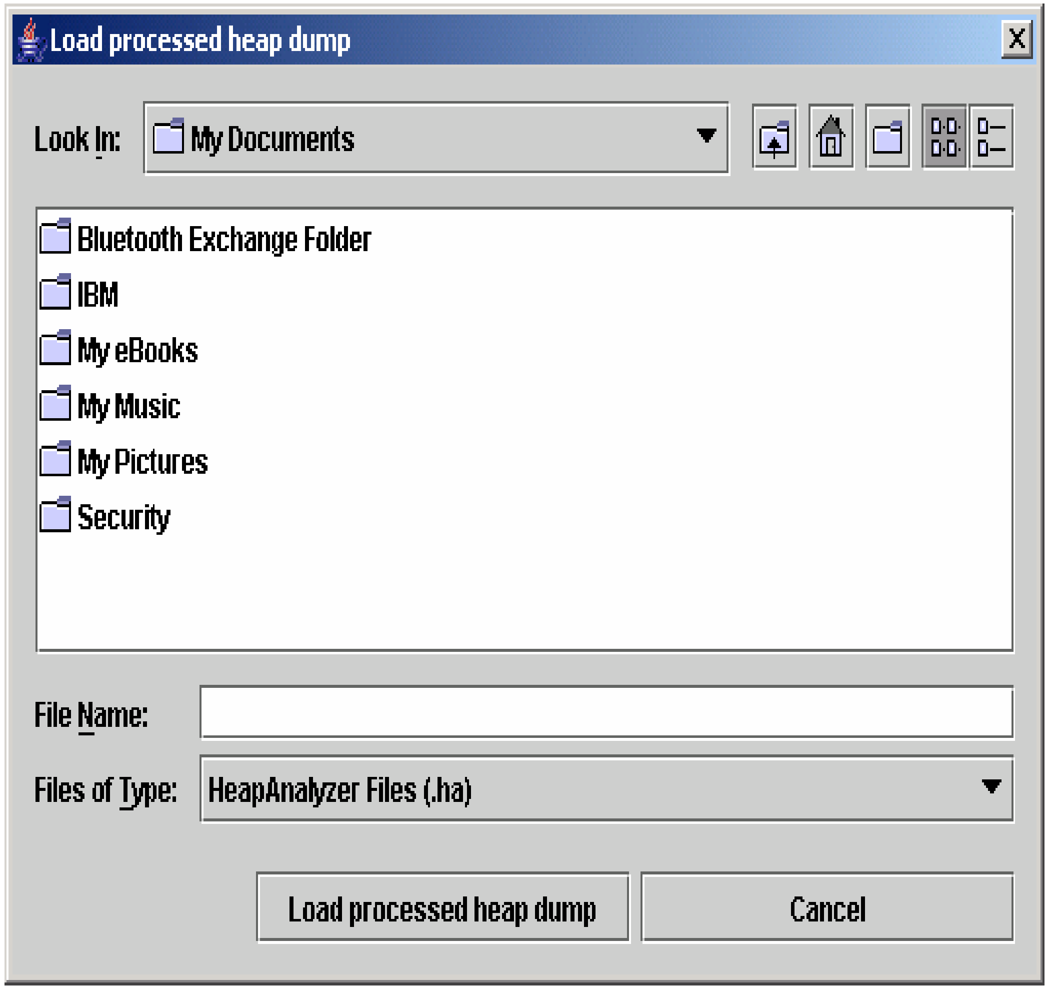
- Open a heap dump (Automatically detects various formats of IBM Java heap dumps, for example text, compressed text, portable heap dump and HeapAnalyzer format)
- Save processed heap dump
- Exit

Open a Java heap dump



- Select File -> Open and select a Java heap dump file

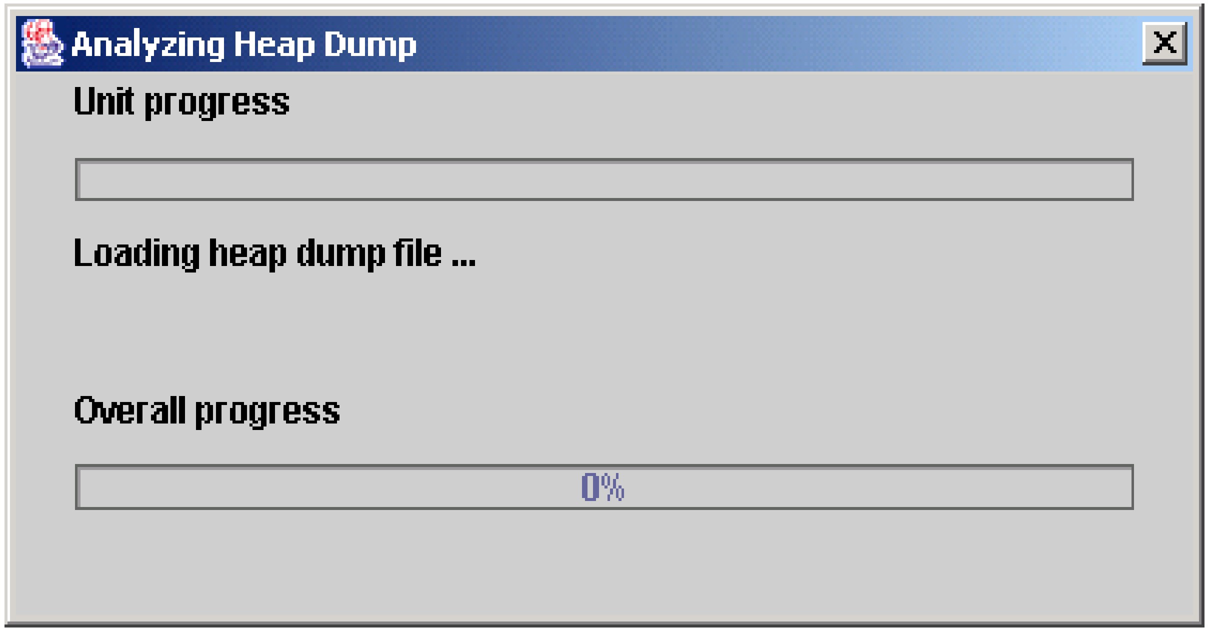
Open a processed heap dump



- If you have a processed heap dump, select File -> Open and select a processed heap dump file which has .ha extension.

Processing heap dumps

- Progress is shown during processing heapdump.



Analyzing Heap Dump

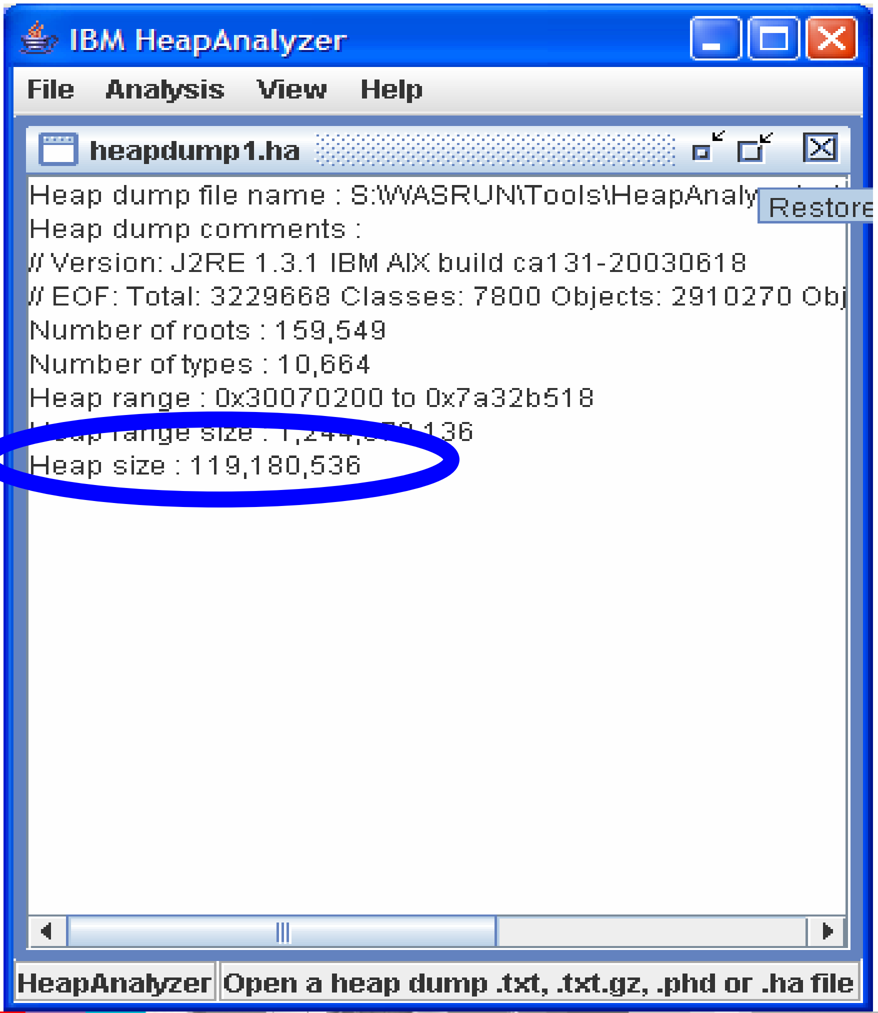
Unit progress

Loading heap dump file ...

Overall progress

0%

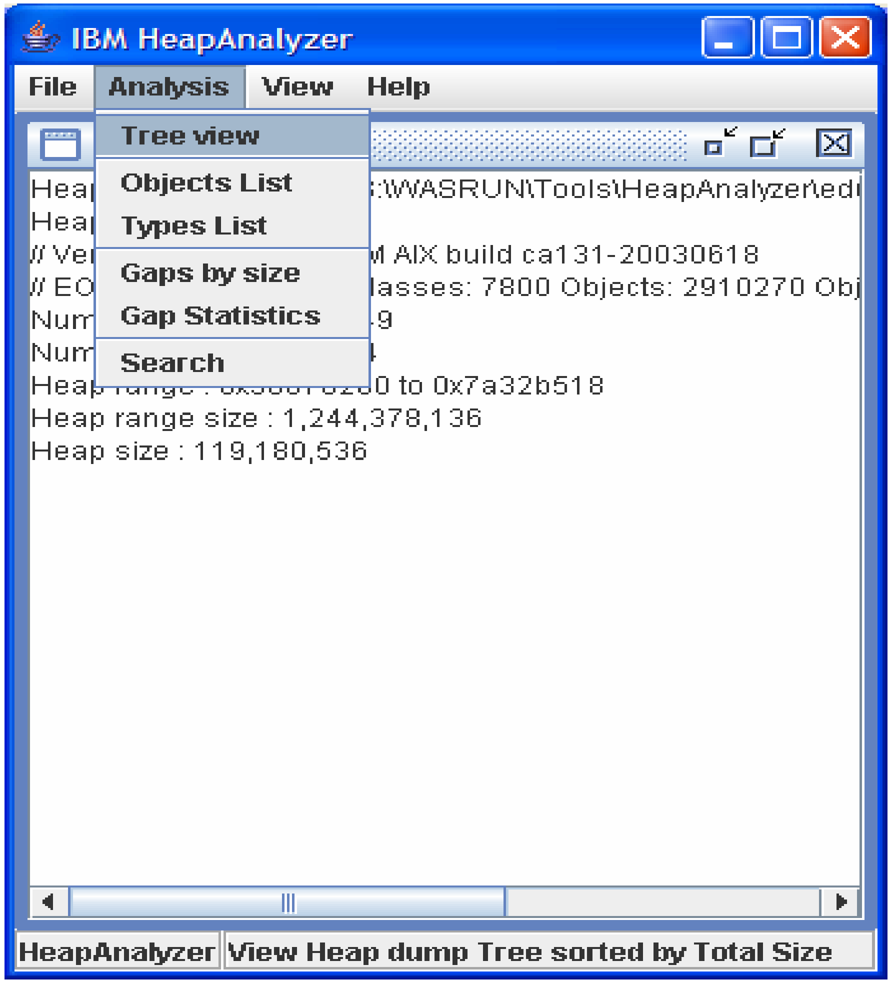
Processing completed



```
Heap dump file name : S:\WASRUN\Tools\HeapAnaly
Heap dump comments :
// Version: J2RE 1.3.1 IBM AIX build ca131-20030618
// EOF: Total: 3229668 Classes: 7800 Objects: 2910270 Obj
Number of roots : 159,549
Number of types : 10,664
Heap range : 0x30070200 to 0x7a32b518
Heap range size : 1,244,[illegible]136
Heap size : 119,180,536
```

- This is the screen when processing is complete.
- Please do not close this window until you do not need this heap dump.

Analysis Menu

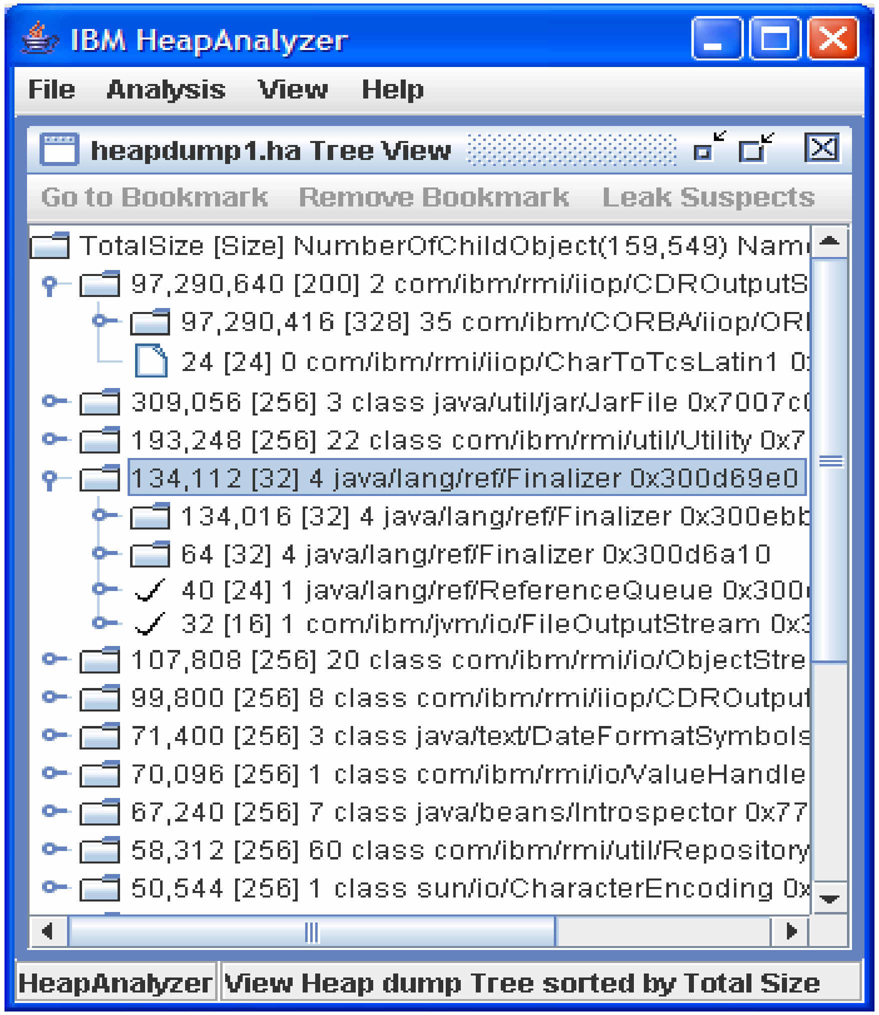


```
Hea  :\WASRUN\Tools\HeapAnalyzer\ed
Hea
// Ve  M AIX build ca131-20030618
// EO  lasses: 7800 Objects: 2910270 Obj
Num  9
Num
Heap range : 0x      0 to 0x7a32b518
Heap range size : 1,244,378,136
Heap size : 119,180,536
```

HeapAnalyzer | View Heap dump Tree sorted by Total Size

- Click on Analysis menu and select a menu item for further analysis.

Tree view

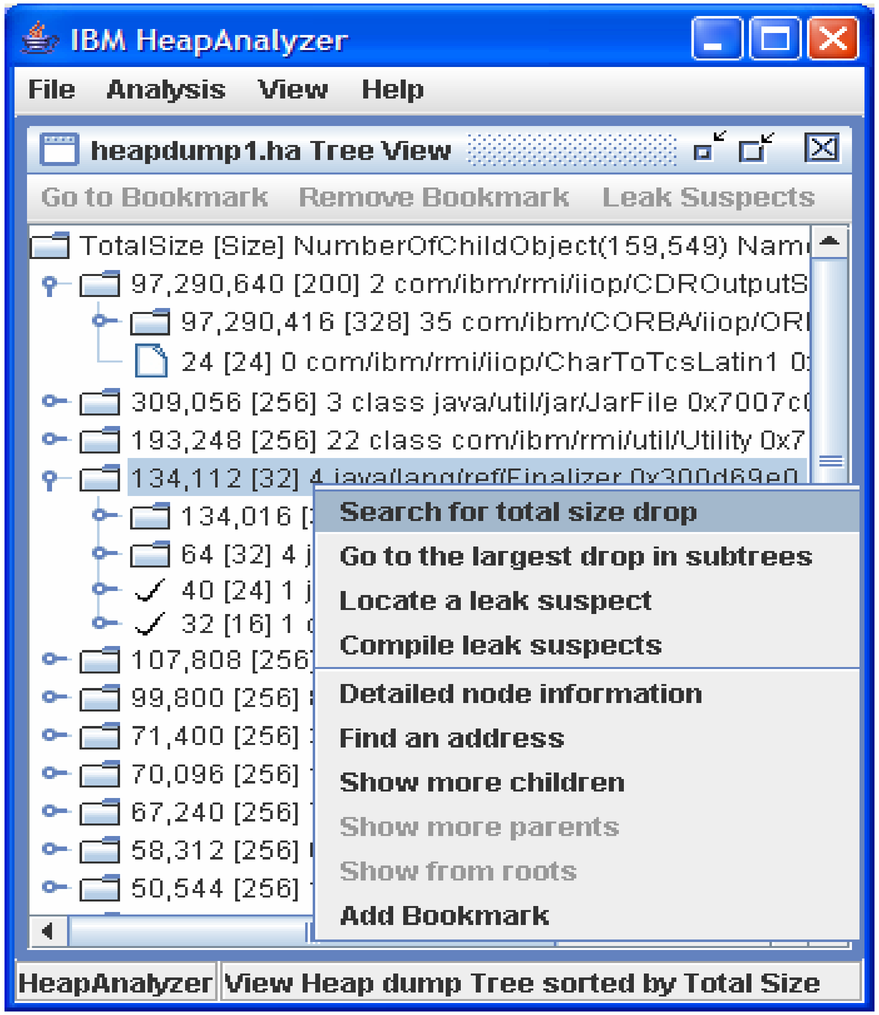


```
TotalSize [Size] NumberOfChildObject(159,549) Nam
97,290,640 [200] 2 com/ibm/rmi/iiop/CDROutputS
  97,290,416 [328] 35 com/ibm/CORBA/iiop/ORI
  24 [24] 0 com/ibm/rmi/iiop/CharToTcsLatin1 0
309,056 [256] 3 class java/util/jar/JarFile 0x7007c
193,248 [256] 22 class com/ibm/rmi/util/Utility 0x7
134,112 [32] 4 java/lang/ref/Finalizer 0x300d69e0
  134,016 [32] 4 java/lang/ref/Finalizer 0x300ebb
  64 [32] 4 java/lang/ref/Finalizer 0x300d6a10
  ✓ 40 [24] 1 java/lang/ref/ReferenceQueue 0x300
  ✓ 32 [16] 1 com/ibm/jvm/io/FileOutputStream 0x3
107,808 [256] 20 class com/ibm/rmi/io/ObjectStre
99,800 [256] 8 class com/ibm/rmi/iiop/CDROutpu
71,400 [256] 3 class java/text/DateFormatSymbols
70,096 [256] 1 class com/ibm/rmi/io/ValueHandle
67,240 [256] 7 class java/beans/Introspector 0x77
58,312 [256] 60 class com/ibm/rmi/util/Repository
50,544 [256] 1 class sun/io/CharacterEncoding 0x
```

HeapAnalyzer | View Heap dump Tree sorted by Total Size

- The check icon indicates that it has already been included as a child object of owner object in tree view
- Each tree node as in the following format: TotalSize[Size] NumberOfChildObject Name Address

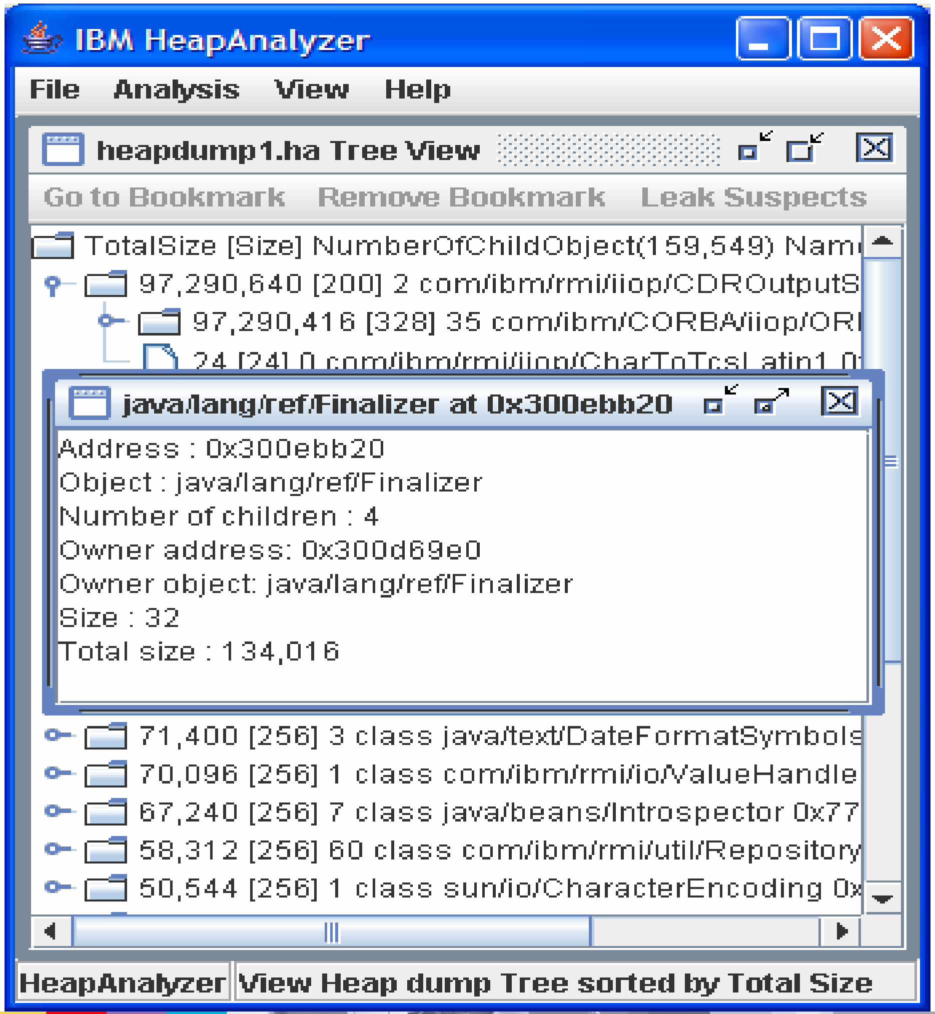
Detailed Node Information


IBM HeapAnalyzer
File Analysis View Help
heapdump1.ha Tree View
Go to Bookmark Remove Bookmark Leak Suspects
Search for total size drop
Go to the largest drop in subtrees
Locate a leak suspect
Compile leak suspects
Detailed node information
Find an address
Show more children
Show more parents
Show from roots
Add Bookmark
HeapAnalyzer View Heap dump Tree sorted by Total Size

```
TotalSize [Size] NumberOfChildObject(159,549) Nam
  97,290,640 [200] 2 com/ibm/rmi/iiop/CDROutputS
    97,290,416 [328] 35 com/ibm/CORBA/iiop/ORI
    24 [24] 0 com/ibm/rmi/iiop/CharToTcsLatin1 0
  309,056 [256] 3 class java/util/jar/JarFile 0x7007c
  193,248 [256] 22 class com/ibm/rmi/util/Utility 0x7
  134,112 [32] 4 java/lang/ref/Finalizer 0x300d69e0
    134,016 [
    64 [32] 4 j
    40 [24] 1 j
    32 [16] 1 c
  107,808 [256
  99,800 [256]
  71,400 [256]
  70,096 [256]
  67,240 [256]
  58,312 [256]
  50,544 [256]
```

- In tree view, you can see detailed information of a node
- You can search for total size drop between parent and child or you can find an address by selecting a node and clicking on right mouse button.

Detailed Node Information



```
TotalSize [Size] NumberOfChildObject(159,549) Nam
97,290,640 [200] 2 com/ibm/rmi/iiop/CDROutputS
97,290,416 [328] 35 com/ibm/CORBA/iiop/ORI
24 [24] 0 com/ibm/rmi/iiop/CharToTcsLatin1 0
```

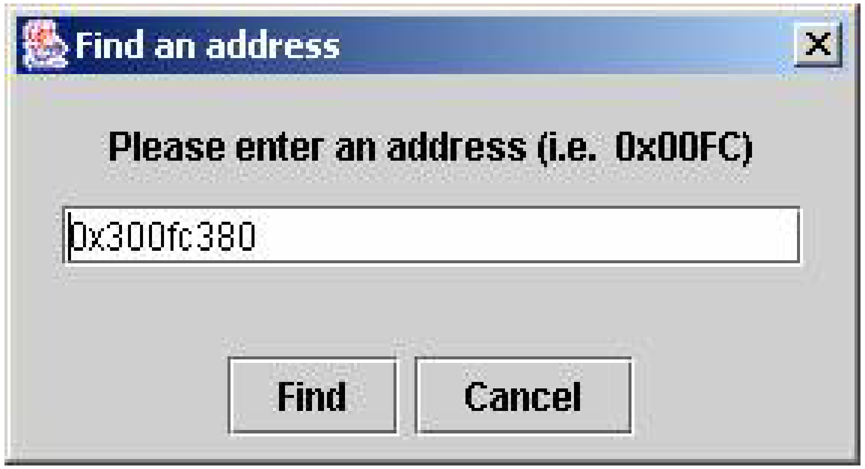
java/lang/ref/Finalizer at 0x300ebb20

```
Address : 0x300ebb20
Object : java/lang/ref/Finalizer
Number of children : 4
Owner address: 0x300d69e0
Owner object: java/lang/ref/Finalizer
Size : 32
Total size : 134,016
```

```
71,400 [256] 3 class java/text/DateFormatSymbols
70,096 [256] 1 class com/ibm/rmi/io/ValueHandle
67,240 [256] 7 class java/beans/Introspector 0x77
58,312 [256] 60 class com/ibm/rmi/util/Repository
50,544 [256] 1 class sun/io/CharacterEncoding 0x
```

- This is the screen of detailed node information in heapdump tree

Find an address

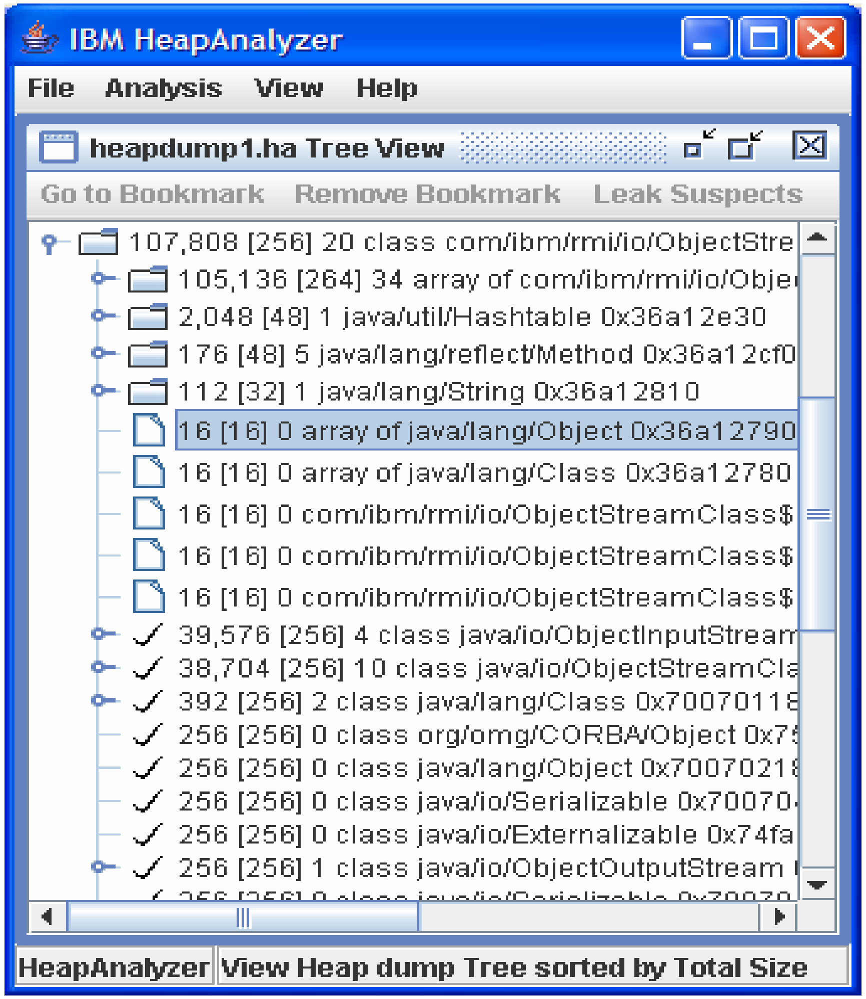


Please enter an address (i.e. 0x00FC)

0x300fc380

- You can find an address in the tree view by selecting the menu “Find an address”

Found the address

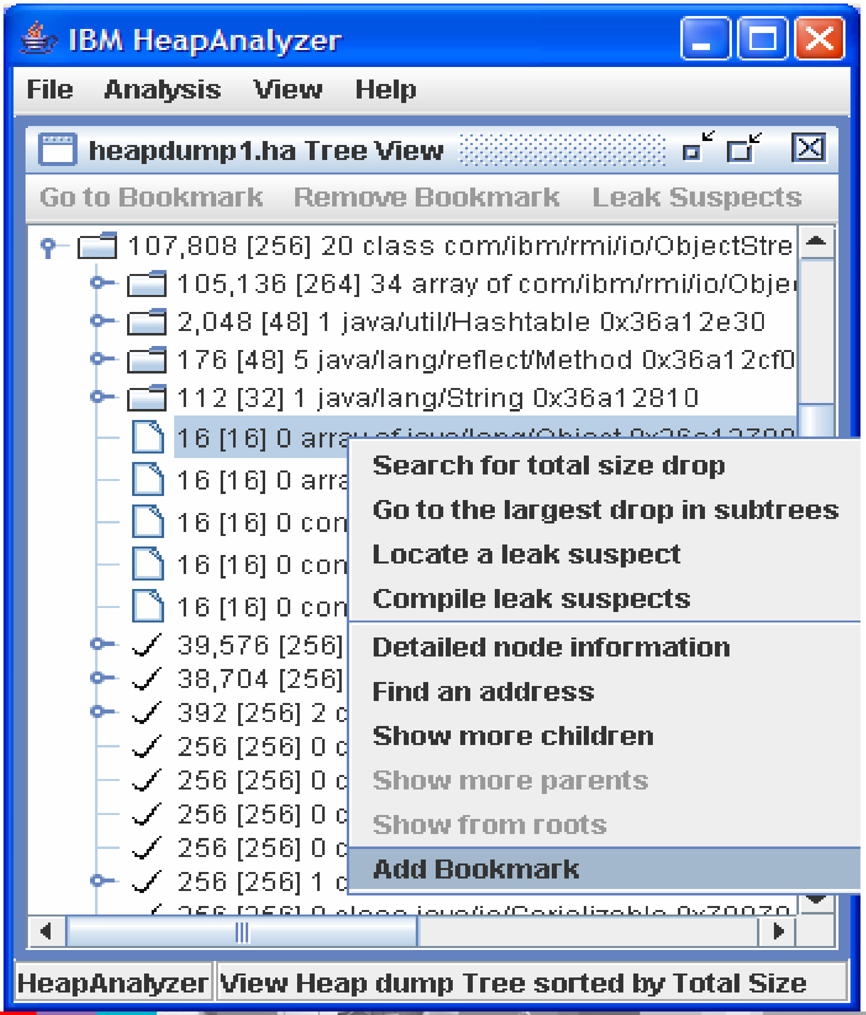


```
107,808 [256] 20 class com/ibm/rmi/io/ObjectStre
  105,136 [264] 34 array of com/ibm/rmi/io/Obje
  2,048 [48] 1 java/util/Hashtable 0x36a12e30
  176 [48] 5 java/lang/reflect/Method 0x36a12cf0
  112 [32] 1 java/lang/String 0x36a12810
  16 [16] 0 array of java/lang/Object 0x36a12790
  16 [16] 0 array of java/lang/Class 0x36a12780
  16 [16] 0 com/ibm/rmi/io/ObjectStreamClass$
  16 [16] 0 com/ibm/rmi/io/ObjectStreamClass$
  16 [16] 0 com/ibm/rmi/io/ObjectStreamClass$
  39,576 [256] 4 class java/io/ObjectInputStream
  38,704 [256] 10 class java/io/ObjectStreamCla
  392 [256] 2 class java/lang/Class 0x7007011
  256 [256] 0 class org/omg/CORBA/Object 0x7
  256 [256] 0 class java/lang/Object 0x7007021
  256 [256] 0 class java/io/Serializable 0x70070
  256 [256] 0 class java/io/Externalizable 0x74fa
  256 [256] 1 class java/io/ObjectOutputStream
```

HeapAnalyzer View Heap dump Tree sorted by Total Size

- This is the result of address search in a tree view

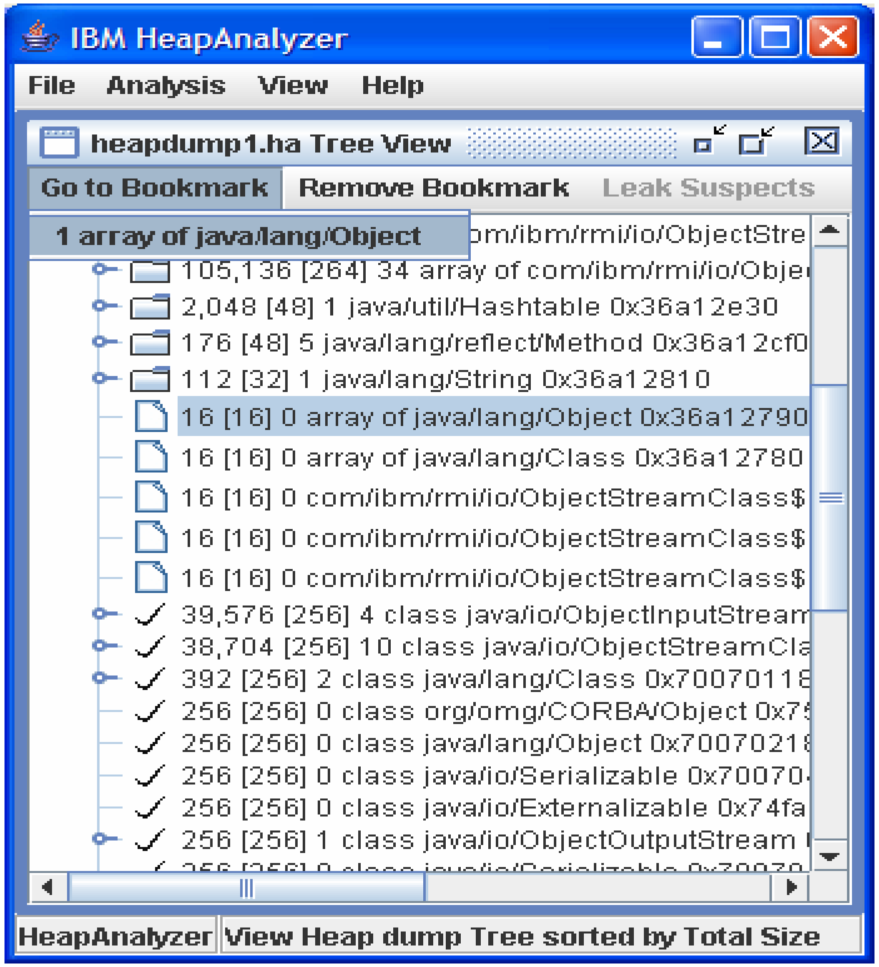
Add Bookmarks



```
107,808 [256] 20 class com/ibm/rmi/io/ObjectStre
  105,136 [264] 34 array of com/ibm/rmi/io/Obje
  2,048 [48] 1 java/util/Hashtable 0x36a12e30
  176 [48] 5 java/lang/reflect/Method 0x36a12cf0
  112 [32] 1 java/lang/String 0x36a12810
  16 [16] 0 arra
  16 [16] 0 arra
  16 [16] 0 con
  16 [16] 0 con
  16 [16] 0 con
  39,576 [256]
  38,704 [256]
  392 [256] 2 c
  256 [256] 0 c
  256 [256] 0 c
  256 [256] 0 c
  256 [256] 0 c
  256 [256] 1 c
```

- You can bookmark nodes and continue to navigate tree

Go to Bookmarks

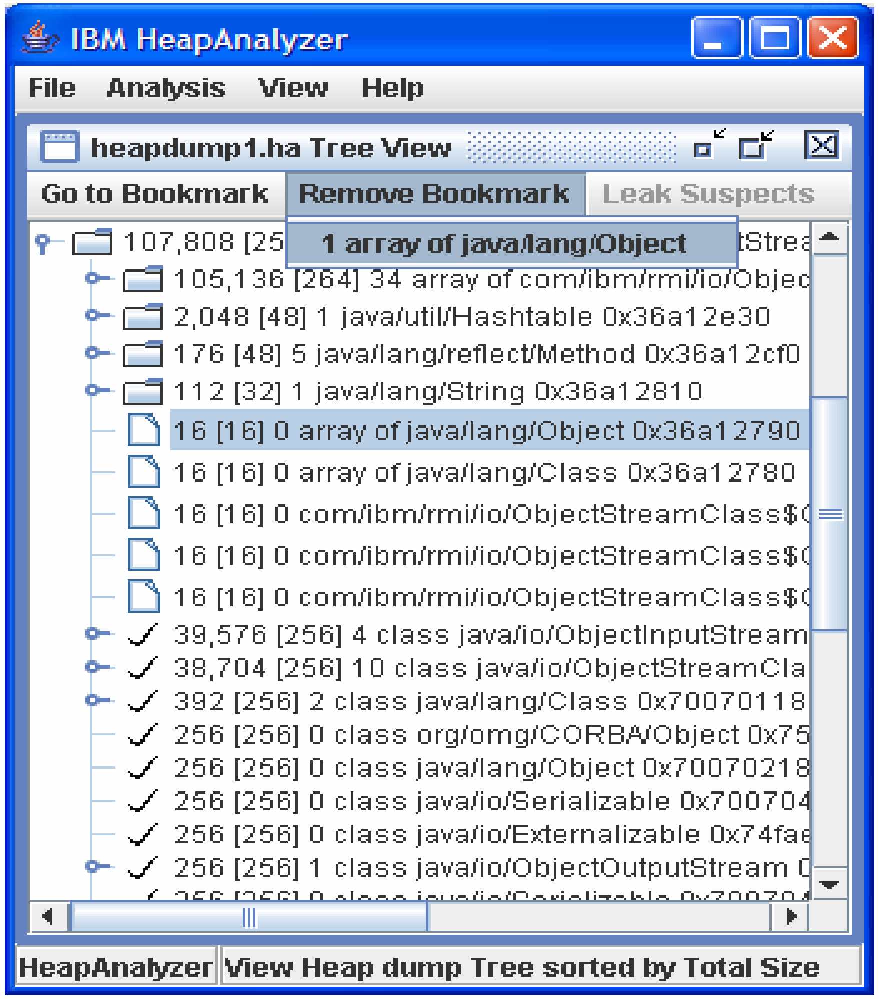


```
om/ibm/rmi/io/ObjectStre
105,136 [264] 34 array of com/ibm/rmi/io/Obje
2,048 [48] 1 java/util/Hashtable 0x36a12e30
176 [48] 5 java/lang/reflect/Method 0x36a12cf0
112 [32] 1 java/lang/String 0x36a12810
16 [16] 0 array of java/lang/Object 0x36a12790
16 [16] 0 array of java/lang/Class 0x36a12780
16 [16] 0 com/ibm/rmi/io/ObjectStreamClass$
16 [16] 0 com/ibm/rmi/io/ObjectStreamClass$
16 [16] 0 com/ibm/rmi/io/ObjectStreamClass$
39,576 [256] 4 class java/io/ObjectInputStream
38,704 [256] 10 class java/io/ObjectStreamCla
392 [256] 2 class java/lang/Class 0x70070118
256 [256] 0 class org/omg/CORBA/Object 0x75
256 [256] 0 class java/lang/Object 0x70070218
256 [256] 0 class java/io/Serializable 0x70070
256 [256] 0 class java/io/Externalizable 0x74fa
256 [256] 1 class java/io/ObjectOutputStream
```

HeapAnalyzer | View Heap dump Tree sorted by Total Size

- You can see list of bookmarks in “Go to Bookmark” menu in Tree view menu bar

Remove Bookmarks

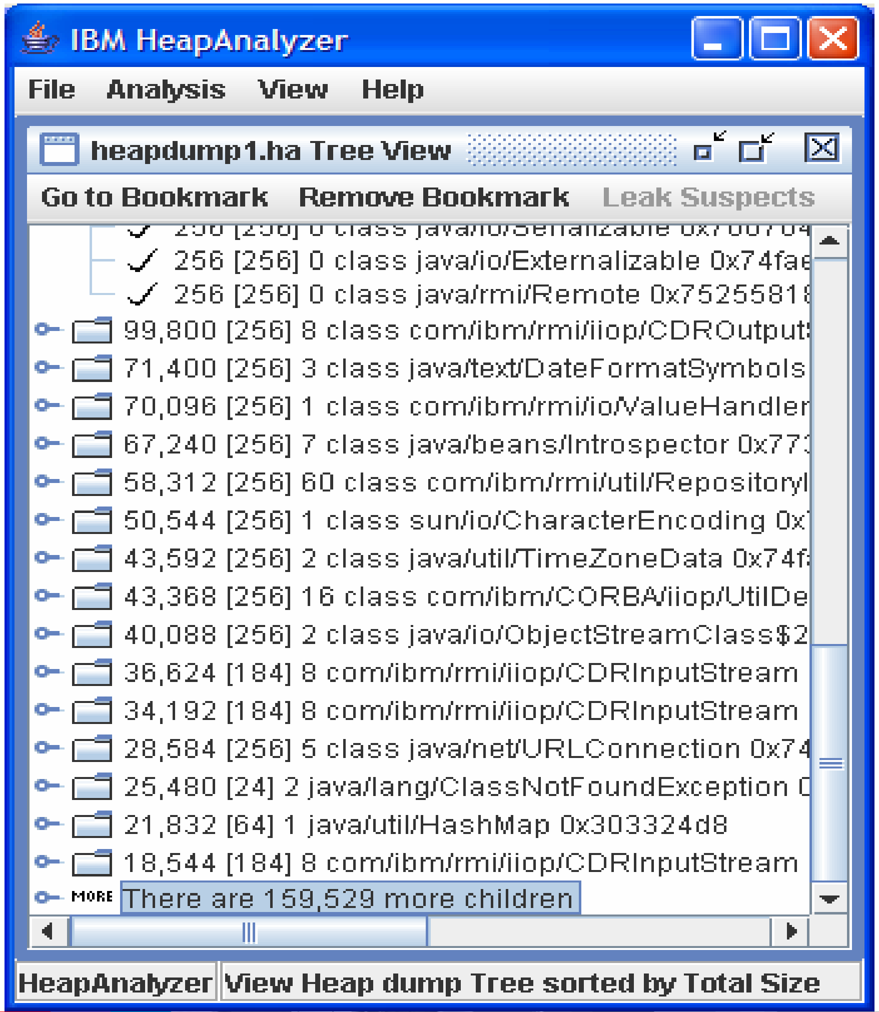


```
107,808 [25
  105,136 [264] 34 array of com/ibm/rmi/io/Objec
  2,048 [48] 1 java/util/Hashtable 0x36a12e30
  176 [48] 5 java/lang/reflect/Method 0x36a12cf0
  112 [32] 1 java/lang/String 0x36a12810
  16 [16] 0 array of java/lang/Object 0x36a12790
  16 [16] 0 array of java/lang/Class 0x36a12780
  16 [16] 0 com/ibm/rmi/io/ObjectStreamClass$0
  16 [16] 0 com/ibm/rmi/io/ObjectStreamClass$0
  16 [16] 0 com/ibm/rmi/io/ObjectStreamClass$0
  39,576 [256] 4 class java/io/ObjectInputStream
  38,704 [256] 10 class java/io/ObjectStreamCla
  392 [256] 2 class java/lang/Class 0x70070118
  256 [256] 0 class org/omg/CORBA/Object 0x75
  256 [256] 0 class java/lang/Object 0x70070218
  256 [256] 0 class java/io/Serializable 0x700704
  256 [256] 0 class java/io/Externalizable 0x74fae
  256 [256] 1 class java/io/ObjectOutputStream 0
```

HeapAnalyzer | View Heap dump Tree sorted by Total Size

- You can remove bookmarks in “Remove Bookmark” menu in Tree view menu bar

Got more children?

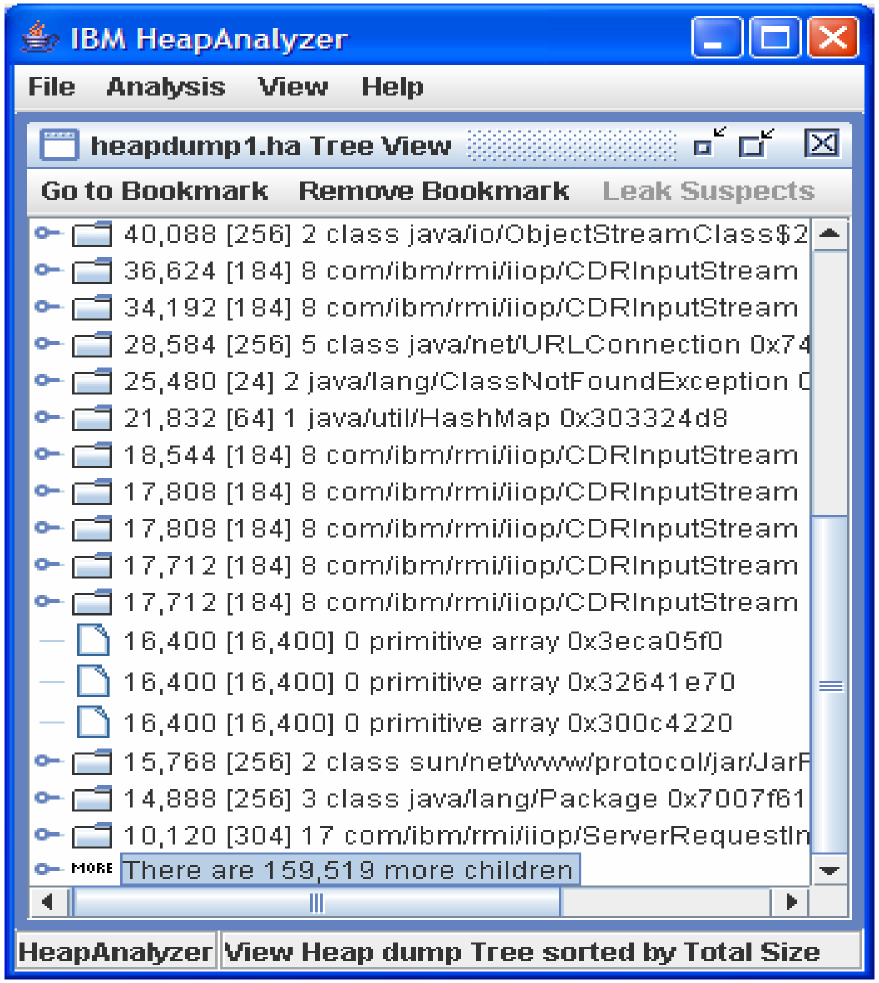


```
✓ 256 [256] 0 class java/io/Serializable 0x7007d4
✓ 256 [256] 0 class java/io/Externalizable 0x74fae
✓ 256 [256] 0 class java/rmi/Remote 0x7525581
99,800 [256] 8 class com/ibm/rmi/iiop/CDROutput
71,400 [256] 3 class java/text/DateFormatSymbols
70,096 [256] 1 class com/ibm/rmi/io/ValueHandler
67,240 [256] 7 class java/beans/Introspector 0x77
58,312 [256] 60 class com/ibm/rmi/util/Repository
50,544 [256] 1 class sun/io/CharacterEncoding 0x
43,592 [256] 2 class java/util/TimeZoneData 0x74f
43,368 [256] 16 class com/ibm/CORBA/iiop/UtilDe
40,088 [256] 2 class java/io/ObjectStreamClass$2
36,624 [184] 8 com/ibm/rmi/iiop/CDRInputStream
34,192 [184] 8 com/ibm/rmi/iiop/CDRInputStream
28,584 [256] 5 class java/net/URLConnection 0x74
25,480 [24] 2 java/lang/ClassNotFoundException
21,832 [64] 1 java/util/HashMap 0x303324d8
18,544 [184] 8 com/ibm/rmi/iiop/CDRInputStream
MORE There are 159,529 more children
```

HeapAnalyzer | View Heap dump Tree sorted by Total Size

- If you have more children in a parent object, you can see how many more children are hidden
- By expanding the node, you can see more children

More children

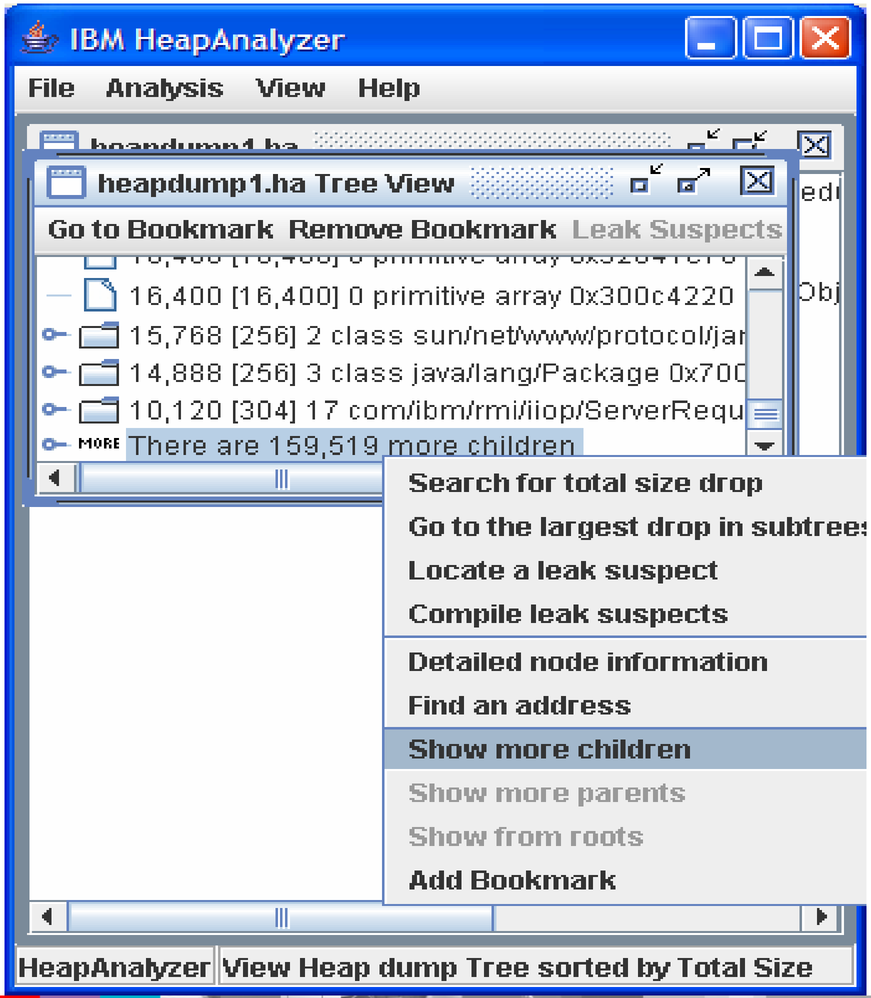


```
40,088 [256] 2 class java/io/ObjectStreamClass$2
36,624 [184] 8 com/ibm/rmi/iiop/CDRInputStream
34,192 [184] 8 com/ibm/rmi/iiop/CDRInputStream
28,584 [256] 5 class java/net/URLConnection 0x74
25,480 [24] 2 java/lang/ClassNotFoundException 0
21,832 [64] 1 java/util/HashMap 0x303324d8
18,544 [184] 8 com/ibm/rmi/iiop/CDRInputStream
17,808 [184] 8 com/ibm/rmi/iiop/CDRInputStream
17,808 [184] 8 com/ibm/rmi/iiop/CDRInputStream
17,712 [184] 8 com/ibm/rmi/iiop/CDRInputStream
17,712 [184] 8 com/ibm/rmi/iiop/CDRInputStream
16,400 [16,400] 0 primitive array 0x3eca05f0
16,400 [16,400] 0 primitive array 0x32641e70
16,400 [16,400] 0 primitive array 0x300c4220
15,768 [256] 2 class sun/net/www/protocol/jar/JarF
14,888 [256] 3 class java/lang/Package 0x7007f61
10,120 [304] 17 com/ibm/rmi/iiop/ServerRequestIn
MORE There are 159,519 more children
```

HeapAnalyzer | View Heap dump Tree sorted by Total Size

- 10 more children are displayed

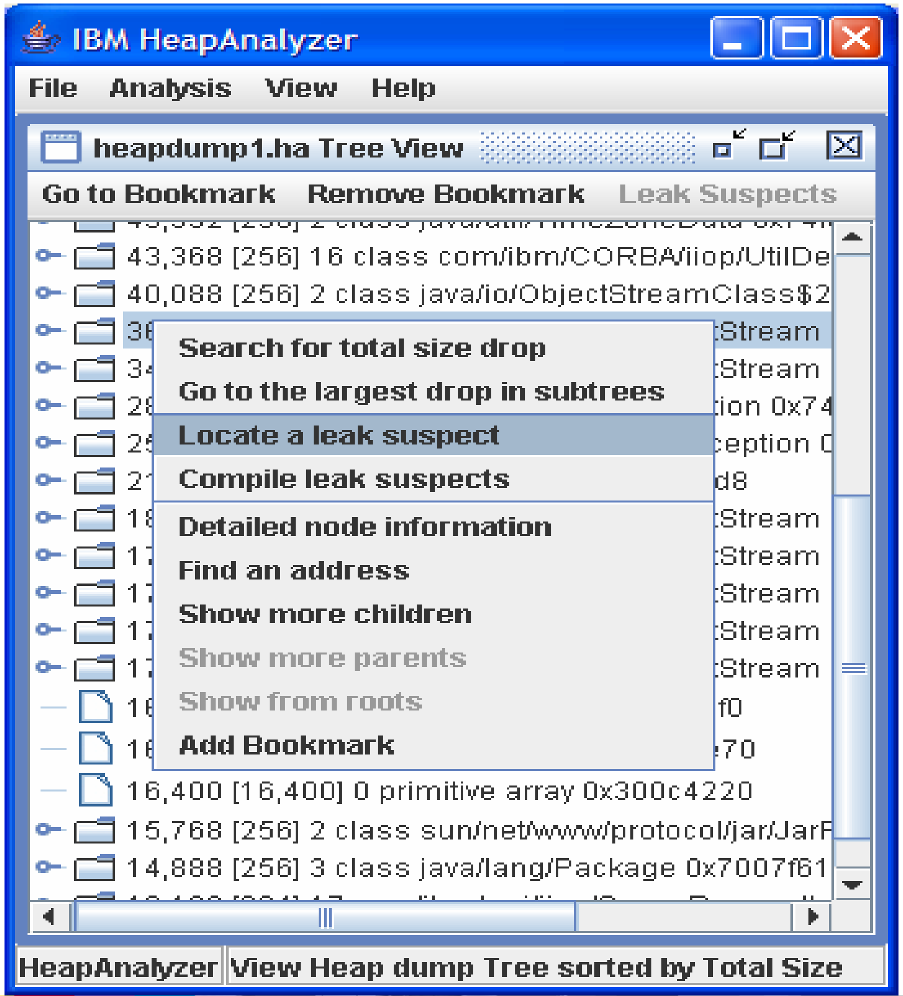
Another way to display more children



```
16,400 [16,400] 0 primitive array 0x300c4220
15,768 [256] 2 class sun/net/www/protocol/jar
14,888 [256] 3 class java/lang/Package 0x700
10,120 [304] 17 com/ibm/rmi/iiop/ServerRequ
MORE There are 159,519 more children
```

- You can use "Show more children" menu from parent node

Locate a leak suspect

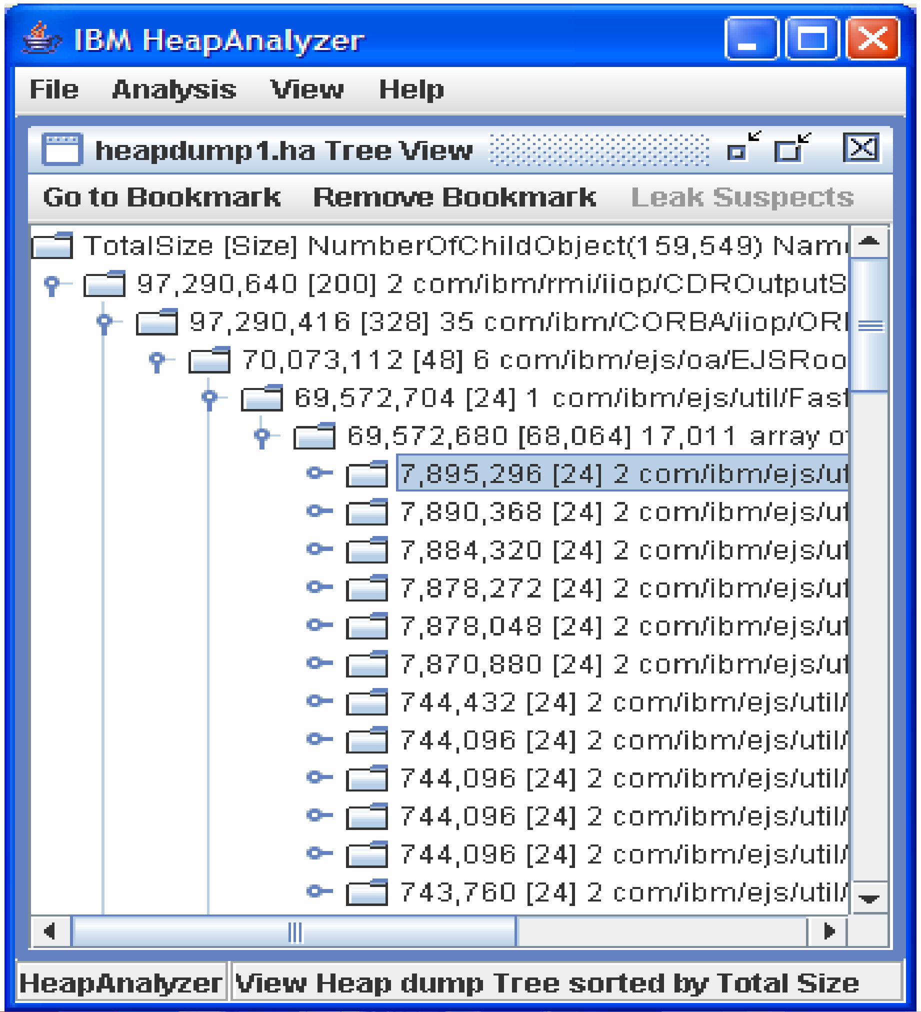


```
43,368 [256] 16 class com/ibm/CORBA/iiop/UtilDe
40,088 [256] 2 class java/io/ObjectStreamClass$2
16,400 [16,400] 0 primitive array 0x300c4220
15,768 [256] 2 class sun/net/www/protocol/jar/JarF
14,888 [256] 3 class java/lang/Package 0x7007f61
```

HeapAnalyzer | View Heap dump Tree sorted by Total Size

- You can locate areas where Java heap leak is suspected

Found a leak suspect?

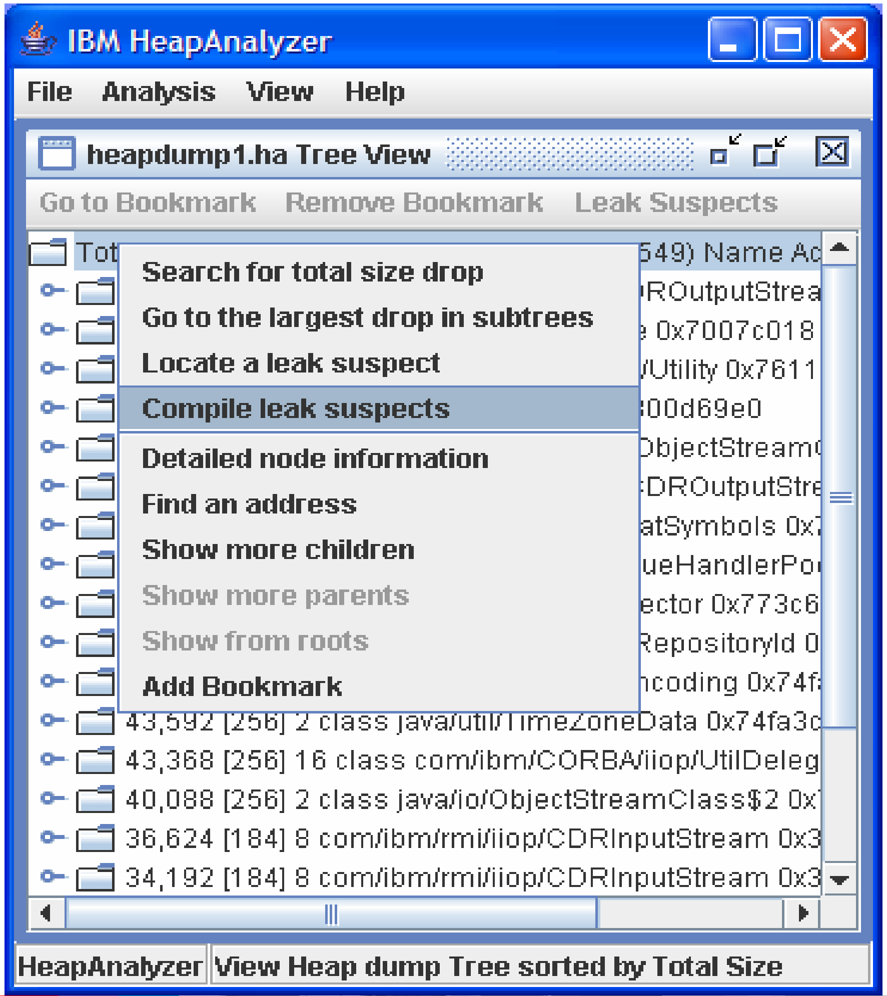


```
TotalSize [Size] NumberOfChildObject(159,549) Nam
  97,290,640 [200] 2 com/ibm/rmi/iiop/CDROutputS
    97,290,416 [328] 35 com/ibm/CORBA/iiop/ORI
      70,073,112 [48] 6 com/ibm/ejs/oa/EJSRoo
        69,572,704 [24] 1 com/ibm/ejs/util/Fast
          69,572,680 [68,064] 17,011 array o
            7,895,296 [24] 2 com/ibm/ejs/ut
            7,890,368 [24] 2 com/ibm/ejs/ut
            7,884,320 [24] 2 com/ibm/ejs/ut
            7,878,272 [24] 2 com/ibm/ejs/ut
            7,878,048 [24] 2 com/ibm/ejs/ut
            7,870,880 [24] 2 com/ibm/ejs/ut
            744,432 [24] 2 com/ibm/ejs/util/
            744,096 [24] 2 com/ibm/ejs/util/
            744,096 [24] 2 com/ibm/ejs/util/
            744,096 [24] 2 com/ibm/ejs/util/
            744,096 [24] 2 com/ibm/ejs/util/
            743,760 [24] 2 com/ibm/ejs/util/
```

HeapAnalyzer | View Heap dump Tree sorted by Total Size

- Found an area where there are relatively excessive number of children

Compile leak suspects



IBM HeapAnalyzer

File Analysis View Help

heapdump1.ha Tree View

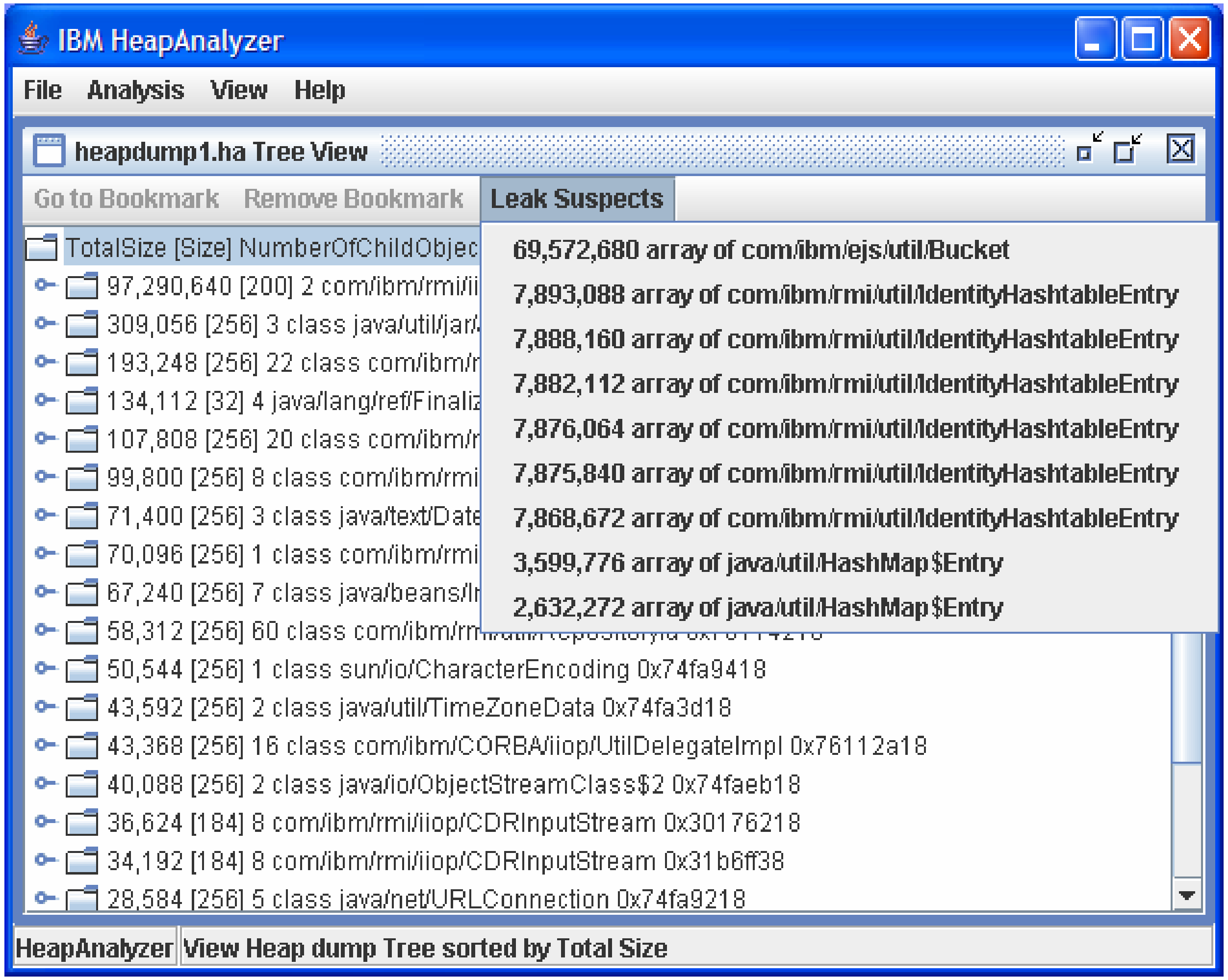
Go to Bookmark Remove Bookmark Leak Suspects

```
Tot                                                  549) Name Ac
                                                     ROutputStrea
                                                     0x7007c018
                                                     /Utility 0x7611
                                                     00d69e0
                                                     ObjectStream
                                                     DROutputStre
                                                     atSymbols 0x
                                                     ueHandlerPo
                                                     ector 0x773c6
                                                     RepositoryId 0
                                                     ncoding 0x74f
43,592 [256] 2 class java/util/TimeZoneData 0x74fa3c
43,368 [256] 16 class com/ibm/CORBA/iiop/UtilDeleg
40,088 [256] 2 class java/io/ObjectStreamClass$2 0x
36,624 [184] 8 com/ibm/rmi/iiop/CDRInputStream 0x3
34,192 [184] 8 com/ibm/rmi/iiop/CDRInputStream 0x3
```

HeapAnalyzer | View Heap dump Tree sorted by Total Size

- You can compile list of locate areas where Java heap leak is suspected

Locate a leak suspect



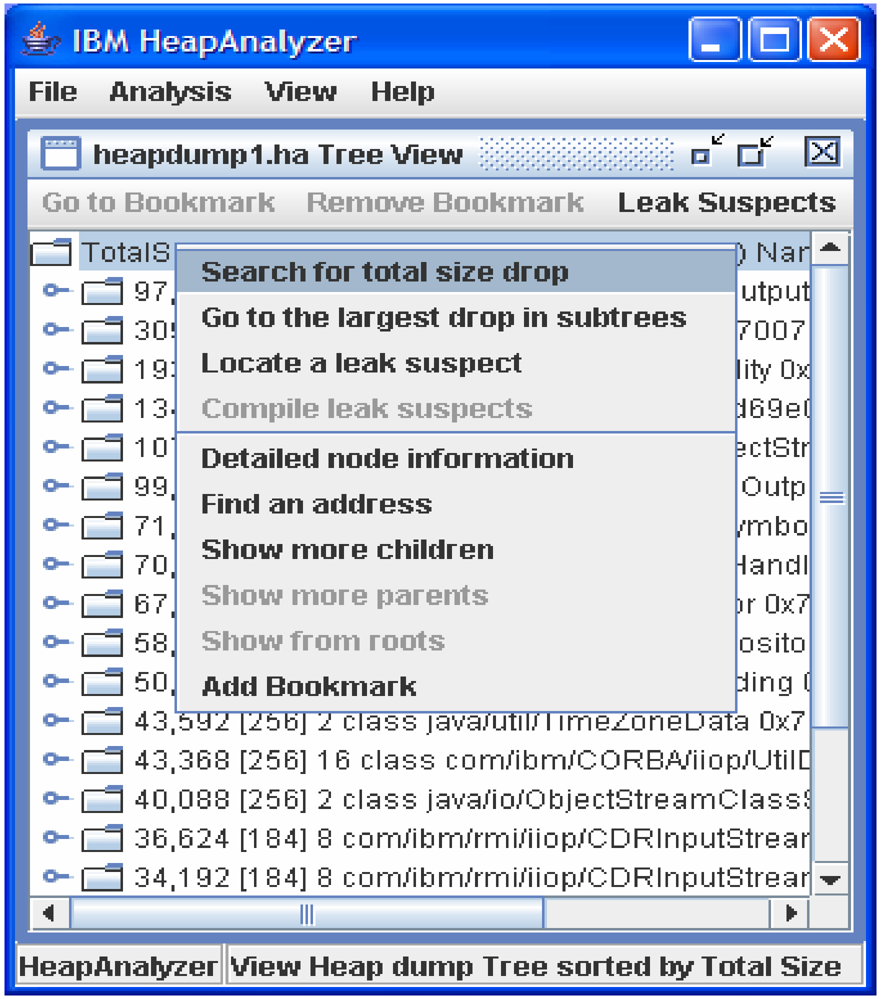
```
69,572,680 array of com/ibm/ejs/util/Bucket
7,893,088 array of com/ibm/rmi/util/IdentityHashtableEntry
7,888,160 array of com/ibm/rmi/util/IdentityHashtableEntry
7,882,112 array of com/ibm/rmi/util/IdentityHashtableEntry
7,876,064 array of com/ibm/rmi/util/IdentityHashtableEntry
7,875,840 array of com/ibm/rmi/util/IdentityHashtableEntry
7,868,672 array of com/ibm/rmi/util/IdentityHashtableEntry
3,599,776 array of java/util/HashMap$Entry
2,632,272 array of java/util/HashMap$Entry
```

```
TotalSize [Size] NumberOfChildObjec
97,290,640 [200] 2 com/ibm/rmi/ii
309,056 [256] 3 class java/util/jar/
193,248 [256] 22 class com/ibm/r
134,112 [32] 4 java/lang/ref/Finaliz
107,808 [256] 20 class com/ibm/r
99,800 [256] 8 class com/ibm/rmi
71,400 [256] 3 class java/text/Date
70,096 [256] 1 class com/ibm/rmi
67,240 [256] 7 class java/beans/I
58,312 [256] 60 class com/ibm/rm
50,544 [256] 1 class sun/io/CharacterEncoding 0x74fa9418
43,592 [256] 2 class java/util/TimeZoneData 0x74fa3d18
43,368 [256] 16 class com/ibm/CORBA/iiop/UtilDelegateImpl 0x76112a18
40,088 [256] 2 class java/io/ObjectStreamClass$2 0x74faeb18
36,624 [184] 8 com/ibm/rmi/iiop/CDRInputStream 0x30176218
34,192 [184] 8 com/ibm/rmi/iiop/CDRInputStream 0x31b6ff38
28,584 [256] 5 class java/net/URLConnection 0x74fa9218
```

HeapAnalyzer | View Heap dump Tree sorted by Total Size

- You can locate areas where Java heap leak is suspected by selecting a leak suspect

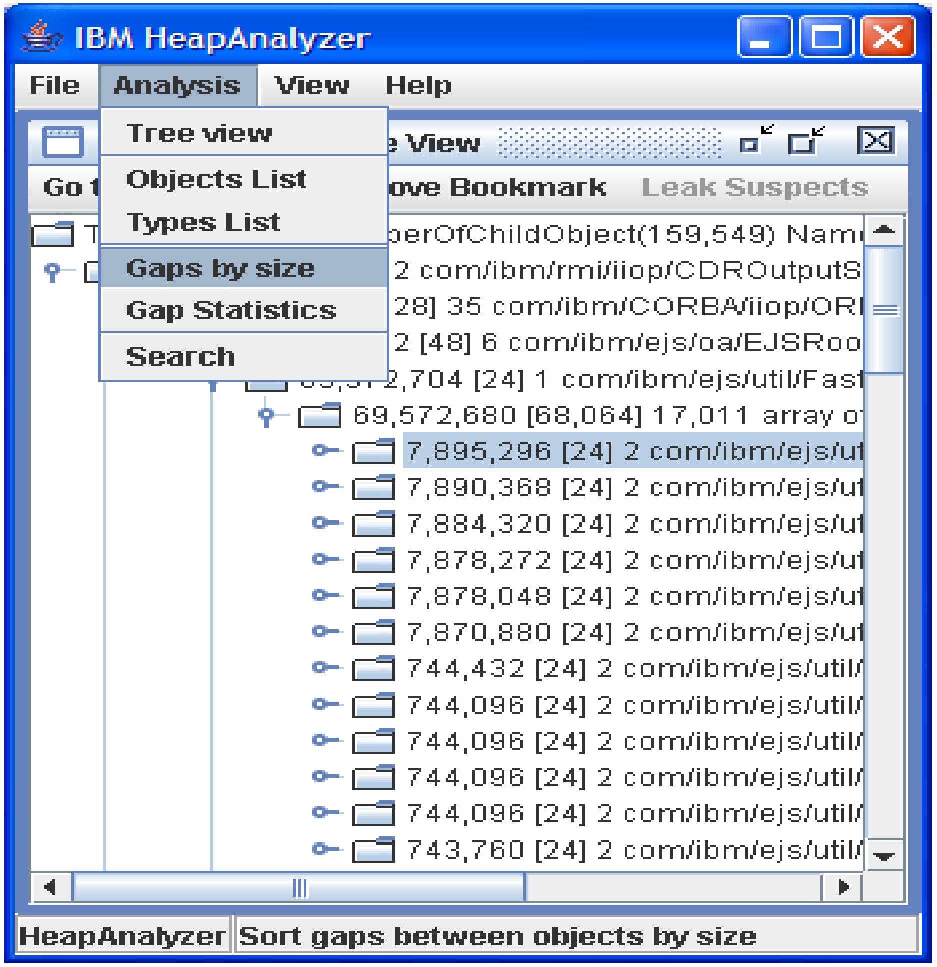
Search for total size drop



```
43,592 [256] 2 class java/util/TimeZoneData 0x7
43,368 [256] 16 class com/ibm/CORBA/iiop/UtilD
40,088 [256] 2 class java/io/ObjectStreamClass
36,624 [184] 8 com/ibm/rmi/iiop/CDRInputStrear
34,192 [184] 8 com/ibm/rmi/iiop/CDRInputStrear
```

- "Search for total size drop" will find a size drop between the total size of a parent and the biggest total size of child of the parent.
- If you cannot find any size drop from the menu "Search for total size drop", you need to decrease Minimum total size drop for search in options.

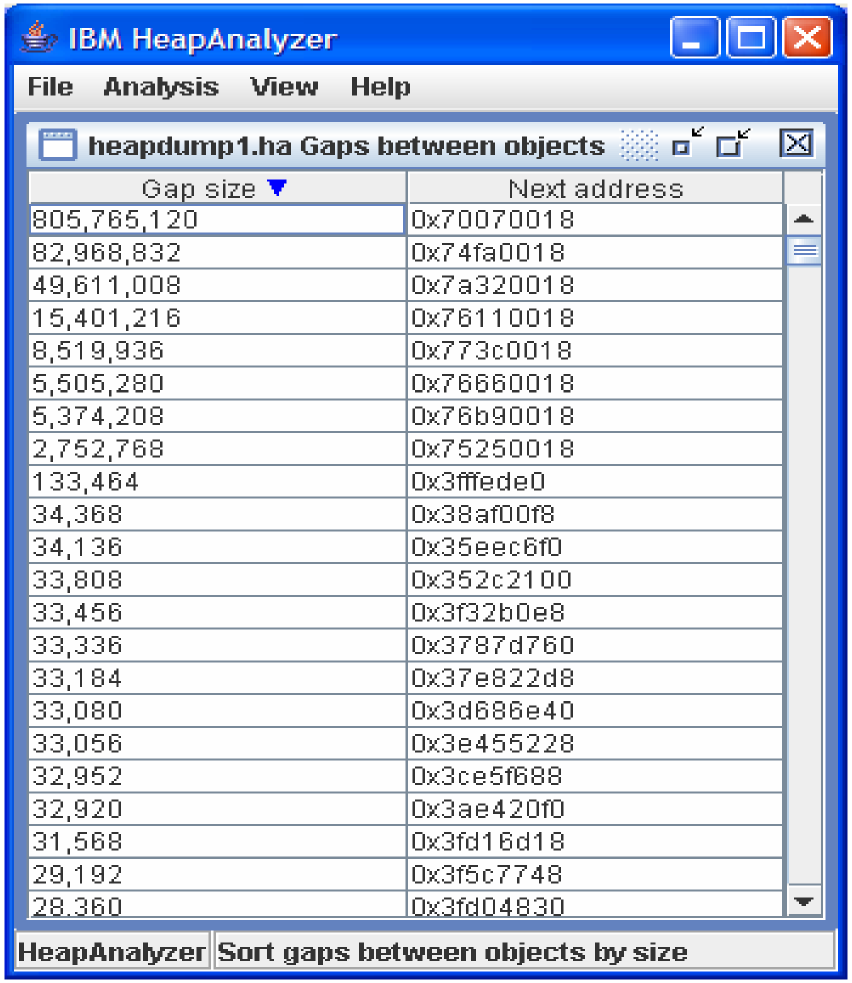
Gaps by size



```
berOfChildObject(159,549) Nam
2 com/ibm/rmi/iiop/CDROutputS
28] 35 com/ibm/CORBA/iiop/ORI
2 [48] 6 com/ibm/ejs/oa/EJSRoo
2,704 [24] 1 com/ibm/ejs/util/Fast
69,572,680 [68,064] 17,011 array of
7,895,296 [24] 2 com/ibm/ejs/ut
7,890,368 [24] 2 com/ibm/ejs/ut
7,884,320 [24] 2 com/ibm/ejs/ut
7,878,272 [24] 2 com/ibm/ejs/ut
7,878,048 [24] 2 com/ibm/ejs/ut
7,870,880 [24] 2 com/ibm/ejs/ut
744,432 [24] 2 com/ibm/ejs/util/
744,096 [24] 2 com/ibm/ejs/util/
744,096 [24] 2 com/ibm/ejs/util/
744,096 [24] 2 com/ibm/ejs/util/
744,096 [24] 2 com/ibm/ejs/util/
743,760 [24] 2 com/ibm/ejs/util/
```

- You can review gaps between objects and classes

Gaps view

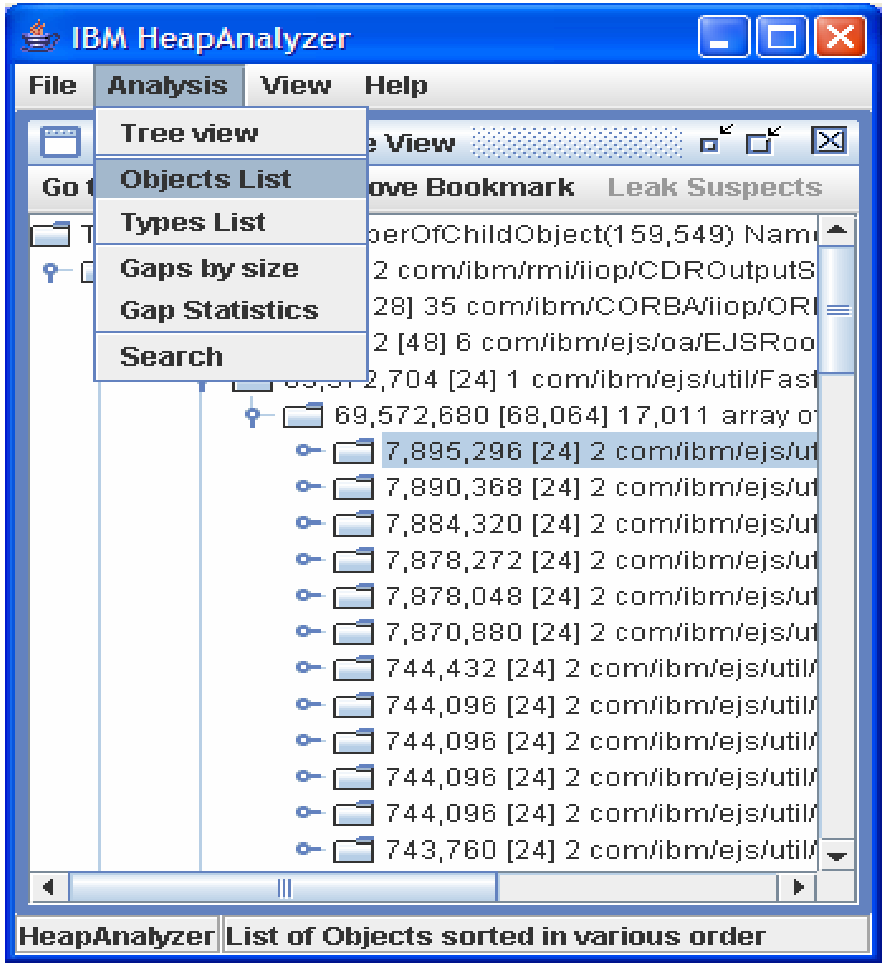


Gap size	Next address
805,765,120	0x70070018
82,968,832	0x74fa0018
49,611,008	0x7a320018
15,401,216	0x76110018
8,519,936	0x773c0018
5,505,280	0x76660018
5,374,208	0x76b90018
2,752,768	0x75250018
133,464	0x3fffede0
34,368	0x38af00f8
34,136	0x35eec6f0
33,808	0x352c2100
33,456	0x3f32b0e8
33,336	0x3787d760
33,184	0x37e822d8
33,080	0x3d686e40
33,056	0x3e455228
32,952	0x3ce5f688
32,920	0x3ae420f0
31,568	0x3fd16d18
29,192	0x3f5c7748
28,360	0x3fd04830

HeapAnalyzer Sort gaps between objects by size

- This is gaps view

Objects List

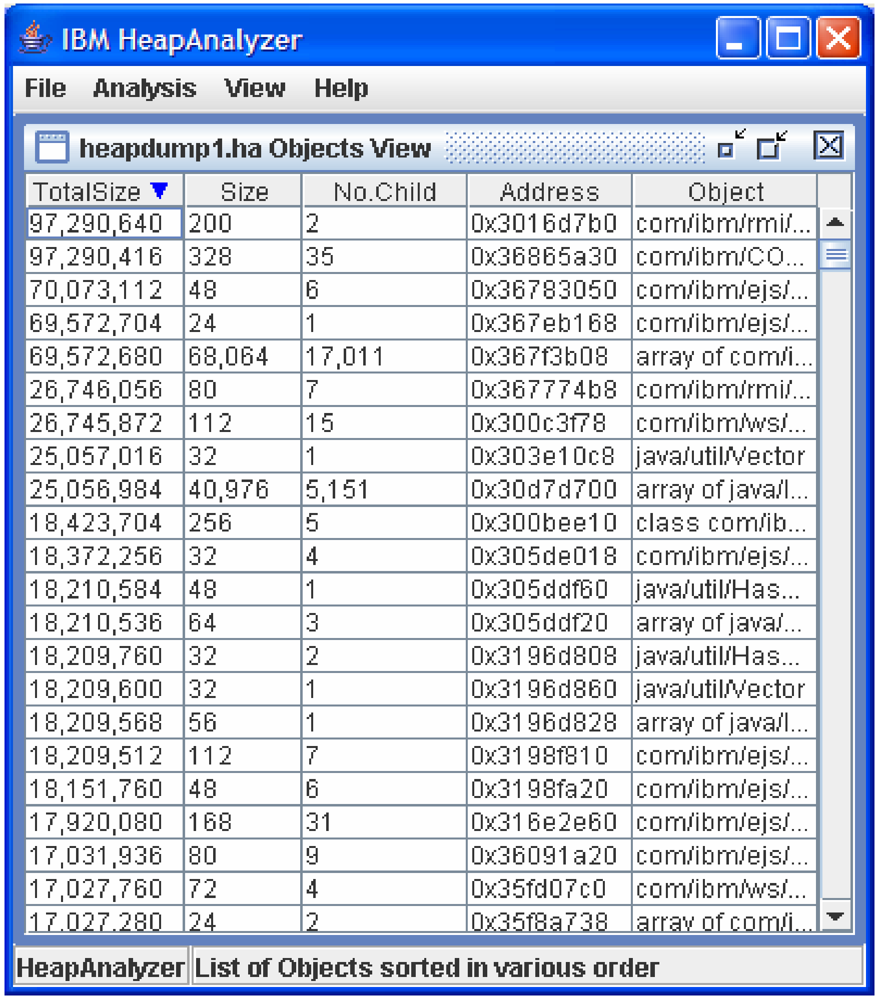


berOfChildObject(159,549) Nam
2 com/ibm/rmi/iiop/CDROutputS
28] 35 com/ibm/CORBA/iiop/ORI
2 [48] 6 com/ibm/ejs/oa/EJSRoo
2,704 [24] 1 com/ibm/ejs/util/Fast
69,572,680 [68,064] 17,011 array of
7,895,296 [24] 2 com/ibm/ejs/ut
7,890,368 [24] 2 com/ibm/ejs/ut
7,884,320 [24] 2 com/ibm/ejs/ut
7,878,272 [24] 2 com/ibm/ejs/ut
7,878,048 [24] 2 com/ibm/ejs/ut
7,870,880 [24] 2 com/ibm/ejs/ut
744,432 [24] 2 com/ibm/ejs/util/
744,096 [24] 2 com/ibm/ejs/util/
744,096 [24] 2 com/ibm/ejs/util/
744,096 [24] 2 com/ibm/ejs/util/
744,096 [24] 2 com/ibm/ejs/util/
743,760 [24] 2 com/ibm/ejs/util/

HeapAnalyzer | List of Objects sorted in various order

- List Objects -> Sort by TotalSize

Objects by TotalSize

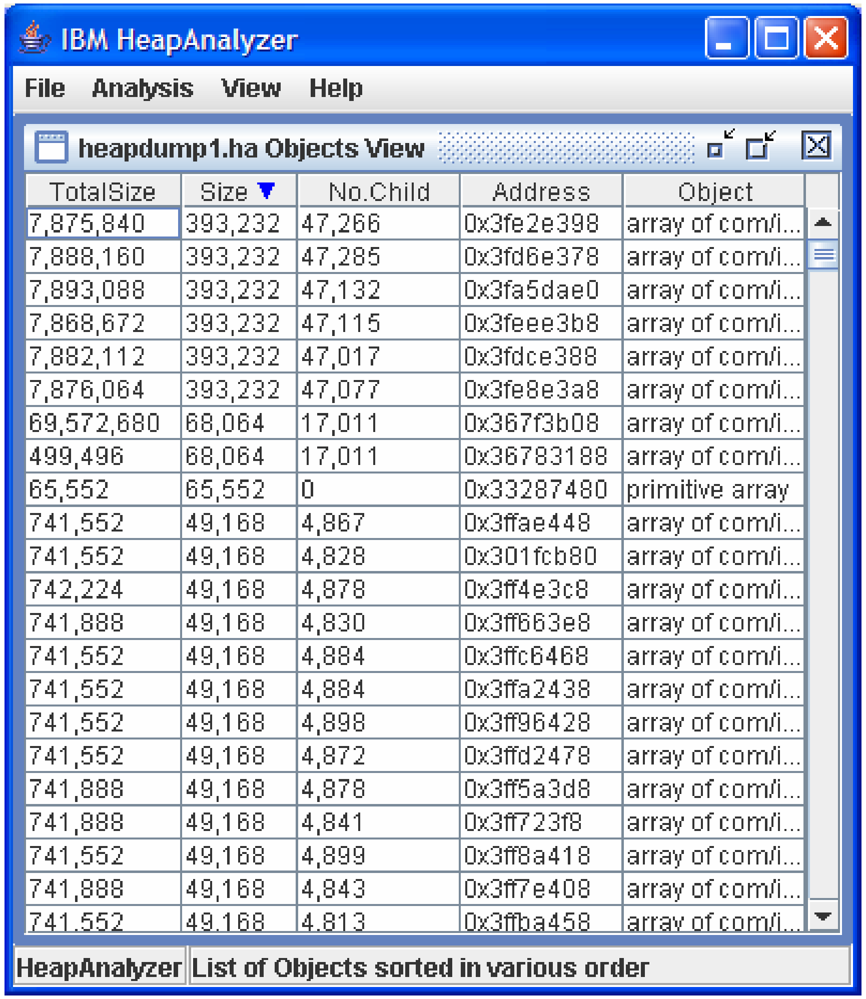


TotalSize ▼	Size	No.Child	Address	Object
97,290,640	200	2	0x3016d7b0	com/ibm/rmi/...
97,290,416	328	35	0x36865a30	com/ibm/CO...
70,073,112	48	6	0x36783050	com/ibm/ejs/...
69,572,704	24	1	0x367eb168	com/ibm/ejs/...
69,572,680	68,064	17,011	0x367f3b08	array of com/i...
26,746,056	80	7	0x367774b8	com/ibm/rmi/...
26,745,872	112	15	0x300c3f78	com/ibm/ws/...
25,057,016	32	1	0x303e10c8	java/util/Vector
25,056,984	40,976	5,151	0x30d7d700	array of java/l...
18,423,704	256	5	0x300bee10	class com/ib...
18,372,256	32	4	0x305de018	com/ibm/ejs/...
18,210,584	48	1	0x305ddf60	java/util/Has...
18,210,536	64	3	0x305ddf20	array of java/...
18,209,760	32	2	0x3196d808	java/util/Has...
18,209,600	32	1	0x3196d860	java/util/Vector
18,209,568	56	1	0x3196d828	array of java/l...
18,209,512	112	7	0x3198f810	com/ibm/ejs/...
18,151,760	48	6	0x3198fa20	com/ibm/ejs/...
17,920,080	168	31	0x316e2e60	com/ibm/ejs/...
17,031,936	80	9	0x36091a20	com/ibm/ejs/...
17,027,760	72	4	0x35fd07c0	com/ibm/ws/...
17,027,280	24	2	0x35f8a738	array of com/i...

HeapAnalyzer List of Objects sorted in various order

- Objects/Classes are sorted by TotalSize

Objects by Size

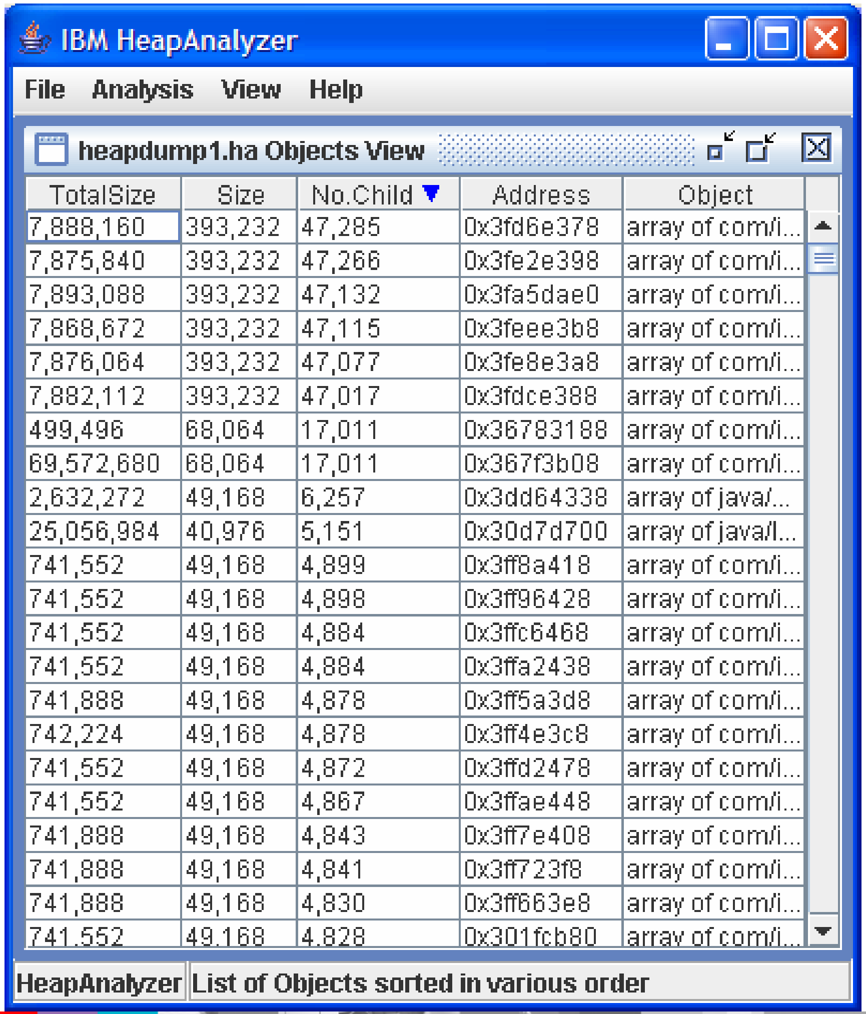


TotalSize	Size ▼	No.Child	Address	Object
7,875,840	393,232	47,266	0x3fe2e398	array of com/i...
7,888,160	393,232	47,285	0x3fd6e378	array of com/i...
7,893,088	393,232	47,132	0x3fa5dae0	array of com/i...
7,868,672	393,232	47,115	0x3feee3b8	array of com/i...
7,882,112	393,232	47,017	0x3fdce388	array of com/i...
7,876,064	393,232	47,077	0x3fe8e3a8	array of com/i...
69,572,680	68,064	17,011	0x367f3b08	array of com/i...
499,496	68,064	17,011	0x36783188	array of com/i...
65,552	65,552	0	0x33287480	primitive array
741,552	49,168	4,867	0x3ffae448	array of com/i...
741,552	49,168	4,828	0x301fcb80	array of com/i...
742,224	49,168	4,878	0x3ff4e3c8	array of com/i...
741,888	49,168	4,830	0x3ff663e8	array of com/i...
741,552	49,168	4,884	0x3ffc6468	array of com/i...
741,552	49,168	4,884	0x3ffa2438	array of com/i...
741,552	49,168	4,898	0x3ff96428	array of com/i...
741,552	49,168	4,872	0x3ffd2478	array of com/i...
741,888	49,168	4,878	0x3ff5a3d8	array of com/i...
741,888	49,168	4,841	0x3ff723f8	array of com/i...
741,552	49,168	4,899	0x3ff8a418	array of com/i...
741,888	49,168	4,843	0x3ff7e408	array of com/i...
741,552	49,168	4,813	0x3ffba458	array of com/i...

HeapAnalyzer | List of Objects sorted in various order

- Objects/Classes are sorted by their sizes

Objects by number of child

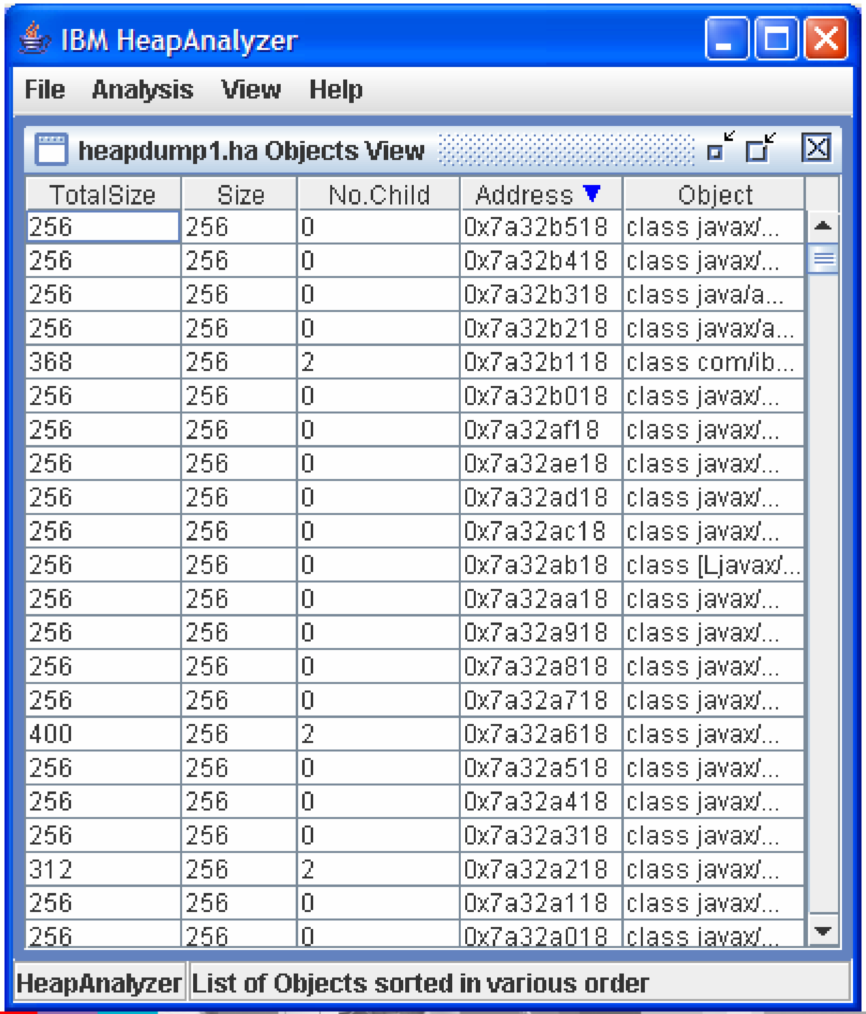


TotalSize	Size	No.Child ▼	Address	Object
7,888,160	393,232	47,285	0x3fd6e378	array of com/i...
7,875,840	393,232	47,266	0x3fe2e398	array of com/i...
7,893,088	393,232	47,132	0x3fa5dae0	array of com/i...
7,868,672	393,232	47,115	0x3feee3b8	array of com/i...
7,876,064	393,232	47,077	0x3fe8e3a8	array of com/i...
7,882,112	393,232	47,017	0x3fdce388	array of com/i...
499,496	68,064	17,011	0x36783188	array of com/i...
69,572,680	68,064	17,011	0x367f3b08	array of com/i...
2,632,272	49,168	6,257	0x3dd64338	array of java/...
25,056,984	40,976	5,151	0x30d7d700	array of java/l...
741,552	49,168	4,899	0x3ff8a418	array of com/i...
741,552	49,168	4,898	0x3ff96428	array of com/i...
741,552	49,168	4,884	0x3ffc6468	array of com/i...
741,552	49,168	4,884	0x3ffa2438	array of com/i...
741,888	49,168	4,878	0x3ff5a3d8	array of com/i...
742,224	49,168	4,878	0x3ff4e3c8	array of com/i...
741,552	49,168	4,872	0x3ffd2478	array of com/i...
741,552	49,168	4,867	0x3ffae448	array of com/i...
741,888	49,168	4,843	0x3ff7e408	array of com/i...
741,888	49,168	4,841	0x3ff723f8	array of com/i...
741,888	49,168	4,830	0x3ff663e8	array of com/i...
741,552	49,168	4,828	0x301fcb80	array of com/i...

HeapAnalyzer | List of Objects sorted in various order

- Objects/Classes are sorted by number of child objects

Objects by address

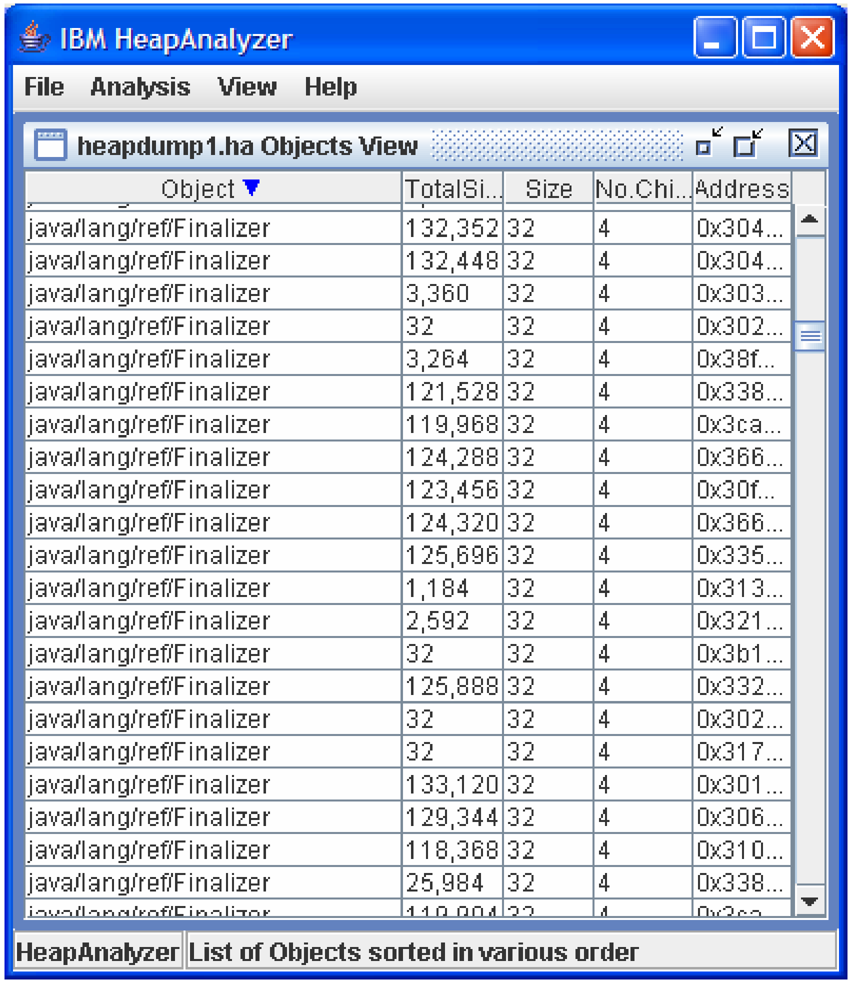


TotalSize	Size	No.Child	Address	Object
256	256	0	0x7a32b518	class javax/...
256	256	0	0x7a32b418	class javax/...
256	256	0	0x7a32b318	class java/a...
256	256	0	0x7a32b218	class javax/a...
368	256	2	0x7a32b118	class com/ib...
256	256	0	0x7a32b018	class javax/...
256	256	0	0x7a32af18	class javax/...
256	256	0	0x7a32ae18	class javax/...
256	256	0	0x7a32ad18	class javax/...
256	256	0	0x7a32ac18	class javax/...
256	256	0	0x7a32ab18	class [Ljavax/...
256	256	0	0x7a32aa18	class javax/...
256	256	0	0x7a32a918	class javax/...
256	256	0	0x7a32a818	class javax/...
256	256	0	0x7a32a718	class javax/...
400	256	2	0x7a32a618	class javax/...
256	256	0	0x7a32a518	class javax/...
256	256	0	0x7a32a418	class javax/...
256	256	0	0x7a32a318	class javax/...
312	256	2	0x7a32a218	class javax/...
256	256	0	0x7a32a118	class javax/...
256	256	0	0x7a32a018	class javax/...

HeapAnalyzer | List of Objects sorted in various order

- Objects/Classes are sorted by address

Objects by name

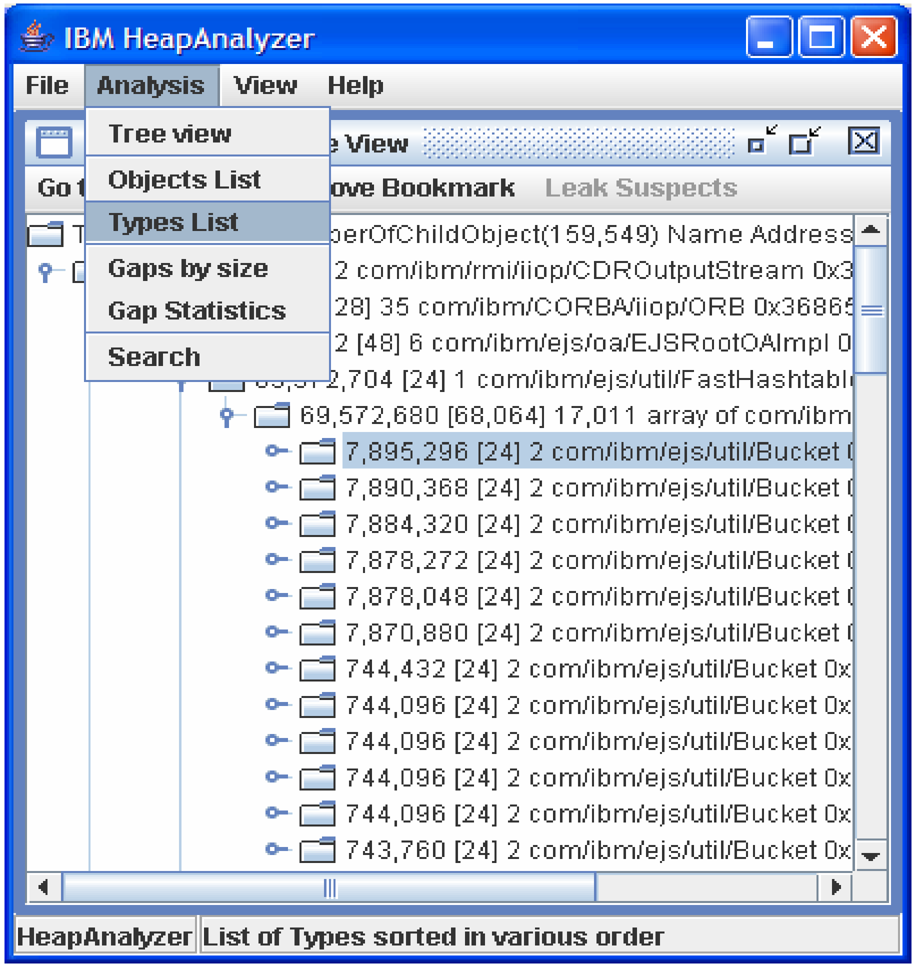


Object	TotalSi...	Size	No.Chi...	Address
java/lang/ref/Finalizer	132,352	32	4	0x304...
java/lang/ref/Finalizer	132,448	32	4	0x304...
java/lang/ref/Finalizer	3,360	32	4	0x303...
java/lang/ref/Finalizer	32	32	4	0x302...
java/lang/ref/Finalizer	3,264	32	4	0x38f...
java/lang/ref/Finalizer	121,528	32	4	0x338...
java/lang/ref/Finalizer	119,968	32	4	0x3ca...
java/lang/ref/Finalizer	124,288	32	4	0x366...
java/lang/ref/Finalizer	123,456	32	4	0x30f...
java/lang/ref/Finalizer	124,320	32	4	0x366...
java/lang/ref/Finalizer	125,696	32	4	0x335...
java/lang/ref/Finalizer	1,184	32	4	0x313...
java/lang/ref/Finalizer	2,592	32	4	0x321...
java/lang/ref/Finalizer	32	32	4	0x3b1...
java/lang/ref/Finalizer	125,888	32	4	0x332...
java/lang/ref/Finalizer	32	32	4	0x302...
java/lang/ref/Finalizer	32	32	4	0x317...
java/lang/ref/Finalizer	133,120	32	4	0x301...
java/lang/ref/Finalizer	129,344	32	4	0x306...
java/lang/ref/Finalizer	118,368	32	4	0x310...
java/lang/ref/Finalizer	25,984	32	4	0x338...

HeapAnalyzer | List of Objects sorted in various order

- Objects/Classes are sorted by name

Types by Name

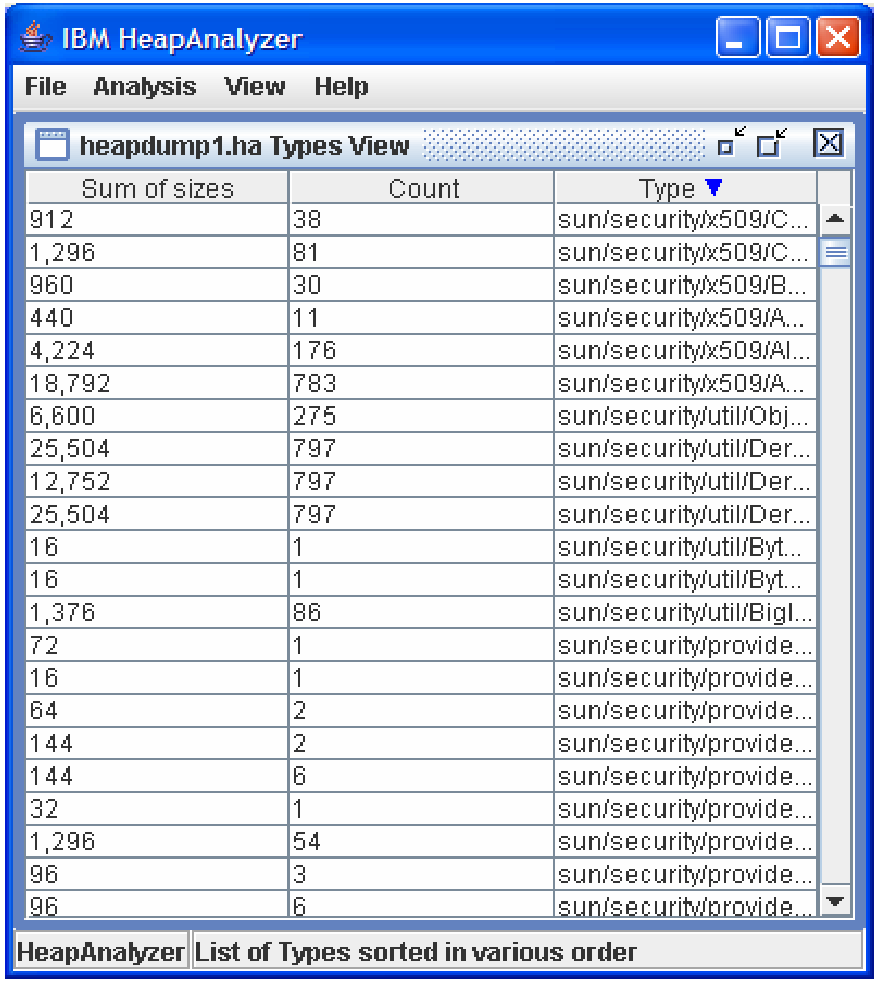


```
perOfChildObject(159,549) Name Address
2 com/ibm/rmi/iiop/CDROutputStream 0x3
28] 35 com/ibm/CORBA/iiop/ORB 0x36865
2 [48] 6 com/ibm/ejs/oa/EJSRootOAImpl 0
2,704 [24] 1 com/ibm/ejs/util/FastHashtabl
69,572,680 [68,064] 17,011 array of com/ibm
7,895,296 [24] 2 com/ibm/ejs/util/Bucket 0
7,890,368 [24] 2 com/ibm/ejs/util/Bucket 0
7,884,320 [24] 2 com/ibm/ejs/util/Bucket 0
7,878,272 [24] 2 com/ibm/ejs/util/Bucket 0
7,878,048 [24] 2 com/ibm/ejs/util/Bucket 0
7,870,880 [24] 2 com/ibm/ejs/util/Bucket 0
744,432 [24] 2 com/ibm/ejs/util/Bucket 0x
744,096 [24] 2 com/ibm/ejs/util/Bucket 0x
744,096 [24] 2 com/ibm/ejs/util/Bucket 0x
744,096 [24] 2 com/ibm/ejs/util/Bucket 0x
744,096 [24] 2 com/ibm/ejs/util/Bucket 0x
743,760 [24] 2 com/ibm/ejs/util/Bucket 0x
```

HeapAnalyzer | List of Types sorted in various order

- List Types -> Sort by Name

Types by Name

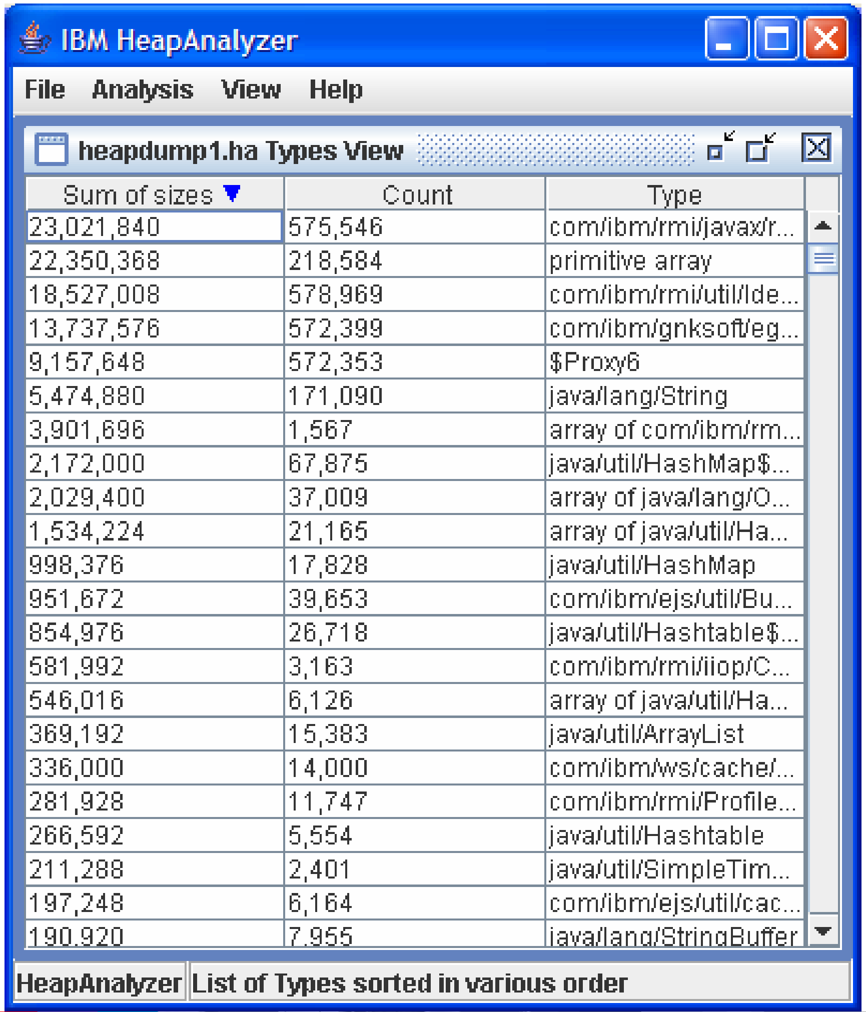


Sum of sizes	Count	Type ▼
912	38	sun/security/x509/C...
1,296	81	sun/security/x509/C...
960	30	sun/security/x509/B...
440	11	sun/security/x509/A...
4,224	176	sun/security/x509/Al...
18,792	783	sun/security/x509/A...
6,600	275	sun/security/util/Obj...
25,504	797	sun/security/util/Der...
12,752	797	sun/security/util/Der...
25,504	797	sun/security/util/Der...
16	1	sun/security/util/Byt...
16	1	sun/security/util/Byt...
1,376	86	sun/security/util/BigI...
72	1	sun/security/provide...
16	1	sun/security/provide...
64	2	sun/security/provide...
144	2	sun/security/provide...
144	6	sun/security/provide...
32	1	sun/security/provide...
1,296	54	sun/security/provide...
96	3	sun/security/provide...
96	6	sun/security/provide...

HeapAnalyzer List of Types sorted in various order

- Types are sorted by their names

Types by Size

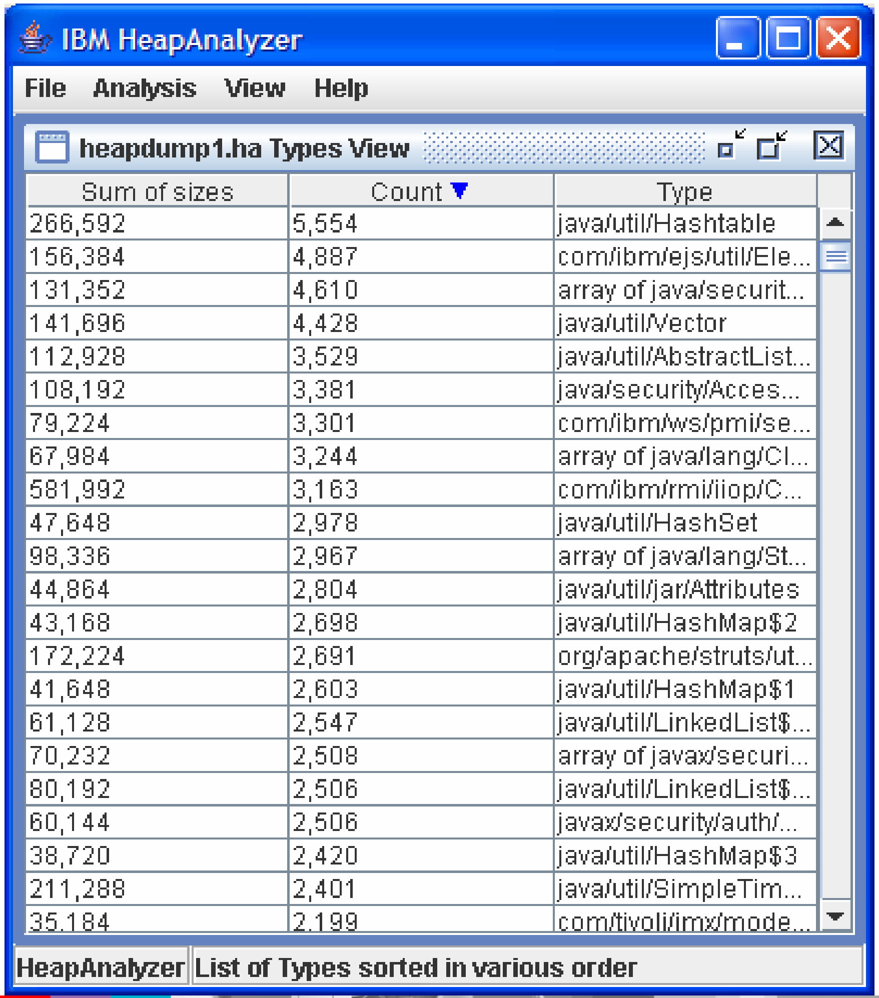


Sum of sizes ▼	Count	Type
23,021,840	575,546	com/ibm/rmi/javax/r...
22,350,368	218,584	primitive array
18,527,008	578,969	com/ibm/rmi/util/Ide...
13,737,576	572,399	com/ibm/gnksoft/eg...
9,157,648	572,353	$Proxy6
5,474,880	171,090	java/lang/String
3,901,696	1,567	array of com/ibm/rm...
2,172,000	67,875	java/util/HashMap$...
2,029,400	37,009	array of java/lang/O...
1,534,224	21,165	array of java/util/Ha...
998,376	17,828	java/util/HashMap
951,672	39,653	com/ibm/ejs/util/Bu...
854,976	26,718	java/util/Hashtable$...
581,992	3,163	com/ibm/rmi/iiop/C...
546,016	6,126	array of java/util/Ha...
369,192	15,383	java/util/ArrayList
336,000	14,000	com/ibm/ws/cache/...
281,928	11,747	com/ibm/rmi/Profile...
266,592	5,554	java/util/Hashtable
211,288	2,401	java/util/SimpleTim...
197,248	6,164	com/ibm/ejs/util/cac...
190,920	7,955	java/lang/StringBuffer

HeapAnalyzer | List of Types sorted in various order

- Types are sorted by sum of sizes

Types by frequency/count

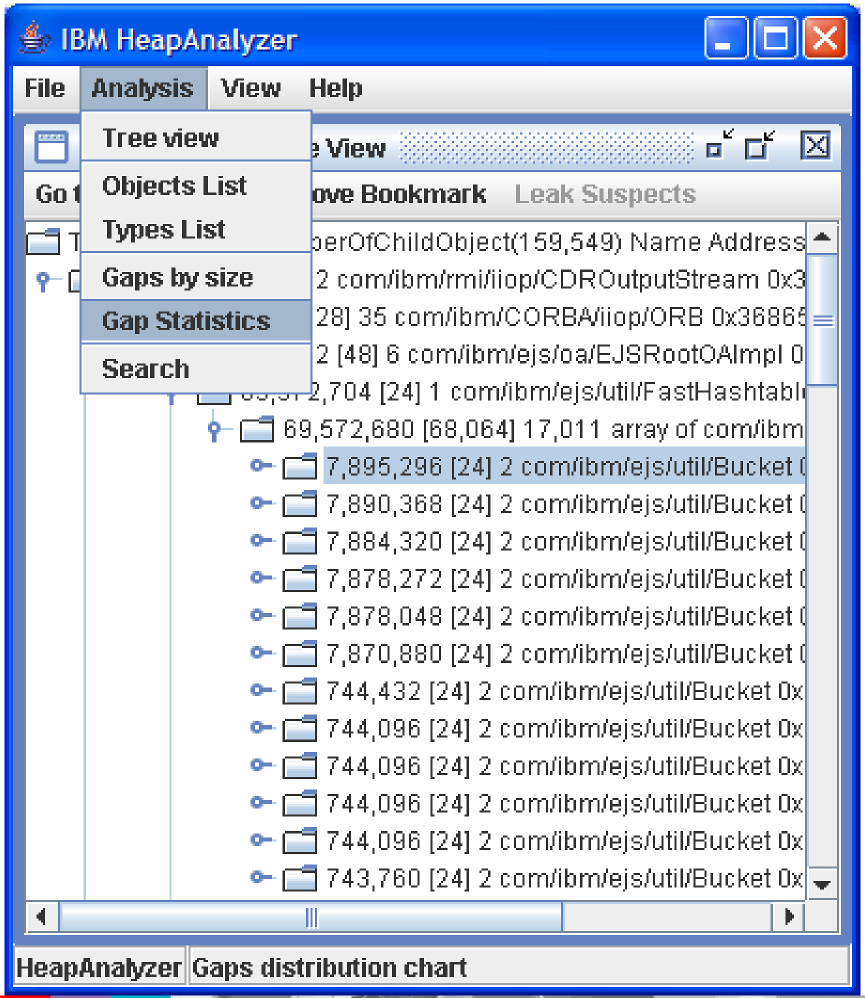


Sum of sizes	Count ▼	Type
266,592	5,554	java/util/Hashtable
156,384	4,887	com/ibm/ejs/util/Ele...
131,352	4,610	array of java/securit...
141,696	4,428	java/util/Vector
112,928	3,529	java/util/AbstractList...
108,192	3,381	java/security/Acces...
79,224	3,301	com/ibm/ws/pmi/se...
67,984	3,244	array of java/lang/Cl...
581,992	3,163	com/ibm/rmi/iiop/C...
47,648	2,978	java/util/HashSet
98,336	2,967	array of java/lang/St...
44,864	2,804	java/util/jar/Attributes
43,168	2,698	java/util/HashMap$2
172,224	2,691	org/apache/struts/ut...
41,648	2,603	java/util/HashMap$1
61,128	2,547	java/util/LinkedList$...
70,232	2,508	array of javax/securi...
80,192	2,506	java/util/LinkedList$...
60,144	2,506	javax/security/auth/...
38,720	2,420	java/util/HashMap$3
211,288	2,401	java/util/SimpleTim...
35,184	2,199	com/tivoli/jmx/mode...

HeapAnalyzer | List of Types sorted in various order

- Types are sorted by frequency

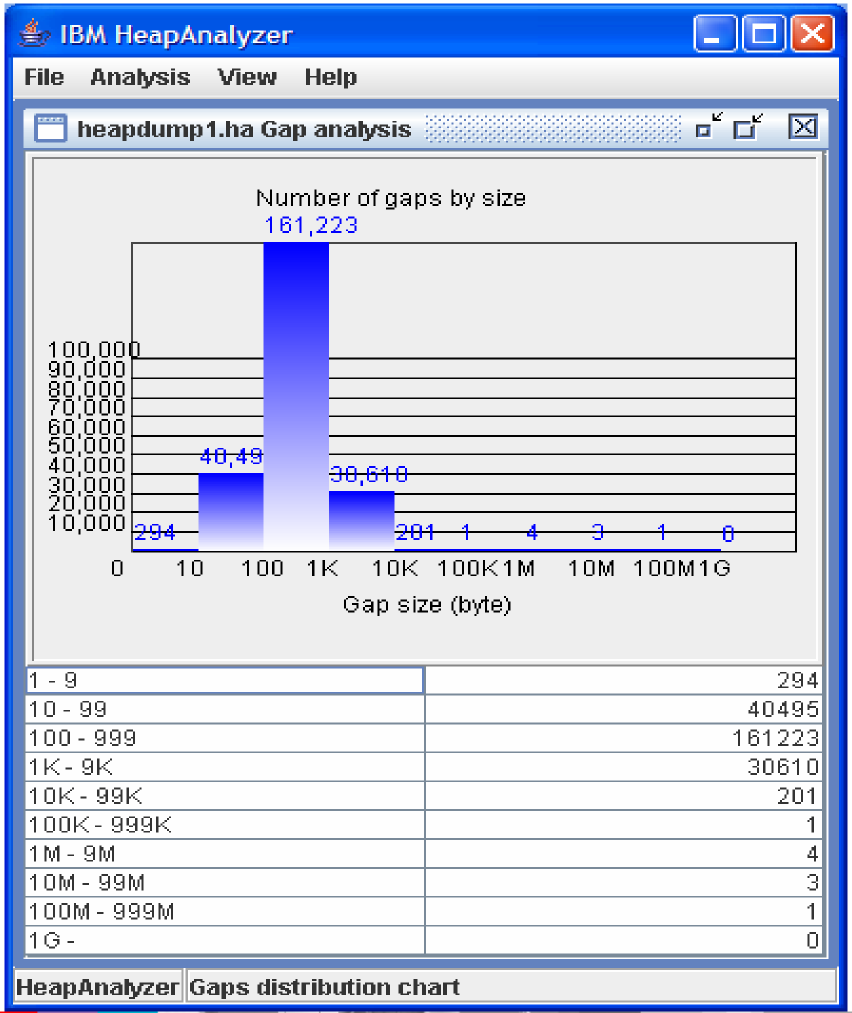
Gap Statistics



```
berOfChildObject(159,549) Name Address
2 com/ibm/rmi/iiop/CDROutputStream 0x3
28] 35 com/ibm/CORBA/iiop/ORB 0x36865
2 [48] 6 com/ibm/ejs/oa/EJSRootOAImpl 0
2,704 [24] 1 com/ibm/ejs/util/FastHashtabl
69,572,680 [68,064] 17,011 array of com/ibm
7,895,296 [24] 2 com/ibm/ejs/util/Bucket 0
7,890,368 [24] 2 com/ibm/ejs/util/Bucket 0
7,884,320 [24] 2 com/ibm/ejs/util/Bucket 0
7,878,272 [24] 2 com/ibm/ejs/util/Bucket 0
7,878,048 [24] 2 com/ibm/ejs/util/Bucket 0
7,870,880 [24] 2 com/ibm/ejs/util/Bucket 0
744,432 [24] 2 com/ibm/ejs/util/Bucket 0x
744,096 [24] 2 com/ibm/ejs/util/Bucket 0x
744,096 [24] 2 com/ibm/ejs/util/Bucket 0x
744,096 [24] 2 com/ibm/ejs/util/Bucket 0x
744,096 [24] 2 com/ibm/ejs/util/Bucket 0x
743,760 [24] 2 com/ibm/ejs/util/Bucket 0x
```

- Analysis -> Gap Statistics

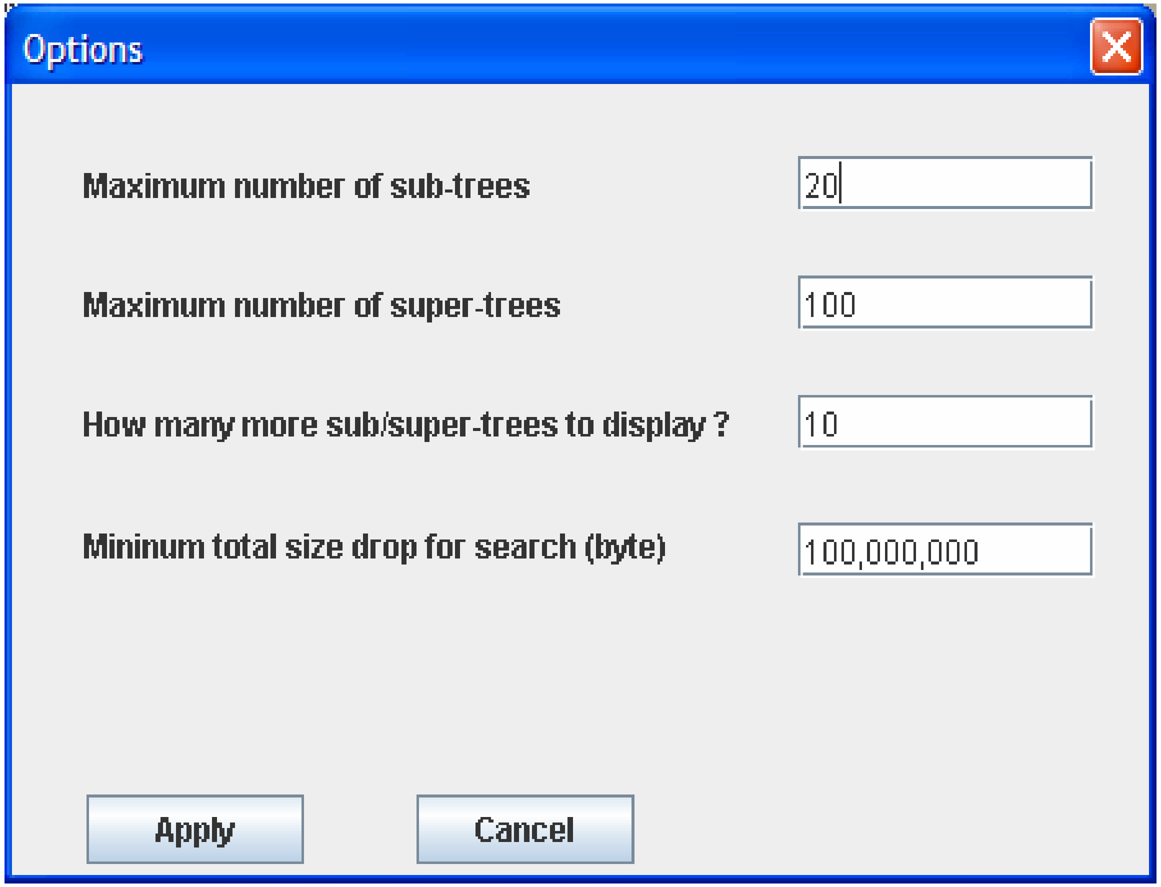
Gap space view



1 - 9	294
10 - 99	40495
100 - 999	161223
1K - 9K	30610
10K - 99K	201
100K - 999K	1
1M - 9M	4
10M - 99M	3
100M - 999M	1
1G -	0

- Gap space distribution view

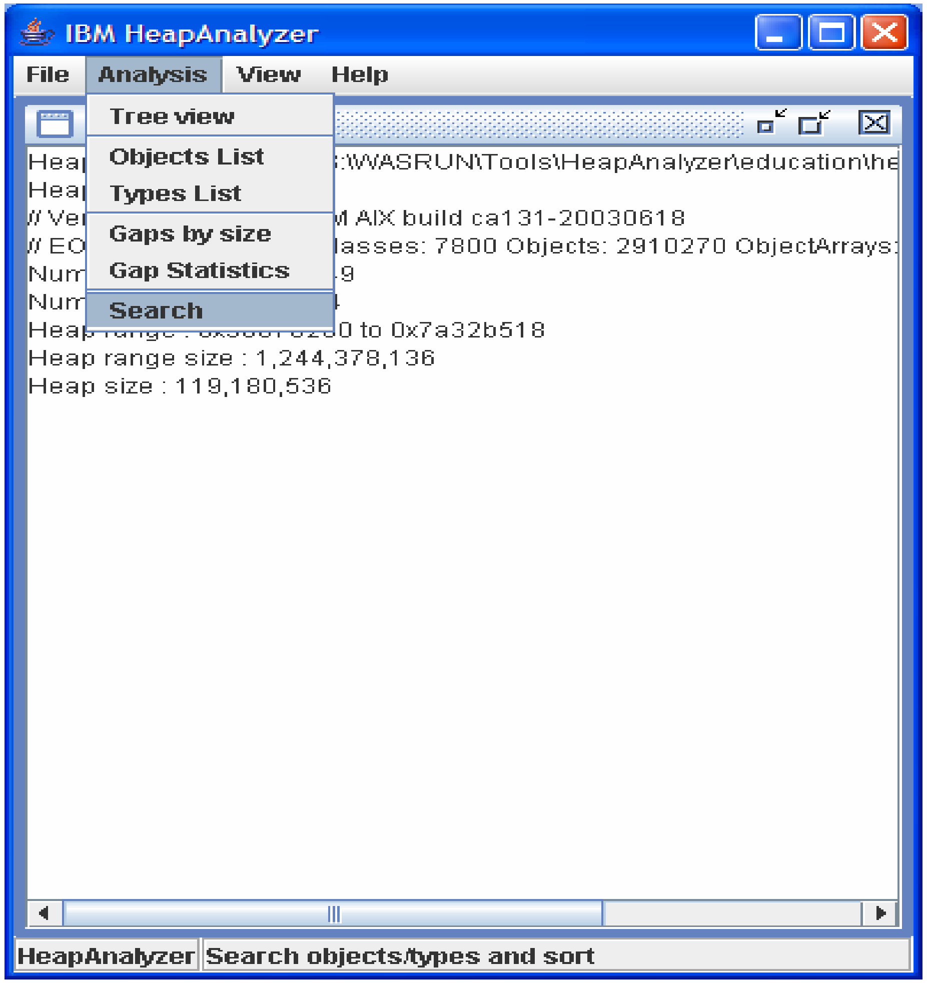
Options menu


Options

Maximum number of sub-trees	20
Maximum number of super-trees	100
How many more sub/super-trees to display ?	10
Mininum total size drop for search (byte)	100,000,000

- You can configure setting in View -> Options menu

Search Objects

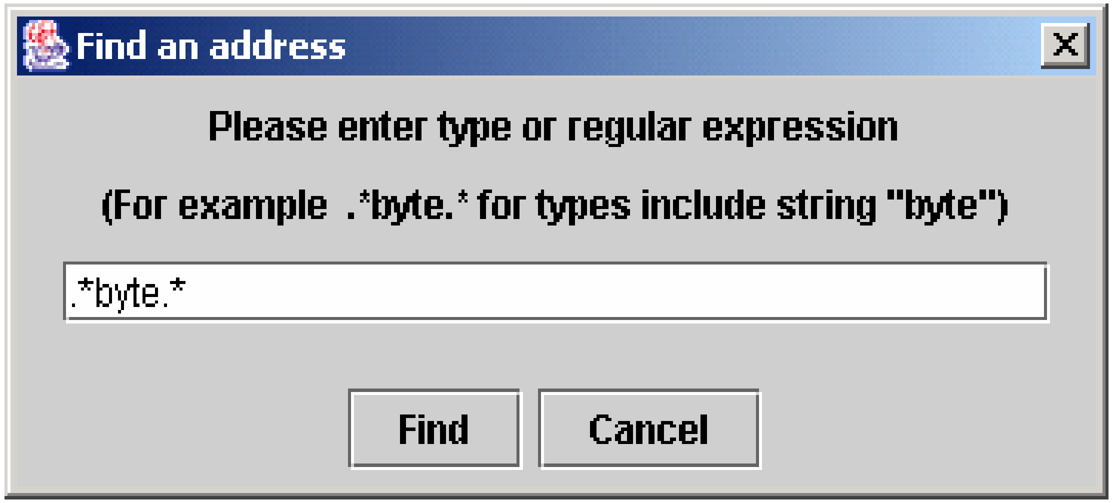


```
Hea| :\WASRUN\Tools\HeapAnalyzer\education\he
Hea|
// Ve| M AIX build ca131-20030618
// EC| lasses: 7800 Objects: 2910270 ObjectArrays:
Num| .9
Num| 4
Heap range : 0x...0 to 0x7a32b518
Heap range size : 1,244,378,136
Heap size : 119,180,536
```

HeapAnalyzer | Search objects/types and sort

- Search object -> Sort by TotalSize

Find types and objects


Find an address

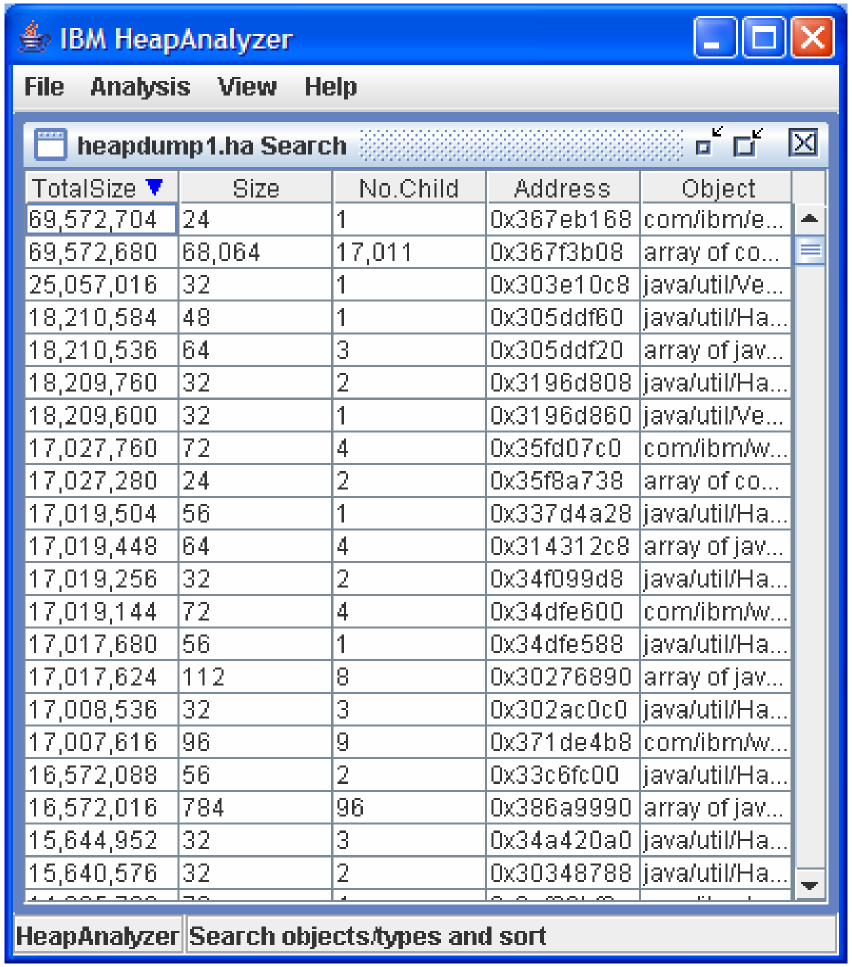
Please enter type or regular expression

(For example .*byte.* for types include string "byte")

.*byte.*

- Address by type to find types include string “byte”

Search objects/types

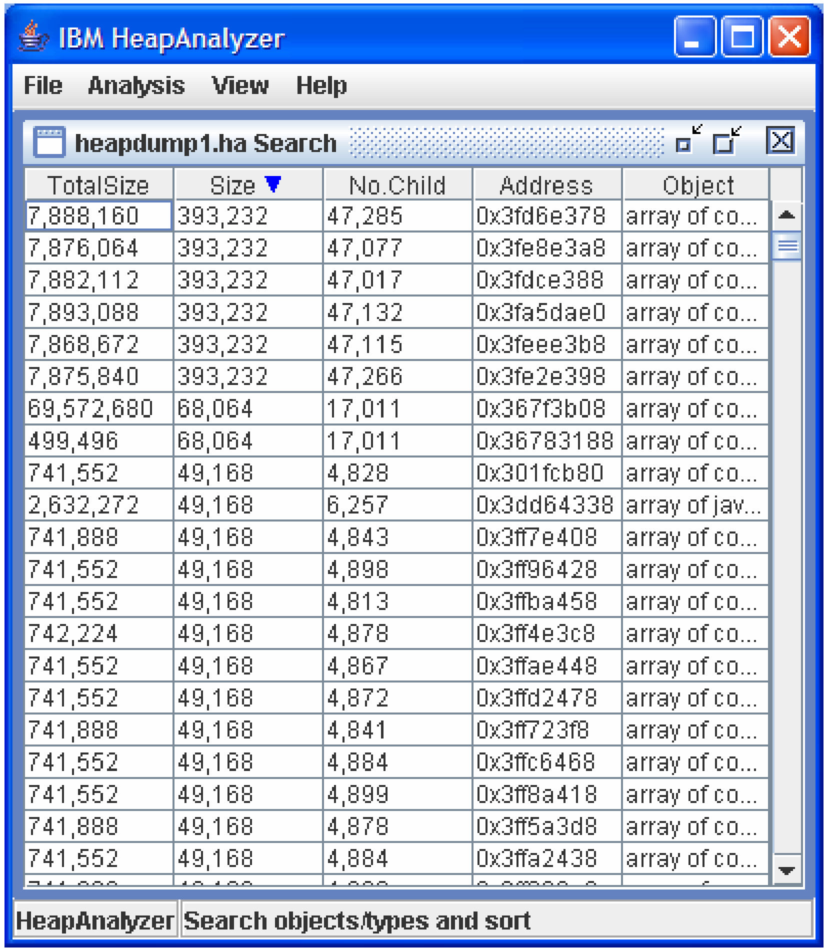


TotalSize	Size	No.Child	Address	Object
69,572,704	24	1	0x367eb168	com/ibm/e...
69,572,680	68,064	17,011	0x367f3b08	array of co...
25,057,016	32	1	0x303e10c8	java/util/Ve...
18,210,584	48	1	0x305ddf60	java/util/Ha...
18,210,536	64	3	0x305ddf20	array of jav...
18,209,760	32	2	0x3196d808	java/util/Ha...
18,209,600	32	1	0x3196d860	java/util/Ve...
17,027,760	72	4	0x35fd07c0	com/ibm/w...
17,027,280	24	2	0x35f8a738	array of co...
17,019,504	56	1	0x337d4a28	java/util/Ha...
17,019,448	64	4	0x314312c8	array of jav...
17,019,256	32	2	0x34f099d8	java/util/Ha...
17,019,144	72	4	0x34dfe600	com/ibm/w...
17,017,680	56	1	0x34dfe588	java/util/Ha...
17,017,624	112	8	0x30276890	array of jav...
17,008,536	32	3	0x302ac0c0	java/util/Ha...
17,007,616	96	9	0x371de4b8	com/ibm/w...
16,572,088	56	2	0x33c6fc00	java/util/Ha...
16,572,016	784	96	0x386a9990	array of jav...
15,644,952	32	3	0x34a420a0	java/util/Ha...
15,640,576	32	2	0x30348788	java/util/Ha...

HeapAnalyzer | Search objects/types and sort

- The following is the list of types which have “byte” in their names.

Search Objects, Sort by Size

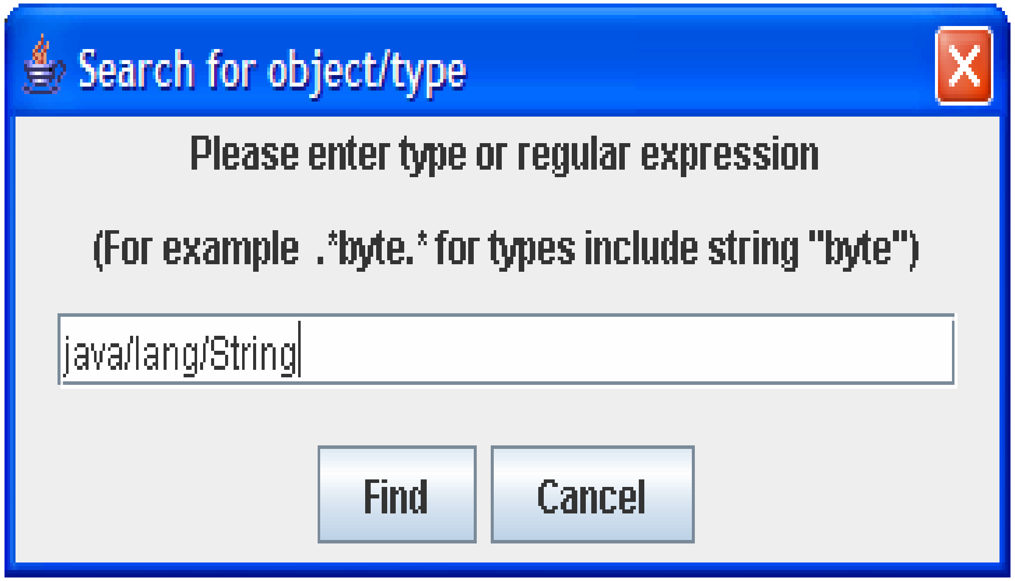


TotalSize	Size ▼	No.Child	Address	Object
7,888,160	393,232	47,285	0x3fd6e378	array of co...
7,876,064	393,232	47,077	0x3fe8e3a8	array of co...
7,882,112	393,232	47,017	0x3fdce388	array of co...
7,893,088	393,232	47,132	0x3fa5dae0	array of co...
7,868,672	393,232	47,115	0x3feee3b8	array of co...
7,875,840	393,232	47,266	0x3fe2e398	array of co...
69,572,680	68,064	17,011	0x367f3b08	array of co...
499,496	68,064	17,011	0x36783188	array of co...
741,552	49,168	4,828	0x301fcb80	array of co...
2,632,272	49,168	6,257	0x3dd64338	array of jav...
741,888	49,168	4,843	0x3ff7e408	array of co...
741,552	49,168	4,898	0x3ff96428	array of co...
741,552	49,168	4,813	0x3ffba458	array of co...
742,224	49,168	4,878	0x3ff4e3c8	array of co...
741,552	49,168	4,867	0x3ffae448	array of co...
741,552	49,168	4,872	0x3ffd2478	array of co...
741,888	49,168	4,841	0x3ff723f8	array of co...
741,552	49,168	4,884	0x3ffc6468	array of co...
741,552	49,168	4,899	0x3ff8a418	array of co...
741,888	49,168	4,878	0x3ff5a3d8	array of co...
741,552	49,168	4,884	0x3ffa2438	array of co...

HeapAnalyzer | Search objects/types and sort

- Objects are sorted by Size

Find a type



Search for object/type

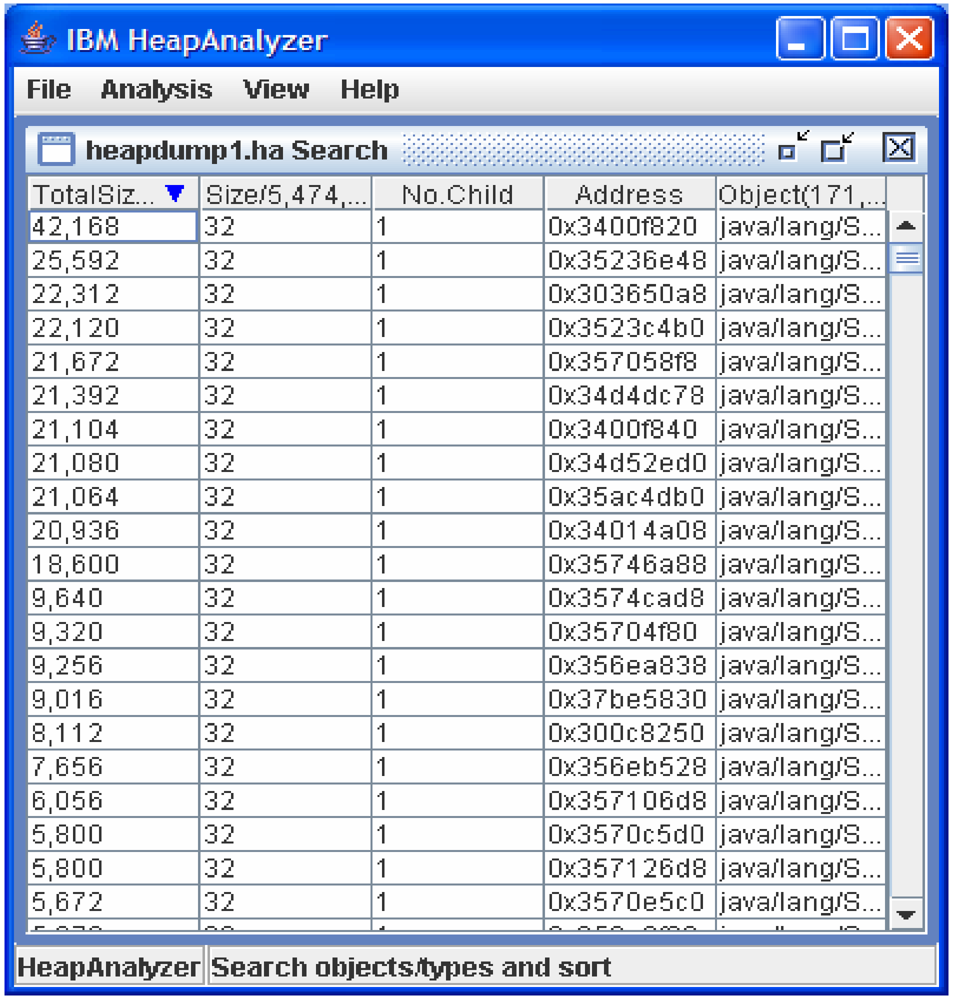
Please enter type or regular expression

(For example .*byte.* for types include string "byte")

java/lang/String

- You can also enter exact name of a type: java/lang/String to get more information about a type

Find a type

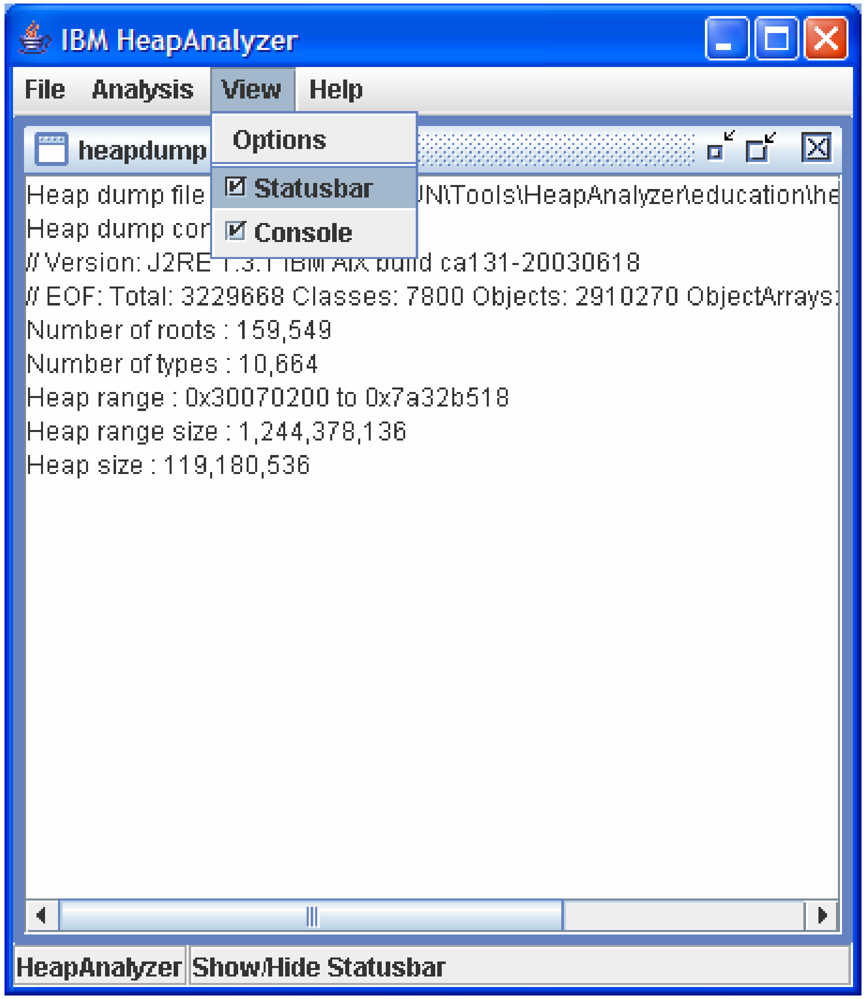


TotalSiz...	Size/5,474,...	No.Child	Address	Object(171,...
42,168	32	1	0x3400f820	java/lang/S...
25,592	32	1	0x35236e48	java/lang/S...
22,312	32	1	0x303650a8	java/lang/S...
22,120	32	1	0x3523c4b0	java/lang/S...
21,672	32	1	0x357058f8	java/lang/S...
21,392	32	1	0x34d4dc78	java/lang/S...
21,104	32	1	0x3400f840	java/lang/S...
21,080	32	1	0x34d52ed0	java/lang/S...
21,064	32	1	0x35ac4db0	java/lang/S...
20,936	32	1	0x34014a08	java/lang/S...
18,600	32	1	0x35746a88	java/lang/S...
9,640	32	1	0x3574cad8	java/lang/S...
9,320	32	1	0x35704f80	java/lang/S...
9,256	32	1	0x356ea838	java/lang/S...
9,016	32	1	0x37be5830	java/lang/S...
8,112	32	1	0x300c8250	java/lang/S...
7,656	32	1	0x356eb528	java/lang/S...
6,056	32	1	0x357106d8	java/lang/S...
5,800	32	1	0x3570c5d0	java/lang/S...
5,800	32	1	0x357126d8	java/lang/S...
5,672	32	1	0x3570e5c0	java/lang/S...

HeapAnalyzer | Search objects/types and sort

This is the list of types of java/lang/String

Status bar

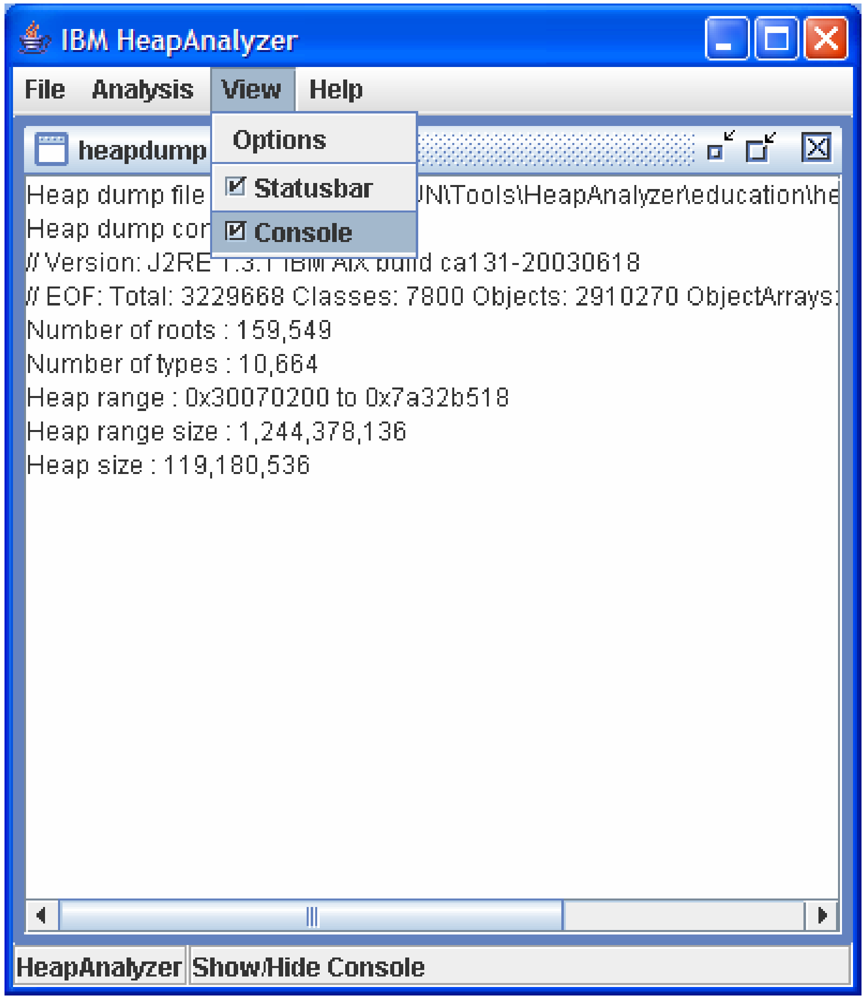


Heap dump file ... N\Tools\HeapAnalyzer\education\he
Heap dump cor
// Version: J2RE 1.3.1 IBM AIX build ca131-20030618
// EOF: Total: 3229668 Classes: 7800 Objects: 2910270 ObjectArrays:
Number of roots : 159,549
Number of types : 10,664
Heap range : 0x30070200 to 0x7a32b518
Heap range size : 1,244,378,136
Heap size : 119,180,536

HeapAnalyzer | Show/Hide Statusbar

- You can hide/show Status bar
- Status bar is used to display description of each menu

Console



```
Heap dump file                N\Tools\HeapAnalyzer\education\he
Heap dump cor
// Version: J2RE 1.3.1 IBM AIX build ca131-20030618
// EOF: Total: 3229668 Classes: 7800 Objects: 2910270 ObjectArrays:
Number of roots : 159,549
Number of types : 10,664
Heap range : 0x30070200 to 0x7a32b518
Heap range size : 1,244,378,136
Heap size : 119,180,536
```

- You can hide/show Console

Common Exceptions/Errors

- Exception in thread "main" java.lang.NoClassDefFoundError: java/util/regex/PatternSyntaxException

  HeapAnalyzer requires Java 2 SDK 1.4.1 or higher.
  The exception is thrown if older versions SDK is used:

- java.lang.StringIndexOutOfBoundsException: String index out of range: 0

  ```
          at java.lang.String.charAt(Unknown Source)
          at com.ibm.jinwoo.heap.FileTask$ActualTask.<init>(FileTask.java:386)
          at com.ibm.jinwoo.heap.FileTask$1.construct(FileTask.java:794)
          at com.ibm.jinwoo.heap.SwingWorker$2.run(SwingWorker.java:45)
          at java.lang.Thread.run(Unknown Source)
  ```

  You can see this exception while processing corrupted heapdumps or truncated ones. Truncated or corrupted heapdumps are not reliable

Common Exceptions/Errors

- Exception while parsing line 9 : 0x0x50003070 [1000] java/lang/String

```
java.lang.RuntimeException
        at com.ibm.jinwoo.heap.FileTask$ActualTask.<init>(FileTask.java:321)
        at com.ibm.jinwoo.heap.FileTask$1.construct(FileTask.java:794)
        at com.ibm.jinwoo.heap.SwingWorker$2.run(SwingWorker.java:45)
        at java.lang.Thread.run(Unknown Source)
```

  Some old Linux IBM SDKs generate invalid address in heapdumps. After replacing 0x0x with 0x, HeapAnalyzer can process heapdumps.

- java.io.IOException: Not in GZIP format

```
        at java.util.zip.GZIPInputStream.readHeader(Unknown Source)
        at java.util.zip.GZIPInputStream.<init>(Unknown Source)
        at java.util.zip.GZIPInputStream.<init>(Unknown Source)
        at com.ibm.jinwoo.heap.OpenTask$ActualTask.<init>(OpenTask.java:32)
        at com.ibm.jinwoo.heap.OpenTask$1.construct(OpenTask.java:111)
        at com.ibm.jinwoo.heap.SwingWorker$2.run(SwingWorker.java:45)
        at java.lang.Thread.run(Unknown Source)
```

  You can see this exception when you try to load invalid .ha file.

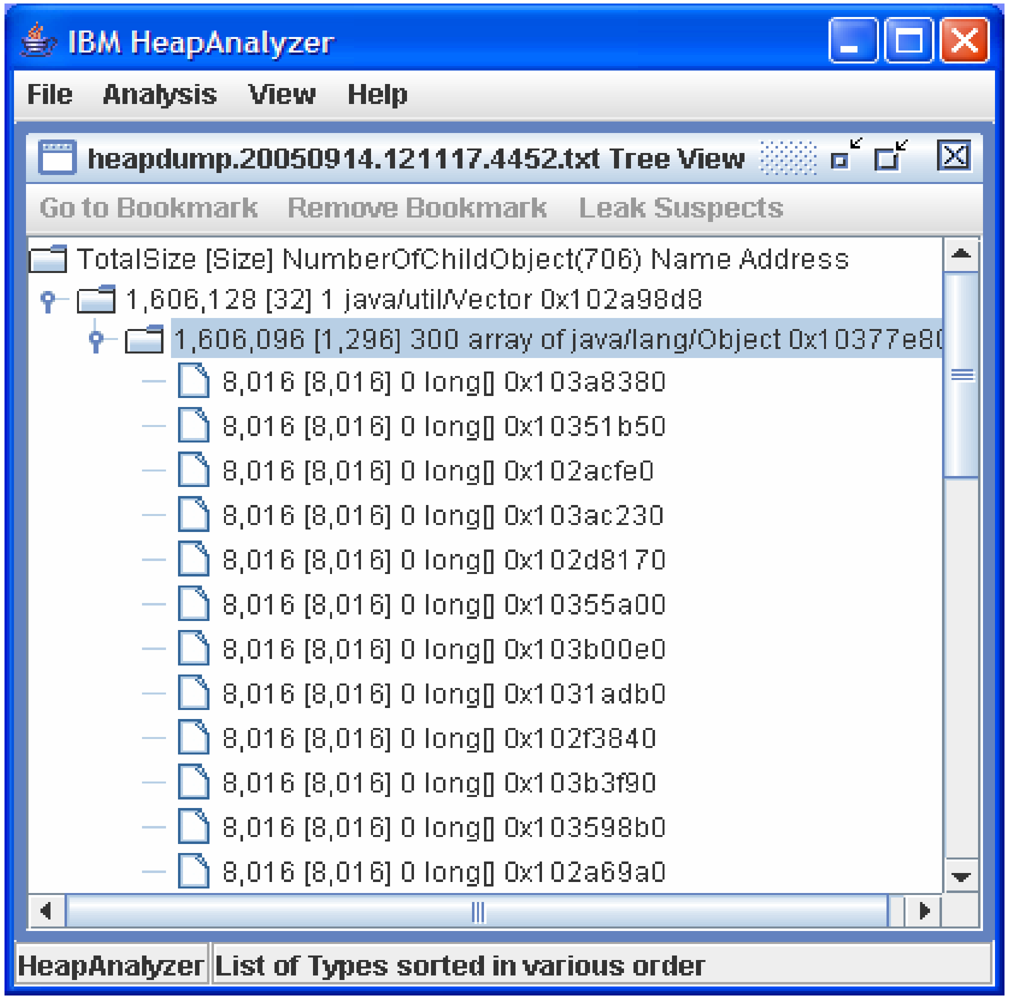
Common Exceptions/Errors

- Format error while parsing line 10 :   0x50004050 0x50004050

  Unexpected format in heapdump. Possibly it's corrupted heapdump. Further analysis is unreliable.

Java heap analysis: Example1

```
Vector v1 = new Vector();
  for(int i=0;i<100;i++)
  {
    int[] s1 = new int[1000];
    long[] s2 = new long[1000];
    float[] s3 = new float[1000];
    v1.add(s1);
    v1.add(s2);
    v1.add(s3);
  }
```

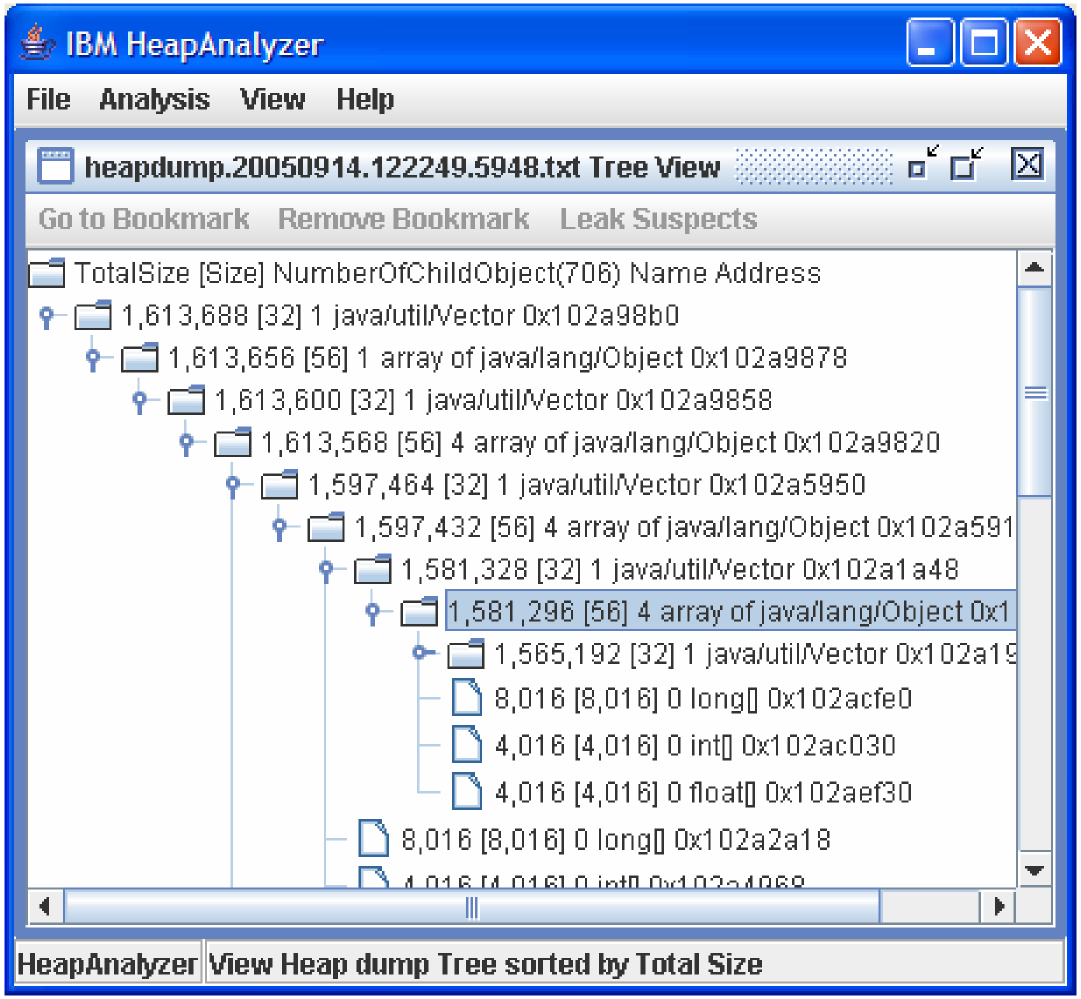


```
TotalSize [Size] NumberOfChildObject(706) Name Address
  1,606,128 [32] 1 java/util/Vector 0x102a98d8
    1,606,096 [1,296] 300 array of java/lang/Object 0x10377e80
      8,016 [8,016] 0 long[] 0x103a8380
      8,016 [8,016] 0 long[] 0x10351b50
      8,016 [8,016] 0 long[] 0x102acfe0
      8,016 [8,016] 0 long[] 0x103ac230
      8,016 [8,016] 0 long[] 0x102d8170
      8,016 [8,016] 0 long[] 0x10355a00
      8,016 [8,016] 0 long[] 0x103b00e0
      8,016 [8,016] 0 long[] 0x1031adb0
      8,016 [8,016] 0 long[] 0x102f3840
      8,016 [8,016] 0 long[] 0x103b3f90
      8,016 [8,016] 0 long[] 0x103598b0
      8,016 [8,016] 0 long[] 0x102a69a0
```

HeapAnalyzer | List of Types sorted in various order

Java heap analysis: Example2

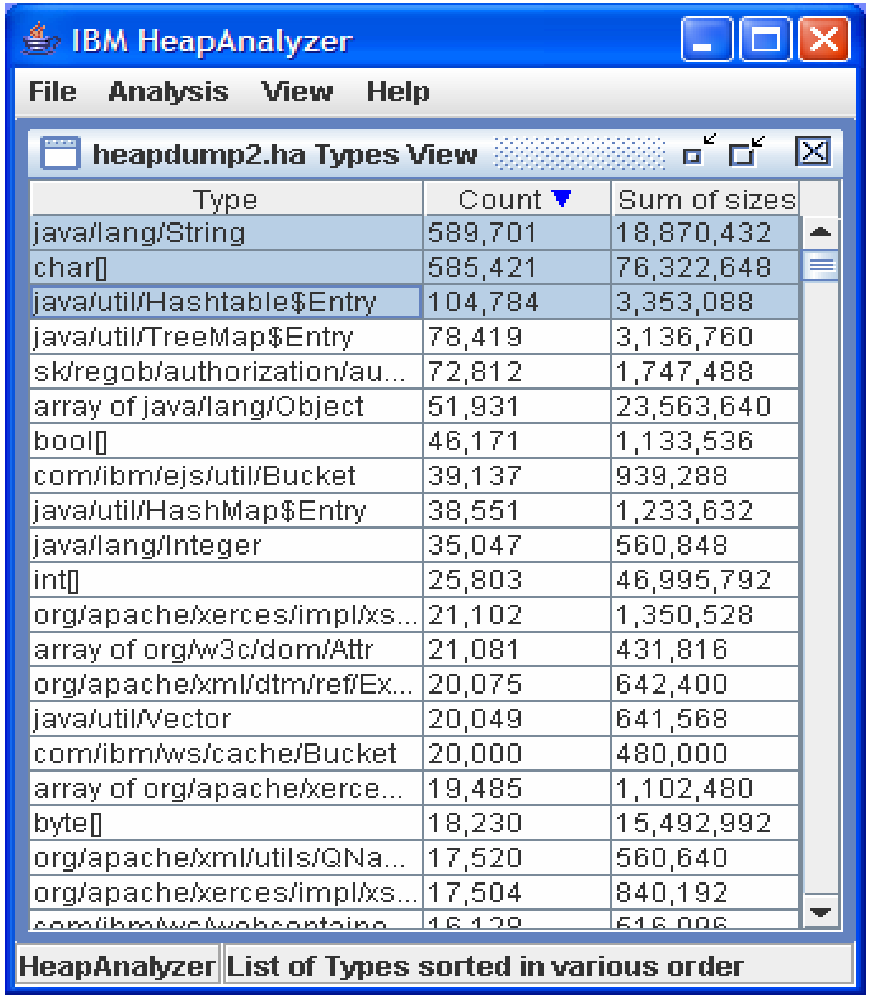
```
Vector v0 = new Vector();
  Vector v2 = v0;
  for(int i=0;i<100;i++)
  {
    Vector v1 = new Vector();
    int[] s1 = new int[1000];
    long[] s2 = new long[1000];
    float[] s3 = new float[1000];
    v1.add(s1);
    v1.add(s2);
    v1.add(s3);
    v2.add(v1);
    v2=v1;
  }
```


IBM HeapAnalyzer
File Analysis View Help
heapdump.20050914.122249.5948.txt Tree View
Go to Bookmark Remove Bookmark Leak Suspects

```
TotalSize [Size] NumberOfChildObject(706) Name Address
1,613,688 [32] 1 java/util/Vector 0x102a98b0
  1,613,656 [56] 1 array of java/lang/Object 0x102a9878
    1,613,600 [32] 1 java/util/Vector 0x102a9858
      1,613,568 [56] 4 array of java/lang/Object 0x102a9820
        1,597,464 [32] 1 java/util/Vector 0x102a5950
          1,597,432 [56] 4 array of java/lang/Object 0x102a591
            1,581,328 [32] 1 java/util/Vector 0x102a1a48
              1,581,296 [56] 4 array of java/lang/Object 0x1
                1,565,192 [32] 1 java/util/Vector 0x102a19
                8,016 [8,016] 0 long[] 0x102acfe0
                4,016 [4,016] 0 int[] 0x102ac030
                4,016 [4,016] 0 float[] 0x102aef30
              8,016 [8,016] 0 long[] 0x102a2a18
```

HeapAnalyzer | View Heap dump Tree sorted by Total Size

How to analyze Java heap



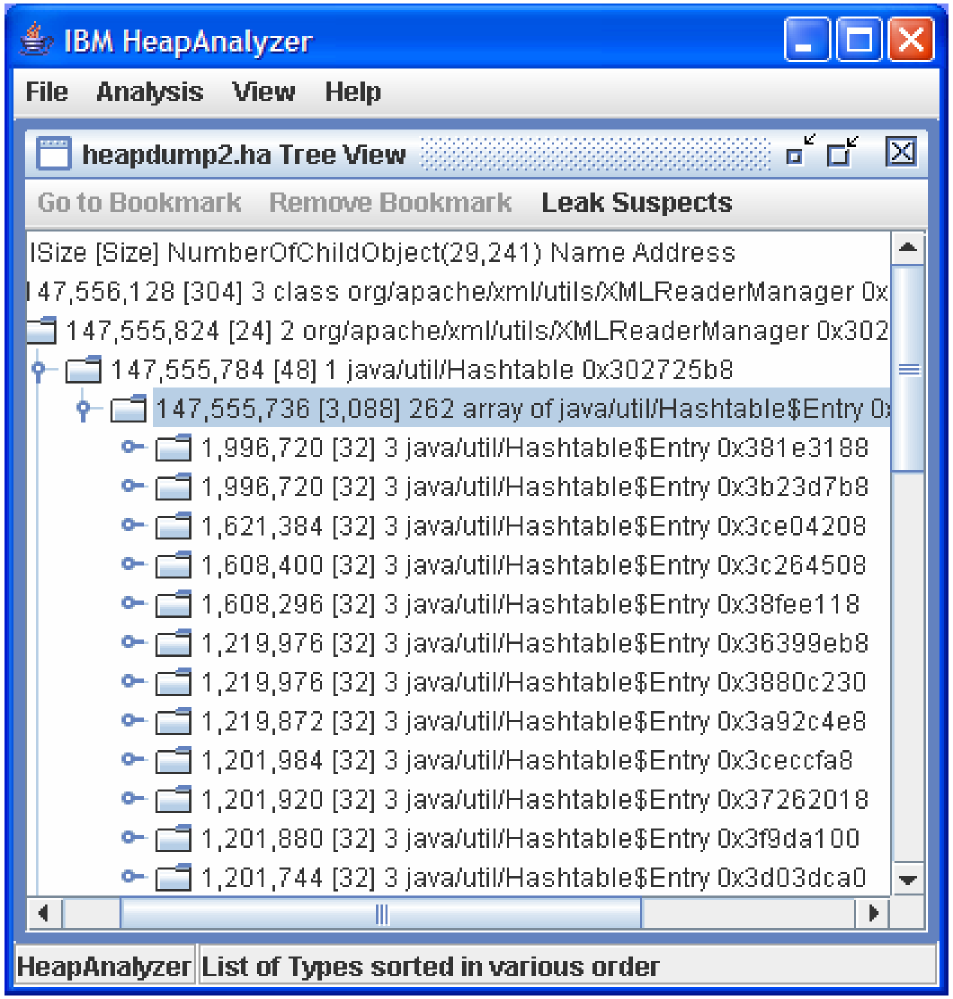
Type	Count	Sum of sizes
java/lang/String	589,701	18,870,432
char[]	585,421	76,322,648
java/util/Hashtable$Entry	104,784	3,353,088
java/util/TreeMap$Entry	78,419	3,136,760
sk/regob/authorization/au...	72,812	1,747,488
array of java/lang/Object	51,931	23,563,640
bool[]	46,171	1,133,536
com/ibm/ejs/util/Bucket	39,137	939,288
java/util/HashMap$Entry	38,551	1,233,632
java/lang/Integer	35,047	560,848
int[]	25,803	46,995,792
org/apache/xerces/impl/xs...	21,102	1,350,528
array of org/w3c/dom/Attr	21,081	431,816
org/apache/xml/dtm/ref/Ex...	20,075	642,400
java/util/Vector	20,049	641,568
com/ibm/ws/cache/Bucket	20,000	480,000
array of org/apache/xerce...	19,485	1,102,480
byte[]	18,230	15,492,992
org/apache/xml/utils/QNa...	17,520	560,640
org/apache/xerces/impl/xs...	17,504	840,192
com/ibm/ws/webcontaine	16,128	516,096

HeapAnalyzer | List of Types sorted in various order

- Review number of objects by selecting List Types -> Sort by Count
- If you see excessive number of objects, pay attention to them.

  For example, DB2PreparedStatements MQQueueManager

How to analyze Java heap



```
ISize [Size] NumberOfChildObject(29,241) Name Address
147,556,128 [304] 3 class org/apache/xml/utils/XMLReaderManager 0x
147,555,824 [24] 2 org/apache/xml/utils/XMLReaderManager 0x302
147,555,784 [48] 1 java/util/Hashtable 0x302725b8
147,555,736 [3,088] 262 array of java/util/Hashtable$Entry 0x
1,996,720 [32] 3 java/util/Hashtable$Entry 0x381e3188
1,996,720 [32] 3 java/util/Hashtable$Entry 0x3b23d7b8
1,621,384 [32] 3 java/util/Hashtable$Entry 0x3ce04208
1,608,400 [32] 3 java/util/Hashtable$Entry 0x3c264508
1,608,296 [32] 3 java/util/Hashtable$Entry 0x38fee118
1,219,976 [32] 3 java/util/Hashtable$Entry 0x36399eb8
1,219,976 [32] 3 java/util/Hashtable$Entry 0x3880c230
1,219,872 [32] 3 java/util/Hashtable$Entry 0x3a92c4e8
1,201,984 [32] 3 java/util/Hashtable$Entry 0x3ceccfa8
1,201,920 [32] 3 java/util/Hashtable$Entry 0x37262018
1,201,880 [32] 3 java/util/Hashtable$Entry 0x3f9da100
1,201,744 [32] 3 java/util/Hashtable$Entry 0x3d03dca0
```

HeapAnalyzer List of Types sorted in various order

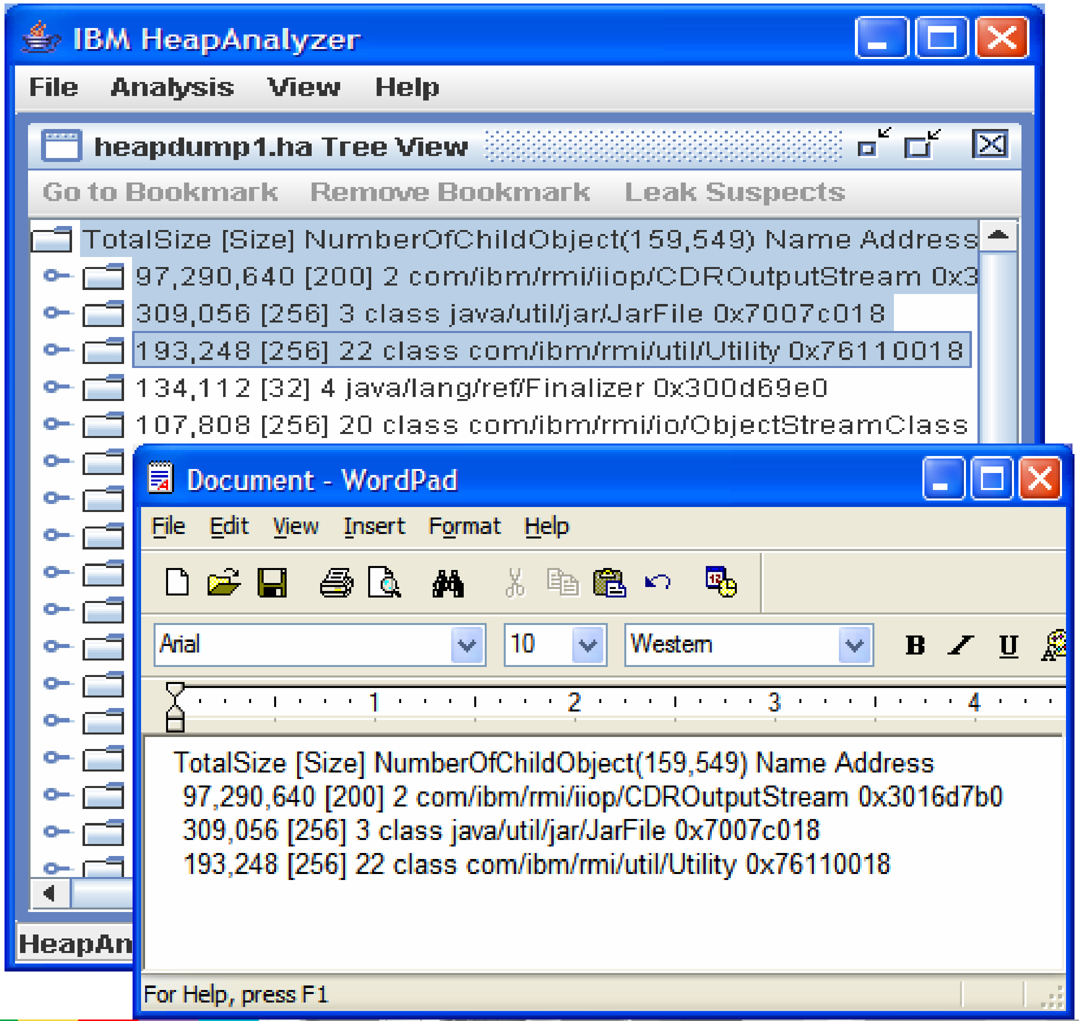
- Review Tree view
- Look for areas where excessive number of child with large difference in total size between parent and child

How to analyze Java heap

- You cannot diagnose all problems by analyzing Java heap dumps. Java Heap dumps are just snapshots of Java heap at specific times. Garbage collector trace is another source of information to figure out what's going on with Java heap and garbage collector.

- To diagnose Java heap usages, enable garbage collector trace and analyze the trace with
IBM Pattern Modeling and Analysis Tool for Java Garbage Collector
available at http://www.alphaworks.ibm.com/tech/pmat

How to copy/paste content



```
TotalSize [Size] NumberOfChildObject(159,549) Name Address
 97,290,640 [200] 2 com/ibm/rmi/iiop/CDROutputStream 0x3
 309,056 [256] 3 class java/util/jar/JarFile 0x7007c018
 193,248 [256] 22 class com/ibm/rmi/util/Utility 0x76110018
 134,112 [32] 4 java/lang/ref/Finalizer 0x300d69e0
 107,808 [256] 20 class com/ibm/rmi/io/ObjectStreamClass
```

```
TotalSize [Size] NumberOfChildObject(159,549) Name Address
 97,290,640 [200] 2 com/ibm/rmi/iiop/CDROutputStream 0x3016d7b0
 309,056 [256] 3 class java/util/jar/JarFile 0x7007c018
 193,248 [256] 22 class com/ibm/rmi/util/Utility 0x76110018
```

- KeyBoard
  Copy: Control-C
  Paste: Control-V
- Mouse
  Select, drag and drop to word processors or editors that support drag and drop

Memory Dump Diagnostic For Java

- Next generation memory leak analysis tool with best-of-breed features from HeapAnalyzer, HeapRoots and Leakbot
- Technical Preview with WebSphere Version 6.0.2. Download from WebSphere DeveloperWorks: WebSphere Technology Previews

  http://www-128.ibm.com/developerworks/websphere/downloads/memory_dump.html

  Download and start using today!!

- Fully supported version to be available with IBM Support Assistant

Main Functions in Memory Dump Diagnostic for Java

- Detects Memory Leaks
  - Single Dump Analysis
  - Comparative analysis of two memory dumps
- Visualizes Memory Dump contents
- Analyzes Java Memory dumps
  - IBM heap dumps (text & binary)
  - HPROF dumps
  - SVC dumps (z-series)
- Detects growing data structures as opposed to low level objects
- Shows footprint of application heap usage

Additional WebSphere Product Resources

- Discover the latest trends in WebSphere Technology and implementation, participate in technically-focused briefings, webcasts and podcasts at: www.ibm.com/developerworks/websphere/community/
- Learn about other upcoming webcasts, conferences and events: www.ibm.com/software/websphere/events_1.html
- Join the Global WebSphere User Group Community: www.websphere.org
- Access key product show-me demos and tutorials by visiting IBM Education Assistant: ibm.com/software/info/education/assistant
- Learn about the Electronic Service Request (ESR) tool for submitting problems electronically: www.ibm.com/software/support/viewlet/probsub/ESR_Overview_viewlet_swf.html
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Questions and Answers