

1. 使用 GCLogAnalysis.java 自己演练一遍串行 / 并行 / CMS/G1 的案例。

2. 使用压测工具 (wrk 或 sb) , 演练 gateway-server-0.0.1-SNAPSHOT.jar 示例。

3. (选做) 如果自己本地有可以运行的项目, 可以按照 2 的方式进行演练。

4. (必做) 根据上述自己对于 1 和 2 的演示, 写一段对于不同 GC 的总结, 提交到 Github。

## Week02 作业题目 (周六) :

1. (选做) 运行课上的例子, 以及 Netty 的例子, 分析相关现象。

2. (必做) 写一段代码, 使用 HttpClient 或 OkHttp 访问 <http://localhost:8801>, 代码提交到 Github。

以上作业, 要求 2 道必做题目提交到 Github 上面, Week02 作业提交地址:

<https://github.com/JAVA-000/JAVA-000/issues/113>

请务必按照示例格式进行提交, 不要复制其他同学的格式, 以免格式错误无法抓取作业。

作业提交截止时间 10 月 28 日 (下周三) 23:59 前。

Github 使用教程: <https://u.geekbang.org/lesson/51?article=294701>

学号查询方式: PC 端登录 time.geekbang.org, 点击右上角头像进入我的教室, 左侧头像下方 G 开头的为学号

## Serial

(图1 java -XX:+UseSerialGC -XX:+PrintGCDetails -XX:+PrintGCTimeStamps -Xmx256m -Xms256m GCLogAnalysis )

```
zhufang@zhuFangs-MacBook-Pro 1 ~ % java -XX:+UseSerialGC -XX:+PrintGCDetails -XX:+PrintGCTimeStamps -Xmx256m -Xms256m GCLogAnalysis
正在执行...
0.108: [Full GC (Allocation Failure) 0.108: [Tenured: 69952K->3780K(78656K), 0.013274K secs] 69952K->2600K(253440K), 0.013571K secs] [Times: user=0.01 sys=0.00, real=0.02 secs]
0.132: [Full GC (Allocation Failure) 0.135: [Tenured: 73387K->3780K(78656K), 0.010927K secs] 94287K->4818K(253440K), 0.010959K secs] [Times: user=0.01 sys=0.01, real=0.02 secs]
0.165: [Full GC (Allocation Failure) 0.165: [Tenured: 78429K->3780K(78656K), 0.0160248K secs] 117912K->7360K(253440K), 0.016059K secs] [Times: user=0.01 sys=0.01, real=0.02 secs]
0.194: [Full GC (Allocation Failure) 0.194: [Tenured: 78643K->3780K(78656K), 0.0148438K secs] 143561K->5480K(253440K), 0.0148817K secs] [Times: user=0.01 sys=0.00, real=0.01 secs]
0.223: [Full GC (Allocation Failure) 0.223: [Tenured: 78639K->3780K(78656K), 0.0171661K secs] 165415K->128156K(253440K), 0.017199K secs] [Times: user=0.01 sys=0.00, real=0.02 secs]
0.255: [Full GC (Allocation Failure) 0.255: [Tenured: 78634K->3780K(78656K), 0.0186398K secs] 190088K->145962K(253440K), 0.018730K secs] [Times: user=0.01 sys=0.01, real=0.02 secs]
0.287: [Full GC (Allocation Failure) 0.287: [Tenured: 78443K->3780K(78656K), 0.0246516K secs] 217280K->172304K(253440K), 0.024685K secs] [Times: user=0.01 sys=0.00, real=0.02 secs]
0.323: [Full GC (Allocation Failure) 0.323: [Tenured: 78439K->3780K(78656K), 0.020066K secs] 242028K->171563K(253440K), 0.020080K secs] [Times: user=0.03 sys=0.01, real=0.03 secs]
0.372: [Full GC (Allocation Failure) 0.372: [Tenured: 69952K->3780K(78656K), 0.0000162K secs] 0.372: [Tenured: 171563K->174738K(174784K), 0.0311434K secs] 241515K->186587K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0312038K secs] [Times: user=0.03 sys=0.00, real=0.03 secs]
0.416: [Full GC (Allocation Failure) 0.416: [Tenured: 174738K->174738K(174784K), 0.02658477K secs] 25337K->19387K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0268926K secs] [Times: user=0.02 sys=0.00, real=0.03 secs]
0.452: [Full GC (Allocation Failure) 0.452: [Tenured: 174702K->174627K(174784K), 0.0378365K secs] 25334K->202488K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0378784K secs] [Times: user=0.04 sys=0.00, real=0.04 secs]
0.500: [Full GC (Allocation Failure) 0.500: [Tenured: 174627K->174627K(174784K), 0.0066802K secs] 253178K->217269K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0067442K secs] [Times: user=0.01 sys=0.00, real=0.00 secs]
0.518: [Full GC (Allocation Failure) 0.518: [Tenured: 174572K->174772K(174784K), 0.0182426K secs] 253018K->222404K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0182797K secs] [Times: user=0.01 sys=0.00, real=0.02 secs]
0.538: [Full GC (Allocation Failure) 0.538: [Tenured: 174572K->174772K(174784K), 0.0182426K secs] 253021K->222404K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0182797K secs] [Times: user=0.01 sys=0.00, real=0.04 secs]
0.571: [Full GC (Allocation Failure) 0.571: [Tenured: 174691K->174690K(174784K), 0.0437570K secs] 25328K->524243K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.043720K secs] [Times: user=0.05 sys=0.00, real=0.04 secs]
0.621: [Full GC (Allocation Failure) 0.621: [Tenured: 174748K->174748K(174784K), 0.0104626K secs] 25336K->233748K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0105077K secs] [Times: user=0.01 sys=0.00, real=0.01 secs]
0.635: [Full GC (Allocation Failure) 0.635: [Tenured: 174748K->174488K(174784K), 0.0116522K secs] 25338K->238617K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0116984K secs] [Times: user=0.01 sys=0.00, real=0.01 secs]
0.650: [Full GC (Allocation Failure) 0.650: [Tenured: 174738K->174485K(174784K), 0.0113747K secs] 25340K->242377K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0114183K secs] [Times: user=0.01 sys=0.00, real=0.01 secs]
0.664: [Full GC (Allocation Failure) 0.664: [Tenured: 174745K->174485K(174784K), 0.03606746K secs] 253023K->234790K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0361202K secs] [Times: user=0.03 sys=0.00, real=0.04 secs]
0.703: [Full GC (Allocation Failure) 0.703: [Tenured: 174739K->174739K(174784K), 0.0098948K secs] 25337K->24095K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0098838K secs] [Times: user=0.01 sys=0.00, real=0.01 secs]
0.716: [Full GC (Allocation Failure) 0.716: [Tenured: 174739K->174739K(174784K), 0.0098948K secs] 25337K->24095K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0098838K secs] [Times: user=0.01 sys=0.00, real=0.01 secs]
0.738: [Full GC (Allocation Failure) 0.738: [Tenured: 174737K->174737K(174784K), 0.003268K secs] 25326K->247275K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.003249K secs] [Times: user=0.01 sys=0.00, real=0.01 secs]
0.741: [Full GC (Allocation Failure) 0.741: [Tenured: 174737K->174739K(174784K), 0.0364937K secs] 25321K->248821K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0365384K secs] [Times: user=0.04 sys=0.00, real=0.03 secs]
0.781: [Full GC (Allocation Failure) 0.781: [Tenured: 174729K->174729K(174784K), 0.00895902K secs] 25336K->254535K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0089042K secs] [Times: user=0.01 sys=0.00, real=0.01 secs]
0.793: [Full GC (Allocation Failure) 0.793: [Tenured: 174729K->174729K(174784K), 0.0032928K secs] 25332K->248019K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0033326K secs] [Times: user=0.01 sys=0.00, real=0.00 secs]
0.797: [Full GC (Allocation Failure) 0.797: [Tenured: 174729K->174729K(174784K), 0.00995616K secs] 25325K->249275K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0100439K secs] [Times: user=0.01 sys=0.00, real=0.01 secs]
0.808: [Full GC (Allocation Failure) 0.808: [Tenured: 174714K->174491K(174784K), 0.03511174K secs] 25304K->256339K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0351204K secs] [Times: user=0.03 sys=0.00, real=0.04 secs]
0.834: [Full GC (Allocation Failure) 0.834: [Tenured: 174691K->174690K(174784K), 0.00890598K secs] 25315K->25870W(253440K), [Metospace: 2737K->2737K(1856768K)], 0.00890490K secs] [Times: user=0.01 sys=0.00, real=0.01 secs]
0.864: [Full GC (Allocation Failure) 0.864: [Tenured: 174722K->174722K(174784K), 0.02020975K secs] 25332K->251680K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0021323K secs] [Times: user=0.01 sys=0.00, real=0.00 secs]
0.866: [Full GC (Allocation Failure) 0.866: [Tenured: 174722K->174722K(174784K), 0.02020975K secs] 25332K->251680K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0021323K secs] [Times: user=0.01 sys=0.00, real=0.00 secs]
0.897: [Full GC (Allocation Failure) 0.897: [Tenured: 174595K->174595K(174784K), 0.00885529K secs] 25279K->25101K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.00885395K secs] [Times: user=0.01 sys=0.00, real=0.03 secs]
0.906: [Full GC (Allocation Failure) 0.906: [Tenured: 174595K->174595K(174784K), 0.0023111K secs] 25245K->25153K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0023449K secs] [Times: user=0.00 sys=0.00, real=0.00 secs]
0.908: [Full GC (Allocation Failure) 0.908: [Tenured: 174595K->174595K(174784K), 0.00015159K secs] 25216K->25268K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0001579K secs] [Times: user=0.00 sys=0.00, real=0.01 secs]
0.936: [Full GC (Allocation Failure) 0.936: [Tenured: 174688K->174688K(174784K), 0.02349007K secs] 25385K->252358K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.02349007K secs] [Times: user=0.02 sys=0.00, real=0.02 secs]
0.938: [Full GC (Allocation Failure) 0.938: [Tenured: 174688K->174688K(174784K), 0.0200209K secs] 25329K->252578K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0200359K secs] [Times: user=0.00 sys=0.00, real=0.01 secs]
0.941: [Full GC (Allocation Failure) 0.941: [Tenured: 174688K->174688K(174784K), 0.0094242K secs] 25309K->252204K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0094837K secs] [Times: user=0.01 sys=0.00, real=0.01 secs]
0.950: [Full GC (Allocation Failure) 0.950: [Tenured: 174688K->174581K(174784K), 0.0311163K secs] 25313K->25125K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0311680K secs] [Times: user=0.03 sys=0.00, real=0.03 secs]
0.987: [Full GC (Allocation Failure) 0.987: [Tenured: 174595K->174595K(174784K), 0.00885529K secs] 25279K->25101K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.00885395K secs] [Times: user=0.01 sys=0.00, real=0.01 secs]
0.996: [Full GC (Allocation Failure) 0.996: [Tenured: 174595K->174595K(174784K), 0.0023111K secs] 25245K->25153K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0023449K secs] [Times: user=0.00 sys=0.00, real=0.00 secs]
0.998: [Full GC (Allocation Failure) 0.998: [Tenured: 174595K->174595K(174784K), 0.00015159K secs] 25216K->25268K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0001579K secs] [Times: user=0.00 sys=0.00, real=0.01 secs]
0.999: [Full GC (Allocation Failure) 0.999: [Tenured: 174595K->174595K(174784K), 0.02349007K secs] 25385K->252358K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.02349007K secs] [Times: user=0.02 sys=0.00, real=0.02 secs]
1.017: [Full GC (Allocation Failure) 1.017: [Tenured: 174772K->174772K(174784K), 0.0023036K secs] 25338K->252580K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0023383K secs] [Times: user=0.00 sys=0.00, real=0.02 secs]
1.019: [Full GC (Allocation Failure) 1.019: [Tenured: 174772K->174550K(174784K), 0.0201836K secs] 25298K->252759K(253440K), [Metospace: 2737K->2737K(1856768K)], 0.0202128K secs] [Times: user=0.02 sys=0.00, real=0.02 secs]
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分析:

第一次为Minor GC, GC原因为分配内存失败, 垃圾收集器名称为DefNew(单线程、标记-复制算法、STW), 经过一次GC年轻代从69952k减少到8704k, 使用占比从69952/78656=89%下降到8704/78656=11%, 消耗13ms, 总的堆内存使用量从69952k减少到24603k, 年轻代的使用量下降了69952-8704=61248, 堆内存的使用量只下降了69952-24603=45349k, 说明61248-45349=15899直接进入到了老年代

每次YoungGC时间在13~20ms

中间两次GC是什么GC? DefNew(没有减少) Tenured(163580k到171563k增加了?) Metaspace(没有减少)

后面都是FullGC, 只回收老年代, 老年代回收后使用量基本没有变化, 消耗时间在1~37ms, Serial为单线程GC, 每次GC都会STW基本没有新对象产生, 最后直接OOM

(图2 java -XX:+UseSerialGC -XX:+PrintGCDetails -XX:+PrintGCTimeStamps -Xmx512m -Xms512m GCLogAnalysis )

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zhufang@zhuFangs-MacBook-Pro 1-JVM % java -XX:+UseSerialGC -XX:+PrintGCDetails -XX:+PrintGCTimeStamps -Xmx512m -Xms512m GCLogAnalysis
正在执行...
0.153: [GC (Allocation Failure) 0.153: [DefNew: 139776K->17472K(157248K), 0x0300723 secs] 139776K->53088K(506816K), 0.0304091 secs] [Times: user=0.02 sys=0.02, real=0.03 secs]
0.204: [GC (Allocation Failure) 0.204: [DefNew: 157248K->17471K(157248K), 0x0323320 secs] 192646K->328212K(506816K), 0.0323616 secs] [Times: user=0.02 sys=0.01, real=0.03 secs]
0.260: [GC (Allocation Failure) 0.260: [DefNew: 157079K->17471K(157248K), 0.0284799 secs] 232404K->135396K(506816K), 0.0285162 secs] [Times: user=0.02 sys=0.01, real=0.03 secs]
0.310: [GC (Allocation Failure) 0.310: [DefNew: 157247K->17471K(157248K), 0.0346658 secs] 275682K->183195K(506816K), 0.0347031 secs] [Times: user=0.02 sys=0.02, real=0.04 secs]
0.375: [GC (Allocation Failure) 0.375: [DefNew: 17469K->17469K(157248K), 0.0298017 secs] 322747K->226416K(506816K), 0.0298377 secs] [Times: user=0.02 sys=0.01, real=0.03 secs]
0.428: [GC (Allocation Failure) 0.428: [DefNew: 157245K->17469K(157248K), 0.0338065 secs] 366192K->272689K(506816K), 0.0331181 secs] [Times: user=0.02 sys=0.01, real=0.04 secs]
0.485: [GC (Allocation Failure) 0.485: [DefNew: 157245K->17470K(157248K), 0.0311263 secs] 412465K->313079K(506816K), 0.0311683 secs] [Times: user=0.02 sys=0.01, real=0.03 secs]
0.540: [GC (Allocation Failure) 0.540: [DefNew: 156988K->17470K(157248K), 0.0307679 secs] 452162K->357927K(506816K), 0.0307218 secs] [Times: user=0.02 sys=0.01, real=0.03 secs]
0.593: [GC (Allocation Failure) 0.593: [DefNew: 157244K->157244K(157248K), 0.0305198 secs] 457163K->281094K(506816K), [Metaspace: 2737K->2737K(1856768K)], 0.030559164 secs] [Times: user=0.06 sys=0.00, real=0.05 secs]
0.669: [GC (Allocation Failure) 0.669: [DefNew: 139776K->17471K(157248K), 0.0888883 secs] 420874K->334876K(506816K), 0.0881224 secs] [Times: user=0.01 sys=0.00, real=0.01 secs]
0.704: [GC (Allocation Failure) 0.704: [DefNew: 157247K->17472K(157248K), 0.0800404 secs] 30.704: [Tenured: 317598K->324540K(349568K), 0.0608005 secs] 474646K->324450K(506816K), [Metaspace: 2737K->2737K(1856768K)], 0.0609244 secs] [Times: user=0.06 sys=0.00, real=0.06 secs]
0.792: [GC (Allocation Failure) 0.792: [DefNew: 139776K->139776K(157248K), 0.0000843 secs] 30.792: [Tenured: 324450K->331745K(349568K), 0.0517690 secs] 464226K->331745K(506816K), [Metaspace: 2737K->2737K(1856768K)], 0.0519068 secs] [Times: user=0.05 sys=0.00, real=0.06 secs]
0.865: [GC (Allocation Failure) 0.865: [DefNew: 139776K->139776K(157248K), 0.0000193 secs] 30.866: [Tenured: 331745K->328611K(349568K), 0.0594194 secs] 471521K->328611K(506816K), [Metaspace: 2737K->2737K(1856768K)], 0.0594872 secs] [Times: user=0.05 sys=0.01, real=0.06 secs]
0.948: [GC (Allocation Failure) 0.948: [DefNew: 139776K->139776K(157248K), 0.0000170 secs] 30.948: [Tenured: 328611K->348592K(349568K), 0.0463657 secs] 468387K->348592K(506816K), [Metaspace: 2737K->2737K(1856768K)], 0.0464301 secs] [Times: user=0.04 sys=0.00, real=0.05 secs]
1.017: [GC (Allocation Failure) 1.017: [DefNew: 139776K->139776K(157248K), 0.0000192 secs] 31.017: [Tenured: 348592K->349308K(349568K), 0.0529759 secs] 488368K->368365K(506816K), [Metaspace: 2737K->2737K(1856768K)], 0.05308486 secs] [Times: user=0.06 sys=0.00, real=0.05 secs]
执行结束!共生成对象次数 :8230
Heap dump:
def new generation total 157248K, used 61193K [0x00000007a00000, 0x00000007a00000, 0x00000007aa0000]
eden space 139776K, 43% used [0x00000007a00000, 0x00000007a5c240, 0x00000007a888000]
from space 17472K, 0% used [0x0000000769990000, 0x0000000769990000, 0x00000007caaa0000]
to space 17472K, 0% used [0x0000000768880000, 0x0000000768880000, 0x00000007c9990000]
tenured generation total 349568K, used 349308K [0x000000076aa0000, 0x000000077000000, 0x00000007c000000]
the space 349568K, 99% used [0x000000076aa0000, 0x000000077000000, 0x000000077fbfb400, 0x00000007c000000]
Metaspace used 2728K, capacity 4486K, committed 4864K, reserved 1056768K
class space used 296K, capacity 386K, committed 512K, reserved 1048576K
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(图3 java -XX:+UseSerialGC -XX:+PrintGCDetails -XX:+PrintGCTimeStamps -Xmx2g -Xms2g GCLogAnalysis )

```
zhufang@zhuFangs-MacBook-Pro 1-JVM % java -XX:+UseSerialGC -XX:+PrintGCDetails -XX:+PrintGCTimeStamps -Xmx2g -Xms2g GCLogAnalysis
正在执行...
0.371: [GC (Allocation Failure) 0.371: [DefNew: 559232K->69888K(629120K), 0.0818189 secs] 559232K->143523K(2027264K), 0.0818522 secs] [Times: user=0.05 sys=0.03, real=0.08 secs]
0.540: [GC (Allocation Failure) 0.540: [DefNew: 629120K->69888K(629120K), 0.1044926 secs] 702755K->260812K(2027264K), 0.1045228 secs] [Times: user=0.07 sys=0.04, real=0.10 secs]
0.716: [GC (Allocation Failure) 0.716: [DefNew: 629120K->69887K(629120K), 0.1182794 secs] 820044K->383092K(2027264K), 0.1183119 secs] [Times: user=0.05 sys=0.03, real=0.12 secs]
0.912: [GC (Allocation Failure) 0.912: [DefNew: 629119K->69888K(629120K), 0.0959482 secs] 942324K->512760K(2027264K), 0.0959824 secs] [Times: user=0.06 sys=0.03, real=0.09 secs]
执行结束!共生成对象次数 :10335
Heap dump:
def new generation total 629120K, used 606066K [0x00000007400000, 0x000000076aaa0000, 0x000000076aaa0000]
eden space 559232K, 95% used [0x00000007400000, 0x0000000760b3c3d0, 0x0000000762220000)
from space 69888K, 100% used [0x0000000762220000, 0x0000000766660000, 0x0000000766660000)
to space 69888K, 0% used [0x0000000766660000, 0x0000000766660000, 0x0000000776aa0000)
tenured generation total 1398144K, used 442872K [0x000000076aa0000, 0x00000007c000000, 0x00000007c000000)
the space 1398144K, 3% used [0x000000076aa0000, 0x00000007785b1e188, 0x00000007785b1e200, 0x00000007c000000)
Metaspace used 2728K, capacity 4486K, committed 4864K, reserved 1056768K
class space used 296K, capacity 386K, committed 512K, reserved 1048576K
```

分析: 堆内存设置为2g, 只发生了4次Minor GC, GC时间在80~120ms

总结: Serial GC 为单线程GC, GC效率低, YoungGC和Full GC都会STW, 内存增大时, GC次数减少, GC时间增大, 单位时间生成对象数增加。

## Parallel GC

(图4 java -XX:+PrintGCDetails -XX:+PrintGCTimeStamps -Xmx256m -Xms256m GCLogAnalysis )

```

.zhuangzhuangs-MacBook-Pro 1-JVM % java -XX:+PrintGCDetails -XX:+PrintGCTimeStamps -Xms256m -Xms256m GLogAnalysis
正在执行 ...
0.108: [GC (Allocation Failure) [PSYoungGen: 65536K->10747K(76288K)] 65536K->204958K(251392K), 0.0087128 secs] [Times: user=0.01 sys=0.06, real=0.01 secs]
0.129: [GC (Allocation Failure) [PSYoungGen: 76283K->10748K(76288K)] 80494K->63546K(251392K), 0.0116833 secs] [Times: user=0.02 sys=0.07, real=0.01 secs]
0.154: [GC (Allocation Failure) [PSYoungGen: 76284K->10744K(76288K)] 11090K->63516K(251392K), 0.0089927 secs] [Times: user=0.03 sys=0.05, real=0.01 secs]
0.173: [GC (Allocation Failure) [PSYoungGen: 76280K->10741K(76288K)] 129852K->85908K(251392K), 0.0140908 secs] [Times: user=0.04 sys=0.08, real=0.01 secs]
0.199: [GC (Allocation Failure) [PSYoungGen: 76281K->10740K(76288K)] 15141K->109496K(251392K), 0.0168945 secs] [Times: user=0.02 sys=0.06, real=0.02 secs]
0.219: [GC (Allocation Failure) [PSYoungGen: 76045K->10701K(40448K)] 178240K->130688K(15552K), 0.0123217 secs] [Times: user=0.03 sys=0.07, real=0.01 secs]
0.239: [GC (Allocation Failure) [PSYoungGen: 76046K->10702K(40448K)] 178240K->130688K(15552K), 0.0123217 secs] [Times: user=0.03 sys=0.07, real=0.01 secs]
0.246: [GC (Allocation Failure) [PSYoungGen: 47502K->23608K(58368K)] 72430K->15621K(233472K), 0.0034392 secs] [Times: user=0.02 sys=0.01, real=0.01 secs]
0.256: [GC (Allocation Failure) [PSYoungGen: 52949K->27626K(58368K)] 179890K->159898K(233472K), 0.0109716 secs] [Times: user=0.07 sys=0.01, real=0.01 secs]
0.273: [GC (Allocation Failure) [PSYoungGen: 5732K->17313K(58368K)] 189594K->167120K(233472K), 0.0083243 secs] [Times: user=0.02 sys=0.05, real=0.01 secs]
0.282: [Full GC (Ergonomics) [PSYoungGen: 17313K->0K(58368K)] [ParOldGen: 14980K->14242K(175104K)] 167120K->14242K(233472K), [Metaspace: 2722K->2722K(1056768K)], 0.0288067 secs] [Times: user=0.23 sys=0.01, real=0.03 secs]
0.324: [GC (Allocation Failure) [PSYoungGen: 41556K->10747K(58368K)] 139318K->105462K(233472K), 0.0042018 secs] [Times: user=0.02 sys=0.01, real=0.00 secs]
0.328: [Full GC (Ergonomics) [PSYoungGen: 11208K->0K(58368K)] [ParOldGen: 5414K->10748K(76288K)] 105462K->10748K(76288K), 0.0251196 secs] [Times: user=0.20 sys=0.02, real=0.03 secs]
0.363: [Full GC (Ergonomics) [PSYoungGen: 2963K->0K(58368K)] [ParOldGen: 16531K->16531K(75104K)] 10748K->165314K(75104K), 0.0279974 secs] [Times: user=0.23 sys=0.02, real=0.02 secs]
0.395: [Full GC (Ergonomics) [PSYoungGen: 2953K->0K(58368K)] [ParOldGen: 16531K->169163K(75104K)] 165314K->169163K(75104K), 0.0174119 secs] [Times: user=0.15 sys=0.00, real=0.02 secs]
0.417: [Full GC (Ergonomics) [PSYoungGen: 2957K->27857K(58368K)] 171943K->174630K(175104K), 0.0275975 secs] [Times: user=0.24 sys=0.02, real=0.03 secs]
0.449: [Full GC (Ergonomics) [PSYoungGen: 2969K->3839K(58368K)] [ParOldGen: 17462K->174884K(175104K)] 174884K->183277K(233472K), [Metaspace: 2722K->2722K(1056768K)], 0.0196663 secs] [Times: user=0.17 sys=0.00, real=0.02 secs]
0.473: [Full GC (Ergonomics) [PSYoungGen: 2969K->3839K(58368K)] [ParOldGen: 174884K->174643K(175104K)] 174643K->204580K(233472K), [Metaspace: 2722K->2722K(1056768K)], 0.0262339 secs] [Times: user=0.23 sys=0.00, real=0.03 secs]
0.503: [Full GC (Ergonomics) [PSYoungGen: 2969K->4440K(58368K)] [ParOldGen: 174643K->174644K(175104K)] 174644K->204580K(233472K), [Metaspace: 2722K->2722K(1056768K)], 0.0194396 secs] [Times: user=0.16 sys=0.00, real=0.02 secs]
0.524: [Full GC (Ergonomics) [PSYoungGen: 2919K->17873K(58368K)] [ParOldGen: 174644K->17462K(175104K)] 17462K->204580K(233472K), [Metaspace: 2722K->2722K(1056768K)], 0.0194396 secs] [Times: user=0.16 sys=0.00, real=0.02 secs]
0.544: [Full GC (Ergonomics) [PSYoungGen: 2940K->17873K(58368K)] [ParOldGen: 17462K->174643K(175104K)] 174643K->204580K(233472K), [Metaspace: 2722K->2722K(1056768K)], 0.0194396 secs] [Times: user=0.16 sys=0.00, real=0.02 secs]
0.572: [Full GC (Ergonomics) [PSYoungGen: 2940K->17873K(58368K)] [ParOldGen: 174643K->17462K(175104K)] 17462K->204580K(233472K), [Metaspace: 2722K->2722K(1056768K)], 0.0192333 secs] [Times: user=0.18 sys=0.00, real=0.02 secs]
0.592: [Full GC (Ergonomics) [PSYoungGen: 2963K->27788K(58368K)] [ParOldGen: 17462K->174606K(175104K)] 174606K->204716K->197404K(233472K), [Metaspace: 2722K->2722K(1056768K)], 0.0186396 secs] [Times: user=0.15 sys=0.00, real=0.02 secs]
0.612: [Full GC (Ergonomics) [PSYoungGen: 2919K->24583K(58368K)] [ParOldGen: 174606K->174772K(175104K)] 174772K->203838K(-199355K(233472K)), [Metaspace: 2722K->2722K(1056768K)], 0.0276942 secs] [Times: user=0.25 sys=0.00, real=0.03 secs]
0.640: [Full GC (Ergonomics) [PSYoungGen: 2941K->25037K(58368K)] [ParOldGen: 174772K->174571K(175104K)] 174571K->204190K(-19988K(233472K)), [Metaspace: 2722K->2722K(1056768K)], 0.0214491 secs] [Times: user=0.19 sys=0.00, real=0.02 secs]
0.663: [Full GC (Ergonomics) [PSYoungGen: 2969K->37331K(58368K)] [ParOldGen: 17459K->174460K(175104K)] 174460K->201800K(233472K), [Metaspace: 2722K->2722K(1056768K)], 0.0206473 secs] [Times: user=0.24 sys=0.00, real=0.02 secs]
0.689: [Full GC (Ergonomics) [PSYoungGen: 2969K->3830K(58368K)] [ParOldGen: 174643K->174645K(175104K)] 174645K->201800K(233472K), [Metaspace: 2722K->2722K(1056768K)], 0.0035856 secs] [Times: user=0.02 sys=0.01, real=0.00 secs]
0.699: [Full GC (Ergonomics) [PSYoungGen: 2969K->3830K(58368K)] [ParOldGen: 174645K->174646K(175104K)] 174646K->201800K(-202185K(233472K)), [Metaspace: 2722K->2722K(1056768K)], 0.00351288 secs] [Times: user=0.02 sys=0.01, real=0.02 secs]
0.729: [Full GC (Ergonomics) [PSYoungGen: 2969K->3830K(58368K)] [ParOldGen: 174646K->174647K(175104K)] 174647K->201800K(-202185K(233472K)), [Metaspace: 2722K->2722K(1056768K)], 0.00351288 secs] [Times: user=0.02 sys=0.01, real=0.02 secs]
0.749: [Full GC (Ergonomics) [PSYoungGen: 2957K->38743K(58368K)] [ParOldGen: 174647K->174650K(175104K)] 174650K->204716K->197404K(233472K), [Metaspace: 2722K->2722K(1056768K)], 0.0025246 secs] [Times: user=0.01 sys=0.00, real=0.01 secs]
0.752: [Full GC (Ergonomics) [PSYoungGen: 2961K->3873K(58368K)] [ParOldGen: 174571K->174571K(175104K)] 174571K->204252K->203364K(233472K), [Metaspace: 2722K->2722K(1056768K)], 0.0024988 secs] [Times: user=0.01 sys=0.00, real=0.00 secs]
0.754: [Full GC (Ergonomics) [PSYoungGen: 2964K->3885K(58368K)] [ParOldGen: 174608K->174772K(175104K)] 174772K->203838K(-199355K(233472K)), [Metaspace: 2722K->2722K(1056768K)], 0.0276942 secs] [Times: user=0.25 sys=0.00, real=0.03 secs]
0.757: [Full GC (Ergonomics) [PSYoungGen: 2913K->28810K(58368K)] [ParOldGen: 174571K->174571K(175104K)] 174571K->203703K->203381K(233472K), [Metaspace: 2722K->2722K(1056768K)], 0.0022223 secs] [Times: user=0.00 sys=0.00, real=0.00 secs]
0.759: [Full GC (Ergonomics) [PSYoungGen: 2965K->28180K(58368K)] [ParOldGen: 174571K->174571K(175104K)] 174571K->204190K(-19988K(233472K)), [Metaspace: 2722K->2722K(1056768K)], 0.0021235 secs] [Times: user=0.01 sys=0.00, real=0.01 secs]
0.762: [Full GC (Ergonomics) [PSYoungGen: 2965K->28303K(58368K)] [ParOldGen: 17459K->17459K(175104K)] 17459K->201800K(233472K), [Metaspace: 2722K->2722K(1056768K)], 0.00206473 secs] [Times: user=0.24 sys=0.00, real=0.02 secs]
0.773: [Full GC (Ergonomics) [PSYoungGen: 2965K->28303K(58368K)] [ParOldGen: 174608K->174608K(175104K)] 174608K->201800K(-202185K(233472K)), [Metaspace: 2722K->2722K(1056768K)], 0.00206473 secs] [Times: user=0.04 sys=0.00, real=0.02 secs]
0.789: [Full GC (Ergonomics) [PSYoungGen: 2965K->29276K(58368K)] [ParOldGen: 174693K->174693K(175104K)] 174693K->204147K(-19859K(-16534K(233472K)), [Metaspace: 2722K->2722K(1056768K)], 0.00206473 secs] [Times: user=0.00 sys=0.00, real=0.01 secs]
0.791: [Full GC (Ergonomics) [PSYoungGen: 2964K->3044K(58368K)] [ParOldGen: 174693K->174693K(175104K)] 174693K->204147K(-19859K(-16534K(233472K)), [Metaspace: 2722K->2722K(1056768K)], 0.0040987 secs] [Times: user=0.02 sys=0.00, real=0.00 secs]
0.797: [Full GC (Ergonomics) [PSYoungGen: 2964K->3044K(58368K)] [ParOldGen: 174693K->174693K(175104K)] 174693K->204147K(-19859K(-16534K(233472K)), [Metaspace: 2722K->2722K(1056768K)], 0.0040987 secs] [Times: user=0.01 sys=0.00, real=0.01 secs]
0.802: [Full GC (Ergonomics) [PSYoungGen: 2969K->30670K(58368K)] [ParOldGen: 175072K->175072K(175104K)] 175072K->204768K(-204748K(233472K)), [Metaspace: 2722K->2722K(1056768K)], 0.0029956 secs] [Times: user=0.01 sys=0.01, real=0.00 secs]
0.805: [Full GC (Ergonomics) [PSYoungGen: 2969K->30670K(58368K)] [ParOldGen: 175072K->175072K(175104K)] 175072K->204712K->204712K(-204712K(233472K)), [Metaspace: 2722K->2722K(1056768K)], 0.0025413 secs] [Times: user=0.02 sys=0.00, real=0.03 secs]
0.807: [Full GC (Allocation Failure) [PSYoungGen: 2964K->30640K(58368K)] [ParOldGen: 175072K->175072K(175104K)] 175072K->204712K->204712K(-204712K(233472K)), [Metaspace: 2722K->2722K(1056768K)], 0.0027848 secs] [Times: user=0.25 sys=0.00, real=0.03 secs]
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
at GLogAnalysis.generatedGObject(GLogAnalysis.java:42)
at GLogAnalysis.main(GLogAnalysis.java:29)

```

```

Heap
PSSyngen total 58368K, used 29690K [0x00000007bd00000, 0x00000007c000000]
eden space 29690K, 100% used [0x00000007bd00000, 0x00000007b80000], 0x00000007b80000
From space 28672K, 0% used [0x00000007bc00000, 0x00000007bc00000], 0x00000007bc00000
to space 28672K, 0% used [0x00000007bc00000, 0x00000007bc00000], 0x00000007bc00000
ParOldGen total 175104K, used 175053K [0x00000007bd00000, 0x00000007bd00000]
object space 175104K, max used 180000K [0x00000007bd00000, 0x00000007bd546K], 0x00000007bd546K
Metaspaces used 2752K, capacity 448K, committed 4864K, reserved 1056768K

```

```

.zhuangzhuangs-MacBook-Pro 1-JVM % java -XX:+PrintGCDetails -XX:+PrintGCTimeStamps -Xms512m -Xms512m GLogAnalysis
正在执行 ...
0.108: [GC (Allocation Failure) [PSYoungGen: 13158K->21486K(15308K)] 13158K->24597K(50278K), 0.0137595 secs] [Times: user=0.02 sys=0.19, real=0.01 secs]
0.133: [GC (Allocation Failure) [PSYoungGen: 15070K->2370K(15308K)] 17181K->2370K(50278K), 0.0221634 secs] [Times: user=0.04 sys=0.15, real=0.02 secs]
0.224: [GC (Allocation Failure) [PSYoungGen: 15085K->21495K(15308K)] 21395K->21481K(50278K), 0.0228945 secs] [Times: user=0.06 sys=0.12, real=0.02 secs]
0.269: [GC (Allocation Failure) [PSYoungGen: 15085K->21495K(15308K)] 21395K->21481K(50278K), 0.0188592 secs] [Times: user=0.04 sys=0.10, real=0.01 secs]
0.309: [GC (Allocation Failure) [PSYoungGen: 15087K->21502K(15308K)] 290194K->20501K(50278K), 0.0228788 secs] [Times: user=0.05 sys=0.13, real=0.02 secs]
0.356: [GC (Allocation Failure) [PSYoungGen: 15087K->21502K(15308K)] 32725K->24152K(43000K), 0.0242157 secs] [Times: user=0.06 sys=0.12, real=0.03 secs]
0.390: [GC (Allocation Failure) [PSYoungGen: 8025K->32941K(116736K)] 306904K->263961K(466432K), 0.0063793 secs] [Times: user=0.04 sys=0.02, real=0.00 secs]
0.410: [GC (Allocation Failure) [PSYoungGen: 91192K->278K(116736K)] 32212K->28192K(466432K), 0.0060825 secs] [Times: user=0.05 sys=0.01, real=0.00 secs]
0.428: [GC (Allocation Failure) [PSYoungGen: 10419K->50493K(116736K)] 340600K->295761K(466432K), 0.0111263 secs] [Times: user=0.06 sys=0.03, real=0.02 secs]
0.452: [GC (Allocation Failure) [PSYoungGen: 10916K->50493K(116736K)] 340643K->295762K(466432K), 0.0211142K secs] [Times: user=0.05 sys=0.11, real=0.02 secs]
0.482: [GC (Allocation Failure) [PSYoungGen: 96216K->19700K(116736K)] 371305K->32987K(466432K), 0.0169586 secs] [Times: user=0.03 sys=0.09, real=0.02 secs]
0.499: [Full GC (Ergonomics) [PSYoungGen: 91700K->116736K)] 30170K->21452K(116736K), 0.0203813 secs] [Times: user=0.28 sys=0.02, real=0.03 secs]
0.543: [GC (Allocation Failure) [PSYoungGen: 58800K->20981K(116736K)] 30807K->20981K(466432K), 0.0087947 secs] [Times: user=0.05 sys=0.00, real=0.00 secs]
0.559: [GC (Allocation Failure) [PSYoungGen: 58800K->20984K(116736K)] 30807K->20984K(466432K), 0.0087947 secs] [Times: user=0.07 sys=0.00, real=0.00 secs]
0.578: [GC (Allocation Failure) [PSYoungGen: 78236K->21194K(116736K)] 342342K->30349K(466432K), 0.0087273 secs] [Times: user=0.05 sys=0.00, real=0.01 secs]
0.598: [GC (Allocation Failure) [PSYoungGen: 80974K->19121K(116736K)] 36278K->32193K(466432K), 0.00864314K secs] [Times: user=0.06 sys=0.06, real=0.00 secs]
0.605: [GC (Ergonomics) [PSYoungGen: 19121K->20116K(116736K)] 326254K->266754K(466432K), 0.00508171K secs] [Times: user=0.05 sys=0.00, real=0.01 secs]
0.655: [GC (Allocation Failure) [PSYoungGen: 58880K->20981K(116736K)] 32534K->28773K(466432K), 0.005081871 secs] [Times: user=0.05 sys=0.00, real=0.01 secs]
0.671: [GC (Allocation Failure) [PSYoungGen: 84682K->21627K(116736K)] 369357K->-31813K(466432K), 0.00508173K secs] [Times: user=0.06 sys=0.01, real=0.00 secs]
0.694: [Full GC (Ergonomics) [PSYoungGen: 11627K->116736K)] 301650K->-30549K(21452K), 0.00505670K secs] [Times: user=0.06 sys=0.04, real=0.05 secs]
0.703: [GC (Allocation Failure) [PSYoungGen: 58572K->17784K(116736K)] 354121K->-323313K(466432K), 0.0024265K secs] [Times: user=0.02 sys=0.02, real=0.00 secs]
0.792: [GC (Allocation Failure) [PSYoungGen: 72824K->18744K(116736K)] 38133K->-33673K(466432K), 0.0050590K secs] [Times: user=0.05 sys=0.01, real=0.00 secs]
0.957: [Full GC (Ergonomics) [PSYoungGen: 18210K->193K(116736K)] 342937K->304374K(466432K), 0.0026032K secs] [Times: user=0.02 sys=0.00, real=0.00 secs]
0.777: [GC (Allocation Failure) [PSYoungGen: 78171K->16596K(116736K)] 362353K->301753K(466432K), 0.006253K secs] [Times: user=0.05 sys=0.00, real=0.01 secs]
0.794: [GC (Allocation Failure) [PSYoungGen: 7576K->20978K(116736K)] 378478K->-339932K(466432K), 0.0082407K secs] [Times: user=0.03 sys=0.03, real=0.01 secs]
0.803: [Full (Ergonomics) [PSYoungGen: 20978K->-29320K(343696K)] 339932K->-29320K(466432K), 0.0367433K secs] [Times: user=0.31 sys=0.01, real=0.04 secs]
0.855: [GC (Allocation Failure) [PSYoungGen: 5849K->24341K(116736K)] 352695K->-31755K(466432K), 0.008258K secs] [Times: user=0.03 sys=0.00, real=0.01 secs]
0.869: [GC (Allocation Failure) [PSYoungGen: 8259K->23832K(116736K)] 375738K->-30392K(466432K), 0.00802493K secs] [Times: user=0.05 sys=0.00, real=0.00 secs]
0.878: [GC (Allocation Failure) [PSYoungGen: 32250K->23832K(116736K)] 375738K->-30392K(466432K), 0.00802493K secs] [Times: user=0.05 sys=0.00, real=0.00 secs]
0.897: [GC (Allocation Failure) [PSYoungGen: 32253K->23832K(116736K)] 375738K->-30392K(466432K), 0.00802493K secs] [Times: user=0.05 sys=0.00, real=0.00 secs]
0.753: [GC (Allocation Failure) [PSYoungGen: 160113K->-27973K(23290K)] 662032K->-57534K(23290K), 0.0365291K secs] [Times: user=0.07 sys=0.20, real=0.04 secs]
0.816: [GC (Allocation Failure) [PSYoungGen: 191358K->-33772K(23290K)] 69266K->-610638K(23290K), 0.0333193K secs] [Times: user=0.05 sys=0.20, real=0.03 secs]
0.872: [GC (Allocation Failure) [PSYoungGen: 160113K->-27973K(23290K)] 662032K->-57534K(23290K), 0.0218032K secs] [Times: user=0.04 sys=0.12, real=0.03 secs]
0.894: [Full GC (Ergonomics) [PSYoungGen: 37973K->0K(23290K)] [ParOldGen: 603470K->-34279K(499392K)] 641444K->-34279K(499392K), 0.0533519K secs] [Times: user=0.41 sys=0.02, real=0.05 secs]
0.969: [GC (Allocation Failure) [PSYoungGen: 156419K->-39749K(23290K)] 499123K->-41808K(932352K), 0.0087600K secs] [Times: user=0.07 sys=0.00, real=0.01 secs]
0.996: [GC (Allocation Failure) [PSYoungGen: 156419K->-39749K(23290K)] 499123K->-41808K(932352K), 0.0087600K secs] [Times: user=0.07 sys=0.00, real=0.01 secs]
1.028: [GC (Allocation Failure) [PSYoungGen: 156440K->-39842K(23290K)] 53482K->-45248K(932352K), 0.0107684K secs] [Times: user=0.10 sys=0.00, real=0.01 secs]
1.058: [GC (Allocation Failure) [PSYoungGen: 156503K->-34786K(23290K)] 56910K->-49044K(932352K), 0.0089834K secs] [Times: user=0.07 sys=0.00, real=0.01 secs]
执行结束!共生成对象数:19228
Heap
PSSyngen total 116736K, used 2691K [0x0000000000b00000, 0x0000000000b00000]
eden space 116736K, 8% used [0x0000000000b00000, 0x0000000000b5750, 0x0000000000b5750]
From space 116224K, 36% used [0x0000000000b00000, 0x0000000000b584910, 0x0000000000b584910]
to space 1162
```

```

zhufang@zhufangs-MacBook-Pro 1-JVM % java -XX:+PrintGCDetails -XX:+PrintGCTimeStamps -Xmx2g -Xms2g GLogAnalysis
正在执行...
0.306: [GC (Allocation Failure) [PSYoungGen: 524800K->87029K(611840K)] 524800K->144032K(2010112K), 0.0566986 secs] [Times: user=0.06 sys=0.37, real=0.06 secs]
0.437: [GC (Allocation Failure) [PSYoungGen: 611829K->8703K(611840K)] 668832K->251652K(2010112K), 0.0641297 secs] [Times: user=0.08 sys=0.43, real=0.07 secs]
0.568: [GC (Allocation Failure) [PSYoungGen: 611833K->87032K(611840K)] 776452K->357301K(2010112K), 0.0556955 secs] [Times: user=0.13 sys=0.32, real=0.06 secs]
0.697: [GC (Allocation Failure) [PSYoungGen: 611832K->87031K(611840K)] 882101K->460978K(2010112K), 0.0544338 secs] [Times: user=0.14 sys=0.30, real=0.06 secs]
0.822: [GC (Allocation Failure) [PSYoungGen: 611831K->87039K(611840K)] 985778K->571839K(2010112K), 0.0572186 secs] [Times: user=0.13 sys=0.31, real=0.06 secs]
0.951: [GC (Allocation Failure) [PSYoungGen: 611839K->87027K(325120K)] 1096639K->692553K(1723392K), 0.0621856 secs] [Times: user=0.14 sys=0.35, real=0.06 secs]
1.048: [GC (Allocation Failure) [PSYoungGen: 325107K->144507K(382976K)] 930633K->754794K(1781248K), 0.0170322 secs] [Times: user=0.15 sys=0.01, real=0.01 secs]
执行结束!共生成对象次数:13038
Heap
PSYoungGen      total 382976K, used 198200K [0x0000000795580000, 0x00000007c0000000, 0x00000007c0000000)
eden space 238080K, 22% used [0x0000000795580000, 0x00000007989f378, 0x00000007d3e00000)
from space 144896K, 99% used [0x00000007a5e00000, 0x00000007acb1ed00, 0x00000007acb80000)
to   space 232960K, 0% used [0x00000007b1c80000, 0x00000007b1c80000, 0x00000007b5580000)
ParOldGen       total 1398272K, used 610287K [0x0000000740000000, 0x00000007653fhc50, 0x0000000795580000)
object space 1398272K, 43% used [0x0000000740000000, 0x00000007653fhc50, 0x0000000795580000)
Metaspaces     used 2728K, capacity 4486K, committed 4864K, reserved 1056768K
class space    used 296K, capacity 386K, committed 512K, reserved 1048576K

```

总结:

- Parallel+ParallelOldGC jdk8默认使用GC
- 使用多线程进行垃圾回收，线程数默认与核心数一样，GC时会STW
- 年轻代使用标记-复制算法，老年代使用标记-整理
- 吞吐量高

```

zhufang@zhufangs-MacBook-Pro 1-JVM % java -XX:+PrintGCDetails -XX:+PrintGCTimeStamps -Xmx4g -Xms4g GLogAnalysis
正在执行...
0.532: [GC (Allocation Failure) [PSYoungGen: 1048576K->174578K(1223168K)] 1048576K->221858K(4019712K), 0.0872024 secs] [Times: user=0.10 sys=0.57, real=0.09 secs]
0.771: [GC (Allocation Failure) [PSYoungGen: 1223154K->174590K(1223168K)] 1270434K->339069K(4019712K), 0.1026534 secs] [Times: user=0.12 sys=0.69, real=0.10 secs]
1.000: [GC (Allocation Failure) [PSYoungGen: 1223166K->174576K(1223168K)] 1387645K->457054K(4019712K), 0.0772491 secs] [Times: user=0.26 sys=0.36, real=0.08 secs]
执行结束!共生成对象次数:11722
Heap
PSYoungGen      total 1223168K, used 217024K [0x000000076ab00000, 0x00000007c0000000, 0x00000007c0000000)
eden space 1048576K, 4% used [0x000000076ab00000, 0x000000076d473d0, 0x00000007aab00000)
from space 174592K, 99% used [0x00000007aab00000, 0x00000007b557c230, 0x00000007b5580000)
to   space 174592K, 0% used [0x00000007b5580000, 0x00000007b5580000, 0x00000007b5580000)
ParOldGen       total 2796544K, used 282478K [0x00000006c0000000, 0x000000076ab00000, 0x000000076ab00000)
object space 2796544K, 10% used [0x00000006c0000000, 0x00000006d13db980, 0x000000076ab00000)
Metaspaces     used 2728K, capacity 4486K, committed 4864K, reserved 1056768K
class space    used 296K, capacity 386K, committed 512K, reserved 1048576K

```

```

zhufang@zhufangs-MacBook-Pro 1-JVM % java -XX:+UseConcMarkSweepGC -XX:+PrintGCTimeStamps -Xmx256m -Xms256m GLogAnalysis
正在执行...
0.103: [GC (Allocation Failure) 69785K->21702K(253440K), 0.0078969 secs]
0.123: [GC (Allocation Failure) 91654K->44224K(253440K), 0.0103481 secs]
0.146: [GC (Allocation Failure) 113875K->20260K(253440K), 0.0163809 secs]
0.174: [GC (Allocation Failure) 140189K->97113K(253440K), 0.0165633 secs]
0.191: [GC (CMS Initial Mark) 97401K(253440K), 0.0001756 secs]
0.206: [GC (Allocation Failure) 167065K->211187K(253440K), 0.0150130 secs]
0.234: [GC (Allocation Failure) 191139K->148042K(253440K), 0.0172228 secs]
0.263: [GC (Allocation Failure) 217994K->177114K(253440K), 0.0163429 secs]
0.280: [GC (CMS Final Remark) 177183K(253440K), 0.0011857 secs]
0.294: [Full GC (Allocation Failure) 232670K->162313K(253440K), 0.0338284 secs]
0.328: [GC (CMS Initial Mark) 163966K(253440K), 0.0002432 secs]
0.341: [Full GC (Allocation Failure) 232175K->176639K(253440K), 0.0328527 secs]
0.389: [Full GC (Allocation Failure) 253308K->185257K(253440K), 0.0317482 secs]
0.421: [GC (CMS Initial Mark) 185472K(253440K), 0.0002297 secs]
0.424: [GC (CMS Final Remark) 193014K(253440K), 0.0010183 secs]
0.435: [Full GC (Allocation Failure) 252758K->197216K(253440K), 0.0326686 secs]
0.468: [GC (CMS Initial Mark) 197360K(253440K), 0.0002578 secs]
0.470: [GC (CMS Final Remark) 202578K(253440K), 0.0011456 secs]
0.480: [Full GC (Allocation Failure) 252859K->203913K(253440K), 0.0337975 secs]
0.514: [GC (CMS Initial Mark) 204498K(253440K), 0.0002334 secs]
0.516: [GC (CMS Final Remark) 215691K(253440K), 0.0009884 secs]
0.524: [Full GC (Allocation Failure) 235343K->212719K(253440K), 0.0335210 secs]
0.558: [GC (CMS Initial Mark) 215908K(253440K), 0.0003210 secs]
0.560: [GC (CMS Final Remark) 223770K(253440K), 0.0011101 secs]
0.567: [Full GC (Allocation Failure) 235040K->219478K(253440K), 0.0357699 secs]
0.603: [GC (CMS Initial Mark) 219771K(253440K), 0.0002467 secs]
0.605: [GC (CMS Final Remark) 232710K(253440K), 0.0011120 secs]
0.610: [Full GC (Allocation Failure) 253413K->228208K(253440K), 0.0317096 secs]
0.642: [GC (CMS Initial Mark) 228352K(253440K), 0.0002183 secs]
0.644: [GC (CMS Final Remark) 240364K(253440K), 0.0010221 secs]
0.648: [Full GC (Allocation Failure) 252721K->234497K(253440K), 0.0359699 secs]
0.684: [GC (CMS Initial Mark) 234692K(253440K), 0.0002371 secs]
0.686: [GC (CMS Final Remark) 244441K(253440K), 0.0011052 secs]
0.689: [Full GC (Allocation Failure) 252975K->36266K(253440K), 0.0271252 secs]
0.717: [GC (CMS Initial Mark) 236338K(253440K), 0.0003371 secs]
0.719: [GC (CMS Final Remark) 246072K(253440K), 0.0011133 secs]
0.722: [Full GC (Allocation Failure) 253234K->238792K(253440K), 0.0312440 secs]
0.753: [GC (CMS Initial Mark) 239386K(253440K), 0.0003010 secs]
0.755: [GC (CMS Final Remark) 249291K(253440K), 0.0010323 secs]
0.757: [Full GC (Allocation Failure) 252759K->239402K(253440K), 0.0317964 secs]
0.790: [GC (CMS Initial Mark) 239960K(253440K), 0.0002887 secs]
0.792: [GC (CMS Final Remark) 249808K(253440K), 0.0010311 secs]
0.794: [Full GC (Allocation Failure) 253369K->243222K(253440K), 0.0314462 secs]
0.826: [GC (CMS Initial Mark) 243510K(253440K), 0.0002263 secs]
0.828: [Full GC (Allocation Failure) 253061K->244159K(253440K), 0.0284382 secs]
0.858: [Full GC (Allocation Failure) 252943K->245722K(253440K), 0.0315760 secs]
0.890: [GC (CMS Initial Mark) 245962K(253440K), 0.0002504 secs]
0.892: [Full GC (Allocation Failure) 252528K->246461K(253440K), 0.0299837 secs]
0.924: [Full GC (Allocation Failure) 253334K->248935K(253440K), 0.0310670 secs]
0.955: [GC (CMS Initial Mark) 249067K(253440K), 0.0002846 secs]
0.957: [Full GC (Allocation Failure) 252823K->248726K(253440K), 0.0319637 secs]
0.978: [Full GC (Allocation Failure) 252999K->249645K(253440K), 0.0324740 secs]
1.011: [GC (CMS Initial Mark) 249933K(253440K), 0.0002438 secs]
1.013: [Full GC (Allocation Failure) 253037K->251035K(253440K), 0.0233667 secs]
1.038: [Full GC (Allocation Failure) 253200K->250701K(253440K), 0.0203128 secs]
1.058: [GC (CMS Initial Mark) 251087K(253440K), 0.0002827 secs]
1.061: [Full GC (Allocation Failure) 253164K->252172K(253440K), 0.02095041 secs]
执行结束!共生成对象次数:4131

```

```
zhufang@zhufangs-MacBook-Pro 1-JVM % java -XX:+UseConcMarkSweepGC -XX:+PrintGC -XX:+PrintGCTimeStamps -Xmx512m -Xms512m GCLogAnalysis
```

正在执行...

```
0.132: [GC (Allocation Failure) 139768K->44560K(506816K), 0.0159757 secs]
0.167: [GC (Allocation Failure) 184336K->89894K(506816K), 0.0246408 secs]
0.218: [GC (Allocation Failure) 229670K->135006K(506816K), 0.0291010 secs]
0.266: [GC (Allocation Failure) 274782K->177658K(506816K), 0.0266136 secs]
0.314: [GC (Allocation Failure) 317434K->220271K(506816K), 0.0257835 secs]
0.340: [GC (CMS Initial Mark) 223155K(506816K), 0.0002083 secs]
0.364: [GC (Allocation Failure) 359952K->260212K(506816K), 0.0249550 secs]
0.408: [GC (Allocation Failure) 399988K->304644K(506816K), 0.0286496 secs]
0.456: [GC (Allocation Failure) 444420K->354940K(506816K), 0.0325284 secs]
0.488: [GC (CMS Final Remark) 355069K(506816K), 0.0009543 secs]
0.508: [Full GC (Allocation Failure) 453227K->265208K(506816K), 0.0479038 secs]
0.556: [GC (CMS Initial Mark) 265850K(506816K), 0.0002481 secs]
0.577: [GC (Allocation Failure) 404975K->314112K(506816K), 0.0073475 secs]
0.609: [GC (Allocation Failure) 453888K->357146K(506816K), 0.0110038 secs]
0.620: [GC (CMS Final Remark) 360058K(506816K), 0.0010921 secs]
0.644: [Full GC (Allocation Failure) 495865K->300090K(506816K), 0.0490138 secs]
0.693: [GC (CMS Initial Mark) 300801K(506816K), 0.0002479 secs]
0.715: [GC (Allocation Failure) 439866K->351155K(506816K), 0.0068095 secs]
0.721: [GC (CMS Final Remark) 351409K(506816K), 0.0009473 secs]
0.743: [Full GC (Allocation Failure) 490931K->326068K(506816K), 0.0508905 secs]
0.794: [GC (CMS Initial Mark) 329142K(506816K), 0.0002818 secs]
0.816: [Full GC (Allocation Failure) 465317K->335324K(506816K), 0.0569586 secs]
0.894: [Full GC (Allocation Failure) 474892K->344978K(506816K), 0.0566271 secs]
0.951: [GC (CMS Initial Mark) 345193K(506816K), 0.0002470 secs]
0.953: [GC (CMS Final Remark) 357911K(506816K), 0.0010807 secs]
0.972: [Full GC (Allocation Failure) 484100K->343143K(506816K), 0.0538767 secs]
1.027: [GC (CMS Initial Mark) 346419K(506816K), 0.0003036 secs]
1.030: [GC (CMS Final Remark) 354471K(506816K), 0.0012470 secs]
1.051: [Full GC (Allocation Failure) 482409K->345242K(506816K), 0.0591367 secs]
1.110: [GC (CMS Initial Mark) 345348K(506816K), 0.0002040 secs]
```

执行结束!共生成对象次数:9411

```
zhufang@zhufangs-MacBook-Pro 1-JVM % java -XX:+UseConcMarkSweepGC -XX:+PrintGC -XX:+PrintGCTimeStamps -Xmx1g -Xms1g GCLogAnalysis
```

正在执行...

```
0.199: [GC (Allocation Failure) 279616K->87957K(1013632K), 0.0343951 secs]
0.273: [GC (Allocation Failure) 367573K->163140K(1013632K), 0.0371395 secs]
0.344: [GC (Allocation Failure) 442756K->236353K(1013632K), 0.0419438 secs]
0.419: [GC (Allocation Failure) 515969K->316268K(1013632K), 0.0434710 secs]
0.493: [GC (Allocation Failure) 595884K->401170K(1013632K), 0.0477725 secs]
0.541: [GC (CMS Initial Mark) 401541K(1013632K), 0.0002737 secs]
0.575: [GC (Allocation Failure) 680786K->479889K(1013632K), 0.0404204 secs]
0.648: [GC (Allocation Failure) 759505K->563071K(1013632K), 0.0438000 secs]
0.736: [GC (Allocation Failure) 842570K->637930K(1013632K), 0.0536353 secs]
0.828: [GC (Allocation Failure) 917546K->714215K(1013632K), 0.0476914 secs]
0.876: [GC (CMS Final Remark) 719903K(1013632K), 0.0010821 secs]
0.916: [GC (Allocation Failure) 855655K->654842K(1013632K), 0.0182318 secs]
0.934: [GC (CMS Initial Mark) 655157K(1013632K), 0.0002464 secs]
0.973: [Full GC (Allocation Failure) 934458K->356509K(1013632K), 0.0722118 secs]
```

执行结束!共生成对象次数:12151

```
zhufang@zhufangs-MacBook-Pro 1-JVM % java -XX:+UseConcMarkSweepGC -XX:+PrintGC -XX:+PrintGCTimeStamps -Xmx2g -Xms2g GCLogAnalysis
```

正在执行...

```
0.339: [GC (Allocation Failure) 559232K->161275K(2027264K), 0.0648438 secs]
0.472: [GC (Allocation Failure) 720507K->290346K(2027264K), 0.0633985 secs]
0.596: [GC (Allocation Failure) 849578K->412964K(2027264K), 0.0731938 secs]
0.737: [GC (Allocation Failure) 972196K->525293K(2027264K), 0.0808853 secs]
0.884: [GC (Allocation Failure) 1084525K->649369K(2027264K), 0.1019921 secs]
1.064: [GC (Allocation Failure) 1208601K->774115K(2027264K), 0.0716035 secs]
1.136: [GC (CMS Initial Mark) 774259K(2027264K), 0.0011313 secs]
```

执行结束!共生成对象次数:12746

总结:

- CMS(标记-清除算法)+ParNewGC(标记-复制)
- CMS将GC分为初始标记-并发标记-并发预处理-最终标记-并发清除-并发重置几个阶段，并发过程中可以和应用线程并发操作
- 由于CMS使用标记-清除，不需要对老年代整理、大部分时间可以和应用线程并发操作，CMS的目标是减少老年代GC暂停时间
- 相比ParallelOld GC CMS 暂停时间短，吞吐量低，会产生空间碎片