實驗目的

了解String 相接 與 系統效能 關係

實驗環境

-Xms30M -Xmx30M -Xmn10M -Xss256k -XX:MaxPermSize=2m -XX:+UseConcMarkSweepGC -XX:CMSFullGCsBeforeCompaction=5 -XX:+CMSScavengeBeforeRemark -XX:+ScavengeBeforeFullGC -XX:MaxTenuringThreshold=30 -XX:+UseCMSCompactAtFullCollection -XX:CMSInitiatingOccupancyFraction=80 -XX:+UseCMSInitiatingOccupancyOnly -XX:+CMSParallelRemarkEnabled -Xloggc:/home/jameschang/test-gc.log -XX:+DisableExplicitGC -verbose:gc -server

<table>
<tr><th>項目</th><th>單純 String 接拼</th><th>StringBuffer 接字串</th><th>StringBuilder 接字串</th></tr>
<tr><td>實驗程式碼</td><td>

```
public class TesString {
    public static void main(String[] args){

        String test = "";
        for(int i =0 ;i <= 50000 ; i++){
            test += "1234"+"5678";
        }
    }
}
```

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```
public class TesString {
    public static void main(String[] args){

        StringBuffer testb = new  StringBuffer();
        for(int i =0 ;i <= 500000 ; i++){
            testb.append("1234").append("5678");
        }

    }
}
```

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```
18  public class TesString {
19      public static void main(String[] args){
20
21          StringBuilder testb = new  StringBuilder();
22          for(int i =0 ;i <= 500000 ; i++){
23              testb.append("1234").append("5678");
24          }
25
26      }
27  }
```

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<tr><td colspan="2">GC 狀況</td><td></td><td></td></tr>
<tr><td>GC 詳細紀錄</td><td>

```
21.495: [GC 17267K(29696K), 0.0000590 secs]
21.496: [GC 24288K->17265K(29696K), 0.0003090 secs]
21.498: [GC 25066K->18047K(29696K), 0.0004340 secs]
21.500: [Full GC 25848K->890K(29696K), 0.0033020 secs
21.505: [GC 8692K->2454K(29696K), 0.0003680 secs]
21.507: [GC 10256K->3232K(29696K), 0.0002450 secs]
21.509: [GC 11035K->4014K(29696K), 0.0003000 secs]
21.511: [GC 11817K->4793K(29696K), 0.0001940 secs]
21.513: [GC 12596K->5575K(29696K), 0.0002830 secs]
21.515: [GC 13378K->6353K(29696K), 0.0001750 secs]
21.517: [GC 14157K->7135K(29696K), 0.0003050 secs]
21.519: [GC 14940K->7913K(29696K), 0.0003210 secs]
21.520: [GC 15718K->8696K(29696K), 0.0003620 secs]
21.522: [GC 16501K->9474K(29696K), 0.0002220 secs]
21.524: [GC 17280K->10256K(29696K), 0.0003620 secs]
21.526: [GC 18063K->11035K(29696K), 0.0003720 secs]
21.528: [GC 18841K->11817K(29696K), 0.0002540 secs]
21.530: [GC 19624K->12596K(29696K), 0.0002840 secs]
21.532: [GC 20403K->13378K(29696K), 0.0003760 secs]
21.534: [GC 21186K->14157K(29696K), 0.0002860 secs]
21.536: [GC 21965K->14940K(29696K), 0.0003540 secs]
21.538: [GC 22748K->15718K(29696K), 0.0002180 secs]
21.539: [GC 23527K->16503K(29696K), 0.0004160 secs]
21.540: [GC 17284K(29696K), 0.0000550 secs]
21.541: [GC 24312K->17282K(29696K), 0.0003020 secs]
21.543: [GC 25091K->18065K(29696K), 0.0004900 secs]
21.546: [Full GC 25875K->891K(29696K), 0.0035380 secs
21.551: [GC 8701K->2457K(29696K), 0.0003590 secs]
21.553: [GC 10268K->3236K(29696K), 0.0002020 secs]
21.554: [GC 11047K->4021K(29696K), 0.0010080 secs]
21.558: [GC 11832K->4800K(29696K), 0.0009170 secs]
21.560: [GC 12612K->5583K(29696K), 0.0009700 secs]
```

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```
> $ cat test-gc.log
0.092: [GC 4863K->2450K(29696K), 0.0020530 secs]
```

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```
> $ cat test-gc.log
0.067: [GC 4863K->2451K(29696K), 0.0013170 secs]
```

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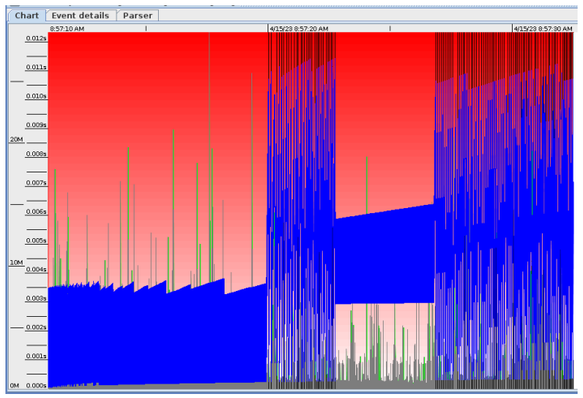
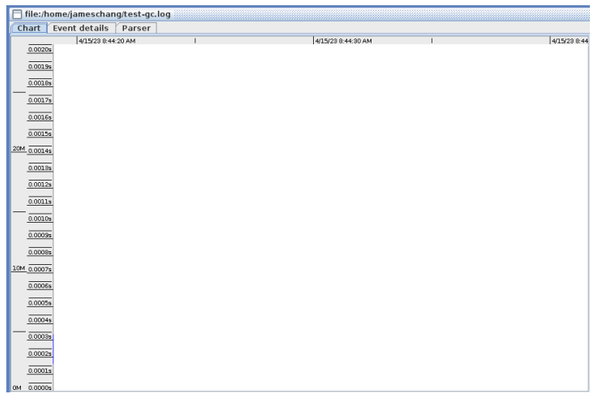
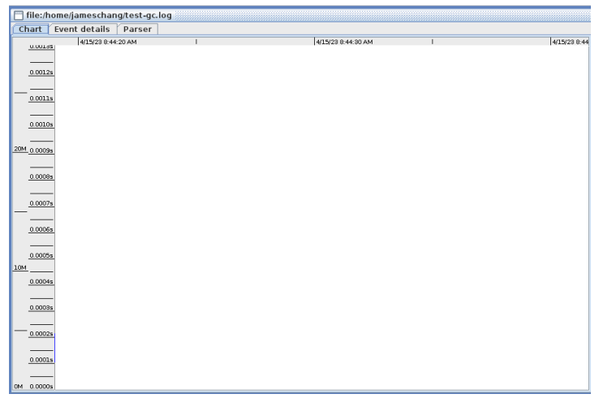
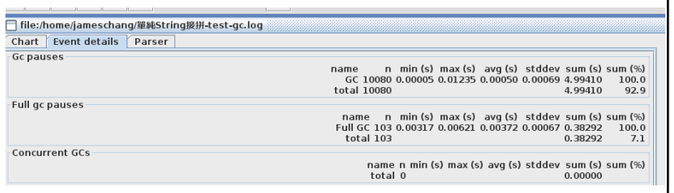
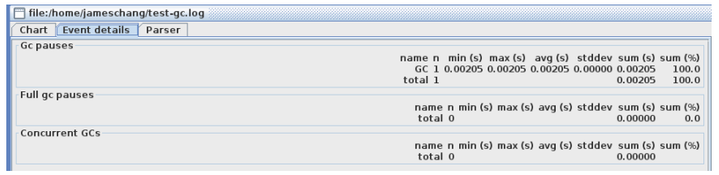
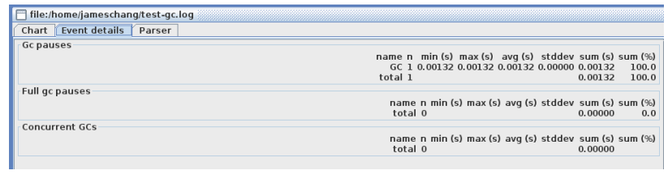
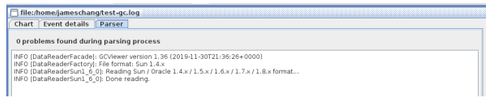
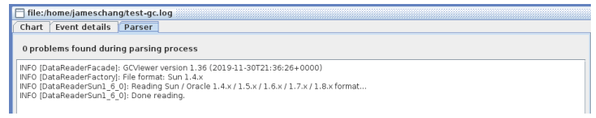
GC Viewer 分析			
Chart			
Event details			
Parser	INFO [DataReaderFacade]: GCViewer version 1.36 (2019-11-30T21:36:26+0000) INFO [DataReaderFactory]: File format: Sun 1.4.x INFO [DataReaderSun1_6_0]: Reading Sun / Oracle 1.4.x / 1.5.x / 1.6.x / 1.7.x / 1.8.x format... WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: java.lang.StringIndexOutOfBoundsException: String index out of range: 60 Line 4401: 9.337: [GC9.337: [GC 19877K->18317K(29696K), 0.0016720 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: com.tagtraum.perf.gcviewer.imp.UnknownGcTypeException: Unknown gc type: 'K(29696K)' Line 4402: 18317K(29696K), 0.0025580 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: java.lang.StringIndexOutOfBoundsException: String index out of range: 62 Line 5168: 10.923: [GC10.923: [GC 18118K->18118K(29696K), 0.0017800 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: com.tagtraum.perf.gcviewer.imp.UnknownGcTypeException: Unknown gc type: 'K(29696K)' Line 5169: 18118K(29696K), 0.0035030 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: java.lang.StringIndexOutOfBoundsException: String index out of range: 62 Line 5389: 11.377: [GC11.377: [GC 19064K->19062K(29696K), 0.0010590 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: com.tagtraum.perf.gcviewer.imp.UnknownGcTypeException: Unknown gc type: 'K(29696K)' Line 5390: 19062K(29696K), 0.0018760 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: java.lang.StringIndexOutOfBoundsException: String index out of range: 62 Line 8096: 16.761: [GC16.761: [GC 19706K->19007K(29696K), 0.0009300 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException:		

	com.tagtraum.perf.gcviewer.imp.UnknownGcTypeException: Unknown gc type: 'K(29696K)' Line 8097: 19007K(29696K), 0.0017820 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: java.lang.StringIndexOutOfBoundsException: String index out of range: 62 Line 9061: 18.825: [GC18.825: [GC 19323K->19323K(29696K), 0.0010170 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: com.tagtraum.perf.gcviewer.imp.UnknownGcTypeException: Unknown gc type: 'K(29696K)' Line 9062: 19323K(29696K), 0.0018200 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: java.lang.StringIndexOutOfBoundsException: String index out of range: 62 Line 9417: 19.628: [GC19.628: [GC 20439K->20437K(29696K), 0.0003260 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: com.tagtraum.perf.gcviewer.imp.UnknownGcTypeException: Unknown gc type: 'K(29696K)' Line 9418: 20437K(29696K), 0.0012290 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: java.lang.StringIndexOutOfBoundsException: String index out of range: 62 Line 9624: 20.188: [GC20.188: [GC 18367K->18365K(29696K), 0.0018650 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: com.tagtraum.perf.gcviewer.imp.UnknownGcTypeException: Unknown gc type: 'K(29696K)' Line 9625: 18365K(29696K), 0.0027340 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: java.lang.StringIndexOutOfBoundsException: String index out of range: 62 Line 9751: 20.509: [GC20.509: [GC 20768K->20005K(29696K), 0.0010360 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: com.tagtraum.perf.gcviewer.imp.UnknownGcTypeException: Unknown gc type: 'K(29696K)' Line 9752: 20005K(29696K), 0.0018840 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: java.lang.StringIndexOutOfBoundsException: String index out of range: 62 Line 9947: 20.988: [GC20.988: [GC 20172K->20172K(29696K), 0.0010130 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: com.tagtraum.perf.gcviewer.imp.UnknownGcTypeException: Unknown gc type: 'K(29696K)' Line 9948: 20172K(29696K), 0.0018310 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: java.lang.StringIndexOutOfBoundsException: String index out of range: 62 Line 9989: 21.099: [GC21.099: [GC 20212K->20212K(29696K), 0.0002560 secs] WARNING [DataReaderSun1_6_0]: com.tagtraum.perf.gcviewer.imp.ParseException: com.tagtraum.perf.gcviewer.imp.UnknownGcTypeException: Unknown gc type: 'K(29696K)' Line 9990: 20212K(29696K), 0.0003810 secs] INFO [DataReaderSun1_6_0]: Done reading.		

summary

Summary | Memory | Pause

Total heap (usage / alloc. max)	26.9M (92.9%) / 29M
Max heap after conc GC	n/a
Max tenured after conc GC	n/a
Max heap after full GC	1,660K (5.6%)
Freed Memory	76,053M
Freed Mem/Min	211,971.036M/min
Total Time	21s
Accumulated pauses	5.38s
Throughput	75.02%
Number of full gc pauses	103
Full GC Performance	6,492.1M/s
Number of gc pauses	10080
GC Performance	14,730.8M/s

Summary | Memory | Pause

Total heap (usage / alloc. max)	4,863K (16.4%) / 29M
Max heap after conc GC	n/a
Max tenured after conc GC	n/a
Max heap after full GC	n/a
Freed Memory	2,413K
Freed Mem/Min	68,868.348M/min
Total Time	
Accumulated pauses	0s
Throughput	0%
Number of full gc pauses	0
Full GC Performance	n/a
Number of gc pauses	1
GC Performance	1,147.8M/s

Summary | Memory | Pause

Total heap (usage / alloc. max)	4,863K (16.4%) / 29M
Max heap after conc GC	n/a
Max tenured after conc GC	n/a
Max heap after full GC	n/a
Freed Memory	2,412K
Freed Mem/Min	107,310.649M/min
Total Time	
Accumulated pauses	0s
Throughput	0%
Number of full gc pauses	0
Full GC Performance	n/a
Number of gc pauses	1
GC Performance	1,788.5M/s

Memory

Summary | Memory | Pause

Total heap (usage / alloc. max)	26.9M (92.9%) / 29M
Tenured heap (usage / alloc. max)	n/a
Young heap (usage / alloc. max)	n/a
Perm heap (usage / alloc. max)	n/a
Max tenured after conc GC	n/a
Avg tenured after conc GC	n/a
Max heap after conc GC	n/a
Avg heap after conc GC	n/a
Max heap after full GC	1,660K (5.6%)
Avg heap after full GC	916.7K (σ=295.141K)
Avg after GC	5,653.9K (σ=5,466.685K)
Freed by full GC	2,486M (3.3%)
Freed by GC	73,567M (96.7%)
Avg freed full GC	24.1M/coll (σ=1,848.607K)
Avg freed GC	7,473.5K/coll (σ=971.654K)
Avg rel inc after FGC	5,386B/coll
Avg rel inc after GC	161.049K/coll
Slope full GC	36.716K/s
Slope GC	76.792M/s
InitiatingOccFraction (avg / max)	n/a
Avg promotion	n/a
Total promotion	n/a

Summary | Memory | Pause

Total heap (usage / alloc. max)	4,863K (16.4%) / 29M
Tenured heap (usage / alloc. max)	n/a
Young heap (usage / alloc. max)	n/a
Perm heap (usage / alloc. max)	n/a
Max tenured after conc GC	n/a
Avg tenured after conc GC	n/a
Max heap after conc GC	n/a
Avg heap after conc GC	n/a
Max heap after full GC	n/a
Avg heap after full GC	n/a
Avg after GC	2,450K (σ=0B)
Freed by full GC	n/a
Freed by GC	2,413K (100.0%)
Avg freed full GC	n/a
Avg freed GC	2,413K/coll (σ=0B)
Avg rel inc after FGC	n/a
Avg rel inc after GC	n/a
Slope full GC	n/a
Slope GC	n/a
InitiatingOccFraction (avg / max)	n/a
Avg promotion	n/a
Total promotion	n/a

Summary | Memory | Pause

Total heap (usage / alloc. max)	4,863K (16.4%) / 29M
Tenured heap (usage / alloc. max)	n/a
Young heap (usage / alloc. max)	n/a
Perm heap (usage / alloc. max)	n/a
Max tenured after conc GC	n/a
Avg tenured after conc GC	n/a
Max heap after conc GC	n/a
Avg heap after conc GC	n/a
Max heap after full GC	n/a
Avg heap after full GC	n/a
Avg after GC	2,451K (σ=0B)
Freed by full GC	n/a
Freed by GC	2,412K (100.0%)
Avg freed full GC	n/a
Avg freed GC	2,412K/coll (σ=0B)
Avg rel inc after FGC	n/a
Avg rel inc after GC	n/a
Slope full GC	n/a
Slope GC	n/a
InitiatingOccFraction (avg / max)	n/a
Avg promotion	n/a
Total promotion	n/a

Pause	Summary Memory Pause **Total pause** Accumulated pauses 5.38s Number of pauses 10183 Avg Pause 0.00053s (σ=0.00076) Min / Max Pause 0.00005s / 0.01235s Avg pause interval 0.00211s (σ=0.00105) Min / max pause interval 0s / 0.021s **Full gc pauses** Accumulated full GC 0.38s (7.1%) Number of full gc pauses 103 Avg full GC 0.00372s (σ=0.00067) Min / max full gc pause 0.00317s / 0.00621s Min / max full gc pause interval 0.043s / 4.129s **Gc pauses** Accumulated GC 4.99s (92.9%) Number of gc pauses 10080 Avg GC 0.0005s (σ=0.00069) Min / max gc pause 0.00005s / 0.01235s	Summary Memory Pause **Total pause** Accumulated pauses 0s Number of pauses 1 Avg Pause 0.00205s (σ=0) Min / Max Pause 0.00205s / 0.00205s Avg pause interval n/a Min / max pause interval n/a **Full gc pauses** Accumulated full GC 0s (0.0%) Number of full gc pauses 0 Avg full GC n/a Min / max full gc pause n/a Min / max full gc pause interval n/a **Gc pauses** Accumulated GC 0s (100.0%) Number of gc pauses 1 Avg GC 0.00205s (σ=0) Min / max gc pause 0.00205s / 0.00205s	Summary Memory Pause **Total pause** Accumulated pauses 0s Number of pauses 1 Avg Pause 0.00132s (σ=0) Min / Max Pause 0.00132s / 0.00132s Avg pause interval n/a Min / max pause interval n/a **Full gc pauses** Accumulated full GC 0s (0.0%) Number of full gc pauses 0 Avg full GC n/a Min / max full gc pause n/a Min / max full gc pause interval n/a **Gc pauses** Accumulated GC 0s (100.0%) Number of gc pauses 1 Avg GC 0.00132s (σ=0) Min / max gc pause 0.00132s / 0.00132s