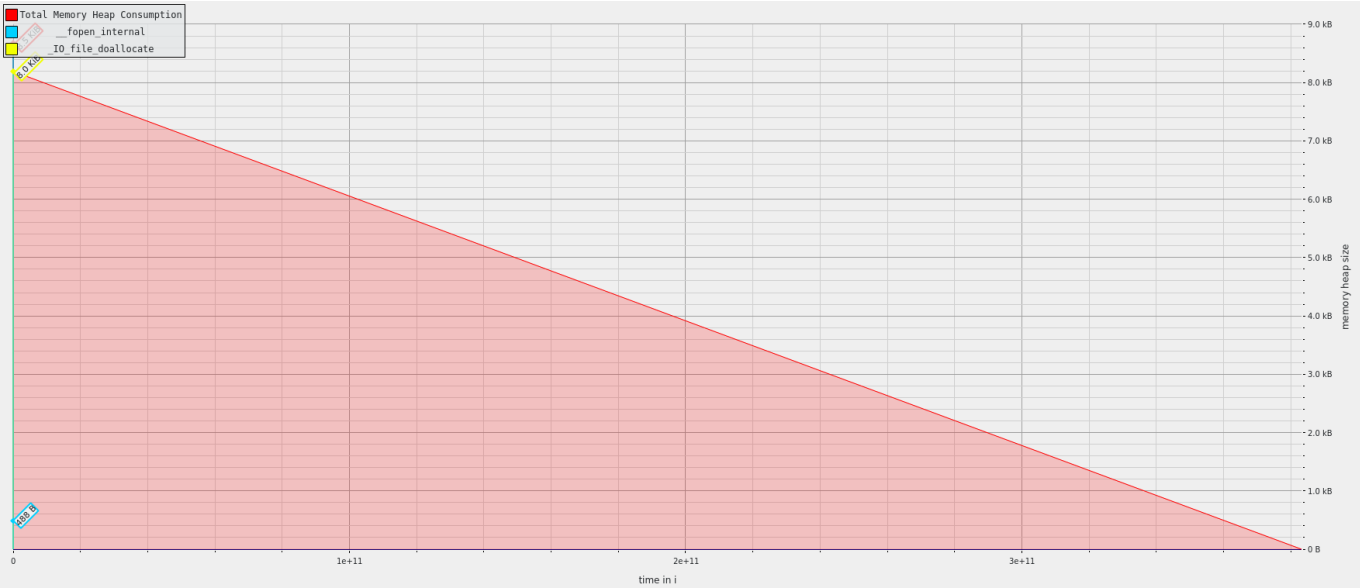
Exercise 1

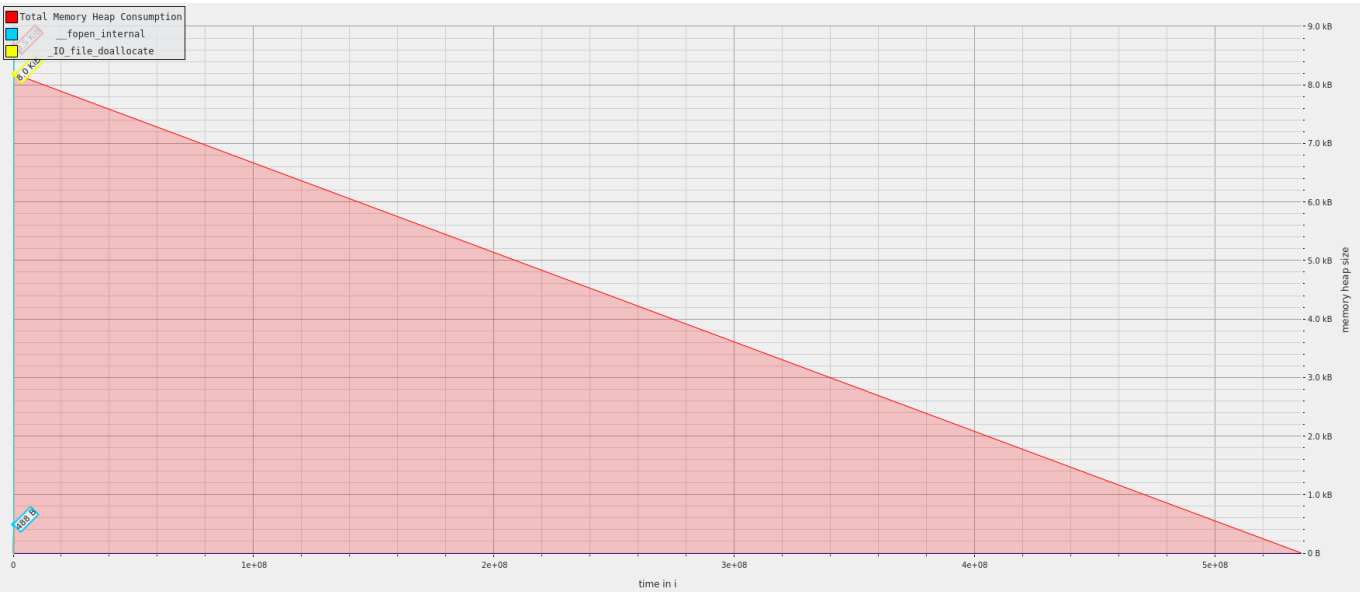
```
massif-visualizer [massif-data-file] => massif.out.%pid
```

As we can see both programs need to allocate more or less the same amount of memory eventho the workload is different

a



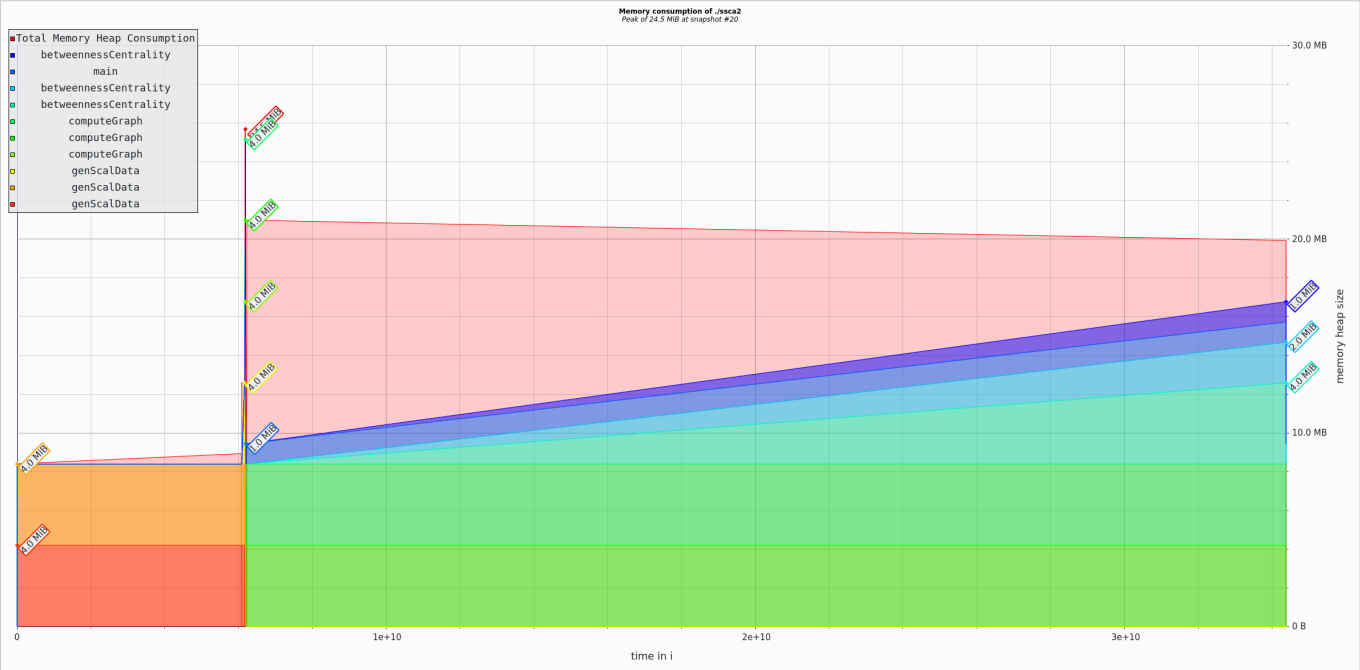
s



Runtime with massif 3.3s

Runtime without massif 0.3s

As for ssca2



The program's memory usage starts at 8.5 MB of the heap. We firtsly generate "Scal Data" three times. It stabilizes for a while before experiencing a sudden peak to 25.69 MB for the betweennessCentrality() of function for all three generated sets. Then it followes a drop to 10 MB. Afterward, it fluctuates between around 8 to 25 MB Towards the end, it reaches another peak of 20.99 MB. In general the computeGraph() functions are stable as they need with time a little more memory.

The perturbation in execution time caused by using Massif can be potentially massive.

Runtime with massif 1.25min

Runtime without massif 0.51s

Exercise 2

a)

```
 Performance counter stats for './npb_bt_a':
     6,851,824,686      L1-dcache-load-misses:u   #    4.37% of all L1-
dcache accesses  (10.71%)
   156,737,123,628      L1-dcache-loads:u
(14.29%)
     4,765,522,189      L1-dcache-prefetch-misses:u
(14.29%)
               398      L1-dcache-prefetches:u
(14.29%)
     2,427,321,825      L1-dcache-store-misses:u
(14.29%)
    73,845,614,252      L1-dcache-stores:u
(14.29%)
        48,642,427      L1-icache-load-misses:u   #    0.03% of all L1-
icache accesses  (14.29%)
   141,648,487,195      L1-icache-loads:u
(14.29%)
```

```
       311,232,083      LLC-load-misses:u         #   52.23% of all LL-
cache accesses  (14.29%)
       595,937,592      LLC-loads:u
(14.29%)
       501,148,957      LLC-prefetch-misses:u
(7.14%)
       803,756,368      LLC-prefetches:u
(7.14%)
        32,216,513      LLC-store-misses:u
(7.14%)
       456,636,730      LLC-stores:u
(7.14%)
     1,832,202,799      branch-load-misses:u
(10.71%)
     1,852,559,669      branch-loads:u
(14.28%)
         1,198,828      dTLB-load-misses:u        #    0.00% of all dTLB
cache accesses  (14.28%)
   156,727,712,592      dTLB-loads:u
(14.28%)
           304,426      dTLB-store-misses:u
(14.28%)
    73,961,570,202      dTLB-stores:u
(14.28%)
             5,488      iTLB-load-misses:u        #    0.00% of all iTLB
cache accesses  (14.28%)
   383,391,530,027      iTLB-loads:u
(14.28%)
               560      node-load-misses:u
(14.28%)
       301,907,089      node-loads:u
(14.28%)
             1,484      node-prefetch-misses:u
(7.14%)
       475,242,662      node-prefetches:u
(7.14%)
                 0      node-store-misses:u
(7.14%)
        25,147,355      node-stores:u
(7.14%)

      73.650137967 seconds time elapsed

      72.723236000 seconds user
       0.012604000 seconds sys
```

s)

```
 Performance counter stats for './ssca2 17':

     4,130,196,129      L1-dcache-load-misses:u   #   36.42% of all L1-
dcache accesses  (10.71%)
```

```
    11,341,237,747      L1-dcache-loads:u
(14.28%)
       483,874,456      L1-dcache-prefetch-misses:u
(14.28%)
           836,558      L1-dcache-prefetches:u
(14.28%)
       647,540,900      L1-dcache-store-misses:u
(14.29%)
     2,647,752,876      L1-dcache-stores:u
(14.29%)
           546,805      L1-icache-load-misses:u   #    0.00% of all L1-
icache accesses  (14.29%)
    32,075,225,580      L1-icache-loads:u
(14.29%)
       290,288,003      LLC-load-misses:u         #   10.22% of all LL-
cache accesses  (14.29%)
     2,840,829,137      LLC-loads:u
(14.29%)
         1,229,459      LLC-prefetch-misses:u
(7.14%)
         4,755,109      LLC-prefetches:u
(7.14%)
        39,641,754      LLC-store-misses:u
(7.14%)
     1,911,332,731      LLC-stores:u
(7.14%)
    10,819,311,257      branch-load-misses:u
(10.72%)
     5,853,271,583      branch-loads:u
(14.29%)
       729,368,723      dTLB-load-misses:u        #    6.41% of all dTLB
cache accesses  (14.29%)
    11,384,895,643      dTLB-loads:u
(14.29%)
       140,237,284      dTLB-store-misses:u
(14.29%)
     2,668,668,444      dTLB-stores:u
(14.29%)
           235,872      iTLB-load-misses:u        #    0.00% of all iTLB
cache accesses  (14.29%)
    34,355,222,136      iTLB-loads:u
(14.29%)
               300      node-load-misses:u
(14.29%)
       288,325,059      node-loads:u
(14.29%)
             1,329      node-prefetch-misses:u
(7.14%)
         1,130,419      node-prefetches:u
(7.14%)
                 0      node-store-misses:u
(7.14%)
        39,532,648      node-stores:u
(7.14%)
```

```
       26.739826313 seconds time elapsed

       26.348368000 seconds user
        0.014802000 seconds sys
```

L1 Cache:

- ssca2 has a significantly higher L1 cache miss rate (36.42%) compared to npb_bt_a (4.37%).

LLC (Last Level Cache):

- npb_bt_a has a higher LLC miss rate (52.23%) compared to ssca2 (10.22%).

Branches:

- ssca2 has a much higher number of branch load misses, indicating potentially less optimized branch prediction.

TLB (Translation Lookaside Buffer):

- ssca2 has more dTLB load misses, suggesting more frequent translation cache misses.

Conclusion

In summary, ssca2 experiences higher cache miss rates across different levels compared to npb_bt_a. This suggests potential inefficiencies in memory access and branch prediction in ssca2. Further optimization efforts may be needed to enhance its performance.

Time influence

npb_bt_a:

time with perf: 1:16.39 time without perf: 1:13.95

ssca2: time with perf: 0:31.75 time without perf: 0:32.53