# ME 766 - HW 3

Profilers used: gprof and valgrind

I did not get a call graph on profiling with gprof maybe due to the fact that the entire calculation has been done in main function itself and size of the problem is small.

## Commands used to obtain the outputs:

**Hit and miss rate using Valgrind:**

$ gcc trapezoid_parallel.c -g -lm -fopenmp
$ valgrind --tool=callgrind --simulate-cache=yes ./a.out

**Detailed profiled graph using valgrind:**

$ callgrind_annotate --inclusive=yes callgrind.out.6043

**gprof output**

$ gcc montecarlo_parallel.c -g -lm -fopenmp -pg
$ ./a.out
$ gprof a.out gmon.out

## Trapezoid Serial

**Hit and miss rate using Valgrind:**

==6043== Callgrind, a call-graph generating cache profiler
==6043== Copyright (C) 2002-2015, and GNU GPL'd, by Josef Weidendorfer et al.
==6043== Using Valgrind-3.11.0 and LibVEX; rerun with -h for copyright info
==6043== Command: ./trap
==6043==
--6043-- warning: L3 cache found, using its data for the LL simulation.
==6043== For interactive control, run 'callgrind_control -h'.
N= 10000000
Integration Answer = 2.000000000
Error = 0.0000000207
Time: 13.730920262
==6043==
==6043== Events    : Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
==6043== Collected : 1179956263 250309092 90762277 1643 3657 847 1561 2563 747
==6043==
**==6043== I   refs:     1,179,956,263**
**==6043== I1  misses:         1,643**
**==6043== LLi misses:         1,561**
**==6043== I1  miss rate:        0.00%**
**==6043== LLi miss rate:        0.00%**
**==6043==**
**==6043== D   refs:      341,071,369  (250,309,092 rd + 90,762,277 wr)**
**==6043== D1  misses:         4,504  (    3,657 rd +      847 wr)**
**==6043== LLd misses:         3,310  (    2,563 rd +      747 wr)**
**==6043== D1  miss rate:        0.0% (     0.0%  +     0.0%  )**
**==6043== LLd miss rate:        0.0% (     0.0%  +     0.0%  )**
**==6043==**

```
==6043== LL refs:         6,147 (    5,300 rd +      847 wr)
==6043== LL misses:       4,871 (    4,124 rd +      747 wr)
==6043== LL miss rate:     0.0% (     0.0%  +      0.0% )
```

**Detailed profiled graph using valgrind:**

```
--------------------------------------------------------------------------------
Profile data file 'callgrind.out.6043' (creator: callgrind-3.11.0)
--------------------------------------------------------------------------------
I1 cache: 32768 B, 64 B, 8-way associative
D1 cache: 32768 B, 64 B, 8-way associative
LL cache: 8388608 B, 64 B, 16-way associative
Timerange: Basic block 0 - 161281235
Trigger: Program termination
Profiled target:  ./trap (PID 6043, part 1)
Events recorded:  Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
Events shown:     Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
Event sort order: Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
Thresholds:      99 0 0 0 0 0 0 0 0
Include dirs:
User annotated:
Auto-annotation:  off
```

```
--------------------------------------------------------------------------------
      Ir         Dr         Dw  I1mr  D1mr  D1mw  ILmr  DLmr DLmw
--------------------------------------------------------------------------------
1,179,956,266 250,309,092 90,762,277 1,644 3,657  847 1,562 2,563  747  PROGRAM TOTALS
```

```
--------------------------------------------------------------------------------
      Ir         Dr         Dw  I1mr  D1mr  D1mw  ILmr  DLmr DLmw  file:function
--------------------------------------------------------------------------------
1,179,956,266 250,309,092 90,762,277 1,644 3,657  847 1,562 2,563  747  ???:
0x0000000000000c30 [/lib/x86_64-linux-gnu/ld-2.23.so]
1,179,745,767 250,253,514 90,741,062  804 1,706   97  734 1,054   48  /build/glibc-Cl5G7W/
glibc-2.23/elf/../sysdeps/x86_64/dl-trampoline.h:_dl_runtime_resolve_avx [/lib/x86_64-linux-gnu/
ld-2.23.so]
1,179,661,043 250,232,366 90,737,800  591  250   28  529  118    3  ???:_start [/home/krishna/
Desktop/HPSC-Homeworks/HW1-Numerical-Integration-method-analysis/trap]
1,179,659,634 250,231,971 90,737,658  584  232   28  526  117    3  /build/glibc-Cl5G7W/
glibc-2.23/csu/../csu/libc-start.c:(below main) [/lib/x86_64-linux-gnu/libc-2.23.so]
1,179,655,547 250,230,864 90,737,177  438  153   17  424  108    1  ???:main [/home/krishna/
Desktop/HPSC-Homeworks/HW1-Numerical-Integration-method-analysis/trap]
1,029,640,749 180,227,187 40,735,183  172   73    0  172   73    .  /build/glibc-Cl5G7W/
glibc-2.23/math/../sysdeps/ieee754/dbl-64/s_sin.c:__sin_avx [/lib/x86_64-linux-gnu/libm-2.23.so]
   90,000,009  10,000,001 20,000,002    .    .    .    .    .    .  /build/glibc-Cl5G7W/glibc-2.23/
math/../sysdeps/i386/fpu/fenv_private.h:__sin_avx
    7,021,647   1,322,919    101,763    6    0    0    6    .    .  /build/glibc-Cl5G7W/glibc-2.23/
math/../sysdeps/ieee754/dbl-64/s_sin.c:do_cos_slow.isra.1 [/lib/x86_64-linux-gnu/libm-2.23.so]
```

**gprof output**

Flat profile:

```
Each sample counts as 0.01 seconds.
  %   cumulative  self            self    total
 time  seconds  seconds   calls Ts/call Ts/call  name
100.85   0.03    0.03                      main
```

```
 %       the percentage of the total running time of the
```

time      program used by this function.

cumulative a running sum of the number of seconds accounted
 seconds   for by this function and those listed above it.

 self     the number of seconds accounted for by this
seconds    function alone.  This is the major sort for this
          listing.

calls     the number of times this function was invoked, if
          this function is profiled, else blank.

 self     the average number of milliseconds spent in this
ms/call    function per call, if this function is profiled,
             else blank.

 total    the average number of milliseconds spent in this
ms/call    function and its descendents per call, if this
            function is profiled, else blank.

name      the name of the function.  This is the minor sort
          for this listing. The index shows the location of
            the function in the gprof listing. If the index is
            in parenthesis it shows where it would appear in
            the gprof listing if it were to be printed.

# Trapezoid openmp

**Hit and miss rate using Valgrind:**

==6003== Callgrind, a call-graph generating cache profiler
==6003== Copyright (C) 2002-2015, and GNU GPL'd, by Josef Weidendorfer et al.
==6003== Using Valgrind-3.11.0 and LibVEX; rerun with -h for copyright info
==6003== Command: ./trap
==6003==
--6003-- warning: L3 cache found, using its data for the LL simulation.
==6003== For interactive control, run 'callgrind_control -h'.
N= 10000
Integration Answer = 1.9999999836
Error = -0.0000008225 Time: 0.049986029
==6003==
==6003== Events    : Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
==6003== Collected : 1753603 393684 122092 1834 3986 1118 1705 2608 978
==6003==
**==6003== I   refs:     1,753,603**
**==6003== I1  misses:      1,834**
**==6003== LLi misses:      1,705**
**==6003== I1  miss rate:     0.10%**
**==6003== LLi miss rate:      0.10%**
**==6003==**
**==6003== D   refs:      515,776  (393,684 rd + 122,092 wr)**

```
==6003== D1  misses:       5,104 (  3,986 rd +   1,118 wr)
==6003== LLd misses:       3,586 (  2,608 rd +    978 wr)
==6003== D1  miss rate:     1.0% (   1.0%  +    0.9%  )
==6003== LLd miss rate:     0.7% (   0.7%  +    0.8%  )
==6003==
==6003== LL refs:          6,938 (  5,820 rd +   1,118 wr)
==6003== LL misses:        5,291 (  4,313 rd +    978 wr)
==6003== LL miss rate:      0.2% (   0.2%  +    0.8%  )
```

--------------------------------------------------------------------------------
Profile data file 'callgrind.out.6003' (creator: callgrind-3.11.0)
--------------------------------------------------------------------------------
I1 cache: 32768 B, 64 B, 8-way associative
D1 cache: 32768 B, 64 B, 8-way associative
LL cache: 8388608 B, 64 B, 16-way associative
Timerange: Basic block 0 - 305125
Trigger: Program termination
Profiled target:  ./trap (PID 6003, part 1)
Events recorded:  Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
Events shown:     Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
Event sort order: Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
Thresholds:      99 0 0 0 0 0 0 0 0
Include dirs:
User annotated:
Auto-annotation:  off

**Detailed profile graph using valgrind:**

--------------------------------------------------------------------------------
     Ir    Dr    Dw I1mr D1mr  D1mw  ILmr  DLmr DLmw
--------------------------------------------------------------------------------
1,753,616 393,685 122,093 1,835 3,986 1,118 1,706 2,608  978  PROGRAM TOTALS

--------------------------------------------------------------------------------
     Ir    Dr    Dw I1mr D1mr  D1mw  ILmr  DLmr DLmw  file:function
--------------------------------------------------------------------------------
1,264,145 273,438 80,489  182  162   94   179   73  76  /build/glibc-Cl5G7W/glibc-2.23/nptl/
pthread_create.c:start_thread [/lib/x86_64-linux-gnu/libpthread-2.23.so]
1,260,841 272,487 80,044  173  118   52   172   68  46  ???:0x000000000000f2e0 [/usr/lib/
x86_64-linux-gnu/libgomp.so.1.0.0]
1,244,406 281,073 91,088  164   99   42   163   68  40  ???:main._omp_fn.0 [/home/krishna/
Desktop/HPSC-Homeworks/HW1-Numerical-Integration-method-analysis/trap]
1,031,919 180,402 40,801  169   79   17   168   72  15  /build/glibc-Cl5G7W/glibc-2.23/math/../
sysdeps/ieee754/dbl-64/s_sin.c:__sin_avx [/lib/x86_64-linux-gnu/libm-2.23.so]
  489,408 120,233 41,597 1,652 3,819 1,024 1,526 2,535 902  ???:0x0000000000000c30 [/lib/
x86_64-linux-gnu/ld-2.23.so]
  283,450  65,820 20,850  816 1,907  305   700 1,031 234  /build/glibc-Cl5G7W/glibc-2.23/elf/../
sysdeps/x86_64/dl-trampoline.h:_dl_runtime_resolve_avx [/lib/x86_64-linux-gnu/ld-2.23.so]
  204,160  46,571 17,868  439  528  255   339   99 182  /build/glibc-Cl5G7W/glibc-2.23/elf/../
sysdeps/x86_64/dl-trampoline.h:_dl_runtime_resolve_avx'2 [/lib/x86_64-linux-gnu/ld-2.23.so]
  198,037  52,030 20,623  686 1,886  727   678 1,502 690  /build/glibc-Cl5G7W/glibc-2.23/elf/
rtld.c:_dl_start [/lib/x86_64-linux-gnu/ld-2.23.so]
  197,389  51,893 20,556  663 1,862  708   657 1,480 672  /build/glibc-Cl5G7W/glibc-2.23/elf/../
elf/dl-sysdep.c:_dl_sysdep_start [/lib/x86_64-linux-gnu/ld-2.23.so]
  196,665  51,723 20,493  626 1,839  701   622 1,459 665  /build/glibc-Cl5G7W/glibc-2.23/elf/
rtld.c:dl_main [/lib/x86_64-linux-gnu/ld-2.23.so]
  193,730  43,288 17,070  595  379  203   489   84 156  ???:_start [/home/krishna/Desktop/
HPSC-Homeworks/HW1-Numerical-Integration-method-analysis/trap]

192,329 42,892 16,928 589 359 203 486 82 156 /build/glibc-Cl5G7W/glibc-2.23/csu/../csu/libc-start.c:(below main) [/lib/x86_64-linux-gnu/libc-2.23.so]

188,233 41,783 16,445 440 264 192 385 75 154 ???:main [/home/krishna/Desktop/HPSC-Homeworks/HW1-Numerical-Integration-method-analysis/trap]

169,930 37,210 14,082 145 137 179 123 17 152 ???:GOMP_parallel [/usr/lib/x86_64-linux-gnu/libgomp.so.1.0.0]

138,936 40,347 14,520 79 923 68 47 449 21 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-lookup.c:_dl_lookup_symbol_x [/lib/x86_64-linux-gnu/ld-2.23.so]

133,686 37,850 14,135 125 1,447 313 125 1,130 281 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-reloc.c:_dl_relocate_object [/lib/x86_64-linux-gnu/ld-2.23.so]

121,125 34,894 13,687 100 1,210 311 100 964 281 /build/glibc-Cl5G7W/glibc-2.23/elf/../sysdeps/x86_64/dl-machine.h:_dl_relocate_object

105,815 33,572 10,544 69 774 45 37 333 11 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-lookup.c:do_lookup_x [/lib/x86_64-linux-gnu/ld-2.23.so]

105,516 15,116 13 4 7 0 4 . . ???:0x0000000000011bd0 [/usr/lib/x86_64-linux-gnu/libgomp.so.1.0.0]

97,622 24,912 3,901 369 1,553 93 357 949 55 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-init.c:_dl_init [/lib/x86_64-linux-gnu/ld-2.23.so]

97,486 24,876 3,886 365 1,550 93 353 949 55 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-init.c:call_init.part.0 [/lib/x86_64-linux-gnu/ld-2.23.so]

90,476 23,144 3,129 249 1,436 69 241 921 37 ???:0x0000000000006c60 [/usr/lib/x86_64-linux-gnu/libgomp.so.1.0.0]

90,027 10,003 20,006 . . . . . . /build/glibc-Cl5G7W/glibc-2.23/math/../sysdeps/i386/fpu/fenv_private.h:__sin_avx

73,685 18,018 2,203 188 1,314 61 182 889 37 ???:0x0000000000011620 [/usr/lib/x86_64-linux-gnu/libgomp.so.1.0.0]

65,063 15,695 1,313 157 1,159 50 155 868 36 /build/glibc-Cl5G7W/glibc-2.23/posix/../sysdeps/unix/sysv/linux/x86/sysconf.c:sysconf [/lib/x86_64-linux-gnu/libc-2.23.so]

65,047 15,692 1,311 153 1,158 50 151 868 36 /build/glibc-Cl5G7W/glibc-2.23/posix/../sysdeps/posix/sysconf.c:sysconf

65,038 15,691 1,310 151 1,157 50 149 867 36 /build/glibc-Cl5G7W/glibc-2.23/misc/../sysdeps/unix/sysv/linux/getsysstats.c:get_nprocs_conf [/lib/x86_64-linux-gnu/libc-2.23.so]

63,462 9,095 44 7 3 1 7 . . ???:0x0000000000011e30 [/usr/lib/x86_64-linux-gnu/libgomp.so.1.0.0]

60,924 14,662 686 101 1,135 56 87 848 40 /build/glibc-Cl5G7W/glibc-2.23/malloc/malloc.c:malloc [/lib/x86_64-linux-gnu/libc-2.23.so]

59,980 14,517 536 98 1,134 53 83 848 37 ???:0x00000000053918a0 [???]

59,849 14,493 517 90 1,133 49 88 849 36 /build/glibc-Cl5G7W/glibc-2.23/dirent/../sysdeps/posix/opendir.c:opendir [/lib/x86_64-linux-gnu/libc-2.23.so]

59,780 14,480 504 81 1,128 49 79 848 36 /build/glibc-Cl5G7W/glibc-2.23/malloc/hooks.c:malloc_hook_ini [/lib/x86_64-linux-gnu/libc-2.23.so]

59,767 14,475 501 79 1,126 49 77 847 36 /build/glibc-Cl5G7W/glibc-2.23/malloc/malloc.c:malloc_hook_ini

58,694 14,392 177 29 1,115 11 27 844 1 /build/glibc-Cl5G7W/glibc-2.23/malloc/arena.c:ptmalloc_init.part.5 [/lib/x86_64-linux-gnu/libc-2.23.so]

58,187 14,223 168 23 1,064 9 21 843 1 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-addr.c:_dl_addr [/lib/x86_64-linux-gnu/libc-2.23.so]

43,420 7,809 2,573 113 102 167 95 16 143 ???:0x000000000000f5d0 [/usr/lib/x86_64-linux-gnu/libgomp.so.1.0.0]

42,870 11,837 3,910 52 533 58 17 130 22 /build/glibc-Cl5G7W/glibc-2.23/elf/../elf/dl-runtime.c:_dl_fixup [/lib/x86_64-linux-gnu/ld-2.23.so]

39,719 9,206 1,796 27 62 1 24 2 1 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-misc.c:_dl_name_match_p [/lib/x86_64-linux-gnu/ld-2.23.so]

37,577 8,124 0 93 152 0 66 72 . /build/glibc-Cl5G7W/glibc-2.23/string/../sysdeps/x86_64/multiarch/../strcmp.S:strcmp [/lib/x86_64-linux-gnu/ld-2.23.so]

37,517 7,526 3,901 138 193 223 138 173 222 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-deps.c:_dl_map_object_deps [/lib/x86_64-linux-gnu/ld-2.23.so]

35,120 7,110 3,740 182 184 245 182 184 245 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-error.c:_dl_catch_error [/lib/x86_64-linux-gnu/ld-2.23.so]

33,938  6,738 3,275  173  184  237  173  184 237 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-load.c:_dl_map_object [/lib/x86_64-linux-gnu/ld-2.23.so]
31,818  6,369 3,059  91  164  209  91  164 209 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-deps.c:openaux [/lib/x86_64-linux-gnu/ld-2.23.so]
16,484  4,569 1,223  48  73  40  47  63  39 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-error.c:_dl_receive_error [/lib/x86_64-linux-gnu/ld-2.23.so]

**gprof output**

Flat profile:

Each sample counts as 0.01 seconds.
 no time accumulated

  %   cumulative  self           self    total
 time   seconds   seconds   calls Ts/call Ts/call  name
52.65    0.06    0.06                     main


 %        the percentage of the total running time of the
time       program used by this function.

cumulative a running sum of the number of seconds accounted
 seconds   for by this function and those listed above it.

 self     the number of seconds accounted for by this
seconds    function alone.  This is the major sort for this
        listing.

calls     the number of times this function was invoked, if
        this function is profiled, else blank.

 self     the average number of milliseconds spent in this
ms/call    function per call, if this function is profiled,
         else blank.

 total     the average number of milliseconds spent in this
ms/call    function and its descendents per call, if this
         function is profiled, else blank.

name      the name of the function.  This is the minor sort
        for this listing. The index shows the location of
         the function in the gprof listing. If the index is
         in parenthesis it shows where it would appear in
         the gprof listing if it were to be printed.

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# Trapezoid MPI

**Hit and miss rate using Valgrind:**

==6321== Callgrind, a call-graph generating cache profiler
==6321== Copyright (C) 2002-2015, and GNU GPL'd, by Josef Weidendorfer et al.
==6321== Using Valgrind-3.11.0 and LibVEX; rerun with -h for copyright info
==6321== Command: ./trap
==6321==
--6321-- warning: L3 cache found, using its data for the LL simulation.
==6321== For interactive control, run 'callgrind_control -h'.
DRM_IOCTL_I915_GEM_APERTURE failed: Invalid argument
Assuming 131072kB available aperture size.
May lead to reduced performance or incorrect rendering.
get chip id failed: -1 [2]
param: 4, val: 0
DRM_IOCTL_I915_GEM_APERTURE failed: Invalid argument
Assuming 131072kB available aperture size.
May lead to reduced performance or incorrect rendering.
get chip id failed: -1 [2]
param: 4, val: 0
beignet-opencl-icd: no supported GPU found, this is probably the wrong opencl-icd package for this hardware
(If you have multiple ICDs installed and OpenCL works, you can ignore this message)
Answer = 2.00000
N = 1000
Time = 0.00855
Error = -0.00008
Number of processes = 1
==6321==
==6321== Events    : Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
==6321== Collected : 115159008 25028950 11790047 91485 790939 139838 15198 95274 86048
==6321==
**==6321== I   refs:      115,159,008**
**==6321== I1  misses:        91,485**
**==6321== LLi misses:        15,198**
**==6321== I1  miss rate:      0.08%**
**==6321== LLi miss rate:      0.01%**
**==6321==**
**==6321== D   refs:      36,818,997  (25,028,950 rd + 11,790,047 wr)**
**==6321== D1  misses:       930,777  (  790,939 rd +    139,838 wr)**
**==6321== LLd misses:       181,322  (   95,274 rd +     86,048 wr)**
**==6321== D1  miss rate:       2.5% (     3.2%   +       1.2%  )**
**==6321== LLd miss rate:       0.5% (     0.4%   +       0.7%  )**
**==6321==**
**==6321== LL refs:        1,022,262  (  882,424 rd +    139,838 wr)**
**==6321== LL misses:        196,520  (  110,472 rd +     86,048 wr)**
**==6321== LL miss rate:       0.1% (     0.1%   +       0.7%  )**

**Deltailed profile graph using Valgrind**

--------------------------------------------------------------------------------
Profile data file 'callgrind.out.6321' (creator: callgrind-3.11.0)
--------------------------------------------------------------------------------
I1 cache: 32768 B, 64 B, 8-way associative
D1 cache: 32768 B, 64 B, 8-way associative
LL cache: 8388608 B, 64 B, 16-way associative
Timerange: Basic block 0 - 24936693
Trigger: Program termination
Profiled target:  ./trap (PID 6321, part 1)
Events recorded:  Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
Events shown:     Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw

Event sort order: Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
Thresholds:       99 0 0 0 0 0 0 0 0
Include dirs:
User annotated:
Auto-annotation:  off

--------------------------------------------------------------------------------
        Ir        Dr        Dw    I1mr    D1mr    D1mw    ILmr    DLmr    DLmw
--------------------------------------------------------------------------------
115,159,016 25,028,950 11,790,047 91,486 790,939 139,838 15,199 95,274 86,048  PROGRAM
TOTALS


--------------------------------------------------------------------------------
        Ir        Dr        Dw    I1mr    D1mr    D1mw    ILmr    DLmr     DLmw  file:function
--------------------------------------------------------------------------------
418,999,042 94,737,582 42,690,438 260,752 3,392,064 648,222 53,208 520,572 456,533  /build/
glibc-Cl5G7W/glibc-2.23/elf/../sysdeps/x86_64/dl-trampoline.h:_dl_runtime_resolve_avx'2 [/lib/
x86_64-linux-gnu/ld-2.23.so]
115,103,809 25,015,649 11,780,572 90,880  790,567 139,660 14,998 95,167 85,923  ???:
0x0000000000000c30 [/lib/x86_64-linux-gnu/ld-2.23.so]
113,584,338 24,598,197 11,621,092 90,073  779,776 137,258 14,158 89,464 83,893  /build/
glibc-Cl5G7W/glibc-2.23/elf/../sysdeps/x86_64/dl-trampoline.h:_dl_runtime_resolve_avx [/lib/
x86_64-linux-gnu/ld-2.23.so]
113,434,071 24,560,454 11,608,069 89,281  777,991 137,041 13,596 88,495 83,729  ???:_start
[/home/krishna/Desktop/HPSC-Homeworks/HW2/trap]
113,432,688 24,560,057 11,607,927 89,266  777,974 137,041 13,593 88,494 83,729  /build/
glibc-Cl5G7W/glibc-2.23/csu/../csu/libc-start.c:(below main) [/lib/x86_64-linux-gnu/libc-2.23.so]
112,822,010 24,403,367 11,523,952 88,682  771,401 136,817 13,190 88,228 83,725  /home/
krishna/Desktop/HPSC-Homeworks/HW2/trapezoid_mpi.c:main
112,822,010 24,403,367 11,523,952 88,682  771,401 136,817 13,190 88,228 83,725
trapezoid_mpi.c:main [/home/krishna/Desktop/HPSC-Homeworks/HW2/trap]
110,502,007 23,798,372 11,216,311 85,485  711,083 129,422 11,989 83,744
81,565  ???:PMPI_Init [/usr/lib/openmpi/lib/libmpi.so.12.0.2]
110,500,145 23,797,815 11,216,165 85,467  711,015 129,421 11,980 83,741
81,565  ???:ompi_mpi_init [/usr/lib/openmpi/lib/libmpi.so.12.0.2]
 95,293,128 20,335,462 9,373,025 21,556  571,367 98,456 6,036 74,993
68,559  ???:opal_hwloc_base_get_topology [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]
 88,549,440 18,179,182 8,762,876 17,966  423,579 90,004 5,505 64,912
66,007  ???:hwloc_topology_load [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]
 86,579,941 17,709,599 8,424,074 11,791  421,571 89,082 4,676 64,528 65,454  ???:
0x0000000000001a60 [/usr/lib/openmpi/lib/openmpi/mca_coll_basic.so]
 64,979,520 12,024,164 6,253,367    485   19,295 23,383    85    268 13,807  ???:
0x0000000000003ac0 [/usr/lib/x86_64-linux-gnu/libpciaccess.so.0.11.1]
 58,035,478 16,507,597 5,865,384 41,333 1,038,549 192,337 10,063 202,489 153,858  /build/
glibc-Cl5G7W/glibc-2.23/elf/dl-error.c:_dl_catch_error'2 [/lib/x86_64-linux-gnu/ld-2.23.so]
 49,557,253 9,180,607 4,573,827    193  134,678 22,946    14     2
13,675  ???:pci_device_get_device_name [/usr/lib/x86_64-linux-gnu/libpciaccess.so.0.11.1]
 49,556,533 9,180,391 4,573,503    191  134,604 22,946    12     2 13,675  ???:
0x0000000000003e50 [/usr/lib/x86_64-linux-gnu/libpciaccess.so.0.11.1]
 27,650,540 8,005,950 2,732,975 34,159  557,529 78,401 5,104 79,264 55,737  /build/glibc-
Cl5G7W/glibc-2.23/elf/dl-error.c:_dl_catch_error [/lib/x86_64-linux-gnu/ld-2.23.so]
 27,427,754 7,956,453 2,711,985 34,026  556,126 77,489 4,905 78,655 54,999  /build/glibc-
Cl5G7W/glibc-2.23/dlfcn/dlerror.c:_dlerror_run [/lib/x86_64-linux-gnu/libdl-2.23.so]
 26,603,045 7,748,955 2,638,676 30,663  516,998 73,810 4,544 78,596 55,138  /build/glibc-
Cl5G7W/glibc-2.23/elf/dl-open.c:_dl_open [/lib/x86_64-linux-gnu/ld-2.23.so]
 26,589,307 7,745,457 2,634,776 30,094  516,612 73,666 4,539 78,594 55,136  /build/glibc-
Cl5G7W/glibc-2.23/elf/dl-open.c:dl_open_worker [/lib/x86_64-linux-gnu/ld-2.23.so]
 26,487,626 7,721,525 2,629,695 30,870  515,874 73,673 4,554 78,351 54,973  /build/glibc-
Cl5G7W/glibc-2.23/dlfcn/dlopen.c:dlopen@@GLIBC_2.2.5 [/lib/x86_64-linux-gnu/libdl-2.23.so]

26,476,656 7,718,239 2,626,911 30,053 515,507 73,530 4,527 78,348 54,973 /build/glibc-Cl5G7W/glibc-2.23/dlfcn/dlopen.c:dlopen_doit [/lib/x86_64-linux-gnu/libdl-2.23.so]

22,219,572 4,388,338 2,893,216 161 8,042 524 36 254 126 ???:gzgets [/lib/x86_64-linux-gnu/libz.so.1.2.8]

20,931,689 6,540,639 2,028,095 4,888 455,132 62,775 180 80,960 48,697 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-reloc.c:_dl_relocate_object [/lib/x86_64-linux-gnu/ld-2.23.so]

19,844,500 6,269,218 2,006,149 3,725 445,069 62,757 153 73,174 48,697 /build/glibc-Cl5G7W/glibc-2.23/elf/../sysdeps/x86_64/dl-machine.h:_dl_relocate_object

18,875,858 6,134,340 1,873,980 5,953 405,690 5,934 98 15,357 161 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-lookup.c:_dl_lookup_symbol_x [/lib/x86_64-linux-gnu/ld-2.23.so]

18,241,725 3,407,224 1,681,240 321 1,902 466 83 266 148 ???:pci_device_get_vendor_name [/usr/lib/x86_64-linux-gnu/libpciaccess.so.0.11.1]

17,694,994 4,902,128 2,026,316 10,199 280,618 62,834 4,462 64,157 51,373 ???:hwloc_insert_pci_device_list [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]

17,670,465 4,895,312 2,023,503 10,023 280,430 62,812 4,405 64,126 51,371 ???:0x00000000000161d0 [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]

17,669,972 4,895,185 2,023,428 10,020 280,388 62,812 4,404 64,109 51,371 ???:0x0000000000015e90 [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]

17,669,864 4,895,134 2,023,428 10,019 280,353 62,812 4,404 64,093 51,371 ???:hwloc_backends_notify_new_object [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]

16,525,311 4,641,974 1,729,781 9,391 280,125 62,718 4,301 64,053 51,371 ???:0x0000000000000fd0 [/usr/lib/openmpi/lib/openmpi/mca_errmgr_default_app.so]

16,401,227 4,612,192 1,705,222 7,970 278,539 61,319 4,302 64,035 50,980 ???:clGetPlatformIDs [/usr/lib/x86_64-linux-gnu/beignet/libcl.so]

16,396,778 4,611,114 1,704,772 7,912 278,483 61,308 4,258 64,019 50,975 ???:0x0000000000004850 [/usr/lib/x86_64-linux-gnu/libOpenCL.so.1.0.0]

16,366,693 4,602,819 1,701,580 7,641 277,898 61,272 4,123 63,927 50,964 ???:0x0000000000004316 [/usr/lib/x86_64-linux-gnu/libOpenCL.so.1.0.0]

16,352,500 4,598,881 1,699,721 7,486 277,816 61,258 4,101 63,923 50,963 ???:0x00000000000042d7 [/usr/lib/x86_64-linux-gnu/libOpenCL.so.1.0.0]

16,015,914 4,490,910 1,665,016 8,584 265,668 60,379 5,101 63,505 50,504 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-init.c:_dl_init [/lib/x86_64-linux-gnu/ld-2.23.so]

16,010,689 4,489,185 1,664,510 8,378 265,592 60,379 5,097 63,504 50,504 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-init.c:call_init.part.0 [/lib/x86_64-linux-gnu/ld-2.23.so]

15,512,065 4,357,417 1,607,044 5,024 257,615 58,729 3,173 61,890 49,244 ???:0x0000000000008cd0 [/usr/lib/x86_64-linux-gnu/beignet/libcl.so]

15,284,569 4,284,656 1,584,009 4,503 253,074 58,518 2,751 61,782 49,097 /build/glibc-Cl5G7W/glibc-2.23/dlfcn/dlerror.c:_dlerror_run'2 [/lib/x86_64-linux-gnu/libdl-2.23.so]

15,232,974 4,269,084 1,578,659 4,455 252,788 58,514 2,741 61,670 49,097 /build/glibc-Cl5G7W/glibc-2.23/dlfcn/dlopen.c:dlopen@@GLIBC_2.2.5'2 [/lib/x86_64-linux-gnu/libdl-2.23.so]

15,232,684 4,268,996 1,578,579 4,435 252,774 58,510 2,740 61,670 49,096 /build/glibc-Cl5G7W/glibc-2.23/dlfcn/dlopen.c:dlopen_doit'2 [/lib/x86_64-linux-gnu/libdl-2.23.so]

15,232,626 4,268,966 1,578,567 4,429 252,769 58,508 2,740 61,670 49,096 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-open.c:_dl_open'2 [/lib/x86_64-linux-gnu/ld-2.23.so]

15,232,232 4,268,864 1,578,461 4,404 252,748 58,506 2,736 61,668 49,095 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-open.c:dl_open_worker'2 [/lib/x86_64-linux-gnu/ld-2.23.so]

15,079,339 5,445,996 1,558,004 4,967 393,187 5,540 59 7,970 144 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-lookup.c:do_lookup_x [/lib/x86_64-linux-gnu/ld-2.23.so]

12,371,666 2,818,809 1,466,679 51,376 116,639 22,939 2,207 6,611 8,465 ???:mca_base_framework_open [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]

12,083,569 2,752,471 1,435,751 48,951 112,141 22,055 1,387 6,326 8,160 ???:mca_base_framework_register [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]

10,953,822 2,522,906 1,267,197 45,103 110,024 20,666 1,180 6,082 7,669 ???:mca_base_framework_components_register [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]

7,575,112 990,448 0 72 8 0 7 5 . /build/glibc-Cl5G7W/glibc-2.23/string/../sysdeps/x86_64/multiarch/../strchr.S:__GI_strchr [/lib/x86_64-linux-gnu/libc-2.23.so]

7,108,632 1,603,177 840,373 32,821 43,130 12,666 2,027 2,896 4,887 ???:orte_init [/usr/lib/openmpi/lib/libopen-rte.so.12.0.2]

7,105,565 1,464,236  953,109  9,401   6,787 6,523  225  1,413 1,682 ???:mca_base_var_register [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]
 6,731,676 2,152,964  608,450  3,514  147,570 8,377  484 10,024 2,548 ???:hwloc_topology_init [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]
 6,727,882 2,152,279  607,768  3,481  147,547 8,344  469 10,023 2,548 ???: 0x00000000000110e0 [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]
 6,673,069 2,137,097  601,616  3,138  146,879 8,326  308  9,962 2,548 ???:lt_dlforeachfile [/usr/lib/x86_64-linux-gnu/libltdl.so.7.3.1]
 6,673,053 2,137,094  601,612  3,136  146,879 8,326  307  9,962 2,548 ???: 0x0000000000003060 [/usr/lib/x86_64-linux-gnu/libltdl.so.7.3.1]
 6,669,854 2,136,422  601,255  3,109  146,855 8,325  289  9,958 2,548 ???: 0x00000000000036e0 [/usr/lib/x86_64-linux-gnu/libltdl.so.7.3.1]
 6,651,384 2,132,028  599,318  2,954  146,748 8,319  244  9,944 2,547 ???: 0x0000000000010950 [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]
 6,623,062 2,124,886  595,656  2,313  146,267 8,269  205  9,925 2,547 ???:lt_dlopenadvise [/usr/lib/x86_64-linux-gnu/libltdl.so.7.3.1]
 6,622,490 2,124,763  595,575  2,286  146,263 8,269  198  9,925 2,547 ???: 0x00000000000041e0 [/usr/lib/x86_64-linux-gnu/libltdl.so.7.3.1]
 6,609,576 2,121,534  593,960  2,190  146,177 8,262  154  9,914 2,547 ???:lt_dlopenext [/usr/lib/x86_64-linux-gnu/libltdl.so.7.3.1]
 6,585,358 2,116,718  590,212  1,845  146,099 8,225  147  9,912 2,547 ???: 0x0000000000002b20 [/usr/lib/x86_64-linux-gnu/libltdl.so.7.3.1]
 6,583,355 2,116,303  589,916  1,767  146,076 8,219  135  9,912 2,547 ???: 0x0000000000006080 [/usr/lib/x86_64-linux-gnu/libltdl.so.7.3.1]
 6,205,795  677,714    0   209   7,322  0   14  238   . /build/glibc-Cl5G7W/ glibc-2.23/string/../sysdeps/x86_64/memchr.S:memchr [/lib/x86_64-linux-gnu/libc-2.23.so]
 5,876,593  968,637  941,105  2,101   5,507 15,799  187  868 5,101 /build/glibc-Cl5G7W/glibc-2.23/malloc/malloc.c:malloc [/lib/x86_64-linux-gnu/libc-2.23.so]
 5,532,466 1,402,243  540,998 36,773  102,921 15,285  574  4,906 6,761 ???:mca_base_component_find [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]
 5,484,274  873,227  316,157  311   536   0   29   16   . /build/glibc-Cl5G7W/ glibc-2.23/stdlib/../stdlib/strtol.c:strtoul [/lib/x86_64-linux-gnu/libc-2.23.so]
 5,427,515  825,358  321,274  354   509   4   25   17   . /build/glibc-Cl5G7W/ glibc-2.23/stdlib/../stdlib/strtol_l.c:____strtoul_l_internal [/lib/x86_64-linux-gnu/libc-2.23.so]
 5,140,734 1,056,849  682,323  6,491   4,527 4,750  31  982 736 ???:mca_base_component_var_register [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]
 4,923,670  676,494  892,953  3,017   5,184 17,905  124   50 5,518 /build/glibc-Cl5G7W/glibc-2.23/malloc/malloc.c:_int_malloc [/lib/x86_64-linux-gnu/libc-2.23.so]
 4,176,938  899,834  516,576  3,358   4,151 5,816 2,690  288 5,041 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-init.c:_dl_init'2 [/lib/x86_64-linux-gnu/ld-2.23.so]
 4,176,681  899,752  516,557  3,350   4,140 5,816 2,689  288 5,041 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-init.c:call_init.part.0'2 [/lib/x86_64-linux-gnu/ld-2.23.so]
 3,984,576 1,103,099  420,713 33,311  97,840 7,077  415  4,650 1,782 ???: 0x0000000000036aa0 [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]
 3,957,915  595,147  606,414  1,383   2,012 7,855  7  683  547 /build/glibc-Cl5G7W/ glibc-2.23/string/strdup.c:strdup [/lib/x86_64-linux-gnu/libc-2.23.so]
 3,892,532  833,648  467,428  310   487 4,021  158   79 3,783 ???: 0x00000000003197d0 [/usr/lib/x86_64-linux-gnu/beignet/libgbe.so]
 3,878,980  833,552  460,676  186   486 3,998  91   79 3,777 ???: 0x0000000000319420 [/usr/lib/x86_64-linux-gnu/beignet/libgbe.so]
 3,665,086 1,030,804  360,598 23,467  93,276 4,827  337  4,525 1,466 ???:opal_dl_open [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]
 3,600,517  578,742  589,993  728   3,570 8,592  114  861  791 ???: 0x00000000054458a0 [???]
 3,519,523  823,563  436,066 22,054  32,652 8,493  951  1,839 2,352 ???: 0x00000000000011b0 [/usr/lib/openmpi/lib/openmpi/mca_ess_singleton.so]
 3,519,170  160,449 1,262,833   64   0   15   10   .   . /build/glibc-Cl5G7W/ glibc-2.23/string/../sysdeps/x86_64/multiarch/memset-avx2.S:__memset_avx2 [/lib/x86_64-linux-gnu/libc-2.23.so]

3,207,328 786,895 614,086 380 725 538 9 132 137 /build/glibc-Cl5G7W/ glibc-2.23/string/../sysdeps/x86_64/multiarch/memcpy-avx-unaligned.S:__memcpy_avx_unaligned [/lib/x86_64-linux-gnu/libc-2.23.so]

3,181,849 746,291 400,586 19,980 29,845 7,993 553 1,464 2,182 ???:orte_ess_base_app_setup [/usr/lib/openmpi/lib/libopen-rte.so.12.0.2]

2,874,527 742,921 448,015 2,747 23,244 658 42 1,840 84 /build/glibc-Cl5G7W/ glibc-2.23/malloc/malloc.c:free [/lib/x86_64-linux-gnu/libc-2.23.so]

2,508,735 564,312 307,712 6,208 21,155 3,933 347 1,526 1,164 ???:mca_base_framework_open'2 [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]

2,478,096 601,872 364,547 2,326 17,962 1,863 43 848 112 /build/glibc-Cl5G7W/glibc-2.23/malloc/malloc.c:_int_free [/lib/x86_64-linux-gnu/libc-2.23.so]

2,371,975 519,406 475,106 4,530 1,096 1,854 77 69 327 /build/glibc-Cl5G7W/ glibc-2.23/debug/asprintf_chk.c:__asprintf_chk [/lib/x86_64-linux-gnu/libc-2.23.so]

2,342,071 517,537 460,154 4,317 1,096 1,797 72 69 326 /build/glibc-Cl5G7W/ glibc-2.23/debug/vasprintf_chk.c:__vasprintf_chk [/lib/x86_64-linux-gnu/libc-2.23.so]

2,341,116 563,506 436,148 5,793 2,430 2,399 320 150 187 /build/glibc-Cl5G7W/glibc-2.23/stdio-common/vfprintf.c:vfprintf [/lib/x86_64-linux-gnu/libc-2.23.so]

2,317,067 496,926 236,472 6,593 5,478 2,156 847 516 1,189 ???:opal_init [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]

2,288,040 508,129 380,004 1,908 10,896 17,522 83 77 13,947 /build/glibc-Cl5G7W/glibc-2.23/malloc/malloc.c:realloc [/lib/x86_64-linux-gnu/libc-2.23.so]

2,249,836 507,025 278,384 4,924 18,059 3,487 330 1,366 1,004 ???: 0x000000000007d290 [/usr/lib/openmpi/lib/libmpi.so.12.0.2]

2,182,482 573,680 296,218 2,859 60,084 7,376 982 4,358 2,156 ???:PMPI_Finalize [/usr/lib/openmpi/lib/libmpi.so.12.0.2]

2,182,470 573,674 296,218 2,858 60,084 7,376 981 4,358 2,156 ???:ompi_mpi_finalize [/usr/lib/openmpi/lib/libmpi.so.12.0.2]

1,919,595 305,347 214,013 1,671 1,244 1,049 71 316 246 ???:mca_base_var_generate_full_name4 [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]

1,727,188 355,336 0 4,875 17,158 0 82 1,028 . /build/glibc-Cl5G7W/ glibc-2.23/string/../sysdeps/x86_64/multiarch/../strcmp.S:strcmp [/lib/x86_64-linux-gnu/ld-2.23.so]

1,724,639 383,200 111,859 12,119 50,322 4,557 242 1,390 1,870 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-load.c:_dl_map_object [/lib/x86_64-linux-gnu/ld-2.23.so]

1,716,381 382,537 73,114 1,403 20,202 79 26 20 4 /build/glibc-Cl5G7W/ glibc-2.23/elf/dl-misc.c:_dl_name_match_p [/lib/x86_64-linux-gnu/ld-2.23.so]

1,548,244 369,972 274,234 5,008 559 341 370 115 251 ???: 0x0000000000027910 [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]

1,467,554 408,253 158,375 717 10,810 2,485 708 5,697 2,110 /build/glibc-Cl5G7W/glibc-2.23/elf/rtld.c:_dl_start [/lib/x86_64-linux-gnu/ld-2.23.so]

1,466,906 408,116 158,308 694 10,786 2,466 687 5,675 2,092 /build/glibc-Cl5G7W/glibc-2.23/elf/../elf/dl-sysdep.c:_dl_sysdep_start [/lib/x86_64-linux-gnu/ld-2.23.so]

1,466,182 407,946 158,245 657 10,763 2,459 652 5,654 2,085 /build/glibc-Cl5G7W/glibc-2.23/elf/rtld.c:dl_main [/lib/x86_64-linux-gnu/ld-2.23.so]

1,389,989 402,836 129,015 3,168 30,076 859 33 2,256 50 /build/glibc-Cl5G7W/ glibc-2.23/elf/../elf/dl-runtime.c:_dl_fixup [/lib/x86_64-linux-gnu/ld-2.23.so]

1,367,099 296,794 214,216 20 23 1,255 3 0 1,178 ???: 0x0000000000319210 [/usr/lib/x86_64-linux-gnu/beignet/libgbe.so]

1,223,056 315,367 249,323 964 10,554 17,225 34 73 13,855 /build/glibc-Cl5G7W/glibc-2.23/malloc/malloc.c:_int_realloc [/lib/x86_64-linux-gnu/libc-2.23.so]

1,220,123 264,701 93,376 4,865 18,783 2,490 214 931 1,100 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-deps.c:_dl_map_object_deps [/lib/x86_64-linux-gnu/ld-2.23.so]

1,145,184 262,602 219,774 4,060 110 185 136 33 155 ???: 0x00000000000057cb [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]


# Montecarlo Serial

**Hit and Miss rate using Valgrind**

```
==6156== Callgrind, a call-graph generating cache profiler
==6156== Copyright (C) 2002-2015, and GNU GPL'd, by Josef Weidendorfer et al.
==6156== Using Valgrind-3.11.0 and LibVEX; rerun with -h for copyright info
==6156== Command: ./trap
==6156==
--6156-- warning: L3 cache found, using its data for the LL simulation.
==6156== For interactive control, run 'callgrind_control -h'.
N= 10000000
Integration Answer = 2.000000000
Error = 0.0000000207
Time: 13.560600534
==6156==
==6156== Events    : Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
==6156== Collected : 1179956284 250309094 90762280 1643 3657 847 1561 2563 747
==6156==
```

**==6156== I   refs:     1,179,956,284**
**==6156== I1  misses:         1,643**
**==6156== LLi misses:         1,561**
**==6156== I1  miss rate:      0.00%**
**==6156== LLi miss rate:       0.00%**
**==6156==**
**==6156== D   refs:      341,071,374  (250,309,094 rd + 90,762,280 wr)**
**==6156== D1  misses:         4,504  (    3,657 rd +      847 wr)**
**==6156== LLd misses:         3,310  (    2,563 rd +      747 wr)**
**==6156== D1  miss rate:       0.0% (    0.0%  +     0.0%  )**
**==6156== LLd miss rate:       0.0% (    0.0%  +     0.0%  )**
**==6156==**
**==6156== LL refs:            6,147  (    5,300 rd +      847 wr)**
**==6156== LL misses:          4,871  (    4,124 rd +      747 wr)**
**==6156== LL miss rate:        0.0% (    0.0%  +     0.0%  )**

**Deltailed profile graph using Valgrind**

```
--------------------------------------------------------------------------------
Profile data file 'callgrind.out.6156' (creator: callgrind-3.11.0)
--------------------------------------------------------------------------------
I1 cache: 32768 B, 64 B, 8-way associative
D1 cache: 32768 B, 64 B, 8-way associative
LL cache: 8388608 B, 64 B, 16-way associative
Timerange: Basic block 0 - 161281240
Trigger: Program termination
Profiled target:  ./trap (PID 6156, part 1)
Events recorded:  Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
Events shown:     Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
Event sort order: Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
Thresholds:       99 0 0 0 0 0 0 0 0
Include dirs:
User annotated:
Auto-annotation:  off


--------------------------------------------------------------------------------
        Ir        Dr       Dw I1mr D1mr D1mw ILmr DLmr DLmw
--------------------------------------------------------------------------------
1,179,956,287 250,309,094 90,762,280 1,644 3,657  847 1,562 2,563  747  PROGRAM TOTALS

--------------------------------------------------------------------------------
        Ir        Dr       Dw I1mr D1mr D1mw ILmr DLmr DLmw  file:function
--------------------------------------------------------------------------------
```

1,179,956,287 250,309,094 90,762,280 1,644 3,657 847 1,562 2,563 747 ???:
0x0000000000000c30 [/lib/x86_64-linux-gnu/ld-2.23.so]
1,179,745,788 250,253,516 90,741,065 804 1,706 97 734 1,054 48 /build/glibc-Cl5G7W/
glibc-2.23/elf/../sysdeps/x86_64/dl-trampoline.h:_dl_runtime_resolve_avx [/lib/x86_64-linux-gnu/
ld-2.23.so]
1,179,661,064 250,232,368 90,737,803 591 250 28 529 118 3 ???:_start [/home/krishna/
Desktop/HPSC-Homeworks/HW1-Numerical-Integration-method-analysis/trap]
1,179,659,655 250,231,973 90,737,661 584 232 28 526 117 3 /build/glibc-Cl5G7W/
glibc-2.23/csu/../csu/libc-start.c:(below main) [/lib/x86_64-linux-gnu/libc-2.23.so]
1,179,655,568 250,230,866 90,737,180 438 153 17 424 108 1 ???:main [/home/krishna/
Desktop/HPSC-Homeworks/HW1-Numerical-Integration-method-analysis/trap]
1,029,640,749 180,227,187 40,735,183 172 73 0 172 73 . /build/glibc-Cl5G7W/
glibc-2.23/math/../sysdeps/ieee754/dbl-64/s_sin.c:__sin_avx [/lib/x86_64-linux-gnu/libm-2.23.so]
  90,000,009 10,000,001 20,000,002 . . . . . . /build/glibc-Cl5G7W/glibc-2.23/
math/../sysdeps/i386/fpu/fenv_private.h:__sin_avx
   7,021,647 1,322,919 101,763 6 0 0 6 . . /build/glibc-Cl5G7W/glibc-2.23/
math/../sysdeps/ieee754/dbl-64/s_sin.c:do_cos_slow.isra.1 [/lib/x86_64-linux-gnu/libm-2.23.so]

# Montecarlo openmp

**Hit and Miss rate using Valgrind**

==5643== Callgrind, a call-graph generating cache profiler
==5643== Copyright (C) 2002-2015, and GNU GPL'd, by Josef Weidendorfer et al.
==5643== Using Valgrind-3.11.0 and LibVEX; rerun with -h for copyright info
==5643== Command: ./mon
==5643==
--5643-- warning: L3 cache found, using its data for the LL simulation.
==5643== For interactive control, run 'callgrind_control -h'.
N= 1000000
Integration Answer = 2.0019296530
Error = 0.0964826509
Time: 4.136073501
==5643==
==5643== Events    : Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
==5643== Collected : 235049242 57473923 27743354 1829 4000 1134 1706 2613 989
==5643==
**==5643== I   refs:     235,049,242**
**==5643== I1  misses:        1,829**
**==5643== LLi misses:        1,706**
**==5643== I1  miss rate:      0.00%**
**==5643== LLi miss rate:      0.00%**
**==5643==**
**==5643== D   refs:      85,217,277  (57,473,923 rd + 27,743,354 wr)**
**==5643== D1  misses:        5,134 (   4,000 rd +    1,134 wr)**
**==5643== LLd misses:        3,602 (   2,613 rd +      989 wr)**
**==5643== D1  miss rate:      0.0% (    0.0%  +      0.0%  )**
**==5643== LLd miss rate:      0.0% (    0.0%  +      0.0%  )**
**==5643==**
**==5643== LL refs:       6,963 (    5,829 rd +    1,134 wr)**
**==5643== LL misses:        5,308 (    4,319 rd +      989 wr)**
**==5643== LL miss rate:      0.0% (    0.0%  +      0.0%  )**

**Comprehensive profile data using valgrind**

--------------------------------------------------------------------------------

Profile data file 'callgrind.out.5643' (creator: callgrind-3.11.0)
--------------------------------------------------------------------------------
I1 cache: 32768 B, 64 B, 8-way associative
D1 cache: 32768 B, 64 B, 8-way associative
LL cache: 8388608 B, 64 B, 16-way associative
Timerange: Basic block 0 - 52081896
Trigger: Program termination
Profiled target:  ./mon (PID 5643, part 1)
Events recorded:  Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
Events shown:     Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
Event sort order: Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
Thresholds:       99 0 0 0 0 0 0 0 0
Include dirs:
User annotated:
Auto-annotation:  off


--------------------------------------------------------------------------------
       Ir        Dr        Dw  I1mr  D1mr  D1mw  ILmr  DLmr DLmw
--------------------------------------------------------------------------------
235,049,245 57,473,923 27,743,354 1,830 4,000 1,134 1,707 2,613  989  PROGRAM TOTALS


--------------------------------------------------------------------------------
       Ir        Dr        Dw  I1mr  D1mr  D1mw  ILmr  DLmr DLmw  file:function
--------------------------------------------------------------------------------
234,126,522 57,302,542 27,712,502  192  143   56  186   88  51 ???:main._omp_fn.0 [/home/krishna/Desktop/HPSC-Homeworks/HW1-Numerical-Integration-method-analysis/mon]
205,302,062 50,203,167 24,249,022  214  204  109  206   92  87 /build/glibc-Cl5G7W/glibc-2.23/nptl/pthread_create.c:start_thread [/lib/x86_64-linux-gnu/libpthread-2.23.so]
205,298,758 50,202,216 24,248,577  205  159   66  199   87  57 ???:0x000000000000f2e0 [/usr/lib/x86_64-linux-gnu/libgomp.so.1.0.0]
102,999,642 18,026,685  4,074,659  172   73   20  172   73  17 /build/glibc-Cl5G7W/glibc-2.23/math/../sysdeps/ieee754/dbl-64/s_sin.c:__sin_avx [/lib/x86_64-linux-gnu/libm-2.23.so]
 97,935,700 28,000,047 16,000,055    8   14   11    8    2   9 /build/glibc-Cl5G7W/glibc-2.23/stdlib/rand.c:rand [/lib/x86_64-linux-gnu/libc-2.23.so]
 89,935,700 26,000,047 14,000,055    7   11    6    7    2   4 /build/glibc-Cl5G7W/glibc-2.23/stdlib/random.c:random [/lib/x86_64-linux-gnu/libc-2.23.so]
 51,935,484 16,000,000  8,000,000    2    4    0    2    2   . /build/glibc-Cl5G7W/glibc-2.23/stdlib/random_r.c:random_r [/lib/x86_64-linux-gnu/libc-2.23.so]
 29,747,120  7,270,742  3,494,325 1,615 3,791 1,025 1,500 2,521 902 ???:0x0000000000000c30 [/lib/x86_64-linux-gnu/ld-2.23.so]
 29,543,122  7,216,994  3,473,834  802 1,912  307  692 1,030 235 /build/glibc-Cl5G7W/glibc-2.23/elf/../sysdeps/x86_64/dl-trampoline.h:_dl_runtime_resolve_avx [/lib/x86_64-linux-gnu/ld-2.23.so]
 29,461,620  7,197,209  3,470,648  412  499  258  332   93 182 /build/glibc-Cl5G7W/glibc-2.23/elf/../sysdeps/x86_64/dl-trampoline.h:_dl_runtime_resolve_avx'2 [/lib/x86_64-linux-gnu/ld-2.23.so]
 29,450,958  7,193,821  3,469,800  558  351  204  463   69 156 ???:_start [/home/krishna/Desktop/HPSC-Homeworks/HW1-Numerical-Integration-method-analysis/mon]
 29,449,310  7,193,430  3,469,658  550  330  204  460   67 156 /build/glibc-Cl5G7W/glibc-2.23/csu/../csu/libc-start.c:(below main) [/lib/x86_64-linux-gnu/libc-2.23.so]
 29,445,214  7,192,321  3,469,175  403  233  193  359   60 154 ???:main [/home/krishna/Desktop/HPSC-Homeworks/HW1-Numerical-Integration-method-analysis/mon]
 29,428,083  7,188,108  3,466,969  139  131  180  120   18 152 ???:GOMP_parallel [/usr/lib/x86_64-linux-gnu/libgomp.so.1.0.0]
  9,000,000  1,000,000  2,000,000    .    .    .    .    .   . /build/glibc-Cl5G7W/glibc-2.23/math/../sysdeps/i386/fpu/fenv_private.h:__sin_avx


**Gprof output**

Flat profile:

Each sample counts as 0.01 seconds.
```
  %   cumulative   self              self     total
 time   seconds   seconds    calls Ts/call Ts/call  name
100.68     1.98     1.98                             main
```

  %          the percentage of the total running time of the
time         program used by this function.

cumulative  a running sum of the number of seconds accounted
 seconds     for by this function and those listed above it.

 self        the number of seconds accounted for by this
seconds      function alone.  This is the major sort for this
             listing.

calls        the number of times this function was invoked, if
             this function is profiled, else blank.

 self        the average number of milliseconds spent in this
ms/call      function per call, if this function is profiled,
             else blank.

 total       the average number of milliseconds spent in this
ms/call      function and its descendents per call, if this
             function is profiled, else blank.

name         the name of the function.  This is the minor sort
             for this listing. The index shows the location of
             the function in the gprof listing. If the index is
             in parenthesis it shows where it would appear in
             the gprof listing if it were to be printed.

# Montecarlo MPI

**Hit and Miss rate using Valgrind**

==6259== Callgrind, a call-graph generating cache profiler
==6259== Copyright (C) 2002-2015, and GNU GPL'd, by Josef Weidendorfer et al.
==6259== Using Valgrind-3.11.0 and LibVEX; rerun with -h for copyright info
==6259== Command: ./a.out
==6259==
--6259-- warning: L3 cache found, using its data for the LL simulation.
==6259== For interactive control, run 'callgrind_control -h'.
DRM_IOCTL_I915_GEM_APERTURE failed: Invalid argument
Assuming 131072kB available aperture size.
May lead to reduced performance or incorrect rendering.
get chip id failed: -1 [2]
param: 4, val: 0
DRM_IOCTL_I915_GEM_APERTURE failed: Invalid argument
Assuming 131072kB available aperture size.
May lead to reduced performance or incorrect rendering.
get chip id failed: -1 [2]

param: 4, val: 0
beignet-opencl-icd: no supported GPU found, this is probably the wrong opencl-icd package for this hardware
(If you have multiple ICDs installed and OpenCL works, you can ignore this message)
Answer = 2.01627
N = 10000
Time = 0.05512
Error = 0.81371
Number of processes = 1
==6259==
==6259== Process terminating with default action of signal 27 (SIGPROF)
==6259==    at 0x552EE0F: write_gmon (gmon.c:354)
==6259==    by 0x552F589: _mcleanup (gmon.c:422)
==6259==    by 0x545FFF7: __run_exit_handlers (exit.c:82)
==6259==    by 0x5460044: exit (exit.c:104)
==6259==    by 0x5446836: (below main) (libc-start.c:325)
==6259==
==6259== Events    : Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
==6259== Collected : 117281447 25541105 12048777 94186 830345 140040 15261 95259 86095
==6259==
**==6259== I   refs:      117,281,447**
**==6259== I1  misses:         94,186**
**==6259== LLi misses:         15,261**
**==6259== I1  miss rate:       0.08%**
**==6259== LLi miss rate:       0.01%**
**==6259==**
**==6259== D   refs:       37,589,882  (25,541,105 rd + 12,048,777 wr)**
**==6259== D1  misses:        970,385  (  830,345 rd +    140,040 wr)**
**==6259== LLd misses:        181,354  (   95,259 rd +     86,095 wr)**
**==6259== D1  miss rate:        2.6% (     3.3%  +       1.2%  )**
**==6259== LLd miss rate:        0.5% (     0.4%  +       0.7%  )**
**==6259==**
**==6259== LL refs:         1,064,571  (  924,531 rd +    140,040 wr)**
**==6259== LL misses:         196,615  (  110,520 rd +     86,095 wr)**
**==6259== LL miss rate:         0.1% (     0.1%  +       0.7%  )**
**Profiling timer expired**

**Comprehensive profile data**

--------------------------------------------------------------------------------
Profile data file 'callgrind.out.6259' (creator: callgrind-3.11.0)
--------------------------------------------------------------------------------
I1 cache: 32768 B, 64 B, 8-way associative
D1 cache: 32768 B, 64 B, 8-way associative
LL cache: 8388608 B, 64 B, 16-way associative
Timerange: Basic block 0 - 25419013
Trigger: Program termination
Profiled target:  ./a.out (PID 6259, part 1)
Events recorded:  Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
Events shown:     Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
Event sort order: Ir Dr Dw I1mr D1mr D1mw ILmr DLmr DLmw
Thresholds:      99 0 0 0 0 0 0 0 0
Include dirs:
User annotated:
Auto-annotation:  off

--------------------------------------------------------------------------------
       Ir       Dr        Dw  I1mr   D1mr   D1mw  ILmr  DLmr  DLmw

```
--------------------------------------------------------------------------------
117,277,273 25,539,874 12,048,776 94,063 829,887 140,039 15,261 95,234 86,094  PROGRAM
TOTALS

--------------------------------------------------------------------------------
     Ir      Dr      Dw      I1mr    D1mr    D1mw    ILmr    DLmr    DLmw  file:function
--------------------------------------------------------------------------------
418,739,377 94,615,113 42,654,656 265,173 3,660,910 647,065 53,113 521,221 456,768  /build/
glibc-Cl5G7W/glibc-2.23/elf/../sysdeps/x86_64/dl-trampoline.h:_dl_runtime_resolve_avx'2 [/lib/
x86_64-linux-gnu/ld-2.23.so]
117,198,477 25,519,461 12,036,038 92,160  828,496 139,657 15,062 95,133 85,972 ???:
0x0000000000000c30 [/lib/x86_64-linux-gnu/ld-2.23.so]
115,682,009 25,103,733 11,876,808 91,337  817,869 137,245 14,210 89,423 83,938 /build/
glibc-Cl5G7W/glibc-2.23/elf/../sysdeps/x86_64/dl-trampoline.h:_dl_runtime_resolve_avx [/lib/
x86_64-linux-gnu/ld-2.23.so]
115,527,659 25,064,889 11,863,123 90,507  816,040 136,995 13,609 88,450 83,730 ???:_start
[/home/krishna/Desktop/HPSC-Homeworks/HW2/a.out]
115,526,278 25,064,492 11,862,981 90,497  816,025 136,995 13,609 88,450 83,730 /build/
glibc-Cl5G7W/glibc-2.23/csu/../csu/libc-start.c:(below main) [/lib/x86_64-linux-gnu/libc-2.23.so]
114,914,945 24,907,636 11,779,018 89,922  809,413 136,765 13,233 88,183 83,727 /home/
krishna/Desktop/HPSC-Homeworks/HW2/montecarlo_mpi.c:main
114,914,945 24,907,636 11,779,018 89,922  809,413 136,765 13,233 88,183 83,727
montecarlo_mpi.c:main [/home/krishna/Desktop/HPSC-Homeworks/HW2/a.out]
110,376,917 23,752,766 11,203,074 86,589  748,701 129,599 11,939 83,682
81,555  ???:PMPI_Init [/usr/lib/openmpi/lib/libmpi.so.12.0.2]
110,375,055 23,752,209 11,202,928 86,569  748,633 129,599 11,930 83,680
81,555  ???:ompi_mpi_init [/usr/lib/openmpi/lib/libmpi.so.12.0.2]
 95,257,704 20,319,134 9,370,018 22,540  610,861 98,317 6,036 74,958
68,605  ???:opal_hwloc_base_get_topology [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]
 88,525,993 18,168,473 8,761,101 18,862  460,467 89,772 5,498 64,878
66,053  ???:hwloc_topology_load [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]
 86,555,967 17,698,897 8,422,308 12,363  458,458 88,798 4,671 64,503 65,473 ???:
0x0000000000001a60 [/usr/lib/openmpi/lib/openmpi/mca_coll_basic.so]
 64,974,982 12,022,364 6,253,362  596  19,384 23,404  90  269 13,805 ???:
0x0000000000003ac0 [/usr/lib/x86_64-linux-gnu/libpciaccess.so.0.11.1]
 57,903,350 16,451,493 5,851,735 41,990 1,148,662 191,712 10,118 202,464 153,889  /build/
glibc-Cl5G7W/glibc-2.23/elf/dl-error.c:_dl_catch_error'2 [/lib/x86_64-linux-gnu/ld-2.23.so]
 49,553,020 9,178,919 4,573,827  223  134,736 22,952  16   2
13,675 ???:pci_device_get_device_name [/usr/lib/x86_64-linux-gnu/libpciaccess.so.0.11.1]
 49,552,300 9,178,703 4,573,503  221  134,663 22,952  14   2 13,675 ???:
0x0000000000003e50 [/usr/lib/x86_64-linux-gnu/libpciaccess.so.0.11.1]
 27,530,536 7,956,008 2,721,037 34,642  594,985 78,520 5,112 79,252 55,756 /build/glibc-
Cl5G7W/glibc-2.23/elf/dl-error.c:_dl_catch_error [/lib/x86_64-linux-gnu/ld-2.23.so]
 27,311,331 7,907,887 2,700,415 34,502  593,634 77,616 4,909 78,644 55,018 /build/glibc-
Cl5G7W/glibc-2.23/dlfcn/dlerror.c:_dlerror_run [/lib/x86_64-linux-gnu/libdl-2.23.so]
 26,482,231 7,698,975 2,626,365 31,143  554,231 73,853 4,593 78,581 55,158 /build/glibc-
Cl5G7W/glibc-2.23/elf/dl-open.c:_dl_open [/lib/x86_64-linux-gnu/ld-2.23.so]
 26,468,493 7,695,477 2,622,465 30,576  553,864 73,725 4,588 78,578 55,157 /build/glibc-
Cl5G7W/glibc-2.23/elf/dl-open.c:dl_open_worker [/lib/x86_64-linux-gnu/ld-2.23.so]
 26,370,180 7,672,927 2,617,752 31,327  553,115 73,733 4,599 78,338 54,993 /build/glibc-
Cl5G7W/glibc-2.23/dlfcn/dlopen.c:dlopen@@GLIBC_2.2.5 [/lib/x86_64-linux-gnu/libdl-2.23.so]
 26,359,210 7,669,641 2,614,968 30,518  552,819 73,576 4,573 78,334 54,993 /build/glibc-
Cl5G7W/glibc-2.23/dlfcn/dlopen.c:dlopen_doit [/lib/x86_64-linux-gnu/libdl-2.23.so]
 22,219,495 4,388,353 2,893,216  186  8,119  553  42  255  124 ???:gzgets [/lib/
x86_64-linux-gnu/libz.so.1.2.8]
 20,804,291 6,487,699 2,014,835  5,025  490,292 62,828  182 80,952 48,698 /build/glibc-
Cl5G7W/glibc-2.23/elf/dl-reloc.c:_dl_relocate_object [/lib/x86_64-linux-gnu/ld-2.23.so]
 19,717,053 6,216,267 1,992,888  3,867  480,237 62,810  154 73,164 48,698 /build/glibc-
Cl5G7W/glibc-2.23/elf/../sysdeps/x86_64/dl-machine.h:_dl_relocate_object
```

18,756,225 6,083,325 1,861,622 6,179 434,462 5,970 96 15,350 157 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-lookup.c:_dl_lookup_symbol_x [/lib/x86_64-linux-gnu/ld-2.23.so]
18,241,420 3,407,112 1,681,235 412 1,949 483 86 267 146 ???:pci_device_get_vendor_name [/usr/lib/x86_64-linux-gnu/libpciaccess.so.0.11.1]
17,675,265 4,893,274 2,024,531 10,430 317,331 62,548 4,452 64,131 51,391 ???:hwloc_insert_pci_device_list [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]
17,650,736 4,886,458 2,021,718 10,237 317,130 62,516 4,394 64,099 51,388 ???:0x00000000000161d0 [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]
17,650,243 4,886,331 2,021,643 10,234 317,095 62,516 4,393 64,087 51,388 ???:0x0000000000015e90 [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]
17,650,135 4,886,280 2,021,643 10,233 317,060 62,516 4,393 64,076 51,388 ???:hwloc_backends_notify_new_object [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]
16,506,318 4,633,214 1,727,996 9,552 316,832 62,423 4,291 64,040 51,388 ???:0x0000000000000fd0 [/usr/lib/x86_64-linux-gnu/hwloc/hwloc_opencl.so]
16,382,362 4,603,463 1,703,456 8,129 315,223 61,009 4,293 64,022 51,002 ???:clGetPlatformIDs [/usr/lib/x86_64-linux-gnu/libOpenCL.so.1.0.0]
16,377,913 4,602,385 1,703,006 8,071 315,163 60,998 4,249 64,008 50,996 ???:0x0000000000004850 [/usr/lib/x86_64-linux-gnu/libOpenCL.so.1.0.0]
16,347,889 4,594,100 1,699,809 7,803 314,564 60,960 4,115 63,921 50,984 ???:0x0000000000004316 [/usr/lib/x86_64-linux-gnu/libOpenCL.so.1.0.0]
16,333,696 4,590,162 1,697,950 7,649 314,480 60,943 4,092 63,917 50,984 ???:0x00000000000042d7 [/usr/lib/x86_64-linux-gnu/libOpenCL.so.1.0.0]
16,019,076 4,490,305 1,665,782 8,939 302,542 60,146 5,207 63,501 50,574 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-init.c:_dl_init [/lib/x86_64-linux-gnu/ld-2.23.so]
16,013,851 4,488,580 1,665,276 8,734 302,464 60,146 5,203 63,500 50,574 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-init.c:call_init.part.0 [/lib/x86_64-linux-gnu/ld-2.23.so]
15,506,446 4,354,370 1,606,386 5,086 294,142 58,395 3,174 61,885 49,249 ???:0x0000000000008cd0 [/usr/lib/x86_64-linux-gnu/beignet/libcl.so]
15,278,903 4,281,594 1,583,346 4,570 289,123 58,194 2,752 61,775 49,102 /build/glibc-Cl5G7W/glibc-2.23/dlfcn/dlerror.c:_dlerror_run'2 [/lib/x86_64-linux-gnu/libdl-2.23.so]
15,227,308 4,266,022 1,577,996 4,520 288,840 58,185 2,746 61,666 49,102 /build/glibc-Cl5G7W/glibc-2.23/dlfcn/dlopen.c:dlopen@@GLIBC_2.2.5'2 [/lib/x86_64-linux-gnu/libdl-2.23.so]
15,227,018 4,265,934 1,577,916 4,500 288,826 58,181 2,746 61,666 49,102 /build/glibc-Cl5G7W/glibc-2.23/dlfcn/dlopen.c:dlopen_doit'2 [/lib/x86_64-linux-gnu/libdl-2.23.so]
15,226,960 4,265,904 1,577,904 4,494 288,823 58,179 2,746 61,666 49,102 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-open.c:_dl_open'2 [/lib/x86_64-linux-gnu/ld-2.23.so]
15,226,566 4,265,802 1,577,798 4,469 288,804 58,176 2,742 61,666 49,100 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-open.c:dl_open_worker'2 [/lib/x86_64-linux-gnu/ld-2.23.so]
14,959,068 5,394,835 1,546,004 5,173 419,902 5,610 60 7,962 140 /build/glibc-Cl5G7W/glibc-2.23/elf/dl-lookup.c:do_lookup_x [/lib/x86_64-linux-gnu/ld-2.23.so]
12,287,234 2,791,391 1,457,505 51,505 114,671 23,256 2,228 6,601 8,456 ???:mca_base_framework_open [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]
11,999,484 2,725,057 1,426,784 49,092 110,191 22,387 1,414 6,319 8,151 ???:mca_base_framework_register [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]
10,871,063 2,495,353 1,258,424 45,248 108,025 20,986 1,208 6,079 7,658 ???:mca_base_framework_components_register [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]
7,571,032 988,816 0 72 7 0 7 5 . /build/glibc-Cl5G7W/glibc-2.23/string/../sysdeps/x86_64/multiarch/../strchr.S:__GI_strchr [/lib/x86_64-linux-gnu/libc-2.23.so]
7,091,845 1,466,923 953,134 9,408 6,758 6,518 224 1,411 1,670 ???:mca_base_var_register [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]
7,085,137 1,591,634 835,634 32,894 42,718 12,773 2,023 2,893 4,888 ???:orte_init [/usr/lib/openmpi/lib/libopen-rte.so.12.0.2]
6,719,699 2,147,345 607,218 3,602 150,168 8,469 491 10,022 2,548 ???:hwloc_topology_init [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]
6,715,905 2,146,660 606,536 3,569 150,144 8,438 476 10,021 2,548 ???:0x00000000000110e0 [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]
6,660,869 2,131,444 600,376 3,223 149,436 8,417 316 9,960 2,548 ???:lt_dlforeachfile [/usr/lib/x86_64-linux-gnu/libltdl.so.7.3.1]

6,660,853 2,131,441 600,372 3,221 149,435 8,417 315 9,960 2,548 ???:
0x0000000000003060 [/usr/lib/x86_64-linux-gnu/libltdl.so.7.3.1]
  6,657,579 2,130,766 599,994 3,197 149,411 8,416 297 9,956 2,548 ???:
0x00000000000036e0 [/usr/lib/x86_64-linux-gnu/libltdl.so.7.3.1]
  6,638,471 2,126,302 597,986 3,029 149,306 8,408 253 9,942 2,547 ???:
0x0000000000010950 [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]
  6,610,396 2,119,191 594,349 2,386 148,795 8,354 216 9,923
2,547 ???:lt_dlopenadvise [/usr/lib/x86_64-linux-gnu/libltdl.so.7.3.1]
  6,609,824 2,119,068 594,268 2,359 148,793 8,354 209 9,923 2,547 ???:
0x00000000000041e0 [/usr/lib/x86_64-linux-gnu/libltdl.so.7.3.1]
  6,596,521 2,115,788 592,607 2,256 148,705 8,347 164 9,912 2,547 ???:lt_dlopenext
[/usr/lib/x86_64-linux-gnu/libltdl.so.7.3.1]
  6,572,613 2,110,992 588,909 1,910 148,626 8,311 157 9,910 2,547 ???:
0x0000000000002b20 [/usr/lib/x86_64-linux-gnu/libltdl.so.7.3.1]
  6,570,425 2,110,571 588,601 1,828 148,599 8,304 145 9,910 2,547 ???:
0x0000000000006080 [/usr/lib/x86_64-linux-gnu/libltdl.so.7.3.1]
  6,206,086 677,726 0 203 7,355 0 14 238  . /build/glibc-Cl5G7W/
glibc-2.23/string/../sysdeps/x86_64/memchr.S:memchr [/lib/x86_64-linux-gnu/libc-2.23.so]
  5,809,452 952,050 939,882 2,061 4,457 15,635 94 23 5,025 /build/glibc-
Cl5G7W/glibc-2.23/malloc/malloc.c:malloc [/lib/x86_64-linux-gnu/libc-2.23.so]
  5,484,272 873,227 316,157 340 563 35 29 16  . /build/glibc-Cl5G7W/
glibc-2.23/stdlib/../stdlib/strtol.c:strtoul [/lib/x86_64-linux-gnu/libc-2.23.so]
  5,462,401 1,372,012 532,138 36,916 101,029 15,595 604 4,901
6,765 ???:mca_base_component_find [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]
  5,427,513 825,358 321,274 385 536 38 25 17  . /build/glibc-Cl5G7W/
glibc-2.23/stdlib/../stdlib/strtol_l.c:____strtoul_l_internal [/lib/x86_64-linux-gnu/libc-2.23.so]
  5,128,072 1,059,415 682,398 6,489 4,453 4,748 31 983
722 ???:mca_base_component_var_register [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]
  4,922,260 676,184 892,597 3,111 5,284 17,778 124 39 5,476 /build/glibc-
Cl5G7W/glibc-2.23/malloc/malloc.c:_int_malloc [/lib/x86_64-linux-gnu/libc-2.23.so]
  4,177,082 899,793 516,624 3,394 4,223 5,796 2,695 285 5,044 /build/glibc-
Cl5G7W/glibc-2.23/elf/dl-init.c:_dl_init'2 [/lib/x86_64-linux-gnu/ld-2.23.so]
  4,176,825 899,711 516,605 3,385 4,211 5,796 2,694 285 5,044 /build/glibc-
Cl5G7W/glibc-2.23/elf/dl-init.c:call_init.part.0'2 [/lib/x86_64-linux-gnu/ld-2.23.so]
  3,958,312 595,035 606,365 1,403 2,135 7,832 6 685 550 /build/glibc-Cl5G7W/
glibc-2.23/string/strdup.c:strdup [/lib/x86_64-linux-gnu/libc-2.23.so]
  3,898,643 1,068,904 411,837 33,665 95,916 7,387 459 4,647 1,785 ???:
0x0000000000036aa0 [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]
  3,892,647 833,659 467,448 310 511 4,019 158 76 3,784 ???:
0x00000000003197d0 [/usr/lib/x86_64-linux-gnu/beignet/libgbe.so]
  3,879,095 833,563 460,696 186 511 3,996 91 76 3,778 ???:
0x0000000000319420 [/usr/lib/x86_64-linux-gnu/beignet/libgbe.so]
  3,579,880 996,703 351,783 23,708 91,375 5,197 381 4,521 1,466 ???:opal_dl_open
[/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]
  3,534,449 562,341 589,012 638 2,341 8,526 13 18 761 ???:
0x00000000054458a0 [???]
  3,519,170 160,449 1,262,833 65 0 15 10  .  . /build/glibc-Cl5G7W/
glibc-2.23/string/../sysdeps/x86_64/multiarch/memset-avx2.S:__memset_avx2 [/lib/x86_64-linux-
gnu/libc-2.23.so]
  3,486,454 811,196 432,132 22,122 32,129 8,564 949 1,837 2,351 ???:
0x00000000000011b0 [/usr/lib/openmpi/lib/openmpi/mca_ess_singleton.so]
  3,207,872 787,033 614,178 394 796 612 9 132 140 /build/glibc-Cl5G7W/
glibc-2.23/string/../sysdeps/x86_64/multiarch/memcpy-avx-
unaligned.S:__memcpy_avx_unaligned [/lib/x86_64-linux-gnu/libc-2.23.so]
  3,155,010 735,970 397,618 20,067 29,371 8,067 549 1,463
2,182 ???:orte_ess_base_app_setup [/usr/lib/openmpi/lib/libopen-rte.so.12.0.2]
  2,873,672 742,698 447,877 2,812 23,249 669 41 1,858 96 /build/glibc-Cl5G7W/
glibc-2.23/malloc/malloc.c:free [/lib/x86_64-linux-gnu/libc-2.23.so]
  2,489,999 560,800 306,522 6,232 20,770 3,944 352 1,521
1,148 ???:mca_base_framework_open'2 [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]

2,477,346   601,683   364,420   2,392   17,984   1,891   42   880   126   /build/glibc-Cl5G7W/glibc-2.23/malloc/malloc.c:_int_free [/lib/x86_64-linux-gnu/libc-2.23.so]
2,372,397   519,437   475,174   4,523   1,059   1,900   78   71   321   /build/glibc-Cl5G7W/glibc-2.23/debug/asprintf_chk.c:__asprintf_chk [/lib/x86_64-linux-gnu/libc-2.23.so]
2,342,493   517,568   460,222   4,309   1,059   1,853   73   71   321   /build/glibc-Cl5G7W/glibc-2.23/debug/vasprintf_chk.c:__vasprintf_chk [/lib/x86_64-linux-gnu/libc-2.23.so]
2,341,384   563,527   436,141   5,938   2,407   2,449   305   150   186   /build/glibc-Cl5G7W/glibc-2.23/stdio-common/vfprintf.c:vfprintf [/lib/x86_64-linux-gnu/libc-2.23.so]
2,330,389   499,391   236,138   6,571   5,526   2,184   842   516   1,190   ???:opal_init [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]
2,288,604   508,164   379,993   1,940   10,905   17,552   84   75   13,951   /build/glibc-Cl5G7W/glibc-2.23/malloc/malloc.c:realloc [/lib/x86_64-linux-gnu/libc-2.23.so]
2,233,463   504,255   277,390   4,954   17,728   3,509   334   1,362   987   ???:0x000000000007d290 [/usr/lib/openmpi/lib/libmpi.so.12.0.2]
2,181,204   573,365   296,187   2,873   60,448   7,145   970   4,369   2,169   ???:PMPI_Finalize [/usr/lib/openmpi/lib/libmpi.so.12.0.2]
2,181,192   573,359   296,187   2,872   60,447   7,145   969   4,369   2,169   ???:ompi_mpi_finalize [/usr/lib/openmpi/lib/libmpi.so.12.0.2]
1,919,145   305,279   213,982   1,677   1,254   993   71   315   240   ???:mca_base_var_generate_full_name4 [/usr/lib/openmpi/lib/libopen-pal.so.13.0.2]
1,736,869   356,752   0   5,055   17,856   0   82   1,029   .   /build/glibc-Cl5G7W/glibc-2.23/string/../sysdeps/x86_64/multiarch/../strcmp.S:strcmp [/lib/x86_64-linux-gnu/ld-2.23.so]
1,723,973   383,142   111,765   12,178   51,429   4,585   237   1,398   1,871   /build/glibc-Cl5G7W/glibc-2.23/elf/dl-load.c:_dl_map_object [/lib/x86_64-linux-gnu/ld-2.23.so]
1,718,134   383,039   73,214   1,406   20,673   88   20   19   5   /build/glibc-Cl5G7W/glibc-2.23/elf/dl-misc.c:_dl_name_match_p [/lib/x86_64-linux-gnu/ld-2.23.so]
1,548,575   369,938   274,217   5,301   617   367   369   105   259   ???:0x0000000000027910 [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]
1,464,511   406,511   158,115   717   10,672   2,484   708   5,704   2,111   /build/glibc-Cl5G7W/glibc-2.23/elf/rtld.c:_dl_start [/lib/x86_64-linux-gnu/ld-2.23.so]
1,463,863   406,374   158,048   694   10,648   2,465   687   5,682   2,093   /build/glibc-Cl5G7W/glibc-2.23/elf/../elf/dl-sysdep.c:_dl_sysdep_start [/lib/x86_64-linux-gnu/ld-2.23.so]
1,463,139   406,204   157,985   657   10,625   2,458   652   5,661   2,086   /build/glibc-Cl5G7W/glibc-2.23/elf/rtld.c:dl_main [/lib/x86_64-linux-gnu/ld-2.23.so]
1,399,425   405,433   130,012   3,265   30,817   818   34   2,246   48   /build/glibc-Cl5G7W/glibc-2.23/elf/../elf/dl-runtime.c:_dl_fixup [/lib/x86_64-linux-gnu/ld-2.23.so]
1,367,025   296,760   214,210   40   22   1,167   20   2   1,132   ???:0x0000000000319210 [/usr/lib/x86_64-linux-gnu/beignet/libgbe.so]
1,223,624   315,415   249,378   976   10,555   17,246   34   71   13,856   /build/glibc-Cl5G7W/glibc-2.23/malloc/malloc.c:_int_realloc [/lib/x86_64-linux-gnu/libc-2.23.so]
1,219,832   264,701   93,364   4,912   19,577   2,464   211   931   1,098   /build/glibc-Cl5G7W/glibc-2.23/elf/dl-deps.c:_dl_map_object_deps [/lib/x86_64-linux-gnu/ld-2.23.so]
1,145,658   262,601   219,766   4,296   122   211   136   21   165   ???:0x00000000000057cb [/usr/lib/x86_64-linux-gnu/libhwloc.so.5.6.8]