Лекция 2

Инструменты отладки:

- cuda-gdb
- Data Display Debugger (ddd)
- Nsight Eclipse Plugins
- Nsight Visual Studio Code Edition

```
> ~Lecture3/Lab3-gdb> g++ lab3a.cpp  -g3 -o lab3a
> ~Lecture3/Lab3-gdb> gdb lab3a
```

```
(gdb) list main
………………………………………………………………………….
36          gettimeofday(&t, NULL);
37          Start =(double)t.tv_sec*1000000.0 +
(double)t.tv_usec;
38          hTest(N,a,b);
39          gettimeofday(&t, NULL);
40          Finish =(double)t.tv_sec*1000000.0 +
(double)t.tv_usec;
…………………………………………………………………………………
(gdb) b 38
Breakpoint 1 at 0x400865: file lab3a.cpp, line 38.
```

```
(gdb) run 256
Starting program: ~/Lecture3/Lab3-gdb/lab3a 16
(gdb) step
hTest (N=16, a=0x613e70, b=0x613ec0) at lab3a.cpp:7
7           for(int i=0; i<N;i++)
(gdb) list hTest
1         #include <malloc.h>
2         #include <stdio.h>
3         #include <stdlib.h>
4         #include <sys/time.h>
5
6         void hTest(int N, int* a, int* b){
7           for(int i=0; i<N;i++)
8              a[i]+=b[i];
9           }
```

```
(gdb) info args
N = 16
a = 0x613e70
b = 0x613ec0
(gdb) info locals
i = 0
(gdb) next 8
7            for(int i=0; i<N;i++)
(gdb) info locals
i = 3
(gdb) print b[2]
$1 = 5
(gdb) print a[2]
$2 = 9
```

```
gdb) break 8 if i==12
Breakpoint 3 at 0x400705: file lab3a.cpp, line 8.
(gdb) c
Continuing.

Breakpoint 3, hTest (N=16, a=0x613e70, b=0x613ec0) at
lab3a.cpp:8
8               a[i]+=b[i];
(gdb) info locals
i = 12
(gdb) finish
Run till exit from #0  hTest (N=16, a=0x613e70,
b=0x613ec0) at lab3a.cpp:8
main (argc=2, argv=0x7fffffffd9b8) at lab3a.cpp:39
39          gettimeofday(&t, NULL);
```

```
(gdb) x/16d  b
0x613ec0:          1          3          5          7
0x613ed0:          9          11         13         15
0x613ee0:          17         19         21         23
0x613ef0:          25         27         29         31
(gdb) x/16d  a
0x613e70:          1          5          9          13
0x613e80:          17         21         25         29
0x613e90:          33         37         41         45
0x613ea0:          49         53         57         61
(gdb) print a[2]-b[2]
$16 = 4
```

```
(gdb) c
Continuing.
Elapsed time: 9.57138e+06 ms
0          1          1
1          5          3
2          9          5
3          13         7
4          17         9
5          21         11

.................................................................
13         53         27
14         57         29
15         61         31
[Inferior 1 (process 4272) exited normally]

(gdb) quit
```

Отладка многопоточных программ

```
~/Lecture3/Lab3-gdb> gdb lab3b
(gdb) list hTest
16   void* hTest(void* arg){
17       struct targ* s arg=(struct targ*)arg;
18       int length=s arg->length;
19       int offset=s_arg->num_thread*length;
20       int i;
21     for(i=0;i<length;i++)
22         a[i+offset]+=/*1000*sin((double)*/b[i+offset];
23     return NULL;
25   }
(gdb) break lab3b.cpp:22
Breakpoint 1 at 0x40083f: file lab3b.cpp, line 22.
```

```
(gdb) run 4 16
Starting program: …/Lecture3/Lab3-gdb/lab3b 4 16
[Thread debugging using libthread_db enabled]
Using host libthread_db library
"/lib64/libthread_db.so.1".
[New Thread 0x7ffff6ed1700 (LWP 10741)]
[New Thread 0x7ffff66d0700 (LWP 10742)]
[New Thread 0x7ffff5ecf700 (LWP 10743)]
[Switching to Thread 0x7ffff6ed1700 (LWP 10741)]

Thread 2 "lab3b" hit Breakpoint 1, hTest (arg=0x614e70)
at lab3b.cpp:22
22              a[i+offset]+=/*1000*sin((double)*/b[i+offset];
```

```
(gdb) info threads
  Id    Target Id                                         Frame
  1     Thread 0x7ffff7fc0740 (LWP 10737) "lab3b" clone ()
at ../sysdeps/unix/sysv/linux/x86_64/clone.S:78
* 2     Thread 0x7ffff6ed1700 (LWP 10741) "lab3b" hTest
(arg=0x614e70) at lab3b.cpp:22
  3     Thread 0x7ffff66d0700 (LWP 10742) "lab3b" hTest
(arg=0x614e7c) at lab3b.cpp:22
  4     Thread 0x7ffff5ecf700 (LWP 10743) "lab3b" clone ()
at ../sysdeps/unix/sysv/linux/x86_64/clone.S:78
```

```
(gdb) print offset
$1 = 0
(gdb) thread 3
[Switching to thread 3 (Thread 0x7ffff66d0700 (LWP
10742))]
#0  hTest (arg=0x614e7c) at lab3b.cpp:22
22
a[i+offset]+=/*1000*sin((double)*/b[i+offset];
(gdb) print offset
$2 = 4
```

```
(gdb) break 22 thread 3
Note: breakpoint 1 (all threads) also set at pc
0x40083f.
Breakpoint 2 at 0x40083f: file lab3b.cpp, line 22.
(gdb) info breakpoints
Num       Type           Disp Enb Address            What
1         breakpoint     keep y   0x000000000040083f in
hTest(void*) at lab3b.cpp:22
          breakpoint already hit 1 time
2         breakpoint     keep y   0x000000000040083f in
hTest(void*) at lab3b.cpp:22 thread 3
          stop only in thread 3
(gdb) delete 1
```

```
(gdb) x/16d a
0x614ee0:          0          2          4          6
0x614ef0:          8         10         12         14
0x614f00:         16         18         20         22
0x614f10:         24         26         28         30
```

```
(gdb) continue
Continuing.

Thread 3 "lab3b" hit Breakpoint 2, hTest (arg=0x614e7c)
at lab3b.cpp:22
22          a[i+offset]+=/*1000*sin((double)*/b[i+offset];
(gdb) c
.........................................................................
(gdb) x/16d a
0x614ee0:          1          2          4          6
0x614ef0:         17         21         12         14
0x614f00:         33         37         20         22
0x614f10:         49         53         28         30
```

```
(gdb) c
Continuing.
[Thread 0x7ffff5ecf700 (LWP 10743) exited]
[Thread 0x7ffff66d0700 (LWP 10742) exited]
Thread-specific breakpoint 2 deleted - thread 3 no
longer in the thread list.
[Thread 0x7ffff56ce700 (LWP 11167) exited]
[Thread 0x7ffff6ed1700 (LWP 10741) exited]
Elapsed time: 2.22941e+06 ms
0         1         1
1         3         5
2         5         9

..................................................................
14        29        57
15        31        61
[Inferior 1 (process 10737) exited normally]
```

```
(gdb)print a[1]
…………………………………………………….
(gdb)info locals
…………………………………………………….
(gdb) info args
arg = 0x614e7c
(gdb) print ((struct targ*)arg)->length
$1 = 4
```

Отладка программ, выполняемых на GPU

https://docs.nvidia.com/cuda/archive/11.2.0/cuda-gdb/index.html

```
> nvcc -g  -G …
```

```
~/Workshop/VSC> cuda-gdb lab3c
```

```
(cuda-gdb) list main
23      __global__ void gSum(int* a, int *b){
24        int i=threadIdx.x+blockIdx.x*blockDim.x;
25        a[i]+=b[i];
26      }
27
28      int main(){
29        int N=VECTOR_LENGTH;
30        int *a, *b;
31        int *a_h;
32
(cuda-gdb) break 25
Breakpoint 1 at 0x403fdd: file lab3c.cu, line 26.
(cuda-gdb) run
```

```
(cuda-gdb) info cuda threads
BlockIdx ThreadIdx To BlockIdx ThreadIdx Count  VirtualPC
                                    Filename  Line
Kernel 0
*  (0,0,0)    (0,0,0)        (0,0,0)    (3,0,0)     4
0x00007fffe525c3e0
…/Lecture3/Lab3-cuda-gdb/lab3c.cu     9
   (1,0,0)    (0,0,0)        (3,0,0)    (3,0,0)    12
0x00007fffe525c2b0
…/Lecture3/Lab3-cuda-gdb/lab3c.cu     8
```

```
cuda-gdb) cuda block 2 thread 3
[Switching focus to CUDA kernel 0, grid 1, block
(2,0,0), thread (3,0,0), device 0, sm 2, warp 0, lane 3]
8           b[i]=2*i+1;
(cuda-gdb) print i
$2 = 11
```

```
(cuda-gdb) n
9           }
(cuda-gdb) x/16d b
0x7fffecc00200: 1          3          5          7
0x7fffecc00210: 0          0          0          0
0x7fffecc00220: 0          0          0          0
0x7fffecc00230: 0          0          0          0
```

```
malkov@192:~> ssh cyber.sibsutis.ru
```

```
malkov@linux-47dw: ~/WORKSHOP/PGP-2023> cuda-gdb  lab3c
```

```
(cuda-gdb) break 8
Breakpoint 1 at 0x403851: file lab3c.cu, line 8.
(cuda-gdb) run
Starting program: /home/malkov/WORKSHOP/PGP-2023/lab3c
......................................................................................................
[Switching focus to CUDA kernel 0, grid 1, block
(0,0,0), thread (0,0,0), device 0, sm 0, warp 0, lane 0]
Thread 1 "lab3c" hit Breakpoint 1,
gInit<<<(4,1,1),(4,1,1)>>> (a=0x7fffe6800000,
b=0x7fffe6800200) at lab3c.cu:8
8            b[i]=2*i+1;
```
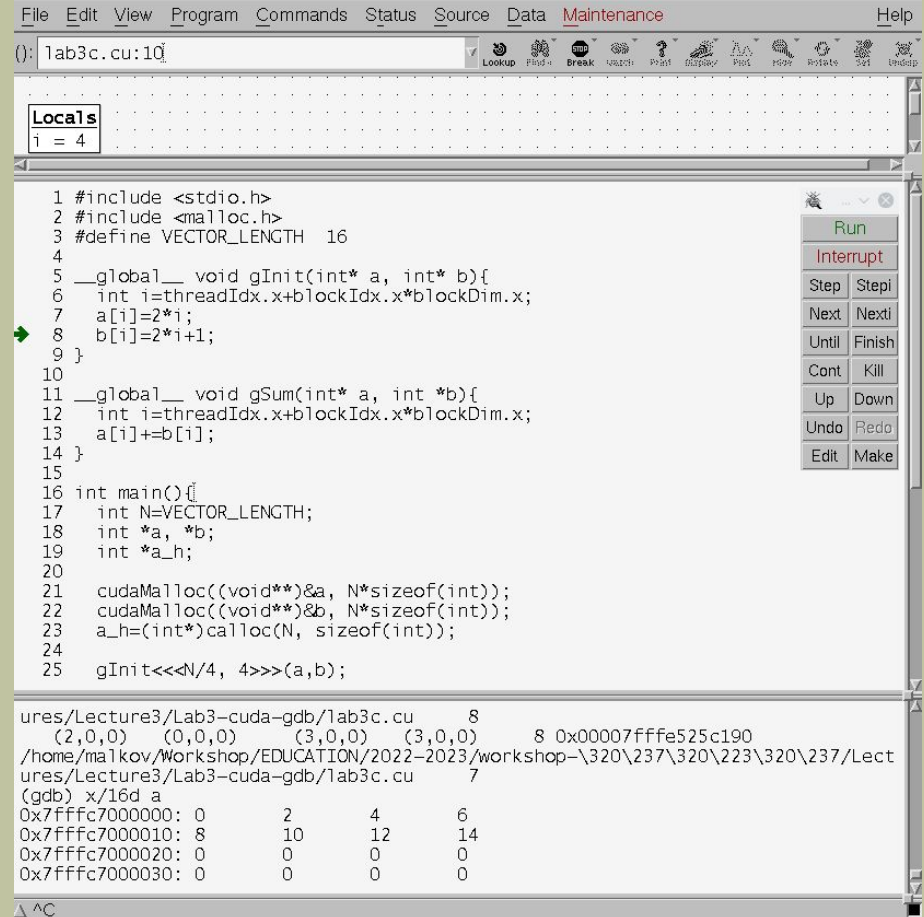
Data Display Debugger (ddd)

…/Lecture3/
Lab3-cuda-gdb>
ddd cuda-gdb lab3c

malkov@192:~> ssh
cyber.sibsutis.ru **-X**

malkov@linux-47dw:
~/WORKSHOP/PGP-2023>
ddd cuda-gdb lab3c

Nsight Eclipse Plugins