

Other Configs (3D Grid with 3D Blocks)

- Properties `threadIdx.x`, `threadIdx.y` and `threadIdx.z` are used to identify a thread inside its block.
- When we have a much more complicated grid, we need additional indexes apart from these in order to calculate `blockIdx` values, which will take on account other blocks in the config.
 - `blockIdx`: determines the index of a block inside a grid. Indexes start in zero. It has x,y,z values.
 - `blockDim`: how many **threads** per dimension are in a block. These are **quantity values**, not indexes, and therefore are constant for all threads. It has x,y,z values.
 - `gridDim`: how many **blocks** per dimension are in the **grid**. These are **quantity values**, not indexes, and therefore are constant for all threads. It has x,y,z values.

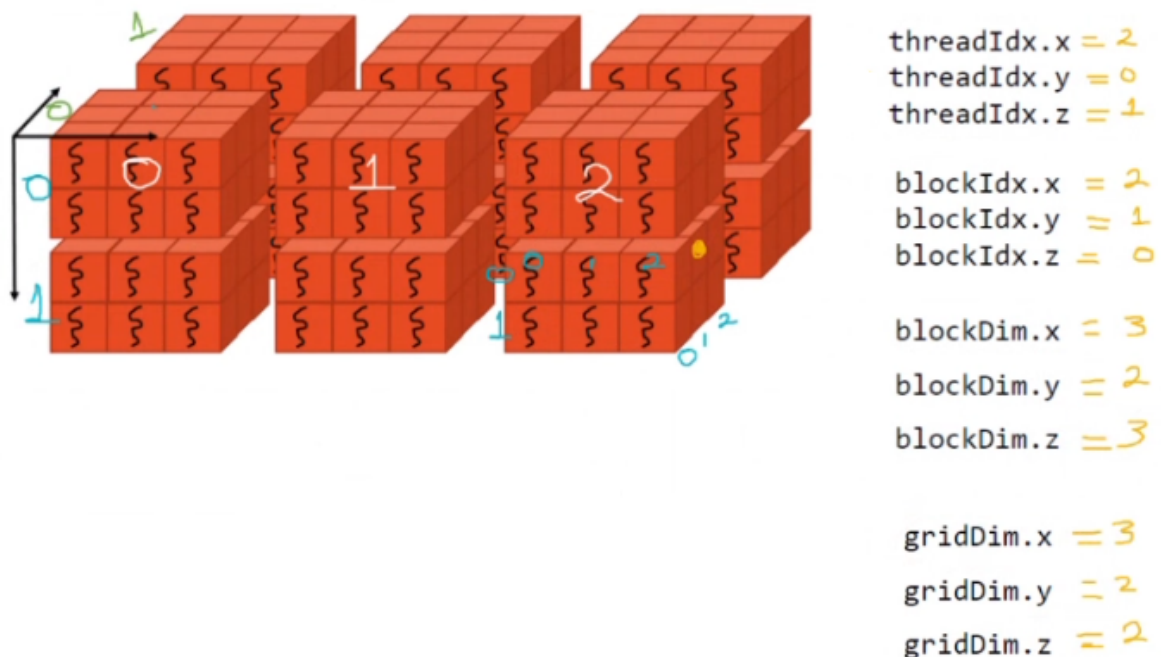


Figure 1: Image

Lab 04

Make a program in c/c++ using CUDA in which you implement a grid in 3D that has 4 threads in each dimension and 2 threads per block dimension. The program must print from kernel the values of the following indexes, considering their three dimensions:

- threadIdx
- blockIdx
- blockDim
- gridDim

Like the image below:

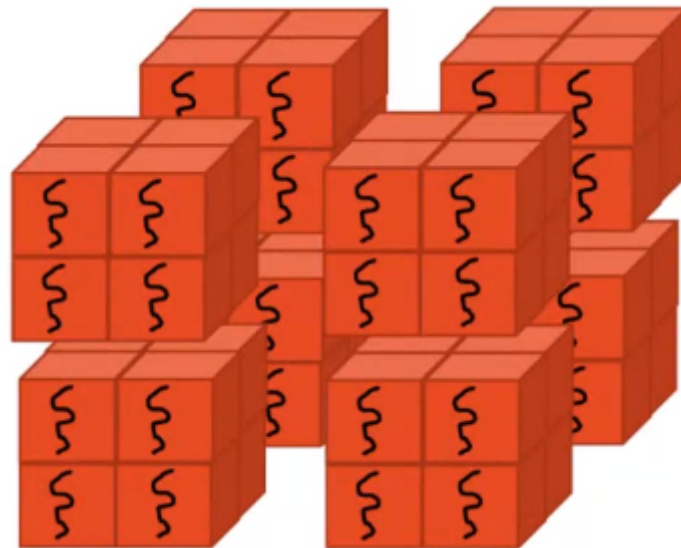


Figure 2: Image

Solution

```
1  #include "cuda_runtime.h"
2  #include "device_launch_parameters.h"
3
4  #include <stdio.h>
5  #include <stdlib.h>
6
7  __global__ void kernel()
8  {
9      printf("threadIdx.x: %d, threadIdx.y: %d, threadIdx.z: %d |
          | blockIdx.x: %d, blockIdx.y: %d, blockIdx.z: %d |
          | blockDim.x: %d, blockDim.y: %d, blockDim.z: %d |
          | gridDim.x: %d, gridDim.y: %d, gridDim.z: %d\n",
10         threadIdx.x, threadIdx.y, threadIdx.z,
11         blockIdx.x, blockIdx.y, blockIdx.z,
12         blockDim.x, blockDim.y, blockDim.z,
13         gridDim.x, gridDim.y, gridDim.z);
14  }
15
16  int main() {
```

```

17     dim3 grid(2, 2, 2);
18     dim3 block(2, 2, 2);
19     kernel <<< grid, block >>> ();
20
21     return 0;
22 }

```

Which outputs 64 lines:

```

1  threadIdx.x: 0, threadIdx.y: 0, threadIdx.z: 0 | blockIdx.x:
   1, blockIdx.y: 0, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
2  threadIdx.x: 1, threadIdx.y: 0, threadIdx.z: 0 | blockIdx.x:
   1, blockIdx.y: 0, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
3  threadIdx.x: 0, threadIdx.y: 1, threadIdx.z: 0 | blockIdx.x:
   1, blockIdx.y: 0, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
4  threadIdx.x: 1, threadIdx.y: 1, threadIdx.z: 0 | blockIdx.x:
   1, blockIdx.y: 0, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
5  threadIdx.x: 0, threadIdx.y: 0, threadIdx.z: 1 | blockIdx.x:
   1, blockIdx.y: 0, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
6  threadIdx.x: 1, threadIdx.y: 0, threadIdx.z: 1 | blockIdx.x:
   1, blockIdx.y: 0, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
7  threadIdx.x: 0, threadIdx.y: 1, threadIdx.z: 1 | blockIdx.x:
   1, blockIdx.y: 0, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
8  threadIdx.x: 1, threadIdx.y: 1, threadIdx.z: 1 | blockIdx.x:
   1, blockIdx.y: 0, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
9  threadIdx.x: 0, threadIdx.y: 0, threadIdx.z: 0 | blockIdx.x:
   0, blockIdx.y: 0, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
10 threadIdx.x: 1, threadIdx.y: 0, threadIdx.z: 0 | blockIdx.x:
   0, blockIdx.y: 0, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
11 threadIdx.x: 0, threadIdx.y: 1, threadIdx.z: 0 | blockIdx.x:
   0, blockIdx.y: 0, blockIdx.z: 1 | blockDim.x: 2, blockDim.y

```

```

        : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
        2
12 threadIdx.x: 1, threadIdx.y: 1, threadIdx.z: 0 | blockIdx.x:
    0, blockIdx.y: 0, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
13 threadIdx.x: 0, threadIdx.y: 0, threadIdx.z: 1 | blockIdx.x:
    0, blockIdx.y: 0, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
14 threadIdx.x: 1, threadIdx.y: 0, threadIdx.z: 1 | blockIdx.x:
    0, blockIdx.y: 0, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
15 threadIdx.x: 0, threadIdx.y: 1, threadIdx.z: 1 | blockIdx.x:
    0, blockIdx.y: 0, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
16 threadIdx.x: 1, threadIdx.y: 1, threadIdx.z: 1 | blockIdx.x:
    0, blockIdx.y: 0, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
17 threadIdx.x: 0, threadIdx.y: 0, threadIdx.z: 0 | blockIdx.x:
    1, blockIdx.y: 1, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
18 threadIdx.x: 1, threadIdx.y: 0, threadIdx.z: 0 | blockIdx.x:
    1, blockIdx.y: 1, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
19 threadIdx.x: 0, threadIdx.y: 1, threadIdx.z: 0 | blockIdx.x:
    1, blockIdx.y: 1, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
20 threadIdx.x: 1, threadIdx.y: 1, threadIdx.z: 0 | blockIdx.x:
    1, blockIdx.y: 1, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
21 threadIdx.x: 0, threadIdx.y: 0, threadIdx.z: 1 | blockIdx.x:
    1, blockIdx.y: 1, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
22 threadIdx.x: 1, threadIdx.y: 0, threadIdx.z: 1 | blockIdx.x:
    1, blockIdx.y: 1, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
23 threadIdx.x: 0, threadIdx.y: 1, threadIdx.z: 1 | blockIdx.x:
    1, blockIdx.y: 1, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
24 threadIdx.x: 1, threadIdx.y: 1, threadIdx.z: 1 | blockIdx.x:

```

```

    1, blockIdx.y: 1, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
25 threadIdx.x: 0, threadIdx.y: 0, threadIdx.z: 0 | blockIdx.x:
    0, blockIdx.y: 1, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
26 threadIdx.x: 1, threadIdx.y: 0, threadIdx.z: 0 | blockIdx.x:
    0, blockIdx.y: 1, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
27 threadIdx.x: 0, threadIdx.y: 1, threadIdx.z: 0 | blockIdx.x:
    0, blockIdx.y: 1, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
28 threadIdx.x: 1, threadIdx.y: 1, threadIdx.z: 0 | blockIdx.x:
    0, blockIdx.y: 1, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
29 threadIdx.x: 0, threadIdx.y: 0, threadIdx.z: 1 | blockIdx.x:
    0, blockIdx.y: 1, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
30 threadIdx.x: 1, threadIdx.y: 0, threadIdx.z: 1 | blockIdx.x:
    0, blockIdx.y: 1, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
31 threadIdx.x: 0, threadIdx.y: 1, threadIdx.z: 1 | blockIdx.x:
    0, blockIdx.y: 1, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
32 threadIdx.x: 1, threadIdx.y: 1, threadIdx.z: 1 | blockIdx.x:
    0, blockIdx.y: 1, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
33 threadIdx.x: 0, threadIdx.y: 0, threadIdx.z: 0 | blockIdx.x:
    0, blockIdx.y: 0, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
34 threadIdx.x: 1, threadIdx.y: 0, threadIdx.z: 0 | blockIdx.x:
    0, blockIdx.y: 0, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
35 threadIdx.x: 0, threadIdx.y: 1, threadIdx.z: 0 | blockIdx.x:
    0, blockIdx.y: 0, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
36 threadIdx.x: 1, threadIdx.y: 1, threadIdx.z: 0 | blockIdx.x:
    0, blockIdx.y: 0, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2

```

```

37 threadIdx.x: 0, threadIdx.y: 0, threadIdx.z: 1 | blockIdx.x:
    0, blockIdx.y: 0, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
38 threadIdx.x: 1, threadIdx.y: 0, threadIdx.z: 1 | blockIdx.x:
    0, blockIdx.y: 0, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
39 threadIdx.x: 0, threadIdx.y: 1, threadIdx.z: 1 | blockIdx.x:
    0, blockIdx.y: 0, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
40 threadIdx.x: 1, threadIdx.y: 1, threadIdx.z: 1 | blockIdx.x:
    0, blockIdx.y: 0, blockIdx.z: 0 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
41 threadIdx.x: 0, threadIdx.y: 0, threadIdx.z: 0 | blockIdx.x:
    0, blockIdx.y: 1, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
42 threadIdx.x: 1, threadIdx.y: 0, threadIdx.z: 0 | blockIdx.x:
    0, blockIdx.y: 1, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
43 threadIdx.x: 0, threadIdx.y: 1, threadIdx.z: 0 | blockIdx.x:
    0, blockIdx.y: 1, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
44 threadIdx.x: 1, threadIdx.y: 1, threadIdx.z: 0 | blockIdx.x:
    0, blockIdx.y: 1, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
45 threadIdx.x: 0, threadIdx.y: 0, threadIdx.z: 1 | blockIdx.x:
    0, blockIdx.y: 1, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
46 threadIdx.x: 1, threadIdx.y: 0, threadIdx.z: 1 | blockIdx.x:
    0, blockIdx.y: 1, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
47 threadIdx.x: 0, threadIdx.y: 1, threadIdx.z: 1 | blockIdx.x:
    0, blockIdx.y: 1, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
48 threadIdx.x: 1, threadIdx.y: 1, threadIdx.z: 1 | blockIdx.x:
    0, blockIdx.y: 1, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
49 threadIdx.x: 0, threadIdx.y: 0, threadIdx.z: 0 | blockIdx.x:
    1, blockIdx.y: 1, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:

```

```

2
50 threadIdx.x: 1, threadIdx.y: 0, threadIdx.z: 0 | blockIdx.x:
   1, blockIdx.y: 1, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
51 threadIdx.x: 0, threadIdx.y: 1, threadIdx.z: 0 | blockIdx.x:
   1, blockIdx.y: 1, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
52 threadIdx.x: 1, threadIdx.y: 1, threadIdx.z: 0 | blockIdx.x:
   1, blockIdx.y: 1, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
53 threadIdx.x: 0, threadIdx.y: 0, threadIdx.z: 1 | blockIdx.x:
   1, blockIdx.y: 1, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
54 threadIdx.x: 1, threadIdx.y: 0, threadIdx.z: 1 | blockIdx.x:
   1, blockIdx.y: 1, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
55 threadIdx.x: 0, threadIdx.y: 1, threadIdx.z: 1 | blockIdx.x:
   1, blockIdx.y: 1, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
56 threadIdx.x: 1, threadIdx.y: 1, threadIdx.z: 1 | blockIdx.x:
   1, blockIdx.y: 1, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
57 threadIdx.x: 0, threadIdx.y: 0, threadIdx.z: 0 | blockIdx.x:
   1, blockIdx.y: 0, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
58 threadIdx.x: 1, threadIdx.y: 0, threadIdx.z: 0 | blockIdx.x:
   1, blockIdx.y: 0, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
59 threadIdx.x: 0, threadIdx.y: 1, threadIdx.z: 0 | blockIdx.x:
   1, blockIdx.y: 0, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
60 threadIdx.x: 1, threadIdx.y: 1, threadIdx.z: 0 | blockIdx.x:
   1, blockIdx.y: 0, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
61 threadIdx.x: 0, threadIdx.y: 0, threadIdx.z: 1 | blockIdx.x:
   1, blockIdx.y: 0, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
   : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
   2
62 threadIdx.x: 1, threadIdx.y: 0, threadIdx.z: 1 | blockIdx.x:
   1, blockIdx.y: 0, blockIdx.z: 1 | blockDim.x: 2, blockDim.y

```

```
        : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
        2
63 threadIdx.x: 0, threadIdx.y: 1, threadIdx.z: 1 | blockIdx.x:
    1, blockIdx.y: 0, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
64 threadIdx.x: 1, threadIdx.y: 1, threadIdx.z: 1 | blockIdx.x:
    1, blockIdx.y: 0, blockIdx.z: 1 | blockDim.x: 2, blockDim.y
    : 2, blockDim.z: 2 | gridDim.x: 2, gridDim.y: 2, gridDim.z:
    2
```