Practical No 11

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Batch: B6

Course: High Performance Computing Lab

Title of practical: Understanding concepts of CUDA Programming

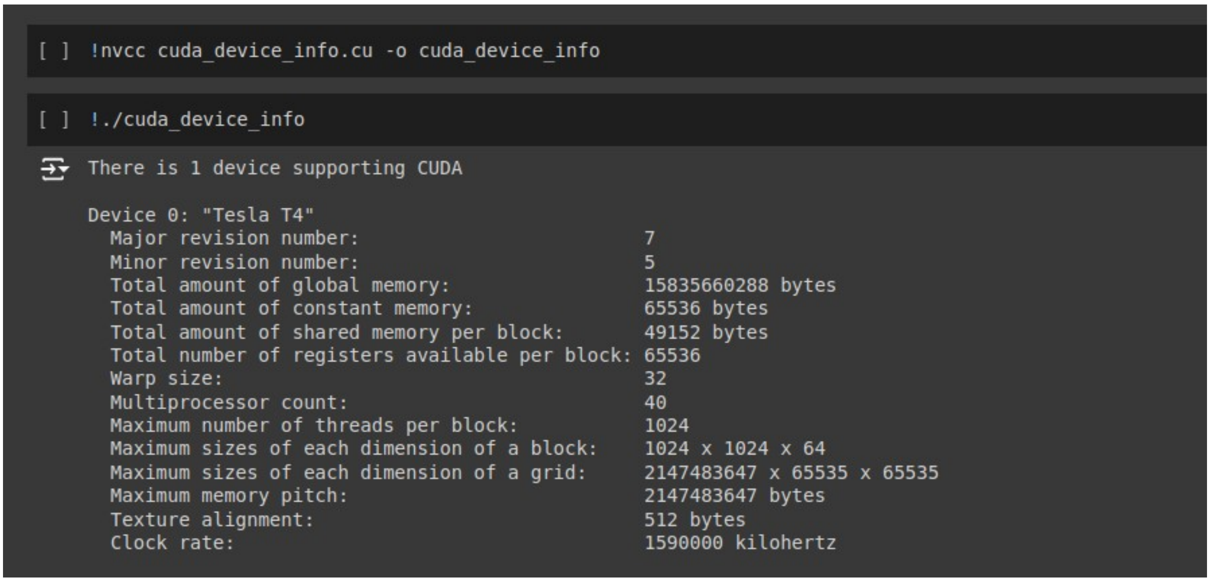
Problem Statement 1:
Execute the following program and check the properties of your GPGPU.

Code:

```
#include <stdio.h>
#include <stdlib.h>
int main()
{
    int deviceCount;
    cudaGetDeviceCount(&deviceCount);
    if (deviceCount == 0)
    {
    printf("There is no device supporting CUDA\n");
    }
    int dev;
    for (dev = 0; dev < deviceCount; ++dev)
    {
    cudaDeviceProp deviceProp;
    cudaGetDeviceProperties(&deviceProp, dev);
    if (dev == 0)
        {
            if (deviceProp.major < 1)
        {
                printf("There is no device supporting CUDA.\n");
            }
            else if (deviceCount == 1)
            {
            printf("There is 1 device supporting CUDA\n");
            }
            else
```

```
                {
                                printf("There are %d devices supporting CUDA\n",
deviceCount);
                        }
        }
        printf("\nDevice %d: \"%s\"\n", dev, deviceProp.name);
        printf("  Major revision number:                    %d\n",
deviceProp.major);
        printf("  Minor revision number:                    %d\n",
deviceProp.minor);
        printf("  Total amount of global memory:            %d bytes\n",
deviceProp.totalGlobalMem);
        printf("  Total amount of constant memory:          %d bytes\n",
deviceProp.totalConstMem);
        printf("  Total amount of shared memory per block:     %d bytes\n",
deviceProp.sharedMemPerBlock);
        printf("  Total number of registers available per block: %d\n",
deviceProp.regsPerBlock);
        printf("  Warp size:                                %d\n", deviceProp.warpSize);
                printf("  Multiprocessor count:                  %d\
n",deviceProp.multiProcessorCount );

        printf("  Maximum number of threads per block:         %d\n",
deviceProp.maxThreadsPerBlock);
        printf("  Maximum sizes of each dimension of a block:    %d x %d x %d\
n", deviceProp.maxThreadsDim[0],deviceProp.maxThreadsDim[1],
deviceProp.maxThreadsDim[2]);
        printf("  Maximum sizes of each dimension of a grid:     %d x %d x %d\
n", deviceProp.maxGridSize[0], deviceProp.maxGridSize[1],
deviceProp.maxGridSize[2]);
        printf("  Maximum memory pitch:                     %d bytes\n",
deviceProp.memPitch);
        printf("  Texture alignment:                        %d bytes\n",
deviceProp.textureAlignment);
        printf("  Clock rate:                               %d kilohertz\n",
deviceProp.clockRate);
        }
}
```

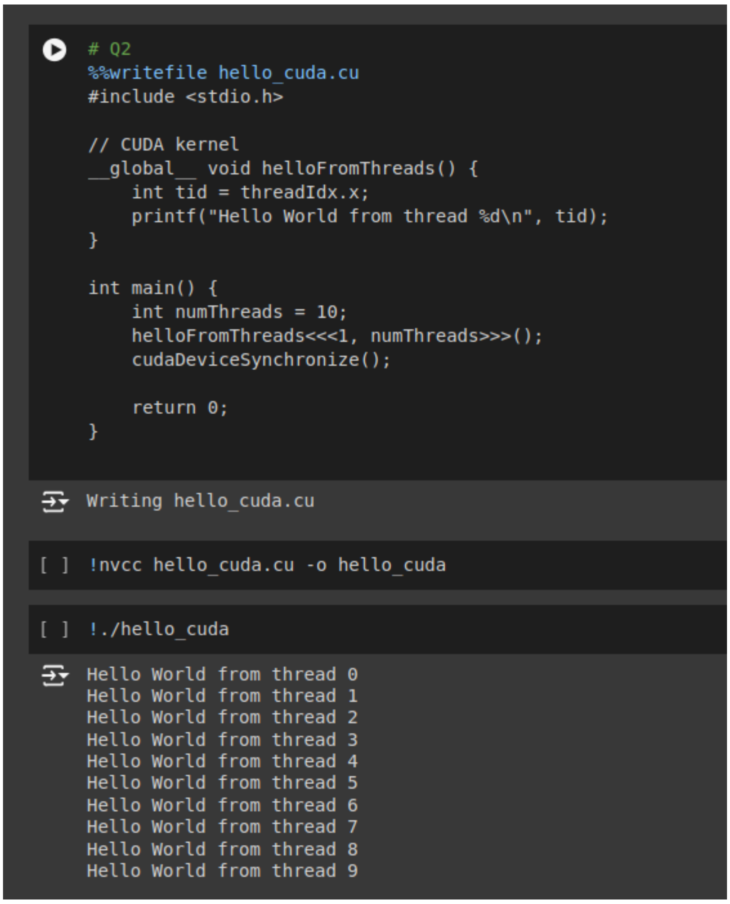
Output:



```
[ ] !nvcc cuda_device_info.cu -o cuda_device_info

[ ] !./cuda_device_info

    There is 1 device supporting CUDA

    Device 0: "Tesla T4"
      Major revision number:                         7
      Minor revision number:                         5
      Total amount of global memory:                 15835660288 bytes
      Total amount of constant memory:               65536 bytes
      Total amount of shared memory per block:       49152 bytes
      Total number of registers available per block: 65536
      Warp size:                                     32
      Multiprocessor count:                          40
      Maximum number of threads per block:           1024
      Maximum sizes of each dimension of a block:    1024 x 1024 x 64
      Maximum sizes of each dimension of a grid:     2147483647 x 65535 x 65535
      Maximum memory pitch:                          2147483647 bytes
      Texture alignment:                             512 bytes
      Clock rate:                                    1590000 kilohertz
```

Problem Statement 2:

Write a program to where each thread prints its thread ID along with hello world. Lauch the kernel with one block and multiple threads.



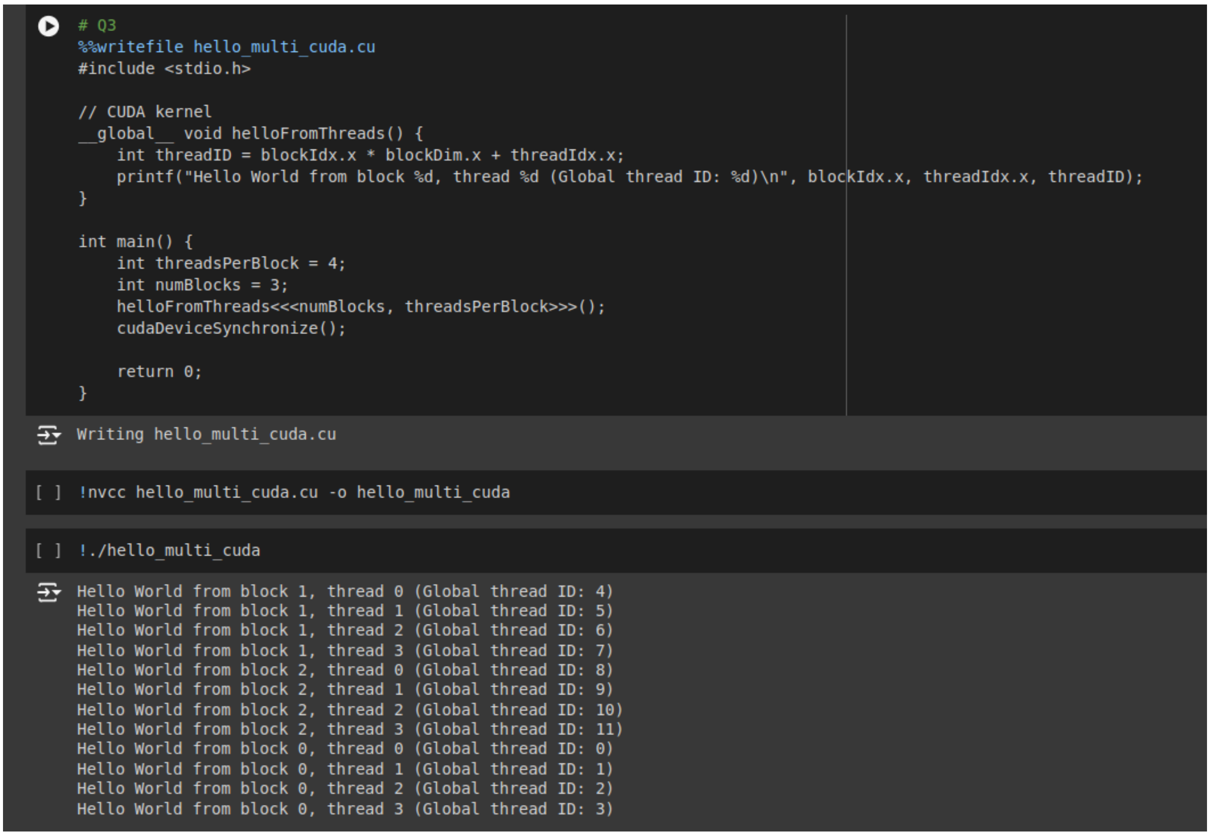
```
# Q2
%%writefile hello_cuda.cu
#include <stdio.h>

// CUDA kernel
__global__ void helloFromThreads() {
    int tid = threadIdx.x;
    printf("Hello World from thread %d\n", tid);
}

int main() {
    int numThreads = 10;
    helloFromThreads<<<1, numThreads>>>();
    cudaDeviceSynchronize();

    return 0;
}
```

```
Writing hello_cuda.cu
```

```
[ ] !nvcc hello_cuda.cu -o hello_cuda

[ ] !./hello_cuda

Hello World from thread 0
Hello World from thread 1
Hello World from thread 2
Hello World from thread 3
Hello World from thread 4
Hello World from thread 5
Hello World from thread 6
Hello World from thread 7
Hello World from thread 8
Hello World from thread 9
```

Problem Statement 3:

Write a program to where each thread prints its thread ID along with hello world. Lauch the kernel with multiple blocks and multiple threads.



```
# Q3
%%writefile hello_multi_cuda.cu
#include <stdio.h>

// CUDA kernel
__global__ void helloFromThreads() {
    int threadID = blockIdx.x * blockDim.x + threadIdx.x;
    printf("Hello World from block %d, thread %d (Global thread ID: %d)\n", blockIdx.x, threadIdx.x, threadID);
}

int main() {
    int threadsPerBlock = 4;
    int numBlocks = 3;
    helloFromThreads<<<numBlocks, threadsPerBlock>>>();
    cudaDeviceSynchronize();

    return 0;
}
```

```
Writing hello_multi_cuda.cu
```

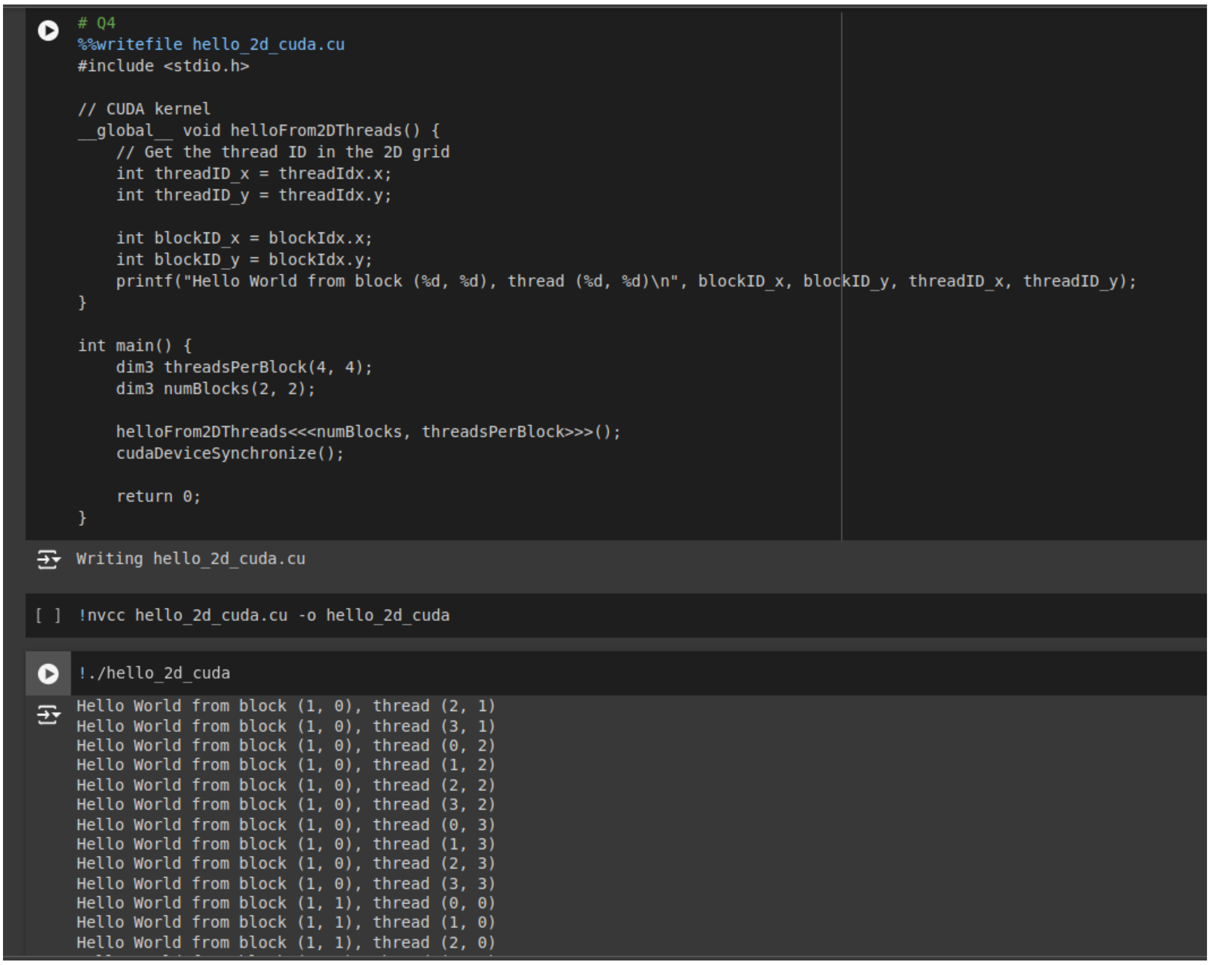
```
!nvcc hello_multi_cuda.cu -o hello_multi_cuda
```

```
!./hello_multi_cuda
```

```
Hello World from block 1, thread 0 (Global thread ID: 4)
Hello World from block 1, thread 1 (Global thread ID: 5)
Hello World from block 1, thread 2 (Global thread ID: 6)
Hello World from block 1, thread 3 (Global thread ID: 7)
Hello World from block 2, thread 0 (Global thread ID: 8)
Hello World from block 2, thread 1 (Global thread ID: 9)
Hello World from block 2, thread 2 (Global thread ID: 10)
Hello World from block 2, thread 3 (Global thread ID: 11)
Hello World from block 0, thread 0 (Global thread ID: 0)
Hello World from block 0, thread 1 (Global thread ID: 1)
Hello World from block 0, thread 2 (Global thread ID: 2)
Hello World from block 0, thread 3 (Global thread ID: 3)
```

Problem Statement 4:

Write a program to where each thread prints its thread ID along with hello world. Lauch the kernel with 2D blocks and 2D threads.



```
# Q4
%%writefile hello_2d_cuda.cu
#include <stdio.h>

// CUDA kernel
__global__ void helloFrom2DThreads() {
    // Get the thread ID in the 2D grid
    int threadID_x = threadIdx.x;
    int threadID_y = threadIdx.y;

    int blockID_x = blockIdx.x;
    int blockID_y = blockIdx.y;
    printf("Hello World from block (%d, %d), thread (%d, %d)\n", blockID_x, blockID_y, threadID_x, threadID_y);
}

int main() {
    dim3 threadsPerBlock(4, 4);
    dim3 numBlocks(2, 2);

    helloFrom2DThreads<<<numBlocks, threadsPerBlock>>>();
    cudaDeviceSynchronize();

    return 0;
}
```

```
Writing hello_2d_cuda.cu
```

```
!nvcc hello_2d_cuda.cu -o hello_2d_cuda
```

```
!./hello_2d_cuda
```

```
Hello World from block (1, 0), thread (2, 1)
Hello World from block (1, 0), thread (3, 1)
Hello World from block (1, 0), thread (0, 2)
Hello World from block (1, 0), thread (1, 2)
Hello World from block (1, 0), thread (2, 2)
Hello World from block (1, 0), thread (3, 2)
Hello World from block (1, 0), thread (0, 3)
Hello World from block (1, 0), thread (1, 3)
Hello World from block (1, 0), thread (2, 3)
Hello World from block (1, 0), thread (3, 3)
Hello World from block (1, 1), thread (0, 0)
Hello World from block (1, 1), thread (1, 0)
Hello World from block (1, 1), thread (2, 0)
```