DD2360 Assignment 2
Group 35
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Github repository: ShiyuanShan/DD2360HT23 (github.com)

Exercise 1

1.1 The program is compiled with command:

```
!nvcc -o hw2_ex1 hw2_ex1.cu
```

It is run with command:

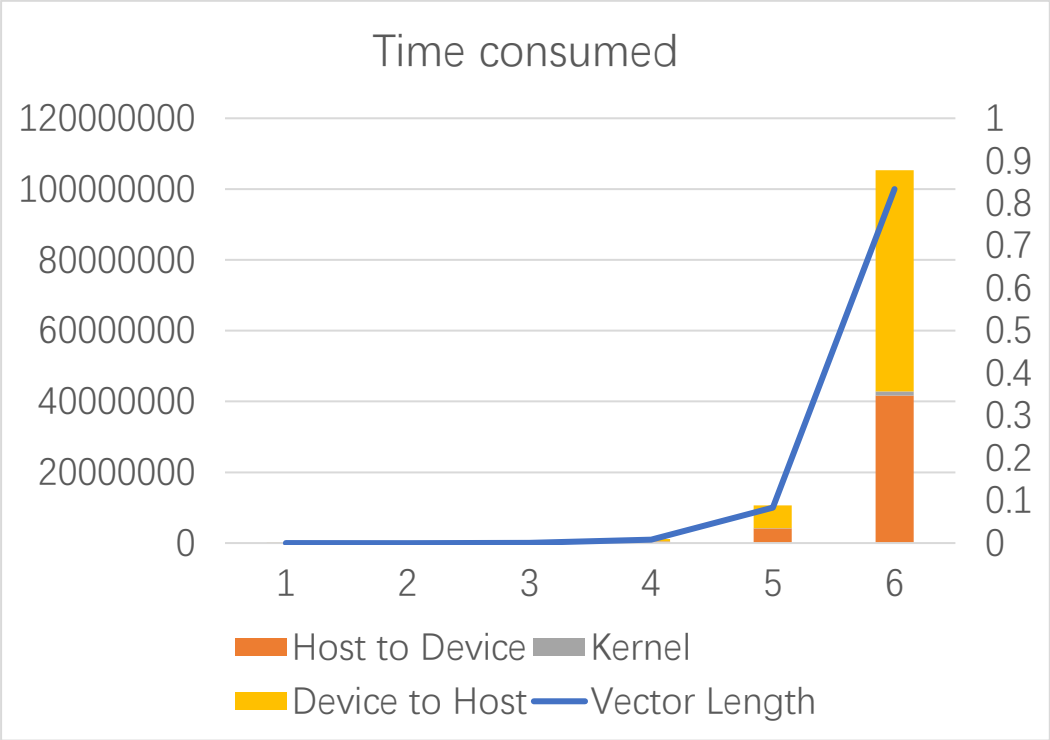
```
!./hw2_ex1 1024
```

1.2 1) N floating point addition is done by the kernel.
2) 2N global memory reads are conducted for N adding operations.

1.3 1) Each block has a size of 256. For vector length 1024, 4 thread blocks are needed. Thus in total 4 blocks, 4*256=1024 threads.
2) Achieved occupancy is 23.44%.

1.4 1) Yes it still works. It works because I have already added the If statement in the kernel so that no overflow takes place.
2) Each block has a size of 256. For vector length 131070, 512 thread blocks are needed. Thus in total 512 blocks, 512*256=131072 threads.
3) Achieved occupancy is 78.62%.

1.5



Exercise 2

2.1 Matrix multiplication is used in computer graphics, neural network and finite element analysis.

2.2 Assume matrix A has dimension a_x, a_y and matrix B has dimension b_x, b_y, then a_y = b_x. There are a_x*b_y elements in matrix C, each of which is through a_y

multiplication and addition. Thus in total 2*a_x*b_y*a_y floating point operations are performed by the kernel.

2.3 Assume matrix A has dimension a_x, a_y and matrix B has dimension b_x, b_y, then a_y = b_x. There are a_x*b_y elements in matrix C, each of which needs 2*a_y global memory reads. Thus in total 2*a_x*b_y*a_y global memory reads are performed by the kernel.

2.4 1) Each block has a dimension of (16,16), 8*8=64 thread blocks are needed. Thus in total 64 blocks, 64*16*16=16384 threads.

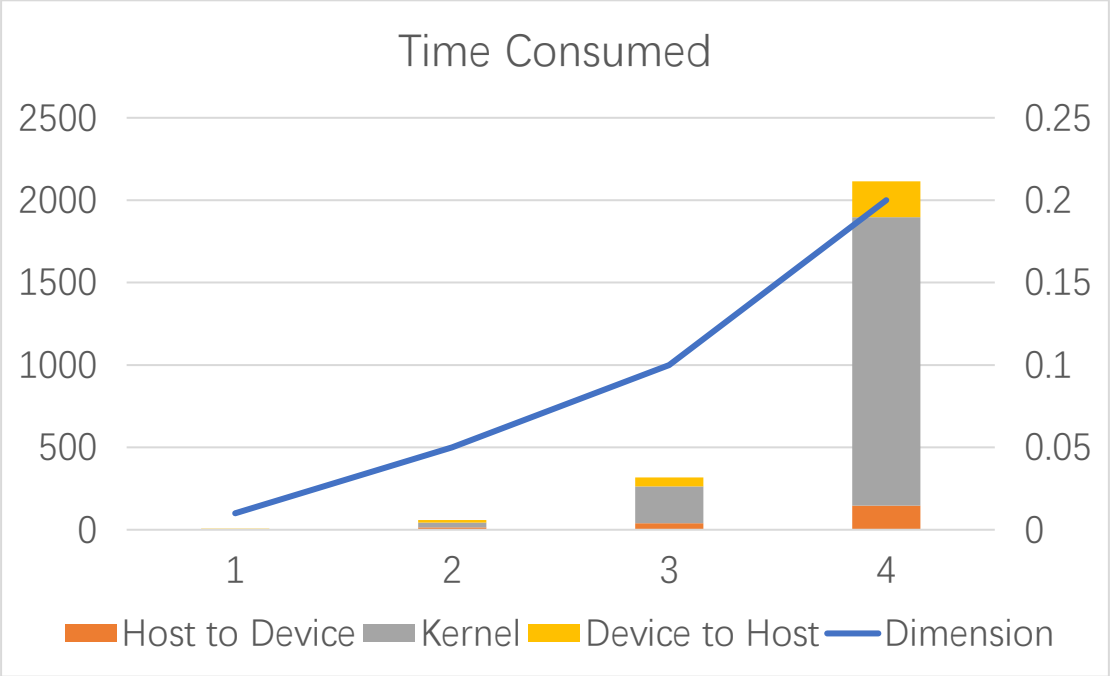
2) Achieved occupancy is 42.82%.

2.5 1) Yes it works. The key point should still be the if statement.

2) Each block has a dimension of (16,16), 32*256=8192 thread blocks are needed. Thus in total 8192 blocks, 8192*16*16=2097152 threads.

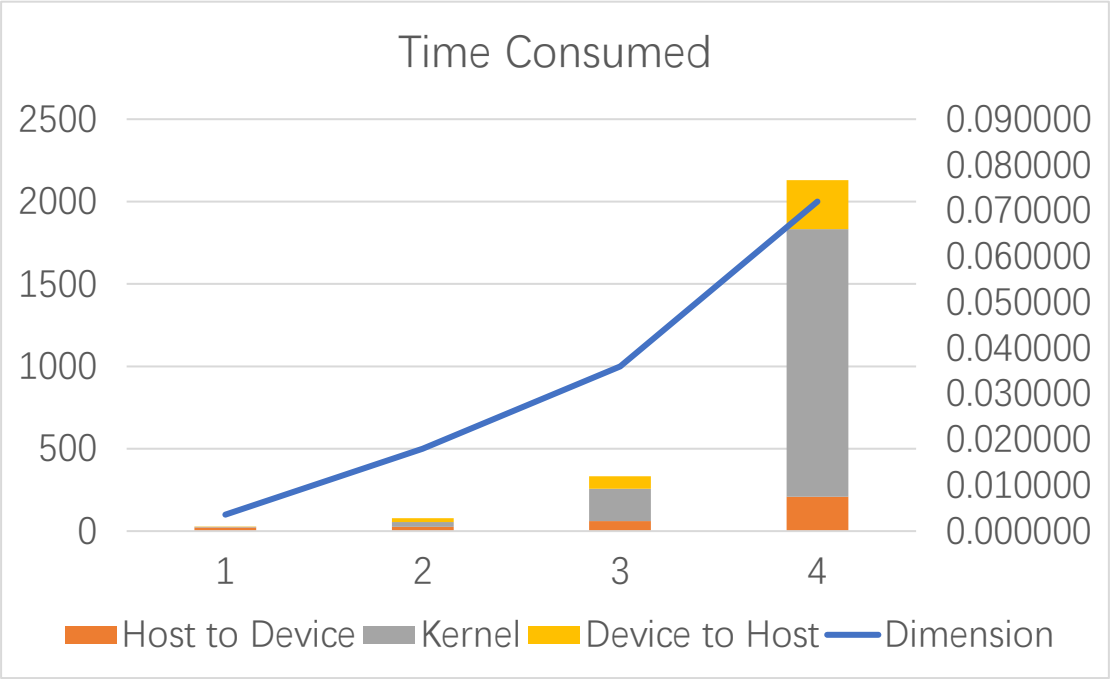
3) Achieved occupancy is 99.18%.

2.6 Dimension in the following graph means matrix A, B and C are all (Dim, Dim)



Unlike the vector addition case, in which most time is consumed by the memcpy processes, in matrix multiplication the major time consumed is for calculation within the kernel. The relation between time consumed and dimension seems to be a power function.

2.7



The memcpy processes cost only half of the original time. The calculation in kernel consumes are 2-3 times faster than the original time. It is quite sensible because when changed from double to float, memory with same bandwidth can carry twice as much data. Similarly goes for the calculation in kernel, double precision floating point operations are much more time consuming than single precision floating point operations.