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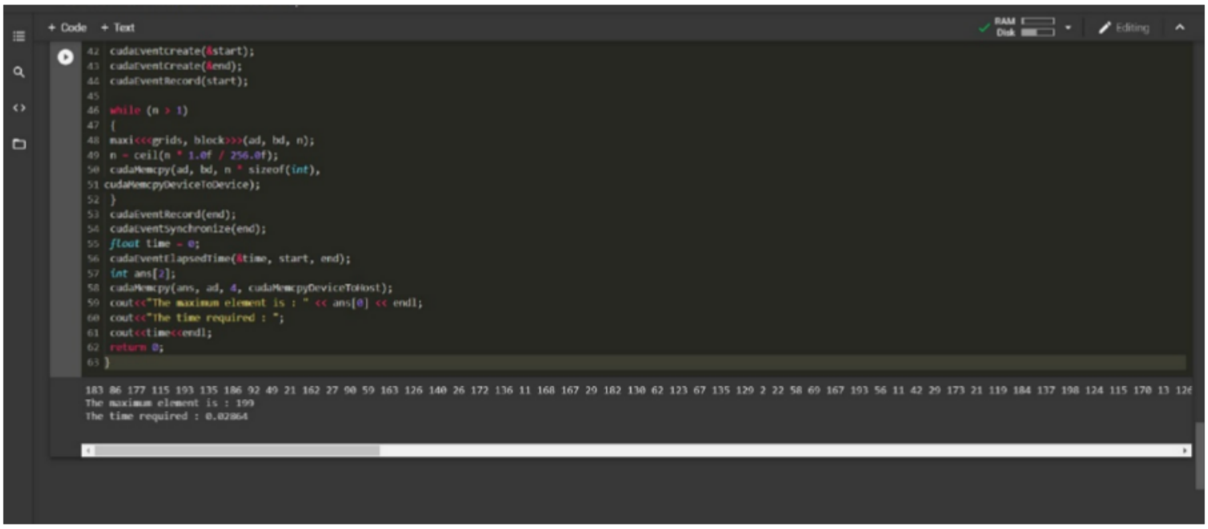
Class: BE Comp SS

Code (Maximum):

```
%%cu
#include <cstdio>
#include <iostream>
using namespace std;

__global__ void maxi(int* a, int* b, int n)
{
 int block = 256 * blockIdx.x;
 int max = 0;
 for (int i = block; i < min(256 + block, n); i++)
 {
 if (max < a[i])
 {
 max = a[i];
 }
 }
 b[blockIdx.x] = max;
}
```

```
int main()
{
 int n;
 n = 200;
 int a[n];
 for (int i = 0; i < n; i++)
 {
 a[i] = rand() % n;
 cout << a[i] << " ";
 }
 cout<<"\n";
 cudaEvent_t start, end;
 int *ad, *bd;
 int size = n * sizeof(int);
 cudaMalloc(&ad, size);
 cudaMemcpy(ad, a, size, cudaMemcpyHostToDevice);
 int grids = ceil(n * 1.0f / 256.0f);
 cudaMalloc(&bd, grids * sizeof(int));

 dim3 grid(grids, 1);
 dim3 block(1, 1);

 cudaEventCreate(&start);
 cudaEventCreate(&end);
 cudaEventRecord(start);
 while (n > 1)
 {
 maxi<<<grids, block>>>(ad, bd, n);
 n =ceil(n * 1.0f / 256.0f);
 cudaMemcpy(ad, bd, n * sizeof(int),
cudaMemcpyDeviceToDevice);
 }
 cudaEventRecord(end);
 cudaEventSynchronize(end);
 float time =0;
 cudaEventElapsedTime(&time, start, end);
 int ans[2];
 cudaMemcpy(ans, ad, 4, cudaMemcpyDeviceToHost);
 cout<<"The maximum element is : " << ans[0] << endl;
 cout<<"The time required : ";
 cout<<time<<endl;
 return 0;
}
```

Output:



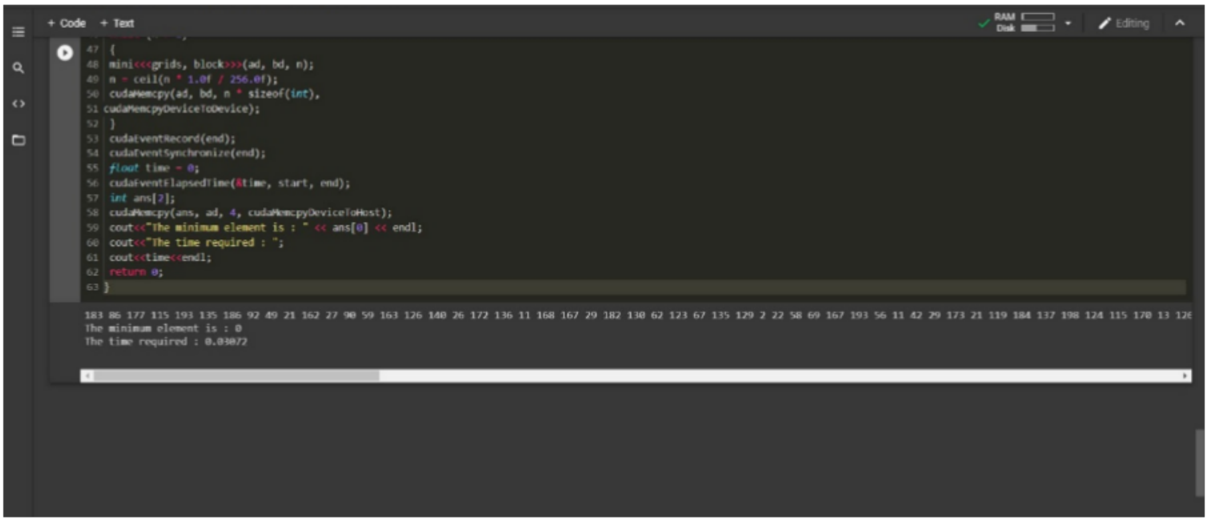
```
cudaEventCreate(&start);
cudaEventCreate(&end);
cudaEventRecord(start);

while (n > 1)
{
maxi<<<grids, block>>>(ad, bd, n);
n = ceil(n * 1.0f / 256.0f);
cudaMemcpy(ad, bd, n * sizeof(int),
cudaMemcpyDeviceToDevice);
}
cudaEventRecord(end);
cudaEventSynchronize(end);
float time = 0;
cudaEventElapsedTime(&time, start, end);
int ans[2];
cudaMemcpy(ans, ad, 4, cudaMemcpyDeviceToHost);
cout<<"The maximum element is : " << ans[0] << endl;
cout<<"The time required : ";
cout<<time<<endl;
return 0;
}
```

```
183 86 177 115 193 135 186 92 49 21 162 27 90 59 163 126 140 26 172 136 11 168 167 29 182 130 62 123 67 135 129 2 22 58 69 167 193 56 11 42 29 173 21 119 184 137 198 124 115 170 13 126
The maximum element is : 199
The time required : 0.02864
```

Code (Minimum):

```
%%cu
#include <cstdio>
#include <iostream>
using namespace std;

__global__ void mini(int* a, int* b, int n)
{
 int block = 256 * blockIdx.x;
 int minimum = 0;
 for (int i = block; i < min(256 + block, n); i++)
 {
 if (minimum > a[i])
 {
 minimum = a[i];
 }
 }
 b[blockIdx.x] = minimum;
}

int main()
{
 int n;
 n = 200;
 int a[n];
 for (int i = 0; i < n; i++)
 {
 a[i] = rand() % n;
 cout << a[i] << " ";
 }
 cout<<"\n";
 cudaEvent_t start, end;
 int *ad, *bd;
 int size = n * sizeof(int);
 cudaMalloc(&ad, size);
 cudaMemcpy(ad, a, size, cudaMemcpyHostToDevice);
 int grids = ceil(n * 1.0f / 256.0f);
 cudaMalloc(&bd, grids * sizeof(int));

 dim3 grid(grids, 1);
 dim3 block(1, 1);
 cudaEventCreate(&start);
 cudaEventCreate(&end);
 cudaEventRecord(start);

 while (n > 1)
 {
 mini<<<grids, block>>>(ad, bd, n);
 n =ceil(n * 1.0f / 256.0f);
 cudaMemcpy(ad, bd, n * sizeof(int),
cudaMemcpyDeviceToDevice);
 }
 cudaEventRecord(end);
 cudaEventSynchronize(end);
 float time =0;
 cudaEventElapsedTime(&time, start, end);
 int ans[2];
 cudaMemcpy(ans, ad, 4, cudaMemcpyDeviceToHost);
 cout<<"The minimum element is : " << ans[0] << endl;
 cout<<"The time required : ";
 cout<<time<<endl;
 return 0;
}
```

Output:



```
{
mini<<<grids, block>>>(ad, bd, n);
n = ceil(n * 1.0f / 256.0f);
cudaMemcpy(ad, bd, n * sizeof(int),
cudaMemcpyDeviceToDevice);
}
cudaEventRecord(end);
cudaEventSynchronize(end);
float time = 0;
cudaEventElapsedTime(&time, start, end);
int ans[2];
cudaMemcpy(ans, ad, 4, cudaMemcpyDeviceToHost);
cout<<"The minimum element is : " << ans[0] << endl;
cout<<"The time required : ";
cout<<time<<endl;
return 0;
}
```

```
183 86 177 115 193 135 186 92 49 21 162 27 90 59 163 126 140 26 172 136 11 168 167 29 182 130 62 123 67 135 129 2 22 58 69 167 193 56 11 42 29 173 21 119 184 137 198 124 115 170 13 12
The minimum element is : 0
The time required : 0.03072
```

Code (Std Dev & Variance):

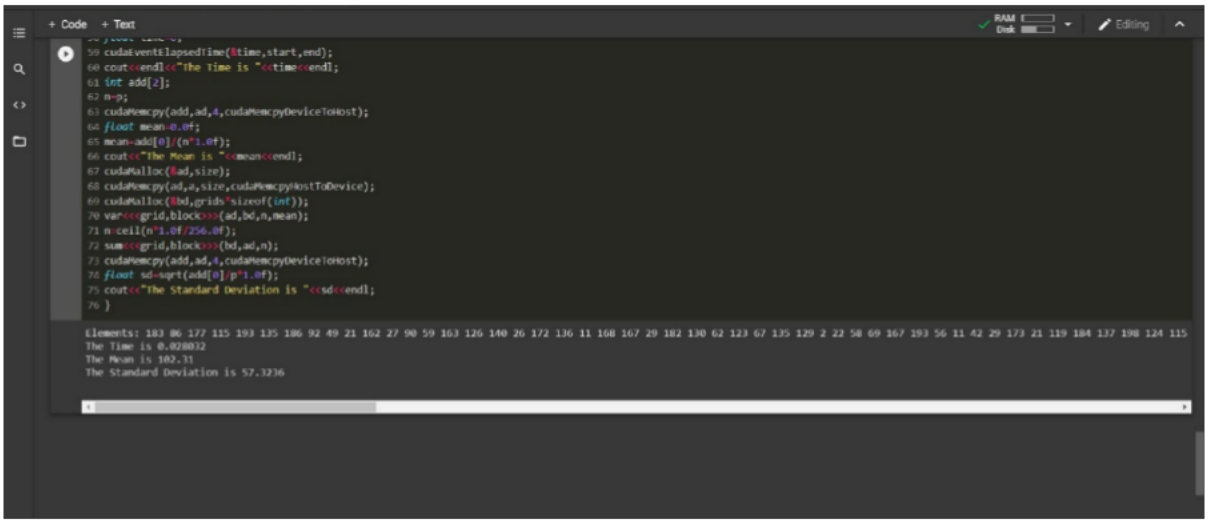
```
%%cu
#include<iostream>
#include<cstdio>
using namespace std;
__global__ void var(int *a,int *b,int n,float mean)
{
 int block=256*blockIdx.x;
 float sum=0;
 for(int i=block;i<min(block+256,n);i++)
 {
 sum=sum+(a[i]-mean)*(a[i]-mean);
 }
 b[blockIdx.x]=sum;
```

```
}
__global__ void sum(int *a,int *b,int n)
{
 int block=256*blockIdx.x;
 int sum=0;
 for(int i=block;i<min(block+256,n);i++)
 {
 sum=sum+a[i];
 }
 b[blockIdx.x]=sum;
}
int main()
{
int n;
n=200;
int a[n];
cout<<"Elements: ";
for(int i=0;i<n;i++)
{
a[i]=rand()%n;
cout<<a[i]<<" ";
}
int *ad,*bd;
int size=n*sizeof(int);
cudaMalloc(&ad,size);
cudaMemcpy(ad,a,size,cudaMemcpyHostToDevice);
```

```
int grids=ceil(n*1.0f/256.0f);
cudaMalloc(&bd,grids*sizeof(int));
dim3 grid(grids,1);
dim3 block(1,1);
int p=n;
cudaEvent_t start,end;
cudaEventCreate(&start);
cudaEventCreate(&end);
cudaEventRecord(start);
while(n>1)
{
 sum<<<grid,block>>>(ad,bd,n);
 n=ceil(n*1.0f/256.0f);

cudaMemcpy(ad,bd,n*sizeof(int),cudaMemcpyDeviceToDevice);
}
cudaEventRecord(end);
cudaEventSynchronize(end);
float time=0;
cudaEventElapsedTime(&time,start,end);
cout<<endl<<"The Time is "<<time<<endl;
int add[2];
n=p;
cudaMemcpy(add,ad,4,cudaMemcpyDeviceToHost);
float mean=0.0f;
mean=add[0]/(n*1.0f);
```

```
cout<<"The Mean is "<<mean<<endl;
cudaMalloc(&ad,size);
cudaMemcpy(ad,a,size,cudaMemcpyHostToDevice);
cudaMalloc(&bd,grids*sizeof(int));
var<<<grid,block>>>(ad,bd,n,mean);
n=ceil(n*1.0f/256.0f);
sum<<<grid,block>>>(bd,ad,n);
cudaMemcpy(add,ad,4,cudaMemcpyDeviceToHost);
float sd=sqrt(add[0]/p*1.0f);
cout<<"The Standard Deviation is "<<sd<<endl;
}
```

Output:



```
cudaEventElapsedTime(&time,start,end);
cout<<endl<<"The Time is "<<time<<endl;
int add[2];
n=p;
cudaMemcpy(add,ad,4,cudaMemcpyDeviceToHost);
float mean=0.0f;
mean=add[0]/(n*1.0f);
cout<<"The Mean is "<<mean<<endl;
cudaMalloc(&ad,size);
cudaMemcpy(ad,a,size,cudaMemcpyHostToDevice);
cudaMalloc(&bd,grids*sizeof(int));
var<<<grid,block>>>(ad,bd,n,mean);
n=ceil(n*1.0f/256.0f);
sum<<<grid,block>>>(bd,ad,n);
cudaMemcpy(add,ad,4,cudaMemcpyDeviceToHost);
float sd=sqrt(add[0]/p*1.0f);
cout<<"The Standard Deviation is "<<sd<<endl;
}
```

```
Elements: 183 86 177 115 193 135 186 92 49 21 162 27 90 59 163 126 140 26 172 136 11 168 167 29 182 130 62 123 67 135 129 2 22 58 69 167 193 56 11 42 29 173 21 119 184 137 198 124 115
The Time is 0.028032
The Mean is 102.31
The Standard Deviation is 57.3236
```