Performance analysis on GPUs with NVIDIA tools

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Example: 2D Jacobi

Get the Source:

```
  git clone https://github.com/te42kyfo/omp_jacobi
```

or

```
  cp -r ../r49n000/omp_jacobi .
```

Load the compiler module

```
  module load nvhpc
  module load cuda
```

Build and run the CPU base line

```
  make main1
  ./main1
```

Run likwid-bench

```
  module load likwid
  likwid-bench -t copy -W S0:1GB
```

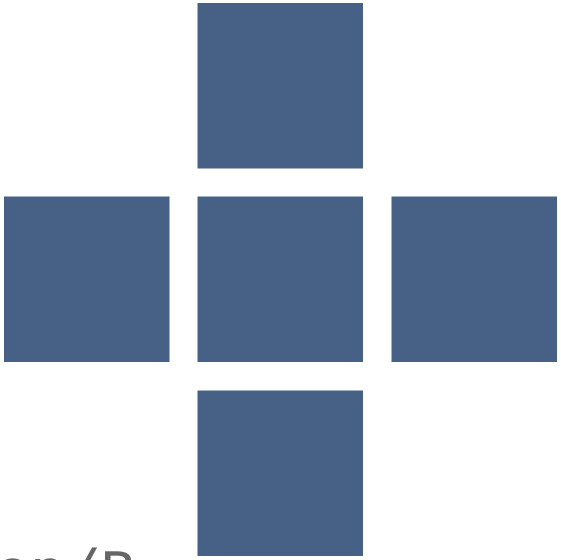
Analysis: 2D Jacobi

3 ADDs, 1 MUL per iteration:

```
A[o] = 0.25 * (B[^] + B[v] + B[<] + B[>])
```

Read entire grid A and B once each → on average: one value per iteration

```
= 2x8B / iteration
```



Code Intensity:

```
4 Flop / 16 B = 0.25 Flop/B
```

A100 Machine Intensity:

```
9.7 Tflop/s / 1555 GB/s = 6.2 Flop/B
```

Build/Run/Profile

Build and run the Nth version

```
make main<N>
./main<N>
```

Create a profile

```
nsys profile main<N>
```

Launch the profiling GUI

```
nsys-ui
```

Kernel Profiling

Kernel profiling

```
ncu <application>
```

List metric sections

```
ncu --list-sections
```

Collect all sections

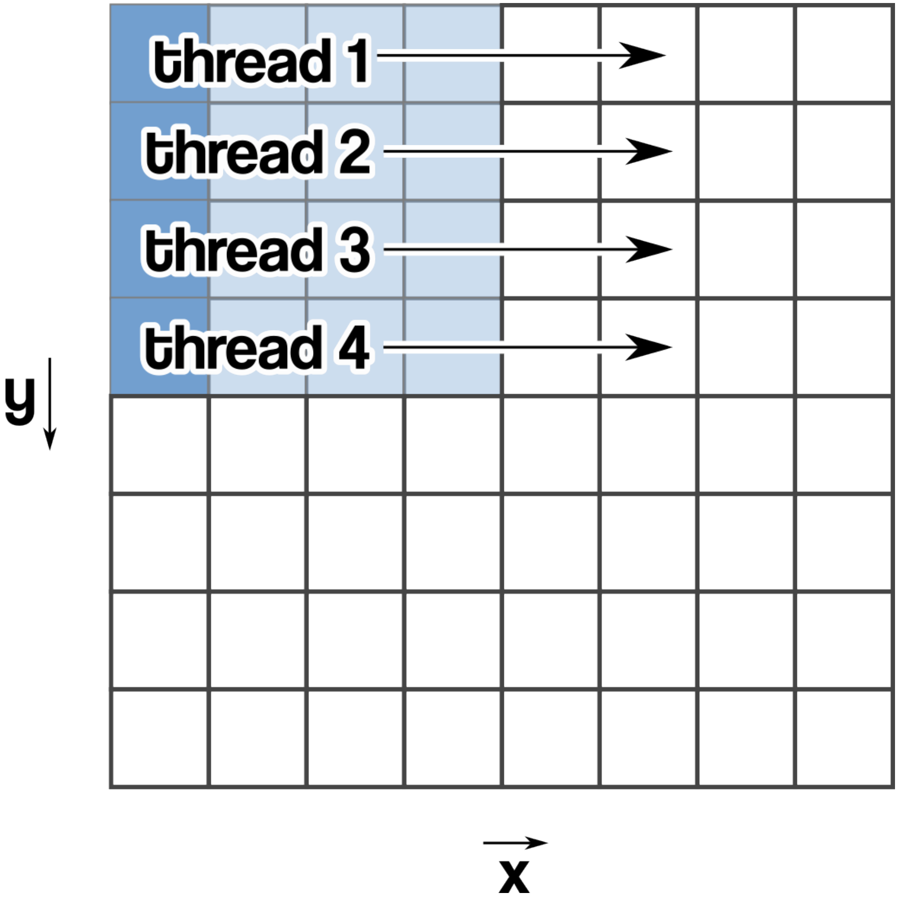
```
ncu --set full -f -o <output file> <application>
```

Launch the ncu profiling GUI

```
ncu-ui
```

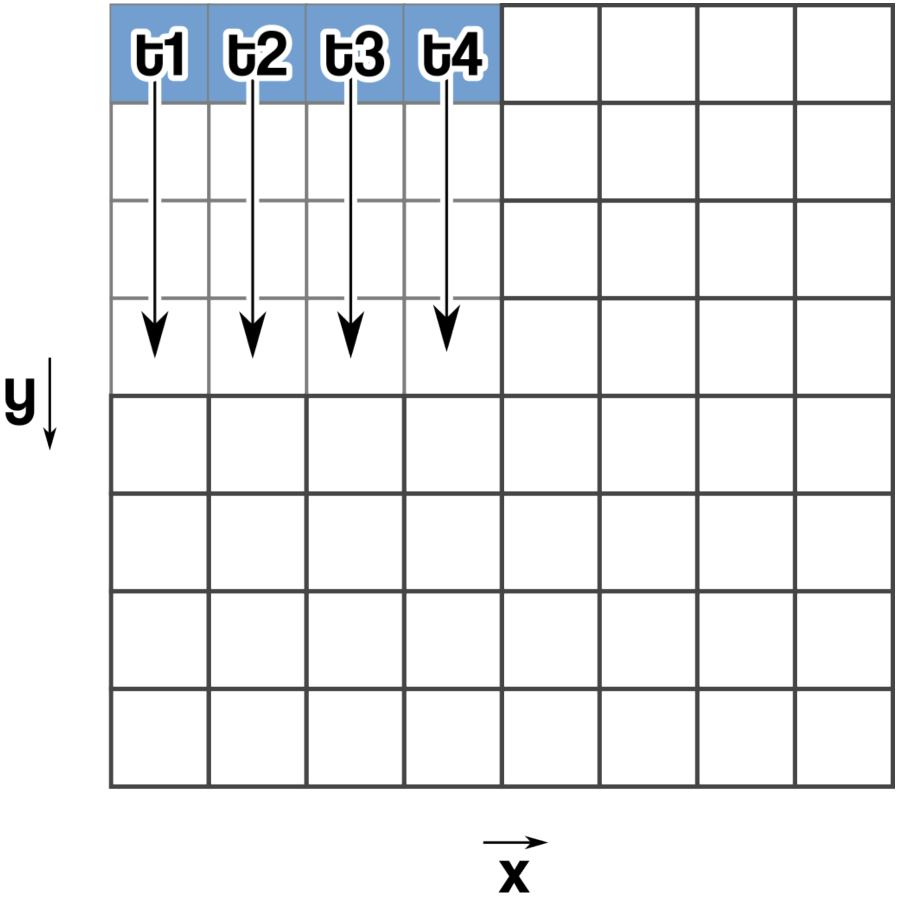
OpenMP Loop main4

```
#pragma omp target parallel for
for (int y = 1; y < height - 1; y++)
  for (int x = 1; x < width - 1; x++)
    ...
```



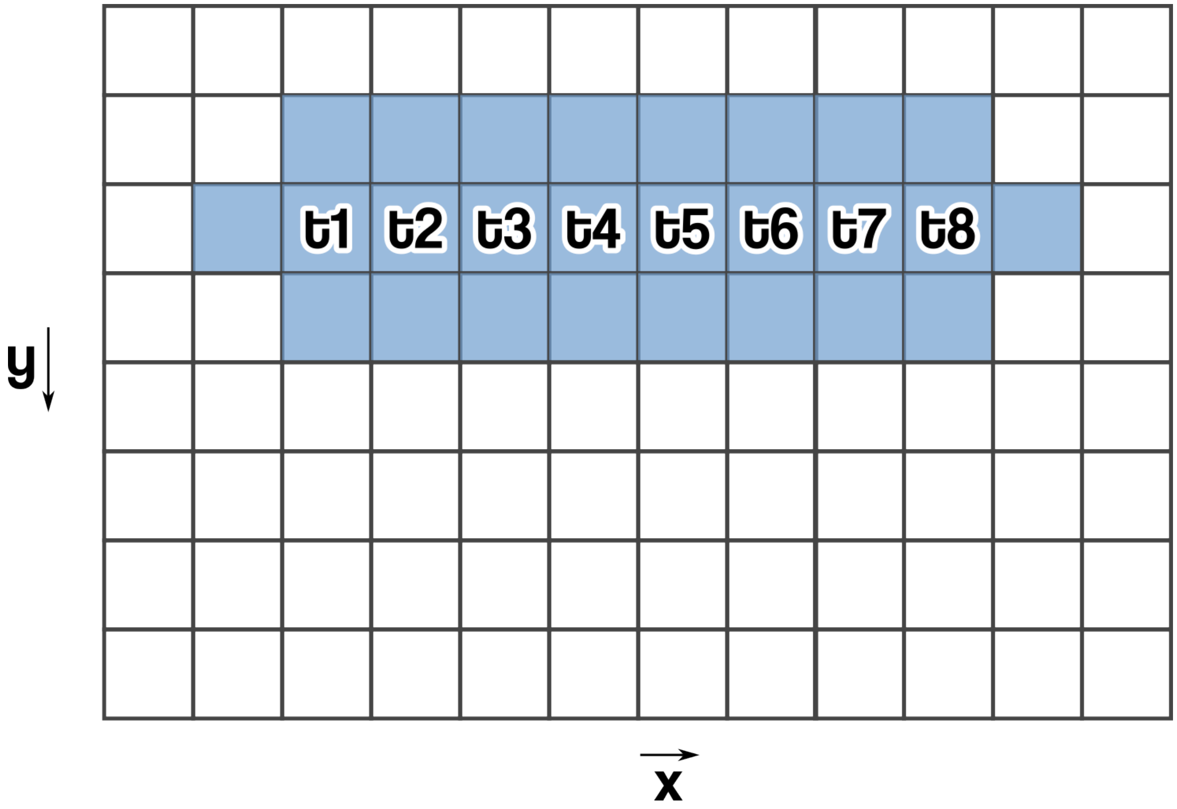
OpenMP Loop main41

```
#pragma omp target parallel for
for (int x = 1; x < width - 1; x++)
  for (int y = 1; y < height - 1; y++)
    ...
```



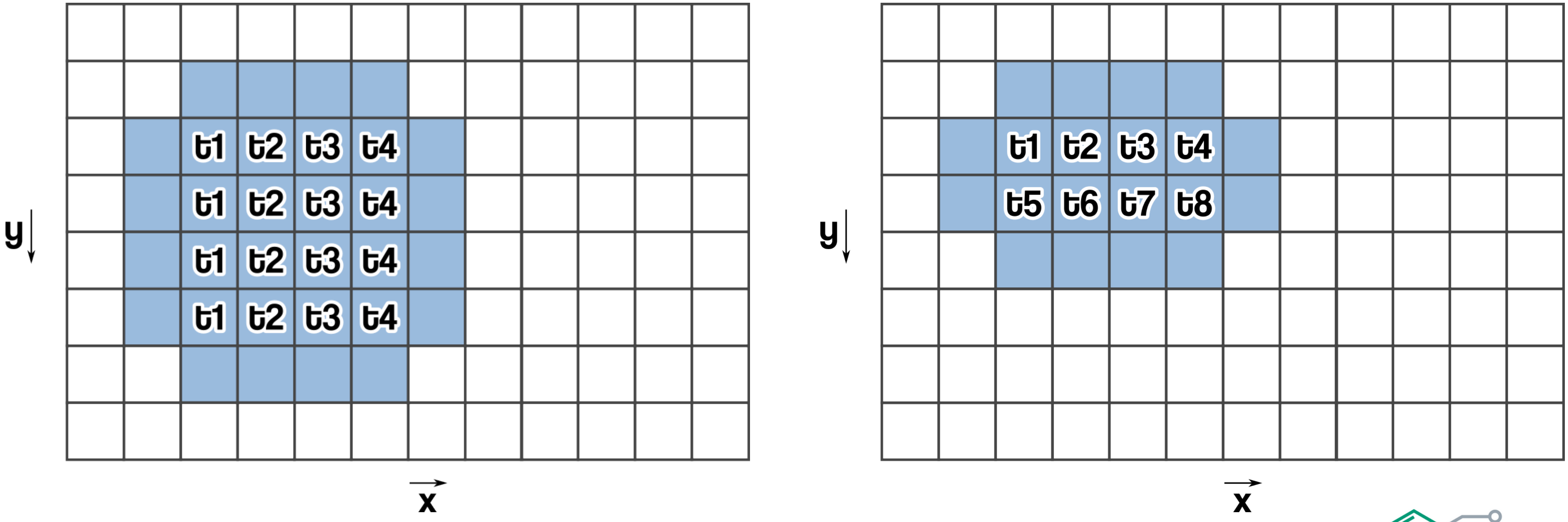
OpenMP main51

```
#pragma omp target parallel for collapse(2)
for (int y = 1; y < height - 1; y++)
  for (int x = 1; x < width - 1; x++)
    ...
```



OpenMP Loop main6 / main7

```
#pragma omp target parallel for collapse(2)
for (int oy = 1; oy < height - 1; oy += 4)
  for (int x = 1; x < width - 1; x++)
    for (int iy = 0; iy < 4; iy++) {
      int y = oy + iy;
```



t1
t2
t3
t4
t1
t2
t3
t4
t1
t2
t3
t4
t1
t2
t3
t4
y
x
t1
t2
t3
t4
t5
t6
t7
t8
y
x