

```
D:\Projects\IPS2018_lecture3\Debug\IPS2018_lecture3.exe
Serial - Forward pass - Elapsed time: 3.64e-07 seconds
Solution:
x(0) = 1.000000
x(1) = 2.000000
x(2) = 2.000000
x(3) = -0.000000
```

HotspotsHotspots by CPU Utilization

Analysis ConfigurationCollection LogSummaryBottom-upCaller/CalleeTop-down TreePlatform

Top Hotspots

This section lists the most active functions in your application. Optimizing these hotspot functions typically results in improving overall application performance.

| Function          | Module               | Module               | CPU Time |
|-------------------|----------------------|----------------------|----------|
| SerialGaussMethod | IPS2018_lecture3.exe | IPS2018_lecture3.exe | 3.298s   |
| rand              | ucrtbased.dll        | ucrtbased.dll        | 0.120s   |
| InitMatrix        | IPS2018_lecture3.exe | IPS2018_lecture3.exe | 0.020s   |
| free_dbg          | ucrtbased.dll        | ucrtbased.dll        | 0.010s   |

N/A is applied to non-summable metrics.

Effective CPU Utilization Histogram

This histogram displays a percentage of the wall time the specific number of CPUs were running simultaneously. Spin and Overhead time adds to the Idle CPU utilization value.

Parallelism: 18.1% (1.086 out of 6 logical CPUs)

Use Threading to explore more opportunities to increase parallelism in your application.

Microarchitecture Usage: 44.1%

Use Microarchitecture Exploration to explore how efficiently your application runs on the used hardware.

Vector Register Utilization: 23.2%

Use Intel Advisor to learn more on vectorization efficiency of your application.

HotspotsHotspots by CPU Utilization

Analysis ConfigurationCollection LogSummaryBottom-upCaller/CalleeTop-down TreePlatform

| Function            | CPU Time: Total | CPU Time: Self | Module               | Function (Full)                            | Source File           | Start Address |
|---------------------|-----------------|----------------|----------------------|--|-----------------------|---------------|
| func@0x4b2e300f     | 100.0%          | 0s             | ntdll.dll            | func@0x4b2e300f                            |                       | 0x4b2e300f    |
| func@0x4b2e302b     | 100.0%          | 0s             | ntdll.dll            | func@0x4b2e302b                            |                       | 0x4b2e302b    |
| BaseThreadInitThunk | 100.0%          | 0s             | kernel32.dll         | BaseThreadInitThunk                        |                       | 0x6b818460    |
| mainCRTStartup      | 100.0%          | 0s             | IPS2018_lecture3.exe | mainCRTStartup                             | exe_main.cpp          | 0x405aa0      |
| func@0x405730       | 100.0%          | 0s             | IPS2018_lecture3.exe | func@0x405730                              |                       | 0x405730      |
| func@0x40588d       | 100.0%          | 0s             | IPS2018_lecture3.exe | func@0x40588d                              |                       | 0x40588d      |
| func@0x405a10       | 100.0%          | 0s             | IPS2018_lecture3.exe | func@0x405a10                              |                       | 0x405a10      |
| main                | 100.0%          | 0s             | IPS2018_lecture3.exe | main                                       | task_for_lecture3.cpp | 0x403c78      |
| SerialGaussMethod   | 95.7%           | 3.298s         | IPS2018_lecture3.exe | SerialGaussMethod(double *, int, double *) | task_for_lecture3.cpp | 0x403844      |
| InitMatrix          | 4.0%            | 0.020s         | IPS2018_lecture3.exe | InitMatrix(double *)                       | task_for_lecture3.cpp | 0x403747      |
| rand                | 3.5%            | 0.120s         | ucrtbased.dll        | rand                                       |                       | 0x100dbdd0    |
| free_dbg            | 0.3%            | 0.010s         | ucrtbased.dll        | free_dbg                                   |                       | 0x1008bf40    |
| operator delete[]   | 0.3%            | 0s             | IPS2018_lecture3.exe | operator delete[](void *, unsigned int)    | delete_array_size.cpp | 0x404db0      |
| operator delete[]   | 0.3%            | 0s             | IPS2018_lecture3.exe | operator delete[](void *)                  | delete_array.cpp      | 0x405f30      |
| operator delete     | 0.3%            | 0s             | IPS2018_lecture3.exe | operator delete(void *)                    | delete_scalar.cpp     | 0x407ce0      |

FILTER

100.0%

ProcessAny Process

ThreadAny Thread

ModuleAny Module

Any Utilization

User functions + 1

Inline Mode

Show inline

Functions only

Intel Inspector 2019

Locate Deadlocks and Data Races

Target Analysis Type Collection Log Summary

Problems

| ID | Type      | Sources                              | Modules              | State |
|----|-----------|--------------------------------------|----------------------|-------|
| P7 | Data race | [Unknown]: task_for_lecture3.cpp     | ips2018_lecture3.exe | New   |
|    | Data race | ips2018_lecture3.exe:0x227e; tas ... | ips2018_lecture3.exe | New   |
|    | Data race | ips2018_lecture3.exe:0x227e; ips ... | ips2018_lecture3.exe | New   |
|    | Data race | ips2018_lecture3.exe:0x2295; tas ... | ips2018_lecture3.exe | New   |
|    | Data race | ips2018_lecture3.exe:0x2295; tas ... | ips2018_lecture3.exe | New   |
|    | Data race | ips2018_lecture3.exe:0x2295; tas ... | ips2018_lecture3.exe | New   |

Filters

Severity: Error 1 item(s)

Type: Data race 1 item(s)

Source: All task\_for\_lecture3.cpp 1 item(s)

Module: ips2018\_lecture3.exe 1 item(s)

State: New 1 item(s)

Suppressed: Not suppressed 1 item(s)

Investigated: Not investigated 1 item(s)

Code Locations: Data race

| Description     | Source                      | Function            | Module               | Variable                                     |
|-----------------|-----------------------------|---------------------|----------------------|--|
| Write           | task_for_lecture3.cpp:126   | ParallelGaussMethod | ips2018_lecture3.exe | block allocated at task_for_lecture3.cpp:142 |
| Write           | ips2018_lecture3.exe:0x2295 | ParallelGaussMethod | ips2018_lecture3.exe | block allocated at task_for_lecture3.cpp:142 |
| Allocation site | task_for_lecture3.cpp:142   | main                | ips2018_lecture3.exe | block allocated at task_for_lecture3.cpp:142 |

Timeline

main (7496)

Cilk Worker (15612)

Гонка за данными на 126 строчке

```
124 //
125 cilk for (int j = k + 1; j < rows; ++j)
126 {
127     result[k] -= matrix[k][j] * result[j];
128 }
129
130 result[k] /= matrix[k][k];
131 }
```

Исправим на

```
120 for (k = rows - 2; k >= 0; --k)
121 {
122     cilk::reducer_opadd<double> add_reducer(matrix[k][rows]);
123     cilk for (int j = k + 1; j < rows; ++j)
124     {
125         *add_reducer -= matrix[k][j] * result[j];
126     }
127     result[k] = add_reducer->get_value() / matrix[k][k];
128 }
```

Intel Inspector 2019

Locate Deadlocks and Data Races

Target Analysis Type Collection Log Summary

Problems

| ID | Type      | Sources                       | Modules              | State |
|----|-----------|-------------------------------|----------------------|-------|
| P1 | Data race | reducer.h; reducer_opadd.h    | ips2018_lecture3.exe | New   |
|    | Data race | reducer.h:277; reducer_op ... | ips2018_lecture3.exe | New   |
|    | Data race | reducer.h:201; reducer_op ... | ips2018_lecture3.exe | New   |
|    | Data race | reducer.h:441; reducer_op ... | ips2018_lecture3.exe | New   |
|    | Data race | reducer.h:201; reducer_op ... | ips2018_lecture3.exe | New   |
|    | Data race | reducer.h:277; reducer_op ... | ips2018_lecture3.exe | New   |
|    | Data race | reducer.h:201; reducer_op ... | ips2018_lecture3.exe | New   |
|    | Data race | reducer.h:441; reducer_op ... | ips2018_lecture3.exe | New   |
|    | Data race | reducer.h:441; reducer_op ... | ips2018_lecture3.exe | New   |
|    | Data race | reducer.h:441; reducer_op ... | ips2018_lecture3.exe | New   |

Filters

Severity: Error 1 item(s)

Type: Data race 1 item(s)

Source: reducer.h; reducer\_opadd.h 1 item(s)

Module: ips2018\_lecture3.exe 1 item(s)

State: New 1 item(s)

Suppressed: Not suppressed 1 item(s)

Investigated:

Code Locations: Data race

| Description | Source              | Function  | Module               | Variable |
|-------------|---------------------|-----------|----------------------|----------|
| Write       | reducer_opadd.h:280 | operator= | ips2018_lecture3.exe | 0x863f00 |
| Write       | reducer.h:201       | allocate  | ips2018_lecture3.exe | 0x863f00 |

Timeline

main (10032)

Cilk Worker (14760)

```
D:\Projects\IPS2018_lecture3\Debug\IPS2018_lecture3.exe
Parallel - Forward pass - Elapsed time: 0.000235943 seconds
Solution:
x(0) = 1.000000
x(1) = 2.000000
x(2) = 2.000000
x(3) = -0.000000
```

```
D:\Projects\IPS2018_lecture3\Release\IPS2018_lecture3.exe
Serial - Forward pass - Elapsed time: 0.760624 seconds
Parallel - Forward pass - Elapsed time: 0.414848 seconds
Time boost: 0.345776 seconds
It's 1.8335 times faster
```