COMPARISON OF PERFORMANCE ANALYSIS TOOLS FOR PARALLEL PROGRAMS APPLIED TO CombBLAS

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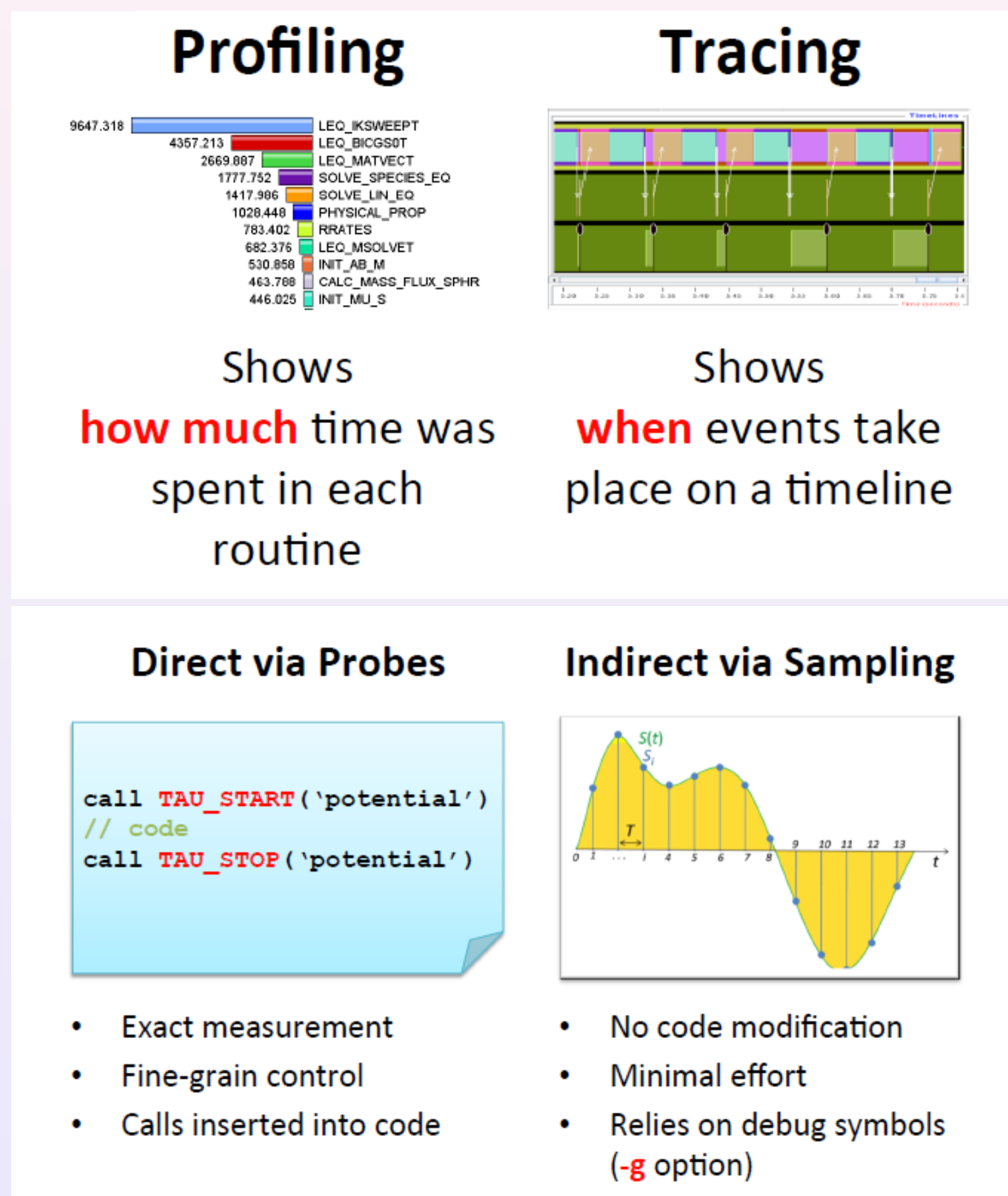
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Performance Analysis Tools (PAT)

We compare four PATs for parallel code analysis: HPCToolkit, Intel VTune, TAU, Threadspotter.

Profiling — Shows **how much** time was spent in each routine

Tracing — Shows **when** events take place on a timeline

Direct via Probes

```
call TAU_START('potential')
// code
call TAU_STOP('potential')
```

- Exact measurement
- Fine-grain control
- Calls inserted into code

Indirect via Sampling

- No code modification
- Minimal effort
- Relies on debug symbols (-g option)

They focus on identifying performance "hotspots" to optimize code, such as CombBLAS, to make it run faster.

Example of CombBLAS

CombBLAS is a library of algorithms for manipulating graphs, for example, Breadth First Search applied to a Twitter-like database: objects are people and links are people's likes. Code is evaluated using the four PATs.
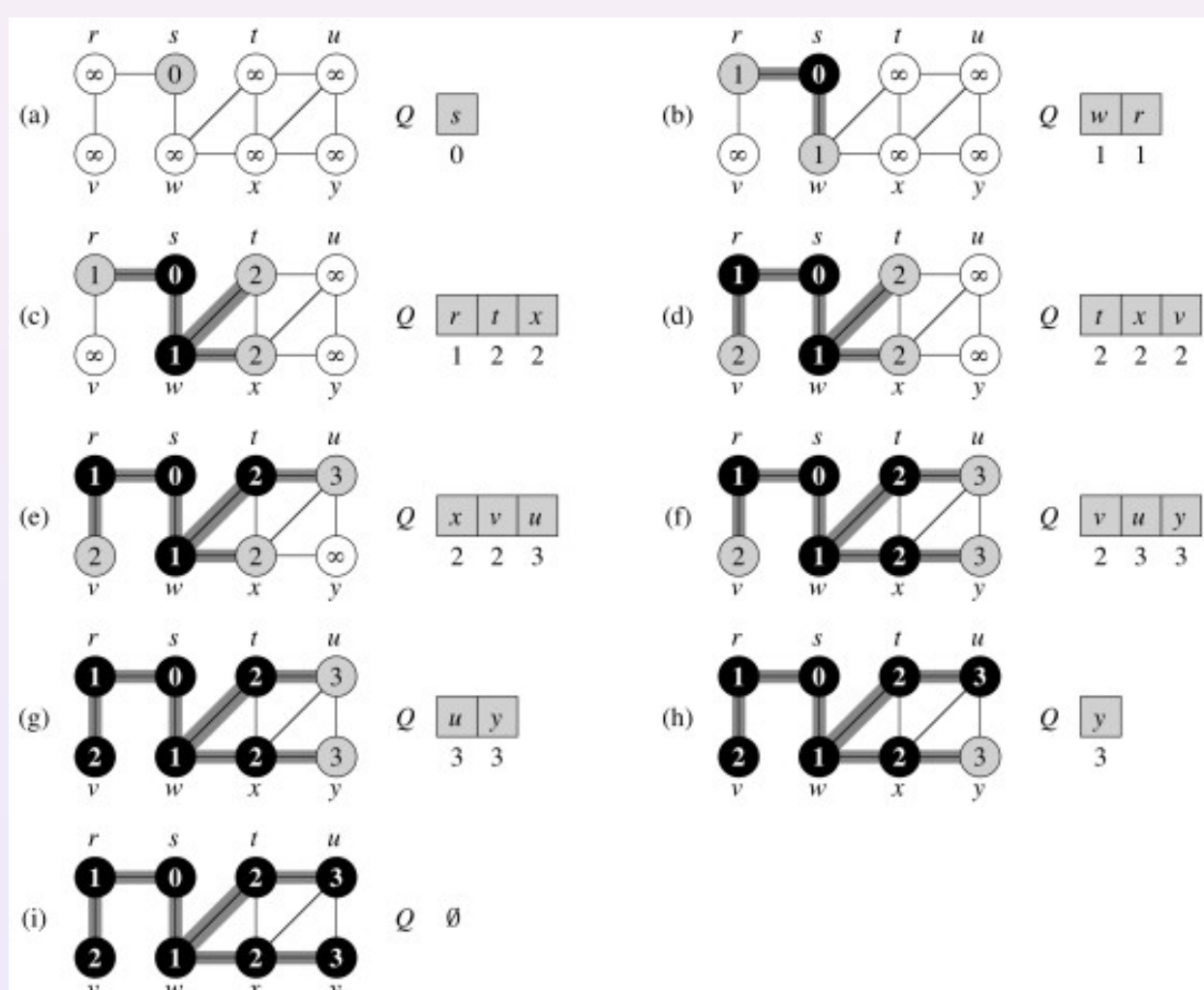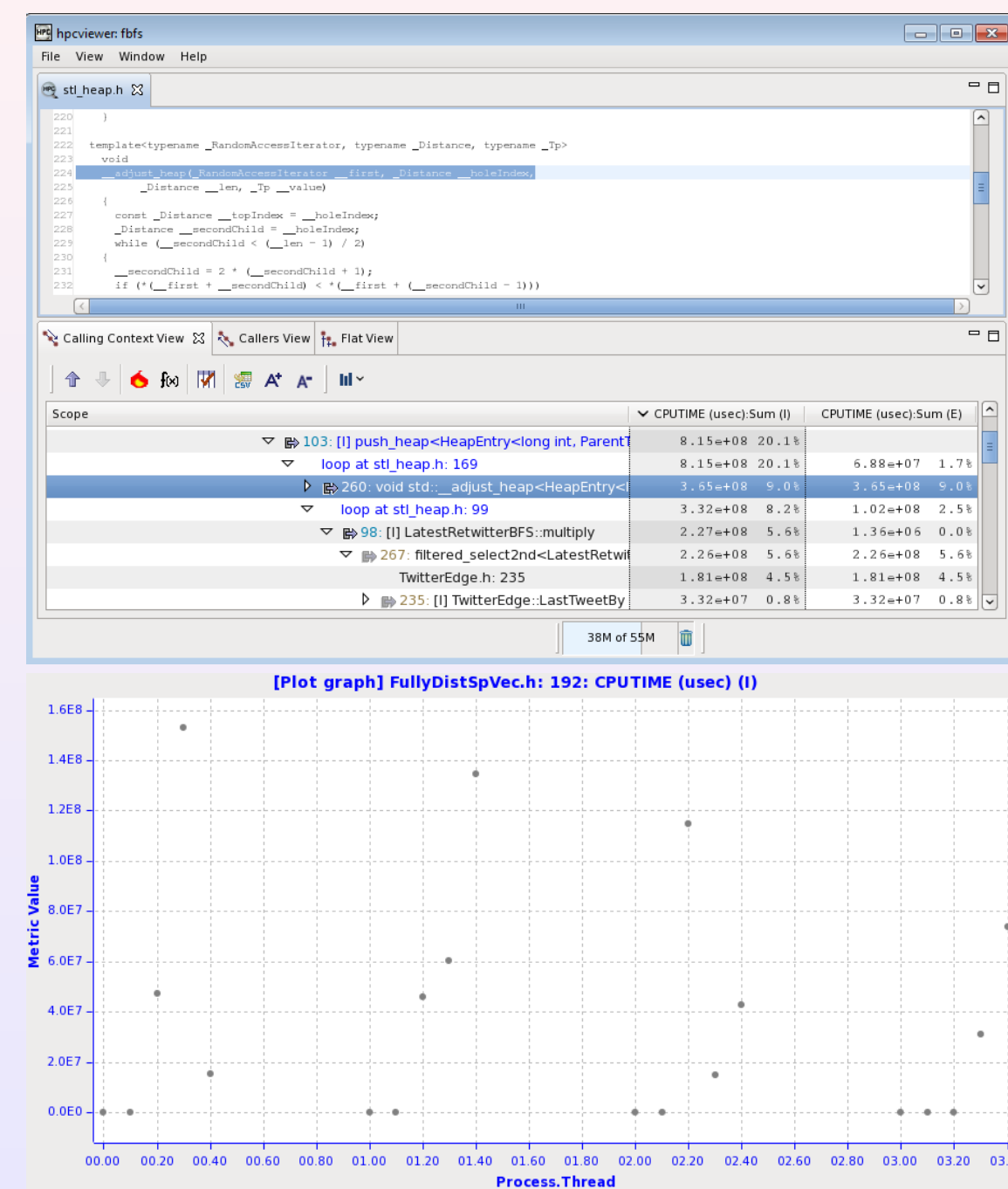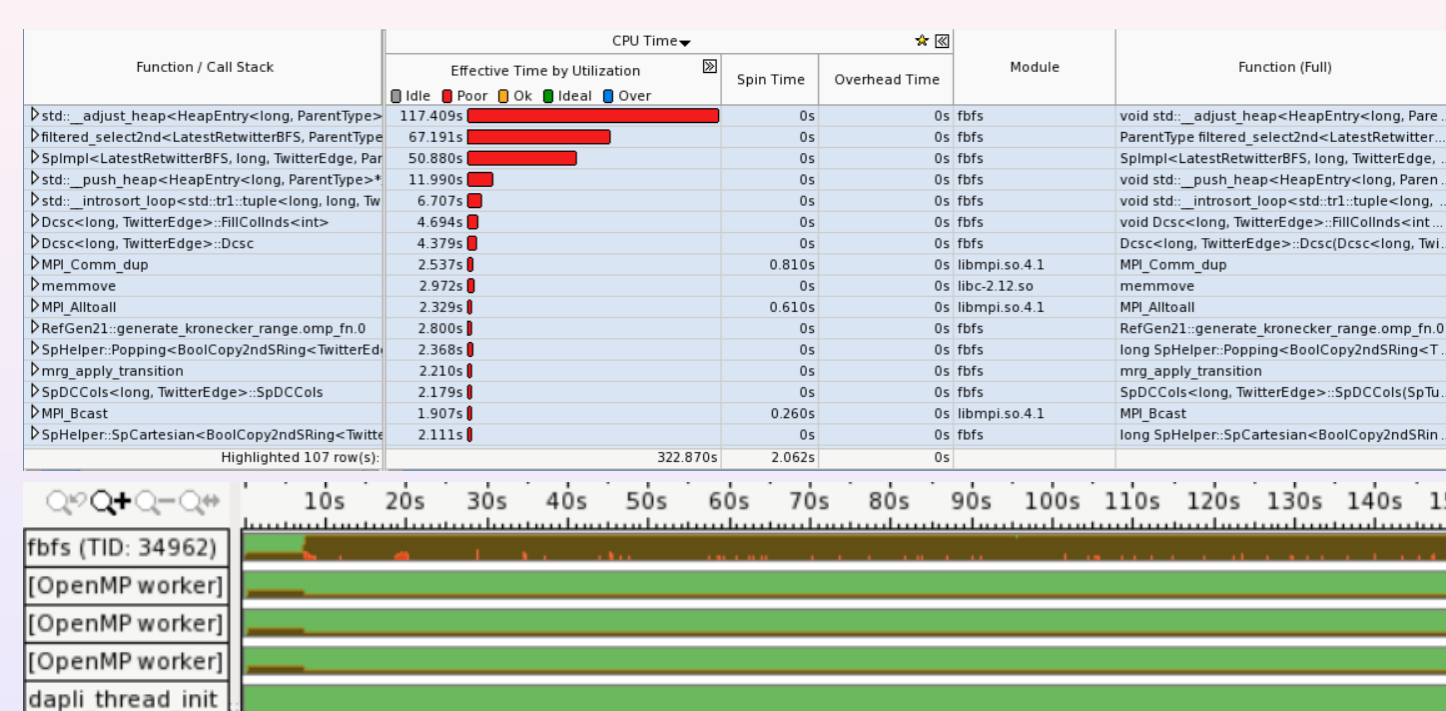

Breadth First Search Example Run

Parallel code implementation:

- C++
- MPI (across nodes)
- OpenMP (on-node)

Tool 1: HPCToolkit (Free)
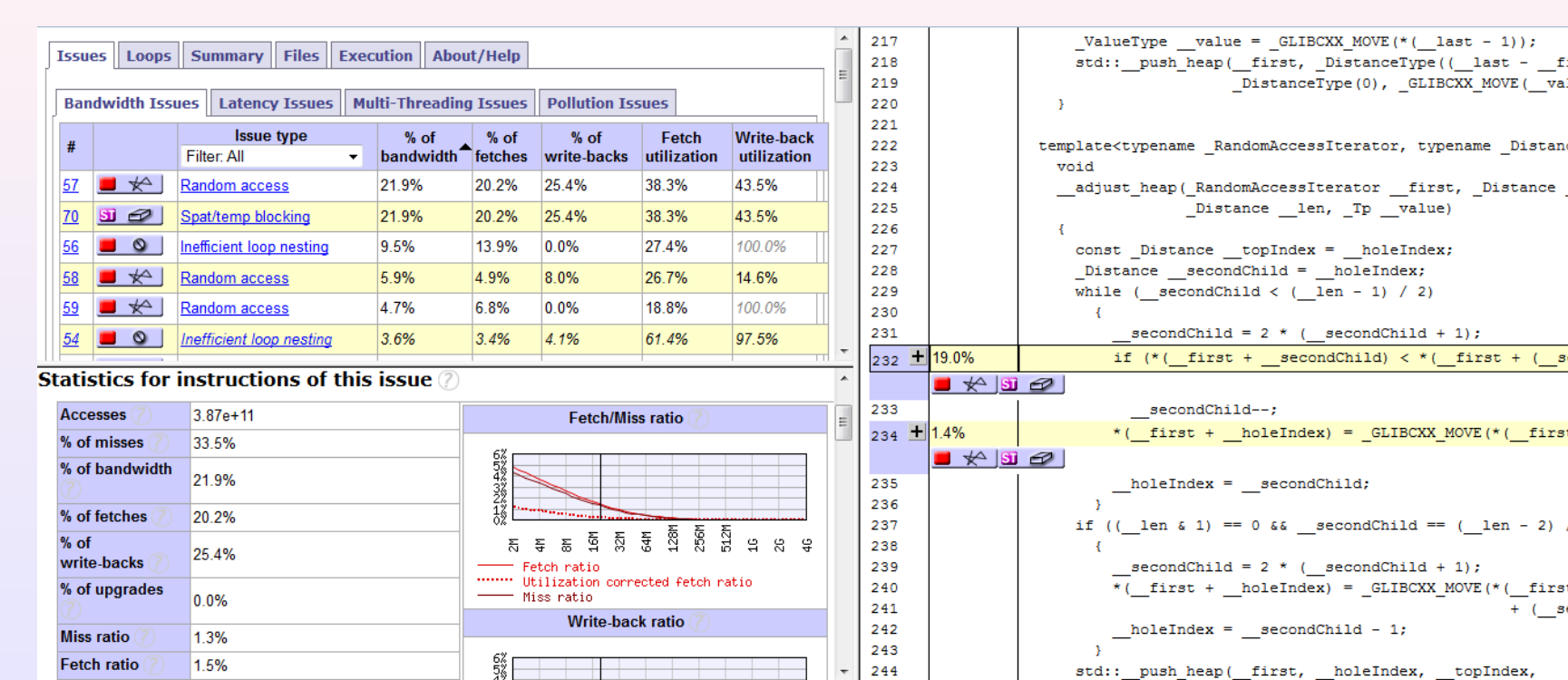

Tool 2: Intel VTune (Cost)

Tool 3: TAU (Free)

Tool 4: Threadspotter (Free)

Comparisons

Cost

- HPCToolkit, Threadspotter, and TAU are free. Intel VTune costs from $899 to $3999.
- The cost of VTune includes tech support, which is available for the others at a charge.

General Observations

- HPCToolkit, Intel VTune, and TAU are both profilers and tracers, while Threadspotter analyzes memory by functions.
- Threadspotter focuses on optimizing software for the target hardware.

Conclusions

- PATs identified "hotspots" and allowed to conclude MPI is efficiently implemented while OpenMP lacks efficiency.
- Code segments in OpenMP regions run for microseconds and are called many times.
- TAU and HPCToolkit are free while Intel VTune costs money, but they all produce the same results.

References

- Background on CombBLAS: http://gauss.cs.ucsb.edu/~aydin/CombBLAS/html/
- Full technical report: HPCF–2015–28 hpcf.umbc.edu > Publications

Acknowledgments