

Intel® Developer Workshop

Intel Advisor - Roofline

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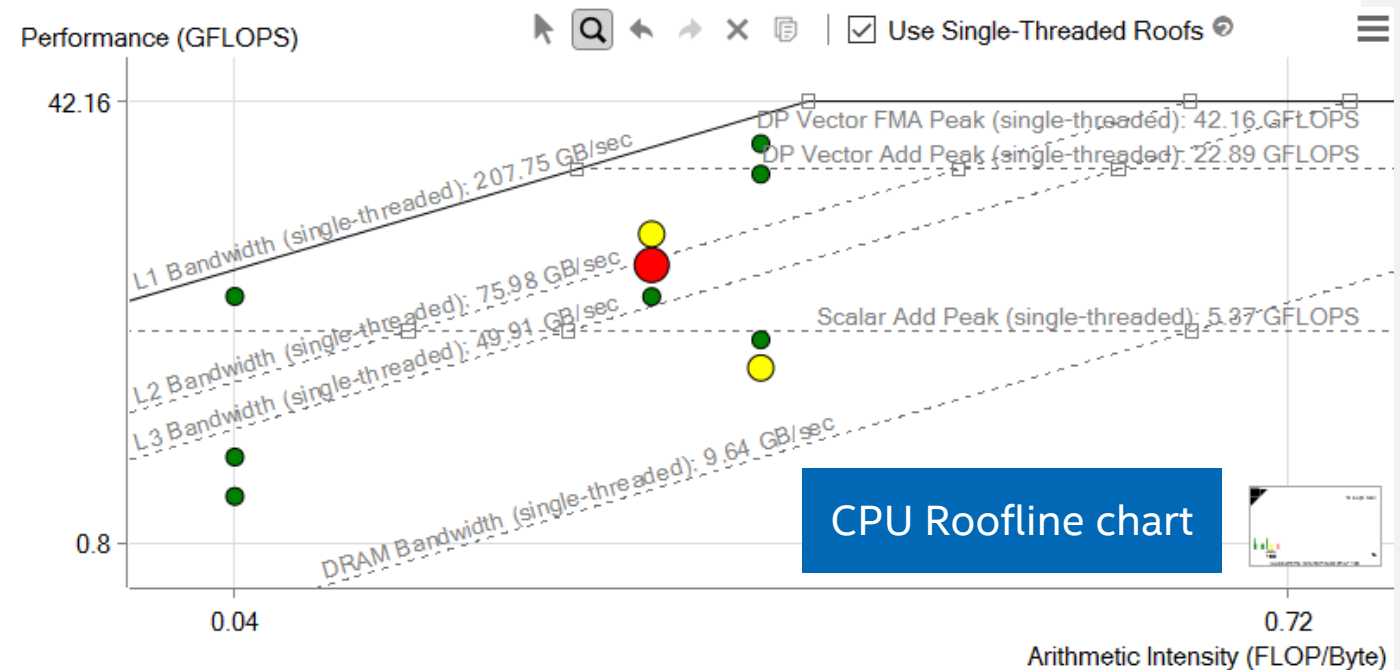
Agenda

- Advisor Roofline – Basic information
- How to generate a Roofline plot in a Cluster environment
- How to identify loops for optimization
- Advanced features

Advisor Roofline – Basic Information

What is a Roofline Chart?

- A Roofline Chart plots application performance against hardware limitations
 - Where are the bottlenecks?
 - How much performance is being left on the table?
 - What are the next steps?
- Values of Rooflines in Intel® Advisor are measured
 - Small benchmarks are run when starting a Roofline Analysis



Roofline first proposed by University of California at Berkeley:
[Roofline: An Insightful Visual Performance Model for Multicore Architectures](#), 2009
Cache-aware variant proposed by University of Lisbon:
[Cache-Aware Roofline Model: Upgrading the Loft](#), 2013

What is the Roofline Model?

Do you know how fast you should run?

- Comes from Berkeley
- Performance is limited by equations/implementation & code generation/hardware
- 2 hardware limitations
 - PEAK Flops
 - PEAK Bandwidth
- The application performance is bounded by hardware specifications

$$\text{Gflop/s} = \min \left\{ \begin{array}{l} \textit{Platform PEAK} \\ \textit{Platform BW} * \textit{AI} \end{array} \right.$$

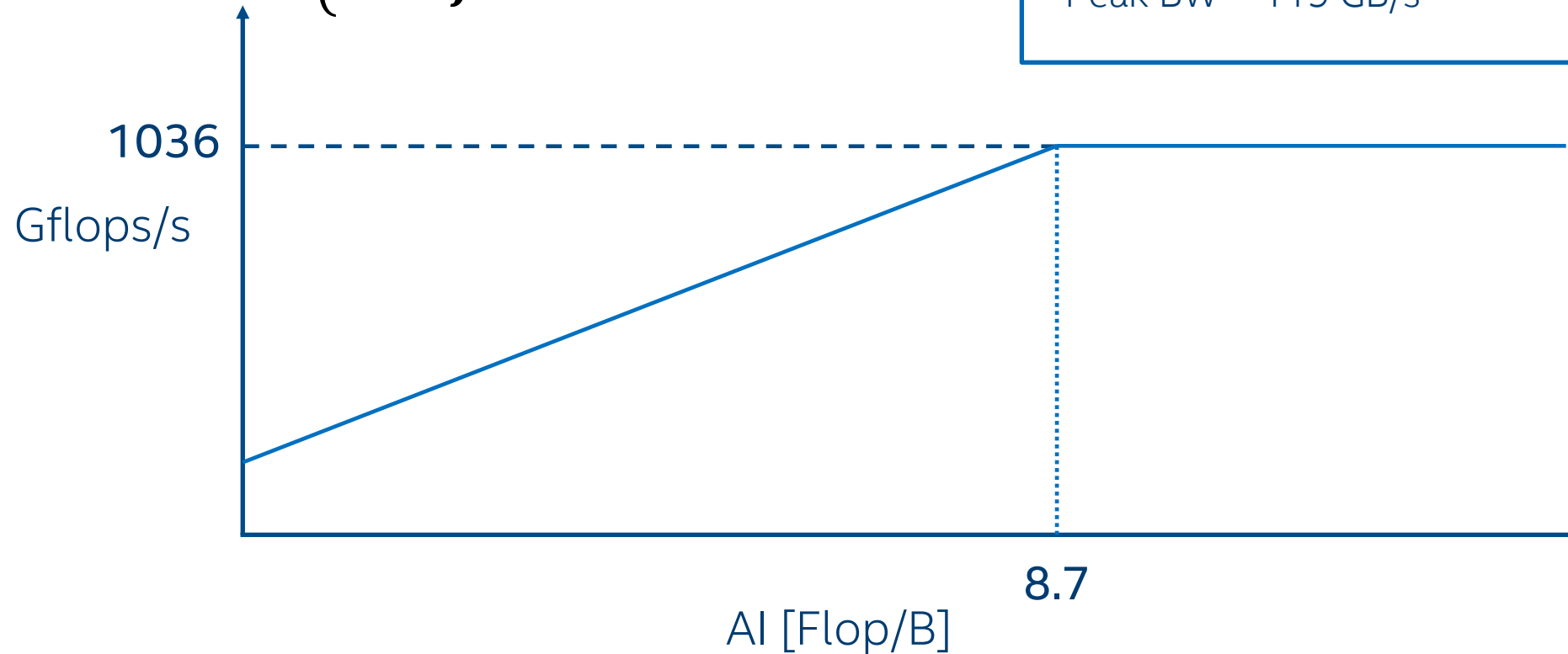
Arithmetic Intensity (Flops/Bytes) 

DRAWING THE ROOFLINE

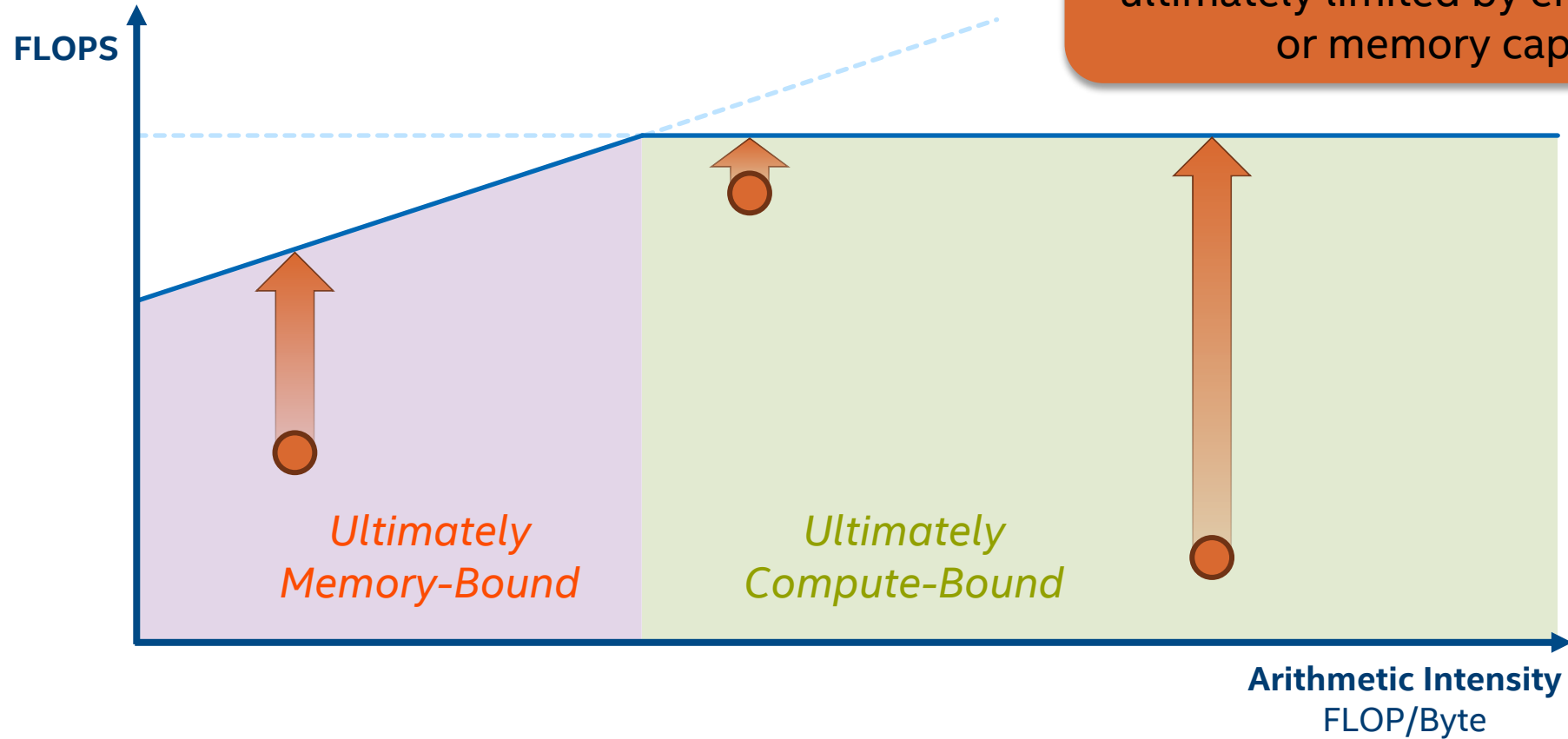
Defining the speed of light

$$\text{Gflop/s} = \min \left\{ \begin{array}{l} \text{Platform PEAK} \\ \text{Platform BW} * \text{AI} \end{array} \right.$$

2 sockets Intel® Xeon® Processor E5-2697 v2
Peak Flop = 1036 Gflop/s
Peak BW = 119 GB/s



Ultimate Performance Limits



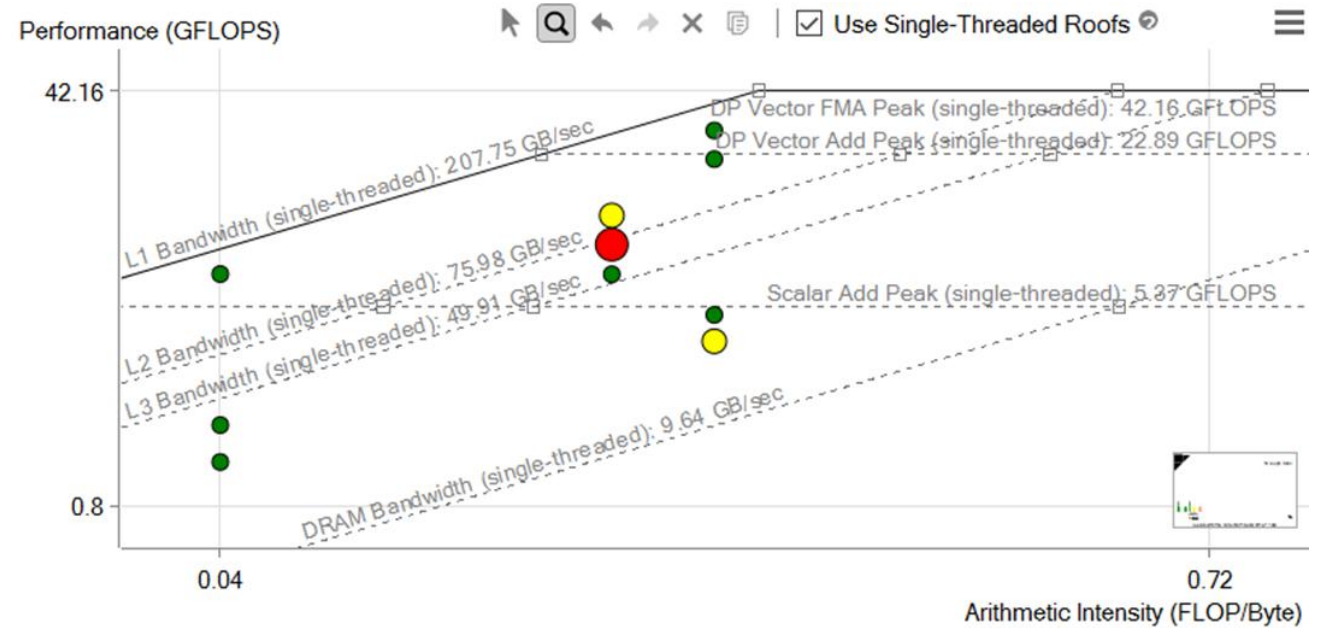
Roofline Analysis

Find Effective Optimization Strategies

Intel® Advisor - CPU Roofline

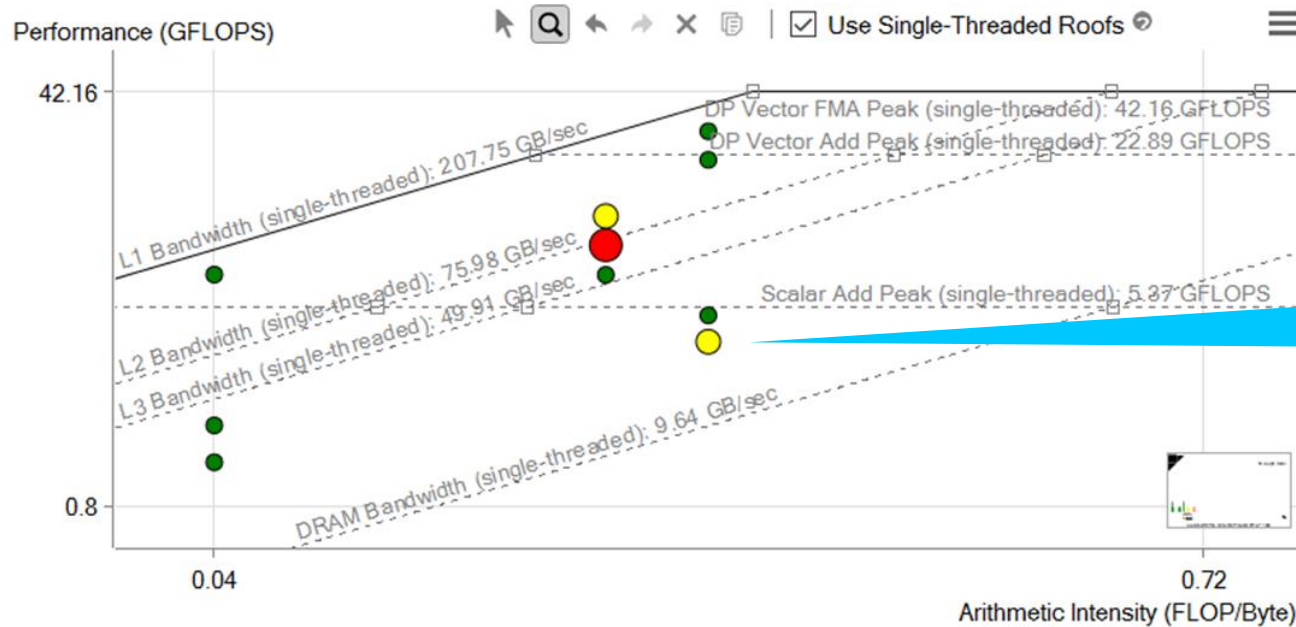
CPU Roofline Performance Insights

- Highlights poor performing loops
- Shows performance 'headroom' for each loop
 - Which can be improved
 - Which are worth improving
- Shows likely causes of bottlenecks
 - Memory bound vs. compute bound
- Suggests next optimization steps



Intel® Advisor Roofline

See how close you are to the system maximums (rooflines)



Roofline indicates room for improvement

How to Run Intel® Advisor – CPU Roofline

Run 2 collections - Use I_MPI_GTOOL for adding advisor to MPI application

First Survey run will do time measurements with minimized overhead:

```
I_MPI_GTOOL="advisor -collect=survey --project-dir=<my_project_directory> :0"
```

Run the Trip Counts and FLOP data collection - use same project dir:

```
I_MPI_GTOOL= "advisor -collect=tripcounts --stacks --flop  
--project-dir=<my_project_directory> :0"
```

Generate a Roofline report:

```
advisor --report=roofline --project-dir=<my_project_directory> \  
--report-output=roofline.html
```

Open the generated `roofline.html` in a web browser to visualize CPU performance.

How to make a snapshot

Results and source might be packed in a snapshot for transfer

```
advisor --snapshot --project-dir=<my_project_directory>  
        --cache-sources --cache-binaries -- new_snapshot
```

This will generate a file: `new_snapshot.advixeexpz`

The snapshot can be used for later comparison or for downloading to your laptop

General Resources

Intel® Advisor

- [Product page](#) – overview, features, FAQs...
- Training materials – [Cookbooks](#), [User Guide](#), [Tutorials](#)
- [Support Forum](#)
- [Online Service Center](#) - Secure Priority Support
- [What's New?](#)



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