Energy Efficient Computing

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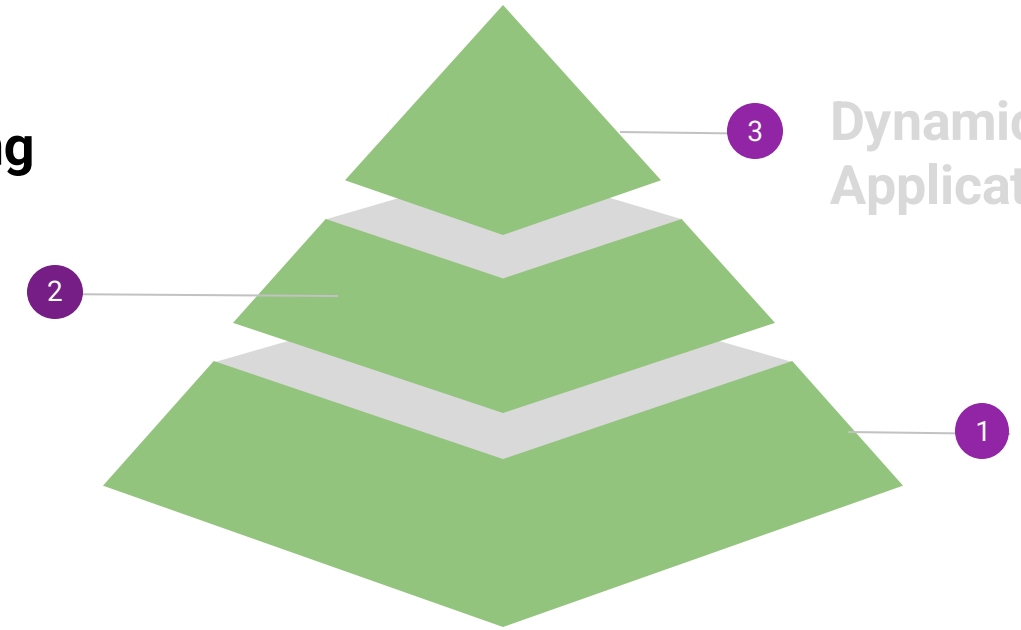
Energy-aware focus

Application Monitoring
Performance
Power usage



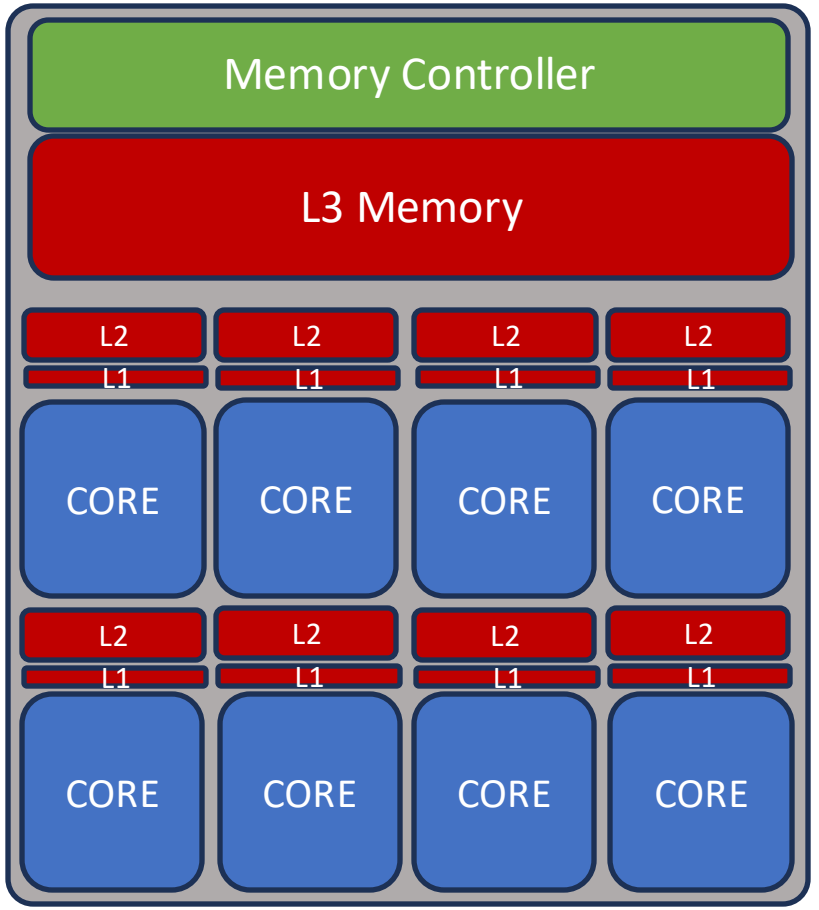
Dynamic Optimization of Applications

System/Architecture
System Monitoring
Energy Accounting

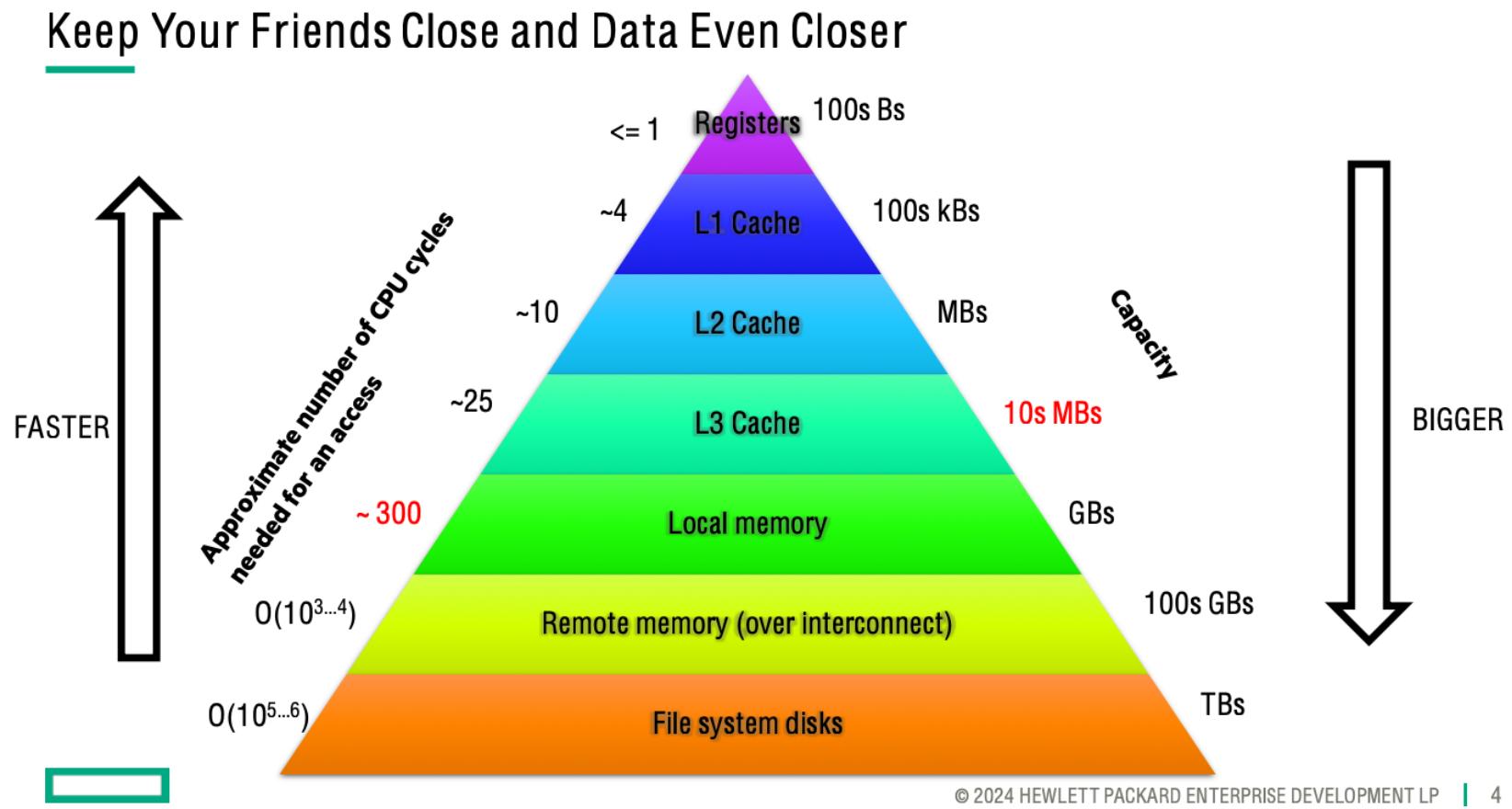
Remember our simple CPU (processor)

A modern Processor has:

- Multiple logical cores
- Hierarchy of memory



Remember our simple CPU (processor)



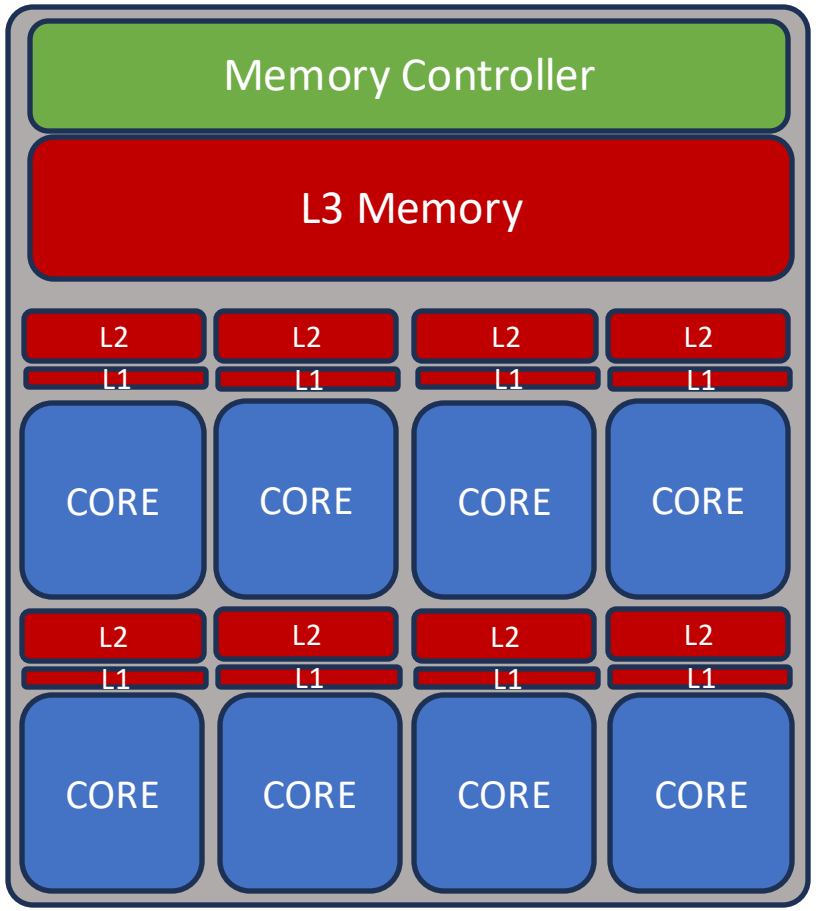
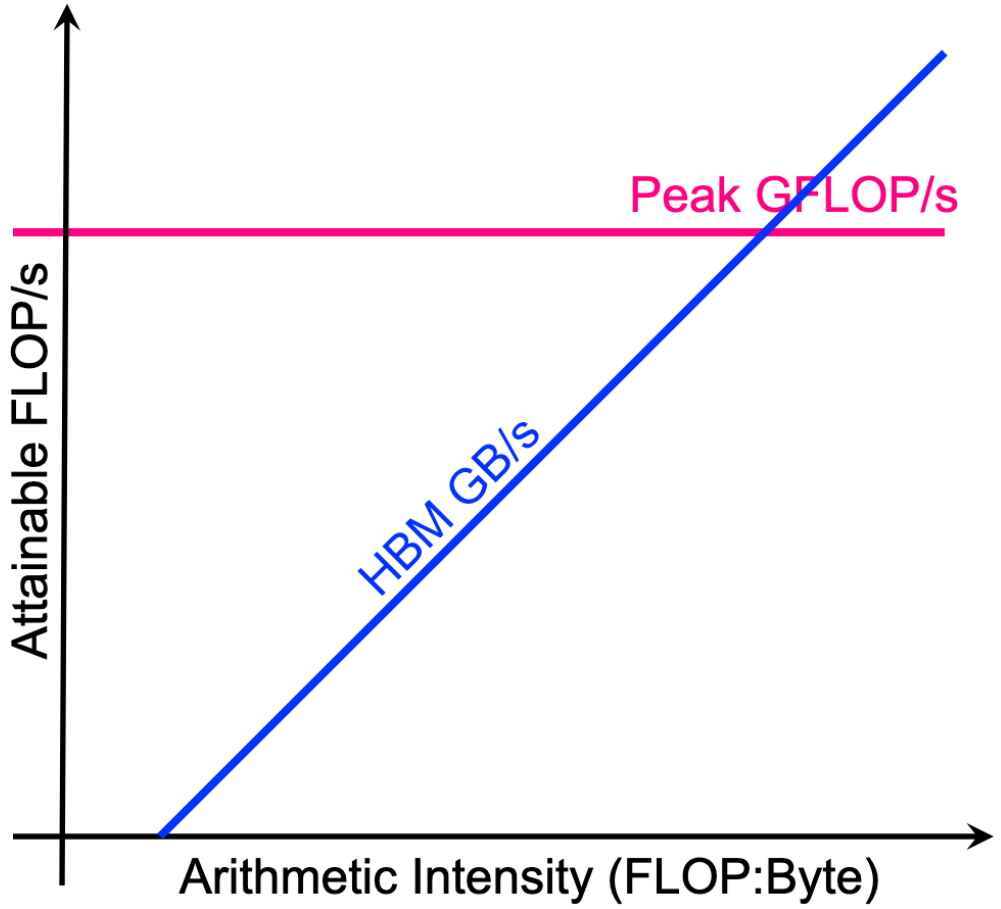


Image Credit HP (from LUMI course)!!!

Roofline Model

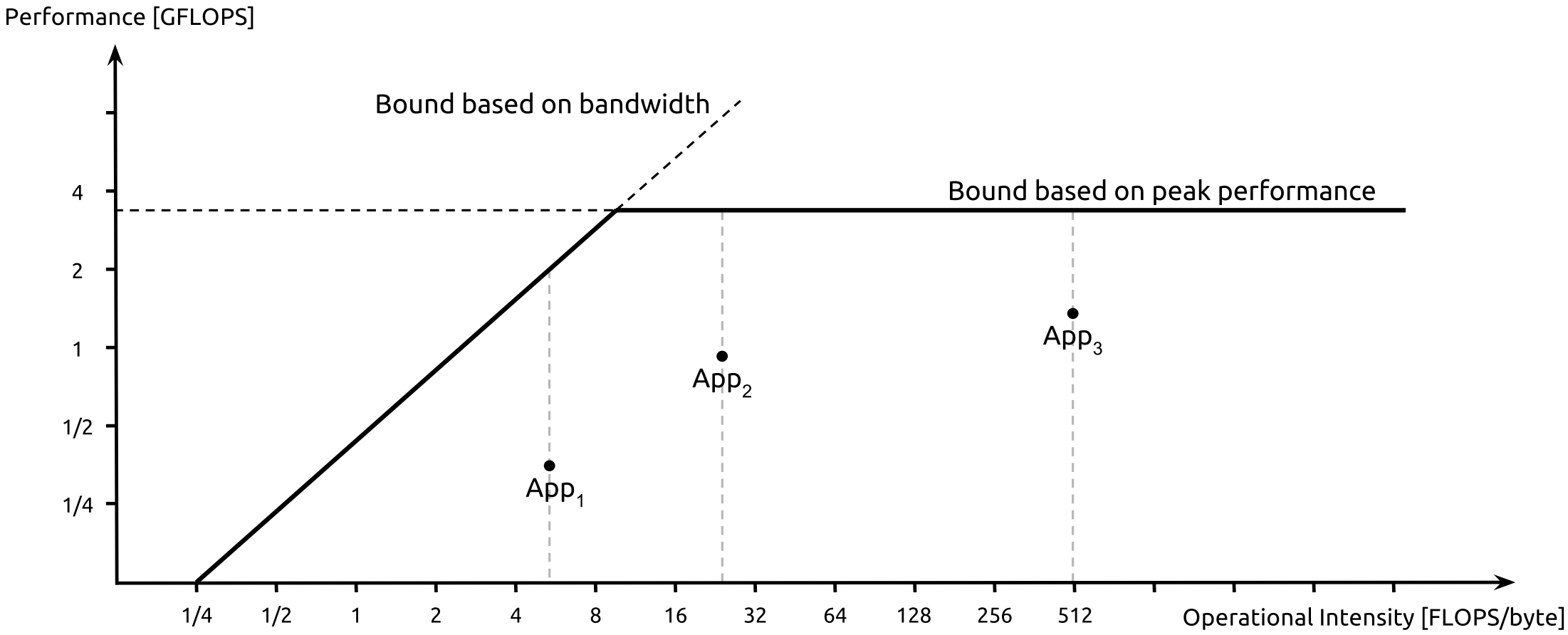


What takes longer….

- Data Movement?
- Compute?

Credit NERSEC: https://www.nersc.gov/users/training/past-training-events/2020/roofline-on-nvidia-gpus-hackathon/

Roofline Model



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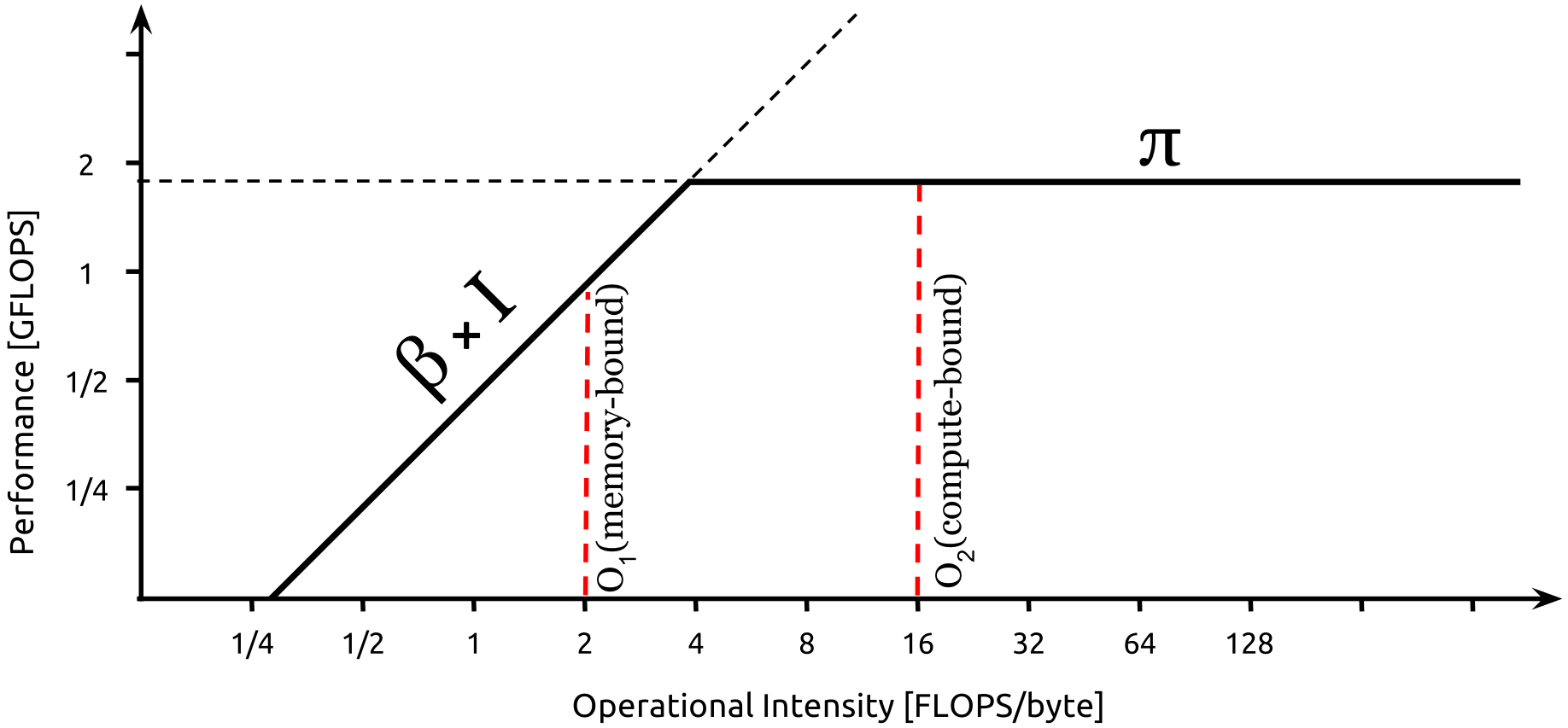
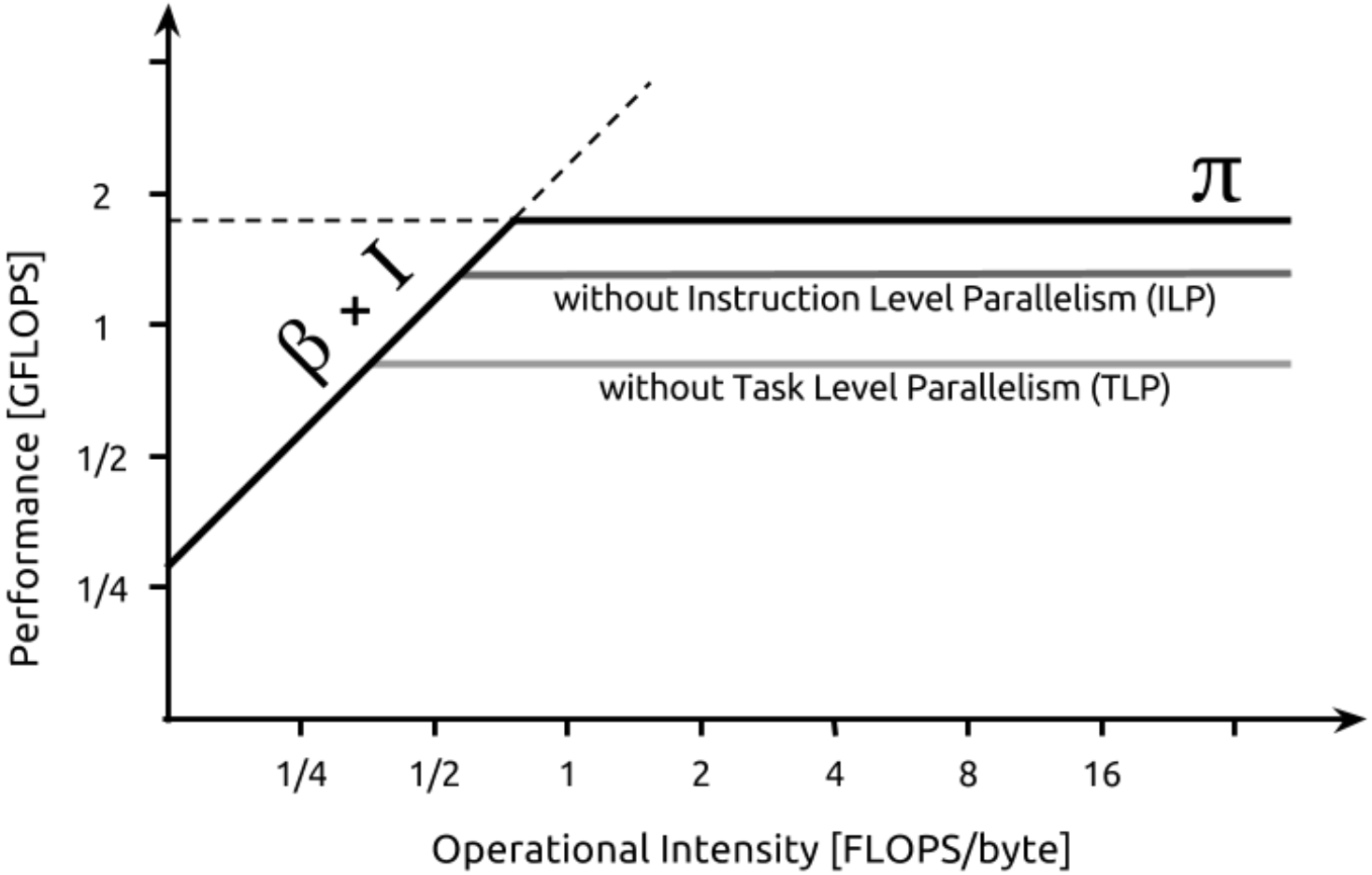
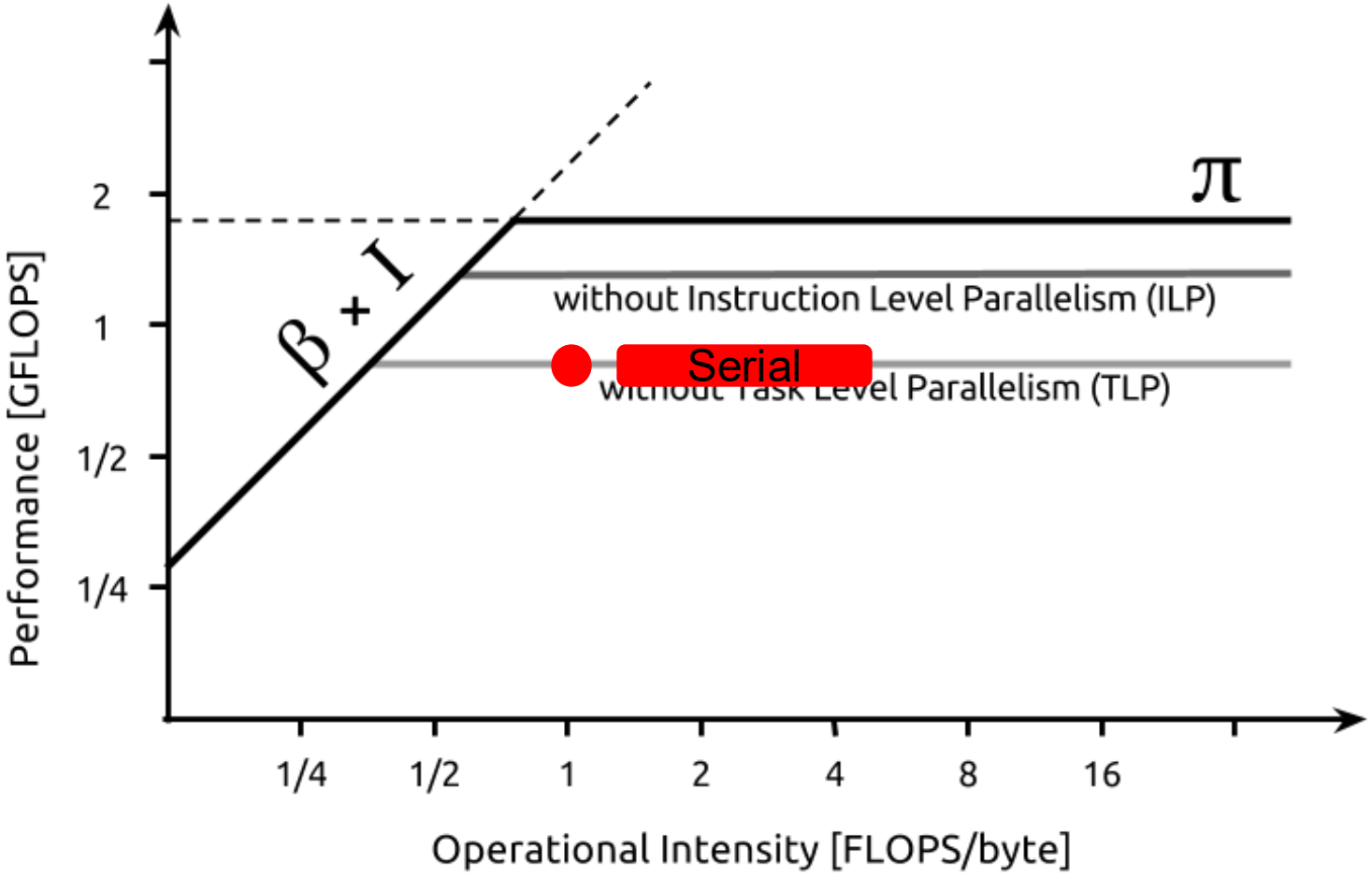
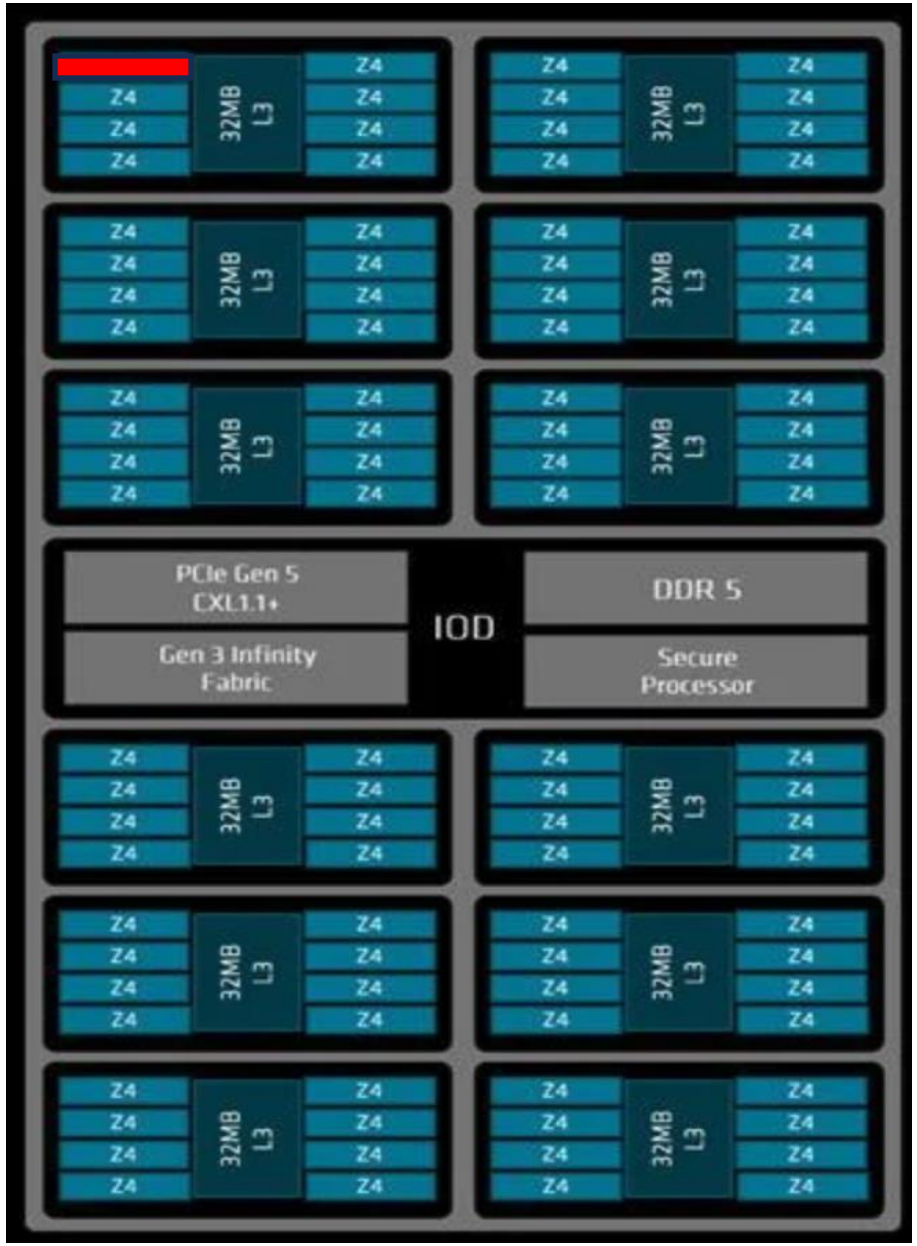


Roofline Model



Roofline Model





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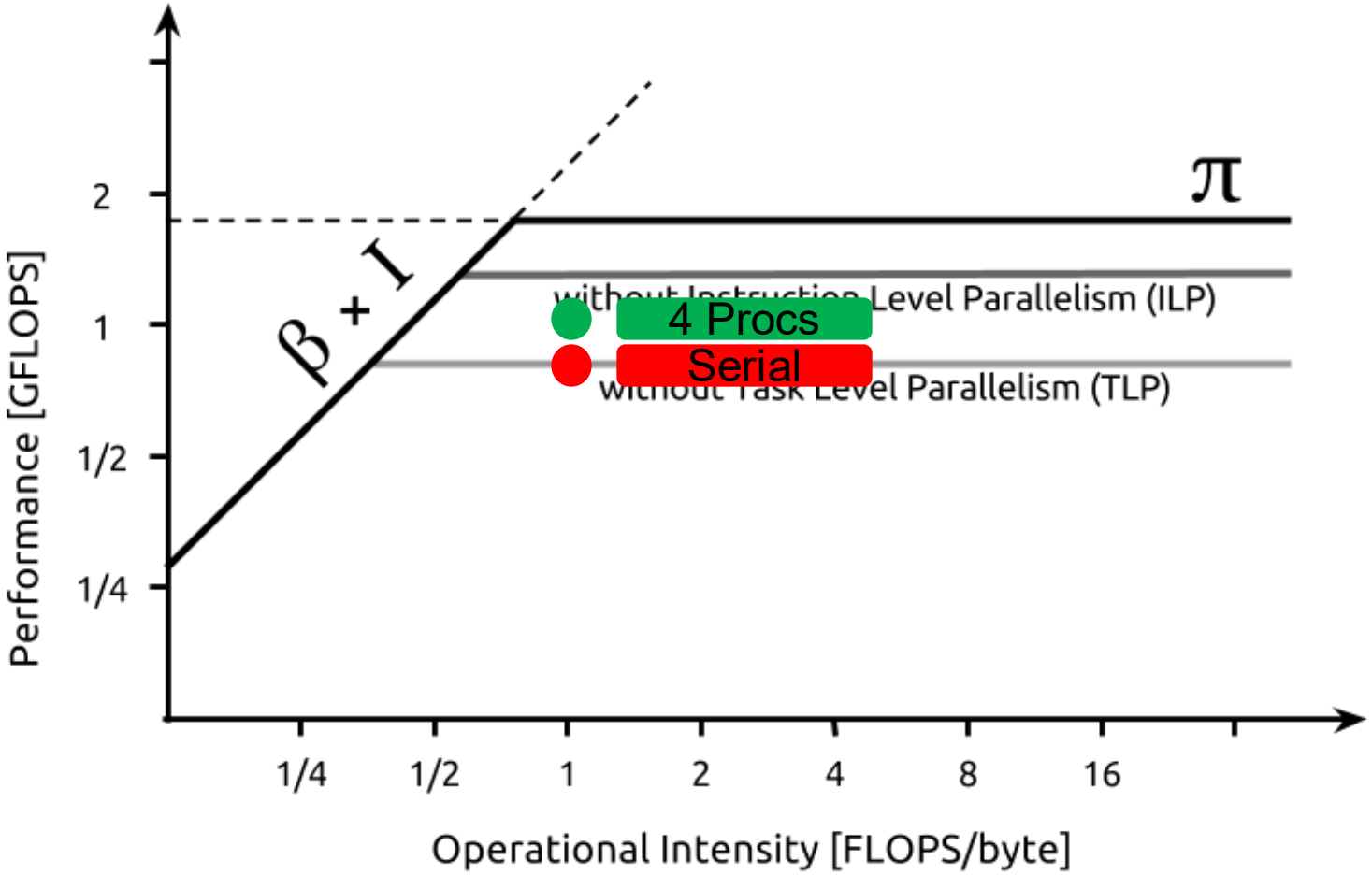

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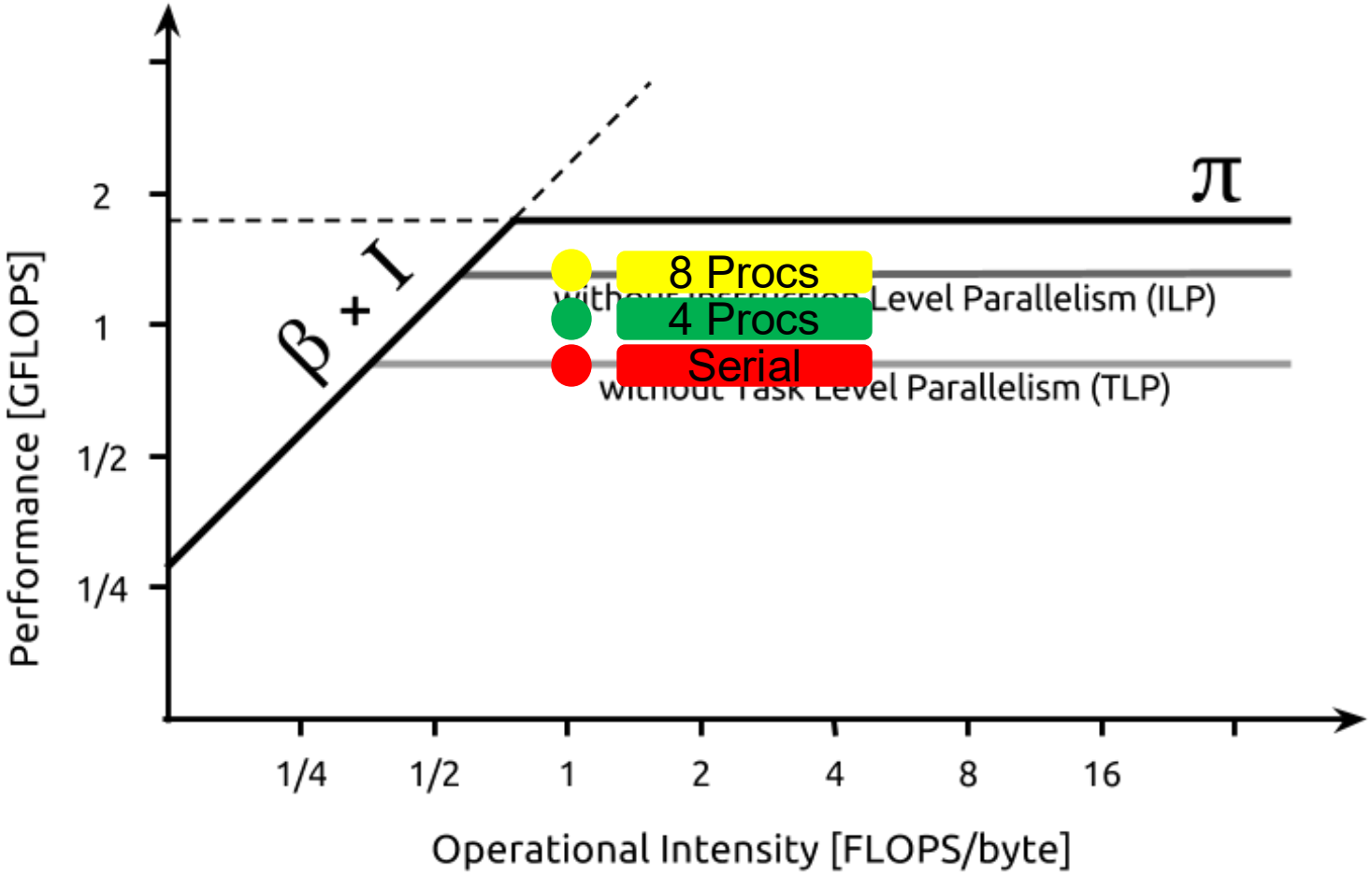

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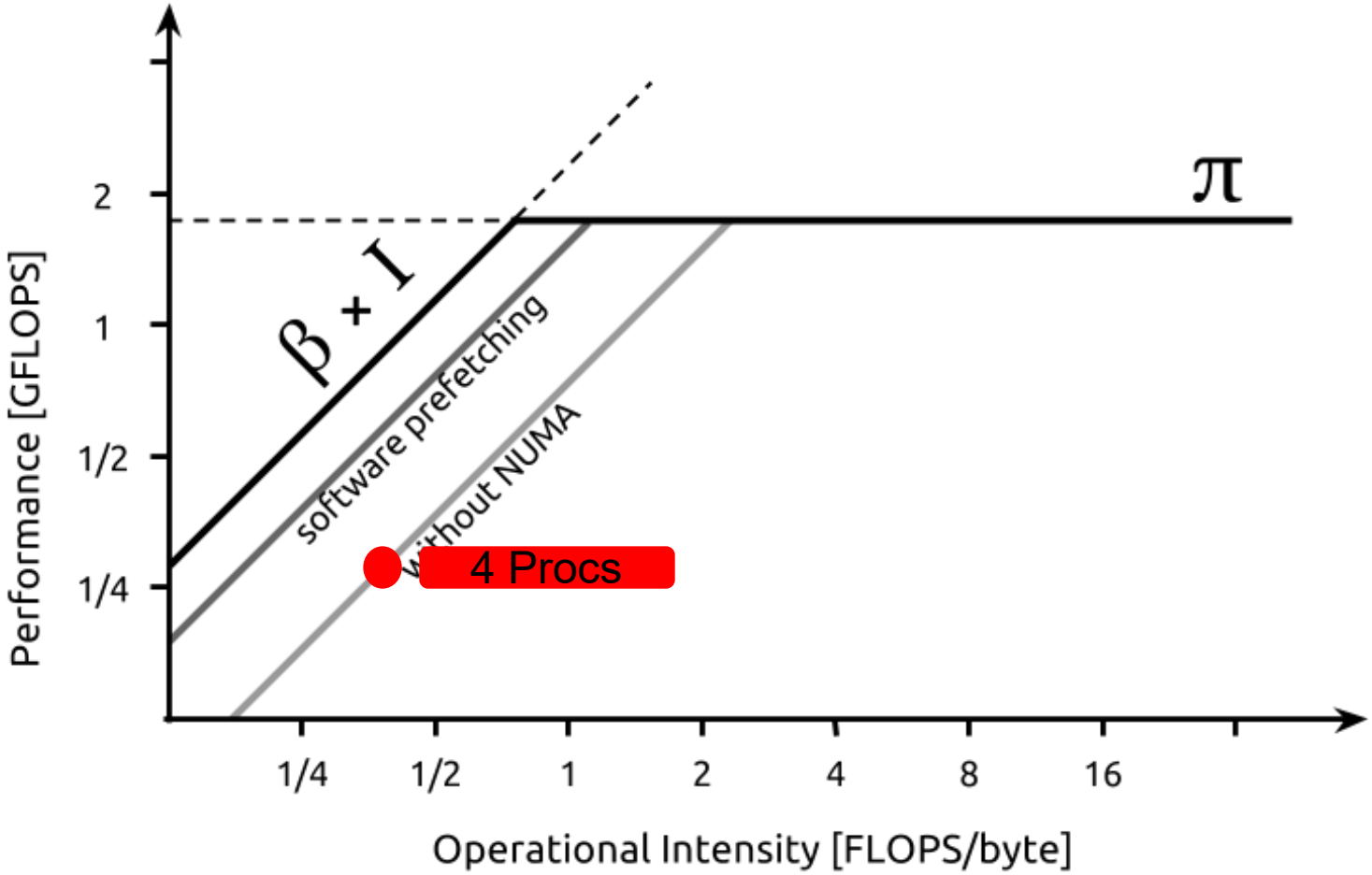

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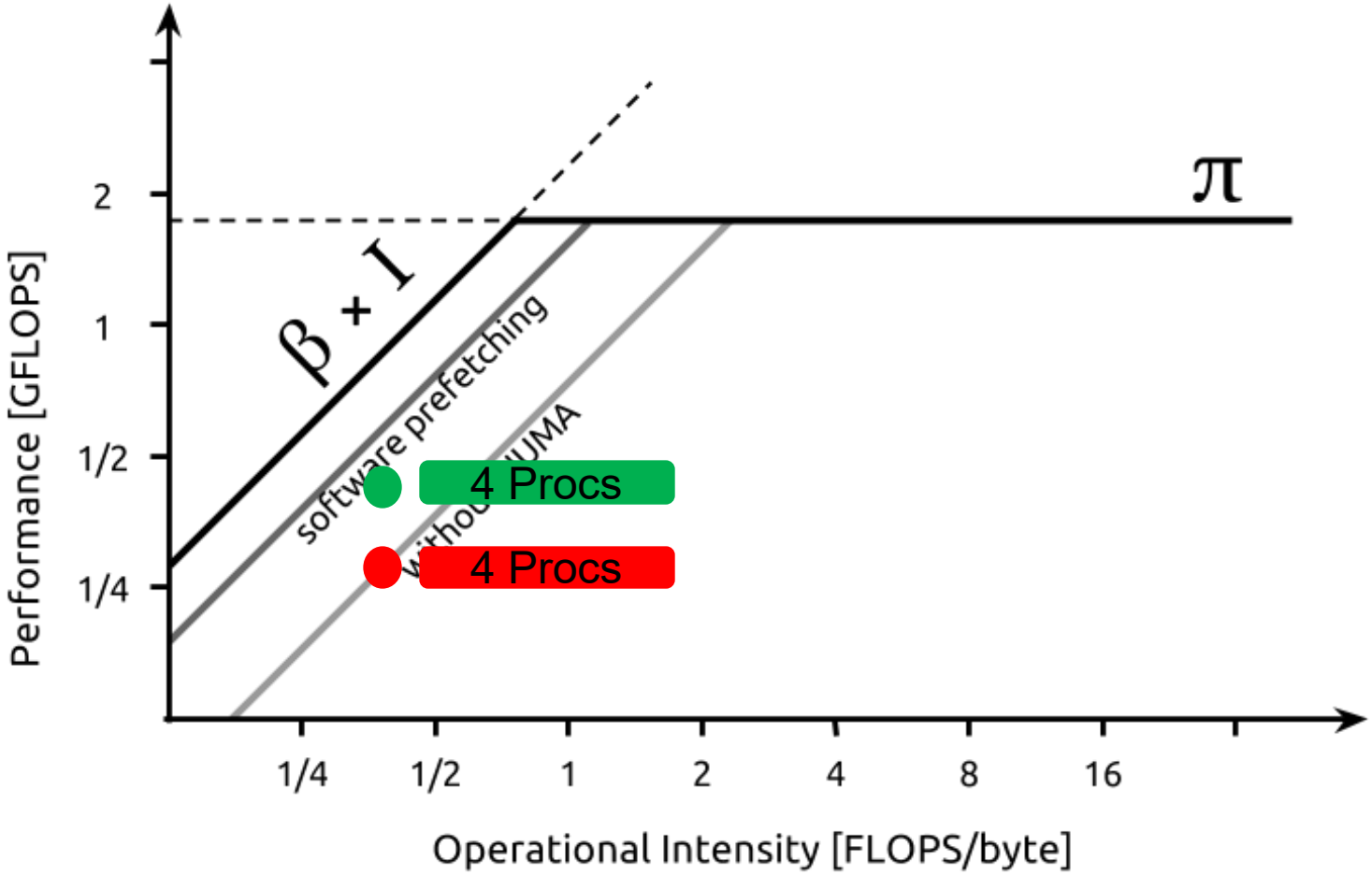

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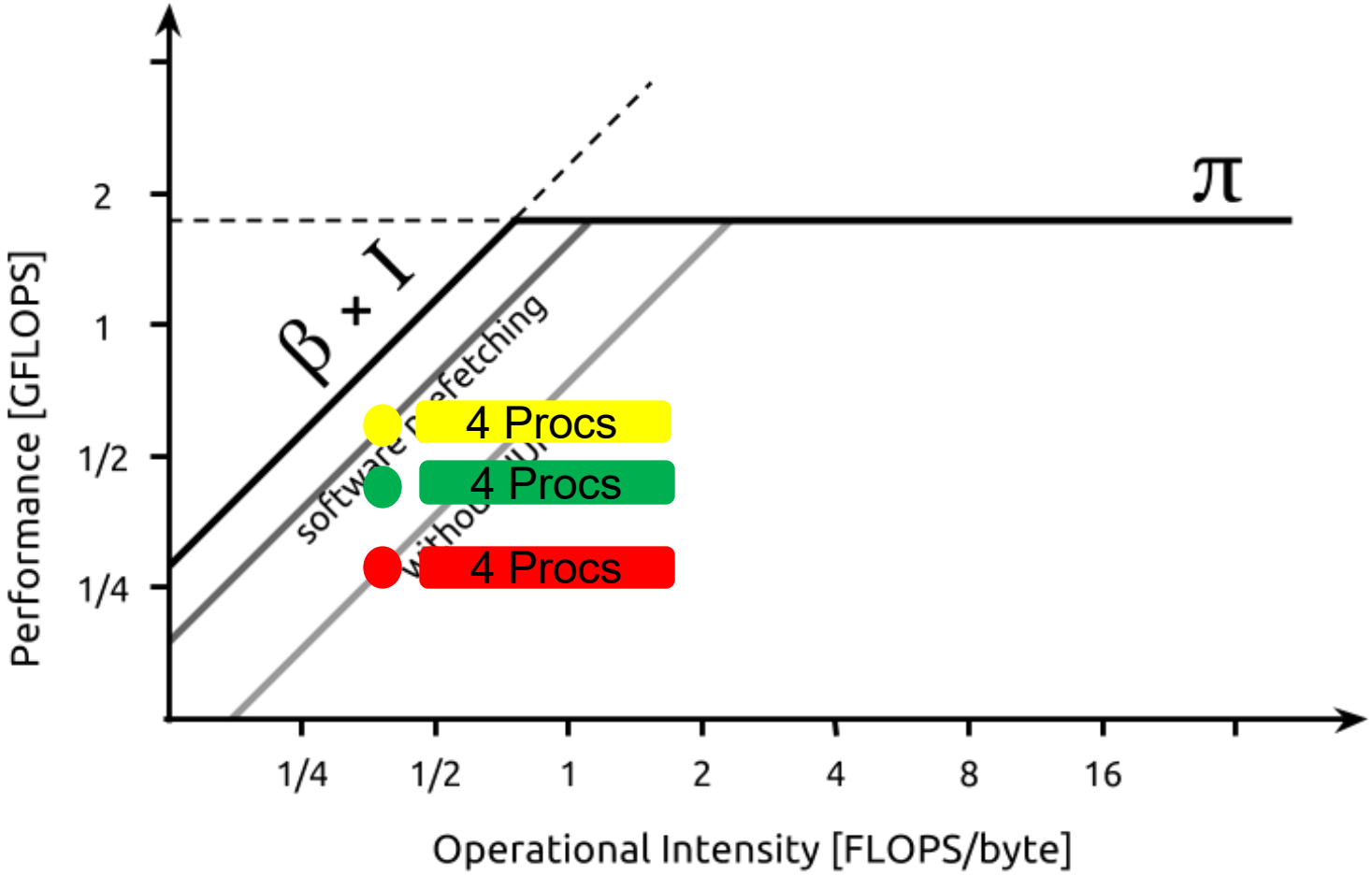

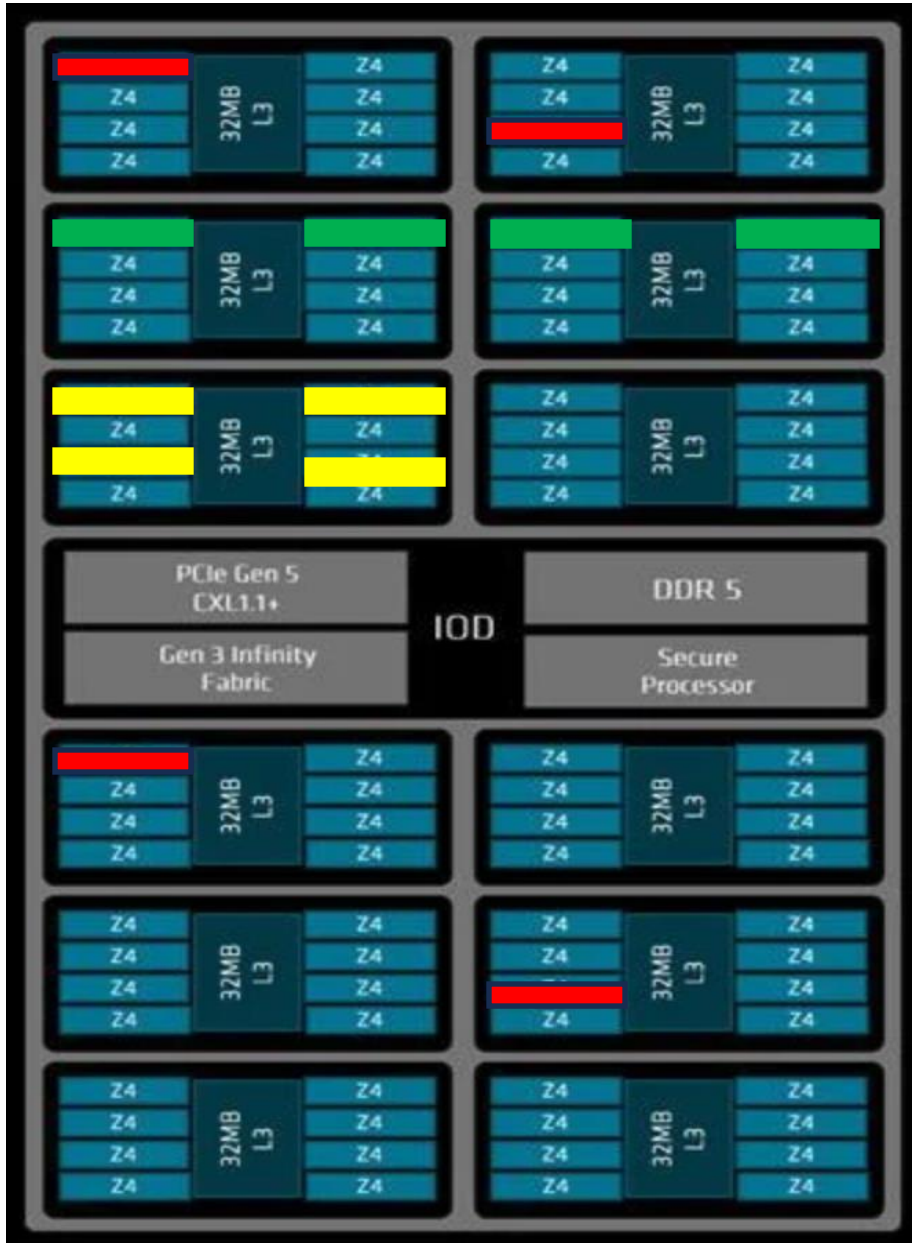

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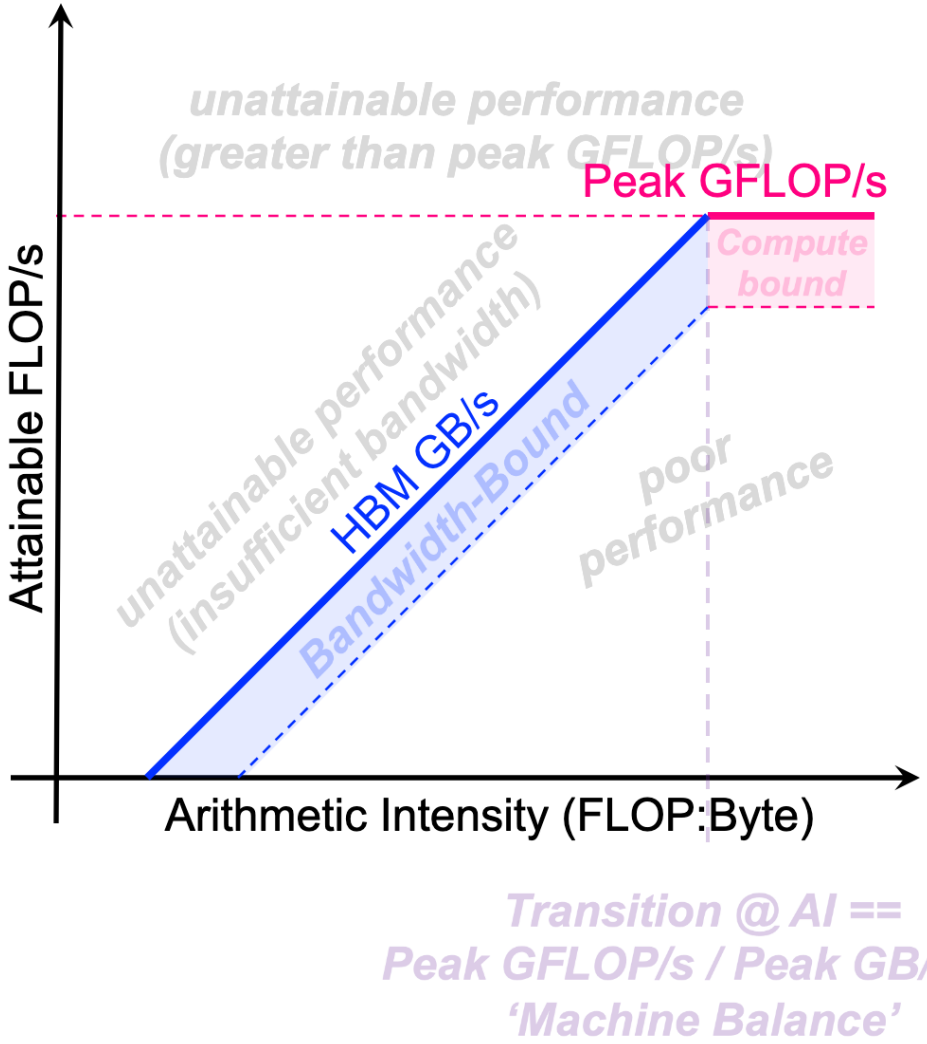

Poor performance regime:

- May be even lower for entire applications

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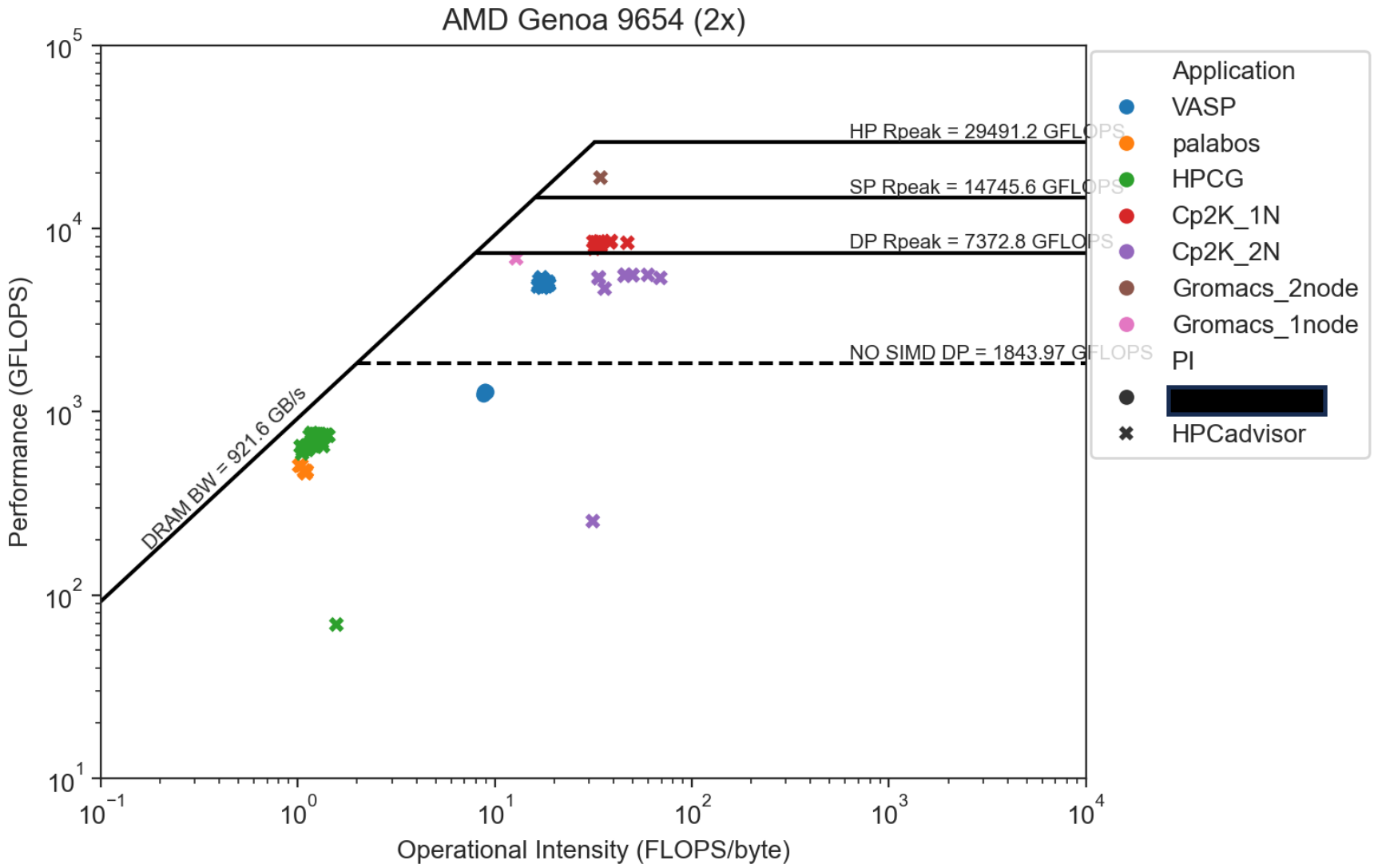
Application Efficiency



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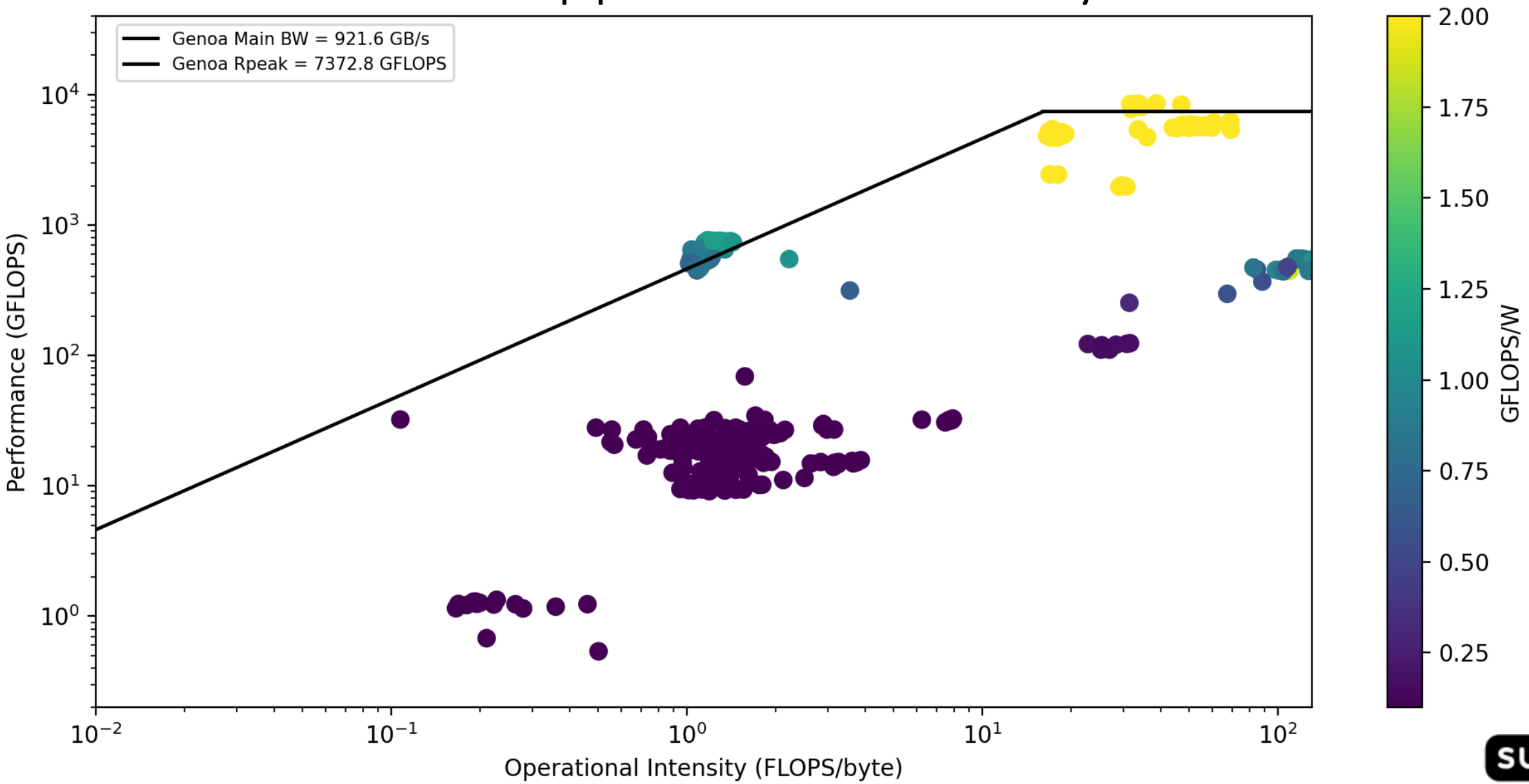
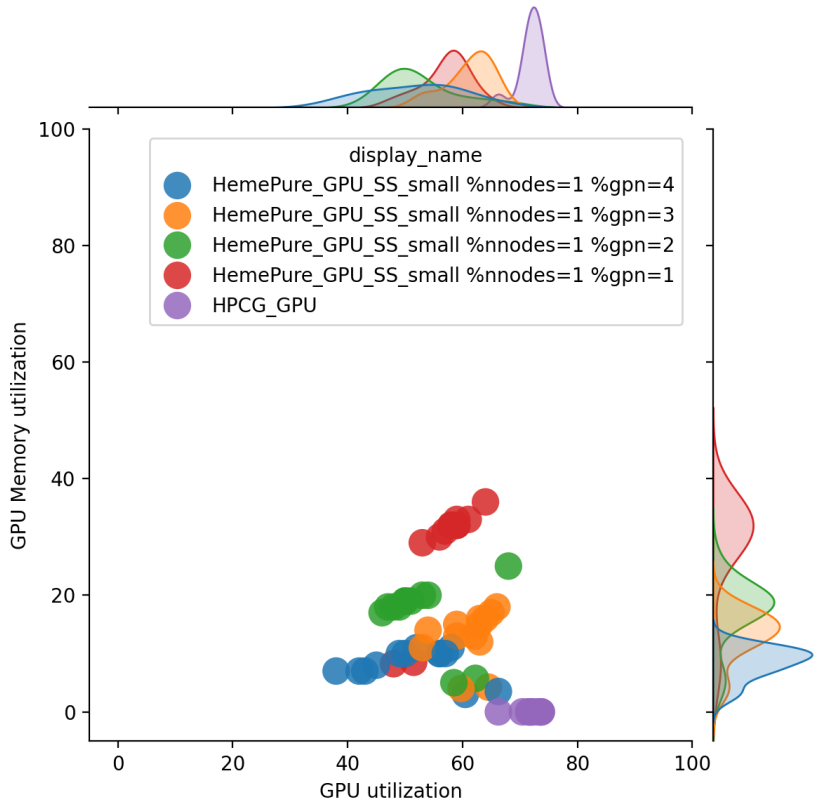
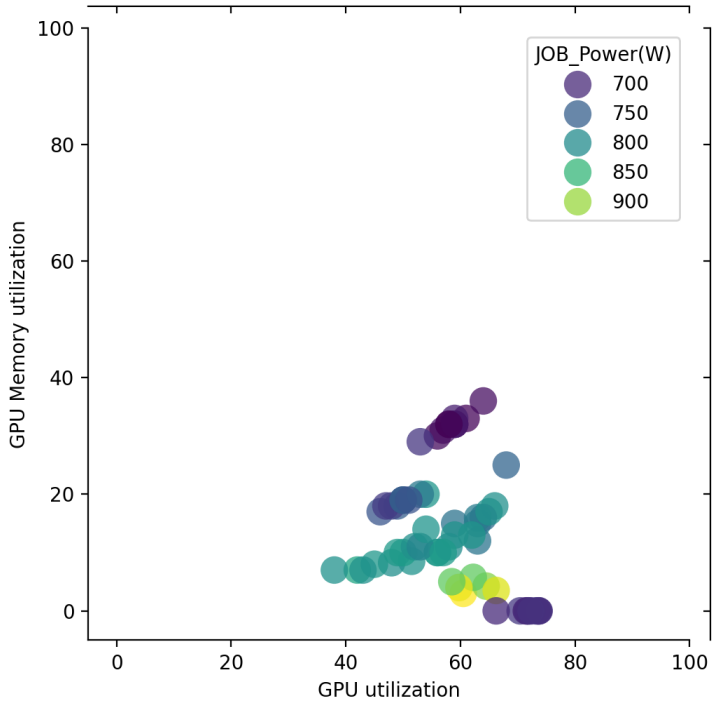
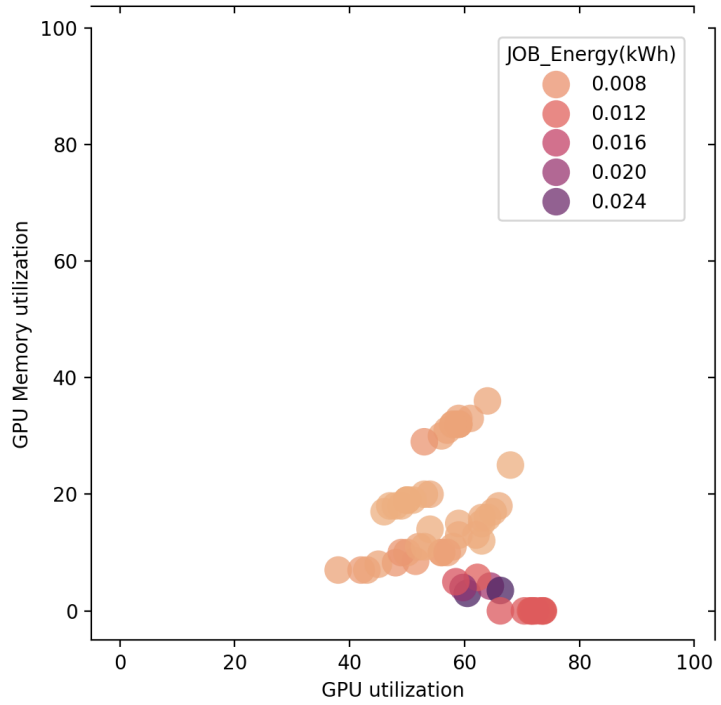


GPU Application Efficiency







Monitoring Tutorial Hints!!!

- Gromacs CPU
  - Vary MPI ranks and OMP threads / rank
- Gromacs GPU
  - Vary OMP threads per GPU
  - Keep 1 MPI Rank per GPU
- Palabos
  - Vary processes per Node
  - CPU binding options?
- PyTorch
  - Vary batch size
  - Try reduced precision