OS Issues for Ultrascale Architectures

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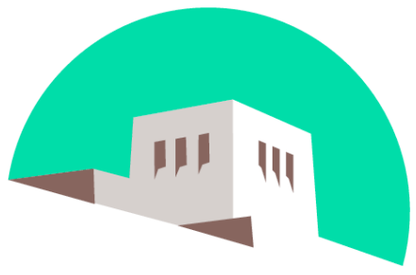
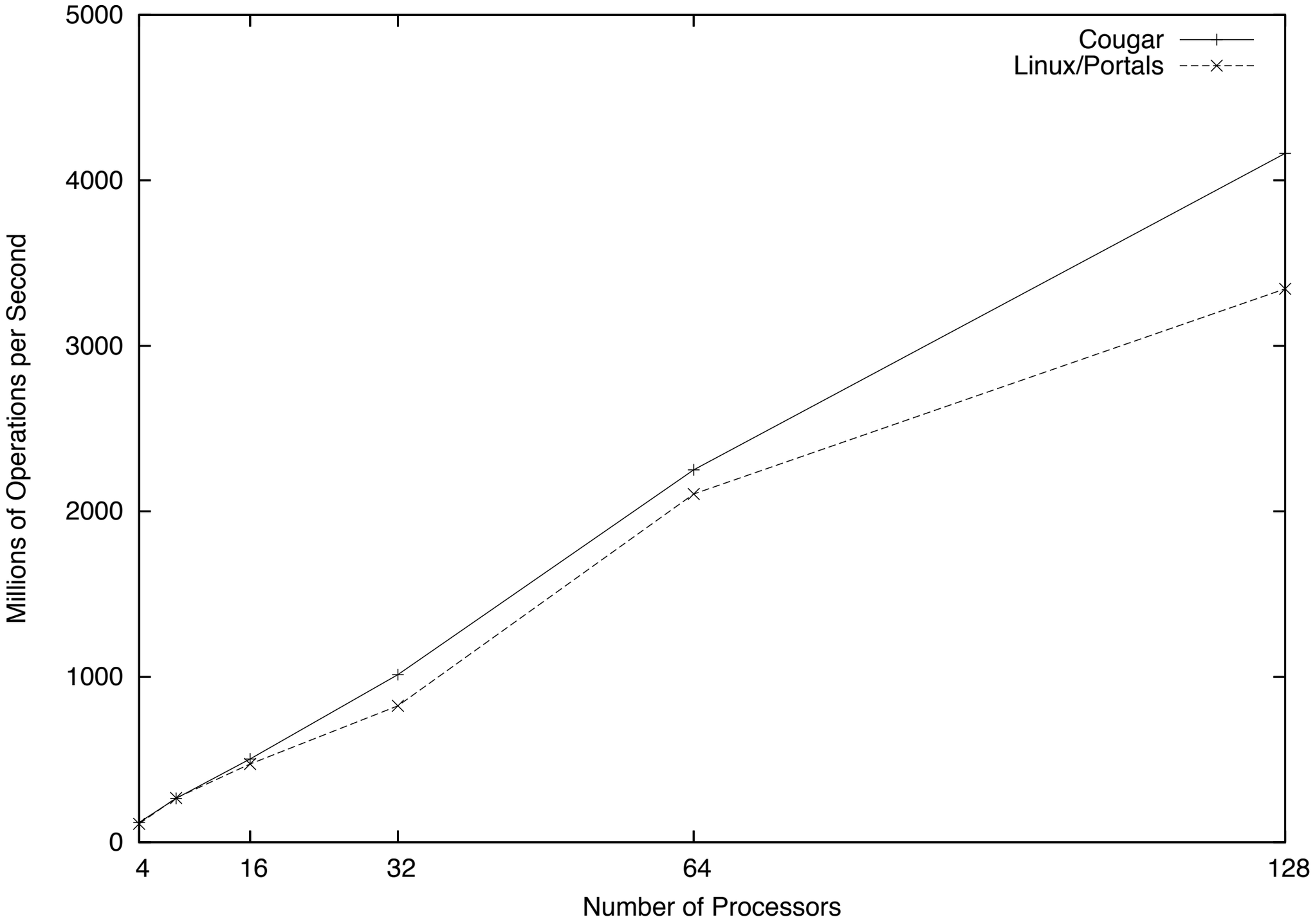
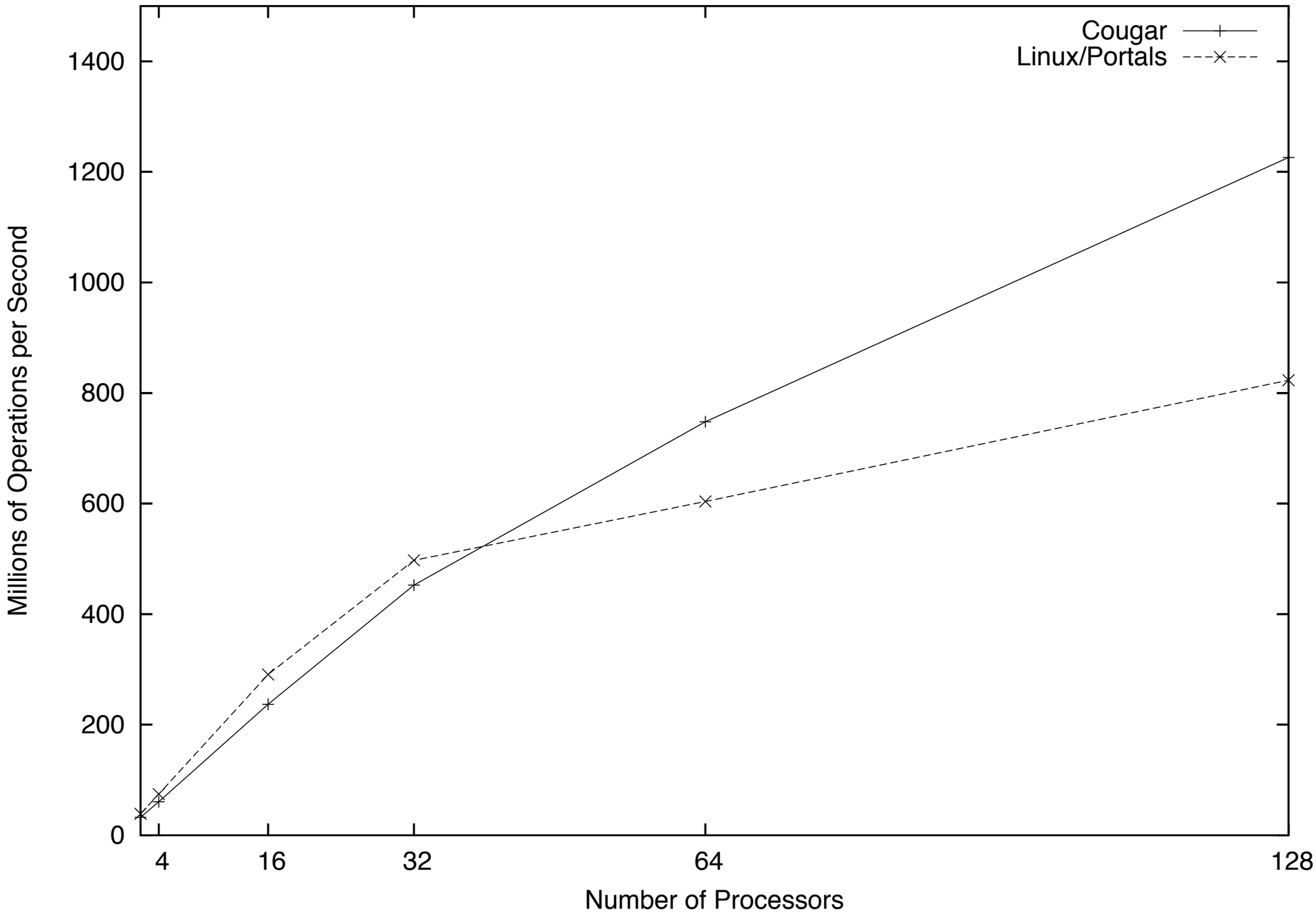


Cougar versus Linux on ASCI/Red

NAS B: mg


Cougar
Linux/Portals
Millions of Operations per Second
Number of Processors
5000
4000
3000
2000
1000
0
4
16
32
64
128

NAS B: cg


Cougar
Linux/Portals
1400
1200
1000
800
600
400
200
0
Millions of Operations per Second
4
16
32
64
128
Number of Processors

Apples and Pears

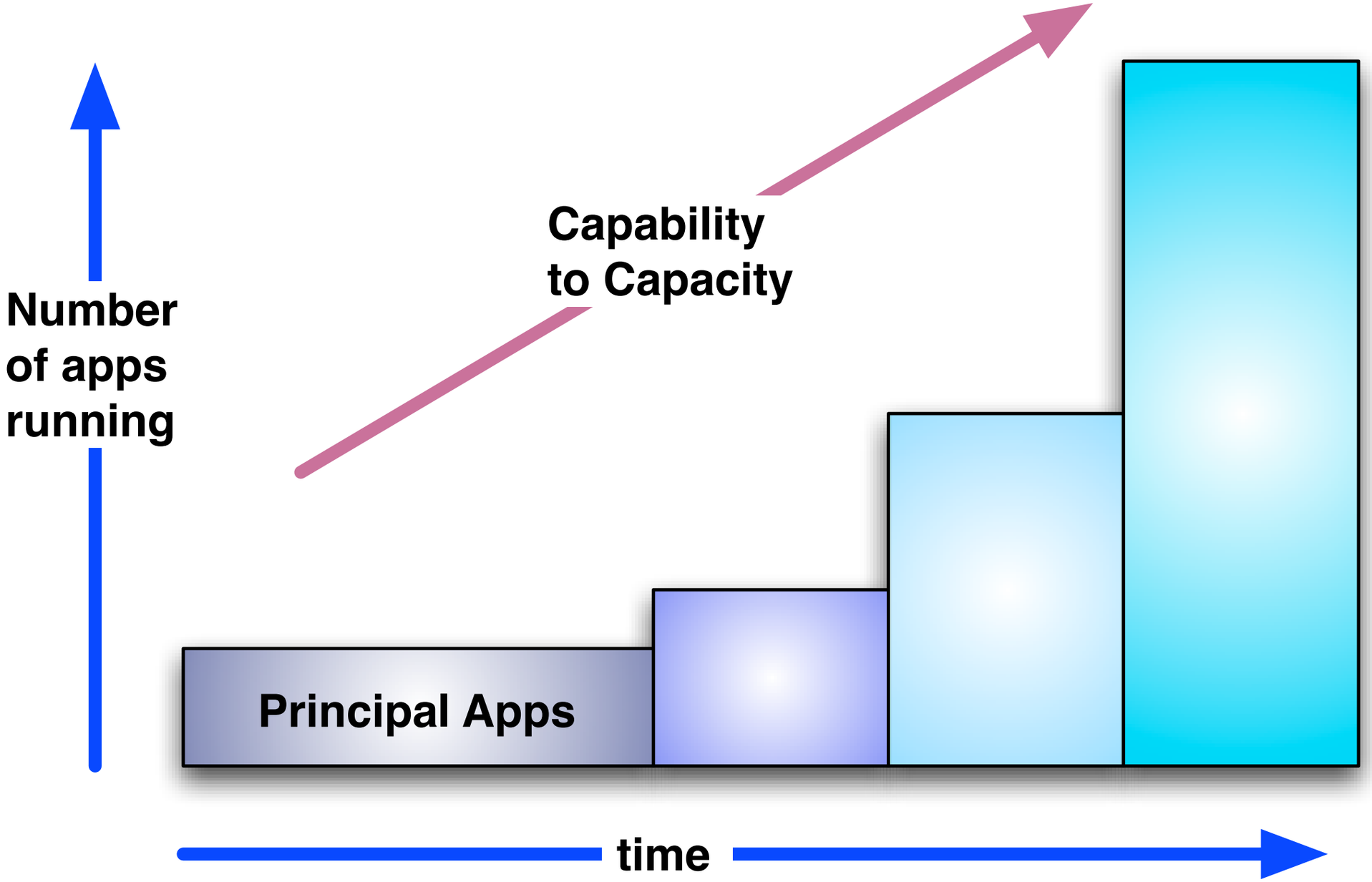
- Unfair to Linux
  - Portals 3 versus Portals 2
  - Random node allocation
- Unfair to Cougar
  - Old compilers and libraries (elf versus coff)
- Is it really unfair?
- Linux issues
  - non contiguous allocation (TLB misses)
  - file centric
- LANL (Tru64) and LLNL (AIX) observations

Linux Advantages

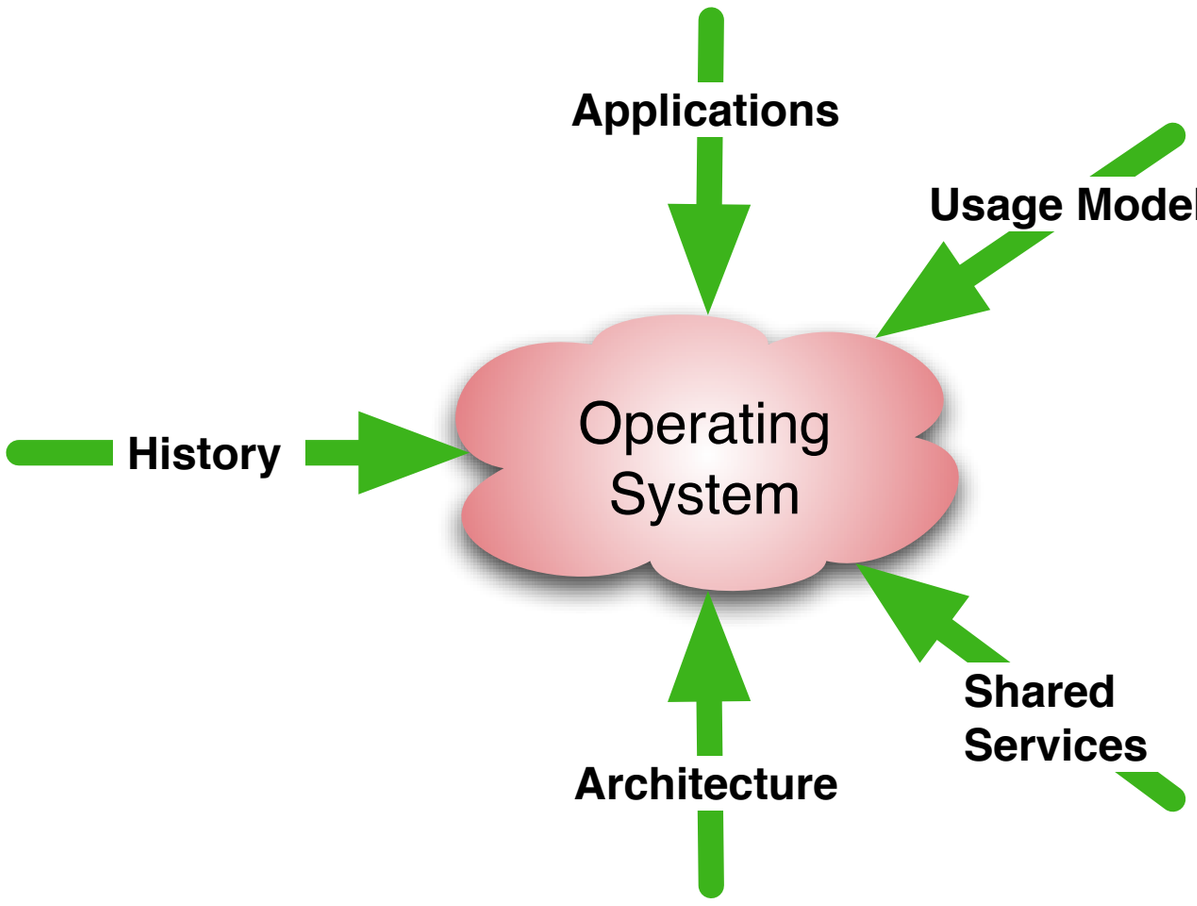
- Community support
  - Lots of device drivers
    - how many do we really need?
  - Lots of bug fixes
    - great when you have to use the same junk hardware that everyone else is using
  - There are people who know or want to know Linux

- Application support
  - Well understood programming environment
  - Is it the right model?
    - process model

System Lifetime

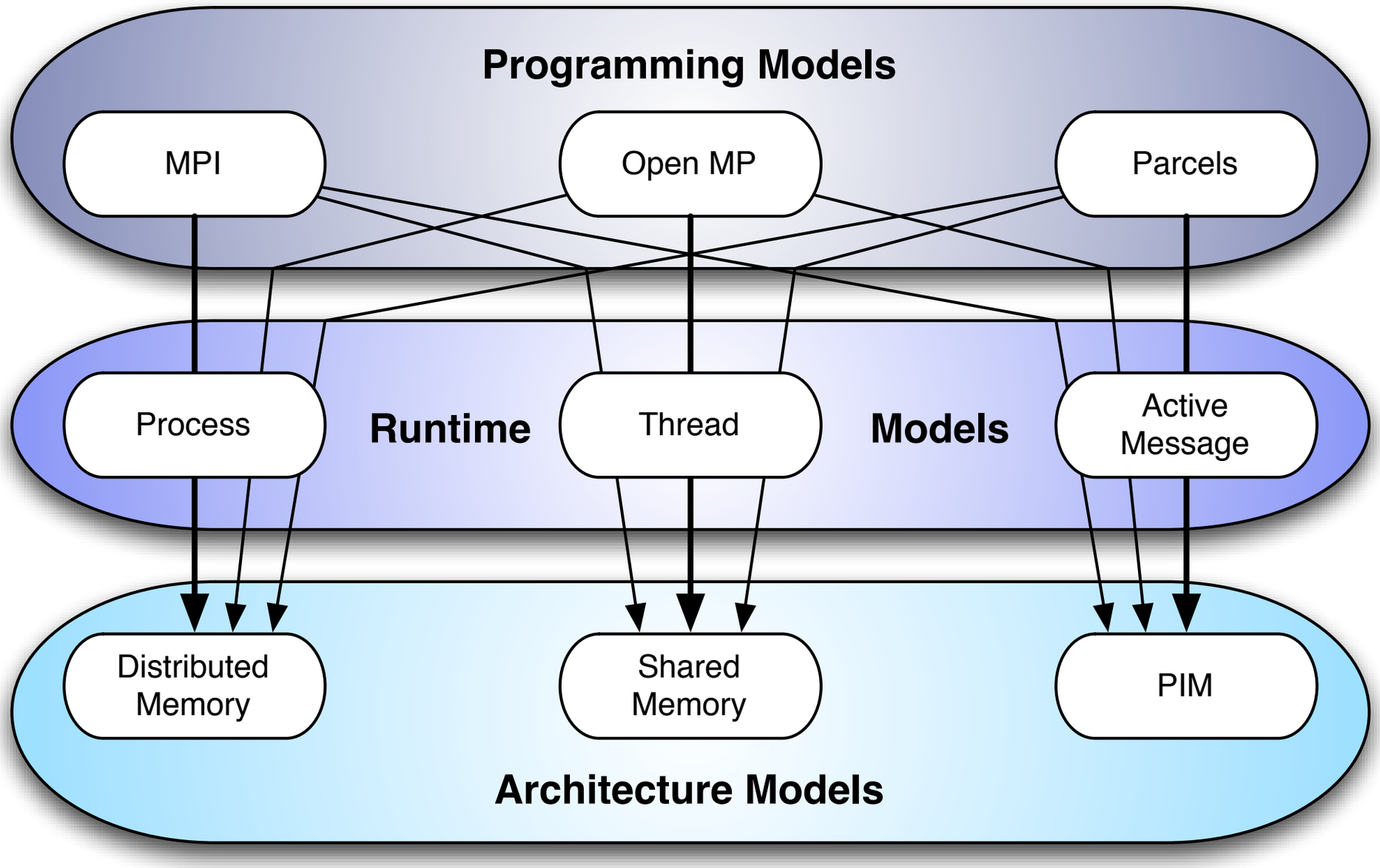


Factors



- Lightweight system
  - small collection of apps
    - single programming model
  - single architecture
  - single usage model
  - small set of shared services
  - no history :)
- Puma/Cougar
  - MPI
  - Distributed memory
  - space shared
  - parallel file system

Programming Models



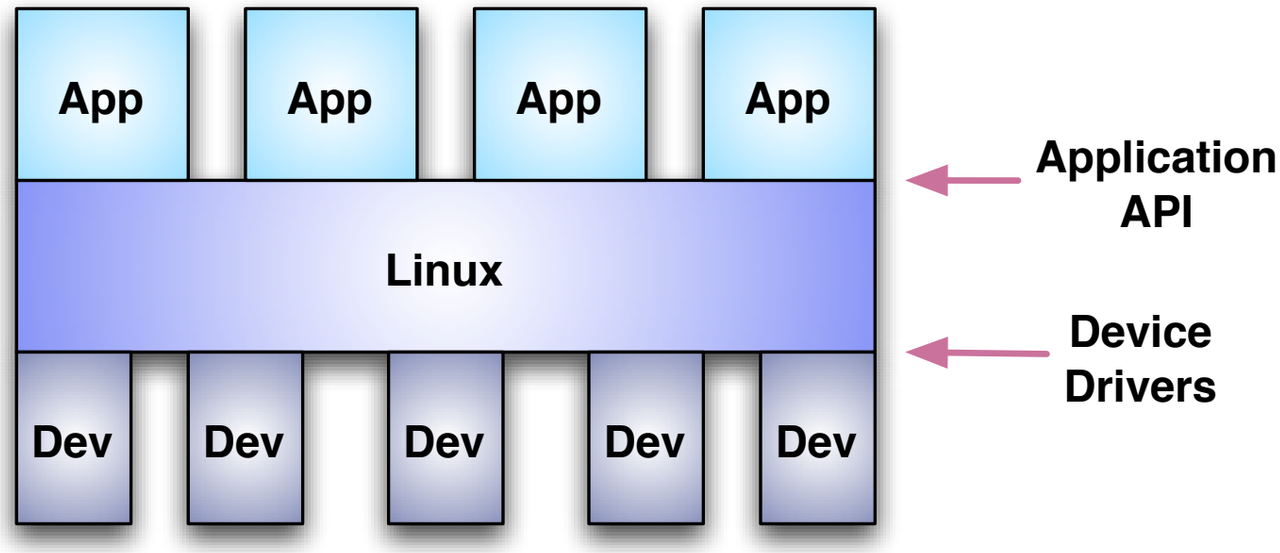
Observations

- If Application variety dominates, Linux wins
  - as long as apps are process based
- If new programming models dominate, Lightweight approaches win

- If you need to use junk hardware, Linux wins
  - I know I don't want to mess with a PCI bus...
- If Architecture changes dominate, Lightweight approaches win

What is Linux?

- An API for applications
  - build a Linux personality
    - performance tradeoffs will be different



- A collection of device drivers
  - runs on a variety of systems
    - as long as you can live with an x86 memory model
    - lots of support for broken hardware

Concluding Thoughts

- Lightweight approaches are the best way to support the development of novel architectures and programming models
- There are lots of other things that need to be done
  - better support for single system image on clusters
  - clean up internal Linux structure
- Testbed systems
  - systems is an experimental discipline
  - need to be able to perform true apples to apples comparisons

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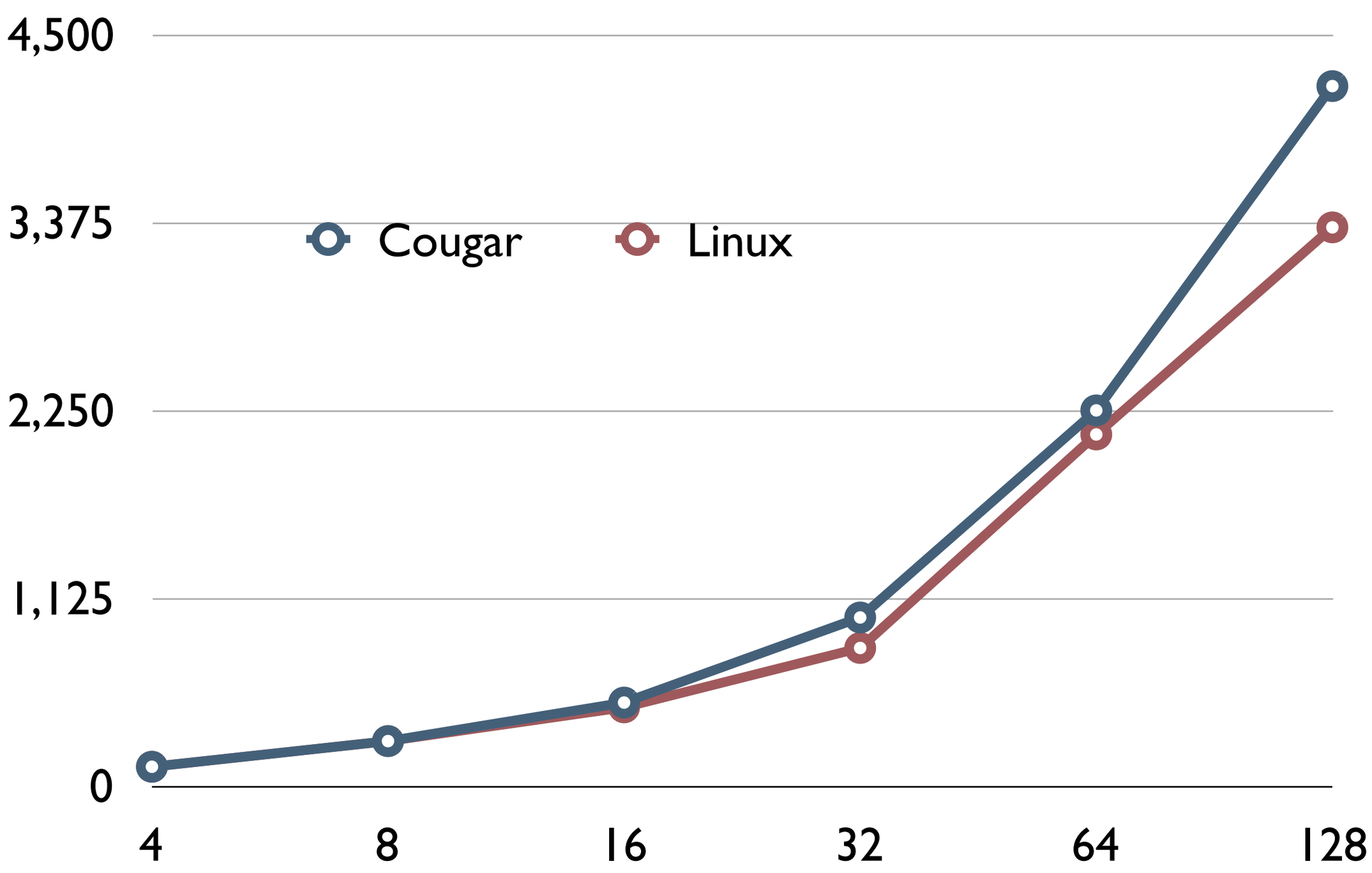
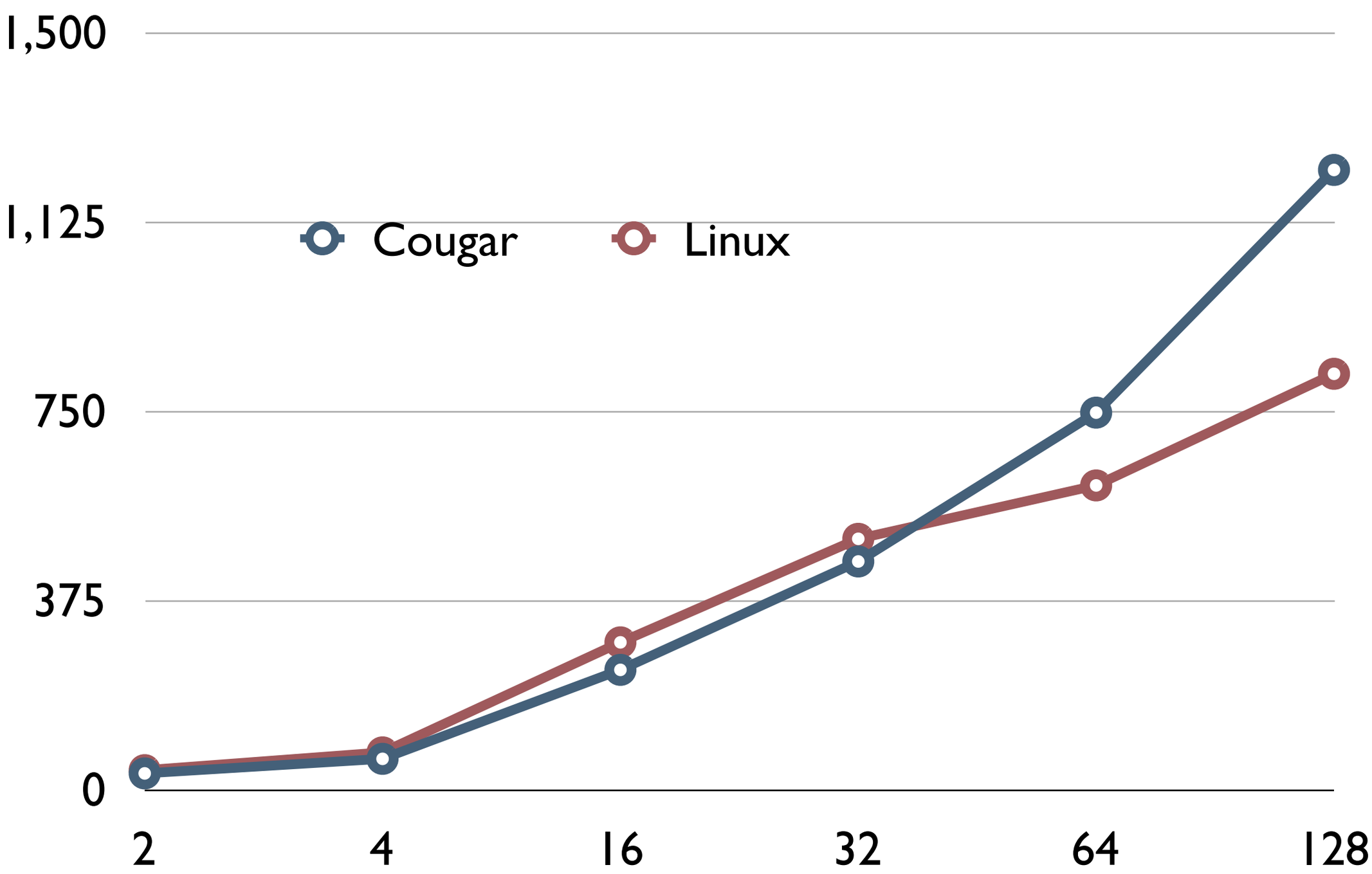
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