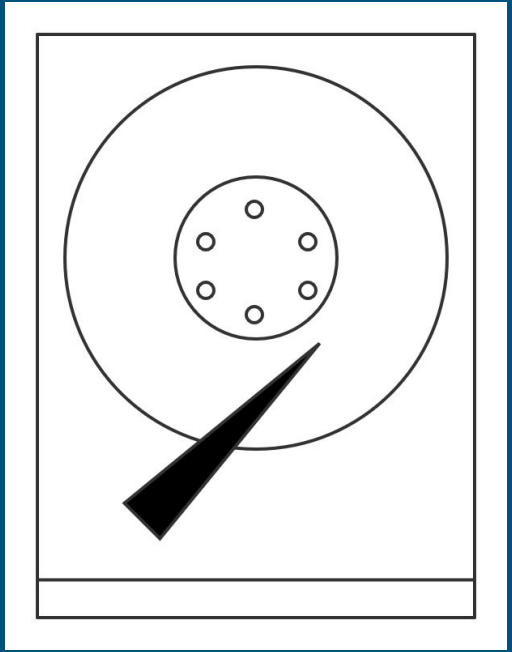
Virtualizing Disk Performance

Presented by:
Aldrin Montana

Virtual Disks

A physical disk

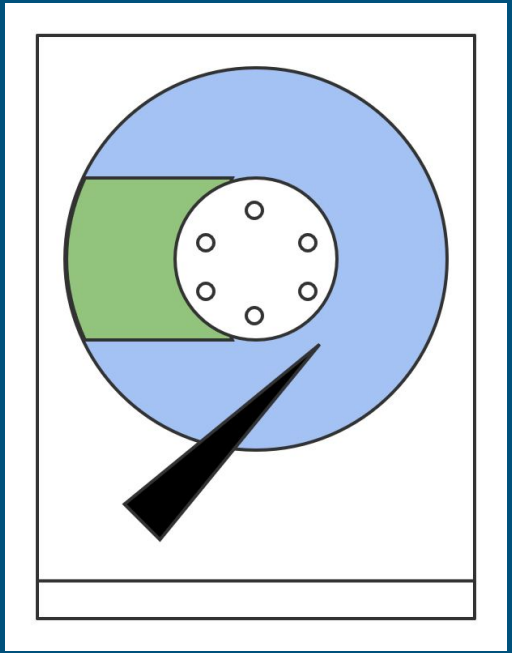


Virtual Disks

A physical disk

Can be portioned into

many virtual disks



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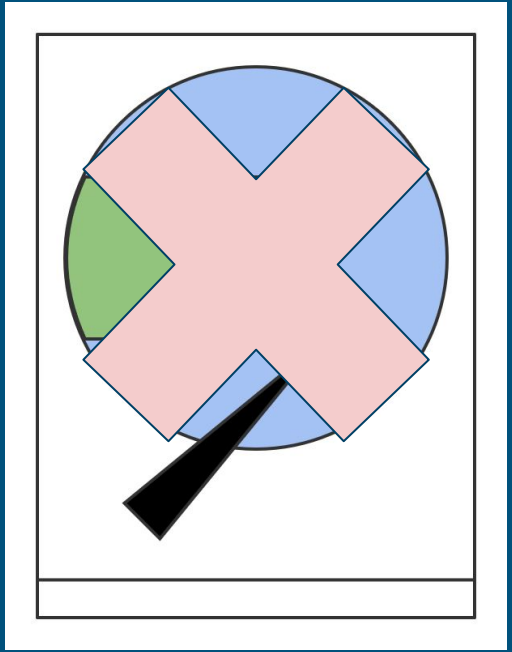

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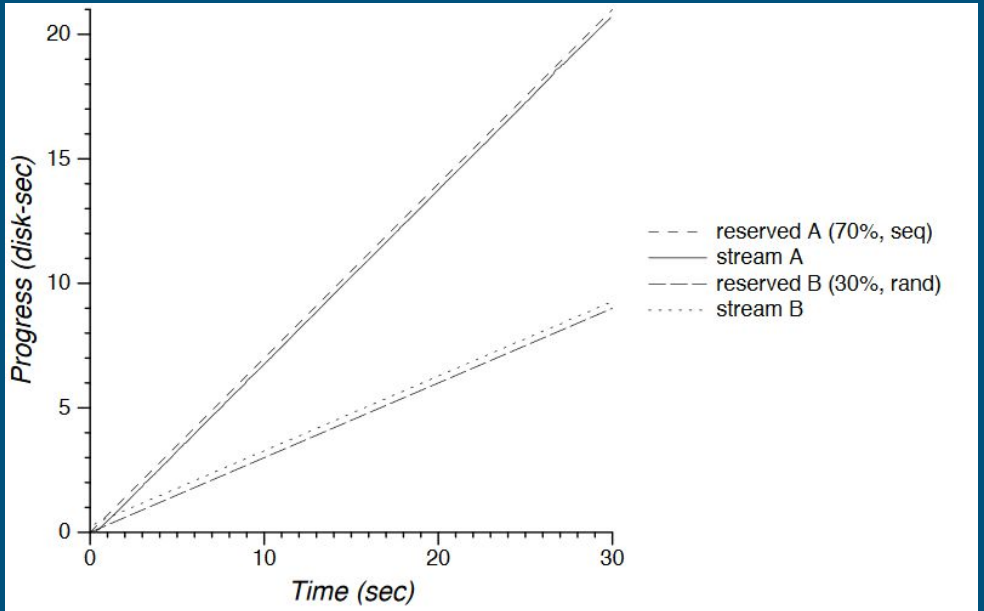


Figure 1: Progress of two I/O streams; one random and one sequential. Each stream uses its own virtual disk, both of which are hosted by a single physical disk. The virtual disk of the sequential stream has reserved 70% of the physical disk time and the virtual disk of the random one has reserved 30%. Other combinations (not shown) are similar.

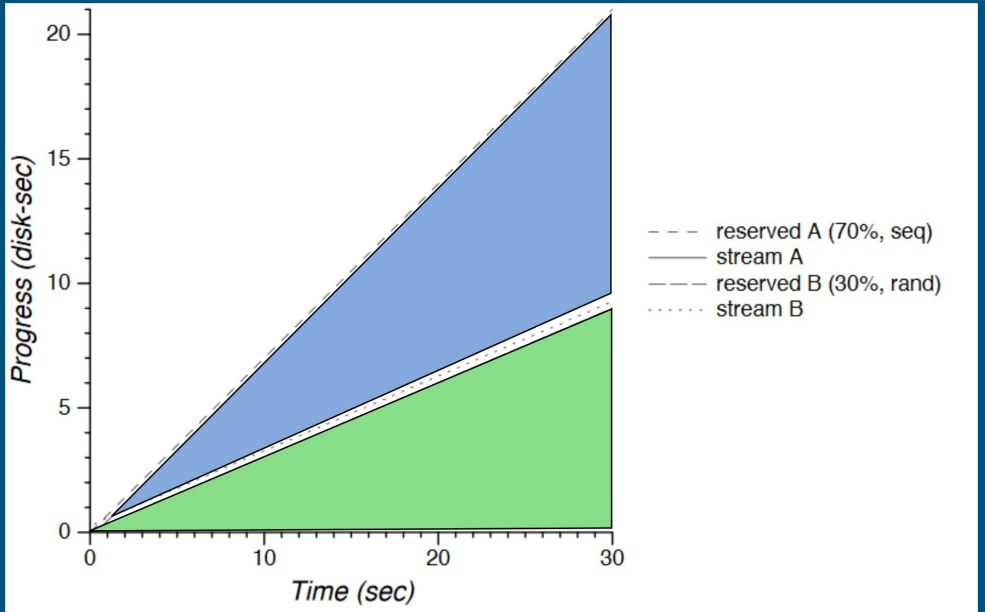
Virtual Disks

A physical disk

Can be portioned into

many virtual disks

by utilization



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Virtual Disks

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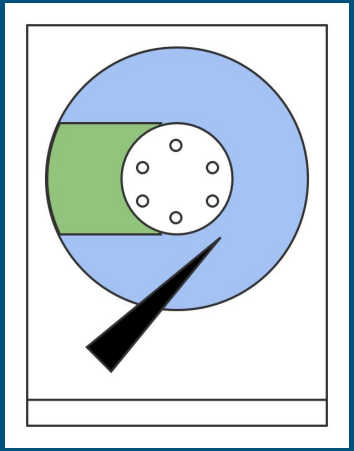

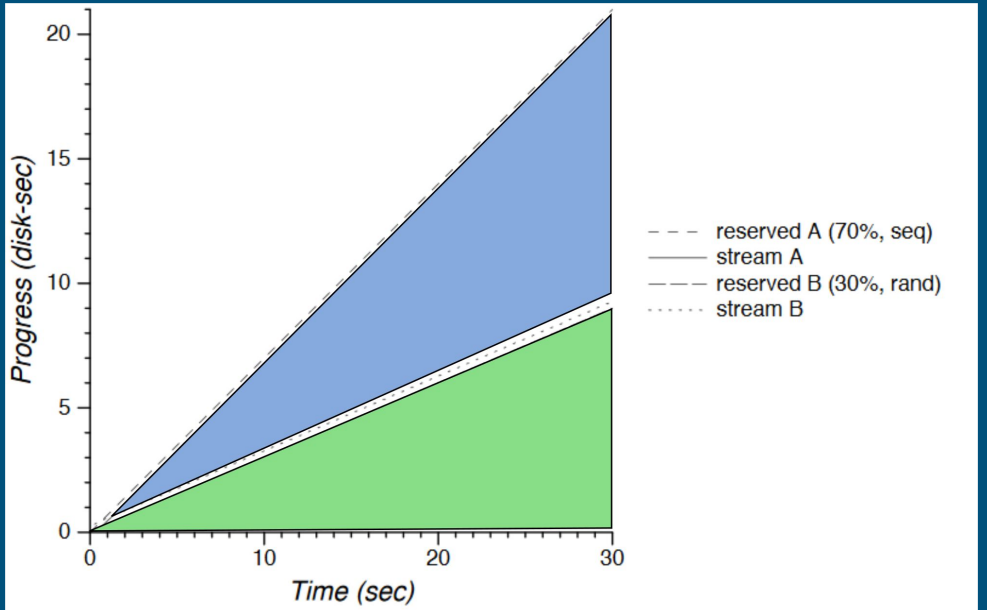

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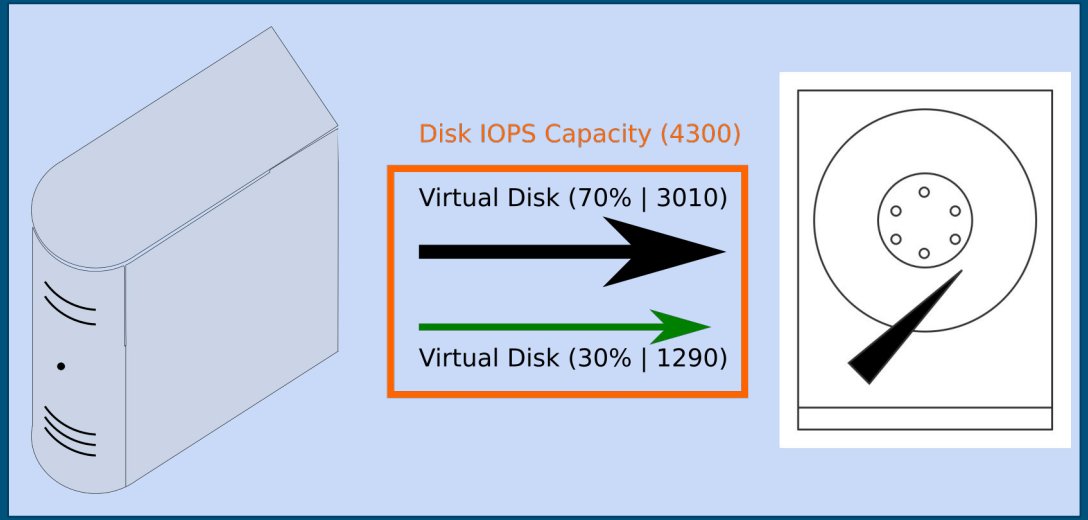
Utilization

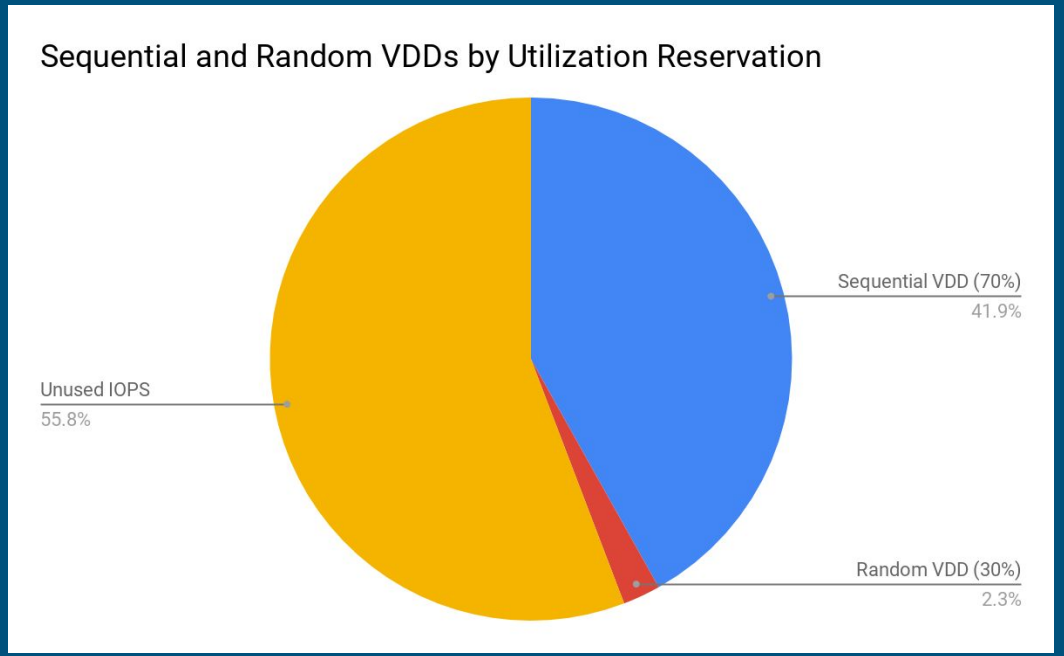
Fraction of disk time:

- A disk has an IOPS capacity
- A μ-second is 1 second of disk time
  - Device normalized metric?



Utilization

Each I/O request consumes μ-seconds of available execution time



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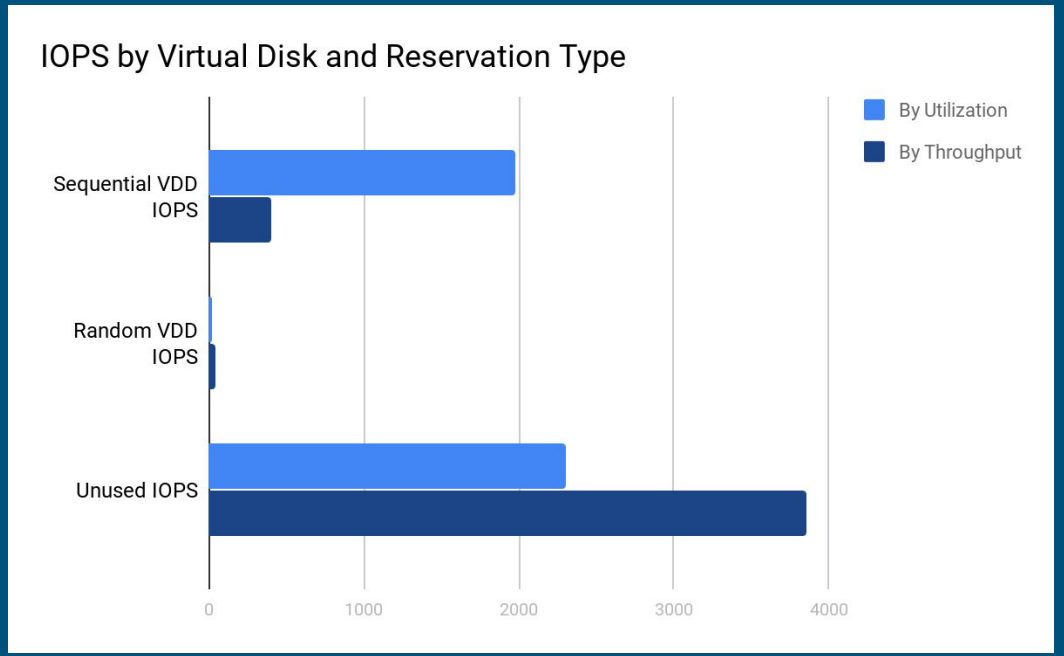


Isolation of VDD behavior

1. Guarantee reserved utilization
2. Account for seeks and other delays
3. Charge VDD for time spent (token buckets)
4. I/O requests coarsely scheduled

Scheduling

Major Life Events:

- Scheduling
- Execution
- Completion

How To:

- Estimate execution time
- Actual execution time
- Track Progress

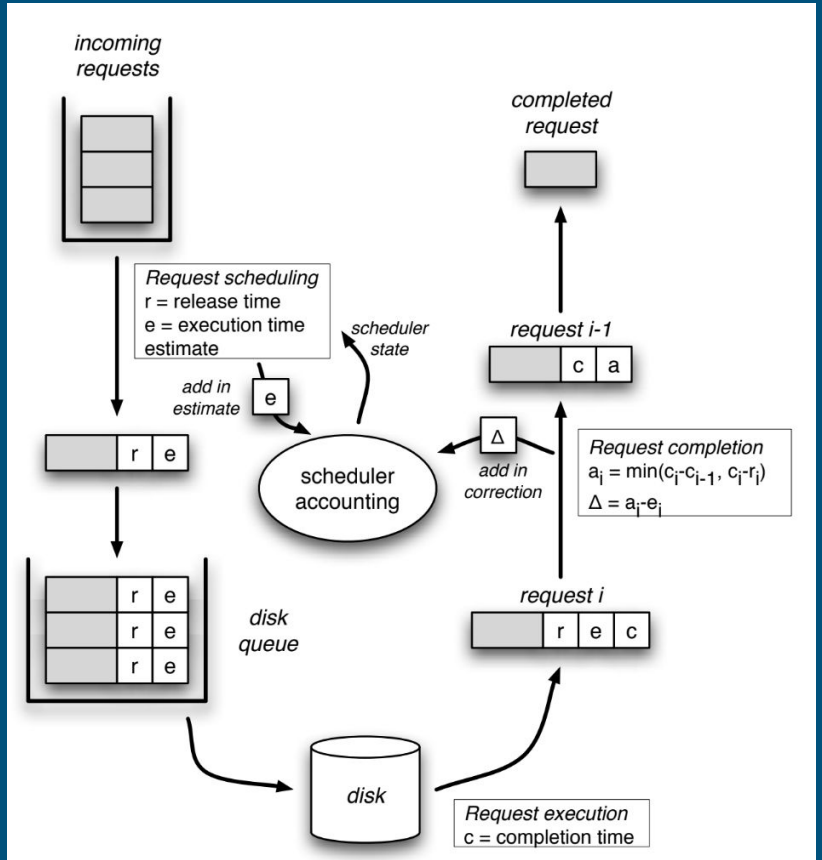


Figure 3: Flow of I/O requests through an I/O scheduler.

Evaluation

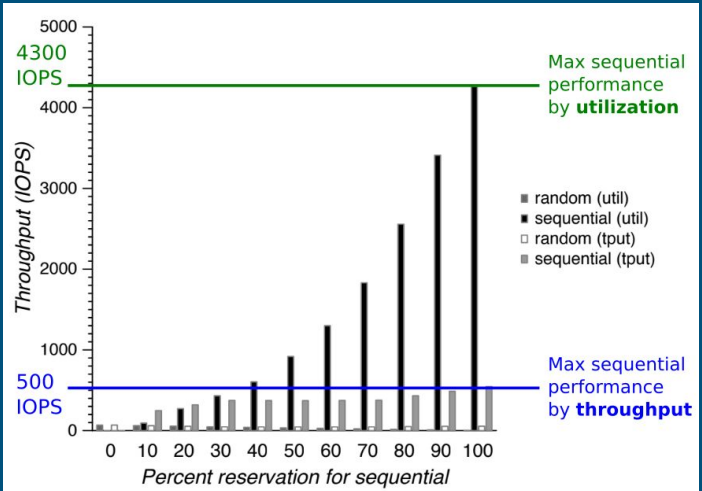
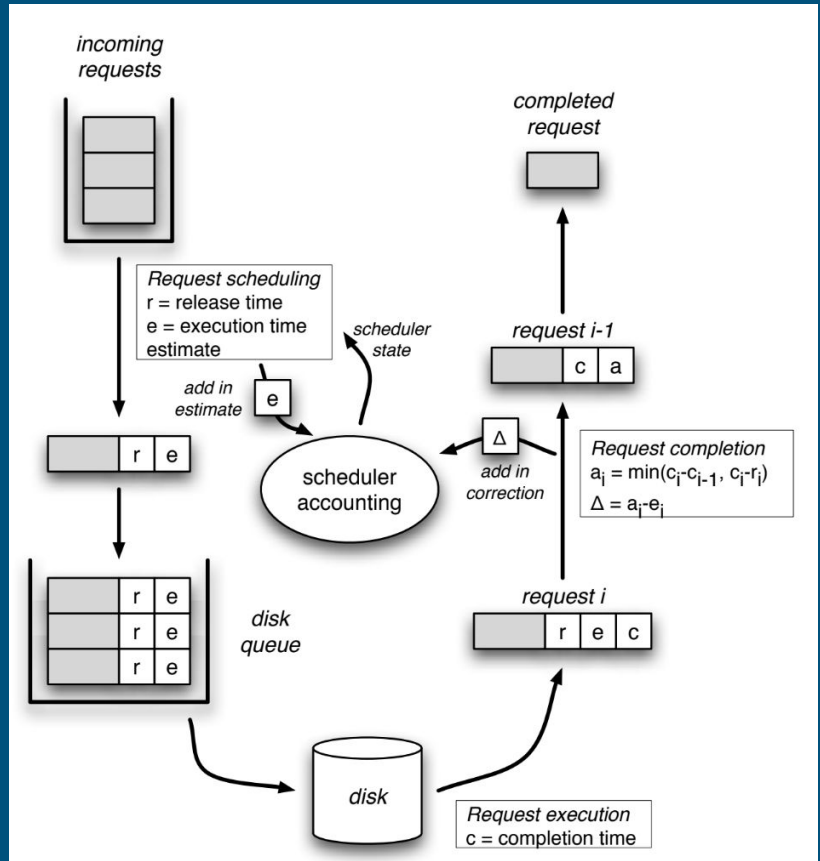


Figure 6: Efficiency comparison: throughput received by one random and one sequential request stream from the utilization- and throughput-based schedulers as the reservation of the sequential stream varies from 0% to 100% (and the reservation of the random stream varies from 100% to 0%) of utilization or throughput (as appropriate for the scheduler).



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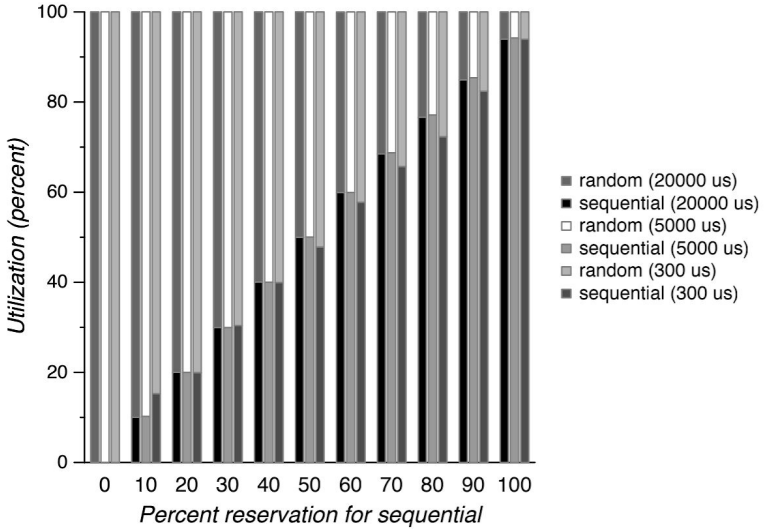
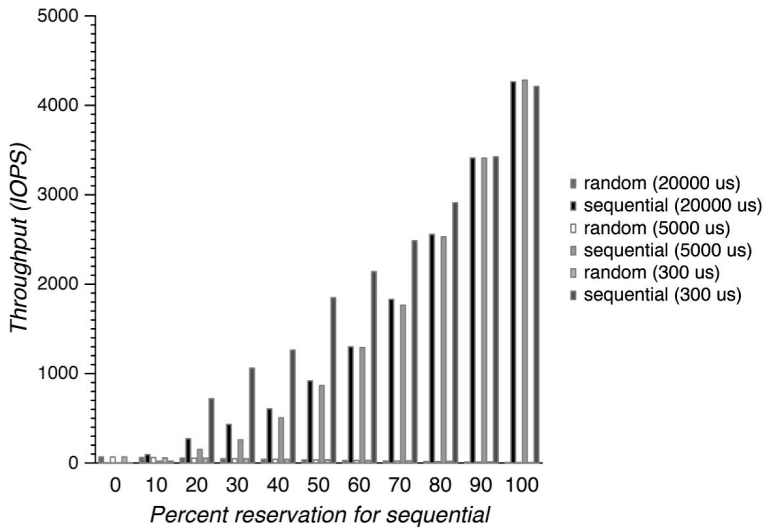


(a) Utilization



(b) Throughput, with sequential (0, 0) results omitted

Figure 7: Sensitivity of the utilization-based scheduler to errors in the random I/O service time estimate. Performance received by two request streams, one random and the other sequential, from the utilization-based scheduler with increasingly underestimated random I/O request service time (in parentheses).

References

Original figures from [1].

[1] https://ieeexplore.ieee.org/document/4550803