Rack Scale Apps

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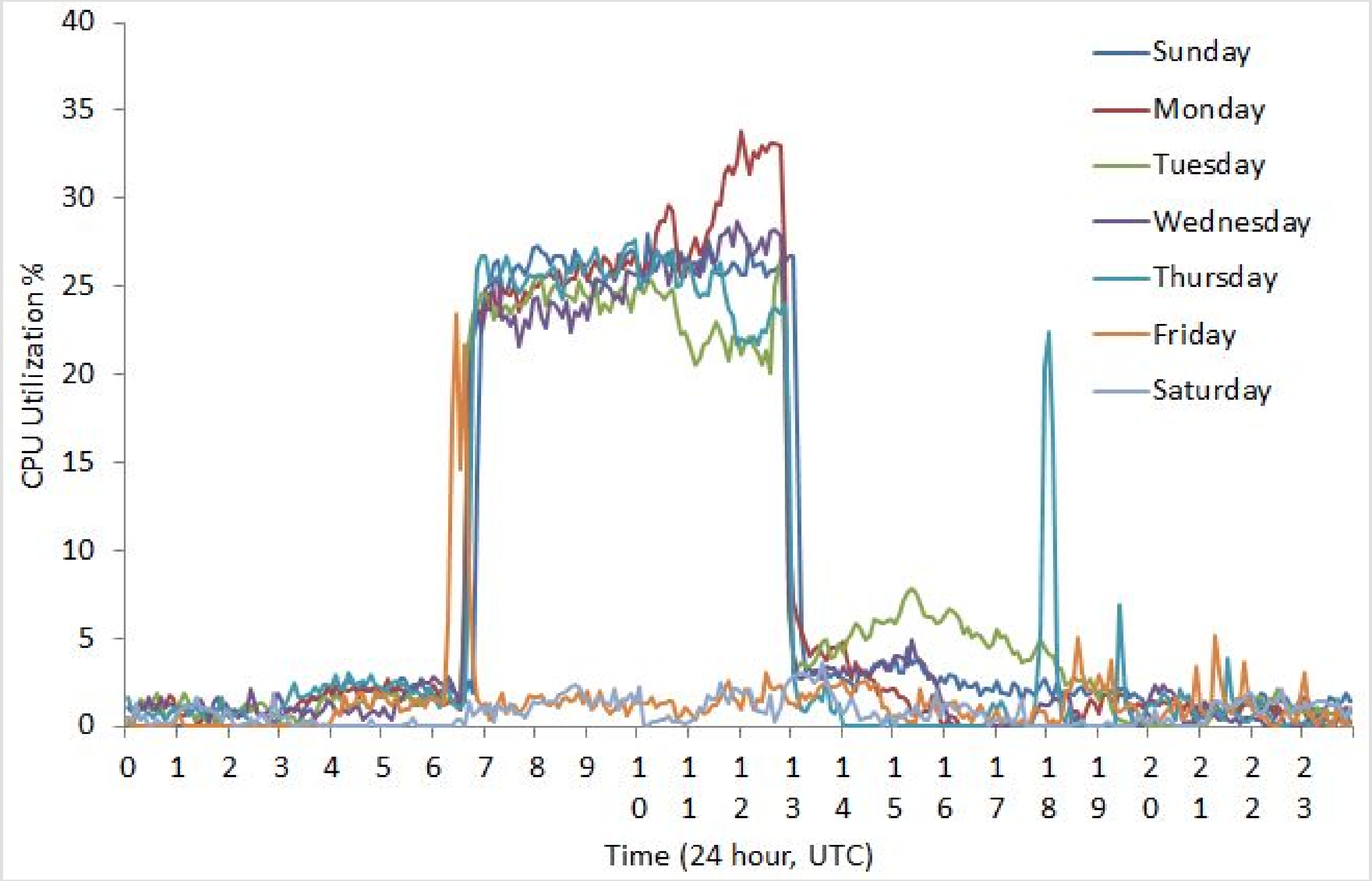
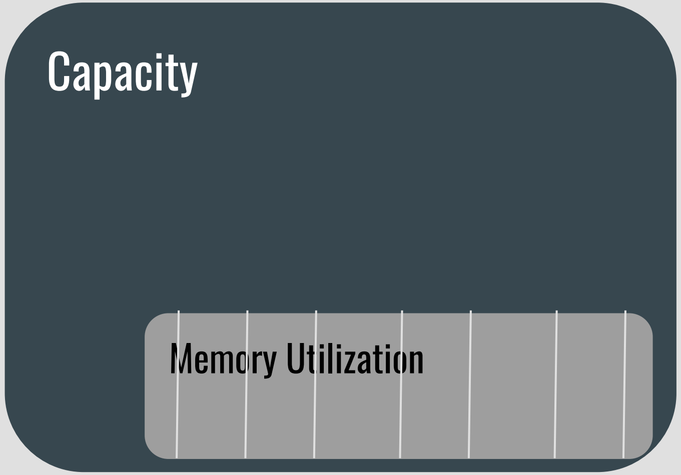
The Cloud

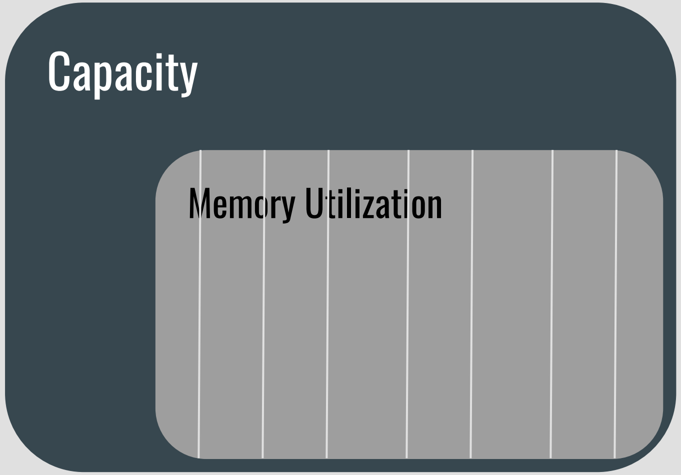
- **Vital to the world!**
- Service providers: Facebook, Twitter, etc.
- Storing/accessing data and programs over the Internet
- Servers living in **DataCenters**
- 2% of energy usage in the US
- **$30 billion** to power *idle servers*



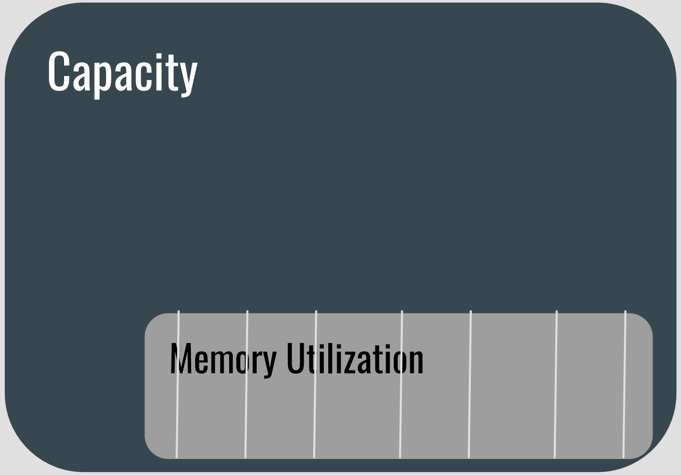
https://huanliu.wordpress.com/2012/02/17/host-server-cpu-utilization-in-amazon-ec2-cloud/



1.) Underutilization



2.) High Utilization



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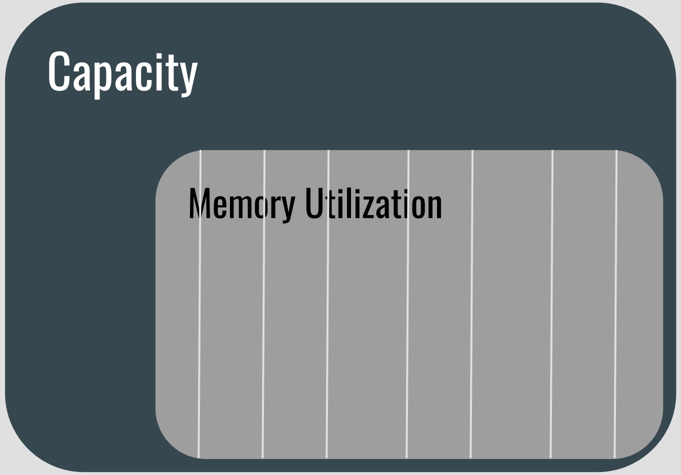
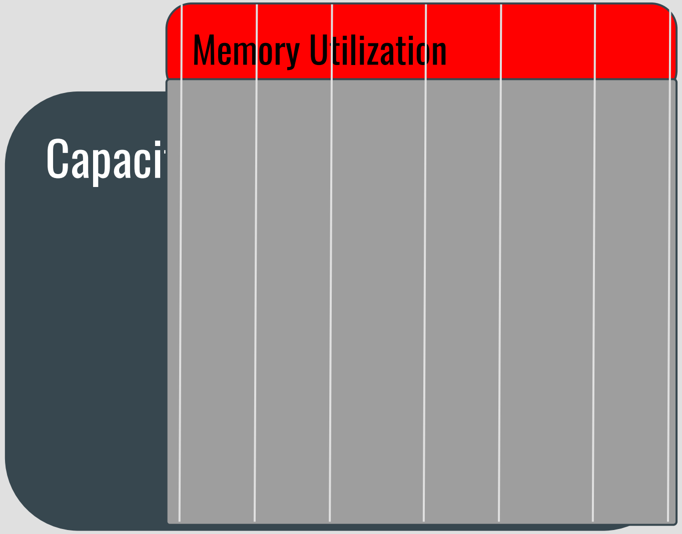
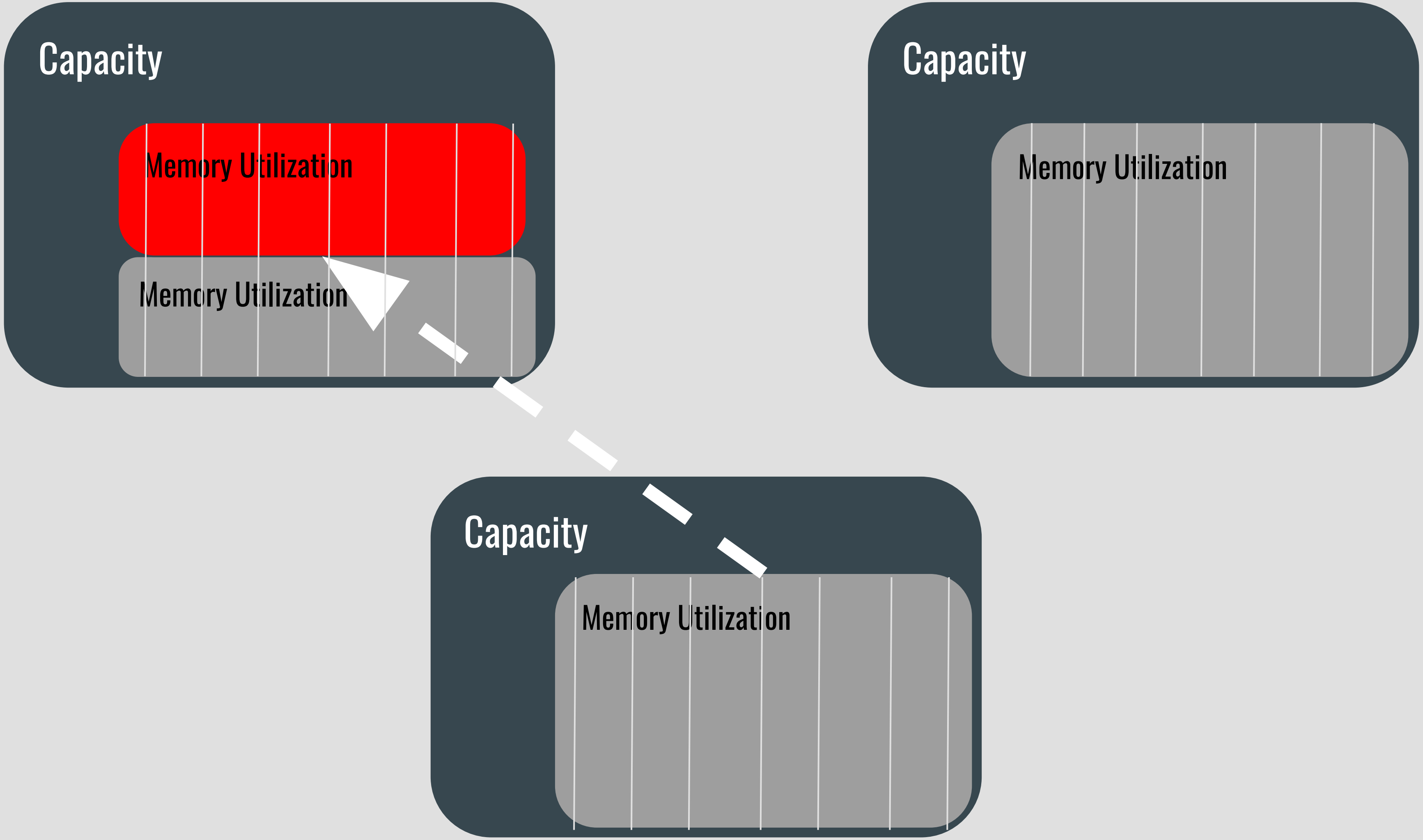


2.) High Utilization



3.) Exceeding Capacity


Capacity
Memory Utilization
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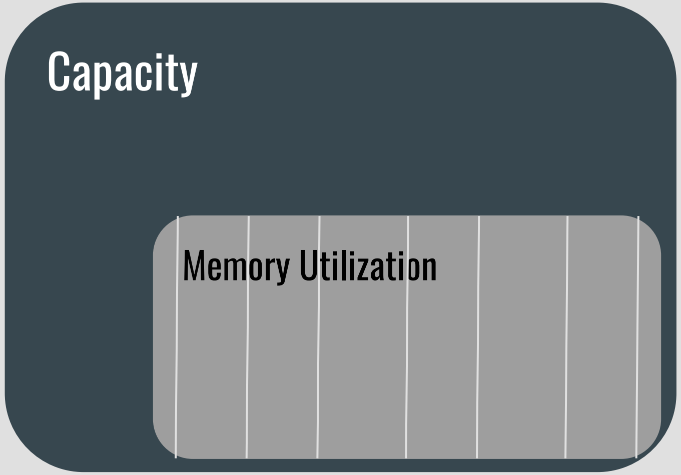
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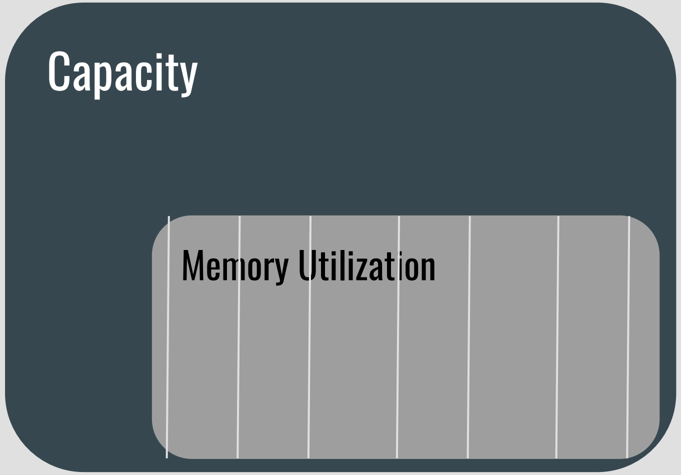
Memory Utilization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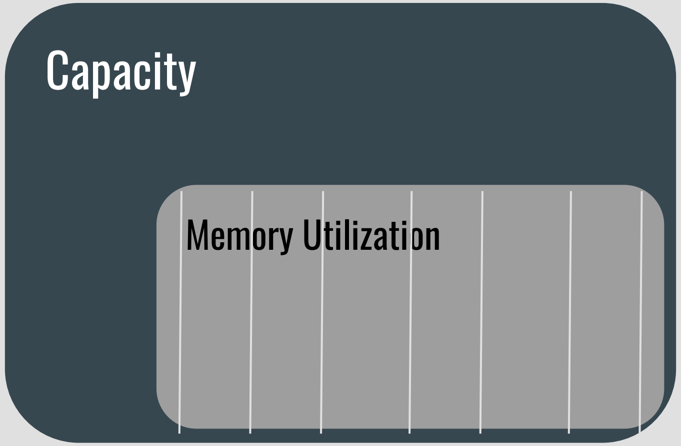
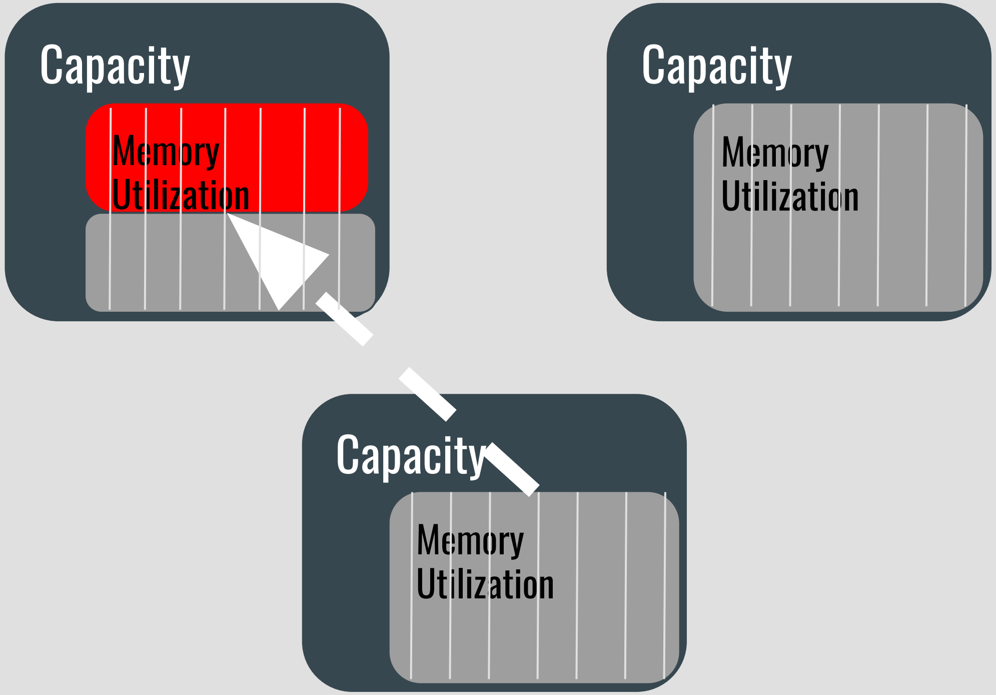
Memory Utilization


Capacity
Memory Utilization

Paging Problem

- Memory organized as "**pages**"
- When do you "**swap**" pages between servers?



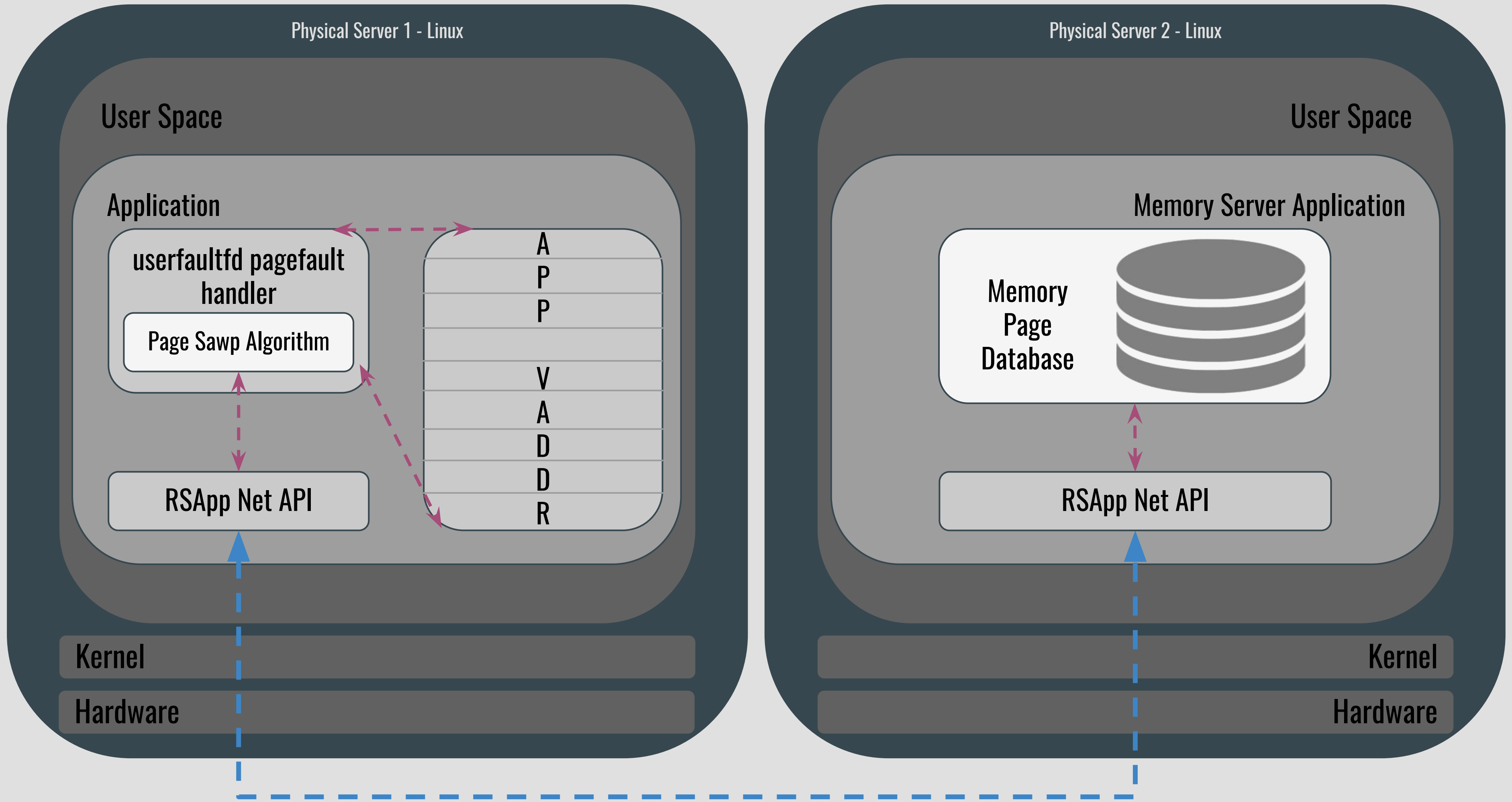
Rack Scale Apps

Rack Scale Apps

- **Pool** server hardware together in a rack
- Focusing only on **memory**
- **Page swapping** algorithm to intelligently manage memory

Rack Scale Apps

- **userfaultfd:** on demand paging and page fault management from userland
- **Memory Server:** remote storage for memory pages
- **RSApp Net API:** connects application to memory server

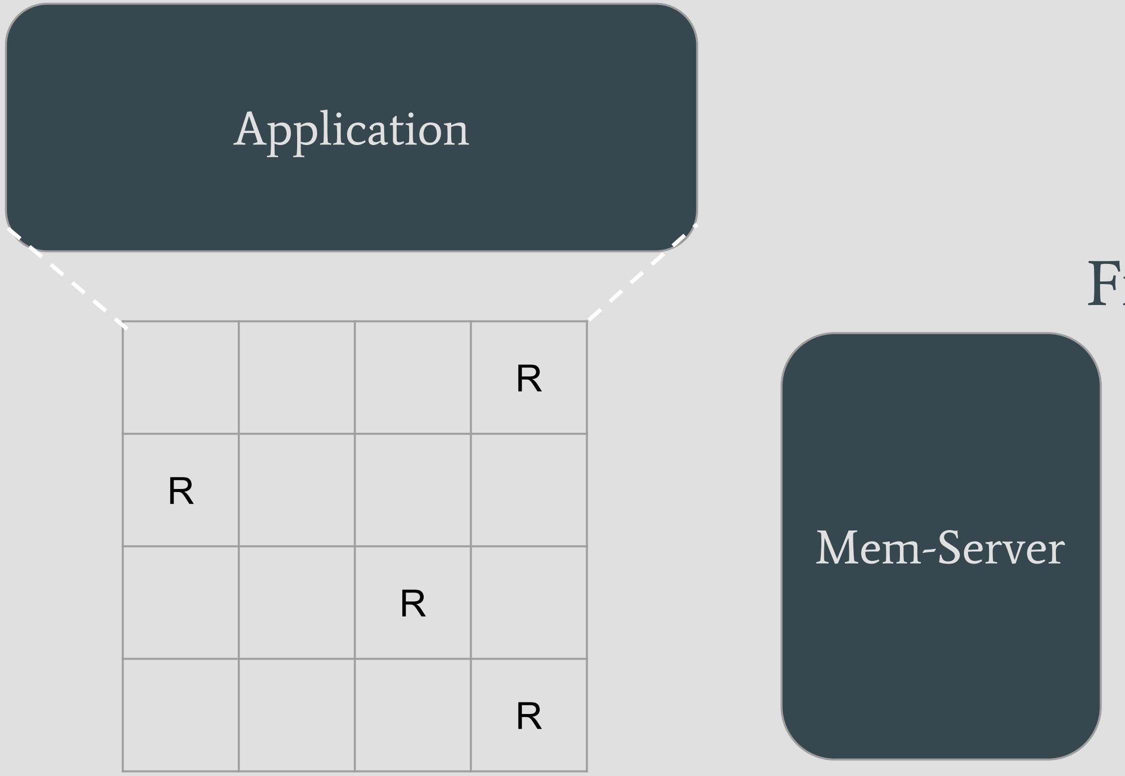

Physical Server 1 - Linux
User Space
Application
userfaultfd pagefault handler
Page Sawp Algorithm
RSApp Net API
A P P V A D D R
Kernel
Hardware
Physical Server 2 - Linux
User Space
Memory Server Application
Memory Page Database
RSApp Net API
Kernel
Hardware

Rack Scale Apps Demo

Page Swapping Algorithm

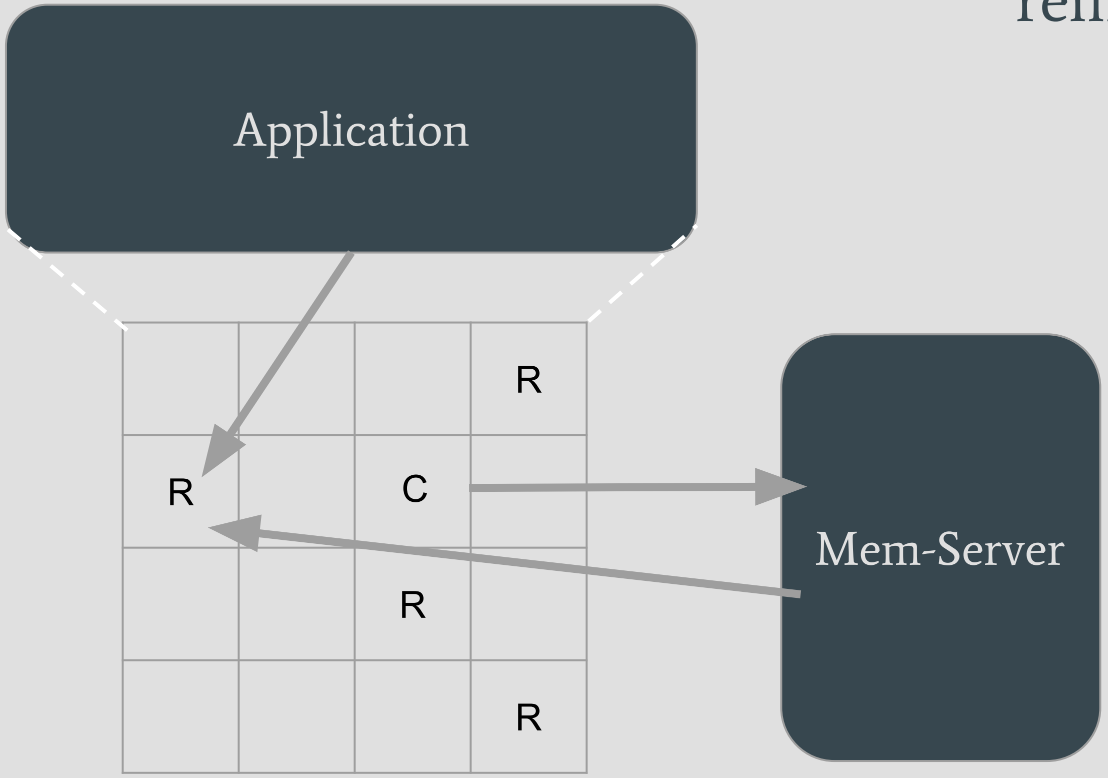
- Fools a process to think it has more memory
- Decides when to keep a page local or remote

Page Swapping Algorithm



First, mark some pages as **"remote"**

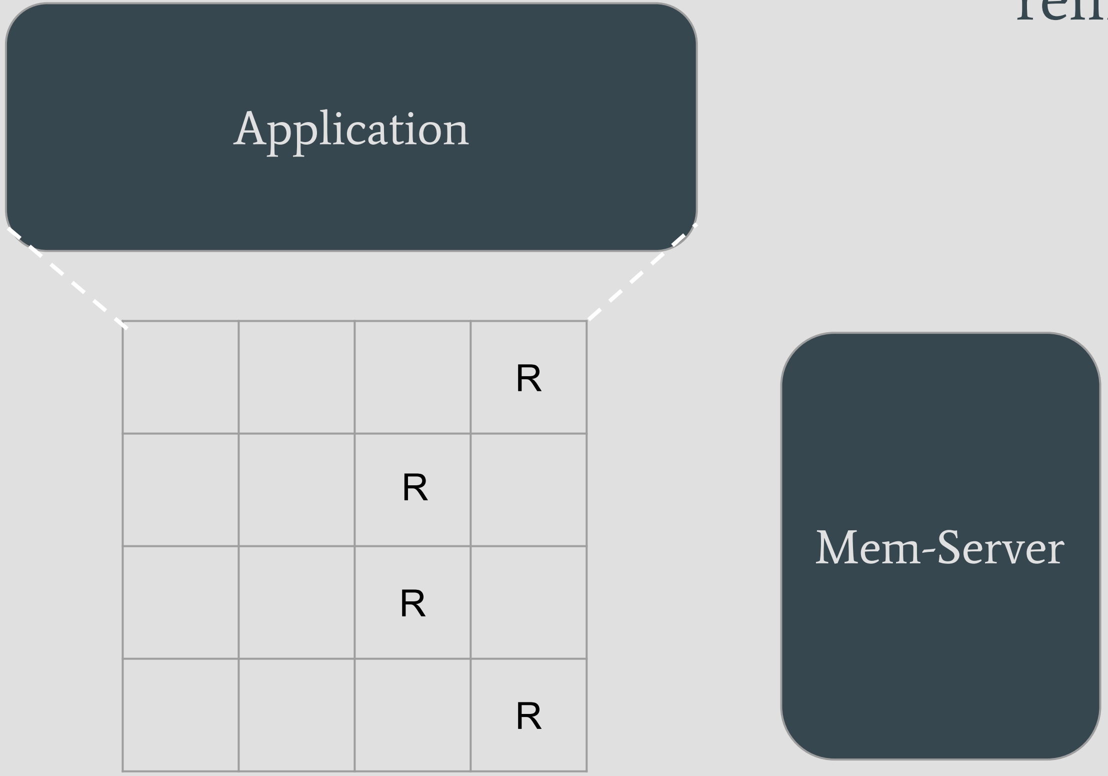
Page Swapping Algorithm



When Application accesses remote page:

1. Find coldest page
2. Swap its data to the mem-server
3. Check mem-server for remote page's data
4. Switch coldest page and remote page

Page Swapping Algorithm



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Analysis

- Throttle memory utilization of Memcached
  - **Low memory:** Memcached incurs low performance
  - **High memory:** Memcached incurs better performance
  - **Low memory + RSA:** Memcached performs closer to high memory case

Conclusion

- Efficient use of hardware can save lots of money
- Resource management is challenging
- Rack Scale Architecture saves the day

Rack Scale Apps

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