



**Barcelona
Supercomputing
Center**
Centro Nacional de Supercomputación



**UNIVERSITAT POLITÈCNICA
DE CATALUNYA
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AI and Predictive Analytics in Data-Center Environments

Performance & Resource Competition

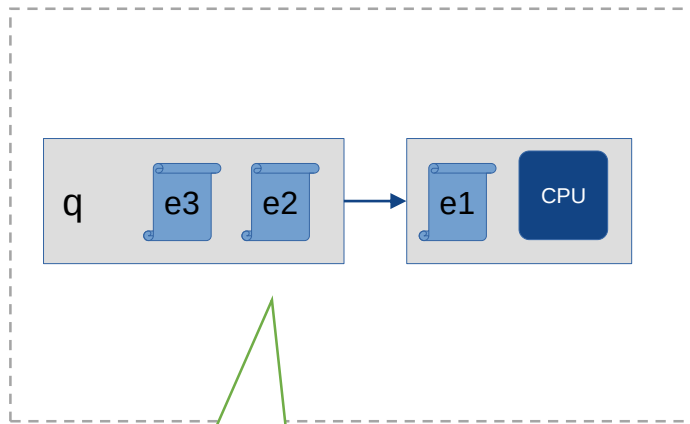
Resource Competition

Systems do not always have “queues”

- But that does not change the previous law
- Concurrent processes → Resources are **shared**

Resource Competition

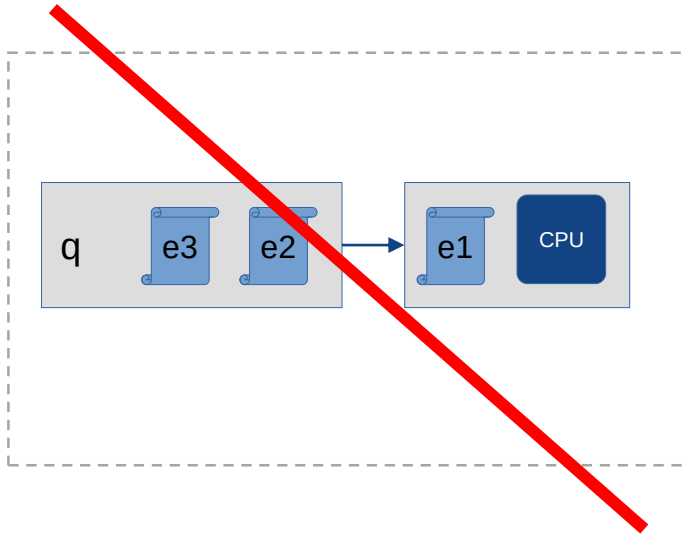
Shared Resources



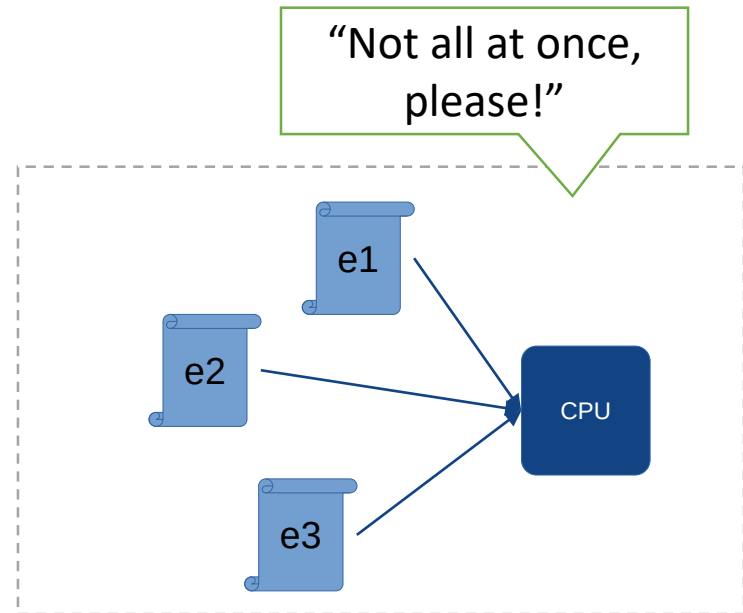
System with a queue for executions

Resource Competition

Shared Resources

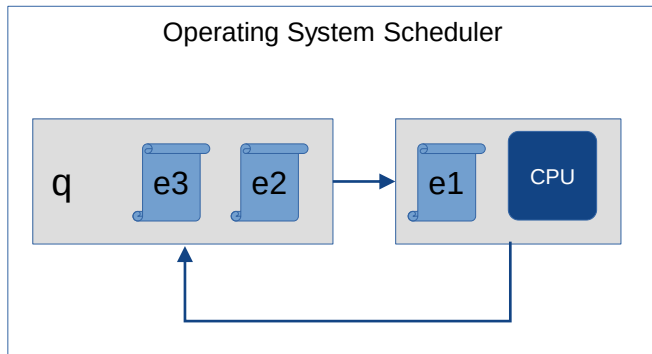


System with no queue for executions



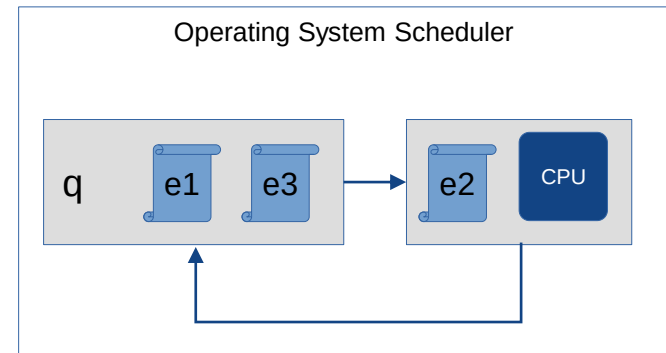
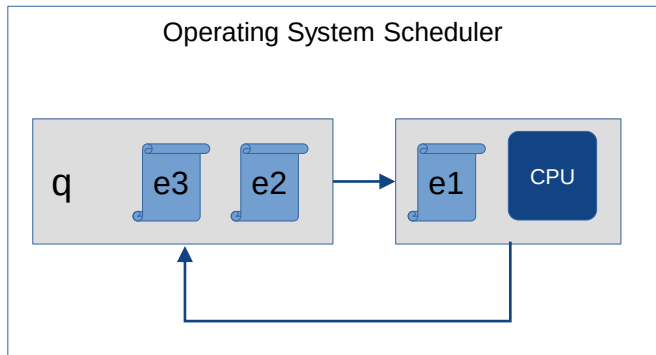
Resource Competition

Schedulers and Shared Resources



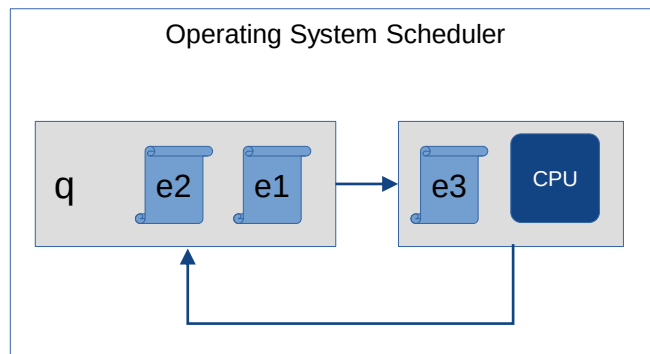
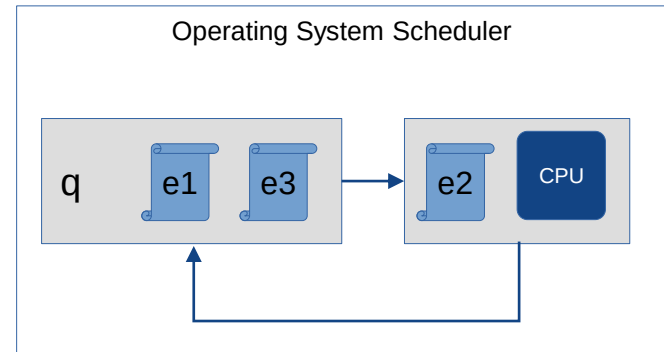
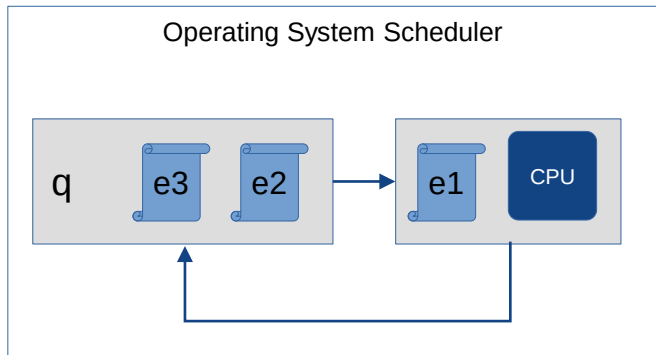
Resource Competition

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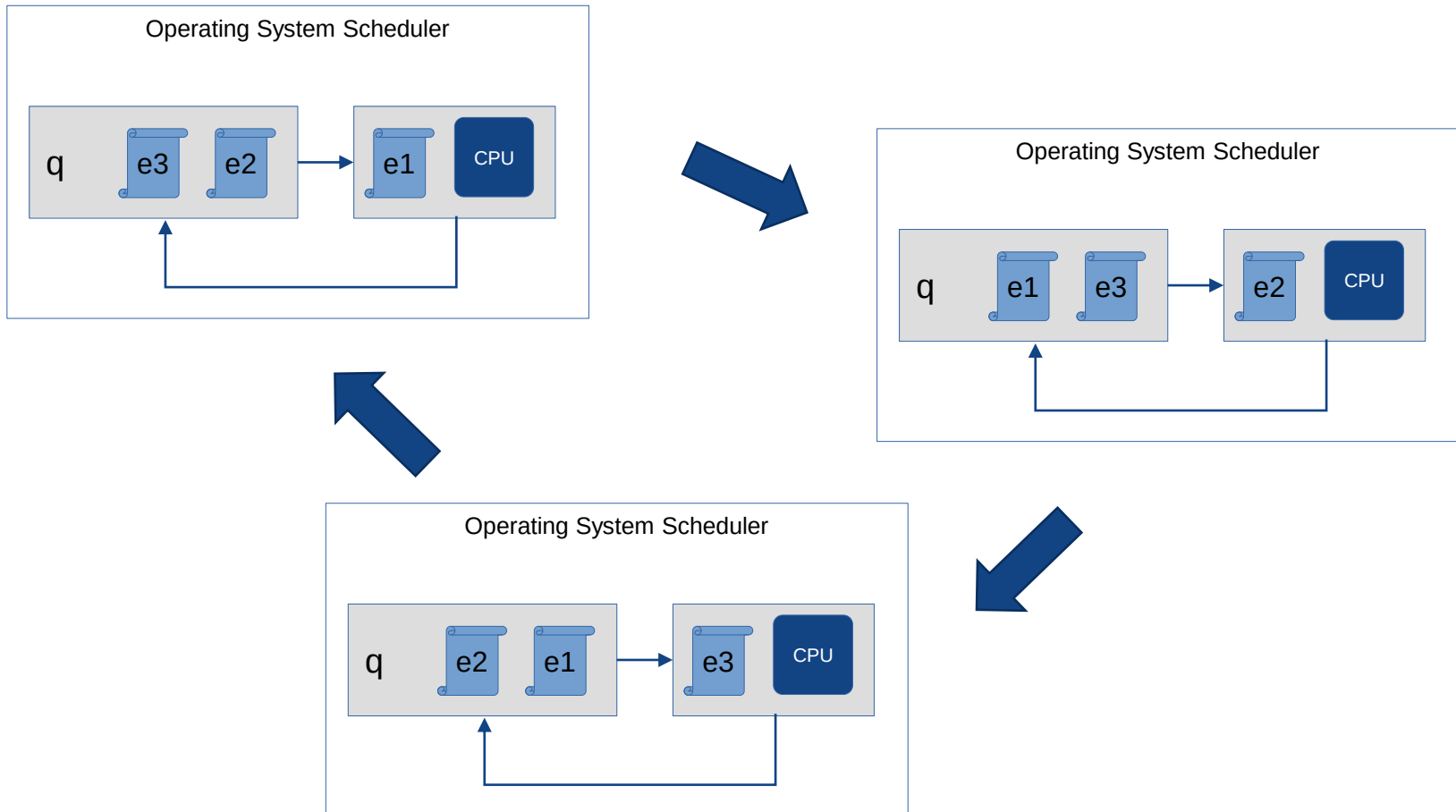
Resource Competition

Schedulers and Shared Resources



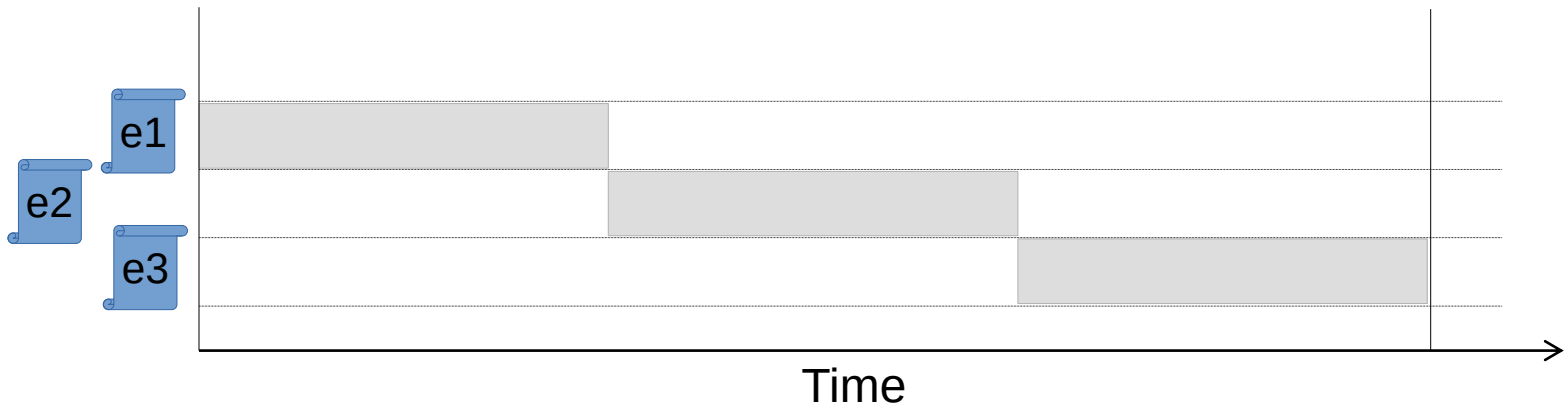
Resource Competition

Schedulers and Shared Resources



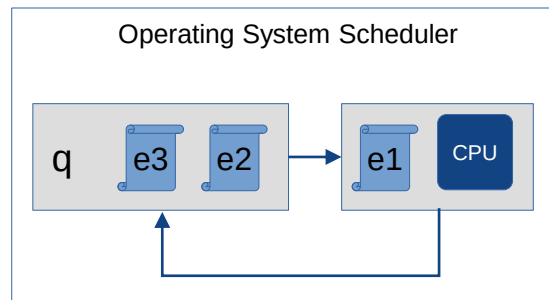
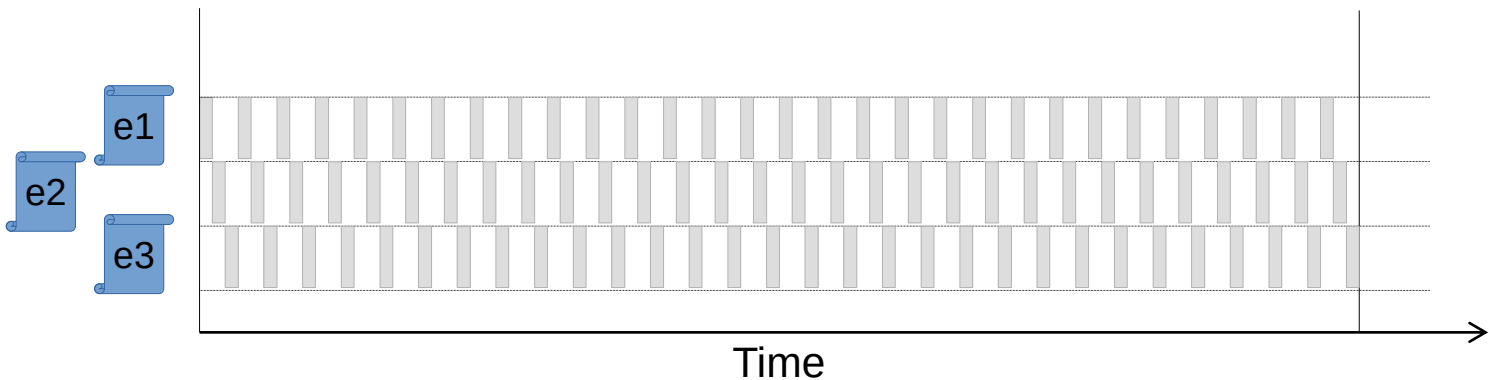
Resource Competition

- Example: 3 applications and 1 CPU
- Simplification:
 - They are executed in order (queue)



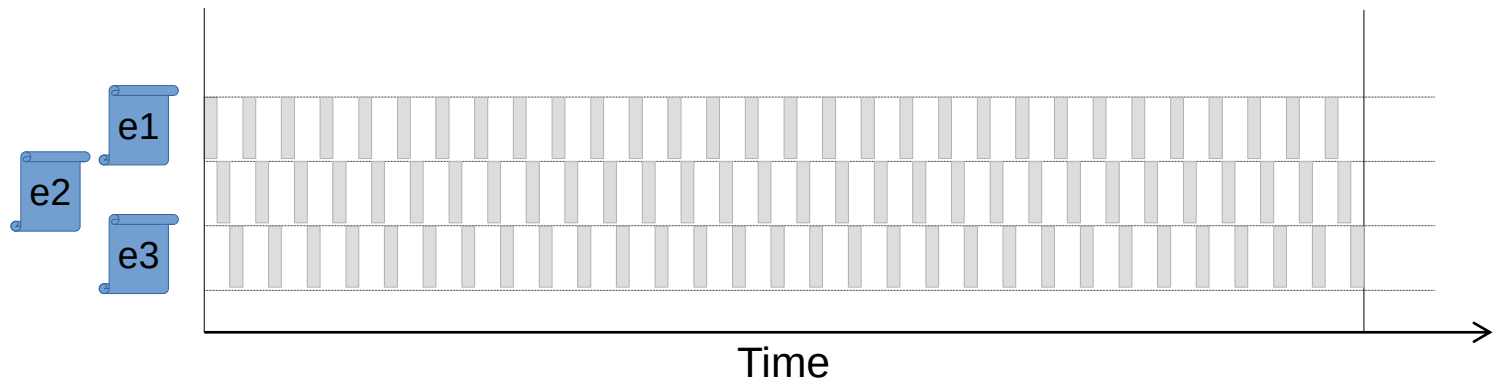
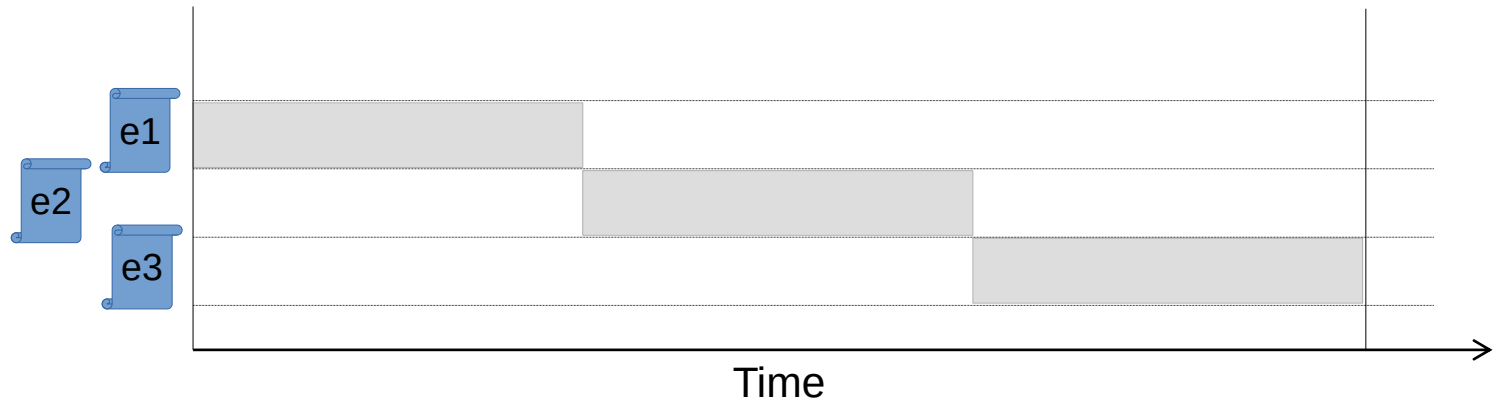
Resource Competition

- Actually:
 - Apps take turns in the CPU → “1/3 of the CPU time” for each app
 - We expect them to last each x3 time
 - ...but it takes the same time to execute the 3 apps



Resource Competition

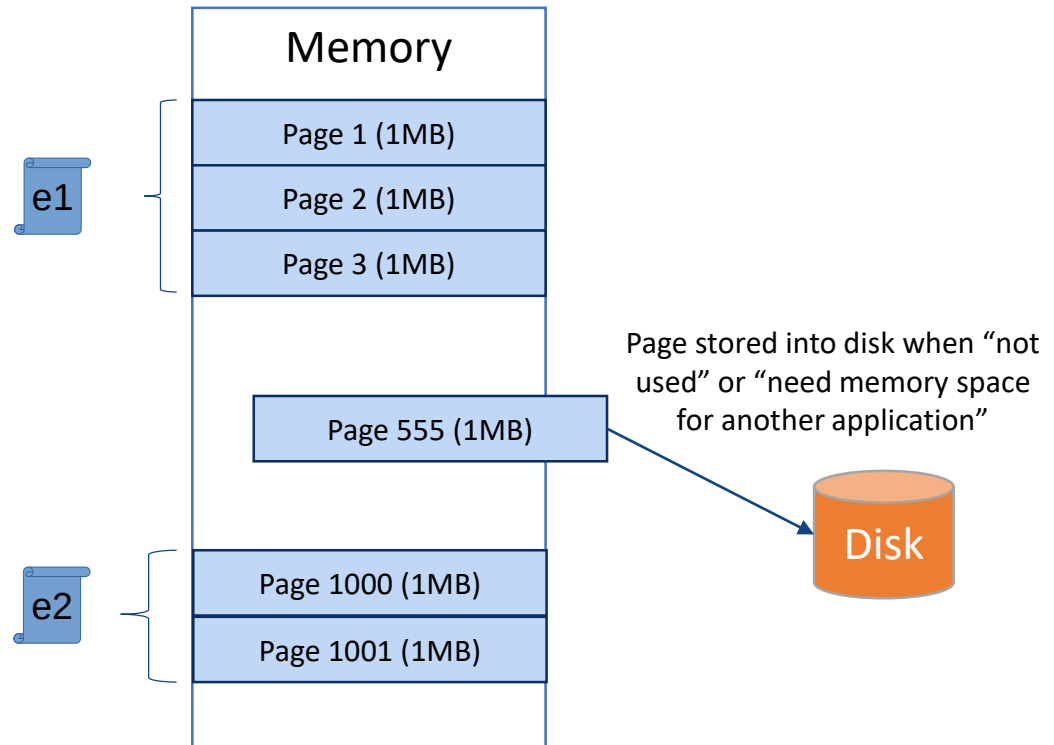
- Same time for “all finished” (ideally)



Resource Competition

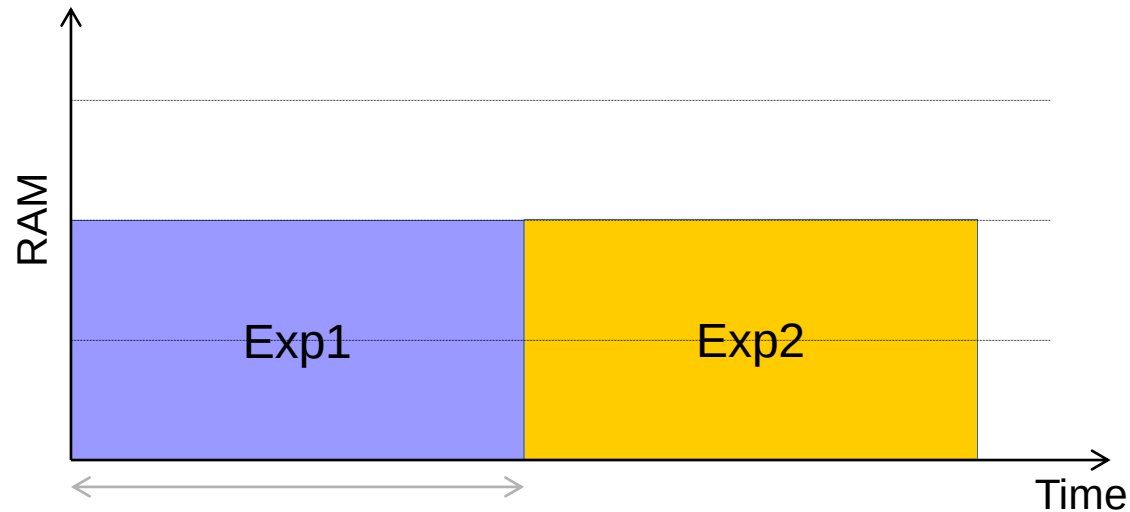
- Memory:
 - Sharing memory and “pages”

Each experiment has a dedicated space in memory



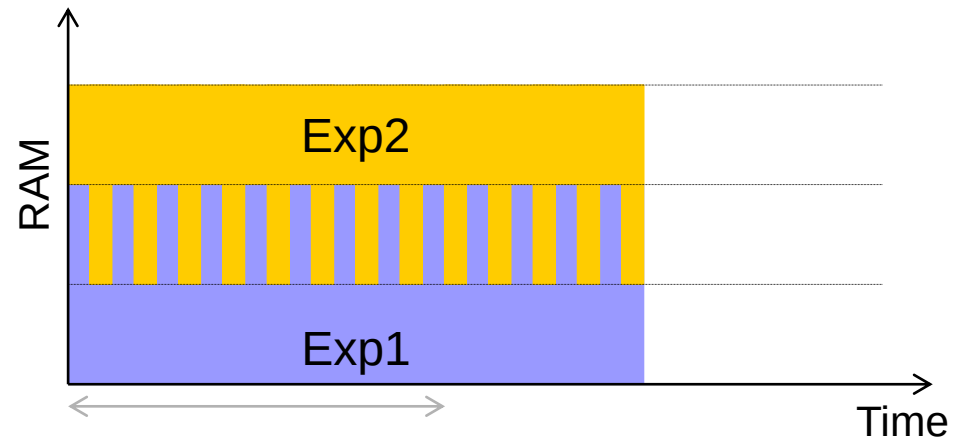
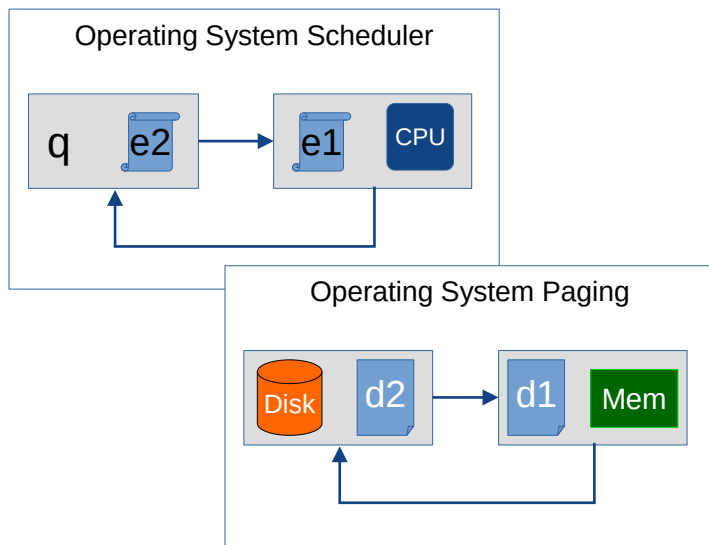
Resource Competition

- Example: 2 x (2GB) apps and 3GB of RAM
- Serialization:
 - They are executed in order. No interference



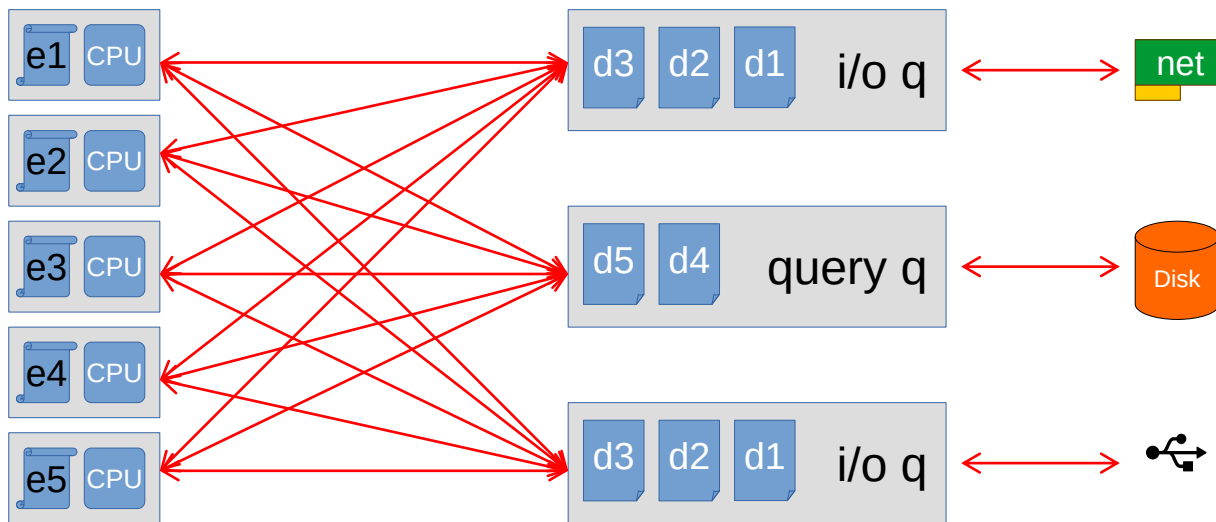
Resource Competition

- Concurrency:
 - 1GB of (shared) RAM will be constantly exchanged



Resource Competition

- Same happens with Input/output (Disk, Network, ...)



Hands-On

- Examples of resource competition
 - E.g.: Launch 1 execution, Launch $N=\text{CPUs}$ executions, Launch $N>\text{CPUs}$ executions, with a HTOP and TIME

Summary

- Basic theory about “Performance” and “Resource Competition”
- We need resources to run experiments/programs/etc...
 - Each experiment has requirements
 - Each system has limited resources
 - Overused resources cause competition (and slow-down)
- We must plan ahead which experiments to run and when

Closing

- Bye!