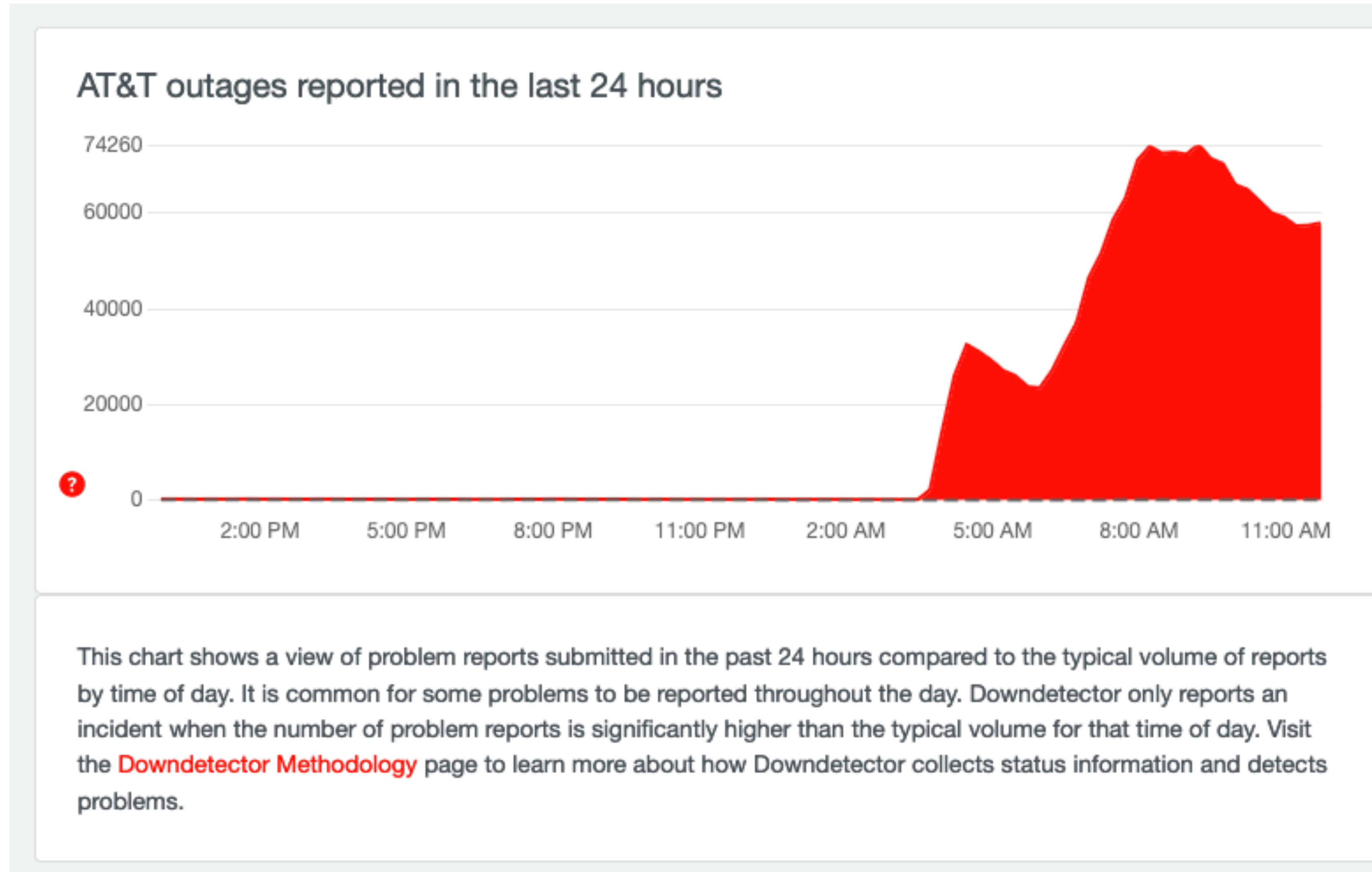


6.1800 Spring 2024

Lecture #7: Performance + Other Concerns

performance, with a deep dive into storage and filesystems

6.1800 in the news



6.1800 in the news



Thank you for reaching us. We understand how important it is to enjoy the most of our services. I would like to thank you for your patience while our systems are undergoing planned maintenance/being optimized for performance.

^DanielG

7:57 AM · Feb 22, 2024 · 2,777 Views

6.1800 in the news



AT&T Help 
@ATTHelp



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Network Update



Last updated February 22, 2024, 6:46 p.m. CT

Based on our initial review, we believe that today's outage was caused by the application and execution of an incorrect process used as we were expanding our network, not a cyber attack. We are continuing our assessment of today's outage to ensure we keep delivering the service that our customers deserve.

6.1800 in the news



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sometimes
performance issues are
a result of **human error**

6.1800 in the news



Mass State Police 
@MassStatePolice



Many 911 centers in the state are getting flooded w/ calls from people trying to see if 911 works from their cell phone. Please do not do this. If you can successfully place a non-emergency call to another number via your cell service then your 911 service will also work. [#outage](#)

9:08 AM · Feb 22, 2024 · **224.1K** Views

6.1800 in the news



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9:08 AM · Feb 22, 2024 · **224.1K** Views

failures in one system can impact people who don't use that service at all

operating systems enforce modularity on a single machine using **virtualization**

in order to enforce modularity + have an effective operating system, a few things need to happen

1. programs shouldn't be able to refer to (and corrupt) each others' **memory**→ **virtual memory**
2. programs should be able to **communicate** with each other→ **bounded buffers**
(virtualize communication links)
3. programs should be able to **share a CPU** without one program halting the progress of the others→ **threads**
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you've also seen virtualization as a technique for running multiple operating systems on the same physical hardware

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today: performance more generally, with a focus on storage, and how the abstractions that an operating system provides impact our systems

performance issues have influenced a lot of the system designs you've seen so far

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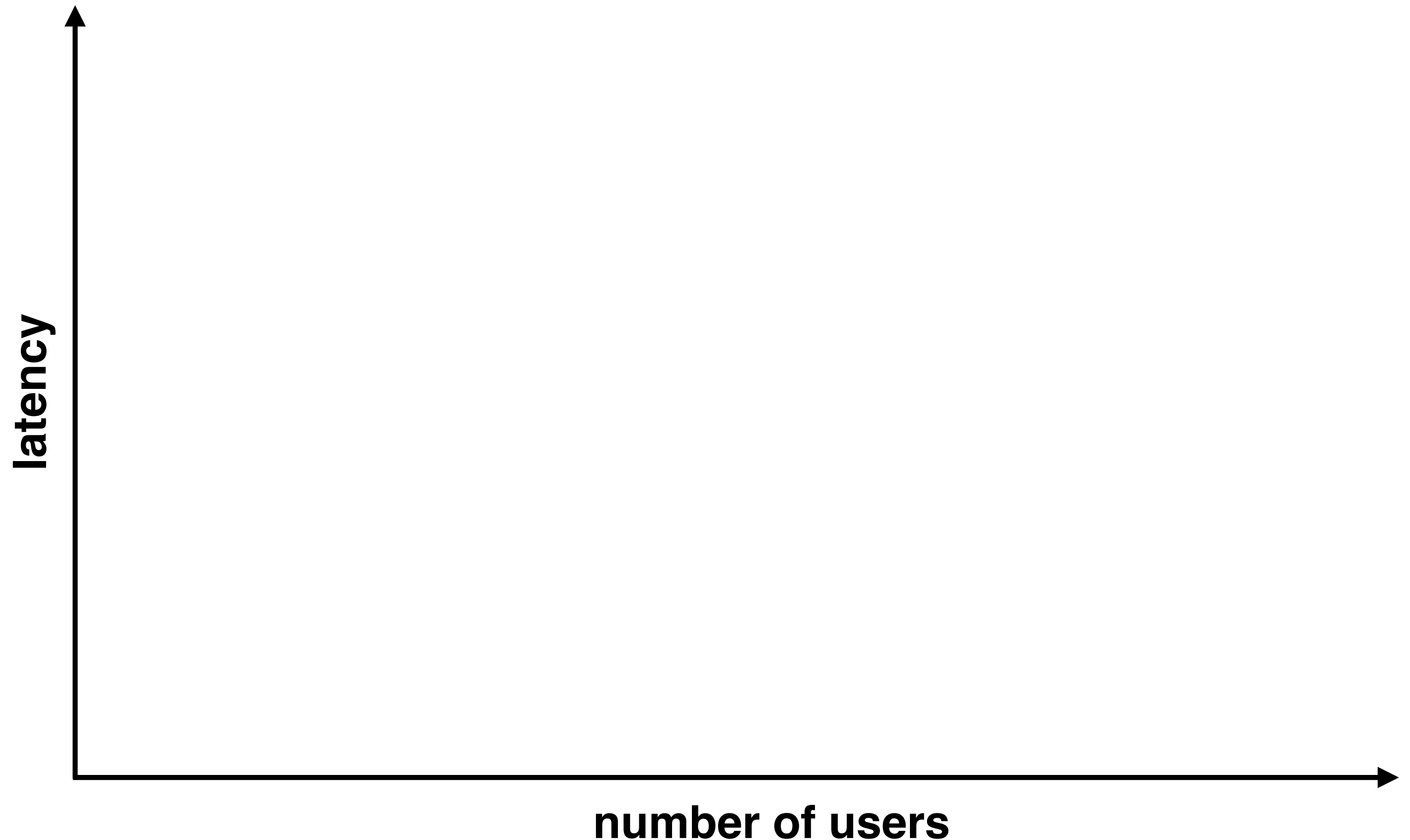
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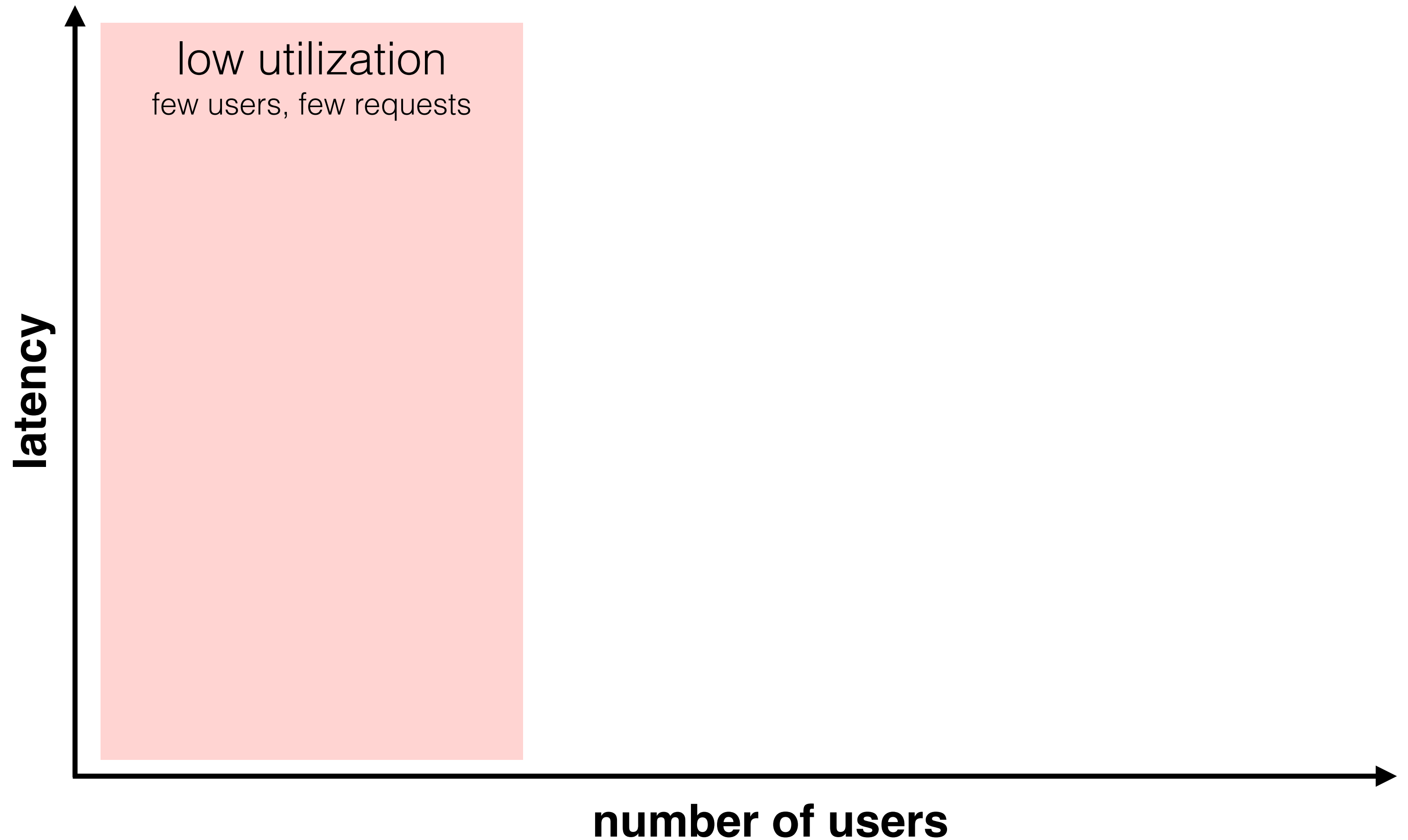
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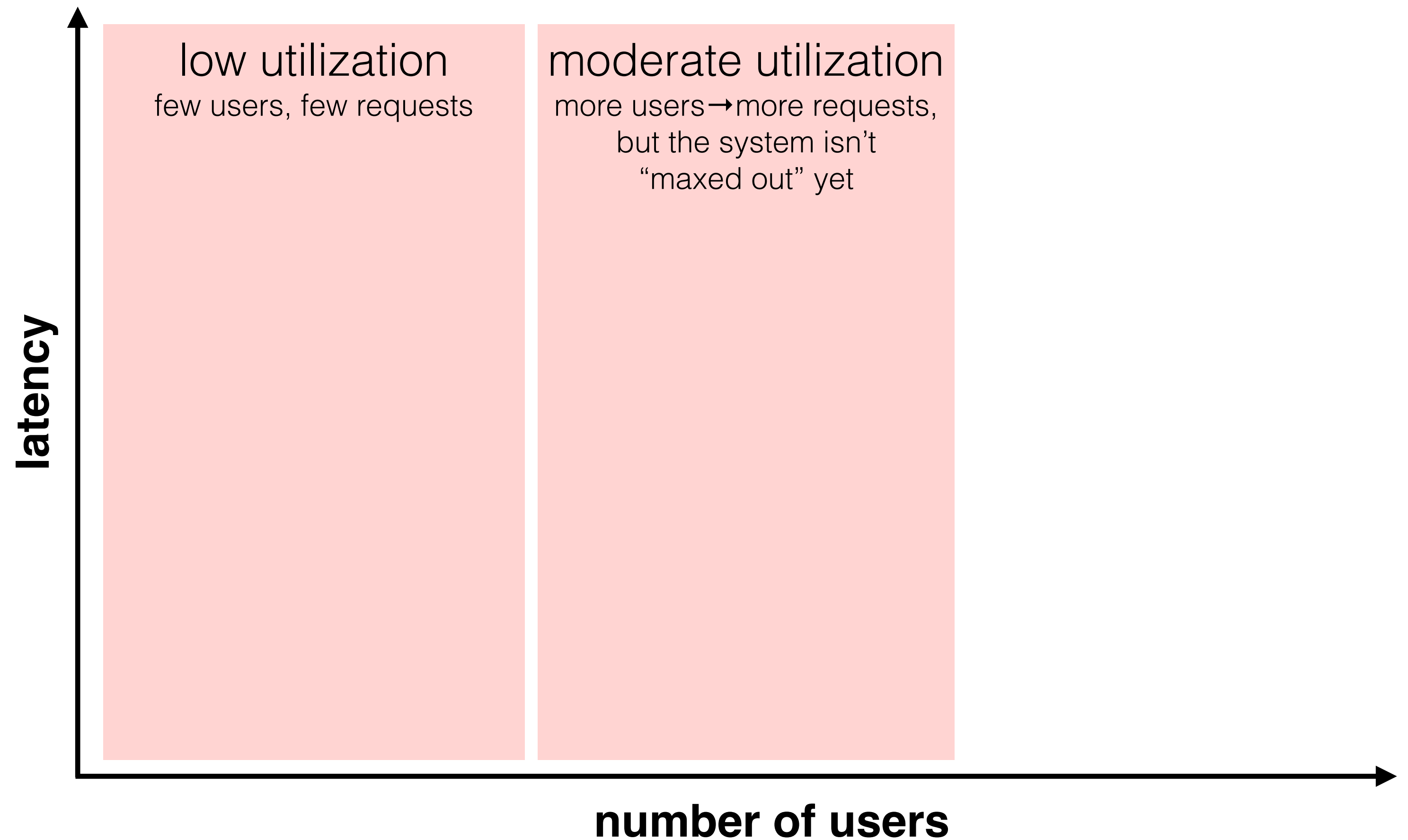
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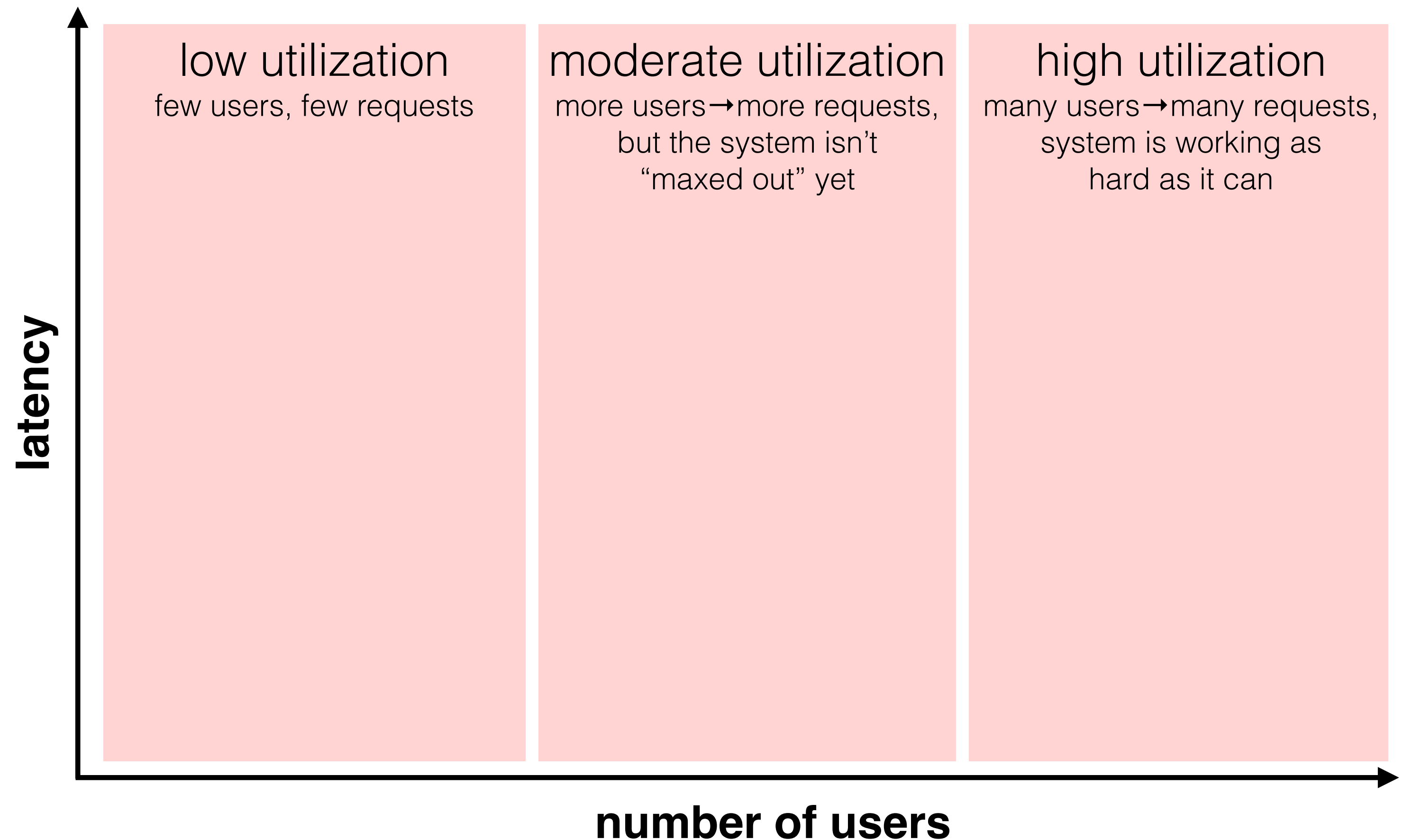
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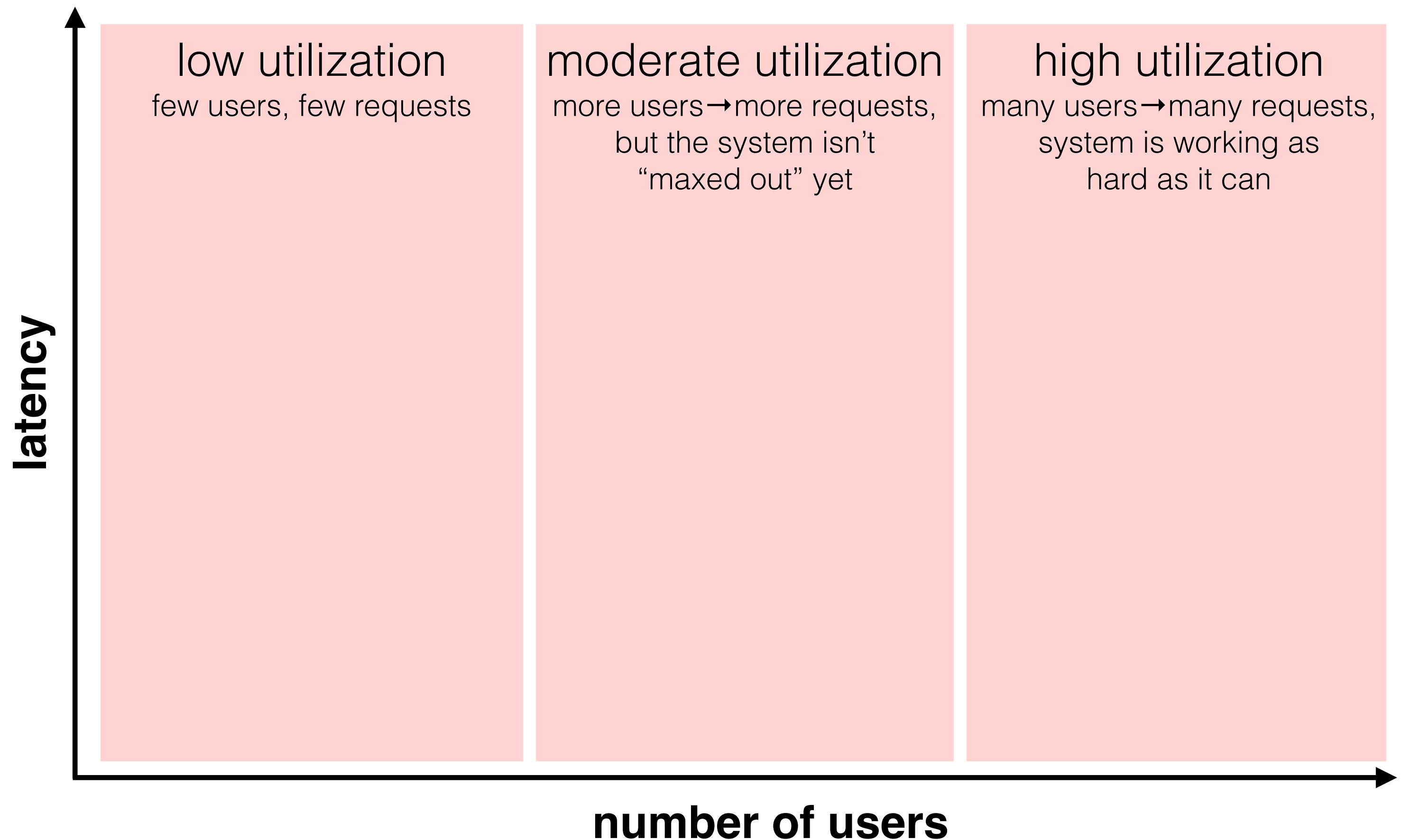
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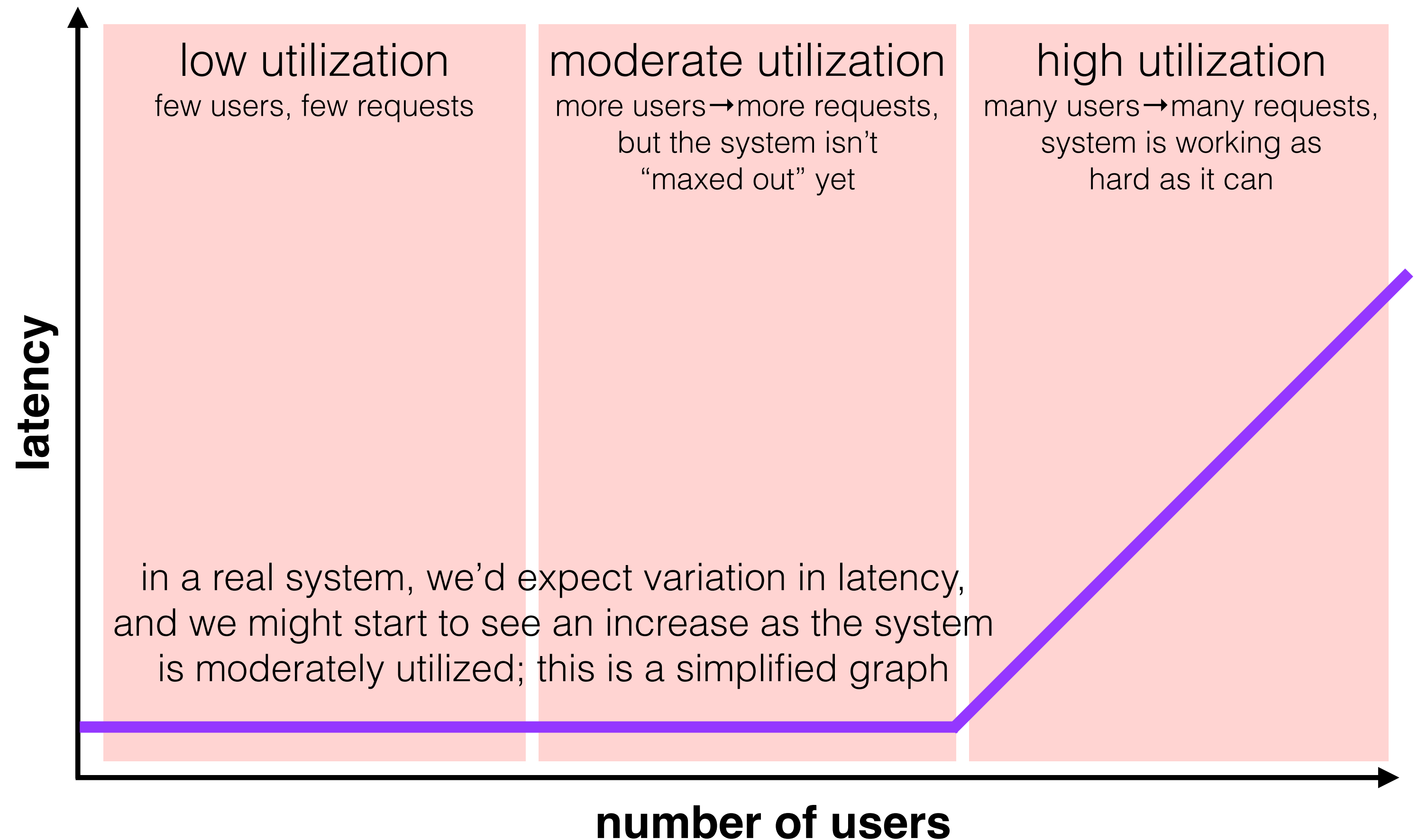
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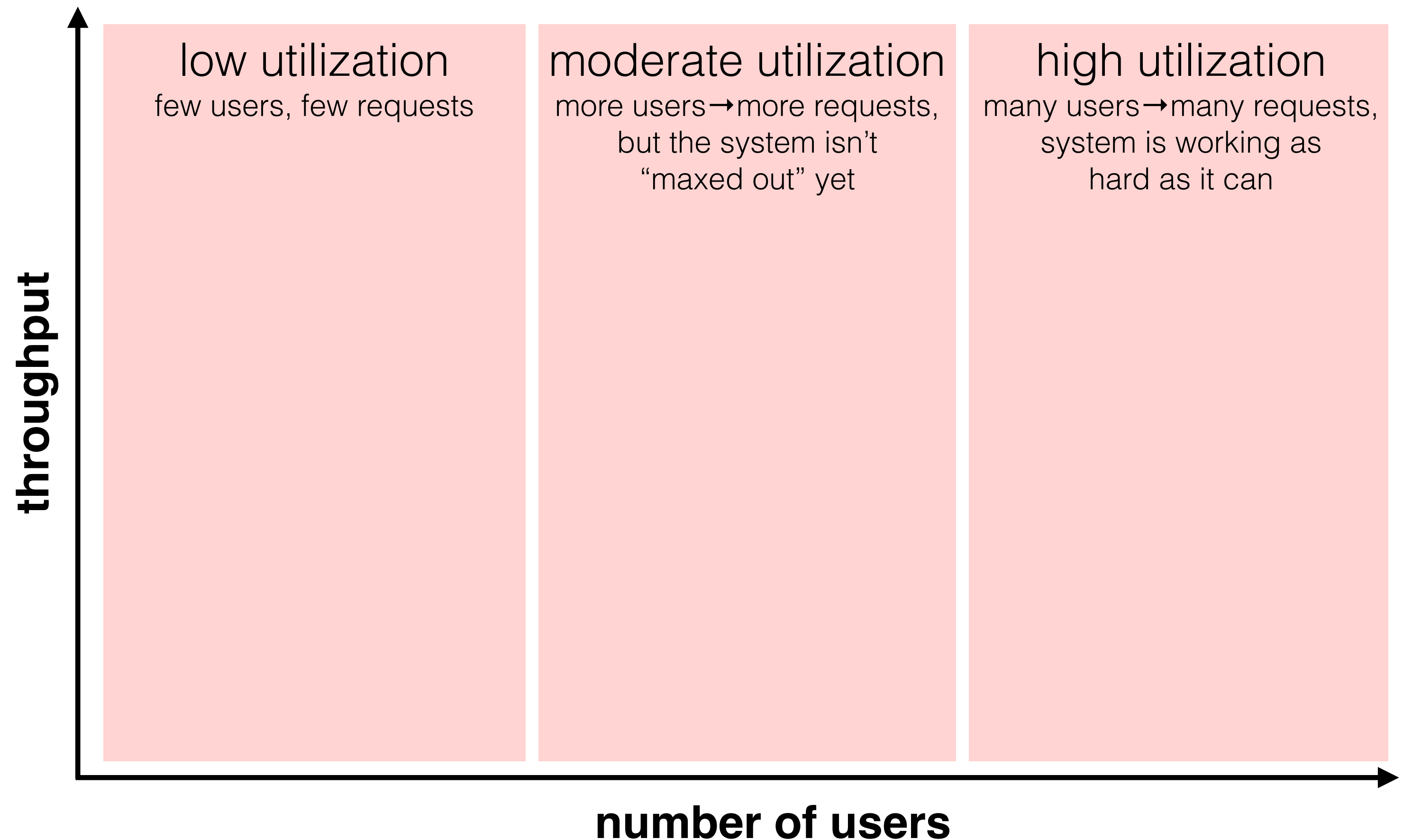
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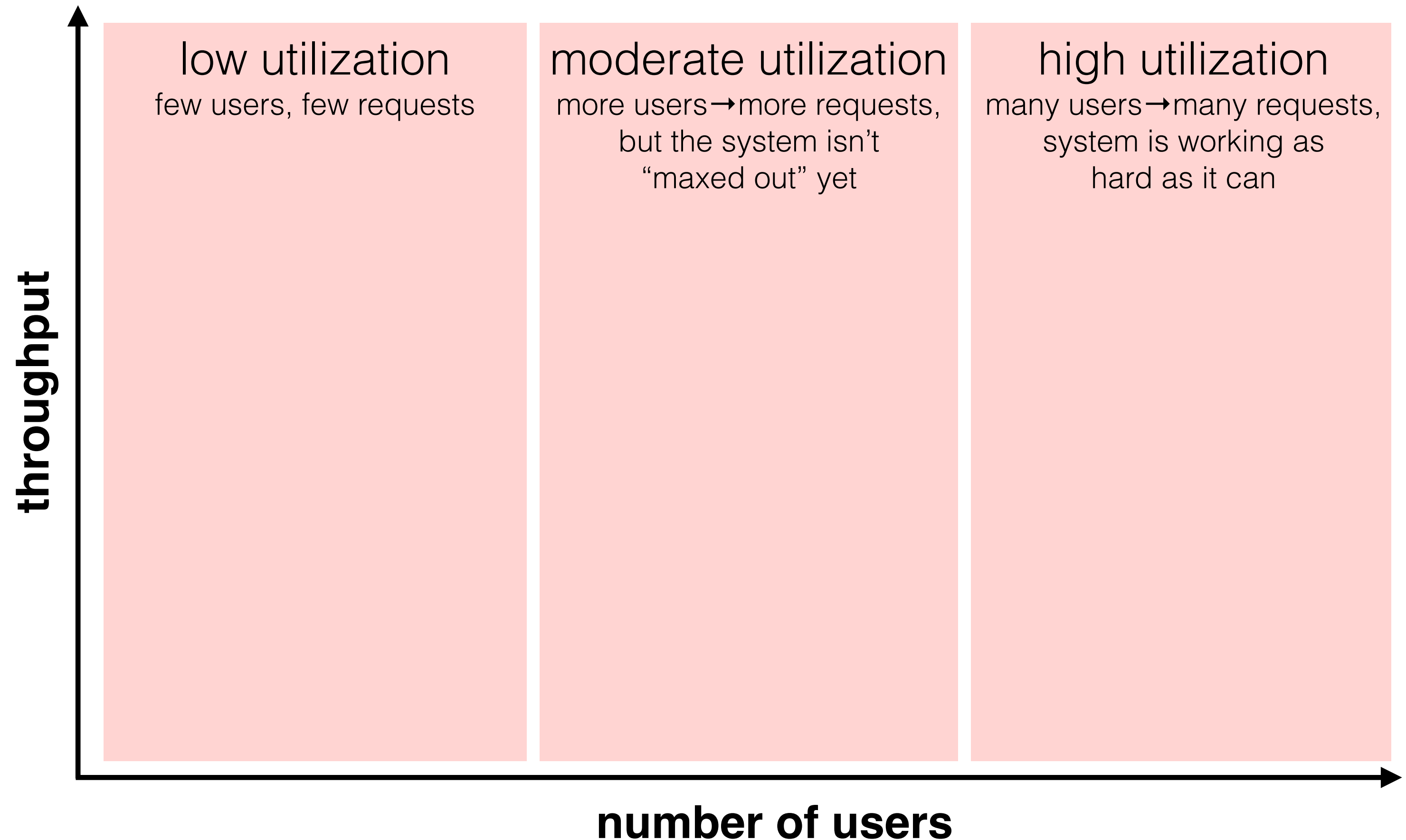
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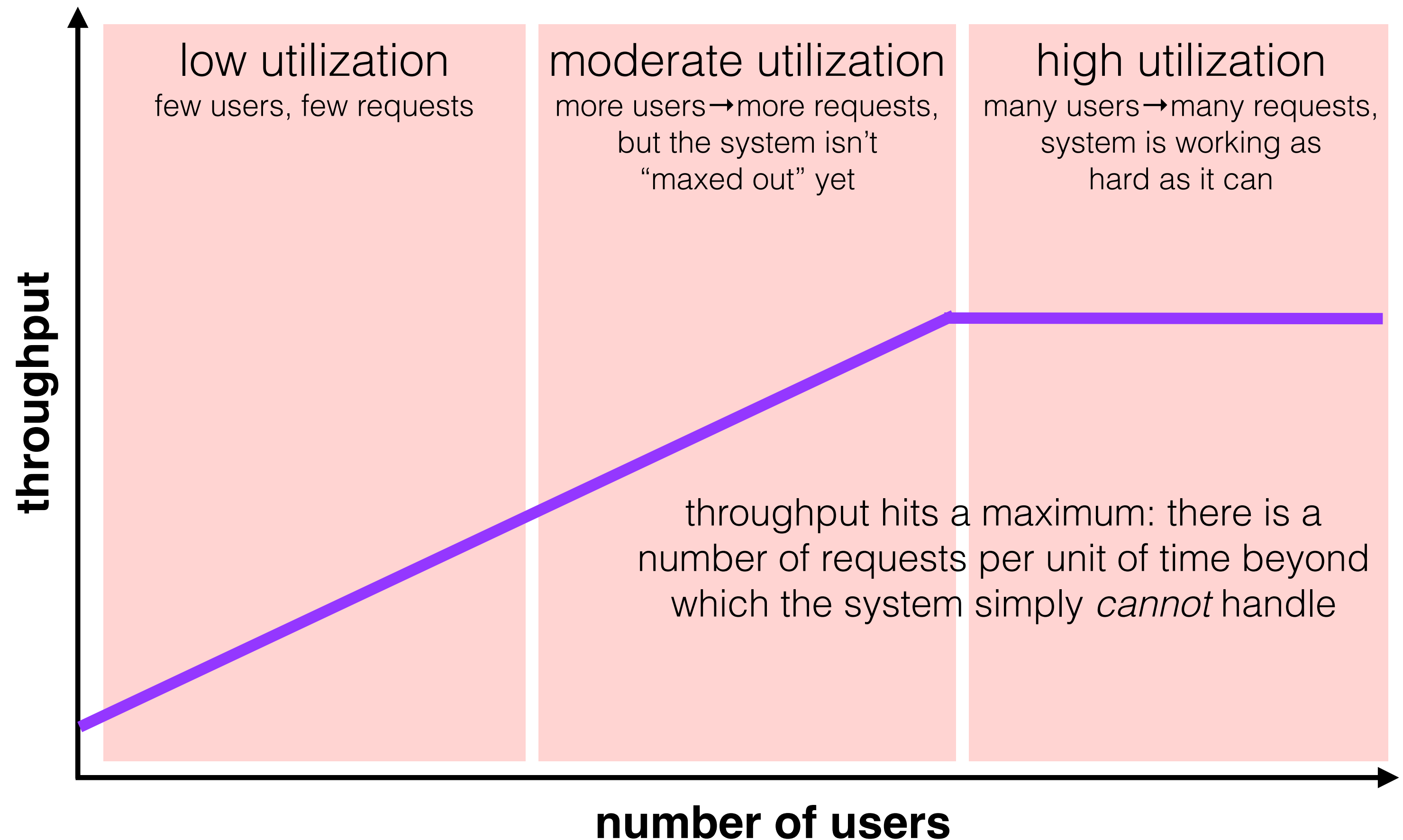
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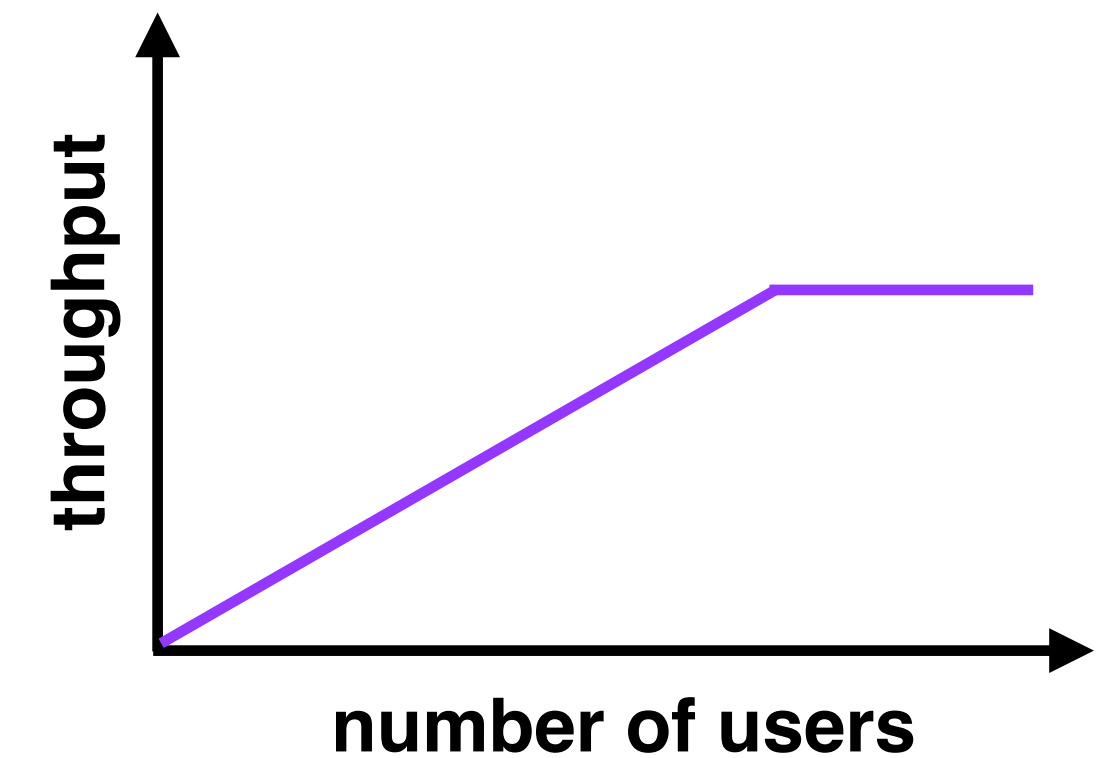
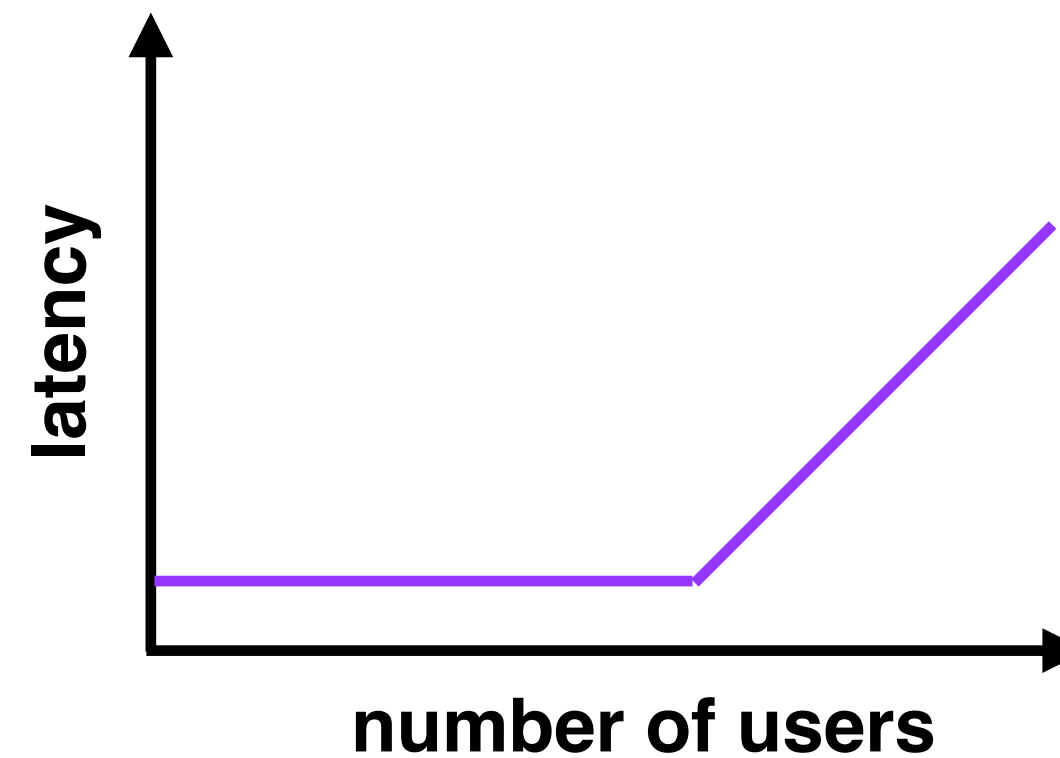
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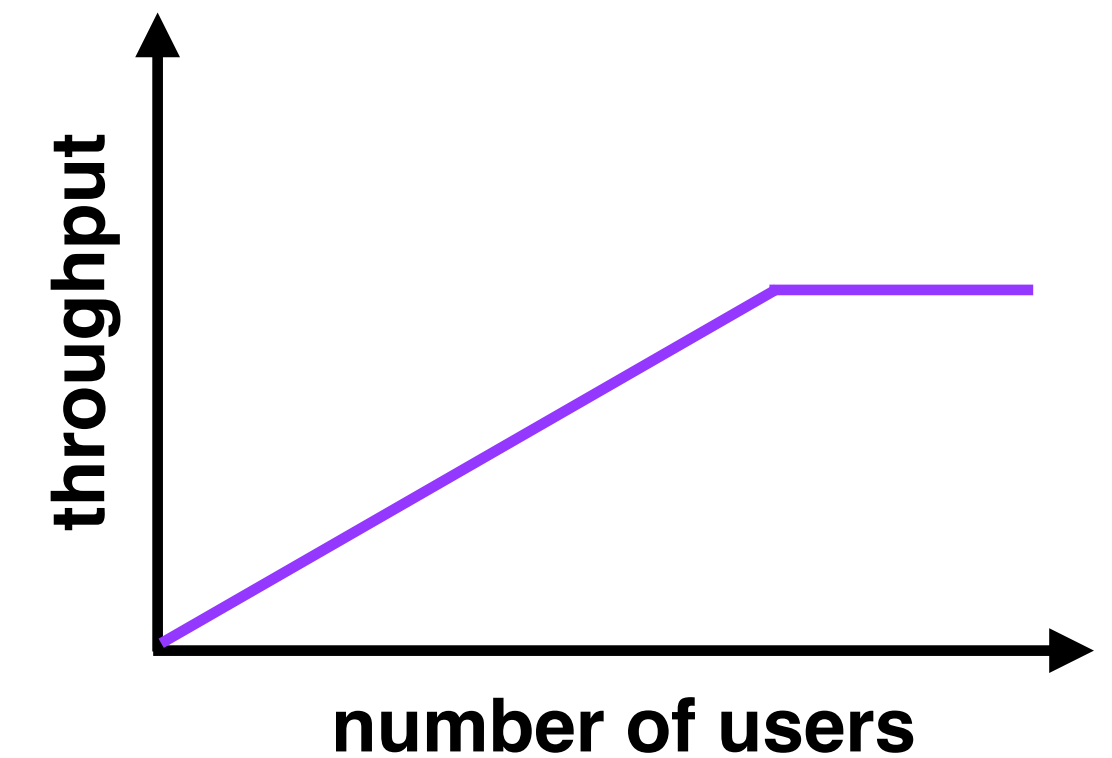
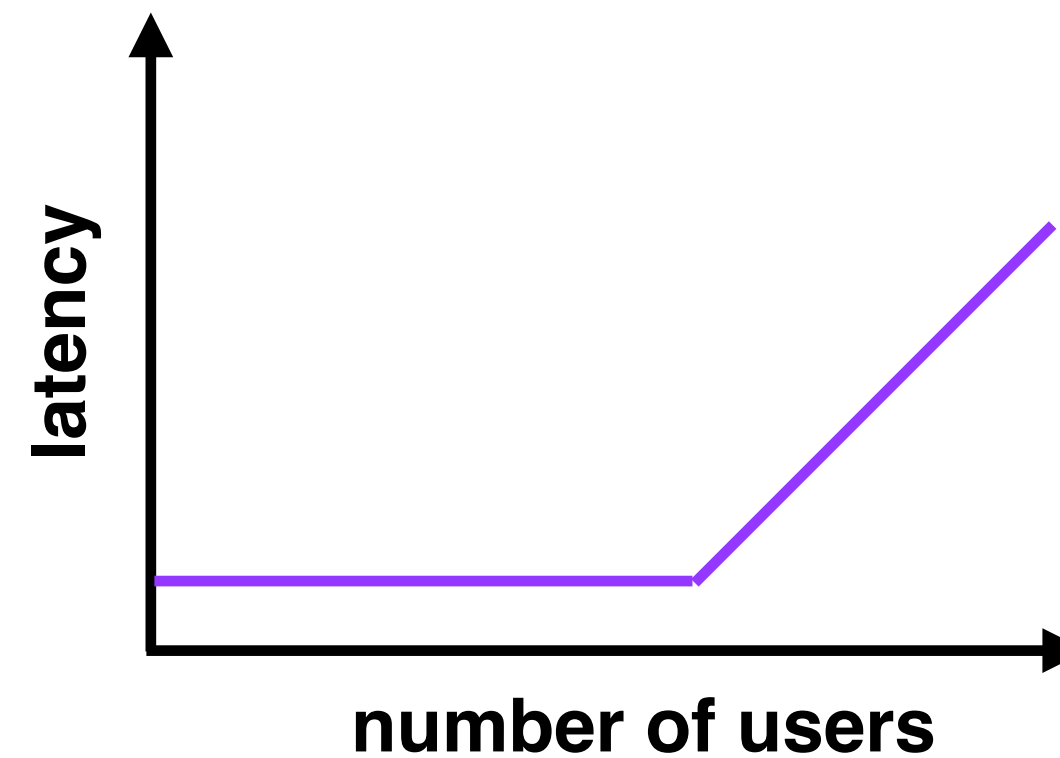
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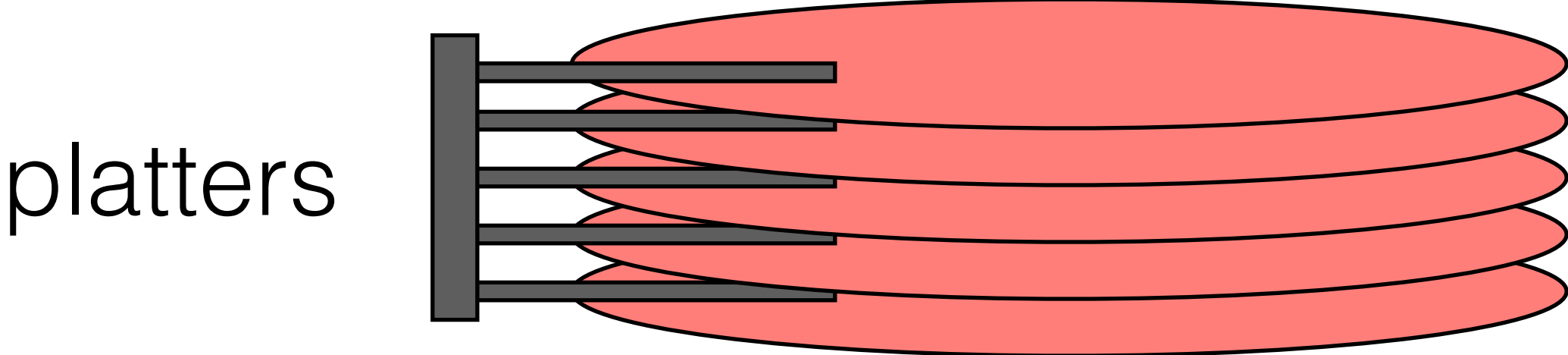
our general approach to improving performance is to measure our systems to find a **bottleneck**, and then to relax the bottleneck with general techniques such as caching, parallelism, etc.

we'll make this concrete with an example: performance in reading/writing to a file

utilization: what fraction of resources are being utilized? this puts our performance measurements in context

the **disk** is often the main bottleneck in reading/writing stored data

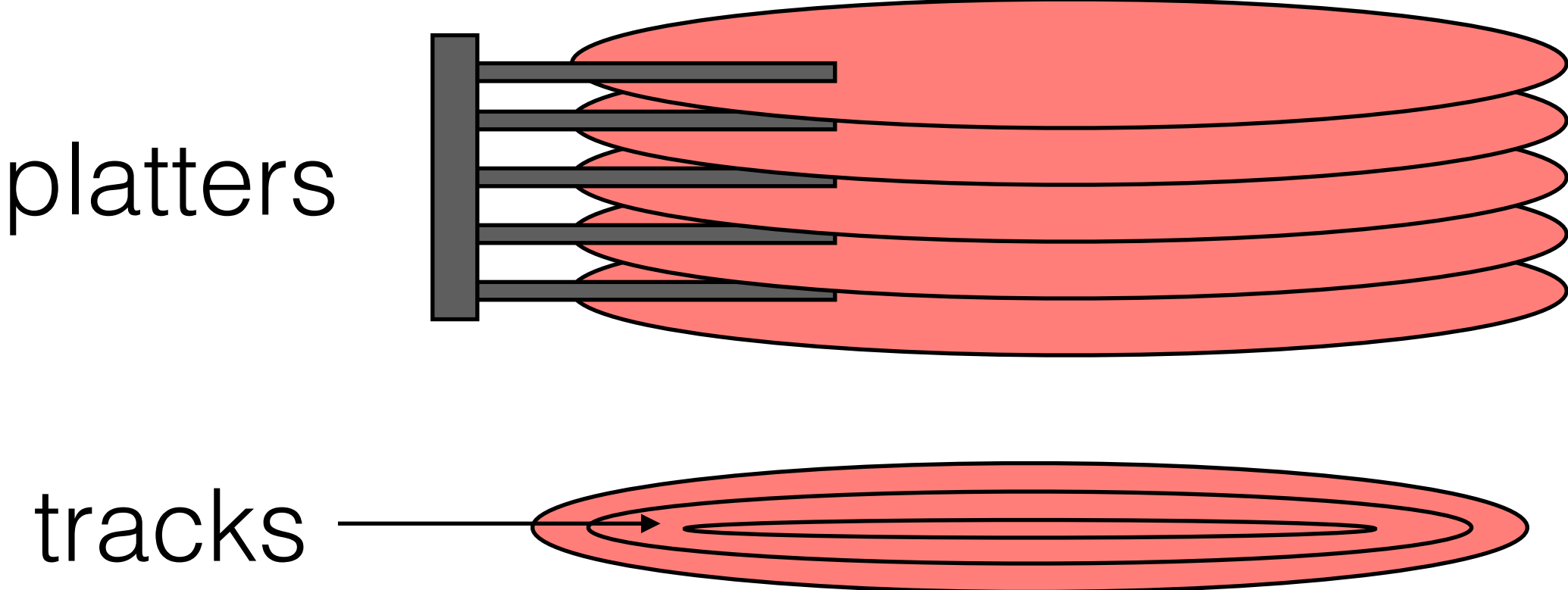
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hard disk drives (HDDs)

common in datacenters

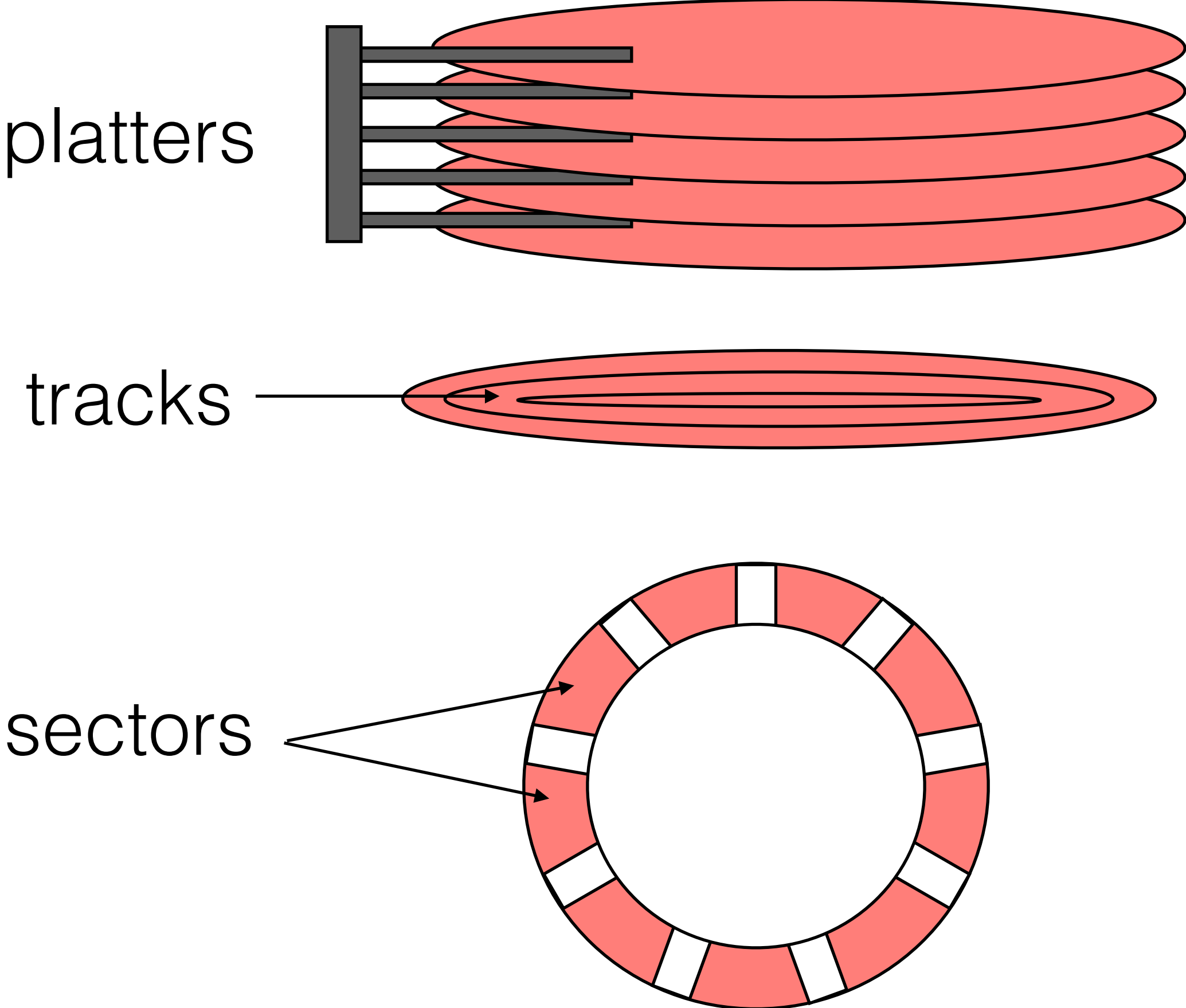
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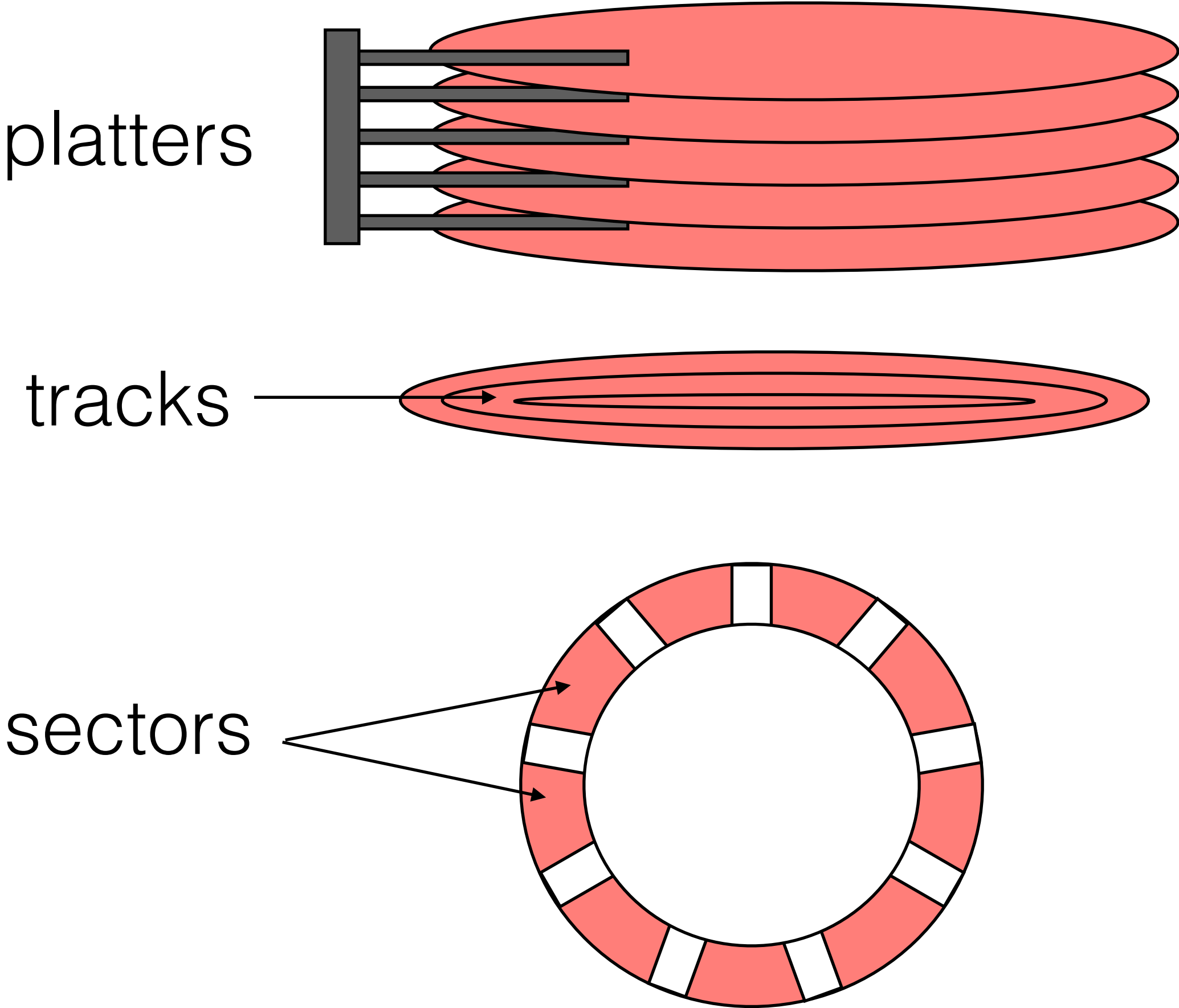
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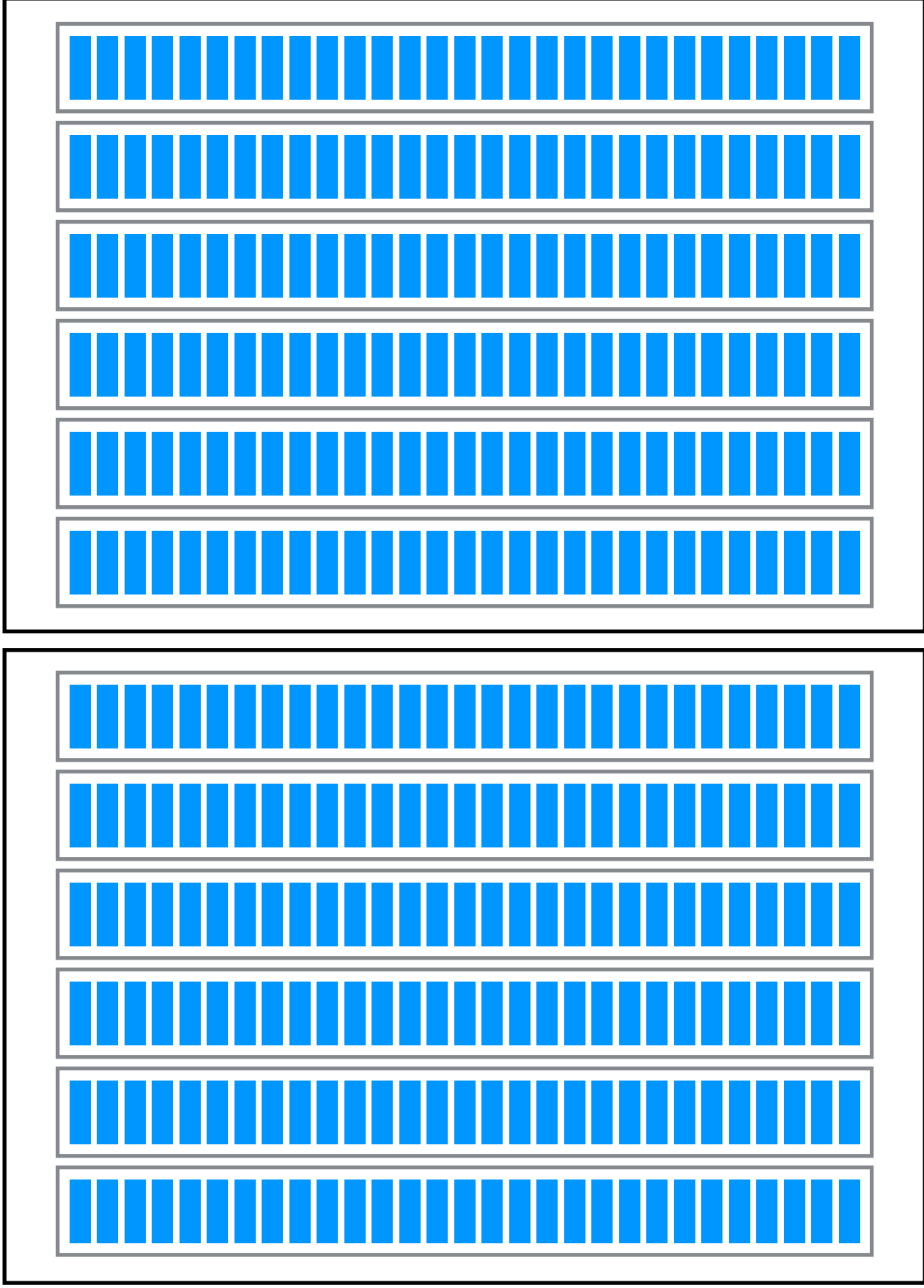
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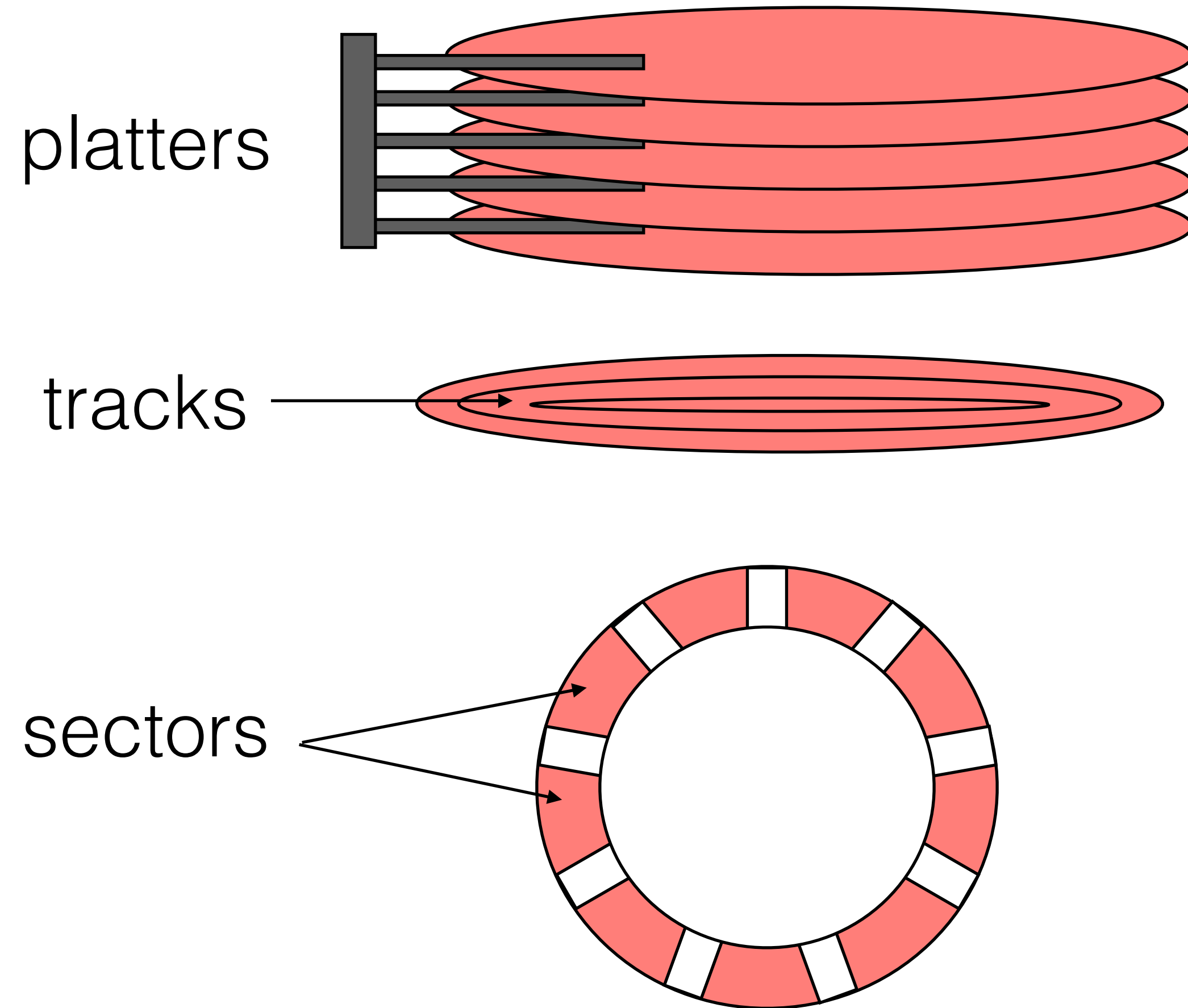


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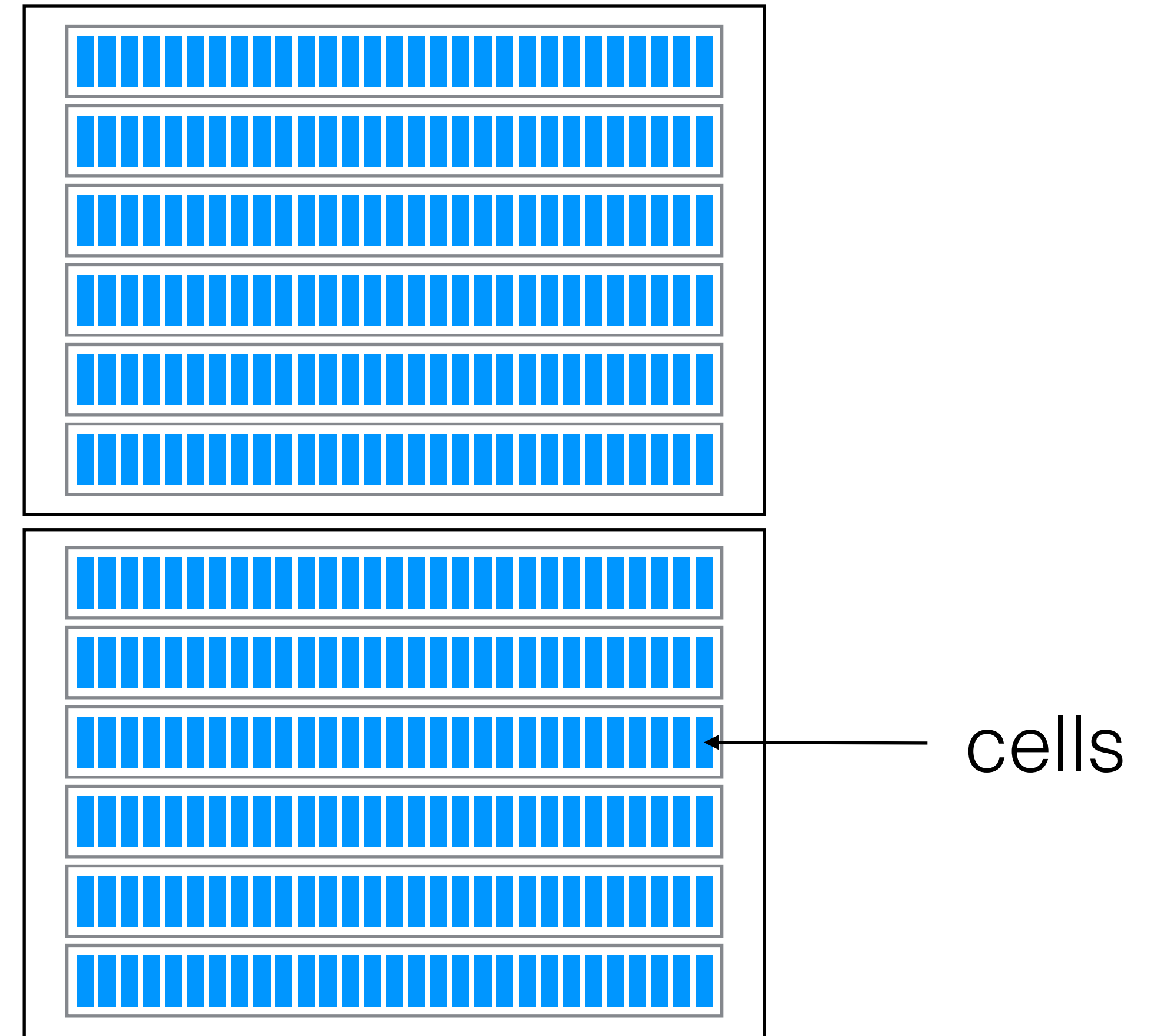
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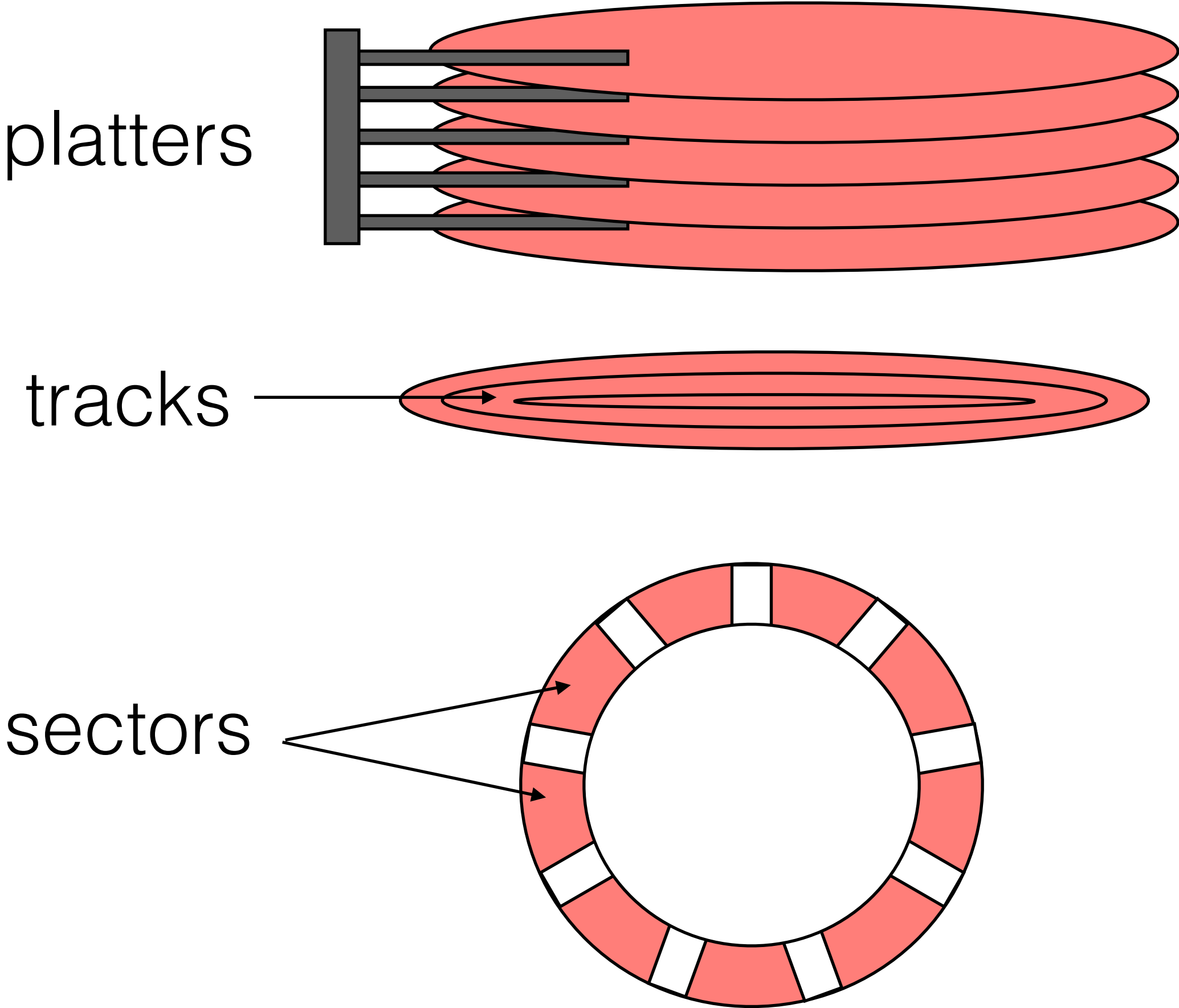
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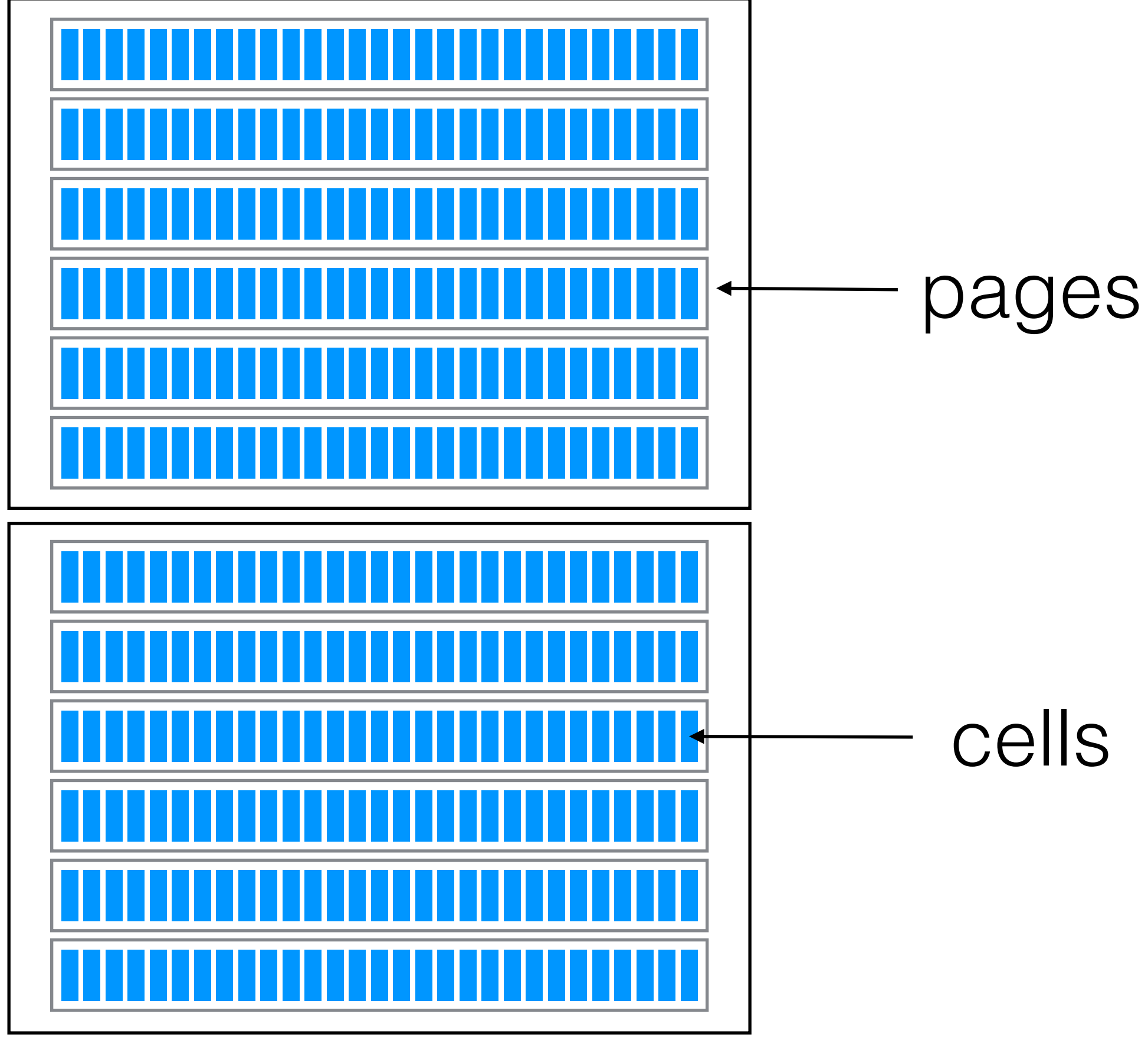
platters

tracks

sectors

hard disk drives (HDDs)

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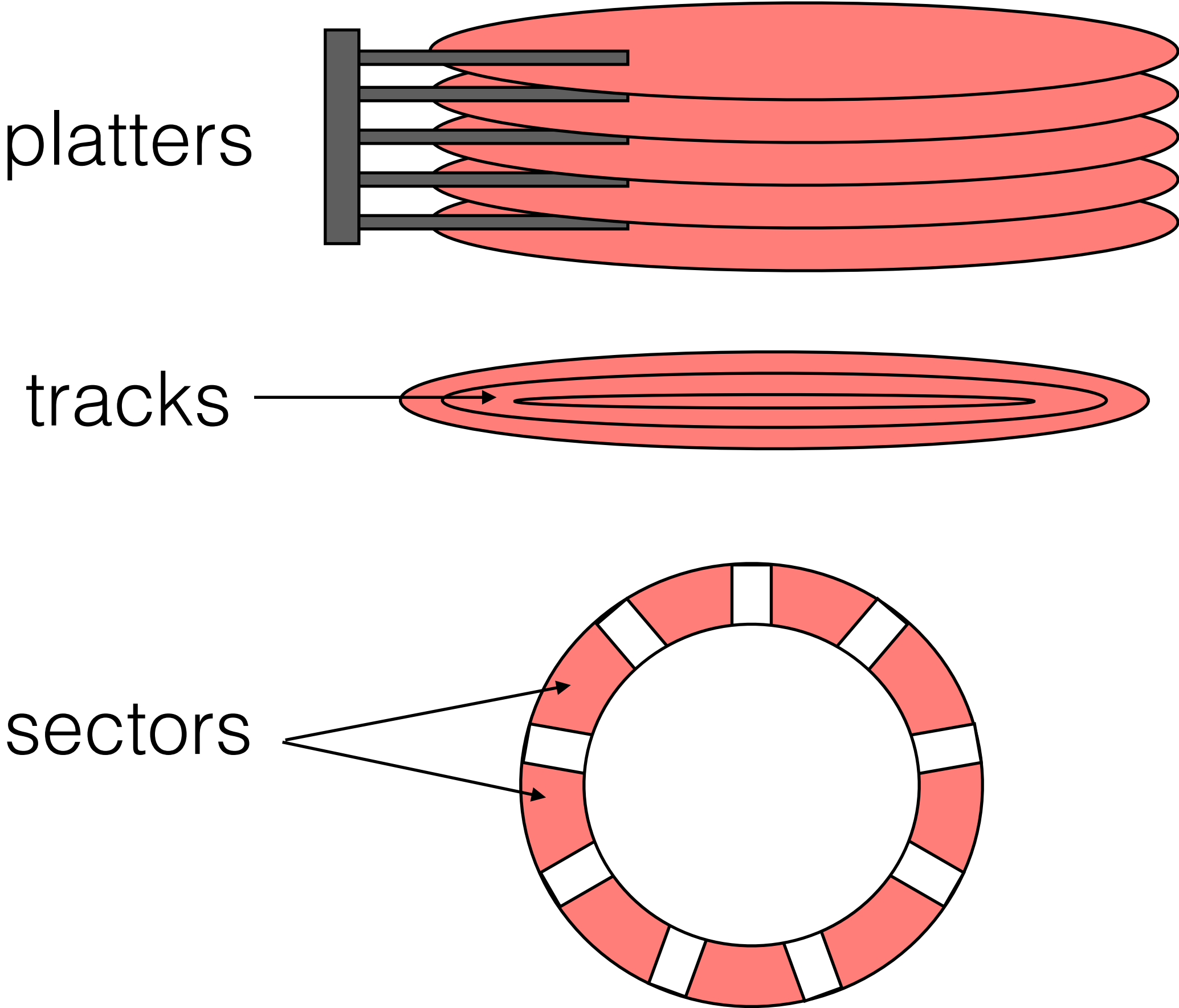
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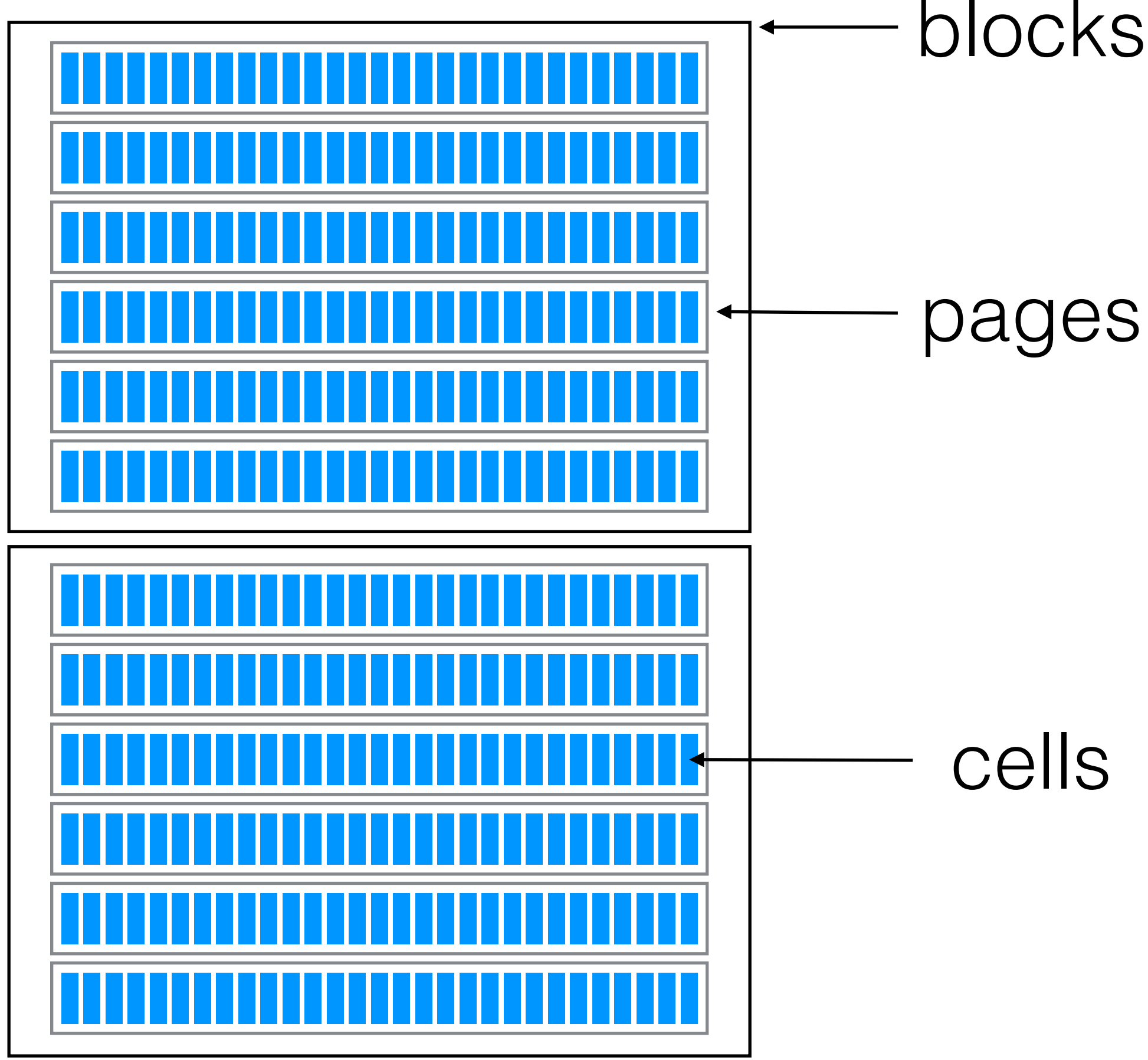
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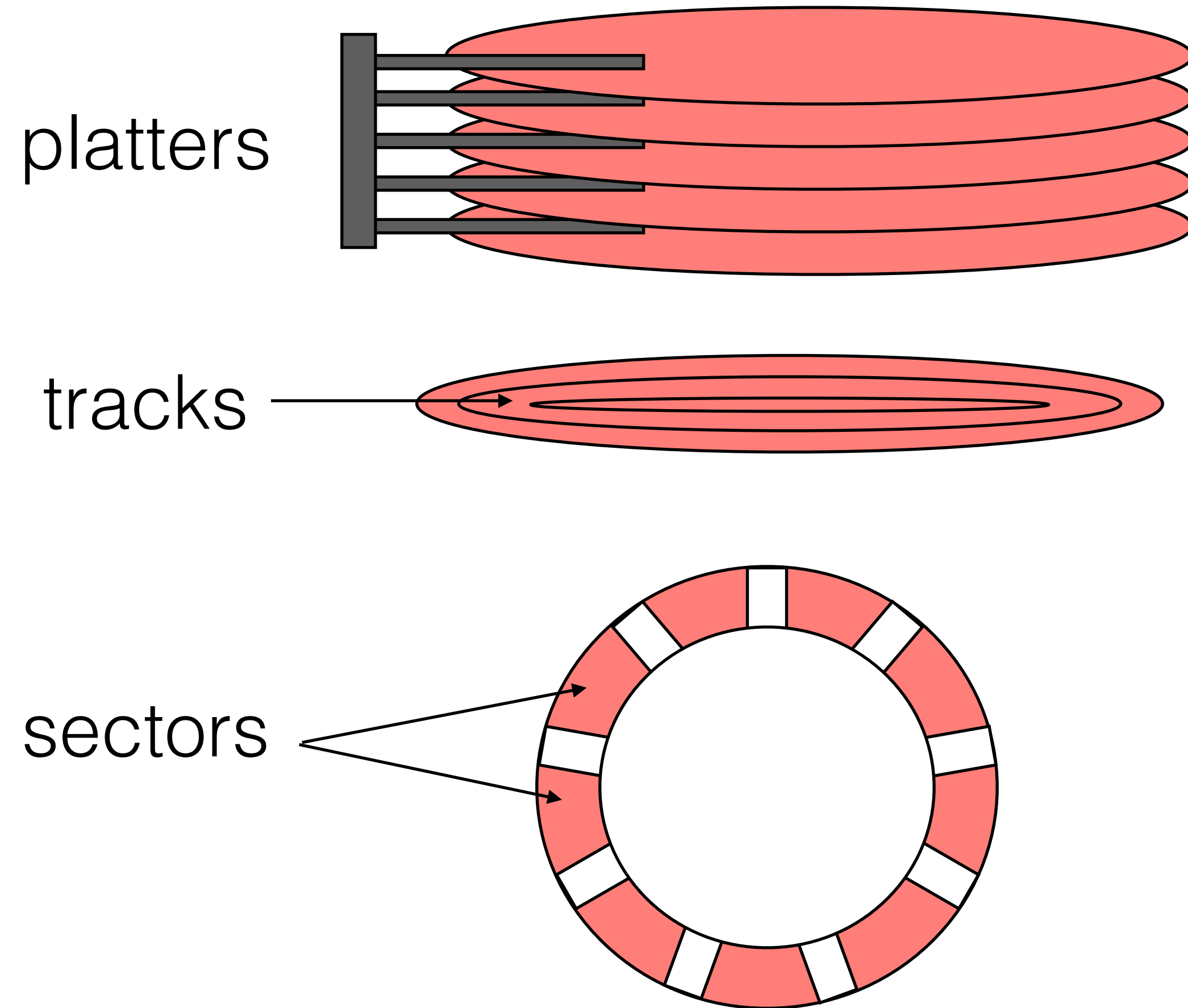
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example HDD specs (Hitachi 7K400)

capacity: 400GB

number of platters: 5

number of heads: 10

number of sectors per track: 567-1170

number of bytes per sector: 512

time for one revolution: 8.3ms

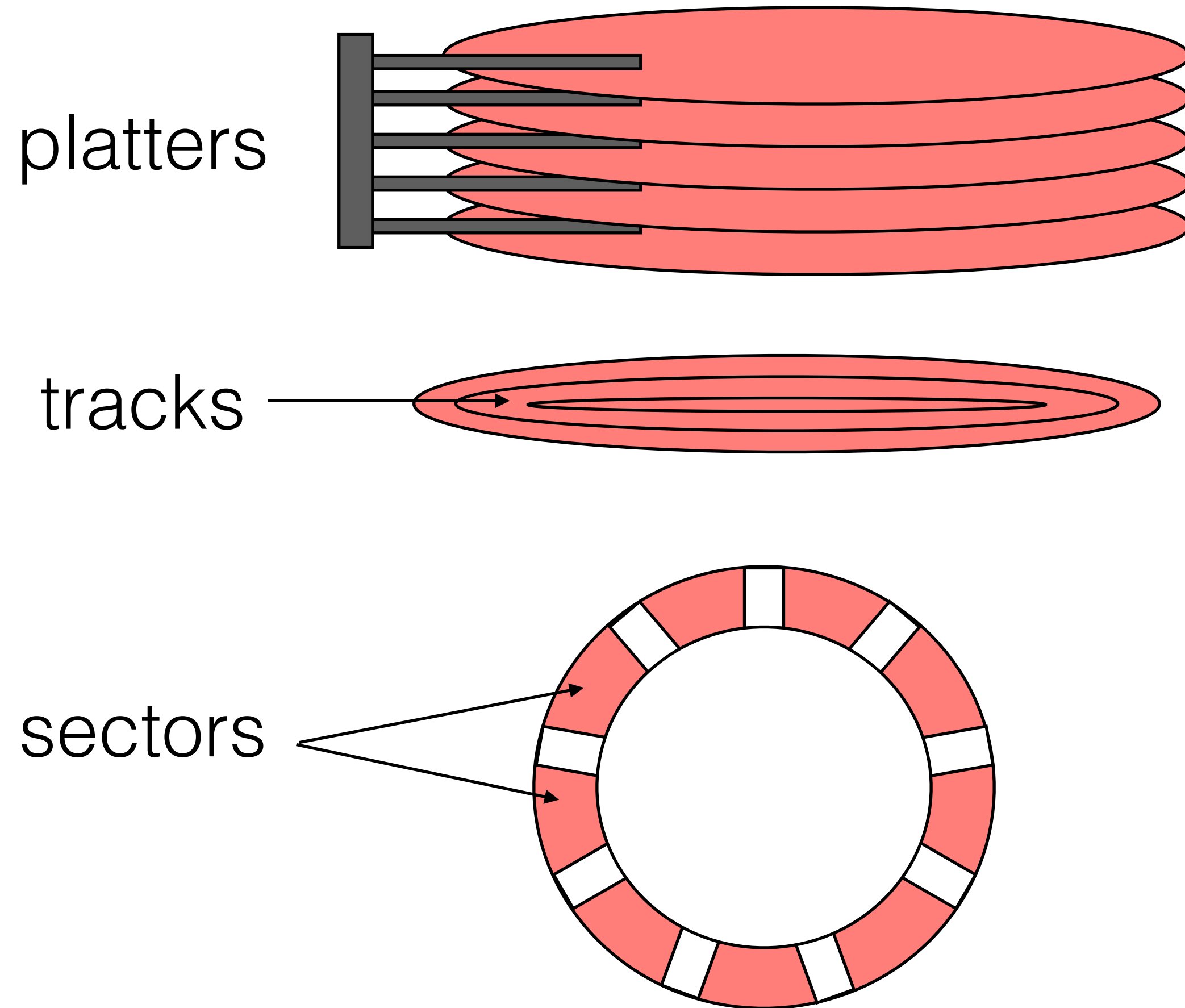
average read seek time: 8.2ms

average write seek time: 9.2ms

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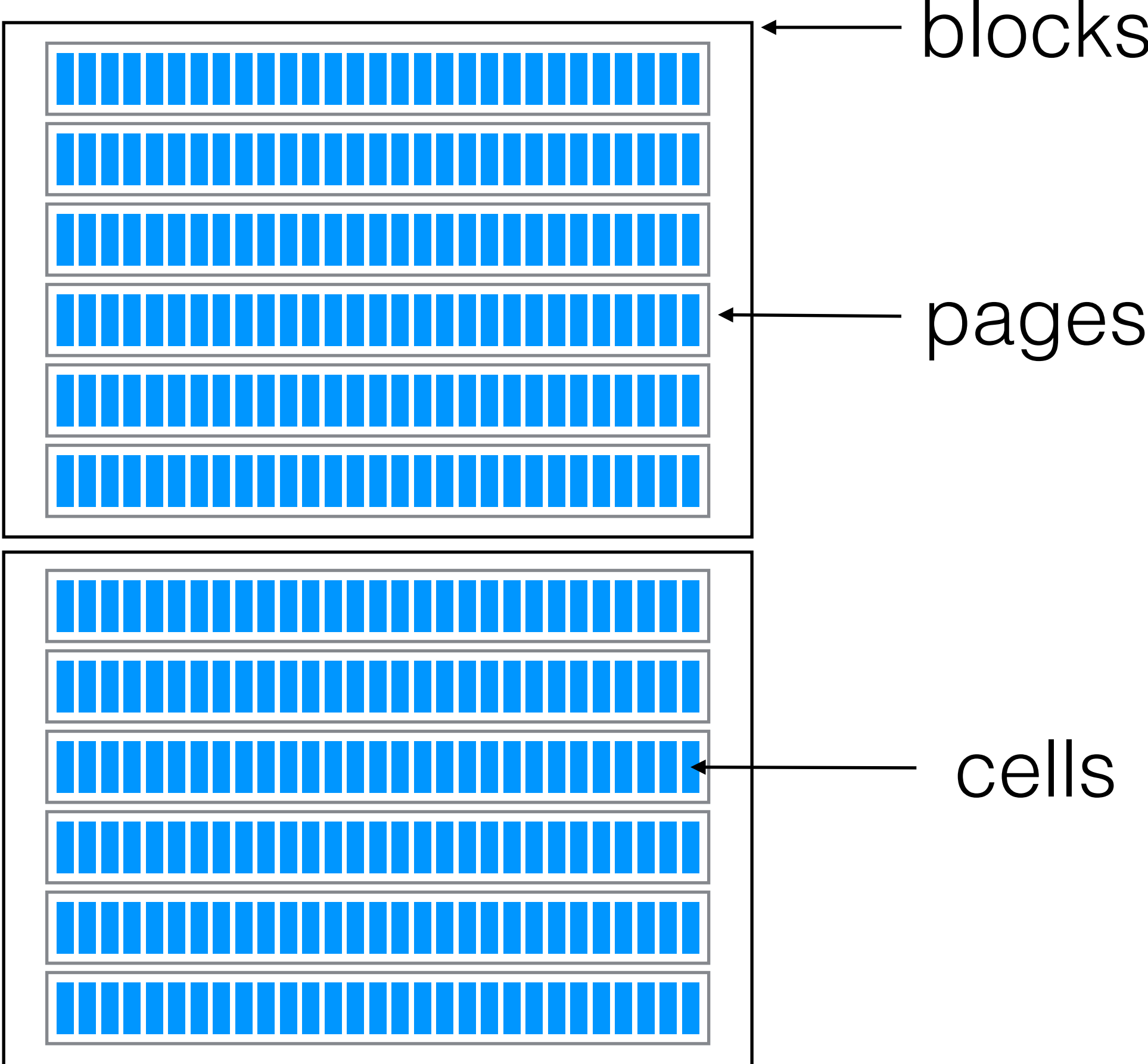
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since so much time of reading/writing is spent seeking, avoiding random access can improve performance

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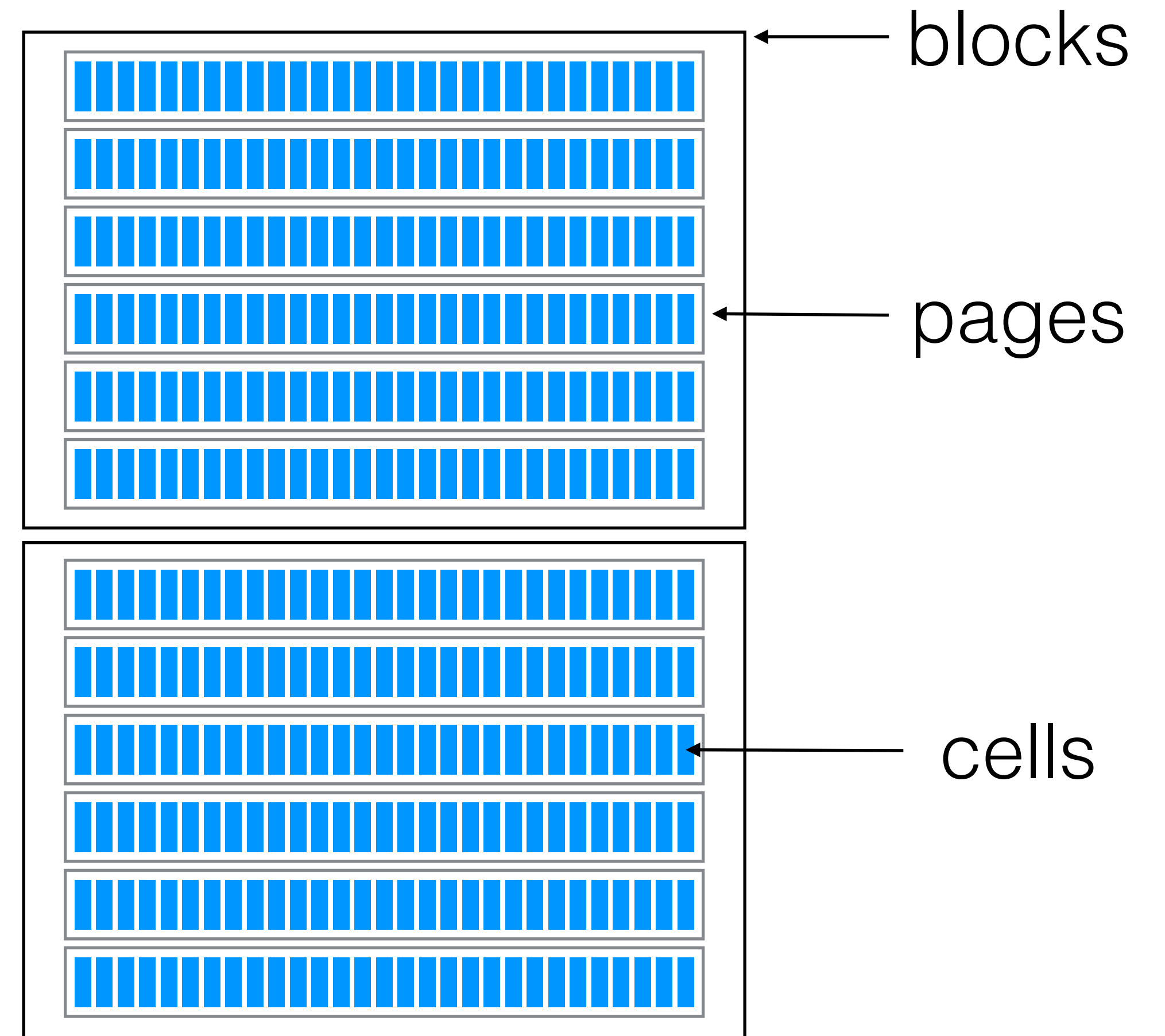
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since SSDs don't involve moving parts, disk seeks are not a concern (this is one of the reasons SSDs are so much faster than HDDs)

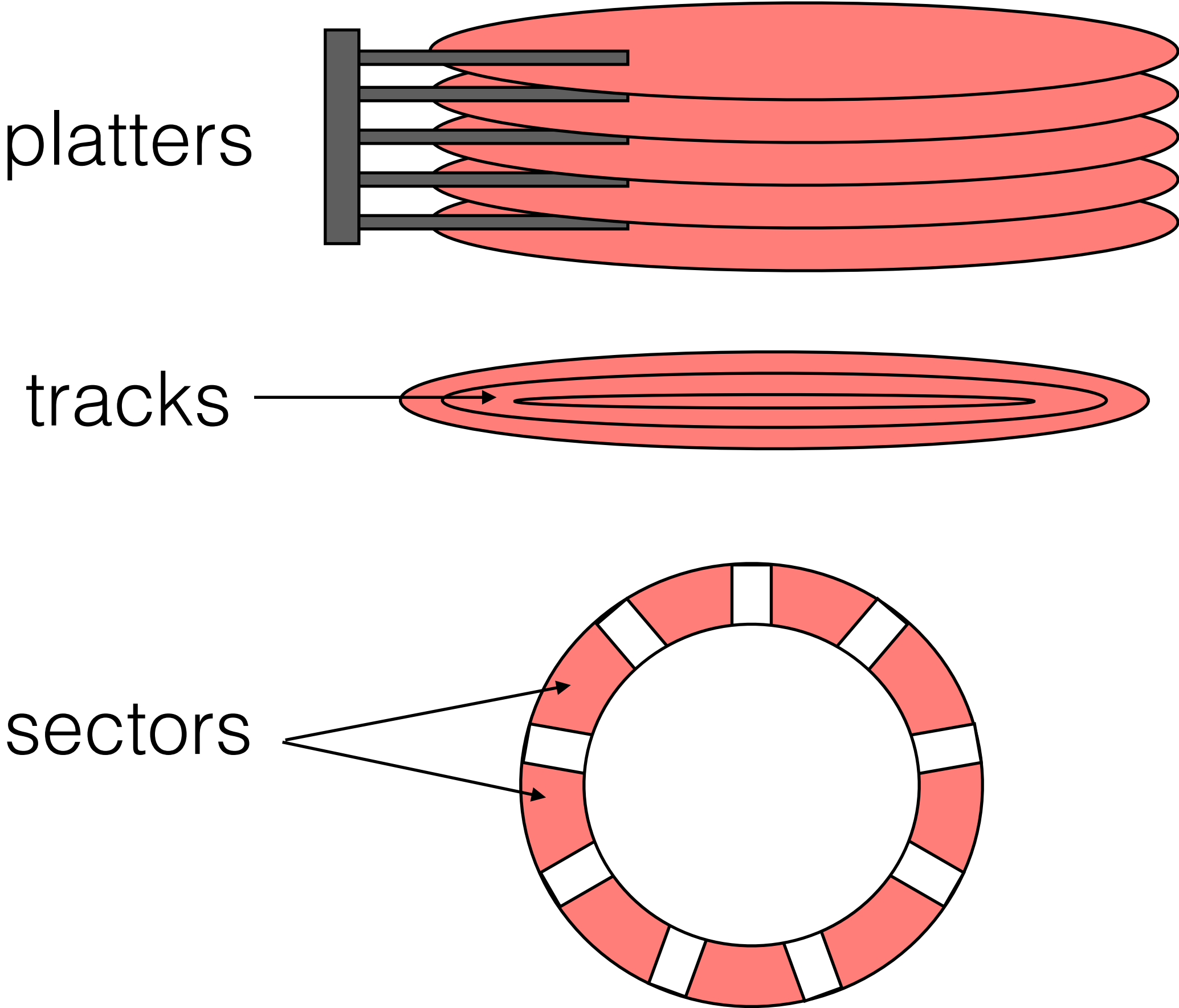
however, because of how writes are done, the SSD controller is careful about how it writes new data and makes changes to existing data



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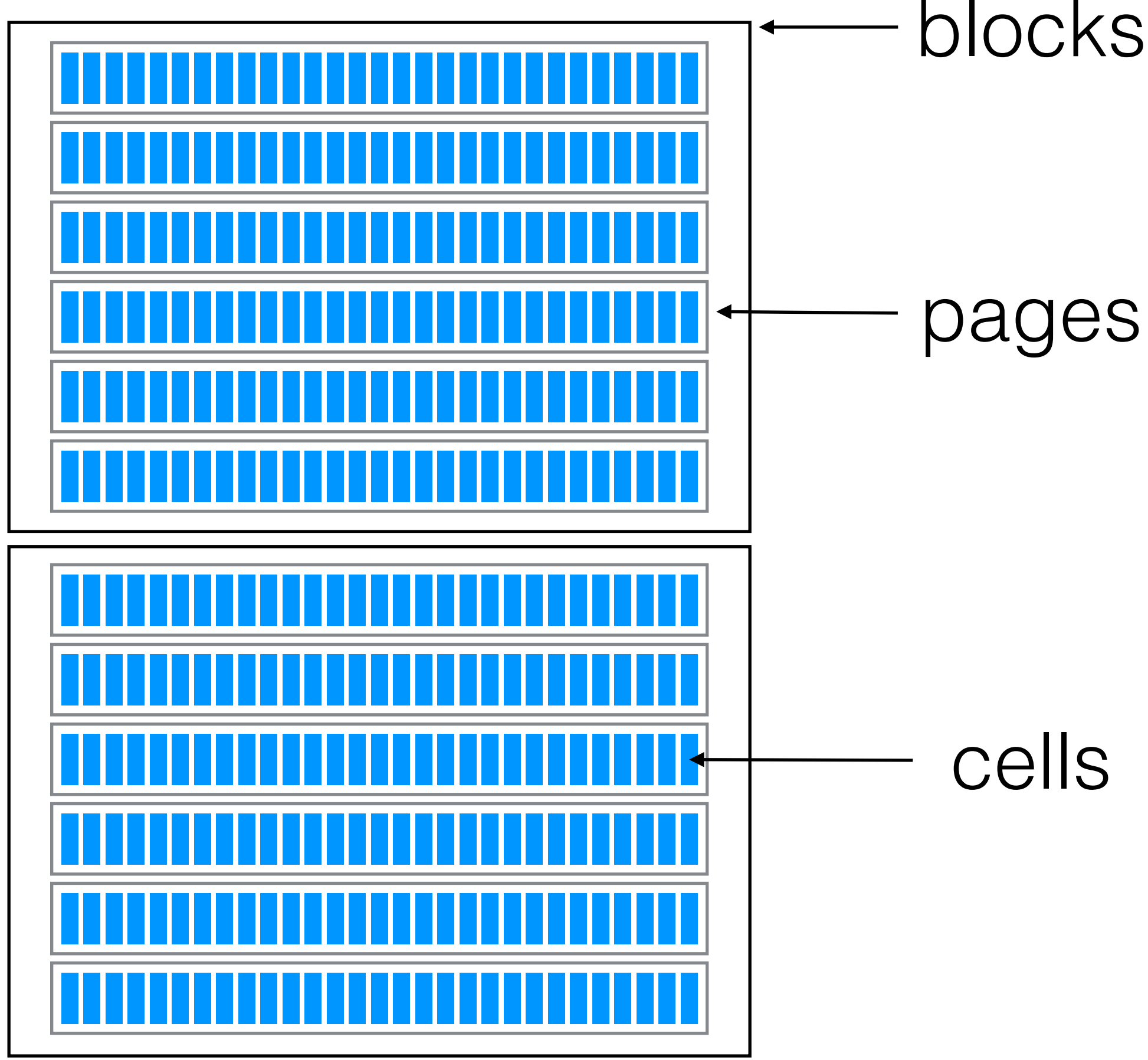
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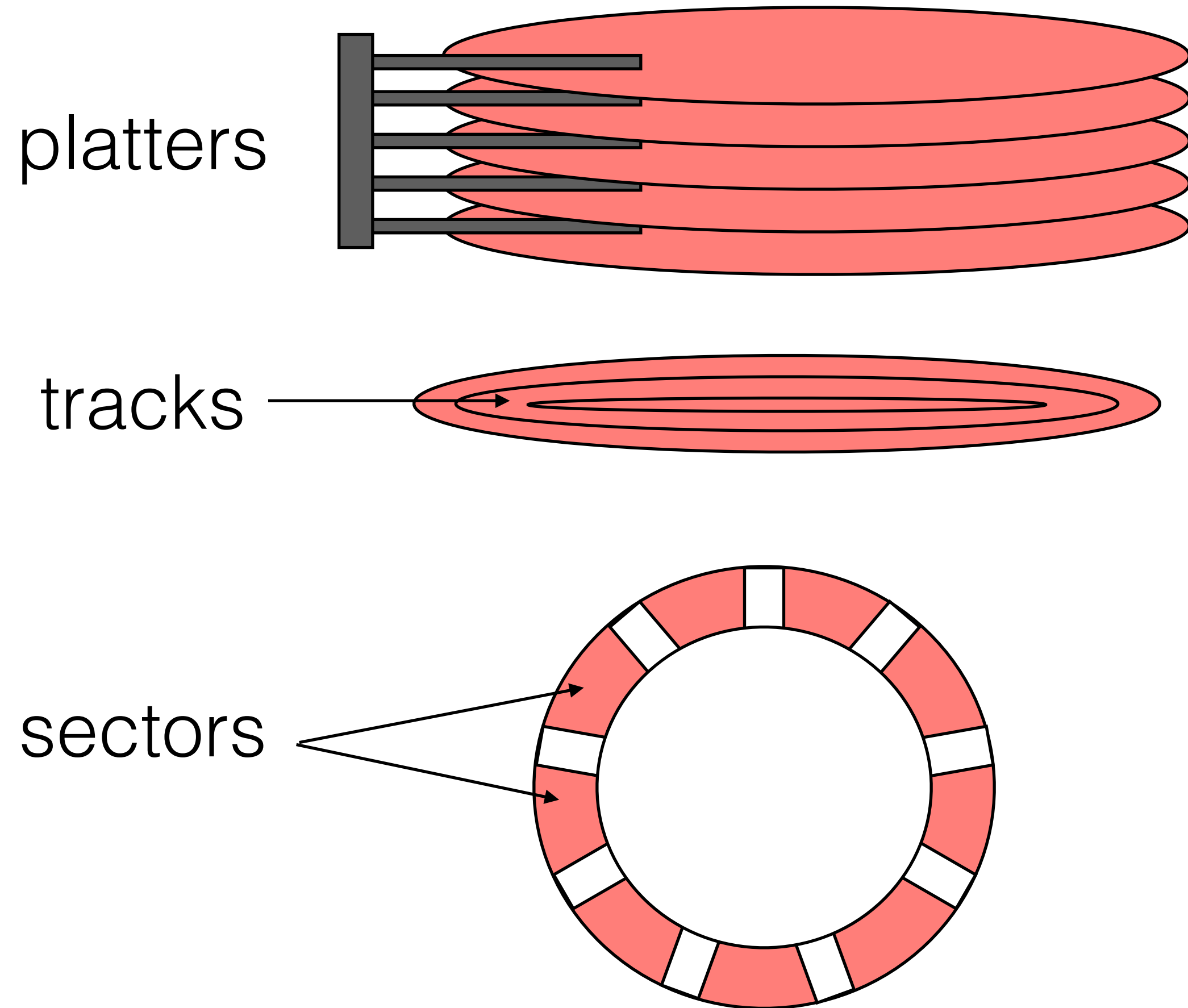
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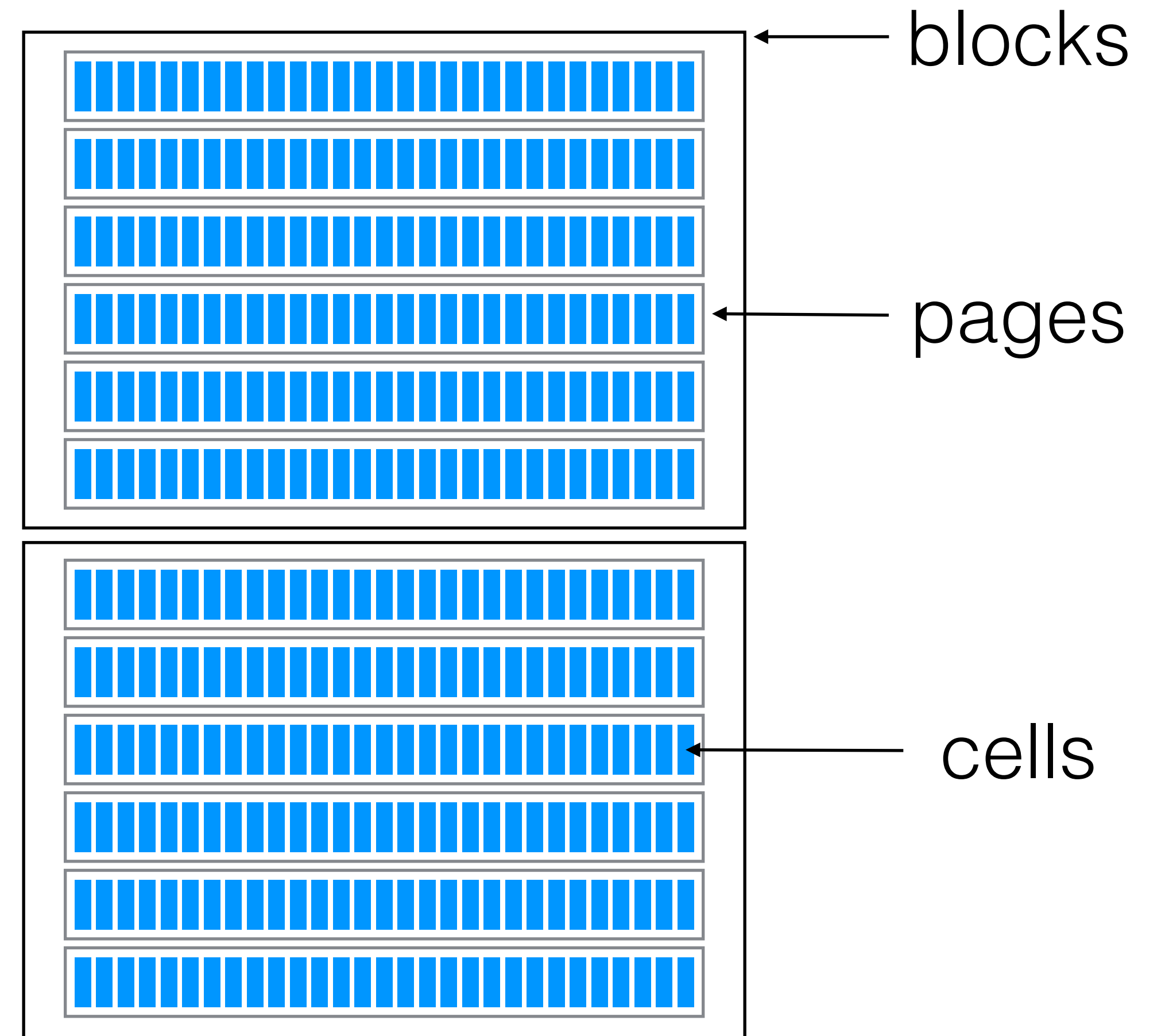
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so far, we have always imagined reading/writing data via the abstraction of a **filesystem**.
does that abstraction ever get in the way?



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katrina	lacurts	38	476
karen	sollins	32	G534
sam	madden	32	G983
...			

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first name	last name	building	room
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...			

first name	last name	role
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karen	sollins	recitation
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...		

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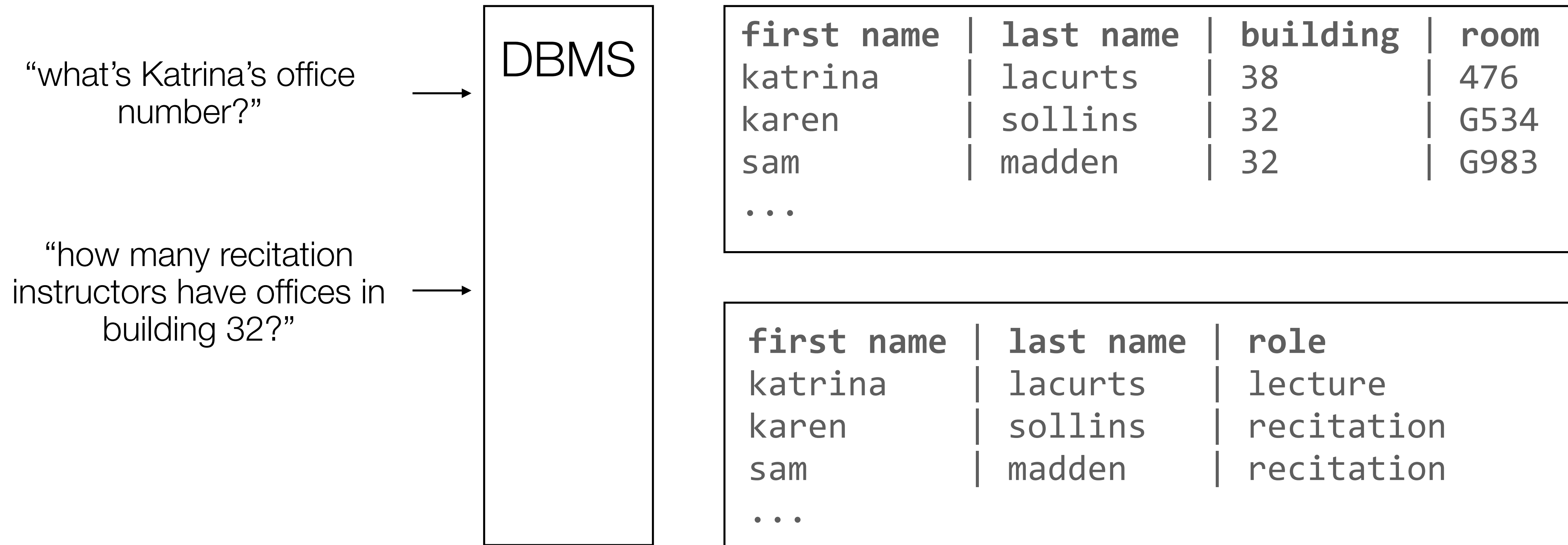
“what’s Katrina’s office
number?”

first name	last name	building	room
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...			

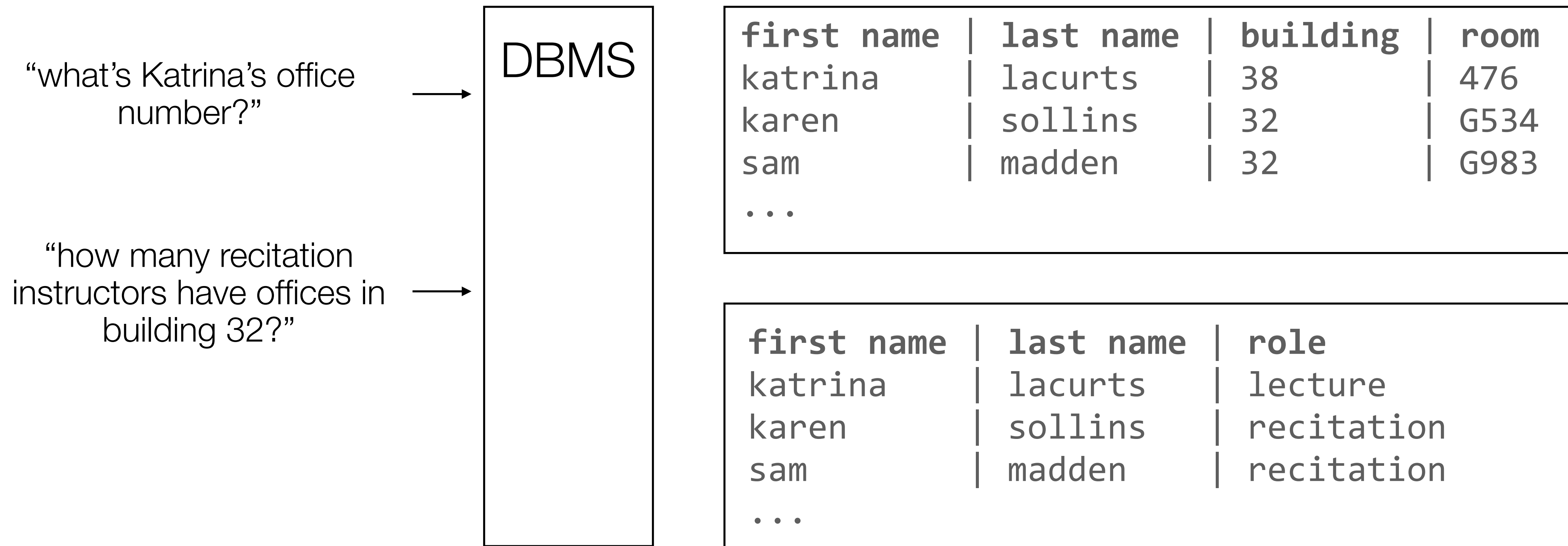
“how many recitation
instructors have offices in
building 32?”

first name	last name	role
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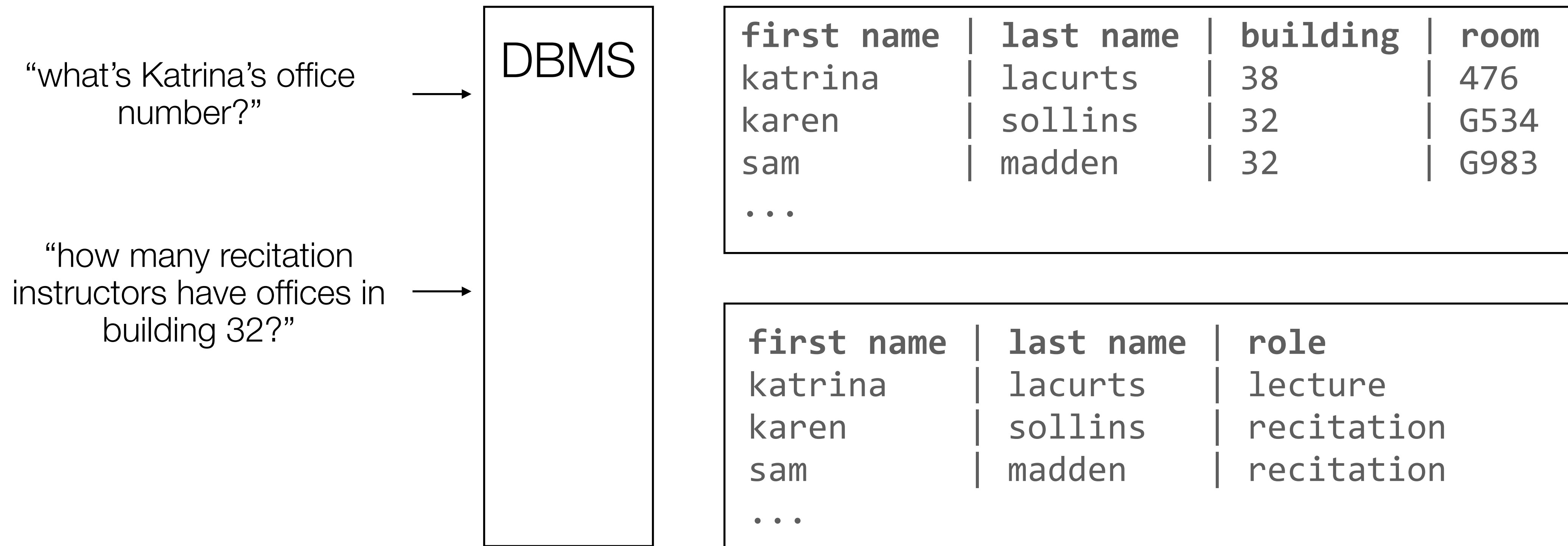
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how should the data be stored as files?

one file for everything? one file per table? per row? per column? per cell?

so far, we have always imagined reading/writing data via the abstraction of a **filesystem**.
does that abstraction ever get in the way?



the DBMS knows so much about the data and related queries that it can do a very good job at predicting which byte it needs next

it's in a good position to exploit block-level control over loading or evicting data to memory

performance is important throughout systems. we often measure throughput, latency, and utilization, and use techniques such as caching and batching to improve performance

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block-level control isn't perfect for *every* type of database; some do just fine with filesystems