System Administration

Week 09, Segment 1
Backups: Core Concepts

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Backups vs. Restores

Backups are boring.

Backups are tedious.

Nobody likes doing backups.

But…

People really like being able to *restore* data!

Backups vs. Restores

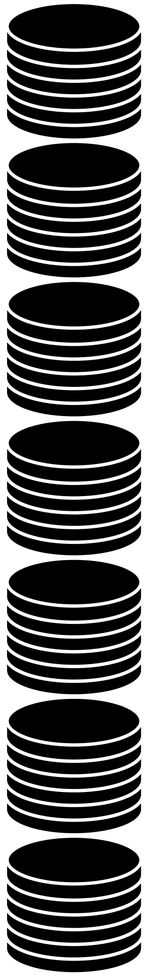
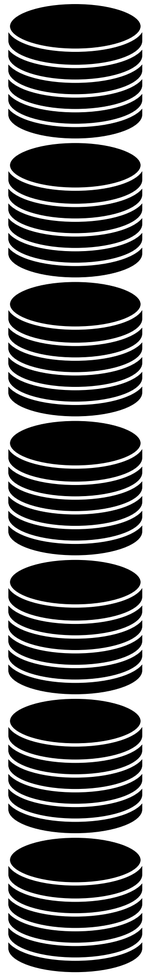
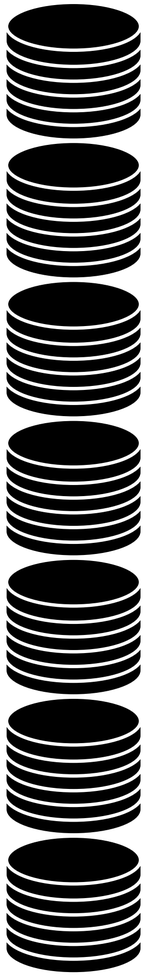
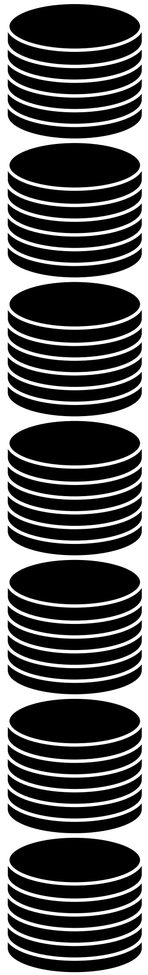
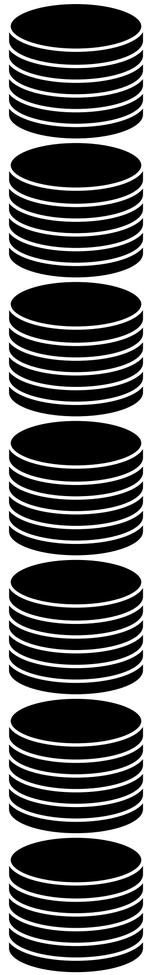
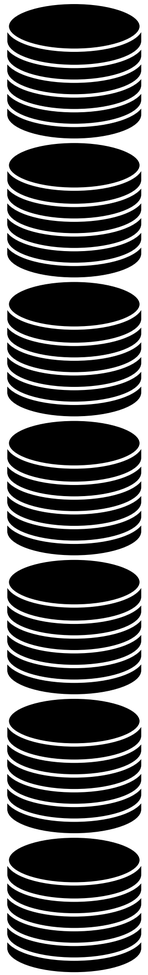
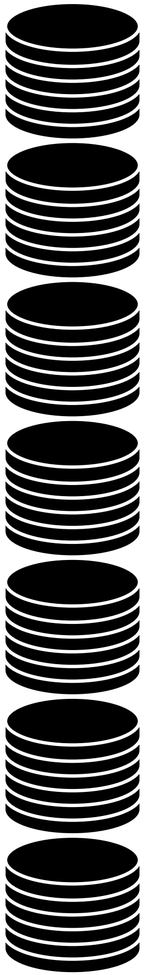
Backups are just a means to accomplish a specific goal:

To have the ability to restore data.

Basic Terminology, Concepts, and Considerations

- ”full backup”
- ”incremental backup”
- “differential backup”
- file level vs. block level
- meta data (e.g., file- and filesystem), file data, live data / open files
- journalling vs. snapshots
- Recovery Point Objective (RPO) / Recovery Time Objective (RTO)
- Business Continuity Plan (BCP)

Full Backups

Sun	Mon	Tue	Wed	Thu	Fri	Sat
						
7 TB	7 TB	7 TB	7 TB	7 TB	7 TB	7 TB

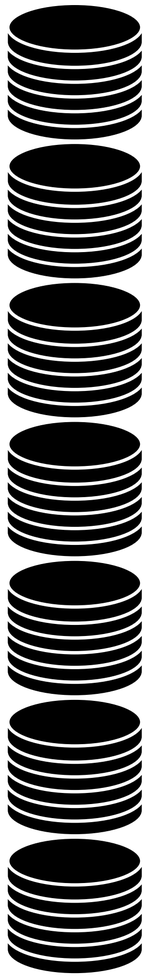
Total:
49 TB

Full Backups

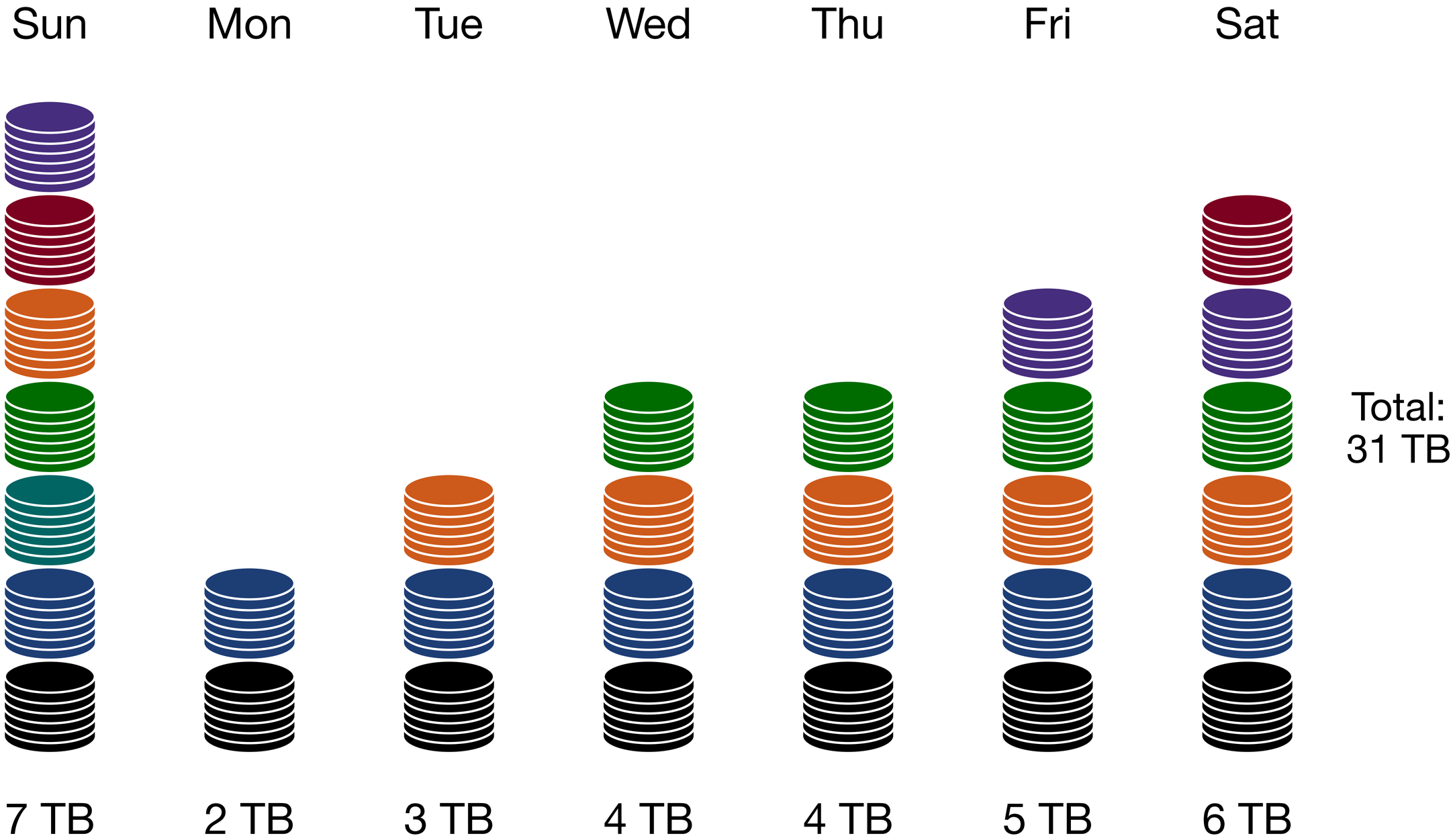
Restore

Back up all data every time:

- slow backup process
- requires lots of storage / bandwidth
- fast restore



Differential Backups



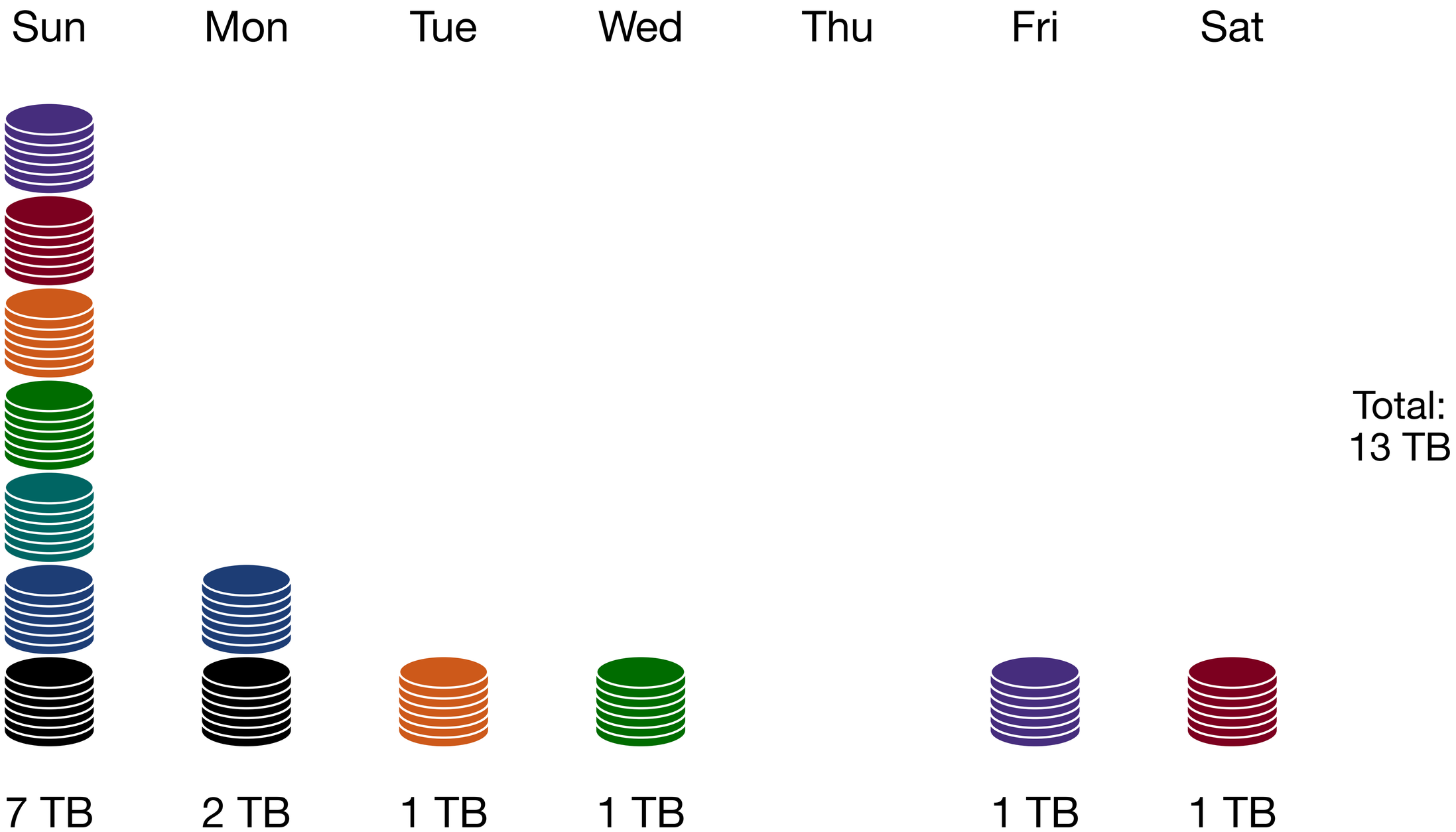
Differential Backups

Restore

Back up only data that has changed *since the last full backup*:

- improved backup performance
- better storage / bandwidth utilization
- slower restore than full backup
- at most two data sets required for recovery

Incremental Backups



Incremental Backups

Restore

Incremental Backups

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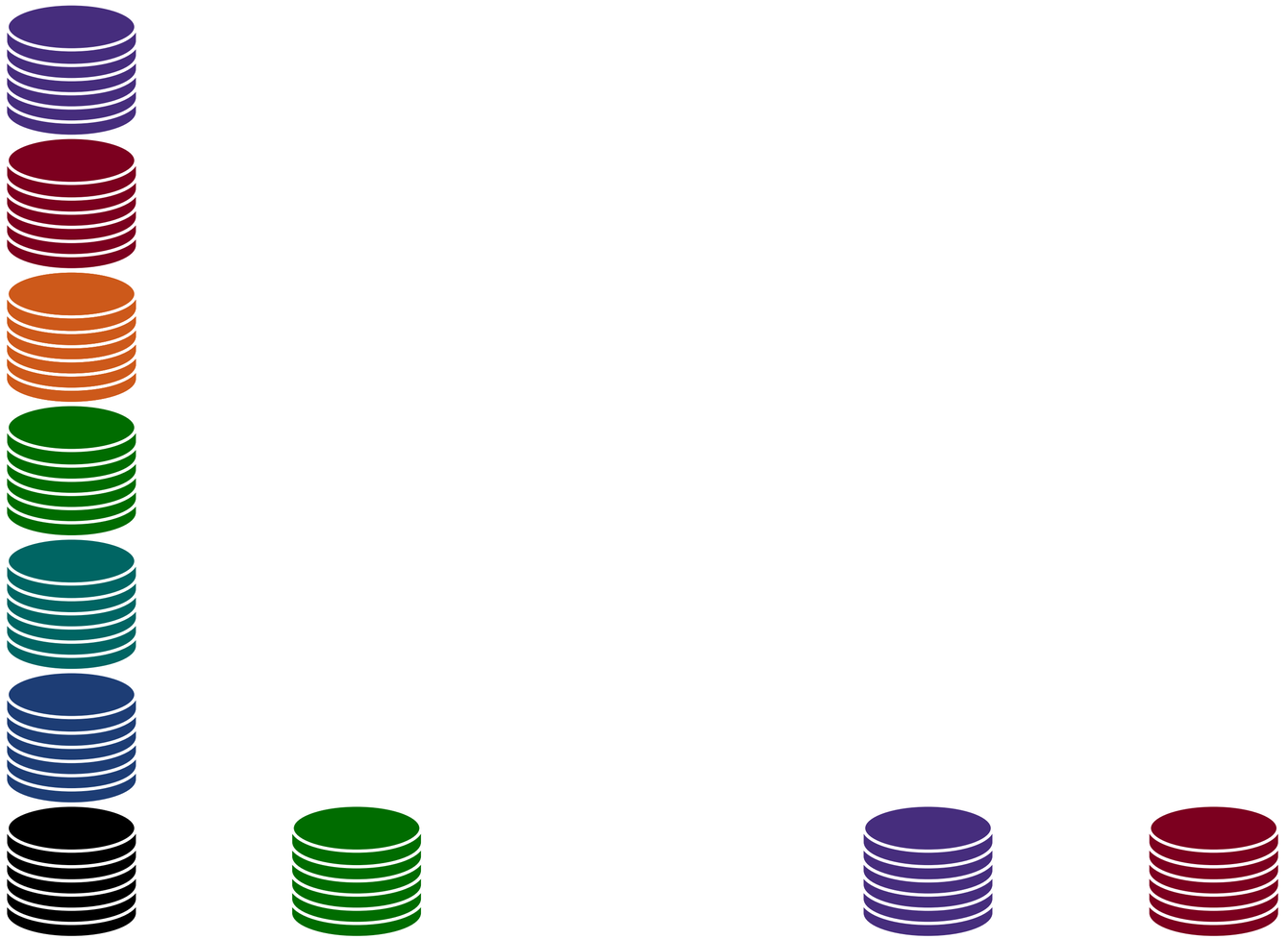
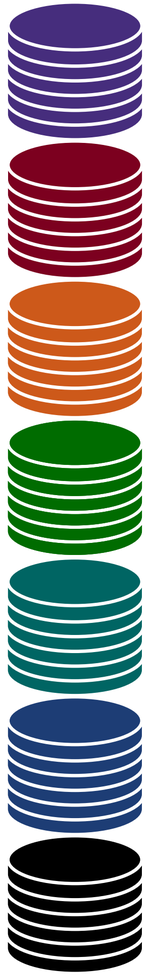
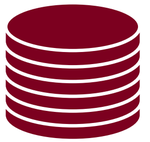


Incremental Backups

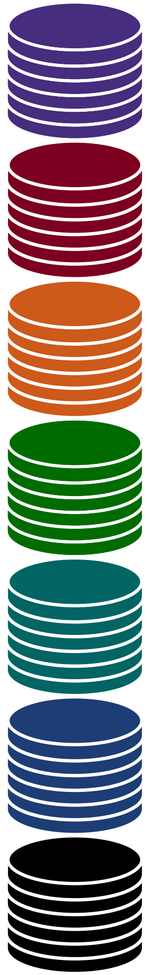
Restore

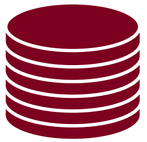




Incremental Backups

Restore



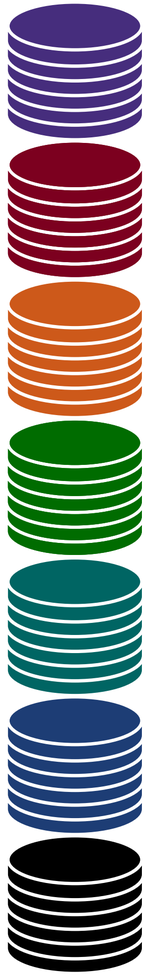


Incremental Backups

Restore

Back up only data that has changed *since the last incremental backup*:

- highest backup performance
- best storage / bandwidth utilization
- slowest restore
- higher risk of failed full recovery since backup across sets is chained



Data Storage Media and Properties

- magnetic tape
- traditional hard disk
- solid-state drive
- the cloud, why not

- I/O performance (read/write, sequential/random, …)
- reusability and degradation
- longevity
- data integrity assurance (e.g., WORM - write once, read many)
- data compression, encryption
- deduplication

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- long-term storage / archival
- recover from data loss

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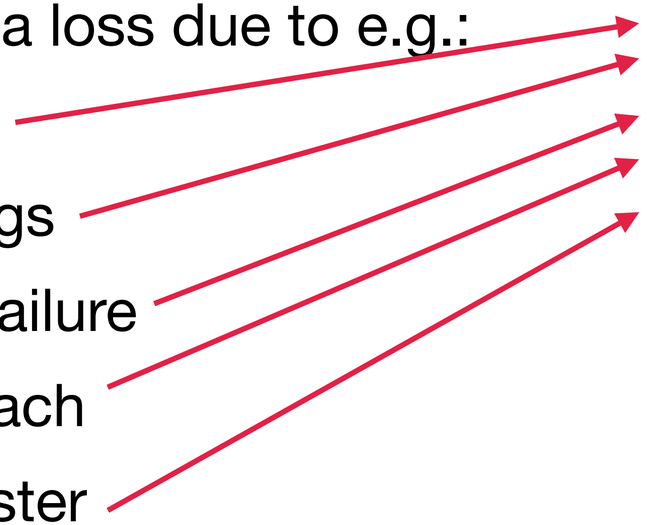
  - complete backup
  - separate set from regular backups
  - usually stored off-site
  - recovery / retrieval takes time
  - limited granularity
  - storage media considerations
  - backup encryption and recovery key management
- recover from data loss

When do we need backups?

- long-term storage / archival
- recover from data loss due to e.g.:
  - user failure
  - software bugs
  - equipment failure
  - security breach
  - natural disaster

Type of restore:

- individual file(s)
- individual system recovery
- disaster recovery



Think of your backups as *insurance*: you invest and pay for it, hoping you will never need it.

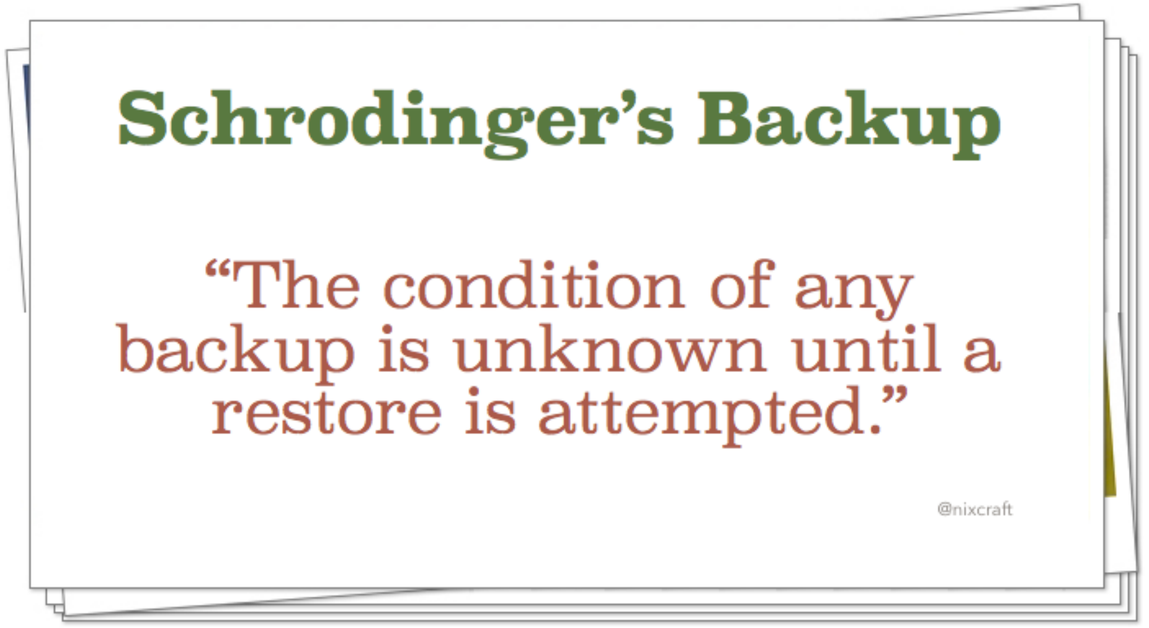
System and Disaster Recovery

- loss of e.g. entire file system
- leads to downtime (of individual systems)
- RAID may help
- takes long time to restore
- may require retrieval of archival backups from long-term storage
- often involves some data loss
- 3-2-1 Rule:
  - keep at least 3 copies of your data
  - keep at least 2 copies on different storage media
  - keep at least 1 copy offsite

Beware: disasters scale up much faster than your backup strategy!

Trusting your backups

- Backing up data requires superuser privileges!
- A backup is a *copy* of the data. If the data is corrupt, your backup may become corrupt.
- To restore data from a trusted backup, you can only use trusted tools.
- Verify the authenticity and integrity of your backups!



Up Next

Practical examples:

- dump(8) / restore(8)
- tar(1)
- rsync(1)

Recommended exercise:

https://stevens.netmeister.org/615/backup-exercise.html

Links

- https://en.wikipedia.org/wiki/Disaster_recovery
- https://en.wikipedia.org/wiki/Write_once_read_many
- https://www.oreilly.com/catalog/unixbr/