Cloud Data Storage: Amazon S3

INF 551

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Roadmap

- Overview
- Eventual consistency model
- Amazon S3

Amazon S3

- Simple Storage Service

- A type of cloud data storage
  - Data are stored in the cloud (Amazon's data center)

Data replication

- Multiple copies of the same data are stored
  - Among different compute nodes of the same center
  - And over different data centers
- Read
  - Can be served from any data center
- Write
  - Need to be propagated to all data centers & all nodes

Features

- Simple API, e.g., RESTful web service
  - Store and retrieve data over HTTP
- High availability
  - Low read & write latency
- Eventual consistency model

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Strong consistency

- Traditionally, a database transaction needs to satisfy ACID properties
  - 'C' in ACID for strong consistency

- Consider a balance-transfer transaction
  - $500 from account A to account B
  - After transfer, the total balance remains the same
  - & users do not get to see the inconsistent state (e.g., debit $500 from A, not yet credit B)

ACID

- Atomicity: Either all or none of operations in the transaction should be executed
- Consistency: After transaction completes, the database is in a consistent state
- Isolation: allow concurrent execution of multiple transactions that do not interfere with each other
- Durability: can recover from failure

Eventual consistency

- If no new updates are made to the object, eventually all accesses to the object will return the last updated value.

- A form of weak consistency
  - Allow users to see the inconsistency state
  - Needed to achieve high availability (HA)

Inconsistency window

- Time between update acknowledged to user and eventual consistency achieved
  - i.e., updates propagated to all replicas

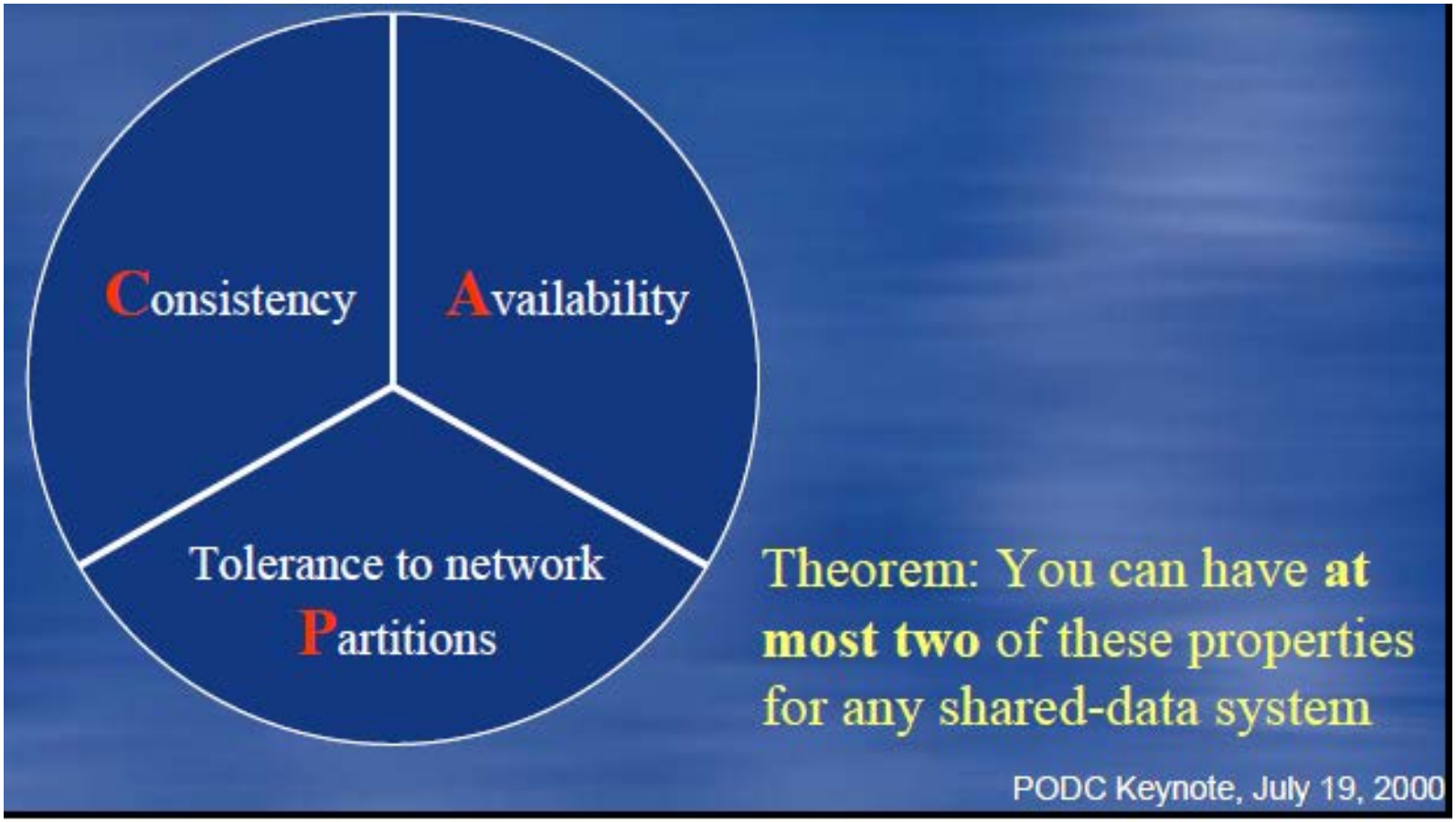
- Length of window determined by:
  - Communication delay
  - Load on the system
  - Number of replicas

Example

- DNS (domain name system) implements eventual consistency
  - DNS resolves www.usc.edu to 128.125.253.146

- Permissible for some DNS servers to have old data
  - As long as updates eventually propagated to them

CAP theorem


Consistency
Availability
Tolerance to network
Partitions
Theorem: You can have at most two of these properties for any shared-data system
PODC Keynote, July 19, 2000

Consequence

- Consider a large distributed system
  - hence partitioning is a given (can not forfeit)

- Availability and (strong) consistency can not be achieved at the same time

  => viability of eventual consistency model

Consequence

- Consider update made to an object O
- User A in LA may see the updated O right away
- But user B in NYC may see the old value of O
  - At least for a while

Eventual consistency model

- Acceptable to many applications
  - E.g., social media, cloud data storage, e-commerce

- Examples:
  - Amazon S3
  - Amazon DynamoDB (backbone of Amazon e-commerce and Web services)

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https://aws.amazon.com/s3/

Search

Menu

amazon web services

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PRODUCTS & SERVICES

- Amazon S3
- Product Details
- Storage Classes
- Pricing
- Getting Started
- FAQs
- Resources
- Amazon S3 SLA

RELATED LINKS

- AWS Management Console
- Documentation
- Release Notes

Amazon S3

Amazon Simple Storage Service (Amazon S3), provides developers and IT teams with secure, durable, highly-scalable object storage. Amazon S3 is easy to use, with a simple web service interface to store and retrieve any amount of data from anywhere on the web. With Amazon S3, you pay only for the storage you actually use. There is no minimum fee and no setup cost.

Amazon S3 offers a range of storage classes designed for different use cases including Amazon S3 Standard for general-purpose storage of frequently accessed data, Amazon S3 Standard - Infrequent

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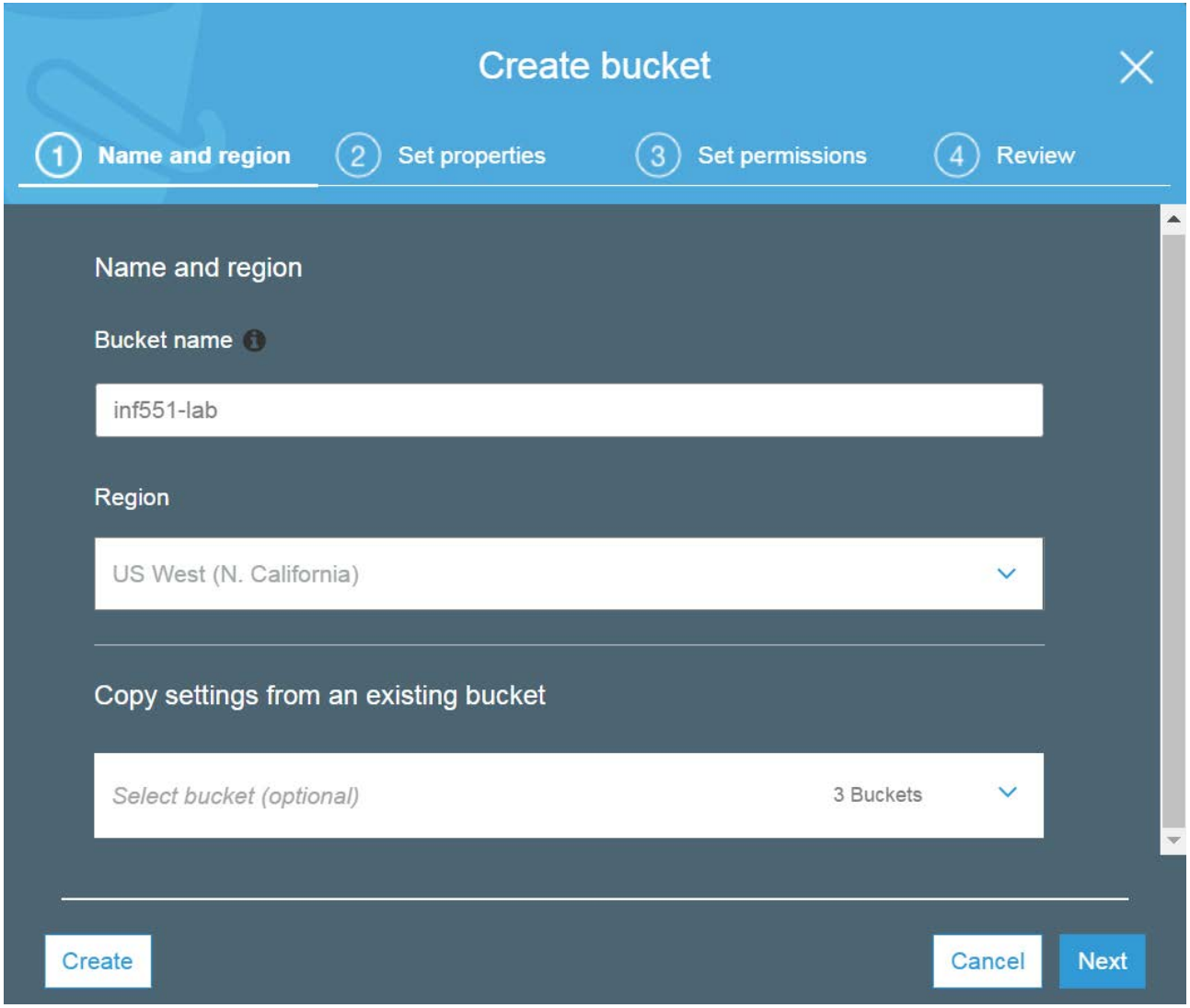
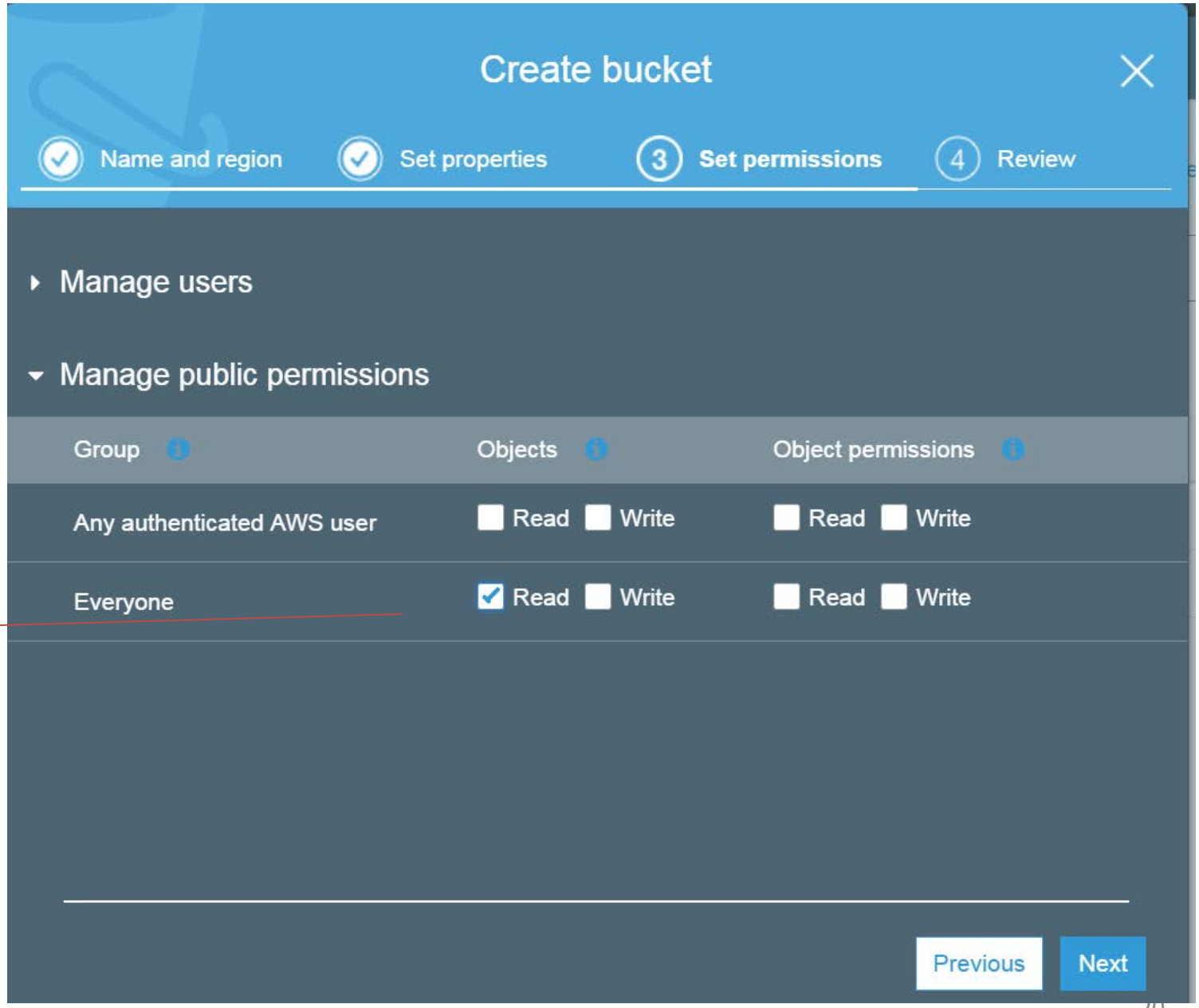
Data organization in S3

- Bucket
  - Container for objects
  - Has a unique name (across S3)
- Objects
  - Text files, images, etc.
- Folders
  - Grouping objects together
  - Can be nested

Create a bucket



Allow public to list the content of bucket



Create bucket

Name and region | Set properties | Set permissions | 4 Review

Name and region

Edit

Bucket name inf551-lab **Region** US West (N. California)

Properties

Edit

Versioning	Disabled
Logging	Disabled
Tagging	0 Tags

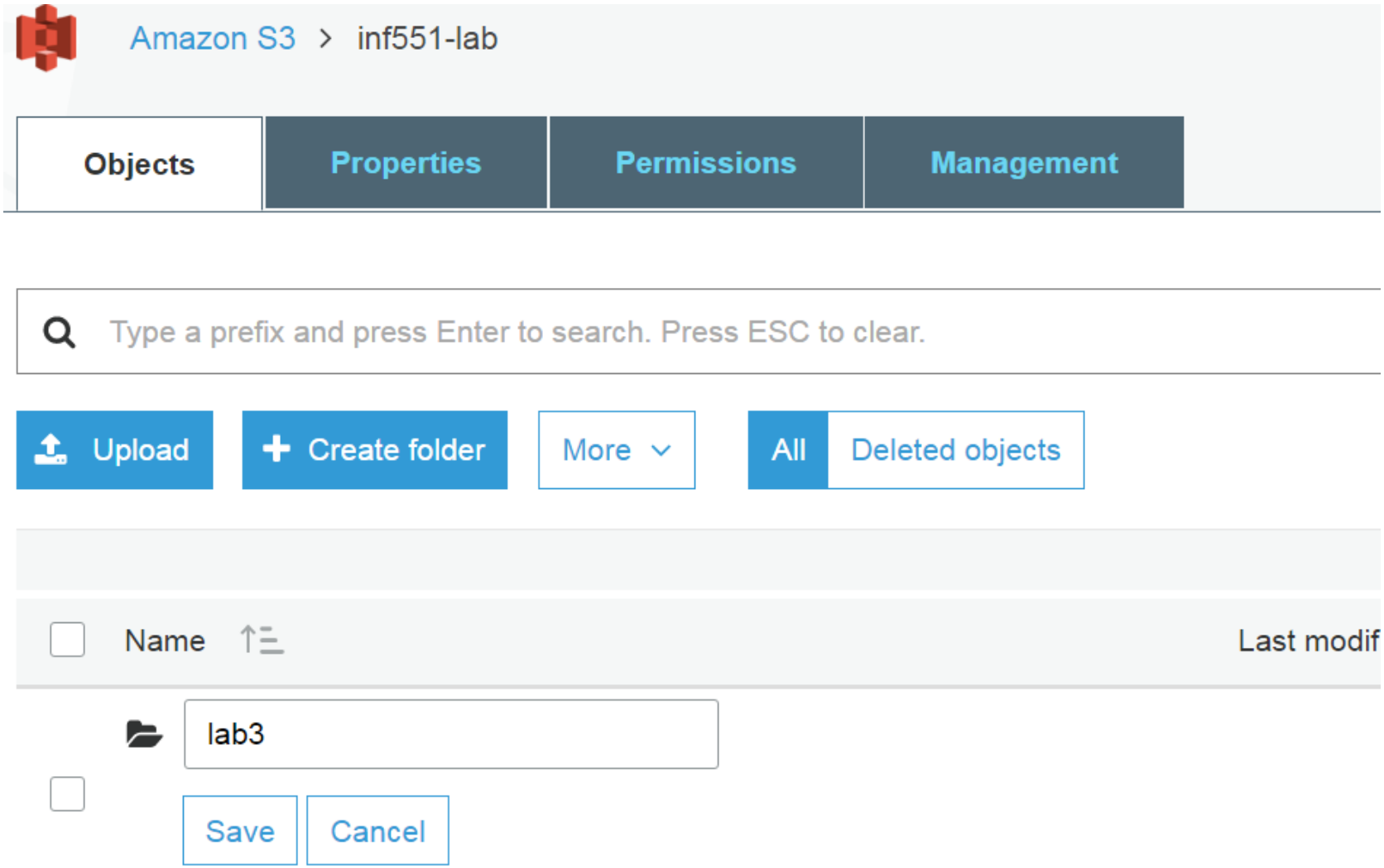
Permissions

Edit

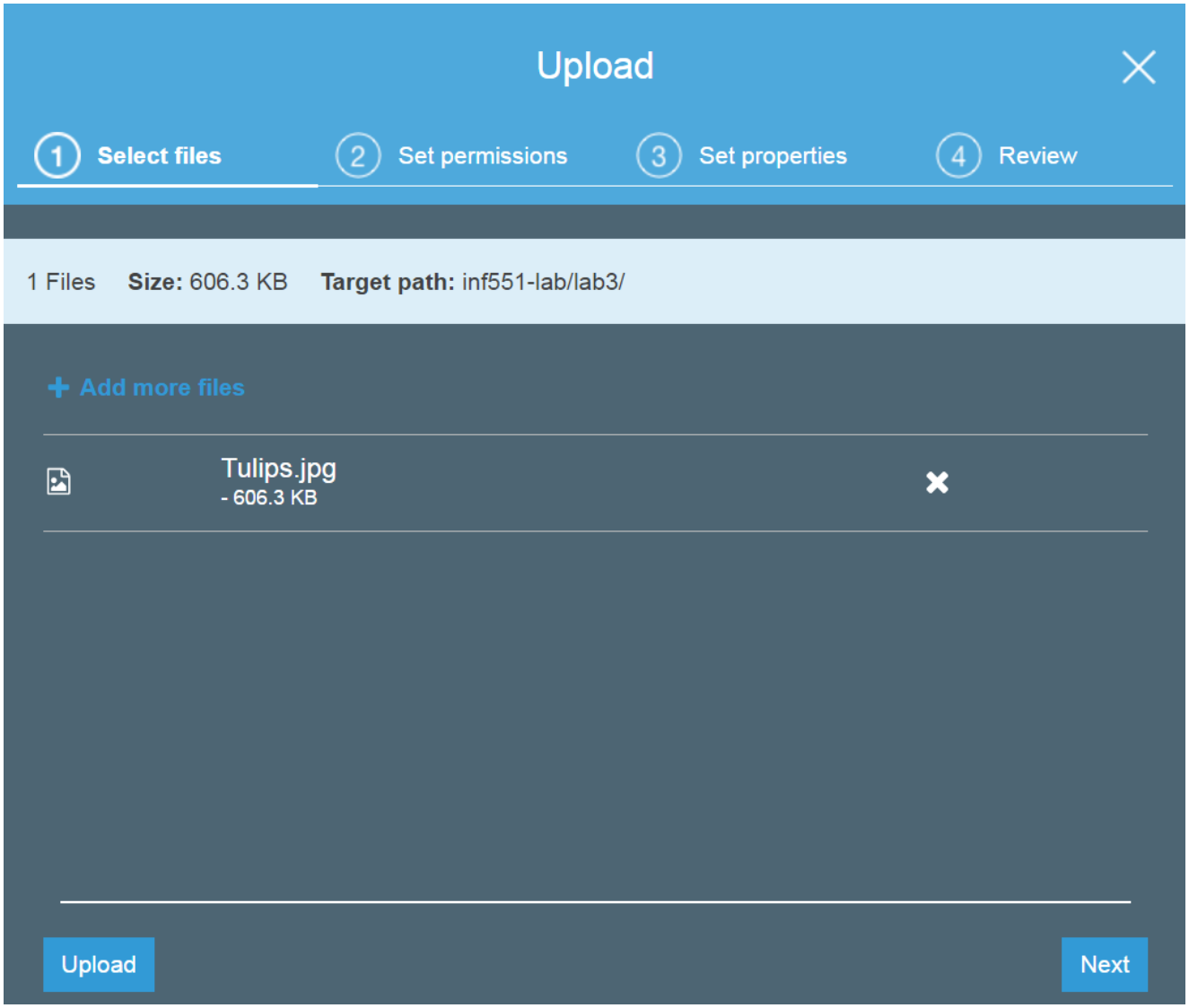
Users	1
Public permissions	Enabled

Previous | Create bucket

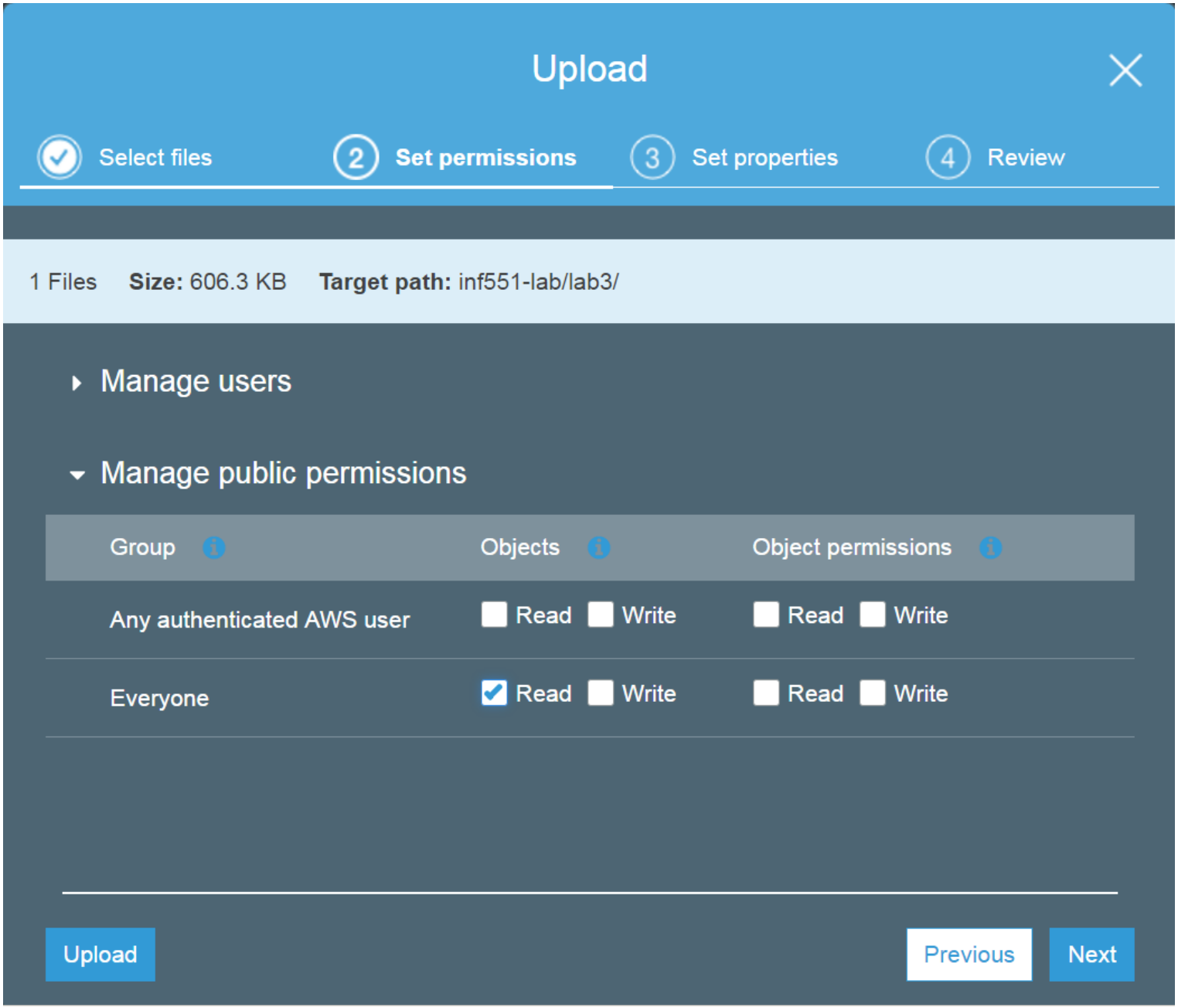
Create a folder inside the bucket



Upload a file to the folder

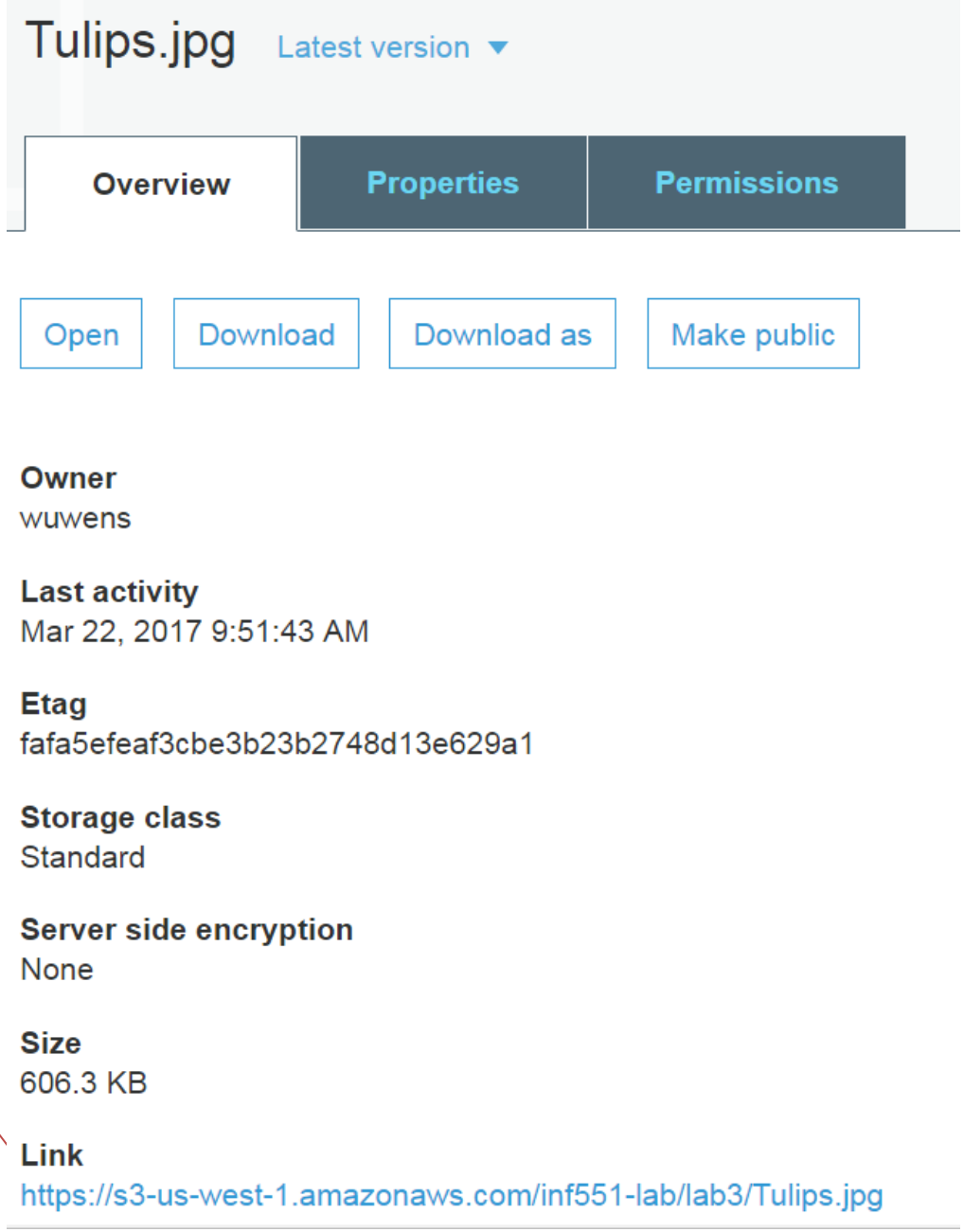


Make it accessible to the public

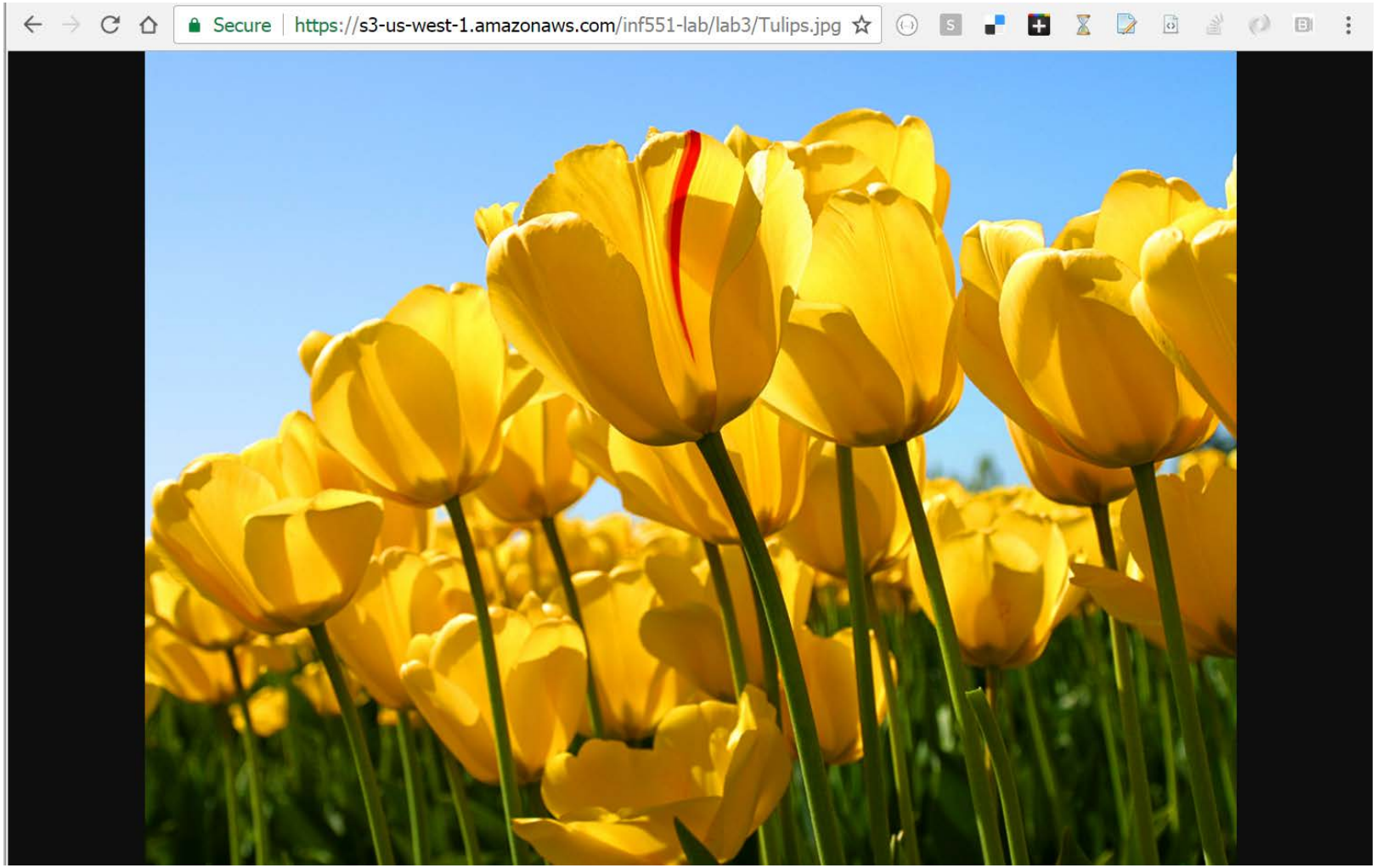


https://s3-us-west-1.amazonaws.com/inf551-lab/lab3/Tulips.jpg

URL for the file



Open it in a browser



Resources

- Amazon S3: https://aws.amazon.com/documentation/s3/
  - Read this: http://docs.aws.amazon.com/AmazonS3/latest/gsg/s3-gsg.pdf

- Amazon S3 Restful API
  - http://docs.aws.amazon.com/AmazonS3/latest/API/APIRest.html

References

- All things distributed by Werner Vogels (Amazon CTO)
  - http://www.allthingsdistributed.com/2008/12/eventually_consistent.html

- Towards robust distributed systems by Brewer
  - https://people.eecs.berkeley.edu/~brewer/cs262b-2004/PODC-keynote.pdf
  - CAP theorem proposed in this keynote