Day 37

BLOB Data Type

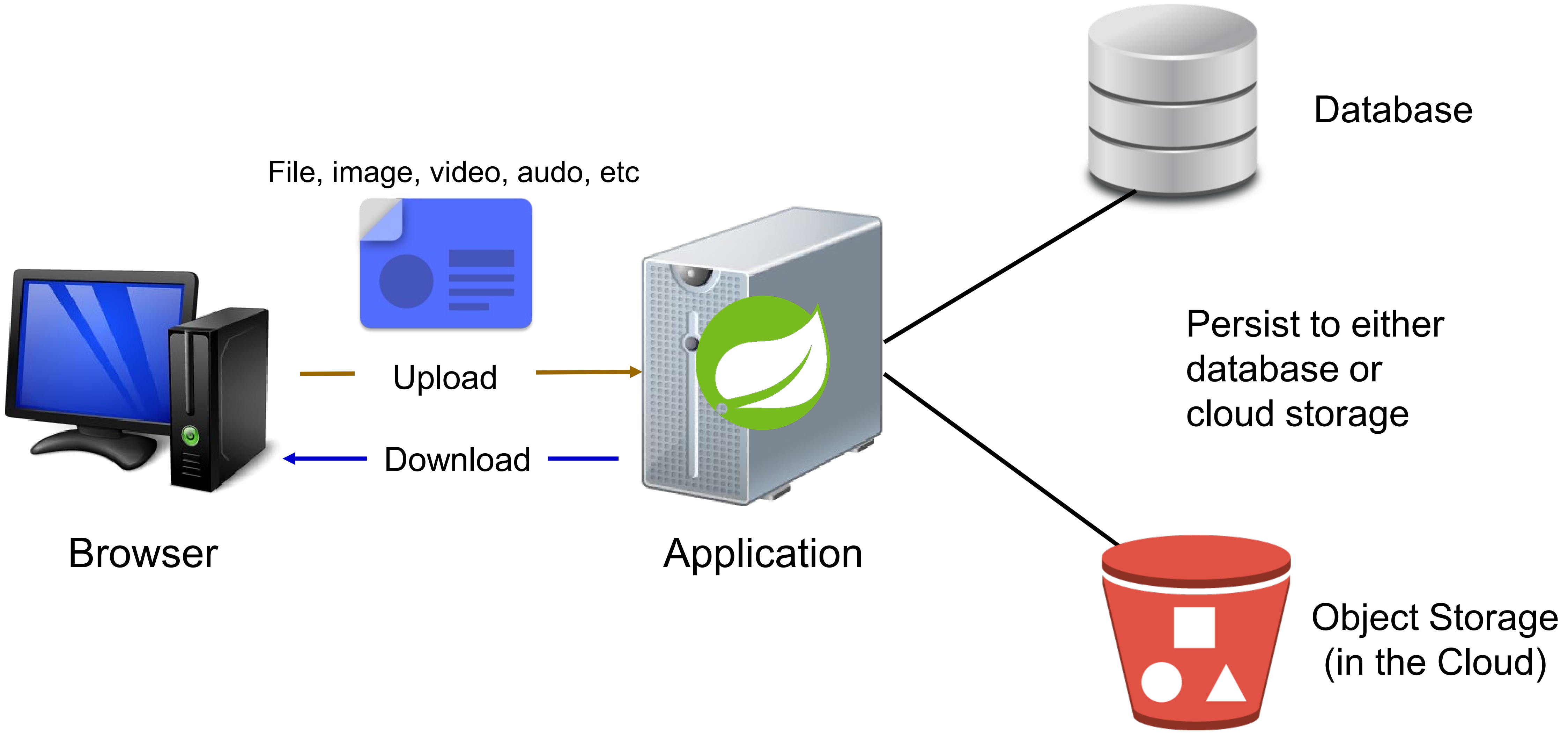
- BLOB (Binary Large Object) is a special type of column in MySQL for storing binary data
  - Eg. images, files, MP3, etc.
- Unlike other columns, the contents of BLOB are not searchable, sortable or comparable
  - Need to have additional columns to hold the BLOB’s metadata
  - Eg. media type, size, original file name, etc.
- BLOB comes in 4 different sizes
  - TINYBLOB < 2^{8} bytes
  - BLOB < 2^{16} bytes / 16Kb
  - MEDIUMBLOB < 2^{24} bytes / 16Mb
  - LONGBLOB < 2^{32} bytes / 4Gb

Blob Data Type

```
create table files (
   id                  int auto_increment,
   filename            varchar(64) not null,
   media_type          varchar(128) not null,
   content             blob not null,
   primary key (prog_id)
);
```

Blob data type

File Upload


File, image, video, audo, etc
Upload
Download
Browser
Application
Database
Persist to either database or cloud storage
Object Storage (in the Cloud)

File Upload

HTTP POST method

Use the multipart encoding type when submitting the form

Set the input type to `file`

Optionally set the type of file to upload

```
<form method="POST" action="/upload"
    enctype="multipart/form-data">
  ...
  <input type="file" name="img-file" accept="image/*">

  <textarea name="notes" cols="30" rows="10">
  </textarea>

  <button type="submit">Upload</button>

</form>
```

File Upload with Angular

- Media type of file upload is `multipart/form-data`
- Use `FormData` object type to hold the fields
  - See https://developer.mozilla.org/en-US/docs/Web/API/FormData
- For the list of files to be uploaded, need to get it from the `input` element
  - `files` attribute; see https://developer.mozilla.org/en-US/docs/Web/API/File/Using_files_from_web_applications
  - Define a template reference on the input as `TemplateRef`
  - Access the `files templateRef.nativeElement.files`

Angular File Upload

```
<form [formGroup]=“form" (ngSubmit)="upload()">
  ...

  Image:
  <input type="file" accept="image/*" #file>

  ...

  <button type="submit">POST</button>
</form>
```

Define a template reference on the input element

Angular File Upload

```
export class AppComponent implements OnInit {
   @ViewChild('file') imageFile: ElementRef;
   form1: FormGroup;
   constructor(private http: HttpClient, private fb: FormBuilder) { }

   ngOnInit() {
      this.formGroup = this.fb.group({
         'image-file': this.fb.control('')
       })
   }
   upload() {
      const formData = new FormData();
      formData.set('name', this.form.get('image-file').value);
      ...
      formData.set('file', this.imageFile.nativeElement.files[0]);
      firstVaulueFrom(
         this.http.post('http://localhost:8080/upload', formData)
      ).then(() => { ... })
         .catch((error) => { ... })
   }
}
```

Get a reference to the input element using its name

Create a instance of `FormData` to hold the parameters to be send to the server

Access the DOM attribute with `nativeElement` attribute

Populate the `FormData` instance

POST the `FormData`. Angular will use the correct media type for making the request

multipart/form-data Media Type

```
POST /upload HTTP/1.1
Host: localhost:3000
Connection: keep-alive
Content-Length: 499207
Content-Type: multipart/form-data; boundary=----0YsU72sGdwPe5B
Accept:
text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8

------0YsU72sGdwPe5B
Content-Disposition: form-data; name="file"; filename="directions.png"
Content-Type: image/png

------0YsU72sGdwPe5B
Content-Disposition: form-data; name="name"

Directions to Bukit Timah Nature Reserve
------0YsU72sGdwPe5B--
```

Field separator

`image-file` form field

`name` form field

Enable Multipart Form Data

- Multipart form data processing is not enabled by default in SpringBoot
  - Add the following configuration to `application.properties`

Enable multipart uploads

Maximum size of a single file

Maximum request size for multiple file uploads

```
spring.servlet.multipart.enabled=true
spring.servlet.multipart.max-file-size=200MB
spring.servlet.multipart.max-request-size=200MB
spring.servlet.multipart.file-size-threshold=1MB
```

Files exceeding this size will be written to disk temporarily instead of residing memory during processing

Processing multipart/form-data

```
@Controller
@RequestMapping(path="/upload")
public class UploadController {

   @Autowired JdbcTemplate template;

   @PostMapping(consumes=Mediatype.MULTIPART_FORM_DATA)
   public ResponseEntity<String> postUpload(@RequestPart MultipartFile file,
         @RequestPart String name, @RequestPart String email) {
      String name = file.getName();
      String originalName = file.getOriginalFileName();
      String mediaType = file.getContentType();
      InputStream is = file.getInputStream();

      template.update("insert into files(..., content) values (..., ?)"
            , ..., is);
      ...
   }
}
```

Handle POST request with `form-data` payload

Retrieve the form-data content. For file upload the type is `MultipartFile`

Get other form fields, if any

Get information about the uploaded file

Insert the contents of the file into a blob column with the file's `InputStream`

File Upload

```
<form method=“POST” action=“/upload” enctype=“multipart/form-data”>
  <input type=”file” name=”file”>
  ...
```

$\downarrow$ as `multipart/data-form`

```
POST /upload HTTP/1.1
Content-Type: multipart/form-data; boundary=----0YsU72sGdwPe5B
```

$\downarrow$

```
@Controller
@RequestMapping(path=“/upload”)
public class UploadController {
  @PostMapping(consumes=MediaType.MULTIPART_FORM_DATA)
  public ResponseEntity<String> postUpload(
       @Requestpart MultipartFile file, ...)
```

Retrieving Images

```
GET /api/tv_shows/1

  {
    “prog_id”: 1,
    “name”: “.....”,
    “lang”: “...”,
    ...,
    “image”: “/image/1”
  }
```

Images/media have to be retrieved separately from the content

Retrieving BLOB with `ResultSetExtractor`

```
@GetMapping("{id}")
public ResponseEntity<byte[]> getImage(@PathVariable Integer id) {

   Optional(FileData) opt = template.query("select * from files where id = ?",
      params, (rs: ResultSet) -> {
         if (!rs.next())
            return Optional.empty();
         FileData file = new FileData();
         file.setName(rs.getString("name"));
         file.setContentType(rs.getString("media_type"));
         file.setContent(rs.getBytes("content"));
         ...
         return Optional.of(file);
      }, id
   )
}
```

Use `next()` to determine if the query produces any result

Get a byte array representing the blob column

Create an array to hold one or more parameters for the query

Multiple Rows with `ResultSetExtractor`

```
List<FileData> opt = template.query("select * from files where name like ?",
    params, (rs: ResultSet) -> {
      List<FileData> list = new LinkedList<>();
      while (rs.next()) {
        FileData file = new FileData();
        file.setName(rs.getString("name"));
        file.setContentType(rs.getString("media_type"));
        file.setContent(rs.getBytes("content"));
        list.add(file);
      }
      return list;
    }, "%dog%"
  )
```

Call `next()`. If `next()` returns true, read a record.
If `next()` returns false, there are no more records
Every call to `next()` advances the cursor

What is Object Storage?

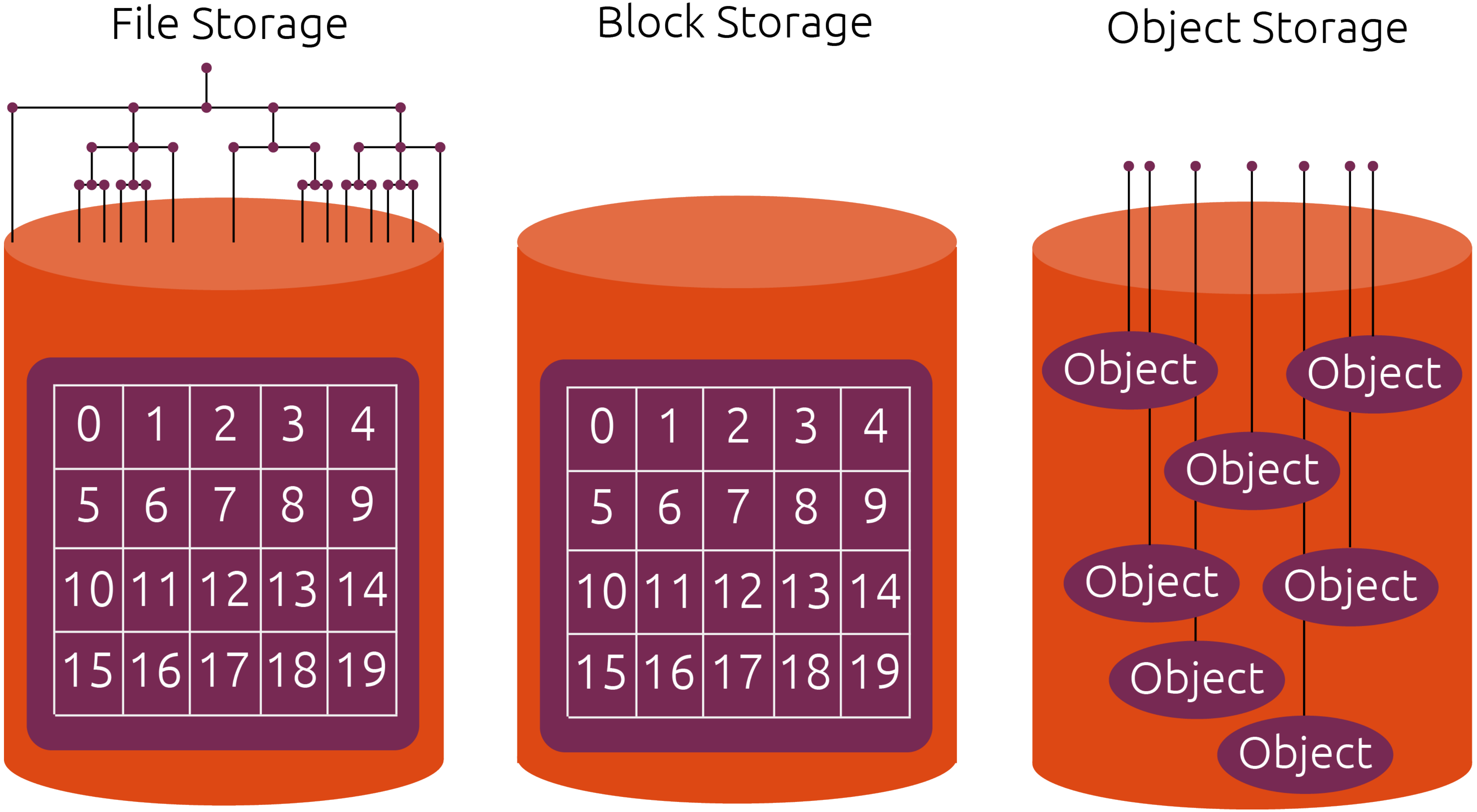
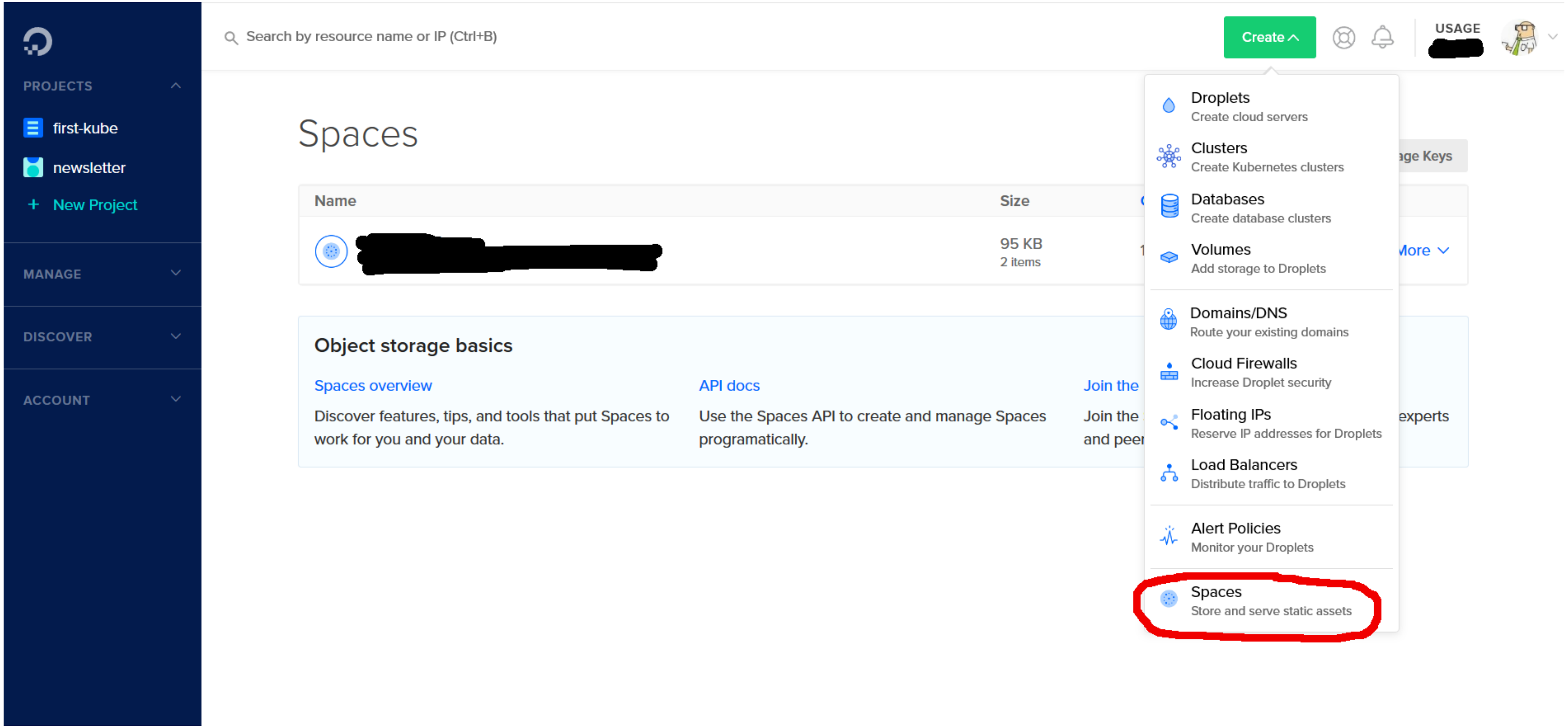


Image from https://ubuntu.com/blog/what-are-the-different-types-of-storage-block-object-and-file

Object Storage

- Object storage stores data as an opaque ‘blob’
    - Cannot search the contents of the blob unlike a file or collection or record
- Identified by a key
- Associated metadata with an object
    - Eg. MIME type, caching options, storage class, permissions
    - Also allow users to set custom metadata
- Examples of object storage
    - AWS - S3
    - GCP - Firebase Storage
    - Azure - Blob Storage
    - MySQL - Blob data type

Creating a S3 Compatible Storage



Search by resource name or IP (Ctrl+B)

Create

USAGE [redacted]

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Spaces

Name	Size
[redacted]	95 KB 2 items

Object storage basics

Spaces overview

Discover features, tips, and tools that put Spaces to work for you and your data.

API docs

Use the Spaces API to create and manage Spaces programatically.

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Clusters
Create Kubernetes clusters

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Create database clusters

Volumes
Add storage to Droplets

Domains/DNS
Route your existing domains

Cloud Firewalls
Increase Droplet security

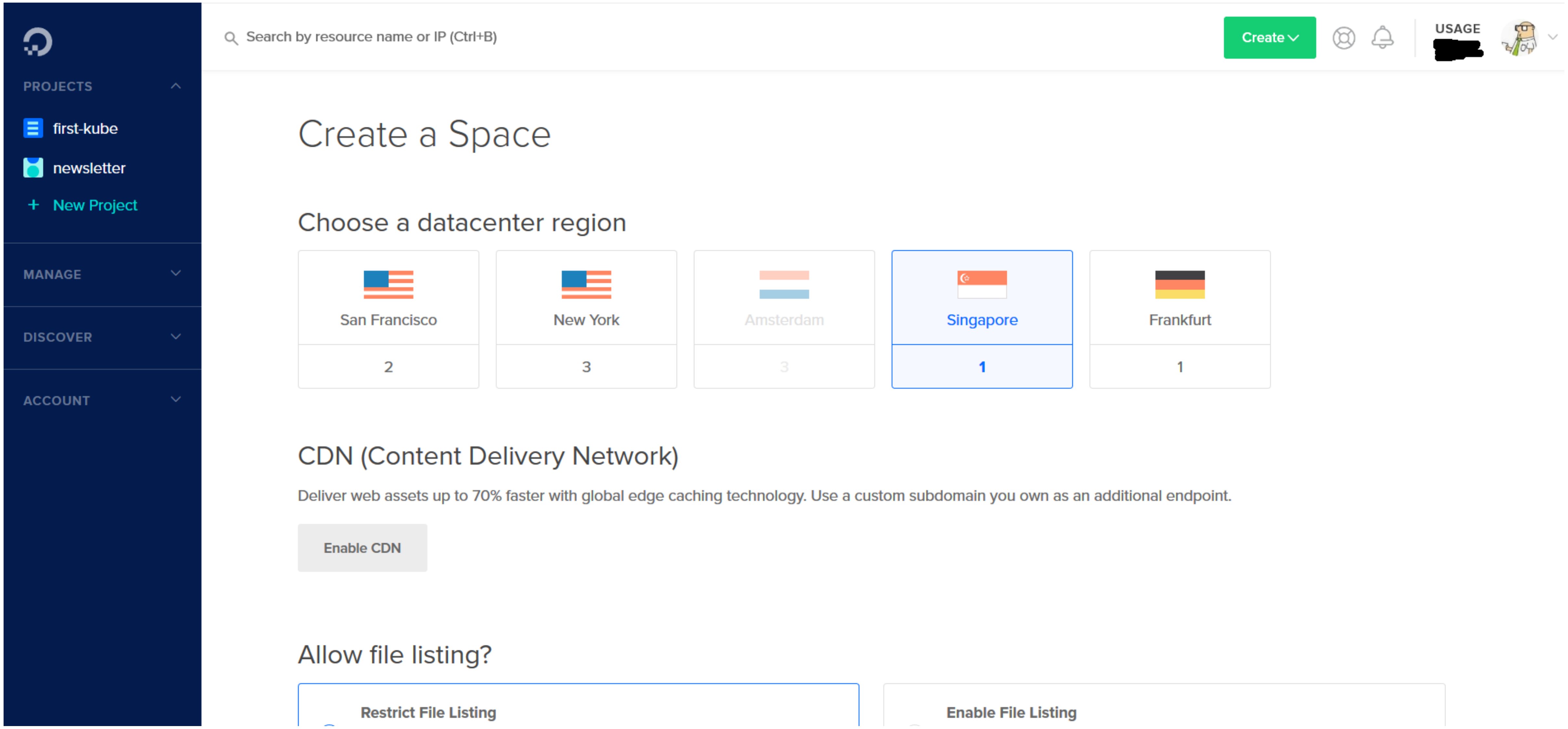
Floating IPs
Reserve IP addresses for Droplets

Load Balancers
Distribute traffic to Droplets

Alert Policies
Monitor your Droplets

Spaces
Store and serve static assets

Select Region



Search by resource name or IP (Ctrl+B)

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Create a Space

Choose a datacenter region

San Francisco	New York	Amsterdam	Singapore	Frankfurt
2	3	3	1	1

CDN (Content Delivery Network)

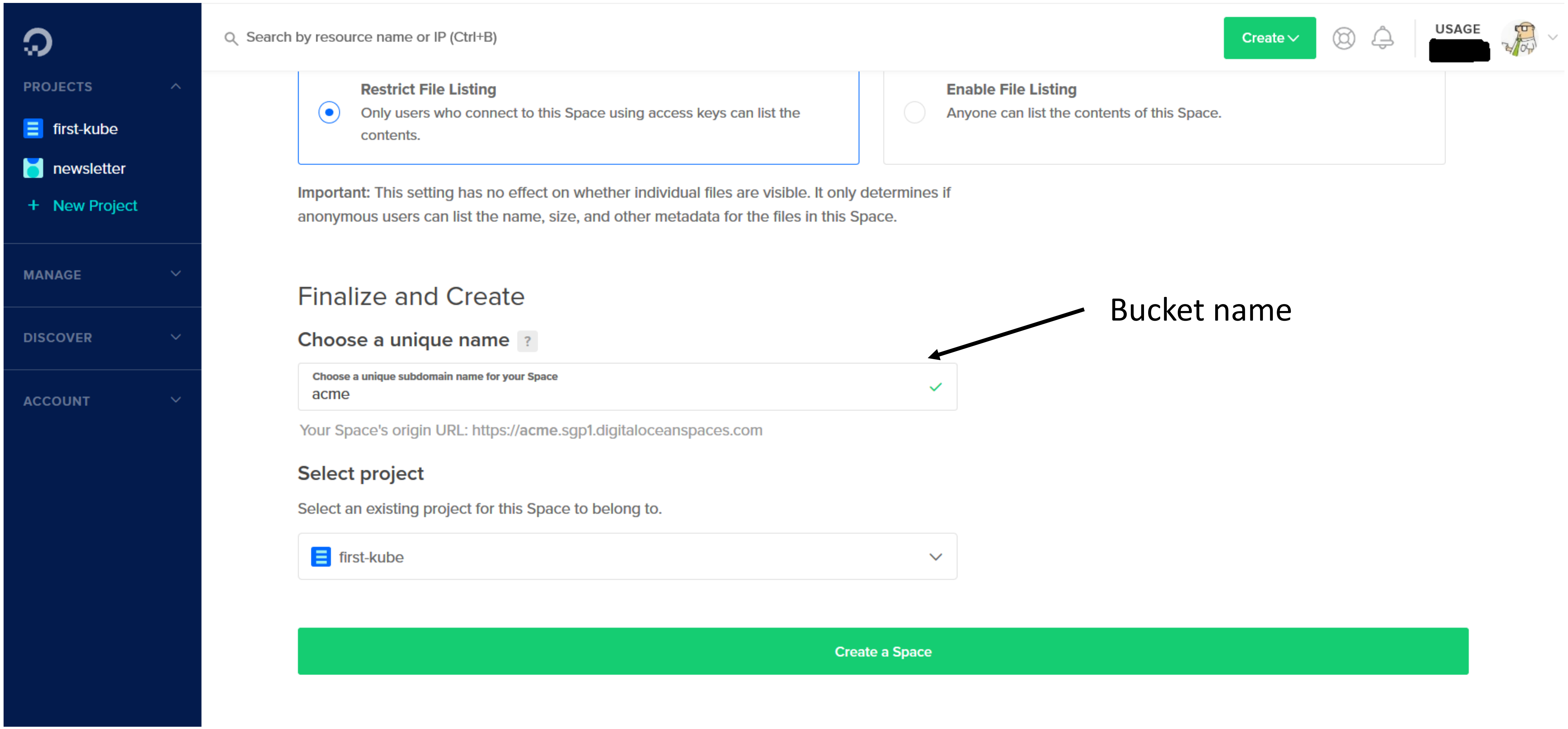
Deliver web assets up to 70% faster with global edge caching technology. Use a custom subdomain you own as an additional endpoint.

Enable CDN

Allow file listing?

[✓ Restrict File Listing] Enable File Listing

Specify Bucket Name



[redacted]

Restrict File Listing [✓]
Only users who connect to this Space using access keys can list the contents.

Enable File Listing
Anyone can list the contents of this Space.

Important: This setting has no effect on whether individual files are visible. It only determines if anonymous users can list the name, size, and other metadata for the files in this Space.

Finalize and Create

Choose a unique name

Choose a unique subdomain name for your Space: acme ✓

Your Space's origin URL: https://acme.sgp1.digitaloceanspaces.com

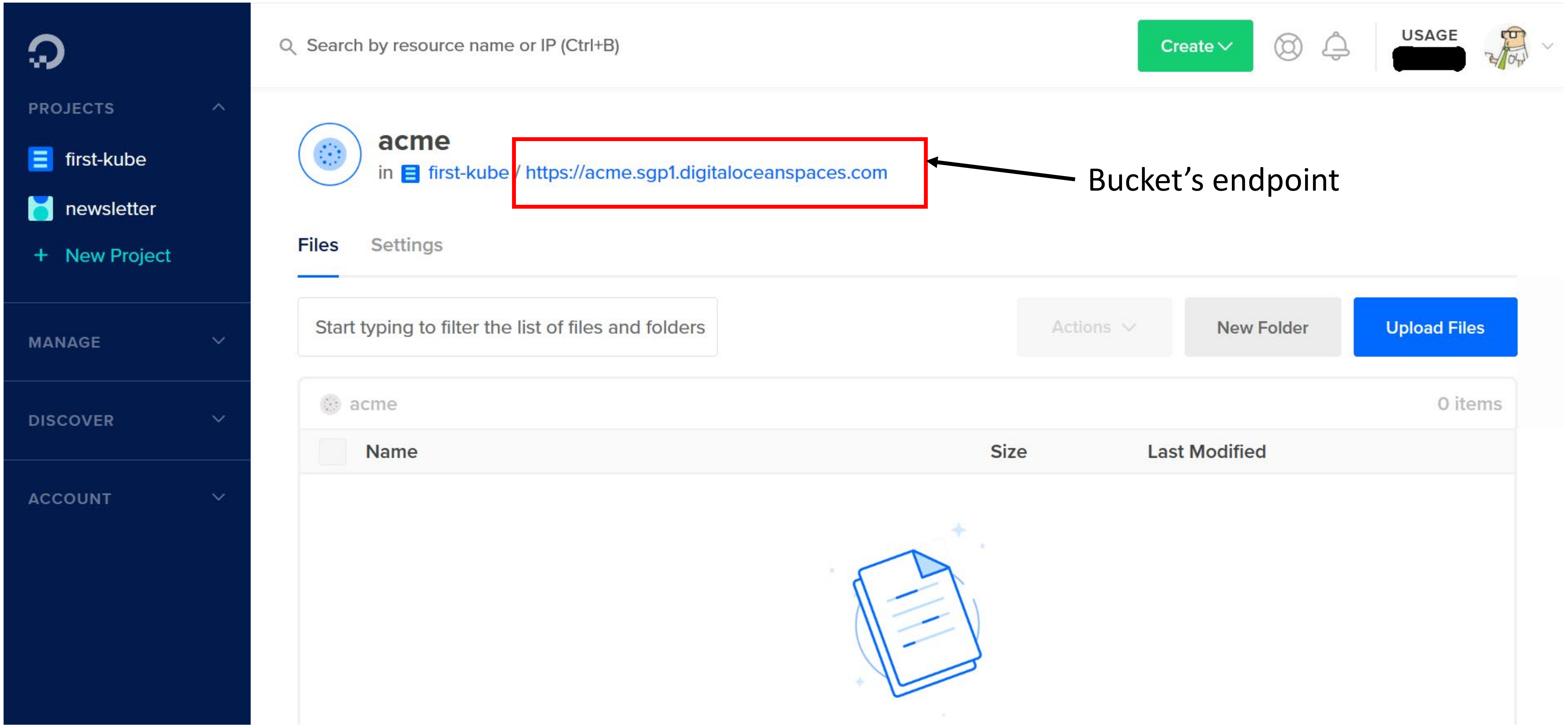
Select project

Select an existing project for this Space to belong to.

first-kube

Bucket name

Provisioned Bucket



Search by resource name or IP (Ctrl+B)

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acme

in first-kube / https://acme.sgp1.digitaloceanspaces.com

Files Settings

Start typing to filter the list of files and folders

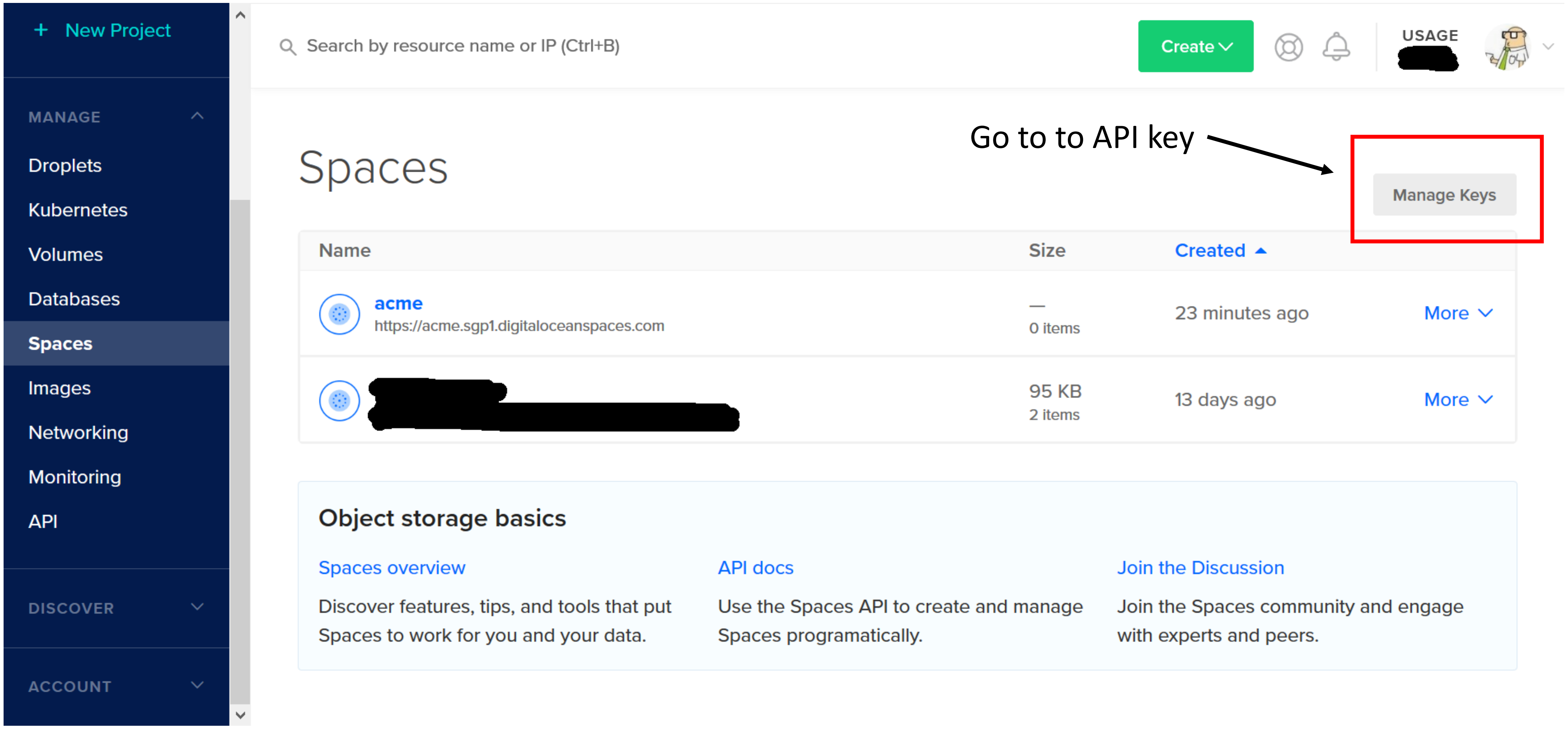
Actions New Folder Upload Files

acme 0 items

Name	Size	Last Modified

Bucket's endpoint

Generate Access Key


Go to to API key

Spaces

Name	Size	Created	
acme https://acme.sgp1.digitaloceanspaces.com	— 0 items	23 minutes ago	More
[redacted]	95 KB 2 items	13 days ago	More

Object storage basics

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Use the Spaces API to create and manage Spaces programatically.

Join the Discussion
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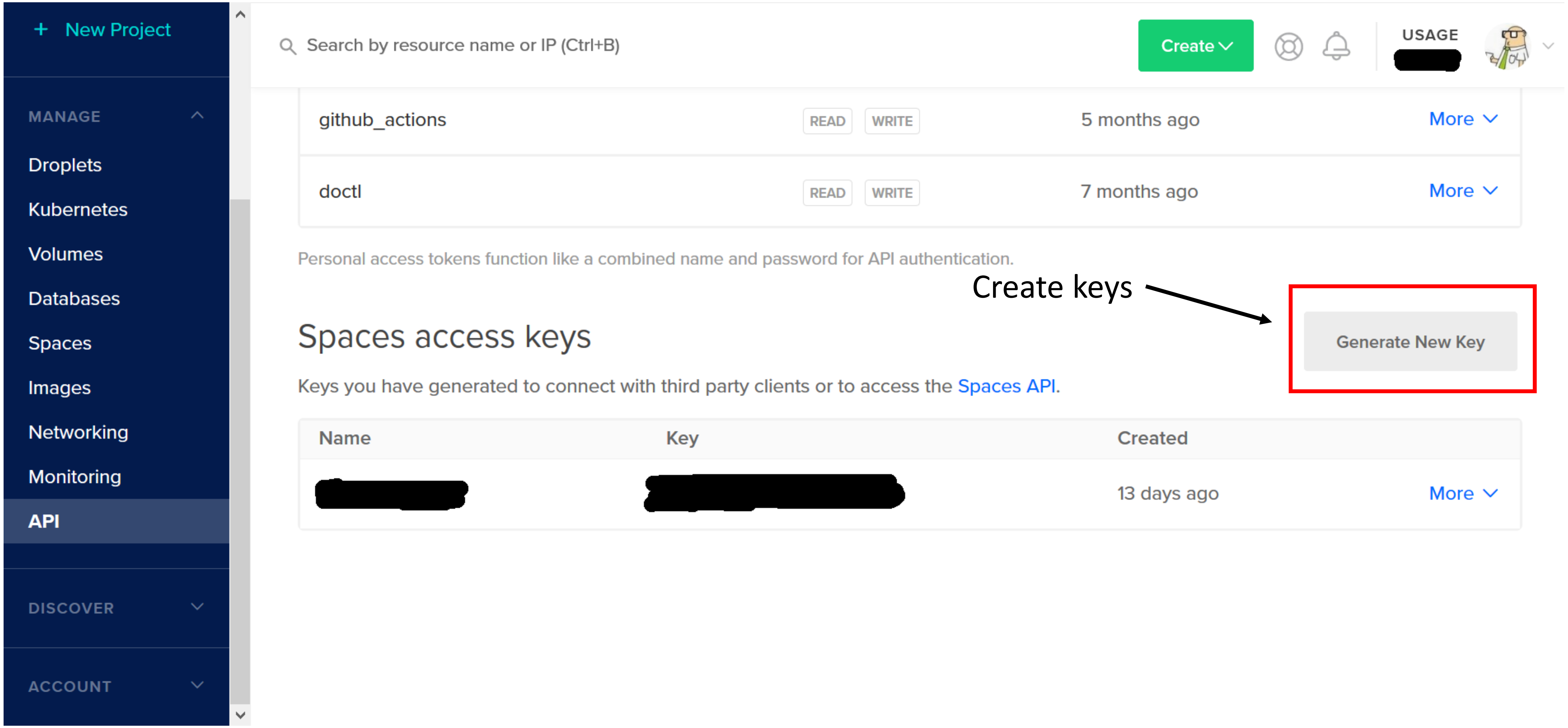
Generate Access Key



github_actions	READ WRITE	5 months ago	More
doctl	READ WRITE	7 months ago	More

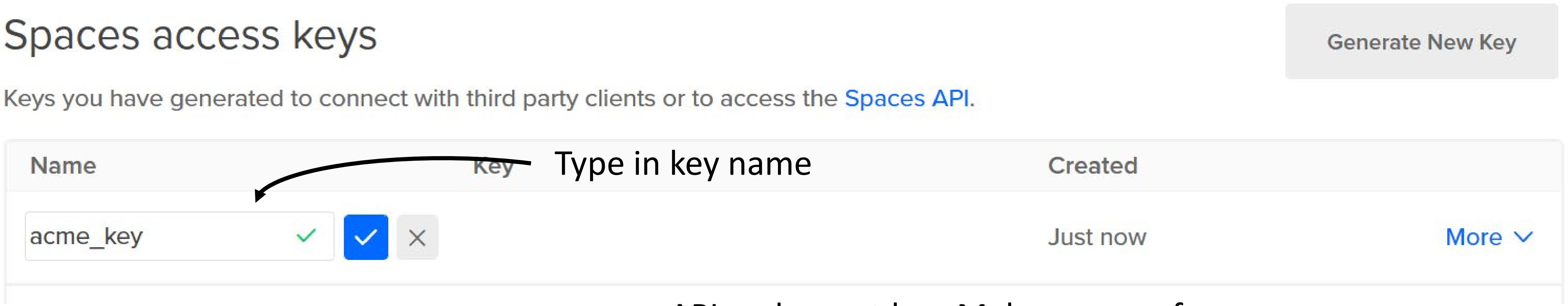
Personal access tokens function like a combined name and password for API authentication.

Spaces access keys

Keys you have generated to connect with third party clients or to access the Spaces API.

Name	Key	Created	
[redacted]	[redacted]	13 days ago	More

Generate Access Key



Spaces access keys

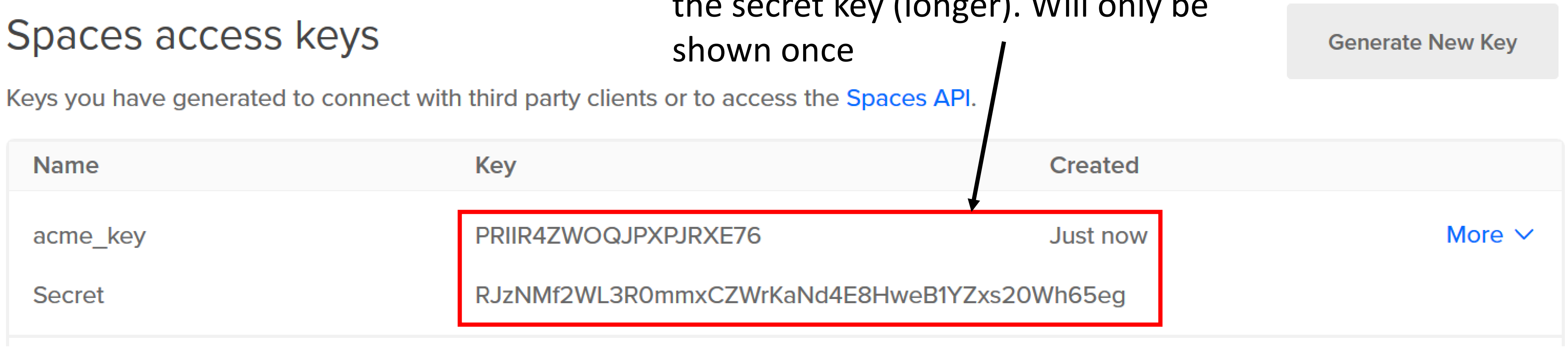
Generate New Key

Keys you have generated to connect with third party clients or to access the Spaces API.

Name	Key	Created	
acme_key		Just now	More

Type in key name

API and secret key. Make a copy of the secret key (longer). Will only be shown once



Spaces access keys

Generate New Key

Keys you have generated to connect with third party clients or to access the Spaces API.

Name	Key	Created	
acme_key	PRIIR4ZWOQJPXPJRXE76	Just now	More
Secret	RJzNMf2WL3R0mmxCZWrKaNd4E8HweB1YZxs20Wh65eg		

Setup

```
<dependency>
   <groupId>com.amazonaws</groupId>
   <artifactId>aws-java-sdk-s3</artifactId>
   <version> latest version </version>
</dependency>
<dependency>
   <groupId>org.glassfish.jaxb</groupId>
   <artifactId>jaxb-runtime</artifactId>
   <version> latest version </version>
</dependency>
<dependency>
   <groupId>javax.xml.bind</groupId>
   <artifactId>jaxb-api</artifactId>
   <version>2.4.0-b180830.0359</version>
</dependency>
```

Configure S3 Client

Create credentials with the access and secret key pair

Configure the S3 endpoint

```
@Bean
public AmazonS3 getS3Client() {
   BasicAWSCeredentials cred = new BasicAWSCredentials(
        spacesAccess, spacesSecret);

   EndpointConfiguration epConfig = new EndpointConfiguration(
        "sgp1.digitaloceanspaces.com", "sgp1");

   return AmazonS3ClientBuilder.standard()
        .withEndpointConfiguration(epConfig)
        .withCredentials(new AWSStaticCredentialsProvider(cred))
        .build();
}
```

Build the S3 client with the credentials and endpoint

PutObject into S3 Bucket

```
@PostMapping(consumes=MediaType.MULTIPART_FORM_DATA_VALUE)
public ResponseEntity<String> postUpload(@RequestPart Multipart file,
     @RequestPart String name, @RequestPart String email) {

   Map<String, String> userData = new HashMap<>();
   userData.put("name", name);
   userData.put("email", email);
   ...

   ObjectMetadata metadata = new ObjectMetadata();
   metadata.setContentType(file.getContentType());
   metadata.setContentLength(file.getSize());
   metadata.setUserMetadata(userData);

   ...
}
```

One or more file metadata to be associated with the object

Set the media type of the object

Associate the user data with the object

PutObject into S3 Bucket

Create a put request with the bucket's name, the key name (eg `dog.png`), input stream and the metadata

```
@Autowired
private AmazonS3 s3;

@PostMapping(consumes=MediaType.MULTIPART_FORM_DATA_VALUE)
public ResponseEntity<String> postUpload(@RequestPart Multipart file,
     @RequestPart String name, @RequestPart String email) {

   ...
   PutObjectRequest putReq = new PutObjectRequest("mybucket",
     "pet/%s".formatted(file.getName()), file.getInputStream(), metadata);
   putReq = putReq.withCannedAcl(CannedAccessControlList.PublicRead);

   s3.putObject(putReq);
   ...
}
```

Configure the object to be publically accessible

Upload the file to the S3 bucket

Handling exception not shown

PutObject into S3 Bucket

```
https://mybucket.sgp1.digitaloceanspaces.com/pet/dog.png
```

```
GET /pet/dog.png
```

```
200 OK
Content-Length: 123456
Content-Type: image/png
X-Amz-Meta-name: fred
X-Amz-Meta-email: fred@gmail.com
```

Content-Length and Content-Type: From `ObjectMetadata`

X-Amz-Meta-name and X-Amz-Meta-email: From user's metadata

GetObject from S3 Bucket

```
try {
  GetObjectRequest getReq = new GetObjectRequest("mybucket", "pet/dog.png");
  S3Object result = s3.getObject(getReq);
  ObjectMetadata metadata = result.getObjectMetadata();
  Map<String, String> userData = metadata.getUserMetadata();
  try (S3ObjectInputStream is = result.getObjectContent()) {
    byte[] buffer = is.getAllBytes();
    return ResponseEntity.status(HttpStatus.OK)
      .contentLength(result.getContentLength())
      .contentType(MediaType.parseMediaType(result.getContentType())
      .header("X-name", userData.get("name"))
      .body(buffer);
  }
} catch (AmazonS3Exception ex) {
  // If key is not found
} catch (Exception ex) {
  // For S3ObjectInputStream
}
```

Create a get object request with the bucket name and key

Get the object

Get the metadata and user data

Get the object's content from its `InputStream`

S3 client will throw an exception if the object is not found. Return a 404