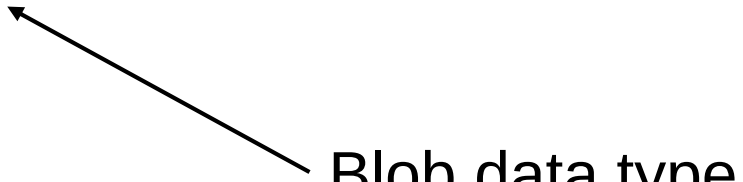
Day 37

BLOB Data Type

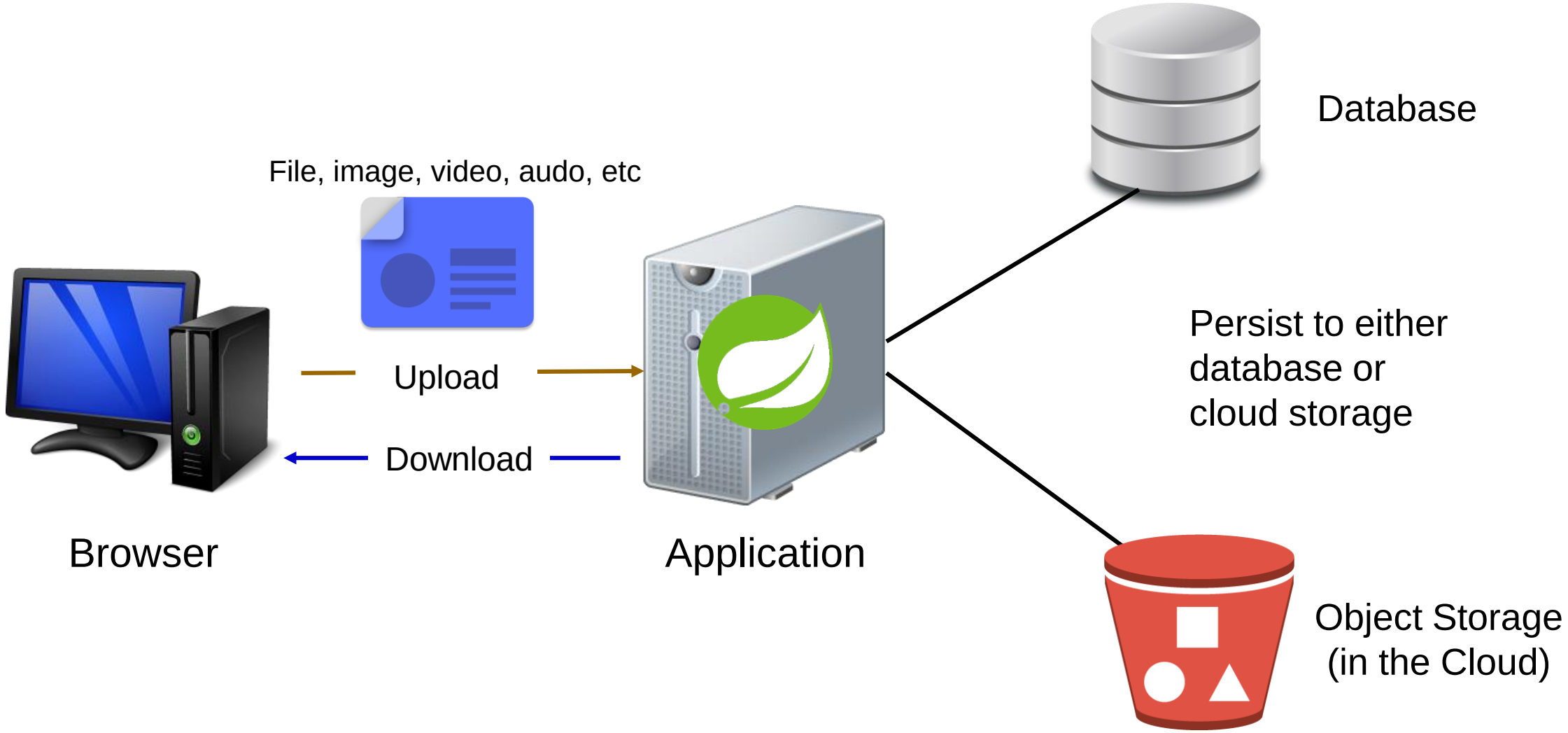
- BLOB (Binary Large Object) is a special type of column in MySQL for storing binary data
  - Eg. images, files, MP3, etc.
- Unlike other columns, the contents of BLOB are not searchable, sortable or comparable
  - Need to have additional columns to hold the BLOB's metadata
  - Eg. media type, size, 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)
);
```



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


```
<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>
```

Set the input type to `file`

Optionally set the type of file to upload

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/*"
    formControlName="file" #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

Populate the `FormData` instance

Access the DOM attribute with `nativeElement` attribute

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--
```

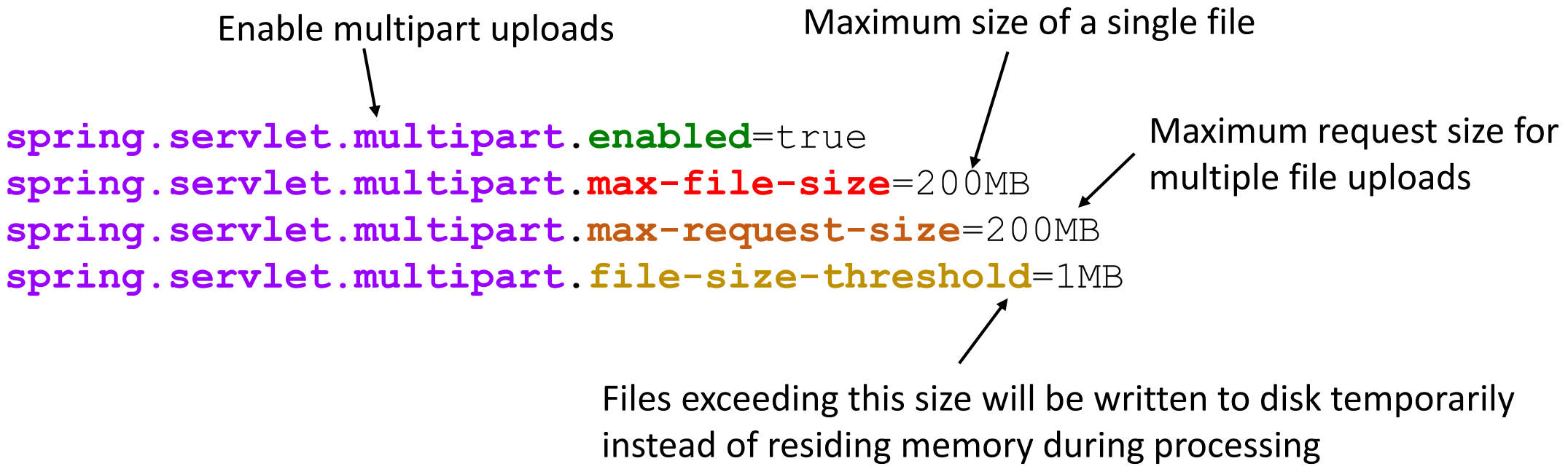
Field separator

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`



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">
  ...
```

as multipart/data-form

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

```
@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
   )
}
```

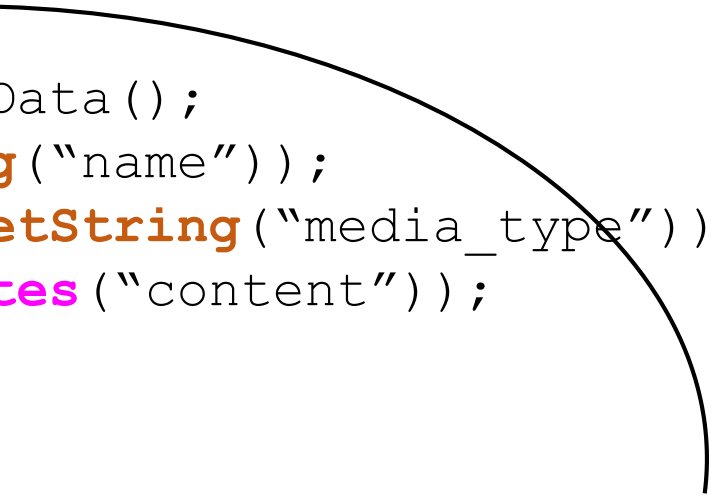
Use `next()` to determine if the query produces any result

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?

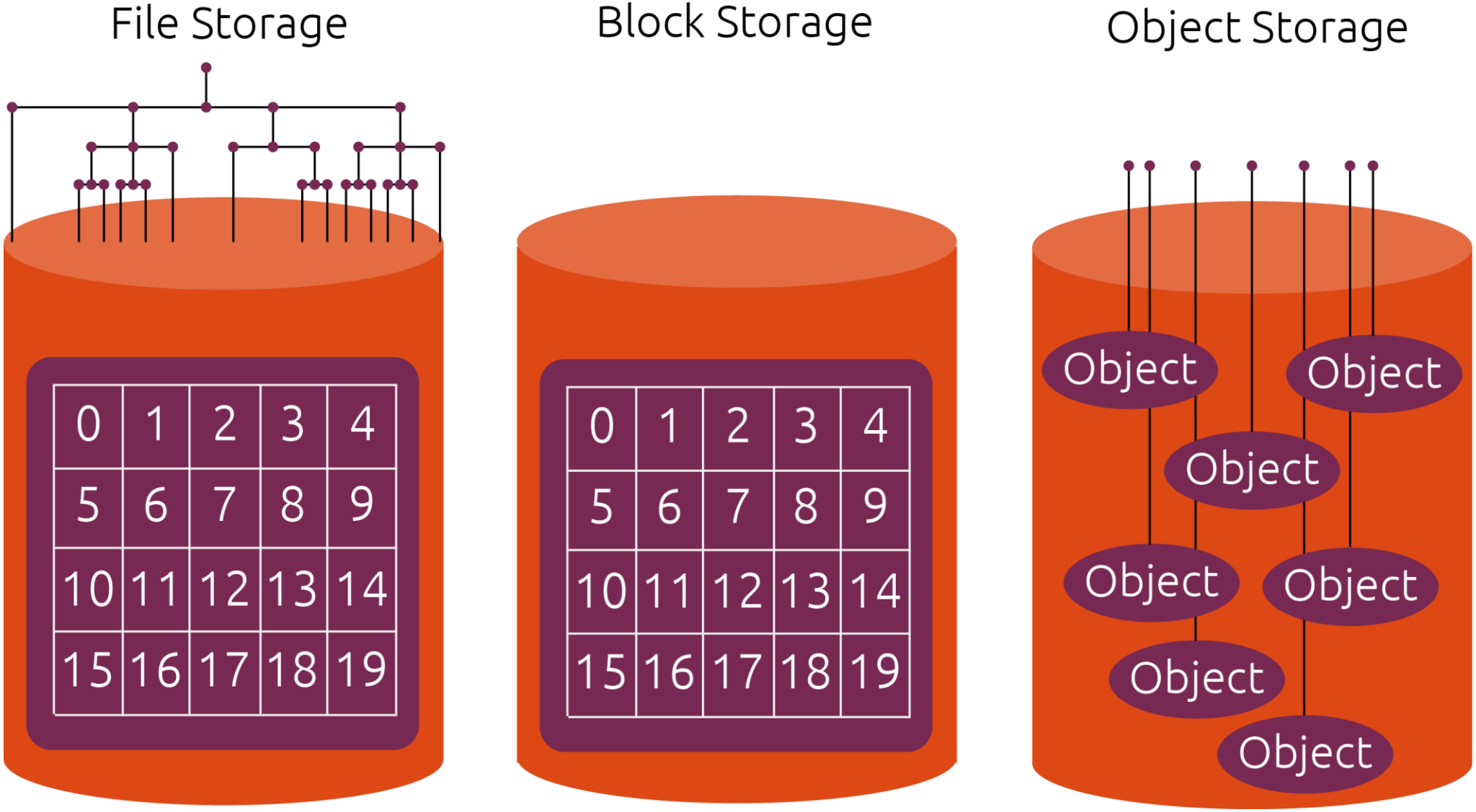
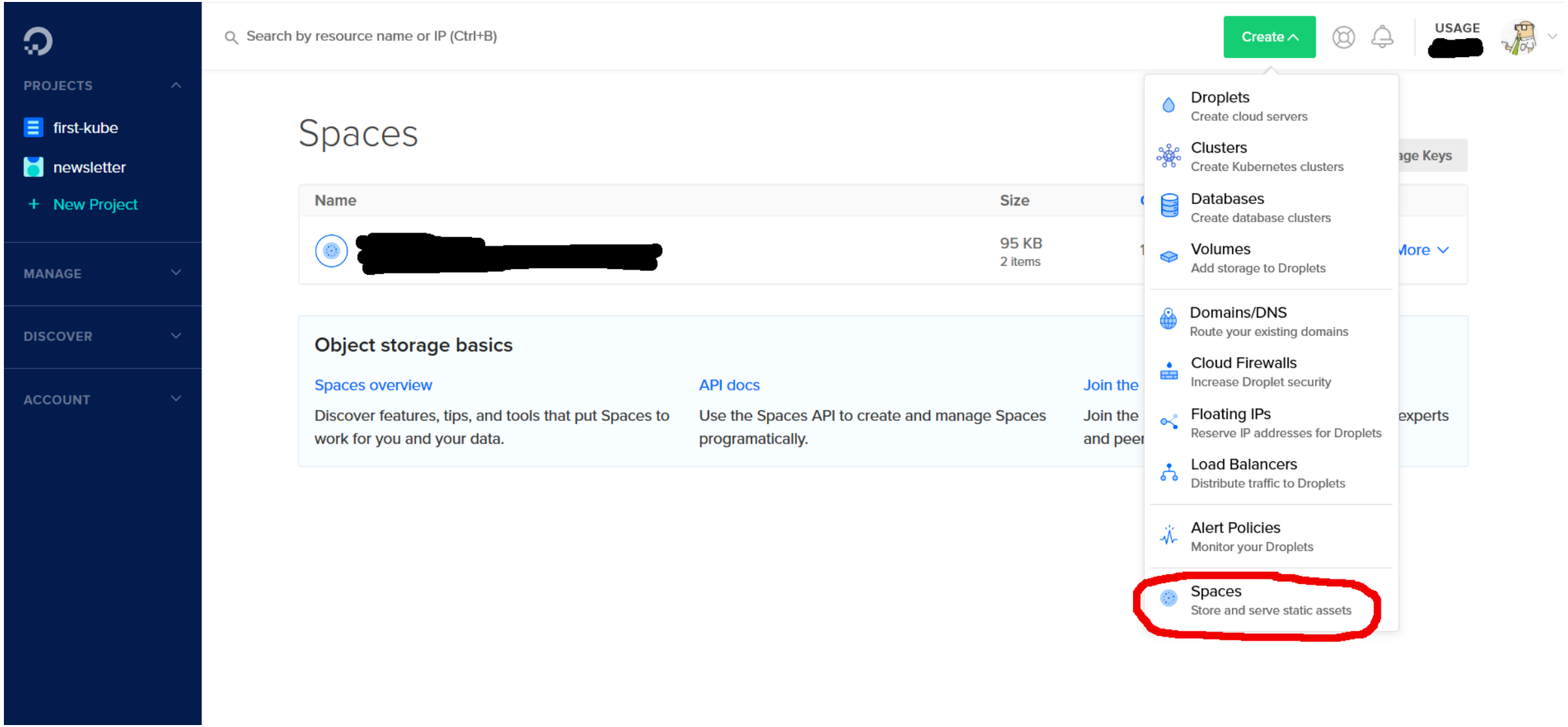


Image from https://ubuntu.com/blog/what-are-the-different-types-of-storage-block-object-and-file

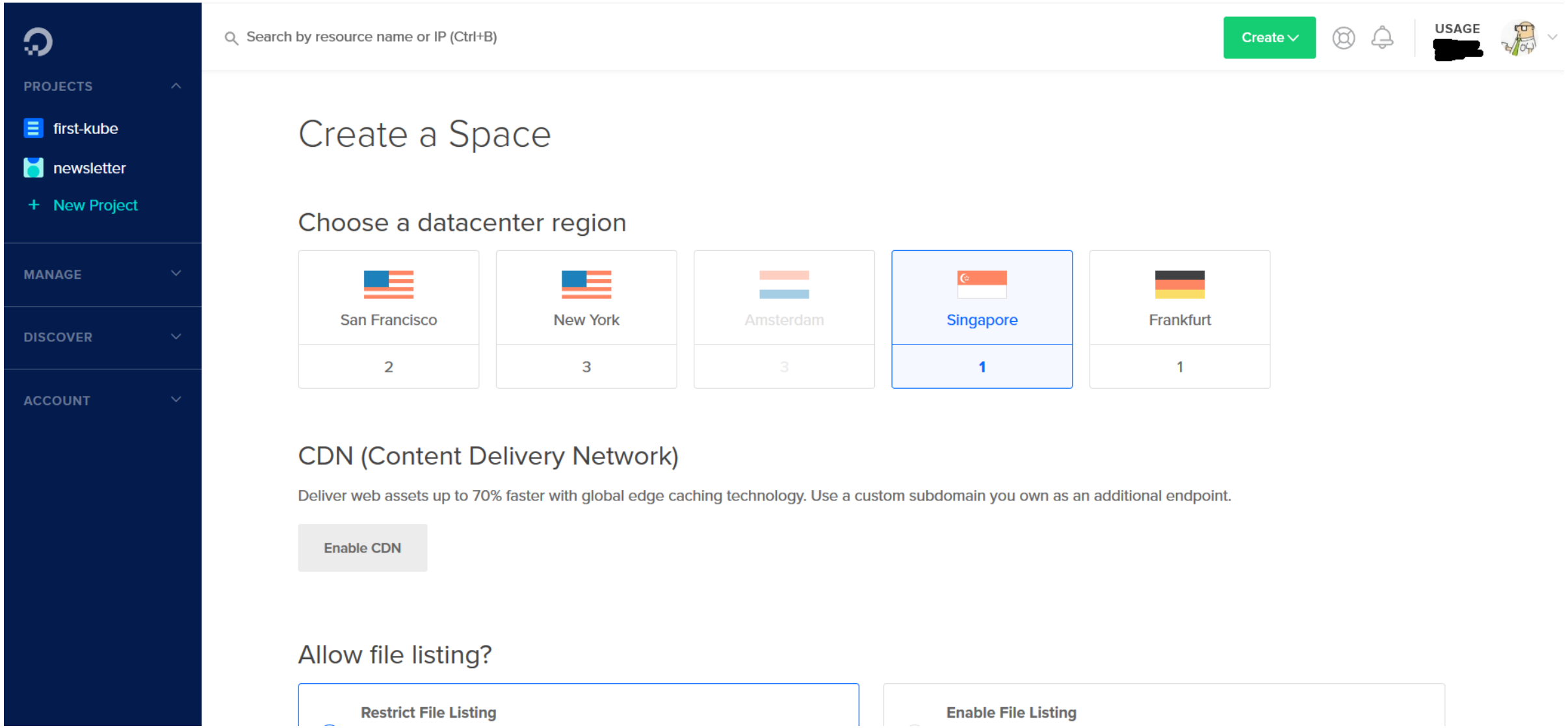
Object Storage

- 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

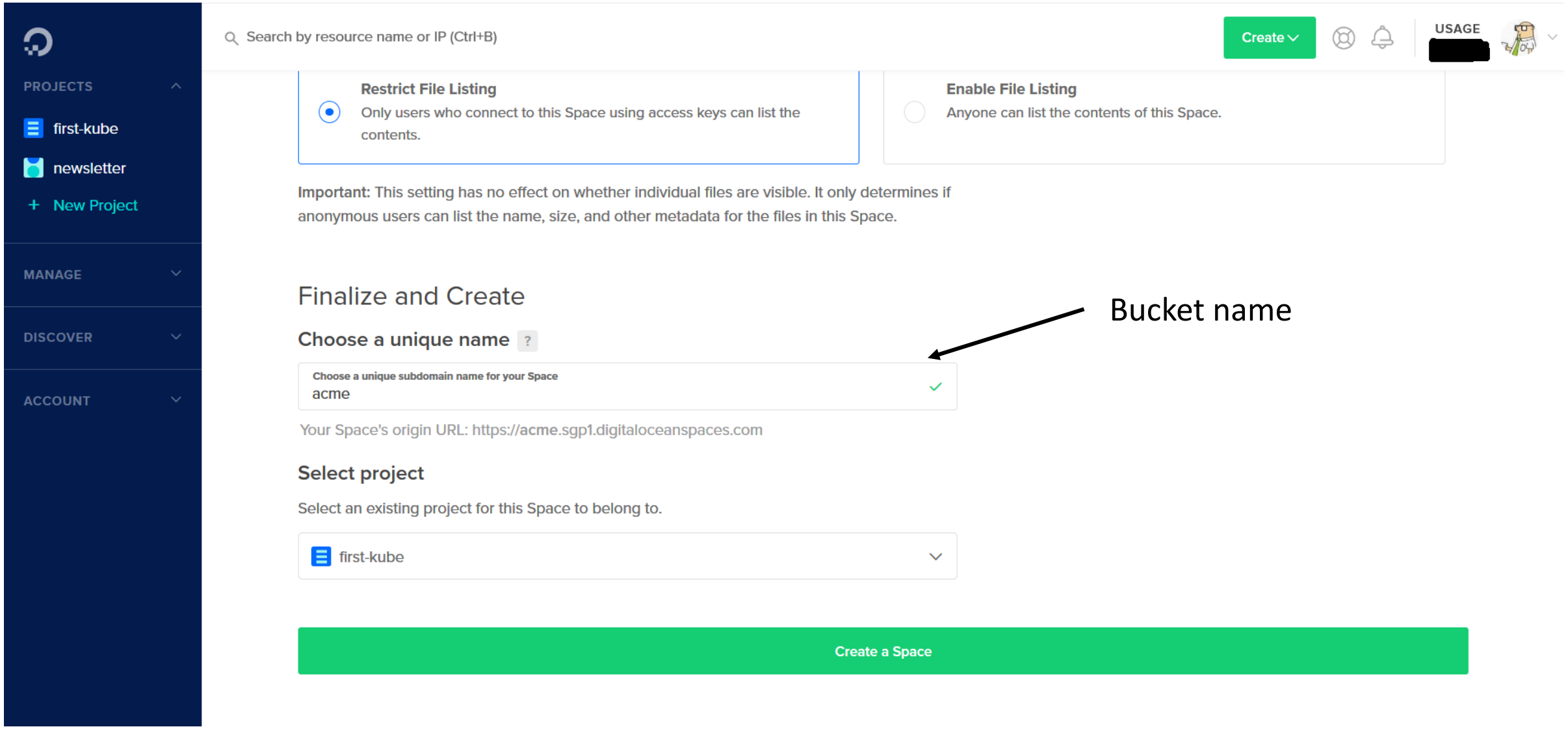
Creating a S3 Compatible Storage



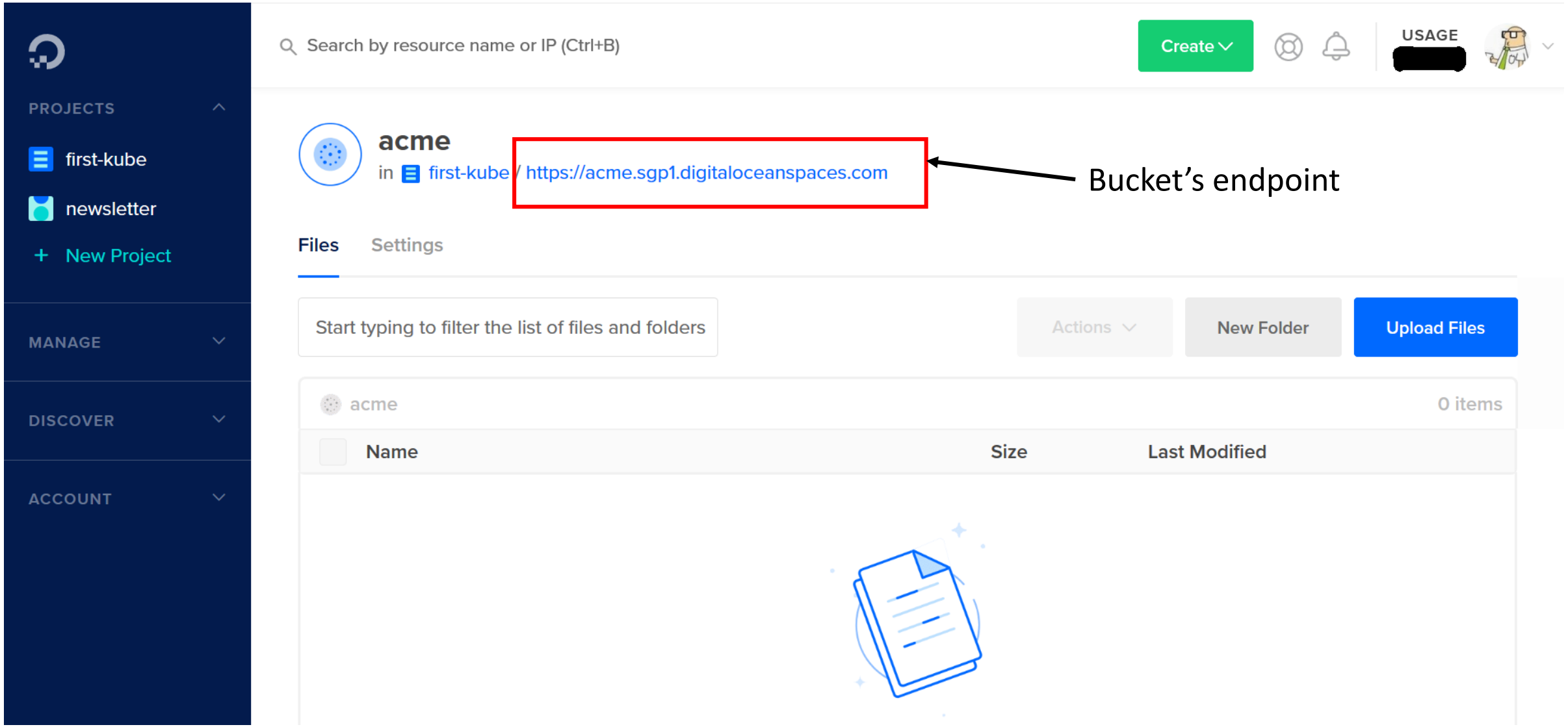
Select Region



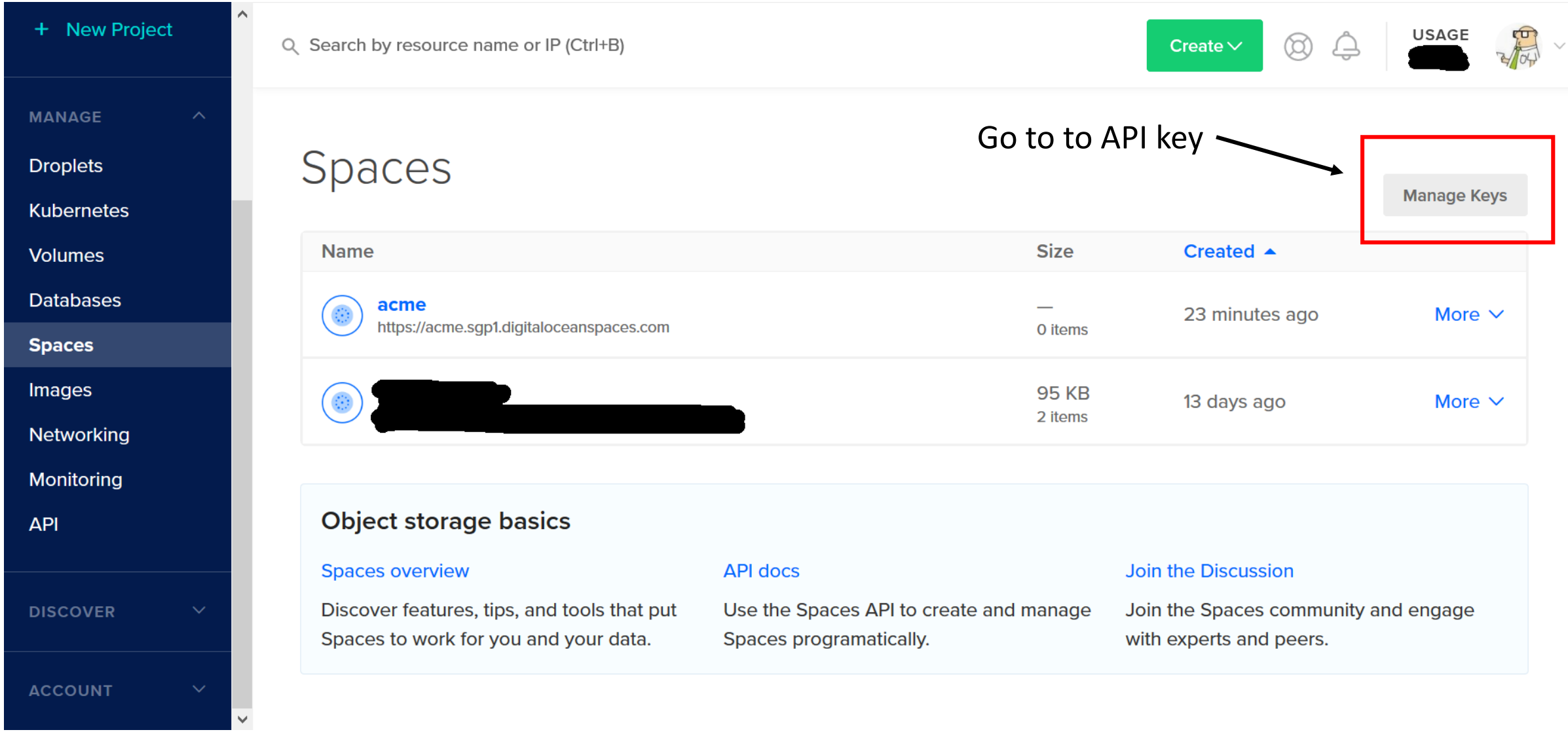
Specify Bucket Name



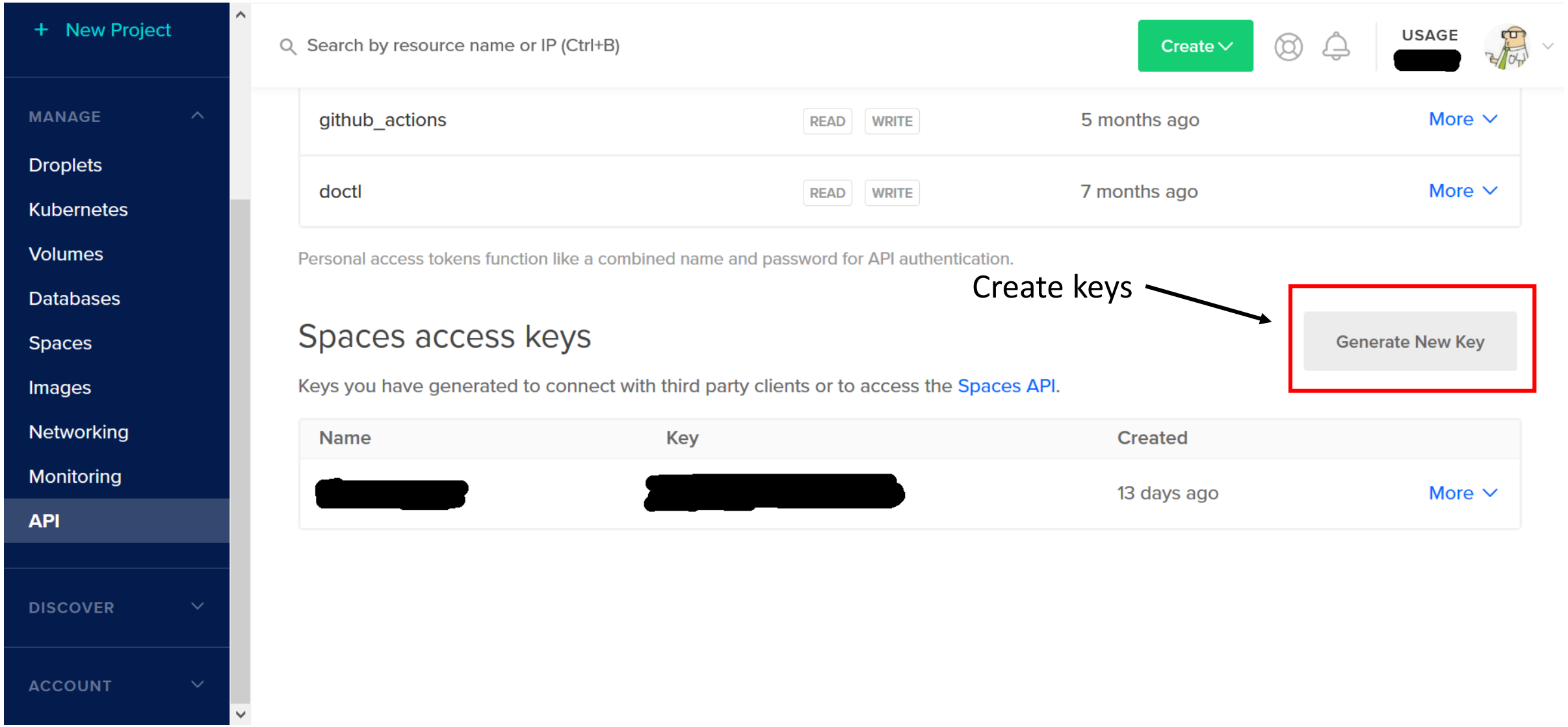
Provisioned Bucket



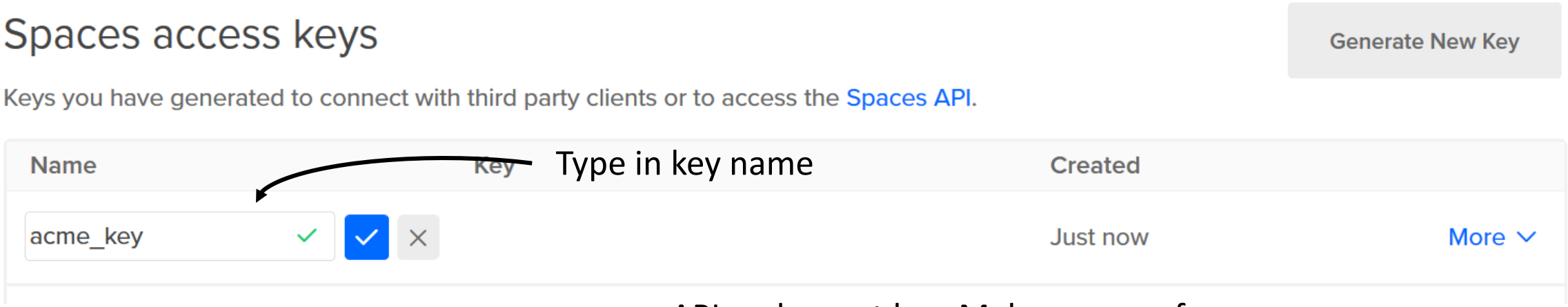
Generate Access Key

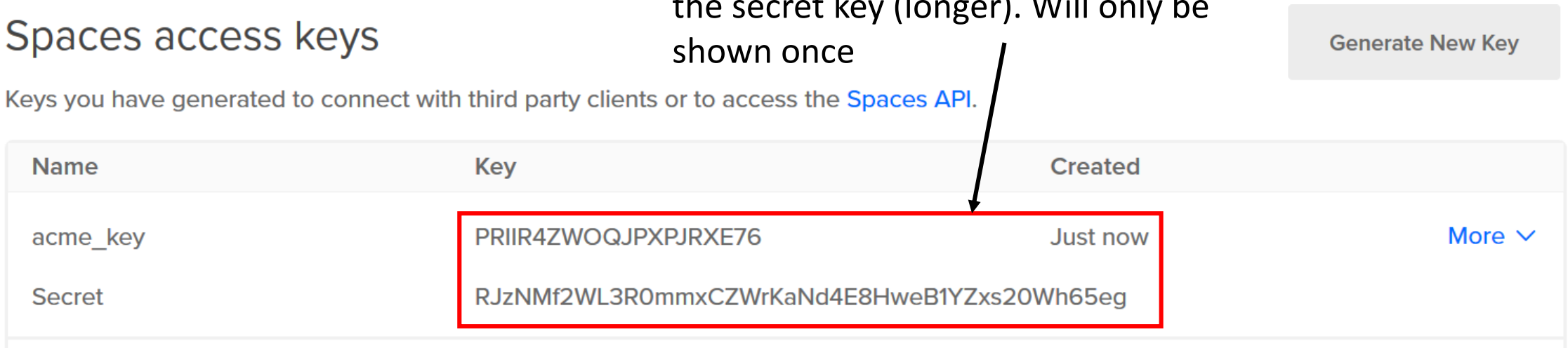


Generate Access Key



Generate Access Key





Setup

- Add the following dependencies

```
<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>
```

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

```
@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);
   ...
}
```

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

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
```

From `ObjectMetadata`

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