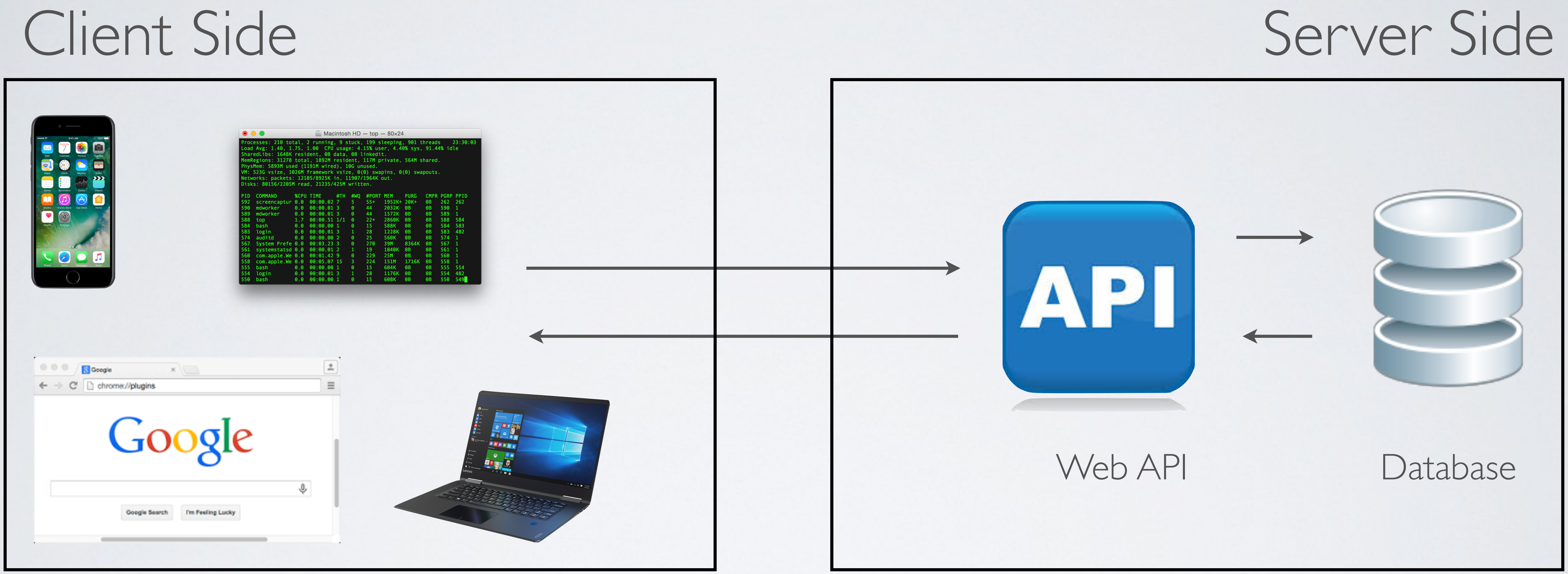
Storing Data and Files

Thierry Sans

Storing Data in a Database

Modern Web Platform



```
Processes: 210 total, 2 running, 9 stuck, 199 sleeping, 901 threads    23:30:03
Load Avg: 1.40, 1.75, 1.00  CPU usage: 4.15% user, 4.40% sys, 91.44% idle
SharedLibs: 1648K resident, 0B data, 0B linkedit.
MemRegions: 31278 total, 1892M resident, 117M private, 564M shared.
PhysMem: 5893M used (1191M wired), 10G unused.
VM: 523G vsize, 1026M framework vsize, 0(0) swapins, 0(0) swapouts.
Networks: packets: 12105/8925K in, 11907/1964K out.
Disks: 80156/2205M read, 21235/425M written.

PID  COMMAND      %CPU TIME     #TH  #WQ  #PORT MEM    PURG   CMPR PGRP PPID
592  screencaptur 0.0  00:00.02 7    5    55+   1952K+ 20K+   0B   262  262
590  mdworker     0.0  00:00.01 3    0    44    2032K  0B     0B   590  1
589  mdworker     0.0  00:00.01 3    0    44    1572K  0B     0B   589  1
588  top          1.7  00:00.51 1/1  0    22+   2860K  0B     0B   588  584
584  bash         0.0  00:00.00 1    0    15    588K   0B     0B   584  583
583  login        0.0  00:00.01 3    1    28    1228K  0B     0B   583  482
574  auditd       0.0  00:00.00 2    0    25    560K   0B     0B   574  1
567  System Prefe 0.0  00:03.23 3    0    270   39M    8364K  0B   567  1
561  systemstatsd 0.0  00:00.01 2    1    19    1040K  0B     0B   561  1
560  com.apple.We 0.0  00:01.42 9    0    229   25M    0B     0B   560  1
558  com.apple.We 0.0  00:05.07 15   3    224   151M   1716K  0B   558  1
555  bash         0.0  00:00.00 1    0    15    604K   0B     0B   555  554
554  login        0.0  00:00.01 3    1    28    1176K  0B     0B   554  482
550  bash         0.0  00:00.00 1    0    15    608K   0B     0B   550  549
```

Why using a database

- Persistency
- Concurrency (avoid race conditions)
- Query
- Scalability

SQL vs NoSQL databases

Relational database (SQL database)

Data structure	tables and tuples
Query language	SQL
Inconvenient	not-optimized for big data analysis
Advantage	complex queries
Technology	*PostgreSQL, MySQL, MariaDB, SQLite, MSSQL*

NoSQL database

Data structure	key/value pairs
Query language	API style
Inconvenient	not adequate for complex queries
Advantage	optimized for big data analysis
Technology	*MongoDB, Redis, CouchDB, NeDB*

ORM - Object Relational Mapping

➡ Mapping between (OOP) objects and the database structure

Examples

- *Sequelize* for *PostgreSQL, MySQL, MariaDB, SQLite*
- *Mongoose* for *MongoDB*

Do/Don't

- Do **retrieve selected elements only**
  rather than retrieving an entire collection and filtering afterwards
- Do **define primary keys**
  rather than relying on auto-generated ones
- Do **split data into different collections**
  rather than storing list attributes
- Do **create join collections** whenever appropriate
  (only for NoSQL database without performant join feature)

Retrieving collections with paginated results

➡ Only retrieve what you need from a potentially large collection

Examples

```
GET /messages[?page=0]
GET /messages?page=1
GET /messages[?max=100]
GET /messages?max=20
```

Handling files

Browser restrictions

- It is **impossible** to write a piece of code that reads an arbitrary file in (client-side) Javascript

➡ Only files selected by users through file input forms can be processed

```
<form . . . >
    <input type="file" name="img" multiple>
    <input type="submit">
</form>
```

[optional] select multiple files

Sending a file from the terminal

```
$ curl -X POST
       -H "Content-Type: multipart/form-data"
       -F "picture=@localpath/to/img.png"
       -F "username=bart"
       http://...
```

Sending a file from the browser

- **Form action** (with page refresh)

```
<form action="/url"
      method="POST"
      enctype="multipart/form-data">
```

- **Fetch request** (without page refresh)

```
const file = document.get ...
const data = new FormData();
data("picture", file);
 fetch( "/api/users/", {
   method: "POST",
      body: data
 })
```

What is received on the server

File metadata

- filename
- mimetype (file type)
- size
- and others

File content

- Compressed binary or string

MIME types

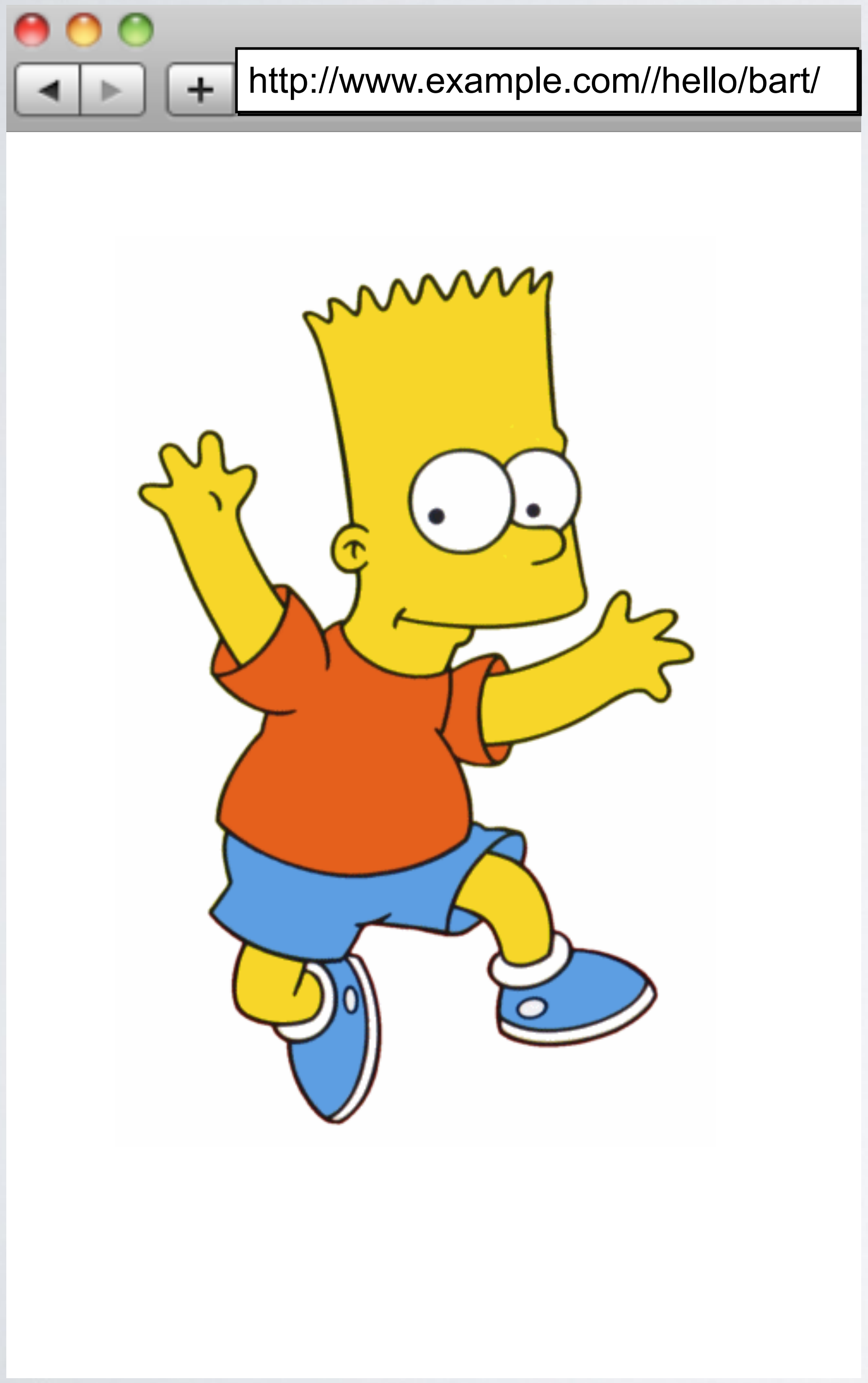
MIME (Multipurpose Internet Mail Extensions)
is also known as the **content type**

➡ Define the format of a document exchanged on internet (IETF standard) http://www.iana.org/assignments/media-types/index.html

Examples of MIME types

- text/html
- text/css
- text/javascript
- image/jpeg - image/gif - image/svg - image/png (and so on)
- application/pdf
- application/json

Example of how images are retrieved



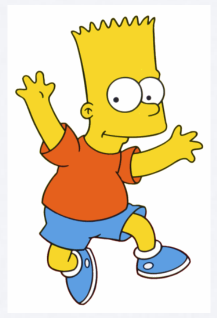
GET hello/bart/

```
<html>
  <body>
    <img src=images/bart.jpg/>
  </body>
</html>
```

MIME : text/html

API

GET images/bart.jpg



MIME : image/jpg

Do/Don't with files

- Do **not** send a base64 encoded file content with JSON, use **`multipart/form-data`** instead (compression)
- Do **not** store uploaded files with the static content
- Do **not** serve uploaded files statically (security)
- Do store the mimetype and set the HTTP response header mimetype when files are sent back