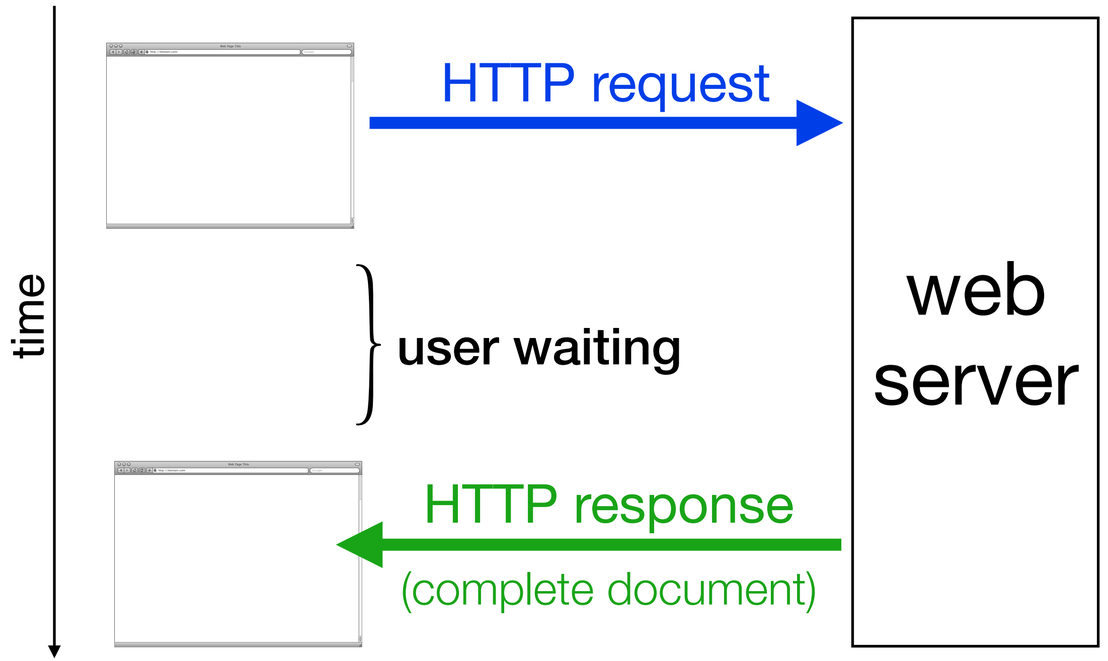
Web Programming
AJAX

Leander Jehl | University of Stavanger

Traditional web interaction

- User requests a page = browser (client) sends HTTP request to server
- Browser is “blocked” from activity while it waits for the server to provide the document
- When the response arrives, the browser renders the document



synchronous request-response communication

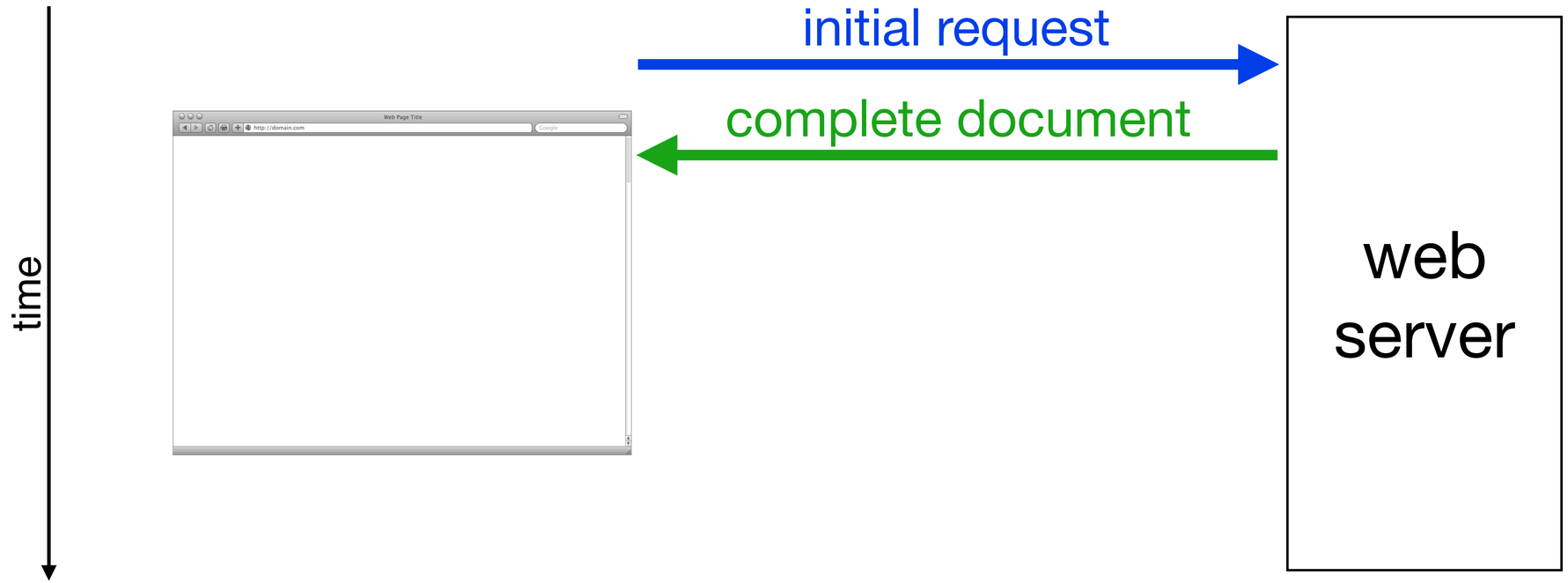
Motivation

- Provide web-based applications with rich user interfaces and responsiveness
- This requires frequent interactions between the user and the server
  - Speed of interactions determines the usability of the application!
- Often, only (relatively small) parts of the documents are modified or updated. No need to reload the entire page
- Client might want to send data to the server in the background

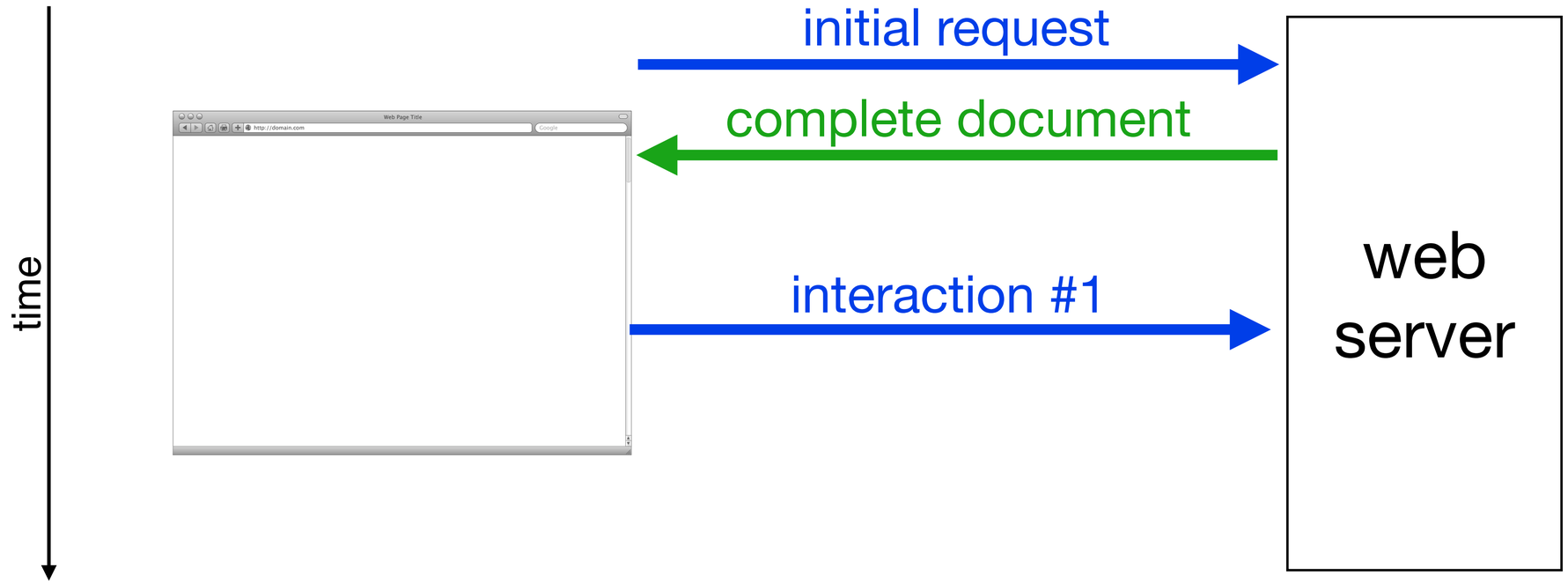
AJAX

- **A**synchronous **J**avaScript **a**nd **X**ML
- Combination of web technologies
  - Client side: HTML, JavaScript
  - Server side: any programming language
  - Despite the name, XML is not required!
- Two key features
  - Retrieve data, not pages
  - Asynchronous, i.e., no need to "lock" the document while waiting for the response

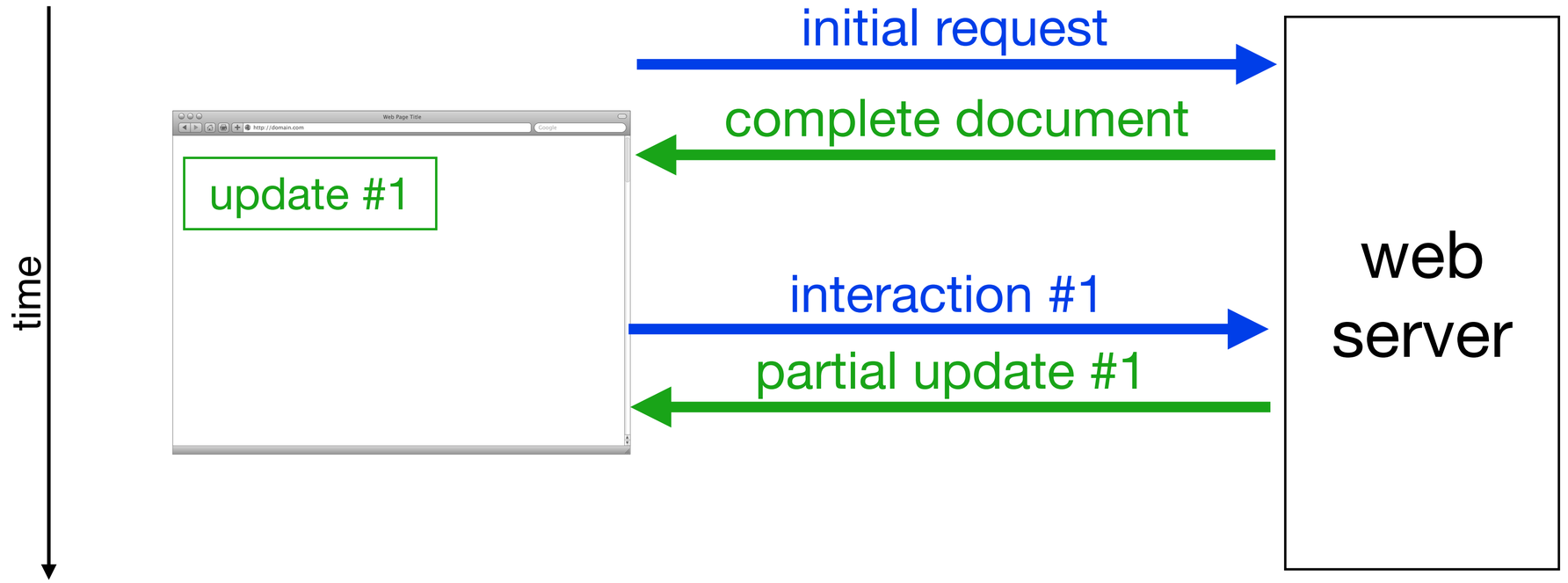
AJAX interaction



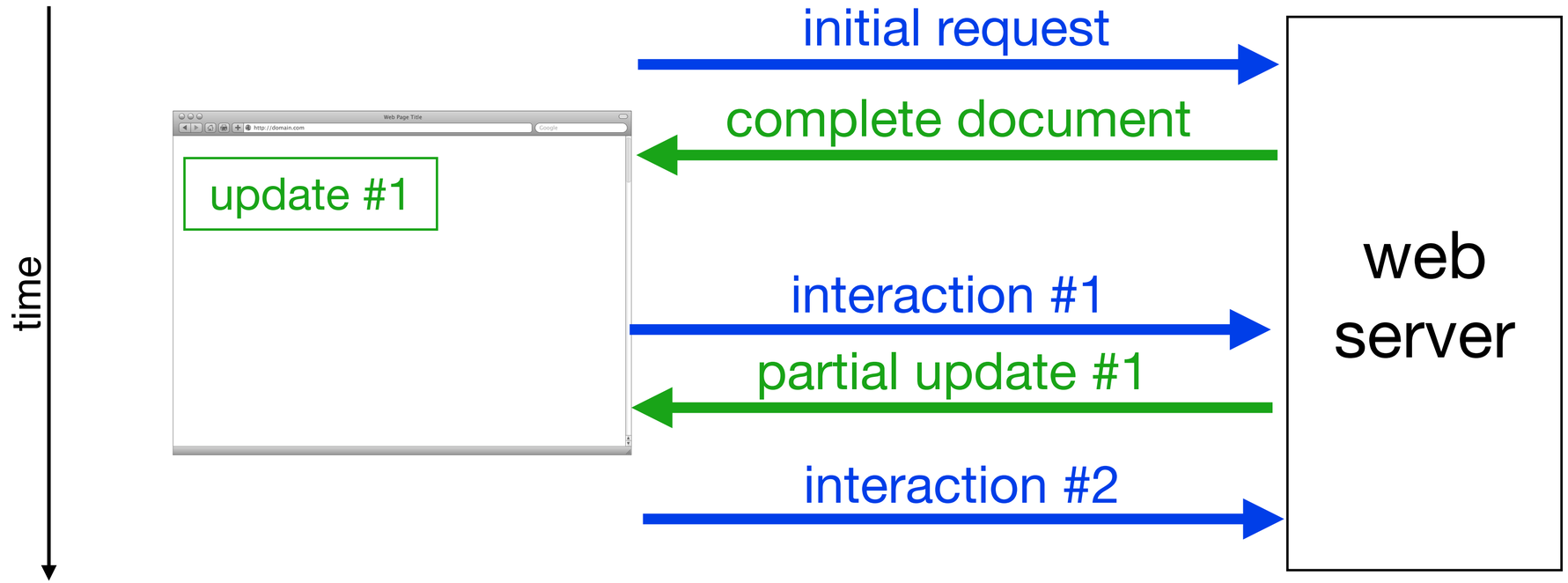
AJAX interaction



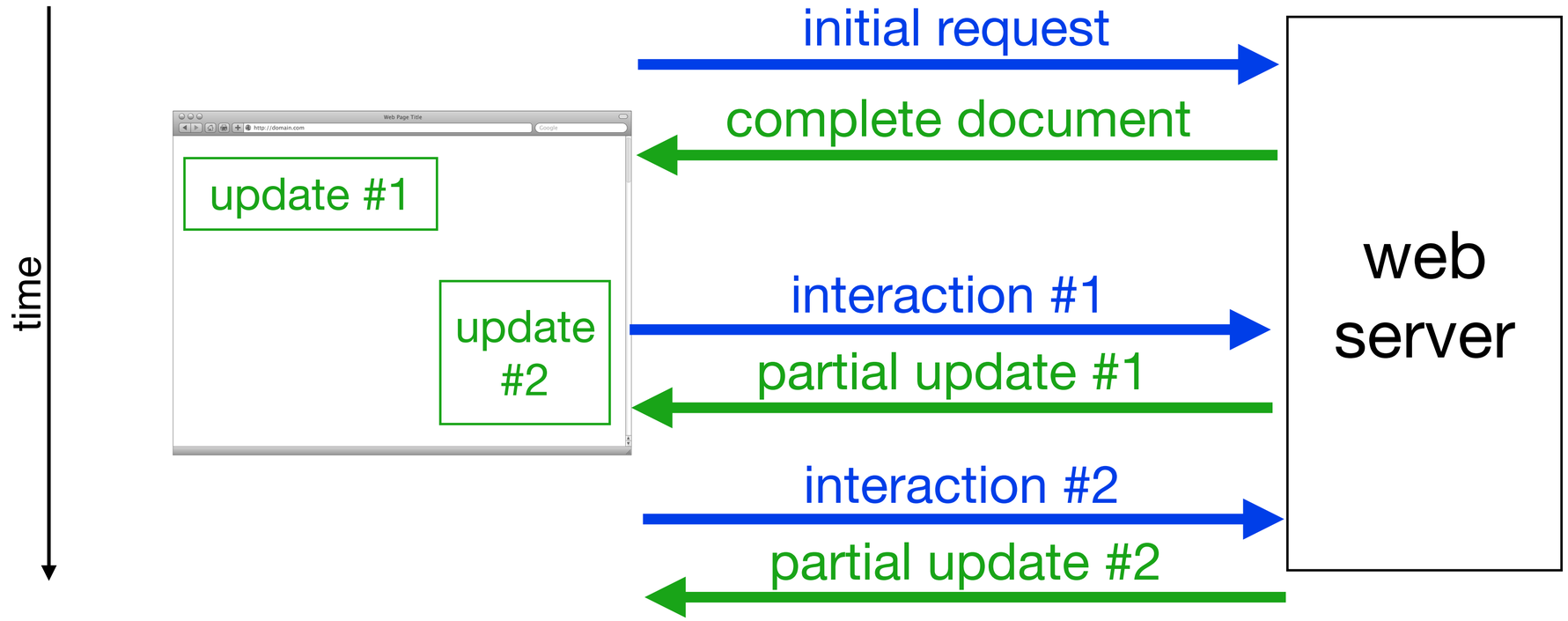
AJAX interaction



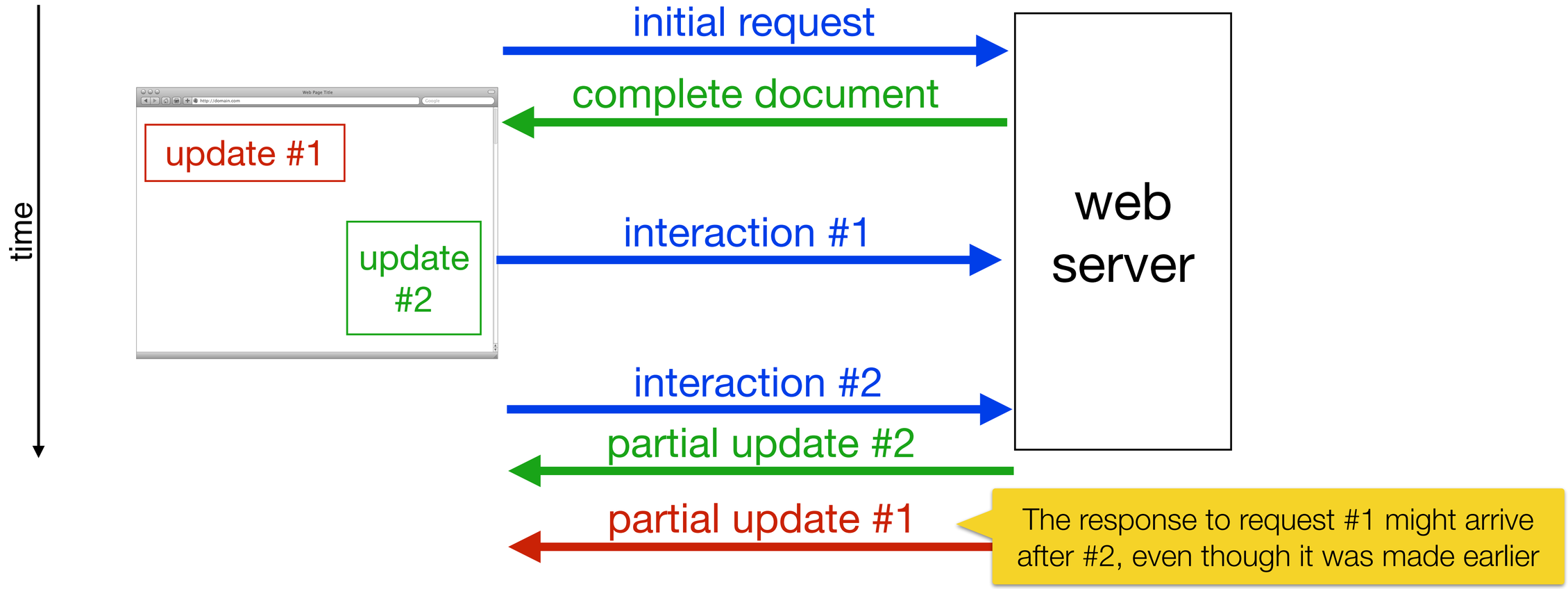
AJAX interaction



AJAX interaction

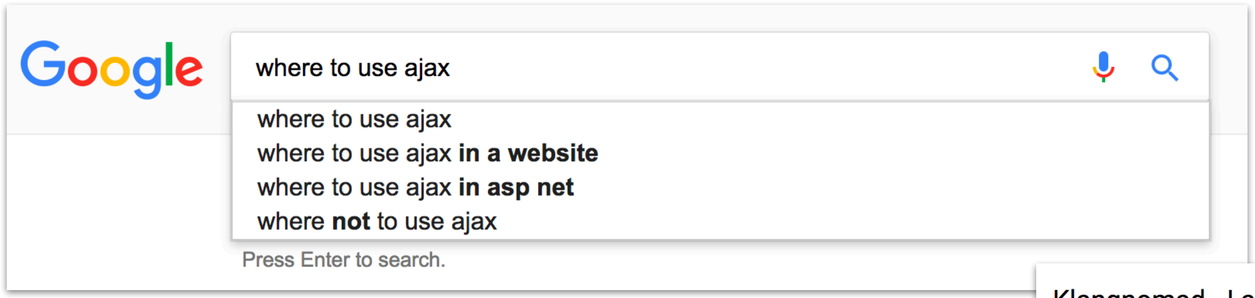


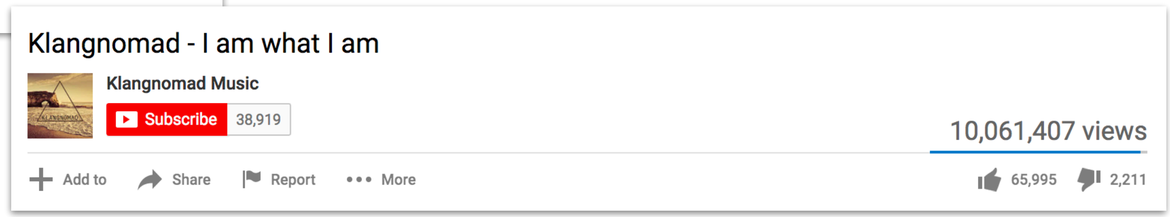
Note that responses are asynchronous

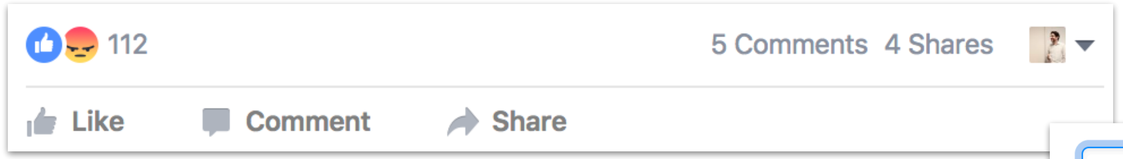


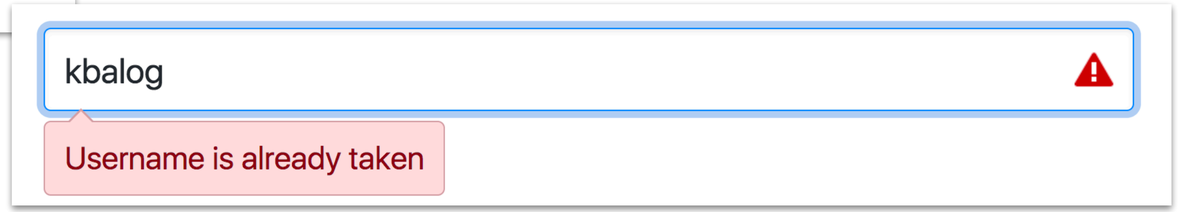
Where to use AJAX?

Where to use AJAX?









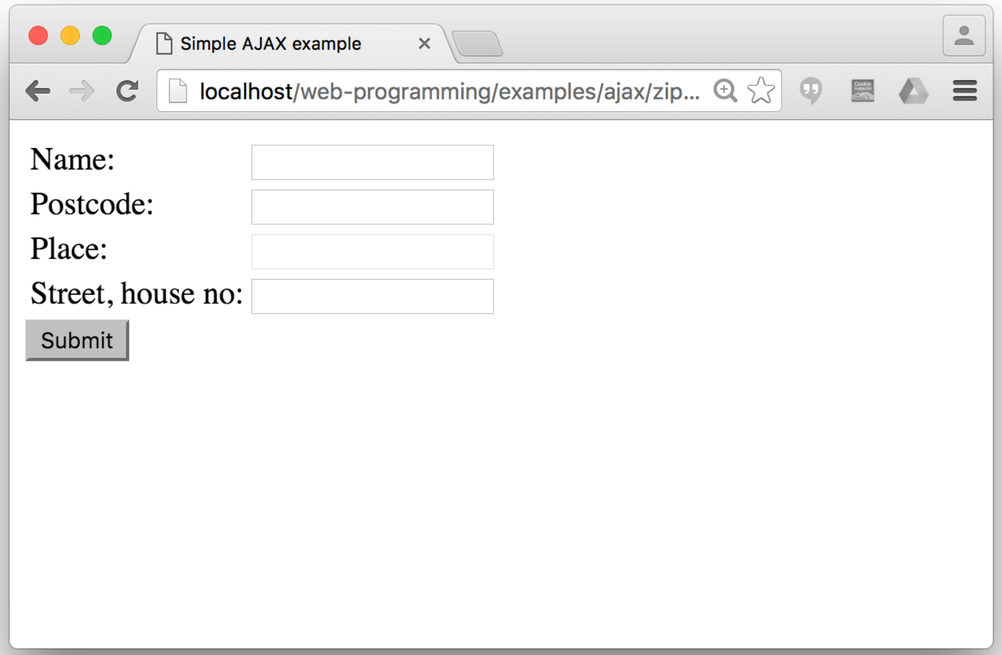
Four main parts

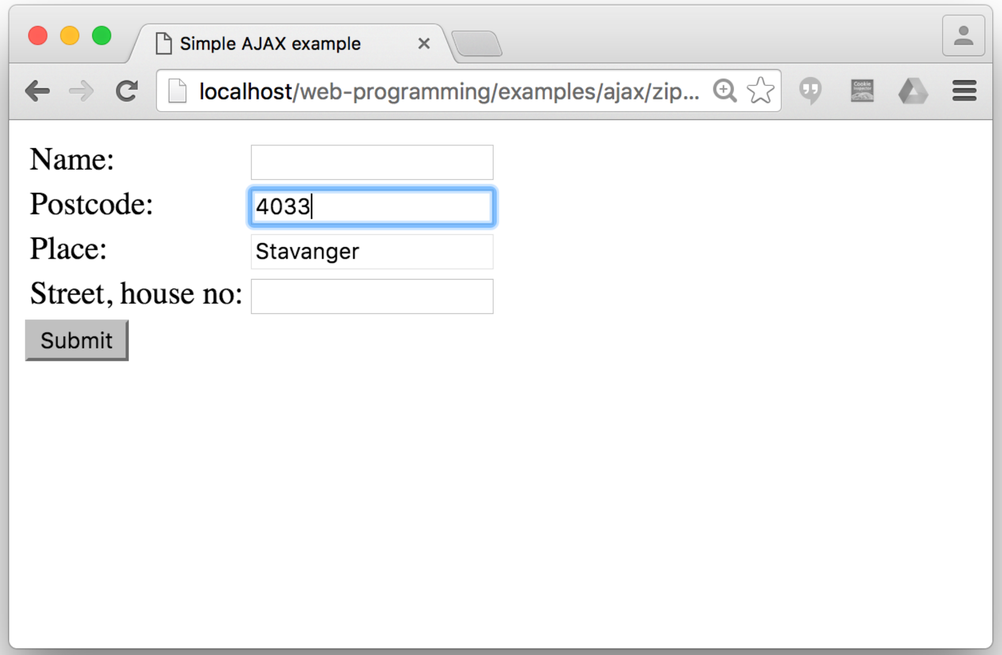
1. Initial HTML document (may be generated using Python)
2. JavaScript to send the AJAX request to the server
3. Server-side program to receive the request and produce the requested data
4. JavaScript to receive the new data and integrate it into the original document being displayed

Example walkthrough

https://github.com/dat310-spring20/course-info/tree/master/**examples/ajax/zipcode**

Example


Simple AJAX example
localhost/web-programming/examples/ajax/zip...
Name:
Postcode:
Place:
Street, house no:
Submit


Simple AJAX example
localhost/web-programming/examples/ajax/zip...
Name:
Postcode:
4033
Place:
Stavanger
Street, house no:
Submit

1. Initial HTML document

- Register JavaScript handler function on onkeyup event
  - I.e., whenever the user presses a key

zipcode.html

```
<input type="text" name="postcode" onkeyup="getPlace(this.value);"/>
```

2. Request phase

- Register callback function
- Make asynchronous call

zipcode.js

```
function getPlace(postcode) {
    var xhr = new XMLHttpRequest();
    /* register an embedded function as the handler */
    xhr.onreadystatechange = function () {
        […]
        }
    };
    /* send the request using GET */
    xhr.open("GET", "/getplace?postcode=" + postcode, true);
    xhr.send(null);
}
```

setting this parameter to **`true`** means making an asynchronous request

3. Response document

- Flask app generates simple text response

app.py

```
@app.route("/getplace", methods=["GET"])
def getplace():
    POSTCODES = {
        "0107": "Oslo",
        "0506": "Oslo",
        "4090": "Hafrsfjord",
        …
   }
    postcode = request.args.get("postcode", None)
    # look up corresponding place or return empty string
    if postcode and (postcode in POSTCODES):
        return POSTCODES[postcode]
    return ""
```

4. Receiver phase

- Callback is called multiple times, readyState indicates the progress (0..4)
- Status is 200 if the request was successfully completed

zipcode.js

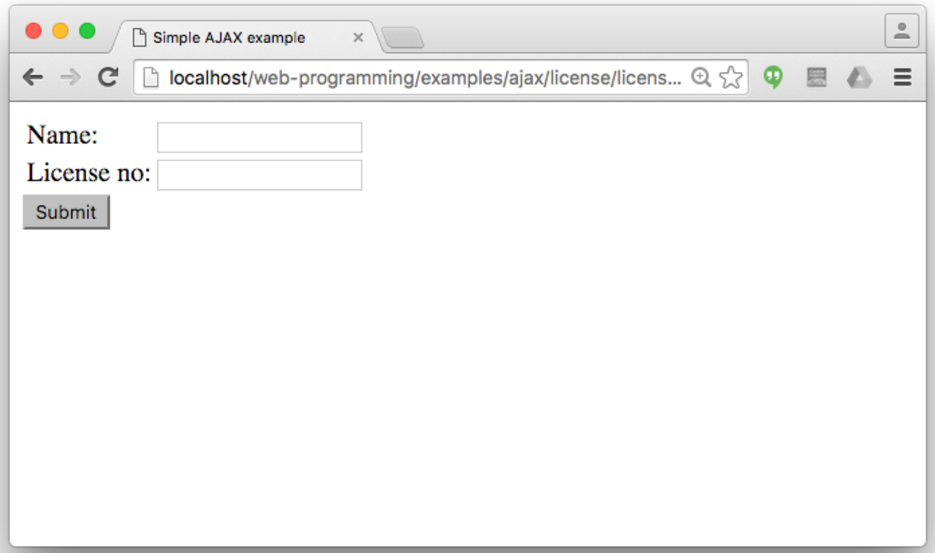
```
xhr.onreadystatechange = function () {
    /* readyState = 4 means that the response has been completed
     * status = 200 indicates that the request was successfully completed */
    if (xhr.readyState == 4 && xhr.status == 200) {
        var result = xhr.responseText;
        document.getElementById("place").value = result;
    }
};
```

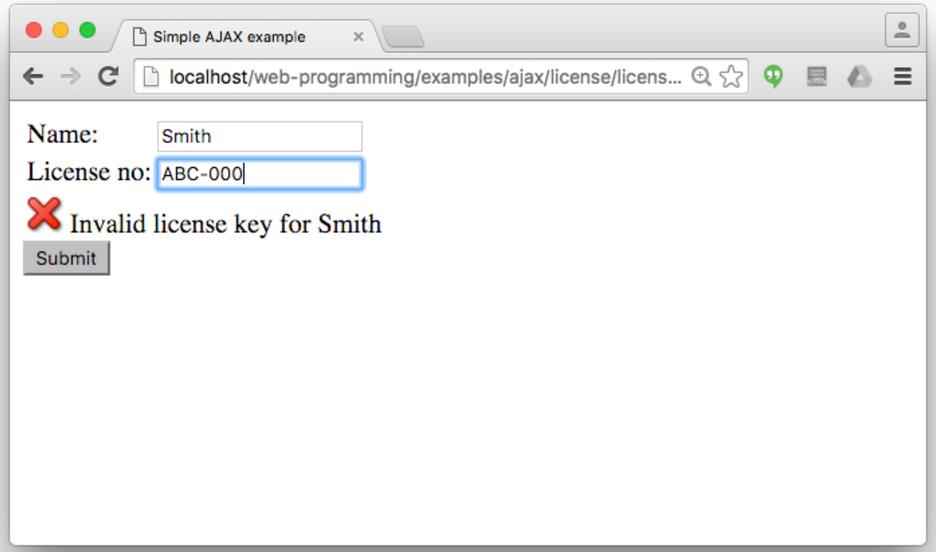
Example walkthrough #2

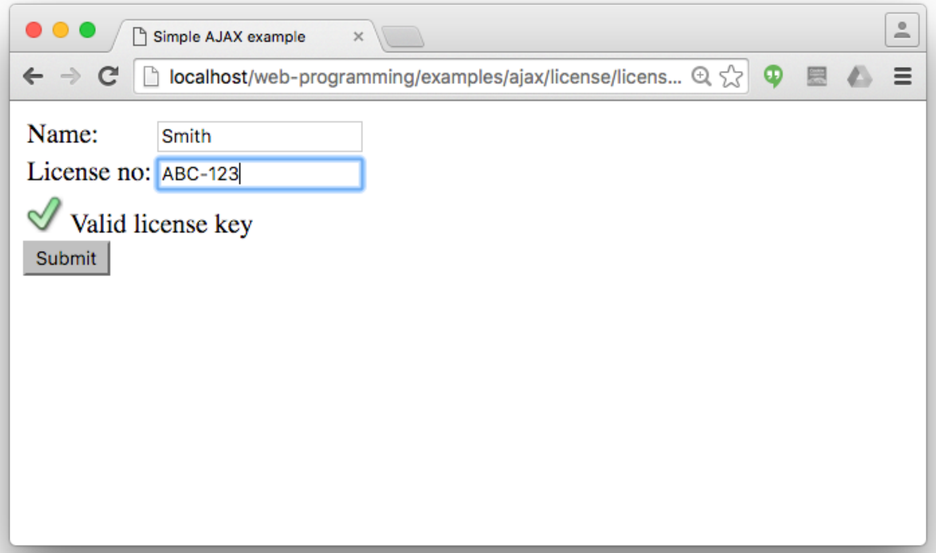
https://github.com/dat310-spring20/course-info/tree/master/

examples/ajax/license

Example #2


Simple AJAX example
localhost/web-programming/examples/ajax/license/licens...
Name:
License no:
Submit


Simple AJAX example
localhost/web-programming/examples/ajax/license/licens...
Name:
Smith
License no:
ABC-000
Invalid license key for Smith
Submit


Simple AJAX example
localhost/web-programming/examples/ajax/license/licens...
Name:
Smith
License no:
ABC-123
Valid license key
Submit

Example #2

- Request can be POST as well
- It is also possible for the server to send back a HTML snippet
- The client updates part of the page (i.e., the DOM) with the received snippet

1. Initial HTML document

- Register JavaScript handler function on onkeyup events
  - I.e., whenever the user presses a key in the name or license fields

`license.html`

```
<input type="text" name="name" id="name" onkeyup="checkLicense();" />

<input type="text" name="license" id="license" onkeyup="checkLicense();" />
```

2. Request phase

- Make asynchronous call using POST
  - Need to add a HTTP header to make it as if it was a form submission

license.js

```
function checkLicense() {
     […]

    /* send the request using POST */
    xhr.open("POST", "/check_license", true);
    /* To POST data like an HTML form, add an HTTP header */
    xhr.setRequestHeader("Content-type", "application/x-www-form-urlencoded");
    /* variables go in the request body */
    xhr.send("name=" + name + "&license=" + license);

     […]
}
```

3. Response document

- Flask app generates a HTML snippet

app.py

```
@app.route("/check_license", methods=["POST"])
def check_license():
    VALID_LICENSES = {…}
    name = request.form.get("name", None)
    license = request.form.get("license", None)
    # check if name and license match
    if name and license:
        if VALID_LICENSES.get(name, None) == license:
            return "<img src='/static/images/yes.png' /> Valid license key"
        else:
            return "<img src='/static/images/no.png' />
                    Invalid license key for {}".format(name)
    return ""
```

4. Receiver phase

- Callback is called multiple times, readyState indicates the progress (0..4)
- Status is 200 if the request was successfully completed

license.js

```
xhr.onreadystatechange = function () {
    /* readyState = 4 means that the response has been completed
     * status = 200 indicates that the request was successfully completed */
    if (xhr.readyState == 4 && xhr.status == 200) {
        var result = xhr.responseText;
        document.getElementById("license_check").innerHTML = result;
    }
};
```

Exercises #1, #1b

github.com/dat310-spring20/course-info/tree/master/
exercises/ajax

What can be the response document?

- Data as a simple string
- HTML snippet
- Data as "object"
  - Both the client and the server need to speak the same language, i.e., how to *encode* and *decode* the object

JSON

- JavaScript Object Notation
- Lightweight data-interchange format
- Language independent
- Two structures
  - Collection of name-value pairs (object)
    - a.k.a. record, struct, dictionary, hash table, associative array
  - Ordered list of values (array)
    - a.k.a. vector, list

JSON

- Values can be
  - string (in between "…")
  - number
  - object
  - array
  - boolean (true/false)
  - null

Example JSON

```
{
 "name":"John Smith",
 "age":32,
 "married":true,
 "interests":[1,2,3],
 "other":{
        "city":"Stavanger",
        "postcode":4041
        }
}
```

JSON with Python

examples/ajax/json/json_python.py

- **`json`** is a standard module
- **`json.dumps(data)`**
  - returns JSON representation of the data
- **`json.loads(json_value)`**
  - decodes a JSON value
- **`json.dumps()`** and **`json.loads()`** work with strings
- **`json.dump()`** and **`json.load()`** work with file streams

JSON with JavaScript

examples/ajax/json/json_js.html

- **`JSON.stringify(value)`**
  - returns JSON representation of a value (encode)
- **`JSON.parse(json)`**
  - parses a JSON value into a JavaScript object (decode)

Exercise #2

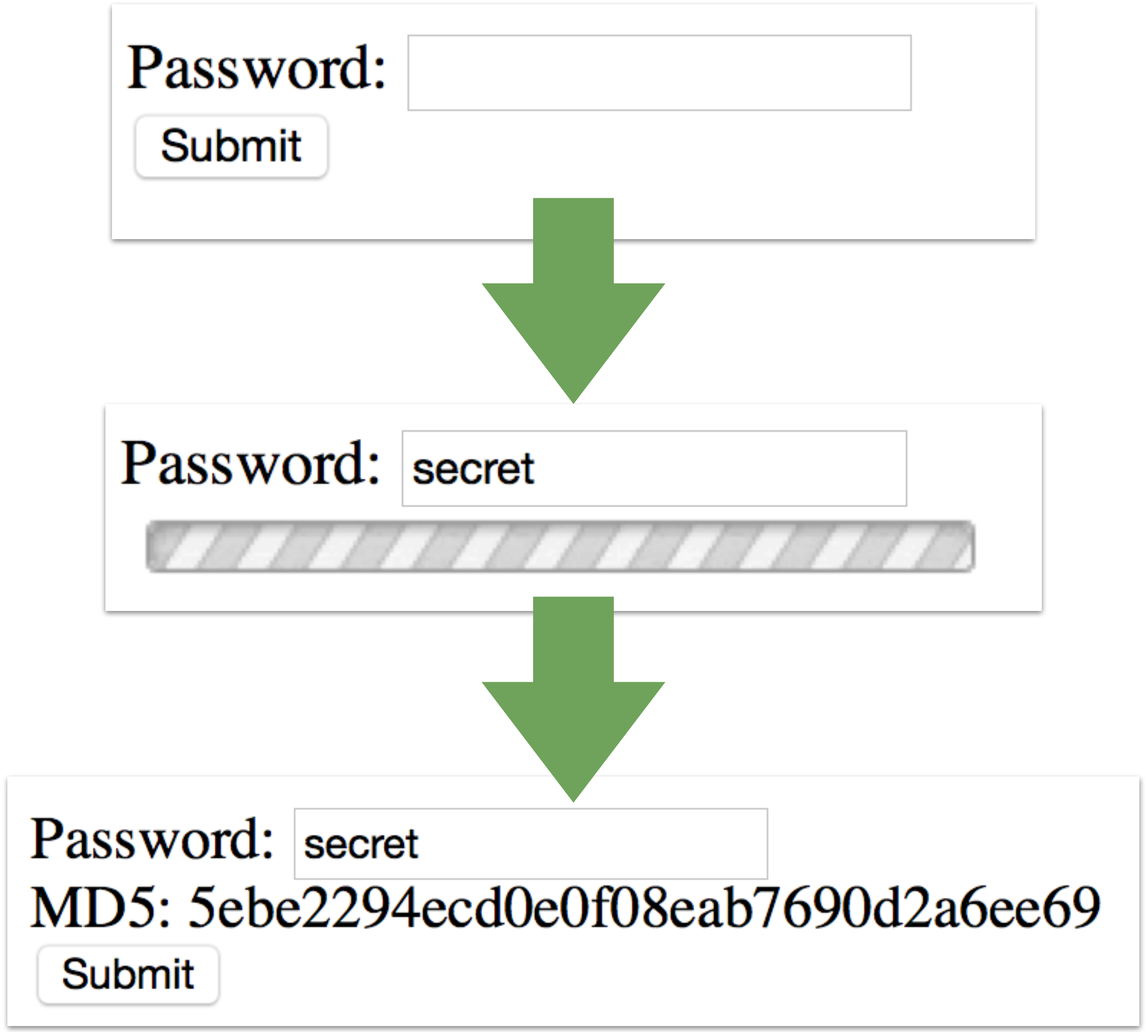
github.com/dat310-spring20/course-info/tree/master/
exercises/ajax

Example

https://github.com/dat310-spring20/course-info/tree/master/
examples/ajax/loading

Indicating waiting

- An animated gif is displayed until the response arrives
- In this example there is an artificial delay of 1sec is added to the Python code



AJAX controls

- **`$.ajax()`** — global function
- Shorthand AJAX methods: **`$.get()`** and **`$.post()`**
- **`load()`** method
  - replaces the HTML content of the matched elements with the content returned from a remote file
  - (does not work with form input fields!)
- Full reference: http://www.w3schools.com/jquery/jquery_ref_ajax.asp

$.ajax()

- **`$.ajax(`*`params`*`)`**
- where ***`params`*** is a settings map object

```
var params = {
    type: "GET",
    url: "requestUrl",
    dataType: "text", // html, xml, json
    success: successCallbackFunction,
    error: errorCallbackFunction
};
```

$.get(), $.post()

- Full syntax:
  - **`$.get(`*`url,data,function(data,status,xhr),dataType`*`)`**
  - **`$.post(`*`url,data,function(data,status,xhr),dataType`*`)`**
- Where:
  - ***`url`*** where the request is sent
  - ***`data`*** (optional) data to be sent (map with variables and values)
  - ***`function(…)`*** callback function to run if the request succeeds
  - ***`dataType`*** (optional) data type setting (xml, html, text, …)

```
$.post("ajax.php", {"var1":"value"}, function (data) {
    $("#bar").html(data);
});
```

Example (zipcode) using JavaScript

examples/ajax/zipcode/

```
function getPlace(postcode) {
    var xhr = new XMLHttpRequest();
    /* register an embedded function as the handler */
    xhr.onreadystatechange = function () {
        /* readyState = 4 means that the response has been completed
         * status = 200 indicates that the request was successfully completed */
        if (xhr.readyState == 4 && xhr.status == 200) {
            var result = xhr.responseText;
            document.getElementById("place").value = result;
        }
    };
    /* send the request using GET */
    xhr.open("GET", "/getplace?postcode=" + postcode, true);
    xhr.send(null);
}
```

```
<input type="text" name="postcode" onkeyup="getPlace(this.value);"/>
```

Example (zipcode) using jQuery

examples/jquery/zipcode2/

```
$(document).ready(function() {
    $("input[name=postcode]").blur(function() {
        $.get("/getplace", {postcode: $(this).val()}, function (data) {
            $("#place").val(data);
        });
    });
});
```

```
<input type="text" name="postcode"/>
```

load()

- Loads data from a server and puts the returned data into the selected element
  - **`$load(`*`url,data,function(data,status,xhr)`*`)`**
- Where:
  - ***`url`*** where the request is sent
  - ***`data`*** (optional) data to be sent to the server along with the request
  - ***`function(…)`*** (optional) callback function to run when the load() method is completed

```
$("button").click(function(){
    $("#div1").load("demo_test.txt");
});
```