# Web Programming
# **AJAX**

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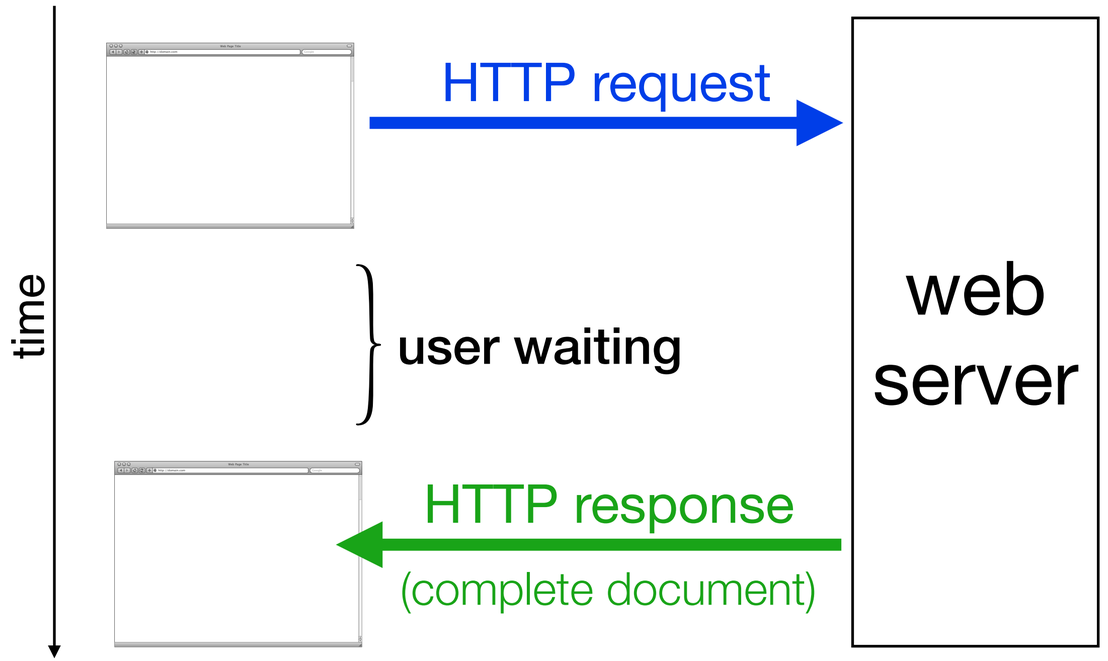
# Traditional web interaction

- 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*

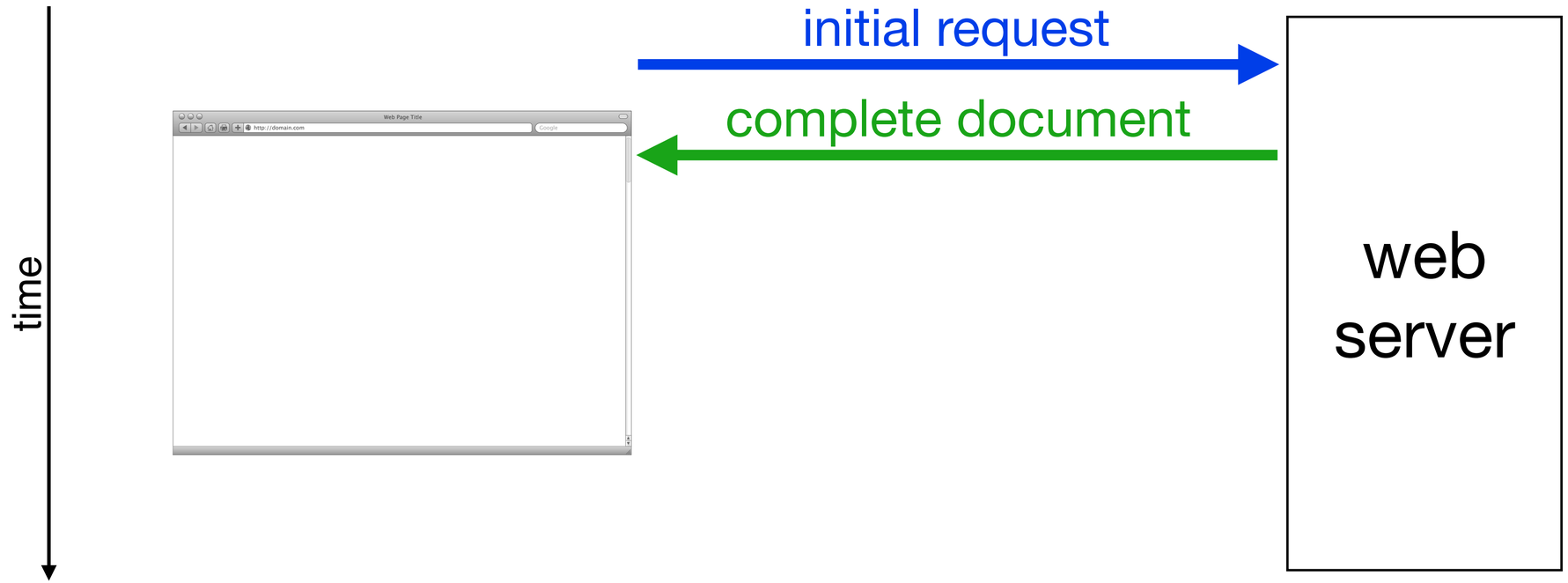
# Motivation

- 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

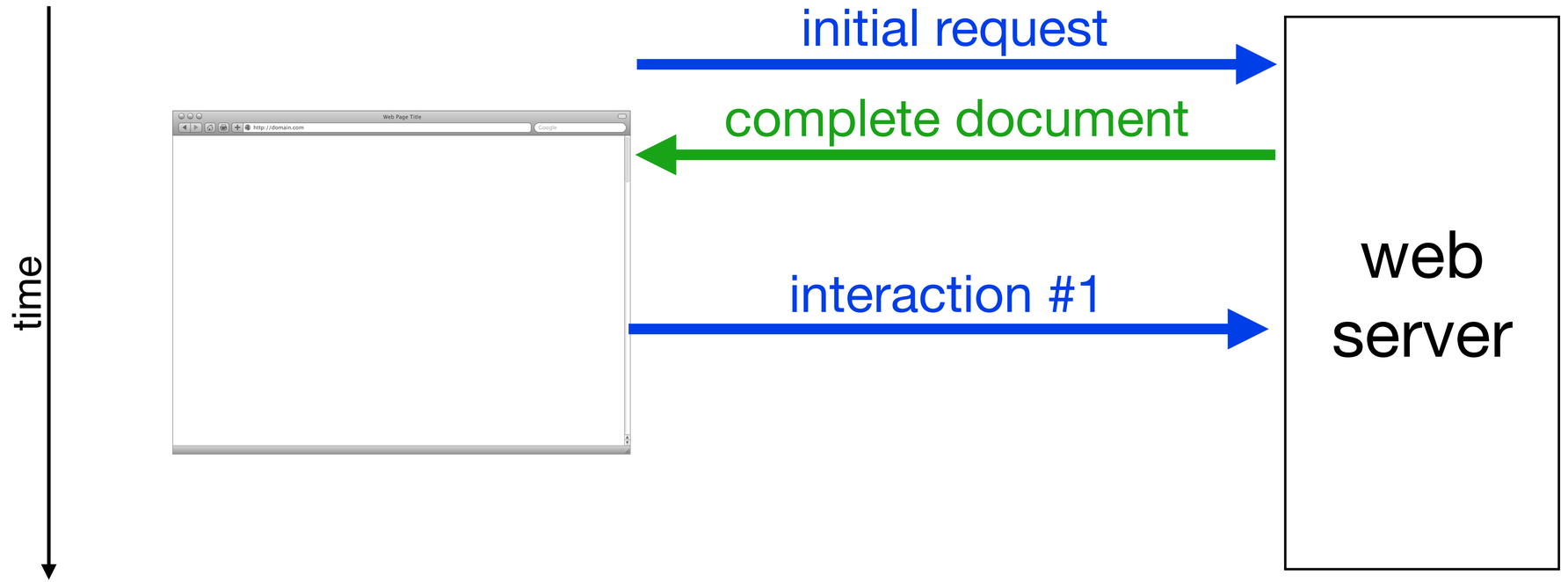
# AJAX

- **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

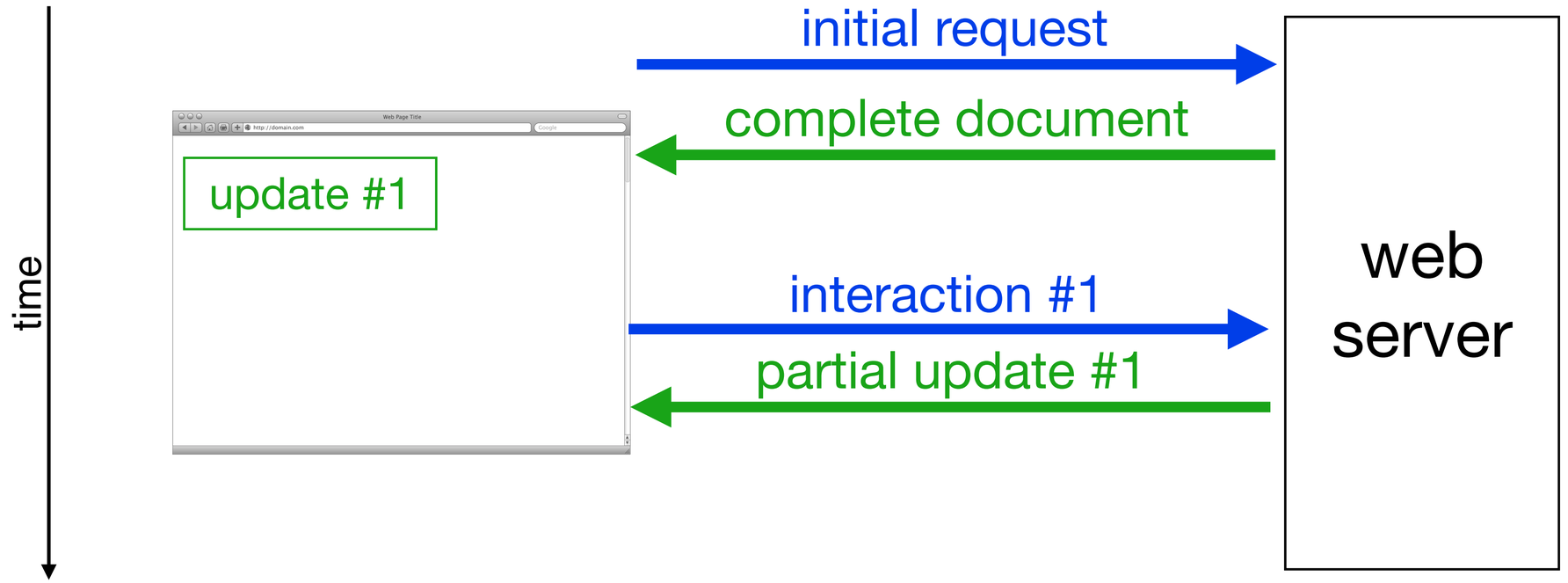
# AJAX interaction



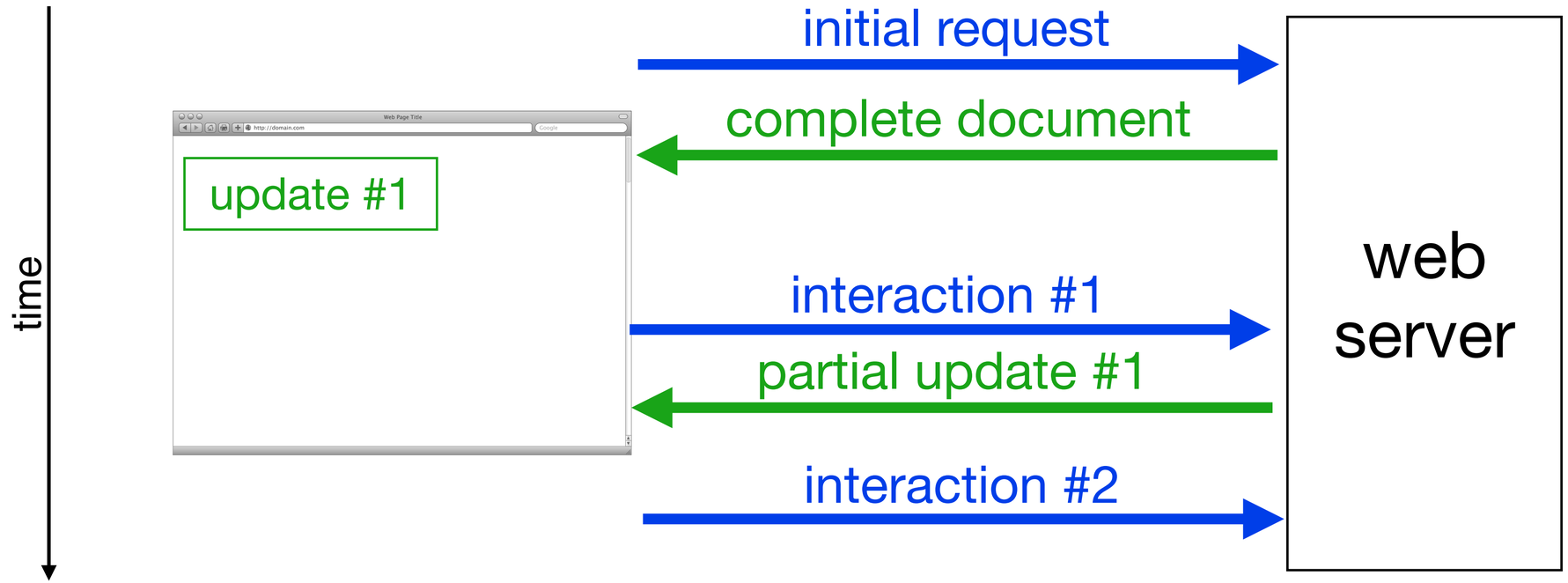
# AJAX interaction



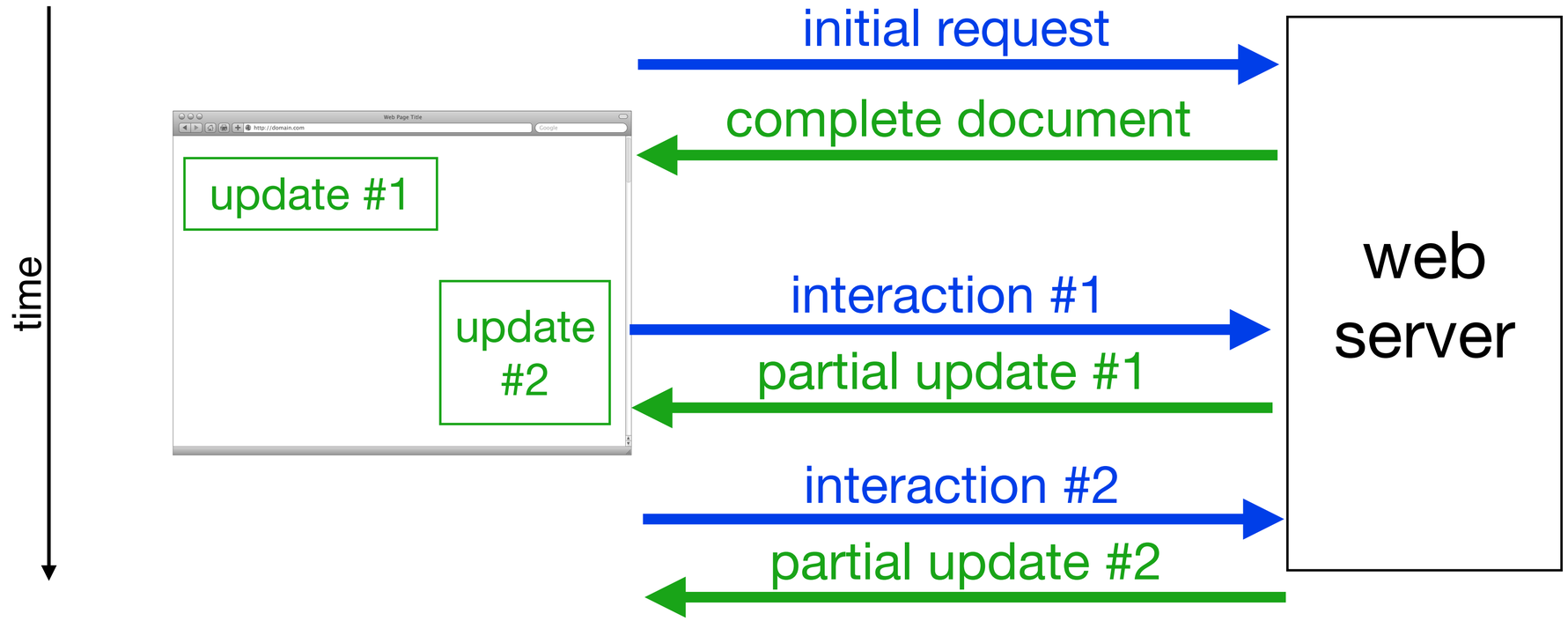
# AJAX interaction



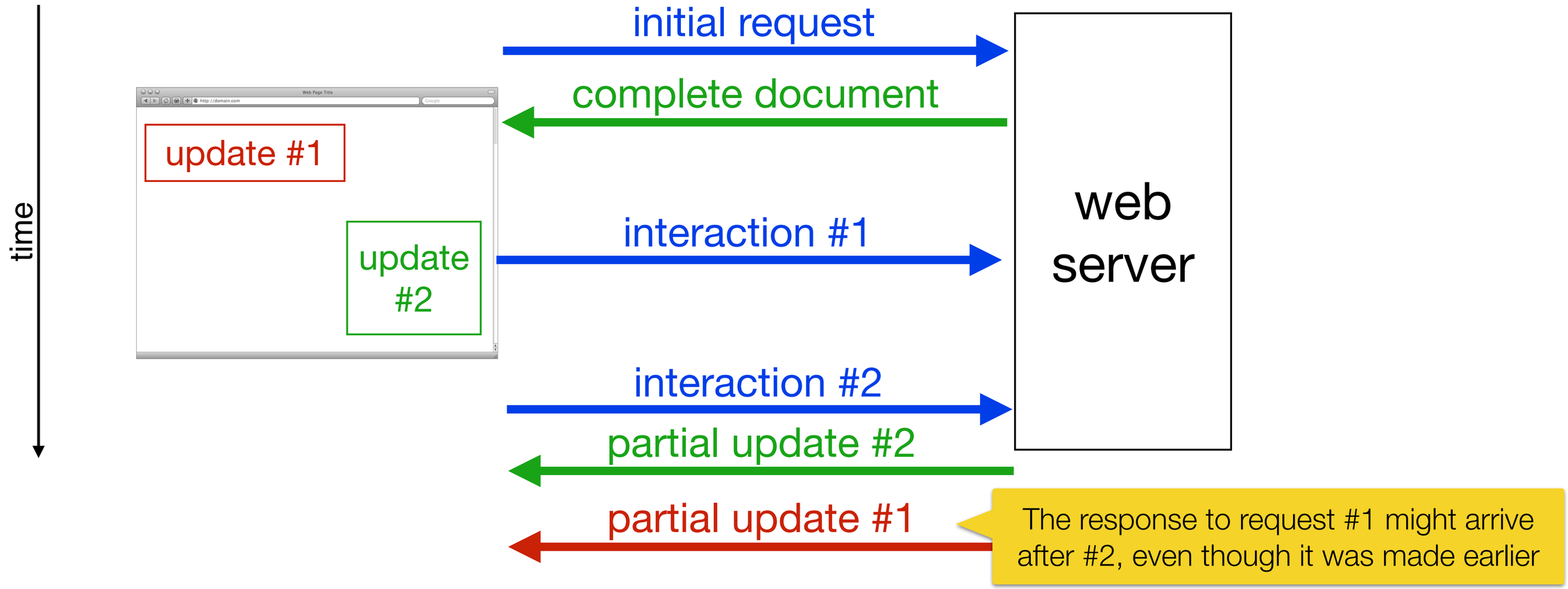
# AJAX interaction



# AJAX interaction

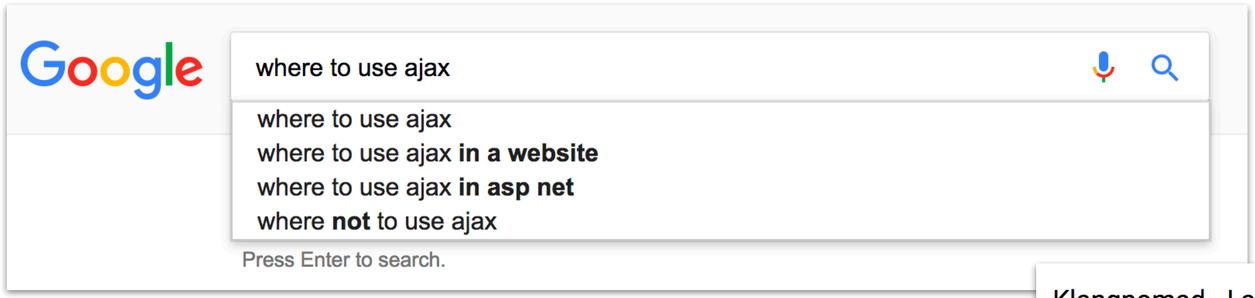


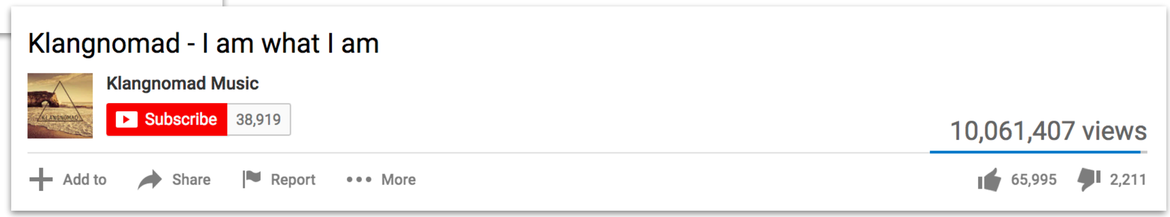
# Note that responses are asynchronous

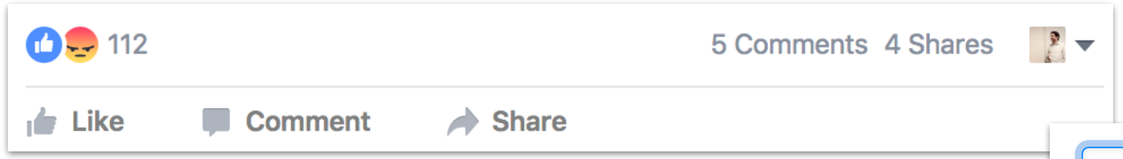


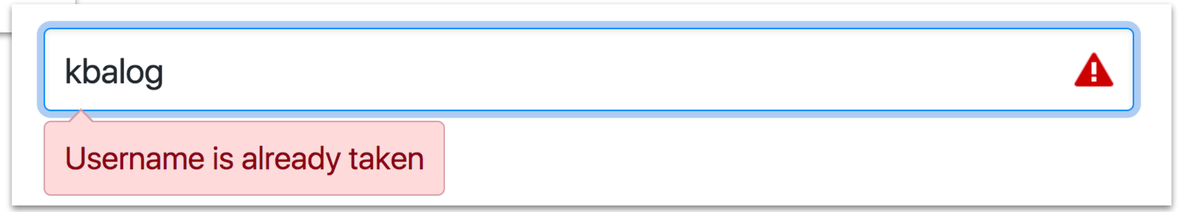
# Where to use AJAX?

# Where to use AJAX?



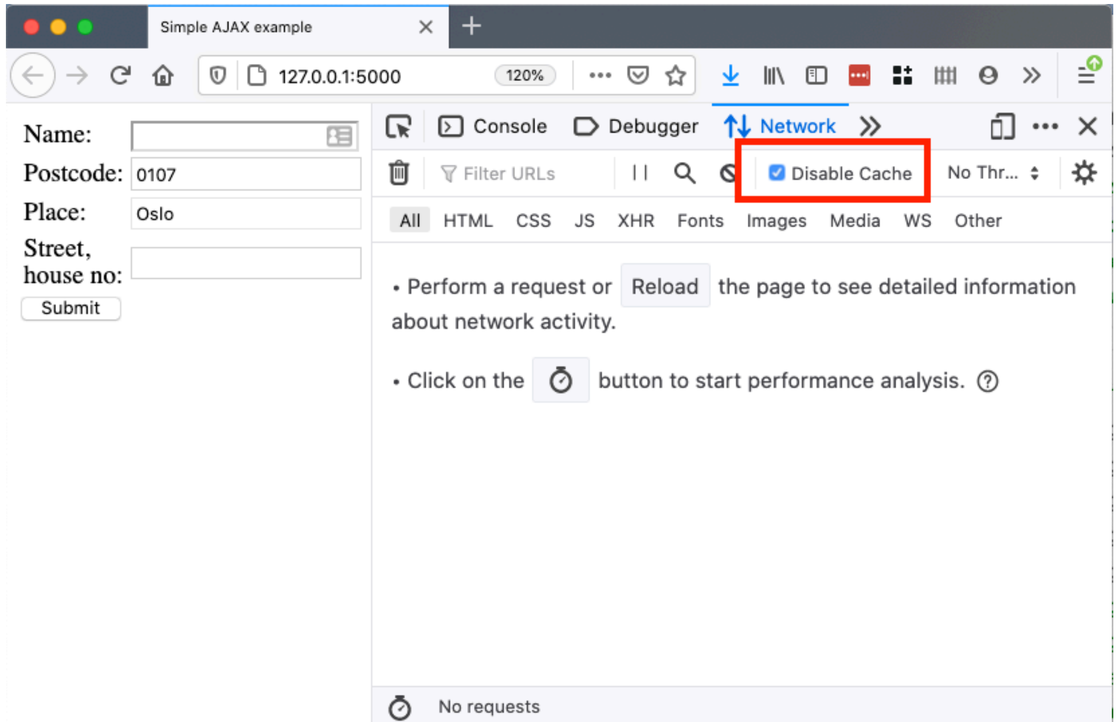



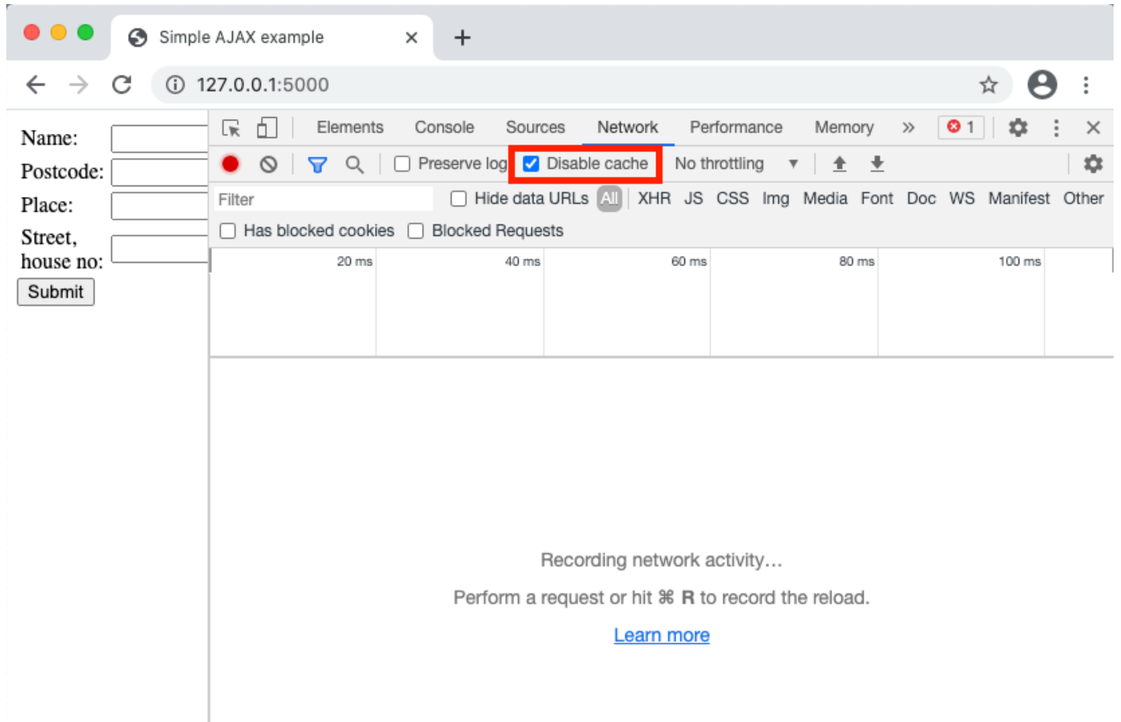
# Four main parts

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

# Tips

When working with AJAX, open the developer tools in your browser, go to network tab, and **disable the cache.**

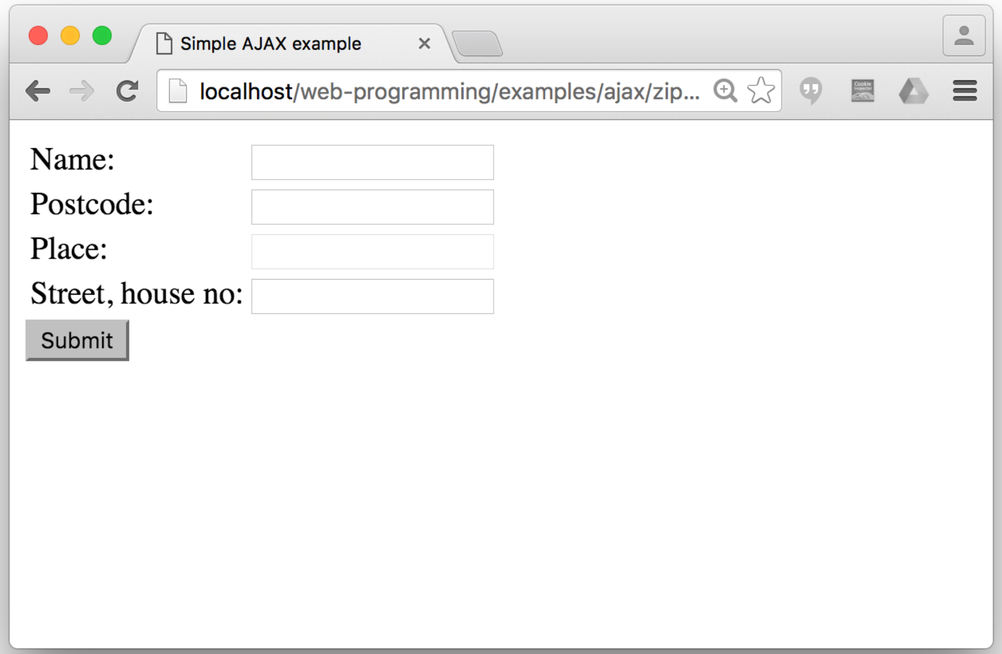


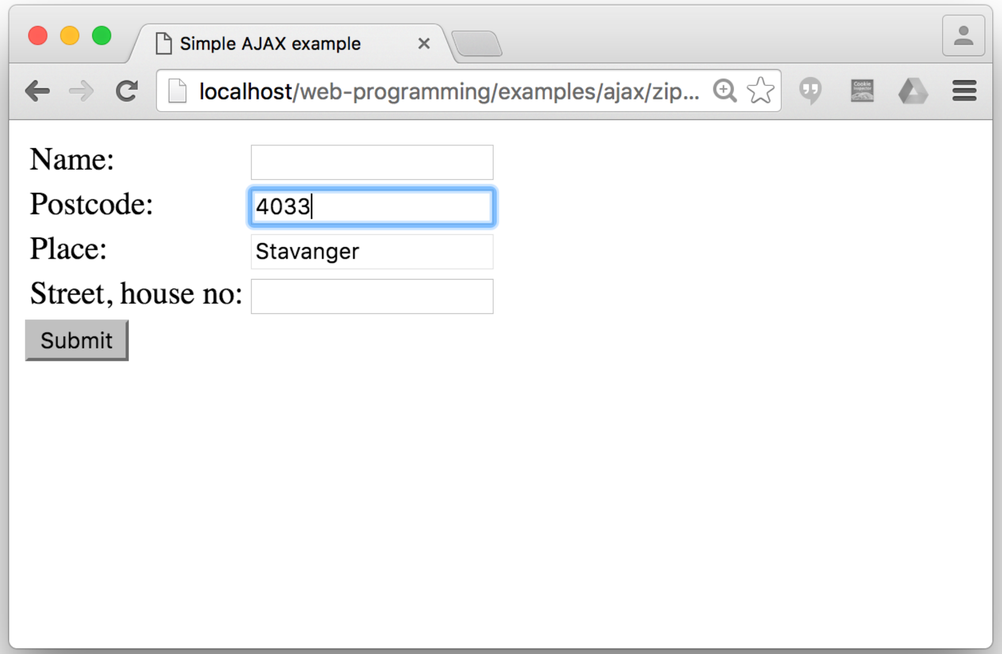



# Example walkthrough

https://github.com/dat310-spring21/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

- Make call using `fetch`
- Wait for reply using `await`

**zipcode.js**

```
async function getPlace(postcode){
    let url = "/getplace?postcode=" + postcode;
    let response = await fetch(url);
    ...
}
```

# 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

- Status is 200 if the request was successfully completed
- `text()` returns a promise, which is resolved to the response text.

**zipcode.js**

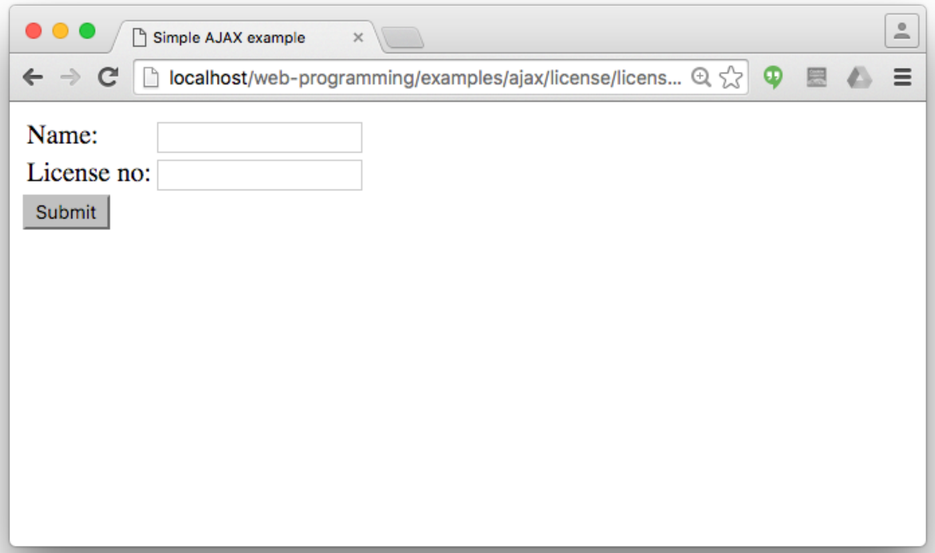
```
async function getPlace(postcode){
    let url = "/getplace?postcode=" + postcode;
    let response = await fetch(url);
    if (response.status == 200){
        let result = await response.text();
        updatePlace(result);
    }
}
```

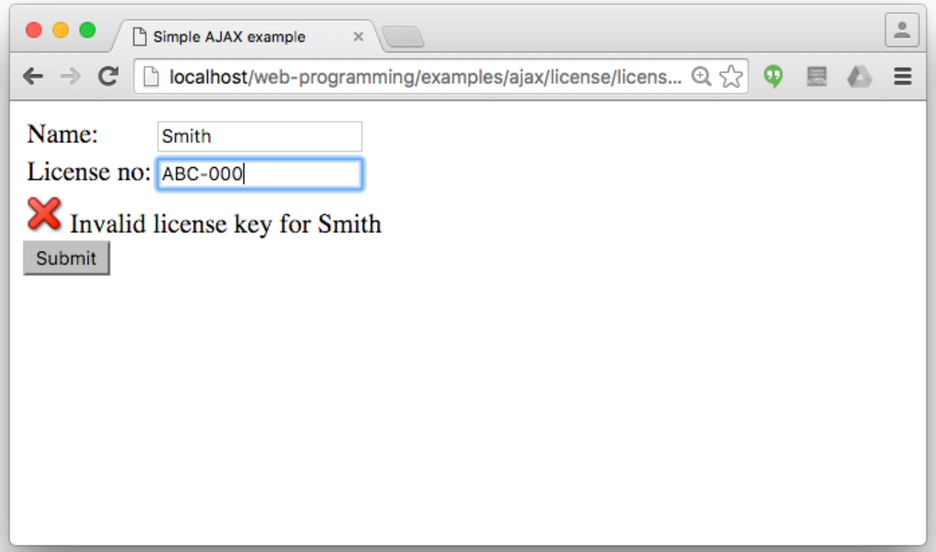
returns a `Promise`, thus we need to `await` the result.

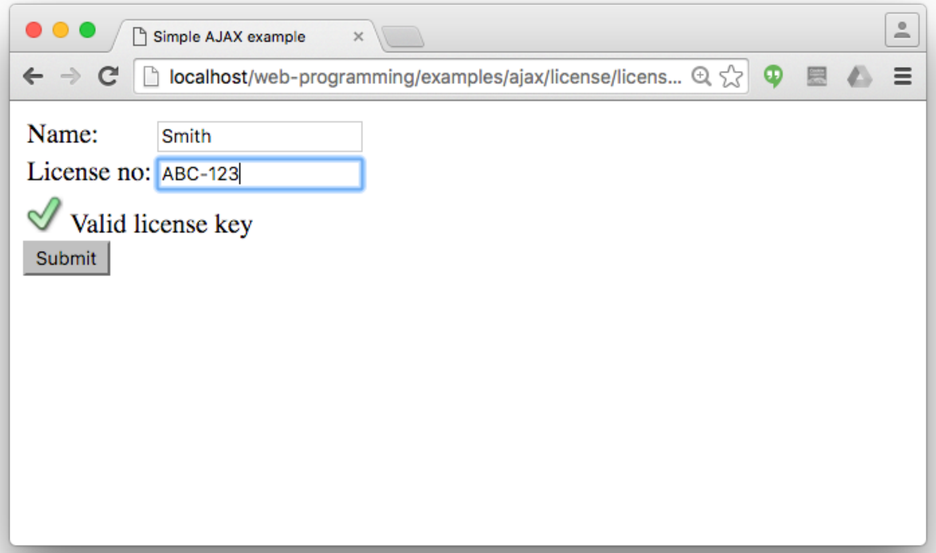
# Example walkthrough #2

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**

```
async function checkLicense(){
    var name = document.getElementById("name").value;
    var license = document.getElementById("license").value;

    let result = await fetch("/check_license",{
        method: "POST",
        headers: {
            "Content-Type": "application/x-www-form-urlencoded",
        },
        body: "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

- Status is 200 if the request was successfully completed
- `text()` returns a promise, which is resolved to the response text.

**license.js**

```
if (response.status == 200){
        let result = await response.text()
        document.getElementById("license_check").innerHTML = result;
    }
```

# Fetch

# Fetch

- Takes as argument the URL to send request to
- Returns a promise
- Use await to wait for reply

```
let reply = await fetch("/getplace?postcode=" + postcode);
```

Sends **GET** request if no additional arguments are given.

Encode parameters, just as when sending form.

# Fetch response

- Access response text using **`response.text()`**
- **`response.text()`** returns another promise
- **await** for actual text result

```
let reply = await fetch("/getplace?postcode=" + postcode);
let result = await reply.text();
```

# Fetch POST

- Fetch takes as second argument, an object

```
let data = "name=" + name + "&license=" + license;
let result = await fetch("/check_license",{
            method: "POST",
            headers: {
                "Content-Type": "application/x-www-form-urlencoded",
            },
            body: data,
        })
```

Encode parameters, just as when sending form.

- Response is handled as with GET request.

```
if (response.status == 200){
        let result = await response.text()
        document.getElementById("license_check").innerHTML = result;
    }
```

# Exercises #1, #1b

github.com/dat310-spring21/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)

# Example

https://github.com/dat310-spring21/course-info/tree/master/
**examples/ajax/json/student**

# Example

examples/ajax/json/student

app.py

```
@app.route("/get_data", methods=["GET"])
def check_license():
    DATA = {
        "name":"John Doe",
        "student_no": 111111
    }
    return json.dumps(DATA)

@app.route("/post_data", methods=["POST"])
def print_data():
    print(request.get_json())
    return "OK"
```

Reply with json data.

Receive json data.

# Example

examples/ajax/json/student

**student.js**

```
async function getStudent(){
    let reply = await fetch("/get_data");
    if (reply.status == 200){
        let result = await reply.json();
 ...
```

Receive json data.

**student.js**

```
async function sendStudent(){
    let student = { name: name, student_no: student_no };

    let reply = await fetch("/post_data",{
        method: "POST",
        headers: {
            "Content-Type": "application/json",
        },
        body: JSON.stringify(student)
    });
   ...
}
```

Include JSON data in request

# Exercise #2

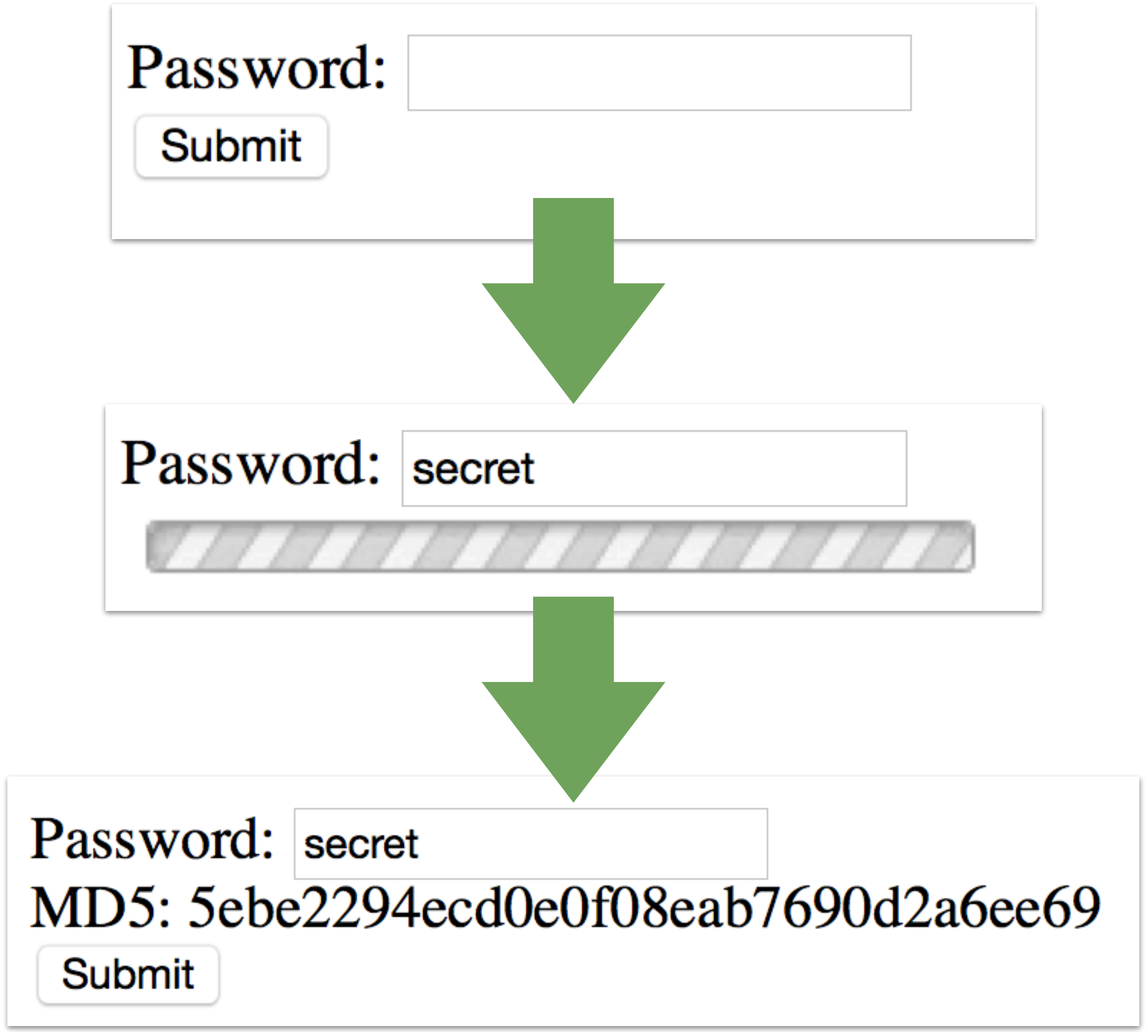
github.com/dat310-spring21/course-info/tree/master/
**exercises/ajax**

# Example

https://github.com/dat310-spring21/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 without async

# 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()

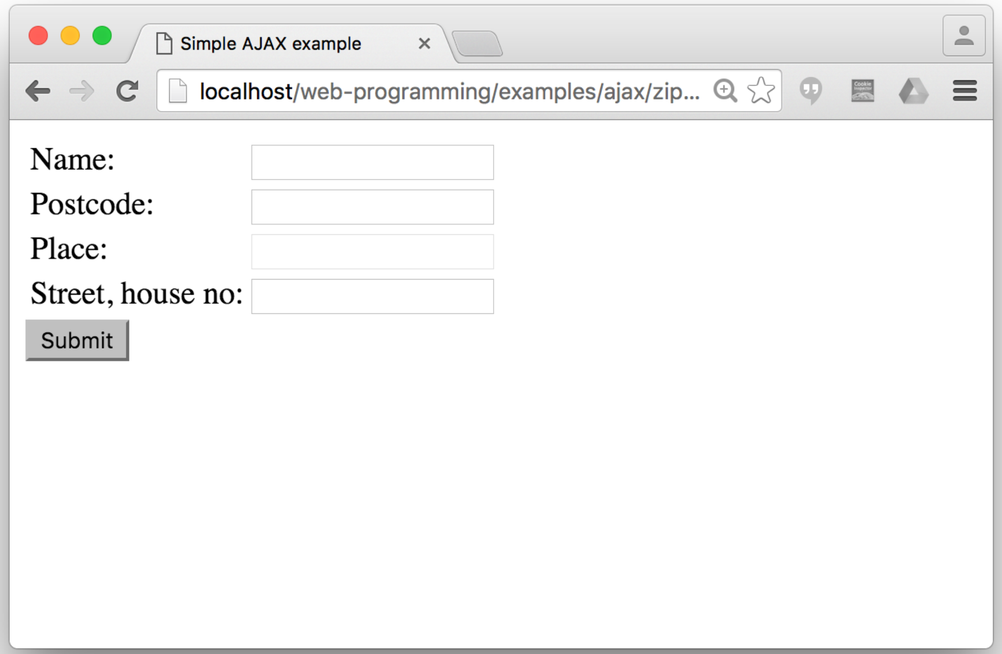
- Loads data from a server and puts the returned data into the selected element
  - **`$load(`*`url,data,function(data,status,xhr)`*`)`**
- Where:
  - ***`url`*** where the request is sent
  - ***`data`*** (optional) data to be sent to the server along with the request
  - ***`function(…)`*** (optional)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

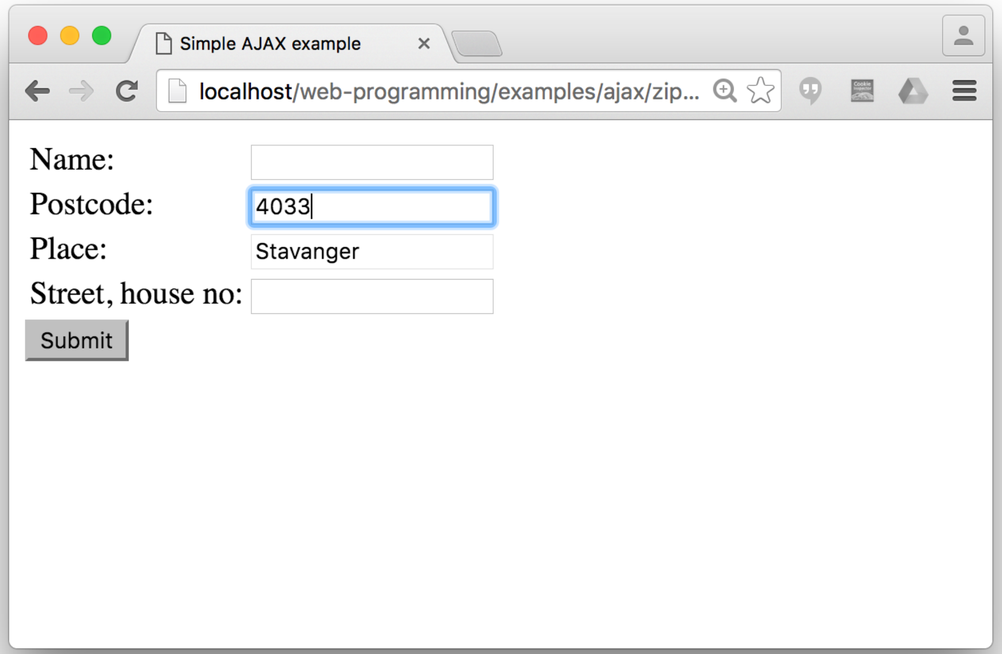
```
$("button").click(function(){
    $("#div1").load("demo_test.txt");
});
```

# Example walkthrough

https://github.com/dat310-spring21/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

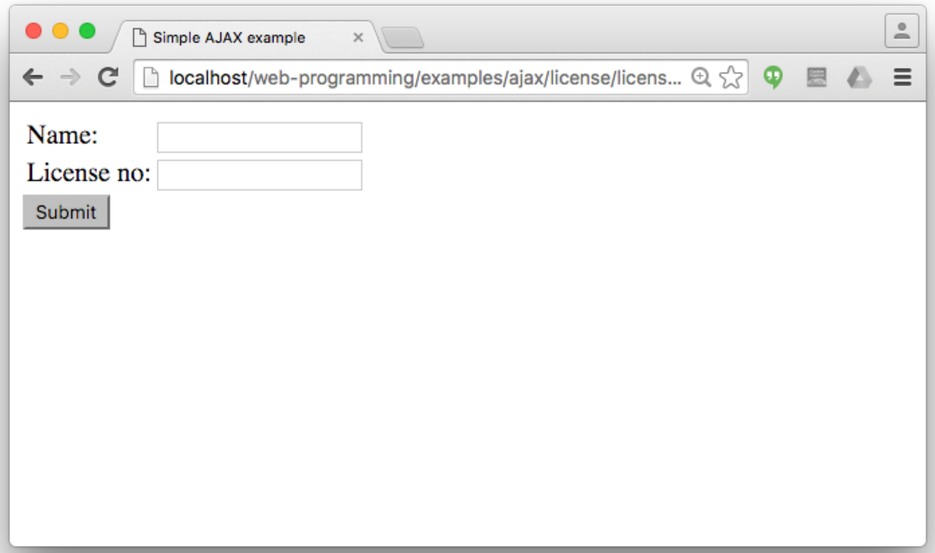
```
xhr.onreadystatechange = function () {
    /* readyState = 4 means that the response has been completed
     * status = 200 indicates that the request was successfully completed */
    if (xhr.readyState == 4 && xhr.status == 200) {
        var result = xhr.responseText;
        document.getElementById("place").value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

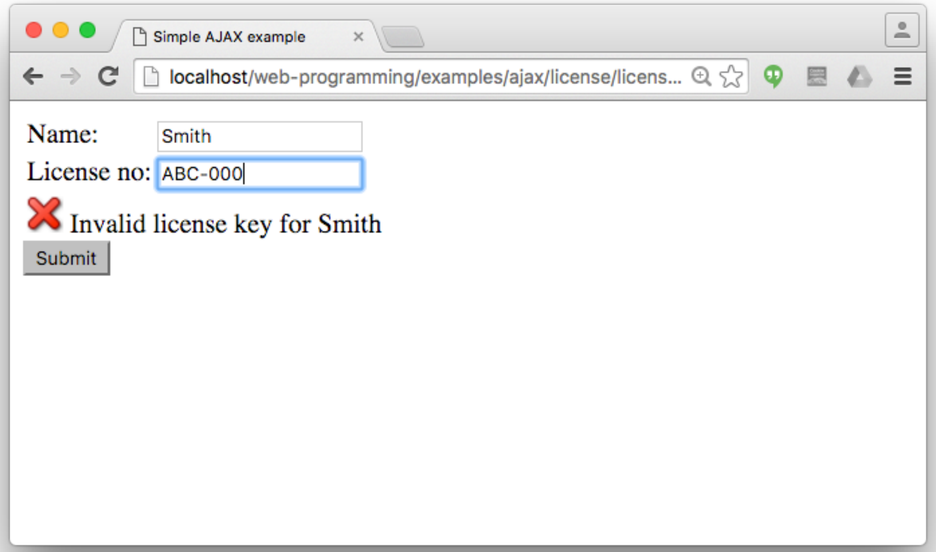
# Example walkthrough #2

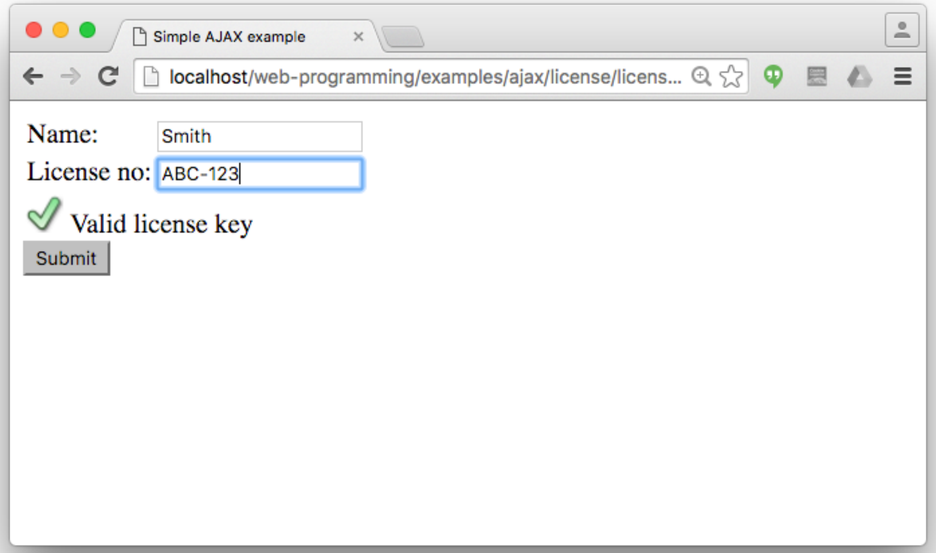
https://github.com/dat310-spring21/course-info/tree/master/

**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

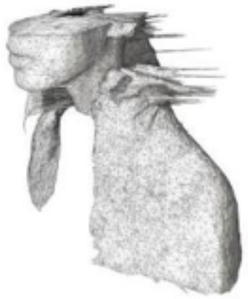
license.js

```
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;
    }
};
```

# Assignment 7

- Use vue or js
- Check next lecture on how to combine vue and flask

Coldplay - coldplay-cover.jpg
Guns N' Roses - Greatest Hits
Nightwish - Century Child
U2 - No Line On The Horizon



| No. | Title | Length |
|---|---|---|
| 1. | Politik | 5:18 |
| 2. | In My Place | 3:48 |
| 3. | God Put a Smile upon Your Face | 4:57 |
| 4. | The Scientist | 5:09 |
| 5. | Clocks | 5:07 |
| 6. | Daylight | 5:27 |
| 7. | Green Eyes | 3:43 |
| 8. | Warning Sign | 5:31 |
| 9. | A Whisper | 3:58 |
| 10. | A Rush of Blood to the Head | 5:51 |
| 11. | Amsterdam | 5:19 |
| **Total length:** | | **54:08** |