<WA1/>

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Fetch API

Enabling the link to the Server Side

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Goal

- Sending asynchronous HTTP requests
- Loading data asynchronously
- Handling multiple requests
- Interrupting requests
- Using alternative libraries

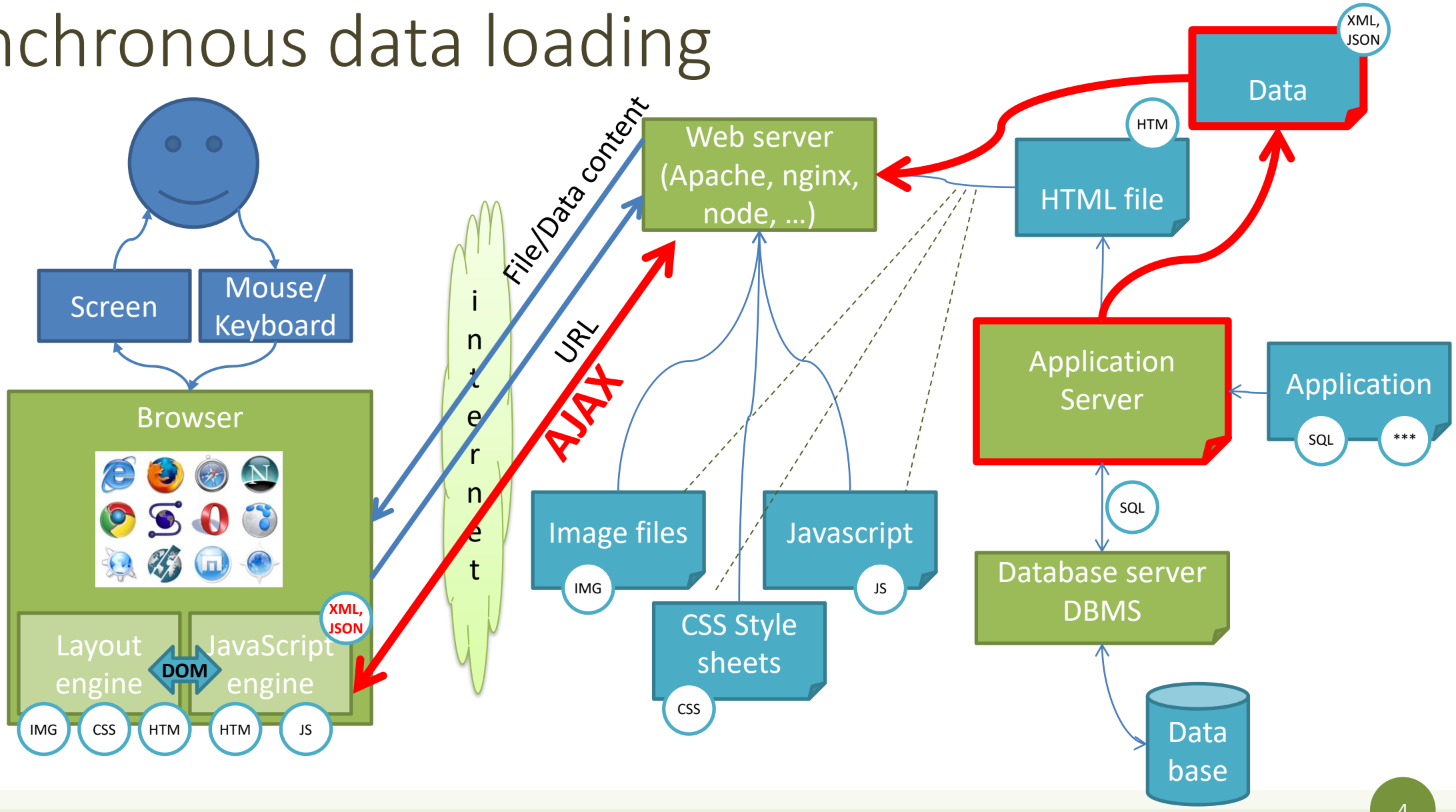
JavaScript: The Definitive Guide, 7th Edition
Chapter 11. Asynchronous JavaScript

Mozilla Developer Network:
Web technology for developers —
Web API — Fetch API
https://developer.mozilla.org/en-US/docs/Web/API/Fetch_API

Fetch API

ASYNCHRONOUS JS REQUESTS

Asynchronous data loading



Typical web applications

- Server provides the first HTML page, with JS and other resources
- User interacts with the application, generating events
  - Input events, mouse events, form events, …
- The JavaScript code decides new data is needed
  - Option #1: loads a new URL
    - **Not recommended** since 20+ years…
  - Option #2: requests new data from the server, receives and interprets the data, and modifies page content via DOM
    - Has to be done **asynchronously** not to **block the user interface**!

Loading data asynchronously

- Make asynchronous HTTP requests using browser-provided Web API
- Possible since IE5 (1998) via the `XMLHttpRequest` (XHR) object
- Popularized a few years later by Google and others
  - Dynamic suggestions while typing in search box, without reloading the page

- NB: For security reasons, loading data is, by default, possible only from the same server
  - Possible to allow loading from other servers via **CORS** (Cross Origin Resource Sharing)

XMLHttpRequest (XHR)

- Standardized by W3C in 2006 but already available in many browsers
- Quite complex to use for the developer
  - Requires managing the XHR object states, callbacks, etc
  - Inconsistencies between browsers
  - Some libraries (notably JQuery) provided some easier interface
- Still supported, but *not recommended*

Fetch API

- Modern way of asynchronous data loading in JS
- Uses Promises instead of callbacks
- Provides a generic definition of Request and Response objects, as well as other support for network requests (Headers)
- Well supported in the browser context: included in the HTML5 living standard
  - Supported by all browsers since 2016/2017 (except IE)

How to use fetch

- Use the **`fetch()`** method
  - Parameter: URL of the resource
- Available in almost any context (e.g., from `window` object)
- Returns a **`Promise`** that will resolve once the load operation finishes
  - Resolves to the **`Response`** object, that allows to access the details of the HTTP transaction and the content
  - The promise is rejected only in case of network errors
- Some small differences with `JQuery.ajax()`
  - E.g., cookie handling

https://developer.mozilla.org/en-US/docs/Web/API/Fetch_API

Example

- Just handle the promise (`.then` or `await`)

```
fetch('http://example.com/tasks.json')
  .then((response) => {
    return response.json();
  })
  .then((data) => {
    console.log(data);
  })
```

```
async function loadData() {
  let response = await
     fetch('http://example.com/tasks.json');
  let data = await response.json();
  console.log(data);
}

loadData();
```

`Response` object

- The fulfilled promise returns a `Response` object
- Main properties
  - `Response.ok` (boolean): HTTP successful (code 200-299)
  - `Response.status`, `Response.statusText`
  - `Response.type` : basic or cors (CORS explained later in the course)
  - `Response.url` : final URL (potentially after HTTP redirects)
  - `Response.body`: a Readable stream of the body content

https://developer.mozilla.org/en-US/docs/Web/API/Response

Accessing response headers

```
fetch('http://localhost/data.json')
  .then(response => {
    console.log(response.headers.get('Content-Type'));
    console.log(response.headers.get('Date'));

    console.log(response.status);
    console.log(response.statusText);
    console.log(response.type);
    console.log(response.url);
  }
```

```
application/html; charset=utf-8
Sat, 11 Apr 2020 13:41:04 GMT

404
Not Found
undefined
http://localhost/data.json
```

https://developers.google.com/web/updates/2015/03/introduction-to-fetch

Error handling

- Promise is only rejected for non-HTTP errors (e.g., network connection error)
  - Any HTTP status value (200 OK, 404: Not found, 500: Internal server error, ...) returns a **fulfilled** Promise
- Suggested error handling approach:
  - Check `response.ok` : boolean value (true for HTTP status 200-299)
  - Check content type header (depends on the application needs)
  - Provide a `catch()` for other types of errors

Example: error handling

```
fetch(url)
  .then(response => {
    if (!response.ok) { throw Error(response.statusText) }
    let type = response.headers.get('content-type');
    if (type !== 'application/json') {
        //then() returns a rejected promise if something is thrown
        throw new TypeError(`Expected JSON, got ${type}`)
    }
    return response;
  })
  .then(response => {
  //...
  })
  .catch(err => console.log(err))  // either the throw value or other errors
```

Fetch options

- `const fetchResponsePromise = fetch(resource [, init])`
- Main properties of `init` object
  - `method`
  - `headers` (an object with a property per each header)
  - `body`
  - `mode` (cors, no-cors, same-origin)
  - `credentials` (omit, same-origin, include), to send cookies with the request
  - `signal`: an AbortSignal object instance to communicate with the fetch request

https://developer.mozilla.org/en-US/docs/Web/API/WindowOrWorkerGlobalScope/fetch

Example: POST method

```
fetch(url, {
    method: 'post',
    headers: {
      "Content-type": "application/x-www-form-urlencoded; charset=UTF-8"
    },
    body: 'foo=bar&lorem=ipsum'
  })
  .then(responseData => console.log(responseData))
  .catch(function (error) {
    console.log('Request failed', error);
  });
```

Example: sending JSON content

```
let objectToSend = {'title': 'Do homework' , 'urgent': true, 'private': false,
'sharedWithIds': [3, 24, 58] };

fetch(url, {
    method: 'POST',
    headers: {
      'Content-Type': 'application/json',
    },
    body: JSON.stringify(objectToSend),  // Conversion in JSON format
  })
  .catch(function (error) {
    console.log('Failed to store data on server: ', error);
  });
```

Example: asynchronous file upload

```
<input type="file" id="fileUpload" />
```

```
const handleImageUpload = event => {
  const files = event.target.files  // all files selected by the user
  const formData = new FormData()   // need to correctly encode body
  formData.append('myFileName', files[0])

  fetch('/saveImage', {
    method: 'POST',
    body: formData
  })
  .then(response => response.json())
  .then(data => { console.log(data.path) })
  .catch(error => { console.error(error) })
}
document.querySelector('#fileUpload').addEventListener('change', event => {
  handleImageUpload(event)
})
```

https://flaviocopes.com/file-upload-using-ajax/

Reading the Response body

- Can use (**only once**) one of the following methods
  - …then body is "**consumed**"
- These methods also return a Promise, that returns the response body…
  - `response.text()` : as plain text (string)
  - `response.json()` : as a JS object, by parsing the body as JSON
  - `response.formData()` : as a FormData object
  - `response.blob()` : as Blob (binary data with type)
  - `response.arrayBuffer()` : as ArrayBuffer (low-level representation of binary data)
- `response.body` is a ReadableStreaming object to read it chunk-by-chunk

https://javascript.info/fetch

Sequential fetches

- Easy with `async`: no need to nest another fetch in `.then()` method

```
const getFirstUserData = async () => {
  const response = await fetch('/users.json'); // get users list
  const users = await response.json(); // parse JSON
  const user = users[0]; // pick first user
  const userResponse = await fetch(`/users/${user.name}`); // get user data
  const userData = await user.json(); // parse JSON
  return userData;
}

getFirstUserData()
```

Parallel fetches

- Multiple fetches in parallel: use `Promise.all()`

```
// array of URLs
const urls = [url1, url2];

// Convert to an array of Promises
const promises = urls.map(url => fetch(url).then(r => r.text()));  // Return promises
// .then(...): Wait on the Promise that is settled when the whole body is arrived

// Run all promises in parallel, wait for all
Promise.all(promises)
  .then(bodies => { for (const body of bodies) console.log(body); })
  .catch(e => console.error(e))
```

Parallel fetches

- Processing content as soon as all fetches receives the start of a (potentially long) response

```
// array of URLs
const urls = [url1, url2];

// Convert to an array of Promises
const promises = urls.map(url => fetch(url) );
// Wait only for the fetch Promise

// Run all promises in parallel, wait for all
Promise.all(promises)
  .then(results => { // process according to the order needed by the app
       for (const res of results) res.text().then( t => console.log(t) );
  })
  .catch(e => console.error(e))
```

Interrupt/cancel a request

- Reasonably well supported in browser: pass `signal` in fetch options

```
const controller = new AbortController();
const cancelButton = document.querySelector('#cancel');

cancelButton.addEventListener('click', function() {
  controller.abort();  // Download canceled
});

function fetchVideo() {
  //...
  fetch(url, {signal: controller.signal}).then(response => {
    //...
  }).catch(err => console.log(err.message); )
}
```

https://developer.mozilla.org/en-US/docs/Web/API/AbortController

Basic fetch vs other libraries

- Most common alternative library: **Axios**
  - Does polyfill for older browsers
  - Has an easier way to cancel a request
  - Has a way to set a response **timeout** (not supported by fetch, which needs a `setTimeout()` to call the `AbortController.abort()` method)
  - Easier support for progress bar via Axios Progress Bar module (fetch requires quite some code around a `ReadableStream` object)
  - Performs automatic JSON conversion
  - Provides an easier way to separate responses of parallel requests
  - Works well also in Node.js (fetch is not included by default)

https://flaviocopes.com/axios/

Axios example

```
axios({
  method: 'post',
  url: '/login',
  timeout: 4000,    // 4 seconds timeout
  data: {    // Directly an object, automatically converted into bytes
    firstName: 'David',
    lastName: 'Pollock'
  }
})
.then(response => {/* handle the response */})
.catch(error => console.error('timeout exceeded'))
```

https://blog.logrocket.com/axios-or-fetch-api/

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