COESIONE ITALIA 21-27 PIEMONTE
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REGIONE PIEMONTE

Web Developer

Programmazione - Javascript e Typescript

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Intervento realizzato da ITS TECNOLOGIE DELL'INFORMAZIONE E DELLA COMUNICAZIONE

Modules and build tools

Building and bundling code

BUILDING: modifica del codice

Shadi Lahham - Web development

Modules

I moduli in JavaScript sono blocchi autonomi di codice che consentono di organizzare, separare e riutilizzare le funzionalità del programma in modo più efficace.

Ogni modulo è un file che contiene funzioni, oggetti, classi o variabili, e può esportare una o più parti del suo contenuto per essere utilizzate in altri file.

Modules

- Import from other files Puoi importare variabili, funzioni, oggetti da altri file usando import.
  - Variables, functions, objects, etc
- Modern browsers only Browser moderni: I moduli sono supportati solo dai browser moderni, richiedendo un server HTTP per funzionare (come http-server, NginX, Apache).
  - Browser compatibility
- Don't work with local files
  - file:///url
- Need an HTTP server
  - http-server ,NginX, Apache, Wamp, XAMPP
  - Live Server - VSCode ext
  - The 8 Best Open Source Web Servers

Modules

Modules

- A self-contained unit of code
- Encapsulates specific functionality for better organization and reusability
- Facilitates dependency management
- Supports code reuse and collaboration on projects
- Promotes clean and manageable code through separation of concerns

Module vs regular JavaScript files

- Variables and functions are scoped to the module by default for better encapsulation and avoiding global scope pollution
- Modules have their own top-level scope to avoid conflicts with other modules
- **import** and **export** are used to define module dependencies

JavaScript modules

Modules

Loading
When a browser encounters a module script with **type="module" or .mjs**, it loads the module file asynchronously while parsing and rendering the HTML. Module scripts are ***deferred*** by default

Execution
When the parser finishes, modules are executed in the order they are encountered in the HTML, ensuring they run after the entire document, along with any dependencies, has been fully parsed

```
<script src="scripts/helper.js" type="module"></script>
<script src="scripts/main.js" type="module"></script>
```

Alternative, but not recommended by MDN

```
<script src="scripts/helper.mjs"></script>
<script src="scripts/main.mjs"></script>
```

Use the ***async*** attribute if you want the browser to execute the module immediately upon loading

```
<script type="module" src="module.js" async></script>
```

Export & import

```
<script src="scripts/helper.js" type="module"></script>
<script src="scripts/main.js" type="module"></script>

// helper.js -- exports a default function
export default function(msg) {
 return `I am a helper function. You passed "${msg}"`;
}

// main.js
import helper from './helper.js';
const msg = helper('external help');
console.log(msg);
```

Multiple exports

```
// helper.js
export default (msg) => `Echo "${msg}"`;
const user = { name: 'james' };
const double = (x) => x * 2;
export { user, double };

// main.js
import echo, { user, double } from './helper.js'; // named imports must match
console.log(echo('external help'));
console.log(user.name);
console.log(double(5));
```

01. Esportazione di default --> una funzione anonima che prende un messaggio (msg) e lo restituisce con il prefisso "Echo". Questa è l'esportazione principale di helper.js.

02. Esportazioni nominate -->
- user: un oggetto con una proprietà name impostata su "james".
- double: una funzione che moltiplica un numero per 2.

Renaming imports

```
// helper.js
export default (msg) => `Echo "${msg}"`;
const user = { name: 'james' };
const double = (x) => x * 2;
export { user, double };

// main.js
import anyName from './helper.js'; // imports the default export as anyName
console.log(anyName('external help'));

// alternative main.js - renaming named imports
import anyName, { user as someone, double as timesTwo} from './helper.js';
console.log(anyName('external help'));
console.log(someone.name);
console.log(timesTwo(5));
```

Renaming imports

```
// helper.js
export default (msg) => `Echo "${msg}"`;
const user = { name: 'james' };
const double = (x) => x * 2;
export { user, double };

// alternative main.js - renaming default
import { default as repeat, user as someone, double as timesTwo} from './helper.js';
console.log(repeat('external help'));

// alternative main.js - import all
import * as everything from './helper.js'; // renaming named imports
console.log(everything.default('external help'));
console.log(everything.user.name);
console.log(everything.double(5));
```

Best practice

```
// main.js
import helper from './helper.js'; // import just one entity, name it meaningfully
console.log(helper.name);

// helper.js
const api = {
 name: 'something'
 // ...
};
export default api; // export only one entity and export it as default
```

IIFE

Una funzione che viene eseguita immediatamente dopo essere stata dichiarata. È utile per creare scope separati, ma non è più necessaria con le moderne pratiche JavaScript.

è come se fosse una funzione usa e getta

What is an IIFE

Immediately invoked function expression

- The old way to create a scope for variables declared using var other than function scope
- Use in the past to create ‘modules’ of separated responsibilities
- Not required in modern Javascript
- You might encounter them in old code or isolated situations

IIFE example

```
// declare and immediately call a function
(function () {
  var message = 'Hello';
  console.log(message); // message exists in this scope
})();

console.log(message); // message is not defined
```

What is an IIFE

IIFE - MDN

Immediately invoked function expression

Why it's Time to Stop Using JavaScript IIFEs

The many ways to write an IIFE

I Love My IIFE

Immediately-Invoked Function Expression (IIFE)

Minification

What is minification

- removing unnecessary or redundant data
- without affecting how the resource is processed by the browser
  - removing code comments
  - removing unnecessary spaces and formatting
  - removing unused code
  - using shorter variable and function names
- Possible to minify HTML, CSS and Javascript

Javascript minification

main.js

```
let greeter = (name, place) => `Mister ${name}
of${place}`;

// function with a side effect
let nameLogger = (name, place) => {
  let newName = `Mister ${name} of${place}`;
  console.log(newName);
  return newName;
};
```

main.min.js

```
let greeter=(e,r)=>`Mister ${e}
of${r}`,nameLogger=(e,r)=>{let o=`Mister ${e}
of${r}`;return console.log(o),o};
```

[UglifyJS 3: Online JavaScript minifier]

CSS minification

style.css

```css
.geo-image {
  margin: 0 auto;
  width: 100%;
  position: relative;
}
.geo-image img {
  width: 100%;
  display: block;
}

/* image caption */
.geo-image figcaption {
  background-color: orange;
  position: absolute;
  bottom: 8px;
}
```

style.min.css

```css
.geo-image{margin:0
auto;width:100%;position:relative}.geo-image
img{width:100%;display:block}.geo-image
figcaption{background-color:orange;position:absol
ute;left:-4px;bottom:8px}
```

Minify CSS and JS

Content Delivery Network

Un sistema di server distribuiti che consegna contenuti agli utenti in modo rapido e con alta disponibilità.

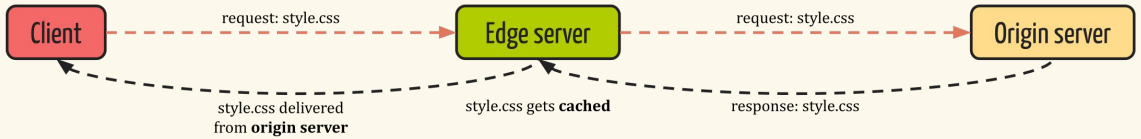
CDN - Content Delivery Network

- A large distributed system of servers deployed in multiple data centers across the Internet
- Serve content to end-users with high availability and high performance
- CDNs serve a large fraction of the Internet content today
  - web objects: text, graphics and scripts
  - downloadable objects: media files, software, documents
  - applications: e-commerce, portals
  - live streaming media
  - on-demand streaming media
  - social networks

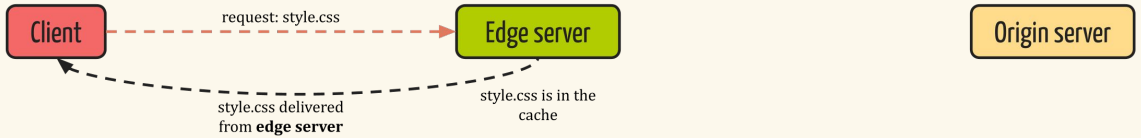
How CDNs work

Content Delivery Network

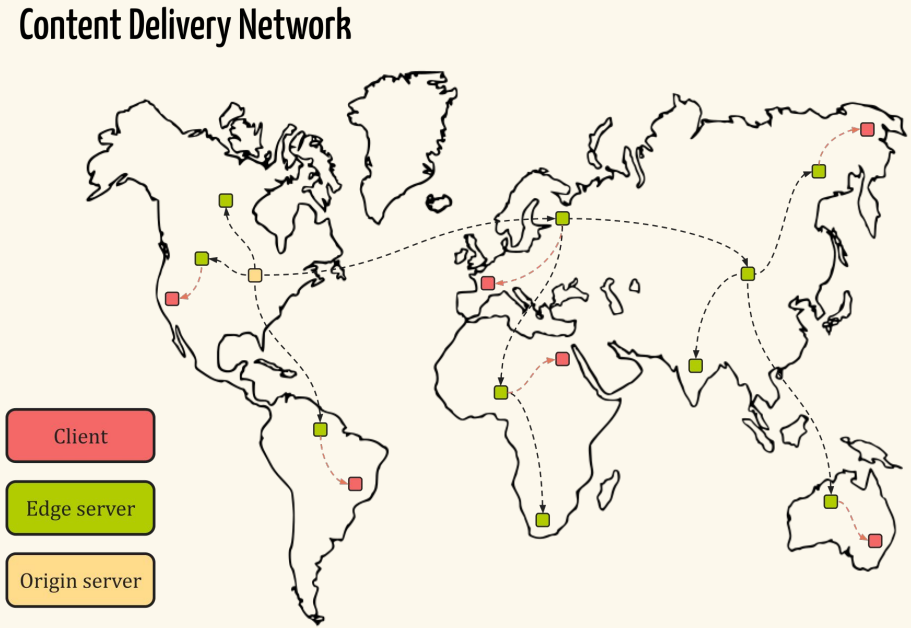
First request



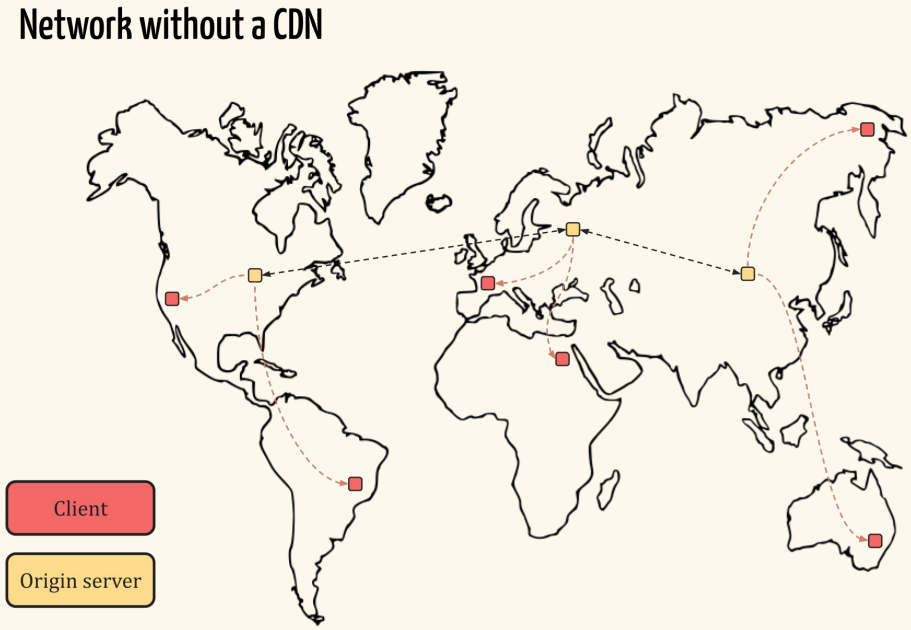
Subsequent requests



How CDNs work



How CDNs work



Using a CDN

```
<link href="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/css/bootstrap.min.css" rel="stylesheet">
<script src="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/js/bootstrap.bundle.min.js"></script>

<script crossorigin src="https://unpkg.com/react@17/umd/react.production.min.js"></script>
<script crossorigin src="https://unpkg.com/react-dom@17/umd/react-dom.production.min.js"></script>

<script src="https://cdnjs.cloudflare.com/ajax/libs/lodash.js/4.17.21/lodash.min.js"></script>
```

Some known CDNs

Cloudflare CDN

Google cloud CDN

Amazon CloudFront CDN

UNPKG

CDN package search

cdnjs

Build tools

Tools

Required to bundle code and also make modern code on older browsers

- NodeJS
  - package manager
  - installs packages
- Babel
  - compiler/transpiler
  - convert modern Javascript to versions compatible with older browsers - documentation
- Webpack
  - bundler
  - parses file imports to create bundles - documentation

Babel

Babel is translates modern Javascript to ES5 that older browsers understand
Technically Babel is a JS transpiler which can

- Transform syntax
- Polyfill missing features
- Perform source code transformations

Try Babel with your own code

Also, use Browserslist for understanding targets

Webpack

Webpack is a bundler that packs many JS module files into one bundle file

- Can produce one or a few bundles, e.g. bundle.js
- Supports many module systems
- Can be used for other types of files CSS, Images, JSON, SASS, etc
- Can minify and uglify Javascript code
- Managed by a configuration file called webpack.config.js and a CLI

Setup

Install NodeJS if it is not already installed

Create the following project folder and files:

```
project
├──src
│   ├── index.html
│   ├──scripts
│   │   ├── main.js
│   │   └── helper.js
│   └──styles
│       └── main.css
├──static
│   └──images
├── package.json
└── webpack.config.js
```

Modules to install

```
// run the following commands to install the required modules

npm i -D babel-loader @babel/core @babel/preset-env
npm i -D webpack webpack-dev-server webpack-cli
npm i -D html-webpack-plugin
npm i -D css-loader mini-css-extract-plugin
npm i core-js@3
```

index.html

```
<!DOCTYPE html>
<html lang="en">

<head>
  <meta charset="utf-8">
  <meta http-equiv="X-UA-Compatible" content="IE=edge">
  <title>JS Webpack</title>
  <meta name="viewport" content="width=device-width, initial-scale=1">
</head>

<body>
  <!-- body content -->
  created with Webpack
</body>

</html>
```

main.css

```
body {
  background: no-repeat url("../../static/images/robot.jpg");
  background-color: orangered;
}
```

Javascript files

```
// main.js
import '../styles/main.css';
import helper from './helper.js';

console.log(`I can run modern Javascript on older browsers`);
console.log(`message from helper: ${helper.msg}`);
const test = [1, 2, 3].includes(1);
console.log('test = ', test);


// helper.js
const api = {
  msg: 'I can use modules'
};
export default api;
```

package.json with webpack 5 dependencies

```
{
  "scripts": {
    "watch": "webpack --watch",
    "start": "webpack serve --open",
    "build": "webpack"
  },
  "devDependencies": {
    "@babel/core": "^7.25.2",
    "@babel/preset-env": "^7.25.3",
    "babel-loader": "^9.1.3",
    "css-loader": "^7.1.2",
    "html-webpack-plugin": "^5.6.0",
    "mini-css-extract-plugin": "^2.9.0",
    "webpack": "^5.93.0",
    "webpack-cli": "^5.1.4",
    "webpack-dev-server": "^5.0.4"
  },
  "dependencies": {
    "core-js": "^3.38.0"
  }
}
```

webpack.config.js

```
const path = require('path');
const HtmlWebpackPlugin = require('html-webpack-plugin');
const MiniCssExtractPlugin = require('mini-css-extract-plugin');

module.exports = {
  mode: 'production',
  entry: './src/scripts/main.js',
  output: { filename: '[name].bundle.js', path: path.resolve(__dirname, 'dist') },
  devServer: {
    static: {
      directory: path.join(__dirname, 'static'),
      publicPath: '/static',
      serveIndex: true // http://localhost:8080/static/ is exposed; use only for learning
    }
  },
  plugins: [new HtmlWebpackPlugin({ template: './src/index.html' }), new MiniCssExtractPlugin()],
```

webpack.config.js -- continued

```
  module: {
    rules: [
      { test: /\.css$/i, use: [MiniCssExtractPlugin.loader, 'css-loader'] },
      { test: /\.m?js$/,
        exclude: /(node_modules|bower_components)/,
        use: {
          loader: 'babel-loader',
          options: {
            presets: [[
                '@babel/preset-env',
                { targets: { edge: '127', firefox: '128', chrome: '127', safari: '17.5', ie: '11' },
                  // targets: '> 0.25%, not dead',
                  useBuiltIns: 'usage',
                  corejs: '3.21.1' }
              ]]
          }
        }
      }
    ]
  }
};
```

Running

install dependencies (wait for installation to finish):
npm install

run webpack dev server:
npm start

build project bundle:
npm run build

Testing
Try your bundled code on various desktop and mobile browsers
Additionally, check websites like Statcounter and Similarweb to compare browser marketshare

Babel & Webpack

detailed configuration

Babel configuration options

The targets option specifies the environments your project supports and can be:

- A browserslist-compatible query
  - **targets: "> 0.25%, not dead"**
- An object listing minimum versions to support
  - **targets: { edge: '127', firefox: '128', chrome: '127', safari: '17.5', ie: '11' }**

If the **targets** option is not included in Babel, it will look for a **.browserslistrc** file in your project that defines the environments to support and use that configuration instead

If neither **targets** nor a **.browserslistrc** file is provided, Babel defaults to supporting a wide range of environments, leading to more polyfills and transformations, which can increase the bundle size

Babel configuration options

The useBuiltIns option controls how polyfills are included

- **entry** - manually import `core-js` at the entry point
  - Babel includes all necessary polyfills based on the **targets**
- **usage** - automatically adds imports for the specific polyfills needed in each file based on the code and **targets**, reducing bundle size

The corejs option specifies the version of core-js to use for polyfilling
Necessary when using the useBuiltIns option to automatically include only the polyfills needed based on the **targets** configuration

Using package.json

In package.json, you can define scripts for different environments

- **dev** - "webpack serve --mode development"
  This script runs Webpack in development mode, which is ideal for building and testing during development. It enables features like detailed error messages, live reloading, and unminified output

- **build** - "webpack --mode production"
  This script runs Webpack in production mode, optimizing the code for deployment. It minifies the output, removes unnecessary code, and generally makes the build more efficient for production

```
{
  "scripts": {
    "dev": "webpack serve --mode development",
    "build": "webpack --mode production"
  }
}
```

Using separate configuration files

Another way to manage different environments is by creating separate Webpack configuration files:

- **webpack.config.dev.js**
  This file would contain settings optimized for development. You can specify the mode and other settings like source maps, dev server configurations, etc

- **webpack.config.prod.js**
  This file would contain settings optimized for production, focusing on performance, minification, and other optimizations

- The common configurations are stored in webpack.config.common.js, and both webpack.config.dev.js and webpack.config.prod.js will extend this common configuration

```
{
  "scripts": {
    "dev": "webpack --config webpack.config.dev.js",
    "build": "webpack --config webpack.config.prod.js"
  }
}
```

webpack.config.common.js

```
// webpack.config.common.js
const path = require('path');

module.exports = {
  entry: './src/index.js', // Common entry point
  output: {
    path: path.resolve(__dirname, 'dist')
  },
  module: {
    rules: [
      {
        test: /\.js$/,
        exclude: /node_modules/,
        use: {
          loader: 'babel-loader' // common loader configuration
        }
      }
    ]
  }
};
```

webpack.config.dev.js

```
// webpack.config.dev.js
const { merge } = require('webpack-merge');
const common = require('./webpack.config.common.js');

module.exports = merge(common, {
  mode: 'development',
  devtool: 'inline-source-map',
  devServer: {
    static: './dist',
    hot: true // enable Hot Module Replacement
  },
  output: {
    filename: '[name].bundle.js' // common filename for development
  }
});
```

webpack.config.prod.js

```
// webpack.config.prod.js
const { merge } = require('webpack-merge');
const common = require('./webpack.config.common.js');

module.exports = merge(common, {
  mode: 'production',
  devtool: 'source-map', // source maps for production debugging
  output: {
    filename: '[name].[contenthash].bundle.js', // contenthash is used for cache busting in production
    clean: true // automatically clean the output directory before each build
  },
  optimization: {
    minimize: true // minimize the output
  }
});
```

Webpack configuration

Concepts | webpack
Mode | webpack

DevServer | webpack
DevServer.static | webpack
webpack-dev-server - npm

Output | webpack
Development - watch mode | webpack

Set Up Webpack 5 To Work With Static Files | Older but useful guide

Your turn

1.To CDN or not to CDN

Find sources similar to this article to understand the pros and cons of a CDN

- Write down as many pros and cons as you can think of
    - Explain why you think they are relevant
- Describe 2 scenarios where you think a CDN is required and 2 where it's not
    - Your examples should be realistic and should emphasize the pros or cons

Summarize your findings in a properly named markdown file

- Markdown Guide
- Online Markdown Editor - Dillinger

2. Webpack friendly

- Implement some of exercises of the previous units as a webpack project
- The aims are
  - to rewrite the same exercises with modern JS syntax
  - to use webpack, and polyfills if necessary, to make the code compatible with the largest number of browsers
- Document any important configuration or code changes in readme.md
- Test the projects with the largest number of browsers you can

Bonus

3. Bundler showcase

Explore Parcel or another bundler of your choice

- Create a small project with HTML, CSS, and JavaScript files
- Use the bundler to build and serve your project
- Ensure the output is optimized and the project runs correctly on various browsers
- Include a README.md with a brief explanation of how the bundler handled your files and any notable features or issues

3 better alternatives for building your javascript

Top 5 alternatives to webpack

4. Stylish bundling challenge

Use the following resources:

- style-loader, sass-loader, Asset Modules Guide

Create a small project with HTML, SCSS, JavaScript files, and images

- Use Webpack to:
  1. Build SCSS files into a single CSS bundle
  2. Handle various image types with automatic decision between inlining and emitting based on file size (e.g., 50KB)
- Include a README.md file with a brief explanation of your Webpack configuration and how it handles SCSS and images

References

Import
Export

Global variables and JavaScript modules
Global Variables in JavaScript

References

webpack

DevServer

Development

Output

webpack additions

HtmlWebpackPlugin

css-loader

sass-loader

References

Webpack 5 : Guide for beginners

Setting up the Webpack Dev Server

How to Webpack 5 - Setup Tutorial

Set up Webpack 5 for Basic Javascript Projects

Setting Up Webpack for JavaScript, TypeScript and using Webpack Server