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2021

Client-Server Interaction in React

Connecting React to HTTP APIs

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Outline

- The “two servers” problem
  - React Development Server’s Proxy
  - Two servers + CORS
  - Build + Express (single server)
  - Also: Understanding Build (webpack, imports, …)

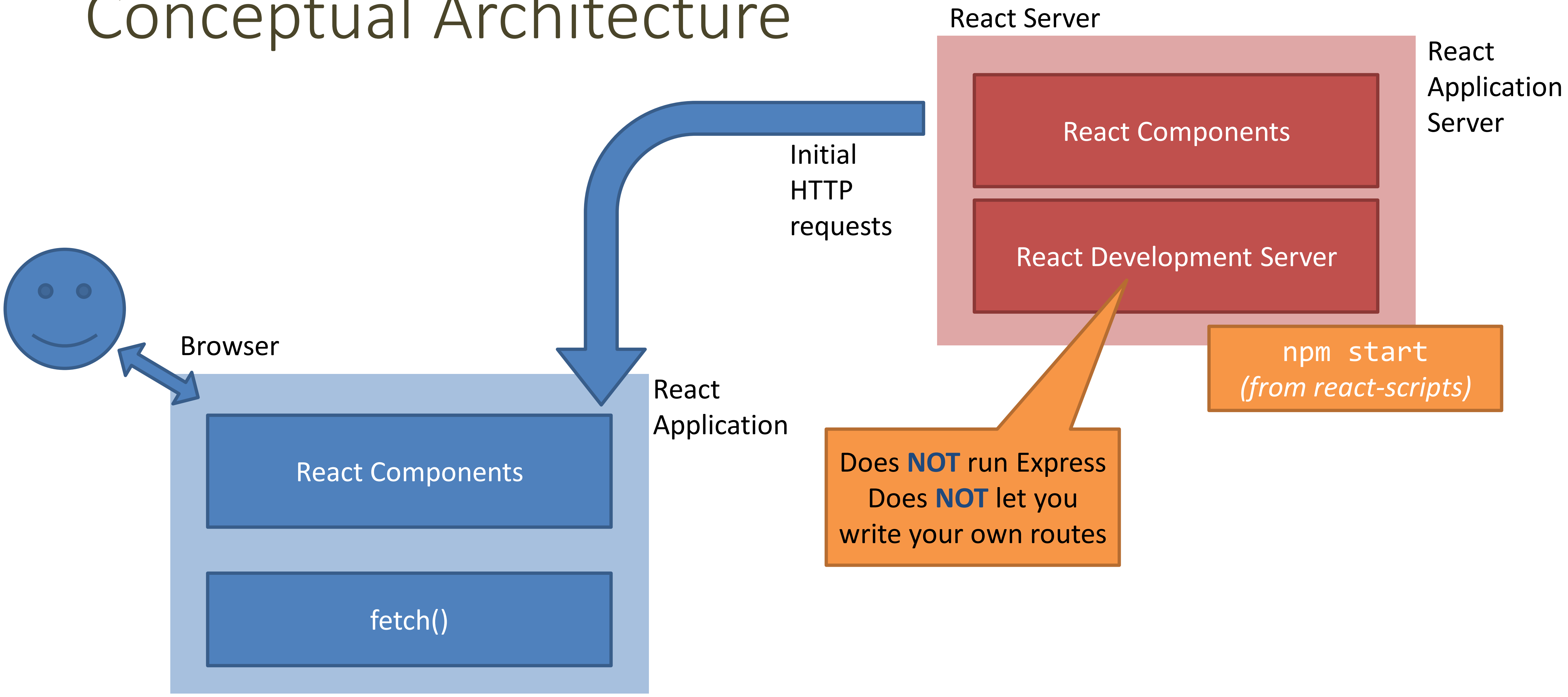
Left as individual reading for interested students https://www.robinwieruch.de/react-fetching-data

Full Stack React, Chapter “Using Webpack with Create React App”

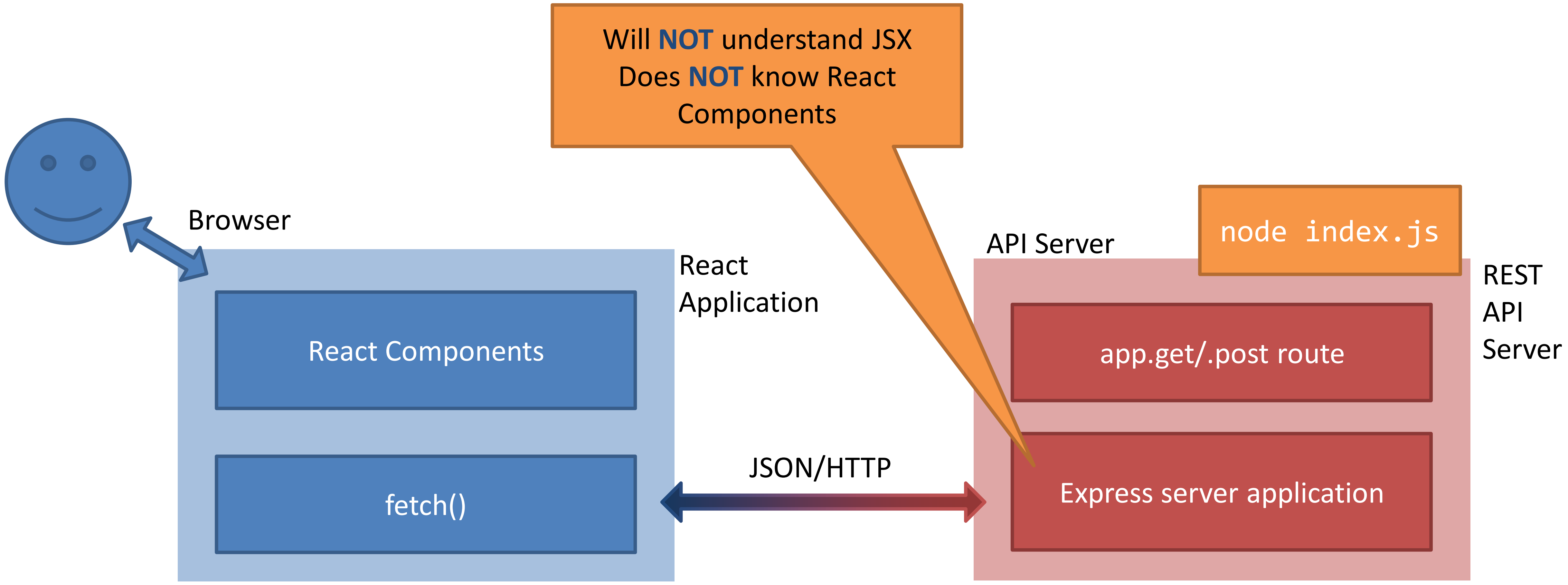
A Client and a Server walk into a bar…

THE “TWO SERVERS” PROBLEM

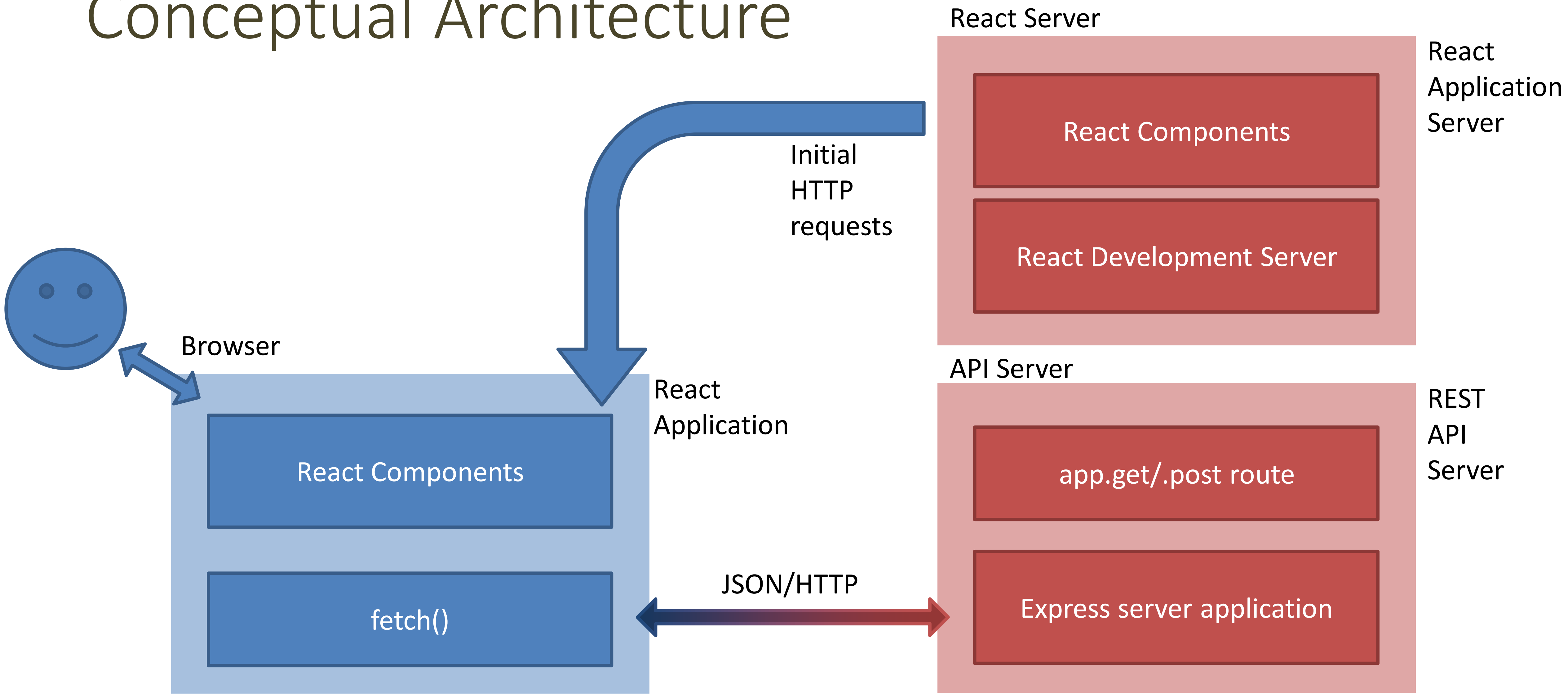
Conceptual Architecture



Conceptual Architecture



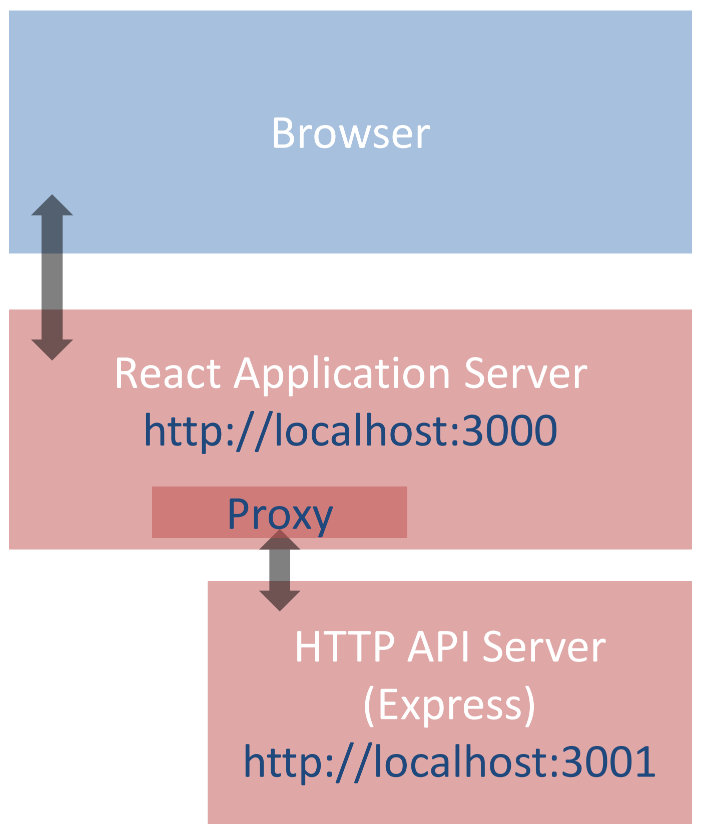
Conceptual Architecture



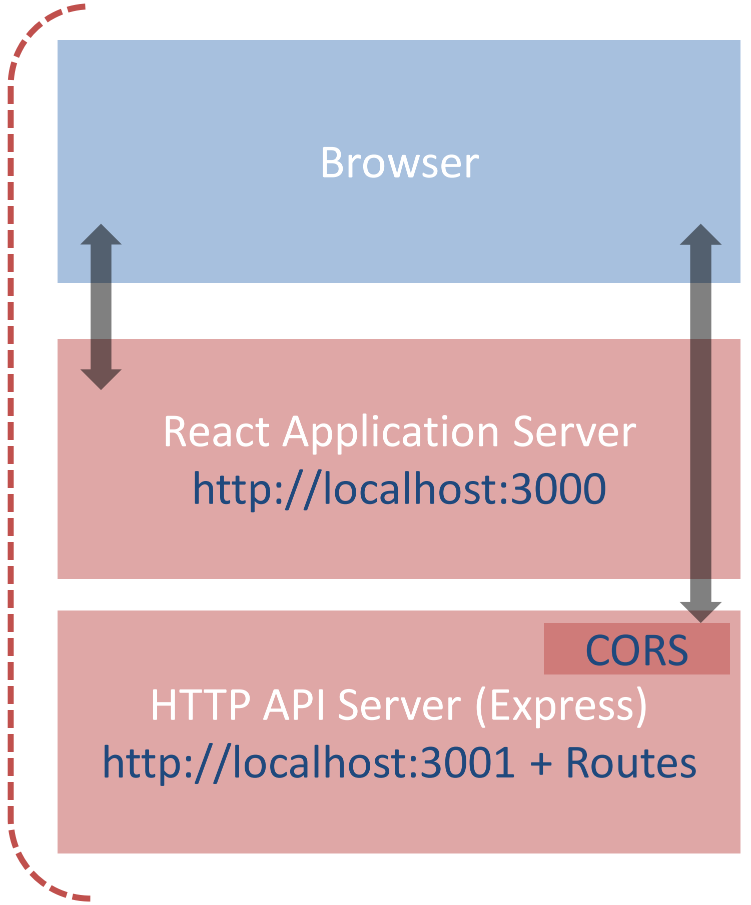
Issues

- Deployment
  - One-server-does-all or two-separate-servers?
  - Development vs. Production trade-off
    - convenience/debug/turnaround time vs performance/security
  - Cross-Origin security limitations
- Opportunities
  - Separate the load
  - Use any API Server (even 3rd party ones)

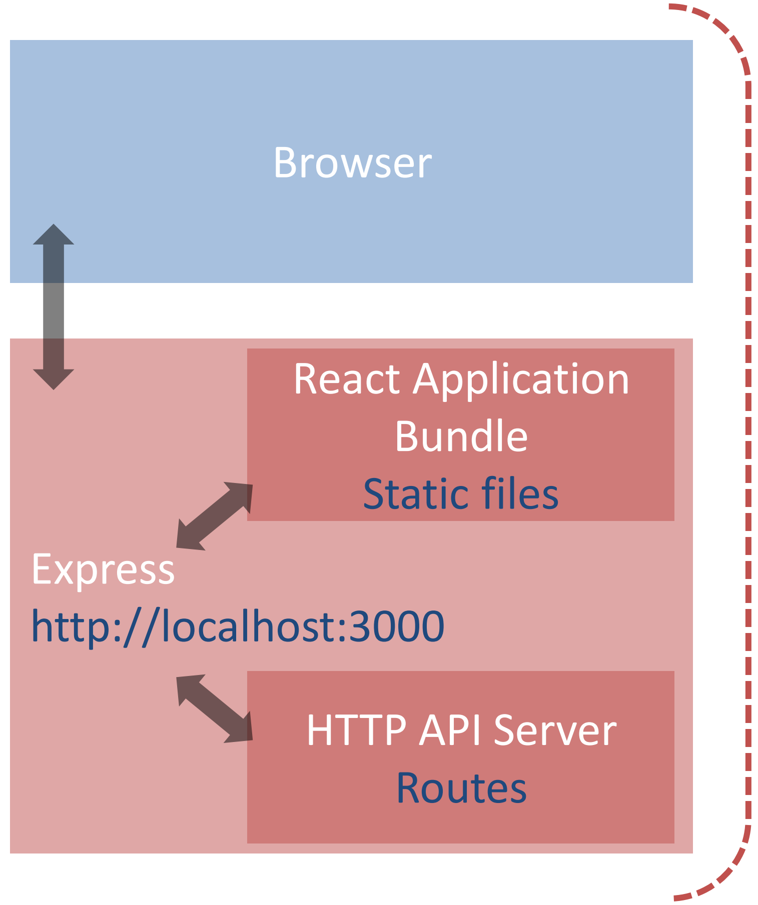
Three Possible Solutions



React Development Server's Proxy



Two independent servers + CORS configuration



Build a production bundle and host it in a web server https://create-react-app.dev/docs/proxying-api-requests-in-development/

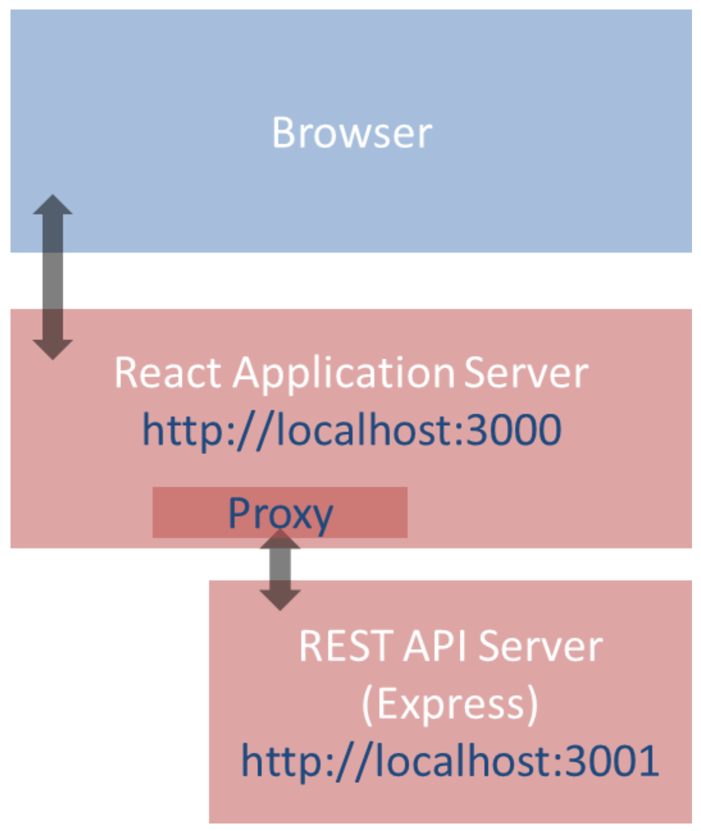
Full Stack React, Chapter “Using Webpack with Create React App / Using Create React App with an API server”

Double-Server made Easier

USING THE REACT DEVELOPMENT PROXY

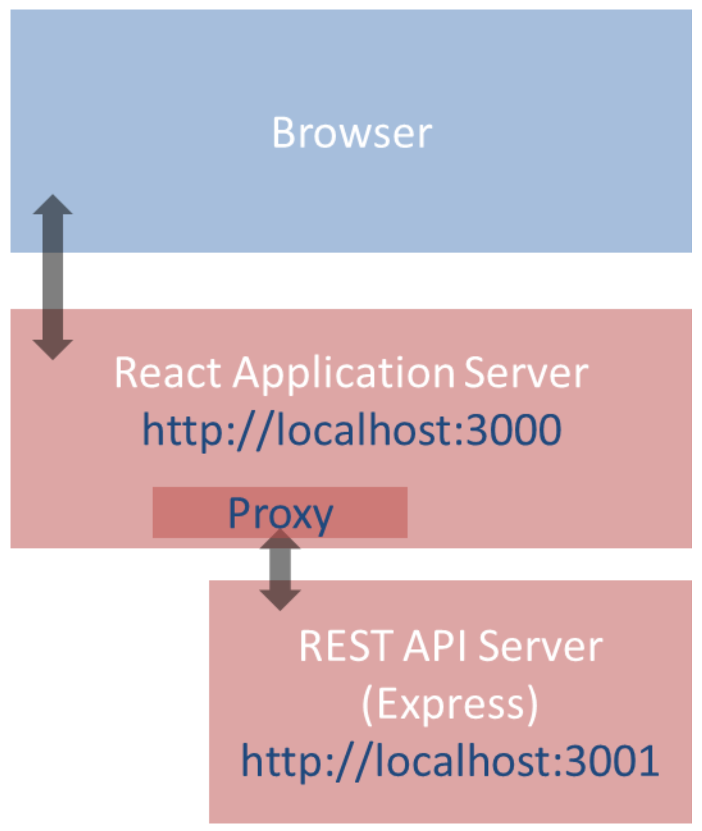
API Server Behind Application Server

- A feature provided by the React Development Server
  - uses react-scripts development modules
- Avoids the need to set-up CORS
- The browser thinks there is only one server



API Server Behind Application Server

- Browsers access only one server: the React application server
- The React web server is configured to act as a *proxy* for certain requests
- Those requests are sent to another web server via the proxy mechanism
- The proxy returns the response unaltered as its own response



How To Configure

- Just add <u>one line</u> in `package.json` originally written by create-react-app

```
// package.json
{    ...
     ...,
     "proxy": "http://localhost:3001",
}
```

Address of the HTTP API server

- N.B.: Works **only in development mode** while using the infrastructure of the `create-react-app` package

Proxy Rules

- The React development server will serve requests **directly** if:
  - It is a recognized static asset (e.g., image, stylesheet, …)
  - The HTTP Accept header is set to `text/html`
- Otherwise, it will *attempt* to send the request to the **proxy**
  - The proxy response is returned
- If the resource is not found, it will serve the default HTML page

- Browsers use `text/html` only when expecting HTML content (e.g., first page)
- Best practice: avoid conflicting paths in URLs, if the path is found in React folders, it is served, otherwise it is passed to the proxy
  - Use unique path prefix for HTTP API requests, e.g., `/api`

Use In Production Mode

Advanced topic

- The approach may be useful in production mode if the HTTP API server should not / cannot be accessed directly from the Internet
  - For instance, application server with private IPs or other network/security configuration reasons
- The main web server (Apache, nginx, etc.) should be able to determine which requests must be redirected to the other web server
  - For instance, depending on URLs (e.g., /api/… requests)

```
# nginx web server
location /api/ {
    proxy_pass http://backend-server;
}
```

```
# Apache web server

ProxyPass /api/ http://backend-server
```

Common Errors

- You are still running two web servers, on different ports
  - Remember to **start** the HTTP API server **before** launching the React application
  - May automate it by tweaking the startup scripts in `package.json`
- Production will be different
  - Need to configure the "real" proxy in production to be compatible with the same application path and API prefix

The remaining part of this presentation is left as individual reading for interested students https://www.newline.co/fullstack-react/articles/using-create-react-app-with-a-server/

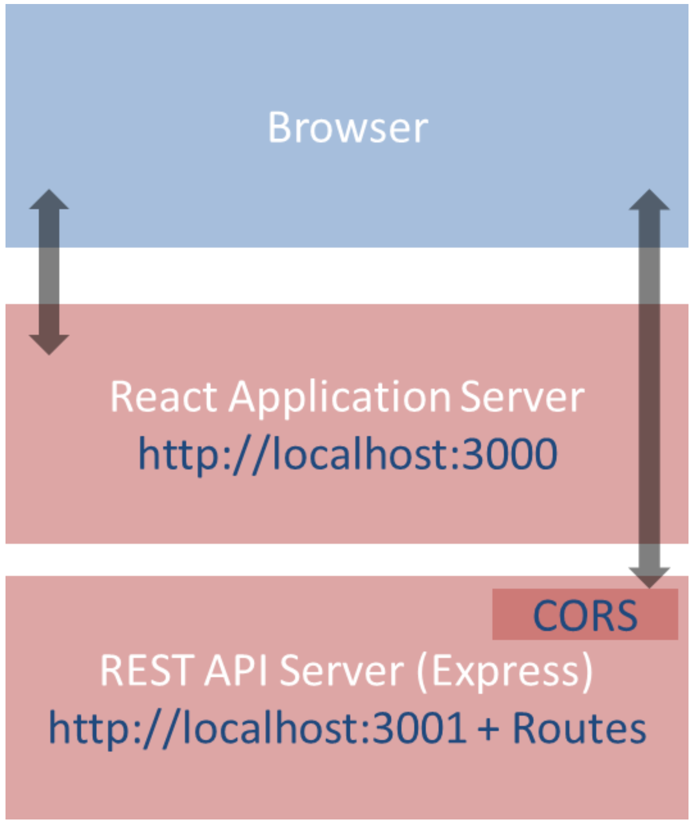
Full Stack React, Chapter “Using Webpack with Create React App / Using Create React App with an API server”

Side-by-side deployment

RUNNING TWO SEPARATE SERVERS

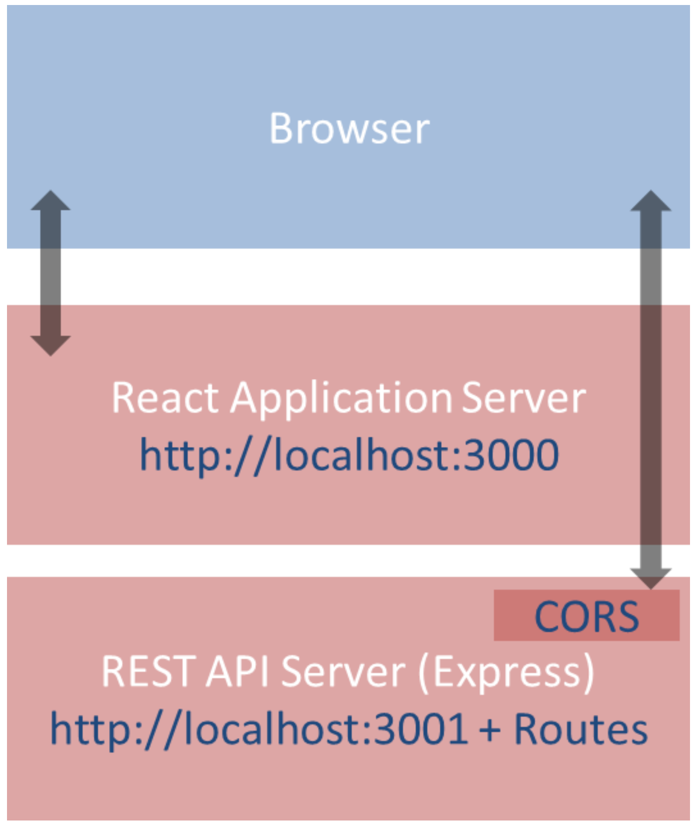
Double-Server Setup

- React Web Server and HTTP API server are hosted separately
  - Different hosts, and/or
  - Different ports
- The browser:
  - Receives the React application
  - Directs the API requests to the API server



Double-Server Setup

- Must run two web servers
  - React project: `npm start`
  - Express project: `node index.js`
  - Two projects, in two different directories (or different servers)
- Problem: handle CORS
  - Default security policy prevents loading data from other servers
  - Not discussed here



Advantages and Disadvantages

- Servers are easy to deploy
- Scalable solution: requests are sent to the appropriate server
- Only possible configuration if the HTTP API is provided by a third party
  - Public APIs

- Need to configure cross-origin resource sharing (CORS) on API server
- Requires using absolute URLs to access APIs
- Wrongly configured CORS might be a security risk (undesired access to APIs from e.g., mock websites)

How To Configure

- Configure CORS on API server for development

```
// index.js (node express server)

//Enable All CORS Requests (for this server)
app.use(cors());
//Use ONLY for development, otherwise restrict domain
```

- In production mode, use different domains for React and API servers, NEVER allow CORS requests from any origin, always specify origin

Example

API.js in the React Application

```
const APIURL=new URL('http://localhost:3001');

async function getCourses() {
  return fetch(new URL('/courses', APIURL))
    .then((response)=>{
      if(response.ok) {
        return response.json() ;
      } else {
        throw response.statusText;
      }
    })
    .catch((error)=>{
      throw error;
    });
}
```

Called in useEffect()

index.js for the API Server

```
const express = require('express');
const port = 3001;
const cors = require('cors');
const app = express();
app.use(cors());

app.get('/courses', (req, res) => {
  dao.listCourses()
    .then((courses) => res.json(courses))
    .catch((err)=>
      res.status(503)
         .json(dbErrorObj));
});

app.listen(port, () => console.log(`Example app
listening at http://localhost:${port}`));
```

Calls DAO.js

https://create-react-app.dev/docs/deployment/#static-server

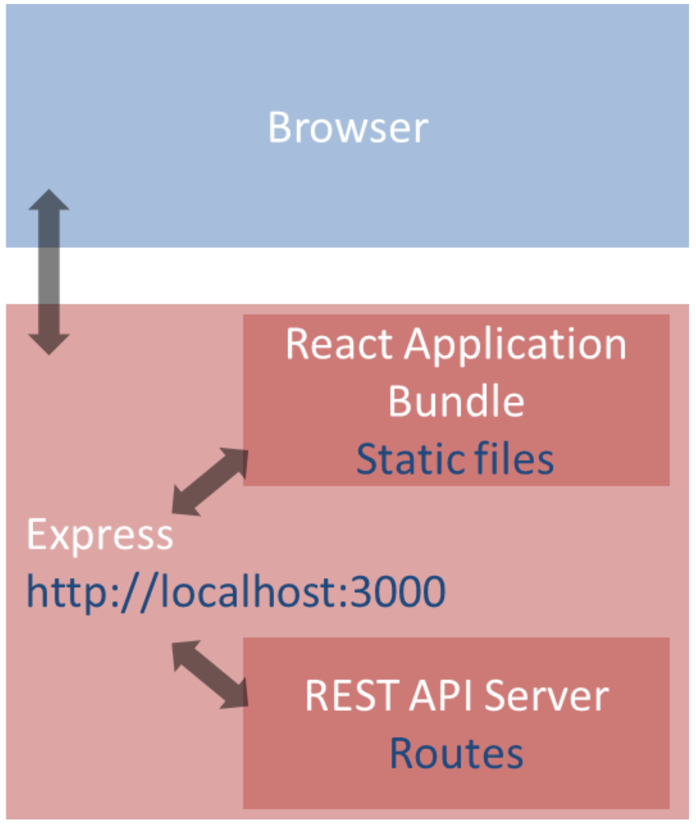
Full Stack React, Chapter “Using Webpack with Create React App / Creating a production build”

Packing and moving the React application into any web server

DEPLOYING A BUILD INSIDE A SERVER

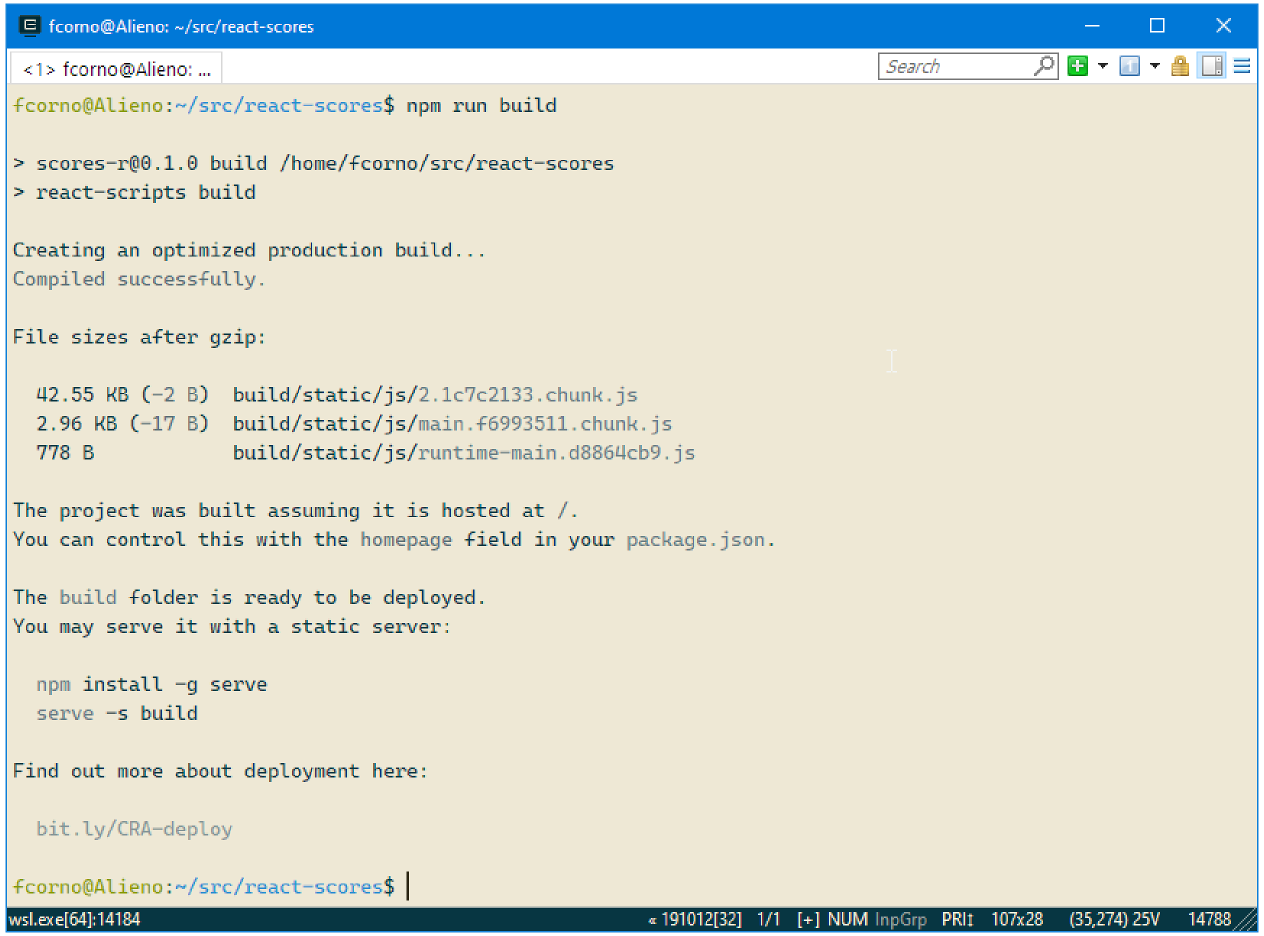
Deploying the React Bundle

- React does not need to run in the Development Server
- `npm run build` will create a "production bundle" with all the contents needed to run the application
- This bundle is composed of static files (html, js, assets) and may be served by *any webserver* (including Apache, nginx, express, php, …)



Build Command

npm run build



```
fcorno@Alieno:~/src/react-scores$ npm run build

> scores-r@0.1.0 build /home/fcorno/src/react-scores
> react-scripts build

Creating an optimized production build...
Compiled successfully.

File sizes after gzip:

  42.55 KB (-2 B)  build/static/js/2.1c7c2133.chunk.js
  2.96 KB (-17 B)  build/static/js/main.f6993511.chunk.js
  778 B            build/static/js/runtime-main.d8864cb9.js

The project was built assuming it is hosted at /.
You can control this with the homepage field in your package.json.

The build folder is ready to be deployed.
You may serve it with a static server:

  npm install -g serve
  serve -s build

Find out more about deployment here:

  bit.ly/CRA-deploy

fcorno@Alieno:~/src/react-scores$ |
```

wsl.exe[64]:14184 « 191012[32] 1/1 [+] NUM InpGrp PRI↕ 107x28 (35,274) 25V 14788

Creates everything under ./build

Publish from / or from 'homepage' property

https://create-react-app.dev/docs/deployment/

What Does “build” Do?

- Most of the work in “building” the static application is done by Babel and Webpack
  - Babel translates all JSX (and new JS syntax) into basic JS (according to the ‘`production`’ property in `package.json`)
  - Webpack packs and minimizes all JS code into a single file
  - Prepares an `index.html` that loads all the JS code
- The content of the “build” folder is self-contained and may be moved to the deployment server
- All debugging capabilities are removed

Hosting The Build in Express

- `cd express-api-server`
- `cp –r ..../react-app/build .`
- Define a static route in `server.js`

```
app.use(express.static('./build'));

app.get('/', (req,res)=> {res.redirect('/index.html')} );
```

- In the application, you may call APIs locally
  – `fetch('/api/courses')...`

Pros and Cons

- Simple to deploy the final application (anywhere)
- May include the application inside the API server (in production, too)
- The JS code runs on every browser (thanks to polyfills and transpiling)

- The build cannot be directly modified
- Need a save/build/copy/reload cycle for every modification

Other “Magic” By Webpack

- Packing of all imported modules
- Bundling of Assets
  - Images
  - CSS files
- CSS Modules

In Development Mode…

- `npm start` runs the “Webpack development server” (WDS)
- All our code is transpiled and packed into a `bundle.js` that is automatically inserted into `index.html`
  – Contains all our code, plus React, plus imported modules
  – Also handles imports of non-JS files
- `bundle.js` does not exist – it’s kept in-memory by the WDS
- Sets up hot-reloading and synchronized error messages (via websockets)

https://create-react-app.dev/docs/adding-a-stylesheet
https://create-react-app.dev/docs/adding-a-css-modules-stylesheet
https://create-react-app.dev/docs/adding-images-fonts-and-files

Imports in Webpack

- `import logo from './logo.svg';`
- `import logo from './logo.png';`
  - Will include the image reference inside the bundle (placed under static/media)
  - Small files are rendered inline
- `import './Button.css';`
  - This component will use these CSS declarations
  - All CSS will be concatenated into a single file, but here we are stating the dependency
- `import styles from './Button.module.css';`
  - Files ending with .module.css are CSS modules
  - Styles may be applied with `className={styles.primary}`
  - Class names are *renamed to be unique*: no conflict with other Components' styles

https://create-react-app.dev/docs/using-the-public-folder

Why Use Imports

- Scripts and stylesheets get minified and bundled together to avoid extra network requests.
- Missing files cause compilation errors instead of 404 errors for your users.
- Result filenames include content hashes, so you do not need to worry about browsers caching their old versions.

- They are an optional mechanism. “Traditional” loading (with link) still works, if you save your files in the public directory

References

- Taming the State in React, Robin Wieruch (2017) http://leanpub.com/taming-the-state-in-react
- The Road to learn React, Robin Wieruch (2019) http://leanpub.com/the-road-to-learn-react

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