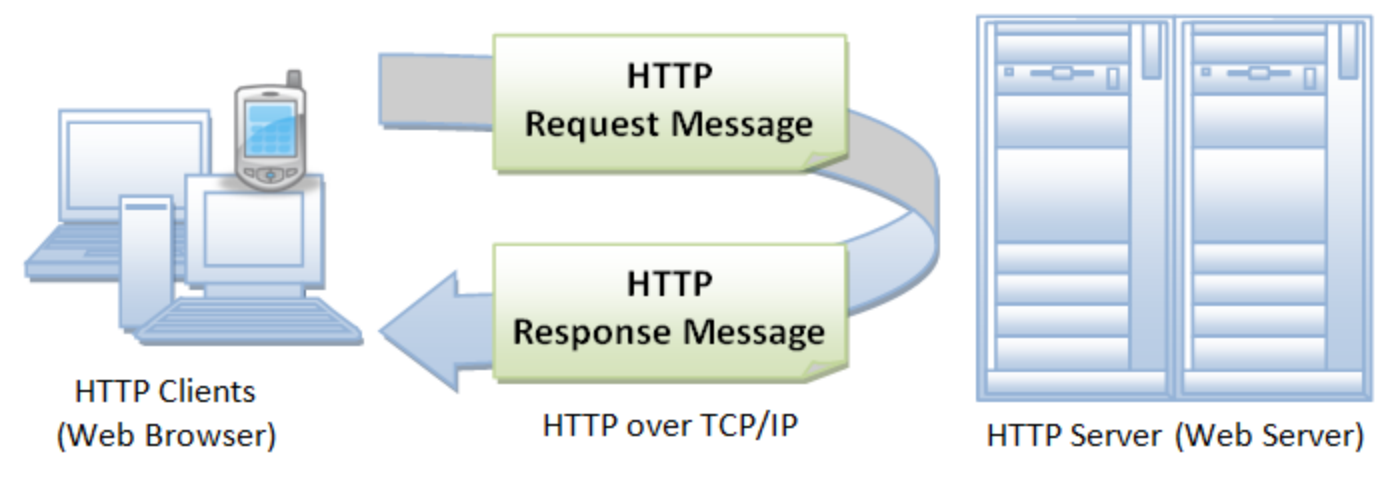
Part 4: **Server-Side Development**

Web Server & HTTP Protocol

Web Server



- Web server: A server that hosts websites
  - To make them accessible to everyone
  - Handles client requests and responses with webpages
    - More freedom to generate contents dynamically
    - Beside HTML, web servers also serves images, CSS stylesheets, JavaScript files, fonts, data, files,…
  - Using a protocol called HTTP
    - Web server is also called HTTP server

HTTP Protocol

- Characteristics:
  - TCP-based
  - Client/server mechanism
  - Text-based requests and responses
  - Stateless
- Versions
  - HTTP/0.9 (1991), HTTP/1.0 (1995)
    - Close and reopen connection for every request
  - HTTP/1.1 (1997)
    - Keep connection alive for next requests
    - Virtual hosts → allows hosting multiple sites at the same IP
    - Partial-content requests
    - Caching mechanism
  - HTTP/2 (2015)
    - Binary data
    - Multiple requests in parallel over the same connection

HTTP URL

`http[s]://`*`host`*`:`*`port`*`/`*`path`*`/`*`resource`*`?`*`query`*`#`*`hash`*

- URL components
  - *`host`*: server address
  - *`port`*: service port (default: 80 for HTTP, 443 for HTTPS)
  - *`path`*: resource path
  - *`resource`*: resource name
  - *`query`*: query string, i.e., data passed to server
  - *`hash`*: fragment identifier specifying a location within the resource
- All components can be omitted in specific circumstances
- Relative URLs may be used to referencing resources on the same host

Client Request

- Structure

```
GET /docs/index.html HTTP/1.1
(headers…)
(blank line)
```

- Example

```
GET /docs/index.html HTTP/1.1
Host: www.nowhere123.com
Accept: image/gif, image/jpeg, */*
Accept-Language: en-us, fr, vi
Accept-Encoding: gzip, deflate
User-Agent: Mozilla/4.0 (compatible; MSIE 6.0;
   Windows NT 5.1)
(blank line)
```

Request Methods

- The desired action to be performed for a given resource
  - GET: requests the specified resource
  - POST: submits data to the specified resource
  - PUT: creates/replaces the specified resource
  - PATCH: applies partial modifications to a resource
  - DELETE: deletes the specified resource
  - HEAD: similar to GET but without getting the response body
  - OPTIONS: gets the communication options for the target resource

Common Request Headers

- `Host`: Interested website when server hosts multiple websites (aka virtual hosts)
- `Accept`: Types and formats of resource that the client accepts/prefers (MIME syntax: *`type/format`*)
- `Accept-Language`: Languages that the client prefers
- `Accept-Encoding`: Encoding and compression methods that the client accepts
- `User-Agent`: Characteristic string that lets servers identify the application, operating system, and version of the requesting user agent

Server Response

- Structure

```
HTTP/1.1 200 OK
(headers…)
(blank line)
(body)
```

- Example

```
HTTP/1.1 200 OK
Date: Sun, 18 Oct 2009 08:56:53 GMT
Server: Apache/2.2.14 (Win32)
Last-Modified: Sat, 20 Nov 2004 07:16:26 GMT
Content-Length: 44
Content-Type: text/html

<html><body><h1>It works!</h1></body></html>
```

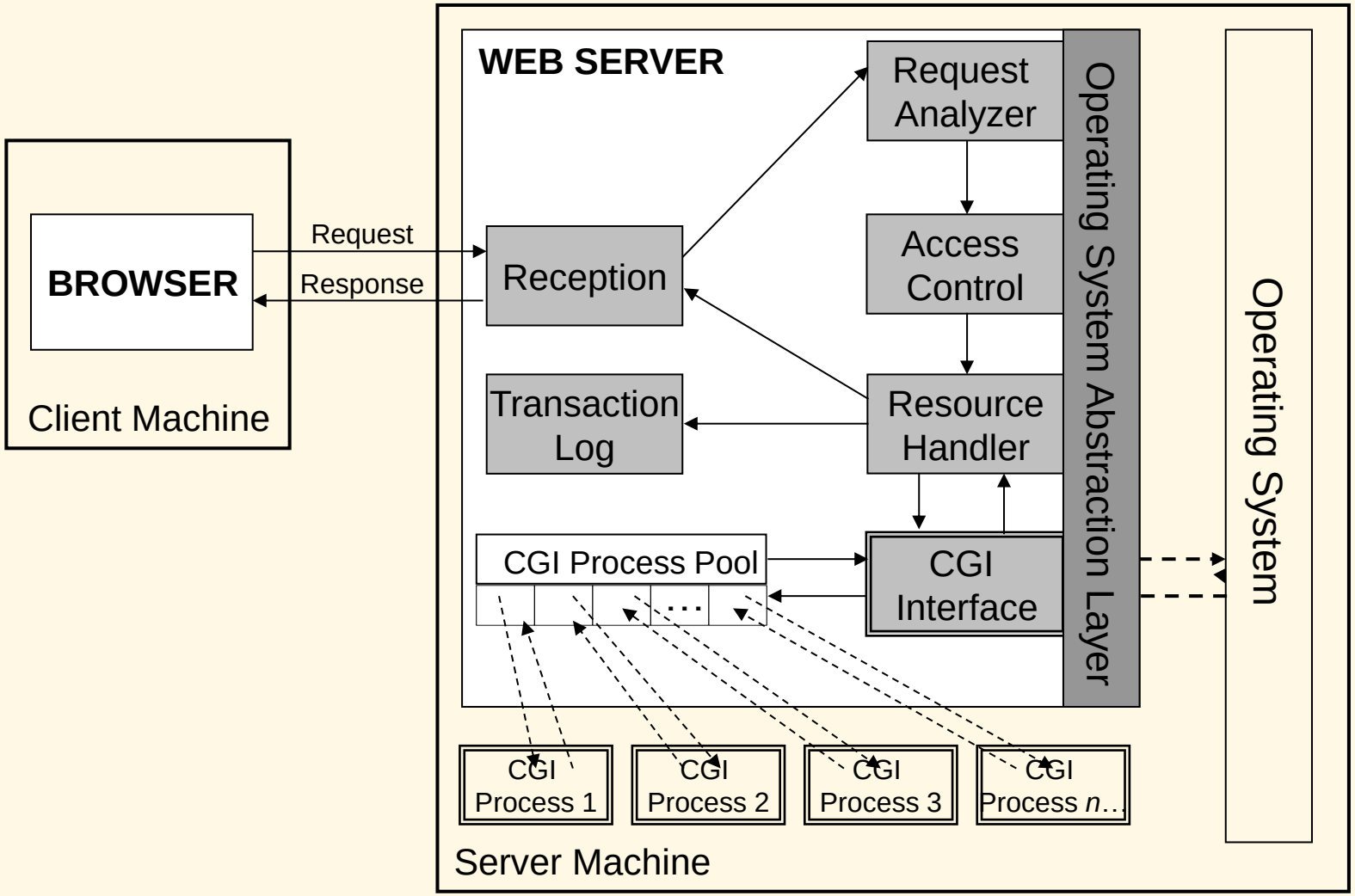
Status Codes

- 1xx: Informational
- 2xx: Success
  - 200: OK
- 3xx: Redirection
  - 301: Moved Permanently
- 4xx: Client Error
  - 401: Bad Request
  - 403: Forbidden
  - 404: Not Found
- 5xx: Server Error
  - 500: Internal Server Error
  - 503: Service Unavailable

Common Response Headers

- `Server`: Server application name and version
- `Content-Length`: Length of the request body in bytes
- `Content-Type`: Type and format of the resource
- `Expires`: Expiration time for caching

How a (Traditional) Web Server Works



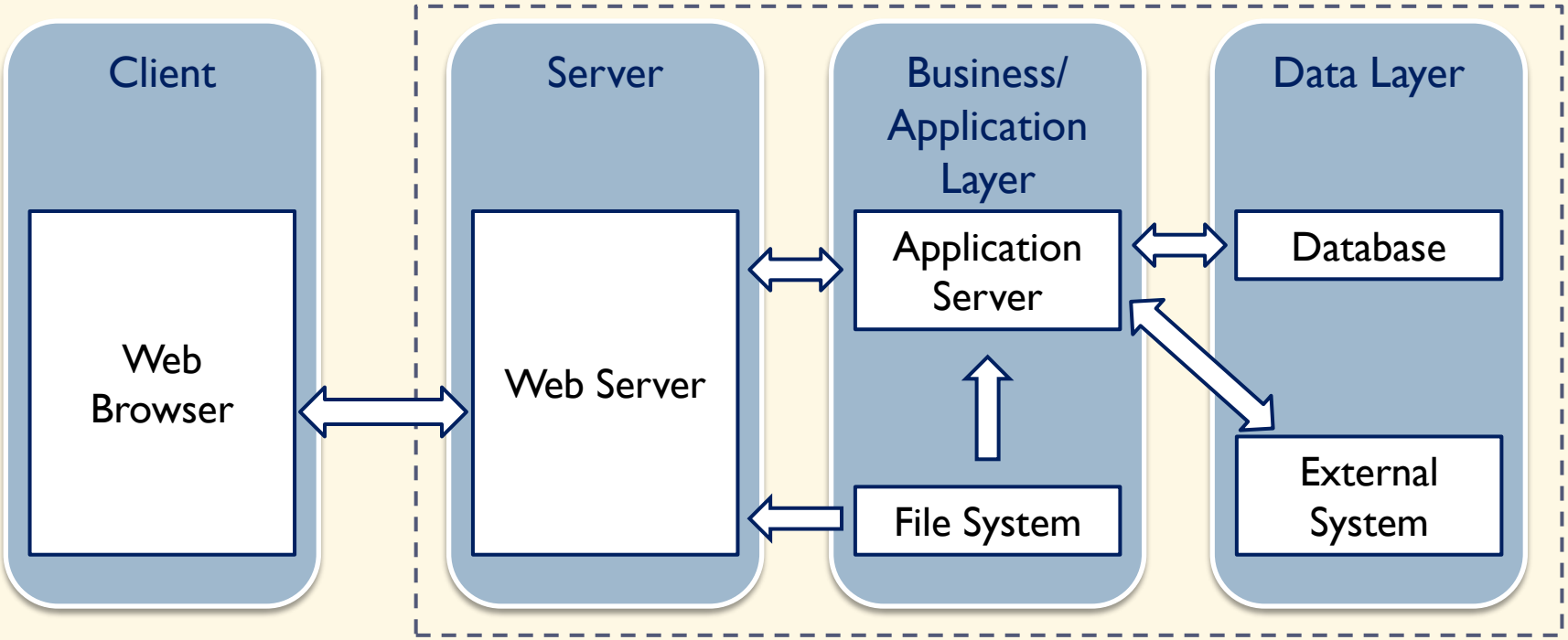
Simple HTTP File Server

```
const http = require('http');
const fs = require('fs');

http.createServer((req, resp) => {
  let path = '.' + req.url;
  if (path == './') path = './index.html';
  fs.readFile(path, (error, content) => {
    if (!error) {
      const headers = {'Content-Type': 'text/html'};
      resp.writeHead(200, headers);
      resp.end(content, 'utf-8');
    }
  });
}).listen(80);
```

Express

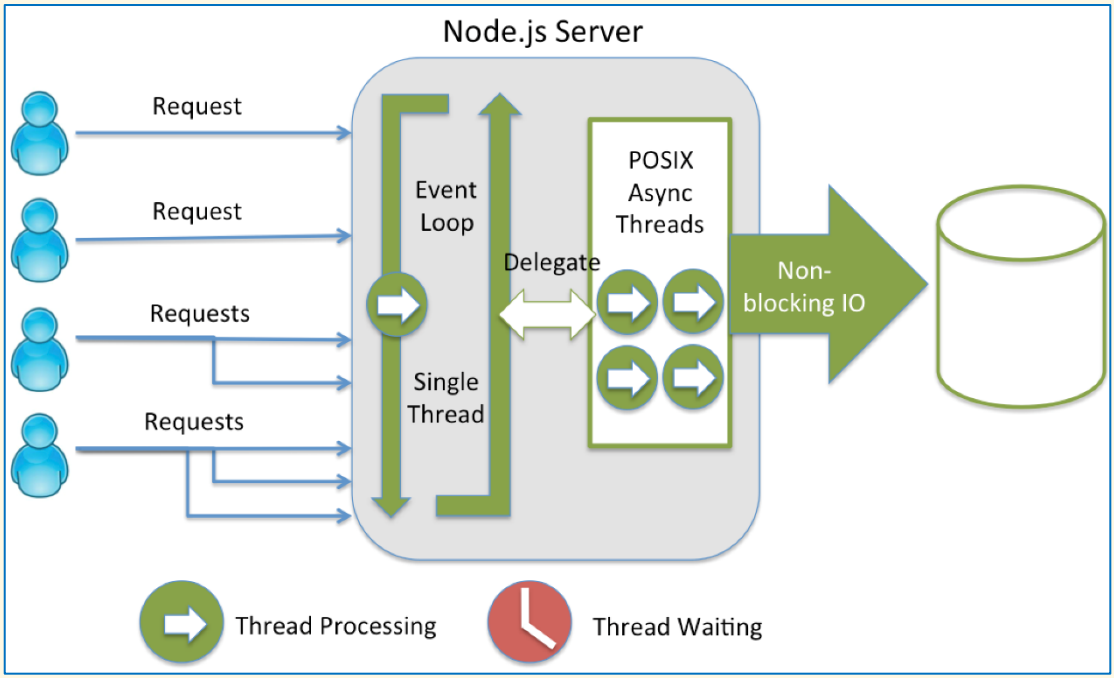
Web Architecture



- 4 layers:
  - Client: consists of web browsers
  - Server: handles client requests
  - Application: handles the business logic
  - Data: consists of storage systems

Express

- Most popular Node.js framework to create websites
- Core features
  - Rule-based routing table
  - Non-blocking event-based I/O (Node.js feature) → able to handle massive number of requests
  - Dynamic HTML page rendering using templates
  - Middleware



- Installation
  - `npm install express`

Hello World Example

```
const express = require('express');
const app = express();
const port = 3000;

app.get('/', (req, res) => {
  res.send('Hello World!');
});

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

Handling GET Requests

```
// To display index.html
app.get('/', (req, res) => {
  res.sendFile(__dirname + "/index.html");
});

// Output data in JSON format
app.get('/getting', (req, res) => {
  const data = {
    fname: req.query.fname,
    lname: req.query.lname
  };
  console.log(data);

  //...

  res.end(JSON.stringify(data));  // or: res.json(data);
});
```

Handling POST Requests

```
// for parsing application/x-www-form-urlencoded
app.use( express.urlencoded({ extended: false }) );

app.post('/posting', (req, res) => {
  const data = {
    fname: req.body.fname,
    lname: req.body.lname
  };
  console.log(data);

  //...

  res.end(JSON.stringify(data));  // or: res.json(data);
});
```

Routing

- Determining how an application responds to a request to a particular endpoint, which is a URL (or path) and a specific HTTP request method (GET, POST,…)
- Each route can have one or more handler functions, which are executed when the route is matched
- Route definition structure:
  - `app.method(path, handler);`

  where:
  - *app*: express instance
  - *method*: HTTP request method, in lower case
  - *path*: path on the server
  - *handler*: function executed when the route is matched

Multiple Methods to Same Path

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

app.post('/path', (req, res) => {
 // ...
});
```

- Possible to use `app.all()`, which accepts all methods:

```
app.all('/path', (req, res) => {
  console.log(req.method);
  // ...
});
```

Multiple Handlers to Same Route

- More than one callbacks can be used to handle a route
  - Call `app.next()` to pass the handle to the next callback

- Example:
  -
```
app.get('/example', (req, res, next) => {
  console.log('Callback #1');
  next();
}, (req, res, next) => {
  console.log('Callback #2');
  next();
}, (req, res) => {
  res.send('Hello from callback #3');
});
```

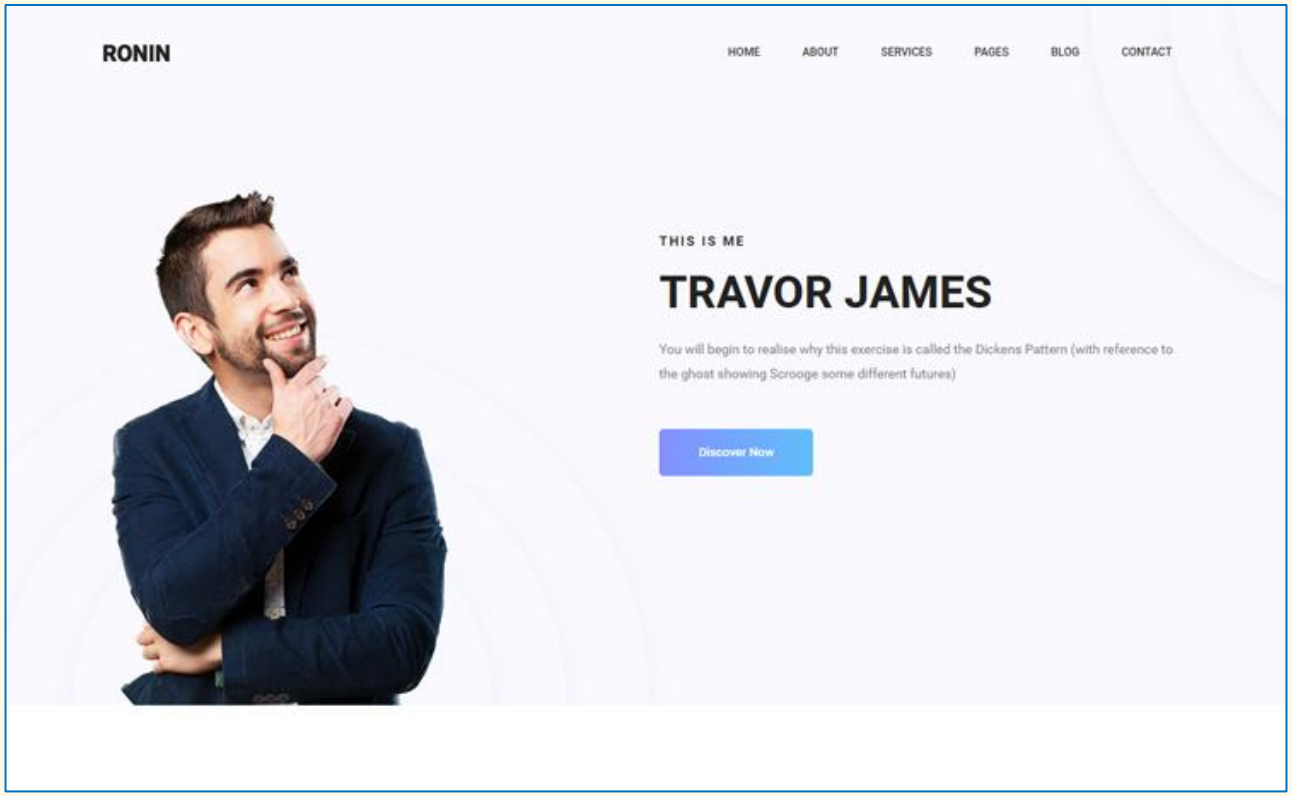
Response Methods

- The following methods on the response object (`res`) can send a response to the client, and terminate
  - If none is called from a route handler, the request will be left hanging

Method	Description
`res.download()`	Prompts a file to be downloaded
`res.end()`	Ends the response process
`res.json()`	Sends a JSON response
`res.jsonp()`	Sends a JSON response with JSONP support
`res.redirect()`	Redirects a request
`res.render()`	Renders a review template
`res.send()`	Sends a response of various types
`res.sendFile()`	Sends a file as a byte stream
`res.sendStatus()`	Sets the response status code and sends its representation as the response body

Exercise

- Create a simple portfolio website.
  - The contact page shows a form that allows the user to submit his/her name, email and comment.



Route Parameters

- Captured values given as parts of the path in `req.params` object
- Match `/user/23/book/71`

```
app.get('/user/:userId/book/:bookId', (req, res) => {
  console.log(req.params.userId);
  console.log(req.params.bookId);
  // ...
});
```

- Match `/download/data.zip`

```
app.get('/download/:name.:ext', (req, res) => {
  console.log(req.params.name);
  console.log(req.params.ext);
  // ...
});
```

Route Paths using Patterns (Regular Expressions)

- Using wildcard characters:
  - `x?`: *x* is optional, may appear 0 or 1 time
  - `x+`: *x* may appear 1 or more times
  - `x*`: *x* may appear any number of times (0, 1 or more)
  - `(x)` : groups *x* as an entity
- Examples:
  - Match `/acd` and `/abcd`
    `app.get('/ab?cd', ...`
  - Match `/abcd`, `/abbcd`, `/abbbcd`,...
    `app.get('/ab+cd', ...`
  - Match `/abcd`, `/abxcd`, `/abRANDOMcd`, `/ab123cd`,...
    `app.get('/ab.*cd', ...`
  - Match `/abe` and `/abcde`
    `app.get('/ab(cd)?e', ...`

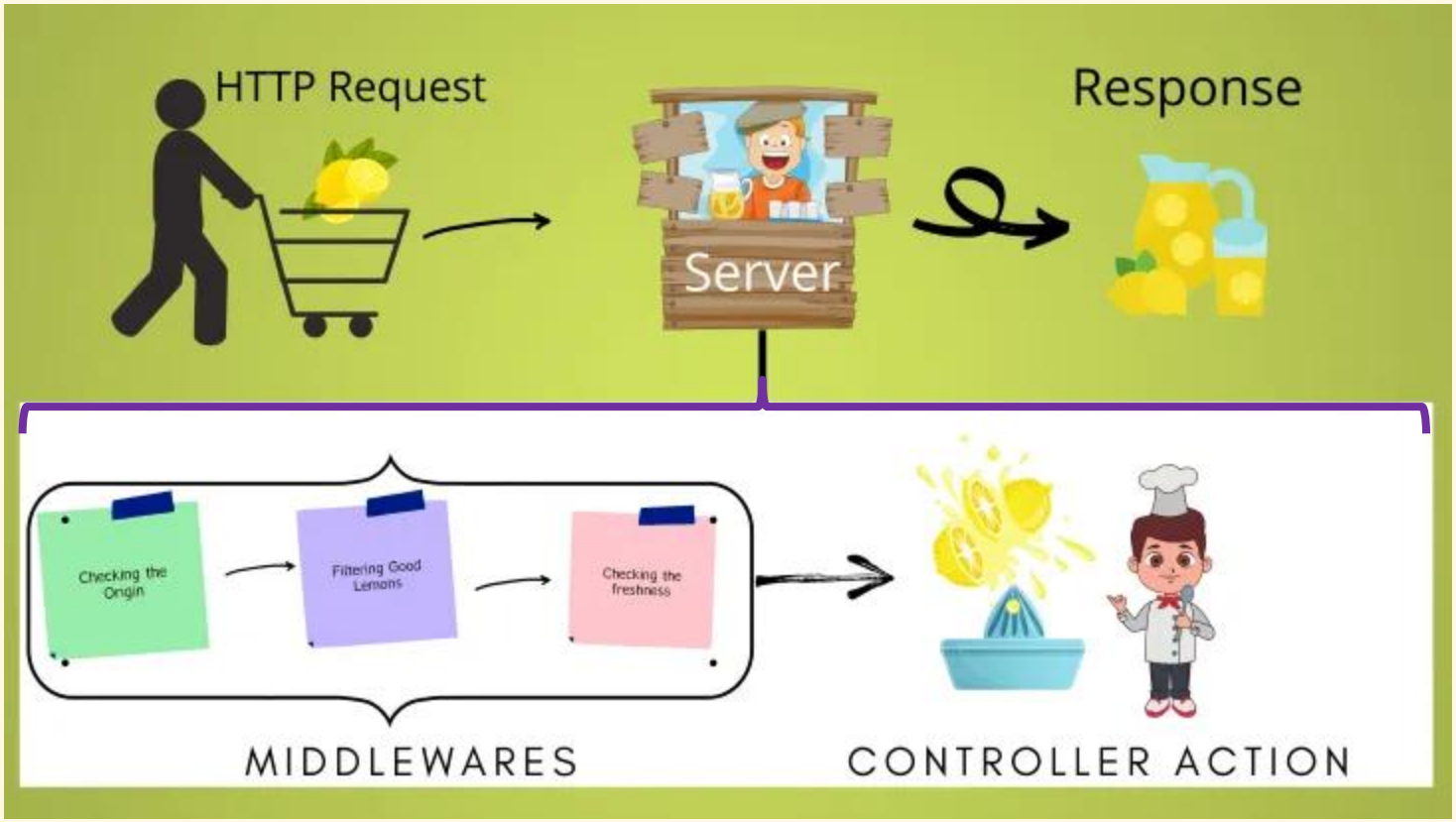
Route Paths using Regular Expressions

- Regular expression: patterns in formal language used to match character combinations in strings
  - https://en.wikipedia.org/wiki/Regular_expression

- Examples:
  - Match `/ab`, `/ab1`, `/ab123`, `/ab222`,…
    `app.get(/^\/ab[0-9]*$/, ...`

  - Match `/lovely-good-guy` and `/lovely-bad-guy`
    `app.get(/^\/lovely-(good|bad)-guy$/, ...`

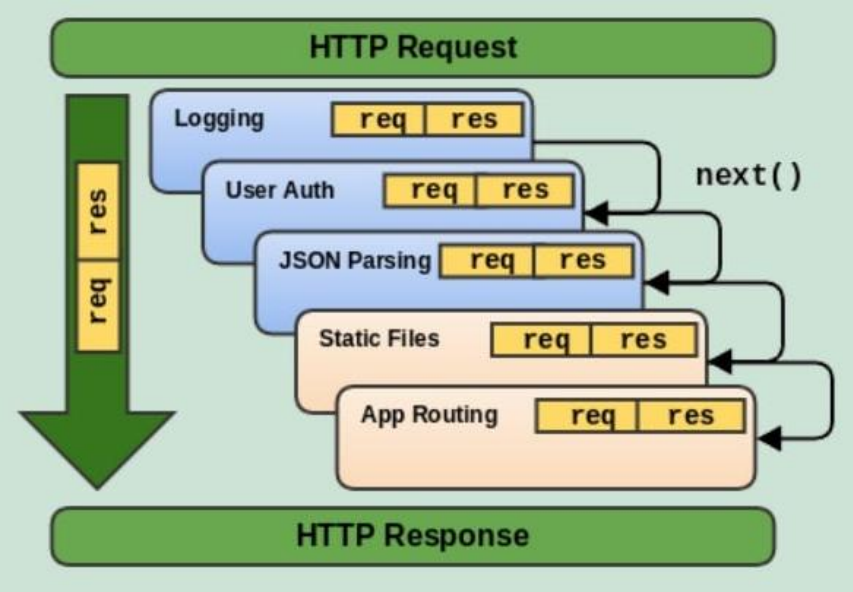
Middleware



- Functions that execute during the request-response cycle and have access to both the request object (`req`) and the response object (`res`)

Express Middleware

- To mount a middleware function at a path and all following it:
  - `app.use([path,] func)`
  - If *path* is not given, it defaults to root
  - Use `next()` in the function to pass to the next middleware
  - If one of the response methods is called, the response will terminate like in request handlers



- Example: Logging requests to paths under `/admin`
  -
```
app.use('/admin', (req, res, next) => {
  console.log(`Time: ${new Date()}`);
  console.log(req);
  next();
});
```

Another Example

- Adding data to the request object (`req`) within a middleware: an application-level middleware that adds request time to `req`
  -
```
app.use((req, res, next) => {
  req.requestTime = new Date();
  next();
});

app.get('/', function (req, res) {
 res.send(`Requested at: ${req.requestTime}`);
});
```

Middleware's Common Usage

- Request filters
- Request data preparation: parsers, decoders
- Loggers
- Error handlers
- Information preprocessors

Serving Static Files

- Resources that are usually served as static: images, CSS stylesheets, JavaScript files, text files,…
- Use `express.static(folder, [options])`, a built-in middleware
  - `app.use('/uploads', express.static('user-uploads'));`

```
app.use('/public', express.static('public-files', {
  dotfiles: 'ignore',           // ignores . and .. files
  extensions: ['htm', 'html'], // serves only html
  index: false,                 // no index files
  maxAge: '1d',                 // cache expiring date

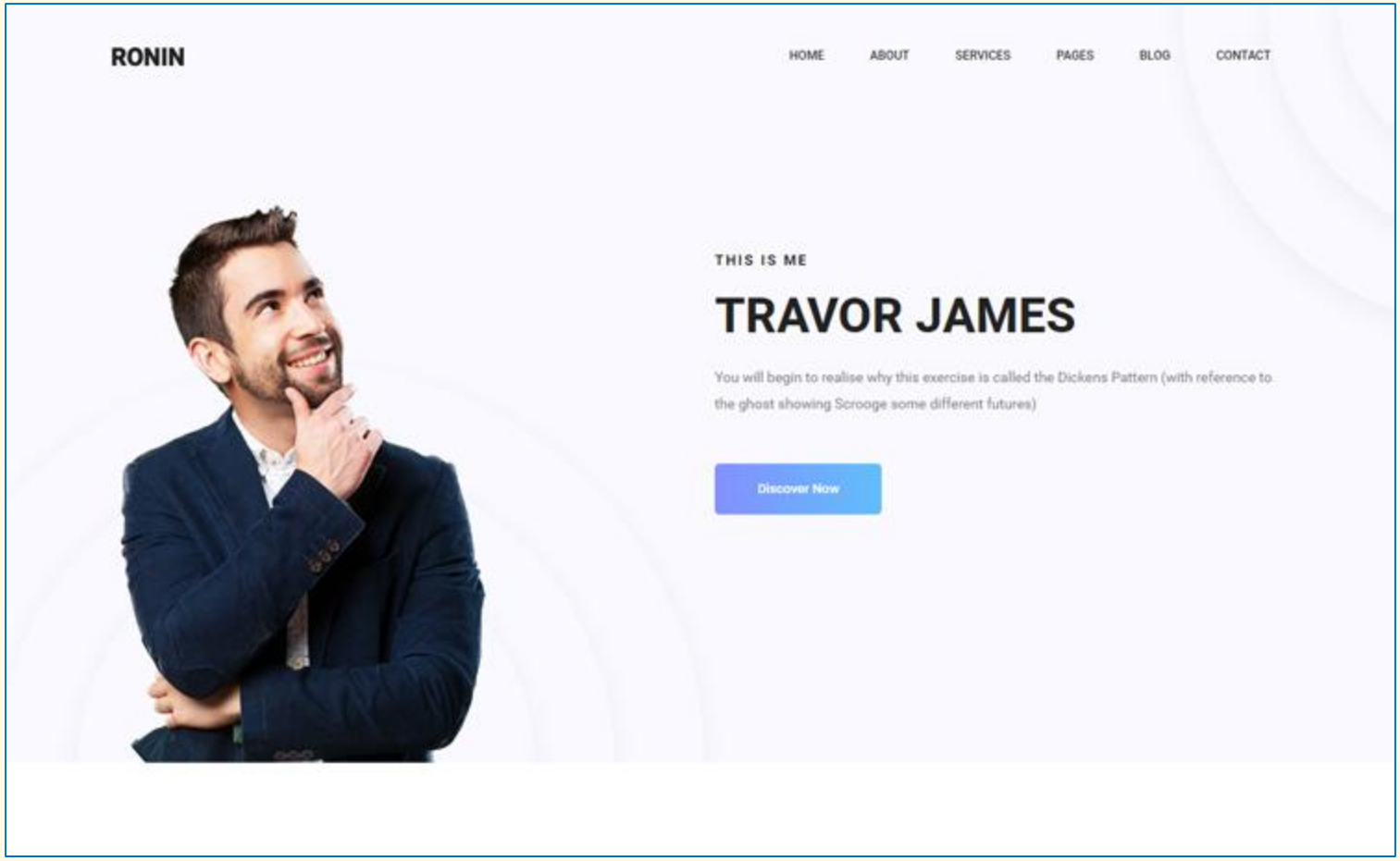
  // additional headers
  setHeaders: (res, path, stat) => {
    res.set('x-timestamp', Date.now());
  }
}));
```

Routers

- A router object is an isolated instance of middleware and routes
  - A router is also a middleware, which is responsible for paths under a given folder
  - The `app` object is also a router, which is responsible for the whole site
- Create a new router object:
  - ```
    const express = require('express');
    const app = express();
    const router = express.Router();
    ```
- Add middleware and handlers: like with `app`
  - `router.use((req, res, next) => { ... });`
  - `router.all('/example', (req, res) => { ... });`
- Mount a router to a folder
  - `app.use('/folder', router);`
    ```

Exercise

- Improve the portfolio website to use common middleware



EJS Template Engine

Template Engines (aka View Engines)

- Generating HTML directly with JavaScript is hard to maintain:
  - Bad separation of presentation and logic layers

  ➔ Where template engines come in
- Principles:
  - Replaces variables in a template file with actual values
  - Transforms the template into an HTML file sent to the client
- Most popular ones:
  - EJS: https://github.com/tj/ejs
  - Pug: https://pugjs.org/
  - Mustache: https://github.com/janl/mustache.js

Using EJS

- Add the engine to project:
  - `npm install ejs`
  - `app.set('view engine', 'ejs');`

- Handle a route with EJS
  - ```
    app.get('/', (req, res) => {
      res.render('index', {
        foo: 'fee-fi-fo'
      });
    });
    ```
  - Parses `views/index.ejs` file and substitutes `foo` variable with `'fee-fi-fo'` where it appears
    ```

EJS Files

- Escaped output: `<%= expression %>`
- Unescaped output: `<%- expression %>`
- Embedded JavaScript code, no output: `<% code %>`
- Comment: `<%# comment %>`
- Include another EJS file:
  ```
  <%- include('partial.ejs') %>
  ```
- Include another EJS with variables:
  ```
  <%- include('user', {
    userId: 12,
    userName: 'John Doe'
  }) %>
  ```

Partials and Reuse

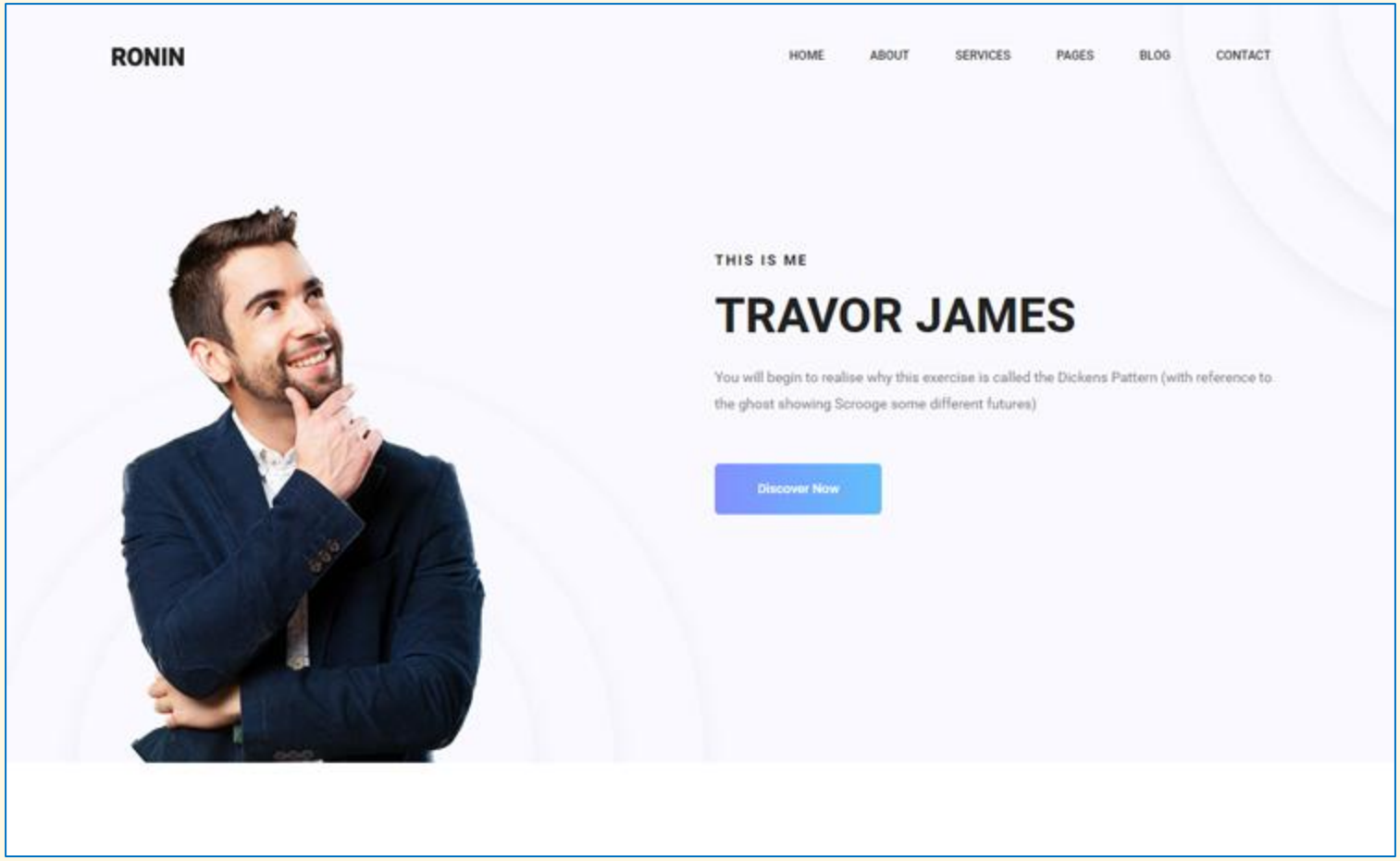
- Put common codes in partials, then include them in main template files
  -
```
<%- include('../partials/header'); %>

<main>
  <div class="jumbotron">
    <h1>This is great</h1>
    <p>Welcome to templating using EJS</p>
  </div>
</main>

<%- include('../partials/footer'); %>
```

Exercise

- Rewrite the portfolio website using EJS template files



Form Submission Handling

Form Submission

- How to submit?
  - Press submit button
  - Hit Enter on some input controls
  - Call `form.submit()`
- On submission, browser sends form data to server as
  - Name-value pairs
  - Query parameters for GET methods
  - Body parameters for POST methods
- Setting form submission path and method:
  -
```
<form action="/action-page" method="GET">
  ...
</form>
```

Handling Request Data

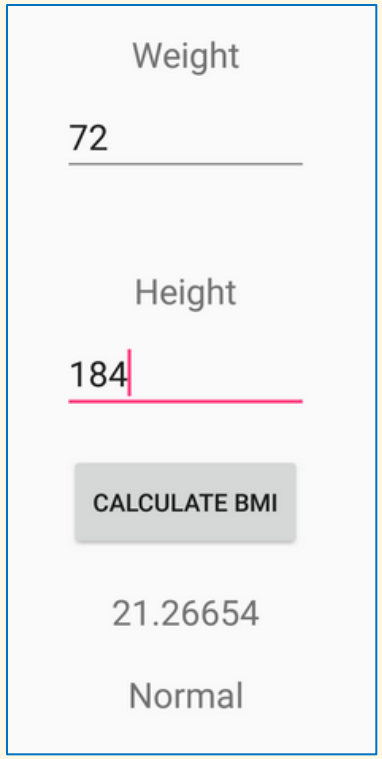
- GET request data can be obtained using `req.query` object
  - ```
    <form method="GET" action="/form">
      <input type="text" name="firstname" />
      <input type="text" name="lastname" />
      <input type="submit" />
    </form>
    ```
  - ```
    console.log(req.query.firstname);
    console.log(req.query.lastname);
    ```
- Similarly, POST request data can be obtained using `req.body` object, but a body parser is needed
  - ```
    app.use(express.urlencoded({extended: false}));
    ```
  - ```
    console.log(req.body.firstname);
    console.log(req.body.lastname);
    ```

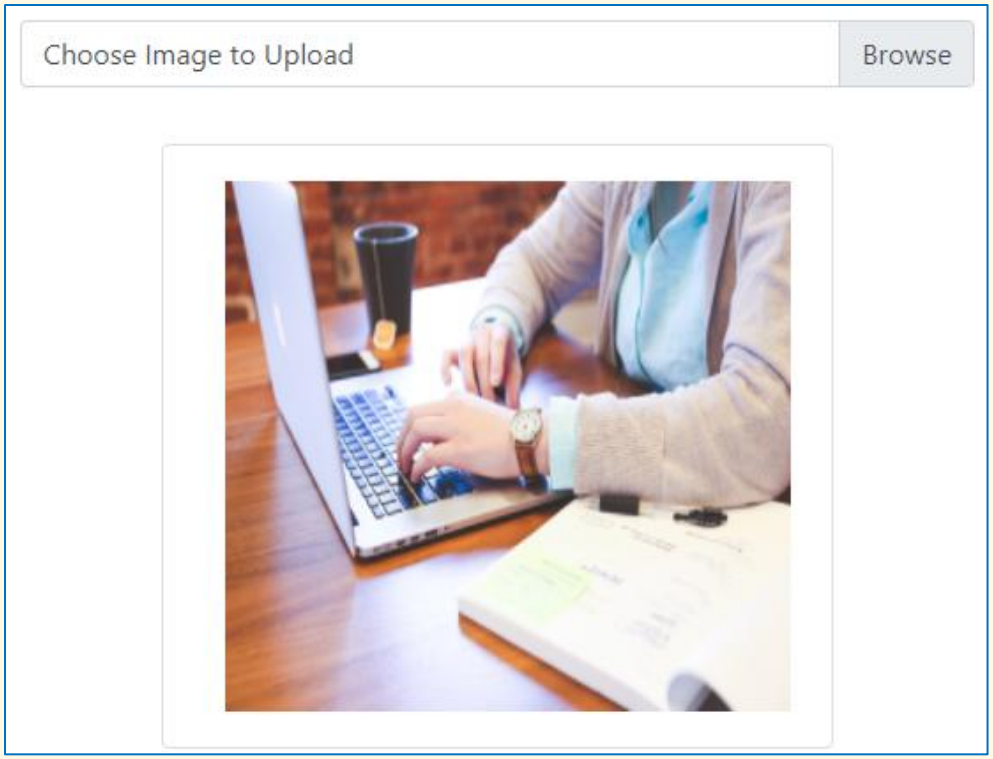
File Uploading

- HTML:
  - ```
    <form action="/upload" method="POST"
          enctype="multipart/form-data">
      <input type="file" name="foo" />
      <input type="submit" />
    </form>
    ```
- Use `express-fileupload` middleware:
  - ```
    const fileUpload = require('express-fileupload');
    app.use(fileUpload({
      limits: { fileSize: 5 * 1024 * 1024 },
      useTempFiles : true,
      tempFileDir : '/tmp/'
    }));
    ```
  - ```
    app.post('/upload', (req, res) => {
      console.log(req.files.foo);
    });
    ```
    ```

Exercises

1. Create a server-side BMI calculator
2. Create a form allowing to upload an image, then display the uploaded image

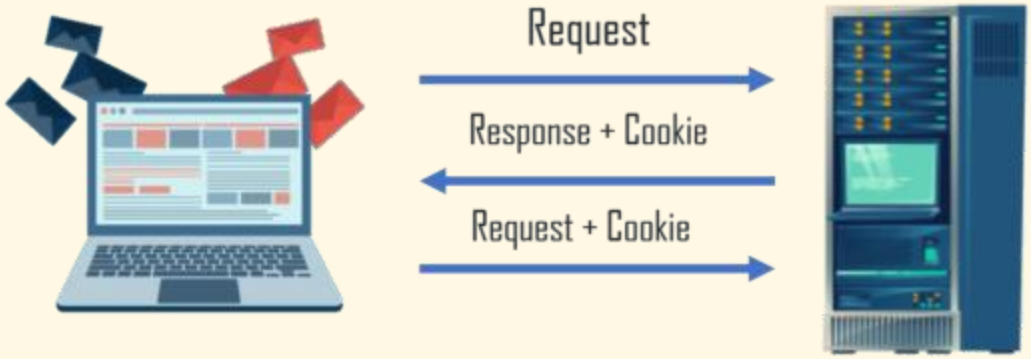




Cookies

Introduction

- How can the server remember information about the user?
  - User action management, user preference, user tracking,…
- Cookies: Small pieces of data provided by web server, and stored locally on the browser
  - Next time the user visits, the same cookies are sent back to the server, allowing the server to restore its memory about that user



Set-Cookie and Cookie Headers

- Server sending headers to tell the client to store a pair of cookies
  - ```
    HTTP/2.0 200 OK
    Content-Type: text/html
    Set-Cookie: theme=dark
    Set-Cookie: font_size=big

    [page content]
    ```
- Browser sends back all previously stored cookies to the server
  - ```
    GET /sample_page.html HTTP/1.1
    Host: www.example.org
    Cookie: theme=dark; font_size=big
    ```

Working with Cookies from Server Side

- Add/update a cookie:
  - `res.cookie("trackid", value);`
  - `res.cookie("cart", {items: [1, 2, 3]},`
    `{maxAge: 7*24*3600000});  // 7 days`
- Delete a cookie:
  - `res.clearCookie("name");`
- Read cookies: using `cookie-parser` middleware
  -
```
const cookieParser = require('cookie-parser');
app.use(cookieParser());

app.get('/', (req, res) => {
  console.log(req.cookies);
});
```

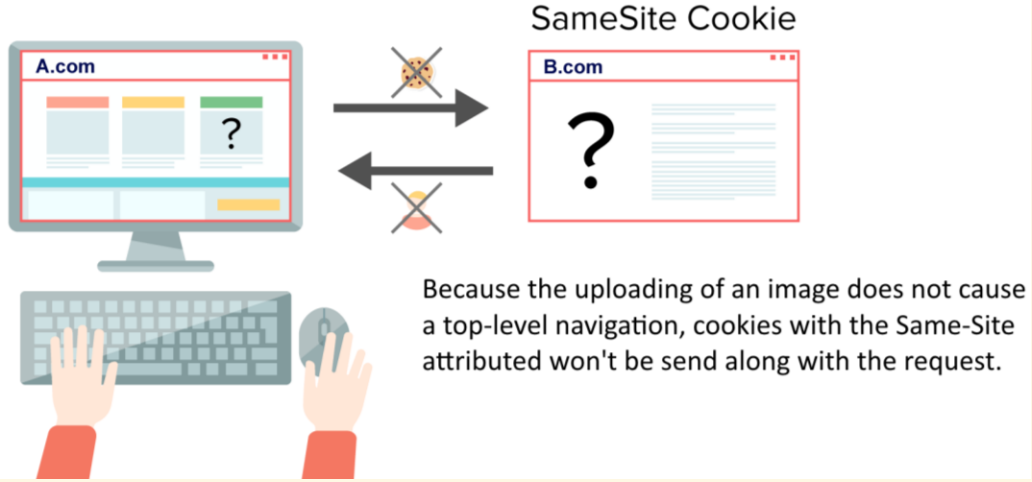
Client-Side Cookie Manipulation

- `document.cookie`: a string holding all the cookies related to the page
- Add/update a cookie:
  - `document.cookie = "name=value";`
  - `document.cookie = "username=John Doe; expires=Wed, 24 Feb 2021 12:00:00 UTC";`
- Delete a cookie: empty value, date in the past
  - `document.cookie = "username=; expires=Thu, 01 Jan 1970 00:00:00 UTC";`
- Read cookies:
  - `let cookies = document.cookie.split(";");`

Notes on Cookies

- Cookies are sent and stored in plaintext
  - Can be viewed, updated, deleted by the user
  - Can be also easily viewed, updated, deleted by other people
  - Can be hijacked on unencrypted network channels
  - Can be collected in large scale for mining user behaviors (3rd party cookies, ex: Google Analytics)
- For security
  - Never store sensitive information in cookies
  - Don't store large data in cookies
  - Limit the number of cookies used for an application
  - Encrypt them when necessary
  - Protect the cookies with proper values for `Path`, `Expires`, `HttpOnly`, `Secure`, `SameSite`,… attributes

`SameSite` Attribute



- `SameSite=Strict`
  - Cookie sent when the site for the cookie matches the site currently shown in the browser's URL bar, and the user has not landed on the site by following the link from another site
- `SameSite=Lax`
  - Cookie sent when the site for the cookie matches the site currently shown in the browser's URL bar
- `SameSite=None`
  - Cookie always sent
  - `Secure` must be set explicitly on modern browsers
- `SameSite` not specified
  - Defaulted to `Lax` on modern browsers

Exercise

- Create a page that allow the user to choose theme options (colors, font size), and use cookies to make the user preferences persistent

Session Handling

Introduction

- A user usually needs to make several requests to perform a task
  - However, HTTP is stateless: subsequent requests from a same client are independent
- Solved with the help of a cookie:
  - Server and client share a common code called session ID, which is generated by the server and sent to the client on the first response
  - The session ID is used by the server to identify and distinguish the clients
  - Unlike normal cookies, server also stores the session ID of all clients
  - After some time (e.g., 15') without request, both sides delete the session ID, making the session expires
  - The session ID is also used to look up other data (called session data) from the server storage

Working with Session

- Use `express-session` middleware
  -
```
const session = require('express-session');
const FileStore = require('session-file-store')(session);

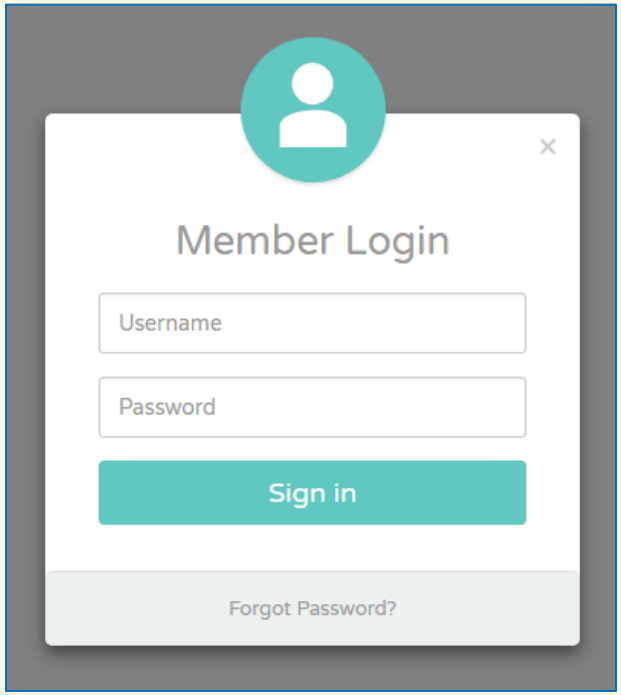
app.use(session({
  store: new FileStore({path: './sessions'}),
  secret: 'secret-password',
  cookie: { maxAge: 15*60000 },
  saveUninitialized: true,
  resave: false
}));
```
- Session data: use `req.session` object

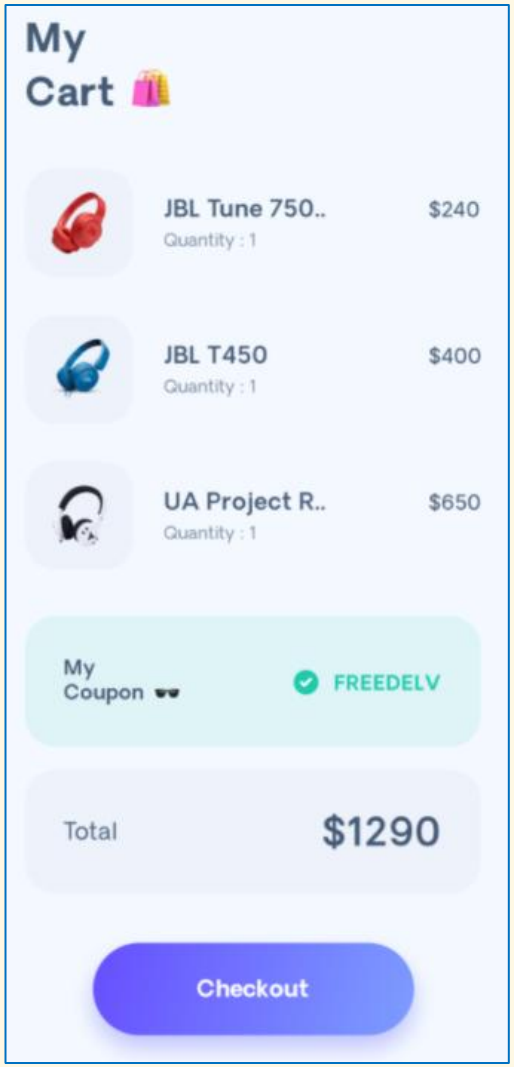
Example: Session View Count

```
app.get('/', (req, res, next) => {
  if (req.session.views) {
    req.session.views++;
    res.setHeader('Content-Type', 'text/html');
    res.write(`<p>Session ID: ${req.session.id}<br>
          Views: ${req.session.views}</p>`);
    res.end();
  } else {
    req.session.views = 1;
    res.end('Refresh to increase the counter!');
  }
});
```

Exercises

- Create a member login page
- Create a simple online shopping site with following features: add item to cart, remove from cart, view cart, purchase

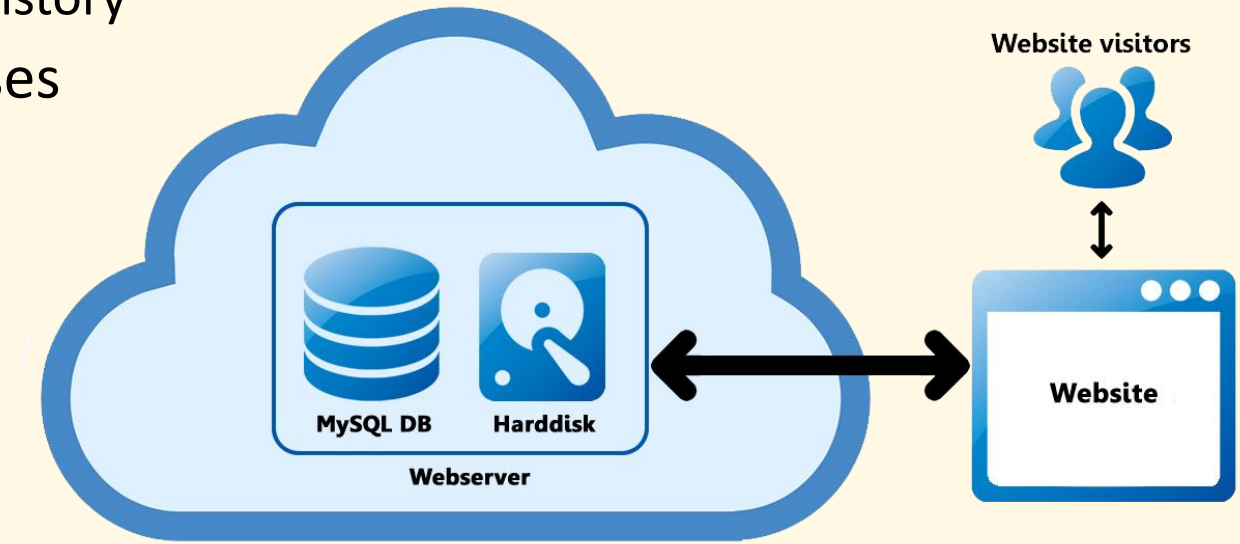




Database Integration

Introduction

- Disk files can be used to store and manage (really) simple data
- But they are not suitable for larger amount of data that requires frequent concurrent query, update operations:
  - Site content
  - User information
  - Product information
  - Usage activity history
- Popular databases
  - MySQL
  - Oracle
  - SQL Server
  - PostgreSQL
  - MongoDB



Setup and Connection

- Install
  - `npm install mysql2`
- Establish connection
  -
```
import mysql from 'mysql2/promise';

try {
  const conn = await mysql.createConnection({
    host     : 'server-address',
    user     : 'me',
    password : 'secret',
    database : 'my_db'
  });
  console.log('Connected to MySQL');
} catch(err) {
  console.error(err);
}
```
- Close connection
  - `conn.end();`

Performing Queries

- Without parameters
  - `const [rows, fields] = await conn.query('SELECT * FROM books WHERE author = "David" and category = 10');`
    - `rows`: Results of the query
    - `fields`: Information about returned results fields
  - Don't forget to validate and escape query values:
    -
```
if (!isNaN(cat)) {
  const [rows, fields] = await conn.query(
    'SELECT * FROM books WHERE author = "' +
    mysql.escape(author) + '" and category = ' + cat);
}
```
- With parameters (aka prepared statements)
  - `const [rows, fields] = await conn.query('SELECT * FROM books WHERE author = ? and category = ?', [author, cat]);`
  - No need to escape query values → more secured!

Reading Result Data

```
try {
  const [rows, fields] = await conn.query(
    "SELECT author, title FROM books");

  rows.forEach(e => {
    console.log(e.author);
    console.log(e["title"]);
  });
} catch(err) {
  //...
}
```

- Be aware of the asynchronous execution

Query Results

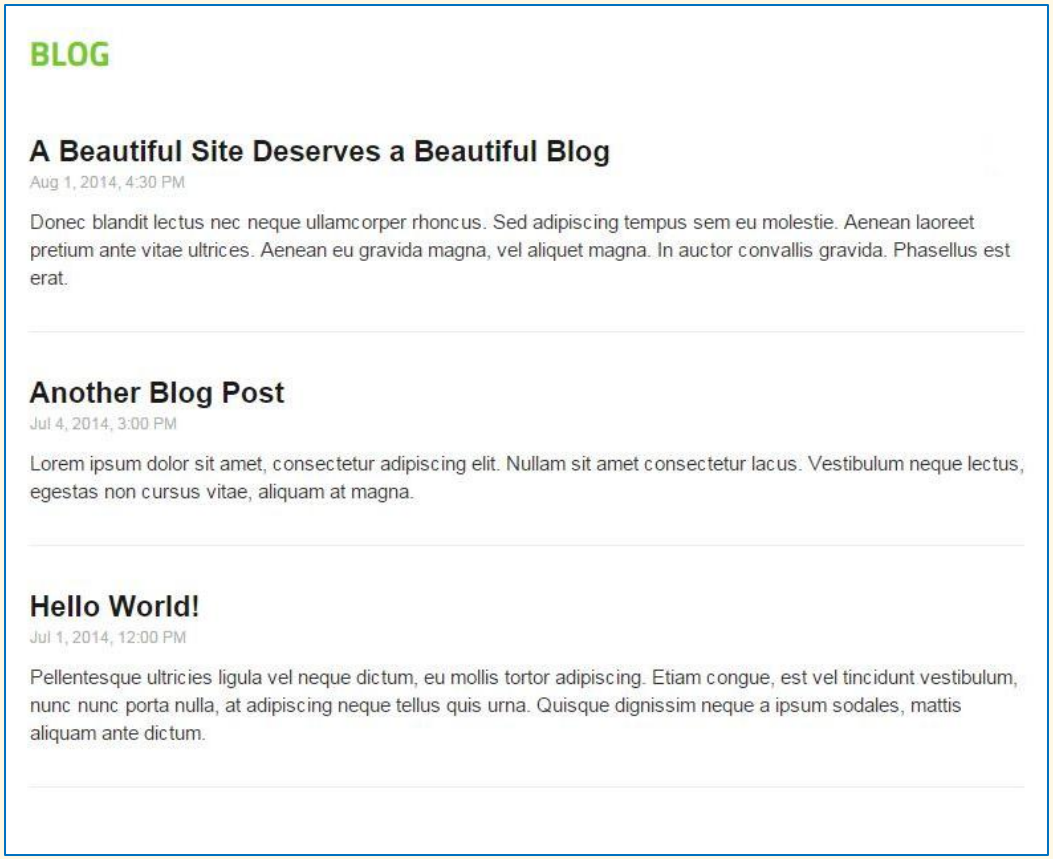
- ID of inserted row
  - ```
    const [rows, fields] = await conn.query('INSERT INTO ...');

    console.log(rows.insertId);
    ```
- Number of affected rows
  - ```
    const [rows, fields] = await conn.query('DELETE FROM ...');

    console.log(`Deleted ${rows.affectedRows} rows`);
    ```

Exercise

- Create a simple blog site with following features
  - Post submission form
  - Post listing
  - Single post viewing
  - Multiple post viewing
    - Pagination
    - Different sorting orders
  - Post view counting

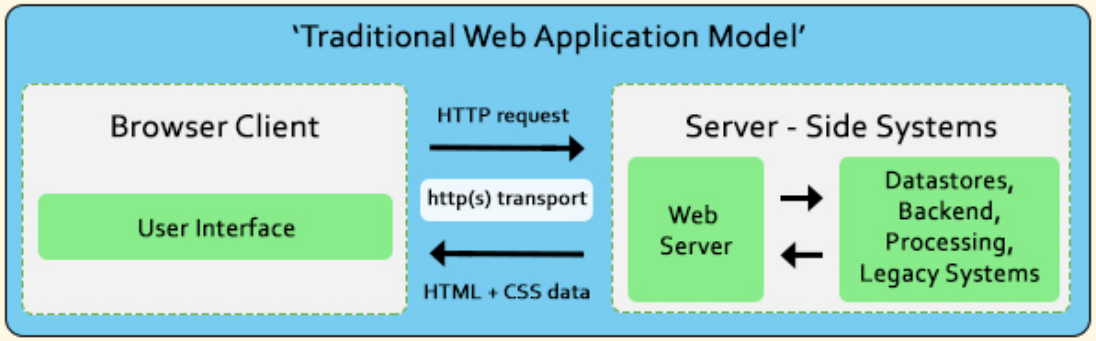


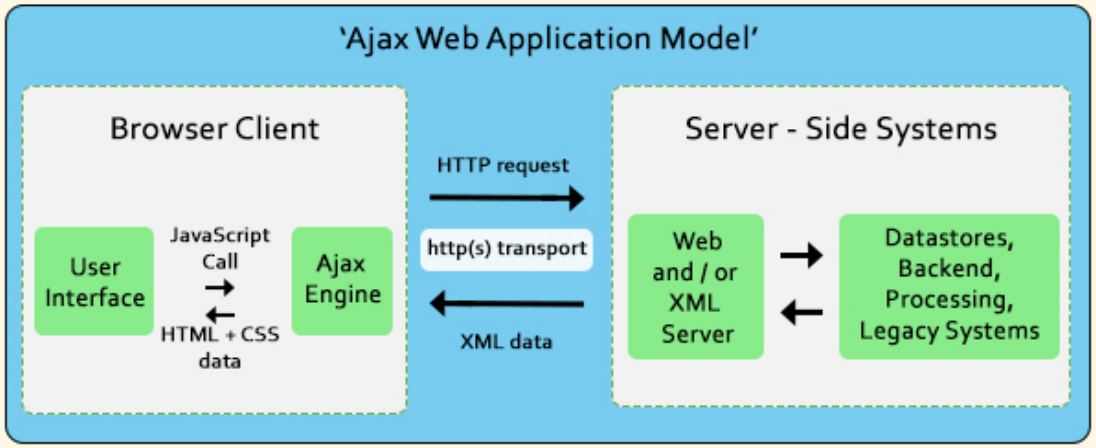
Client-Server Communication

- AJAX
- Fetch API
- CORS

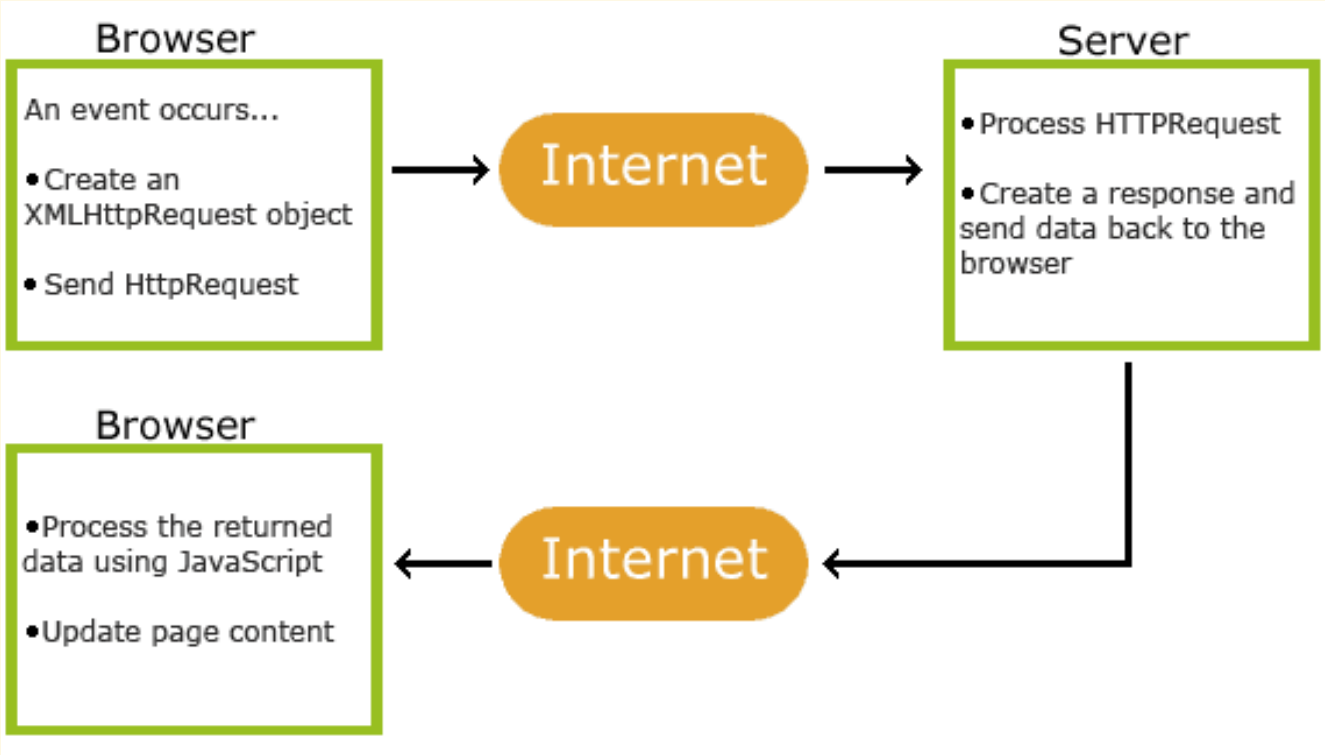
Introduction

- Classic web pages must reload the entire page even if a small part need to be updated with information from server
- AJAX (Asynchronous JavaScript and XML) comes to change the situation
  - Client loads data from server by an async request
  - Updates the page with the returned data
  - Originally, XML was the intended format for the data exchange, but any format can be used, and JSON is now more common





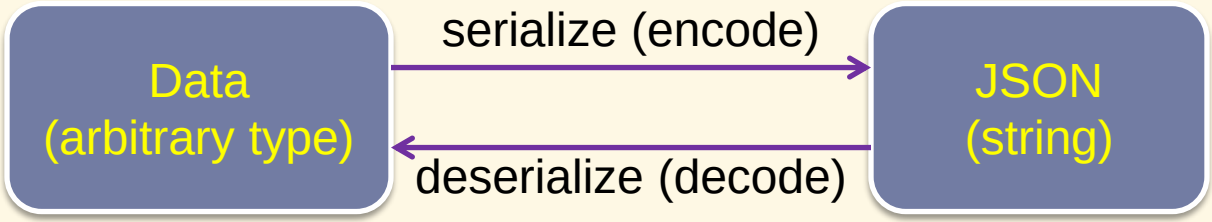
How AJAX Works



- AJAX is done using JavaScript by:
  - Requesting data from the server (on same domain) using a browser built-in `XMLHttpRequest` object
  - (Optionally) updating the HTML DOM

JSON Format

- Client and server sides need a consensus on the data format. The most used: JSON, XML, text,...
- JSON (JavaScript Object Notation):
  - A syntax for data serialization and deserialization
  - Natively supported in JavaScript



- Serialization and deserialization
  - `const json = JSON.stringify(data);`
  - `const data = JSON.parse(json);`

Making GET Requests

- Create `XMLHttpRequest` object
  - `const xhttp = new XMLHttpRequest();`
- GET request without parameters
  - ```
    xhttp.open("GET", "/info.txt", true);
    xhttp.send();
    ```
- GET request with URL-encoded parameters
  - ```
    const query = "author=Jack+London&category=fiction";
    xhttp.open("GET", "/search-book?" + query, true);
    xhttp.send();
    ```
  - Use `encodeURIComponent()` to encode parameters, or `encodeURI()` to encode a full URL
- GET request with a `URL` object
  - ```
    const url = new URL("/search-book");
    url.search = new URLSearchParams({
      author: "Jack London",
      category: "fiction"
    });
    xhttp.send(url.toString());
    ```
    ```

Making POST Requests

- POST request with URL-encoded parameters
  - ```
    xhttp.open("POST", "/search-book", true);
    xhttp.setRequestHeader("Content-Type",
             "application/x-www-form-urlencoded");
    xhttp.send("author=Jack+London&category=fiction");
    ```
- POST request with `FormData`
  - ```
    const fd = new FormData();
    fd.append("author", "Jack London");
    fd.append("category", "fiction");

    xhttp.open("POST", "/search-book", true);
    xhttp.send(fd);   // HTTP header is set automatically
    ```
- Build `FormData` object with data from a real form
  - ```
    const form = document.getElementById("my-form");
    const fd = new FormData(form);
    ```
    ```

Handling Request Results

- Listen to `load` and `error` events on the `XMLHttpRequest` object (or use old-fashioned `readystatechange` event to handle both cases)
- Example:

```
xhttp.onload = event => {
  const ret = JSON.parse(xhttp.response);
  if (ret == null || ret.msg != "OK") throw "Error";

  const ul = document.getElementById("li.list");
  ret.list.forEach(e => {
    const el = document.createElement("li");
    el.setAttribute("value", e.id);
    el.innerHTML = `${e.title} (${e.author})`;
    ul.appendChild(el);
  });
};

xhttp.addEventListener("error", event => {
  alert("Something went wrong");
});
```

Server Side

```
app.post('/search-book', async (req, res) => {
  try {
    const [data, fields] = await db.query(
      "SELECT id, title, author FROM books where category = ?",
      [req.body.category]);

    res.json({
      msg: "OK",
      list: data.map(e => ({
        authorId: e.id,
        authorName: e.author,
        bookTitle: e.title
      })
    });

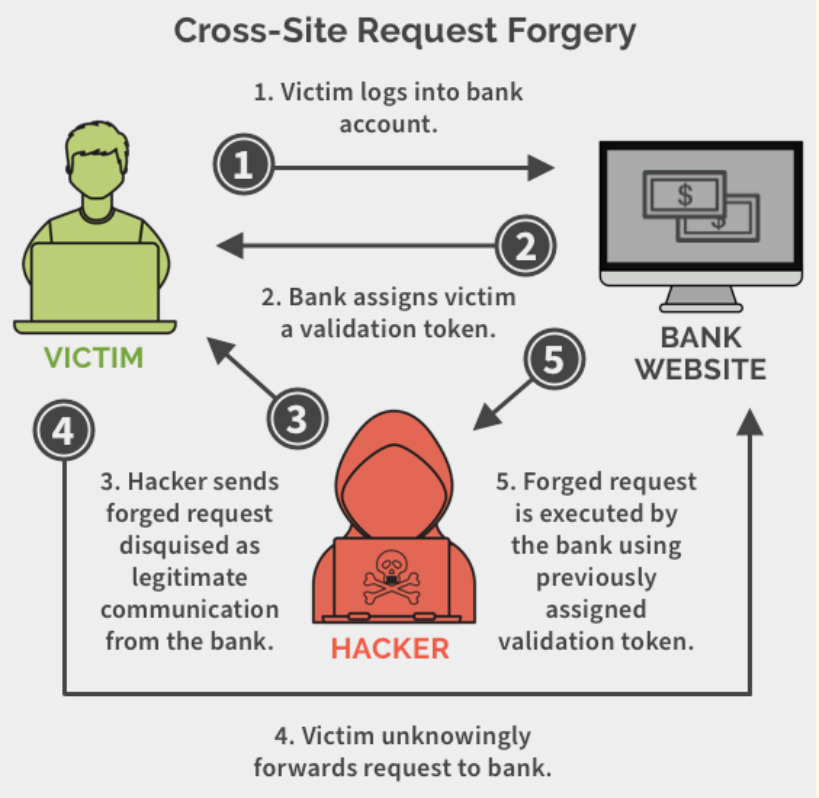
  } catch (err) {
    res.json({ msg: err });
  }
});
```

Fetch API

- Newer (and better) alternative to `XMLHttpRequest`
  - `Promise` based
- Example (NB: `options` is optional):
  -
```
fetch('http://...', options)
.then(response => response.json())
.then(data => {
  // Handle returned data
});
```
- Option examples:
  - `method: 'POST'`
  - `body: JSON.stringify(sentData)`
  - `headers: {...}`

CORS Control

- CSRF (Cross-Site Request Forgery) attack
- Example of a cross-origin request: the front-end JavaScript code served from https://a.com makes a request for https://b.com/c.json



- CORS: Cross-Origin Resource Sharing
  - Browsers restrict cross-origin HTTP requests initiated from scripts
  - Browsers make a "preflight" request to the server hosting the cross-origin resource, in order to check that the server will permit the actual request

CORS Control: With Express Only

```
const express = require('express');
const app = express();

// CORS middleware
app.use((req, res, next) => {
  res.append('Access-Control-Allow-Origin', ['*']);
  res.append('Access-Control-Allow-Methods',
     'DELETE,GET,PATCH,POST,PUT');
  res.append('Access-Control-Allow-Headers',
     'Content-Type,Authorization');

  if (res.method == 'OPTIONS')
    res.send(200);  // Only headers for preflight requests
  else next();      // Continue the process for other ones
});
```

CORS Control: Using `cors` Package

- `cors`: a ready-to-use package for the CORS control in Express

- Installation
  - `npm install cors`
- Usage
  -
```
const express = require('express');
const cors = require('cors');
const app = express();

// Simple usage: Enable all CORS requests
app.use(cors());
```

Exercises

- Reimplement the BMI server-side calculator using AJAX or Fetch API
- Add a feature allowing the user to rate blog posts

Web Security

Most Common Web Vulnerabilities

- SQL Injection
- Cross-site scripting (XSS)
- Cross-site resource forgery (CSRF)
- Phishing
- Broken authentication, session management

SQL Injection

- Attacker attempts to inject unintended commands and tricks the application into divulging sensitive data
- Example:
  - Query

```
"SELECT * FROM users WHERE name='" + userName + "';"
```

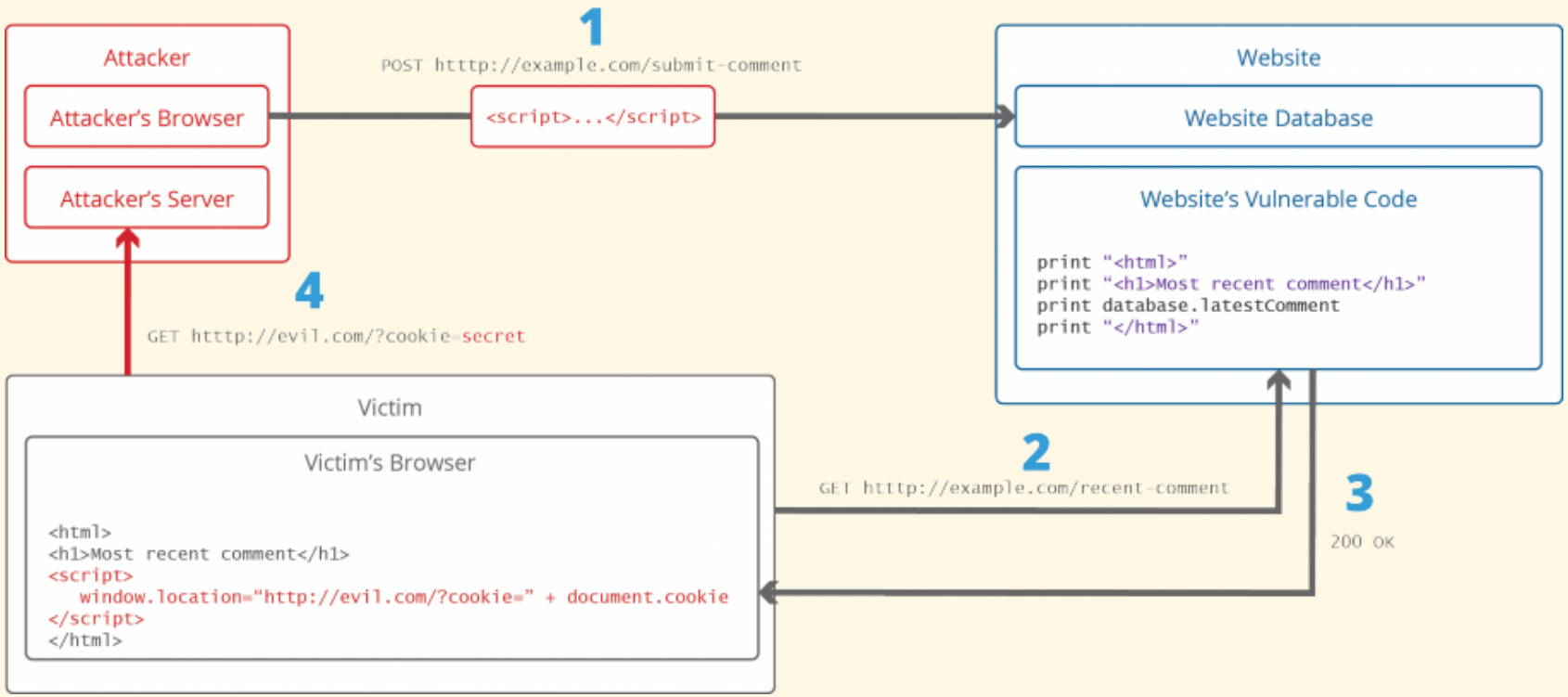
  - User input

```
a'; UPDATE users SET password='xyz' WHERE name='a
```

- Countermeasures
  - Filter and validate all user input
  - Escape all parameters in SQL queries
  - Use prepared statements

Cross-Site Scripting XSS

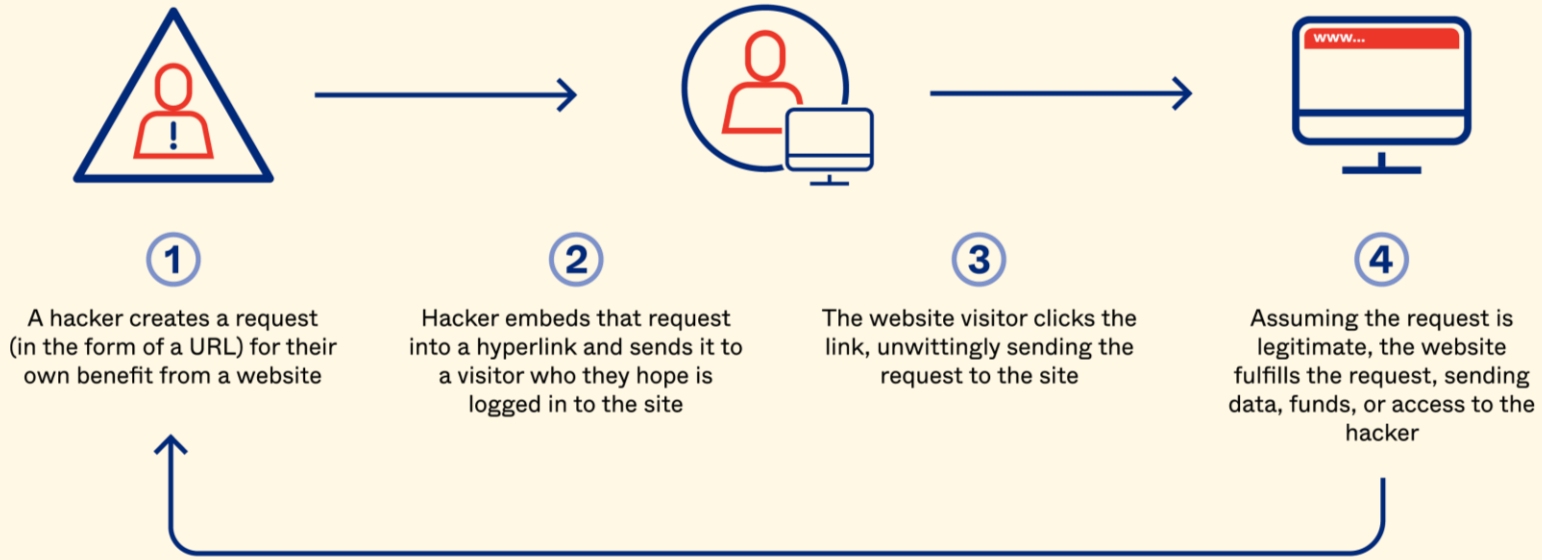
- Attacker injects malicious JavaScript code into a page that will be opened by other users



- Countermeasure: Filter out scripts from user content.

Cross-Site Resource Forgery (CSRF)

- Malicious email, links, or websites make the browser perform operations intended by attackers on a trusted site authenticated by the user



- Countermeasures:
  - Always use POST methods for requests that make changes on server
  - Use SameSite cookie attribute
  - Use one-time tokens
  - Apply CORS (Cross-origin resource sharing) measures

Other Considerations

- Avoid storing sensitive information on client (cookie, local storage)
- Avoid session hijacking
- Protect passwords with hashing and salts
- Encrypt transmitted data
- Use HTTPS

Final Remarks

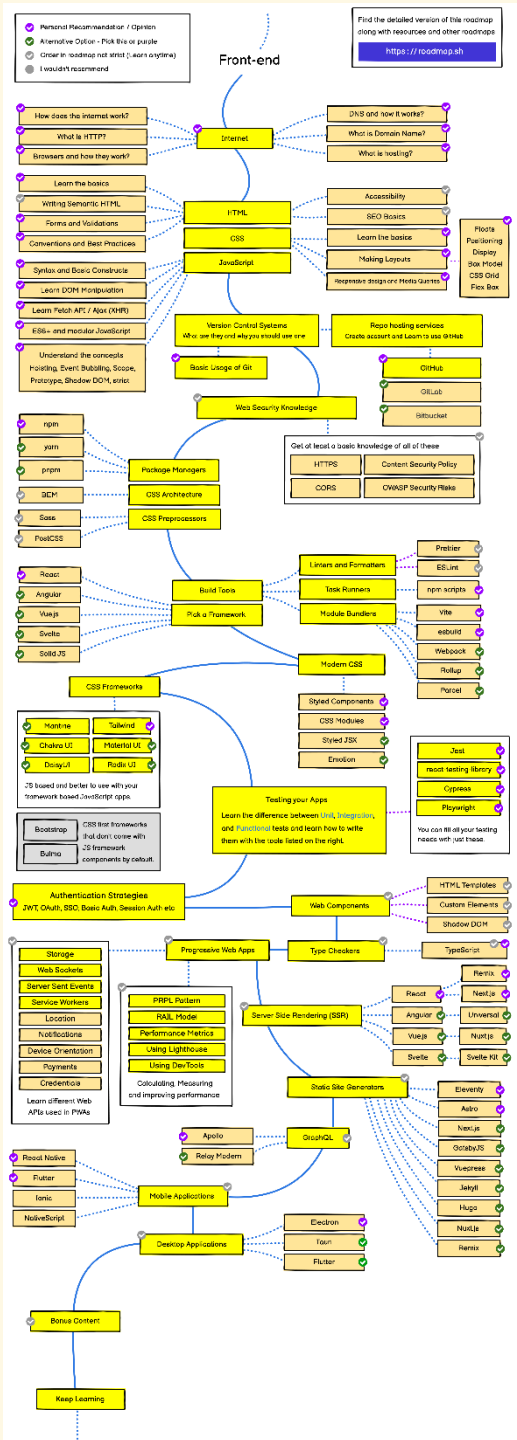
Best Practices

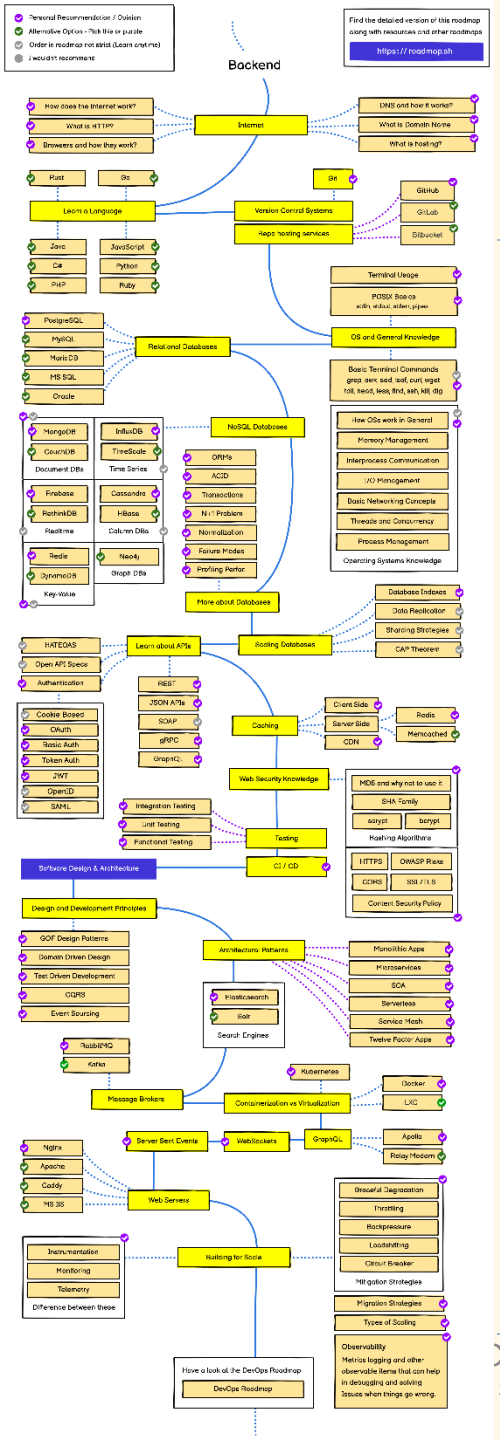
- Design responsive UI
- Simplify the navigation
- Avoid raster images, use CSS, SVG instead
- Avoid JavaScript when CSS can do the work
- Use AJAX instead of full requests whenever possible
- Minimize the initial render time
  - Avoid blocking scripts
  - Avoid loading all large scripts on startup, load parts of them on demand
- For security
  - Don’t store sensitive information in cookies
  - Sanitize user inputs before processing
  - Escape values in SQL queries
  - Use HTTPS
- Learn from other websites and developers

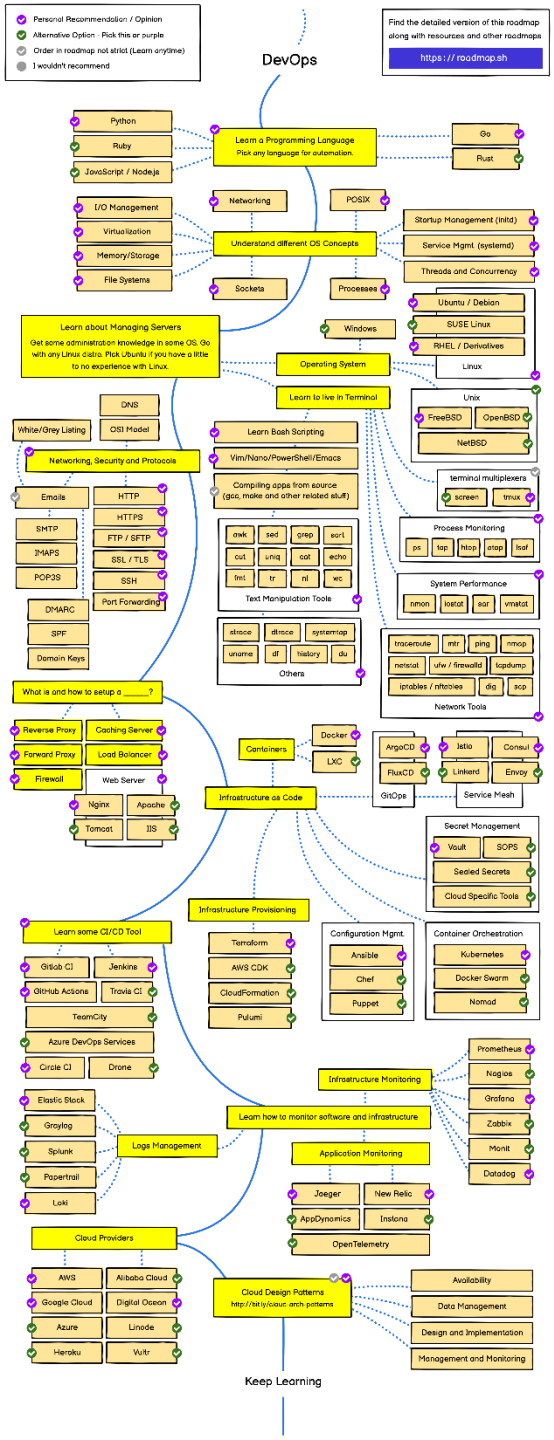
That's not All

- Single Page Applications (SPA), Progressive Web Apps (PWA)
  - AngularJS: https://angularjs.org/
  - React: https://reactjs.org/
  - Vue.js: https://vuejs.org/
- CSS preprocessors
  - Sass: https://sass-lang.com/
  - Less: http://lesscss.org/
- UI frameworks
  - Bootstrap: https://getbootstrap.com/
  - Tailwind: https://tailwindcss.com/
  - Foundation: https://get.foundation/
- SEO optimization:
  - https://moz.com/beginners-guide-to-seo
- Where will the web go?
  - https://webvision.mozilla.org/full/

Web Development Roadmap *







Source: roadmap.sh