REST

CS477 – Server-side Programming

Maharishi International University

Department of Computer Science

M.S. Thao Huy Vu

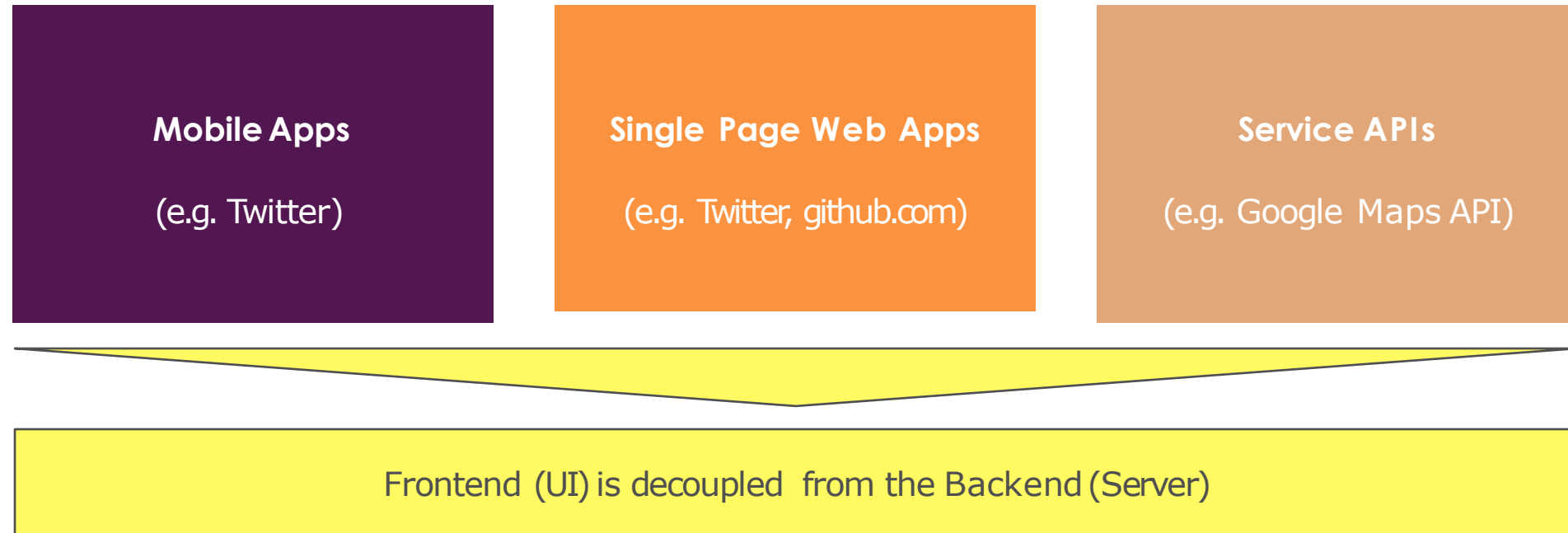# Maharishi International University - Fairfield, Iowa
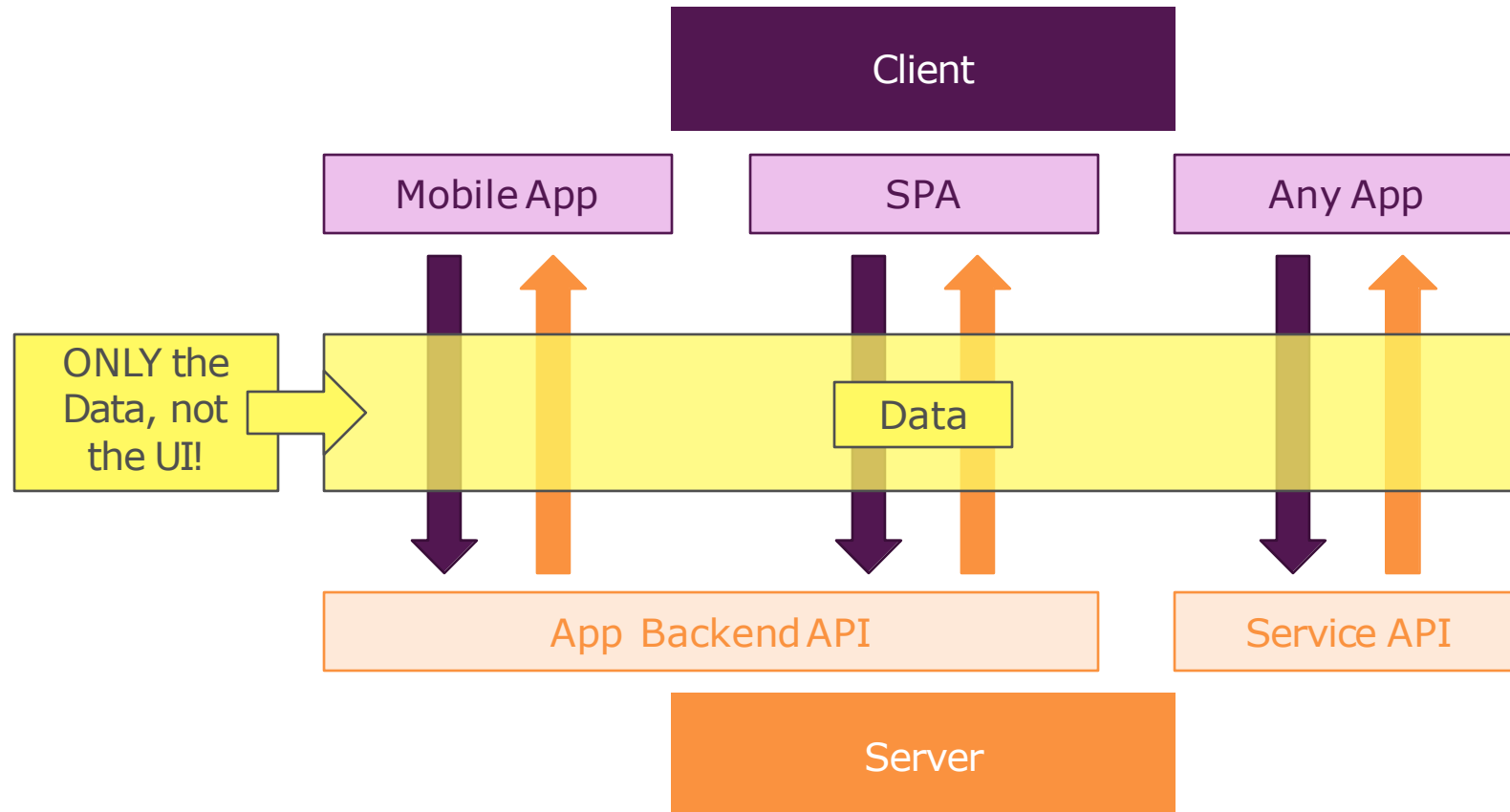
Main Points

- REST API
- MVC
- CORS

REST

- REST = **RE**presentational **S**tate **T**ransfer
- REST is an architectural style consisting of a coordinated set of architectural constraints
- First described in 2000 by Roy Fielding in his doctoral dissertation at UC Irvine
- RESTful is typically used to refer to web services implementing a REST architecture
- Alternative to other distributed-computing specifications such as SOAP
- Simple HTTP client/server mechanism to exchange data
- Everything – the UNIVERSE is available through a URI
- Utilizes HTTP: GET/POST/PUT/DELETE operations

REST advantage

Not every Frontend (UI) requires HTML Pages!

Mobile Apps	Single Page Web Apps	Service APIs
(e.g. Twitter)	(e.g. Twitter, github.com)	(e.g. Google Maps API)

Frontend (UI) is decoupled from the Backend (Server)

REST API Big Picture

Data Formats

HTML	Plain Text	XML	JSON
`<p>Node.js</p>`	`Node.js`	`<name>Node.js</name>`	`{"title": "Node.js"}`
Data + Structure	Data	Data	Data
Contains User Interface	No UI Assumptions	No UI Assumptions	No UI Assumptions
Unnecessarily difficult to parse if you just need the data	Unnecessarily difficult to parse, no clear data structure	Machine-readable but relatively verbose; XML-parser needed	Machine-readable and concise; Can easily be converted to JavaScript

Architectural Constraints

▸ **Uniform interface**
  ▸ Individual resources are identified in requests, i.e.,using URIs in web-based REST systems.
▸ **Client-server**
  ▸ Separation of concerns. A uniform interface separates clients from servers.
▸ **Stateless**
  ▸ The client-server communication is further constrained by no client context being stored on the server between requests.
▸ **Cacheable**
  ▸ Basic WWW principle: clients can cache responses.
▸ **Layered system**
  ▸ A client cannot necessarily tell whether it is connected directly to the end server, or to an intermediary along the way.
▸ **Code on demand (optional)**
  ▸ REST allows client functionality to be extended by downloading and executing code in the form of applets or scripts. This simplifies clients by reducing the number of features required to be pre-implemented.

Resource

▸ The key abstraction of information in REST is a **resource**.

  ▸ a document or image, a temporal service, a collection of other resources, a non-virtual object (e.g. a person), and so on.

▸ Resource representation: consists of data, metadata describing the data and **hypermedia** links which can help the clients in transition to the next desired state.

Resource Naming Best Practices
-Use nouns to represent resources

▸ **Document:**

  ▸ a singular concept, like an object instance or db record.

  ▸ Use "singular" name to denote document resource archetype.

    ▸ http://api.example.com/device-management/managed-devices/{device-id}

    ▸ http://api.example.com/user-management/users/{id}

    ▸ http://api.example.com/user-management/users/admin

▸ **Collection:**

  ▸ sever-managed directory of resources.

  ▸ Use "plural" name to denote collection resource archetype

    ▸ http://api.example.com/device-management/managed-devices

    ▸ http://api.example.com/user-management/users

    ▸ http://api.example.com/user-management/users/{id}/accounts

Resource Naming Best Practices
-Use nouns to represent resources

- **store**
  - a client-managed resource repository.
  - Use "plural" name to denote store resource archetype.
    - http://api.example.com/cart-management/users/{id}/carts
    - http://api.example.com/song-management/users/{id}/playlists

- **controller**
  - A controller resource models a procedural concept.
  - Use "verb" to denote controller archetype.
    - http://api.example.com/cart-management/users/{id}/cart/checkout
    - http://api.example.com/song-management/users/{id}/playlist/play

Resource Naming Best Practices -Consistency is the key

- Use forward slash (/) to indicate hierarchical relationships
  - The forward slash (/) character is used in the path portion of the URI to indicate a hierarchical relationship between resources.
  - http://api.example.com/device-management
  - http://api.example.com/device-management/managed-devices
  - http://api.example.com/device-management/managed-devices/{id}
- Do not use trailing forward slash (/) in URIs
  - http://api.example.com/device-management/managed-devices/
  - http://api.example.com/device-management/managed-devices   /*This is much better version*/
- Use hyphens (-) to improve the readability of URIs
  - http://api.example.com/inventory-management/managed-entities/{id}/install-script-location //More readable
  - http://api.example.com/inventory-management/managedEntities/{id}/installScriptLocation //Less readable
- Do not use underscores (_)
  - http://api.example.com/inventory-management/managed-entities/{id}/install-script-location //More readable
  - http://api.example.com/inventory_management/managed_entities/{id}/install_script_location //More error prone
- Use lowercase letters in URIs
- Do not use file extensions
  - http://api.example.com/device-management/managed-devices.xml /*Do not use it*/
  - http://api.example.com/device-management/managed-devices   /*This is correct URI*/

Resource Naming Best Practices
-Never use CRUD function names in URIs

- ▶ HTTP request methods should be used to indicate which CRUD function is performed.
  - ▶ HTTP GET http://api.example.com/device-management/managed-devices //Get all devices
  - ▶ HTTP POST http://api.example.com/device-management/managed-devices //Create new Device

  - ▶ HTTP GET http://api.example.com/device-management/managed-devices/{id} //Get device for given Id
  - ▶ HTTP PUT http://api.example.com/device-management/managed-devices/{id} //Update device for given Id
  - ▶ HTTP DELETE http://api.example.com/device-management/managed-devices/{id} //Delete device for given Id
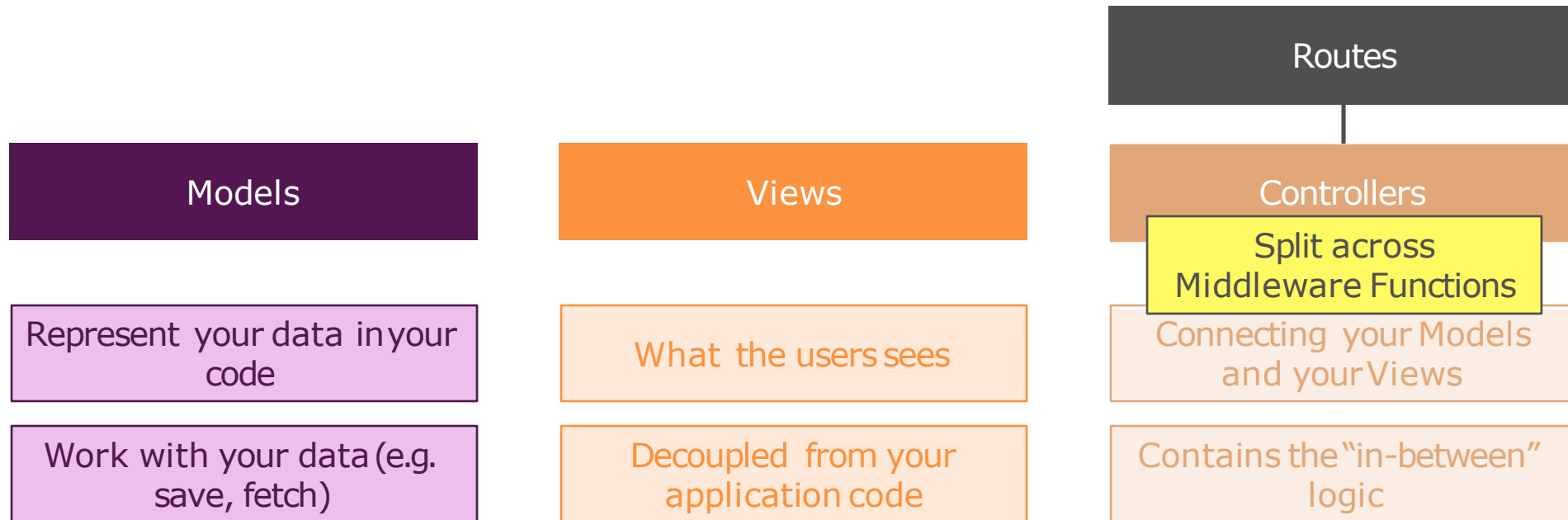
Resource Naming Best Practices
-Use query component to filter URI collection

▶ Many times, you will come across requirements where you will need a collection of resources sorted, filtered or limited based on some certain resource attribute. For this, do not create new APIs – rather enable sorting, filtering and pagination capabilities in resource collection API and pass the input parameters as query parameters. e.g.

  ▶ http://api.example.com/device-management/managed-devices

  ▶ http://api.example.com/device-management/managed-devices?region=USA

  ▶ http://api.example.com/device-management/managed-devices?region=USA&brand=XYZ

  ▶ http://api.example.com/device-management/managed-devices?region=USA&brand=XYZ&sort=installation-date

HTTP Methods for RESTful APIs

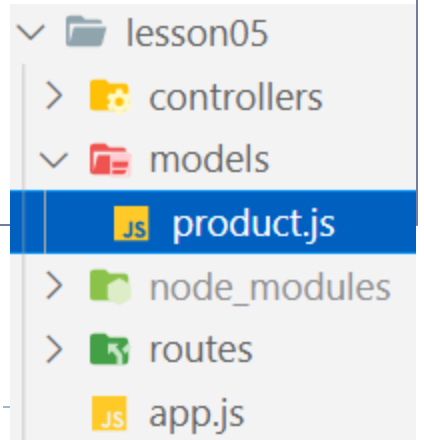| HTTP METHOD	CRUD	ENTIRE COLLECTION (E.G. /USERS)	SPECIFIC ITEM (E.G. /USERS/123)
POST	Create	201 (Created), 'Location' header with link to /users/{id} containing new ID.	Avoid using POST on single resource
GET	Read	200 (OK), list of users. Use pagination, sorting and filtering to navigate big lists.	200 (OK), single user. 404 (Not Found), if ID not found or invalid.
PUT	Update/Replace	405 (Method not allowed), unless you want to update every resource in the entire collection of resource.	200 (OK) or 204 (No Content). Use 404 (Not Found), if ID not found or invalid.
PATCH	Partial Update/Modify	405 (Method not allowed), unless you want to modify the collection itself.	200 (OK) or 204 (No Content). Use 404 (Not Found), if ID not found or invalid.
DELETE	Delete	405 (Method not allowed), unless you want to delete the whole collection — use with caution.	200 (OK). 404 (Not Found), if ID not found or invalid.

MVC

Separation of Concerns

Models	Views	Routes
		Controllers

Split across Middleware Functions

| Represent your data in your code | What the users sees | Connecting your Models and your Views |
| Work with your data (e.g. save, fetch) | Decoupled from your application code | Contains the "in-between" logic |

Demo: Shopping Cart - Model

```javascript
let products = [];

module.exports = class Product {

    constructor(id, title, price, description) {
        this.id = id;
        this.title = title;
        this.price = price;
        this.description = description;
    }

    save() {
        this.id = Math.random().toString();
        products.push(this);
        return this;
    }

    update() {
        const index = products.findIndex(p => p.id === this.id);
        if (index > -1) {
            products.splice(index, 1, this);
            return this;
        } else {
            throw new Error('NOT Found');
        }
    }

}
```

```javascript
    static fetchAll() {
        return products;
    }

    static findById(productId) {
        const index = products.findIndex(p => p.id === productId);
        if (index > -1) {
            return products[index];
        } else {
            throw new Error('NOT Found');
        }
    }

    static deleteById(productId) {
        const index = products.findIndex(p => p.id === productId);
        if (index > -1) {
            products = products.filter(p => p.id !== productId);
        } else {
            throw new Error('NOT Found');
        }
    }
}
```

- ∨ 📁 lesson05
  - › 📁 controllers
  - ∨ 📁 models
    - JS product.js
  - › 📁 node_modules
  - › 📁 routes
  - JS app.js

19

Demo: Shopping Cart – Controller

```javascript
const Product = require('../models/product');

exports.getProducts = (req, res, next) => {
    res.status(200).json(Product.fetchAll());
}

exports.getProductById = (req, res, next) => {
    res.status(200).json(Product.findById(req.params.prodId));
}

exports.save = (req, res, next) => {
    const prod = req.body;
    const savedProd = new Product(null, prod.title, prod.price, prod.description).save();
    res.status(201).json(savedProd);
}

exports.update = (req, res, next) => {
    const prod = req.body;
    const updatedProd = new Product(req.params.prodId, prod.title, prod.price, prod.description).update();
    res.status(200).json(updatedProd);
}

exports.deleteById = (req, res, next) => {
    Product.deleteById(req.params.prodId);
    res.status(200).end();
}
```
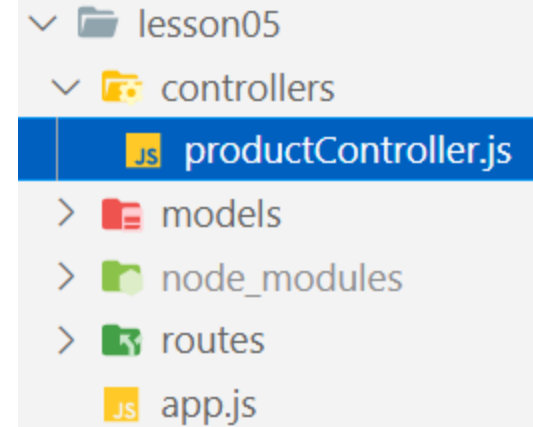
```
∨ 📁 lesson05
  ∨ 📁 controllers
        JS productController.js
  > 📕 models
  > 📗 node_modules
  > 📗 routes
     JS app.js
```

Demo: Shopping Cart – Route

```javascript
const express = require('express');
const productController = require('../controllers/productController');

const router = express.Router();

router.get('/', productController.getProducts);

router.get('/:prodId', productController.getProductById);

router.post('/', productController.save);

router.put('/:prodId', productController.update);

router.delete('/:prodId', productController.deleteById);

module.exports = router;
```
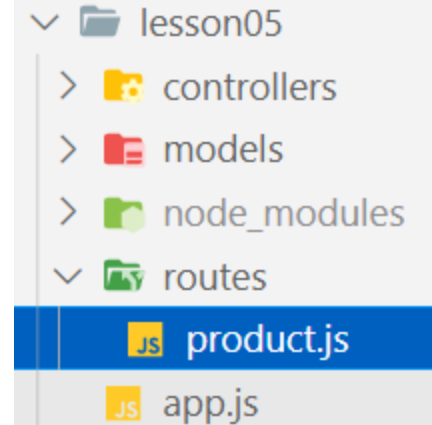
```
∨ 📁 lesson05
  › 📁 controllers
  › 📕 models
  › 📂 node_modules
  ∨ 📂 routes
      JS product.js
      JS app.js
```

Demo: Shopping Cart – app.js

```javascript
const express = require('express');
const productRouter = require('./routes/product');
const cors = require('cors');

const app = express();

app.use(cors());
app.use(express.json());

app.use('/products', productRouter);

app.use((req, res, next) => {
    res.status(404).json({ error: req.url + ' API not supported!' });
});

app.use((err, req, res, next) => {
    if (err.message === 'NOT Found') {
        res.status(404).json({ error: err.message });
    } else {
        res.status(500).json({ error: 'Something is wrong! Try later' });
    }
});

app.listen(3000, () => console.log('listening to 3000...'));
```
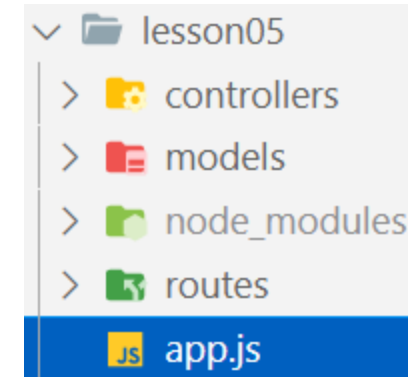
- lesson05
  - controllers
  - models
  - node_modules
  - routes
  - app.js

22

Demo: Shopping Cart – Testing APIs

CORS (Cross-Origin Resource Sharing)

▸ **Cross-Origin Resource Sharing** (CORS) is a mechanism that uses additional HTTP headers to tell browsers to give a web application running at one origin, access to selected resources from a different origin. A web application executes a cross-origin HTTP request when it requests a resource that has a different origin (domain, protocol, or port) from its own.

Client		Server
localhost:3000	⟷	localhost:3000

Client		Server
localhost:4000	CORS Error	localhost:3000
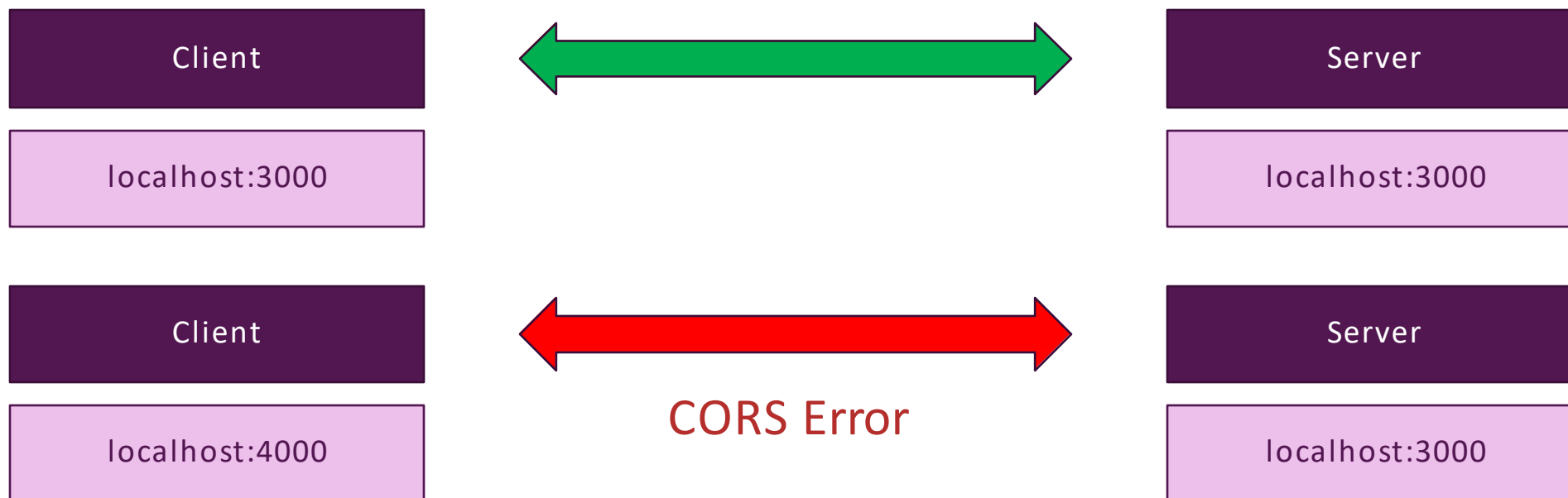
cors

- npm install cors

- **Simple Usage (Enable *All* CORS Requests)**
  - ```
    const cors = require('cors');
    ```
  - ```
    app.use(cors());
    ```

- **Enable CORS for a Single Route**
  - ```
    router.post('/users', cors(), userController.insert);
    ```

Resources

▸ REST
  ▸ https://restfulapi.net/

▸ CORS
  ▸ https://developer.mozilla.org/en-US/docs/Web/HTTP/CORS
  ▸ https://github.com/expressjs/cors