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B.Tech - Computer Science and Engineering
A.Y 2024-25

Course Code	Course Name	Course Category	L T P S I N*	Credit*
23SDCS12R	FULL STACK APPLICATION DEVELOPMENT	SDC	0 0 2 4 0 0	2
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Syllabus:

Module -1: Introduction to React and Web Development Basics :
Setting up a development environment - Overview of HTML, CSS - Single Page Application (SPA) JavaScript and ES6 - **React JSX**: JSX Styling, JSX Using External Style Sheet - **React Components:** Function Component, Class Component - **React State:** Props and State management, Hooks - Event Handling - Node Package Manager • Adding Dependencies in package.json.

1 Setting up a development environment

1.1 Guide to installing Node.js, NPM, and Visual Studio Code

1. Installing Node.js and NPM

Node.js is a JavaScript runtime that lets you run JavaScript on the server side, and NPM (Node Package Manager) comes with Node.js to manage project dependencies.

1. **Download Node.js:**
   - Go to the Node.js official website.
   - You'll see two options for download: **LTS** (Long-Term Support) and **Current**. The LTS version is recommended for stability, especially for production environments.
   - Click **Download** to get the installer for your operating system (Windows, macOS, or Linux).
2. **Install Node.js:**
   - Run the downloaded installer file.
   - Follow the setup prompts. When prompted, check the box that says **"Add to PATH"** so that you can run Node.js from the command line.
   - Accept the default installation settings and proceed until the installation is complete.
3. **Verify the Installation:**

    - Open a **terminal** (Command Prompt on Windows or Terminal on macOS/Linux).
    - Type the following commands to check the installed versions of Node.js and NPM:

bash

```
node -v
npm -v
```

    - You should see version numbers, confirming that Node.js and NPM are installed successfully.

2. Installing Visual Studio Code

Visual Studio Code (VS Code) is a popular code editor with many features to support web and full-stack development.

1. **Download Visual Studio Code:**
    - Go to the Visual Studio Code website.
    - Download the installer for your operating system.
2. **Install Visual Studio Code:**
    - Run the downloaded installer.
    - Follow the installation prompts. On Windows, you may want to check the boxes for **"Add to PATH"** and **"Register Code as an editor for supported file types"** for easier access.
    - Once installed, open Visual Studio Code.

3. Setting Up Extensions in Visual Studio Code

To enhance your development experience, install extensions in VS Code:

- Open **VS Code** and go to the **Extensions** sidebar by clicking the Extensions icon (or press Ctrl + Shift + X).
- Search for and install these popular extensions:
    - **ESLint**: Helps with identifying and fixing code quality issues.
    - **Prettier**: For automatic code formatting.
    - **Live Server**: Provides a local development server with live reload capabilities.
    - **JavaScript (ES6) code snippets**: For quick JavaScript snippets.

4. Verifying the Setup

1. **Create a Test File**:

    - Open VS Code and create a new folder for your project (e.g., "NodeTest").
    - Inside the folder, create a file named index.js.

2. **Write a Simple Test Script**:
    - In index.js, write the following code:

javascript

```
console.log("Node.js is working!");
```

3. **Run the Test Script**:
    - Open the terminal in VS Code by going to **View > Terminal** or pressing `Ctrl + ``.
    - Run the script by typing:

bash

```
node index.js
```

    - You should see Node.js is working! printed in the terminal, indicating that Node.js is correctly set up.

With these steps, you’ve successfully installed and configured Node.js, NPM, and Visual Studio Code, and you’re ready to start developing! Let me know if you need additional help with configuration or setting up specific extensions.

1.2 Overview of package managers, command-line tools, and setting up Git for version control

Here’s a comprehensive overview of **package managers**, **command-line tools**, and **setting up Git for version control** to help you build a solid foundation for managing and collaborating on projects.

1. Package Managers

Package managers are essential tools in modern development for handling libraries and dependencies within projects. Here’s a quick overview of popular package managers:

NPM (Node Package Manager)

- **Purpose**: NPM is the default package manager for Node.js. It’s used to install, update, and manage packages (libraries or dependencies) in JavaScript projects.
- **Installation**: Comes automatically with Node.js.
- **Basic Commands**:
    - **Install a package**: npm install <package-name>
    - **Install a package globally**: npm install -g <package-name> (useful for CLI tools)
    - **Uninstall a package**: npm uninstall <package-name>

    - **Create a package.json file**: npm init (contains project metadata, scripts, and dependencies)

Yarn

- **Purpose**: Yarn is an alternative package manager for JavaScript that focuses on speed and reliability.
- **Installation**: Requires Node.js and can be installed with NPM: npm install -g yarn
- **Basic Commands**:
    - **Install dependencies**: yarn install
    - **Add a package**: yarn add <package-name>
    - **Remove a package**: yarn remove <package-name>

Package managers simplify dependency management by tracking required libraries, ensuring version compatibility, and managing dependency updates.

2. Command-Line Tools

Command-line tools (CLI tools) allow developers to interact directly with the operating system or specific applications through typed commands. Here are a few commonly used command-line tools:

Shell Commands

- **Navigation**:
    - cd <directory>: Change directory
    - ls (Linux/macOS) or dir (Windows): List files and directories
    - mkdir <directory-name>: Create a new directory
- **File Management**:
    - touch <file-name> (Linux/macOS) or echo. > <file-name> (Windows): Create a new file
    - rm <file-name>: Delete a file
    - mv <source> <destination>: Move or rename a file
- **Viewing Files**:
    - cat <file-name>: Display file contents (Linux/macOS)
    - type <file-name>: Display file contents (Windows)

Git Commands

- Git is a version control system, typically managed through the CLI, that tracks changes in code and helps with collaboration.
- **Basic Git Commands**:
    - git init: Initialize a new Git repository

  - git add <file-name> or git add .: Stage changes for commit
  - git commit -m "message": Commit staged changes with a descriptive message
  - git status: Check the status of the working directory
  - git log: View commit history

NPM and Yarn Commands

- **Running Scripts**:
  - npm run <script-name> or yarn <script-name>: Run a custom script defined in package.json
- **Viewing Installed Packages**:
  - npm list or yarn list: List installed packages and dependencies

CLI tools are highly efficient for managing files, navigating directories, and interacting with version control and package managers.

3. Setting Up Git for Version Control

Git is an essential tool for tracking code changes and collaborating on projects.

Installing Git

- **Download Git** from the official Git website.
- Follow the installation instructions. During installation, you can choose to enable Git in the command line.

Setting Up Git

1. **Configure Git with Your Information**:
   - Open your terminal and set up your Git username and email (used to tag commits):

bash

```
git config --global user.name "Your Name"

git config --global user.email "you@example.com"
```

2. **Creating a Repository**:
   - To start tracking files in a project, navigate to the project folder and initialize a Git repository:

```
cd path/to/your-project

git init
```

3. **Basic Git Workflow**:
   - **Add Files**: Add files to be tracked:

```
git add <file-name>  # To add specific files
git add .  # To add all files in the project folder
```

  - **Commit Changes**: Commit added files to the repository with a message describing the changes:

```
git commit -m "Initial commit"  # or any descriptive message
```

4. **Connecting to a Remote Repository (e.g., GitHub)**:
    - To collaborate with others or back up your code, push your repository to GitHub or a similar remote service.
    - First, create a new repository on GitHub, then link it with:

```
git remote add origin https://github.com/username/repository-name.git

git push -u origin main
```

  - Once linked, you can push updates with git push and pull new changes with git pull.

Branching and Merging

- Git branches allow you to work on different features or fixes without disturbing the main codebase:

```
git branch <new-branch>  # Create a new branch

git checkout <new-branch>  # Switch to the new branch
```

- After making changes on a branch, you can merge it back into the main branch:

```
git checkout main  # Switch to main branch

git merge <branch-name>  # Merge branch into main
```

With package managers, command-line tools, and Git, you can efficiently manage dependencies, streamline workflows, and keep your code organized and collaborative. Let me know if you need further assistance with any specific tools or commands!

1.3 Installing and setting up a local server for development

Here's a guide to installing and setting up a local server for development. Local servers are essential for testing and building web applications on your machine before deploying them.

1. Using Node.js and Express for a Local Server

One of the most common ways to set up a local server in JavaScript development is by using **Node.js** with the **Express** framework. Here's how to set it up:

Step 1: Install Node.js and NPM

If you haven't installed Node.js and NPM yet, follow these steps:

1. **Download Node.js** from the official Node.js website.

2. Run the installer and follow the prompts, making sure to check the box that says **"Add to PATH"**.
3. Open a terminal and check if Node.js and NPM were installed successfully:

```
node -v  # To check Node.js version
npm -v   # To check NPM version
```

Step 2: Set Up a New Project Folder

1. Open your terminal and navigate to the folder where you want to create your project.
2. Create a new project folder:

```
mkdir my-local-server
cd my-local-server
```

3. Initialize a new Node.js project with a package.json file:

```
npm init -y
```

Step 3: Install Express

1. In your project folder, install **Express** as a dependency:

```
npm install express
```

Step 4: Create the Server File

1. In your project folder, create a file named server.js:

```
touch server.js
```

2. Open server.js in your text editor (such as Visual Studio Code) and add the following code:

javascript

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

// Set up a route to respond to a GET request
app.get('/', (req, res) => {
  res.send('Hello, world! Your local server is running!');
});

// Start the server
app.listen(PORT, () => {
  console.log(`Server is running on http://localhost:${PORT}`);
});
```

  - This code initializes an Express server that listens on port 3000 and responds with "Hello, world!" when you access the root URL (/).

Step 5: Run the Server

1. In the terminal, start the server by running:

```
node server.js
```

2. You should see a message like:

arduino

```
Server is running on http://localhost:3000
```

3. Open a web browser and go to http://localhost:3000. You should see the message "Hello, world! Your local server is running!"

2. Using Live Server Extension in Visual Studio Code

If you're building static websites (HTML, CSS, JavaScript), you can also use the **Live Server** extension in Visual Studio Code, which provides a local development server with live reload.

Step 1: Install the Live Server Extension

1. Open **Visual Studio Code**.
2. Go to the **Extensions** sidebar (or press Ctrl + Shift + X).
3. Search for **Live Server** and click **Install**.

Step 2: Start Live Server

1. Open the HTML file you want to serve.
2. Right-click on the HTML file in the editor and select **"Open with Live Server"**.
3. A new browser window should open, displaying your HTML file at a local address like http://127.0.0.1:5500/your-file.html.

2 Overview of HTML & CSS

2.1 HTML structure basics (tags, elements, attributes)

Understanding the basics of HTML structure is essential for web development. Here's an overview of HTML **tags**, **elements**, and **attributes**.

1. HTML Tags and Elements

Tags are the building blocks of HTML, used to define the structure and content of web pages. Tags usually come in pairs: an opening tag and a closing tag.

- **Opening Tag**: The start of an element, enclosed in angle brackets (e.g., <p>).
- **Closing Tag**: The end of an element, also enclosed in angle brackets but with a forward slash before the element name (e.g., </p>).

- **Self-Closing Tags**: Tags that don't need a closing counterpart. Examples include <img /> and <br />.

Elements are made up of tags and the content between them. They can contain text, other elements, or a combination of both.

Example of an HTML Element:

html

```
<p>This is a paragraph.</p>
```

In this example:

- <p> is the opening tag.
- </p> is the closing tag.
- This is a paragraph. is the content of the element.

2. HTML Document Structure

A basic HTML document includes a standard set of tags to organize the content and metadata. Here's an example of a complete HTML document:

html

Copy code

```
<!DOCTYPE html>
<html>
<head>
  <title>My Web Page</title>
</head>
<body>
  <h1>Welcome to My Web Page</h1>
  <p>This is a paragraph with some text content.</p>
</body>
</html>
```

- **<!DOCTYPE html>**: Tells the browser that the document is in HTML5.
- **<html>**: The root element that contains all other elements in the document.
- **<head>**: Contains metadata, like the page title, character set, and links to CSS or JavaScript files.
- **<title>**: Sets the title of the page displayed on the browser tab.
- **<body>**: Contains the visible content of the web page.

3. Common HTML Tags

Here's a list of common HTML tags used in basic web page structure:

- **Headings**: <h1> to <h6> define headings, with <h1> as the largest and <h6> as the smallest.

html

```
<h1>Main Heading</h1>

<h2>Subheading</h2>
```

- **Paragraphs**: <p> defines a paragraph of text.

html

```
<p>This is a paragraph.</p>
```

- **Links**: <a> defines a hyperlink.

html

```
<a href="https://example.com">Visit Example</a>
```

- **Images**: <img> displays an image. It's a self-closing tag.

html

```
<img src="image.jpg" alt="Description of image" />
```

- **Lists**:
    - **Ordered List** (<ol>): Creates a numbered list.

html

```
<ol>

  <li>Item 1</li>

  <li>Item 2</li>

</ol>
```

- - **Unordered List** (<ul>): Creates a bulleted list.

html

```
<ul>

  <li>Item 1</li>

  <li>Item 2</li>

</ul>
```

4. Attributes

Attributes provide additional information about HTML elements. They appear inside the opening tag and consist of a **name** and **value**.

- **Syntax**: attribute-name="value"
- **Common Attributes**:
    - **id**: A unique identifier for an element (e.g., id="header").

  - **class**: Assigns a class to an element, useful for CSS styling (e.g., class="button").
  - **href**: Specifies the URL for an anchor (<a>) link.
  - **src**: Specifies the path to an image file in <img>.
  - **alt**: Provides alternative text for an image.

Example Using Attributes:

html

```
<a href="https://example.com" target="_blank">Visit Example</a>

<img src="image.jpg" alt="A description of the image" />
```

In this example:

- The <a> tag has an href attribute pointing to a URL, and a target attribute specifying it should open in a new tab.
- The <img> tag has a src attribute specifying the image file path, and an alt attribute describing the image.

5. Nesting Elements

HTML elements can be nested, which means putting one element inside another. However, it's important to maintain proper structure so that elements close in the order they were opened.

Example of Nested Elements:

html

```
<div class="content">

  <h1>Welcome to My Site</h1>

  <p>This is a paragraph with a <a href="https://example.com">link</a>.</p>

</div>
```

In this example:

- The <h1> and <p> tags are nested within the <div> tag.
- The <a> tag is nested within the <p> tag.

Summary

- **Tags** define the start and end of elements.
- **Elements** include the tags and content.
- **Attributes** add extra information to elements.
- Use **common tags** (like <h1>, <p>, <a>, <img>, <ul>, <ol>) for structure and content.
- **Nesting** allows organizing content within other elements.

These basics will help you structure HTML documents effectively. Let me know if you need more information on any specific tags or attributes!

2.2 CSS fundamentals (selectors, properties, values, styling basics)

CSS (Cascading Style Sheets) is used to style HTML elements on a web page. It allows you to control the layout, colors, fonts, spacing, and more to make your website visually appealing. Here's an overview of CSS fundamentals:

1. Selectors

Selectors are used to target HTML elements that you want to style. CSS offers various types of selectors:

- **Element Selector**: Selects all elements of a specific type.
- **Class Selector**: Selects all elements with a specific class.
- **ID Selector**: Selects an element with a specific ID.
- **Attribute Selector**: Selects elements based on an attribute (e.g., type="text").
- **Pseudo-Class Selector**: Selects elements based on their state (e.g., :hover).

Examples:

css

```
/* Element Selector */
p {
  color: blue;
}

/* Class Selector */
.container {
  padding: 20px;
  background-color: #f2f2f2;
}

/* ID Selector */
#main-heading {
  font-size: 24px;
  color: darkgreen;
}

/* Attribute Selector */
input[type="text"] {
  border: 1px solid gray;
  padding: 5px;
}

/* Pseudo-Class Selector */
a:hover {
  color: red;
}
```

2. Properties and Values

In CSS, **properties** define what you want to style (e.g., color, font-size, margin), and **values** specify the styling for that property (e.g., red, 20px, 10px).

Example Properties and Values:

css

```
/* Sets the font color to green */
p {
  color: green;
}

/* Sets the font size to 16px */
h1 {
  font-size: 16px;
}

/* Sets the background color to light gray */
body {
  background-color: lightgray;
}
```

```
/* Sets the width to 200px and height to 100px */
div {
  width: 200px;
  height: 100px;
}
```

3. Styling Basics

With CSS, you can create basic styles like **text styling**, **color adjustments**, **layout styling**, and **spacing**.

Example Program for Basic Styling

Here’s a simple HTML and CSS example demonstrating basic styling.

html

Copy code

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>CSS Basics</title>
  <style>
    /* Styling the body background color and text */
    body {
      background-color: #f0f0f0;
      font-family: Arial, sans-serif;
      color: #333;
    }

    /* Styling the main heading */
    #main-heading {
      font-size: 24px;
      color: #0066cc;
      text-align: center;
    }

    /* Styling paragraphs */
    p {
      font-size: 16px;
      line-height: 1.5;
      color: #555;
    }

    /* Styling a container class */
    .container {
      width: 80%;
      margin: 0 auto;
      padding: 20px;
      background-color: white;
      border: 1px solid #ddd;
      border-radius: 5px;
    }

    /* Styling links with pseudo-class */
    a {
      color: #0066cc;
      text-decoration: none;
    }

    a:hover {
      text-decoration: underline;
      color: darkred;
    }
  </style>
</head>
```

```
<body>

  <div class="container">
    <h1 id="main-heading">Welcome to CSS Basics</h1>
    <p>This is a paragraph of text styled with CSS. You can adjust colors, fonts, and layout easily with CSS.</p>
    <p>Check out more details <a href="#">here</a>.</p>
  </div>

</body>
</html>
```

Explanation:

- **Element Selector**: body, p, and a selectors style all <body>, <p>, and <a> elements, respectively.
- **ID Selector**: #main-heading styles the heading with the ID main-heading.
- **Class Selector**: .container styles the <div> with the class container.
- **Pseudo-Class**: a:hover changes the link color and underlines it when hovered.

4. Layout Styling

CSS also includes properties to control **layout** (positioning, display, and alignment) of elements.

Layout Example

css

```
/* Flexbox layout */
.container {
  display: flex;
  justify-content: center;
  align-items: center;
  height: 100vh;
}
```

5. Combining Selectors and Styling

CSS selectors can be combined to create more specific styles.

Combined Selectors Example

css

Copy code

```
/* Selects only paragraphs within the container class */
.container p {
  font-weight: bold;
}
```

Summary of Key CSS Concepts

- **Selectors** target elements for styling.
- **Properties** define what aspect to style, and **values** specify how.
- **Styling basics** include text color, background, margins, padding, and borders.
- **Layout styling** positions and arranges elements using Flexbox, Grid, or positioning properties.

This basic understanding of CSS will help you style web pages efficiently. Let me know if you need further examples or clarification on any concept!

2.3 Document Object Model (DOM) basics and how HTML and CSS interact in a webpage

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Examples:

css

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  <title>CSS Basics</title>
  <style>
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```

```
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  border: 1px solid #ddd;
  border-radius: 5px;
}

/* Styling links with pseudo-class */
```

```
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    }

    a:hover {
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    }
  </style>
</head>
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  <div class="container">
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    <p>This is a paragraph of text styled with CSS. You can adjust colors, fonts, and layout easily with CSS.</p>
    <p>Check out more details <a href="#">here</a>.</p>
  </div>

</body>
</html>
```

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4o

You said:

explain Document Object Model (DOM) basics and how HTML and CSS interact in a webpage with example programs

ChatGPT said:

ChatGPT

The **Document Object Model (DOM)** is a programming interface for web documents, representing the structure of an HTML document as a tree of objects. With the DOM, JavaScript can access and manipulate HTML and CSS, enabling interactive and dynamic web pages.

1. Understanding the DOM

When a web page loads, the browser creates a **DOM tree** based on the HTML structure. This DOM tree consists of nodes (elements, attributes, and text), representing every element in the HTML document. The DOM allows JavaScript to access, modify, add, or delete elements, making the page interactive.

Basic DOM Structure

Here's an example HTML document:

html

Copy code

```
<!DOCTYPE html>
<html>
<head>
  <title>DOM Basics</title>
  <style>
    /* CSS styles to see the changes */
    #content {
      font-size: 16px;
      color: blue;
    }
  </style>
</head>
<body>

  <h1 id="heading">Welcome to the DOM</h1>
  <p id="content">This is some text content.</p>
  <button onclick="changeContent()">Click Me</button>

  <script>
    // JavaScript function to interact with DOM elements
    function changeContent() {
      // Accessing the DOM element with id "content"
      const content = document.getElementById("content");
      // Modifying the inner text of the content element
      content.textContent = "You clicked the button!";
      // Changing the style of the element
      content.style.color = "red";
    }
  </script>

</body>
</html>
```

Explanation:

1. **HTML Structure**: The DOM is created based on the HTML structure with elements like <h1>, <p>, and <button>.
2. **CSS Styling**: CSS in the <style> tag styles the elements. The #content selector makes the paragraph text blue initially.
3. **JavaScript Interaction**:
   - getElementById("content"): Accesses the <p> element with the ID content.
   - textContent: Modifies the text inside the paragraph.
   - style.color: Changes the CSS color property of the paragraph to red.

When the button is clicked, JavaScript changes the paragraph text to “You clicked the button!” and the color to red.

2. How HTML, CSS, and JavaScript Interact via the DOM

- **HTML** defines the **structure** of a webpage.
- **CSS** provides the **style** to the HTML structure.
- **JavaScript** uses the **DOM** to dynamically **modify HTML and CSS**, allowing for interactive features on the page.

Example Program: Changing CSS and HTML Using JavaScript and the DOM

html

Copy code

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

```
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>HTML, CSS, and DOM Interaction</title>
  <style>
    /* Initial styling */
    .box {
      width: 100px;
      height: 100px;
      background-color: skyblue;
      text-align: center;
      line-height: 100px;
      margin: 20px auto;
    }
  </style>
</head>
<body>

  <div id="myBox" class="box">Box</div>
  <button onclick="changeBox()">Change Box</button>

  <script>
    // JavaScript function to modify the box style and content
    function changeBox() {
      // Access the box element
      const box = document.getElementById("myBox");

      // Change the background color and dimensions
      box.style.backgroundColor = "coral";
      box.style.width = "150px";
      box.style.height = "150px";
      // Change the inner text
      box.textContent = "Updated Box";
    }
  </script>

</body>
</html>
```

Explanation:

1. **HTML**:
    - The <div> element with the ID myBox and class box represents a square box with initial text “Box.”
    - A <button> calls the changeBox() function when clicked.
2. **CSS**:
    - The .box class defines the initial width, height, background color, and centering for the box.
3. **JavaScript (DOM Manipulation)**:
    - The changeBox() function:
        - Uses document.getElementById("myBox") to access the myBox element.
        - Modifies the box’s backgroundColor, width, and height properties.
        - Changes the box’s text to “Updated Box.”

When the button is clicked, JavaScript modifies the box’s style and content, showing how the DOM can control both HTML and CSS.

3. DOM Methods for Selecting Elements

JavaScript offers various methods to access DOM elements, enabling a wide range of manipulations:

- **getElementById(id)**: Selects an element by its ID.
- **getElementsByClassName(className)**: Selects all elements with a specific class.
- **getElementsByTagName(tagName)**: Selects all elements with a specific tag.
- **querySelector(selector)**: Selects the first element that matches a CSS selector.
- **querySelectorAll(selector)**: Selects all elements that match a CSS selector.

Example Using Different DOM Selection Methods

html

Copy code

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>DOM Selection Methods</title>
</head>
<body>

  <h1 id="header">Welcome!</h1>
  <p class="text">This is the first paragraph.</p>
  <p class="text">This is the second paragraph.</p>
  <button onclick="changeText()">Change Text</button>

  <script>
    function changeText() {
      // Select by ID
      const header = document.getElementById("header");
      header.style.color = "blue";
      header.textContent = "Hello, DOM!";

      // Select by class name
      const paragraphs = document.getElementsByClassName("text");
      paragraphs[0].style.color = "green"; // First paragraph
      paragraphs[1].style.color = "purple"; // Second paragraph

      // Select by query selector (CSS-like selection)
      const firstParagraph = document.querySelector(".text");
      firstParagraph.style.fontWeight = "bold"; // Applies only to the first .text paragraph
```

```
   }
  </script>


</body>

</html>
```

Explanation:

1. **Selecting by ID**: getElementById("header") changes the text and color of the <h1> element.
2. **Selecting by Class Name**: getElementsByClassName("text") selects all paragraphs with the text class and applies different colors to each.
3. **Selecting with querySelector**: querySelector(".text") applies bold font weight to the first paragraph with class text.

Summary of the DOM's Role

- **DOM Structure**: HTML creates a DOM tree, with elements represented as nodes.
- **CSS Styling**: CSS defines the default appearance of elements.
- **JavaScript DOM Manipulation**: JavaScript interacts with the DOM to dynamically change HTML structure and CSS styles, making web pages interactive.

The DOM is key to creating dynamic, interactive web applications by enabling the connection between HTML, CSS, and JavaScript.

3 Single Page Application (SPA) Overview

What is React?

Understanding

React is SQL for HTML or more specifically the Document Object Model (DOM)

React is a JavaScript library for building user interfaces. More specifically, React provides a declarative library that keeps the DOM in sync with your data.

A declarative language that most developers are familiar with is SQL. SQL is declarative because you declare what data you want and the database figures out how to efficiently return you that data. React is SQL for HTML or more specifically the Document Object Model (DOM). You declare what HTML and data you want and React figures out how to efficiently (with the least amount of changes to the DOM) render your data to HTML.

The architecture is component-based and allows you to create new custom, reusable, encapsulated HTML tags to use in web pages and web apps.

Why is it useful?

React makes it painless to create interactive UIs on top of web standards.

Why React?

There are so many JavaScript libraries and frameworks it is difficult to keep up and understand which are worth learning and how they might be valuable to your organization.

React is one of the most popular JavaScript libraries currently so in this overview we are going to step back and take a look at the big picture and examine:

- **Why you might want to consider adopting it as part of your technology stack**
- **What problem React is solving**
- **Compare React to similar technologies**
- **Understand evolving web application architectures**

Adoption

StackOverflow.com 2021 Survey of 65,000 developers:

- **Most Popular Web Frameworks**
- **Most Loved/Dreaded/Wanted Web Frameworks**

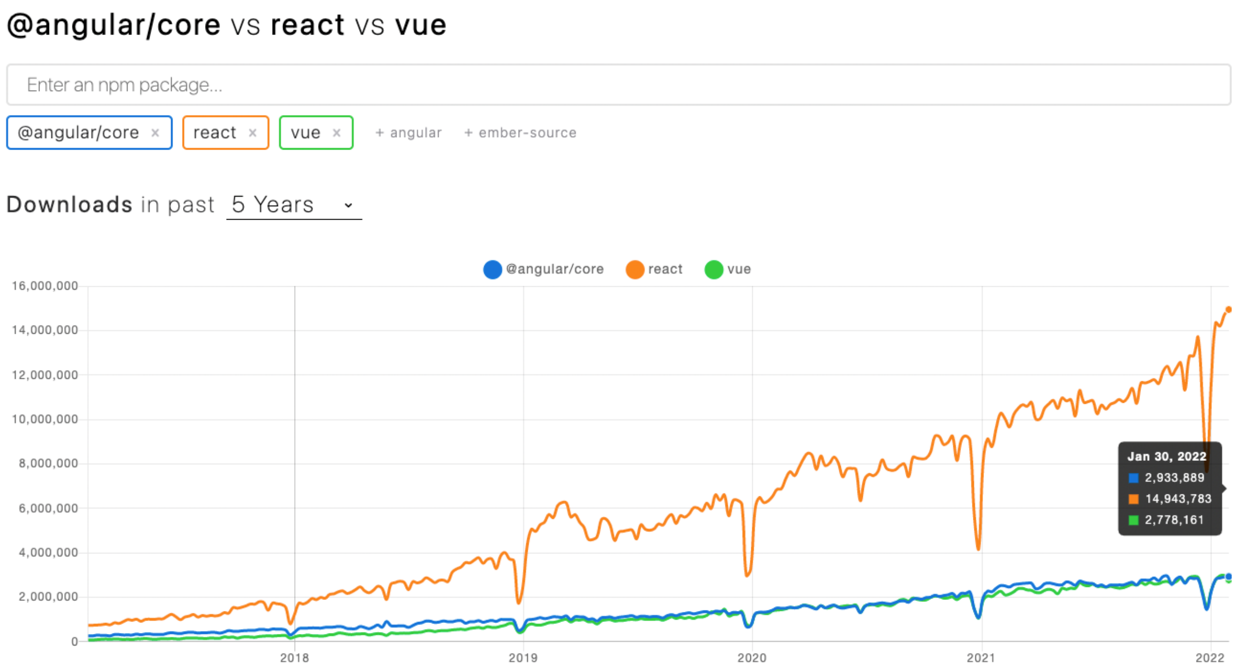
StackOverflow.com 2020 Survey of 65,000 developers:

- **Most Popular Web Frameworks**
- **Most Loved/Dreaded/Wanted Web Frameworks**

StackOverflow.com 2019 Survey of 90,000 developers:

- **Most Popular Web Frameworks**
- **Most Loved/Dreaded/Wanted Web Frameworks**

Looking at this chart from npm trends (npm is the most popular package manager for JavaScript) it becomes clear that both React has extremely strong adoption.



[View interactive chart online]()

In addition, lots of companies are using React in their technology stack including:

- **Facebook**
- **Netflix**
- **Uber**
- **Twitter**
- **Pinterest**
- **Airbnb**
- **Instagram**
- **reddit**
- **Instacart**
- **and more...**

Easy to Learn

The React library itself has a *very low concept count* and is subsequently easy to learn.

Ecosystem & Community

Not to worry though as React has an entire ecosystem of other tools and libraries...

After you begin building applications with the React library you quickly learn that it does one thing and does it well but you need a lot of other things to create a web application using it.

Not to worry though as React has an entire ecosystem of other tools and libraries to fill those gaps. Think of building a React app as being similar to buying best-of-breed software and integrating it. You integrate React

with other best-of-breed libraries and tools to build an application. Here is a quick list of some of the more popular libraries and tools often used with React.

- **Babel: a JavaScript compiler that allows you to use the latest JavaScript language features today**
- **TypeScript: TypeScript is a typed superset of JavaScript that compiles to plain JavaScript. Either the Babel or TypeScript compiler are used to get the features of a modern programming language today**
- **webpack: efficiently bundles your JavaScript, CSS, HTML, and images for deployment**
- **Create-React App: Creates a React project with best practices by running only one command**
- **Next.js: the features you need for production: hybrid static & server rendering, TypeScript support, smart bundling, route pre-fetching, and more. No config needed.**
- **State Management Libraries including Redux and MobX to architect and manage the data in your application**
- **GraphQL: a query language for your data APIs**
- **React Native: Create native apps for Android and iOS using React**
- **Gatsby: framework based on React that helps developers build blazing fast websites and apps**

Timeless Technology

React is built on top of timeless web standard technology including JavaScript, HTML, CSS, and the browser's Document Object Model (DOM).

Subsequently, learning and getting better at React is really just becoming better at web development. This includes deeply understanding web standards which are technologies that seem to never go out of style.

Comparison

React, Angular, Vue Compared

JavaScript libraries and frameworks have more similarities than differences. The reality is that they borrow ideas from each other to improve the JavaScript ecosystem.

React

- **Facebook**
- **Components**
- **Library**
- **Just the View in MVC**
- **Need to include other libraries**
  - **React Router (Routing)**
  - **HTTP: Axios or fetch API**
- **ES6 (Babel compiler) or TypeScript (tsc compiler)**
- **Create React App**
- **Uses Webpack**

- **Redux**

Angular

- **Google**
- **Components**
- **Framework**
- **Modular**
- **Component Router**
- **HttpClient**
- **Forms**
- **Usually TypeScript (tsc compiler)**
- **Angular CLI**
- **Uses Webpack**
- **Reactive Extensions for Angular (ngrx)**

Vue

- **Community**
    - **Started by former Google Technologist and Meteor core team member Evan You**
- **Components**
- **Framework**
- **Modular**
- **Vue Router (official Router)**
- **Need to include other libraries**
    - **HTTP: Axios or fetch API**
    - **Forms**
- **ES6 (Babel compiler) or TypeScript (tsc compiler)**
- **Vue CLI**
- **Vuex (State Management)**

React, Angular, Vue: Key Insights

Angular continues to put “JS” into HTML. React puts “HTML” into JS. – Cory House

- **Vue and Angular have templates which are often favored by developers without as much JavaScript experience**
- **React does not have templates because it just relies on JavaScript combined with JSX so it is often favored by developers who are fluent in JavaScript**

- Angular is a more comprehensive framework while React is more of a targeted micro library. Vue can starts as a micro library and scales to a comprehensive framework.
- Because React and Vue are smaller they can be:
    - Easier to understand
        - Vue even more than React because of its use of templates and excellent documentation
    - Easier to include in a project
- React is much more popular (but has existed longer)
- React and Vue is used more by design/digital/interactive agencies to build interactive websites as well as in the applications in an enterprise
- Angular is used more for building applications in the enterprise, particularly at larger organizations, and is getting better for website use cases

3.1 Architecture

It's valuable to understand how JavaScript applications are architected. In particular, it's valuable to understand how JavaScript application architecture is different from other web frameworks.

Where to Render

It's useful to think about where the HTML and data come together or where the contents of a web page are rendered. There are three places to render:

1. Server-side Rendering (SSR)

- on the web server in the chosen server-side programming language
- the most common servers-side programming languages are Java, C#, Python, Ruby, and PHP but it could be JavaScript running on a JavaScript runtime environment (for example: Node.js)

2. Client-side Rendering (CSR)

- in the end user's web browser using a client-side programming language
- the most common client-side programming language is JavaScript
- Web Assembly has made it possible to use other languages in the browser

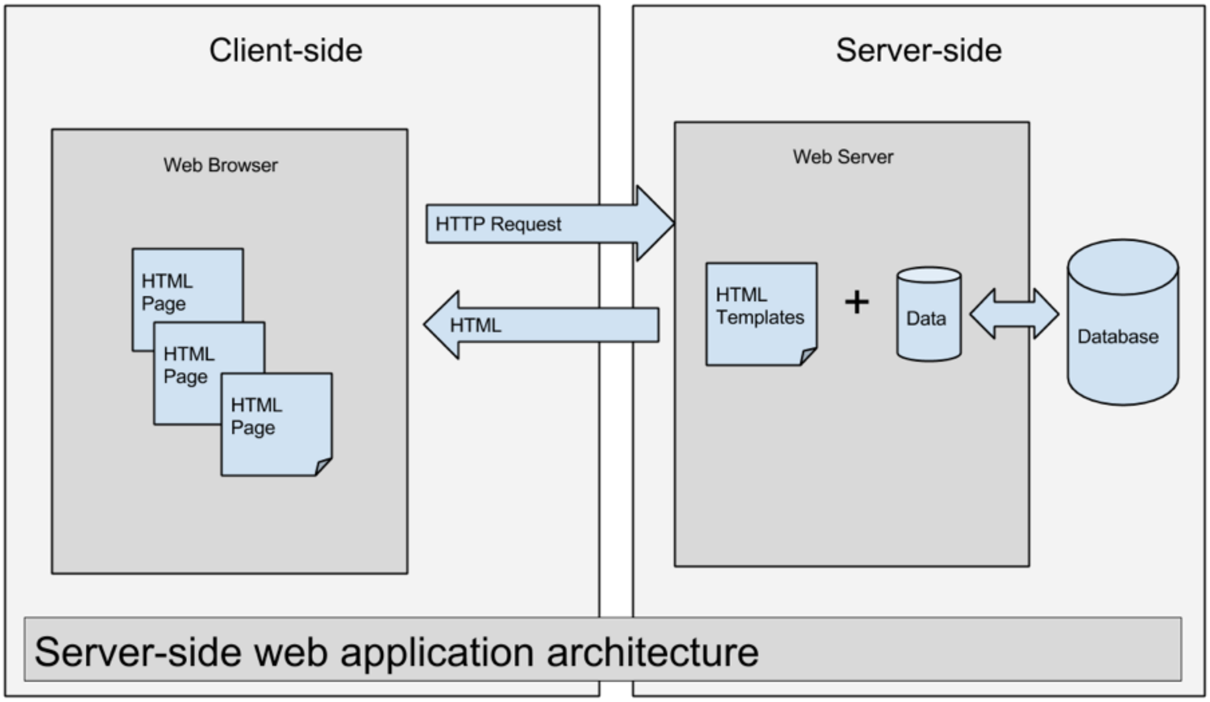
3. Static Site Generation (SSG)

- on the developer machine or continuous build server at build time
- the most common languages are JavaScript (Next.js, Gatsby, Docusaurus, Nuxt, Astro), Go (Hugo), and Ruby (Jekyll)
- this is sometimes referred to as a Jamstack architecture
- here is a list of common SSGs

Web application architectures

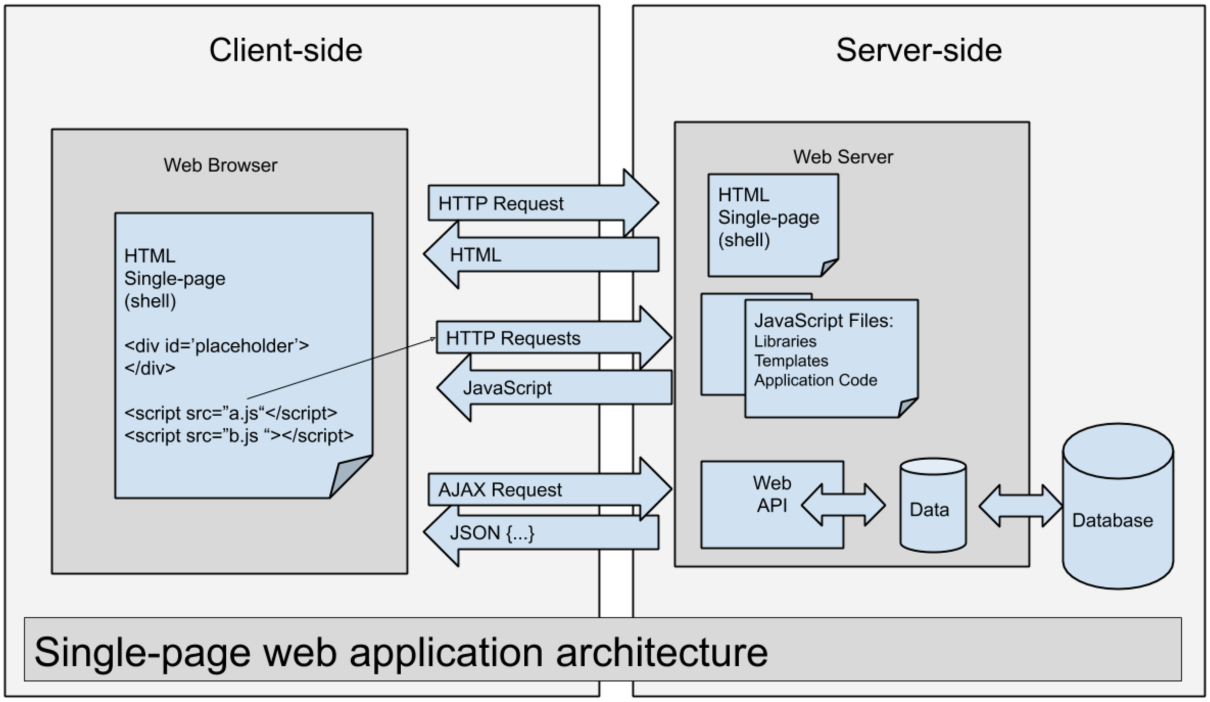
Server-side web application architecture (SSR)

- **Java Spring**
- **ASP.NET**
- **Ruby on Rails**
- **PHP (Laravel, CodeIgniter)**
- **Python (Django)**



Single-page web application architecture (CSR)

- **React**
- **Angular**
- **Vue**
- **AngularJS**
- **Ember**
- **Backbone**



What's Next

- **SSR + CSR + SSG**
- **Can make the decision on where to render per page**
  - **Next.js**
- **Can make the decision on where to render per component (part of the page)**
  - **Next.js or Remix + React Server Components**

Why a Single-page web application architecture (CSR)?

So why are single-page web application architectures (client-side rendering) so popular? I think it can be summed up in the following statement.

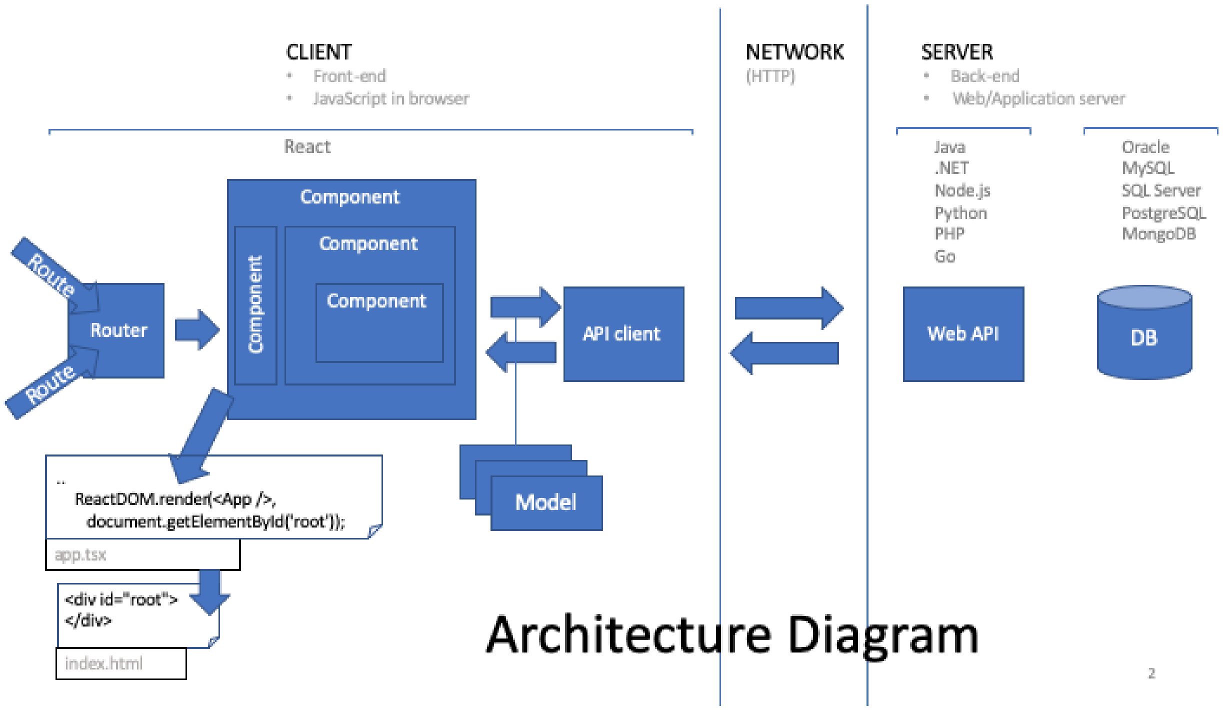
JavaScript libraries and frameworks provide an interactive user experience similar to a desktop or native application that is as easy to update as a web application.

In the past, developers have commonly used technologies from Microsoft (Windows Forms, WPF, Silverlight), Oracle (Java Swing), Adobe (Flash, Flex) and/or mobile solutions such as iOS or Android development to provide rich interactive user experiences. These technologies were never easy to deploy or update for a large number of users. Which is why the business applications are built as web applications today.

These JavaScript libraries and frameworks allow developers to "have their cake and eat it to" by enabling an interactive user experience while remaining a web application.

React Architecture

Lots of my students struggle with how everything comes together in a React application. Below is a diagram that helps answer that question.



```
..
ReactDOM.render(<App />,
  document.getElementById('root'));
```

```
<div id="root">
</div>
```

Computer Setup

Your computer should have:

1. A **recent** version of **Windows** (10 or later), **macOS**, or **Linux**, with:
   - *current system updates*
   - at least 4 GB of RAM
2. **Node.js** installed, a recent **16.x, 18.x, or 20.x LTS** version.
   - Why? Create React App requires Node >= 14 on your local development machine (not on the server)
   - **Visit** http://nodejs.org/.
   - **Click** the Download Node.js (LTS) (or similar) **button** to **download** the **installer** file.
   - **Run** the **installer**, accepting all *default settings*.
   - After installation, **confirm** that the Path environment variable on your computer has been modified to include the path for node and npm by following these steps.
     - **Open** a command prompt (Windows) or terminal (Mac).

In Windows, click the Start button and type cmd

- **Run** the following **commands**:

```
node -v
npm -v
```

        - **Verify** the **version** of each program is **returned**.
    - Please **DO use** a recent Node.js (Long Term Support (LTS)) versions for this class.
        - 16.x
        - 18.x
        - 20.x
    - Please **DO NOT use** these Node.js versions for this class.
        - ~~8.x~~
        - ~~11.x~~
        - ~~13.x~~
        - ~~15.x~~
        - ~~19.x~~
    - Why?

Major Node.js versions enter Current release status for six months, which gives library authors time to add support for them. After six months, odd-numbered releases (9, 11, etc.) become unsupported, and even-numbered releases (10, 12, etc.) move to Active LTS status and are ready for general use. LTS release status is "long-term support", which typically guarantees that critical bugs will be fixed for a total of 30 months. Production applications should only use Active LTS or Maintenance LTS releases.

- If you are using one of the older or experimental versions of Node.js listed above, uninstall it and reinstall a recent **LTS** version.
    - How to remove Node.js from Windows

tldr;
1. Uninstall from Programs & Features with the uninstaller.
2. Reboot (or you probably can get away with killing all node-related processes from Task Manager).

    - How to Remove Node.js from Mac OSX
- If you are **using another version of Node** and **do not want to uninstall it** because you need to support an existing application that uses that version I would recommend using a **Node Version Manager** so you can install multiple versions of Node.js on a machine.
    - For details on how to do this see this article.
    - Note: As explained in the article, depending on your operating system there are two different open-source projects for installing multiple versions of Node.js: one is named nvm (Mac) and the other nvm for Windows...make sure you use the appropriate one.

1. **Install Create React App** and **verify** a project can be created.

i. Create a working directory for the course somewhere on your computer that you will remember.

ii. **Open** a command prompt (Windows) or terminal (Mac).

iii. **Change directory** (cd) into the working directory you created.

iv. **Run** the following **commands**:

```
npx create-react-app my-app --use-npm
cd my-app
npm start
```

If you've previously installed create-react-app globally via npm install -g create-react-app, it is recommended that you uninstall the package using npm uninstall -g create-react-app to ensure that npx always uses the latest version.

v. After the application builds, your default browser should open to http://localhost:3000/.

If http://localhost:3000/ does not open automatically, open your browser and navigate there manually.

vi. **Verify** the **React logo** is displayed in the browser.

2. An **IDE** (Integrated Development Environment) *or* code **editor** of your choice.

Students may use any IDE/editor that they are comfortable with using.

- We **recommend Visual Studio Code**.
    - It is **free**, **cross-platform** has a small download, and is a quick install.
    - **Visit** code.visualstudio.com to **install**.

Don't confuse Visual Studio Code with the heavier Visual Studio IDE used for .NET development.

-
    - **Configure Visual Studio Code** for the course by following these directions.

! Don't miss the above link to configure Visual Studio Code with appropriate extensions for the course

- **WebStorm** or **IntelliJ IDEA Ultimate** both made by JetBrains are also great choices.
    - In summary, these IDEs are heavier but have more features built-in.
    - **Visit** Download WebStorm to **install**.
        - OR
    - **Visit** Download IntelliJ IDEA to **install**.

Note: IntelliJ IDEA Ultimate includes TypeScript support while the Community Edition does not.

Each download comes with a free 30-day trial.

5. Google Chrome browser.
    - **Visit** http://www.google.com/chrome/ to **install**.

Any recent version will work for the class.

-
    - Also, any other browsers that you plan to support

6. **Internet access in the classroom is required** because attendees will download additional software packages and material from github.com as part of the class. This can be confirmed by following these steps.
    - **Visit**: https://github.com/facebook/react/
    - **Verify** the **page loads** successfully on your company's network. s
7. You will need to have **Git** installed. To verify it is installed open a terminal or command-prompt and run the command:

```
git --version
```

- Any version should work.
- Here is a link to a page describing the process for installing git if you need to install it.

3.2 benefits over traditional multi-page applications

Single Page Applications (SPAs) offer several advantages over traditional Multi-Page Applications (MPAs), especially in terms of speed, user experience, and development efficiency. Here's an overview of the main benefits of SPAs:

1. Improved Speed and Performance

- **Faster Loading**: In SPAs, only the initial page load is heavy, as it includes all necessary resources (HTML, CSS, JavaScript) for the application to function. After that, only the necessary data is fetched as users navigate, making page loads faster.
- **Reduced Server Load**: SPAs rely on AJAX calls to retrieve only the needed data, avoiding full-page reloads. This reduces server requests and bandwidth usage, especially for users who interact frequently with the app.
- **Dynamic Content Loading**: SPAs dynamically update parts of the page, leading to a smoother and faster experience, as only changed content is re-rendered.

2. Better User Experience

- **Smooth Transitions**: SPAs provide a seamless experience by eliminating the flash between pages, often present in MPAs, as only the content area is refreshed rather than the entire page.
- **Native-like Feel**: SPAs mimic the user experience of a mobile or desktop application, providing a more immersive experience. This consistency makes SPAs feel smoother and more modern than MPAs, especially on mobile devices.

- **Offline Capability**: SPAs can work offline if they are cached properly using service workers. This allows users to access the app and make changes even when they are temporarily offline, a feature that MPAs struggle to support.

3. Efficient Development and Maintenance

- **Reusable Code**: SPAs are often built using modern JavaScript frameworks like React, Angular, or Vue, which encourage modular and reusable components. This makes code easier to maintain and scale.
- **Simplified Backend**: Since the SPA itself handles routing and state management, the backend can focus on delivering data through an API (e.g., RESTful or GraphQL). This separation of concerns allows for a more organized and modular architecture.
- **Easier Debugging**: Modern JavaScript frameworks include robust development tools (e.g., React DevTools, Vue DevTools) that make it easier to debug issues by allowing developers to inspect component states, data flows, and network requests directly within the browser.

4. Scalability and Flexibility

- **API-Driven Architecture**: SPAs communicate with backends via APIs, making it easier to scale specific parts of the application independently. Additionally, this API-centric approach allows for integrating with other services and reusing the backend for different platforms (e.g., mobile apps).
- **Compatibility with Microservices**: SPAs work well in a microservices architecture because the frontend is decoupled from the backend. This enables teams to independently develop, deploy, and scale each service without affecting the SPA.

5. SEO Improvements (with Modern Solutions)

- Historically, SPAs had poor SEO because search engines couldn't index dynamic content loaded by JavaScript. However, with server-side rendering (SSR) and prerendering (e.g., using Next.js with React), modern SPAs can be SEO-friendly.
- **Dynamic Content Optimization**: SPAs can dynamically load and update content, and by using SSR or CSR (Client-Side Rendering), search engines can index updated content more effectively.

Comparison Summary

Aspect	**Single Page Application (SPA)**	**Multi-Page Application (MPA)**
Speed	Faster after initial load	Slower due to page reloads
User Experience	Smooth, app-like	Traditional, with page reloads
Offline Support	Possible with caching	Limited or none
SEO	Challenging but possible with SSR/prerendering	Easier due to server-rendered pages
Scalability	Easy to scale as frontend and backend are decoupled	Scaling often requires changes across the app

Development	Component-based, reusable, easier maintenance	Less modular, requires more coordination

---

Example Scenario

Consider an e-commerce website:

- **With SPA**: When users navigate between product pages, they experience smooth transitions without full-page reloads. The shopping cart updates in real-time, and the app feels responsive and fluid.
- **With MPA**: Each page load involves server requests for the entire page, causing delays as users browse. Updates to cart information and other features require additional server interactions, potentially slowing the experience.

In summary, SPAs provide a faster, more interactive, and modern user experience with better scalability and efficient development processes. However, MPAs are sometimes better suited for applications that require extensive SEO and very complex, content-heavy structures.

4 JavaScript and ES6 Basics

JavaScript is a powerful, versatile programming language that plays a crucial role in front-end development. ES6 (ECMAScript 6, also known as ECMAScript 2015) introduced several new features and syntax improvements that made JavaScript more powerful and easier to use. Let's go over the basics of JavaScript and some of the key ES6 features.

JavaScript Basics

1. **Variables: Variables in JavaScript are used to store data values. Prior to ES6, var was used for variable declaration, but ES6 introduced let and const.**
    - **var: Has function scope, which can lead to unexpected results in loops or conditional statements.**
    - **let: Has block scope, meaning it is only accessible within the block it's defined in.**
    - **const: Also has block scope, but its value cannot be reassigned.**

javascript
Copy code

```
var x = 5;  // function-scoped
let y = 10; // block-scoped
const z = 15; // block-scoped, constant
```

2. **Data Types: JavaScript has dynamic typing, meaning variables don't need a specific type to be declared. Common types include:**
    - **Number: Integers and floats (e.g., 5, 3.14)**
    - **String: Text (e.g., "hello")**
    - **Boolean: true or false**
    - **Array: Collection of items (e.g., [1, 2, 3])**
    - **Object: Collection of key-value pairs (e.g., { name: "John", age: 30 })**

javascript
Copy code

```
let name = "Alice";      // String
let age = 25;            // Number
let isStudent = true;    // Boolean
let colors = ["red", "blue", "green"]; // Array
let person = { name: "Alice", age: 25 }; // Object
```

3. Functions: JavaScript functions allow you to encapsulate reusable blocks of code.
    - Function Declaration:

javascript
Copy code

```
function greet(name) {
  return "Hello, " + name;
}
```

- Function Expression:

javascript
Copy code

```
const greet = function(name) {
  return "Hello, " + name;
};
```

ES6 Features

1. Arrow Functions: Arrow functions provide a shorter syntax for writing functions and don't bind their own this context, making them especially useful in callbacks.

javascript
Copy code

```
const add = (a, b) => a + b; // concise syntax
const greet = name => `Hello, ${name}`; // template literals
```

2. Template Literals: ES6 introduced template literals, allowing you to create strings with embedded variables and expressions using backticks (`).

javascript
Copy code

```
let name = "Alice";
let greeting = `Hello, ${name}!`; // "Hello, Alice!"
```

3. Destructuring: Destructuring makes it easy to extract values from arrays or objects into distinct variables.
    - Array Destructuring:

javascript
Copy code

```
const colors = ["red", "blue", "green"];
const [first, second, third] = colors;
```

- Object Destructuring:

javascript
Copy code

```
const person = { name: "Alice", age: 25 };
const { name, age } = person;
```

4. Default Parameters: You can set default values for function parameters in case they aren't provided.

javascript
Copy code

```
const greet = (name = "Guest") => `Hello, ${name}`;
greet(); // "Hello, Guest"
```

5. Spread and Rest Operators: The spread (...) and rest (...) operators make it easier to work with arrays and objects.
    - Spread: Expands an array or object.

javascript
Copy code

```
const arr1 = [1, 2];
const arr2 = [...arr1, 3, 4]; // [1, 2, 3, 4]
```

- Rest: Gathers remaining elements into an array.

javascript
Copy code

```
const add = (a, b, ...rest) => {
  console.log(rest); // contains any additional arguments
  return a + b;
};
```

6. Classes: ES6 introduced classes, which provide a cleaner, simpler syntax for creating objects and handling inheritance.

javascript
Copy code

```
class Person {
  constructor(name, age) {
    this.name = name;
    this.age = age;
  }
  greet() {
    return `Hello, ${this.name}`;
  }
}
const person = new Person("Alice", 25);
```

7. Modules: ES6 introduced import and export syntax for modules, allowing you to organize code into separate files.
    - Export:

javascript
Copy code

```
// in file person.js
export const name = "Alice";
export const age = 25;
```

- Import:

javascript
Copy code

```
// in another file
import { name, age } from './person';
```

8. Promises: ES6 introduced promises, which allow you to handle asynchronous operations more cleanly. Promises have three states: pending, fulfilled, and rejected.

javascript
Copy code

```
const fetchData = () => {
  return new Promise((resolve, reject) => {
    setTimeout(() => {
      resolve("Data loaded");
    }, 2000);
  });
};
fetchData().then((data) => console.log(data));
```

Example Program: Using ES6 Features

Here's a quick example that combines several ES6 features:

javascript
Copy code

```
class Calculator {
  constructor() {
    this.history = [];
  }

  // Arrow function with default parameter and rest operator
  add = (a, b = 0, ...rest) => {
    let sum = a + b + rest.reduce((acc, curr) => acc + curr, 0);
    this.history.push(sum); // storing result in history
    return sum;
  };

  getHistory() {
    return this.history;
  }
}

// Using template literals, destructuring, and spread operator
const calc = new Calculator();
const [result1, result2] = [calc.add(5, 10), calc.add(20, 30, 10)];
const history = [...calc.getHistory()];

console.log(`Results: ${result1}, ${result2}`); // "Results: 15, 60"
console.log(`History: ${history.join(", ")}`);   // "History: 15, 60"
```

In this example:

- **We use an arrow function for add, with a default parameter and rest operator.**
- **getHistory returns an array that we spread into a new variable.**
- **We print results using template literals and destructuring.**

Summary

ES6 made JavaScript more powerful, organized, and easier to write. It introduced new variable declarations (let and const), arrow functions, template literals, destructuring, default parameters, classes, modules, and promises, all of which enhanced JavaScript's capabilities and improved developer productivity. These additions enable more modular, maintainable, and readable code.

4.1 JavaScript fundamentals (variables, functions, control structures)

JavaScript fundamentals include variables, functions, and control structures. Together, they form the core of JavaScript programming. Here's an overview of these fundamentals with examples.

---

1. Variables

Variables are used to store data values that can be accessed and manipulated in the program. JavaScript supports three types of variable declarations: var, let, and const.

- **var**: Function-scoped, can be re-declared and updated. It's older syntax but still functional.
- **let**: Block-scoped (available only within the block it's defined in), can be updated but not re-declared in the same scope.
- **const**: Block-scoped, cannot be re-assigned or re-declared. Useful for values that shouldn't change.

javascript

Copy code

```
// var example

var x = 10;

console.log(x); // 10

x = 20;

console.log(x); // 20
```

```
// let example

let y = 15;

console.log(y); // 15

y = 25;

console.log(y); // 25


// const example

const z = 30;

console.log(z); // 30

// z = 40; // Error: Assignment to constant variable
```

---

2. Functions

Functions are blocks of code designed to perform a particular task. They can take parameters, perform actions, and return values.

- **Function Declaration**: Creates a function with a name.
- **Function Expression**: Assigns a function to a variable, useful for passing functions as data.
- **Arrow Function** (ES6): A shorter syntax, often used for simpler functions.

Function Declaration

javascript

Copy code

```
function add(a, b) {

  return a + b;

}

console.log(add(5, 3)); // 8
```

Function Expression

javascript

Copy code

```
const multiply = function(a, b) {

  return a * b;

};

console.log(multiply(4, 5)); // 20
```

Arrow Function (ES6)

javascript

Copy code

```
const subtract = (a, b) => a - b;
console.log(subtract(10, 4)); // 6
```

3. Control Structures

Control structures manage the flow of the program, allowing decisions to be made based on conditions, loops to repeat actions, and branching to specific code blocks.

a. Conditional Statements

Conditional statements allow the code to execute based on certain conditions. The most common are if, else if, and else.

javascript

Copy code

```
let score = 85;

if (score > 90) {
  console.log("Grade: A");
} else if (score > 75) {
  console.log("Grade: B");
} else {
  console.log("Grade: C");
}
// Output: Grade: B
```

Switch Statement: Useful when there are multiple values to check.

javascript

Copy code

```
let color = "red";

switch (color) {
  case "red":
    console.log("Color is red");
    break;
  case "blue":
    console.log("Color is blue");
    break;
  default:
    console.log("Unknown color");
}
// Output: Color is red
```

b. Loops

Loops allow you to execute a block of code multiple times.

1. **for Loop**: Runs a block of code a specified number of times.

javascript

Copy code

```
for (let i = 0; i < 5; i++) {
  console.log(i);
}
// Output: 0 1 2 3 4
```

2. **while Loop**: Runs as long as a specified condition is true.

javascript

Copy code

```
let i = 0;
while (i < 5) {
  console.log(i);
  i++;
}
// Output: 0 1 2 3 4
```

3. **do...while Loop**: Executes the code block once before checking the condition.

javascript

Copy code

```
let j = 0;
do {
  console.log(j);
  j++;
} while (j < 5);
// Output: 0 1 2 3 4
```

c. Break and Continue

- **break**: Exits a loop or switch early.
- **continue**: Skips the current iteration and moves to the next one.

javascript

Copy code

```
for (let i = 0; i < 5; i++) {
  if (i === 3) break;
  console.log(i);
}
// Output: 0 1 2 (loop stops when i is 3)

for (let i = 0; i < 5; i++) {
  if (i === 2) continue;
  console.log(i);
}
// Output: 0 1 3 4 (skips when i is 2)
```

---

4. Example Program Using Variables, Functions, and Control Structures

Here's a program that calculates the factorial of a number using a function, variables, and a loop.

javascript

Copy code

```
function factorial(n) {
  if (n < 0) {
    return "Factorial of a negative number is not defined.";
  }

  let result = 1;
  for (let i = 1; i <= n; i++) {
    result *= i;
  }

  return result;
}
```

```
console.log(factorial(5)); // Output: 120

console.log(factorial(0)); // Output: 1

console.log(factorial(-3)); // Output: Factorial of a negative number is not defined.
```

Explanation:

1. **Variables**: result is used to accumulate the factorial result.
2. **Function**: factorial is a function that calculates the factorial of n.
3. **Loop**: The for loop multiplies result by each number up to n.
4. **Conditionals**: If n is negative, it returns an error message.

Summary

- **Variables** store data that can be manipulated.
- **Functions** encapsulate reusable code.
- **Control Structures** manage the flow of execution.

These basics form the foundation of JavaScript programming, allowing you to write interactive and dynamic applications.

4.2 Introduction to ES6+ features like let and const, arrow functions, template literals, destructuring, and modules

ES6 (ECMAScript 2015) and later versions introduced new syntax and features to JavaScript, making the language more powerful, easier to write, and more readable. These new features include let and const for variable declaration, arrow functions, template literals, destructuring, and modules. Here's an introduction to each of these ES6+ features with examples.

---

1. let and const

Prior to ES6, variables were declared using var, which has function-level scope. ES6 introduced let and const, which offer block-level scope (variables are only accessible within the block they're defined in).

- **let: Use let when you need a variable whose value might change.**
- **const: Use const for values that shouldn't change (constants).**

javascript

Copy code

```
// Using `let`

let name = "Alice";

name = "Bob"; // allowed

console.log(name); // "Bob"
```

```
// Using `const`
const age = 30;
// age = 31; // Error: Assignment to constant variable
console.log(age); // 30

// `var` allows re-declaration in the same scope, which can lead to issues:
var x = 10;
var x = 20; // No error, x is overwritten
console.log(x); // 20

// `let` and `const` prevent accidental re-declaration:
let y = 10;
// let y = 20; // Error: Identifier 'y' has already been declared
```

2. Arrow Functions

Arrow functions provide a shorter, cleaner syntax for writing functions. They also have a lexical this binding, which means they inherit the this value from the surrounding scope.

Syntax:

javascript

Copy code

```
// Traditional function
function add(a, b) {
  return a + b;
}

// Arrow function
const add = (a, b) => a + b;
console.log(add(5, 3)); // 8

// Arrow function without parameters
const greet = () => "Hello!";
console.log(greet()); // "Hello!"
```

```
// Arrow function with one parameter (no parentheses needed)
const square = x => x * x;
console.log(square(4)); // 16
```

Arrow functions are particularly useful for concise code and for callbacks, such as in map, filter, and reduce methods.

javascript

Copy code

```
const numbers = [1, 2, 3, 4];
const doubled = numbers.map(n => n * 2);
console.log(doubled); // [2, 4, 6, 8]
```

3. Template Literals

Template literals provide an easier way to create strings with embedded expressions and variables. Instead of using concatenation with +, template literals use backticks (`) and ${} for variable interpolation.

javascript

Copy code

```
const firstName = "John";
const lastName = "Doe";
const age = 25;

// Using template literals
const greeting = `Hello, my name is ${firstName} ${lastName} and I am ${age} years old.`;
console.log(greeting); // "Hello, my name is John Doe and I am 25 years old."

// Multi-line strings with template literals
const multiLineString = `This is a multi-line
string that is easier to
read and write.`;
console.log(multiLineString);
```

4. Destructuring

Destructuring allows you to unpack values from arrays or properties from objects into distinct variables. It makes working with complex data structures simpler and more readable.

Array Destructuring

```
const colors = ["red", "green", "blue"];

// Destructure elements into variables
const [firstColor, secondColor, thirdColor] = colors;
console.log(firstColor); // "red"
console.log(secondColor); // "green"
console.log(thirdColor); // "blue"

// Skipping elements
const [first, , third] = colors;
console.log(third); // "blue"
```

Object Destructuring

```
const person = { name: "Alice", age: 30, city: "New York" };

// Destructuring object properties
const { name, age, city } = person;
console.log(name); // "Alice"
console.log(age); // 30
console.log(city); // "New York"

// Assigning to different variable names
const { name: personName, age: personAge } = person;
console.log(personName); // "Alice"
console.log(personAge); // 30
```

Destructuring can also be used with function parameters, making it useful for handling options objects.

```
function greet({ name, age }) {
  return `Hello, my name is ${name} and I am ${age} years old.`;
}
console.log(greet({ name: "Alice", age: 30 })); // "Hello, my name is Alice and I am 30 years old."
```

---

5. Modules

Modules allow you to split JavaScript code into separate files that can be imported and exported. This feature encourages code modularity, reusability, and maintainability.

Exporting and Importing in ES6

In math.js file:

```
// Exporting functions
export const add = (a, b) => a + b;
export const subtract = (a, b) => a - b;

// Exporting a variable
export const pi = 3.14159;
```

In app.js file:

javascript

Copy code

```
// Importing specific functions and variables
import { add, subtract, pi } from './math';

console.log(add(5, 3)); // 8
console.log(subtract(5, 3)); // 2
console.log(pi); // 3.14159
```

You can also use export default for a single default export from a module.

In multiply.js file:

javascript

Copy code

```
// Exporting a default function
export default function multiply(a, b) {
  return a * b;
}
```

In app.js file:

```
// Importing the default export
import multiply from './multiply';

console.log(multiply(5, 3)); // 15
```

Summary

These ES6+ features have transformed JavaScript, making it more efficient and easier to read:

- let and const: Improved variable declaration with block-scoping and immutability.

- **Arrow Functions: Concise syntax for functions and lexical this binding.**
- **Template Literals: Easy string interpolation and multi-line strings.**
- **Destructuring: Simplified extraction of data from arrays and objects.**
- **Modules: Enable modular programming with import/export syntax.**

These tools have become essential for modern JavaScript development, offering a more powerful and expressive way to code.

5 React JSX

5.1 Understanding JSX syntax and how it relates to HTML

JSX (JavaScript XML) is a syntax extension for JavaScript that resembles HTML and is used in React to describe the UI structure. Although it looks like HTML, JSX is not the same as HTML and comes with its own syntax rules and special characteristics. In a React application, JSX is compiled to JavaScript, specifically into React.createElement() calls, allowing it to be executed in the browser.

Here's a guide on understanding JSX syntax and how it compares and relates to HTML, including examples to illustrate the key points.

1. JSX Resembles HTML but is Actually JavaScript

In JSX, we use syntax similar to HTML to define the structure of the UI. However, this syntax is converted to JavaScript by Babel, a JavaScript compiler, before it is executed. This means that JSX has HTML-like syntax but follows JavaScript rules and can leverage JavaScript expressions.

Example: Basic JSX Syntax

javascript

Copy code

```
// A simple JSX element
const element = <h1>Hello, World!</h1>;


// Under the hood, this is equivalent to:
const element = React.createElement('h1', null, 'Hello, World!');
```

This React.createElement() function is what actually renders the h1 element in the browser. JSX allows us to write this HTML-like syntax directly, which is more intuitive.

2. Embedding JavaScript Expressions in JSX

In JSX, JavaScript expressions can be embedded within curly braces {}. This feature allows dynamic data to be displayed in the UI based on variables, state, or logic.

Example: Embedding JavaScript Expressions

```
const name = "Alice";

const element = <h1>Hello, {name}!</h1>; // Outputs: Hello, Alice!


// With mathematical expression

const age = 30;

const element2 = <p>Next year, you will be {age + 1} years old.</p>;
```

In this example, {name} and {age + 1} are JavaScript expressions that are evaluated, and the resulting values are displayed in the UI.

---

3. Differences Between JSX and HTML

While JSX closely resembles HTML, there are a few notable differences:

- **Attribute Naming**: JSX uses camelCase for attribute names instead of lowercase, as in HTML. For instance, class in HTML becomes className in JSX, and onclick becomes onClick.

javascript

Copy code

```
const element = <div className="container" onClick={handleClick}>Click me</div>;
```

- **Self-Closing Tags**: In JSX, elements without children must be self-closed, similar to XML syntax. For example, an image element would look like this:

javascript

Copy code

```
const image = <img src="logo.png" alt="Logo" />;
```

- **JavaScript Reserved Words**: Certain HTML attributes, like class and for, are reserved keywords in JavaScript. In JSX, these are renamed to className and htmlFor.

javascript

Copy code

```
const label = <label htmlFor="input-id">Enter Name:</label>;
```

4. Conditional Rendering with JSX

JSX doesn’t support if statements directly within its syntax. Instead, you can use conditional (ternary) operators or logical && to conditionally render elements.

Example: Conditional Rendering

javascript

Copy code

```
const isLoggedIn = true;

const greeting = (
  <div>
    {isLoggedIn ? <h1>Welcome back!</h1> : <h1>Please log in.</h1>}
  </div>
);
```

Here, <h1>Welcome back!</h1> is rendered only if isLoggedIn is true. If isLoggedIn is false, the output will be <h1>Please log in.</h1>.

5. Styling in JSX

In JSX, inline styles are written as JavaScript objects, where style properties are written in camelCase and values are in quotes if they're strings.

Example: Inline Styling

javascript

Copy code

```
const style = {
  color: 'blue',
  backgroundColor: 'lightgray',
  padding: '10px',
};

const element = <h1 style={style}>Styled Heading</h1>;
```

For simpler styling, external CSS is usually preferred. But inline styles like this can be useful for dynamic styling based on state or props.

6. Rendering Lists with Keys

When rendering lists of elements in JSX, each element should have a unique key attribute. This helps React track which items have changed, been added, or removed, making rendering more efficient.

Example: Rendering a List

javascript

Copy code

```
const fruits = ["Apple", "Banana", "Cherry"];
const fruitList = (
  <ul>
    {fruits.map((fruit, index) => (
      <li key={index}>{fruit}</li>
    ))}
  </ul>
);
```

In this example, each list item has a key prop, set to index of the item in the array. Using a unique key is crucial for optimal performance when dealing with lists.

7. JSX in Components

JSX is commonly used within React components, which can be either functions or classes. Components return JSX, defining the UI based on input props or internal state.

Example: Function Component with JSX

javascript

Copy code

```
function Greeting(props) {
  return <h1>Hello, {props.name}!</h1>;
}

// Using the component
function App() {
  return (
    <div>
      <Greeting name="Alice" />
      <Greeting name="Bob" />
    </div>
  );
}
```

Here, the Greeting component takes a name prop and displays a personalized greeting. When called in App, JSX allows us to directly insert the Greeting component within the main div.

Example Program: Putting It All Together

Let’s look at an example React application using multiple JSX features, like embedding JavaScript expressions, conditional rendering, and event handling.

javascript

Copy code

```
import React, { useState } from 'react';

function App() {
  const [showMessage, setShowMessage] = useState(false);
  const [count, setCount] = useState(0);

  const toggleMessage = () => setShowMessage(!showMessage);
  const increment = () => setCount(count + 1);

  return (
    <div>
      <h1>Hello, World!</h1>

      {/* Inline conditional rendering */}
      {showMessage && <p>This is a toggled message.</p>}

      <button onClick={toggleMessage}>
        {showMessage ? 'Hide' : 'Show'} Message
      </button>

      <div style={{ marginTop: '20px' }}>
        <button onClick={increment}>Increment</button>
        <p>Counter: {count}</p>
      </div>
    </div>
  );
}

export default App;
```

Explanation

- **Conditionally Rendered Message**: {showMessage && <p>This is a toggled message.</p>} only displays the <p> tag if showMessage is true.
- **Button Text Based on State**: The button text dynamically changes based on the showMessage state with {showMessage ? 'Hide' : 'Show'} Message.
- **Inline Styles**: We use an inline style for the div containing the counter, adding some marginTop space.
- **Event Handlers**: toggleMessage and increment functions handle click events for their respective buttons.

Summary

JSX is a powerful feature in React that combines the ease of HTML-like syntax with JavaScript's capabilities, making it easier to define complex UIs:

1. **HTML-like Syntax**: JSX provides a syntax similar to HTML but with the flexibility of JavaScript.
2. **Dynamic Expressions**: JavaScript expressions can be embedded within JSX using curly braces {}.
3. **Attributes and Events**: Attributes are camel-cased, and JavaScript functions can handle events directly within JSX.
4. **Conditionals and Lists**: JSX handles conditional rendering and lists with key attributes to optimize performance.

JSX makes it straightforward to express the UI in a declarative way, enhancing readability and maintainability in React applications.

5.2 Styling in JSX (inline styling, importing CSS files)

In React, styling can be done in several ways, with two common methods being inline styling and importing CSS files. Each method has its own use cases and advantages, allowing developers to apply styles dynamically or manage them centrally.

1. Inline Styling in JSX

Inline styles in React are written as JavaScript objects. Each style property is written in camelCase, and the values are usually strings (unless they're numeric values, in which case you can write them directly).

Example of Inline Styling

```
import React from 'react';

function App() {
  const headingStyle = {
    color: 'blue',
    backgroundColor: 'lightgray',
    padding: '10px',
    fontFamily: 'Arial, sans-serif'
  };

  return (
    <div>
      <h1 style={headingStyle}>Hello, World!</h1>
      <p style={{ fontSize: '18px', color: 'green' }}>This is a paragraph with inline styling.</p>
    </div>
  );
}

export default App;
```

Explanation:

- headingStyle is an object containing various CSS properties.
- The h1 element uses the headingStyle object by setting style={headingStyle}.
- The p element applies styles directly within JSX by setting style={{ fontSize: '18px', color: 'green' }}.

Pros and Cons of Inline Styling

Pros:

- Useful for applying dynamic styles based on state or props.
- Scoped to the specific element, so no risk of affecting other components.

Cons:

- Hard to reuse styles across multiple components.
- Can make code harder to read if too many inline styles are used.

- Limited support for pseudo-classes like :hover or :active.

---

2. Importing CSS Files

For larger projects, separating styles into external CSS files is more manageable and keeps your components clean. You can create a CSS file and import it directly into your component file in React.

Example of Importing a CSS File

Create a CSS file named App.css:

```
/* App.css */
.container {
  text-align: center;
  background-color: #f8f9fa;
  padding: 20px;
}

.heading {
  color: darkblue;
  font-size: 24px;
}

.paragraph {
  color: #28a745;
  font-size: 16px;
}
```

Now, import and apply this CSS file in your component:

```
import React from 'react';
import './App.css';

function App() {
  return (
    <div className="container">
      <h1 className="heading">Hello, World!</h1>
      <p className="paragraph">This is a paragraph styled with an external CSS file.</p>
    </div>
  );
}

export default App;
```

Explanation:

- App.css contains classes such as .container, .heading, and .paragraph.
- These classes are applied to elements using the className attribute, which is the JSX equivalent of class in HTML.
- The styles from the CSS file will be globally available to the entire application but scoped to only the elements with the specified classes.

Pros and Cons of Importing CSS Files

Pros:

- Styles are reusable across different components.
- CSS files support more complex styles, including animations, pseudo-classes, and media queries.
- Helps keep JSX clean and focused on the structure.

Cons:

- Styles are global, which may lead to conflicts or unintended styling if class names are not unique.
- Managing large amounts of CSS can become difficult without naming conventions or methodologies like BEM (Block Element Modifier).

---

3. Combining Inline Styles with Imported CSS

Sometimes, you may need the flexibility of both inline styling and CSS files. For instance, you could use an external CSS file for basic, reusable styles and inline styles for dynamic, component-specific styling.

Example of Combining Inline Styles and Imported CSS

```
/* App.css */
.card {
  padding: 20px;
  border: 1px solid #ddd;
  border-radius: 8px;
  margin: 10px;
}
```

```
.title {
  font-size: 20px;
  color: #333;
}
```

javascript

Copy code

```
import React, { useState } from 'react';
import './App.css';

function Card({ title, isActive }) {
  const dynamicStyle = {
    backgroundColor: isActive ? '#dff0d8' : '#f2f2f2',
    color: isActive ? '#3c763d' : '#333'
  };

  return (
    <div className="card" style={dynamicStyle}>
      <h2 className="title">{title}</h2>
      <p>This card is {isActive ? 'active' : 'inactive'}.</p>
    </div>
  );
}

function App() {
  const [active, setActive] = useState(false);

  return (
    <div>
      <Card title="Card 1" isActive={active} />
      <button onClick={() => setActive(!active)}>
    Toggle Active
   </button>
  </div>
 );
}


export default App;
```

Explanation:

- The App.css file is used for styling the basic layout of the card and title elements.
- dynamicStyle is an inline style object used to apply different background and text colors based on the isActive prop.
- The isActive state toggles between true and false when the button is clicked, updating the inline style dynamically.

---

4. CSS Modules (for Scoped CSS)

CSS Modules are a popular approach to style React components without the risk of global class name conflicts. CSS Modules work by automatically generating unique class names, ensuring that styles are scoped to a specific component.

To use CSS Modules:

1. Rename the CSS file to App.module.css.
2. Import it as a module in the React component.

Example Using CSS Modules

Create a CSS file named Card.module.css:

```
/* Card.module.css */
.card {
 padding: 20px;
 border: 1px solid #ddd;
 border-radius: 8px;
 margin: 10px;
}


.title {
 font-size: 20px;
```

```
  color: #333;
}
```

Now import and apply it in a React component:

javascript

Copy code

```
import React from 'react';
import styles from './Card.module.css';

function Card({ title }) {
  return (
    <div className={styles.card}>
      <h2 className={styles.title}>{title}</h2>
      <p>This is a card component with CSS modules.</p>
    </div>
  );
}

export default Card;
```

Explanation:

- The CSS file is imported as styles (or any name) and applied with styles.className.
- Each class name in Card.module.css will be unique to Card, reducing the risk of style conflicts.

Summary

- **Inline Styles**: Useful for dynamic or one-off styles, written directly in JSX as JavaScript objects.
- **Imported CSS Files**: Best for reusable and complex styles, keeps JSX clean, but the styles are globally scoped.
- **Combining Both**: Allows flexibility, with base styles in CSS and dynamic styles inline.
- **CSS Modules**: Provides scoped styles, preventing class name conflicts and offering modularity.

Each method has its advantages, and choosing one depends on the project's needs and style preferences.

5.3 Using external stylesheets with JSX

Using external stylesheets in React is one of the most common ways to style components, especially when you need a centralized, maintainable approach. An external stylesheet allows you to define reusable and complex styles without cluttering your components with inline styles. You can link external CSS files in React components by importing them at the top of your component file.

Here’s how to use external stylesheets with JSX, along with example programs to illustrate this approach.

Step 1: Create an External CSS File

First, create an external CSS file where you define your styles. Save it with a .css extension.

Example: App.css

```css
/* App.css */
.container {
  text-align: center;
  padding: 20px;
  background-color: #f5f5f5;
}

.title {
  color: #4a90e2;
  font-size: 24px;
  margin-bottom: 10px;
}

.button {
  padding: 10px 20px;
  color: white;
  background-color: #4a90e2;
  border: none;
  border-radius: 4px;
  cursor: pointer;
}

.button:hover {
  background-color: #357abd;
}
```

In this CSS file, we have three classes:

- .container for styling the outer container.
- .title for styling the title text.
- .button for styling a button with hover effects.

Step 2: Import the CSS File into a React Component

To use the CSS classes from App.css in a React component, import the CSS file at the top of your component file. This is similar to how you would import a JavaScript module.

Example: App.js

```
import React from 'react';
import './App.css'; // Import the CSS file

function App() {
  return (
    <div className="container">
      <h1 className="title">Welcome to My React App</h1>
      <button className="button">Click Me</button>
    </div>
  );
}

export default App;
```

In this example:

- The App.css file is imported using import './App.css';.
- The CSS classes defined in App.css are then applied to the elements in the JSX using className, like className="container".

Explanation

- className="container" applies the .container class to the div element, giving it a background color and padding.
- className="title" applies the .title class to the h1 element, setting its color and font size.

- className="button" applies the .button class to the button element, with a background color, padding, and a hover effect.

Example Program: Using Multiple Components with an External CSS File

Let’s create a more complex example with two separate components, each using the same App.css file for consistency in styling.

Step 1: Define App.css

```css
/* App.css */
.header {
  background-color: #282c34;
  padding: 20px;
  color: white;
  text-align: center;
}

.card {
  border: 1px solid #ddd;
  border-radius: 8px;
  padding: 20px;
  margin: 10px;
  box-shadow: 0 4px 8px rgba(0, 0, 0, 0.2);
}

.card-title {
  color: #333;
  font-size: 18px;
}

.card-content {
  color: #666;
  font-size: 14px;
}
```

Step 2: Create Header.js Component

```
// Header.js
import React from 'react';
import './App.css'; // Importing the CSS file

function Header() {
  return (
    <header className="header">
      <h1>Welcome to My Website</h1>
    </header>
  );
}

export default Header;
```

Step 3: Create Card.js Component

```
// Card.js
import React from 'react';
import './App.css'; // Importing the CSS file

function Card({ title, content }) {
  return (
    <div className="card">
      <h2 className="card-title">{title}</h2>
      <p className="card-content">{content}</p>
    </div>
  );
}

export default Card;
```

Step 4: Main App.js Component

javascript

Copy code

```
// App.js
import React from 'react';
import Header from './Header';
import Card from './Card';

function App() {
  return (
    <div>
      <Header />
      <div style={{ display: 'flex', justifyContent: 'center' }}>
        <Card title="Card 1" content="This is the content of Card 1." />
        <Card title="Card 2" content="This is the content of Card 2." />
      </div>
    </div>
  );
}

export default App;
```

Explanation of Multi-Component Styling

- The App.css file is imported separately in each component file (Header.js, Card.js, and App.js), allowing each component to use the defined styles.
- The Header component uses the .header style to set the background color and padding for the header section.
- The Card component uses the .card, .card-title, and .card-content classes to apply consistent styling to each card.

Pros and Cons of Using External CSS in React

Pros:

- CSS can be reused across multiple components.
- Keeps JSX structure cleaner and more readable.
- Full support for CSS features, including media queries, animations, and pseudo-classes (like :hover).

Cons:

- Classes are globally scoped by default, which can lead to conflicts if class names are not unique.
- Lacks built-in support for dynamically applying styles based on state or props (for this, inline styles or CSS-in-JS libraries might be more suitable).

Summary

Using external stylesheets in React allows you to:

1. Centralize and reuse styles across components.
2. Keep the styling consistent and manageable in larger applications.
3. Apply standard CSS practices, like hover effects and media queries, easily.

This approach is a simple and effective way to manage styles, especially for small to medium-sized React applications where global styling is beneficial.

6 React Components

6.1 Difference between function components and class components

In React, there are two primary types of components: **Function Components** and **Class Components**. Both types can be used to build and render components, but they differ in syntax, behavior, and features. Here's a breakdown of their key differences, along with example programs.

---

1. Function Components

Function components are JavaScript functions that take props as an argument and return JSX. They are simpler and more concise than class components and, since the introduction of React hooks, they have gained the ability to manage state and lifecycle methods, which were previously only possible in class components.

Example of a Function Component

```
import React, { useState } from 'react';


function Counter() {
  // Using the useState hook to manage state in a function component
  const [count, setCount] = useState(0);


  const increment = () => setCount(count + 1);
  const decrement = () => setCount(count - 1);


  return (
    <div>
```

```
      <h1>Count: {count}</h1>
      <button onClick={increment}>Increment</button>
      <button onClick={decrement}>Decrement</button>
    </div>
  );
}

export default Counter;
```

Explanation:

- This component uses the useState hook to manage the count state.
- The increment and decrement functions modify the state, and each button is linked to an onClick event that triggers these functions.

Characteristics of Function Components

- **Simpler Syntax**: Function components are simple and concise, using plain JavaScript functions.
- **Hooks**: Hooks (like useState, useEffect) allow function components to use features like state and lifecycle methods.
- **No this keyword**: Function components don't require the this keyword, making them less error-prone.
- **Performance**: Function components generally perform better because they're easier for React to optimize.

---

2. Class Components

Class components are ES6 classes that extend React.Component. They have additional features like lifecycle methods (componentDidMount, componentDidUpdate, componentWillUnmount) and the ability to use this.state and this.setState for managing component state. Class components were the primary way to create stateful components before React hooks were introduced.

Example of a Class Component

javascript

Copy code

```
import React, { Component } from 'react';

class Counter extends Component {
  constructor(props) {
    super(props);
    // Initializing state in a class component
    this.state = {
      count: 0
    };
  }

  // Method to increment the count
  increment = () => {
    this.setState({ count: this.state.count + 1 });
  };

  // Method to decrement the count
  decrement = () => {
    this.setState({ count: this.state.count - 1 });
  };

  render() {
    return (
      <div>
        <h1>Count: {this.state.count}</h1>
        <button onClick={this.increment}>Increment</button>
        <button onClick={this.decrement}>Decrement</button>
      </div>
    );
  }
}

export default Counter;
```

Explanation:

- Class components use a constructor to initialize state (this.state).
- The increment and decrement methods update the state using this.setState().

- The render method is required in class components to return the JSX.

Characteristics of Class Components

- **this keyword**: Class components require the use of this to access props and state.
- **Lifecycle Methods**: Class components have lifecycle methods (componentDidMount, componentDidUpdate, componentWillUnmount), which help manage side effects.
- **State and setState**: State is managed through this.state, and changes are made with this.setState().
- **More Verbose**: Class components are often more verbose due to the constructor, this keyword, and lifecycle methods.

Key Differences Between Function and Class Components

Feature	**Function Component**	**Class Component**
Syntax	Simple function	ES6 Class
State Management	useState hook	this.state and this.setState()
Lifecycle Methods	Hooks (e.g., useEffect)	Built-in lifecycle methods (e.g., componentDidMount)
this keyword	Not required	Required to access props and state
Code Complexity	Less verbose, simpler syntax	More verbose, complex
Performance Optimization	Often performs better due to simpler structure	May require additional optimization
Legacy Support	Primarily used in modern React with Hooks	Traditional way, widely used in older codebases

Example: Converting a Class Component to a Function Component

Here’s a simple example of a class component converted to a function component.

Class Component

```
import React, { Component } from 'react';

class Welcome extends Component {
  render() {
    return <h1>Hello, {this.props.name}</h1>;
  }
}

export default Welcome;
```

Function Component

```
import React from 'react';

function Welcome(props) {
  return <h1>Hello, {props.name}</h1>;
}

export default Welcome;
```

In this conversion:

- We removed the class declaration and render method.
- We used a function to receive props as an argument and directly returned the JSX.

---

3. Example: Using Hooks in a Function Component for State Management

Let’s look at a more comprehensive example where we use hooks in a function component to mimic the behavior of a class component.

Class Component with State and Lifecycle Methods

```
import React, { Component } from 'react';

class Timer extends Component {
  constructor(props) {
    super(props);
    this.state = { time: new Date().toLocaleTimeString() };
  }

  componentDidMount() {
    this.intervalID = setInterval(() => {
      this.setState({ time: new Date().toLocaleTimeString() });
    }, 1000);
  }

  componentWillUnmount() {
    clearInterval(this.intervalID);
  }
  render() {
    return <h1>Current Time: {this.state.time}</h1>;
  }
}

export default Timer;
```

Function Component with Hooks

```
import React, { useState, useEffect } from 'react';

function Timer() {
  const [time, setTime] = useState(new Date().toLocaleTimeString());

  useEffect(() => {
    const intervalID = setInterval(() => {
      setTime(new Date().toLocaleTimeString());
    }, 1000);

    return () => clearInterval(intervalID); // Cleanup function
  }, []);

  return <h1>Current Time: {time}</h1>;
}

export default Timer;
```

Explanation:

- useState is used to manage the time state.
- useEffect is used to replicate componentDidMount and componentWillUnmount. It sets up an interval when the component mounts and cleans it up when it unmounts.

Summary

- **Function Components**: Simple, concise, and can use hooks for state and lifecycle management. Preferred for modern React development.

- **Class Components**: More verbose and traditional, but with built-in lifecycle methods and this for handling props and state. Still useful for older React projects or legacy codebases.

In general, **function components with hooks** are now the recommended way to write components in React due to their simplicity and performance benefits.

6.2 Creating reusable components, passing props, and managing component structure

Creating reusable components in React is a core concept that allows you to build modular, maintainable, and scalable applications. By breaking down the UI into smaller, self-contained components, you can pass data between them through **props** and manage the overall component structure effectively.

Let's dive into how to create reusable components, pass props, and structure components in React.

1. Creating Reusable Components

Reusable components are components that can be used multiple times across your application with different configurations or data. They allow you to keep your code DRY (Don't Repeat Yourself) and consistent.

For example, let's create a reusable Button component that can be customized with different text and styles.

Button.js

javascript

Copy code

```
import React from 'react';


function Button({ text, onClick, style }) {
  return (
    <button onClick={onClick} style={style}>
      {text}
    </button>
  );
}


export default Button;
```

In this example:

- The Button component accepts three props: text, onClick, and style.

- text specifies the button label, onClick is the click event handler, and style allows for inline styling.

Usage in App.js

```
import React from 'react';
import Button from './Button';

function App() {
  const handleClick = () => {
    alert('Button clicked!');
  };

  return (
    <div>
      <h1>Reusable Button Component</h1>
      <Button text="Click Me" onClick={handleClick} style={{ backgroundColor: 'blue', color: 'white' }} />
      <Button text="Submit" onClick={handleClick} style={{ backgroundColor: 'green', color: 'white' }} />
    </div>
  );
}

export default App;
```

Explanation:

- Here, we use the Button component twice, each with different text and styles.
- The handleClick function is passed as a prop, and it displays an alert when either button is clicked.

2. Passing Props to Components

Props (short for "properties") are used to pass data from a parent component to a child component. This makes components customizable and dynamic.

Example: UserCard Component

Let’s create a UserCard component that displays user information based on the props passed to it.

UserCard.js

```
import React from 'react';

function UserCard({ name, age, location }) {
  return (
    <div style={{ border: '1px solid #ddd', padding: '10px', margin: '10px', borderRadius: '5px' }}>
      <h2>{name}</h2>
      <p>Age: {age}</p>
      <p>Location: {location}</p>
    </div>
  );
}

export default UserCard;
```

Usage in App.js

```
import React from 'react';
import UserCard from './UserCard';

function App() {
  return (
    <div>
      <h1>User Profiles</h1>
      <UserCard name="Alice" age={25} location="New York" />
      <UserCard name="Bob" age={30} location="Los Angeles" />
      <UserCard name="Charlie" age={35} location="Chicago" />
    </div>
  );
}

export default App;
```

Explanation:

- The UserCard component takes name, age, and location as props and displays them.

- Each UserCard instance is rendered with different data, showing the flexibility of using props to create customized outputs from a single reusable component.

3. Structuring Components

When building applications with React, it's important to structure components in a way that makes the code maintainable and modular. Generally, your component structure should follow a hierarchical pattern where parent components pass data (props) to child components.

Let's consider a basic structure of an e-commerce app with components like App, ProductList, and ProductItem.

Example of a Component Structure

```
App
 ├── ProductList
 └── ProductItem (repeated for each product)
```

ProductItem.js

javascript

Copy code

```javascript
import React from 'react';

function ProductItem({ name, price, description }) {
  return (
    <div style={{ border: '1px solid #ddd', padding: '10px', margin: '10px', borderRadius: '5px' }}>
      <h2>{name}</h2>
      <p>Price: ${price}</p>
      <p>{description}</p>
    </div>
  );
}

export default ProductItem;
```

ProductList.js

```javascript
import React from 'react';
import ProductItem from './ProductItem';

function ProductList() {
  // Sample product data
  const products = [
    { id: 1, name: 'Laptop', price: 999, description: 'A powerful laptop' },
    { id: 2, name: 'Smartphone', price: 499, description: 'A smart smartphone' },
    { id: 3, name: 'Tablet', price: 299, description: 'A convenient tablet' },
  ];

  return (
    <div>
      <h1>Product List</h1>
      {products.map(product => (
        <ProductItem
          key={product.id}
          name={product.name}
          price={product.price}
          description={product.description}
        />
      ))}
    </div>
  );
}

export default ProductList;
```

App.js

```
import React from 'react';
import ProductList from './ProductList';

function App() {
  return (
    <div>
      <ProductList />
    </div>
  );
}

export default App;
```

Explanation:

- **ProductItem Component**: Displays individual product information. It receives name, price, and description as props.
- **ProductList Component**: Holds an array of products and uses map to render a list of ProductItem components, passing the product data as props to each instance.
- **App Component**: Serves as the root component, rendering the ProductList.

Summary of Key Concepts

1. **Reusable Components**: Write components that can be used multiple times with different data or styles. Examples include buttons, cards, or list items.
2. **Props**: Pass data from parent to child components to make them dynamic and customizable.
3. **Component Structure**: Organize components hierarchically, allowing the application to be modular and scalable.

Full Example Program

Here’s a full example integrating everything.

App.js

```
import React from 'react';
import ProductList from './ProductList';

function App() {
  return (
    <div>
      <h1>Online Store</h1>
      <ProductList />
    </div>
  );
}
```

```
export default App;
```

ProductList.js

```
import React from 'react';
import ProductItem from './ProductItem';

function ProductList() {
  const products = [
    { id: 1, name: 'Laptop', price: 999, description: 'High-performance laptop' },
    { id: 2, name: 'Phone', price: 499, description: 'Latest smartphone' },
    { id: 3, name: 'Headphones', price: 199, description: 'Noise-cancelling headphones' },
  ];

  return (
    <div>
      <h2>Product List</h2>
      {products.map((product) => (
        <ProductItem
          key={product.id}
          name={product.name}
          price={product.price}
          description={product.description}
        />
      ))}
    </div>
  );
}

export default ProductList;
```

ProductItem.js

```
import React from 'react';
```

```
function ProductItem({ name, price, description }) {
  return (
    <div style={{ border: '1px solid #ddd', padding: '10px', margin: '10px', borderRadius: '5px' }}>
      <h3>{name}</h3>
      <p>Price: ${price}</p>
      <p>{description}</p>
    </div>
  );
}

export default ProductItem;
```

In this example:

- App serves as the main container.
- ProductList maps through the products array, creating a ProductItem for each one.
- ProductItem renders the product information, keeping each component small, readable, and reusable.

7 React State

7.1 Introduction to state management in React

State management is essential in React because it allows us to keep track of data changes within components and update the UI accordingly. In React, **state** refers to an object that holds data specific to a component and can change over time. React's declarative nature means that when the state of a component changes, the component re-renders to reflect the new data.

Key Concepts of State Management in React

1. **State**: The state is a built-in object in React that allows components to create and manage their own data. It's typically used in class components via this.state or in function components with the useState hook.
2. **Props vs. State**: While props are used to pass data from a parent component to a child component, state is local to a component and controlled by that component. Changes to state can only be made from within the component itself.
3. **Updating State**: In React, you should never mutate the state directly. Instead, use setState (in class components) or the setState function from useState (in function components) to update it.

Example: Using State in Function Components with useState

React provides the useState hook, which allows us to add state to functional components.

Here’s an example where we create a simple counter that increments every time a button is clicked:

```
import React, { useState } from 'react';

function Counter() {
  // Declare a new state variable, "count", and a function to update it
  const [count, setCount] = useState(0);

  return (
    <div>
      <p>You clicked {count} times</p>
      <button onClick={() => setCount(count + 1)}>
        Increment
      </button>
    </div>
  );
}

export default Counter;
```

Explanation:

- useState(0) initializes a state variable called count with an initial value of 0.
- setCount is a function used to update count. Each time the button is clicked, it increments the count by 1, causing the component to re-render and display the updated value.

Class Component Example with this.setState

For class components, state management works a bit differently. Here's the same counter example implemented as a class component.

```
import React, { Component } from 'react';

class Counter extends Component {
  constructor(props) {
    super(props);
    this.state = { count: 0 };
  }
  incrementCount = () => {
    this.setState({ count: this.state.count + 1 });
  };

  render() {
    return (
      <div>
        <p>You clicked {this.state.count} times</p>
        <button onClick={this.incrementCount}>
          Increment
        </button>
      </div>
    );
  }
}

export default Counter;
```

Explanation:

- this.state initializes count to 0.
- this.setState is used to update count. When this.setState is called, React schedules a re-render of the component to reflect the new state.

State Management in Complex Applications

In larger applications, managing state becomes more challenging as components need to share data and state updates across different parts of the application. React provides several approaches to handle this:

1. **Lifting State Up**: When multiple components need access to the same state, it can be lifted to their closest common parent and passed down via props.
2. **Context API**: For global state that many components need access to, the Context API allows you to create a shared state that can be accessed anywhere in the component tree.
3. **External Libraries**: Libraries like **Redux** or **MobX** provide advanced state management solutions, particularly useful when an application has complex state interactions or a very large component hierarchy.

Example: Lifting State Up

In the following example, a Parent component keeps track of a count state, which it shares with two child components.

```
import React, { useState } from 'react';


function Parent() {
  const [count, setCount] = useState(0);


  const incrementCount = () => {
    setCount(count + 1);
  };


  return (
    <div>
      <h1>Parent Component</h1>
      <p>Count: {count}</p>
      <ChildA count={count} />
      <ChildB incrementCount={incrementCount} />
    </div>
  );
}


function ChildA({ count }) {
  return <p>Child A Count: {count}</p>;
}


function ChildB({ incrementCount }) {
  return (
    <button onClick={incrementCount}>
      Increment from Child B
    </button>
  );
}
```

export default Parent;

Explanation:

- Parent maintains the count state.
- ChildA receives count as a prop and displays it, while ChildB receives the incrementCount function as a prop and can increment the count by calling this function.

Summary

- **State** is crucial for making React components interactive.
- **useState** (for functional components) and **this.setState** (for class components) are the primary ways to manage state.
- **Lifting State Up** and using the **Context API** help manage state in larger applications.
- **State libraries** like Redux can provide more structure and organization in complex applications.

React's state management is designed to handle a wide range of applications, from simple UIs to complex, data-driven apps, making it a powerful tool for front-end development.

7.2 Using props vs. state in components

In React, **props** and **state** are two essential concepts for handling data and making components dynamic. While they might seem similar, they serve different purposes and have distinct behaviors. Let's break down the differences between props and state, along with examples to show how each is used.

Key Differences Between Props and State

1. **Props (short for "properties")**:
    - Props are **read-only** and are passed from a parent component to a child component.
    - They allow data to be passed into a component and define the component's configuration.
    - Props cannot be changed or modified by the child component. They are immutable once received.
    - Typically, props are used to display data or to trigger functions passed from the parent.
2. **State**:
    - State is **internal** to a component and managed within that component.
    - It is mutable and can be changed using this.setState (in class components) or useState (in function components).
    - State changes trigger a re-render of the component, making it dynamic and interactive.

Example: Using Props vs. State in React

Let's create a simple example that illustrates the difference between props and state. We'll build a Counter app where:

- The App component holds a title that it passes as a **prop** to the CounterDisplay component.

- The Counter component manages an internal count **state** that increments when a button is clicked.

Step 1: App.js (Parent Component)

In the App component, we define a title as a constant and pass it as a prop to the CounterDisplay component.

```
import React from 'react';
import Counter from './Counter';
import CounterDisplay from './CounterDisplay';

function App() {
  const title = "Welcome to the Counter App";

  return (
    <div>
      <CounterDisplay title={title} />
      <Counter />
    </div>
  );
}

export default App;
```

Step 2: CounterDisplay.js (Child Component - Props Example)

In the CounterDisplay component, we receive the title as a prop from the App component and display it.

```
import React from 'react';

function CounterDisplay({ title }) {
  return <h1>{title}</h1>;
}

export default CounterDisplay;
```

Explanation:

- The CounterDisplay component takes title as a prop and renders it inside an <h1> tag.

- Since title is passed as a prop, it is read-only within CounterDisplay and cannot be modified by this component.

Step 3: Counter.js (State Example)

The Counter component maintains an internal state for the count and displays the current count, with a button to increment it.

```
import React, { useState } from 'react';


function Counter() {
  const [count, setCount] = useState(0);


  const incrementCount = () => {
    setCount(count + 1);
  };


  return (
    <div>
      <p>Current Count: {count}</p>
      <button onClick={incrementCount}>Increment</button>
    </div>
  );
}


export default Counter;
```

Explanation:

- useState(0) initializes count as a state variable with an initial value of 0.
- setCount is a function used to update count. When the button is clicked, incrementCount is called, which increments count by 1.
- This change in state causes the Counter component to re-render, updating the displayed count.

Summary of Props vs. State

Feature	**Props**	**State**
Data Ownership	Passed down from parent	Managed within the component
Mutability	Immutable	Mutable
Functionality	Configuration and display data	Dynamic behavior within component

Access	Available in child components	Accessible only in declaring component
Usage	Display data, pass event handlers from parent	Store and manage changing data

Example Application to Illustrate Both Props and State

Let’s put this all together into a more practical example with a Task component that displays a list of tasks. Each Task component can toggle between "completed" and "not completed" when clicked. We’ll pass the task name as a **prop** and manage the completion status using **state**.

App.js (Parent Component)

```
import React from 'react';

import Task from './Task';


function App() {

  return (

    <div>

      <h1>Task List</h1>

      <Task name="Learn React Basics" />

      <Task name="Build a To-Do App" />

      <Task name="Explore Advanced React Concepts" />

    </div>

  );

}


export default App;
```

Task.js (Child Component Using Props and State)

```
import React, { useState } from 'react';


function Task({ name }) {

  // Initialize completion status in state

  const [isCompleted, setIsCompleted] = useState(false);


  // Toggle completion status

  const toggleCompletion = () => {

    setIsCompleted(!isCompleted);
  };


  return (
    <div onClick={toggleCompletion} style={{ cursor: 'pointer', textDecoration: isCompleted ? 'line-through' : 'none' }}>
      {name} - {isCompleted ? 'Completed' : 'Not Completed'}
    </div>
  );
}


export default Task;
```

Explanation:

- **Props**: name is passed from the App component to each Task component, making it possible to reuse the Task component with different task names.
- **State**: isCompleted is a state variable within each Task component to keep track of whether the task is completed or not. When the task is clicked, toggleCompletion toggles isCompleted between true and false.
- **Result**: Clicking on any task will toggle its completion status, displaying "Completed" or "Not Completed" and applying a line-through style to indicate a completed task.

Summary

- **Props** are for passing data from parent to child components, and they cannot be changed by the receiving component. Props are useful for static data or configuration options.
- **State** is for managing internal, changeable data within a component. Changes in state trigger re-renders, making it essential for creating interactive UIs.
- Using **props** and **state** together allows you to create flexible, reusable components that can display and manage data in a dynamic way.

7.3 **Basics of hooks (useState, useEffect) for functional components**

In React, **hooks** allow you to add state and lifecycle features to functional components. Before hooks, only class components could manage state and lifecycle events, but with hooks, functional components can now manage both state and side effects in a simpler and more intuitive way.

Key Hooks in React

1. **useState**: This hook is used to add **state** to functional components. It allows you to create a state variable and a function to update that state.
2. **useEffect**: This hook is used to perform **side effects** in functional components. Side effects include operations like data fetching, DOM manipulation, subscriptions, etc.

1. useState Hook

The useState hook allows you to create state variables inside a functional component. You can use the state and update it as needed.

Syntax of useState:

```
const [stateVariable, setState] = useState(initialValue);
```

- stateVariable: The state variable that holds the value.
- setState: A function that allows you to update the value of the state.
- initialValue: The initial value of the state variable.

Example: Using useState to manage a counter

```
import React, { useState } from 'react';

function Counter() {
  // Declare state variable "count" with initial value 0
  const [count, setCount] = useState(0);

  // Function to increment the count
  const increment = () => {
    setCount(count + 1);
  };

  // Function to decrement the count
  const decrement = () => {
    setCount(count - 1);
  };

  return (
    <div>
      <h1>Counter: {count}</h1>
      <button onClick={increment}>Increment</button>
      <button onClick={decrement}>Decrement</button>
    </div>
  );
}
```

```
export default Counter;
```

Explanation:

- const [count, setCount] = useState(0); initializes the count state variable with a value of 0.
- setCount(count + 1) updates the state, causing the component to re-render with the new value.

---

2. useEffect Hook

The useEffect hook is used for **side effects** in a functional component. Side effects include operations such as data fetching, updating the DOM, setting up subscriptions, and timers.

Syntax of useEffect:

```
useEffect(() => {
  // Code for the side effect
}, [dependencies]);
```

- The first argument is a function that contains the code for the side effect.
- The second argument is an optional array of dependencies. If the array is empty ([]), the effect runs only once when the component mounts. If the array contains variables, the effect runs when those variables change.

Example: Using useEffect to fetch data

Here’s an example of using useEffect to fetch data when the component mounts:

```
import React, { useState, useEffect } from 'react';

function DataFetcher() {
  const [data, setData] = useState(null);
  const [loading, setLoading] = useState(true);

  // Fetch data when the component mounts
  useEffect(() => {
    // Simulate a data fetching operation
    fetch('https://jsonplaceholder.typicode.com/posts')
      .then(response => response.json())
      .then(data => {
        setData(data);
    setLoading(false);
   })
   .catch(error => console.error("Error fetching data:", error));
 }, []); // Empty array means the effect runs once on mount

 return (
  <div>
   {loading ? <p>Loading...</p> : <pre>{JSON.stringify(data, null, 2)}</pre>}
  </div>
 );
}

export default DataFetcher;
```

Explanation:

- The useEffect hook is used to initiate the data fetch when the component is mounted ([] as the second argument ensures it only runs once).
- When the data is fetched, it updates the data state using setData, and the loading state is set to false to stop showing the loading message.

Example: Cleanup in useEffect

If your side effect involves setting up something like a timer or a subscription, you might need to clean up when the component unmounts or when the dependencies change. You can return a cleanup function inside useEffect.

```
import React, { useState, useEffect } from 'react';

function Timer() {
 const [seconds, setSeconds] = useState(0);

 useEffect(() => {
  // Set up a timer to increment seconds
  const interval = setInterval(() => {
   setSeconds(prevSeconds => prevSeconds + 1);
  }, 1000);
```

```
    // Cleanup function to clear the timer when the component unmounts
    return () => clearInterval(interval);
  }, []); // Empty dependency array means effect runs once when component mounts

  return (
    <div>
      <p>Seconds: {seconds}</p>
    </div>
  );
}

export default Timer;
```

Explanation:

- useEffect starts a timer when the component mounts.
- The return statement inside useEffect is used to clean up by clearing the interval when the component unmounts or before the effect runs again (in this case, the effect runs only once).

Key Points About useState and useEffect:

- **useState** is used to create state variables in functional components. It allows you to track and update data that affects the rendering of your component.
- **useEffect** allows you to run side effects (such as data fetching, timers, subscriptions) in functional components. It runs after every render by default, but you can control when it runs by providing a dependency array.
- The **dependency array** in useEffect controls when the effect runs:
  - If the array is empty ([]), the effect runs only once (on mount).
  - If the array contains variables, the effect runs whenever any of the variables change.

Conclusion:

React’s hooks (useState and useEffect) provide a powerful way to manage state and side effects in functional components. They make it easy to write functional components that are interactive, perform operations like data fetching, handle component lifecycle events, and more, all in a clean and concise way.

8 **Event Handling in React**

8.1 Handling user interactions (onClick, onChange, onSubmit)

In React, **event handling** refers to the process of responding to user interactions such as clicks, form submissions, typing, and other actions that can occur on the DOM elements. React provides a set of event handler props (e.g., onClick, onChange, onSubmit) to manage these interactions in a declarative manner.

Event Handling Basics in React

1. **Event Handlers**: React events are written in camelCase. For example, onClick for a mouse click, onChange for changes in input fields, and onSubmit for form submissions.
2. **Passing Functions**: Event handlers are passed as functions, and you typically define these functions as class methods (in class components) or functions (in functional components).
3. **Event Objects**: React events provide an event object to the event handler, which contains useful data like the target element, type of event, etc. You can access this event object in your handler function.
4. **Binding Event Handlers**: In class components, you may need to bind event handlers to the component's context (this). In functional components, this is not necessary.

Common Event Handlers in React

1. **onClick**: Handles click events (mouse clicks).
2. **onChange**: Handles changes in input fields (like text, checkboxes).
3. **onSubmit**: Handles form submission events.

Example 1: Handling onClick Event

The onClick event is triggered when a user clicks on an element (e.g., a button).

```
import React, { useState } from 'react';

function ClickCounter() {
 const [count, setCount] = useState(0);

 const handleClick = () => {
  setCount(count + 1); // Increment the counter
 };

 return (
  <div>
   <button onClick={handleClick}>Click Me!</button>
   <p>You've clicked {count} times.</p>
  </div>
 );
}


export default ClickCounter;
```

Explanation:

- handleClick is the event handler for the onClick event.
- Each time the button is clicked, setCount(count + 1) increments the count state, causing the component to re-render and display the updated count.

Example 2: Handling onChange Event

The onChange event is used for form inputs (e.g., <input>, <textarea>). It is triggered whenever the value of the element changes.

```
import React, { useState } from 'react';


function NameForm() {
  const [name, setName] = useState('');


  const handleChange = (event) => {
    setName(event.target.value); // Update state with the new input value
  };


  return (
    <div>
      <input
        type="text"
        value={name}
        onChange={handleChange}
        placeholder="Enter your name"
      />
      <p>Hello, {name}!</p>
    </div>
  );
}


export default NameForm;
```

Explanation:

- handleChange updates the name state with the value of the input field (event.target.value) every time the user types.
- The input field is controlled because its value is tied to the name state, and React updates the UI accordingly.

Example 3: Handling onSubmit Event

The onSubmit event is triggered when a form is submitted, usually by clicking the submit button or pressing Enter within a form field.

```
import React, { useState } from 'react';


function LoginForm() {
  const [email, setEmail] = useState('');
  const [password, setPassword] = useState('');


  const handleSubmit = (event) => {
    event.preventDefault(); // Prevent the default form submission
    alert(`Email: ${email}, Password: ${password}`);
  };


  return (
    <form onSubmit={handleSubmit}>
      <div>
        <label>Email:</label>
        <input
          type="email"
          value={email}
          onChange={(e) => setEmail(e.target.value)}
          required
        />
      </div>
      <div>
        <label>Password:</label>
        <input
          type="password"
```

```
     value={password}
     onChange={(e) => setPassword(e.target.value)}
     required
    />
   </div>
   <button type="submit">Submit</button>
  </form>
 );
}

export default LoginForm;
```

Explanation:

- handleSubmit is the event handler for the form's onSubmit event.
- event.preventDefault() prevents the default form submission, which would normally cause the page to reload.
- The form values (email and password) are managed via state, and the onSubmit handler displays an alert with the entered data.

Example 4: Using Multiple Event Handlers (Combining onClick, onChange, and onSubmit)

You can combine multiple event handlers to create more complex interactions.

```
import React, { useState } from 'react';

function SurveyForm() {
 const [name, setName] = useState('');
 const [age, setAge] = useState('');
 const [submitted, setSubmitted] = useState(false);

 const handleNameChange = (event) => {
  setName(event.target.value);
 };

 const handleAgeChange = (event) => {
  setAge(event.target.value);
 };
```

```
const handleSubmit = (event) => {
  event.preventDefault();
  setSubmitted(true);
};

return (
  <div>
    <form onSubmit={handleSubmit}>
      <div>
        <label>Name:</label>
        <input
          type="text"
          value={name}
          onChange={handleNameChange}
          placeholder="Enter your name"
        />
      </div>
      <div>
        <label>Age:</label>
        <input
          type="number"
          value={age}
          onChange={handleAgeChange}
          placeholder="Enter your age"
        />
      </div>
      <button type="submit">Submit</button>
    </form>
    {submitted && (
      <div>
        <h2>Thank you for your submission!</h2>
        <p>Name: {name}</p>
```

```
          <p>Age: {age}</p>
        </div>
      )}
    </div>
  );
}

export default SurveyForm;
```

Explanation:

- We use onChange to update the state when the user enters their name or age.
- onSubmit prevents the form from submitting the traditional way and displays a thank you message with the entered data.

Key Points about Event Handling in React

1. **Event Naming**: React uses camelCase for event names (e.g., onClick, onSubmit, onChange).
2. **Event Handlers as Functions**: Event handlers are defined as functions that will be called when the event occurs.
3. **event.preventDefault()**: In case of form submissions or other default browser behaviors, event.preventDefault() can be used to prevent those behaviors, like preventing page reload on form submission.
4. **Passing Parameters to Event Handlers**: You can pass parameters to event handlers using arrow functions:

```
<button onClick={() => handleClick("Hello")}>Click Me!</button>
```

5. **Event Object**: React event handlers receive a **synthetic event object** which is wrapped around the browser's native event. You can access details like event.target, event.type, and more.

Conclusion

In React, handling user interactions such as clicks, form submissions, and changes in input fields is straightforward using event handlers. By using React's synthetic event system (onClick, onChange, onSubmit, etc.), you can create interactive and dynamic UIs with ease. React's declarative approach to event handling allows you to write clean, maintainable code while managing user interactions effectively.

8.2 Binding event handlers and passing parameters

In React, event handlers are functions that handle events like mouse clicks, form submissions, keyboard inputs, and more. React provides a declarative way of binding event handlers to UI elements such as buttons, inputs, and forms.

Sometimes, you need to pass **parameters** to event handlers, or you may need to **bind** event handlers to the component's this context (in class components). Let's dive into these concepts with examples.

1. Binding Event Handlers in Class Components

In class components, you often need to explicitly **bind** event handlers to the component’s this context. This is because this inside an event handler refers to the element that triggered the event (not the class component itself).

Example: Binding Event Handlers in Class Component

```
import React, { Component } from 'react';

class Counter extends Component {
  constructor() {
    super();
    this.state = { count: 0 };

    // Binding the event handler to the class instance (this)
    this.handleClick = this.handleClick.bind(this);
  }

  handleClick() {
    this.setState({ count: this.state.count + 1 });
  }

  render() {
    return (
      <div>
        <button onClick={this.handleClick}>Click Me!</button>
        <p>You've clicked {this.state.count} times.</p>
      </div>
    );
  }
}

export default Counter;
```

Explanation:

- In the constructor, this.handleClick.bind(this) binds the handleClick method to the current instance of the component (this), so that when handleClick is called, this refers to the component instance and not the button element.

2. Binding Event Handlers Using Arrow Functions

Another way to handle binding in class components is by using **arrow functions**, which automatically bind the function to the current instance.

Example: Arrow Function for Event Handling in Class Component

```
import React, { Component } from 'react';


class Counter extends Component {
  constructor() {
    super();
    this.state = { count: 0 };
  }


  // Using arrow function to avoid explicit binding
  handleClick = () => {
    this.setState({ count: this.state.count + 1 });
  };


  render() {
    return (
      <div>
        <button onClick={this.handleClick}>Click Me!</button>
        <p>You've clicked {this.state.count} times.</p>
      </div>
    );
  }
}


export default Counter;
```

Explanation:

- Using an arrow function (handleClick = () => { ... }) automatically binds the function to the class instance. This is more concise and avoids having to explicitly bind the function in the constructor.

3. Passing Parameters to Event Handlers

In some situations, you may want to **pass parameters** to an event handler. You cannot directly pass parameters to an event handler in JSX. However, you can use an **arrow function** or **anonymous function** to pass parameters.

Example: Passing Parameters to Event Handlers

```
import React, { useState } from 'react';


function Greeting() {
  const [greeting, setGreeting] = useState('');


  const handleClick = (message) => {
    setGreeting(message);
  };


  return (
    <div>
      <button onClick={() => handleClick('Hello, World!')}>Greet</button>
      <button onClick={() => handleClick('Goodbye, World!')}>Farewell</button>
      <p>{greeting}</p>
    </div>
  );
}


export default Greeting;
```

Explanation:

- The handleClick function takes a message as a parameter.
- The onClick event handlers for the two buttons use arrow functions (() => handleClick('Hello, World!')) to pass the respective messages to the handleClick function when the buttons are clicked.

4. Passing Event Object and Parameters Together

Sometimes, you want to pass both the event object and additional parameters. You can achieve this by using an arrow function in the onClick handler.

Example: Passing Event and Additional Parameters

```
import React, { useState } from 'react';


function EventAndParams() {
  const [info, setInfo] = useState('');

  const handleClick = (event, customMessage) => {
    setInfo(`${customMessage} | Event type: ${event.type}`);
  };

  return (
    <div>
      <button onClick={(e) => handleClick(e, 'Button clicked')}>Click Me</button>
      <p>{info}</p>
    </div>
  );
}

export default EventAndParams;
```

Explanation:

- The handleClick function takes two arguments: the event object (event) and a custom message (customMessage).
- The onClick handler passes the event object (e) and a custom message ('Button clicked') to the handleClick function.

5. Using this with Event Handlers in Class Components

In class components, this refers to the component instance. When you use event handlers in class components, you need to make sure that this is bound correctly to the component instance, especially when accessing this.state or this.props.

Example: Handling Events in Class Components with this

```
import React, { Component } from 'react';

class EventHandlerExample extends Component {
  constructor() {
    super();
    this.state = { message: 'Welcome!' };

    // Bind the handler to the class instance
    this.handleClick = this.handleClick.bind(this);
  }
  handleClick() {
    this.setState({ message: 'Hello, User!' });
  }

  render() {
    return (
      <div>
        <button onClick={this.handleClick}>Click Me!</button>
        <p>{this.state.message}</p>
      </div>
    );
  }
}

export default EventHandlerExample;
```

Explanation:

- this.handleClick.bind(this) ensures that when handleClick is invoked, this refers to the class component, allowing access to this.state.

6. Performance Considerations

When using **arrow functions** in JSX (e.g., (e) => handleClick(e, param)), a new function is created each time the component re-renders. This may have performance implications in some cases, particularly with many components or frequent re-renders. In such cases, you can define the event handler outside the JSX to avoid unnecessary function creation during re-renders.

7. Summary of Binding and Passing Parameters

- **Binding**: In class components, event handlers need to be bound to the component instance, either in the constructor or using arrow functions.
- **Passing Parameters**: You can pass parameters to event handlers using arrow functions or anonymous functions in JSX.
- **Event Object**: The event object is automatically passed to event handlers by React, providing details like the event type and target.

Conclusion

In React, handling events and passing parameters is straightforward but can be tricky in class components due to this binding. In functional components, event handling is much simpler and doesn’t require explicit binding. Using **arrow**

functions allows you to easily pass additional parameters to event handlers and manage user interactions in a clean and declarative manner.

9 **Node Package Manager (NPM)**

9.1 Introduction to NPM and its role in managing dependencies

NPM (Node Package Manager) is a tool used to manage JavaScript packages and dependencies, particularly for Node.js applications. It is an essential part of the JavaScript ecosystem, allowing developers to share and reuse code libraries or packages. Whether you are building a server-side application with Node.js or a front-end web application using frameworks like React or Angular, NPM plays a crucial role in managing the dependencies required for your project.

Key Roles of NPM:

1. **Package Management**: NPM allows developers to install, update, and manage libraries (packages) or modules that a project depends on.
2. **Dependency Management**: It helps manage the specific versions of packages that your project relies on, ensuring that the correct versions are used across all environments (development, production, etc.).
3. **Script Running**: NPM allows you to define and run scripts to automate tasks like building, testing, or deploying your application.

Key Features of NPM

1. **NPM Registry**:
    - The NPM registry is a large collection of open-source packages that are publicly available for download and use in projects.
    - These packages are stored on the NPM servers and can be installed using the npm install command.
2. **Package.json**:
    - A package.json file is at the heart of most Node.js projects. It contains metadata about the project, including its dependencies, scripts, and versioning information.
    - NPM uses the package.json file to manage dependencies and scripts.

Example of a simple package.json file:

```
{
  "name": "my-app",
  "version": "1.0.0",
  "description": "A simple project",
  "main": "index.js",
  "scripts": {
    "start": "node index.js",
    "test": "echo \"Error: no test specified\" && exit 1"
  },
  "dependencies": {
    "express": "^4.17.1"
  },
  "devDependencies": {
    "nodemon": "^2.0.7"
  },
  "author": "Your Name",
  "license": "MIT"
}
```

Explanation:

- "dependencies": Lists the production dependencies that your project requires, such as express in this case.
- "devDependencies": Lists the development dependencies needed for things like testing or code quality checks, such as nodemon for live server reloading during development.
- "scripts": Defines custom command-line scripts that can be run using npm run <script-name>. For example, npm run start will run node index.js.

3. **Installing Packages**:
    - NPM allows you to install packages using the npm install command.

To install a package:

bash

Copy code

```
npm install <package-name>
```

Example:

bash

Copy code

```
npm install express
```

- By default, this installs the package and saves it as a dependency in your package.json file.

To install development dependencies:

bash

Copy code

```
npm install <package-name> --save-dev
```

Example:

bash

Copy code

```
npm install nodemon --save-dev
```

4. **Managing Package Versions**:
    - NPM allows you to manage the versions of dependencies. For example, you can specify which version of a package you want to install, such as express@4.17.1, or you can install the latest version available.
    - Versioning follows a semantic versioning scheme (major.minor.patch), and you can specify version ranges in package.json.

Example:

```
"dependencies": {
  "express": "^4.17.1"
}
```

- "^4.17.1": This will install version 4.17.1 or any later version that doesn't introduce breaking changes (i.e., it will update to any 4.x.x version but not to version 5.x.x).

5. **Updating Packages**:
    - You can update a package using the npm update command, which checks for newer versions of packages defined in package.json and installs them.

Example:

bash

Copy code

```
npm update
```

6. **Uninstalling Packages**:
    - If you no longer need a package, you can uninstall it using the npm uninstall command.

Example:

```
npm uninstall <package-name>
```

Example: Installing and Using NPM Packages

Let’s go through a simple example of setting up a project and installing a dependency using NPM.

1. **Step 1: Initialize the Project** First, you need to initialize a new Node.js project by creating a package.json file. You can do this by running the following command:

```
npm init -y
```

The -y flag generates a package.json file with default values.

2. **Step 2: Install Dependencies** Install a package like express (a web framework for Node.js) by running:

bash

Copy code

```
npm install express
```

This will download and install the latest version of express and add it to your dependencies in package.json.

3. **Step 3: Using the Installed Package** Now, you can use express in your application:

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

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

app.listen(port, () => {
  console.log(`Server is running on http://localhost:${port}`);
});
```

4. **Step 4: Running the Application** To run the application, you can add a custom script in package.json:

```
"scripts": {
  "start": "node index.js"
}
```

Then, you can run the application by using the following command:

bash

Copy code

```
npm start
```

NPM's Role in Managing Dependencies

- **Centralized Dependency Management**: NPM provides a centralized place for managing your project's dependencies. It helps you control which packages are used, what versions are installed, and ensures that all developers on a project are using the same package versions.
- **Version Control**: NPM's versioning system ensures that your project uses compatible versions of packages, reducing the risk of breaking changes when updating dependencies.
- **Automation**: NPM allows you to define custom scripts to automate repetitive tasks like testing, building, and deploying your application.
- **Sharing and Reusability**: NPM allows you to share your own packages with others and reuse packages developed by others, improving productivity and collaboration.

Conclusion

NPM is an essential tool for managing packages in Node.js and JavaScript projects. It simplifies the process of adding, updating, and removing dependencies, automates common tasks, and ensures consistency across environments. By managing your project's dependencies with NPM, you can focus on writing code rather than dealing with the complexities of package management.

9.2 Basic NPM commands (npm init, npm install, npm start)

NPM (Node Package Manager) provides a variety of commands to help manage your project dependencies and scripts. Below are the explanations and usage examples of some of the most common NPM commands: npm init, npm install, and npm start.

---

1. npm init

Purpose:

The npm init command is used to create a package.json file for your project. This file contains important metadata about the project (such as the project's name, version, description, and dependencies) and is essential for managing the dependencies and configurations of your Node.js application.

Usage:

```
npm init
```

- When you run this command, it prompts you for various pieces of information about the project (name, version, description, entry point, etc.).
- You can skip the prompts and automatically accept the default values by using the -y flag:

bash

Copy code

```
npm init -y
```

This generates a package.json file with default values for your project.

Example:

```
npm init
```

Output:

yaml

Copy code

```
name: (my-app) my-node-project

version: (1.0.0) 1.0.0

description: My awesome Node.js project

entry point: (index.js) index.js

test command:

git repository:

keywords: node, express
```

author: Your Name

license: (ISC) MIT

After you complete the prompts, a package.json file will be generated with the provided details.

---

2. npm install

Purpose:

The npm install (or npm i) command is used to install the dependencies (packages) required for your project. This command downloads and installs the specified package(s) from the NPM registry and adds them to your project. It also updates the node_modules directory where the installed packages are stored.

Usage:

- **Install all dependencies listed in package.json**:

```
npm install
```

This command installs all dependencies (both regular and development dependencies) that are listed in the dependencies and devDependencies sections of the package.json file.

- **Install a specific package**:

bash

Copy code

```
npm install <package-name>
```

Example:

```
npm install express
```

This installs the latest version of the express package and adds it to the node_modules folder and the package.json file.

- **Install a specific version of a package**:

```
npm install <package-name>@<version>
```

Example:

```
npm install express@4.17.1
```

- **Save package as a development dependency**:

```
npm install <package-name> --save-dev
```

This installs the package and adds it to the devDependencies section in package.json, indicating that the package is only needed for development (e.g., for testing or bundling tools).

3. npm start

Purpose:

The npm start command is used to start your application. This command runs the script defined in the start property of the scripts section in package.json. Typically, it is used to run the main file (like a Node.js server or a web app).

Usage:

To use npm start, first, you need to define a start script in your package.json file under the "scripts" section. If you don't define it, running npm start will give an error, because there is no script to execute.

- **Running the start script**:

```
npm start
```

This runs the script specified under the "start" property in package.json.

Example:

1. **Define start script in package.json**:

json

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```
{
  "name": "my-app",
  "version": "1.0.0",
  "scripts": {
    "start": "node index.js"
  }
}
```

2. **Run the start command**:

```
npm start
```

This command will run node index.js, which starts your application (assuming index.js is the entry point for your app).

More Examples

1. **Basic Setup of a Node.js Project**:
    - First, initialize your project:

```
npm init -y
```

    - Then, install the required dependencies:

```
npm install express
```

- Finally, define the start script in package.json:

```
"scripts": {
  "start": "node app.js"
}
```

- Run the application:

```
npm start
```

Conclusion

Here's a summary of the basic NPM commands:

1. **npm init**: Initializes a new Node.js project and creates a package.json file to manage your dependencies and project settings.
2. **npm install**: Installs the dependencies listed in package.json or a specific package from the NPM registry. It updates the node_modules folder and package.json (with --save-dev or --save options).
3. **npm start**: Runs the application by executing the script defined under "start" in package.json. This is typically used to launch the main server or application file.

These commands are essential for managing and running your Node.js projects, automating repetitive tasks, and managing dependencies effectively.