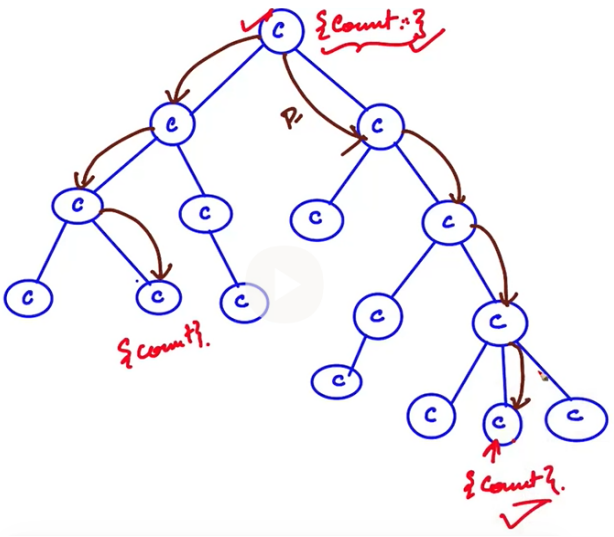
Context API

Passing Data From Parent to Child

Prop Drilling - Passing State from Parent to Child

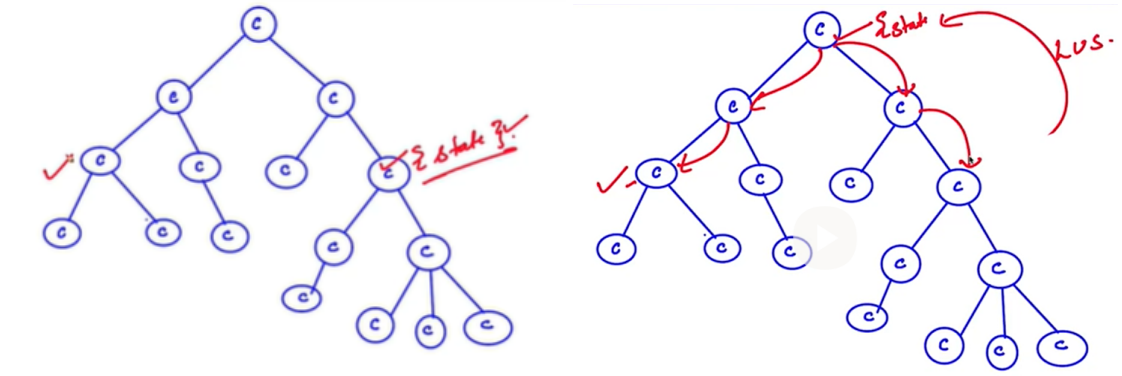
Your application might initially only have one component, but as it becomes more sophisticated, you must continue dividing it into smaller components. We can create a separation of concerns by isolating specific portions of a bigger application using components. Whenever anything in your program malfunctions, fault isolation makes it simple to pinpoint the problem area.

Props can be used to enable communication between our components in React. Prop drilling is a situation where data is passed from one component through multiple interdependent components until you get to the component where the data is needed. Prop drilling is not ideal as it quickly introduces complicated, hard-to-read code, re-rendering excessively, and slows down performance. Component re-rendering is especially damaging since passing data down multiple levels of components triggers the re-rendering of components unnecessarily.



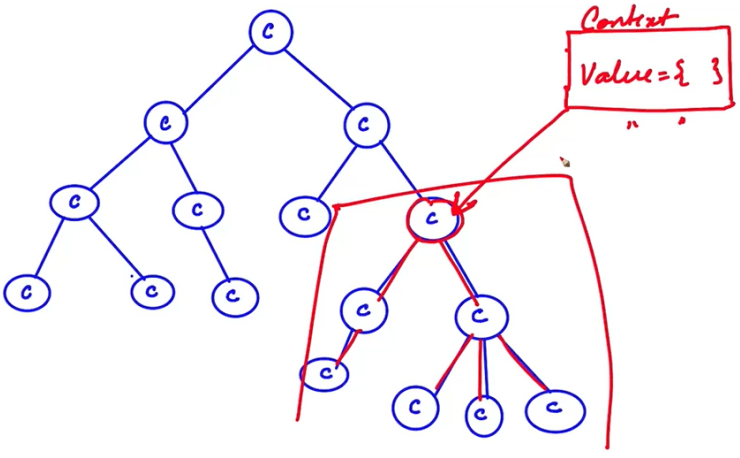
Lifting Up the State - Passing State to siblings

Lifting state up occurs when the state is placed in a common ancestor (or parent) of child components. Because each child component has access to the parent, they will then have access to the state (via prop drilling). If the state is updated inside the child component, it is lifted back to the parent container. However, as we are utilizing a poorly maintained pattern for the state, this approach can create issues in the future.



Context

Context provides a way to pass data through the component tree without having to pass props down manually at every level. This is the alternative to "prop drilling" or moving props from grandparent to child to parent, and so on. Context is designed to share data that can be considered “global” for a tree of React components, such as the current authenticated user, theme, or preferred language.

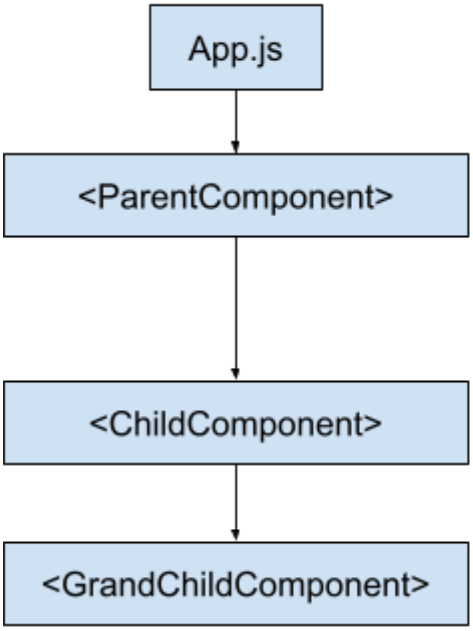


React Context API

The React Context API is a component structure that allows us to share data across all levels of the application. The main aim of Context API is to solve the problem of prop drilling (also called "Threading"). There are three steps to using React context:

1. **Create context -** using the `createContext` method.
2. **Provide Context -** Setup a `Context.provider` and define the data which you want to store.
3. **Consume the Context -** Use a `Context.consumer` or `useContext` hook whenever you need the data from the store.

Let's consider the following example:



1. Creating the Context

```
import { createContext } from "react";
export const colorContext= createContext();
```

2. Providing the Context

```
[color, setColor] = useState("#000000")
<colorContext.Provider value={{ color, setColor }}>
    <ChildComponent />
</colorContext.Provider>
```

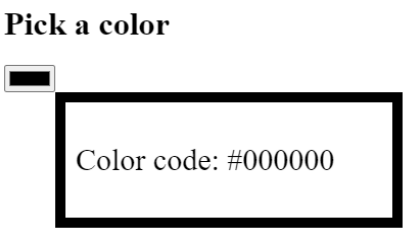
3. Consuming the Context (Way 1)

```
const {color} = useContext(colorContext);
```

3. Consuming the Context (Way 2)

```
<colorContext.Consumer>
    {(value) =>
        <p style={{ color: value.color }}>
            Color code: {value.color}
        </p>
    }
</colorContext.Consumer>
```

Output:



Creating the Context

React.createContext

`const MyContext = React.createContext(defaultValue);`

It is used for creating a Context object. When React renders a component subscribing to this Context object, it will read the current context value from the closest matching Provider above it in the tree.

```
import { createContext } from "react";
export const colorContext= createContext();
```

Providing the Context

Context.Provider

`<MyContext.Provider value={/* some value */}>`

Every Context object has a Provider React component which allows consuming components to subscribe to context changes. It acts as a delivery service. When a consumer component asks for something, it finds it in the context and provides it to where it is needed. The provider accepts a prop (value), and the data in this prop can be used in all the other child components. This value could be anything from the component state.

All consumers that are child components of a Provider will re-render whenever the Provider's value prop changes. Changes are determined by comparing the new and old values using the same algorithm as Object.is.

```
import { useState } from "react";
import ChildComponent from "./ChildComponent";
import { colorContext } from "../context";

const ParentComponent = (props) => {
  const [color, setColor] = useState("#000000");

  return (
```

```
    <>
      <h1>Pick a color</h1>
      <input type="color" onChange={(e) => { setColor(e.target.value);}}
value={color} />
      {/* Providing the context to the child component */}
      <colorContext.Provider value={{ color, setColor }}>
        <ChildComponent />
      </colorContext.Provider>
    </>
  );
};
```

Consuming the Context in Functional Components

useContext hook

`const value = useContext(SomeContext)`

useContext is a React Hook that lets you read and subscribe to context from your component.It can be used with the useState Hook to share the state between deeply nested components more easily.

```
import { useContext } from "react";
import { colorContext } from "../context";

const GrandChildComponent = () => {
  //Consuming the context
  const {value} = useContext(colorContext)
  return (
  <p style={{ color: value.color }}>Color code: {value.color}</p>
)
};
```

Consuming the Context in Class-Based Components

Context.Consumer

```
<MyContext.Consumer>
  {value => /* render something based on the context value */}
```

`</MyContext.Consumer>`

A React component that subscribes to context changes. Requires a function as a child. The function receives the current context value and returns a React node. The value argument passed to the function will equal the value prop of the closest Provider for this context in the component tree. If there is no Provider for this context, the value argument will be equal to the defaultValue, which was passed to createContext().

```
import React from 'react';
import { colorContext } from "../context";

class GrandChildComponent extends React.Component {
    render() {
        return (
            <colorContext.Consumer>
                {(value) => <p style={{ color: value.color }}>Color code:
{value.color}</p>}
            </colorContext.Consumer>
        );
    }
}
```

Using Multiple contexts

React also allows you to create multiple contexts. By providing multiple contexts in this way, components that require access to both context values can consume them both and be able to interact with their respective states. We should always try to separate contexts for different purposes to maintain the code structure and better readability.To keep context re-rendering fast, React needs to make each context consumer a separate node in the tree.

For Example, the Items component may need access to the item state from itemContext and the total state from totalContext, allowing it to display the total number of items in the shopping cart along with the total cost.

```
import { itemContext } from "./itemContext";
import { totalContext } from "./totalContext";
```

```
function App() {
  const [total, setTotal] = useState(0);
  const [item, setItem] = useState(0);
  return (
    // providing multiple contexts
    <itemContext.Provider value={{ item, setItem }}>
      <totalContext.Provider value={{ total, setTotal }}>
        <div className="App">
          <h2>Shopping Cart</h2>
          <Navbar />
          <Items />
        </div>
      </totalContext.Provider>
    </itemContext.Provider>
  );
}
export default App;
```

Custom Provider

It is a component which acts as a provider and it makes use of the default provider. Custom providers are created using the **createContext** function from the React library, which creates a new context object that can be passed down to child components using a provider component. The provider component is responsible for passing the context data down to its child components via a special prop called **value**.

By using a custom provider, you can centralize the management of shared data and state in a single place, making it easier to maintain and update your application. This can be particularly useful when working with complex applications that require a lot of shared state management, such as e-commerce sites or large data-driven applications.

For Example:

```
import { createContext, useState } from "react";
```

```
const itemContext = createContext();

function CustomItemContext({children}) {
  const [total, setTotal] = useState(0);
  const [item, setItem] = useState(0);

  return(
    <itemContext.Provider value={{total,setTotal,item, setItem}}>
        {children}
    </itemContext.Provider>
  )
}

export { itemContext };
export default CustomItemContext;
```

Using Custom Providers:

```
import CustomItemContext, { itemContext } from "./itemContext";

function App() {
  return (
    // providing multiple contexts
    <CustomItemContext>
      <div className="App">
        <h2>Shopping Cart</h2>
        <Navbar />
        <Items />
      </div>
    </CustomItemContext>
  );
}
export default App;
```

Using Custom Hooks

Creation of a custom provider component that provides context data to its child components, as well as the creation of a custom hook that consumes the context

data. Using custom hooks with custom providers allows for greater flexibility and reusability in sharing data across a React application. All the logic of the context file, updating logic and event handling, will be at one place

For Example, The **useValue** hook is defined to consume the context data provided by the **itemContext** using the **useContext** hook. The hook returns the total and item variables, functions handleAdd, and handleRemove from the context, making them available to any components that use the useValue hook.

```
import { createContext, useState, useContext } from "react";

const itemContext = createContext();

function useValue() {
  const value = useContext(itemContext);
  return value;
}

function CustomItemContext({ children }) {
  const [total, setTotal] = useState(0);
  const [item, setItem] = useState(0);

  const handleAdd = (price) => {
    setTotal(total + price);
    setItem(item + 1);
  };

  const handleRemove = (price) => {
    if (total <= 0) {
      return;
    }
    setTotal((prevState) => prevState - price);
    setItem(item - 1);
  };

  return (
    <itemContext.Provider value={{ total, item, handleAdd, handleRemove }}>
      {children}
```

```
    </itemContext.Provider>
  );
}

export {  useValue };
export default CustomItemContext;
```

Summarising it

Let's summarise what we have learned in this Lecture:

- Learned about Prop Drilling.
- Learned how to create Context.
- Learned how to provide Context.
- Learned how to consume the Context.
- Learned how to use multiple contexts.
- Learned about custom providers.
- Learned about custom hooks.

Some References:

- Context: link
- React Context for beginners: link

React Router

Routing Mechanism

Routing in React is used to manage the URLs of the application and map them to different views or components that need to be displayed on the page.

In MPAs, each page has its own URL, and when the user navigates to a new page, the browser sends a request to the server, and the server responds with a new HTML page, which replaces the current page in the browser. The server determines which page to return based on the URL requested by the client. This process is known as server-side routing. This approach can be slower and less responsive, and it can lead to longer load times.

In contrast, in SPAs, the application is loaded once, and all the content is loaded dynamically without the need for page refreshes. Instead of loading new pages, the application updates the current view by manipulating the DOM. SPAs use client-side routing, which means that the routing is handled by the client-side JavaScript code. This process is known as client-side routing.This allows for faster and more responsive navigation, as the entire page does not need to be reloaded.

React Router

ReactJS Router is mainly used for developing Single Page Web Applications. React Router is used to define multiple routes in the application. A Route is used to define and render components based on the specified path. When the user navigates to a particular URL, React Router renders the component associated with that route.

For Example,

```
src/
    components/
      Header.js
```

```
    Footer.js
    Button.js
    Input.js
    ...
  pages/
    Home.js
    About.js
    Contact.js
    ...
  routes.js
  App.js
  index.js
```

In this example, the components folder contains reusable UI components that can be used across different pages. The pages folder contains the different views or pages of the application.

The routes.js file contains the route definitions for the application. This is where the <Route> components are defined, along with the path and the component to be rendered for each route.

Types of React Router

In React Router v6.4, there are different types of routers that can be used depending on the needs of the application:

- **<BrowserRouter> -** This is the most commonly used router and is designed for applications that will be hosted on a server that will serve all requests to the application. It uses HTML5 history API to keep the UI in sync with the URL.
- **<HashRouter> -** This router is designed for applications that will be hosted on a server that does not support HTML5 history API, such as GitHub Pages or static file servers. It uses the URL hash to keep the UI in sync with the URL.
- **<MemoryRouter> -** This router is designed for testing and non-visual use cases, such as server-side rendering or testing.

- **<NativeRouter> -** This router is designed for React Native applications and uses the native routing features of the platform.
- **<StaticRouter> -** This router is designed for server-side rendering and generates a set of static routes based on a given location.

In v6.4, new routers were introduced that support the new data APIs and to create custom routers:

- **createBrowserRouter:** This function creates a custom <BrowserRouter> router with a custom history object. The custom history object can be used to manipulate the browser's URL and handle navigation between pages without causing a full page refresh.
- **createMemoryRouter:** This function creates a custom <MemoryRouter> router with a custom history object. The custom history object can be used to manipulate the router's state and handle navigation between pages.
- **createHashRouter:** This function creates a custom <HashRouter> router with a custom history object. The custom history object can be used to manipulate the browser's URL hash and handle navigation between pages without causing a full page refresh.

createBrowserRouter

This is the recommended router for all React Router web projects. It uses the DOM History API to update the URL and manage the history stack.

For example, WAY-1

```
import { createBrowserRouter, RouterProvider } from "react-router-dom";
import Home from "./pages/Home";
import About from "./pages/About";

function App() {
  const router = createBrowserRouter([
    { path: "/", element: <Home /> },
    { path: "/about", element: <About /> },
  ]);
```

```
  return (
    <>
      <RouterProvider router={router} />
    </>
  );
}

export default App;
```

In this example, the createBrowserRouter function is used to create a custom <BrowserRouter> router with two routes: one for the home page, and one for the about page. The RouterProvider component is used to wrap the app and provide access to the custom router.

1. Import the necessary modules, including createBrowserRouter, RouterProvider, Home, and About.
2. Use createBrowserRouter to create a custom <BrowserRouter> router with the two routes: Home and About.
3. Wrap the app with RouterProvider and pass in the custom router as a prop. The RouterProvider component ensures that the routing context is available to all child components of your app.
4. Render the App component.

For Example, WAY-2

```
import {
    createBrowserRouter,
    createRoutesFromElements,
    Route,
    RouterProvider,
  } from "react-router-dom";
  import Home from "./pages/Home";
  import About from "./pages/About";
  import Items from "./pages/Items";

  function App() {
    const routes = createRoutesFromElements(
      <>
        <Route path="/" element={<Home />} />
```

```
        <Route path="/about" element={<About />} />
        <Route path="/items" element={<Items />} />
      </>
    );
    const router = createBrowserRouter(routes);

    return (
      <>
        <RouterProvider router={router} />
      </>
    );
  }

  export default App;
```

In this example, the **createRoutesFromElements** function is used to create an array of route objects from JSX elements and avoid manually creating an array of route objects. The **createBrowserRouter** function is then used to create a custom **<BrowserRouter>** router with the array of route objects. Finally, the **RouterProvider** component is used to wrap the app and provide access to the custom router.

<Link> Component

The <Link> component is a core component of React Router that is used to navigate between different routes in your application. It is a declarative way to create hyperlinks that allows you to handle navigation without reloading the entire page. The to prop specifies the target route. When a user clicks on a <Link> component, React Router will automatically update the URL and render the appropriate component for the target route.

For Example,

```
import { Link } from "react-router-dom";

function Home() {
  return (
    <>
      <main>
        <h1>Home Page</h1>
```

```
        <Link to="/about">About</Link>  
        <Link to="/items">Items</Link>
      </main>
    </>
  );
}

export default Home;
```

The Link component can be used to create the back link, and the to prop is set to "/" to specify the target route. When the link is clicked, the user will be taken back to the home page.

```
import { Link } from "react-router-dom";
function About() {
  return (
    <>
      <main>
        <h1>About Page</h1>
        <Link to="/">back</Link>
      </main>
    </>
  );
}

export default About;
```

Nested Routes

Nested routes in React Router allow you to define routes that are nested within another route. This can be useful for building more complex UIs, such as layouts with multiple sections that have their own routes.

For Example,

```
import {
    createBrowserRouter,
    createRoutesFromElements,
    Route,
    RouterProvider,
  } from "react-router-dom";
```

```
import Home from "./pages/Home";
import About from "./pages/About";
import Items from "./pages/Items";
import Navbar from "./components/Navbar";

function App() {

  const router = createBrowserRouter([
    {
      path: "/",
      element: <Navbar />,
      children: [
        { index: true, element: <Home /> },
        { path: "/about", element: <About /> },
        { path: "/items", element: <Items /> },
      ],
    },
  ]);
  return (
    <>
      <RouterProvider router={router} />
    </>
  );
}

export default App;
```

Parent route is defined with the path of / and an element of Navbar. The children property is an array of child routes, which includes an index route, a route with the path of /about, and a route with the path of /items.

```
import { Link, Outlet } from "react-router-dom";

function Navbar() {
  return (
    <>
      <div className="nav">
        <Link to="/">
          <h4>HOME</h4>
        </Link>
```

```
        <Link to="/about">
          <h4>ABOUT</h4>
        </Link>

        <Link to="/items">
          <h4>ITEMS</h4>
        </Link>
      </div>
      <Outlet />
    </>
  );
}

export default Navbar;
```

The Navbar component renders links to the child routes using the Link component. The Outlet component renders the appropriate child component based on the current nested route. The Outlet component renders the appropriate child component based on the current nested route. For example, if the current URL is /about, the Outlet component will render the About component.

<NavLink> Component

The <NavLink> component is similar to the <Link> component in that it creates a hyperlink to a specified location. However, it adds the ability to add styling and active classes to the link when it is active. This can be useful for highlighting the current page or route in a navigation menu.

For Example,

```
import { NavLink, Outlet } from "react-router-dom";

function Navbar() {
  return (
    <>
      <div className="nav">
        <NavLink
          style={({ isActive }) => (isActive ? { color: "blue" } : undefined)}
```

```
          to="/"
        >
          <h4>HOME</h4>
        </NavLink>

        <NavLink
          style={({ isActive }) => (isActive ? { color: "blue" } : undefined)}
          to="/about"
        >
          <h4>ABOUT</h4>
        </NavLink>

        <NavLink
          style={({ isActive }) => (isActive ? { color: "blue" } : undefined)}
          to="/items"
        >
          <h4>ITEMS</h4>
        </NavLink>
      </div>
      <Outlet />
    </>
  );
}

export default Navbar;
```

In this example, the exact attribute is used with the to prop of the first NavLink. This ensures that the link is only active when the exact URL path matches the value of to.

Relative vs Absolute Paths

In web development, a path is a URL endpoint that specifies the location of a specific resource or content on a web server. A base URL is the root URL that serves as the starting point for all the other URLs in a website. In React Router, paths are used to define routes that map to specific components in your application. These routes can be either relative or absolute.

A relative path is a path that is relative to the current location. For example, if the current location is "/users", and you want to link to the "profile" page, the relative path would be "profile". The resulting link would be "/users/profile".

An absolute path is a path that starts with a forward slash ("/") and is relative to the root of the website. For example, if the current location is "/users", and you want to link to the "home" page, the absolute path would be "/home". The resulting link would be "/home".

In general, it is recommended to use relative paths whenever possible, as they are more flexible and can be used in different contexts. Absolute paths are useful when you need to link to a specific page that is not in the current directory or when you want to link to a page in a different part of the website.

Dynamic Routes

Dynamic routes are routes that contain parameters, which can be used to dynamically generate content based on user input or other data. In React Router, dynamic routes are defined using a colon (:) followed by the name of the parameter. For example, a dynamic route for a user profile page might look like /users/:id, where :id is the parameter that will be replaced with the actual user ID.

To access the parameter in your component, you can use the useParams hook provided by React Router. For example:

```
import { useParams } from "react-router-dom";

function UserProfile() {
  const { id } = useParams();
  return <div>User profile for user {id}</div>;
}
```

Summarizing it

Let's summarize what we have learned in this Lecture:

- Learned about Routing Mechanism in React.

- Learned about React Router.
- Learned about types of React Router.
- Learned about createBrowserRouter.
- Learned about Nested Routes.
- Learned about <Link> and <NavLink> Components.
- Learned about Relative, Absolute and Dynamic Routes.

Some References:

- React Router Documentation: link
- Client Side Routing: link

Pure Functions

Pure Functions in Javascript

A pure function is a function that always returns the same output given the same input and has no side effects (i.e., it doesn't modify any variables outside of its scope, it doesn't mutate its input arguments, and it doesn't have any I/O operations such as reading from or writing to a file or a database). Pure functions are predictable and easier to reason about since they don't have any hidden dependencies or side effects. Pure functions can be composed together to create more complex functions or pipelines of functions since their input and output types are well-defined and consistent.

```
function add(a, b){ // A pure function adding two integers passed in it.
    return a+b;
}

function divide(a, b){  // Pure function to divide two integers passed
in it.
    return a/b;
}

function multi(a, b){    // Pure function to multiply two integers
passed in it.
    return a*b;
}
console.log(        // Calling all the pure functions
  add(2,5),
  multi(3,2),
  divide(20,5)
);
```

All three functions in the above code are pure functions. Their return value depends on the input arguments, they don't mutate any non-local state, and

they have no side effects (we will discuss side effects further in this article). Examples of pure functions in JavaScript include Math.abs(), parseInt(), JSON.stringify(), and many others.

Pure functions can be used with functional programming techniques such as higher-order functions, currying, and partial application. JavaScript libraries and frameworks such as Redux, Ramda, and Lodash emphasize using pure functions and functional programming principles.

Impure Functions

An impure function is a function that either modifies variables outside of its scope, mutates its input arguments, has I/O operations such as reading from or writing to a file or a database, or has other side effects that are not purely computational. Impure functions can have hidden dependencies and side effects, which can make them harder to reason about and debug.

```
const message = 'Hi ! ';
function myMessage(value) {
    return `${message} ${value}`
}
console.log(myMessage('Aayushi'));
```

In the above code, the result the function returns is dependent on the variable that is not declared inside the function. That's why this is an impure function.
Examples of impure functions in JavaScript include console.log(), Math.random(), and Date.now(), Array.sort(), Array.splice(), and many others.

Impure functions can be necessary for tasks such as reading and writing to a file or a database, generating random numbers, or interacting with the user interface. However, it's important to minimize impure functions and keep them separate from pure functions as much as possible, to maintain a clear separation of concerns and avoid unexpected interactions or bugs. Pure functions can be composed together to create complex logic and pipelines of functions, whereas impure functions can only be used in a more limited and isolated way.

JavaScript libraries and frameworks such as React and Angular provide mechanisms for managing the state of an application and minimizing the use of impure functions in the user interface.

Redux

Issues with Prop Drilling

Prop drilling is a common problem in React applications where data is passed down through multiple layers of components via props. Prop drilling can lead to several issues:

1. **Storage Issue:** When large amounts of data is passed down through many layers of components via props, It can lead to issues with data storage and retrieval, as well as code maintainability and performance.
2. **Predictability of data**: Prop drilling can also make it difficult to predict where data comes from and how it will be used. It can be difficult to keep track of where the data is being used and where it is being modified. This can lead to issues with data consistency and can make it difficult to debug issues.
3. **Flow of Data:** Prop drilling can also make it difficult to pass data back up the component hierarchy.
4. **Data from multiple sources:** In complex applications, data may come from multiple sources, such as APIs or external services. Prop drilling can make it difficult to manage data and adds complexity to the application.

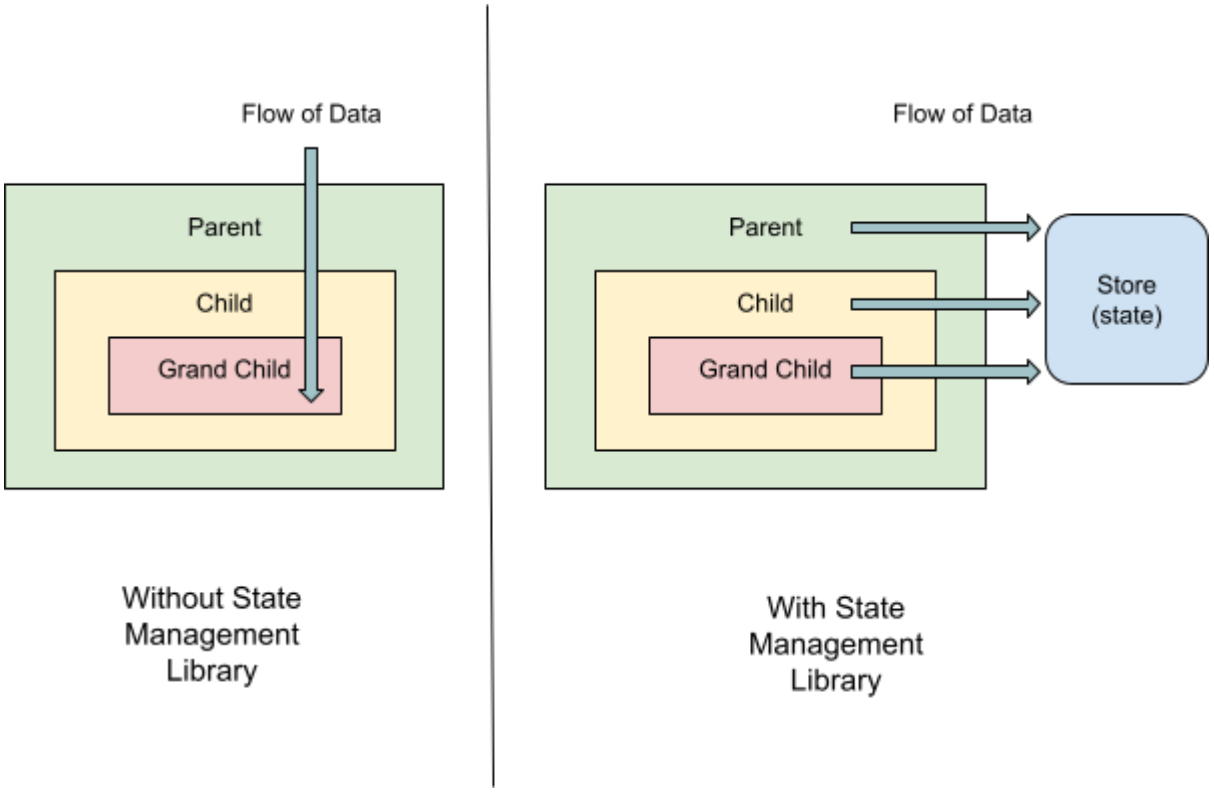
State Management

State management is a way to facilitate communication and sharing of data across components. State management libraries are tools used to manage and organize the state of an application predictably and efficiently. These libraries provide a set of rules and techniques for storing, retrieving, and updating application states. Advantages of using state management libraries are:

- **Centralized state:** State management libraries typically use a centralized store to manage the application state. This store is often implemented as a

JavaScript object that can be accessed and modified by components throughout the application.

- **Unidirectional data flow:** Data flows in a single direction in state management libraries, from the store to components. Components can update the store, but they cannot update other components directly.
- **Predictable state updates:** State management libraries provide a set of rules for updating the state, which helps to ensure that state changes are predictable and consistent across the application.
- **Immutable state:** Many state management libraries encourage the use of immutable data structures, which can help to prevent unintended side effects and make state updates more predictable.



Context API

Context API is a feature in React that provides a way to pass data through the component tree without having to pass props down manually at every level. It allows you to create a global state that can be accessed and modified by any component in the tree without the need for prop drilling. Context API can be useful for managing

states in cases where a small amount of data needs to be shared across multiple components, but is not ideal for larger and more complex state management needs.

Limitations

- **Overuse of context:** Overusing context can lead to a complex and difficult-to-manage application. Context should be used sparingly and only for data that needs to be shared across multiple components.
- **Designed for static content:** Context is designed for passing static data through the component tree, so it may not be the best choice for managing a dynamic state that changes frequently.
- **Re-renders the Context Consumers:** Whenever the value of the context changes, all the components that consume that context will re-render. This can lead to performance issues if the context value changes frequently.
- **Performance:** Context can cause performance issues if the context value is deeply nested and needs to be updated frequently.
- **Difficult to debug:** When an issue arises, debugging can be difficult since the data flow is not always clear. It can be difficult to trace where data is being passed and where it is being modified.
- **Difficult to extend and scale:** As an application grows in size and complexity, context can become difficult to manage and maintain.

Currying

Currying is defined as changing a function having multiple arguments into a sequence of functions with a single argument.
When currying a function in JavaScript, closures are used to retain the values of previous arguments that have been passed to the curried function. This is because each time a new argument is passed, a new function is returned that has access to the previous arguments.

For Example:

```
function sum(x){
    return function(y){
        return function(z){
            return x+y+z;
```

```
        }
    }
}

const sumXResult = sum(2);
const sumYResult = sumXResult(4);
const sumZResult = sumYResult(6);
console.log(sumZResult);
```

sum is a curried function that takes one argument x and returns another function that takes one argument y, which returns a third function that takes one argument z. The final function returns the sum of **x, y, and z**.

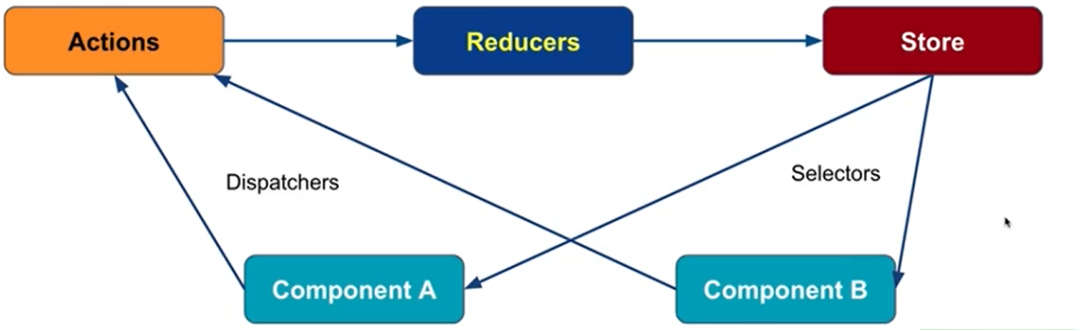
- When **sum(2)** is called, it returns a new function that takes one argument y. This returned function is assigned to **sumXResult**.
- When **sumXResult(4)** is called, it returns a new function that takes one argument z. This returned function is assigned to **sumYResult**.
- When **sumYResult(6)** is called, the final function is invoked, and it returns the sum of 2, 4, and 6, which is 12.

Finally, the result of **sumZResult** is printed to the console, which outputs 12.

Benefits of Currying

- Reusability: Currying allows you to create reusable functions by breaking down a function that takes multiple arguments into smaller functions that can be reused.
- Readability: Currying can improve the readability of the code by reducing the number of arguments passed to a function.
- Function Composition: Currying is useful for function composition, where the output of one function is the input to another function. It makes it easier to chain multiple functions together and create new functions that perform complex operations.

Redux Architecture



In Redux, the state of an application is represented as a single JavaScript object called the "store". The store is responsible for managing the application's state and updating the view when the state changes. The data flow in Redux is unidirectional, meaning that the data flows in one direction, from the view to the store and back to the view. This makes it easier to reason about the application's state and simplifies debugging.

Redux uses a "one-way data flow" app structure.

- The state describes the condition of the app at a point in time, and UI renders based on that state
- When something happens in the app:
    - The UI dispatches an action
    - The store runs the reducers, and the state is updated based on what occurred
    - The store notifies the UI that the state has changed
- The UI re-renders based on the new state

Installation of Redux

Run the following command to install Redux as a dependency for your project:

```
npm install redux
```

Components of the Redux Architecture

Store

The store is the central place where the application's state is stored. It is created using a reducer function that determines how the state should be updated based on the actions dispatched to the store.

For Example:

```
// store
const redux = require('redux');
const store = redux.createStore(todoApp);
```

Actions

Actions are plain JavaScript objects that describe what should happen in the application. They are created by calling action creator functions and are dispatched to the store using the store.dispatch() method. Payload is the data that needs to be transferred.

For Example:

```
// action types
const ADD_TODO = 'ADD_TODO';
const TOGGLE_TODO = 'TOGGLE_TODO';

// action creators
const addTodo = (text) => ({ type: ADD_TODO, text });
const toggleTodo = (index) => ({ type: TOGGLE_TODO, index });
```

Reducers

Reducers are pure functions that take the current state and an action as arguments and return a new state. They are responsible for updating the application's state based on the actions dispatched to the store.

For Example:

```
// reducer
```

```
function todoApp(state = initialState, action) {
  switch (action.type) {
    case ADD_TODO:
      return {
        ...state,
        todos: [
          ...state.todos,
          {
            text: action.text,
            completed: false,
          },
        ],
      };
    case TOGGLE_TODO:
      return {
        ...state,
        todos: state.todos.map((todo, i) => {
          if (i === action.index) {
            return {
              ...todo,
              completed: !todo.completed,
            };
          }
          return todo;
        }),
      };
    default:
      return state;
  }
}
```

View

The view is responsible for displaying the current state of the application to the user. It subscribes to changes in the store and updates the view when the state changes.

Dispatchers

a dispatcher is a function that receives an action object and dispatches it to the Redux store, triggering a state change. The dispatcher then passes the action object to the store's reducer function, which applies the update to the application state according to the rules defined by the application's business logic.

For Example:

```
// dispatch actions
store.dispatch(addTodo('Learn Redux'));
store.dispatch(addTodo('Build an app'));
store.dispatch(toggleTodo(0));

// get the current state
console.log(store.getState());
```

Selectors

Selectors are functions that extract specific data from the application's state. They provide a way to access and transform the data stored in the store.

For Example:

```
// selector
const getCompletedTodos = (state) => {
    return state.todos.filter((todo) => todo.completed === true);
    };
```

Principles of Redux

- Global app state is kept in a single store
- The store state is read-only to the rest of the app
- Reducer functions are used to update the state in response to actions

Summarizing it

Let’s summarize what we have learned in this Lecture:

- Learned about Issues with Prop Drilling.
- Learned about State Management.

- Learned about Context API.
- Learned about Redux and Architecture.
- Learned about components of Redux.
- Learned about the Principles of Redux.

Some References:

- Context: link
- Redux Documentation: link

Redux in React

React Redux Library

React Redux is a popular library that provides a predictable state container for JavaScript applications using the React library. The react-redux library provides a centralized store for state management in React applications. It offers several hooks that help in optimizing code and improving application performance. Hooks are an important concept in React Redux because they allow developers to extract logic from components and reuse it across the application.

Installation

To use React Redux with your React app, install it as a dependency:

```
// If you use npm:
npm install react-redux

// Or if you use Yarn:
yarn add react-redux
```

Provider Component

The Provider component is a React component that allows you to provide the Redux store to all components in your application. It is the top-level component that wraps your entire application and makes the store available to all child components.
The Provider component takes a store prop, which is the Redux store that you want to provide to your application.

Here's an example of how to use the Provider component in a ToDo application:

```
import { useState } from "react";
import { Provider } from "react-redux";
import TodoForm from "./components/ToDoForm/ToDoForm";
import TodoList from "./components/ToDoList/ToDoList";
import store from "./redux/store";

import './App.css';

function App() {
  const [todos, setTodos] = useState([]);

  const createTodo = (text) => {
    setTodos([...todos, { id: todos.length + 1, text, completed: false}]);
  };

  const toggleTodo = (index)=>{
    const list = [...todos];
    list[index].completed = !list[index].completed;
    setTodos(list);
  }

  return (
    <div>
      <h1>To Do App</h1>
      <Provider store={store}>
        <TodoForm onCreateTodo={createTodo} />
        <TodoList todos={todos} onToggle={toggleTodo} />
      </Provider>
    </div>
  );
}

export default App;
```

By default, when the Provider element is used, all child components will have access to the entire Redux store. However, it is possible to scope store access to specific

components using the store prop of the Provider element. To do this, you can create a separate Redux store for each component that requires scoped access to the store. Then, when rendering the component, pass in the appropriate store as a prop to the Provider element.

Hooks

React Redux provides a pair of custom React hooks that allow your React components to interact with the Redux store.

useSelector

The **useSelector** hook is used to extract data from the Redux store. It takes a selector function as input and returns the selected data from the store. So, if store gets updated it will not directly impact the components. This also helps in abstraction and encapsulation of store by hiding the important object. For example, Here the useSelector hook is used to retrieve the todos state from the store. The todos state is then mapped over and rendered to the screen as a list of todo items.

```
import { useSelector } from "react-redux";
import "./ToDoList.css";

function ToDoList() {

  const todos=useSelector((state)=> state.todos)

  return (
    <div className="container">
    <ul>
      {todos.map((todo,index) => (
        <li key={todo.id}>
          <span className="content">{todo.text}</span>
          <span className={todo.completed ?
'completed':'pending'}>{todo.completed ? 'Completed': 'Pending'}</span>
          <button className="btn btn-warning">Toggle</button>
          </li>
```

```
      ))}
    </ul>
    </div>
  );
}

export default ToDoList;
```

The useSelector hook is useful for optimizing performance by avoiding unnecessary re-renders. It allows you to select only the data you need from the store, which can help reduce the amount of data that needs to be processed by the component.

useDispatch

The **useDispatch** hook is used to dispatch actions to modify the state. It returns a reference to the dispatch function provided by the store. This hook can be used to dispatch actions from any component in the application, without the need for prop drilling. The useDispatch hook can be used to dispatch actions from any component in the application.

For example, Each todo item includes a button that, when clicked, dispatches a toggleTodo action to the store. The toggleTodo action is imported from the todoActions file, which contains action creators for various todo-related actions.

The dispatch function is used to dispatch the toggleTodo action, passing in the index of the current todo item as a parameter. This will update the completed property of the selected todo item in the store, which will trigger a re-render of the TodoList component.

```
import { useSelector, useDispatch } from "react-redux";
import { toggleTodo } from "../../redux/actions/todoActions";

import "./ToDoList.css";

function ToDoList() {

  const todos=useSelector((state)=> state.todos);
```

```
  const disptach = useDispatch();

  return (
    <div className="container">
    <ul>
      {todos.map((todo,index) => (
        <li key={todo.id}>
          <span className="content">{todo.text}</span>
          <span className={todo.completed ?
'completed':'pending'}>{todo.completed ? 'Completed': 'Pending'}</span>
          <button className="btn btn-warning"
          onClick={()=>{dispatch(toggleTodo(index))}}
          >Toggle</button>
          </li>
      ))}
    </ul>
    </div>
  );
}

export default ToDoList;
```

The useDispatch hook is useful for optimizing code efficiency by providing a simplified way of dispatching actions. It allows you to avoid the need to pass dispatch down as a prop to child components.

Multiple Reducers

In a typical React Redux application, the state is managed by reducers, which are functions responsible for handling different parts of the state. The decision to use multiple reducers or a single reducer depends on the complexity of your application's state. If your application's state is simple and straightforward, a single reducer may suffice. However, as your application grows in complexity, it can become difficult to manage a large state with a single reducer. Using multiple reducers in your React Redux application can provide better organization, improved scalability, and better performance. For example, let's say you have an e-commerce application that

manages user accounts, products, and orders. You can create three separate reducers for each of these parts of the state.

Combining Reducers

Combining reducers is a technique used in React Redux to manage a complex state in a more organized and manageable way. It involves creating multiple reducers that handle different parts of the state and then combining them into a single root reducer using the **combineReducers** function. The combineReducers function takes an object as its argument, where the keys represent the keys of the root state object, and the values represent the individual reducers.

For example in this case, the root state object has two keys, todos and notes, each of which maps to the corresponding reducer.

```
import * as redux from "redux";
import { combineReducers } from "redux";
import { noteReducer } from "./reducers/noteReducer";
import {todoReducer} from "./reducers/todoReducer";

const result = combineReducers({
    todos:todoReducer,
    notes:noteReducer
})

export const store = redux.createStore(result);
```

With this setup, you can now dispatch actions to update the state managed by each reducer separately. For example, to add a todo item, you can dispatch the following action:

```
{
  type: 'ADD_TODO',
  id: 1,
  text: 'Buy milk'
}
```

This action will be handled by the todoReducer, which will update the todos state accordingly. Similarly, to add a note, you can dispatch the following action:

```
{
  type: 'ADD_NOTE',
  id: 1,
  text: 'Call John'
}
```

This action will be handled by the noteReducer, which will update the notes state accordingly.

Summarizing it

Let's summarize what we have learned in this Lecture:

- Learned about React Redux library.
- Learned about Provider Component.
- Learned about useSelector Hook.
- Learned about useDispatch Hook.
- Learned about Multiple Reducers.
- Learned about Combining the Reducers

Some References:

- Redux API Reference: link
- React Redux Quick Start: link

Redux Toolkit

Introduction

Redux is a state management library that helps manage application states in a predictable and consistent manner. It is widely used in modern web development with React and has been an essential tool for building scalable and maintainable applications. However, working with Redux can sometimes be challenging, especially when it comes to setting up and managing reducers, actions, and selectors. To address these challenges, the Redux team has released Redux Toolkit, a package that simplifies the process of setting up and using Redux.

Challenges with Redux

- **Boilerplate Code:** Setting up Redux involves a lot of boilerplate code. You must create separate files for actions, reducers, and store configuration. This can be time-consuming and error-prone.
- **Complex Reducers:** Writing complex reducers can be difficult, especially when dealing with nested data structures or asynchronous actions.
- **Debugging:** Debugging Redux applications can be challenging, especially when dealing with large and complex application states.

Redux Toolkit library

Redux Toolkit provides a streamlined way of working with Redux, eliminating many of the common pain points of building large-scale Redux applications. It is designed to be backward-compatible with existing Redux code, making it easy to adopt and integrate into existing projects. Some of its key features include:

- A "slice" API that simplifies the process of creating Redux reducers
- A "createAsyncThunk" API that simplifies the process of handling asynchronous actions
- A simplified and standardized file structure for Redux code

- Automatic generation of Redux actions and reducers for common use cases
- A collection of other useful utilities and middleware for Redux.

Migrating from Redux to Redux Toolkit

Install Redux Toolkit

Start by installing Redux Toolkit in your application by running the command:

```
npm install @reduxjs/toolkit
yarn add @reduxjs/toolkit
```

Create slices

Replace your existing Redux actions and reducers with "slices," which are predefined Redux logic blocks in Redux Toolkit. You can create slices using the createSlice() function provided by Redux Toolkit.

To define a slice using createSlice, you need to call the function and pass in an object that contains the name, initialState, and reducers properties.

- name: This property is used to define the name of the slice. It is used to generate the action types for the slice automatically and to create action creators with the correct names.
- initialState: This property is used to define the initial state of the slice. It is used to set the initial state of the store when it is first created.
- reducers: This property defines a set of reducer functions that can update the slice's state. It takes an object as an argument where each key-value pair represents a case reducer. The key is the name of the action, and the value is a function that updates the state. When an action is dispatched, the corresponding reducer function will be called, and the slice's state will be updated accordingly. The payload property of the action object can be accessed using action.payload inside the reducer functions.

```
const todoSlice = createSlice({
  name:'todo',
  initialState:initialState,
  reducers:{
      // this is add action
```

```
      add:(state, action)=>{
              state.todos.push({
                  text:action.payload,
                  completed: false
              })
      },
      toggle:(state, action)=>{
          state.todos.map((todo, i)=>{
              if(i==action.payload){
                  todo.completed=!todo.completed;
              }
              return todo;
          })
      }
  }
});
```

Migrating Store

Replace your existing store creation code with the configureStore() function provided by Redux Toolkit. This function simplifies the store creation process by automatically adding common middleware and other settings.

```
export const store = configureStore({
  reducer:{
      todoReducer,
      noteReducer
  }
})
```

Dispatching Actions

The actions object is exported separately from the reducer.

```
export const todoReducer=todoSlice.reducer;
export const actions = todoSlice.actions;
```

You can use this object to access your actions by importing them and passing them as arguments to the dispatch function.

```
<button className="btn btn-warning"
onClick={()=>{disptach(actions.toggle(index))}}>Toggle</button>
```

Setting Up Selectors

You can define a new selector function called todoSelector, which extracts the todoReducer slice of the state.

```
// selector
export const todoSelector = (state)=>state.todoReducer.todos;
```

Once you have defined your selectors, you can use the useSelector hook from the react-redux library to access the selected data in your components.

Create React App with Redux Template

Redux Toolkit provides a template for creating a React app with Redux preconfigured, which you can use to start quickly with building a new Redux-powered React application. Run the following command to create a new React app with the Redux Toolkit template:

```
npx create-react-app my-app --template redux
```

This will create a new React app with the Redux Toolkit template and install all the necessary dependencies.

Extra Reducers

Extra Reducer allows you to execute an action which is the action of some other reducer. It allows you to share an action, invoke an action or dispatch an action that belongs to some other reducer. Using extra reducers like this can help simplify your code and make it easier to share actions between different reducers in your Redux store.

For Example, if we want to dispatch a notification when a todo is added. Whenever an action with the type todo/add is dispatched, the function defined in the extraReducers property is executed.

```
const notificationSlice = createSlice({
  name:'notification',
  initialState,
  reducers:{
      reset: (state, action)=>{
          state.message="";
      }
  },
  extraReducers:{
      "todo/add":(state, action)=>{
          console.log("todo/add in notificationReducer");
        state.message="Todo is created";
      }
  }
});
```

The reset action allows you to clear the notification message when it is no longer needed, such as after a user has read the message. "reset" action that can be dispatched to reset the message property to an empty string.

Creating Extra Reducers using Builder and addCase

Creating extra reducers using the Builder and Case API in Redux Toolkit allows you to handle actions dispatched from other slices of your Redux store without hardcoding their names into your reducer.

```
const notificationSlice = createSlice({
  name:'notification',
  initialState,
  reducers:{
      reset: (state, action)=>{
          state.message="";
      }
  },
  extraReducers:(builder)=>{
      builder.addCase(actions.add, (state, action)=>{
          state.message="Todo is created";
      })
  }
});
```

The builder argument is an instance of the ActionReducerMapBuilder class, which provides methods for adding new case reducers to your slice. The addCase method takes two arguments: the action creator function and a callback function that handles the action. In this case, we pass the actions.add action creator function, which is defined elsewhere in our application, and a callback function that sets the message property of our state to "Todo is created". This approach allows us to handle actions from other parts of our application without tightly coupling our reducers to the actions that they handle.

Creating Extra Reducers using Maps

The extraReducers field uses a map object to define an action handler for the add action. The key of the map object is the action type, and the value is the function that will handle the action. In this case, when the add action is dispatched, the message is set to "Todo is created".

```
const notificationSlice = createSlice({
  name:'notification',
  initialState,
  reducers:{
      reset: (state, action)=>{
          state.message="";
      }
  },
  extraReducers:{
      // map objects: [key]: value
      [actions.add]: (state, action)=>{
          state.message="Todo is created";
      }
  }
});
```

Summarizing it

Let’s summarize what we have learned in this Lecture:

- Learned about challenges with Redux.
- Learned what Redux Toolkit is.

- Learned how to migrate from redux to the redux toolkit.
- Learned how to create react app with the redux template.
- Learned about Extra Reducers.

Some References:

- Getting started with Redux Toolkit: link
- Installation: link

Advanced Redux

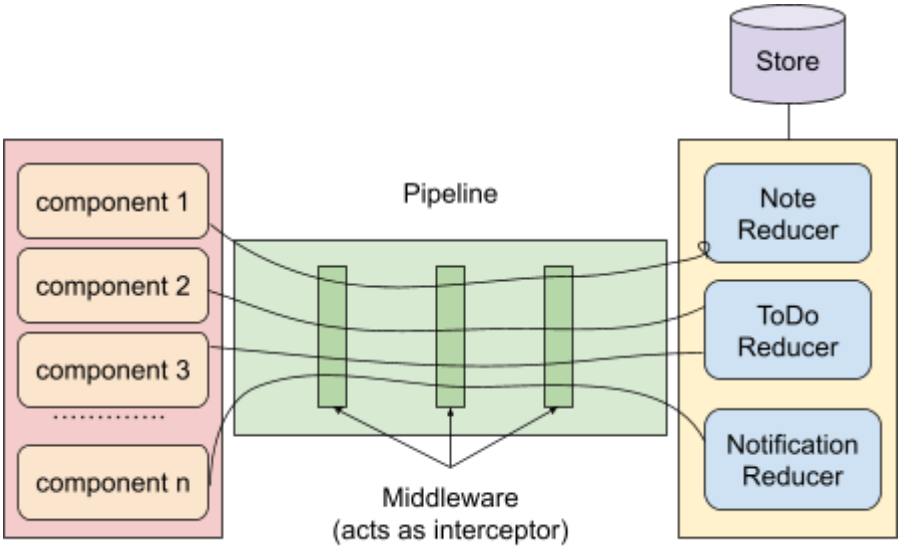
The Problem

In large projects, it is important to keep track of what is happening inside the application at all times. This is where loggers come into play. A logger is a utility that captures information about various events that occur during the application's runtime, such as user actions, server responses, errors, and warnings.
In Redux, actions are dispatched from components to the store to update the state. Logging every action dispatched from the components to the store using console.log() can help debug and track the application flow. However, modifying every reducer to add console.log statements is not an ideal approach, as it can become difficult to manage when there are many components and reducers. One solution to this problem is to use middleware in Redux.

Middleware - as a solution,

Middleware in Redux intercepts actions as they are dispatched to the store and can perform some additional logic on them before they reach the reducer.
One such middleware that can be used to log all actions is the loggerMiddleware.
In the case of Redux, middleware is added to the store as a pipeline, and each middleware in the pipeline can access the store, the next middleware in the pipeline, and the action being dispatched. When an action is dispatched from the component, it first passes through the middleware pipeline before reaching the reducer. Each middleware in the pipeline has the option to modify the action, dispatch additional actions, or perform other logic before passing it on to the next middleware using the next pointer. The concept of closure allows the middleware to access the Redux store and the next function even after the middleware function has completed execution.
It is important to note that every middleware in the pipeline should call the next function with the action as its argument to pass it along to the next middleware. This

ensures that all middleware in the pipeline can process the action before it reaches the reducer.



To solve the problem of logging every action, we can create a custom middleware that logs the action before passing it on to the next middleware. To use the middleware, we can add it to the middleware array in the Redux store.

```
export const loggerMiddleware = (store)=>{
  return function(next){
      return function(action){
          // log actions
          console.log("[LOG]: "+action.type+ " "+ new Date().toString());
          // call next middleware in pipeline.
          next(action);
          // log the modified state of app.
          console.log(store.getState());
      }
  }
}
```

Calling an API

Fetch function

To make an asynchronous call to an API in React using the fetch function, you can wrap the fetch function in a useEffect hook. Since the fetch function is asynchronous

and returns a promise, you can use either then and catch or async/await to handle the promise.

For Example, we make an API call to fetch todos from the server running on http://localhost:4100/api/todos. We then convert the response to JSON using the json() function, which also returns a promise. Finally, we log the parsed JSON data to the console.

```
useEffect(() => {
  fetch("http://localhost:4100/api/todos")
    .then(res=>res.json())
      .then(parsedJson=>{
        console.log(parsedJson);
      })
}, []);
```

Axios Function

Axios is a commonly used library for making HTTP requests to an API. Axios provides an easy-to-use interface for making asynchronous requests, and it can be used in combination with Redux to manage state and handle API responses.

You can run `npm install axios` to install Axios.

For example, the useEffect hook is used to make an HTTP GET request to an API using Axios. The axios.get method takes the API URL as its argument and returns a promise that resolves with the response data. Once the response is received, the data is logged into the console. The [] as the second argument to useEffect ensures that the effect runs only once when the component mounts.

```
useEffect(() => {
  axios.get("http://localhost:4100/api/todos")
    .then(res=>
        {
          console.log(res.data);
        }
      );
}, []);
```

How to manage API Data?

To manage API data in React Redux, there are two ways: either in the components or in the Redux itself.

Using Components

If you choose to manage API calls in the components, you can use the useEffect hook to fetch the initial data from the API, and then once you have received the data, dispatch an action to update the Redux store.

For Example,

You can specify an action to update the Redux Store.

```
const todoSlice = createSlice({
  name:'todo',
  initialState:initialState,
  reducers:{
      setInitialState:(state, action)=>{
          state.todos=action.payload;
      },
 ...........
```

Then you can dispatch the action, once you receive data from the API.

```
useEffect(() => {
  axios.get("http://localhost:4100/api/todos")
    .then(res=>
        {
          console.log(res.data);
          disptach(actions.setInitialState(res.data));
        }
      );
}, []);
```

Using Redux

When managing API data in Redux, it's important to note that we cannot make asynchronous calls from our reducer actions. This is because reducers are designed to be pure functions, meaning they should not have any side effects. They should only handle state updates based on the actions they receive. Instead, we can use the createAsyncThunk function provided by Redux Toolkit to handle async calls and update the Redux store accordingly. This allows you to manage API calls and state

updates in a centralized location in the Redux store, making it easier to manage your application's state and data flow.

Create AsyncThunk

createAsyncThunk is a utility function provided by the Redux Toolkit that generates a Redux thunk. A thunk is a function that can be dispatched like a regular Redux action, but it can also contain asynchronous logic, such as fetching data from an API. The generated thunk function can be dispatched to trigger the async operation. When the async operation completes, it will automatically dispatch the appropriate action type based on the result.

For Example, When calling createAsyncThunk, you provide it with two parameters: a string that represents the base action type and a callback function that performs the asynchronous operation. The callback function passed to createAsyncThunk should be an async function. It should return the result of the operation as its resolved value or throw an error if the operation fails.

```
export const getInitialState = createAsyncThunk("todo/getInitialState",
    async (_,thunkAPI)=>{
    // async calls.
    try{
        const res = await axios.get("http://localhost:4100/api/todos")
        thunkAPI.dispatch(actions.setInitialState(res.data));
    }catch(err){
        console.log(err);
    }

})
```

When using createAsyncThunk, you may encounter an issue with the middleware in the Redux store. By default, the Redux Toolkit adds some middleware to the store, including the thunk middleware that enables using thunks like createAsyncThunk. However, if you have other middleware in your store that modifies the action or dispatch behavior, it may interfere with the behavior of createAsyncThunk. By using getDefaultMiddleware and spreading it into your middleware array, you ensure that

the necessary middleware for createAsyncThunk is included while also allowing you to add any other middleware that you need to the store.

```
middleware:[...getDefaultMiddleware(),loggerMiddleware]
```

Advantages

- **Separation of Async Code:** By using createAsyncThunk, you can separate the async logic from the component code and move it to the Redux actions. This keeps the components lightweight and easier to manage and also simplifies testing.
- **Consistent pattern:** By using createAsyncThunk, you establish a consistent pattern for representing async operation states in your Redux store. This makes it easier to reason about your code and to debug it when issues arise.
- **Flexibility:** createAsyncThunk is flexible enough to allow you to customize its behavior if needed. For example, you can provide your own middleware to modify the behavior of the async operation or to add additional logic to the action dispatching process.

Summarizing it

Let's summarize what we have learned in this Lecture:

- Learned about logging in projects.
- Learned what middlewares are?
- Learned how to call an API.
- Learned how to manage API data.
- Learned about createAsyncThunk.

Some References:

- createAsyncThunk: link
- Axios: link