

Experiment 4

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Branch: BE CSE

Semester: 6th

Subject Name: Full Stack Development

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Subject Code: 23CSH-309

Aim:

To optimize the performance of the EcoTrack React application using memoization techniques and code splitting, and to enhance the user interface using enterprise-grade Material UI components.

Objective:

After completing this experiment, the student will be able to:

- Understand the causes of unnecessary re-renders in React applications
- Optimize React components using `React.memo` to prevent avoidable re-renders
- Apply `useMemo` to efficiently compute derived data and avoid redundant calculations
- Use `useCallback` to memoize event handler functions and improve component performance
- Implement lazy loading of components and routes using `React.lazy` and `Suspense`
- Reduce initial bundle size and improve application load performance through code splitting
- Enhance the visual appearance and usability of the EcoTrack application using Material UI components
- Design a clean, consistent, and responsive user interface using Material UI layouts and typography

Implementation/Code:

Login.jsx:

```
import { useAuth } from "../context/AuthContext";
import { useNavigate } from "react-router-dom";
import Button from '@mui/material/Button';
import Box from '@mui/material/Box';
import Typography from '@mui/material/Typography';

const Login = () => {
  const { login } = useAuth();
  const navigate = useNavigate();
```

```
const handleLogin = () => {
  login();
  navigate("/dashboard");
};

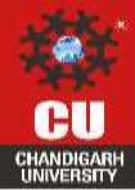
return (
  <Box sx={{{
    display: 'flex',
    flexDirection: 'column',
    alignItems: 'center',
    justifyContent: 'center',
    minHeight: '100vh',
    p: 3
  }}>
  <Typography variant="h4" gutterBottom>
    Welcome to EcoTrack
  </Typography>
  <Button
    variant="contained"
    color="primary"
    size="large"
    onClick={handleLogin}
    sx={{ mt: 3, px: 6, py: 1.5 }}
  >
    Login to EcoTrack
  </Button>
</Box>
);
};

export default Login;
```

Dashboard.jsx:

```
import { useState } from 'react';
import { Outlet, useNavigate, Link as RouterLink } from 'react-router-dom';
import { useAuth } from "../context/AuthContext";
import Header from "../components/Header";

import AppBar from '@mui/material/AppBar';
import Box from '@mui/material/Box';
import Toolbar from '@mui/material/Toolbar';
import Typography from '@mui/material/Typography';
```



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```
import Drawer from '@mui/material/Drawer';
import List from '@mui/material/List';
import ListItem from '@mui/material/ListItem';
import ListItemButton from '@mui/material/ListItemButton';
import ListItemIcon from '@mui/material/ListItemIcon';
importListItemText from '@mui/material/ListItemText';
import Divider from '@mui/material/Divider';
import IconButton from '@mui/material/IconButton';
import Button from '@mui/material/Button';

import HomeIcon from '@mui/icons-material/Home';
import DashboardIcon from '@mui/icons-material/Dashboard';
import AssessmentIcon from '@mui/icons-material/Assessment';
import LogoutIcon from '@mui/icons-material/Logout';
import MenuIcon from '@mui/icons-material/Menu';

const drawerWidth = 240;

const Dashboard = () => {
  const { logout } = useAuth();
  const navigate = useNavigate();
  const [mobileOpen, setMobileOpen] = useState(false);

  const handleLogout = () => {
    logout();
    navigate("/login");
  };

  const handleDrawerToggle = () => {
    setMobileOpen(!mobileOpen);
  };

  const drawerContent = (
    <div>
      <Toolbar /> {/* spacer under AppBar */}
      <Divider />
      <List>
        <ListItem disablePadding>
          <ListItemButton
            component={RouterLink}
            to=""
            onClick={() => setMobileOpen(false)}
          >
```

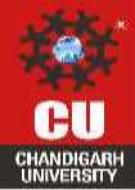


```
<ListItemIcon><HomeIcon /></ListItemIcon>
<ListItemText primary="Home" />
</ListItemButton>
</ListItem>

<ListItem disablePadding>
<ListItemButton
  component={RouterLink}
  to="overview"
  onClick={() => setMobileOpen(false)}
>
  <ListItemIcon><DashboardIcon /></ListItemIcon>
  <ListItemText primary="Overview" />
</ListItemButton>
</ListItem>

<ListItem disablePadding>
<ListItemButton
  component={RouterLink}
  to="reports"
  onClick={() => setMobileOpen(false)}
>
  <ListItemIcon><AssessmentIcon /></ListItemIcon>
  <ListItemText primary="Reports" />
</ListItemButton>
</ListItem>
</List>
<Divider />
<List>
  <ListItem disablePadding>
    <ListItemButton onClick={handleLogout} sx={{ color: 'error.main' }}>
      <ListItemIcon><LogoutIcon color="error" /></ListItemIcon>
      <ListItemText primary="Logout" />
    </ListItemButton>
  </ListItem>
</List>
</div>
);

return (
<Box sx={{ display: 'flex' }}>
  {/* AppBar at top */}
<AppBar
```



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```
position="fixed"
sx={{
  width: { sm: `calc(100% - ${drawerWidth}px)` },
  ml: { sm: `${drawerWidth}px` }, // ← important: push content right
  backgroundColor: '#4CAF50',
}}
>
<Toolbar>
<IconButton
  color="inherit"
  edge="start"
  onClick={handleDrawerToggle}
  sx={{ mr: 2, display: { sm: 'none' } }}
>
  <MenuIcon />
</IconButton>
<Typography variant="h6" noWrap component="div">
  Dashboard
</Typography>
</Toolbar>
</AppBar>

/* Sidebar - LEFT side */
<Box
  component="nav"
  sx={{
    width: { sm: drawerWidth },
    flexShrink: { sm: 0 }
  }}
>
  /* Mobile temporary drawer */
<Drawer
  variant="temporary"
  open={mobileOpen}
  onClose={handleDrawerToggle}
  ModalProps={{ keepMounted: true }}
  sx={{
    display: { xs: 'block', sm: 'none' },
    '& .MuiDrawer-paper': {
      boxSizing: 'border-box',
      width: drawerWidth,
      backgroundColor: '#4CAF50', // green theme
      color: 'white',
    }
  }}
>
```



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```
        },
      })
    >
  {drawerContent}
</Drawer>

{/* Desktop permanent drawer - LEFT */}
<Drawer
  variant="permanent"
  sx={{
    display: { xs: 'none', sm: 'block' },
    '& .MuiDrawer-paper': {
      boxSizing: 'border-box',
      width: drawerWidth,
      backgroundColor: '#4CAF50',
      color: 'white',
    },
  }}
  open
>
  {drawerContent}
</Drawer>
</Box>

{/* Main content - pushed to right */}
<Box
  component="main"
  sx={{
    flexGrow: 1,
    p: 3,
    width: { sm: `calc(100% - ${drawerWidth}px)` },
    ml: { sm: `${drawerWidth}px` }, // ← ensures shift
    mt: '64px', // space under AppBar (Toolbar height)
    backgroundColor: 'background.default',
  }}
>
  {/* Spacer for fixed AppBar */}
  <Toolbar />

  {/* This is where your child routes render: DashboardHome / Overview / Reports
  */}
  <Outlet />
</Box>
```

```
</Box>
);
};

export default Dashboard;

App.jsx:
import { lazy, Suspense } from "react";
import { Routes, Route, Navigate } from "react-router-dom";
import ProtectedRoute from "./routes/ProtectedRoute";

// Lazy load pages
const Dashboard = lazy(() => import("./pages/Dashboard"));
const DashboardHome = lazy(() => import("./pages/DashboardHome"));
const Overview = lazy(() => import("./pages/Overview"));
const Reports = lazy(() => import("./pages/Reports"));
const Login = lazy(() => import("./pages/Login"));

const App = () => {
  return (
    <Suspense fallback={
      <div style={{ display: 'flex', justifyContent: 'center', alignItems: 'center', minHeight: '100vh' }}>
        Loading application...
      </div>
    }>
      <Routes>
        <Route path="/login" element={<Login />} />

        <Route
          path="/dashboard"
          element={
            <ProtectedRoute>
              <Dashboard />
            </ProtectedRoute>
          }
        >
          <Route index element={<DashboardHome />} />
          <Route path="overview" element={<Overview />} />
        
```

```
<Route path="reports" element={<Reports />} />
</Route>

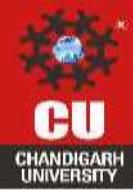
<Route path="/" element={<Navigate to="/dashboard" />} />
</Routes>
</Suspense>
);
};

export default App;
```

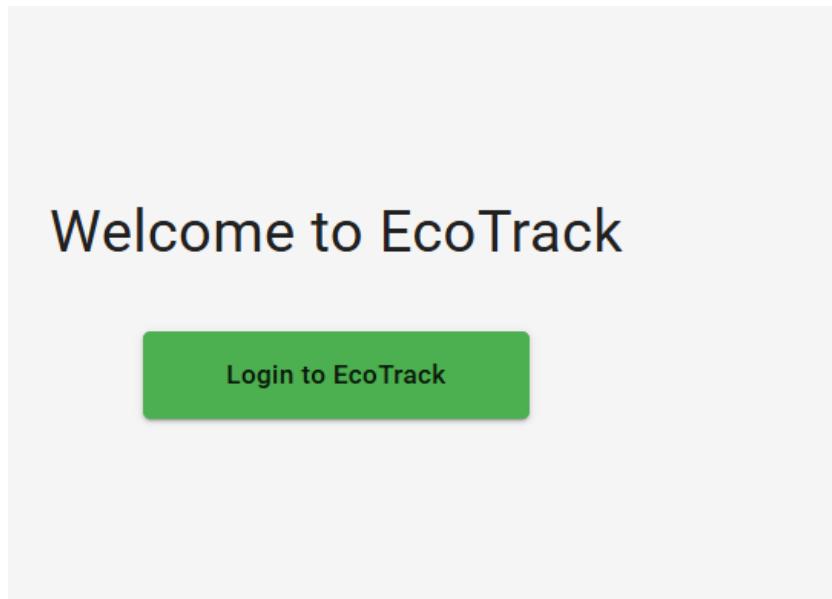
Main.jsx:

```
import React from "react";
import ReactDOM from "react-dom/client";
import App from "./App";
import { BrowserRouter } from "react-router-dom";
import { AuthProvider } from "./context/AuthContext";
import { Provider } from "react-redux";
import { store } from "./redux/store";
import { ThemeProvider } from '@mui/material/styles';
import CssBaseline from '@mui/material/CssBaseline';
import theme from "./theme";
import "./index.css";
import "@fontsource/roboto/300.css";
import "@fontsource/roboto/400.css";
import "@fontsource/roboto/500.css";
import "@fontsource/roboto/700.css";
```

```
ReactDOM.createRoot(document.getElementById("root")).render(
<React.StrictMode>
  <Provider store={store}>
    <ThemeProvider theme={theme}>
      <CssBaseline />
      <BrowserRouter>
        <AuthProvider>
          <App />
        </AuthProvider>
      </BrowserRouter>
    </ThemeProvider>
  </Provider>
</React.StrictMode>
);
```



Output:



Dashboard

- [Home](#)
- [Overview](#)
- [Reports](#)
- [Logout](#)

Total Activities

- Car Travel: 4 Kg
- Electricity Usage: 6 Kg
- Cycling: 0 Kg

High Carbon (> 4 Kg)

- Electricity Usage

Low Carbon (\leq 4 Kg)

- Car Travel
- Cycling

[Refresh Logs](#)



Overview Page

This is the Overview section of EcoTrack.

Reports & Analytics

Detailed reports and carbon footprint analysis coming soon...

Learning Outcome:

1. Identify and analyze causes of unnecessary re-renders in a React application.
2. Apply React.memo, useMemo, and useCallback to optimize component rendering performance.
3. Implement code splitting and lazy loading using React.lazy and Suspense to improve load time.
4. Design a responsive and consistent UI using Material UI components and theming.
5. Integrate performance optimization techniques with secure routing and modern React architecture.