CHANDIGARH UNIVERSITY
Discover. Learn. Empower.

Experiment 4

Student Name: Geetika **UID: 23BCS12885**
Branch: BE CSE **Section/Group: KRG 3A**
Semester: 6th **Date of Performance: 03/02/26**
Subject Name: Full Stack Development **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';
```

```
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';
import ListItemText 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
```

```
  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',
```

```
        },
      }}
    >
      {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:

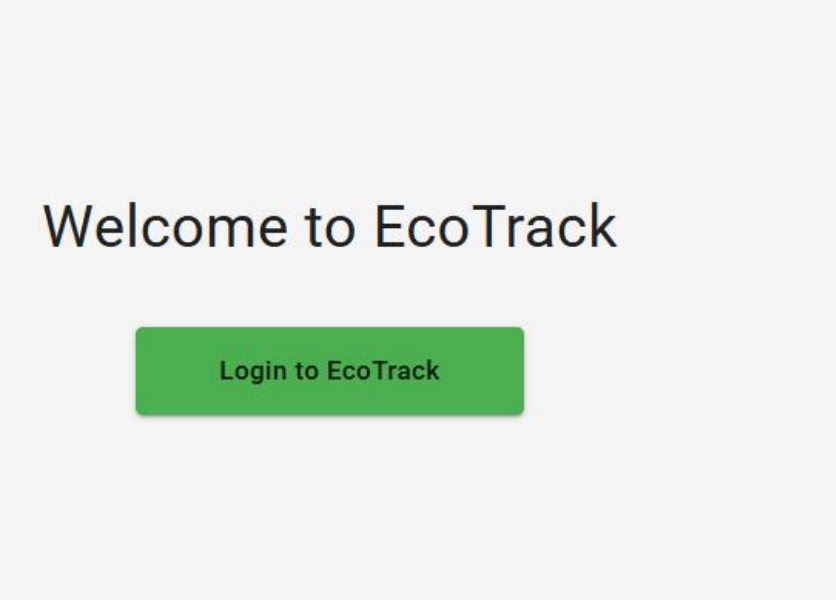
```
import { lazy, Suspense } from "react";
import { Routes, Route, Navigate } from "react-router-dom";
import ProtectedRoute from "./routes/ProtectedRoute";

// 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 />} />
```

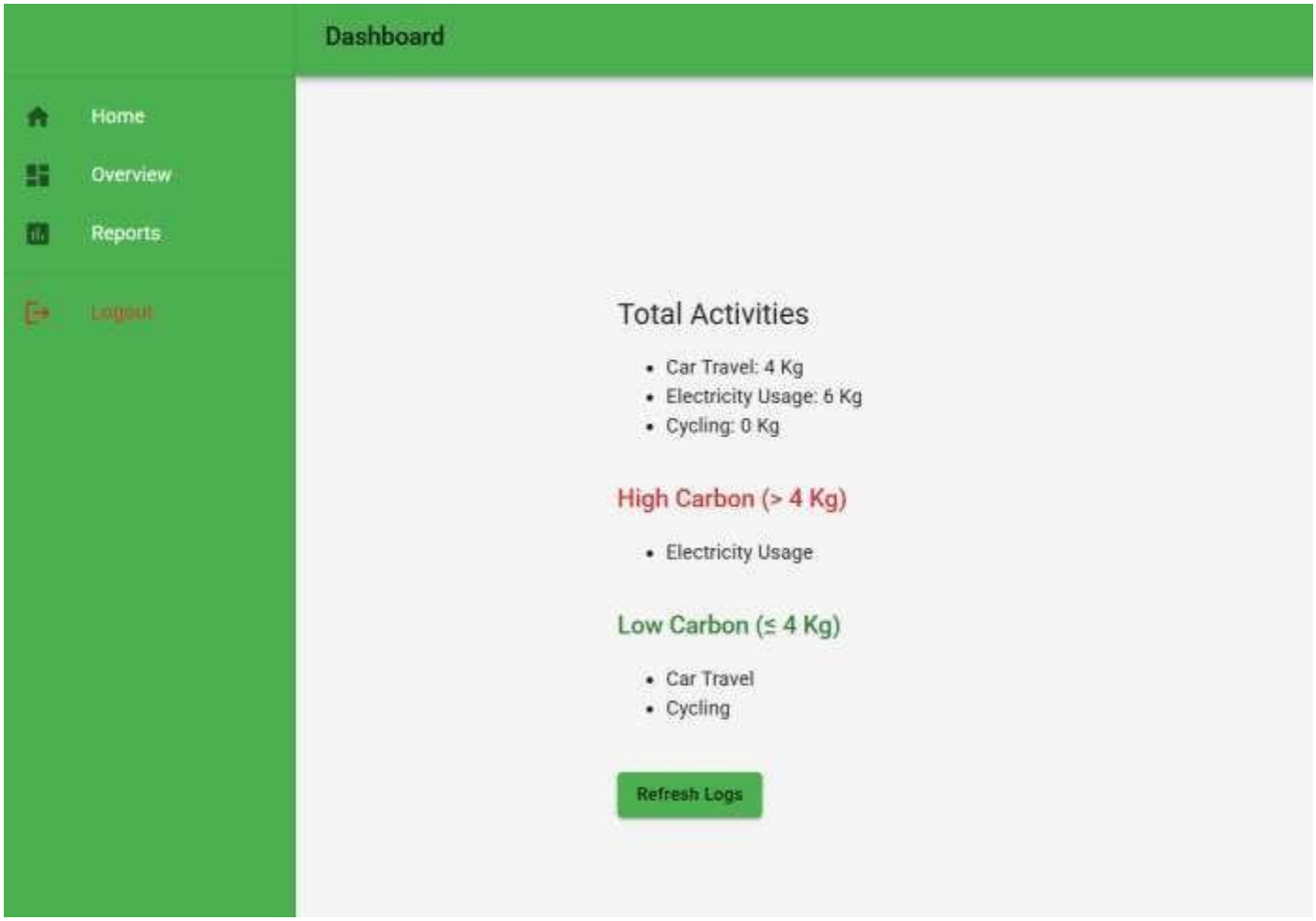
```
            <Route path="reports" element={<Reports />} />
          </Route>

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

  export default App;
```

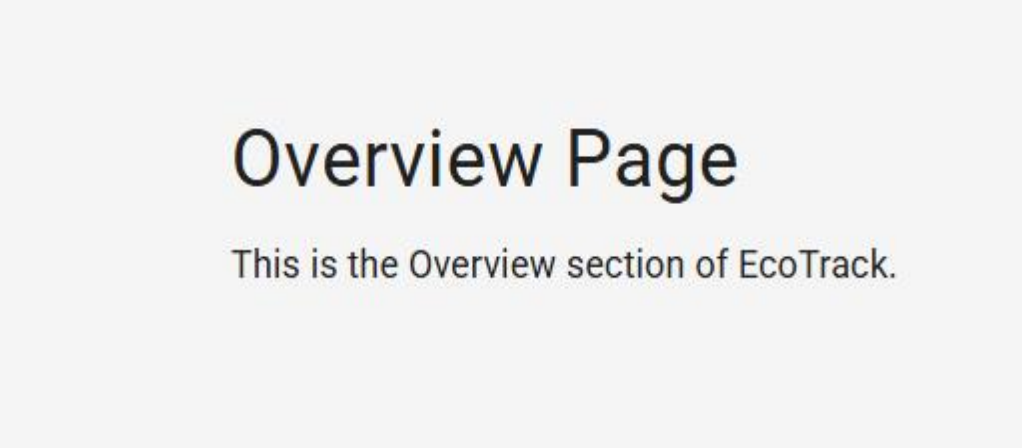
Main.jsx:

```
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:


Welcome to EcoTrack
Login to EcoTrack


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 (≤ 4 Kg)
Car Travel
Cycling
Refresh Logs



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.