CHANDIGARH UNIVERSITY

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Experiment 4

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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;
```

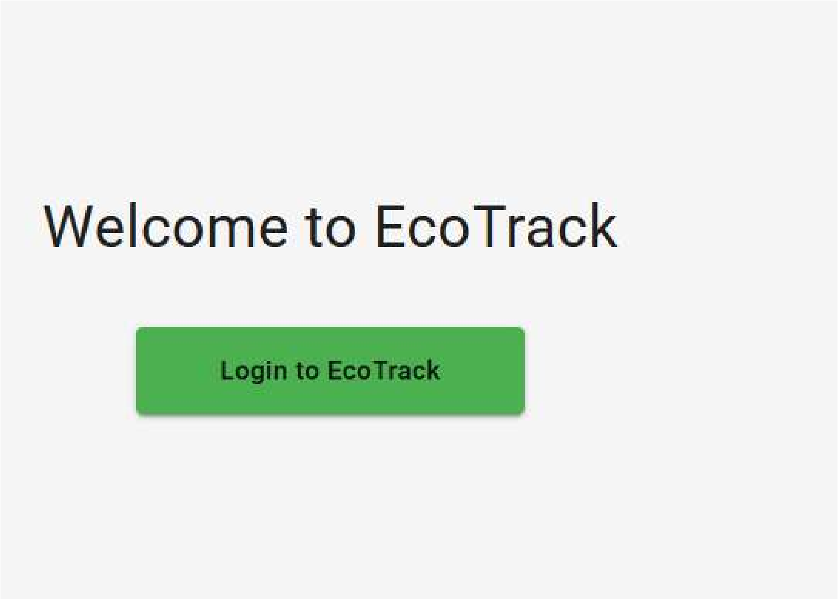
App.jsx:

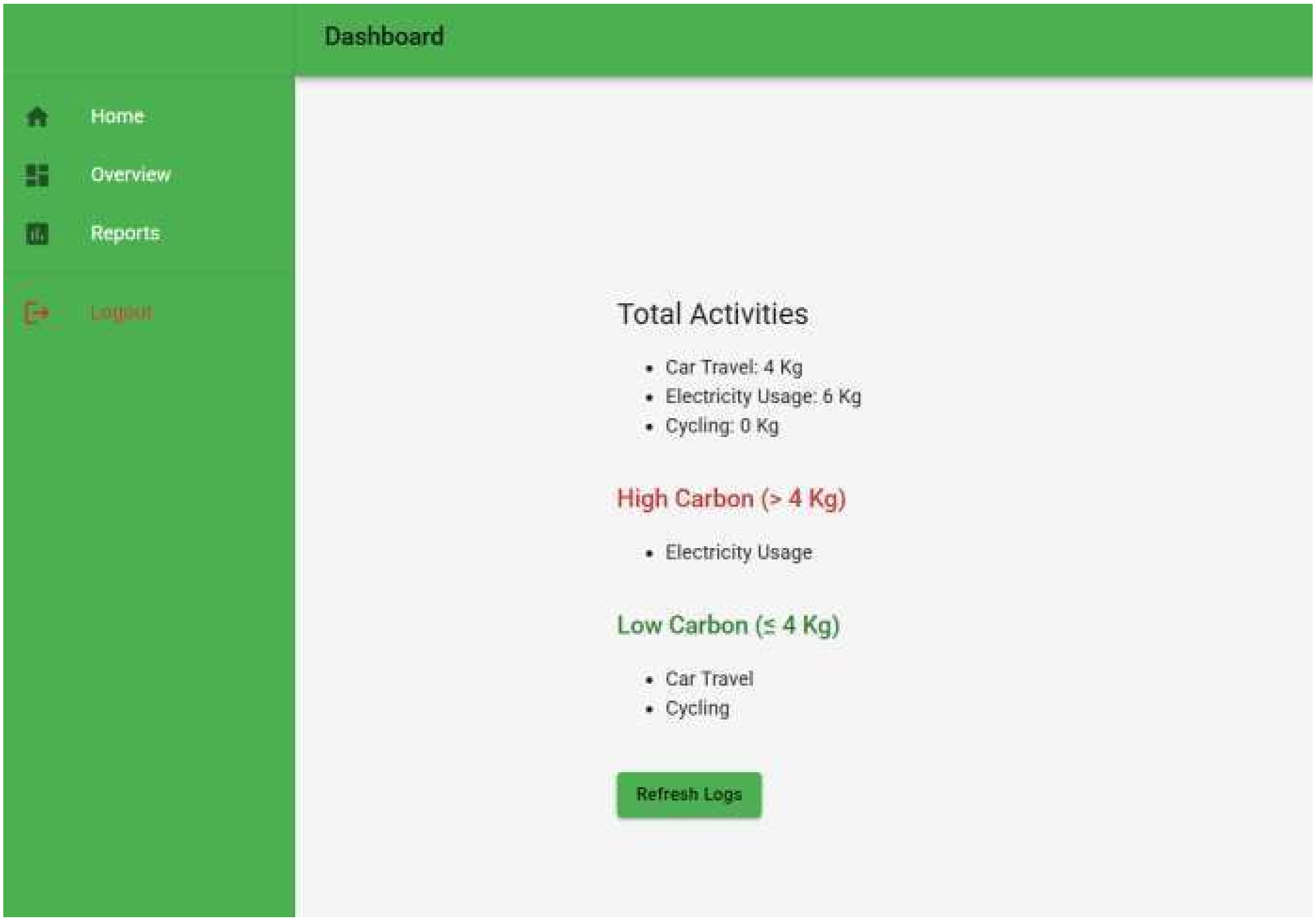
```
import { lazy, Suspense } from "react";
import { Routes, Route, Navigate } from "react-router-dom";
import ProtectedRoute from "./routes/ProtectedRoute";

// 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



Total Activities

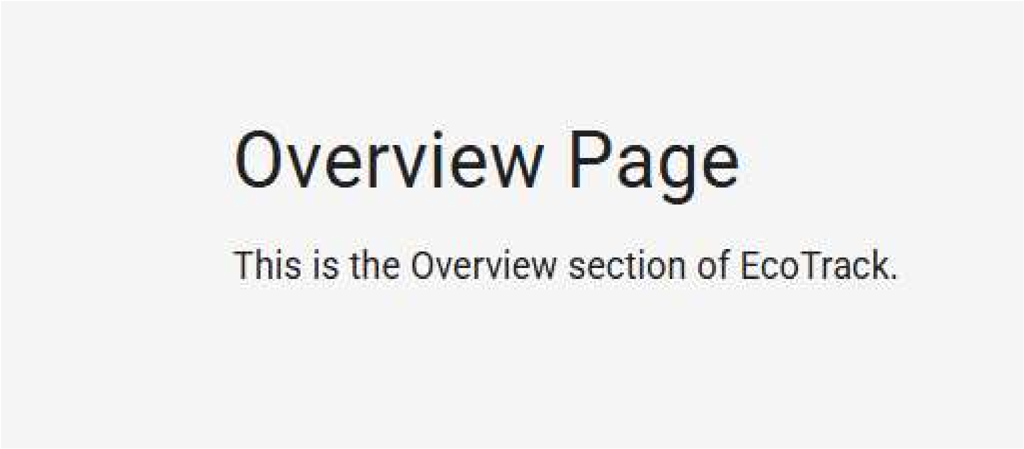
- Car Travel: 4 Kg
- Electricity Usage: 6 Kg
- Cycling: 0 Kg

High Carbon (> 4 Kg)

- Electricity Usage

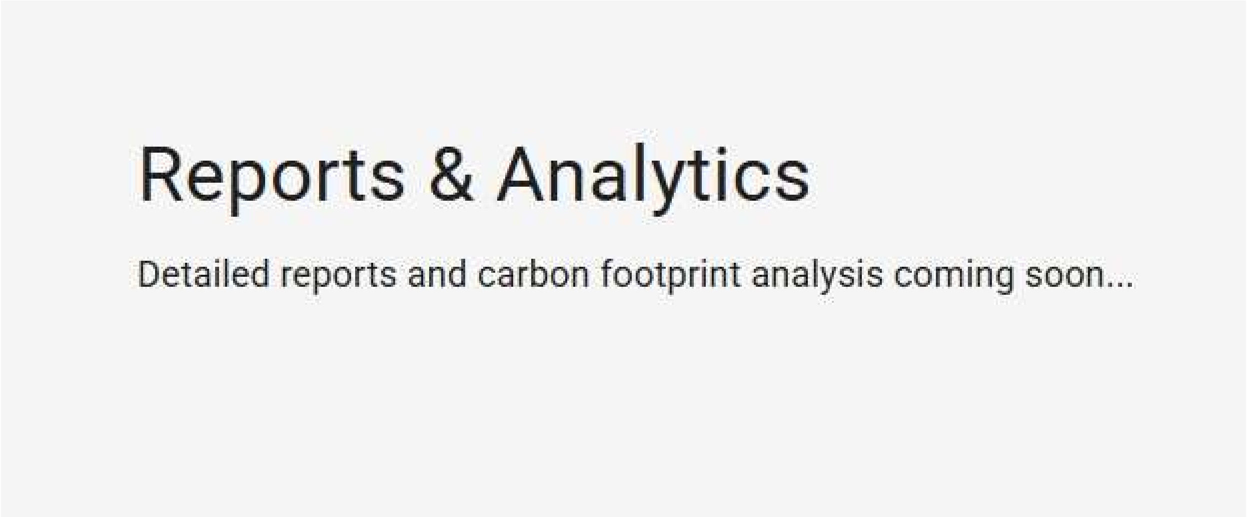
Low Carbon (≤ 4 Kg)

- Car Travel
- Cycling



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.