



Edux: A Centralized Smart E-Learning Platform For Personalized Online Education

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Abstract: EduX is a centralized and smart E-learning platform developed to enhance the digital education experience for both students and educators. It integrates essential features such as secure user authentication, personalized dashboards, real-time chatbot support, interactive quizzes, attendance monitoring, and a responsive design. Built using modern web technologies like HTML, CSS, JavaScript, Node.js, Express.js, MongoDB, EJS, and Bootstrap, EduX aims to deliver a seamless, interactive, and user-friendly learning environment. This paper outlines the system's development process, feature implementation, and the use of each technology stack component, providing a comprehensive understanding of how EduX meets the growing needs of digital education.

Index Terms - Smart E-learning Platform, User Authentication, Personalized Dashboard, Notes, Chatbot Integration, Quiz Monitoring, Attendance Tracking, Responsive Web Design.

I. INTRODUCTION

The shift to digital learning has highlighted the need for efficient and interactive online platforms that cater to diverse student needs. EduX addresses this demand by offering a centralized platform where students can access their course content, track progress, manage notes, interact with a chatbot, and take quizzes in a secure and responsive environment. This paper describes the core features of EduX and explains how various technologies and algorithms have been used to implement them.

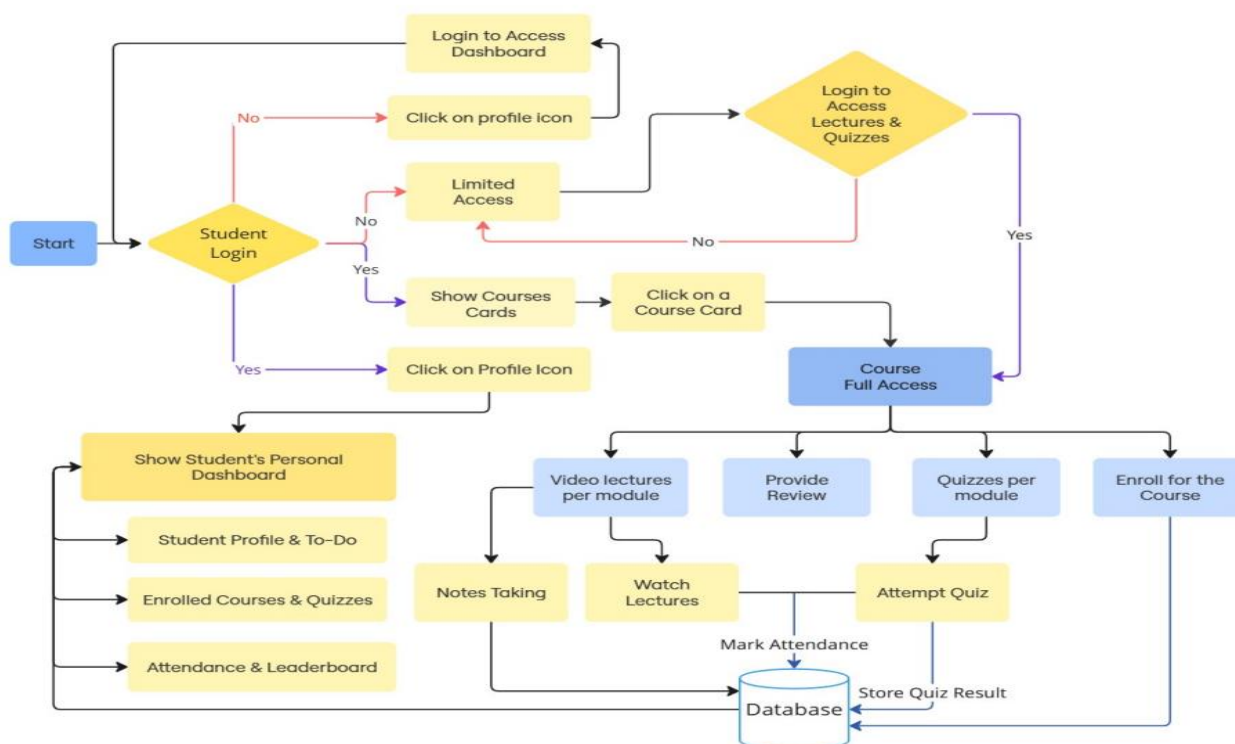


Fig1: System/Process Architecture

II. System Features

EduX comes with several features that make the online learning experience more organized, interactive, and user-friendly:

- **User Authentication and Authorization:** EduX ensures secure login and logout functionality so that users can safely access their personalized dashboard. Authentication and session handling are implemented using Passport in Node.js to ensure secure access and role-based permissions.
- **Personalized Dashboard:** Once logged in, users are greeted with their dashboard. This contains their profile information, a personalized To-Do application for tracking and managing their tasks, enrolled courses with their progress, attendance records, quiz results and a leaderboard section to access other user's profile and dashboard. This helps students stay organized and keep track of their academic journey and to connect with other users in one place.
- **Notes-Taking Feature:** Students have the option to write, save, and download notes for each module. These notes are saved in PDF format and efficiently stored using a NoSQL schema. Notes per module can also be saved in system to access/read/update anytime online, making it easy for students to access their study material offline/online whenever they need it.
- **Quiz and Attendance Monitoring:** EduX simplifies tracking by automatically marking a student's attendance and track each enrolled course's progress once they start watching video lecture and attempt/submit quiz. Quizzes are integrated into each module to help evaluate learning. The quiz scores and attendance records are stored in the database securely. Attendance and progress for each course is calculated using the formula:

$$\text{Progress} = \Sigma (\text{Total number of quizzes completed in the course} / \text{Total Number of quizzes in the course}) * 100,$$

Attendance = Σ (Progress% of [All enrolled courses]) / Total Number of Enrolled Courses, allowing dynamic and real-time updates.

- **Chatbot Integration:** A built-in chatbot powered by generative AI using Google's Gemini API helps answer frequently asked questions or provide assistance in real time. It improves student engagement by giving quick support without having to wait for manual replies.
- **Search Feature with MongoDB Regex:** Users can search courses dynamically using tutor names or course titles through MongoDB's regular expression search functionality, ensuring flexible and efficient filtering.
- **Mobile-Responsive Design:** Whether it's a desktop, tablet, or smartphone, EduX adapts its layout to the screen size. This ensures a smooth user experience across different devices and allows students to learn from anywhere.
- **Progressive Web Application (PWA) Support:** One of EduX's standout features is that it is developed as a Progressive Web Application. This means the platform is not only accessible through the browser but can also be installed directly on both desktop and mobile devices. Once installed, users can access EduX like a native app without needing to open the browser, offering faster access and better user engagement. Offline capabilities and push notifications (if integrated) further enhance the user experience, especially for students with limited internet access.

III. Methodology and Technology Stack Usage

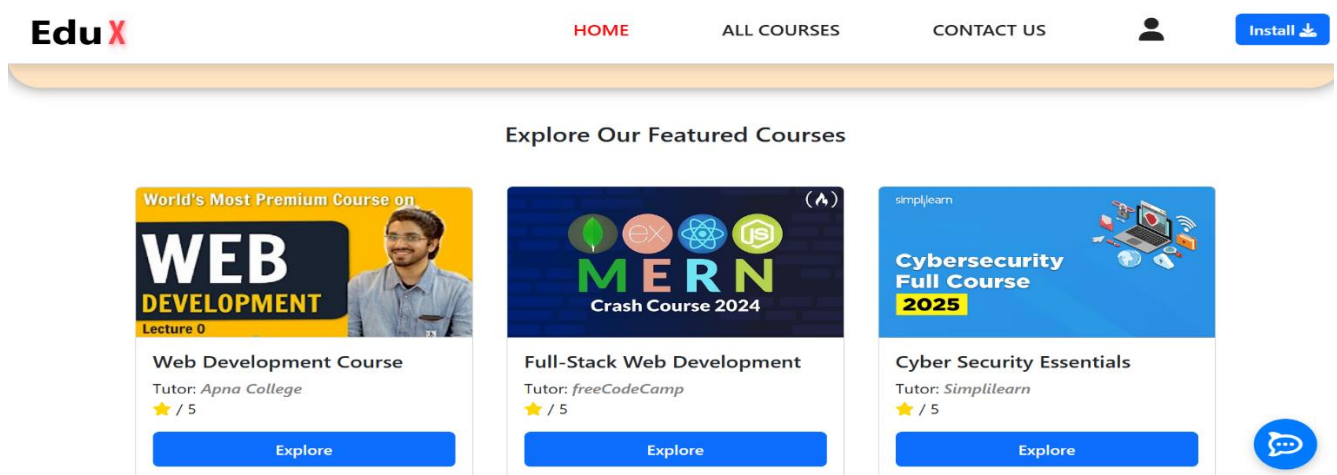
To bring EduX to life, various modern web development technologies and methods were used:

- **Frontend Technologies:**
 - **HTML & CSS:** Used for creating the basic structure and styling of the web pages.
 - **JavaScript:** Adds interactivity, such as handling events, form validation, and DOM manipulation.
 - **Bootstrap:** Provides pre-styled components for responsive and mobile-friendly layouts.
- **Templating Engine:**
 - **EJS (Embedded JavaScript Templates):** Used to dynamically render HTML content with embedded JavaScript, helping in sending personalized content like user dashboards and course details.
- **Backend Technologies:**
 - **Node.js:** Serves as the runtime environment for executing JavaScript on the server side, handling requests and responses.
 - **Express.js:** A web application framework used to set up routes, middleware, and RESTful APIs efficiently.
- **Database:**
 - **MongoDB Atlas:** A cloud-hosted NoSQL database used to store user data, course information, quiz scores, and attendance records. It provides scalability and flexibility in handling various types of data.

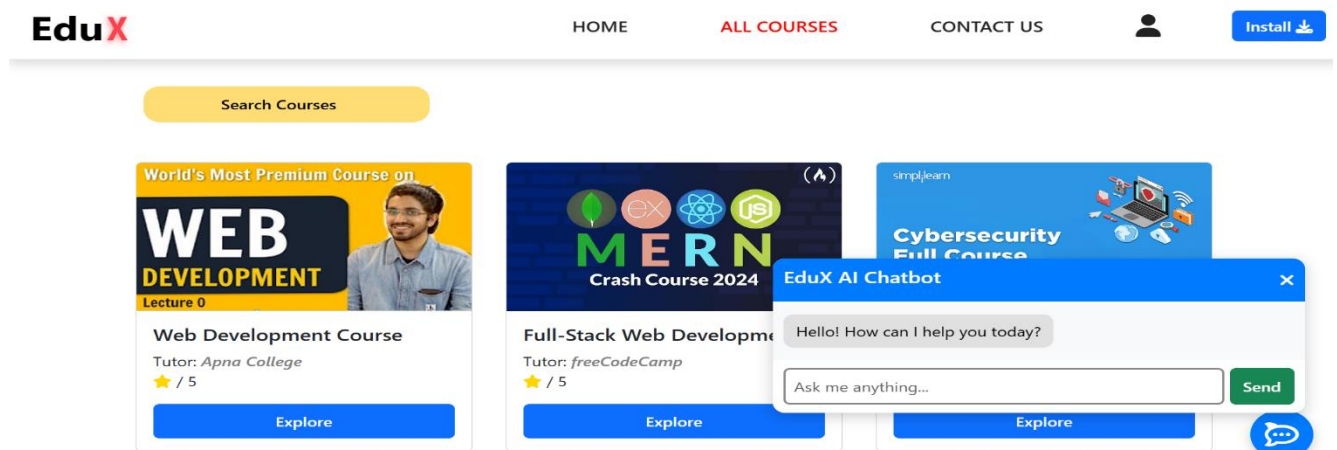
- **APIs:**
 - **REST APIs:** Enable communication between the frontend and backend, supporting operations like login/logout, fetching user data, submitting quiz answers, and storing notes.
- **Architecture and Algorithms:**
 - The project follows the **MVC (Model-View-Controller)** architecture to separate logic, user interface, and data flow, ensuring better code organization and scalability.
 - **Event-driven updates** are used for real-time tracking of student activities like progress and attendance.
 - **MongoDB regex** is applied for efficient searching of courses using tutor name and course title.
- **Hosting and Deployment:**
 - The web application is deployed on **Render**, providing a scalable and reliable cloud hosting environment.
 - The **MongoDB** database is hosted on MongoDB Atlas, ensuring secure and accessible cloud storage.

IV. Results

Home Page and install button to download & install the application for desktop/mobile devices: -



All Courses Page: search by tutor or course name & chatbot can be accessed from any page for real-time query resolution -



Course Overview: -

The screenshot shows the EduX website interface. At the top, there's a navigation bar with 'HOME', 'ALL COURSES', 'CONTACT US', a user profile icon, and an 'Install' button. The main content area is titled 'Overview' and features a large banner for 'MERN Crash Course 2024' with logos for MongoDB, Express, React, and Node.js. Below the banner, it says 'Full-Stack Web Development' and 'Tutor: freeCodeCamp' with a 5-star rating. A sidebar on the left lists the course topics: 1. Introduction to MERN Stack, 2. Frontend Development with React, 3. Backend Development with Node.js and Express, 4. Database Management with MongoDB, and 5. Deploying a MERN Stack Application. The 'Enrolled' status is shown at the bottom of the banner.

Course Video Lectures and Quiz/Notes per chapter: -

This screenshot shows the 'Chapter 1: Introduction to MERN Stack' page. The sidebar on the left highlights '1. Introduction to MERN Stack' and lists other chapters: '2. Frontend Development with React', '3. Backend Development with Node.js and Express', and '4. Database Management with MongoDB'. The main content area features a video player titled 'Learn the MERN Stack - Full Tutorial (MongoDB, Express, ...)' showing code for a MongoDB connection. Below the video player are buttons for 'Quiz' and 'Notes'. The top navigation bar is identical to the previous screenshot.

Course Notes per chapter, can be saved, updated any time and can be downloaded as PDF: -

This screenshot shows the 'Notes' page for Chapter 1. The sidebar on the left has 'Notes' selected. The main content area displays the text 'Types of cyber attacks: -' followed by a list: 1) Denial of Service Attack, 2) DDoS Attack, 3) Active & Passive Attacks, and 4) Man-in-the-middle-attack. At the bottom, there are buttons for 'Save Notes' and 'PDF'. The top navigation bar remains the same.

Course quizzes per chapter: -

The screenshot shows the EduX website interface. On the left, a sidebar lists course chapters: Debugging and Datatypes, 5. Conditionals and Loops + Calculator Program, 6. Switch Statements + Nested Case in Java, 7. Functions / Methods in Java, and 8. Introduction to Arrays and ArrayList in Java (highlighted). The main content area displays a quiz question: "1. What is the index of the first element in an array in Java?". Below the question are three input fields with values 0, 1, and -1. The value 1 is highlighted in a purple box. At the top, there are navigation links: HOME, ALL COURSES, CONTACT US, and an Install button. A Quiz button and a Notes button are also visible.

Personalized Dashboard: Personalized To-Do For task management, Edit Profile, Delete profile -

The screenshot shows the EduX personalized dashboard for a user named Krishna. The dashboard is divided into two main sections. On the left, the "To-Do Application" section includes a task input field, a list of pending tasks (Java + DSA, CSS Tutorial for Beginners), and a list of completed tasks. On the right, the "Krishna's Dashboard" section displays the user's profile (Krishna Muskawad, Web Developer || Full Stack), social media links, and buttons for "Your To-Do", "Edit Profile", and "Delete Account". A "Logout" button is also visible in the top right corner. The dashboard is styled with a clean, modern layout and includes a chat bubble icon in the bottom right corner.

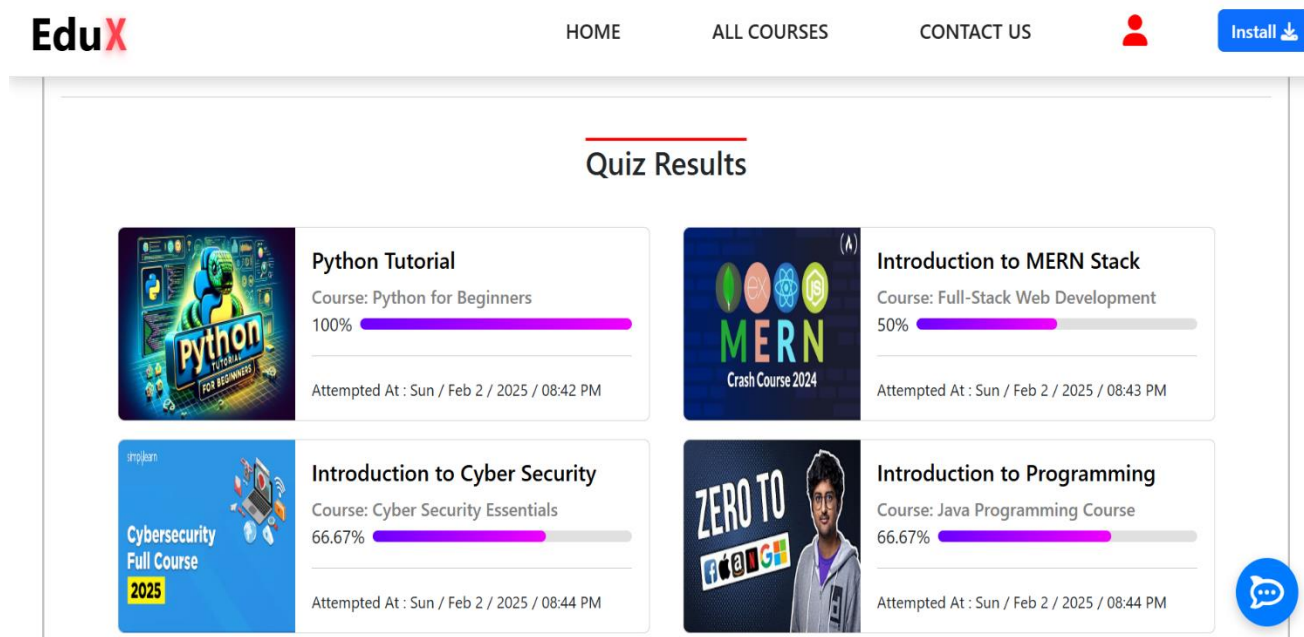
Personalized Dashboard: Enrolled Courses -

The screenshot shows the EduX personalized dashboard for a user named Krishna, specifically the "Enrolled Courses" section. The dashboard displays four enrolled courses with their progress bars and enrollment dates:

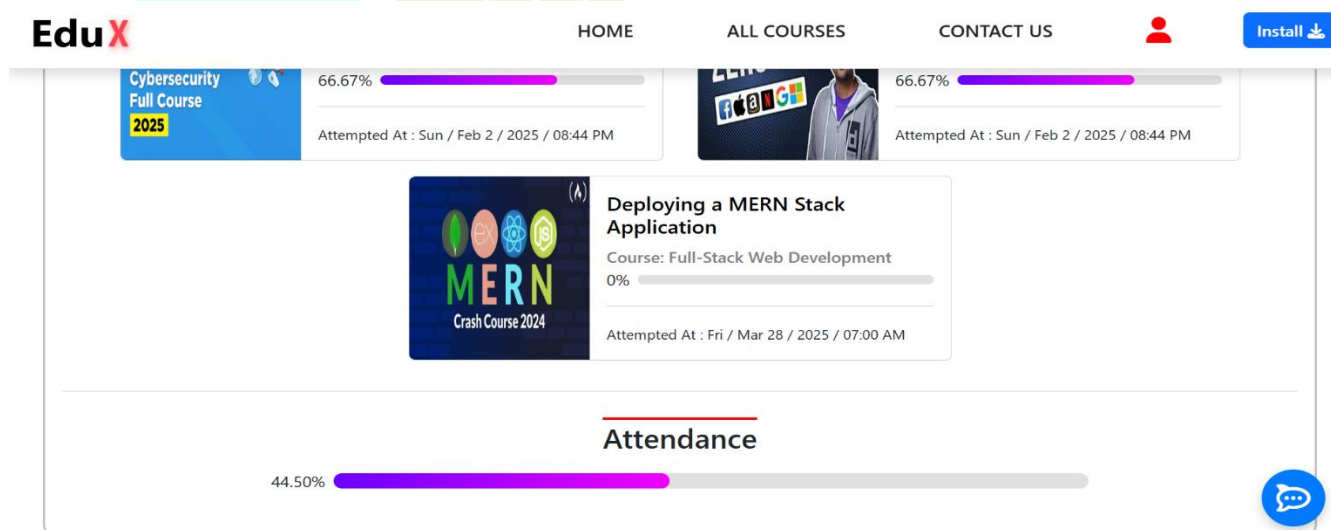
- Full-Stack Web Development** (Tutor: freeCodeCamp, 40% progress, Enrolled At: Sun / Feb 2 / 2025 / 08:41 PM)
- Java Programming Course** (Tutor: Kunal Kushwaha, 13% progress, Enrolled At: Sun / Feb 2 / 2025 / 08:42 PM)
- Python for Beginners** (Tutor: Telusko, 100% progress, Enrolled At: Sun / Feb 2 / 2025 / 08:42 PM)
- Cyber Security Essentials** (Tutor: Simplilearn, 25% progress, Enrolled At: Sun / Feb 2 / 2025 / 08:42 PM)

The dashboard also includes a chat bubble icon in the bottom right corner.

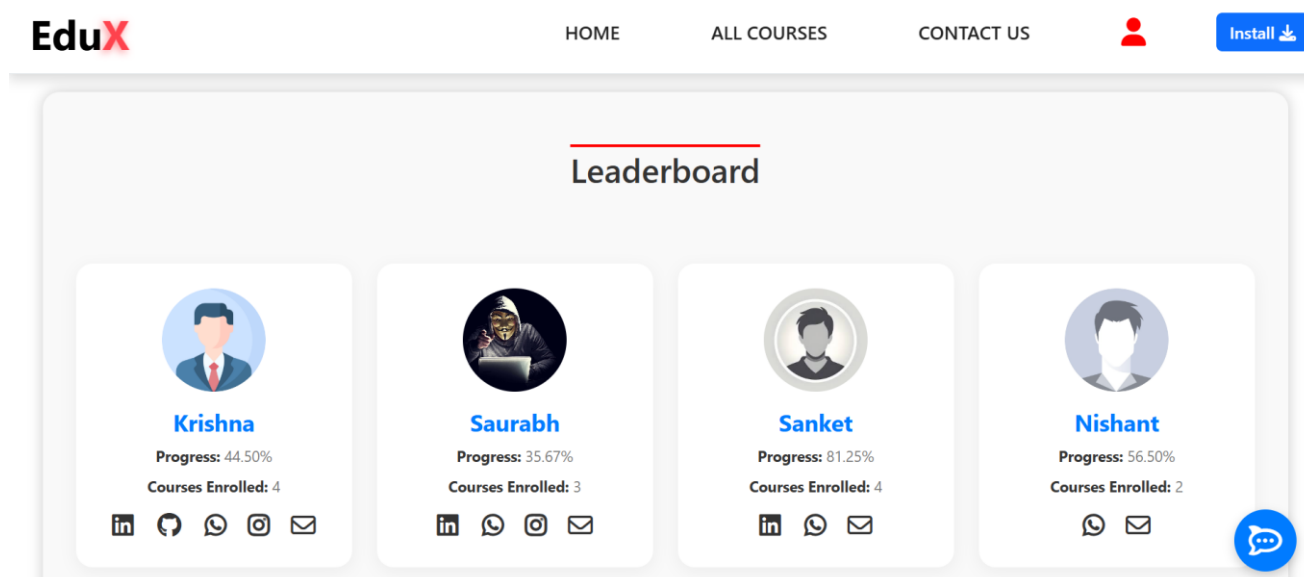
Personalized Dashboard: Quiz Results -



Personalized Dashboard: Attendance Visualization (Dynamically Calculated based on all enrolled courses progress) -



Personalized Dashboard: Leaderboard to access other user's profiles/dashboard to see their enrolled courses progress, quiz results and attendance.



Reviews per course: -

EduX

HOME ALL COURSES CONTACT US  [Install](#)

4. First Java Program - Input/Output, Debugging and Datatypes

5. Conditionals and Loops + Calculator Program

6. Switch Statements + Nested Case in Java

7. Functions / Methods in Java

8. Introduction to Arrays and ArrayList in Java

Java Programming Course
Tutor: *Kunal Kushwaha*
★ / 5

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All Reviews

Nishant
★★★★★
Best course for beginners

Saurabh
★★★★★
Awesome..Waiting for full course..!

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When logged in, users can submit their reviews: -

EduX

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5. Conditionals and Loops + Calculator Program

6. Switch Statements + Nested Case in Java

7. Functions / Methods in Java

8. Introduction to Arrays and ArrayList in Java

Enrolled

Leave a Review

Rating
★★★★★

Comment
Enter your comment here..!

[Submit](#)

All Reviews


Krishna
[Logout](#)



V. Development Goals and Outcomes

The main aim behind EduX was to create an all-in-one E-learning platform that goes beyond just delivering content. We wanted to build a system that supports interactive and personalized learning experiences. The final platform successfully integrates features like automated attendance, instant note-taking, and a built-in chatbot while ensuring a responsive design. Its modular structure makes it easy to add more features or scale it for more users in the future. Event-driven logic ensures real-time updates to attendance and progress. The addition of PWA support makes it even more accessible and usable, as students can install the platform directly on their devices.

VI. Conclusion

EduX is an example of how modern full-stack web technologies can be combined with smart design and algorithms to create a meaningful and efficient digital learning platform. From its user-friendly interface to its intelligent backend operations, it serves both students and educators by simplifying and enhancing online education. The system can be expanded further with features like certificate generation, live classes, and performance analytics to make it even more comprehensive.

Live Project Link: [Click Here](https://edux-ad83.onrender.com) [https://edux-ad83.onrender.com]

GitHub Link: [Click Here](https://github.com/KrishnaM0/EduX) [https://github.com/KrishnaM0/EduX]

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