# Course Outline

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|---|---|
| School: | Eng. Tech. & Applied Science |
| Department: | Information and Communication Engineering Technology (ICET) |
| Course Title: | Web Application Development |
| Course Code: | COMP 229 |
| Course Hours/Credits: | 56 |
| Prerequisites: | COMP 213, COMP 125 |
| Co-requisites: | N/A |
| Eligible for Prior Learning, Assessment and Recognition: | Yes |
| Originated by: | Joanne Filotti |
| Creation Date: | Fall 2012 |
| Revised by: | Blessing Ajiboye |
| Revision Date: | Summer 2025 |
| Current Semester: | Fall 2025 |
| Approved by: | Clarence Cheung, Associate Dean/Dean, Eng. Tech. & Applied Science |

*Students are expected to review and understand all areas of the course outline.*

*Retain this course outline for future transfer credit applications. A fee may be charged for additional copies.*

*This course outline is available in alternative formats upon request.*

## Acknowledgement of Traditional Lands

Centennial is proud to be a part of a rich history of education in this province and in this city. We acknowledge that we are on the treaty lands and territory of the Mississaugas of the Credit First Nation and pay tribute to their legacy and the legacy of all First Peoples of Canada, as we strengthen ties with the communities we serve and build the future through learning and through our graduates. Today the traditional meeting place of Toronto is still home to many Indigenous People from across Turtle Island and we are grateful to have the opportunity to work in the communities that have grown in the treaty lands of the Mississaugas. We acknowledge that we are all treaty people and accept our responsibility to honor all our relations.

## Course Description

Web Application Development is the third course in a sequence of web courses, following COMP213 and COMP125. In this course, students will learn how to design, code, and test a full-stack web application.

The major topics covered in COMP229 include both frontend and backend development, equipping students with the skills to build robust and secure web applications. Throughout the course, students will gain hands-on experience by leveraging a variety of open-source frontend and backend frameworks. By applying these frameworks, they will develop dynamic web applications alongside their corresponding APIs.

The course provides in-depth coverage of integrating web applications with a wide range of databases and data stores. Students will learn how to manipulate data and seamlessly present the results within web browsers. The course places a strong emphasis on crucial topics such as securing and deploying advanced web applications on production environments.

## External Standard Information (ESI)

N/A

## Program Outcomes

Successful completion of this and other courses in the program culminates in the achievement of the Vocational Learning Outcomes (program outcomes) set by the Ministry of Colleges and Universities in the Program Standard. The VLOs express the learning a student must reliably demonstrate before graduation. To ensure a meaningful learning experience and to better understand how this course and program prepare graduates for success, students are encouraged to review the Program Standard by visiting http://www.tcu.gov.on.ca/pepg/audiences/colleges/progstan/. For apprenticeship-based programs, visit https://www.skilledtradesontario.ca/about-trades/trades-information/.

## Course Learning Outcomes

The student will reliably demonstrate the ability to:

1. Develop a responsive front-end user interface using a library or front-end framework that effectively communicates with the back-end of the web application.
2. Implement server-side functionality using an open-source back-end framework to manage data requests and server-side computations.

3. Secure the full-stack app by implementing user authentication and authorization using common authentication mechanisms such as OAuth2, JSON Web Tokens (JWT), or session management.
4. Design and implement a data storage solution using a variety of database management systems, including both relational and non-relational, and implement CRUD operations to allow users to interact with data and ensure data integrity and security through best practices.
5. Perform rigorous testing across different browsers, devices, and user scenarios to validate the project's compatibility, responsiveness, and user experience.
6. Deploy the web application to a production environment using cloud platforms such as AWS, Azure, or Google Cloud Platform.
7. Collaborate effectively with other team members using common software development tools such as Git, GitHub, and Agile methodologies, and participate in code reviews and testing to ensure a high-quality final project.
8. Develop a full-stack AI-powered chatbot utilizing large language models (LLMs) to create an interactive and intelligent chat application.

## Essential Employability Skills (EES)

The student will reliably demonstrate the ability to*:
1. Communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience.
4. Apply a systematic approach to solve problems.
5. Use a variety of thinking skills to anticipate and solve problems.
7. Analyze, evaluate, and apply relevant information from a variety of sources.
9. Interact with others in groups or teams in ways that contribute to effective working relationships and the achievement of goals.
10. Manage the use of time and other resources to complete projects.
11. Take responsibility for one's own actions, decisions, and consequences.

*There are 11 Essential Employability Skills outcomes as per the Ministry Program Standard. Of these 11 outcomes, the following will be assessed in this course.

## New Essential Skills (NES)

The student will reliably demonstrate the ability to*:
3. Explore and create ideas that lead to innovation, entrepreneurship and social enterprise opportunities.
4. Evaluate, create and share meaning through the use of new technology and media in a responsible and ethical manner.
6. Work with others toward a common purpose.

*There are 9 institutional New Essential Skills outcomes. Of these 9 outcomes, the following will be assessed in this course.

## Global Citizenship and Equity (GC&E) Outcomes

The student will reliably demonstrate the ability to*:
1. Identify one's roles and responsibilities as a global citizen in personal and professional life.
2. Identify beliefs, values and behaviours that form individual and community identities and the basis for respectful relationships.
4. Analyze the use of the world's resources to achieve sustainability and equitable distribution at the personal, professional, and global level.

*There are 6 institutional Global Citizenship & Equity outcomes. Of these 6 outcomes, the following will be assessed in this course.

# Methods of Instruction

Interactive Lectures,

Demonstrations

and hands-on

exercises,

Class discussions

# Text and Other Instructional/Learning Materials

The costs of textbooks or other learning material are available through the Centennial College Bookstore
https://www.bkstr.com/centennialprogressstore/shop/textbooks-and-course-materials.

**Text Book(s):**

Text Book(s):

Reference books

Amos Haviv, MEAN Web Development - Second Edition, Pact Publishing, ISBN 139781785886300,2016.
Available on Safari IT Books online.

Banks, Alex, Porcello, Eve. Learning React, 2nd Edition Learning React, 2nd Edition, Publisher: O'Reilly
Media, Inc., Release Date: June 2020, ISBN: 9781492051725, available at
http://go.oreilly.com/centennial-college

Shama Hoque, Full-Stack React Projects- Second Edition, Publisher: Packt Publishing, April 2020, ISBN:
9781839215414, available at http://go.oreilly.com/centennial-college

**Online Resource(s):**

posted in centennial Luminate on a weekly basis

**Material(s) Required for Completing this Course:**

MS Visual Studio Code (current version)

MongoDB (current version)

Git (current version)

NodeJS (current version)

Please see the weekly topical outline for any Additional Learning Resources required for your section of
this course.

# Classroom and Equipment Requirements

MS Visual Studio Code (current version)

MongoDB (current version)

Git (current version)

NodeJS (current version)

# Evaluation Scheme

- ➪ Assignment 1: Create a portfolio site with React.
- ➪ Assignment 2: Add the Backend code - NodeJS, ExpressJS and  Database to Portfolio Site, User CRUD.
- ➪ Test 1: NodeJS, ExpressJS, MVC
- ➪ Project Part 1: Team Contract - Team Forming
- ➪ Project Part 2: First Runnable Release, Basic Functionality, Proof of Concept, Pitch, Peer Review 1, Weekly Report 1
- ➪ Project Part 3: Authentication, Full CRUD, Peer Review 2, Weekly Reports 2 and 3
- ➪ Project Part 4: Final Release, Peer Review 3, Weekly Reports 4 and 5
- ➪ Project Part 5: Final Presentation
- ➪ Quiz 1: node
- ➪ Quiz 2: Express
- ➪ Quiz 3: MongoDB
- ➪ Quiz 4: React Forms, useState, Hooks
- ➪ Assignment 3: Add Authentication to Portfolio Site, User CRUD.
  Constructing the interactive UI of web App.
- ➪ Assignment 4: Develop a Full-Stack Authentication System Login forms in the Frontend Application.

| Evaluation Name | CLO(s) | EES Outcome(s) | NES Outcome(s) | GCE Outcome(s) | Weight/ 100 |
|---|---|---|---|---|---|
| Assignment 1 | 1, 2 | 1, 7 | | | 5 |
| Assignment 2 | 1, 2, 5 | 4, 5 | | | 5 |
| Test 1 | 1, 2, 3, 4 | 1, 5 | | | 15 |
| Project Part 1 | 1, 2, 4, 7 | 1, 4, 5, 9, 10 | 6 | 1, 2 | 5 |
| Project Part 2 | 1, 2, 3, 7 | 1, 4, 5 | | | 10 |
| Project Part 3 | 1, 2, 3, 4, 7 | 1, 4, 5, 9, 10, 11 | | | 10 |
| Project Part 4 | 1, 2, 3, 4, 5, 6, 7 | 1, 4, 5, 9, 10 | 4 | 4 | 10 |
| Project Part 5 | 1, 2, 3, 4, 5, 6, 7, 8 | 1, 9, 10 | 3 | | 10 |
| Quiz 1 | 2, 3, 4, 5 | 1, 5, 7, 11 | | | 5 |
| Quiz 2 | 2, 3, 4, 5 | 1, 5, 7, 11 | | | 5 |
| Quiz 3 | 1, 2, 3, 4, 5 | 1, 5, 7, 11 | | | 5 |
| Quiz 4 | 1, 3, 4 | 1, 5, 7, 11 | | | 5 |
| Assignment 3 | 1, 2, 3, 4 | 4, 5, 7 | | | 5 |
| Assignment 4 | 1, 2, 3, 4 | 4, 5, 7 | | | 5 |
| Total | | | | | 100% |

If students are unable to write a test they should immediately contact their professor or program Associate Dean for advice. In exceptional and well documented circumstances (e.g. unforeseen family problems, serious illness, or death of a close family member), students may be able to write a make-up test.

All submitted work may be reviewed for authenticity and originality utilizing College approved plagiarism prevention software. Students who do not wish to have their work submitted to College approved plagiarism prevention software must, by the end of the second week of class, communicate this in writing to the instructor and make mutually agreeable alternate arrangements.

When writing tests, students must be able to produce official Centennial College photo identification or they may be refused the right to take the test or test results will be void.

Tests or assignments conducted remotely may require the use of online proctoring technology where the student's identification is verified and their activity is monitored and/or recorded, both audibly and visually through remote access to the student's computer and web camera. Students must communicate in writing to the instructor as soon as possible and prior to the test or assignment due date if they require an alternate assessment format to explore mutually agreeable alternatives.

## Student Accommodation

The Centre for Accessible Learning and Counselling Services (CALCS) (http://centennialcollege.ca/calcs) provides programs and services which empower students in meeting their wellness goals, accommodation and disability-related needs. Our team of professional psychotherapists, social workers, educators, and staff offer brief, solution-focused psychotherapy, accommodation planning, health and wellness education, group counselling, psycho-educational workshops, adaptive technology, and peer support. Walk in for your first intake session at one of our service locations (Ashtonbee Room L1-04, Morningside Room 190, Progress Room C1-03, The Story Arts Centre Room 285, Downsview Room 105) or contact us at calcs@centennialcollege.ca, 416-289-5000 ext. 3850 to learn more about accessing CALCS services.

## Use of Dictionaries

## Program or School Policies

N/A

## Course Policies

N/A

## College Policies

Students should familiarize themselves with all College Policies that cover academic matters and student conduct.

All students and employees have the right to study and work in an environment that is free from discrimination and harassment and promotes respect and equity. Centennial policies ensure all incidents of harassment, discrimination, bullying and violence will be addressed and responded to accordingly.

Academic Honesty

Academic honesty is integral to the learning process and a necessary ingredient of academic integrity. Forms of academic dishonesty include cheating, plagiarism, and impersonation, among others. Breaches of academic honesty may result in a failing grade on the assignment or course, suspension, or expulsion from the college. Students are bound to the College's AC100-11 Academic Honesty and Plagiarism policy.

To learn more, please visit the Libraries information page about Academic Integrity https://libraryguides.centennialcollege.ca/academicintegrity and review Centennial College's Academic Honesty Module: https://myappform.centennialcollege.ca/ecentennial/articulate/Centennial_College_Academic_Integrity_Module_%202/story.html

Use of Lecture/Course Materials

Materials used in Centennial College courses are subject to Intellectual Property and Copyright protection, and as such cannot be used and posted for public dissemination without prior permission from the original creator or copyright holder (e.g., student/professor/the College/or third-party source). This includes class/lecture recordings, course materials, and third-party copyright-protected materials (such as images, book chapters and articles). Copyright protections are automatic once an original work is created, and applies whether or not a copyright statement appears on the material. Students and employees are bound by College policies, including AC100-22 Intellectual Property, and SL100-02 Student Code of Conduct, and any student or employee found to be using or posting course materials or recordings for public dissemination without permission and/or inappropriately is in breach of these policies and may be sanctioned.

For more information on these and other policies, please visit www.centennialcollege.ca/about-centennial/college-overview/college-policies.

Students enrolled in a joint or collaborative program are subject to the partner institution's academic policies.

# PLAR Process

This course is eligible for Prior Learning Assessment and Recognition (PLAR). PLAR is a process by which course credit may be granted for past learning acquired through work or other life experiences. The PLAR process involves completing an assessment (portfolio, test, assignment, etc.) that reliably demonstrates achievement of the course learning outcomes. Contact the academic school to obtain information on the PLAR process and the required assessment.

**This course outline and its associated weekly topical(s) may not be reproduced, in whole or in part, without the prior permission of Centennial College.**

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|---|---|---|---|---|---|---|
| Semester: | Fall 2025 | | | Professor(s) Name: | Check your course shell | |
| Section Code: | ALL | | | Contact Information: | Check your course shell | |
| Meeting Time & Location: | As scheduled on your Time-Table | | | Office Hours: | see your professor | |

# Topical Outline (subject to change):

# ORIGINAL TOPICAL

| Week | Topics | Readings/Materials | Weekly Learning Outcome(s) | Instructional Strategies | Evaluation Name and Weight | Evaluation Date |
|---|---|---|---|---|---|---|
| 1 | Introduction to Modern Web App Development Setting Up Development Environment  ES+ Review  Version Control with Git and GitHub | MEAN Web Development (Amos Q. Haviv) Second Edition Online materials. https://nodejs.org/en https://expressjs.com/ https://git-scm.com/ https://www.mongodb.com/try/download/community | Explain the advancements in JavaScript. Explain Module pattern. Use ES6+ classes, arrow functions, new keywords for symbol declaration, and new features related to function parameters. Define JavaScript closures. Explain MEAN and MERN stack architecture. Install and run MongoDB. Install and run Node.js | Lecture Demonstration Lab Session | | |
| 2 | React-Introduction to Front-End Development with a Modern library of Framework  Components  JSX | Chapter 4 Learning React, 2nd Edition by Alex Banks, Eve Porcello  Pages 102-126. Full-Stack React Projects Second Edition  https://www.geeksforgeeks.org/reactjs-components/  https://legacy.reactjs.org/docs/react-component.html | Differentiate between front-end frameworks and UI libraries, understanding their unique characteristics, strengths, and use cases within web application development.  Define the fundamental concepts of React, including its component-based architecture, virtual DOM, and unidirectional data flow.  Explain and apply JSX syntax, a JavaScript extension used in React to combine HTML-like syntax with JavaScript logic for efficient component rendering.  Develop simple React components, utilizing the modular and reusable nature of React to create interactive UI elements and enhance the overall functionality of web applications. Create a React App. that displays users portfolio. | Lecture Demonstration Lab Session | Assignment 1 Assigned - 5% | Week2 |

| Week | Topics | Readings/Materials | Weekly Learning Outcome(s) | Instructional Strategies | Evaluation Name and Weight | Evaluation Date |
|---|---|---|---|---|---|---|
| 3 | Introduction to Node.js, Execution, Environment, Building a Simple Node.js server, Node.js Core Modules<br><br>Introduction to Web Server Frameworks and Express, File Structure of Express Apps, Developing Fast Web Apps with Express | Chapter 1 & 2 MEAN Web Development (Amos Q. Haviv) Second Edition<br><br>Chapter 3 MEAN Web Development (Amos Q. Haviv) Second Edition<br><br>Pages 102-126. Full-Stack React Projects Second Edition | Evaluate Node.js runtime execution environment.<br>Apply JavaScript closures.<br>Discuss the concept of event-driven programming in the context of Node.js.<br><br>Explain Connect web framework and Connect middleware pattern.<br><br>Explore current Web Server Frameworks.<br>Discuss MVC Pattern.<br>Create a new Express Application.<br>Configure the Express application.<br>Develop an Express App for a website that includes multiple pages.<br>Design a simple REST API. | Lecture Demonstration Lab Session | Quiz - 5%<br><br>Quiz - 5% | |
| 4 | Building a REST API with Express, Express Routing, Handling GET, POST, PUT, DELETE requests, Introduction to MongoDB, Mongoose | Chapter 3,4 & 5 MEAN Web Development (Amos Q. Haviv) Second Edition<br><br>Pages 102-126. Full-Stack React Projects Second Edition | Explain REST architectural style.<br> <br>Build routes for an Express app.<br> <br>Explain NoSQL.<br> <br>Install and run MongoDB.<br> <br>Examine MongoDB's document model, query  language, and deployment architecture.<br> <br>Apply MongoDB shell commands.<br> <br>Explain Mongoose schemas and models.<br>Explain Schema indexes, modifiers, and virtual attributes.<br>Perform CRUD operations using the model's methods.<br>Build a simple CRUD API. | Lecture Demonstration Lab Session | Assignment 2 Assigned - 5%<br>Quiz - 5% | Assignment 1 Due |
| 5 | Testing REST API. | Full-Stack React Projects Second Edition.<br>Pages 102-126.<br>ISBN 978-1-83921-541-4 By Shama | Assess and validate a CRUD API using specialized tools like POSTMAN or equivalent alternatives, ensuring the functionality and reliability of API endpoints. | Lecture Demonstration Lab Session | | |

| Week | Topics | Readings/Materials | Weekly Learning Outcome(s) | Instructional Strategies | Evaluation Name and Weight | Evaluation Date |
|---|---|---|---|---|---|---|
| | | Hoque | | | | |
| 6 | Implementing Authentication - backend code<br><br>2FA - Two Factor Authentication | Full-Stack React Projects Second Edition ISBN 978-1-83921-541-4 By Shama Hoque page 109-172<br><br>https://medium.com/onfrontiers-engineering/two-factor-authentication-flow-with-node-and-react-7cbdf249f13 | Distinguish between different authentication methods, including Passport.js, JSON Web Token (JWT), OAuth2, 2FA (Two-Factor Authentication), and more, understanding their unique features and use cases.<br><br>Apply JWT authentication methods to secure an Express server, effectively implementing token-based authentication for user management and access control.<br><br>Validate and evaluate the functionality of authentication mechanisms through testing, ensuring reliable and secure authentication processes within the Express server. | Lecture Demonstration Lab Session | Assignment 2 Due<br>Quiz-5% | Assignment 2 Due |
| 7 | Review and Test | N/A | N/A | practice exercises | Test 1 | Test 1 Due |
| 8 | Constructing the Interactive UI of Web Apps | Chapter 4:Learning React, 2nd Edition by Alex Banks, Eve Porcello Publisher: O'Reilly Media, Inc. Release Date: June 2020ISBN: 9781492051725; page 64-72<br><br>Learning React, 2nd Edition by Alex Banks, Eve Porcello Publisher: O'Reilly Media, Inc. Release Date: June 2020ISBN: 9781492051725; page 206-256<br><br>https://blog.logrocket.com/modern-guide- | Develop React forms, employing best practices to create efficient and user-friendly input interfaces.<br><br>Utilize React props to facilitate the seamless transfer of data between components, enabling effective communication and data flow within the React application.<br><br>Employ React hooks to manage the state of variables within components, ensuring proper state management and enhancing the reactivity and responsiveness of the application.<br><br>Implement interactive features for various React form elements, enabling user interaction and capturing user input effectively.<br><br>Enhance the React application's navigation | Lecture Demonstration Lab Session | Group Project Assigned Project Part 1 - Team Contract Due<br><br>Assignment 3 Assigned - 5% | Project Part 1 - Team Contract Due |

| Week | Topics | Readings/Materials | Weekly Learning Outcome(s) | Instructional Strategies | Evaluation Name and Weight | Evaluation Date |
|------|--------|--------------------|-----------------------------|---------------------------|-----------------------------|-----------------|
| | | react-state-patterns/<br><br>https://blog.logrocket.com/guide-usestate-react<br><br>https://www.freecodecamp.org/news/how-to-build-forms-in-react/ | capabilities by incorporating dynamic routes using React Router, enabling flexible and intuitive routing within the application. | | | |
| 9 | Developing a Full-Stack Authentication Systems, Login Forms in the Front-End Application | Full-Stack React Projects Second Edition ISBN 978-1-83921-541-4 By Shama Hoque; page 206-256 | Establish a connection between the React user interface (UI) and the Express CRUD API, enabling seamless communication and data transfer between the front-end and back-end of the application<br><br>Develop a React login form, implementing user authentication features and ensuring a secure and user-friendly login experience. | Lecture Demonstration Lab Session | Project Part 2 - First Release<br><br>Assignment 3 Due.<br><br>Assignment 4 Assigned - 5% | Project Part 2 - First Release Due |
| 10 | Testing and Deploying a Full-Stack App | Full-Stack React Projects Second Edition ISBN 978-1-83921-541-4 By Shama Hoque; page 461-625<br><br>https://medium.com/orlyknop/how-to-deploy-angular-app-with-node-js-and-express-backend-to-netlify-9abb81d7027e<br><br>https://www.youtube.com/watch?v=oocZSB5W5d0<br><br>https://blog.logrocket.com/8-ways-deploy-react-app-free/ | Test the login functionalities of the application, ensuring robustness and reliability in handling user authentication and authorization.<br><br>Execute and evaluate the full-stack application, examining its functionality, performance, and user experience as a cohesive system.<br><br>Deploy the app on a cloud platform, making it accessible and available to users over the internet, and ensuring scalability and reliability in the deployment process. | Lecture Demonstration Lab Session | Project Part III-Authentication - release | |
| 11 | Authentication Revised: Authentication | https://www.makeuseof.com/react-app-firebase-connect/ | Explore different authentication providers and their integration possibilities within the application, understanding their features, | Lecture Demonstration Lab Session | Project Part 4 - Deployment - release | Project Part 3 - Authenticat |

| Week | Topics | Readings/Materials | Weekly Learning Outcome(s) | Instructional Strategies | Evaluation Name and Weight | Evaluation Date |
|------|--------|--------------------|-----------------------------|--------------------------|-----------------------------|------------------|
| | Providers, Firebase and 2FA | https://www.makeuseof.com/firebase-react-authentication/<br><br>https://www.freecodecamp.org/news/how-to-use-the-firebase-database-in-react/ | strengths, and limitations.<br><br>Investigate Firebase as an authentication solution, gaining knowledge of its features and capabilities for user authentication in web applications.<br><br>Implement Firebase authentication in the application, integrating it with the existing authentication system and leveraging its features such as user management, authentication methods, and secure data storage.<br><br>Explore the concept of Two-Factor Authentication (2FA) and its significance in enhancing the security of user accounts, understanding its implementation options and benefits.<br><br>Develop and integrate a Two-Factor Authentication mechanism within the authentication system of the application, ensuring an additional layer of security for user accounts.<br><br>Assess and validate the effectiveness of the authentication system, including Firebase integration and Two-Factor Authentication, through comprehensive testing and evaluation to ensure its reliability, security, and seamless user experience. | | | ion Release Due |
| 12 | Real-Time Applications with WebSockets and Exploring Serverless Architecture<br><br>AI ChatBot<br><br>AI tools for backend optimization | https://blog.logrocket.com/websocket-tutorial-real-time-node-react/<br><br>Using WebSockets for two-way communication in React apps - LogRocket Blog | Real-Time Applications with WebSockets and Exploring Serverless Architecture<br><br>Discuss the architecture and components necessary for designing an AI-powered chatbot<br><br>Develop a backend service to manage chatbot interactions and integrate it with an LLM. | Lecture Demonstration Lab Session | Project Part 5 -release | |

| Week | Topics | Readings/Materials | Weekly Learning Outcome(s) | Instructional Strategies | Evaluation Name and Weight | Evaluation Date |
|---|---|---|---|---|---|---|
| | Introducing RAG for building scalable APIs. | https://socket.io/<br><br>https://www.freecodecamp.org/news/how-to-build-a-chatbot-with-openai-chatgpt-nodejs-and-react/<br><br>Online resources. | Configure and utilize APIs to facilitate communication between the chatbot and the LLM for generating responses.<br><br>Create a user-friendly frontend interface for the chatbot, ensuring smooth and interactive user experiences.<br><br>Perform testing and debugging to ensure the chatbot functions correctly and efficiently across different use cases.<br><br>Use AI tools for backend optimization including AI Toolkit for VS Code and GitHub Copilot.<br><br>Introduce RAG for building scalable APIs. | | | |
| 13 | Finalizing the project | online material.<br><br>https://testsigma.com/blog/unit-test-vs-e2e-test/ | Conduct thorough testing and perform a comprehensive review and refinement of the project to ensure it meets all requirements and resolves any remaining issues or bugs.<br><br>Optimize the project's performance, including load times and responsiveness, to enhance the user experience.<br><br>Document the project's features, functionalities, and technical specifications to provide clear and comprehensive documentation for future reference and maintenance.<br><br>Prepare the project for deployment by configuring hosting environments and addressing any necessary deployment processes or scripts.<br><br>Update the GitHub repository with the latest version of the application code, ensuring proper version control and documentation of changes made during the finalization process. | Lecture Demonstration Lab Session | | Project Part 4 - Final Release Due |

| Week | Topics | Readings/Materials | Weekly Learning Outcome(s) | Instructional Strategies | Evaluation Name and Weight | Evaluation Date |
|------|--------|--------------------|----------------------------|--------------------------|----------------------------|-----------------|
| 14 | Project Demonstrations | N/A | N/A | Class demonstrations | Project Part 5 - Demonstration | Project Part 5 - Demonstration Due |