Team Name: HelloWorld

Technical Report

https://github.com/SeanMcClennen/TeamHelloWorldRepo.git

Team Members:
Cody Rodriguez, Ryan Jammes, Sean McClennen, Gavin Bean

Chapter 1: Vision

Project Overview

Our team is developing an AI chatbot using the open-source Llama model, MongooseDB for chat storage, and Express.js for the user interface. The system will be fully containerized to ensure consistency across development, testing, and deployment environments. The final deployment and demonstration will take place on CloudLab.

This project aims to provide researchers access to a bare-metal cloud environment, allowing for precise experimentation, repeatability, and scientific design of cloud computing experiments. We will leverage CloudLab to ensure our implementation meets the necessary requirements for scalability and reliability.

Architecture

The architecture consists of several interconnected components:

1. **Chatbot Backend:** A Node.js service that processes user inputs using the distilbert-base-uncased-finetuned-sst-2-english and the Salesforce/codet5-small model from huggingface.
2. **Database:** A MongoDB instance for storing chat history and user interactions.
3. **Frontend UI:** A lightweight Express.js-based web interface for user interaction.
4. **Containerization Layer:** Docker is used to encapsulate each component, ensuring compatibility across environments.
5. **Deployment Infrastructure:** CloudLab will host and manage the deployment.

This structure ensures modularity, scalability, and easy deployment in a cloud environment.

Chapter 2: Implementation

Containerization Strategy

To streamline development and deployment, all components will be containerized using Docker. This ensures:

- Consistency across different environments (development, testing, and production).
- Isolation between services, preventing conflicts.

- Easy scaling of individual components.

Tools Used:

- Docker for containerization.
- Docker Compose for defining multi-container services.
- Kubernetes for managing container orchestration (optional for scalability testing).

Implementation Plan

Component Breakdown

1. **Backend Service:**
    - Developed using Node.js and Express.js.
    - Hosts the AI chatbot (Llama model) and processes user messages.
    - Implements API routes for interaction.
2. **Database Service:**
    - Uses MongooseDB to store chat logs and user data.
    - Ensures fast retrieval and optimized indexing for efficient search and query operations.
3. **Frontend Service:**
    - A simple yet interactive UI built using HTML, CSS, and JavaScript.
    - Communicates with the backend via API calls.
4. **Containerization and Orchestration:**
    - Each component runs in its own container.
    - Docker Compose used for local testing.
    - Kubernetes utilized for load balancing and high availability in CloudLab.

Automation and Deployment Strategy

- **CI/CD Pipeline:**
    - GitHub Actions automates testing and deployment.
    - Unit tests verify backend and database functionality before merging changes.
    - Automatic deployment to CloudLab on successful CI/CD run.
- **Logging and Monitoring:**
    - ELK Stack (Elasticsearch, Logstash, Kibana) used for real-time log monitoring.
    - Prometheus and Grafana set up for performance metrics.
- **Security Measures:**
    - API gateway with authentication to prevent unauthorized access.
    - HTTPS encryption enforced for data transfer.
    - Role-based access control (RBAC) implemented for secure interactions.

- **Performance Optimization:**
    - AI model optimized for fast response times using TensorFlow.js.
    - Load testing performed with Apache JMeter to analyze system behavior under different loads.

Final Deployment on CloudLab

- CloudLab configured with necessary dependencies and environment settings.
- Automated scripts ensure smooth deployment and initialization.
- Live demonstration showcasing chatbot interactions and system resilience.

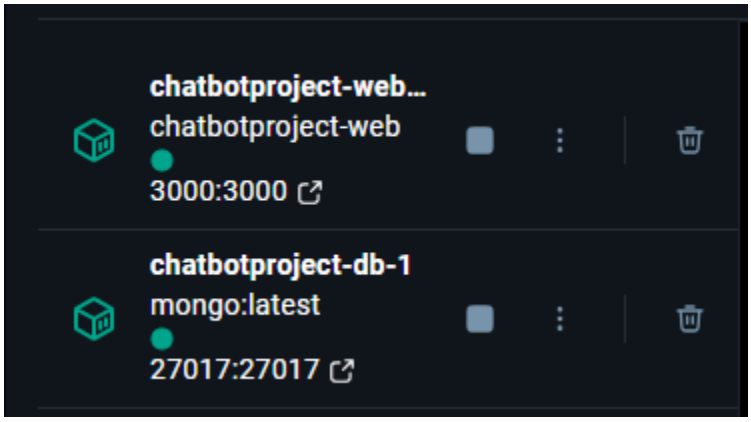
Conclusion

This implementation strategy ensures our AI chatbot meets all required technical standards while maintaining flexibility and scalability. The project's cloud-based deployment guarantees accessibility and ease of integration with CloudLab's infrastructure.

Chapter 3: Procedures and Testing

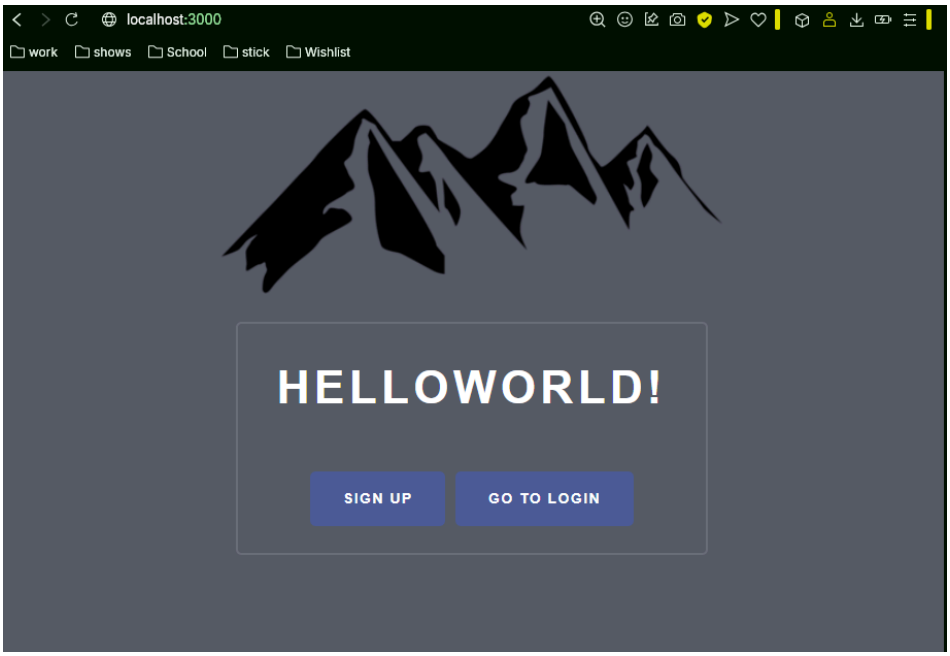
Procedures

1. **Build Process:**
    - The project consists of three components so far. A Web User Interface consisting of NodeJS and ExpressJS running on a node:18-alpine image and a MongoDB instance.
    - The components described are built using a docker-compose.yml file for ease of use and each part is containerized within docker.
    - The web service running through NodeJS is exposed on port 3000 and has been accessed locally for testing so far.
    - The MongoDB database uses the latest Mongo image and exposes the default port 27017.



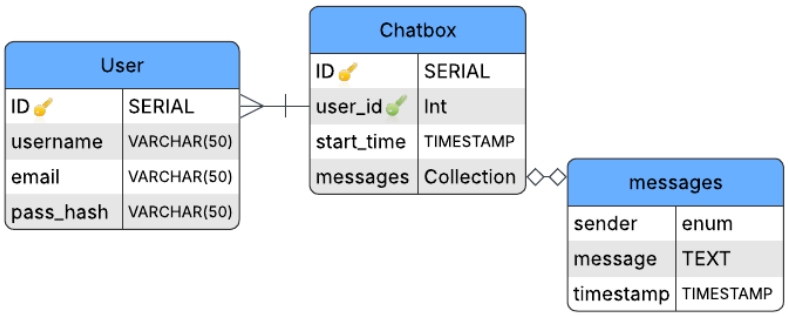
Website Testing in Docker

We have done some basic testing with the web-ui locally hosted. The login page and the chat page both function as intended when running as a container in docker. However, the website has some issues when running as a container on cloudlab.



Database Structure

The data for user authentication information and chatting history is saved in the MongoDB database that was mentioned previously. The database will use the following schema:



We are currently weighing the options of using email for sign up as well as not requiring email. Requiring emails can prevent spam accounts, but for the purposes of this project the implementation of an email verification system may be a time sink that would end up not being worthwhile. A final decision will come once we start pushing more work toward the backend systems.

The User table stores the user authentication information, with the password hashed for protection. When a user saves a chat box, it will be saved in the database as a Chatbox table that is linked to the user that saved it. The chat box will have a field “messages”, which is a Collection of all of the messages sent in the chat. Each message will contain the message sent as text, the sender (either “user” or “bot”), as well as the time that it was sent. The time will be saved on the backend in UTC, with the time being formatted accordingly on the frontend. When a saved chat box is reloaded by a user it will use the sender to display the messages as the correct sender and use the stored timestamps to order the messages correctly to guarantee perfect and consistent readability.

AI Response Service

Overview

This component provides an AI-based response system to automatically classify and reply to user-submitted posts on the website. The service identifies the nature of the post—whether it's a success update, a request for help, a helpful reply, or unrelated—and generates a context-appropriate response.

The system is implemented in Python using FastAPI and is exposed through a RESTful endpoint (/analyze).

AI Models Used

The service utilizes two pre-trained models from Hugging Face:

- distilbert-base-uncased-finetuned-sst-2-english for sentiment classification, used to help determine whether a post is celebratory, frustrated, or neutral.

- Salesforce/codet5-small for code generation and repair. When a user post includes a code snippet, this model attempts to generate a corrected code version.

Pipeline and Logic

When a post is received, the system classifies it using a combination of rule-based logic and sentiment analysis. If the post indicates a request for help, it attempts to extract any included Python code and use the code generation model to suggest a possible fix. If no code is detected, it prompts the user to submit a code and an error message. Posts representing successful completions receive congratulatory messages, while helpful replies from other users are acknowledged. All other content is ignored.

Testing and Results

Testing was conducted using Swagger UI. Results confirm that the AI system classifies posts accurately and returns appropriate responses. Example cases include:

- **Input:** “I finally fixed my recursion bug.”
  Output: “Great job, user. Keep it up.”

- **Input:** “My code crashes with an IndexError.”
  Output: “Can you share your code and the error you're getting?”

These results indicate that the model is functioning correctly across various input types.

Feasibility

The AI service is working as expected. Integration with the front end is straightforward, and the component is on track for successful deployment and demonstration on CloudLab.

Chapter 4: Final Results

Challenges / missed milestones

AI:

- Handling ambiguous posts that contain both successes and errors
- Optimizing runtime performance and memory usage in Docker
- Maintaining response quality without overfitting rules to specific cases

Docker:

- Containerizing an AI is difficult and requires many dependencies.
- Images sometimes will load in Docker locally but not Cloudlab.

Database:

- Thinking about scalability (even if it is not needed for the project).
- Working to secure sensitive data to ensure account security.
- Finding a way to standardize time stamps on the back-end throughout different time zones.
- Some discussed features such as adding other users as friends or following users were never able to be started.

Conclusions

Through the semester we were able to gain valuable experience in group software development and how to handle a team dynamic. We learned what it was like to operate in specific roles and how to collaborate and connect our sections together to make a cohesive product.

At a technical level, we faced various challenges in each project section. The AI reached the first milestone of working. We were skeptical whether combining two open-source models into one algorithm was possible. Unfortunately, it didn't meet the other milestones of being more accurate and better used for both broad and niche questions and problems. Containerizing the project in Docker proved to be difficult as well with numerous errors and missing containers/images

When making the database there were a few issues that popped up in the design process. The first technical issue was scalability, even though the project won't reach a point where scalability would start playing a role. Despite this, it was important to decide on a format that would provide avenues for scaling and expansion, so we went with a design that would allow for users to be related to their messages and for future relations to be added with ease. Securing data, specifically user passwords was a second technical concern, with our solution being to have the passwords hashed in the database for security. We also had to come up with a way to ensure that users would be seeing times consistent to their own time zone while also seeing consistent and accurate orderings to messages coming from all over the world. To do this we settled on storing the times as UTC on the backend and having all of the regional formatting be done on the frontend. As far as direct future expansions, the next step that was discussed was a friending and following feature between users so that people could chat with each other as well as the AI bots.

Gavin Bean

(215) 859-1937 | gavin.bean23@gmail.com
linkedin.com/in/gavin-bean-a52376241/
github.com/amphibiousbean

Education

Bachelor of Computer Science 2023-2025

West Chester University of Pennsylvania | GPA : 3.794 | Dean's List

- Relevant courses : **Software Engineering**, **Data Science**, **Artificial Intelligence**, **Cloud Computing**

Skills

Languages: Java, Python, SQL
Applications: Jira, pgAdmin, GitHub, Frappe, ERPNext
Applicable Skills: Object Oriented Programming, Project Collaboration, Pandas, use of APIs

---

Experience

Famous Footwear | Lansdale, PA 06/2021-08/2021

Sales Associate

- Customer communication
- Task management
- Store cleanliness

Downingtown Bicycle Shop | Downingtown, PA 06/2023-01/2024

Store Associate/Junior Mechanic

- Inventory management
- Tailored sales and recommendations
- Order fulfillment
- Basic repairs
- Bike assembly

West Chester University IS&T | West Chester, PA 02/2024-Present

AV Multimedia IS&T Intern

- IT/AV Support
- Large team environment
- Preventative maintenance projects
- Asset keeping projects
- Data input
- Basic Microsoft Excel

Gavin Bean

(215) 859-1937 | gavin.bean23@gmail.com

Projects

- **Discord Bot** : Collaborated with friends to build a discord bot for our personal server. Functions include playing music from a YouTube or Spotify link, displaying regional weather, functionalities for multiple games, including live rank tracking. Uses APIs to pull data and sends it to output as well as a database.

- **PostgreSQL Database** : Created a PostgreSQL database to store long term data for easy and fast retrieval as well as made the scripts to allow it to auto-update periodically.

- **GameAPI** : Collaborative project with friends to create an API wrapper to be used by the aforementioned discord bot. Runs on the same machine as the discord and takes the simplified url and turns it into the proper url for the given API. Made for easy expansion when new APIs are added.

- **LeepFrog/ClimbingRams** : Worked in a group with LeepFrog and ClimbingRams in software engineering to create a portal for their upcoming projects. Primarily a front-end project using Frappe framework and ERPNext.

- **Hello World** : Worked in a group for a course project to build an application where users can chat with each other as well as an AI chat bot, make posts, and have their own profile pages.

RYAN JAMMES

137 East Market St., PA 19382
Phone: 703-635-5745 | Email: ryanjam2002@gmail.com

Dedicated and motivated individual with a strong computer science and AI development background. I am passionate about leveraging technology to solve real-world problems and continuously seek opportunities to grow and learn. With a proven ability to lead teams, tackle complex challenges, and adapt quickly to new environments, I am committed to driving innovation and delivering results. In addition to my technical expertise, I bring a diverse skill set, bilingual communication abilities, hard work, and a detail-oriented focus on collaboration and efficiency. Currently, I am exploring AI-driven solutions for stock trading as a personal project.

SKILLS

- Proficient in **C/C++/C# Python**, **Java/Javascript, Haskell** and **HTML**
- Strong **team leader** and quick learner
- Familiar with **Docker**
- Excellent **organizational** and **problem-solving abilities**
- Passionate about **continuous learning**
- Familiar with **AWS**

RELEVANT EXPERIENCE

SAIC | INTERN *Chantilly, VA | June 2024 – August 2024*

- Led a team on a project focused on AI development (details withheld due to NDA).
- Applied technical skills and leadership to ensure project success.
- Developed machine learning models using Python and TensorFlow.
- Implemented data preprocessing and feature engineering using Pandas and NumPy.
- Used Jupyter Notebooks and other IDEs to develop AI and coding projects related to training the AI.
- Collaborated with cross-functional teams to refine AI algorithms and improve performance

EXPERIENCE

YORI'S BAKERY | Assistant Manager *West Chester, PA | May 2023 – Present*

- Assist customers with custom orders and decorating baked goods.
- Operate cash registers and collaborate with a team of cashiers.
- Utilize quick thinking to address and resolve on-the-job challenges effectively.
- Learned new skills such as baking and decorating.
- Train new employees on customer service protocols and cash register operations.
- Manage daily cash flow and reconcile cash registers at the end of shifts.
- Coordinate with the bakery team to ensure timely completion of large orders.
- Implement inventory tracking to maintain stock levels and reduce waste.
- Lead team meetings to discuss strategies for improving customer satisfaction and operational efficiency.

EASTERN UNIVERSITY | OPERATIONS ASSISTANT *St. Davids, PA | May 2022 – August 2022*

- Coordinated event setup and dismantling, led volunteer teams, resolved challenges efficiently, optimized processes for increased efficiency, and served as the primary contact for organizers and attendees to ensure smooth operations.

RYAN JAMMES

137 East Market St., PA 19382
Phone: 703-635-5745 | Email: ryanjam2002@gmail.com

FORD'S FISH SHACK | Food Runner *South Riding, VA | August 2020 – February 2021*

- Streamlined dine-in and takeout order processes, optimized team communication, trained staff on accuracy and customer service, and proactively resolved issues to improve efficiency and satisfaction

TAREY HOUSTON REFEREEING SERVICES | Referee *Loudoun County, VA | January 2013 – January 2019*

- Officiated youth soccer games focusing on safety and rule enforcement, maintained professionalism with stakeholders, organized league reports, led referee briefings, and mentored junior referees.

EDUCATION

WEST CHESTER UNIVERSITY / COMPUTER SCIENCE *January 2023 – Present*

- Currently studying computer science. Set to graduate in the **Spring of 2025**. Played on the school soccer team for a year.

EASTERN UNIVERSITY / COMPUTER SCIENCE *August 2021 – December 2022, St. Davids, PA*

- Studied computer science, was a member of the Honors College, and played on the school soccer team for a year and a half.

AWARDS

- **Dean's List Honors College**: *Eastern University*
- **All-MAC Conference** *Academics 2021 Fall*
- **All-MAC Conference** *Academics 2022 Spring*
- **All-MAC Conference**: *Academics 2022 Fall*
- **Honorable Mention MAC Team** *2022 Fall*

Sean McClennen

Computer Science Student

seanmcclennen@gmail.com

(484) 832-9010

I am a Student at West Chester University of Pennsylvania and an IT Helpdesk Consultant with 4 years' experience seeking an opportunity to apply my skills in the Computer Industry.

Education:

West Chester University of Pennsylvania,
West Chester, Pennsylvania
Major: Computer Science
2022 - Present

Penncrest High school,
Media, Pennsylvania,
Class of 2021

Experience:

2021 - Present
IT Helpdesk Consultant • West Chester University of Pennsylvania IT Helpdesk

Technical Support for a Large Community:

- Provide technical support to over 17,000 students, faculty, and staff in person and remotely.

Use of Remote Assistance Tools:

- Utilize tools like Bomgar (BeyondTrust Remote Support) for secure remote access and control of computers and mobile devices.
- Employ Finesse for managing interactions across different communication channels (phone, email, chat, social media).

Device Management:

- Image and re-image faculty loaner devices to ensure they are ready for use.
- Install required software for faculty and staff, ensuring their devices are equipped with necessary tools.

2017 - 2018
Lifeguard • IM Pools Management, INC

Safety and Supervision:

- Enforce pool rules to maintain a safe environment.
- Watch swimmers to ensure safety.

Pool Maintenance and Management:

- Responsible for cleaning the pool and maintaining proper chlorine levels.

Access Control:

- Managed who was allowed to enter the pool area, ensuring compliance with entry requirements.

Key Skills:

- Troubleshooting
- Coding (Java, Python, C++)
- MacOS, Windows and Linux
- Interpersonal Communication
- ServiceNow
- Duo Mobile Admin
- Beyond Trust Remote Support
- Microsoft Teams

Hobbies:

- Building Computers
- Video Games
- Modding
- 3D printing

Cody Rodriguez

Philadelphia, Pennsylvania| (215)-237-5934 | cody.rodriguez1970@gmail.com |
https://www.linkedin.com/in/cody-rodriguez-5a83a724a/

Profile

As a computer science student at West Chester University, I have cultivated a diverse skill set through hands-on experiences and academic pursuits. Proficient in Java, C, and JavaScript, I have a solid understanding in both front-end and back-end development. My familiarity with HTML, CSS, and JavaScript enables me to create responsive and visually appealing web pages. With my excellent interpersonal and communication skills, I can convey technical concepts to anyone. My ability to break down complex problems and devise effective solutions, and a willingness to adapt to new tools and methods, position me to excel in technical challenges.

Work Experience

WEB DEVELOPMENT INTERN | WEST CHESTER UNIVERSITY OF PENNSYLVANIA | SEPTEMBER 2023-PRESENT

- Maintain and enhance university websites, ensuring compliance with branding and accessibility standards.
- Develop new web pages, contributing to both technical and creative aspects of online presence.
- Troubleshoot and resolve technical issues using XML, CSS, and JavaScript.
- Assist in website updates and maintenance, ensuring up-to-date and accurate content.
- Gain practical experience in web technologies, significantly improving technical skills.

BLI COMPUTER SCIENCE INSTRUCTOR | HEIGHTS PHILADELPHIA | JULY 2023-AUGUST 2023/JULY 2024-AUGUST 2024

- Collaborated with co-instructor to design and implement a curriculum covering Java basics and object-oriented programming concepts.
- Utilized interactive teaching methods to engage students in practical coding exercises and projects, reinforcing their understanding of Java principles.
- Guided students through the development of a culminating final project, providing support and feedback to ensure successful completion and application of learned skills.
- Monitored and assessed student performance throughout the program, identifying areas for improvement and adapting teaching strategies to meet individual learning needs.

BLI COMPUTER SCIENCE INSTRUCTOR | STEPPINGSTONE SCHOLARS | JULY 2022-AUGUST 2022

- Co-developed JavaScript-focused curriculum to effectively teach programming fundamentals.
- Implemented project-based learning methodologies to reinforce Java concepts and facilitate practical application.
- Provided personalized guidance and support to students, fostering a collaborative learning environment.
- Coordinated with co-instructors to perfect lesson plans and ensure cohesive teaching strategies.

Education

BACHELOR OF SCIENCE IN COMPUTER SCIENCE | 2021-CURRENT| WEST CHESTER UNIVERSITY OF PENNSYLVANIA, WEST CHESTER, PA

SKILLS & ABILITIES

- Proficiency in Java, C/C++, JavaScript.
- Familiarity with web development languages such as HTML, XML, CSS, and JavaScript.
- Excellent interpersonal and communication skills
- Ability to break down complex problems and devise effective solutions.
- Ability to articulate technical concepts to both technical and non-technical audiences.
- Willingness to adapt to new tools, languages, and methodologies.

Hobbies

- Web Development
- Making music
- Playing video games