Project proposal for building scalable and robust

CHESS

Submitted as partial fulfilment for CS-6359 by:

Group-1

Akshat Gangrade
Alec Brown
Mohana Rupa Mavuluri
Muktan Rahulkumar Patel
Vishesh Mehta

Summary

As part of the project, we will be designing and implementing a classic chess game which has different modes of play. It is a two player game where both the players are humans in one mode while the other mode is player vs computer in which the computer intelligently plays with the player. Although we try to implement an intelligent system, that is not the primary objective of the project.The players will create a profile for themselves and the scores of their games will be recorded for rating purposes.

Each piece on the board follows the basic rules of chess including check and checkmate. For this we encode the pieces using Object-oriented programming and devise necessary algorithms for their movements.

We plan to start by building a MVP (minimum viable product) initially and keep adding features to it as per the timeline by following agile software development techniques. The detailed timelines and deliverables are mentioned in the deliverables section.

Contents

3. Introduction

a. Importance of the problem

- ➔ To gain insights on how two player board games need to be designed.
- ➔ Problem consists of various objects which would be most suitable for the understanding of the OOP design patterns.
- ➔ Even though the chess game has been around for a long time, there have been various variations of the game coming up each year. Also, the chess platform needs to satisfy the use case of thousands of teams and millions of players. So, there can't be any final version of this platform, it needs changes as per requirement of the majority of the end users. Hence, we want to build a robust system that can accommodate these changes easily.

b. Background information

Chess is a board game played between 2 players. We as a team are trying to build a platform to play the game online. The system will consist of 3 main modules: Human vs random Human (similar to Over the Board), Human vs Human, Human vs Bot. The system will also have modules where the players will be able to solve chess puzzles to improve their skills, a tournament room, analysis board where they will be able to load their previous games and analyze them.

c. Related Work

There are multiple articles and papers regarding the design of the chess game [The following are the links 1, 2, 3, 4]. All of the articles suggest using object oriented design concepts instead of procedural design concepts as they are scalable and reusable in the future.

There have been various chess platforms, most famous of them are 1) chess.com 2) lichess . The major reason behind the popularity of these platforms have been that they offer a lot of features and they are ever evolving.

d. Problem description

Chess is a robust game. The game has been played for a long time. And in recent times due to increase in the online gaming culture the game is being played online on a tremendous scale. Therefore we decided to design a platform using the OOP concepts to play chess. Following are the main problems we need to solve to build the platform

i. Executing Moves

ii. Checking if the moves are valid or not
iii. Allowing the players to make special moves like castling and en-passant
iv. Determining if the player is in check/checkmate/stalemate or if the game is drawn by three-fold repetition
v. Making the game flexible in such a way that there is always scope adding new features(more variants)

4. Objectives

➔ Project objectives

a. Creating a system that shall allow a user to play with a computer or another player (choice of the player).
b. Creating a system that shall allow the player to play puzzles and improve skills.
c. The system allows the player to create a club, add friends, share the games and also specific moves of the game and discuss their game.
d. Organize competitions within the club.

➔ Critical design issues and constraints

a. Handling the case when the opponent is not making a move and quitting (by player) may cause reduction of the points for the player. So, the game goes on infinitely. If the player doesn't make a move and goes offline then the game has to be aborted in a certain amount of time without reducing the rating of the players.
b. Handling concurrent pairing requests. As these platforms can have large amounts of concurrent requests.

5. Approach

Based on the 20-80 rule we are planning to build important features first and then work on adding various intricacies of the project in the remaining time. We will be working in 3 iterations. So, we have kept all the important features (like basic chess gameplay and user authentication and its profile) in the Iteration 1. In iteration 2, after the major requirements are satisfied we will add extra features (variants of chess, discussion board, and team/ club building) on top of the current version.

There would be multiple phases that we would follow in each of our iterations. We have adapted test driven agile development using scrum framework as it enables us to build a robust system, which is the major goal of the project. Following are the major phases in a sprint/ iteration of our process.

1. Sprint Planning (1-2 days)- The major task of this is to pick important tasks to be done from the product backlog and add it to the sprint backlog.

2. Create test cases that might fail - This is a continuous process and it will be done before building every functionality. The major task here is to try to find all the major cases where the functionality that we are developing would fail.
3. Development process - major part of the sprint (10 -15 days). The task here is to consider all the test cases and write a robust code that takes care of all the corner cases.
4. Quality Assurance & Testing (1-3 days) - Here we perform unit tests and Integration testing and check for any bugs.
5. Increment (deploy) and sprint review - (2 days) - Review all the good and bad points of the sprint and try to improve based on that.

➔ Performance Analysis

As we are planning to use the test driven approach we will analyze our performance based on the number and size of functionalities we are able to build that passes all the test cases in a sprint. Another performance measurement will be how well our system performs on integrity testing and how easy it is for us to make changes in the future.

➔ Alternatives

We will see alternatives for the following:

i. **Project topic**: If at any point it feels that the project we are building is not feasible, we have a few alternate projects like Online quiz portal, Hospital management system, Code Editor, Simcity Simulation game.

ii. **Language and Framework to be used:** We will be using Java as our primary language and the Spring framework for our project. If we need to change the framework while using Java language we would try to use JSF. But In case we have to change the language we may use Javascript or C#.

How will we decide on the best alternative?
We will decide on the best alternative based on the ease of switching to the other alternative with minimal wastage of time, money, and human resource cumulatively.

6. Project Management

i) **Project duration** - 2 Months

ii & iii) **Milestones**

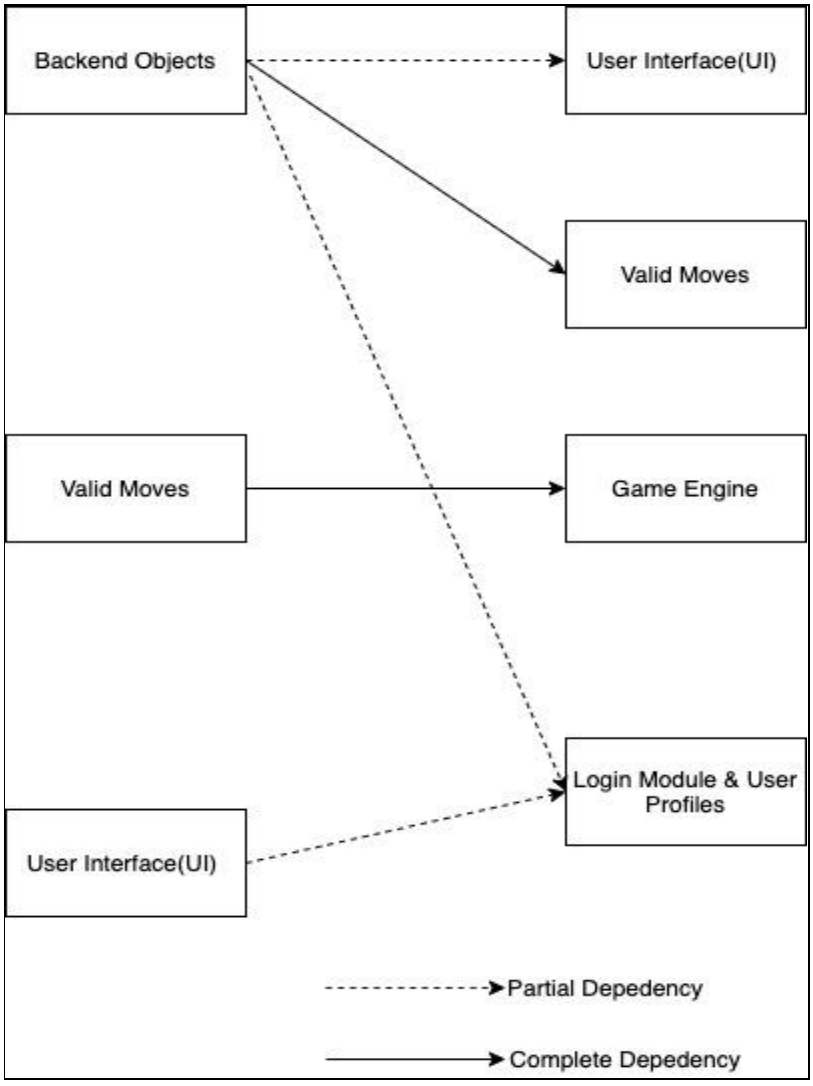
➔ Iteration 1: Basic Chess Gameplay and User profile.
Oct 8, 2021

- ➔ Iteration 2: Variants of Chess and team/ organization building
  Oct 28, 2021
- ➔ Iteration 3: Tournament organization, Puzzle play and enhanced discussions
  Nov 19, 2021

iv) Tasks and the group members assigned [Iteration-1]

1. Creating basic backend object **(Mohana) [4-7]**
2. Creating basic UI for actual game(board, pieces, and other stuff) **(vishesh and akshat and Mohana) [7-14]**
3. Checking valid moves **(Alec) [7-10]**
4. Game engine - storing the past states and current state and saving the game once completed.**(vishesh and akshat and Muktan) [10-20]**
5. Login module and User profile info displaying and linking to stored past games. **(Muktan) [7-12]**

v) Dependency of tasks



7. Deliverables

Iteration 1:

1) Basic chess game play: 1. Human vs human 2. Human vs Bot (1-OCT)
   > Iteration 1 will allow both human vs. human and human vs. bot gameplay, for 2 players.
2) User Authentication, User information and past games (1-OCT)
   > Iteration 1 will allow users to make accounts, with information such as total games won and lost, including a “winning streak” statistic. The user will also be able to watch replays of the move sequences of past games.

Iteration 2:

1) Various variants of chess.(15-OCT)
   > Iteration 2 will allow users to play variants of chess such as 4-player chess, Chess 360, and chess with each player's pieces randomly shuffled across their first two rows.
2) Creation of Team/ Club.(20-OCT)
   > Players can join teams/clubs, private groups. Any user can create a team that others can join.
3) Discussion Board for Team/ Club.(23-OCT)
   > Each team will have a private chat room where the members can discuss chess games with each other.

Iteration 3:

1) Solving chess puzzles.(2-Nov)
   > Iteration 3 will have a chess puzzle of the week, with solutions to be revealed at the end of the week. Each user's profile will have a "number of puzzles solved" statistic and a "puzzle streak" statistic.
2) Sharing a game in discussion board.(8-Nov)
   > Users can share a game replay in the discussion board.
3) Creating tournament within team.(12-Nov)
   > Users can schedule a tournament that all the team members can participate in. If a user wins the tournament, it will be displayed on their user profile.

8. Team Qualifications

1. Alec

I worked with Java when I learned Computer Science I, II, and Data Structure and Algorithms and had many opportunities to practice the language for coding competitions in high school. I have also taken classes in Database Design, Web Programming, and Algorithmic Analysis and Design. The projects I have done for graduate school include designing a miniature file system with a team for Operating Systems and designing a miniature database with a team for Database Design. With this project and other kinds of work in the future, I hope to continue to learn and to develop my skills in computer science.

2. Akshat

A self-taught computer scientist, I started with using MIT Scratch to build simple applications & games in high school. I was fascinated by the ease with which a few lines of code can be arranged to build complex logic. As the head of the computer club at my high school, I spread this love for computing with other students by conducting several hackathons and computer-driven activities across different schools and local colleges in my city. Eventually, my goal as an individual is to create products that create an impact on the world and in the lives of people. I want to develop skills to work on scalable systems and technologies in computer science, as an individual contributor to the tech industry, or as a startup founder.

3. Mohana

Although my undergrad is in Electronics, I got a chance to take up Object oriented programming, Operating Systems and Cryptography during that time. My work experience was not more of development but went around working with business and tech teams to gather requirements, create product backlogs, conduct A/B testing etc. as an associate product manager. I am always enthusiastic to learn new stuff and work with it. By the end of this project, I would expect to get hands-on experience in product development and object oriented design, front-end and back-end technologies and working with a database.

4. Muktan

During my undergrad I had the opportunity to undertake two relevant courses: 1) Object-oriented programming in Java 2) Advance Java. Also, I had the opportunity to gain industrial experience of working on a large project during my summer internship that allowed me to apply my object-oriented programming skills to tests. Primary programming language that I use is Python as it allows me to work on an object oriented paradigm along with the support of its powerful libraries. But, along with that I have experience working with Java, C#, Javascript, and C. I am always eager to learn new technologies which help me to broaden my skill set.

5. Vishesh

I learnt Object oriented concepts and Java during my bachelors as a part of the curriculum. I have made several projects during the curriculum using Java and developed Web and Android Applications. During my internship period I learnt Python and worked on frameworks like Django Rest Framework. During my industrial experience I used Python and NodeJS and frameworks like serverless framework to build websites and Alexa skills. Also I used a lot of Amazon Web services to meet the

requirements for the projects. As an individual I always want to learn new concepts and technologies to grow as a developer.

ALEC BROWN
1049 Woodbriar Dr.
Grapevine, TX 76051
682-360-4518
alecbrown.u4@gmail.com

EDUCATION

BS in Applied Mathematics with focus in Computer Science. GPA: 3.61
The University of Texas at Dallas, Richardson, TX
May 2017

MS in Computer Science, Intelligent Systems Track.
The University of Texas at Dallas, Richardson, TX August 2018-present

COMPUTER SKILLS

Languages: C++, Java, Prolog, Python, R, Assembly Language, MATLAB, SQL
Operating Systems: UNIX, Windows
Packages: MS Office

RELEVANT COURSEWORK

Web Programming
Organization of Programming Languages
Abstract Algebra I
Discrete Math I and II
Data Structures and Algorithms
Operating Systems
Statistical Methods of Data Science
Machine Learning
Probability
Computational Logic
Database Design
C/C++ Programming in a UNIX Environment

ACADEMIC PROJECTS

Computer Science II Project
Developed a minesweeper game in Java utilizing event listeners, exception handling, and GUI.
The program also included a menu interface allowing the user to play on various difficulty levels.

C++/UNIX Programming Project
Developed a restaurant simulation in C++ complete with waiter, table, menu, and order classes.
This project utilized memory management with pointers as well as pipes in UNIX.

Database Design Team Project
Developed a library simulation in SQL using a database with multiple levels.

Operating Systems Team Project
Developed a miniature file system with a team, using C and UNIX.

Computational Logic Project
Developed a program that models a game of checkers, using Prolog.

AKSHAT GANGRADE

Phone: +1(469)927-2252 · Email: akshatgangrade18@gmail.com · Linkedin: https://www.linkedin.com/in/akshatgangrade/

Academic Details

Year	Degree	Institute	CGPA
2021-2023	MS in Computer Science	The University of Texas at Dallas	NA
2016-2020	Bachelors in Computer Science	Rajiv Gandhi Proudyogiki Vishwavidyalaya	8.66 / 10

Key Technical Projects

- **BINARY CLASSIFICATION USING IMAGE PROCESSING [Link]** *(February 2020 – April 2020)*
  - Developed a cat/dog binary image classification system using **10,000** images dataset, spilt in **20:80** for test and training.
  - Created a logistic regression algorithm initially, which gives an accuracy of **68 %** on the test dataset.
  - Performed a **Mini-Batch Gradient Descent** for hyperparameter tuning & optimization, batch sizes are divided into **64 samples**.
  - Improved by using a Deep CNN model, improved accuracy to **80 %** by using TensorFlow as backend, running **50 epochs**.
- **CREDIT CARD FRAUD DETECTION [Link]** *(July 2020 – August 2020)*
  - Developed a credit card fraud detection model using a dataset of **280k transactions**, using anomaly detection methods.
  - Created initial model using **local outlier factor algorithm**, resulting in a precision of **2%** & recall of **2%** for fraud transactions.
  - Used Isolation forest algorithm to improve metrics, with resultant **precision of 28% and recall of 29%** for fraud transactions.
  - Iteratively improved performance by analyzing data histograms and correlation matrix, used **sci-kit learn** python libraries.
- **SCHOLARSHIP INFORMATION PORTAL [Link]** *(October 2019 – December 2019)*
  - Created a **web portal** to connect deserving and underprivileged students with government scholarships and opportunities.
  - Students can upload educational and economic details in the system, to be notified using **SMS/E-mail** about scholarships.
  - Implemented Frontend using **Bootstrap-4** and **SCSS**, and used **Spring Framework** and **MySQL** as backend.
  - Used Mailchimp API for data storage on servers and **Gmail API** & **OTP** services for pushing Notifications.
- **STUDENT ATTENDANCE PORTAL [Link]** *(January 2019 – March 2019)*
  - Created a **Web application** to note attendance happening within the class and to display all student details on a web portal.
  - Setup **MySQL** database on a VM to store data of students, professors, admins etc.
  - Setup API endpoints using **NodeJS** on a VM to upload data and keep the application in sync with the on-line database.
  - Website is deployed on **Heroku** which visualizes data of marked attendance and previews instant data at a specified time.

Research Work

- **Survey of DES and AES Techniques in cryptography along with their comparisons:**
  - In the era of Computer and Mobile technologies the Computer network technology is proliferating at a breakneck speed and frequency therefore safe transmission and security of information are of high essence.
  - Data breaches and safe transmission are a major concern for network security armed with certain technologies like cryptography, these pains in the neck can be battened down and avoided effectively.
  - Comparisons of both algorithms is done on the basis of Keys needed, Space needed, Time factor and complexity, Avalanche effect and Simulation time.
  - The aim is to understand which algorithm is more efficient and secure as per todays highly confidential world.
  - This paper reviews and compares common types of these algorithms mainly AES and DES, the symmetric ones.

Internship

- **INSTITUTE OF TECHNICAL EDUCATION (ITE), Bhopal |** *Summer Trainee* *(June 2019 – August 2019)*
  - Manage physical storage as well as installing and configuring software components and services.
  - Established network connections & firewall restrictions to monitor & manage running processes, secure files & file systems.
  - Created administrator users and groups, review the system log files and journal for issues and troubleshoot problems and analyze systems with **Red Hat** insights and remotely manage systems with **SSH** and the **Web Console**.

Skills Summary

- **Technical Languages:** C++ · Python · JavaScript (ES6) · HTML-5/CSS-3 · Bash · LaTeX
- **Frameworks/Libraries:** Bootstrap-4 · NodeJS · Express · React · TensorFlow · NumPy · Pandas · Matplotlib
- **Development Tools:** Git · Heroku · Postman · Microsoft Visual Studio · Pycharm · Spyder · Jupyter Notebooks
- **Databases:** MySQL · PostgreSQL · MongoDB

RESUME

Mohana Rupa Mavuluri

Email: mxm210013@utdallas.edu Moblie: +1 (610) 545-9747
Linkedin: www.linkedin.com/in/mohana-rupa-mavuluri-446131118/

EDUCATION

The University of Texas at Dallas
Master of Science in Computer Science — Aug 2021 - Present

Birla Institute of Technology and Sciences, Pilani — CGPA 7.98
B.E. (Hons) in Electronics and Communication Engineering — Aug 2015 - May 2019

TECHNICAL SKILLS

Programming : C,C++, Java, Data Structures and Algorithms, Operating Systems, Product management, MS Office Suite
Soft Skills : Communication skills, Content writing

BUSINESS EXPERIENCE

KFIN Technologies Pvt. Ltd, Hyderabad
Deputy Manager-II, Product Management — Jun 2019 - Jan 2020

- Lead product development by following Agile Methodologies
- Micro automation and optimisation of human intensive processes
- Creating user stories and defining product requirements
- Collaborating and coordinating with cross functional teams including programmers, business analysts and UX-designers in the product life cycle

Bundl Technologies Pvt. Ltd. (Swiggy)
Intern, Business Management — Jul 2018 - Dec 2018

- Crafting strategies to optimise the working processes in cloud kitchens and designing a step by step procedure for optimised operations
- Prototyping and experimenting to fill the gaps in the best possible solution
- Successfully reduced the process time by 7% and reduced the manpower requirement in the cloud kitchens by 8%

National Textile Corporation, Coimbatore — May 2017 - Jul 2017
Intern, Research

- Research on scope of automation in the industry to reduce manual intervention and increase efficiency

ACADEMIC PROJECTS

Equity Analysis - Derivatives and Risk Management
An analysis on the Equity stock options and forwards contracts and their returns for Indo Count Industries Ltd (ICIL) using python

Online voting application
Group project to validate voters and declare results using blockchain technology in Java

Product Dashboard Design
Design of metrics dashboard for all the web and mobile based products

CERTIFICATIONS

- Bloomberg market concepts certification - Bloomberg
- The complete Product Management Course - Udemy

EXTRACURRICULAR ACTIVITIES

Treasurer - NIRMAAN Organisation — Aug 2017 - Jul 2018
Made the budget and handled the finances of the BITS-Hyderabad chapter of the NGO. Played a leading role in planning and organising the annual fest during which 600 orphan kids come over to stay on campus for 3 days.

Muktan R Patel

muktan123@gmail.com · https://linkedin.com/in/muktan-patel/ · https://github.com/Muktan · +1 (469)943-4578

Education

University of Texas at Dallas — Dallas, TX, USA
MS Computer Science *(Intelligent Systems specialization)* — Aug 2021 - Present
Relevant coursework: Natural Language Processing, Database Design, Object-oriented Analysis and Design

Dharmsinh Desai University — Nadiad, Gujarat, India
BS Computer Engineering *CPI: 9.26/10* — July 2017 - May 2021
Relevant coursework: Machine Learning, AI, Operating System, Computer Architecture, Algorithms & Data Structure.

Skills

- **Programming Languages:** Python, Java, C#, C
- **Databases:** MySQL, MSSQL, MongoDB, PostgreSQL
- **Framework & Libraries:** Pytorch, Tensorflow, Pandas, Matplotlib, Numpy, Hugging face, NLTK, Librosa, Optuna
- **Tools & Services:** Git, Github, GCP, AWS, Microsoft Azure, Visual Studio, Google Colab, Agile Development Process (SCRUM)

Publications

- Deepang Raval, Vyom Pathak, **Muktan Patel**, Brijesh Bhatt, **Improving Deep Learning based Automatic Speech Recognition for Gujarati**. *ACM Transactions on Asian and Low-Resource Language Information Processing* (ACM TALLIP) (2021).
- Deepang Raval, Vyom Pathak, **Muktan Patel**, Brijesh Bhatt, **End-to-End Automatic Speech Recognition for Gujarati**. The *17th International Conference on Natural Language Processing* (ICON-2020) (2020). https://aclanthology.org/2020.icon-main.56

Competitions and Projects

CommonLit Readability Prize - *Kaggle NLP competition*
Silver medal · 106/3566 (Top 3%)

- Using **innovative 2D attention mechanism** for Roberta large **improved** the performance by 15%.
- **Experimented** and implemented various technique like **Layer re-initialization, Gradient Accumulation, Custom attention heads, Pre-training Language model**.

End-to-End Speech Recognition for low-resource (Gujarati) Language - *Python Project*

- **Scrapped 2.5 million words** from **Gujarati Wikipedia** to use as a corpus for the language model.
- Novel **decoding technique** that **reduced** the word error rate **(WER)** by **2.1%**.
- Innovative **post-processing** using **BERT** boosted the performance by **3%** .

Data Visualizer - *C# ASP.net MVC project*

- Performed **dimensionality reduction**, reducing input data size by 80% on average.
- Created **visualizations** with the help of **canvasJS** and **Plotly**.

Web Scraper - *Python (Django) project*

- Scrapped and displayed the **connected words** links of the input word in **graph structure**.

Work Experience

ISRO - Indian Space Research Organisation - *Data Analyst Intern* — Dec 2020 - Apr 2021
Comparison of Indian satellite precipitation estimates with global satellites.

- **Calibrated** & **validated** the rainfall **image dataset** of multiple satellites (40-80 GB each) using **python libraries**.
- To **avoid pixelation**, the plots were smoothed using amalgamation of multiple interpolation.

Atliq Technologies - *Python Developer Intern* — Apr 2020 - Jun 2020

- **Accelerated** data ingestion **performance** by **80%** by **Indexing** RDBMS tables.
- **Increased code coverage** by **35%** by writing test cases in **Pytest**.

Opensource Contributions

Pandas (PR#39932, PR#40107), **Huggingface** (PR#11538), **Pytorch** (PR#2021), **Optuna** (PR#2709).

Position of responsibility

Developer Student Clubs - *Senior Machine Learning team member*

- **Mentored** a team of 5 juniors to develop and solve various problems using Deep Learning.
- Also, **delivered** and **organised** seminars and workshops in university.

VISHESH J MEHTA

Richardson, Texas, 75080 | www.linkedin.com/in/vishesh-mehta3 | +14699274592 | mehtavishesh9795@gmail.com

EDUCATION

The University Of Texas at Dallas **Richardson, USA Spring 2023**
Master of Science in Computer Science

Sarvajanik College of Engineering and Technology (GTU) **Surat, India May 2019**
Bachelor's in Computer Engineering (8.61/10 CGPA)

Laurentian University **Sudbury, Canada Summer 2018**
International Global Experience Program

TECHNICAL SKILLS

Languages:	Python, Java, C++, PHP, HTML, CSS, GraphQL
Web Technologies:	Flask, Django Rest Framework, NodeJs, Serverless Framework
Development Tools and other:	AWS, Android Studio, Microsoft Visual Studio, Eclipse
Databases:	DynamoDB, MySQL, Firebase

INDUSTRY PROJECT EXPERIENCE

Software Developer at Appgambit **Surat, India November 2019 - April 2021**

- Developed Alexa skill using AWS lambda function for the City of East Point, USA for the users to get city events and utility bill updates.
- Implemented services to enable information about the available COVID hospitals/agencies near the user's location.
- Designed and implemented Alexa skill for LA Sanitation Dept. for scheduling Christmas tree recycling pickups.
- Skill was implemented for English and Spanish, helping to manage and check status of 2k-3k user requests daily.
- Monitored, notified and stored user information using AWS CloudWatch, AWS SNS and DynamoDB respectively.
- Developed secured dashboard to access information from S3 buckets using Vanilla JS and AWS Cognito.

Software Intern at Avinashi Ventures Pvt. Ltd. **Surat, India August 2018 - April 2019**

- Led team of 4, to develop Android and Web Application notifying users to buy products when it reaches below a user specified threshold.
- Exercised *Web Scrapping* to get details of products from web pages like Amazon, Flipkart and Snapdeal.
- Implemented a crawler to fetch prices periodically of user preferred products on the watchlists.
- **Technologies consumed:** *Firebase, Android Studio, PHP, Python, Java.*

Software Intern at Eleiss **Surat, India February 2019 - June 2019**

- Implemented RESTful APIs for the career section of Eleiss.com using Django Rest Framework.
- Documented for clear references helping developers to get detailed information and implementation of features.

ACADEMIC PROJECTS

Hostel Management System *using HTML, CSS and JSP* **Fall,2016**

- Designed a Web Application to administer hostel rooms based on users demands.
- Manage rooms on the basis of user's preference (AC/Non-AC) and generated a monthly bill of user based on room type (AC/Non-AC) and food choice (Vegetarian/Non-Vegetarian).

Health Care Advisor System *using ASP.Net* **Spring, 2016**

- Led a team of four, to build a software suggesting respective doctors to patients according to inputted disease.
- Automated a system to take symptoms as input, asking user a series of question.
- Analyzed symptoms and, on its basis, computes probability of disease and suggests related doctors.
- Designed a system helping users to book appointments.

Build an Estate Dealing Application *using Java, Android Studio and MySQL* **Fall, 2017**

- Created an Android Application, helping users to buy and sell lands online.
- Achieved feature according to basic location and demand of land.

Television Show Recommendation System *using Java, Android Studio and MySQL* **Spring, 2018**

- Built an Android Application recommending users Top 5 TV shows based on selected genres preference.
- Incorporated TV shows rating dataset from Hullu shows to local database using *MySQL*
- Developed a local server using *PhpMyAdmin* to store ratings and users' preferences.