Enterprise Backend as a Service

(Code that writes the code)

Project Workbook

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Chapter 1. Literature Search, State of the Art

Literature Search

- Natural Language Processing:

Natural Language Processing or NLP is a field where the interactions between humans and machines are dealt using the natural language. The purpose of NLP is to use machines to understand human languages. One of the applications of NLP is chatbots. In the research paper "Implementation of an inquisitive chatbot for database supported knowledge bases" by S Reshmi and Kannan Balakrishnan, they tell chatbot imitates humans in conversations using English or any other natural language as the input. The paper also tells how inquisitive chatbots have become a part of our system. Virtual support, electronic commerce doubt solving or tutoring, and social media uses chatbots with NLP heavily.

- Backend as a Service:

Backend is a middleware that handles the functionality of an enterprise application via API or SDK. Backend as a Service allows users to maintain only the frontend with everything behind the scenes aspects related to the backend being managed by the service model. As demand for business applications is rising, the need for fast growth in development is also rising parallelly. Companies are constantly urging developers to create applications and other business software more quickly without sacrificing quality. In the paper "Availability Evaluation and Sensitivity Analysis of a Mobile Backend-as-a-service Platform", Costa, Igor, Jean Araujo, Jamilson Dantas, Eliomar Campos, Francisco Airton Silva, and Paulo Maciel have explained how backend as a service enables engineers to connect their application backend to cloud servers. They also explain, how backend as a service can be used to integrate with other apps.

- Database:

Efficient management of any data can't be done without a consistent and integrated database. For the modern IT and current science and industry maintaining such databases is an important task. For smooth functioning of backend we need to have a proper database management system which would make the interaction of code using the REST APIs fluent. In the research paper "Looking into a REST-Based Universal API for Database-as-a-Service Systems" Till Haselmann has explained that the goals of API should be to have maximum flexibility and exchangeability, for which the relational databases serves as the best source and hence we should use SQL database. To support this thought we found that in "A relational database environment for numerical simulation backend storage" Jacek Nazdrowicz also supports the thought of using SQL databases for backend.

- Prediction & Smart Insights:

In one of the research papers "Forecasting Nike's sales using Facebook data" Linda Camilla Boldt has explained how Big Social Data can be used to predict real-world outcomes like the global sales of Nike Inc. Analytics and critical insights are the most important factors which can help expanding business at any level. To get greater competitive advantage companies are using machine learning (ML) and artificial intelligence (AI) to get prediction based on their past and current data and get smart recommendation from them. The most visible developments in Google's neural network research has been the DeepMind network, the "machine that dreams." According to Google, the company is researching "virtually all aspects of machine learning," which will lead to exciting developments in what Google calls "classical algorithms" as well as other applications including natural language processing, speech translation, search ranking, prediction systems, and Recommendation Systems.

- Deployment:

There's an old dev saying that goes something like, "Always develop in an environment that is the same as your deployment environment." Therefore, things like Virtual Environments exist. This is sage advice. AppScale is a free and open-source software framework for running Google App Engine applications. The main goal of AppScale is to permit developers to have appliance portability. It is a cloud computing platform (marketed as platform as a service), supporting Xen, Kernel-based Virtual Machine (KVM), Google Compute Engine, Amazon EC2, Rackspace, OpenStack, Cloud Stack, and Eucalyptus. It is developed and maintained by AppScale Systems, based in Santa Barbara, California. AppScale was initially funded by Google, IBM, the NSF, and NIH.

AppScale chains the capability to host several App Engine applications with the ability to exchange distributed datastores such as Accumulo, HBase, Hyper table, and Apache Cassandra. It has held up for Python, Go, PHP, and Java applications by implementing scalable services such as the datastore, memcache, blobs tore, users API, and channel API

State-of-the-Art Summary

ZenQuery and apiOmat

When it comes to providing APIs without writing a trace of code, we have several technologies to take inspiration from. ZenQuery provides API instantly given an SQL Query to it. It is basically a JAVA application which is hosted on user's server and thus providing security of their data. apiOmat does have extra features like it supports the specification user's data and also provide SDKs for mobile platform for Android and iOS. The only problem here is that the code for the API which is being generated by these technologies stays with them and is not provided to the users. Our project aims to provide the code for the exact same APIs.

Util-RAML-Code-Generator

Util-RAML-Code-Generator generates a code based on RAML specification. It needs RAML specification for the API i.e services which needs to be generated and the RAML specification for entities i.e the objects which will be manipulated by the services. This gives us a good base to start generating API at a very basic level like the CRUD operations. The challenge over here is that there is no way we can integrate the database with which we want the APIs to communicate.This is one feature which is missed dearly while using this software.

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Chapter 2. Project Justification

The purpose of this project is to create a web application, that can be used to create backends, databases, host them on cloud servers and connect them to machine learning services. Small organizations or start up ideas face problems in creating back-end API's and hosting the server on cloud platforms. Automated generation of back-end API's can save a lot of time. It can benefit not only IT experts but non ITpeople also. It can help back-end developers, front-end developers, data scientists and non technical people as follows:

1. **Back-end Developers:** It can help back-end developers to create databases, quickly create API's by auto generation, modify the API's if needed and quickly host the server on some cloud platform.
2. **Front-end Developers:** It can save a lot of time for front-end developers who needs backend API's and databases hosted on a cloud platform.
3. **Data Scientists:** It can help data scientists and machine learning engineers as they can quickly save data into databases using API's, add on the API's for their purpose.
4. **Non Technical People:** It can be a life saver for non technical people as they can create databases using this, create and host a server with RESTful API's, connect with a machine learning service. Later they can even use the code to extend the functionalities.

The need for fast development of applications is rising. Companies constantly urge developers to create more quickly applications and other business software without sacrificing quality. It is very important to increase the development speed. By using the application created under this project, a user can rapidly develop databases, backend servers, host them on cloud services and use AWS machine learning services. They can

talk to create their applications using chatbot. Thus the project is important for non technical people as well as software engineers.

Chapter 3. Identify Baseline Approaches

An API, when explaining to a layman can simply be explained as a code which will allow two different software to work and communicate with each other. As the software industry is growing more and more microservices being produced, APIs have played a huge role. Consider a situation where a microservice has been developed but to use it, you need to download it rather than having an API which one can call to get the desired operation. Obviously that microservice is doomed to fail. But as heavily as we are relying on APIs to help us out, it is interesting to know that there is almost no industry standard for creating APIs as well as documenting it. We need to have common vocabulary for various software to communicate. A proper definition of designing an API is half the work done. There are various languages out there which deals with this and the most popular ones are RAML(RESTful API Modelling Language) and Swagger. Various characteristics need to be analyzed like the code reusability, the support-base, the allowance of design patterns and the ease of use. RAML does have an edge over swagger when it comes to supporting the entire API's lifecycle and is considered to be the fastest framework to work with. We are planning to use RAML for defining our APIs.

RAML is an approach to create backend API's. It is used by Util-RAML-Code-Generator, which is an open source package used to create API's. It takes input specification in RAML format and creates code. We plan to provide RAML specification for the API i.e services which needs to be generated and the RAML specification for entities i.e the objects which will be manipulated by the services. We also plan to add database connection by providing the endpoint in the RAML specification. In our scenario, the user will provide the requirements to create the database like table names, the fields, and the operations. Our application will create a database and will also dynamically create RAML specification files for tables(means

entity) which will have fields to describe that entity and also for the operations(means services) which will finally be translated to APIs.

Chapter 4. Dependencies and Deliverables

Dependencies:

According to our plan, we plan to have our code running on our server and we would take input from user for where user wants it database to be hosted and provide a docker image of the APIs. So we are assuming that user must have a servers for this purpose.
The other concern is right now we are planning to work with relational database specifically SQL if the user wants the database to be NoSQL or any other database we will have to make changes and reconsider the complete plan for the project.

Our code which would be interacting with the user through chat bot or voice commands would be needing the ML services provided by Amazon, So our code is directly dependent on the ML services provided by Amazon. If we try to use our own ML code that will increase the scope of project significantly, so we decided to use AWS ML services.

Deliverables:

The one main deliverable is the prototype of the project, Where user would interact with either our website or chatbot or through voice commands to give the requirements as well as the details related to servers. Then our code would create the database with proper schema according to the requirement and generate a docker image which would have the code for accessing this database through REST APIs with basic operations. The docker container would be running on the API server if details are provided otherwise user would have a link to the published docker image which he can download and spawn a docker container from it.

Chapter 5. Project Architecture

The project architecture can be divided into 3 parts. The first part is the User interaction part. Here we would have a website wherein user would input data in forms or user can use the chatbot to give his inputs. We also plan to use dialogue flow to get inputs via voice commands. After collecting the input in the second part we have the EBaaS server, Where our code would process the inputs and generate the database with the schema on the user provided database server and generate the code for APIs for the same and publish a docker image with the code for the code. We plan to use the machine learning services provided by AWS to suggest the data points which user should consider adding to their schema to make it more good. Also use the ML services for natural language processing required for chatbot/ voice command to understand the user input and get the requirements. The output would be a published docker image which the user can download and spawn a container out of it on its API server. The container will also have the code so the user can get into the container and customize the code if he wishes to do so.

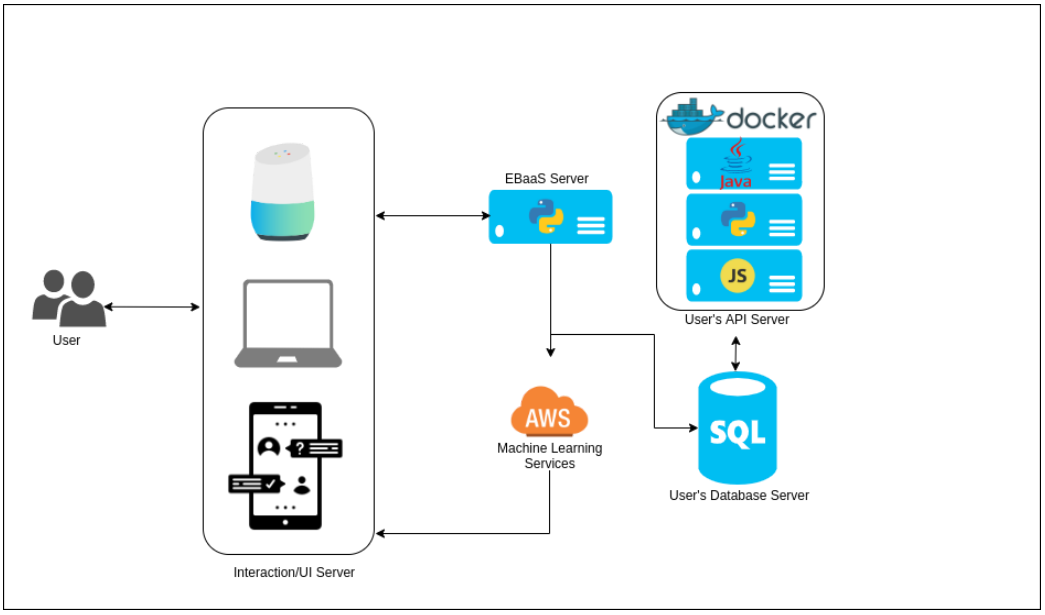


Fig1. Architecture of the Project

Chapter 6. Implementation Plan and Progress

We will be starting with creating a website which provides the user to provide us inputs in a form of story. At the end of the interaction, we will have all the requirements for creating a database and we will host a database with required tables and fields on the server provided by the user. After that, we will be creating RAML files to develop the specification files which in turn translate the database operation and manipulation to APIs. We will be using React.js for the front-end and Python for the back-end. The database will strictly be created as a SQL Database. For the insights we are thinking of using cloud services like Google Cloud and AWS.

PHASES	TASK NAME	ACTIVITIES	ASSIGNED TO	% Completed
Planning	Business analysis	Selection of Topic	Team	100
		Determining Project Scope	Team	100
	Requirement Elicitation	Identification Risk involved	Team	100
		Defining the use cases	Team	100
		Determining Functional requirements	Aditya	100
		Identifying Infrastructure Requirements	Darshil, Aditya	100
		Abstract submission	Devashish	100

Design	High Level Design	Project architecture	Aditya	100
		Outlining use cases to be implemented	Maulin	50
	Detailed Design	UML diagrams	Maulin	50
		Backend Design	Darshil,Devasish	50
		UI Mockup	Darshil,Aditya	50
		Work Book 1 submission	Devashish	50
Prototype Development and Testing	Prototype Development	UI development/ChatBot	Devashish, Darshil	0
		Backend Development	Aditya, Darshil	0
		Smart Predictor & Recommender Development	Devashish,Maulin	0
		Integration	Aditya	0
	Deployment Setup	AWS setup	Maulin, Darshil	0
		AWS Deployment	Team	0
		Work Book 2 submission	Devashish	0
	Testing	Functional testing and Bug fixing	Team	0

		Integration testing and bug fixing	Team	0
Documentation	Documentation	Project Report	Team	0

Chapter 7. Project Schedule

We have divided our project into different modules like business analysis, requirement gathering, prototype development, deployment, testing & documentation and have scheduled our whole project based on those modules and their respective deadlines with the subtasks for each module.

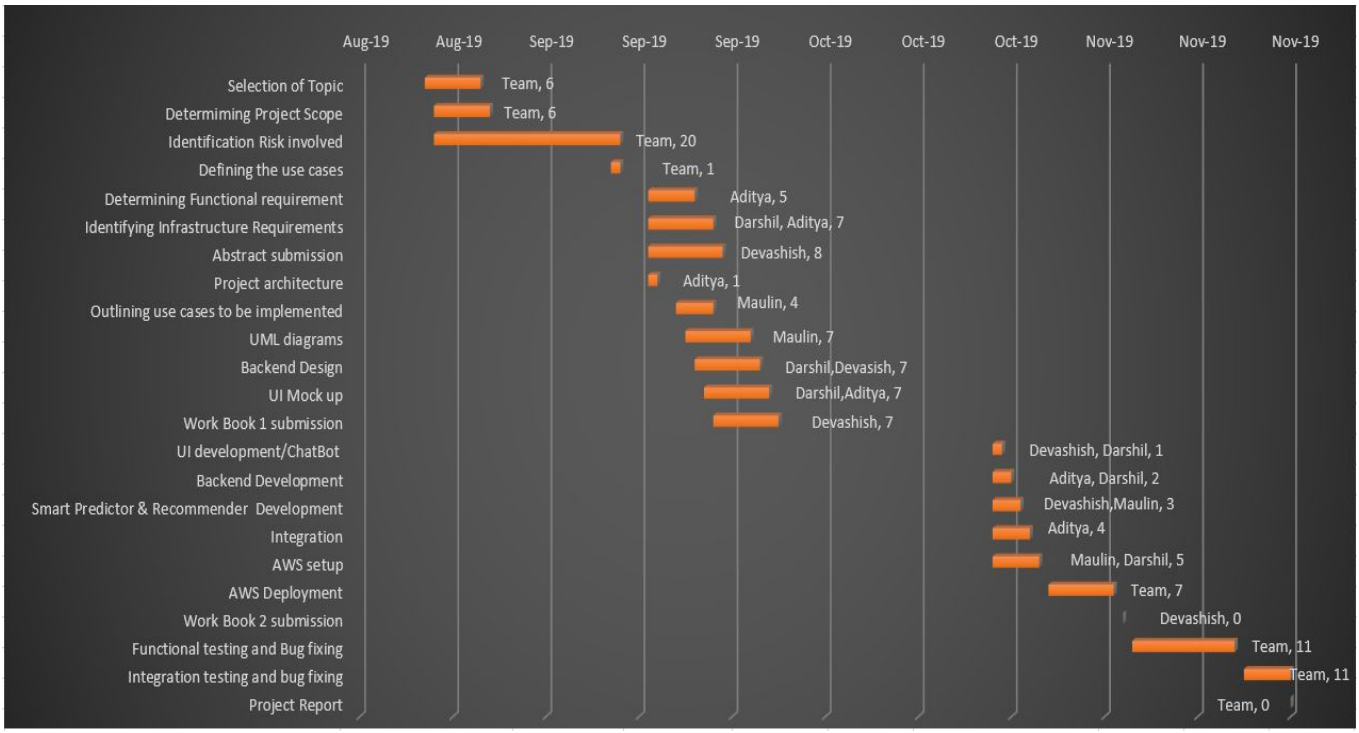
The table includes the activities, the people who that is assigned to (very important to delegate the responsibilities to deliver results within a deadline), start date and an end date. The duration field in our table is expressed in days. We have followed that with a gantt chart to show the division of work as well.

ACTIVITIES	ASSIGNED TO	START DATE	END DATE	DURATION
Selection of Topic	Team	8/20/2019	8/26/2019	**6**
Determining Project Scope	Team	8/21/2019	8/27/2019	**6**
Identification Risk involved	Team	8/21/2019	9/10/2019	**20**
Defining the use cases	Team	9/9/2019	9/10/2019	**1**

Determining Functional requirements	Aditya	9/13/2019	9/18/2019	**5**
Identifying Infrastructure Requirements	Darshil, Aditya	9/13/2019	9/20/2019	**7**
Abstract submission	Devashish	9/13/2019	9/21/2019	**8**
Project architecture	Aditya	9/13/2019	9/14/2019	**1**
Outlining use cases to be implemented	Maulin	9/16/2019	9/20/2019	**4**
UML diagrams	Maulin	9/17/2019	9/24/2019	**7**
Backend Design	Darshil,Devasish	9/18/2019	9/25/2019	**7**
UI Mockup	Darshil,Aditya	9/19/2019	9/26/2019	**7**
Work Book 1 submission	Devashish	9/20/2019	9/27/2019	**7**

UI development/ChatBot	Devashish, Darshil	10/20/2019	10/21/2019	**1**
Backend Development	Aditya, Darshil	10/20/2019	10/22/2019	**2**
Smart Predictor & Recommender Development	Devashish,Maulin	10/20/2019	10/23/2019	**3**
Integration	Aditya	10/20/2019	10/24/2019	**4**
AWS setup	Maulin, Darshil	10/20/2019	10/25/2019	**5**
AWS Deployment	Team	10/26/2019	11/2/2019	**7**
Work Book 2 submission	Devashish	11/3/2019	11/3/2019	**0**
Functional testing and Bug fixing	Team	11/4/2019	11/15/2019	**11**

Integration testing and bug fixing	Team	11/16/2019	11/27/2019	**11**
Project Report	Team	12/1/2019	12/1/2019	**0**



(Fig 2. Gantt Chart)