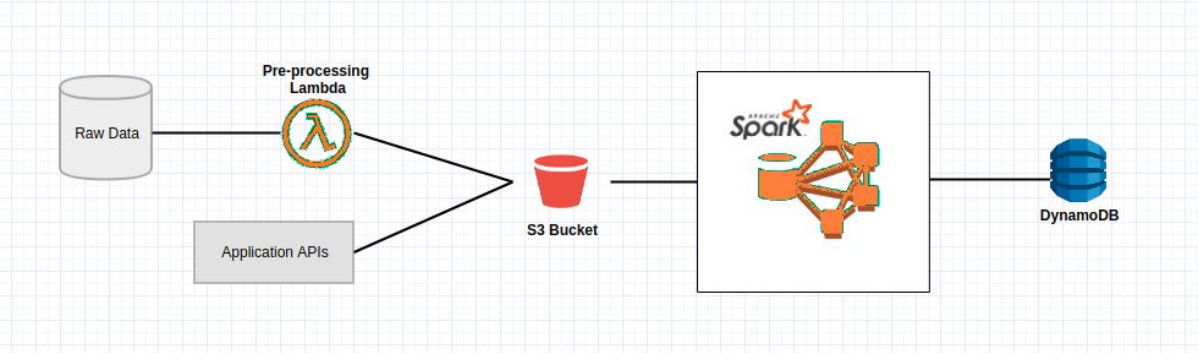
PROJECT PROPOSAL
DATA CENTER SCALE COMPUTING

PROBLEM DESCRIPTION

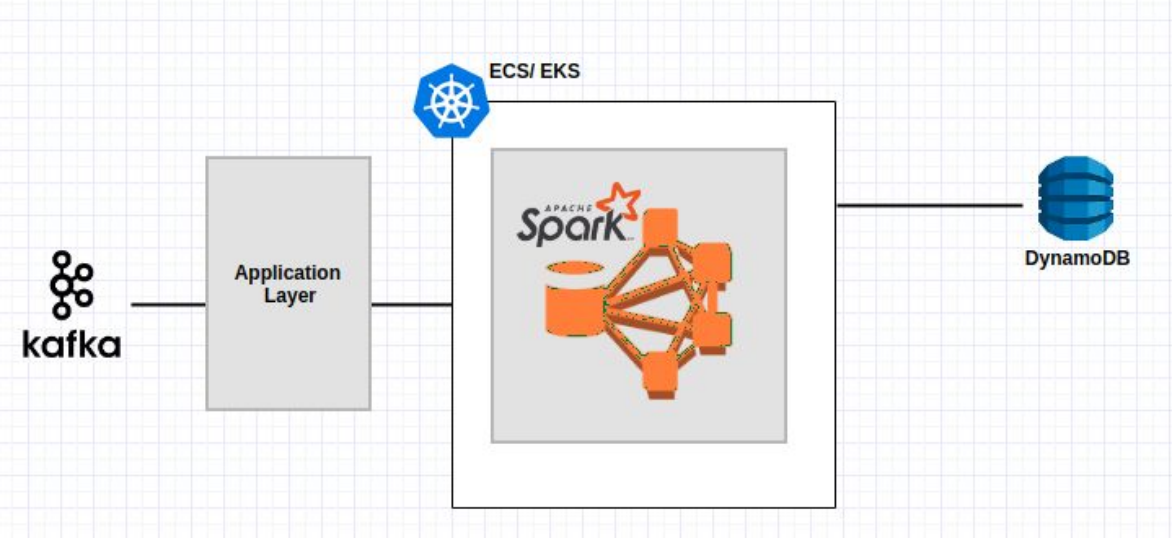
- Through this project, we aim to focus on scalability. In an application like Uber or any taxi service app, it is pertinent that the user requests of a cab are met in an acceptable amount of time. If the application delays a user's response a lot or fails to return a response, this could lead to a reduced popularity for the application.
- The application should be able to handle a large number of requests at the same time, to promote user satisfaction and also for monetary purposes.
- We plan to explore Kubernetes/Docker services (EKS/ECS) to handle multiple requests parallely. We also plan to split independent requirements of a request and delegate them to different microservices so that they are computed parallelly and independently.

HIGH-LEVEL ARCHITECTURE



Pre-Processing data and storing the structured data in DynamoDB database

- Raw data would be put into some kind of database (Maybe S3)
- Pre-processing lambda function takes data from this database, preprocesses it and stores it in S3.
- Spark then takes care of creating tables and columns in DynamoDB.



Kafka to process “real time” requests

- Kafka would contain user requests. For example, a request to search for a cab at a particular location.
- This request would then go to the application layer which would structure the user query, maybe add additional context and send it to a node with Spark capabilities in EKS/ECS (Elastic Kubernetes Service or Elastic Container Service).
- EKS is Elastic Kubernetes Service which provides an option to configure a Kubernetes cluster. ECS is Elastic Container Service which provides an option of creating multiple dockers.
- We then configure some nodes in EKS/ECS to have Spark functionalities.
- When a request reaches the EKS/ECS a new node might be created on the fly or use an existing node with spark functionalities.
- Spark takes care of interacting with the DynamoDb and querying for results which it sends back to the application layer.
- Extended Goal: Show some kind of visualization of the result.

DATASET

- We will be using NYC taxi trip data from Yellow Taxi, Green Taxi and Uber.
- Description:
  - Format: .csv
  - The data requires minimal preprocessing. (Removal of unnecessary metadata)
  - The dataset is static.

- The data can be exported as a CSV. There is no need of a developer account.
- The data will be stored in S3 buckets.
- Sample dataset - (Next Page)

Column Name	Description	Type
vendorid	A code indicating the TPEP provider that provided the reco...	Plain Text
pickup_datetime	The date and time when the meter was engaged.	Date & Time
dropoff_datetime	The date and time when the meter was disengaged.	Date & Time
Store_and_fwd_flag	This flag indicates whether the trip record was held in vehi...	Plain Text
rate_code	The final rate code in effect at the end of the trip. 1= Stand...	Number
Pickup_longitude		Number
Pickup_latitude	Latitude where the meter was engaged.	Number
Dropoff_longitude	Longitude where the meter was disengaged.	Number
Dropoff_latitude	Latitude where the meter was disengaged.	Number
Passenger_count	The number of passengers in the vehicle. This is a driver-e...	Number

Some Columns that are present in the [database]

CHALLENGES

- One of the challenges is to process the incoming requests fast and gain a major boost in the processing time through our architecture.
- Our architecture consists of multiple technologies like Kafka, EKS/ECS, ElasticSearch alongwith Microservices. The biggest challenge would be to integrate all the components and run the queries.
- There are technologies like Kubernetes, ECS, EKS, Kafka which our group is not familiar with. It would be a challenge to gain holistic conceptual understanding and recognize appropriate implementation strategies.
- Our metrics of measuring performance of our project would be to calculate the average running times of 100 different requests which requires a considerable processing power and time and compare the running times with and without using ECS/EKS etc.

GENERAL TASKS AND TIMELINE

Given that we are to present two checkpoints for the given project, we have divided our timeline accordingly.

Weeks	**Tasks planned**
Oct 23 - Oct 30	Project Proposal ● Teaming up to discuss architecture and write proposal
Nov 1 - Nov 13	● Finalise project Design ● Start setting up EKS/ECS ● Preprocessing, data cleaning and structuring ● Setting up Kafka ● Designing the Application Layer
Nov 14- Nov 29	Project Implementation
	● Integrating Spark with EKS/ECS ● Structuring the queries from Spark on DynamoDB ● Kafka processing ● Kafka-Application Layer integration ● Application Layer ● Application Layer-EKS/ECS Integration ● Writing Unit test cases
Nov 30 - Dec 10	● Project Completion ● Documentation ● Integration testing ● Performance Measure

TASK DIVISION AND TIMELINE

S. No.	Name	Tasks	Timeline
1	Akriti Kapur	● Defining Architecture ● Overlooking preprocessing, data cleaning and structuring ● Kafka processing ● Structure the queries ● Creating test cases to produce “real-time” data	● Week 0 ● Week 1 ● Week 2 ● Week 2 ● Week 3
2	Amith Gopal	● Identifying Challenges ● Containerization using EKS/ECS ● Integration of Spark with EKS/ECS ● Integration of Application Layer with EKS/ECS ● Simple queries to test Spark-dynamoDB	● Week 0 ● Week 1 ● Week 2 ● Week 3 ● Week 3
3	Sowmya	● Identifying the AWS services ● Containerization using EKS/ECS ● Integration of Spark with EKS/ECS ● Integration of Application Layer with EKS/ECS ● Documentation	● Week 0 ● Week 1 ● Week 2 ● Week 3 ● Week 3
4	Tarunianand	● Finding datasets ● Working with Akriti on Kafka processing ● Developing application layer (Django etc.) ● Creating test cases to produce “real-time” data ● Documentation and Demonstration prep	● Week 0 ● Week 1 ● Week 2 ● Week 3 ● Week 3

CONCERN

- Since our project is heavily dependent on the AWS services, we are concerned about the potential cost incurred by the time we complete the project.