Lambda Architecture Assignment

1. Explain the factors leading to Big Data. List & explain major sources of Big Data.

→ The rise in technology has led to the production and storage of Large amounts of Data. & Affordibility of smartphones.

→ Earlier MetaBytes of data were used but nowadays Petabytes of data are used for analyzing, discovering new facts & Knowledge.

→ Traditional systems were not built to handle large amount of data so there is a need for new systems to analyze the fast growing complex and unstructured Data.

→ The Big Data is a high-volume, high-velocity, high variety & a high veracity im formation set.

The Major Sources of Big Data are:

→ Social Networks & Web Data: Such as Facebook, Twitter, emails blogs & Youtube. On an average Per day Billions of Bytes of data are produced by social Networking Sites making it a large contributor of Big Data.

→ Transaction data & Business Processes: Such as credit card, transactions, flight bookings etc & Medical records.

→ · Machine generated Data: From IoT sensors, Home automation, traffic sensors etc. Data from computer system like Logs, web logs etc

→ Human-generated Data: biometrics data, human Machine interaction data.

2. List and explain the charctristics of Big Data.

→ Volume: It represents the big size of the data. It comes from large piece of data or collection of small data over a peroid of time.

→ Velocity: The term velocity refers to the speed of generation of data. Velocity is so fast to meet the demands & the challenges of processing Big Data, the velocity of generation of data plays a crucial role.

→ Variety: Big Data comprises of variety of data. Data is generated from multiple sources in a system. This introduces variety in data & therefore introduces 'complexity'. It is caused to the availability of large number of hetrogenous platforms in the industry.

→ Veracity: It defines the quality of data captured, which can vary greatly, affecting its accurate analysis.

3. List & explain the major challenges of Big Data Systems.

→ Scaling up & down Big Data according to current Demand.
* Due to data verity it is difficult to create common storage & dificult to integrate.

→ Collecting and Integrating massive & Diverse Datasets.
* Collection of data might be difficult as a lot of institutions would refuse to share & available data consists of diverse datasets. Finding a common ground to integrate would be difficult.

→ Picking the Right NoSQL Tools:
→ Depending on the type of data choosing the right NoSQL tools can be difficult as it might take trail & error approach.

→ Maintaing Data Integrity, Security and Privacy:
→ Securing the Data for the analyzis can be tough as Some ~~has~~ data can be sensitive like patient information.

→ Overcoming Big Data talent & Resource constraint.

④ Due to increasing tools & technologies in big Data it is hard to find the Right talent as people are still workingon traditional methods.

④ To Maitain & process data of large volume it is near impossible due to hardware constraints

4. Discuss the problems faced by traditiond database Systems.

→ Big data is too big for traditional storage

④ Though in theory traditional database systems can handle large amounts of data. It simply can't Keepup with demands of mordon data to deliver the effiency & insights we need.

→ Scaling up vs scaling out.

→ traditional data storage Systems are centralized, So we are forced to Scale up which is less resource effiont than scaling out.

→ Big data is too compler for traditionalstorage:

→ Since big data consib of more than rows & colums Some may be structured but large part of it is unstructured. which can be an issue as they can't properly catogrize it.

→ Big data is too fast for traditional storage.
→ An RDBMS isn't designed for rapid fluctuations. But Big data grows almost instantaneously & analysis needs to occur in real time. for example senson data, which produce at concurrent rate. which maybe dificult to analyze.

5. Discuss the required Properties for Big Data Systems.

→ Robustness & error tolerance:
→ Systems are required to behave in a right manner despite machines going down randomly. Robustness of big data System is the solution to overcome the obstacles associated with it.

→ De buggability: A system must be debug when onfair thing happens by the required information. delivered by the big Data system

→ Scalability: It is the tendency to handle the performance in the context of growing data & load by adding resource to the system.

→ Generalization: It is important to generalize a wide range of application can be function in a general system.

→ Ad hoc queries: Every large dataset contains an anticipated value in it. The ability to perform ad hoc queries on data is significant.

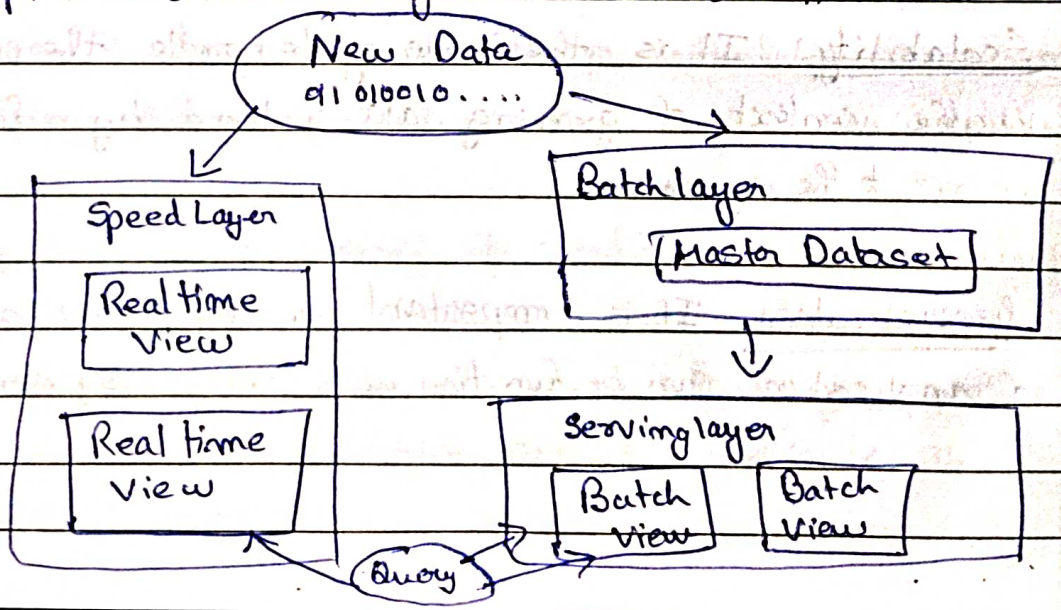
→ extensivity: Extensible system enables to function to be added cost effectively.

→ Low latency reads & updates: In big data system, there is a need of applications low latency on updates propogated shortly

→ Minimal maintenance: selecting components with probably little complexity plays asignificant role in minimal maintenace.

Most of these problems are solved by Lambda Architecture.

6. Explain diffent layers of Lambda Architecture.



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Page

Speed Layer: Batch Layer:

→ The batch layer stores the master copy of the dataset & precomputes batch views on that master dataset which can be thought of as a very large list of records.

→ Batch layer should be able to store an immutable, constantly growing master dataset and,
→ compute arbitarily functions on the dataset.

Serving Layer:

→ The batch layer emits batch views as the result of its functions.
→ The serving layer is a specilized distributed database that loads in a batch view & makes it possible to do random reads.

Speed layer:

→ The serving layer updates whenever the batch layer finishes precomputing a batch view.
→ The goal is to ensure new data is represented in query functions as quickly as needed for the application requirement.

7. Differentiate between re-computation algorithm & increment algorithm.

re-computation algorithm	Increment Algorithm
→ When new data arrives it throws away the old batch views and recomputing functions over the entire master dataset.	→ When new data arrives it will update the batch views directly when new data arrives
→ It will update the count by first appending the new data to master dataset & then counting all the records from scratch.	→ It will count the number of new data records & add it to the existing count.
→ Lower efficiency compared to Increment Algorithm	→ Higher efficiency compared to re-computation Algorithm.
→ Extremely tolerant of human errors	→ Doesn't facilitate repairing errors in the batch views.
→ Requires computational effort to process the entire master dataset	→ Requires less computational ressources. but may generate much larger batch views.

8. List the requirements & responsibilities of batch layer.

Responsiblites of the Batch Layer:

→ **Data Processing:** Batch Layer processes large volume of data in batches. It is designed to handle comprehensive computations & genrate results.

→ **Data Storage:** It relies on immutable storage systems which helps in ensuring data consistency & reliability

→ **Consistency & Accuracy:**
→ Accurate Results ensure high accuray in data processing by relying on complete datasets & executing through computations.

Requirements of Batch layer:

1. **Scalability:** It must be able to scale horizontally to handle large volumes of data.

2. **Fault tolerance:** It should be designed to recover gracefully from failures.

3. **Performance:** The system should efficiently perform large scale data computations.

4. **Data Intergity:** Ensuring that the results produced are consistent & accurate, even in the face of failures.

9. Requirements of serving layer in Lambda Architecture.

→ Batch writable: The batch views for a serving layer are produced from Scratch. When a new version of a view becomes available, it must be possible to completely swapout the older version.

→ Scalable: A serving layer database must be capable of handling views of arbitary size.

→ Random reads: A serving layer database must support random reads, with indexes providing directaccess

→ Fault tolerant - Because a serving layer database is distributed it must be tolerant of machine failures.

10. With example show how low latency & high throughput can be achieved in serving layer of lambda architecture

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11. List the requirements & responsiblites of speed layer

→ Random reads - A realtime view should support fast random reads to answer qu'os quickly. This means the data it contains must be indexed.

→ Random writes - To support incremental algorithms, it must also be possible to modify a realtime view with low latency.

→ Scalablity: As with the saving bygo views, the realtime views should scale with amount of data they store and the read/write rates required by the application.

→ Fault tolerance: If a disk or a machine crashes, a realtime view should continue to function normally.

12. Differentiate between batch and speed layers.