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Data Engineering with Azure: Modern Steps

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Abstract

In the rapidly evolving landscape of data engineering, leveraging cloud platforms has become crucial for organizations aiming to manage and process vast amounts of data efficiently. Azure, Microsoft's cloud computing service, offers a comprehensive suite of tools and services tailored for modern data engineering workflows. This abstract explores the contemporary steps involved in data engineering with Azure as of 2019.Key components include Azure Data Factory for data integration and orchestration, Azure Databricks for advanced analytics and machine learning, and Azure Synapse Analytics (formerly SQL Data Warehouse) for data warehousing and big data processing. These tools enable seamless data ingestion, transformation, storage, and analysis, facilitating scalable and cost-effective solutions for enterprises of all sizes. Moreover, the abstract discusses best practices and considerations for implementing data engineering solutions on Azure, such as optimizing data pipelines, ensuring data quality and security, and harnessing Azure's scalability and elasticity. It also highlights the integration of Azure services with existing on-premises infrastructure and third-party applications, emphasizing Azure's role as a versatile and robust platform for modern data engineering initiatives. Ultimately, this abstract aims to provide insights into leveraging Azure effectively for data engineering purposes in 2019, addressing both technical capabilities and strategic advantages for organizations navigating the complexities of big data processing and analytics in the cloud.

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1. Introduction

The world of data platforms and ETL is changing immensely. There was once a time when the only options you had were SQL Server, Oracle, or MySQL for a database, and the only option for ETL was using custom C# or Java code. Today, regardless of your preferred choice of code language, there's a whole host of data storage options including SQL Server, and NoSQL databases like Azure Table StoraGE Data Warehouse, Spark databases, and Azure Blob storage. For ETL, there are so many options including SSIS, Azure Data Factory, Spark, and HDInsight. This morning's article is going to focus on the Data Factory pipeline. Data Factory doesn't always get the love that it deserves. We all know that if you truly want to scale and if you want to save money, you need to focus on Spark. The thing is, like many companies, many don't have Spark experts floating around and ready to create the ETL frameworks that Data Factory allows you to create in just a few clicks of a button. Not only can you get going quickly, but you can do amazing things like make sure that you don't rebuild computed data that hasn't changed, so much so that the Azure Data Factory costs page says that one of the ways to make ADF cheaper is by changing data. The evolution of data platforms and ETL tools has democratized data engineering, offering a diverse array of options beyond traditional SQL Server or Oracle databases and custom C# or Java ETL scripts. Modern cloud platforms like Azure now provide a rich ecosystem of data storage choices including SQL and NoSQL databases like Azure Cosmos DB and Azure Table Storage, Hadoop data lakes, Azure SQL Data Warehouse, Spark databases, and Azure Blob storage. Among these, Azure Data Factory stands out for its capability to streamline ETL workflows without the need for extensive Spark expertise. It empowers organizations to quickly build robust ETL pipelines that optimize data processing, ensuring efficiency and cost-effectiveness by minimizing unnecessary data recalculations. Azure Data Factory exemplifies how modern data engineering can be both accessible and powerful, enabling businesses to leverage advanced capabilities while managing costs effectively in today's data-driven landscape.

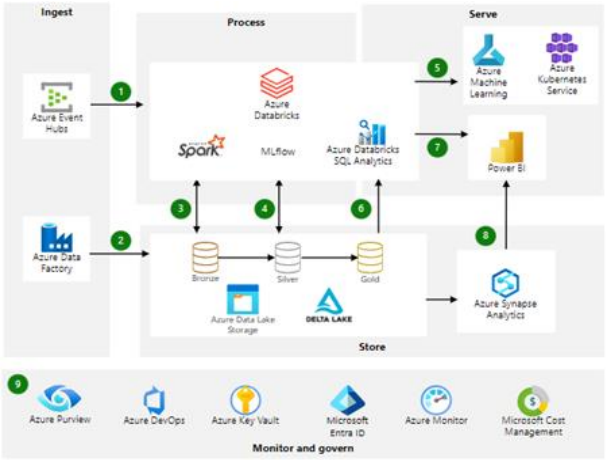

Fig 1: Modern analytics architecture with Azure Databricks

1.1. Overview of Data Engineering

Data engineering is the groundwork with which all other fields like data science, analytics, big data, and machine learning are built. Data engineering deals with all kinds of data, ranging from big to small volumes and from simple types of data like raw, structured tabular data to semi-structured and unstructured data like images, geo-spatial data, and natural language text. An important aspect of data

engineering is the ability to work with different sources of data like those from files, and message queues as well as varied types of data stores like SQL Server, HDFS, Azure Blob Storage, Cassandra, MongoDB, Couchbase, cloud storage among others. Thus, becoming skilled in data engineering includes a solid understanding of data analysis and preparation along with in-depth knowledge and hands-on experience with data. Data engineering has been traditionally performed starting with data exploration using big data technologies, followed by cleaning with functions as a service, data curation and modeling, storage, and serving. With the changing landscape of the cloud, we now have better tools, platforms, and frameworks that can integrate and orchestrate these tasks seamlessly and effectively, and the result is modern data engineering.

2. Evolution of Data Engineering

The cycle of modern data processing started with the first digital computers in the 1950s. Companies began accumulating digital representations of processes and events. Systems converted this data into a human-intelligible format on paper, produced by typewriters. Organizations set up small computer rooms with batch operational systems in the 1960s. Executives invested time in complex data models, physical data organizations, and algorithms to transform bytes into paper reports. This scenario changed with the availability of disk drives and screens. Technology advanced, and in the next decade, information became accessible to people through interactive interfaces. Data started being presented back to the systems to aid decision-making. Concepts such as linked data, databases, structured query language, relational theory, and data management constructs have already been introduced. These concepts only became reality when databases were filled with busy files, which in turn filled the data models. This created work for computer scientists who developed programs to manage data, validate transactional integrity, create backup copies, and facilitate recovery. Departments advocating for Information Systems at that time benefited from this cycle. The evolution of data processing since the 1950s marks a transformative journey in how information is managed, analyzed, and utilized within organizations. Initially, with the advent of the first digital computers, companies began digitizing their processes and accumulating data in digital form. However, the accessibility of this data was limited, as outputs were often converted into human-readable formats through typewriters, generating paper reports that executives relied upon for decision-making throughout the 1960s. This era saw the establishment of small computer rooms with batch processing systems, where complex data models and physical data organizations were meticulously crafted to transform raw data into actionable insights. The landscape of data processing underwent significant change in the subsequent decades with the introduction of disk drives and interactive screens. This technological leap paved the way for information to be presented back to systems in real-time, enabling more dynamic and responsive decision-making processes. Concurrently, foundational concepts in data management such as databases, structured query language (SQL), relational theory, and data management constructs emerged and gained prominence. These concepts became crucial as databases evolved from simple data stores to robust repositories filled with diverse and interconnected data sets, driving the need for sophisticated data management solutions. During this period, the role of computer scientists and IT professionals became increasingly pivotal. They developed programs and systems to manage data effectively, ensuring transaction integrity, creating backups, and enabling swift recovery mechanisms. Departments advocating for Information Systems gained significant traction as they leveraged these advancements to streamline operations, enhance efficiency, and gain competitive advantage through data-driven insights. In essence, the evolution of data processing from its humble beginnings with early digital computers to the sophisticated systems of today reflects a continuous cycle of innovation, adaptation, and optimization. Each technological advancement and conceptual development has contributed to reshaping how organizations collect, manage, and derive value from their data, laying the foundation for the data-driven decision-making processes that define modern business practices. As technology continues to advance, the cycle of data processing will undoubtedly continue to evolve, driving further innovations and efficiencies across industries worldwide.

2.1. Traditional Methods vs Modern Approaches

In the past, companies and developers used traditional approaches and methods to perform different activities and tasks. The problem with traditional engineering patterns is that they had to implement and perform well with different infrastructures and architectures. The truth is businesses nowadays have adapted and transformed their activities to achieve better data and system accuracy and speediness. This is the reason why modern data and engineering approaches were developed and are being used by analysts and developers. A data-driven development approach is a trendy method and is frequently used to develop and create new systems. Unit tests, A/B tests, and integration tests are examples of important methods used by analysts and developers to develop security, performance, and quality in the code base. In succinct terms, a key part of the testing environment is the use of different tests. Modern data systems that are carefully developed and designed using traditional approaches and methods can be delivered to production with reliable security, fast performance, and high quality.

3. Azure Data Services

Azure provides a lot of amazing data services, so give them to engineers and they will succeed a lot. These are some of the Azure services: - Azure Data Lake Storage Gen2: The combination of Azure Data Lake Storage Gen2 and Azure Databricks provides a powerful analytics service for handling big data. This article describes how to process data using interactive notebooks via Azure Databricks. Fully integrated with Azure services, Azure ADLS Gen2 allows organizations to take full - Azure SQL Data Warehouse: Azure SQL Data Warehouse is a cloud-based Enterprise Data Warehouse that can grow according to the users' needs. It can also pause/resume, allowing you to pay for what you use. We will also use both the web service and Power BI to perform an ETL (extract - transform - load) process and bring real-time analytics to the end user.

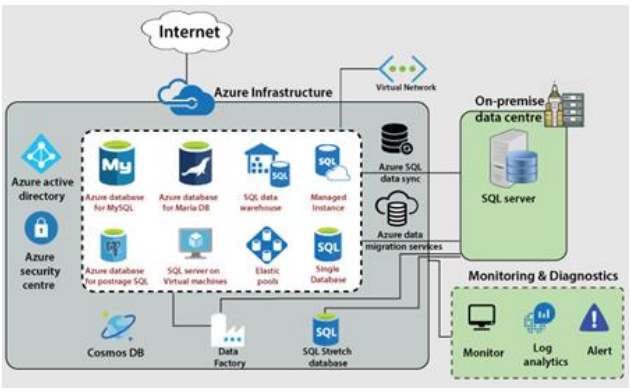

Fig 2: Azure Database service

3.1. Overview of Azure Data Services

Azure Cloud is vast and offers a lot of services. However, in the realm of data engineering, we primarily use a few services. A few important ones are HDInsight, Azure Databricks, Azure Machine Learning, and Data Factory. Each of these services is designed with a very specific purpose in mind and interoperates well with each other. Their overview is as follows: HDInsight is used to manage clustering applications. This includes the creation, scaling, and termination of applications. Azure Databricks is designed for big data analytics. It is a collaborative platform to convert data into actionable intelligence, making the interaction among data engineers, data scientists, and businesses productive. Azure Machine Learning is used for building, packaging, and deployment of machine learning models at scale. Data Factory is used for data preparation, movement, and transformation. It ranges from creating simple ETL pipelines to orchestrating complex data science workflows. There are many other services provided by Azure Cloud. Basic data processing is usually done using services like Azure Storage, Azure SQL Database, and Azure SQL Data Warehouse. The integration of these services with the data engineering-specific services is seamless. As a result, they are often used as a source and target by us. Line service provides high throughput and low latency with extremely consistent throughput. Specifically, Azure Storage and Azure SQL Database services are often used to ingest the structured data into the Azure Cloud from on-premises data sources such as databases, log files, etc.

4. Modern Steps in Data Engineering with Azure

Traditional data engineering follows strict steps or principles to reach an impressive outcome and supply the organization with the required insights for smarter decisions. In this segment, I will show the modern steps in data engineering with Azure. This is an Azure tutorial on modern steps in data engineering using Databricks, Data Lake, Stream Analytics, etc. All these steps and the products mentioned by Azure are nowadays new or skilled data engineers must be ready to move data and knowledge and make it possible for machine learning algorithms to solve business problems.Data sources - It all starts with data. It may even sound like a cheesy motto, but the truth is that increasingly, data comes from every edge. Data by itself means nothing, but when processed and analyzed, it can bring insights, patterns, needs, and the right questions for quest evolution and business growth.

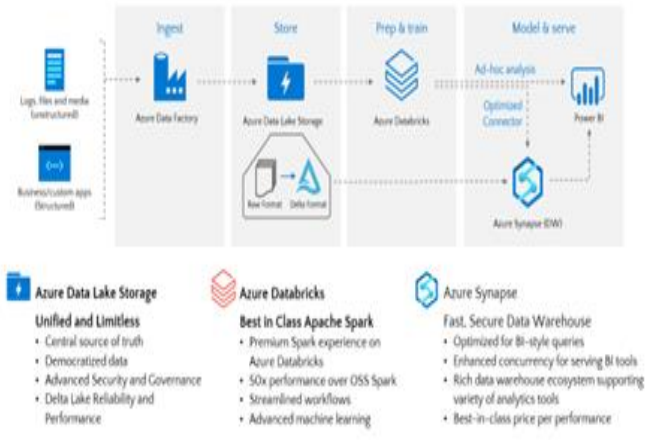

Fig 3: Architecting Modern Data Engineering using Azure Databricks

4.1. Data Ingestion

The first thing in every data processing tool is data ingestion. In Azure, you have multiple choices like Azure Data Lake, Azure Blob Storage, and others. One popular pattern is to put all the data in a data lake. This allows you to use any tools you want on the data. It is very important because tools and services come and go. Whatever service you use to get data from the source, try to push it into a data lake storage before processing it further. One of the popular ways to push data is using Azure Data Factory (ADF). The data factory does not store the data. It just creates a pipeline which comes with the ability to kick off pipelines. ADF built-in support is available for about 25 data stores including Azure SQL Database, Cosmos DB, and Google Big Query. There are a few things like OData, automation storage account, and Cosmos DB SQL API that count as managed. However, for all other sources like Amazon S3, Salesforce, MySQL, and more, we can use copy activity, which supports the following capabilities. Now let us list all the available options for data ingestion in Azure generically: - Azure Blob storage - Azure Data Lake Storage Gen1 - File system - FTP - Amazon S3 - SFTP - Publicly available data. Transform the data if needed before moving it to a suitable location for further processing.

5. Conclusion

Data engineering is becoming more popular, important, and lucrative as cloud solutions simplify big data work. In this article, I discuss a modern, quick, and comprehensive way to start data engineering with Azure in 2019. Azure is the best solution for big data, offering the cheapest storage, a large number of tools, and simplicity across all areas of IT. While AWS is the leader in terms of volume, Azure is showing higher growth rates. In this tutorial, we discuss the most modern and complete way to quickly start as a big data engineer on Azure, almost for free. Our modern steps are:1) Set up an Azure Storage account (lightweight, can be removed after studying) 2) Attach it as Azure File (the simplest and lightweight solution for an emulated big data approach) 3) Install Azure Storage Explorer (the most comprehensive tool to interact with Azure Storage, or use Cloud Berry or cross-platform copy) 4) Create a Databricks workspace (a data science and engineering tool with a pay-per-second approach) 5) Attach it to the Spark cluster and premium blob storage for Databricks (in the case of practicing Azure Data Engineering)We also discuss and explore the general view of Azure Cloud architecture. Azure has more modern and innovative solutions than AWS, such as Serverless SQL DB. Azure is a great solution because it has a single account concept, Azure Search, and Fastly on PaaS. AWS still leads in the field of the cloud.

5.1. Future Trends

When it comes to future trends, companies must focus on the expedited growth of enterprise AI and data. While in full swing, most companies still have not unlocked the value of their data. In 2019, they will recognize that potentially, their most valuable asset within the enterprise is that enormous amount of data trapped inside it. Several companies will now take vital strides when it comes to cutting-edge AI and machine learning technologies for high industry value. Companies that will infuse these models in their custom-built apps and pre-configured AI applications will lead the movement, increase overall data quality, and remove bias.The urge to improve this key asset means data governance and master data management are important practices that companies will enforce. This task isn't easy, but it's essential to fix data quality mistakes and accelerate digital transformation. AI is a large factor that will play into modern data-driven solutions and handle the problem of poor data quality

and large unmanageable datasets by learning from the data, cleaning the data, and gaining valuable insights. The amount of data movement across more than one cloud provider or on-premises environment will center on how IT component suppliers deal with consideration for another information customer security asset: keys to encrypt info and top-secret info storage.

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