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.NET Conf

探索 .NET 新世界

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Azure 上打造日資料量一百 TB 的資料分析系統

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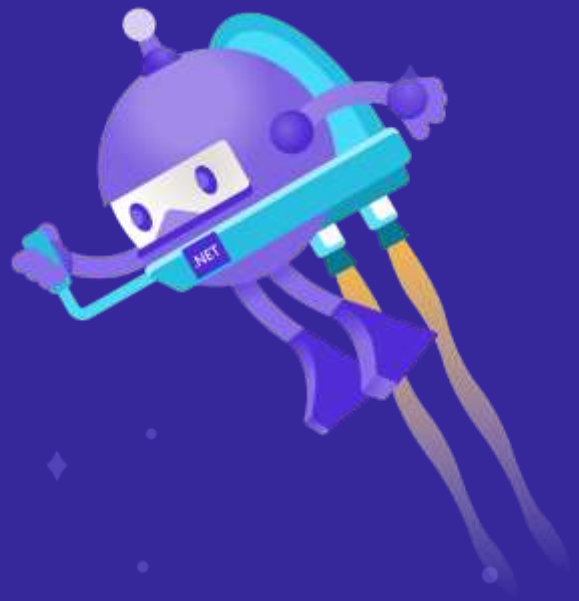

- Herman Wu

- 經歷:
  - 微軟 資深軟體工程師 (前瞻技術合作部)
  - 微軟 資深企業平台技術架構經理 (開發平台暨技術推廣部)
  - 微軟 企業技術顧問 (企業顧問服務部)


Data Is Gold

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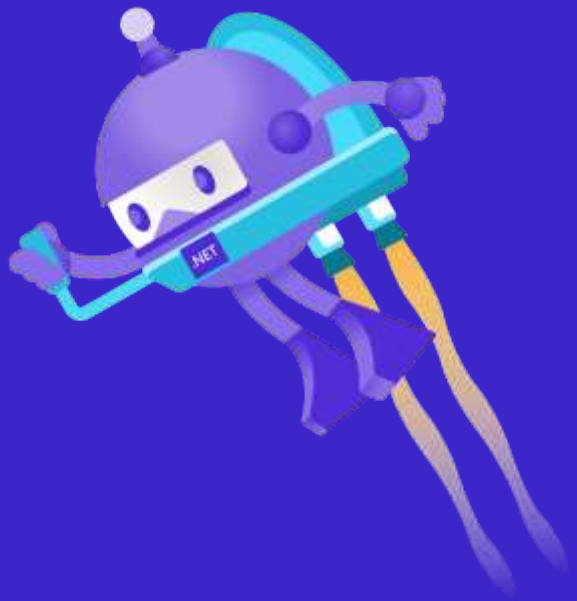
But How You Can be Rich?



Before you go Bankruptcy

This is the first topic you should think about when you have 100TB data per-day

Warning! We are talking about historical data here.

Think about Event Sourcing pattern

https://docs.microsoft.com/en-us/azure/architecture/patterns/event-sourcing

How we design the solution

H

Lesson 1: Change of Data Schema is Normal

- Data is always dirty, and the format will change over time
- Strategy: Data Lake, Data Lake…
  - Lambda architecture
  - bronze, silver, and gold architecture
- Data Lake powered by
  - Elastic Search, Azure Data Lake Gen2, Azure Synapse, Azure Data Explorer, Delta Lake (Spark)/Databricks, Hbase/Hive, Casandra, Big Query…
- CSV, JSON, Parquet, ORC
- How easy is it to handle schema change

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Lesson 2: Query & Charting is step 0

- Query Scenarios like:
  - Aggregate data by every 5, 20 mins, 6 hrs, 1 week.
  - Get time range of specific events
    - Some system error only happens a few times
  - Split an array into multiple rows
    - Dynamic object
    - Mv-expand
- Charting
  - Time series

- by bin(dataTime,10m)
- summarize count() by bin(dataTime, 7d)
- extend dt=todatetime(str) | extend dt_unixtime=toUnixTime(dt)

- let min_t = toscalar(subsetdata | summarize min(dataTime));let max_t = toscalar(subsetdata | summarize max(dataTime));

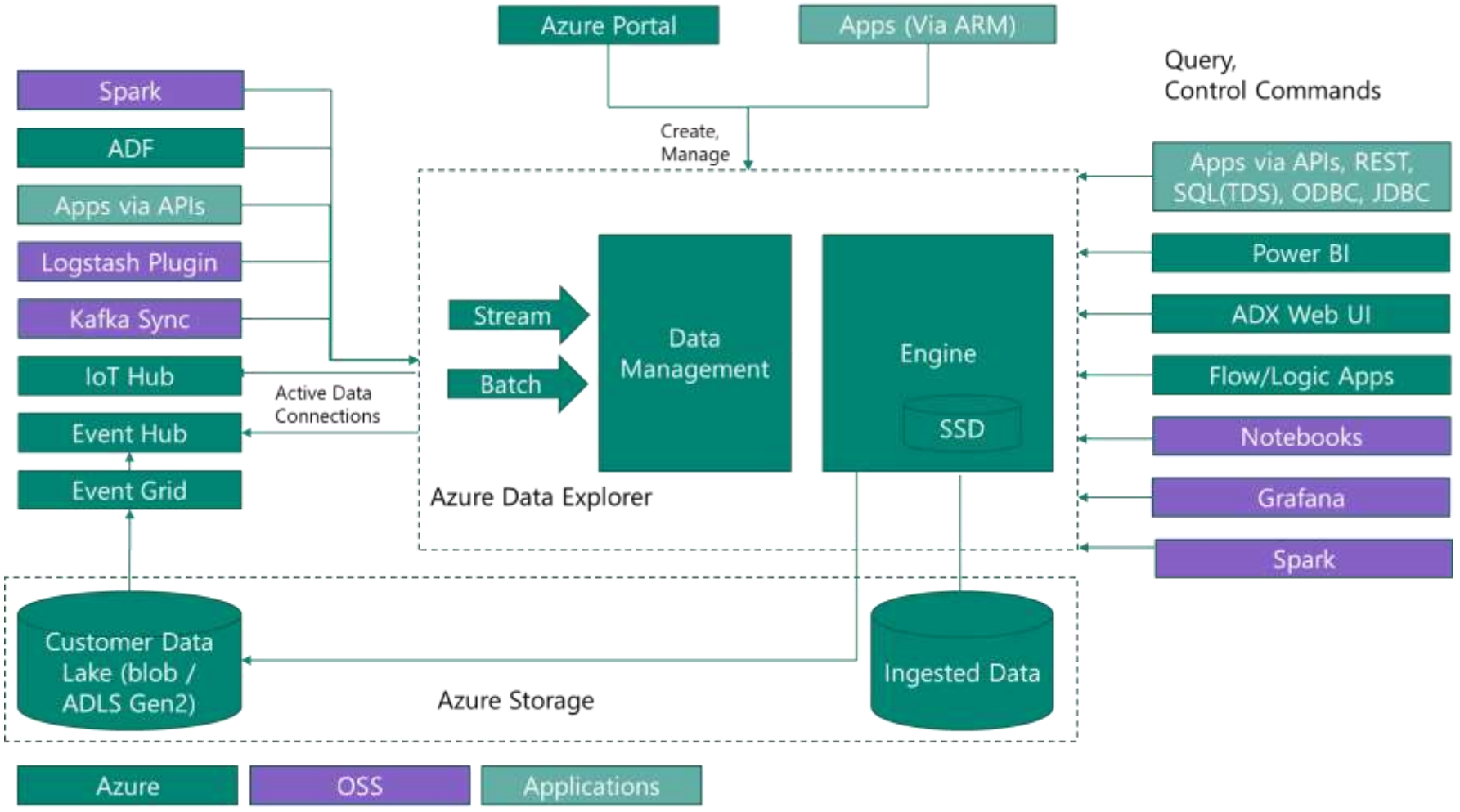
- datatable (a:int, b:dynamic)[1,dynamic({"prop1":"a", "prop2":"b"})] | mv-expand b max(dataTime));

a	b
1	{"prop1":"a"}
1	{"prop2":"b"}

Example: default charting-Time Series Data

```
let ts=range t from 1 to 24*7*5 step 1
| extend Timestamp = datetime(2018-03-01 05:00) + 1h * t
| extend y = 2*rand() + iff((t/24)%7>=5, 10.0, 15.0) - (((t%24)/10)*((t%24)/10)) // generate a series with weekly seasonality
| extend y=iff(t==150 or t==200 or t==780, y-8.0, y) // add some dip outliers
| extend y=iff(t==300 or t==400 or t==600, y+8.0, y) // add some spike outliers
| summarize Timestamp=make_list(Timestamp, 10000),y=make_list(y, 10000);
ts
| extend series_decompose(y)
| render timechart
```

Azure Data Explorer
A big data interactive platform



Comprehensive Strength

- Metrics and time-series data
- Text search and text analytics
- Multi-dimensional/relational analysis

Analytics Query language

- Simple and powerful data exploration
- Rich relational query language
- Full text Search
- ML Extensibility
- SQL/TDS endpoint

Data Ingestion and Management

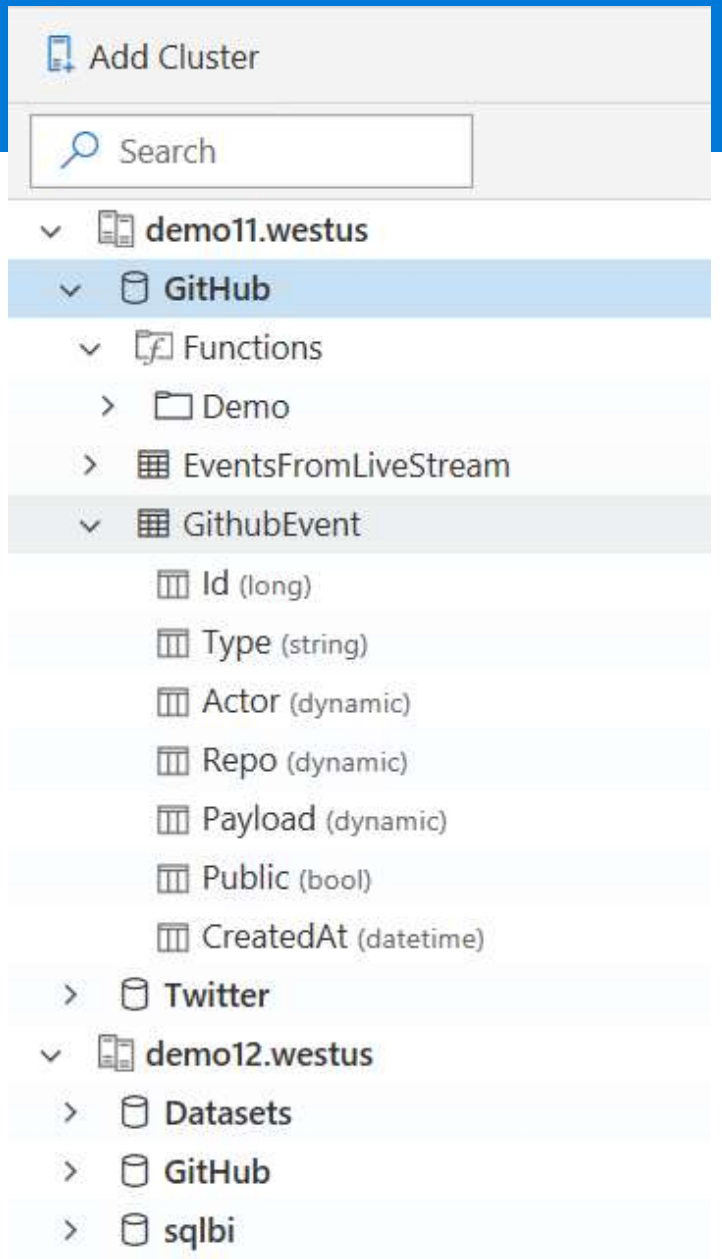
- Low latency ingestion
- Compression and indexing
- Automatic Retention
- Hot/cold resource allocation

High performance over large data sets

- Scale out in hardware
- Scale out across geos
- Granular resource utilization Control
- Cross geo queries

Logical Entities

- Cluster
  - The ADX Azure Resource
  - Top level entity holding a collection of Databases
  - Database
    - A collection of tables, stored functions, policies
    - Authorization model
    - Table
      - Well defined schema – ordered list of typed fields
      - Columns
        - No PK/FK constraints between columns
    - Stored Functions



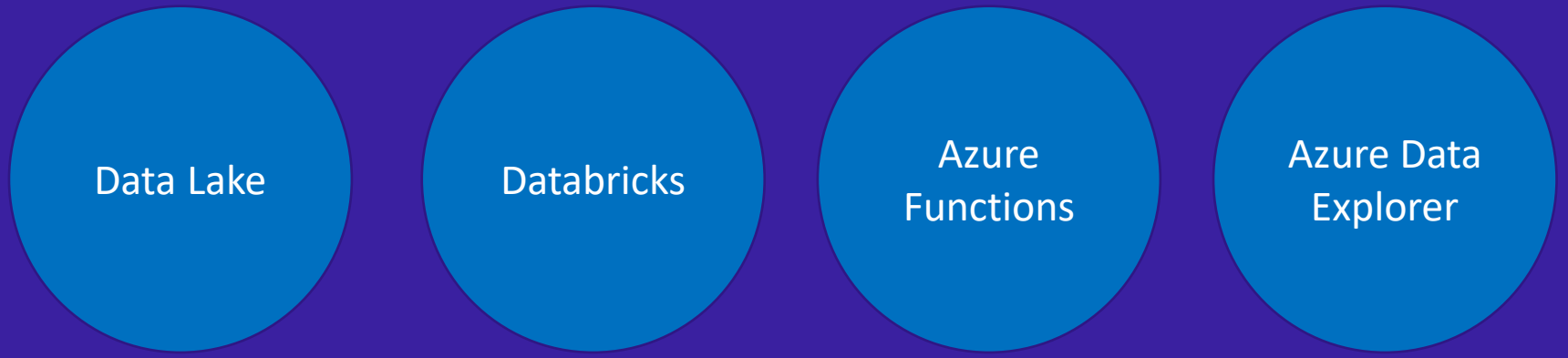
Supported Data Types

- ADX can store the following data types:
  - `Boolean`
  - `Integer`
  - `Long`
  - `Real (double)`
  - `Decimal (SqlDecimal)`
  - `String`
  - `DateTime`
  - `TimeSpan`
  - `Dynamic`
  - `Guid`

- ADX maintains an *index* for each field type
- The *Dynamic* type has special handling, intended for efficient handling of Json values
  - Nested values are all indexed, speeds up access in queries

Lesson 3: Balance the workload of each resources

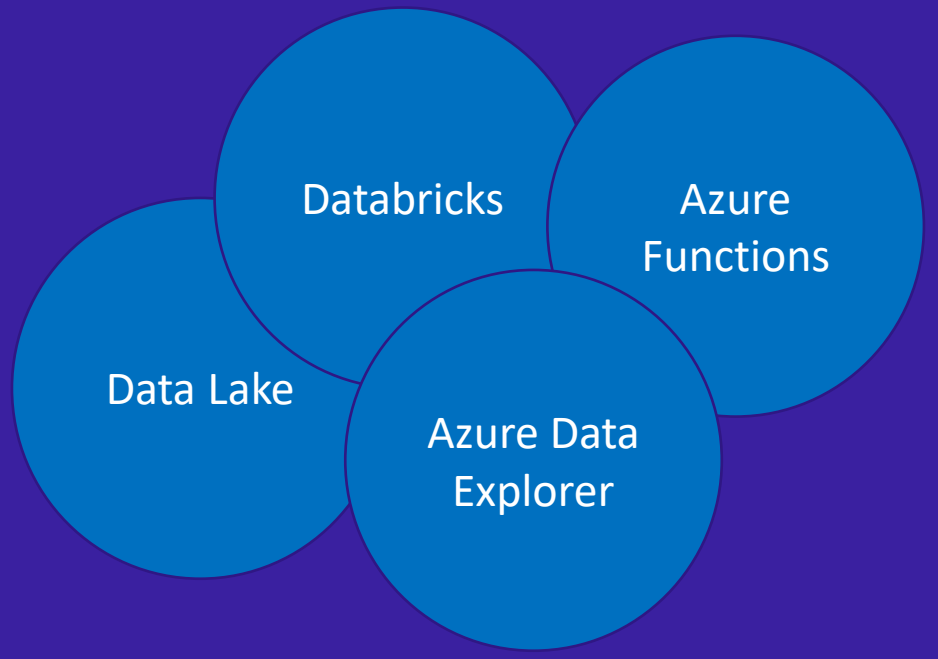
- Common components of End-to-End Historical/Log Data platform



- Echo product is unique

Lesson 3: Balance the workload of each resources

- Echo product is unique, and with some overlap
- Use Design Pattern to define the role & responsibly
  - Clam-Check Pattern



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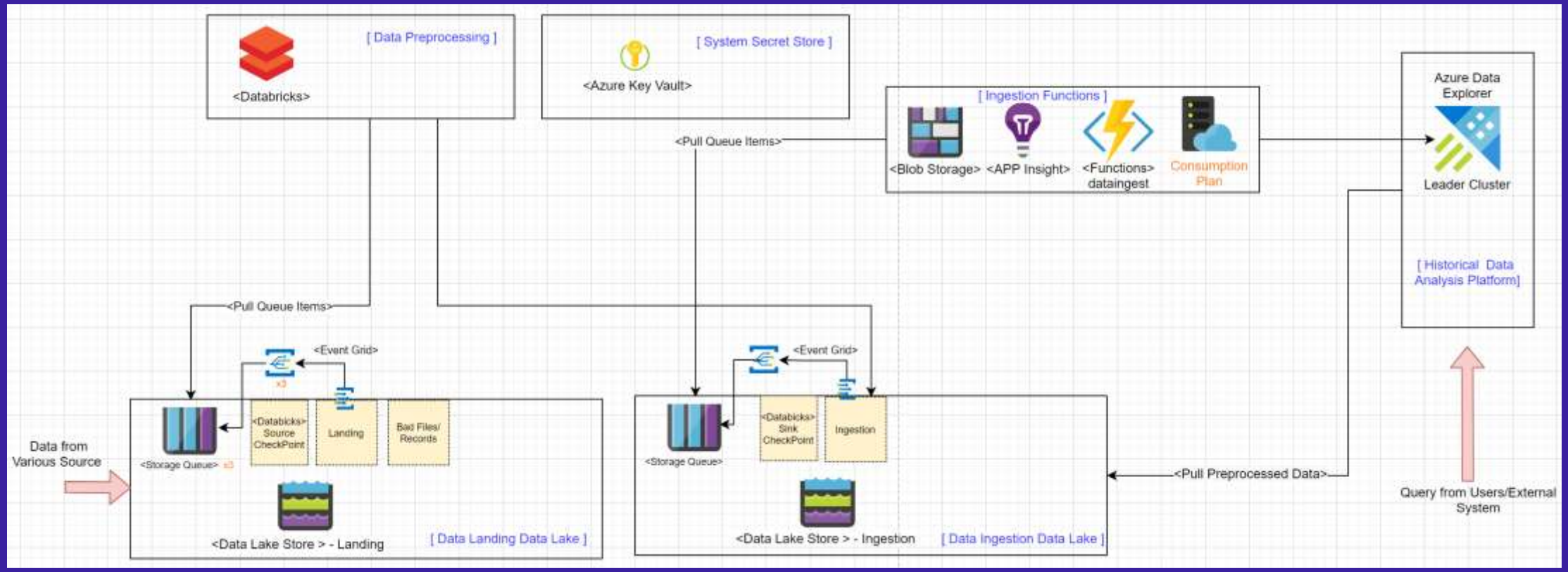
Architecture V1



Lesson 4: I hate duplicated data

- It will be great if we can ignore it
- Strategy
  - Ingestion Time Check
    - Update Policy in AXD
  - Handle duplicate rows during query

```
DeviceEventsAll | where EventDateTime > ago(90d) | summarize
hint.strategy=shuffle arg_max(EventDateTime, *) by DeviceId, EventId,
StationId
```

- Understand the infrastructure
  - At least once v.s Exactly once
  - Checkpoint files in Databricks

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Lession 5: Performance comes from deep understanding of products

- Databricks
  - # of Cores, memory
  - Job, Stage, Tasks
  - Fair scheduler Pool
  - Structured Steaming : max-files, max-size per trigger
  - Shuffle partitions
  - Shuffle spill (memory)
  - ….
- Azure Data Explore
  - Ingestion
    - MaximumBatchingTimeSpan
    - MaximumNumberOfItems
    - MaximumRawDataSizeMB
  - Capacity policy
    - Ingestion capacity
    - Extents merge capacity
    - Extents purge rebuild capacity
    - Export capacity
    - Extents partition capacity
    - Materialized views capacity policy….

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Lesson 6: Every small problem can be BIG

Cloud is a Live Infrastructure

Network Transient Failure

Have you heard about “Re-Try”

Waiting before retrying

- Polly (.net core) , Tenacity (python)…

Defragment of Disk I/O

Storage API call : Store 1 file is not 1 API call

Shard, extents, delta-table merge

Partioning, sorting will increase file fragmentation

Log exploding

Lesson 7 Testing

Your code works good in everywhere, except in production

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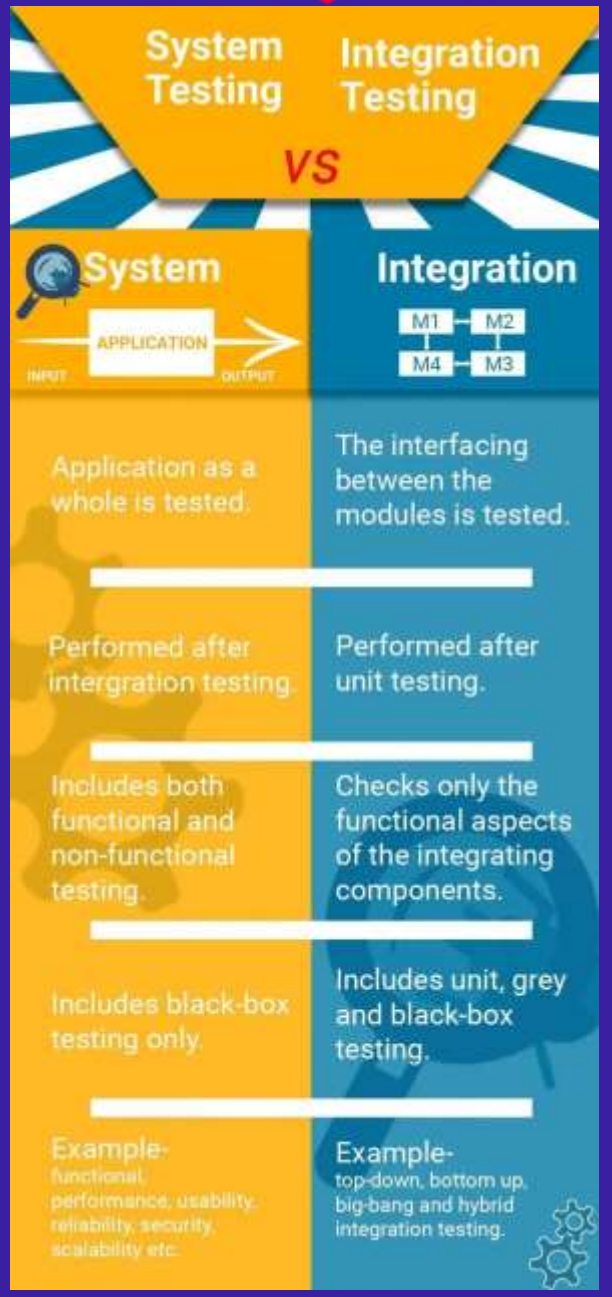
- Unit Testing & Integration Testing no longer enough
- System Testing is essential
- CI/CD pipeline becomes more complicated



https://artoftesting.com/difference-between-system-and-integration-testing

Title: Returns and exchanges go to inventory. **As a** store owner, **I want** to add items back to inventory when they are returned or exchanged, **so that** I can track i

Behavior-driven development

Title: Returns and exchanges go to inventory.

As a store owner,

I want to add items back to inventory when they are returned or exchanged,

so that I can track inventory.

Scenario 1: Items returned for refund should be added to inventory.

Given that a customer previously bought a black sweater from me

and I have three black sweaters in inventory,

when they return the black sweater for a refund,

then I should have four black sweaters in inventory.

Scenario 2: Exchanged items should be returned to inventory.

Given that a customer previously bought a blue garment from me

and I have two blue garments in inventory

and three black garments in inventory,

when they exchange the blue garment for a black garment,

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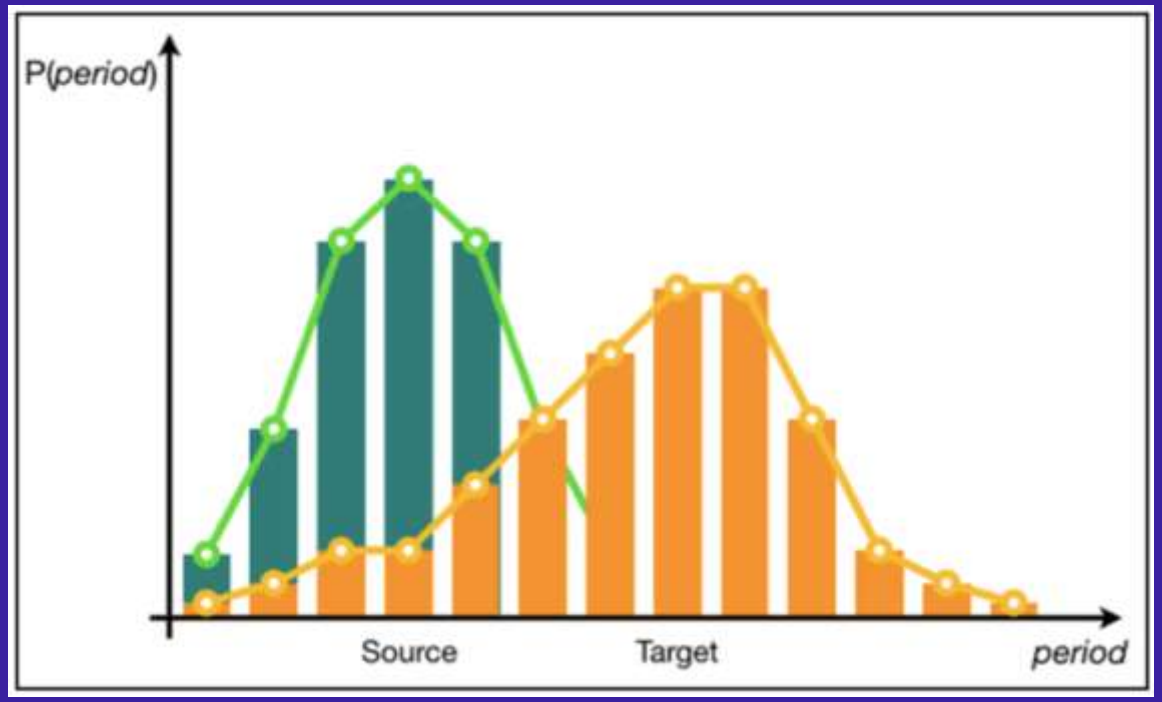
Lesson 8 Measure your Data Drift

You will not be notified!



and your performance
fine-tuned code think

5 x 20 != 20 x 5

1+2+2+15 != 5+5+5+5

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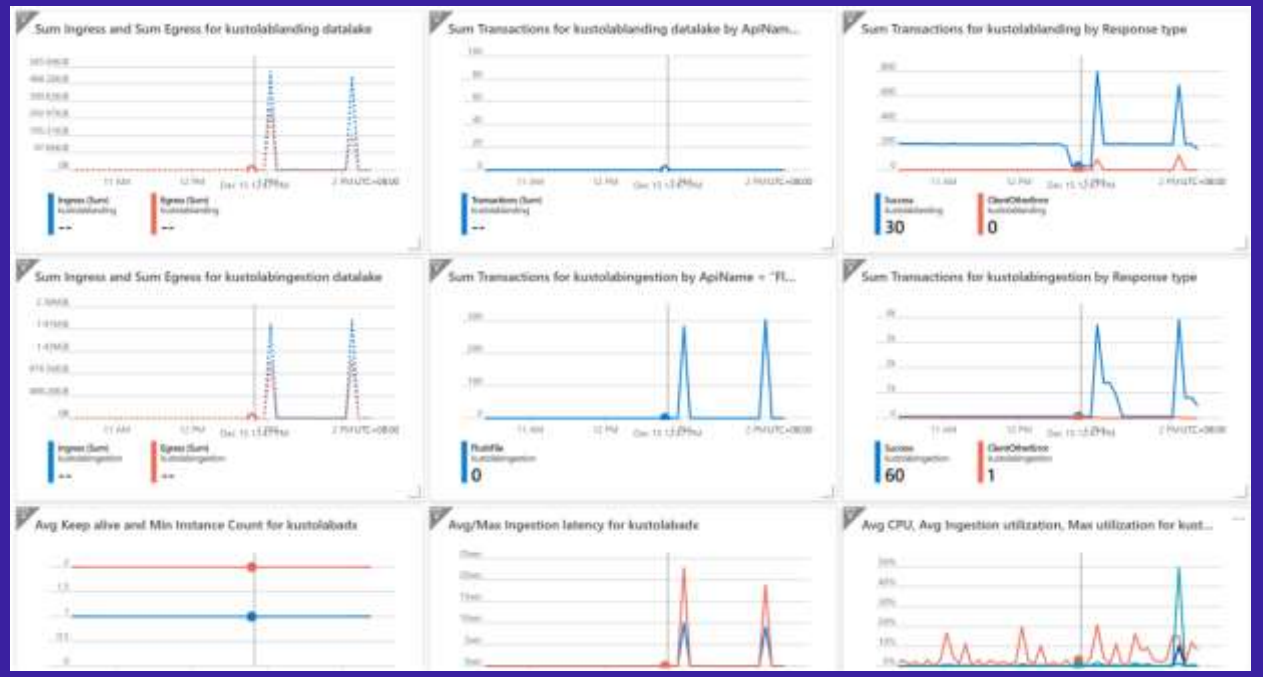
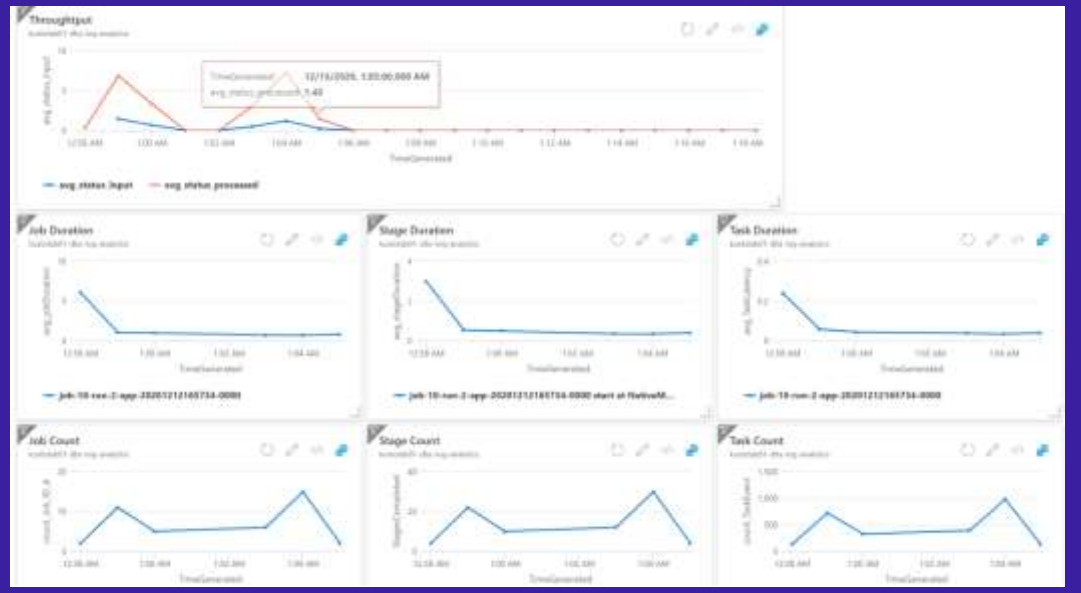
Application Insight,
Log Analytics,
Azure Monitor
are your friends





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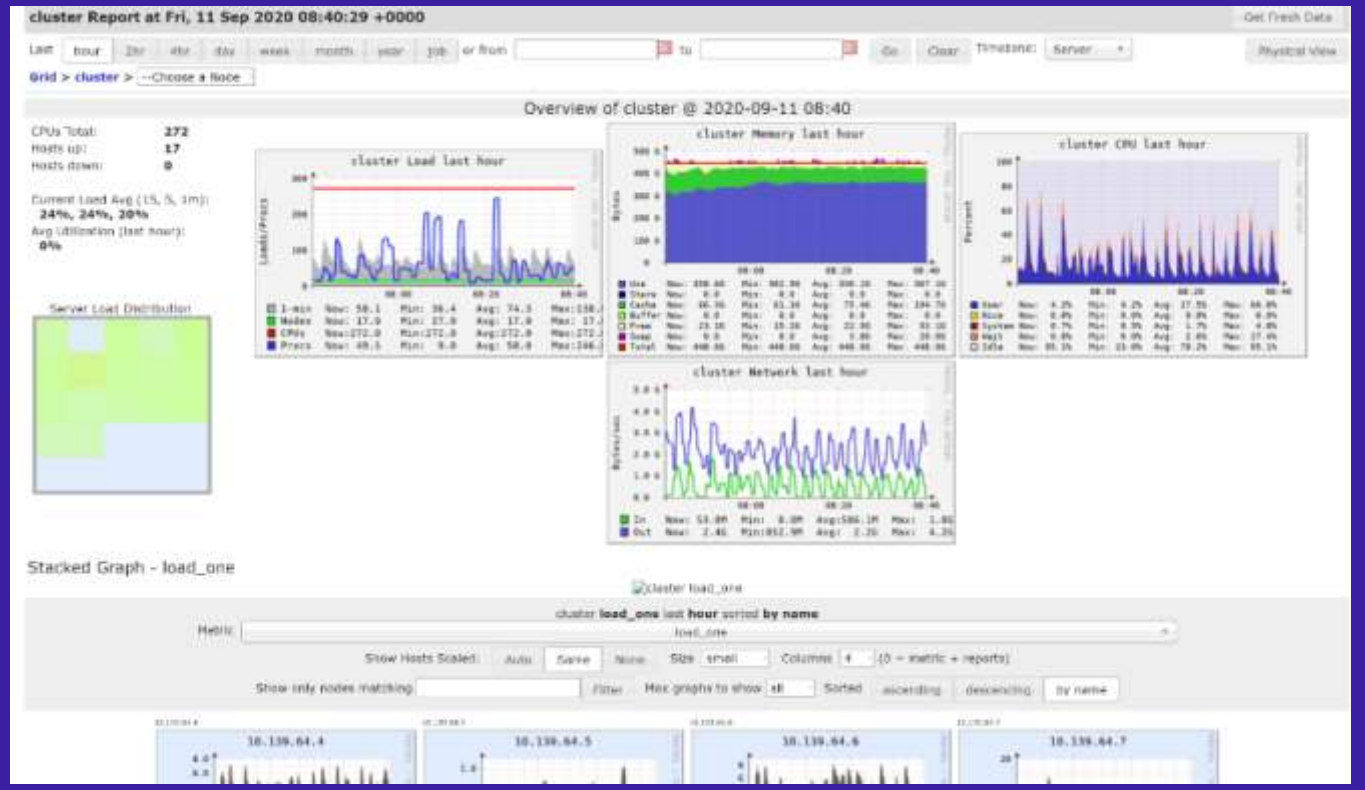
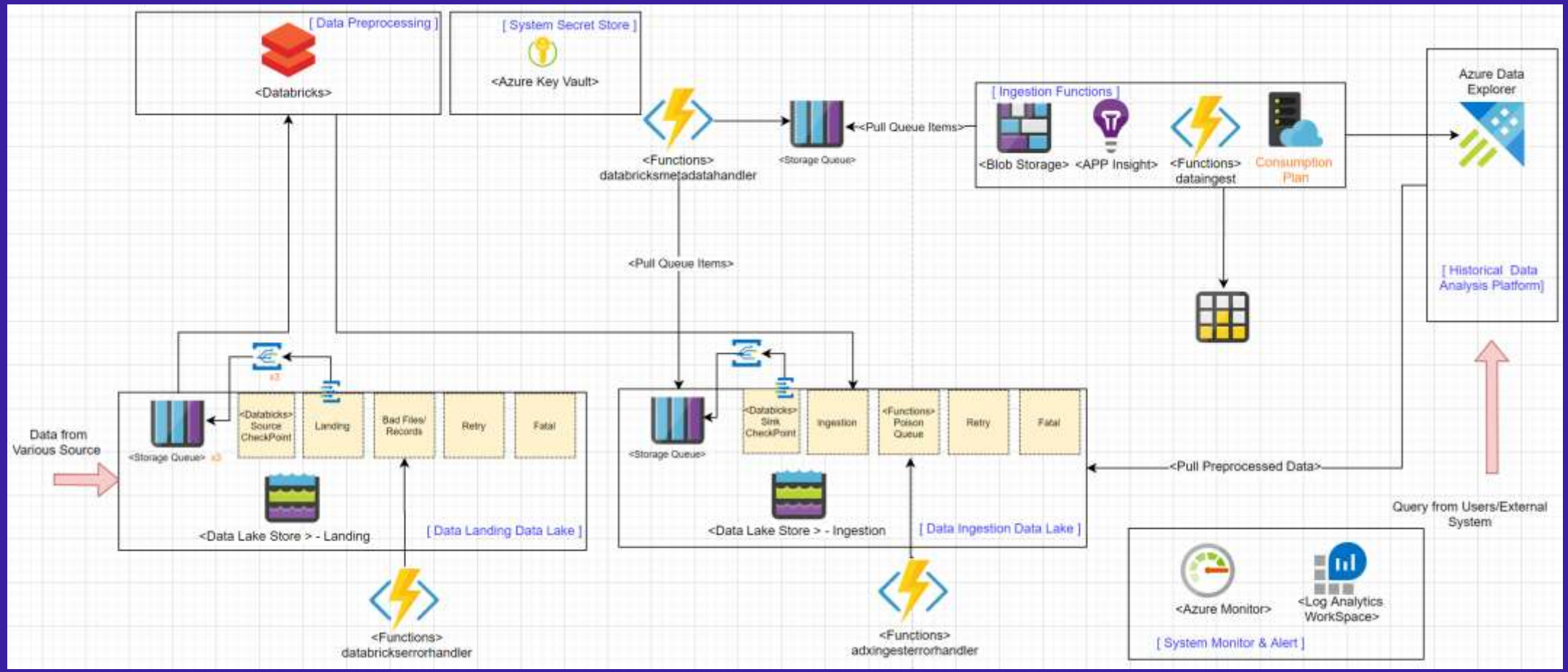
Monitoring Azure Databricks in an Azure Log Analytics Workspace

(https://github.com/mspnp/spark-monitoring)

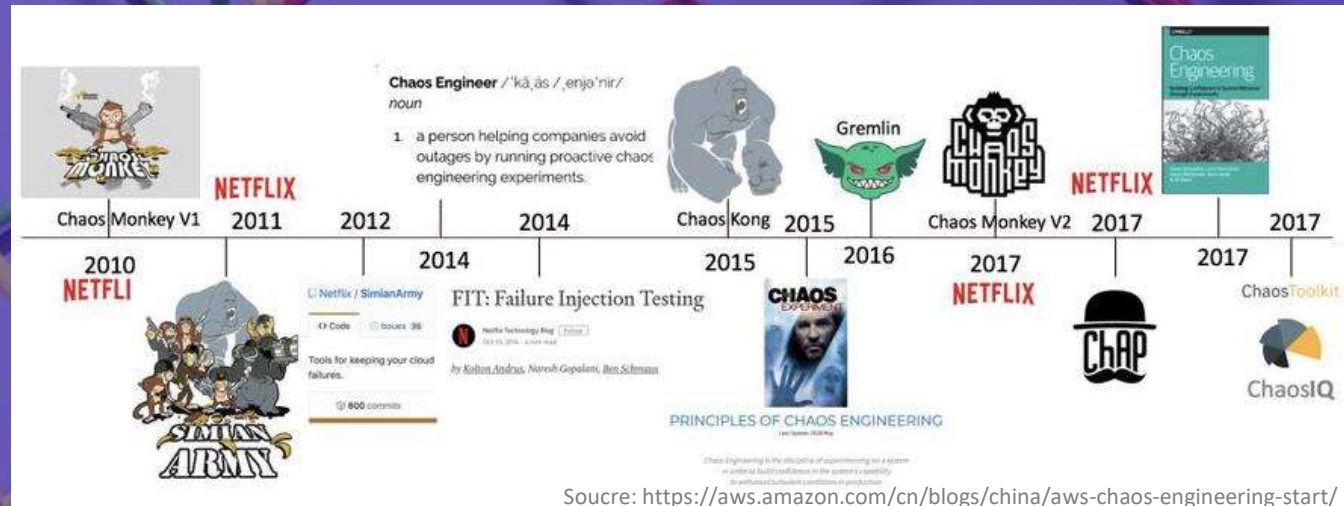


Architecture V2

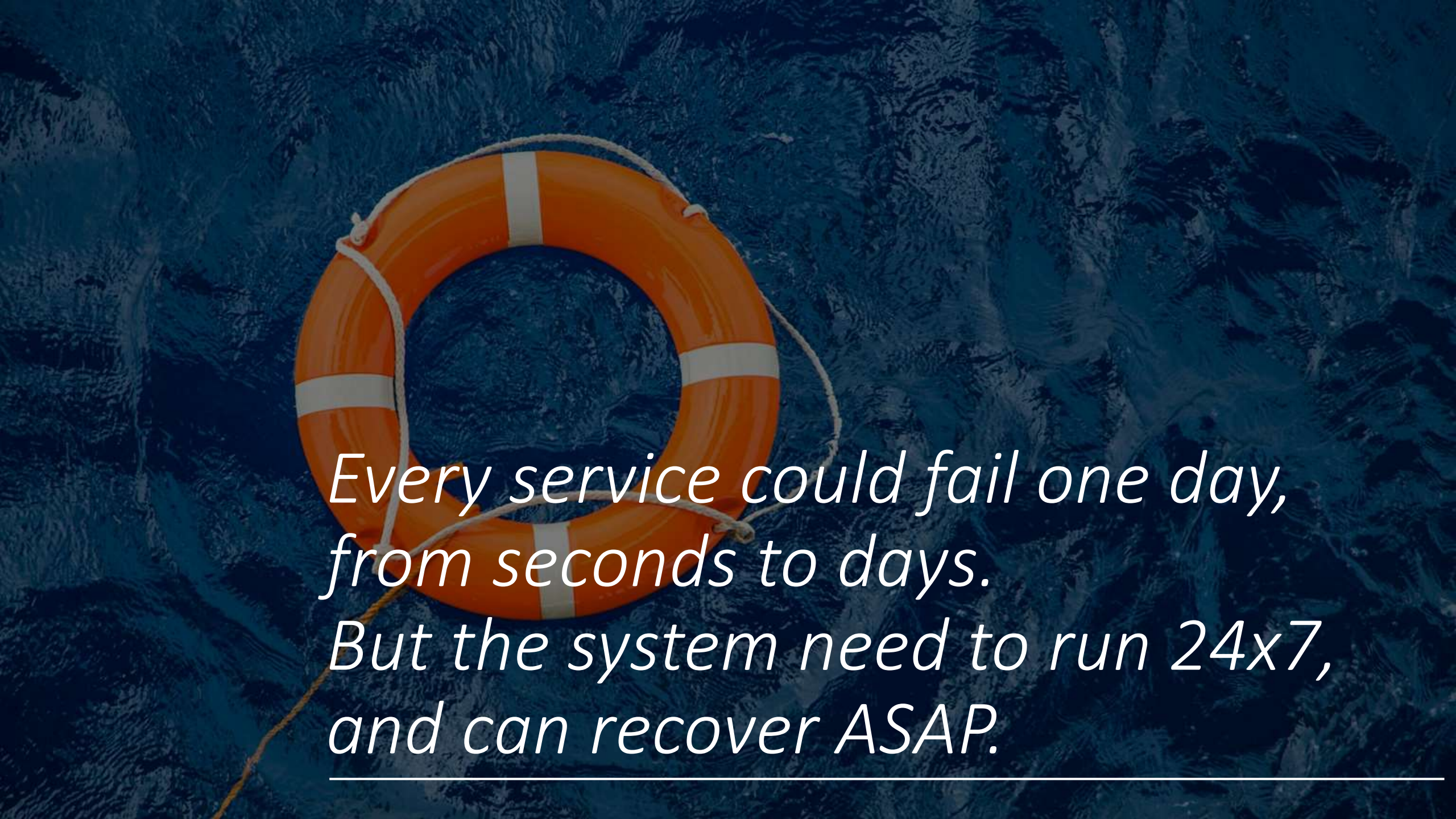


Lesson 9 The necessary of Chaos Engineering

- *Chaos engineering is the discipline of experimenting on a software system in production in order to build confidence in the system's capability to withstand turbulent and unexpected conditions* - "Principles of Chaos Engineering", principlesofchaos.org
- *Finding faults in a distributed system goes beyond the capability of standard application testing*



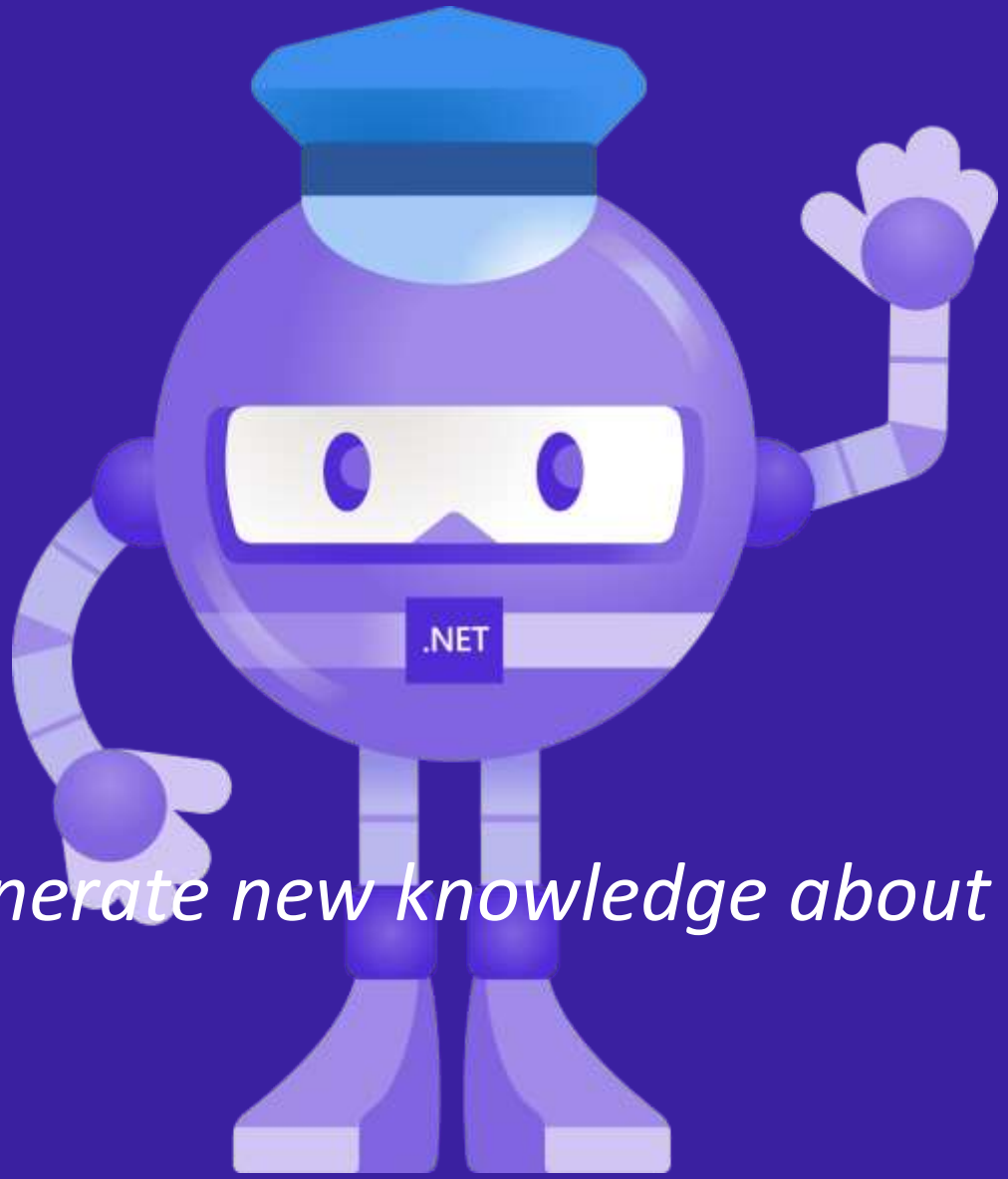
Soucre: https://aws.amazon.com/cn/blogs/china/aws-chaos-engineering-start/



Every service could fail one day,
from seconds to days.
But the system need to run 24x7,
and can recover ASAP.

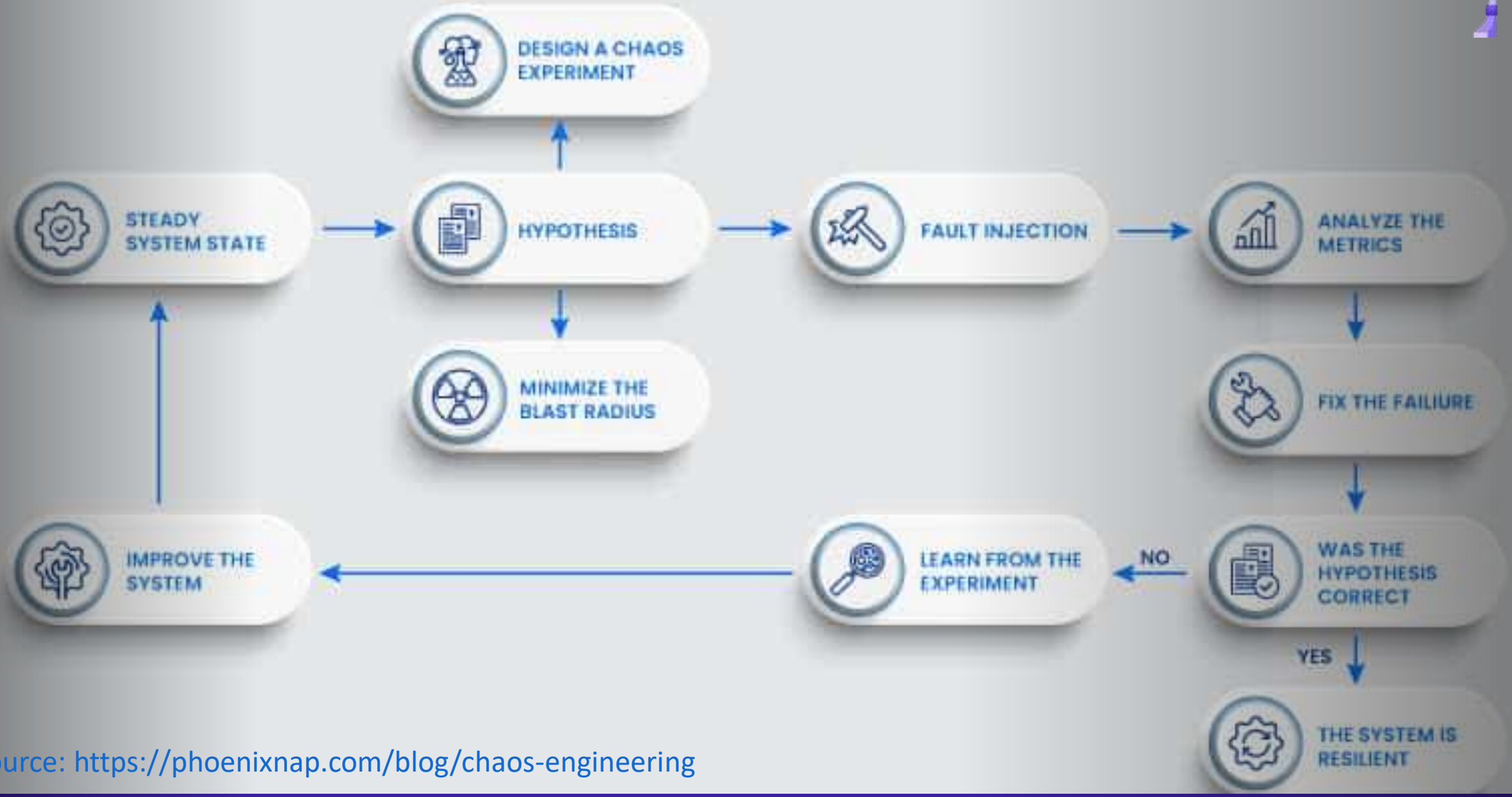
Chaos Engineering will

- Identify weak points in a system.
- See in real-time how a system responds to pressure.
- Prepare the team for real failures.
- Identify bugs that are yet to cause system-wide issues.



The goal of a chaos test is to generate new knowledge about the system.

How Chaos Engineering Works



source: https://phoenixnap.com/blog/chaos-engineering

Chaos Engineering Tools

- Chaos Monkey
- Gremlin
- Chaos Toolkit
- Pumba
- Litmus

The architecture is been used in several production systems to process terabytes data every day

A LAB for codes/deployment scripts of the architecture will be published in Kusto-Lab soon.
https://github.com/Azure/azure-kusto-labs

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Thanks for joining!

Ask questions on Twitter using #dotNETConf

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Reference

- Big data analytics with Azure Data Explorer
- Modern Data Warehouse Architecture
- Describe bronze, silver, and gold architecture
- Chaos Engineering: How it Works, Principles, Benefits, & Tools

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