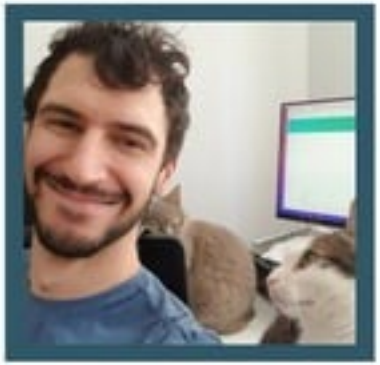
Introduction to Kafka Cruise Control

Viktor Somogyi-Vass



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Operating Kafka clusters are hard.

1

Surprises

There can be data center outages, maintenance can go wrong and upgrades can go wrong.

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Performance

Brokers can be overloaded or even underloaded. Rebalances can ruin your cluster.

How do we solve these problems?

SOME HIGHLIGHTS

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SELF-HEALING

By rebalances

Detect—failures and anomalies are detected automatically

Rebalance—healing will be done via rebalancing partitions to healthy brokers

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Scaling and maintenance

Upscaling—brokers can be added to Cruise Control and populated with partitions

Downscaling—brokers can be removed from the cluster and partitions will be reassigned optimally

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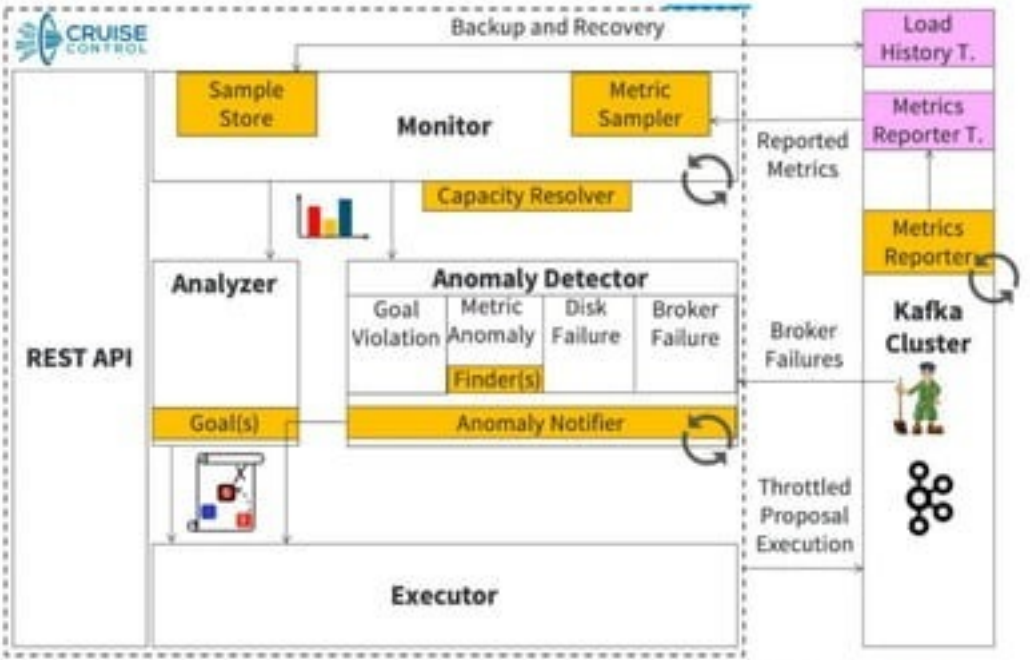
MONITORING
Even load everywhere

Metrics—are collected periodically to ensure an up-to-date view of the cluster

Estimation—partitions level utilization is estimated with a linear model

How does it work?

ARCHITECTURE



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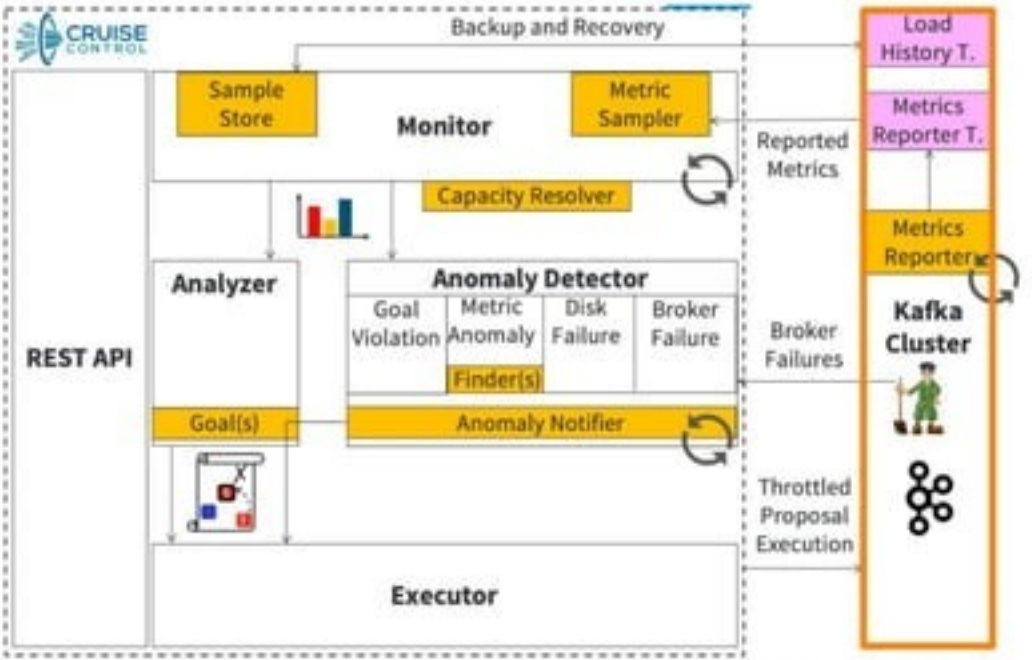

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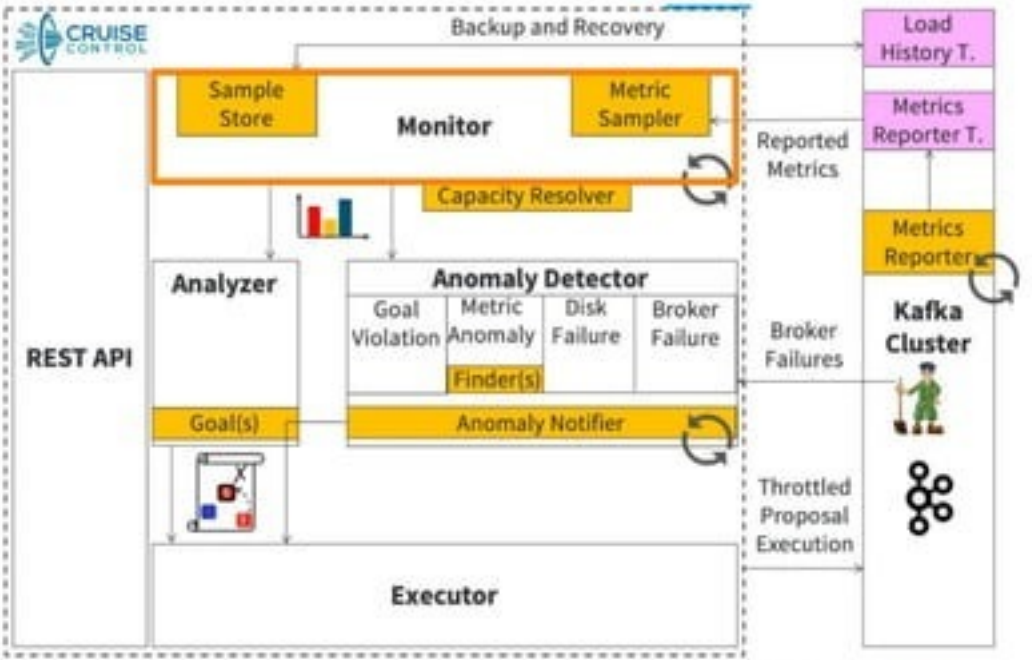

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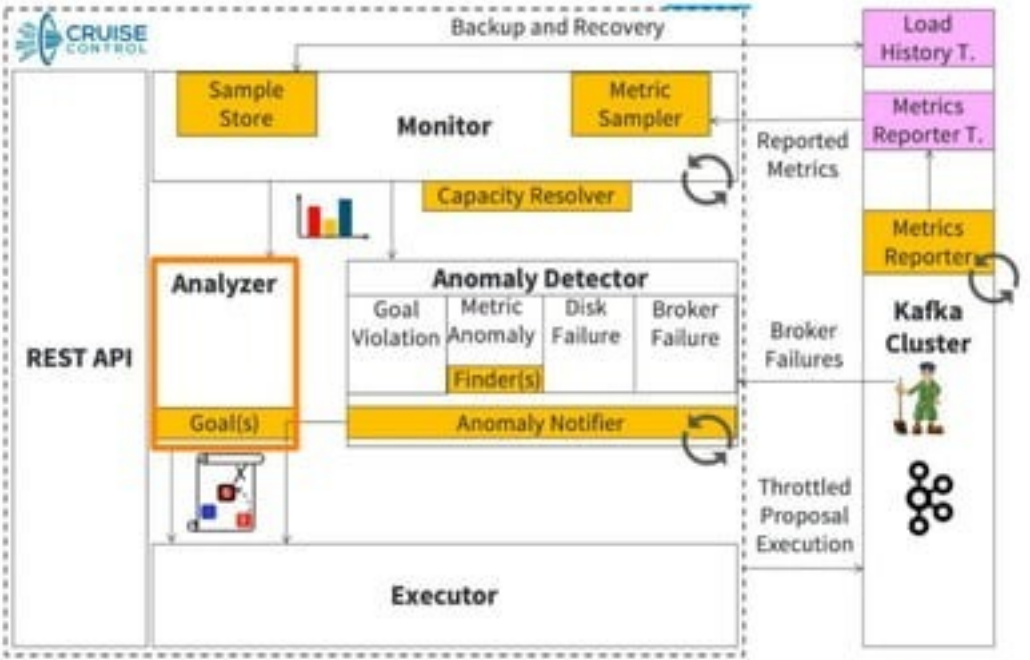

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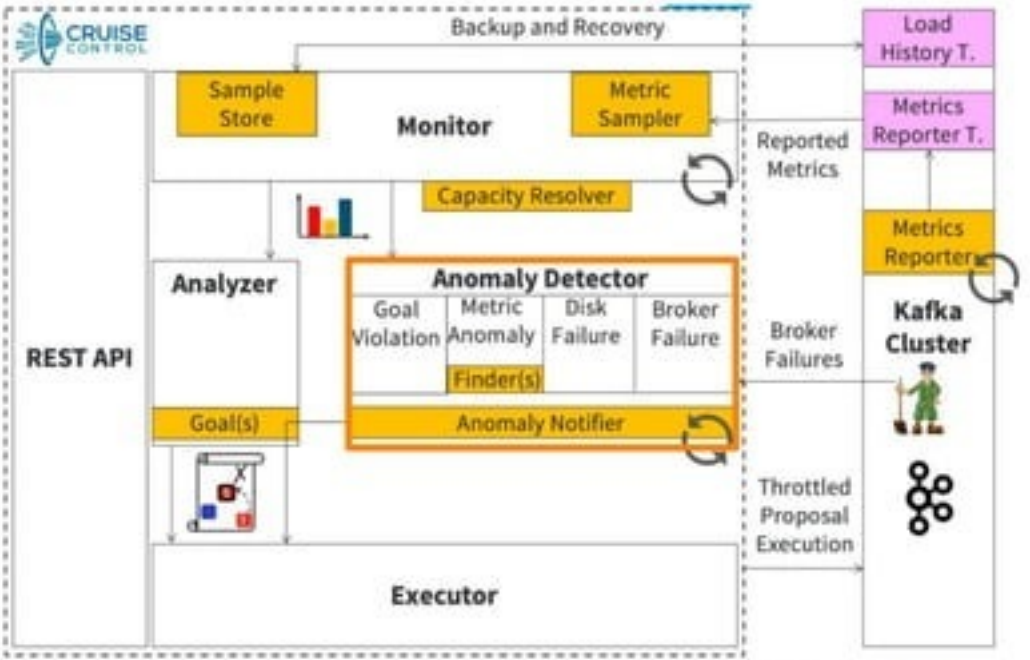

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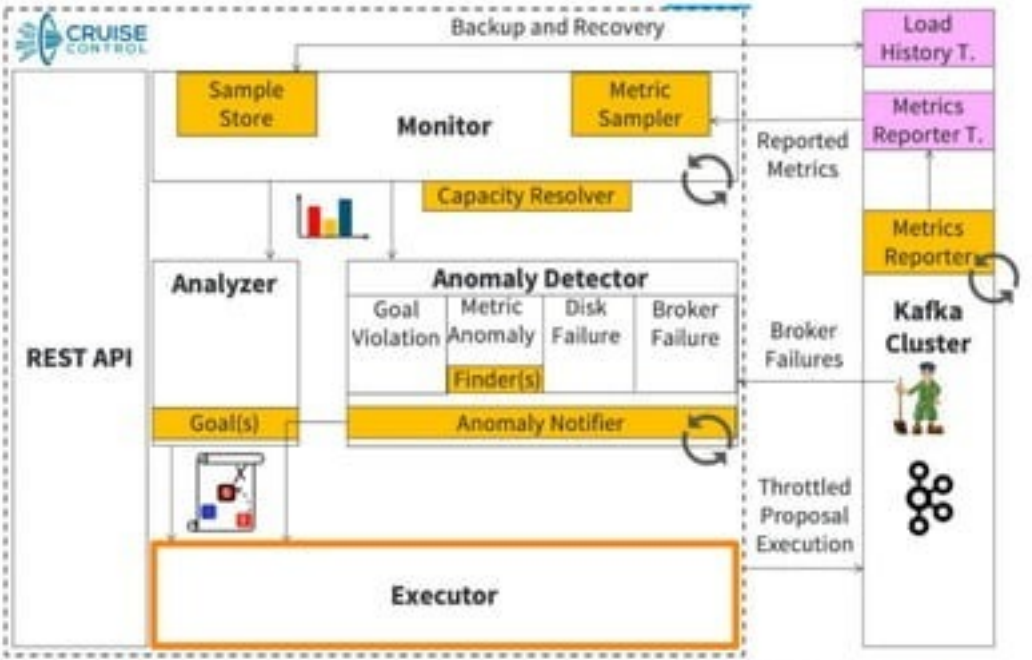
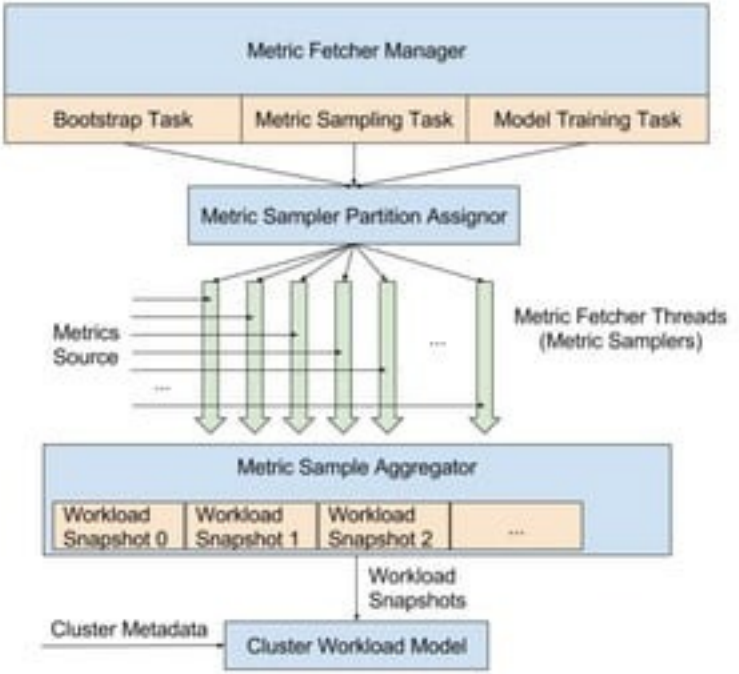


THE LOAD MONITOR



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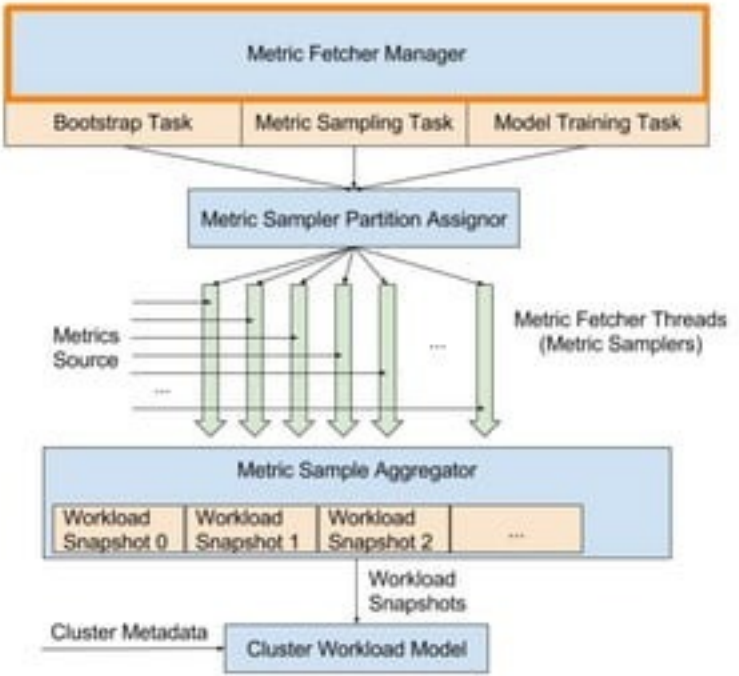

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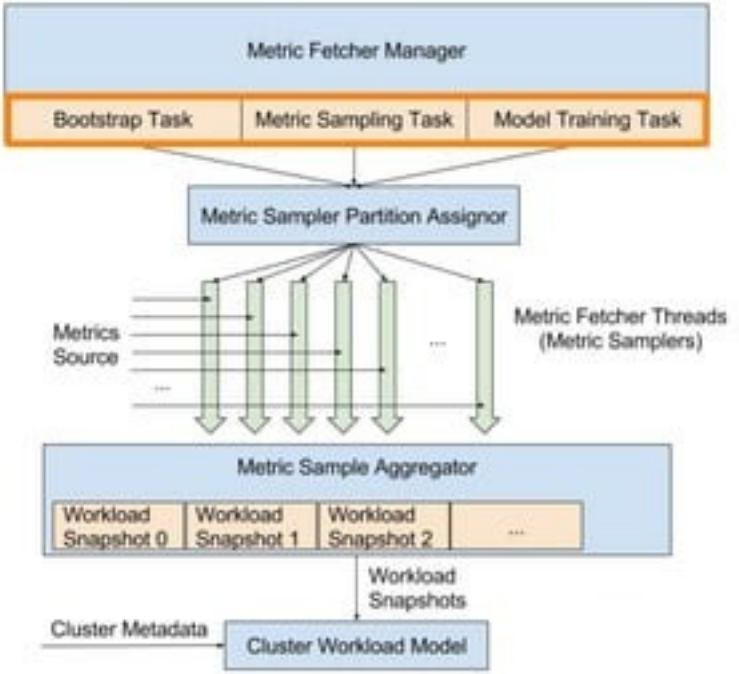

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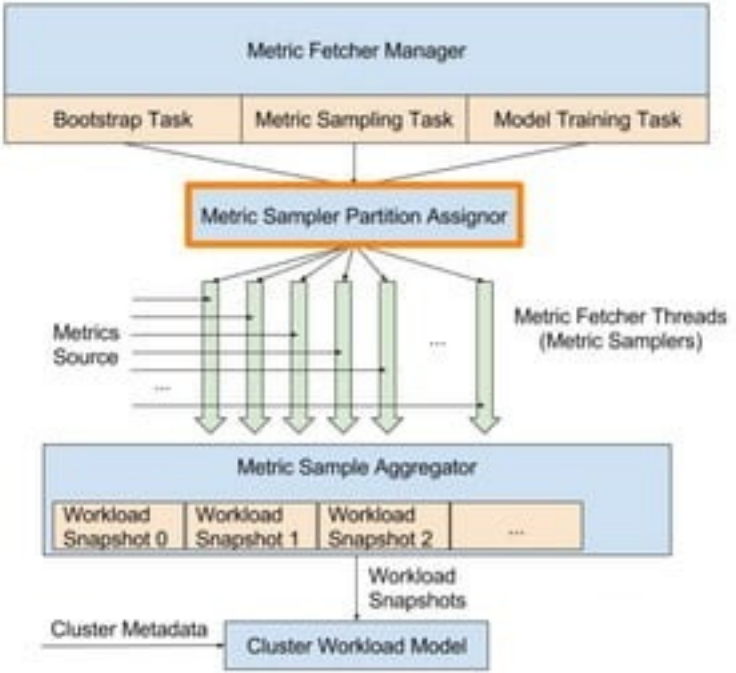

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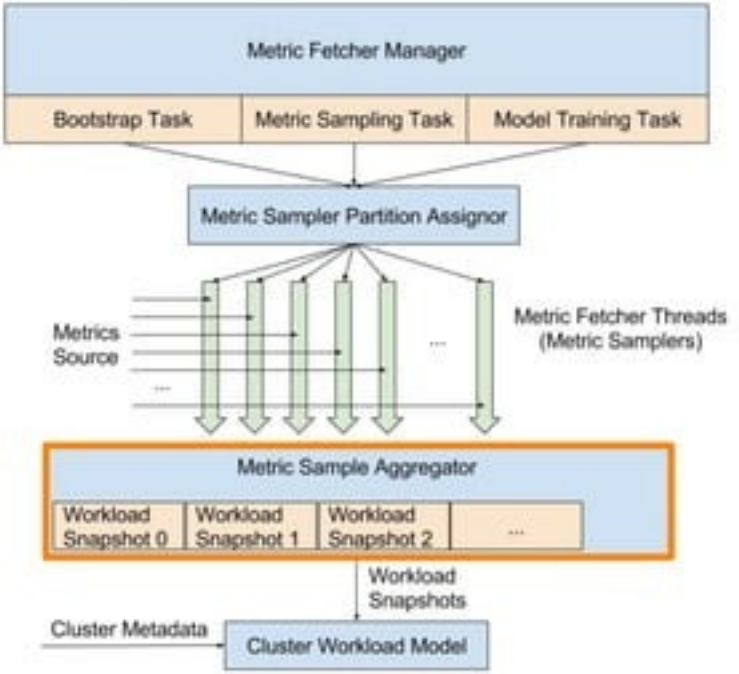

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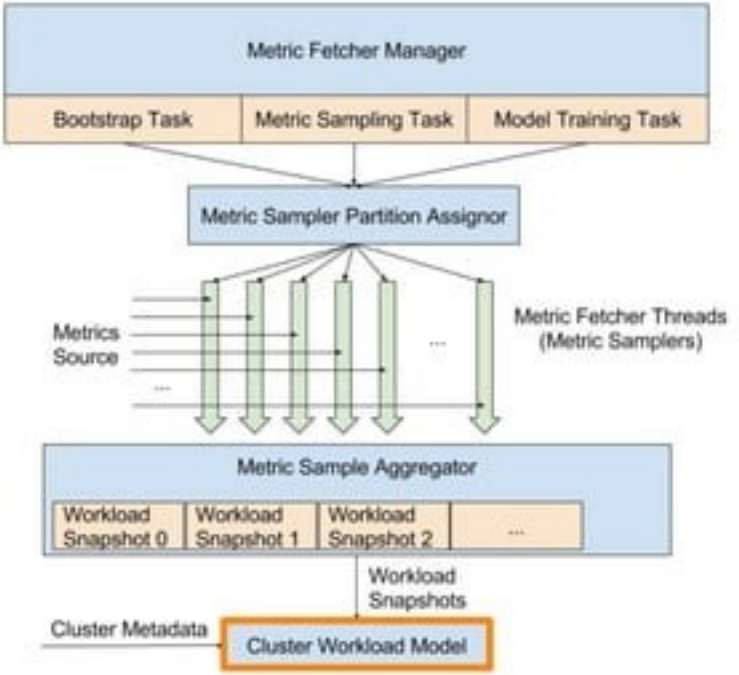

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Define the characteristics of an optimal aspect

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Heuristic model

An iterative model defines how it reaches the optimal load

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```
For each goal g in the goal list ordered by priority {
 For each broker b {
   while b does not meet g's requirement {
     For each replica r on b sorted by the resource utilization density {
       Move r (or the leadership of r) to another eligible broker b' so b'
still satisfies g and all the satisfied goals
       Finish the optimization for b once g is satisfied.
     }
     Fail the optimization if g is a hard goal and is not satisfied for b
   }
 }
 Add g to the satisfied goals
 }
```

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An optimization goal is violated. Unbalanced cluster.

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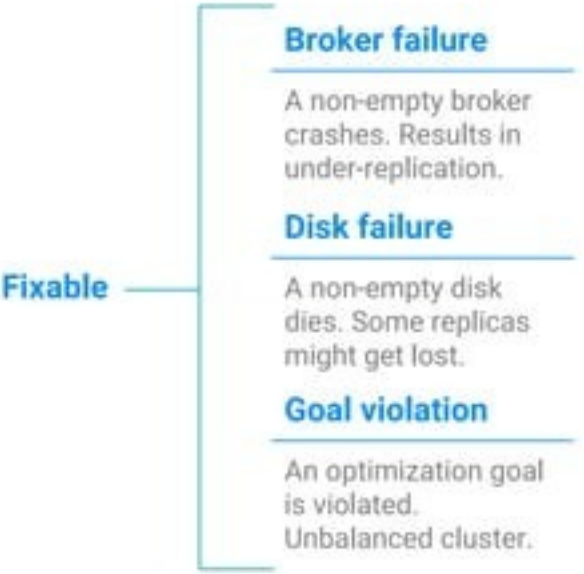

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Fixable

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Metric anomaly

One of the collected metric observes an unexpected value.

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Concurrent

Reassignment is concurrent, limits are set either manually or by the concurrency adjuster

So how do we use it?

What else can it do?

SLOW BROKER FINDER

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DETECTION
With metrics

Log flush—broker log flush 99.9th percentile is used, both absolute and relative to incoming traffic

Scoring—brokers have score, every anomaly increases it and every normal behavior decreases it

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REMEDIATION
Demoting and rebalance

Demoting—brokers will be demoted as a first attempt

Removal—slow brokers can be removed from the cluster if the problem persists after demotion

PROVISIONER

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RIGHTSIZING
With API

Underprovisioned—the cluster lacks certain kind of resources

Overprovisioned—by removing resources and rebalancing it can achieve some cost saving

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Resource—a goal can request a resource, like broker, disk to be added or removed

Constraints—every goal can give constraints, e.g. racks for which brokers should not be added

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IMPLEMENTATION
Provider dependent

API—there is an API that can be used as a basis for your implementation

Providers—for all providers like AWS or Azure you need to add glue code to acquire or release resources

CONCURRENCY ADJUSTER

Inter-broker replica reassignment limits aren't easy

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MANUAL LIMITS

Challenging

Destructive—if the manually set limit is too high, then it can be fast but also overwhelm the cluster

Slow—If the limit is too small then rebalances can last for a long time

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FEEDBACK LOOP
Adaptive limit

Metrics—metrics are collected to assess whether rebalance concurrency needs adjustments

Limits—if metrics are over a threshold then concurrency will adjust with AIMD algorithm

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RESULTS
AIMD

Automated—no need for constant oversight for setting concurrency in a fluctuating traffic environment

Fast—rebalances will complete faster due to the optimal limit

Stable—clients won't experience any side effects caused by rebalances

Security matters

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The simple basic authentication that sends username and password

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If a process acts on behalf of a user, the doAs header will forward the username.

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Communication is secured via HTTPS to the server and TLS to Zookeeper or Kafka

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Authorization

Simple model with viewer, user and admin roles.

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Trusted Proxy

If a process acts on behalf of a user, the doAs query param will forward the username.

THANK YOU

CLOUDERA