

1.19.2

## Best Practices

Date published: 2023-06-22

Date modified: 2023-06-22

# CLOUDERA

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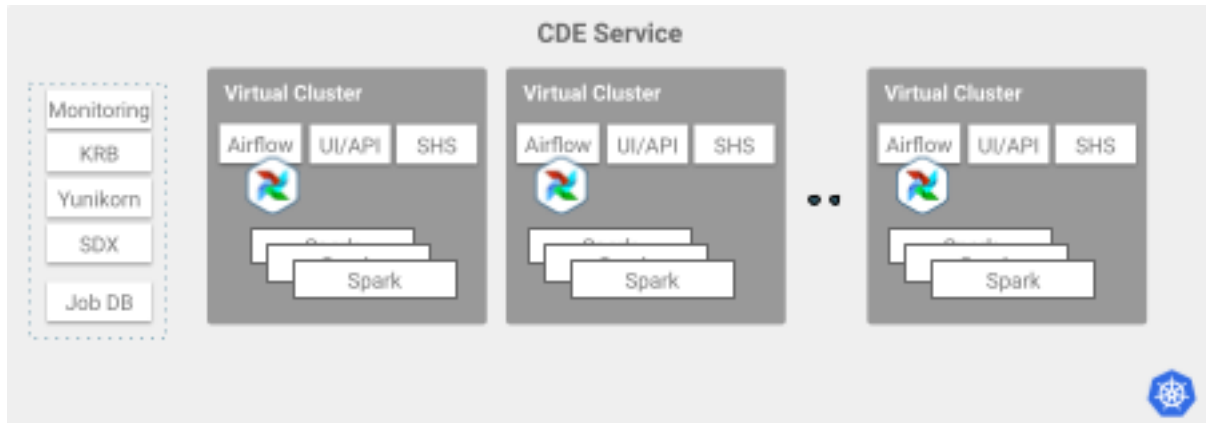
## Recommendations for scaling CDE deployments

Your business might experience a sudden increase or drop in demand due to which your Cloudera Data Engineering (CDE) deployment needs to autoscale. You can scale your CDE deployment by either adding new instances of a CDE service or Virtual Cluster, or by adding additional resources to the existing ones.

There are two ways to scale your CDE deployment:

- Vertically - More resources are provisioned within the same instance of a CDE service or Virtual Cluster.
- Horizontally - New instances of CDE service or Virtual Cluster are provisioned.

The key components of a typical CDE service deployment are depicted below:



Virtual Clusters provide an isolated autoscaling compute capacity to run Spark and/or Airflow jobs. Virtual Clusters can be used to isolate individual teams or lines of business by using user-based access control lists (ACL).

### Guidelines for scaling Virtual Clusters

- Each Virtual Cluster requires infrastructure capacity to run various services such as Airflow, API server, and Spark-History-Server (SHS).

Recommendation: Do not scale horizontally beyond 50 Virtual Clusters within the same CDE service.

- Virtual Clusters can actively run hundreds of parallel jobs. In certain scenarios, it might be required to simultaneously submit multiple jobs as per the schedule or due to a burst in demand. In these scenarios the API server cannot exceed 60 simultaneous job submissions. Once the jobs move from submission to running state, more jobs can be submitted.

Recommendation: Distribute simultaneous submission of jobs over time or horizontally scale across multiple Virtual Clusters.

### Job submission rate guardrails

When jobs are submitted to the CDE API server of a particular Virtual Cluster, it takes time and resources, known as "preparing" and "starting" states, before they begin running. This process is called the job submission intake process. To ensure proper resourcing and handling of incoming jobs, guardrails have been setup. By default, the guardrail or limit is set to 60 simultaneous job submissions. Simultaneous incoming job submissions that exceed 60 will return a 429 error message to the client. The example error message is as follows: "Failed to submit. Too many requests".

Recommendation:

- CDE Clients should incorporate error handling for this error. The CDE CLI exit code is 77. The CDE CLI will receive an HTTP 429 response code for the request to the Runtime API Server's REST Api. For more information on exit codes, see Cloudera Data Engineering CLI exit codes linked below.

- If needed, the guardrail limit can be increased or decreased during the creation of the Virtual Cluster by setting the following configuration:

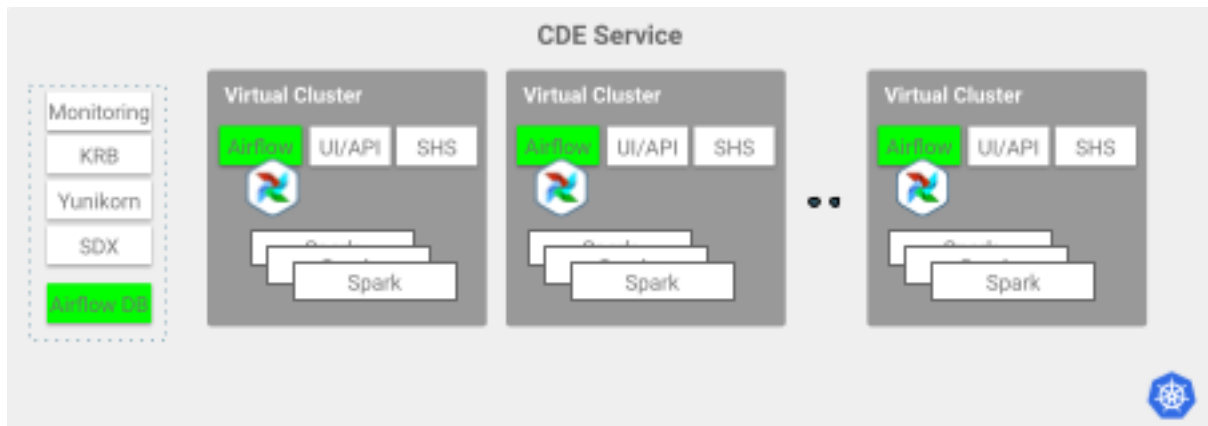
"limiting.simultaneousJobSubmissions"

## Apache Airflow scaling and tuning considerations

There are certain limitations related to the deployment architecture, and guidelines for scaling and tuning of the deployment, that you must consider while creating or running Airflow jobs (DAGs).

### CDE deployment architecture

If you use Airflow to schedule and/or develop multi-step pipelines, you must consider the following deployment limitations to scale your environment.



These guidelines describe when to scale horizontally, given total loaded DAGs and/or number of parallel (concurrent) tasks. These apply to all cloud providers.

### CDE service guidelines

The number of Airflow jobs that can run at the same time is limited by the number of parallel tasks that are triggered by the associated DAGs. The number of tasks can reach up to 250-300 when running in parallel per CDE service.

Recommendation: Create more CDE services to increase Airflow tasks concurrency beyond the limits noted above.

### Virtual Cluster guidelines

- Each Virtual Cluster has a maximum parallel task execution limit of 250. This applies to both Amazon Web Services (AWS) and Azure.



**Note:** It is recommended that you do not exceed 300 parallel tasks across all Virtual Clusters.

- For AWS: The recommended maximum number of Airflow jobs loaded per virtual cluster is 1500. As the number of jobs increases, the job page loading time experiences latency along with Airflow job creation time.
- For Azure: The recommended maximum number of Airflow jobs loaded per virtual cluster is 300 to 500. Higher capacity can be achieved but will require manual configuration changes.

Recommendation: Create more Virtual Clusters to load additional Airflow DAGs.

- The suggested number of Airflow jobs created in parallel is three or less. For jobs that are created in parallel, specify a DAG and/or a task\_group for each Airflow operator.

Recommendation: Distribute the creation of Airflow jobs so that you do not create more than three jobs at the same time.

# Cloudera Data Engineering performance tuning

## Use local SSD

Using default instances without local SSD does impact performance. Instances with local SSDs generally provide faster performance, but you need to ensure you choose instance types that have large enough local storage for intermediate results.

## Avoid instance types with low compute profiles

Make sure there is reasonable headroom (at least 20%) between the per executor memory and core usage and what the instance profile provides.

## Disable Spark Analysis

By default, CDE collects metrics around CPU, memory, and I/O. This can have a negative impact on performance - especially for long running jobs that take several hours to complete. Profiling metrics are useful in development and testing, but an unnecessary overhead in a production setting.

You can turn this feature off using the Spark Analysis toggle on the job Configuration tab.

## Turn off dynamic allocation

Dynamic allocation is ideal for cost management but does have overhead associated with it. For best performance, disable it.

## Use Spark 3 instead of Spark 2

Spark 3 introduced performance improvements over Spark 2, therefore Cloudera recommends using it whenever possible.

# Best practices for building Apache Spark applications

Follow these best practices when building Apache Spark Scala and Java applications:

- Refrain from using `withColumn` in chain, loop, and calling it multiple times in a single query. Doing so may cause performance issues. To avoid issues, use `select()` with multiple columns at once. See the Apache Spark API reference linked below for more information.
- Compile your applications against the same version of Spark that you are running.
- Build a single assembly JAR ("Uber" JAR) that includes all dependencies. In Maven, add the Maven assembly plug-in to build a JAR containing all dependencies:

```
<plugin>
  <artifactId>maven-assembly-plugin</artifactId>
  <configuration>
    <descriptorRefs>
      <descriptorRef>jar-with-dependencies</descriptorRef>
    </descriptorRefs>
  </configuration>
  <executions>
    <execution>
      <id>make-assembly</id>
      <phase>package</phase>
      <goals>
```

```
<goal>single</goal>
</goals>
</execution>
</executions>
</plugin>
```

This plug-in manages the merge procedure for all available JAR files during the build. Exclude Spark, Hadoop, and Kafka classes from the assembly JAR, because they are already available on the cluster and contained in the runtime classpath. In Maven, specify Spark, Hadoop, and Kafka dependencies with scope provided. For example:

```
<dependency>
  <groupId>org.apache.spark</groupId>
  <artifactId>spark-core_2.11</artifactId>
  <version>2.4.0.7.0.0.0</version>
  <scope>provided</scope>
</dependency>
```