

# What's new in Airflow 2

Apache Airflow Online Summit  
8th of July 2020



# Who are we?



Tomek Urbaszek

Committer, **PMC Member**  
Software Engineer @ Polidea



Jarek Potiuk

Committer, **PMC member**  
Principal Software Engineer @ Polidea



Kamil Breguła

Committer, **PMC member**  
Software Engineer @ Polidea



Ash Berlin-Taylor

Committer, **PMC member**  
Airflow Engineering Lead @ Astronomer



Daniel Imberman

Committer, **PMC Member**  
Senior Data Engineer @ Astronomer



Kaxil Naik

Committer, **PMC member**  
Senior Data Engineer @ Astronomer

# Announcements

## New PMC members



Tomek Urbaszek  
Committer, **PMC Member**  
Software Engineer @ Polidea



Daniel Imberman  
Committer, **PMC Member**  
Senior Data Engineer @ Astronomer



Kamil Breguła  
Committer, **PMC member**  
Software Engineer @ Polidea

## New committer



QP Hou  
Committer  
Senior Engineer @ Scribd

*Talk: Teaching an old DAG new tricks  
Friday July 10 th, 5 am UTC*

# “Ask Me Anything” session with Airflow PMCs

- **Asia friendly time-zone**
- **Thursday 11 pm PDT / Friday 6 am UTC**
- **Hosted by Bangalore Meetup.**  
Join from anywhere.
- **BYO questions** [airflowsummit.org](http://airflowsummit.org)

# High Availability



# Scheduler High Availability

Goals:

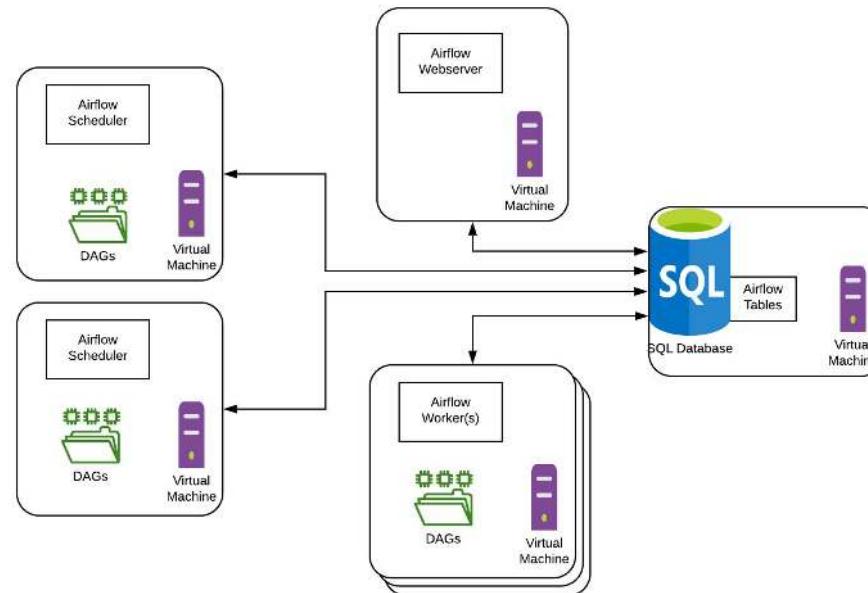
- Performance - reduce task-to-task schedule "lag"
- Scalability - increase task throughput by horizontal scaling
- Resiliency - kill a scheduler and have tasks continue to be scheduled

# Scheduler High Availability: Design

- Active-active model. Each scheduler does everything
- Uses existing database - no new components needed, no extra operational burden
- Plan to use row-level-locks in the DB (SELECT ... FOR UPDATE)
- Will re-evaluate if performance/stress testing show the need

# Example HA configuration

Airflow Schedulers running in High Availability  
on virtual machines - example configuration



# Scheduler High Availability: Tasks

- Separate DAG parsing from DAG scheduling ✓

This removes the tie between parsing and scheduling that is still present

- Run a mini scheduler *in the worker* after each task is completed ✓

A.K.A. "fast follow". Look at immediate down stream tasks of what just finished and see what we can schedule

- Test it to destruction - In progress

This is a big architectural change, we need to be sure it works well.

# Measuring Performance

Key performance we define as "Scheduler lag":

- Amount of "wasted" time not running tasks
- $ti.state\_date - \max(t.end\_date \text{ for } t \text{ in } upstream\_tis)$
- Zero is the goal (we'll never get to 0.)
- Tasks are "echo true" -- tiny but still executing

# *Preliminary* performance results

Case: 100 DAG files | 1 DAG per file | 10 Tasks per DAG | 1 run per DAG

Workers: 4 | Parallelism: 64

**1.10.10:** 54.17s ( $\sigma$ 19.38) Total runtime: 22m22s

**HA branch - 1 scheduler:** 4.39s ( $\sigma$ 1.40) 1m10s

**HA branch - 3 schedulers:** 1.96s ( $\sigma$ 0.51) Total runtime: 48s

# *Preliminary* performance results

Case: 1 Dag File | 1 Dag Per File | 20 Tasks per DAG | 1000 runs per DAG

Workers: 30 | Parallelism: 40960 | Default pool size 40960

**1.10.10:** 42.14s ( $\sigma$ 7.06) Total runtime: 1h 30m 14s

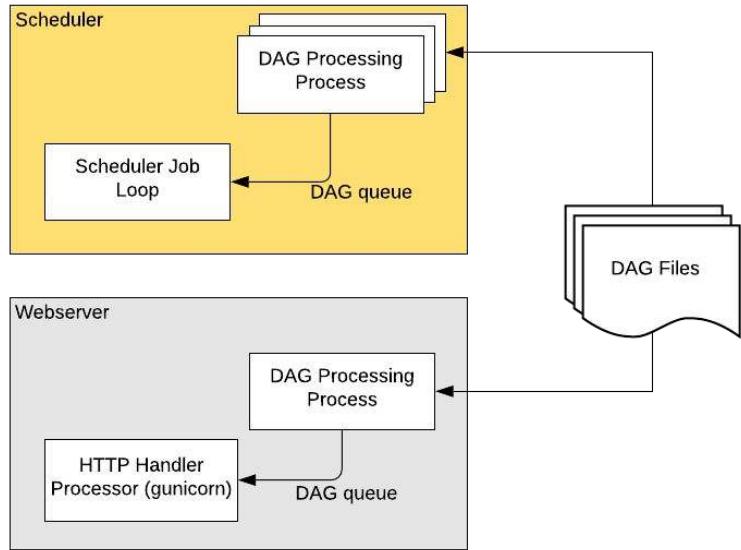
**HA branch - 1 scheduler:** 0.68s ( $\sigma$ 0.19) Total runtime: 18m 51s

**HA branch - 3 schedulers\*:** 1.54s ( $\sigma$ 1.79) Total runtime: 12m 52s

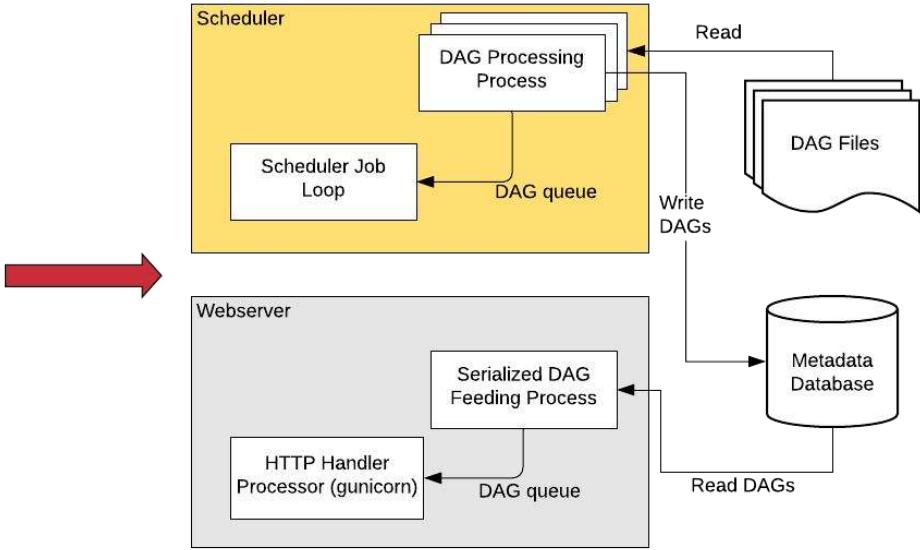
# DAG Serialization



# Dag Serialization



(1) Vanilla Airflow



(2) Airflow with DAG  
Serialization

# Dag Serialization (Tasks Completed)

- **Stateless Webserver:** Scheduler parses the DAG files, serializes them in JSON format & saves them in the Metadata DB.
- **Lazy Loading of DAGs:** Instead of loading an entire DagBag when the Webserver starts we only load each DAG on demand. This helps **reduce Webserver startup time and memory**. This reduction in time is notable with large number of DAGs.
- Deploying new DAGs to Airflow - no longer requires long restarts of webserver (if DAGs are baked in Docker image)
- Feature to use the “JSON” library of choice for Serialization (default is inbuilt ‘json’ library)
- Paves way for **DAG Versioning & Scheduler HA**

# Dag Serialization (Tasks In-Progress for Airflow 2.0)

- Decouple DAG Parsing and Serializing from the scheduling loop.
- Scheduler will fetch DAGs from DB
- DAG will be parsed, serialized and saved to DB by a separate component “Serializer”/ “Dag Parser”
- This should reduce the delay in Scheduling tasks when the number of DAGs are large

# DAG Versioning



# Dag Versioning

## Current Problem:

- Change in DAG structure affects viewing previous DagRuns too
- Not possible to view the code associated with a specific DagRun
- Checking logs of a deleted task in the UI is not straight-forward

# Dag Versioning (Current Problem)

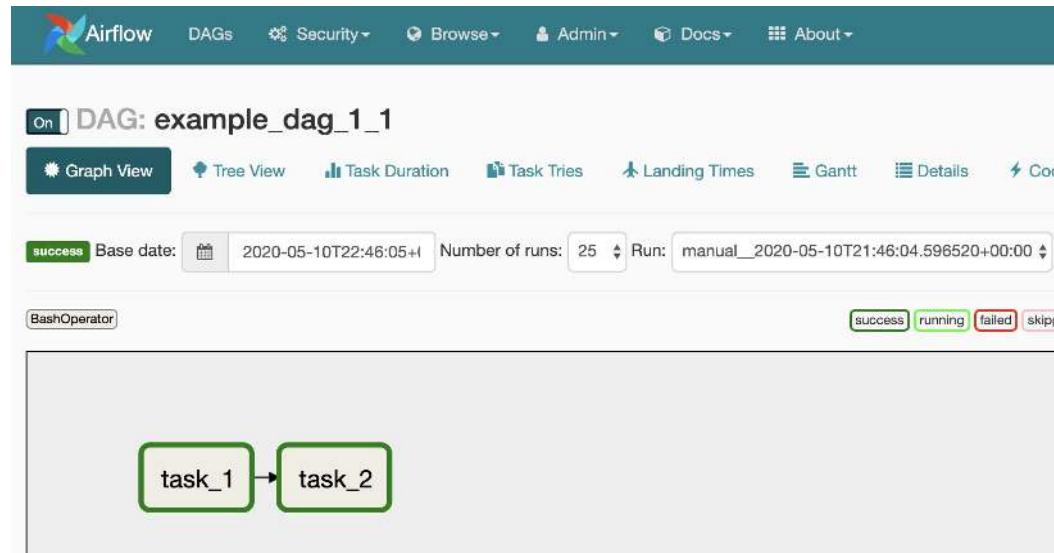
```
from airflow.models.dag import DAG
from airflow.operators.bash_operator import BashOperator
from datetime import datetime

with DAG('example_dag_1_1', schedule_interval=None,
         start_date=datetime(2020, 4, 25)) as example_dag_1_1:

    task_1 = BashOperator(
        task_id='task_1',
        bash_command='echo hello',
    )

    task_2 = BashOperator(
        task_id='task_2',
        bash_command='echo hello',
    )

    task_1 >> task_2
```



# Dag Versioning (Current Problem)

```
from airflow.models.dag import DAG
from airflow.operators.bash_operator import BashOperator
from datetime import datetime

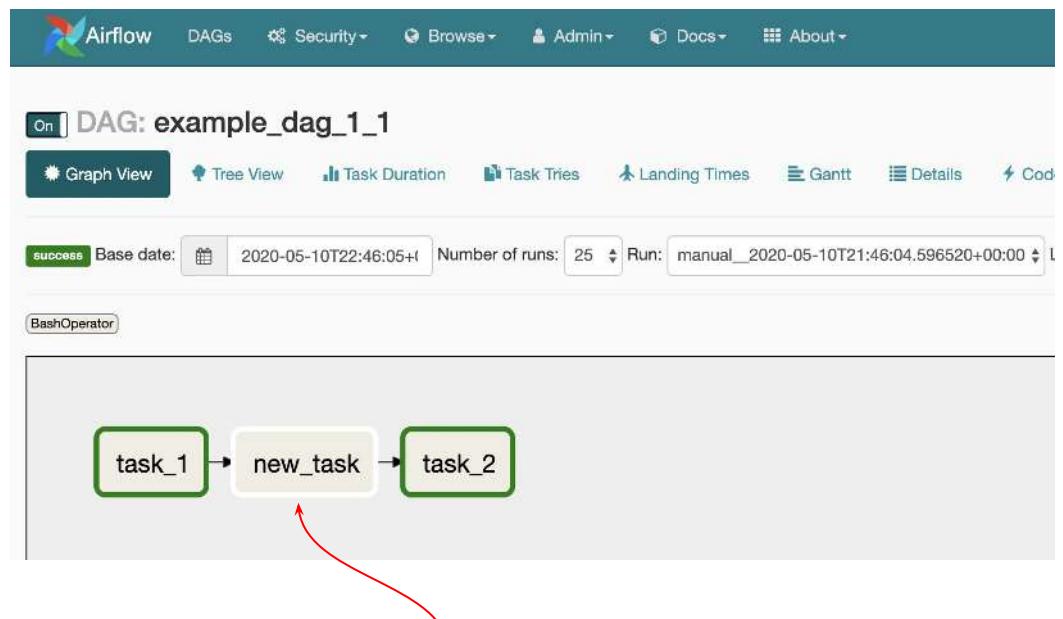
with DAG('example_dag_1_1', schedule_interval=None,
         start_date=datetime(2020, 4, 25)) as example_dag_1_1:

    task_1 = BashOperator(
        task_id='task_1',
        bash_command='echo hello',
    )

    new_task = BashOperator(
        task_id='new_task',
        bash_command='echo hello',
    )

    task_2 = BashOperator(
        task_id='task_2',
        bash_command='echo hello',
    )

    task_1 >> new_task >> task_2
```



New task is shown in Graph View for older DAG Runs too with “no status”.

# Dag Versioning

## Current Problem:

- Change in DAG structure affects viewing previous DagRuns too
- Not possible to view the code associated with a specific DagRun
- Checking logs of a deleted task in the UI is not straight-forward

## Goal:

- Support for storing multiple versions of Serialized DAGs
- Baked-In Maintenance DAGs to cleanup old DagRuns & associated Serialized DAGs
- Graph View shows the DAG associated with that DagRun

# Performance Improvements



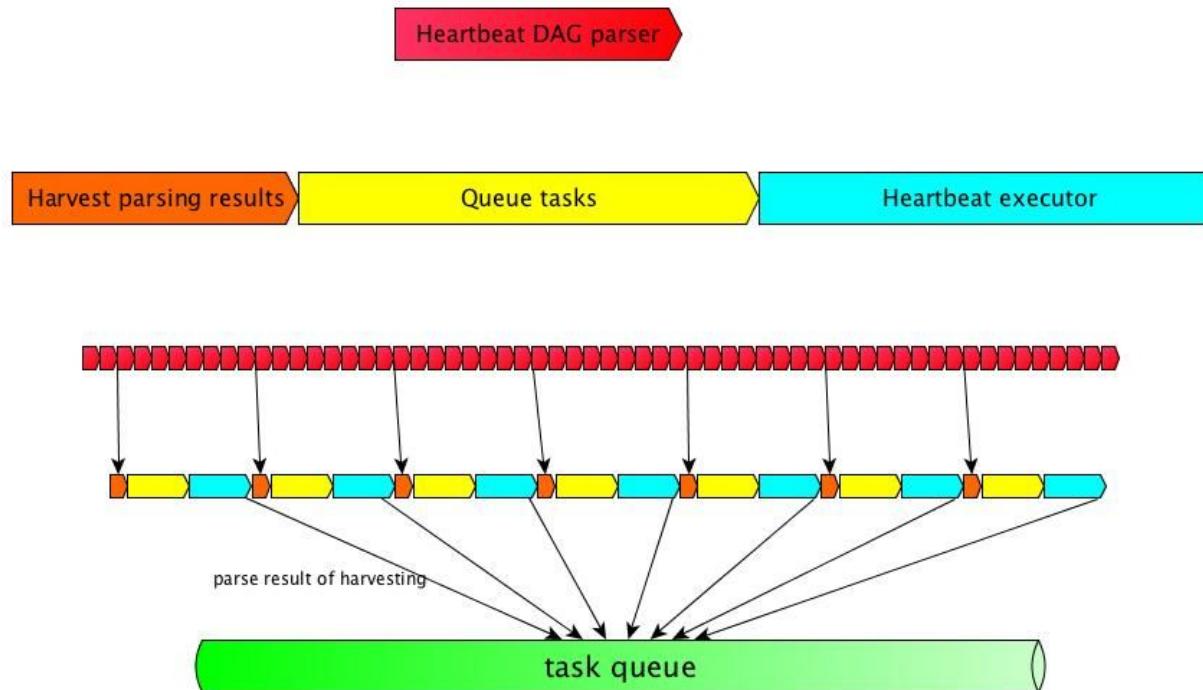
# Components performance improvements

- Focus on the current code
  - Reviews each components in turn
- Tools supporting performance tests - *perf\_kit*



```
@timing()
def test_dag_sync():
    with count_queries():
        DAG.bulk_sync_to_db()
```

# Avoid loading DAGs in the main scheduler loop



# Limit queries count

## DagFileProcessor:

When we have one DAG file with 200 DAGs, each DAG with 5 tasks:

	Before	After	Diff
Average time:	8080.246 ms	628.801 ms	-7452 ms (92%)
Queries count:	2692	5	-2687 (99%)

## Celery Executor:

When we have one DAG file with 200 DAGs, each DAG with 5 tasks:

	Postgres		Redis	
	Before	After	Before	After
Average time	3.1 s	27.825 ms	778.557 ms	3.417 ms
Queries count	5000	1	5000	1

# How to avoid regression?



```
with assert_queries_count(3):  
    DAG.bulk_sync_to_db(dags)
```

# REST API



# API: follows Open API 3.0 specification

Swagger Editor

File ▾ Edit ▾ Insert ▾ Generate Server ▾ Generate Client ▾

```
1 # Licensed to the Apache Software Foundation (ASF) under one
2 # or more contributor license agreements. See the NOTICE file
3 # distributed with this work for additional information
4 # regarding copyright ownership. The ASF licenses this file
5 # to you under the Apache License, Version 2.0 (the
6 # "License"); you may not use this file except in compliance
7 # with the License. You may obtain a copy of the License at
8 #
9 # http://www.apache.org/licenses/LICENSE-2.0
10 #
11 # Unless required by applicable law or agreed to in writing,
12 # software distributed under the License is distributed on an
13 # "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY
14 # KIND, either express or implied. See the License for the
15 # specific language governing permissions and limitations
16 # under the License.
17 ...
18 openapi: 3.0.3
19 ...
20 info:
21   title: "Airflow API (Stable)"
22   description: Apache Airflow management API.
23   version: "1.0.0"
24   termsOfService:
25     name: Apache 2.0
26     url: http://www.apache.org/licenses/LICENSE-2.0.html
27   contact:
28     name: Apache Foundation
29     url: https://airflow.apache.org
30     email: dev@airflow.apache.org
31 ...
32 servers:
33   - url: /api/v1
34     description: Airflow Stable API.
35 ...
36 paths:
37   # Database entities
38   /connections:
39     get:
40       summary: Get all connection entries
41       operationId: getConnections
42       tags: [Connection]
43       parameters:
44         - $ref: '#/components/parameters/PageLimit'
45         - $ref: '#/components/parameters/PageOffset'
46       responses:
47         '200':
48           description: List of connection entry.
49           content:
50             application/json:
51               schema:
52                 $ref:
53                   - $ref: '#/components/schemas/ConnectionCollection'
54                   - $ref: '#/components/schemas/CollectionInfo'
55 ...
56         '401':
57           $ref: '#/components/responses/Unauthorized'
58         '403':
59           $ref: '#/components/responses/PermissionDenied'
60 ...
61 post:
62   summary: Create connection entry
63   operationId: createConnection
64   tags: [Connection]
65   requestBody:
66     required: true
67     content:
68       application/json:
69         schema:
70           $ref: '#/components/schemas/Connection'
71       responses:
72         '200':
73           description: Successful response.
74           content:
75             application/json:
```

Config

GET /config Get current configuration

Connection

GET /connections Get all connection entries

POST /connections Create connection entry

GET /connections/{connection\_id} Get a connection entry

PATCH /connections/{connection\_id} Update a connection entry

DELETE /connections/{connection\_id} Delete a connection entry

DAG

GET /dags Get all DAGs

GET /dags/{dag\_id} Get basic information about a DAG

PATCH /dags/{dag\_id} Update a DAG

POST /dags/{dag\_id} /clearTaskInstances Clears a set of task instances associated with the DAG for a specified date range.

GET /dags/{dag\_id}/structure Get simplified representation of DAG.

GET /dags/{dag\_id}/tasks Get tasks for DAG

GET /dags/{dag\_id}/tasks/{task\_id} Get simplified representation of a task.

GET /dagSources/{file\_token} Get source code using file token

DAGRun

Outreachy interns



Ephraim Anierobi



Omair Khan

# API development progress

## AIP-32 - Airflow REST API

⌚ Updated 5 days ago



	API Endpoints - Read - Connection #8127	Done
	API Endpoints - Read - DAG Model #8128	Community review
	API Endpoints - Read - DAG Runs #8129	Done
	API Endpoints - Read - Task Instance #8132	Development in progress
	API Endpoints - Read - Variable #8133	Done
	API Endpoints - Read - XCOM #8134	Done
	API Endpoint - Dag source #8137	Community review
	API Endpoint - Dags structure/Task #8138	Done
<b>Community tasks</b> <a href="#">High level info #8107</a>		Done
	Basic OpenAPI spec #8108	Done
	Basic integration Airflow and connexion #8109	Done
	API Endpoints #8118	Blocked
	API Endpoints - CRUD - Connection #8127	Development in progress
	API Endpoints - CRUD - DAG Model #8128	Done
	API Endpoints - CRUD - DAG Runs #8129	Development in progress
	API Endpoints - CRUD - Import errors #8130	Done
	API Endpoints - CRUD - Pools #8131	Done
<b>HATEOS for API #8117</b> <b>CRUD Framework for API #8116</b>	API Endpoints - CRUD - Task Instance #8132	Blocked
	API Endpoints - CRUD - Variable #8133	Done
	API Endpoints - CRUD - XCOM #8134	Development in progress
	API Endpoint - Logs #8135	Done
	API Endpoint - Config #8136	Done
	API Endpoint - Dags structure/Task #8138	Done
	API Endpoint - Extra Links #8140	Done
		Next up
		Next up
<b>Authorization and Permissions #8112</b> <b>Authentication in API #8111</b>		Next up
	Custom WEB UI screen to control permissions #8124	Next up
	Docs for REST API #8143	Blocked
	API security tests #8113	Research in progress

# Dev/CI environment



# CI environment

- Moved to GitHub Actions
  - Kubernetes Tests ✓
  - Easier way to test Kubernetes Tests locally ✓
- Quarantined tests
  - Fixing the Quarantined tests ✓
- Thinning CI image
  - Moved integrations out of the image ✓
- Future: Automated System Tests (AIP-21)

# Dev environment

- Breeze

- unit testing ✓
- package building ✓
- release preparation ✓
- kubernetes tests ✓
- refreshed videos ✓

- Code Spaces / VSCode

```
Usage: breeze [FLAGS] [COMMAND] -- <EXTRA_ARGS>

By default the script enters IT environment and drops you to bash shell, but you can choose one
of the commands to run specific actions instead. Add --help after each command to see details:

Commands without arguments:
shell                                     [Default] Enters interactive shell in the container
build-docs                                Builds documentation in the container
build-image                               Builds CI or Production docker image
cleanup-image                            Cleans up the container image created
exec                                      Execs into running breeze container in new terminal
generate-requirements          Generates pinned requirements for pip dependencies
push-image                                 Pushes images to registry
initialize-local-virtualenv   Initializes local virtualenv
setup-autocomplete                     Sets up autocomplete for breeze
stop                                       Stops the docker-compose environment
restart                                    Stops the docker-compose environment including DB cleanup
toggle-suppress-cheatsheet           Toggles on/off cheatsheet
toggle-suppress-asciart              Toggles on/off asciart

Commands with arguments:
docker-compose      <ARG>        Executes specified docker-compose command
kind-cluster        <ARG>        Manages KinD cluster on the host
prepare-backport-readme    <ARG>        Prepares backport packages readme files
prepare-backport-packages    <ARG>        Prepares backport packages
static-check         <ARG>        Performs selected static check for changed files
tests               <ARG>        Runs selected tests in the container

Help commands:
flags                           Shows all breeze's flags
help                            Shows this help message
help-all                        Shows detailed help for all commands and flags
```

# Backport Packages ✓

- Bring Airflow 2.0 providers to 1.10.\* ✓
- Packages per-provider ✓
- 58 packages (!) ✓
- Python 3.6+ only(!) ✓
- Automatically tested on CI ✓
- Future
  - Automated System Tests (AIP-4)
  - Split Airflow (AIP-8)?

```
✓ Prepare & test backport packages
1880 -----
1881 Prepared backporting package jdbc
1882 =====
1883 Preparing backporting package jenkins
1884 -----
1885 Prepared backporting package jenkins
1886 =====
1887 Preparing backporting package jira
1888 -----
1889 Prepared backporting package jira
1890 =====
1891 Preparing backporting package microsoft.azure
1892 -----
1893 Prepared backporting package microsoft.azure
1894 =====
1895 Preparing backporting package microsoft.mssql
1896 -----
1897 Prepared backporting package microsoft.mssql
1898 =====
1899 Preparing backporting package microsoft.winrm
1900 -----
1901 Prepared backporting package microsoft.winrm
1902 -----
1903 Preparing backporting package mssql
```

```
✓ Prepare & test backport packages
2499 -----
2500 Installing apache-airflow-backport-providers-microsoft-mssql
2501 -----
2502 Installed apache-airflow-backport-providers-microsoft-mssql
2503 -----
2504 Uninstalling apache-airflow-backport-providers-microsoft-mssql
2505 -----
2506 Uninstalled apache-airflow-backport-providers-microsoft-mssql
2507 -----
2508 Airflow version after installation 1.10.10
2509 =====
2510 Installing apache-airflow-backport-providers-microsoft-winrm
2511 -----
2512 Installed apache-airflow-backport-providers-microsoft-winrm
2513 -----
2514 Uninstalling apache-airflow-backport-providers-microsoft-winrm
2515 -----
2516 Uninstalled apache-airflow-backport-providers-microsoft-winrm
2517 -----
2518 Airflow version after installation 1.10.10
2519
```

Talk: Migration to Airflow backport providers, Anita Fronczak

Thursday July 16th, 4 am UTC

# Support for Production Deployments

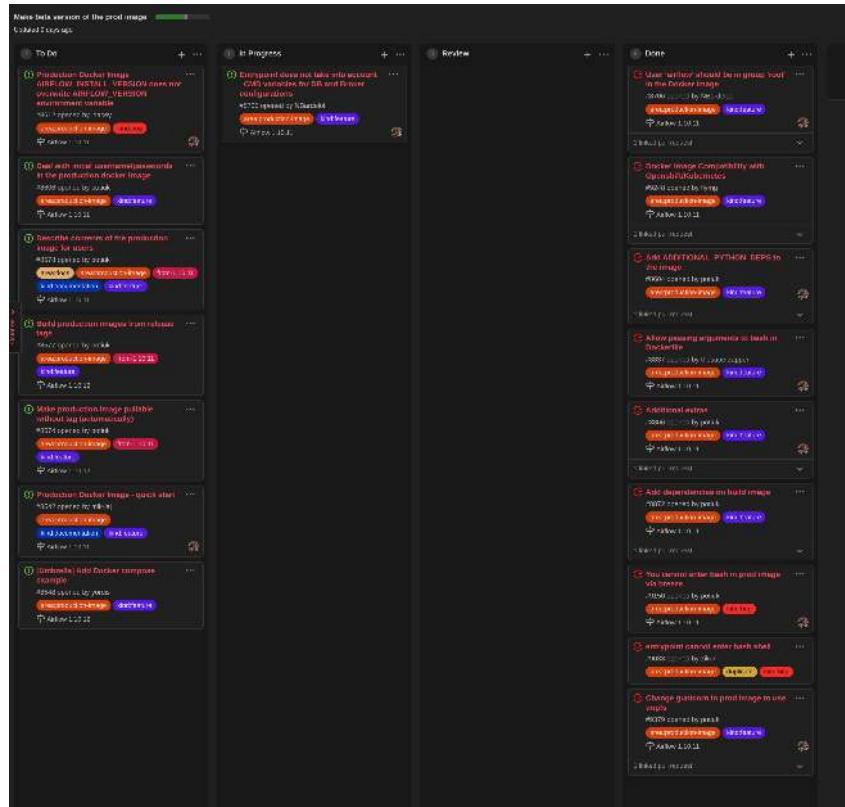


# Production Image

- Beta quality image is nearly ready ✓
  - Started with “bare image” ✓
  - Listened to use cases from users ✓
  - Integration with Helm Chart ✓
  - Implemented feedback ✓
  - Docker Compose

# *Talk, Production Docker image for Apache Airflow*

## *Jarek Potiuk, Tuesday July 14th, 5 am UTC*



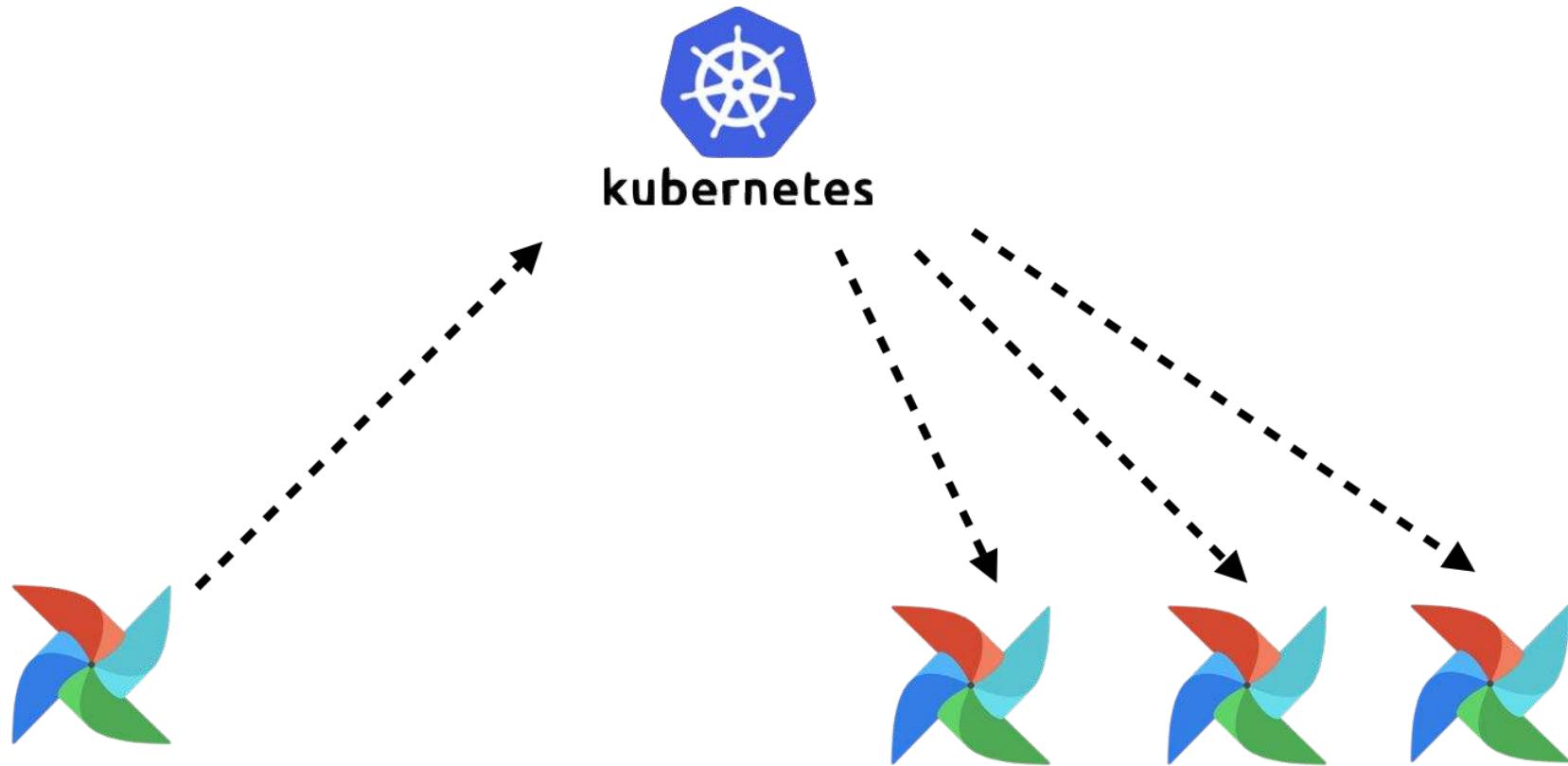
# What's new in Airflow + Kubernetes



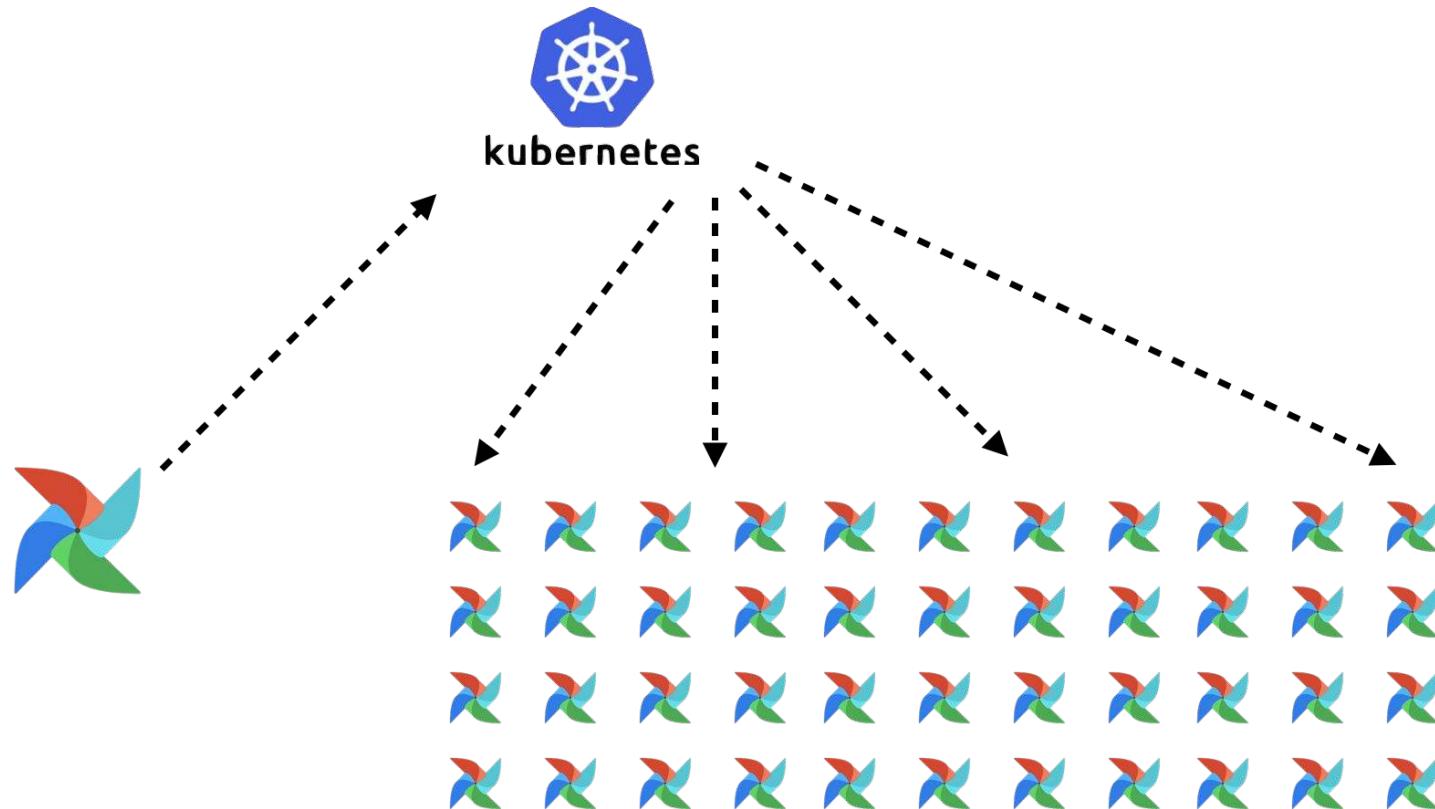
# KEDA Autoscaling



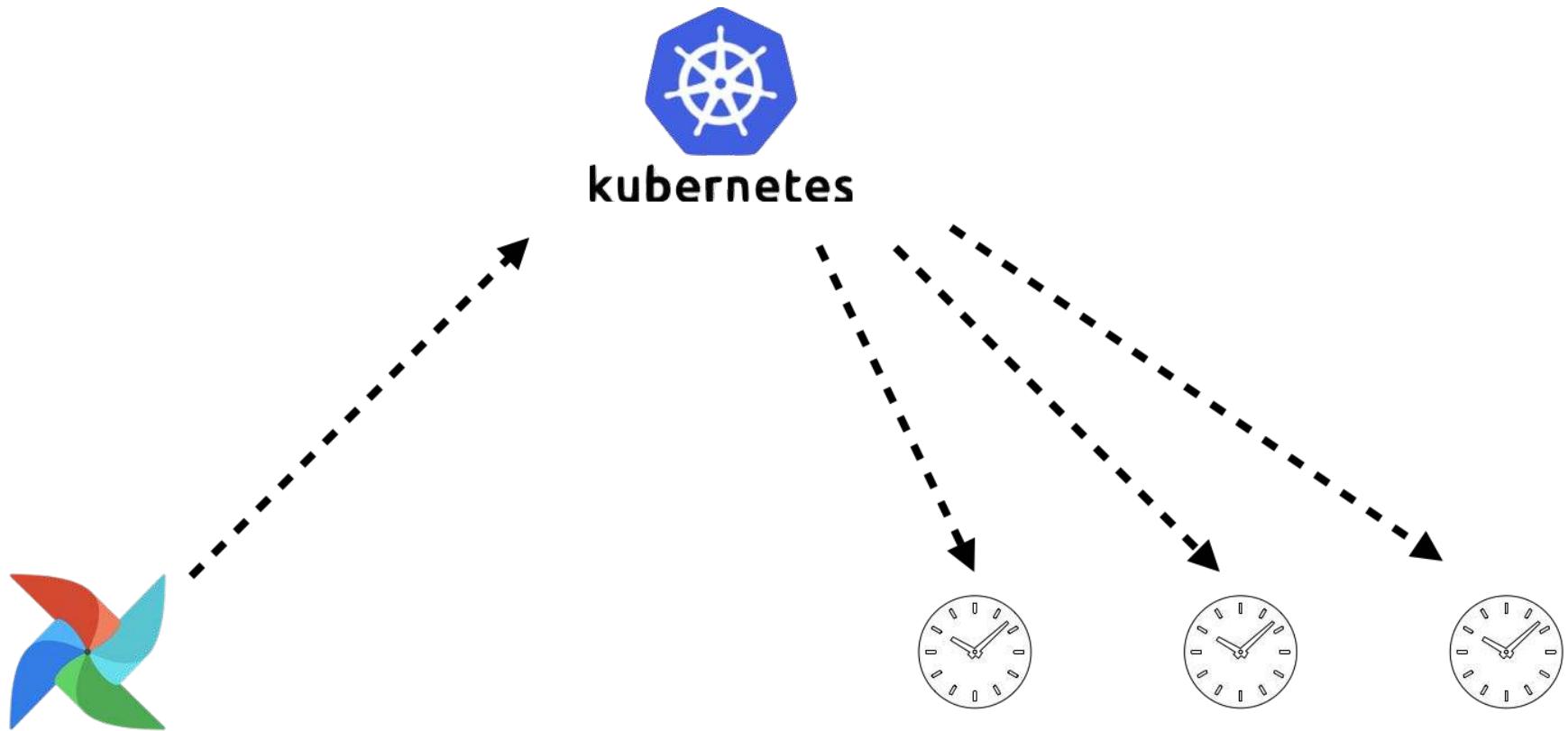
# KubernetesExecutor



# KubernetesExecutor



# KubernetesExecutor



# KubernetesExecutor vs. CeleryExecutor

## KubernetesExecutor

- Dynamic Allocation
- executor\_config

## CeleryExecutor

- Immediate SLAs
- Multiple tasks per-worker

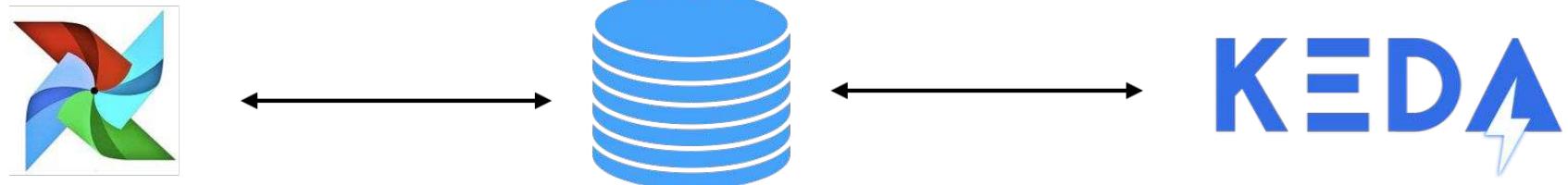
KEDA

A blue lightning bolt icon is positioned to the right of the letter 'A' in the word 'KEDA'. The lightning bolt is white with blue outlines, pointing upwards and to the left.

# KEDA Autoscaling

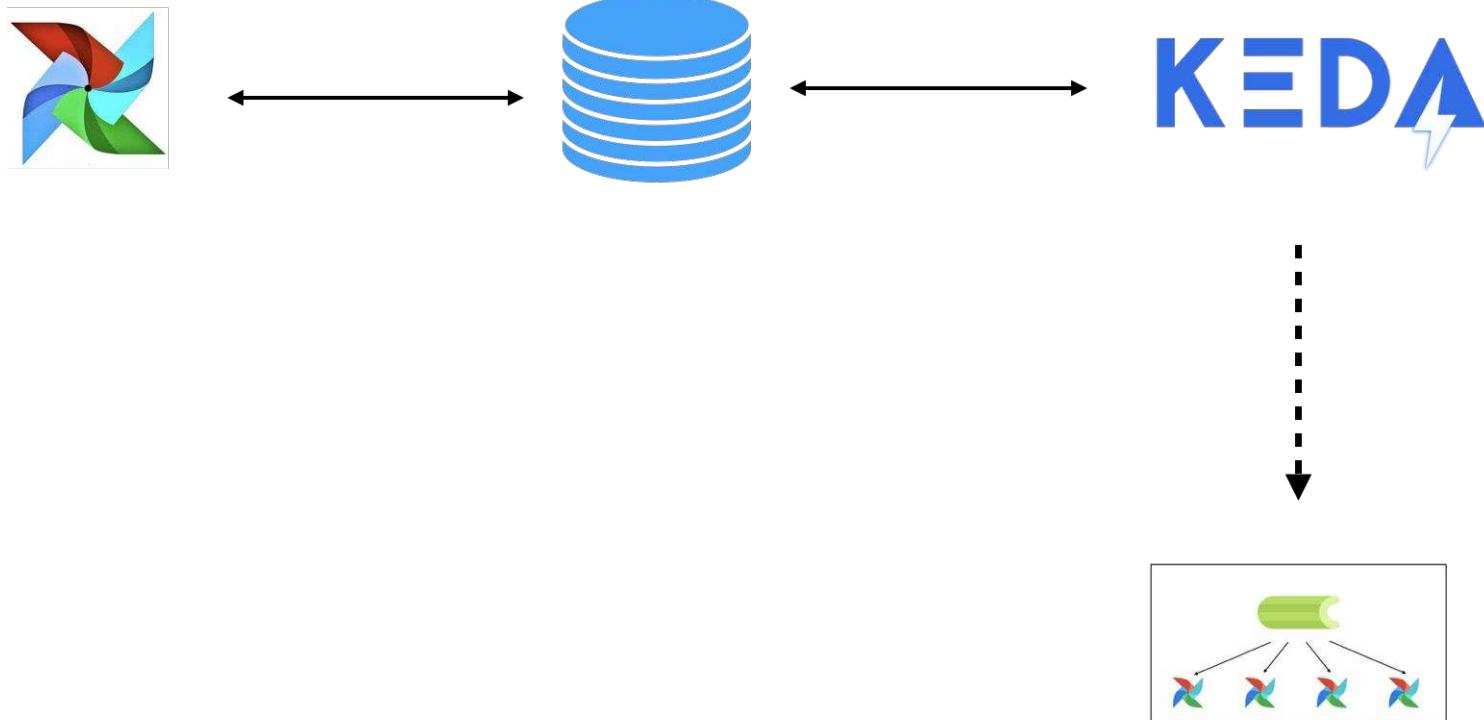
- Kubernetes Event-driven Autoscaler
- Scales based on # of RUNNING and QUEUED tasks in PostgreSQL backend

# KEDA Autoscaling



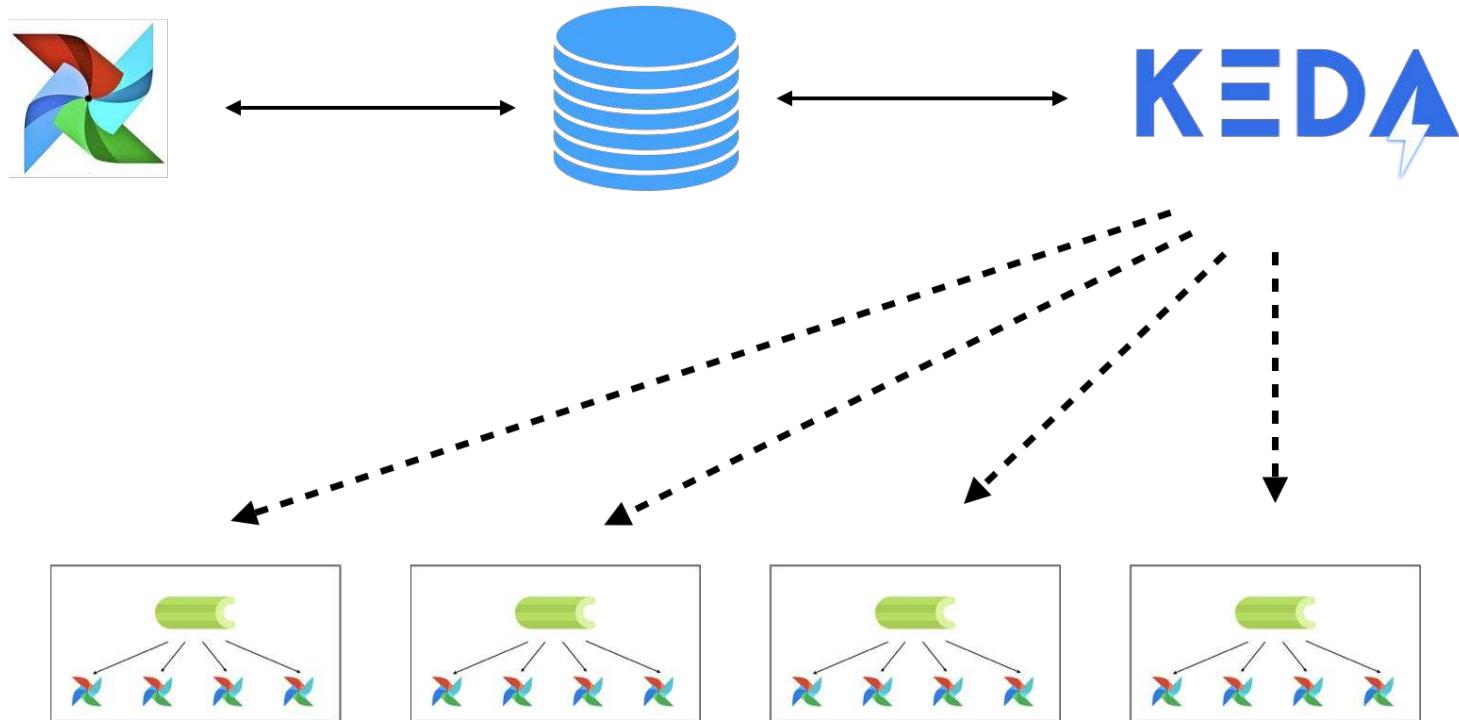
**CEIL((0 RUNNING + 0 QUEUED)/16) = 0 workers**

# KEDA Autoscaling



**CEIL((0 RUNNING + 1 QUEUED)/16) = 1 workers**

# KEDA Autoscaling



**CEIL((20 RUNNING + 20 QUEUED)/16) = 4 workers**

# KEDA Queues

- Historically Queues were expensive and hard to allocate
- With KEDA, queues are free! (can have 100 queues)
- KEDA works with k8s deployments so any customization you can make in a k8s pod, you can make in a k8s queue (worker size, GPU, secrets, etc.)

# KubernetesExecutor Pod Templating from YAML/JSON



# KubernetesExecutor Pod Templating

- In the K8sExecutor currently, users can modify certain parts of the pod, but many features of the k8s API are abstracted away
- We did this because at the time the airflow community was not well acquainted with the k8s API
- We want to enable users to modify their worker pods to better match their use-cases

# KubernetesExecutor Pod Templating

- Users can now set the `pod_template_file` config in their `airflow.cfg`
- Given a path, the KubernetesExecutor will now parse the yaml file when launching a worker pod
- Huge thank you to `@davlum` for this feature

# Official Airflow Helm Chart



# Helm Chart

- Donated by astronomer.io.
- This is the official helm chart that we have used both in our enterprise and in our cloud offerings (thousands of deployments of varying sizes)
- Helm 3 compliant
- Users can turn on KEDA autoscaling through helm variables
- “helm install apache/airflow”

# Helm Chart

- Chart will cut new releases with each airflow release
- Will be tested on official docker image
- Significantly simplifies airflow onboarding process for Kubernetes users

# Functional DAGs



# Functional DAGs

```
● ● ●  
def get_cat_pictures(num: int) -> List[Dict]:  
    response = requests.get("https://cat_pictures.com", params={"num": num})  
    return response.json()["cats"]  
  
def save_cats(list_of_cats: List[Dict]) -> None:  
    for cat in list_of_cats:  
        save_it_somehow(cat)  
  
with DAG("cat_fetcher"):  
    get_task = PythonOperator(  
        task_id="get_task", python_callable=get_cat_pictures, op_args=[42]  
    )  
    cats = "{{ task_instance.xcom_pull('get_task') }}"  
    save_task = PythonOperator(  
        task_id="save_task", python_callable=save_cats, op_args=[cats]  
    )  
    get_task >> save_task
```

- PythonOperator boilerplate code
- Define separately:
  - ◆ order relation
  - ◆ data relation
- Writing jinja strings by hand

# Functional DAGs

```
def get_cat_pictures(num: int) -> List[Dict]:  
    response = requests.get("https://cat_pictures.com", params={"num": num})  
    return response.json()["cats"]  
  
def save_cats(list_of_cats: List[Dict]) -> None:  
    for cat in list_of_cats:  
        save_it_somewhere(cat)  
  
with DAG("cat_fetcher"):  
    get_task = PythonOperator(  
        task_id="get_task", python_callable=get_cat_pictures, op_args=[42]  
    )  
    cats = "{{ task_instance.xcom_pull('get_task') }}"  
    save_task = PythonOperator(  
        task_id="save_task", python_callable=save_cats, op_args=[cats]  
    )  
    get_task >> save_task
```

```
@task  
def get_cat_pictures(num: int) -> List[Dict]:  
    response = requests.get("https://cat_pictures.com", params={"num": num})  
    return response.json()["cats"]  
  
@task  
def save_cats(list_of_cats: List[Dict]) -> None:  
    for cat in list_of_cats:  
        save_it_somewhere(cat)  
  
with DAG("cat_fetcher"):  
    get_task = get_cat_pictures(42)  
    save_task = save_cats(get_task)
```

Data and order relationship are same!  
And works for all operators

# Functional DAGs

Data and order relationship are same!

And works for all operators

## AIP-31: Airflow functional DAG definition

- Easy way to convert a function to an operator
- Simplified way of writing DAGs
- Pluggable XCom Storage engine

Find out more:

[AIP-31: Airflow functional DAG definition](#)

by Gerard Casas Saez

10th of July

```
@task
def get_cat_pictures(num: int) -> List[Dict]:
    response = requests.get("https://cat_pictures.com", params={"num": num})
    return response.json()["cats"]

@task
def save_cats(list_of_cats: List[Dict]) -> None:
    for cat in list_of_cats:
        save_it_somewhere(cat)

with DAG("cat_fetcher"):
    get_task = get_cat_pictures(42)
    save_task = save_cats(get_task)
```

**Example:** store and retrieve DataFrames on GCS or S3 buckets without boilerplate code

Smaller changes



# Other changes of note

- Connection IDs now need to be unique ([#8608](#))

It was often confusing, and there are better ways to do load balancing

- Python 3 only ✓

Python 2.7 unsupported upstream since Jan 1, 2020

- "RBAC" UI is now the only UI ✓

Was a config option before, now only option. Charts/data profiling removed due to security risks

# Road to Airflow 2.0



# When will Airflow 2.0 be available?



# Airflow 2.0 – deprecate, but (try) not to remove

- Breaking changes should be avoided where we can – if upgrade is too difficult users will be left behind
- Release "backport providers" to make new code layout available "now":

```
pip install apache-airflow-backport-providers-aws \
          apache-airflow-backport-providers-google
```

- Before 2.0 we want to make sure we've fixed everything we want to remove or break.

# How to upgrade to 2.0 safely

- Install the latest 1.10 release
- Run `airflow upgrade-check` (doesn't exist, yet [#8765](#))
- Fix any warnings
- Upgrade Airflow

Thank you!

Time for Q & A

