AIRFLOW SUMMIT

Implementing Airflow Governance With Cluster Policies

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3.0

Introduction to cluster policies

- Defined as Python functions
- Check or mutate Airflow objects.
- Enforce standards
- Useful for governance.

Types

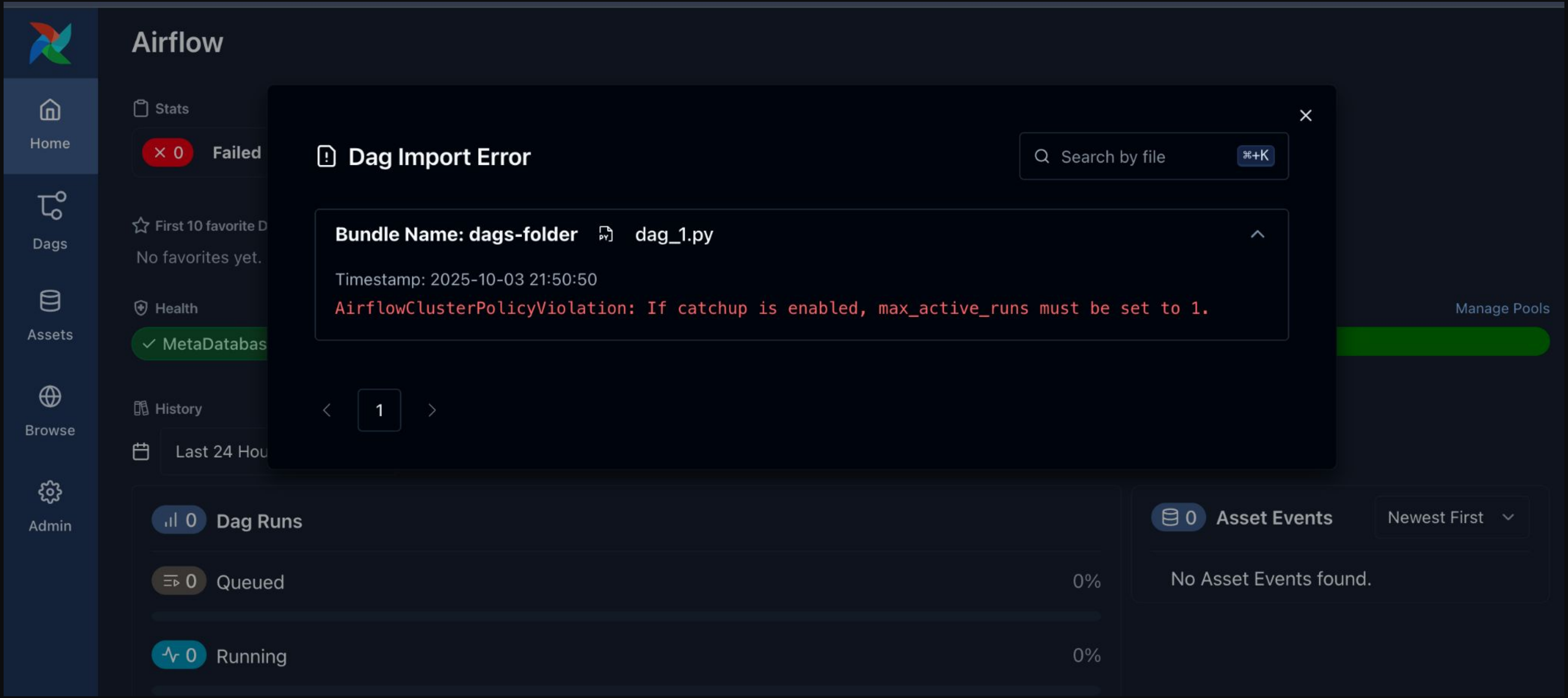
- dag policy
- task policy
- task instance mutation hook
- pod mutation hook

Dag Policies

- Applied to a dag object
- When it is loaded in the dagbag.
- Check and mutate parameters in the dag definition.

Governance Use Cases

- dag_id naming convention
- dag description, tags, owner_links
- dagrun_timeout

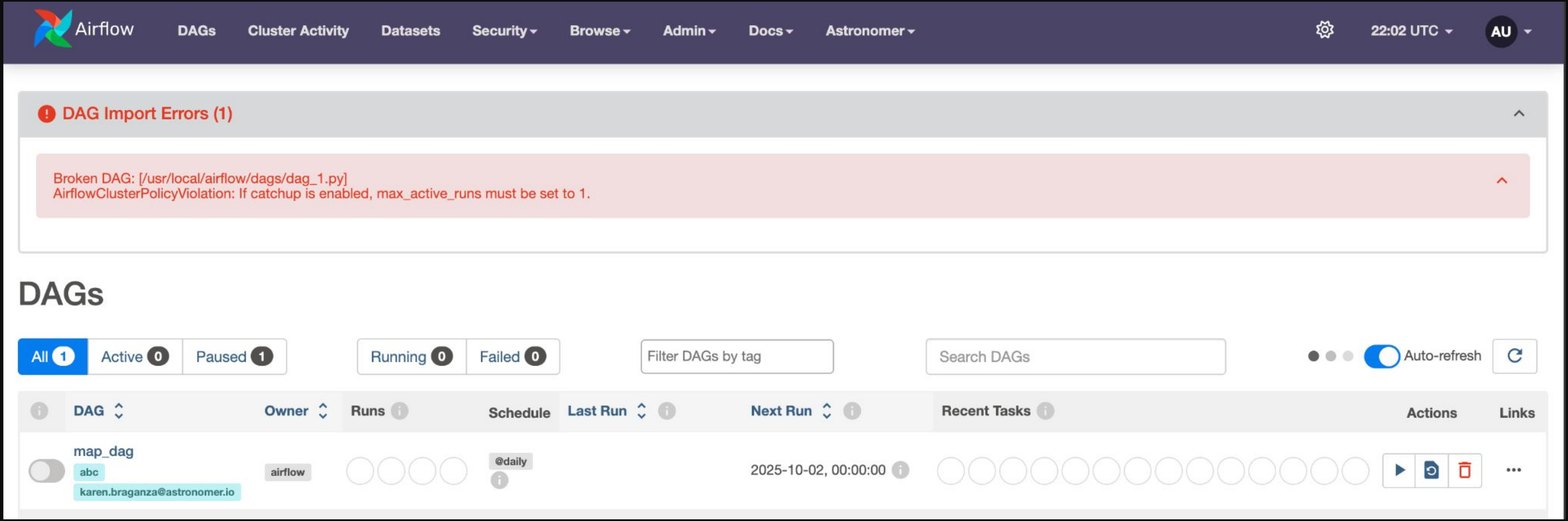


Dag Import Error

Bundle Name: dags-folder dag_1.py

Timestamp: 2025-10-03 21:50:50

```
AirflowClusterPolicyViolation: If catchup is enabled, max_active_runs must be set to 1.
```



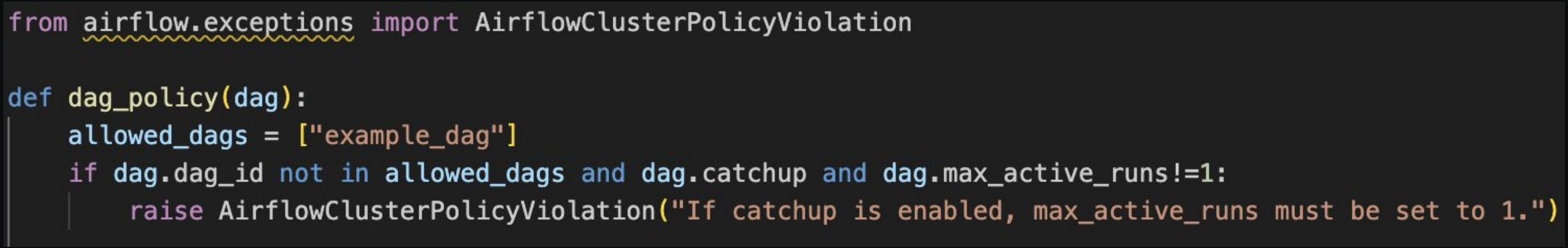
DAG Import Errors (1)

```
Broken DAG: [/usr/local/airflow/dags/dag_1.py]
AirflowClusterPolicyViolation: If catchup is enabled, max_active_runs must be set to 1.
```

DAGs

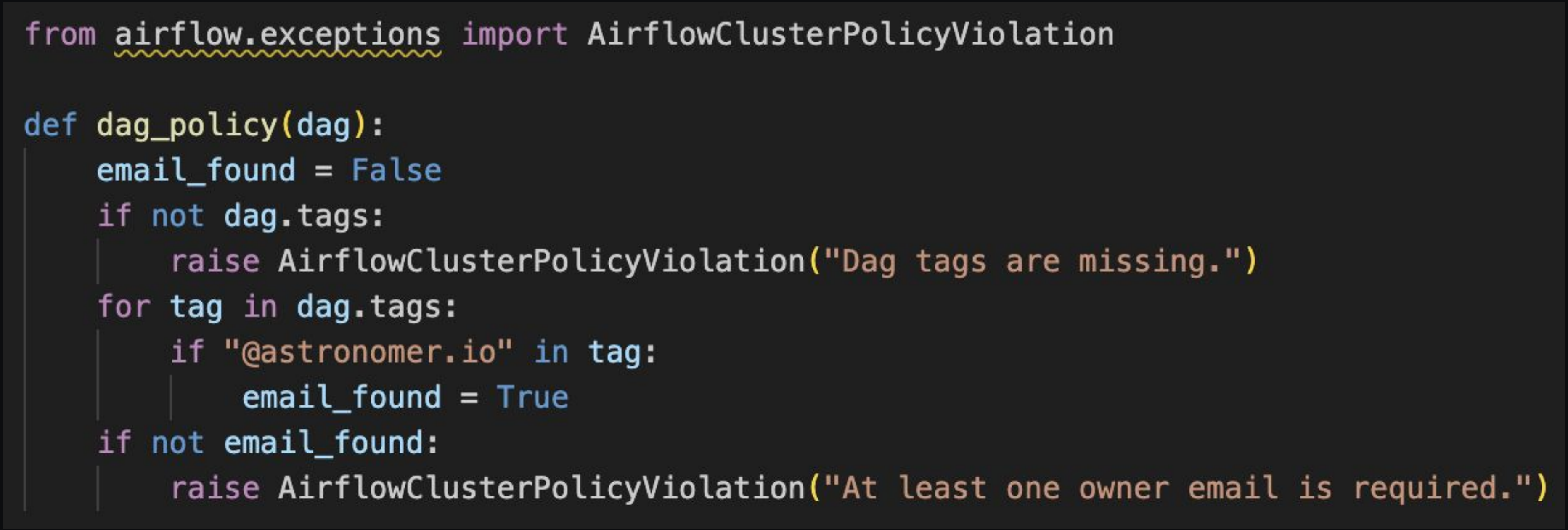
DAG	Owner	Runs	Schedule	Last Run	Next Run	Recent Tasks	Actions	Links
map_dag abc karen.braganza@astronomer.io	airflow		@daily		2025-10-02, 00:00:00			

Disallow catchup with max_active_runs>1



```python
from airflow.exceptions import AirflowClusterPolicyViolation

def dag_policy(dag):
    allowed_dags = ["example_dag"]
    if dag.dag_id not in allowed_dags and dag.catchup and dag.max_active_runs!=1:
        raise AirflowClusterPolicyViolation("If catchup is enabled, max_active_runs must be set to 1.")
```

Require owner email in tags



```python
from airflow.exceptions import AirflowClusterPolicyViolation

def dag_policy(dag):
    email_found = False
    if not dag.tags:
        raise AirflowClusterPolicyViolation("Dag tags are missing.")
    for tag in dag.tags:
        if "@astronomer.io" in tag:
            email_found = True
    if not email_found:
        raise AirflowClusterPolicyViolation("At least one owner email is required.")
```

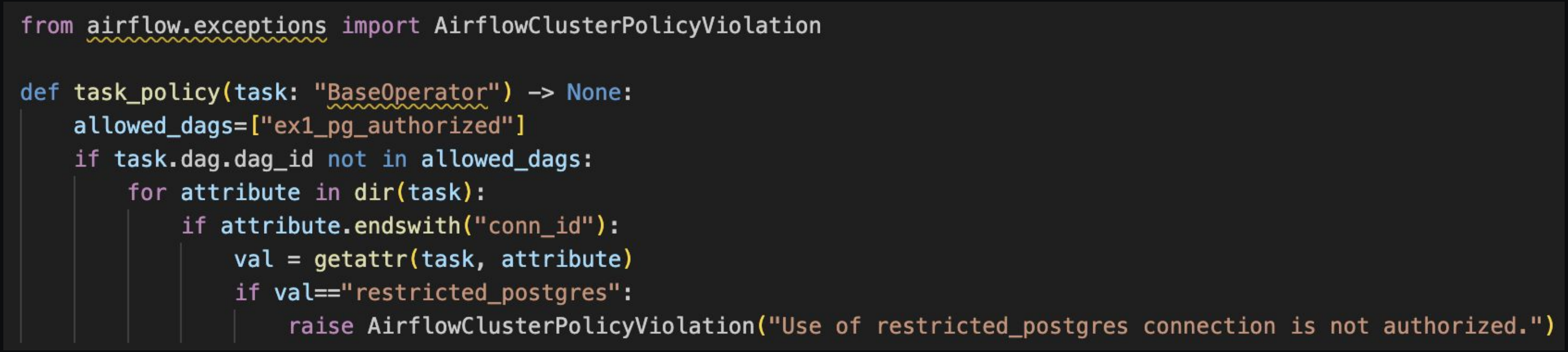
Task Policies

- Applied to a task object (BaseOperator)
- When it is loaded in the dagbag.
- Check and mutate task parameters.
- Applies to every task instance of the task object.

Governance Use Cases

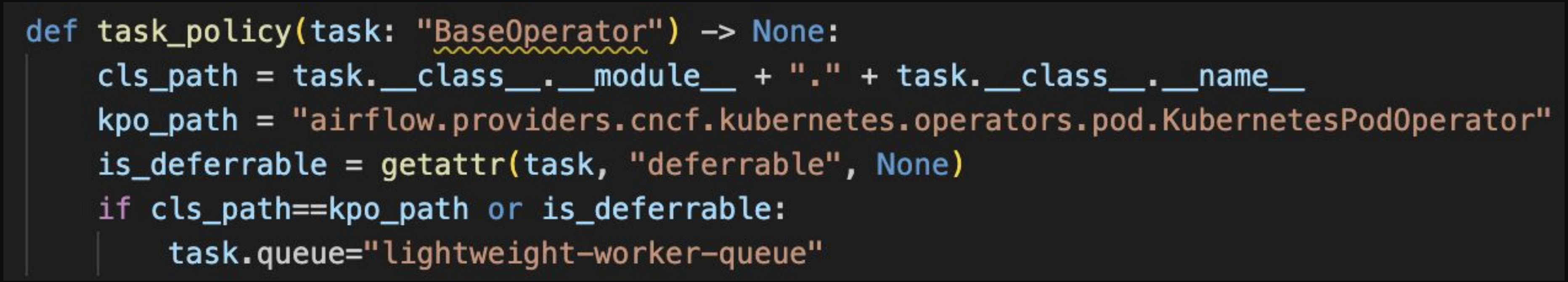
- callbacks
- worker queues
- ban operators
- executor_config

Restrict usage of a specific connection



```python
from airflow.exceptions import AirflowClusterPolicyViolation

def task_policy(task: "BaseOperator") -> None:
    allowed_dags=["ex1_pg_authorized"]
    if task.dag.dag_id not in allowed_dags:
        for attribute in dir(task):
            if attribute.endswith("conn_id"):
                val = getattr(task, attribute)
                if val=="restricted_postgres":
                    raise AirflowClusterPolicyViolation("Use of restricted_postgres connection is not authorized.")
```

Run KPO & deferrable tasks on a lightweight queue



```python
def task_policy(task: "BaseOperator") -> None:
    cls_path = task.__class__.__module__ + "." + task.__class__.__name__
    kpo_path = "airflow.providers.cncf.kubernetes.operators.pod.KubernetesPodOperator"
    is_deferrable = getattr(task, "deferrable", None)
    if cls_path==kpo_path or is_deferrable:
        task.queue="lightweight-worker-queue"
```

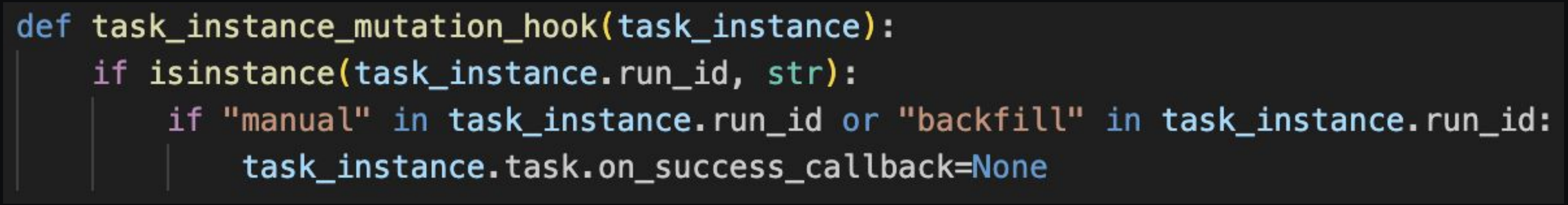
Task Instance Mutation Hook

- Applied to a task instance object
- When the TI is initialized on the scheduler
- Again after the TI has landed on a worker.
- Selectively applied to some task instances of a task.

Governance Use Cases

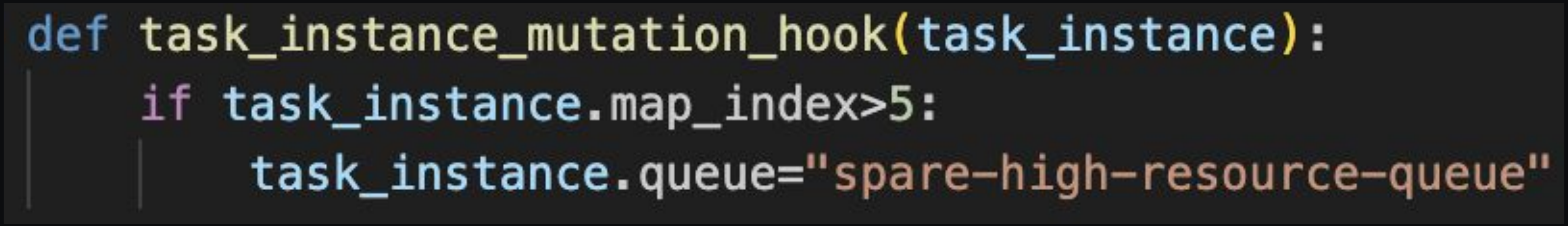
- Mutate task instances between:
    - tries
    - map indices
    - runs

Remove success callbacks for manual & backfill runs



```python
def task_instance_mutation_hook(task_instance):
    if isinstance(task_instance.run_id, str):
        if "manual" in task_instance.run_id or "backfill" in task_instance.run_id:
            task_instance.task.on_success_callback=None
```

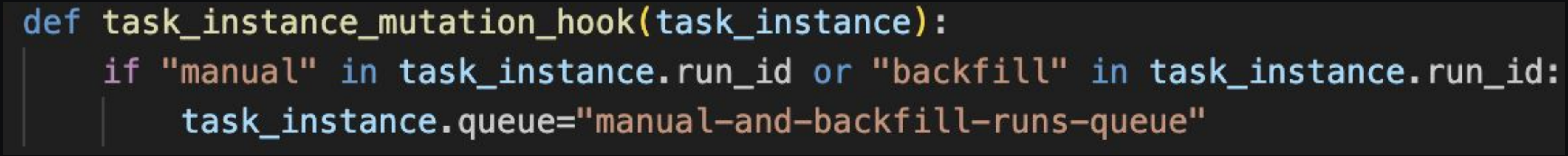
Assign map indices>5 to a separate queue



```python
def task_instance_mutation_hook(task_instance):
    if task_instance.map_index>5:
        task_instance.queue="spare-high-resource-queue"
```

This does not work!

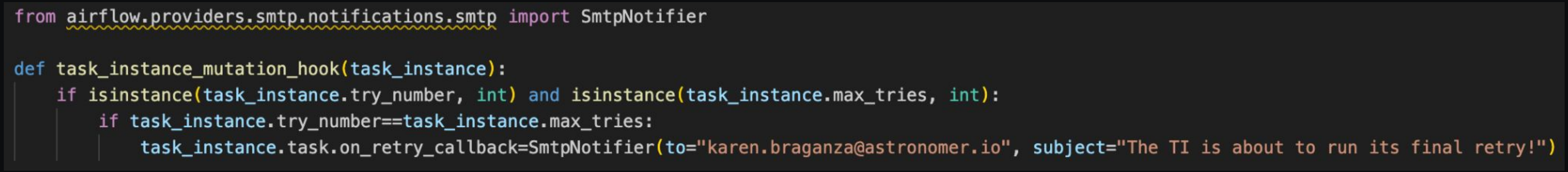
Run manual and backfill dags on a specific queue



```python
def task_instance_mutation_hook(task_instance):
    if "manual" in task_instance.run_id or "backfill" in task_instance.run_id:
        task_instance.queue="manual-and-backfill-runs-queue"
```

TypeError: argument of type 'NoneType' is not iterable

Add retry callback only before the final retry



```python
from airflow.providers.smtp.notifications.smtp import SmtpNotifier

def task_instance_mutation_hook(task_instance):
    if isinstance(task_instance.try_number, int) and isinstance(task_instance.max_tries, int):
        if task_instance.try_number==task_instance.max_tries:
            task_instance.task.on_retry_callback=SmtpNotifier(to="karen.braganza@astronomer.io", subject="The TI is about to run its final retry!")
```

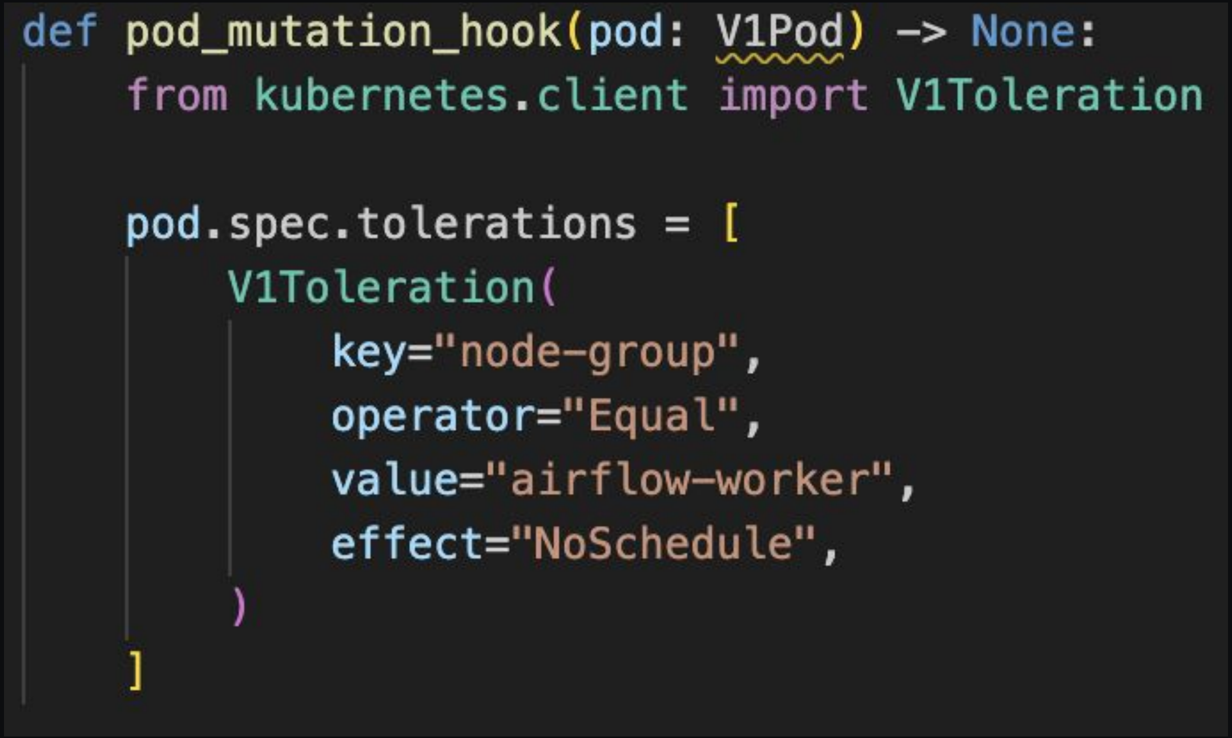
Pod Mutation Hook

- Applied to a Kubernetes pod created using the KubernetesExecutor or KubernetesPodOperator.
- Run when building the pod.
- Examine or mutate a kubernetes.client.models.V1Pod object.

Governance Use Cases

- sidecar containers
- NodeSelector
- annotations
- default pod resources.
- termination grace period

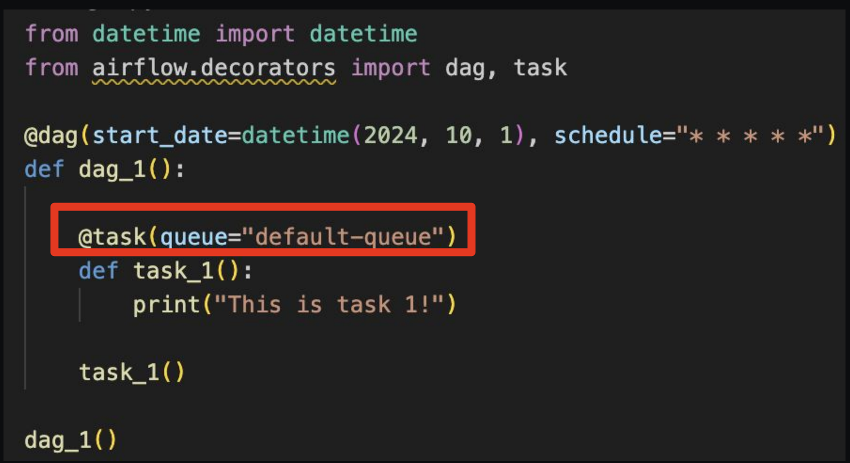
Add tolerations to KE worker pod



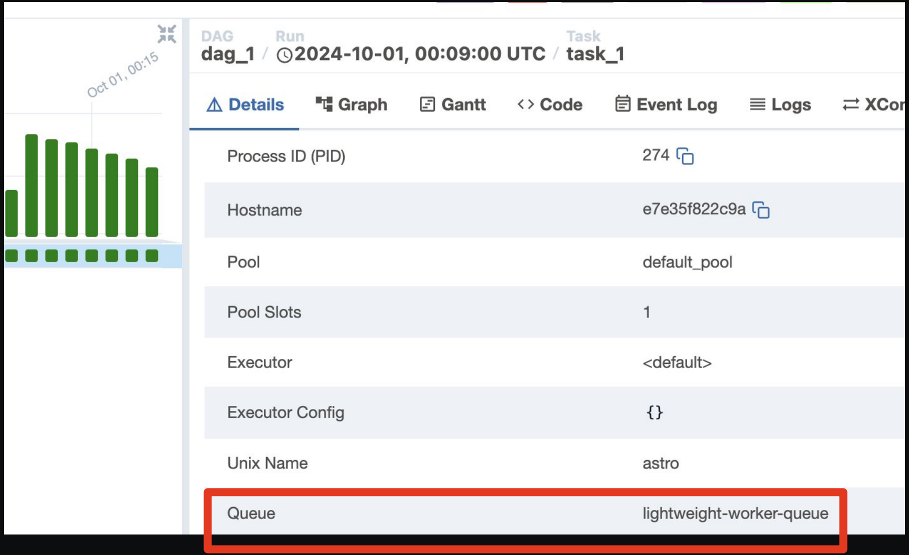
```python
def pod_mutation_hook(pod: V1Pod) -> None:
    from kubernetes.client import V1Toleration

    pod.spec.tolerations = [
        V1Toleration(
            key="node-group",
            operator="Equal",
            value="airflow-worker",
            effect="NoSchedule",
        )
    ]
```

Overall Considerations

Cluster policy mutations lack user visibility.



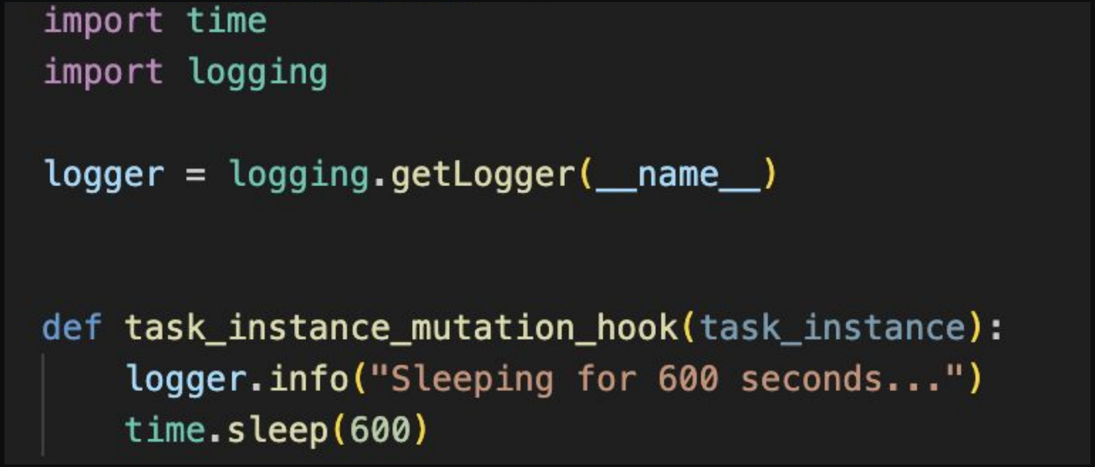
```
from datetime import datetime
from airflow.decorators import dag, task

@dag(start_date=datetime(2024, 10, 1), schedule="* * * * *")
def dag_1():

    @task(queue="default-queue")
    def task_1():
        print("This is task 1!")

    task_1()

dag_1()
```



Process ID (PID)	274
Hostname	e7e35f822c9a
Pool	default_pool
Pool Slots	1
Executor	<default>
Executor Config	{}
Unix Name	astro
Queue	lightweight-worker-queue

Overall Considerations

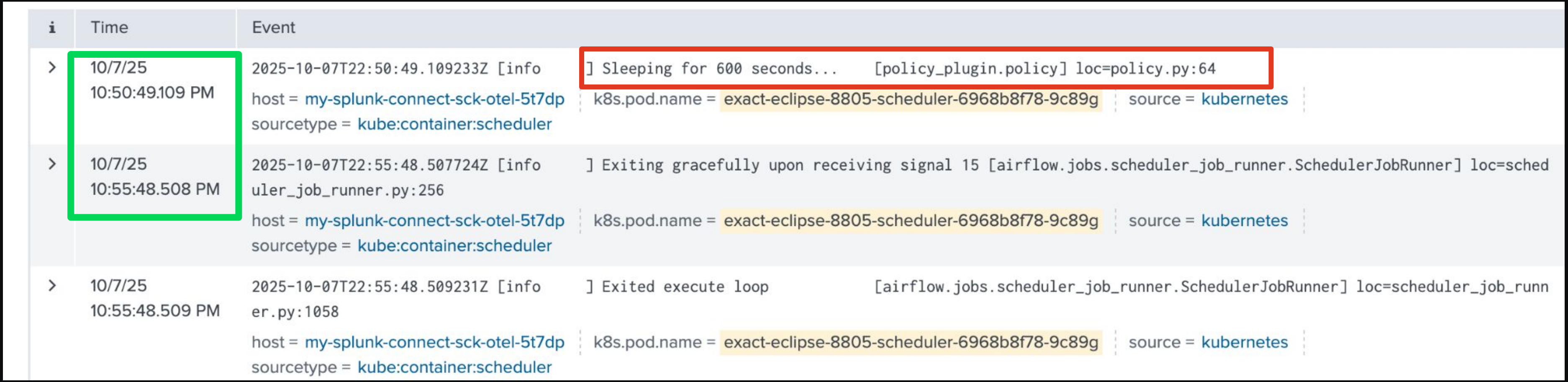
Cluster policies can impact critical Airflow components like the scheduler!



```python
import time
import logging

logger = logging.getLogger(__name__)


def task_instance_mutation_hook(task_instance):
    logger.info("Sleeping for 600 seconds...")
    time.sleep(600)
```

Overall Considerations

Cluster policies can impact critical Airflow components like the scheduler!



i	Time	Event
>	10/7/25 10:50:49.109 PM	`2025-10-07T22:50:49.109233Z [info     ] Sleeping for 600 seconds...     [policy_plugin.policy] loc=policy.py:64` host = my-splunk-connect-sck-otel-5t7dp · k8s.pod.name = exact-eclipse-8805-scheduler-6968b8f78-9c89g · source = kubernetes · sourcetype = kube:container:scheduler
>	10/7/25 10:55:48.508 PM	`2025-10-07T22:55:48.507724Z [info     ] Exiting gracefully upon receiving signal 15 [airflow.jobs.scheduler_job_runner.SchedulerJobRunner] loc=scheduler_job_runner.py:256` host = my-splunk-connect-sck-otel-5t7dp · k8s.pod.name = exact-eclipse-8805-scheduler-6968b8f78-9c89g · source = kubernetes · sourcetype = kube:container:scheduler
>	10/7/25 10:55:48.509 PM	`2025-10-07T22:55:48.509231Z [info     ] Exited execute loop            [airflow.jobs.scheduler_job_runner.SchedulerJobRunner] loc=scheduler_job_runner.py:1058` host = my-splunk-connect-sck-otel-5t7dp · k8s.pod.name = exact-eclipse-8805-scheduler-6968b8f78-9c89g · source = kubernetes · sourcetype = kube:container:scheduler

Implementation

- airflow_local_settings.py
- custom module with pluggy (using a setuptools entrypoint)

Questions?

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References

- OSS Airflow docs
- Astronomer docs
- OSS Airflow GitHub code