

# DAG Structure and Operators

Estimated time needed: 15 minutes

## Introduction

Apache Airflow is a Python framework that helps create workflows using multiple technologies using both CLI and a user-friendly WebUI. An Apache Airflow Directed Acyclic Graph (DAG) is a Python program where you define the tasks and the pipeline with the order in which the tasks will be executed.

## Objectives

After completing this reading, you'll be able to:

- Explain the structure of Directed Acyclic Graphs
- Categorize the operators that you can use with the DAGs
- Identify DAG arguments
- Describe how to create tasks for a DAG
- Explain how to define the dependencies for the tasks

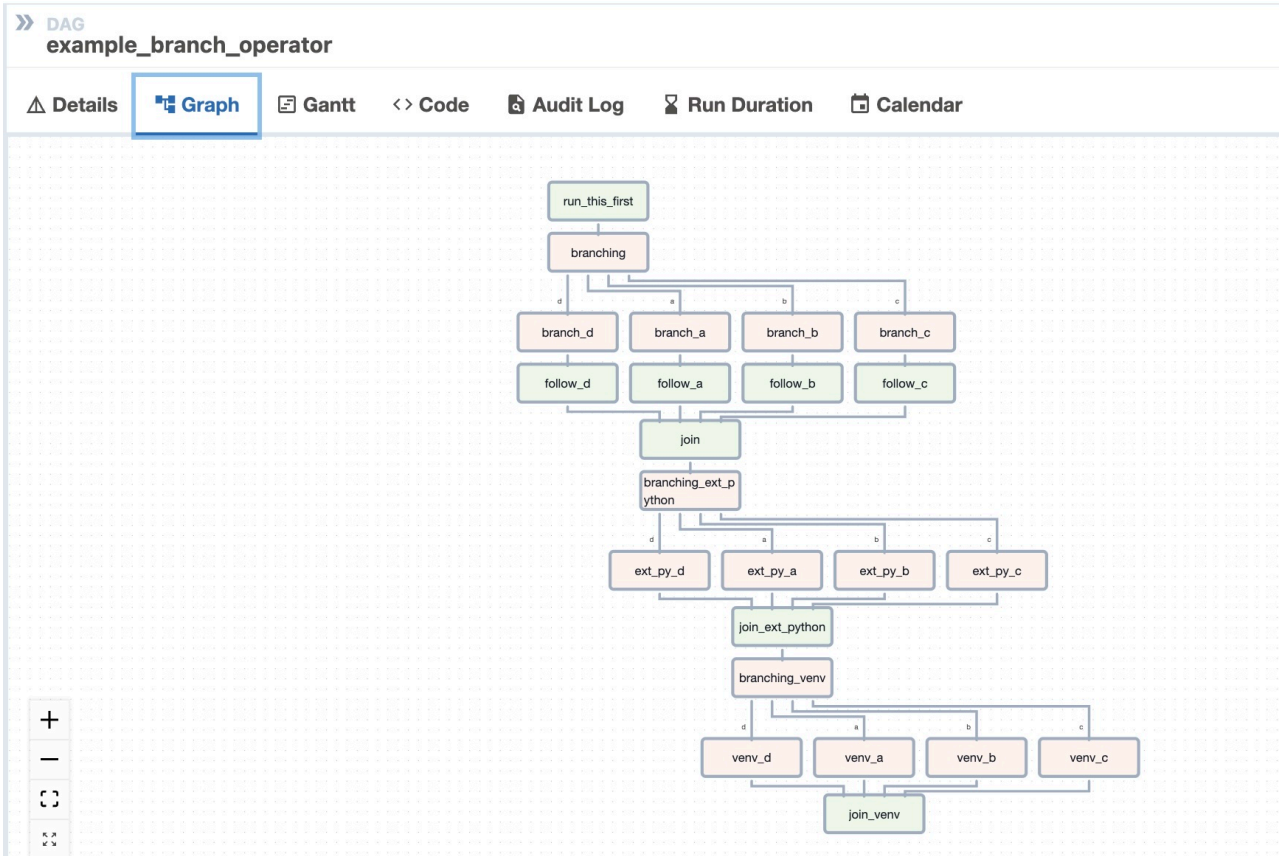
## Airflow operator for task definition

Airflow offers a wide range of operators, including many that are built into the core or are provided by pre-installed providers. Some popular core operators include:

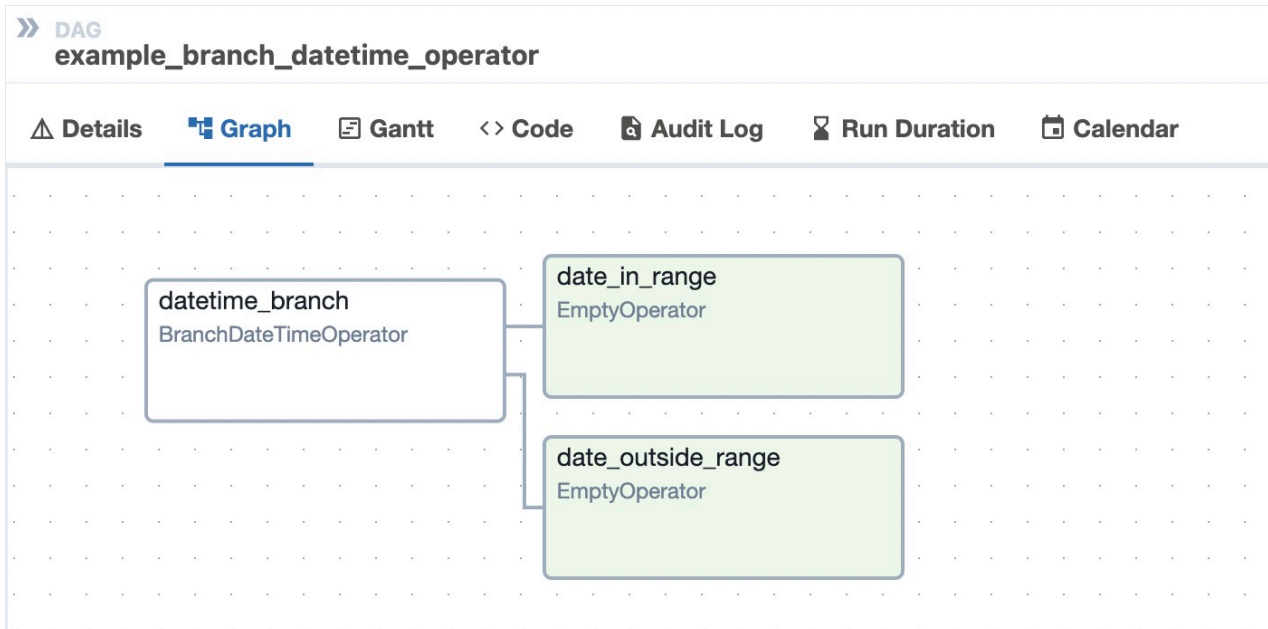
- BashOperator - executes a bash command
- PythonOperator - calls an arbitrary Python function
- EmailOperator - sends an email

The other core operators available include:

- BaseBranchOperator - A base class for creating operators with branching functionality



- BranchDateTimeOperator



- EmptyOperator - Operator that does nothing
- GenericTransfer - Moves data from one database connection to another.
- LatestOnlyOperator - Skip tasks that are not running during the most recent schedule interval.
- TriggerDagRunOperator - Triggers a DAG run for a specified dag\_id.

Besides these, there are also many community provided operators. Some of the popular and useful ones are:

- HttpOperator
- MySQLOperator
- PostgresOperator
- MsSqlOperator
- OracleOperator
- JdbcOperator
- DockerOperator
- HiveOperator
- S3FileTransformOperator
- PrestoToMySQLOperator
- SlackAPIOperator

In addition to operators, you also have sensors and decorators that allow you to combine bash and Python. You can find more information regarding the same in this [link](#).

## Anatomy of a DAG

A DAG consists of these logical blocks.

- Imports
- DAG Arguments
- DAG Definition
- Task Definitions
- Task Pipeline

### imports block example

```

# import the libraries
from datetime import timedelta
# The DAG object; we'll need this to instantiate a DAG
from airflow.models import DAG
# Operators; you need this to write tasks!
from airflow.operators.bash_operator import BashOperator
from airflow.operators.python import PythonOperator
from airflow.operators.email import EmailOperator
  
```

### DAG Arguments block example

```
#defining DAG arguments
# You can override them on a per-task basis during operator initialization
default_args = {
    'owner': 'Your name',
    'start_date': days_ago(0),
    'email': ['youemail@somemail.com'],
    'retries': 1,
    'retry_delay': timedelta(minutes=5),
}
```

DAG arguments are like the initial settings for the DAG.

The above settings mention:

- The owner name
- When this DAG should run from: `days_ago(0)` means today
- The email address where the alerts are sent to
- The number of retries in case of failure
- The time delay between retries

The other options that you can include are:

- 'queue': The name of the queue the task should be a part of
- 'pool': The pool that this task should use
- 'email\_on\_failure': Whether an email should be sent to the owner on failure
- 'email\_on\_retry': Whether an email should be sent to the owner on retry
- 'priority\_weight': Priority weight of this task against other tasks.
- 'end\_date': End date for the task
- 'wait\_for\_downstream': Boolean value indicating whether it should wait for downtime
- 'sla': Time by which the task should have succeeded. This can be a `timedelta` object
- 'execution\_timeout': Time limit for running the task. This can be a `timedelta` object
- 'on\_failure\_callback': Some function, or list of functions to call on failure
- 'on\_success\_callback': Some function, or list of functions to call on success
- 'on\_retry\_callback': Another function, or list of functions to call on retry
- 'sla\_miss\_callback': Yet another function, or list of functions when 'sla' is missed
- 'on\_skipped\_callback': Some function to call when the task is skipped
- 'trigger\_rule': Defines the rule by which the generated task gets triggered

### DAG definition block example

```
# define the DAG
dag = DAG(
    dag_id='unique_id_for_DAG',
    default_args=default_args,
    description='A simple description of what the DAG does',
    schedule_interval=timedelta(days=1),
)
```

Here you are creating a variable named `dag` by instantiating the DAG class with the following parameters:

`unique_id_for_DAG` is the ID of the DAG. This is what you see on the web console. This is what you can use to trigger the DAG using a `TriggerDagRunOperator`.

You are passing the dictionary `default_args`, in which all the defaults are defined.

`description` helps us in understanding what this DAG does.

`schedule_interval` tells us how frequently this DAG runs. In this case every day. (`days=1`).

### task definitions block example

The tasks can be defined using any of the operators that have been imported.

```
# define the tasks
# define a task with BashOperator
task1 = BashOperator(
```

```

        task_id='unique_task_id',
        bash_command='<some bashcommand>',
        dag=dag,
    )
    # define a task with PythonOperator
    task2 = PythonOperator(
        task_id='bash_task',
        python_callable=<the python function to be called>,
        dag=dag,
    )
    # define a task with EmailOperator
    task3 = EmailOperator(
        task_id='mail_task',
        to='recipient@example.com',
        subject='Airflow Email Operator example',
        html_content='<p>This is a test email sent from Airflow.</p>',
        dag=dag,
    )

```

A task is defined using:

- A task\_id which is a string that helps in identifying the task
- The dag this task belongs to
- The actual task to be performed
  - The bash command it represents in case of BashOperator
  - The Python callable function in case of a PythonOperator
  - Details of the sender, subject of the mail and the mail text as HTML in case of EmailOperator

#### task pipeline block example

```

# task pipeline
task1 >> task2 >> task3

```

You can also use upstream and downstream to define the pipeline. For example:

```

task1.set_downstream(task2)
task3.set_upstream(task2)

```

Task pipeline helps us to organize the order of tasks. In the example, the task task1 must run first, followed by task2, followed by the task task3.

#### Author(s)

[Lavanya T S](#)



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