

# Airflow operators

INTRODUCTION TO AIRFLOW IN PYTHON



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# Operators

- Represent a single task in a workflow.
- Run independently (usually).
- Generally do not share information.
- Various operators to perform different tasks.

```
# New way, Airflow 2.x+  
EmptyOperator(task_id='example')  
  
# Old way, Airflow <2.0  
EmptyOperator(task_id='example', dag=dag_name)
```

# BashOperator

```
BashOperator(  
    task_id='bash_example',  
    bash_command='echo "Example!"',  
    # Next line only for Airflow before v2.0.0  
    dag=dag  
)
```

```
BashOperator(  
    task_id='bash_script_example',  
    bash_command='runcleanup.sh',  
)
```

- Executes a given Bash command or script.
- Runs the command in a temporary directory.
- Can specify environment variables for the command.

# BashOperator examples

```
from airflow.operators.bash import BashOperator
example_task = BashOperator(task_id='bash_ex',
                             bash_command='echo 1',
                             )
```

```
bash_task = BashOperator(task_id='clean_addresses',
                           bash_command='cat addresses.txt | awk "NF==10" > cleaned.txt',
                           )
```

# Operator gotchas

- Not guaranteed to run in the same location / environment.
- May require extensive use of Environment variables.
- Can be difficult to run tasks with elevated privileges.

# Let's practice!

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# Airflow tasks

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# Tasks

*Tasks* are:

- Instances of operators
- Usually assigned to a variable in Python

```
example_task = BashOperator(task_id='bash_example',  
                             bash_command='echo "Example!"')
```

- Referred to by the task\_id within the Airflow tools



# Task dependencies

- Define a given order of task completion
- Are not required for a given workflow, but usually present in most
- Are referred to as *upstream* or *downstream* tasks
- In Airflow 1.8 and later, are defined using the *bitshift* operators
  - `>>`, or the upstream operator
  - `<<`, or the downstream operator

# Upstream vs Downstream

*Upstream* means **before**

*Downstream* means **after**


# Simple task dependency

```
# Define the tasks
task1 = BashOperator(task_id='first_task',
                      bash_command='echo 1'
                      )

task2 = BashOperator(task_id='second_task',
                      bash_command='echo 2'
                      )

# Set first_task to run before second_task
task1 >> task2    # or task2 << task1
```

# Task dependencies in the Airflow UI

 Airflow

DAGsCluster ActivityDatasetsSecurity▼Browse▼Admin▼Docs▼01:41 UTC → Log In

☐ DAG: simple\_dependency

Schedule: 1 day, 0:00:00Next Run: 2024-01-10, 00:00:00

Grid

Graph

Calendar

Task Duration

Task Tries

Landing Times

Gantt

Details

Code

Audit Log

01/30/2024, 01:41:01 AM

25

All Run Types

All Run States

Clear Filters

Auto-refresh

Press **shift** + **/** for Shortcuts

deferred

failed

queued

removed

restarting

running

scheduled

shutdown

skipped

success

up\_for\_reschedule

up\_for\_retry

upstream\_failed

no\_status

« » DAG simple\_dependency

Details

Graph

Gantt

Code

first\_task

BashOperator

second\_task

BashOperator


Layout:

Top -> Bottom

first\_task

second\_task

# Task dependencies in the Airflow UI

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DAGsCluster ActivityDatasetsSecurity▼Browse▼Admin▼Docs▼01:41 UTC → Log In

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upstream\_failed

no\_status

« » DAG simple\_dependency

Details

Graph

Gantt

Code

first\_task  
BashOperator


second\_task  
BashOperator

Layout:  
Top -> Bottom

first\_task

second\_task

# Task dependencies in the Airflow UI

 Airflow

DAGsCluster ActivityDatasetsSecurity▼Browse▼Admin▼Docs▼01:43 UTC → Log In

☐ DAG: simple\_dependency

Schedule: 1 day, 0:00:00Next Run: 2024-01-10, 00:00:00

Grid

Graph

Calendar

Task Duration

Task Tries

Landing Times

Gantt

Details

Code

Audit Log

▶

🗑

01/30/2024, 01:42:44 AM 📅

25 ▼

All Run Types ▼

All Run States ▼

Clear Filters

Auto-refresh ☐

Press **shift** + **/** for Shortcuts

deferredfailedqueuedremovedrestartingrunningscheduledshutdownskippedsuccessup\_for\_rescheduleup\_for\_retryupstream\_failedno\_status

« » DAG simple\_dependency

DetailsGraphGanttCode

first\_task  
BashOperator

second\_task  
BashOperator

Layout:  
Left -> Right ▼

first\_task

second\_task

# Multiple dependencies

Chained dependencies:

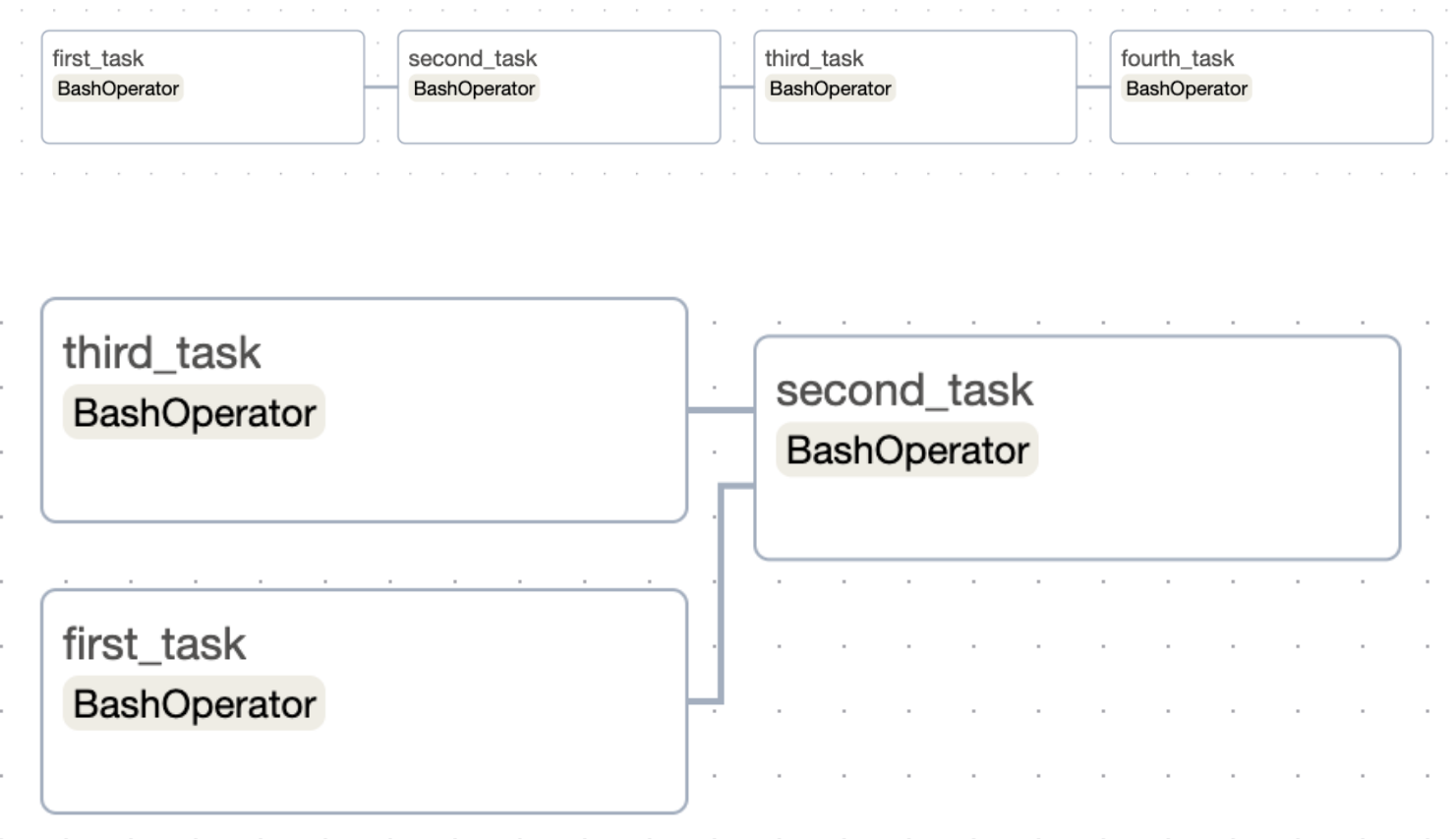
```
task1 >> task2 >> task3 >> task4
```

Mixed dependencies:

```
task1 >> task2 << task3
```

or:

```
task1 >> task2  
task3 >> task2
```



# Let's practice!

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# Additional operators

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# PythonOperator

- Executes a Python function / callable
- Operates similarly to the BashOperator, with more options
- Can pass in arguments to the Python code

```
from airflow.operators.python import PythonOperator
def printme():
    print("This goes in the logs!")
python_task = PythonOperator(
    task_id='simple_print',
    python_callable=printme
)
```

# Arguments

- Supports arguments to tasks
  - Positional
  - Keyword
- Use the `op_kwargs` dictionary

# op\_kwargs example

```
def sleep(length_of_time):  
    time.sleep(length_of_time)  
  
sleep_task = PythonOperator(  
    task_id='sleep',  
    python_callable=sleep,  
    op_kwargs={'length_of_time': 5}  
)
```

# EmailOperator

- Found in the `airflow.operators` library
- Sends an email
- Can contain typical components
  - HTML content
  - Attachments
- Does require the Airflow system to be configured with email server details

# EmailOperator example

```
from airflow.operators.email import EmailOperator

email_task = EmailOperator(
    task_id='email_sales_report',
    to='sales_manager@example.com',
    subject='Automated Sales Report',
    html_content='Attached is the latest sales report',
    files='latest_sales.xlsx'
)
```

# Let's practice!

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# Airflow scheduling

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# DAG Runs

- A specific instance of a workflow at a point in time
- Can be run manually or via `schedule_interval`
- Maintain state for each workflow and the tasks within
  - `running`
  - `failed`
  - `success`

<sup>1</sup> <https://airflow.apache.org/docs/stable/scheduler.html>

# DAG Runs view

 Airflow

DAGs

Cluster Activity

Datasets

Security

Browse

Admin

Docs

04:39 UTC







→ Log In

List Dag Run


Search

Actions

Record Count: 5

	State	Dag Id	Logical Date	Run Id	Queued At	Start Date
<input type="checkbox"/>	  <span>running</span>	example_dag	2024-01-12, 00:00:00	scheduled__2024-01-12T00:00:00+00:00	scheduled	2024-01-29, 04:38:41
<input type="checkbox"/>	  <span>success</span>	example_dag	2024-01-11, 00:00:00	scheduled__2024-01-11T00:00:00+00:00	scheduled	2024-01-29, 04:38:30
<input type="checkbox"/>	  <span>failed</span>	update_state	2024-01-11, 00:00:00	scheduled__2024-01-11T00:00:00+00:00	scheduled	2024-01-29, 04:38:36

# DAG Runs state

 Airflow

DAGs

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04:39 UTC

→ Log In

List Dag Run

Search

Actions

Record Count: 5

	State	Dag Id	Logical Date	Run Id	Run Type	Queued At	Start Date
<input type="checkbox"/>	running	example_dag	2024-01-12, 00:00:00	scheduled__2024-01-12T00:00:00+00:00	scheduled	2024-01-29, 04:38:41	2024-01-29, 04:38:41
<input type="checkbox"/>	success	example_dag	2024-01-11, 00:00:00	scheduled__2024-01-11T00:00:00+00:00	scheduled	2024-01-29, 04:38:30	2024-01-29, 04:38:30
<input type="checkbox"/>	failed	update_state	2024-01-11, 00:00:00	scheduled__2024-01-11T00:00:00+00:00	scheduled	2024-01-29, 04:38:36	2024-01-29, 04:38:36

# Schedule details

When scheduling a DAG, there are several attributes of note:

- `start_date` - The date / time to initially schedule the DAG run
- `end_date` - Optional attribute for when to stop running new DAG instances
- `max_tries` - Optional attribute for how many attempts to make
- `schedule_interval` - How often to run

# Schedule interval

`schedule_interval` represents:

- How often to schedule the DAG
- Between the `start_date` and `end_date`
- Can be defined via `cron` style syntax or via built-in presets.

# cron syntax

```
# |----- minute (0 - 59)
# | |----- hour (0 - 23)
# | | |----- day of the month (1 - 31)
# | | | |----- month (1 - 12)
# | | | | |----- day of the week (0 - 6) (Sunday to Saturday;
# | | | | | 7 is also Sunday on some systems)
# | | | | |
# | | | | |
# * * * * * command to execute
```

- Is pulled from the Unix cron format
- Consists of 5 fields separated by a space
- An asterisk `*` represents running for every interval (ie, every minute, every day, etc)
- Can be comma separated values in fields for a list of values

# cron examples

```
0 12 * * *          # Run daily at noon
```

```
* * 25 2 *          # Run once per minute on February 25
```

```
0,15,30,45 * * * *  # Run every 15 minutes
```

# Airflow scheduler presets

Preset:

- @hourly
- @daily
- @weekly
- @monthly
- @yearly

cron equivalent:

- 0 \* \* \* \*
- 0 0 \* \* \*
- 0 0 \* \* 0
- 0 0 1 \* \*
- 0 0 1 1 \*

<sup>1</sup> <https://airflow.apache.org/docs/stable/scheduler.html>



# Special presets

Airflow has two special `schedule_interval` presets:

- `None` - Don't schedule ever, used for manually triggered DAGs
- `@once` - Schedule only once

# schedule\_interval issues

When scheduling a DAG, Airflow will:

- Use the `start_date` as the earliest possible value
- Schedule the task at `start_date` + `schedule_interval`

```
'start_date': datetime(2020, 2, 25),  
'schedule_interval': @daily
```

This means the earliest starting time to run the DAG is on February 26th, 2020

# Let's practice!

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