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.

```
DummyOperator(task_id='example', dag=dag)
```

BashOperator

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

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

- 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_operator import BashOperator
example_task = BashOperator(task_id='bash_ex',
                            bash_command='echo 1',
                            dag=dag)
```

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

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!"',
                            dag=dag)
```

- 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

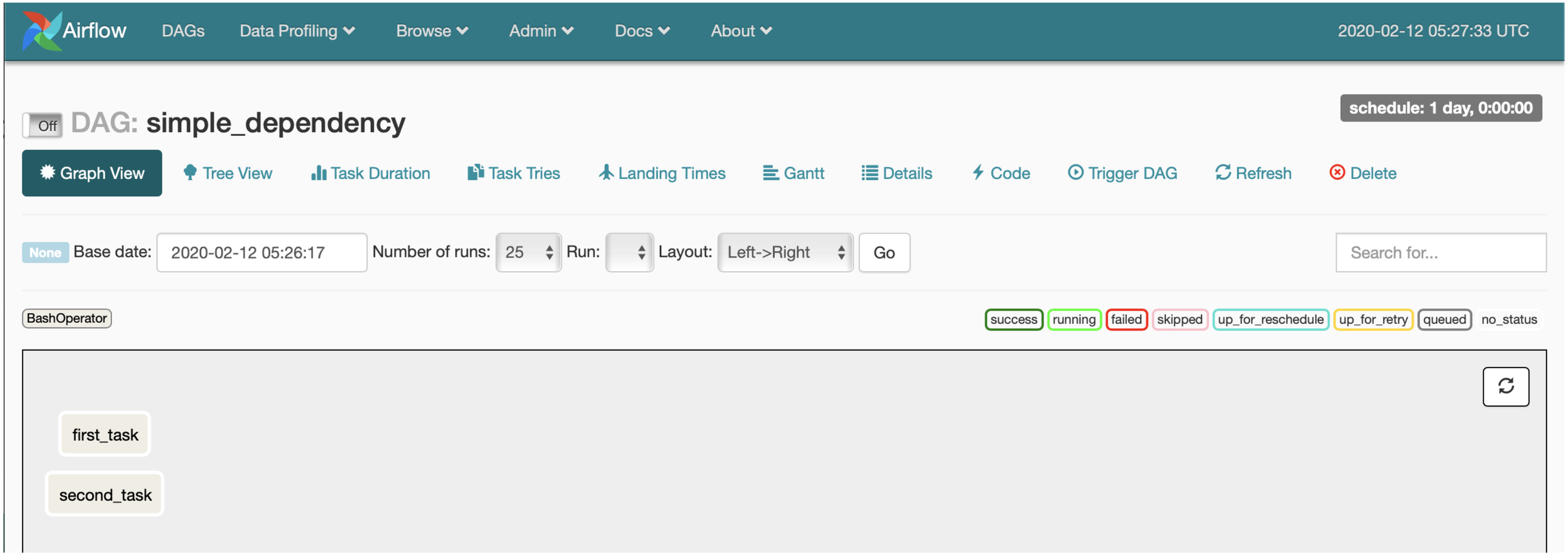
Upstream means **before**

Downstream means **after**

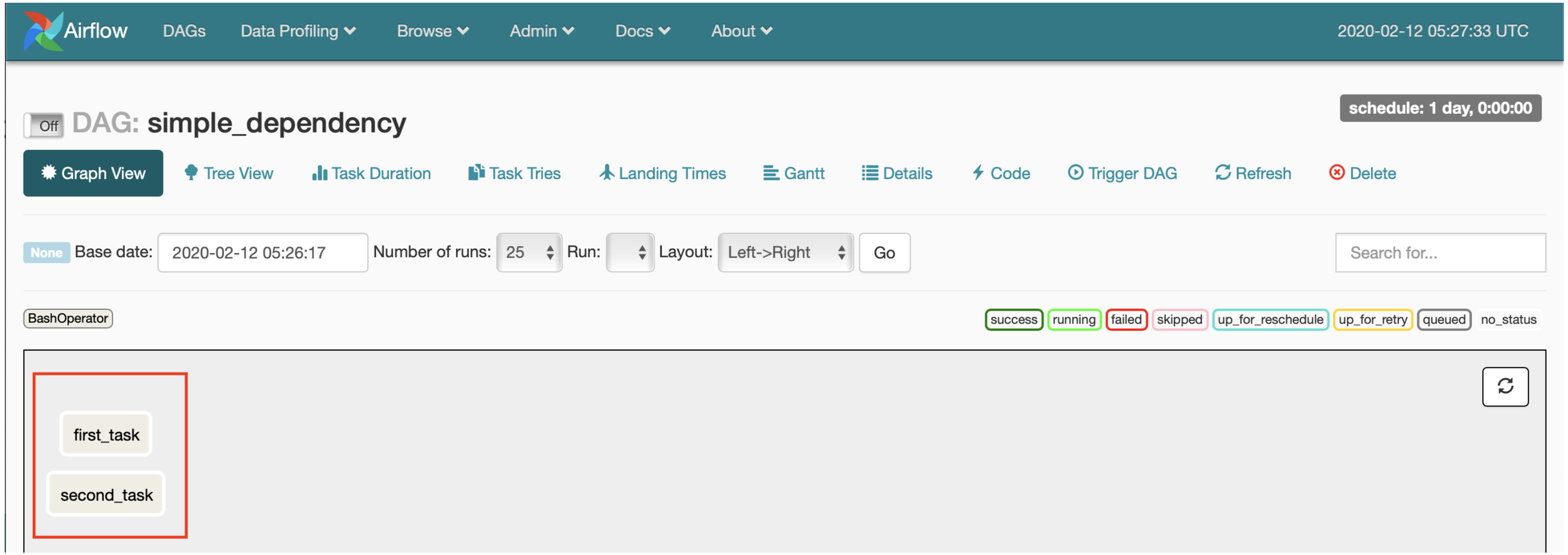
Simple task dependency

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

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

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

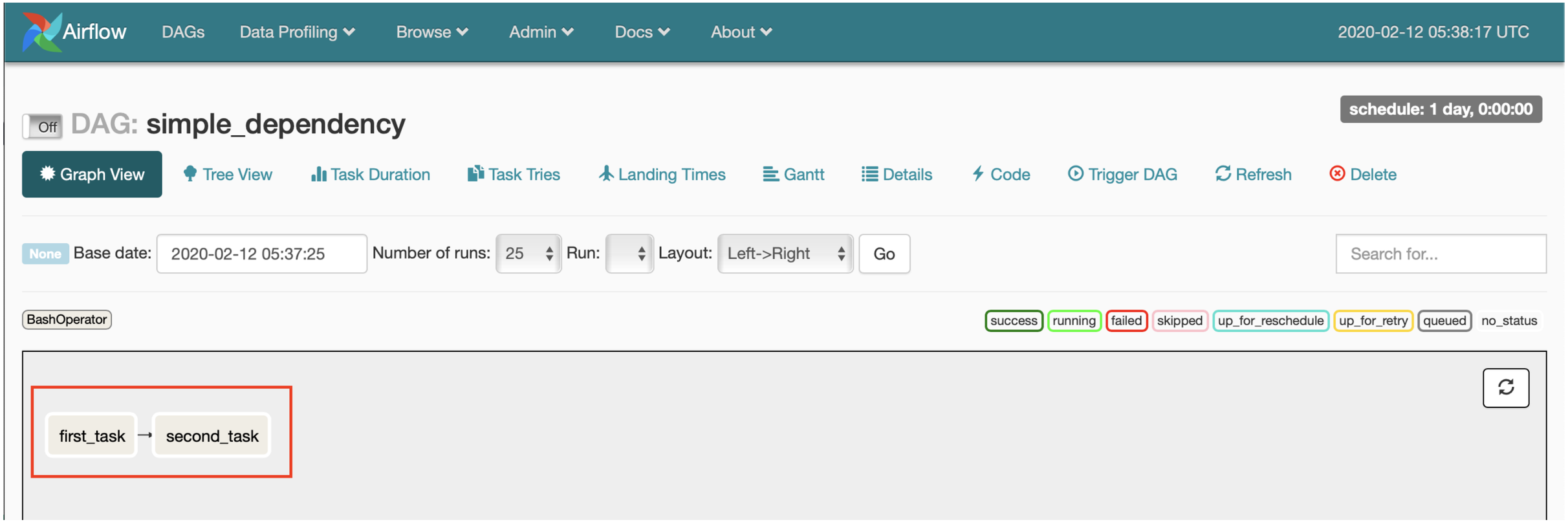
Task dependencies in the Airflow UI



Task dependencies in the Airflow UI



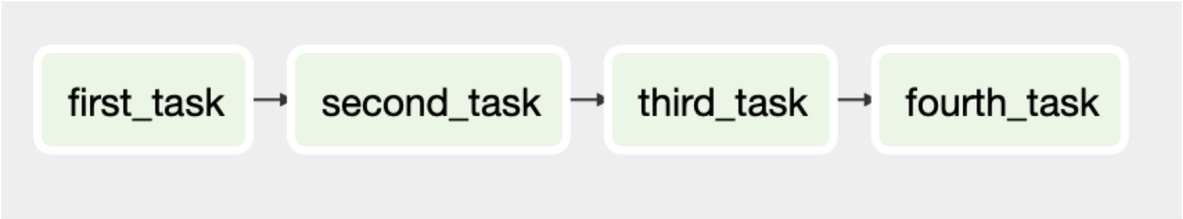
Task dependencies in the Airflow UI



Multiple dependencies

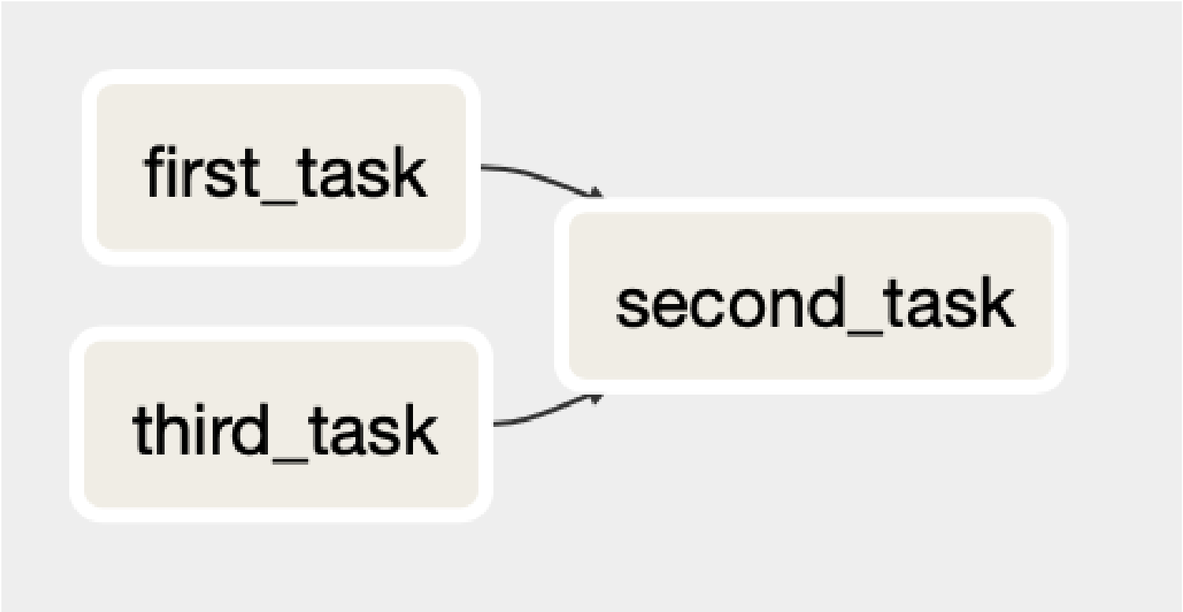
Chained dependencies:

```
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_operator import PythonOperator
def printme():
    print("This goes in the logs!")
python_task = PythonOperator(
    task_id='simple_print',
    python_callable=printme,
    dag=example_dag
)
```

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}
    dag=example_dag
)
```

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_operator 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',
    dag=example_dag
)
```

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`

[1] https://airflow.apache.org/docs/stable/scheduler.html

DAG Runs view

Airflow | DAGs | Data Profiling | Browse | Admin | Docs | About | 2020-02-26 14:31:13 UTC

Dag Runs

List (12) | Create | Add Filter | With selected | Search: dag_id, state, run_id

	State	Dag Id	Execution Date	Run Id	External Trigger
	failed	simple_python_operator	02-25T06:39:50.248084+00:00	manual__2020-02-25T06:39:50.248084+00:00	
	success	simple_python_operator	02-25T06:08:08.823092+00:00	manual__2020-02-25T06:08:08.823092+00:00	
	failed	simple_python_operator	02-25T06:02:54.809486+00:00	manual__2020-02-25T06:02:54.809486+00:00	
	success	simple_python_operator	02-25T05:42:19.997484+00:00	manual__2020-02-25T05:42:19.997484+00:00	
	failed	simple_python_operator	02-25T05:39:23.812012+00:00	manual__2020-02-25T05:39:23.812012+00:00	
	success	simple_python_operator	02-25T05:29:00.355729+00:00	manual__2020-02-25T05:29:00.355729+00:00	
	success	simple_python_operator	02-25T05:25:40.655538+00:00	manual__2020-02-25T05:25:40.655538+00:00	
	success	simple_python_operator	02-25T05:21:10.765962+00:00	manual__2020-02-25T05:21:10.765962+00:00	

DAG Runs state

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Dag Runs

List (12) | Create | Add Filter | With selected | Search: dag_id, state, run_id

		State	Dag Id	Execution Date	Run Id	External Trigger
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		failed	simple_python_operator	02-25T06:02:54.809486+00:00	manual__2020-02-25T06:02:54.809486+00:00	
		success	simple_python_operator	02-25T05:42:19.997484+00:00	manual__2020-02-25T05:42:19.997484+00:00	
		failed	simple_python_operator	02-25T05:39:23.812012+00:00	manual__2020-02-25T05:39:23.812012+00:00	
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		success	simple_python_operator	02-25T05:25:40.655538+00:00	manual__2020-02-25T05:25:40.655538+00:00	
		success	simple_python_operator	02-25T05:21:10.765962+00:00	manual__2020-02-25T05:21:10.765962+00:00	

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:	cron equivalent:
@hourly	`0 * * * *`
@daily	`0 0 * * *`
@weekly	`0 0 * * 0`
@monthly	`0 0 1 * *`
@yearly	`0 0 1 1 *`

[1] 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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