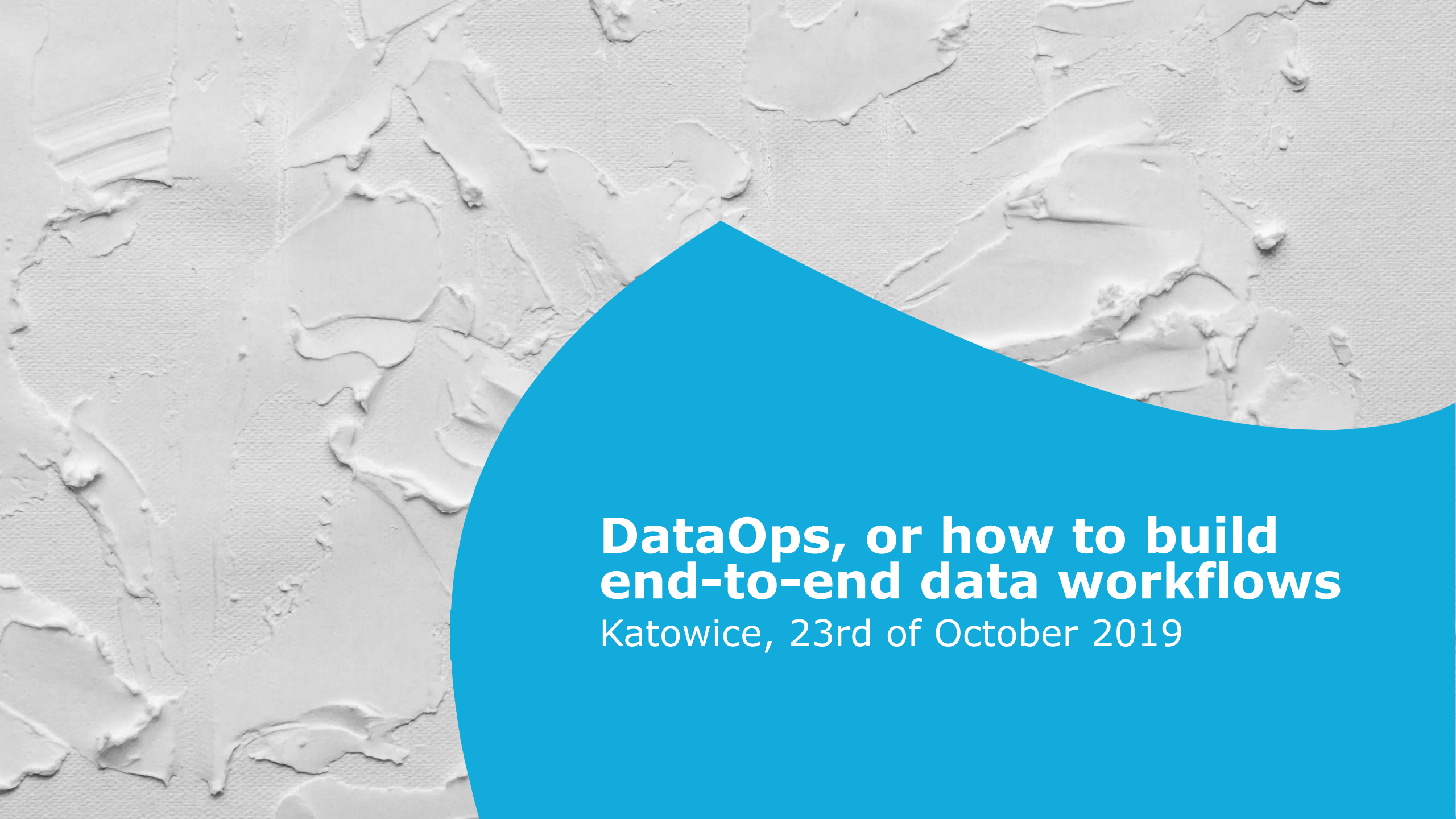


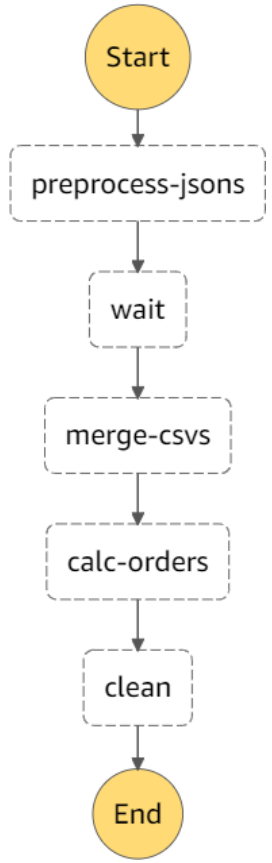
DataOps, or how to build end-to-end data workflows

Katowice, 23rd of October 2019

Relationships

Expectation

Reality



DataOps

DataOps

DevOps improves quality, velocity and scaling of software development.

Borrowing methods from DevOps, **DataOps** offers the same improvements to production Data Science.

Best practices

12 Best Practices

- Alerting
- CI/CD
- Code review
- Integration testing
- Logging
- Metrics collection
- Monitoring
- Quality validation
- Reproducibility
- Scheduling
- Test regressions
- Unit testing

Project Jupyter exists to develop open-source software, open-standards, and services for interactive computing across dozens of programming languages.

12 Best Practices

- Alerting
- CI/CD
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MVP

MVP

- Alerting
- **CI/CD**
- Code review
- Integration testing
- Logging
- Metrics collection
- Monitoring
- **Quality validation**
- **Reproducibility**
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- Unit testing

How to start

How to start

- Share data science code to private git repository.
- Use versioning of data science code. Use requirements.txt and add version to scripts.
- Add owner to scripts.
- Write readable Markdown documentation.
- Verify code quality with unittest, flake8, and regular code reviews. Automate tests.

Workflow manager

Scripts with Cron

- No reproducibility.
- No logs, no monitoring, no alerts.
- Code and logic duplication.
- Maintenance time grows exponentially.

Workflow managers

- Pinball 04-03-2015
- Airflow 06-10-2014
- Mistral 11-10-2013
- Azkaban 03-05-2012
- Luigi 17-11-2011
- Oozie 19-08-2011

Workflow managers

- Pinball 04-03-2015 (Pinterest)
- **Airflow** 06-10-2014 (Airbnb -> Apache)
- Mistral 11-10-2013 (OpenStack)
- Azkaban 03-05-2012 (LinkedIn)
- **Luigi** 17-11-2011 (Spotify)
- Oozie 19-08-2011 (Yahoo -> Apache)

Airflow

Airflow. Import

```
import datetime

from airflow import DAG
from airflow.operators.bash_operator import BashOperator
from airflow.operators.python_operator import PythonOperator
```

Airflow. Task #2

```
def task2():
    print('task2')
```

Airflow. Default

```
default_args = {
    'owner': 'Ruslan Korniichuk',
    'start_date': datetime.datetime(2019, 10, 22)
}
```

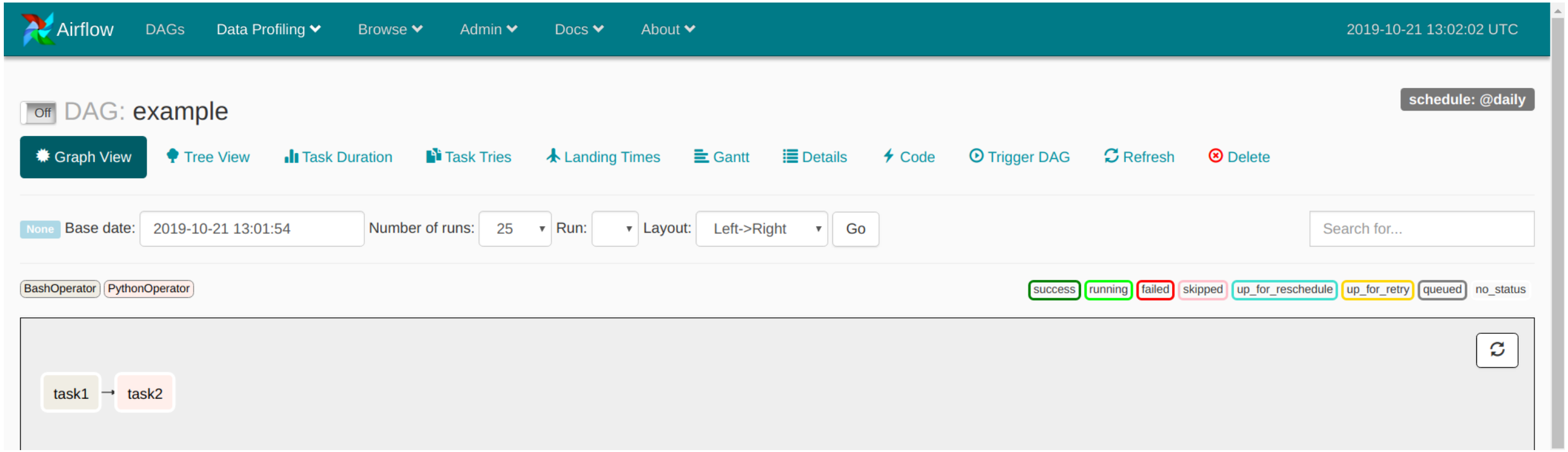
Airflow. DAG

```
with DAG('example',
         default_args=default_args,
         schedule_interval='@daily') as dag:

    task1 = BashOperator(task_id='task1',
                         bash_command='echo task1')
    task2 = PythonOperator(task_id='task2',
                           python_callable=task2)
```

DAG

DAG - or a Directed Acyclic Graph - is a is a collection of all the tasks you want to run, organized in a way that reflects their relationships.



Airflow. DAG

```
with DAG('example',
         default_args=default_args,
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    task1 = BashOperator(task_id='task1',
                         bash_command='echo task1')
    task2 = PythonOperator(task_id='task2',
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```

Airflow. Relationships

```
task1 >> task2
```

Airflow. All-in-one

```python
import datetime

from airflow import DAG
from airflow.operators.bash_operator import BashOperator
from airflow.operators.python_operator import PythonOperator


def task2():
    print('task2')


default_args = {
    'owner': 'Ruslan Korniichuk',
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with DAG('example',
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    task1 = BashOperator(task_id='task1', bash_command='echo task1')
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task1 >> task2
```
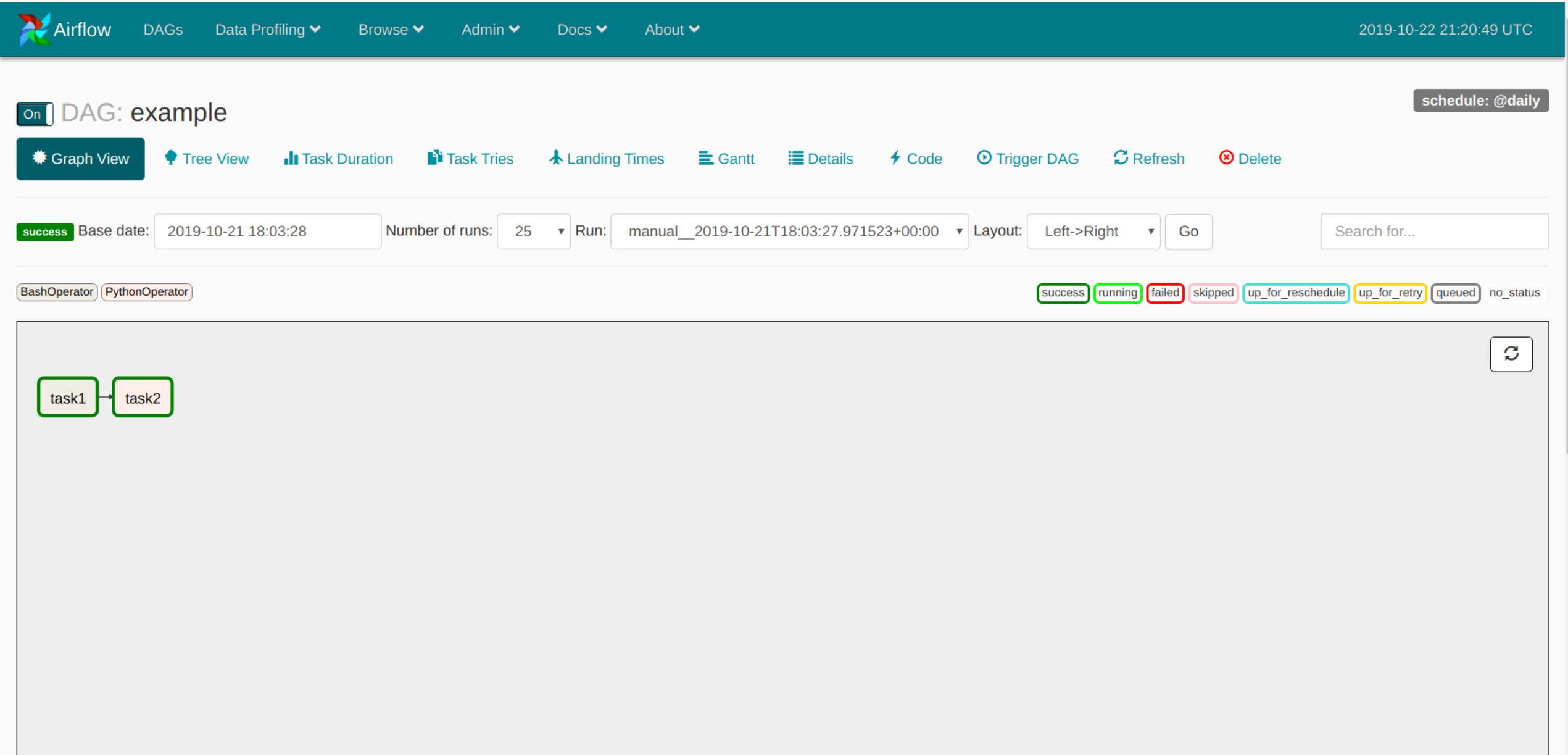

Airflow. Graph view



Luigi

Luigi. Import

```
import luigi
from luigi.contrib.external_program import ExternalProgramTask
```

Luigi. Tasks

```python
class Task1(ExternalProgramTask):

    dst = 'task1'

    def program_args(self):
        return ['touch', self.dst]

    def output(self):
        return luigi.LocalTarget(self.dst)
```

```python
class Task2(luigi.Task):

    def requires(self):
        return Task1()

    def run(self):
        dst = self.input().path
        with open(dst, 'a') as f:
            f.write('task2')
```

Luigi. All-in-one

```
import luigi
from luigi.contrib.external_program import ExternalProgramTask


class Task1(ExternalProgramTask):

    dst = 'task1'

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    def run(self):
        dst = self.input().path
        with open(dst, 'a') as f:
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```
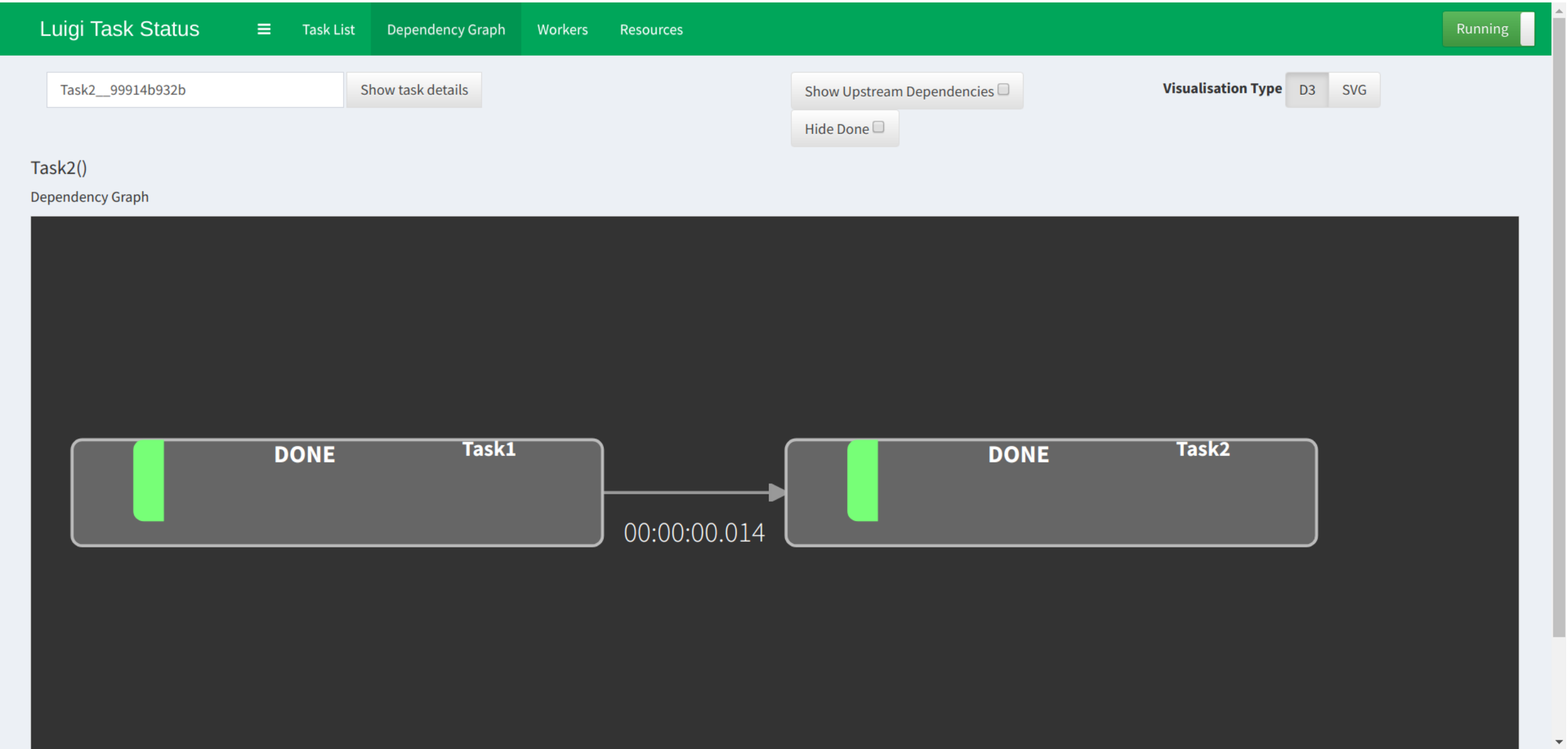

Luigi. Execution

```
...


if __name__ == '__main__':
    luigi.run()
```

Luigi. Graph view



Airflow vs Luigi

Airflow vs Luigi

Airflow

pros
- everything in Python (no XML)
- DAGs catalog
- annoying scheduler
- readable DAG concept
- built-in features (e.g. BashOperator)
- readable relationships
- DAG's owner
- open-source

cons
- delay between task execution
- cannot test/run task and all its relationships
- hard maintenance
- cross-communication via XCom

example

Luigi

pros
- everything in Python (no XML)
- rapid prototyping
- cross-communication
- built-in Target
- built-in features (e.g. ExternalProgramTask)
- easy-to-start
- open-source

cons
- no DAG concept and DAGs catalog
- no scheduling
- maintenance

example

Airflow vs Luigi

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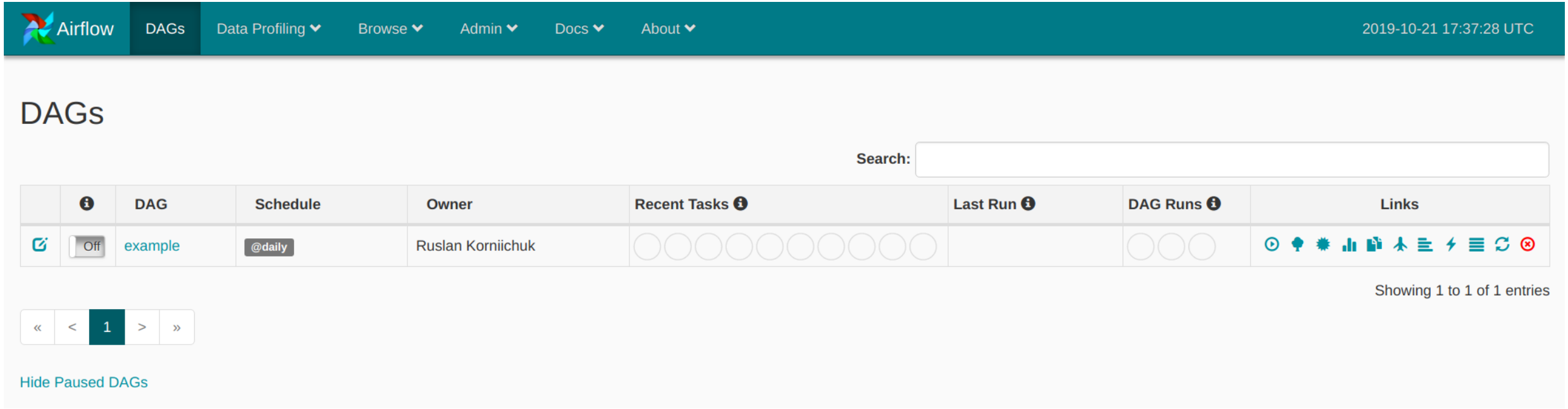
example

Airflow. DAGs catalog



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example

Airflow. Relationships

```
task1.set_downstream(task2)
```

or

```
task2.set_upstream(task1)
```

Airflow. Relationships

```
task1.set_downstream(task2)
```

or

```
task2.set_upstream(task1)
```

or

```
dag.set_dependency('task1', 'task2')
```

Airflow. Relationships

```
task1.set_downstream(task2)
```

or

```
task2.set_upstream(task1)
```

or

```
dag.set_dependency('task1', 'task2')
```

or

```
task1 >> task2
```

Luigi. Relationships

The `requires()` method is used to specify dependencies on other `Task` object:

```
def requires(self):
    return Task1()
```

Luigi. Relationships

The `requires()` method is used to specify dependencies on other `Task` object:

```
def requires(self):
    return Task1()
```

We can add Airflow-like relationships readability:

```
# Task1 >> Task2
```

Airflow vs Luigi

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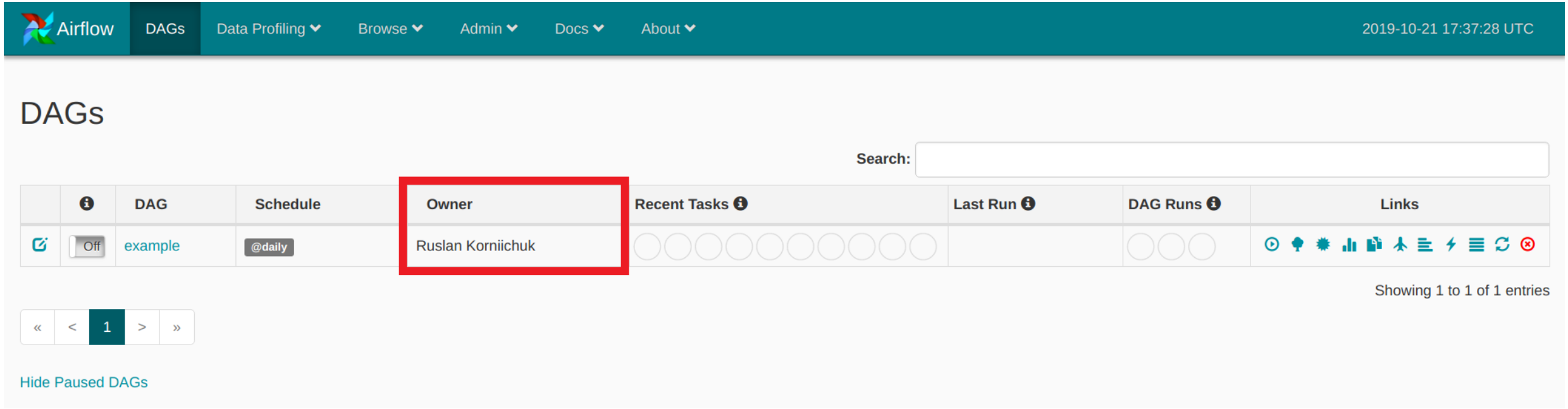
example

Airflow. DAG's owner



Ownership

Airflow

```
default_args = {
    'owner': 'Ruslan Korniichuk'
}
```

Luigi

We can add Airflow-like ownership:

```
    # Owner: Ruslan Korniichuk
```

Airflow vs Luigi

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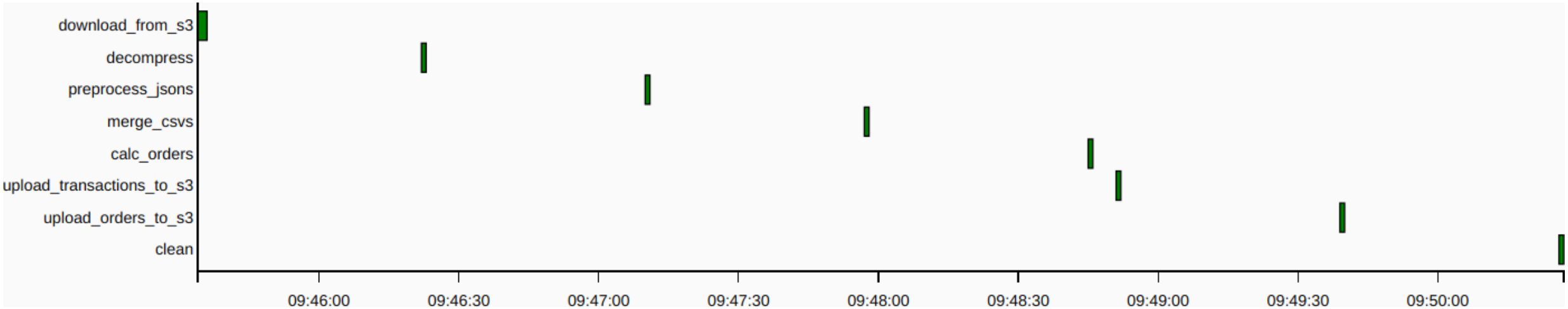
Airflow. Delay between task execution



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example

Airflow. XCom

XCom lets tasks exchange messages, allowing more nuanced forms of control and shared state. The name is an abbreviation of "cross-communication".

XCom can be "pushed" (sent) or "pulled" (received). When a task pushes an XCom, it makes it generally available to other tasks.

Airflow. Cross-communication

```
def task1():
    return 'task1'

def task2(**context):
    text = context['ti'].xcom_pull(task_ids='task1')
    with open('task2', 'w') as f:
        f.write(text)
...
    task1 = PythonOperator(task_id='task1', python_callable=task1)
    task2 = PythonOperator(task_id='task2', python_callable=task2,
                           provide_context=True)
...
```

Luigi. Cross-communication

```python
class Task1(ExternalProgramTask):

    dst = 'task1'

    def program_args(self):
        return ['touch', self.dst]

    def output(self):
        return luigi.LocalTarget(self.dst)
```

```python
class Task2(luigi.Task):

    def requires(self):
        return Task1()

    def run(self):
        dst = self.input().path
        with open(dst, 'a') as f:
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```

Airflow vs Luigi

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example

Luigi. Target

The `output()` method returns one or more `Target` objects.:

```
def output(self):
    return luigi.LocalTarget('file.txt')
```

Luigi. Target

The `output()` method returns one or more `Target` objects.:

```
    def output(self):
        return luigi.LocalTarget('file.txt')
```

or

```
    def output(self):
        return S3Target('s3://bucket/file.txt')
```

Airflow. Luigi-like Target

```
os.path.exists('file.txt')
```

Airflow. Luigi-like Target

```
os.path.exists('file.txt')
```

or

```
s3 = boto3.resource('s3')
try:
    s3.Object('bucket', 'file.txt').load()
except botocore.exceptions.ClientError as e:
    if e.response['Error']['Code'] == '404':
        # The object does not exist
    else:
        raise
else:
    # The object does exist
```

Airflow vs Luigi

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example

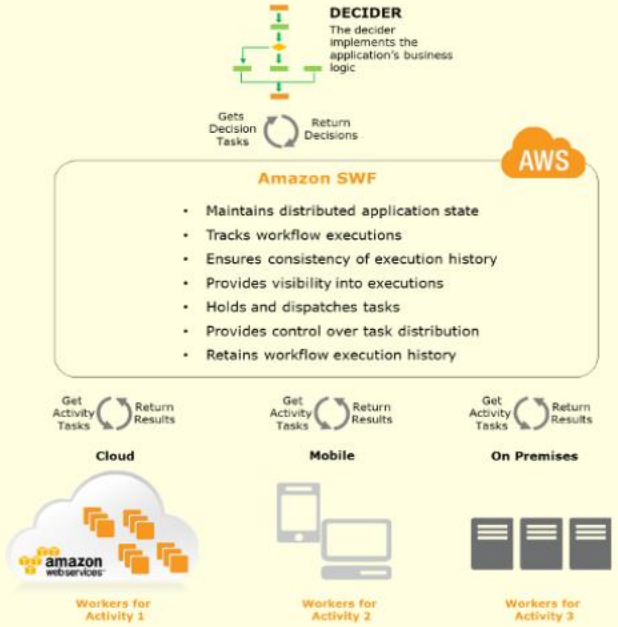
AWS

AWS. Simple Workflow Service (SWF)

Amazon Simple Workflow Service Dashboard

Welcome to Amazon Simple Workflow Service (Amazon SWF)

Amazon Simple Workflow Service (Amazon SWF) is a workflow service for building scalable, resilient applications. With Amazon SWF, you can build many kinds of applications as workflows. Amazon SWF maintains the execution state of the workflow consistently and reliably so that you can focus on building and running your application. For more details on Amazon SWF, click here.



Run a Sample Workflow

The sample workflow introduces you to basic concepts in Amazon SWF. Running this sample will introduce you to basic concepts of Amazon SWF and also create resources such as a domain and types that you can reuse.

Launch sample walkthrough

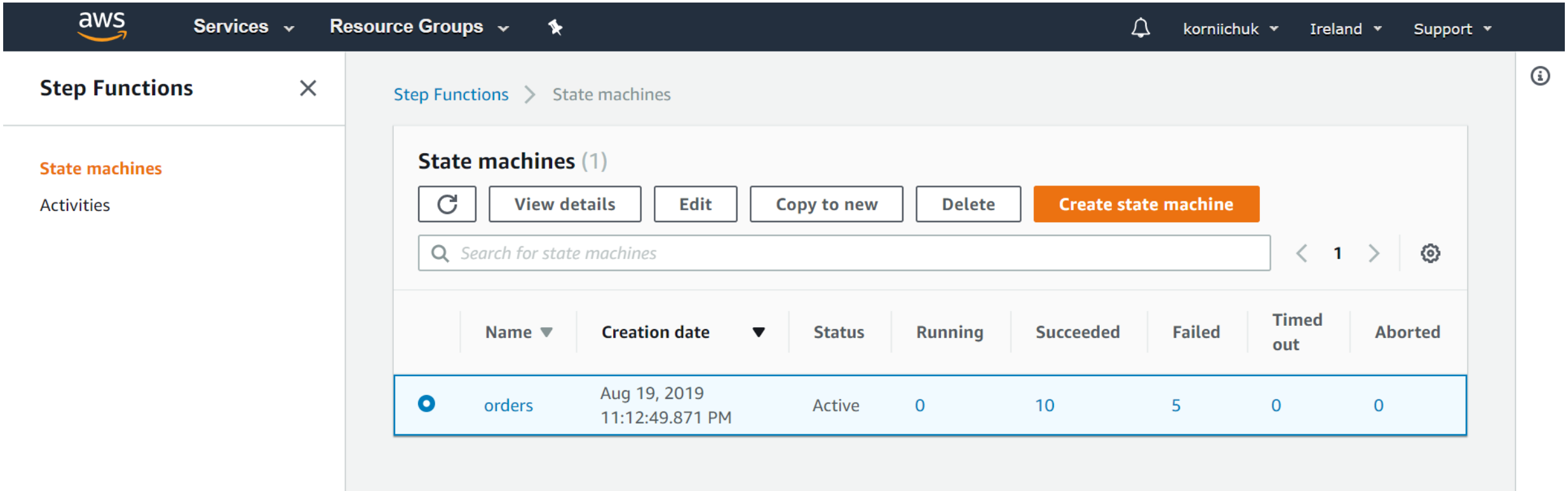
Create your own domain

You can create a domain and register your own workflows and activities. Click below to get started.

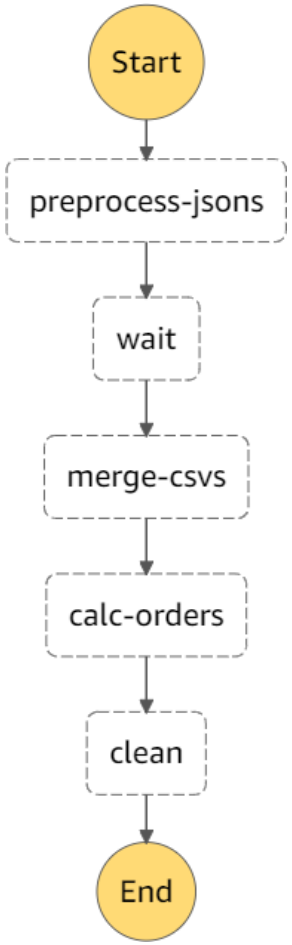
Create a new Domain

AWS. Step Functions

Using **Step Functions**, you can design and run workflows that stitch together services such as AWS Lambda and Amazon ECS.



AWS. Step Functions



Amazon States Language

```
{
  "Comment": "orders ver. 0.1a1 by Ruslan Korniichuk",
  "StartAt": "preprocess-jsons",
  "States": {
    "preprocess-jsons": {
      "Type": "Task",
      "Resource": "arn:aws:lambda:eu-west-
1:539199393808:function:workflow-preprocess-jsons",
      "Next": "wait"
    },
    "wait": {
      "Type": "Wait",
      "Seconds": 5,
      "Next": "merge-csvs"
    },
    "merge-csvs": {
      "Type": "Task",
      "Resource": "arn:aws:lambda:eu-west-
1:539199393808:function:workflow-merge-csvs",
      "Next": "calc-orders"
    },
    "calc-orders": {
      "Type": "Task",
      "Resource": "arn:aws:lambda:eu-west-
1:539199393808:function:workflow-calc-orders",
      "Next": "clean"
    },
    "clean": {
      "Type": "Task",
      "Resource": "arn:aws:lambda:eu-west-
1:539199393808:function:workflow-clean",
      "End": true
    }
  }
}
```

More code

korniichuk / workflow

Unwatch 1 | Star 0 | Fork 0

Code | Issues 0 | Pull requests 0 | Projects 0 | Wiki | Security | Insights | Settings

In progress... Workflow management platforms comparison http://www.korniichuk.com

Edit

dataops airflow luigi aws Manage topics

55 commits | 1 branch | 0 releases | 1 contributor | Unlicense

Branch: master | New pull request | Create new file | Upload files | Find file | Clone or download

korniichuk [workflow][luigi] Add Airflow-like relationships — Latest commit 8c690c3 yesterday

input	[workflow] Add input data	3 months ago
workflow-airflow	[workflow][airflow] Change owner to 'Ruslan Korniichuk'	yesterday
workflow-aws	[workflow][aws] Add owner to Step Fucntions	2 months ago
workflow-luigi	[workflow][luigi] Add Airflow-like relationships	yesterday
.gitignore	[workflow][aws] Add workflow-calc-orders Lambda	2 months ago
LICENSE	Initial commit	3 months ago
README.md	Initial commit	3 months ago
fabfile.py	[workflow][aws] Fix repo name	2 months ago

README.md

About Capgemini

A global leader in consulting, technology services and digital transformation, Capgemini is at the forefront of innovation to address the entire breadth of clients' opportunities in the evolving world of cloud, digital and platforms. Building on its strong 50-year heritage and deep industry-specific expertise, Capgemini enables organizations to realize their business ambitions through an array of services from strategy to operations. Capgemini is driven by the conviction that the business value of technology comes from and through people. It is a multicultural company of over 200,000 team members in more than 40 countries. The Group reported 2018 global revenues of EUR 13.2 billion.

Learn more about us at

www.capgemini.com

People matter, results count.

Ruslan Korniichuk

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Capgemini
ruslan.korniichuk@capgemini.com
+48 791 065 877