



DataOps 3.0

12th of December 2020

The 2nd law of IT



The first 80% of the development are not as hard
as **the second 80%**.

Source: bit.ly/3pnwl4C

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



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



MVP



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

How to start



How to start

- Share data science code to 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 [pytest](#), [flake8](#), and regular code reviews. Automate tests.



Workflow managers



Scripts with Cron

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

Python Schedule



```
import time

import schedule

def job():
    print("I'm working...")

schedule.every(10).minutes.do(job)
schedule.every().hour.do(job)
schedule.every().day.at("10:30").do(job)
schedule.every().monday.do(job)
schedule.every().wednesday.at("13:15").do(job)
schedule.every().minute.at(":17").do(job)

while True:
    schedule.run_pending()
    time.sleep(1)
```



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)

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<mediawiki xmlns="http://www.mediawiki.org/xml/export-0.3/" xml:lang="uk">
  <page>
    <title>Фукідід</title>
    <id>1529</id>
    <revision>
      <id>4382</id>
      <timestamp>2006-09-18T22:11:53Z</timestamp>
      <minor />
      <comment>Interwiki</comment>
      <text xml:space="preserve">{{Wikipedia}}
        *Історія — це філософія в прикладах.
      </text>
    </revision>
  </page>
</mediawiki>
```

Source: uk.wikipedia.org/wiki/XML

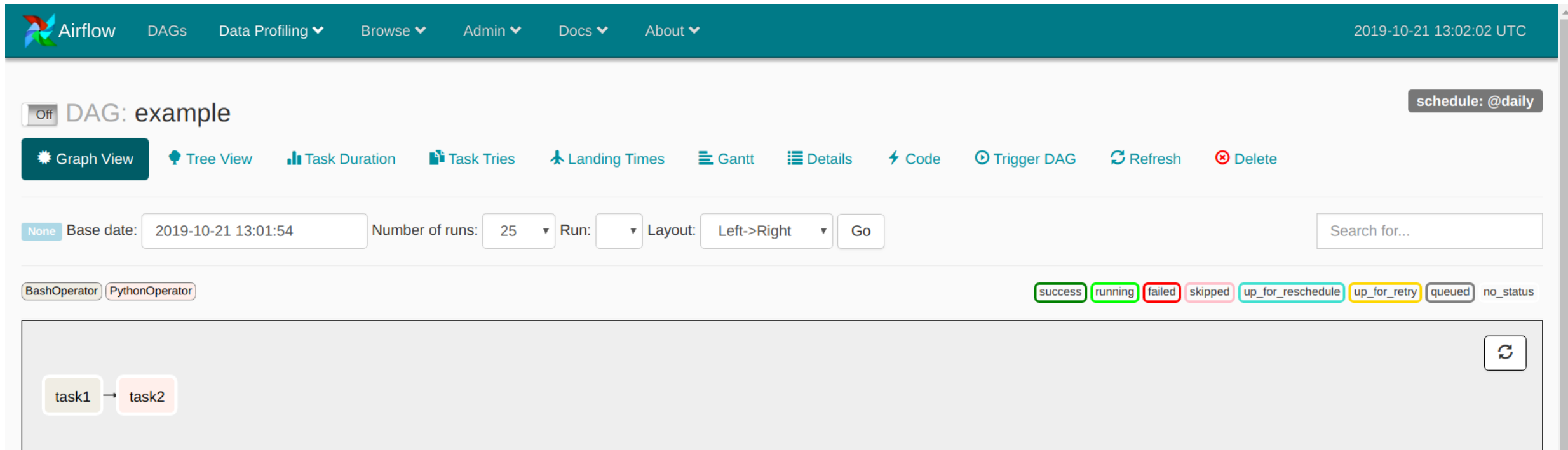


Workflow managers

- 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

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



The screenshot shows the Apache Airflow web interface. At the top is a teal navigation bar with the Airflow logo and links for DAGs, Data Profiling, Browse, Admin, Docs, and About. The current date and time are 2019-10-21 13:02:02 UTC.

The main content area displays a DAG named "example". A toggle switch is set to "Off". A "schedule: @daily" button is visible. Below this is a row of view options: Graph View (selected), Tree View, Task Duration, Task Tries, Landing Times, Gantt, Details, Code, Trigger DAG, Refresh, and Delete.

Below the view options are filters: "None" for Base date (set to 2019-10-21 13:01:54), Number of runs (25), Run (dropdown), Layout (Left->Right), and a Go button. A search bar is also present.

Below the filters are tabs for BashOperator and PythonOperator. A status bar shows various task states: success, running, failed, skipped, up_for_reschedule, up_for_retry, queued, and no_status.

The DAG graph shows two tasks, task1 and task2, connected by a directed arrow from task1 to task2. A refresh button is located in the bottom right corner of the graph area.



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 arguments

```
default_args = {  
    'owner': 'Ruslan Korniiichuk',  
    'start_date': datetime.datetime(2020, 12, 11)  
}
```

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)
```



Airflow. Relationships

```
task1 >> task2
```



Airflow. All-in-one

```
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',
    'start_date': datetime.datetime(2020, 12, 11)
}

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)

task1 >> task2
```

Airflow. Graph view



On **DAG: example**

schedule: @daily

- Graph View
- Tree View
- Task Duration
- Task Tries
- Landing Times
- Gantt
- Details
- Code
- Trigger DAG
- Refresh
- Delete

success

Base date: 2020-11-12 00:00:01

Number of runs: 25 ▾

Run: scheduled__2020-11-12T00:00:00+00:00 ▾

Layout: Left->Right ▾

Go

Search for...

BashOperator

PythonOperator

scheduled

skipped

upstream_failed

up_for_reschedule

up_for_retry

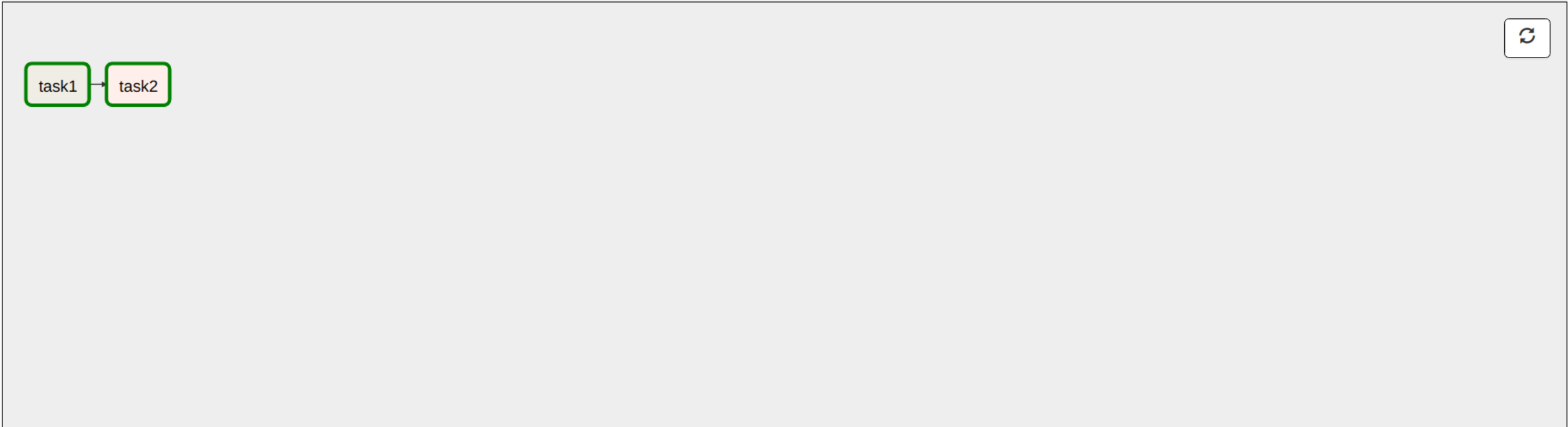
failed

success

running

queued

no_status



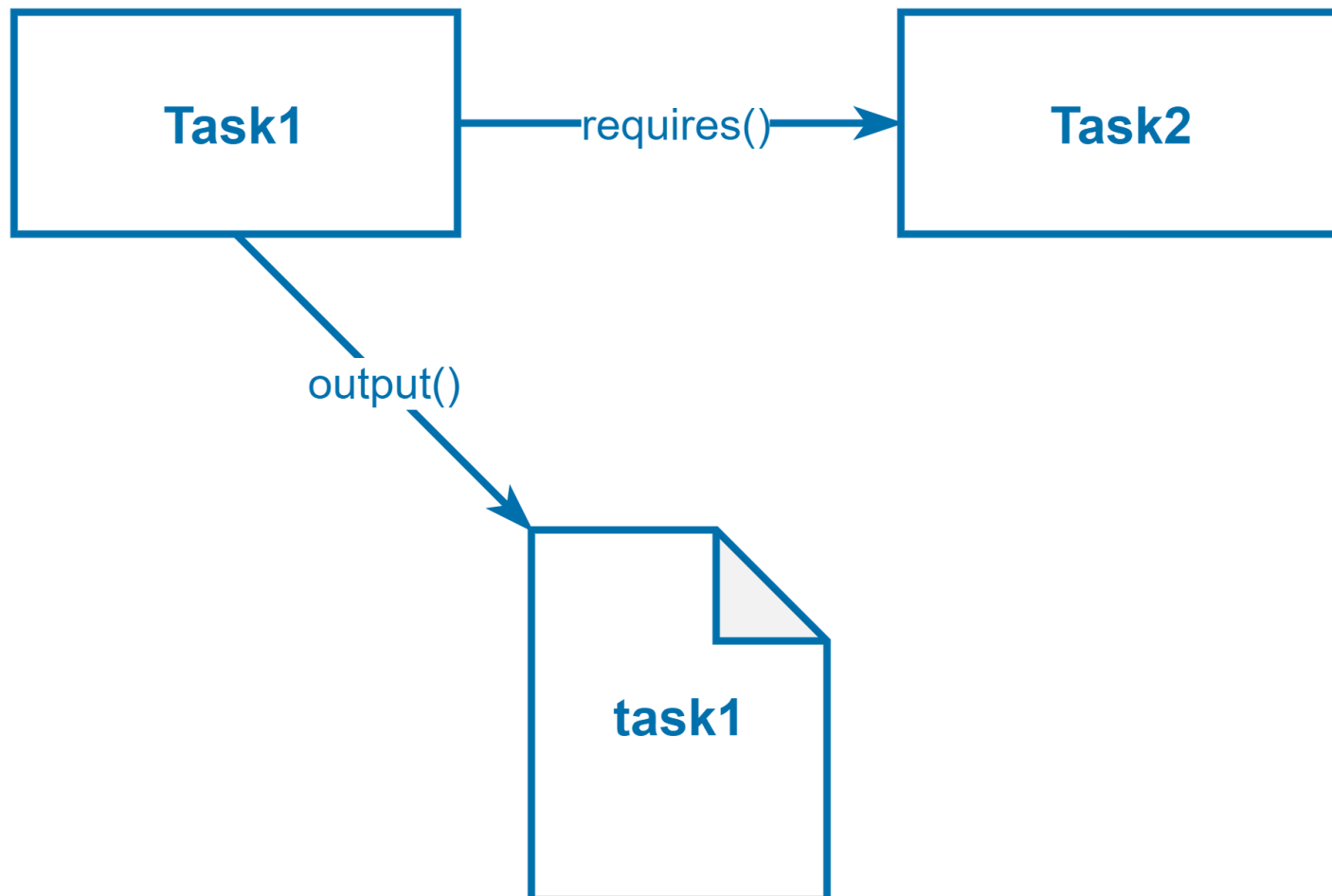


Luigi

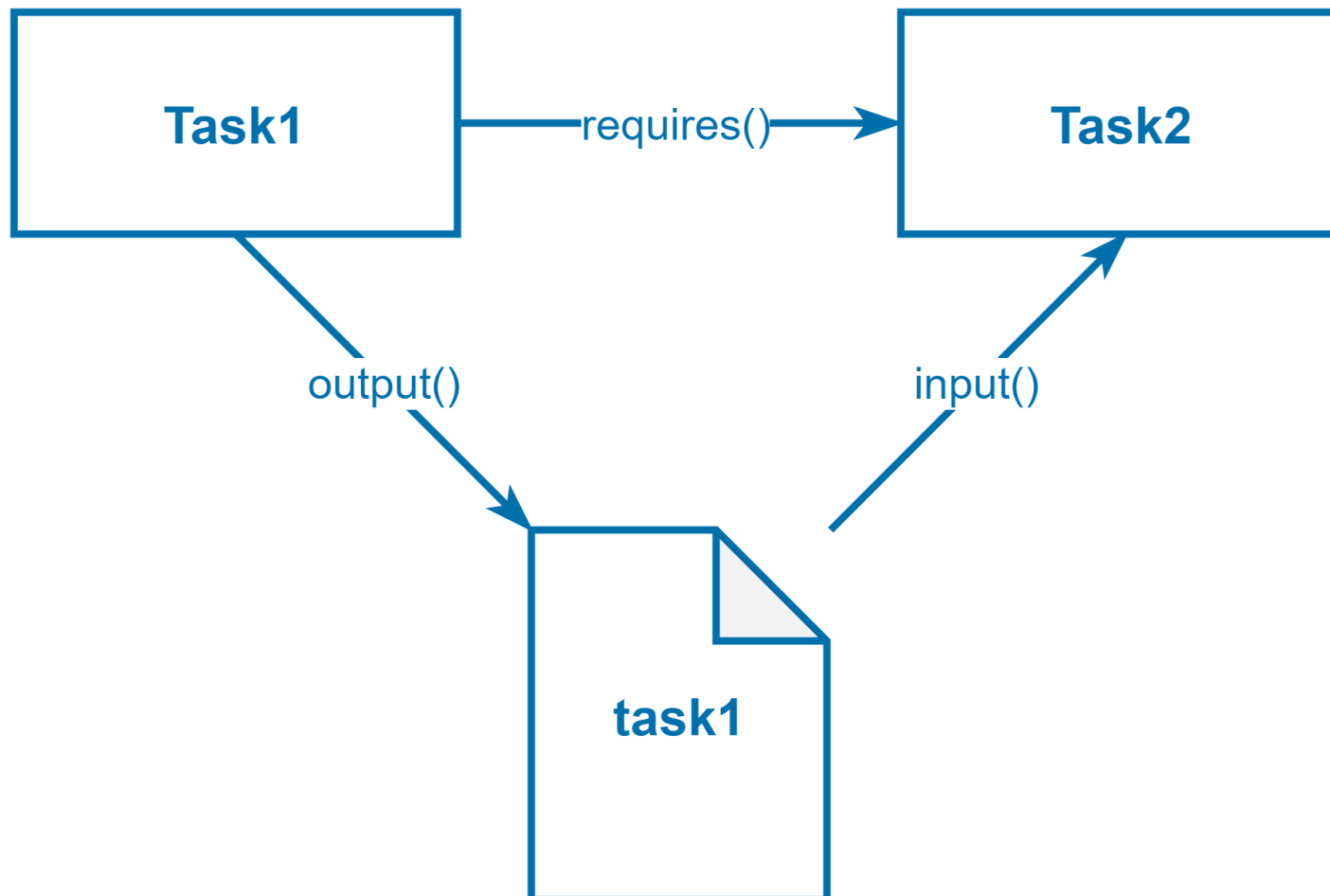
Luigi. Core idea



Luigi. Core idea



Luigi. Core idea





Luigi. Import

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

Luigi. Tasks



```
class Task1(ExternalProgramTask):

    dst = 'task1'

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

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

```
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'

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

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

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. Graph view



Luigi Task Status



Task List

Dependency Graph

Workers

Resources

Running

Task2__99914b932b

Show task details

Show Upstream Dependencies ☐

Visualisation Type

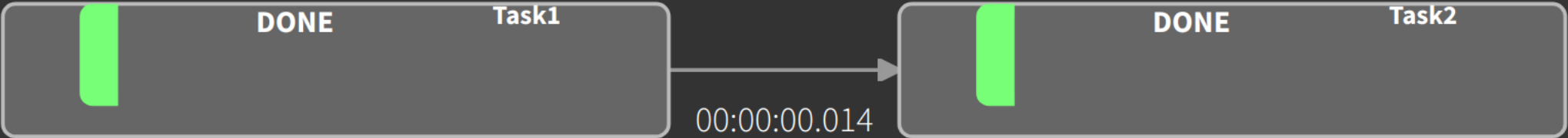
D3

SVG

Hide Done ☐

Task2()

Dependency Graph



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

[example](#)

Luigi

pros

- everything in Python (no XML)
- rapid prototyping
- 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



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~~

[example](#)

Luigi

pros

- ~~everything in Python (no XML)~~
- rapid prototyping
- 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



Airflow

pros

- DAGs catalog
- annoying scheduler
- readable DAG concept
- readable relationships
- DAG's owner

cons

- delay between task execution
- cannot test/run task and all its relationships

[example](#)

Luigi

pros

- rapid prototyping
- built-in Target
- easy-to-start

cons

- no DAG concept and DAGs catalog
- no scheduling

[example](#)

Airflow. DAGs catalog



Airflow

DAGs

Data Profiling ▾

Browse ▾

Admin ▾

Docs ▾

About ▾

2019-10-21 17:37:28 UTC

DAGs

Search:

		DAG	Schedule	Owner	Recent Tasks	Last Run	DAG Runs	Links
	☐ Off	example	@daily	Ruslan Korniiichuk				

Showing 1 to 1 of 1 entries

«

<

1

>

»

[Hide Paused DAGs](#)

Airflow vs Luigi



Airflow

pros

- DAGs catalog
- annoying scheduler
- readable DAG concept
- readable relationships
- DAG's owner

cons

- delay between task execution
- cannot test/run task and all its relationships

[example](#)

Luigi

pros

- rapid prototyping
- built-in Target
- easy-to-start

cons

- no DAG concept and DAGs catalog
- no scheduling

[example](#)



Airflow. Relationships

Can be done with the Python bitshift operators `>>` and `<<`. The following two statements are functionally equivalent:

```
task1 >> task2
```

or

```
task2 << task1
```



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



Airflow

pros

- DAGs catalog
- annoying scheduler
- readable DAG concept
- ~~readable relationships~~
- DAG's owner

cons

- delay between task execution
- cannot test/run task and all its relationships

[example](#)

Luigi

pros

- rapid prototyping
- built-in Target
- easy-to-start

cons

- no DAG concept and DAGs catalog
- no scheduling

[example](#)

Airflow vs Luigi



Airflow

pros

- DAGs catalog
- annoying scheduler
- readable DAG concept
- DAG's owner

cons

- delay between task execution
- cannot test/run task and all its relationships

[example](#)

Luigi

pros

- rapid prototyping
- built-in Target
- easy-to-start

cons

- no DAG concept and DAGs catalog
- no scheduling

[example](#)

Airflow. DAG's owner



Airflow

DAGs

Data Profiling ▾

Browse ▾

Admin ▾

Docs ▾

About ▾

2019-10-21 17:37:28 UTC

DAGs

Search:

		DAG	Schedule	Owner	Recent Tasks	Last Run	DAG Runs	Links
	☐ Off	example	@daily	Ruslan Korniiichuk				

«

<

1

>

»

Showing 1 to 1 of 1 entries

Hide Paused DAGs

Ownership



Airflow

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

Luigi

We can add Airflow-like ownership:

```
# Owner: Ruslan Korniiichuk
```

Airflow vs Luigi



Airflow

pros

- DAGs catalog
- annoying scheduler
- readable DAG concept
- ~~DAG's owner~~

cons

- delay between task execution
- cannot test/run task and all its relationships

[example](#)

Luigi

pros

- rapid prototyping
- built-in Target
- easy-to-start

cons

- no DAG concept and DAGs catalog
- no scheduling

[example](#)

Airflow vs Luigi



Airflow

pros

- DAGs catalog
- annoying scheduler
- readable DAG concept

cons

- delay between task execution
- cannot test/run task and all its relationships

[example](#)

Luigi

pros

- rapid prototyping
- built-in Target
- easy-to-start

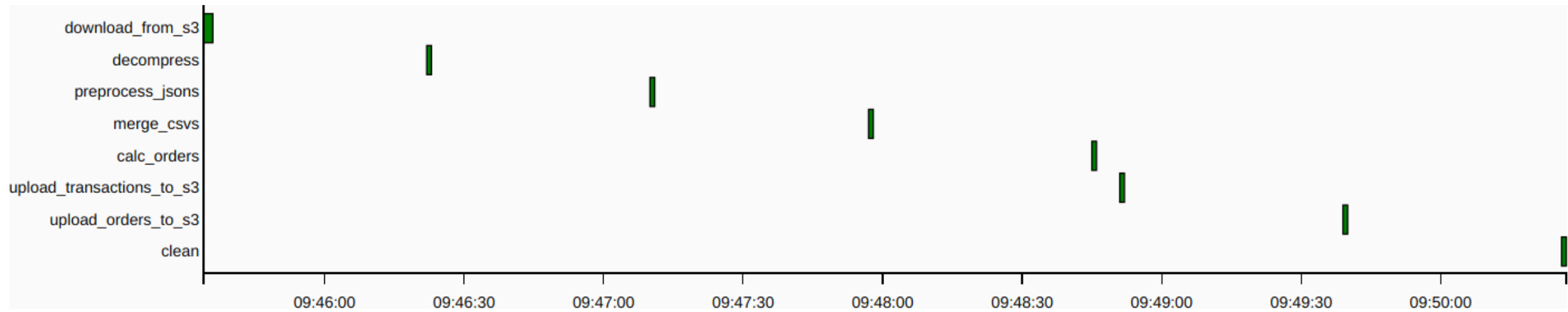
cons

- no DAG concept and DAGs catalog
- no scheduling

[example](#)



Airflow. Delay between task execution



Airflow vs Luigi



Airflow

pros

- DAGs catalog
- annoying scheduler
- readable DAG concept

cons

- delay between task execution
- cannot test/run task and all its relationships

[example](#)

Luigi

pros

- rapid prototyping
- built-in Target
- easy-to-start

cons

- no DAG concept and DAGs catalog
- no scheduling

[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



Airflow

pros

- DAGs catalog
- annoying scheduler
- readable DAG concept

cons

- delay between task execution
- cannot test/run task and all its relationships

[example](#)

Luigi

pros

- rapid prototyping
- ~~built-in Target~~
- easy-to-start

cons

- no DAG concept and DAGs catalog
- no scheduling

[example](#)

Airflow vs Luigi



Airflow

pros

- DAGs catalog
- annoying scheduler
- readable DAG concept

cons

- delay between task execution
- cannot test/run task and all its relationships

[example](#)

Luigi

pros

- rapid prototyping
- easy-to-start

cons

- no DAG concept and DAGs catalog
- no scheduling

[example](#)



AWS

Simple Workflow Service (SWF)



Services ▾

Resource Groups ▾



korniichuk ▾

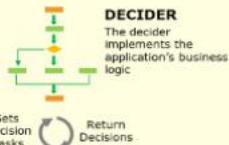
Ireland ▾

Support ▾

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](#).



Amazon SWF

- Maintains distributed application state
- Tracks workflow executions
- Ensures consistency of execution history
- Provides visibility into executions
- Holds and dispatches tasks
- Provides control over task distribution
- Retains workflow execution history



Cloud



Workers for Activity 1



Mobile



Workers for Activity 2



On Premises



Workers for Activity 3

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](#)

Step Functions

Using **Step Functions**, you can design and run workflows that stitch together services such as Lambda, Fargate, Glue.

aws

Services

Resource Groups

🔔

korniichuk

Ireland

Support

Step Functions

State machines

Activities

State machines (1)

↺

View details

Edit

Copy to new

Delete

Create state machine

🔍

Search for state machines

<

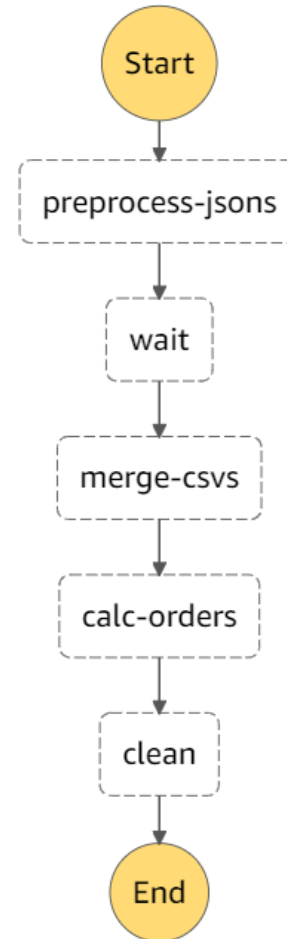
1

>

⚙️

	Name	Creation date	Status	Running	Succeeded	Failed	Timed out	Aborted
🔵	orders	Aug 19, 2019 11:12:49.871 PM	Active	0	10	5	0	0

Step Functions



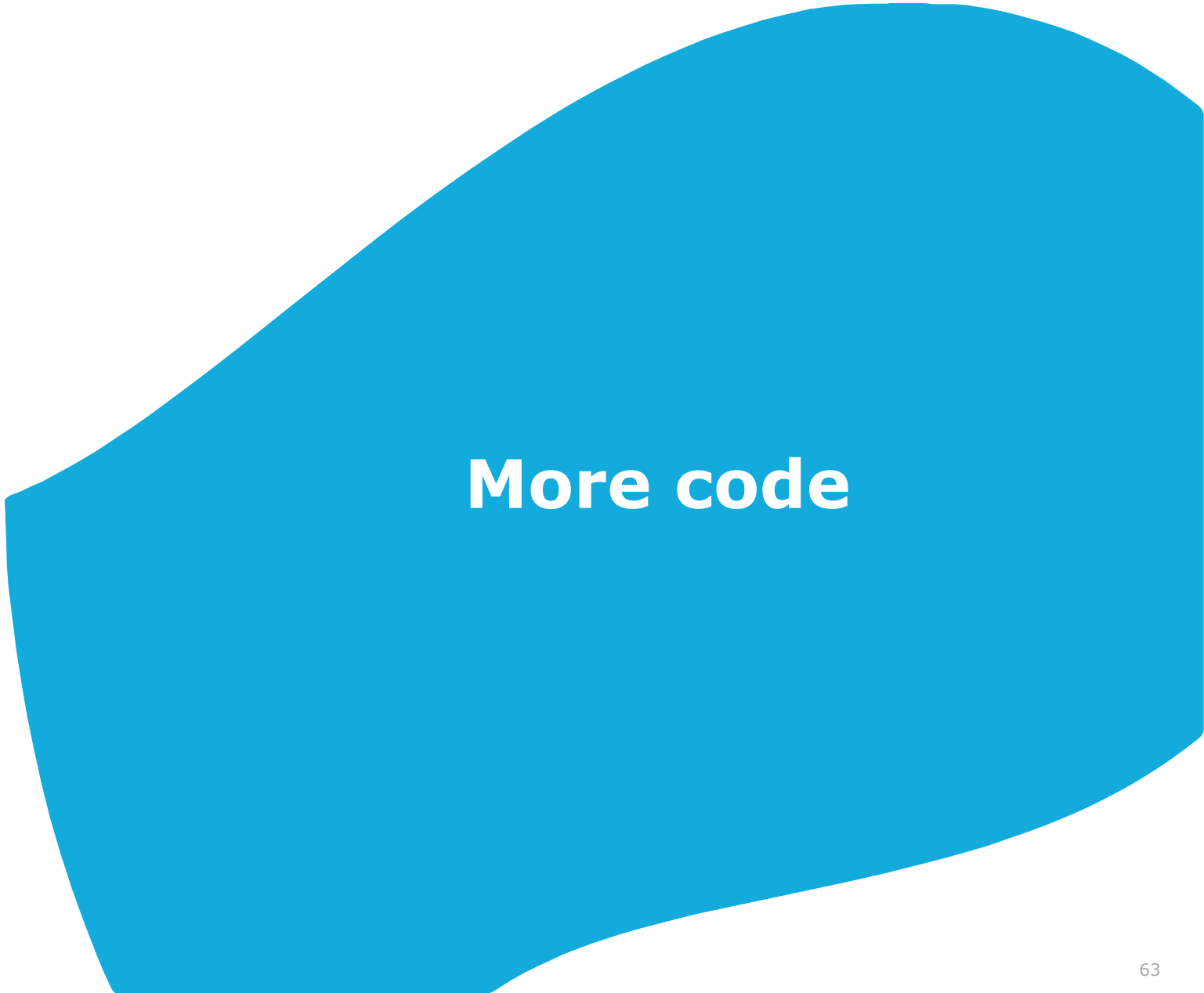


Amazon States Language

```
{
  "Comment": "orders ver. 0.1a1 by Ruslan Korniiichuk",
  "StartAt": "preprocess-jsons",
  "States": {
    "preprocess-jsons": {
      "Type": "Task",
      "Resource": "arn:aws:lambda:eu-west-
1:999999999999:function:workflow-preprocess-jsons",
      "Next": "wait"
    },
    "wait": {
      "Type": "Wait",
      "Seconds": 5,
      "Next": "merge-csvs"
    },
    "merge-csvs": {
      "Type": "Task",
      "Resource": "arn:aws:lambda:eu-west-
1:999999999999:function:workflow-merge-csvs",
      "Next": "calc-orders"
    },

```

```
    "calc-orders": {
      "Type": "Task",
      "Resource": "arn:aws:lambda:eu-west-
1:999999999999:function:workflow-calc-orders",
      "Next": "clean"
    },
    "clean": {
      "Type": "Task",
      "Resource": "arn:aws:lambda:eu-west-
1:999999999999:function:workflow-clean",
      "End": true
    }
  }
}
```



More code

[Pull requests](#) [Issues](#) [Marketplace](#) [Explore](#)[korniichuk / workflow](#)[Unwatch](#) 1 [Star](#) 1 [Fork](#) 0[Code](#) [Issues](#) [Pull requests](#) 1 [Actions](#) [Projects](#) [Wiki](#) [Security](#) [Insights](#) [Settings](#)[master](#) 2 branches 0 tags[Go to file](#)[Add file](#)[Code](#)

About



Workflow management platforms comparison

www.korniichuk.com[dataops](#) [airflow](#) [luigi](#) [aws](#)
[aws-step-functions](#) [step-functions](#)
[apache-airflow](#)[Readme](#)[Unlicense License](#)

Languages

Python 100.0%

	korniichuk Update requirements.txt	7f86a77 13 seconds ago	🕒 56 commits
input	[workflow] Add input data	15 months ago	
workflow-airflow	Update requirements.txt	13 seconds ago	
workflow-aws	[workflow][aws] Add owner to Step Fucntions	15 months ago	
workflow-luigi	[workflow][luigi] Add Airflow-like relationships	13 months ago	
.gitignore	[workflow][aws] Add workflow-calc-orders Lambda	15 months ago	
LICENSE	Initial commit	16 months ago	
README.md	Initial commit	16 months ago	
fabfile.py	[workflow][aws] Fix repo name	15 months ago	

README.md



workflow

Workflow management platforms comparison



Cześć! Jesteśmy SaaS-em ze Śląska
i tworzymy 60-osobowy
#teamlandingi

Wykorzystujemy **Machine Learning**
oraz takie technologie jak: **Python, React,**
PHP (Symfony framework)

Dołącz do nas: **landingi.com/kariera**

Obserwuj nas na:



@landingi_com



@landingi.kariera



@landingi



About Capgemini

Capgemini is a global leader in consulting, digital transformation, technology and engineering services. The Group 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. Today, it is a multicultural company of 270,000 team members in almost 50 countries. With Altran, the Group reported 2019 combined revenues of €17billion.

Learn more about us at

www.capgemini.com



People matter, results count.

This presentation contains information that may be privileged or confidential and is the property of the Capgemini Group.
Copyright © 2020 Capgemini. All rights reserved.

Ruslan Korniiichuk

Information Technology Architect

Capgemini Poland

ruslan.korniichuk@capgemini.com

+48 791 065 877