Airflow at UniCredit

Our journey from mainframe scheduling to modern data processing

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Airflow Summit

Let's flow together

September 19-21, 2023,
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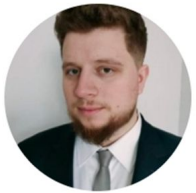
Speakers



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Murex Reporting Team Head

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Python Developer

Our Warsaw team manages Front Office data feeds across the UC Group.

Scale of daily activity:

- 8k batch tasks executed
- 5k data files dispatched
- 2.5bn data points processed

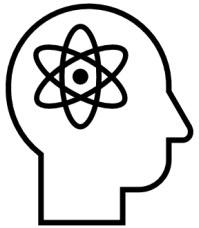
Agenda

1. Legacy issues – why we moved to Airflow
2. How we got here
3. Moving to Airflow - the challenges
4. The target solution
5. What we gained

Legacy issues: why we moved to Airflow

Mainframe scheduler

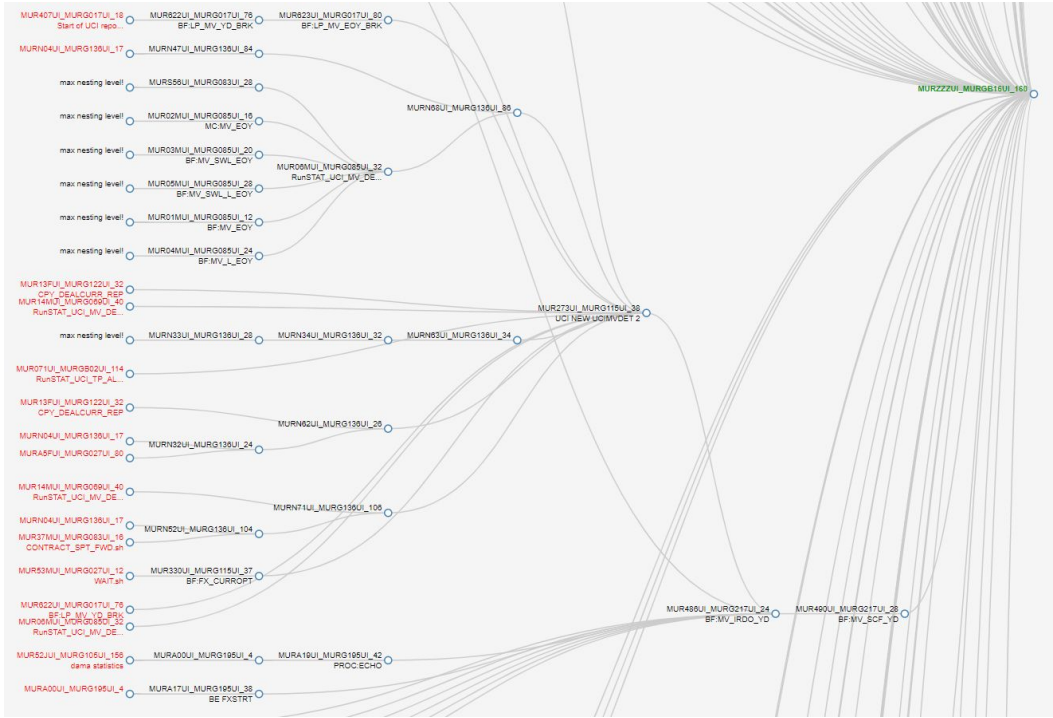
- Difficult maintenance: **manual** change process involving multiple teams
  (eg. team A misreads request from team B and removes a task instead of moving it)
- **Limited** number of available **environments**/instances
- Only **one run** scheduled per day – no test flexibility
- **No CI** process – no version control/automated testing
- **Long time to market**: minimum 1 day for simple changes
- Poor resource control due to **rigid scheduling** model



Legacy issues: why we moved to Airflow

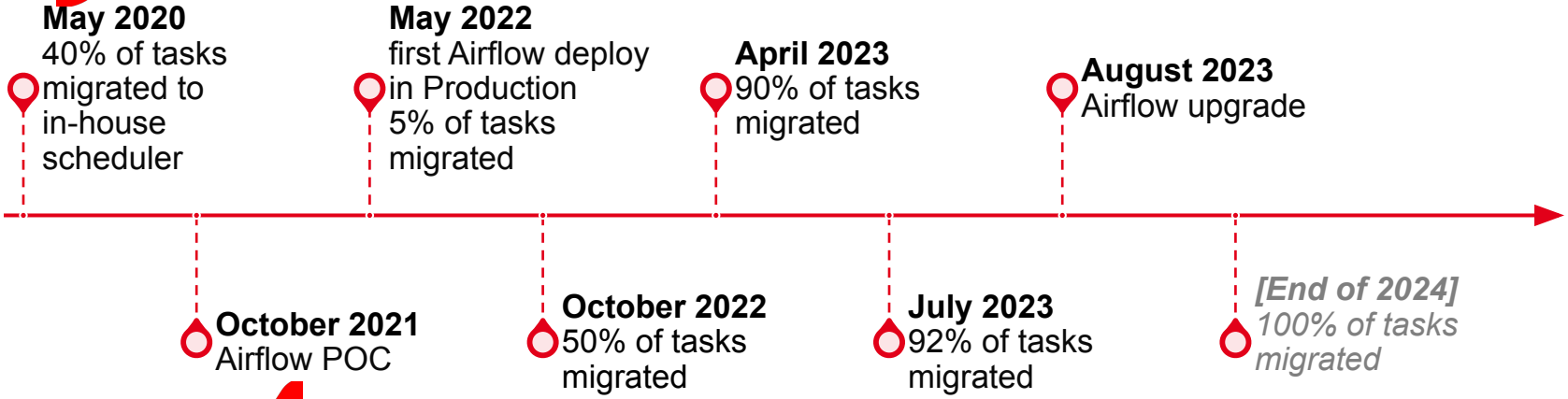
The mainframe scheduler's most painful issue: no dependency visualization.

Thousands of tasks with many-to-many dependencies created a huge dependency network



How we got here

- **Python scheduler script: a major scheduling upgrade vs mainframe**
- **We later decided to shift to an existing solution: too much effort to keep upgrading in-house**
- **This led us to finding Airflow**



- **After the POC, initiatives to shift our scheduling into Airflow were launched**
- **Production deployments followed in 2022 and 2023**

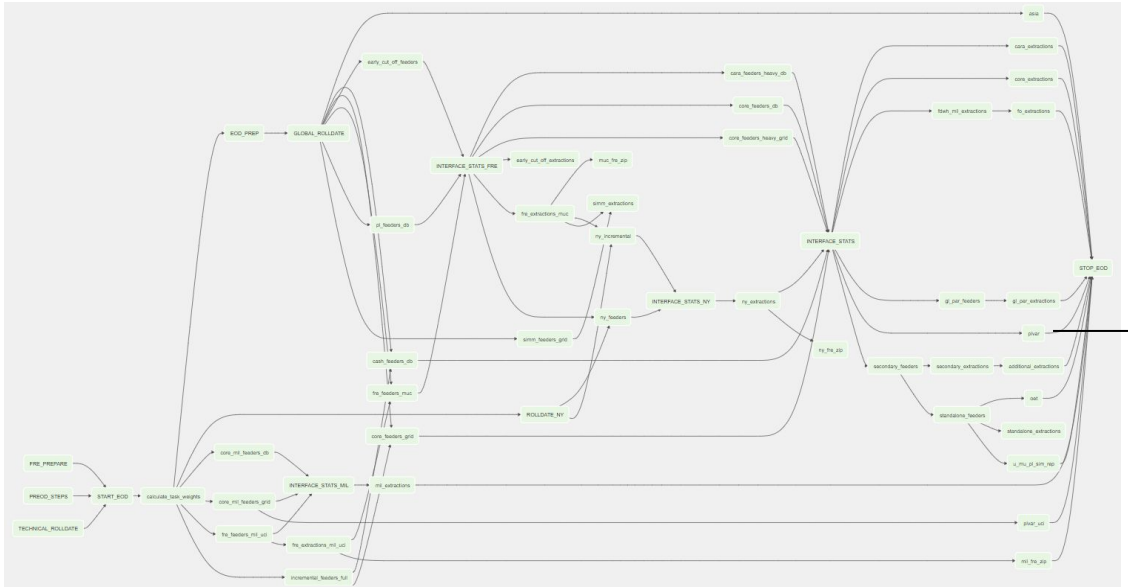
Moving to Airflow: the challenges

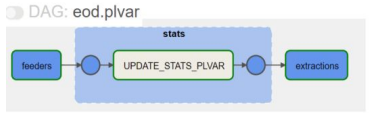
1. Understanding our own **scheduling dependencies** to be able to redefine and simplify them -> months of analytical work
2. **Production** environment **requirements** (eg. incident management requiring a mainframe task crash in the event of a Production failure)
3. **Integration** with overall IT landscape (other systems to continue using mainframe scheduling)
4. Understanding the concept of Airflow **DAG dependencies** – how to trigger a DAG upon another DAG's success?
5. Airflow resets DAGs after crash + restart, instead of resuming their execution – how to speed up **failure recovery**?

The „main DAG” concept – our final solution

Structure: one main DAG with multiple sub-DAGs

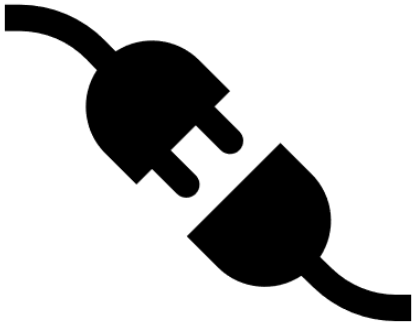
Scope: > 8k batch tasks executed daily





The target solution - plugins

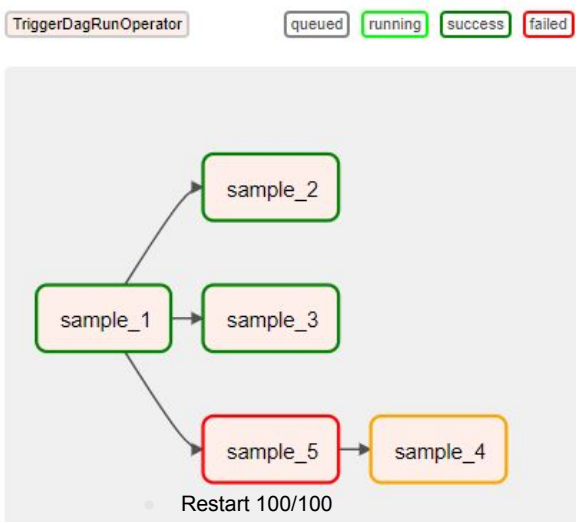
- **ResumeDagRunOperator** - evolution of the TriggerDagRunOperator functionality
- **DAG task search**
- **Static time predecessors**
- **Sensor** to provide incident management (checks for failed tasks and crashes if any are detected)



ResumeDagRunOperator

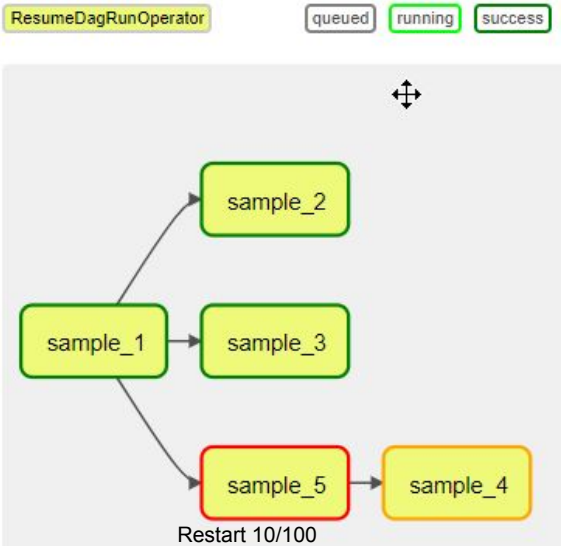
Example: Our 100-task DAG **sample_5** crashes at 90 tasks. To save time, it is better to resume the DAG run, rather than rerunning the whole scope.

Default solution



Clearing **sample_5** will restart the DagRun (rerunning 100 tasks) or raise a DagRunAlreadyExists error.

Custom solution



Clearing **sample_5** will resume the DagRun (rerunning only 10 tasks).

Custom DateTimeSensor

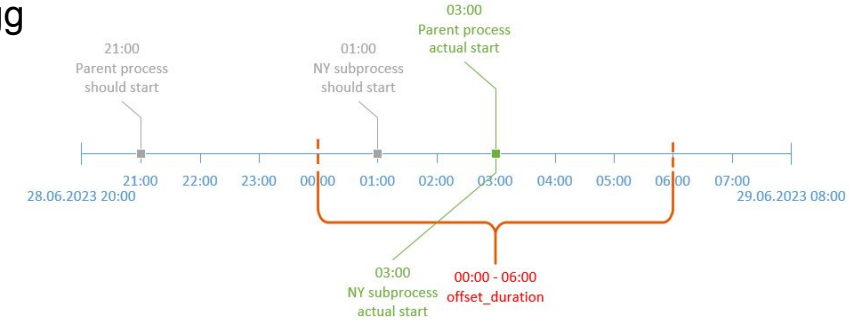
Problem: the parent Airflow process is ran manually* at 9pm, while NY sub-tasks are scheduled for 1am. In case of a severe delay (eg. parent process starts at 3am), NY tasks would start on 1am of the next calendar day:


```
wait_to_0100 = CustomDateTimeSensor(
    task_id="wait_to_0100",
    dag_execution_datetime="{{ ts_nodash_with_tz }}",
    target_time=pendulum.Time(hour=1),
    delta_days=pendulum.Duration(days=1),
    offset_duration=pendulum.Duration(hours=6)
)
```

The customized **DateTimeSensor** lets us define *offset_duration,* specifying the period during which *delta_days* is decreased by 1.

*the
Airflow execution_date is t he same as DagRun start_date

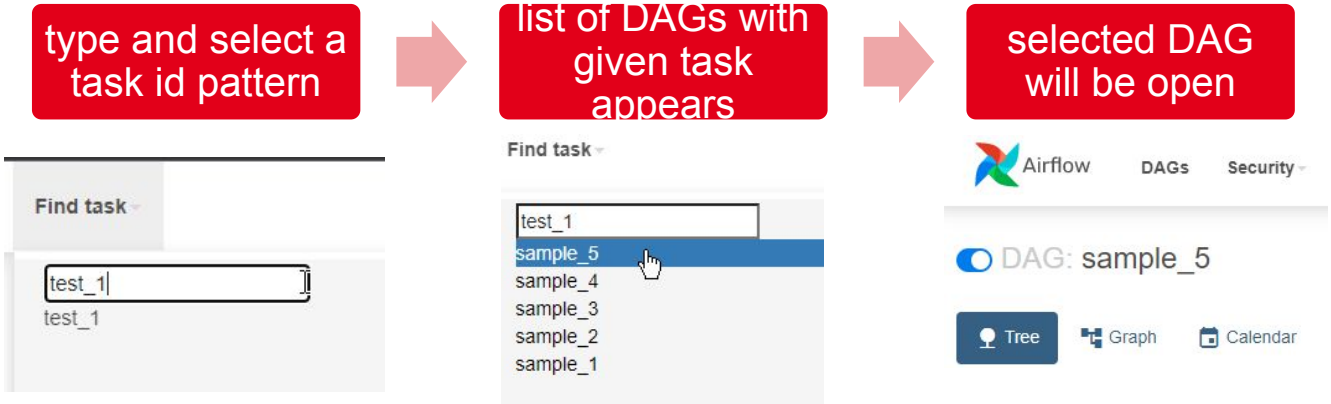
Solution: thanks to *offset_duration,* the custom DateTimeSensor allows dependencies to be met even in this scenario: NY tasks are trigg



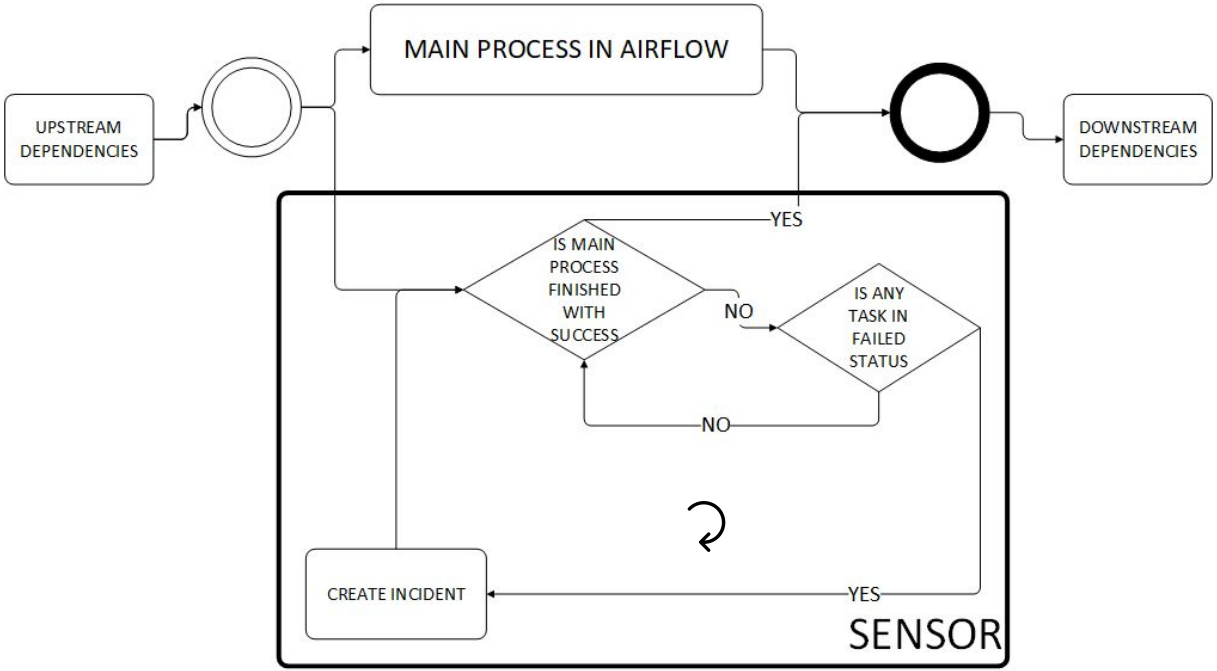
Task search through DAGs – new feature

Problem: While debugging an application crash, the team has to quickly locate the DAG in which the failed task is located.

Solution: A new search option was added to the Airflow toolbar, allowing us to quickly locate tasks in our DAGs.



The target framework – a hybrid approach



We combined Airflow and mainframe scheduling:

- Incident management via Airflow task fail sensor (new feature)
- Downstream dependencies to other systems via mainframe

What we gained

- **Automated testing (CI with Jenkins)**
- **Test capacity increased, enabling multiple runs per day across many environments**
- **Versioning (eg. possibility of defining branching strategies for parallel projects)**
- **Scheduling as code**
- **Scalability**
- **Task latency reduced from 10-60s to 3-10s**
- **Dependency visualization**
- **Block approach for tasks**
- **POC for Airflow in UniCredit** - *we're open to discuss best practices for usage at scale*

- 4 main DAGs
- >250 sub DAGs
- 480 daily DAG runs
- ~8000 daily task runs

Questions?

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