

Usability and Debuggability

Airflow at Pinterest

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Workflow Platform

2022/05/25

Agenda

- Workflow **Discoverability** and **Searchability**
- Workflow **Debuggability**
- Workflow **Profiling**



Pinterest - a one-stop shop for inspiration, new products and new possibilities.

Scale

1.3K+
ACTIVE USERS

14K+
DAILY DAG
RUNS

131K+
DAILY TASK
INSTANCES

160K+
DAILY UI/API
REQUESTS

Discovering and Searching

Recently Visited Dags



Where is my workflow? I can't find it, and I just had it open!

DAGs

You recently visited DAGs



[My DAGs](#) [All DAGs](#)

Search Dags ▾

	DAG	Schedule	Owner	Tier	Recent Tasks
<input checked="" type="checkbox"/>	agaur_test_dag_0	1 day, 0:00:00	airflow	tier1	
<input checked="" type="checkbox"/>	demo_dag	None	dyu	tier1	

Favorite Dags



Is there a way I can save a subset of dags to display first?

DAGs

ⓘ You recently visited DAGs: No item to show yet...

	DAG	
<input checked="" type="checkbox"/>	On ace_ixia_readable_dump_workflow	★
<input checked="" type="checkbox"/>	On actalike_eval_expansion_v4	Click this star to Favourite
<input checked="" type="checkbox"/>	On actalike_expansion_v4	★

Airflow DAGs Security Browse Admin Docs Spinner Tour Guides

DAG Import Errors (80)

DAGs

ⓘ You recently visited DAGs: ace_ixia_readable_dump_workflow ads_optimization.check_conversio... consumer_ap

★ Favourites Select a DAG Search Template.. To search DAGs or go back to All DAGs, click on the Favourite

Favourites tab shows DAGs that you have chosen as your favourite by clicking on the star next to their name.

	DAG	Schedule
<input checked="" type="checkbox"/>	On consumer_app_strike_system	★ 0 10 * * *
<input checked="" type="checkbox"/>	On user_role_backup	★ @hourly

« < 1 > »

Hide Paused DAGs

Dag Template Type - Search Templates



Is there a filter I can setup for my team to access dags we care for?

DAGs

ⓘ You recently visited DAGs: [migrated.canary.jss_pinball_wor...](#)

★ Favourites	asdfasdf	X
Add New +		
Currently Applied		
i	DAG ID	Share Template
On	migrated.canary.jss_pinball_workflow_w_k8s_pii	
On	migrated.canary.jss_pinball_workflow_w_k8s_pii_merged_pod	

Create a new User DAG Search Template.

Add Filter ▾

NOTE: Logical **and** operator is when you select multiple filters.

x Owner	Starts with	Owners
x Dag Id	Starts with	Dag Id
x Tier	Starts with	Tier
x Project	Starts with	Project

Template Name

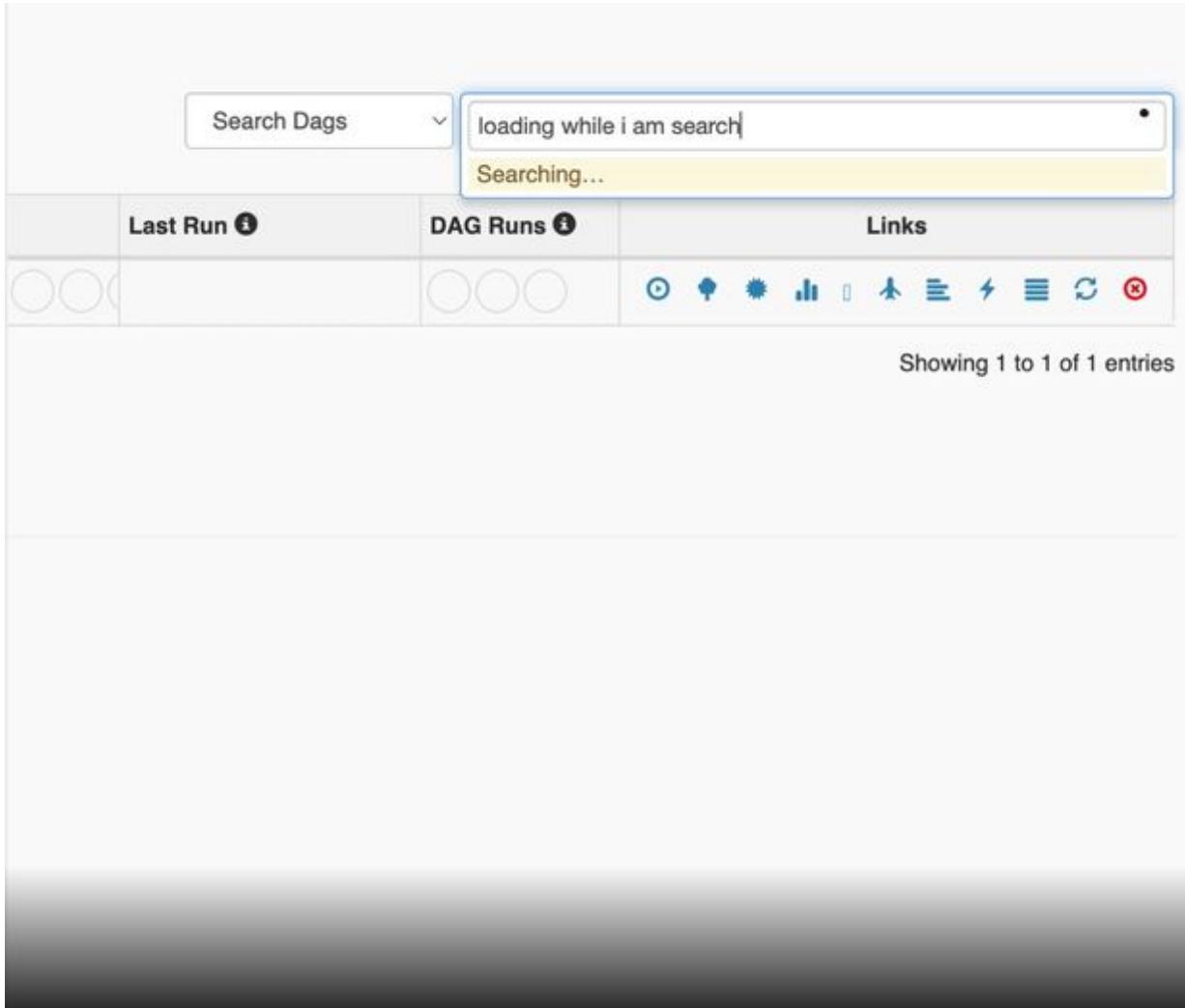
NOTE: Template name is auto-formatted to all lower cases with max length 40 characters, spaces are replaced by underscore (_).

Cancel Share Preview Create Create and Apply

Cross Cluster Search



There are 3 clusters. How do I find the dag I need to view without checking each?



A screenshot of a web-based interface for managing data pipelines. At the top, there is a search bar labeled "Search Dags" with a dropdown arrow, containing the text "loading while i am search". Below the search bar is a progress bar with the text "Searching...". The main area features a table with three columns: "Last Run" (with a tooltip), "DAG Runs" (with a tooltip), and "Links". Each column contains three small circular icons. To the right of the table, there is a set of ten small, colorful icons representing various actions or metrics. At the bottom of the table area, the text "Showing 1 to 1 of 1 entries" is displayed.

Tour Guides



Spinner has all these cool features, but how to know when to use and what to use?

DAG: test_hadoop_streaming_dag

Graph View Tree View DagRun History Duration History Task Tries Landing Logs

Tour Guides Requests Tools

DAGs / Home
Graph View
Logs
Details
Code
Trig

Say **hi** to your new tour guide!

This wizard will guide you through the important parts of the UI with the goal of helping you better understand the system and possibly find those not easily discoverable features.

Shortcuts

Key	Action
Esc	Exit Tour / Show me later
→	Next Step / Begin / Finished!
←	Previous Step

Show me tomorrow..

Begin!

Tour Guides Demo

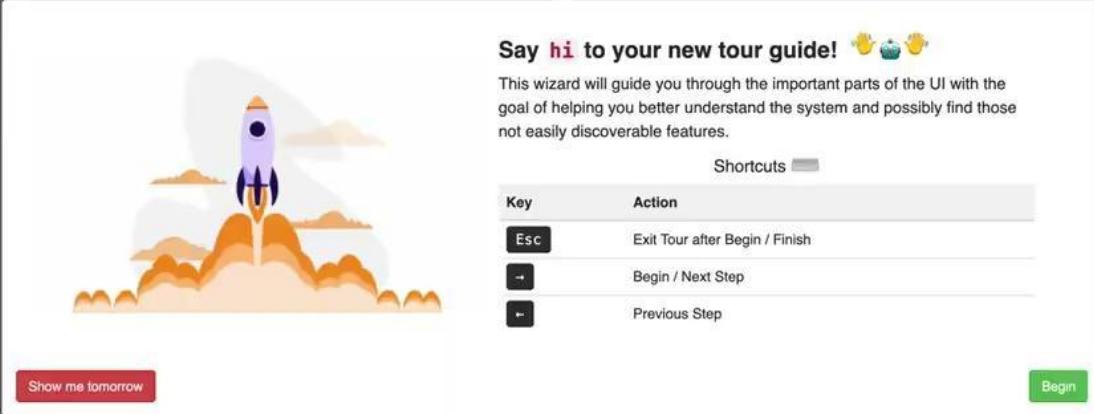
Schedule: @once

Graph View Tree View DagRun History Duration History Task Tries Landing Times Gantt Details Trigger DAG Dag Parsing Error Audit Log Refresh

Base date: 2021-08-19 19:24:32.00 Number of runs: 25 Go

MyTaskOperator

(DAG) task_1 task_2 task_3 task_4



Say **hi** to your new tour guide! 🎉Rocket🎉

This wizard will guide you through the important parts of the UI with the goal of helping you better understand the system and possibly find those not easily discoverable features.

Shortcuts

Key	Action
Esc	Exit Tour after Begin / Finish
→	Begin / Next Step
←	Previous Step

Begin

Show me tomorrow

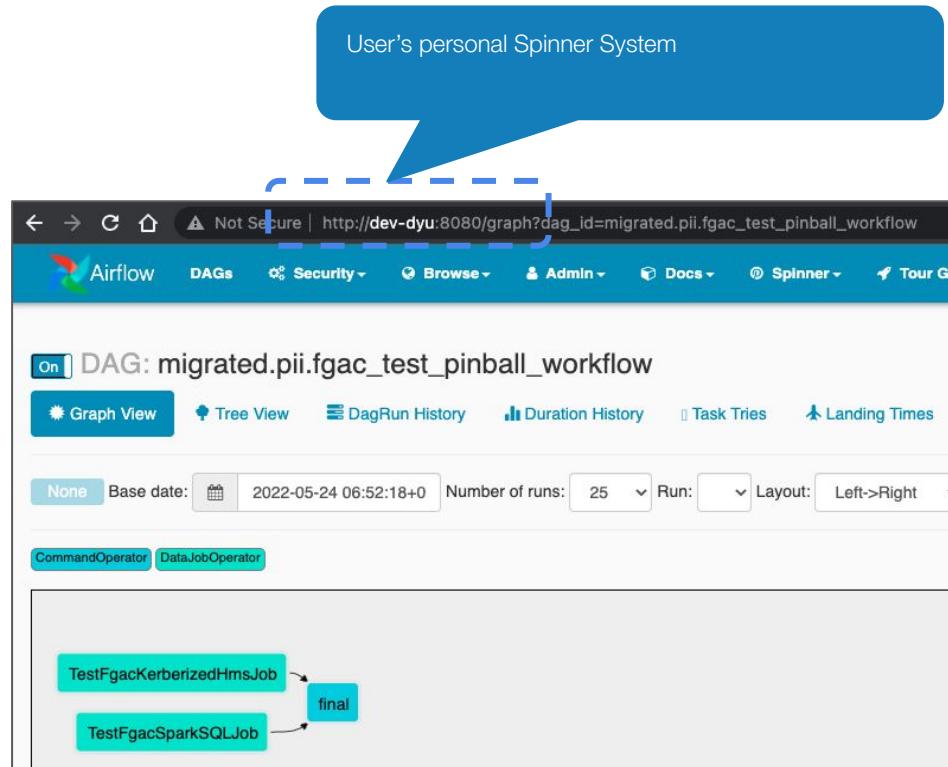
Debuggability

Unified Testing



How can I test changes end to end?

- Single script to bring up a local testing container

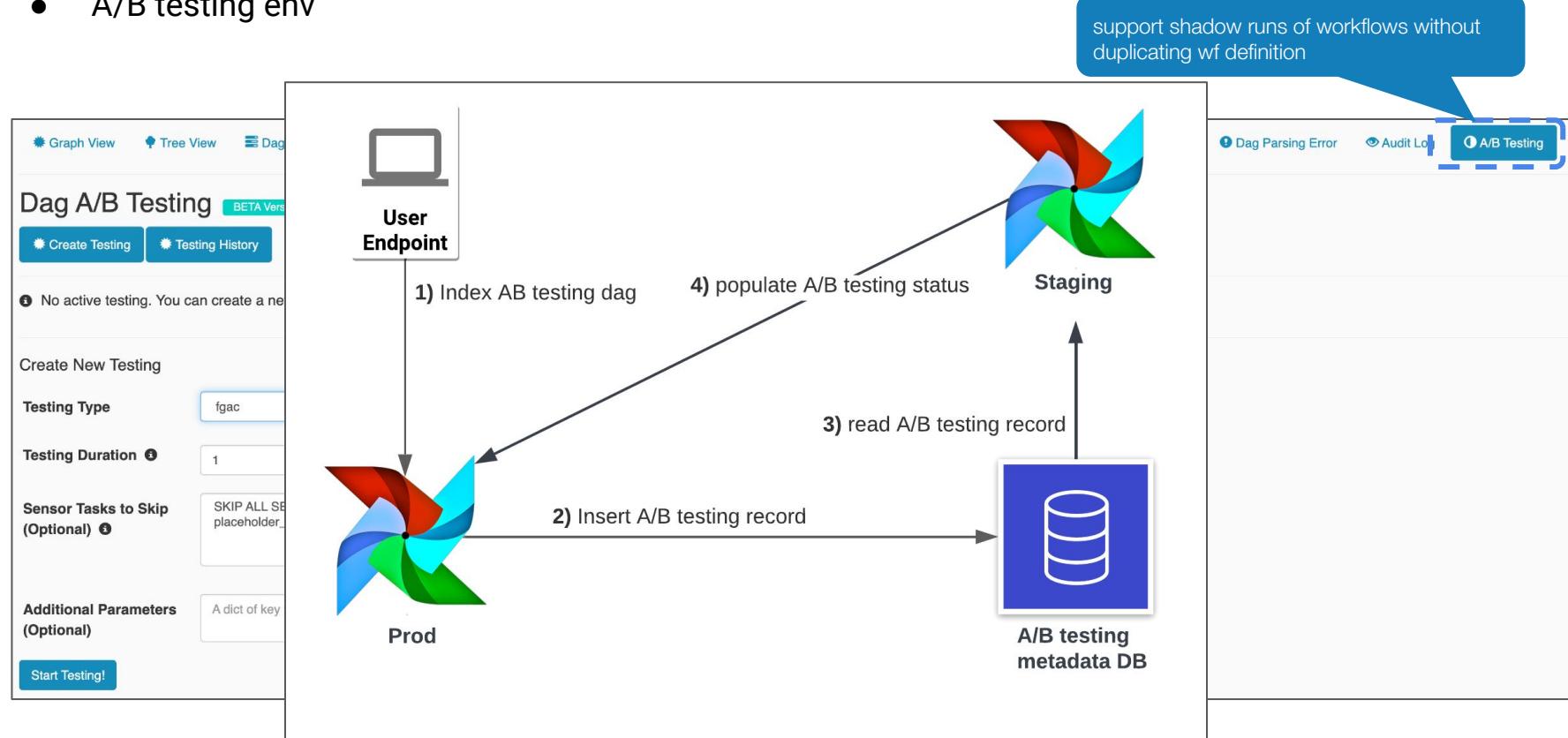


Managed Testing Envs



How can I test experimental changes in prod env without affecting product dags?

- A/B testing env

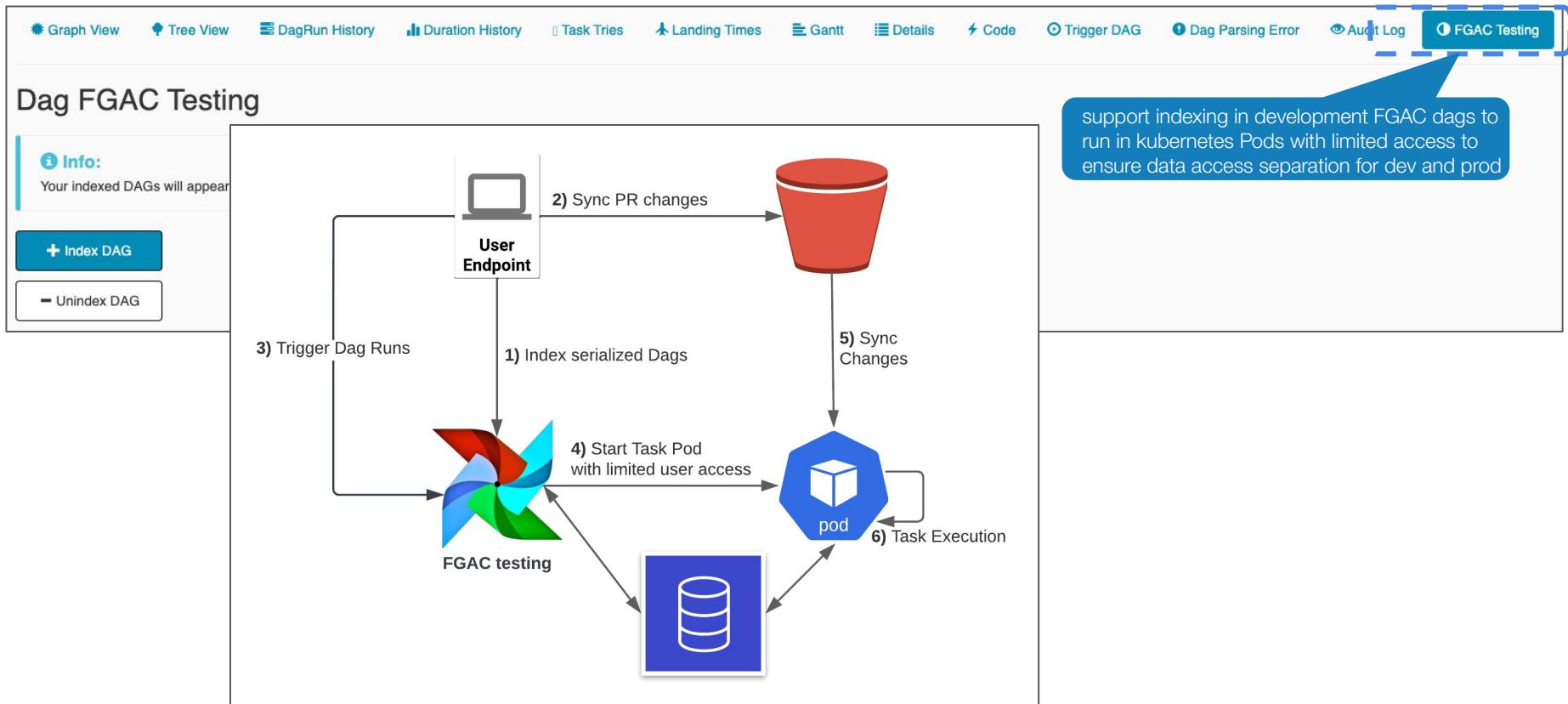


Managed Testing Envs



How can I test in development FGAC dags?

- FGAC testing env



Next Deployment Time



When will my changes be deployed?

2022-05-24, 16:28:16 UTC Deployment Schedule Ace Haidrey ▾

Next estimated deployment time:

spinner-workflows	: in 28 mins
pinboard (migrated)	: in 2 mins
pinboard (native)	: in 1 min

Last deployment finish time:

spinner-workflows	: 15 mins ago
pinboard (migrated)	: 18 hrs 20 mins ago
pinboard (native)	: 22 hrs 24 mins ago

Non Scheduled Reason



My dag did not have an error message, and it still didn't have a run. What can be happening?

New DAG run is not scheduled!

Reason: one of task's `end_date` passed

How to fix

The next scheduled DAG run can't be created because one of its tasks has user-defined `end_date` that already passed. If this is not expected, please update its value.

x

On DAG: migrated.pii.jss_pinball_workflow_w_k8s_pii_merged_pod

schedule: @daily

nonscheduled reason: task_end_date

Graph View

Tree View

DagRun History

Duration History

Task Tries

Landing Times

Gantt

Details

Code

Trigger DAG

Dag Parsing Error

Critical Error Messaging Highlighting

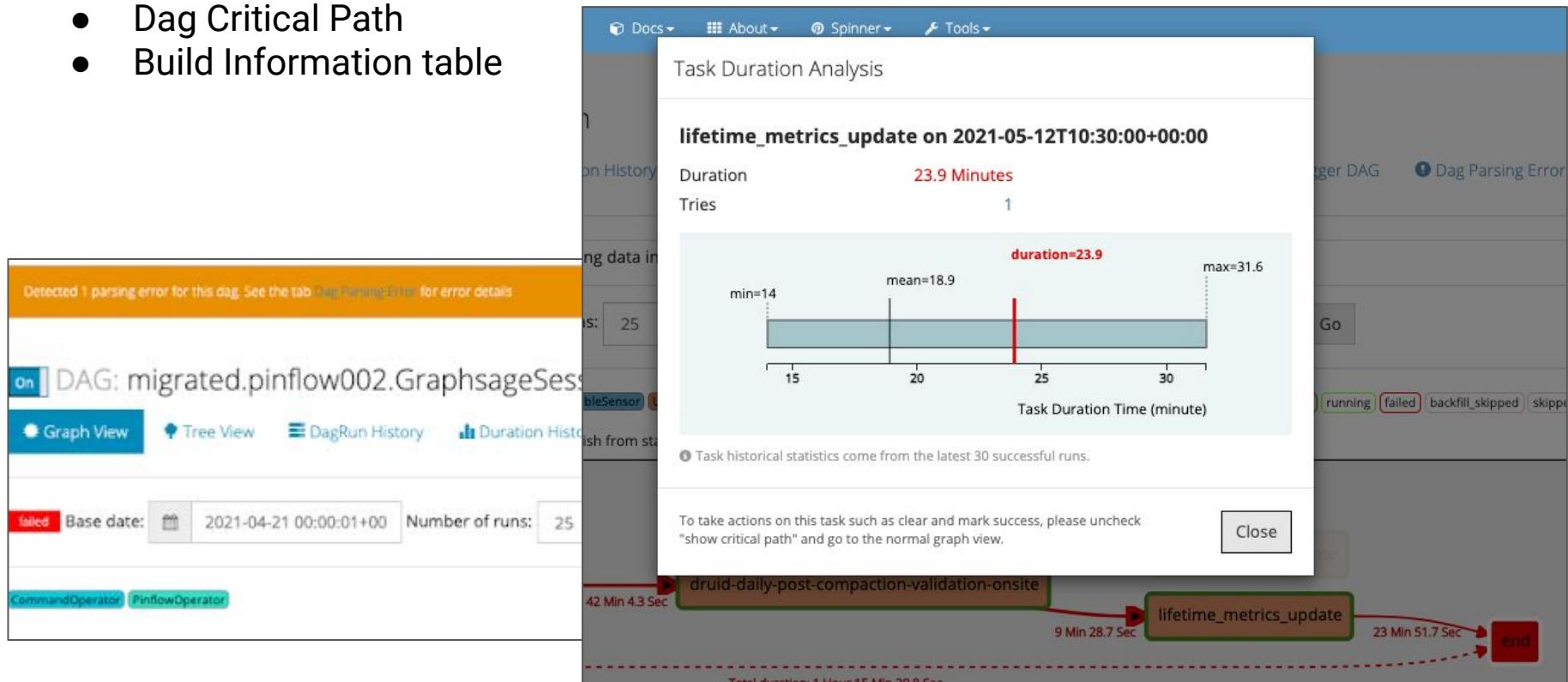


I see the logs but it is too verbose. Is there an easier way to identify the error messages?

```
File "/pinairflow/dags/test_tier_1_0/dyu_test_dag_diff_error_s.py", line 81, in python_knox_issue
    primary_key = AutoKnox(knox_key).get_primary()
File "/usr/local/lib/python3.7/dist-packages/knox/_init_.py", line 401, in __init__
    self.cached_key = self.register_and_get(timeout=timeout)
File "/usr/local/lib/python3.7/dist-packages/knox/_init_.py", line 359, in register_and_get
    raise KnoxException(message)
knox.KnoxException: Knox failed to get key jobservice:does_not_exit: Client says "t=2022-02-04T01:30:35+0000 lvl=error msg="Error" getting key from daemon (hit timeout after 5 seconds); logs for details (most recent error: open /var/lib/knox/v0/keys/jobservice:does_not_exit: no such file or directory)". See /var/log/knox_client.log for details.
[2022-02-04 01:30:35,474+00:00] [1644 MainThread] {logging_mixin.py:90} INFO - [2022-02-04 01:30:35,474+00:00] {stage_base.py:183} INFO - Exiting stage TaskExecStage for task {'environment': 'spinner-test', 'dag_id': 'dyu_test_dag_diff_error_s', 'task_id': 'test_knox_issue', 'execution_date': '2022-02-04T01:28:37.155957+00:00', 'try_number': 1}
[2022-02-04 01:30:36,165+00:00] [1644 Thread-1] {logging_mixin.py:90} INFO - [2022-02-04 01:30:36,164+00:00] {task_exec_stage.py:98} INFO - Done Root Cause Analysis for stage TaskExecStage
Error Category KNOX_ISSUE for task {'environment': 'spinner-test', 'dag_id': 'dyu_test_dag_diff_error_s', 'task_id': 'test_knox_issue', 'execution_date': '2022-02-04T01:28:37.155957+00:00', 'try_number': 1}
[2022-02-04 01:30:36,648+00:00] [1644 MainThread] {taskinstance.py:1513} INFO - Marking task as FAILED.
[2022-02-04 01:30:36,780+00:00] [1644 MainThread] {logging_mixin.py:90} INFO - [2022-02-04 01:30:36,780+00:00] {stage_base.py:162} INFO - Entering stage CallbackStage for task {'environment': 'spinner-test', 'dag_id': 'dyu_test_dag_diff_error_s', 'task_id': 'test_knox_issue', 'execution_date': '2022-02-04T01:28:37.155957+00:00', 'try_number': 1}
[2022-02-04 01:30:37,539+00:00] [1644 MainThread] {configuration.py:246} WARNING - section/key [smtp/smtp_user] not found in config
[2022-02-04 01:30:37,539+00:00] [1644 MainThread] {logging_mixin.py:90} INFO - [2022-02-04 01:30:37,539+00:00] {configuration.py:246} WARNING - section/key [smtp/smtp_user] not found in config
[2022-02-04 01:30:37,773+00:00] [1644 MainThread] {email.py:143} INFO - Sent an alert email to ['dyu@pinterest.com']
[2022-02-04 01:30:37,773+00:00] [1644 MainThread] {logging_mixin.py:90} INFO - [2022-02-04 01:30:37,773+00:00] {email.py:143} INFO - Sent an alert email to ['dyu@pinterest.com']
[2022-02-04 01:30:38,084+00:00] [1644 MainThread] {callback_utils.py:555} INFO - Log job execution record to workflow_job_executions kafka topic upon job completion
[2022-02-04 01:30:38,085+00:00] [1644 MainThread] {logging_mixin.py:90} INFO - [2022-02-04 01:30:38,084+00:00] {callback_utils.py:555} INFO - Log job execution record to workflow_job_executions kafka topic upon job completion
[2022-02-04 01:30:38,169+00:00] [1644 MainThread] {logging_mixin.py:90} INFO - [2022-02-04 01:30:38,169+00:00] {stage_base.py:183} INFO - Exiting stage CallbackStage for task {'environment': 'spinner-test', 'dag_id': 'dyu_test_dag_diff_error_s', 'task_id': 'test_knox_issue', 'execution_date': '2022-02-04T01:28:37.155957+00:00', 'try_number': 1}
[2022-02-04 01:30:38,539+00:00] [1644 MainThread] {taskinstance.py:1327} INFO - [JobExecutionRecord] Updating final status of JobExecutionRecord in the db
[2022-02-04 01:30:38,555+00:00] [1644 MainThread] {taskinstance.py:1350} INFO - [JobExecutionRecord] Updated final status of JobExecutionRecord in the db: JobExecutionRecord(workflow_name=diff_error_s, workflow_cluster=spinner-test, job_name=test_knox_issue, instance_id=manual_2022-02-04T01:28:37.155957+00:00, try_number=1, status=failed, application_id_string=, jss_id=tart_time=2022-02-04 01:30:30, end_time=2022-02-04 01:30:38.545561, project=workflow, tier=tier1, data={"pinairflow_build": "8ed9cb07bbea8dc99f274f968cc5cda9c615bf0f", "pinboard_build": "be3ac0b9dff9af8b5ecd7e01be8c", "spinner_workflows_build": "75bffa10897d829070430db87375781e304d523"})
[2022-02-04 01:30:47,124+00:00] [1517 MainThread] {logging_mixin.py:90} INFO - [2022-02-04 01:30:47,123+00:00] {resource_utilization.py:70} INFO - TASK_ID PROCESS: test_knox_issue PEAK_R
55_4M
```

Debuggability features demoed in Airflow Summit 2021

- Dag Parsing Errors
- Dag Critical Path
- Build Information table



Artifacts Information

Workflows have a lot of moving parts, and this table is to inform you what the commit sha for each major component was at the time of your execution. This will help you understand if any change made were in at the time of the run or not.

Artifact	Build Link	Deploy Status
Pinairflow Build	f88116bdec02bce497d10df9e66a09aa399f5f6e	Lupa Link
Pinboard Build	f027eab8dd24b6a755482a27efab4c284829abad	Lupa Link

Dag Parsing Errors



This dag was supposed to have a run today but it didn't, anything went wrong?



I see an error message saying my dag is broken, what happened?

Detected 1 parsing error for this dag. See the tab [Dag Parsing Error](#) for error details.

Error Type	Dag Filepath	Dag Id	Execution Date	Detected At	Last Updated At	Stacktrace
DagImportError	/pinairflow/dags/spinner_tier_3_0/related_pins/navboost/xperf_navboost_idea_pins.py	None	None	2022-05-24 04:11:46.473727+00:00	2022-05-24 05:23:57.988122+00:00	Traceback (most recent call last): File "/usr/local/lib/python3.7/dist-packages/airflow/models/dagbag.py", line 321, in process_file m = imp.load_source(mod_name, filepath) File "/usr/lib/python3.7/imp.py", line 171, in load_source module = _load(spec) File "<frozen importlib._bootstrap>", line 696, in _load File "<frozen importlib._bootstrap>", line 677, in _load_unlocked File "<frozen importlib._bootstrap_external>", line 728, in exec_module File "<frozen importlib._bootstrap>", line 219, in _call_with_frames_removed File "/pinairflow/dags/spinner_tier_3_0/related_pins/navboost/xperf_navboost_idea_pins.py", line 125, in <module> xperf_external_table_aggregator_job, post_agg_ranking_job, ... = create_x_perf_logic(dag, x_perf_args) File "/pinairflow/versioned/1.0.20220524040817/plugins/dag_plugins/x_perf/create_x_perf_logic_util.py", line 138, in create_x_perf_logic raise AirflowException("xPerf logic: not enough arguments for the aggregation job") airflow.exceptions.AirflowException: xPerf logic: not enough arguments for the aggregation job!

DAGs

Search Dags
 Search Dag Errors

Type dag id or dag filepath to search for dag parsing error records

	DAG	Schedule	Owner	Tier	Recent Tasks	Last Run	DAG Runs
<input checked="" type="checkbox"/>	[On] geo_inia_readable_dumps_workflow	15 12 * * *	[redacted]	tier3	 2	2021-07-13 12:15	219 2
<input checked="" type="checkbox"/>	[On] [redacted]	@weekly	[redacted]	tier3	 7	2021-07-04 00:00	17 8
<input checked="" type="checkbox"/>	[On] [redacted]	0 0 * * *	[redacted]	tier3	 72	2021-07-13 00:00	129 23
<input checked="" type="checkbox"/>	[On] [redacted]	0 * /6 * * *	[redacted]	tier3	 75 1	2021-07-14 12:00	84 1 3

Build information Table



Were changes deployed at the time my task ran?

Task Instance: spark_sql_test_task on 2022-05-23T18:30:00+00:00

[Task Instance Details](#) [Rendered Template](#) [Log](#) [XCom](#) [Quick Actions](#)

Log by attempts

1

Try 1 Execution Stages

Execution pipeline shows the status and time taken for each stage of your task. You can hover over the circles to see stage details and failure root cause analysis.



Artifacts Information

Workflows have a lot of moving parts, and this table is to inform you what the commit sha for each major component was at the time of your execution. This will help you understand if any change made were in at the time of the run or not.

Artifact	Build Link	Deploy Status
Pinairflow Build	f88116bdec02bce497d10df9e66a09aa399f5f6e	Lupa Link
Pinboard Build	f027eab8dd24b6a755482a27efab4c284829abad	Lupa Link
Spinner Workflows Build	b8c24d15473fd5d54950441a29ea36b9f2d7b1d9	Lupa Link

Critical Path Finder



This dag run took 5 hours, why is it so slow?

DAG: ads_reporting_daily_compaction

Graph View Tree View DagRun History Audit Log Refresh

This DAG generates the compacted daily rollup view for ads.

success Base date: 2021-05-12 10:30:01+00 Number of runs: 25

DruidDailyCompactionOperator DruidDailyCompactionValidationOperator Pin

Critical path highlights the pathway where the tasks take the longest time.

Diagram showing the critical path tasks and their execution times:

- onsite_druid_ingestion_sensor → onsite_daily_compaction (5.1 Sec)
- onsite_daily_compaction → druid-daily-post-compaction-validation-onsite (42 Min 4.3 Sec)
- druid-daily-post-compaction-validation-onsite → lifetime_metrics_update (9 Min 28.7 Sec)
- lifetime_metrics_update → end (23 Min 51.7 Sec)

Total duration: 1 Hour 15 Min 29.8 Sec

Task Duration Analysis

lifetime_metrics_update on 2021-05-12T10:30:00+00:00

Duration: 23.9 Minutes

Tries: 1

duration=23.9

min=14 mean=18.9 max=31.6

Task Duration Time (minute)

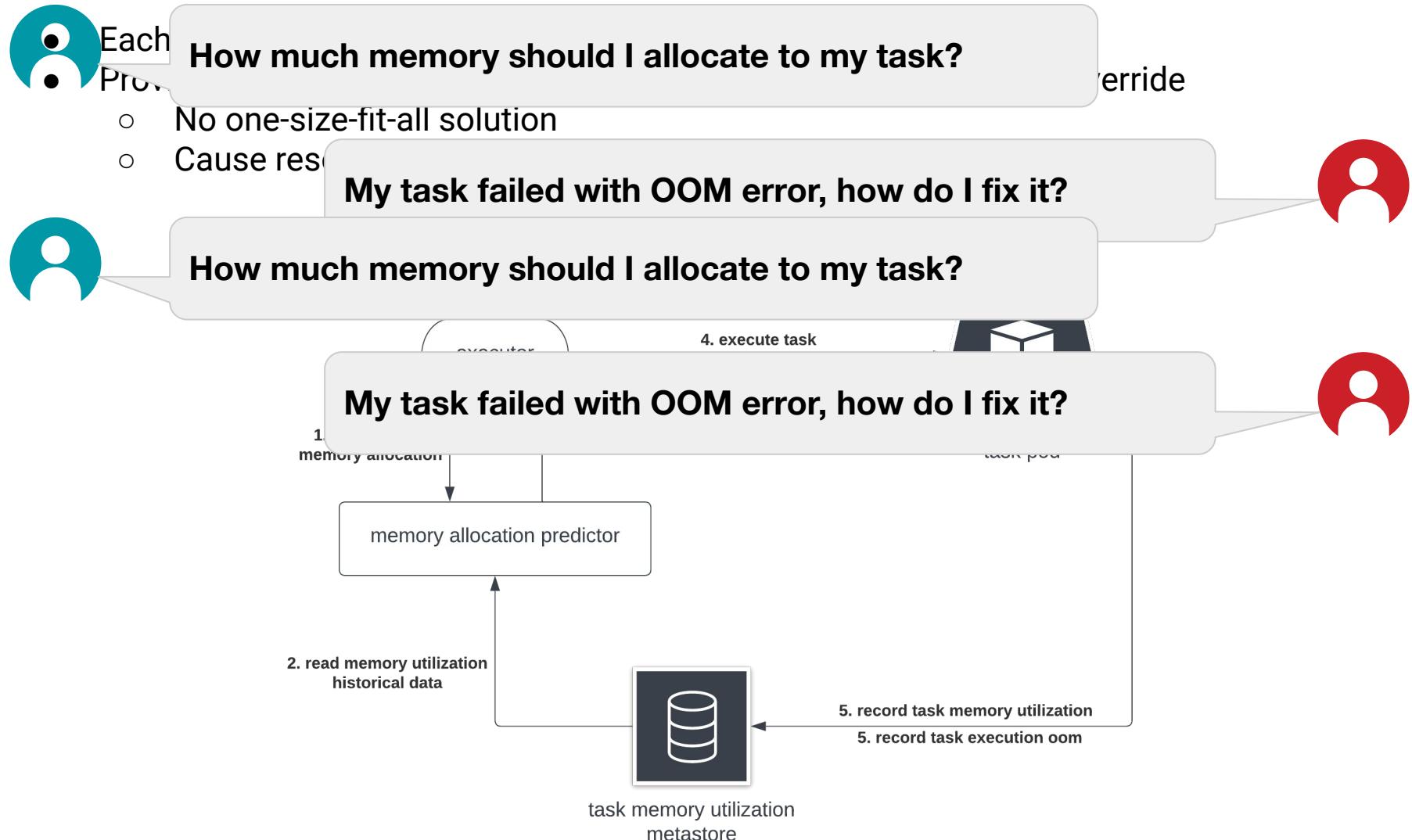
Task historical statistics come from the latest 30 successful runs.

To take actions on this task such as clear and mark success, please uncheck "show critical path" and go to the normal graph view.

Close

Workflow Profiling

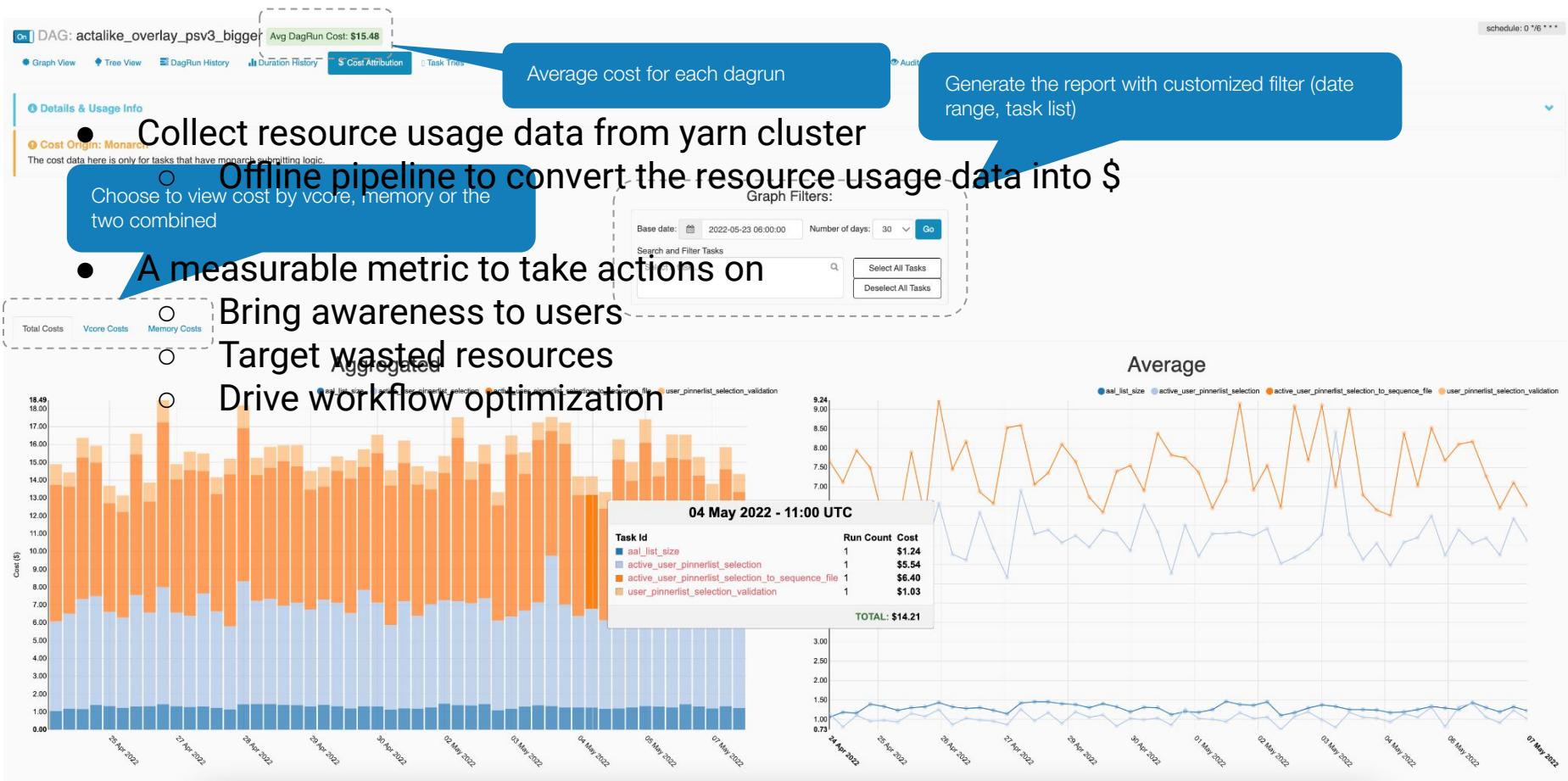
Task Execution Memory Prediction



Workflow Cost Display



How much computing resources do each of my workflow run use?



Workflow Cost Demo



Incident Manager Tooling



I have a few workflow jobs suddenly start to fail today, is there something wrong in Spinner?

DAG Import Errors (54)

Attention Workflow Users !

mitigated IM-8464 Incident: Task failed with OOM error (exit code -9) in Spinner started at 2021-05-06T06:00:00+00:00 mitigated at 2021-05-06T13:20:45+00:00
Increased task failures caused by OOM in Spinner. Workflow tasks failed with error: INFO - Task exited with return code -9. Details in slack #im-8464

reported !!! Spinner Change Freeze is In Effect !!! started at 2021-05-05T12:00:00+00:00
Production Change Freeze for Knit Con has taken effect on Wednesday, May 5, 2021 at 12 noon PT. We expect the change freeze to end on Monday, May 10, 2021 at 10am PT. During the change freeze Spinner does not allow workflow changes in spinner-workflows repo, and Pinboard deploy stops. For more details please consult #workflow. Thank you!

DAGs

	DAG	Schedule	Owner	Tier	Recent Tasks	Last Run	DAG Runs	Links
On	ace_ixia_readable_dump_workflow	15 12 * * *	ads-review	tier3	2	2021-05-05 12:15	151	1
On	actalike_eval_expansion_v4	@weekly	ralekar	tier3	7	2021-04-25 00:00	7	8
On	actalike_expansion_v4	0 12 * * *	pnunez	tier3	138 1 1 2	2021-05-05 12:00	62	1 20
On	add_merchants_to_extended_verified_retailer_domains	@daily	zhechen	tier3	3	2021-05-05 00:00	51	7
On	ads_budget_data_prod	*20 * * * *	sreshtav	tier1	5 2	2021-05-06 20:00	765	1 91
Off	ads_budget_data_staging	*20 * * * *	sreshtav	tier1	1	2021-05-06 20:00	1	1

Incident Management Admin Tooling

Add New Incident

Status *	reported
Incident status must be reported, mitigated, or closed	
Reporter *	root
Name *	Name

All Incidents

Record Count: 5

	ID	Status	Reporter	Name	Description	Jira	Severity	Allow Auto Retry	Created At	Updated At
<input type="checkbox"/>	377	closed	euccaschen	Incident: Task failed with OOM error (exit code -9) in Spinner	Increased task failures caused by OOM in Spinner. Workflow tasks failed with error: INFO - Task exited with return code -9. Details in slack #im-8464. [Update 3:07PT] we have just bumped the default memory settings for Spinner native tasks, you can RETRY your previously failed tasks and the new memory settings should be sufficient!	IM-8464	1	No	2021-05-06 20:18:13+00:00	2021-05-07 20:22:40+00:00
<input type="checkbox"/>	376	closed	euccaschen	!!! Spinner Change Freeze is In Effect !!!	Production Change Freeze for Knit Con has taken effect on Wednesday, May 5, 2021 at 12 noon PT. We expect the change freeze to end on Monday, May 10, 2021 at 10am PT. During the change freeze Spinner does NOT allow landing workflow changes in spinner-workflows repo without an approved Change Management ticket, and Pinboard deploy stops. For more details please consult #workflow. Thank you!		1	No	2021-05-05 21:22:12+00:00	2021-05-10 17:05:41+00:00
<input type="checkbox"/>	375	closed	euccaschen	Incident Notification is enabled in Spinner	Ongoing incidents that impact Spinner workflows will be shown here! You can close this banner using the x button on the right side.		1	No	2021-04-30 05:22:55+00:00	2021-05-05 19:06:05+00:00
<input type="checkbox"/>	311	closed	euccaschen	Spinner web down due to endpoint-register issue in canary	spinner.pinadmin.com is not accessible, with "upstream request timeout" error.	IM-8253	3	No	2021-04-26 06:54:40+00:00	2021-05-04 01:59:38+00:00
<input type="checkbox"/>	309	closed	euccaschen	[Drill] Service discovery for MySQL problem blocked spinner scheduling	spinner new tasks cannot be scheduled.	IM-8138	1	No	2021-04-22 05:32:38+00:00	2021-05-05 18:28:26+00:00

Allow failed tasks to retry or not, 0 means disallow, 1 means allow

Save

Incident Management Smart Retries



Is there a way for retrying all failed jobs if the platform had an issue?

Allow Auto Retry *

0

Allow failed tasks to retry or not, 0 means disallow, 1 means allow

Triggering Dag Clarification



I try to trigger my dag manually but the conf doesn't work right?

 Click here to learn how to use the Configuration JSON option.

If you want to pass extra configurations to the DAG run, you can put the configuration in the form. Please note the type of your configuration must be a dictionary, and other formats are disallowed. You can take look at the below examples or [read on the open source doc](#) to better understand the usage.

A valid configuration example:

```
{ "input_key": "input_value" }
```

Both the **key** and the **value** are enclosed in double quotes (") and everything is wrapped in curly braces ({}).

An invalid configuration example:

```
"input_key": "input_value"
```

How can I access this configuration in my DAG?:

Configuration JSON:

```
{ "input_key": "input_value" }
```

Using input_key in the code:

```
from airflow import DAG
from airflow.operators.bash import BashOperator
from airflow.utils.dates import days_ago

dag = DAG("example_parameterized_dag", schedule_interval=None, start_date=days_ago(2))

parameterized_task = BashOperator(
    task_id='parameterized_task',
    bash_command="echo value: {{ dag_run.conf['input_key'] }}", # ==> using the given "input_key"
    dag=dag,
)
```

Note

The parameters from `{{ dag_run.conf }}` can only be used in a template field of an operator.

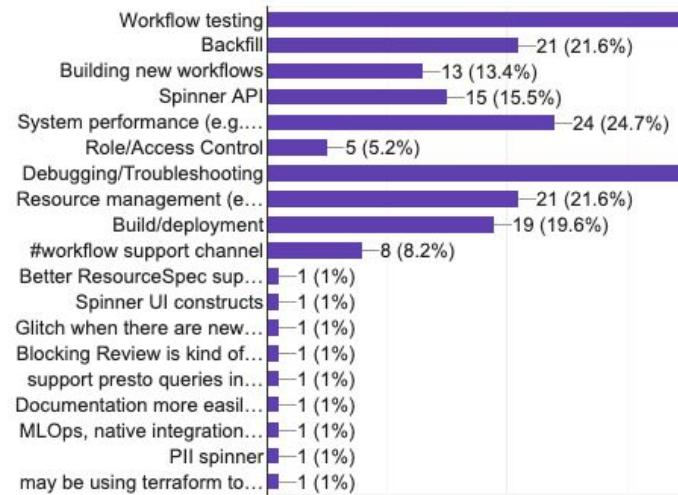
Wrap Up

Identifying What Users Want

Focus Areas

Select the top 3 areas you'd like enhanced

97 responses



Spinner
[By spinner](#)

Summary

Reviews

Analytics

Requests

Uptime

Edit

Open

Order By: Trending ▾ Filter By: Open ▾

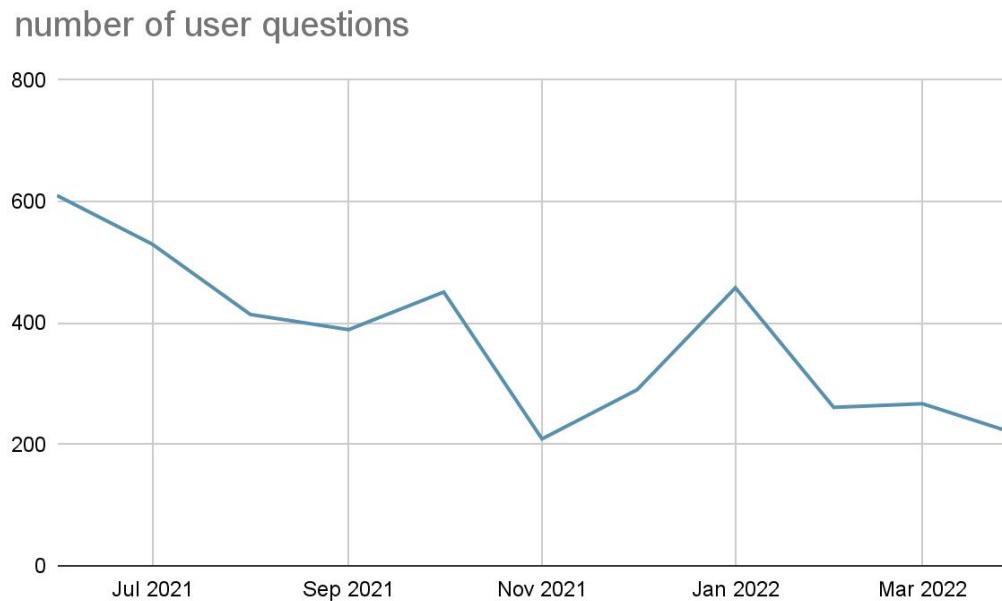
+ Create a New Request

- ▲ 12 Sending alerts when a dagrun or workflow can't finish within its SLO >
- ▲ 5 Support for retrying a job with new parameters
- ▲ 0 Paste ability for a comma separated task list into the backfill form
- ▲ 7 Add an Option to Turn off Alerts for backfill runs
- ▲ 0 Ensure compatible artifacts are used in jobs that depend on multiple deployment pipeli...
- ▲ 5 Workflow team will create JIRA tickets for the requests have more upvotes! (>=5)
- ▲ 3 Differentiate 'Success' with 'Marked as Success'
- ▲ 3 Support send_dag_level_fail_email param similar to send_dag_level_failure_message (...)
- ▲ 3 Frequent pinboard deploys to both migrated & native environments
- ▲ 2 Differentiate the PROD Spinner UI and devapp Spinner UI
- ▲ 2 support multi-partition sensor
- ▲ 2 Add a '[DAG Final]' node in Graph View
- ▲ 1 add Callback hook for native spinner when job is marked failed/success
- ▲ 1 Run access control scripts automatically for spinner users

User Surveys

Wrap Up

- Our goal is to make the Spinner workflow system more **usable**
 - Improve the workflow discoverability for our multi-environment setup
 - Streamline the debugging experience
 - Profile workflow and surface data on UI
 - ...
- Meanwhile, free the system admins from heavy & repetitive user support routine
 - Drop in our user support load



Future Work

- Improvements to the cost report to include other infra costs
- Search by the task_id, not just the dag_id
- Features to further reduce noise and identify errors in the logs
 - Improvement in log filtering tooling
 - Link source code in error messages
- Upgrade Airflow Version to 2.0+
- Blog post regarding UI feature development
- And More!

Additional Resources

- Airflow Summit 2021:
 - [Pinterest's Migration Journey](#)
 - [Usability Improvements for Debugging](#)
- Airflow Summit 2020:
 - [Airflow as the next gen of workflow system at Pinterest](#)
- Tech Blog
 - [Spinner: Pinterest's Workflow Platform](#)
 - [Spinner: The Mass Migration to Pinterest's New Workflow Platform](#)

Thank you!



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The Faces Behind The Work