Orchestrating & Optimizing a Batch Ingestion Data Platform for Americas #1 Sportsbook

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AGENDA

Introduction to FanDuel Group

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Overview of FanDuel Group

- Innovative sports-tech entertainment company
- Diverse portfolio – gaming, sports betting, daily fantasy sports, advance deposit wager, TV/media

Market Presence

- Operating in all 50 states
- Serving ~17 million customers
- Nearly 30 retail locations

Industry Leadership

- As of 2023…
  - #1 sports betting company in US
  - Fastest growing operator in iGaming
  - First US online operator to turn a profit for a full year

Workforce

- Over 4,000 employees
- 1,600+ in Technology
- ~100 in Data Engineering

Batch Ingestion Data Platform Evolution

2013 - Luigi

Onset of development for batch pipelines

2018 - Erie

Libraries - code reusability

Alembic - data warehouse migrations are "self-served" Infrastructure-as-Code

Python 3

Airflow - improved scalability

2019 - Automata

Erie lacked standardization

Code reusability - enforced consistency

TOML files vs. Python - faster scalability of business

2022 - Automata v2

All Airflow deployments managed by Astronomer

Improved consistency in meeting internal SLAs for business-critical pipelines

2023 - Automata v3

Cost optimizations - separate deployments per business vertical

Increased data governance - serve regulatory compliance reporting & daily business reports

Present

By the numbers…

Astronomer Workspaces	Astronomer Deployments
3	**17**
Monthly DAG Runs	Monthly Tasks Executed
350K+	**3.6 M**

Creating & Managing DAGs

Automata

- Greek for “self-acting, self-willed, self-moving”
- Internal name for FanDuel’s batch ingestion data platform
- Orchestrator that serves both data and product needs – testament to the extensibility and generality of the batch ingestion platform
    - *Data*: ingest data from a source → perform data transformations → move data to storage
    - *Product*: perform custom-built, self-served steps as specified by a user
- Automated data processing managed by an internal team so stakeholders can place more efforts on business deliverables

What has made it successful?

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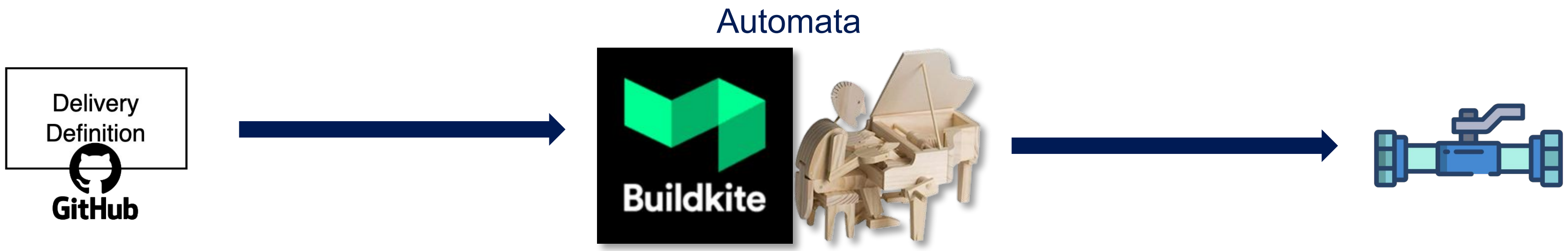
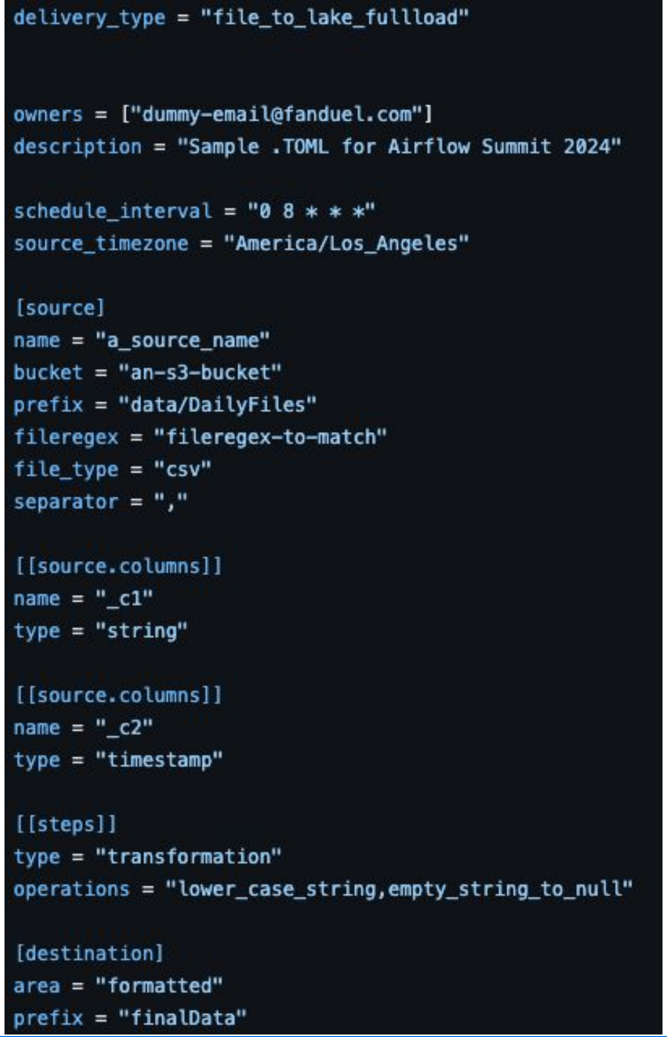
Self-serving data platform with standardized way of pipeline development



“The **goal** of software architecture is to **minimize** the **human resources** required to build and maintain the required system.”

Delivery Definition Example

- Sources:
  - JDBC, file sources (.csv, .zip, .parquet, etc.), Kafka, Redshift, SFTP
- Destinations:
  - Delta Lake, FTP, Lake, Redshift, S3
- Cleansing/Light Transformations:
  - Time zone conversions, data type standardizations, permission settings (PII)

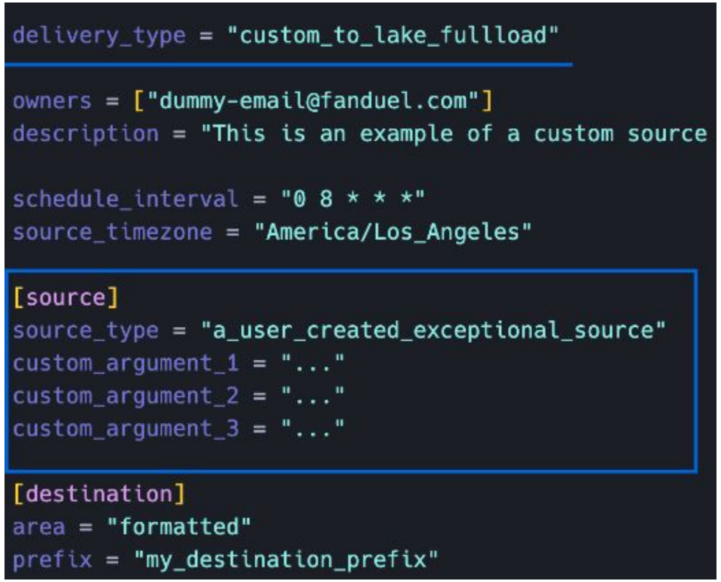


```
delivery_type = "file_to_lake_fullload"


owners = ["dummy-email@fanduel.com"]
description = "Sample .TOML for Airflow Summit 2024"

schedule_interval = "0 8 * * *"
source_timezone = "America/Los_Angeles"

[source]
name = "a_source_name"
bucket = "an-s3-bucket"
prefix = "data/DailyFiles"
fileregex = "fileregex-to-match"
file_type = "csv"
separator = ","

[[source.columns]]
name = "_c1"
type = "string"

[[source.columns]]
name = "_c2"
type = "timestamp"

[[steps]]
type = "transformation"
operations = "lower_case_string,empty_string_to_null"

[destination]
area = "formatted"
prefix = "finalData"
```

Which scenarios should the platform self-serve?

80/20 Principle

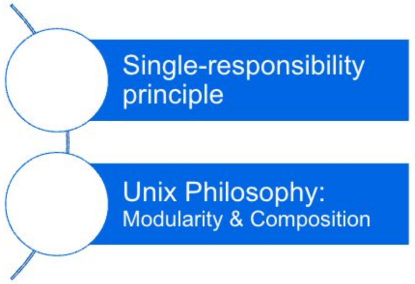
- Cover **most-common** data pipeline requirements
- Give the ability to users to **“hook up” custom code** in a self-serving fashion



```
delivery_type = "custom_to_lake_fullload"

owners = ["dummy-email@fanduel.com"]
description = "This is an example of a custom source

schedule_interval = "0 8 * * *"
source_timezone = "America/Los_Angeles"

[source]
source_type = "a_user_created_exceptional_source"
custom_argument_1 = "..."
custom_argument_2 = "..."
custom_argument_3 = "..."

[destination]
area = "formatted"
prefix = "my_destination_prefix"
```

Enforce consistency in the design of data pipelines

- “A data pipeline should have one, and only one, reason to change.”
- “Make each data pipeline do one thing well.”
- “Be able to compose more complex pipelines from simpler ones.”



Single Data source
Single Data destination

Automata is a factory of data pipelines:

✔Code is **re-used** inside the platform

✔Pipeline-generation code is **tested once and used many times**

Monitoring and Troubleshooting

Monitoring, Alerting, & Observability Overview

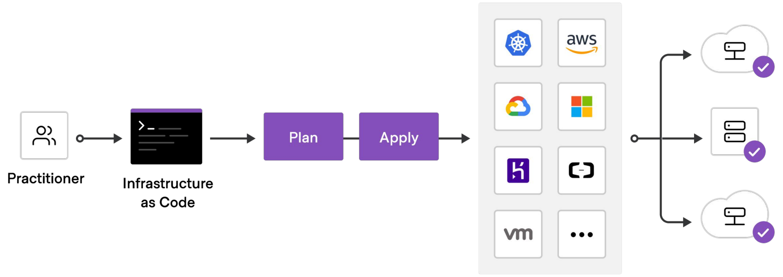
An attractive feature to the batch ingestion data platform is structure monitoring, alerting, & observability

Technologies utilized:

- Terraform
- Slack & PagerDuty integrations
- Datadog
- Databand

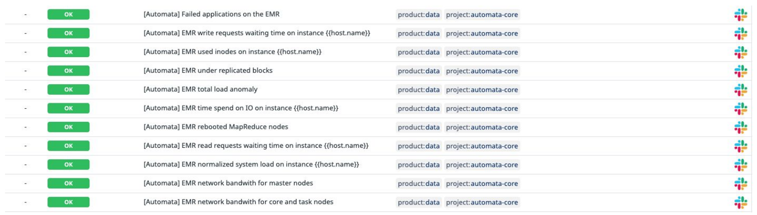
Terraform: Infrastructure-as-Code

- Terraform allows the team to **manage infrastructure** in a safe, consistent, and repeatable way by defining resource configurations that can be **versioned and reused**
- Deploy configurations in different environments in a seamless manner
- Utilized to define:
  - Platform infrastructure for cloud compute resources
  - Datadog monitors and dashboards

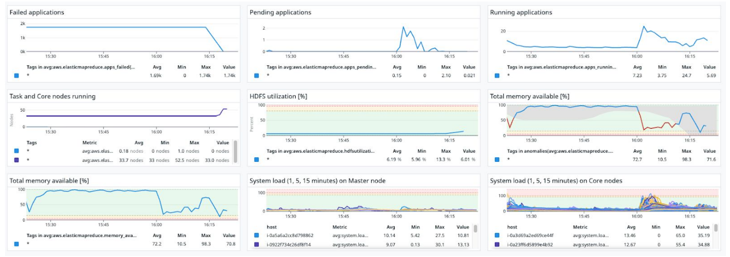


Datadog: Platform Compute Resource Monitoring

- Datadog is the primary tool utilized for data platform engineers to monitor various **performance and health metrics on compute resources** such as EMR, RDS, EKS, Airflow deployments, etc.
- Integrated with PagerDuty as well as dedicated alerting Slack channel
- Provides the ability to configure monitors with **adjustable thresholds** for iterative fine-tuning
- Aids in identifying issues before they escalate
- Dashboards provide **observability** benefits that have been particularly useful on **business-critical events** – 100% uptime throughout 2024 Super Bowl

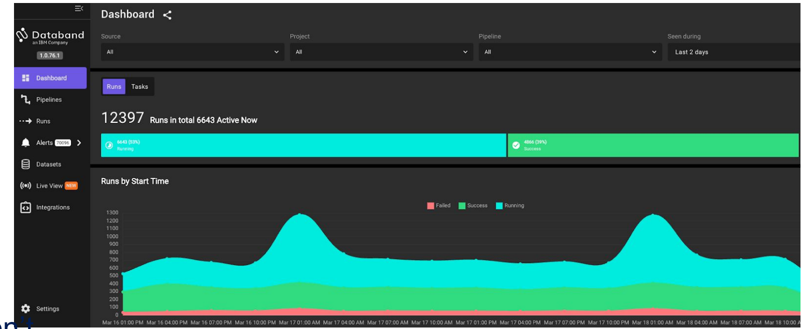


-	OK	[Automata] Failed applications on the EMR	product:data	project:automata-core
-	OK	[Automata] EMR write requests waiting time on instance {{host.name}}	product:data	project:automata-core
-	OK	[Automata] EMR used inodes on instance {{host.name}}	product:data	project:automata-core
-	OK	[Automata] EMR under replicated blocks	product:data	project:automata-core
-	OK	[Automata] EMR total load anomaly	product:data	project:automata-core
-	OK	[Automata] EMR time spend on IO on instance {{host.name}}	product:data	project:automata-core
-	OK	[Automata] EMR rebooted MapReduce nodes	product:data	project:automata-core
-	OK	[Automata] EMR read requests waiting time on instance {{host.name}}	product:data	project:automata-core
-	OK	[Automata] EMR normalized system load on instance {{host.name}}	product:data	project:automata-core
-	OK	[Automata] EMR network bandwith for master nodes	product:data	project:automata-core
-	OK	[Automata] EMR network bandwith for core and task nodes	product:data	project:automata-core


Failed applications
Pending applications
Running applications
Task and Core nodes running
HDFS utilization [%]
Total memory available [%]
Total memory available [%]
System load (1, 5, 15 minutes) on Master node
System load (1, 5, 15 minutes) on Core nodes

Databand: Pipeline Specific Monitoring & Alerting

- Databand is the primary mechanism for pipeline owners to **define and customize alerts on a per pipeline and task basis**
- Integrated with PagerDuty as well as dedicated alerting channels within Slack
- Alerts are defined with respect to:
  - Pipeline run and state (running/success/failure)
  - Schema changes (column type change, column added, column removed, etc.)
  - Missing dataset operation (dependent operations to a pipeline aren't operational)
  - Custom task metrics (anomaly detection)



Source: All
Project: All
Pipeline: All
Seen during: Last 2 days

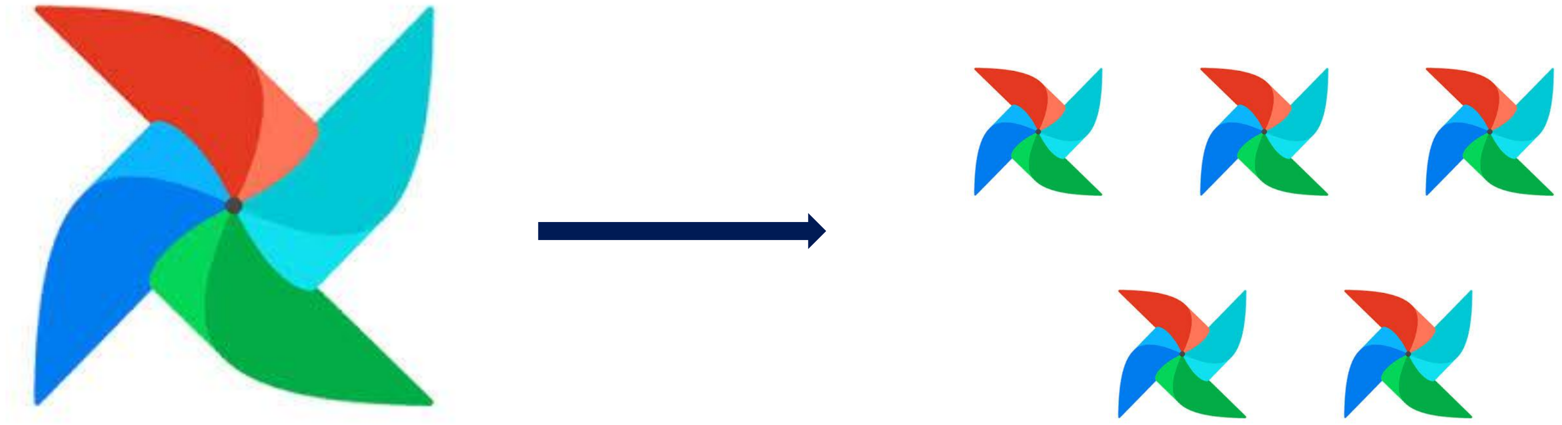
12397 Runs in total 6643 Active Now

6643 (53%) Running
4866 (39%) Success

Scaling and Optimization

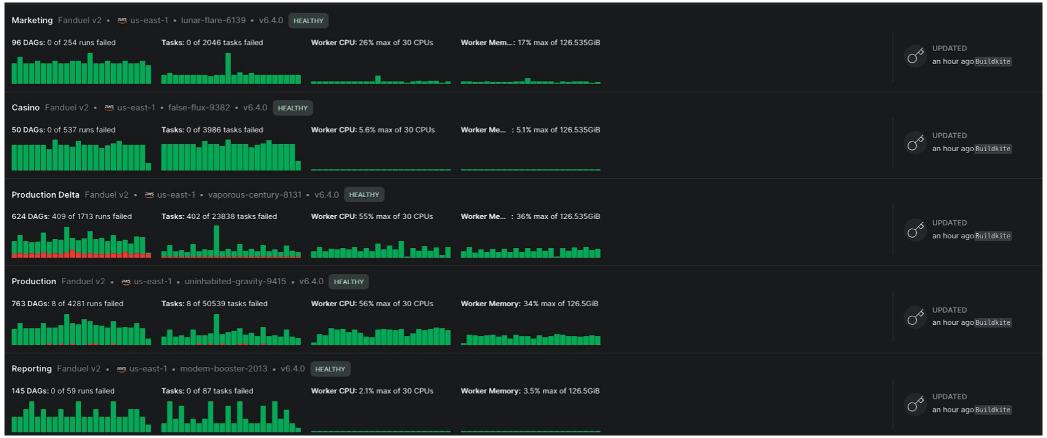
Decoupling a Monolithic Deployment

- In 2022, saw over a 3x increase in the number of production pipelines
- Continuing to operate under one production monolithic deployment posed several risks to the **robustness of the platform**
- Set out to create separate deployments segmented by business vertical, which provided several benefits



Decoupling a Monolithic Deployment

- ✔ Security – restricting access to individuals on a **“need-to-have” basis**
- ✔ Stability – as the volume of data ingestion increases, the **blast radius is reduced** on production issue
- ✔ Scalability – **enhanced governance** on Astronomer deployment configuration parameters on a per deployment basis



Marketing Fanduel v2 • us-east-1 • lunar-flare-6139 • v6.4.0 HEALTHY
96 DAGs: 0 of 254 runs failed | **Tasks:** 0 of 2046 tasks failed | **Worker CPU:** 26% max of 30 CPUs | **Worker Mem...:** 17% max of 126.535GiB
UPDATED an hour ago Buildkite

Casino Fanduel v2 • us-east-1 • false-flux-9382 • v6.4.0 HEALTHY
50 DAGs: 0 of 537 runs failed | **Tasks:** 0 of 3986 tasks failed | **Worker CPU:** 5.6% max of 30 CPUs | **Worker Me... :** 5.1% max of 126.535GiB
UPDATED an hour ago Buildkite

Production Delta Fanduel v2 • us-east-1 • vaporous-century-8131 • v6.4.0 HEALTHY
624 DAGs: 409 of 1713 runs failed | **Tasks:** 402 of 23838 tasks failed | **Worker CPU:** 55% max of 30 CPUs | **Worker Me... :** 36% max of 126.535GiB
UPDATED an hour ago Buildkite

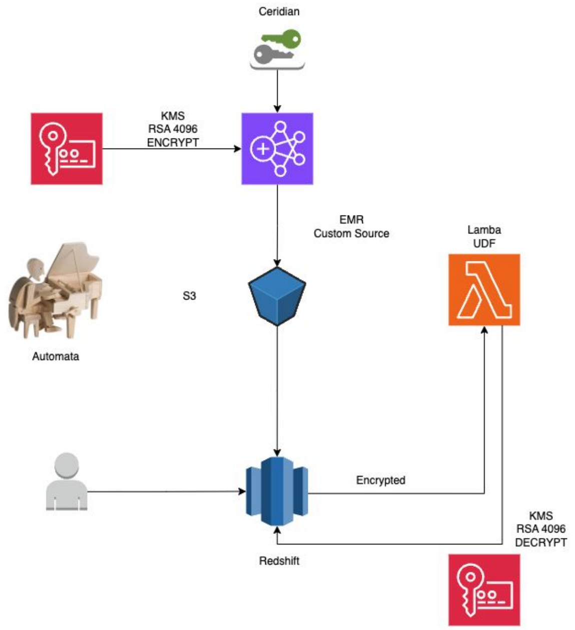
Production Fanduel v2 • us-east-1 • uninhabited-gravity-9415 • v6.4.0 HEALTHY
763 DAGs: 8 of 4281 runs failed | **Tasks:** 8 of 50539 tasks failed | **Worker CPU:** 56% max of 30 CPUs | **Worker Memory:** 34% max of 126.5GiB
UPDATED an hour ago Buildkite

Reporting Fanduel v2 • us-east-1 • modem-booster-2013 • v6.4.0 HEALTHY
145 DAGs: 0 of 59 runs failed | **Tasks:** 0 of 87 tasks failed | **Worker CPU:** 2.1% max of 30 CPUs | **Worker Memory:** 3.5% max of 126.5GiB
UPDATED an hour ago Buildkite

~$10k/mo savings in EC2 instances

Additional Optimizations: Sensitive PII Data with Encryption Requirements

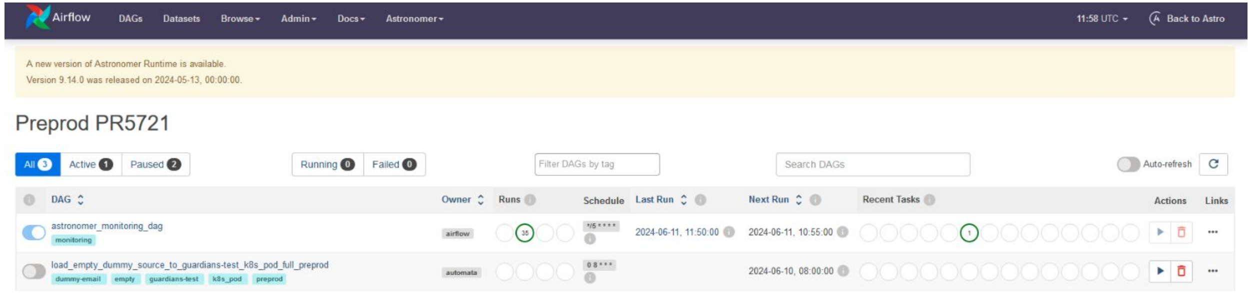
- Restricted access to only stakeholders
- Separate IAM permissions to connections and secrets per workspace
- Users without access to the deployment will not be able to turn on/off the pipelines



Data remains encrypted throughout the whole process, even when it's copied to Redshift

Additional Optimizations:
Auto-Scaling of Development Environments

- Developers can provision dedicated Airflow deployments for testing changes in Pull Requests prior to merging to production
- Integrates with CI/CD steps (Buildkite) – Pull Request and deployment IDs documented in Postgres database
- Maintenance DAG runs to delete deployments and database records that are 8+ hours old



A new version of Astronomer Runtime is available.
Version 9.14.0 was released on 2024-05-13, 00:00:00.

Preprod PR5721

DAG	Owner	Runs	Schedule	Last Run	Next Run	Recent Tasks	Actions	Links
astronomer_monitoring_dag monitoring	airflow	35	*/5 * * * *	2024-06-11, 11:50:00	2024-06-11, 10:55:00	1		•••
load_empty_dummy_source_to_guardians-test_k8s_pod_full_preprod dummy-email empty guardians-test k8s_pod preprod	automata		0 8 * * *		2024-06-10, 08:00:00			•••

Future Trends and Considerations

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How else can Automata be leveraged outside data engineering?

Batch ingestion data platform provides value to the organization for being the primary tool for **orchestrating scheduled jobs**

- Scheduling logging & reporting via Buildkite for business analytics & **extrapolating insights**
- Automating process for sending scheduled emails to customers on performed transactions for tax purposes
- Migrating Casino iOS game files and automating the process of delivering them to the iOS App Store

Conclusion

Key Principles of Automata

- ✔ **Self-Service**: allows users to interact with and create data pipelines through writing easily digestible .TOML files
- ✔ **Standardization**: enhances the reliability and maintainability of the platform as well as improvements to consistently meeting SLAs
- ✔ **Scalability**: yields substantial performance improvements and cost reductions with multiple workspaces and deployments
- ✔ **Observability**: enables monitoring for a centralized platform at a granular level with circa 100 engineers actively contributing to it
- ✔ **Orchestration Diversity**: provides the framework to the creation of data pipelines in a streamlined manner and enlightens other business cases outside of data

Questions?

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