Elevating Data Quality:
Great Expectations and Airflow at PepsiCo

Russell Lamb

Airflow Summit

Let's flow together

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Toronto, Canada

Introduction

WHO AM I?

Name
Russell Lamb

Role
Retail Data Engineering Lead in PepsiCo's eCommerce

Mission
Deliver retailer data to drive value for eCommerce

Based in
Me: New York - Team: Asia, Europe, USA

Favorite PepsiCo Products
SodaStream + Cool Ranch Doritos

Why do I love Airflow?
Flexible, scalable, extensible

PepsiCo: Global Presence & Powerful Portfolio

BEVERAGES

FOODS & SNACKS

Performance

More than **$79 billion** net revenue in 2021

Brands

23 billion-dollar brands

Scale

More than **200** countries & territories

Purpose

Creating **Growth & Value**

Consumers Get our Products via 3 Main Channels

Retail

Consumers buy our products to consume at home. Many types of Retailers, offering a wide variety of brands and flavors.

Foodservice

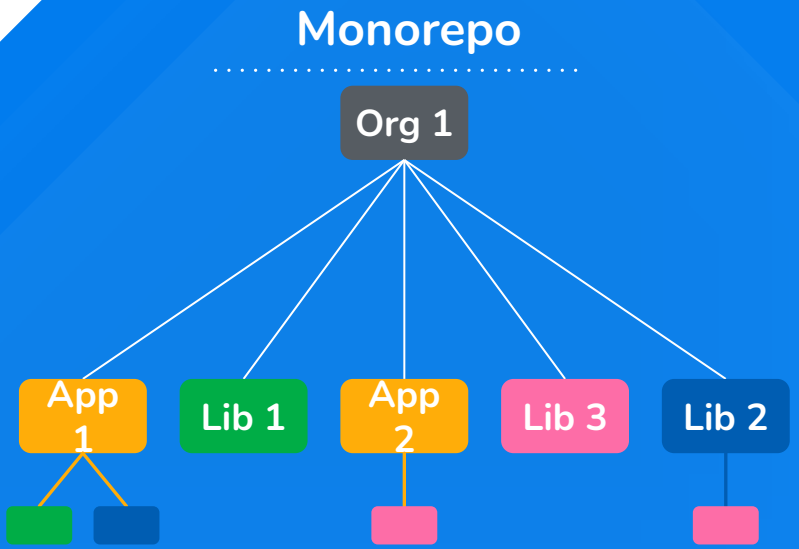
Consumers buy our products outside of a retail location to consume on site. Usually our brands are exclusive at that site.

Ecommerce

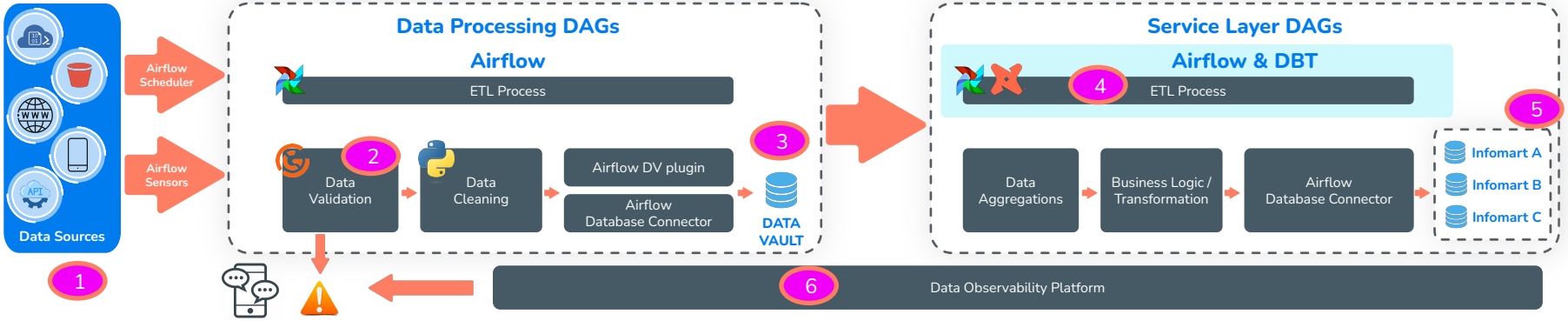
Consumers buy our products via online merchants to have either delivered to their home or pick-up in store.

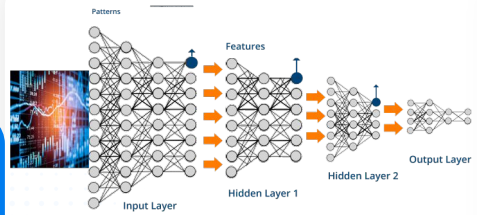
Airflow Usage

- **800+ active Production Airflow pipelines**
  - Self-hosted Airflow on managed Kubernetes
  - Multi-cloud: AWS and Azure
  - Dedicated data platform team in-house
- **50+ Data Sources**
  - Mostly customers, some 3rd party providers
  - Multiple data types & formats
- **Multi-team Airflow instance**
  - Tag Airflow jobs by team
  - Mono-repo: Shared code repository with several teams
- **Decentralized Development**
  - Data Vault Airflow plug-in
  - Distributed ownership by domain
  - Collaborative governance
  - Shared data models

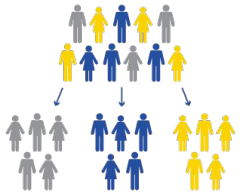


Modern Data Platform & Architecture





Tensorflow / Deep Learning algorithms



Segmentation / Clustering

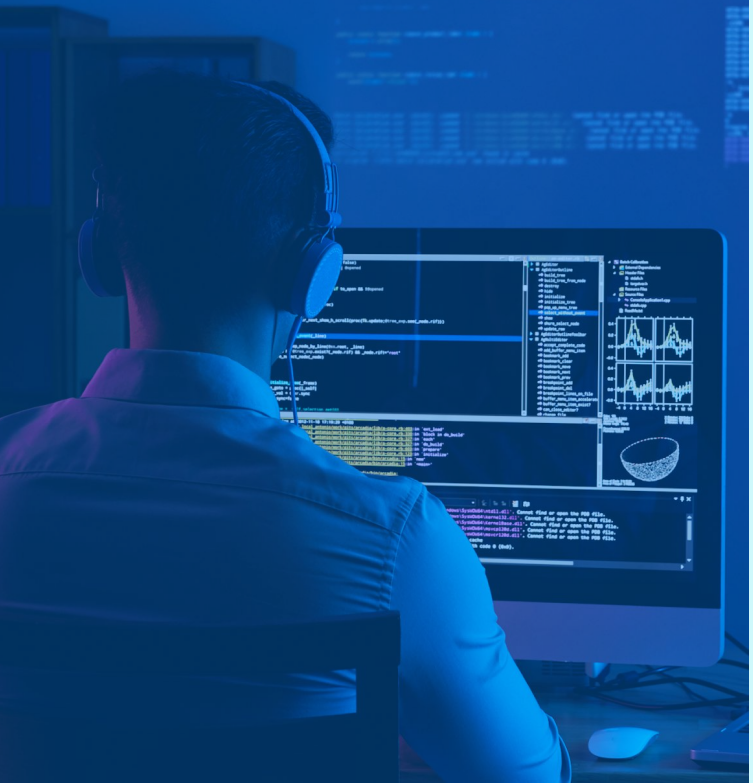
Spark connector

Analytics jobs

Applications

Business Intelligence

Data Quality – Challenges



Schema Changes

- Monitoring needed for consistency
- Data is 2nd and 3rd party

Bad Data Hard to Remove

- Requires changes to production
- Custom logic used once

Docs for Data

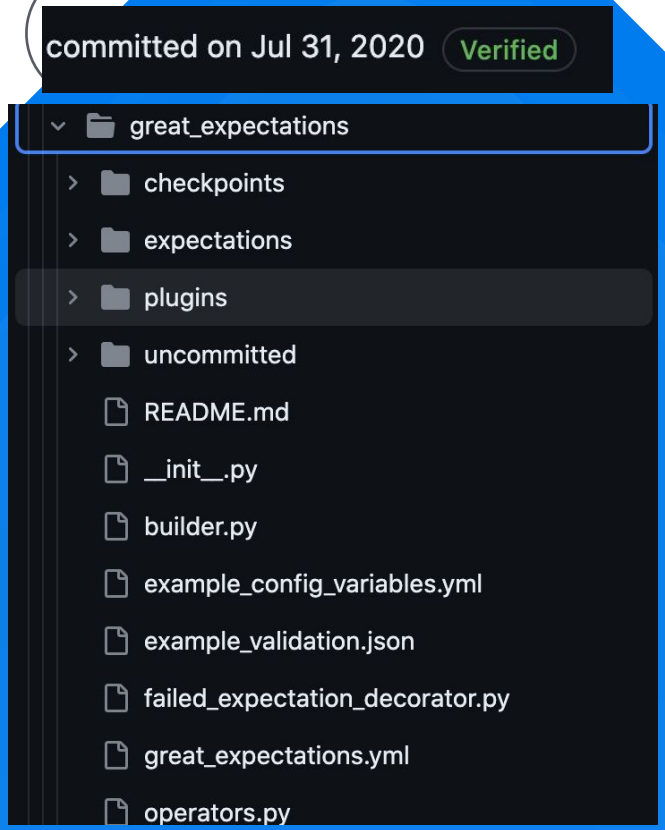
- Capturing the business context
- What does good data look like?

Errors

- Missing Data
- Duplicates

Our Solution

- **Great Expectations**
  - Version 0.13, July 2020
  - 300+ Expectation suites
  - Soft fail vs Hard fail
- **Custom Code**
  - Expectations Operator for Cloud Storage and Database
  - Action class for Slack and Rendering
  - Action for Data Docs Rendering
- **Why**
  - More notification options, e.g. multi-channel
  - Handling Authentication, especially on Azure
- **Many options “out of the box”**
  - GreatExpectationsOperator
  - Webhook for Slack
  - Use existing data docs



What is Great Expectations?

Great Expectations

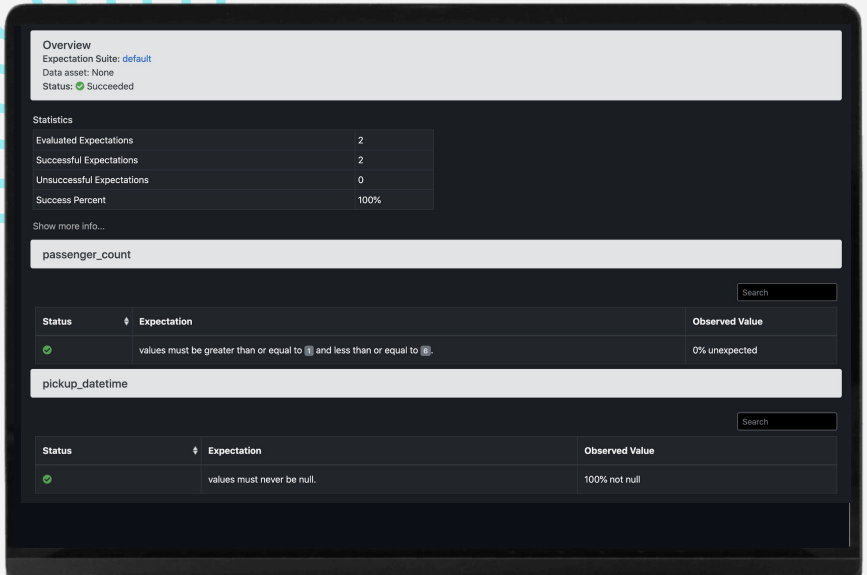
- Python library
- Open Source

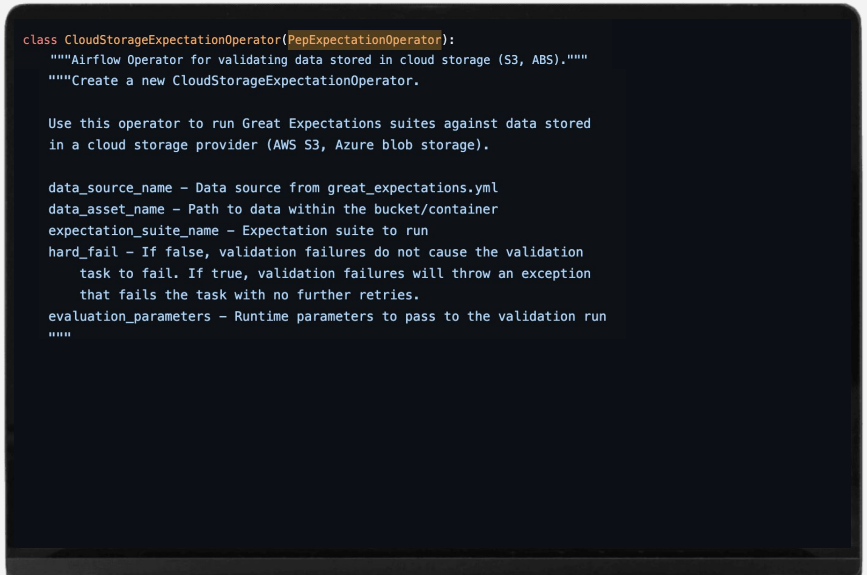
Components

- Web App: Data Docs
- Validation Engine
- Notifications via Webhook

Integrates with Airflow

- Validation step in pipeline
- Open Source Operator
- Custom Operator





Three-Tiered Approach to Quality

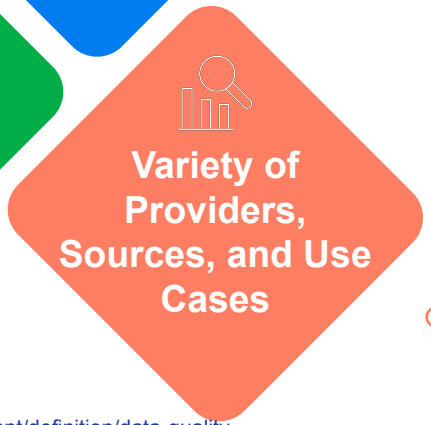
Inbound Data → Transforming Data → Warehoused Data

Great Expectations	Data Build Tool	Data Observability

Why Data Quality is Important

- Sales decisions
- Marketing Spend
- Inventory replenishment

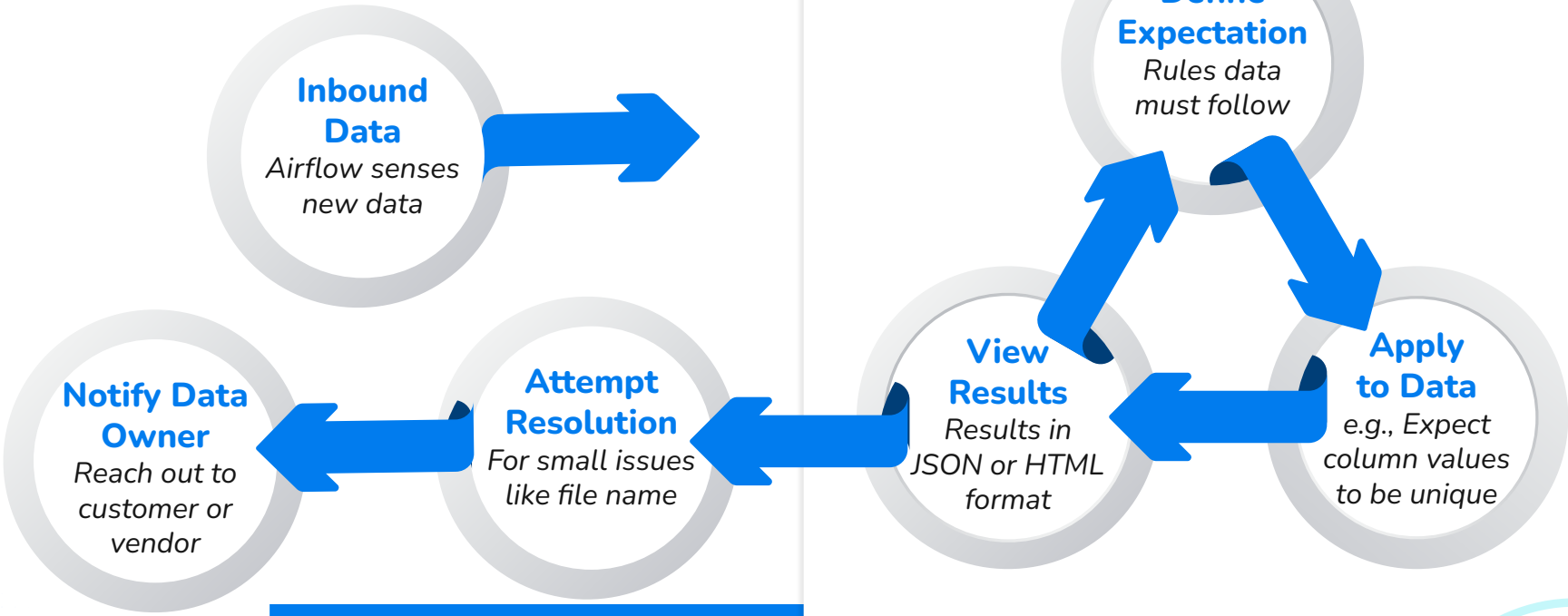
- Investing in data quality systems allows us to focus on building new capabilities
- Gartner: Bad data costs companies an average of $12.9 Million per year [1]
- IBM: Bad data costs the US $3.1 trillion [2]



- Logic of each must be documented
- Documentation should change with code, not in a separate document to maintain
- Good documentation allows engineers to build off the efforts of their peers

1. Tech Target – data quality - https://www.techtarget.com/searchdatamanagement/definition/data-quality
2. Harvard Business Review Bad Data Costs the U.S. $3 Trillion Per Year- https://hbr.org/2016/09/bad-data-costs-the-u-s-3-trillion-per-year

Validation Lifecycle



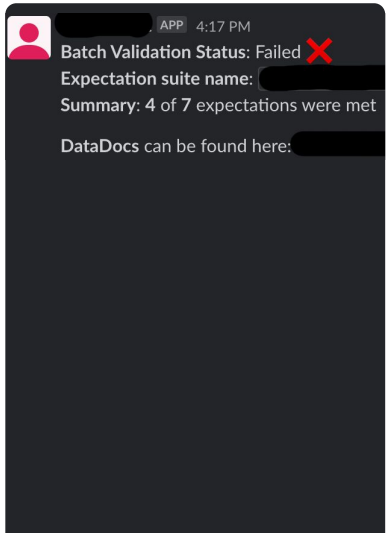
Running in Production

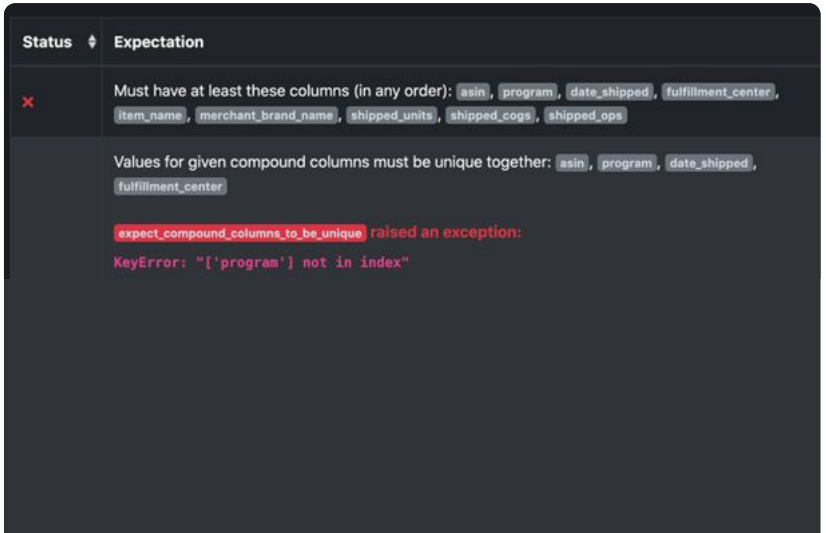
Slack Alert notifies Data team of failed validation

Data analyst clicks link to Great Expectations "Data Docs" site

Data Docs contains readable results of the evaluation

Check the Airflow logs to verify the error



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    "shipped_cogs",
    "shipped_ops",
    "shipped_units"
  ],
  "details": {
    "mismatched": {
      "missing": [
        "program"
      ]
    }
```

Benefits of Great Expectations

Document Assumptions

- Gives clarity to non-Subject matter experts
- Which columns can be null?
- What's a valid value?

Streamline Support

- Find the reason for failure quickly
- Embed Great Expectations "Data docs" links in Airflow log & Slack

Keep Bad Data Out

- Stop pipelines before loading data

Questions?

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www.linkedin.com/in/russelllamb