Snowtrail: Testing with Production Queries on a Cloud Database

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Snowflake Database

• The Snowflake Elastic Data Warehouse, or “Snowflake”
  • Analytics database built for the cloud
  • Multi-tenant, transactional, secure, highly scalable, elastic
  • Implemented from scratch (no Hadoop, Postgres, etc.)
  • SQL

• Currently runs on AWS and Azure
• Serves tens of millions of queries per day over hundreds petabytes of data
• 1000+ active customers, growing fast
Multi-cluster Shared-data Architecture

- All data in one place
- Independently scale every layer
- Every virtual warehouse can access all data

Data Storage

Cloud Services
- Authentication & access control
- Infrastructure manager
- Optimizer
- Transaction Manager
- Security

Virtual Warehouse
- Cache

Rest (UI/JDBC/ODBC/Python)
Motivation

• Challenges
  • Highly available service, no downtime allowed
  • Fast (weekly) online upgrade process
  • Huge size and variation in customer workloads, hard to exhaustively test

• Opportunities
  • Detailed information of every customer query
  • Multi-tenant capability – easy and secure access from privileged role
  • Resource isolation and elasticity – replay queries with no impact on production workloads

• Our Solution: Snowtrail
Use Case

• Release Testing
  • Integrated into pre-release pipeline
  • Effective coverage of customer workloads

• Feature Development
  • Incremental Feature Development
  • Immediate Understanding of exact impact

• Workload Runner
  • Cache warming before workload migration
  • Stress Testing
  • Capture and Replay workload for POC
Workloads

- Sets of queries with their configurations
- Imported workloads
- Workload selection
  - Tens of millions of queries / day – needs sampling
  - Heuristics-based filtering
  - Query2Vec\(^1\)
- Integration with Usage Tracking

\(^1\) Query2Vec: An Evaluation of NLP Techniques for Generalized Workload Analytics, arXiv:1801.05613
Runs

- **Mechanisms:**
  - Result obfuscation
  - Query redirection
  - Query compilation context
  - Time travel
  - ...

- **Configurations:**
  - Query compilation context
  - Concurrency
  - Target cloud services
  - Amount of compute resource to use
  - Parameter settings
  - ...
Analysis

• Look for:
  • New errors / crashes / incidents
  • Wrong results
  • Performance Regression

• Queries can be skipped due to:
  • Change in schema (e.g. dropped tables)
  • Non-deterministic queries are skipped for result comparison
  • False Positives in performance comparison
Verification

• False positives due to:
  • Cache state
  • Network latency
  • Concurrency
  • …

• Verification runs:
  • Replay regressed queries on the same cloud configuration with isolated resources multiple times

• Result analysis
  • Generate report after verification runs
  • All results stored in Snowflake
  • Run data available in a separate SQL Schema

• High false positive rates a major problem
Streaming Mode
Stream Runs

• Enable continuous runs of arbitrary duration
• Picks up the latest customer queries
• Avoid falling out of time travel retention
• Fewer data and schema changes
• Snapshot reports available
Feature Development Workflow

1. Instrument Usage Tracking
2. Code Deployment
3. Construct Workload based on Usage
4. Run Workload with Feature On/Off
5. Assess Impact on Real Customer Workload
6. Quick Prototype / Iterate

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Lessons Learned

• Snowtrail has:
  • Greatly improved release stability
  • Changed how we develop new features
  • Made debugging production queries much easier

• On the other hand:
  • Workload selection is hard
  • Impossible to catch every issue pre-release
  • Complex queries could be expensive to run
  • Lots of non-deterministic queries leads to missed opportunities
Questions?
Thank You