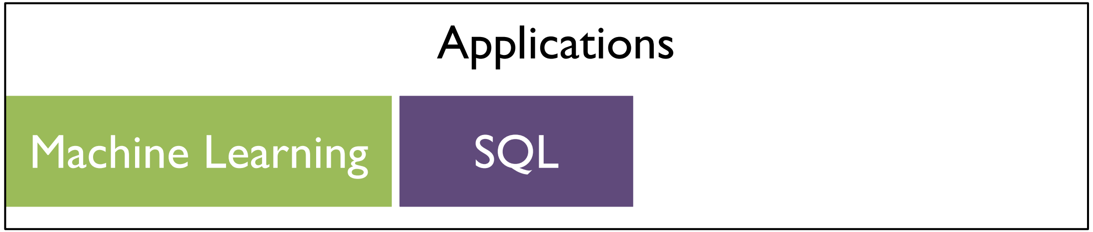
CS 744: SNOWFLAKE

Shivaram Venkataraman

Fall 2021

ADMINISTRIVIA

- Assignment 1 grades out!
- Assignment 2 by mid-week
- Midterm on Thursday! Seating layout?



Applications

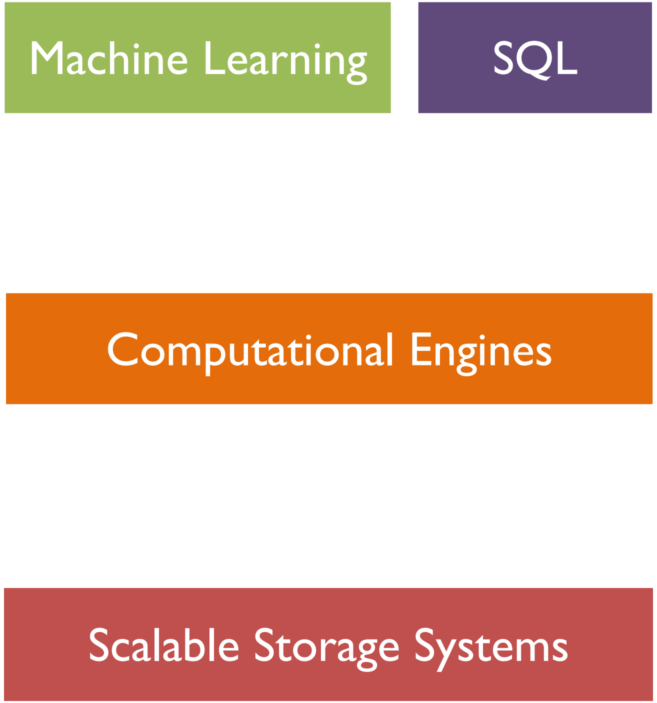
Machine Learning

SQL

SparkSQL/Scope: Given a query how do you run it efficiently?

Snowflake: How do you build an elastic data warehouse?

CLOUD COMPUTING STACK



Machine Learning

SQL

Computational Engines

Scalable Storage Systems

SNOWFLAKE: GOALS

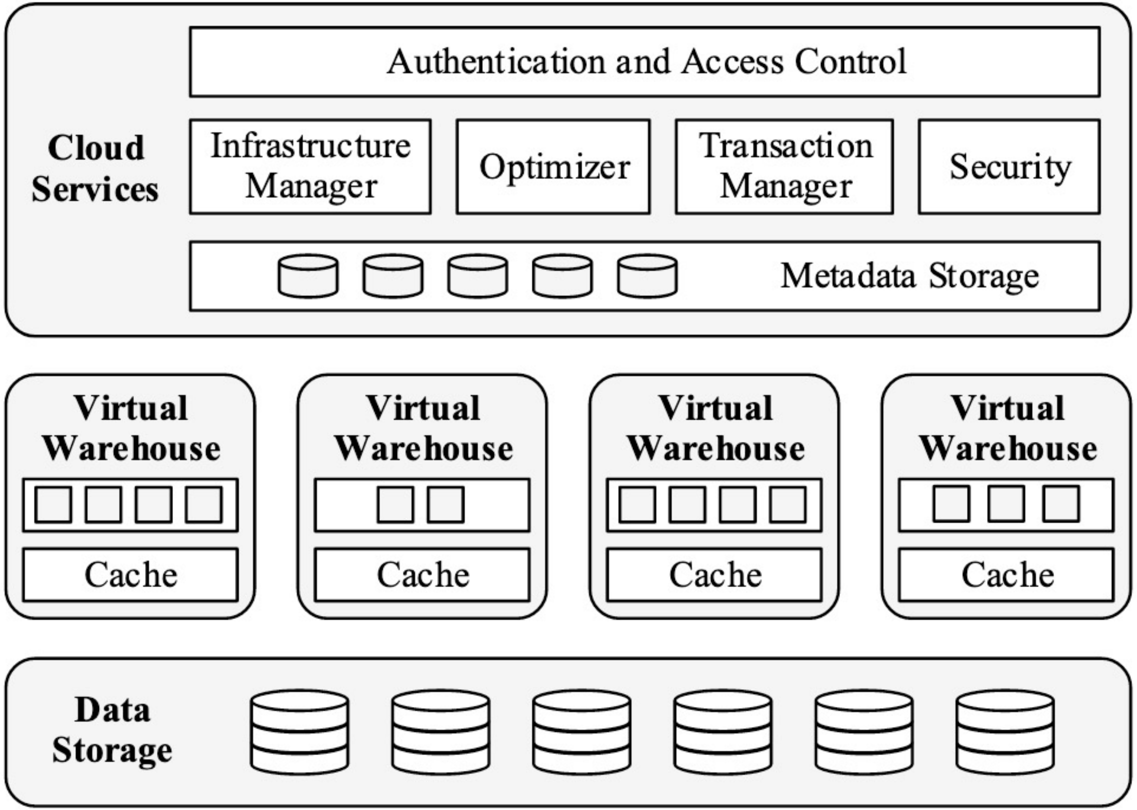
Software-as-a-Service

Elastic

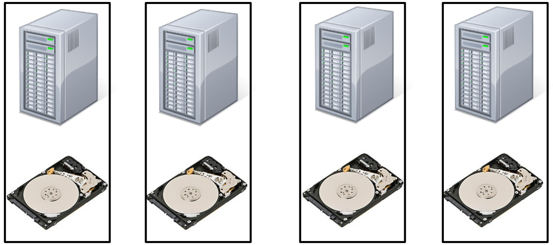
Highly Available

Semi-Structured Data

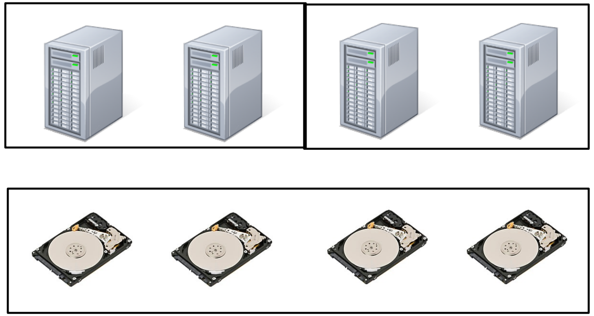
SNOWFLAKE DESIGN



STORAGE VS COMPUTE



Shared Nothing



Multi Cluster, Shared Data

STORAGE: HYBRID COLUMNAR

Alice	32
Bob	22
Eve	24
Victor	27

Alice,32,Bob,22

Eve,24,Victor,27

Row-oriented

Alice, Bob, 32,22

Eve, Victor,24,27

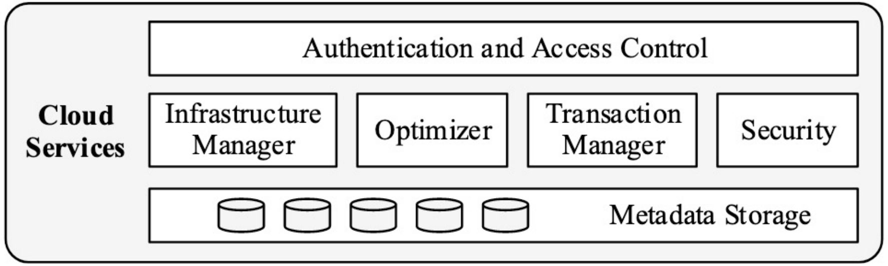
Hybrid Columnar

VIRTUAL WAREHOUSES

Elasticity, Isolation

Local caching, Stragglers

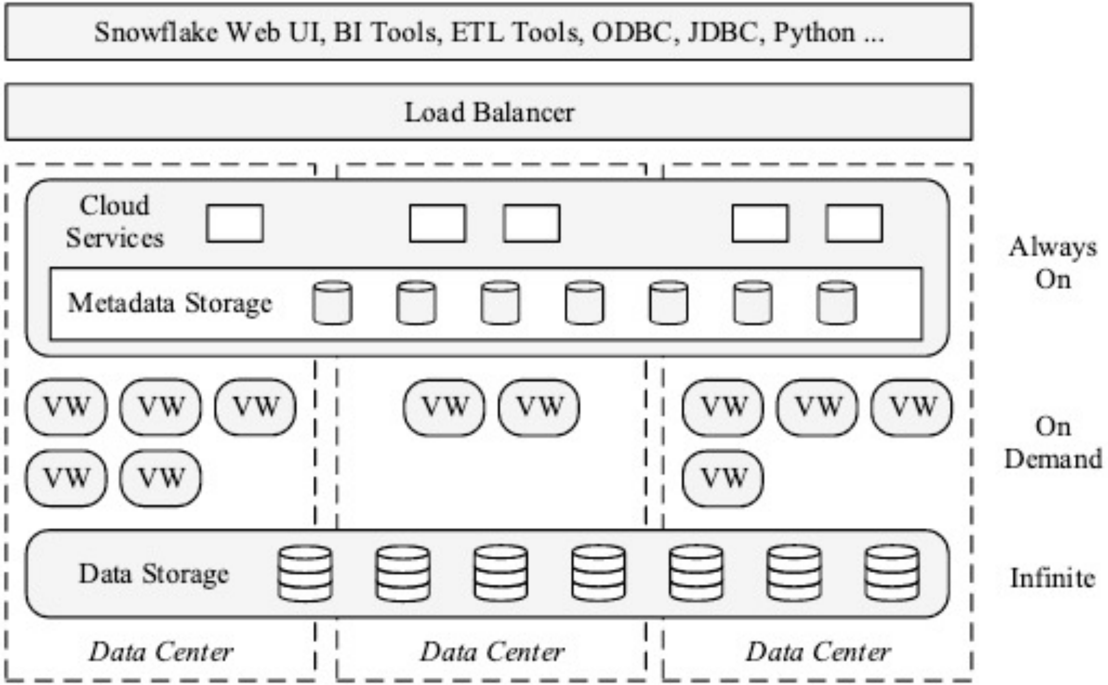
CLOUD SERVICES



Concurrency Control

Pruning

FAULT TOLERANCE



SEMI STRUCTURED DATA

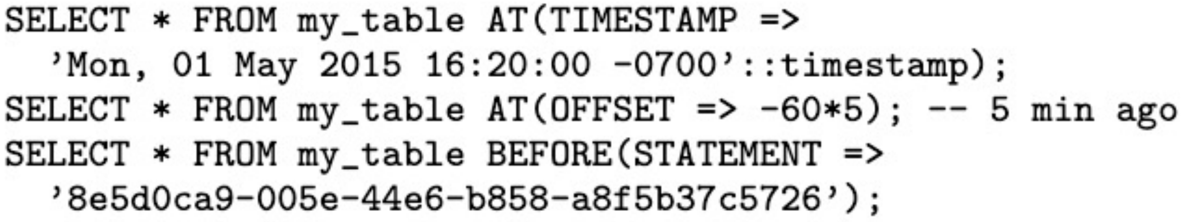
```
{
    first_name: “john”,
     last_name: “doe”,
     order_id: “1234”,
}
{
   first_name: “bucky”,
   last_name: “badger”,
   order_id: “52342”,
   order_date: “3/3/2020”,
}
```

Extraction operation

Flattening

Infer types, Pruning

TIME TRAVEL?



```
SELECT * FROM my_table AT(TIMESTAMP =>
  ’Mon, 01 May 2015 16:20:00 -0700’::timestamp);
SELECT * FROM my_table AT(OFFSET => -60*5); -- 5 min ago
SELECT * FROM my_table BEFORE(STATEMENT =>
  ’8e5d0ca9-005e-44e6-b858-a8f5b37c5726’);
```

Multiple versions of table (MVCC)

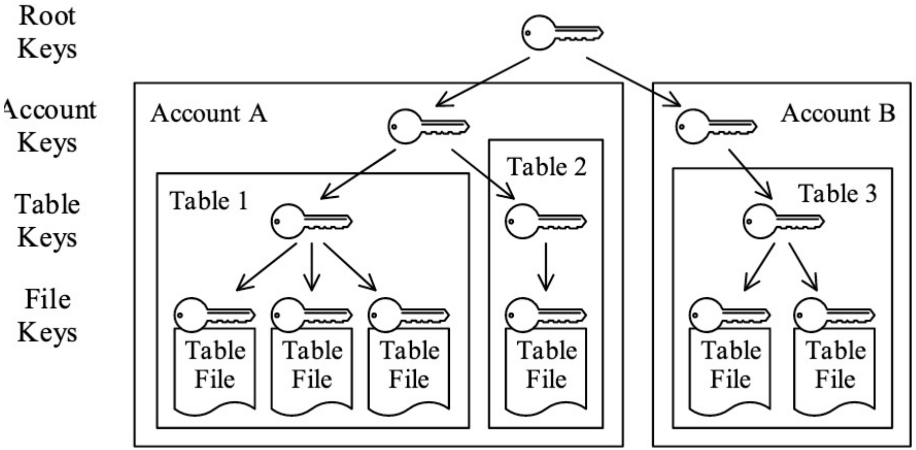
Undo accidental deletes

Cheap to clone / snapshot a table

SECURITY

Hierarchical key management

Key rotation, re-keying



SUMMARY, TAKEAWAYS

Snowflake

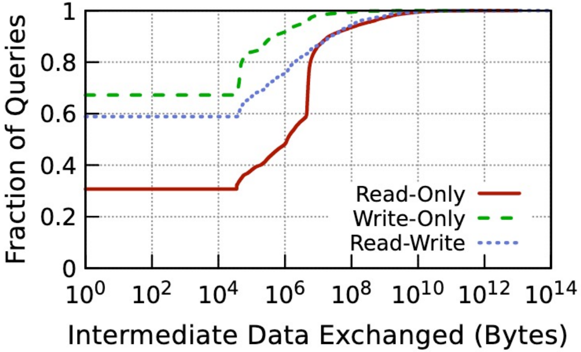
- Cloud computing → Elastic data warehouse
- Key idea: Separation of compute and storage!

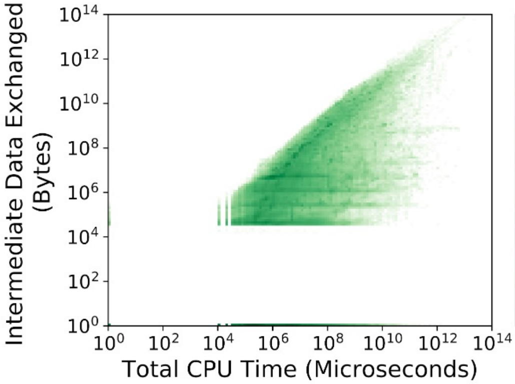
- Hybrid columnar storage format
- Elastic compute with virtual warehouses
- Pruning, semi-structured optimizations, fault tolerant

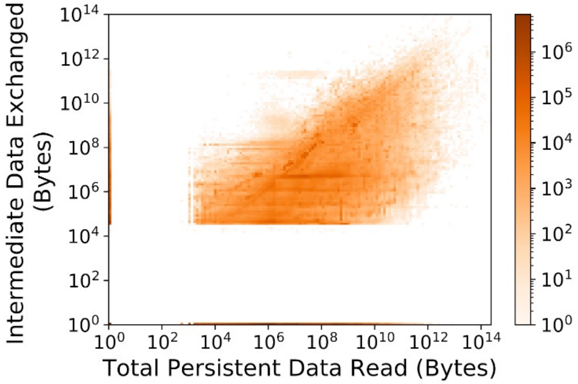
DISCUSSION

https://forms.gle/buUDM9nRs6Gg9tURA

We see how Snowflake leads to the design of an elastic data warehouse. If we were to similarly design an Elastic PyTorch for training how would the design look? What are some design trade-offs compared to existing PyTorch?


Fraction of Queries
1
0.8
0.6
0.4
0.2
0
10^0 10^2 10^4 10^6 10^8 10^{10} 10^{12} 10^{14}
Intermediate Data Exchanged (Bytes)
Read-Only
Write-Only
Read-Write


Intermediate Data Exchanged (Bytes)
10^{14} 10^{12} 10^{10} 10^8 10^6 10^4 10^2 10^0
10^0 10^2 10^4 10^6 10^8 10^{10} 10^{12} 10^{14}
Total CPU Time (Microseconds)
10^6 10^5 10^4 10^3 10^2 10^1 10^0


Intermediate Data Exchanged (Bytes)
10^{14} 10^{12} 10^{10} 10^8 10^6 10^4 10^2 10^0
10^0 10^2 10^4 10^6 10^8 10^{10} 10^{12} 10^{14}
Total Persistent Data Read (Bytes)
10^6 10^5 10^4 10^3 10^2 10^1 10^0

NEXT STEPS

Next class: Midterm!