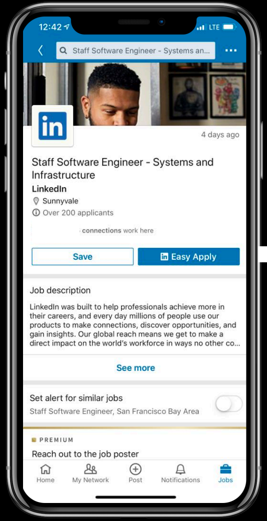
Coral & Transport UDFs

Building Blocks of a Postmodern Data Warehouse

Walaa Eldin Moustafa

Staff Software Engineer @ LinkedIn

The lifecycle of a data application at LinkedIn *[Simplified]*



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Staff Software Engineer - Systems an...

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Staff Software Engineer - Systems and Infrastructure

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Job description

LinkedIn was built to help professionals achieve more in their careers, and every day millions of people use our products to make connections, discover opportunities, and gain insights. Our global reach means we get to make a direct impact on the world's workforce in ways no other co...

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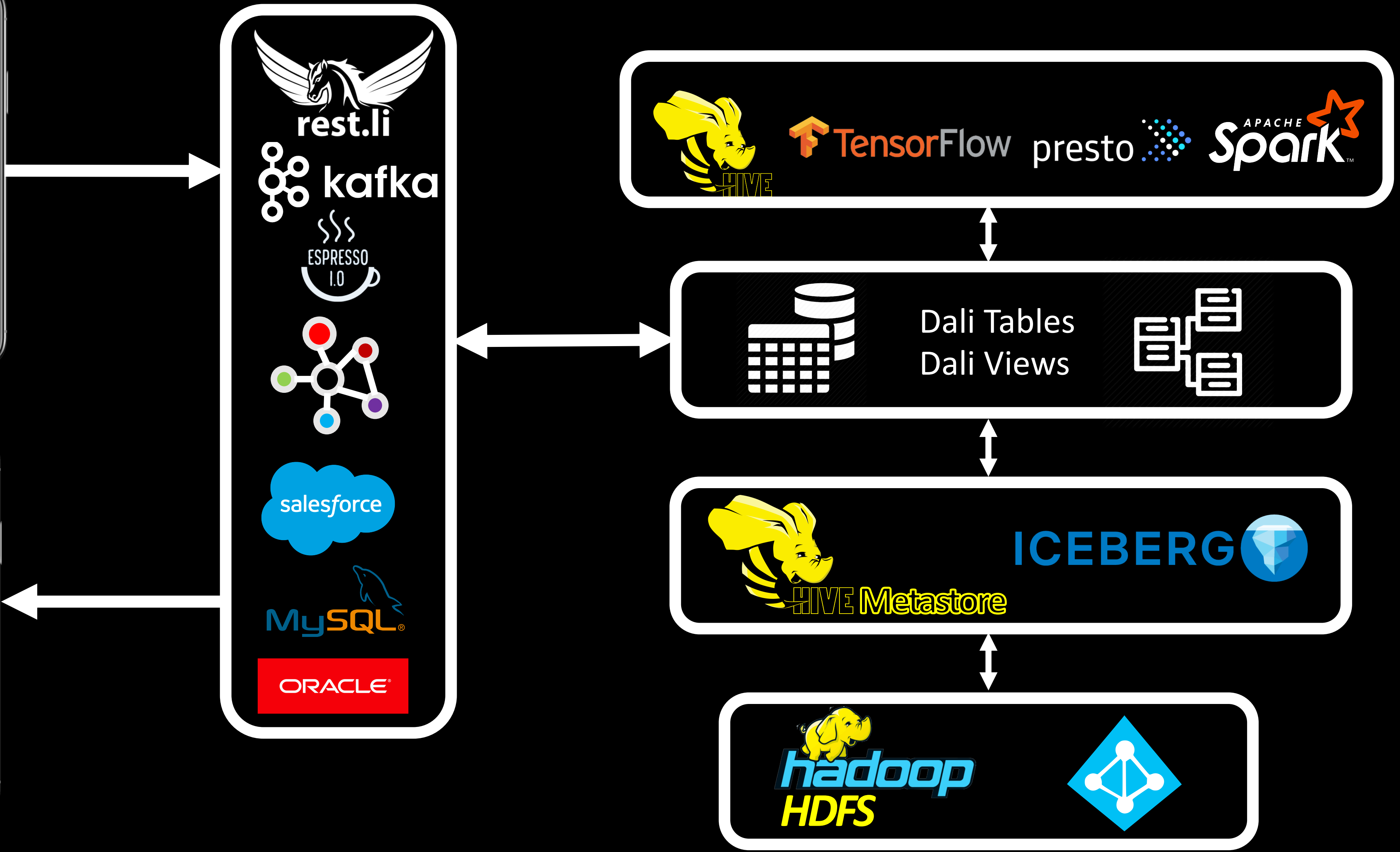

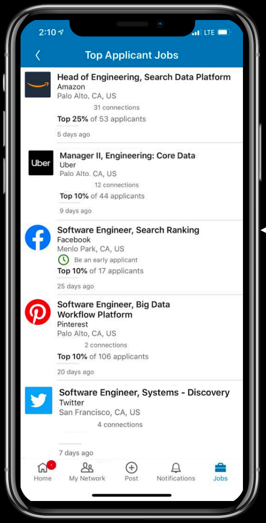

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Top Applicant Jobs

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Amazon
Palo Alto, CA, US
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Top 25% of 53 applicants
5 days ago

Manager II, Engineering: Core Data
Uber
Palo Alto, CA, US
12 connections
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Software Engineer, Search Ranking
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Be an early applicant
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Software Engineer, Big Data Workflow Platform
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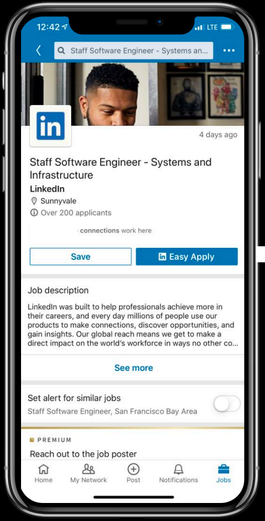

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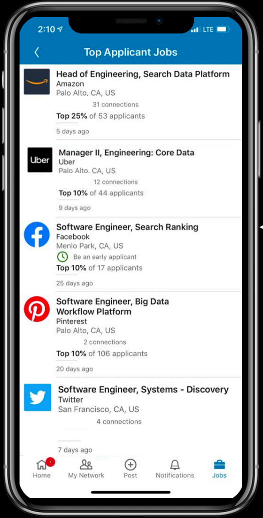

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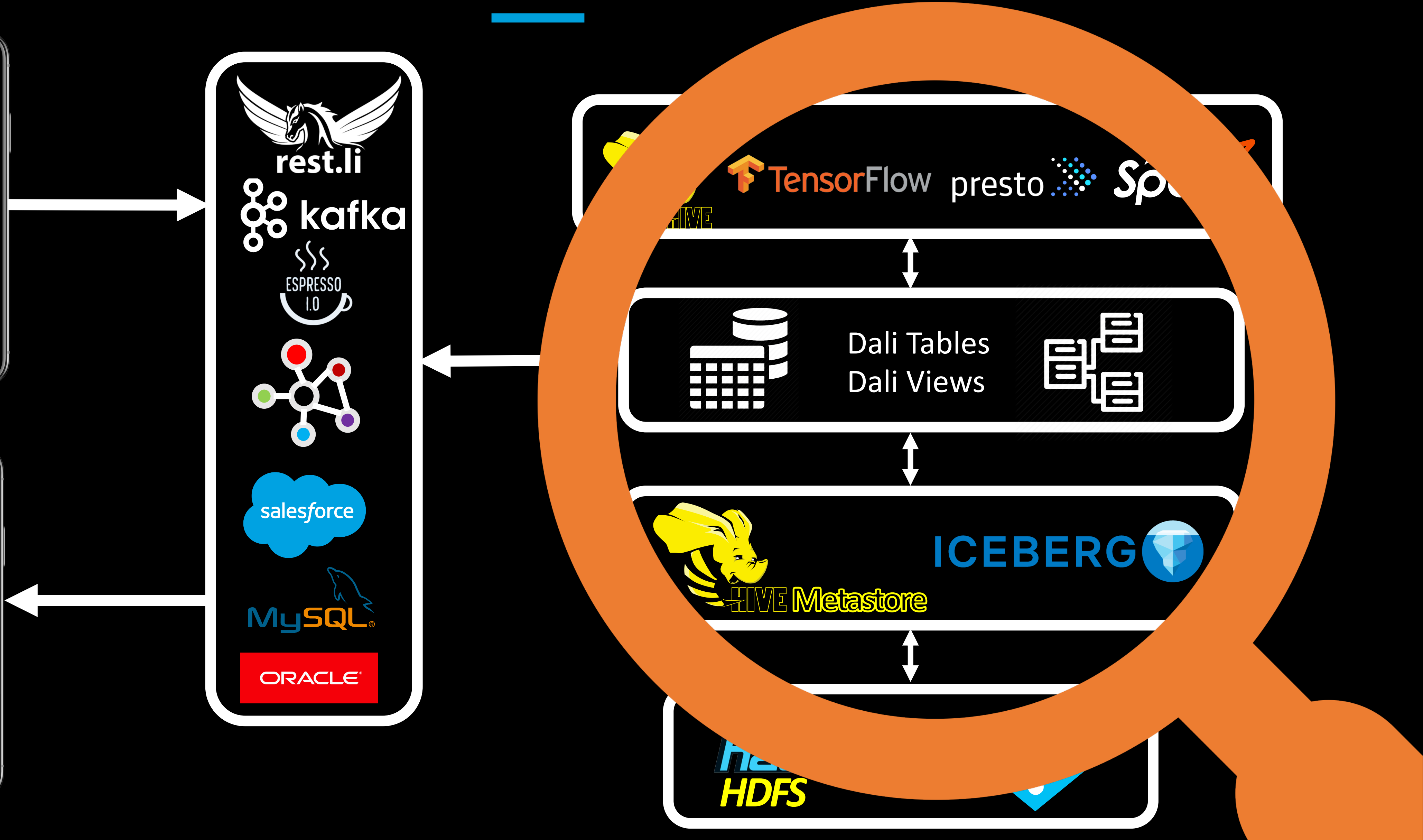

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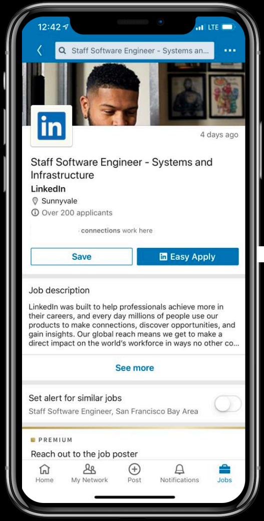

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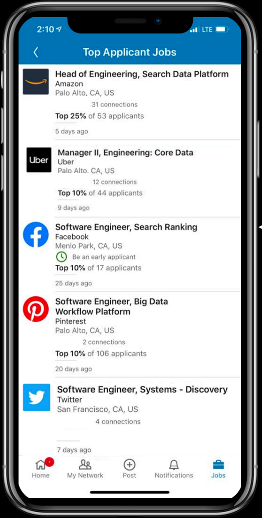

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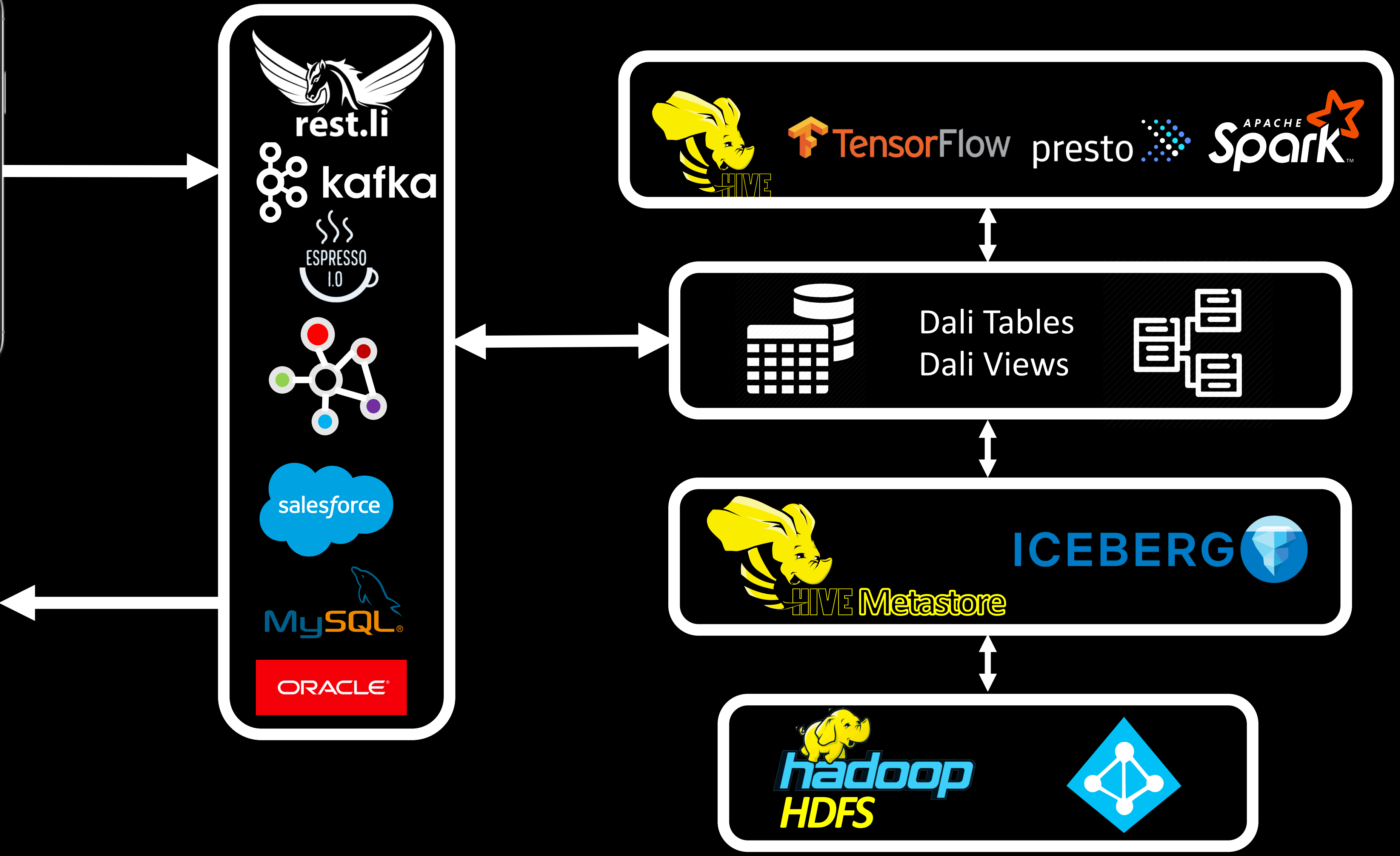
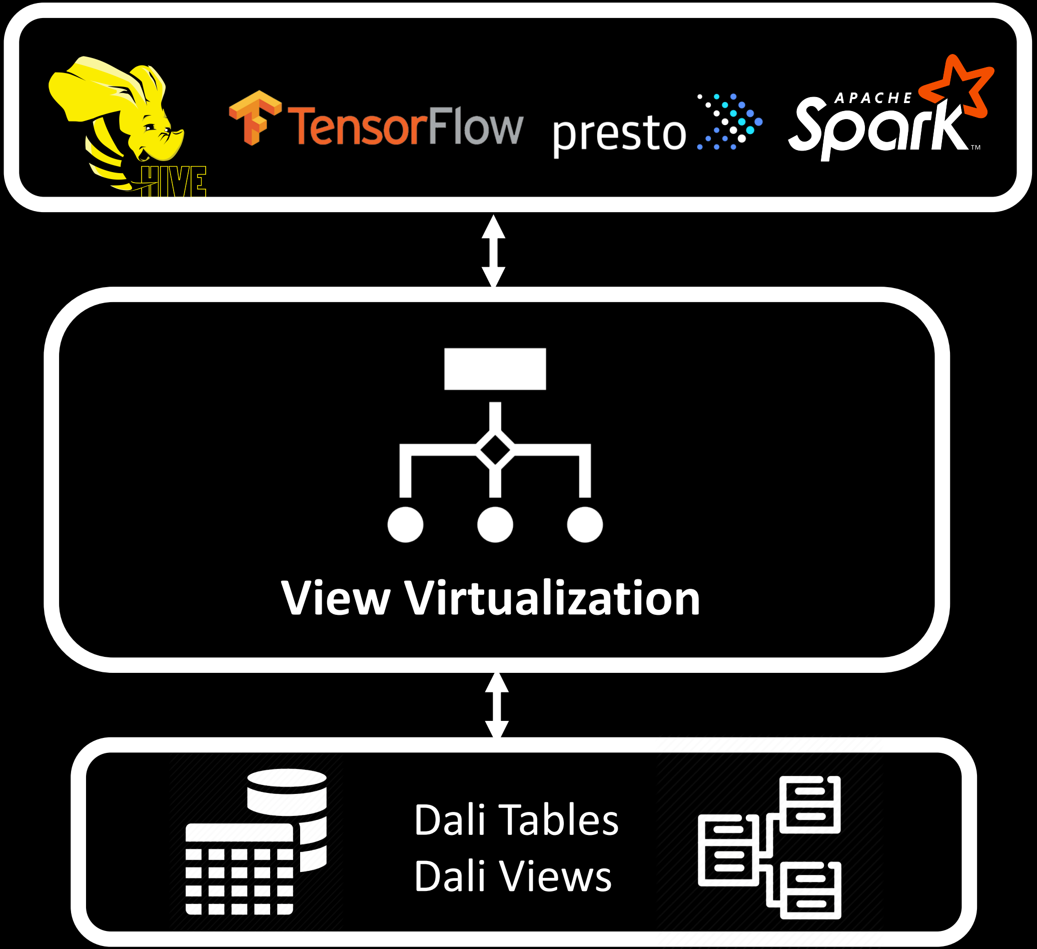


View Virtualization



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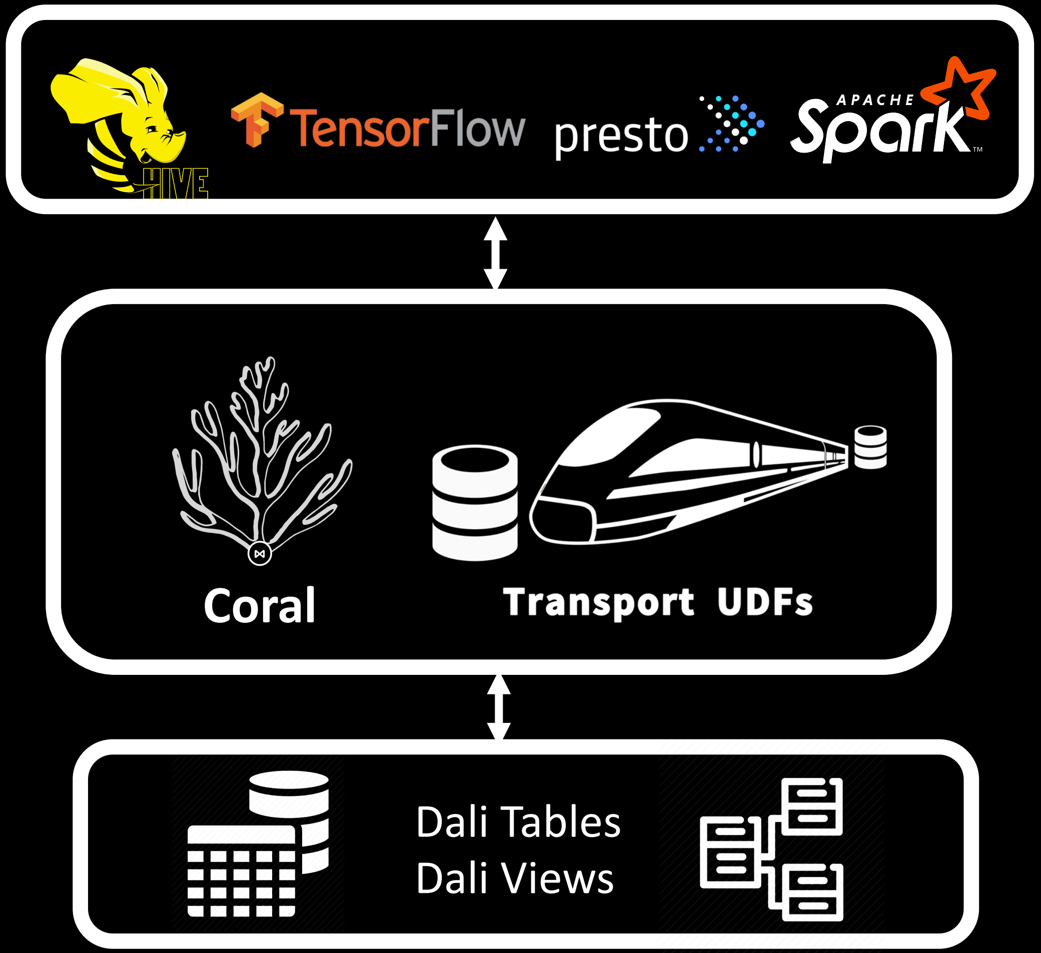
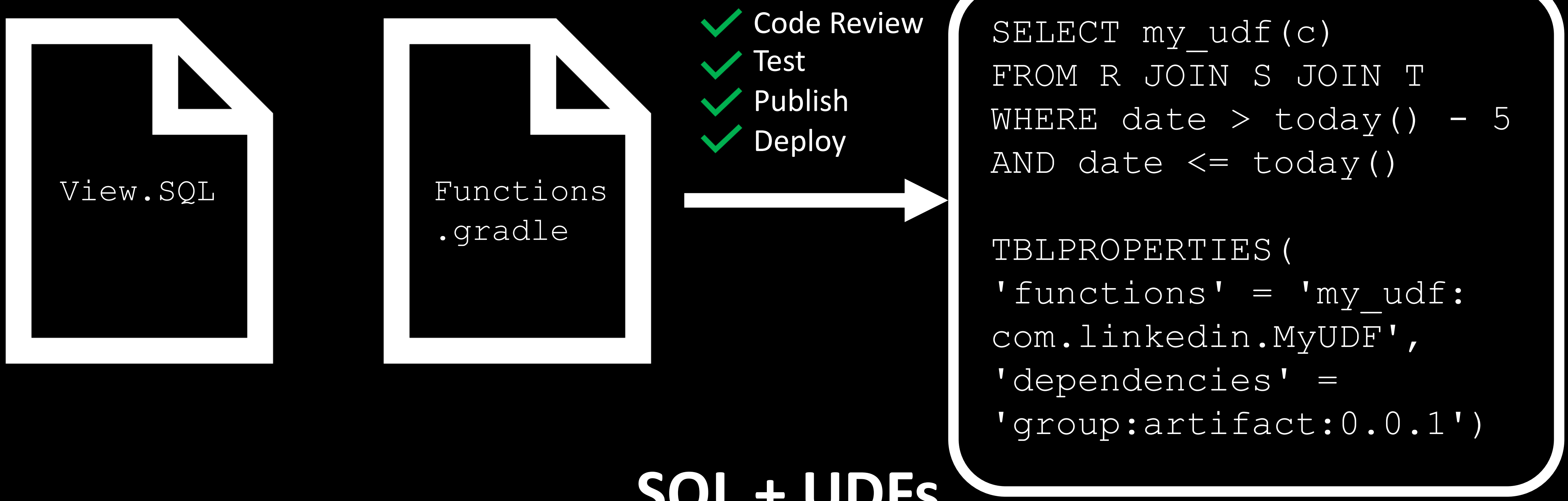


Dali Views

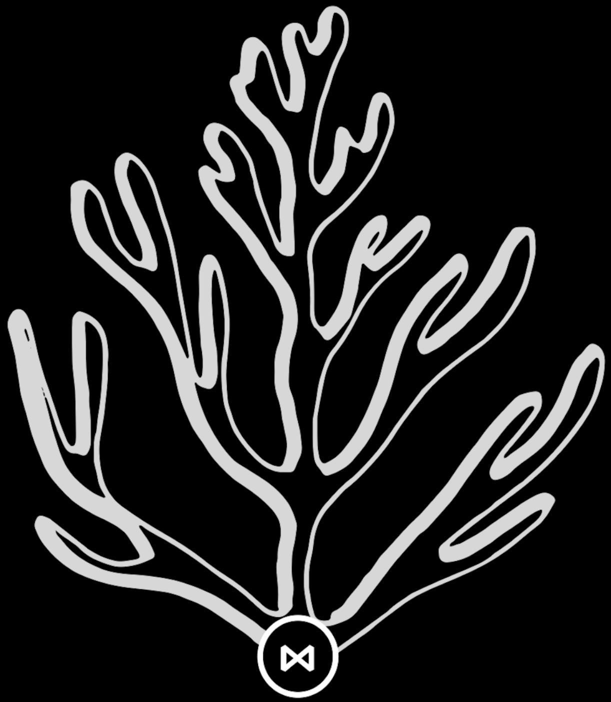


```
SELECT my_udf(c)
FROM R JOIN S JOIN T
WHERE date > today() - 5
AND date <= today()

TBLPROPERTIES(
'functions' = 'my_udf:
com.linkedin.MyUDF',
'dependencies' =
'group:artifact:0.0.1')
```

SQL + UDFs

Coral



github.com/linkedin/coral

Coral

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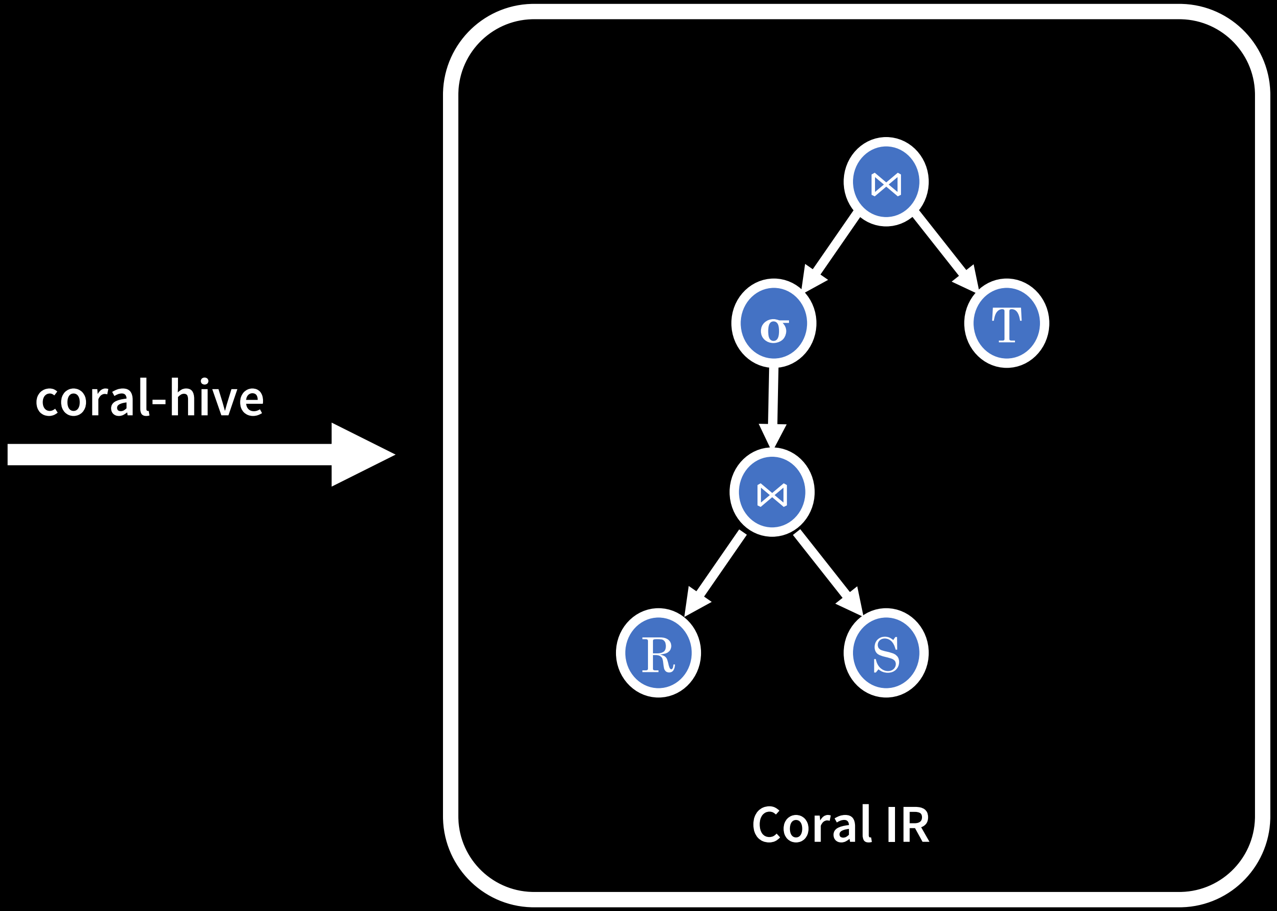
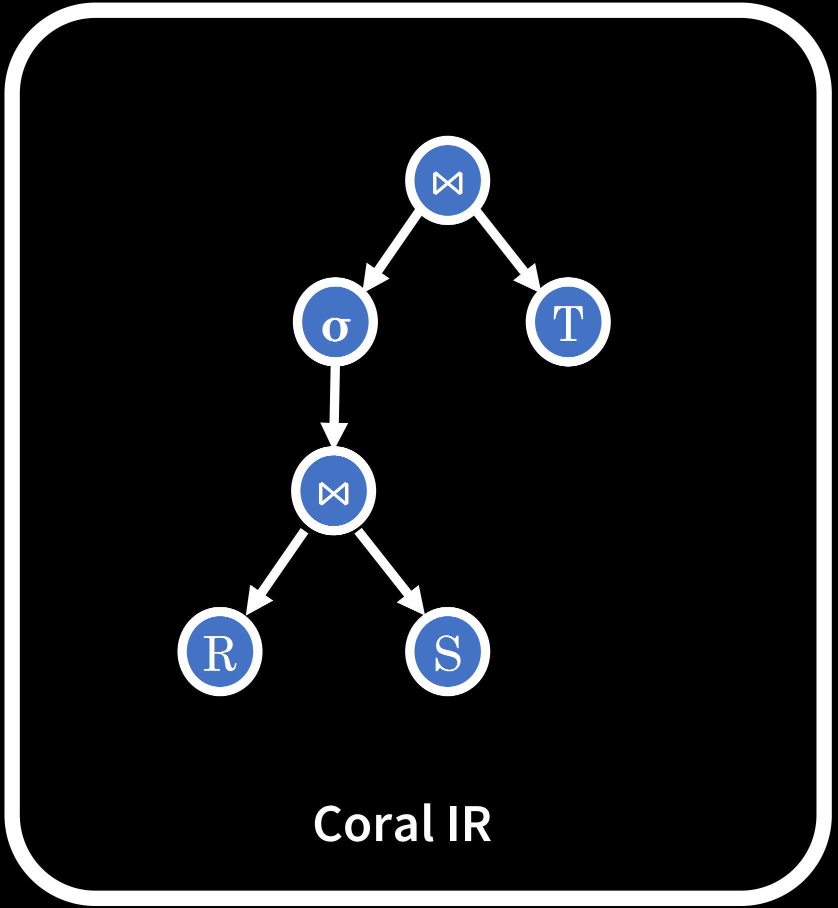


Coral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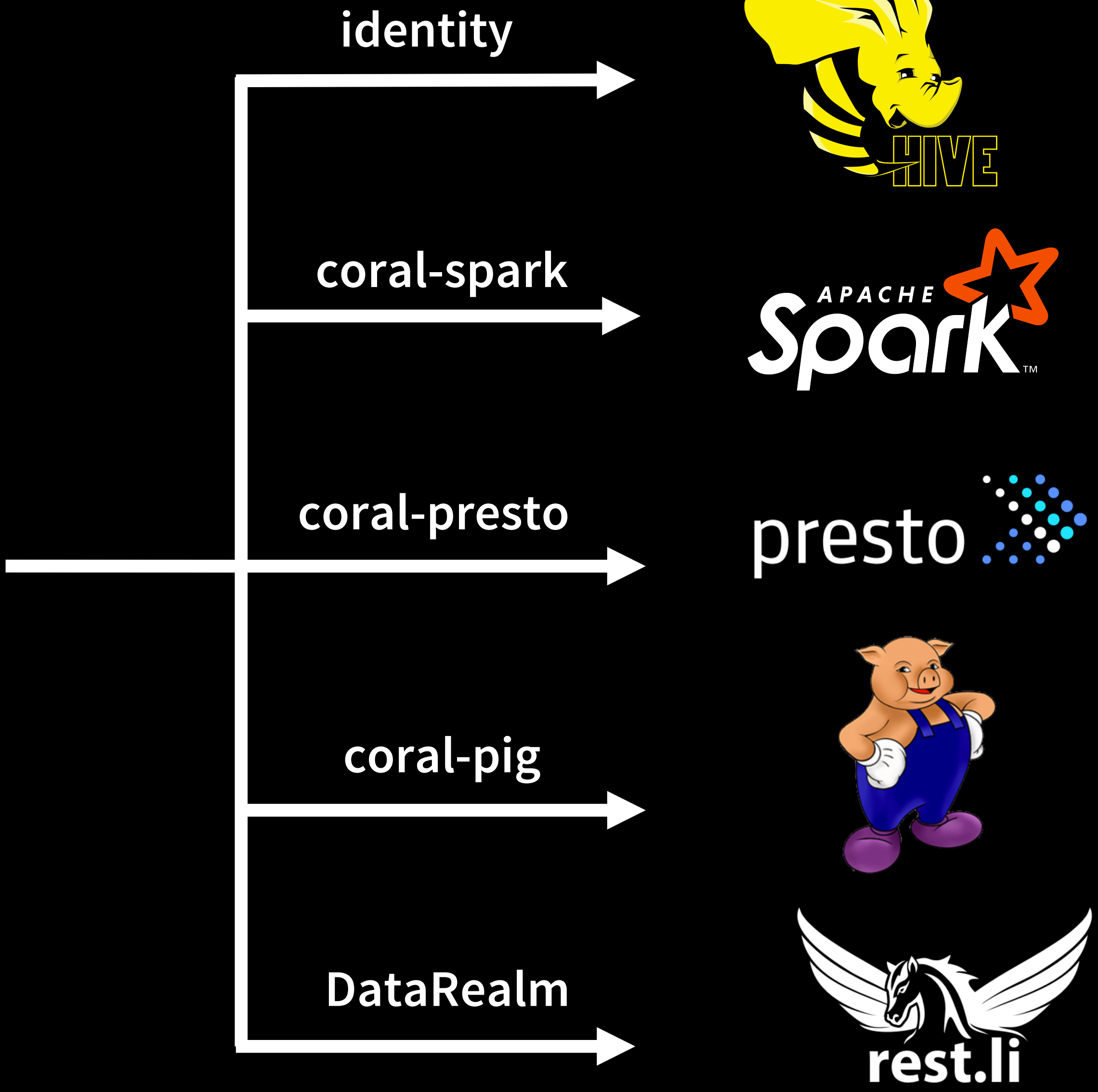
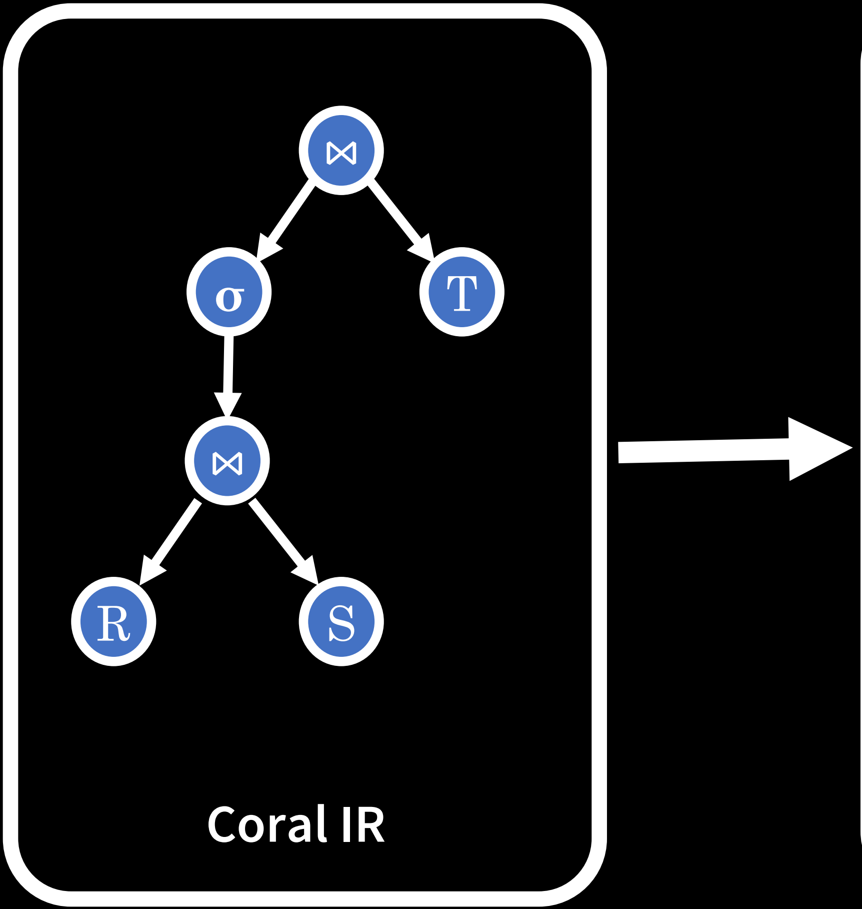
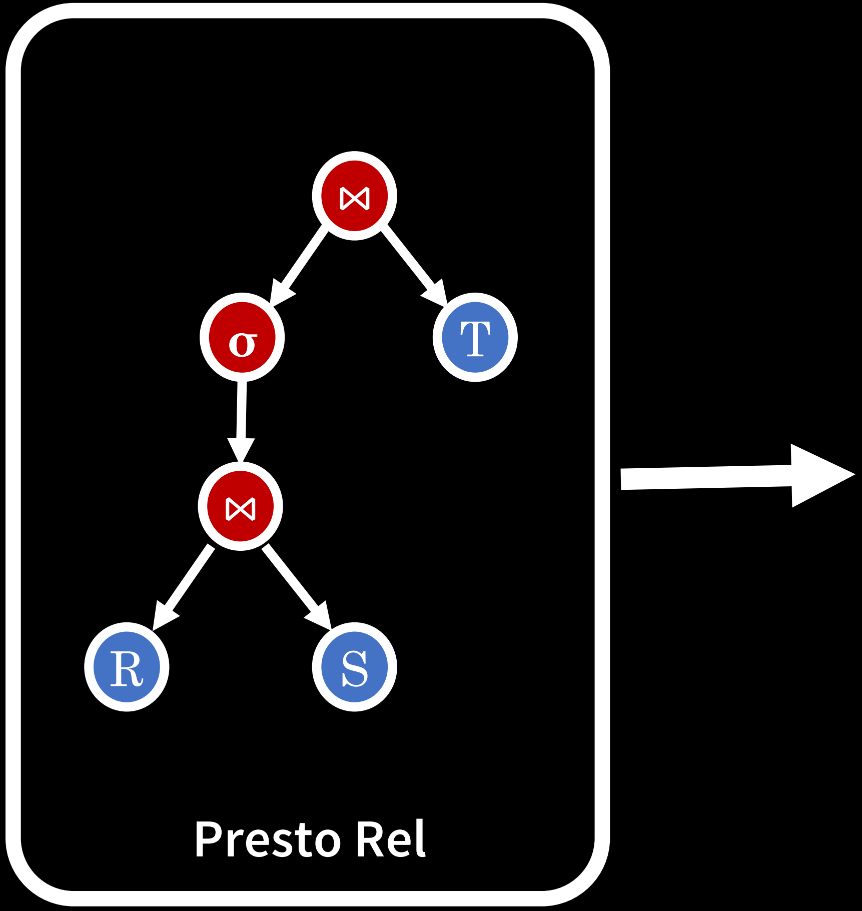
Coral IR


identity
coral-spark
coral-presto
coral-pig
DataRealm

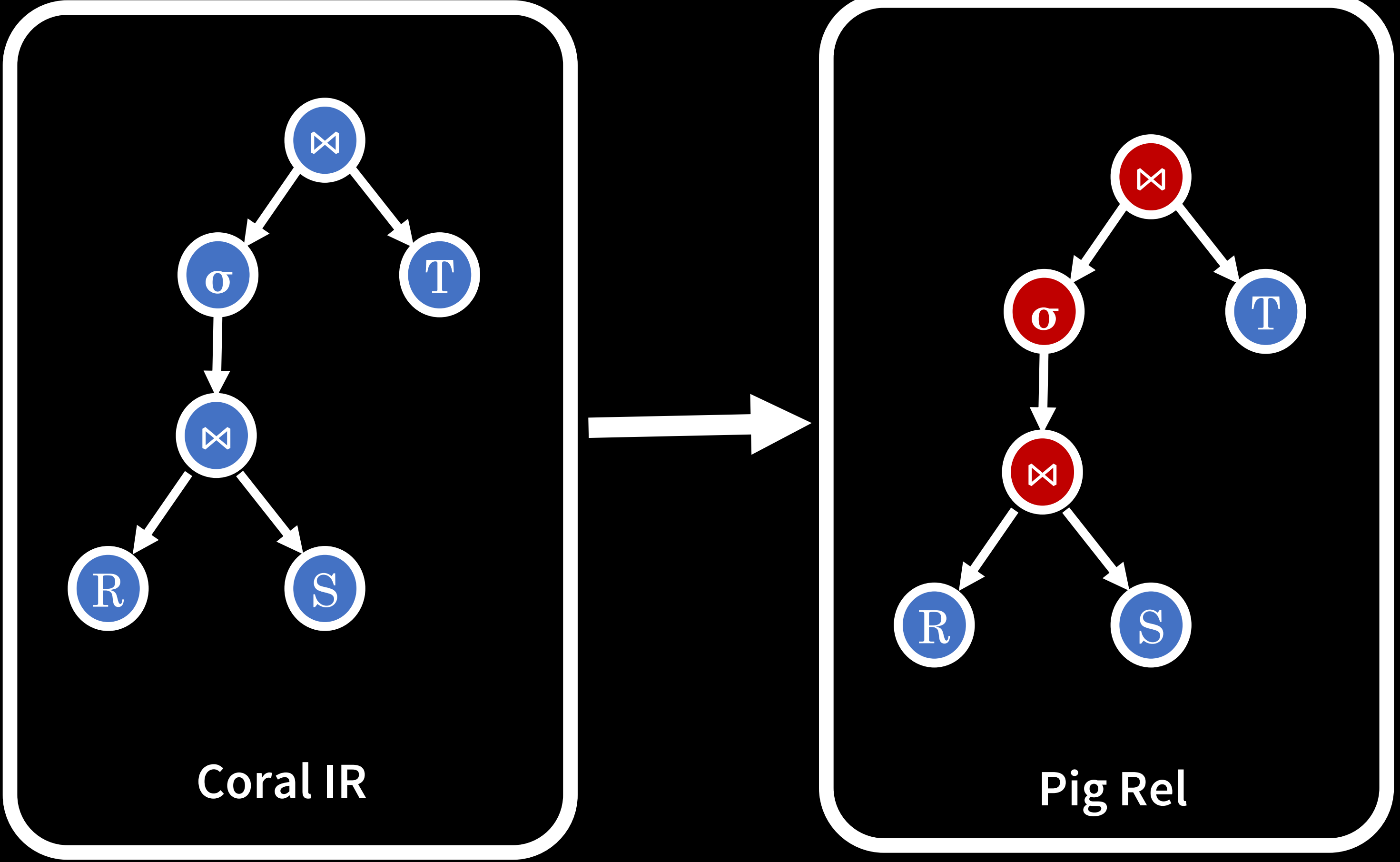
Coral-Presto





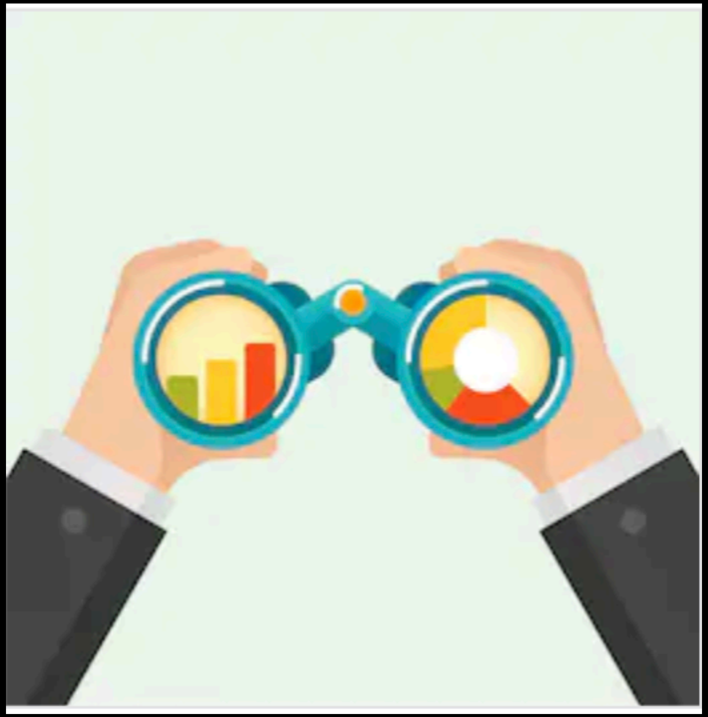
```
SELECT presto_udf(c + 1)
FROM R JOIN S JOIN T
WHERE date > today() - 5
AND date <= today()
```

Coral-Pig



```
R = LOAD "R"
S = LOAD "S"
T = LOAD "T"
RS = R JOIN S
RSF = FILTER RS BY ...
RSFT = RSF JOIN T
```

What does the future look like?



Flexible Language Interface

```
user {
  name
address{}
}
```

GraphQL

```
A = LOAD
B = LOAD
C = A
JOIN B
```

Pig Latin

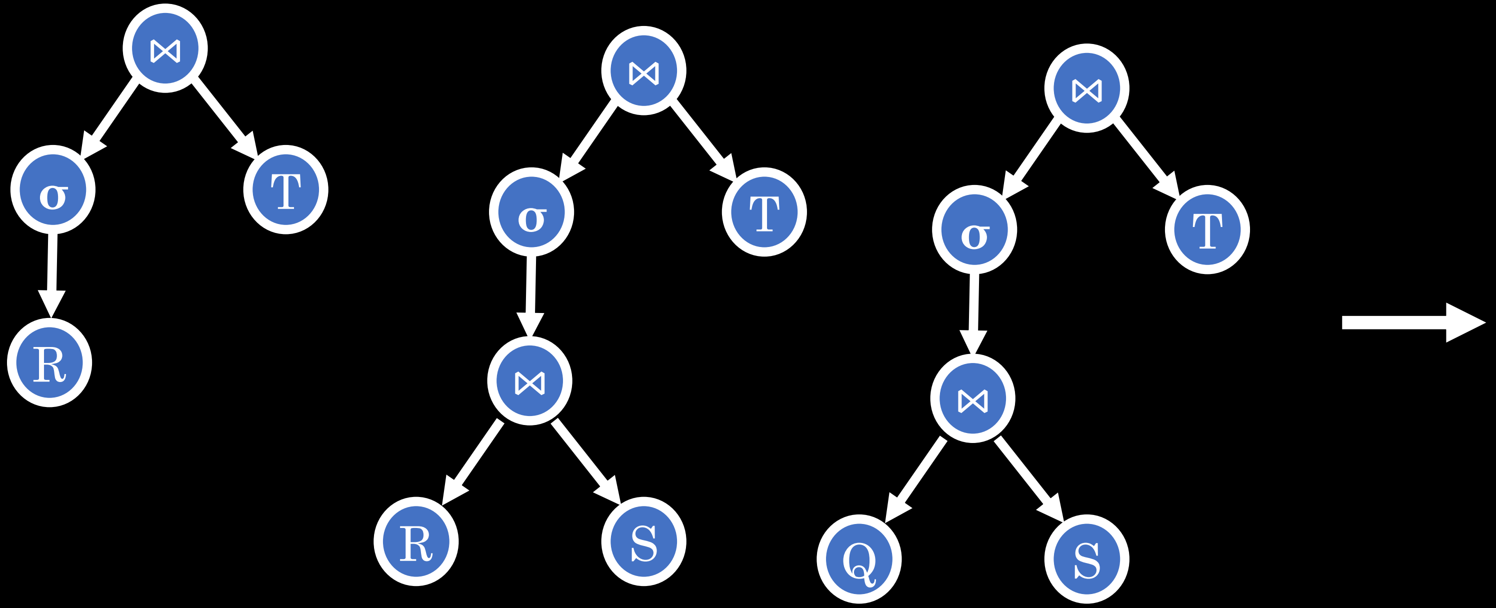
```
d = load()
.filter()
.map()
.count()
```

Dataflow

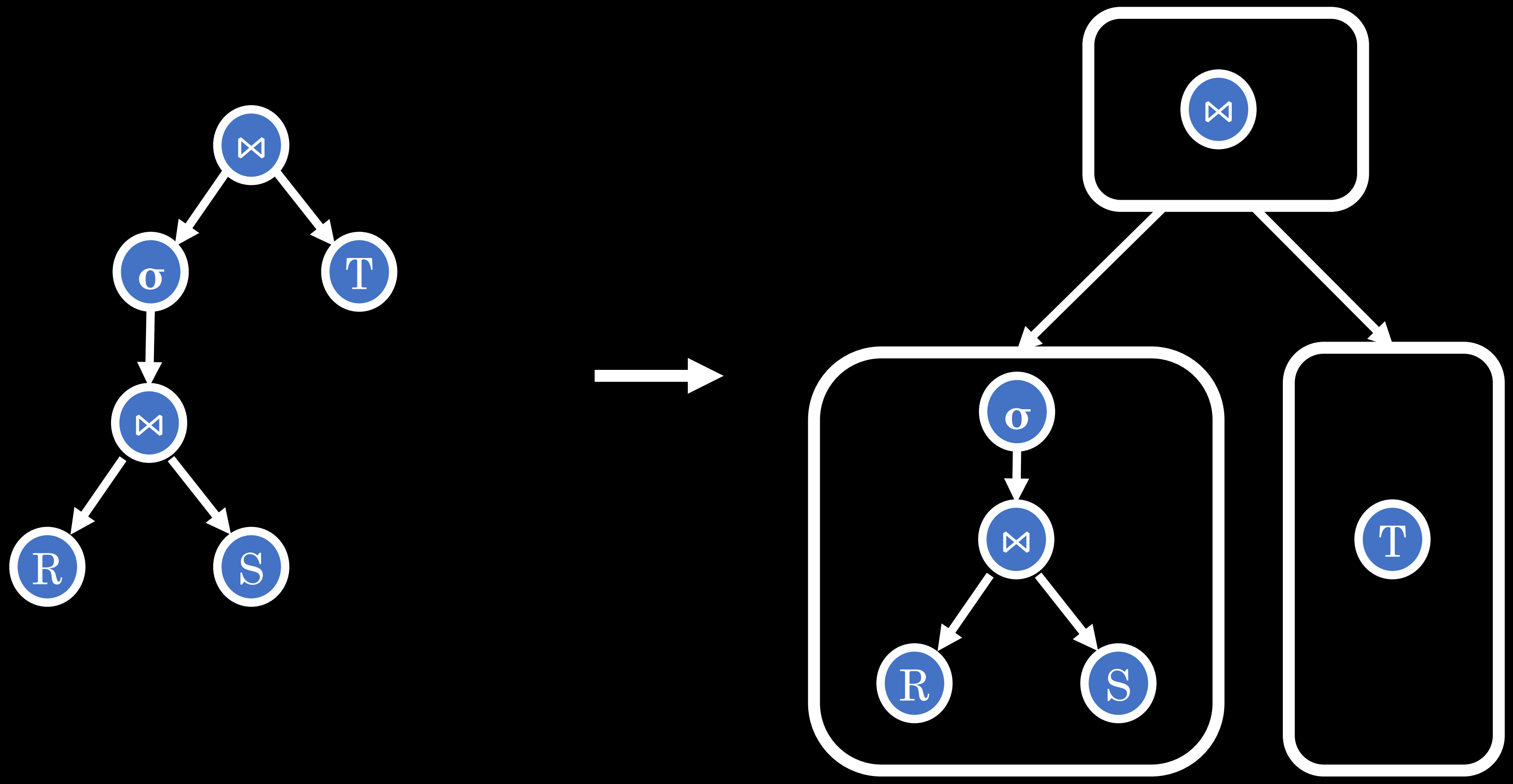
```
TwoHop
(X,Y) :-
E(X,Z),
E(Z,Y).
```

Datalog

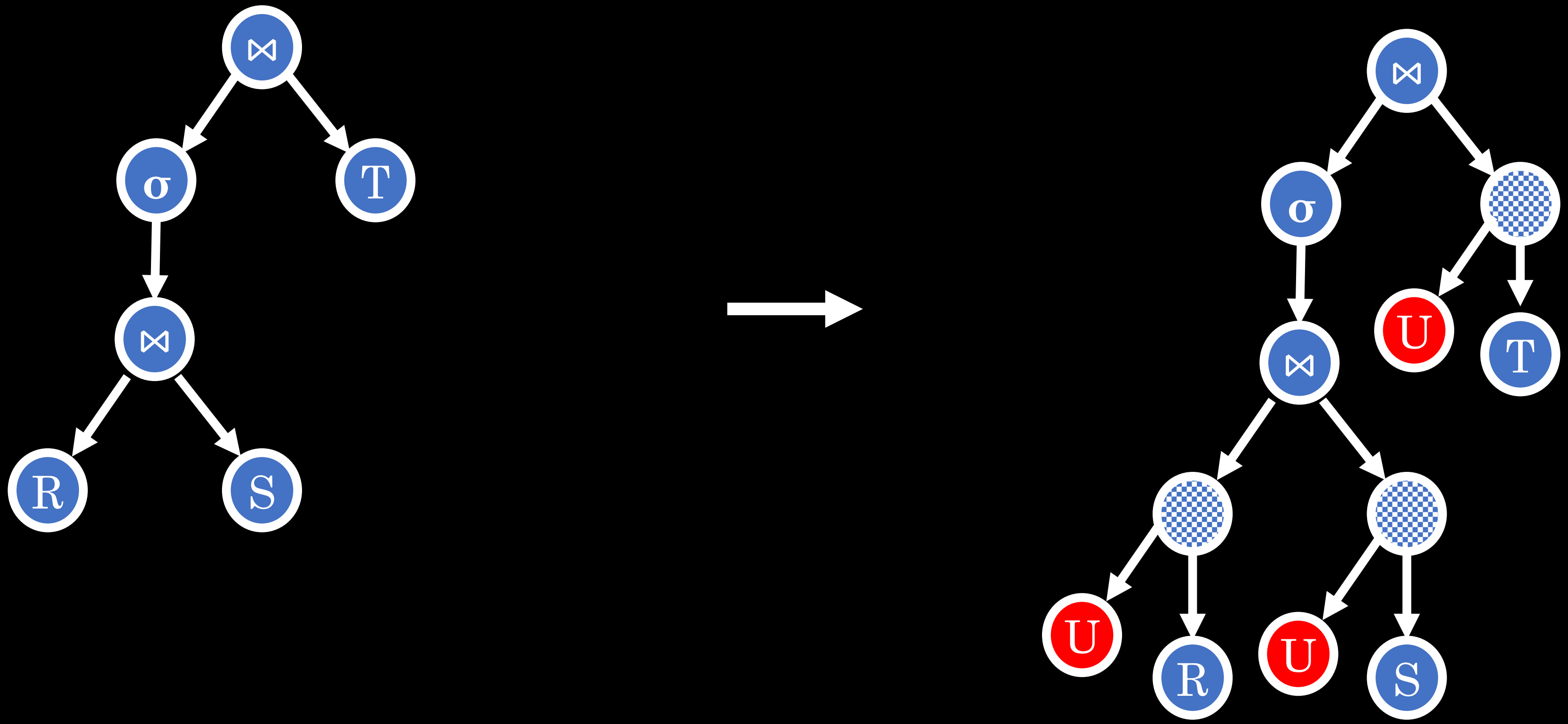
Workload Analytics



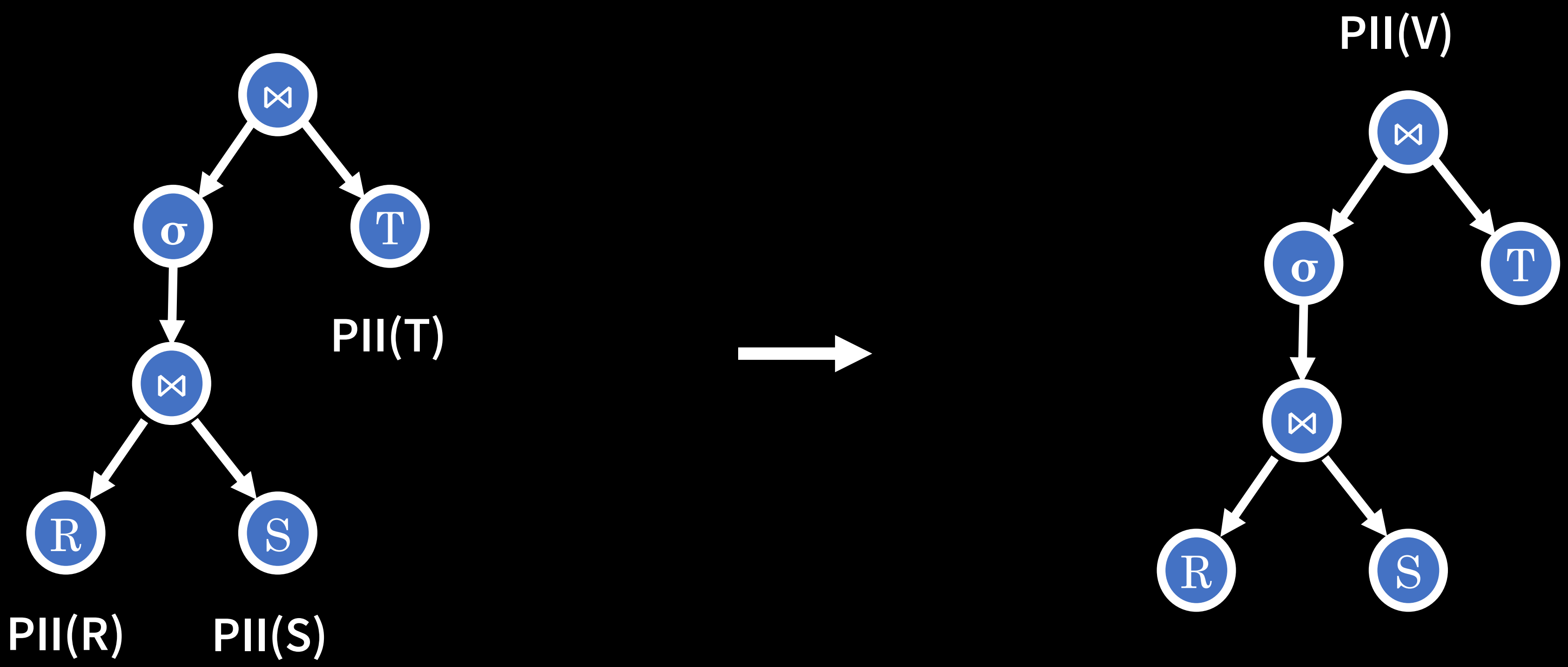
Materialized View Selection



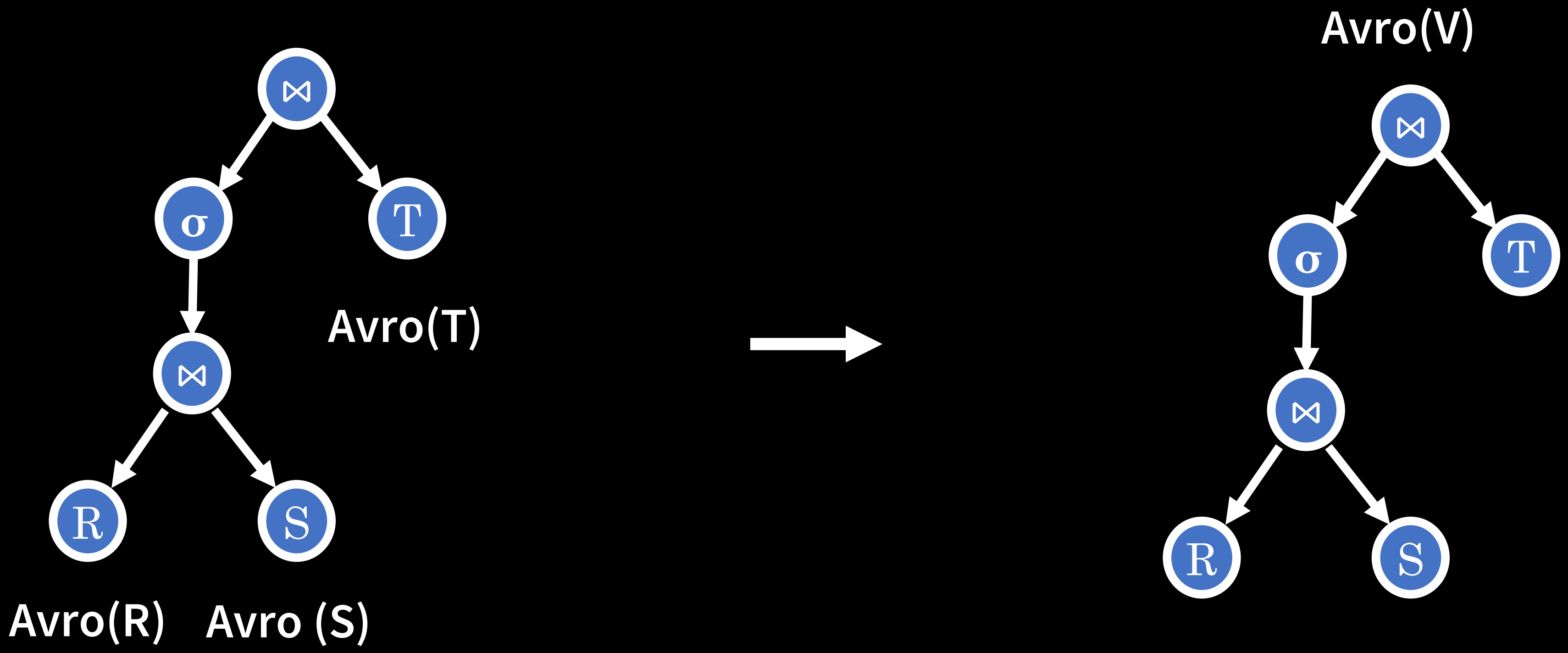
Data Governance



PII Lineage and Derivation



Format-specific View Schema Derivation



Transport UDFs: *Translatable Portable* UDFs

github.com/linkedin/transport

IR

- SQL has pretty well-understood IR: Relational Algebra
- Standard Operators
  - Scan, Filter, Project, Join, Group By, etc
- UDFs
  - Opaque
  - Use imperative language
  - Not portable or translatable

UDF Denormalization

Duplication

Multiple versions of the same UDF. Not clear which is the source of truth.

Inconsistency

Duplicate implementations can diverge causing data inconsistency

Low Productivity

Developers need to learn multiple APIs, implement same logic multiple times.

Low Performance

In some cases, use tuple conversion adapters to enable portability.

UDF APIs

- API Complexity
  - APIs expose low-level details of engines
  - Data types may not intuitvely map to SQL type-system
- API Disparity
  - APIs differ in what to expect from developer
  - APIs differ in features they can provide

Transport UDFs

```java
public class MapFromTwoArrays
    extends StdUDF2<StdArray, StdArray, StdMap> {

  @Override
  public List<String> getInputParameterSignatures() {
    return ImmutableList.of(
        "array(K)",
        "array(V)"
    );
  }

  @Override
  public String getOutputParameterSignature() {
    return "map(K,V)";
  }

  @Override
  public StdMap eval(StdArray a1, StdArray a2) {
    StdMap map = getStdFactory().createMap(
        getOutputParameterSignature());
    for (int i = 0; i < a1.size(); i++) {
      map.put(a1.get(i), a2.get(i));
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    return map;
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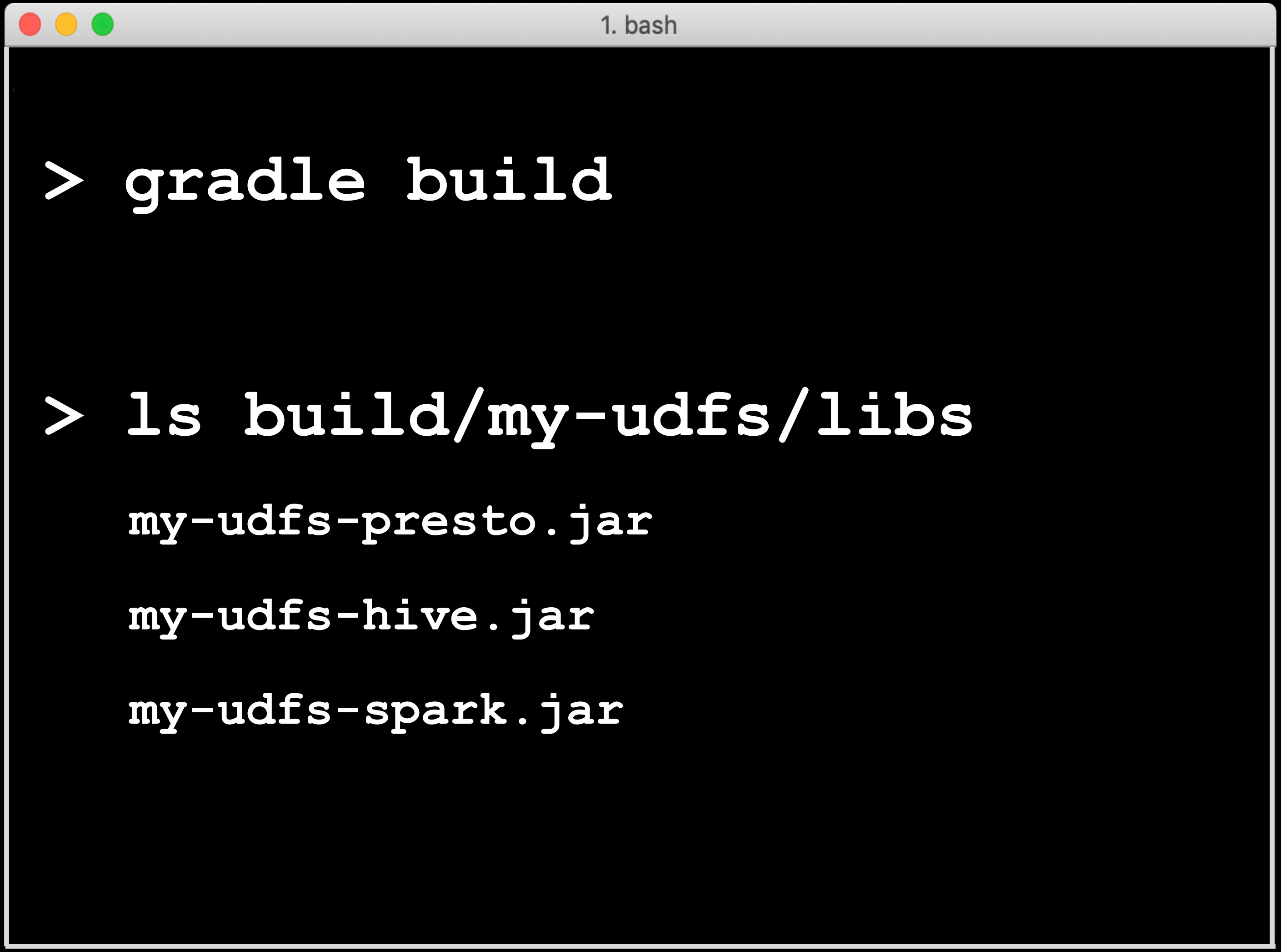
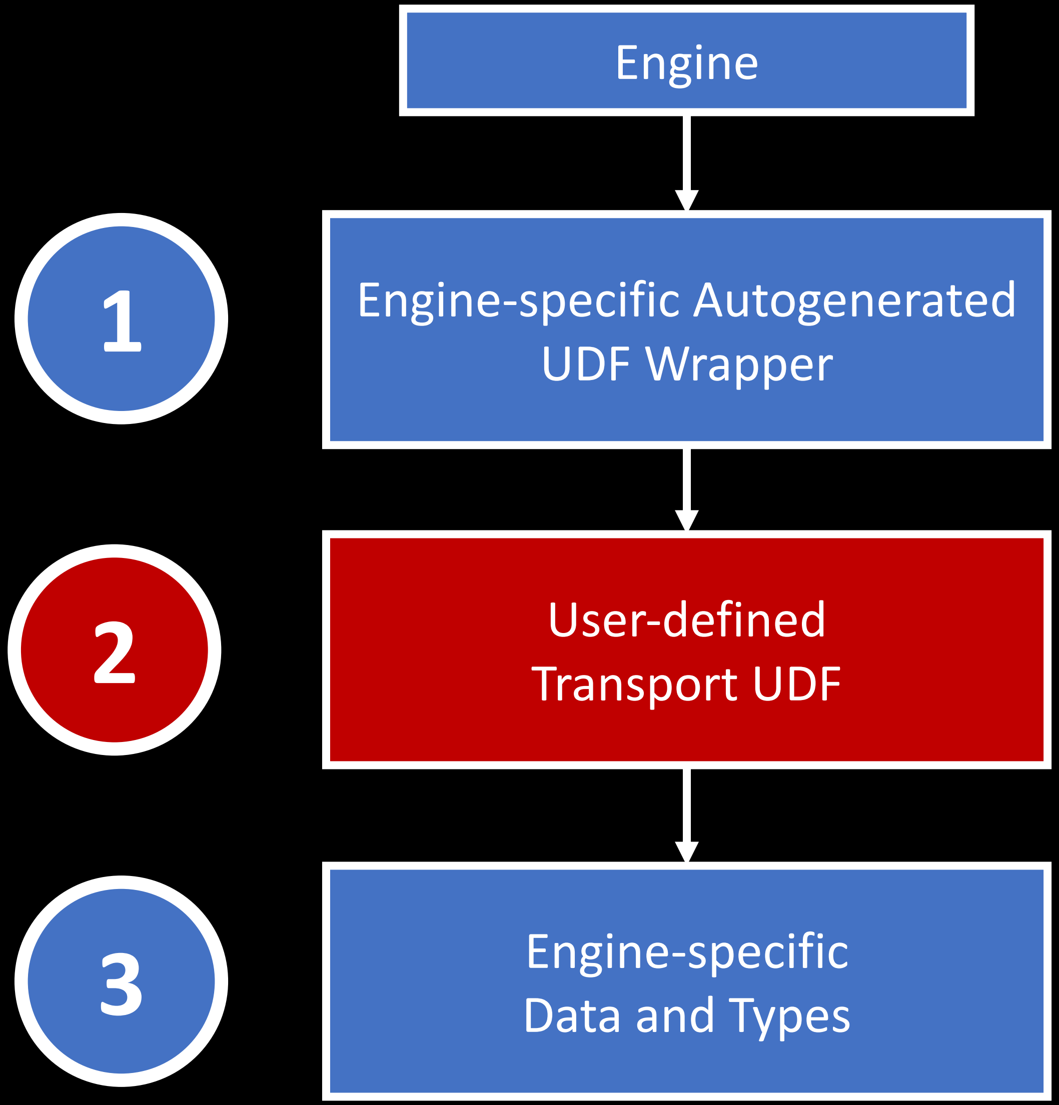
Then What?



```
> gradle build


> ls build/my-udfs/libs
  my-udfs-presto.jar
  my-udfs-hive.jar
  my-udfs-spark.jar
```

Architecture


Engine
1
Engine-specific Autogenerated UDF Wrapper
2
User-defined Transport UDF
3
Engine-specific Data and Types

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