Drill / SQL / Optiq

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SQL

SQL: Pros & cons

Fact:

- SQL is older than Macaulay Culkin

Less interesting but more relevant:

- Can be written by (lots of) humans
- Can be written by machines
- Requires query optimization
- Allows query optimization
- Based on “flat” relations and basic relational operations
- Can be extended

Quick intro to Optiq

Introducing Optiq

Framework

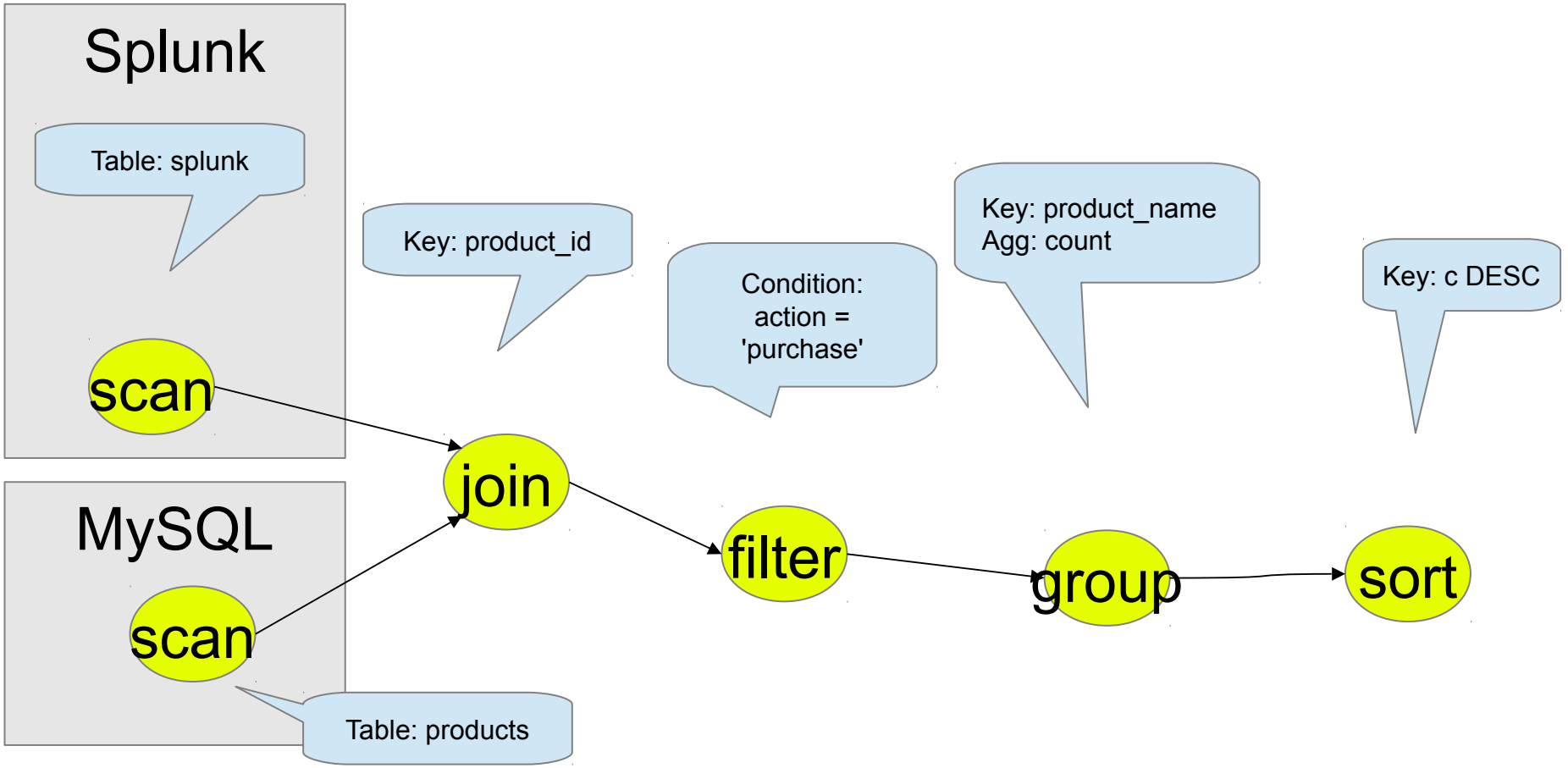
Derived from LucidDB

Minimal query mediator:

- No storage
- No runtime
- No metadata
- Query planning engine
- Core operators & rewrite rules
- Optional SQL parser/validator

Expression tree

```
SELECT p.“product_name”, COUNT(*) AS c
FROM “splunk”.”splunk” AS s
    JOIN “mysql”.”products” AS p
    ON s.”product_id” = p.”product_id”
WHERE s.“action” = 'purchase'
GROUP BY p.”product_name”
ORDER BY c DESC
```



Expression tree (optimized)

```
SELECT p.“product_name”, COUNT(*) AS c
FROM “splunk”.”splunk” AS s
    JOIN “mysql”.”products” AS p
    ON s.”product_id” = p.”product_id”
WHERE s.“action” = 'purchase'
GROUP BY p.”product_name”
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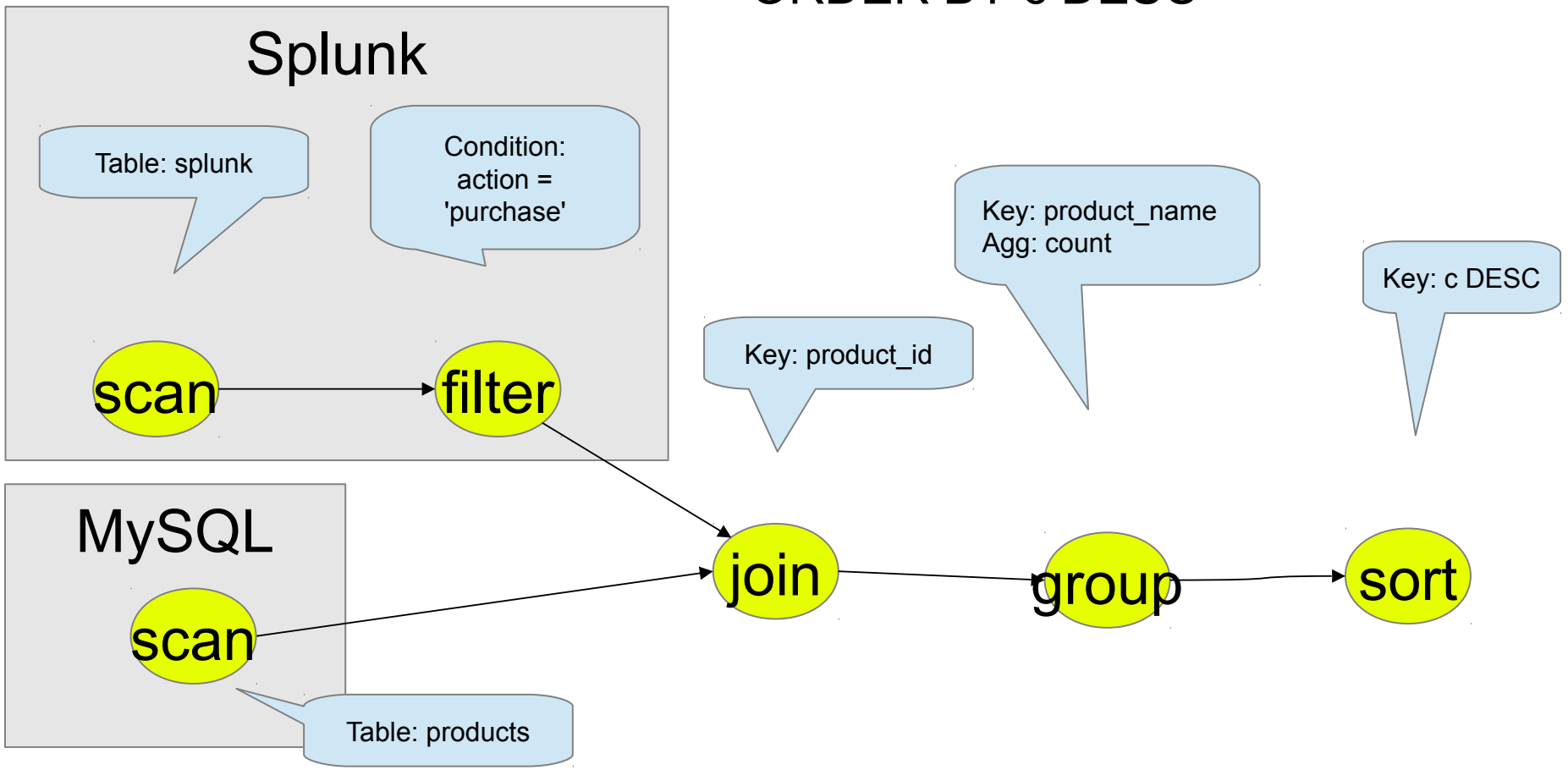


Metadata SPI

- interface Table
  - RelDataType getRowType()
- interface TableFunction
  - List<Parameter> getParameters()
  - Table apply(List arguments)
  - e.g. ViewTableFunction
- interface Schema
  - Map<String, List<TableFunction>> getTableFunctions()

Operators and rules

- Rule: interface RelOptRule
- Operator: interface RelNode
- Core operators: TableAccess, Project, Filter, Join, Aggregate, Order, Union, Intersect, Minus, Values
- Some rules: MergeFilterRule, PushAggregateThroughUnionRule, RemoveCorrelationForScalarProjectRule + 100 more

Planning algorithm

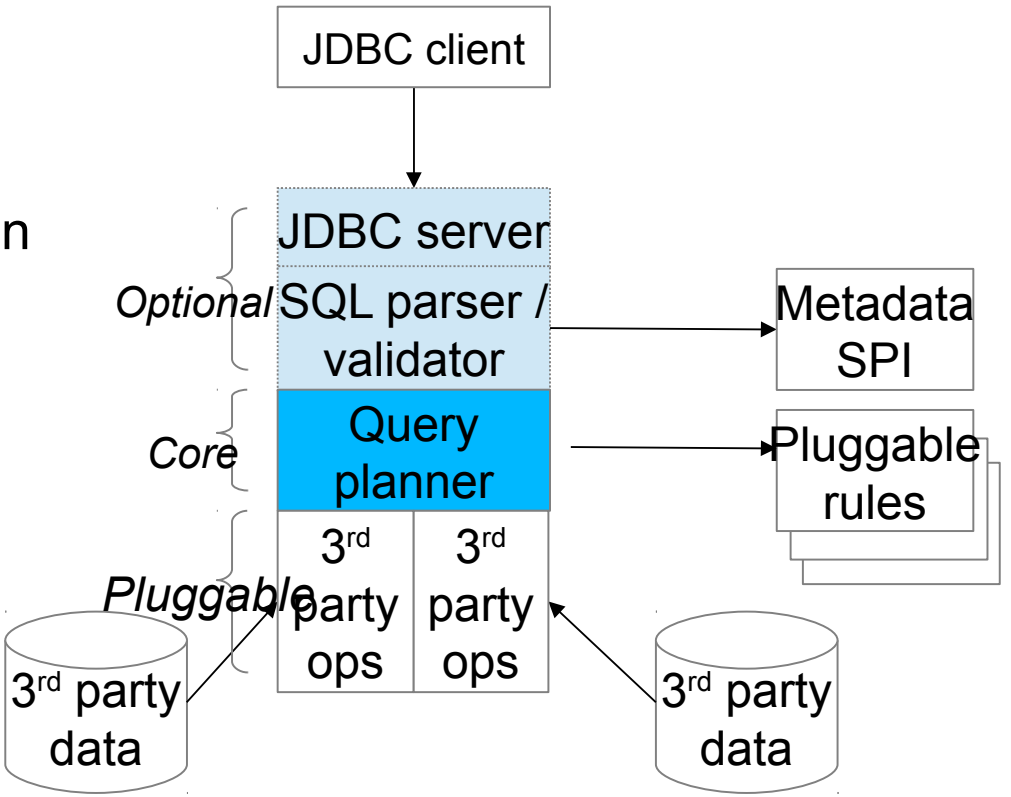
- Start with a logical plan and a set of rewrite rules
- Form a list of rewrite rules that are applicable (based on pattern-matching)
- Fire the rule that is likely to do the most good
- Rule generates an expression that is equivalent (and hopefully cheaper)
- Queue up new rule matches
- Repeat until cheap enough

Concepts

- Cost
- Equivalence sets
- Calling convention
- Logical vs Physical
- Traits
- Implementation

Outside the kernel

- SQL parser/validator
- JDBC driver
- SQL function library (validation + code-generation)
- Lingual (Cascading adapter)
- Splunk adapter
- Drill adapter
- Clone (compact in-memory tables)
- JSON-based catalog
- Views



Optiq roadmap

- Building blocks for analytic DB:
  - In-memory tables in a distributed cache
  - Materialized views
  - Partitioned tables
- Faster planning
- Easier rule development
- ODBC driver
- Adapters for XXX, YYY

Applying Optiq to Drill

1. Enhance SQL

2. Query translation

Drill vs Traditional SQL

- SQL:
  - Flat data
  - Schema up front
- Drill:
  - Nested data (list & map)
  - No schema
- We'd like to write:
  - SELECT name, toppings[2] FROM donuts WHERE ppu > 0.6
- Solution: ARRAY, MAP, ANY types

ARRAY & MAP SQL types

- ARRAY is like java.util.List
- MAP is like java.util.LinkedHashMap

Examples:

- VALUES ARRAY ['a', 'b', 'c']
- VALUES MAP ['Washington', 1, 'Obama', 44]
- SELECT name, address[1], address[2], state FROM Employee
- SELECT * FROM Donuts WHERE CAST(donuts['ppu'] AS DOUBLE) > 0.6

ANY SQL type

- ANY means “type to be determined at runtime”
- Validator narrows down possible type based on operators used
- Similar to converting Java's type system into JavaScript's. (Not easy.)

Sugaring the donut

Query:

- SELECT c['ppu'], c['toppings'][1] FROM Donuts

Additional syntactic sugar:

- `c.x` means `c['x']`

So:

- CREATE TABLE Donuts(c ANY)
- SELECT c.ppu, c.toppings[1] FROM Donuts

Better:

- CREATE TABLE Donuts(_MAP MAP(VARCHAR TO ANY))
- SELECT ppu, toppings[1] FROM Donuts

UNNEST

Employees nested inside departments:

- CREATE TYPE employee (empno INT, name VARCHAR(30));
- CREATE TABLE dept (deptno INT, name VARCHAR(30),
  employees EMPLOYEE ARRAY);

Unnest:

- SELECT d.deptno, d.name, e.empno, e.name
  FROM department AS d
  CROSS JOIN UNNEST(d.employees) AS e

SQL standard provides other operations on collections:

- COLLECT, FUSION, MEMBER OF

More: http://farrago.sourceforge.net/design/CollectionTypes.html

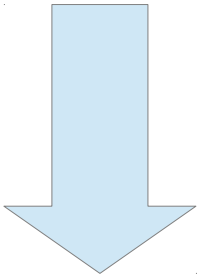
Applying Optiq to Drill

1. Enhance SQL
2. **Query translation**

Query translation

SQL:

- select d['name'] as name, d['xx'] as xx
  from (
    select _MAP['donuts'] as d from donuts)
  where cast(d['ppu'] as double) > 0.6



Drill:

- { head: { … },
  storage: { … },
  query: [{
    op: “sequence”, do: [
      { op: “scan”, … selection: { path: "/donuts.json", … }},
      { op: “transform”, transforms: [{ ref: "d", expr: "donuts"}] },
      { op: “filter”, expr: “d.ppu > 0.6” },
      { op: “transform”, transforms: [{ ref: “name”, expr: “d.name”, … }] }] }

Planner log

```
Original rel:
AbstractConverter(subset=[rel#14:Subset#3.ARRAY], convention=[ARRAY])
  ProjectRel(subset=[rel#10:Subset#3.NONE], NAME=[ITEM($0, 'name')], XX=[ITEM($0, 'xx')])
    FilterRel(subset=[rel#8:Subset#2.NONE], condition=[>(CAST(ITEM($0, 'ppu')):DOUBLE NOT NULL, 0.6)])
      ProjectRel(subset=[rel#6:Subset#1.NONE], D=[ITEM($0, 'donuts')])
        DrillScan(subset=[rel#4:Subset#0.DRILL], table=[[DONUTS, DONUTS]])
…

Cheapest plan:
EnumerableDrillRel
  DrillProjectRel(NAME=[ITEM($0, 'name')], XX=[ITEM($0, 'xx')])
    DrillProjectRel(D=[ITEM($0, 'donuts')])
      DrillFilterRel(condition=[>(CAST(ITEM(ITEM($0, 'donuts'), 'ppu')):DOUBLE NOT NULL, 0.6)])
        DrillScan(table=[[DONUTS, DONUTS]])
```

Next

- Translate join, aggregate, sort, set ops
- Operator overloading with ANY
- Mondrian on Drill

Thank you!

https://github.com/julianhyde/share/slides
https://github.com/julianhyde/incubator-drill
https://github.com/julianhyde/optiq
http://incubator.apache.org/drill

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