CS 744: SCOPE

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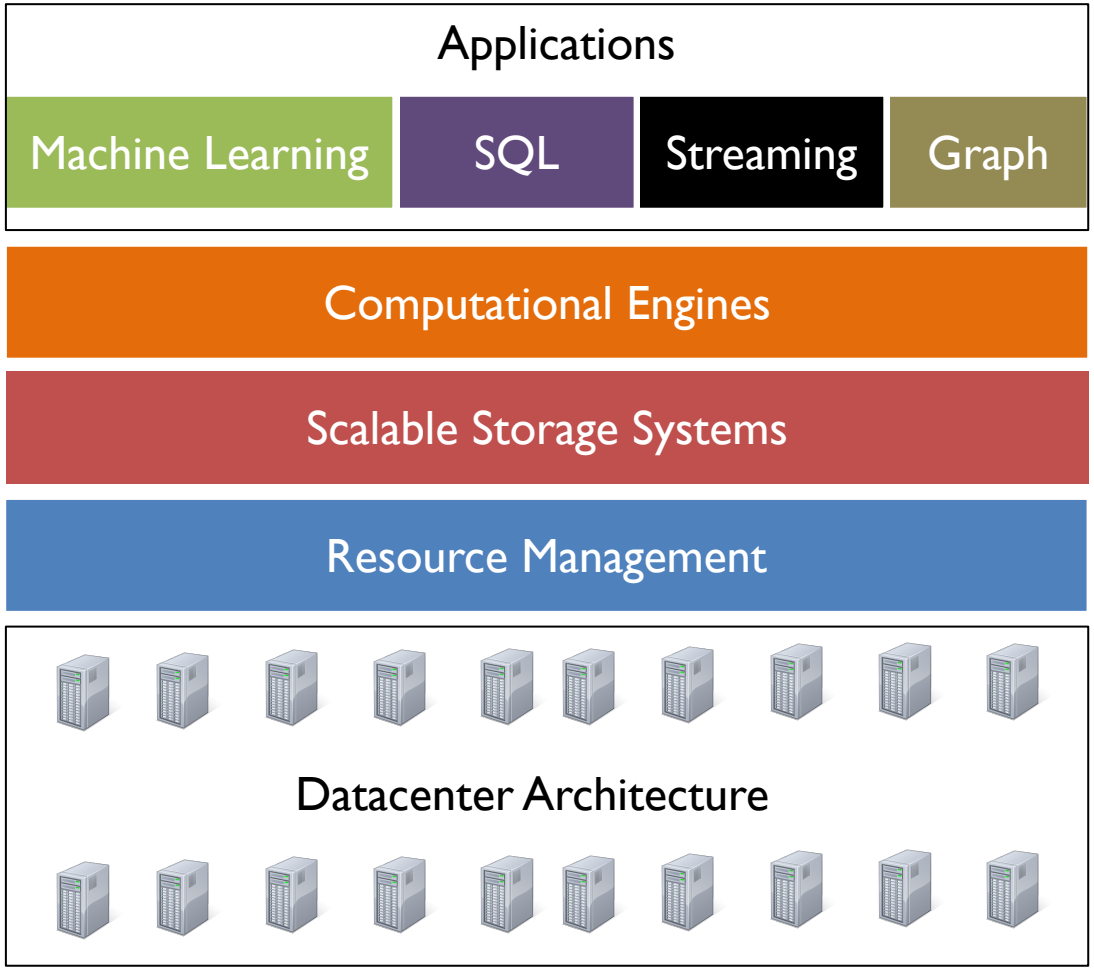
Fall 2021

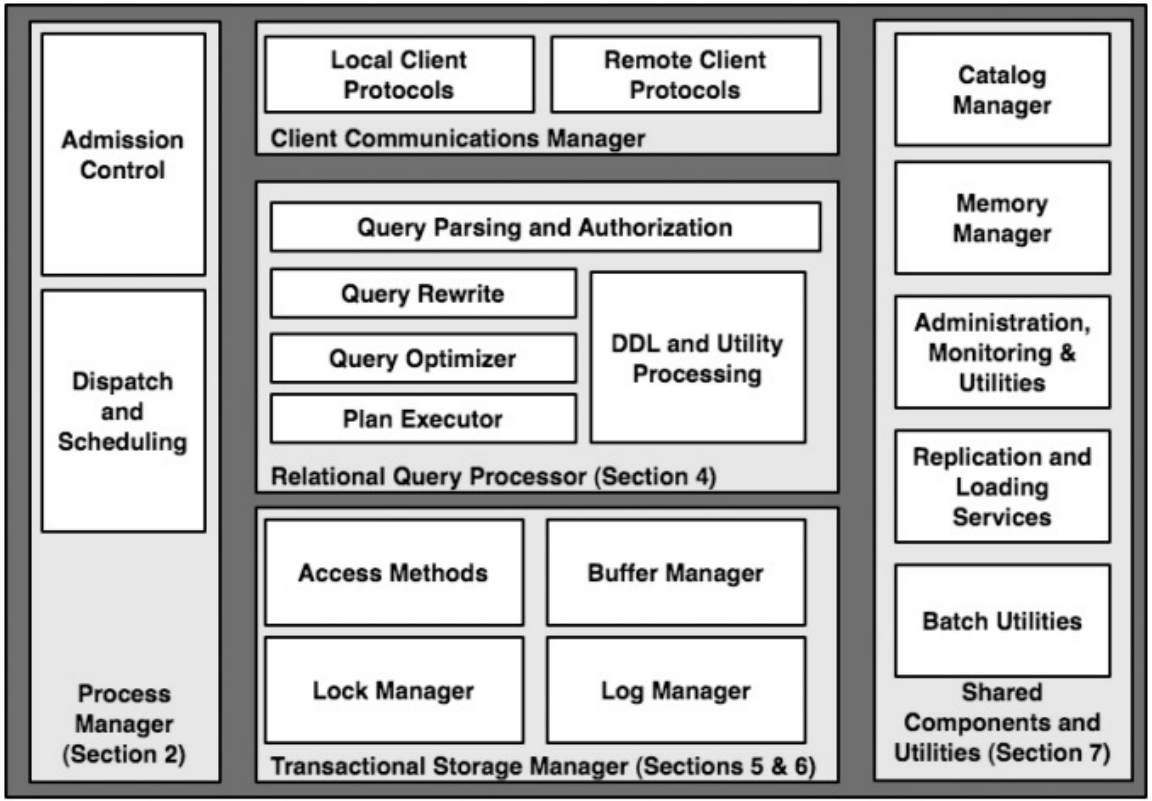
ADMINISTRIVIA

- Assignment 1 grades: this week
- Course Project Proposal: Due Monday
- Midterm more details today on Piazza


Applications
Machine Learning
SQL
Streaming
Graph
Computational Engines
Scalable Storage Systems
Resource Management
Datacenter Architecture

SQL: STRUCTURED QUERY LANGUAGE

DATABASE SYSTEMS



PROCEDURAL VS. RELATIONAL

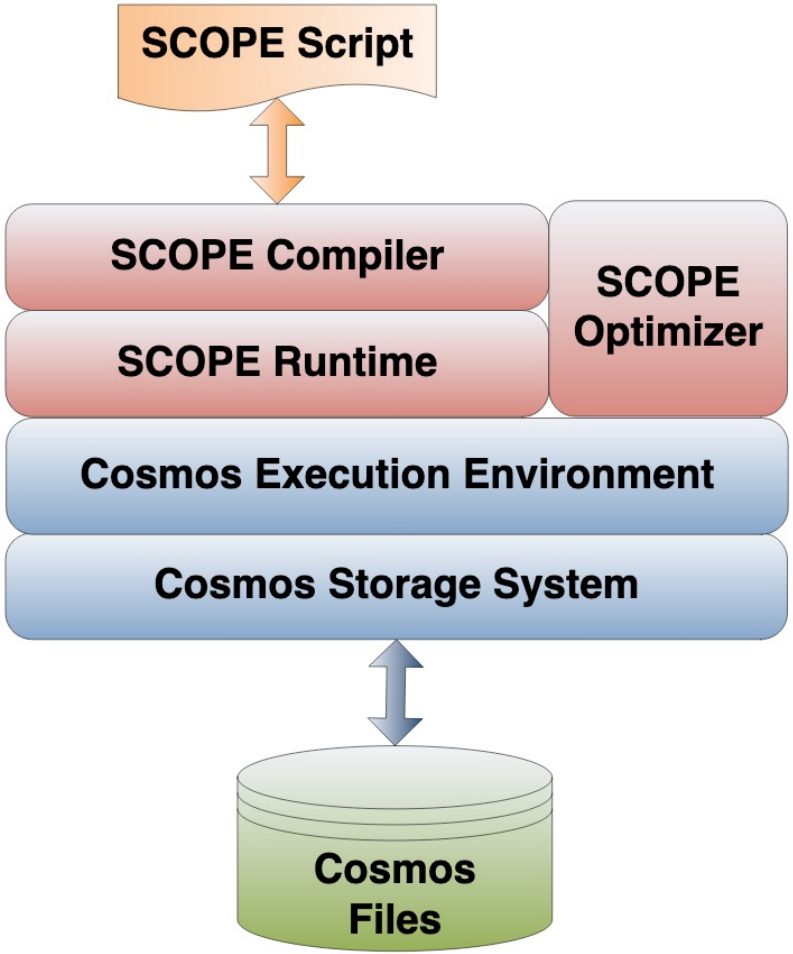
```
lines = sc.textFile(“users")
csv = lines.map(x =>
    x.split(‘,’))
young = csv.filter(x =>
    x(1) < 21)
println(young.count())
```

```
SELECT COUNT(*)
FROM “users”
WHERE age < 21
```

SCOPE

```
SELECT query, COUNT(*)
AS count
FROM "search.log"

USING LogExtractor
GROUP BY query
HAVING count > 1000
ORDER BY count DESC;
```



SCOPE OPERATORS

Input reading: What is different?

```
EXTRACT column[:<type>][, ...]
FROM <input_stream(s) >
USING <Extractor> [(args)]
[HAVING <predicate>]
```

SQL OPERATORS

Select – read rows that satisfy some predicate

Join – Equijoin with support for Inner and Outer join

GroupBy – Group by some column

OrderBy – Sorting the output

Aggregations – COUNT, SUM, MAX etc.

LANGUAGE INTEGRATION

```
R1 = SELECT A+C AS ac, B.Trim() AS B1
FROM R
WHERE StringOccurs(C,"xyz") > 2

#CS
public static int StringOccurs(string str, string ptrn){
 int cnt=0; int pos=-1;
 while (pos+1 < str.Length) {
    pos = str.IndexOf(ptrn, pos+1);
    if (pos < 0) break;
    cnt++;
  }
  return cnt;
}
#ENDCS
```

MAPREDUCE-LIKE?

Process

Reduce

Combine

```
COMBINE S1 WITH S2
ON S1.A==S2.A AND S1.B==S2.B AND S1.C==S2.C
USING MultiSetDifference
PRODUCE A, B, C
```

EXECUTION: COMPILER

```
SELECT query, COUNT() AS count
FROM "search.log"
USING LogExtractor
GROUP BY query
HAVING count > 1000
ORDER BY count DESC;
```

Check syntax, resolve names

Checks if columns have been defined

Result: Internal parse tree

OPTIMIZER

Rewrite the query expression → lowest cost

Examples:

- Removing unnecessary columns
- Pushing down selection predicates
- Pre-aggregating

```
SELECT query, COUNT() AS count
FROM "search.log"
USING LogExtractor
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```
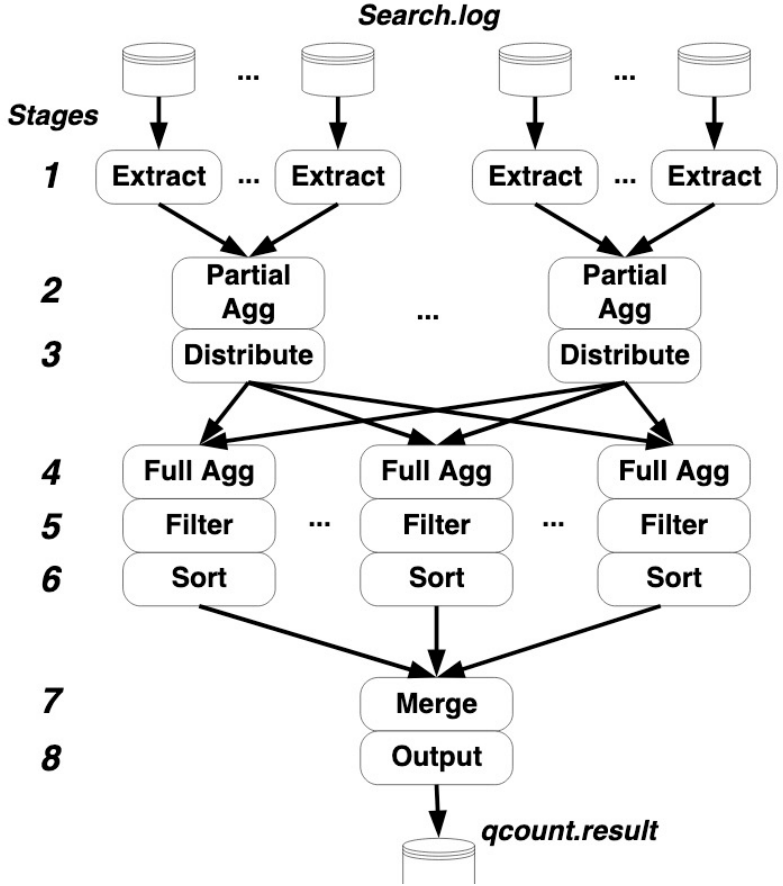



RUNTIME OPTIMIZATIONS

Hierarchical aggregation

Locality-sensitive task placement

SUMMARY, TAKEAWAYS

Relational API

- Enables rich space of optimizations
- Easy to use, integration with C#

Scope Execution

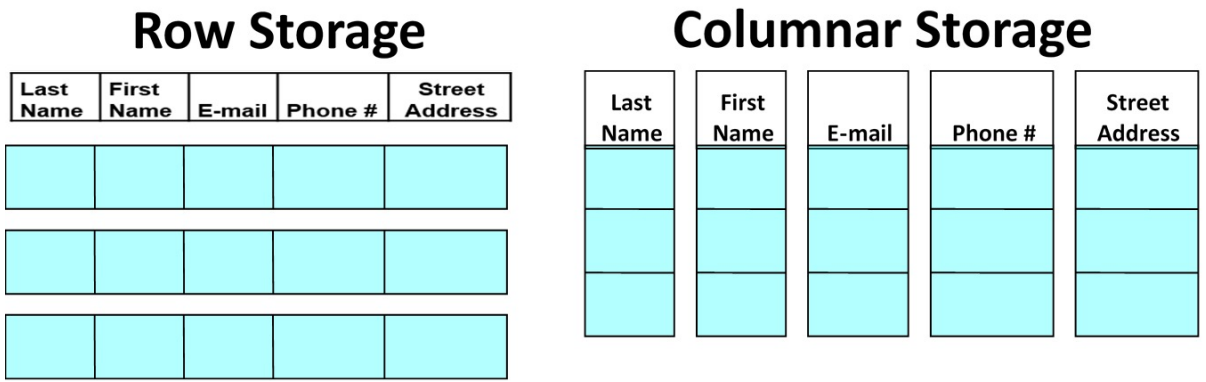
- Compiler to check for errors, generate DAG
- Optimizer to accelerate queries (static + dynamic)

Precursor to systems like SparkSQL

DISCUSSION

https://forms.gle/eaCacDp6budf5cTDA

Consider you have a column-oriented data layout on your storage system (Example below). What are some reasons that a SCOPE query might be faster than running equivalent MR program?



http://dbmsmusings.blogspot.com/2017/10/apache-arrow-vs-parquet-and-orc-do-we.html

Does SCOPE-like Optimizer help ML workloads? Consider the code in your Assignment2. What parts of your code would benefit and what parts would not?

NEXT STEPS

Next class: Elastic Data Warehousing with SnowFlake

Project proposals due Monday! See Piazza!

Midterm coming up next week