Dremel: Interactive Analysis of Web-Scale Datasets

Introduction

- Need: Large-scale data processing
- Challenge: Nested data formats
  - Expensive to normalise

Features & Contributions

- SQL-like querying syntax
- In-situ data processing to avoid data loading and transformations
- Serverless and multi-tenant
- Columnar format for nested data
  - Multi-level execution trees

Splitting records into columnar format

Repetition Level -
"At what repeated field in the field's path has the value repeated?"

Definition Level -
"How many fields in the path that could be undefined (repeated/optional) are actually present?"

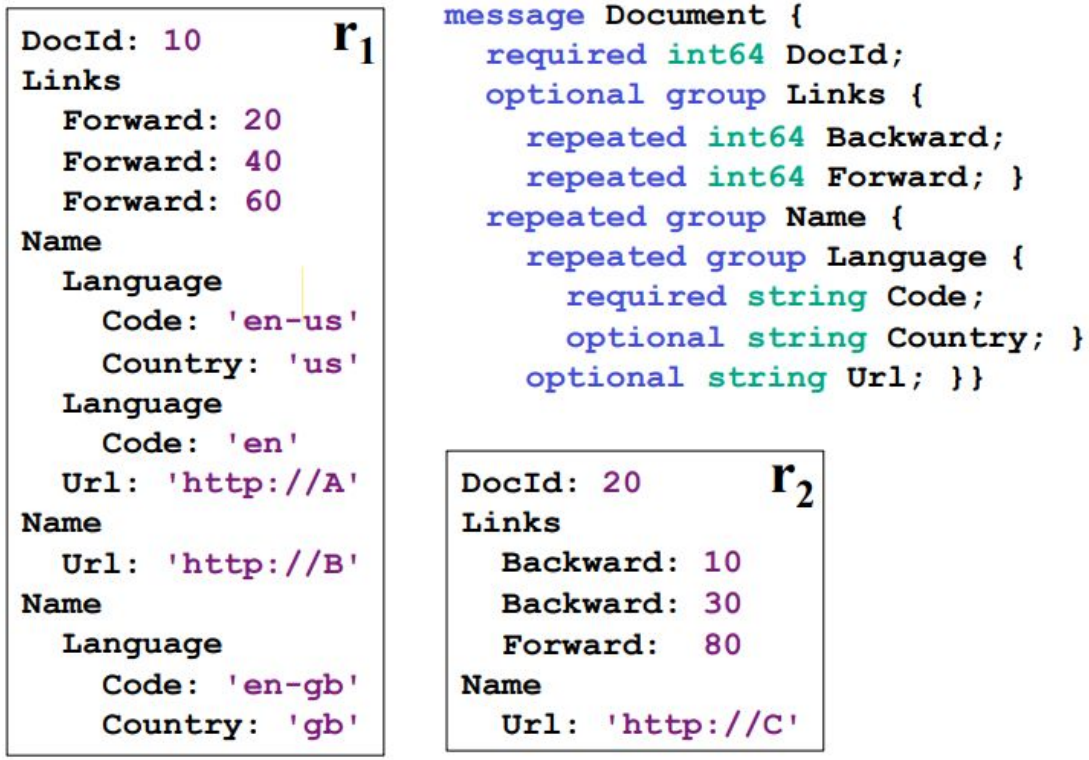


Figure 1*

*All figures are taken from the paper

Repetition & Definition

Name.Language.Code

At what repeated field in the field's path has the value repeated

- Both Name and Language can be repeated

How many fields in the path that could be undefined (repeated/optional) are actually present?

- Both Name and Language are undefined fields (repeated, in this case)

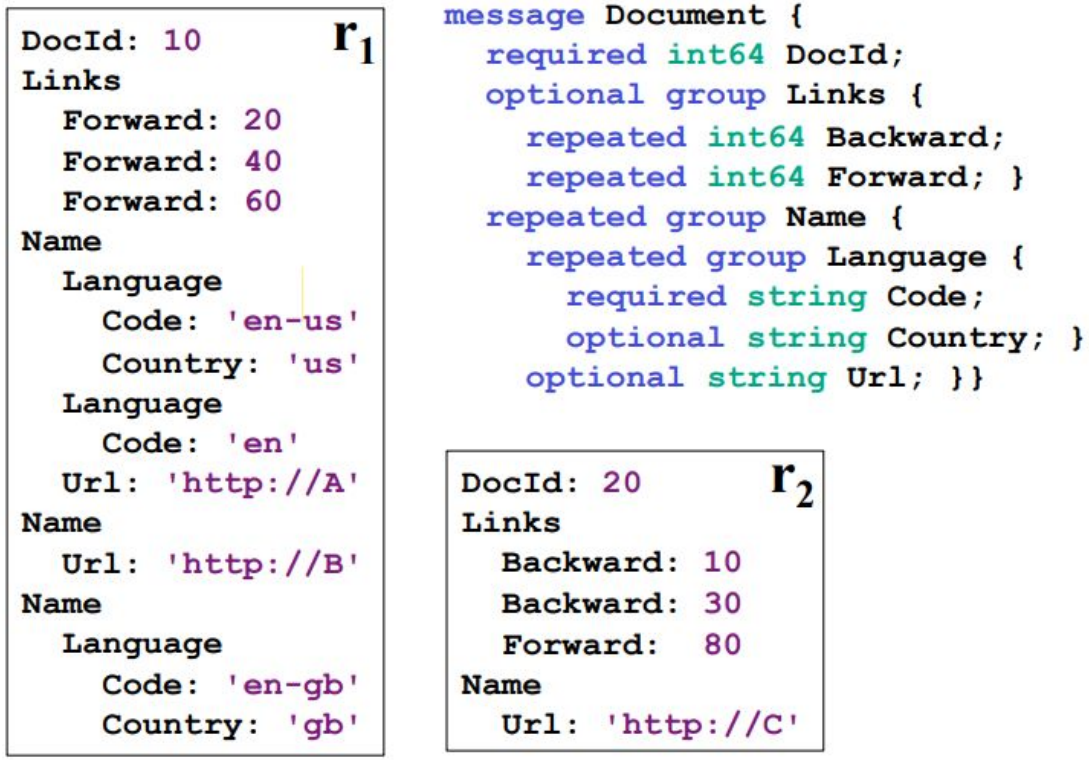


Figure 1

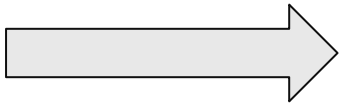
Repetition & Definition

```
DocId: 10                    r1
Links
  Forward: 20
  Forward: 40
  Forward: 60
Name
  Language
    Code: 'en-us'
    Country: 'us'
  Language
    Code: 'en'
  Url: 'http://A'
Name
  Url: 'http://B'
Name
  Language
    Code: 'en-gb'
    Country: 'gb'
```

```
message Document {
  required int64 DocId;
  optional group Links {
    repeated int64 Backward;
    repeated int64 Forward; }
  repeated group Name {
    repeated group Language {
      required string Code;
      optional string Country; }
    optional string Url; }}
```

```
DocId: 20                    r2
Links
  Backward: 10
  Backward: 30
  Forward:  80
Name
  Url: 'http://C'
```

Figure 1



Name.Language.Code

value	r	d
en-us	0	2
en	2	2
NULL	1	1
en-gb	1	2
NULL	0	1

Figure 2

Record assembly

Finite State Machine

- Each state is a field reader for the field in the query
- State transitions are repetition levels of the field
- For a subset of fields, construct a simpler FSM

Query Execution

- Root server and Leaf servers
- Partitions are called Tablets
- Scheduling Slots

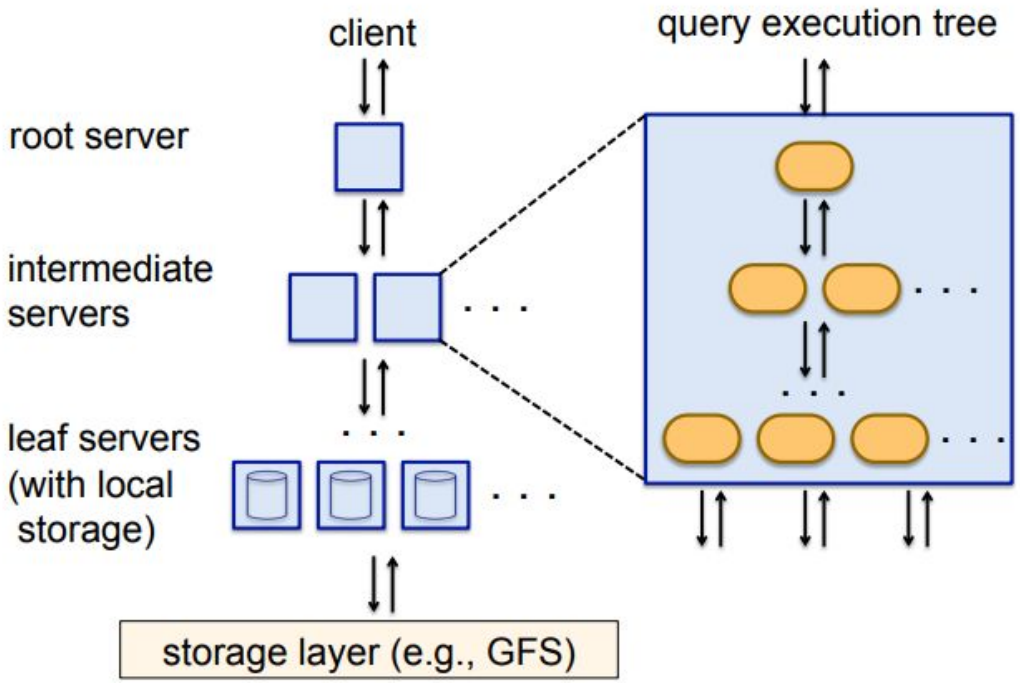


Figure 4

Experimentation

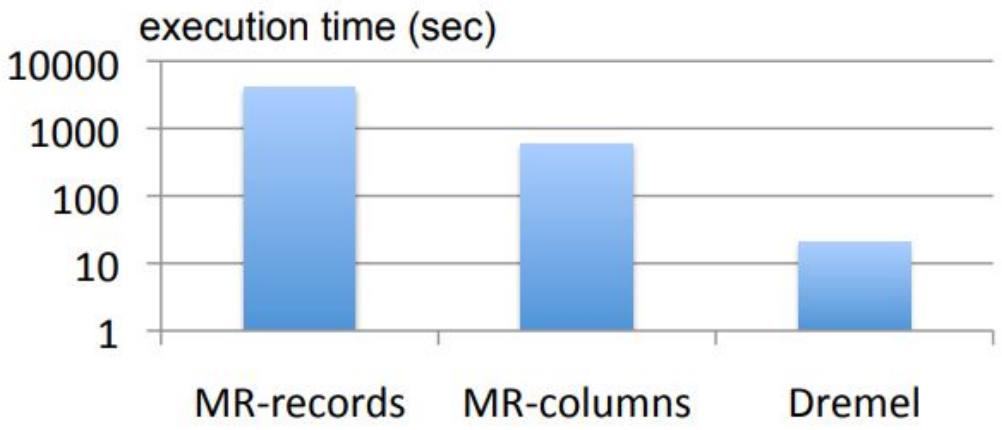


Figure 5: Comparing execution time with MapReduce

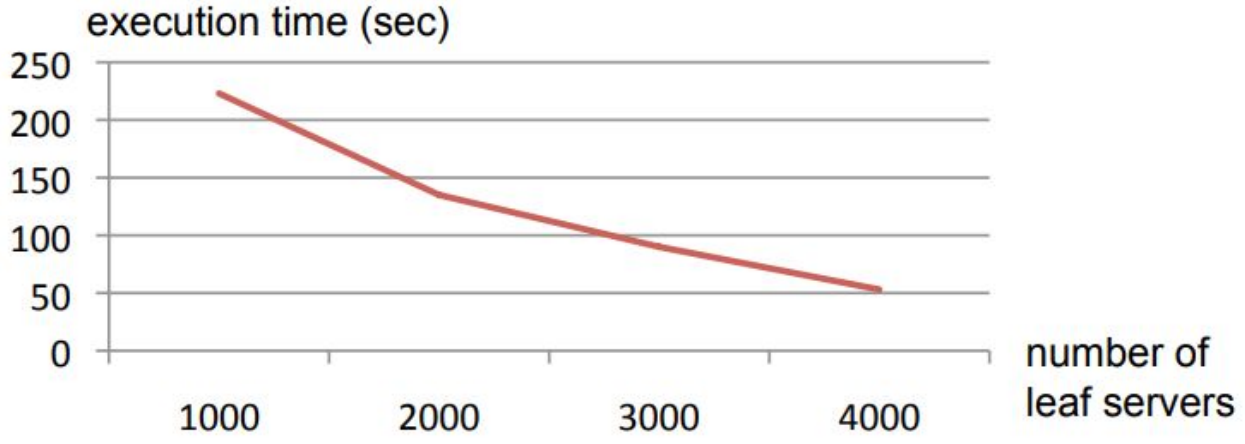


Figure 6: Comparing execution time by varying the number of leaf servers

Experimentation

Q2: SELECT country, SUM(item.amount) FROM T2 GROUP BY country
Q3: SELECT domain, SUM(item.amount) FROM T2 WHERE domain CONTAINS '.net' GROUP BY domain

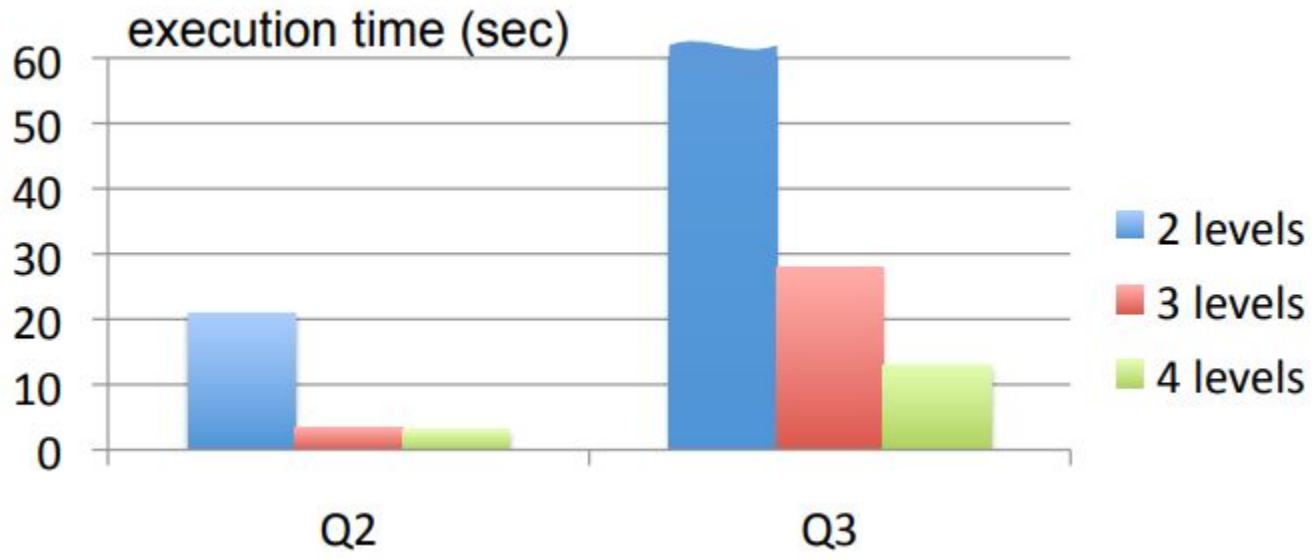


Figure 6: Execution times for Q2 and Q3

Summary

- SQL-like syntax
- In-situ data processing
- Serverless
- Columnar format for nested data

Discussion

- In-situ data processing unsuitable in case of external data management tools
- Columnar format for nested data encodes redundant information
- Record assembly for deeply nested data or large number of columns is inefficient

In recent years,

- Unifying framework for SQL dialects
- Hybrid approach with managed and in-situ data
- Query execution as a Directed Acyclic Graph, with a shuffle persistence layer

Reference: Melnik, Sergey, et al. Dremel: A decade of interactive SQL analysis at web scale VLDB, 2020

Thank you!