TECH VAULT

INTRODUCTION TO Parquet

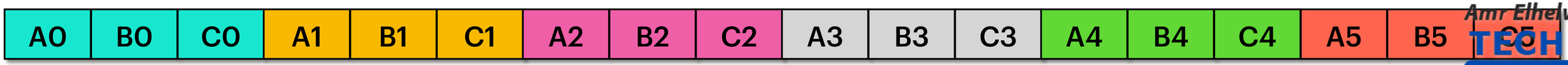
AMR ELHELW

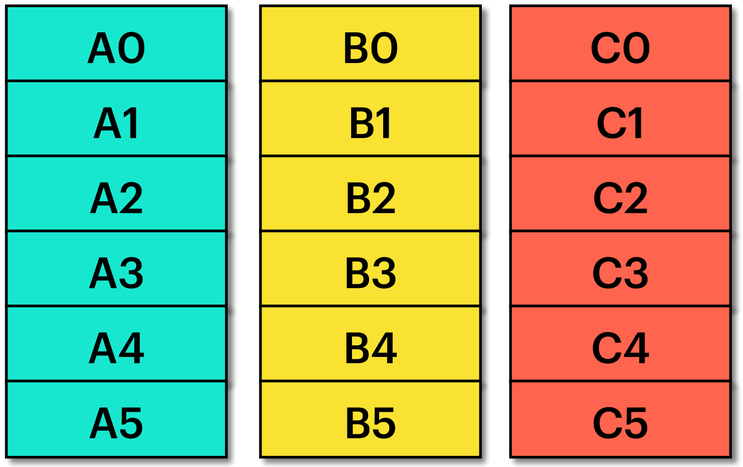
	Col A	Col B	Col C
Row 0	A0	B0	C0
Row 1	A1	B1	C1
Row 2	A2	B2	C2
Row 3	A3	B3	C3
Row 4	A4	B4	C4
Row 5	A5	B5	C5

A0	B0	C0
A1	B1	C1
A2	B2	C2
A3	B3	C3
A4	B4	C4
A5	B5	C5

Row-oriented

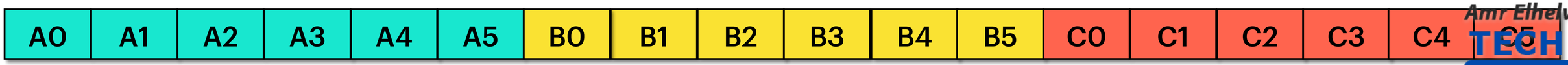
Physical Storage





Column-oriented (Columnar)

Physical Storage



OLTP

- *Access a small number of rows*
- *Read/Update several attributes from the same row.*
- *Primary focus is operational*

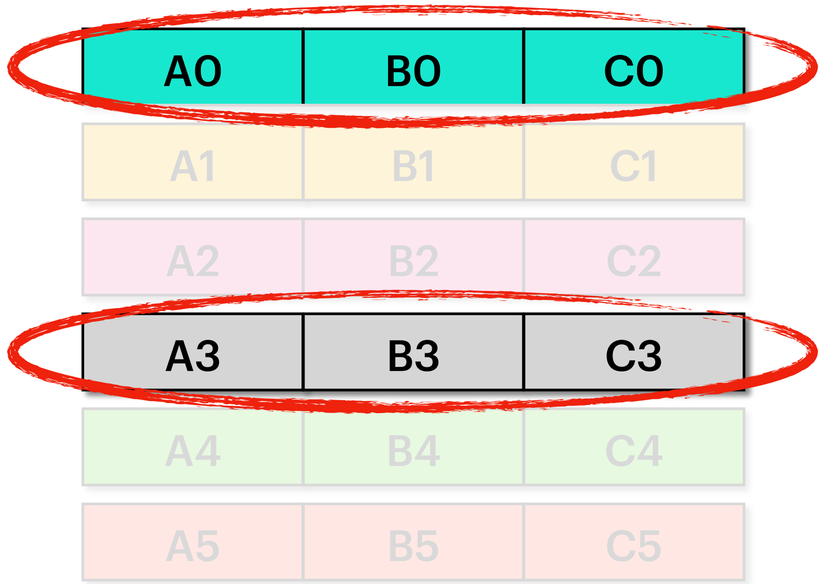
```
select *
from employees
where dept = 'IT'
```

OLAP

- *Read a lot of rows (usually very large tables)*
- *Focus on a small number of columns in order to do some kind of aggregation*
- *Primary focus here is analytics*

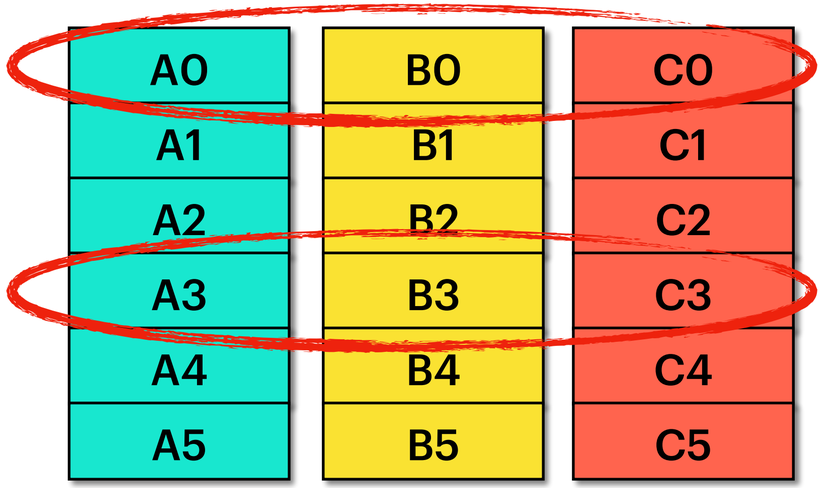
```
select avg(salary)
from employees
```

```sql
select *
from employees
where dept = 'IT'
```



Row-oriented

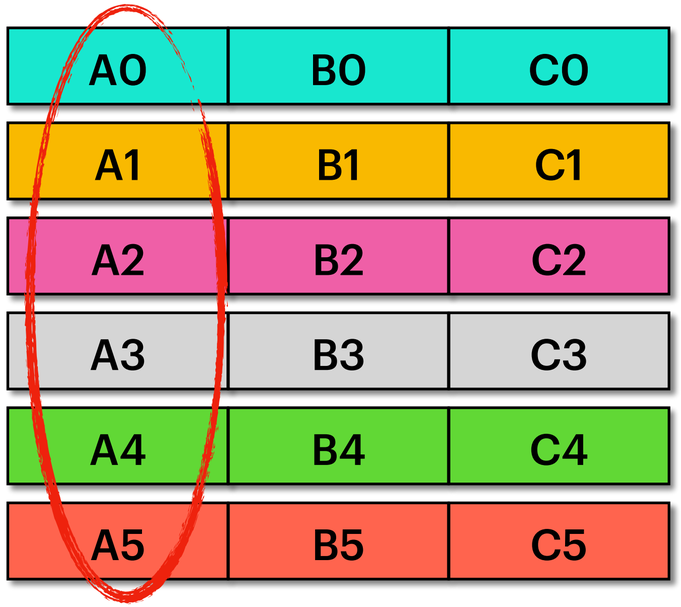
OLTP 👍



Columnar

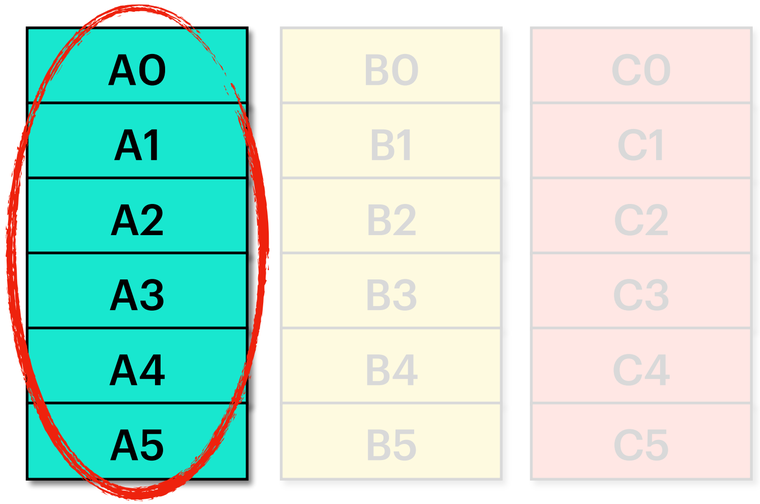
OLTP 👎

```
select avg(salary)
from employees
```



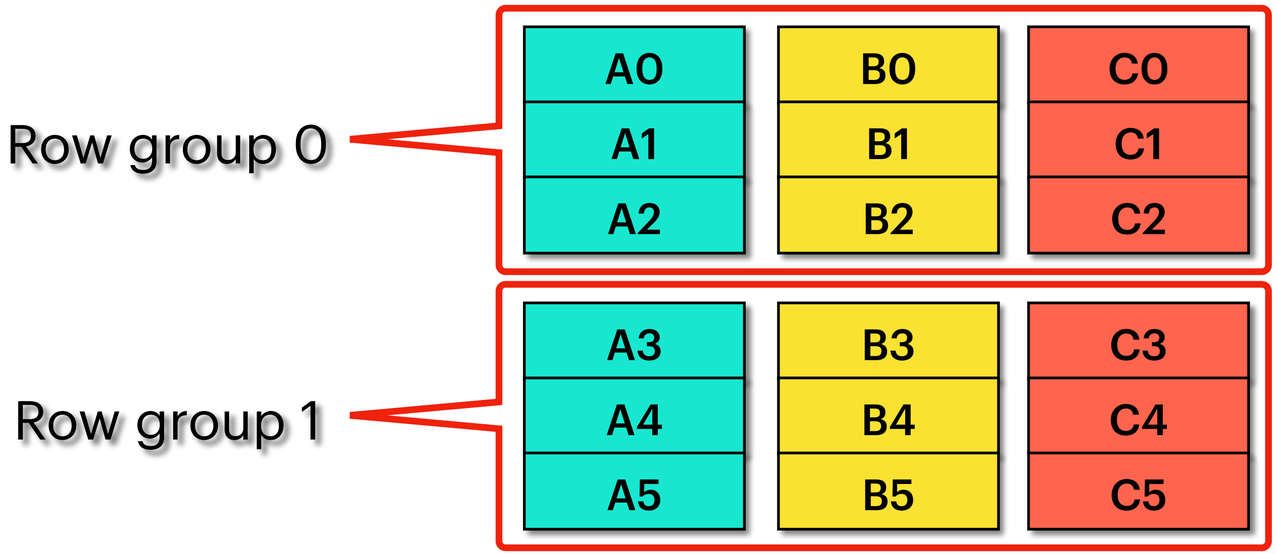
Row-oriented

OLTP 👍 OLAP 👎



Columnar

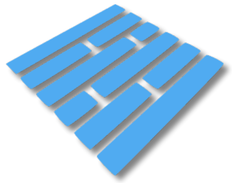
OLTP 👎 OLAP 👍



Parquet

Physical Storage

A0	A1	A2	B0	B1	B2	C0	C1	C2	A3	A4	A5	B3	B4	B5	C3	C4	C5



Parquet

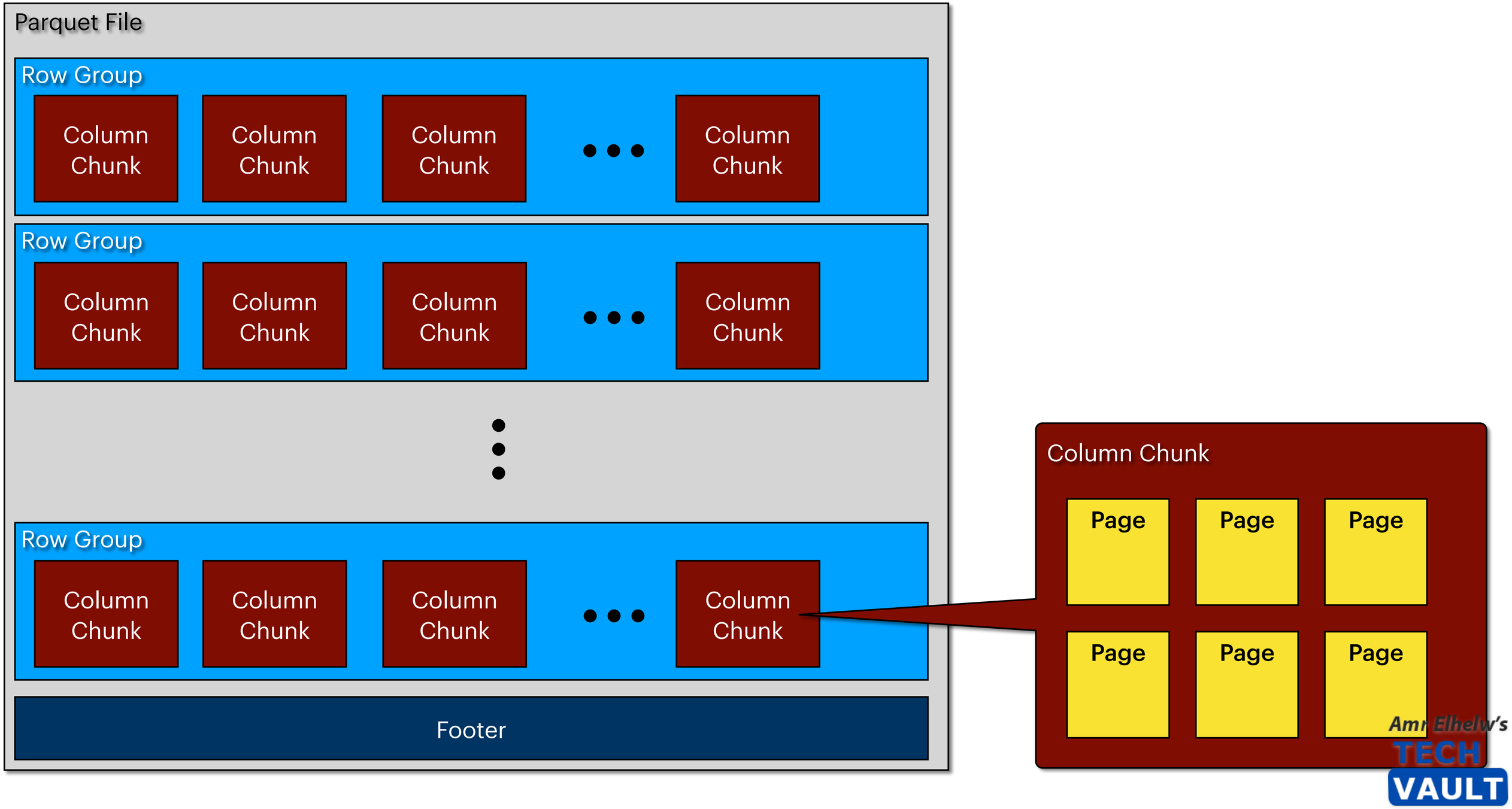
https://parquet.apache.org/docs/overview

Documentation / Overview

Overview

All about Parquet.

Apache Parquet is an open source, column-oriented data file format designed for efficient data storage and retrieval. It provides high performance compression and encoding schemes to handle complex data in bulk and is supported in many programming language and analytics tools.


Parquet File
Row Group
Column Chunk
Column Chunk
Column Chunk
Column Chunk
Row Group
Column Chunk
Column Chunk
Column Chunk
Column Chunk
Row Group
Column Chunk
Column Chunk
Column Chunk
Column Chunk
Footer
Column Chunk
Page
Page
Page
Page
Page
Page
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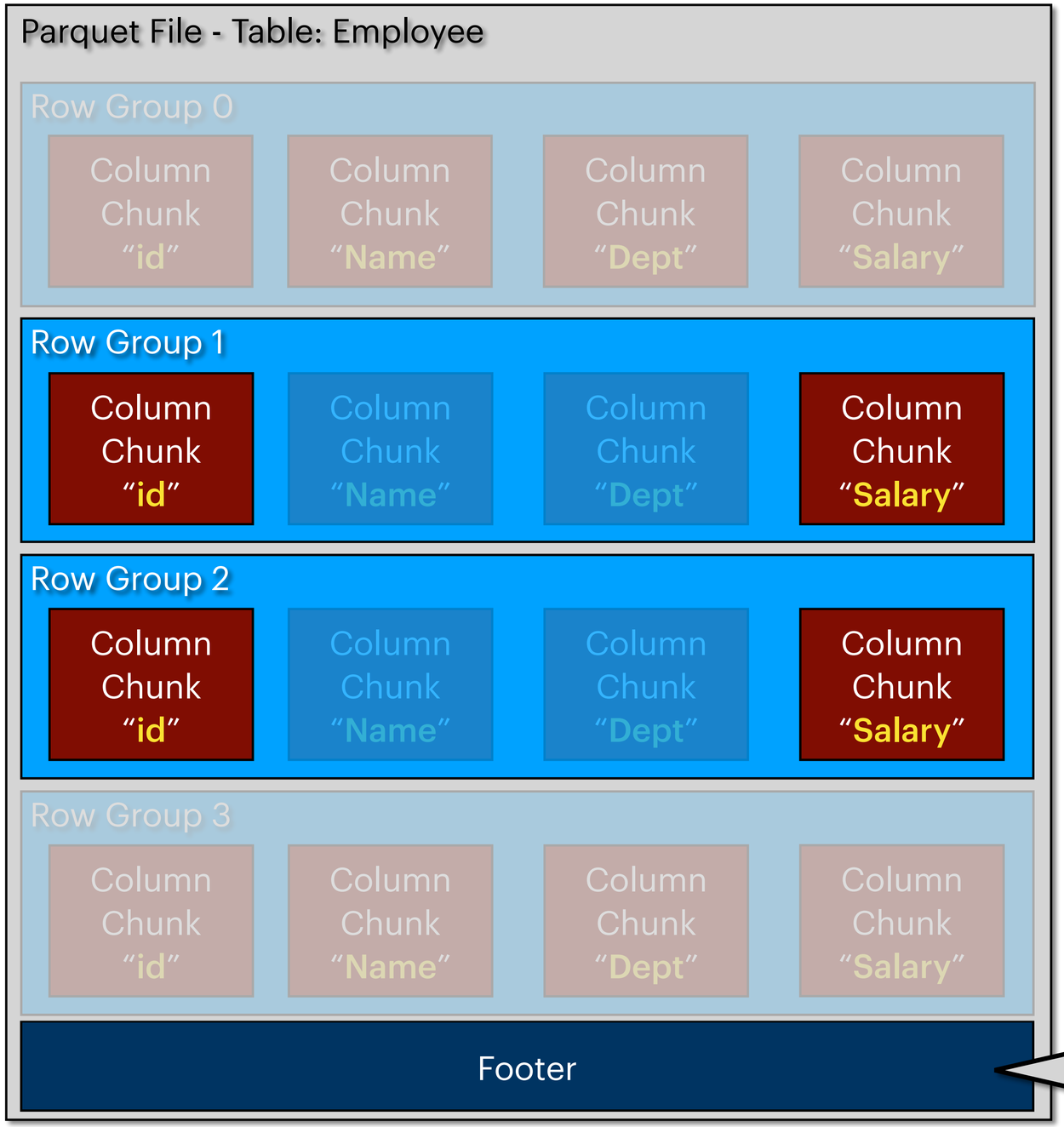
Footer Contents

- Schema (Column names, types, etc.)
- Total number of rows in the file
- **Row group metadata (for each Row Group)**
  - # rows, byte size, file offset
  - **Column Chunk metadata (for each Column Chunk)**
    - File offset, chunk size
    - # distinct values in chunk, # nulls in chunk
    - Min/max values in chunk
    - Encoding/compression info for each page


```
select avg(salary)
from employees
```




```
select avg(salary)
from employee
where id between 400 and 600
```

Row group 0:
"id": min = 102, max = 256 ✗
"dept": min = 10, max = 55
...

Row group 1:
"id": min = 260, max = 529 ✓
"dept": min = 5, max = 48
...

Row group 2:
"id": min = 570, max = 863 ✓
"dept": min = 18, max = 57
...

Row group 3:
"id": min = 869, max = 1104
"dept": min = 12, max = 41
...


```
select avg(salary)
from employee
where dept = 30
```

Row group 0:
"id": min = 102, max = 256
"dept": min = 10, max = 55 ✓
...

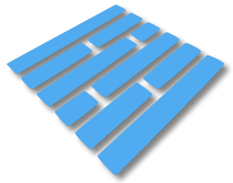
Row group 1:
"id": min = 260, max = 529
"dept": min = 5, max = 48 ✓
...

Row group 2:
"id": min = 570, max = 863
"dept": min = 18, max = 57 ✓
...

Row group 3:
"id": min = 869, max = 1104
"dept": min = 12, max = 41 ✓
...

Note on file size

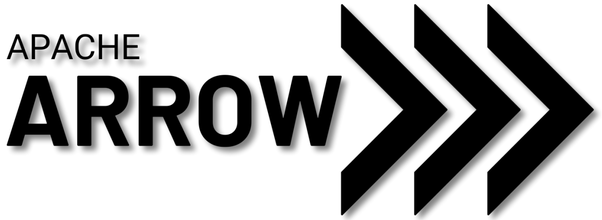
- **Many small files**
  - Overhead of fetching multiple files
  - Setting up reader objects
  - Too many footers to read
- **Few huge files**
  - Footer gets too large — too many row groups, with info for each
- **No “magic number” for how big a file should be**
  - Trial and error
  - System specific guidelines



Parquet

SQL

Programming Languages



C, C++, C#, Go, Java, JavaScript, Python, R, Ruby, Rust ...

Python

Limitations

- **Overhead for small datasets**
  - *Metadata adds cost*
- **Not ideal for frequent appends/updates**
  - *Requires rewrite*
- **Not suited for OLTP workloads**
  - *Inefficient for Row-Level Operations*