Druid源码导读

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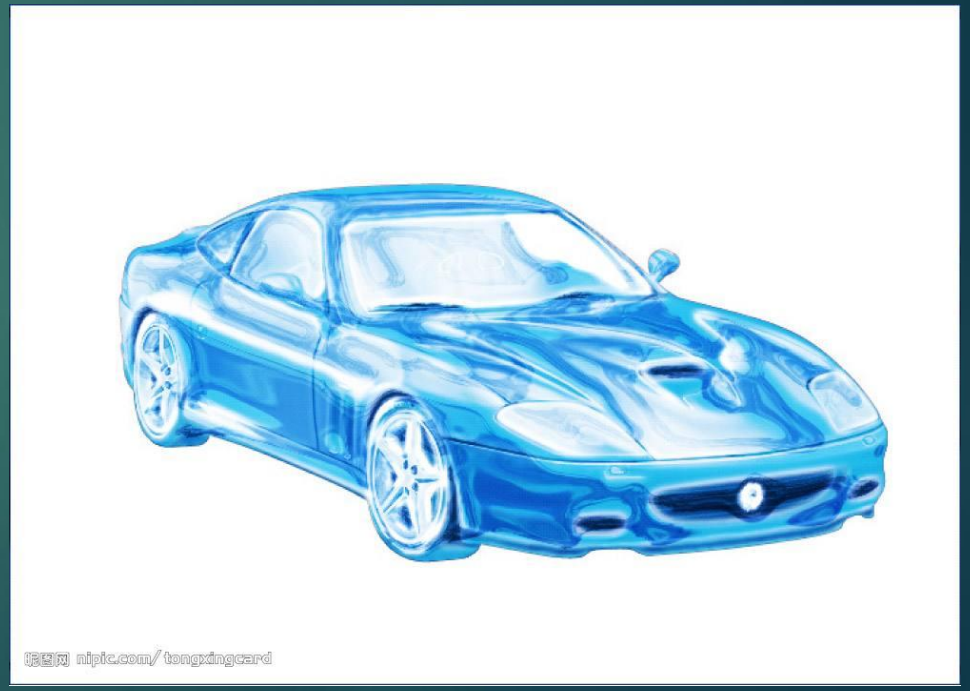
Druid编程风格

- 用java编写的函数式编程
- 使用Guice Module管理

源码结构

- Druid-api
- Druid-common
- Druid-process 索引和查询的核心
- Druid-server
- Druid-indexing-service
- Druid-indexing-Hadoop Hadoop 离线索引实现
- Extensions-core
- Extensions-contrib
- benchmarks



Process-核心引擎

- 重要分为两部分segment和query
- Segment中包括Segment的数据结构布局以及编码方式
- Query中包括不同类型查询的实现

Column

- “索引”结构的核心接口
- 位于“io.druid.segment.column”包内
- 不同类型Column的定义

```
/**
 */
public interface Column
{
  public static final String TIME_COLUMN_NAME = "__time";
  public ColumnCapabilities getCapabilities();

  public int getLength();
  public DictionaryEncodedColumn getDictionaryEncoding();
  public RunLengthColumn getRunLengthColumn();
  public GenericColumn getGenericColumn();
  public ComplexColumn getComplexColumn();
  public BitmapIndex getBitmapIndex();
  public SpatialIndex getSpatialIndex();
}
```

data

- 位于“io.druid.segment.data”包内
- 索引和存储结构的实现
- 编码和压缩的实现

存储

- 定长存储
- 不定长存储

定长存储

- 接口IndexedInts、IndexedFloats和IndexedLongs
- 结合压缩实现，CompressedIndexedLongs

- 按块压缩 FixedSizeCompressedObjectStrategy

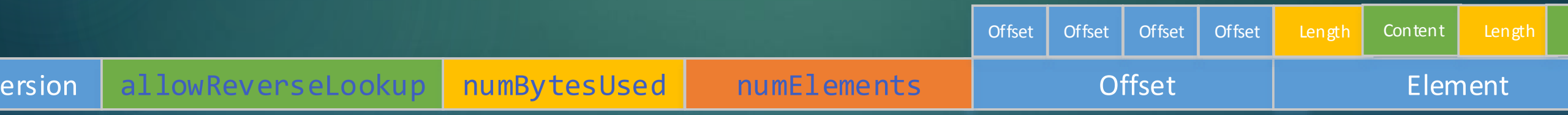
```
@Override
public long get(int index)
{
  final int bufferNum = index / sizePer;
  final int bufferIndex = index % sizePer;

  if (bufferNum != currIndex) {
    loadBuffer(bufferNum);
  }

  return buffer.get(buffer.position() + bufferIndex);
}
```

不定长存储

- 实现类GenericIndexed



编码

- Long和float采用JDK的编码方式，采用8个字节
- Int采用多种，JDK原生和变长整数编码
- Vsize开头的类是变长整数编码
- 在0.9.2版本中增加对long的新编码方式

serde

- 位于“io.druid.segment.serde”包中
- 提供了对各种不同类型的Column和Metric的Ser和De

Filter

- 位于“io.druid.segment.filter”包内
- 各种Filter逻辑的实现
- SelectorFilter 获取bitmap index
- AndFIlter bitmap之间的交集

Filter 如何实现？ a=‘1’ and b=‘1’

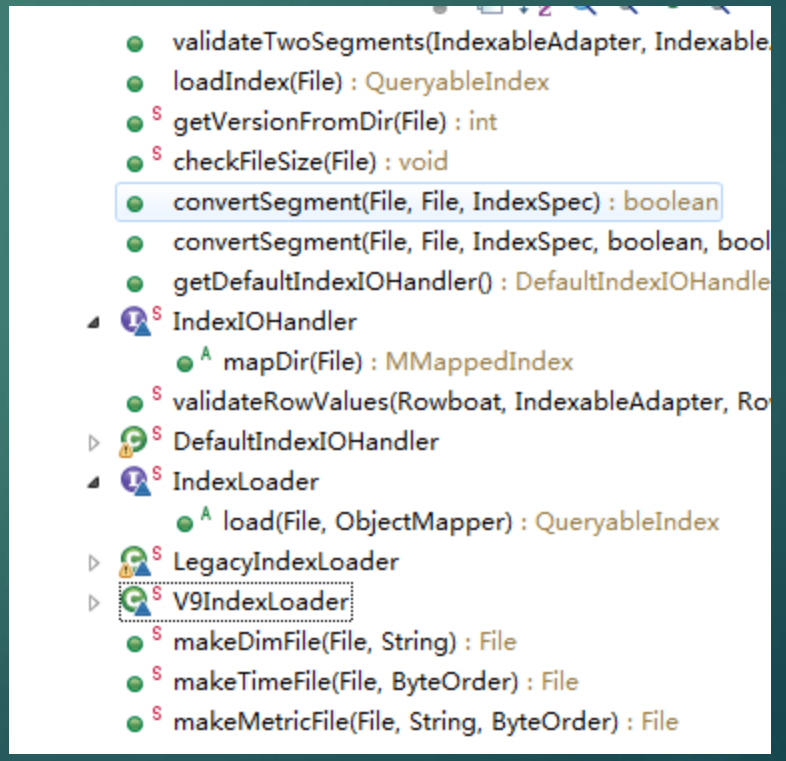
```
public interface Filter
{
  public ImmutableBitmap getBitmapIndex(BitmapIndexSelector selector);
  public ValueMatcher makeMatcher(ValueMatcherFactory factory);
  public ValueMatcher makeMatcher(ColumnSelectorFactory columnSelectorFactory);
}
```

Increment Index

- 实时实现的关键类
- 内存增量索引，类似LSM-Tree中的memstore
- 采用map存储，无索引，开启sortFacts，使用SkipListMap
- 有两种实现OnHeap和OffHeap
- OffHeap，使用堆外内存存储aggregators，更好地管理内存

IndexIO

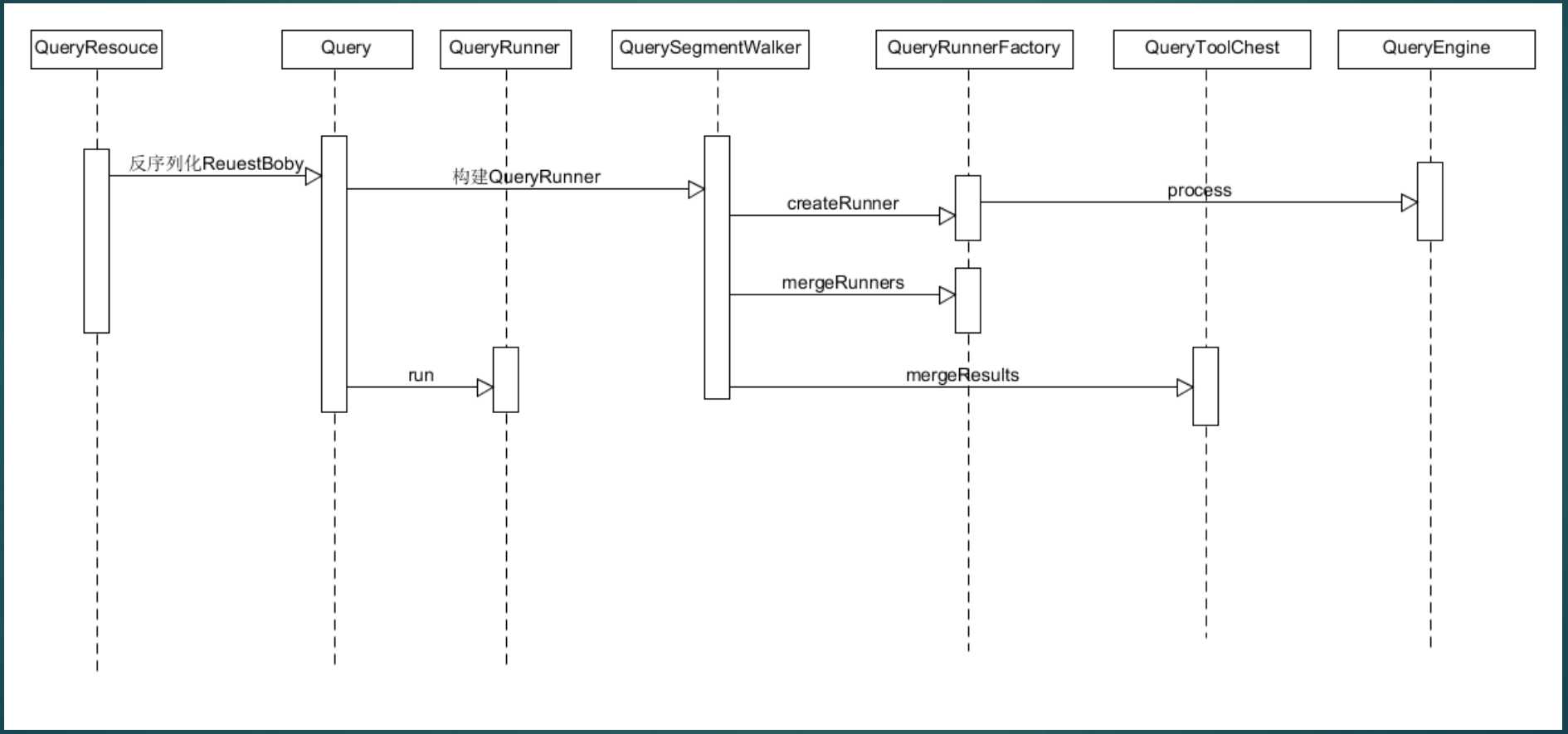
- 负责Segment的加载，通过Mmap的方式加载



IndexMerger

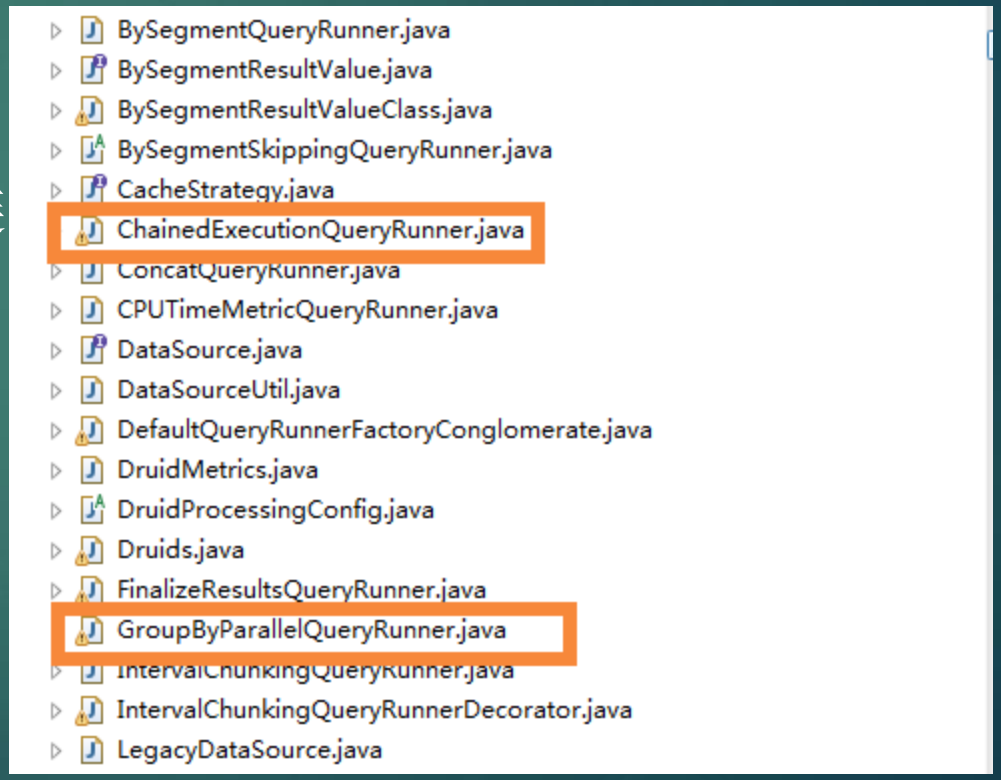
- 将IncrementalIndex持久化
- 合并多个持久化的索引成Segment

查询总览


QueryResouce
Query
QueryRunner
QuerySegmentWalker
QueryRunnerFactory
QueryToolChest
QueryEngine
反序列化ReuestBoby
构建QueryRunner
createRunner
process
mergeRunners
run
mergeResults

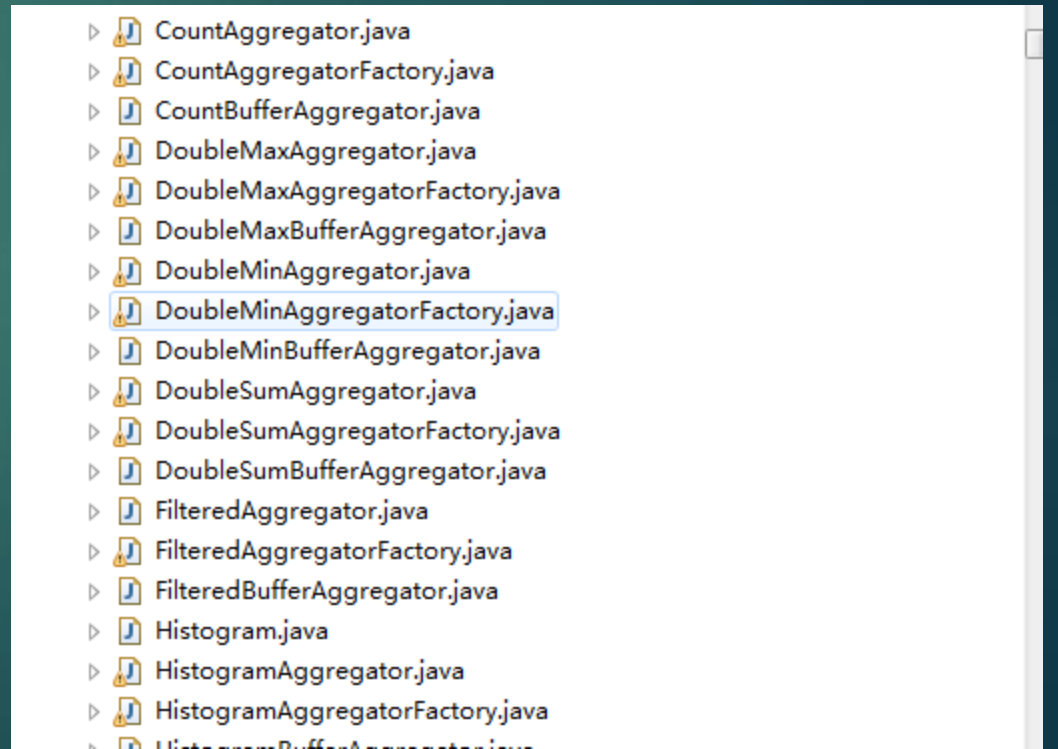
query

- 位于“io.druid.query”包内
- 定义了query通用的接口和类
- QueryRunner是执行查询逻辑的接口
- 不同职责的QueryRunner构建成职责链



aggregation

- 各种Aggregator的实现
- Aggregator接口提供了基于对象的聚合计算
- BufferAggregator提供了基于ByteBffer的聚合计算，一般采用堆外内存
- 使用AggregatorFactory创建
- 官方的Aggregator在AggregatorsModule注册



StorageAdapter

- 根据index和Filter构建Cursor
- IncrementalIndexStorageAdapter是实时查询的实现
- QueryableIndexStorageAdapter是bitmap索引查询实现

```
    }

    final Offset offset;
    if (filter == null) {
      offset = new NoFilterOffset(0, index.getNumRows(), descending);
    } else {
      final ColumnSelectorBitmapIndexSelector selector = new ColumnSelectorBitmapIndexSelector(
          index.getBitmapFactoryForDimensions(),
          index
      );

      offset = new BitmapOffset(selector.getBitmapFactory(), filter.getBitmapIndex(selector), descending);
    }

    return Sequences.filter(
        new CursorSequenceBuilder(
            index,
            actualInterval,
            gran,
            offset,
            minDataTimestamp,
            maxDataTimestamp,
            descending
        ).build(),
```

谢谢