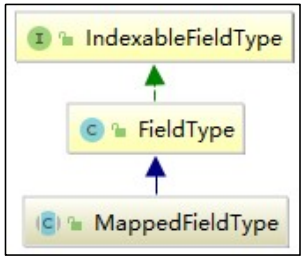
目 录

基本概念：FieldType

FieldType

Lucene用于存储字段的索引、存储设置

```
private boolean stored;
private boolean tokenized = true;
private boolean storeTermVectors;
private boolean storeTermVectorOffsets;
private boolean storeTermVectorPositions;
private boolean storeTermVectorPayloads;
private boolean omitNorms;
private IndexOptions indexOptions = IndexOptions.NONE;
private boolean frozen;
private DocValuesType docValuesType = DocValuesType.NONE;
private int dimensionCount;
private int indexDimensionCount;
private int dimensionNumBytes;
private Map<String, String> attributes;
```



MappedFieldType

ES用于额外的字段设置
（字段名、索引和搜索分词器、字段元数据）

```
private String name;
private float boost;
// TODO: remove this docvalues flag and us
private boolean docValues;
private NamedAnalyzer indexAnalyzer;
private NamedAnalyzer searchAnalyzer;
private NamedAnalyzer searchQuoteAnalyzer;
private SimilarityProvider similarity;
private Object nullValue;
private String nullValueAsString; // for s
private boolean eagerGlobalOrdinals;
private Map<String, String> meta;
```

Mapping

Removal of mapping types

+ Field datatypes
+ Meta-Fields
+ Mapping parameters
+ Dynamic Mapping

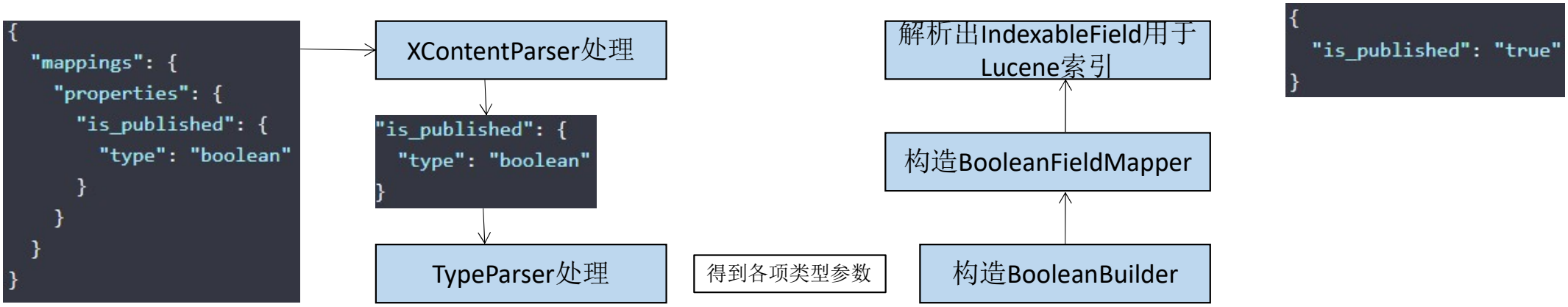
XXXXXFieldType

ES定义的各类具体字段类型

- Field datatypes
  - Alias
  - Arrays
  - Binary
  - Boolean
  - Date
  - Date nanoseconds
  - Dense vector

基本概念：Mapper

TypeParser	ES使用各个字段的TypeParser来获取对应的MapperBuilder
Mapper::Builder	ES使用MapperBuilder来获取对应的Mapper
Mapper	ES使用Mapper将文档的字段解析为Lucene::IndexableField

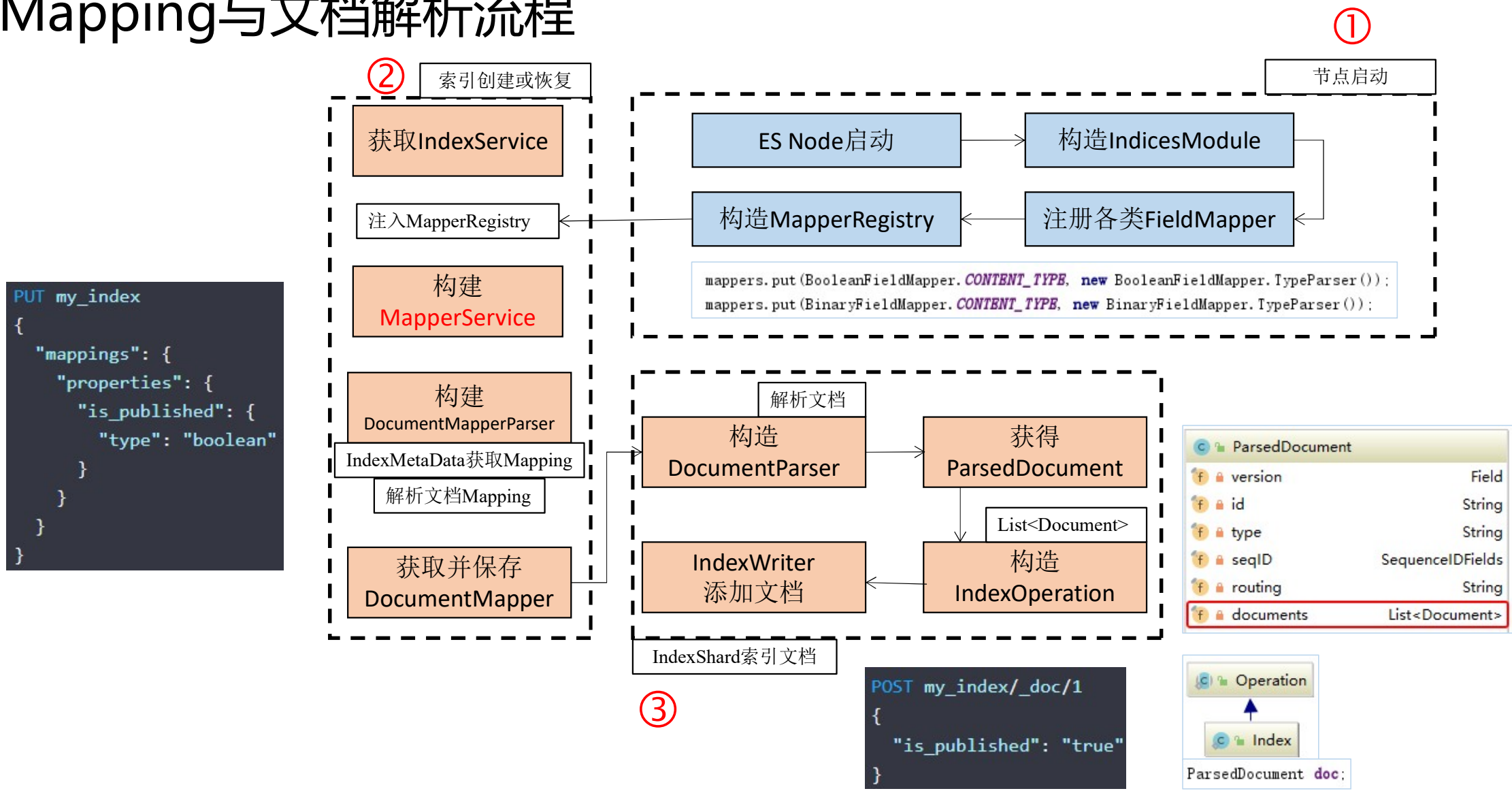


基本概念：索引Mapper

DocumentMapperParser	用于根据Mapping获取DocumentMapper
DocumentMapper	用于根据文档json获取ParsedDocument
ParsedDocument	存储解析好的Document
Document	ES对Lucene Document的扩展，增加了parent、path等信息

```
class Document implements Iterable<IndexableField>
```

Mapping与文档解析流程



Mapping解析流程

从IndexMetaData获取
Compressed Mapping Source

```
{
    "_doc": {
        "properties": {
            "user": {
                "type": "nested",
                "properties": {
                    "last": {
                        "type": "keyword"
                    },
                    "first": {
                        "type": "keyword"
                    }
                }
            }
        }
    }
}
```

解析source获取
source mapping

```
mapping = {LinkedHashMap@10256}  size = 1
 0 = {LinkedHashMap$Entry@10259} "properties" -> " size = 1"
  key = "properties"
  value = {LinkedHashMap@10261}  size = 1
   0 = {LinkedHashMap$Entry@10264} "user" -> " size = 2"
    key = "user"
    value = {LinkedHashMap@10267}  size = 2
     0 = {LinkedHashMap$Entry@10270} "type" -> "nested"
     1 = {LinkedHashMap$Entry@10271} "properties" -> " size = 2"
```

构造ParserContext用于存储解析
过程需要用到的工具与状态

```
parserContext = {Mapper$TypeParser$ParserContext
 similarityLookupService = {DocumentMapperPars
 mapperService = {MapperService@10223}
 typeParsers =                                    所有type parser
  arg$1 = {Collections$UnmodifiableMap@1023
   0 = {Collections$UnmodifiableMap$Unmod
    key = "half_float"
    value = {NumberFieldMapper$TypePars
     type = {NumberFieldMapper$Numb
   1 = {Collections$UnmodifiableMap$Unmod
    key = "float"
    value = {NumberFieldMapper$TypePars
```

针对meta-fields属性

针对properties属性

```
"mappings": {
    "_source": {
        "enabled": true
    },
    "properties": {
        "user": {
```

遍历source mapping，逐一用
TypeParser处理每个field

使用RootObjectMapper根据
mapping构造Mapper::Builder

构造出
DocumentMapper

```
Iterator<Map.Entry<String, Object>> iterator = mapping.entrySet().iterator();
// parse DocumentMapper
while(iterator.hasNext()) {
    Map.Entry<String, Object> entry = iterator.next();
    String fieldName = entry.getKey();
    Object fieldNode = entry.getValue();

    MetadataFieldMapper.TypeParser typeParser = rootTypeParsers.get(fieldName);
```

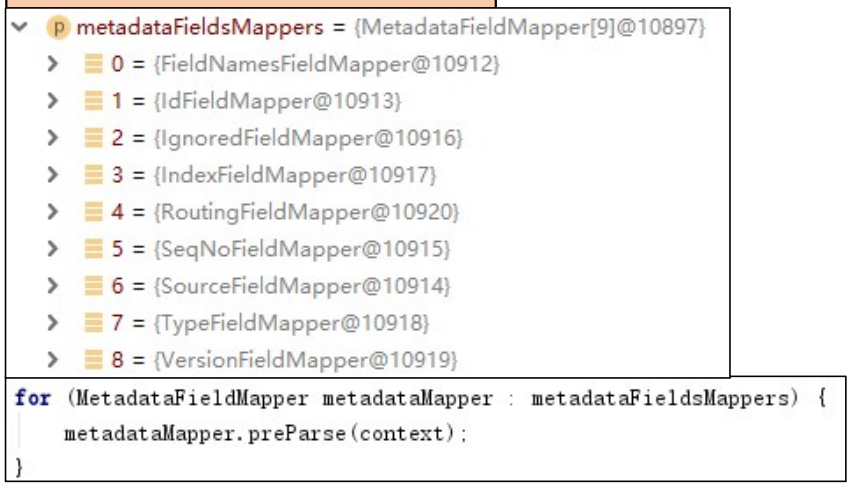
嵌套map表示的field

获取field对应的TypeParser

```
Mapper.TypeParser typeParser = parserContext.typeParser(type);
if (typeParser == null) {...}
String[] fieldNameParts = fieldName.split( regex: "\\.");
String realFieldName = fieldNameParts[fieldNameParts.length - 1];
Mapper.Builder<?,?> fieldBuilder = typeParser.parse(realFieldName, propNode, parser
for (int i = fieldNameParts.length - 2; i >= 0; --i) {...}
objBuilder.add(fieldBuilder);
propNode.remove( key: "type");
DocumentMapperParser.checkNoRemainingFields(fieldName, propNode, parserContext.inde
iterator.remove();
```

Document解析流程

处理所有meta field




```
for (MetadataFieldMapper metadataMapper : metadataFieldsMappers) {
    metadataMapper.preParse(context);
}
```

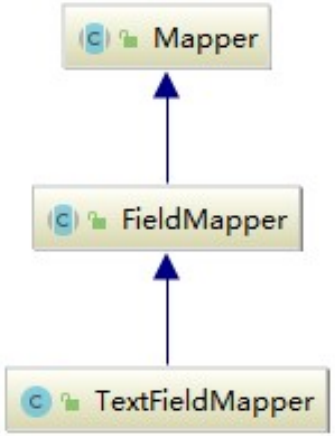
逐个处理文档每个字段

根据token类型采用对应处理方式

```
while (token != XContentParser.Token.END_OBJECT) {
    if (token == XContentParser.Token.FIELD_NAME) {...}
    else if (token == XContentParser.Token.START_OBJECT) {...}
    else if (token == XContentParser.Token.START_ARRAY) {...}
    else if (token == XContentParser.Token.VALUE_NULL) {...}
    else if (token == null) {...}
    else if (token.isValue()) {
        parseValue(context, mapper, currentFieldName, token, paths);
    }
    token = parser.nextToken();
}
```

FieldMapper解析流程：TextField

满足如下条件的字段才需要被处理（其他字段只会存于_source中）：
需要被索引、需要存储字段值



创建Lucene::Field

```
if (fieldType().indexOptions() != IndexOptions.NONE || fieldType().stored()) {
    Field field = new Field(fieldType().name(), value, fieldType());  field: "i
    fields.add(field);  field: "indexed,tokenized<group:fans>"
```

将Field放入Document

```
for (IndexableField field : fields) {
    context.doc().add(field);
}
```

一个ES Field可能会根据设置创建多个Lucene Field

为了加速exist查询，若该字段值不为空，且没有存norm或docvalue信息，将该字段名存于_field_names字段中

index_prefixes

用于加速前缀搜索

If enabled, term prefixes of between 2 and 5 characters are indexed into a separate field. This allows prefix searches to run more efficiently, at the expense of a larger index.

index_phrases

用于加速Phrase搜索

If enabled, two-term word combinations (*shingles*) are indexed into a separate field. This allows exact phrase queries (no slop) to run more efficiently, at the expense of a larger index. Note

FieldMapper解析流程：BooleanField

满足如下条件的字段才需要被处理（其他字段只会存于_source中）：
需要被索引、需要存储字段值、或需要字段具有docValue

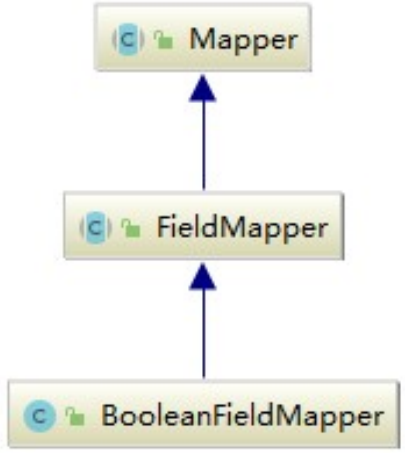
创建Lucene::Field

```
if (fieldType().indexOptions() != IndexOptions.NONE || fieldType().stored()) {
    fields.add(new Field(fieldType().name(), value ? "T" : "F", fieldType()));
}
```

若设置了docvalue

doc_values	Should the field be stored on disk in a column-stride fashion, so that it can later be used for sorting, aggregations, or scripting? Accepts `true` (default) or `false`.

```
if (fieldType().hasDocValues()) {
    fields.add(new SortedNumericDocValuesField(fieldType().name(), value ? 1 : 0));
} else {
    createFieldNamesField(context, fields);  context: ParseContext$InternalParseCont
}
```



FieldMapper解析流程：NestedField

创建NestedContext

获取nestedDoc与parentDoc

```
private final List<Document> documents;
```

parentDoc与nestedDoc在各自被创建时，依次添加进documents中

```
context = context.createNestedContext(mapper.fullPath());
ParseContext.Document nestedDoc = context.doc();  nestedDo
ParseContext.Document parentDoc = nestedDoc.getParent();
```

设置nestedDoc的_id为parentDocId（方便统一删除）

```
// We just need to store the id as indexed field, so that IndexWriter#deleteDocuments(term) can then
// delete it when the root document is deleted too.
nestedDoc.add(new Field(IdFieldMapper.NAME, idField.binaryValue(), IdFieldMapper.Defaults.NESTED_FIELD_TYPE));
```

设置nestedDoc的_type字段为__XXX（以__开头，方便过滤）

```
nestedDoc.add(new Field(TypeFieldMapper.NAME, mapper.nestedTypePathAsString(), TypeFieldMapper.Defaults.FIELD_TYPE));
```

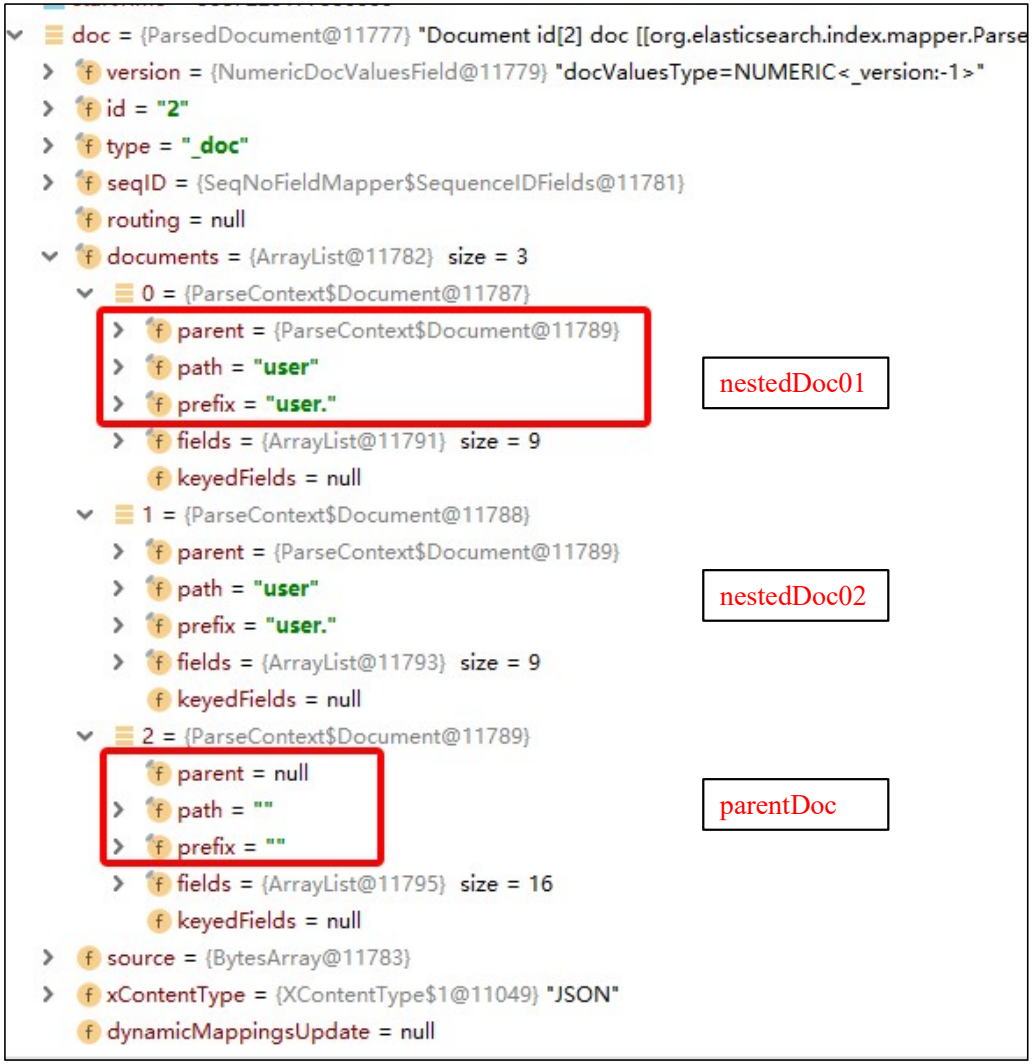
依次解析每个内部字段，生成对应Field并放入nestedDoc中

nestedDoc

```
document = {ParseContext$Document@11359}
  parent = {ParseContext$Document@11192}
  path = "user"
  prefix = "user."
  fields = {ArrayList@11385}  size = 2
    0 = {Field@11389} "indexed,omitNorms,indexOptions=DOCS<_id:[fe 1f]>"
    1 = {Field@11390} "indexed,omitNorms,indexOptions=DOCS<_type:__user>"
  keyedFields = null
```

```
"user": {
    "type": "nested",
    "properties": {
        "first": {
            "type": "keyword"
        },
        "last": {
            "type": "keyword"
        }
    }
}
```

```
mapper = {ObjectMapper@10935}
  fullPath = "user"
  enabled = true
  nested = {ObjectMapper$Nested@11348}
  nestedTypePathAsString = "__user"
  nestedTypePathAsBytes = {BytesRef@11350} "[5f 5f 75 73 65 72]"
  nestedTypeFilter = {TermQuery@11351} "_type:__user"
  dynamic = null
  mappers = {CopyOnWriteHashMap@11352}  size = 2
    0 = {AbstractMap$SimpleImmutableEntry@11374} "last" ->
      key = "last"
      value = {KeywordFieldMapper@11378}
    1 = {AbstractMap$SimpleImmutableEntry@11375} "first" ->
  simpleName = "user"
```



重排序，保证子文档出现在父文档前面

```
void postParse() {
    if (documents.size() > 1) {
        docsReversed = true;
        if (indexSettings.getIndexVersionCreated().onOrAfter(Version.V_6_5_0)) {
            /**
             * For indices created on or after {@link Version#V_6_5_0} we preserve the order
             * of the children while ensuring that parents appear after them.
             */
            List<Document> newDocs = reorderParent(documents);
            documents.clear();
            documents.addAll(newDocs);
        } else {
            // reverse the order of docs for nested docs support, parent should be last
            Collections.reverse(documents);
        }
    }
}
```

保留父文档、子文档之间的相对顺序

```
"user": {
    "type": "nested",
    "properties": {
        "first": {
            "type": "keyword"
        },
        "last": {
            "type": "keyword"
        }
    }
}
```

```
private List<Document> reorderParent(List<Document> docs) {
    List<Document> newDocs = new ArrayList<>(docs.size());
    LinkedList<Document> parents = new LinkedList<>();
    for (Document doc : docs) {
        while (parents.peek() != doc.getParent()){
            newDocs.add(parents.poll());
        }
        parents.add( index: 0, doc);
    }
    newDocs.addAll(parents);
    return newDocs;
}
```

KeywordField

获取keyword值

获取field normalizer

标准化keyword

添加Field至Document

添加docvalue至Document

```
final NamedAnalyzer normalizer = fieldType().normalizer();
if (normalizer != null) {
    try (TokenStream ts = normalizer.tokenStream(name(), value)) {
        final CharTermAttribute termAtt = ts.addAttribute(CharTermAttribute.class);
        ts.reset();
        if (ts.incrementToken() == false) {...}
        final String newValue = termAtt.toString();
        if (ts.incrementToken()) {...}
        ts.end();
        value = newValue;
    }
}

// convert to utf8 only once before feeding postings/dv/stored fields
final BytesRef binaryValue = new BytesRef(value);
if (fieldType().indexOptions() != IndexOptions.NONE || fieldType().stored())  {
    Field field = new Field(fieldType().name(), binaryValue, fieldType());
    fields.add(field);

    if (fieldType().hasDocValues() == false && fieldType().omitNorms()) {
        createFieldNamesField(context, fields);
    }
}

if (fieldType().hasDocValues()) {
    fields.add(new SortedSetDocValuesField(fieldType().name(), binaryValue));
}
```

KeywordField相关查询

判断字段是否为空

```
public Query existsQuery(QueryShardContext context) {
    if (hasDocValues()) {
        return new DocValuesFieldExistsQuery(name());
    } else if (omitNorms()) {
        return new TermQuery(new Term(FieldNamesFieldMapper.NAME, name()));
    } else {
        return new NormsFieldExistsQuery(name());
    }
}
```

Terms查询

```
public Query termsQuery(List<?> values, QueryShardContext context) {
    failIfNotIndexed();
    BytesRef[] bytesRefs = new BytesRef[values.size()];
    for (int i = 0; i < bytesRefs.length; i++) {
        bytesRefs[i] = indexedValueForSearch(values.get(i));
    }
    return new TermInSetQuery(name(), bytesRefs);
}
```

模糊查询

```
failIfNotIndexed();
return new FuzzyQuery(new Term(name(), indexedValueForSearch(value)),
        fuzziness.asDistance(BytesRefs.toString(value)), prefixLength, maxExpansions, tran
```

前缀查询

```
failIfNotIndexed();
PrefixQuery query = new PrefixQuery(new Term(name(), indexedValueForSearch(value)));
if (method != null) {
    query.setRewriteMethod(method);
}
return query;
```

通配符查询

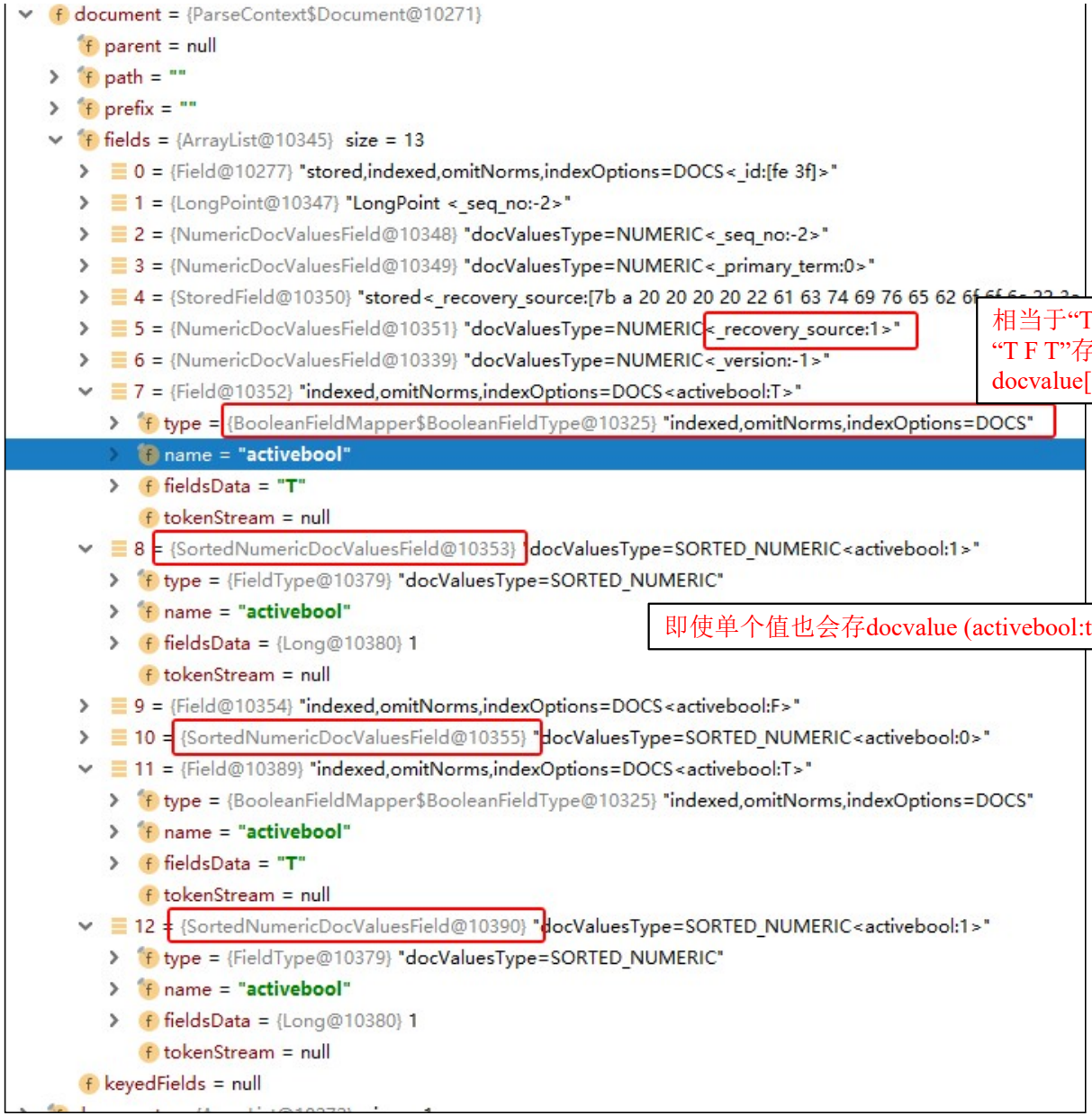
范围查询

正则查询

Term查询

Arrays

```
{
    "activebool": [true, false, true]
}
```



相当于“T F T” 与 docvalue[1, 0, 1]两个字段
“T F T”存于倒排索引，用于检索
docvalue[1, 0, 1]用于排序和聚类

即使单个值也会存docvalue (activebool:true)

Array与Object

```
{
    "activeobject": [
        {
            "offset": 0,
            "enable": true
        },
        {
            "offset": 10,
            "enable": false
        }
    ]
}
```

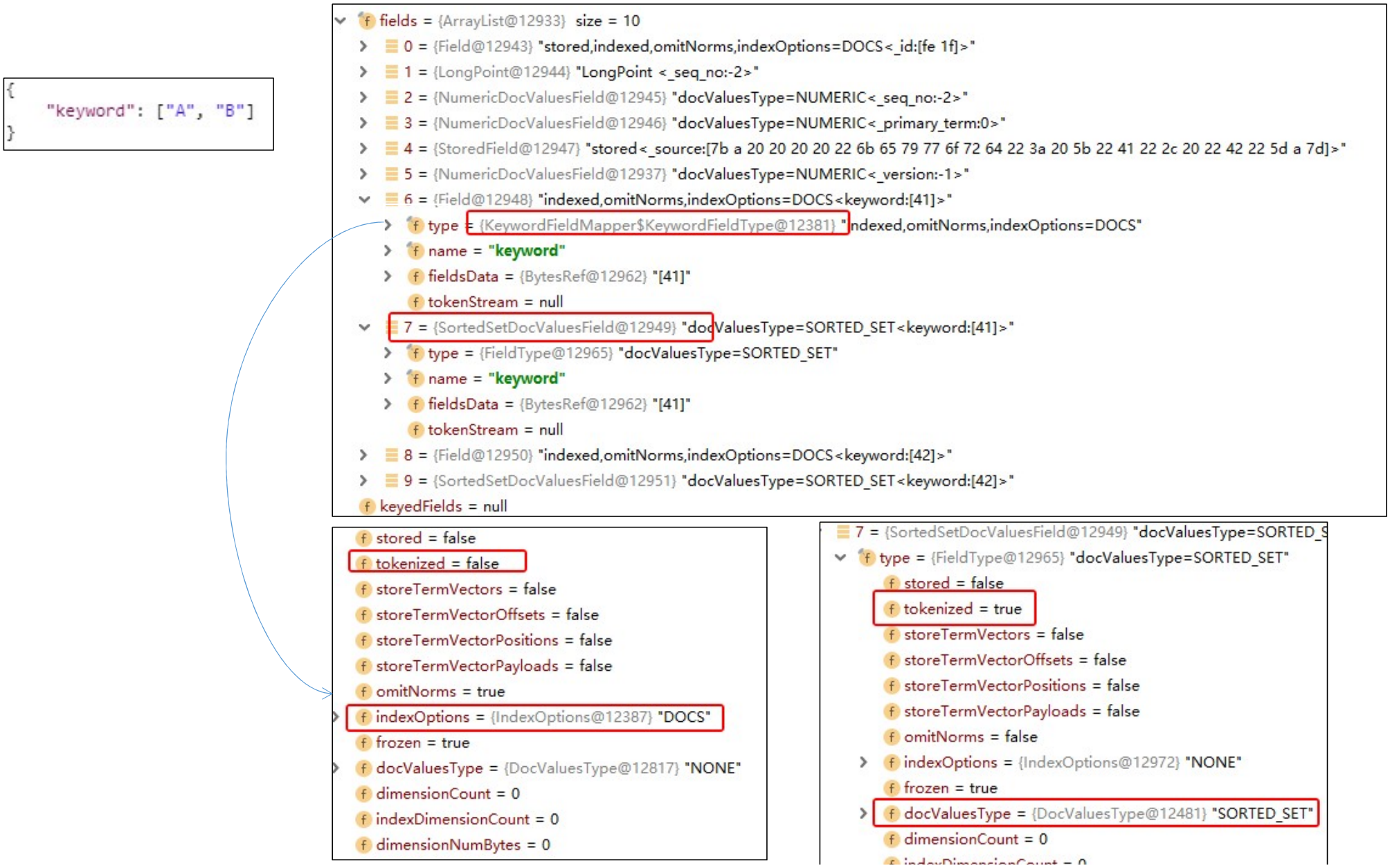
↓

```
{
    "activeobject.offset": [0, 10],
    "activeobject.enable": [true, false]
}
```

```
documents = {ArrayList@10898} size = 1
  0 = {ParseContext$Document@10897}
    parent = null
    path = ""
    prefix = ""
    fields = {ArrayList@10906} size = 15
      0 = {Field@10908} "stored,indexed,omitNorms,indexOptions=DOCS<_id:[fe 3f]>"
      1 = {LongPoint@10909} "LongPoint <_seq_no:-2>"
      2 = {NumericDocValuesField@10910} "docValuesType=NUMERIC<_seq_no:-2>"
      3 = {NumericDocValuesField@10911} "docValuesType=NUMERIC<_primary_term:0>"
      4 = {StoredField@10912} "stored<_recovery_source:[7b a 20 20 20 20 22 61 63 74 69 76 65 6f 62 6a 65 63 74
      5 = {NumericDocValuesField@10913} "docValuesType=NUMERIC<_recovery_source:1>"
      6 = {NumericDocValuesField@10899} "docValuesType=NUMERIC<_version:-1>"
      7 = {LongPoint@10914} "LongPoint <activeobject.offset:0>"
        type = {FieldType@10937} "pointDimensionCount=1,pointIndexDimensionCount=1,pointNumBytes=8"
        name = "activeobject.offset"
        fieldsData = {BytesRef@10939} "[80 0 0 0 0 0 0 0]"
        tokenStream = null
      8 = {SortedNumericDocValuesField@10915} "docValuesType=SORTED_NUMERIC<activeobject.offset:0>"
        type = {FieldType@10379} "docValuesType=SORTED_NUMERIC"
        name = "activeobject.offset"
        fieldsData = {Long@10374} 0
        tokenStream = null
      9 = {Field@10916} "indexed,omitNorms,indexOptions=DOCS<activeobject.enable:T>"
        type = {BooleanFieldMapper$BooleanFieldType@10946} "indexed,omitNorms,indexOptions=DOCS"
        name = "activeobject.enable"
        fieldsData = "T"
        tokenStream = null
      10 = {SortedNumericDocValuesField@10917} "docValuesType=SORTED_NUMERIC<activeobject.enable:1>"
        type = {FieldType@10379} "docValuesType=SORTED_NUMERIC"
        name = "activeobject.enable"
        fieldsData = {Long@10380} 1
        tokenStream = null
      11 = {LongPoint@10918} "LongPoint <activeobject.offset:10>"
      12 = {SortedNumericDocValuesField@10919} "docValuesType=SORTED_NUMERIC<activeobject.offset:10>"
      13 = {Field@10920} "indexed,omitNorms,indexOptions=DOCS<activeobject.enable:F>"
      14 = {SortedNumericDocValuesField@10921} "docValuesType=SORTED_NUMERIC<activeobject.enable:0>"
    keyedFields = null
```

相当于4个lucene字段：
[0, 10] longpoint --- kdtree
[0, 10] docvalue --- docvalue
“T F” text --- inverted index
[1, 0] docvalue --- docvalue

可以根据term搜出文档，
但是数组字段间相对顺序无法保证


{
"keyword": ["A", "B"]
}
fields = {ArrayList@12933} size = 10
0 = {Field@12943} "stored,indexed,omitNorms,indexOptions=DOCS<_id:[fe 1f]>"
1 = {LongPoint@12944} "LongPoint <_seq_no:-2>"
2 = {NumericDocValuesField@12945} "docValuesType=NUMERIC<_seq_no:-2>"
3 = {NumericDocValuesField@12946} "docValuesType=NUMERIC<_primary_term:0>"
4 = {StoredField@12947} "stored<_source:[7b a 20 20 20 20 22 6b 65 79 77 6f 72 64 22 3a 20 5b 22 41 22 2c 20 22 42 22 5d a 7d]>"
5 = {NumericDocValuesField@12937} "docValuesType=NUMERIC<_version:-1>"
6 = {Field@12948} "indexed,omitNorms,indexOptions=DOCS<keyword:[41]>"
type = {KeywordFieldMapper$KeywordFieldType@12381} "indexed,omitNorms,indexOptions=DOCS"
name = "keyword"
fieldsData = {BytesRef@12962} "[41]"
tokenStream = null
7 = {SortedSetDocValuesField@12949} "docValuesType=SORTED_SET<keyword:[41]>"
type = {FieldType@12965} "docValuesType=SORTED_SET"
name = "keyword"
fieldsData = {BytesRef@12962} "[41]"
tokenStream = null
8 = {Field@12950} "indexed,omitNorms,indexOptions=DOCS<keyword:[42]>"
9 = {SortedSetDocValuesField@12951} "docValuesType=SORTED_SET<keyword:[42]>"
keyedFields = null
stored = false
tokenized = false
storeTermVectors = false
storeTermVectorOffsets = false
storeTermVectorPositions = false
storeTermVectorPayloads = false
omitNorms = true
indexOptions = {IndexOptions@12387} "DOCS"
frozen = true
docValuesType = {DocValuesType@12817} "NONE"
dimensionCount = 0
indexDimensionCount = 0
dimensionNumBytes = 0
7 = {SortedSetDocValuesField@12949} "docValuesType=SORTED_S
type = {FieldType@12965} "docValuesType=SORTED_SET"
stored = false
tokenized = true
storeTermVectors = false
storeTermVectorOffsets = false
storeTermVectorPositions = false
storeTermVectorPayloads = false
omitNorms = false
indexOptions = {IndexOptions@12972} "NONE"
frozen = true
docValuesType = {DocValuesType@12481} "SORTED_SET"
dimensionCount = 0

Nested Docvalue方案

需要建立字段间的连接关系，用于检索

保留docvalue，用于排序、聚类

需要建立字段间的连接关系，用于对象检索

Nested改造

```
{
"tagkey" : {
        "type" : "nested",
        "properties" : {
                "value" : {
                 "type" : "keyword"
                },
                "weight" : {
                 "type" : "double"
                }
        }
       }
}
```

```
{
"tagkey" : {
        "properties" : {
                "value" : {
                 "type" : "multiKeyword"
                },
                "weight" : {
                 "type" : "double"
                }
        }
       }
}
```

```
{
    "tagkey": [
        {
            "value": "football",
            "weight": 0.2
        },
        {
            "value": "running",
            "weight": 0.1
        }
    ]
}
```

ES存储方式:
tagkey.value: “football running” <inverted>
tagkey.value: [football running] <docvalue>
tagkey.weight: [0.2, 0.1] <floatpoint>
tagkey.weight: [0.2, 0.1] <docvalue>
无法独立查找每个子对象

docid	Nested.value	Nested.weight	NotNested
100	football	0.2	
101	running	0.1	
102			xxx

docid	Nested.value	Nested.weight	NotNested
100	Football Running	0.2	xxx

方案一：DocValue过滤

mapping

```
{
    "tagkey": {
        "type": "relation_object",
        "relations": [
            "value",
            "weight",
            "enable"
        ],
        "properties": {
            "value": {
                "type": "keyword"
            },
            "weight": {
                "type": "double"
            },
            "enable": {
                "type": "boolean"
            }
        }
    }
}
```

_source

```
{
    "tagkey": [
        {
            "value": "football",
            "weight": 0.2,
            "enable": true
        },
        {
            "value": "running",
            "weight": 0.1,
            "enable": false
        }
    ]
}
```

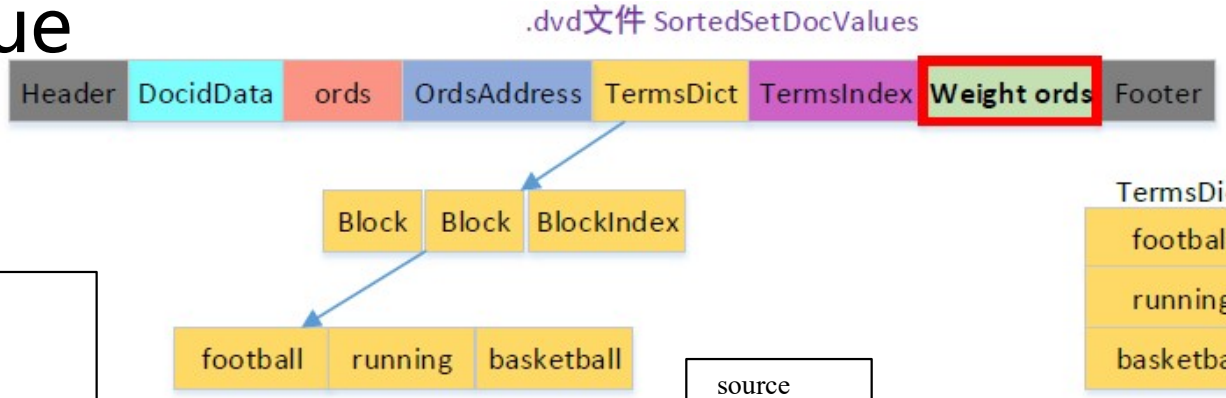
fields

```
tagkey.value: "football running”                    <inverted> IndexOption<doc>
tagkey.value: ["football", "running"]               <docvalue>
tagkey.weight: [0.2, 0.1]                           <floatpoint>
tagkey.weight: [0.2, 0.1]                           <docvalue>
tagkey.enable: "T F"                                <inverted> IndexOption<doc>
tagkey.enable: [1, 0]                               <docvalue>
tagkey.relations: ["football#0.2#T, running#0.1#F] <docvalue>
```

根据value、weight查找出对应文档（此时包含部分不严格匹配的文档）

Lucene层提供RelationObjectCollector，根据relations字段对文档进行过滤

方案二：带权DocValue



mapping

```
{
    "tagkey": {
        "type": "object",
        "properties": {
            "value": {
                "type": "weighted_keyword",
            },
            "enable": {
                "type": "boolean"
            }
        }
    }
}
```

fields

```
tagkey.value: "football running"                    <inverted> IndexOption<doc>
tagkey.value: [["football",0.2], ["running",0.1]]   <weighted_docvalue>
tagkey.enable: "T F"                                <inverted> IndexOption<doc>
tagkey.enable: [1, 0]                               <docvalue>
```

Lucene层提供带权DocValue实现和对应Collector，
根据权重进行文档过滤

_source

```
{
    "tagkey": [
        {
            "value": {
                "value": "football",
                "weight": 0.2
             },
            "enable": true
        },
        {
            "value": {
                "value": "running",
                "weight": 0.1
             },
            "enable": false
        }
    ]
}
```

方案三：ES层实现文档过滤

mapping

```
{
    "tagkey": {
        "type": "object",
        "properties": {
            "value": {
                "type": "keyword"
            },
            "weight": {
                "type": "double"
            },
            "enable": {
                "type": "boolean"
            }
        }
    }
}
```

_source

```
{
    "tagkey": [
        {
            "value": "football",
            "weight": 0.2,
            "enable": true
        },
        {
            "value": "running",
            "weight": 0.1,
            "enable": false
        }
    ]
}
```

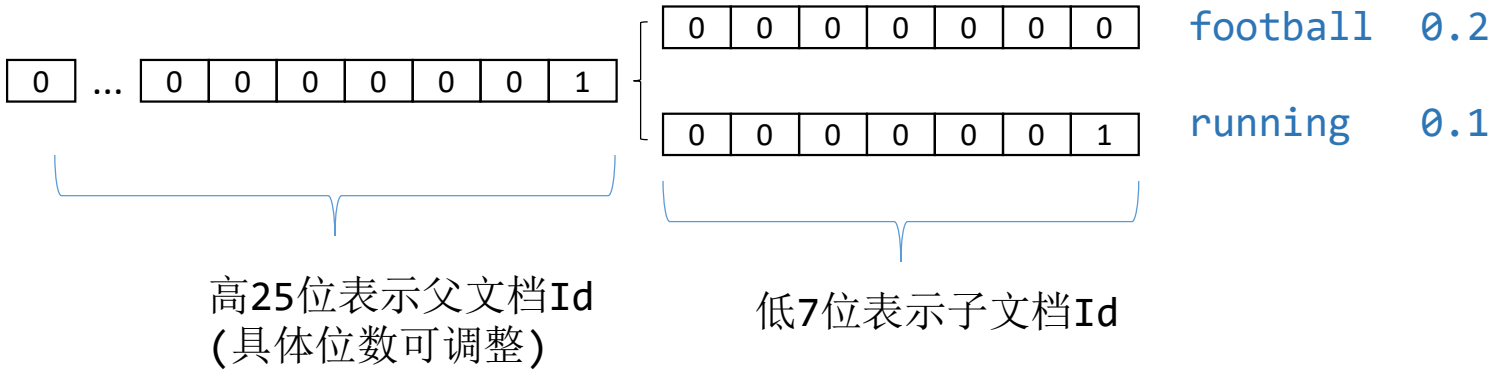
query

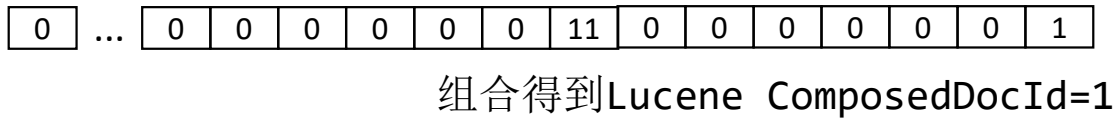
```
{
    "query": {
        "bool": {
            "must": [
                {
                    "term": {"value": "football"}
                },
                {
                "range": {"weight": {"gte": 0.1,"lte": 0.3}}
                }
            ],
            "relation_filter": {
                "condition": [
                    {
                        "term": {"value": "football"}
                    },
                    {
                "range": {"weight": {"gte": 0.1,"lte": 0.3}}
                    }
                ]
            }
        }
    }
}
```

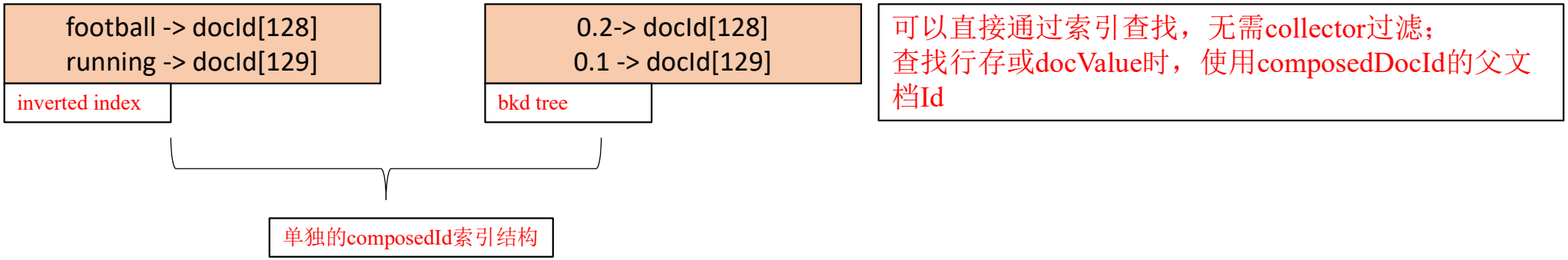
先根据must查出文档，再使用relation_filter过滤

方案四：修改Lucene DocId结构

```
tagkey.value: "football running”                    <inverted> IndexOption<doc>
tagkey.weight: [0.2, 0.1]                           <docvalue>
```







转移具体实现到Lucene

方法一：在dvd文件中增加Weight ords数组，与ord数组一一对应，标识每个ord的权重

在ES层完成设计实现

方法二：将权重也保存成docvalue多值，SortedSetDocValuesField原生是文档内部排序，可能会乱序，要考虑其对应关系

```
doc = new Document();
doc.add(new SortedSetDocValuesField("Field", new BytesRef("Football")));
doc.add(new SortedSetDocValuesField("Field", new BytesRef("Running")));
doc.add(new SortedSetDocValuesField("Weight", new BytesRef("0.2")));
doc.add(new SortedSetDocValuesField("Weight", new BytesRef("0.1")));
indexWriter.addDocument(doc);
```

转移具体实现到Lucene

方法三：将权重和列值一致保存成多值

```
doc = new Document();
doc.add(new SortedSetDocValuesField("Field", new BytesRef("Football#0.2")));
doc.add(new SortedSetDocValuesField("Field", new BytesRef("Running#0.1")));
indexWriter.addDocument(doc);
```

```
public class BinaryDocValuesField extends Field {

  /**
   * Type for straight bytes DocValues.
   */
  public static final FieldType TYPE = new FieldType();
  static {
    TYPE.setDocValuesType(DocValuesType.BINARY);
    TYPE.freeze();
  }
```

```
public class NumericDocValuesField extends Field {

  /**
   * Type for numeric DocValues.
   */
  public static final FieldType TYPE = new FieldType();
  static {
    TYPE.setDocValuesType(DocValuesType.NUMERIC);
    TYPE.freeze();
  }
```

```
public enum DocValuesType {
  /**
   * No doc values for this field.
   */
  NONE,
  /**
   * A per-document Number
   */
  NUMERIC,
  /**
   * A per-document byte[].  Values may be larger than
   * 32766 bytes, but different codecs may enforce their own limits.
   */
  BINARY,
  /**
   * A pre-sorted byte[]. Fields with this type only store distinct byte values
   * and store an additional offset pointer per document to dereference the shared
   * byte[]. The stored byte[] is presorted and allows access via document id,
   * ordinal and by-value.  Values must be {@code <= 32766} bytes.
   */
  SORTED,
  /**
   * A pre-sorted Number[]. Fields with this type store numeric values in sorted
   * order according to {@link Long#compare(long, long)}.
   */
  SORTED_NUMERIC,
  /**
   * A pre-sorted Set&lt;byte[]&gt;. Fields with this type only store distinct byte values
   * and store additional offset pointers per document to dereference the shared
   * byte[]s. The stored byte[] is presorted and allows access via document id,
   * ordinal and by-value.  Values must be {@code <= 32766} bytes.
   */
  SORTED_SET,
}
```