你知道MyBatis执行过程之初始化是如何执行的吗?

题目标签

学习时长：20分钟

题目难度：中等

知识点标签：MyBatis、执行过程

题目描述

你知道MyBatis执行过程之初始化是如何执行的吗?

题目解决

在了解MyBatis架构以及核心内容分析后，我们可以研究MyBatis执行过程，包括

- **MyBatis初始化**
- **SQL执行过程**

而且在面试会问到一下关于MyBatis初始化的问题，比如：

- **Mybatis需要初始化哪些?**
- **MyBatis初始化的过程?**

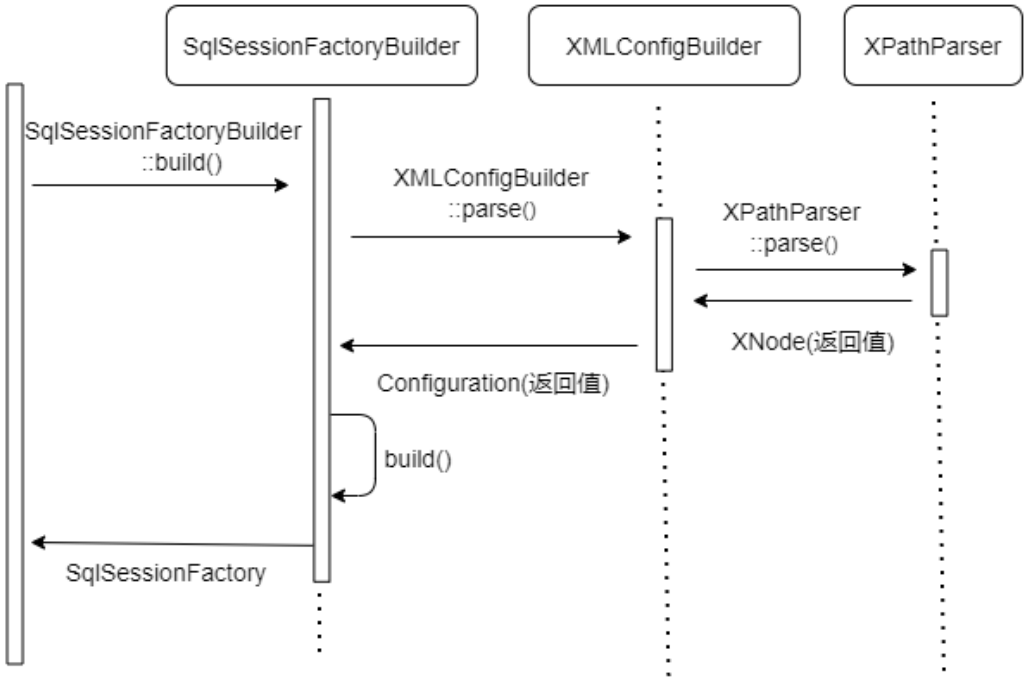
MyBatis初始化

在 MyBatis 初始化过程中，会加载 `mybatis-config.xml` 配置文件、`Mapper.xml` 映射配置文件以及 Mapper 接口中的注解信息，解析后的配置信息会形成相应的对象并保存到 `Configuration` 对象中。初始化过程可以分成三部分：

- 解析 `mybatis-config.xml` 配置文件
  - `SqlSessionFactoryBuilder`
  - `XMLConfigBuilder`
  - `Configuration`
- 解析 `Mapper.xml` 映射配置文件
  - `XMLMapperBuilder::parse()`
  - `XMLStatementBuilder::parseStatementNode()`
  - `XMLLanguageDriver`
  - `SqlSource`
  - `MappedStatement`
- 解析Mapper接口中的注解
  - `MapperRegistry`
  - `MapperAnnotationBuilder::parse()`

解析`mybatis-config.xml`配置文件

`MyBatis` 的初始化流程的**入口**是 `SqlSessionFactoryBuilder::build(Reader reader, String environment, Properties properties)` 方法，看看具体流程图：




```
 public SqlSessionFactory build(InputStream inputStream, String environment,
Properties properties) {
    try {
      XMLConfigBuilder parser = new XMLConfigBuilder(inputStream, environment,
properties);
      return build(parser.parse());
    } catch (Exception e) {
      throw ExceptionFactory.wrapException("Error building SqlSession.", e);
    } finally {
      ErrorContext.instance().reset();
      try {
        inputStream.close();
      } catch (IOException e) {
        // Intentionally ignore. Prefer previous error.
      }
    }
  }
123456789101112131415
```

首先会使用`XMLConfigBuilder::parser()`解析`mybatis-config.xml`配置文件，

- 先解析标签`configuration`内的数据封装成`XNode`，`configuration`也是 MyBatis 中最重要的一个标签
- 根据`XNode`解析`mybatis-config.xml`配置文件的各个标签转变为各个对象

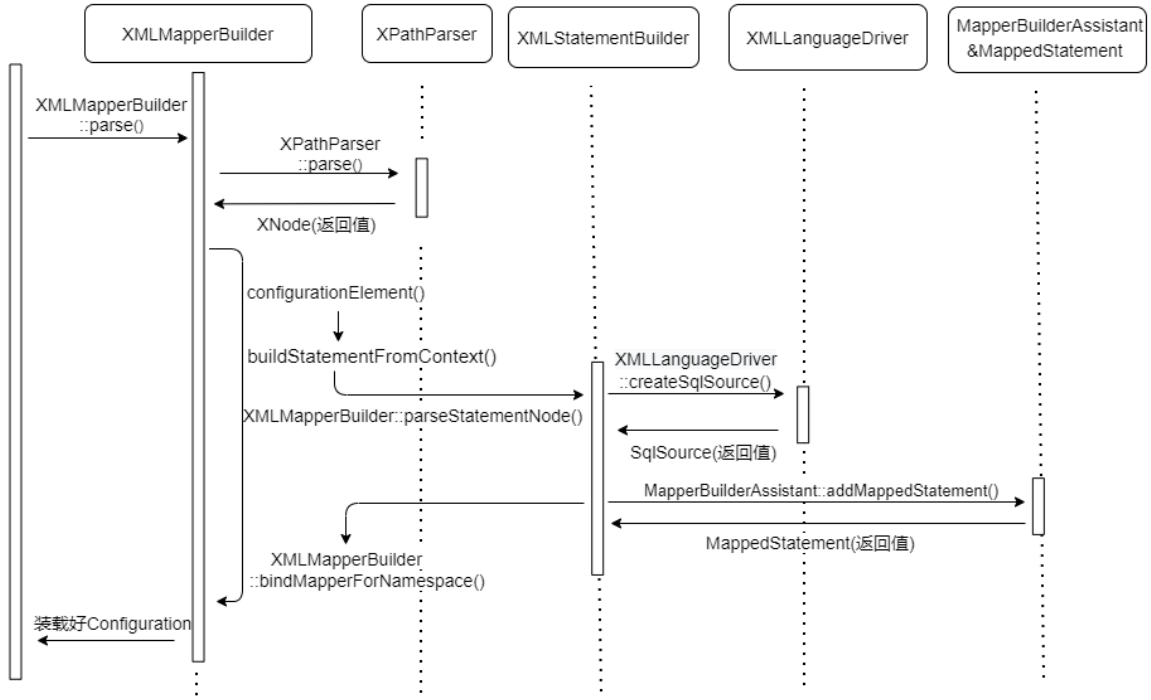
```
private void parseConfiguration(XNode root) {
    try {
      //issue #117 read properties first
      propertiesElement(root.evalNode("properties"));
      Properties settings = settingsAsProperties(root.evalNode("settings"));
      loadCustomVfs(settings);
```

```
      typeAliasesElement(root.evalNode("typeAliases"));
      pluginElement(root.evalNode("plugins"));
      objectFactoryElement(root.evalNode("objectFactory"));
      objectWrapperFactoryElement(root.evalNode("objectWrapperFactory"));
      reflectorFactoryElement(root.evalNode("reflectorFactory"));
      settingsElement(settings);
      // read it after objectFactory and objectWrapperFactory issue #631
      environmentsElement(root.evalNode("environments"));
      databaseIdProviderElement(root.evalNode("databaseIdProvider"));
      typeHandlerElement(root.evalNode("typeHandlers"));
      mapperElement(root.evalNode("mappers"));
    } catch (Exception e) {
      throw new BuilderException("Error parsing SQL Mapper Configuration. Cause:
" + e, e);
    }
  }
12345678910111213141516171819202 1
```

再基于`Configuration`使用`SqlSessionFactoryBuilder::build()`生成`DefaultSqlSessionFactory`供给后续执行使用。

解析`Mapper.xml`映射配置文件

首先使用`XMLMapperBuilder::parse()`解析`Mapper.xml`，看看加载流程图来分析分析



通过`XPathParser::evalNode`将`mapper`标签中内容解析到`XNode`

```
public void parse() {
    if (!this.configuration.isResourceLoaded(this.resource)) {
        this.configurationElement(this.parser.evalNode("/mapper"));
        this.configuration.addLoadedResource(this.resource);
        this.bindMapperForNamespace();
    }

    this.parsePendingResultMaps();
    this.parsePendingCacheRefs();
    this.parsePendingStatements();
}
1234567891011
```

再由`configurationElement()`方法去解析`XNode`中的各个标签：

- `namespace`
- `parameterMap`
- `resultMap`
- `select|insert|update|delete`

```
private void configurationElement(XNode context) {
    try {
      String namespace = context.getStringAttribute("namespace");
      if (namespace == null || namespace.equals("")) {
        throw new BuilderException("Mapper's namespace cannot be empty");
      }
      builderAssistant.setCurrentNamespace(namespace);
      cacheRefElement(context.evalNode("cache-ref"));
      cacheElement(context.evalNode("cache"));
      parameterMapElement(context.evalNodes("/mapper/parameterMap"));
      resultMapElements(context.evalNodes("/mapper/resultMap"));
      sqlElement(context.evalNodes("/mapper/sql"));
      //解析MapperState

 buildStatementFromContext(context.evalNodes("select|insert|update|delete"));
    } catch (Exception e) {
      throw new BuilderException("Error parsing Mapper XML. The XML location is
'" + resource + "'. Cause: " + e, e);
    }
  }
12345678910111213141516171718
```

其中，基于`XMLMapperBuilder::buildStatementFromContext()`，遍历`、`、`、`节点们，逐个创建`XMLStatementBuilder`对象，执行解析,通过`XMLStatementBuilder::parseStatementNode()`解析，

- `parameterType`
- `resultType`
- `selectKey`等

并会通过`LanguageDriver::createSqlSource()`(默认`XmlLanguageDriver`)解析动态sql生成`SqlSource`(**详细内容请看下个小节**)，

- 使用`GenericTokenParser::parser()`负责将 SQL 语句中的`#{}`替换成相应的`?`占位符，并获取该`?`占位符对应的

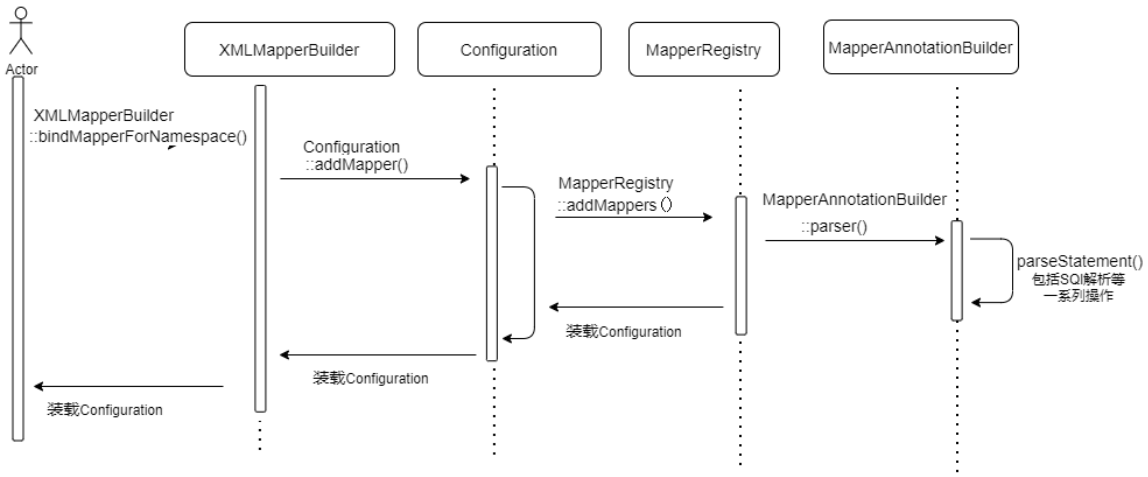
而且通过`MapperBuilderAssistant::addMappedStatement()`生成`MappedStatement`

```
public void parseStatementNode() {
  //获得 id 属性，编号
  String id = context.getStringAttribute("id");
  String databaseId = context.getStringAttribute("databaseId");
  // 判断 databaseId 是否匹配
  if (!databaseIdMatchesCurrent(id, databaseId, this.requiredDatabaseId)) {
    return;
  }
  //解析获得各种属性
  Integer fetchSize = context.getIntAttribute("fetchSize");
  Integer timeout = context.getIntAttribute("timeout");
  String parameterMap = context.getStringAttribute("parameterMap");
  String parameterType = context.getStringAttribute("parameterType");
  Class<?> parameterTypeClass = resolveClass(parameterType);
  String resultMap = context.getStringAttribute("resultMap");
  String resultType = context.getStringAttribute("resultType");
  String lang = context.getStringAttribute("lang");
  //获得 lang 对应的 LanguageDriver 对象
  LanguageDriver langDriver = getLanguageDriver(lang);
  //获得 resultType 对应的类
  Class<?> resultTypeClass = resolveClass(resultType);
  String resultSetType = context.getStringAttribute("resultSetType");
  //获得 statementType 对应的枚举值
  StatementType statementType =
StatementType.valueOf(context.getStringAttribute("statementType",
StatementType.PREPARED.toString()));
  //获得 resultSet 对应的枚举值
  ResultSetType resultSetTypeEnum = resolveResultSetType(resultSetType);

  String nodeName = context.getNode().getNodeName();
  //获得 SQL 对应的 SqlCommandType 枚举值
  SqlCommandType sqlCommandType =
SqlCommandType.valueOf(nodeName.toUpperCase(Locale.ENGLISH));
  boolean isSelect = sqlCommandType == SqlCommandType.SELECT;
  //解析获得各种属性
  boolean flushCache = context.getBooleanAttribute("flushCache", !isSelect);
  boolean useCache = context.getBooleanAttribute("useCache", isSelect);
  boolean resultOrdered = context.getBooleanAttribute("resultOrdered", false);

  //创建 XMLIncludeTransformer 对象，并替换 <include /> 标签相关的内容
  XMLIncludeTransformer includeParser = new XMLIncludeTransformer(configuration,
builderAssistant);
  includeParser.applyIncludes(context.getNode());

  //解析 <selectKey /> 标签
  processSelectKeyNodes(id, parameterTypeClass, langDriver);

  //创建 SqlSource生成动态sql
  SqlSource sqlSource = langDriver.createSqlSource(configuration, context,
parameterTypeClass);
  String resultSets = context.getStringAttribute("resultSets");
  String keyProperty = context.getStringAttribute("keyProperty");
  String keyColumn = context.getStringAttribute("keyColumn");
  KeyGenerator keyGenerator;
  String keyStatementId = id + SelectKeyGenerator.SELECT_KEY_SUFFIX;
```

```
  keyStatementId = builderAssistant.applyCurrentNamespace(keyStatementId, true);
  if (configuration.hasKeyGenerator(keyStatementId)) {
    keyGenerator = configuration.getKeyGenerator(keyStatementId);
  } else {
    keyGenerator = context.getBooleanAttribute("useGeneratedKeys",
        configuration.isUseGeneratedKeys() &&
SqlCommandType.INSERT.equals(sqlCommandType))
        ? Jdbc3KeyGenerator.INSTANCE : NoKeyGenerator.INSTANCE;
  }
  //创建 MappedStatement 对象
  this.builderAssistant.addMappedStatement(id, sqlSource, statementType,
sqlCommandType,                    fetchSize, timeout, parameterMap,
parameterTypeClass,
                    resultMap, resultTypeClass, resultSetTypeEnum, flushCache,
                    useCache, resultOrdered, (KeyGenerator)keyGenerator,
keyProperty,
                    keyColumn, databaseId, langDriver, resultSets);
}
12345678910111213141516171819202122232425262728293031323334353637383940414243444
5464748495051525354555657585960616263 64
```

解析`Mapper`接口中的注解

当执行完`XMLMapperBuilder::configurationElement()`方法后,会调用`XMLMapperBuilder::bindMapperForNamespace()`会转换成对接口上注解进行扫描，具体通过`MapperRegistry::addMapper()`调用`MapperAnnotationBuilder`实现的



`MapperAnnotationBuilder::parse()`是注解构造器，负责解析`Mapper`接口上的注解,解析时需要注意避免和`XMLMapperBuilder::parse()`方法冲突，重复解析，最终使用`parseStatement`解析，那怎么操作?

```
public void parse() {
  String resource = type.toString();
  //判断当前 Mapper 接口是否应加载过。
  if (!configuration.isResourceLoaded(resource)) {
    //加载对应的 XML Mapper,注意避免和 `XMLMapperBuilder::parse()` 方法冲突
    loadXmlResource();
    //标记该 Mapper 接口已经加载过
    configuration.addLoadedResource(resource);
    assistant.setCurrentNamespace(type.getName());
    //解析 @CacheNamespace 注解
```

```
    parseCache();
    parseCacheRef();
     //遍历每个方法，解析其上的注解
    Method[] methods = type.getMethods();
    for (Method method : methods) {
      try {
        if (!method.isBridge()) {
          //执行解析
          parseStatement(method);
        }
      } catch (IncompleteElementException e) {
        configuration.addIncompleteMethod(new MethodResolver(this, method));
      }
    }
  }
  //解析待定的方法
  parsePendingMethods();
}
```

那其中最重要的`parseStatement()`是怎么操作？其实跟解析`Mapper.xml`类型主要处理流程类似：

- 通过加载`LanguageDriver`,`GenericTokenParser`等为生成`SqlSource`动态sql作准备
- 使用`MapperBuilderAssistant::addMappedStatement()`生成注解`@mapper`,`@CacheNamespace`等的`MappedStatement`信息

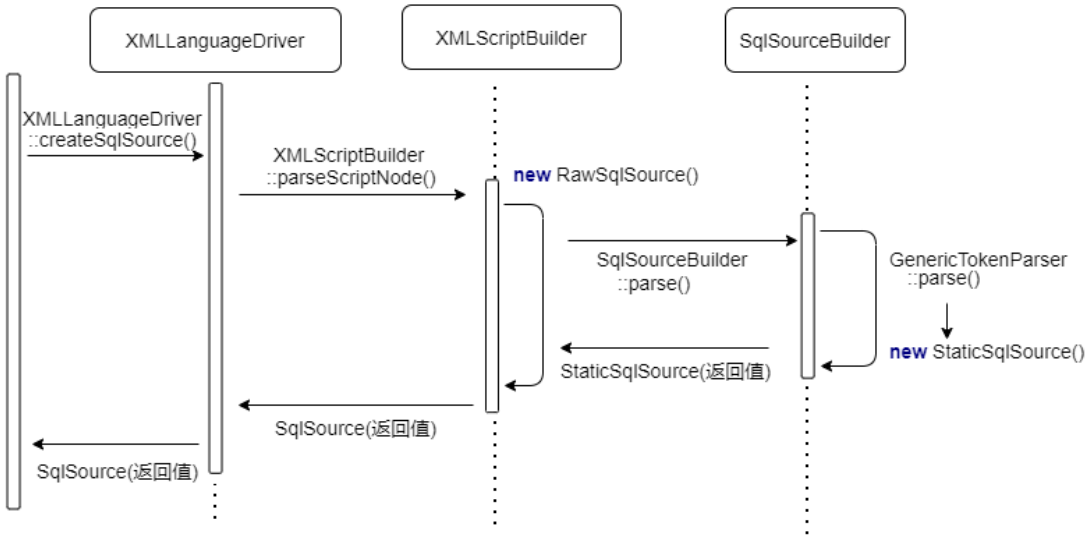
```
void parseStatement(Method method) {
    //获取接口参数类型
    Class<?> parameterTypeClass = getParameterType(method);
    //加载语言处理器，默认XmlLanguageDriver
    LanguageDriver languageDriver = getLanguageDriver(method);
    //根据LanguageDriver，GenericTokenParser生成动态SQL
    SqlSource sqlSource = getSqlSourceFromAnnotations(method,
parameterTypeClass, languageDriver);
    if (sqlSource != null) {
      //获取其他属性
        Options options = method.getAnnotation(Options.class);
        final String mappedStatementId = type.getName() + "." +
method.getName();
        Integer fetchSize = null;
        Integer timeout = null;
        StatementType statementType = StatementType.PREPARED;
        ResultSetType resultSetType = null;
        SqlCommandType sqlCommandType = getSqlCommandType(method);
        boolean isSelect = sqlCommandType == SqlCommandType.SELECT;
        boolean flushCache = !isSelect;
        boolean useCache = isSelect;

        //获得 KeyGenerator 对象
        KeyGenerator keyGenerator;
        String keyProperty = null;
        String keyColumn = null;
        if (SqlCommandType.INSERT.equals(sqlCommandType) ||
SqlCommandType.UPDATE.equals(sqlCommandType)) { // 有
            // first check for SelectKey annotation - that overrides everything
else
            //如果有 @SelectKey 注解，则进行处理
```

```
            SelectKey selectKey = method.getAnnotation(SelectKey.class);
            if (selectKey != null) {
                keyGenerator = handleSelectKeyAnnotation(selectKey,
mappedStatementId, getParameterType(method), languageDriver);
                keyProperty = selectKey.keyProperty();
            //如果无 @Options 注解，则根据全局配置处理
            } else if (options == null) {
                keyGenerator = configuration.isUseGeneratedKeys() ?
Jdbc3KeyGenerator.INSTANCE : NoKeyGenerator.INSTANCE;
            // 如果有 @Options 注解，则使用该注解的配置处理
            } else {
                keyGenerator = options.useGeneratedKeys() ?
Jdbc3KeyGenerator.INSTANCE : NoKeyGenerator.INSTANCE;
                keyProperty = options.keyProperty();
                keyColumn = options.keyColumn();
            }
        // 无
        } else {
            keyGenerator = NoKeyGenerator.INSTANCE;
        }

        //初始化各种属性
        if (options != null) {
            if (FlushCachePolicy.TRUE.equals(options.flushCache())) {
                flushCache = true;
            } else if (FlushCachePolicy.FALSE.equals(options.flushCache())) {
                flushCache = false;
            }
            useCache = options.useCache();
            fetchSize = options.fetchSize() > -1 || options.fetchSize() ==
Integer.MIN_VALUE ? options.fetchSize() : null; //issue #348
            timeout = options.timeout() > -1 ? options.timeout() : null;
            statementType = options.statementType();
            resultSetType = options.resultSetType();
        }

        // 获得 resultMapId 编号字符串
        String resultMapId = null;
        //如果有 @ResultMap 注解，使用该注解为 resultMapId 属性
        ResultMap resultMapAnnotation = method.getAnnotation(ResultMap.class);
        if (resultMapAnnotation != null) {
            String[] resultMaps = resultMapAnnotation.value();
            StringBuilder sb = new StringBuilder();
            for (String resultMap : resultMaps) {
                if (sb.length() > 0) {
                    sb.append(",");
                }
                sb.append(resultMap);
            }
            resultMapId = sb.toString();
        // 如果无 @ResultMap 注解，解析其它注解，作为 resultMapId 属性
        } else if (isSelect) {
            resultMapId = parseResultMap(method);
        }
      //构建 MappedStatement 对象
      assistant.addMappedStatement(
          mappedStatementId,
          sqlSource,
```

```
            statementType,
            sqlCommandType,
            fetchSize,
            timeout,
            // ParameterMapID
            null,
            parameterTypeClass,
            resultMapId,
            getReturnType(method),
            resultSetType,
            flushCache,
            useCache,
            // TODO gcode issue #577
            false,
            keyGenerator,
            keyProperty,
            keyColumn,
            // DatabaseID
            null,
            languageDriver,
            // ResultSets
            options != null ? nullOrEmpty(options.resultSets()) : null);
    }
  }
12345678910111213141516171819202122232425262728293031323334353637383940414243444
54647484950515253545556575859606162636465666768697071727374757677787980818283848
58687888990919293949596979899100101102103104105
```

生成动态`SqlSource`

当在执行`langDriver::createSqlSource(configuration, context, parameterTypeClass)`中的时候， 是怎样从`Mapper XML`或方法注解上读取`SQL`内容生成动态`SqlSource`的呢？现在来一探究竟，



首先需要获取`langDriver`实现`XMLLanguageDriver`/`RawLanguageDriver`，现在使用默认的`XMLLanguageDriver::createSqlSource(configuration, context, parameterTypeClass)`开启创建，再使用`XMLScriptBuilder::parseScriptNode()`解析生成`SqlSource`

- `DynamicSqlSource`： 动态的`SqlSource`实现类，适用于使用了 OGNL 表达式，或者使用了`${}`表达式的 SQL

- `RawSqlSource`： **原始**的 `SqlSource` 实现类，适用于仅使用 `#{}` 表达式，或者不使用任何表达式的情况

```
public SqlSource parseScriptNode() {
        MixedSqlNode rootSqlNode = this.parseDynamicTags(this.context);
        Object sqlSource;
        if (this.isDynamic) {
            sqlSource = new DynamicSqlSource(this.configuration, rootSqlNode);
        } else {
            sqlSource = new RawSqlSource(this.configuration, rootSqlNode,
this.parameterType);
        }

        return (SqlSource)sqlSource;
    }
1234567891011
```

那就选择其中一种来分析一下`RawSqlSource`，怎么完成构造的呢？看看`RawSqlSource`构造函数：

```
 public RawSqlSource(Configuration configuration, String sql, Class<?>
parameterType) {
        SqlSourceBuilder sqlSourceParser = new SqlSourceBuilder(configuration);
        Class<?> clazz = parameterType == null ? Object.class : parameterType;
        this.sqlSource = sqlSourceParser.parse(sql, clazz, new HashMap());
    }
12345
```

使用`SqlSourceBuilder::parse()`去解析SQl，里面又什么神奇的地方呢？

```
 public SqlSource parse(String originalSql, Class<?> parameterType, Map<String,
Object> additionalParameters) {
        SqlSourceBuilder.ParameterMappingTokenHandler handler = new
SqlSourceBuilder.ParameterMappingTokenHandler(this.configuration, parameterType,
additionalParameters);
        //创建基于#{}的GenericTokenParser
        GenericTokenParser parser = new GenericTokenParser("#{", "}", handler);
        String sql = parser.parse(originalSql);
        return new StaticSqlSource(this.configuration, sql,
handler.getParameterMappings());
    }
1234567
```

`ParameterMappingTokenHandler` 是 `SqlSourceBuilder` 的内部私有静态类，`ParameterMappingTokenHandler` ，负责将匹配到的 `#{` 和 `}` 对，替换成相应的 `?` 占位符，并获取该 `?` 占位符对应的 `org.apache.ibatis.mapping.ParameterMapping` 对象。

并基于`ParameterMappingTokenHandler`使用`GenericTokenParser::parse()`将SQL中的`#{}`转化占位符`?`占位符后创建一个`StaticSqlSource`返回。

总结

在 MyBatis 初始化过程中，会加载 `mybatis-config.xml` 配置文件、`Mapper.xml` 映射配置文件以及 Mapper 接口中的注解信息，解析后的配置信息会形成相应的对象并全部保存到 `Configuration` 对象中，并创建 `DefaultSqlSessionFactory` 供SQl执行过程创建出顶层接口 `SqlSession` 供给用户进行操作。