

第二部分：Spring 中的数据操作



扫码试看/订阅
《玩转 Spring 全家桶》

JDBC 必知必会

如何配置数据源

Spring Boot 的配置演示



- 引入对应数据库驱动——H2
- 引入 JDBC 依赖——spring-boot-starter-jdbc
- 获取 DataSource Bean，打印信息
- 也可通过 /actuator/beans 查看 Bean

Dependencies

Add Spring Boot Starters and dependencies to your application

Search for dependencies

Web, Security, JPA, Actuator, Devtools...

Selected Dependencies

H2 ×

JDBC ×

Lombok ×

Web ×

Actuator ×

```
@SpringBootApplication
@Slf4j
public class DataSourceDemoApplication implements CommandLineRunner {
    @Autowired
    private DataSource dataSource;

    public static void main(String[] args) {
        SpringApplication.run(DataSourceDemoApplication.class, args);
    }

    @Override
    public void run(String... args) throws Exception {
        log.info(dataSource.toString());
        Connection conn = dataSource.getConnection();
        log.info(conn.toString());
        conn.close();
    }
}
```

```
HikariDataSource (null)
HikariPool-1 - Starting...
HikariPool-1 - Start completed.
HikariProxyConnection@5181771 wrapping conn0: url=jdbc:h2:mem:testdb user=SA
```

直接配置所需的Bean

数据源相关

- DataSource（根据选择的连接池实现决定）

事务相关（可选）

- PlatformTransactionManager（DataSourceTransactionManager）
- TransactionTemplate

操作相关（可选）

- JdbcTemplate

```
@Configuration
@EnableTransactionManagement
public class DataSourceDemo {
    @Autowired
    private DataSource dataSource;

    public static void main(String[] args) throws SQLException {
        ApplicationContext applicationContext =
            new ClassPathXmlApplicationContext("applicationContext*.xml");
        showBeans(applicationContext);
        dataSourceDemo(applicationContext);
    }

    @Bean(destroyMethod = "close")
    public DataSource dataSource() throws Exception {
        Properties properties = new Properties();
        properties.setProperty("driverClassName", "org.h2.Driver");
        properties.setProperty("url", "jdbc:h2:mem:testdb");
        properties.setProperty("username", "sa");
        return BasicDataSourceFactory.createDataSource(properties);
    }

    @Bean
    public PlatformTransactionManager transactionManager() throws Exception {
        return new DataSourceTransactionManager(dataSource());
    }
}
```


Spring Boot 做了哪些配置

DataSourceAutoConfiguration

- 配置 DataSource

DataSourceTransactionManagerAutoConfiguration

- 配置 DataSourceTransactionManager

JdbcTemplateAutoConfiguration

- 配置 JdbcTemplate

符合条件时才进行配置


数据源相关配置属性



通用

- `spring.datasource.url=jdbc:mysql://localhost/test`
- `spring.datasource.username=dbuser`
- `spring.datasource.password=dbpass`
- `spring.datasource.driver-class-name=com.mysql.jdbc.Driver` (可选)

初始化内嵌数据库

- `spring.datasource.initialization-mode=embedded|always|never` 
- `spring.datasource.schema`与`spring.datasource.data`确定初始化SQL文件
- `spring.datasource.platform=hsqldb | h2 | oracle | mysql | postgresql` (与前者对应)

配置多数据源的注意事项



不同数据源的配置要分开


关注每次使用的数据源

- 有多个DataSource时系统如何判断
- 对应的设施（事务、ORM等）如何选择DataSource

Spring Boot中的多数据源配置

💬 手工配置两组 DataSource 及相关内容

💬 与Spring Boot协同工作（二选一）

- 配置@Primary类型的Bean 
- 排除Spring Boot的自动配置 
 - DataSourceAutoConfiguration
 - DataSourceTransactionManagerAutoConfiguration
 - JdbcTemplateAutoConfiguration

```
@SpringBootApplication(exclude = { DataSourceAutoConfiguration.class,  
    DataSourceTransactionManagerAutoConfiguration.class,  
    JdbcTemplateAutoConfiguration.class})  
  
@Slf4j  
public class MultiDataSourceDemoApplication {
```

```
@Bean  
@ConfigurationProperties("bar.datasource")  
public DataSourceProperties barDataSourceProperties() {  
    return new DataSourceProperties();  
}  
  
@Bean  
public DataSource barDataSource() {  
    DataSourceProperties dataSourceProperties = barDataSourceProperties();  
    log.info("bar datasource: {}", dataSourceProperties.getUrl());  
    return dataSourceProperties.initializeDataSourceBuilder().build();  
}  
  
@Bean  
@Resource  
public PlatformTransactionManager barTxManager(DataSource barDataSource) {  
    return new DataSourceTransactionManager(barDataSource);  
}
```

```
@Bean  
@ConfigurationProperties("foo.datasource")  
public DataSourceProperties fooDataSourceProperties() {  
    return new DataSourceProperties();  
}  
  
@Bean  
public DataSource fooDataSource() {  
    DataSourceProperties dataSourceProperties = fooDataSourceProperties();  
    log.info("foo datasource: {}", dataSourceProperties.getUrl());  
    return dataSourceProperties.initializeDataSourceBuilder().build();  
}  
  
@Bean  
@Resource  
public PlatformTransactionManager fooTxManager(DataSource fooDataSource) {  
    return new DataSourceTransactionManager(fooDataSource);  
}
```

那些好用的连接池

HikariCP

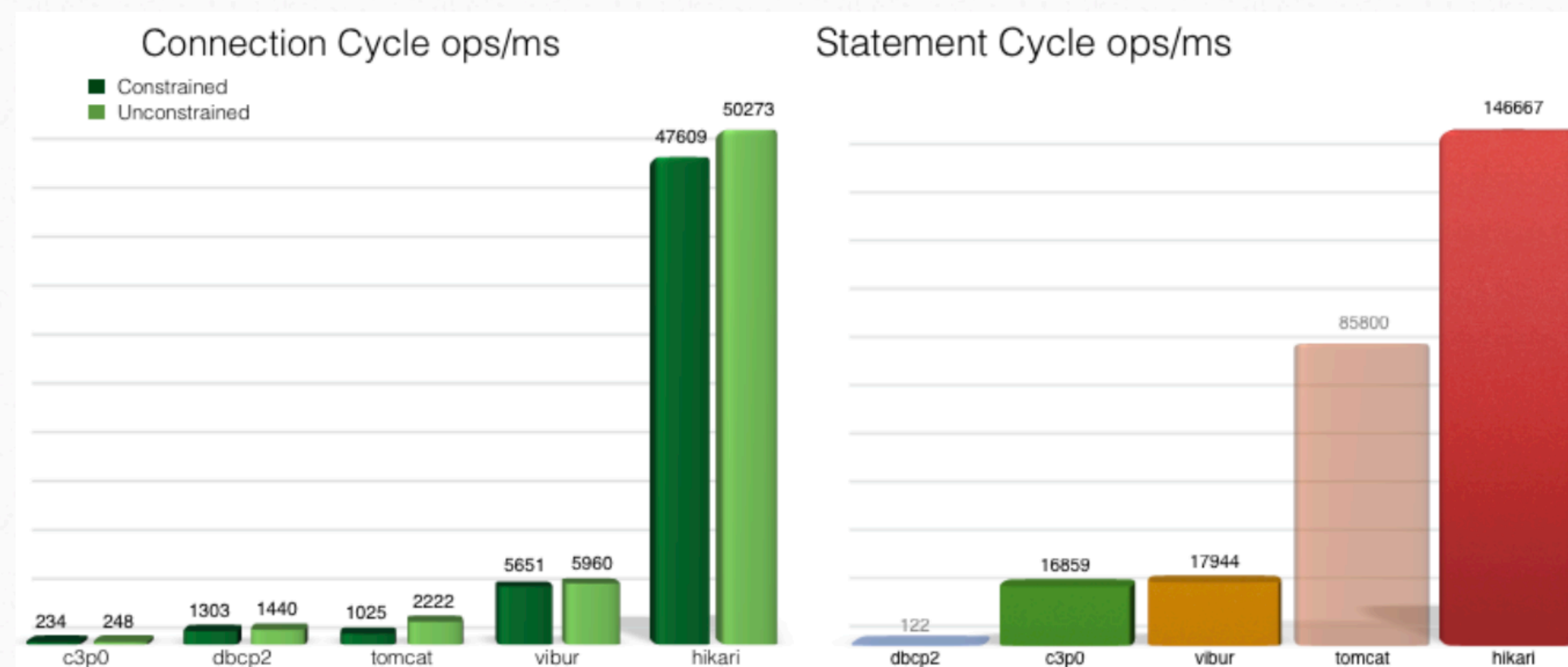
光 HikariCP

A high-performance JDBC connection pool.

// It's Faster.

There is nothing **faster**. There is nothing more **correct**. HikariCP is a “zero-overhead” production-quality connection pool.

Using a stub-JDBC implementation to isolate and measure the overhead of HikariCP, comparative benchmarks were performed on a commodity PC.



Just drop it in and let your code run like its pants are on fire.

HikariCP 为什么快

1. 字节码级别优化（很多方法通过 `JavaAssist` 生成）

2. 大量小改进

- 用 `FastStatementList` 代替 `ArrayList`
- 无锁集合 `ConcurrentBag`
- 代理类的优化（比如，用 `invokestatic` 代替了 `invokevirtual`）

在 Spring Boot 中的配置

Spring Boot 2.x

- 默认使用 HikariCP
- 配置 `spring.datasource.hikari.*` 配置

Spring Boot 1.x

- 默认使用 Tomcat 连接池，需要移除 tomcat-jdbc 依赖
- `spring.datasource.type=com.zaxxer.hikari.HikariDataSource`

常用 HikariCP 配置参数

常用配置

- `spring.datasource.hikari.maximumPoolSize=10`
- `spring.datasource.hikari.minimumIdle=10`
- `spring.datasource.hikari.idleTimeout=600000`
- `spring.datasource.hikari.connectionTimeout=30000`
- `spring.datasource.hikari.maxLifetime=1800000`

其他配置详见 HikariCP 官网

- <https://github.com/brettwooldridge/HikariCP>

那些好用的连接池

Alibaba Druid



“Druid连接池是阿里巴巴开源的数据库连接池项目。Druid连接池为监控而生，内置强大的监控功能，监控特性不影响性能。功能强大，能防SQL注入，内置Logging能诊断Hack应用行为。”

-Alibaba Druid 官方介绍

Druid

经过阿里巴巴各大系统的考验，值得信赖

实用的功能

- 详细的监控（真的是全面）
- ExceptionSorter，针对主流数据库的返回码都有支持
- SQL 防注入
- 内置加密配置
- 众多扩展点，方便进行定制

数据源配置

直接配置 DruidDataSource

通过 druid-spring-boot-starter

- spring.datasource.druid.*

```
spring.output.ansi.enabled=ALWAYS

spring.datasource.url=jdbc:h2:mem:foo
spring.datasource.username=sa
spring.datasource.password=n/z7PyA5cvcXvs8px8FVmBVpaRyNsvJb3X7YfS38DJrIg25EbZaZGvH4aHcnc970m0islpCAPc3MqsGvsrxVJw==

spring.datasource.druid.initial-size=5
spring.datasource.druid.max-active=5
spring.datasource.druid.min-idle=5
spring.datasource.druid.filters=conn,config,stat,slf4j

spring.datasource.druid.connection-properties=config.decrypt=true;config.decrypt.key=${public-key}
spring.datasource.druid.filter.config.enabled=true

spring.datasource.druid.test-on-borrow=true
spring.datasource.druid.test-on-return=true
spring.datasource.druid.test-while-idle=true
```

数据源配置




Filter 配置

- `spring.datasource.druid.filters=stat,config,wall,log4j` （全部使用默认值）

密码加密

- `spring.datasource.password=<加密密码>`
- `spring.datasource.druid.filter.config.enabled=true`
- `spring.datasource.druid.connection-properties=config.decrypt=true;config.decrypt.key=<public-key>`

SQL 防注入

- `spring.datasource.druid.filter.wall.enabled=true`
- `spring.datasource.druid.filter.wall.db-type=h2`
- `spring.datasource.druid.filter.wall.config.delete-allow=false` 
- `spring.datasource.druid.filter.wall.config.drop-table-allow=false`

Druid Filter

- 用于定制连接池操作的各种环节
-  可以继承 FilterEventAdapter 以便方便地实现 Filter
- 修改 META-INF/druid-filter.properties 增加 Filter 配置

Druid Filter

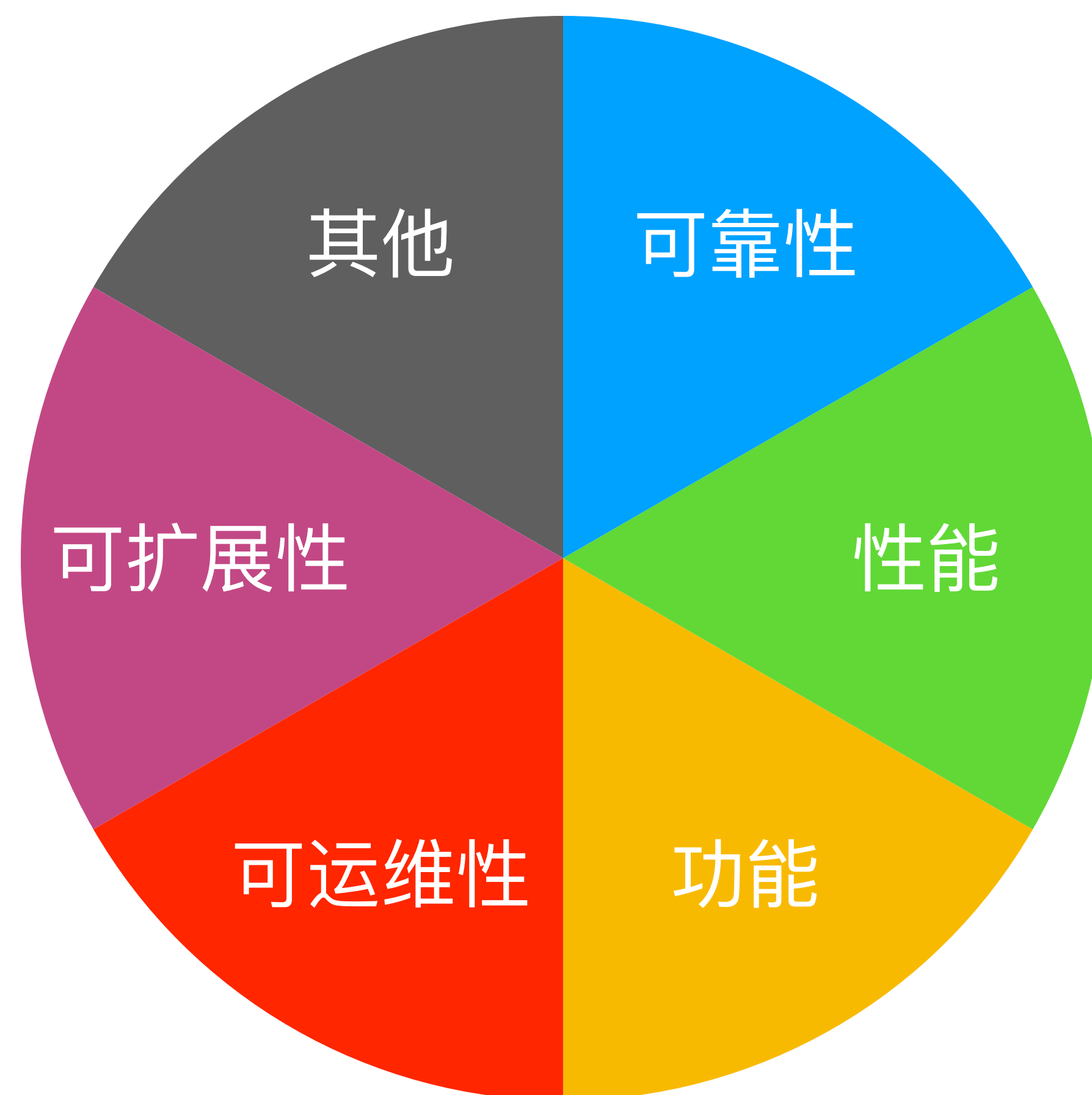
```
@Slf4j
public class ConnectionLogFilter extends FilterEventAdapter {

    @Override
    public void connection_connectBefore(FilterChain chain, Properties info) {
        log.info("BEFORE CONNECTION!");
    }

    @Override
    public void connection_connectAfter(ConnectionProxy connection) {
        log.info("AFTER CONNECTION!");
    }
}
```

```
com.alibaba.druid.pool.DruidDataSource : testOnBorrow is true,
g.s.data.druiddemo.ConnectionLogFilter : BEFORE CONNECTION!
g.s.data.druiddemo.ConnectionLogFilter : AFTER CONNECTION!
g.s.data.druiddemo.ConnectionLogFilter : BEFORE CONNECTION!
g.s.data.druiddemo.ConnectionLogFilter : AFTER CONNECTION!
```

连接池选择时的考量点



通过 Spring JDBC 访问数据库

Spring 的 JDBC 操作类

spring-jdbc

- core, JdbcTemplate 等相关核心接口和类
- datasource, 数据源相关的辅助类
- object, 将基本的 JDBC 操作封装成对象
- support, 错误码等其他辅助工具

常用的 Bean 注解

通过注解定义 Bean

- @Component
- @Repository
- @Service
- @Controller
- @RestController

简单的 JDBC 操作



JdbcTemplate

- query
- queryForObject
- queryForList
- update
- execute

“Talk is cheap, show me the code.”

–Linus Torvalds

SQL 批处理



JdbcTemplate

- batchUpdate
- BatchPreparedStatementSetter

NamedParameterJdbcTemplate

- batchUpdate
- SqlParameterSourceUtils.createBatch

“Talk is cheap, show me the code.”

–Linus Torvalds

了解 Spring 的抽象

事务抽象

Spring 的事务抽象

一致的事务模型

- JDBC/Hibernate/myBatis
- DataSource/JTA

事务抽象的核心接口

PlatformTransactionManager

- DataSourceTransactionManager
- HibernateTransactionManager
- JtaTransactionManager

TransactionDefinition

- Propagation
- Isolation
- Timeout
- Read-only status

```
void commit(TransactionStatus status) throws TransactionException;
```

```
void rollback(TransactionStatus status) throws TransactionException;
```

```
TransactionStatus getTransaction(@Nullable TransactionDefinition definition) throws TransactionException;
```

事务传播特性



传播性	值	描述
PROPAGATION_REQUIRED	0	当前有事务就用当前的，没有就用新的
PROPAGATION_SUPPORTS	1	事务可有可无，不是必须的
PROPAGATION_MANDATORY	2	当前一定要有事务，不然就抛异常
PROPAGATION_REQUIRES_NEW	3	无论是否有事务，都起个新的事务
PROPAGATION_NOT_SUPPORTED	4	不支持事务，按非事务方式运行
PROPAGATION_NEVER	5	不支持事务，如果有事务则抛异常
PROPAGATION_NESTED	6	当前有事务就在当前事务里再起一个事务


事务隔离特性



隔离性	值	脏读	不可重复读	幻读
ISOLATION_READ_UNCOMMITTED	1	√	√	√
ISOLATION_READ_COMMITTED	2	×	√	√
ISOLATION_REPEATABLE_READ	3	×	×	√
ISOLATION_SERIALIZABLE	4	×	×	×

编程式事务

TransactionTemplate

- TransactionCallback 
- TransactionCallbackWithoutResult

PlatformTransactionManager

- 可以传入TransactionDefinition进行定义

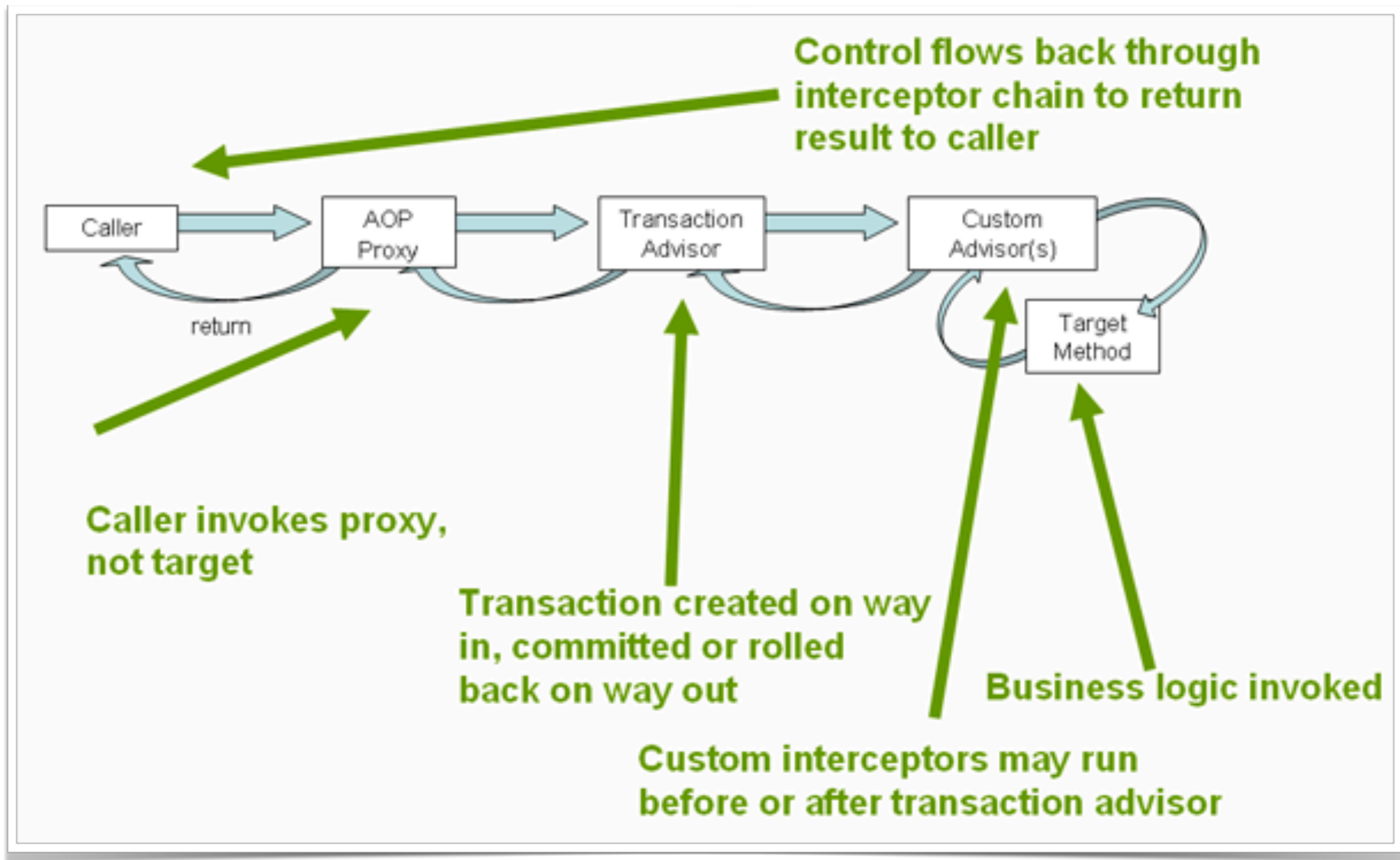
```
@SpringBootApplication
@Slf4j
public class ProgrammaticTransactionDemoApplication implements CommandLineRunner {
    @Autowired
    private TransactionTemplate transactionTemplate;
    @Autowired
    private JdbcTemplate jdbcTemplate;

    public static void main(String[] args) {
        SpringApplication.run(ProgrammaticTransactionDemoApplication.class, args);
    }

    @Override
    public void run(String... args) throws Exception {
        log.info("COUNT BEFORE TRANSACTION: {}", getCount());
        transactionTemplate.execute(new TransactionCallbackWithoutResult() {
            @Override
            protected void doInTransactionWithoutResult(TransactionStatus transactionStatus) {
                jdbcTemplate.execute("INSERT INTO FOO (ID, BAR) VALUES (1, 'aaa')");
                log.info("COUNT IN TRANSACTION: {}", getCount());
                transactionStatus.setRollbackOnly();
            }
        });
        log.info("COUNT AFTER TRANSACTION: {}", getCount());
    }

    private long getCount() {
        return (long) jdbcTemplate.queryForList("SELECT COUNT(*) AS CNT FROM FOO")
            .get(0).get("CNT");
    }
}
```


声明式事务



基于注解的配置方式

开启事务注解的方式

- @EnableTransactionManagement
- <tx:annotation-driven/>

一些配置

- proxyTargetClass
- mode
- order

@Transactional

- transactionManager
- propagation
- isolation
- timeout
- readOnly
- 怎么判断回滚

```
@Component
public class FooServiceImpl implements FooService {
    @Autowired
    private JdbcTemplate jdbcTemplate;

    @Override
    @Transactional
    public void insertRecord() {
        jdbcTemplate.execute("INSERT INTO FOO (BAR) VALUES ('AAA')");
    }

    @Override
    @Transactional(rollbackFor = RollbackException.class)
    public void insertThenRollback() throws RollbackException {
        jdbcTemplate.execute("INSERT INTO FOO (BAR) VALUES ('BBB')");
        throw new RollbackException();
    }

    @Override
    public void invokeInsertThenRollback() throws RollbackException {
        insertThenRollback();
    }
}
```

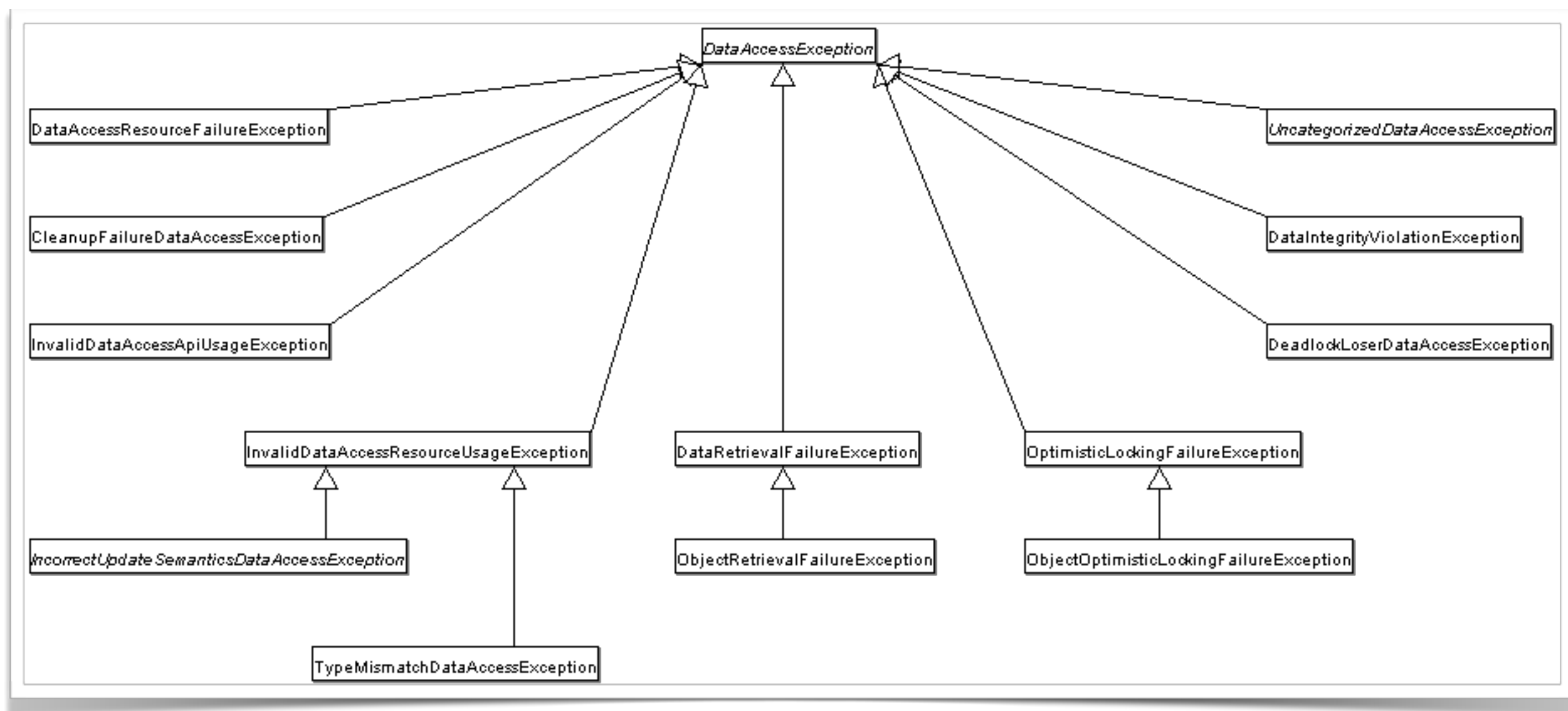
了解 Spring 的抽象

JDBC 异常抽象

Spring 的 JDBC 异常抽象

Spring 会将数据操作的异常转换为 `DataAccessException`

无论使用何种数据访问方式，都能使用一样的异常



Spring是怎么认识那些错误码的

通过 **SQLExceptionTranslator** 解析错误码

ErrorCode 定义

- [org/springframework/jdbc/support/sql-error-codes.xml](https://org.springframework.jdbc.support.sql-error-codes.xml)
- Classpath 下的 `sql-error-codes.xml`

定制错误码解析逻辑

```
<bean id="H2" class="org.springframework.jdbc.support.SQLErrorCodes">
  <property name="badSqlGrammarCodes">
    <value>42000,42001,42101,42102,42111,42112,42121,42122,42132</value>
  </property>
  <property name="duplicateKeyCodes">
    <value>23001,23505</value>
  </property>
  <property name="dataIntegrityViolationCodes">
    <value>22001,22003,22012,22018,22025,23000,23002,23003,23502,23503,23506,23507,23513</value>
  </property>
  <property name="dataAccessResourceFailureCodes">
    <value>90046,90100,90117,90121,90126</value>
  </property>
  <property name="cannotAcquireLockCodes">
    <value>50200</value>
  </property>
  <property name="customTranslations">
    <bean class="org.springframework.jdbc.support.CustomSQLErrorCodesTranslation">
      <property name="errorCodes" value="23001,23505" />
      <property name="exceptionClass"
        value="geektime.spring.data.errorcodedemo.CustomDuplicatedKeyException" />
    </bean>
  </property>
</bean>
```



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