


数据访问进阶

Project Reactor 介绍

“在计算机中，响应式编程或反应式编程（英语：Reactive Programming）是一种面向数据流和变化传播的编程范式。这意味着可以在编程语言中很方便地表达静态或动态的数据流，而相关的计算模型会自动将变化的值通过数据流进行传播。”


—— 维基百科

Project Reactor




Create efficient Reactive systems

Reactor is a fourth-generation Reactive library for building non-blocking applications on the JVM based on the Reactive Streams Specification




REACTIVE CORE

Reactor is a **fully non-blocking** foundation with efficient demand management. It directly interacts with Java *functional API*, *Completable Future*, *Stream* and *Duration*.



TYPED [0|1|N] SEQUENCES

Reactor offers 2 **reactive composable API** Flux [N] and Mono [0|1] extensively implementing Reactive Extensions.



NON BLOCKING IO

Suited for **Microservices Architecture**, Reactor offers **backpressure-ready network engines** for HTTP (including Websockets), TCP and UDP.

Example of Callback Hell

```
userService.getFavorites(userId, new Callback<List<String>>() { 1
    public void onSuccess(List<String> list) { 2
        if (list.isEmpty()) { 3
            suggestionService.getSuggestions(new Callback<List<Favorite>>() { 4
                public void onSuccess(List<Favorite> list) { 4
                    UiUtils.submitOnUiThread(() -> { 5
                        list.stream()
                            .limit(5)
                            .forEach(uiList::show); 6
                    });
                }
            });
        } else { 7
            list.stream() 8
                .limit(5)
                .forEach(favId -> favoriteService.getDetails(favId, 9
                    new Callback<Favorite>() {
                        public void onSuccess(Favorite details) {
                            UiUtils.submitOnUiThread(() -> uiList.show(details));
                        }
                        public void onError(Throwable error) {
                            UiUtils.errorPopup(error);
                        }
                    }
                ));
        }
    }
    public void onError(Throwable error) {
        UiUtils.errorPopup(error);
    }
});
```

Example of Reactor code equivalent to callback code

```
userService.getFavorites(userId) 1
    .flatMap(favoriteService::getDetails) 2
    .switchIfEmpty(suggestionService.getSuggestions()) 3
    .take(5) 4
    .publishOn(UiUtils.uiThreadScheduler()) 5
    .subscribe(uiList::show, UiUtils::errorPopup); 6
```

Example of Reactor code with timeout and fallback

```
userService.getFavorites(userId)
    .timeout(Duration.ofMillis(800)) 1
    .onErrorResume(cacheService.cachedFavoritesFor(userId)) 2
    .flatMap(favoriteService::getDetails) 3
    .switchIfEmpty(suggestionService.getSuggestions())
    .take(5)
    .publishOn(UiUtils.uiThreadScheduler())
    .subscribe(uiList::show, UiUtils::errorPopup);
```

一些核心的概念

Operators - Publisher / Subscriber

- Nothing Happens Until You subscribe()
- Flux [0..N] - onNext()、onComplete()、onError()
- Mono [0..1] - onNext()、onComplete()、onError()

Backpressure

- Subscription
- onRequest()、onCancel()、onDispose()

一些核心的概念

线程调度 Schedulers

- `immediate()` / `single()` / `newSingle()`
- `elastic()` / `parallel()` / `newParallel()`

错误处理

- `onError` / `onErrorReturn` / `onErrorResume`
- `doOnError` / `doFinally`

“Talk is cheap, show me the code.”

Chapter 5 / simpler-reactor-demo

通过 Reactive 的方式访问数据

Redis

Spring Data Redis

Lettuce 能够支持 Reactive 方式

Spring Data Redis 中主要的支持

- `ReactiveRedisConnection`
- `ReactiveRedisConnectionFactory`
- `ReactiveRedisTemplate`
 - `opsForXxx()`

“Talk is cheap, show me the code.”

Chapter 5 / reactive-redis-demo

通过 Reactive 的方式访问数据

MongoDB

Spring Data MongoDB

MongoDB 官方提供了支持 Reactive 的驱动

- mongodb-driver-reactivestreams

Spring Data MongoDB 中主要的支持

- ReactiveMongoClientFactoryBean
- ReactiveMongoDatabaseFactory
- ReactiveMongoTemplate

“Talk is cheap, show me the code.”

Chapter 5 / reactive-mongo-demo

通过 Reactive 的方式访问数据

RDBMS

Spring Data R2DBC

R2DBC (<https://spring.io/projects/spring-data-r2dbc>)

- Reactive Relational Database Connectivity

支持的数据库

- Postgres (`io.r2dbc:r2dbc-postgresql`)
- H2 (`io.r2dbc:r2dbc-h2`)
- Microsoft SQL Server (`io.r2dbc:r2dbc-mssql`)

Spring Data R2DBC

一些主要的类

- ConnectionFactory
- DatabaseClient
 - `execute().sql(SQL)`
 - `inTransaction(db -> {})`
- R2dbcExceptionTranslator
 - `SqlErrorCodeR2dbcExceptionTranslator`

“Talk is cheap, show me the code.”

Chapter 5 / simple-r2dbc-demo

R2DBC Repository 支持

一些主要的类

- `@EnableR2dbcRepositories`
- `ReactiveCrudRepository<T, ID>`
 - `@Table` / `@Id`
 - 其中的方法返回都是 `Mono` 或者 `Flux`
 - 自定义查询需要自己写 `@Query`

“Talk is cheap, show me the code.”

Chapter 5 / r2dbc-repository-demo

通过 AOP 打印数据访问层摘要

Spring AOP 的一些核心概念

概念	含义
Aspect	切面
Join Point	连接点，Spring AOP里总是代表一次方法执行
Advice	通知，在连接点执行的动作
Pointcut	切入点，说明如何匹配连接点
Introduction	引入，为现有类型声明额外的方法和属性
Target object	目标对象
AOP proxy	AOP 代理对象，可以是 JDK 动态代理，也可以是 CGLIB 代理
Weaving	织入，连接切面与目标对象或类型创建代理的过程

常用注解

- `@EnableAspectJAutoProxy`
- `@Aspect`
- `@Pointcut`
- `@Before`
- `@After` / `@AfterReturning` / `@AfterThrowing`
- `@Around`
- `@Order`

如何打印 SQL

HikariCP

- P6SQL, <https://github.com/p6spy/p6spy>

Alibaba Druid

- 内置 SQL 输出
- [https://github.com/alibaba/druid/wiki/Druid中使用log4j2进行日志输出](https://github.com/alibaba/druid/wiki/Druid%E4%B8%AD%E7%94%A8log4j2%E8%BF%BC%E6%97%B4%E8%BE%9C%E8%BE%9C)

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Chapter 5 / performance-aspect-demo

SpringBucks 进度小结

本章小结

- Project Reactor 的基本用法
- 如何通过 Reactive 的方式访问 NoSQL
- 如何通过 Reactive 的方式访问 RDBMS
- Spring AOP 的基本概念
- 监控 DAO 层的简单方案

SpringBucks 进度小结

- 通过 Reactive 的方式来保存数据与操作缓存