


# 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%9C%E6%BB%8E%E6%97%A5%E8%BE%9C%E8%BE%9C)

**“Talk is cheap, show me the code.”**

*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