CS665 Final Project

API Gateway + Pipeline Pattern

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Project Introduction

Project Background

New Patterns and Goals

- New design patterns I used:
  - API Gateway
  - Pipeline
- Re-make of earlier project for CS622
- Original project was a Spring boot backend, with JS Chatbot front-end
- Still interesting problem to solve - ETL and big data processing is something I do at work

Overview

What was wrong with the original project?

- The original project was very messy
- Monolith class that handled most of the orchestration
- Data load and parsing was very hard to understand and debug
- Search methods were confusing

Goals

What was I solving for?

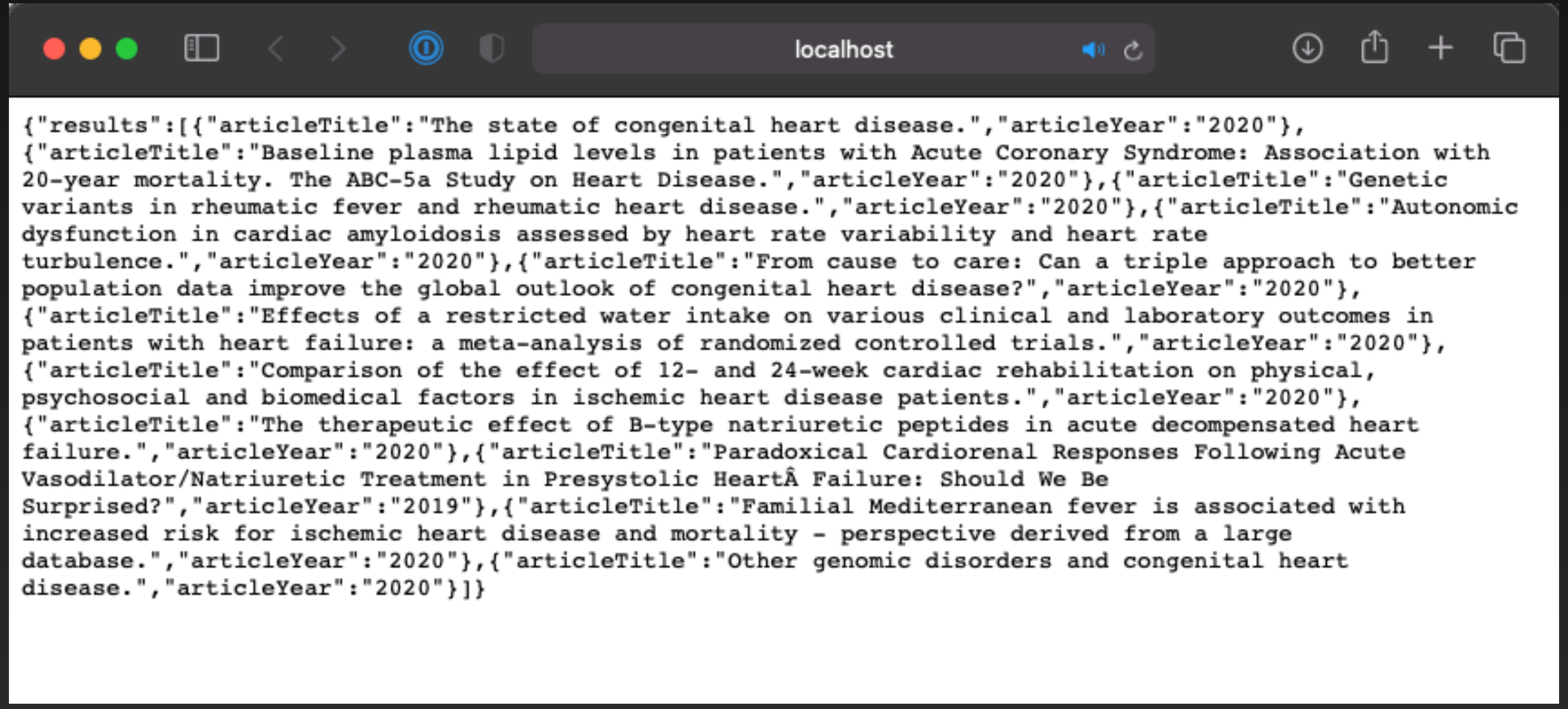
- Make the project more extensible
- Improve readability of the data load + parsing process
- Make it easier to implement different searching algorithms
- Loosen the coupling between databases and parsing

What does the application do?

XML

```xml
<?xml version="1.0" encoding="utf-8"?>
<!DOCTYPE PubmedArticleSet PUBLIC "-//NLM//DTD PubMedArticle, 1st January 2019//EN"
"https://dtd.nlm.nih.gov/ncbi/pubmed/out/pubmed_190101.dtd">
<PubmedArticleSet>
  <PubmedArticle>
    <MedlineCitation Status="PubMed-not-MEDLINE" Owner="NLM">
      <PMID Version="1">31909768</PMID>
      <DateRevised>
        <Year>2018</Year>
        <Month>01</Month>
        <Day>07</Day>
      </DateRevised>
      <Article PubModel="Electronic-eCollection">
        <Journal>
          <ISSN IssnType="Electronic">2452-302X</ISSN>
          <JournalIssue CitedMedium="Internet">
            <Volume>4</Volume>
            <Issue>8</Issue>
            <PubDate>
              <Year>2019</Year>
              <Month>Dec</Month>
            </PubDate>
          </JournalIssue>
          <Title>JACC. Basic to translational science</Title>
          <ISOAbbreviation>JACC Basic Transl Sci</ISOAbbreviation>
        </Journal>
        <ArticleTitle>The <i>Bslc2</i> <sup>-/-</sup> Mouse: Adding a Missing Phenotype
to the Repertoire of HFpEF Animal Models.</ArticleTitle>
```

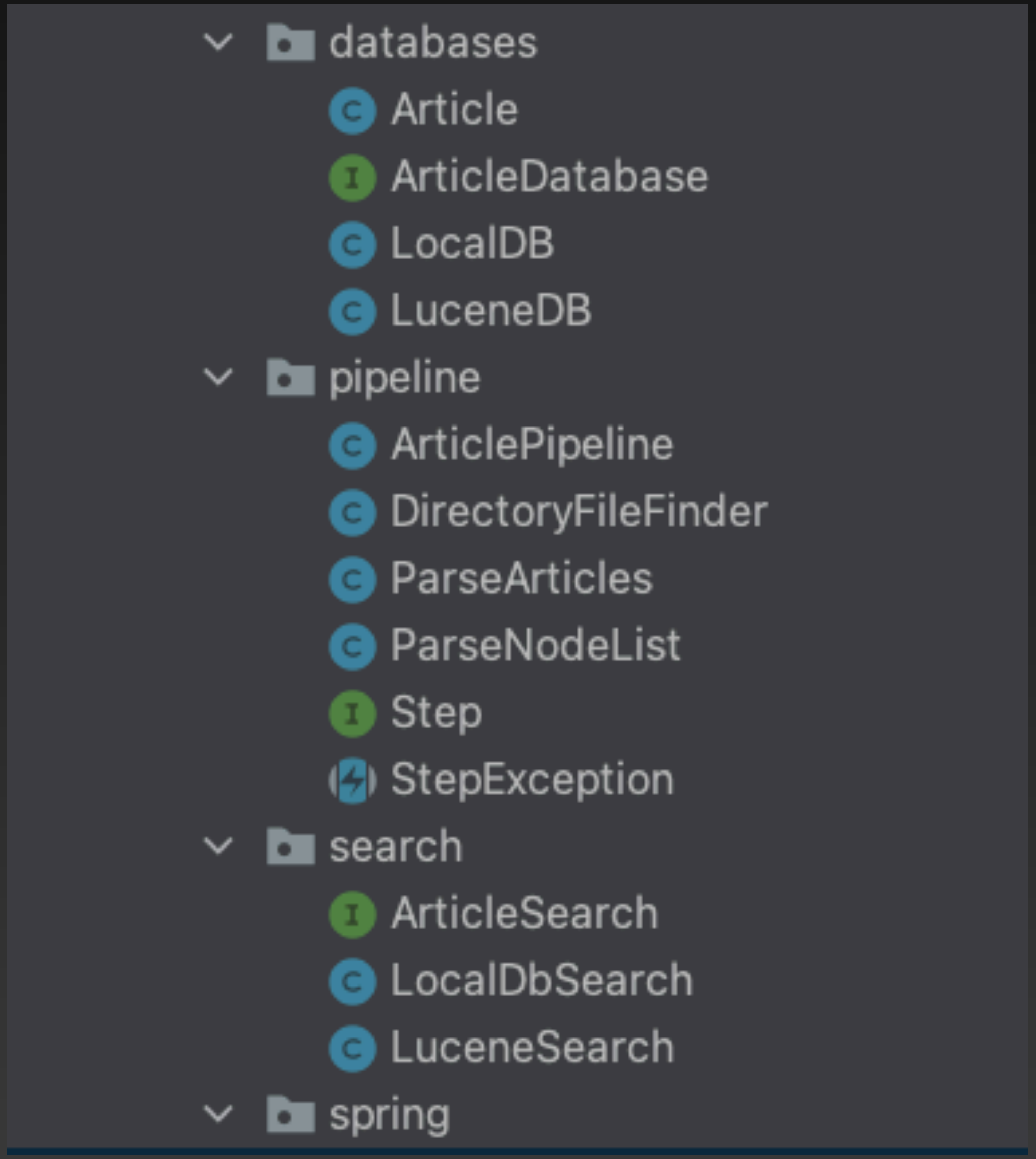
JSON Via REST API



```
{"results":[{"articleTitle":"The state of congenital heart disease.","articleYear":"2020"},
{"articleTitle":"Baseline plasma lipid levels in patients with Acute Coronary Syndrome: Association with
20-year mortality. The ABC-5a Study on Heart Disease.","articleYear":"2020"},{"articleTitle":"Genetic
variants in rheumatic fever and rheumatic heart disease.","articleYear":"2020"},{"articleTitle":"Autonomic
dysfunction in cardiac amyloidosis assessed by heart rate variability and heart rate
turbulence.","articleYear":"2020"},{"articleTitle":"From cause to care: Can a triple approach to better
population data improve the global outlook of congenital heart disease?","articleYear":"2020"},
{"articleTitle":"Effects of a restricted water intake on various clinical and laboratory outcomes in
patients with heart failure: a meta-analysis of randomized controlled trials.","articleYear":"2020"},
{"articleTitle":"Comparison of the effect of 12- and 24-week cardiac rehabilitation on physical,
psychosocial and biomedical factors in ischemic heart disease patients.","articleYear":"2020"},
{"articleTitle":"The therapeutic effect of B-type natriuretic peptides in acute decompensated heart
failure.","articleYear":"2020"},{"articleTitle":"Paradoxical Cardiorenal Responses Following Acute
Vasodilator/Natriuretic Treatment in Presystolic HeartÂ Failure: Should We Be
Surprised?","articleYear":"2019"},{"articleTitle":"Familial Mediterranean fever is associated with
increased risk for ischemic heart disease and mortality - perspective derived from a large
database.","articleYear":"2020"},{"articleTitle":"Other genomic disorders and congenital heart
disease.","articleYear":"2020"}]}
```

New

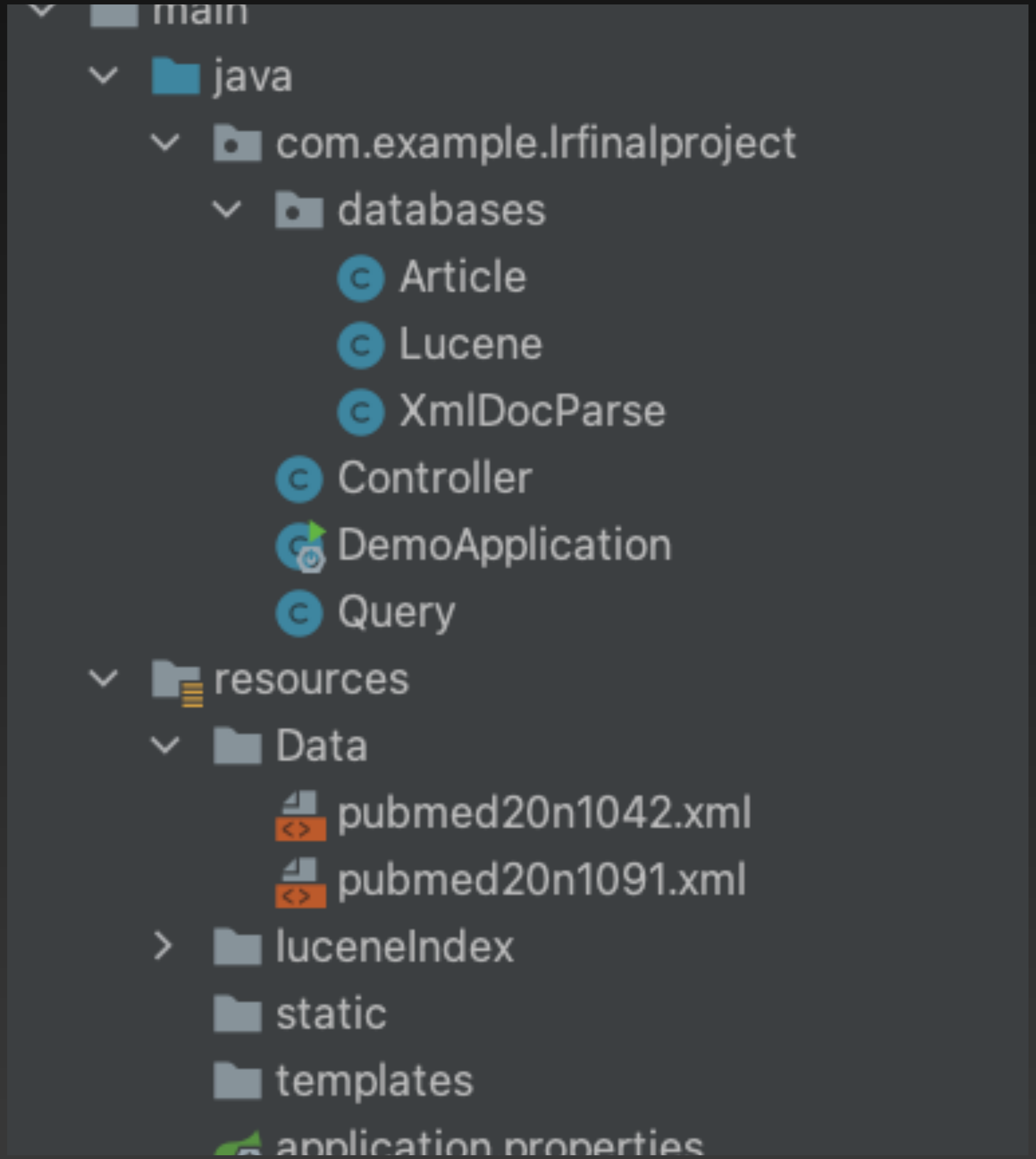
- More, but simpler and clearly defined classes
- Easy to understand how elements fit together



```
databases
    Article
    ArticleDatabase
    LocalDB
    LuceneDB
pipeline
    ArticlePipeline
    DirectoryFileFinder
    ParseArticles
    ParseNodeList
    Step
    StepException
search
    ArticleSearch
    LocalDbSearch
    LuceneSearch
spring
```

Orignal

- Fewer, more complex classes
- Hard to understand how elements fit together

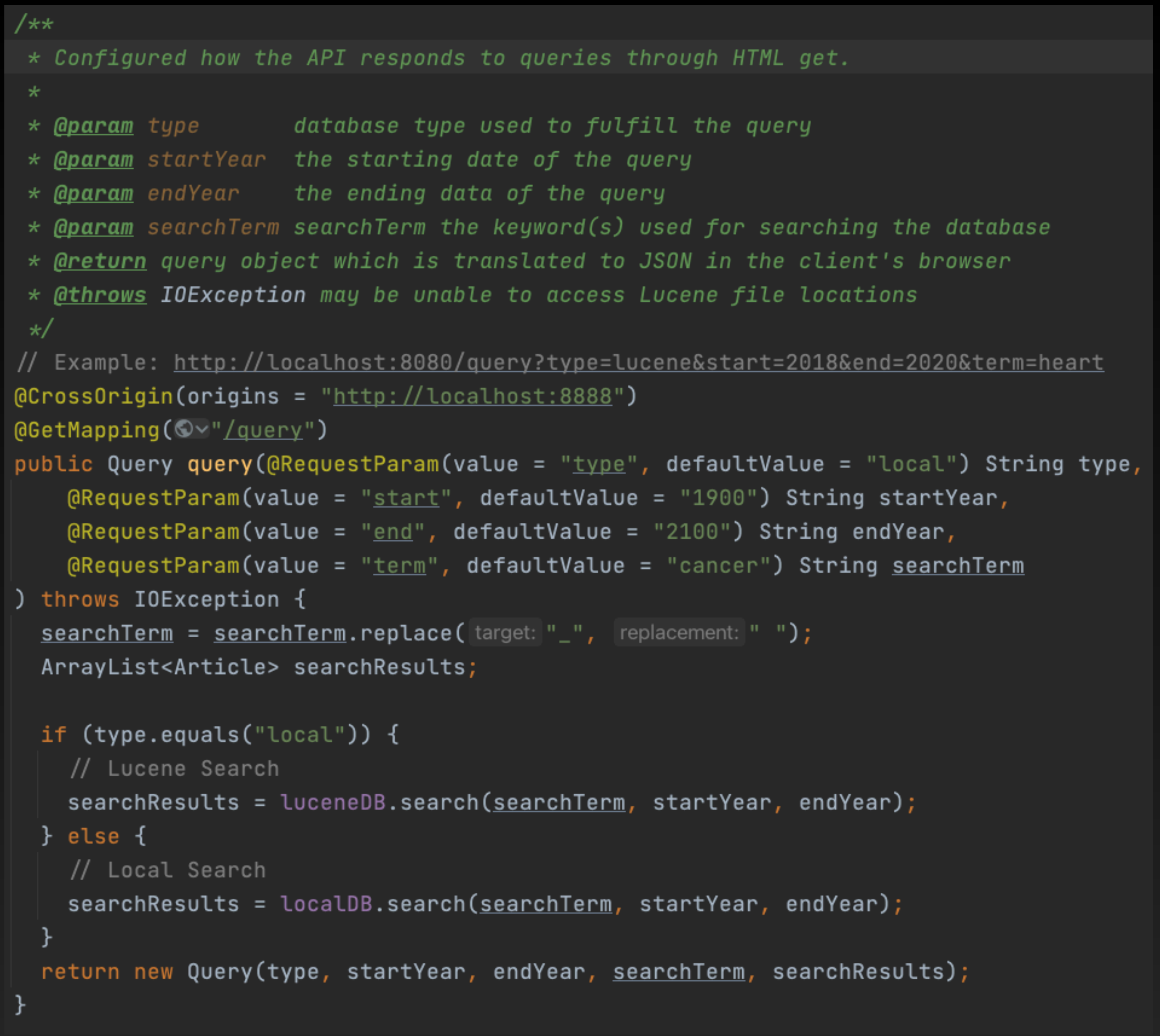


```
main
  java
    com.example.lrfinalproject
      databases
        Article
        Lucene
        XmlDocParse
      Controller
      DemoApplication
      Query
  resources
    Data
      pubmed20n1042.xml
      pubmed20n1091.xml
    luceneIndex
    static
    templates
    application properties
```

New Patterns

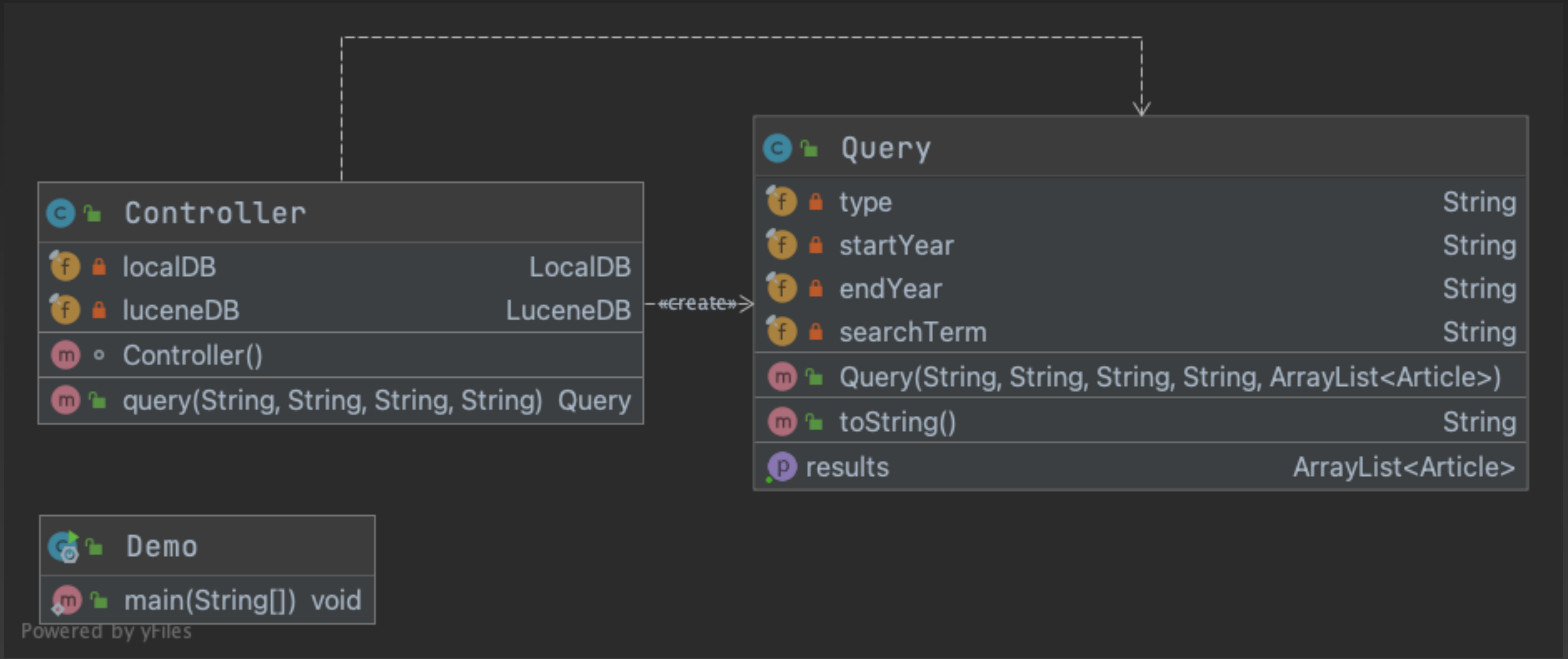
API Gateway & Microservices

- Provides overarching structure and entry point to application
- Simple endpoint for the client that manages an aggregation of microservices
- Allows microservices to change without client needing to change, too
- Utilizes Spring Boot
- **RE**presentational **S**tate **T**ransfer REST API
  - Stateless
  - Uniform
  - Client-server
  - Layered



```java
/**
 * Configured how the API responds to queries through HTML get.
 *
 * @param type       database type used to fulfill the query
 * @param startYear  the starting date of the query
 * @param endYear    the ending data of the query
 * @param searchTerm searchTerm the keyword(s) used for searching the database
 * @return query object which is translated to JSON in the client's browser
 * @throws IOException may be unable to access Lucene file locations
 */
// Example: http://localhost:8080/query?type=lucene&start=2018&end=2020&term=heart
@CrossOrigin(origins = "http://localhost:8888")
@GetMapping("/query")
public Query query(@RequestParam(value = "type", defaultValue = "local") String type,
    @RequestParam(value = "start", defaultValue = "1900") String startYear,
    @RequestParam(value = "end", defaultValue = "2100") String endYear,
    @RequestParam(value = "term", defaultValue = "cancer") String searchTerm
) throws IOException {
  searchTerm = searchTerm.replace( target: "_",  replacement: " ");
  ArrayList<Article> searchResults;

  if (type.equals("local")) {
    // Lucene Search
    searchResults = luceneDB.search(searchTerm, startYear, endYear);
  } else {
    // Local Search
    searchResults = localDB.search(searchTerm, startYear, endYear);
  }
  return new Query(type, startYear, endYear, searchTerm, searchResults);
}
```



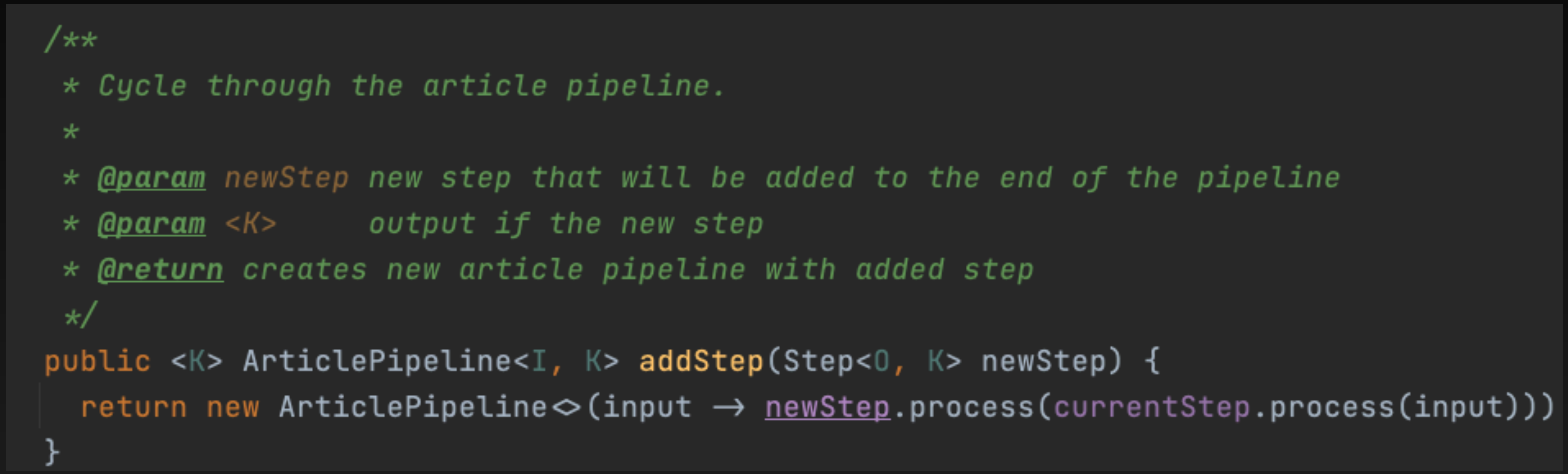
Pipeline

New Pattern

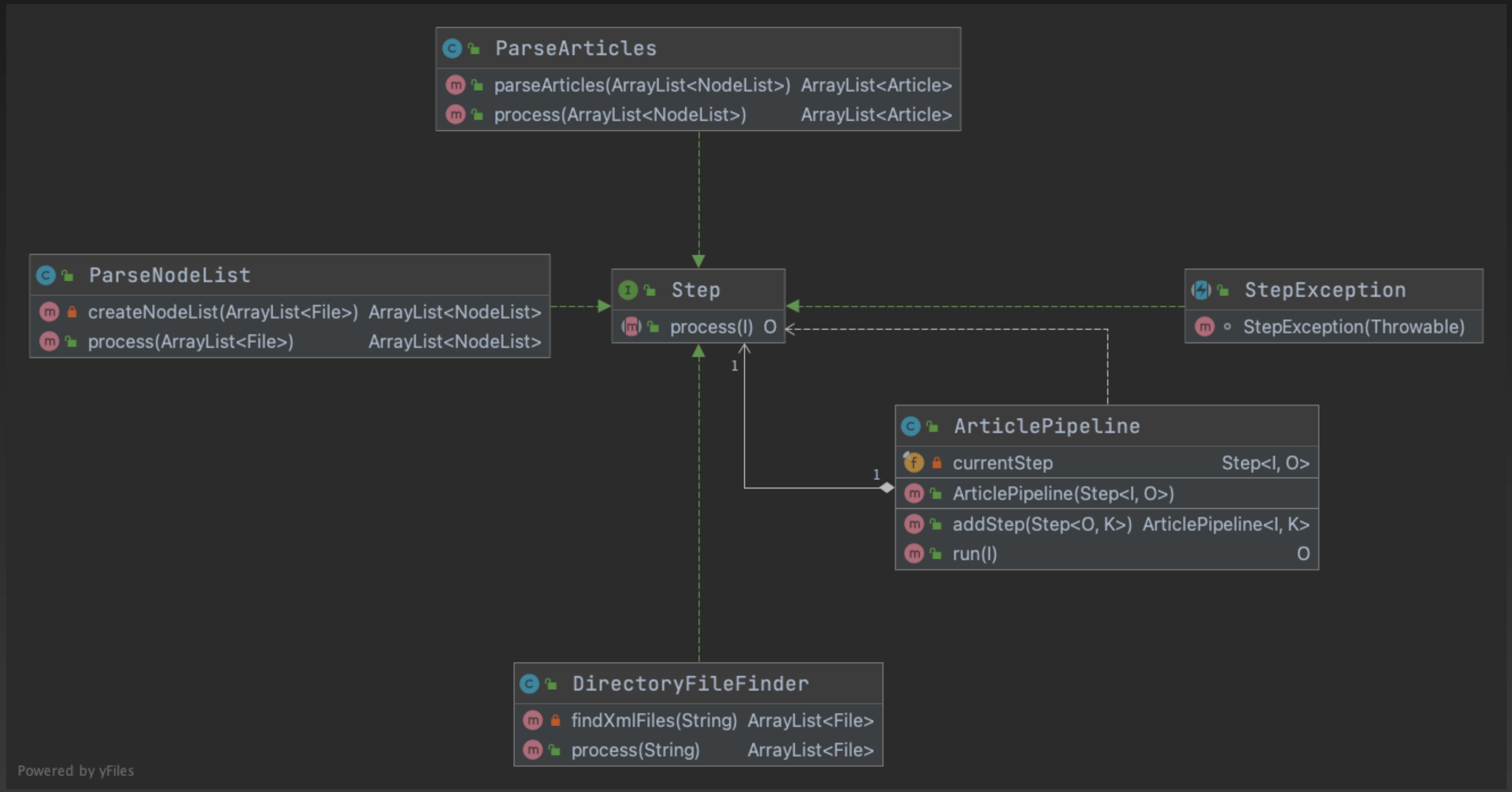
- Behavioral pattern
- Improves Modularity
- Functional Java
- Used for XML parsing data pipeline
- Enables processing of data in stages, with each step feeding directly to the next.

Benefits:

- Enhanced troubleshooting
- Readability of complex processes
- Supports the use of the Single Responsibility Principle (SRP)



```java
/**
 * Cycle through the article pipeline.
 *
 * @param newStep new step that will be added to the end of the pipeline
 * @param <K>     output if the new step
 * @return creates new article pipeline with added step
 */
public <K> ArticlePipeline<I, K> addStep(Step<O, K> newStep) {
  return new ArticlePipeline<>(input → newStep.process(currentStep.process(input)));
}
```



ParseArticles
parseArticles(ArrayList<NodeList>) ArrayList<Article>
process(ArrayList<NodeList>) ArrayList<Article>
ParseNodeList
createNodeList(ArrayList<File>) ArrayList<NodeList>
process(ArrayList<File>) ArrayList<NodeList>
Step
process(I) O
StepException
StepException(Throwable)
1
1
ArticlePipeline
currentStep Step<I, O>
ArticlePipeline(Step<I, O>)
addStep(Step<O, K>) ArticlePipeline<I, K>
run(I) O
DirectoryFileFinder
findXmlFiles(String) ArrayList<File>
process(String) ArrayList<File>
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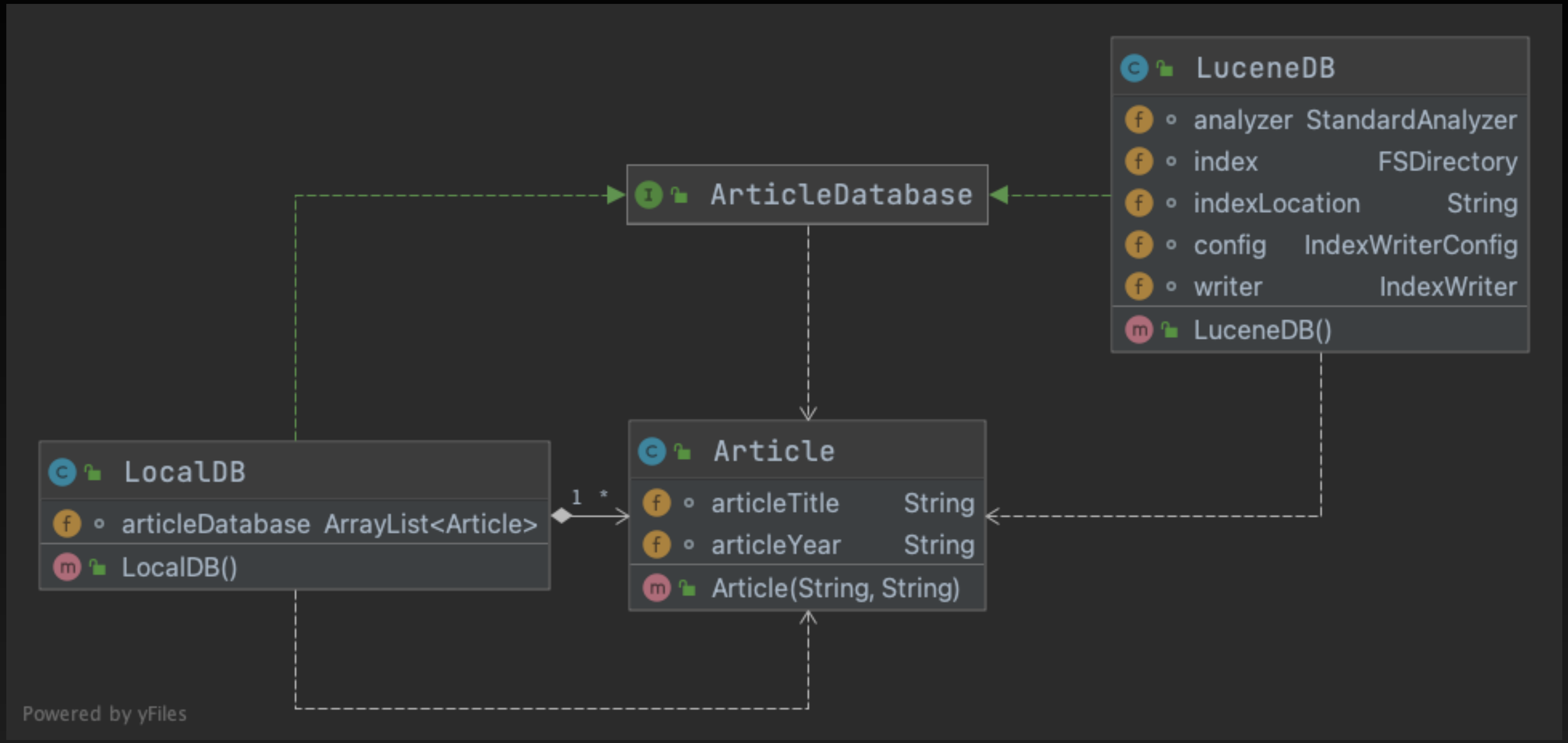
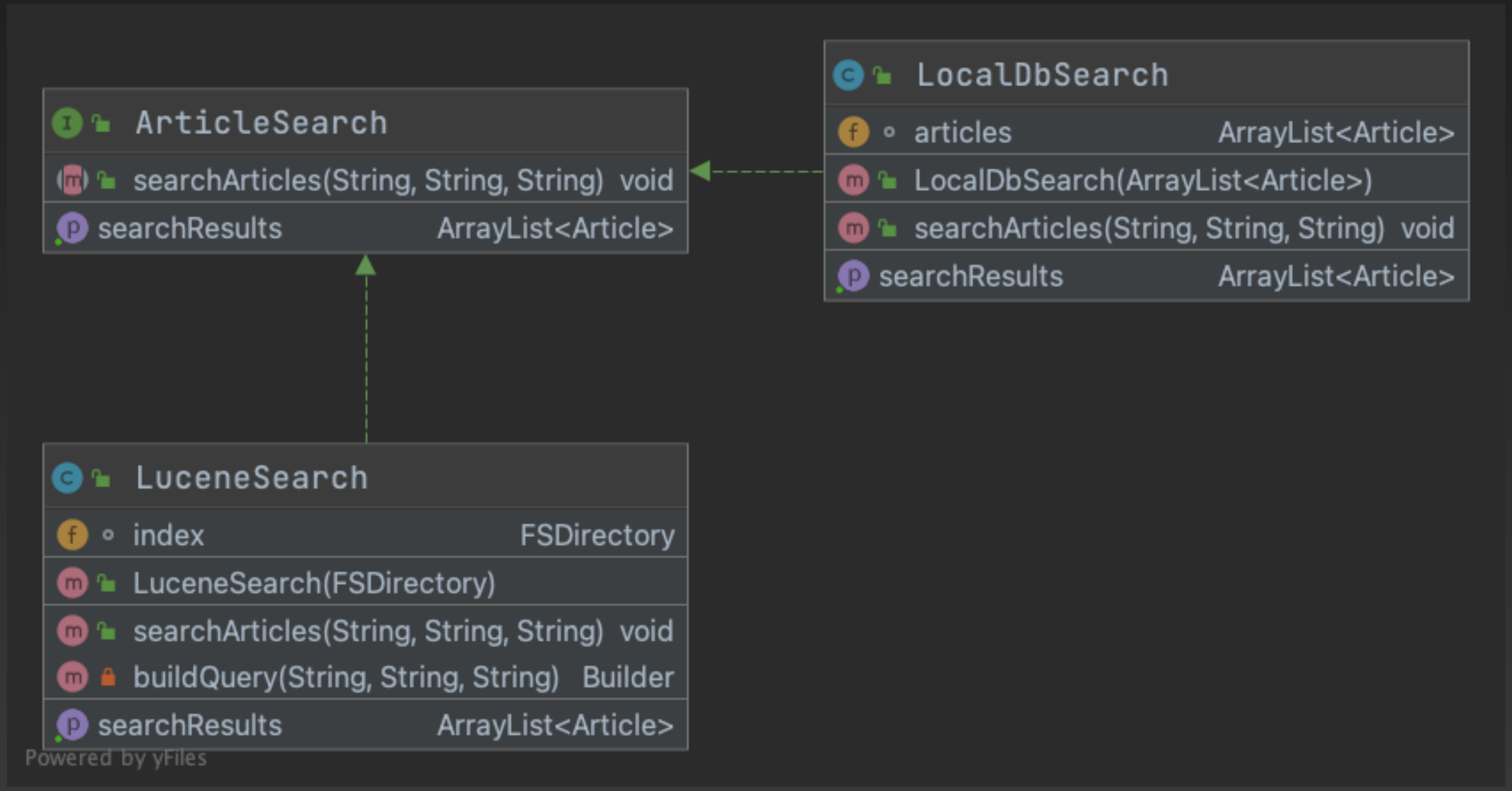
Other Patterns

Strategy + Facade

- The strategy pattern is used for different searching behaviors
- Database provides the context for the search strategy
- The database classes act as a facade for additional search complexity
- Where search items and indexes are passed to the search methods, which also utilize the Strategy pattern





ArticleSearch
searchArticles(String, String, String) void
searchResults ArrayList<Article>
LocalDbSearch
articles ArrayList<Article>
LocalDbSearch(ArrayList<Article>)
searchArticles(String, String, String) void
searchResults ArrayList<Article>
LuceneSearch
index FSDirectory
LuceneSearch(FSDirectory)
searchArticles(String, String, String) void
buildQuery(String, String, String) Builder
searchResults ArrayList<Article>
Powered by yFiles

Demo