

The AutoRouter library allows the automatic creation of HTTP handlers for a `pt.isel.autorouter.JsonServer` based on a router object with specific annotations, according to the next [example of ClassroomRouter](#).

All methods annotated with `@ArMethod`, `@ArPath` and returning an `Optional` are eligible for HTTP handlers. To avoid ambiguity with existing types of JDK we choose to prefix annotations with `Ar`.

For simplicity, `JsonServer` is only responding with status codes of 200, 404, and 500, depending on whether the handler returns a fulfilled `Optional`, an empty `Optional` or an exception. (you may consider the use of an alternative `Either`, or other type to enhance responses)

The Java function `Stream<ArHttpRequest> autorouterReflect(Object router)`, builds a stream of `ArHttpRequest` objects for each eligible method in given router object parameter.

The next figure shows the resulting stream of `ArHttpRequest` objects for the example of a [ClassroomRouter instance](#). The `autorouterReflect` can be used in Kotlin through a statement such as: `ClassroomRouter().autorouterReflect().jsonServer().start(4000)`

ClassroomRouter example

```
class ClassroomRouter {
    /**
     * Example: http://localhost:4000/classroom/i42d?student=jo
     */
    @ArMethod(GET)
    @ArPath("/classroom/{classroom}")
    fun search(@ArRoute classroom: String, @ArQuery student: String?): Optional<List<Student>> {
        ...
    }
    /**
     * Example:
     * curl --header "Content-Type: application/json" \
     *      --request PUT \
     *      --data '{"name":"Ze Gato","group":"11", "semester":"3"}' \
     *      http://localhost:4000/classroom/i42d/students/7777
     */
    @ArMethod(PUT)
    @ArPath("/classroom/{classroom}/students/{nr}")
    fun addStudent(
        @ArRoute classroom: String,
        @ArRoute nr: Int,
        @ArBody name: String,
        @ArBody group: Int,
        @ArBody semester: Int
    ): Optional<Student> {
        ...
    }
    /**
     * Example:
     * curl --request DELETE http://localhost:4000/classroom/i42d/students/4536
     */
    @ArMethod(DELETE)
    @ArPath("/classroom/{classroom}/students/{nr}")
    fun removeStudent(@ArRoute classroom: String, @ArRoute nr: Int) : Optional<Student> {
        ...
    }
}
```

```
}  
}
```

We follow a different approach `autorouterDynamic` to invoke the functions of a router object. Instead of using `Reflection` we will generate different implementations of `ArHandler` for each function in router object, as denoted in the next figure. Notice, these implementations (e.g. `ArHandlerSearch`, `ArHandlerAddStudent`, `ArHandlerRemoveStudent`) do not use reflection to call the methods of `ClassroomRouter`.

Usage

To run these benchmarks on you local machine just run:

`./gradlew jmhJar`
And then:

`java -jar autorouter-bench/build/libs/autorouter-bench-jmh.jar -i 4 -wi 4 -f 1 -r 2 -w 2`

- `-i 4` iterations
- `-wi 4` warmup iterations
- `-f 1` fork
- `-r 2` run each iteration for 2 seconds
- `-w 2` run each warmup iteration for 2 seconds.

Results on 2023-02-20

Apple M1 Pro with OpenJDK Runtime Environment Corretto-17.0.5.8.1

Benchmark	(approach)	(domain)	Mode	Cnt	Score	Error	Units
addStudent	reflect	empty	thrpt	4	3773.368 ±	264.859	ops/ms
addStudent	reflect	classroom	thrpt	4	3790.482 ±	313.750	ops/ms
addStudent	dynamic	empty	thrpt	4	9025.689 ±	714.827	ops/ms
addStudent	dynamic	classroom	thrpt	4	4853.550 ±	582.861	ops/ms
addStudent	baseline	empty	thrpt	4	10762.076 ±	1305.249	ops/ms
addStudent	baseline	classroom	thrpt	4	5335.725 ±	2142.943	ops/ms
removeStudent	reflect	empty	thrpt	4	13438.279 ±	279.203	ops/ms
removeStudent	reflect	classroom	thrpt	4	10272.376 ±	244.500	ops/ms
removeStudent	dynamic	empty	thrpt	4	32286.002 ±	879.368	ops/ms
removeStudent	dynamic	classroom	thrpt	4	26031.841 ±	191.146	ops/ms
removeStudent	baseline	empty	thrpt	4	33042.347 ±	84.395	ops/ms
removeStudent	baseline	classroom	thrpt	4	25804.282 ±	220.817	ops/ms
search	reflect	empty	thrpt	4	20238.233 ±	125.485	ops/ms
search	reflect	classroom	thrpt	4	20223.444 ±	131.934	ops/ms
search	dynamic	empty	thrpt	4	95606.066 ±	971.023	ops/ms
search	dynamic	classroom	thrpt	4	95367.123 ±	1937.836	ops/ms
search	baseline	empty	thrpt	4	95250.903 ±	2881.199	ops/ms
search	baseline	classroom	thrpt	4	95665.850 ±	1400.391	ops/ms