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3rd Year Software Engineering

TD06 TP12

SOA University Project

SOA & Web Services (REST & SOAP) Architecture

ORBIT

Project Context

University information systems are complex and distributed.

Need for scalable and interoperable services.

Service-Oriented Architecture (SOA) is an effective solution.

Main Goal

Design and implement a complete SOA-based university system.

Project Objectives

Design a Service-Oriented Architecture.

Develop RESTful and SOAP web services.

Ensure interoperability between heterogeneous technologies.

Secure services using JWT.

Deploy services using Docker.

Why SOA Architecture?

Loose coupling between services.

Technology independence.

High scalability and flexibility.

Reusability of services.

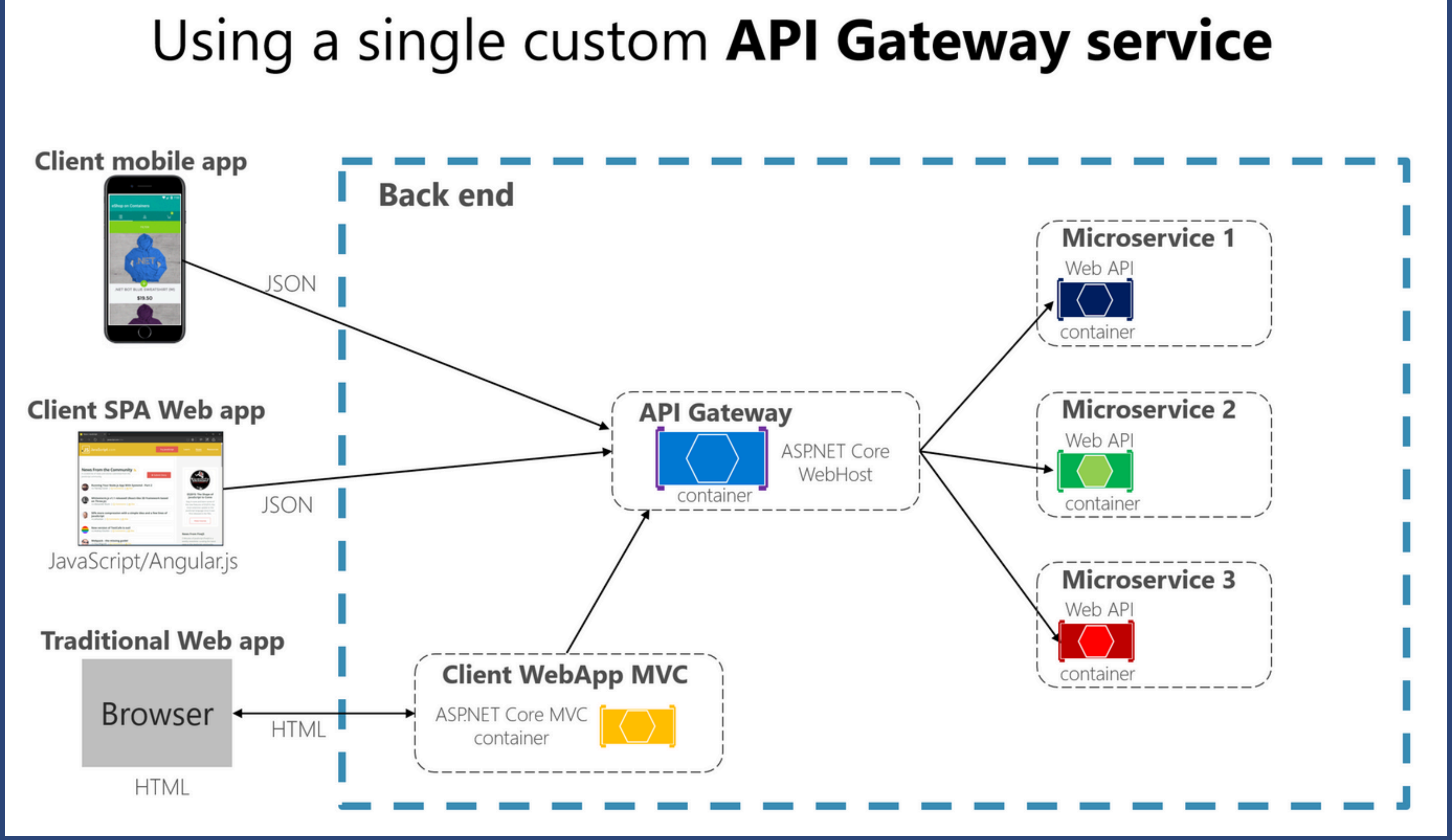
Easy maintenance and evolution.

Global System Architecture

The system is composed of independent business services.

An API Gateway acts as a single entry point.

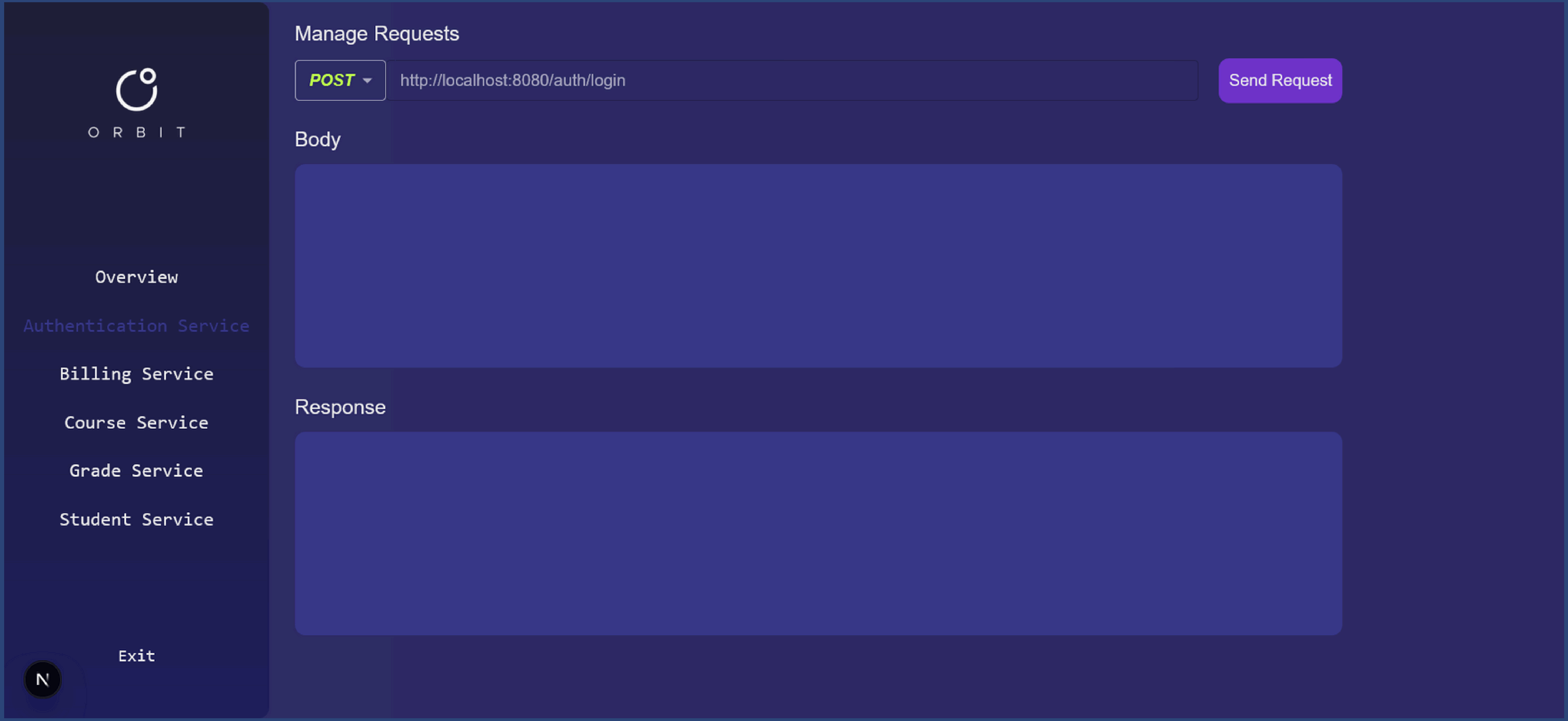
Services communicate via HTTP.



Authentication Service

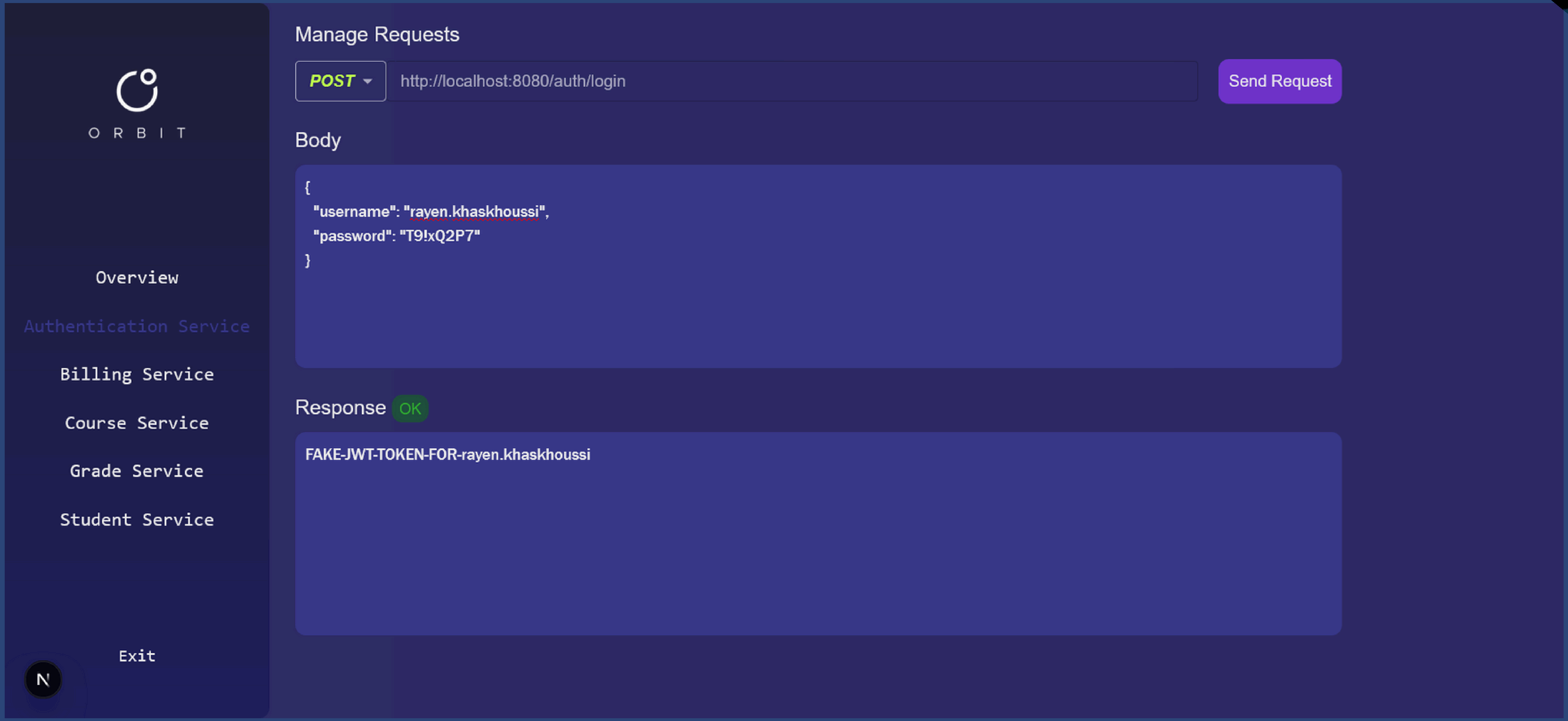
The Authentication Service is a core component of the system, responsible for managing user access and ensuring secure communication between services. It authenticates users based on their credentials and generates JSON Web Tokens (JWT) used to authorize requests across the platform. By centralizing authentication, this service enhances security, reduces duplication, and enables a scalable and loosely coupled architecture.

Overview of the Authentication Service



http://localhost:8080/auth/login

POST request executed successfully with valid JSON data

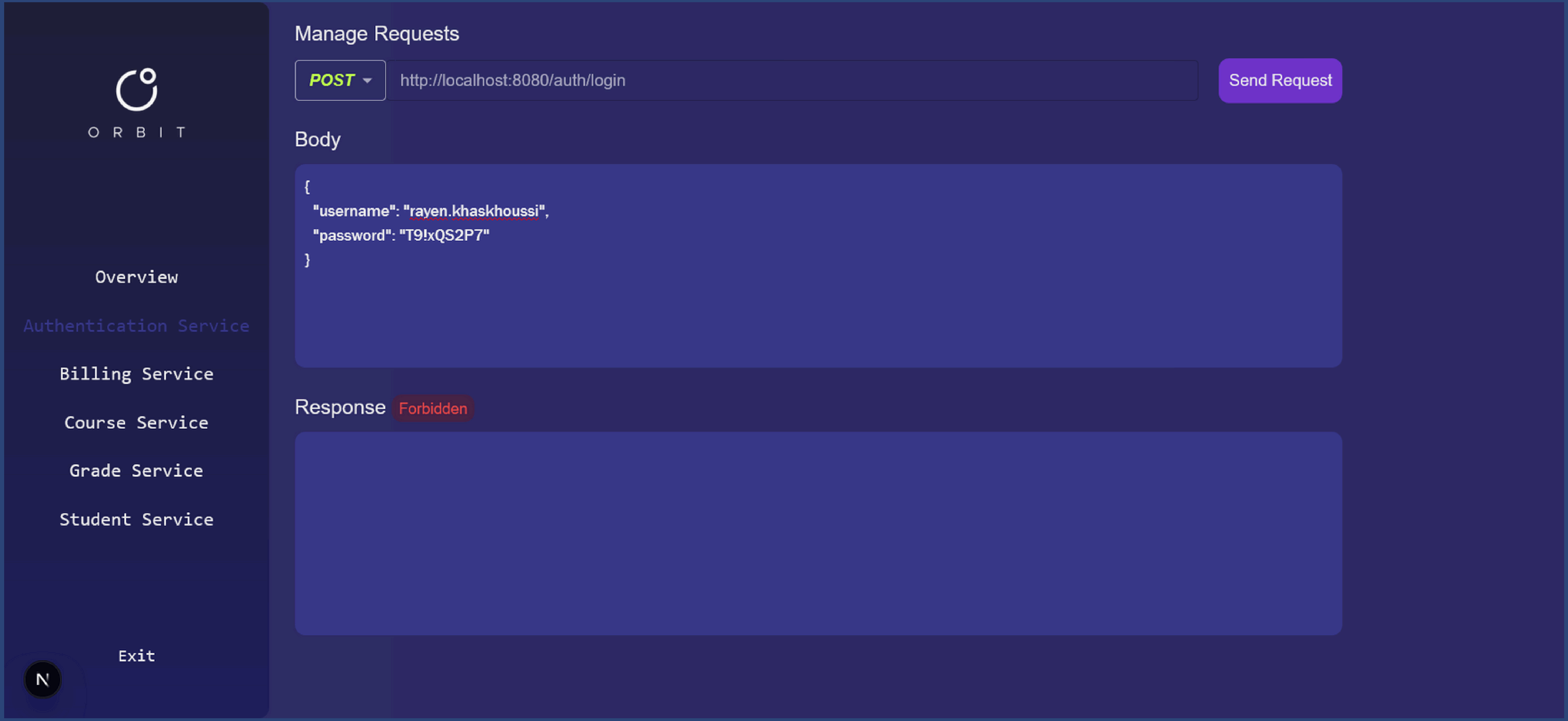


http://localhost:8080/auth/login

```
{
  "username": "rayen.khaskhoussi",
  "password": "T9!xQ2P7"
}
```

```
FAKE-JWT-TOKEN-FOR-rayen.khaskhoussi
```

POST request with an invalid JSON payload



Manage Requests

POST http://localhost:8080/auth/login

Body

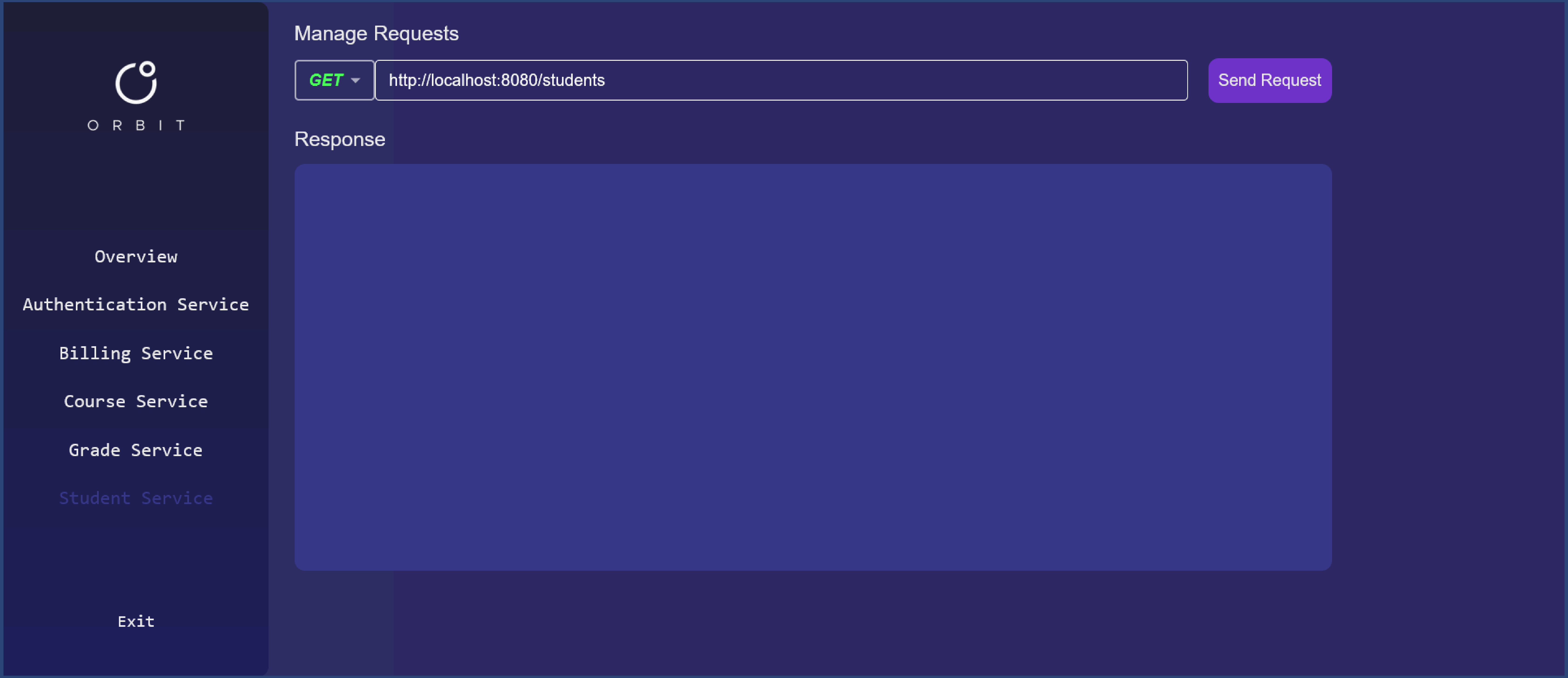
```
{
  "username": "rayen.khaskhoussi",
  "password": "T9!xQS2P7"
}
```

Response Forbidden

Student Service

The Student Service is responsible for managing student-related data within the system. It provides RESTful endpoints to perform Create, Read, Update, and Delete (CRUD) operations on student records. This service ensures efficient handling of student information and enables seamless integration with other services through standardized HTTP communication.

Student Service Interface

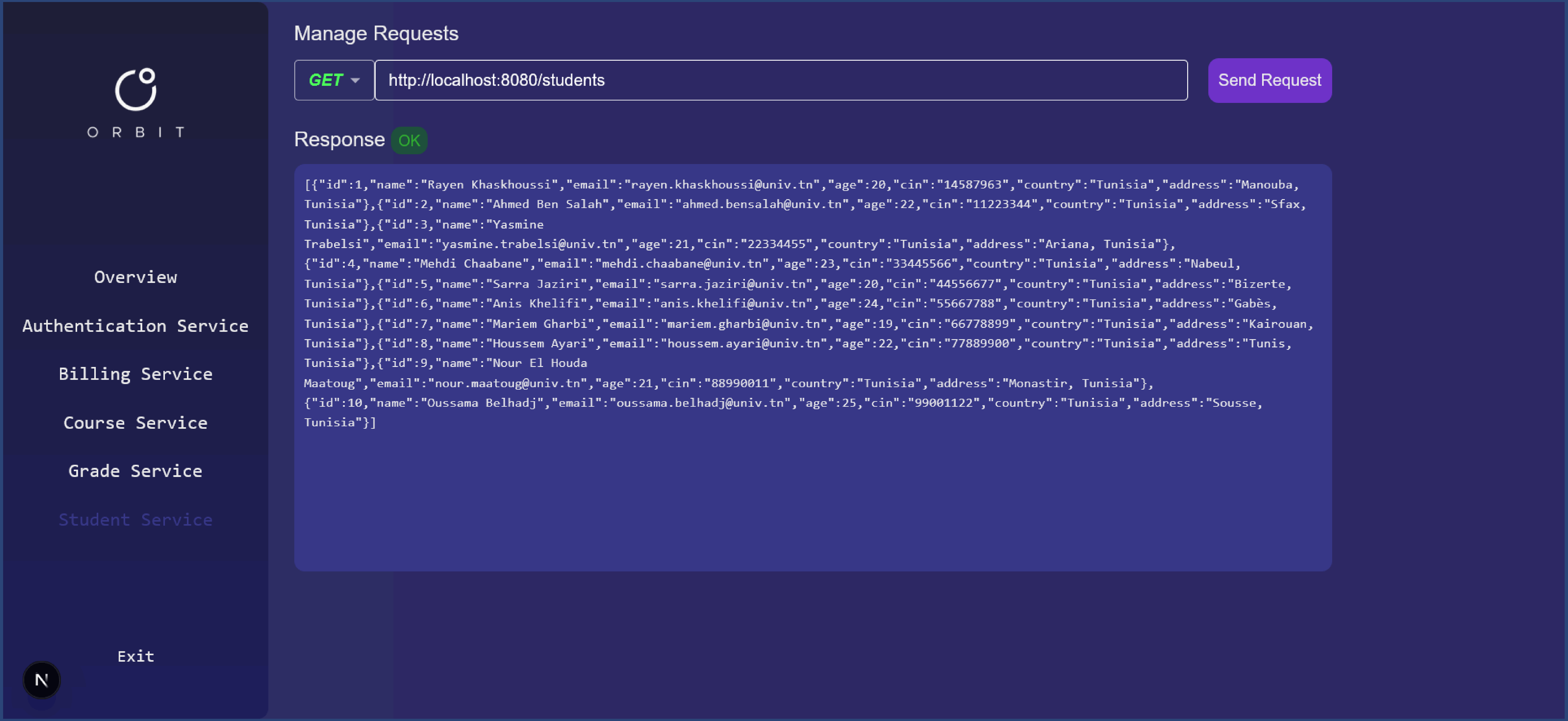


Manage Requests

GET http://localhost:8080/students

Response

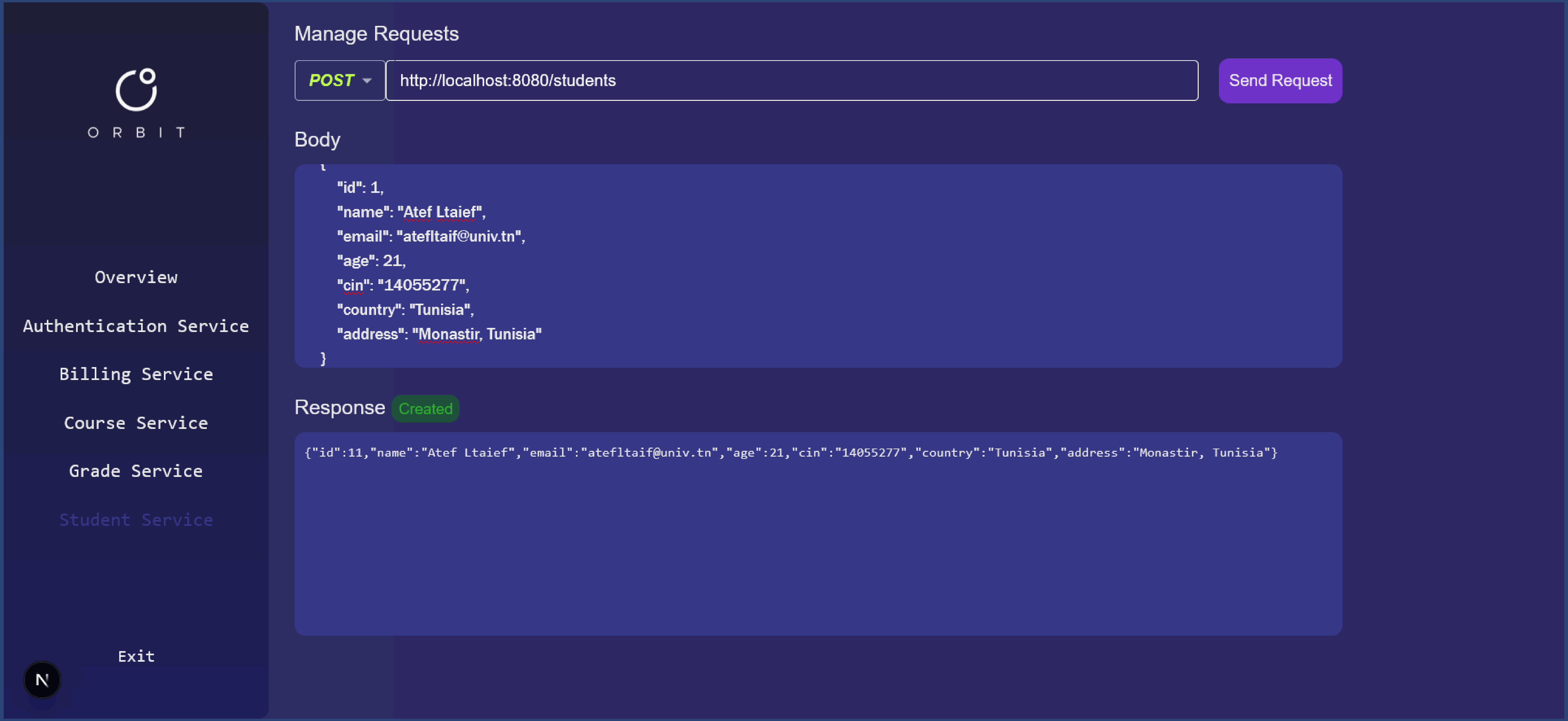
Retreiving all Students



http://localhost:8080/students

```
[{"id":1,"name":"Rayen Khaskhoussi","email":"rayen.khaskhoussi@univ.tn","age":20,"cin":"14587963","country":"Tunisia","address":"Manouba,
Tunisia"},{"id":2,"name":"Ahmed Ben Salah","email":"ahmed.bensalah@univ.tn","age":22,"cin":"11223344","country":"Tunisia","address":"Sfax,
Tunisia"},{"id":3,"name":"Yasmine
Trabelsi","email":"yasmine.trabelsi@univ.tn","age":21,"cin":"22334455","country":"Tunisia","address":"Ariana, Tunisia"},
{"id":4,"name":"Mehdi Chaabane","email":"mehdi.chaabane@univ.tn","age":23,"cin":"33445566","country":"Tunisia","address":"Nabeul,
Tunisia"},{"id":5,"name":"Sarra Jaziri","email":"sarra.jaziri@univ.tn","age":20,"cin":"44556677","country":"Tunisia","address":"Bizerte,
Tunisia"},{"id":6,"name":"Anis Khelifi","email":"anis.khelifi@univ.tn","age":24,"cin":"55667788","country":"Tunisia","address":"Gabès,
Tunisia"},{"id":7,"name":"Mariem Gharbi","email":"mariem.gharbi@univ.tn","age":19,"cin":"66778899","country":"Tunisia","address":"Kairouan,
Tunisia"},{"id":8,"name":"Houssem Ayari","email":"houssem.ayari@univ.tn","age":22,"cin":"77889900","country":"Tunisia","address":"Tunis,
Tunisia"},{"id":9,"name":"Nour El Houda
Maatoug","email":"nour.maatoug@univ.tn","age":21,"cin":"88990011","country":"Tunisia","address":"Monastir, Tunisia"},
{"id":10,"name":"Oussama Belhadj","email":"oussama.belhadj@univ.tn","age":25,"cin":"99001122","country":"Tunisia","address":"Sousse,
Tunisia"}]
```

Adding new Students



http://localhost:8080/students

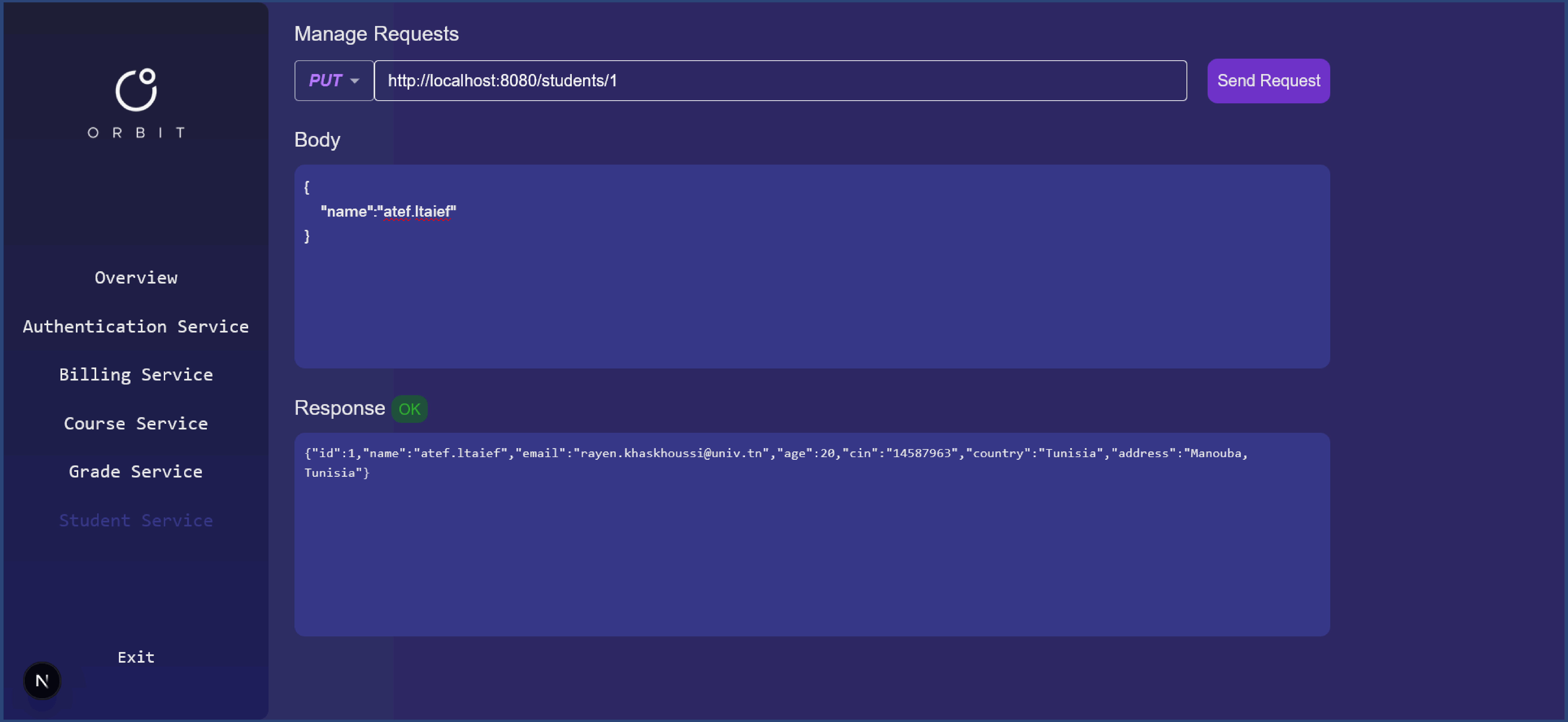
Body

```
{
    "id": 1,
    "name": "Atef Ltaief",
    "email": "atefltaif@univ.tn",
    "age": 21,
    "cin": "14055277",
    "country": "Tunisia",
    "address": "Monastir, Tunisia"
}
```

Response Created

```
{"id":11,"name":"Atef Ltaief","email":"atefltaif@univ.tn","age":21,"cin":"14055277","country":"Tunisia","address":"Monastir, Tunisia"}
```

Updating Student information



Manage Requests

PUT http://localhost:8080/students/1 Send Request

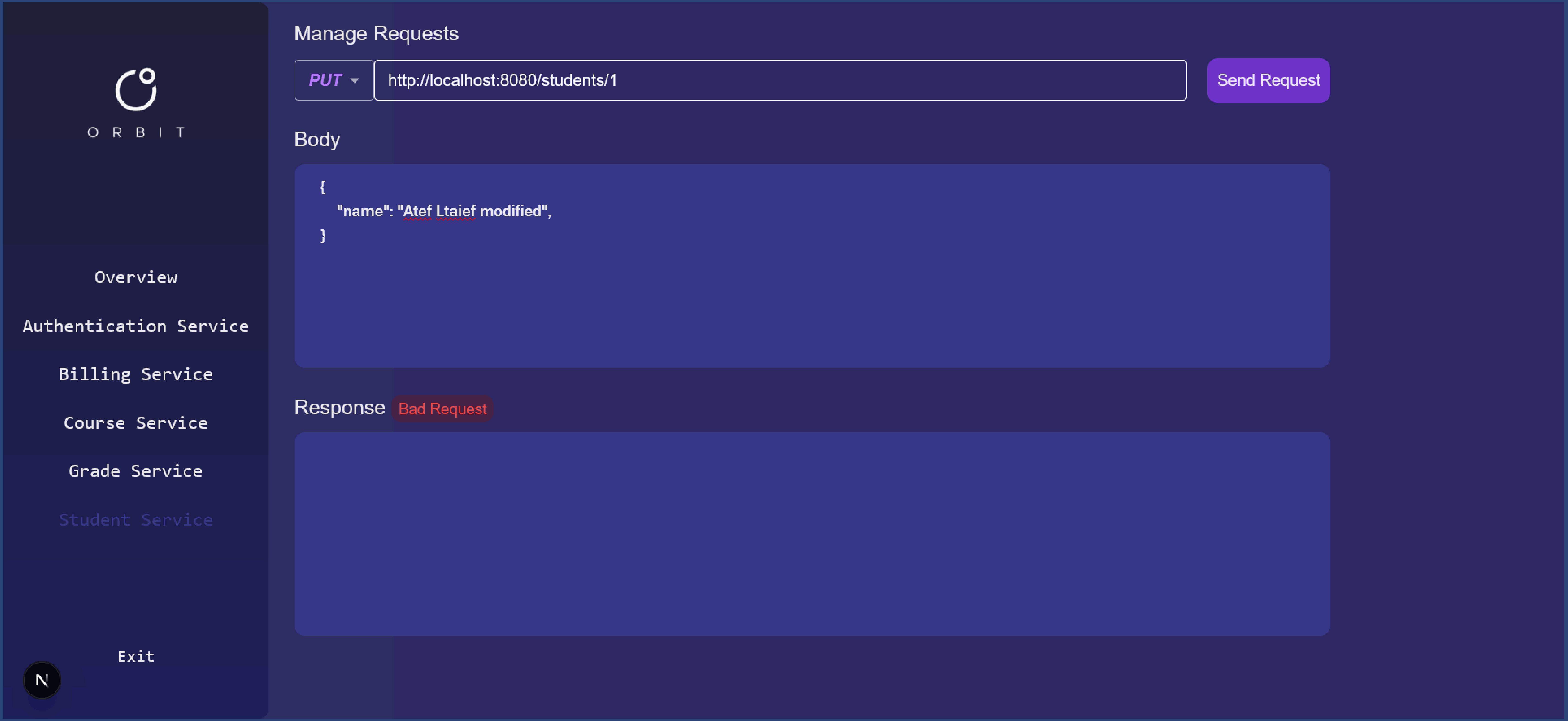
Body

```
{
  "name":"atef.ltaief"
}
```

Response OK

```
{"id":1,"name":"atef.ltaief","email":"rayen.khaskhoussi@univ.tn","age":20,"cin":"14587963","country":"Tunisia","address":"Manouba,
Tunisia"}
```

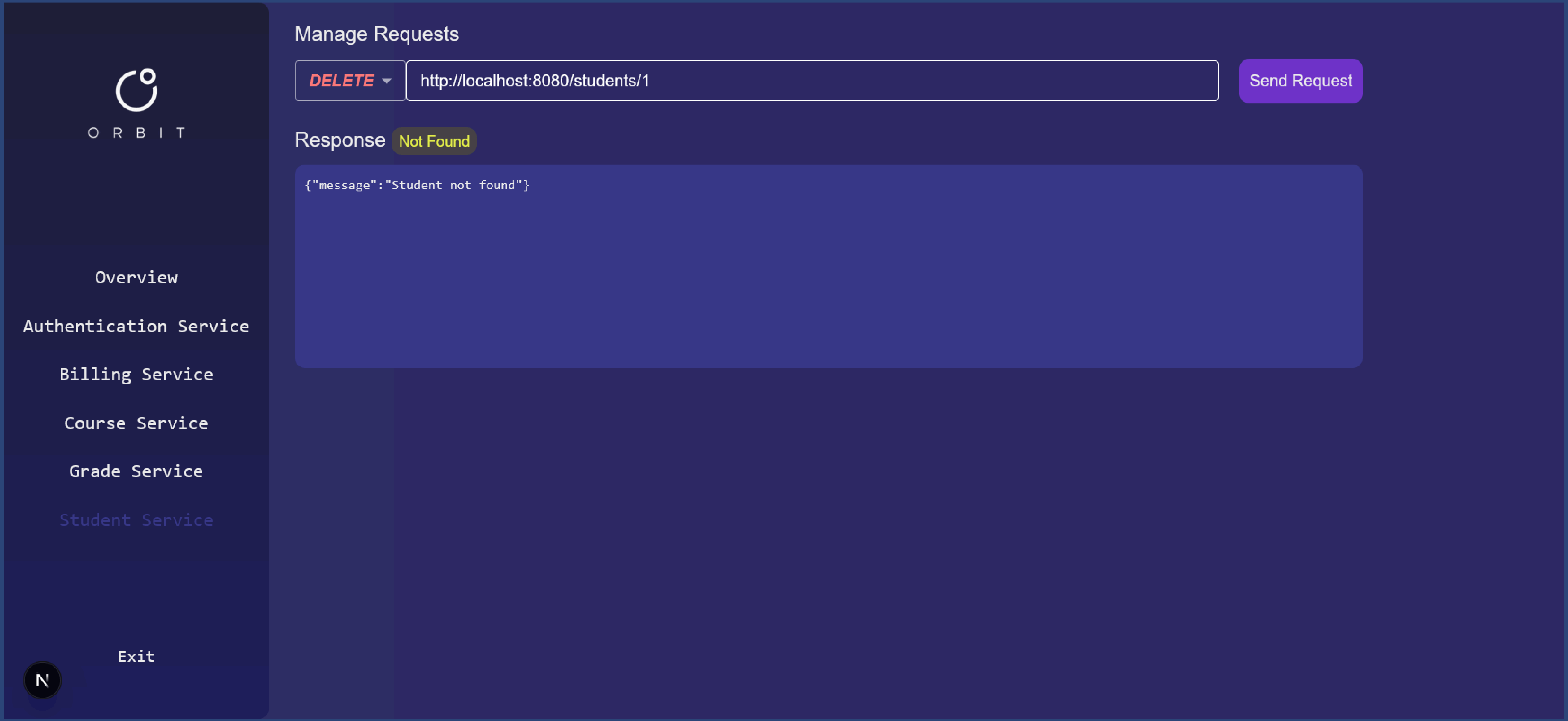
Updating Student information (case student does not exist)



http://localhost:8080/students/1

```
{
  "name": "Atef Ltaief modified",
}
```

Deleting Student (case not found)



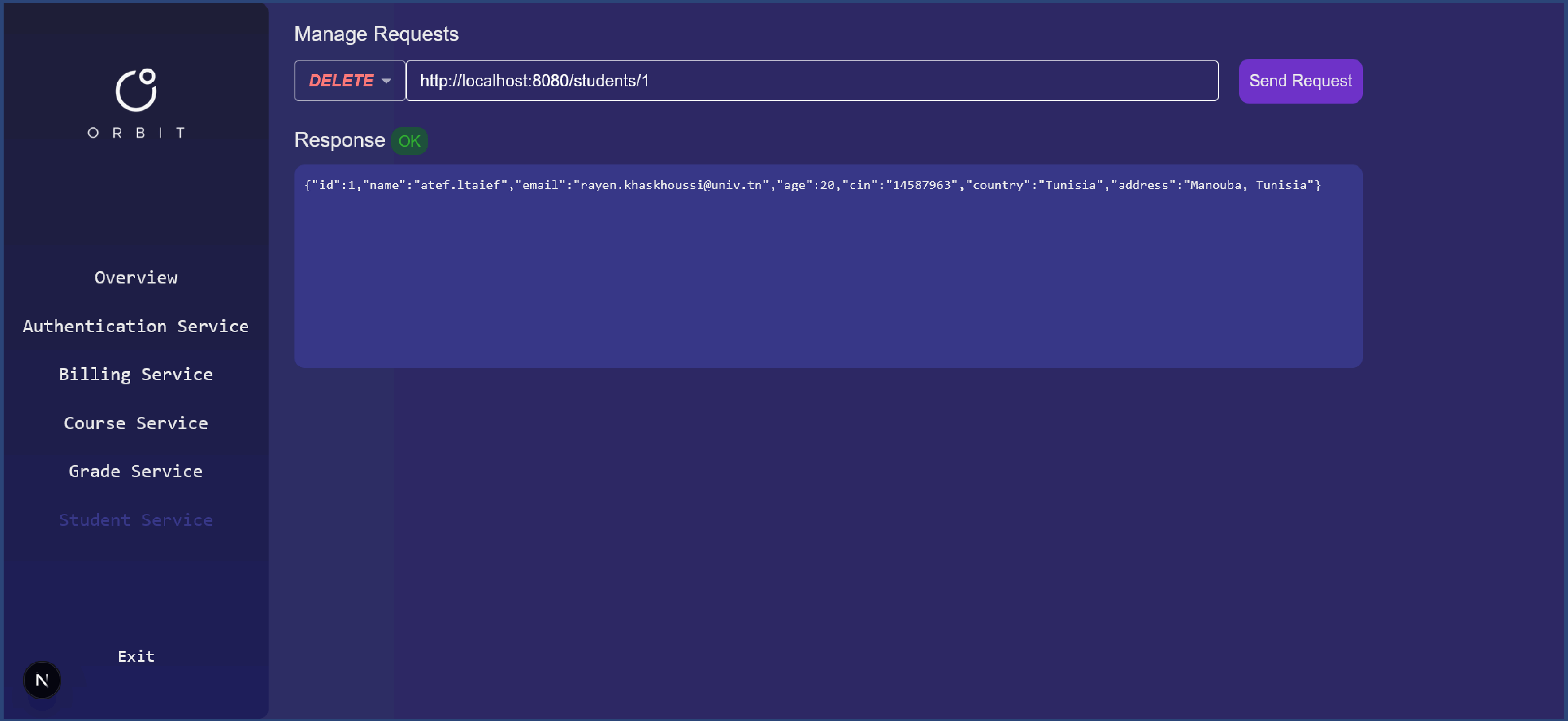
Manage Requests

DELETE http://localhost:8080/students/1

Response Not Found

```
{"message":"Student not found"}
```

Deleting Student (case not found)



Manage Requests

DELETE http://localhost:8080/students/1

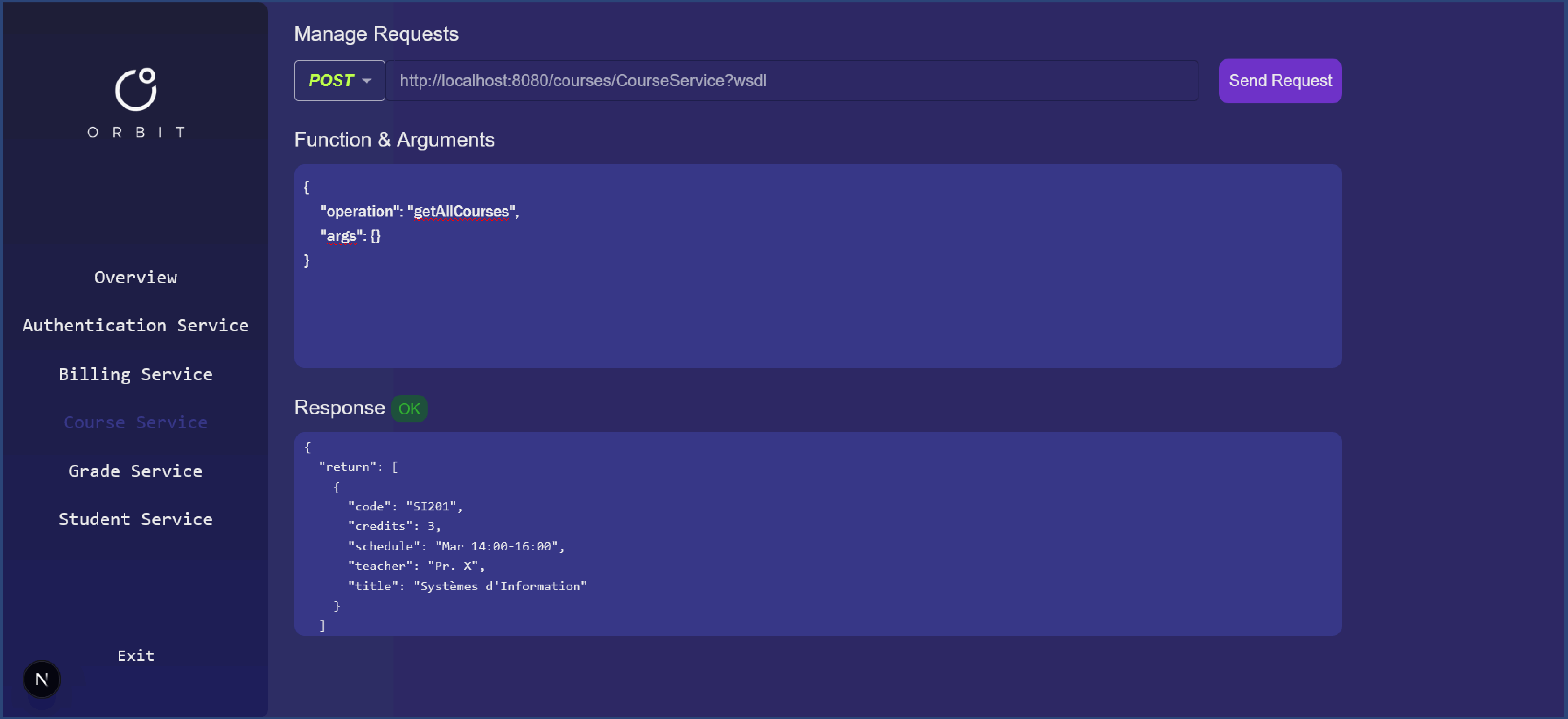
Response OK

```
{"id":1,"name":"atef.ltaief","email":"rayen.khaskhoussi@univ.tn","age":20,"cin":"14587963","country":"Tunisia","address":"Manouba, Tunisia"}
```

Course Service

The Course Service is responsible for managing academic courses and schedules within the university system. Implemented as a SOAP-based service, it provides well-defined operations through a WSDL contract, ensuring reliable and standardized communication. This service enables structured data exchange and interoperability with other system components.

Retreiving All Courses

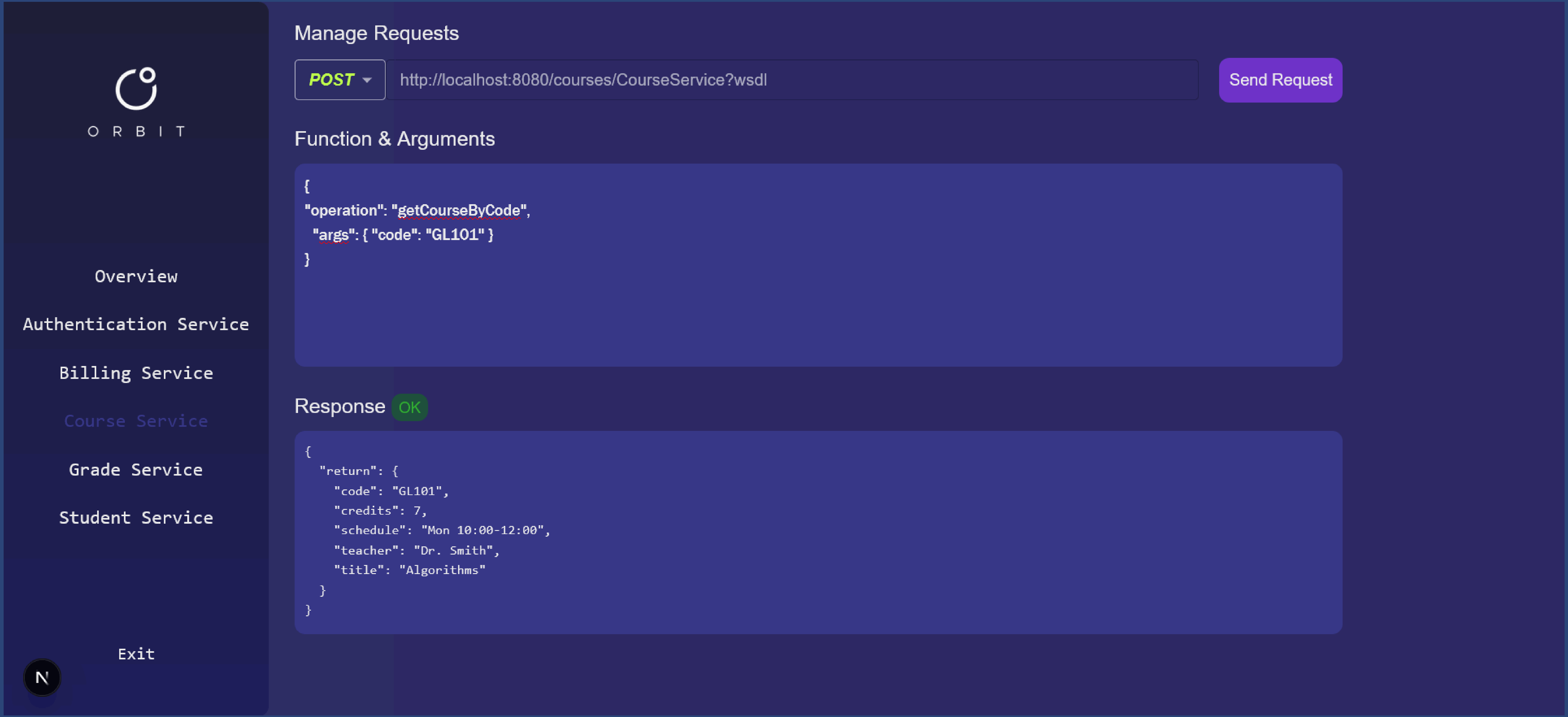


http://localhost:8080/courses/CourseService?wsdl

```
{
   "operation": "getAllCourses",
   "args": {}
}
```

```
{
  "return": [
    {
      "code": "SI201",
      "credits": 3,
      "schedule": "Mar 14:00-16:00",
      "teacher": "Pr. X",
      "title": "Systèmes d'Information"
    }
  ]
```

Retreiving All Courses



Manage Requests

http://localhost:8080/courses/CourseService?wsdl

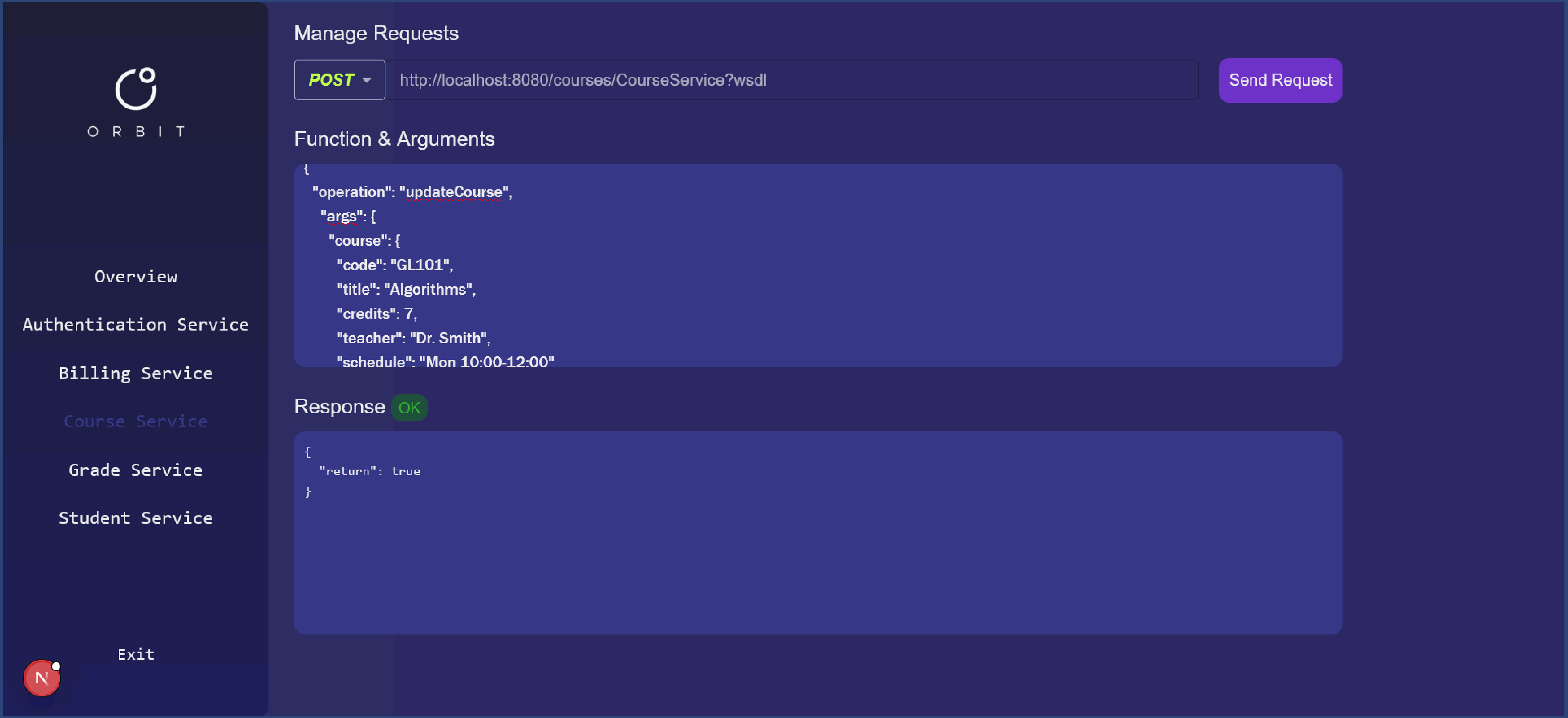
Function & Arguments

```
{
"operation": "getCourseByCode",
  "args": { "code": "GL101" }
}
```

Response OK

```
{
  "return": {
    "code": "GL101",
    "credits": 7,
    "schedule": "Mon 10:00-12:00",
    "teacher": "Dr. Smith",
    "title": "Algorithms"
  }
}
```

Update Specific Course by code



Manage Requests

POST http://localhost:8080/courses/CourseService?wsdl

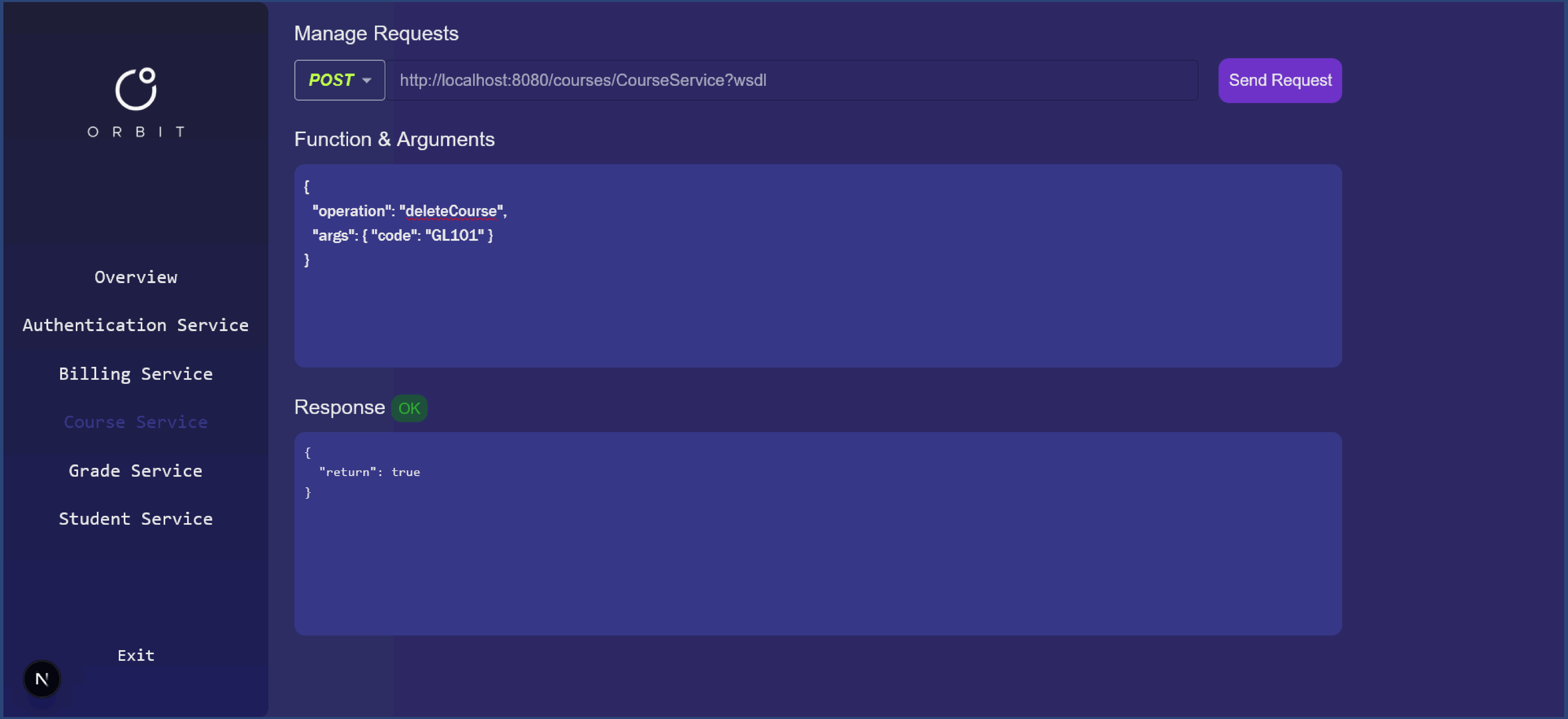
Function & Arguments

```
{
 "operation": "updateCourse",
  "args": {
   "course": {
    "code": "GL101",
    "title": "Algorithms",
    "credits": 7,
    "teacher": "Dr. Smith",
    "schedule": "Mon 10:00-12:00"
```

Response OK

```
{
  "return": true
}
```

Delete Course by code



Manage Requests

POST http://localhost:8080/courses/CourseService?wsdl

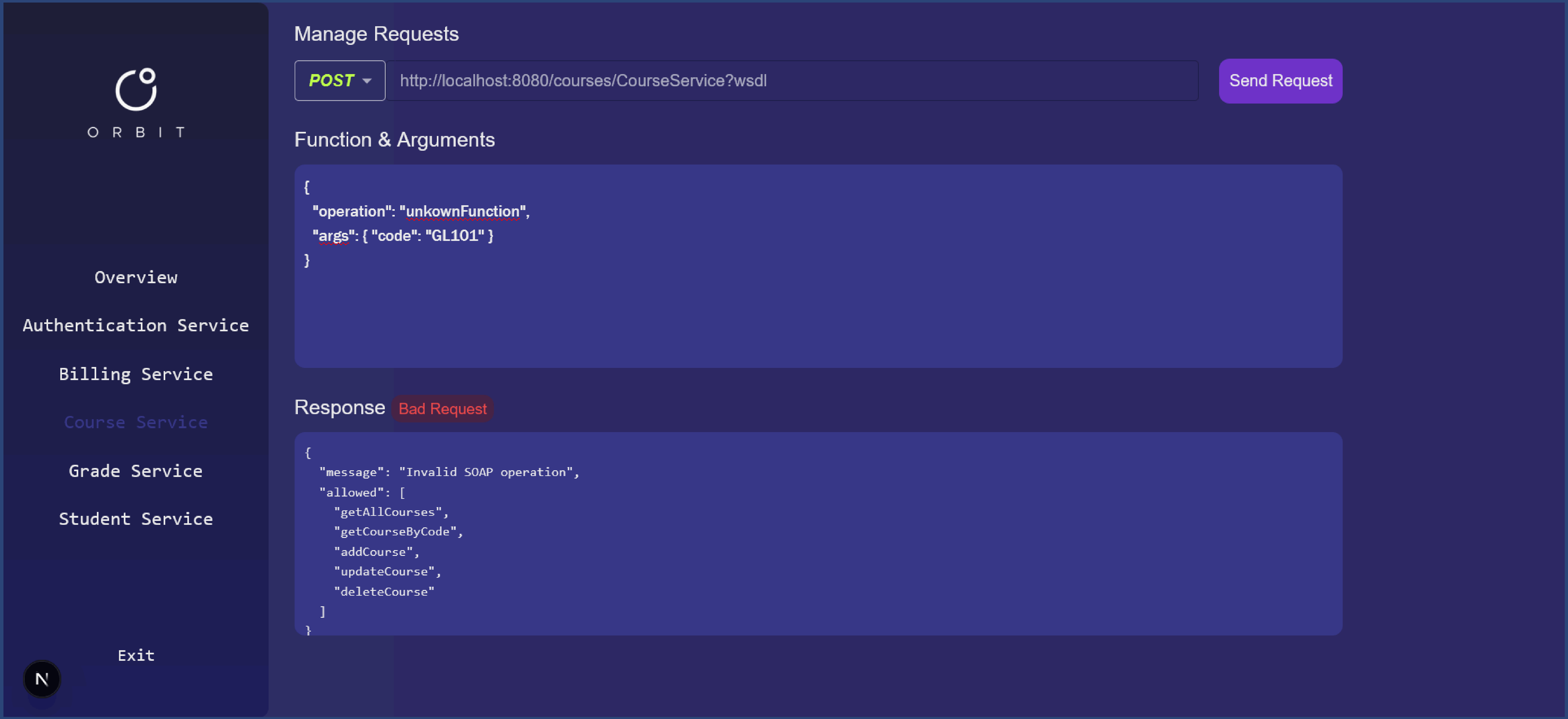
Function & Arguments

```
{
 "operation": "deleteCourse",
 "args": { "code": "GL101" }
}
```

Response OK

```
{
  "return": true
}
```

Handling unkown function error



http://localhost:8080/courses/CourseService?wsdl

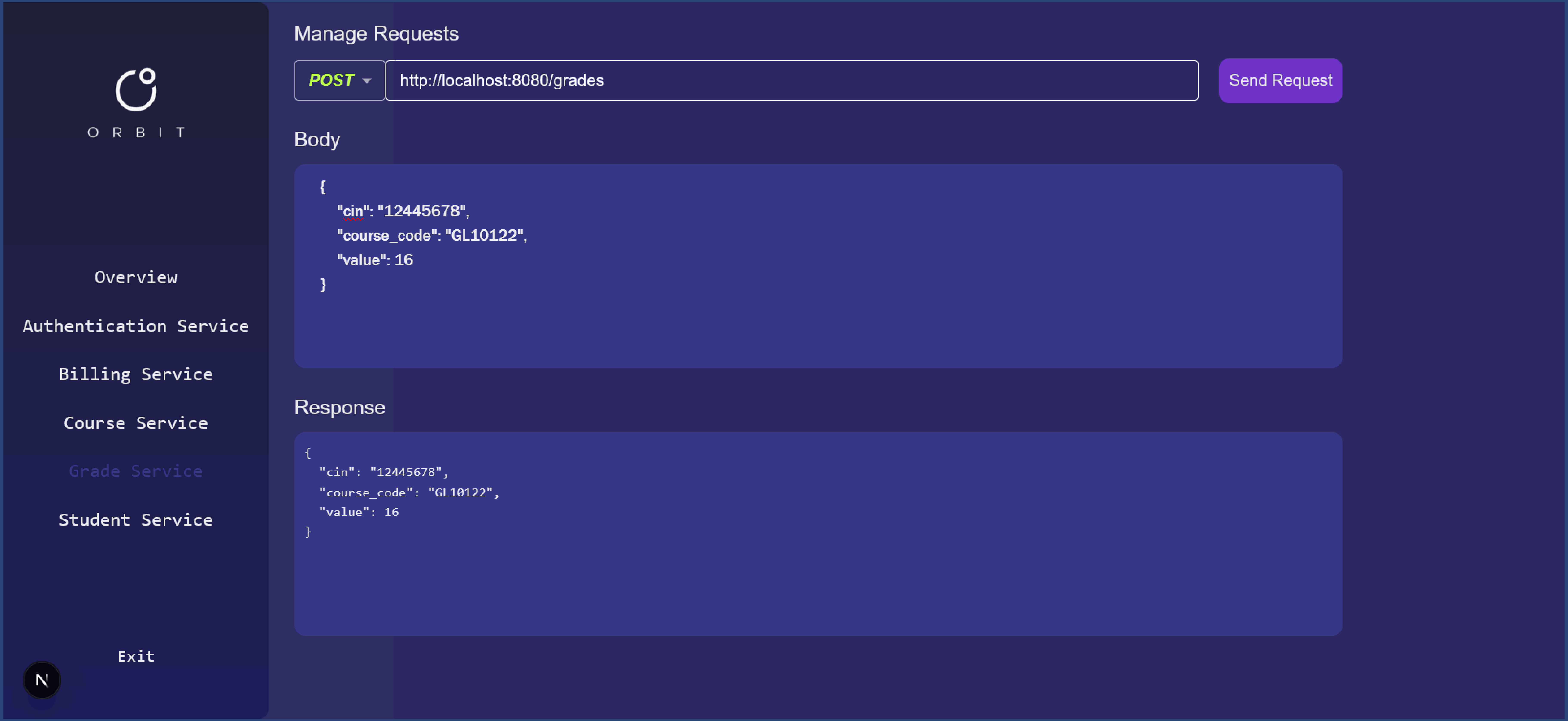
```
{
  "operation": "unkownFunction",
  "args": { "code": "GL101" }
}
```

```
{
  "message": "Invalid SOAP operation",
  "allowed": [
    "getAllCourses",
    "getCourseByCode",
    "addCourse",
    "updateCourse",
    "deleteCourse"
  ]
}
```

Grade Service

The Grade Service is responsible for managing students' grades and calculating academic averages. Implemented as a RESTful service using FastAPI, it provides efficient endpoints for adding grades and retrieving computed averages. This service ensures high performance, simplicity, and seamless integration with other system components.

Adding a grade



Manage Requests

POST http://localhost:8080/grades

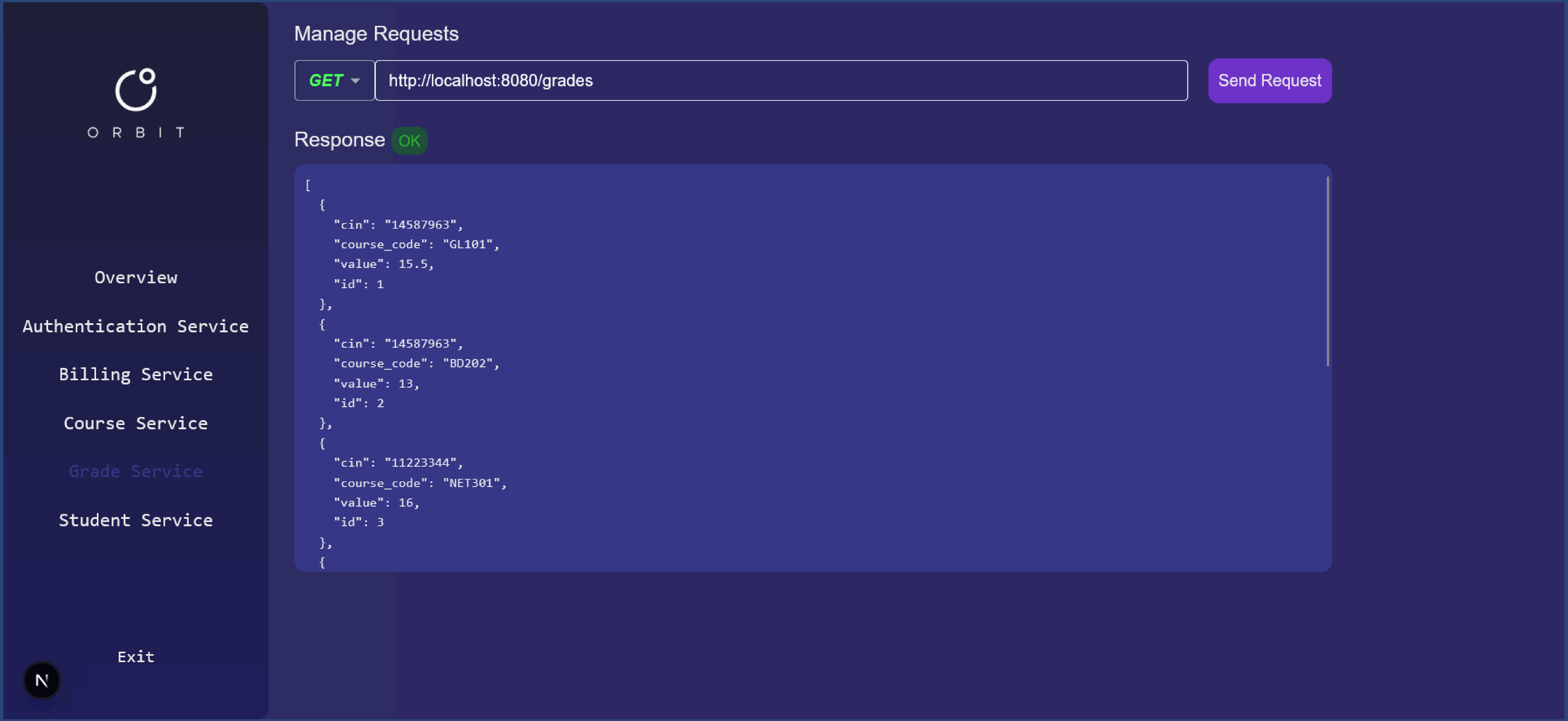
Body

```
{
  "cin": "12445678",
  "course_code": "GL10122",
  "value": 16
}
```

Response

```
{
  "cin": "12445678",
  "course_code": "GL10122",
  "value": 16
}
```

Retreiving all grades

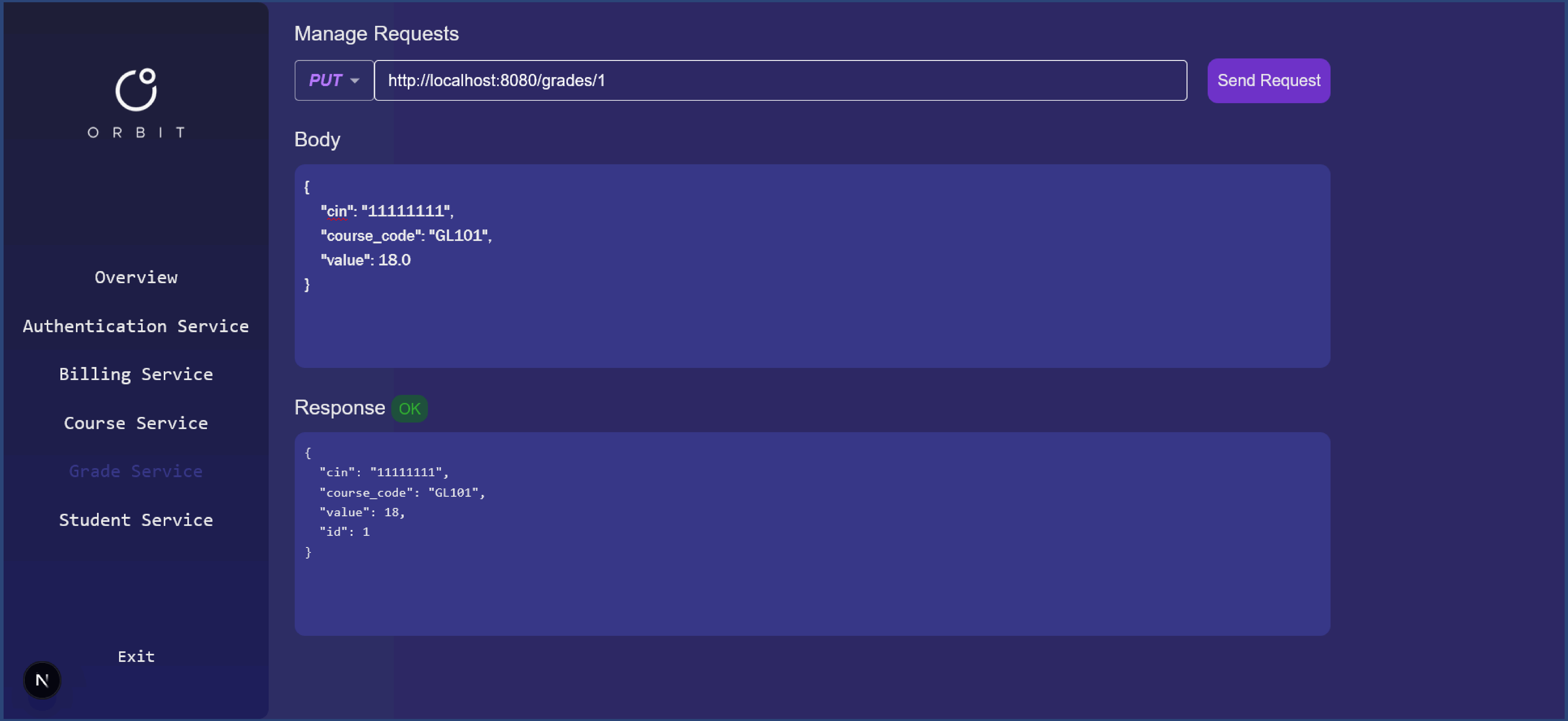


http://localhost:8080/grades

Response OK

```
[
  {
    "cin": "14587963",
    "course_code": "GL101",
    "value": 15.5,
    "id": 1
  },
  {
    "cin": "14587963",
    "course_code": "BD202",
    "value": 13,
    "id": 2
  },
  {
    "cin": "11223344",
    "course_code": "NET301",
    "value": 16,
    "id": 3
  },
  {
```

Retreiving a Specific Grade

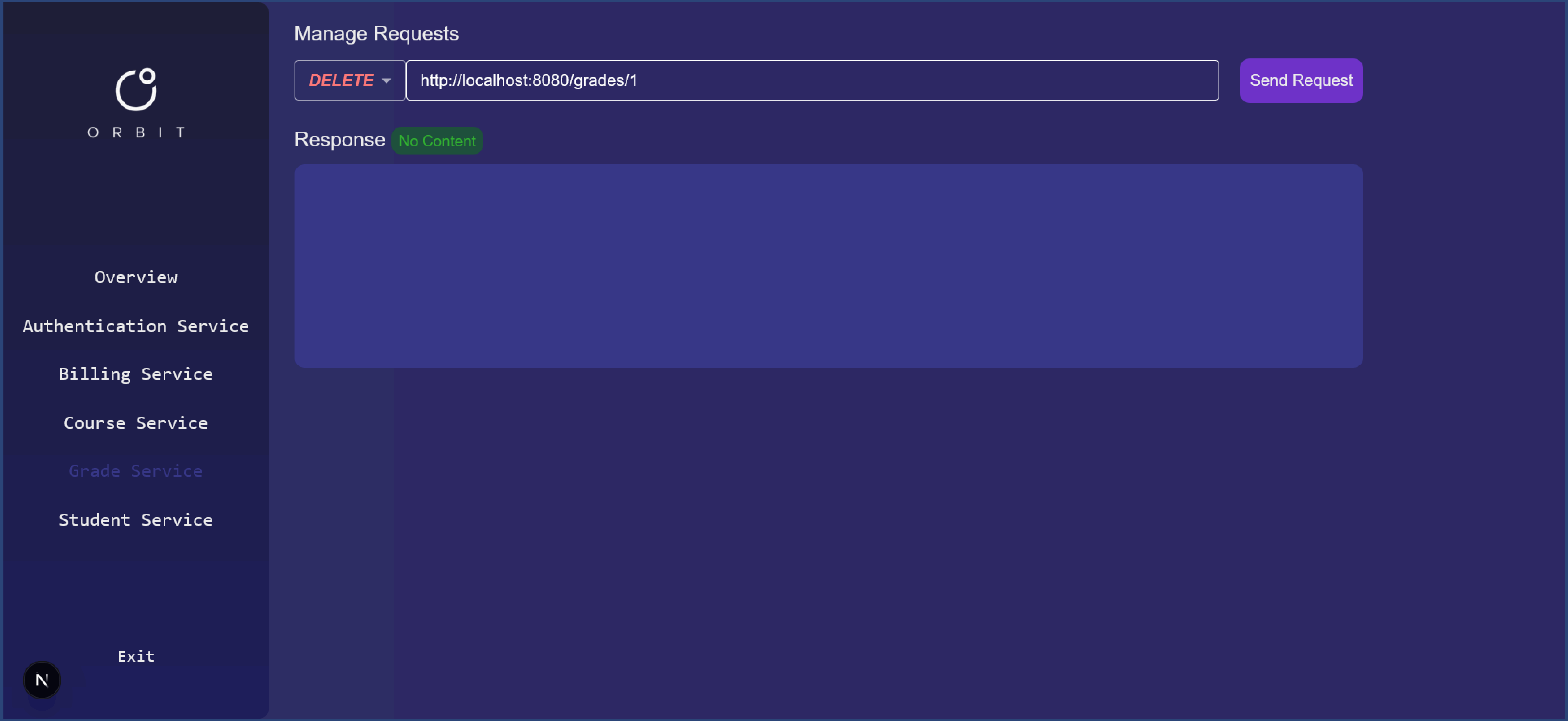


http://localhost:8080/grades/1

```
{
  "cin": "11111111",
  "course_code": "GL101",
  "value": 18.0
}
```

```
{
  "cin": "11111111",
  "course_code": "GL101",
  "value": 18,
  "id": 1
}
```

Deleting a Specific Grade

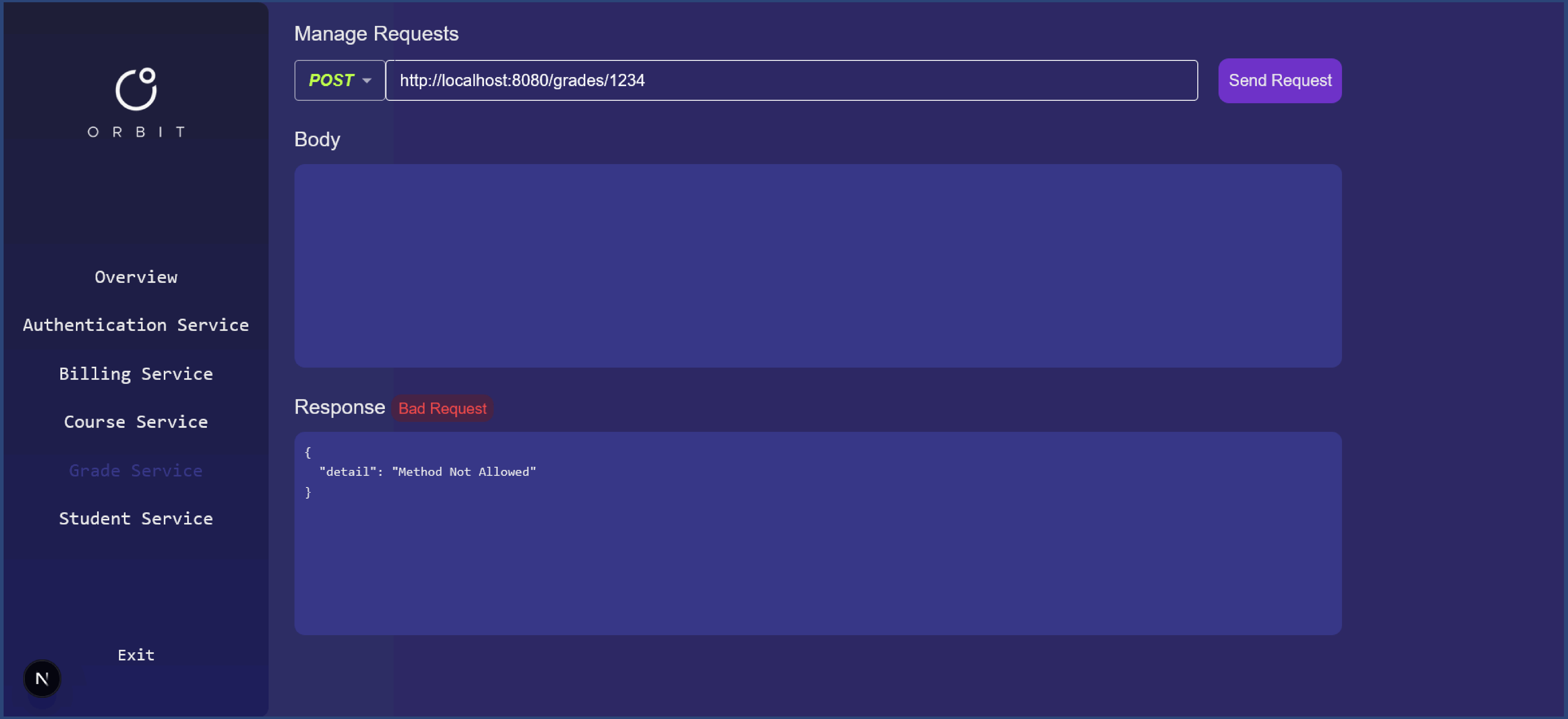


Manage Requests

DELETE http://localhost:8080/grades/1

Response No Content

Handling Uknown Grade ID



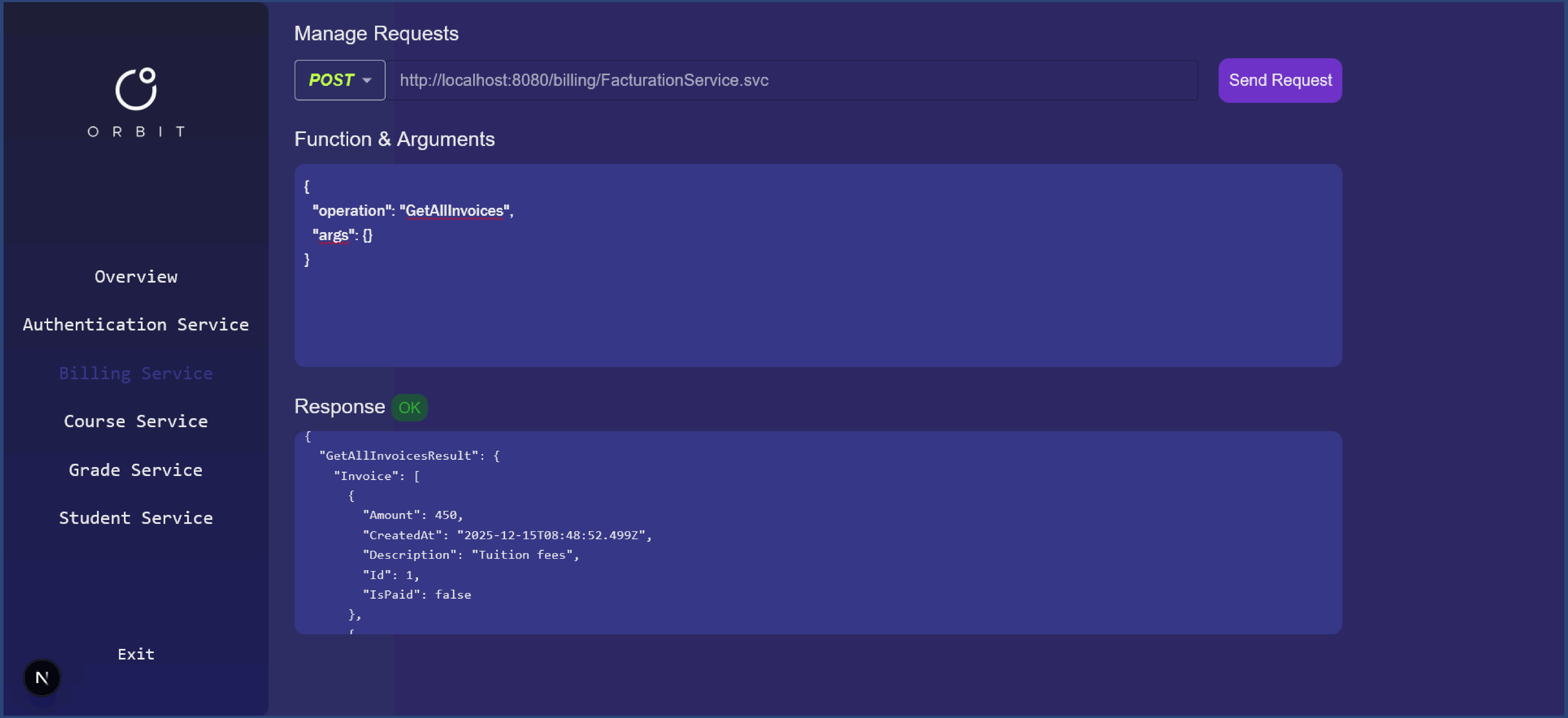
http://localhost:8080/grades/1234

```
{
  "detail": "Method Not Allowed"
}
```

Billing Service

The Billing Service is responsible for managing university fees and financial transactions related to students. Implemented as a SOAP-based service, it provides standardized operations for retrieving fee details and generating invoices. This service ensures reliable, secure, and contract-driven communication within the SOA architecture.

Retreiving all Invoices

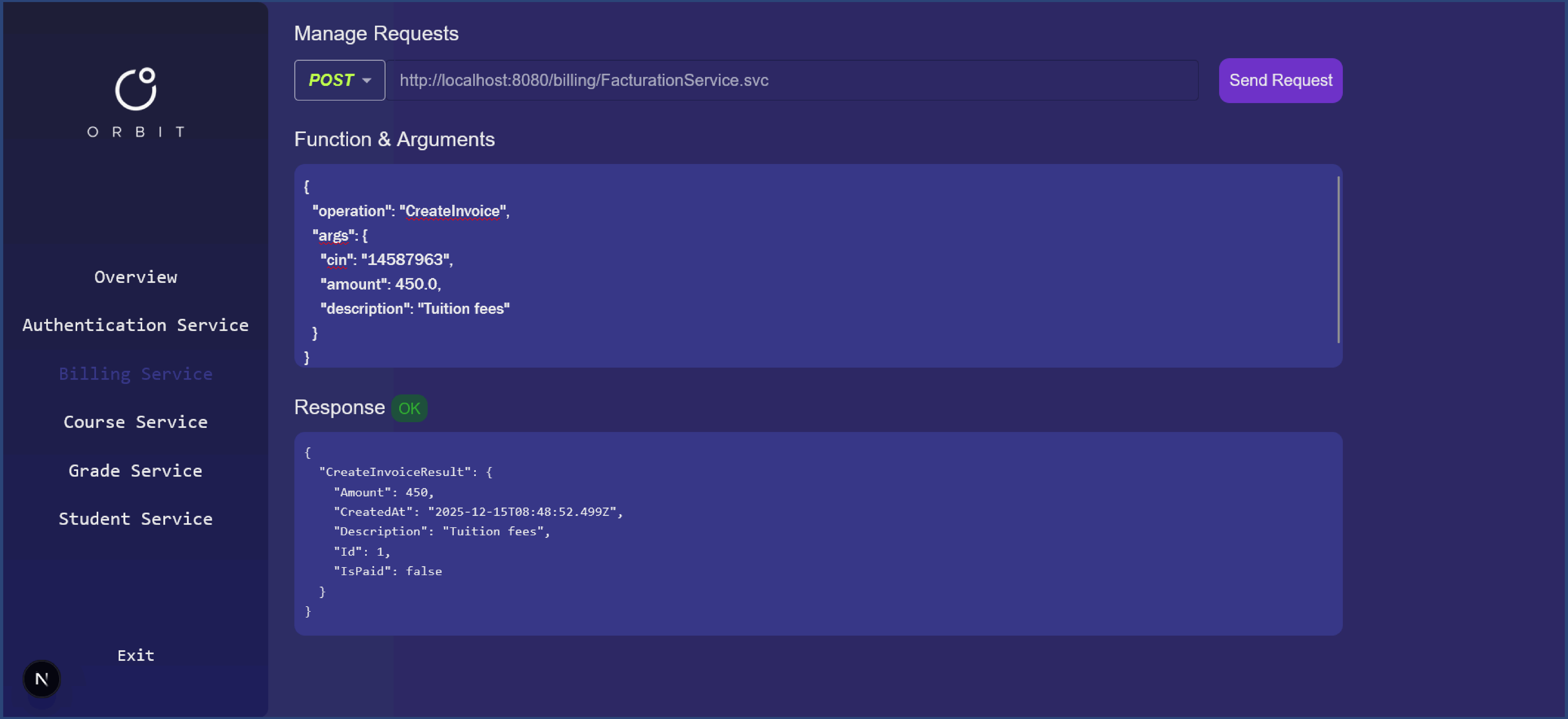


http://localhost:8080/billing/FacturationService.svc

```
{
  "operation": "GetAllInvoices",
  "args": {}
}
```

```
{
  "GetAllInvoicesResult": {
    "Invoice": [
      {
        "Amount": 450,
        "CreatedAt": "2025-12-15T08:48:52.499Z",
        "Description": "Tuition fees",
        "Id": 1,
        "IsPaid": false
      },
      {
```

Create an Invoice for payment



Manage Requests

POST ▾ http://localhost:8080/billing/FacturationService.svc

Send Request

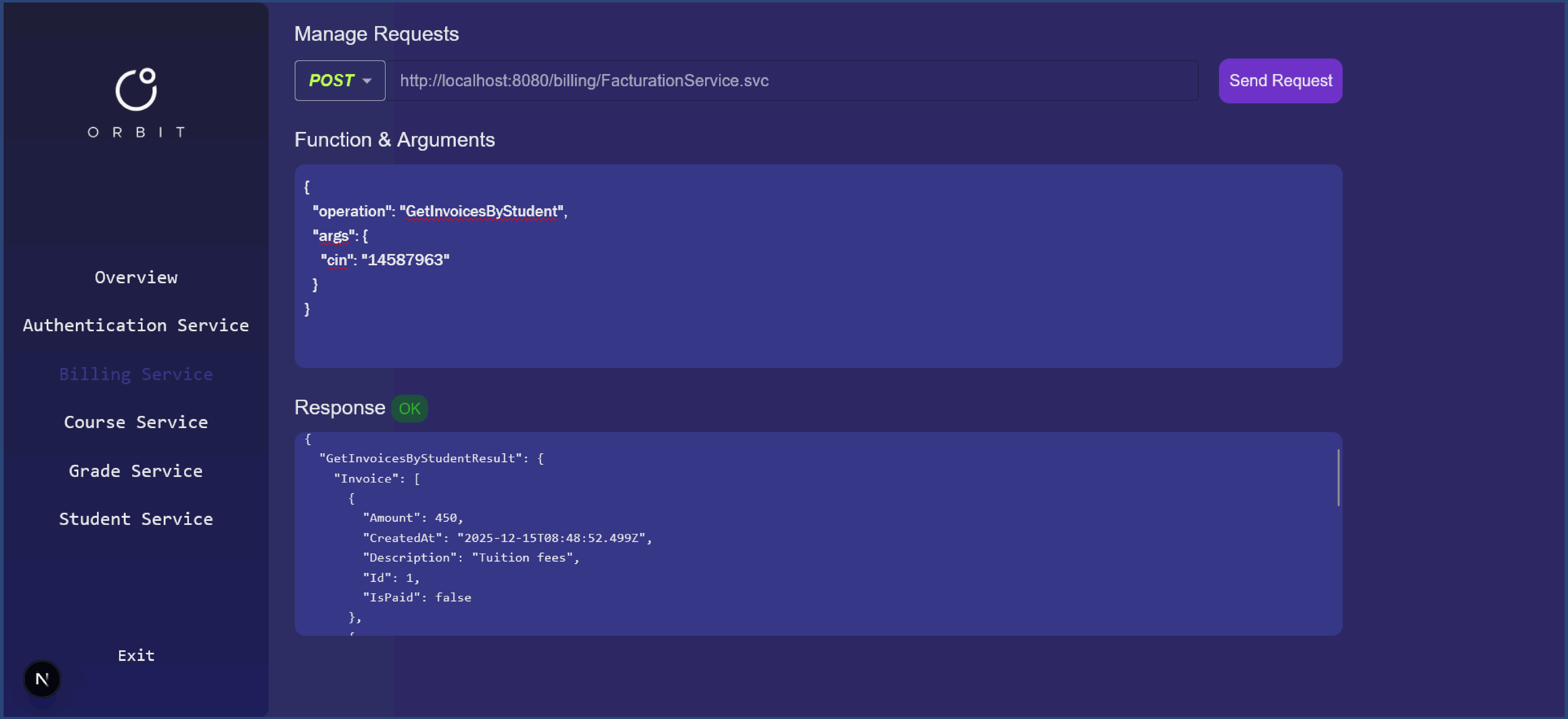
Function & Arguments

```
{
  "operation": "CreateInvoice",
  "args": {
   "cin": "14587963",
   "amount": 450.0,
   "description": "Tuition fees"
  }
}
```

Response OK

```
{
  "CreateInvoiceResult": {
    "Amount": 450,
    "CreatedAt": "2025-12-15T08:48:52.499Z",
    "Description": "Tuition fees",
    "Id": 1,
    "IsPaid": false
  }
}
```

Retrieving Invoice by Student CIN

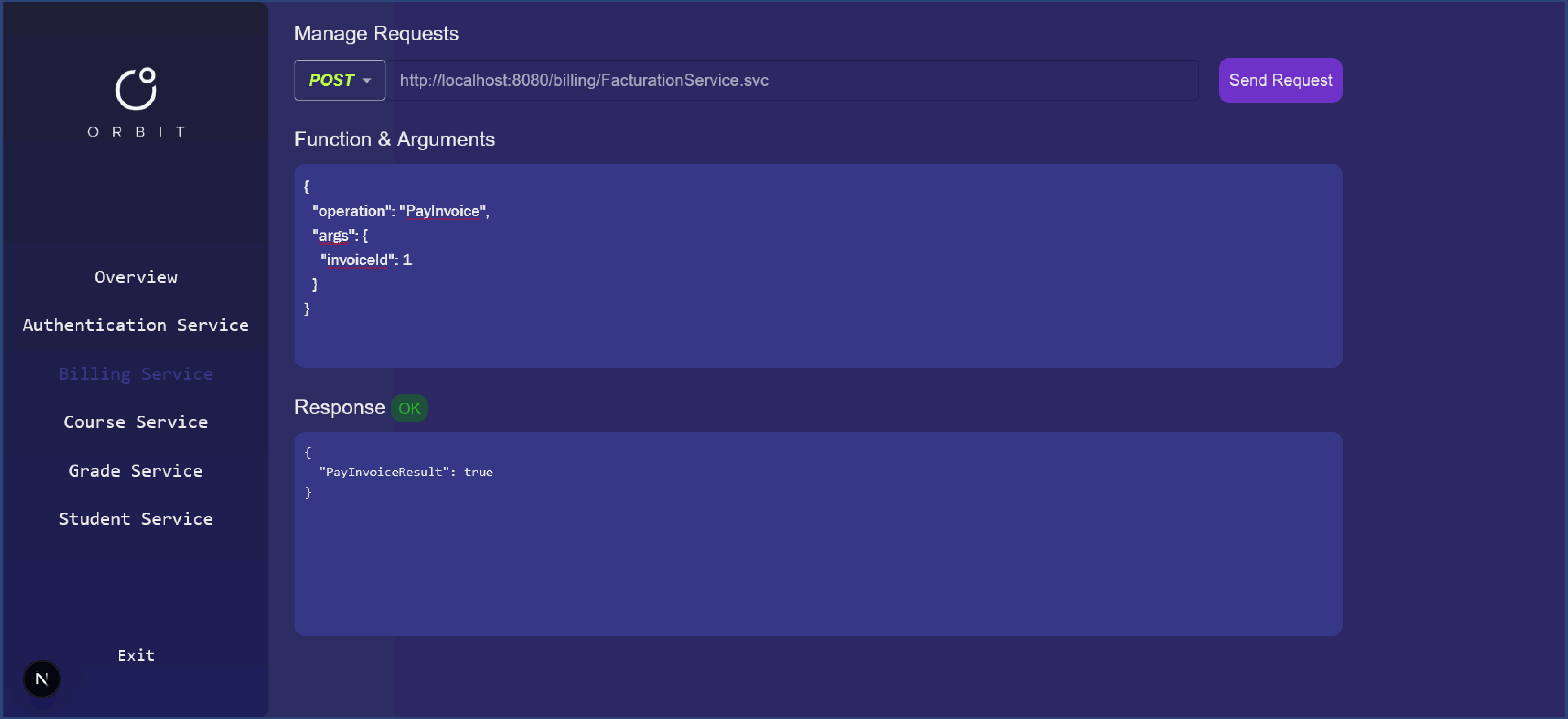


http://localhost:8080/billing/FacturationService.svc

```
{
 "operation": "GetInvoicesByStudent",
 "args": {
  "cin": "14587963"
 }
}
```

```
{
  "GetInvoicesByStudentResult": {
    "Invoice": [
      {
        "Amount": 450,
        "CreatedAt": "2025-12-15T08:48:52.499Z",
        "Description": "Tuition fees",
        "Id": 1,
        "IsPaid": false
      },
```

Paying Invoice



http://localhost:8080/billing/FacturationService.svc

Function & Arguments

```
{
 "operation": "PayInvoice",
 "args": {
  "invoiceId": 1
 }
}
```

Response OK

```
{
  "PayInvoiceResult": true
}
```

API Gateway

The API Gateway acts as a single entry point for all client requests, routing them to the appropriate backend services. It centralizes authentication, request forwarding, and load balancing, ensuring secure and efficient communication between clients and the distributed services in the SOA architecture.

Security

The Security module ensures that only authorized users can access the system services. It relies on JWT (JSON Web Tokens) for authentication, validating tokens at the API Gateway level, and securing internal communication between services. This approach provides centralized, scalable, and robust protection for the SOA architecture.

Deployment & Containerization

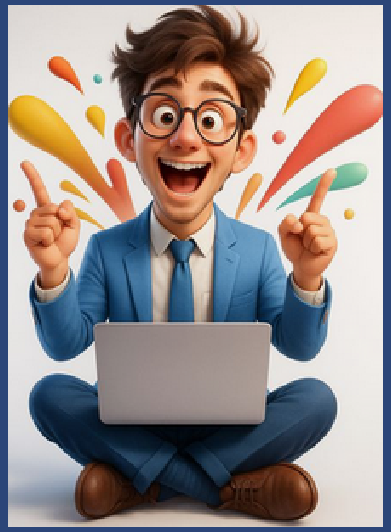
The system is fully containerized using Docker, and all services are orchestrated via Docker Compose. Each service runs in an isolated container with its own environment and network configuration, enabling easy deployment, scalability, and maintenance. This approach ensures seamless communication between services while simplifying the setup of the entire SOA architecture.

Project Organization

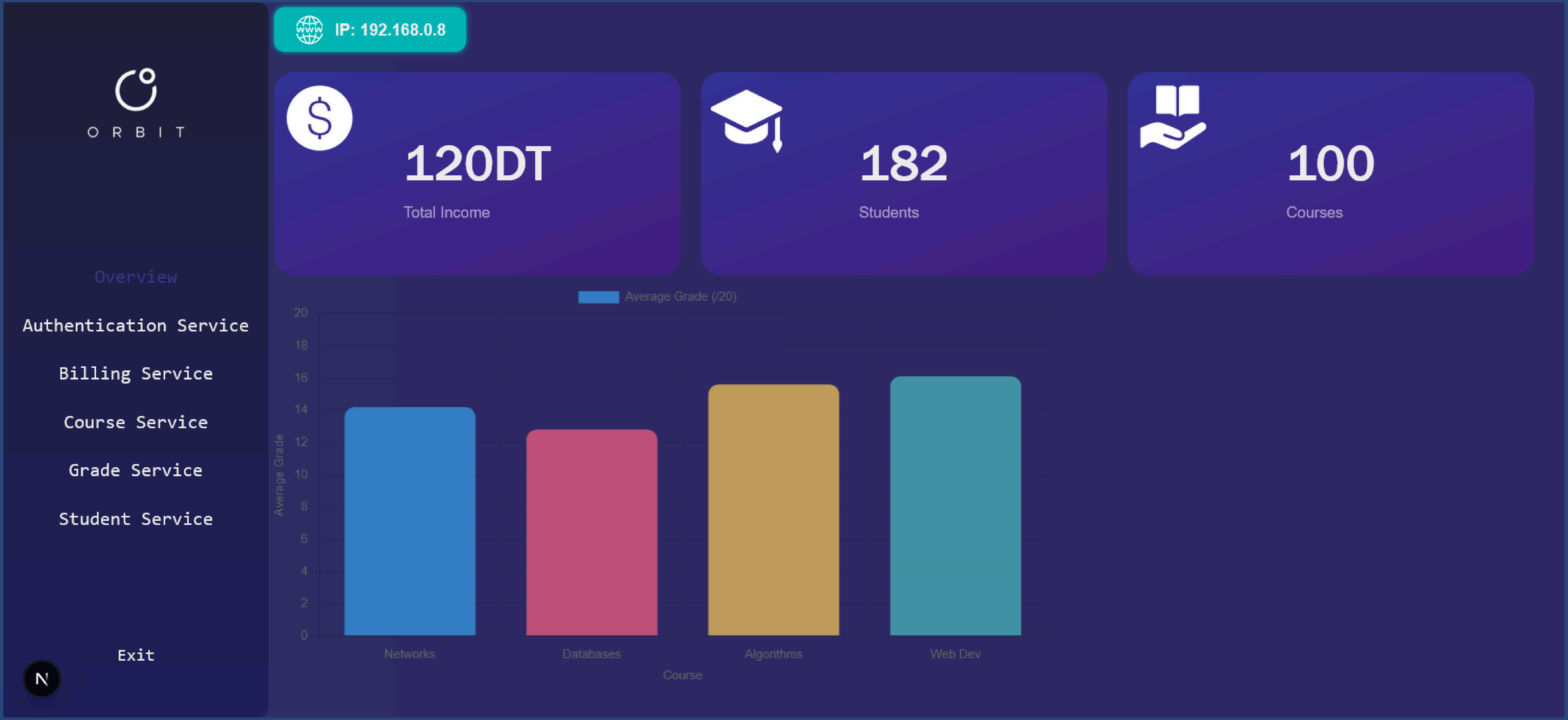
The project is structured to ensure clarity, maintainability, and effective teamwork. Services are separated into individual folders, documentation is centralized, and deployment configurations are organized under a dedicated directory. This organization supports collaborative development, agile practices, and simplifies navigation and future maintenance of the SOA system.

Conclusion

In conclusion, the SOA-based University Information System demonstrates a fully functional architecture integrating REST and SOAP services across multiple technologies. The system ensures interoperability, scalability, security, and maintainability, while Docker-based deployment simplifies orchestration. Future improvements may include enhanced security, real database integration, and monitoring for better performance and reliability.



Final Overview



IP: 192.168.0.8

120DT
Total Income

182
Students

100
Courses

Thank You

For listening