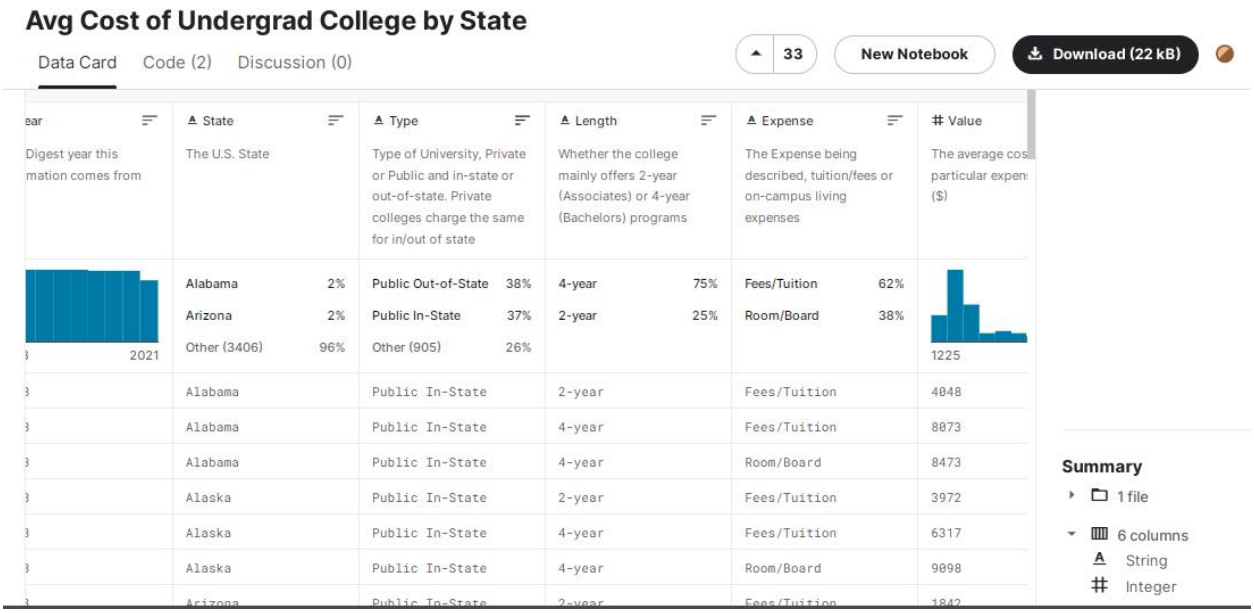
COEN 6731 Winter 2023 Assignment Two

This assignment has the purpose of practicing (1) RPC communication for resources and services; (2) data operations on MongoDB, a NoSQL database; (3) implementation of aggregation pipelines for data processing.

A public data source is available on Kaggle. It is compiled from the National Center of Education Statistics Annual Digest, USA. The data contains the statistics of average undergraduate tuition and fees and room and board rates charged for full-time students in degree-granting postsecondary institutions.

https://www.kaggle.com/datasets/kfoster150/avg-cost-of-undergrad-college-by-state/versions/10?resource=download



This assignment will implement the following architecture as shown in the figure below.

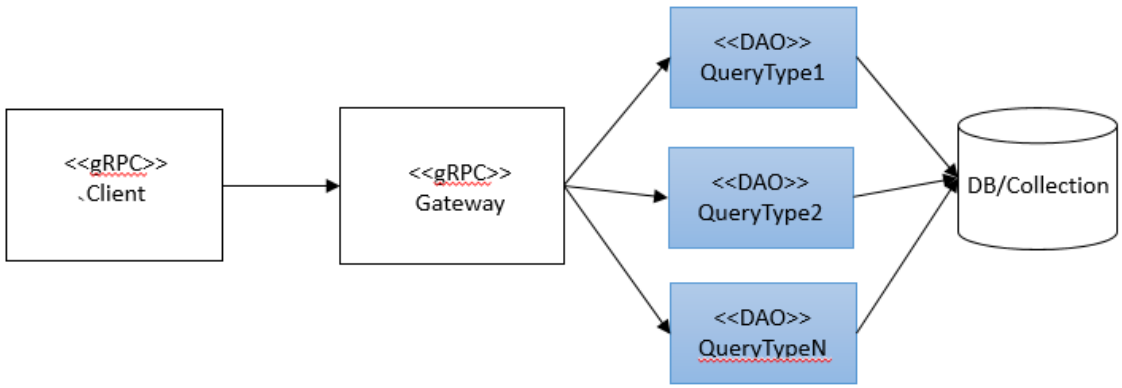


Figure 1 Overall Assignment 2 Data Operation Architecture with RCP Communication

Task 1. MongoDB Data Storage and Operation

Task 1.1 is to create a MongoDB collection named **EduCostStat** to store the data to the MongoDB instance running on MongoDB online cluster. No local database is accepted. The dataset can be downloaded as excel sheets or a .csv file. Please write a program to create a collection in the MongoDB by reading the data samples from the file. (10 marks)

Task 1.2 is to develop data access objects in Java that represents different queries to the data. Please be aware that **duplicated queries should not be inserted as a new document in a collection.**

1) Query the cost given specific year, state, type, length, expense; and save the query as a document in a collection named **EduCostStatQueryOne. (10 marks)**
2) Query the top 5 most expensive states (with overall expense) given a year, type, length; and save the query as a document in a collection named **EduCostStatQueryTwo. (10 marks)**
3) Query the top 5 most economic states (with overall expense) given a year, type, length; and save the query as a document in a collection named **EduCostStatQueryThree. (10 marks)**
4) Query the top 5 states of the highest growth rate of overall expense given a range of past years, one year, three years and five years (using the latest year as the base) , type and length; and save the query as a document in a collection named **EduCostStatQueryFour. (10 marks)**
5) Aggregate region's average overall expense for a given year, type and length; and save the query as a document in a collection named **EduCostStatQueryFive.** The region's map can be found here. https://education.nationalgeographic.org/resource/united-states-regions/ (you can search the key words "Five US Region Map" to find our text based mapping) **(10 marks)**

Task 2. Data Communication Interface Definition and Service Implementation

Task 2.1 Define a ProtoBuff definition file to represent the request, response and service for reach query in Task 1. **(10 marks)** You may use the conversion tool from JSON to ProtoBuff.

https://www.site24x7.com/tools/json-to-protobuf.html

Task 2.2 Develop the Java program for reach service defined in Task 2.1 as gRPC services. Each service invokes the corresponding data access object classes developed in Task 1. **(50 marks)**

Task 2.3 Develop the gRPC client and server (or gateway) code to communicate as RPC calls for the five queries defined in Task 1. (20 marks)

Submission Specification

- Redraw the Figure 1 to reflect the context of your distributed system architecture. Provide the concrete names of each component in Figure 1 as your own program solution. For example, replace the name "gateway" with the actual component's name that implements service.
- A report in PDF that documents the concrete architecture diagram with explanation of each component's function in the diagram and presents the solution of tasks 1 and 2 with necessary screen shots.
- The project code with the pom.xml file.
- Make one archive file of the project code and the report with .zip or .gz or .tar. NO .rar is accepted for grading.
- The deadline of submission is March 31 23:59