

# ICS202 PROJECT

Multi-Index Data Structure: Student Records Management System

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## Introduction to Our Student Database Management Project

In our project, we aim to develop an efficient and robust student database management system using Java. The core of our system will be a sophisticated data structure that allows for quick and reliable access to student records based on various attributes such as student ID, last name, first name, and academic level.

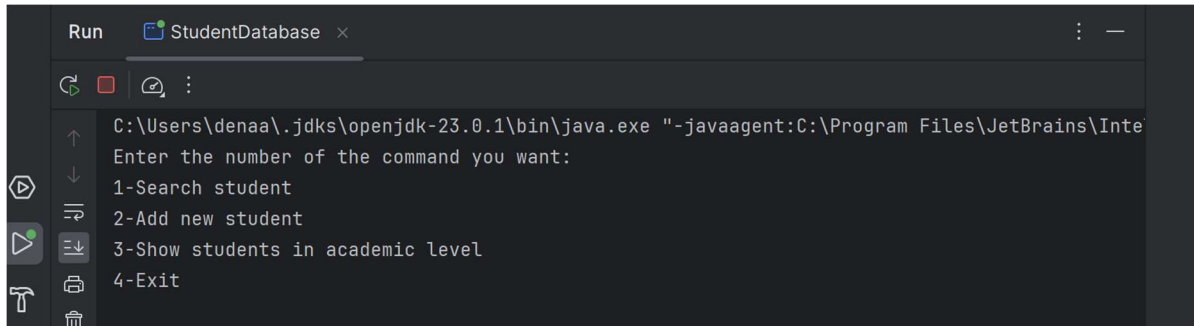
To achieve this, we have chosen to implement B+ trees as our primary data structure. B+ trees are known for their efficiency in handling large datasets and their ability to maintain sorted data, which makes them ideal for our needs. This choice ensures that our system will be both scalable and capable of handling diverse queries efficiently.

Our goal is to create a user-friendly, command-based interface that allows users to perform various operations such as searching, adding, updating, and deleting student records. By leveraging the power of B+ trees, we aim to provide a seamless and efficient experience for all users interacting with our student database management system.

# Implementation

The interface has a main menu with these options

1. Search Student
2. Add New Student
3. Show students at an academic level
4. Exit

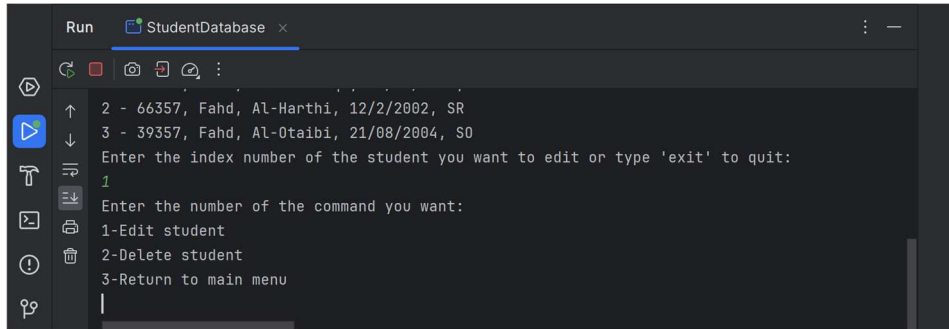


The screenshot shows a Java application window titled "StudentDatabase". The window contains a command prompt interface. The command line shows the Java executable path: `C:\Users\denaa\.jdk\openjdk-23.0.1\bin\java.exe -javaagent:C:\Program Files\JetBrains\IntelliJ IDEA\lib\idea_rt.jar=12173:C:\Program Files\JetBrains\IntelliJ IDEA\bin\idea.exe`. The prompt asks "Enter the number of the command you want:" and displays a menu with four options: "1-Search student", "2-Add new student", "3-Show students in academic level", and "4-Exit".

Under "Search Student", display all possible ways to retrieve a student. Once retrieved, prompt whether the user wants to:

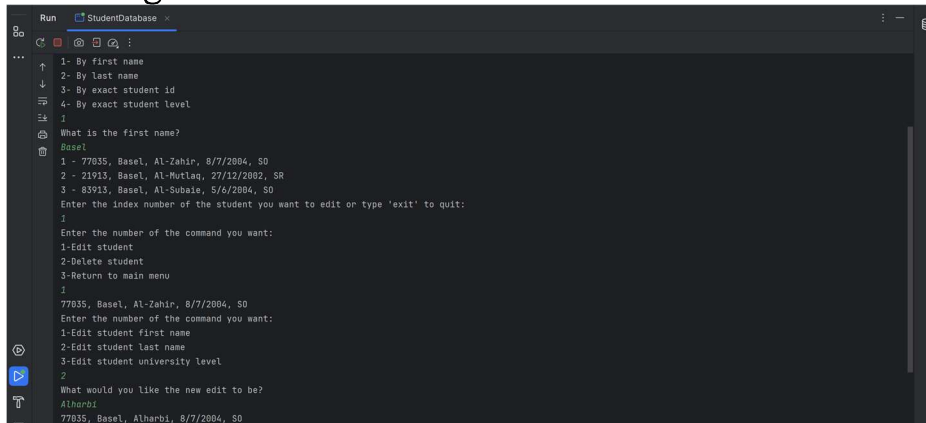
- Edit the student
- Delete the student
- Return to main menu.

## 1- Possible actions to a certain student UNDER SEARCH:

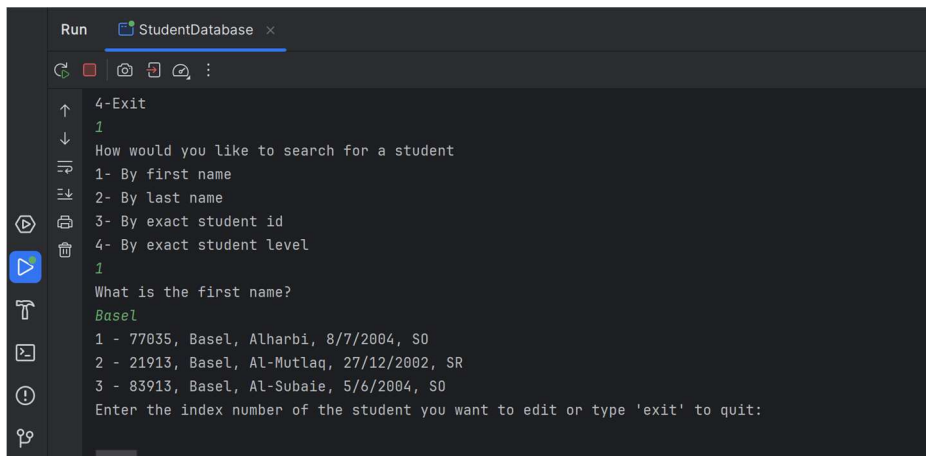


```
Run StudentDatabase x
2 - 66357, Fahd, Al-Harhi, 12/2/2002, SR
3 - 39357, Fahd, Al-Otaibi, 21/08/2004, S0
Enter the index number of the student you want to edit or type 'exit' to quit:
1
Enter the number of the command you want:
1-Edit student
2-Delete student
3-Return to main menu
|
```

### a- Editing:

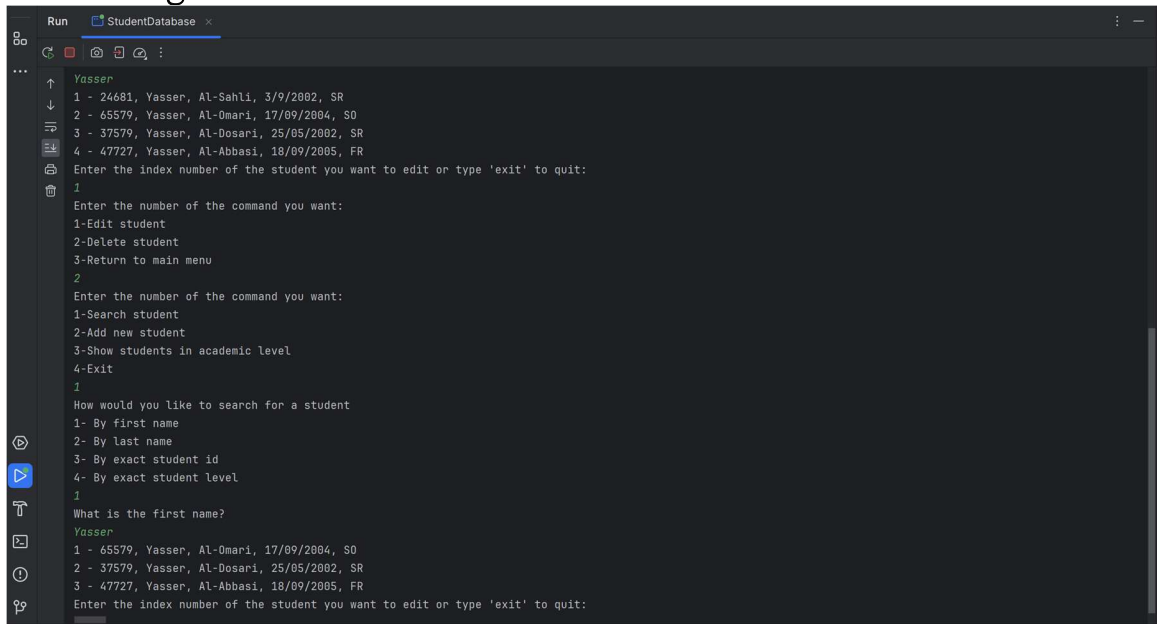


```
Run StudentDatabase x
1- By first name
2- By last name
3- By exact student id
4- By exact student level
1
What is the first name?
Basel
1 - 77035, Basel, Al-Zahir, 8/7/2004, S0
2 - 21913, Basel, Al-Mutlaq, 27/12/2002, SR
3 - 83913, Basel, Al-Subaie, 5/6/2004, S0
Enter the index number of the student you want to edit or type 'exit' to quit:
1
Enter the number of the command you want:
1-Edit student
2-Delete student
3-Return to main menu
1
77035, Basel, Al-Zahir, 8/7/2004, S0
Enter the number of the command you want:
1-Edit student first name
2-Edit student last name
3-Edit student university level
2
What would you like the new edit to be?
Alharbi
77035, Basel, Alharbi, 8/7/2004, S0
```



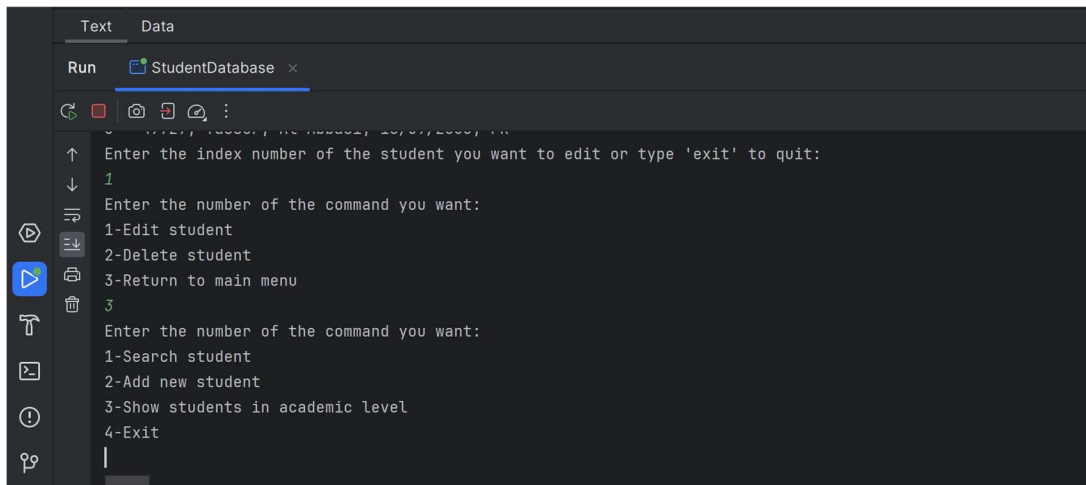
```
Run StudentDatabase x
4-Exit
1
How would you like to search for a student
1- By first name
2- By last name
3- By exact student id
4- By exact student level
1
What is the first name?
Basel
1 - 77035, Basel, Alharbi, 8/7/2004, S0
2 - 21913, Basel, Al-Mutlaq, 27/12/2002, SR
3 - 83913, Basel, Al-Subaie, 5/6/2004, S0
Enter the index number of the student you want to edit or type 'exit' to quit:
```

## b- Deleting:



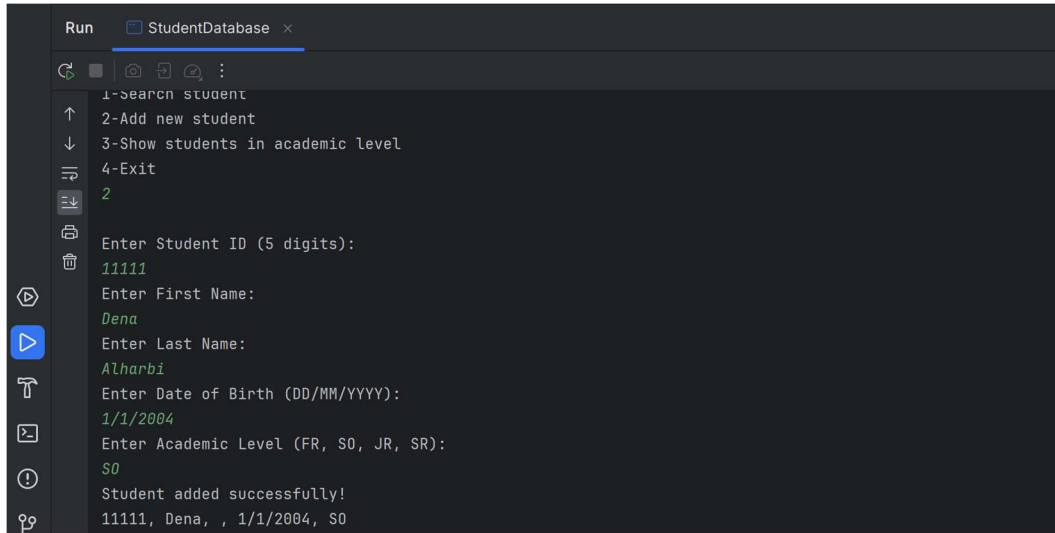
```
Run StudentDatabase x
Yasser
1 - 24681, Yasser, Al-Sahli, 3/9/2002, SR
2 - 65579, Yasser, Al-Omari, 17/09/2004, SO
3 - 37579, Yasser, Al-Dosari, 25/05/2002, SR
4 - 47727, Yasser, Al-Abbasi, 10/09/2005, FR
Enter the index number of the student you want to edit or type 'exit' to quit:
1
Enter the number of the command you want:
1-Edit student
2-Delete student
3-Return to main menu
2
Enter the number of the command you want:
1-Search student
2-Add new student
3-Show students in academic level
4-Exit
1
How would you like to search for a student
1- By first name
2- By last name
3- By exact student id
4- By exact student level
1
What is the first name?
Yasser
1 - 65579, Yasser, Al-Omari, 17/09/2004, SO
2 - 37579, Yasser, Al-Dosari, 25/05/2002, SR
3 - 47727, Yasser, Al-Abbasi, 10/09/2005, FR
Enter the index number of the student you want to edit or type 'exit' to quit:
1
```

## c- Return to menu



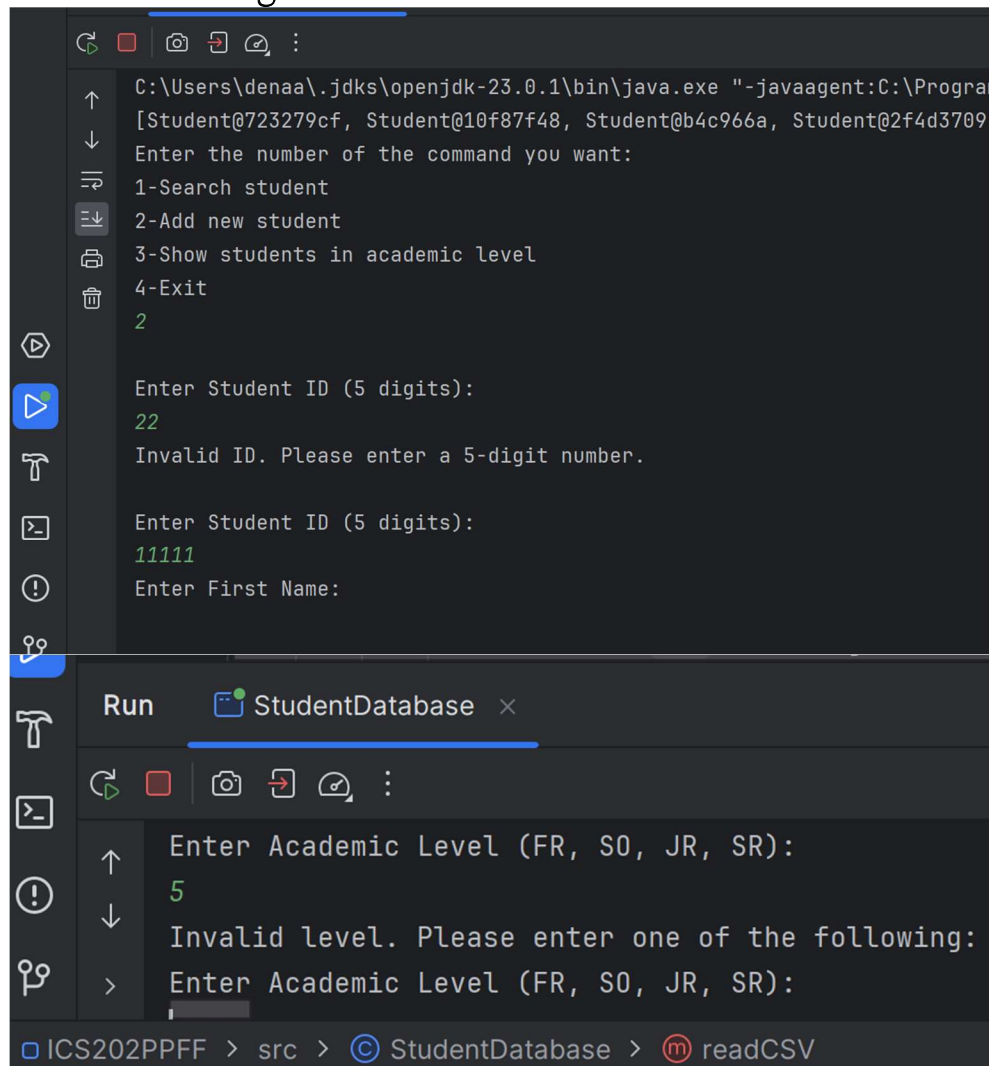
```
Text Data
Run StudentDatabase x
Enter the index number of the student you want to edit or type 'exit' to quit:
1
Enter the number of the command you want:
1-Edit student
2-Delete student
3-Return to main menu
3
Enter the number of the command you want:
1-Search student
2-Add new student
3-Show students in academic level
4-Exit
|
```

## 2- Add new students:



```
Run StudentDatabase x
1-Search student
2-Add new student
3-Show students in academic level
4-Exit
2
Enter Student ID (5 digits):
11111
Enter First Name:
Dena
Enter Last Name:
Alharbi
Enter Date of Birth (DD/MM/YYYY):
1/1/2004
Enter Academic Level (FR, SO, JR, SR):
SO
Student added successfully!
11111, Dena, , 1/1/2004, SO
```

### a- Error handling



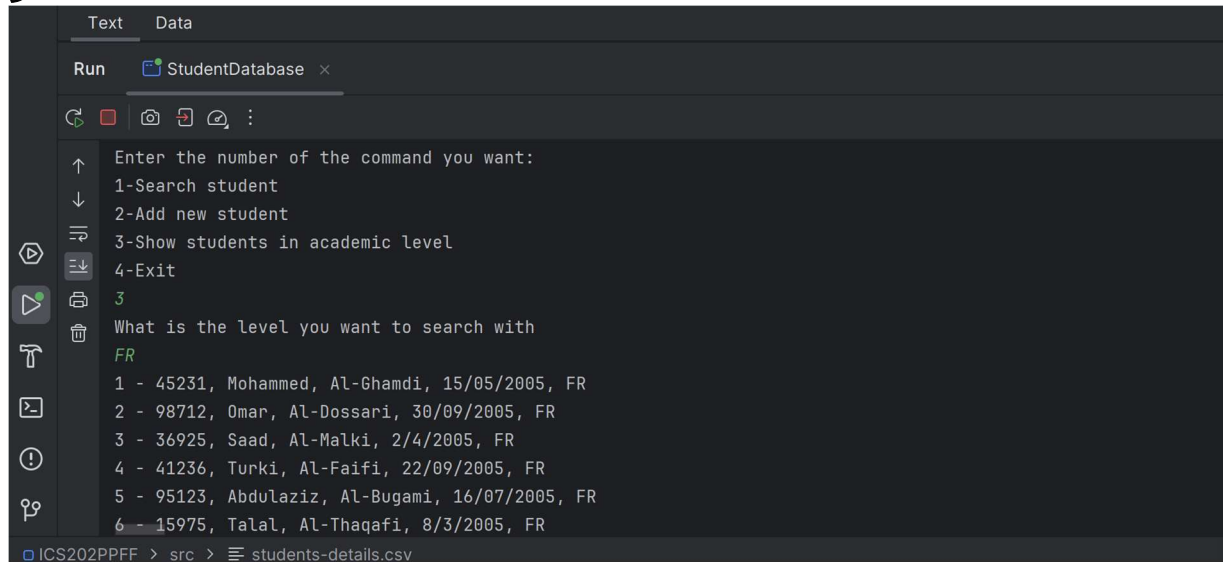
```
C:\Users\denaa\.jdk\openjdk-23.0.1\bin\java.exe "-javaagent:C:\Program
[Student@723279cf, Student@10f87f48, Student@b4c966a, Student@2f4d3709]
Enter the number of the command you want:
1-Search student
2-Add new student
3-Show students in academic level
4-Exit
2
Enter Student ID (5 digits):
22
Invalid ID. Please enter a 5-digit number.
Enter Student ID (5 digits):
11111
Enter First Name:
Enter Academic Level (FR, SO, JR, SR):
5
Invalid level. Please enter one of the following: FR, SO, JR, SR.
Enter Academic Level (FR, SO, JR, SR):

```

Run StudentDatabase x

ICS202PPFF > src > StudentDatabase > readCSV

### 3- Show students at an academic level:

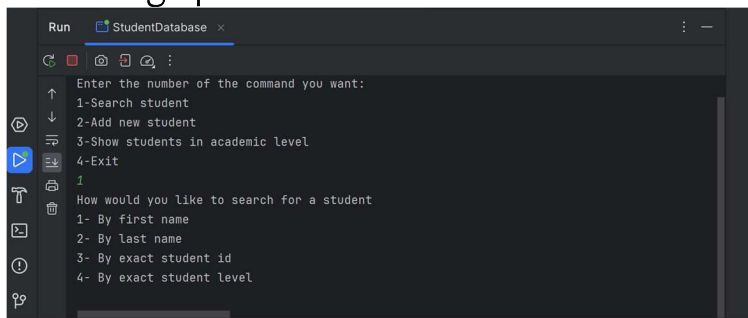


```
Text  Data
Run  StudentDatabase x
Enter the number of the command you want:
1-Search student
2-Add new student
3-Show students in academic level
4-Exit
3
What is the level you want to search with
FR
1 - 45231, Mohammed, Al-Ghamdi, 15/05/2005, FR
2 - 98712, Omar, Al-Dossari, 30/09/2005, FR
3 - 36925, Saad, Al-Malki, 2/4/2005, FR
4 - 41236, Turki, Al-Faifi, 22/09/2005, FR
5 - 95123, Abdulaziz, Al-Bugami, 16/07/2005, FR
6 - 15975, Talal, Al-Thaqafi, 8/3/2005, FR
ICS202PPFF > src > students-details.csv
```

The data structure provides the following operation:

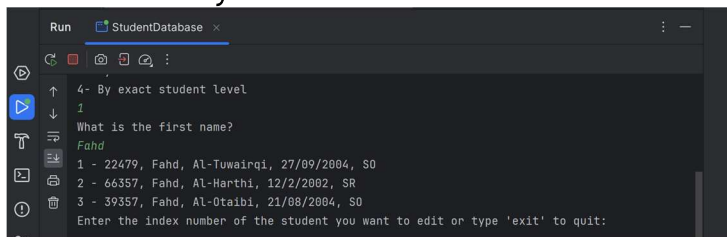
- Efficient insertion maintaining all indices
- Deletion with proper reference cleanup
- Updates with automatic index maintenance
- Retrieval through any index, those retrievals will provide the capabilities to search
  - By exact student ID
  - By last name
  - By First name
- Retrieve a list for an academic level

Retrieving options:



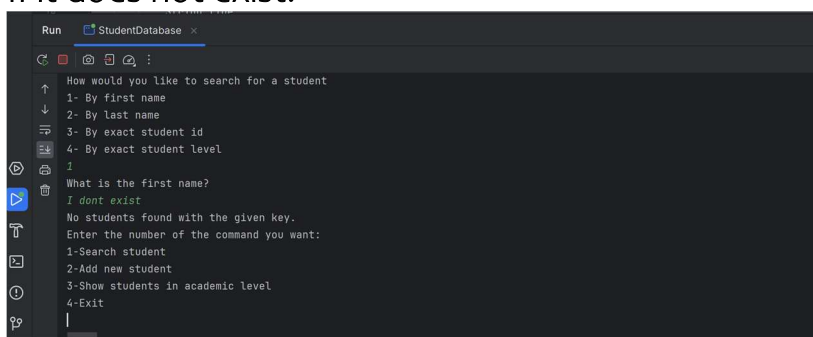
```
Run StudentDatabase x
Enter the number of the command you want:
1-Search student
2-Add new student
3-Show students in academic level
4-Exit
1
How would you like to search for a student
1- By first name
2- By last name
3- By exact student id
4- By exact student level
```

1- Retrieve by first name:



```
Run StudentDatabase x
4- By exact student level
1
What is the first name?
Fahd
1 - 22479, Fahd, Al-Tuwairqi, 27/09/2004, SO
2 - 66357, Fahd, Al-Harathi, 12/2/2002, SR
3 - 39357, Fahd, Al-Otaibi, 21/08/2004, SO
Enter the index number of the student you want to edit or type 'exit' to quit:
```

If it does not exist:



```
Run StudentDatabase x
How would you like to search for a student
1- By first name
2- By last name
3- By exact student id
4- By exact student level
1
What is the first name?
I dont exist
No students found with the given key.
Enter the number of the command you want:
1-Search student
2-Add new student
3-Show students in academic level
4-Exit
1
```

## 2- Retrieve by last name:

```
Run StudentDatabase x
1- By first name
2- By last name
3- By exact student id
4- By exact student level
2
What is the last name?
Al-Ghamdi
1 - 45231, Mohammed, Al-Ghamdi, 15/05/2005, FR
2 - 32579, Thamer, Al-Ghamdi, 30/07/2002, SR
3 - 11791, Hatim, Al-Ghamdi, 30/03/2002, SR
4 - 17135, Tamin, Al-Ghamdi, 27/01/2002, SR
5 - 52180, Eyad, Al-Ghamdi, 5/4/2002, SR
6 - 61026, Essam, Al-Ghamdi, 8/1/2002, SR
Enter the index number of the student you want to edit or type 'exit' to quit:
```

## 3- Retrieve by ID:

```
Run StudentDatabase x
1
How would you like to search for a student
1- By first name
2- By last name
3- By exact student id
4- By exact student level
3
What is the Id?
65432
65432, Khalid, Al-Harbi, 25/03/2003, JR
Enter the number of the command you want:
1-Edit student
```

## 4- By exact student level

```
Run StudentDatabase x
How would you like to search for a student
1- By first name
2- By last name
3- By exact student id
4- By exact student level
4
What is the level ?
S0
1 - 78456, Abdullah, Al-Otaibi, 23/11/2004, S0
2 - 23498, Ibrahim, Al-Zahrani, 12/1/2004, S0
3 - 75321, Majed, Al-Ruwaili, 28/06/2004, S0
4 - 96325, Saud, Al-Subaie, 9/10/2004, S0
5 - 45678, Meshal, Al-Shahrani, 3/6/2004, S0
6 - 05126, Randar, Al-Wairani, 19/12/2004, S0
```