A Quarterly E-Magazine
ISSN 2582-5895
Volume 8 Issue 4 Month 10 Year 2025

Communications of Adhikari Academy of Learning

in

Computer Science and Information Technology

Adhikari Academy of Learning Private Limited

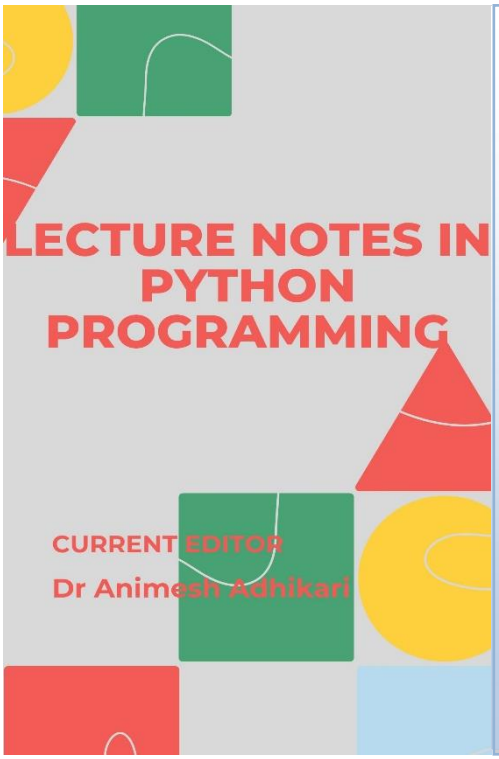
Communications of Adhikari Academy of Learning
in
Computer Science and Information Technology

EDITORS

Published by Adhikari Academy of Learning Private Limited, F-2, Kurtarkar Nagari-30, Shantinagar, Ponda, Goa - 403401, India

News

We published the book *Lecture Notes in Python Programming* recently. Details of the book are given as follows. Python programming language has many features such as simplicity, readability, extensive library support, cross-platform compatibility, and scalability. It is useful in accomplishing real-world tasks in many areas. The capability of Python is virtually unlimited. Today, Python is included in all the academic programs as a computer programming language to learn. The book contains 155 pages with twenty-six lecture notes covering the most relevant concepts.



Editor(s): Dr Animesh Adhikari, Ph D

Biography: Dr Animesh Adhikari is Founder and Editor of Adhikari Academy of Learning Private Limited, Goa, India. Animesh received Master of Technology and Ph D degrees, both in Computer Science, from Indian Statistical Institute and Goa University, respectively.

Animesh has been working in both academia and software industry since 1993. In the past, he served to K L University, Guntur; Chowgule College, Margao; and Price Waterhouse Associates, Kolkata.

Animesh published three research monographs on *Data and Knowledge Engineering* with Springer, Germany, and twenty research papers in international journals and international conferences. He published twenty-nine books on various aspects of Computer Science and Information Technology with Adhikari Academy of Learning, Goa. Animesh also published a few derived books such as Mathematics for Computer Science and Information Technology, and GATE - Computer Science and Information Technology.

For more details about the book, please visit book webpage.

Table of Contents

Keywords

1. What are aggregate functions in SQL? Elaborate most commonly used SQL aggregate functions.

Communicated by Jhimli Adhikari

Answer: An aggregate function performs a calculation on a set of values, and returns a single value. The most commonly used SQL aggregate functions are given below.

- `MIN()` is used to find the smallest value within the selected column
- `MAX()` is used to find the largest value within the selected column
- `COUNT()` is used to find the number of rows in a set
- `SUM()` is used to find total sum of a numerical column
- `AVG()` is used to find average value of a numerical column

We take an example query involving above aggregate functions, one function at a time (in the `fetch` section) of the program as given below.

```
--create
CREATE TABLE EMPLOYEE (
     empId INTEGER PRIMARY KEY,
     name TEXT NOT NULL,
     dept TEXT NOT NULL,
     salary INTEGER
);
--insert
INSERT INTO EMPLOYEE VALUES (0001, 'Ravana', 'Sales', 30000);
INSERT INTO EMPLOYEE VALUES (0002, 'Eva', 'Accounting', 40000);
INSERT INTO EMPLOYEE VALUES (0002, 'Ava', 'Sales', 20000);
INSERT INTO EMPLOYEE VALUES (0002, 'Salil', 'Sales', 60000);
--fetch
SELECT name, MIN(salary) FROM EMPLOYEE;
```

The output of program is given below.

```
Ava | 20000
```

Text after `--` stands as a comment.

Replacing `fetch` block by the following block.

```
--fetch
SELECT name, MAX(salary) FROM EMPLOYEE;
```

The output of program is given below.

```
Salil | 60000
```

Replacing `fetch` block by the following block.

```
--fetch
SELECT name, COUNT(*) FROM EMPLOYEE;
```

The output of program is given below.

```
4
```


Replacing `fetch` block by the following block.

```
--fetch
SELECT name, SUM(salary) FROM EMPLOYEE;
```

The output of program is given below.

```
150000
```

Replacing `fetch` block by the following block.

```
--fetch
SELECT name, AVG(salary) FROM EMPLOYEE;
```

The output of program is given below.

```
37500.0
```

NOTE: The above program is executed online using *sqlite*, supported by *onecompiler.com*

2. Evaluate $\int_0^{\frac{1}{6}} \frac{x^5}{(36x^2+1)^{\frac{3}{2}}} dx$.

Communicated by Animesh Adhikari

Answer: Let $I = \int_0^{\frac{1}{6}} \frac{x^5}{(36x^2+1)^{\frac{3}{2}}} dx$

Here denominator $= (36x^2+1)^{\frac{3}{2}} = \left(\sqrt{36x^2+1}\right)^3$

For type of expression $\sqrt{a^2+b^2x^2}$, substitute $x = \frac{a}{b}\tan\theta, -\frac{\pi}{2} < \theta < \frac{\pi}{2}$

In this case, $a = 1, b = 6$. Put $x = \frac{1}{6}\tan\theta$. Then $dx = \frac{1}{6}sec^2\theta\, d\theta$

When $x = 0, \theta = tan^{-1}(0) = 0$

When $x = \frac{1}{6}, \theta = tan^{-1}(1) = \frac{\pi}{4}$

$$I = \int_0^{\frac{\pi}{4}} \frac{\left(\frac{1}{7776}tan^5\theta\right)}{sec^3\theta}\frac{1}{6}sec^2\theta d\theta = \frac{1}{46656}\int_0^{\frac{\pi}{4}} \frac{tan^5\theta}{sec\theta}d\theta = \frac{1}{46656}\int_0^{\frac{\pi}{4}} \frac{sin^5\theta}{cos^4\theta}d\theta$$

Let $t = \cos\theta$. Then $dt = -sin\theta\, d\theta$

When $\theta = 0, t = cos(0) = 1$

When $\theta = \frac{\pi}{4}, t = cos\left(\frac{\pi}{4}\right) = \frac{\sqrt{2}}{2}$

$$I = \frac{1}{46656}\int_0^{\frac{\pi}{4}} \frac{(1-cos^2\theta)^2}{cos^4\theta} sin\theta\, d\theta = -\frac{1}{46656}\int_1^{\frac{\sqrt{2}}{2}} \frac{(1-t^2)^2}{t^4}\, dt = -\frac{1}{46656}\int_1^{\frac{\sqrt{2}}{2}} \frac{1-2t^2+t^4}{t^4}\, dt$$

$$I = -\frac{1}{46656}\int_{1}^{\frac{\sqrt{2}}{2}} (t^{-4} - 2t^{-2} + 1)\ dt = -\frac{1}{46656}\left(-\frac{1}{3t^3} + \frac{2}{t} + t\right)\Big|_{1}^{\frac{\sqrt{2}}{2}}$$

$$I = -\frac{1}{46656}\left[-\frac{8}{3(\sqrt{2})^3} + \frac{4}{\sqrt{2}} + \frac{\sqrt{2}}{2} + \frac{1}{3} - 2 - 1\right] = -\frac{1}{46656}\left[-\frac{4}{3\sqrt{2}} + 2\sqrt{2} + \frac{1}{\sqrt{2}} - \frac{8}{3}\right]$$

$$I = \frac{1}{46656}\left[\frac{4\sqrt{2}}{6} - 2\sqrt{2} - \frac{\sqrt{2}}{2} + \frac{8}{3}\right] = \frac{1}{46656}\left[\frac{8}{3} - \frac{11\sqrt{2}}{6}\right] = \frac{1}{17496} - \frac{11\sqrt{2}}{279936}$$

3. In a balanced binary search tree with n elements, what is the worst-case time complexity of reporting all elements in range $[a, b]$? Assume that the number of reported elements is k.

(A) $\theta(log\ n)$ ***(B) $\theta(log\ n + k)$*** ***(C) $\theta(k\ log\ n)$*** ***(D) $\theta(n\ log\ n)$***

Communicated by Animesh Adhikari

Answer: A range tree on a set of 1-dimensional points is a balanced binary search tree on those points. A range query on a range tree reports the set of points that lie inside a given interval. Consider 1-dimensional range query $[x_1, x_2]$, where $x_1 = a, x_2 = b$.The search paths to $x_1$and x_2 have length $\theta(log\ n)$. Using a tree traversal algorithm, one can report all points in subtree of a vertex in linear time. In this case, there are k elements in the query interval. The time complexity to perform range query is $\theta(log\ n + k)$. So, option (B) is correct.

NOTE: For more information about range tree, see Wikipedia.

4 What is heterogeneous object? Give a programming example using Java.

Communicated by Animesh Adhikari

Answer: Java is a strongly typed language. Java technology provides the developer with a comprehensive security framework for writing applications, and also provides the user or administrator with a set of tools to securely manage applications. In this context, the heterogeneity can be achieved through mechanisms like object. In Java, a heterogeneous object typically refers to a collection or data structure that can store elements of different data types. A programming example using Java is given below.

```
import java.util.ArrayList;
import java.util.List;

public class HeterogeneousList {
    public static void main(String[] args) {
        List<Object> heteroList = new ArrayList<>();
        heteroList.add("Hello, Mahesh"); // String
        heteroList.add(555);    // Integer
        heteroList.add(true);   // Boolean
        heteroList.add(new MyCustomClass()); // Custom object
        for (Object obj : heteroList) {
            System.out.println(obj.getClass().getName());
        }
    }
}
class MyCustomClass{
```



```
        public static void message(String[] args) {
                System.out.println("Good morning!");
        }
    }
```

In this example, `heteroList` object stores different types of data. The output of the above program is given below.

```
java.lang.String
java.lang.Integer
java.lang.Boolean
MyCustomClass
```

5 Why does rename operation is considered as a fundamental operation in relational algebra.

Communicated by Animesh Adhikari

Answer: The purpose of rename operation (ρ) is to rename a relation. For example, $\rho_X(Student)$ renames the relation $Student$ to relation X. In some queries, the value of a field for a particular record is required to compare the value of the same field for other records. For example, one such query could be to find the name of the highest salaried employee. We need to compare the salary of one employee with salary of other employees. This is only possible if we have two instances of the same relation. So, we need to create another relation by changing the name of the original relation.
Consider the following query: Using relational algebra, find the largest account balance in table $Account = (accNo, balance)$.

This query, perhaps impossible to express in relational algebra without involving rename operation. The query can be expressed in relational algebra as follows.

$$\pi_{balance}(Account) - \pi_{Account.balance}\left(\sigma_{Account.balance<Y.balance}(Account \times \rho_Y(Account))\right)$$

where, π and σ are projection and selection operations in relational algebra respectively.

Contact Emails

01 **Animesh Adhikari**

animeshadhikari@yahoo.com

02 **Jhimli Adhikari**

jhimli_adhikari@yahoo.co.in

