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**DATA STRUCTURE AND ALGORITHM**

**DSA Practical No. 1**

**Title -**

Consider telephone book database of N clients. Make use of a hash table implementation to quickly look up client’s telephone Number. Make Use of two Collision Techniques and Compare them using number of Comparisons required to find a set of telephone numbers.

**Program -**

**Python program :LinearProbing.py –**

# Program to implement Hashing with Linear Probing

from Record import Record

class hashTable:

# initialize hash Table

def \_\_init\_\_(self):

self.size = int(input("Enter the Size of the hash table : "))

# initialize table with all elements 0

self.table = list(None for i in range(self.size))

self.elementCount = 0

self.comparisons = 0

# method that checks if the hash table is full or not

def isFull(self):

if self.elementCount == self.size:

return True

else:

return False

# method that returns position for a given element

def hashFunction(self, element):

return element % self.size

# method that inserts element into the hash table

def insert(self, record):

# checking if the table is full

if self.isFull():

print("Hash Table Full")

return False

isStored = False

position = self.hashFunction(record.get\_number())

# checking if the position is empty

if self.table[position] == None:

self.table[position] = record

print("Phone number of " + record.get\_name() + " is at position " + str(position))

isStored = True

self.elementCount += 1

# collisionoccured hence we do linear probing

else:

print("Collision has occured for " + record.get\_name() + "'s phone number at position " + str(

position) + " finding new Position.")

while self.table[position] != None:

position += 1

if position >= self.size:

position = 0

self.table[position] = record

print("Phone number of " + record.get\_name() + " is at position " + str(position))

isStored = True

self.elementCount += 1

return isStored

# method that searches for an element in the table

# returns position of element if found

# else returns False

def search(self, record, isFound=None):

found = False

position = self.hashFunction(record.get\_number())

self.comparisons += 1

if (self.table[position] != None):

if (self.table[position].get\_name() == record.get\_name() and self.table[

position].get\_number() == record.get\_number()):

isFound = True

print("Phone number found at position {} ".format(position) + " and total comparisons are " + str(1))

return position

# if element is not found at position returned hash function

else:

position += 1

if position >= self.size - 1:

position = 0

while self.table[position] != None or self.comparisons<= self.size:

if (self.table[position].get\_name() == record.get\_name() and self.table[

position].get\_number() == record.get\_number()):

isFound = True

# i=0

i = self.comparisons + 1

print(

"Phone number found at position {} ".format(position) + " and total comparisons are " + str(

i))

return position

position += 1

# print(position)

if position >= self.size - 1:

position = 0

# print(position)

self.comparisons += 1

# print(self.comparisons)

if isFound == False:

print("Record not found")

return false

# method to display the hash table

def display(self):

print("\n")

for i in range(self.size):

print("Hash Value: " + str(i) + "\t\t" + str(self.table[i]))

print("The number of phonebook records in the Table are : " + str(self.elementCount))

**Python Program: Record.py**

class Record:

    def \_\_init\_\_(self):

        self.\_name = None

        self.\_number = None

    def get\_name(self):

        return self.\_name

    def get\_number(self):

        return self.\_number

    def set\_name(self,name):

        self.\_name = name

    def set\_number(self,number):

        self.\_number = number

    def \_\_str\_\_(self):

        record = "Name: "+str(self.get\_name())+"\t"+"\tNumber: "+str(self.get\_number())

        return record

**Python Program: DoubleHashing.py –**

from Record import Record

class doubleHashTable:

    # initialize hash Table

    def \_\_init\_\_(self):

        self.size = int(input("Enter the Size of the hash table : "))

        # initialize table with all elements 0

        self.table = list(None for i in range(self.size))

        self.elementCount = 0

        self.comparisons = 0

    # method that checks if the hash table is full or not

    def isFull(self):

        if self.elementCount == self.size:

            return True

        else:

            return False

    # First hash function

    def h1(self, element):

        return element % self.size

    # Second hash function

    def h2(self, element):

        return 5-(element % 5)

    # method to resolve collision by double hashing method

    def doubleHashing(self, record):

        posFound = False

        # limit variable is used to restrict the function from going into infinite loop

        # limit is useful when the table is 80% full

        limit = self.size

        i = 1

        # start a loop to find the position

        while i<= limit:

            # calculate new position by quadratic probing

            newPosition = (self.h1(record.get\_number()) + i\*self.h2(record.get\_number())) % self.size

            # ifnewPosition is empty then break out of loop and return new Position

            if self.table[newPosition] == None:

                posFound = True

                break

            else:

                # as the position is not empty increase i

                i += 1

        return posFound, newPosition

    # method that inserts element inside the hash table

    def insert(self, record):

        # checking if the table is full

        if self.isFull():

            print("Hash Table Full")

            return False

        posFound = False

        position = self.h1(record.get\_number())

        # checking if the position is empty

        if self.table[position] == None:

            # empty position found , store the element and print the message

            self.table[position] = record

            print("Phone number of " + record.get\_name() + " is at position " + str(position))

            isStored = True

            self.elementCount += 1

        # If collision occured

        else:

            print("Collision has occured for " + record.get\_name() + "'s phone number at position " + str(position) + " finding new Position.")

            while not posFound:

                posFound, position = self.doubleHashing(record)

                if posFound:

                    self.table[position] = record

                    #print(self.table[position])

                    self.elementCount += 1

                    #print(position)

                    #print(posFound)

                    print("Phone number of " + record.get\_name() + " is at position " + str(position))

        return posFound

    # searches for an element in the table and returns position of element if found else returns False

    def search(self, record):

        found = False

        position = self.h1(record.get\_number())

        self.comparisons += 1

        if(self.table[position] != None):

            if(self.table[position].get\_name() == record.get\_name()):

                print("Phone number found at position {}".format(position) + " and total comparisons are " + str(1))

                return position

            # if element is not found at position returned hash function

            # then we search element using double hashing

            else:

                limit = self.size

                i = 1

                newPosition = position

                # start a loop to find the position

                while i<= limit:

                    # calculate new position by double Hashing

                    position = (self.h1(record.get\_number()) + i\*self.h2(record.get\_number())) % self.size

                    self.comparisons += 1

                    # if element at newPosition is equal to the required element

                    if(self.table[position] != None):

                        if self.table[position].get\_name() == record.get\_name():

                            found = True

                            break

                        elifself.table[position].get\_name() == None:

                            found = False

                            break

                        else:

                            # as the position is not empty increase i

                            i += 1

            if found:

                print("Phone number found at position {}".format(position) + " and total comparisons are " + str(i+1))

#return position

            else:

                print("Record not Found")

                return found

    # method to display the hash table

    def display(self):

        print("\n")

        for i in range(self.size):

            print("Hash Value: "+str(i) + "\t\t" + str(self.table[i]))

        print("The number of phonebook records in the Table are : " + str(self.elementCount))

**Python Program: main.py –**

from LinearProbing import hashTable

from Record import Record

from DoubleHashing import doubleHashTable

def input\_record():

    record = Record()

    name = input("Enter Name:")

    number = int(input("Enter Number:"))

    record.set\_name(name)

    record.set\_number(number)

    return record

choice1 = 0

while(choice1 != 3):

    print("\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*")

    print("1. Linear Probing      \*")

    print("2. Double Hashing      \*")

    print("3. Exit                \*")

    print("\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*")

    choice1 = int(input("Enter Choice"))

    if choice1>3:

        print("Please Enter Valid Choice")

    if choice1 == 1:

        h1 = hashTable()

        choice2 = 0

        while(choice2 != 4):

            print("\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*")

            print("1. Insert              \*")

            print("2. Search              \*")

            print("3. Display             \*")

            print("4. Back                \*")

            print("\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*")

            choice2 = int(input("Enter Choice"))

            if choice2>4:

                print("Please Enter Valid Choice")

            if(choice2==1):

                record = input\_record()

                h1.insert(record)

            elif(choice2 == 2):

                record = input\_record()

                position = h1.search(record)

            elif(choice2 == 3):

                h1.display()

    elif choice1 == 2:

        h2 = doubleHashTable()

        choice2 = 0

        while(choice2 != 4):

            print("\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*")

            print("1. Insert              \*")

            print("2. Search              \*")

            print("3. Display             \*")

            print("4. Back                \*")

            print("\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*")

            choice2 = int(input("Enter Choice"))

            if choice2>4:

                print("Please Enter Valid Choice")

            if(choice2==1):

                record = input\_record()

                h2.insert(record)

            elif(choice2 == 2):

                record = input\_record()

                position = h2.search(record)

            elif(choice2 == 3):

                h2.display()

**Output -**

F:\pythonProject\venv\Scripts\python.exe F:/pythonProject/main.py

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1. Linear Probing \*

2. Double Hashing \*

3. Exit \*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Enter Choice1

Enter the Size of the hash table : 5

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1. Insert \*

2. Search \*

3. Display \*

4. Back \*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Enter Choice1

Enter Name:Priyanka

Enter Number:1234

Phone number of Priyanka is at position 4

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1. Insert \*

2. Search \*

3. Display \*

4. Back \*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Enter Choice2

Enter Name:Priyanka

Enter Number:1234

Phone number found at position 4 and total comparisons are 1

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1. Insert \*

2. Search \*

3. Display \*

4. Back \*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Enter Choice3

Hash Value: 0 None

Hash Value: 1 None

Hash Value: 2 None

Hash Value: 3 None

Hash Value: 4 Name: Priyanka Number: 1234

The number of phonebook records in the Table are : 1

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1. Insert \*

2. Search \*

3. Display \*

4. Back \*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Enter Choice4

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1. Linear Probing \*

2. Double Hashing \*

3. Exit \*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Enter Choice2

Enter the Size of the hash table : 5

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1. Insert \*

2. Search \*

3. Display \*

4. Back \*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Enter Choice1

Enter Name:Prasad

Enter Number:7865

Phone number of ram is at position 0

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1. Insert \*

2. Search \*

3. Display \*

4. Back \*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Enter Choice2

Enter Name:Prasad

Enter Number:7865

Phone number found at position 0 and total comparisons are 1

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1. Insert \*

2. Search \*

3. Display \*

4. Back \*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Enter Choice3

Hash Value: 0 Name: Prasad Number: 7865

Hash Value: 1 None

Hash Value: 2 None

Hash Value: 3 None

Hash Value: 4 None

The number of phonebook records in the Table are : 1

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1. Insert \*

2. Search \*

3. Display \*

4. Back \*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Enter Choice4

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1. Linear Probing \*

2. Double Hashing \*

3. Exit \*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Enter Choice3

Process finished with exit code 0