Hash Function Report

Data Structures Assignment 4
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Hash Function #1: Summation Hash Code

```
long FlightHASHTABLE::hashCode(string key){
    unsigned int h = 0;
    for (int i=0;i<key.length();i++) {
        h += (unsigned int) key[i];
    }
    return h%capacity;
}
```

Number of Collisions per Dataset:

1k dataset

```
---------------------------------
import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions        :Print number of collisions
add                     :Add a new flight-ticket
delete <key>            :Delete a flight-ticket
find <key>              :Find a flight-ticket's details
allinday <date>         :Display all flight-tickets in a day
printASC <key>          :Print flight-tickets in ascending order
exit                    :Exit the program
>count_collisions
Total number of collisions is 391
```

10k dataset

```
---------------------------------
import <path>            :Import flight-tickets from a CSV file
export <path>            :Export flight-tickets to a CSV file
count_collisions         :Print number of collisions
add                      :Add a new flight-ticket
delete <key>             :Delete a flight-ticket
find <key>               :Find a flight-ticket's details
allinday <date>          :Display all flight-tickets in a day
printASC <key>           :Print flight-tickets in ascending order
exit                     :Exit the program
>count_collisions
Total number of collisions is 1772
```

100k dataset

```
---------------------------------
import <path>            :Import flight-tickets from a CSV file
export <path>            :Export flight-tickets to a CSV file
count_collisions         :Print number of collisions
add                      :Add a new flight-ticket
delete <key>             :Delete a flight-ticket
find <key>               :Find a flight-ticket's details
allinday <date>          :Display all flight-tickets in a day
printASC <key>           :Print flight-tickets in ascending order
exit                     :Exit the program
>count_collisions
Total number of collisions is 1809
```

Hash Function #2: Polynomial Summation Hash Code

```
long FlightHASHTABLE::hashCode(string key){
    unsigned int h = 0;

    for (int i=0;i<key.length();i++) {
        h = h*29+(unsigned int) key[i];
    }

    return h%capacity;
}
```

Number of Collisions per Dataset:

1k dataset

```
---------------------------------
import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions        :Print number of collisions
add                     :Add a new flight-ticket
delete <key>            :Delete a flight-ticket
find <key>              :Find a flight-ticket's details
allinday <date>         :Display all flight-tickets in a day
printASC <key>          :Print flight-tickets in ascending order
exit                    :Exit the program
>count_collisions
Total number of collisions is 1
```

10k dataset

```
---------------------------------
import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions        :Print number of collisions
add                     :Add a new flight-ticket
delete <key>            :Delete a flight-ticket
find <key>              :Find a flight-ticket's details
allinday <date>         :Display all flight-tickets in a day
printASC <key>          :Print flight-tickets in ascending order
exit                    :Exit the program
>count_collisions
Total number of collisions is 8
```

100k dataset

```
---------------------------------
import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions        :Print number of collisions
add                     :Add a new flight-ticket
delete <key>            :Delete a flight-ticket
find <key>              :Find a flight-ticket's details
allinday <date>         :Display all flight-tickets in a day
printASC <key>          :Print flight-tickets in ascending order
exit                    :Exit the program
>count_collisions
Total number of collisions is 8
```

Hash Function #3: Cyclic Shift Hash Code

```
long FlightHASHTABLE::hashCode(string key){
    unsigned int h = 0;
    int l = key.length();
    for (int i = 0; i < l; i++) {
        h = (h << 5) | (h >> 27);
        h += (unsigned int) key[i];
    }
    return h%capacity;
}
```

Number of Collisions per Dataset:

1k dataset

```
---------------------------------
import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions        :Print number of collisions
add                     :Add a new flight-ticket
delete <key>            :Delete a flight-ticket
find <key>              :Find a flight-ticket's details
allinday <date>         :Display all flight-tickets in a day
printASC <key>          :Print flight-tickets in ascending order
exit                    :Exit the program
>count_collisions
Total number of collisions is 0
```

10k dataset

```
---------------------------------
import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions        :Print number of collisions
add                     :Add a new flight-ticket
delete <key>            :Delete a flight-ticket
find <key>              :Find a flight-ticket's details
allinday <date>         :Display all flight-tickets in a day
printASC <key>          :Print flight-tickets in ascending order
exit                    :Exit the program
>count_collisions
Total number of collisions is 0
```

100k dataset

```
---------------------------------
import <path>            :Import flight-tickets from a CSV file
export <path>            :Export flight-tickets to a CSV file
count_collisions         :Print number of collisions
add                      :Add a new flight-ticket
delete <key>             :Delete a flight-ticket
find <key>               :Find a flight-ticket's details
allinday <date>          :Display all flight-tickets in a day
printASC <key>           :Print flight-tickets in ascending order
exit                     :Exit the program
>count_collisions
Total number of collisions is 0
```

Hash Function #4: XOR Based Summation Hash Code

```
long FlightHASHTABLE::hashCode(string key){
    unsigned int h = 0;

    for (int i=0;i<key.length();i++) {
        h += h^((unsigned int) key[i]);
    }

    return h%capacity;
}
```

Number of Collisions per Dataset:

1k dataset

```
---------------------------------
import <path>            :Import flight-tickets from a CSV file
export <path>            :Export flight-tickets to a CSV file
count_collisions         :Print number of collisions
add                      :Add a new flight-ticket
delete <key>             :Delete a flight-ticket
find <key>               :Find a flight-ticket's details
allinday <date>          :Display all flight-tickets in a day
printASC <key>           :Print flight-tickets in ascending order
exit                     :Exit the program
>count_collisions
Total number of collisions is 272
```

10k dataset

```
---------------------------------
import <path>             :Import flight-tickets from a CSV file
export <path>             :Export flight-tickets to a CSV file
count_collisions          :Print number of collisions
add                       :Add a new flight-ticket
delete <key>              :Delete a flight-ticket
find <key>                :Find a flight-ticket's details
allinday <date>           :Display all flight-tickets in a day
printASC <key>            :Print flight-tickets in ascending order
exit                      :Exit the program
>count_collisions
Total number of collisions is 1484
```

100k dataset

```
---------------------------------
import <path>            :Import flight-tickets from a CSV file
export <path>            :Export flight-tickets to a CSV file
count_collisions         :Print number of collisions
add                      :Add a new flight-ticket
delete <key>             :Delete a flight-ticket
find <key>               :Find a flight-ticket's details
allinday <date>          :Display all flight-tickets in a day
printASC <key>           :Print flight-tickets in ascending order
exit                     :Exit the program
>count_collisions
Total number of collisions is 1518
```

Hash Function #5: Modular Multiplication Hash Code

```
long FlightHASHTABLE::hashCode(string key){
    unsigned int h = 0;

    for (int i=0;i<key.length();i++) {
        h = (h*29)%101+(unsigned int) key[i];
    }

    return h%capacity;
}
```

Number of Collisions per Dataset:

1k dataset

```
---------------------------------
import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions        :Print number of collisions
add                     :Add a new flight-ticket
delete <key>            :Delete a flight-ticket
find <key>              :Find a flight-ticket's details
allinday <date>         :Display all flight-tickets in a day
printASC <key>          :Print flight-tickets in ascending order
exit                    :Exit the program
>count_collisions
Total number of collisions is 67
```

10k dataset

```
---------------------------------
import <path>            :Import flight-tickets from a CSV file
export <path>            :Export flight-tickets to a CSV file
count_collisions         :Print number of collisions
add                      :Add a new flight-ticket
delete <key>             :Delete a flight-ticket
find <key>               :Find a flight-ticket's details
allinday <date>          :Display all flight-tickets in a day
printASC <key>           :Print flight-tickets in ascending order
exit                     :Exit the program
>count_collisions
Total number of collisions is 570
```

100k dataset

```
---------------------------------
import <path>            :Import flight-tickets from a CSV file
export <path>            :Export flight-tickets to a CSV file
count_collisions         :Print number of collisions
add                      :Add a new flight-ticket
delete <key>             :Delete a flight-ticket
find <key>               :Find a flight-ticket's details
allinday <date>          :Display all flight-tickets in a day
printASC <key>           :Print flight-tickets in ascending order
exit                     :Exit the program
>count_collisions
Total number of collisions is 587
```

Hash Function #6: Combined XOR and Cyclic Shift Hash Code:

```
long FlightHASHTABLE::hashCode(string key){
    unsigned int h = 0;

    for (int i=0;i<key.length();i++) {
        h = (h<<5)^((unsigned int) key[i]);
    }

    return h%capacity;
}
```

Number of Collisions per Dataset:

1k dataset

```
---------------------------------
import <path>           :Import flight-tickets from a CSV file
export <path>           :Export flight-tickets to a CSV file
count_collisions        :Print number of collisions
add                     :Add a new flight-ticket
delete <key>            :Delete a flight-ticket
find <key>              :Find a flight-ticket's details
allinday <date>         :Display all flight-tickets in a day
printASC <key>          :Print flight-tickets in ascending order
exit                    :Exit the program
>count_collisions
Total number of collisions is 233
```

10k dataset

```
---------------------------------
import <path>            :Import flight-tickets from a CSV file
export <path>            :Export flight-tickets to a CSV file
count_collisions         :Print number of collisions
add                      :Add a new flight-ticket
delete <key>             :Delete a flight-ticket
find <key>               :Find a flight-ticket's details
allinday <date>          :Display all flight-tickets in a day
printASC <key>           :Print flight-tickets in ascending order
exit                     :Exit the program
>count_collisions
Total number of collisions is 935
```

100k dataset

```
---------------------------------
import <path>            :Import flight-tickets from a CSV file
export <path>            :Export flight-tickets to a CSV file
count_collisions         :Print number of collisions
add                      :Add a new flight-ticket
delete <key>             :Delete a flight-ticket
find <key>               :Find a flight-ticket's details
allinday <date>          :Display all flight-tickets in a day
printASC <key>           :Print flight-tickets in ascending order
exit                     :Exit the program
>count_collisions
Total number of collisions is 949
```

Summary

1. **Summation Hash Code**: 1k: 391, 10k:1772, 100k:1809
2. **Polynomial Summation Hash Code**: 1k: 1, 10k:8, 100k:8
3. **Cyclic Shift Hash Code**: 1k: 0, 10k:0, 100k:0
4. **Xor Based Summation Hash Code**: 1k:272, 10k:1484, 100k:1518
5. **Modular Multiplication Hash Code**: 1k: 67, 10k:570, 100k: 587
6. **Combined XOR and Cyclic Shift Hash Code**: 1k:233, 10k:935, 100k:949

Since cyclic shift gives zero collisions for all three datasets, it is set as the default dataset