ASSIGNMENT 5
16/03/23

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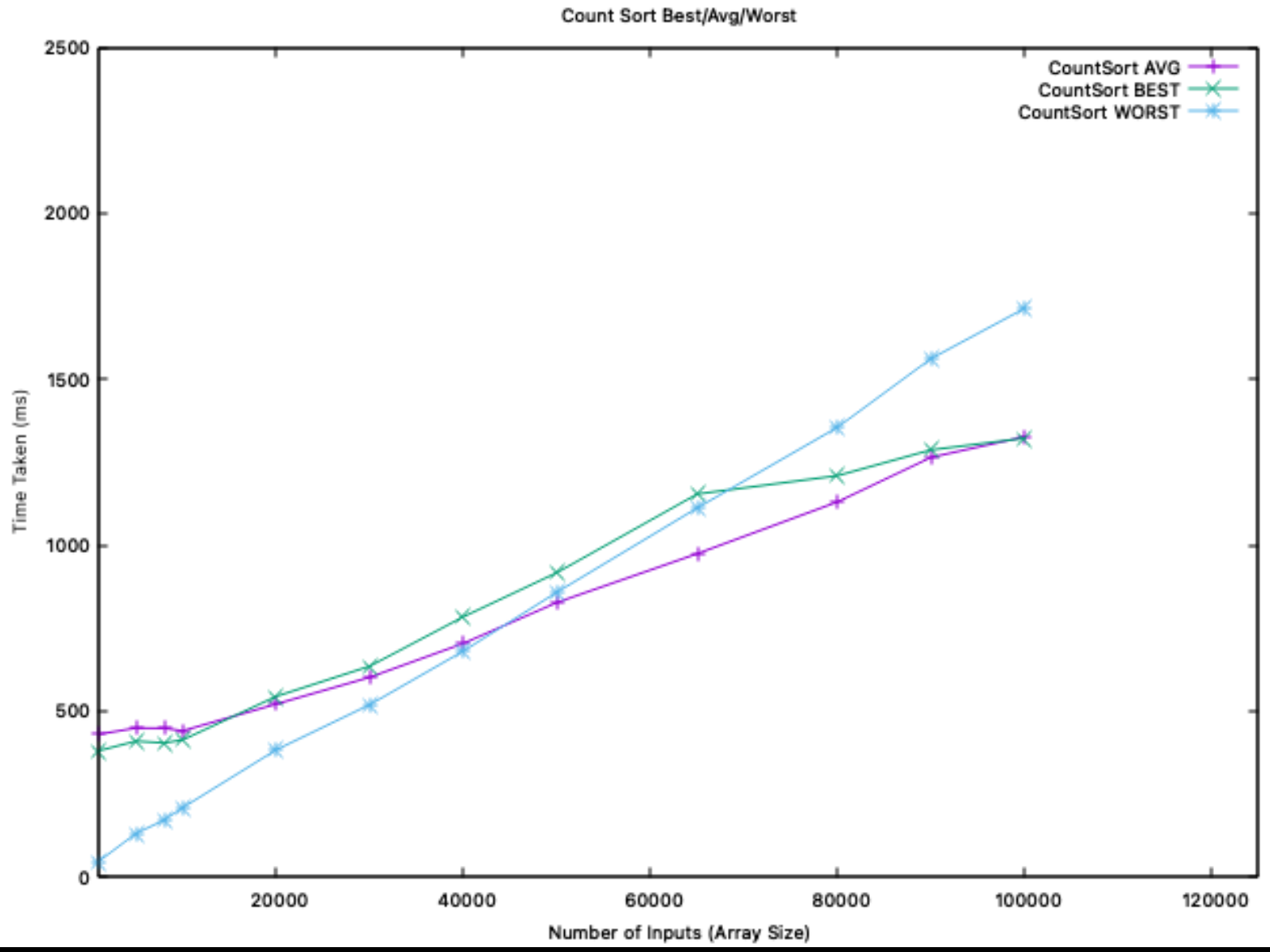
GROUP : CS4D
TOPIC : ANALYSIS OF ALGORITHM LAB
CODE : CS-14202

Q1

```c
// Analysis of CountSort over 100K entries

#include <stdio.h>
#include <stdlib.h>
#include <time.h>

clock_t begin;
clock_t end;

int findMax(int arr[], int n) {
    int i, mx = -16777216;
    for (i = 0; i < n; i++) {
        if (arr[i] > mx)
            mx = arr[i];
    }
    return mx;
}

void cSort(int arr[], int n) {
    int mx = findMax(arr, n);
    int i, j, *c;
    c = (int *) malloc(sizeof(int) * mx + 1);

    for (i = 0; i < mx + 1; i++)
        c[i] = 0;
    for (i = 0; i < n; i++)
        c[arr[i]]++;

    i = 0;
    j = 0;
    while (j < mx + 1) {
        if (c[j] > 0) {
            arr[i++] = j;
            c[j]--;
        } else j++;
    }
}

void writeTable(int size, double time, char *filename)
{
    int i;
    FILE *fp = fopen(filename, "a+");
```

```c
    if (fp == NULL) printf("FILE CANNOT BE OPENED\n");
    else {
        fprintf(fp, "%d %lf", size, time);
        fprintf(fp, "\n");
    }
    fclose(fp);
}

void readData(int arr[], char *filename) {
    FILE *fp = fopen(filename, "r+");
    char x[16];
    int i, k = 0;

    if (fp == NULL) printf("FILE CANNOT BE OPENED\n");
    else {
        while (fgets(x, 16, fp) != NULL) {
            int num = 0;
            fscanf(fp, "%d", &num);
            if (num == 0) break;
            arr[k++] = num;
        }
    }
    fclose(fp);
}

int main(int argc, char **argv) {
    int arr[100000];
    int size[] = {1000, 5000, 8000, 10000, 20000,
30000, 40000, 50000, 65000, 80000, 90000, 100000};
    int i = 0;
    for (i = 0; i <= 11; i++) {
        readData(arr, argv[1]);
        begin = clock();
        cSort(arr, size[i]);
        end = clock();
        writeTable(size[i], (end - begin), argv[2]);
    }
    return 0;
}
```




```
set autoscale                          # scale axes automatically
unset log                              # remove any log-scaling
unset label                            # remove any previous labels
set xtic auto                          # set xtics automatically
set ytic auto                          # set ytics automatically   set tics font
"Helvetica,10"
set title "Count Sort Best/Avg/Worst"
set xlabel "Number of Inputs (Array Size)"
set ylabel "Time Taken (ms)"

#set key 0.01,100
#set label "Yield Point" at 0.003,260
#set arrow from 0.0028,250 to 0.003,280

set xr [1000:125000]
set yr [0:2500]
plot    "cTableAVG.txt" using 1:2 title 'CountSort AVG' with linespoints, \
        "cTableBST.txt" using 1:2 title 'CountSort BEST' with linespoints, \
        "cTableWST.txt" using 1:2 title 'CountSort WORST' with linespoints
```

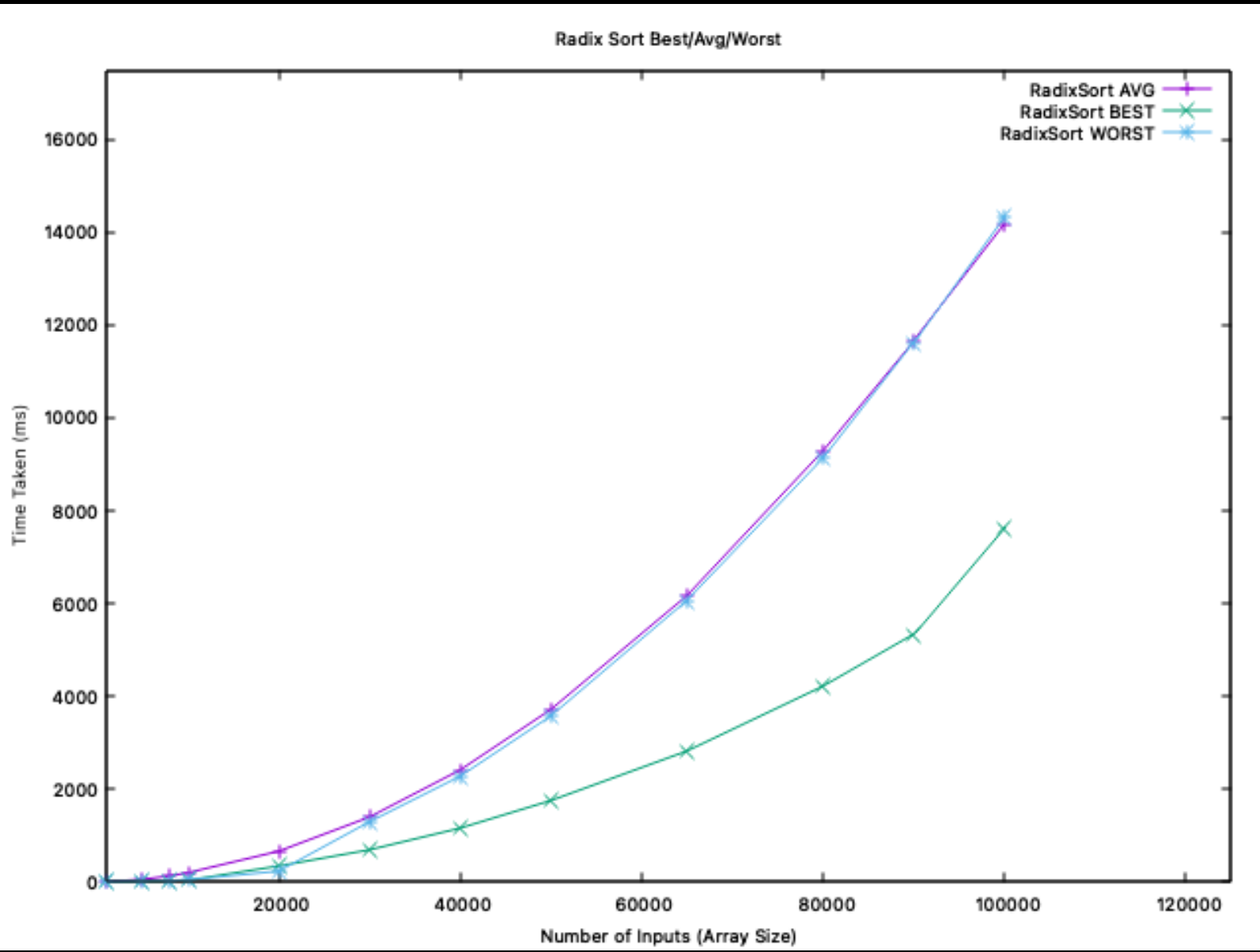
Q2

```
// Analysis of RadixSort over 100K entries

#include <iostream>
#include <stdlib.h>
#include <stdio.h>
#include <math.h>
#include <ctime>

using namespace std;

clock_t st;
clock_t en;

template<class T>
void Print(T &vec, int n, string s) {
    cout << s << ": [" << flush;
    for (int i = 0; i < n; i++) {
        cout << vec[i] << flush;
        if (i < n - 1) {
            cout << ", " << flush;
        }
    }
    cout << "]" << endl;
}

int Max(int A[], int n) {
    int max = -32768;
    for (int i = 0; i < n; i++) {
        if (A[i] > max) {
            max = A[i];
        }
    }
    return max;
}

class Node {
public:
    int value;
    Node *next;
};

int countDigits(int x) {
    int count = 0;
```

```
    while (x != 0) {
        x = x / 10;
        count++;
    }
    return count;
}

void initializeBins(Node **p, int n) {
    for (int i = 0; i < n; i++) {
        p[i] = nullptr;
    }
}

void Insert(Node **ptrBins, int value, int idx) {
    Node *temp = new Node;
    temp->value = value;
    temp->next = nullptr;

    if (ptrBins[idx] == nullptr) {
        ptrBins[idx] = temp;
    } else {
        Node *p = ptrBins[idx];
        while (p->next != nullptr) {
            p = p->next;
        }
        p->next = temp;
    }
}

int Delete(Node **ptrBins, int idx) {
    Node *p = ptrBins[idx];
    ptrBins[idx] = ptrBins[idx]->next;
    int x = p->value;
    delete p;
    return x;
}

int getBinIndex(int x, int idx) {
    return (int) (x / pow(10, idx)) % 10;
}

void rSort(int A[], int n) {
    int max = Max(A, n);
    int nPass = countDigits(max);
    Node **bins = new Node *[10];
```

```
    initializeBins(bins, 10);

    for (int pass = 0; pass < nPass; pass++) {
        for (int i = 0; i < n; i++) {
            int binIdx = getBinIndex(A[i], pass);
            Insert(bins, A[i], binIdx);
        }

        int i = 0;
        int j = 0;
        while (i < 10) {
            while (bins[i] != nullptr) {
                A[j++] = Delete(bins, i);
            }
            i++;
        }
        initializeBins(bins, 10);
    }
    delete[] bins;
}

void writeTable(int size, double time, char *filename)
{
    int i;
    FILE *fp = fopen(filename, "a+");

    if (fp == NULL) printf("FILE CANNOT BE OPENED\n");
    else {
        fprintf(fp, "%d %lf", size, time);
        fprintf(fp, "\n");
    }
    fclose(fp);
}

void readData(int arr[], char *filename) {
    FILE *fp = fopen(filename, "r+");
    char x[16];
    int i, k = 0;

    if (fp == NULL) printf("FILE CANNOT BE OPENED\n");
    else {
        while (fgets(x, 16, fp) != NULL) {
            int num = 0;
            fscanf(fp, "%d", &num);
            if (num == 0) break;
```

```
                arr[k++] = num;
            }
        }
        fclose(fp);
    }

    int main(int argc, char **argv) {
        int arr[100000];
        int size[] = {1000, 5000, 8000, 10000, 20000,
    30000, 40000, 50000, 65000, 80000, 90000, 100000};
        int i = 0;
        for (i = 0; i <= 11; i++) {
            readData(arr, argv[1]);
            st = clock();
            rSort(arr, size[i]);
            en = clock();
            writeTable(size[i], (en - st) / 2000, argv[2]);
        }
        return 0;
    }
```



Q3

```
// Analysis of BinSort over 100K entries

#include <iostream>
#include <stdlib.h>
#include <stdio.h>
#include <math.h>
#include <ctime>

using namespace std;

clock_t st;
clock_t en;

template<class T>
void Print(T &vec, int n, string s) {
    cout << s << ": [" << flush;
    for (int i = 0; i < n; i++) {
        cout << vec[i] << flush;
        if (i < n - 1) {
            cout << ", " << flush;
        }
    }
    cout << "]" << endl;
}

int Max(int A[], int n) {
    int max = -32768;
    for (int i = 0; i < n; i++) {
        if (A[i] > max) {
            max = A[i];
        }
    }
    return max;
}

class Node {
public:
    int value;
    Node *next;
};

void Insert(Node **ptrBins, int idx) {
    Node *temp = new Node;
```

```
    temp->value = idx;
    temp->next = nullptr;

    if (ptrBins[idx] == nullptr) {
        ptrBins[idx] = temp;
    } else {
        Node *p = ptrBins[idx];
        while (p->next != nullptr) {
            p = p->next;
        }
        p->next = temp;
    }
}

int Delete(Node **ptrBins, int idx) {
    Node *p = ptrBins[idx];
    ptrBins[idx] = ptrBins[idx]->next;
    int x = p->value;
    delete p;
    return x;
}

void binSort(int A[], int n) {
    int max = Max(A, n);
    Node **bins = new Node *[max + 1];

    for (int i = 0; i < max + 1; i++) {
        bins[i] = nullptr;
    }

    for (int i = 0; i < n; i++) {
        Insert(bins, A[i]);
    }

    int i = 0;
    int j = 0;
    while (i < max + 1) {
        while (bins[i] != nullptr) {
            A[j++] = Delete(bins, i);
        }
        i++;
    }
    delete[] bins;
}
```

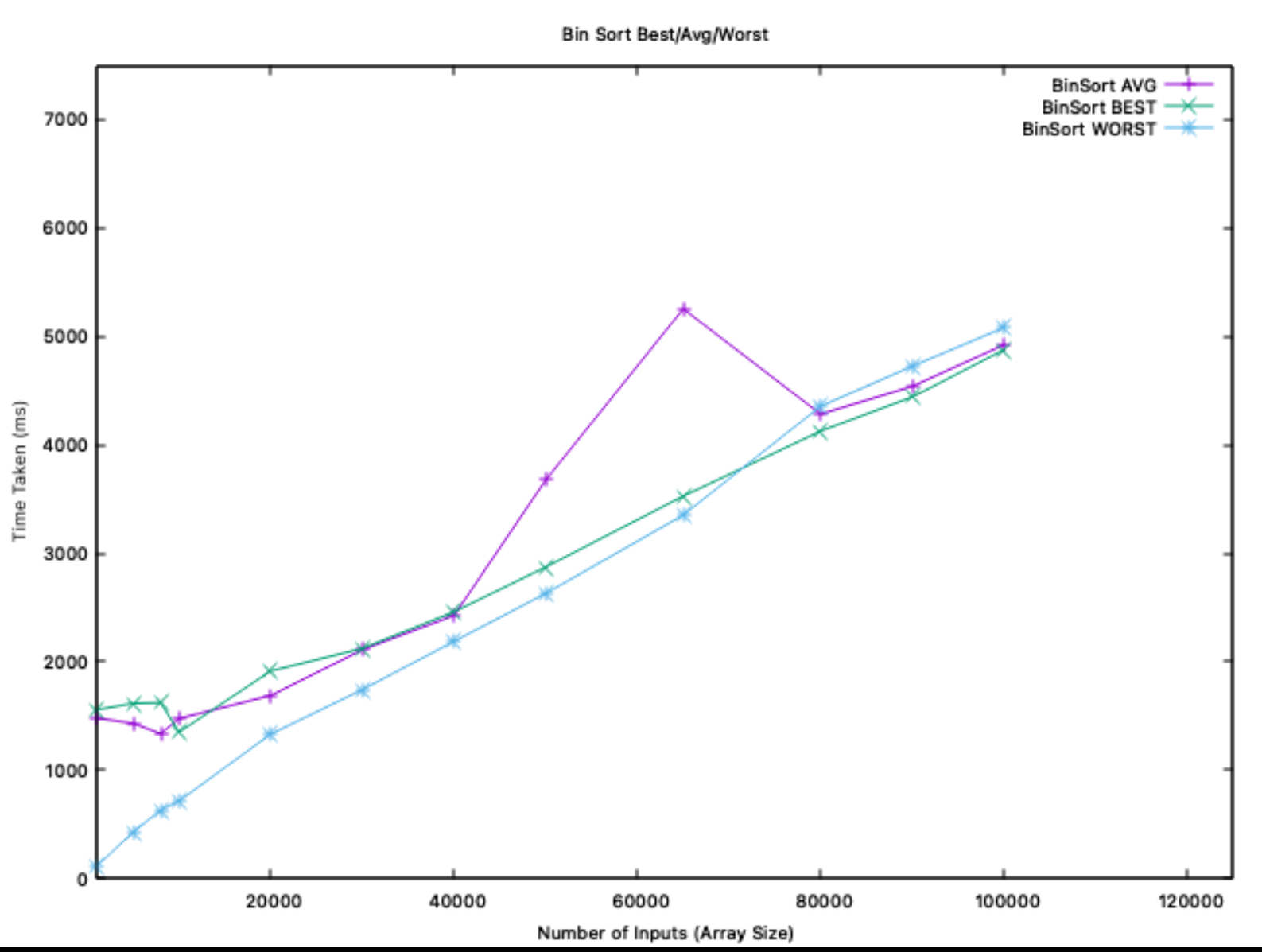
```c
void writeTable(int size, double time, char *filename)
{
    int i;
    FILE *fp = fopen(filename, "a+");

    if (fp == NULL) printf("FILE CANNOT BE OPENED\n");
    else {
        fprintf(fp, "%d %lf", size, time);
        fprintf(fp, "\n");
    }
    fclose(fp);
}

void readData(int arr[], char *filename) {
    FILE *fp = fopen(filename, "r+");
    char x[16];
    int i, k = 0;

    if (fp == NULL) printf("FILE CANNOT BE OPENED\n");
    else {
        while (fgets(x, 16, fp) != NULL) {
            int num = 0;
            fscanf(fp, "%d", &num);
            if (num == 0) break;
            arr[k++] = num;
        }
    }
    fclose(fp);
}

int main(int argc, char **argv) {
    int arr[100000];
    int size[] = {1000, 5000, 8000, 10000, 20000,
30000, 40000, 50000, 65000, 80000, 90000, 100000};
    int i = 0;
    for (i = 0; i <= 11; i++) {
        readData(arr, argv[1]);
        st = clock();
        binSort(arr, size[i]);
        en = clock();
        writeTable(size[i], (en - st), argv[2]);
    }
    return 0;
}
```

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set xtic auto                          # set xtics automatically
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"Helvetica,10"
set title "Bin Sort Best/Avg/Worst"
set xlabel "Number of Inputs (Array Size)"
set ylabel "Time Taken (ms)"

#set key 0.01,100
#set label "Yield Point" at 0.003,260
#set arrow from 0.0028,250 to 0.003,280

set xr [1000:125000]
set yr [0:7500]
plot    "bnTableAVG.txt" using 1:2 title 'BinSort AVG' with linespoints, \
        "bnTableBST.txt" using 1:2 title 'BinSort BEST' with linespoints, \
        "bnTableWST.txt" using 1:2 title 'BinSort WORST' with linespoints
```