分析 Sorting 時間

計算機演算法 作業 1

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目錄

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壹、　規則建立說明

分別建立五種排序法的程式，執行時會計算執行時間，並分別輸出執行結果，並建立一個批次檔輪流執行五種排序法。

貳、　程式碼

一、氣泡排序（Bubble sort）

```
# include <stdio.h>
# include <stdlib.h>
# include <unistd.h>
# include <windows.h>
# include <time.h>
# define TIMES 25
# define MAX 50000

int *generate_number (int *data) {
    for (int i = 0; i < MAX; i++) {
        data[i] = rand() % 1000000 + 1;
        ((i+1)%10 == 0) ? printf("%10d\n", data[i]) : printf("
%10d ", data[i]);
    }
    return (int *) data;
}

void check_number (int *data) {
    for (int i = 1; i < MAX; i++) {
        ((i+1)%10 == 0) ? printf("%10d\n", data[i]) : printf("
%10d ", data[i]);
    }
}

double bubble_sort (int *data) {
    srand(time(NULL));
```

```
    clock_t t_start = clock();

    for (int i = 0; i < MAX; i++) {
        for (int j = 0; j < MAX-i-1; j++) {
            if (data[j] > data[j+1]) {
                int temp = data[j];
                data[j] = data[j+1];
                data[j+1] = temp;
            }
        }
    }

    clock_t t_end = clock();
    return ((double)t_end - t_start) / CLOCKS_PER_SEC;
}

int main () {
    int data[MAX] = {0};
    double times[TIMES] = {0};

    FILE *output = fopen("bubble_sort_output.txt", "w");

    for (int i = 0; i < TIMES; i++) {
        generate_number(data);
        printf("\n\t%2d times Sorting Start...\n\n\n", i + 1);

        times[i] = bubble_sort(data);
        sleep(1);

        printf("\n\t%2d times Sorting End...\n\n\n", i + 1);
        check_number(data);

        printf("\n\t%2d times -
> Spend : %lf sec\n", i + 1, times[i]);
        sleep(2);
    }

    system("cls");

    for (int i = 0; i < TIMES; i++) {
```

```
        printf("%2d times -
> Spend : %lf sec\n", i + 1, times[i]);
        fprintf(output, "%2d times -
> Spend : %lf sec\n", i + 1, times[i]);
    }

    fclose(output);

    return 0;
}
```

二、選擇排序（Selection sort）

```
# include <stdio.h>
# include <stdlib.h>
# include <unistd.h>
# include <windows.h>
# include <time.h>
# define TIMES 25
# define MAX 50000

int *generate_number (int *data) {
    for (int i = 0; i < MAX; i++) {
        data[i] = rand() % 1000000 + 1;
        ((i+1)%10 == 0) ? printf("%10d\n", data[i]) : printf("
%10d ", data[i]);
    }
    return (int *) data;
}

void check_number (int *data) {
    for (int i = 1; i < MAX; i++) {
        ((i+1)%10 == 0) ? printf("%10d\n", data[i]) : printf("
%10d ", data[i]);
    }
}

double selection_sort (int *data) {
    srand(time(NULL));
    clock_t t_start = clock();
```

```
    for (int i = 0; i < MAX; i++) {
        for (int j = i + 1; j < MAX; j++) {
            if (data[i] > data[j]) {
                int temp = data[i];
                data[i] = data[j];
                data[j] = temp;
            }
        }
    }

    clock_t t_end = clock();
    return ((double)t_end - t_start) / CLOCKS_PER_SEC;
}

int main () {
    int data[MAX] = {0};
    double times[TIMES] = {0};

    FILE *output = fopen("selection_sort_output.txt", "w");

    for (int i = 0; i < TIMES; i++) {
        generate_number(data);
        printf("\n\t%2d times Sorting Start...\n\n\n", i + 1);

        times[i] = selection_sort(data);
        sleep(1);

        printf("\n\t%2d times Sorting End...\n\n\n", i + 1);

        check_number(data);

        printf("\n\t%2d times -
> Spend : %lf sec\n", i + 1, times[i]);
        sleep(2);
    }

    system("cls");

    for (int i = 0; i < TIMES; i++) {
```

```
        printf("%2d times -
> Spend : %lf sec\n", i + 1, times[i]);
        fprintf(output, "%2d times -
> Spend : %lf sec\n", i + 1, times[i]);
    }

    fclose(output);

    return 0;
}
```

三、插入排序（Insertion sort）

```
# include <stdio.h>
# include <stdlib.h>
# include <unistd.h>
# include <windows.h>
# include <time.h>
# define TIMES 25
# define MAX 50000

int *generate_number (int *data) {
    for (int i = 0; i < MAX; i++) {
        data[i] = rand() % 1000000 + 1;
        ((i+1)%10 == 0) ? printf("%10d\n", data[i]) : printf("
%10d ", data[i]);
    }
    return (int *) data;
}

void check_number (int *data) {
    for (int i = 1; i < MAX; i++) {
        ((i+1)%10 == 0) ? printf("%10d\n", data[i]) : printf("
%10d ", data[i]);
    }
}

double insertion_sort (int *data) {
    srand(time(NULL));
    clock_t t_start = clock();
```

```
    for (int i = 1; i < MAX; i++) {
        int insertion_index = i;
        while (insertion_index > 0 && (data[insertion_index-
1] > data[insertion_index])) {
            int temp = data[insertion_index];
            data[insertion_index] = data[insertion_index-1];
            data[insertion_index-1] = temp;
            insertion_index -= 1;
        }
    }

    clock_t t_end = clock();
    return ((double)t_end - t_start) / CLOCKS_PER_SEC;
}

int main () {
    int data[MAX] = {0};
    double times[TIMES] = {0};

    FILE *output = fopen("insertion_sort_output.txt", "w");

    for (int i = 0; i < TIMES; i++) {
        generate_number(data);
        printf("\n\t%2d times Sorting Start...\n\n\n", i + 1);

        times[i] = insertion_sort(data);
        sleep(1);

        printf("\n\t%2d times Sorting End...\n\n\n", i + 1);
        check_number(data);

        printf("\n\t%2d times -
> Spend : %lf sec\n", i + 1, times[i]);
        sleep(2);
    }

    system("cls");

    for (int i = 0; i < TIMES; i++) {
```

```
        printf("%2d times -
> Spend : %lf sec\n", i + 1, times[i]);
        fprintf(output, "%2d times -
> Spend : %lf sec\n", i + 1, times[i]);
    }

        fclose(output);

    return 0;
}
```

四、快速排序（Quick sort）

```
# include <stdio.h>
# include <stdlib.h>
# include <unistd.h>
# include <windows.h>
# include <time.h>
# define TIMES 25
# define MAX 50000

int *generate_number (int *data) {
    for (int i = 0; i < MAX; i++) {
        data[i] = rand() % 1000000 + 1;
        ((i+1)%10 == 0) ? printf("%10d\n", data[i]) : printf("
%10d ", data[i]);
    }
    return (int *) data;
}

void check_number (int *data) {
    for (int i = 1; i < MAX; i++) {
        ((i+1)%10 == 0) ? printf("%10d\n", data[i]) : printf("
%10d ", data[i]);
    }
}

int Partition(int *data, int front, int end){
    int i = front - 1, temp = 0;
    for (int j = front; j < end; j++) {
        if (data[j] < data[end]) {
```

```
            i++;
            temp = data[i];
            data[i] = data[j];
            data[j] = temp;
        }
    }
    i++;
    temp = data[i];
    data[i] = data[end];
    data[end] = temp;
    return i;
}

double quick_sort (int *data, int front, int end) {
    srand(time(NULL));
    clock_t t_start = clock();

    if (front < end) {
        int seed = Partition(data, front, end);
        quick_sort(data, front, seed - 1);
        quick_sort(data, seed + 1, end);
    }

    clock_t t_end = clock();
    return ((double)t_end - t_start) / CLOCKS_PER_SEC;
}

int main () {
    int data[MAX] = {0};
    double times[TIMES] = {0};

    FILE *output = fopen("quick_sort_output.txt", "w");

    for (int i = 0; i < TIMES; i++) {
        generate_number(data);
        printf("\n\t%2d times Sorting Start...\n\n\n", i + 1);

        times[i] = quick_sort(data, 0, MAX-1);
        sleep(1);
```

```
        printf("\n\t%2d times Sorting End...\n\n\n", i + 1);

        check_number(data);

        printf("\n\t%2d times -
> Spend : %lf sec\n", i + 1, times[i]);
        sleep(2);
    }

    system("cls");

    for (int i = 0; i < TIMES; i++) {
        printf("%2d times -
> Spend : %lf sec\n", i + 1, times[i]);
        fprintf(output, "%2d times -
> Spend : %lf sec\n", i + 1, times[i]);
    }

    fclose(output);

    return 0;
}
```

五、堆積排序（Heap sort）

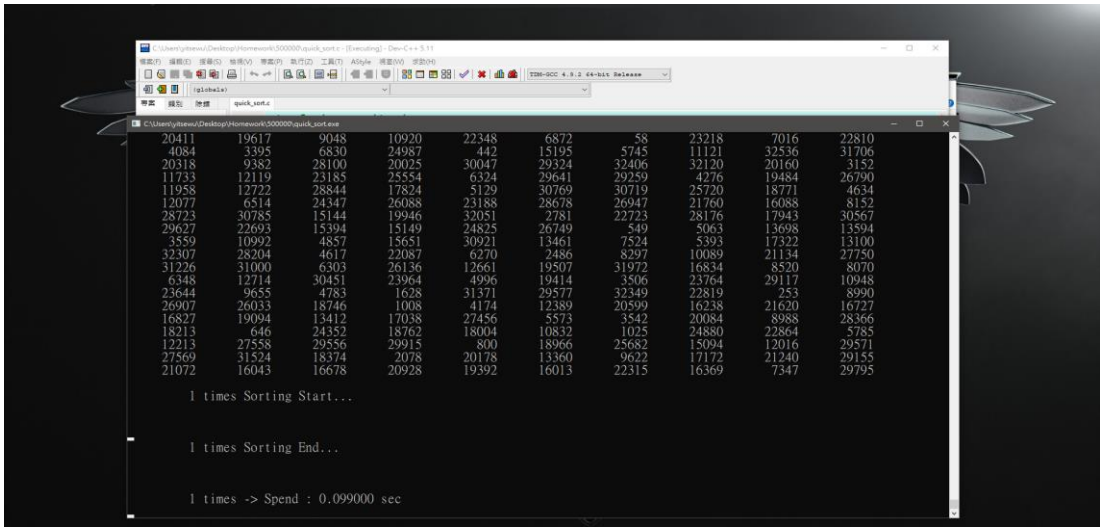
```
# include <stdio.h>
# include <stdlib.h>
# include <unistd.h>
# include <windows.h>
# include <time.h>
# define TIMES 25
# define MAX 50000

int *generate_number (int *data) {
    for (int i = 1; i < MAX; i++) {
        data[i] = rand() % 1000000 + 1;
        ((i+1)%10 == 0) ? printf("%10d\n", data[i]) : printf("
%10d ", data[i]);
    }
    return (int *) data;
}
```

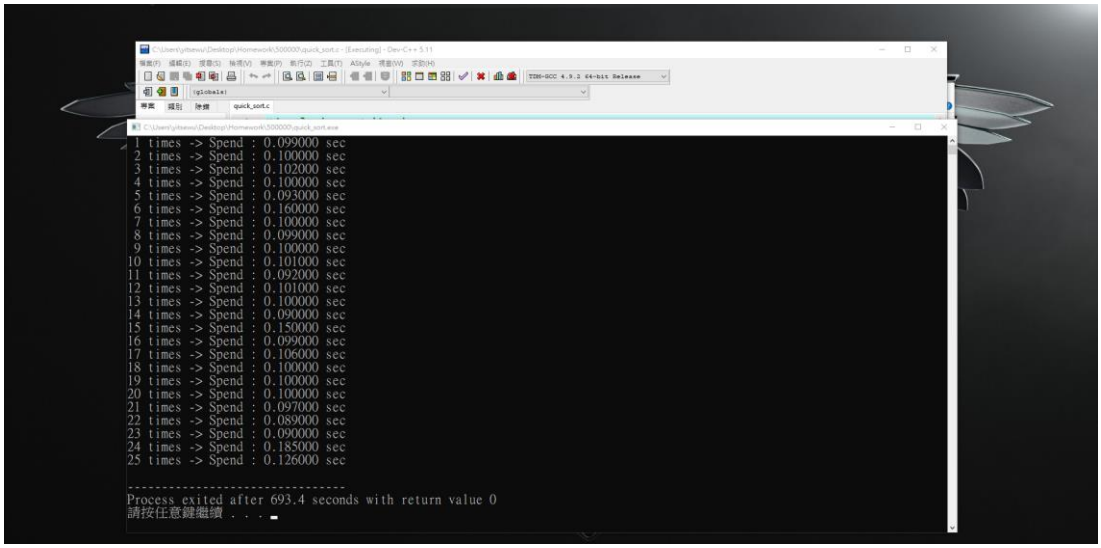
```
void check_number (int *data) {
    for (int i = 1; i < MAX; i++) {
        ((i+1)%10 == 0) ? printf("%10d\n", data[i]) : printf("
%10d ", data[i]);
    }
}

void MaxHeapify(int *data, int root, int length) {
    int left_child = 2 * root;
    int right_child = 2 * root + 1;
    int largest = 0;

    if (left_child <= length && data[left_child] > data[root])
 {
        largest = left_child;
    } else {
        largest = root;
    }

    if (right_child <= length && data[right_child] > data[larg
est]) {
        largest = right_child;
    }

    if (largest != root) {
        int temp = data[largest];
        data[largest] = data[root];
        data[root] = temp;
        MaxHeapify(data, largest, length);
    }
}

void BuildMaxHeap (int *data) {
    for (int i = MAX/2; i >= 1;i--) {
        MaxHeapify(data, i, MAX-1);
    }
}

double heap_sort (int *data) {
```

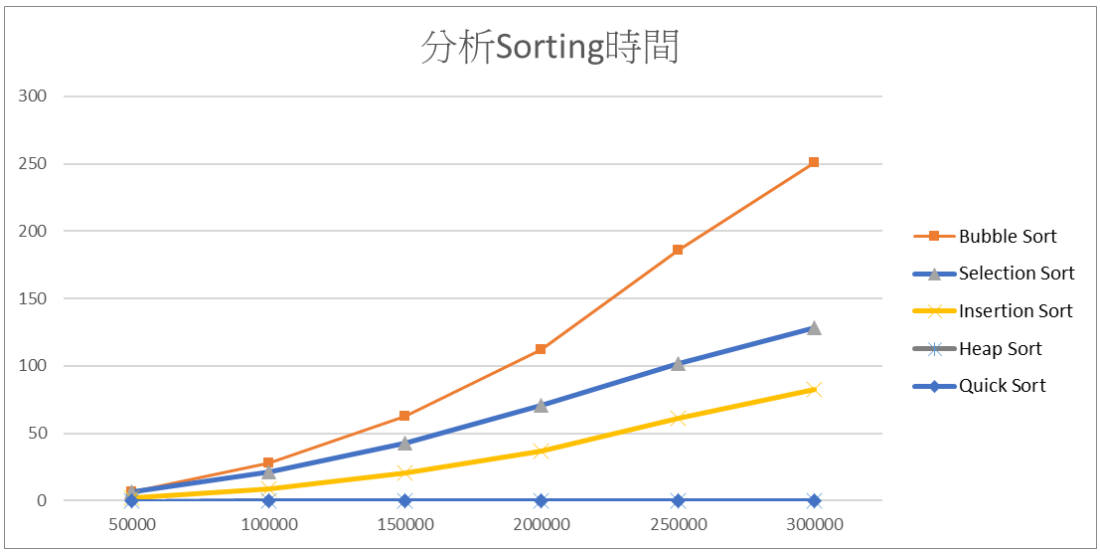
```
    srand(time(NULL));
    clock_t t_start = clock();

    BuildMaxHeap(data);

    int size = MAX-1;
    for (int i = size; i>=2 ; i--) {
        int temp = data[1];
        data[1] = data[i];
        data[i] = temp;
        size--;
        MaxHeapify(data, 1, size);
    }

    clock_t t_end = clock();
    return ((double)t_end - t_start) / CLOCKS_PER_SEC;
}

int main () {
    int data[MAX] = {0};
    double times[TIMES] = {0};

    FILE *output = fopen("heap_sort_output.txt", "w");


    for (int i = 0; i < TIMES; i++) {
        generate_number(data);
        printf("\n\t%2d times Sorting Start...\n\n\n", i + 1);

        times[i] = heap_sort(data);
        sleep(1);

        printf("\n\t%2d times Sorting End...\n\n\n", i + 1);

        check_number(data);

        printf("\n\t%2d times -
> Spend : %lf sec\n", i + 1, times[i]);
        sleep(2);
    }
```

```
    system("cls");

    for (int i = 0; i < TIMES; i++) {
        printf("%2d times -
> Spend : %lf sec\n", i + 1, times[i]);
        fprintf(output, "%2d times -
> Spend : %lf sec\n", i + 1, times[i]);
    }

    fclose(output);

    return 0;
}
```

參、 執行結果







肆、 討論

時間上來說，Bubble sort 真的最花時間，然後 Quick sort 跟 Heap sort 議整個快到不行，在測資 500000 的時候最有感覺。以下全部花費時間 Bubble Sort > Selection Sort > Insertion Sort > Quick Sort ~= Heap Sort。

伍、 心得

我寫好以後發現他真的要跑好久，然後一開始我沒有想好，沒有寫任何可以寫檔記錄的功能，然後分開寫的五隻程式，每隻跑六次，我花很多時間在等待要執行下一次，然後還會跑完沒記錄到，然後後來搞了寫檔，又寫了一隻批次檔，可以幫我跑全部，結果我寫檔的部分因為都是複製貼上寫好的同個模板，居然把 Selection Sort 跟 Bubble Sort 的輸出寫到同檔案，後來要寫報告的時候才發現大事不妙，只好再跑一次，然後再重新等那 500000 的跑完，整個氣到不行。