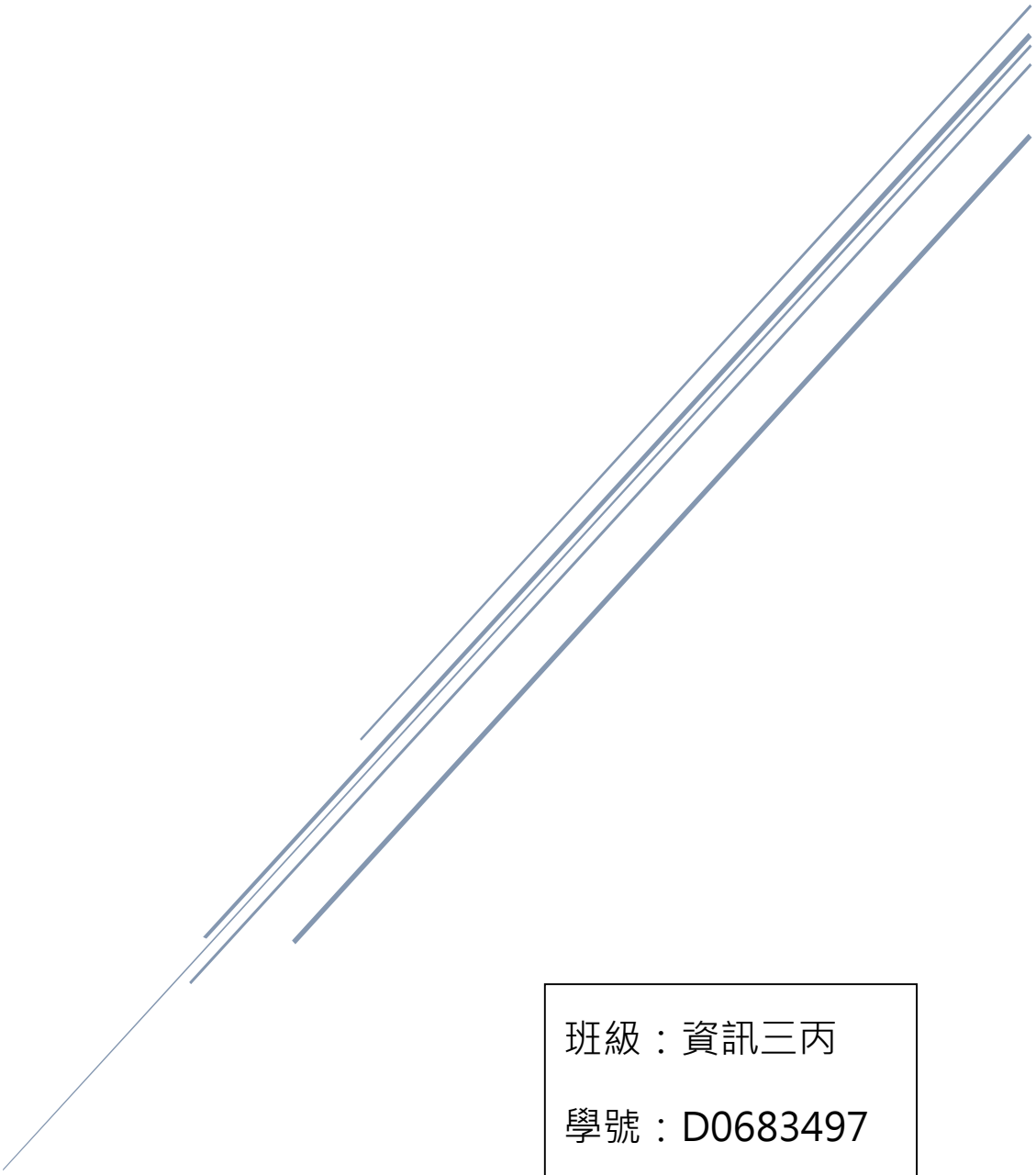
# 計算機演算法

作業一



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一、作法

依照 Bubble Sort、Selection Sort、Insertion Sort、Quick Sort、Heap Sort 的順序去做，每個排序法分別有一個 class，class 中的 Sort 方法為排序法的主程式、StartTest_排序法 會產生亂數、排序、計時，完成後會呼叫寫 excel 檔的 function。

二、程式碼

```
using System;

namespace HW01
{
    class Program
    {
        static void Main(string[] args)
        {
            foreach (var name in Config.SortList)
            {
                switch (name)
                {
                    case "Bubble Sort":
                        Console.WriteLine($"開始 {name}");
                        BubbleSort.StartTestBubbleSort();
                        break;
                    case "Selection Sort":
                        Console.WriteLine($"\n\n 開始 {name}");
                        SelectionSort.StartTestSelectionSort();
                        break;
                    case "Insertion Sort":
                        Console.WriteLine($"\n\n 開始 {name}");
                        InsertionSort.StartTestInsertionSort();
                        break;
                    case "Quick Sort":
                        Console.WriteLine($"\n\n 開始 {name}");
```

```
                        QuickSort.StartTestQuickSort();
                        break;
                    case "Heap Sort":
                        Console.WriteLine($"\n\n開始 {name}");
                        HeapSort.StartTestHeapSort();
                        break;
                    default:
                        break;
                }
            }

            Console.WriteLine("請按任意鍵退出");
            Console.ReadLine();
        }
    }
}
```

```
using System.Collections.Generic;
using System.IO;

namespace HW01
{
    public class Config
    {
        public static List<string> SortList = new List<string> { "Bu
bble Sort", "Selection Sort", "Insertion Sort", "Quick Sort", "Heap
Sort" };

        public static List<int> SeedList = new List<int> { 50000, 10
0000, 150000, 200000, 250000, 300000 };

        public static int Round = 25;

        public static string FileName = Path.Combine(Directory.GetCu
rrentDirectory(), "D0683497_HW01.xlsx");
    }
}
```

```
using System;
using System.Collections.Generic;
using System.Linq;
using DocumentFormat.OpenXml;
using DocumentFormat.OpenXml.Packaging;
using DocumentFormat.OpenXml.Spreadsheet;

namespace HW01
{
    public class Heaplers
    {
        public static List<int> GenderateRadomNumbers(int seed)
        {
            Random rand = new Random(Guid.NewGuid().GetHashCode());
            List<int> randList = new List<int>(Enumerable.Range(1, s
eed));
            return randList.OrderBy(o => rand.Next()).ToList<int>();
        }

        public static void Swap<T>(IList<T> list, int indexA, int in
dexB)
        {
            T tmp = list[indexA];
            list[indexA] = list[indexB];
            list[indexB] = tmp;
        }

        public class Record
        {
            public string SortName { get; set; }
            public string Seed { get; set; }
            public string Round { get; set; }
            public string Time { get; set; }
        }

        public static void WriteExcel(List<Record> records)
        {
            string sortName = records[0].SortName;
```

```
            if (sortName == "Bubble Sort")
            {
                CreateExcel(records);
            }
            else
            {
                EditExcel(records);
            }
        }

        private static void CreateExcel(List<Record> records)
        {
            using (SpreadsheetDocument document = SpreadsheetDocumen
t.Create(Config.FileName, SpreadsheetDocumentType.Workbook))
            {
                WorkbookPart workbookPart = document.AddWorkbookPart
();
                workbookPart.Workbook = new Workbook();
                WorksheetPart worksheetPart = workbookPart.AddNewPar
t<WorksheetPart>();
                worksheetPart.Worksheet = new Worksheet();

                Sheets sheets = workbookPart.Workbook.AppendChild(ne
w Sheets());
                Sheet sheet = new Sheet() { Id = workbookPart.GetIdO
fPart(worksheetPart), SheetId = 1, Name = records[0].SortName };
                sheets.Append(sheet);
                workbookPart.Workbook.Save();

                SheetData sheetData = worksheetPart.Worksheet.Append
Child(new SheetData());

                #region Header

                Row row = new Row();
                row.Append(
```

```
                    new Cell() { CellValue = new CellValue("演算法名
稱"), DataType = CellValues.String },
                    new Cell() { CellValue = new CellValue("亂數總數
"), DataType = CellValues.String },
                    new Cell() { CellValue = new CellValue("回合數
"), DataType = CellValues.String },
                    new Cell() { CellValue = new CellValue("時間
(秒)"), DataType = CellValues.String }
                );
                sheetData.AppendChild(row);

                #endregion

                #region Content

                foreach (var record in records)
                {
                    row = new Row();
                    row.Append(new Cell() { CellValue = new CellValu
e(record.SortName), DataType = CellValues.String });
                    row.Append(new Cell() { CellValue = new CellValu
e(record.Seed), DataType = CellValues.String });
                    row.Append(new Cell() { CellValue = new CellValu
e(record.Round), DataType = CellValues.String });
                    row.Append(new Cell() { CellValue = new CellValu
e(record.Time), DataType = CellValues.String });
                    sheetData.AppendChild(row);
                }

                #endregion

                worksheetPart.Worksheet.Save();
            }
        }

        private static void EditExcel(List<Record> records)
        {
```

```
            using (SpreadsheetDocument document = SpreadsheetDocumen
t.Open(Config.FileName, true))
            {
                WorksheetPart newWorksheetPart = document.WorkbookPa
rt.AddNewPart<WorksheetPart>();
                newWorksheetPart.Worksheet = new Worksheet();
                Sheets sheets = document.WorkbookPart.Workbook.GetFi
rstChild<Sheets>();
                string relationshipId = document.WorkbookPart.GetIdO
fPart(newWorksheetPart);

                uint sheetId = 1;
                if (sheets.Elements<Sheet>().Count() > 0)
                {
                    sheetId = sheets.Elements<Sheet>().Select(s => s
.SheetId.Value).Max() + 1;
                }
                Sheet sheet = new Sheet() { Id = relationshipId, She
etId = sheetId, Name = records[0].SortName };
                sheets.Append(sheet);
                newWorksheetPart.Worksheet.Save();

                SheetData sheetData = newWorksheetPart.Worksheet.App
endChild(new SheetData());

                #region Header

                Row row = new Row();
                row.Append(
                    new Cell() { CellValue = new CellValue("演算法名
稱"), DataType = CellValues.String },
                    new Cell() { CellValue = new CellValue("亂數總數
"), DataType = CellValues.String },
                    new Cell() { CellValue = new CellValue("回合數
"), DataType = CellValues.String },
                    new Cell() { CellValue = new CellValue("時間
(秒)"), DataType = CellValues.Number }
                );
```

```
                sheetData.AppendChild(row);

                #endregion

                #region Content

                foreach (var record in records)
                {
                    row = new Row();
                    row.Append(new Cell() { CellValue = new CellValu
e(record.SortName), DataType = CellValues.String });
                    row.Append(new Cell() { CellValue = new CellValu
e(record.Seed), DataType = CellValues.String });
                    row.Append(new Cell() { CellValue = new CellValu
e(record.Round), DataType = CellValues.String });
                    row.Append(new Cell() { CellValue = new CellValu
e(record.Time), DataType = CellValues.String });
                    sheetData.AppendChild(row);
                }

                #endregion

                newWorksheetPart.Worksheet.Save();
            }
        }
    }
}
```

```
using System;
using System.Collections.Generic;
using System.Diagnostics;

namespace HW01
{
    public class BubbleSort
    {
        #region 排序法
```

```
        public static void Sort(List<int> randList)
        {
            int lenght = randList.Count;

            for (int i = 1; i <= lenght - 1; i++)
            {
                for (int j = 1; j <= lenght - i; j++)
                {
                    if (randList[j] < randList[j - 1])
                    {
                        Heaplers.Swap(randList, j, j - 1);
                    }
                }
            }
        }

        #endregion

        public static void StartTestBubbleSort()
        {
            Stopwatch sw = new Stopwatch();
            List<Heaplers.Record> result = new List<Heaplers.Record>
();

            foreach (int seed in Config.SeedList)
            {
                for (int i = 1; i <= Config.Round; i++)
                {
                    List<int> randList = Heaplers.GenderateRadomNumb
ers(seed);

                    sw.Reset();
                    sw.Start();
                    Sort(randList);
                    sw.Stop();

                    result.Add(new Heaplers.Record
                    {
```

```
                        SortName = "Bubble Sort",
                        Seed = seed.ToString(),
                        Round = i.ToString(),
                        Time = sw.Elapsed.TotalSeconds.ToString()
                    });

                    Console.WriteLine($"({seed}) 第 {i} 回合 花費時
間 {sw.Elapsed.TotalSeconds.ToString()} 秒");
                }
            }

            Console.WriteLine("Bubble Sort 結束");
            Console.WriteLine("開始將 Bubble Sort 結果寫入檔案");
            Heaplers.WriteExcel(result);
            Console.WriteLine("寫檔完畢");
        }
    }
}
```

```
using System;
using System.Collections.Generic;
using System.Diagnostics;

namespace HW01
{
    public class InsertionSort
    {
        #region 排序法

        public static void Sort(List<int> randList)
        {
            int lenght = randList.Count;

            for (int i = 0; i < lenght - 1; i++)
            {
                for (int j = i + 1; j > 0; j--)
                {
                    if (randList[j - 1] > randList[j])
```

```
                    {
                        Heaplers.Swap(randList, j - 1, j);
                    }
                }
            }
        }

        #endregion

        public static void StartTestInsertionSort()
        {
            Stopwatch sw = new Stopwatch();
            List<Heaplers.Record> result = new List<Heaplers.Record>
();

            foreach (int seed in Config.SeedList)
            {
                for (int i = 1; i <= Config.Round; i++)
                {
                    List<int> randList = Heaplers.GenderateRadomNumb
ers(seed);

                    sw.Reset();
                    sw.Start();
                    Sort(randList);
                    sw.Stop();

                    result.Add(new Heaplers.Record
                    {
                        SortName = "Insertion Sort",
                        Seed = seed.ToString(),
                        Round = i.ToString(),
                        Time = sw.Elapsed.TotalSeconds.ToString()
                    });

                    Console.WriteLine($"({seed}) 第 {i} 回合 花費時
間 {sw.Elapsed.TotalSeconds.ToString()} 秒");
                }
```

```
            }

            Console.WriteLine("Insertion Sort 結束");
            Console.WriteLine("開始將 Insertion Sort 結果寫入檔案");
            Heaplers.WriteExcel(result);
            Console.WriteLine("寫檔完畢");
        }
    }
}
```

```
using System;
using System.Collections.Generic;
using System.Diagnostics;

namespace HW01
{
    public class SelectionSort
    {
        #region 排序法

        public static void Sort(List<int> randList)
        {
            int lenght = randList.Count;

            int smallest;

            for (int i = 0; i < lenght - 1; i++)
            {
                smallest = i;
                for (int j = i + 1; j < lenght; j++)
                {
                    if (randList[j] < randList[smallest])
                    {
                        smallest = j;
                    }
                }
                Heaplers.Swap(randList, smallest, i);
            }
```

```
        }

        #endregion

        public static void StartTestSelectionSort()
        {
            Stopwatch sw = new Stopwatch();
            List<Heaplers.Record> result = new List<Heaplers.Record>
();

            foreach (int seed in Config.SeedList)
            {
                for (int i = 1; i <= Config.Round; i++)
                {
                    List<int> randList = Heaplers.GenderateRadomNumb
ers(seed);

                    sw.Reset();
                    sw.Start();
                    Sort(randList);
                    sw.Stop();

                    result.Add(new Heaplers.Record
                    {
                        SortName = "Selection Sort",
                        Seed = seed,
                        Round = i,
                        Time = sw.Elapsed.TotalSeconds
                    });

                    Console.WriteLine($"({seed}) 第 {i} 回合 花費時
間 {sw.Elapsed.TotalSeconds.ToString()} 秒");
                }
            }

            Console.WriteLine("Selection Sort 結束");
            Console.WriteLine("開始將 Selection Sort 結果寫入檔案");
            Heaplers.WriteExcel(result);
```

```
            Console.WriteLine("寫檔完畢");
        }
    }
}
```

```
using System;
using System.Collections.Generic;
using System.Diagnostics;

namespace HW01
{
    public class QuickSort
    {
        #region 排序法

        // https://dotblogs.com.tw/kennyshu/2009/10/24/11270

        public static void Sort(List<int> randList, int left, int ri
ght)
        {
            if (left < right)
            {
                int i = left;
                int j = right + 1;
                while (true)
                {
                    while (i + 1 < randList.Count && randList[++i] <
 randList[left]) ;
                    while (j - 1 > -1 && randList[--
j] > randList[left]) ;
                    if (i >= j)
                    {
                        break;
                    }
                    Heaplers.Swap(randList, i, j);
                }
                Heaplers.Swap(randList, left, j);
                Sort(randList, left, j - 1);
```

```
                Sort(randList, j + 1, right);
            }
        }

        #endregion

        public static void StartTestQuickSort()
        {
            Stopwatch sw = new Stopwatch();
            List<Heaplers.Record> result = new List<Heaplers.Record>
();

            foreach (int seed in Config.SeedList)
            {
                for (int i = 1; i <= Config.Round; i++)
                {
                    List<int> randList = Heaplers.GenderateRadomNumb
ers(seed);

                    sw.Reset();
                    sw.Start();
                    Sort(randList, 0, randList.Count - 1);
                    sw.Stop();

                    result.Add(new Heaplers.Record
                    {
                        SortName = "Quick Sort",
                        Seed = seed.ToString(),
                        Round = i.ToString(),
                        Time = sw.Elapsed.TotalSeconds.ToString()
                    });

                    Console.WriteLine($"({seed}) 第 {i} 回合 花費時
間 {sw.Elapsed.TotalSeconds.ToString()} 秒");
                }
            }

            Console.WriteLine("Quick Sort 結束");
```

```
            Console.WriteLine("開始將 Quick Sort 結果寫入檔案");
            Heaplers.WriteExcel(result);
            Console.WriteLine("寫檔完畢");
        }
    }
}
```

```
using System;
using System.Collections.Generic;
using System.Diagnostics;

namespace HW01
{
    public class HeapSort
    {
        #region 排序法

        public static void Sort(List<int> randList)
        {
            int length = randList.Count;

            for (int i = length / 2 - 1; i >= 0; i--)
            {
                Heapify(randList, length, i);
            }
            for (int i = length - 1; i >= 0; i--)
            {
                Heaplers.Swap(randList, 0, i);
                Heapify(randList, i, 0);
            }
        }

        private static void Heapify(List<int> list, int length, int
i)
        {
            int largest = i;
            int left = 2 * i + 1;
            int right = 2 * i + 2;
```

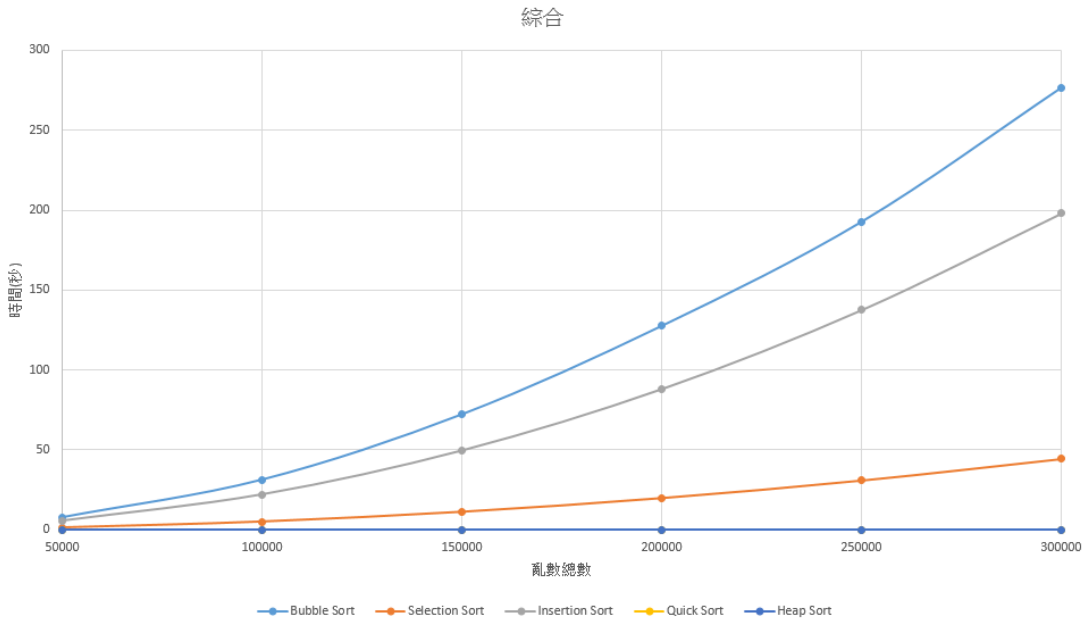
```
            if (left < length && list[left] > list[largest])
            {
                largest = left;
            }
            if (right < length && list[right] > list[largest])
            {
                largest = right;
            }
            if (largest != i)
            {
                Heaplers.Swap(list, i, largest);
                Heapify(list, length, largest);
            }
        }

        #endregion

        public static void StartTestHeapSort()
        {
            Stopwatch sw = new Stopwatch();
            List<Heaplers.Record> result = new List<Heaplers.Record>
();

            foreach (int seed in Config.SeedList)
            {
                for (int i = 1; i <= Config.Round; i++)
                {
                    List<int> randList = Heaplers.GenderateRadomNumb
ers(seed);

                    sw.Reset();
                    sw.Start();
                    Sort(randList);
                    sw.Stop();

                    result.Add(new Heaplers.Record
                    {
                        SortName = "Heap Sort",
```

```
                        Seed = seed.ToString(),
                        Round = i.ToString(),
                        Time = sw.Elapsed.TotalSeconds.ToString()
                    });

                    Console.WriteLine($"({seed}) 第 {i} 回合 花費時
間 {sw.Elapsed.TotalSeconds.ToString()} 秒");
                }
            }

            Console.WriteLine("Heap Sort 結束");
            Console.WriteLine("開始將 Heap Sort 結果寫入檔案");
            Heaplers.WriteExcel(result);
            Console.WriteLine("寫檔完畢");
        }
    }
}
```

三、執行結果

(一) 程式執行過程

(二) 圖表結果




四、討論

從結果來看 Quick Sort、Heap Sort 最快，全部 case 都在 0.1 秒內就完成了。

五、心得

基本上過程中沒有遇到太大的困難，只是因為我不想把結果一個一個貼到

Excel 中，所以我就直接把結果寫到 Excel，寫的過程中讀檔的部分，因為套件的官方文件沒有寫的很清楚所以研究了一下。