

Project in ME001 – Sampling system Group 1

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December 2, 2020

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1 Restatement of the Problem

In this project, we are expected to extract a subset of samples of big data. Assume there are m samples ($45 \leq m \leq 54$), any n ($7 \leq n \leq 25$) samples out of these m samples are selected. There are C_n^m groups of n samples. From one of these groups of n samples, we randomly selected k ($4 \leq k \leq 7$) samples to form some groups. So there will be C_n^k groups of k samples selected. There are at least **ONE** group of k samples, in which s ($3 \leq s \leq 7$) samples have been selected from the j (where $s \leq j \leq k$) samples. Among these groups of k samples, we would like to optimize them by selecting **ONLY** some of them.

2 Basic Ideas

We can divide the problem into two parts, $j = s$ and $j \neq s$.

2.1 $j = s$

2.1.1 Algorithm to Find Subsets

Now, we have a set whose number of the element is n . Then we want to find out all the subsets whose number of the element is k .

Algorithm:

- First, we put the origin set to a container, and then we label every element to one (illustrate the picture below). We assume that the origin set is S , $S = \{1, 2, 3, 4, 5\}$ in Table.1. Then, the subset which has the same element

5	4	3	2	1
1	1	1	1	1

Table. 1

with the original set's is labeled the element to 1, otherwise labeling it to 0. For example, we suppose that one the subset is $S_1, S_1 = \{1, 2, 4\}$. We can represent it as Table.2. Now we can change the number below the array to a binary number, which means that each subset can be represented by a unique number from 0(empty set) to $2^n - 1$ (original set). Just like the example above set S can be represented by $11111_2 = 31_{10}$ and S_1 can be expressed as $01011_2 = 11_{10}$

5	4	3	2	1
0	1	0	1	1

Table. 2

- Subsequently, we know how to find subsets of the original set, but I want to know how to find the subset with the specific number of elements. Therefore, we only need to know the subset whose binary number representation contains k 1s. As the example in Table.2, $S_1 = \{1, 2, 4\}$: So, the S_1 contains three elements, because it has three 1s.

In this way, we can easily find out the subset whose number of elements is k from 0 to $2^n - 1$, the code block `findSubsetOfk` illustrates the situation.

```

1 void findSubsetOfk(int n, int k, vector<int> subsetK){
2     int count=0; //number of 1s
3     for(int i = 1 ; i < (1<<n); i++){
4         for(int j = 0; j < n; j++){
5             //the binary number representation
6             //of subset has an 1 on the jth position
7             if(i & (1<<j)!=0){
8                 count++;
9             }
10        }
11        if(count==k)
12            subsetK.emplace_back(i);
13        count=0;
14    }
15 }
16 }
```

However, we can easily find that the binary number representation of the subset whose number of elements is k is no less than $2^k - 1$. Therefore, we the code above, we can have an optimization on the i . The optimized code `findSubsetOfkOptim` is

```

1 void findSubsetOfkOptim(int n, int k, vector<int> subsetK){
2     int count=0; //number of 1s
3     for(int i = (1<<k)-1 ; i < (1<<n); i++){
4         for(int j = 0; j < n; j++){
```

```

5          //the binary number representation
6          //of subset has an 1 on the jth position
7          if (i & (1<<j)!=0){
8              count++;
9          }
10         }
11         if (count==k)
12             subsetK.empalce_back(i);
13         count=0;
14     }
15
16 }

```

- Currently, we can use the same way what we say above to find out the subset of the set whose number of element is k and its number of elements is s .

2.1.2 Calculate the Combination Number

If we calculate the combination number directly, it is likely to out of bounds of int. So we can use **combination formula**:

$$C_n^m = C_{n-1}^{m-1} + C_{n-1}^m$$

to calculate the combination number. And the specific implementation code can be seen in **calculateCombination**.

```

1 int calculateCombinationNumber (int n, int m){
2     for (int i=0; i<=n; i++)
3         C[i][0]=1;
4     for (int i=1; i<=n; i++)
5         for (int j=1; j<=i; j++)
6             C[i][j]=C[i-1][j-1]+C[i-1][j];
7     return C[n][m];
8 }

```

2.1.3 Greedy Algorithm to Calculate the Set Covered

We denote that the input is a set \mathcal{U} of n elements, and a collection $S = \{S_1, S_2, \dots, S_m\}$ of m subsets of \mathcal{U} such that $\cup_i S_i = \mathcal{U}$. Our goal is to take as few subsets as pos-

sible from S such that their union covers \mathcal{U} . We can solve this problem easily by greedy algorithm. The algorithm is below in Table.3:

Greedy Cover(S, \mathcal{U})
1. repeat
2. pick the set that covers the maximum number of uncover element
3. mark elements in the chosen set as covered
4. remove the set from S to the result set
5. done

Table. 3. Greedy Cover

Based on the three lemmas above, we can easily transform the problem to that the set $\mathcal{U} = \{1, 2, \dots, C_n^j\}$, which means that we map each different subset whose the number of the elements is j to a unique code from 1 to C_n^j . Each subset of S , represents the each k set's subsets whose number of elements is j . Ultimately, we can solve the problem easily.

2.2 $j \neq s$

The way to solve the problem is just like the way we mentioned above. However, after finishing finding the subset of the k set whose element number is s , we should know how many sets whose the number of elements is j include it. Therefore, we use **DFS(depth first search)** to find out them. Assuming that $n = 5, s = 3, j = 4$, and the subset whose number of elements is equal to 3 is labeled as 01011₂. Therefore, we can expand it as below in Table.4.

5	4	3	2	1
0	1	0	1	1
0	1	1	1	1
1	1	0	1	1

Table. 4

Then, we should mark the last two rows of the set above in the \mathcal{U} as covered.

3 Essential Codes and Functions Analysis

3.1 Realization of Modifying DB files

As the request said, we need output the group of k samples and corresponding result in DB files. Consequently, the OOP program language **C#** can provide abundant libraries to help realize combine with modifying DB files.

Depending on **C#** powerful library and interface, we can apply our algorithm source code on GUI platform, and realizing the operation of creating new files(Code.1) as well as exporting result into corresponding files(Code.2).

```
1 public void CreateTableInToMdb(string fileNameWithPath)
2 {
3     try
4     {
5         OleDbConnection myConnection = new OleDbConnection
6             ("Provider=Microsoft.Jet.OLEDB.4.0; Data Source="
7             + fileNameWithPath);
8         myConnection.Open();
9         OleDbCommand myCommand = new OleDbCommand();
10        myCommand.Connection = myConnection;
11        myCommand.CommandText =
12            "CREATE TABLE my_table([m] NUMBER, " +
13            "[n] NUMBER, [k] NUMBER, [j] Number, " +
14            "[s] NUMBER, [n numbers] TEXT, " +
15            "[minium number of sets] NUMBER, "+
16            "[answer] TEXT) ";
17        myCommand.ExecuteNonQuery();
18        myCommand.Connection.Close();
19    }
20    catch { }
21 }
```

```
1 public void InsertToMdb(string fileNameWithPath)
2 {
3     var con = new OleDbConnection(
4         "Provider = Microsoft.Jet.OLEDB.4.0; Data Source = "
5         + fileNameWithPath);
6     var cmd = new OleDbCommand();
7     cmd.Connection = con;
```

```

8      cmd.CommandText = "insert into my_table ([m],[n],[k],[j], " +
9          "[s],[n numbers],[minium number of sets], [answer]) " +
10         "values (@m, @n, @k, @j, @s, @series1, @number, @answer);";
11      cmd.Parameters.AddWithValue( "@m", numericUpDown1.Value );
12      cmd.Parameters.AddWithValue( "@n", numericUpDown2.Value );
13      cmd.Parameters.AddWithValue( "@k", numericUpDown3.Value );
14      cmd.Parameters.AddWithValue( "@j", numericUpDown4.Value );
15      cmd.Parameters.AddWithValue( "@s", numericUpDown5.Value );
16      cmd.Parameters.AddWithValue( "@series1", series1Fordb() );
17      cmd.Parameters.AddWithValue( "@number", vs.Count() );
18      cmd.Parameters.AddWithValue( "@answer", series2Fordb() );
19      con.Open();
20      cmd.ExecuteNonQuery();
21      con.Close();
22 }

```

3.2 Multi-Threading

We adopt multi-threading programming way. We split the program into two parts, which are the GUI part and the calculation part. In this way, even if the program haven't figured out, the window of the program won't be stick. The specific implemented function is bound in [button2_Click](#).

```

1 private async void button2_Click(object sender, EventArgs e)
2 // Run buttom
3 {
4     button2.Enabled = false;
5     Algorithm algorithm = new Algorithm(
6         (int)numericUpDown2.Value,
7         (int)numericUpDown3.Value,
8         (int)numericUpDown4.Value,
9         (int)numericUpDown5.Value,
10        totalList, judgeNumber);
11     if (numericUpDown4.Value == numericUpDown5.Value)
12     {
13         vs= await Task.Run(()=>algorithm.ExecuteAlgorithm1());
14     }
15     else
16     {

```



```

17         vs = await Task.Run(() => algorithm.ExecuteAlgorithm2());
18     }
19     //InsertToMdb(openFileDialog1.FileName);
20     //UpdateToMdb(openFileDialog1.FileName);
21     textBox3.Text = GetSeries2();
22     //textBox3.Enabled = false;
23
24
25 }

```

4 Steps to Run the Program

The detailed information of programming are listed in Table.5.

Attribute	Content
Operation System	Windows SDK edition: 10.0
Integrated Development Environment	Visual Studio 2019(v142)
Solution Settings	Release in x86 Platform
Optimization	O2 optimize
Programming Language	C#
Framework	. Net framework 4.7.2
Source Code hosting Platform	Github

Table. 5. Settings and Attribute

In order to make the operation more smooth, all the program environment and settings are completed and included in the file package. Just required to follow the steps below to run the program.

1. Open the package and find the Information System Project.exe file. Double-click the file to enter the program interface as Figure.1 exactly.

In order to record the relevant output data of the program and facilitate display and modification later. It is required to create a *.mdb* file to store it, which is called —.mdb in project package.

2. Choose the data of each parameter and input on the program surface as Figure.2.

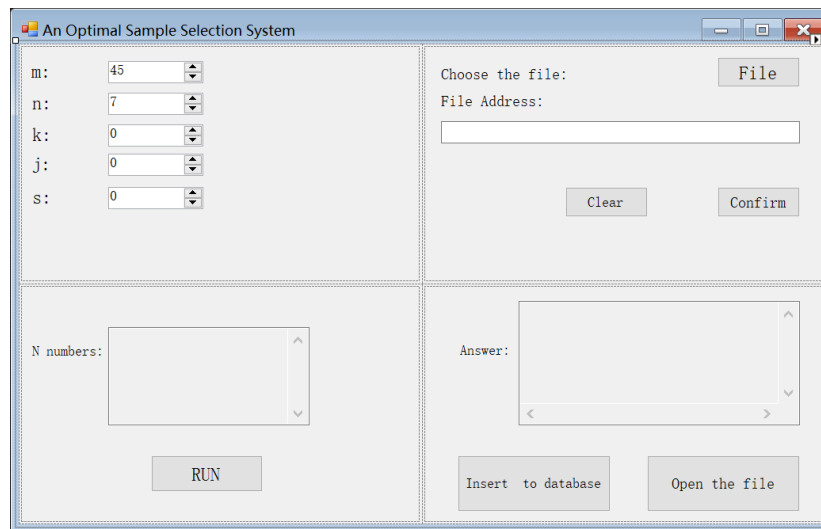


Figure. 1. Initial GUI

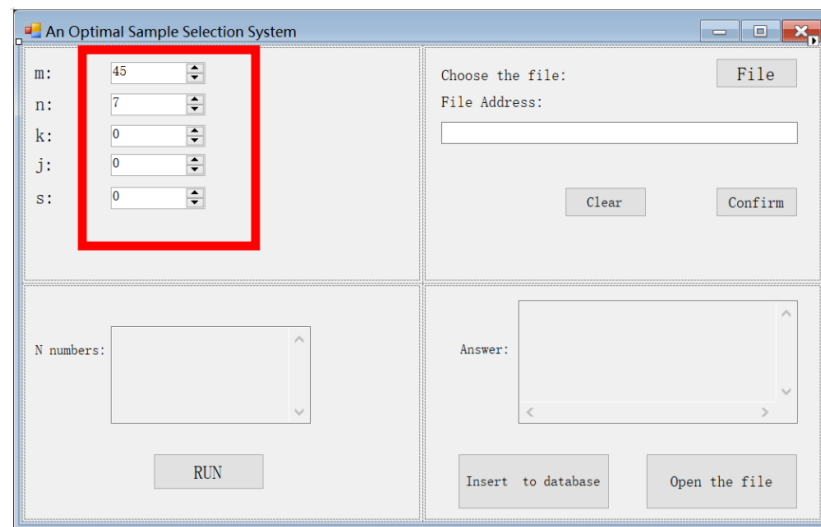


Figure. 2. Step1

3. Choose the DB file to store and operate the data, click the button **File** and choose the *.mdb* as Figure.3 In the previous step and **Confirm** if all get right. (**Clear** is a function that clear all the data you have input, including the parameter followed Figure.4)

The screenshot shows a window titled "An Optimal Sample Selection System". On the left, there are five input fields: "m:" with value 45, "n:" with value 7, "k:" with value 0, "j:" with value 0, and "s:" with value 0. Below these is a "N numbers:" label and a text area. At the bottom left is a "RUN" button. On the right, there is a "Choose the file:" label, a "File Address:" text box, and a "File" button highlighted with a red box. Below the text box are "Clear" and "Confirm" buttons. At the bottom right are "Insert to database" and "Open the file" buttons. An "Answer:" text area is located above the bottom right buttons.

Figure. 3. Step2

This screenshot is identical to Figure 3, showing the same window and input values. However, in this step, the "Clear" and "Confirm" buttons are highlighted with a red box, indicating the next action to be taken after selecting a file.

Figure. 4. Step3

4. Push the **RUN** button and the **N** number and final answer of your input will be shown on the surface window as Figure.5, you can check the answer after that.

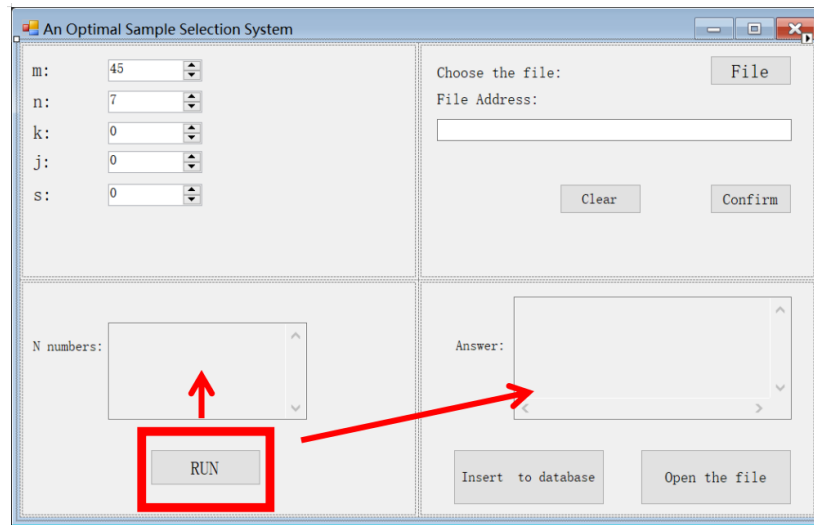


Figure. 5. Step4

5. After confirming the data is correct, use **Insert to database**(Figure.6) to download the data on the DB file(.mdb), and **Open the file**(Figure.7) can open it to display the data you have calculate. It is also easy for you to delete or use any other operation on the data though your DB file.

5 Program Test

If the program window can be displayed normally, you can enter the value for verification. The conditions of 1, 2, 3 and 4, 5 and 6, 7 in the project requirement file are similar, so we choose 1(Figure.8), 4(Figure.9), and 6(Figure.10) as the demo of our program.

6 Summary

This project is based on the theoretical direction of **ME001** subject and combines some knowledge of data structure and mathematic, including optimal algorithms

An Optimal Sample Selection System

m: 45
n: 7
k: 0
j: 0
s: 0

Choose the file: File
File Address:
Clear Confirm

N numbers:
RUN

Answer:
Insert to database Open the file

Figure. 6. Step5

An Optimal Sample Selection System

m: 45
n: 7
k: 0
j: 0
s: 0

Choose the file: File
File Address:
Clear Confirm

N numbers:
RUN

Answer:
Insert to database Open the file

Figure. 7. Step6

An Optimal Sample Selection System

m: 45
n: 7
k: 6
j: 5
s: 5

Choose the file: File
File Address: C:\Lab06\Database1.mdb
Clear Confirm

N numbers: 13 33 16 27 21 19 22
Answer: 13 33 16 27 21 19
13 33 16 27 21 22
13 33 16 27 19 22
13 33 16 21 19 22
13 33 27 21 19 22
13 16 27 21 19 22

RUN Insert to database Open the file

Figure. 8. E.g.1: Input the data: $m = 45, n = 7, k = 6, j = 5, s = 5$.

An Optimal Sample Selection System

m: 45
n: 8
k: 6
j: 6
s: 5

Choose the file: File
File Address: C:\Lab06\Database1.mdb
Clear Confirm

N numbers: 13 33 16 27 21 19 22 34
Answer: 13 33 16 27 21 19
13 33 16 27 22 34
13 33 21 19 22 34
13 16 27 21 19 22

RUN Insert to database Open the file

Figure. 9. E.g.4: Input the data: $m = 45, n = 8, k = 6, j = 6, s = 5$.

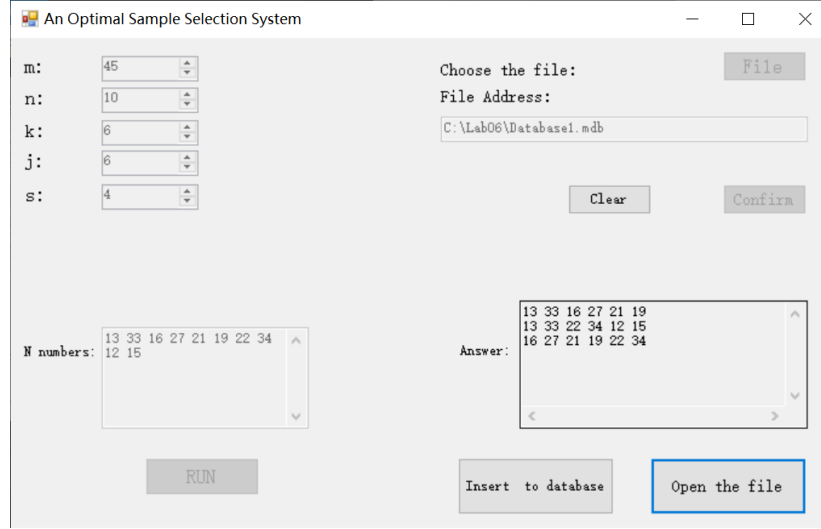


Figure. 10. E.g.6: Input the data: $m = 45, n = 10, k = 6, j = 6, s = 4$.

and combinatorics. But there are no correct understanding of some part of difficult and profound mathematic problems like fuzzy set. Authors point out about converse decimal digits to the binary make the big data abstraction in order to descend the time complexity. Besides, authors have already comprehend the core of program language **C#** with utilizing **. Net Framework**. By using program, authors realize the process from theory to practice reflecting the theoretical view of unity of knowledge and practice. When writing large-scale projects, people often need cooperation and collaborative development, authors use **GitHub** for collaborative development and submit own patch code to collaborator's repository. In this article, we will utilize ideas to achieve team cooperation on **GitHub**. The last but not least, the goal of the future study and work is to work harder to learn this knowledge, in order to enrich, improve our level.

Appendices

A Programs for Algorithms

source/Algorithm.cs

```
1 using System;
2 using System.Collections.Generic;
3 using System.Collections.Specialized;
4 using System.ComponentModel;
5 using System.ComponentModel.Design;
6 using System.Diagnostics;
7 using System.Drawing.Drawing2D;
8 using System.Drawing.Text;
9 using System.Linq;
10 using System.Security.Cryptography;
11 using System.Text;
12 using System.Threading.Tasks;
13
14 namespace Information_System_Project
15 {
16     public class Algorithm
17     {
18         private int n;
19         private int k;
20         private int j;
21         private int s;
22         private List<int> setNumberForK = new List<int>();
23         private List<int> setNumberForJ = new List<int>();
24         private Dictionary<int, int> dictionaryForAllSets
25             = new Dictionary<int, int>();
26         private Dictionary<int, int> dictionaryForAllSets2
27             = new Dictionary<int, int>();
28         private bool[] visit = new bool[10000000];
29         private List<int> totalList = new List<int>();
30         private Queue<int> queueForSet = new Queue<int>();
31         private bool[] judgeNumber = new bool[46];
32         private int[,] C = new int[26, 26];
```



```

33     public Algorithm(int n, int k, int j, int s,
34         List<int> totalList, bool[] judgeNumber)
35     {
36         this.n = n;
37         this.k = k;
38         this.j = j;
39         this.s = s;
40         this.totalList = totalList;
41         this.judgeNumber = judgeNumber;
42     }
43     public Queue<int> ExecuteAlgorithm1()
44     {
45         GreedyAlgorithm();
46         return queueForSet;
47     }
48     public Queue<int> ExecuteAlgorithm2()
49     {
50         GreedyAlgorithm2();
51         return queueForSet;
52     }
53     private void GreedyAlgorithm()
54     {
55         setNumberForK=CombinationForAllNum(n, k);
56         int max;
57         int now = 0;
58         int allNum = TotalNumberForJ(n, j);
59         int node;
60         int index;
61         List<int> vis = new List<int>();
62         List<int> result = new List<int>();
63         while (allNum > 0)
64         {
65             //Debug.WriteLine(allNum);
66             max = 0;
67             node = 0;
68             index = 0;
69             foreach (var element
70                 in setNumberForK)

```

```

71         {
72             int numOfUnfound = 0;
73             for (int j1 = (1 << s) - 1;
74                 j1 <= element; j1++)
75             {
76                 int cnt = 0;
77                 for (int k1 = 0; k1 < n; k1++)
78                 {
79                     if ((j1 & (1 << k1)) != 0)
80                     {
81                         cnt++;
82                     }
83                 }
84                 if ((j1 & element) == j1
85                     && cnt == s &&
86                     !dictionaryForAllSets.
87                       ContainsKey(j1))
88                 {
89                     numOfUnfound++;
90                     vis.Add(j1);
91                 }
92             }
93             if (max < numOfUnfound)
94             {
95                 node = index;
96                 max = numOfUnfound;
97                 result.Clear();
98                 foreach (var eachNum in vis)
99                 {
100                     result.Add(eachNum);
101                 }
102             }
103             vis.Clear();
104             index++;
105         }
106         queueForSet.Enqueue(setNumberForK[node]);
107         setNumberForK.RemoveAt(node);
108         foreach (var eachNum in result)

```

```

109         {
110             dictionaryForAllSets [eachNum] = ++now;
111         }
112         allNum -= max;
113     }
114 }
115
116 }
117 private void GreedyAlgorithm2()
118 {
119     setNumberForK=CombinationForAllNum(n, k);
120     int max;
121     int now = 0;
122     int allNum = TotalNumberForJ(n, j);
123     int node;
124     int index;
125     List<int> vis = new List<int>();
126     List<int> result = new List<int>();
127     while (allNum > 0)
128     {
129         max = 0;
130         node = 0;
131         index = 0;
132         foreach (var element in setNumberForK)
133         {
134             int numOfUnfound = 0;
135             for (int j1 = (1 << s) - 1;
136                 j1 <= element; j1++)
137             {
138                 int cnt = 0;
139                 var answer = 0;
140                 for (int k1 = 0; k1 < n; k1++)
141                 {
142                     if ((j1 & (1 << k1)) != 0)
143                     {
144                         cnt++;
145                     }
146                 }

```

```

147         if ((j1 & element) == j1
148             && cnt == s &&
149             !dictionaryForAllSets.
150                 ContainsKey(j1))
151         {
152             int num = j - s;
153             numOfSetContainj1
154                 (0, j1, num, ref answer);
155             numOfUnfound += answer;
156             vis.Add(j1);
157         }
158     }
159     foreach (var eachNum in setNumberForJ)
160     {
161         dictionaryForAllSets2.Remove(eachNum);
162     }
163     setNumberForJ.Clear();
164     if (max < numOfUnfound)
165     {
166         max = numOfUnfound;
167         node = index;
168         result.Clear();
169         foreach (var eachNum in vis)
170         {
171             result.Add(eachNum);
172         }
173     }
174     index++;
175     vis.Clear();
176 }
177 //Debug.WriteLine(max);
178 SetDictionary2(result);
179 queueForSet.Enqueue(setNumberForK[node]);
180 foreach (var eachNum in result)
181 {
182     //Debug.WriteLine(eachNum + " ");
183     dictionaryForAllSets[eachNum] = ++now;
184 }

```

```

185         setNumberForK.RemoveAt(node);
186         allNum -= max;
187     }
188 }
189 private void numOfSetContainj1(int node, int j1,
190     int num, ref int answer)
191 {
192     if (num == 0 &&
193         !dictionaryForAllSets2.
194             ContainsKey(j1))
195     {
196         answer += 1;
197         setNumberForJ.Add(j1);
198         dictionaryForAllSets2[j1] =
199             dictionaryForAllSets2.Count() + 1;
200         return;
201     }
202     else if (num == 0 &&
203         dictionaryForAllSets2.
204             ContainsKey(j1))
205         return;
206     for(int i1 = node; i1 < n; i1++)
207     {
208         if(((1<<i1) & j1) == 0)
209         {
210             numOfSetContainj1(i1+1, j1 | (1 << i1),
211                 num - 1, ref answer);
212         }
213     }
214 }
215
216 private void SetDictionary2(List<int> result)
217 {
218     foreach(var eachNum in result)
219     {
220         FindEachElement(0, eachNum, j-s);
221     }
222 }

```

```

223
224     private void FindEachElement(int node, int element,
225         int num)
226     {
227         if (num == 0 &&
228             !dictionaryForAllSets2.
229                 ContainsKey(element))
230         {
231             dictionaryForAllSets2[element]
232                 = dictionaryForAllSets2.Count() + 1;
233             return;
234         }
235         else if (num == 0 &&
236             dictionaryForAllSets2.
237                 ContainsKey(element))
238             return;
239         for (int i1 = node; i1 < n; i1++)
240         {
241             if (((1 << i1) & element) == 0)
242             {
243                 FindEachElement(i1, element | (1 << i1),
244                     num - 1);
245             }
246         }
247     }
248
249     private List<int> CombinationForAllNum(int n, int k)
250     {
251         List<int> Combination = new List<int>();
252         for (int i = (1<<(k))-1; i < (1 << n); i++)
253         {
254             var cnt = 0;
255             for (int j1 = 0; j1 < n; j1++)
256             {
257                 if ((i & (1 << j1)) != 0)
258                 {
259                     cnt++;
260                 }

```

```

261         }
262         if (cnt == k)
263         {
264             Combination.Add(i);
265             //myBV.Add(new BitVector32(i));
266         }
267     }
268     return Combination;
269 }
270 private int TotalNumberForJ(int n, int j)
271 {
272     for (int i = 0; i <= n; i++)
273     {
274         for (int m = 0; m <= j; m++)
275         {
276             C[i, m] = 0;
277         }
278     }
279     for (int i = 0; i <= n; i++)
280     {
281         C[i, 0] = 1;
282         if (i == n && j == 0)
283             return C[n, j];
284     }
285     for (int i = 1; i <= n; i++)
286     {
287         for (int m = 1; m <= i; m++)
288         {
289             C[i, m] = C[i - 1, m - 1] + C[i - 1, m];
290             if (i == n && m == j)
291                 return C[n, m];
292         }
293     }
294     return C[n, j];
295 }
296
297 private void Dfs(int start, int setNum,
298                 int currentNumber, int totalNum, ref int result)

```

```

299     {
300
301         int now = currentNumber;
302         List<int> vis = new List<int>();
303         if (setNum >= result)
304             return;
305         if (currentNumber == totalNum)
306         {
307
308             //if (setNum < result)
309             result = setNum;
310             return;
311         }
312         for (int i = start; i < setNumberForK.Count; i++)
313         {
314             if (!visit[i])
315             {
316                 for (int j1 = (1 << s) - 1;
317                     j1 <= setNumberForK[i]; j1++)
318                 {
319                     int cnt = 0;
320                     for (int k1 = 0; k1 < n; k1++)
321                     {
322                         if ((j1 & (1 << k1)) != 0)
323                         {
324                             cnt++;
325                         }
326                     }
327                     if ((j1 & setNumberForK[i]) == j1
328                         && cnt == s &&
329                         !dictionaryForAllSets.
330                             ContainsKey(j1))
331                     {
332                         now++;
333                         dictionaryForAllSets[j1] = now;
334                         vis.Add(j1);
335                     }
336                 }

```



```

337         //Debug.WriteLine(" ");
338         Dfs(i + 1, setNum + 1, now,
339             totalNum, ref result);
340         visit[i] = false;
341         now = currentNumber;
342
343     }
344     foreach (var eachNum in vis)
345     {
346         dictionaryForAllSets.Remove(eachNum);
347     }
348     vis.Clear();
349 }
350 return ;
351 }
352 }
353 }

```

B Programs for GUI

source/Form1.cs

```

1 using System;
2 using System.Collections.Generic;
3 using System.ComponentModel;
4 using System.Data;
5 using System.Data.OleDb;
6 using System.Diagnostics;
7 using System.Drawing;
8 using System.IO;
9 using System.Linq;
10 using System.Text;
11 using System.Threading;
12 using System.Threading.Tasks;
13 using System.Windows.Forms;
14
15 namespace Information_System_Project
16 {
17     public partial class Form1 : Form

```

```

18 {
19     Queue<int> vs;
20     List<int> totalList = new List<int>();
21     bool[] judgeNumber = new bool[55];
22     OpenFileDialog openFileDialog1
23         = new OpenFileDialog();
24
25     public Form1()
26     {
27         InitializeComponent();
28     }
29
30
31     private void numericUpDown3_ValueChanged
32         (object sender, EventArgs e)
33     {
34         numericUpDown3.Maximum
35             = numericUpDown2.Value;
36
37     }
38
39     private void numericUpDown4_ValueChanged
40         (object sender, EventArgs e)
41     {
42         numericUpDown4.Maximum
43             = numericUpDown3.Value;
44     }
45
46     private void numericUpDown5_ValueChanged
47         (object sender, EventArgs e)
48     {
49         numericUpDown5.Maximum
50             = numericUpDown4.Value;
51     }
52
53     private void button1_Click
54         (object sender, EventArgs e) //Confirm button
55     {

```

```

56         button1.Enabled=false;
57         ChooseTotalList();
58         //DisableNumericUpDown();
59         textBox2.Enabled = false;
60         button1.Enabled = false;
61         button3.Enabled = false;
62         button2.Enabled = true;
63     }
64
65     private async void button2_Click
66         (object sender, EventArgs e)// Run button
67     {
68         button2.Enabled = false;
69         Algorithm algorithm = new Algorithm
70             ((int)numericUpDown2.Value,
71             (int)numericUpDown3.Value,
72             (int)numericUpDown4.Value,
73             (int)numericUpDown5.Value,
74             totalList, judgeNumber);
75         if (numericUpDown4.Value
76             == numericUpDown5.Value)
77         {
78             vs= await Task.Run
79                 (()=>algorithm.ExecuteAlgorithm1());
80         }
81         else
82         {
83             vs = await Task.Run
84                 (()=>algorithm.ExecuteAlgorithm2());
85         }
86         //InsertToMdb(openFileDialog1.FileName);
87         //UpdateToMdb(openFileDialog1.FileName);
88         textBox3.Text = GetSeries2();
89         //textBox3.Enabled = false;
90
91
92     }
93

```

```

94     private void button3_Click
95         (object sender, EventArgs e) // File button
96     {
97
98         openFileDialog1.InitialDirectory = "c:\\ ";
99         openFileDialog1.Filter =
100             "Database files (*.mdb)|*.mdb";
101         openFileDialog1.FilterIndex = 0;
102         openFileDialog1.RestoreDirectory = true;
103
104
105         if (openFileDialog1.ShowDialog()
106             == DialogResult.OK)
107         {
108             DisableNumericUpDown();
109             textBox1.Enabled = false;
110             button1.Enabled = true;
111             textBox2.Text =
112                 openFileDialog1.FileName;
113             CreateTableInToMdb
114                 (openFileDialog1.FileName);
115         }
116     }
117
118
119     //Clear function
120     private void button4_Click
121         (object sender, EventArgs e)
122     {
123         InitializeFunctionForClear();
124     }
125
126     //Open the file button
127     private void button5_Click
128         (object sender, EventArgs e)
129     {
130         Process proc = new Process();
131         proc.EnableRaisingEvents = false;

```

```

132         proc.StartInfo.FileName = openFileDialog1.FileName;
133         proc.Start();
134     }
135
136     //Insert to database button
137     private void button6_Click
138         (object sender, EventArgs e)
139     {
140         InsertToMdb(openFileDialog1.FileName);
141     }
142
143     private void ChooseTotalList()
144     {
145         InitializeJudgeNumber();
146         totalList.Clear();
147         var rand = new Random();
148         StringBuilder str = new StringBuilder();
149         for (int i = 1; i <= numericUpDown2.Value; i++)
150         {
151             int randNumber =
152                 rand.Next
153                     (1, (int)numericUpDown1.Value + 1);
154             if (!judgeNumber[randNumber])
155             {
156                 judgeNumber[randNumber] = true;
157                 totalList.Add(randNumber);
158                 str.Append(totalList[i - 1].ToString());
159                 str.Append(" ");
160             }
161             else
162             {
163                 i--;
164             }
165         }
166         textBox1.Text = str.ToString();
167     }
168     private void InitializeJudgeNumber()
169     {

```

```

170         for (int i = 0; i < judgeNumber.Length; i++)
171             judgeNumber[i] = false;
172     }
173
174     private void InitializeFunctionForClear()
175     {
176         EnableNumericUpDown();
177         button1.Enabled = true;
178         textBox1.Enabled = true;
179         textBox1.Clear();
180         //textBox2.Enabled = true;
181         //textBox2.Clear();
182         textBox3.Clear();
183         button3.Enabled = true;
184     }
185
186     private void DisableNumericUpDown()
187     {
188         numericUpDown1.Enabled = false;
189         numericUpDown2.Enabled = false;
190         numericUpDown3.Enabled = false;
191         numericUpDown4.Enabled = false;
192         numericUpDown5.Enabled = false;
193     }
194
195     private void EnableNumericUpDown()
196     {
197         numericUpDown1.Enabled = true;
198         numericUpDown2.Enabled = true;
199         numericUpDown3.Enabled = true;
200         numericUpDown4.Enabled = true;
201         numericUpDown5.Enabled = true;
202     }
203
204     public void CreateTableInToMdb
205         (string fileNameWithPath)
206     {
207         try

```

```

208         {
209             OleDbConnection myConnection
210                 = new OleDbConnection
211                 ( "Provider=Microsoft.Jet.OLEDB.4.0;"
212                 + " Data Source="
213                 + fileNameWithPath );
214             myConnection.Open();
215             OleDbCommand myCommand = new OleDbCommand();
216             myCommand.Connection = myConnection;
217             myCommand.CommandText =
218                 "CREATE TABLE my_table ([m] NUMBER, " +
219                 " [n] NUMBER, [k] NUMBER, [j] Number, "
220                 + "[s] NUMBER, [n numbers] TEXT, " +
221                 "[minium number of sets] NUMBER, " +
222                 "[answer] TEXT) ";
223             myCommand.ExecuteNonQuery();
224             myCommand.Connection.Close();
225         }
226         catch { }
227     }
228
229     public void InsertToMdb(string fileNameWithPath)
230     {
231         var con = new OleDbConnection
232             ( "Provider = Microsoft.Jet.OLEDB.4.0; "
233             + "Data Source = "
234             + fileNameWithPath );
235         var cmd = new OleDbCommand();
236         cmd.Connection = con;
237         cmd.CommandText = "insert into my_table " +
238             "([m],[n],[k],[j],[s],[n numbers]," +
239             "[minium number of sets], [answer]) " +
240             "values (@m, @n, @k,@j,@s,@series1, " +
241             "@number, @answer)";
242         cmd.Parameters.AddWithValue
243             ( "@m", numericUpDown1.Value );
244         cmd.Parameters.AddWithValue
245             ( "@n", numericUpDown2.Value );

```

```

246 cmd.Parameters.AddWithValue
247     ( "@k", numericUpDown3.Value );
248 cmd.Parameters.AddWithValue
249     ( "@j", numericUpDown4.Value );
250 cmd.Parameters.AddWithValue
251     ( "@s", numericUpDown5.Value );
252 cmd.Parameters.AddWithValue
253     ( "@series1", series1Fordb() );
254 cmd.Parameters.AddWithValue
255     ( "@number", vs.Count() );
256 cmd.Parameters.AddWithValue
257     ( "@answer", series2Fordb() );
258 con.Open();
259 cmd.ExecuteNonQuery();
260 con.Close();
261 }
262
263 private string series1Fordb()
264 {
265     string series1 = "";
266     foreach (var num in totalList)
267     {
268         series1 += num.ToString();
269         series1 += " ";
270     }
271     return series1;
272 }
273
274 private string series2Fordb()
275 {
276     string series2 = "";
277     int index = 0;
278     foreach (var num in vs)
279     {
280         if (index != 0)
281             series2 += "; ";
282         for (int i = 0; i < numericUpDown2.Value;
283             i++)

```



```

284         {
285             if (((1 << i) & num) != 0)
286             {
287                 series2 += totalList[i].ToString();
288                 series2 += " ";
289             }
290         }
291
292         index++;
293     }
294     return series2;
295 }
296
297 private string GetSeries2()
298 {
299     string series2 = "";
300     foreach(var num in vs)
301     {
302         for(int i = 0; i < numericUpDown2.Value;
303             i++)
304         {
305             if (((1 << i) & num) != 0)
306             {
307                 series2 += totalList[i].ToString();
308                 series2 += " ";
309             }
310         }
311         series2 += "\r\n";
312     }
313     return series2;
314 }
315
316 }
317
318
319 }

```