ICEELT 2012

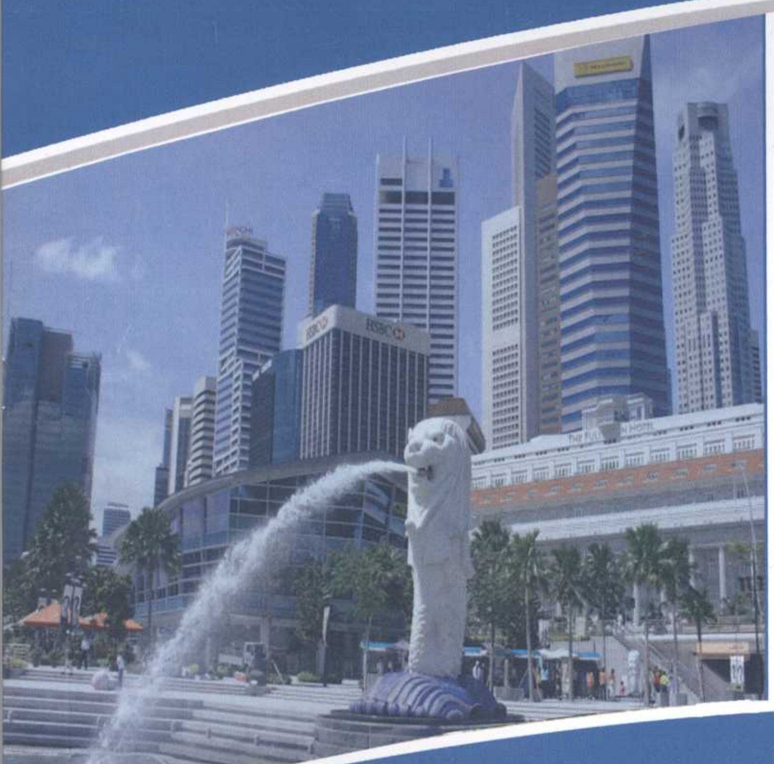
Singapore

August 13-14, 2012

International Conference on E-Education & Learning Technologies

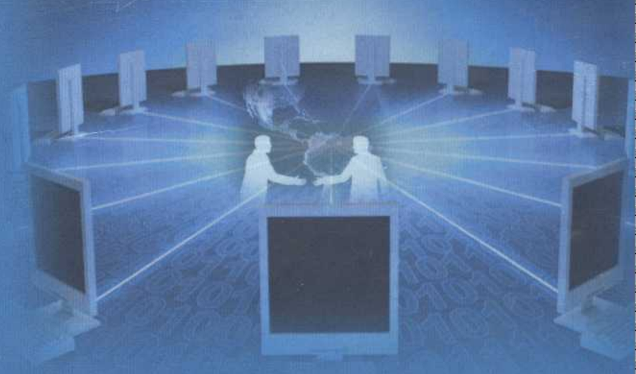
@ Singapore

CONFERENCE PROCEEDINGS BOOK



ORGANIZED BY

Technical Supported By



IISRC - UPCOMING CONFERENCE

ICAISED 2012

Nove 05-06 , 2012 - Malaysia
http://www.icaised.com

2nd ICAISED 2012 - 2nd International Meeting of the advance Information System, E-Education & Development (ICAISED 2012) is designed to provide a common platform to the experts and delegates to share their experiences, research ideas and discuss various related issues and challenges

ICICCT 2012

10-11 November, 2012
Singapore
http://www.icicct.com
The objectives of the 2nd ICICCT ' 12 is to bridge the knowledge gap between academia and industry, promote research esteem in secured Internet transactions and the importance of information technology evolution to secured transactions

HCILT 2012

1-2 December, 2012
Abu Dhabi, UAE
http://www.ichciit.com

2nd ICHCILT 2012 was designed to provide a common platform to the experts and delegates to share their experiences, research ideas and discuss various related issues and challenges

Proceedings papers are available @

International Journal of Information Technology & Computer Science (IJITCS)

(ISSN : 2091-1610) (http://www.ijitcs.com)

International Journal of Wireless Information Networks & Business Information System (WINBIS)

(ISSN No : 2091-0266) (http://www.e-winbis.com)

ISSN : 2091 - 0266

International Conference on E-Education & Learning Technologies

(ICEELT 2012)

Hotel Changi Village , Singapore

13th - 14th August, 2012

http://www.iceelt.com

Conference Final Programme Schedule :

13th August , 2012	
Time	
8:45 am. – 9:15 AM	Assemble in conference Hall / Registration for National / International participants
9:15 am – 9:45 am	Hi – tea / coffee break
9:45 am – 10:15 am	Melissa Casino
10:15 am - 10:45 am	Richard T. Grenci
10:45 am – 11:15 pm	F. Moradi
11:15 pm – 11:45 pm	Yen Nee, Chong , Mohd Fauzy, Wan, Seong Chong, Toh and Balakrishnan, Muniandy
11:45 am – 12:15 pm	Yen Nee, Chong Mohd Fauzy, Wan and Seong Chong, Toh
12:15 pm – 12 : 45 pm	Lunch break
12:45 pm – 1:15 pm	Dr. Mehmet ŞAHİN and Dr. Lina Abu Safieh
1:15 pm – 2:00 pm	Tiamyod Pasawano
2:00 pm – 2:30 pm	Michael Grosch
2:30 pm – 3:00 pm	Suphin Sanruang,
3:00 pm – 3:30 pm	Aleksandar Karadimce, Danco Davcev, Ustijana Rechkoska Shikoska
3:30 pm – 4:00 pm	Saipin Rakkratok and Jessada Tanthanuch
4:00 pm – 4:30 pm	Dussadee Yod-on
4:30 pm – 5:00 pm	Minako Yogi
5:00 – 5:30 pm	Mijin Noh and Hyunhee Park
5:30 – 6 : 00 pm	Les Sztandera
6:00 pm Onwards	Tea / Coffee Break and Closing for Day

14th August 2012	
Time	
9:00 am – 9:30 am	Assemble in conference Hall / Registration for National / International participants
9:30 am – 9:45 am	Tea / Coffee Break
9:45 am – 10:15 am	SugHee Kim, Dongjung Kim, Jisu Park, Daeyong Jung, Jongbeom Lim, HeonChang Yu

Tables of Content :

Solutions of Mathematics Problems Using Fibonacci Numbers and Examples by Spreadsheets

Saipin Rakkratok
Graduate School
Nakhon Ratchasima Rajabhat University
Nakhon Ratchasima, Thailand
palmyfon@gmail.com

Jessada Tanthanuch
School of Mathematics, Institute of Science
Suranaree University of Technology
Nakhon Ratchasima, Thailand
jessada@g.sut.ac.th

Abstract *:*

The objective of this research is to apply the concept of recurrence relation to solve three mathematical problems, which are 1) determine the number of patterns for bricks rearrangement, 2) determine the number of subsets of {1,2,…,*n*} which do not contain two consecutive numbers, and 3) determine the number of paths for traveling between 5 cities such that the traveler can change direction at any intermediate city. It is found that the solutions can be expressed by the Fibonacci numbers. The spreadsheets using *Microsoft Excel 2010* were developed to be a tool for giving examples of Fibonacci numbers, Fibonacci-like numbers and solutions of the proposed mathematics problems.

Keywords-component; *mathematics problem; recurrence relation; Fibonacci; spreadsheet*

I. Introduction

The Fibonacci numbers are the sequence of numbers 1, 1, 2, 3, 5, 8, 13, …. The sequence is defined by the recurrence relation $a_{n+2} = a_{n+1}+a_n$, for n = 1, 2, 3, …, where $a_1 = a_2 = 1$. The Fibonacci sequence is named after Leonardo Pisano Bigollo, who was known as Fibonacci [1]. He introduced this sequence for solving the mathematical problem involving the growth of population of rabbits based on idealized assumptions. Assuming that: a newly born pair of rabbits, one male, one female, are put in a field; rabbits are able to mate at the age of one month so that at the end of its second month a female can produce another pair of rabbits; rabbits never die and a mating pair always produces one new pair (one male, one female) every month from the second month on. The puzzle that Fibonacci posed was: how many pairs will there be in one year? The concept of recurrence relation was applied to solve his puzzle mathematically. The Fibonacci sequence becomes one of very famous sequences in the world.

There are many applications of Fibonacci numbers, e.g.

- The ratios of consecutive Fibonacci numbers approach the Golden Ratio, which is widely used in aesthetics, architectures, paintings and music.
- The numbers of spiral arrangements of seeds in many flowers are Fibonacci numbers.
- Fibonacci numbers are used for creating random numbers by some pseudorandom number generators.

The Fibonacci numbers can be also applied to solve the following mathematics problems.

I. DETERMINE THE NUMBER OF PATTERNS FOR BRICKS REARRANGEMENT

Suppose that there is a $2 \times n$ hole on the wall, and we wish to fill it using 1×2 boards. A board may be placed in either orientation. What is the number of different patterns of filling in this hole?

II. DETERMINE THE NUMBER OF SUBSETS OF $\{1,2,\ldots,N\}$ WHICH DO NOT CONTAIN TWO CONSECUTIVE NUMBERS.

- For N=1, there are 2 subsets, i.e. ∅ (empty set) and {1}.
- For N=2, there are 3 subsets, i.e. ∅, {1} and {2}.
- For N=3, there are 5 subsets, i.e. ∅, {1}, {2}, {3} and {1,3}.
- For N=4, there are 8 subsets, i.e. ∅, {1}, {2}, {3}, {4}, {1,3}, {1,4} and {2,4}.

III. DETERMINE THE NUMBER OF PATHS FOR TRAVELING BETWEEN 5 CITIES SUCH THAT THE TRAVELER CAN CHANGE DIRECTION AT ANY INTERMEDIATE CITY.

Spreadsheets were invented in the 1970's as tools for business calculation, especially financial calculation. Spreadsheets first became evident in secondary schools in the 1980's, especially in the educational computing areas of schools. In the early 1980's, the possibility of using spreadsheets for relatively sophisticated mathematical tasks was explored and the possibilities of using spreadsheets as tools for mathematics education was also discussed in some circles [2]. In order to give more examples to explain the proposed mathematics problems, the spreadsheets using *Microsoft Excel 2010* was created. *Microsoft Excel* contains "macro" which is a series of commands and functions that can be triggered by a toolbar button or an icon in a spreadsheet. In *Microsoft Excel*, macro is stored in Microsoft Visual Basic module and its code can be designed by programming in Visual Basic for Applications (VBA). The spreadsheets were created to give examples and Fibonacci numbers, Fibonacci-like numbers and solutions of the proposed mathematics problems. The calculation parts in the spreadsheets were created by recurrence relation concept and recursive programming technique.

II. Applications of the Fibonacci number to the mathematical problems

I. DETERMINE THE NUMBER OF PATTERNS FOR BRICKS REARRANGEMENT

To solve this problem, we start on letting the number of patterns be a_n. We have $a_0 = 1$ vacuously. There is only one pattern to place a board in 2×1 hole, i.e. $a_1 = 1$. It is obviously found that $a_2 = 2$ and $a_3 = 3$. (See in Figure 1.) For $n \geq 2$, we classify a filling as **type I** if two horizontal boards are touching the right edge of the hole, and as **type II** if one vertical board is touching the right edge. Each filling of **type I** can be obtained from a filling of the $2\times(n-2)$ hole by adding two horizontal boards. Hence the number of patterns for **type I** filling is a_{n-2}. Similarly, the number of pattern for **type II** filling is a_{n-1}, and we have $a_n = a_{n-1} + a_{n-2}$.

Thus the solution of this problem is a sequence of Fibonacci numbers likewise,

$$a_0 = a_1 = 1,\ a_2 = a_1 + a_0 = 2,\ a_3 = a_2 + a_1 = 3,\ a_4 = a_3 + a_2 = 5 \text{ and } a_n = a_{n-1} + a_{n-2} \text{ for } n = 2,3,4,\ldots$$

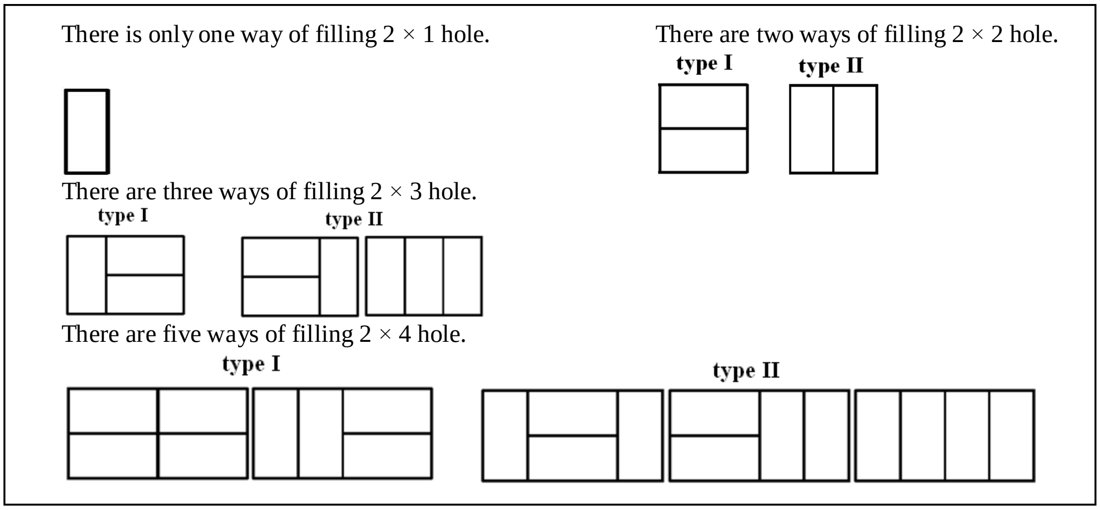


Figure 1. Examples of filling bricks in the holes.

II. DETERMINE THE NUMBER OF SUBSETS OF $\{1,2,\ldots,N\}$ WHICH DO NOT CONTAIN TWO CONSECUTIVE NUMBERS.

Consider the number of subsets of {1, 2, 3, 4, 5, 6, 7} of size 3 which do not contain two consecutive numbers. The size of this problem is small enough for us to work out the desirable subsets, of which there are 10, i.e. {1,3,5}, {1,3,6}, {1,3,7},{1,4,6}, {1,4,7}, {1,5,7},{2,4,6}, {2,4,7}, {2,5,7}, {3,5,7}.Clearly, we cannot do this when the size of the problem is significantly larger. We use a transformation transforming the subsets to the new subsets by the following. 1) The smallest numbers in the subsets are transformed to the same as the corresponding ones on the new sets. 2) The second smallest numbers are transformed to the numbers which are 1 less and 3) The biggest numbers are transformed to the numbers which are 2 less.

TABLE I. TABLE OF TRANSFORMED SUBSETS.

{1,3,5}	is transformed to	{1,2,3}.
{1,3,6}	is transformed to	{1,2,4}.
{1,3,7}	is transformed to	{1,2,5}.
{1,4,6}	is transformed to	{1,4,5}.
{1,4,7}	is transformed to	{1,4,5}.
{1,5,7}	is transformed to	{1,4,5}.
{2,4,6}	is transformed to	{2,3,4}.
{2,4,7}	is transformed to	{2,3,5}.
{2,5,7}	is transformed to	{2,4,5}.
{3,5,7}	is transformed to	{3,4,5}.

It follows that the numbers on the right side of table I. represent subsets of {1, 2, 3, 4, 5} of size 3. Since this transformation is bijective, the answer to this problem is corresponding to the number of all subsets of size 3 of {1, 2, 3, 4, 5}, which is nCr(5,3)=5!/(2!3!)=10. By the given idea, we found that numbers of subsets of {1, 2, 3, 4, 5, 6, 7} of different sizes are in the following table.

TABLE II. THE NUMBER OF VARIOUS SIZES SUBSETS OF {1, 2, 3, 4, 5, 6, 7} WHICH DO NOT CONTAIN TWO CONSECUTIVE NUMBERS.

size	number
0	nCr(8,0)=1
1	nCr(7,1)=7
2	nCr(6,2)=15
3	nCr(5,3)=10
4	nCr(4,4)=1
total	34

In general, let S_n be a set of all subsets of $\{1,2,\ldots,n\}$ which do not contain two consecutive numbers. We have $S_0 = \{\varnothing\}$ where $|S_0| = 1$, $S_1 = \{\varnothing,\{1\}\}$ where $|S_1| = 2$, $S_2 = \{\varnothing,\{1\},\{2\}\}$ where $|S_2| = 3$ and $S_3 = \{\varnothing,\{1\},\{2\},\{3\},\{1,3\}\}$ where $|S_3| = 5$. For $n \geq 2$, we classify an element S_n of as **type I** if it is a subset of $\{1,2,\ldots,n\}$ containing n, and as **type II** if the subset contains no n. Because we do not want the consecutive number, the **type I** subset can be obtained from a union of an element of S_{n-2} with $\{n\}$, where the **type II** subset can be obtained directly from an element of S_{n-1}. For example, **type I** elements of S_3 are {3} and {1, 3} where they are produced from the union of elements of S_1, $\varnothing$ and {1}, with {3}. **Type II** elements of S_3 are $\varnothing$, {1} and {2}, which are elements of S_2. Thus number of elements of S_n is equal to $|S_{n-2}|+|S_{n-1}|$, i.e.

$$|S_n|=|S_{n-2}|+|S_{n-1}|, \text{ for } n=2,3,4,\ldots,\ |S_0| = 1,\ |S_1| = 2.$$

It shows that the solution of this problem has the same structure with a sequence of Fibonacci numbers.

III. DETERMINE THE NUMBER OF PATHS FOR TRAVELING BETWEEN 5 CITIES SUCH THAT THE TRAVELER CAN CHANGE DIRECTION AT ANY INTERMEDIATE CITY.

Example. There is a road passing though 5 cities, *A*, *B*, *C*, *D* and *E*, in row. A traveler starts traveling from city *A* and heads for city *E*. At any intermediate city, he will decide either to continue in the same direction or to turn back. His journey will come to an end if he reaches city *A* or returns to city *E*.

Let K_n denote the number of possible forms for the traveler's path if he changed directions n times. Then K_0= 1 since he will go directly to city *E*, his path taking the unique form

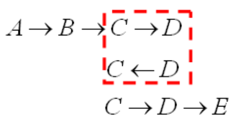
(a) $A \to B \to C \to D \to E$

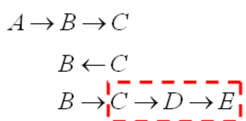
We have K_1 = 2 since he could turn back to *A* from *C* or *D*, his path taking the possible forms

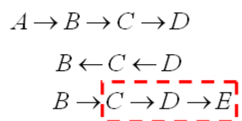
(b) $A \to B \to C \quad D \quad E$
$A \leftarrow B \leftarrow C$

(c) $A \to B \to C \to D \quad E$
$A \leftarrow B \leftarrow C \leftarrow D$

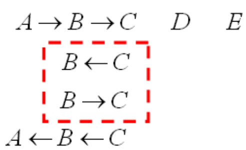
Consider K_2. He will end up in E, and the last change in directions must occur in B or C. If it occurs in C, this means that he must return from D, and goes there earlier from C. If we shorten the last segment "$C \to D \to C$" to just "C", we will get the unique form for K_0. On the other hand, if the last change in directions occurs in B, which does not allow him to go to A. If we replace the segment "$C \to D \to E$" at the very end by "A", we will get either of the forms for K_1. This means that $K_2 = K_0 + K_1 = 3$, and the three possible forms of the path are

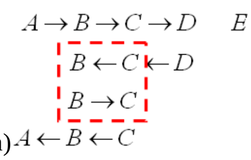
(d)


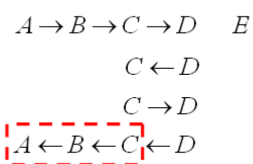
(e)


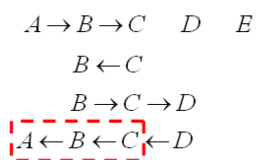
(f)


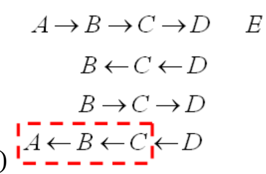
If he changes directions three times altogether, his path could have taken any of the following forms:

(g)


(h)


(i)


(j)


(k)


Note that (g) and (h) arise from (b) and (c) respectively, with replacing "C" by "$C \to B \to C$". Also (i), (j) and (k) arise from (d), (e) and (f) respectively, with replacing "E" by "$C \to B \to A$". This shows that the path is one of the forms for K_1 or K_2. This justifies that $K_3 = K_1 + K_2 = 5$. In the same way, we have $K_4 = K_2 + K_3 = 8$, $K_5 = K_3 + K_4 = 13$, $K_6 = 21$, $K_7 = 34$, $K_8 = 55$, $K_9 = 89$ and $K_{10} = 144$. In general,

$$K_n = K_{n-1} + K_{n-2} \text{ for } n=2,3,4,\ldots,\ K_0 = 1,\ K_1 = 2.$$

III. The spreadsheets

To show examples of the proposed problems, the spreadsheets using *Microsoft Excel 2010* were developed. Since the solutions of the problems relate with sequences and recurrence relation, the source code composes of arrays and recursive programming technique. Seven spreadsheets are presented by the followings.

I. SPREADSHEET I – SHOW THE FIBONACCI NUMBERS

This spreadsheet shows a sequence of Fibonacci numbers by clicking the given button.

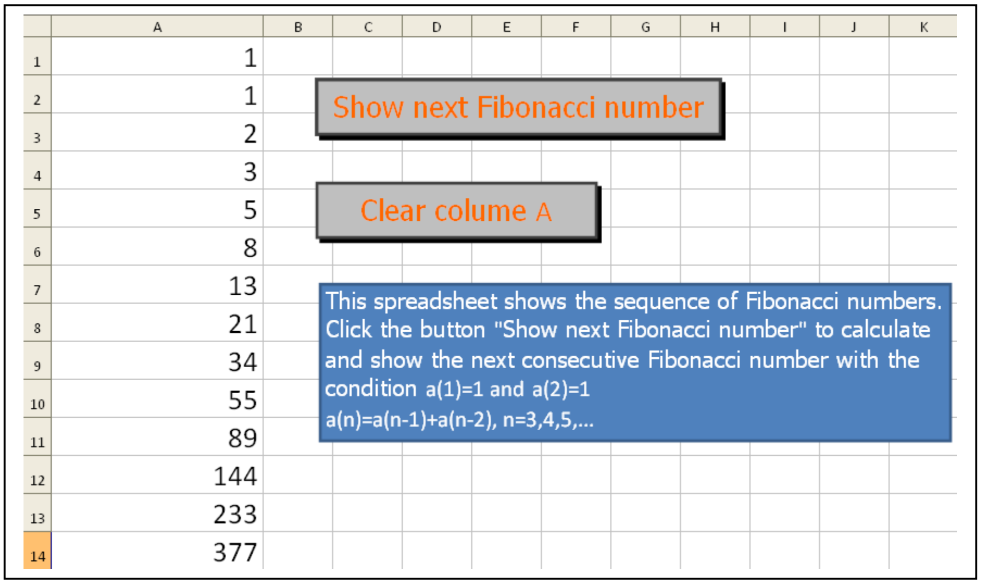


Figure 2. Figure of spreadsheet I.

II. SPREADSHEET II – SHOW THE FIRST N FIBONACCI NUMBERS

This spreadsheet shows the first N Fibonacci numbers.

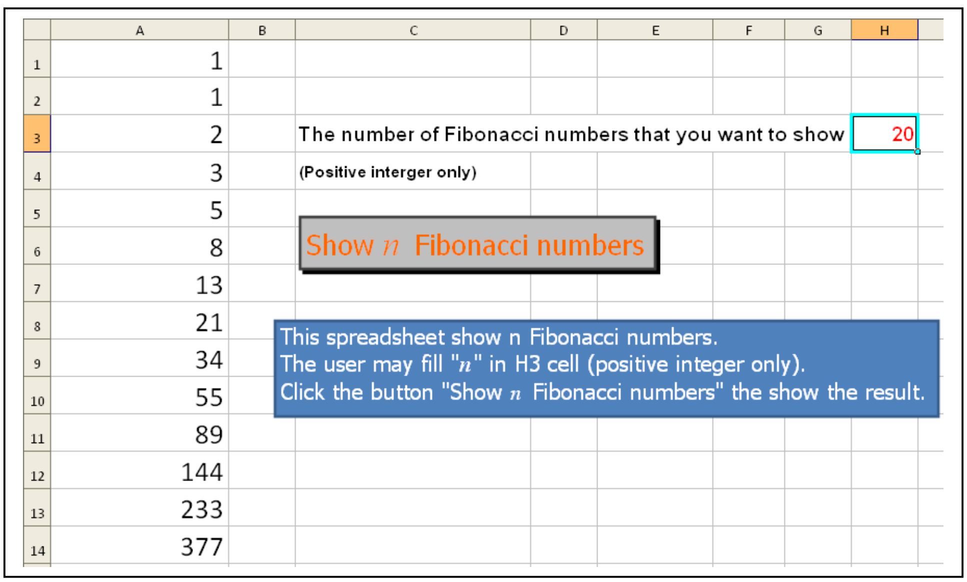


Figure 3. Figure of spreadsheet II.

III. SPREADSHEET III – SHOW THE FIRST *N* FIBONACCI-LIKE NUMBERS

The sequence of Fibonacci-like numbers is defined by the recurrence relation $a_{n+2} = a_{n+1}+a_n$, for n = 1, 2, 3, …, where a_1 and a_2 are not necessary to be 1. This spreadsheet shows the first *N* Fibonacci-like numbers.

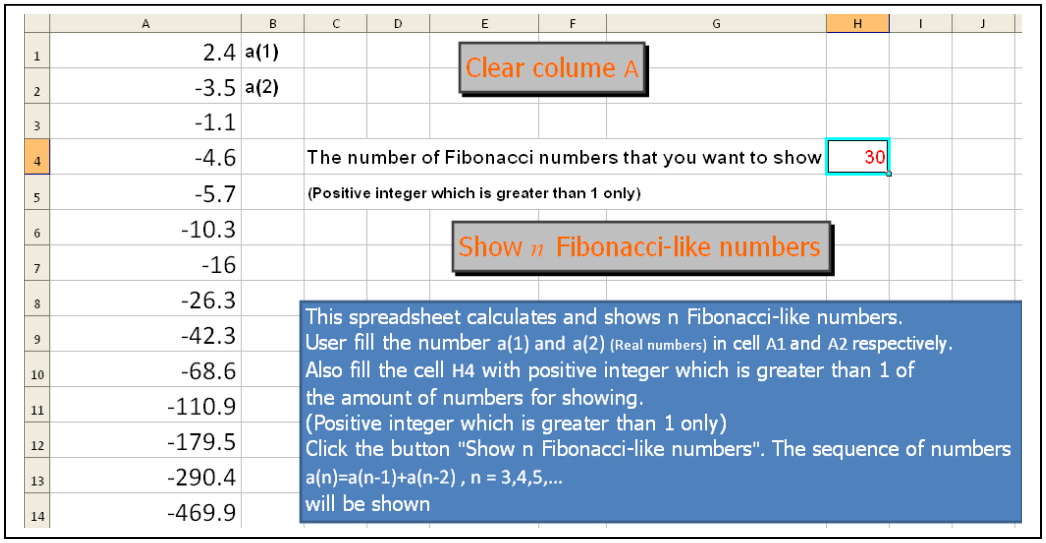


Figure 4. Figure of spreadsheet III.

IV. SPREADSHEET IV – SHOW PATTERNS OF FILLING BRICKS IN THE DIFFERENT SIZE HOLES.

Given size of the hole, this spreadsheet shows all patterns of filling bricks in the hole.

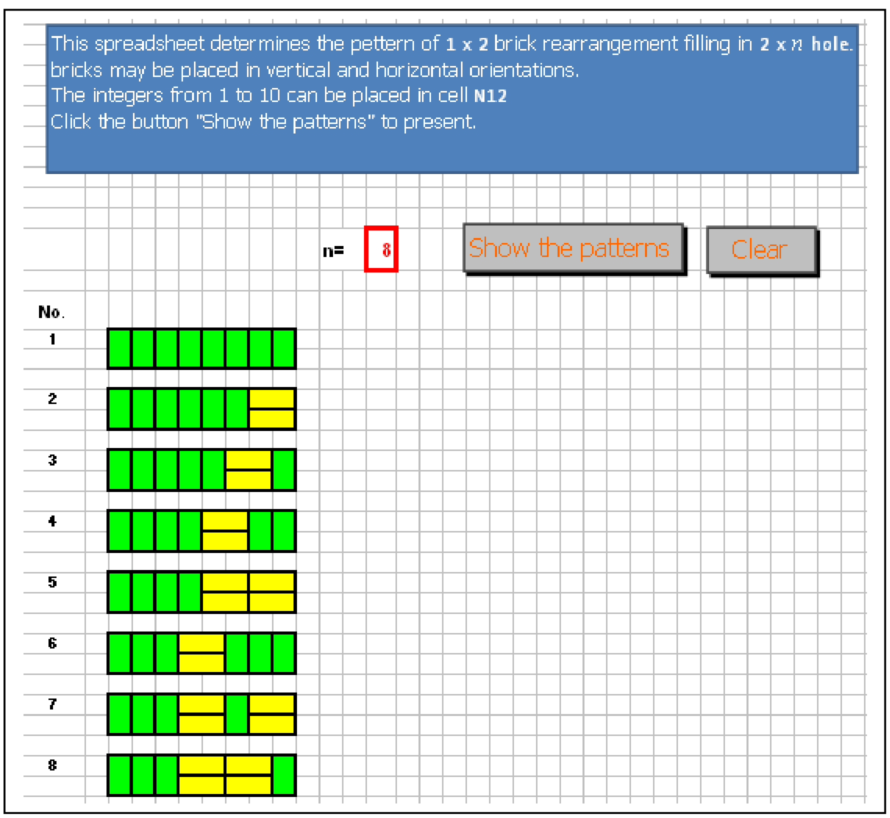
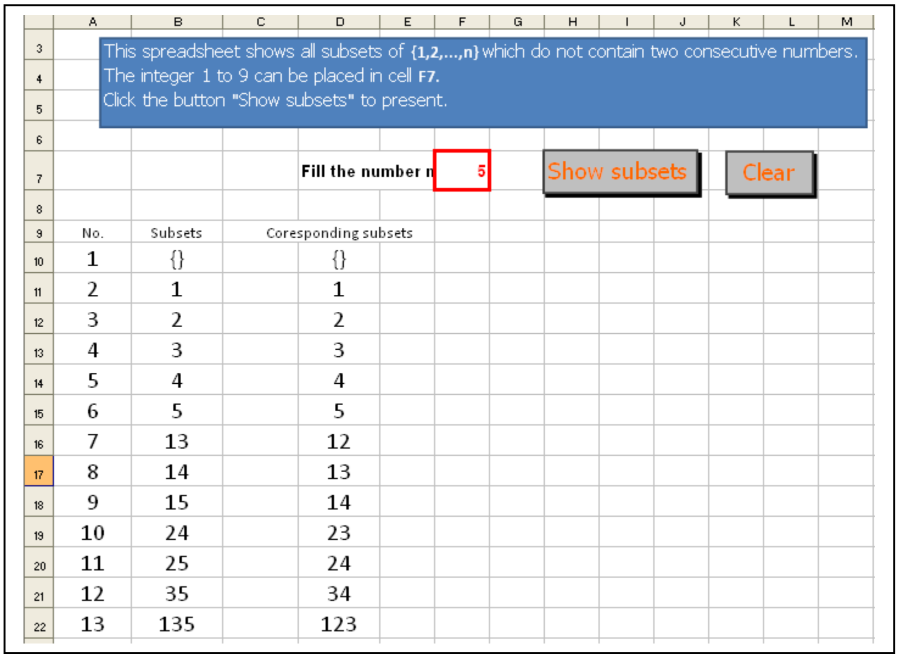


Figure 5. Figure of spreadsheet IV.

V. SPREADSHEET V – SHOW ALL SUBSETS OF {1,2,…,*N*} WHICH DO NOT CONTAIN TWO CONSECUTIVE NUMBERS.

Given the number *N*, this spreadsheet shows all subsets of {1,2,…,*N*} which do not contain two consecutive numbers.

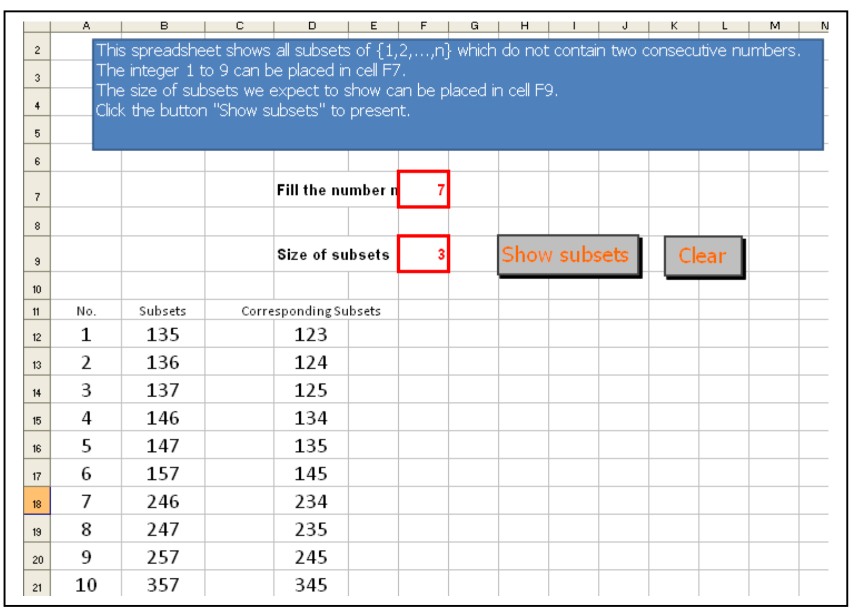


No.	Subsets	Coresponding subsets
1	{}	{}
2	1	1
3	2	2
4	3	3
5	4	4
6	5	5
7	13	12
8	14	13
9	15	14
10	24	23
11	25	24
12	35	34
13	135	123

Figure 6. Figure of spreadsheet V.

VI. SPREADSHEET VI – SHOW SOME SUBSETS OF {1,2,…,*N*} WHICH DO NOT CONTAIN TWO CONSECUTIVE NUMBERS.

Given the numbers *N* and *M*, this spreadsheet shows subsets of {1,2,…,*N*} which do not contain two consecutive numbers and have only *M* elements.



No.	Subsets	Corresponding Subsets
1	135	123
2	136	124
3	137	125
4	146	134
5	147	135
6	157	145
7	246	234
8	247	235
9	257	245
10	357	345

Figure 7. Figure of spreadsheet VI.

VII. SPREADSHEET VII – SHOW ALL PATHS FOR TRAVELING BETWEEN 5 CITIES SUCH THAT THE TRAVELER CAN CHANGE DIRECTION AT ANY INTERMEDIATE CITY.

Given the numbers *N* and five names of the cities, this spreadsheet shows all possible paths for traveling between 5 cities such that the traveler can change direction *N* times.

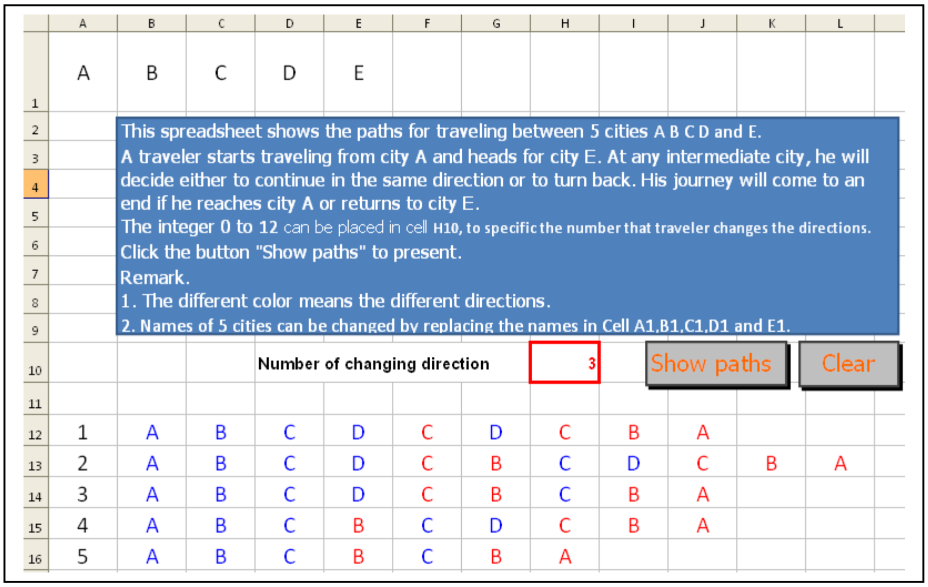


Figure 8. Figure of spreadsheet VII.

IV. Conclusion

It was found that the suggested problems could be explained by the sequence of Fibonacci numbers. The spreadsheets are helpful for giving more complicated examples. The concept of recurrence relation is used for both solving the problems and programming via VBA..

ACKNOWLEDGMENT

This research was a part of the master degree thesis, "Applications of Fibonacci numbers for solving mathematical problems by using multimedia"**,** Mathematics and Technology for Teaching Program, Graduate School, Nakhon Ratchasima Rajabhat University. It was supported by Suranaree University of Technology and Nakhon Ratchasima Rajabhat University. Authors are deeply indebted to Prof. Dr. Andy Liu, University of Alberta, Canada, for his original idea. We would like to express our sincere thanks to him very much. The result of this research is dedicated to our beloved friend, Assist Prof. Dr. Apichai Hematulin.

REFERENCES

[1] Wikipedia, "Fibonacci," http://en.wikipedia.org/wiki/Fibonacci, online.

[2] B. Kissane, "Spreadsheet and mathematics education," http://wwwstaff.murdoch.edu.au/~kissane/spreadsheets.htm, online.

[3] A. Liu, "Fibonacci Numbers", unpublished.

[4] K. H. Rosen, Discrete Mathematics and Its Applications, 6th ed., McGraw-Hill: Singapore, 2007