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Computational Approach for Finding Pythagoras Heptagon Using Programming language Java

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***Abstract*: In this paper, using computer programming language JAVA, for any natural number n, we determine the Pythagoras heptagon (a, b, c, d, e, f, g) where g denotes the length of the hypotenuse and is ≤ n, when one of a, b, c, d, e or f is given thereby the number of such Pythagoras heptagon are also known.**
***Keywords*: Pythagoras theorem, heptagon, Pythagoras heptagon, natural numbers, programming language.**

I. INTRODUCTION

In [1, 2, 3, 4], we found the remaining side lengths of the Pythagoras triangle, quadrilateral, pentagon and hexagon, if one of the side lengths is known. Now in this paper, we exhibit all possible Pythagoras heptagons, knowing only one side length that is not hypotenuse. For example, suppose we take the length of one side as 12 and the maximum limit n as 15 then all the possible Pythagoras heptagons are (2,3,4,4,6,12,15), (1,2,2,6,6,12,15), (3,3,3,3,4,12,14), (1,1,3,4,5,12,14), (2,2,2,2,6,12,14), (2,2,2,2,3,12,13). Because the above all combinations satisfies extension of Pythagoras theorem. This process is very difficult if one side length is sufficiently large and n is also large. Now our aim is to find the number of Pythagoras heptagons using programming language.

II. MAIN RESULT

A. Algorithm

1) Step-1: START.
2) Step-2: Enter maximum limit value ‘l’.
3) Step-3: Read ‘l’ value.
4) Step-4: Enter one side of Pythagoras Heptagon ‘a’.
5) Step-5: Read ‘a’ value.
6) Step-6: Initialise the variables b, c ,d, e, f, g, x.
7) Step-7: Give x value as 1.
8) Step-8: If a > l, go to step9, else go to step 10.
9) Step-9: Display that the side length exceeds maximum limit.
10) Step-10: Initialise a for loop with condition g=l, g>a, g decreases by 1; If condition fails, go to step 19.
11) Step-11: Initialize a for loop with condition b=1, b<=g, increment b by1; If condition fails, go to step 10
12) Step-12: Initialize a for loop with condition c=1, c<=b, increment c by1; If condition fails, go to step 11.
13) Step-13: Initialize a for loop with condition d=1, d<=c, increment d by1; If condition fails, go to step 12.
14) Step-14: Initialize a for loop with condition e=1, e<=d, increment e by 1; If condition fails, go to step 13.
15) Step-15: Initialize a for loop with condition f=1, f<=e, increment f by1; If condition fails, go to step 14.
16) Step-16: If $a^2+b^2+c^2+d^2+e^2+f^2=g^2$, go to step 17, else, go to step 15.
17) Step-17: Display values of a, b, c, d, e, f, g, h
18) Step-18: Increment count x.
19) Step-19: End for-loops
20) Step-20: Display x value.
21) Step-21: STOP.

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B. Result Analysis

We are required to display all the possible combinations of a Pythagoras heptagon's by taking one side as parameter which is not a hypotenuse. This can be achieved by the following steps.

1) Step-1: Write all the possible combinations that are possible to form a Pythagoras Heptagon by keeping a maximum limit to the hypotenuse.
2) Step-2: Arrange the side lengths in the combinations in ascending order and count the number of combinations and display all the combinations and count.

To illustrate how this works, let us perform this process with one side length 18 and the maximum limit as 20.

Step 1: Write all the possible combinations to form Pythagoras Heptagon with the given number 18 are............

TABLE I

a	b	c	d	e	f	g
1	3	4	5	5	18	20
2	2	4	4	6	18	20
1	1	3	4	7	18	20
1	1	1	3	8	18	20
1	3	3	3	3	18	19
2	2	2	3	4	18	19
1	1	1	3	5	18	19

In the above table every combination is a Pythagoras heptagon and satisfies the extension of Pythagoras theorem and we can form total 9 Pythagoras heptagon's if one side length is 18 and maximum limit n as 20.

If the side length is exceed the maximum limit n then result displays no Pythagoras Heptagons. For example suppose we take the length of one side as 40 and the maximum limit n as 20 then the result is no Heptagons

III. OUTPUTS

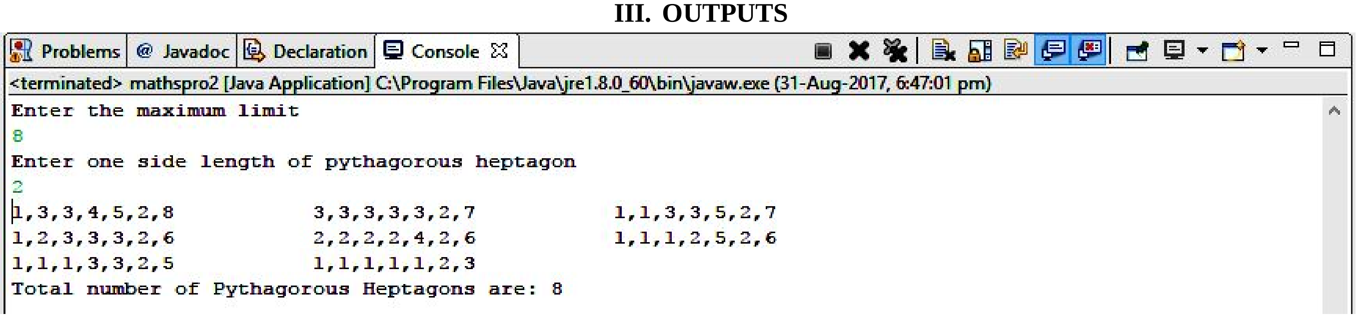

Fig. 1 One side length=2, Maximum limit=8

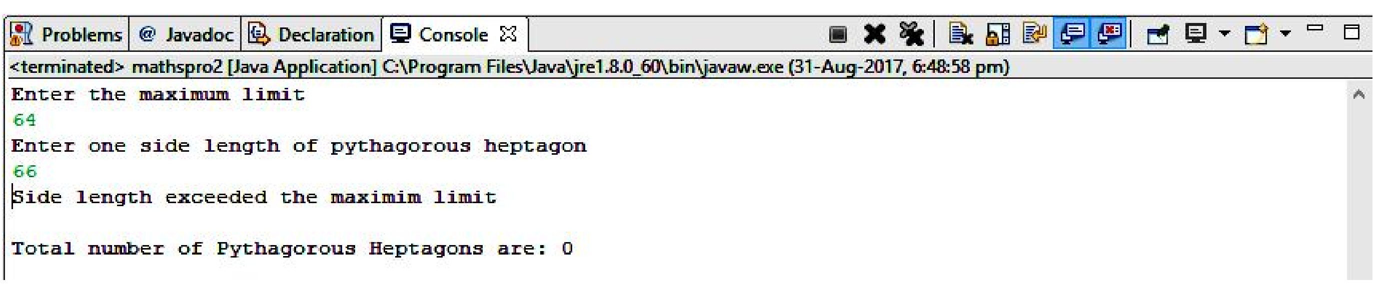

Fig. 2 One side length=66, Maximum limit=64

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Problems  Javadoc  Declaration  Console
<terminated> mathspro2 [Java Application] C:\Program Files\Java\jre1.8.0_60\bin\javaw.exe (31-Aug-2017, 6:42:40 pm)
Enter the maximum limit
15
Enter one side length of pythagorous heptagon
6
2,6,6,7,8,6,15      3,4,6,8,8,6,15      3,5,5,7,9,6,15      1,3,7,7,9,6,15      2,2,6,8,9,6,15      3,3,3,9,9,6,15
1,1,5,9,9,6,15      1,4,6,6,10,6,15     3,3,5,5,11,6,15     1,3,3,7,11,6,15     2,3,4,4,12,6,15     1,2,2,6,12,6,15
1,1,3,3,13,6,15     4,6,6,6,6,6,14      5,5,5,6,7,6,14      1,5,6,7,7,6,14      2,3,7,7,7,6,14      2,5,5,5,9,6,14
3,3,5,6,9,6,14      1,2,5,7,9,6,14      1,3,5,5,10,6,14     2,2,4,6,10,6,14     1,1,3,7,10,6,14     1,2,3,5,11,6,14
1,1,1,6,11,6,14     2,2,2,2,12,6,14     3,4,6,6,6,6,13      3,5,5,5,7,6,13      4,4,4,6,7,6,13      1,3,5,7,7,6,13
1,4,4,6,8,6,13      2,2,5,6,8,6,13      2,4,4,4,9,6,13      3,3,3,5,9,6,13      1,1,5,5,9,6,13      1,1,1,7,9,6,13
2,2,3,4,10,6,13     1,1,1,3,11,6,13     2,4,4,6,6,6,12      3,3,4,5,7,6,12      1,3,3,5,8,6,12      1,1,3,4,9,6,12
1,3,5,5,5,6,11      1,4,4,4,6,6,11      2,2,4,5,6,6,11      3,3,3,3,7,6,11      1,1,3,5,7,6,11      2,2,2,3,8,6,11
1,1,1,1,9,6,11      1,2,3,5,5,6,10      1,3,3,3,6,6,10      2,2,2,4,6,6,10      1,1,1,5,6,6,10      1,1,2,3,7,6,10
3,3,3,3,3,6,9       1,1,3,3,5,6,9       1,1,1,3,4,6,8       1,1,1,1,3,6,7
Total number of Pythagorous Heptagons are: 58
```

Fig. 3 One side length=6, Maximum limit=15

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Problems  Javadoc  Declaration  Console
<terminated> mathspro2 [Java Application] C:\Program Files\Java\jre1.8.0_60\bin\javaw.exe (31-Aug-2017, 7:01:03 pm)
Enter the maximum limit
275
Enter one side length of pythagorous heptagon
273
14,15,15,15,15,273,275   2,15,17,17,17,273,275    8,14,16,16,18,273,275    2,16,16,16,18,273,275    5,13,17,17,18,273,275
9,13,14,17,19,273,275    10,11,15,17,19,273,275   5,14,15,17,19,273,275    6,11,17,17,19,273,275    11,11,13,18,19,273,275
1,11,17,18,19,273,275    6,13,13,19,19,273,275    3,13,14,19,19,273,275    7,10,15,19,19,273,275    6,7,17,19,19,273,275
2,9,17,19,19,273,275     5,5,18,19,19,273,275     1,7,18,19,19,273,275     2,3,19,19,19,273,275     10,12,14,16,20,273,275
4,10,16,18,20,273,275    6,8,14,20,20,273,275     2,6,16,20,20,273,275     11,13,13,14,21,273,275   6,13,15,15,21,273,275
3,14,15,15,21,273,275    7,11,14,17,21,273,275    1,13,14,17,21,273,275    9,9,13,18,21,273,275     5,9,15,18,21,273,275
5,10,13,19,21,273,275    2,11,13,19,21,273,275    7,7,14,19,21,273,275     1,2,17,19,21,273,275     3,6,13,21,21,273,275
3,3,14,21,21,273,275     7,13,13,15,22,273,275    9,9,15,15,22,273,275     4,12,14,16,22,273,275    6,8,16,16,22,273,275
9,11,11,17,22,273,275    7,7,15,17,22,273,275     3,5,17,17,22,273,275     4,4,16,18,22,273,275     7,9,11,19,22,273,275
3,11,11,19,22,273,275    1,9,13,19,22,273,275     1,5,15,19,22,273,275     2,8,12,20,22,273,275     3,9,9,21,22,273,275
5,5,11,21,22,273,275     1,7,11,21,22,273,275     1,1,13,21,22,273,275     9,11,13,14,23,273,275    10,11,11,15,23,273,275
2,13,13,15,23,273,275    5,11,14,15,23,273,275    6,9,15,15,23,273,275     6,11,11,17,23,273,275    3,10,13,17,23,273,275
1,9,14,17,23,273,275     2,7,15,17,23,273,275     9,9,9,18,23,273,275      1,11,11,18,23,273,275    5,7,13,18,23,273,275
3,3,15,18,23,273,275     5,9,10,19,23,273,275     6,7,11,19,23,273,275     2,9,11,19,23,273,275     1,6,13,19,23,273,275
1,3,14,19,23,273,275     3,6,9,21,23,273,275      1,5,10,21,23,273,275     1,2,11,21,23,273,275     3,5,7,22,23,273,275
1,1,9,22,23,273,275      2,3,5,23,23,273,275      1,1,6,23,23,273,275      6,12,12,14,24,273,275    8,8,14,14,24,273,275
8,10,10,16,24,273,275    2,8,14,16,24,273,275     2,2,16,16,24,273,275     4,6,12,18,24,273,275     2,4,10,20,24,273,275
2,4,4,22,24,273,275      9,10,11,13,25,273,275    5,9,13,14,25,273,275     5,10,11,15,25,273,275    2,11,11,15,25,273,275
5,5,14,15,25,273,275     1,7,14,15,25,273,275     1,9,10,17,25,273,275     5,6,11,17,25,273,275     2,3,13,17,25,273,275
7,7,7,18,25,273,275      1,5,11,18,25,273,275     5,6,7,19,25,273,275      2,5,9,19,25,273,275      1,3,10,19,25,273,275
1,2,5,21,25,273,275      7,9,11,13,26,273,275     3,11,11,13,26,273,275    1,9,13,13,26,273,275     4,8,12,14,26,273,275
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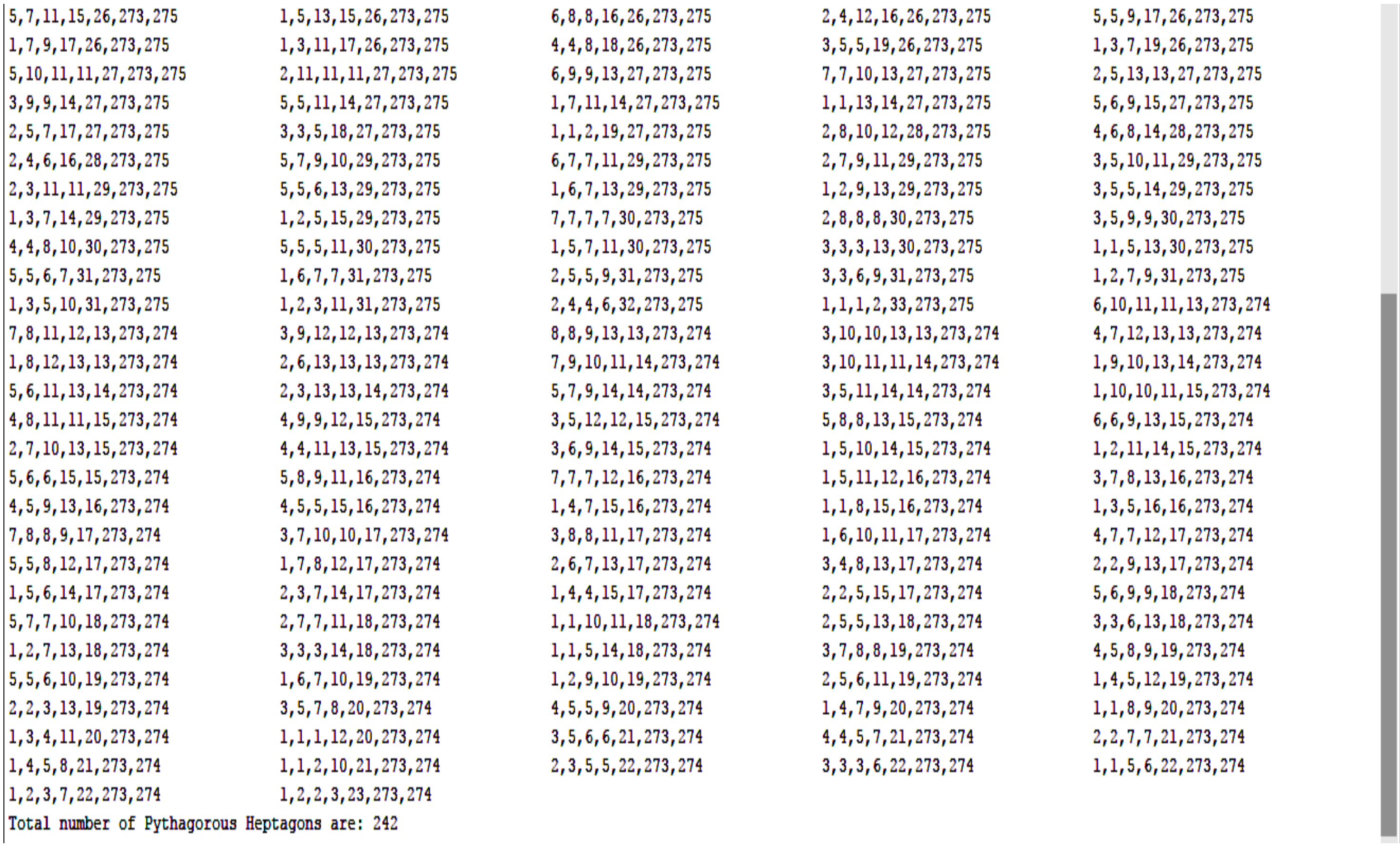

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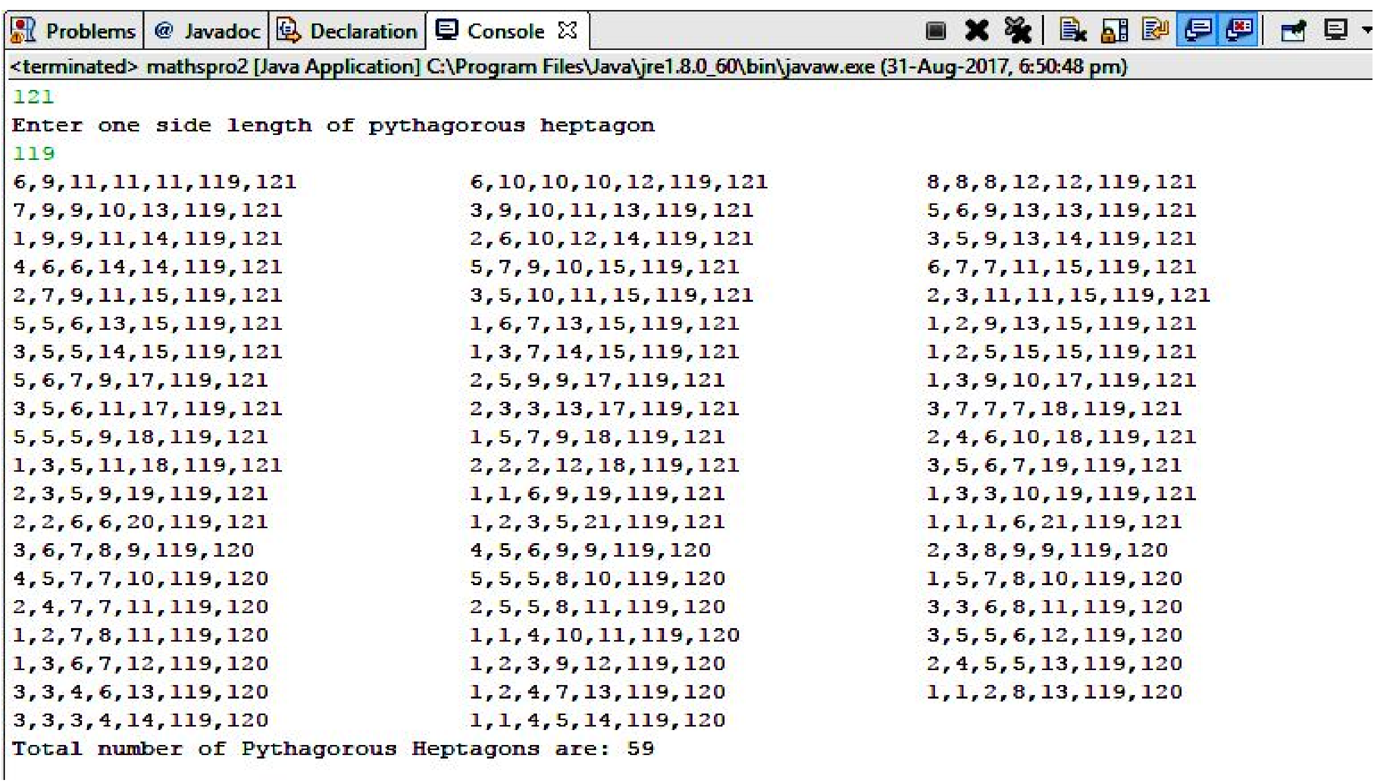
5,7,11,15,26,273,275     1,5,13,15,26,273,275     6,8,8,16,26,273,275      2,4,12,16,26,273,275     5,5,9,17,26,273,275
1,7,9,17,26,273,275      1,3,11,17,26,273,275     4,4,8,18,26,273,275      3,5,5,19,26,273,275      1,3,7,19,26,273,275
5,10,11,11,27,273,275    2,11,11,11,27,273,275    6,9,9,13,27,273,275      7,7,10,13,27,273,275     2,5,13,13,27,273,275
3,9,9,14,27,273,275      5,5,11,14,27,273,275     1,7,11,14,27,273,275     1,1,13,14,27,273,275     5,6,9,15,27,273,275
2,5,7,17,27,273,275      3,3,5,18,27,273,275      1,1,2,19,27,273,275      2,8,10,12,28,273,275     4,6,8,14,28,273,275
2,4,6,16,28,273,275      5,7,9,10,29,273,275      6,7,7,11,29,273,275      2,7,9,11,29,273,275      3,5,10,11,29,273,275
2,3,11,11,29,273,275     5,5,6,13,29,273,275      1,6,7,13,29,273,275      1,2,9,13,29,273,275      3,5,5,14,29,273,275
1,3,7,14,29,273,275      1,2,5,15,29,273,275      7,7,7,7,30,273,275       2,8,8,8,30,273,275       3,5,9,9,30,273,275
4,4,8,10,30,273,275      5,5,5,11,30,273,275      1,5,7,11,30,273,275      3,3,3,13,30,273,275      1,1,5,13,30,273,275
5,5,6,7,31,273,275       1,6,7,7,31,273,275       2,5,5,9,31,273,275       3,3,6,9,31,273,275       1,2,7,9,31,273,275
1,3,5,10,31,273,275      1,2,3,11,31,273,275      2,4,4,6,32,273,275       1,1,1,2,33,273,275       6,10,11,11,13,273,274
7,8,11,12,13,273,274     3,9,12,12,13,273,274     8,8,9,13,13,273,274      3,10,10,13,13,273,274    4,7,12,13,13,273,274
1,8,12,13,13,273,274     2,6,13,13,13,273,274     7,9,10,11,14,273,274     3,10,11,11,14,273,274    1,9,10,13,14,273,274
5,6,11,13,14,273,274     2,3,13,13,14,273,274     5,7,9,14,14,273,274      3,5,11,14,14,273,274     1,10,10,11,15,273,274
4,8,11,11,15,273,274     4,9,9,12,15,273,274      3,5,12,12,15,273,274     5,8,8,13,15,273,274      6,6,9,13,15,273,274
2,7,10,13,15,273,274     4,4,11,13,15,273,274     3,6,9,14,15,273,274      1,5,10,14,15,273,274     1,2,11,14,15,273,274
5,6,6,15,15,273,274      5,8,9,11,16,273,274      7,7,7,12,16,273,274      1,5,11,12,16,273,274     3,7,8,13,16,273,274
4,5,9,13,16,273,274      4,5,5,15,16,273,274      1,4,7,15,16,273,274      1,1,8,15,16,273,274      1,3,5,16,16,273,274
7,8,8,9,17,273,274       3,7,10,10,17,273,274     3,8,8,11,17,273,274      1,6,10,11,17,273,274     4,7,7,12,17,273,274
5,5,8,12,17,273,274      1,7,8,12,17,273,274      2,6,7,13,17,273,274      3,4,8,13,17,273,274      2,2,9,13,17,273,274
1,5,6,14,17,273,274      2,3,7,14,17,273,274      1,4,4,15,17,273,274      2,2,5,15,17,273,274      5,6,9,9,18,273,274
5,7,7,10,18,273,274      2,7,7,11,18,273,274      1,1,10,11,18,273,274     2,5,5,13,18,273,274      3,3,6,13,18,273,274
1,2,7,13,18,273,274      3,3,3,14,18,273,274      1,1,5,14,18,273,274      3,7,8,8,19,273,274       4,5,8,9,19,273,274
5,5,6,10,19,273,274      1,6,7,10,19,273,274      1,2,9,10,19,273,274      2,5,6,11,19,273,274      1,4,5,12,19,273,274
2,2,3,13,19,273,274      3,5,7,8,20,273,274       4,5,5,9,20,273,274       1,4,7,9,20,273,274       1,1,8,9,20,273,274
1,3,4,11,20,273,274      1,1,1,12,20,273,274      3,5,6,6,21,273,274       4,4,5,7,21,273,274       2,2,7,7,21,273,274
1,4,5,8,21,273,274       1,1,2,10,21,273,274      2,3,5,5,22,273,274       3,3,3,6,22,273,274       1,1,5,6,22,273,274
1,2,3,7,22,273,274       1,2,2,3,23,273,274
Total number of Pythagorous Heptagons are: 242
```

Fig. 4 One side length=273, Maximum limit=275



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Problems  Javadoc  Declaration  Console
<terminated> mathspro2 [Java Application] C:\Program Files\Java\jre1.8.0_60\bin\javaw.exe (31-Aug-2017, 6:50:48 pm)
121
Enter one side length of pythagorous heptagon
119
6,9,11,11,11,119,121      6,10,10,10,12,119,121     8,8,8,12,12,119,121
7,9,9,10,13,119,121       3,9,10,11,13,119,121      5,6,9,13,13,119,121
1,9,9,11,14,119,121       2,6,10,12,14,119,121      3,5,9,13,14,119,121
4,6,6,14,14,119,121       5,7,9,10,15,119,121       6,7,7,11,15,119,121
2,7,9,11,15,119,121       3,5,10,11,15,119,121      2,3,11,11,15,119,121
5,5,6,13,15,119,121       1,6,7,13,15,119,121       1,2,9,13,15,119,121
3,5,5,14,15,119,121       1,3,7,14,15,119,121       1,2,5,15,15,119,121
5,6,7,9,17,119,121        2,5,9,9,17,119,121        1,3,9,10,17,119,121
3,5,6,11,17,119,121       2,3,3,13,17,119,121       3,7,7,7,18,119,121
5,5,5,9,18,119,121        1,5,7,9,18,119,121        2,4,6,10,18,119,121
1,3,5,11,18,119,121       2,2,2,12,18,119,121       3,5,6,7,19,119,121
2,3,5,9,19,119,121        1,1,6,9,19,119,121        1,3,3,10,19,119,121
2,2,6,6,20,119,121        1,2,3,5,21,119,121        1,1,1,6,21,119,121
3,6,7,8,9,119,120         4,5,6,9,9,119,120         2,3,8,9,9,119,120
4,5,7,7,10,119,120        5,5,5,8,10,119,120        1,5,7,8,10,119,120
2,4,7,7,11,119,120        2,5,5,8,11,119,120        3,3,6,8,11,119,120
1,2,7,8,11,119,120        1,1,4,10,11,119,120       3,5,5,6,12,119,120
1,3,6,7,12,119,120        1,2,3,9,12,119,120        2,4,5,5,13,119,120
3,3,4,6,13,119,120        1,2,4,7,13,119,120        1,1,2,8,13,119,120
3,3,3,4,14,119,120        1,1,4,5,14,119,120
Total number of Pythagorous Heptagons are: 59
```

Fig. 5 One side length=119, Maximum limit=121

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Problems  @ Javadoc  Declaration  Console
<terminated> mathspro2 [Java Application] C:\Program Files\Java\jre1.8.0_60\bin\javaw.exe (31-Aug-2017, 6:38:39 pm)
Enter the maximum limit
92
Enter one side length of pythagorous heptagon
88
12,12,12,12,12,88,92     6,11,13,13,15,88,92     7,9,13,14,15,88,92     3,11,13,14,15,88,92     7,10,11,15,15,88,92
1,10,13,15,15,88,92      5,7,14,15,15,88,92      3,6,15,15,15,88,92     6,6,14,14,16,88,92      9,9,10,13,17,88,92
5,9,10,15,17,88,92       6,7,11,15,17,88,92      2,9,11,15,17,88,92     1,6,13,15,17,88,92      1,3,14,15,17,88,92
5,6,9,17,17,88,92        5,9,11,13,18,88,92      3,7,13,13,18,88,92     6,8,10,14,18,88,92      3,9,9,15,18,88,92
5,5,11,15,18,88,92       1,7,11,15,18,88,92      1,1,13,15,18,88,92     2,6,10,16,18,88,92      3,7,7,17,18,88,92
1,5,9,17,18,88,92        2,2,8,18,18,88,92       6,9,11,11,19,88,92     3,9,10,13,19,88,92      1,9,9,14,19,88,92
6,7,7,15,19,88,92        2,7,9,15,19,88,92       3,5,10,15,19,88,92     2,3,11,15,19,88,92      3,5,6,17,19,88,92
1,3,5,18,19,88,92        4,4,12,12,20,88,92      6,9,9,9,21,88,92       7,7,9,10,21,88,92       3,7,10,11,21,88,92
1,6,11,11,21,88,92       5,6,7,13,21,88,92       2,5,9,13,21,88,92      1,3,10,13,21,88,92      3,5,7,14,21,88,92
1,1,9,14,21,88,92        2,5,5,15,21,88,92       3,3,6,15,21,88,92      1,2,7,15,21,88,92       5,7,9,9,22,88,92
6,6,8,10,22,88,92        3,5,9,11,22,88,92       3,3,7,13,22,88,92      1,1,3,15,22,88,92       5,6,7,9,23,88,92
2,5,9,9,23,88,92         1,3,9,10,23,88,92       3,5,6,11,23,88,92      2,3,3,13,23,88,92       6,6,6,6,24,88,92
2,2,6,10,24,88,92        3,5,5,6,25,88,92        1,3,6,7,25,88,92       1,2,3,9,25,88,92        1,3,3,5,26,88,92
7,10,10,12,12,88,91      8,8,11,12,12,88,91      4,8,12,12,13,88,91     4,9,10,12,14,88,91      2,7,12,12,14,88,91
6,6,10,13,14,88,91       3,6,10,14,14,88,91      2,8,10,12,15,88,91     4,6,8,14,15,88,91       6,8,9,10,16,88,91
3,8,8,12,16,88,91        1,6,10,12,16,88,91      2,4,6,15,16,88,91      2,6,8,12,17,88,91       6,7,8,8,18,88,91
2,8,8,9,18,88,91         4,4,9,10,18,88,91       2,3,10,10,18,88,91     2,4,7,12,18,88,91       1,2,8,12,18,88,91
2,2,6,13,18,88,91        2,2,3,14,18,88,91       2,6,6,10,19,88,91      4,6,6,7,20,88,91        1,6,6,8,20,88,91
2,4,6,9,20,88,91         2,2,3,6,22,88,91        7,8,9,9,9,88,90    8,8,8,8,10,88,90        3,8,9,9,11,88,90
4,7,7,11,11,88,90        5,5,8,11,11,88,90       1,7,8,11,11,88,90      5,5,9,9,12,88,90        1,7,9,9,12,88,90
1,3,9,11,12,88,90        4,4,6,12,12,88,90       5,7,7,8,13,88,90       3,4,9,9,13,88,90        4,5,5,11,13,88,90
1,4,7,11,13,88,90        1,1,8,11,13,88,90       3,3,5,12,13,88,90      1,1,4,13,13,88,90       4,4,8,8,14,88,90
3,3,7,8,15,88,90         3,4,5,9,15,88,90        5,5,5,5,16,88,90       1,5,5,7,16,88,90        1,1,7,7,16,88,90
2,4,4,8,16,88,90         1,3,3,9,16,88,90        1,4,5,5,17,88,90       1,1,4,7,17,88,90        1,1,1,8,17,88,90
4,5,6,6,8,88,89      2,3,6,8,8,88,89      3,4,4,6,10,88,89        1,2,6,6,10,88,89        2,2,3,4,12,88,89

Total number of Pythagorous Heptagons are: 125
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Fig. 6 One side length=88, Maximum limit=92

IV. CONCLUSIONS

The process of finding side lengths using manually is very difficult. So by using MATLAB finding the Pythagoras heptagon by knowing any one of the side length is becomes novel and easy process. Further we are planning to extend this to Pythagoras n-sided polygon.

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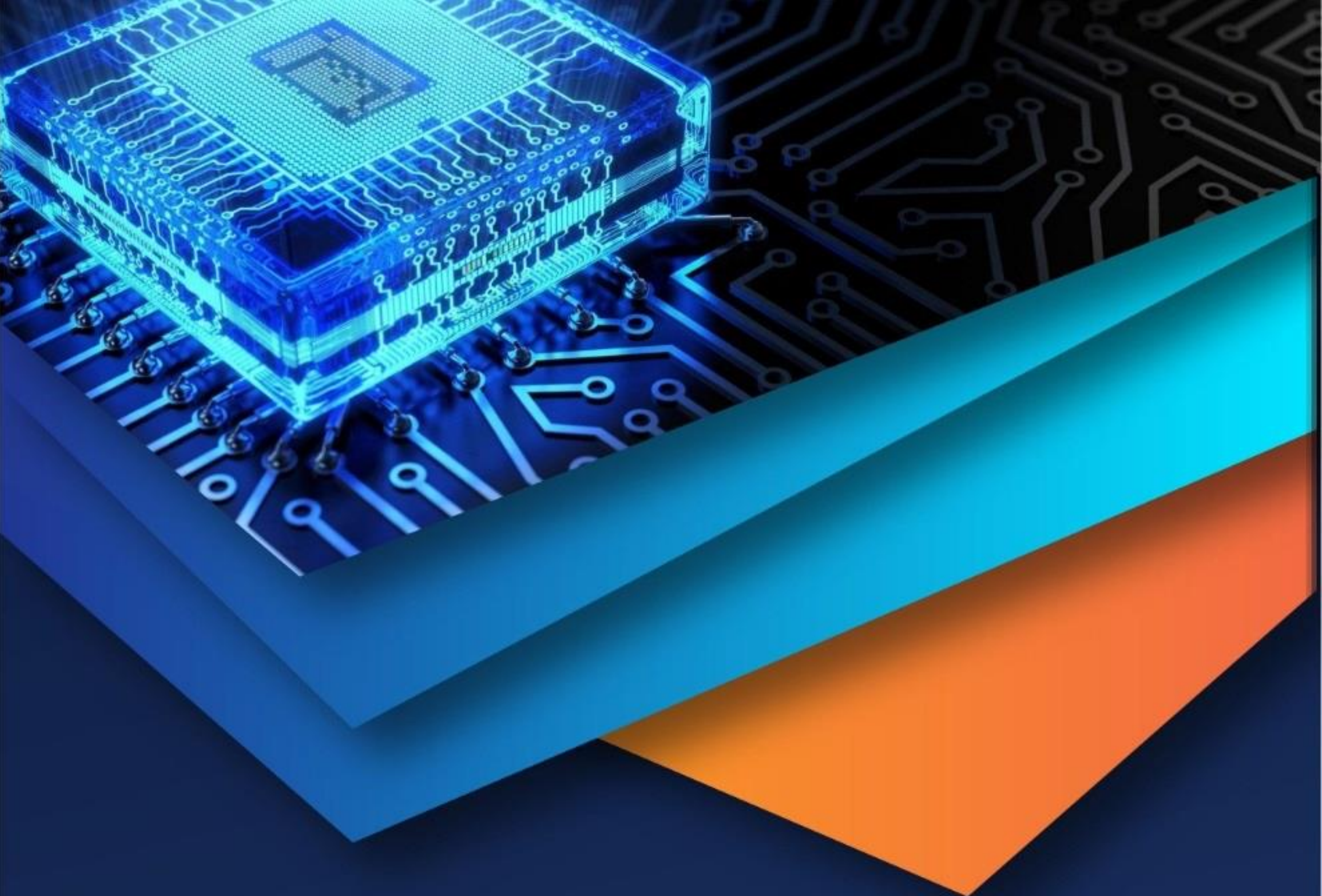

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