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Computational Approach for Finding Pythagoras Octagon Using Programming language MATLAB

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

I. INTRODUCTION

In [1, 2, 3, 4, 5], we found the remaining side lengths of the Pythagoras triangle, quadrilateral, pentagon, hexagon and heptagon, if one of the side lengths is known. Now in this paper, we exhibit all possible Pythagoras octagons, knowing only one side length that is not hypotenuse. For example, suppose we take the length of one side as 9 and the maximum limit n as 12 then all the possible Pythagoras octagons are (1, 1, 2, 3, 3, 4, 9, 11) , (2,3,3, 3,4,4, 9,12) , (1,1,2,4,4,5, 9,12) , (1,2,2,2,5,5,9,12) , (1,2,2,3,3,6,9,12) , (1,1,2,2,2,7,9,12) . 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 octagons using programming language Matlab.

II. MAIN RESULT

A. Algorithm

1) Step-1: START.
2) Step-2: Enter the length of one side of Pythagoras Octagon ‘c’.
3) Step-3: Read ‘c’ value.
4) Step-4: Enter the maximum limit of hypotenuse of Pythagoras Heptagon ‘n’.
5) Step-5: Read ‘n’ value.
6) Step-6: Initialise the variables a, b, d, e, f, g, k.
7) Step-7: Give k value as 0.
8) Step-8: If c>n, 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 h=4, h<=n, h increases by 1; If condition fails, go to step 19.
11) Step-11: Initialize a for loop with condition a=1, a<=h, increment a by1; If condition fails, go to step 10.
12) Step-12: Initialize a for loop with condition b=1, b<=a, increment b by1; If condition fails, go to step 11.
13) Step-13: Initialize a for loop with condition d=1, d<=b, 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: Initialize a for loop with condition g=1, g<=f, increment g by1; If condition fails, go to step 15.
17) Step-17:If $a^2+b^2+c^2+d^2+e^2+f^2+g^2=h^2$ go to step 18, else, go to step 16.
18) Step-18:Display values of a, b, c, d, e, f, g, h.
19) Step-19:Increment count k.
20) Step-20: End for-loops.
21) Step-21: Display k value.
22) Step-22:STOP.

B. Result Analysis

We are required to display all the possible combinations of a Pythagoras octagons 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 Octagon 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 19 and the maximum limit as 21.

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

a	b	c	d	e	f	g	h
2	2	2	3	3	3	19	20
1	1	1	2	4	4	19	20
1	1	2	2	2	5	19	20
1	2	3	4	5	5	19	21
1	3	3	3	4	6	19	21
2	2	2	4	4	6	19	21
1	1	1	4	5	6	19	21
1	1	2	3	4	7	19	21
1	1	1	2	3	8	19	21

TABLE I

In the above table every combination is a Pythagoras octagon and satisfies the extension of Pythagoras theorem and we can form total 9 Pythagoras octagons if one side length is 19 and maximum limit n as 21.

If the side length is exceed the maximum limit n then result displays no Pythagoras Octagons. For example suppose we take the length of one side as 50 and the maximum limit n as 45 then the result is no Octagons

III.OUTPUTS

```
>> hexoct
 Enter the length of any one of the sides of Pythogoras Octagon 4
 Enter the maximum limit for the hypotenuse of the Pythogoras Octagon 8
 1    1    1    1    1    2    4    5
 1    1    1    2    2    3    4    6
 1    1    2    3    3    3    4    7
 1    2    2    2    2    4    4    7
 1    1    1    1    2    4    5    7
 1    2    3    3    3    4    4    8
 2    2    2    2    4    4    4    8
 1    1    1    2    4    4    5    8
The total number of Pythogoras Octagons possible
k =8
```

Fig. 1 One side length=4, Maximum limit=8

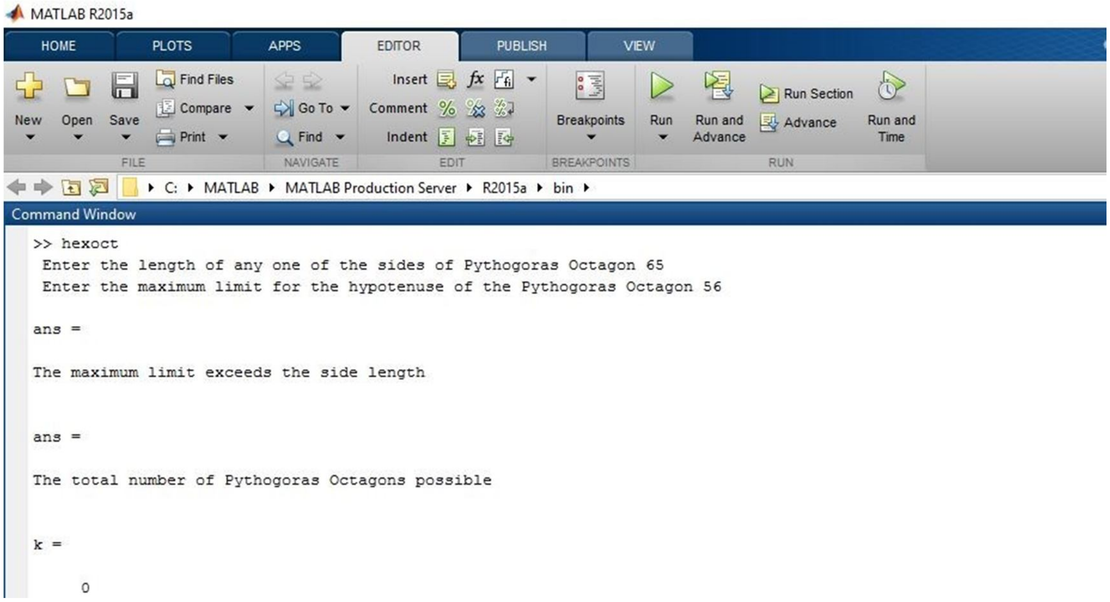

Fig. 2One side length=65, Maximum limit=56

```
>> hexoct
Enter the length of any one of the sides of Pythogoras Octagon 15
Enter the maximum limit for the hypotenuse of the Pythogoras Octagon 20
```

1	2	2	2	3	3	15	16	2	3	3	4	7	7	15	19	1	1	3	6	8	8	15	20
1	2	3	3	4	5	15	17	2	3	3	5	5	8	15	19	1	4	4	5	6	9	15	20
1	1	1	3	4	6	15	17	3	3	3	3	6	8	15	19	2	2	5	5	6	9	15	20
1	4	4	4	5	5	15	18	1	1	3	5	6	8	15	19	2	3	3	6	6	9	15	20
2	2	4	5	5	5	15	18	1	2	3	3	7	8	15	19	2	3	4	4	7	9	15	20
2	3	3	4	5	6	15	18	1	2	3	4	5	9	15	19	1	2	2	6	7	9	15	20
1	1	3	4	6	6	15	18	1	1	1	4	6	9	15	19	1	2	3	4	8	9	15	20
1	1	4	4	4	7	15	18	1	1	3	3	4	10	15	19	1	2	2	2	9	9	15	20
1	2	2	4	5	7	15	18	2	5	5	6	6	7	15	20	3	3	4	4	5	10	15	20
2	2	3	3	3	8	15	18	3	3	6	6	6	7	15	20	1	2	3	5	6	10	15	20
1	1	1	4	4	8	15	18	3	4	4	6	7	7	15	20	1	1	1	6	6	10	15	20
1	1	2	2	5	8	15	18	1	2	6	6	7	7	15	20	2	2	3	3	7	10	15	20
3	4	5	5	5	6	15	19	3	4	5	5	6	8	15	20	2	3	3	4	4	11	15	20
4	4	4	4	6	6	15	19	1	3	4	6	7	8	15	20	1	2	2	3	6	11	15	20
1	3	4	5	6	7	15	19	2	3	3	5	8	8	15	20	1	1	2	3	4	12	15	20

```
The total number of Pythogoras Octagons possible
k=45
```

Fig. 3 One side length=15, Maximum limit=20

```
>> hexoct
Enter the length of any one of the sides of Pythogoras Octagon 49
Enter the maximum limit for the hypotenuse of the Pythogoras Octagon 50
   1   4   4   4   5   5   49   50
   2   2   4   5   5   5   49   50
   2   3   3   4   5   6   49   50
   1   1   3   4   6   6   49   50
   1   1   4   4   4   7   49   50
   1   2   2   4   5   7   49   50
   2   2   3   3   3   8   49   50
   1   1   1   4   4   8   49   50
   1   1   2   2   5   8   49   50
The total number of Pythogoras Octagons possible   k =9
```

Fig. 4,5One side length=45, Maximum limit=50

IV. CONCLUSIONS

The process of finding side lengths using manually is very difficult. So by using MATLABfinding the Pythagoras octagon 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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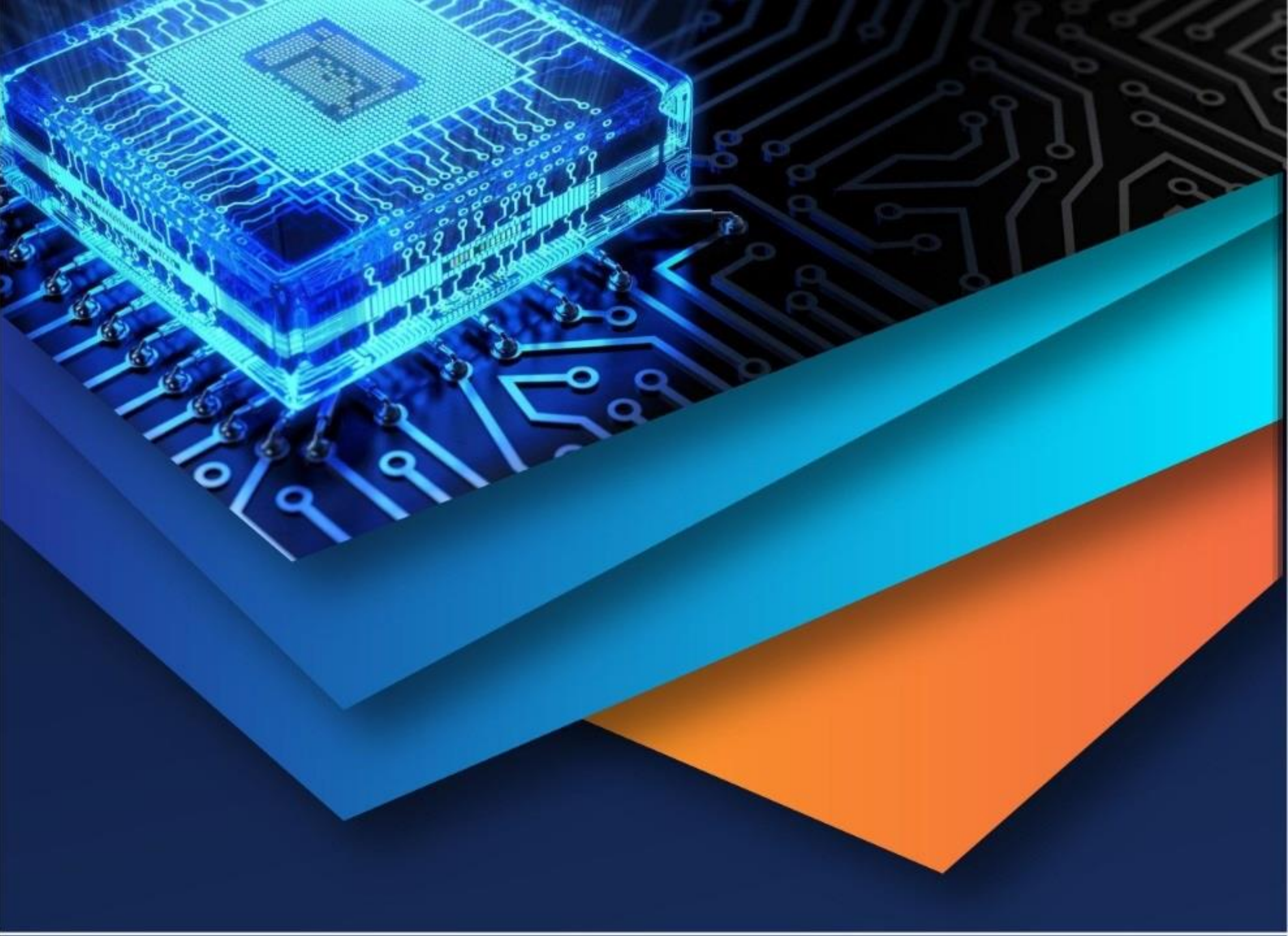

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