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Computational Approach for Finding Pythagoras Heptagon Using Programming language Java

S.N.AR.G. Bharat Iragavarapu¹, Kuppli Sai Rahul²

¹Department of Mathematics G.V.P. College of Engineering (Autonomous), Visakhapatnam, A.P., India

²Department of Electronics and Communication Engineering, G.V.P. College of Engineering (Autonomous), Visakhapatnam, A.P., India

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 $\leq n$, 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 $g=1, g \leq a$, g decreases by 1; If condition fails, go to step 19.
- 11) Step-11: Initialize a for loop with condition $b=1, b \leq g$, increment b by 1; If condition fails, go to step 10
- 12) Step-12: Initialize a for loop with condition $c=1, c \leq b$, increment c by 1; If condition fails, go to step 11.
- 13) Step-13: Initialize a for loop with condition $d=1, d \leq c$, increment d by 1; If condition fails, go to step 12.
- 14) Step-14: Initialize a for loop with condition $e=1, e \leq d$, increment e by 1; If condition fails, go to step 13.
- 15) Step-15: Initialize a for loop with condition $f=1, f \leq e$, increment f by 1; 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.

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

```

<terminated> mathsp2 [Java Application] C:\Program Files\Java\jre1.8.0_60\bin\javaw.exe (31-Aug-2017, 6:47:01 pm)
Enter the maximum limit
8
Enter one side length of pythagorous heptagon
2
1, 3, 3, 4, 5, 2, 8      3, 3, 3, 3, 3, 2, 7      1, 1, 3, 3, 5, 2, 7
1, 2, 3, 3, 3, 2, 6      2, 2, 2, 2, 4, 2, 6      1, 1, 1, 2, 5, 2, 6
1, 1, 1, 3, 3, 2, 5      1, 1, 1, 1, 1, 2, 3
Total number of Pythagorous Heptagons are: 8

```

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

```

<terminated> mathsp2 [Java Application] C:\Program Files\Java\jre1.8.0_60\bin\javaw.exe (31-Aug-2017, 6:48:58 pm)
Enter the maximum limit
64
Enter one side length of pythagorous heptagon
66
Side length exceeded the maximim limit
Total number of Pythagorous Heptagons are: 0

```

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


```

Problems @ Javadoc Declaration Console
<terminated> mathsp2 [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

```

Problems @ Javadoc Declaration Console
<terminated> mathsp2 [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

```

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	5, 6, 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

Problems	@ Javadoc	Declaration	Console
<terminated> mathsp2 [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

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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AUTHOR PROFILE

S.N.R.G.Bharat Iragavarapu (born April 25, 1990) is working as Assistant professor in the Department of Mathematics, GVP College of Engineering (A), Visakhapatnam, Andhra Pradesh, India. He completed his Masters degree in Mathematics from Andhra University in the year 2012 with 8.9 CGPA. (Secured university second). Worked as Junior research fellow in NBHM-DAE project during 2012-2015. Published 3 research papers in international journals. During this academic year 2016-17 there are 10 publications in national journals on the topic related to the present work.

Kuppli Sai Rahul is studying B.Tech, fourth year in the Department of Electronics and communication engineering, GVP College of Engineering (A), Visakhapatnam, Andhra Pradesh, India

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