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Breaking a Stick to form a Decagon with Positive Integers using MATLAB

S.N.R.G. Bharat Iragavarapu[1]
[1]*Department of Mathematics GVP College of Engineering (Autonomous), Visakhapatnam, AP, India*

Abstract: In this paper, using a computer programming language MATLAB, we determine the number of decagons that can be formed by using a stick of given length say n units, n being a positive integer greater than 10
Keywords: Decagon, Triangle inequality, Polygon, inequality condition, Programming language MATLAB.

I. INTRODUCTION

In [1, 2, 3, 4, 5, 6, 7] we formed a triangle, quadrilateral, pentagon, hexagon, heptagon, octagon, nonagon through breaking a stick using programming language. In this paper, by using MATLAB we form all possible decagons with positive integers through braking stick, for any such n. For example, suppose we take a stick of length 12 units and cut this stick at 9 places to form 10 parts of the stick. Let a, b, c, d, e, f, g, h, i, j be the lengths of the ten parts of the stick and assume that a, b, c, d, e, f, g, h, i, j are positive integers. Hence we have the basic relation a + b + c+ d + e + f +g + h+ i +j= n. Here number n is given but a, b, c, d, e, f, g, h, i, j are variable numbers. For formation of a nonagon having side lengths a, b, c, d, e, f, g, h, i we need to see that the condition a + b + c + d + e + f + g + h +i > j and i is the largest side length compare to others i.e, the sum of the remaining side lengths is greater than the largest side length. Here (a, b, c, d, e, f, g, h, i, j) = (b, c, d, e, f, g, h, i, j, a) = (c, d, e, f, g, h, i, j, a, b)=(d, e, f, g, h, i, j, a, b, c)=(e, f, g, h, i, j, a, b, c, d)=(f, g, h, i, j, a, b, c, d, e) =(g, h, i, j, a, b, c, d, e, f) =(h, i, j, a, b, c, d, e, f, g)=(i, j, a, b, c, d, e, f, g, h)=)=(j, a, b, c, d, e, f, g, h, i).

This is very difficult if the numbers of our selection are considerably large. Now our aim is to find how many decagons existwith positive integers using programming language MATLAB**.**

II. MAIN RESULT

A. Algorithm

1) *Step 1:* start
2) *Step 2*: Initialize a, b, c, d, e, f, g, h, i, j, l all to zero
3) *Step 3:* read stick length value as n
4) *Step 4:* initialize for loop with j<n
5) *Step 5 :* if step 4 satisfies goto step 6 else goto step 35
6) *Step 6:* initialize for loop i=1 with j<i
7) *Step 7*: if step 6 satisfies goto step 8 else goto step 34
8) *Step 8 :* initialize for loop h=1 with h<i
9) *Step 9 :* if step 8 satisfies goto step 10 else goto step 33
10) *Step 10 :* initialize for loop g=1 with g<h
11) *Step 11 :* if step 10 satisfies goto step 12 else goto step 32
12) *Step 12 :* initialize for loop f=1 with f<g
13) *Step 13 :* if step 12 satisfies goto step 14 else goto step 31
14) *Step 14* : initialize for loop e=1 with e<f
15) *Step 15* : if step 14 satisfies goto step 16 else goto step 30
16) *Step 16:* initialize for loop d=1 with d<e
17) *Step 17* : if step 16 satisfies goto step 18 else goto step 2
18) *Step 18 :* initialize for loop c=1 with c<d
19) *Step 19 :* if step 18 satisfies goto step 20 else goto step 28
20) *Step 20:* initialize for loop b=1 with b<c
21) *Step 21 :* if step 20 satisfies goto step 22 else goto step 27

22) *Step 22* : initialize for loop a=1 with a<b
23) *Step 23* : if step 22 satisfies goto step 24 else goto step 26
24) *Step 24: if* the condition a +b +c +d +e +f + g +h+i>j and a + b +c +d +e +f +g +h +i+j=n and j>a and j>b and j>c and j>d and j>e and j>f and j>g and j>h and j>i satisfies goto step 25 else goto step 22
25) *Step 25* : print a, b, c, d, e, f, g, h, i, j values as output and increment l value
26) *Step 26 :* increment a value by 1
27) *Step 27* : increment b value by 1
28) *Step 28* : increment c value by 1
29) *Step 29 :* increment d value by 1
30) *Step 30:* increment e value by 1
31) *Step 31 :* increment f value by 1
32) *Step 32 :* increment g value by 1

B. Result Analysis

We are required to display all the combinations that follow the triangle inequality. This can be achieved with help of the following steps.

1) *Step 1:* Write all permutations in form of triads for a given integer.
2) *Step 2:* Eliminate equivalent permutations so that only the combinations remain.
3) *Step 3:* Display only the combinations that satisfy the triangle inequality.

The above procedure can be explained below:

For example,

a) Consider a stick length 12.
b) Let the combinations are (1, 1, 1, 1, 1, 1, 1, 1, 1, 3)
c) The total number of decagons with stick length 12 are 1 We can represent this result in outputs.

II. OUTPUTS

```
enter stick length =12

1    1    1    1    1    1    1    1    1    3

total number of Decagons are  1
```

Fig. 1 Stick length n=12

```
enter stick length=14

1    1    1    1    1    1    1    2    2    3

1    1    1    1    1    1    1    1    2    4

1    1    1    1    1    1    1    1    1    5

total number of Decagons are 3
```

Fig. 2 Stick length n=14

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```
enter stick length=15

1    1    1    1    1    1    2    2    2    3
1    1    1    1    1    1    1    2    2    4
1    1    1    1    1    1    1    1    3    4
1    1    1    1    1    1    1    1    2    5
1    1    1    1    1    1    1    1    1    6

total number of Decagons are 5
```

Fig. 2 Stick length n=15

```
enter stick length=20
1    2    2    2    2    2    2    2    2    3
1    1    2    2    2    2    2    2    2    4
1    1    1    2    2    2    2    2    3    4
1    1    1    1    2    2    2    3    3    4
1    1    1    1    1    2    3    3    3    4
1    1    1    2    2    2    2    2    2    5
1    1    1    1    2    2    2    2    3    5
1    1    1    1    1    2    2    3    3    5
1    1    1    1    1    1    3    3    3    5
1    1    1    1    1    2    2    2    4    5
1    1    1    1    1    1    2    3    4    5
1    1    1    1    1    1    1    4    4    5
1    1    1    1    2    2    2    2    2    6
1    1    1    1    1    2    2    2    3    6
1    1    1    1    1    1    2    3    3    6
1    1    1    1    1    1    2    2    4    6
1    1    1    1    1    1    1    3    4    6
1    1    1    1    1    1    1    2    5    6

1    1    1    1    1    2    2    2    2    7
1    1    1    1    1    1    2    2    3    7
1    1    1    1    1    1    1    3    3    7
1    1    1    1    1    1    1    2    4    7
1    1    1    1    1    1    1    1    5    7
1    1    1    1    1    1    2    2    2    8
1    1    1    1    1    1    1    2    3    8
1    1    1    1    1    1    1    1    4    8
1    1    1    1    1    1    1    2    2    9
1    1    1    1    1    1    1    1    3    9

total number of Decagons are   28
```

Fig. 3 Stick length n=15

III. CONCLUSIONS

By using this program, we can easily find the number of decagons that can be formed through breaking a stick using MATLAB. In future, we are planning to extend this idea to find number of n-sided polygons that can be formed through breaking a stick.

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