Encryption coding on DryasOctopetala with weight injective labeling

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Encryption Coding on DryasOctopetalawith Weight injective labeling

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Abstract. DryasOctopetala is a flowering plant that grows near the arctic and mountain region. DryasOctopetala structure is used to develop a graph called D_8O. The D_8O graph is divided into two segments Petal and Pistil. Consider the Pistil of the flower to be a Wheel Graph by avoiding the hub and spokes of the wheel. Take each corner of petals to be vertex and sides to be an edge. Number each vertex by $f(v) = 2n + 1$where n=0,1,2,3…. and edges by weight injective labeling with difference 6. The prime focus is to create a different pattern of coding techniques using matrix coders. Eventually, the ordinary message is converted into the Ciphertext using the coding system. Further, a final inference is achieved in this part by elaborating the algorithm through examples and pictures by SageMath software.

Keywords: Weight injective labeling, DryasOctopetala, Flower graph, Wheel graph, Matrix coder, Alphabet Ordinal.

2010 Mathematical subject classification Number: 05C78.

INTRODUCTION

Cryptography is a method of securing information or communications in hidden form. The word crypt means secret and graphy means writing. The method of writing the series of procedures is called a cryptographic algorithm. This algorithm is divided into two forms one is symmetric and asymmetric. Graph Labeling is the assigning of numbers or symbols to the vertex and edges. In this paper, take a D_8O graph by assigning $f(v) = 2n + 1$ where n=0, 1, 2, 3…. to the vertices and edges is labeled using Weight injective labeling. Then follow the Matrix encryption algorithm to secure the message and decryption of the message is done using clues given by the sender.

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DryasOctopetala is an evergreen short shrubsthat belongs to the family of Rosaceae.It grows in the arctic, alpine regions of Europe, Asia and North America. The flowers are upright white in colour with a yellow at the center. It grows more in rockeries and alpine gardens. The flowers are produced on stalks 3–10 cm long. The stems are sylvan, crooked, short and horizontal rooting branches. The leaves are smooth above, densely white beneath.The hybrid Dryas is a cream-coloured flower that gained an Award of Garden Merit from the Royal Horticultural Society.

LITERATURE REVIEW

The secret of sharing messages can be done using graph labeling techniques. The researchers developed many graph labeling techniques. Researchers like G.Prasad and G.UmaMaheswari[6] developed a new coding technique on Sunflower Graph with edge product cordial labeling. M.Yamuna, K.Karthika[13]discussed transferring of the message using a bipartite graph. D.A.AngelSherin, V.Maheswari[2] explained the encryption and decryption process using edge magic labeling. Jia-Bao Liu, Hafiz UsmanAfzal and Muhammad Javaid [11] inspected magic labeling on rooted products of graphs. J.BaskarBabujee, V.Vishnupriya[12] portrayed encrypting numbers using pair labeling in path graphs. G.UmaMaheswari, J.Arthy and Suzan JabbarObaiys[7] sketched a secret coding technique on two-star graphs. Femina.P, Antony Xavier.D[5] interpreted a study of encryption standards using graph theory. D.A.AngelSherin, V.Maheswari and V.Balaji[1] related the encryption of dual numbers using weight injective labeling.Getting motivated by the above research work we refined the safe coding technique.

PRELIMINARY

Definition

A wheel graph is a graph formed by connecting all the vertices to the global vertices.

Weight Injective Label (*EIL*)

Let D_8O be a graph with injection on vertices $f(v) = 2n+1$ where n=0,1,2,3…. which results in an induced edge set of common difference 6 when $y = 3X - 1$ where X is the sum of $u+v$ vertices.

Definition

D_8O is a graph combination of eight petals with a wheel graph at the center.

ALPHABET ORDINAL

Allot each alphabet by an ordinal pattern.

1. Initially consider the value of z and each time the value of z increases as $z+k$

2. Let us take $a_z = b$ and $a_{z+1} = a_z + c$ $a_{z+2} = a_{z+1} + c$ and so on where b=11, c=6

3. Avoid the ordinal pattern of multiples of four a_4, a_8, a_{12}, a_{16}.....

4. Rarest used alphabet X,Y,Z and W are labeled using Arabian scripts α β γ λ

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
11	17	23	35	41	47	59	65	71	83	89	95	107	113	119	131	137	143

R	S	T	U	V	W	X	Y	Z
143	155	161	167	179	λ	α	β	γ

Label Algorithm

Let D_8O be a flower graph with an inward wheel graph. Let us allot random numbers to each vertex such that edge sets are defined by $y = 3X - 1$ of common difference 6.

Encryption Algorithm

1. Divide D_8O graph into two parts one is wheel graph (W) and another is flower graph (F)

2. Number all the vertices by the label using $f(v) = 2n+1$ where n=0,1,2,3….

3. The edges are numbered using weight injective labeling

4. Alphabet ordinal is given with the difference 6starting from XI

5. Denote WR for wheel rim and P for flower petal. Divide the whole diagram into left and right sides. Avoid the hub and spokes in the wheel graph

6. Intend PL for petal left, PR for petal right, WRL for wheel rim left and WRR for wheel rim right

Decryption Algorithm

1. Petal top vertices are given by $PT_i = 2y+1$ where y is the odd numbers from 1 to 15

and i= 1,2,3….8

2. Rim vertices are given by $RV_i = 2y + 1$ where y is the even numbers from 0 to 14

and i= 1,2,3….8

3. The edges are numbered using weight injective labelingwhich is known to both sender and receiver

4. Denote WR for wheel rim and P for flower petal. Divide the whole diagram into left

and right sides

Matrix Coder

Define the matrix in the form pxq where p indicates some rows and q indicate number of columns. Divide the encrypted strings into an equal number of rows and columns. If $p \neq q$ then add dummy variable to the matrix.

SageMath

SageMath is an open-source package comprises of unified interface features. This unified interface is a notebook in display program. It is software where you can design numerousgraphic designs, Mathematical expressions, add and delete the input and share the work with others through a network.SageMath is used to study the application of elementary, advance, pure and applied mathematics. This application is used in basic algebra, calculus, number theory, cryptography, numerical computation, commutative algebra, group theory, combinatorics, graph theory, exact linear algebra and more. This software is very much useful for education and research purpose.

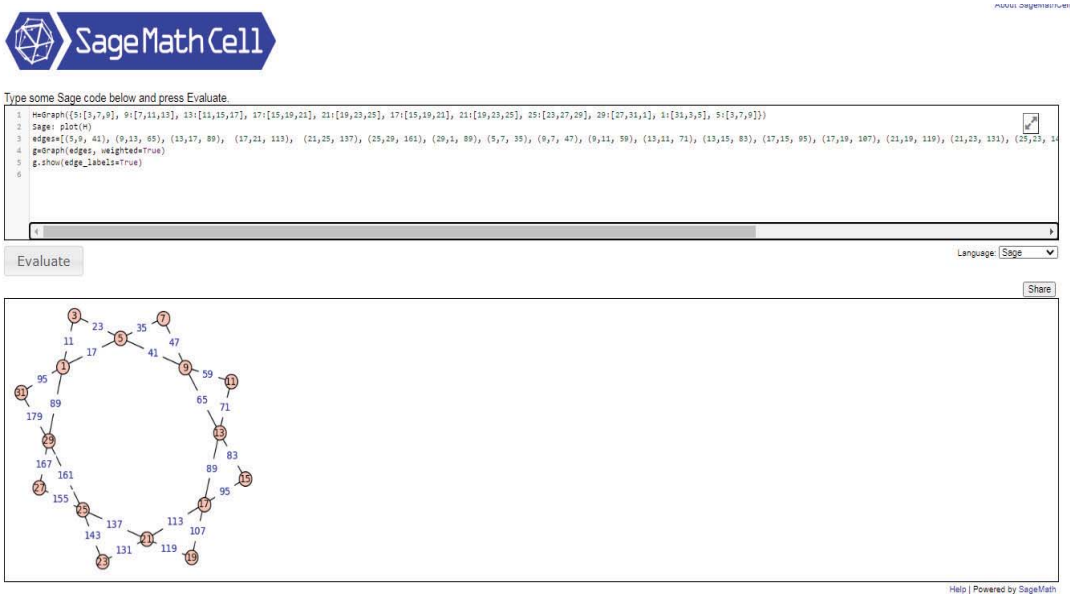
Method of coding SageMath Graph

We implemented the graph using https://sagecell.sagemath.org/

Coding:

```
H=Graph({5:[3,7,9], 9:[7,11,13], 13:[11,15,17], 17:[15,19,21], 21:[19,23,25], 17:[15,19,21], 21:[19,23,25], 25:[23,27,29], 29:[27,31,1], 1:[31,3,5], 5:[3,7,9]})
Sage: plot(H)
edges=[(5,9, 41), (9,13, 65), (13,17, 89), (17,21, 113), (21,25, 137), (25,29, 161), (29,1, 89), (5,7, 35), (9,7, 47), (9,11, 59), (13,11, 71), (13,15, 83), (17,15, 95), (17,19, 107), (21,19, 119), (21,23, 131), (25,23, 143), (25,27, 155), (29,27, 167), (29,31, 179), (1,31, 95), (1,3, 11), (3,5, 23), (1,5, 17)]
g=Graph(edges, weighted=True)
g.show(edge_labels=True)
```

Output:



RESULTS

Theorem

Theorem 3.7.

A graph is D_8O graph by admitting weight injective labeling.

Proof:

Let us consider two graphs wheel and flower graph. Join both graphs to form D_8O. Label the vertices by

$V_1(D_8O) = \{v_i = i : i = 2n+1 : n = 0,2,4...\}$, $V_2(D_8O) = \{v_j = j : j = 4n-1 : n = 1,2,3....\}$

$V(D_8O) = V_1(D_8O) \cup V_2(D_8O)$

Let the edge labels are defined by

$E(D_8O) = 3X - 1$where X=sum of vertices

Let us define the following functions

$f(OV) = v_j$

$f(IV) = v_i$

Now set the edges as $f(Oe_k)$, $f(Ie_l)$

$f(Oe_k) = Oe_{k-2} + m$; $Oe_1 = 11$; $Oe_2 = 23$; $k = 3,4,5...n$; $m = 24$

$f(Ie_l) = Oe_{l-1} + m$; $Oe_1 = 17$; $l = 2,3,4...7$

$f(Ie_l) = Oe_{l-1} - z$; $l = 8$; $z = 72$

Hence $f(Oe_k), f(Ie_l)$ is an edge labeling of graph D_8O. Hence D_8O is a weight injective labeling.

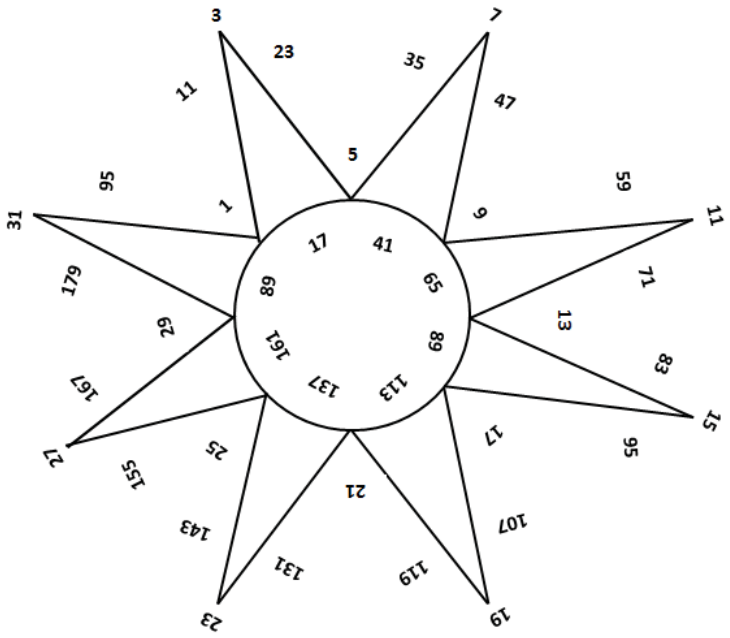


FIGURE 1

Illustration

Example

Let us take a D_8O graph of Fig.1. Number the vertices using the function $f(v) = 2n+1$ where n=0,1,2,3…. which results in induced edge set of common difference 6 when $y = 3X - 1$ where X is the sum of $u+v$ vertices.

Message:

NORTH BATTALION REPORT TO CHECK POINT

First, find the corresponding values of each alphabet from the Alphabet Ordinal. Then trace the location of the corresponding values in the D_8O graph.

N-113 O-119 R-143 T-161 H-65 B-17 A-11 T-161 T-161 A-11 L-95 I-71 O-119 N-113 R-143

E-41 P-131 O-119 R-143 T-161 T-161 O-119 C-23 H-65 E-41 C-71 K-89 P-131 O-119 I-71

N-113 T-161

Divide the whole D_8O graph diagram into the left and right sides. PL-Petal left, PR- Petal right, WRL- wheel rim Left and WRR-wheel rim right. Also,differentiate edge and vertex by e and v letters.

113-WRR_{e4} 119-PRS_{e8} 143-PLS_{e7} 161-WRL_{e3} 65-WRR_{e2} 17-WRL_{v4} 11-PRT_2
95-PRS_{e6} 71-PRS_{e4} 41-WRR_{e1} 131-PLS_{e8} 23-PRT_4 89-WRL_{e2}

Horizontal String

WRR_{e4} PRS_{e8} PLS_{e7} WRL_{e3} WRR_{e2} WRL_{v4} PRT_2 $WRL_{e3}WRL_{e3}$ PRT_2PRS_{e6}
$PRS_{e4}PRS_{e8}WRR_{e4}$ $PLS_{e7}WRR_{e1}PLS_{e8}PRS_{e8}PLS_{e7}WRL_{e3}WRL_{e3}PRS_{e8}$
PRT_4 WRR_{e2} WRR_{e1} PRT_4WRL_{e3} PLS_{e8} PRS_{e8} PRS_{e4} $WRR_{e4}WRL_{e3}$

Matrix Coder

6 x 6

$$\begin{bmatrix} WRR_{e4} & PRS_{e8} & PLS_{e7} & WRL_{e3} & WRR_{e2} & WRL_{v4} \\ PRT_2 & WRL_{e3} & WRL_{e3} & PRT_2 & PRS_{e6} & PRS_{e4} \\ PRS_{e8} & WRR_{e4} & PLS_{e7} & WRR_{e1} & PLS_{e8} & PRS_{e8} \\ PLS_{e7} & WRL_{e3} & WRL_{e3} & PRS_{e8} & PRT_4 & WRR_{e2} \\ WRR_{e1} & PRT_4 & WRL_{e3} & PLS_{e8} & PRS_{e8} & PRS_{e4} \\ WRR_{e4} & WRL_{e3} & 0 & 0 & 0 & 0 \end{bmatrix}$$

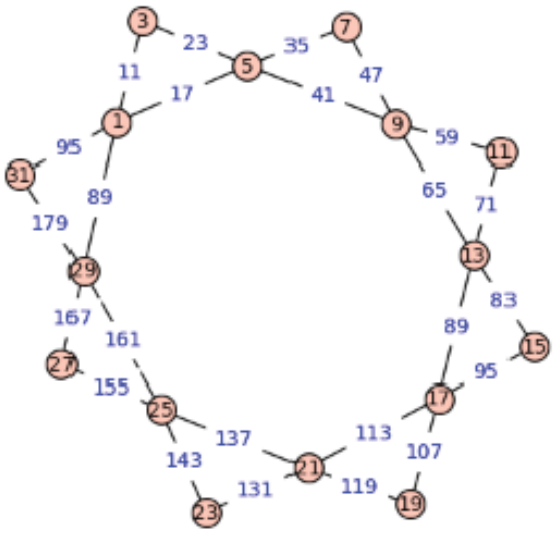
Decryption

The Receiver gets matrix code and clue.

$$\begin{bmatrix} WRR_{e4} & PRS_{e8} & PLS_{e7} & WRL_{e3} & WRR_{e2} & WRL_{v4} \\ PRT_2 & WRL_{e3} & WRL_{e3} & PRT_2 & PRS_{e6} & PRS_{e4} \\ PRS_{e8} & WRR_{e4} & PLS_{e7} & WRR_{e1} & PLS_{e8} & PRS_{e8} \\ PLS_{e7} & WRL_{e3} & WRL_{e3} & PRS_{e8} & PRT_4 & WRR_{e2} \\ WRR_{e1} & PRT_4 & WRL_{e3} & PLS_{e8} & PRS_{e8} & PRS_{e4} \\ WRR_{e4} & WRL_{e3} & 0 & 0 & 0 & 0 \end{bmatrix}$$

Clue: DryasOctopetala flower on weight injective labeling with a variation of XI Hexa ordinal.
Chakra rim-WR, leaf-P.

This clue gives the receiver an idea about eight-petal graphs. Variation denotes as difference, Hexa denotes as six, and ordinal as alphabet numbering starting with 11. Using the decryption algorithm step 1 & 2 the receiver plots the value of the Chakra rim and leaf top.



After the setup of vertices, the receiver will be able to compute the value of edges using EIL labeling. In a matrix coder order, the receiver places all the edge label values and relates the values with Alphabet ordinal.

113-WRR_{e4} 119-PRS_{e8} 143-PLS_{e7} 161-WRL_{e3}65-WRR_{e2} 17-WRL_{v4}11-PRT_2 95-PRS_{e6} 71-PRS_{e4}41-WRR_{e1} 131-PLS_{e8} 23-$PRT_4$89-WRL_{e2}

$$\begin{bmatrix} 113 & 119 & 143 & 161 & 65 & 17 \\ 11 & 161 & 161 & 11 & 95 & 71 \\ 119 & 113 & 143 & 41 & 131 & 119 \\ 143 & 161 & 161 & 119 & 23 & 65 \\ 41 & 23 & 89 & 131 & 119 & 71 \\ 113 & 161 & 0 & 0 & 0 & 0 \end{bmatrix}$$

Finally, the receiver gets the message NORTH BATTALION REPORT TO CHECK POINT.

CONCLUSION

In this paper, we have inspected secrecy of message using graph labeling and matrix coder on DryasOctopetala (D_8O). We imposed EIL labeling on D_8O by partitioned the graph into wheel and flower graph. The encrypted message will be safe and secure since we have generated the edge values using graph labeling techniques. This labeling technique is unique and known only to sender and the receiver. So we have more concealment of the message. We can also develop numerous graph labeling techniques on different graphs.

APPLICATION

This pattern of graphs is extensively used in different lock system like pattern screen lock, padlock system and bank lock system. It is also used in transferring message in small or big group. Designing of transplanting mechanism in gear train is done using flower graph pattern.

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