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APPLICATION OF COMPLETE BIPARTITE GRAPH IN GENETIC FIELDS TO COMPUTE PHENOTYPE RATIO AND GENOTYPE RATIO

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Abstract:

One of the important areas in graph theory is complete bipartite graph. It is a convenient tool to understand gene, and crossing one pair that differ in alleles. Adjacency matrix obtained from complete bipartite graph. Input an Adjacency matrix solution in Python. Genotype ratio and Phenotype ratio analysis of Trihybrid crosses using a Python program, combined imaging tool.

MSC Classification: 05C05,05C22,05C90,92D15,97P50.

Key words: bipartite graph, bi adjacency matrix, Gene, phenotype ratio, genotype ratio.

1.Introduction:

Euler was the father of graph theory (1707-1782). Euler's work on the Konigsberg bridges problem begun in 1735[2]. Euler states that, seven crossing the bridge and returning to the starting point, could not come without swimming in the river [1][5]. Mendel is known as the 'father of genetics'. Gregor Johann Mendel was interested in learning the method to offspring. He started experiments on a pea plant [6][7]. Connectivity can be represented by a graph. Many real life problems can be clearly defined in graph theory. Graph theory applied to Internet, electric networks, bio-chemistry, medical field, computer science, communication network, genetics [1] [15] [13]. A complete bipartite graph whose vertices can be partitioned into two subsets M and F [16]. Complete bipartite graph is a convenient tool to understand gene. Crossing single pair that differ in hair. A weighted bipartite graph has a join for both M and F gametes [3] [6] [14]. Obtain the Bi adjacency matrix from a complete bipartite graph. A bi adjacency matrix is used to find Trihybrid M_2 generation [3] [12]. Python Program is applied to combined imaging tool. Python combine image tool use to genotype ratio and phenotype ratio of trihybrid cross [4] [9] [10].

2. Basic definitions of graph theory:

2.1 Graph:

A graph contains of points and lines. Points on a graph are labelled vertices. Lines on a graph are labelled edges. Every edge connects the points to another points.

2.2 Tree:

A tree has vertices and edges and has no rotation.

2.3 Bipartite graph:

Bipartite graph is said to be complete if all the vertices in set-1 are connected to vertices of set-2.

2.4 Complete Bipartite graph:

Complete bipartite graph is said to be complete if all the vertices in set-1 are connected to every vertex of set-2.

So, if set-1 has Male Gametes (M) and set-2 has Female gametes(F) then the total number of edges will be M*F.

2.5 Weighted Bipartite graph:

A graph is a Weighted Bipartite graph, then the elements are taken to be the weight of the edge respectively.

2.6 Bi adjacency Matrix:

Let G (M, F, E) be a bipartite graph with parts M= {m_ {1}, ...m_{r}}, F= {f_{1}...f_{s}} and edges E. the bi adjacency Matrix is the M×F.

If G is a Weighted Bipartite graph, then the elements b_{mf} are taken to be the weight of the edge {m_ {1} f_{1}, ...m_{r}f_{s}} respectively.

3.Basics of Genetics:

3.1 Heredity

Transmission of genetic characters from parent to offspring.

3.2Variation

Individuals have some differences these are called variation.

3.3 Gene

One of a group of units that line up on chromosomes and are thought to influence the visual characteristics of offspring.

3.4 Locus:

The place on a chromosome, where an allele can be established.

3.5 Allele:

A pair of genes controlling the same character and located at the same locus in the homologous chromosome.

3.6 Trait:

It is a unique genetic trait of a structure.

3.7 Genome [11]

The entire set of genes in an organism.

- The gene that carry all traits.
- Two different forms of the same Gene Alleles.
- Ex: Gene: Hair

  Alleles: Kinky, Pure.

3.8 Dominant Allele:

Expressed even when the dominant allele is combined with the recessive allele **[11]**.

3.9 Recessive Allele:

When two recessive alleles are combined, the recessive allele is visible. **[11]**.

3.10 Homozygous Allele:

Two alleles identical for a trait are homozygous alleles. **[8]**.

3.11 Heterozygous Alleles:

Two alleles different for a trait are heterozygous alleles. **[8]**.

3.12 Genotype:

The genetic structure of each individual organism is known as genotype.

3.13 Phenotype:

Phenotype is the physical looks of a particular trait.

3.14 Genotype Ratio:

Genotype Ratio is the communicate of genes in the generation gained after a gene.

3.15 Phenotype Ratio:

Phenotype Ratio is the communicate of physical features in the generation gained after a gene.

3.16 Gametes:

Gametes are the reproductive cells of an organism. Female gametes are ova and Male gametes are sperm.

3.17 Monohybrid cross:

Monohybrid cross is a cross between single pair that differ in single traits.

3.18 Dihybrid cross:

Dihybrid cross is a cross between single pair that differ in three traits.

3.19 Trihybrid cross:

Trihybrid cross is a cross between single pair that differ in three traits.

4.Main results

4.1 Trihybrid Cross:

A Trihybrid cross is a combination of three separate Monohybrid cross.

We have taken a single pair that differ by three traits. The selected three traits Hair style, Skin colour, Nose shape. Here, the example

Human hair type [kinky hair-ϕ, pure hair-δ], Human skin colour [dark skin -μ, bright skin -β], Human Nose type [fleshy nose –α, Sharp nose –γ].

4.2 Problem 1

4.2.1 M_1 [Maternity]Generation:

The M_1 generation is the first son or daughter generation of a Trihybrid cross. A genetic cross of that concentrate on the inheritance of two separate traits.

4.2.2 Parents of M_1 Generation:

A generation that normally homozygous store for one or more traits. Parents were selected to be applied in the M_1 generation cross of a genetic testing. The M_1 Generation are two persons that are same hybrid for two traits. One parent is homozygous dominant another parent is homozygous recessive. M_1 Generation shows the homozygous dominant allele. The Fig.1 expos that Trihybrid cross M_1 generation.

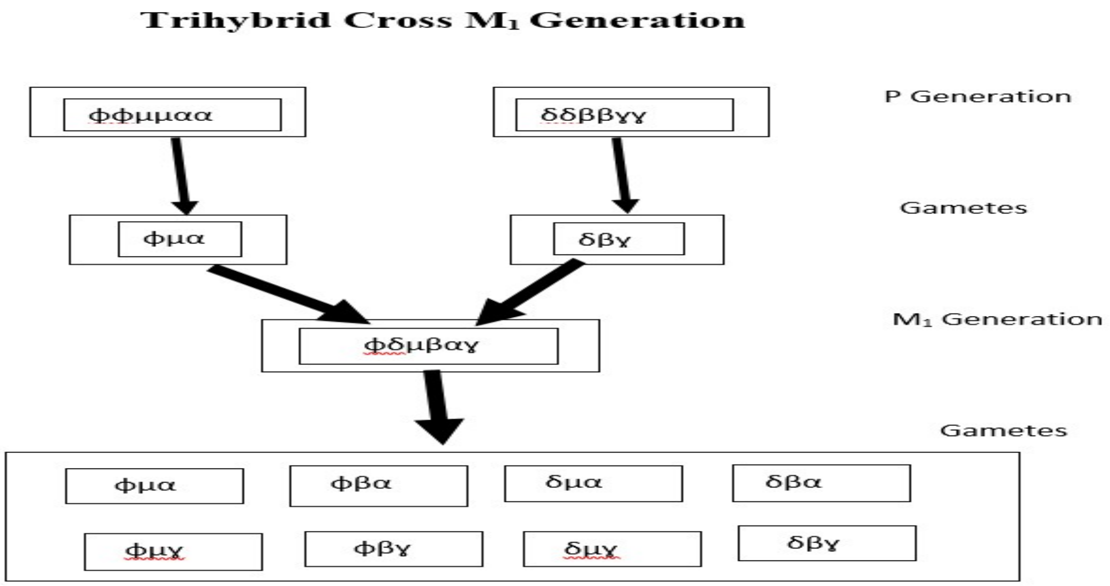

Fig.1. Trihybrid cross in M_1 Gametes

4.2.3 Result 1:

Genotype ratio:

The M_1 generation exposes an Eight gametes that is Heterozygous for pair of features.

4.2.4 Result -2

Phenotype ratio:

M1 generation exposes a three phenotype that is dominant heterozygous for pair of features. So, first generation exhibits a kinky hair, Dark skin, Fleshy nose.

5 Problem 2.

5.1 M_2 Generation:

The M_2 Generation is the second maternity generation of the Trihybrid cross. A genetic cross that focuses on the inheritance of two separate M_1 Generation.

5.2 Parents of M_2 Generation:

The M_2 generation are heterozygous for pair of features. Male gametes have heterozygous alleles. Female gametes have heterozygous alleles.

5.3 Complete bipartite graph:

A complete bipartite graph is used to M_2 generation. The M_2 generation are heterozygous for pair of features. Crossing single pair that differ in Hair type, Skin colour, Nose shape.

Kinky hair denoted by ϕ and Pure hair by δ.

Dark skin colour denoted by μ and bright skin colour by β.

Fleshy nose shape denoted by α and sharp nose shape by γ.

A graph Whose vertices can be partitioned in to two subsets M and F.

Every vertex of set M is joined to every vertex of set F. Set M has Male gametes for kinky hair, pure hair, Dark skin, bright skin, Fleshy nose, and sharp nose. Set F has Female gametes for kinky hair, pure hair, kinky hair, pure hair, Dark skin, bright skin, Fleshy nose, and sharp nose. We calculate the total number of edges will be multiplied by number of male gametes and number of female gametes.

A weighted of bipartite graph has a join for both Male gametes and Female gametes. The Fig.2 expos that Trihybrid cross of M_2 generation.

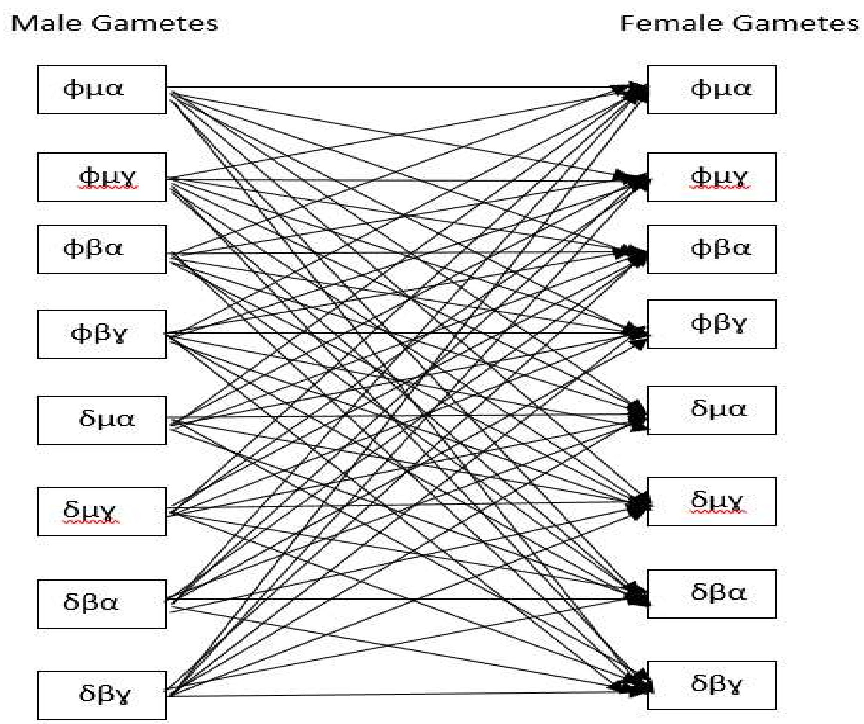

Fig 2. Trihybrid cross in M_2 generation

5.4 Bi adjacency matrix:

A bi adjacency matrix is used to find Trihybrid M_2 generation. Adjacency matrix expos a square matrix. Let's construct the adjacency Matrix through a complete bipartite graph[fig.2]. The factor of the matrix specified if both of vertices are adjacent in the graph.

5.5 Result -1

5.5.1 Genotype:

Parent's differ by a Three traits

Crossing single pair that differ in style, colour, shape.

{φμα, φμɣ, φβα, φβɣ, δμα, δμɣ, δβα, δβɣ} this type of Male Gametes married with {φμα, φμɣ, φβα, φβɣ, δμα, δμɣ, δβα, δβɣ} type of Female Gametes. We can see what kind of child it is in the adjacency matrix. The Fig.3 expos that Genotype Adjacency Matrix.

FM / M	φμα	φμγ	φβα	φβγ	δμα	δμγ	δβα	δβγ
φμα	ϕϕμμαα	ϕϕμμαγ	φφμβαα	ϕϕμβαγ	ϕδμμαα	ϕδμμαγ	ϕδμβαα	ϕδμβαγ
φμγ	ϕϕμμγα	ϕϕμμγγ	φφμβγα	ϕϕμβγγ	ϕδμμγα	ϕδμμγγ	ϕδμβγα	ϕδμβγγ
φβα	ϕϕβμαα	ϕϕβμαγ	ϕϕββαα	ϕϕββαγ	φδβμαα	φδβμαγ	φδββαα	φδββαγ
φβγ	ϕϕβμγα	ϕϕβμγγ	ϕϕββγα	ϕϕββγγ	φδβμγα	φδβμαγ	φδββγα	φδβμγγ
δμα	ϕδμμαα	ϕδμμαγ	ϕδμβαα	ϕδμβαγ	δδμμαα	δδμμαγ	δδμβαα	δδμβαγ
δμγ	ϕδμμαγ	ϕδμβγγ	ϕδμβαγ	ϕδμβγγ	δδμμαγ	δδμμγγ	δδμβαγ	δδμβγγ
δβα	ϕδμβαα	ϕδμβαγ	ϕδββαα	ϕδββαγ	δδμβαα	δδμβαγ	δδββαα	δδββαγ
δβγ	ϕδμβαγ	ϕδμβγγ	ϕδββαγ	ϕδββγγ	δδμβαγ	δδμβγγ	δδβαγβ	δδββγγ

Fig 3. Genotype Adjacency Matrix.

Solution :

M_2 generation genotype in 27 different types are obtained:

Genotype ratio for 1 :2 :1: 2: 4 : 2 : 1 : 2 : 1 : 2 : 4: 2 :4: 8:4:2:4:2:1:2:1:2:4:2:1:2:1

1: ϕϕμμαα-kinky hair, dark skin, fleshy nose child

2: ϕϕμμαγ- kinky hair, dark skin, medium nose child

1: ϕϕμμγγ- kinky hair, dark skin, sharp nose child

2: ϕϕμβαα- kinky hair, light skin, fleshy nose child

4: ϕϕμβαγ- kinky hair, light skin, medium nose child

2: ϕϕμβγγ- kinky hair, light skin, sharp nose child

1: ϕϕββαα- kinky hair, bright skin, fleshy nose child

2: ϕϕββαγ- kinky hair, bright skin, medium nose child

1: ϕϕββγγ- kinky hair, bright skin, sharp nose child

2: ϕδμμαα-Wavy hair,dark skin, fleshy nose child

4: ϕδμμαγ- Wavy hair, dark skin, medium nose child

2: ϕδμμγγ- Wavy hair, dark skin, sharp nose child

4: ϕδμβαα- Wavy hair, light skin, fleshy nose child

8: ϕδμβαγ- Wavy hair, light skin, medium nose child

4: ϕδμβγγ- Wavy hair, light skin, sharp nose child

2: ϕδββαα- Wavy hair, bright skin, fleshy nose child

4: ϕδββαγ- Wavy hair, bright skin, medium nose child

2: ϕδββγγ- Wavy hair, bright skin, sharp nose child

1: δδμμαα- pure hair, dark skin, fleshy nose child

2: δδμμαγ- pure hair, dark skin, medium nose child

1: δδμμγγ- pure hair, dark skin, sharp nose child

2: δδμβαα- pure hair, light skin, fleshy nose child

4: δδμβαγ- pure hair, light skin, medium nose child

2: δδμβγγ- pure hair, light skin, sharp nose child
1: δδββαα - pure hair, bright skin, fleshy nose child
2: δδββαγ - pure hair, bright skin, medium nose child
1: δδββγγ - pure hair, bright skin, sharp nose child.

5.5.2. Python combined image tool:

Python combined image tool is applied to get the child image. Input a Bi– adjacency matrix solution in Python program. Python combined image tool used to genotype ratio of Trihybrid cross. Finally, output for Trihybrid genotype ratio.

5.6 Result -2

5.6.1 Bi adjacency matrix:

Phenotype:
Parent's differ by a Three traits
Crossing single pair that differ in style, colour, shape.
{φμα, φμɣ, φβα, φβɣ, δμα, δμɣ, δβα, δβɣ} this type of Male Gametes married with {φμα, φμɣ, φβα, φβɣ, δμα, δμɣ, δβα, δβɣ} type of Female Gametes. We can see what kind of child it is in the adjacency matrix. The Fig.4 expos that Phenotype Adjacency Matrix.

FM / M	φμα	φμɣ	φβα	φβɣ	δμα	δμɣ	δβα	δβɣ
φμα	ϕμα	ϕμα	φμα	ϕμα	ϕμα	ϕμα	ϕμα	ϕμα
φμɣ	ϕμα	ϕμɣ	φμα	ϕμɣ	ϕμα	ϕμɣ	ϕμα	ϕμɣ
φβα	ϕμα	ϕμα	ϕβα	ϕβα	φμα	φμα	φβα	φββγ
φβɣ	ϕμα	ϕμγ	ϕβα	ϕβγ	φμα	φμα	φβα	φμγ
δμα	ϕμα	ϕμα	ϕμα	ϕμα	δμα	δμα	δμα	δμα
δμɣ	ϕμα	ϕμγ	ϕμα	ϕμγ	δμα	δμγ	δμα	δμγ
δβα	ϕμα	ϕμα	ϕβα	ϕβα	δμα	δμα	δβα	δβα
δβɣ	ϕμα	ϕμγ	ϕβα	ϕβγ	δμα	δμγ	δβγ	δβγ

Fig 4 Phenotype Adjacency Matrix.

Solution:

Phenotype Ratio:
M_2 generation phenotype 8 different types are obtained:
Phenotype ratio for 27: 9: 9: 9: 3: 3: 3: 1
27: φμα→ kinky hair, dark skin, fleshy nose child
9: φμɣ→ kinky hair, dark skin, sharp nose child
9: φβα→ kinky hair, bright skin, fleshy nose child
9: φβɣ→ kinky hair, bright skin, sharp nose child
3: δμα→ pure hair, dark skin, fleshy nose child
3: δμɣ→ pure hair, dark skin, sharp nose child

3: δβα→ pure hair, bright skin, fleshy nose child
1: δβɣ→ pure hair, bright skin, sharp nose child

5.6.2 Python program to count occurrences of in list using count:

Python combined image tool is applied to get the child image. Input a Bi– adjacency matrix solution in Python program. Python combined image tool used to phenotype ratio of Trihybrid cross. Finally, output for Trihybrid phenotype ratio.

Conclusion

In this paper we have discussed about trihybrid cross in Genotype ratio and phenotype ratio. Crossing single pair that differ in Hair type, Skin colour, and Nose shape. A bi-adjacency matrix can be constructed from a complete bipartite graph. The adjacency matrix Solution is used as Python input to find the Genotype ratio and phenotype ratio in the three types of traits. Finally, Genotype ratio and Phenotype ratio method determine the characteristics of the offspring based on the characteristics of the parents.

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