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Graphics Representation Using Adjacency Matrix, Incidence Matrix, Adjacency List and Isomorphic Graph

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Abstract A graph is a non-empty set of elements called points and those points are connected by sides (edge). The set of points of the dinotic graph with "V" and the set of side dinotics with "E". What will be discussed in this article is the representation of the graph using the matrix of compass, compass and compass list. In this study used is the study of libraries that is by collecting information from books or journals related to the representation of graphs. In a graph matrix, it can be concluded that the representation of the graph by using the matrix of inconsistency on on on each column and line is worth 1 if the node i is adjacent to j and is worth 0 if Simpul i is not inconsistent with j. The difference is by counting the values that exist on each row and column with a value of 1 if the node i is in line with node j and is in value of 0 if the Simpul i is not adjacent to the simpul j.

Keywords: Adjacency Matrix; Incidence Matrix; Adjacency List.

INTRODUCTION

In a mathematical model, various problems and situations of everyday life are usually defined and then expressed in a system that is systematic. The graph is another example of a representation of real circumstances that is very useful. The graph theory was first proposed in 1937 by a mathematician named Leonhard Euler. This problem arose after problems arose in the area of origin known as the “Seven Konigsberg Bridges”. A telecommunications network of its structure can be presented on a graph, its points can be easily connected directly indicated by the adjacent vertex-vertex. All terminal stations can be connected, but hamper all relationships or connections in work indirectly through other points, so the chart will be very complex. A graph can be interpreted as a diagram that contains certain information if interpreted correctly. The aim is to visualize objects to make it easier to understand.

Mathematics is the most fundamental field of science of everyday human life that deals with ideas, relationships and structures related to abstract concepts that have been structured hierarchically and logically arranged. One of the fields or sub-fields that exist in mathematical science is discrete mathematics.

Discrete Mathematics is a branch of mathematics that deals with everything that is discrete. Discrete here means not interrelated, one that is discussed in this branch of mathematics is the graph. The graph is used to represent discrete objects and relationships between them, so simply the graph is defined as a set of points connected by lines/sides.

METHOD

The attempt to obtain data, in this writing uses descriptive (library research) or generally referred to as a library study where by procedures and steps refer to the books and relevant articles.

RESULT AND DISCUSSION

Representation of the Graf

Graph representation is by expressing an object as a point, circle, or point, while the relationship between objects is expressed by a line. Objects associated with a graph can be in the shape of rows and columns, which means that the graph may be represented in a matrix.

1. Adjacency matrix

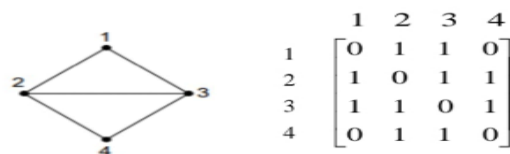
The adjacency matrix is one of the most common representations of graphs. Suppose $G = (V, E)$ is a graph without a folded side with n nodes. Matrix A of G is a square matrix of $n \times n$ with the following rules.

$$A_{ij} = \{1, \text{ if } \{i, j\} \in E(G) \mid 0, \text{ if } \{i, j\} \notin E(G)\}$$

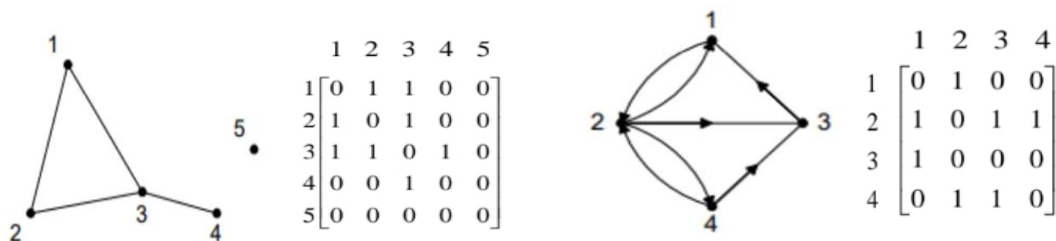
It can be seen that the matrix of consistency of a simple graph (without a fold or bracelet) is a symmetrical matrix, i.e. a matrix whose transposes are equal to itself, and such a matrix has a primary diagonal whose all entries are value 0. In other words, $a_{ij} = a_{ji}$ and $a_{ij}=0$ when $i = j$. If the result i on the graph carries a bracelet, the node is adjacent to itself so that $a_{ij} = 1$.

The graph is presented by stating it in the number of lines that connect the points. The number of rows and columns of the matrix is equal to the number of points in the graph.

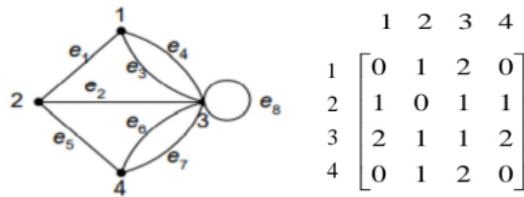
Example of:



A zero-one impasse matrix cannot be used to represent a graph that has double sides.



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A few things that are to be noted in the presentation of graphs in a stable matrix: the stable Matrix for simple and non-directed graphs is a symmetrical matrix. The graph has no loop if and only if all the primary diagonal elements are equal to 0. Loop on v_i corresponds to $a_{ii} = 1$. Strength matrices can be used to easily detect unconnected graphs.

Degrees of each node:

The non-directional graph

$$d(v_i) = \sum_{j=1}^n a_{ij} = \sum_{i=1}^n a_{ij}$$

The Graph Direction

$$d \text{ in } (v_j) = \text{jumlah nilai pada kolom } j = \sum_{i=1}^n a_{ij}$$

$$d \text{ out } (v_i) = \text{jumlah nilai pada kolom } i = \sum_{j=1}^n a_{ij}$$

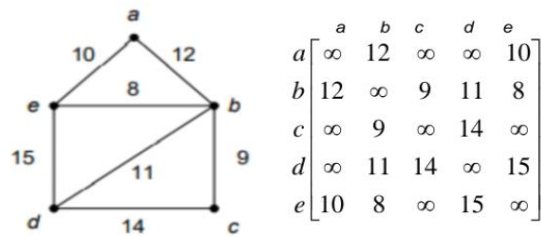
Graph G is the sum of all matrix components.

$$\sum_i \sum_j a_{ij}$$

Graph G is a bipartite graph $(K_{m,n})$ if and only if the matrix of its proximity

$\begin{pmatrix} O & 1_m \\ 1_n & O \end{pmatrix}$ is shaped with O = matrix 0, 1_m = matrice $m \times n$ all the elements =1, 1_n = matrices $n \times m$ all elements =1.

Adjacency matrix for weighing graphs.



G graph is complete if and only if all elements in the primary diagonal = 0, all elements outside of the principal diagonal is = 1.

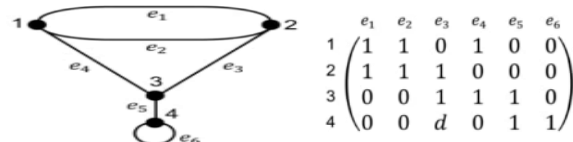
The rigidity matrix can be used to calculate the number of possible walks with a certain length between two points. Suppose $A = (a_{ij})$ the matrix of agility of graph G. $A^n = A \times A \times A \dots \times A$ (sebanyak n kali). The number of possible path length n from point v_i to v_j is the element a_{ij} on the matrix $A^n = (a_{ijn})$.

2. Incidences Matrix

A hypersensitivity matrix is a width of a node with sides on a graph different from the width matrix that expresses the strength of the nodes in a graph. Suppose $G = (V, E)$ is a graph with n nodes and m sides. The hypersensitivity matrix of G is $n \times m$. The hypersonic matrix line shows the part of the node, while the hypersical matrix column shows the matrix of the side part. Suppose the matrix $A = [a_{ij}]$. The value of $a_{ij} = 1$ if the node i is aligned with node j; on the contrary, the value of $A_{ij} = 0$ if the Node i does not align with Node j.

A hypersensitivity matrix can be used to present a non-simple graph, which means that the graph has the sides of the fold or bracelet. Using the hypersensitivity matrix, the degrees of each node i can be calculated by counting the entries on the row for the nod i, except for the graph that carries the bracelet.

Here is the model of the G graph with the matrix of its dimensions.



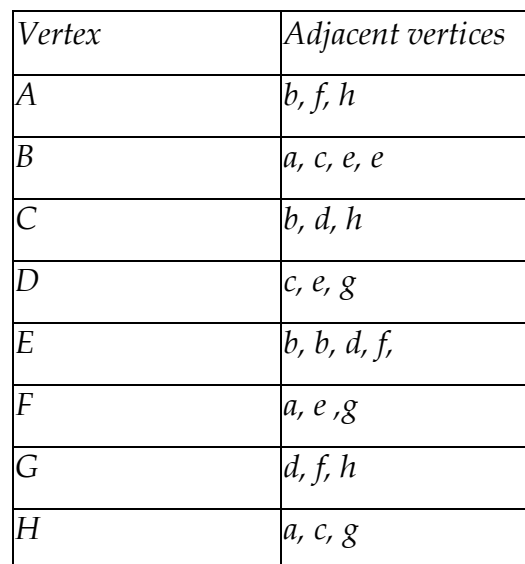
Graph G and its dimensions

3. Adjacency List

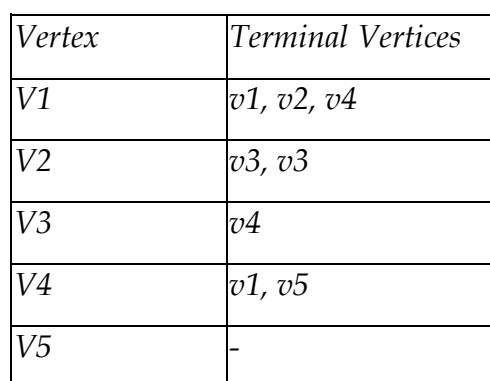
If a graph has relatively few sides, its adjacent matrix will contain many entries with a value of 0. A matrix with a lot of zero entries is sometimes called a rare

In the distortion list, we list every node that has been labeled from a chart, then from each of those nodes. If the mean nodes are zero degrees (no neighbors), we can get the then strip (-) instead. To present an aggregate list, we typically use a two-column table: the first column contains the initial node, while the second column includes the final node. In a multigraph, if two nodes are connected by more than one side, we must write the end node as many sides on the same bars.

Here is a model of the non-directional H graph with a list of its versatilities.



Here is a graph model with a P-direction along with a list of its versatilities.



In geometry, two images are called congruent if they both have the same geometric properties. In the same way, two graphs are called isomorphic if they both

show the same "shape", both graphs only differ in terms of giving the label of the point and the line.

Simple graphs $G_1 = \{V_1, E_1\}$ and $G_2 = \{V_2, E_2\}$ say isomorphic if there is a one-to-one function and on, say a function from V_1 to V_2 with the nature that the nodes a and B are neighboring in G_1 if and only if $f(a)$ and $f(b)$ are neighbors in G_2 for each $a, b \in V_1$ (isomorphism). Two simple graphs that are not isomorphic are called taxismorphs. (nnisomorphic). Mathematically, if G_1 and G_2 are isomorphic, we note $G_1 \cong G_2$.

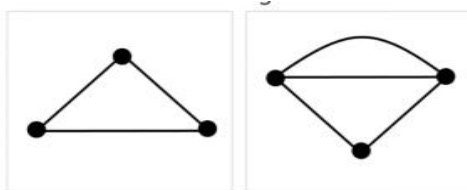
In other words, when two simple graphs are isomorphic, there is a one-on-one correspondence between the nodes in the two graphs that preserves the unity relationship. The isomorphism of a simple graph is a relationship of equivalence because it is reflective, symmetrical, and transitive.

Some important facts relating to isomorphism graphs are given as follows.

1. If two graphs are isomorphic, then the two charts must have many nodes and many sides of the same, but not the opposite.
2. If two graphs are isomorphic, then the two charts must have the same grade rows of nodes, but not the opposite.
3. Two graphs are isomorphic if and only if the complementary graph is also isomorf.

Look at the following two graphs.

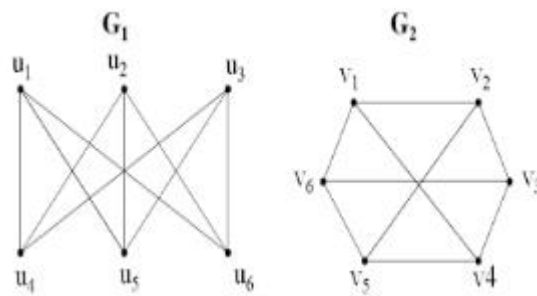
Example 1 :



The graphs G_1 and G_2 are not isomorphic. This is easy to see because many sides of the two graphs are not the same. G_1 has only three sides, while G_2 has four sides. As a result, there is no one-on-

one correspondence between the nodes on G_1 and G_2 .

Example 2 :



Check whether the two graphs are isomorphic. If so, determine the nodes that correspond to each other between G1 and G2.

Answer to:

Both graphs are isomorphic. The graph appears to contain a node where each node has three degrees. The corresponding symbols of the two graphs are:

U1 node with V1 node

U2 node with v3 node

U3 node with V5 node

U4 node with V6 node

U5 node with V4 node

U6 node with V2 node

In two isomorphic graphs, the two graphs have the same matrix of inconsistency, of course after the corresponding matrix is ordered in the same order.

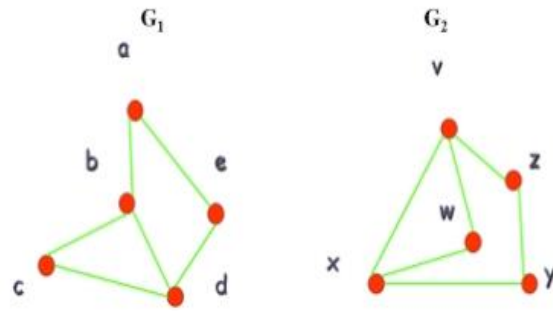
Look at the matrix of the two graphs. Below are the stable matrix of the graphs G1 and G2:

$$M_{G1} = \begin{matrix} & \begin{matrix} u1 & u2 & u3 & u4 & u5 & u6 \end{matrix} \\ \begin{matrix} u1 \\ u2 \\ u3 \\ u4 \\ u5 \\ u6 \end{matrix} & \begin{bmatrix} 0 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 & 0 \end{bmatrix} \end{matrix}$$

$$M_{G2} = \begin{matrix} & \begin{matrix} v1 & v3 & v5 & v6 & v4 & v2 \end{matrix} \\ \begin{matrix} v1 \\ v3 \\ v5 \\ v6 \\ v4 \\ v2 \end{matrix} & \begin{bmatrix} 0 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 & 0 \end{bmatrix} \end{matrix}$$

It appears that the two graphs have the same matrix of rigidity, namely $M_{G1} = M_{G2}$.

Example 3:



Once these nodes are corresponding, we will produce the following matrix:

$$G1 = \begin{matrix} & \begin{matrix} a & b & c & d & e \end{matrix} \\ \begin{matrix} a \\ b \\ c \\ d \\ e \end{matrix} & \begin{bmatrix} 0 & 1 & 0 & 0 & 1 \\ 1 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 & 0 \end{bmatrix} \end{matrix} \quad G2 = \begin{matrix} & \begin{matrix} z & v & w & x & y \end{matrix} \\ \begin{matrix} z \\ v \\ w \\ x \\ y \end{matrix} & \begin{bmatrix} 0 & 1 & 0 & 0 & 1 \\ 1 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 & 0 \end{bmatrix} \end{matrix}$$

Because the matrix is the same, both matrixes are isomorphic.

CONCLUSION

Graph representation is by expressing an object as a point, circle, or point, while the relationship between objects is expressed by a line. Objects associated with a graph can be in the shape of rows and columns, which means that the graph may be represented in a matrix.

Matrix of Strength (Adjacency matrix)

The Matrix (incidency matrix)

List of Tango (adjacency list).

Simple graphs $G1 = \{ V1, E1\}$ and $G2 = \{V2, E2\}$ say isomorphic if there is a one-to-one function and on, say a function from $V1$ to $V2$ with the nature that the nodes a and B are neighboring in $G1$ if and only if $f(a)$ and $f(b)$ are neighbors in $G2$ for each $a,b \in V1$ (isomorphism). Two simple graphs that are not isomorphic are called taxismorphs. (nnisomorphic). Mathematically, if $G1$ and $G2$ are isomorphic, we note $G1 \cong G2$.

In other words, when two simple graphs are isomorphic, there is a one-on-one correspondence between the nodes in the two graphs that preserves the unity

relationship. The isomorphism of a simple graph is a relationship of equivalence because it is reflective, symmetrical, and transitive.

Two graphs G_1 and G_2 are said to be homeomorphic if one of the two graphs can be obtained from the other graph by inserting and repeatedly throwing out graded nodes.

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