

Structures of Nano-Topologies Via Graphs in the Human Double Circulation System

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Article History:

Received: 17-10-2024

Revised: 01-12-2024

Accepted: 10-12-2024

Abstract:

Introduction: The key theme of present research work is to propose an initial left (resp. right) neighbourhood system for an ordering on nano-topological spaces. Based on these neighbourhoods, we explain how the connection between nano-topological spaces and digraph theory may be used in the study of human double circulation system.

Objectives: The most current findings and medical application methods utilize graph theory to demonstrate certain complicated structures with advanced application trends. The basis of this work is the creation of a nano-topological structures for the supremacy position of vertices of plain digraphs. We use digraph for derive the nano-topologies in many scientific and medical models to ensure functionality.

Methods: To construct a directed graph for the human double circulation system. In addition we derive the nano-topologies by using initial left (resp. right) neighbourhoods for certain probable sub-graphs and also verified the comparison between these two types of neighbourhoods

Results: In this paper we have derived certain nano-topological properties by creating initial left (resp. right) neighbourhoods and also we have identified the union and intersection of initial neighbourhoods might help us to ensure the cause of lung and heart failure.

Conclusions: The findings of the digraph application approaches that we acquired are really helpful to ensure the functionality of double circulation system in the human body.

Keywords: Digraph of human double circulation system, Nano-topological space, initial lower (resp. upper) approximation and initial left (resp. right) neighbourhoods.

1.Introduction

Richard and Lellis Thivagar proposed the notion of nano-topology. They developed the theme of Nano-topology is based on a general topology from Pawlak rough set approximations.

Graph theory is currently a growing field of study as well as a key to establish the mathematical application for various fields such as statistics, physics, chemistry, sociology and biology.

In order to give more generalised nano-topology emerging from graphs, several innovative types of topological structures on a basic directed graph has been derived. A new method for applying nano-

topological graph reduction to analysis of symbolic circuits has been built using the graph's structural equivalence in nano-topology. The estimated sub-graphs of graphs based on the neighbourhood have been established and framed using an algorithm designed to detect patent infringement cases.

As an example of a practical application, Ashraf S. Nawar and El Atik A.A have used a neighbourhood network of a digraph to generate new types of nano-topological spaces in human heart [1]. It is advantageous to develop a tool to address the human organs' blood circulation system. Creating a nano-topological construction using the power set of vertices of basic digraphs serves as the basis for this effort. We utilise the relationship between digraph theory and nano-topological spaces to address practical issues in various scientific and medical frameworks.

The idea behind this study is to present new kinds of nano-topological structures that are generated by graphs via a system of initial vertex neighbourhood systems to the digraph. Certain characteristics of the generated nano-topological spaces, featuring an initial left border area, initial left upper approximation, and initial left lower approximation, have been demonstrated. In the application of this research, we have created the nano-topological structures generated by the same graph with regard to the initial left neighbourhood of the vertex using a simple digraph of the human lung.

An assumption of Nano-topology was projected by LellisThivagar and Richard. The idea of Nano-topology is based on a general topology introduced from Pawlak rough set approximations Graph theory is currently a growing field of study as well as a key to establish the mathematical application for various fields such as fuzzy theory, physics, chemistry, sociology and biology.

A quantity of recent forms of Nano-topological structures on a simple directed graph and provide added generalized Nano-topology induce by graphs are recognized by ArafahNasef, Abd El Fattah El-Atik [8]. A new nano-topological graph cutback to representational circuit testing has been urbanized by way of structural equality in Nano-topology induce by the graph. An algorithm "have framed for detecting patent infringement suits by LellisThivagar M, Paul Manuel and Sutha Devi V. They defined the approximation of the sub-graphs. In which a newest nano-topological graph drop to figurative trip investigation is expanded [7].

The most current findings and medical application methods utilize graph theory to demonstrate certain complicated structures with advanced application trends [2]. The basis of this work is the creation of a nano-topological structures for the supremacy position of vertices of plain digraphs. We use digraph for derive the nano-topologies in many scientific and medical models to ensure functionality.

2.Objectives

A summary of several fundamental concepts in graph theory and Nano-topology is provided below.

Definition:2.1[4]

The equivalency relation on U is denoted by R and U be the universe and $\tau_R(E) = \{U, \varphi, L_R(E), U_R(E), B_R(E)\}$ where $E \subseteq U$. $\tau_R(E)$ fulfils the axioms:

- (i) U and $\varphi \in \tau_R(E)$.
- (ii) $\tau_R(E)$ contains the union of all the components of any subcollection.

(iii) $\tau_R(E)$ contains the intersection of all the components of a finite subcollection.

On U , $\tau_R(E)$ creates a nano-topology that matches E . Through the method of nano-topological space, we refer to $\{U, \tau_R(E)\}$. The term nano-topology refers to the parameters of $\tau_R(E)$.

Definition: 2.2[11]

Graph $G(\rho, \sigma)$, where $\sigma = \sigma(G)$ is a subset of unordered pairs of ρ and $\rho = \rho(G)$ is nonempty. If G (resp. infinite) is finite, then $\rho(G)$ is also finite (resp. infinite). The number of edges that contain a vertex u in $\rho(G)$ is its degree; if u 's degree is zero, then u is referred to as an isolated point. An edge with a vertex that is similar to its ends is called a loop, whereas an edge with specific ends is called a link.

Definition: 2.3[2]

If $u, o \in O$ and $G(\rho, \sigma)$ is a directed graph, then:

- In case $\overline{u\rho} \in \sigma(G)$, let u be the left vertex of ρ .
- If $\overline{\rho u} \in \sigma(G)$, then u be a right vertex of ρ .
- The number of vertices u such that $\overline{u\rho} \in \sigma(G)$ is the left degree of a vertex ρ .
- The number of vertices u such that $\overline{\rho u} \in \sigma(G)$ is the correct degree of a vertex ρ .

Definition: 2.4[3]

If $\hat{G}(\hat{\rho}, \hat{\sigma})$ is simple digraph, $\hat{\rho} \in \hat{\theta}(\hat{G})$ then new varieties of initial neighbourhoods of $\hat{N}_l^i(\hat{\rho})$ are computed as:

- (1) Initial left neighbourhood: $\hat{N}_l^i(\hat{\rho}) = \{\hat{u} \in \hat{\theta}(\hat{G}) / \hat{N}_l^i(\hat{\rho}) \subseteq \hat{N}_l^i(\hat{u})\}$
- (2) Initial right neighbourhood: $\hat{N}_r^i(\hat{\rho}) = \{\hat{u} \in \hat{\theta}(\hat{G}) / \hat{N}_r^i(\hat{\rho}) \subseteq \hat{N}_r^i(\hat{u})\}$
- (3) Union of initial neighbourhoods: $\hat{N}_u^i(\hat{\rho}) = \hat{N}_l^i(\hat{\rho}) \cup \hat{N}_r^i(\hat{\rho})$
- (4) Intersection of initial neighbourhoods: $\hat{N}_i^i(\hat{\rho}) = \hat{N}_l^i(\hat{\rho}) \cap \hat{N}_r^i(\hat{\rho})$

Definition: 2.5

If \hat{L} be sub-graph of \hat{G} , $\hat{N}_l^i(\hat{\rho})$ be the initial left neighbourhoods of $\hat{\rho} \in \hat{\theta}(\hat{G})$ and $\hat{G}(\hat{\theta}, \hat{\sigma})$ be a simple digraph, at that point,

- (i) Initial left lower-approximation is $\underline{L}_{N_l^i}[\hat{\theta}(\hat{L})] = \cup_{\hat{\rho} \in \hat{\theta}(\hat{G})} \{\hat{\rho} / N_l^i(\hat{\rho}) \subseteq \hat{\theta}(\hat{L})\}$
- (ii) Initial left upper-approximation is $\overline{L}_{N_l^i}[\hat{\theta}(\hat{L})] = \cup_{\hat{\rho} \in \hat{\theta}(\hat{G})} \{\hat{\rho} / N_l^i(\hat{\rho}) \cap \hat{\theta}(\hat{L}) \neq \varphi\}$
- (iii) Initial left boundary region is $\hat{B}_{N_l^i}[\hat{\theta}(\hat{L})] = \overline{L}_{N_l^i}[\hat{\theta}(\hat{L})] - \underline{L}_{N_l^i}[\hat{\theta}(\hat{L})]$

That is $\hat{\tau}_{N_l^i}[\hat{\theta}(\hat{L})] = \{\hat{\theta}(\hat{G}), \varphi, \underline{L}_{N_l^i}[\hat{\theta}(\hat{L})], \overline{L}_{N_l^i}[\hat{\theta}(\hat{L})], \hat{B}_{N_l^i}[\hat{\theta}(\hat{L})]\}$ describes the topology of a graph $\hat{G}(\hat{\theta}, \hat{\sigma})$ captioned "Graph's enticing nanotopology" with corresponds to a vertex $N_l^i(\rho)$.

Definition: 2.6[5]

Let $\hat{G}(\hat{\theta}, \hat{\sigma})$ is simple digraph, \hat{L} be a sub-graph of \hat{G} . Then $N_l^i(\hat{\rho})$ is initial left neighbourhood and $\hat{\tau}_R(X) = \{\hat{\theta}(\hat{G}), \varphi, \underline{L}_{N_l^i}[\hat{\theta}(\hat{L})], \bar{L}_{N_l^i}[\hat{\theta}(\hat{L})], \hat{B}_{N_l^i}[\hat{\theta}(\hat{L})]\}$. That is $\hat{\tau}_R(\sigma)$ forms a nano-topology on $\hat{G}(\hat{\theta}, \hat{\sigma})$ corresponding to neighborhood of vertex $N_l^i(\hat{\rho})$. We call $(\hat{\theta}(\hat{G}), \hat{\tau}_{N_l^i}[\hat{\theta}(\hat{L})])$ as nano-topological space encouraged by initial left neighbourhood.

Definition: 2.7

If \hat{L} be sub-graph of \hat{G} , $\hat{N}_r^i(\hat{\rho})$ be the initial right neighbourhoods of $\hat{\rho} \in \hat{\theta}(\hat{G})$ and $\hat{G}(\hat{\theta}, \hat{\sigma})$ be a digraph, at that point,

- (i) Initial right lower-approximation is $\underline{L}_{N_r^i}[\hat{\theta}(\hat{L})] = \cup_{\hat{\rho} \in \hat{\theta}(\hat{G})} \{\hat{\rho} / N_r^i(\hat{\rho}) \subseteq \hat{\theta}(\hat{L})\}$
- (ii) Initial right upper-approximation is $\bar{L}_{N_r^i}[\hat{\theta}(\hat{L})] = \cup_{\hat{\rho} \in \hat{\theta}(\hat{G})} \{\hat{\rho} / N_r^i(\hat{\rho}) \cap \hat{\theta}(\hat{L}) \neq \varphi\}$
- (iii) Initial right boundary region is $\hat{B}_{N_r^i}[\hat{\theta}(\hat{L})] = \bar{L}_{N_r^i}[\hat{\theta}(\hat{L})] - \underline{L}_{N_r^i}[\hat{\theta}(\hat{L})]$

That is $\hat{\tau}_{N_r^i}[\hat{\theta}(\hat{L})] = \{\hat{\theta}(\hat{G}), \varphi, \underline{L}_{N_r^i}[\hat{\theta}(\hat{L})], \bar{L}_{N_r^i}[\hat{\theta}(\hat{L})], \hat{B}_{N_r^i}[\hat{\theta}(\hat{L})]\}$ describes the topology of a graph $\hat{G}(\hat{\theta}, \hat{\sigma})$ captioned "Graph's enticing nanotopology" with corresponds to a vertex $N_r^i(\hat{\rho})$.

3.Methods

SOME NANO-TOPOLOGIES BY USING INITIAL NEIGHBOURHOODS

Example: 3.1

Consider a simple directed graph \hat{G} with $\hat{\theta}(\hat{G}) = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$ and $\hat{\theta}(\hat{L}) \subseteq \hat{\theta}(\hat{G})$.

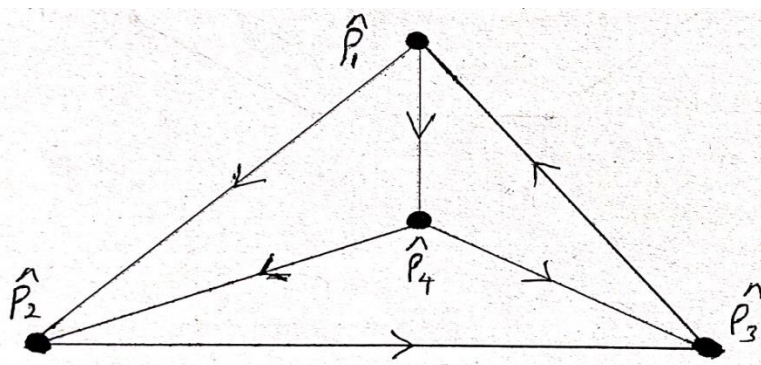


Figure 1: A simple directed graph \hat{G}

Next, we obtain,

Table 3.1: Initial left and right neighborhoods for simple directed graph \hat{G}

$\hat{\rho} \in \hat{\theta}(\hat{G})$	$\hat{\rho}_1$	$\hat{\rho}_2$	$\hat{\rho}_3$	$\hat{\rho}_4$
$N_l(\hat{\rho})$	$\{\hat{\rho}_1, \hat{\rho}_3\}$	$\{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$	$\{\hat{\rho}_1, \hat{\rho}_4\}$
$N_l^i(\hat{\rho})$	$\{\hat{\rho}_1\}$	$\{\hat{\rho}_2\}$	$\{\hat{\rho}_3\}$	$\{\hat{\rho}_2, \hat{\rho}_4\}$

$N_r(\hat{\rho})$	$\{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\rho}_2, \hat{\rho}_3\}$	$\{\hat{\rho}_1, \hat{\rho}_3\}$	$\{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$
$N_r^i(\hat{\rho})$	$\{\hat{\rho}_1\}$	$\{\hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\rho}_3\}$	$\{\hat{\rho}_4\}$

Table 3.2: Nano-topologies for possible subgraphs of \hat{G} by using initial leftneighborhoods.

$\hat{\theta}(\hat{L})$	$\underline{L}_{N_r^i}[\hat{\theta}(\hat{L})]$	$\bar{L}_{N_r^i}[\hat{\theta}(\hat{L})]$	$\hat{B}_{N_r^i}[\hat{\theta}(\hat{L})]$	$\hat{\tau}_{N_r^i}[\hat{\theta}(\hat{L})]$
$\{\hat{\rho}_1\}$	$\{\hat{\rho}_1\}$	$\{\hat{\rho}_1\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_1\}\}$
$\{\hat{\rho}_2\}$	$\{\hat{\rho}_2\}$	$\{\hat{\rho}_2\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_2\}\}$
$\{\hat{\rho}_3\}$	$\{\hat{\rho}_3\}$	$\{\hat{\rho}_3\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_3\}\}$
$\{\hat{\rho}_4\}$	φ	$\{\hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_2, \hat{\rho}_4\}\}$
$\{\hat{\rho}_1, \hat{\rho}_2\}$	$\{\hat{\rho}_1, \hat{\rho}_2\}$	$\{\hat{\rho}_1, \hat{\rho}_2\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_1, \hat{\rho}_2\}\}$
$\{\hat{\rho}_1, \hat{\rho}_3\}$	$\{\hat{\rho}_1, \hat{\rho}_3\}$	$\{\hat{\rho}_1, \hat{\rho}_3\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_1, \hat{\rho}_3\}\}$
$\{\hat{\rho}_1, \hat{\rho}_4\}$	$\{\hat{\rho}_1\}$	$\{\{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}\}$	$\{\hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_1\}, \{\{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}\}, \{\hat{\rho}_2, \hat{\rho}_4\}\}$
$\{\hat{\rho}_2, \hat{\rho}_3\}$	$\{\hat{\rho}_2, \hat{\rho}_3\}$	$\{\hat{\rho}_2, \hat{\rho}_3\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_2, \hat{\rho}_3\}\}$
$\{\hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\rho}_2, \hat{\rho}_4\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_2, \hat{\rho}_4\}\}$
$\{\hat{\rho}_3, \hat{\rho}_4\}$	$\{\hat{\rho}_3\}$	$\{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$	$\{\hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_3\}, \{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}, \{\hat{\rho}_2, \hat{\rho}_4\}\}$
$\{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3\}$	$\{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3\}$	$\{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3\}\}$
$\{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}\}$
$\{\hat{\rho}_1, \hat{\rho}_3, \hat{\rho}_4\}$	$\{\hat{\rho}_1, \hat{\rho}_3\}$	$V(\hat{G})$	$\{\hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_1, \hat{\rho}_3\}, \{\hat{\rho}_2, \hat{\rho}_4\}\}$
$\{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$	$\{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$	$\{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}\}$
$\hat{\theta}(\hat{G})$	$\hat{\theta}(\hat{G})$	$\hat{\theta}(\hat{G})$	φ	$\{\hat{\theta}(\hat{G}), \varphi\}$
φ	φ	φ	φ	$\{\hat{\theta}(\hat{G}), \varphi\}$

Table 3.3: Nano-topologies for possible subgraphs of G by using initial right neighborhoods.

$V(\hat{H})$	$L_{N_r^i}[V(\hat{H})]$	$U_{N_r^i}[V(\hat{H})]$	$B_{N_r^i}[V(\hat{H})]$	$\tau_{N_r^i}[V(\hat{H})]$
$\{\hat{\rho}_1\}$	$\{\hat{\rho}_1\}$	$\{\hat{\rho}_1\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_1\}\}$
$\{\hat{\rho}_2\}$	φ	$\{\hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_2, \hat{\rho}_4\}\}$
$\{\hat{\rho}_3\}$	$\{\hat{\rho}_3\}$	$\{\hat{\rho}_3\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_3\}\}$
$\{\hat{\rho}_4\}$	$\{\hat{\rho}_4\}$	$\{\hat{\rho}_4\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_4\}\}$
$\{\hat{\rho}_1, \hat{\rho}_2\}$	$\{\hat{\rho}_1\}$	$\{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_2, \hat{\rho}_4\}, \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}\}$
$\{\hat{\rho}_1, \hat{\rho}_3\}$	$\{\hat{\rho}_1, \hat{\rho}_3\}$	$\{\hat{\rho}_1, \hat{\rho}_3\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_1, \hat{\rho}_3\}\}$

$\{\hat{\rho}_1, \hat{\rho}_4\}$	$\{\hat{\rho}_1, \hat{\rho}_4\}$	$\{\hat{\rho}_1, \hat{\rho}_4\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_1, \hat{\rho}_4\}\}$
$\{\hat{\rho}_2, \hat{\rho}_3\}$	$\{\hat{\rho}_3\}$	$\{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$	$\{\hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_3\}, \{\hat{\rho}_2, \hat{\rho}_4\}, \{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}\}$
$\{\hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\rho}_2, \hat{\rho}_4\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_2, \hat{\rho}_4\}\}$
$\{\hat{\rho}_3, \hat{\rho}_4\}$	$\{\hat{\rho}_3, \hat{\rho}_4\}$	$\{\hat{\rho}_3, \hat{\rho}_4\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_3, \hat{\rho}_4\}\}$
$\{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3\}$	$\{\hat{\rho}_1, \hat{\rho}_3\}$	$V(\hat{G})$	$\{\hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_1, \hat{\rho}_3\}, \{\hat{\rho}_2, \hat{\rho}_4\}\}$
$\{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}$	$\{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}\}$
$\{\hat{\rho}_1, \hat{\rho}_3, \hat{\rho}_4\}$	$\{\hat{\rho}_1, \hat{\rho}_3, \hat{\rho}_4\}$	$\{\hat{\rho}_1, \hat{\rho}_3, \hat{\rho}_4\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_1, \hat{\rho}_3, \hat{\rho}_4\}\}$
$\{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$	$\{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$	$\{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$	φ	$\{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}\}$
$\hat{\theta}(\hat{G})$	$\hat{\theta}(\hat{G})$	$\hat{\theta}(\hat{G})$	φ	$\{\hat{\theta}(\hat{G}), \varphi\}$
φ	φ	φ	φ	$\{\hat{\theta}(\hat{G}), \varphi\}$

Observation: 3.2

If $\hat{G}(\hat{\theta}, \hat{\sigma})$ be a simple digraph, \hat{L} and \hat{T} are two subgraphs of \hat{G} then by previous example 3.2, we state some properties as follows:

- (i) $\underline{L}_{N_i^i}[\theta(\hat{L}) \cup \theta(\hat{T})] \subseteq \underline{L}_{N_i^i}[\theta(\hat{L})] \cup \underline{L}_{N_i^i}[\theta(\hat{T})]$
- (ii) $\overline{L}_{N_i^i}[\theta(\hat{L}) \cup \theta(\hat{T})] \not\subseteq \overline{L}_{N_i^i}[\theta(\hat{L})] \cap \overline{L}_{N_i^i}[\theta(\hat{T})]$
- (iii) $\underline{L}_{N_r^i}[\theta(\hat{L}) \cup \theta(\hat{T})] \subseteq \underline{L}_{N_r^i}[\theta(\hat{L})] \cup \underline{L}_{N_r^i}[\theta(\hat{T})]$
- (iv) $\overline{L}_{N_r^i}[\theta(\hat{L}) \cup \theta(\hat{T})] \not\subseteq \overline{L}_{N_r^i}[\theta(\hat{L})] \cap \overline{L}_{N_r^i}[\theta(\hat{T})]$

Proof: (i) $\underline{L}_{N_i^i}[\theta(\hat{L}) \cup \theta(\hat{T})] \subseteq \underline{L}_{N_i^i}[\theta(\hat{L})] \cup \underline{L}_{N_i^i}[\theta(\hat{T})]$

Let $\theta(\hat{L}) = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}$ and $\theta(\hat{T}) = \{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$

Then $\theta(\hat{L}) \cup \theta(\hat{T}) = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$

i.e., $\underline{L}_{N_i^i}[\theta(\hat{L}) \cup \theta(\hat{T})] = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$ ------(1)

Now i.e., $\underline{L}_{N_i^i}[\theta(\hat{L})] = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}$ and $\underline{L}_{N_i^i}[\theta(\hat{T})] = \{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$

i.e., $\underline{L}_{N_i^i}[\theta(\hat{L})] \cup \underline{L}_{N_i^i}[\theta(\hat{T})] = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$ ------(2)

From equations (1) and (2), we get

$$\underline{L}_{N_i^i}[\theta(\hat{L}) \cup \theta(\hat{T})] \subseteq \underline{L}_{N_i^i}[\theta(\hat{L})] \cup \underline{L}_{N_i^i}[\theta(\hat{T})]$$

(ii) $\overline{L}_{N_i^i}[\theta(\hat{L}) \cup \theta(\hat{T})] \not\subseteq \overline{L}_{N_i^i}[\theta(\hat{L})] \cap \overline{L}_{N_i^i}[\theta(\hat{T})]$

Let $\theta(\hat{L}) = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}$ and $\theta(\hat{T}) = \{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$

Then $\theta(\hat{L}) \cup \theta(\hat{T}) = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$

$$i.e., \bar{L}_{N_r^i}[\theta(\hat{L}) \cup \theta(\hat{T})] = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\} \text{-----(1)}$$

Now $\bar{L}_{N_r^i}[\theta(\hat{L})] = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}$ and $\bar{L}_{N_r^i}[\theta(\hat{T})] = \{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$

$$i.e., \bar{L}_{N_r^i}[\theta(\hat{L})] \cap \bar{L}_{N_r^i}[\theta(\hat{T})] = \{\hat{\rho}_2, \hat{\rho}_4\} \text{-----(2)}$$

From equations (1) and (2), we get

$$\bar{L}_{N_r^i}[\theta(\hat{L}) \cup \theta(\hat{T})] \not\subseteq \bar{L}_{N_r^i}[\theta(\hat{L})] \cap \bar{L}_{N_r^i}[\theta(\hat{T})]$$

$$(iii) \underline{L}_{N_r^i}[\theta(\hat{L}) \cup \theta(\hat{T})] \subseteq \underline{L}_{N_r^i}[\theta(\hat{L})] \cup \underline{L}_{N_r^i}[\theta(\hat{T})]$$

Let $\theta(\hat{L}) = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}$ and $\theta(\hat{T}) = \{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$

Then $\theta(\hat{L}) \cup \theta(\hat{T}) = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$

$$i.e., \underline{L}_{N_r^i}[\theta(\hat{L}) \cup \theta(\hat{T})] = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\} \text{-----(1)}$$

Now $\underline{L}_{N_r^i}[\theta(\hat{L})] = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}$ and $\underline{L}_{N_r^i}[\theta(\hat{T})] = \{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$

$$i.e., \underline{L}_{N_r^i}[\theta(\hat{L})] \cup \underline{L}_{N_r^i}[\theta(\hat{T})] = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\} \text{-----(2)}$$

From equations (1) and (2), we get

$$\underline{L}_{N_r^i}[\theta(\hat{L}) \cup \theta(\hat{T})] \subseteq \underline{L}_{N_r^i}[\theta(\hat{L})] \cup \underline{L}_{N_r^i}[\theta(\hat{T})]$$

$$(iv) \bar{L}_{N_r^i}[\theta(\hat{L}) \cup \theta(\hat{T})] \not\subseteq \bar{L}_{N_r^i}[\theta(\hat{L})] \cap \bar{L}_{N_r^i}[\theta(\hat{T})]$$

Let $\theta(\hat{L}) = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}$ and $\theta(\hat{T}) = \{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$

Then $\theta(\hat{L}) \cup \theta(\hat{T}) = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$

$$i.e., \bar{L}_{N_r^i}[\theta(\hat{L}) \cup \theta(\hat{T})] = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\} \text{-----(1)}$$

Now $\bar{L}_{N_r^i}[\theta(\hat{L})] = \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_4\}$ and $\bar{L}_{N_r^i}[\theta(\hat{T})] = \{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4\}$

$$i.e., \bar{L}_{N_r^i}[\theta(\hat{L})] \cap \bar{L}_{N_r^i}[\theta(\hat{T})] = \{\hat{\rho}_2, \hat{\rho}_4\} \text{-----(2)}$$

From equations (1) and (2), we get

$\bar{L}_{N_r^i}[\theta(\hat{L}) \cup \theta(\hat{T})] \not\subseteq \bar{L}_{N_r^i}[\theta(\hat{L})] \cap \bar{L}_{N_r^i}[\theta(\hat{T})]$. Hence the proof.

Theorem: 3.3

If $\hat{G}(\hat{\theta}, \hat{\sigma})$ is a simple digraph and \hat{L} be a sub graph of \hat{G} then the following statements are holds good:

- (i) $\bar{L}_{N_r^i} \{ \underline{L}_{N_r^i}[\theta(\hat{L})] \} \subseteq \theta(\hat{L}) \subseteq \underline{L}_{N_r^i} \{ \bar{L}_{N_r^i}[\theta(\hat{L})] \} \hat{U}_{N_r^i} \{ \hat{L}_{N_r^i}[\hat{V}(\hat{H})] \} \subseteq \hat{V}(\hat{H}) \subseteq \hat{L}_{N_r^i} \{ \hat{U}_{N_r^i}[\hat{V}(\hat{H})] \}$
- (ii) $\bar{L}_{N_r^i} \{ \underline{L}_{N_r^i}[\theta(\hat{L})] \} \subseteq \theta(\hat{L}) \subseteq \underline{L}_{N_r^i} \{ \bar{L}_{N_r^i}[\theta(\hat{L})] \} \hat{U}_{N_r^i} \{ \hat{L}_{N_r^i}[\hat{V}(\hat{H})] \} \subseteq \hat{V}(\hat{H}) \subseteq \hat{L}_{N_r^i} \{ \hat{U}_{N_r^i}[\hat{V}(\hat{H})] \}$

Proof: Proof of (i):

$$\text{Let } \hat{u} \in \bar{L}_{N_i^i} \{ \underline{L}_{N_i^i} [\theta(\hat{L})] \} \text{-----(i)}$$

$$\Rightarrow \hat{\rho} \in \underline{L}_{N_i^i} \{ [\theta(\hat{L})] \} \text{ such that } \overline{\hat{u}\hat{\rho}} \in \sigma(G)$$

$$\underline{L}_{N_i^i} [\hat{\theta}(\hat{L})] = \bigcup_{\hat{\rho} \in \hat{\theta}(\hat{G})} \{ \hat{\rho} / N_i^i(\hat{\rho}) \subseteq \hat{\theta}(\hat{L}) \}$$

$$\text{i.e., } \hat{u} \in N_i^i(\hat{\rho}) \subseteq \theta(\hat{L})$$

$$\therefore \hat{u} \in \theta(\hat{L}) \text{----- (ii)}$$

From equations (i) and (ii), we get

$$\bar{L}_{N_i^i} \{ \underline{L}_{N_i^i} [\theta(\hat{L})] \} \subseteq \theta(\hat{L}) \text{-----(1)}$$

$$\text{Now let } \hat{u} \in \theta(\hat{L}) \text{----- (iii)}$$

$$\text{Then } N_i^i(\hat{\rho}) \subseteq \underline{L}_{N_i^i} [\theta(\hat{L})]$$

$$\text{Since } \hat{u} \in \theta(\hat{L}) \text{ and } N_i^i(\hat{u}) \subseteq \bar{L}_{N_i^i} [\theta(\hat{L})]$$

$$\text{i.e., } \hat{u} \in \underline{L}_{N_i^i} \{ \bar{L}_{N_i^i} [\theta(\hat{L})] \} \text{-----(iv)}$$

From equations (iii) and (iv), we get

$$\theta(\hat{L}) \underline{L}_{N_i^i} \subseteq \{ \bar{L}_{N_i^i} [\theta(\hat{L})] \} \text{-----(2)}$$

From equations (1) and (2), we get

$$\bar{L}_{N_i^i} \{ \underline{L}_{N_i^i} [\theta(\hat{L})] \} \subseteq \theta(\hat{L}) \subseteq \underline{L}_{N_i^i} \{ \bar{L}_{N_i^i} [\theta(\hat{L})] \}$$

Proof of (ii):

$$\text{Let } \hat{u} \in \bar{L}_{N_r^i} \{ \underline{L}_{N_r^i} [\theta(\hat{L})] \} \text{----- (i)}$$

$$\Rightarrow \hat{\rho} \in \underline{L}_{N_r^i} \{ [\theta(\hat{L})] \} \text{ such that } \overline{\hat{u}\hat{\rho}} \in \sigma(G)$$

$$\underline{L}_{N_r^i} [\hat{\theta}(\hat{L})] = \bigcup_{\hat{\rho} \in \hat{\theta}(\hat{G})} \{ \hat{\rho} / N_r^i(\hat{\rho}) \subseteq \hat{\theta}(\hat{L}) \}$$

$$\text{i.e., } \hat{u} \in N_r^i(\hat{\rho}) \subseteq \theta(\hat{L})$$

$$\therefore \hat{u} \in \theta(\hat{L}) \text{----- (ii)}$$

From equations (i) and (ii), we get

$$\bar{L}_{N_r^i} \{ \underline{L}_{N_r^i} [\theta(\hat{L})] \} \subseteq \theta(\hat{L}) \text{-----(1)}$$

$$\text{Now let } \hat{u} \in \theta(\hat{L}) \text{----- (iii)}$$

Then $N_r^i(\hat{\rho}) \subseteq \underline{L}_{N_r^i}[\theta(\hat{L})]$

Since $\hat{u} \in \theta(\hat{L})$ and $N_r^i(\hat{u}) \subseteq \bar{L}_{N_r^i}[\theta(\hat{L})]$

i.e., $\hat{u} \in \underline{L}_{N_r^i}\{\bar{L}_{N_r^i}[\theta(\hat{L})]\}$ -----(iv)

From equations (iii) and (iv), we get

$$\theta(\hat{L}) \subseteq \underline{L}_{N_r^i}\{\bar{L}_{N_r^i}[\theta(\hat{L})]\}$$
-----(2)

From equations (1) and (2), we get

$$\bar{L}_{N_r^i}\{\underline{L}_{N_r^i}[\theta(\hat{L})]\} \subseteq \theta(\hat{L}) \subseteq \underline{L}_{N_r^i}\{\bar{L}_{N_r^i}[\theta(\hat{L})]\}.$$

Hence the proof.

4.Results

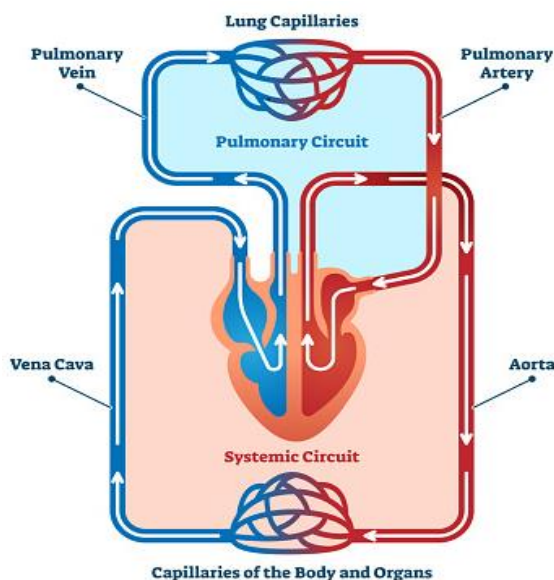
NANO-TOPOLOGICAL STRUCTURES VIA GRAPH FOR HUMAN DOUBLE CIRCULATION SYSTEM

The circulatory system is responsible for the transportation of nutrients and gases like oxygen, for the body and metabolic waste products away from the body.

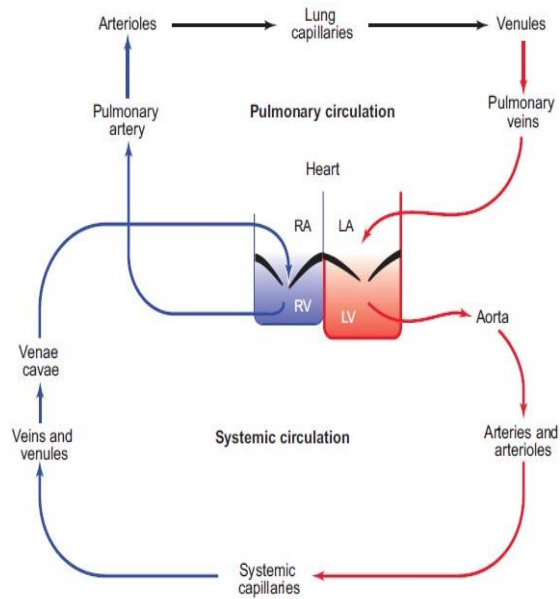
The heart and the lungs play an important role in circulating and purification of blood throughout the body.

Here we shows that different parts of human double circulation system in figure-4.1, 4.2 and the corresponding graphical representation as in figure-4.3.

DOUBLE CIRCULATION



(Figure-4.1)



(Figure-4.2)

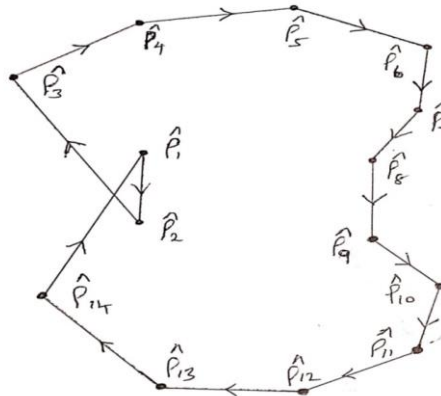
Let $\widehat{G}(\widehat{\theta}, \widehat{\sigma})$ be a simple digraph (figure-3), \widehat{L} be a sub-graph of \widehat{G} and the set of vertices of a simple digraph is $\widehat{\theta}(\widehat{G}) = \{\widehat{\rho}_1, \widehat{\rho}_2, \widehat{\rho}_3, \widehat{\rho}_4, \widehat{\rho}_5, \widehat{\rho}_6, \widehat{\rho}_7, \widehat{\rho}_8, \widehat{\rho}_9, \widehat{\rho}_{10}, \widehat{\rho}_{11}, \widehat{\rho}_{12}, \widehat{\rho}_{13}, \widehat{\rho}_{14}\}$

Where $\widehat{\rho}_1$ =right atrium, $\widehat{\rho}_2$ = right ventricle, $\widehat{\rho}_3$ =pulmonary artery, $\widehat{\rho}_4$ =arteriols, $\widehat{\rho}_5$ =lung capillaries, $\widehat{\rho}_6$ = venules, $\widehat{\rho}_7$ = pulmonary veins, $\widehat{\rho}_8$ = left atrium, $\widehat{\rho}_9$ = left ventricle, $\widehat{\rho}_{10}$ =aorta, $\widehat{\rho}_{11}$ = arteries and arterioles, $\widehat{\rho}_{12}$ = systemic capillaries, $\widehat{\rho}_{13}$ = veins and venules, $\widehat{\rho}_{14}$ = venae cavae.

In this work we find the initial left (resp. right) neighbourhoods of a vertex which can be used as a tool for nano-topological space.

Table: 4.1	
Left neighbourhood	Initial left neighbourhood
$\widehat{N}_l(\widehat{\rho}_1) = \{\widehat{\rho}_1, \widehat{\rho}_{14}\}$	$\widehat{N}_l^i(\widehat{\rho}_1) = \{\widehat{\rho}_1\}$
$\widehat{N}_l(\widehat{\rho}_2) = \{\widehat{\rho}_1, \widehat{\rho}_2\}$	$\widehat{N}_l^i(\widehat{\rho}_2) = \{\widehat{\rho}_2\}$
$\widehat{N}_l(\widehat{\rho}_3) = \{\widehat{\rho}_2, \widehat{\rho}_3\}$	$\widehat{N}_l^i(\widehat{\rho}_3) = \{\widehat{\rho}_3\}$
$\widehat{N}_l(\widehat{\rho}_4) = \{\widehat{\rho}_3, \widehat{\rho}_4\}$	$\widehat{N}_l^i(\widehat{\rho}_4) = \{\widehat{\rho}_4\}$
$\widehat{N}_l(\widehat{\rho}_5) = \{\widehat{\rho}_4, \widehat{\rho}_5\}$	$\widehat{N}_l^i(\widehat{\rho}_5) = \{\widehat{\rho}_5\}$
$\widehat{N}_l(\widehat{\rho}_6) = \{\widehat{\rho}_5, \widehat{\rho}_6\}$	$\widehat{N}_l^i(\widehat{\rho}_6) = \{\widehat{\rho}_6\}$
$\widehat{N}_l(\widehat{\rho}_7) = \{\widehat{\rho}_6, \widehat{\rho}_7\}$	$\widehat{N}_l^i(\widehat{\rho}_7) = \{\widehat{\rho}_7\}$
$\widehat{N}_l(\widehat{\rho}_8) = \{\widehat{\rho}_7, \widehat{\rho}_8\}$	$\widehat{N}_l^i(\widehat{\rho}_8) = \{\widehat{\rho}_8\}$
$\widehat{N}_l(\widehat{\rho}_9) = \{\widehat{\rho}_8, \widehat{\rho}_9\}$	$\widehat{N}_l^i(\widehat{\rho}_9) = \{\widehat{\rho}_9\}$
$\widehat{N}_l(\widehat{\rho}_{10}) = \{\widehat{\rho}_9, \widehat{\rho}_{10}\}$	$\widehat{N}_l^i(\widehat{\rho}_{10}) = \{\widehat{\rho}_{10}\}$
$\widehat{N}_l(\widehat{\rho}_{11}) = \{\widehat{\rho}_{10}, \widehat{\rho}_{11}\}$	$\widehat{N}_l^i(\widehat{\rho}_{11}) = \{\widehat{\rho}_{11}\}$
$\widehat{N}_l(\widehat{\rho}_{12}) = \{\widehat{\rho}_{11}, \widehat{\rho}_{12}\}$	$\widehat{N}_l^i(\widehat{\rho}_{12}) = \{\widehat{\rho}_{12}\}$
$\widehat{N}_l(\widehat{\rho}_{13}) = \{\widehat{\rho}_{12}, \widehat{\rho}_{13}\}$	$\widehat{N}_l^i(\widehat{\rho}_{13}) = \{\widehat{\rho}_{13}\}$
$\widehat{N}_l(\widehat{\rho}_{14}) = \{\widehat{\rho}_{13}, \widehat{\rho}_{14}\}$	$\widehat{N}_l^i(\widehat{\rho}_{14}) = \{\widehat{\rho}_{14}\}$

Table: 4.2	
Right neighbourhood	Initial right neighbourhood
$\widehat{N}_r(\hat{\rho}_1) = \{\hat{\rho}_1, \hat{\rho}_2\}$	$\widehat{N}_r^i(\hat{\rho}_1) = \{\hat{\rho}_1\}$
$\widehat{N}_r(\hat{\rho}_2) = \{\hat{\rho}_2, \hat{\rho}_3\}$	$\widehat{N}_r^i(\hat{\rho}_2) = \{\hat{\rho}_2\}$
$\widehat{N}_r(\hat{\rho}_3) = \{\hat{\rho}_3, \hat{\rho}_4\}$	$\widehat{N}_r^i(\hat{\rho}_3) = \{\hat{\rho}_3\}$
$\widehat{N}_r(\hat{\rho}_4) = \{\hat{\rho}_4, \hat{\rho}_5\}$	$\widehat{N}_r^i(\hat{\rho}_4) = \{\hat{\rho}_4\}$
$\widehat{N}_r(\hat{\rho}_5) = \{\hat{\rho}_5, \hat{\rho}_6\}$	$\widehat{N}_r^i(\hat{\rho}_5) = \{\hat{\rho}_5\}$
$\widehat{N}_r(\hat{\rho}_6) = \{\hat{\rho}_6, \hat{\rho}_7\}$	$\widehat{N}_r^i(\hat{\rho}_6) = \{\hat{\rho}_6\}$
$\widehat{N}_r(\hat{\rho}_7) = \{\hat{\rho}_7, \hat{\rho}_8\}$	$\widehat{N}_r^i(\hat{\rho}_7) = \{\hat{\rho}_7\}$
$\widehat{N}_r(\hat{\rho}_8) = \{\hat{\rho}_8, \hat{\rho}_9\}$	$\widehat{N}_r^i(\hat{\rho}_8) = \{\hat{\rho}_8\}$
$\widehat{N}_r(\hat{\rho}_9) = \{\hat{\rho}_9, \hat{\rho}_{10}\}$	$\widehat{N}_r^i(\hat{\rho}_9) = \{\hat{\rho}_9\}$
$\widehat{N}_r(\hat{\rho}_{10}) = \{\hat{\rho}_{10}, \hat{\rho}_{11}\}$	$\widehat{N}_r^i(\hat{\rho}_{10}) = \{\hat{\rho}_{10}\}$
$\widehat{N}_r(\hat{\rho}_{11}) = \{\hat{\rho}_{11}, \hat{\rho}_{12}\}$	$\widehat{N}_r^i(\hat{\rho}_{11}) = \{\hat{\rho}_{11}\}$
$\widehat{N}_r(\hat{\rho}_{12}) = \{\hat{\rho}_{12}, \hat{\rho}_{13}\}$	$\widehat{N}_r^i(\hat{\rho}_{12}) = \{\hat{\rho}_{12}\}$
$\widehat{N}_r(\hat{\rho}_{13}) = \{\hat{\rho}_{13}, \hat{\rho}_{14}\}$	$\widehat{N}_r^i(\hat{\rho}_{13}) = \{\hat{\rho}_{13}\}$
$\widehat{N}_r(\hat{\rho}_{14}) = \{\hat{\rho}_1, \hat{\rho}_{14}\}$	$\widehat{N}_r^i(\hat{\rho}_{14}) = \{\hat{\rho}_{14}\}$



(Figure-4.3)

Table: 4.3	
Union of initial Neighbourhoods	Intersection of initial neighbourhoods
$\widehat{N}_u^i(\hat{\rho}_1) = \{\hat{\rho}_1\}$	$\widehat{N}_i^i(\hat{\rho}_1) = \{\hat{\rho}_1\}$
$\widehat{N}_u^i(\hat{\rho}_2) = \{\hat{\rho}_2\}$	$\widehat{N}_i^i(\hat{\rho}_2) = \{\hat{\rho}_2\}$
$\widehat{N}_u^i(\hat{\rho}_3) = \{\hat{\rho}_3\}$	$\widehat{N}_i^i(\hat{\rho}_3) = \{\hat{\rho}_3\}$
$\widehat{N}_u^i(\hat{\rho}_4) = \{\hat{\rho}_4\}$	$\widehat{N}_i^i(\hat{\rho}_4) = \{\hat{\rho}_4\}$
$\widehat{N}_u^i(\hat{\rho}_5) = \{\hat{\rho}_5\}$	$\widehat{N}_i^i(\hat{\rho}_5) = \{\hat{\rho}_5\}$
$\widehat{N}_u^i(\hat{\rho}_6) = \{\hat{\rho}_6\}$	$\widehat{N}_i^i(\hat{\rho}_6) = \{\hat{\rho}_6\}$
$\widehat{N}_u^i(\hat{\rho}_7) = \{\hat{\rho}_7\}$	$\widehat{N}_i^i(\hat{\rho}_7) = \{\hat{\rho}_7\}$
$\widehat{N}_u^i(\hat{\rho}_8) = \{\hat{\rho}_8\}$	$\widehat{N}_i^i(\hat{\rho}_8) = \{\hat{\rho}_8\}$
$\widehat{N}_u^i(\hat{\rho}_9) = \{\hat{\rho}_9\}$	$\widehat{N}_i^i(\hat{\rho}_9) = \{\hat{\rho}_9\}$
$\widehat{N}_u^i(\hat{\rho}_{10}) = \{\hat{\rho}_{10}\}$	$\widehat{N}_i^i(\hat{\rho}_{10}) = \{\hat{\rho}_{10}\}$

$\widehat{N}_u^i(\hat{\rho}_{11}) = \{\hat{\rho}_{11}\}$	$\widehat{N}_i^i(\hat{\rho}_{11}) = \{\hat{\rho}_{11}\}$
$\widehat{N}_u^i(\hat{\rho}_{12}) = \{\hat{\rho}_{12}\}$	$\widehat{N}_i^i(\hat{\rho}_{12}) = \{\hat{\rho}_{12}\}$
$\widehat{N}_u^i(\hat{\rho}_{13}) = \{\hat{\rho}_{13}\}$	$\widehat{N}_i^i(\hat{\rho}_{13}) = \{\hat{\rho}_{13}\}$
$\widehat{N}_u^i(\hat{\rho}_{14}) = \{\hat{\rho}_{14}\}$	$\widehat{N}_i^i(\hat{\rho}_{14}) = \{\hat{\rho}_{14}\}$

Table 4.4: Nano topologies $\hat{\tau}_{N_i^i}[\widehat{\theta}(\widehat{L})]$ by using initial left neighbourhoods for subgraph of Figure

4.3

$\widehat{\theta}(\widehat{L})$	$\hat{\tau}_{N_i^i}[\widehat{\theta}(\widehat{L})]$
$\{\hat{\rho}_1, \hat{\rho}_5\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_1, \hat{\rho}_5\}\}$
$\{\hat{\rho}_6, \hat{\rho}_9\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_6, \hat{\rho}_9\}\}$
$\{\hat{\rho}_{10}, \hat{\rho}_{13}\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_{10}, \hat{\rho}_{13}\}\}$
$\{\hat{\rho}_2, \hat{\rho}_8\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_2, \hat{\rho}_8\}\}$
$\{\hat{\rho}_7, \hat{\rho}_{12}\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_7, \hat{\rho}_{12}\}\}$
$\{\hat{\rho}_3, \hat{\rho}_6, \hat{\rho}_{11}\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_3, \hat{\rho}_6, \hat{\rho}_{11}\}\}$
$\{\hat{\rho}_4, \hat{\rho}_6, \hat{\rho}_{12}\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_4, \hat{\rho}_6, \hat{\rho}_{12}\}\}$
$\{\hat{\rho}_5, \hat{\rho}_7, \hat{\rho}_{13}\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_5, \hat{\rho}_7, \hat{\rho}_{13}\}\}$
$\{\hat{\rho}_9, \hat{\rho}_{12}, \hat{\rho}_{14}\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_9, \hat{\rho}_{12}, \hat{\rho}_{14}\}\}$
$\{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_7, \hat{\rho}_8, \hat{\rho}_9\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_7, \hat{\rho}_8, \hat{\rho}_9\}\}$
$\{\hat{\rho}_4, \hat{\rho}_8, \hat{\rho}_9, \hat{\rho}_{11}, \hat{\rho}_{12}\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_4, \hat{\rho}_8, \hat{\rho}_9, \hat{\rho}_{11}, \hat{\rho}_{12}\}\}$
$\{\hat{\rho}_8, \hat{\rho}_9, \hat{\rho}_{10}, \hat{\rho}_{11}, \hat{\rho}_{13}\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_8, \hat{\rho}_9, \hat{\rho}_{10}, \hat{\rho}_{11}, \hat{\rho}_{13}\}\}$
$\{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_7, \hat{\rho}_9\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_7, \hat{\rho}_9\}\}$
$\{\hat{\rho}_2, \hat{\rho}_4, \hat{\rho}_6, \hat{\rho}_7, \hat{\rho}_9, \hat{\rho}_{10}\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_2, \hat{\rho}_4, \hat{\rho}_6, \hat{\rho}_7, \hat{\rho}_9, \hat{\rho}_{10}\}\}$
$\{\hat{\rho}_3, \hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_7, \hat{\rho}_8, \hat{\rho}_9\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_3, \hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_7, \hat{\rho}_8, \hat{\rho}_9\}\}$
$\{\hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_8, \hat{\rho}_9, \hat{\rho}_{12}, \hat{\rho}_{14}\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_8, \hat{\rho}_9, \hat{\rho}_{12}, \hat{\rho}_{14}\}\}$
$\{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_7, \hat{\rho}_9\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_1, \hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_7, \hat{\rho}_9\}\}$
$\{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4, \hat{\rho}_6, \hat{\rho}_8, \hat{\rho}_9, \hat{\rho}_{10}\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4, \hat{\rho}_6, \hat{\rho}_8, \hat{\rho}_9, \hat{\rho}_{10}\}\}$
$\{\hat{\rho}_4, \hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_8, \hat{\rho}_9, \hat{\rho}_{10}, \hat{\rho}_{11}\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_4, \hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_8, \hat{\rho}_9, \hat{\rho}_{10}, \hat{\rho}_{11}\}\}$
$\{\hat{\rho}_3, \hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_9, \hat{\rho}_{10}, \hat{\rho}_{11}, \hat{\rho}_{12}\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_3, \hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_9, \hat{\rho}_{10}, \hat{\rho}_{11}, \hat{\rho}_{12}\}\}$
$\{\hat{\rho}_5, \hat{\rho}_7, \hat{\rho}_8, \hat{\rho}_9, \hat{\rho}_{10}, \hat{\rho}_{11}, \hat{\rho}_{13}\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_5, \hat{\rho}_7, \hat{\rho}_8, \hat{\rho}_9, \hat{\rho}_{10}, \hat{\rho}_{11}, \hat{\rho}_{13}\}\}$
$\{\hat{\rho}_4, \hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_8, \hat{\rho}_9, \hat{\rho}_{10}, \hat{\rho}_{12}, \hat{\rho}_{13}\}$	$\{\widehat{\theta}(\widehat{G}), \varphi, \{\hat{\rho}_4, \hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_8, \hat{\rho}_9, \hat{\rho}_{10}, \hat{\rho}_{12}, \hat{\rho}_{13}\}\}$

$$\frac{\{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4, \hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_7, \hat{\rho}_9, \hat{\rho}_{11}, \hat{\rho}_{13}\}}{\{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4, \hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_8, \hat{\rho}_9, \hat{\rho}_{11}, \hat{\rho}_{13}, \hat{\rho}_{14}\}} \left| \begin{array}{l} \{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4, \hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_7, \hat{\rho}_9, \hat{\rho}_{11}, \hat{\rho}_{13}\}\} \\ \{\hat{\theta}(\hat{G}), \varphi, \{\hat{\rho}_2, \hat{\rho}_3, \hat{\rho}_4, \hat{\rho}_5, \hat{\rho}_6, \hat{\rho}_8, \hat{\rho}_9, \hat{\rho}_{11}, \hat{\rho}_{13}, \hat{\rho}_{14}\}\} \end{array} \right.$$

5. Discussion

A theme of the current research work is that we have developed a digraph of the human double cycle system. From this we have derived certain nano-topological properties by creating initial left (resp. right) neighbourhoods and also we have identified the union and intersection of initial neighbourhoods might help us to ensure the cause of lung and heart failure. In addition we derived the nano-topologies by using initial left (resp. right) neighbourhoods for certain probable sub-graphs and also verified the comparison between these two types of neighbourhoods. The findings of the digraph application approaches that we acquired are really helpful to ensure the functionality of double circulation system in the human body.

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