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Coronavirus Decision-Making Based on a Locally $\overset{\mathbf{M}^*}{S}$ α-Generalized Closed Set

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Abstract: Real-world applications now deal with a massive amount of data, and information about the world is inaccurate, incomplete, or uncertain. Therefore, we present in our paper a proposed model for solving problems. This model is based on the class of locally generalized closed sets, namely, locally simply* alpha generalized closed* sets and locally simply* alpha generalized closed** sets (briefly, $L\overset{\mathrm{M}^*}{S}\alpha GC^*$-sets and $L\overset{\mathrm{M}^*}{S}\alpha GC^{**}$-sets), based on simply* alpha open set. We also introduce various concepts of their properties and their relationship with other types, and we are studying several of their properties. Finally, we apply the concept of the simply* alpha open set to illustrate the importance of our method in decision-making for information systems about the infections of Coronavirus in humans. In fact, we were able to decide the impact factors of Coronavirus infection. The results were also programmed using the MATLAB program. Therefore, it is recommended that our proposed concept be used in future decision-making.

Keywords: Corona virus; simply* alpha open sets; locally simply* alpha generalized closed*sets; decision making

1 Introduction

The most recent Coronavirus epidemic was an outbreak in China at the start of 2019. China increased its national public-health response to the highest level on January 23, 2020. A variety of public social distancing initiatives to minimize the transmission rate of Corona virus have been introduced as part of the emergency response [1]. As a result, many papers were published by several researchers to study and analyze this virus, such as [1–7].

In diverse research areas, the mathematical modeling of vagueness and ambiguity has become an increasingly important topic. There exists another statistical instrument that has been utilized in many aspects of life [8,9]. Topology is an important branch of mathematics which contains several subfields such as soft topology, algebraic topology, and differential topology [10,11]. These subfields increase the limit of the topology applications [12]. The field of topology has many results and concepts, which can help us to discover the hidden information of data, composed of real-life applications [13]. The topological methods are thus compatible with the processing static methods and geometric representation the concept of a locally closed set-in topological space, introduced by Balachandran et al. [14]. Ganster et al. [15–17] continued to study of locally closed sets.

Our aim in this paper is to introduce three new classes of sets called $L\overset{M^*}{S}\alpha\breve{G}C$-closed-sets, $L\overset{M^*}{S}\alpha\breve{G}C^*$, and $L\overset{M^*}{S}\alpha\breve{G}C^{**}$-sets which are contained in $\breve{G}LC$- sets by using the notions of $\overset{M^*}{S}\alpha$-open sets and $\overset{M^*}{S}\alpha$-closed sets which is new classes. We shall define these classes in this paper. Also, we introduce some different classes of $\overset{M^*}{S}\alpha\breve{G}$-closed sets and $\overset{M^*}{S}\alpha\breve{G}$-open sets and study some of their characteristics. This method is used to identify and take the optimal decision for any life problem using near open sets named the class of simply stare alpha Star open sets, which is a new method that is considered as an essential tool for processing information for any life problem and is useful for any decision maker to take the appropriate decision for it. For example, the current application can help in making the right decision for patients, the algorithm used in the manuscript can be applied to any number of patients or objects.

Finally, we explain the importance of the proposed method in the medical sciences for application in decision making problems. In fact, a medical application has been introduced in the decision making process of COVID-19 Medical Diagnostic Information System with the algorithm. This application may help the world to reduce the spread of Coronavirus.

The paper is structured as follows: The basic concepts of the locally generalized closed set and locally simply* α -generalized closed sets are introduced in Section Two and Three. The implementation of COVID-19 for each subclass of attributes in the information systems and comparative analysis is presented in Section Four. Section Five concludes and highlights future scope.

2 Preliminaries

In this section, the present study is inspired by pointing out locally generalized closed set blind spots.

Definition 2.1 [17] A subset $\hat{A}$ of a space $\hat{W}$ is called g-closed if $cL(\hat{A}) \Subset \breve{G}$ wherever $\hat{A} \Subset \breve{G}$, and $\breve{G}$ is open

Definition 2.2 A subset $\hat{A}$ of a space $(\hat{W}, T)$ it's called,

i. Locally-closed [15] if $\hat{A} = \breve{G} \Cap F$ where $\breve{G} \in T$ and F is closed-set in $(\hat{W}, T)$
ii. Generalized locally closed [14] (briefly $\breve{G}LC$-set) if $\hat{A} = \breve{G} \Cap F$ whereas $\breve{G} \in \breve{G}O(\hat{W})$ and $F \in GC(W)$.
iii. $\breve{G}LC^*$-closed [14] if there is a g-open set $\breve{G}$ and closed F of $(\hat{W}, T)$ whereas $\hat{A} = \breve{G} \Cap F$.
iv. $\breve{G}LC^{**}$-set [14] if there is an open-set $\breve{G}$ and a g-closed set $F \in \breve{G}CO(\hat{W})$ whereas $\hat{A} = \breve{G} \Cap F$

The collection of all locally $\breve{G}LC$-sets (resp. $\breve{G}LC^{**}$-sets, $\breve{G}LC^*$-sets, $\overset{M^*}{S}\alpha\breve{G}$-sets, closed sets, and g-closed sets) will denoted by $\breve{G}LC(\hat{W})$ (resp. $\breve{G}LC^{**}(\hat{W})$, $\breve{G}LC^*(\hat{W})$, $\overset{M^*}{S}\alpha\breve{G}C(\hat{W})$, $C(\hat{W})$, $\breve{G}C(\hat{W})$.

Definition 2.3 [14] A topological space $(\hat{W}, T)$ is called g-submaximal if every dense is g-open.

3 Locally Simply*α-Generalized Closed Sets

In this section, we shall introduce a new class of generalization say $L\overset{M^*}{S}\alpha\breve{G}C$-sets and we study some properties of this class.

Definition 3.1 A subset $\hat{A}$ of a space $(\hat{W},\ T)$ it's called $\overset{M^*}{S}$ α-open set if $\hat{A} \in \{\hat{W},\ \phi,\ \breve{G}^* \Cup N$ where $\breve{G}^*$ is proper α-open set and N is nowhere dense $\}$ and the complement of the class of $\overset{M^*}{S}$α- open set is called $\overset{M^*}{S}$α-closed set and well denoted by $\overset{M^*}{S}\ \alpha\, O(\hat{W})$ and its complement is denoted by $\overset{M^*}{S}\ \alpha C(\hat{W})$.

Definition 3.2 A subset $\hat{A}$ of a topological space $(\hat{W},\ T)$ is called:

i. Simply alpha interior (shortly, $\overset{M^*}{S}\ \alpha int(\hat{A})$) is the largest simply* alpha open set contained in $\hat{A}$ and $\overset{M^*}{S}\ \alpha int(\hat{A}) = \Cup\ \breve{G} :\ \breve{G} \in\ \overset{M^*}{S}\ \alpha O(\hat{W})$ such that $\breve{G} \Subset \hat{A}\}$.

ii. Simply alpha closure (briefly, $\overset{M^*}{S}\ \alpha cL(\hat{A})$) is the smallest simply* alpha closed-set contained in $\hat{A}$ and $\overset{M^*}{S}\ \alpha cL(\hat{A}) =\ \Cap F :\ F \in \overset{M^*}{S}\ \alpha C(\hat{W})$ such that $\hat{A} \Subset F\}$.

Definition 3.3 A subset $\hat{A}$ of a topological space $(\hat{W},\ T)$ is called simply* alpha dense (briefly, $\overset{M^*}{S}$ α-dense) if $\overset{M^*}{S}\ \alpha\, cL(\hat{A}) = \hat{W}$.

Remark 3.1 The following Fig. 1 shows the relation between a new class of generalization and the other types of generalization of sets such that the implication in this diagram cannot be reversible as indicated in Example 3.1.

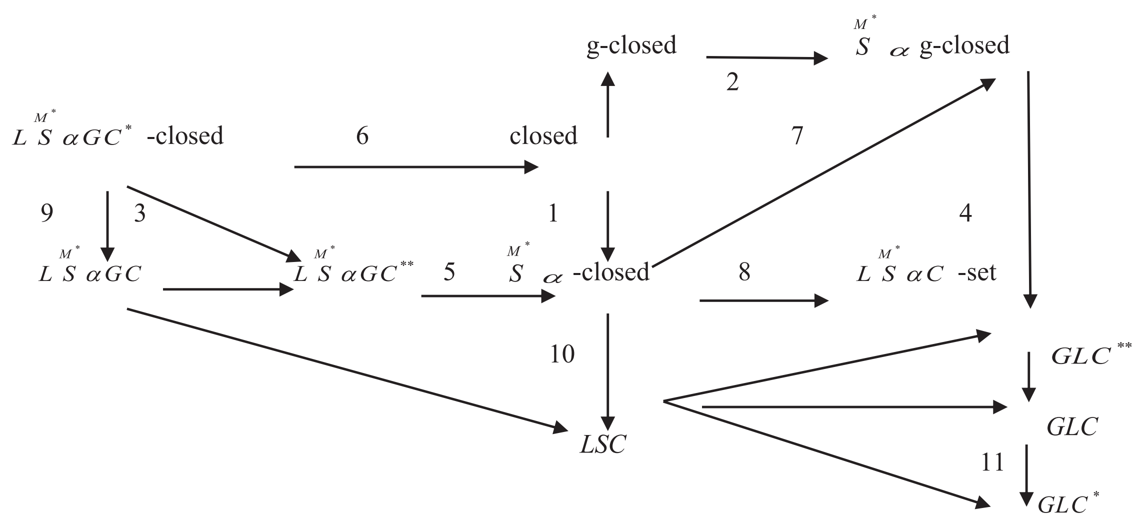

Figure 1: Shows the relation between a new class of generalized closed-sets

Definition 3.4 A subset $\hat{A}$ of a space $(\hat{W},\ T)$ it's called.

i. Simply*α-generalized-closed (shortly, $\overset{M^*}{S}\ \alpha\breve{G}$-closed) set if $\overset{M^*}{S}\ \alpha cL(\hat{A}) \Subset \breve{G},\ \hat{A} \Subset \breve{G}$ where $\breve{G}$ is open-set.

ii. Simply*α-generalized-open (shortly, $\overset{M^*}{S}\ \alpha\breve{G}$-open) set if $F \Subset \overset{M^*}{S}\ \alpha int(\hat{A}),\ F \Subset \hat{A}$ where F is closed set.

iii. Locally $\overset{M^*}{S}$ α-generalized closed (shortly, $L\overset{M^*}{S}\ \alpha\breve{G}C$) sets if there is a proper $\overset{M^*}{S}\ \alpha\breve{G}$-open set $\breve{G}$ and proper $\overset{M^*}{S}\ \alpha\breve{G}$-closed set F of $(\hat{W},\ T)$ whereas $\hat{A} = \breve{G} \Cap F$.

iv. Locally simply*α-generalized closed*-sets (shortly, $L\overset{M^*}{S}\ \alpha\breve{G}C^*$-sets) if there is a proper $\overset{M^*}{S}\ \alpha\breve{G}$-open set $\breve{G}$ and proper $\overset{M^*}{S}$ α-closed set F of $(\hat{W},\ T)$ whereas $\hat{A} = \breve{G} \Cap F$.

v. Locally simply*α-generalized closed**sets (shortly, $L\overset{M^*}{S}\,\alpha\breve{G}C^{**}$-sets) if there exists a proper $\overset{M^*}{S}\,\alpha$-open-set $\breve{G}$ and proper $\overset{M^*}{S}\,\alpha\breve{G}$-closed set F of $(\hat{W},\ T)$ wherever $\hat{A}=\breve{G}\Cap F$.

vi. Locally simply*α -closed set (shortly, $L\overset{M^*}{S}\,C$-set) if $\hat{A}=\breve{G}\Cap F$ wherever $\breve{G}$ is $\overset{M^*}{S}\,\alpha$-open set and F is $\overset{M^*}{S}\,\alpha$-closed sets.

The collection of all locally simply* alpha generalized closed set (resp. locally simply* alpha generalized closed* set, and locally simply* alpha generalized closed** set) of a universe set $\hat{W}$ is denoted by $L\overset{M^*}{S}\,\alpha\breve{G}C(\hat{W})$, (resp. $L\overset{M^*}{S}\,\alpha\breve{G}C^{*}(\hat{W})$, $L\overset{M^*}{S}\,\alpha\breve{G}C^{**}(\hat{W})$, and $L\overset{M^*}{S}\,C(\hat{W})$) is denoted by $L\overset{M^*}{S}\,\alpha\breve{G}C(\hat{W})$ (resp. $L\overset{M^*}{S}\,\alpha\breve{G}C^{*}(\hat{W})$, $L\overset{M^*}{S}\,\alpha\breve{G}C^{**}(\hat{W})$, $(\hat{W})$, and $L\overset{M^*}{S}\,C(\hat{W})$).

Example 3.1 Let $\hat{W}=\{a,\ b,\ c,\ d\}$, $T=\{\hat{W},\ \phi,\ \{c\},\ \{a,\ b\},\ \{a,\ b,\ c\}\}$. Then we have,

(implication 3) A set $\{a,\ d\}\in L\overset{M^*}{S}\,\alpha\breve{G}C^{**}(\hat{W})$ but $\{a,\ d\}\notin L\overset{M^*}{S}\,\alpha\breve{G}C^{*}(\hat{W})$.

(implications 6, 7) A set $\{b',\ d\}\in\breve{G}LC(\hat{W})$ but $\{b,\ d\}\notin\breve{G}LC^{*}(\hat{W})$, but $\{a,\ b',\ c\}\notin L\overset{M^*}{S}\,\alpha\breve{G}C(\hat{W})$.

(implication 5, 1) $\{a\}\in L\overset{M^*}{S}\,\alpha\breve{G}C^{**}(\hat{W})$ but $\{a\}\notin\ \overset{M^*}{S}\,\alpha C(\hat{W})$, and $\{a,\ b'\}\in\ \overset{M^*}{S}\,\alpha C(\hat{W})$ but $\{a,\ b\}\notin C(\hat{W})$.

(implication 6, 2, 4) $\{a,\ b\}\in L\overset{M^*}{S}\,\alpha\breve{G}C^{*}(\hat{W})$ but $\{a,\ b\}\notin C(\hat{W})$, $\{a\}\in\ \overset{M^*}{S}\,\alpha\breve{G}C(\hat{W})$ but $\{a\}\notin\breve{G}C(\hat{W},\ T)$, $\{a,\ b,\ c\}\in\breve{G}LC^{**}(\hat{W})$ but $\{a,\ b,\ c\}\notin\ \overset{M^*}{S}\,\alpha\breve{G}C(\hat{W})$.

(implication 8, 9, 10, 11) A set $\{a,\ b,\ c\}\in L\overset{M^*}{S}\,\alpha C(\hat{W})$, but $\{a,\ b,\ c\}\notin\ \overset{M^*}{S}\,\alpha C(\hat{W})$, $\{a,\ b,\ c\}\in L\overset{M^*}{S}\,\alpha\breve{G}C(\hat{W})$ but $\{a,\ b,\ c\}\notin L\overset{M^*}{S}\,\alpha\breve{G}C^{*}(\hat{W})$. Also there exists a set $\{b\}\in\ \overset{M^*}{S}\,\alpha\breve{G}C(\hat{W})$ but it is not $\{b\}\notin\ \overset{M^*}{S}\,\alpha C(\hat{W})$.

Remark 3.2 For any topological space $(\hat{W},\ T)$ then we have,

i. $L\overset{M^*}{S}\,\alpha\breve{G}C^{*}$-sets and α g-closed sets are not comparable.

ii. $\overset{M^*}{S}\,\alpha\breve{G}$-closed sets and $L\overset{M^*}{S}\,\alpha\breve{G}C^{**}$-closed sets are not comparable.

iii. α g-closed sets and $L\overset{M^*}{S}\,\alpha\breve{G}C^{**}$-closed sets are not comparable.

iv. $L\overset{M^*}{S}\,\alpha C-$ closed sets and α g-closed sets are not comparable.

v. g-closed sets and $\breve{G}LC^{*}$-closed sets are not comparable.

vi. $\overset{M^*}{S}\,\alpha\breve{G}$-closed sets and $\breve{G}LC^{*}$-closed sets are not comparable.

vii. LSC and $L\overset{M^*}{S}\,\alpha\breve{G}C$-sets are not comparable.

viii. $L\overset{M^*}{S}\,C$ and g-closed are not comparable.

ix. $L\overset{M^*}{S}\,\alpha C$ set and $L\overset{M^*}{S}\,\alpha\breve{G}C^{*}$ sets are not comparable.

x. $L\overset{M^*}{S}\,\alpha C$ set and $L\overset{M^*}{S}\,\alpha\breve{G}C^{**}$ sets are not comparable.

Example 3.2 From example 3.1 we have.

i. There exist a set $\{c\}\in L\overset{M^*}{S}\,\alpha\breve{G}C^{*}(\hat{W})$ but $\{c\}\notin\breve{G}C(\hat{W})$ and there exists a set $\{b,\ c,\ d\}\in\alpha\,\breve{G}C(\hat{W})$ but $\{b,\ c,\ d\}\notin L\overset{M^*}{S}\,\alpha\breve{G}C^{*}(\hat{W})$.

ii. There exists a set $\{b,\ c\}\in L\overset{M^*}{S}\,\alpha\breve{G}C^{**}(\hat{W},\ T)$ but $\{b,\ c\}\notin\ \overset{M^*}{S}\,\alpha\breve{G}C(\hat{W},\ T)$, and there exists a set $\{a,\ c,\ d\}\in\ \overset{M^*}{S}\,\alpha\breve{G}C(\hat{W},\ T)$ but $\{a,\ c,\ d\}\notin L\overset{M^*}{S}\,\alpha\breve{G}C^{**}(\hat{W},\ T)$.

iii. There exist a set $\{b\} \notin \alpha\breve{G}C(\hat{W})$ but $\{b\} \in L\overset{M^*}{S}\alpha\breve{G}C^{**}(\hat{W})$, and there exists a set $\{b, c, d\} \in \alpha\breve{G}C(\hat{W})$, but $\{b, c, d\} \notin L\overset{M^*}{S}\alpha\breve{G}C^{**}(\hat{W})$.

iv. There exists a set $\{c\} \in L\overset{M^*}{S}\alpha C(\hat{W})$ but $\{c\} \notin \alpha\breve{G}C(\hat{W})$, and there exists a set $\{b, d\} \in \alpha\breve{G}C(\hat{W})$, but $\{b, d\} \notin L\overset{M^*}{S}\alpha C(\hat{W})$.

v. $L\overset{M^*}{S}C\{b, d\} \in \alpha\breve{G}C(\hat{W})$ but $\{b, d\} \notin \breve{G}LC^*(\hat{W})$. and there exists a set $\{c\} \in \breve{G}LC(\hat{W})$ but $\{c\} \notin \breve{G}LC(\hat{W})$.

vi. There exists a set $\{a, c\} \in \breve{G}LC^*(\hat{W})$, but $\{a, c\} \notin \overset{M^*}{S}\alpha\breve{G}C(\hat{W})$, and there exists a set $\{b, c, d\} \in \overset{M^*}{S}\alpha\breve{G}C(\hat{W})$, but $\{b, c, d\} \notin \breve{G}LC^*(\hat{W})$.

vii. There exists a set $\{a\} \in L\overset{M^*}{S}\alpha\breve{G}C(\hat{W})$, but $\{a\} \notin L\delta C(\hat{W})$, and there exist a set $\{a, b, c\} \in L\delta C(\hat{W})$, but $\{a, b, c\} \notin L\overset{M^*}{S}\alpha\breve{G}C(\hat{W})$.

viii. There exists a set $\{a, b, c\} \in L\overset{M^*}{S}\alpha C(\hat{W})$, but $\{a, b, c\} \notin \breve{G}C(\hat{W})$, and there exists a set $\{b, d\} \in \breve{G}C(\hat{W})$, but $\{b, d\} \notin L\overset{M^*}{S}C(\hat{W})$.

xi. There exists a set $\{a, b, c\} \in L\overset{M^*}{S}\alpha C(\hat{W})$, but $\{a, b, c\} \notin L\overset{M^*}{S}\alpha\breve{G}C^*(\hat{W})$, and there exists a set $\{a\} \in L\overset{M^*}{S}\alpha\breve{G}C^*(\hat{W})$, but $\{a\} \notin L\overset{M^*}{S}\alpha C(\hat{W})$.

x. There exists a set $\{a, b, c\} \in L\overset{M^*}{S}\alpha C(\hat{W})$, but $\{a, b, c\} \notin L\overset{M^*}{S}\alpha\breve{G}C^{**}(\hat{W})$, and there exists a set $\{a\} \in L\overset{M^*}{S}\alpha\breve{G}C^{**}(\hat{W})$, but $\{a\} \notin L\overset{M^*}{S}\alpha C(\hat{W})$.

Definition 3.5 A subset $\hat{A}$ of a space $(\hat{W}, T)$; it is called $\overset{M^*}{S}$ α-closure of $\hat{A}$ (resp. $\overset{M^*}{S}$ α-interior) briefly as $\overset{M^*}{S}\alpha cL(\hat{A})$ (resp. $\overset{M^*}{S}\alpha int(\hat{A})$) is defined by $\overset{M^*}{S}\alpha cL(\hat{A}) = \Cap\{F \Supset \hat{A}$, such that $F \Subset \overset{M^*}{S}C(\hat{W}, T)\}$, and $\overset{M^*}{S}\alpha int(\hat{A}) = \Cup\{\breve{G} \Subset \hat{A}$, such that $\breve{G} \in \overset{M^*}{S}\alpha O(\hat{W}, T)\}$.

Theorem 3.1 The collection of all $L\overset{M^*}{S}\alpha\breve{G}C^*(\hat{W})$ is not true under finite union; the collection of $L\overset{M^*}{S}\alpha\breve{G}C(\hat{W})$ is not true under finite union.

The following example indicates this theorem;

i. From Example 2.1 we get that there exists a set $\{b\}, \{c\} \in L\overset{M^*}{S}\alpha\breve{G}C^*(\hat{W})$ but $\{b\}\Cup\{c\} = \{b, c\} \notin L\overset{M^*}{S}\alpha\breve{G}C^*(\hat{W})$.

ii. Let $\{c\}, \{a, b\} \in L\overset{M^*}{S}\alpha\breve{G}C^*(\hat{W})$ but $\{c\}\Cup\{a, b\} = \{a, b, c\} \notin L\overset{M^*}{S}\alpha\breve{G}C(\hat{W})$.

Remark 3.3 From the above result, the classes of $L\overset{M^*}{S}\alpha\breve{G}C(\hat{W})$ and $L\overset{M^*}{S}\alpha\breve{G}C^*(\hat{W})$ are not form supra topology.

Theorem 3.2 For a subset $\hat{A}$ of a space $(\hat{W}, T)$ then the following statements are equivalent.

i. $\hat{A} \in L\overset{M^*}{S}\alpha\breve{G}C^*(\hat{W})$.

ii. $\hat{A} \in \breve{G} \Cap \overset{M^*}{S}\alpha cL(\hat{A})$ for some proper $\overset{M^*}{S}$ α g-open set $\breve{G}$.

iii. $\overset{M^*}{S}\alpha cL(\hat{A})\backslash\hat{A}$ is proper $\overset{M^*}{S}\alpha\breve{G}$-closed.

iv. $\hat{A}\Cup(\hat{W}\backslash\overset{M^*}{S}\alpha cL(\hat{A}))$ is proper $\overset{M^*}{S}$ α g-open.

Proof : *i*) → *ii*) and $\hat{A} \in L\overset{M^*}{S}\alpha\breve{G}C^*(\hat{W}, T)$ then $\hat{A} = \breve{G} \Cap F$ where $\breve{G}$ is proper $\overset{M^*}{S}\alpha\breve{G}$-open and F is proper $\overset{M^*}{S}$ α-closed, $\hat{A} \Subset F$ implies $\overset{M^*}{S}\alpha cL(\hat{A}) \Subset F$ and also

$\hat{A} = \breve{G} \Cap F \Supset \breve{G} \Cap \overset{M^*}{S}\ \alpha cL(\hat{A})$ and $\hat{A} \Subset \overset{M^*}{S}\ \alpha cL(\hat{A})$, $\hat{A} \Subset \breve{G}$ implies $\hat{A} \Subset \breve{G} \Cap \overset{M^*}{S}\ \alpha cL(\hat{A})$ hence $\hat{A} = \breve{G} \Cap \overset{M^*}{S}\ \alpha cL(\hat{A})$.

ii) → *i*) Since $\breve{G}$ is proper $\overset{M^*}{S}\ \alpha\breve{G}$-open and $\overset{M^*}{S}\ \alpha cL(\hat{A})$ is $\overset{M^*}{S}\ \alpha G$-closed, $\breve{G} \Cap \overset{M^*}{S}\ \alpha cL(\hat{A}) \in L\overset{M^*}{S}\ \alpha\breve{G}C^*(\hat{W},\ T)$ by definition 2.1.

ii) → *iii*) Since $\overset{M^*}{S}\ \alpha cL(\hat{A})\backslash\hat{A} = \overset{M^*}{S}\ \alpha cL(\hat{A}) \Cap (\hat{W}\backslash\hat{A})$ which is $L\overset{M^*}{S}\ \alpha\breve{G}$-closed but $\hat{A} = \breve{G} \Cap \overset{M^*}{S}\ \alpha cL(\hat{A})$ then $\overset{M^*}{S}\ \alpha cL(\hat{A}) \Cap (\hat{W}\backslash(\breve{G} \Cap \overset{M^*}{S}\ \alpha cL(\hat{A})) = \overset{M^*}{S}\ \alpha cL(\hat{A}) \Cap (\hat{W}\backslash\breve{G}) \Cup (\hat{W}\backslash \overset{M^*}{S}\ \alpha cL(\hat{A}))$, $\overset{M^*}{S}\ \alpha cL(\hat{A})\backslash\hat{A} = \overset{M^*}{S}\ \alpha cL(\hat{A}) \Cap (\hat{W}\backslash\breve{G}) \Cup \overset{M^*}{S}\ \alpha cL(\hat{A}) \Cap (\hat{W}\backslash \overset{M^*}{S}\ \alpha cL(\hat{A})) = \overset{M^*}{S}\ \alpha cL(\hat{A}) \Cap (\hat{W}\backslash\breve{G}) \Cup \phi = \overset{M^*}{S}\ \alpha cL(\hat{A}) \Cap (\hat{W}\backslash\breve{G})$ by lemma 2.1 so $\overset{M^*}{S}\ \alpha cL(\hat{A})\backslash\hat{A}$ is $\overset{M^*}{S}\ \alpha\breve{G}$-closed.

iii) → *ii*) Let $U = \hat{W}\backslash(\overset{M^*}{S}\ \alpha cL(\hat{A})\backslash\hat{A})$ then U is $\overset{M^*}{S}\ \alpha\breve{G}$-open and hence $\hat{A} = U \Cup \overset{M^*}{S}\ \alpha cL(\hat{A})$.

iii) → *iv*) Let $F = \overset{M^*}{S}\ \alpha cL(\hat{A})\backslash\hat{A}$ is proper $\overset{M^*}{S}\ \alpha\breve{G}$-closed then $F = \overset{M^*}{S}\ \alpha cL(\hat{A}) \Cap (\hat{W}\backslash\hat{A})$, $\hat{W}\backslash F = (\hat{W}\backslash \overset{M^*}{S}\ \alpha cL(\hat{A})) \Cup \hat{A}$, $\hat{W}\backslash F$ is proper $\overset{M^*}{S}\ \alpha\breve{G}$-open.

iv) → *iii*) Let $U = \hat{A} \Cup (\hat{W}\backslash \overset{M^*}{S}\ \alpha cL(\hat{A}))$ then $(\hat{W}\backslash U) = (\hat{W}\backslash\hat{A}) \Cap \overset{M^*}{S}\ \alpha cL(\hat{A}) = \overset{M^*}{S}\ \alpha cL(\hat{A})\backslash\hat{A}$ is proper $\overset{M^*}{S}\ \alpha\breve{G}$-closed and hence $\hat{W}\backslash U = \overset{M^*}{S}\ \alpha cL(\hat{A})\backslash\hat{A}$.

Remark 3.4 It is not true that $\hat{A} \in L\overset{M^*}{S}\ \alpha\breve{G}C^*(\hat{W},\ T) \Leftrightarrow \overset{M^*}{S}\ int(\hat{A} \Cup (\hat{W}\backslash \overset{M^*}{S}\ \alpha cL(\hat{A})) \Supset \hat{A}$ in fact shown as the next example 3.3,

Example 3.3 Let $\hat{W} = \{a,\ b,\ c\}$, $T = \{\hat{W},\ \phi,\ \{a\},\ \{a,\ c\}\}$ and let $\hat{A} = \{b\}$ be subset of $(\hat{W},\ T)$ then $\overset{M^*}{S}\ int(\hat{A} \Cup (\hat{W}\backslash \overset{M^*}{S}\ \alpha cL(\hat{A})) = \overset{M^*}{S}\ int(\{b,\ c\}) = \phi \Supset \hat{A}$ and $\hat{A} \in L\overset{M^*}{S}\ \alpha\breve{G}C^*(\hat{W},\ T)$.

Definition 3.6 A topological space $(\hat{W},\ T)$ is called $\overset{M^*}{S}\ \alpha\breve{G}$-submaximal if each $\overset{M^*}{S}\ \alpha$-dense is $\overset{M^*}{S}\ \alpha\breve{G}$-open.

Proposition 3.1 A topological space $(\hat{W},\ T)$ is called $\overset{M^*}{S}\ \alpha\breve{G}$-sub-maximal if $P(\hat{W}) = L\overset{M^*}{S}\ \alpha\breve{G}C^*(\hat{W},\ T)$.

Proof. Let $\hat{A} \in P(\hat{W})$ and $U = \hat{A} \Cup (\hat{W}\backslash \overset{M^*}{S}\ \alpha cL(\hat{A}))$ then $\hat{W} = \overset{M^*}{S}\ \alpha cL(U)$ i.e., U is $\overset{M^*}{S}\ \alpha$-dense then U is proper $\overset{M^*}{S}\ \alpha\breve{G}$-open by theorem 2.1 $U \in L\overset{M^*}{S}\ \alpha\breve{G}C^*(\hat{W},\ T)$ and hence $P(\hat{W}) = L\overset{M^*}{S}\ \alpha\breve{G}C^*(\hat{W},\ T)$. Conversely, let $\hat{A}$ is $\overset{M^*}{S}\ \alpha$-dense subset of $(\hat{W},\ T)$ then from (4) in theorem 2.1 then $\hat{A} \Cup (\hat{W}\backslash \overset{M^*}{S}\ \alpha cL(\hat{A})) = \hat{A}$ and $\hat{A} \in L\overset{M^*}{S}\ \alpha\breve{G}C^{**}(\hat{W},\ T)$ and hence $\hat{A}$ is proper $\overset{M^*}{S}\ \alpha\breve{G}$-open implies that a space $(\hat{W},\ T)$ is sub-maximal.

Proposition 3.2 For a subset $\hat{A}$ of $(\hat{W},\ T)$ if $\hat{A} \in L\overset{M^*}{S}\ \alpha\breve{G}C^{**}(\hat{W},\ T)$ then there exists a proper $\overset{M^*}{S}\ \alpha\breve{G}$-open set $\breve{G}$ such that $\hat{A} \Subset \breve{G} \Cap \overset{M^*}{S}\ \alpha cL(\hat{A})$.

Proof. Let $\hat{A} \in L\overset{M^*}{S}\ \alpha\breve{G}C^{**}(\hat{W},\ T)$ then there are both a proper $\overset{M^*}{S}\ \alpha\breve{G}$-open set $\breve{G}$ and proper $\overset{M^*}{S}\ \alpha\breve{G}$-closed set F such that $\hat{A} = \breve{G} \Cap F$, as $\hat{A} \Subset \overset{M^*}{S}\ \alpha cL(\hat{A})$, $\hat{A} \Cap \breve{G} \Subset \breve{G} \Cap \overset{M^*}{S}\ \alpha cL(\hat{A})$, $\breve{G} \Cap F \Subset \breve{G} \Cap \overset{M^*}{S}\ \alpha cL(\hat{A})$, $\hat{A} \Subset \breve{G} \Cap \overset{M^*}{S}\ \alpha cL(\hat{A})$.

4 Application via Simply Alpha Open Set-in Decision Making of Coronavirus

In this section, we provide an application of our approaches for decision making for information systems on Coronavirus infections. Indeed, our approach identifies the critical factors for Coronavirus infection in humans. We find gatherings, contacting with injured people, and working in hospitals is the only factor determining the transmission of infection. We conclude that staying home and not having contact with humans protect against viral infection with the Coronavirus. According [2], (Human-to-Human transmissions have been described with incubation times between 2–10 days, facilitating its spread via droplets, contaminated hands or surfaces). We present a method for data reduction using the class of simply alpha star open sets, where in this method the topology is calculated from the right neighborhood, then we form the class of simply alpha star open sets for the whole table. Then, we delete one of the symptoms and repeat the previous step and make a comparison process between the class of simply alpha star open sets and the resulting sets from the whole table, if they are equal, then it is reduct otherwise core.

We would like to recall that the information obtained in this analysis of the Coronavirus is from 1000 patient. Because the attributes in rows (objects) were identical, it has been reduced to 10 patients. The application can be described as follows, where the objects as; $U = \{s_1, s_2, \ldots.., s_{10}\}$ denotes 10 listed patients, the features as $A = \{a_1, a_2, \ldots\ldots, a_{10}\}$={Difficulty breathing, Chest pain, Temperature, Dry coughs Headache, Loss of taste or smell} and Decision Coronavirus $\{d\}$, as information was collected by the World Health Organization as well as through medical groups specializing in Coronavirus. The following information system is illustrated in Tab. 1 and Tab. 2,

Algorithm 1: Core attributes one removal

```
function [core] = core_attributes_one_removal(M);
  [pos] = object reduction(M);
s = find(pos == 0);
pos(s) = [ ];
M = M(pos,:);
core = [ ];
M1 = M;
[nl, nc] = size(M1);
for i = 1:nc
  M1(:, i) = [ ];
  [pos] = object reduction(M1);
  if is empty (find (pos == 0)) == 0
    core = [core; [I, length(find(pos == 0))]];
  end
```

Then, we get the removal of attributes as the next Tab. 3,

From Tab. 3 we obtain the symptoms of every patient as follows:

$V(s_1) = \{a_1, a_3, a_4\}$, $V(s_2) = \{a_1, a_3, a_4\}$, $V(s_3) = \{a_4, a_6\}$, $V(s_4) = \phi$, and $V(s_5) = \{a_4\}$. Now, we can generate the following relation: $s_i \, R \, s_j \Leftrightarrow V(s_i) \subseteq V(s_j)$.

We apply this relation for all features in the table to induce the neighborhoods as follows.

Table 1: The information's decisions data set

Objects	Serious symptoms			Most common symptoms			Decision
	Difficulty breathing	Chest pain	Temperature	Dry cough	Headache	Loss of taste or smell	
$\mathbf{s_1}$	Yes	Yes	High	Yes	Yes	No	Yes
$\mathbf{s_2}$	Yes	Yes	High	Yes	Yes	No	Yes
$\mathbf{s_3}$	No	Yes	Normal	Yes	No	Yes	No
$\mathbf{s_4}$	No	Yes	Normal	No	No	No	No
$\mathbf{s_5}$	No	Yes	Normal	Yes	No	No	No
$\mathbf{s_6}$	Yes	No	High	Yes	Yes	No	Yes
$\mathbf{s_7}$	No	No	High	Yes	Yes	No	Yes
$\mathbf{s_8}$	No	No	Normal	Yes	Yes	No	No
$\mathbf{s_9}$	No	No	High	No	No	Yes	Yes
$\mathbf{s_{10}}$	No	No	High	Yes	Yes	No	Yes

Table 2: Consistent part of Tab. 1

Objects	Attributes						Decision
	a_1	a_2	a_3	a_4	a_5	a_6	d
$\mathbf{s_1}$	2	2	2	2	2	1	2
$\mathbf{s_2}$	2	2	2	2	2	1	2
$\mathbf{s_3}$	1	2	1	2	1	2	1
$\mathbf{s_4}$	1	2	1	1	1	1	1
$\mathbf{s_5}$	1	2	1	2	1	1	1
$\mathbf{s_6}$	2	1	2	2	2	1	2
$\mathbf{s_7}$	1	1	2	2	2	1	2
$\mathbf{s_8}$	1	1	1	2	2	1	1
$\mathbf{s_9}$	1	1	2	1	1	2	2
$\mathbf{s_{10}}$	1	1	2	2	2	1	2

Note: We note that, $IND\ (A) \neq IND\ (A - \{a_1\})$, …., then a_1, a_3, a_4 and a_6 are indispensable. Also, we get a_2 removed then we obtain $IND\ (A) = IND\ (A - \{a_2\})$, and superfluous are $a_2,\ a_5$.

$R = \{(\mathbf{s_1}, \mathbf{s_1}), (\mathbf{s_1}, \mathbf{s_2}), (\mathbf{s_2}, \mathbf{s_2}), (\mathbf{s_2}, \mathbf{s_1}), (\mathbf{s_3}, \mathbf{s_3}), (\mathbf{s_4}, \mathbf{s_4}), (\mathbf{s_4}, \mathbf{s_1}), (\mathbf{s_4}, \mathbf{s_2}), (\mathbf{s_4}, \mathbf{s_3}), (\mathbf{s_4}, \mathbf{s_5}), (\mathbf{s_5}, \mathbf{s_5}), (\mathbf{s_5}, \mathbf{s_1}), (\mathbf{s_5}, \mathbf{s_2})\}$. Thus, the right neighborhoods of each element in U of this relation are $R_r\ s_1 = \{\mathbf{s_1}, \mathbf{s_2}\}$, $R_r\ s_2 = \{\mathbf{s_1}, \mathbf{s_2}\}$,

$R_r\ s_3 = \{\mathbf{s_3}\}$, $R_r\ s_4 = U$, $R_r\ s_5 = \{\mathbf{s_1}, \mathbf{s_2}, \mathbf{s_3}, \mathbf{s_5}\}$. Then the topology deduced from this relation is $T = \{U,\ \phi,\ \{s_1,\ s_2\},\ \{s_3\},\ \{s_1,\ s_2.\ s_3\},\ \{s_1,\ s_2,\ s_3,\ s_5\}\}$, $T^c = \{U,\ \phi,\ \{s_4,\ s_5\},\ \{s_4\},\ \{s_5,\ s_4.\ s_3\},\ \{s_1,\ s_2,\ s_4,\ s_5\}\}$.

Then, we construct the following Tab. 4 to obtain the class of simply* alpha open set,

Then the class of simply* alpha open set is $\overset{M^*}{S}\ \alpha O(U) = \{U,\ \phi,\ \{s_3\}, \{s_3,\ s_5\}, \{s_1,\ s_2,\ s_3\}, \{s_1,\ s_2,\ s_4\},\ \{s_1,\ s_2,\ s_5\}\}$

Table 3: Consistent part of Tab. 2

U/A′	Attributes (A')				Decision
	a_1	a_3	a_4	a_6	d
s_1	2	2	2	1	2
s_2	2	2	2	1	2
s_3	1	1	2	2	1
s_4	1	1	1	1	1
s_5	1	1	2	1	1
s_6	2	2	2	1	2
s_7	1	2	2	1	2
s_8	1	1	2	1	1
s_9	1	2	1	2	2
s_{10}	1	2	2	1	2

Table 4: Class of simply* alpha open set

P(U)	$\overline{A}$	A^{0-}	A^0	A^{-O}	A^{O-O}	$\alpha O(U)$	$\overset{M\bullet}{S_A} \alpha O(U)$
U	U	U	U	U	U	U	U
ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ
$\{s_1\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	ϕ	ϕ	ϕ	-	-
$\{s_2\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	ϕ	ϕ	ϕ	-	-
$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	$\{s_3\}$	$\{s_3\}$
$\{s_4\}$	$\{s_4\}$	ϕ	ϕ	ϕ	ϕ	-	-
$\{s_5\}$	$\{s_4, s_5\}$	ϕ	ϕ	ϕ	ϕ	-	-
$\{s_1, s_2\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	$\{s_1, s_2\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	$\{s_1, s_2\}$	$\{s_1, s_2\}$
$\{s_1, s_3\}$	U	U	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	-
$\{s_1, s_4\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	ϕ	ϕ	ϕ	-	-
$\{s_1, s_5\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	ϕ	ϕ	ϕ	-	-
$\{s_2, s_3\}$	U	U	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	-
$\{s_2, s_4\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	ϕ	ϕ	ϕ	-	-
$\{s_2, s_5\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	ϕ	ϕ	ϕ	-	$\{s_3, s_4\}$
$\{s_3, s_4\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	$\{s_3, s_4\}$
$\{s_3, s_5\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	-
$\{s_4, s_5\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	ϕ	ϕ	ϕ	-	-
$\{s_1, s_2, s_3\}$	U	U	$\{s_1, s_2, s_3\}$	U	U	-	$\{s_1, s_2, s_3\}$
$\{s_1, s_2, s_4\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	$\{s_1, s_2\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	-	$\{s_1, s_2, s_4\}$
$\{s_1, s_2, s_5\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	$\{s_1, s_2\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	-	$\{s_1, s_2, s_5\}$
$\{s_1, s_3, s_4\}$	U	U	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	-
$\{s_1, s_3, s_5\}$	U	U	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	-

(Continued)

Table 4 (continued)

$P(U)$	$\overline{A}$	A^{0-}	A^{0}	A^{-O}	A^{O-O}	$\alpha O(U)$	$\underset{A}{\overset{M^{\bullet}}{S}} \alpha O(U)$
$\{s_2, s_3, s_4\}$	U	U	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	-
$\{s_2, s_3, s_5\}$	U	U	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	-
$\{s_2, s_4, s_5\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	ϕ	ϕ	ϕ	-	-
$\{s_3, s_4, s_5\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	$\{s_3, s_4, s_5\}$
$\{s_1, s_4, s_5\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	ϕ	ϕ	ϕ	-	-
$\{s_1, s_2, s_3, s_4\}$	U	U	$\{s_1, s_2, s_3\}$	U	U	$\{s_1, s_2, s_3, s_4\}$	$\{s_1, s_2, s_3, s_4\}$
$\{s_1, s_2, s_3, s_5\}$	U	U	$\{s_1, s_2, s_3, s_5\}$	$\{s_1, s_2, s_3, s_5\}$	U	$\{s_1, s_2, s_3, s_5\}$	$\{s_1, s_2, s_3, s_5\}$
$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	-	$\{s_1, s_2\}$	-
$\{s_1, s_3, s_4, s_5\}$	U	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	U	-
$\{s_2, s_3, s_4, s_5\}$	U	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	U	-

Step 1: When the feature a_1-Difficulty breathing is removed, the symptoms of every patient are: $V(s_1) = \{a_3, a_4\}$, $V(s_2) = \{a_3, a_4\}$, $V(s_3) = \{a_4, a_6\}$, $V(s_4) = \phi$, and $V(s_5) = \{a_4\}$.

Thus, the right neighborhoods of each element in U of this relation are.

$R_r(s_1) = \{s_1, s_2\}$, $R_r(s_2) = \{s_1, s_2\}$, $R_r(s_3) = \{s_3\}$, $R_r(s_4) = U$, and $R_r(s_5) = \{s_1, s_2, s_3, s_5\}$.

Then the topology deduced from this relation is $T = \{U, \phi, \{s_1, s_2\}, \{s_3\}, \{s_1, s_2, s_3\}, \{s_1, s_2, s_3, s_5\}\}$, $T^c = \{U, \phi, \{s_3, s_4, s_5\}, \{s_1, s_2, s_4, s_5\}, \{s_4, s_5\}, \{s_4\}\}$, and hence the class of simply* alpha open set of the whole is identical with the class of simply* alpha open set without the symptom a_1; this means that $\underset{A}{\overset{M^*}{S}} \alpha O(U) = \underset{A-\{a_1\}}{\overset{M^*}{S}} \alpha O(U)$.

Step 2: When the feature a_3-Temperature is removed, the symptoms of every patient are: $V(s_1) = \{a_1, a_4\}$, $V(s_2) = \{a_1, a_4\}$, $V(s_3) = \{a_1, a_4, a_6\}$, $V(s_4) = \{a_1\}$, and $V(s_5) = \{a_1, a_4\}$.

Thus, the right neighborhoods of each element in U of this relation are.

$R_r(s_1) = \{s_1, s_2, s_3\}$, $R_r(s_2) = \{s_1, s_2, s_3\}$, $R_r(s_3) = \{s_3\}$, $R_r(s_4) = \{s_1, s_2, s_3, s_4\}$, and $R_r(s_5) = \{s_1, s_2, s_3, s_5\}$. Then, the topology deduced from this relation is $T = \{U, \phi, \{s_1, s_2, s_3\}, \{s_1, s_2, s_3, s_4\}, \{s_1, s_2, s_3, s_5\}\}$, $T^c = \{U, \phi, \{s_4, s_5\}, \{s_5\}, \{s_4\}\}$, and hence the class of simply* alpha open set of the whole is not identical with the class of simply* alpha open set without the symptom a_3, if $\underset{A}{\overset{M^*}{S}} \alpha O(U) \neq \underset{A-\{a_3\}}{\overset{M^*}{S}} \alpha O(U)$, as in Tab. 5,

Step 3: When the feature a_4-Dry cough is removed, the symptoms of every patient are:

$V(s_1) = \{a_1, a_3\}$, $V(s_2) = \{a_1, a_3\}$, $V(s_3) = \{a_1, a_6\}$, $V(s_4) = \{a_1\}$, and $V(s_5) = \{a_1\}$.

Thus, the right neighborhoods of each element in U of this relation are $R_r(s_1) = \{s_1, s_2\}$, $R_r(s_2) = \{s_1, s_2\}$, $R_r(s_3) = \{s_3\}$, $R_r(s_4) = U$, and $R_r(s_5) = U$.

Then the topology deduced from this relation is $T = \{U, \phi, \{s_1, s_2\}, \{s_3\}, \{s_1, s_2, s_3\}\}$, $T^c = \{U, \phi, \{s_3, s_4, s_5\}, \{s_1, s_2, s_4, s_5\}, \{s_4, s_5\}\}$, and hence the class of simply* alpha open set of the whole is identical with the class of simply* alpha open set without the symptom a_4, this means that $\underset{A}{\overset{M^*}{S}} \alpha O(U) = \underset{A-\{a_4\}}{\overset{M^*}{S}} \alpha O(U)$. As the following Tab. 6,

Table 5: Class of simply* alpha open set when we remove a_3-Temperature

P(U)	$\overline{A}$	A^{0-}	A^{0}	A^{-O}	A^{O-O}	$\alpha O(U)$	$S^{M^{\bullet}}_{A-\{a_3\}}\alpha O(U)$
U	U	U	U	U	U	U	U
ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ
$\{s_1\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_2\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_3\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_4\}$	$\{s_4\}$	ϕ	ϕ	ϕ	ϕ	-	-
$\{s_5\}$	$\{s_5\}$	ϕ	ϕ	ϕ	ϕ	-	-
$\{s_1, s_2\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_1, s_3\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_1, s_4\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_1, s_5\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_2, s_3\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_2, s_4\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_2, s_5\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_3, s_4\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_3, s_5\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_4, s_5\}$	$\{s_4, s_5\}$	ϕ	ϕ	ϕ	ϕ	-	-
$\{s_1, s_2, s_3\}$	U	U	$\{s_1, s_2, s_3\}$	U	U	$\{s_1, s_2, s_3\}$	$\{s_1, s_2, s_3\}$
$\{s_1, s_2, s_4\}$	U	U	ϕ	ϕ	$\{s_1, s_2\}$	-	-
$\{s_1, s_2, s_5\}$	U	U	ϕ	ϕ	$\{s_1, s_2\}$	-	-
$\{s_1, s_3, s_4\}$	U	U	ϕ	ϕ	$\{s_3\}$	-	-
$\{s_1, s_3, s_5\}$	U	U	ϕ	ϕ	$\{s_3\}$	-	-
$\{s_2, s_3, s_4\}$	U	U	ϕ	ϕ	$\{s_3\}$	-	-
$\{s_2, s_3, s_5\}$	U	U	ϕ	ϕ	$\{s_3\}$	-	-
$\{s_2, s_4, s_5\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_3, s_4, s_5\}$	U	U	ϕ	ϕ	$\{s_3\}$	-	-
$\{s_1, s_4, s_5\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_1, s_2, s_3, s_4\}$	U	U	$\{s_1, s_2, s_3, s_4\}$	U	U	$\{s_1, s_2, s_3, s_4\}$	$\{s_1, s_2, s_3, s_4\}$
$\{s_1, s_2, s_3, s_5\}$	U	U	$\{s_1, s_2, s_3, s_5\}$	U	U	$\{s_1, s_2, s_3, s_5\}$	$\{s_1, s_2, s_3, s_5\}$
$\{s_1, s_2, s_4, s_5\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_1, s_3, s_4, s_5\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_2, s_3, s_4, s_5\}$	U	U	ϕ	ϕ	ϕ	-	-

Table 6: Class of simply* alpha open set when we remove a_4-Dry cough

P(U)	$\overline{A}$	A^{0-}	A^{0}	A^{-O}	A^{O-O}	$\alpha O(U)$	$S_{A-\{a_4\}}^{M^{\bullet}} \alpha O(U)$
U	U	U	U	U	U	U	U
ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ
$\{s_1\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	ϕ	ϕ	ϕ	-	-
$\{s_2\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	ϕ	ϕ	ϕ	-	-
$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	$\{s_3\}$	$\{s_3\}$
$\{s_4\}$	$\{s_4, s_5\}$	ϕ	ϕ	ϕ	ϕ	-	-
$\{s_5\}$	$\{s_4, s_5\}$	ϕ	ϕ	ϕ	ϕ	-	-
$\{s_1, s_2\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	$\{s_1, s_2\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	$\{s_1, s_2\}$	$\{s_1, s_2\}$
$\{s_1, s_3\}$	U	U	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	-
$\{s_1, s_4\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	ϕ	ϕ	ϕ	-	-
$\{s_1, s_5\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	ϕ	ϕ	ϕ	-	-
$\{s_2, s_3\}$	U	U	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	-
$\{s_2, s_4\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	ϕ	ϕ	ϕ	-	-
$\{s_2, s_5\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	ϕ	ϕ	ϕ	-	-
$\{s_3, s_4\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	$\{s_3, s_4\}$
$\{s_3, s_5\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	$\{s_3, s_5\}$
$\{s_4, s_5\}$	$\{s_4, s_5\}$	ϕ	ϕ	ϕ	ϕ	-	-
$\{s_1, s_2, s_3\}$	U	U	$\{s_1, s_2, s_3\}$	U	U	$\{s_1, s_2, s_3\}$	$\{s_1, s_2, s_3\}$
$\{s_1, s_2, s_4\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	$\{s_1, s_2\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	-	$\{s_1, s_2, s_4\}$
$\{s_1, s_2, s_5\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	$\{s_1, s_2\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	-	$\{s_1, s_2, s_5\}$
$\{s_1, s_3, s_4\}$	U	U	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	-
$\{s_1, s_3, s_5\}$	U	U	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	-
$\{s_2, s_3, s_4\}$	U	U	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	-
$\{s_2, s_3, s_5\}$	U	U	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	-
$\{s_2, s_4, s_5\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	ϕ	ϕ	ϕ	-	-
$\{s_3, s_4, s_5\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	-	-

(Continued)

Table 6 (continued)

$P(U)$	$\overline{A}$	A^{0-}	A^{0}	A^{-O}	A^{O-O}	$\alpha O(U)$	$\overset{M^{\bullet}}{S}_{A-\{a_4\}}\alpha O(U)$
$\{s_1, s_4, s_5\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	ϕ	ϕ	ϕ	-	-
$\{s_1, s_2, s_3, s_4\}$	U	U	$\{s_1, s_2, s_3\}$	U	U	$\{s_1, s_2, s_3, s_4\}$	$\{s_1, s_2, s_3, s_4\}$
$\{s_1, s_2, s_3, s_5\}$	U	U	$\{s_1, s_2, s_3\}$	U	U	$\{s_1, s_2, s_3, s_5\}$	$\{s_1, s_2, s_3, s_5\}$
$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	$\{s_1, s_2\}$	$\{s_1, s_2\}$	-	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2, s_4, s_5\}$
$\{s_1, s_3, s_4, s_5\}$	U	U	$\{s_3\}$	$\{s_3\}$	-	$\{s_3, s_4, s_5\}$	-
$\{s_2, s_3, s_4, s_5\}$	U	U	$\{s_3\}$	ϕ	-	$\{s_3, s_4, s_5\}$	-

Step 3: When the feature a_6-Loss of taste or smell is removed, the symptoms of every patient are: $V(s_1) = \{a_1, a_3\}$, $V(s_2) = \{a_1, a_3\}$, $V(s_3) = \{a_1, a_6\}$, $V(s_4) = \{a_1\}$, and $V(s_5) = \{a_1\}$.

Thus, the right neighborhoods of each element in U of this relation are $R_r(s_1) = \{s_1, s_2\}$, $R_r(s_2) = \{s_1, s_2\}$, $R_r(s_3) = \{s_3\}$, $R_r(s_4) = U$, and $R_r(s_5) = U$.

Then the topology deduced from this relation is $T = \{U, \phi, \{s_1, s_2\}, \{s_3\}, \{s_1, s_2, s_3\}\}$, $T^c = \{U, \phi, \{s_3, s_4, s_5\}, \{s_1, s_2, s_4, s_5\}, \{s_4, s_5\}\}$, and hence the class of simply* alpha open set of the whole is not identical with the class of simply* alpha open set without the symptom a_6-Loss of taste or smell this means that $\overset{M^*}{\underset{A}{S}}\alpha O(U) \neq \overset{M^*}{\underset{A-\{a_6\}}{S}}\alpha O(U)$, as described in Tab. 7,

Hence, from Steps (1–3), we observe that: the CORE is $\{a_3, a_6\}$, that is the impact factors to determine Coronavirus infection are High Temperature and Loss of taste or smell.

Table 7: Class of simply* alpha open set when we remove a_6-Loss of taste or smell

$P(U)$	$\overline{A}$	A^{0-}	A^{0}	A^{-O}	A^{O-O}	$\alpha O(U)$	$\overset{M^{\bullet}}{S}_{A-\{a_6\}}\alpha O(U)$
U	U	U	U	U	U	U	U
ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ
$\{s_1\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_2\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_3\}$	$\{s_3, s_4, s_5\}$	$\{s_3\}$	$\{s_3\}$	$\{s_3, s_4, s_5\}$	ϕ	-	-
$\{s_4\}$	$\{s_4\}$	ϕ	ϕ	ϕ	ϕ	-	-
$\{s_5\}$	$\{s_3, s_4, s_5\}$	ϕ	ϕ	ϕ	ϕ	-	-
$\{s_1, s_2\}$	U	U	$\{s_1, s_2\}$	U	U	$\{s_1, s_2\}$	$\{s_1, s_2\}$
$\{s_1, s_3\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_1, s_4\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_1, s_5\}$	U	U	ϕ	ϕ	ϕ	-	-

(Continued)

Table 7 (continued)

$P(U)$	$\overline{A}$	A^{0-}	A^{0}	A^{-O}	A^{O-O}	$\alpha O(U)$	$S^{M^{\bullet}}_{A-\{a_6\}} \alpha O(U)$
$\{s_2, s_3\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_2, s_4\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_2, s_5\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_3, s_4\}$	$\{s_3, s_4, s_5\}$	ϕ	ϕ	ϕ	ϕ	-	-
$\{s_3, s_5\}$	$\{s_3, s_4, s_5\}$	ϕ	ϕ	ϕ	ϕ	-	-
$\{s_4, s_5\}$	$\{s_3, s_4, s_5\}$	ϕ	ϕ	ϕ	ϕ	-	-
$\{s_1, s_2, s_3\}$	U	U	$\{s_1, s_2, s_3\}$	U	U	$\{s_1, s_2, s_3\}$	$\{s_1, s_2, s_3\}$
$\{s_1, s_2, s_4\}$	U	U	$\{s_1, s_2\}$	U	U	$\{s_1, s_2, s_4\}$	$\{s_1, s_2, s_4\}$
$\{s_1, s_2, s_5\}$	U	U	ϕ	ϕ	U	$\{s_1, s_2, s_5\}$	$\{s_1, s_2, s_5\}$
$\{s_1, s_3, s_4\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_1, s_3, s_5\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_2, s_3, s_4\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_2, s_3, s_5\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_2, s_4, s_5\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_3, s_4, s_5\}$	$\{s_3, s_4, s_5\}$	ϕ	ϕ	ϕ	ϕ	-	-
$\{s_1, s_4, s_5\}$	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2\}$	ϕ	ϕ	ϕ	-	-
$\{s_1, s_2, s_3, s_4\}$	U	U	$\{s_1, s_2, s_3\}$	U	U	$\{s_1, s_2, s_3, s_4\}$	$\{s_1, s_2, s_3, s_4\}$
$\{s_1, s_2, s_3, s_5\}$	U	U	$\{s_1, s_2, s_3\}$	U	U	$\{s_1, s_2, s_3, s_5\}$	$\{s_1, s_2, s_3, s_5\}$
$\{s_1, s_2, s_4, s_5\}$	U	U	$\{s_1, s_2\}$	U	U	$\{s_1, s_2, s_4, s_5\}$	$\{s_1, s_2, s_4, s_5\}$
$\{s_1, s_3, s_4, s_5\}$	U	U	ϕ	ϕ	ϕ	-	-
$\{s_2, s_3, s_4, s_5\}$	U	U	ϕ	ϕ	ϕ	-	-

Algorithm:

Step 1: Input the set U and the set of features represent the data as an information table, rows of which are labeled by features A, columns by objects and entries of the table are features values.

Step 2: From the information table compute the right-neighborhoods of each object.

Step 3: Compute the topology from the right-neighborhoods.

Step 4: Compute simply* alpha open set, according to Definition 2.1.

Step 5: Remove a feature a_1 from the conditions features $A$and then find the simply* alpha open set on $A - \{a_1\}$

Step 6: reiterate steps 5 for all features in A. Those feature in A for any $\underset{A}{\overset{M^*}{S}} \alpha O(U) \neq \underset{A-\{a_1\}}{\overset{M^*}{S}} \alpha O(U)$ forms the Core (U).

5 Conclusion

Our study in this article aims for defining a new type of simply* alpha generalized namely Simply*α -generalized closed, locally simply*α-generalized closed, and locally simply*α-generalized closed** sets. We show the relation between this type of set and the other of generalized open sets. We concluded that the generalized simple closed set contains most of the generalized closed sets and also, we defined new kinds of locally generalized simply closed sets based on simply* alpha open set. Furthermore, we studied the relation between these collections and other. We presented an application to a group of patients, where we presented a method using topological concepts to determine one of the main symptoms causing Coronavirus. Finally, using the class of simply alpha* open set, we identified the impact factors of Coronavirus infection and then we helped the physician to make an accurate decision making about patients. At the end of paper, this method has also proven effective in acquiring the basic symptoms that cause COVID-19. We plan to extend the proposed methodology in future work to include a multi-label classification issue.

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