زانكۆی سەلاحەدین-هەولێر

Salahaddin University-Erbil

$S_c - open\ set\ in\ topological\ spaces$

Submitted to the department of (mathematic) in partial fulfilment of the Requirements for the degree of BSc. In Mathematic

By:

Altun Anwar Muhamadamin

Supervised by:

Nehmat K. Ahmad

April-2023

Aknowledgment

I would like to thanks Allah for giving me the power to complete this work And I would like to present my profound thanks to supervisor and lecturer **Assist.Prof.Dr.Nehmat K. Ahmad** for his kind valuable suggestions that assisted me to accomplish this work I would also like to extend my gratitude to the head of mathematic department **Assist.Prof.Dr.Rashad Rashid Haji,** and especially thanks for my family to support me and make me what am I today ,and thanks all my friends

Abstract

In this report we have of set which contain three and four elements X={a,b,c) And x={a,b,c,d}

Which the 3 element has 9 comparable topology elements and four element has 33 comparable topology and we try to obtain the S_C *open set in topological space*

Table of Contents

Aknowledgment ii
Abstract iii
Table of Contents iv
Introduction 1
Definition1.1:Topology 2
Definition1.2: S-open 2
Definition1.3: Sc-open 2
Definition1.4: gSc-closed 2
Definition1.5: $gScT0$-Space 2
Definition1.6:$gScT1$-Space 3
Definition1.7: gScT2-Space 3
The comparable sets 3
References 23

INTRODUCTION

In 1963 [4], Levine defined a subset A of a space X to be semi-open if A ⊆ Cl(Int(A)),or equivalently, a set A of a space X will be termed semi-open if and only if there exists an open set U such that U ⊆ A ⊆ Cl(U). Joseph and Kwack [3] introduced the concept of θ-semi open sets using semi-open sets to improve the notion of S-closed spaces. In the present paper we introduce a new class of semi-open sets called sc-open sets, this class of sets lies strictly between the class of θ-semi open sets and semi-open sets. We also study its fundamental properties and compare it with some other types of sets, and then we define further topological properties such as, sc-neighborhood, sc-interior, sc-closure, sc-derived sets and sc-boundary of a set.

Definition1.1:Topology (KURONYA January 24, 2010)

A topological space is ordered pair (X, π),where X is a set, π a collection of subsets of X satisfying the following properties

1) X ∈ π and ∅ ∈ π

2)U, V ∈ π implies U ∩V,

3)$\{U_\alpha | \propto \in I\}$ implies $U_{\propto \in I}\, U_\propto \in \pi$.

The collection π is called topology on X, the pair (X, π) a topological space, the elements of π are called open sets.

Definition1.2: S-open (A.A.Nasef Volume 2,2009)

A subset A of a (T.S) is said to be **S-open** set if $A \subseteq clintA$

Definition1.3: S_c-open

A subset A of a space X is called $\boldsymbol{S_c - open}$ if for each $x \in A \in SO(X)$,∃ $a\ closed\ set\ F\ s.t.\, x \in F \subseteq A$.

Definition1.4: gS_c-closed

A subset A of X, is said to be $\boldsymbol{gS_c}$**-closed** set iff $S_c\ cl\ A \subseteq U, A \subseteq U$ whenever $, U\ is\ S_c$-open set.

Definition1.5: $\boldsymbol{gS_cT_0}$-Space

The topological space (X,π) is said to be $gS_cT_0 - \text{Space}$ iff for every two distinct point of X , there exist gS_c open set U which contain one at them, but not the other.

I.e, $gS_c\boldsymbol{T_0}$**-Space** ↔ $\forall x, y \in X\,; x \neq y\ \exists U \in t\,; (x \in U \wedge y \notin U) \vee (x \notin U \wedge y \in U)$.

Definition1.6:gS_cT_1-Space

The topological space (X,π) is said to be gS_cT_1**-Space** iff for every two distinct point of X, there exist two gS_c open sets U and V s.t . $x \in U \wedge y \notin U$ and $x \notin V \wedge y \in V$ I.e,

gS_c $\boldsymbol{T_1}$**-Space** $\leftrightarrow \forall x, y \in X \,; x \neq y \ \exists U, V \in t \,; (x \in U \wedge y \notin U) \wedge (x \notin V \wedge y \in V)$.

Definition1.7: gS_cT_2-Space

The topological space (X,π) is said to be gS_cT_2**-Space** iff for every two distinct point of X, there exist two gS_c open sets U and V s.t, $x \in U, y \in V \ And \ U \cap V = \emptyset$. I,e.,

$gS_c\boldsymbol{T_2}$**-Space** $\leftrightarrow \forall x, y \in X \,; x \neq y \ \exists U, V \in t \,; \ U \cap V = \emptyset \,, (x, y \in U \vee \ x, y \in V)$

The comparable sets

π_1={∅,X}

$\pi_2 = \{\emptyset, X, \{a\}\}$

π_3=$\{\emptyset, X, \{a, b\}\}$

$\pi_4 = \{\emptyset, X, \{a\}, \{b, c\}\}$

π_5=$\{\emptyset, X, \{a\}, \{a, b\}\}$

π_6=$\{\emptyset, X, \{a\}, \{b\}, \{a, b\}\}$

π_7=$\{\emptyset, X, \{a\}, \{a, b\}, \{a, c\}\}$

π_8=$\{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{b, c\}\}$

π_9=$\{\emptyset, X, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}\}$

let X={a,b,c}

π_1={∅,X}

$\pi^C = \{X, \emptyset\}$

$SO(X) = S_C(X) = S_CC(X) = \{\emptyset, X\}$

$gS_C(X) = gS_CO(X) = P(x)$

$\pi_2 = \{\emptyset, X, \{a\}\}$

$\pi^C = \{X, \emptyset, \{b, c\}\}$

$SO(X) = \{X, \emptyset, \{a\}, \{a, b\}, \{a, c\}\}$

$S_C(X) = S_CC(X) = \{\emptyset, X\}$

$gS_C(X) = gS_CO(X) = P(x)$

π_3=$\{\emptyset, X, \{a, b\}\}$

$\pi^C = \{X, \emptyset, \{c\}\}$

$SO(X) = \{\emptyset, X, \{a, b\}\}$

$S_C(X) = S_CC(X) = \{\emptyset, X\}$

$gS_C(X) = gS_CO(X) = P(x)$

$\pi_4 = \{\emptyset, X, \{a\}, \{b, c\}\}$

$\pi^C = \{X, \emptyset, \{b, c\}, \{a\}\}$

$SO(X) = \{\emptyset, X, \{a\}, \{b, c\}\}$

$S_C(X) = \{\emptyset, X, \{a\}, \{b, c\}\}$

$S_C C(X) = \{X, \emptyset, \{b, c\}, \{a\}\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_5=$\{\emptyset, X, \{a\}, \{a, b\}\}$

$\pi^C = \{X, \emptyset, \{c\}, \{b, c\}\}$

$SO(X) = \{X, \emptyset, \{a\}, \{a, b\}, \{a, c\}\}$

$S_C(X) = \{\emptyset, X\}$

$S_C C(X) = \{X, \emptyset\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_6=$\{\emptyset, X, \{a\}, \{b\}, \{a, b\}\}$

$\pi^C = \{X, \emptyset, \{b, c\}, \{a, c\}, \{c\}\}$

$SO(X) = \{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{a, c\}, \{b, c\}\}$

$S_C(X) = \{\emptyset, X, \{a, c\}, \{b, c\}\}$

$S_C C(X) = \{X, \emptyset, \{b\}, \{a\}\}$

$gS_C(X) = \{\emptyset, X, \{a\}, \{b\}, \{a, b\}\}$

$gS_C O(X) = \{\emptyset, X, \{b, c\}, \{a, c\}, \{c\}\}$

π_7=$\{\emptyset, X, \{a\}, \{a,b\}, \{a,c\}\}$

$\pi^C = \{X, \emptyset, \{b\}, \{c\}, \{b,c\}\}$

$SO(X) = \{X, \emptyset, \{a\}, \{a,b\}, \{a,c\}\}$

$S_C(X) = S_C C(X) = \{\emptyset, X\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_8=$\{\emptyset, X, \{a\}, \{b\}, \{a,b\}, \{b,c\}\}$

$\pi^C = \{X, \emptyset, \{b,c\}, \{a,c\}, \{c\}\{a\}\}$

$SO(X) = \{\emptyset, X, \{a\}, \{b\}, \{a,b\}, \{b,c\}\}$

$S_C(X) = \{\emptyset, X, \{a\}, \{b,c\}\}$

$S_C C(X) = \{X, \emptyset, \{b,c\}, \{a\}\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_9=$\{\emptyset, X, \{a\}, \{b\}, \{c\}, \{a,b\}, \{a,c\}, \{b,c\}\}$

π^C =$\{\emptyset, X, \{a\}, \{b\}, \{c\}, \{a,b\}, \{a,c\}, \{b,c\}\}$

$SO(X)$ =$\{\emptyset, X, \{a\}, \{b\}, \{c\}, \{a,b\}, \{a,c\}, \{b,c\}\}$

$S_C(X) = S_C C(X) = gS_C(X) = gS_C O(X) = P(x)$

X={a,b,c}	$gS_CT0-space$	$gS_CT1-space$	$gS_CT2-space$
π_1	1	1	1
π_2	1	1	1
π_3	1	1	1
π_4	1	1	1
π_5	1	1	1
π_6	1	0	0
π_7	1	1	1
π_8	1	1	1
π_9	1	1	1

let X={a,b,c,d}

π_1={∅,X}

$\pi_2 = \{\emptyset, X, \{a\}\}$

$\pi_3=\{\emptyset, X, \{a, b\}\}$

$\pi_4=\{\emptyset, X, \{a, b, c\}\}$

$\pi_5 = \{\emptyset, X, \{a\}, \{b, c, d\}$

$\pi_6=\{\emptyset, X, \{a, b\}, \{\mathrm{c, d}\}\}$

$\pi_7=\{\emptyset, X, \{\mathrm{a}\}, \{a, b\}\}$

$\pi_8=\{\emptyset, X, \{\mathrm{a}\}, \{a, b, c\}\}$

$\pi_9=\{\emptyset, X, \{\mathrm{a}, b\}, \{a, b, c\}\}$

$\pi_{10}=\{\emptyset, X, \{\mathrm{a}\}, \{\mathrm{a}, b\}, \{a, b, c\}\}$

$\pi_{11}=\{\emptyset, X, \{\mathrm{a}, b\}, \{a, b, c\}, \{\mathrm{a, b, d}\}$

$\pi_{12}=\{\emptyset, X, \{\mathrm{a}\}, \{\mathrm{b}\}, \{a, b\}\}$

$\pi_{13}=\{\emptyset, X, \{\mathrm{a}\}, \{\mathrm{b, c}\}, \{a, b, c\}\}$

$\pi_{14}=\{\emptyset, X, \{\mathrm{a}\}, \{a, b\}, \{\mathrm{a, c, d}\}\}$

$\pi_{15}=\{\emptyset, X, \{\mathrm{a}\}, \{\mathrm{a}, b\}, \{\mathrm{a, c}\}, \{a, b, c\}\}$

$\pi_{16}=\{\emptyset, X, \{\mathrm{a}\}, \{\mathrm{a}, b\}, \{a, b, c\}, \{\mathrm{a, b, d}\}\}$

$\pi_{17}=\{\emptyset, X, \{\mathrm{a}\}, \{\mathrm{b}\}, \{a, b\}, \{\mathrm{a, b, c}\}\}$

π_{18}=$\{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{a, c, d\}\}$

π_{19}=$\{\emptyset, X, \{c\}, \{a, b\}, \{a, b, c\}, \{a, b, d\}\}$

π_{20}=$\{\emptyset, X, \{a\}, \{a, b\}, \{c, d\}, \{a, c, d\}\}$

π_{21}=$\{\emptyset, X, \{a\}, \{a, b\}, \{a, c\}, \{a, b, c\}, \{a, b, d\}\}$

π_{22}=$\{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{b, c\}, \{a, b, c\}\}$

π_{23}=$\{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{a, b, c\}, \{a, b, d\}\}$

π_{24}=$\{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{c, d\}, \{a, c, d\}, \{b, c, d\}\}$

π_{25}=$\{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{b, d\}, \{a, b, c\}, \{a, b, d\}\}$

π_{26}=$\{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{a, c\}, \{a, b, c\}, \{a, c, d\}\}$

π_{27}=$\{\emptyset, X, \{a\}, \{a, b\}, \{a, c\}, \{a, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}\}$

π_{28}=$\{\emptyset, X, \{a\}, \{b\}, \{c\}, \{a, b\}, \{b, c\}, \{a, b, c\}\}$

π_{29}=$\{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{a, c\}, \{b, d\}, \{a, b, c\}, \{a, b, d\}\}$

π_{30}=$\{\emptyset, X, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}, \{a, b, c\}, \{a, b, d\}\}$

π_{31}=$\{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{a, c\}, \{a, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}\}$

π_{32}=$\{\emptyset, X, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{a, d\}, \{b, c\}, \{a, b, c\},$

$\{a, b, d\}, \{a, c, d\}\}$

π_{33}=$\{\emptyset, X, \{a\}, \{b\}, \{c\}, \{d\}, \{a, b\}, \{a, c\}, \{a, d\}, \{b, c\}, \{b, d\}, \{c, d\},$

$\{a, b, c\}, \{a, b, d\}, \{a, c, d\}, \{b, c, d\}\}$

π_1={∅,X}

$\pi^C = \{X, \emptyset\}$

$SO(X) = \{\emptyset, X\}$

$S_C(X) = S_C C(X) = \{\emptyset, X\}$

$gS_C(X) = gS_C O(X) = P(x)$

$\pi_2 = \{\emptyset, X, \{a\}\}$

$\pi^C = \{X, \emptyset, \{b, c, d\}\}$

$SO(X) = \{X, \emptyset, \{a\}, \{a, b\}, \{a, c\}\{a, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}$

$S_C(X) = S_C C(X) = \{\emptyset, X\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_3={∅, $X, \{a, b\}\}$

$\pi^C = \{X, \emptyset, \{c, d\}\}$

$SO(X) = \{\emptyset, X, \{a, b\}, \{a, b, c\}, \{a, b, d\}$

$S_C(X) = S_C C(X) = \{\emptyset, X\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_4={$\emptyset, X, \{a,b,c\}$}

$\pi^C = \{X, \emptyset, \{d\}\}$

$SO(X) = \{\emptyset, X, \{a,b,c\}\}$

$S_C(X) = S_C C(X) = \{\emptyset, \{\emptyset, X\}$

$gS_C(X) = gS_C O(X) = P(x)$

$\pi_5 = \{\emptyset, X, \{a\}, \{b,c,d\}$

$\pi^C = \{X, \emptyset, \{b,c,d\}, \{a\}\}$

$\mathrm{SO}(X) = \{\emptyset, X, \{a\}, \{b,c,d\}\}$

$S_C(X) = \{\emptyset, X, \{a\}, \{b,c,d\}\}$

$S_C C(X) = \{\emptyset, X, \{b,c,d\}, \{a\}\}$

$gS_C(X) = PgS_C O(X) = (x)$

π_6={$\emptyset, X, \{a,b\}$, {c, d}}

$\pi^C = \{X, \emptyset, \{c,d\}, \{a,b\}\}$

$\mathrm{SO}(X) = \{\emptyset, X, \{a\}, \{b\}, \{a,b\}, \{a,c\}, \{b,c\}\}$

$S_C(X) = \{\emptyset, X, \{a,b\}, \{c,d\}\}$

$S_C C(X) = \{\emptyset, X, \{c,d\}, \{a,b\}\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_7={∅, X, {a}, {a,b}}

$\pi^C = \{X, \emptyset, \{b,c,d\}, \{c,d\}\}$

$\mathrm{SO}(X) = \{\emptyset, X, \{a\}, \{a,b\}, \{a,c\}, \{a,d\}, \{a,b,c\}, \{a,b,d\}, \{a,c,d\}\}$

$S_C(X) = S_C C(X) = \{\emptyset, X\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_8={∅, X, {a}, {a,b,c}}

$\pi^C = \{X, \emptyset, \{b,c,d\}, \{d\}\}$

$\mathrm{SO}(X) = \{\emptyset, X, \{a\}, \{a,b\}, \{a,c\}, \{a,d\}, \{a,b,c\}, \{a,b,d\}, \{a,c,d\}\}$

$S_C(X) = S_C C(X) = \{\emptyset, \{\emptyset, X\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_9={∅, X, {a, b}, {a,b,c}}

$\pi^C = \{X, \emptyset, \{c,d\}, \{d\}\}$

$SO(X) = \{\emptyset, X, \{a,b\}, \{a,b,c\}, \{a,b,d\}\}$

$S_C(X) = S_C C(X) = \{\emptyset, X\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_{10}={$\emptyset, X$, {a}, {a, b}, {a, b, c}}

$\pi^C = \{X, \emptyset, \{b, c, d\}, \{c, d\}, \{d\}\}$

$SO(X) = \{\emptyset, X, \{a\}, \{a, b\}, \{a, c\}, \{a, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}\}$

$S_C(X) = S_C C(X) = \{\emptyset, X\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_{11}={$\emptyset, X$, {a, b}, {a, b, c}, {a, b, d}

$\pi^C = \{X, \emptyset, \{c, d\}, \{d\}, \{c\}\}$

$SO(X) = \{\emptyset, X, \{a, b\}, \{a, b, c\}, \{a, b, d\}\}$

$S_C(X) = S_C C(X) = \{\emptyset, X\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_{12}={$\emptyset, X$, {a}, {b}, {a, b}}

$\pi^C = \{X, \emptyset, \{b, c, d\}, \{a, c, d\}, \{c, d\}\}$

$SO(X) = \{P(x)/\{c, d\}, \{d\}, \{c\}\}$

$S_C(X) = \{\emptyset, \mathrm{X}, \{\mathrm{b, c, d}\}, \{\mathrm{a, c, d}\}\}$

$S_C C(X) = \{\emptyset, \mathrm{X}, \{\mathrm{a}\}, \{\mathrm{b}\}\}$

$gS_C(X) = \{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{\mathrm{a, b, c}\}, \{\mathrm{a, b, d}\}\}$

$gS_C O(X) = \{\emptyset, X, \{b, c, d\}, \{a, c, d\}, \{c, d\}, \{\mathrm{d}\}, \{\mathrm{c}\}\}$

π_{13}=$\{\emptyset, X, \{\mathrm{a}\}, \{\mathrm{b, c}\}, \{a, b, c\}\}$

$\pi^C = \{X, \emptyset, \{b, c, d\}, \{a, d\}, \{d\}\}$

$SO(X) = \{\emptyset, X, \{a\}, \{b, c\}, \{a, d\}, \{a, b, c\}, \{b, c, d\}\}$

$S_C(X) = \{\emptyset, X, \{a, d\}, \{b, c, d\}\}$

$S_C C(X) = \{\emptyset, X, \{a\}, \{b, c\}\}$

$gS_C(X) = \{\emptyset, X, \{a\}, \{b\}, \{c\}, \{a, b\}, \{\mathrm{a, c}\}, \{\mathrm{b, c}\}, \{\mathrm{a, b, c}\}, \{\mathrm{a, b, d}\}, \{\mathrm{a, c, d}\}\}$

$gS_C O(X) = \{\emptyset, X, \{b, c, d\}, \{a, c, d\}, \{a, b, d\}, \{\mathrm{c, d}\}, \{\mathrm{b, d}\}, \{\mathrm{a, d}\}, \{\mathrm{d}\}, \{\mathrm{c}\}\{\mathrm{b}\}\}$

π_{14}=$\{\emptyset, X, \{\mathrm{a}\}, \{a, b\}, \{\mathrm{a, c, d}\}\}$

$\pi^C = \{X, \emptyset, \{b, c, d\}, \{c, d\}, \{b\}\}$

$SO(X) = \{\emptyset, X, \{a\}, \{a, b\}, \{a, c\}, \{a, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}\}$

$S_C(X) = S_C C(X) = \{\emptyset, X\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_{15}=$\{\emptyset, X, \{\mathrm{a}\}, \{\mathrm{a}, b\}, \{\mathrm{a, c}\}, \{a, b, c\}\}$

$\pi^C = \{X, \emptyset, \{b, c, d\}, \{c, d\}, \{b, d\}, \{d\}\}$

$SO(X) = \{\emptyset, X, \{a\}, \{a, b\}, \{a, c\}, \{a, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}\}$

$S_C(X) = S_C C(X) = \{\emptyset, X\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_{16}=$\{\emptyset, X, \{\mathrm{a}\}, \{\mathrm{a}, b\}, \{a, b, c\}, \{\mathrm{a, b, d}\}\}$

$\pi^{C} = \{X, \emptyset, \{b, c, d\}, \{c, d\}, \{d\}, \{c\}\}$

$SO(X) = \{\emptyset, X, \{a\}, \{a, b\}, \{a, c\}, \{a, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}\}$

$S_C(X) = S_C C(X) = \{\emptyset, X\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_{17}=$\{\emptyset, X, \{\mathrm{a}\}, \{\mathrm{b}\}, \{a, b\}, \{\mathrm{a, b, c}\}\}$

$\pi^{C} = \{X, \emptyset, \{b, c, d\}, \{a, c, d\}, \{c, d\}, \{d\}\}$

$SO(X) = \{P(x)/\{c, d\}, \{d\}, \{c\}\}$

$S_C(X) = \{\emptyset, X, \{b, c, d\}, \{a, c, d\}\}$

$S_C C(X) = \{\emptyset, X, \{a\}, \{b\}\}$

$gS_C(X) = \{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{\mathrm{a, b, c}\}, \{\mathrm{a, b, d}\}\}$

$gS_C O(X) = \{\emptyset, X, \{\mathrm{b, c, d}\}, \{\mathrm{a, c, d}\}, \{\mathrm{c, d}\}, \{\mathrm{d}\}, \{\mathrm{c}\}\}$

π_{18}=$\{\emptyset, X, \{\mathrm{a}\}, \{\mathrm{b}\}, \{a, b\}, \{\mathrm{a, c, d}\}\}$

$\pi^{C} = \{X, \emptyset, \{b, c, d\}, \{a, c, d\}, \{c, d\}, \{b\}\}$

$SO(X) = \{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{a, c\}, \{a, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}\}$

$S_C(X) = \{\emptyset, X, \{b\}, \{a, c, d\}\}$

$S_C C(X) = \{\emptyset, X, \{a, c, d\}, \{b\}\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_{19}={∅, X, {c}, {a, b}, {a, b, c}, {a, b, d}}

$\pi^C = \{X, \emptyset, \{a, b, d\}, \{c, d\}, \{d\}, \{c\}\}$

$SO(X) = \{\emptyset, X, \{c\}, \{a, b\}, \{a, b, c\}, \{a, b, d\}, \}$

$S_C(X) = \{\emptyset, X, \{c\}, \{a, b, d\}\}$

$S_C C(X) = \{\emptyset, X, \{a, b, d\}, \{c\}\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_{20}={∅, X, {a}, {a, b}, {c, d}, {a, c, d}}

$\pi^C = \{X, \emptyset, \{b, c, d\}, \{c, d\}, \{a, b\}, \{b\}\}$

$SO(X) = \left\{\emptyset, X, \{a\}, \{a, b\}, \{c, d\}, \{a, c, d\}\right\}$

$S_C(X) = \{\emptyset, X, \{a, b\}, \{c, d\}\}$

$S_C C(X) = \{\emptyset, X, \{c, d\}, \{a, b\}\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_{21}={∅, X, {a}, {a, b}, {a, c}, {a, b, c}, {a, b, d}}

$\pi^C = \{X, \emptyset, \{b, c, d\}, \{c, d\}, \{b, d\}, \{d\}, \{c\}\}$

$SO(X) = \left\{\emptyset, X, \{a\}, \{a, b\}, \{a, c\}, \{a, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}\right\}$

$S_C(X) = S_C C(X) = \{\emptyset, \{\emptyset, X\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_{22}=$\{\emptyset, X, \{\mathrm{a}\}, \{b\}, \{\mathrm{a}, b\}, \{b, c\}, \{\mathrm{a, b, c}\}\}$

$\pi^C = \{X, \emptyset, \{b, c, d\}, \{a, c, d\}, \{c, d\}, \{a, d\}, \{d\}\}$

$SO(X) = \{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{a, d\}, \{b, c\}, \{b, d\}, \{a, b, c\}, \{a, b, d\}, \{b, c, d\}\}$

$S_C(X) = \{\emptyset, X, \{a, d\}, \{b, c, d\}\}$

$S_C C(X) = \{\emptyset, X, \{b, c\}, \{a\}\}$

$gS_C(X) = \{\emptyset, X, \{a\}, \{b\}, \{\mathrm{c}\}, \{a, b\}, \{\mathrm{a, c}\}, \{\mathrm{b, c}\}, \{\mathrm{a, b, c}\}, \{\mathrm{a, b, d}\}, \{\mathrm{a, c, d}\}\}$

$gS_C O(X) = \{\emptyset, X, \{b, c, d\}, \{a, c, d\}, \{\mathrm{a, b, d}\}, \{c, d\}, \{\mathrm{b, d}\}, \{\mathrm{a, d}\}, \{\mathrm{d}\}, \{\mathrm{c}\}, \{\mathrm{b}\}\}$

π_{23}=$\{\emptyset, X, \{\mathrm{a}\}, \{\mathrm{b}\}, \{\mathrm{a}, b\}, \{\mathrm{a, b, c}\}, \{\mathrm{a, b, d}\}\}$

$\pi^C = \{X, \emptyset, \{b, c, d\}, \{a, c, d\}, \{c, d\}, \{d\}, \{c\}\}$

$SO(X) = \{P(x)/\{c, d\}, \{d\}, \{c\}\}$

$S_C(X) = \{\emptyset, X, \{b, c, d\}, \{a, c, d\}\}$

$S_C C(X) = \{\emptyset, X, \{a\}, \{b\}\}$

$gS_C(X) = \{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{\mathrm{a, b, c}\}, \{\mathrm{a, b, d}\}\}$

$gS_C O(X) = \{\emptyset, X, \{b, c, d\}, \{a, c, d\}, \{\mathrm{c, d}\}, \{\mathrm{d}\}, \{\mathrm{c}\}\}$

π_{24}={$\emptyset, X$, {a}, {b}, {a, b}, {c, d}, {a, c, d}, {b, c, d}}

$\pi^C = \{X, \emptyset, \{b, c, d\}, \{a, c, d\}, \{c, d\}, \{a, b\}, \{b\}, \{a\}\}$

$SO(X) = \{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{c, d\}, \{a, c, d\}, \{b, c, d\}\}$

$S_C(X) = \{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{c, d\}, \{a, c, d\}, \{b, c, d\}\}$

$S_C C(X) = \{\emptyset, X, \{b, c, d\}, \{a, c, d\}, \{c, d\}, \{a, b\}, \{b\}, \{a\}\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_{25}={$\emptyset, X$, {a}, {b}, {a, b}, {b, d}, {a, b, c}, {a, b, d}}

$\pi^C = \{X, \emptyset, \{b, c, d\}, \{a, c, d\}, \{c, d\}, \{a, c\}, \{d\}, \{c\}\}$

$SO(X) = \{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{a, c\}, \{b, c\}, \{b, d\}, \{a, b, c\}, \{a, b, d\}, \{b, c, d\}\}$

$S_C(X) = \{\emptyset, X, \{a, c\}, \{b, c, d\}\}$

$S_C C(X) = \{\emptyset, X, \{b, d\}, \{a\}\}$

$gS_C(X) = \{\emptyset, X, \{a\}, \{b\}$, {d}, $\{a, b\}$, {a, d}, {b, d}, {a, b, c}, {a, b, d}, {a, c, d}}

$gS_C O(X) = \{\emptyset, X$, {b, c, d}, {a, c, d}, {a, b, c}, {c, d}, {b, c}, {a, c}, {d}, {c}, {b}}

π_{26}={$\emptyset, X$, {a}, {b}, {a, b}, {a, c}, {a, b, c}, {a, c, d}}

$\pi^C = \{X, \emptyset, \{b, c, d\}, \{a, c, d\}, \{c, d\}, \{b, d\}, \{d\}, \{b\}\}$

$SO(X) = \{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{a, c\}, \{a, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}\}$

$S_C(X) = \{\emptyset, X, \{b\}, \{a, c, d\}\}$

$S_C C(X) = \{\emptyset, X, \{a, c, d\}, \{b\}\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_{27}=$\{\emptyset, X, \{a\}, \{a, b\}, \{a, c\}, \{a, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}\}$

$\pi^C = \{X, \emptyset, \{b, c, d\}, \{c, d\}, \{b, d\}, \{b, c\}, \{d\}, \{c\}, \{b\}\}$

$SO(X) = \{\emptyset, X, \{a\}, \{a, b\}, \{a, c\}, \{a, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}\}$

$S_C(X) = S_C C(X) = \{\emptyset, X\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_{28}=$\{\emptyset, X, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}, \{a, b, c\}\}$

$\pi^C = \{X, \emptyset, \{b, c, d\}, \{a, c, d\}, \{a, b, d\}, \{c, d\}, \{b, d\}, \{a, d\}, \{d\}\}$

$SO(X) = \{P(x)/\{d\}\}$

$S_C(X) = \{\emptyset, X, \{b, c, d\}, \{a, c, d\}, \{a, b, d\}, \{c, d\}, \{b, d\}, \{a, d\}\}$

$S_C C(X) = \{\emptyset, X, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}\}$

$gS_C(X) = \{\emptyset, X, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}, \{a, b, c\}\}$

$gS_C O(X) = \{\emptyset, X, \{b, c, d\}, \{a, c, d\}, \{a, b, d\}, \{c, d\}, \{b, d\}, \{a, d\}, \{d\}\}$

π_{29}=$\{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{a, c\}, \{b, d\}, \{a, b, c\}, \{a, b, d\}\}$

$\pi^C = \{X, \emptyset, \{b, c, d\}, \{a, c, d\}, \{c, d\}, \{b, d\}, \{a, c\}, \{d\}, \{c\}\}$

$SO(X) = \{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{a, c\}, \{b, d\}, \{a, b, c\}, \{a, b, d\}\}$

$S_C(X) = \{\emptyset, X, \{a, c\}, \{b, d\}\}$

$S_C C(X) = \{\emptyset, X, \{b, d\}, \{a, c\}\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_{30}={$\emptyset, X$, {a}, $\{b\}, \{c\}$, {a, b}, {a, c}, {b, c}, {a, b, c}, {a, b, d}}

$\pi^{C} = \{X, \emptyset, \{b, c, d\}, \{a, c, d\}, \{a, b, d\}, \{c, d\}, \{b, d\}, \{a, d\}, \{d\}, \{c\}\}$

$SO(X) = P(x)/\{\{d\},\{c,d\}\}$

$S_C(X) = \{\emptyset, X, \{b, c, d\}, \{a, c, d\}, \{a, b, d\}, \{b, d\}, \{a, d\}, \{c\}\}$

$S_C C(X) = \{\emptyset, X, \{a\}, \{b\}, \{c\}, \{a, c\}, \{b, c\}, \{a, b, d\}\}$

$gS_C(X) = \{\emptyset, X, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}, \{a, b, c\}, \{a, b, d\}\}$

$gS_C O(X) = \{\emptyset, X, \{b, c, d\}, \{a, c, d\}, \{a, b, d\}, \{c, d\}, \{b, d\}, \{a, d\}, \{d\}, \{c\}\}$

π_{31}={$\emptyset, X$, {a}, $\{b\}$, {a, b}, {a, c}, {a, d}, {a, b, c}, {a, b, d}, {a, c, d}}

$\pi^{C} = \{X, \emptyset, \{b, c, d\}, \{a, c, d\}, \{c, d\}, \{b, d\}, \{b, c\}, \{d\}, \{c\}, \{b\}\}$

$SO(X) = \{\emptyset, X, \{a\}, \{b\}, \{a, b\}, \{a, c\}, \{a, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}\}$

$S_C(X) = \{\emptyset, X, \{b\}, \{a, c, d\}\}$

$S_C C(X) = \{\emptyset, X, \{a, c, d\}, \{b\}\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_{32}={$\emptyset, X, \{a\}, \{b\}, \{c\}, \{a,b\}, \{a,c\}, \{a,d\}, \{b,c\}, \{a,b,c\},$

$\{a,b,d\}, \{a,c,d\}\}$

$\pi^C = \{X, \emptyset, \{b,c,d\}, \{a,c,d\}, \{a,b,d\}, \{c,d\}, \{b,d\}, \{b,c\}, \{a,d\}, \{d\}, \{c\}, \{b\}\}$

$SO(X) = \{\emptyset, X, \{a\}, \{b\}, \{c\}, \{a,b\}, \{a,c\}, \{a,d\}, \{b,c\}, \{a,b,c\}, \{a,b,d\}, \{a,c,d\}$

$S_C(X) = \{\emptyset, X, \{b\}, \{c\}, \{a,d\}, \{b,c\}, \{a,b,d\}, \{a,c,d\}\}$

$S_C C(X) = \{\emptyset, X, \{a,c,d\}, \{a,b,d\}, \{b,c\}, \{a,d\}, \{c\}, \{b\}\}$

$gS_C(X) = gS_C O(X) = P(x)$

π_{33}={$\emptyset, X, \{a\}, \{b\}, \{c\}, \{d\}, \{a,b\}, \{a,c\}, \{a,d\}, \{b,c\}, \{b,d\}, \{c,d\},$

$\{a,b,c\}, \{a,b,d\}, \{a,c,d\}, \{b,c,d\}\}$

$\pi^C = SO(X) = S_C(X) = S_C C(X) = gS_C(X) = gS_C O(X) = P(x)$

X={a,b,c,d}	$gS_C T0 - space$	$gS_C T1 - space$	$gS_C T2 - space$
π_1	1	1	1
π_2	1	1	1
π_3	1	1	1
π_4	1	1	1
π_5	1	1	1
π_6	1	1	1
π_7	1	1	1
π_8	1	1	1
π_9	1	1	1
π_{10}	1	1	1
π_{11}	1	1	1

π_{12}	1	0	0
π_{13}	1	0	0
π_{14}	1	1	1
π_{15}	1	1	1
π_{16}	1	1	1
π_{17}	1	0	0
π_{18}	1	1	1
π_{19}	1	1	1
π_{20}	1	1	1
π_{21}	1	1	1
π_{22}	1	0	0
π_{23}	1	0	0
π_{24}	1	1	1
π_{25}	1	0	0
π_{26}	1	1	1
π_{27}	1	1	1
π_{28}	1	0	0
π_{29}	1	1	1
π_{30}	1	0	0
π_{31}	1	1	1
π_{32}	1	1	1
π_{33}	1	1	1

REFERENCES

[1] A.A.Nasef, A.I. El- Maghrabi &. "Between semi- closed and GSc-closed sets." *Journal of Taibah University for Science*, Volume 2,2009: 78-87.

https://www.sciencedirect.com/science/article/pii/S1658365512600107

[2] KURONYA, ALEX. *INTRODUCTION TO TOPOLOGY.* Budapest: Alex Küronya, January 24, 2010.

https://www.academia.edu/15399931/Functions_on_Okounkov_bodies_coming_from_geometric_valuations_with_an_appendix_by_S_ebastien_Boucksom_

[3] J.E. Joseph, M.H. Kwack. On S-closed spaces. Proc. Amer. Math. Soc., 1980, 80(2): 341 - 348.

https://www.proquest.com/docview/1406185434

[4] N. Levine, Semi-open sets and semi-continuity in topological spaces, Amer. Math. Monthly, 1963, 70(1): 36 - 41.

https://www.jstor.org/stable/2312781