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Pentapartitioned Neutrosophic Pythagorean Strongly Irresolvable Spaces

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Abstract: The aim of this paper is to develop many characterizations of Pentapartitioned Neutrosophic Pythagorean (PNP) strongly irresolvable spaces and its properties is also studied. Several characterizations of Pentapartitioned Neutrosophic Pythagorean strongly irresolvable spaces are investigated in this study. Also examined are the conditions under which Pentapartitioned Neutrosophic Pythagorean strongly irresolvable spaces become Pentapartitioned Neutrosophic Pythagorean first category spaces, Pentapartitioned Neutrosophic Pythagorean Baire spaces, and Pentapartitioned Baire spaces.

Keywords: Pentapartitioned neutrosophic pythagorean set, pentapartitioned neutrosophic pythagorean resolvable space, pentapartitioned neutrosophic pythagorean irresolvable spaces, pentapartitioned neutrosophic pythagorean strongly irresolvable spaces.

1. Introduction

Zadeh [17] proposed the fuzzy set concept in 1965 as a new technique to modelling uncertainties. Researches revealed the value of the fuzzy concept and have effectively used it to all fields of mathematics. Topology provides the most natural framework for fuzzy set theories to flourish in mathematics. Chang [3] first suggested the method of fuzzy topological space in 1968. Chang's paper established the stage for the tremendous growth of several fuzzy topological concepts that followed. Several mathematicians have continued to integrate all of the key notions of general topology to fuzzy circumstances, resulting in the development of a current theory of fuzzy topology. Today, fuzzy topology has been firmly established as one of the basic disciplines of fuzzy mathematics. Atanassov and plenty of researchers [1] worked on intuitionistic fuzzy sets within the literature. Florentin Smarandache [14] introduced the idea of Neutrosophic set in 1995 that provides the information of neutral thought by introducing the new issue referred to as uncertainty within the set. thus neutrosophic set was framed and it includes the parts of truth membership function(T), indeterminacy membership function(I), and falsity membership function(F) severally. Neutrosophic sets deals with non normal interval of]−0 1+[. Pentapartitioned neutrosophic set and its properties were introduced by Rama Malik and Surpati Pramanik [13]. In this case, indeterminacy is divided into three components: contradiction, ignorance, and an unknown membership function. The concept of Pentapartitioned neutrosophic pythagorean sets was initiated by R. Radha and A. Stanis Arul Mary[7]. The concept of intuitionistic fuzzy almost resolvable spaces and irresolvable spaces was introduced by Sharmila s [15].R. Radha and A.Stanis Arul Mary introduced Pentapartitioned neutrosophic pythagorean resolvable and irresolvable spaces. Also we have studied the concept of Pentapartitioned neutrosophic pythagorean almost resolvable and irresolvable spaces. Now we extend the concepts to pentapartitioned neutrosophic pythagorean strongly irresolvable spaces and studied relations with other Pentapartitioned neutrosophic pythagorean baire spaces, first category set, second category set and hyper connected spaces.

2. Preliminaries

2.1 Definition [14]

Let X be a universe. A Neutrosophic set A on X can be defined as follows:

$$A = \{< x, T_A(x), I_A(x), F_A(x) >: x \in X\}$$

Where T_A , $I_A, F_A: U \to [0,1]$ *and* $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$

Here, $T_A(x)$ is the degree of membership, $I_A(x)$ is the degree of inderminancy and $F_A(x)$ is the degree of non-membership.

2.2 Definition [7]

Let X be a universe. A Pentapartitioned neutrosophic pythagorean [PNP] set A with T, F, C and U as dependent neutrosophic components and I as independent component for A on X is an object of the form

$$A = \{< x, T_A, C_A, I_A, U_A, F_A >: x \in X\}$$

Where $T_A + F_A \leq 1, C_A + U_A \leq 1$ *and*

$$(T_A)^2 + (C_A)^2 + (I_A)^2 + (U_A)^2 + (F_A)^2 \leq 3$$

Here, $T_A(x)$ is the truth membership, $C_A(x)$ is contradiction membership, $U_A(x)$ is ignorance membership,

$F_A(x)$ is the false membership and I_A (x) is an unknown membership.

2.3 Definition [13]

Let P be a non-empty set. A Pentapartitioned neutrosophic set A over P characterizes each element p in P a truth -membership function T_A , a contradiction membership function C_A, an ignorance membership function G_A, unknown membership function U_A and a false membership function F_A , such that for each p in P

$$T_A + C_A + G_A + U_A + F_A \leq 5$$

2.4 Definition [7]

The complement of a pentapartitioned neutrosophic pythagorean set A on R Denoted by A^C or A^* and is defined as

$A^C = \{< x, F_A(x), U_A(x), 1 - G_A(x), C_A(x), T_A(x) > : x \in X\}$

2.5 Definition [7]

Let A $= < x, T_A(x), C_A(x), G_A(x), U_A(x), F_A(x) >$ and B $= < x, T_B(x), C_B(x), G_B(x), U_B(x), F_B(x) >$ are pentapartitioned neutrosophic pythagorean sets. Then

A $\cup$ B $= < x, max(T_A(x), T_B(x)), max(C_A(x), C_B(x)), \min(G_A(x), G_B(x)), \min(U_A(x), U_B(x)),$
$\min(F_A(x), F_B(x)), >$

A $\cap$ B $= < x, min(T_A(x), T_B(x)), min(C_A(x), C_B(x)), \max(G_A(x), G_B(x))$

$$, max\big(U_A(x), U_B(x)\big), max(F_A(x), F_B(x)) >$$

2.6 Definition [7]

A PNP topology on a nonempty set R is a family of a PNP sets in R satisfying the following axioms

1) $0,1 \in \tau$
2) $R_1 \cap R_2 \in \tau$ for any $R_1, R_2 \in \tau$
3) $\cup R_i \in \tau$ for any $R_i : i \in I \subseteq \tau$

The complement R* of PNP open set (PNPOS, in short) in PNP topological space [PNPTS] (R,$\boldsymbol{\tau}$), is called a PNP closed set [PNPCS].

2.7 Definition [7]

Let (R,$\boldsymbol{\tau}$) be a PNPTS and L be a PNPTS in R. Then the PNP interior and PNP Closure of R denoted by

Cl(L) = $\cap\{\boldsymbol{K}$: K is a PNPCS in R and L$\subseteq$ K}.

Int(L) = $\cup$\{G: G is a PNPOS in R and G$\subseteq$ L\}.

2.8 Definition [11]

Let (R,$\boldsymbol{\tau}$) be a PNPTS and K be a PNP set in (R,$\boldsymbol{\tau}$). Then the PNP closure operator satisfy the following properties.

1-PNPCl(K) = PNPInt(1-K)

1-PNPInt(K) = PNPCl(1-K)

2.9 Definition [11]

A PNP A in PNPTS (R,$\boldsymbol{\tau}$) is called PNP dense if there exists no PNPCS L in (R,$\boldsymbol{\tau}$) such that K $\subseteq$ **L** $\subseteq$ **1.** That is PNPCl(K) = 1.

2.10 Definition [11]

A PNP A in PNPTS (R,$\boldsymbol{\tau}$) is called PNP nowhere dense if there exists no nonzero PNPOS L in (R,$\boldsymbol{\tau}$) such that **L** $\subseteq$ PNPCl(K). That is PNPInt (PNPCl(K)) = 0.

2.11 Definition [11]

A PNPTS (R,$\boldsymbol{\tau}$) is called PNP resolvable if there exists a PNP dense set K in (R,$\boldsymbol{\tau}$) such that PNPCl (1-K) = 1. Otherwise (R,$\boldsymbol{\tau}$) is called PNP irresolvable.

2.12 Definition [11]

A PNPTS (R,$\boldsymbol{\tau}$) is called PNP submaximal if PNPCl(K) = 1 for any non-zero PNP set K in (R,$\boldsymbol{\tau}$).

2.13 Definition [11]

A PNPTS (R,$\boldsymbol{\tau}$) is called a PNP open hereditarily resolvable if PNPInt (PNPCl(K)) $\neq \mathbf{0}$ for any PNP set K in (R,$\boldsymbol{\tau}$).

2.14 Definition [11]

APNPTS (R,$\boldsymbol{\tau}$) is called PNP first category if $\bigcup_{i=1}^{\infty} \boldsymbol{K_i}$, where $\mathbf{K_i'}\boldsymbol{s}$ are PNP nowhere dense sets in (R,$\boldsymbol{\tau}$). A PNPTS which is not first category is said to be PNP second category.

2.15 Definition [11]

A PNPTS (R,$\boldsymbol{\tau}$) is called a PNP baire space if PNPInt $(\bigcup_{i=1}^{\infty} \mathbf{K_i}) = \mathbf{0}$, where $\boldsymbol{K_i's}$ are PNP nowhere dense sets in (R,$\boldsymbol{\tau}$).

2.16 Definition [12]
A PNP K in a PNPTS (R,τ) is called PNPR_1 if K = $\bigcap_{1=1}^{\infty} K_i$ where each $K_i \in \tau$.

2.17 Definition [12]
A PNP K in a PNPTS (R,τ) is called PNPR_2 if K = $\bigcup_{i=1}^{\infty} K_i$ where each $K_i \in \tau$.

2.18 Definition [12]
A PNPTS (R,τ) is called a PNP hyper- connected space if every PNP open set is PNP dense in (R,τ). That is PNPCl $(K_i) = 1$ for all $K_i \in \tau$.

2.19 Definition [12]
A PNPTS (R,τ) is called Pentapartitioned Neutrosophic Pythagorean nodec space, if every non-zero PNP nowhere dense set in (R,τ) is PNP closed.

3. Pentapartitioned Neutrosophic Pythagorean (PNP) Strongly Irresolvable Spaces

3.1 Definition
A Pentapartitioned Neutrosophic Pythagorean topological space PNPTS (R, τ) is called a Pentapartitioned Neutrosophic Pythagorean strongly irresolvable space if PNPCl (K) = 1 for any non-zero Pentapartitioned neutrosophic pythagorean set K in (R,τ) implies that PNPCl (PNPInt(K)) = 1 .

3.2 Example
Let R = {p}. Let A and B be the PNP sets defined on R as follows.
A = {p,0.4,0.3,0.3,0.5,0.4}
B = {p,0.5,0.6,0.5,0.2,0.3}
Then, clearly τ = {0, A, 1} is a PNP topology on R.
Then, PNPCl(A) = 1 and PNPCl (PNPInt(A) = 1,
PNPCl(B) = 1 and PNPCl (PNPInt (B) = 1.
Hence (R,τ) is a PNP strongly irresolvable space.

3.3 Theorem
If (R,τ) is a PNP strongly irresolvable space and if PNPInt(K) = 0 for any non-zero PNP set K in (R,τ) , then PNPInt (PNPCl(K)) = 0.
Proof
Let K be a non-zero PNP set in (R,τ) such that PNPInt(K) = 0. Then 1 – PNPInt(K) = 1 which implies that PNPCl(1-K) = 1. Since (R,τ) is PNP strongly irresolvable space, we have PNPCl (PNPInt(1-k)) = 1 which implies that 1 – PNPInt (PNPCl(K)) = 1. Therefore PNPInt (PNPCl(K)) = 0.

3.4 Theorem

If (R,τ) is a PNP strongly irresolvable space and if PNPInt(PNPCl(K)) $\neq 0$ for any non-zero PNP set K in (R,τ) then PNPInt (K) $\neq$ 0.

Proof

Let K be a non-zero PNP set in (R,τ) such that PNPInt(PNPCl(K)) $\neq 0$. We claim that PNPInt(K) $\neq$ 0. Supp ose that PNPInt(K) $= 0$. Then 1 – PNPInt(K) $= 1$. Now PNPCl$(1 - \mathrm{K}) = 1$. Since (R, τ) is a PNP strongly irresolvable space, we have PNPCl(PNPInt(1-K)) = 1. Hence 1 – PNPInt(PNPCl(K)) = 1 implies that PNPInt(PNPCl(K)) = 0, which is a contradiction. Hence we must have PNPInt(K) $\neq$ 0.

3.5 Theorem

If (R,τ) is a PNP strongly irresolvable space, then (R,τ) is a PNP irresolvable space.

Proof

Let K be a non-zero PNP set in (R,τ) such that PNPCl(K) = 1. We claim that PNPInt(K) $\neq$ 0. Suppose that PNPInt(K) = 0, then 1 – PNPInt(K) = 1, which implies that PNPCl(1-K) = 1. Then PNPInt(PNPCl(1-K)) = PNPInt(1) = 1. This implies that 1 – PNPCl(PNPInt(K)) = 1. Then we have PNPCl(PNPInt(K)) = 0 which is a contradiction to (R,τ) is a PNP strongly irresolvable spaces. Hence our assumption PNPInt(K) = 0 is wrong,. Hence we must have PNPInt(K) $\neq$ 0 for all PNP dense sets K in (R,τ). Therefore (R,τ) must be a PNP irresolvable space.

3.6 Theorem

If (R,τ) is a PNP strongly irresolvable space , then PNPInt(K_1) $\subseteq 1 -$ PNPInt(K_2) for any two dense sets K_1, K_2 in (R,τ).

Proof

Let K_1 and K_2 be any two non-zero PNP dense sets in (R,τ). Then PNPCl(K_1) = 1 and PNPCl(K_2) = 1 which implies that PNPInt(PNPCl(K_1) $\neq$ 0 and PNPInt(PNPCl(K_2) $\neq$ 0. Since is a PNP strongly irresolvable space, by theorem 3.4, we have PNPInt(K_1) $\neq$ 0 and PNPInt(K_2) $\neq$ 0. By theorem 3.5, (R,τ) is a PNP irresolvable space, But (R,τ) is PNP irresolvable if has a pair of dense sets, K_1 & K_2 $\exists\, K_1 \subseteq K_{2,}$ Now PNPInt(K_1) $\subseteq K_1 \subseteq 1 - K_2 \subseteq 1 -$ PNPInt(K_2). Therefore we have PNPInt(K_1) $\subseteq$ $K_1 \subseteq 1 -$PNPInt(K_2) for any two PNP dense sets K_1, K_2 in (R,τ),

3.7 Theorem

If a PNPTS (R,τ) is a PNP submaximal space, then (R,τ) is a PNP strongly irresolvable space.

Proof

Let (R,τ) be a PNP submaximal space and K be a PNP dense set in (R,τ). Since K is a PNP dense set in (R,τ), PNPCl(K) = 1, which implies PNPInt(1-K) = 1-1 = 0.Therefore PNPCl(PNPInt(1-K)) = 0. That is 1 – PNPCl(PNPInt(K)) = 1, which implies 1 – PNPInt(PNPCl(1- K)) = 1. Hence PNPCl(PNPInt(K)) = 1. Therefore (R,τ) is a strongly irresolvable space

3.8 Theorem

If K is a PNP nowhere dense set in a PNP topological space (R,τ), then (1 – K) is a PNP dense set in (R,τ).

Proof

Let K be a PNP nowhere dense set in (R,τ). Then we have PNPInt(PNPCl(K)) = 0. Now 1 – PNPInt(PNPCl(K)) = 1- 0 = 1.Then PNPCl(1 – PNPCl(K)) = 1, which implies that PNPCl(1-PNPInt(1-K)) = 1.But PNPCl(1 – PNPInt(1- K)) $\subseteq$ PNPCl(PNPCl(1-K)). Hence 1 $\subseteq$ PNPCl(PNPCl(1-K)). Therefore PNPCl(1-PNPInt(1-K)) = 1. Also 1 – PNPInt(PNPCl(K)) = 1-0=1. Then we have PNPCl(1-PNPCl(K)) = 1, which implies that PNPCl(PNPInt(1-K)) = 1. But PNPCl(PNPInt(1-K)) $\subseteq$ PNPCl(PNPCl(1-K)). Hence 1 $\subseteq$ PNPCl(PNPCl(1-K)). That is PNPCl(PNPCl(1-K)) = 1. Therefore 1- K is a PNP dense set in (R,τ).

3.9 Theorem

If a PNPTS (R,τ) is a PNP submaximal space, then (R,τ) is a PNP nodec space.

Proof

Let (R,τ) be a PNP submaximal space and K be a PNP nowhere dense set in (R,τ). Then by theorem 3.8, 1-K is a PNP dense set in (R,τ). Since (R,τ) is a PNP submaximal space, 1-K is a PNP open set in (R,τ). This implies that K is a PNP closed set in (R,τ). Hence each PNP nowhere dense set is a PNP closed set in (R,τ) and therefore (R,τ) is a PNP nodec space.

3.10 Theorem

If (R,τ) is a PNP strongly irresolvable then (R,τ) is a PNP Baire space if and only if PNPCl($\bigcap_{i=1}^{\infty} K_i$) = 1.

Proof

Let (R,τ) be a PNP strongly irresolvable space. Suppose that $K_i's$ are PNP dense set in (R,τ), then PNPCl(PNPInt(K_i)) = 1. Now 1 – PNPCl(PNPInt(K_i)) = 1-1 = 0. Then we have PNPInt(PNPCl(1-K_i)) = 0. Hence (1-K_i)'s are PNP nowhere dense sets in (R,τ). Now PNPCl($\bigcap_{i=1}^{\infty} K_i$) = 1 implies that 1 – PNPCl($\bigcap_{i=1}^{\infty} K_i$) = 0 and hence PNPInt(1 – ($\bigcap_{i=1}^{\infty} K_i$)) = 0 and hence PNPInt($\bigcup_{i=1}^{\infty}$(1-$K_i$)) = 0 ,where (1-$K_i$)'s are PNP nowhere dense sets in (R,τ) and therefore (R,τ) is a PNP baire space.

Conversely, Let K_i's be PNP nowhere dense sets in a PNP strongly irresolvable space and PNP baire space (R,τ). Since (R,τ) is a PNP baire space, PNPInt($\bigcup_{i=1}^{\infty} K_i$) = 0. Then 1 – PNPInt($\bigcup_{i=1}^{\infty} K_i$) = 1. This implies that

$$\text{PNPCl}\left(\bigcap_{i=1}^{\infty}(1-K_i)\right) = 1 \qquad (1)$$

Since K_i's be PNP nowhere dense sets in a PNP strongly irresolvable space then by theorem3.8, (1-K_i)'s are PNP dense sets in . Let B_i = 1-K_i. Then from(1), PNPCl($\bigcap_{i=1}^{\infty} K_i$) = 1, where $K_i's$ are PNP nowhere dense sets in (R,τ).

3.11 Theorem

If (R,τ) is a PNP strongly irresolvable and K = $\bigcap_{i=1}^{\infty} K_i$ be a PNP dense set in (R,τ). Then 1 - K is a PNP first category set in (R,τ),

Proof

Let K = be a PNP dense set in (R,τ). Then PNPCl($\bigcap_{i=1}^{\infty} K_i$) = 1. But PNPCl($\bigcap_{i=1}^{\infty} K_i$) ⊆ $\bigcap_{i=1}^{\infty} P$ NPCl(K_i). Thus 1 ⊆ PNPCl($\bigcap_{i=1}^{\infty} K_i$) ⊆ $\bigcap_{i=1}^{\infty} P$ NPCl(K_i) . Then $\bigcap_{i=1}^{\infty}(PNPCl(K_i)$= 1. This implies that PNPCl(K_i) = 1. Thus K_i's are PNP dense set in (R,τ). Since (R,τ) is PNP strongly irresolvable, by theorem 3.8,(1- K_i)'s are PNP dense sets in (R,τ). Therefore , we have 1 – K = $\bigcup_{i=1}^{\infty}$(1-K_i), where (1-K_i)'s are PNP nowhere dense sets. Hence 1 – K is a PNP first category set in (R,τ).

3.12 Theorem

If is a PNP strongly irresolvable space and K = $\bigcap_{i=1}^{\infty} K_i$ be a PNP dense set in (R,τ). Then K is a PNP residual set in (R,τ).

Proof

Let K = $\bigcap_{i=1}^{\infty} K_i$ be a PNP dense set in (R,τ). Since (R,τ) is a PNP strongly irresolvable space, by theorem 3.11, 1 – K is a PNP first category set in (R,τ). Therefore K is a PNP residual set in (R,τ).

3.13 Theorem

Let (R,τ) be a PNP strongly irresolvable space. If K is a PNP dense set in (R,τ), then 1 – K is a PNP nowhere dense set.

Proof

Let K be a PNP dense set in (R,τ). Since (R,τ) is a PNP strongly irresolvable space, PNPCl(PNPInt(K)) = 1. This implies that 1 – PNPCl(PNPInt(K)) = 0. Therefore PNPInt(PNPCl(1-K)) = 0 and hence 1 – K is a PNP nowhere dense set in (R,τ).

3.14 Theorem

If (R,τ) is a PNP strongly irresolvable and PNP nodec space, then (R,τ) is a PNP submaximal space,

Proof

Let (R,τ) be a PNP strongly and PNP nodec space. Let K be a PNP dense set in (R,τ). Since (R,τ) is a PNP strongly irresolvable, by theorem 3.13, 1-K is a PNP nowhere dense set in (R,τ). Since (R,τ) is a PNP nodec space, 1-K is a PNP closed set in (R,τ). Then K is a PNP open set in (R,τ). Hence every PNP dense set is PNP open set in (R,τ). Therefore (R,τ) is a PNP submaximal space.

3.15 Theorem

If (R,τ) is a PNP strongly irresolvable and PNP second category space, then $\bigcap_{i=1}^{\infty} K_i \neq 0$ where $K_i's$ are PNP dense sets in (R,τ).

Proof

Let (R,τ) be a PNP second category space. Let us assume that $\bigcap_{i=1}^{\infty} K_i \neq 0$. Since K_i's are PNP dense sets in (R,τ), by theorem 3.12, $(1-K_i)'s$ are PNP nowhere dense sets in (R,τ). Now $1 - \bigcap_{i=1}^{\infty} K_i$ = 1, implies that $\bigcup_{i=1}^{\infty}(1 - K_i)$ and (1 - K_i)'s are PNP nowhere dense sets in (R,τ).Hence (R,τ) is a PNP first category space, which is a contradiction. Therefore $\bigcap_{i=1}^{\infty} K_i \neq 0$, where $K_i's$ are PNP dense sets in (R,τ).

3.16 Theorem

If (R,τ) is a PNP submaximal space and K is a PNP first category set, then 1 – K is a PNPR_2 set in (R,τ).

Proof

Let K be a PNP first category set in (R,τ). Then K = $\bigcup_{i=1}^{\infty} K_i$, where K_i's are PNP nowhere dense sets in (R,τ). Therefore, by theorem 3.8, (1− K_i) 's are PNP dense sets in (R,τ). Since (R,τ) is a PNP submaximal space, (1− K_i)'s are open set in (R,τ). Also 1-K = 1-($\bigcup_{i=1}^{\infty} K_i$) = $\bigcap_{i=1}^{\infty}(1 - K_i)$, where (1-$K_i$)'s are PNP open sets in (R,τ). Therefore 1-K is a PNPR_2set in (R,τ).

3.17 Theorem

If (R,τ) is a PNP submaximal space, then every PNP first category set is a PNPR_1 set in (R,τ).

Proof

Let K be a PNP first category set in (R,τ). Since (R,τ) is a PNP submaximal space, by theorem 3.16, 1-K is a PNPR_2 set in (R,τ) and hence K is a PNPR_1 set in (R,τ).

3.18 Theorem

If (R,τ) is a PNP submaximal space, then every PNP residual set is a PNPR_1 set in (R,τ).

Proof

Let K be a PNP residual set in (R,τ). Then 1-K is a PNP first category set in **3.17 Theorem**

If (R,τ) is a PNP submaximal space, then every PNP first category set is a PNPR_1 set in (R,τ).

Proof

Let K be a PNP first category serin (R,τ). Since (R,τ) is a PNP submaximal space, by theorem 3.16, 1-K is a PNPR_2 set in (R,τ) and hence K is a PNPR_1 set in (R,τ). Since (R,τ) is a PNP submaximal space, by theorem 3.17, 1-K is a PNPR_1 set in (R,τ) and hence K is a PNPR_2 set in (R,τ).

5. Conclusion

In this paper, it is established that in PNP strongly irresolvable spaces, the condition under which PNP topological spaces become PNP strongly irresolvable spaces is obtained by means of the PNP denseness of PNP open sets. It is proved that PNP first category sets are PNP closed sets in a PNP Baire, PNP nodec and PNP strongly irresolvable spaces. It is established that PNP resolvable and PNP *ir*resolvable spaces are not PNP strongly irresolvable spaces. The conditions under which PNP strongly irresolvable spaces become PNP Baire spaces are also obtained. In future study, we cans study about filters and ultra filters in PNP irresolvable space.

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