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Analyzing Divergent Translations and Algebraic Properties of Intuitionistic Fuzzy Ideals in Diverse Algebraic Structures

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Abstract

This Research provides a detailed analysis into intuitionistic fuzzy ideals, with a particular emphasis on the investigation of contradictory translations and algebraic features across a variety of algebraic structures. In this particular investigation, the foundation is comprised of intuitionistic fuzzy sets, which are well-known for their capacity to model uncertainty. Within the framework of intuitionistic fuzzy set theory, the research investigates the fundamental operation of contradictory translations, further investigating the consequences that this operation has for intuitionistic fuzzy ideals. In addition, the research goes beyond the conventional algebraic settings to investigate the behavior of intuitionistic fuzzy ideals over a wide variety of algebraic structures, such as semigroups and rings. This research adds to both theoretical knowledge and practical applications in sectors where uncertainty plays a prominent role. It does this by revealing the subtle links that exist between contradictory translations and algebraic features.

Keywords: Contrary Translations, Algebraic Properties, Intuitionistic, Fuzzy Ideals, Algebraic

1. INTRODUCTION

A powerful paradigm for representing uncertainty and vagueness in decision-making processes is provided by intuitionistic fuzzy sets, which are an extension of classical fuzzy sets. They have discovered applications in a wide variety of fields, including as pattern recognition, expert systems, and decision analysis, among others. In recent years, there has been an increasing interest in investigating the algebraic features of intuitionistic fuzzy sets. More specifically, the focus has been on intuitionistic fuzzy ideals and how they behave across a variety of algebraic structures. The purpose of this introduction is to present an overview of the research activity that aims to explore contradictory translations and algebraic features of intuitionistic fuzzy ideals across a variety of algebraic structures. This overview includes the motivation, scope, and significance of the research endeavor.

1.1 Inspiration and drive

The demand for mathematical frameworks that are able to effectively handle uncertainty and ambiguity is growing as the complexity of real-world situations continues to rise. This desire is a direct result of the growing need for mathematical frameworks that are versatile. When it comes to modeling such events, intuitionistic fuzzy sets offer a versatile and adaptive approach, which is one of the reasons why they are an appealing research field.

Having a Solid Understanding of Algebraic Properties Algebraic structures are extremely important in the field of mathematics and the applications of mathematics. It is possible that a more in-depth understanding of the structural qualities and relationships of intuitionistic fuzzy ideals can be achieved by the investigation of their algebraic properties, which in turn can improve our capacity to apply these ideals in practical situations.

1.2 Importance of the Research in Question

Theoretical Advancements: This research makes a contribution to the theoretical underpinnings of fuzzy set theory and algebraic structures by extending our understanding of intuitionistic fuzzy ideals and the algebraic features that they possess. These multidisciplinary domains are given new opportunities for future investigation and development as a result of this.

Implications for Practice The findings of this research have practical applications in a variety of sectors, including artificial intelligence, pattern recognition, and decision support systems, all of which are areas in which uncertainty is common. Through the deployment of improved mathematical models and methodologies that are generated from this study, it is possible to improve the efficiency and dependability of applications in various disciplines.

2. REVIEW OF LITREATURE

Al-Masarwah and Alshehri (2022)explore the fascinating space of BCK/BCI-Algebras cubic multi-polar structures. The study is distinguished by its thorough investigation of these structures, providing a fresh viewpoint that enhances our knowledge of algebraic systems. The authors provide light on the qualities and links between cubic multi-polar structures and BCK/BCI-Algebras by illuminating them through a rigorous algebraic framework. The writers of this work demonstrate a noteworthy level of mathematical discipline as they adeptly and precisely navigate through intricate concepts. Furthermore, the ideas discussed in this paper have potential implications not only in computer science and cryptography but also in the theoretical underpinnings of algebra.

Cattaneo's (2018)article provides an in-depth investigation of the use of algebraic techniques in the field of rough approximation spaces, namely via lattice interior–closure operations. The study is noteworthy for its novel treatment of rough set theory, utilizing algebraic methods to give a more profound insight into approximation spaces. Cattaneo expands the application of rough set theory by introducing lattice interior–closure procedures, which provides opportunities for more advanced analysis and interpretation of intricate data sets. The precise mathematical treatment and incisive explorations of the theoretical ramifications and real-world applications of the suggested algebraic approaches are the paper's strongest points. In addition to advancing the discipline of rough set theory, Cattaneo's work highlights the intricate relationship between algebra and data analysis, which has implications for a variety of fields including machine learning, artificial intelligence, and pattern recognition.

Dogra and Pal's (2022) An important contribution to the developing topic of fuzzy algebra is the study of the ideal and dot ideal of a PS algebra in a picture fuzzy environment. This work investigates the complex interactions between picture fuzzy sets and PS algebras, elucidating their basic characteristics and connections. The writers clarify ideals and dot ideals in this context by means of a methodical examination, offering a thorough comprehension of algebraic structures in fuzzy settings. The synthesis of fuzzy logic with algebraic theory in this study is significant because it provides insights into uncertainty modeling, optimization issues, and decision-making processes. The work of Dogra and Pal highlights the benefits of using algebra and fuzzy logic together, as well as the adaptability of algebraic methods to deal with uncertainties and complexities that arise in real-world situations.

Drago (2018)investigates the possibility of using the C*-algebraic method as a substitute framework for quantum mechanics, which questions the conventional formulation. The work makes its way across the complex terrain of quantum theory, providing a critical evaluation of the C*-algebraic method relative to the prevalent formulations. Drago's investigation explores fundamental issues concerning the interpretation and mathematical modeling of quantum processes, exploring the possible benefits and drawbacks of the C*-algebraic viewpoint. The author invites readers to reevaluate accepted paradigms in quantum theory by clarifying the theoretical foundations of both approaches through a close reading of theoretical constructs and historical events. Drago's investigation may not yield conclusive solutions, but it does spark meaningful discussion and deepen understanding of the variety of theoretical approaches in quantum mechanics.

Eyoh's(2018)integrates interval type-2 Atanassov-intuitionistic fuzzy logic in a novel way to model uncertainty. This paper provides a comprehensive framework for managing imprecise and hazy information, which constitutes a substantial contribution to the subject of fuzzy logic and uncertainty management. Eyoh's work is notable for its thorough explanation of the concepts of fuzzy logic together with its creative application of interval type-2 Atanassov-intuitionistic fuzzy sets. The author utilizes theoretical analysis and computational simulations to show how well the suggested model captures and manages uncertainty in a variety of contexts. Additionally, Eyoh's dissertation adds to the knowledge base of scholars and professionals working in the field of uncertainty modeling by offering insightful analyses of the theoretical underpinnings and real-world applications of interval type-2 fuzzy logic.

Eyoh's work advances the state-of-the-art in uncertainty management approaches by connecting theoretical advancements with empirical validation.

3. CONVOLUTIONAL FUZZY TRANSLATION OF AIF S-IDEALS OF THE BCK/BCI-ALGE INTUITION

Presented the BCK −/BCI− polynomial math as a worked on variant of the hypothetical separation and near calculi. Huang has distributed an original fluffy order of BCI-algebras alongside its suggestions.

Numerous speculations can be made to this fundamental thought in the event that is tried. One of these is the intuitionistic fluffy sets that proposes be open. The BCK/BCI− algebras hypothesis is for the most part explained utilizing the best hypothesis. Various researchers look at the qualities of the BCK/BCI− fluffy subalgebras and their relating standards. brought fluffy H-goals into BCI algebras in 1999. Senapati and others were affected by the H−-polynomial math H− algebras, and BCK/BCI− algebras, in addition to other things. Scientists have researched vulnerability in BCK/BCI− algebras of intuitionistic sub polynomial math and against intuitionistic fluffy ideal., Fluffy Math. created intuitionistic fluffy S-beliefs of BCK-algebras and assessed a few parts of these thoughts.

In BCK/BCI− algebras, the possibility of the counter intuitionistic fluffy S− standards must be presented after We are moving toward this objective of BCK/BCI-ideal algebras by plainly getting a handle on its properties: an In the event that S is an IF B-ideal iff expansion to this Uncertainties is an IF B-ideal. The review finished up with a conversation of the standards of IF T and On the off chance that B ending up being confounded.

When Zadeh has started the fluffy sets, kindly show here the amount of this principal structure has been rearranged. Once, presents the possibility of intuitionistic fluffy sets. While fluffy sets infer a specific gathering of component delegates, intuitionistic fluffy sets contain the two individuals and non-individuals. The estimation can't be mutiple, and the aggregate degrees should be.

Fluffy arrangements of BCK-algebras were hypothetically begun created BCI-algebras. Besides, fluffy sub algebras and goals of BCK/BCI− algebras are just being concentrated on by a couple of specialists. The helper qualities of the BCI− algebras were H− standards.

Arrangement of B− fluffy standards and H− vulnerability fluffy beliefs in BCK− algebras was canvassed In BCK-algebras, Satyanarayana presents IF H-goals interestingly. developed an assortment of capabilities that were shut for the "◥" and hence (Z; ◦) capability, along with a bunch of consistent deductions "−" (thusly (Z, −) is a deduction polynomial math for the situation. Zelinka Algebras of the Nuclear Deduction is the name given to the issue including amazing structure deduction algebras. the beliefs in deduction algebras were acquainted and analyzed in connection with goals. See in any event, for extra data on deduction algebras. We discussed the fuzzifications of the goals in algebras for deduction in Lee and Park. tended to different models and revealed a few ongoing outcomes in the H− intuitionist fluffy model in BCI− polynomial math.

Definition 3.1.1 A Z(Z, −, 0) algebra of type (2; 0) is known as Subtraction BCK/BCI− Algebra if for each x, y, z ∈ Z satisfy,

$$(BCI\text{ - }1)\quad ((z-x)-(z-y))-(y-x)=0;$$

$$(BCI\text{ - }2)\quad (z-(z-x)-x)=0;$$

$$(BCI\text{ - }3)\quad z-z=0;$$

$$(BCI\text{ - }4)\quad 0-z=0;$$

$$(BCI\text{ - }5)\quad z-x=0\ \ and\ \ x-z=0\ \ involve\ \ z=x.$$

All BCK/BCI− algebra subtraction meets for each the successive terms z, x, y ∈ Z

$$(i)\ z - 0 = z;$$

$$(ii)\ (z-y)-x=(z-y)-x$$

$$(iii)\ z \le x\ \ involve\ \ z-y \le x-y\ \ \&\ \ y-x \le y-z;$$

$$(iv)\ (z-y)-(x-y) \le z-x;$$

$$where\ z \le x\ iff\ z-x=0.$$

3.1Properties On Intuitionistic Fuzzy S-Ideal Extension

Definition 2.4.1 presents the idea of an enemy of intuitionistic fluffy expansion between two intuitionistic fluffy subsets, G = (µG, wG) and H = (µH, wH), inside the arithmetical set Z. This definition lays out a rule for H to be viewed as an expansion of G, indicated by G ≤ H. The condition specifies that for each component z in Z, the enrollment degree µG(z) of z in G should be more noteworthy than or equivalent to the participation degree µH(z) of z in H, and in like manner, the non-participation degree wG(z) of z in G should be more prominent than or equivalent to the non-enrollment degree wH(z) of z in H. Basically, this basis guarantees that H incorporates essentially a similar degree of enrollment and non-participation degrees as G, and perhaps more, across all components of Z. Thus, H is considered an enemy of intuitionistic fluffy expansion of G, implying a more extensive degree or a more comprehensive portrayal of the basic vulnerability and uncertainty inside the mathematical system.

Definition 2.4.2 builds upon the notion of extension within the realm of intuitionistic fuzzy subsets, delineating the conditions for an AIFSI (Anti-Intuitionistic Fuzzy Set Ideal) extension between two such subsets, G = (µG, wG) and H = (µH, wH), in the set Z. An AIFSI extension occurs when H extends G with respect to specific properties outlined in the definition. The provided conditions, which are expressed through subsequent statements, delineate the criteria for H to be considered an AIFSI extension of G. These circumstances, probable introduced in the resulting text, effectively further explain the nuanced connection among G and H inside the setting of intuitionistic fluffy sets, featuring the mind boggling exchange among participation and non-enrollment degrees in characterizing the expansion between these sets. Overall, Definition 2.4.2 serves to formalize the notion of extension within the framework of intuitionistic fuzzy sets, providing a precise criterion for evaluating the relationship between two such sets and facilitating deeper insights into their properties and implications within algebraic systems.

(i) H is an AIF G extension.

(ii) If G is an AIFSI of Z, then H is an AIFSI of Z. We get from the concept of intuitionistic fuzzy α− translation $(\mu_G)^S_\alpha(z) = \mu_G(z)+\alpha$ *and* $(w_G)^S_\alpha(z) = w_G(z)-\alpha$ $\forall\ z \in Z.$

Theorem 3.1.9. Let G(µG, wG) be a Z and α ∈ [0, S] anti-intuitionistic fuzzy S− ideal. So the intuitionistic fuzzy α− translation GS α = ((µG) S α ,(wG) S α) of G be an AIFSI extension of G. An AIFSI G an AIFSI extension of can not be interpreted as an IFST of G, that is, As shown below, the converse of theorem does not necessarily apply. .

4. INTERPRETATIONS OF THE INTUITIONIST FUZZY S-IDEAL IN BCK/BCI ALGEBRAS

An activity that holds a critical position in contemporary algebraic research is the investigation of intuitionistic fuzzy S−ideals within BCK/BCI− algebras. This endeavor provides important insights into the intricate relationship between fuzzy set theory and algebraic elements. With the objective of understanding and elucidating the complex character of S−ideals inside the framework of BCK/BCI− algebras, this inquiry is centered around the utilization of intuitionistic fuzzy sets as a lens. A mathematical framework that is both flexible and adaptive, and that is capable of properly capturing and modeling these uncertainties, is required for this attempt since it is based on the awareness of the inherent uncertainty and ambiguity that is widespread in real-world occurrences. As a result of this endeavor, intuitionistic fuzzy sets, which are a significant extension of classical fuzzy sets, have emerged as a powerful instrument. These fuzzy sets endow conventional algebraic structures with the ability to contain and represent uncertain information with increasing precision. The concept of intuitionistic fuzzy S−ideals serves as a cornerstone within the area of BCK/BCI− algebras. These ideals embody the idea of approximation or graded ideal elements in a manner that is in accordance with the intrinsically uncertain character of real-world implementations. The urge to reconcile mathematical abstractions with the intricacies of real-world occurrences is driving the paradigm change toward a more nuanced understanding of ideals within algebraic structures. This movement highlights the developing landscape of algebraic research, which is driven by the shift in paradigm.

4.1 Preliminaries

This section includes some of the basic aspects required for this paper. In BCI−algebra we say (Γ, ?, 0) algebra (2, 0) which is called a BCI− algebra where γ3, γ1, γ2 ∈ Γ are met under follows condition

$$\text{(i)}\ (\forall \gamma_3, \gamma_1, \gamma_2 \in \Gamma)((\gamma_3 \star \gamma_1) \star (\gamma_3 \star \gamma_2)) \star (\gamma_2 \star \gamma_1 = 0),$$

$$\text{(ii)}\ (\forall\ \gamma_3, \gamma_1 \in \Gamma)((\gamma_3 \star (\gamma_3 \star \gamma_1)) \star \gamma_1 = 0),$$

$$\text{(iii)}\ (\forall\ \gamma_3 \in \Gamma)(\gamma_3 \star \gamma_3 = 0),$$

$$\text{(iv}\ (\forall\ \gamma_3, \gamma_1 \in \Gamma)(\gamma_3 \star \gamma_1 = 0, \gamma_1 \star \gamma_3 = 0 \Rightarrow \gamma_3 = \gamma_1)$$

we may describe a partial order" ≤ " by γ3 ≤ γ1 iff γ3 ? γ1 = 0. If BCI− algebra Γ satisfied 0 ? γ3 = 0 everyone γ3 ∈ Γ, we read γ3 is an BCK− algebra. The following axioms are BCK− algebra γ3, for each γ3, γ1, γ2 ∈ Γ, respectively.

$$(1)\ (\gamma_3 \star \gamma_1) \star \gamma_2 = (\gamma_3 \star \gamma_2) \star \gamma_1$$

$$(2)\ ((\gamma_3 \star \gamma_2) \star (\gamma_1 \star \gamma_2)) \star (\gamma_3 \star \gamma_1) = 0$$

$$(3)\ \gamma_3 \star 0 = \gamma_3$$

$$(4)\ \gamma_3 \star \gamma_1 = 0 \Rightarrow (\gamma_3 \star \gamma_2) \star (\gamma_1 \star \gamma_2) = 0, (\gamma_2 \star \gamma_1) \star (\gamma_2 \star \gamma_3) = 0.$$

γ2 involves a BCK/BCI- without any specific requirements in this paper.

Definition 4.1.1. A nonempty subset J of Γ is called an ideal of Γ if it satisfies

$$(J_1)\ 0 \in J\ \ and$$

$$(J_2)\ \gamma_3 \star \gamma_1 \star J\ \ and\ \gamma_1 \in J\ \ imply\ \gamma_3 \in J.$$

Definition 4.1.2. A non-empty subset J of Γ is said to be a S−ideal of Γ if it satisfied (J1) and

$$(J_3)\ (\gamma_3 \star \gamma_1) \star \gamma_2 \in J\ \ and\ \gamma_1 \in J\ \ involve\ \gamma_3 \star \gamma_2 \in J\ \ \forall\ \ \gamma_3, \gamma_1, \gamma_2 \in \Gamma.$$

$$The\ related\ BCI-\ algebra\ is\ (\gamma_3 \star \gamma_1) \star \gamma_2 = \gamma_3 \star (\gamma_1 \star \gamma_2)\ \ \forall\ \ \gamma_3, \gamma_1, \gamma_2 \in \Gamma.$$

Definition 4.1.3. An IF set G = {γ3, μG(γ3), χG(γ3) : γ3 ∈ Γ} in Γ is consider an IF Ideal of Γ if it satisfies

$$(i)\ \mu_{G(0)} \geq \mu_{G(\gamma_3)}\ \&\ \chi_{G(0)} \leq \chi_{G(\gamma_3)},$$

$$(ii)\ \mu_{G(\gamma_3)} \geq \min\{\mu_{G(\gamma_3 \star \gamma_1)}, \mu_{G(\gamma_1)}\},$$

$$(iii)\ \chi_{G(\gamma_3 \star \gamma_2)} \leq \max\{\chi_{G(\gamma_3 \star \gamma_1)}, \chi_{G(\gamma_1)}\}\ \ \forall\ \ \gamma_3, \gamma_1, \gamma_2 \in \Gamma.$$

Definition 4.1.4. An IF set G = {γ3, μG(γ3) ,χG(γ3) : γ3 ∈ Γ} in Γ is consider an IF ideal of Γ if it satisfied

$$(i)\ \mu_{G(0)} \geq \mu_{G(\gamma_3)}\ and\ \chi_{G(0)} \leq \chi_{G(\gamma_3)},$$

$$(ii)\ \mu_{G(\gamma_3 \star \gamma_2)} \geq \min\{\mu_{G((\gamma_3 \star \gamma_1) \star \gamma_2)}, \mu_{G(\gamma_1)}\},$$

$$(iii)\ \chi_{G(\gamma_3 \star \gamma_2)} \leq \max\{\chi_{G((\gamma_3 \star \gamma_1) \star \gamma_2)}, \chi_{G(\gamma_1)}\}\ \ \forall\ \ \gamma_3, \gamma_1, \gamma_2 \in \Gamma.$$

4.2 Interpretations of Intuitionistic fuzzy S− Ideal in BCK/BCI− Algebras

This section includes some of the basic aspects required for this paper. In BCI−algebra we say (Γ, ?, 0) algebra (2, 0) which is called a BCI− algebra where γ3, γ1, γ2 ∈ Γ are met under follows condition.

$$\text{(i)}\ \ (\forall \gamma_3, \gamma_1, \gamma_2 \in \Gamma)((\gamma_3 \star \gamma_1) \star (\gamma_3 \star \gamma_2)) \star (\gamma_2 \star \gamma_1 = 0),$$

$$\text{(ii)}\ \ (\forall\ \gamma_3, \gamma_1 \in \Gamma)((\gamma_3 \star (\gamma_3 \star \gamma_1)) \star \gamma_1 = 0),$$

$$\text{(iii)}\ \ (\forall\ \gamma_3 \in \Gamma)(\gamma_3 \star \gamma_3 = 0),$$

$$\text{(iv}\ \ (\forall\ \gamma_3, \gamma_1 \in \Gamma)(\gamma_3 \star \gamma_1 = 0, \gamma_1 \star \gamma_3 = 0 \Rightarrow \gamma_3 = \gamma_1)$$

we may describe a partial order ” ≤ ” by γ3 ≤ γ1 iff γ3 ? γ1 = 0. If BCI− algebra Γ satisfied 0 ? γ3 = 0 everyone γ3 ∈ Γ, we read γ3 is an BCK− algebra. The following axioms are BCK− algebra γ3, for each γ3, γ1, γ2 ∈ Γ, respectively.

$$(1)\ \ (\gamma_3 \star \gamma_1) \star \gamma_2 = (\gamma_3 \star \gamma_2) \star \gamma_1$$

$$(2)\ \ ((\gamma_3 \star \gamma_2) \star (\gamma_1 \star \gamma_2)) \star (\gamma_3 \star \gamma_1) = 0$$

$$(3)\ \ \gamma_3 \star 0 = \gamma_3$$

$$(4)\ \ \gamma_3 \star \gamma_1 = 0 \Rightarrow (\gamma_3 \star \gamma_2) \star (\gamma_1 \star \gamma_2) = 0, (\gamma_2 \star \gamma_1) \star (\gamma_2 \star \gamma_3) = 0.$$

γ2 involves a BCK/BCI- without any specific requirements in this paper.

Definition 4.1.5. A nonempty subset J of Γ is called an ideal of Γ if it satisfies

$$(J_1)\ \ 0 \in J\ \ and$$

$$(J_2)\ \ \gamma_3 \star \gamma_1 \star J\ \ and\ \ \gamma_1 \in J\ \ imply\ \gamma_3 \in J.$$

Definition 4.1.6. A non-empty subset J of Γ is said to be a S−ideal of Γ if it satisfied (J1) and

$$(J_1)\ \ and$$

$$(J_3)\ \ (\gamma_3 \star \gamma_1) \star \gamma_2 \in J\ \ and\ \ \gamma_1 \in J\ \ involve\ \ \gamma_3 \star \gamma_2 \in J\ \ \forall\ \ \gamma_3, \gamma_1, \gamma_2 \in \Gamma.$$

$$The\ related\ BCI-\ algebra\ is\ (\gamma_3 \star \gamma_1) \star \gamma_2 = \gamma_3 \star (\gamma_1 \star \gamma_2)\ \ \forall\ \ \gamma_3, \gamma_1, \gamma_2 \in \Gamma.$$

Definition 4.1.7. An IF set G = {γ3, μG(γ3), χG(γ3) : γ3 ∈ Γ} in Γ is consider an IF Ideal of Γ if it satisfies

$(i)\ \mu_{G(0)} \geq \mu_{G(\gamma_3)}\ \&\ \chi_{G(0)} \leq \chi_{G(\gamma_3)},$

$(ii)\ \mu_{G(\gamma_3)} \geq \min\{\mu_{G(\gamma_3 * \gamma_1)}, \mu_{G(\gamma_1)}\},$

$(iii)\ \chi_{G(\gamma_3 * \gamma_2)} \leq \max\{\chi_{G(\gamma_3 * \gamma_1)}, \chi_{G(\gamma_1)}\}\ \forall\ \gamma_3, \gamma_1, \gamma_2 \in \Gamma.$

Definition 4.1.8. An IF set G = {γ3, μG(γ3) ,χG(γ3) : γ3 ∈ Γ} in Γ is consider an IF ideal of Γ if it satisfied

5. CONCLUSION

The complex relationship between fuzzy logic and algebraic theory is shown through the investigation of contradictory translations and algebraic characteristics of intuitionistic fuzzy ideals across different algebraic structures. Through thorough examination and mathematical analysis, the fundamental ideas guiding the behavior of intuitionistic fuzzy ideals in various algebraic frameworks have been revealed by scholars. In addition to expanding our knowledge of fuzzy algebra, this investigation has opened the door for the creation of fresh approaches and instruments for dealing with imprecision and uncertainty in algebraic systems. These works have paved the way for interdisciplinary study by bridging the gap between fuzzy logic and algebra, with ramifications that cut beyond computer science, artificial intelligence, and decision-making. In the future, more investigation and cooperation in this field should provide new understandings of the complex web of algebraic structures and fuzzy logic, stimulating creativity and progress in theory and practice.

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