Dear Editor:

Thank you for allowing us to revise our manuscript entitled “﻿﻿Improved General Attribute Reduction Algorithms for Inconsistent Decision Tables”. We appreciate the editor and reviewers very much for the constructive comments and suggestions on our manuscript.

The summary of the revisions made is as follows.

1. We have changed the title, which no longer emphasize inconsistent decision tables now.

2. We have added the general reduct definition proposed by Yao et al. [30] to Section 2 (line 162). Subsequently, we have presented the inadequacies of Yao’s definition and presented the tentative solution of granularity space in Section 3.1 (line 358-385). Meanwhile, we improved the description of the relationship between granularity space and two algorithms, which is clearer and more explicit (line 281-290).

2. We have explained the relationship between GS, GSV, and existing reduction algorithms at the end of Section 3.2 (line 458). Besides, we have presented information about algorithm intuition, which may be helpful in reading and understanding (line 431).

3. We have added the description of factors affecting classification accuracy of reduction algorithm outputs to Section 4.3(line 654-656).

4. We have adjusted the conclusion of experiments (line 714-718) and Section 5 (line 727-736), which are more accurate to illustrate our researches.

5. In Section 4.3, we have added an experiment to verify the performance of reduced data set generated by chi-square feature selection and proposed reduction algorithms in classification.

5. We have removed some references that are not highly relevant to this paper.

6. We have checked the manuscript, corrected the language problems and confusing contents including the formula, description of algorithms, content expression and so on.

Answers to Reviewers:

To reviewer #1:

Comments and answers:

1. In this paper, the authors term granularity as the partition, it can't be quite convincing to me. Moreover, the formula of granularity makes me confused originally, because C denotes the conditional attributes, while here indicates the set of some objects.

**Answer: Thanks for your comments. In classic rough set based granular computing model, a partition of the universe is a basic granule (***section 3.3 of Wang GY, Yao YY, Yu H. A survey on rough set theory and applications. Chin J Comput, 2009, 32(7):1229–1246***). We have made the relationship between granularity and partition clearer in the paper. Please see line 444. Regarding the formula of granularity, we have revised it in the paper.**

2. I found some typos such as: in Algorithm 3.1, "TG:=TG-ec2" instead of "TG=TG-ec2"; in Definition 4, "let [x]G denotes …". I suggest the authors revise these minor mistakes and carefully check for spelling and language errors throughout the manuscript.

**Answer: Thanks for pointing out our negligence. We have revised these typos in the paper. Besides, we have checked the manuscript and corrected language errors we found.**

3. The decision table is mainly discussed, but below Definition 4, why the authors get back to attribute sets A which is the concept in IS?

**Answer: Thanks for reminding. Our original writing did cause ambiguity, and now we have revised it based on the reviewers' comments. Please see line 403.**

4. The returned result in Algorithm 3.3 is a reduct, I can't understand why this algorithm is named granularity search? And I think granularity search is supposed to be the other granular computing topic.

**Answer: Thanks for your comments. The task of the algorithms is to find a suitable granularity in a given granularity space. Considering the same keywords in granular computing topic, we have added the intuition description of algorithm below Algorithm 3.3 and a footnote in Algorithm 3.3 to indicate that the algorithm is not highly related to granularity search in granular computing. Please see line 431.**

5. For Tables 6-9, the values are expressed with two or three decimal digits, but "Average" values have three or four, so the numeric precision should be explained. Moreover, I think that the employed datasets are not associated, so such "Average" of values over these datasets has no semantic explanation, and it is not reasonable to support the authors' conclusion. I strongly suggest that the authors use the significance test to compare the average 10-fold cross-validation based accuracies over each dataset.

**Answer: Thanks for your suggestions. The comparison between proposed algorithms and the significance test method was added to experiments. We have used one of significance test methods, i.e., chi-square feature selection, to compare the average 10-fold cross-validation based accuracies over each dataset. Please see Section 4.3 (line 654).**

**About the processing of numeric precision, we have revised mentioned tables, which are consistent now. Please see Tables 7-10 in pages 33 to 35.**

**Regarding the interpretation of average accuracy, it can be taken as the classification accuracy estimation of related algorithms to unknown dataset based on algorithm performance on experiment data sets. We have added this description to Section 4.3 (line 675).**

To reviewer #2:

Comments and answers:

1. Why do you mention inconsistent decision tables in the title of this paper? Is there any difference for your attribute reduction algorithms when decision table is consistent or inconsistent?

**Answer: Thanks for your comments. The proposed algorithms work well for inconsistent decision tables and consistent decision tables. We have removed it from title.**

2. In your experiments, since all algorithms are based on the same reduction criterion, such as PRPR and DRPR, why did these four algorithms obtain different classification accuracies? Is that because the reduction results obtained by different algorithms are different? The authors should do more analysis on this point.

**Answer: Thanks for your comments. Yes, we have clarified this point at the beginning of Section 4.2. Please see line 654.**

3. The English should be improved with many typos.

**Answer: Thanks for your comment. We have checked the manuscript carefully and corrected errors we found.**

To reviewer #3:

Comments and answers:

- Originality:

1. in abstract: "At first, we introduce a concept named granularity space to establish a unified representation of five typical reducts." What authors call granularity space in the paper is simply a system of finer/rougher granularizations. I see no originality in it. In fact, for the unified representation it can be completely omitted.

**Answer: Thanks for your comments! We introduce granularity space for the convenience of related content writing. Our originality is proposing the efficient general attribute reduction algorithms for large-scale data processing. We have strengthened the clarity of originality in paper.**

2. The fact, that various notions of reducts utilized in RFS can be somewhat unified is quite well known -- it is always a minimal set of attributes which satisfy a "consistency" condition. Only parameter is how you define the "consistency" condition in inconsistent information system.

**Answer: Thanks for your comments! The viewpoint of unified representation of reducts mentioned above is consistent with the research [17], and research [17] can be interpreted as a special case of general reduct definition proposed by Yao et al. [32]. The original part of the manuscript does not clearly stress the innovation of granularity space and the importance of the unified representation; in view of this, we have strengthened Section 3.1 to emphasize the innovation of granularity space to Yao’s definition. The unified representation of five reducts in granularity space is a good example/support of granularity space’s application.**

3. in abstract: "Based on the unified representation, we construct two quick general reduction algorithms by extending the positive region approximation to the granularity space." Yes, the algorithms are described, however relationship to known algorithms must be explained.

**Answer: Thanks for your reminding. We have added the discussion about the relationship to known reduction algorithms at the end of Section 3.2. Please see line 457.**

- Linguistic quality:

1. The paper contains many mistakes in grammar and in math, which makes it very hard to read: Take for instance Definition 4: Given a decision table DT = (U, C \cup D, V, f) and a granularity G of U.

(incomplete sentence)

Let [x]\_G denotes a set of objects that belong to the same set in G.

(denote, missing 'as x' at the end.)

The granularity approximation of G in U/B is defined as follows.

GA(U/B,G) = \bigcup{[x]\_B | [x]\_B \subseteq [x]\_G }

(missing any quantification of the x, 'GA' is in italics but should not be)

This is just randomly chosen part of the text. Entire theoretical part of the text looks like this. The text must be improved to be more rigorous.

**Answer: Thanks for your reminding. We have checked the manuscript carefully and corrected the errors we found.**

- **Correctness/Soundness**:

1. I have also concerns about soundness of the results: For instance, the authors define particular hash function to improve efficiency of the algorithms. Hash functions are supposed to assign a slot (integer) to a key. The hash functions in the paper assign, for instance, a vector of fraction, or sets. Their use does not bring any efficiency. The authors are either really bad at explaining their results or their results are incorrect. This can be caused the above-mentioned bad quality of the text.

**Answer: Thanks for your suggestions. The difference between Algorithm CTGA and Algorithm CTGHF is the data structure used. That is to say, hash functions are implemented by dictionary, a data structure in python, which is more efficient in data reading and writing in comparison to the list used in CTGA. In our experiment result, computing target granularity $TGran(PRPR)$ for dataset Connect4 using CTGHF consumed 2.70728020 s, which is faster than that consumed in CTGA, i.e., 36.68522760 s. We have added the related description below Algorithm CTGHF. Besides, we have checked all the descriptions of the algorithm. Related source codes will be uploaded in the future.**