Dear Editor,

We are very much thankful to the editor and the three reviewers in providing positive comments and the constructive reviews in the second phase of reviews. We have revised the manuscript to address the reviewers’ comments. We took every effort to provide answers and justifications for all the comments. We believe that all the comments made by reviewers have been carefully addressed and accommodated. The track changes in the manuscript are corresponding to the changes we made to the manuscript based on reviewers’ comments. The comments of the editor and the three reviews have been considered separately and provided answers for them point by point as follows.

Thank you very much.

Yours sincerely,

M.A.P. Chamikara

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| **Responses to Editor's comments** |

We thank the editor for your efforts and valuable comments. Please see our responses and the track changes made in the revised manuscript.

1. Put special emphasis in addressing the recommendations of reviewer 1.

Authors’ Response

Special emphasis has been laid upon the comments of Reviewer 1.

### Resubmission checklist:

When resubmitting, in addition to any revised files (e.g. a clean manuscript version, figures, tables, which you will add to the "Primary Files" upload section), please also provide the following two items:

1. A rebuttal Letter: A single document where you address all the Editor and reviewers' suggestions or requirements, point-by-point.

Authors’ Response  
We have addressed all the comments either by justifying our methods or incorporating the reviewers’ comments to our paper.

1. A 'Tracked Changes' version of your manuscript: A document that shows the tracking of the revisions made to the manuscript. You can also choose to simply highlight or mark in bold the changes if you prefer.

Authors’ Response  
A tracked changes version of the manuscript was submitted. The page numbers and line numbers of the modified content is provided under the author’s response (Please be kind enough to refer the “Tracked Review” version to check for the modifications).

1. Accepted formats for the rebuttal letter and tracked changes document are: DOCX (preferred), DOC, or PDF.

Authors’ Response  
We submitted docx versions of the rebuttal letter and the tracked changes document.

1. As you previously uploaded a single manuscript file for your initial submission you will need to upload any primary high resolution image and table files separately if you have not already done so.

Authors’ Response  
High resolution images and table files were uploaded separately.

1. PeerJ does not offer copyediting, so please ensure that your revision is free from errors and that the English language meets our standards: uses clear and unambiguous text, is grammatically correct, and conforms to professional standards of courtesy and expression.

Authors’ Response  
The paper was copyedited in the previous review by a Qualified Instructor, English Teaching Unit (ELTU), University of Peradeniya. A scanned copy of the acknowledgement letter was provided with the previously submitted rebuttal letter.

The same English instructor proofread the newly reviewed version also.

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| **Responses to Reviewer 1** |

We thank the reviewer for your efforts and valuable comments. Positive comments are really appreciated. Please see our responses to the constructive comments below and the tracked changes made in the revised manuscript.

**Basic reporting**

1. I have to object that I cannot really see the necessity of this new method, mainly looking at the results on the general data-sets. They are always worse than previous ones when looking at the statistical comparison. Hence, why not to apply previous methods to their problem instead of inventing some new complex algorithm? I cannot really see this point. I would expect an application paper where they consider different existing algorithms, and in case that the new one is better in that scenario, which would make much more sense.

Authors’ Response

* The main functionality of the proposed algorithm is to find the similarity between a crime under investigation and a criminal with a historical criminal record. As the main output of the algorithm, it generates a percentage similarity value (similarity score) which gives an insight to how much a crime and a criminal are related.
  + For example, let’s assume that there is a criminal with previous convictions. Let’s also assume that there has been a crime with a particular modus operandi (MO). The proposed system evaluates the previous convictions of that particular criminal and finds a similarity score. If the MO properties of the criminal and the crime are very similar, a high similarity score close to 100 is calculated.
* As the literature provides a very few number of methods dealing with automated MO analysis, we had to use a generalized way of comparing the performance with existing methods.
* Therefore, for the evaluation of the proposed method, the algorithm was adapted to a classifier.
* But, we have to be clear that the main purpose served by the algorithm is not classification, rather it is used in a more generalized way to find the percentage of similarity between a criminal and a crime.

1. Moreover, why are they considering the RMSE? Being a classification model, it does not make much sense

Authors’ Response

Thank you very much for noting that RMSE is not a good measurement to measure/compare the performance in this study. Initially what we expected from RMSE measurements was to strengthen the performance results obtained through the AUC values of ROC results of the general classification algorithms that were used for the comparison. After your review, we excluded the RMSE results from the paper and conducted the performance evaluation using the AUC values of ROC results and the execution time values.

1. With respect to the problem of classes with only one instance, I continue not understanding why this is not a problem.

Authors’ Response

* The proposed model is already finalized and will not be adjusted during the training process. Therefore, there will not be any negative impact from the classes with single instances on the model.
* What is actually subjected to change is the feature matrix resulting the deviation probability (DP) and completeness probability (CP) to be changed accordingly.
* The threshold to what the crime to be actually classified into is decided with the highest similarity score in turn.
* It’s a true that the stability of DP and CP get decreased with the smaller number of instances of a particular class.
* In practice we see a considerable number of criminals who have committed only one crime. This was one reason for us to consider criminals with one previous conviction. The results prove that our method produces unbiased results under such situations.

1. I cannot understand how this can work in a classification scenario where cross-validation is used to validate the models.

Authors’ Response

As noted in the authors’ response to comment 1, the 10-fold cross-validation was used only for the validation of the proposed method. But, in the actual scenario, the concept of similarity score will be used.

#### Experimental design

1. I do not understand why they considered the RMSE

Authors’ Response

As mentioned under the authors’ response to comment 2 of “Basic Reporting” we removed the RMSE results from the results and discussion of the paper.

1. Also, they did not show the p-values of the statistical tests.

Authors’ Response

Thank you very much for noticing the unavailability of p-values. We have added them to the corresponding sections where Friedman’s rank test was carried out. Please refer lines 713,714,715, 737,738 and 738 to see the information about p-values and the test statistics.

1. The problem with classes with one instance still continues.

Authors’ Response

Justifications have been provided under the authors’ response to comment 3 of “basic reporting”.

#### Validity of the findings

1. Not clear due to the data-set used.

Authors’ Response

Justifications have been provided under the authors’ response to comment 3 of “basic reporting”.

Following, we have also provided some of the justifications provided under rebuttal letter one to make our justifications more clear.

The actual dataset was prepared from the solved cases where the criminal profiling was conducted by police officers in Sri Lanka Police. The data set was verified by a domain expert before being used in the analysis.

* 1. It should be noted that the selected 67 records are the best representative records that we could find from the available crime records at Sri Lanka Police. These records were verified by the domain experts at Sri Lanka Police.

Although the Sri Lanka police crime investigation procedure is more than 100 years old, the system is totally a manual system. There are no any methods to keep track of crimes conducted by the same criminal. Therefore, we had to conduct a very deep scraping on GCR (grave crime record) data to find the crimes conducted by each criminal. Since, there are no any methods to track the crimes, sometimes the same criminal has provided different identities. But, of course we can generate a huge dataset of classes (criminals) with single instances of crimes. But, for the validation procedure, it’s not suitable.

* 1. Due to these problems, we tried in deriving a suitable dataset from online databases. But none of those data repositories contain datasets similar to what we actually wanted (modus operandi datasets)

Also, the effects of the classes with single instances do not have a huge impact on the core module of our algorithm. If we further worry about our algorithm (as shown below), The main functionality of the proposed algorithm is to find the similarity between a crime under investigation and a criminal with a historical criminal record. As the main output of the algorithm, it generates a percentage similarity value (similarity score) which gives an insight to how much a crime and a criminal are related.

* For the evaluation of the dataset, the algorithm was then adapted to a classifier where the classification is done in the following manner.
  + Assuming 20 suspects (classes) are there, a particular crime will be classified into the class (suspect) which produces the highest similarity score.
* In our algorithm a model has already been finalized and will not be adjusted during the training process. Therefore, there will not be any negative impact from the classes with single instances on the model.

This in turn provides a positive aspect of our method which produces unbiased results under such circumstances.

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| **Responses to Reviewer 2** |

We thank the reviewer for your efforts and valuable comments.

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| **Responses to Reviewer 3** |

#### We thank the reviewer for your efforts and valuable comments.