MUSIC: Make Unification Simple In Image Classification

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***Abstract*—Training a model is the backbone of Machine learning because all the decisions will be done on its basis. Once it is trained we further improve it on the basis of feedback and our requirements. To perform this we use the process of fine-tuning, it is process to further retrain the pre-trained model on small target dataset, we combine multiple tasks and then retrain it on already trained model to improve the performance on these specific tasks. We observed the flaw in the process that when we merge our tasks and then do fine-tuning, our performance decreases. To solve this issue the concept of MUSIC (Make Utility Simple In Image Classification) takes place, we simply fine-tune the model on each task individually instead of merging them as one and as a result we achieved accuracy of 88**

***Index Terms*—component, formatting, style, styling, insert**

I. Introduction

In the last few years AI (Artificial Intelligence) has taken the world. AI models are trained on data to perform specific tasks. Common type of AI models include Supervised learning models which are trained in labeled data to predict outcomes such as regression and classification , Unsupervised learning models which are trained on unlabeled data to identify patterns such as K means classification, Deep learning models which uses neural networks like humans and process complex data like images, voice notes etc. AI models are used commonly as core of AI, we often edit them after training to achieve desired results. We train them to change the behavior, if we want to increase the response of specific class in case of classification then we need to retrain the model accordingly and vice versa. This process is called fine-tuning and it is different from training a model. In the context of training the model has not learned anything we assign it parameters and weights to operate while fine-tuning is process after training model where we take the pre trained model's behavior as a starting point and then tune it on specific tasks.

While performing fine tuning for experimentation on MNIST dataset we observed that overall our accuracy is decreasing, before fine tuning our accuracy was 91.70

A. Equations

The fine-tuning process can be mathematically represented as follows:

1. Start with the pre-trained model:

$$\mathcal{M}_0(\theta_0) \tag{1}$$

2. Fine-tune on the dataset of class 1 ($\mathcal{D}_1$):

$$\mathcal{M}_1(\theta_1) = \arg\min_{\theta} \mathcal{L}(\mathcal{M}(\theta), \mathcal{D}_1) \tag{2}$$

3. Fine-tune the updated model on the dataset of class 2 ($\mathcal{D}_2$):

$$\mathcal{M}_2(\theta_2) = \arg\min_{\theta} \mathcal{L}(\mathcal{M}_1(\theta), \mathcal{D}_2) \tag{3}$$

4. Fine-tune the updated model further on the dataset of class 3 ($\mathcal{D}_3$):

$$\mathcal{M}_3(\theta_3) = \arg\min_{\theta} \mathcal{L}(\mathcal{M}_2(\theta), \mathcal{D}_3) \tag{4}$$

Here:

- $\mathcal{L}$ represents the loss function (e.g., cross-entropy loss).
- $\mathcal{M}_i(\theta_i)$ denotes the model fine-tuned after training on class i.

Summary of the Fine-Tuning Process

In this approach, the pre-trained model $\mathcal{M}$ is fine-tuned incrementally on datasets corresponding to individual classes. Instead of merging datasets, we fine-tune the model sequentially for better class-specific learning.

1) We begin by fine-tuning the pre-trained model on data from class 1, updating its parameters to θ_1.
2) Next, the model fine-tuned on class 1 is further fine-tuned on data from class 2, resulting in updated parameters θ_2.
3) Finally, the model fine-tuned on class 2 is fine-tuned on class 3, producing the final model with parameters θ_3.

This method ensures that each class contributes to the model's performance individually, preventing performance degradation that can arise from merging tasks. As a result, we achieved a significant accuracy improvement compared to merging all classes before fine-tuning.

II. Related Work

a) Positioning Figures and Tables: Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns. Figure captions should be below the figures; table heads should appear above the tables. Insert figures and tables after they are cited in the text. Use the abbreviation "Fig. 1", even at the beginning of a sentence.

III. Design and Implementation

a) Positioning Figures and Tables: Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns. Figure captions should be below the figures; table heads should appear above the tables. Insert figures and tables after they are cited in the text. Use the abbreviation "Fig. 1", even at the beginning of a sentence.

A. Data Set

a) Positioning Figures and Tables: Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns.

B. Enviornment Specifications

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C. Methodology

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TABLE I
Table Type Styles

Table Head	**Table Column Head**		
	Table column subhead	***Subhead***	***Subhead***
copy	More table copy[a]		

[a]Sample of a Table footnote.

Fig. 1. Example of a figure caption.

Figure Labels: Use 8 point Times New Roman for Figure labels. Use words rather than symbols or abbreviations when writing Figure axis labels to avoid confusing the reader. As an example, write the quantity "Magnetization", or "Magnetization, M", not just "M". If including units in the label, present them within parentheses. Do not label axes only with units. In the example, write "Magnetization (A/m)" or "Magnetization {A[m(1)]}", not just "A/m". Do not label axes with a ratio of quantities and units. For example, write "Temperature (K)", not "Temperature/K".

IV. Evaluation

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V. Conclusion

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References

Please number citations consecutively within brackets [1]. The sentence punctuation follows the bracket [2]. Refer simply to the reference number, as in [3]—do not use "Ref. [3]" or "reference [3]" except at the beginning of a sentence: "Reference [3] was the first ..."

Number footnotes separately in superscripts. Place the actual footnote at the bottom of the column in which it was cited. Do not put footnotes in the abstract or reference list. Use letters for table footnotes.

Unless there are six authors or more give all authors' names; do not use "et al.". Papers that have not been published, even if they have been submitted for publication, should be cited as "unpublished" [4]. Papers that have been accepted for publication should be cited as "in press" [5]. Capitalize only the first word in a paper title, except for proper nouns and element symbols.

For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [6].

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