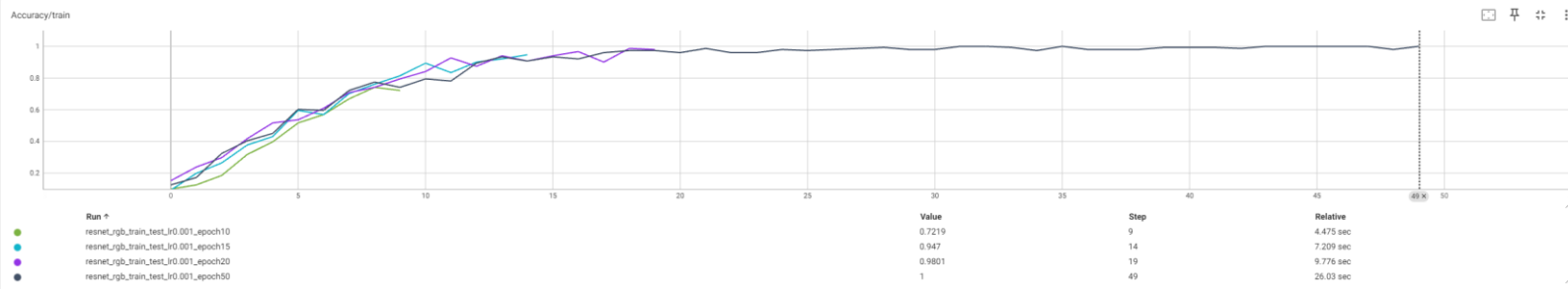
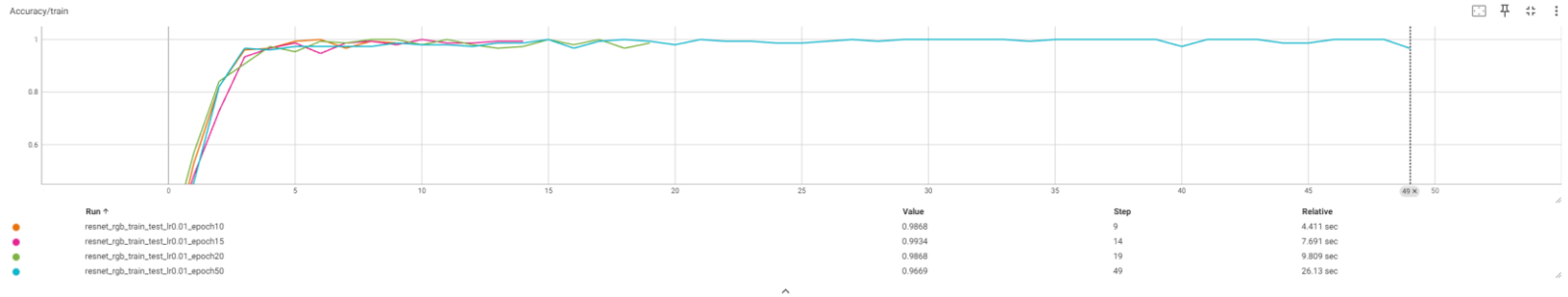
AI capstone project 1

0. Project GitHub: https://github.com/c1uc/2024_Spring-Artificial-Intelligence-Capstone/tree/master/Proj1
1. Research target: try to use some ML/DL method to classify the dataset containing the cards in BangDream! Game.
2. Dataset:
    a. The dataset containing 189 RGB images (thumbnail of cards) with shape (180 * 180).
    b. Data source: Bestdori!
    c. Labels: the dataset containing 10 different characters in the game, with 10~20 images collected for each character.
3. Methods:
    a. For supervised learning: I used RESNET-18 and HOG+SVM to classify the images.
    b. For unsupervised learning: I flattened the images and use k-means to cluster them.
4. Libraries:
    a. PyTorch as the main framework.
    b. Sklearn, skimage for k-means, SVM, and HOG.
    c. Matplotlib to make result plots.
    d. Some code is slightly modified from the help of ChatGPT.
5. Parameters:
    a. SVM: Linear kernel
    b. RESNET: combination of learning rate = [0.1, 0.01, 0.001] and epochs = [10, 15, 20, 50].
6. Results:
    a. RESNET with 80% train 20% test split

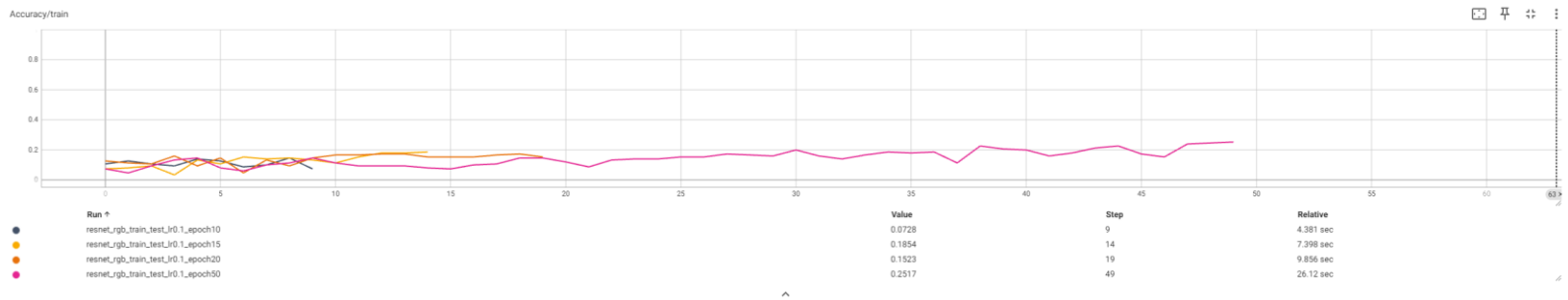
i. Training accuracy with learning rate = 0.001 and different epochs.



ii. Training accuracy with learning rate = 0.01 and different epochs.



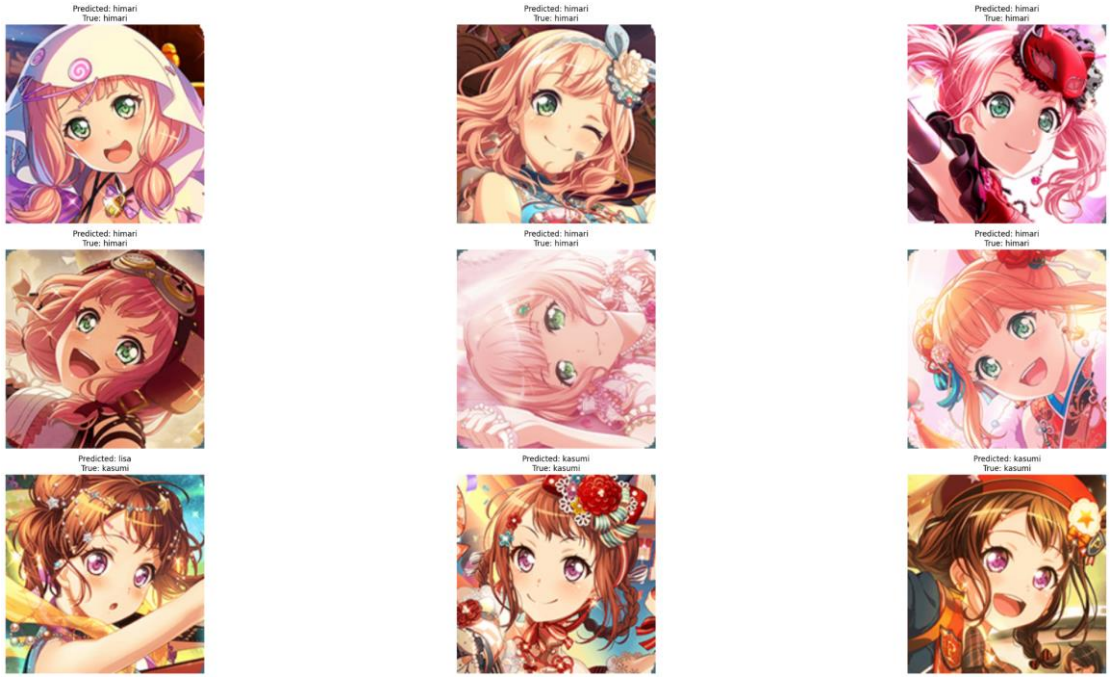
iii. Training accuracy with learning rate = 0.1 and different epochs.



iv. Test Accuracy Result Chart

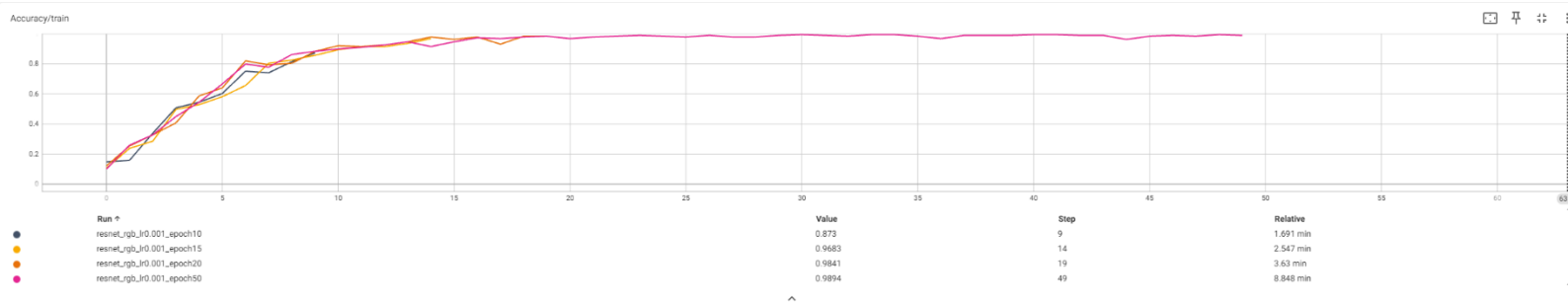
	Lr=0.001	0.01	0.1
Epoch=10	34.2%	60.5%	18.4%
15	47.3%	71.5%	21.5%
20	44.7%	65.7%	7.8%
50	57.8%	63.1%	28.9%

v. Example Result (whole image on GitHub)

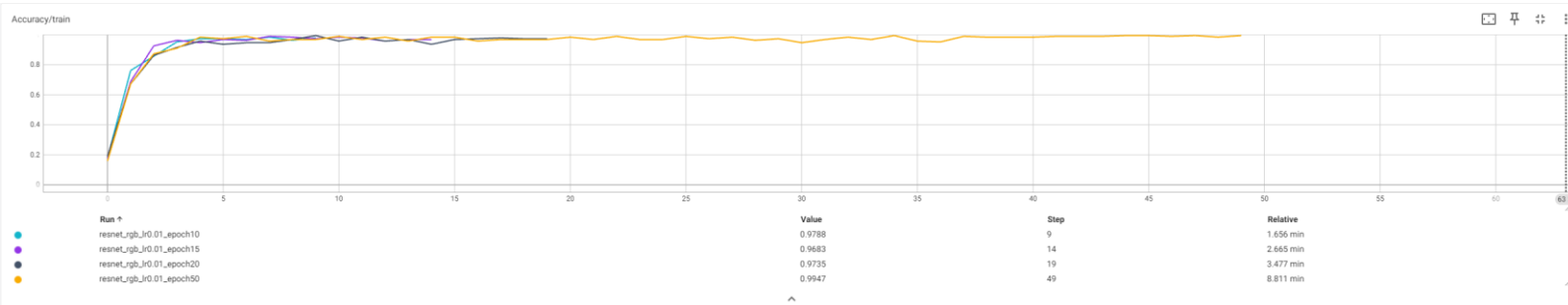


b. RESNET without train test split

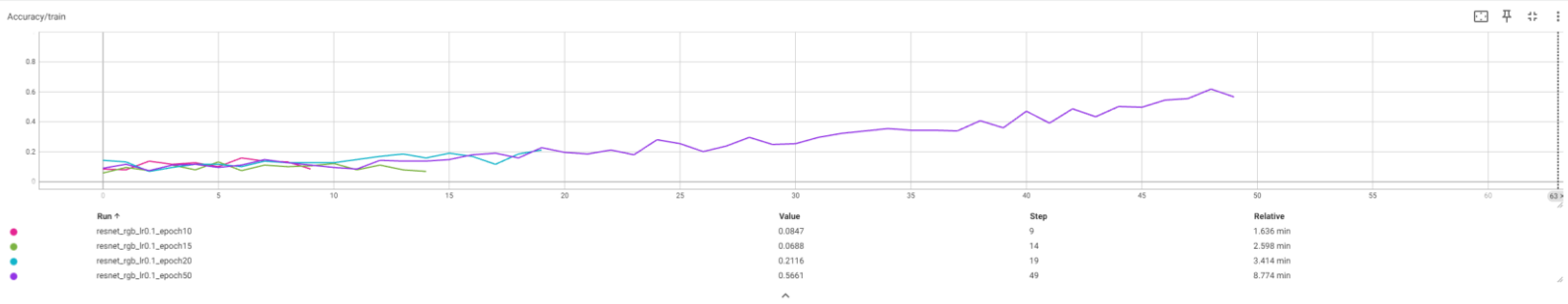
i. Training accuracy with learning rate = 0.001 and different epochs.



ii. Training accuracy with learning rate = 0.01 and different epochs.



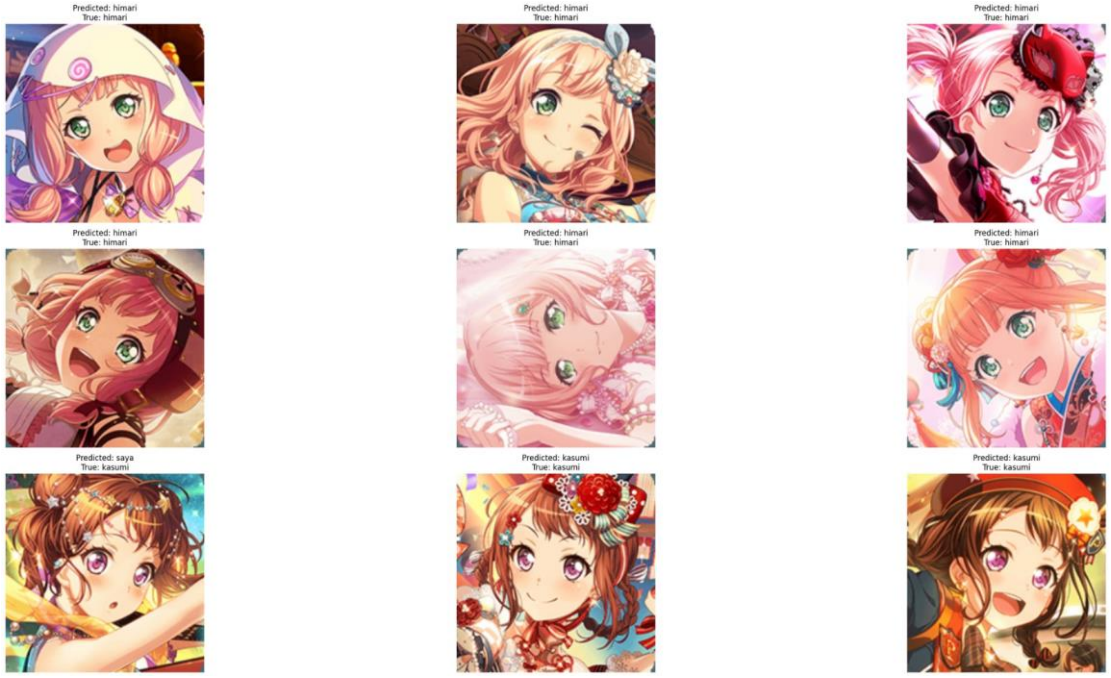
iii. Training accuracy with learning rate = 0.1 and different epochs.



iv. Ending Accuracy Result Chart

	Lr=0.001	0.01	0.1
Epoch=10	87.3%	97.8%	8.4%
15	96.8%	96.8%	6.8%
20	98.4%	97.3%	21.1%
50	98.9%	99.4%	56.6%

v. Example Result (whole image on GitHub)

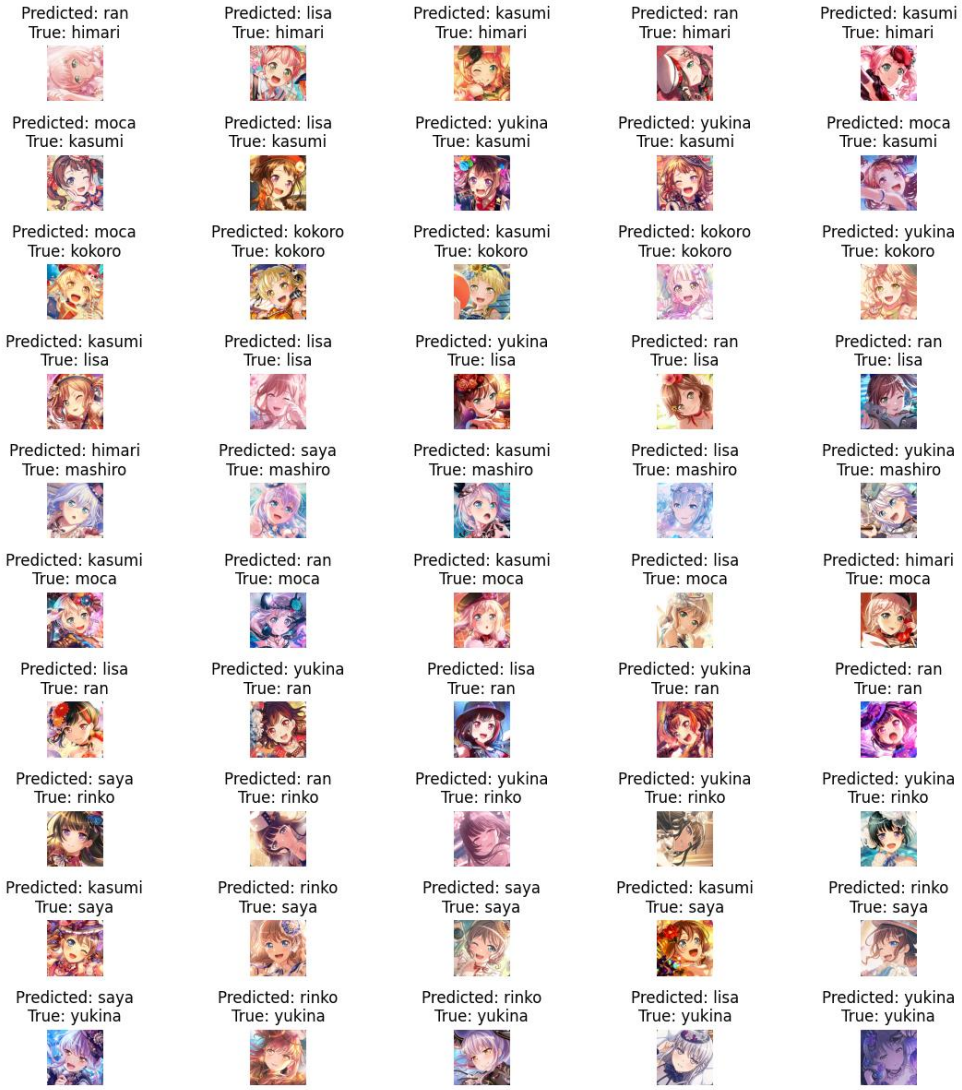


c. HOG+SVM with cross validation

i. 5-fold cross validation accuracy:

23.6%	21.0%	5.2%	34.2%	18.9%
Mean:	20.6%			

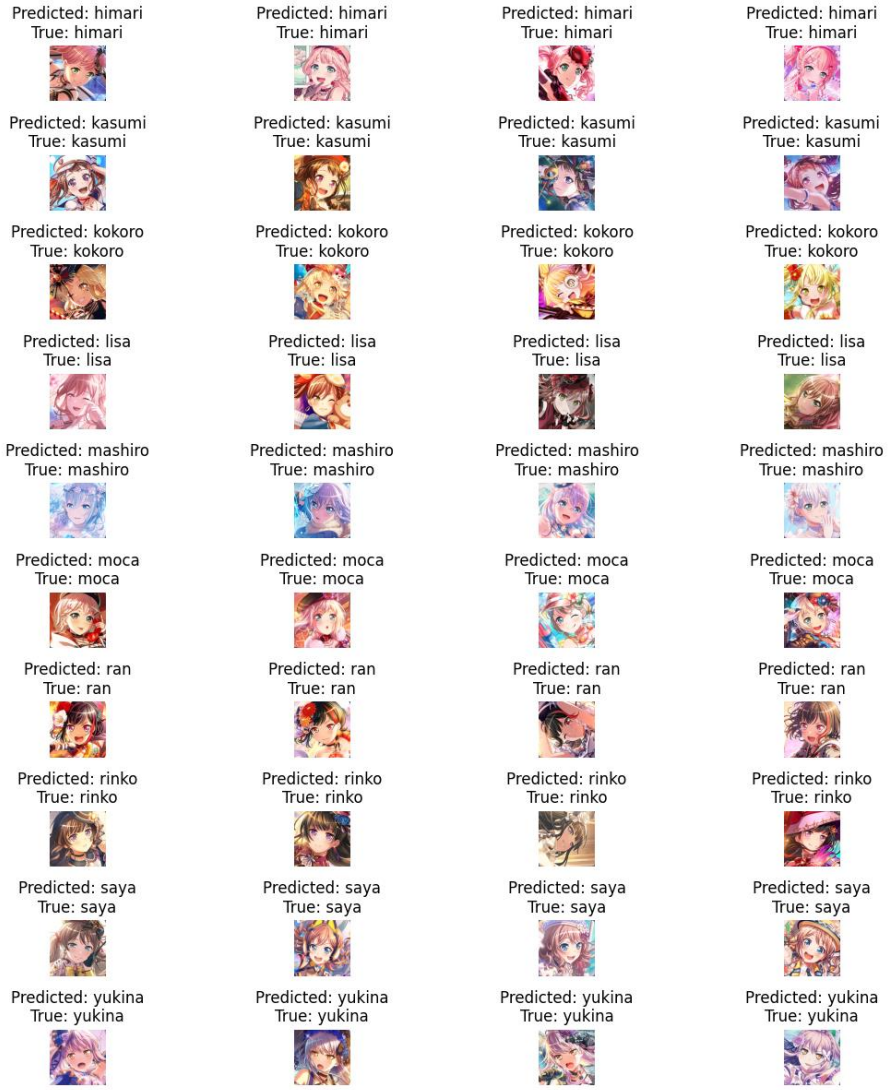
ii. Example Result:



d. HOG+SVM without split

i. Accuracy: 100%

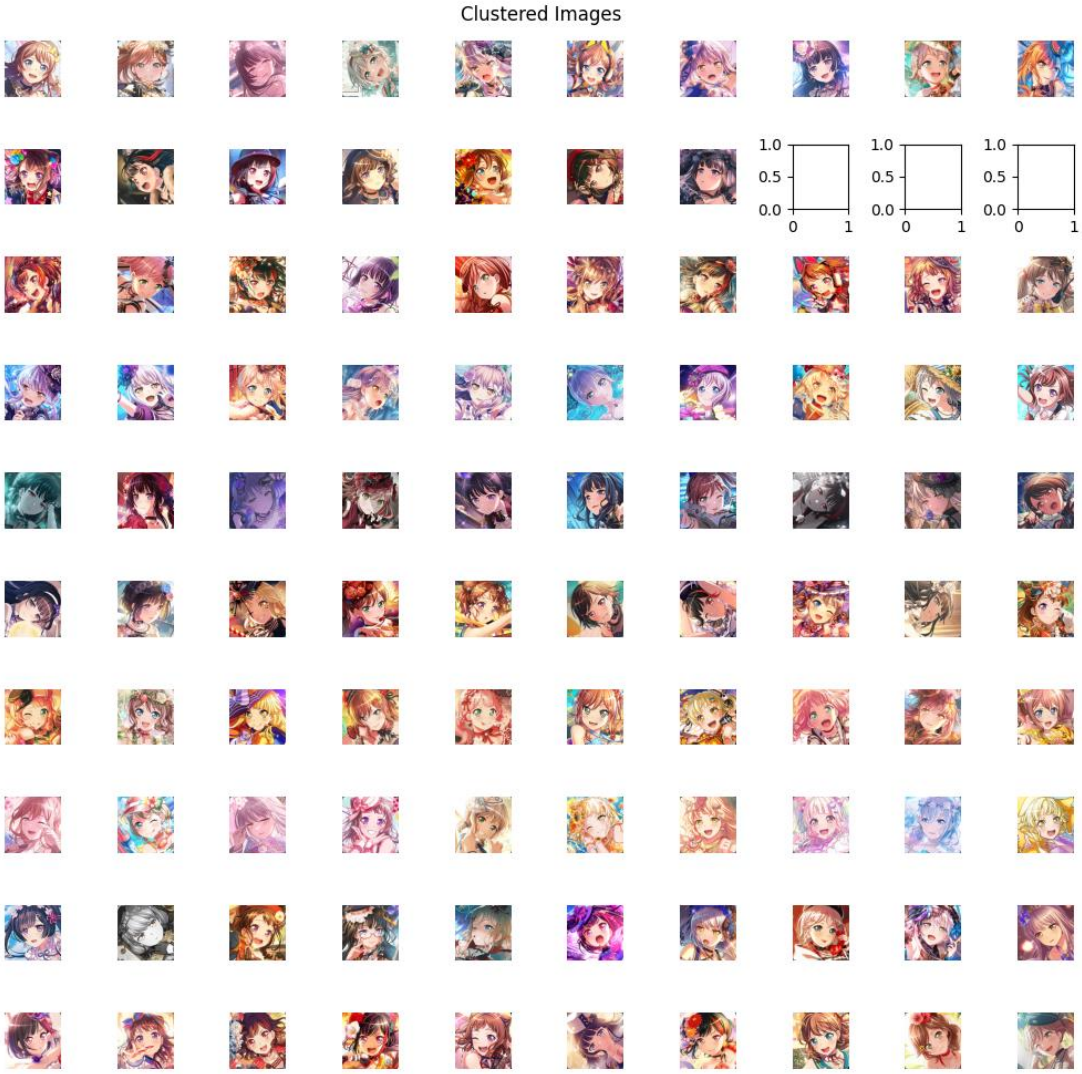
ii. Example Result:



e. K-means with 10 clusters

i. Accuracy: 2.6%

ii. Example Result:



7. Discussion
    a. Because I know classifying these images is quite a difficult job, especially for the models that are not CNN-based. So, I don't expect those models perform good.
    b. For RESNET, it could extract the features like the color accent, the eyes, the hairstyle, to classify the images. As you can see, if we use same dataset for training and testing, it can nearly reach 100% accuracy and this is the job what we need to do in reality (because we can get all available cards' thumbnail and train on it). Although I've trained it on train test split, it still performs well (around 60%).

c. For SVM+HOG, it can classify the train set well, but since the HOG feature extractor is trained on gray scale image, so it can't extract those features I've mentioned above well. Thus, it performs badly when encountering the images other than training images. As for the case when all images are known, it can perform perfectly to classify all the images, so this could be the best to conduct the game-card classification job in reality.
d. For k-means, it could cluster the images based on the color accent, but not learning the features of the characters, so its performance is surely bad.
e. If I could have more time, I want to experience more unsupervised learning to classify these images. Since I've searched and found some deep learning based unsupervised image clustering model, but I don't have time to dig into and understand the background, so I haven't taken those methods into experience.
f. From this project, I've learned about how to use the pretrained feature extractor (RESNET) and train on another dataset, and this is also first time for me to use HOG to extract features.
g. Remaining problem could be how to use the model to classify the unseen images, because training could be expensive and time-consuming, so maybe I need more hyperparameter tuning, or even try another Deep Learning feature extractor to train on this dataset.

8. References:

a. Bestdori: https://bestdori.com
b. ChatGPT: https://chat.openai.com