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Internship Report

LC25000: Comparative Analysis of CNN Models for Lung Cancer Classification Using Histopathology Images

1 Summary of Internship

1.1 Motivation

Lung cancer is one of the leading causes of cancer-related deaths worldwide. Early detection and accurate classification of lung cancer are crucial for effective treatment and improved patient outcomes. The application of deep learning techniques, especially Convolutional Neural Networks (CNNs), has shown promising results in the field of medical image analysis. This internship project aims to perform a comparative analysis of different CNN models for lung cancer classification using histopathology images.

1.2 Scope

The scope of this project is to explore and evaluate the performance of various CNN models on the LC25000 dataset, focusing on lung images of three classes for classification. The selected models include a custom model, ResNet50, EfficientNetB7, MobileNetV2, and VGG19. Additionally, an extended training of ResNet50 for 100 epochs was conducted for comparison.

1.3 Objectives

The objectives of this internship project are as follows:

1. Collect and preprocess the LC25000 dataset, containing histopathology images of lung cancer.
2. Implement different CNN models for lung cancer classification.
3. Train and validate each model using appropriate evaluation metrics.
4. Compare the performance of the models based on accuracy, precision, recall, F1-score, and other relevant metrics.
5. Identify the best-performing model for lung cancer classification.

2 Contribution

2.1 Dataset

Lung and Colon Cancer Histopathological Image Dataset (LC25000)

- **Name:** LC25000
- **Description:** The LC25000 dataset is a collection of 25,000 color images of histopathological tissue samples from the lungs and colon. The images are divided into 5 classes:
    1. Colon adenocarcinoma
    2. Benign colonic tissue

3. Lung adenocarcinoma
4. Lung squamous cell carcinoma
5. Benign lung tissue

- **Image size**: All images are 768 x 768 pixels in size.
- **File format:** All images are in JPEG format.
- **Source:** The images in the LC25000 dataset were originally obtained from HIPAA compliant and validated sources. They were then augmented using the Augmentor package to create the final dataset of 25,000 images.
- **License:** The LC25000 dataset is licensed under the Creative Commons Attribution 4.0 International

2.2 Work done

2.2.1 Evaluation of CNN Models

Various CNN models were implemented for lung cancer classification using the TensorFlow framework. The performance of each model was evaluated on the test set using accuracy and F1-score as the evaluation metrics.

1. **Custom Model:** This model achieved an accuracy of 92.4
2. **ResNet50 (10 epochs):** The ResNet50 model trained for 10 epochs achieved an accuracy of 84.1
3. **EfficientNetB7:** The EfficientNetB7 model obtained an accuracy of 33.9
4. **MobileNetV2:** The MobileNetV2 model showed better performance, achieving an accuracy of 84.9
5. **VGG19:** The VGG19 model had the lowest accuracy among all models, reaching only 31.7
6. **ResNet50 (100 epochs):** The ResNet50 model trained for 100 epochs achieved remarkable results, with an accuracy of 97.9

Table 1: Model Performance in Classification Task

Model	Test Accuracy	Precision	Recall	F1 Score
Custom Model	0.924	0.928	0.924	0.924
ResNet50 (10 epochs)	0.841	0.889	0.841	0.835
EfficientNetB7	0.339	0.115	0.339	0.171
MobilenetV2	0.849	0.872	0.849	0.844
VGG19	0.317	0.1	0.317	0.152

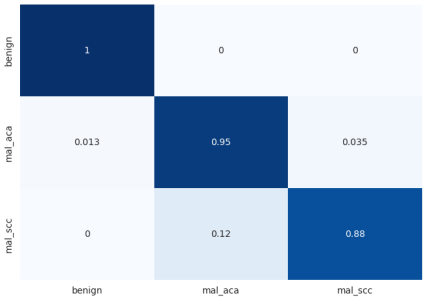

Figure 1: Confusion Matrix Table of Custom Model

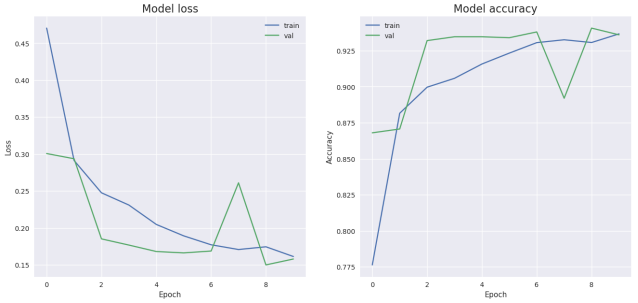

Figure 2: Model loss and Model accuracy of Custom CNN Model

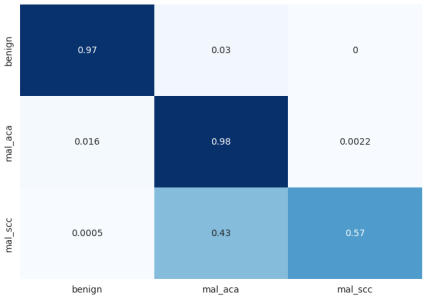

Figure 3: Confusion Matrix Table of ResNet50 Model

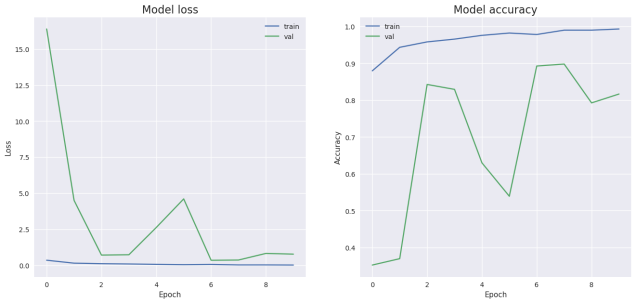

Figure 4: Model loss and Model accuracy of ResNet50 Model

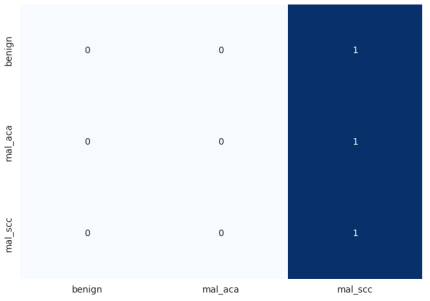

Figure 5: Confusion Matrix Table of EfficientnetB7 Model

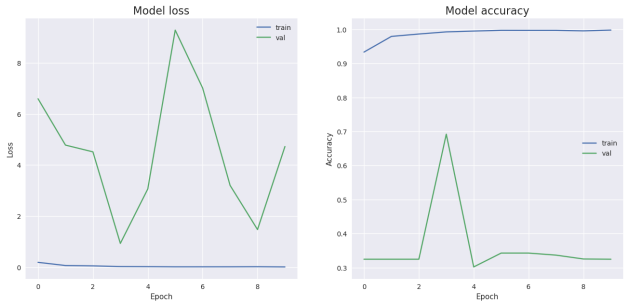

Figure 6: Model loss and Model accuracy of EfficientnetB7 CNN Model

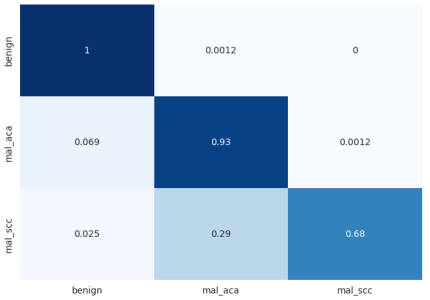

Figure 7: Confusion Matrix Table of MobilenetV2 Model

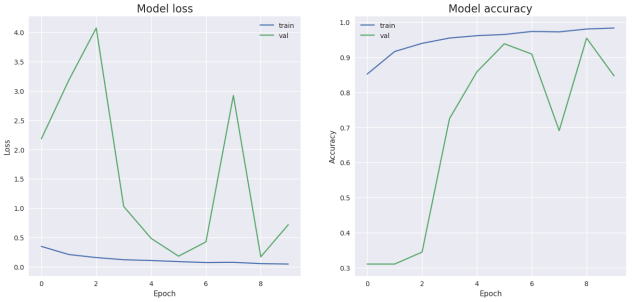

Figure 8: Model loss and Model accuracy of MobilenetV2 Model

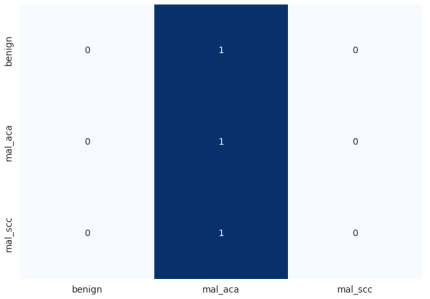

Figure 9: Confusion Matrix Table of VGG19Model

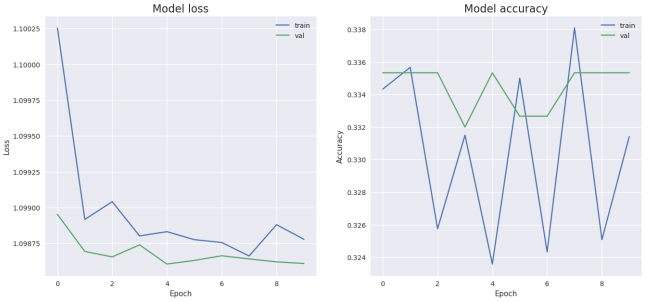

Figure 10: Model loss and Model accuracy of VGG19 CNN Model

The evaluation clearly indicates that the extended ResNet50 model trained for 100 epochs outperforms all other models in terms of accuracy and F1-score. This model shows great promise for practical clinical applications and may aid medical professionals in diagnosing lung cancer with high accuracy.

However, it is essential to consider the limitations of the study, such as the dataset's size and potential biases, which may influence the generalizability of the findings.

3 Conclusions

After conducting a comparative analysis of various CNN models for lung cancer classification using the LC25000 dataset, the results reveal that the model trained with ResNet50 for 100 epochs achieved the highest accuracy of 97.9% and an impressive F1 score of 0.976 on the test set. This extended training significantly improved the model's performance, making it the best accuracy model for lung cancer classification in this internship project. The custom model and MobileNetV2 also demonstrated reasonably good results, with accuracies above 84%.

For future work, exploring ensemble models by combining the best-performing CNN models could potentially further improve classification accuracy. Additionally, incorporating data augmentation techniques may enhance the model's ability to generalize across diverse histopathology images. Finally, investigating the use of transfer learning with large-scale medical imaging datasets could facilitate the development of robust and efficient models for lung cancer classification.

References

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