# Skin Cancer Detection Model Evaluation Report

Date: August 30, 2025
Model: Transfer Learning with ResNet50
Dataset: Subset of ISIC Skin Cancer Dataset
Epochs Trained: 10

## 1. Objective

The objective of this project was to train a deep learning model to classify skin lesion images into one of nine categories, including melanoma and various benign lesions. The approach utilized transfer learning with a pre-trained ResNet50 model to leverage its powerful feature extraction capabilities.

## 2. Model Performance

The model's performance was evaluated on a held-out test dataset consisting of 118 images. The key performance metrics are as follows:

- **Final Test Accuracy:** 0.4661 (46.61%)
- **Final Test Loss:** 2.8345

While a test accuracy of 46.61% is better than random chance for a 9-class problem (11.11%), it indicates that the model is not yet robust enough for practical use. The model's performance is not consistent across all classes, and there are significant areas for improvement.

## 3. Analysis of Training and Validation Metrics

An analysis of the training history plots reveals a clear case of overfitting.

- **Training Accuracy vs. Validation Accuracy:** The training accuracy consistently increased over the 10 epochs, reaching over 90%. In contrast, the validation accuracy remained relatively flat and low, hovering around 40-45%. This growing gap between training and validation accuracy is the primary indicator of overfitting. The model is effectively memorizing the training images instead of learning generalized features that apply to new, unseen images.
- **Training Loss vs. Validation Loss:** Similarly, the training loss steadily decreased, suggesting that the model was successfully minimizing errors on the training data. The validation loss, however, began to increase after the first few epochs, which is a classic symptom of overfitting. An increasing validation loss while training loss decreases means the model's ability to generalize is deteriorating.

# 4. Conclusion and Recommendations

The current model, while built on a strong foundation (ResNet50), suffers from severe overfitting. The limited size of the validation dataset may also contribute to the instability of the validation accuracy. To improve the model's performance and reduce overfitting, the following recommendations should be considered:

1. **Data Augmentation:** Implement data augmentation techniques such as random rotations, flips, and shifts to artificially increase the size and diversity of the training dataset. This can help the model learn more robust and generalizable features.
2. **Hyperparameter Tuning:** Experiment with different hyperparameters, such as a lower learning rate, to allow for more gradual and stable weight updates.
3. **Regularization:** Introduce regularization techniques like dropout layers to prevent the model from relying too heavily on specific features from the training data.
4. **Fine-Tuning the Base Model:** Instead of freezing all layers, unfreeze the top few layers of the ResNet50 model and train them with a very low learning rate. This allows the model to slightly adapt the pre-trained features to the specific task of skin cancer detection.