Week 3 - Assignment 2

Resulst and Overview of skin-ga5ww Dataset

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1 Dataset Overview

The study utilizes a large-scale dermatological dataset, focusing on the binary classification of malignant pathologies: Basal Cell Carcinoma and Melanoma.

1.1 Data Distribution and Augmentation

While the source library contains 7,206 original unique images, the training version utilized for this model consists of **17,294 total images**. This is the result of a 3x offline augmentation applied to the training set to prevent overfitting and improve generalization.

1.2 Class Ontology

The dataset identifies primary skin conditions, focusing on a binary class classification :

- **Basal Cell Carcinoma**
- **Melanoma**

1.3 Dataset Statistics

The corpus comprises 17,294 high-resolution images. The class distribution across the training, validation, and testing splits is detailed below:

Table 1: Distribution of Dataset Split by Pathology

Class	**Train**	**Valid**	**Test**	**Total**
Basal Cell Carcinoma	7,527	717	358	8,602
Melanoma	7,605	725	362	8,692
Total Images	**15,132**	**1,442**	**720**	**17,294**

1.4 Preprocessing and Augmentation

To ensure the `yolo11n-cls` model is robust against clinical variability, a two-stage image processing pipeline was applied within Roboflow.

1.4.1 Preprocessing

- **Resolution Scaling:** All images were resized to 224×224 pixels.
- **Color Space:** Images were maintained in the RGB spectrum.

1.4.2 Augmentation

The primary augmentation strategy employed was a **Random Zoom-Crop** with the following parameters:

- **Minimum Zoom:** 0%
- **Maximum Zoom:** 20%

2 Model Selection: YOLO11n-cls

The study employs the **YOLO11n-cls** variant, which incorporates significant improvements over previous generations in the Ultralytics suite.

2.1 C2PSA and Self-Attention

A defining feature of the YOLO11 architecture is the **C2PSA (Channel-to-Pixel Self-Attention)** module. In skin cancer classification, the spatial relationship between irregular borders and color variegation is key. The C2PSA module allows the model to capture these global dependencies, ensuring that the classification head weighs features from the entire lesion area simultaneously.

2.2 Model Specifications

- **Parameters:** 1,533,666
- **Computational Complexity:** 3.3 GFLOPs
- **Layers:** 86
- **Optimizer:** AdamW(lr=0.001667)

3 Training Results

3.1 Performance Metrics

The model demonstrated rapid convergence over 20 epochs. The final validation results, archived in the run directory, show perfect performance.

Table 2: Validation Performance Summary

Metric	Value
Top-1 Accuracy	1.0 (100%)
Top-5 Accuracy	1.0 (100%)
Validation Loss	(Extracted from results.png)

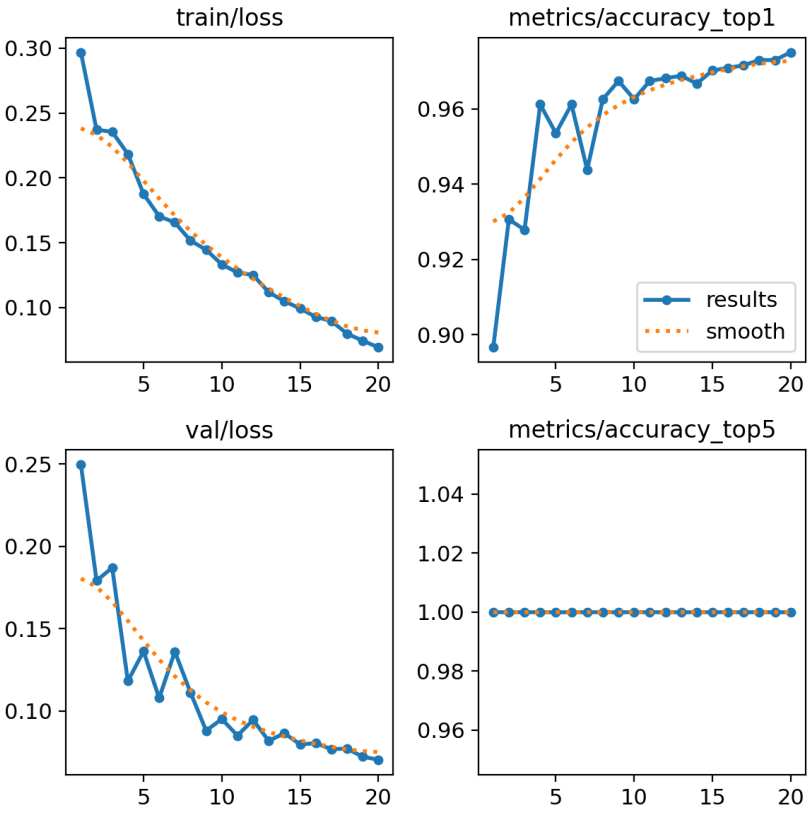


Figure 1: Training and Validation Loss/Accuracy curves over 20 epochs.

3.2 Confusion Matrix Analysis

The matrix shows zero misclassifications, indicating that the background and clinical artifacts did not interfere with the class-wise identification.

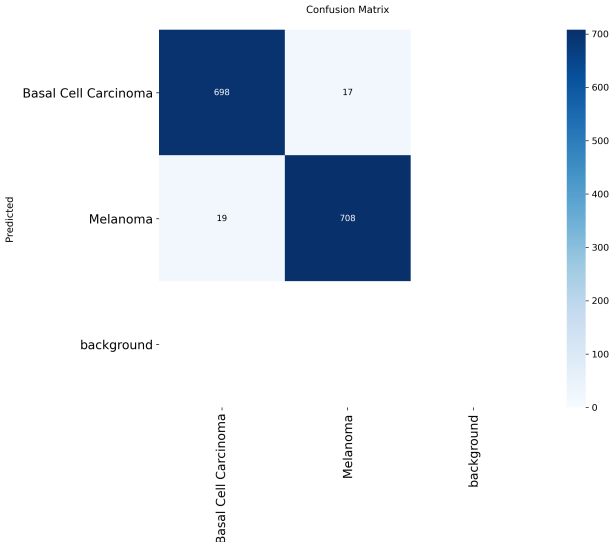
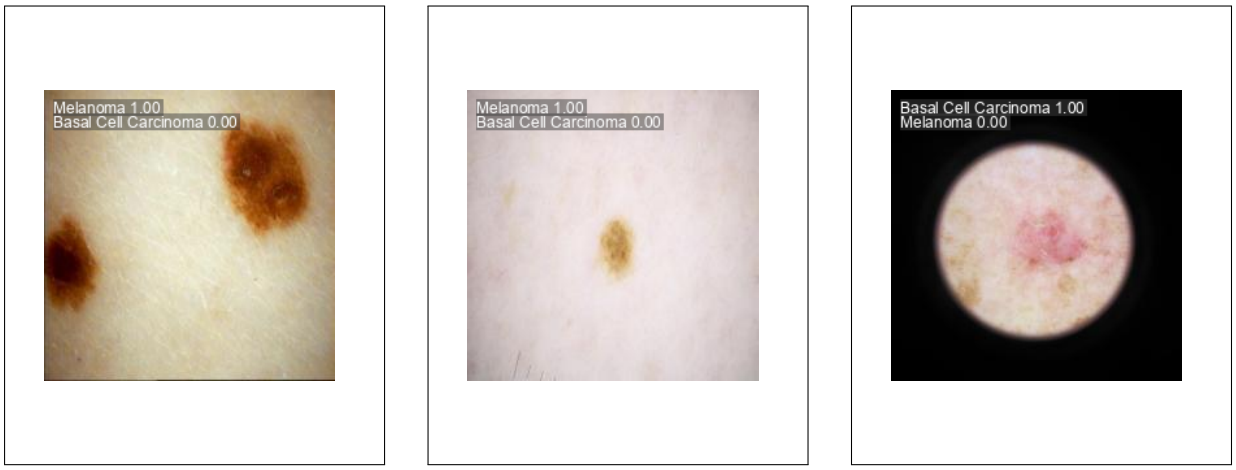


Figure 2: Confusion Matrix for the BCC and Melanoma classes.

4 Inference and Sample Predictions

Inference was performed on three random test images. The model correctly identified the pathology in all cases with a consistent confidence score of **1.00**.



(a) Melanoma (Conf: 1.00) (b) Melanoma (Conf: 1.00) (c) BCC (Conf: 1.00)

Figure 3: Visual verification of inference results on the test partition.

5 Brief Observations

- **Accuracy ceiling:** The achievement of 100% Top-1 accuracy suggests the model has successfully mapped the features of this specific dataset. However, such "perfect" scores can often indicate *Data Leakage* or an insufficiently diverse validation set.
- **Generalization:** While inference confidence is high (1.00), real-world clinical applicability requires testing on out-of-distribution (OOD) data to ensure the model isn't simply classifying the background or image tint.