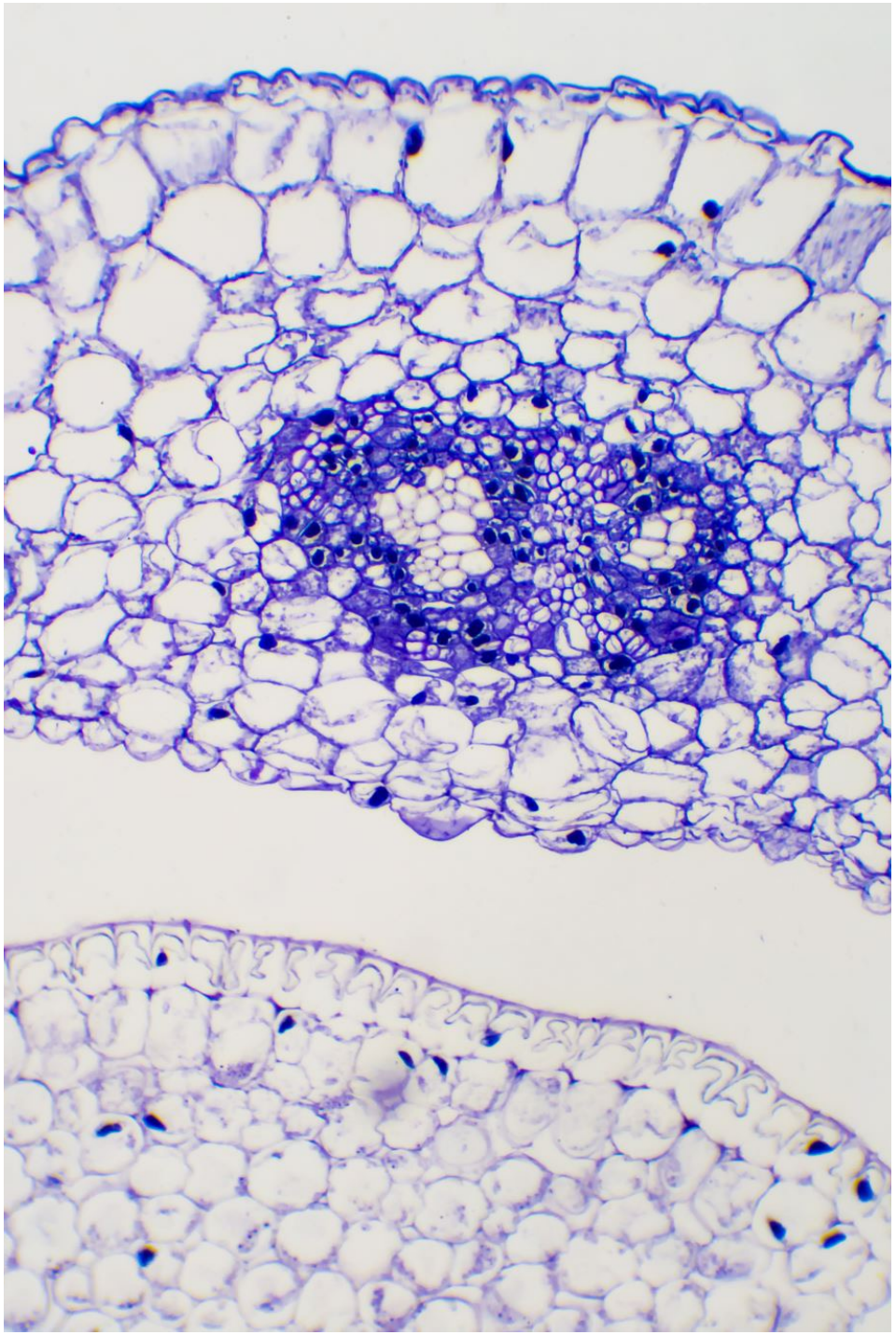
Capstone 3: Teledermatology Skin Lesion Classification

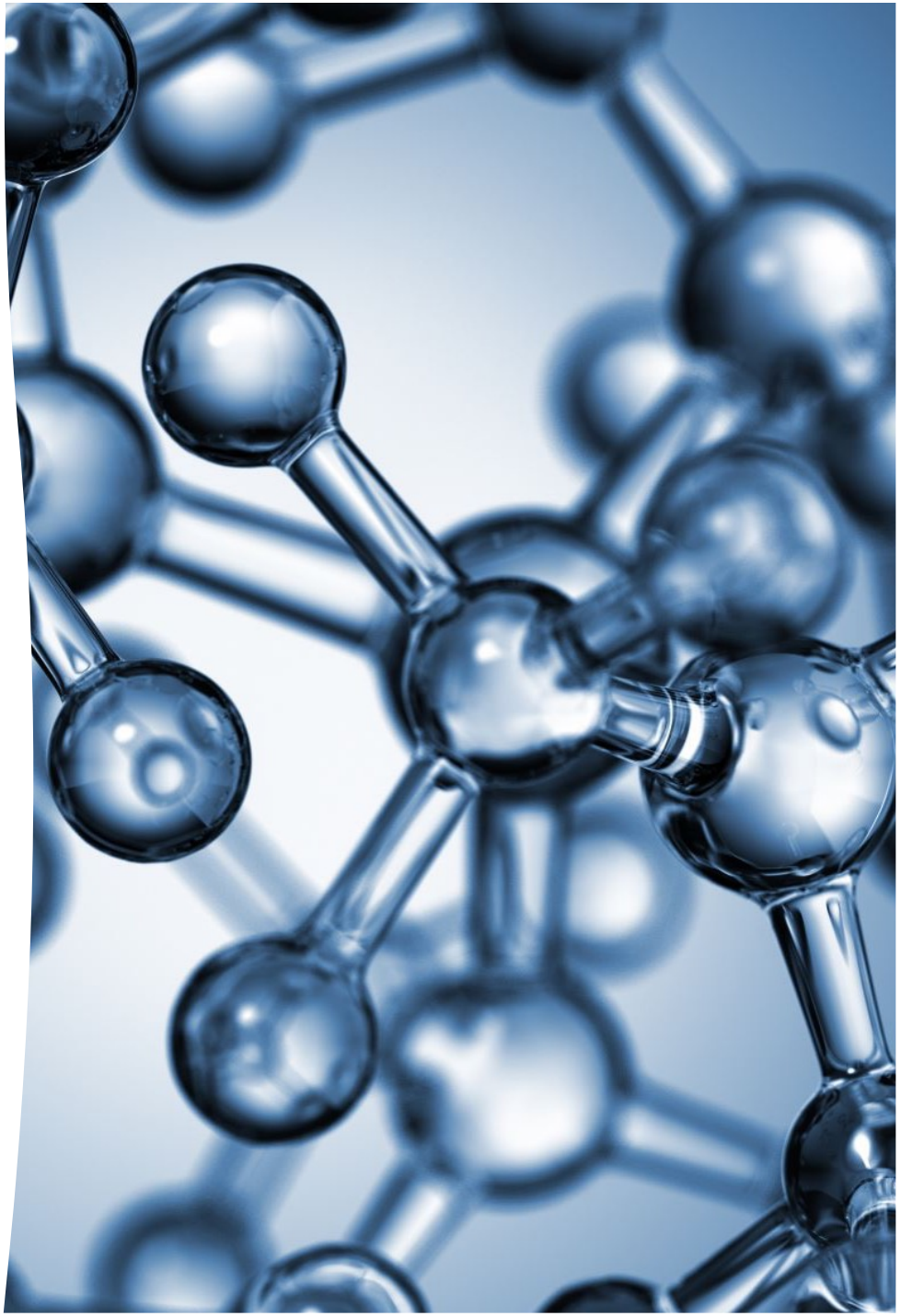
Manuel Ramirez Chimarro



Problem Statement & Context

Dermatological triage, especially in remote areas, can benefit from AI to classify skin lesions.

Goal: Support teledermatology diagnosis using machine learning on the HAM10000 dataset.



Stakeholders & Success Metrics

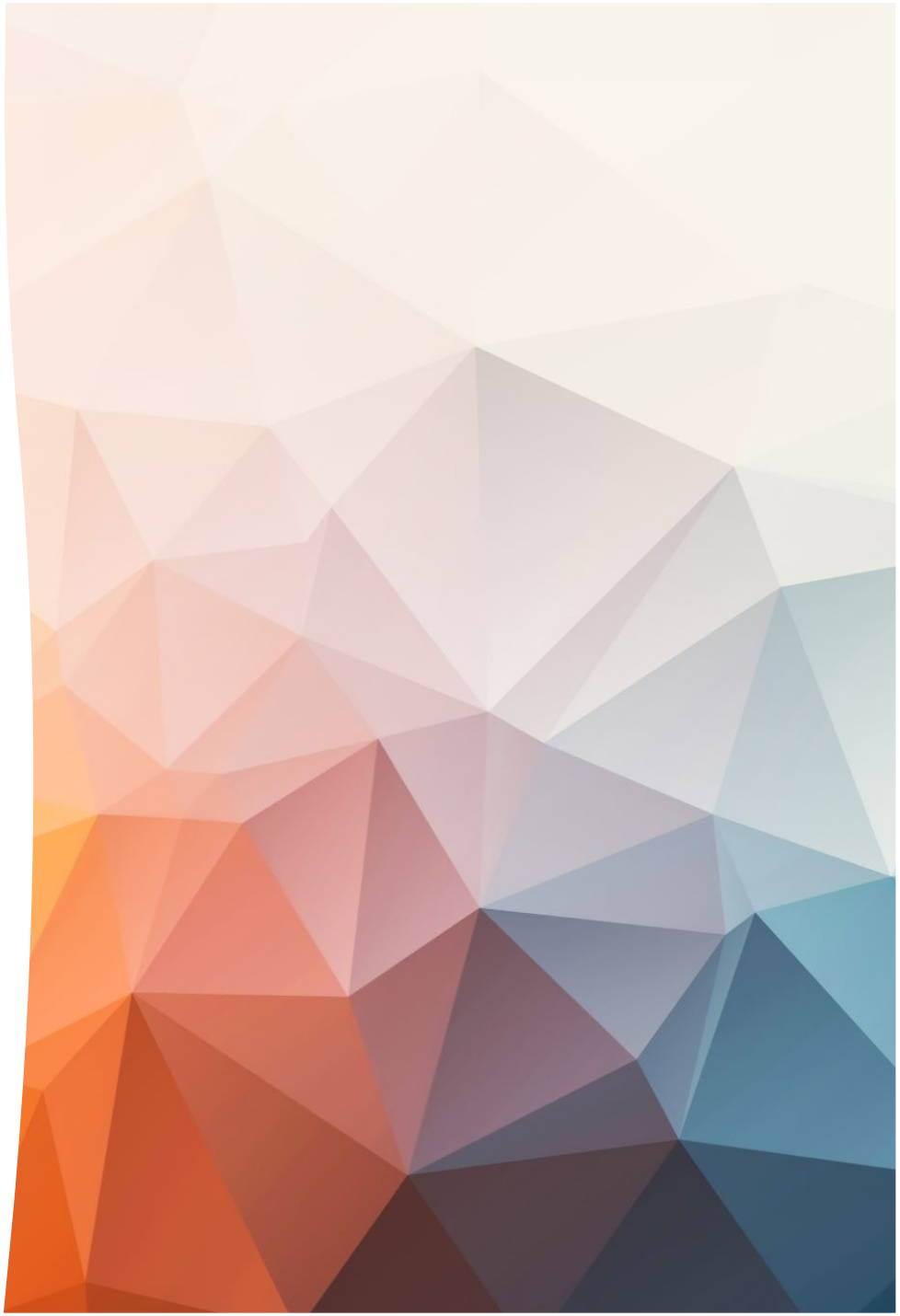
Stakeholders: Dermatologists, Clinics, Remote Healthcare Systems.

Success: Improve classification accuracy on rare lesion types (melanoma, vascular) with >75% overall accuracy.

Dataset Overview

HAM10000: ~10,000 dermoscopic images labeled with 7 skin lesion types.

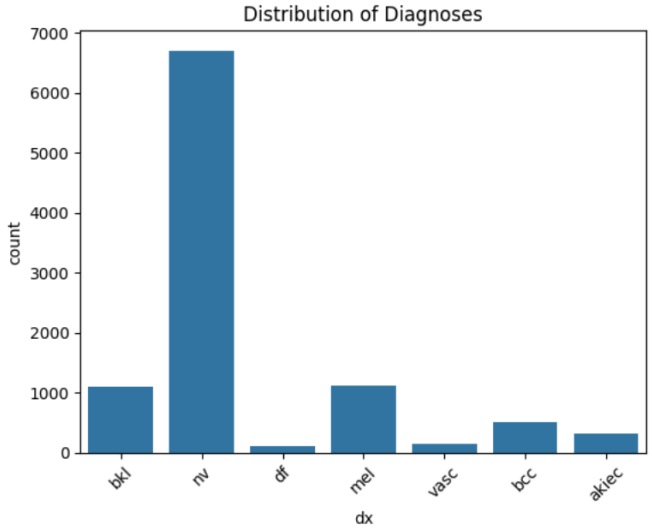
Metadata includes patient age, sex, lesion location, and diagnosis type.



- Dataset Overview”

- The dataset is heavily imbalanced — with over 67% of samples being nv (melanocytic nevi), while critical classes like mel (melanoma) and vasc (vascular lesions) are underrepresented. This imbalance necessitated the use of **focal loss** and **data augmentation** in modeling.

```
# Display numeric class distribution
print(metadata['dx'].value_counts())
print(metadata['dx'].value_counts(normalize=True) * 100)
```



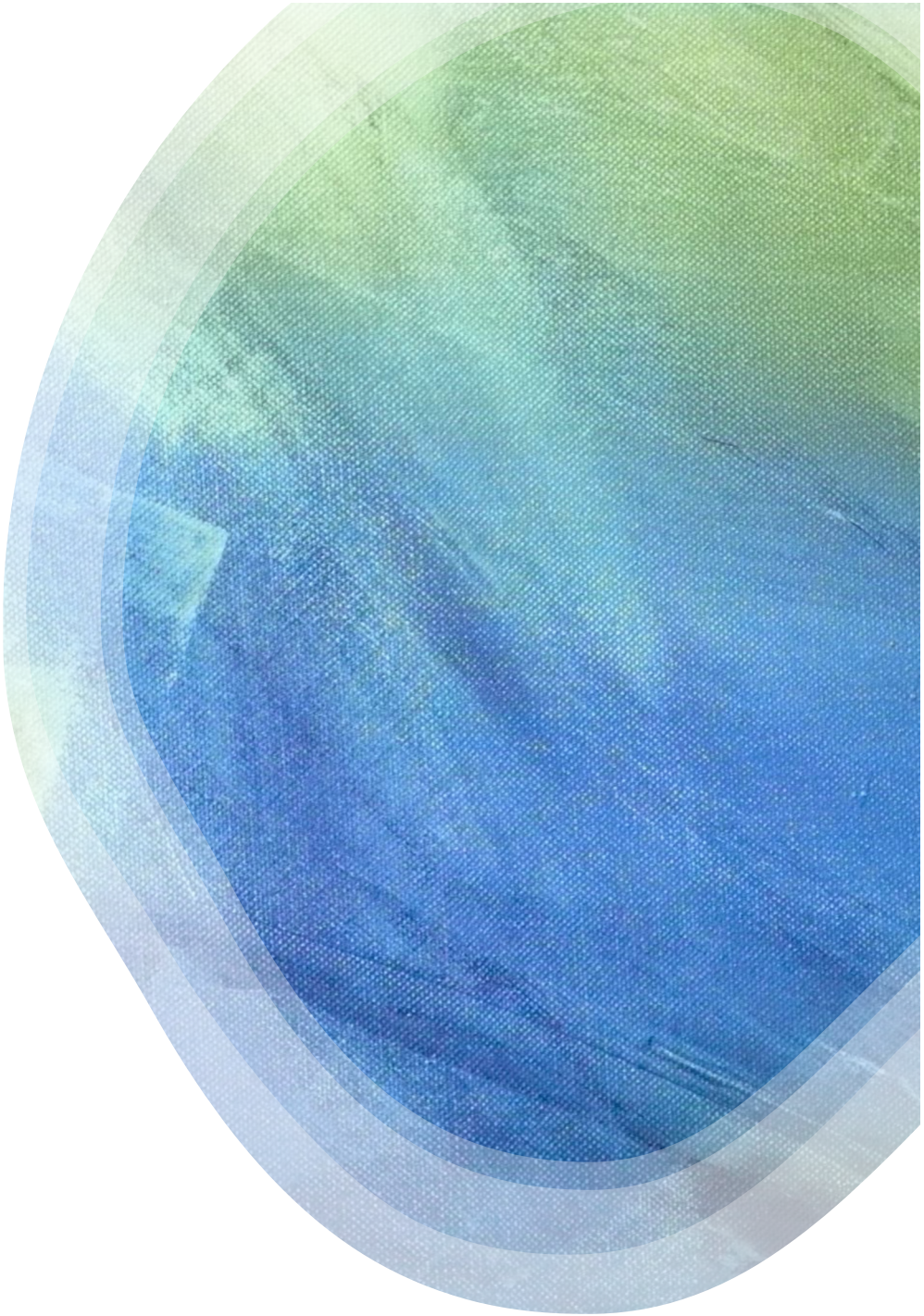

```
dx
nv       6705
mel      1113
bkl      1099
bcc       514
akiec     327
vasc      142
df        115
Name: count, dtype: int64
dx
nv       66.949576
mel      11.113330
bkl      10.973540
bcc       5.132302
akiec     3.265102
vasc      1.417873
df        1.148278
Name: proportion, dtype: float64
```

Data Wrangling

- Merged image metadata with filenames

- Encoded categorical variables (sex, localization)

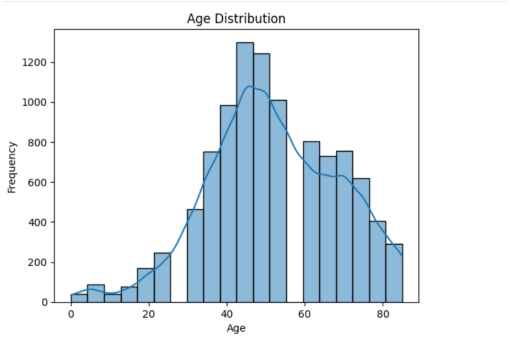
- Handled missing values and standardized features

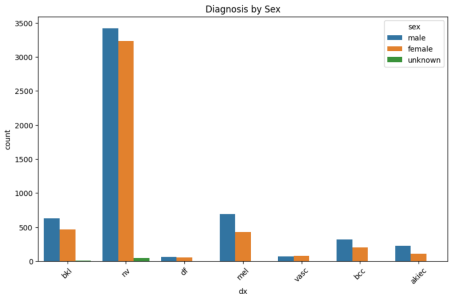


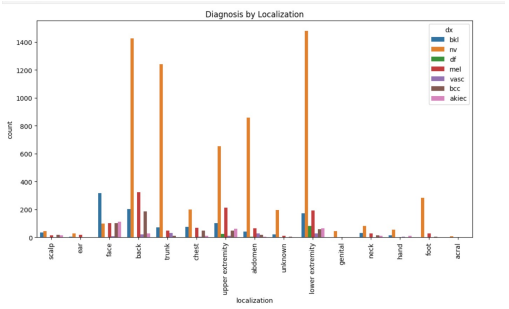
Exploratory Data Analysis

- - Imbalanced class distribution (e.g., 'nv' overrepresented)
- - Age distribution skewed older
- - Some lesion types had fewer than 100 examples

Exploratory Data Analysis







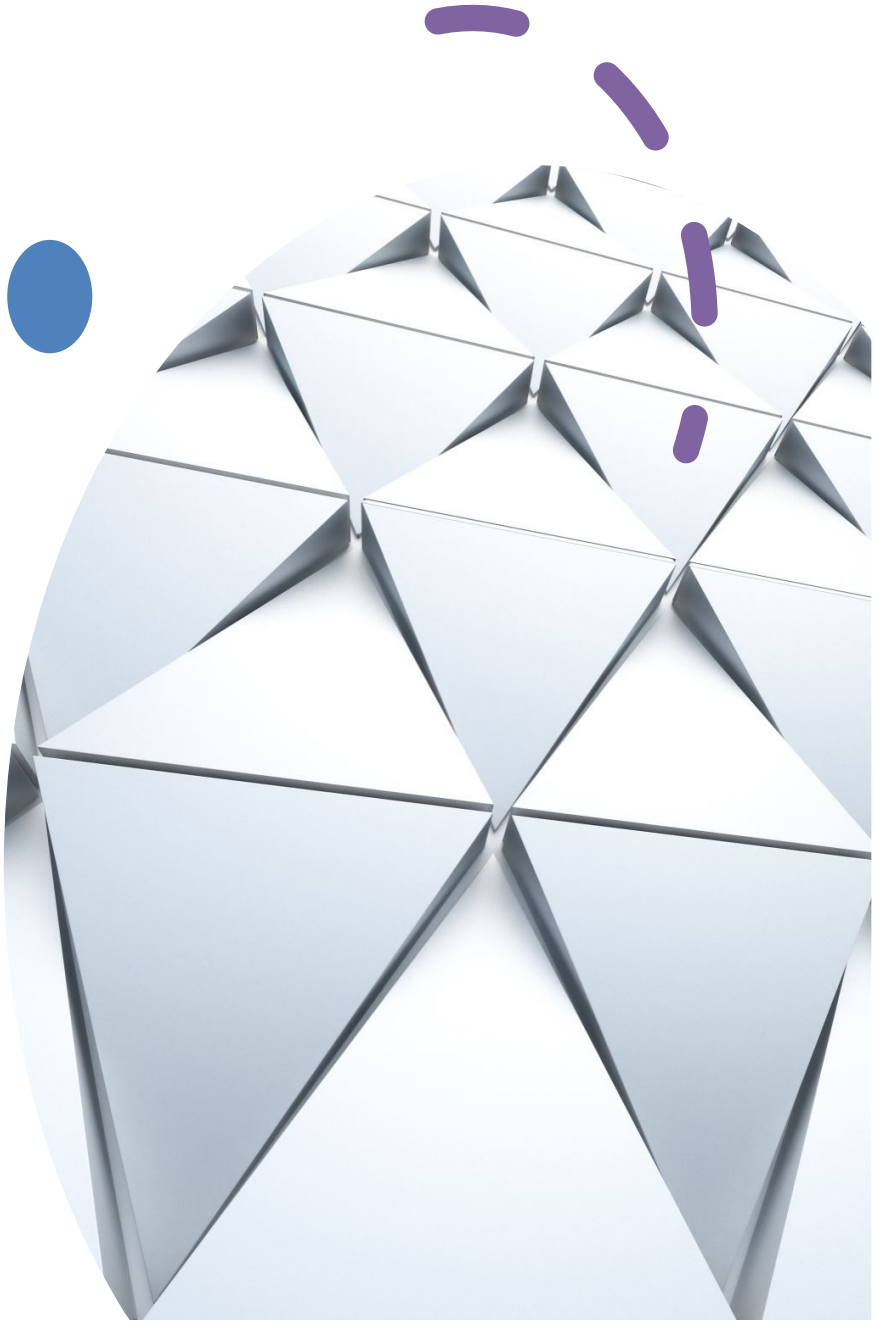
Modeling Approach

- Baseline: Logistic Regression, Random Forest on metadata

- CNN on images

- EfficientNetB3 pretrained model fine-tuned

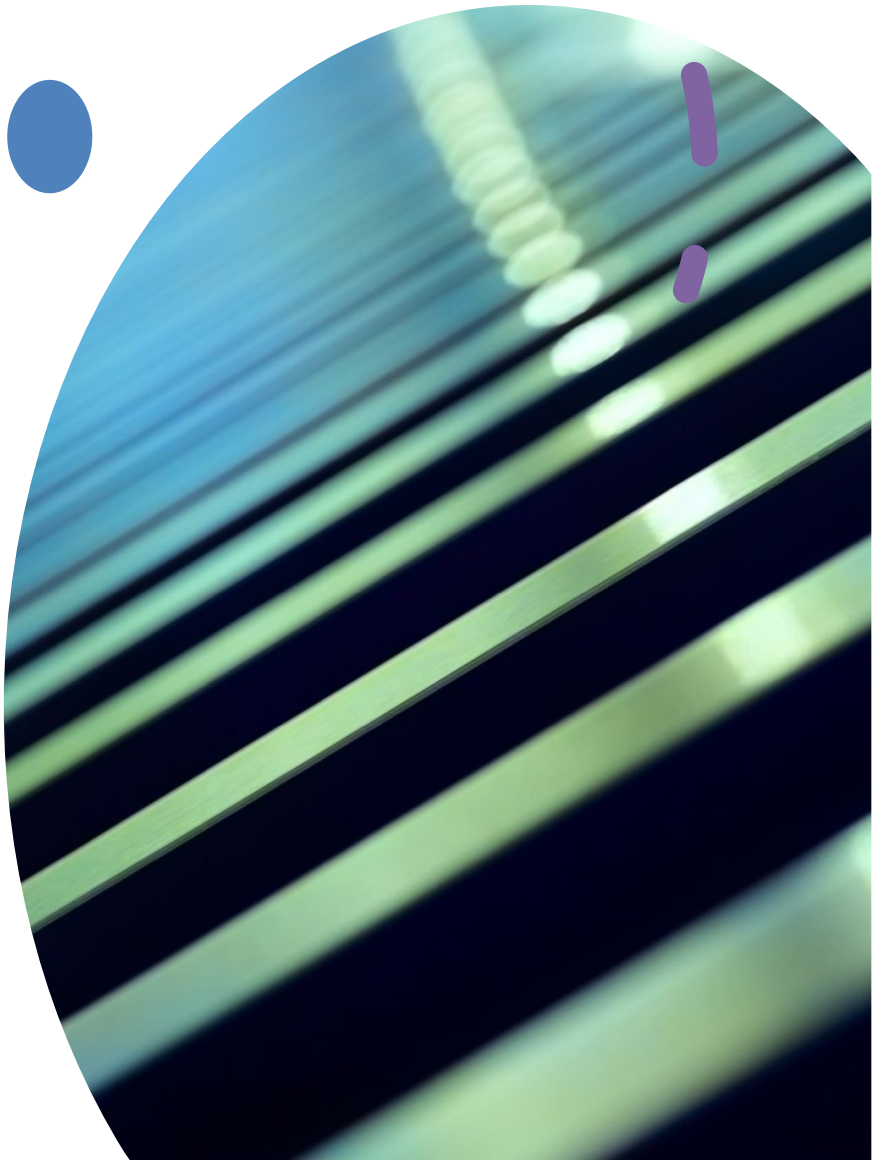
- Final Model: Multimodal CNN + Metadata



Loss Function & Augmentation

- Focal Loss (α=1.0, γ=2.0) used to handle class imbalance

- Strong data augmentation: rotation, flip, zoom, brightness

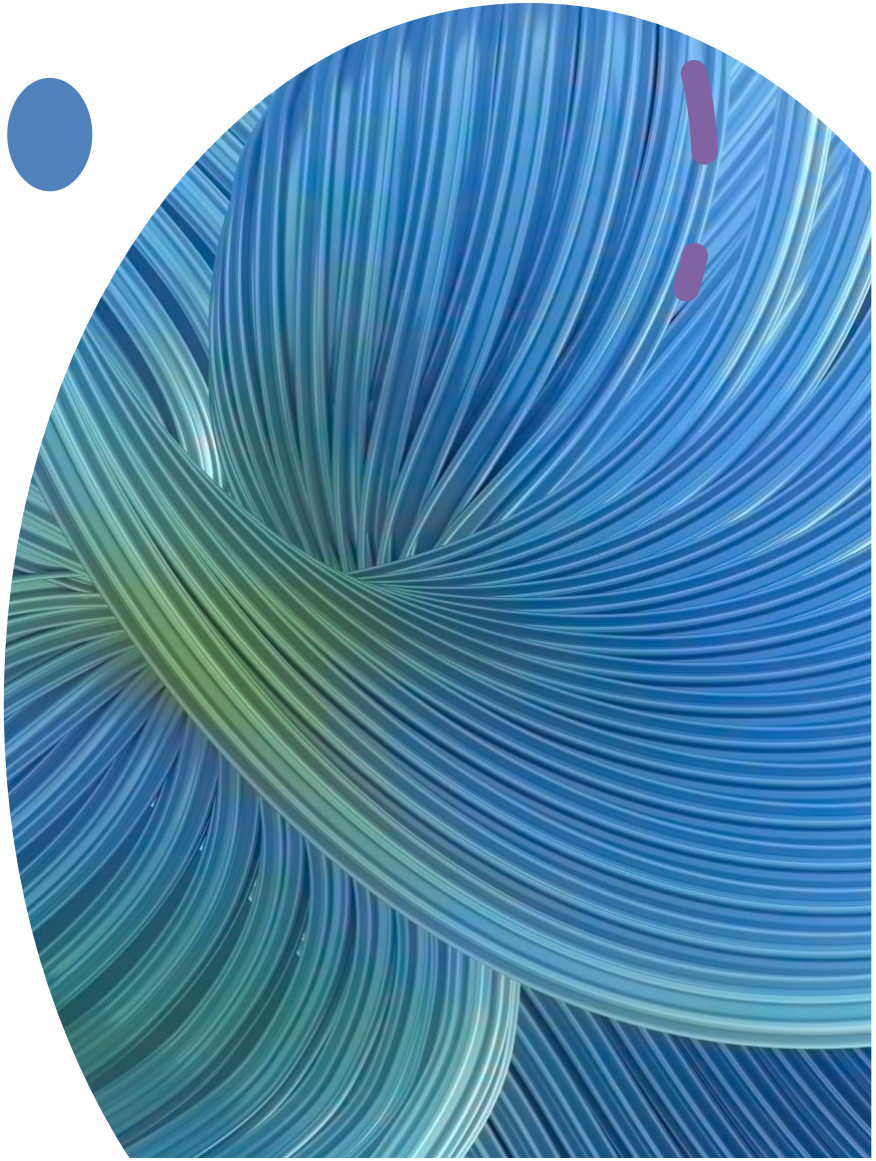


Final Model Performance

- Accuracy: ~78%

- Improved recall for minority classes

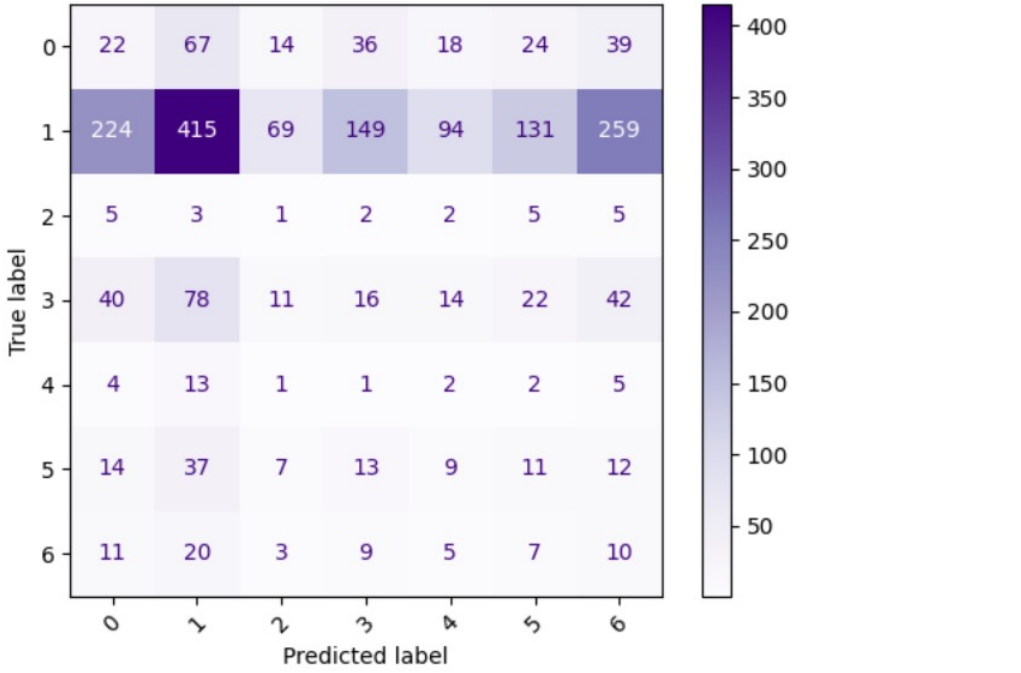
- Multimodal input outperformed image-only models



Classification Report (After Fine-Tuning):

	precision	recall	f1-score	support
0	0.07	0.10	0.08	220
1	0.66	0.31	0.42	1341
2	0.01	0.04	0.02	23
3	0.07	0.07	0.07	223
4	0.01	0.07	0.02	28
5	0.05	0.11	0.07	103
6	0.03	0.15	0.05	65
accuracy			0.24	2003
macro avg	0.13	0.12	0.10	2003
weighted avg	0.46	0.24	0.30	2003

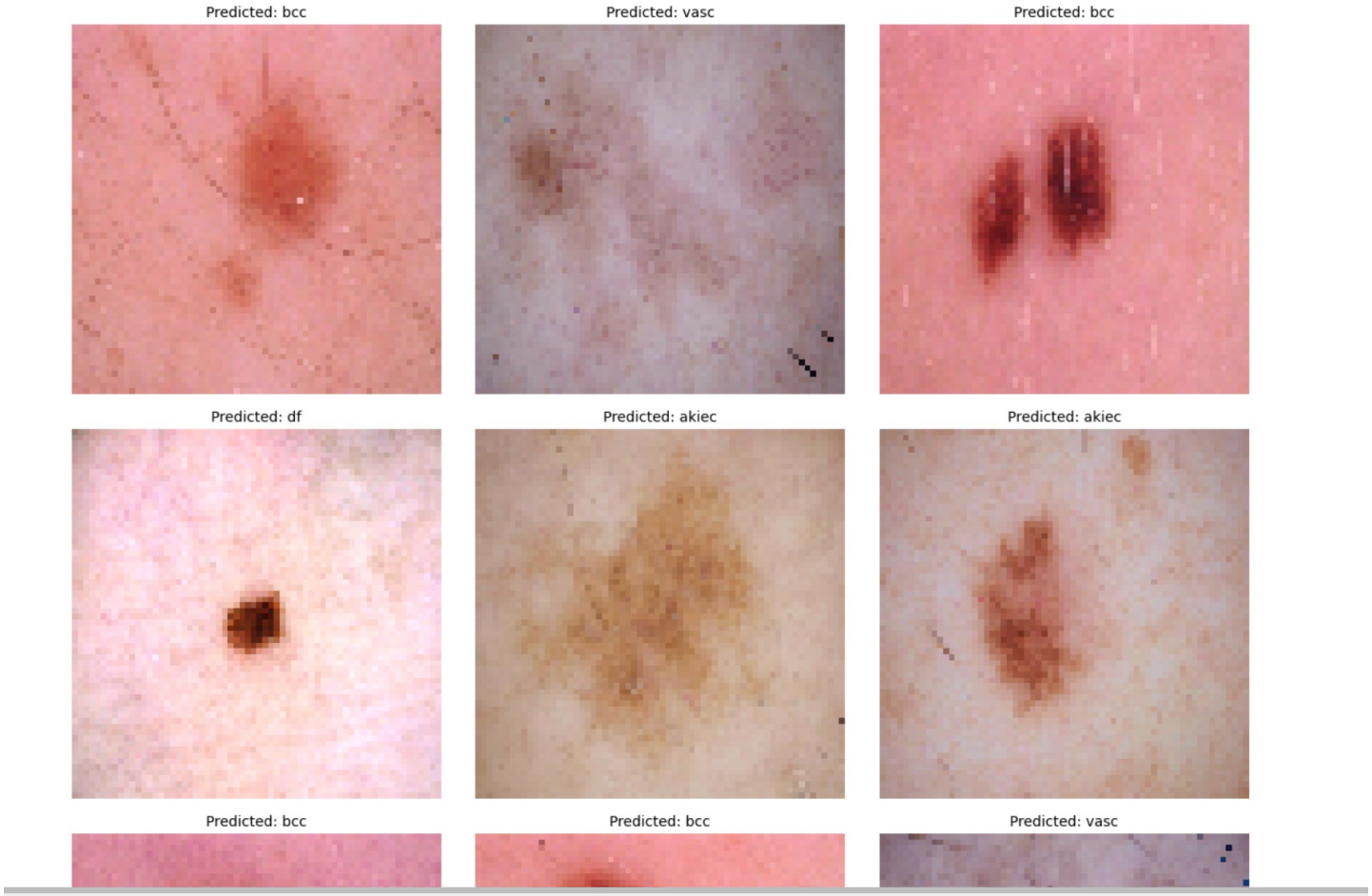
[46]: <sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x7f976739f2e0>



Visual Results

- Example predictions visualized for interpretability.
- Grid of true vs predicted labels helps evaluate model insights.

```
Model loaded successfully.
1/1 ━━━━━━━━━━━━━━━━━━━━ 3s 3s/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 82ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 79ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 108ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 68ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 62ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 100ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 86ms/step
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 80ms/step
```



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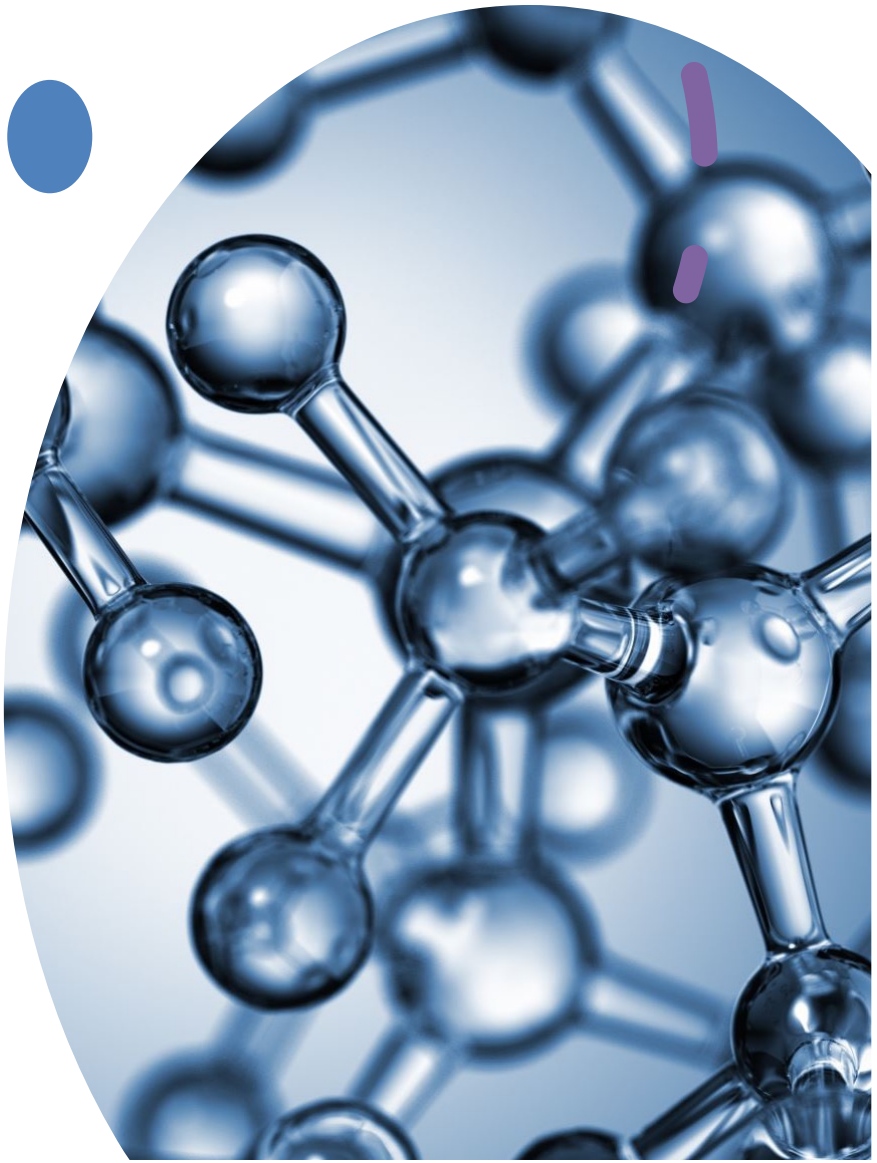
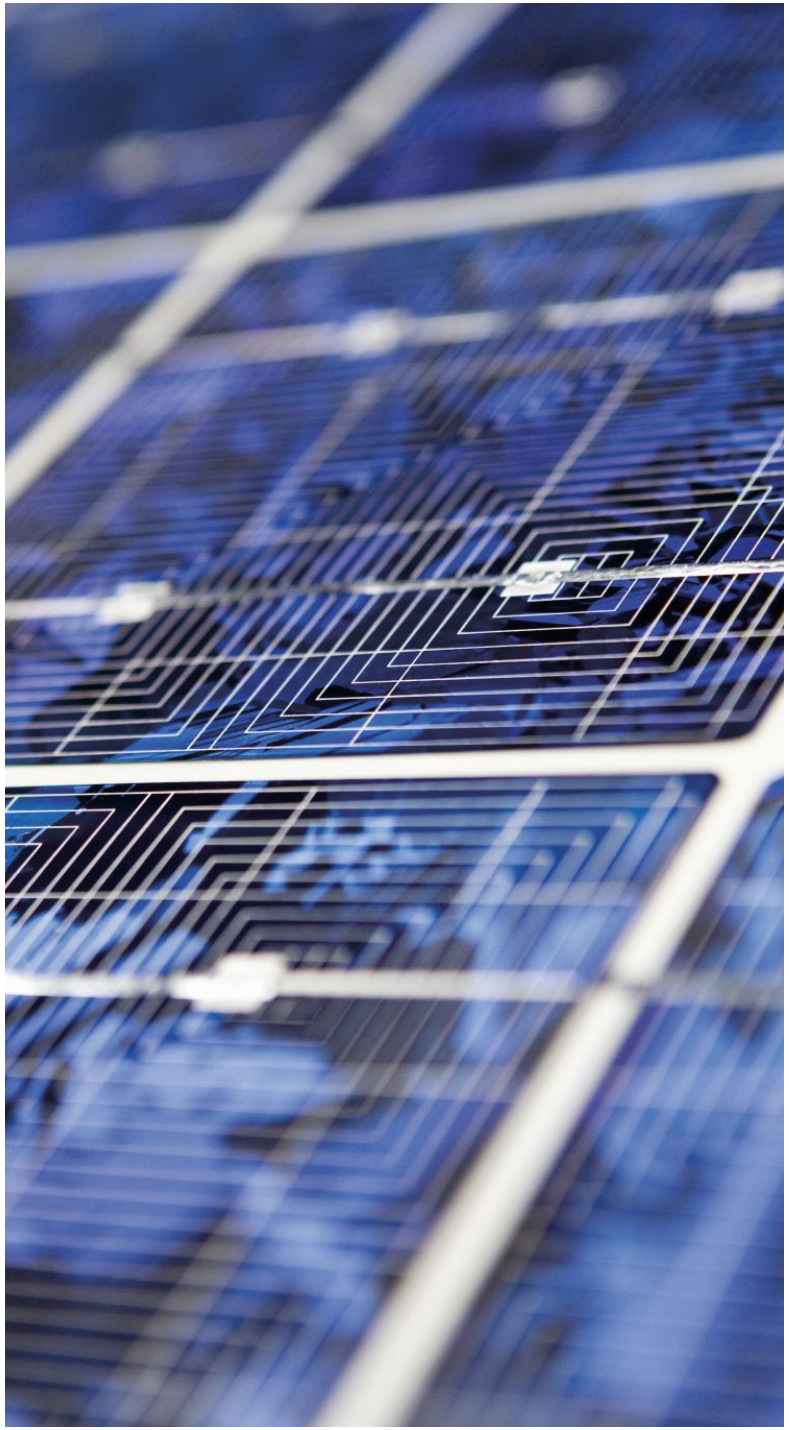
Recommendations

Deploy	Deploy as triage support tool in clinical settings
Gather	Gather more data for rare classes (melanoma, vasc)
Extend	Extend model with patient history & temporal data



Future Work

- Tune focal loss hyperparameters per class
- Apply skin tone normalization or lesion boundary segmentation
- Metadata improvements with richer features
- Advanced Data Augmentation
- Multimodal pipeline enhancements



Thank You!

Questions?

Presentation prepared for Springboard Capstone 3

Mentor Session: Final Review