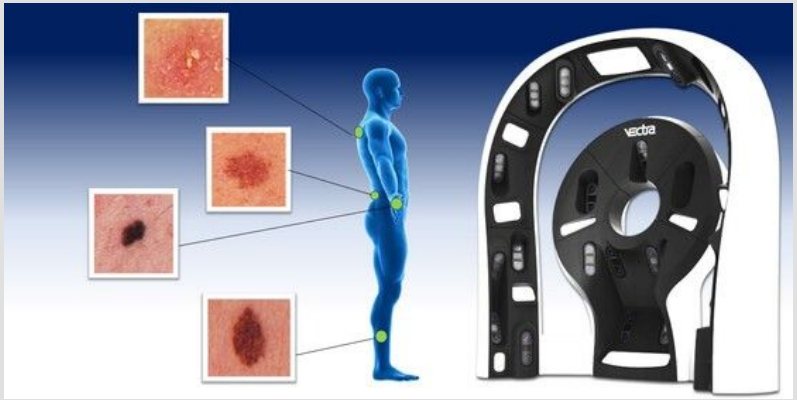
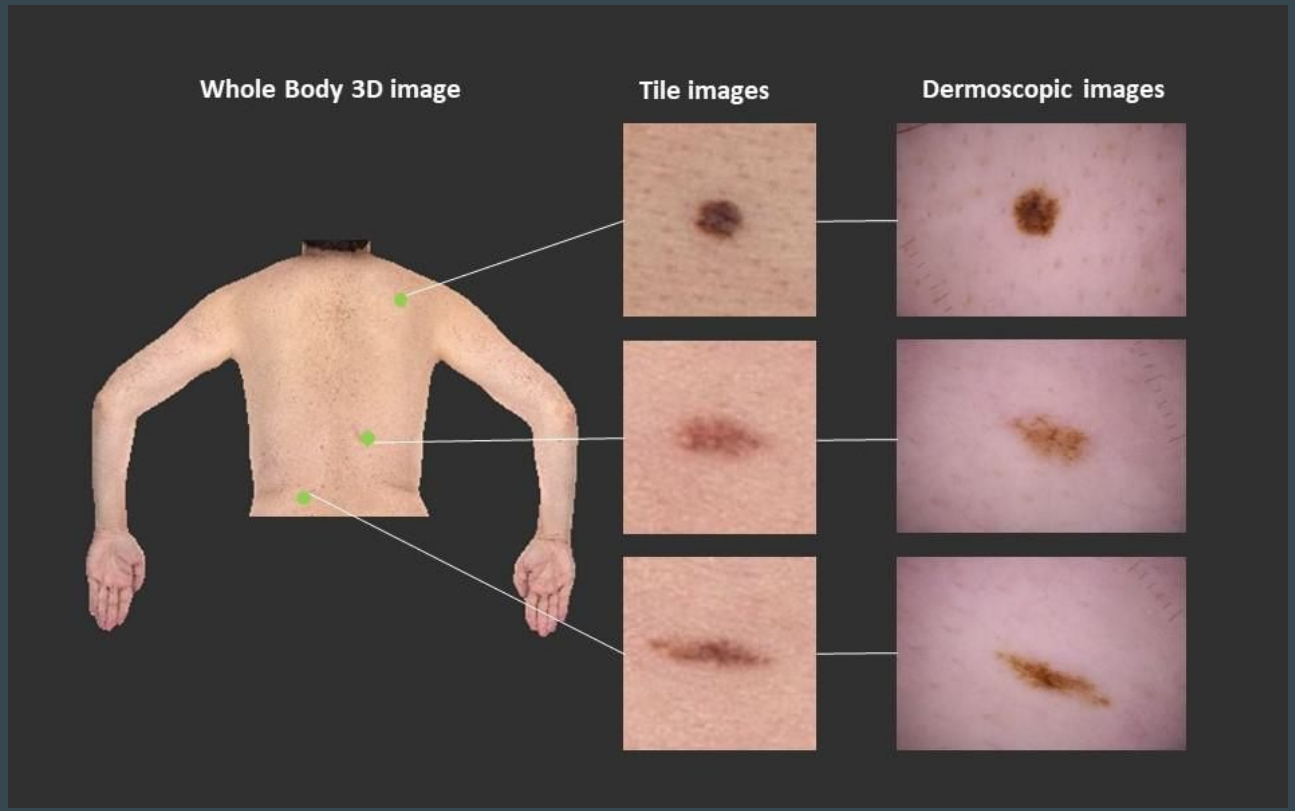
# Kaggle challenge: ISIC 2024 - Skin Cancer Detection with 3D-TBP




Opencampus: Intermediate Machine Learning
by: Tim Prause

# Single-lesion crops from 3D total body photos (TBP):




https://www.kaggle.com/competitions/isic-2024-challenge/overview

# How to detect cancer:

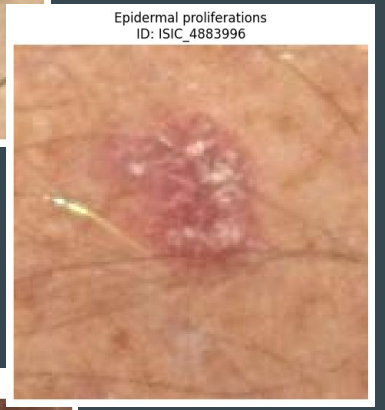

https://www.researchgate.net/publication/357904169_Hybridization_of_CNN_with_LBP_for_Classification_of_Melanoma_Images

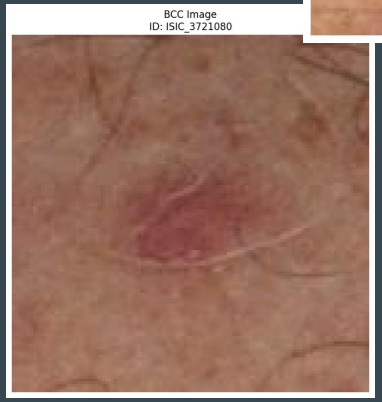
# Tabular Data:

- Structure:
  - Total Rows: 401,059
  - Total Columns: 56
  - Number of Patients: 1,042
- Diagnosis Distribution
  - Benign (non cancerous) Cases: 400,666
  - Malignant (cancerous) Cases: 393
- Patient Demographics
  - Age Range: 13–85 years
  - Sex
- Lesion Characteristics:
  - Size
  - Symmetry
  - Color
  - Shape
  - Location
- Diagnostic Information:
  - 52 Diagnosis Categories
  - Malignant Diagnosis
    - Melanoma
    - Squamous Cell Carcinoma (SCC)
    - Basal Cell Carcinoma (BCC)
  - Benign Diagnosis
    - mole
    - cyst
    - ...

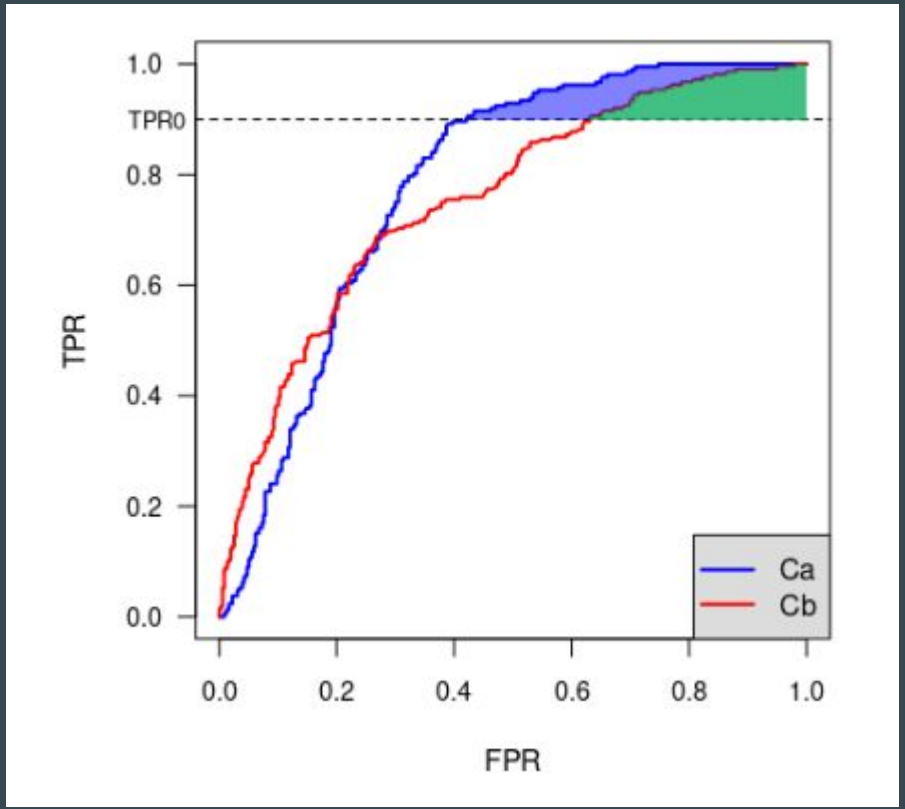
# Types of Skincancer:

- Melanoma
  - Appearance: Dark, irregular moles with an asymmetrical shape, variable colors (brown, black, red, white), often > 6 mm.
- Squamous Cell Carcinoma (SCC)
  - Appearance: Red, scaly patches, sores that do not heal, or raised, crusty nodules.
- Basal Cell Carcinoma (BCC)
  - Appearance: Pearly, shiny nodules, often with visible blood vessels; sometimes red patches or open sores.

# Evaluation metric: pAUC




True Positive Rate (TPR)

*also called sensitivity/recall/hit rate*

$$= \frac{TP}{P} = \frac{TP}{TP + FN}$$

False Positive Rate (FPR)

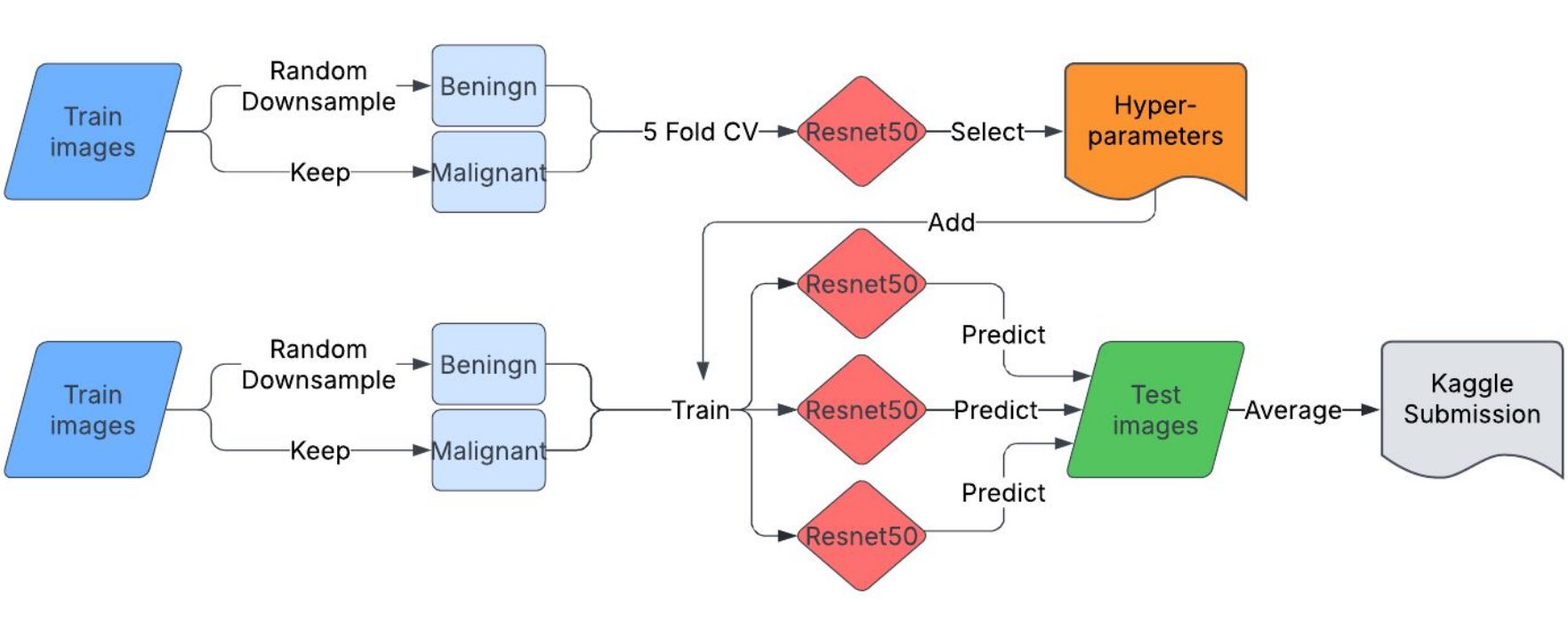
*also called fall out*

$$= \frac{FP}{N} = \frac{FP}{FP + TN}$$

# Basic Plan

1. Research: kaggle + other papers
2. Process the data:
    a. Potentially add/delete features according the ABCD
    b. Data over/under sampling
3. Cross Validate Models:
    a. Image only model
    b. Metadata only model
    c. Ensemble models
4. Submit Models

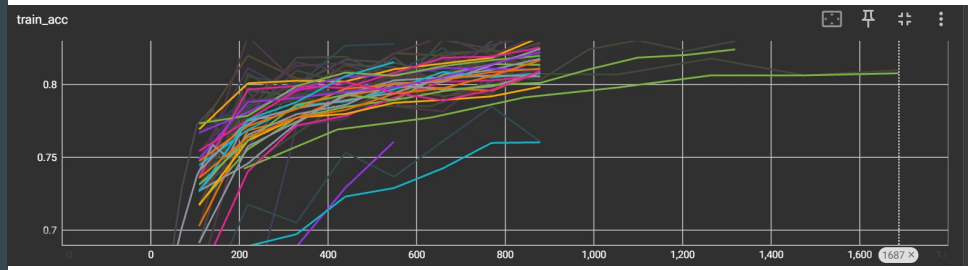
# Workflow: Resnet only prediction

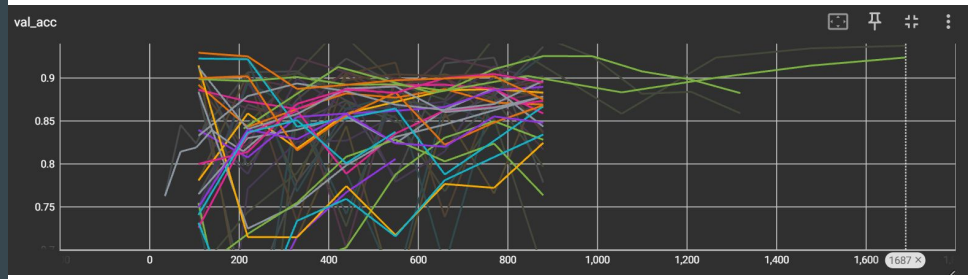


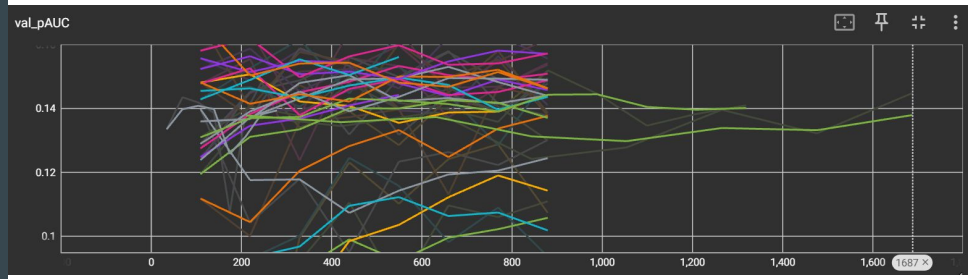
# Resnet only: Architecture

- Downsample: 1/100s
- Data augmentation:
  - colorjitter, erasing, flipping, rotating, blur...
- Custom class weights
- Resnet50 with unfrozen last layer
- Loss: binary cross-entropy
- Adam optimizer with learningrate: 0.001 + StepLR scheduler
- Epochs: 8-16
- Training time on 4080 Nvidia GPU
  - CV: ~1 std
  - Final model: ~9 minutes

# Resnetonly: Results

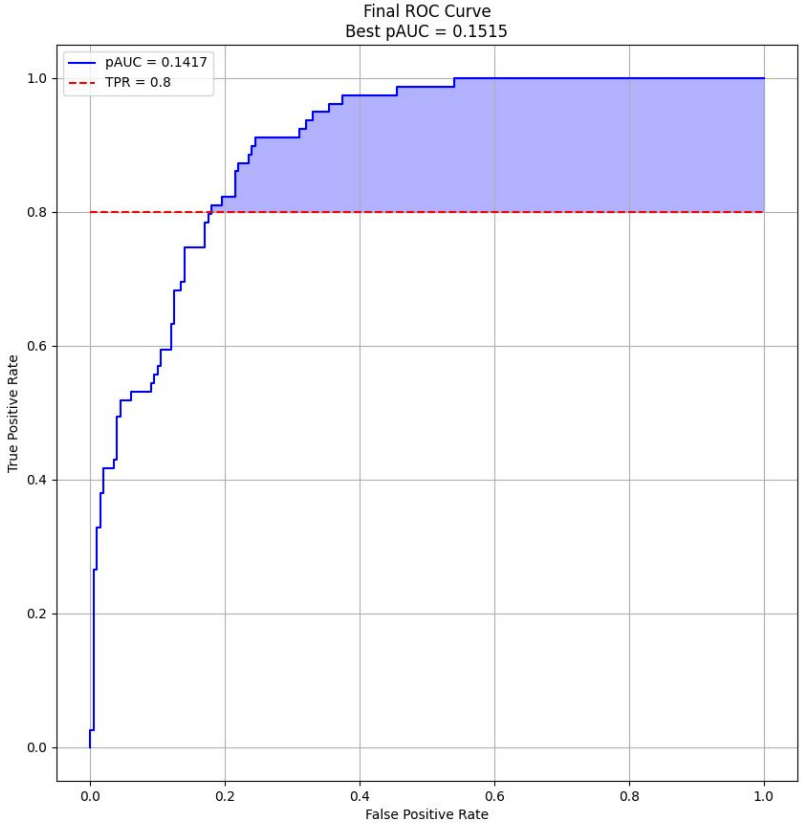


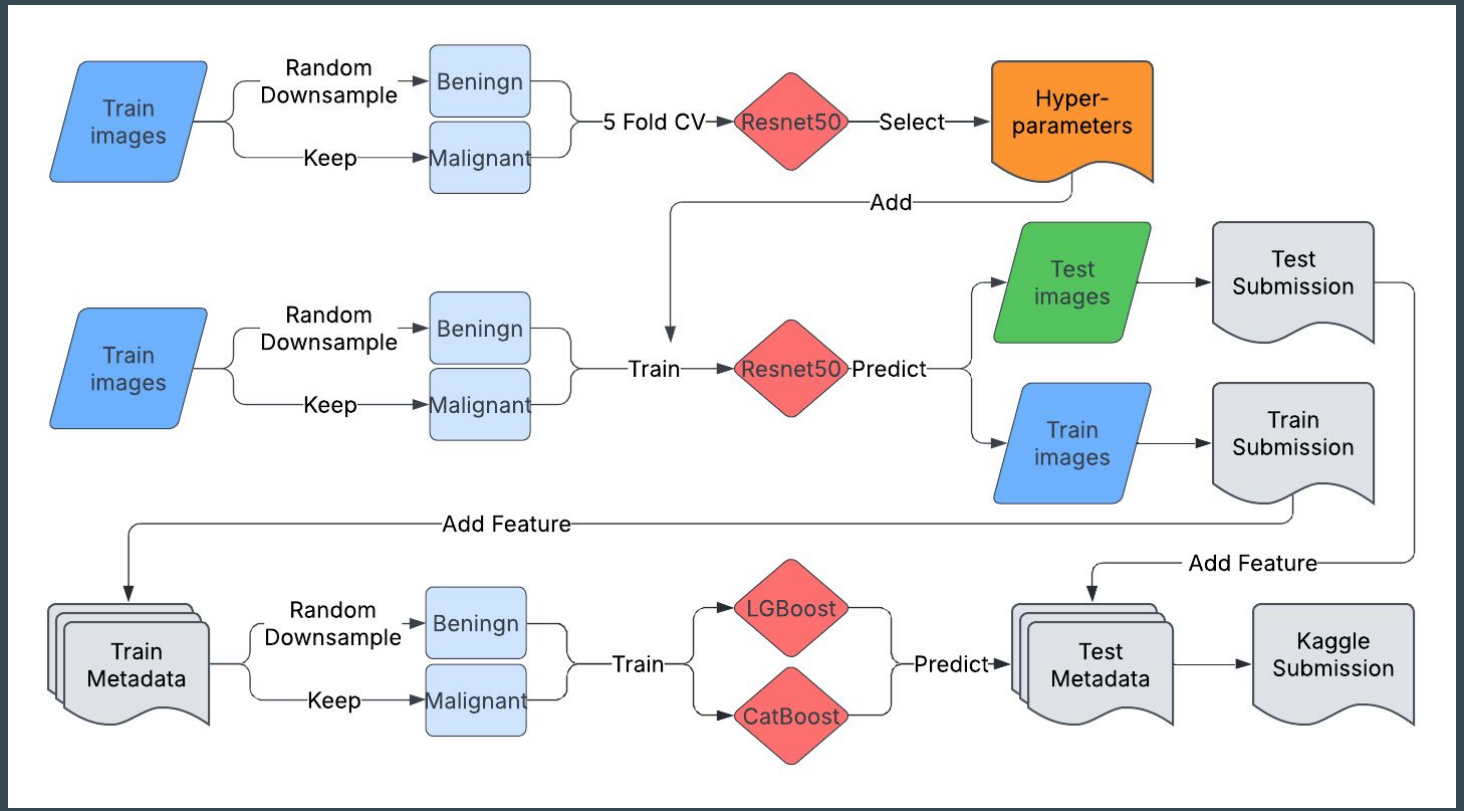



# Resnetonly: Results

Best CV Result: 0.1470 ± 0.0101

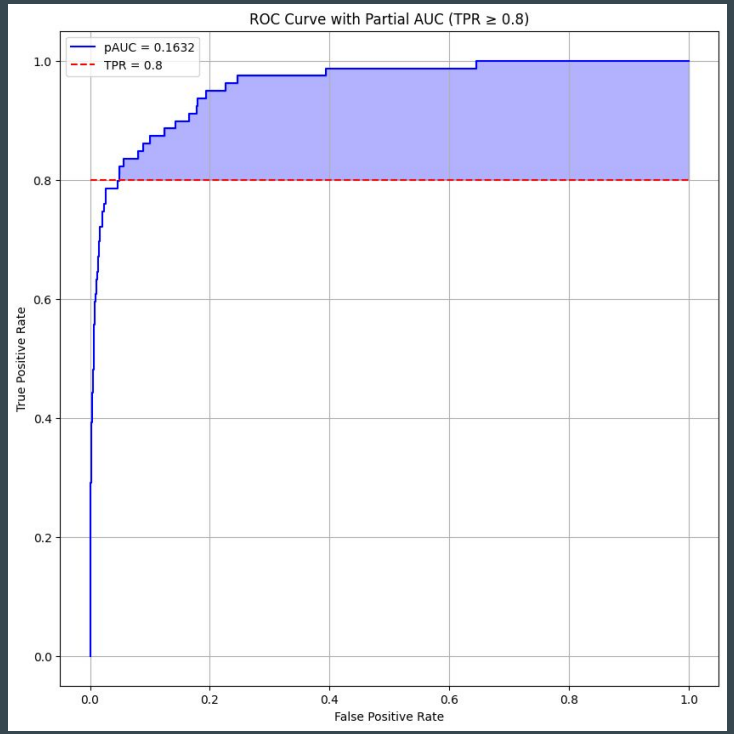


# Resnet + Tree Models Workflow:

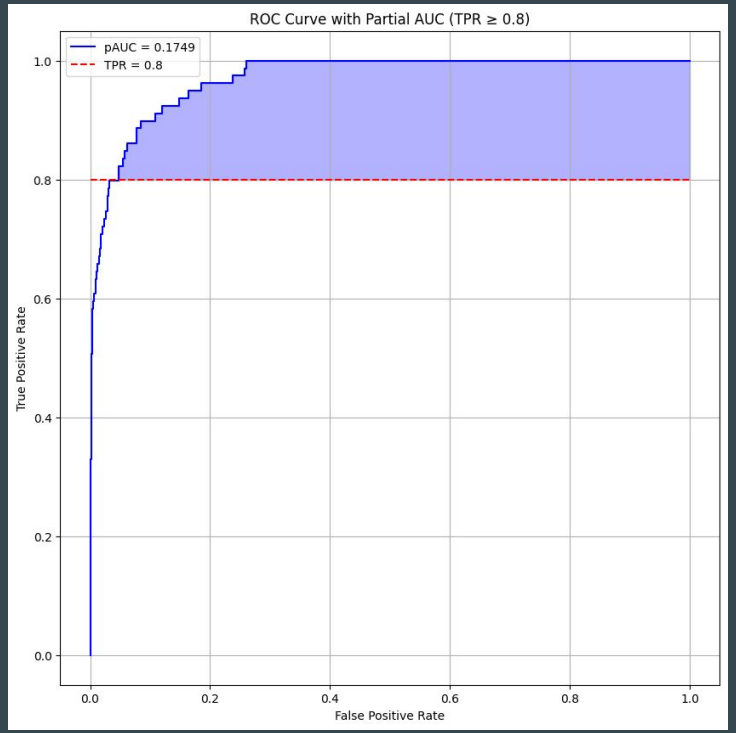


# Resnet + Tree Models result:

CatBoost:




LGBoost:



# Model Results:

| Model | Number of trained models | CV pAUC | kaggle score (Private) |
|---|---|---|---|
| LGBoost | 1 | 0.17160 | - |
| | 3 | 0.17255 | - |
| | 6 | 0.17352 | - |
| | 12 | 0.17401 | - |
| | 24 | 0.17398 | - |
| CatBoost | 1 | 0.16877 | - |
| | 4 | 0.1703229 | - |
| Ensemble | 3LGB, 2Cat (w/o CNN) | 0.17310 | 0.16208 |
| | 12LGB + 2Cat | 0.17462 | 0.16253 |
| CNN | 1 | 0.14470 | 0.12460 |
| | 3 | - | 0.09780 |
| | 6 | - | 0.10764 |

# Outlook:

- Extract Resnet last layer instead of final probability or predict the specific diagnosis
- Add more data from other datasets or artificially
- Change method for sampling benign class
- Try out different CNNs:
  - Other pretrained models
  - LSTM/Transformer for Ugly Duckling
  - NN with CNN and tabular data
- Try out different Tree models:
  - XGBoost
  - Randomforrest

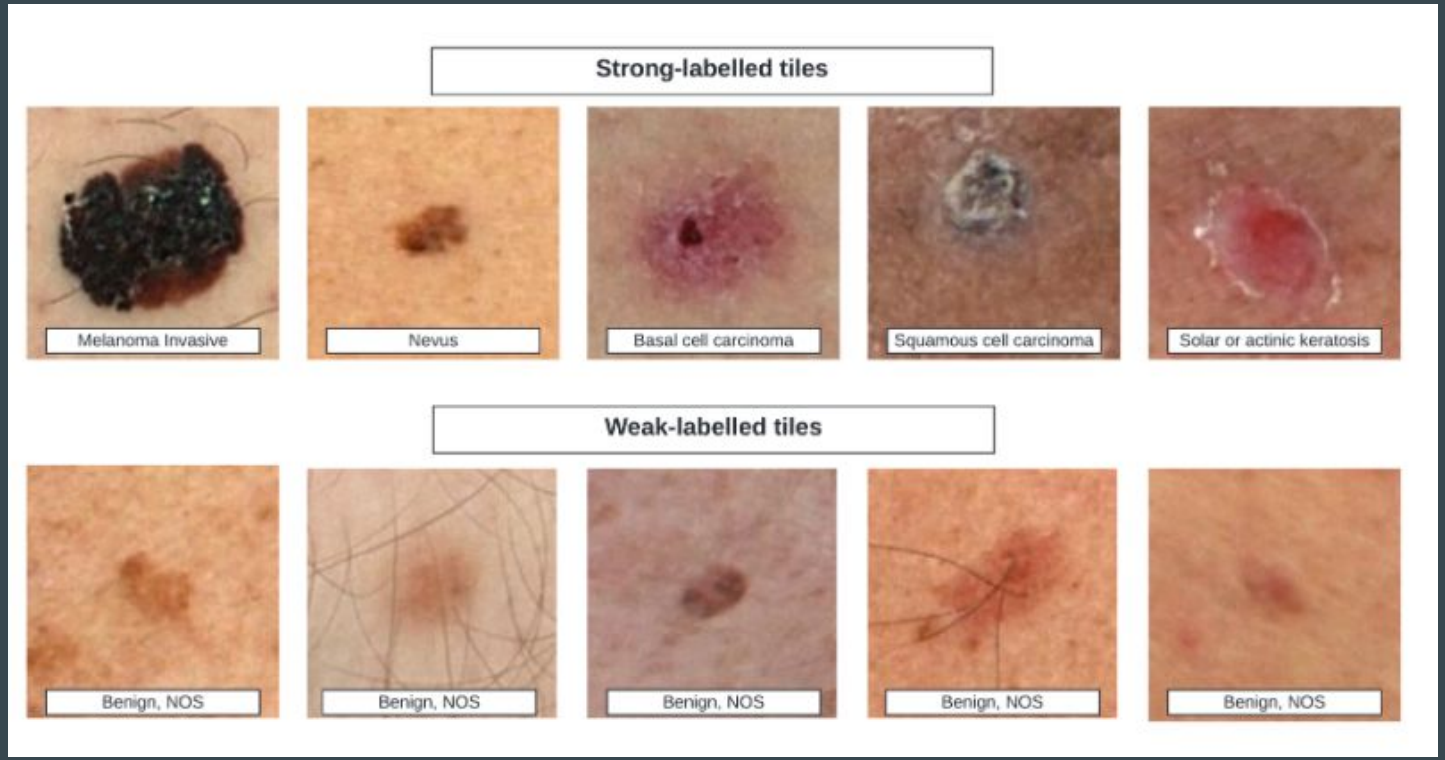
# Summary:

- The Results other teams got showed a lot of potential for Skin Cancer detection
- Image data could add to the Tabular data for better prediction
- Image Quality needs to improve for reliably prediction

# Thank you for listening!
# Any questions?


tagesschau

# Single-lesion crops from 3D total body photos (TBP):

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# Research:

- General
  - Easy: MobileNetV2 (DOI: 10.20473/jisebi.8.2.218-225, this dataset)
  - Moderat: ResNet50 + new dataset: HAM10000 (DOI: 10.1109/ICATMRI51801.2020.9398388)
  - Komplex: Google Net Inception v3 CNN (DOI: 10.1109/IATMSI60426.2024.10502664)
  - comprehensive model review and related papers: https://www.kaggle.com/competitions/isic-2024-challenge/discussion/515303
- Kaggle
  - Feature Engineering of metadata
  - Combined Gradient boosted trees + CNNs
  - Class weighting + data Augmentation
  - Different Ensemble Methods
  - four other possible datasets:
    - Isic 2018,2019,2020
    - HAM10000

# Metadata Feature Engineering: Adapted from here

- Handling Missing Values:
  - Filled missing age with median value
  - Encoded missing sex as a separate category
- Categorical Encoding:
  - One-hot encoding for sex and anatom_site_general
- Feature Scaling:
  - Standardized age to have mean = 0, std = 1
- New Feature Creation:
  - Created binary flags and grouped categories for relevancy
- Dropping Irrelevant Features:
  - Removed image_name and patient_id to reduce noise