Akunet
Alkaptonuria image analysis

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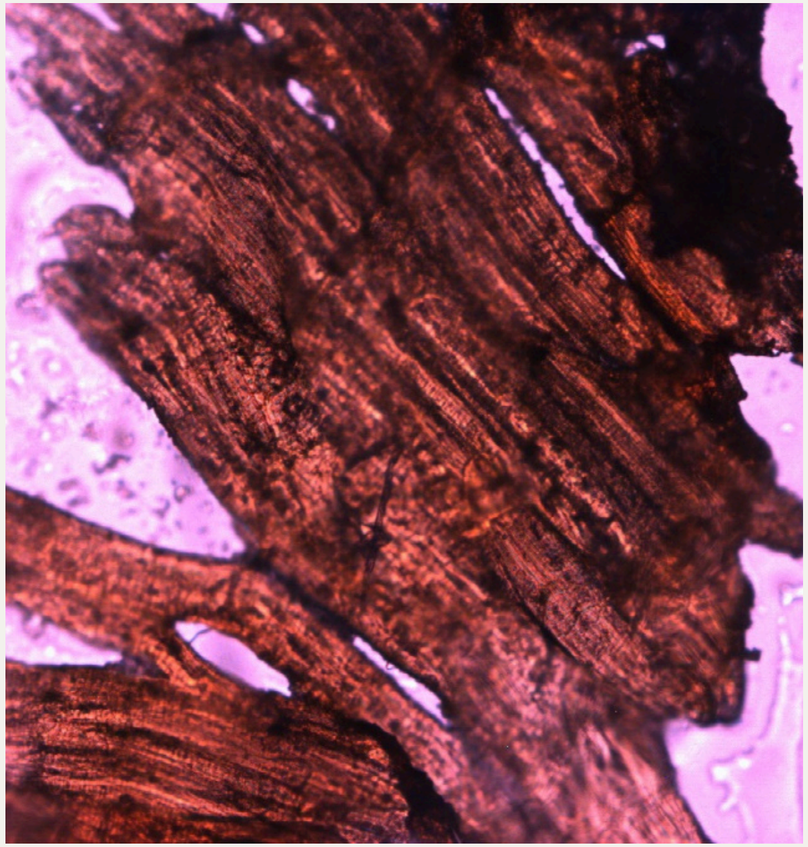
Introduction

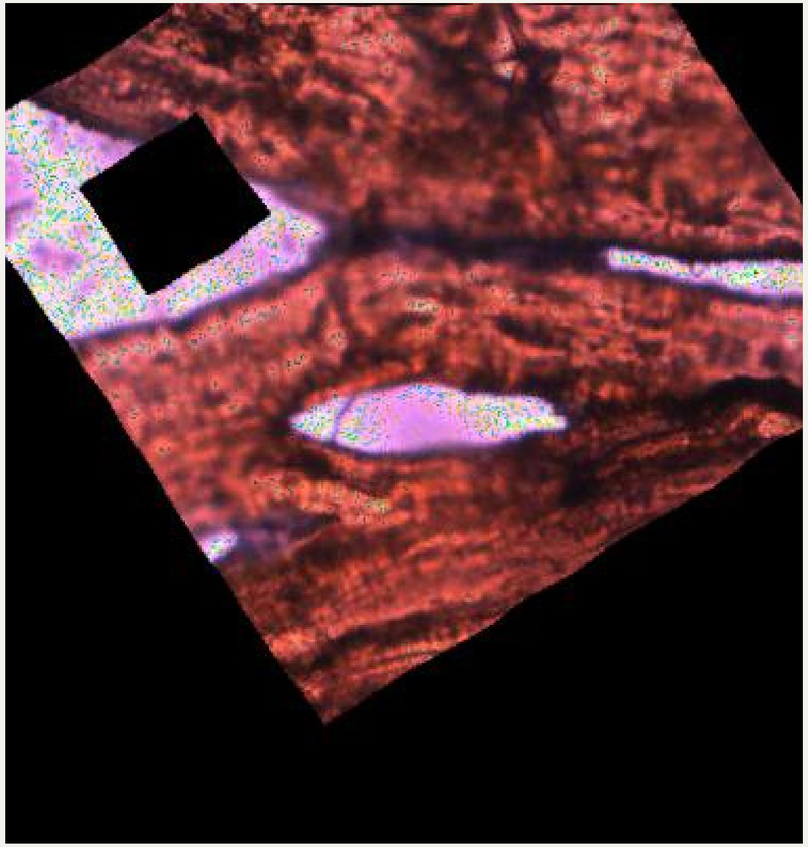
- Alkaptonuria, highly rare disease that can cause, among other effects, calcification of the tissues.
- We’ve analyzed images of ill cartilage against healthy ones.
- Our results show an efficient network able to tell whether a tissue is healthy or not.
- Our samples come from the AkuIMG dataset.
- The code for the project is available at https://github.com/HolidayOugi/CHL-Project

Data Augmentation

Very few images available (37 AKU, 20 Healthy)

Used transformations and compositions of the original images to get 10x the sample size





Augmentation techniques used

Single images

- Random Crop
- Gaussian Noise
- Random Horizontal and Vertical Flip
- Random Erasing
- Random Perspective
- Random Affine
- Elastic Transformation

Batch of images

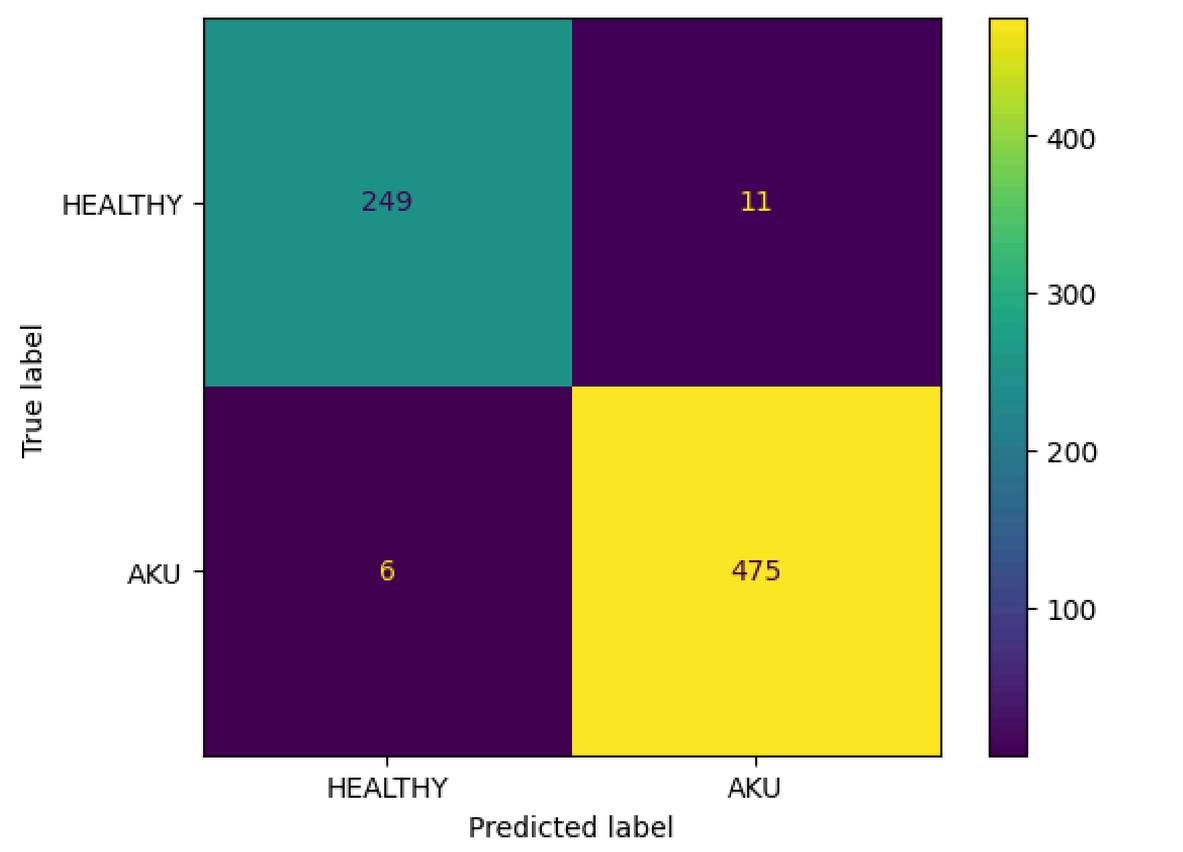
- CutMix
- MixUp

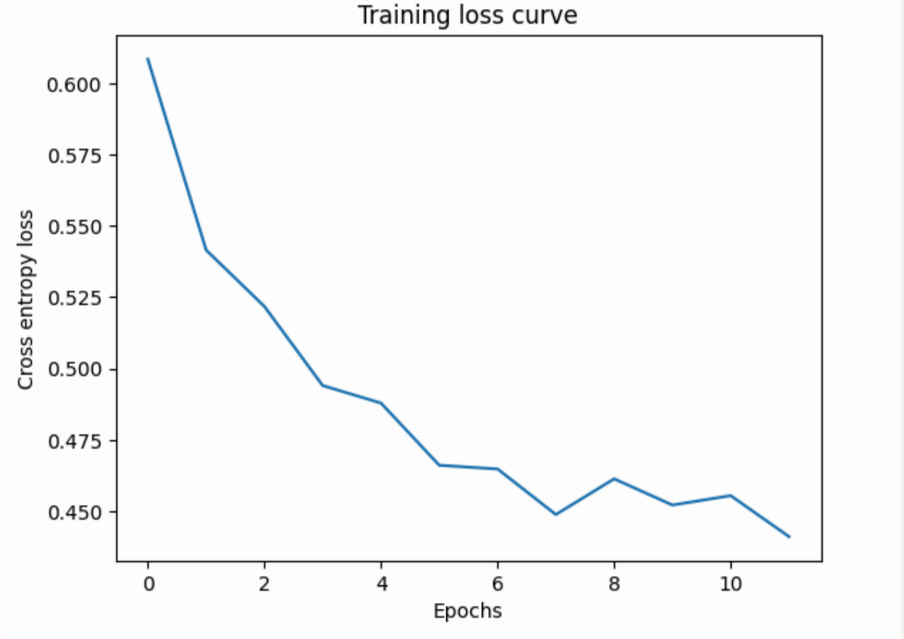
CNN Choice

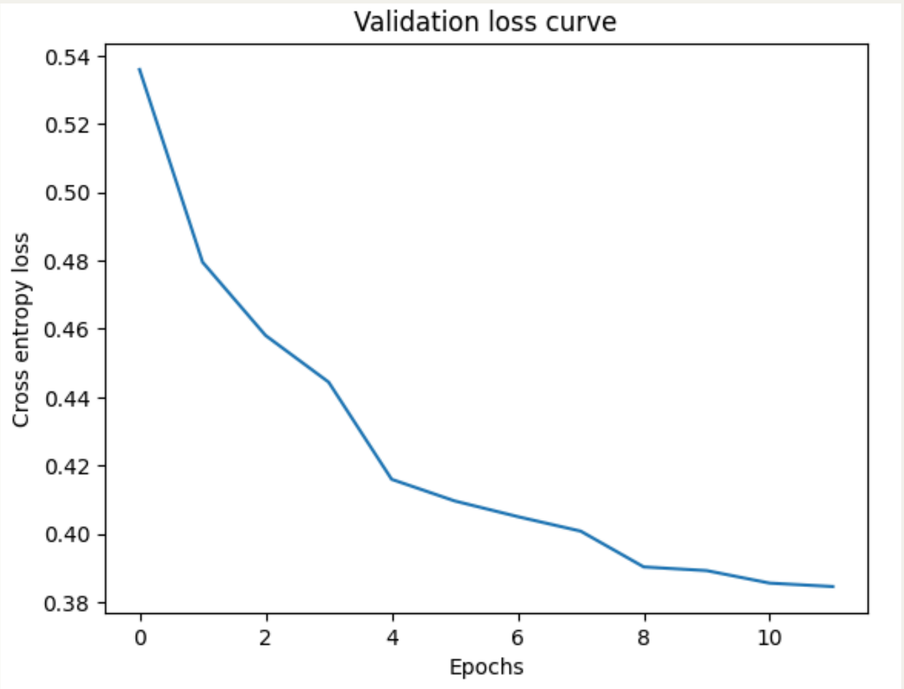
- Tested ResNet, GoogLeNet from PyTorch models.
- Also tested a convolutional network written from scratch.
- In the end, ResNet gave the best results.

CNNs	Accuracy	F1 Score
ResNet (AKUNet)	0.98	0.98
GoogLeNet	0.97	0.95
Convolutional Network	0.77	0.44

Results of Classification







Visual XAI

XAI allows for better interpretability of the results

Couldn’t use Non-Visual XAI methods due to insufficient informations about the samples.

Unused XAI methods	Notes
TCAV	Only available for TensorFlow, PyTorch repo is from an unreliable source
Ace	Same as TCAV
Network Dissection	Just a Demo for fixed models, can’t be used on custom models
Influence Points	Only for single label problems and unfeasible to compute
ProtoTree	Same as Network Dissection
Image Captioning	Not useful for only two labels

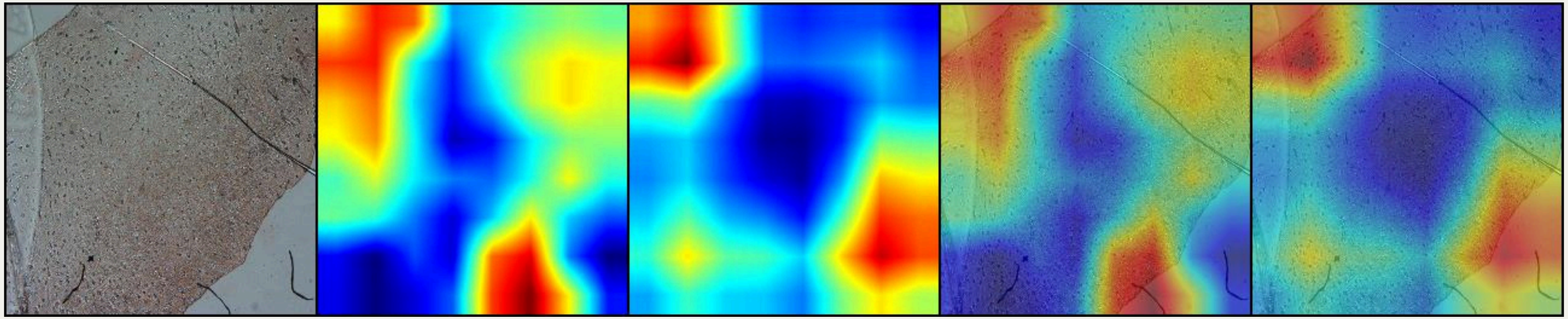
XAI Choices

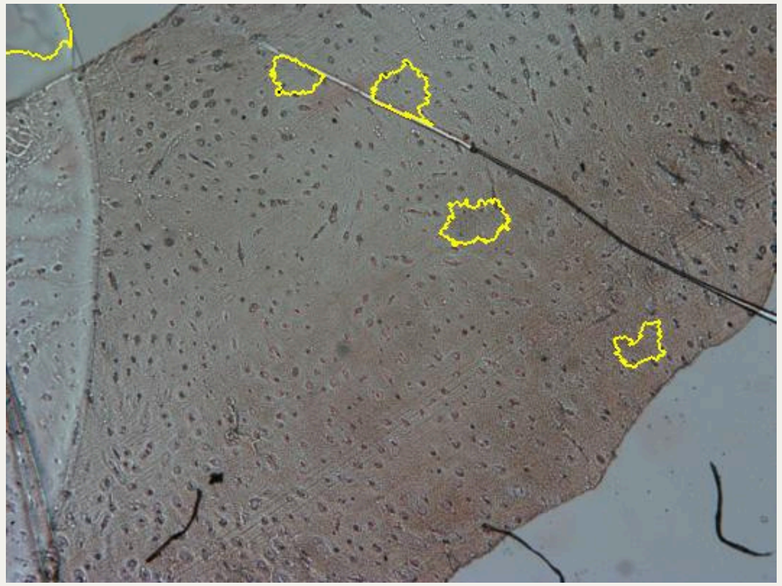
In the end we used GradCAM and Lime to interpret the results.

GradCAM implementation from https://github.com/1Konny/gradcam_plus_plus-pytorch

Lime implementation from https://github.com/marcotcr/lime

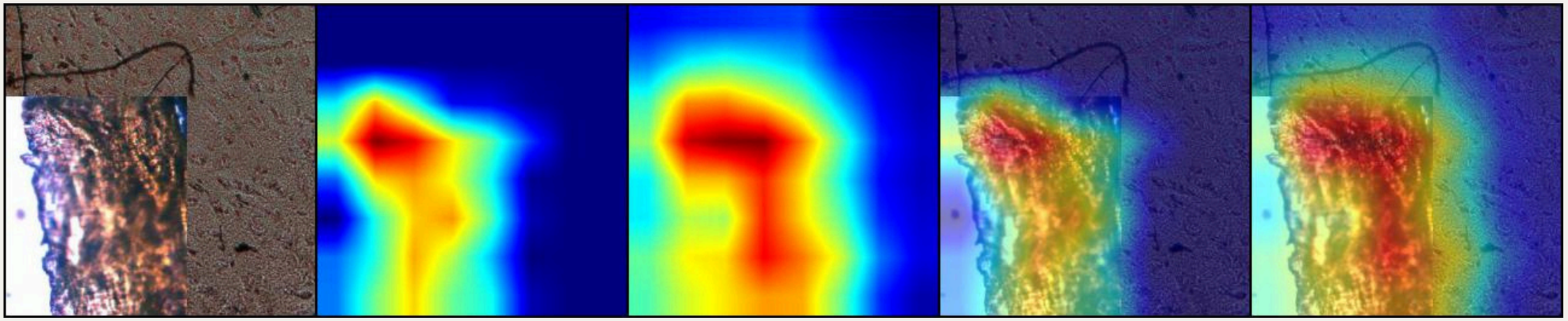
Example of correct classification

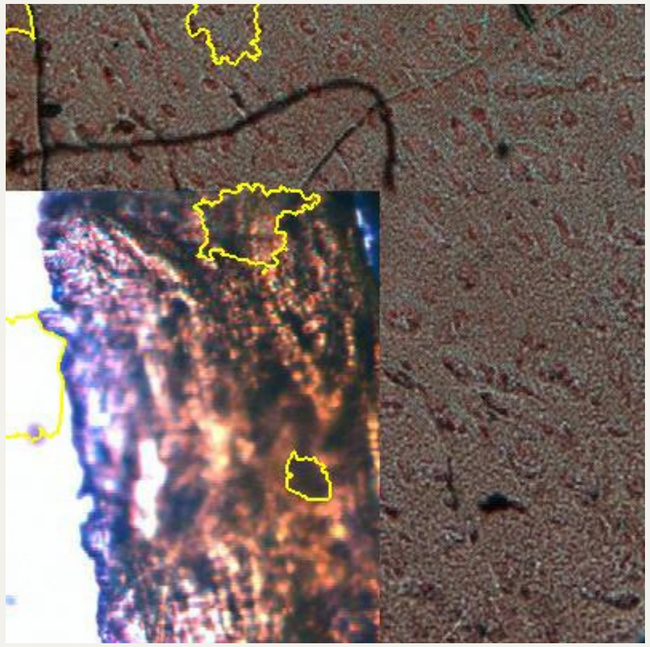




Predicted: Healthy
Real Label: Healthy
GradCAM: focus on whiter zones
Lime: focus on stripe pattern

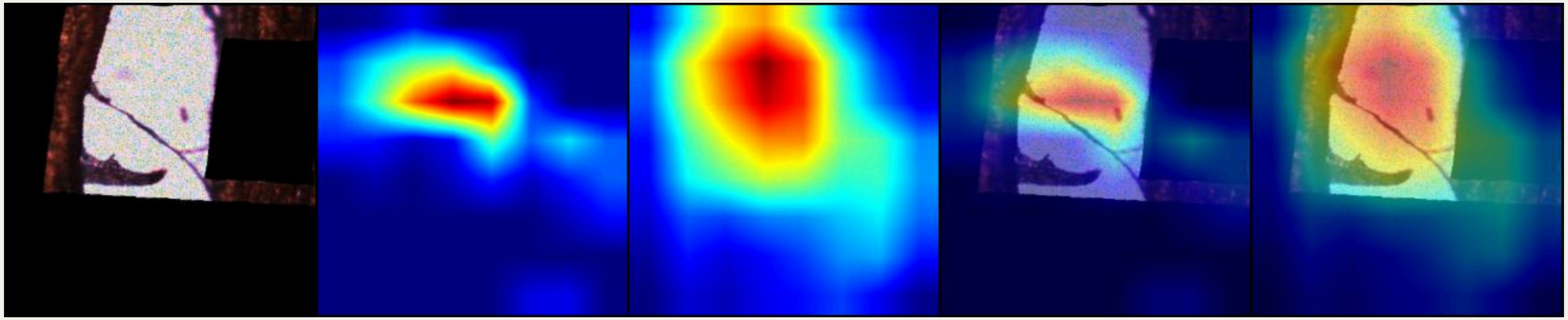
Example of False Negative

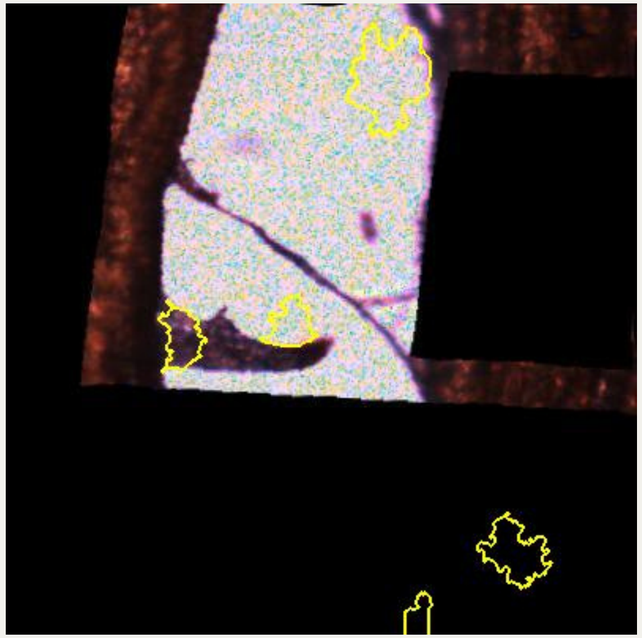




Predicted: AKU
Real Label: Healthy
GradCAM: focus on AKU tissue
Lime: focus on AKU tissue

Example of False Positive





Predicted: Healthy
Real Label: AKU
GradCAM: focus on white background
Lime: mainly focus on white background

Conclusions & Future Work

- We’ve estabilished a network able to tell whether an image of a tissue is healthy or not.
- The network does not fail on original images, only on augmented ones.
- How it could improve:
  - More clinical informations about the samples for a possible multimodal model
  - Further testing on more datasets