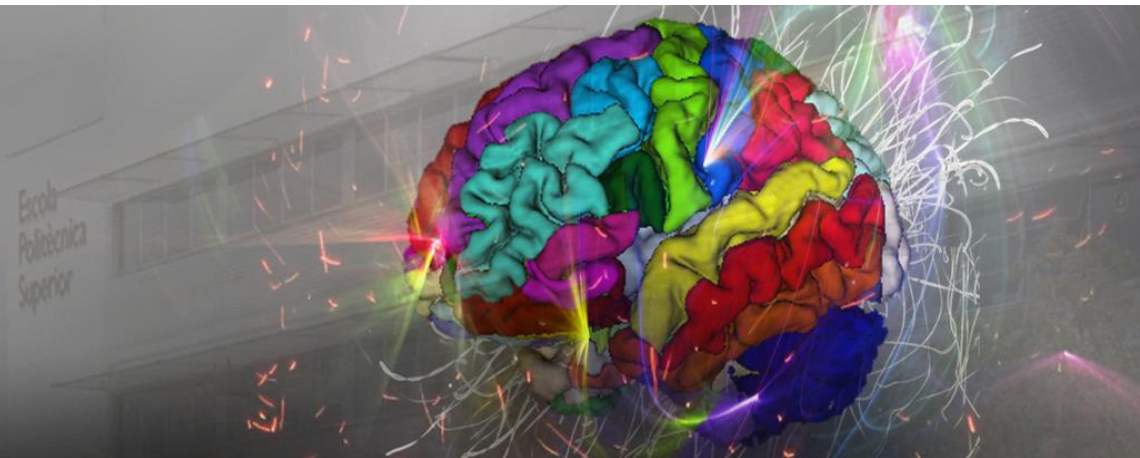




Dermoscopic diagnosis using Deep Learning

Agustin CARTAYA, Micaela RIVAS



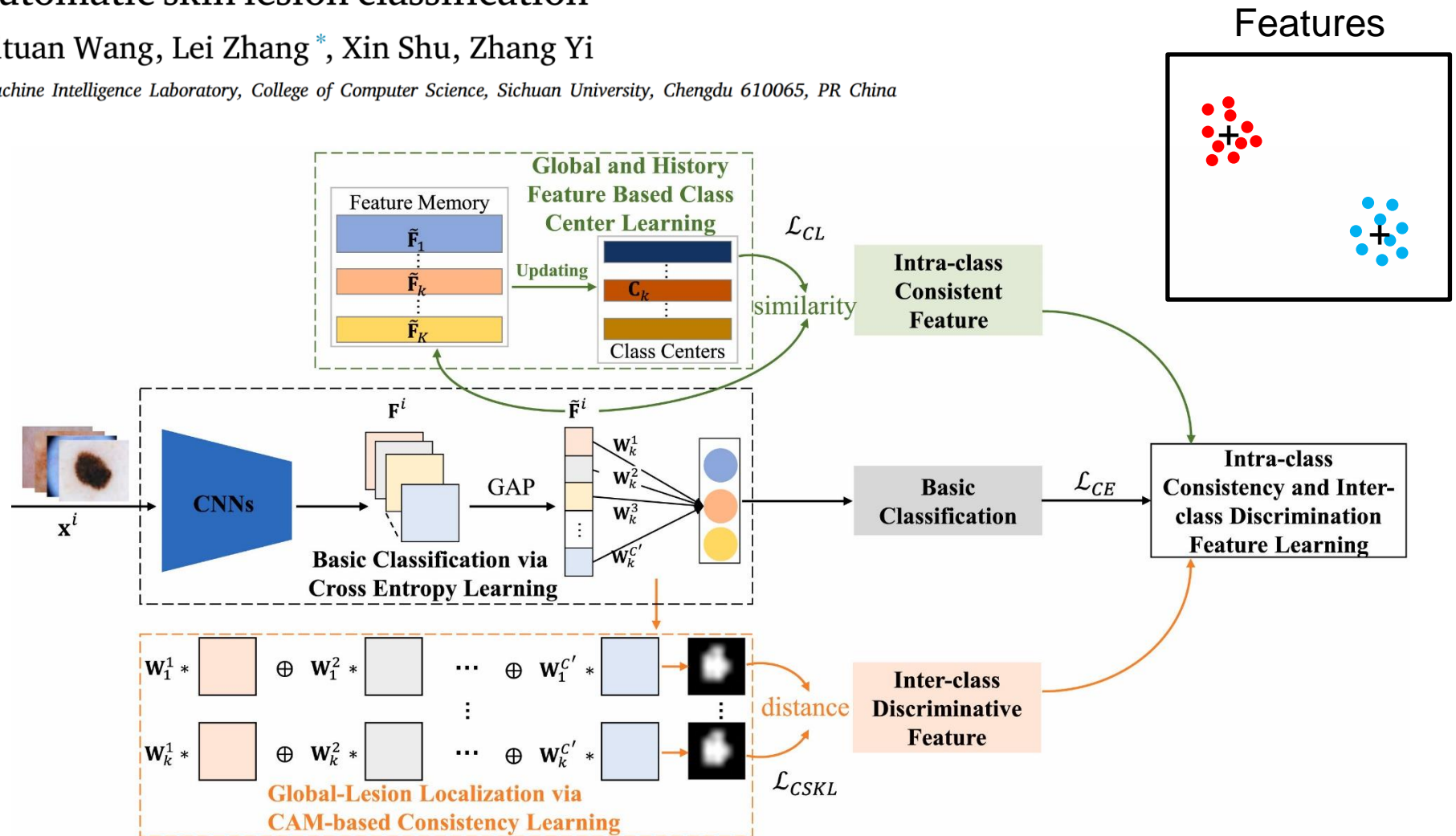
Best approach

Main approach

Intra-class consistency and inter-class discrimination feature learning for automatic skin lesion classification

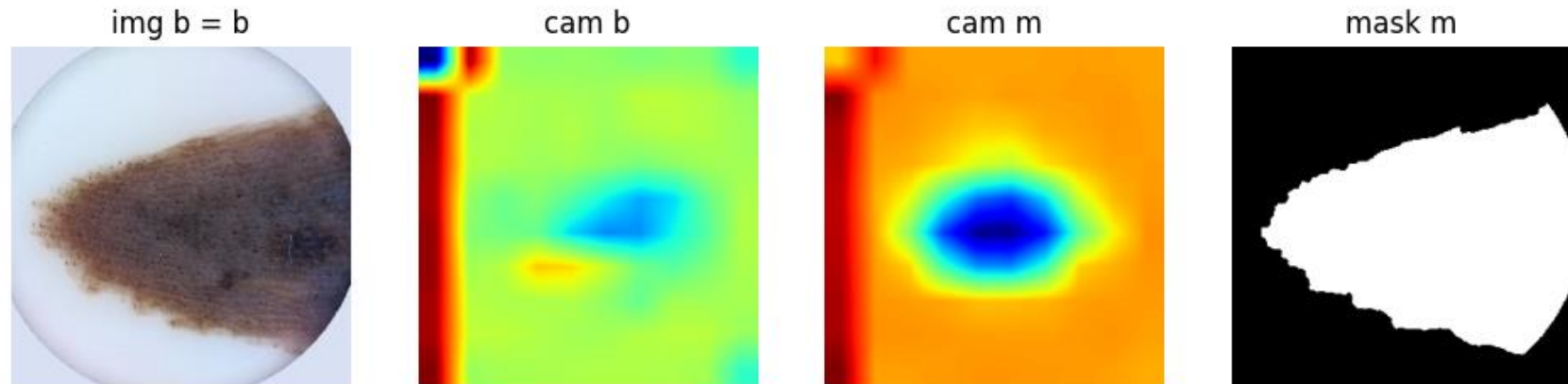
Lituan Wang, Lei Zhang*, Xin Shu, Zhang Yi

Machine Intelligence Laboratory, College of Computer Science, Sichuan University, Chengdu 610065, PR China



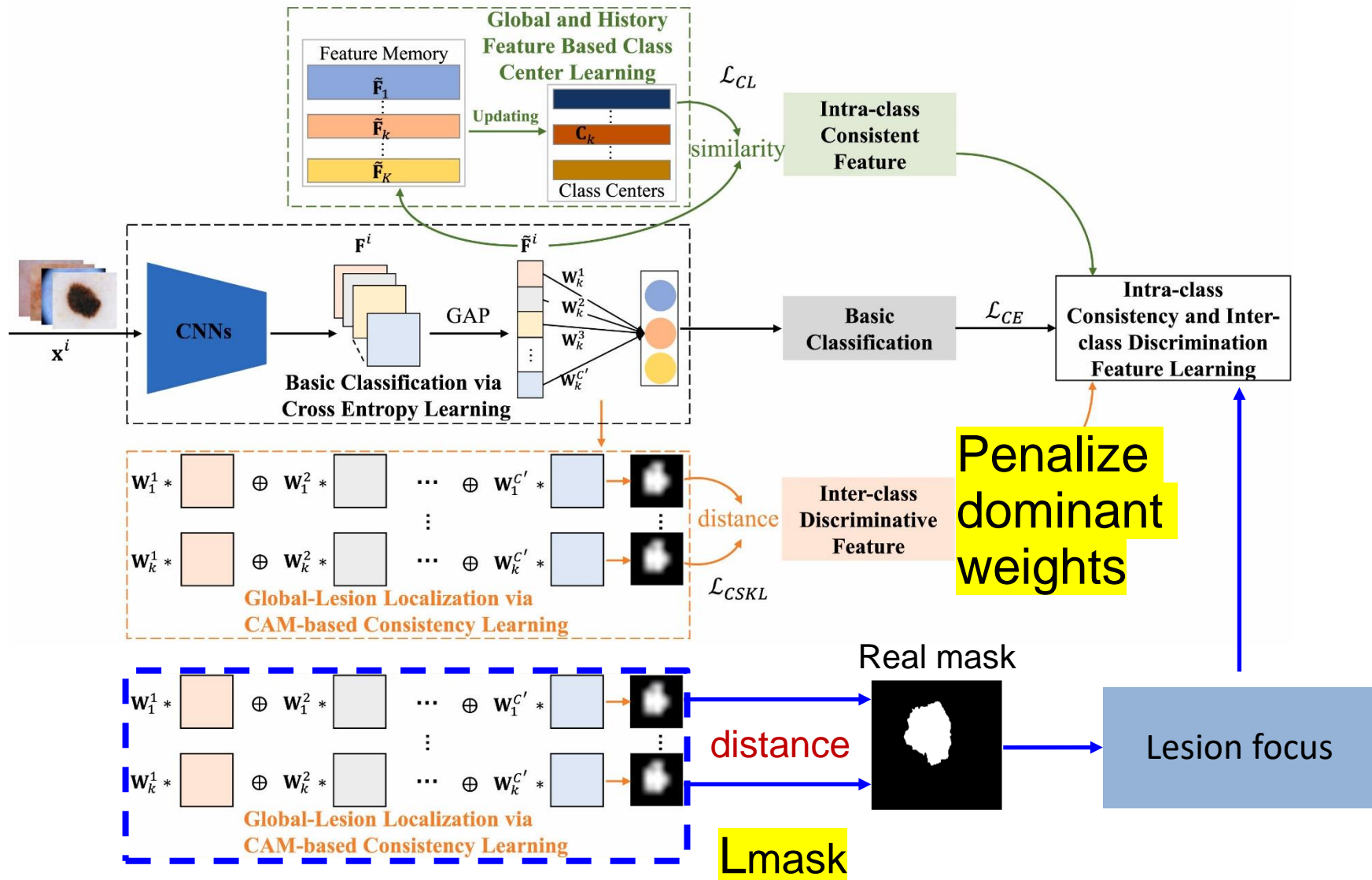
Main approach: 2 main problems

1. Model not focused on the lesion
2. Dominant weights

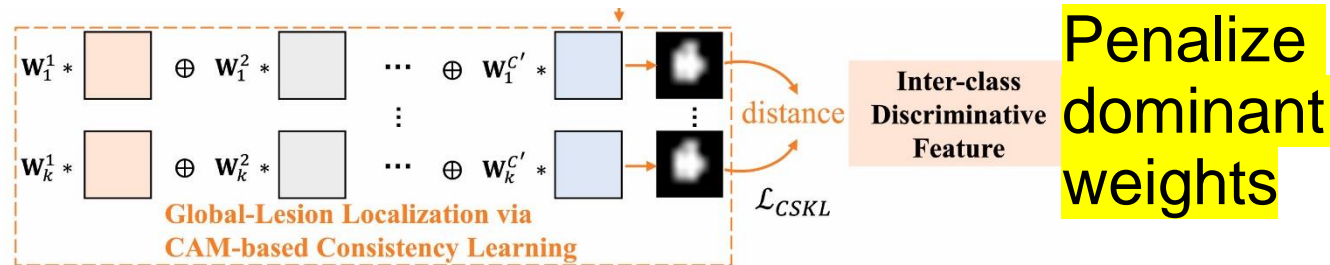


CAM	Min	Max	STD
B	-25.71	30.55	10.79
M	1.52	46.10	10.45

Main approach: proposed changes



Main approach: Inter-class loss penalized



Original loss

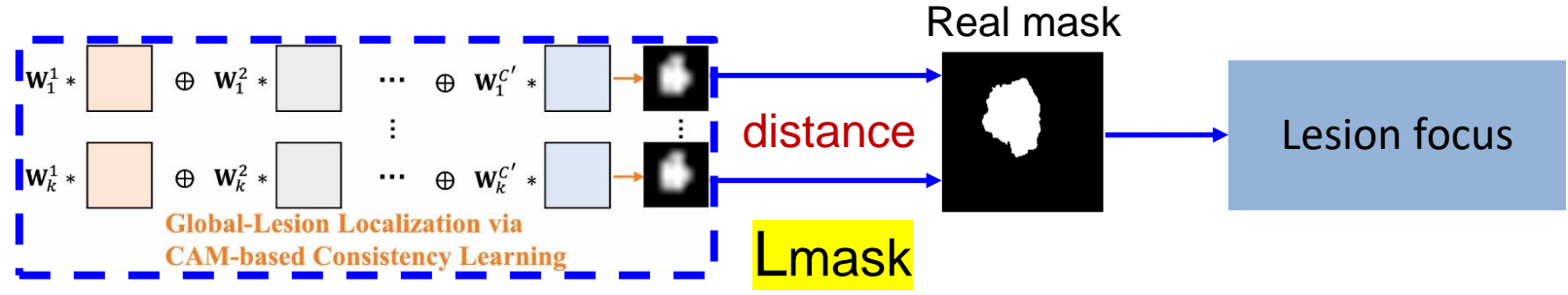
$$\mathcal{L}_{CSKL}(p, q) = p \log p - p \log q + q \log q - q \log p$$

Penalized loss

$$\mathcal{L}_{CSKL}(p, q) = \frac{p \log p - p \log q}{\lambda_a (p \log p - p \log q)^2 + 1} + \frac{q \log q - q \log p}{\lambda_a (q \log q - q \log p)^2 + 1}$$

Where: p and q are the class activation maps (CAM) and λ_a is the regularization weight

Main approach: Lesion focus loss

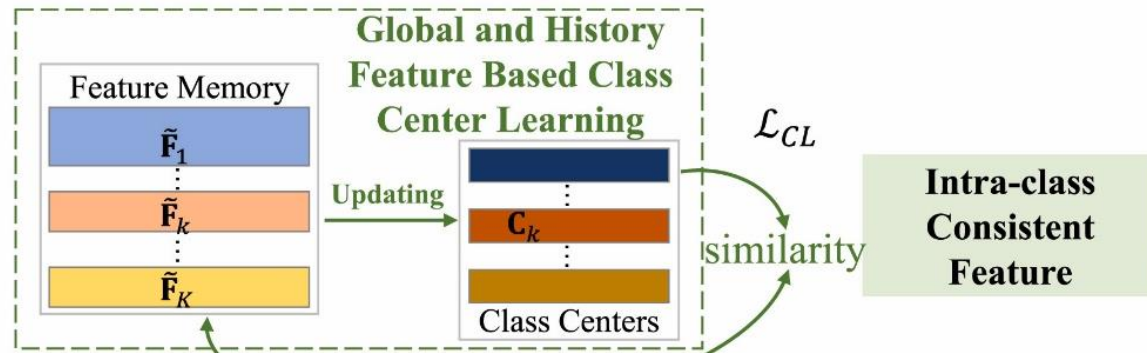


Proposed loss:

$$L_{\text{mask}} = - \frac{\mathbb{E}[(X - \mu_X)(Y - \mu_Y)]}{\sigma_X \sigma_Y} + 1$$

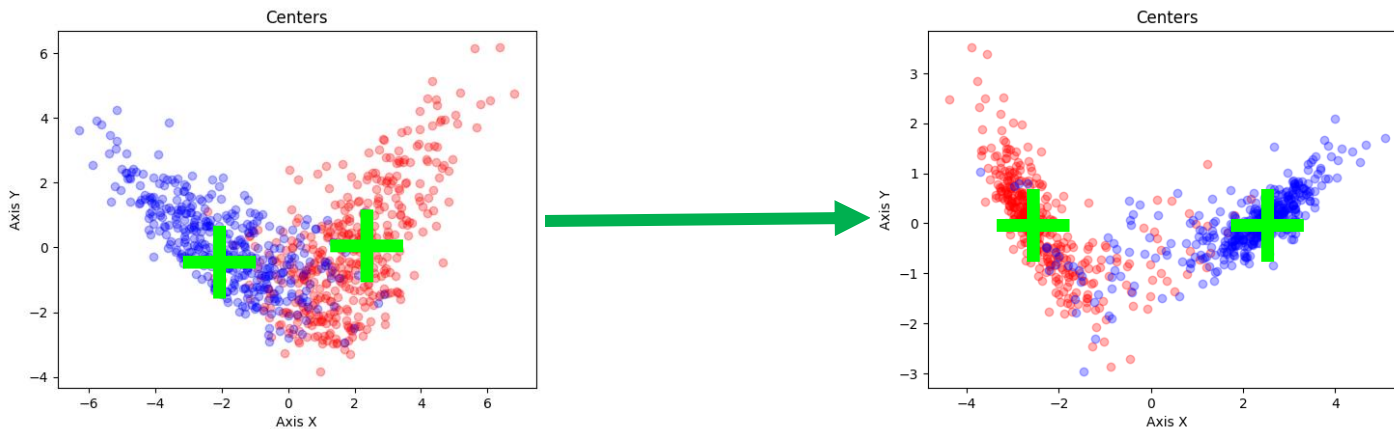
Loss based on the pearson correlation coefficient between the mask (Y) and each CAM (X)

Main approach: Intra class loss



Proposed loss:

$$\mathcal{L}_{CL} = \left\| \tilde{\mathbf{F}}^i - \mathbf{C}_{y^i} \right\|_2^2$$

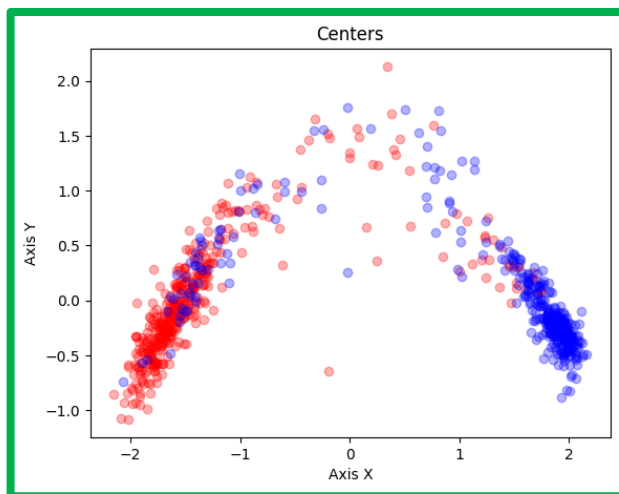
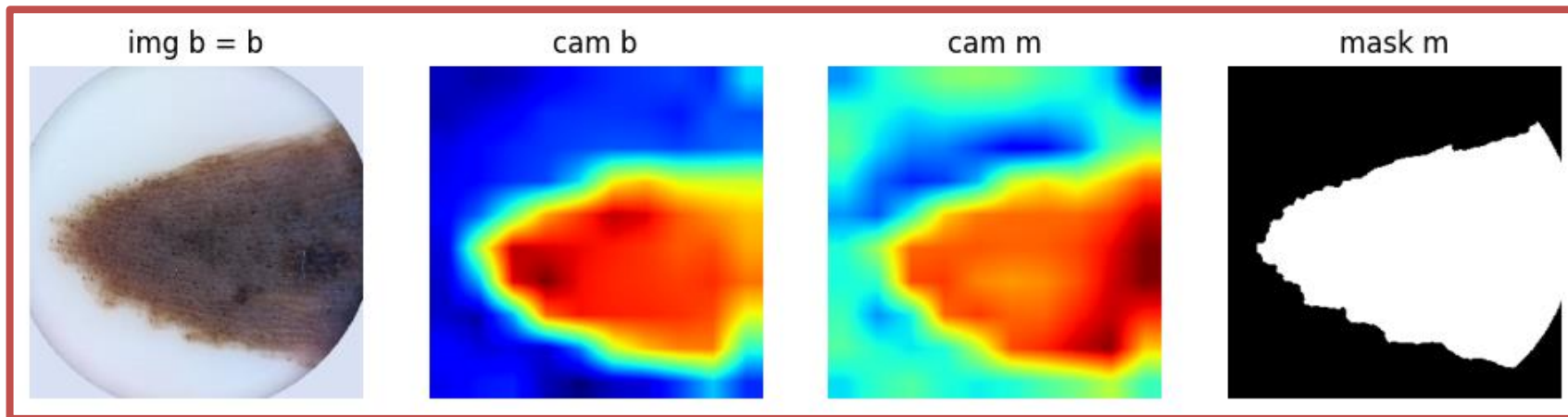


Loss based on the precomputed center for class y (C_y) and the features extracted for image i after Global Average Pooling Layer.

Main approach: Combined loss (Binary)

Proposed loss for **Binary classification**:

$$L = L_{ce} + \lambda_1 L_{cl} + \lambda_2 L_{cskl} + \lambda_3 L_{mask}$$



Where:

L_{ce}: cross-entropy loss

$$\lambda_1 = 1.0$$

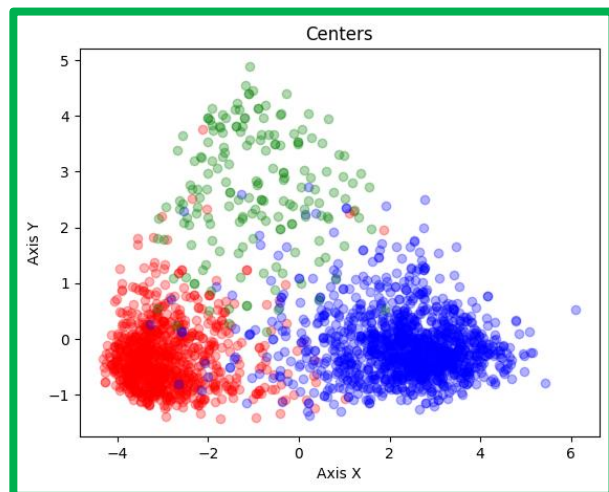
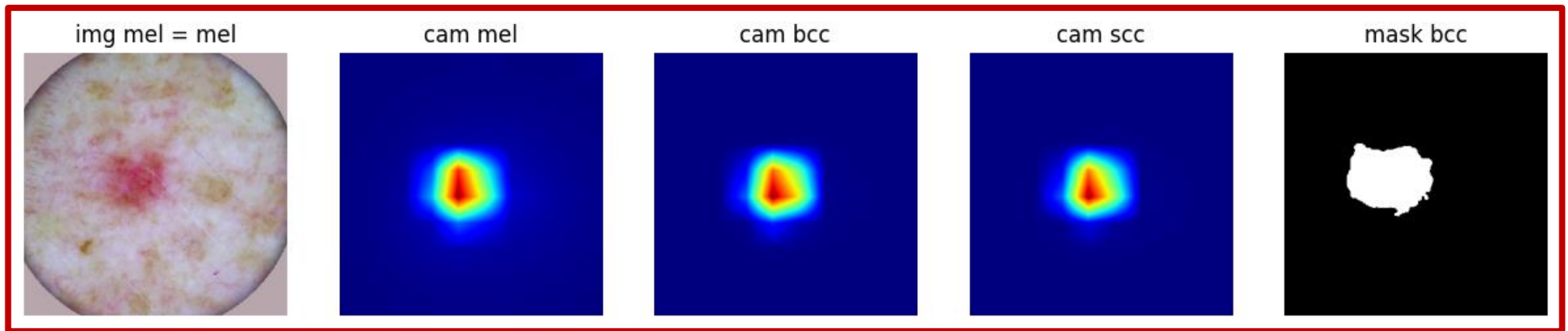
$$\lambda_2 = 0.1$$

$$\lambda_3 = 0.5$$

Main approach: Combined loss (Binary)

Proposed loss for **Multi class classification** :

$$L = L_{focal} + \lambda_1 L_{cl} + \lambda_2 L_{cskl} + \lambda_3 L_{mask}$$



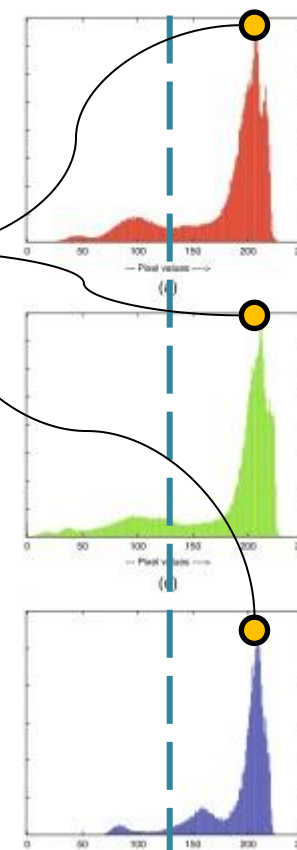
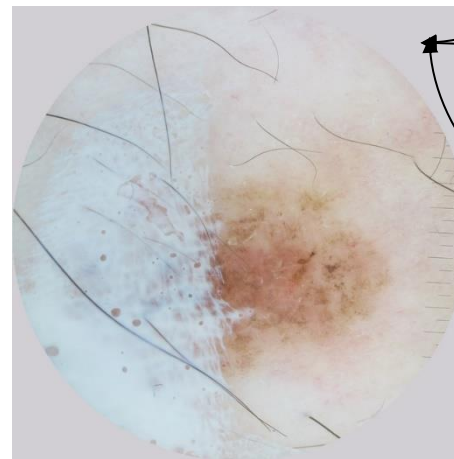
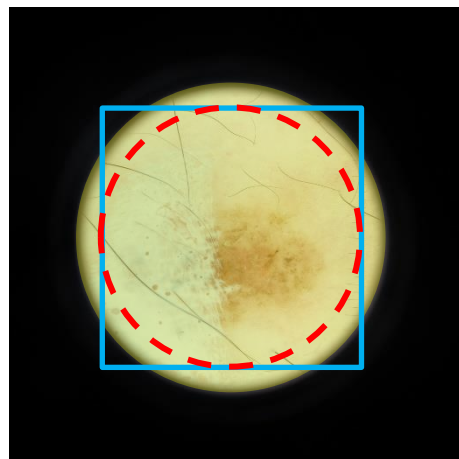
Where:
L_{focal}: Focal loss
 $\lambda_1 = 1.0$
 $\lambda_2 = 0.1$
 $\lambda_3 = 0.5$

Training

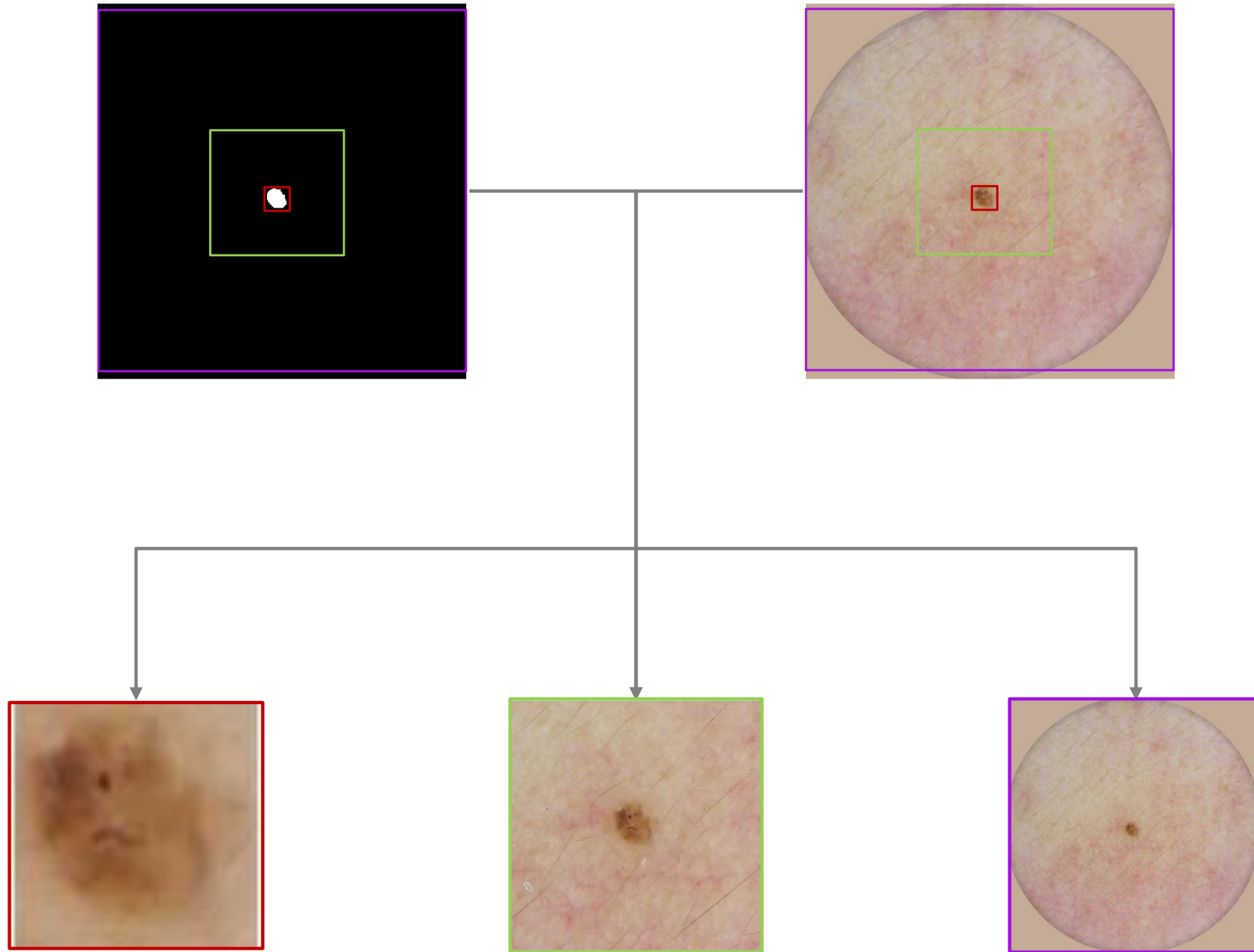
Parameters	Values
Backbone	EfficientNet (B0/B1/B3/B4)
Initial weights	ImageNet
Max epochs	50
Batch size	16/32
Image Size	299 x 299 x 3
Optimizer	Adadelta: lr=1.0, rho=0.9
LR Monitor	Metric="val_loss", factor=0.5, patience=2, min=0.0001
Early stopping	Metric="val_acc", patience=10

Preprocessing

Outer circle removal



Data preparation



Data preparation

Original image



Normalized as ImageNet



Vertical Flip



Random resize and crop



Shift scale rotation

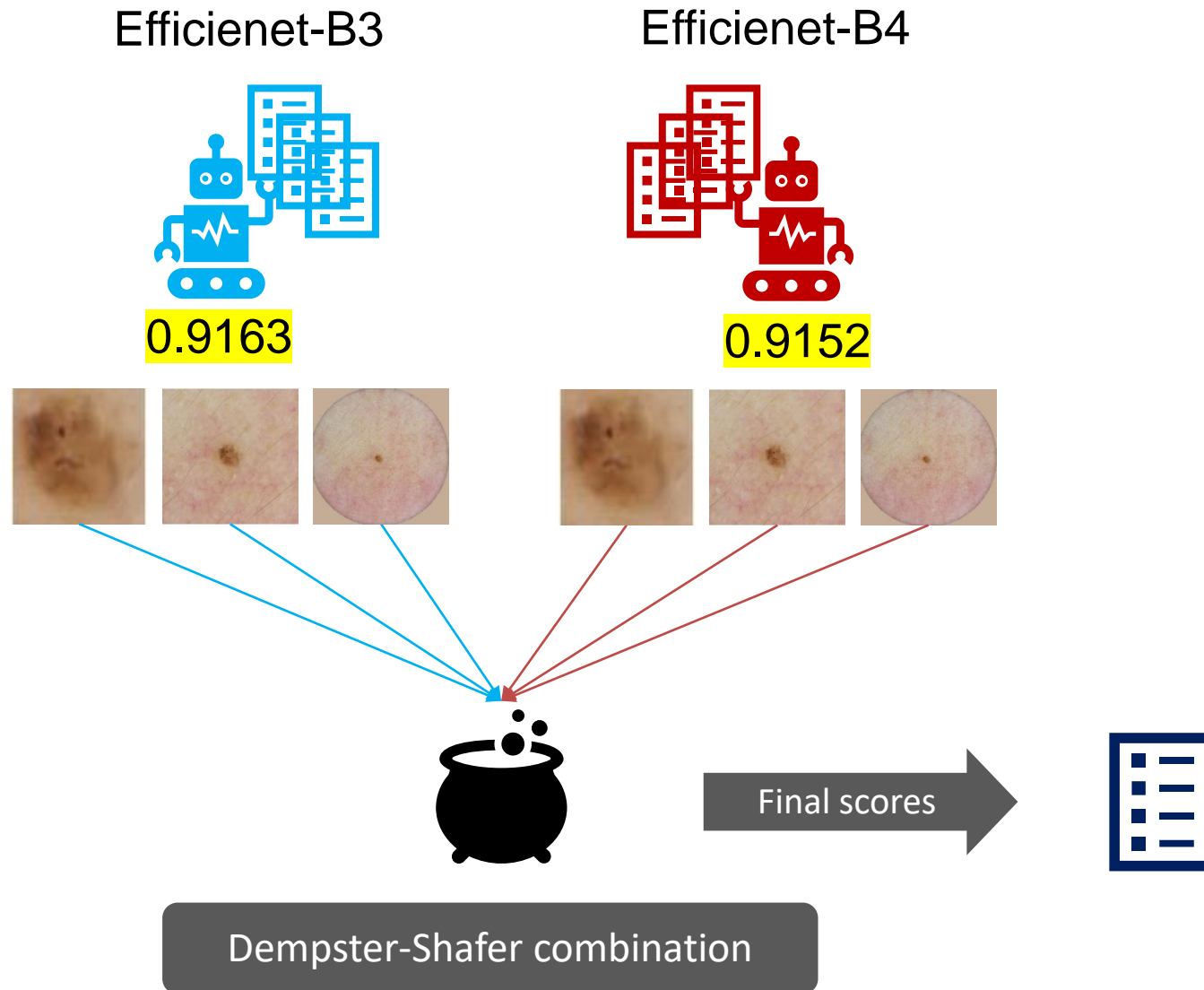


Horizontal Flip



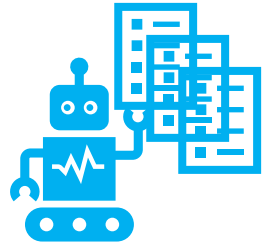
Ensamble methods

Ensemble method Binary



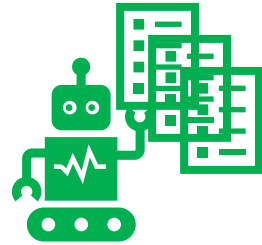
Ensemble method Multi Class

Efficient-B0



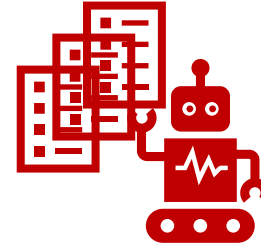
0.9191

Efficient-B2



0.9376

Efficient-B3



0.9298



Dempster-Shafer combination



Final scores

Mean between the 3 square images scores



Results

Results Binary

Validation results

```
accuracy: 0.9354583772391991
```

```
Classification report:
```

	precision	recall	f1-score	support
0	0.93	0.95	0.94	1931
1	0.94	0.93	0.93	1865
accuracy			0.94	3796
macro avg	0.94	0.94	0.94	3796
weighted avg	0.94	0.94	0.94	3796

Validation results

```
kappa: 0.9573417052569351
```

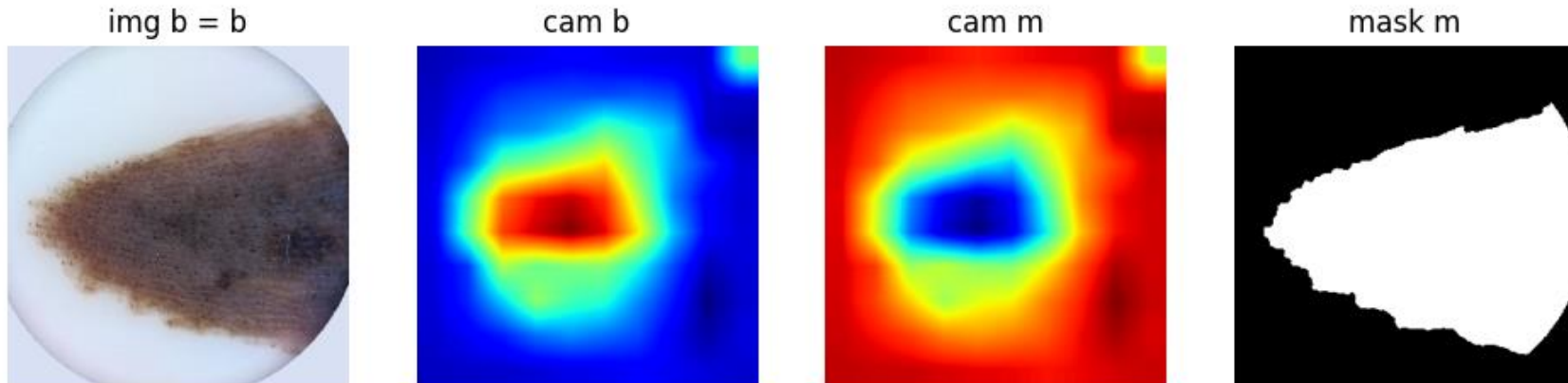
```
Classification report:
```

	precision	recall	f1-score	support
0	0.97	0.99	0.98	498
1	0.98	0.98	0.98	678
2	0.95	0.87	0.91	94
accuracy			0.98	1270
macro avg	0.97	0.95	0.96	1270
weighted avg	0.98	0.98	0.98	1270

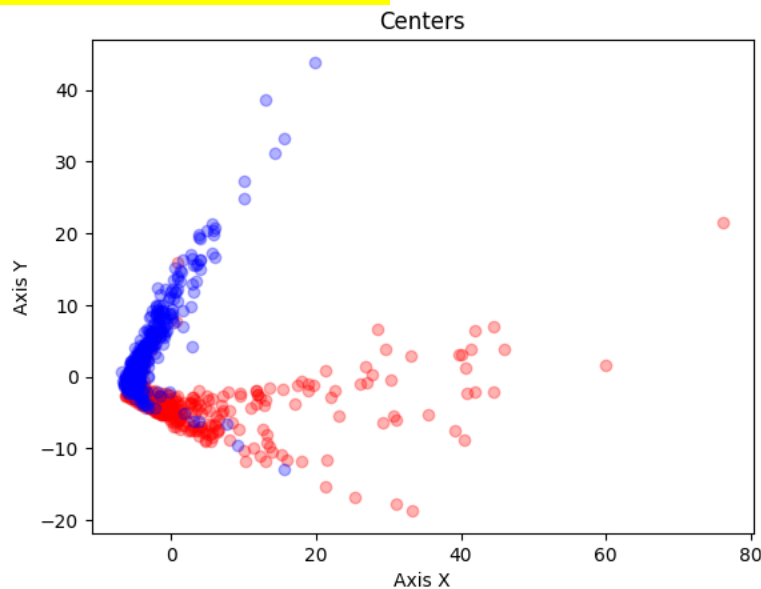
Other tests

Other tests: Basic approach

CAM consistency



Center learning



Results

```

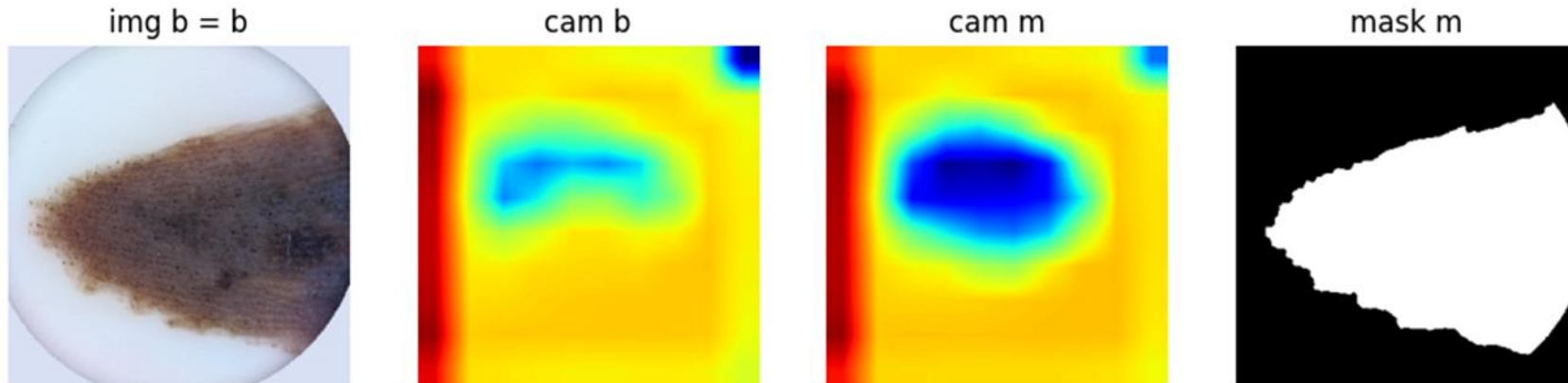
accuracy: 0.910958904109589
Classification report:

```

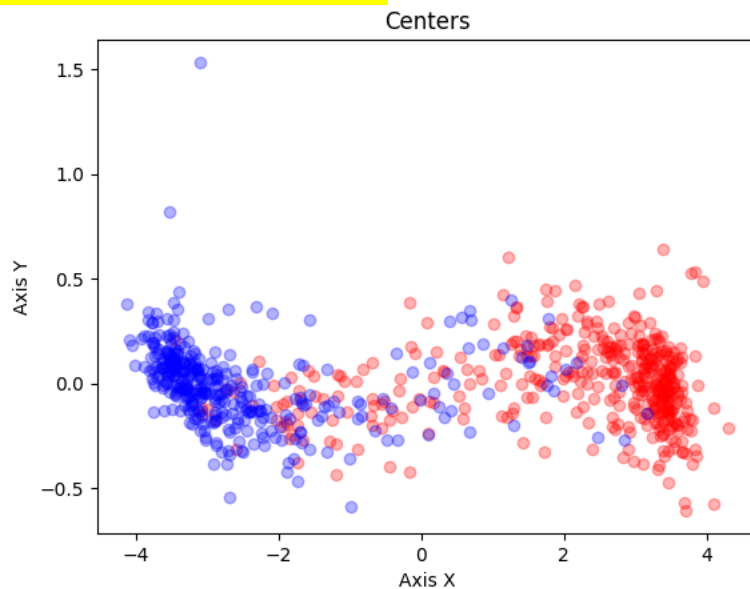
	precision	recall	f1-score	support
0.0	0.91	0.91	0.91	1865
1.0	0.91	0.91	0.91	1931
accuracy			0.91	3796
macro avg	0.91	0.91	0.91	3796
weighted avg	0.91	0.91	0.91	3796

Other tests: Paper approach

CAM consistency



Center learning



Results

```

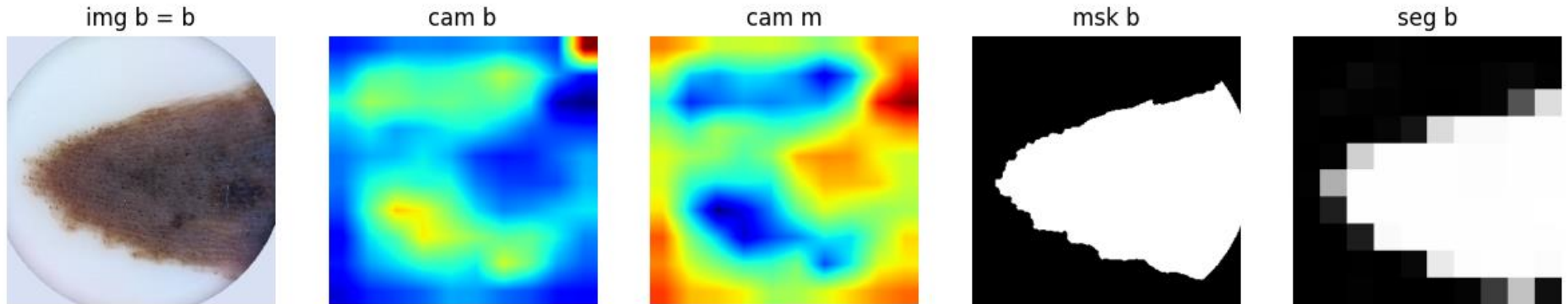
accuracy: 0.8948893572181243
Classification report:

```

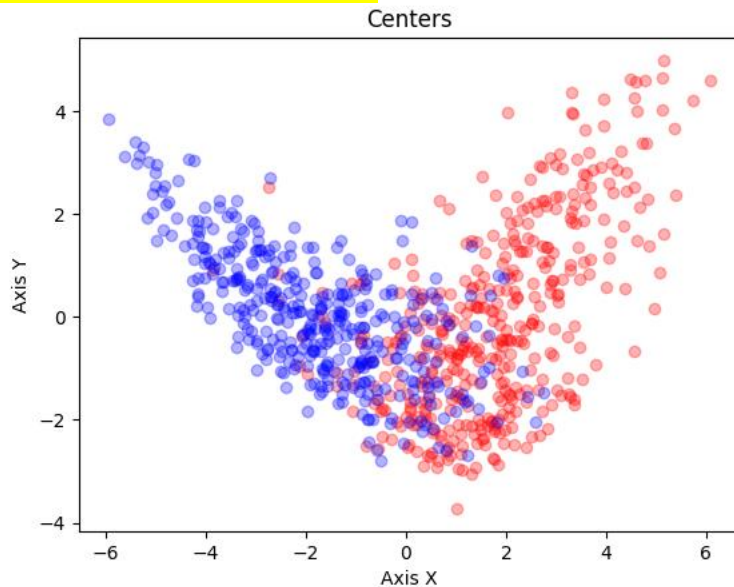
	precision	recall	f1-score	support
0.0	0.90	0.88	0.89	1865
1.0	0.89	0.91	0.90	1931
accuracy			0.89	3796
macro avg	0.90	0.89	0.89	3796
weighted avg	0.90	0.89	0.89	3796

Other tests: Classification and segmentation

CAM consistency



Center learning



Results

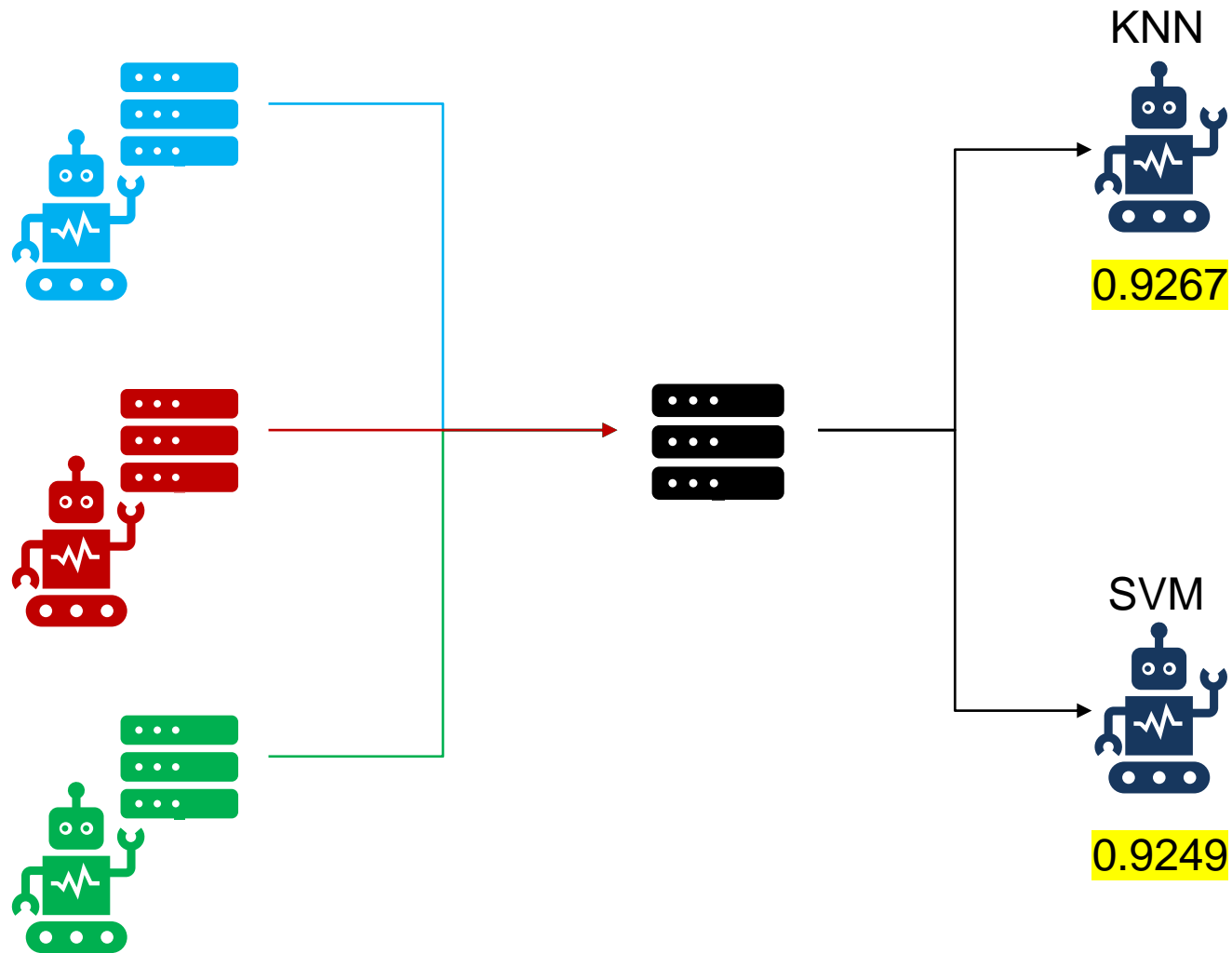
```

accuracy: 0.8843519494204426
Classification report:

```

	precision	recall	f1-score	support
0.0	0.94	0.82	0.87	1865
1.0	0.84	0.95	0.89	1931
accuracy			0.88	3796
macro avg	0.89	0.88	0.88	3796
weighted avg	0.89	0.88	0.88	3796

Other tests: Classification with ML



Thanks

Questions?