Uncertainty measurements for the reliable classification of mammograms

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Whoami

Mickael Tardy

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- Chief Researcher at Hera-MI
- IT Engineer in everyday life
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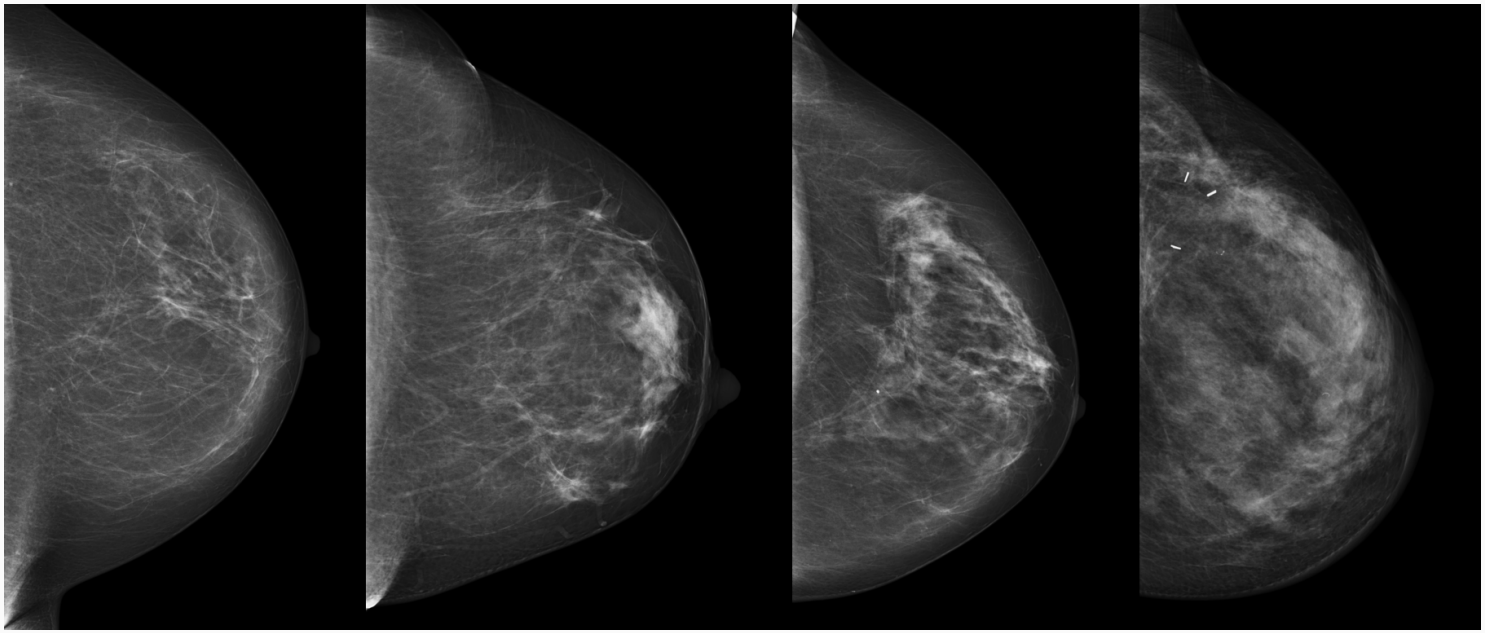
Context

Deep learning applied on breast imaging (i.e. mammography)

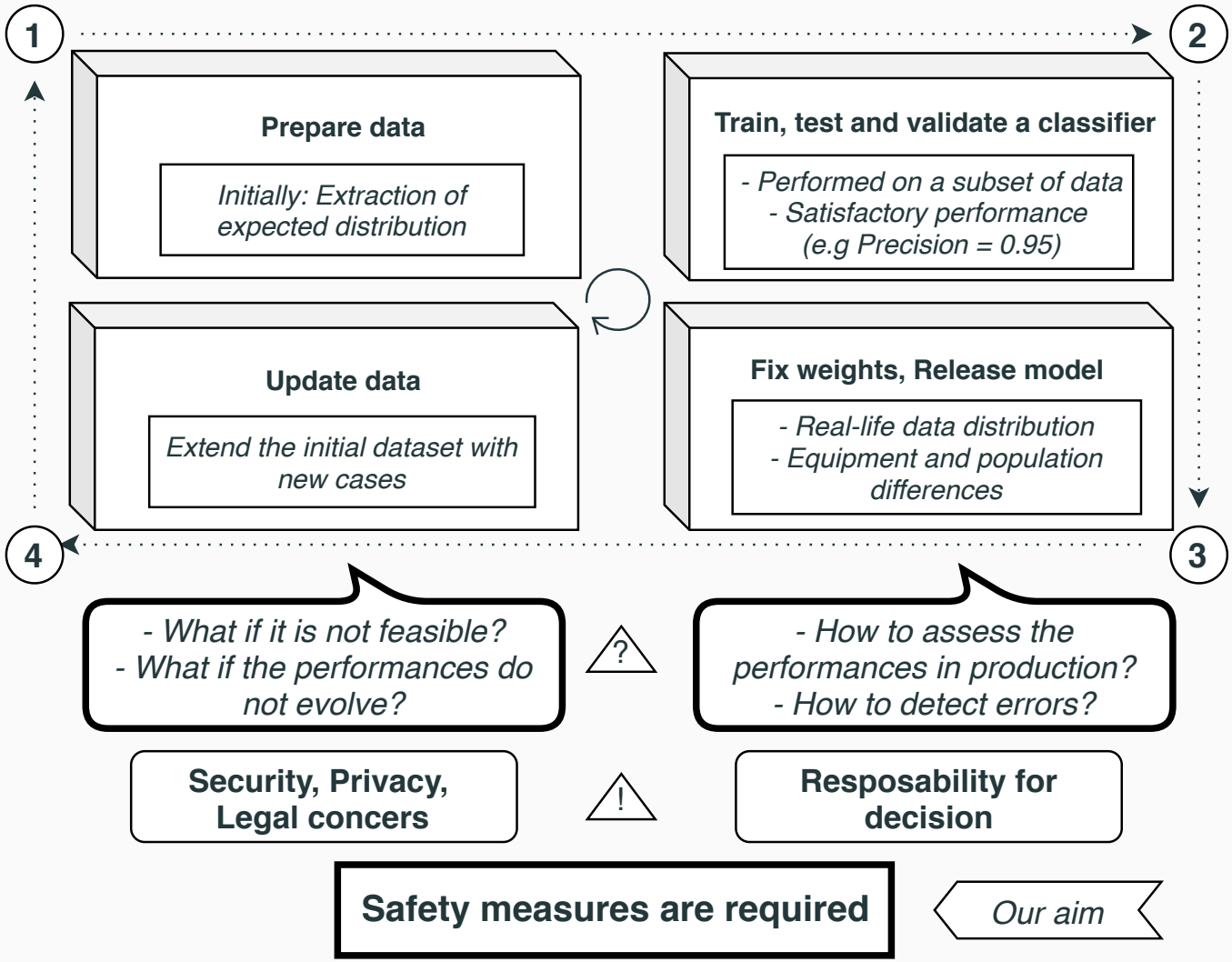


Context

Deep learning applied on breast imaging (i.e. mammography)

- **Imaging classification (e.g malignant vs. benign)**
- Imaging segmentation (e.g. find pixels from malignant region)
- Object detection (e.g. find coordinates of findings: masses, calcifications, etc.)

Problem


1
2
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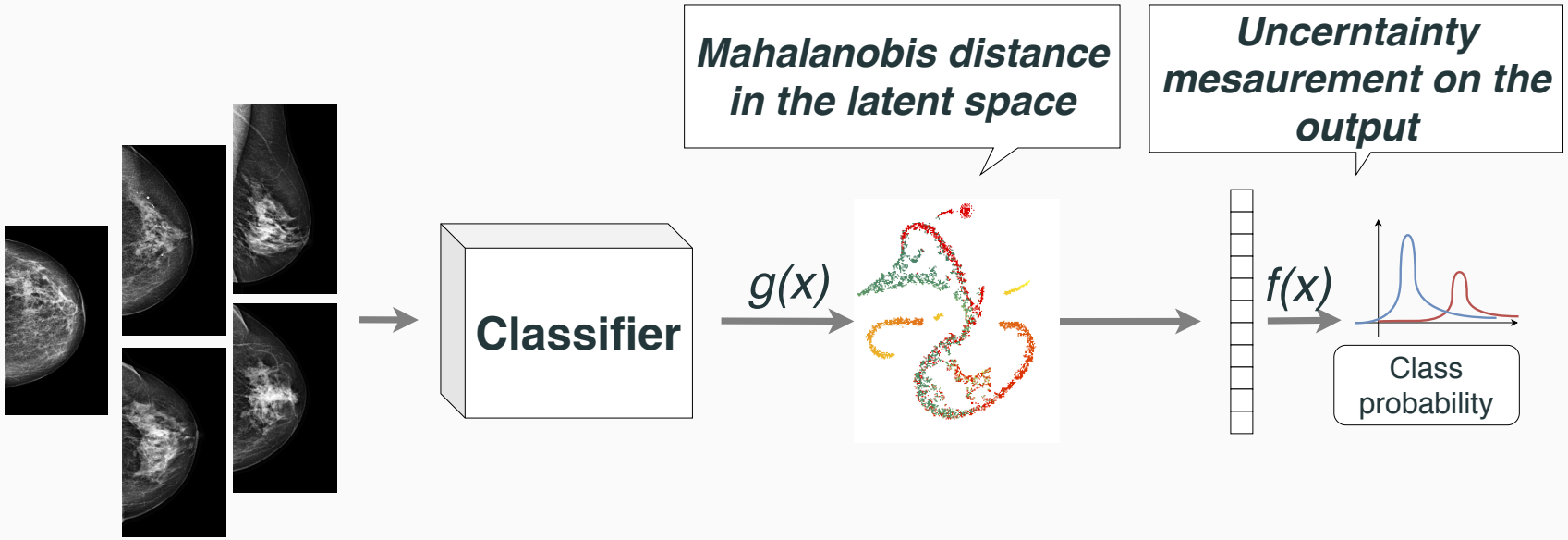
Prepare data
Initially: Extraction of expected distribution
Train, test and validate a classifier
- Performed on a subset of data
- Satisfactory performance
(e.g Precision = 0.95)
Update data
Extend the initial dataset with new cases
Fix weights, Release model
- Real-life data distribution
- Equipment and population differences
- What if it is not feasible?
- What if the performances do not evolve?
?
- How to assess the performances in production?
- How to detect errors?
Security, Privacy, Legal concers
!
Resposability for decision
Safety measures are required
Our aim

Problem

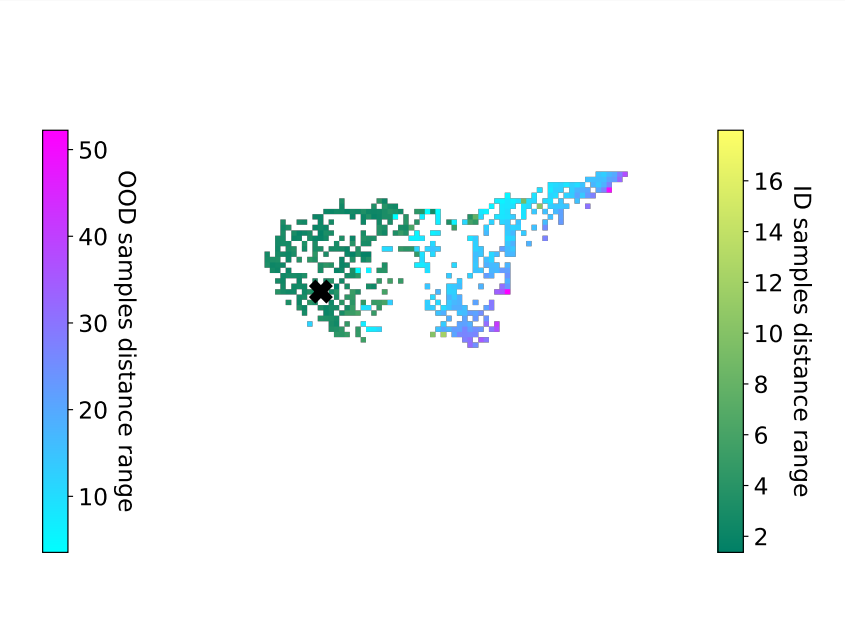
- The prediction of a model is not always correct
- Safety measures are needed to prevent from wrong decision
- **How to identify, if the deep learning model is wrong?**

Solution highlights



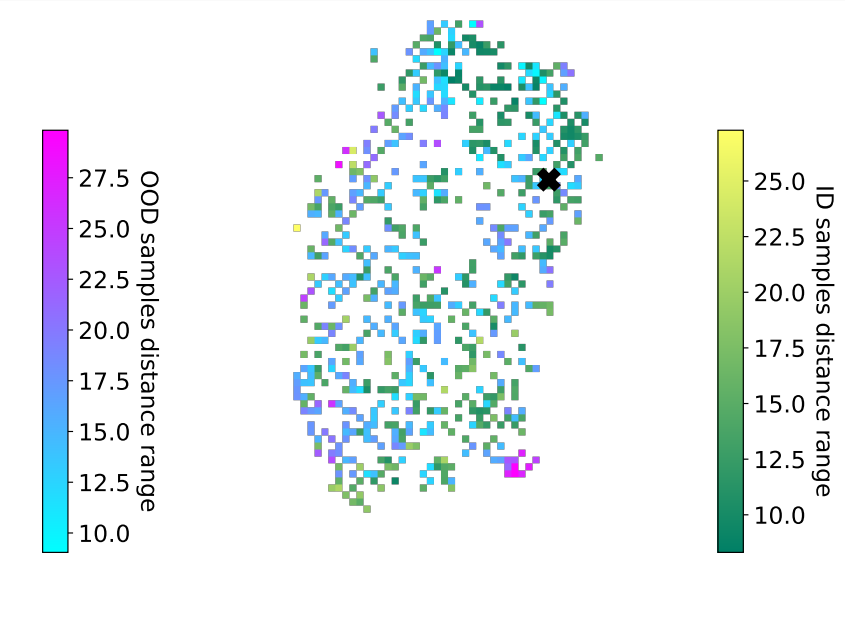
Solution highlights: Latent space

Easy case: Known data (Green-ish): mammography vs. Unknown data (Blue-ish): natural images

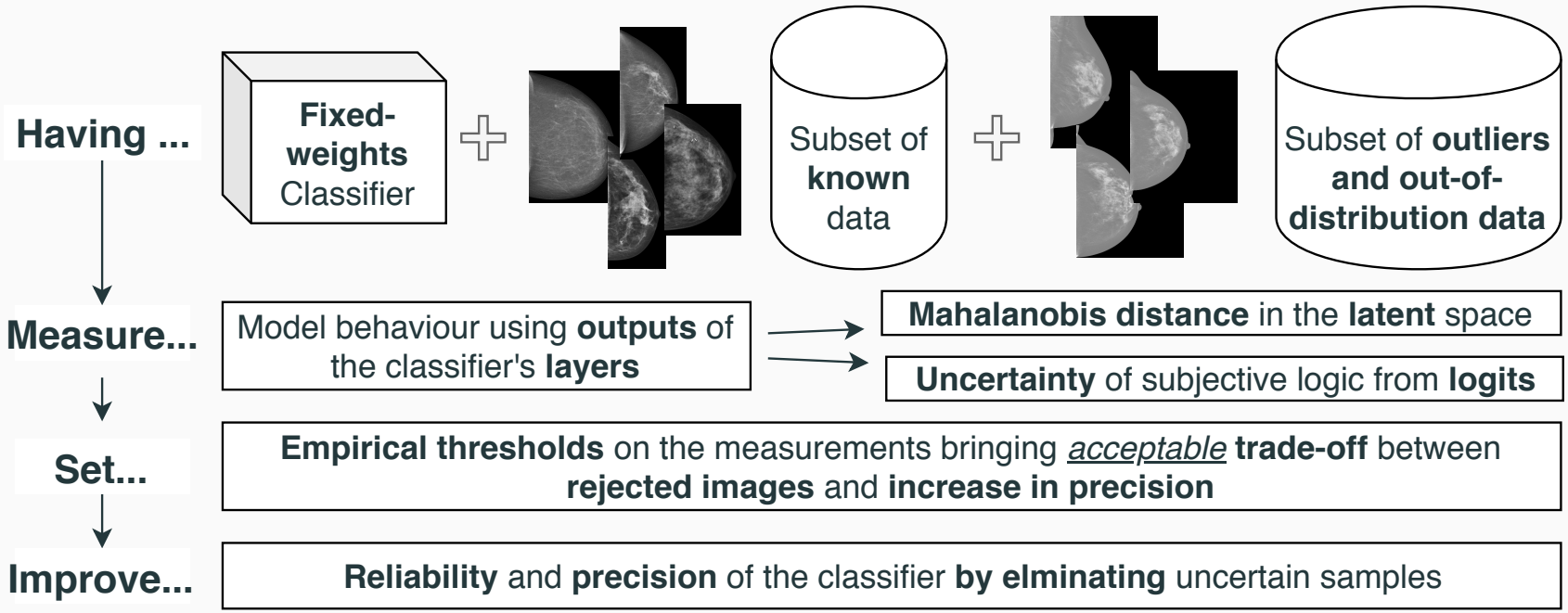


Solution highlights: Latent space

Less obvious: Known data (Green-ish) vs Unknown data (Blue-ish), both are mammographies

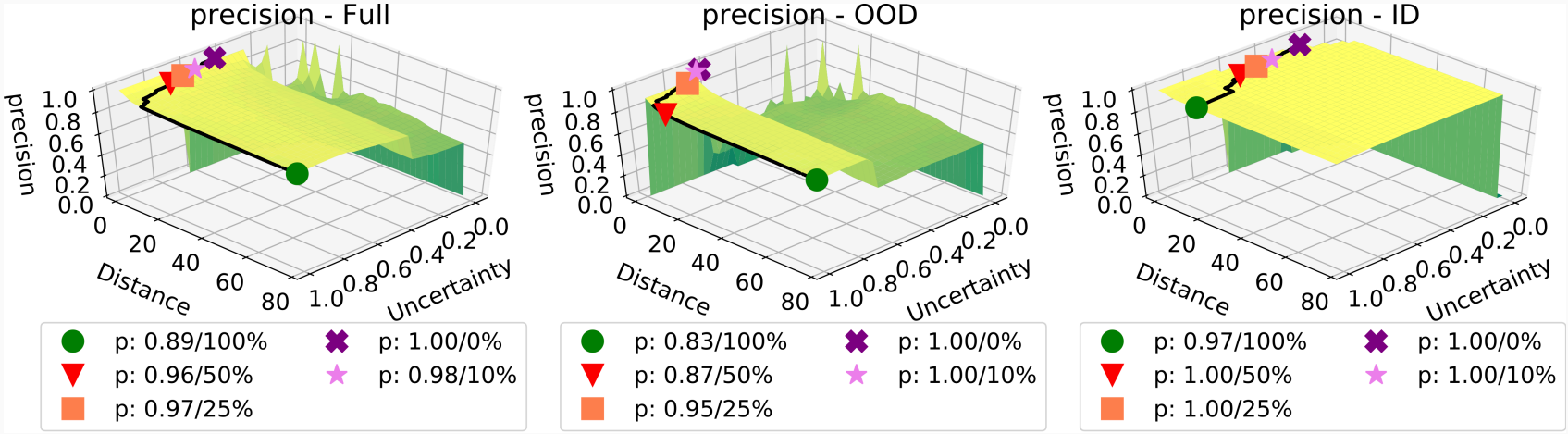


Solution


Having ...
Fixed-weights Classifier
Subset of known data
Subset of outliers and out-of-distribution data
Measure...
Model behaviour using outputs of the classifier's layers
Mahalanobis distance in the latent space
Uncertainty of subjective logic from logits
Set...
Empirical thresholds on the measurements bringing acceptable trade-off between rejected images and increase in precision
Improve...
Reliability and precision of the classifier by elminating uncertain samples

Results

Navigation in measurements space: identifying erroneous data samples in known data (ID) and unknown data (OOD)



Conclusion

- **Improved reliability** of a classifier in a few steps, available **out-of-the box** in any classifier in **a single shot**
- Ability to **identify** both, **uncertain inliers** and unknown **outliers** thanks to **combined threshold**.
- Unlike the state-of-the-art, our method may be used **without retraining** nor **architecture changes**

Q&A

- Q&A