DBT – Density Classification

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Medical Image Analysis

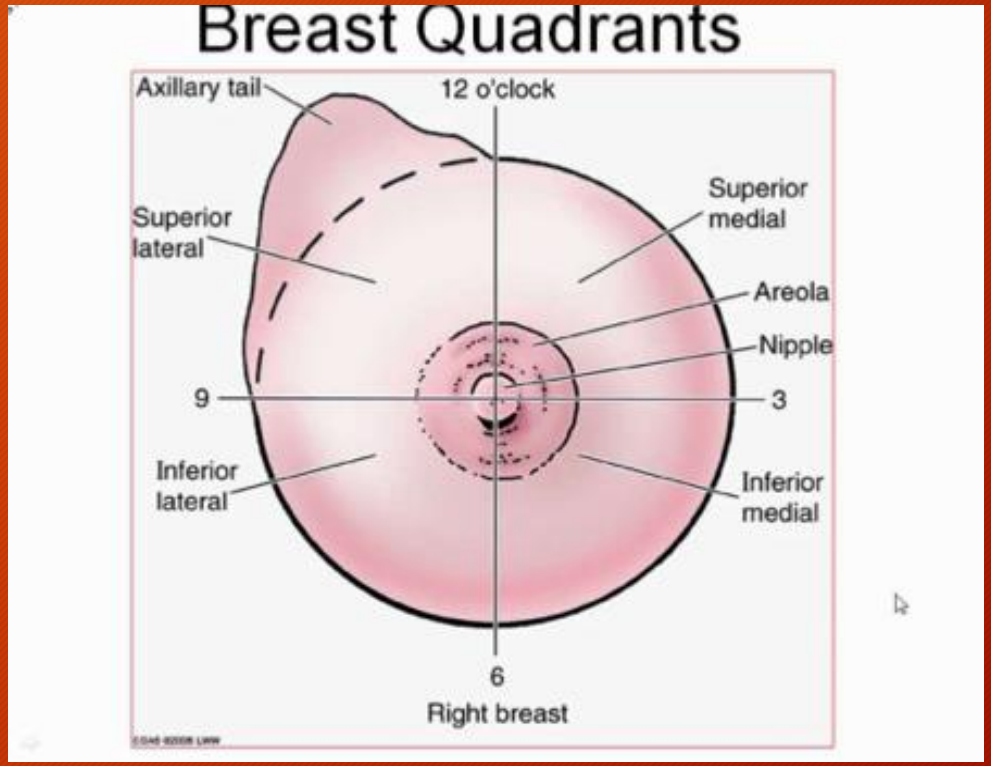
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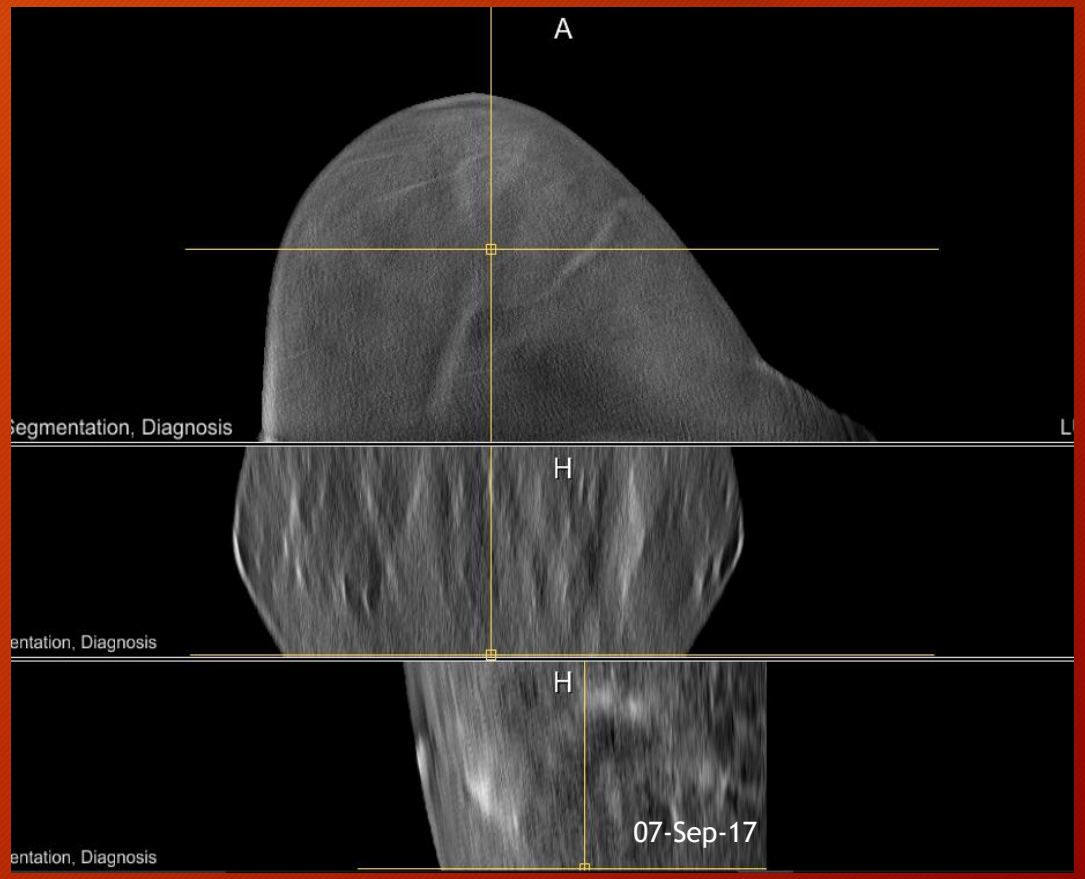
Introduction

- **What is breast density?**
- Breast density is a radiologic assessment of how well x-rays pass through the breast tissue. It is a surrogate for how much of the breast is composed of glandular tissue and how much is fat.

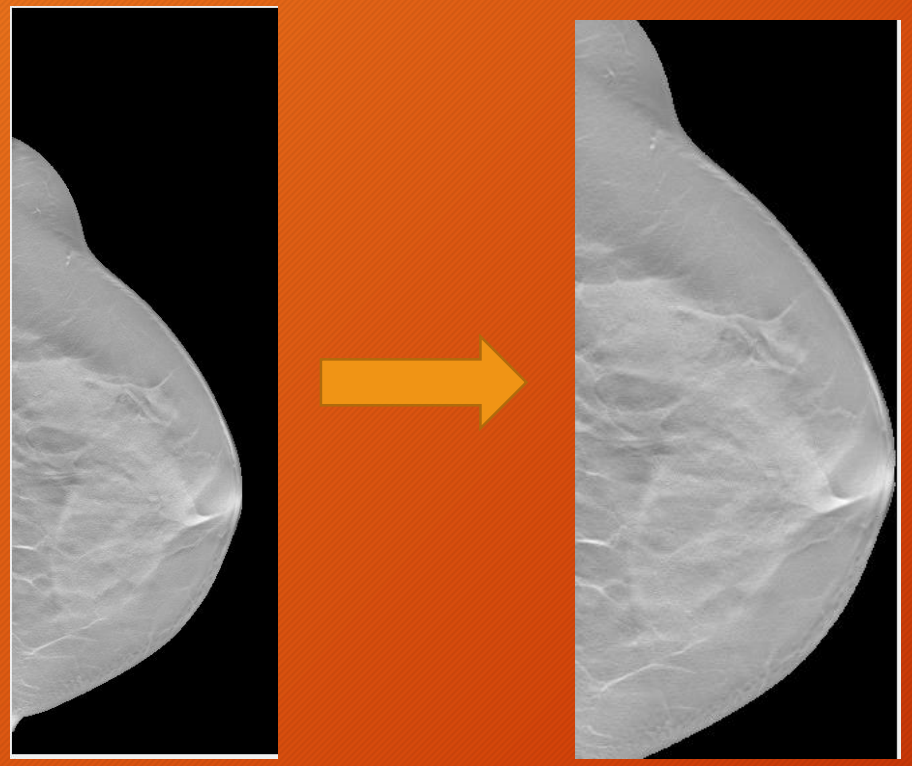


Fatty tissue and dense tissue

- Different radiologists may give the same mammogram different ratings.
- There is not yet a standardized computer rating system.
- For the purposes of the law, dense breasts are defined as those that are heterogeneously dense or extremely dense.



Pre-processing



- Cropping
- Gray scale normalization
- Skin line: Erosion (binary mask)

Techniques tried

- Texture features extraction based on GLCM. (Homogeneity, contrast, entropy, correlation)
- Region of interest (ROI)
- SIFT descriptor

There are some limitations of them:

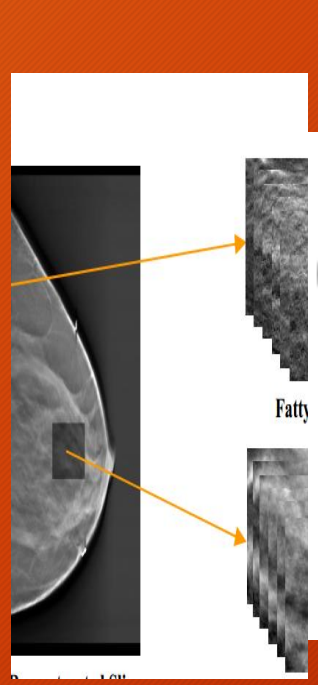
- The features computed from GLCM are not distinctive from class to class.
- ROI varies in different DBTs due to the various locations of dense tissue and the size of different DBTs.
- SIFT descriptor is not giving valuable information.

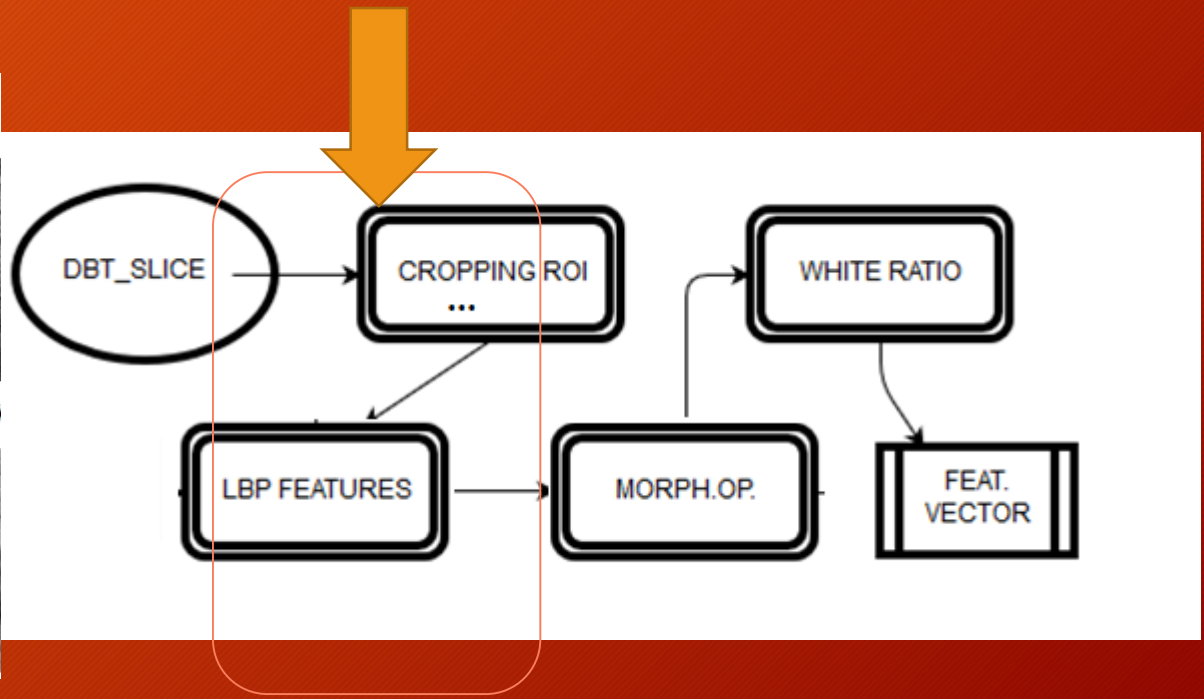




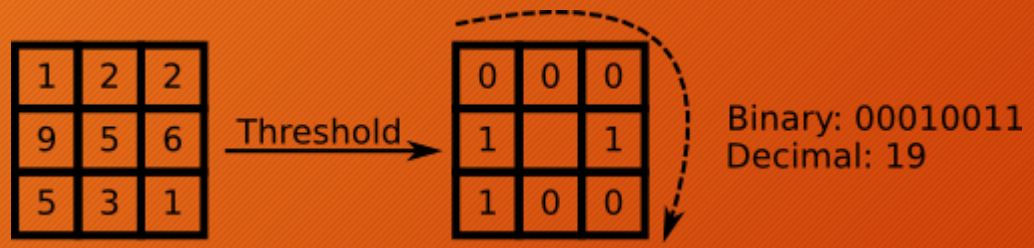
Approach used

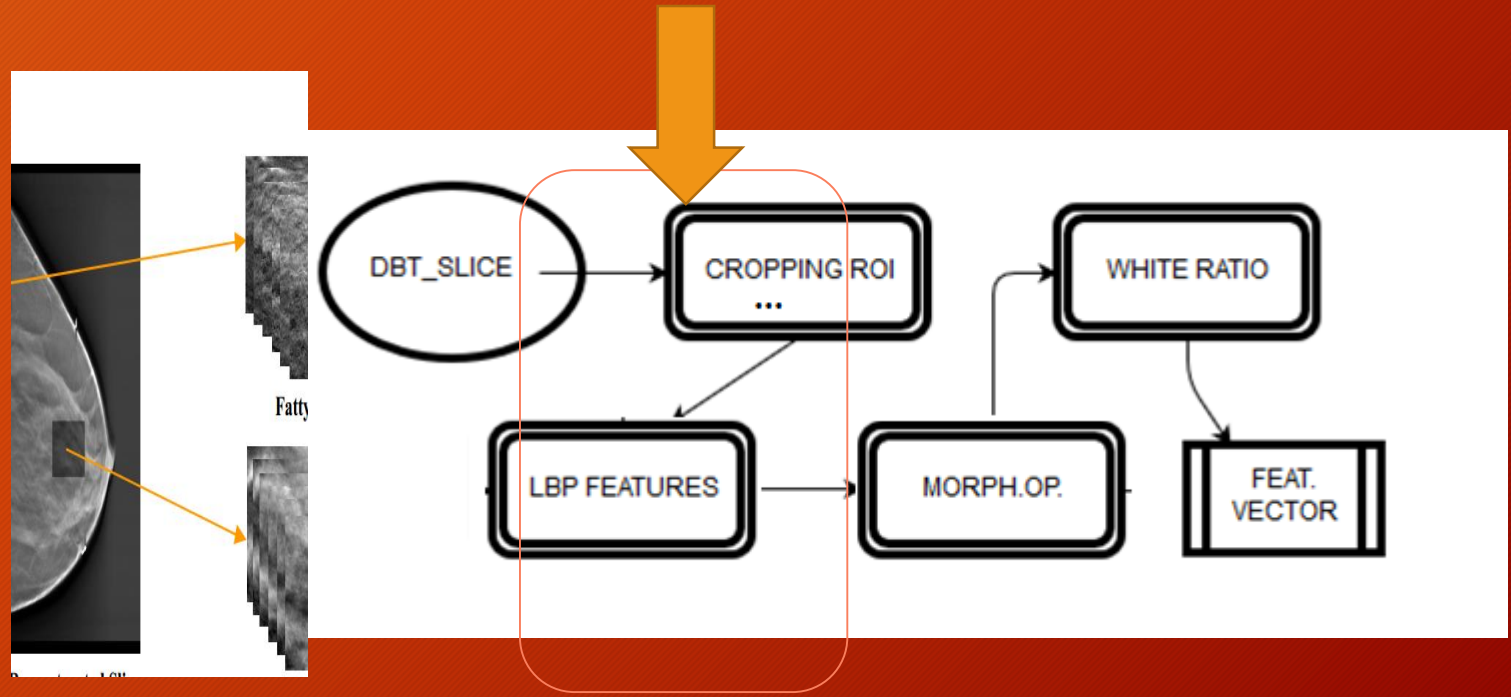
- **Local Binary Patterns**
- Good edge detection
- Computationally simple
- Reduces the data to train as we use the W_Ratio





Approach used



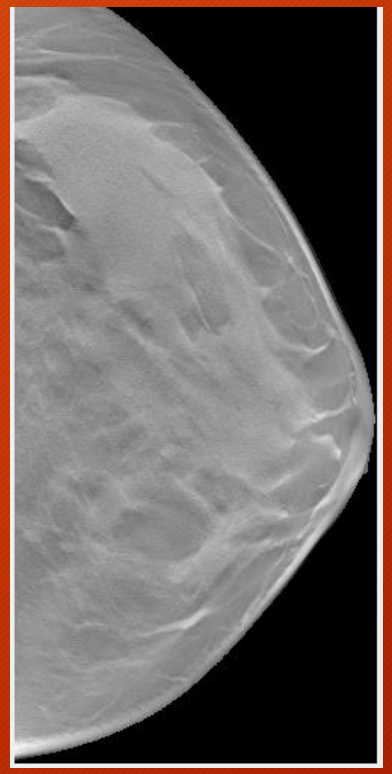


Approach used

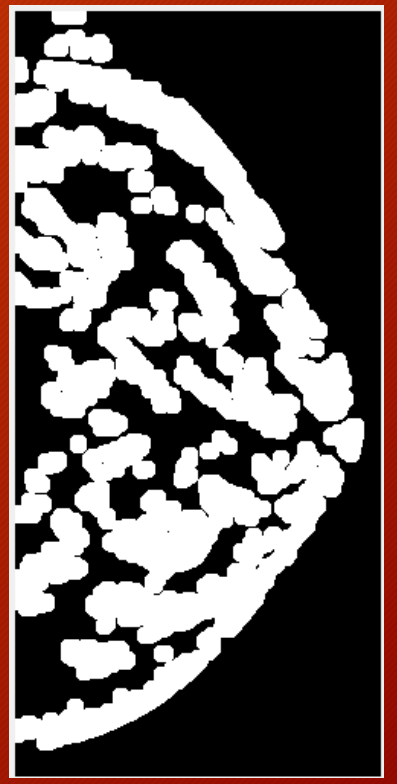


BIRADS 1





BIRADS 4



The white ratio is increasing from B1 to B4

Current results

- Multi-class SVM
- Leave-p-out cross-validation: **85% accuracy** (avg)
- Testing time for one patient: 0.17 seconds



Comparison

KNN	Naive Bayes	Multi-class SVM
56% accuracy	75% accuracy	85% accuracy
4 sec	4 sec	4.24 sec

Evaluation

Measures	Class 1	Class 2	Class 3	Class 4
Accuracy	100%	66.67%	100%	75%
Sensitivity	1	0.5	1	NaN
Specificity	1	1	1	0.75
Dice coefficient	1	0.667	1	0

Conclusions

- The results depend on the data trained
- BIRADS is a subjective way of qualifying

Future work:

- More investigation need to be done for optimal classification
- VLBP/LBP-TOP

References

- TORTAJADA, Meritxell, et al. Adapting breast density classification from digitized to full-field digital mammograms. *Breast imaging*, 2012, p. 561-568.
- KONTOS, Despina, et al. Breast tissue classification in digital breast tomosynthesis images using texture features: a feasibility study. En *SPIE Medical Imaging*. International Society for Optics and Photonics, 2009. p. 726024-726024-10.
- OJALA, Timo; PIETIKAINEN, Matti; MAENPAA, Topi. Multiresolution gray-scale and rotation invariant texture classification with local binary patterns. *IEEE Transactions on pattern analysis and machine intelligence*, 2002, vol. 24, no 7, p. 971-987.