

Machine Learning for Cancer Detection in Dense Breast

Gobert Lee, Mariusz Bajger

**Medical Device Research Institute;
College of Science & Engineering
Flinders University, SA, Australia**



Flinders
UNIVERSITY

inspiring achievement

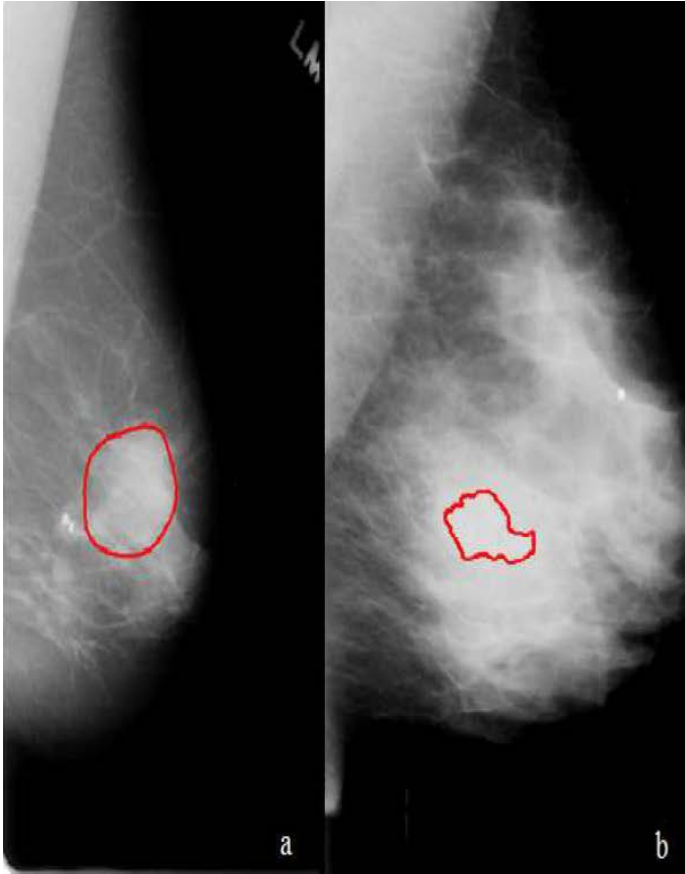
Aim:

- It is difficult to find breast cancer mass in dense breast.
- Machine Learning can analyse the image numerically.

Dense Breast

Local Dense Breast

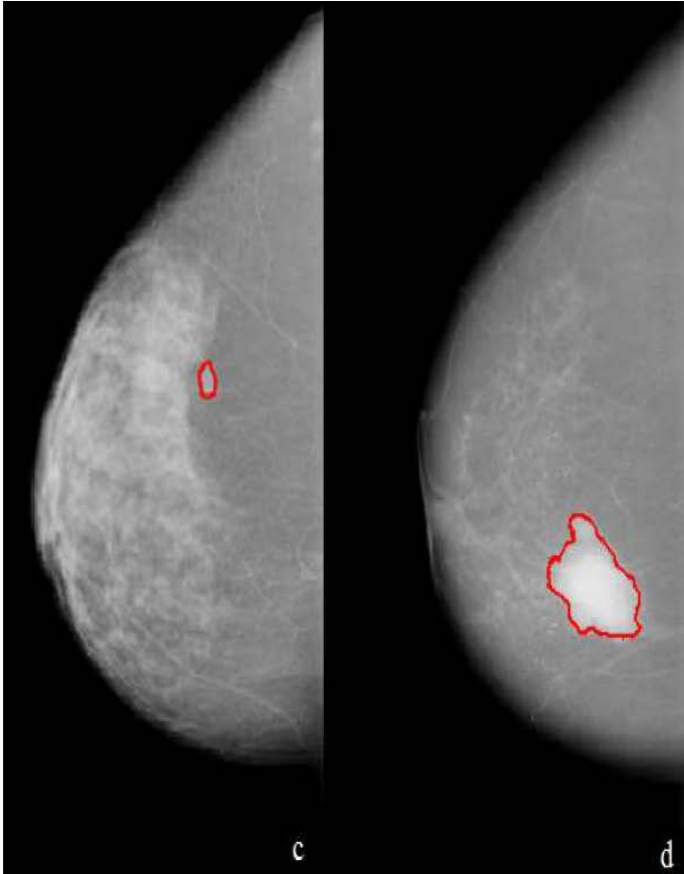
Local Dense Breast



BI-RADS II

BI-RADS IV

Local Dense

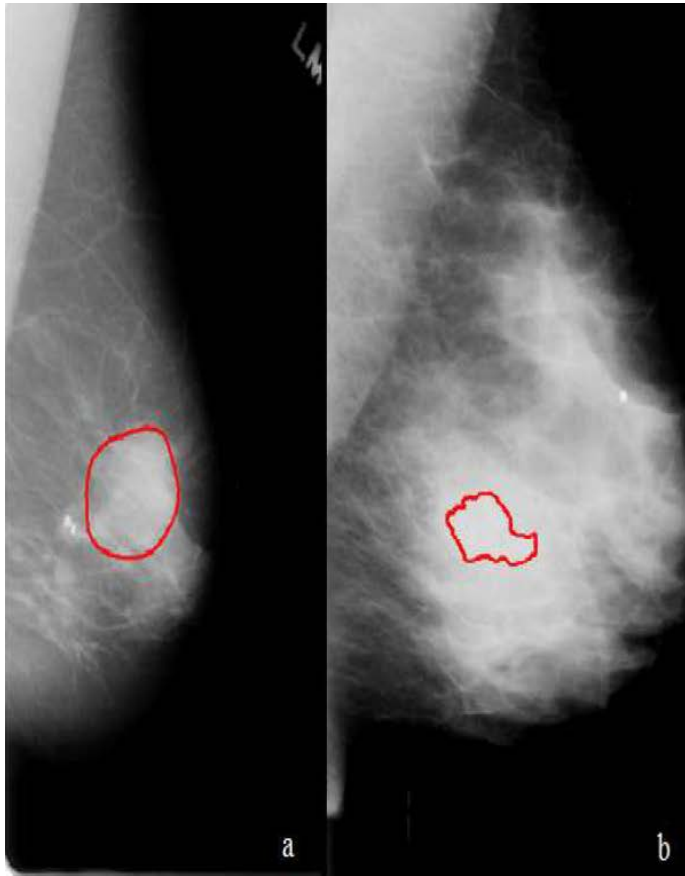


BI-RADS III

BI-RADS I

Local Non-Dense

Local Dense Breast



BI-RADS II

BI-RADS IV

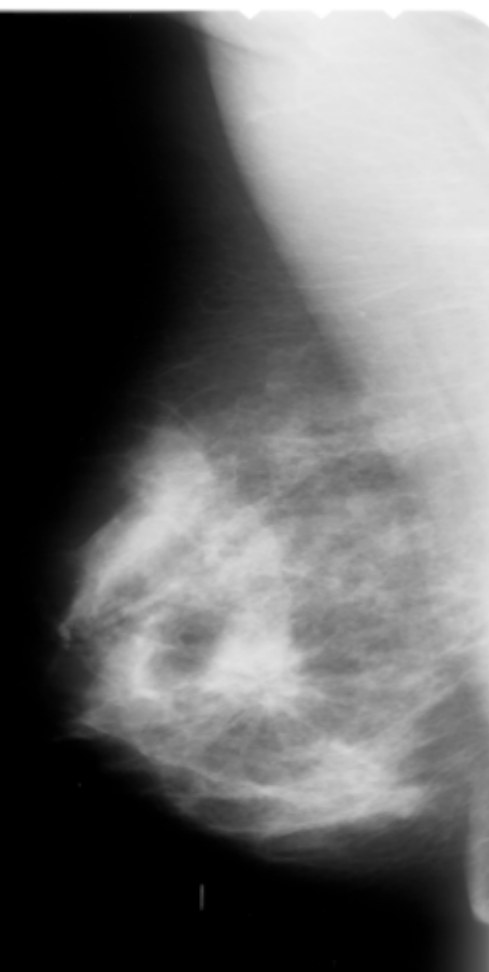
Local Dense



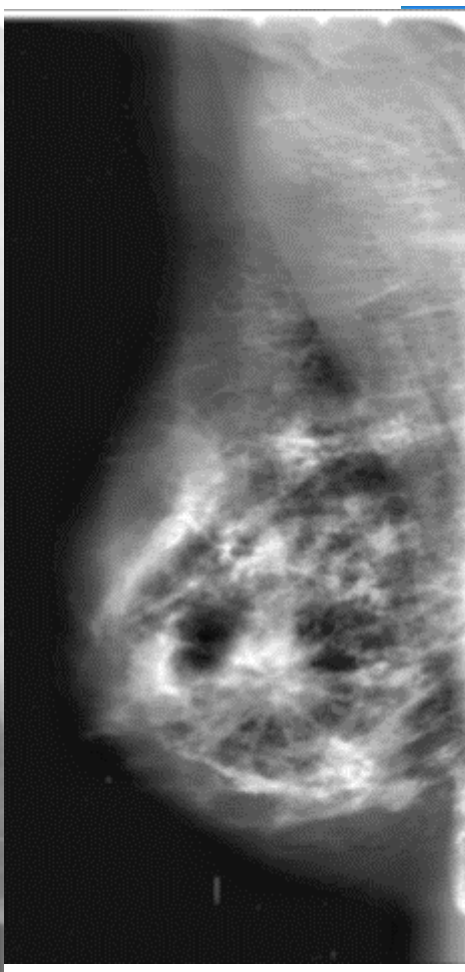
BI-RADS III

BI-RADS I

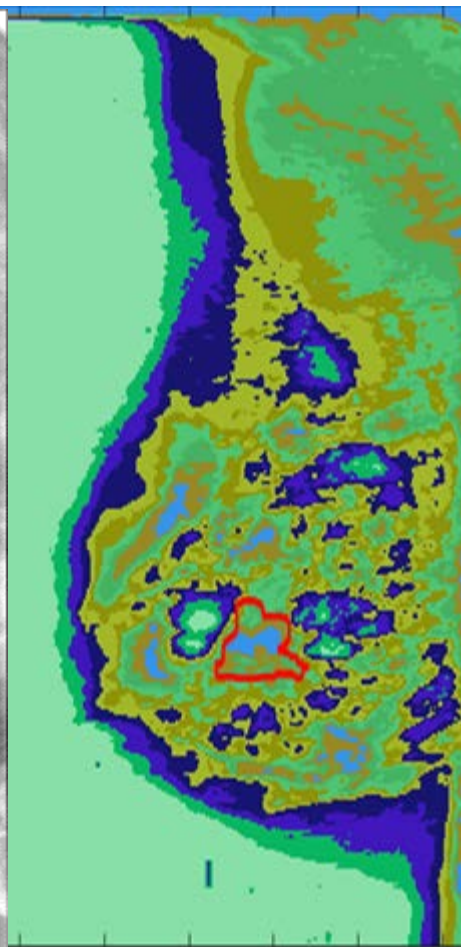
Local Non-Dense



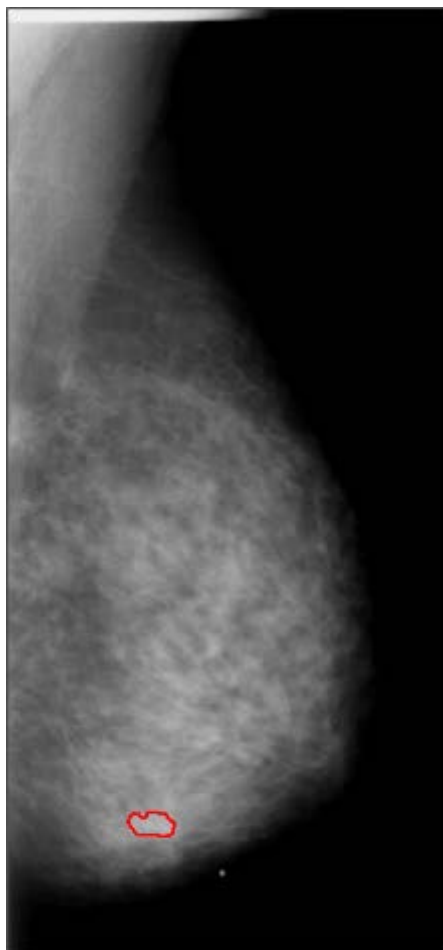
Original



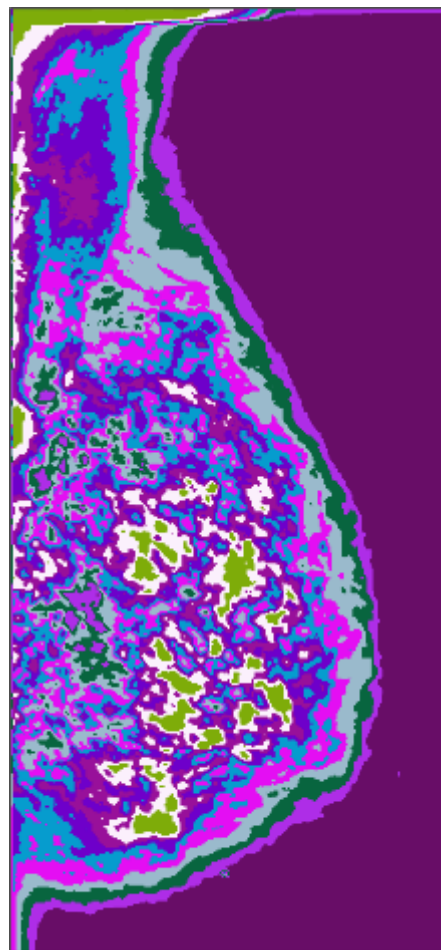
**Enhanced
(CLAHE)**



**Fuzzy C-Means
Segmentation**



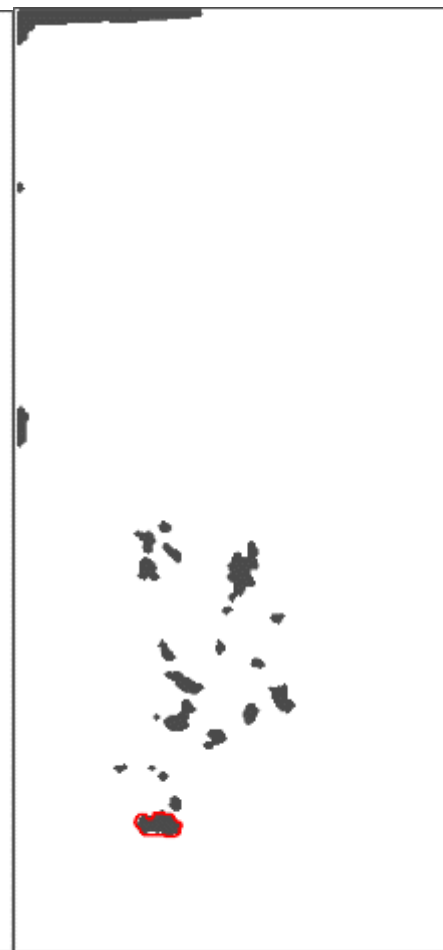
original



processed



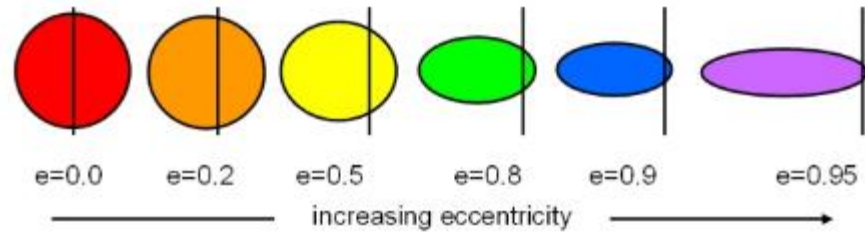
A page of the
Breast book



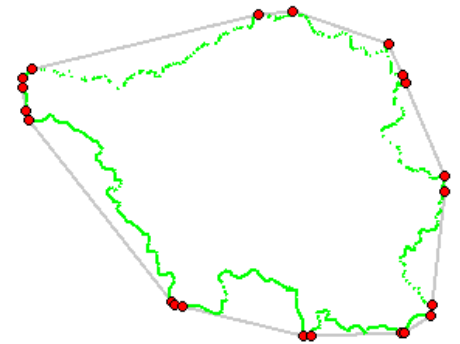
Another page
Containing the
mass

Features

- (1) Mean Intensity
- (2) Eccentricity (measures similarity to ellipse, 0 – circle)



- (3) Solidity (proportion of the pixels in the Convex hull that are also in the region)



Bayesian classifiers

- Two classes
e.g. Malignant vs benign;
Cancer vs non-cancer
- Assuming the feature values are normally distributed
- Assign to the class most probable (i.e. **likelihood approach**)

$$P(x|\omega_i) = \frac{1}{(2\pi)^{N/2}|\Sigma_i|^{1/2}} \exp\left(-\frac{1}{2}(x - M_i)^T \Sigma_i^{-1}(x - M_i)\right).$$

DDSM

- 41 **M**alignant breasts
- 52 **H**ealthy breasts

	(M-N)	(M-H)
	41 / 41	41 / 52

Cancer	41	41
Normal (in cancer)	12,100	-
Healthy	-	13,983

BSSA



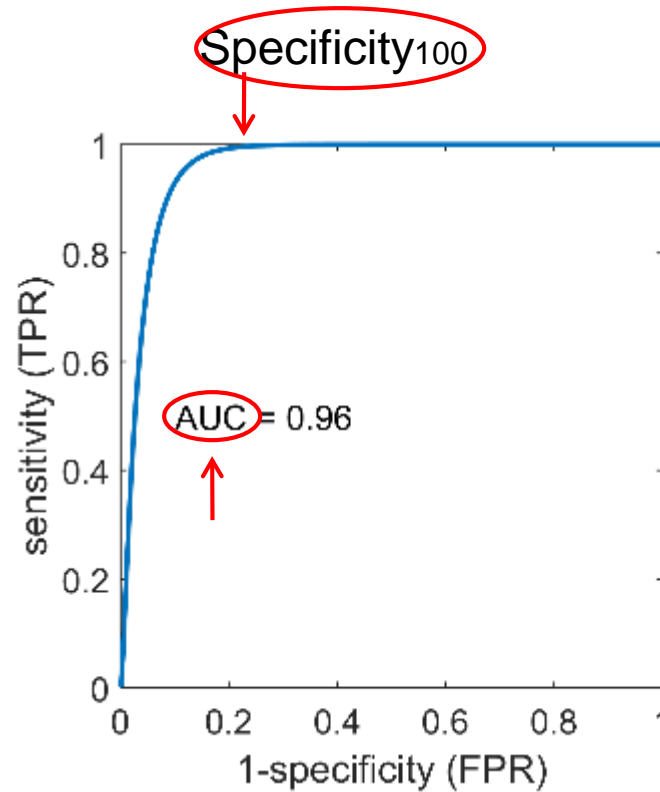
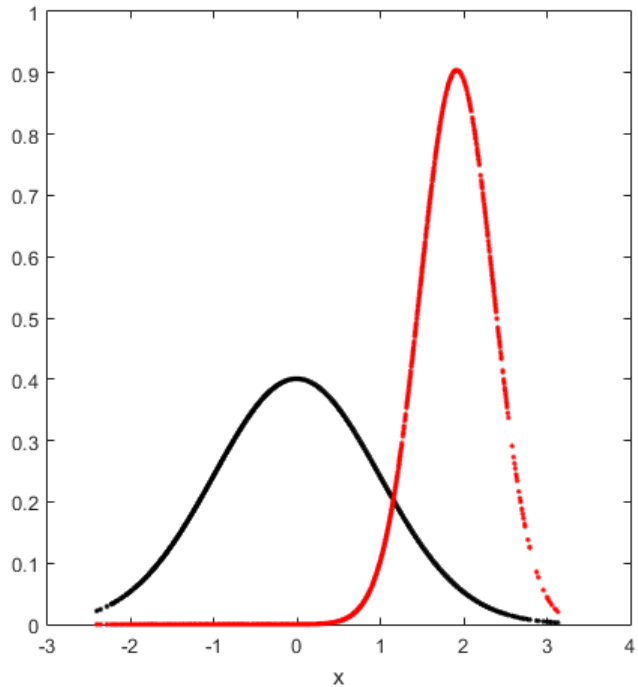
- 29 malignant breasts
- 41 healthy breasts

	(M-N)	(M-H)
	29 / 29	29 / 41

	29	29
	11,345	-
	-	15,583

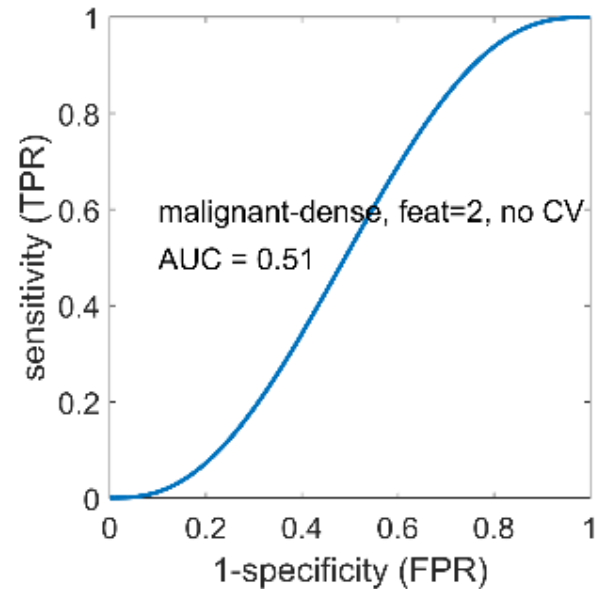
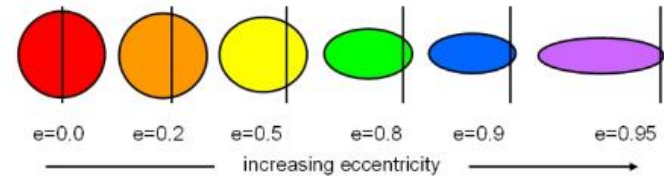
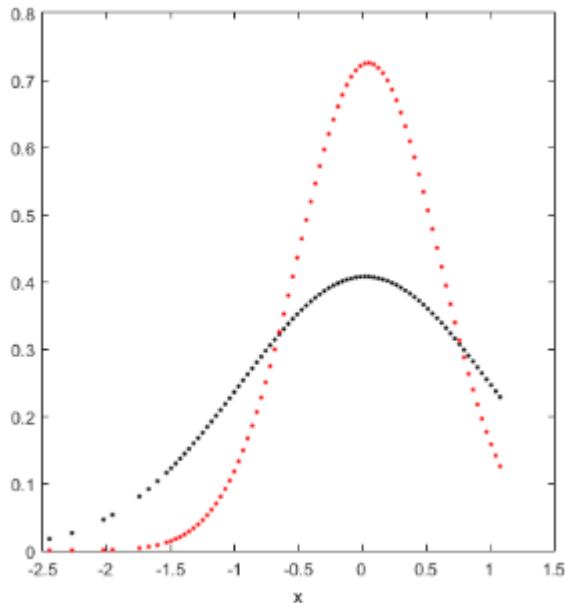
Feature: Mean Intensity (DDSM, M-N)

- 41 cancerous ROIs (from red pdf), 12361 normal ROIs (from black pdf),
- feature = mean intensity



Feature: Eccentricity (DDSM, M-N)

41 cancerous ROIs (red pdf),
12361 normal ROIs (black pdf)



Results for other features

feature = 1 (area) AUC = 0.52

feature = 3 (solidity) AUC = 0.69

DDSM

(M-N)

	AUC	Spec ₁₀₀
Intensity	0.94	82 %
I, eccentricity	0.95	86 %
I, solidity	0.97	<u>88 %</u>
I, e, s	0.96	87 %

(M-H)

Intensity	0.95	85 %
I, eccentricity	0.97	86 %
I, solidity	0.97	<u>86 %</u>
I, e, s	0.96	82 %

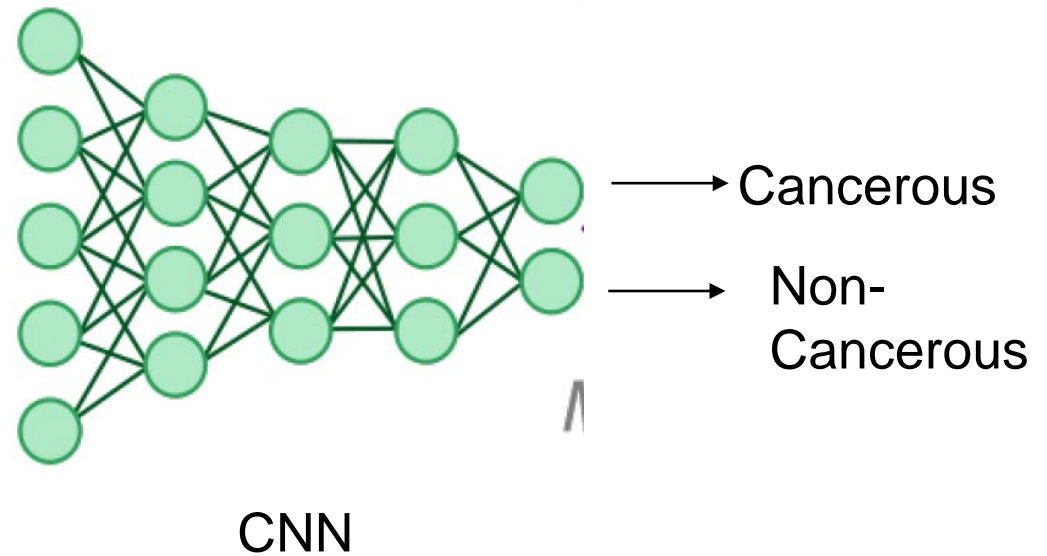
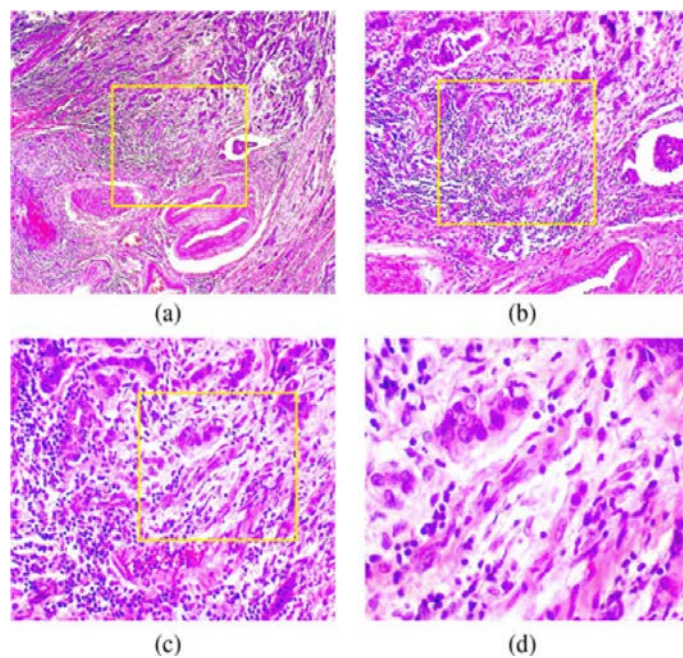
BSSA



	AUC	Spec ₁₀₀
	0.95	85 %
	0.96	80 %
	0.98	<u>84 %</u>
	0.94	70 %

	0.94	81 %
	0.93	72 %
	0.97	<u>83 %</u>
	0.96	74 %

Deep Learning and Breast Cancer Detection in Histopathology Images



Breast malignant tumor (HE stained)
(a-d) 40x, 100x, 200x, 400x
BreKHis dataset (Spanhol tme 2016)

Acknowledgement

Thank you to BSSA for providing the data and Dr Peter Downey for clinical advice and annotation

