

# Classification of Histopathological Breast cancer images using Deep Learning

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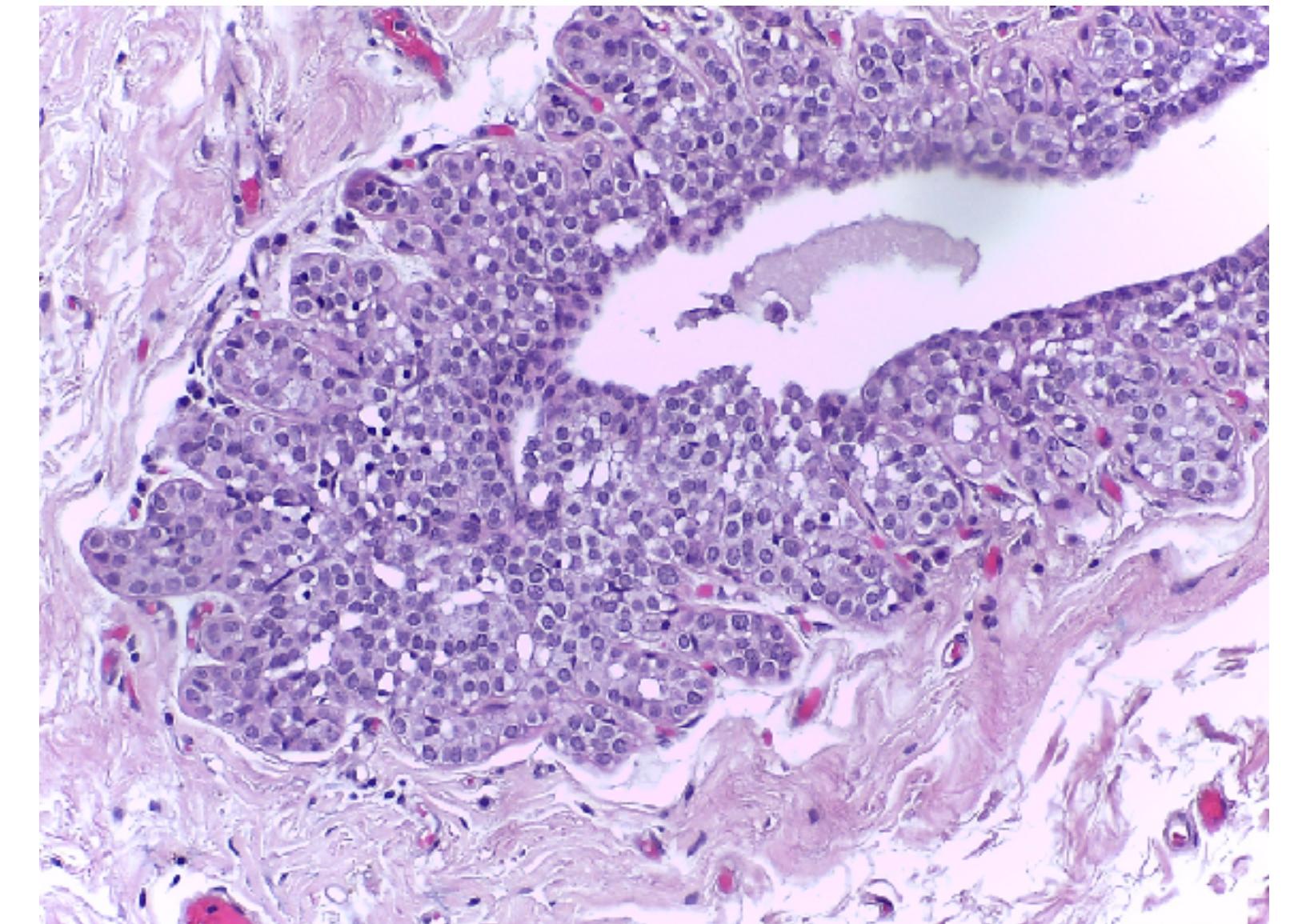
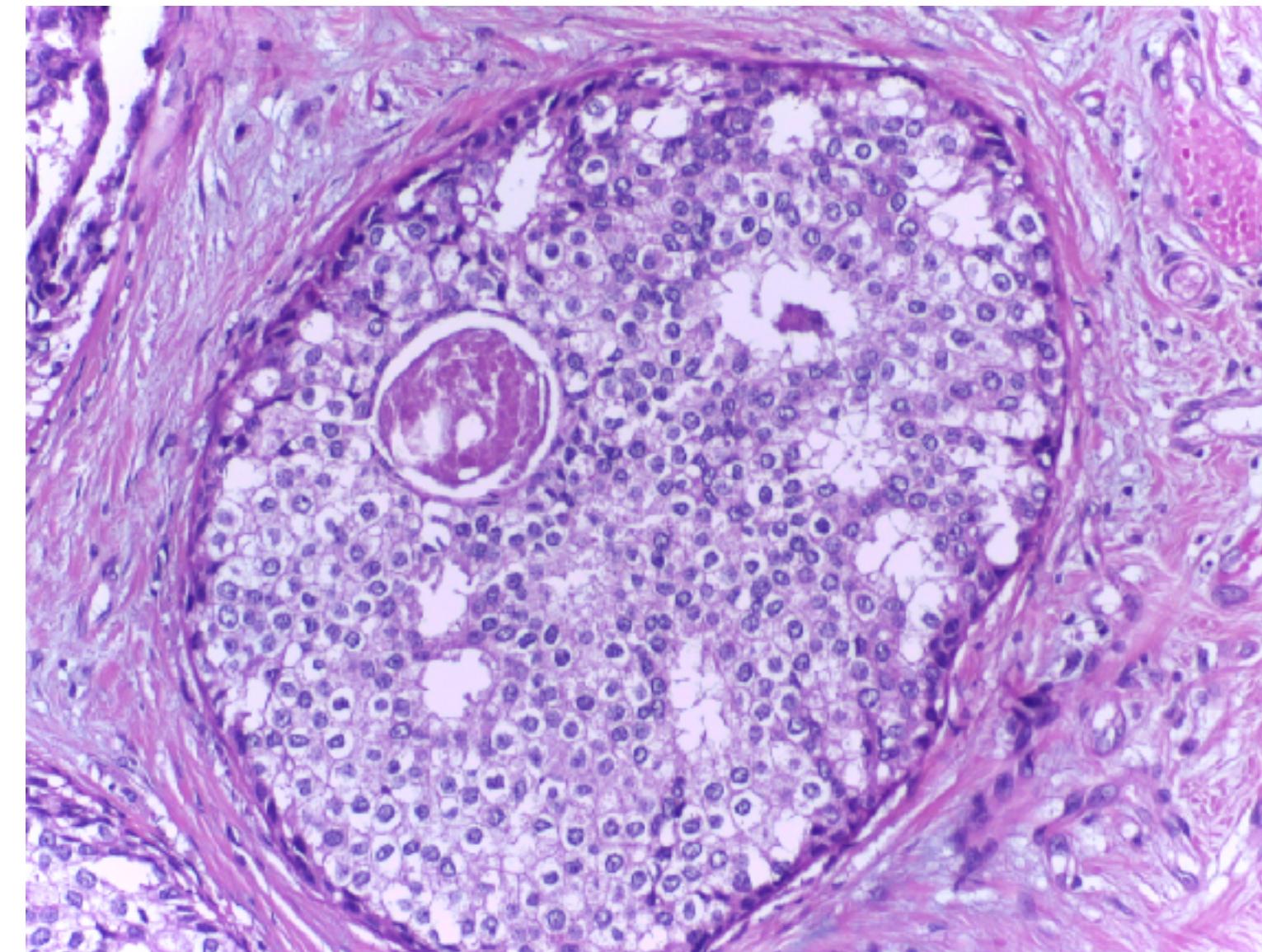
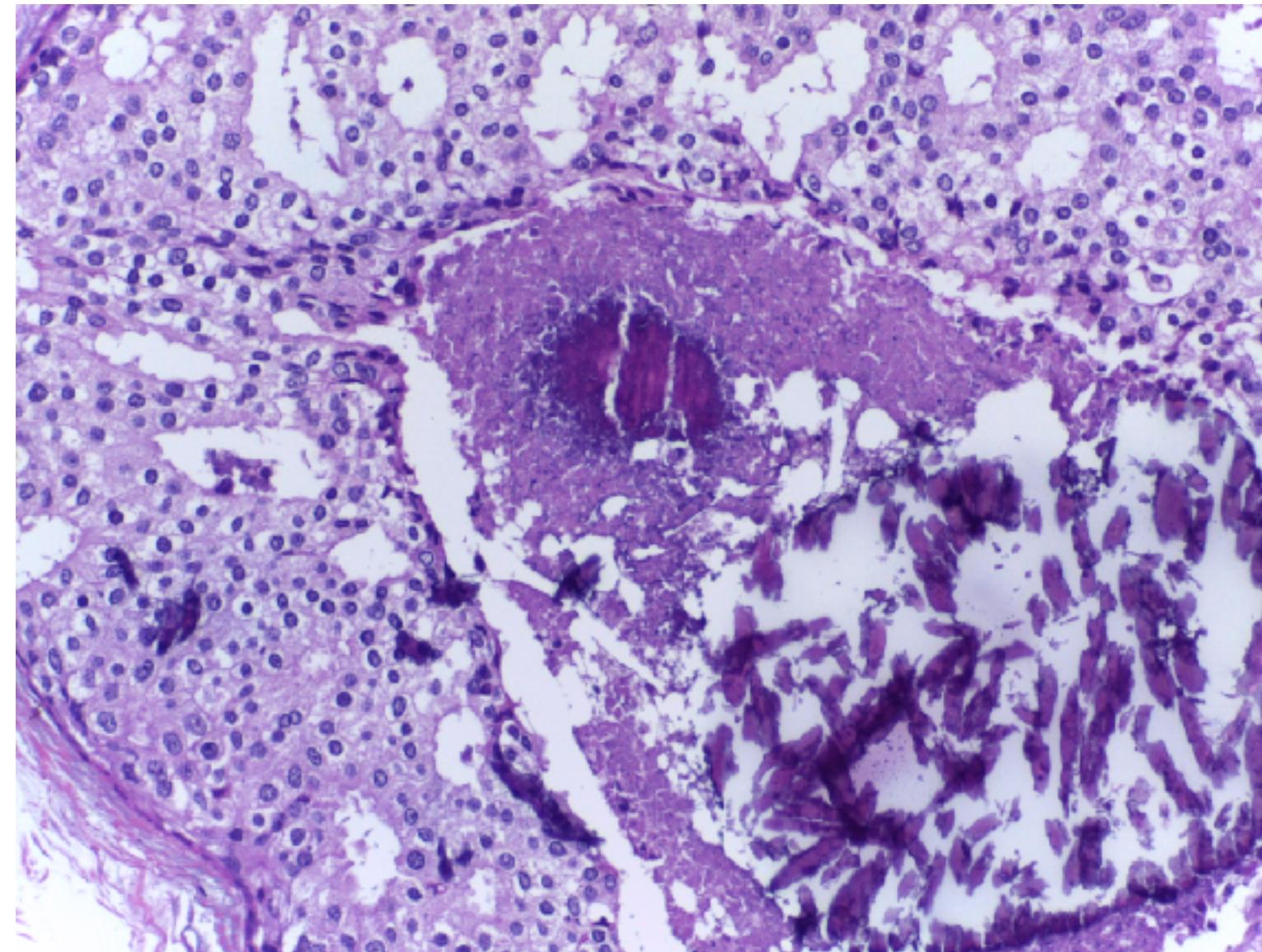
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*Under the guidance of Dr. M H Kolekar*

# INTRODUCTION

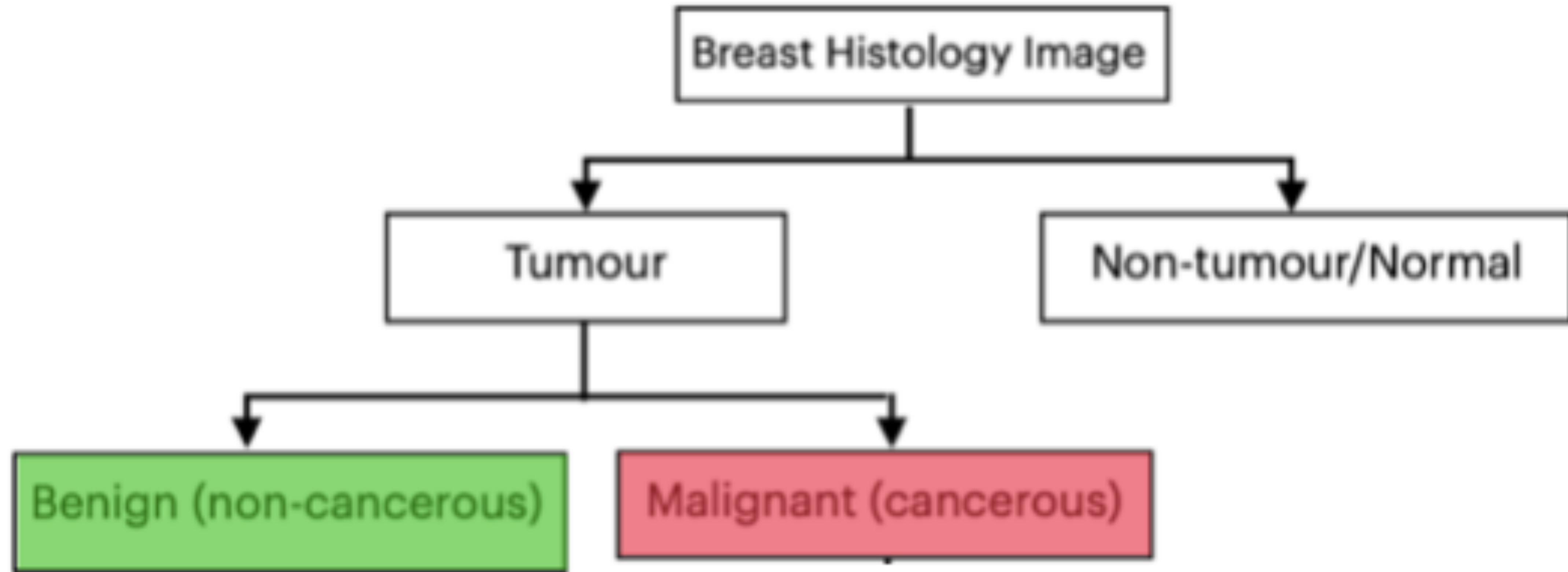
## Certain types of breast cancer images

- Histopathological images
- Mammogram images
- Extracted feature based data
- Ultrasounds
- MRI images



*Histopathological images from ICIAR2018 dataset*

# CLASSIFICATION OF BREAST HISTOLOGY IMAGES



# DATASETS

*Three standard datasets were chosen for training and testing purposes*

1. Breakhis Dataset - 7,909 images
2. ICIAR2018 Dataset - 400 images
3. Kaggle Breast Histology Images Dataset - 277,524 images

## Breast Cancer Histopathological Database (BreakHis)

The Breast Cancer Histopathological image Classification (BreakHis) is composed of 9,109 microscopic images of breast tumor tissue collected from 82 patients using different magnifying factors (40X, 100X, 200X, and 400X). To date, it contains 2,430 benign and 5,429 malignant samples (700x460 pixels, 3-channel RGB, 8-bit depth in each channel, PNG format). This database has been built in collaboration with the P&D Laboratory – Pathological Anatomy and Cytopathology, Paraná, Brazil (<http://www.prevencaodediagnose.com.br>). We believe that researchers will find this database a useful tool since it makes future benchmarking and evaluation possible.

### Characteristics

The dataset BreakHis is divided into two main groups: benign tumors and malignant tumors. Histologically benign is a term referring to a lesion that does not match any criteria of malignancy – e.g., marked cellular atypia, mitosis, disruption of basement membranes, metastasize, etc. Normally, benign tumors are relatively “innocent”, presents slow growing and remains localized. Malignant tumor is a synonym for cancer: lesion can invade and destroy adjacent structures (locally invasive) and spread to distant sites (metastasize) to cause death.

In current version, samples present in dataset were collected by SB method, also named partial mastectomy or excisional biopsy. This type of procedure, compared to any methods of needle biopsy, removes the larger size of tissue sample and is done in a hospital with general anesthetic.



ICIR 2018 Grand Challenge on **Breast Cancer Histology** images

BACH's dataset is publicly available under the CC BY-NC-ND license. The citation should refer to [10.1101/medRxiv.2019.05.010](https://doi.org/10.1101/medRxiv.2019.05.010). Teams must notify the organisers of the challenge about any publication that is (partly) based on the results or data published on this site, in order to the challenge organization being able to maintain a list of publications associated with the challenge.

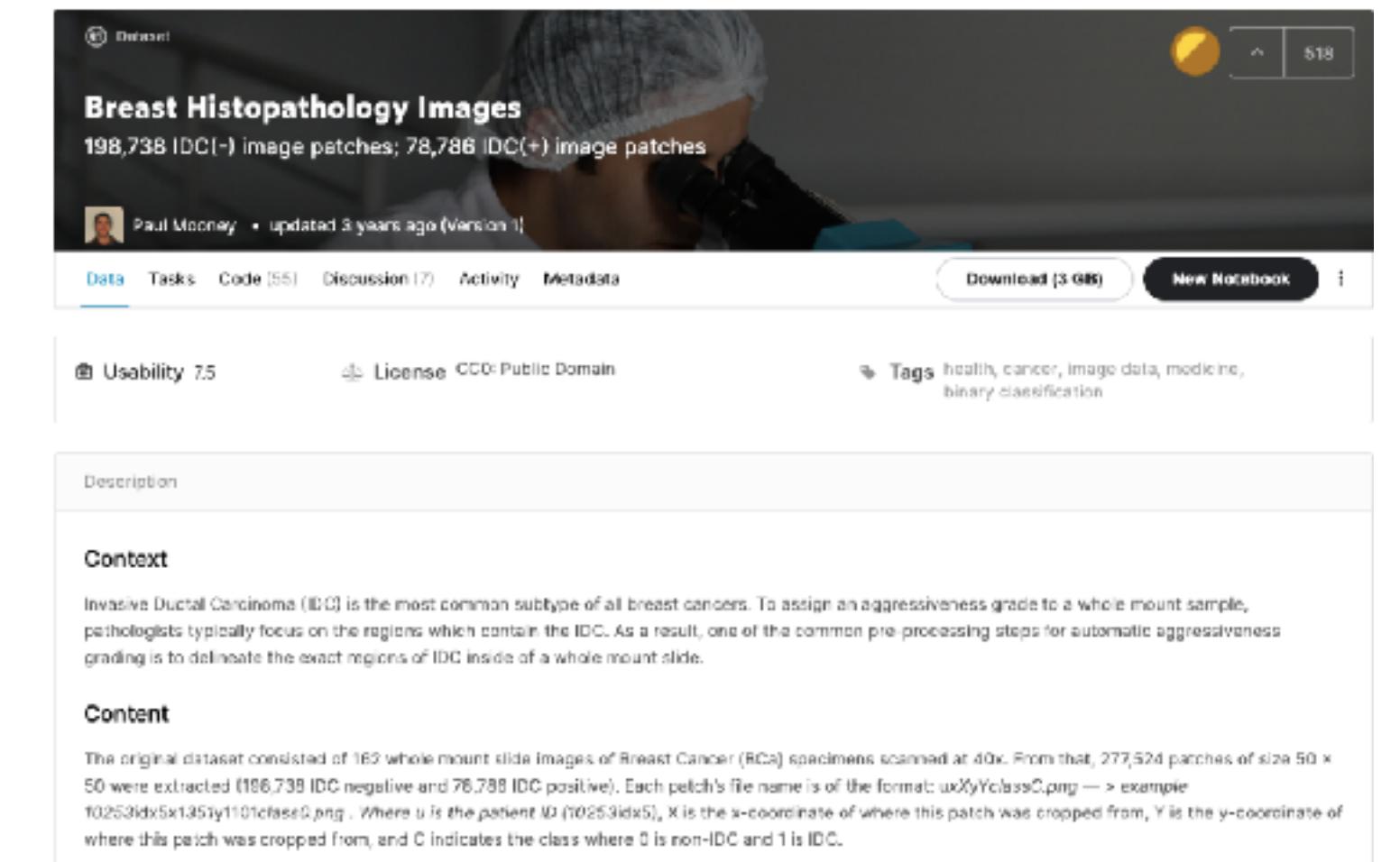
### Dataset

The dataset is composed of hematoxylin and eosin (H&E) stained breast histology microscopy and whole-slide images. Challenge participants should evaluate the performance of their method on either/both sets of images.

[CLICK HERE TO REQUEST THE DATASET](#)

### 1. Microscopy images

Microscopy images are labelled as normal, benign, in situ carcinoma or invasive carcinoma according to the predominant cancer type in each image. The annotation was performed by two medical experts and images where there was disagreement were discarded.



A screenshot of a Kaggle dataset page titled "Breast Histopathology Images". The page shows a thumbnail of a pathologist working, the dataset title, the number of patches (198,738 IDC(-) and 78,786 IDC(+)), and a user profile for Paul Mooney. Below this, there are sections for Data, Tasks, Code (55), Discussion (17), Activity, and Metadata. A summary section includes Usability (7.5), License (CC0: Public Domain), and Tags (health, cancer, image data, medicine, binary classification). There are also sections for Description, Context, and Content, with detailed descriptions of the dataset's characteristics and usage.

Breakhis

ICIAR2018

Kaggle BHI

# METHODOLOGY

Combining the features extracted from 5 best performing classification architectures

Chance that an important feature will be missed is very less if we are using 5 independent classification architectures in concatenation

**DenseNet201**: consists of 201 layers

**ResNet152**: consists of 152 layers

**VGG19**: consists of 19 layers

**Xception**: consists of 71 layers

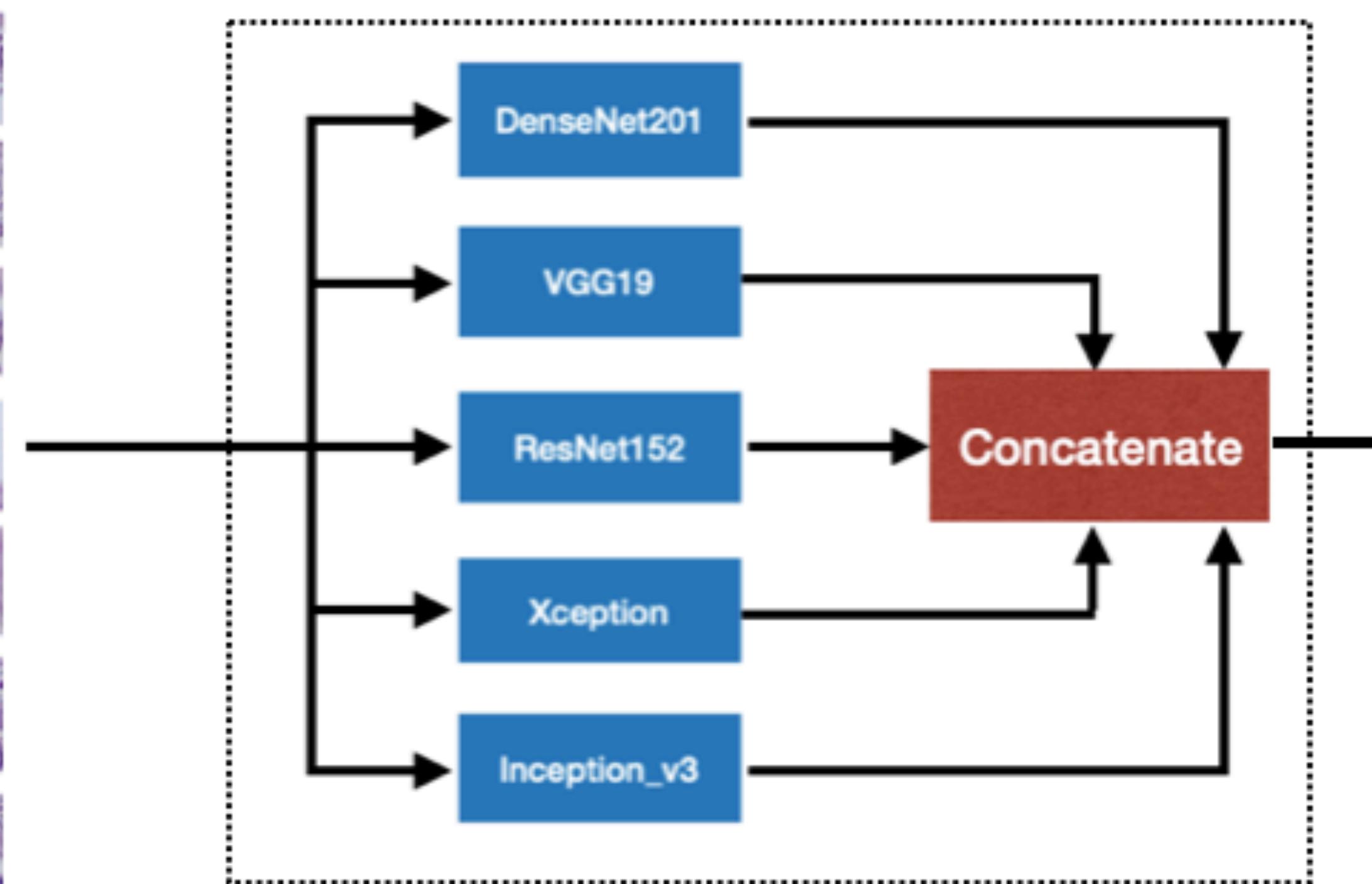
**Inception\_v3**: consists of 48 layers

# MODEL FLOWCHART

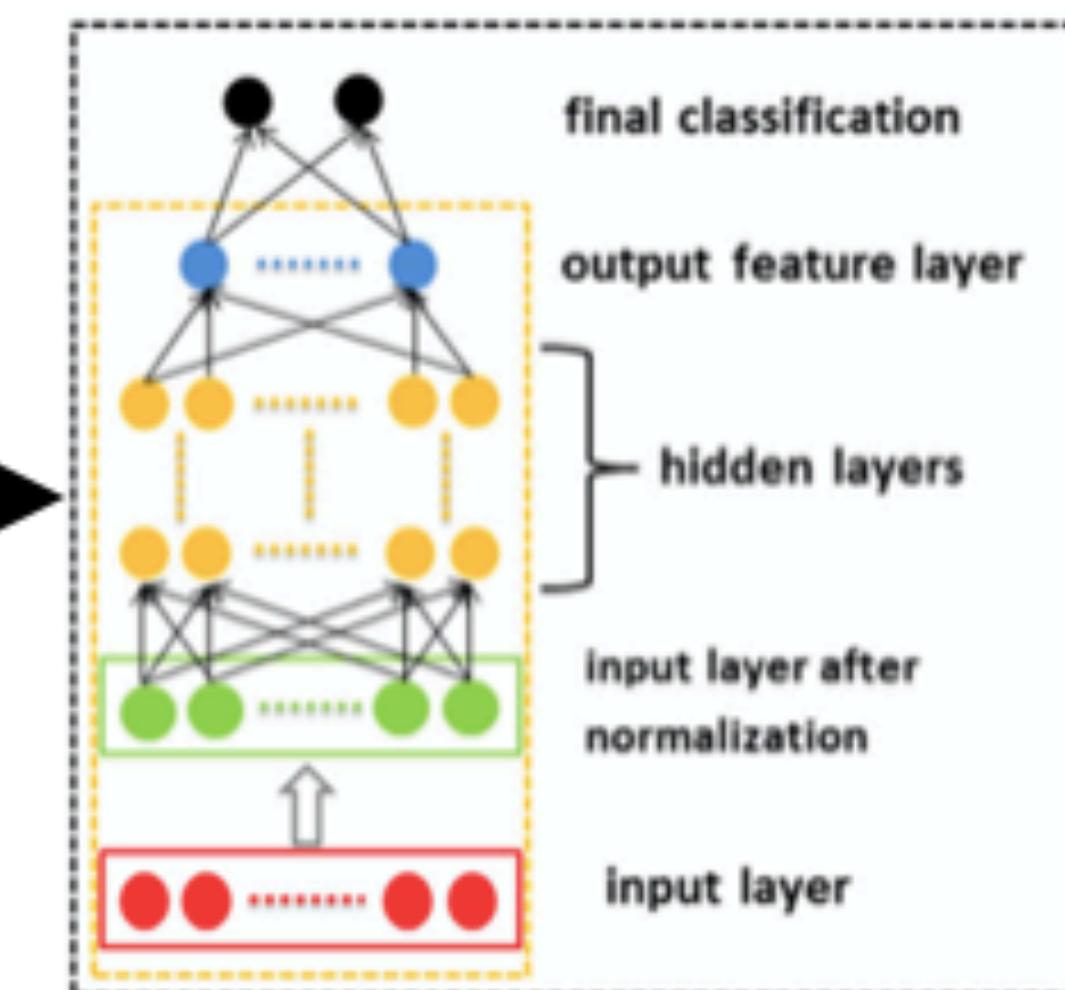
Training Images



Feature Extraction Module



Classification Module



Breast Histopathological images

# TRAINING

80% training  
20% testing

Batch size : 16  
Epochs: 100

Break his	Dataset Name	TRAIN		TEST	
		Benign	Malignant	Benign	Malignant
40x	40x	501	1097	126	275
	100x	517	1151	129	288
	200x	500	1113	125	279
	400x	472	987	118	247
ICIAR 2018		652	712	148	88
KAGGLE BHI		1149	791	280	181

# PERFORMANCE MEASURES

Positive is taken as MALIGNANT and negative is taken as BENIGN

$$Accuracy = \frac{(TP + TN)}{(TP + FP + FN + TN)}$$

$$Recall = \frac{TP}{(TP + FN)}$$

$$Precision = \frac{TP}{(TP + FP)}$$

$$Specificity = \frac{TN}{(TN + FP)}$$

$$Sensitivity = \frac{TP}{(TP + FN)}$$

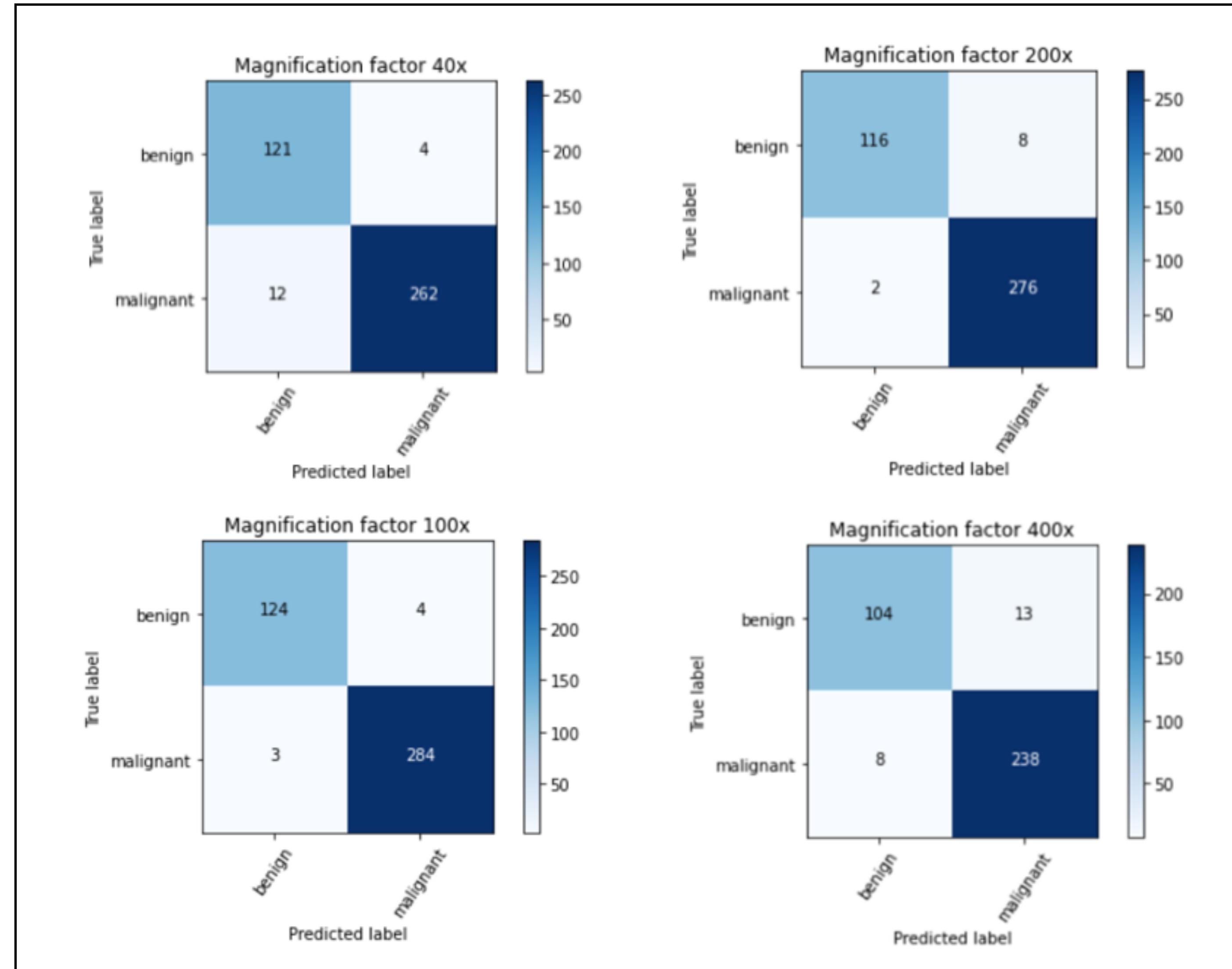
$$F1 - Score = 2 * \frac{Recall * Precision}{Recall + Precision}$$

# RESULT

<i>Dataset Name</i>	<i>Accuracy</i>	<i>Sensitivity/Recall</i>	<i>Specificity</i>	<i>Precision</i>	<i>F1-score</i>
BREAKHIS	40x	95.98%	98.49%	90.97%	95.62%
	100x	98.31%	98.61%	97.63%	98.95%
	200x	97.51%	97.18%	98.30%	99.28%
	400x	94.21%	94.82%	92.85%	96.74%
ICIAR 2018	91.52%	81.48%	100%	100%	0.90
KAGGLE BHI	96.74%	99.40%	95.22%	92.26%	0.96

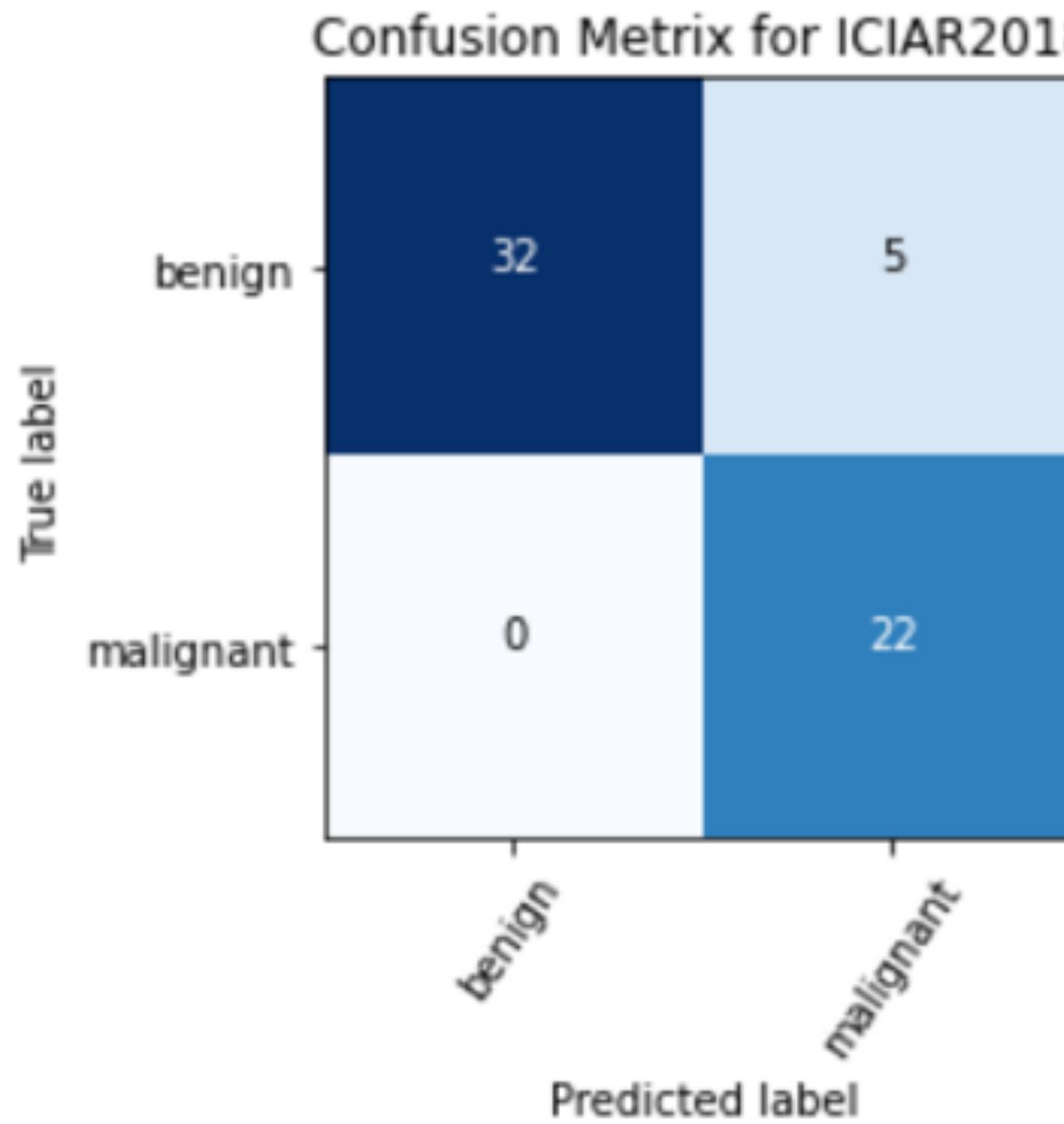
# RESULT

Breakhis Dataset

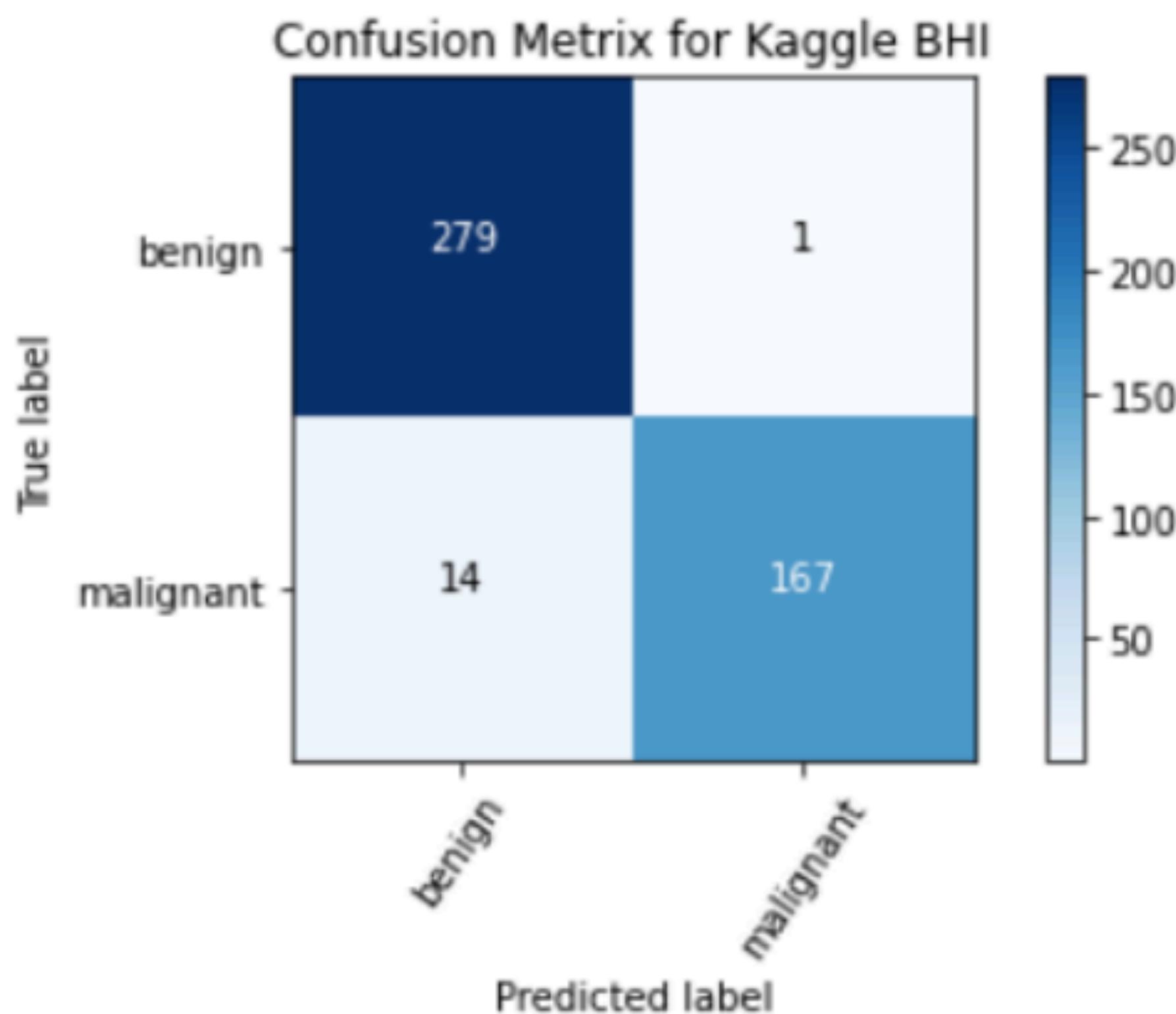


# RESULT

ICIAR2018



Kaggle BHI



# COMPARISON FROM OTHER MODELS ON BREAKHIS DATASET

References	40x	100x	200x	400x
Kahya et al. (2017)	94.97	93.62	94.54	94.42
Wei et al. (2017)	<b>97.89</b>	97.64	97.50	<b>97.97</b>
Pratiher et al. (2018)	96.8	98.1	98.2	97.5
Bardou et al. (2018)	96.82	96.96	96.36	95.97
Bardou et al. (2018)	92.71	93.75	92.72	92.12
<b>Present Work</b>	95.98	<b>98.31</b>	<b>97.51</b>	94.21

# CONCLUSIONS

- The used model achieved an average accuracy of 96.5% on the breakhis dataset, 91.52% on the ICIAR2018 dataset and 96.74% on Kaggle BHI dataset
- The used model has performed good as comparable to the existing models.
- The parallel model has proved to be more efficient in terms of the accuracy as it combines all the extracted features from 5 different models and then uses all those features to classify the images.
- It is better than using a single CNN network as any single model misses some features.

# REFERENCES

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# THANK YOU

