Dataset details:

1- **BCDR-F03** is part of the Breast Cancer Digital Repository (**BCDR**) called **BCDR-F03**. It contains 736 mammography images (mediolateral oblique and craniocaudal) views of which 426 contain benign mass lesions and 310 containing malign mass lesions. The mammography's in the dataset belong to 344 patients. The dataset also includes a description of each image along with clinical data including age and breast density. The dataset contains MLO and CC views. Public

Found on: https://bcdr.ceta-ciemat.es

http://bcdr.inegi.up.pt mentioned in articles but website not working

2- **DDSM (Digital Database of Screening Mammography):** contains a total of 2620 patients each with 4 view mammograms (two images from each breast) and a total of 10,480 breast images. The cases involve benign, malign, and normal cases and are associated with information including age, breast density, and time of acquisition.

Found on: http:// marathon.csee.usf.edu/Mammography/Database.html

3- **INbreast:** obtained from Massachusetts General Hospital and contains 115 patients with 410 images taken from MLO view only (right and left mediolateral oblique) and CC (right and left craniocaudal) views of each breast. 90 cases of the 115 have 4 images per case since they have both breasts affected. The rest have one breast affected and therefore have 2 images per case. Uses MammoNovation Siemens FFDM full-field digital mammography, with a solid-state detector of amorphous selenium was used. The cases contain one of the following lesions: masses, calcifications, asymmetries, and distortions. Age, time acquisition of the image and breast density annotations are provided. **This dataset was built using full-field digital mammograms as opposed to digitized mammograms. Public**

Found on: http://medicalresearch.
inescporto.pt/breastresearch/GetINbreastDatabase.html

4- **MIAS(Mammographic Image Analysis Society):** The oldest available dataset. contains 322 digitized MLO images of 161 cases that have marked lesion locations. The cases can be either malign, benign, or normal. The dataset contains a lot if speculated masses. Found on: http://peipa.essex.ac.uk/info/mias.html **Public.** The resolution of the images is very low (old)

1- Article1: Representation learning for mammography mass lesion classification with convolutional neural networks

Model: **CNN3 (CNN+SVM)**

Model Description/Preprocess:

Process: For preprocessing, the image is **resized** to 150x150. **Normalization** is performed by subtracting from each pixel the mean. Normalization helps the gradient-based optimization technique used to converge.

CNN3 is made of two convolutional layers each followed by a max pooling layer. The first convolutional layer is made of 64 (11x11) filters followed by max pooling layer having 64 (5x5). The second convolutional layer is made of 64 (4x4) filters followed my max pooling layer also made of 64 (4x4) filters. This is followed by a fully connected layer. Rectifier linear activation function is used in the two convolutional layers. The feature vectors outputted from the CNN is inputted to a Linear SVM classifier to classify the mammography as either malign or benign.

Tested on: **BCDR-F03** dataset

Results based on ROC curve and AUC: **CNN3 with normalization:** AUC: 82+-0.03%**, CNN3 without normalization:** AUC: 70%.

Need to test it on: **DDSM, INBreast, MIAS datasets**

Source code: https://github.com/johnarevalo/cnn-bcdr

2- Article2: Deep Neural Networks Improve Radiologists' Performance in Breast Cancer Screening

Model: **ResNet+softmax+ with or without heatmaps**

Model Description/Preprocess:

Tested on: **NYU** dataset which is not publicly available

Results:

AUC when only breast images are inputted and with transfer learning: malignant: 78.1+-0.006/ benign: 67.3+-0.003

AUC when only breast images are inputted and without transfer learning: malignant:

69.3+-0.006/ benign: 56.4+-0.006

AUB when heatmaps and breast images are inputted and with transfer learning:
malignant: 84.3+-0.004/ benign: 69.0+-0.002

AUB when heatmaps and breast images are inputted and without transfer learning:
malignant: 82.8+-0.008/ benign: 63.3+-0.006

Need to test it on: BCDR-F03, DDSM, INBreast, MIAS datasets

Source code: https://github.com/nyukat/breast_cancer_classifier

3- Article3: Deep Convolutional Neural Networks for breast cancer screening

Model: Inception v3 or ResNet50 or VGG16+ transfer learning from natural images to mammography

Model Description/Preprocess:

Deep Convolutional Networks: Here Transfer Learning is used by finetuning models previously trained on natural domain datasets. The previously used models **(VGG16, ResNet50, Inception v3)** are used as is but the fully connected layers are changed to fit the benign vs malign classification problem versus the old problem which has 1000 classes. In addition, for classification, Softmax is used.

Tested on: DDSM, BCDR-F03, INBreast

Results based on ROC curve and AUC:

Results after finetuning the last 2 layers based on Accuracy and AUC:

VGG16:

DDSM: 97.12%,

BCDR-F03: 96.5%

INbreast: 95.00%

ResNet50

DDSM: 97.27%

BCDR-F03: 96.50%

INbreast: 92.50%

Inception v3

DDSM: 97.35%, 0.98

BCDR-F03: 96.67%, 0.96

INbreast: 95.5%, 0.97

Need to test the above 3 pretrained models while finetuning last 1,2, or 3 layers on: MIAS datasets

Didn't find source code

4- Article4: A deep feature based framework for breast masses classification

Model: CNN + two SVM classifiers + hierarchical features

Model Description/Preprocess:

Feature extraction model: The CNN is made of 5 convolutional layers each followed by a ReLU activation function. The first, second and fifth convolutional layers are followed by pooling layers. The network ends with 3 fully connected layers with the first two followed by ReLU.

The input to the model is 227x227 mammography image. Hierarchical features (obtained from the 5^{th} convolutional layer and the second fully connected layer) were used to train two SVM classifiers.

The CNN was first trained on ImageNet dataset which is a dataset made on around 1 million natural images with 1000 classes. Afterwards the learned weights are finetuned using the mammography images.

Tested on: **DDSM**

Results:

Results based on accuracy: 96.7% on DDSM

Need to test it on: **BCDR-F03**, **INBreast, MIAS datasets**

Didn't find source code

5- Article5: Detecting and classifying lesions in mammograms with Deep Learning

Model/Process: **FasterR-CNN (Faster Region-based CNN)**

Tested on: **INBreast**

Results based on AUC on the INBreast:

Faster-RNN: 0.95

Need to test it on: **BCDR-F03**, **DDSM, MIAS datasets**

Source code: https://github.com/riblidezso/frcnn_cad

6- Large scale deep learning for computer aided detection of mammographic lesions

Model: **(candidate detector+CNN) or (candidate detector+ some manually extracted features+ CAD)**

Tested on: **None**

Need to test it on: **BCDR-F03**, **DDSM, MIAS, INBreast datasets**

Didn't find Source code