Breast Cancer Screening Mammography

By Bekzod Tolipov

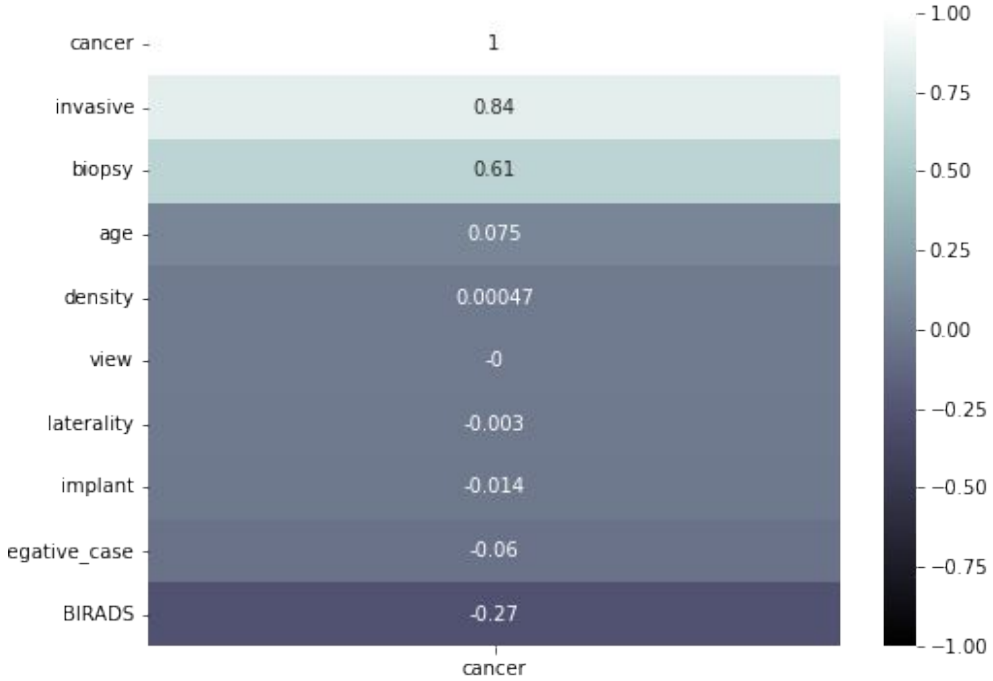
Problem Statement

- According to WHO, breast cancer is the **most common** type of cancer occurring worldwide
- In **2020** alone, there were **2.3 million** new breast cancer diagnosis and **685,000 deaths**
- Breast Cancer dropped in high income countries by **40%** since 1980s after health authorities implemented regular mammography screening
- **Early** detection and treatment are critical to reduce fatalities. Improving the automation of detection in screening mammography may improve **accuracy** and **efficiency** of diagnosis

Data Collection

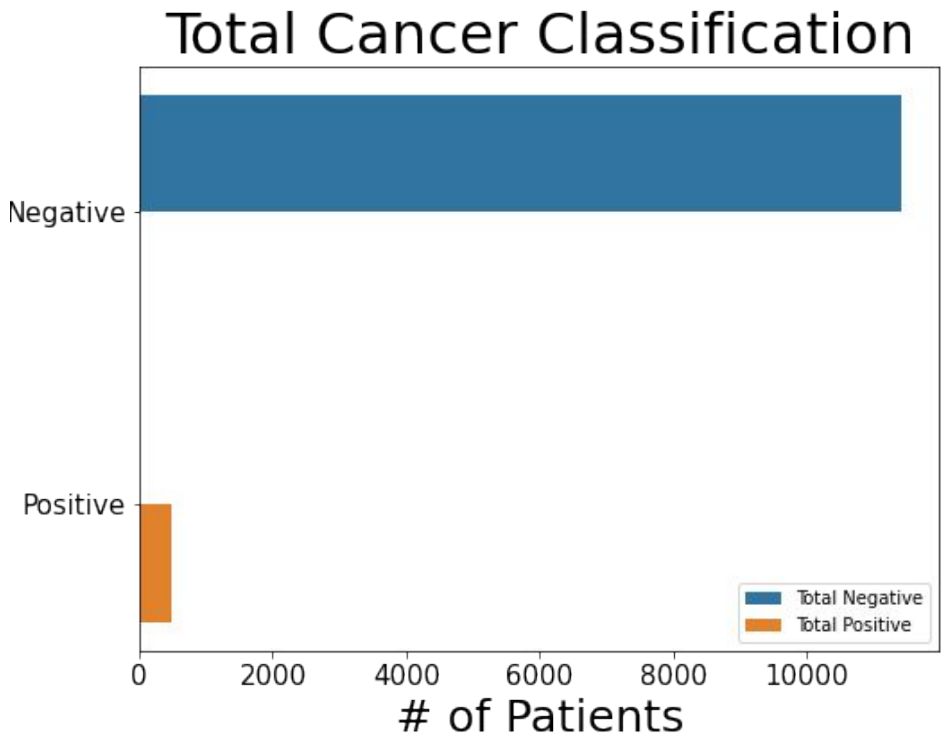
- Data has been provided by Radiological Society of North America (RSNA) organization which represents 31 radiologic subspecialties from 145 different countries around the world
- Metadata for each patient and mammographic image in dicom format
- Roughly 8,000 patients and usually 4 images per patient

Initial Findings



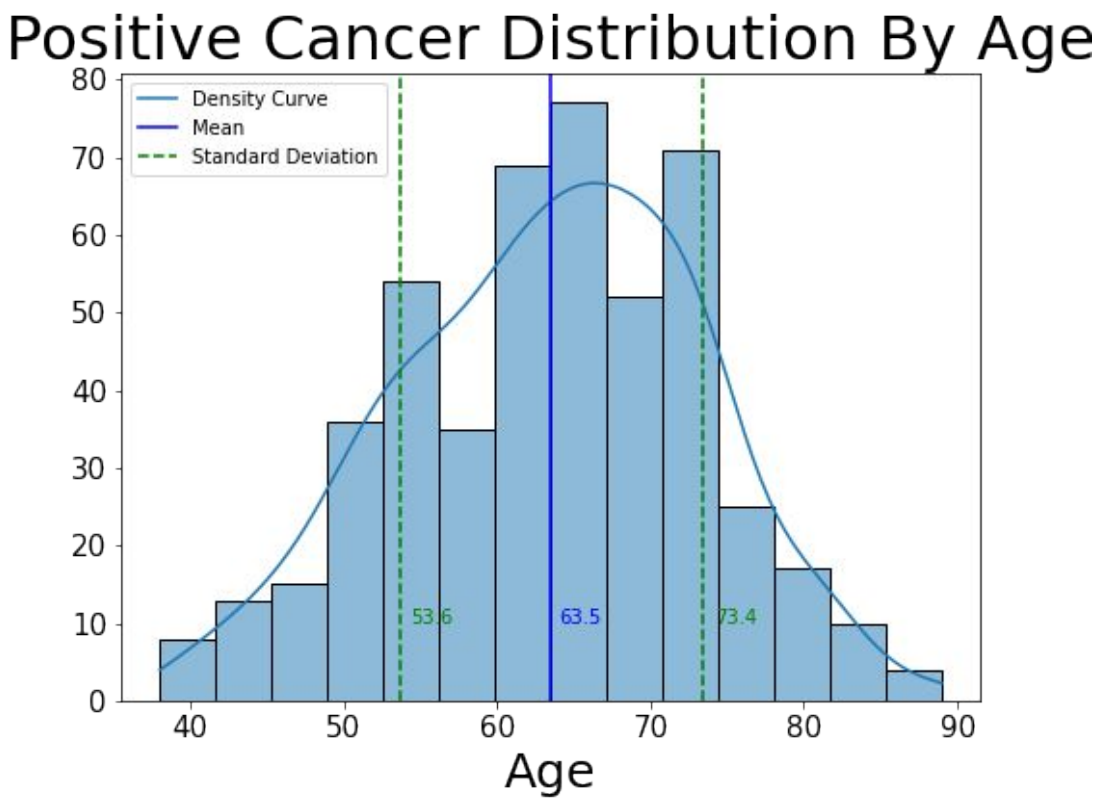
Initial Findings

- Combined laterality with patient id and dropped duplicates
  - 11,419 Negative Cases
  - 486 Positive Cases



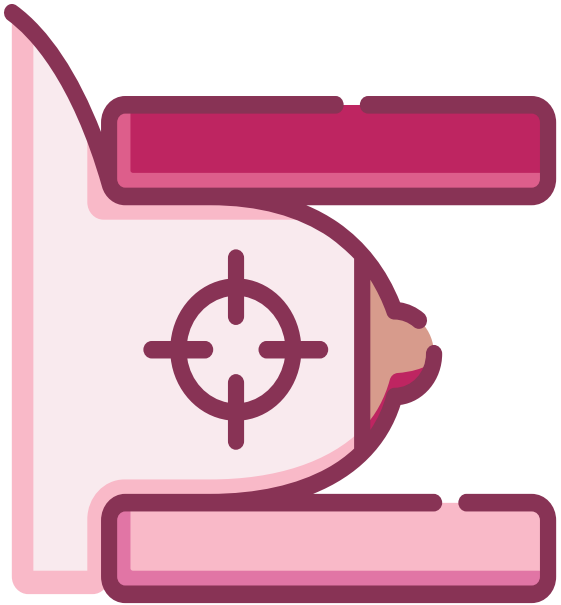
Initial Findings

- Average age: 63
- Standard deviation: 10



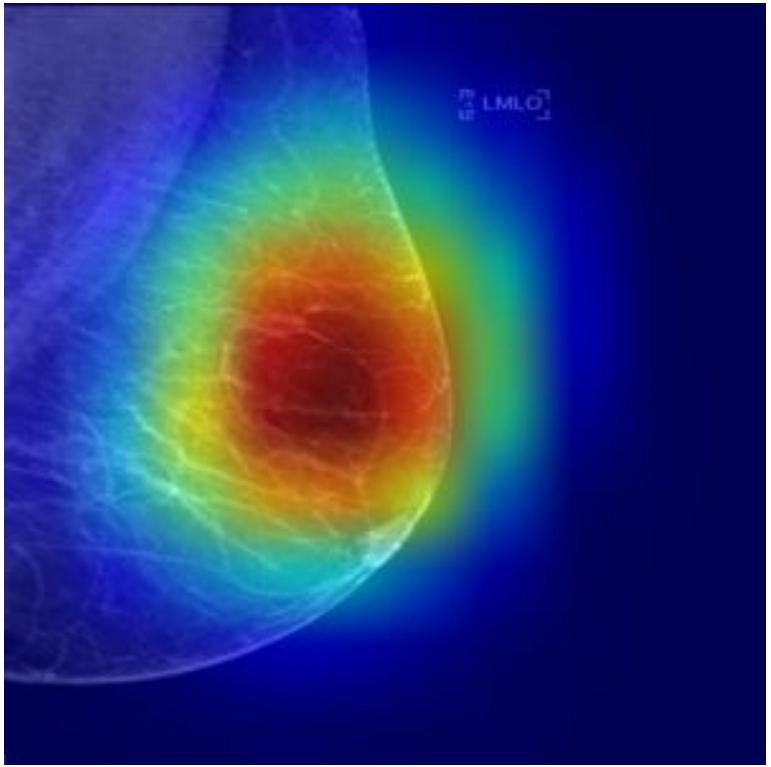
Initial Findings

- In each mammogram examination, a breast is typically imaged with two different views:
  - Mediolateral Oblique (**MLO**)
  - Cranial Caudal (**CC**)
- Breast Density assessment is a qualitative process made by visual observation of both the **MLO** and **CC** views by radiologists.



Modeling

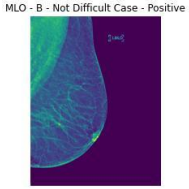
Tensorflow Xception model image augmentation visual using **gradient cam**

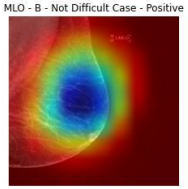


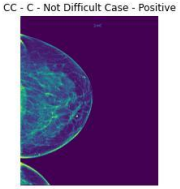
Modeling

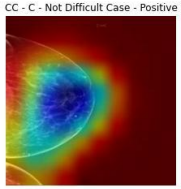
Tensorflow Xception model image augmentation **heatmap**

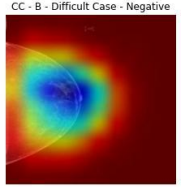
Gradient Cam XCEPTION

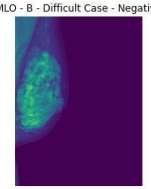


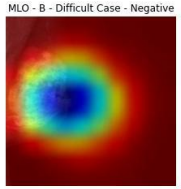








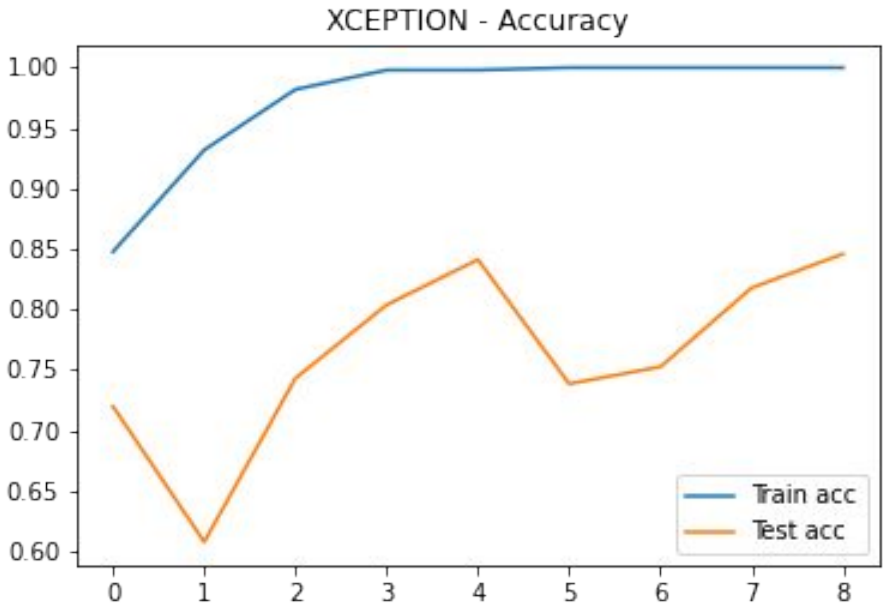


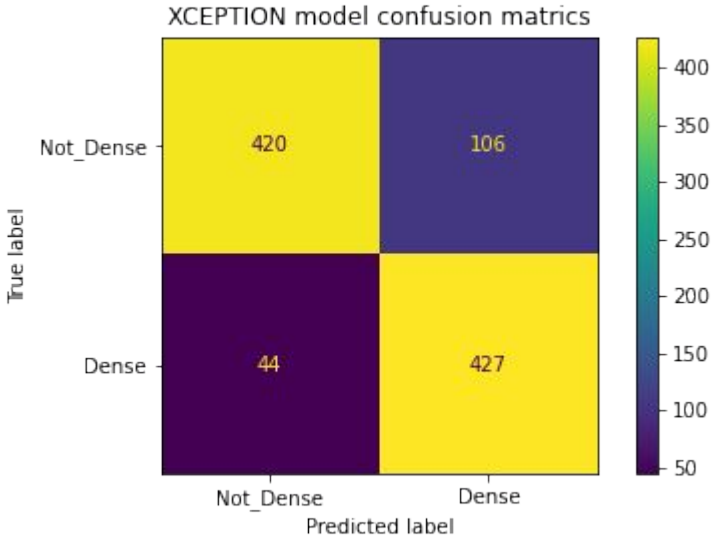


Modeling

- According National Library of Medicine NIH, **density** plays a crucial role on how difficult it is going to be to identify cancer
- There were **50%** of density missing from data provided
- **4** categories been grouped into **2**
- **CNN+MLP** Mixed Dataset model
    - Pre-built Xception Model
    - 4 Hidden Layers
- Baseline: **0.53** for “Not Dense” group

Modeling





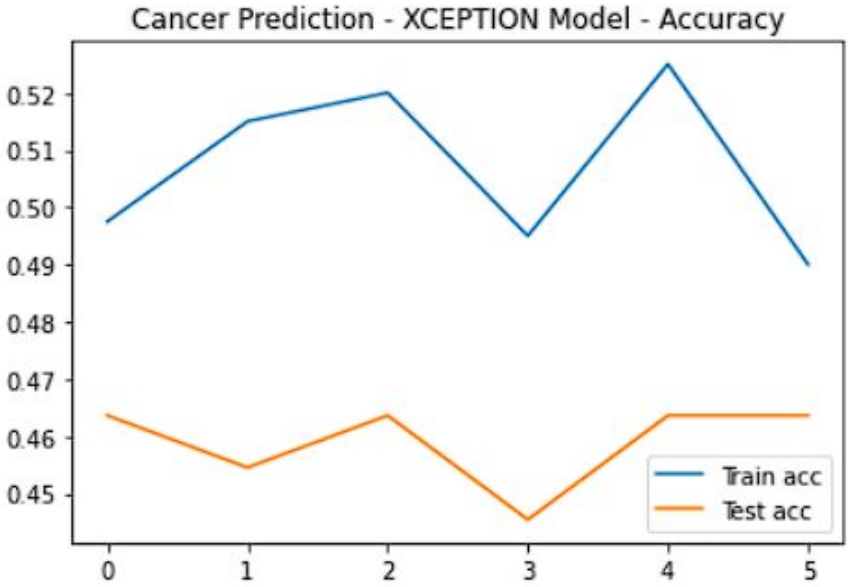
- Model reached **85%** accuracy

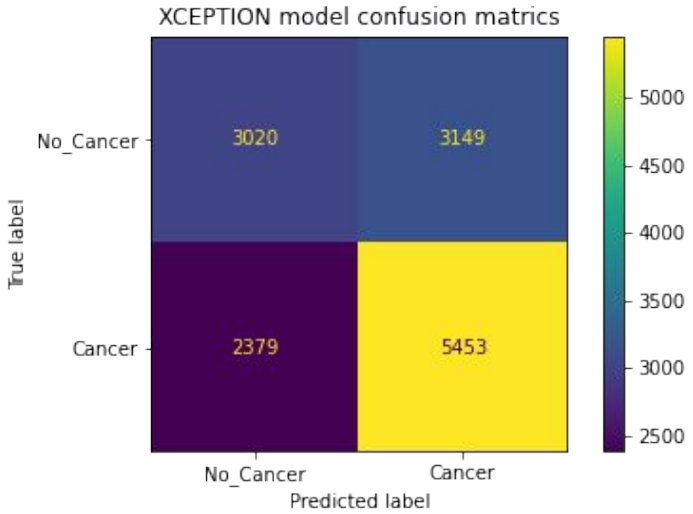
- **Type II** error threshold adjusted
- F1-score **0.86**

Modeling

- Cancer classification required more in depth work since it was highly imbalance **97%** of patients in dataset having **negative cancer** cases
- Baseline: **0.97** for “Negative Cancer” group
- **Under Sampling** and **Over Sampling** methods implemented

Modeling - Under Sampled Dataset

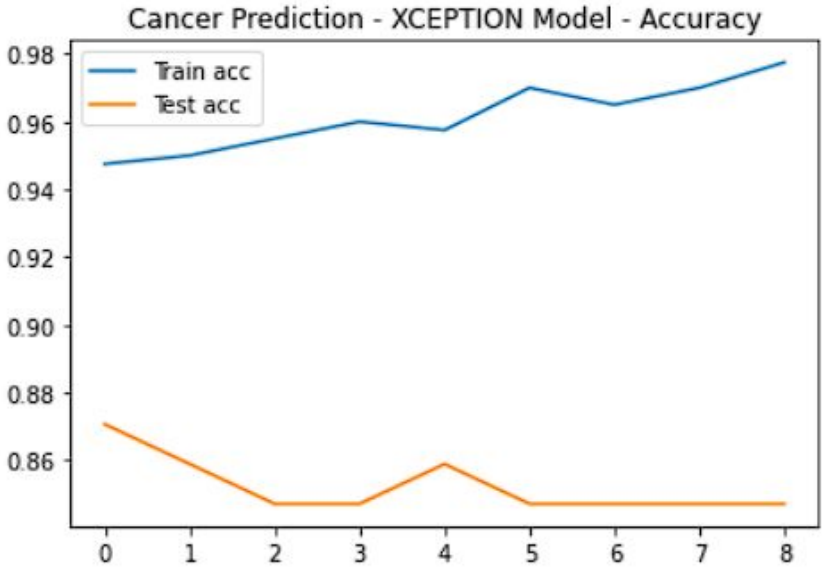


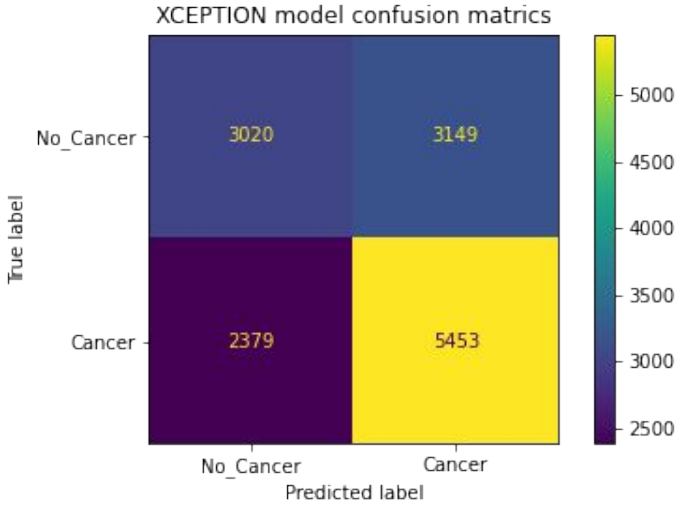


- Model reached **46%** accuracy

- **Type II** error threshold adjusted
- F1-score **0.54**

Modeling - Over Sampled Dataset



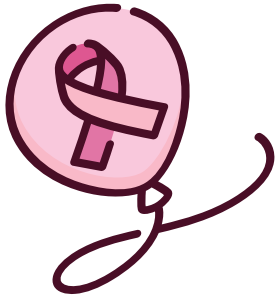


- Model reached **85%** accuracy

- **Type II** error threshold adjusted
- F1-score **0.61**

Conclusion & Recommendation

- Dataset contained **BIRADS** feature which was not utilized due to time constraint
- Working with **highly imbalance** dataset presented difficulties
- **Under Sampling** data was not helpful since model is not learning as much compared to **Over Sampling**
- I recommend adding more hidden layers, adjust learning rate, add random dropouts and test with different models to check the differences



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