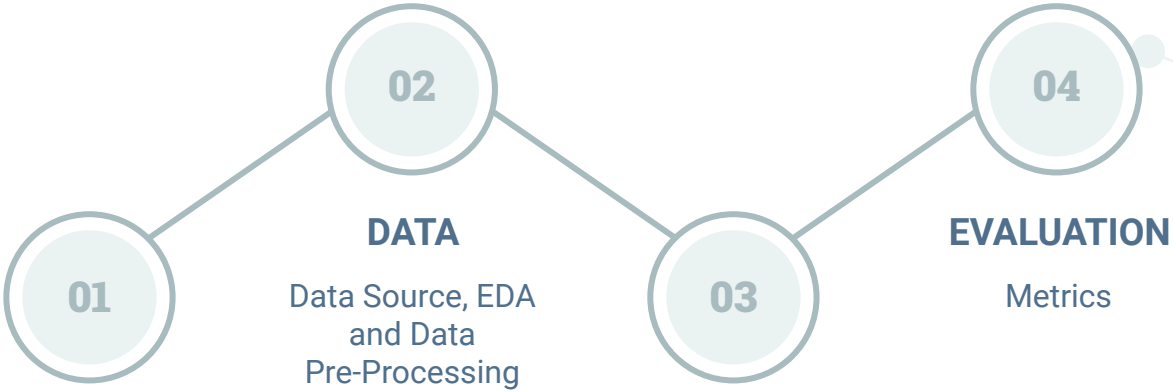
Tumor Detection From Histopathological Slides

Names: Srila Maiti, Justin To, Hector Rincon, Chenyu Wang and Ifrah Javed

Overview



RESEARCH QUESTION

Motivation and Problem Statement

DATA

Data Source, EDA and Data Pre-Processing

ALGORITHM

Proposed Approach and Baseline Model

EVALUATION

Metrics

01

Research Question

Motivation and Problem Statement

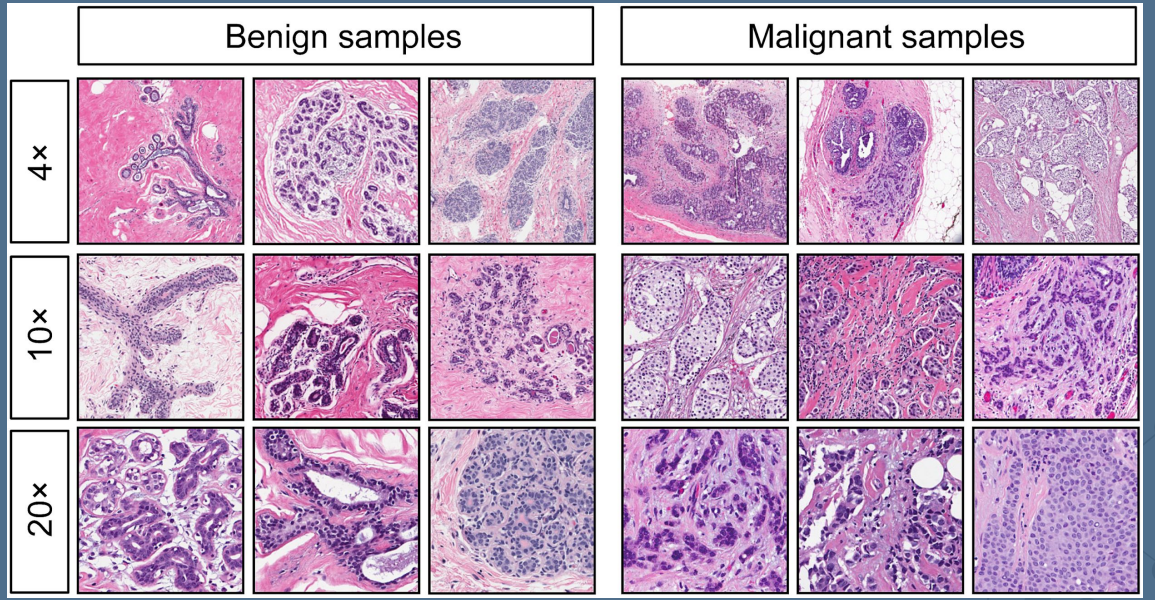
Background

Cancer is the Rapid Growth of Mutated Cells

Histopathology is a Diagnostic Tool

28% Misdiagnosis Rate[1]

Early Diagnosis is Key



Can we identify the presence of metastatic tumor from histopathological slides?

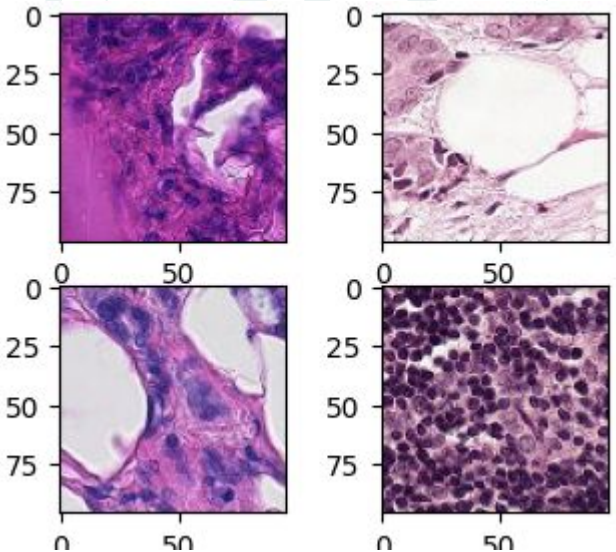
02

Dataset

Data Source, EDA and Transformations

Data

- Working with image data of pathological cells for cancer detection
- A version of the PCAM data set (https://github.com/basveeling/pcam)
- Cleaned from duplicates by Kaggle for the Histopathologic Cancer Detection competition
- Dataset contains 277,483 total images (220,025 train / 57,458 test)
- Positive label: center 32x32px (out of 96x96 image) region of a patch contains at least one pixel of tumor tissue

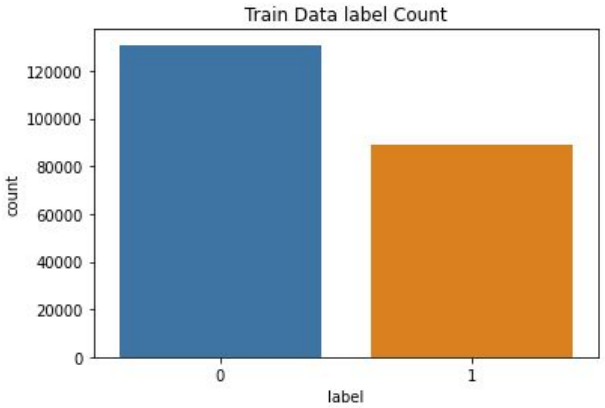


[1] B. S. Veeling, J. Linmans, J. Winkens, T. Cohen, M. Welling. "Rotation Equivariant CNNs for Digital Pathology". arXiv:1806.03962

[2] Ehteshami Bejnordi et al. Diagnostic Assessment of Deep Learning Algorithms for Detection of Lymph Node Metastases in Women With Breast Cancer. JAMA: The Journal of the American Medical Association, 318(22), 2199–2210. doi:jama.2017.14585

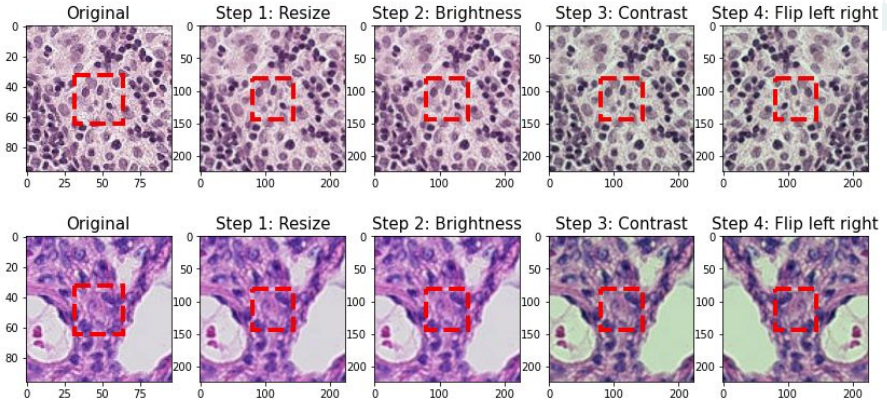
Data

There is a slight class imbalance between the positive and negative labels in the train data. To remediate this, we will undersample from the negative label class



Data Preprocessing

- Images were:
  - Converted to grayscale
  - Resized randomly
  - Standardized brightness
  - Standardized contrast
  - Rotated 90, 180, and 270 degrees
  - Randomly flipped
- In the train data there are:
  - 130,908 negative (59.5%)
  - 89,117 positive examples (40.5%)
- We will use a 60/20/20 split (train, validation, test)



03

Algorithm

Proposed Approaches

Algorithm Approaches:

Logistic regression

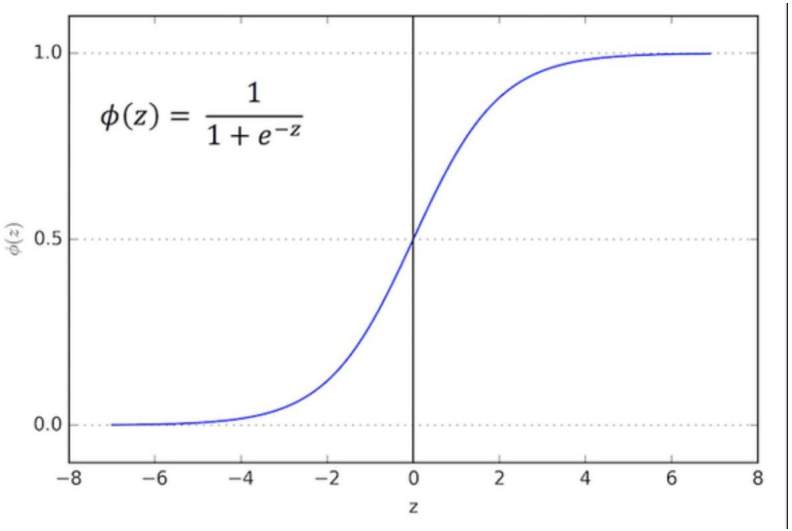
CNN

Algorithm: Logistic Regression

Problem category: Image Classification.

Output y: 0 or 1 (indicating whether there is at least one pixel of tumor tissue)

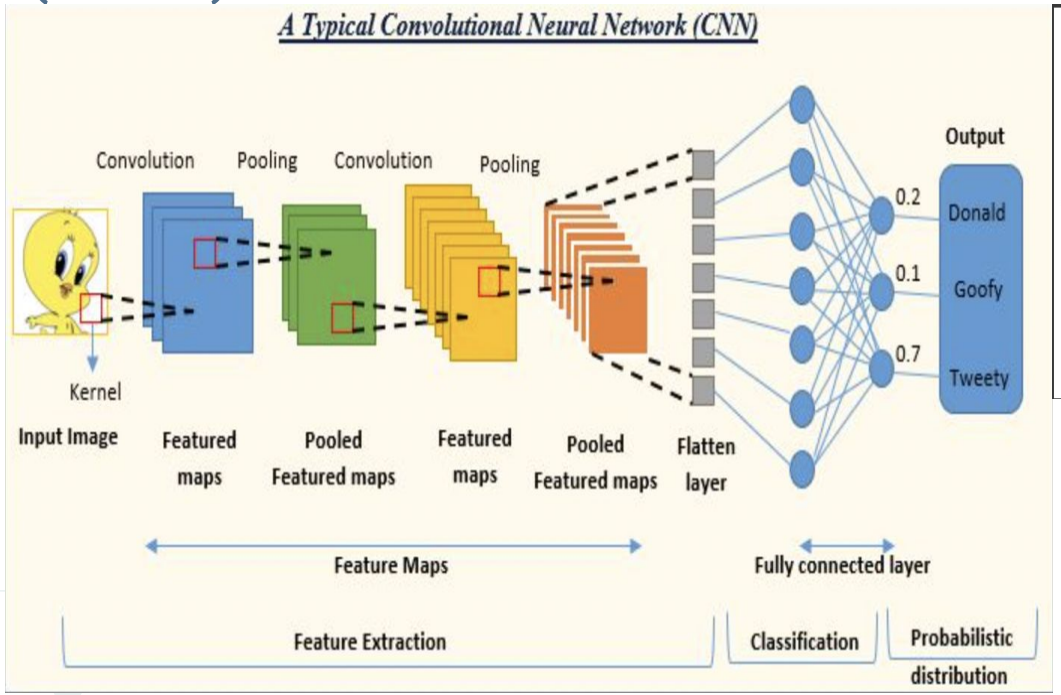
Input x: 32*32 → 1024 total pixel.

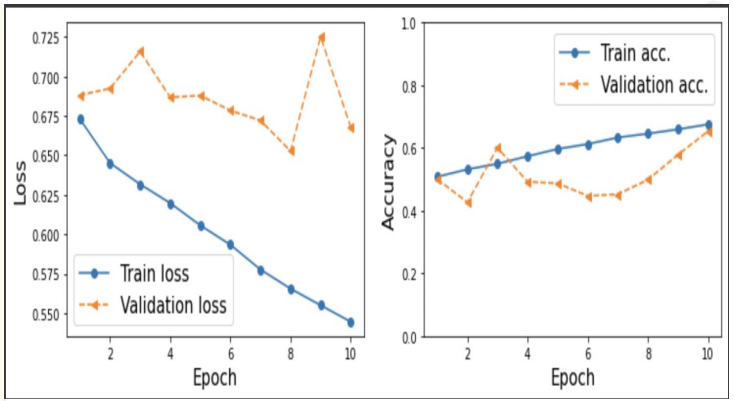


Loss function: for logistic regression:

$$-\frac{1}{|Y|}\sum_{y_i \in Y} y_i log(\hat{y}_i) + (1-y_i) log(1-\hat{y}_i)$$

Algorithm: Convolutional Neural Network (CNN)





Test Accuracy is 81.8% in the initial run.

04

Evaluation

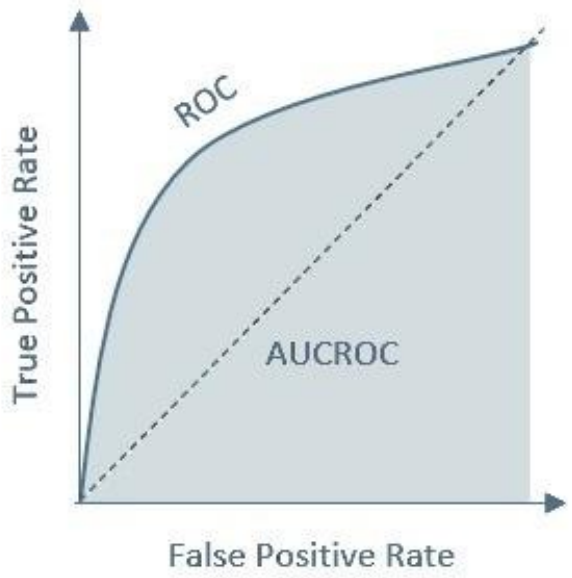
Metrics

Model Evaluation

As the task is one of **classification**…

Overall metric

- **AUC under ROC**
- general sense of model effectiveness
- yet to cater for use case
- **Baseline: 50%** (given lack of context)



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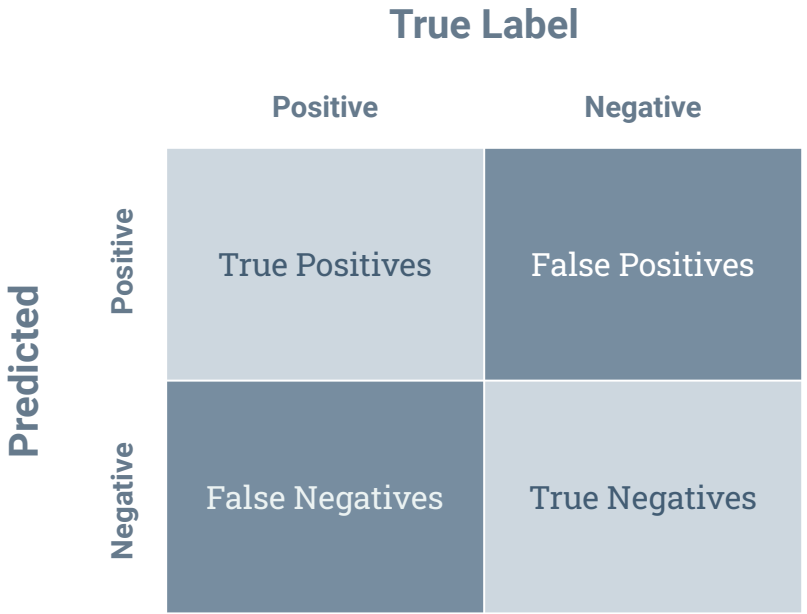
Additional metrics

- **Confusion matrix**
- **Precision, recall**: for specific use cases
- **F1, MCC**: balanced estimate



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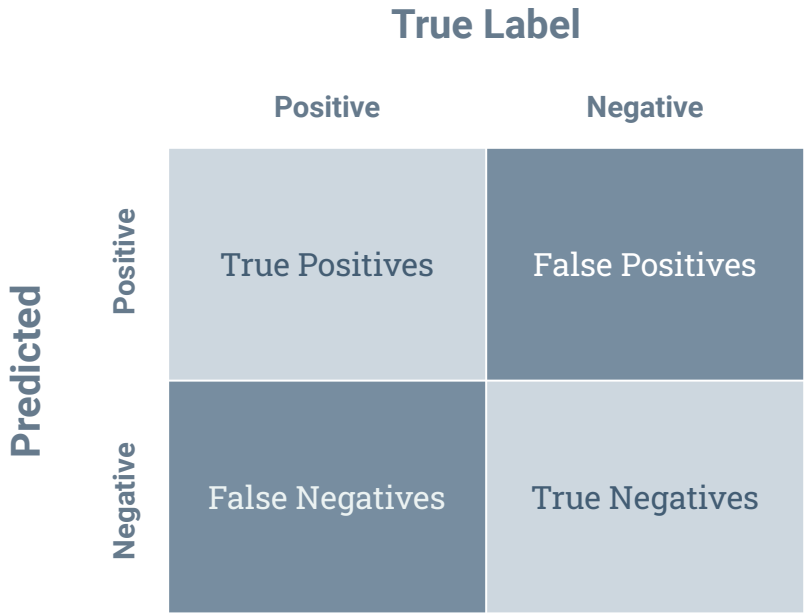
Validation

- **k-fold** cross validation
- stretch goal: subject to computation time



Thank You

Questions?