

ACTIVE LEARNING FOR BIO-MEDICAL IMAGE SEGMENTATION

CSE MS Project

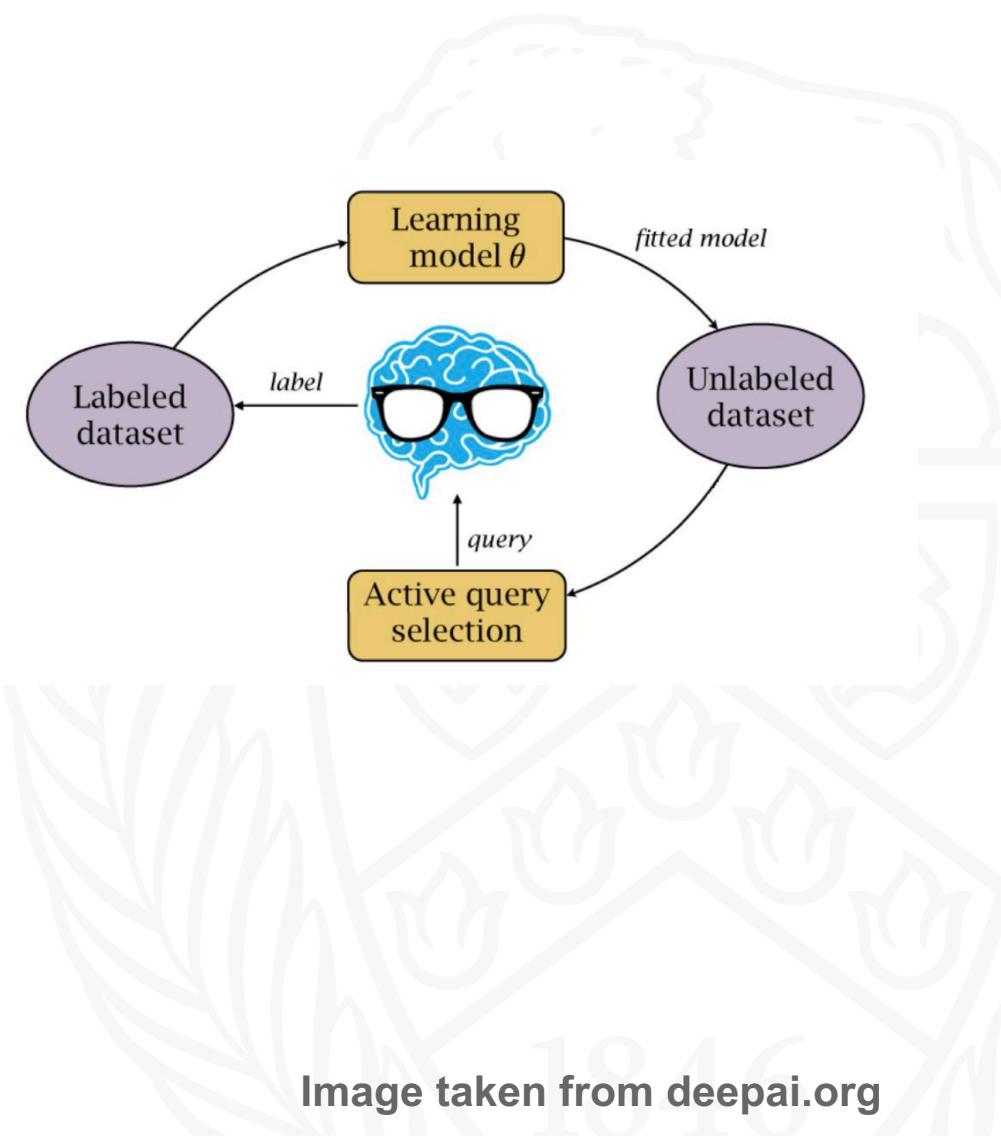
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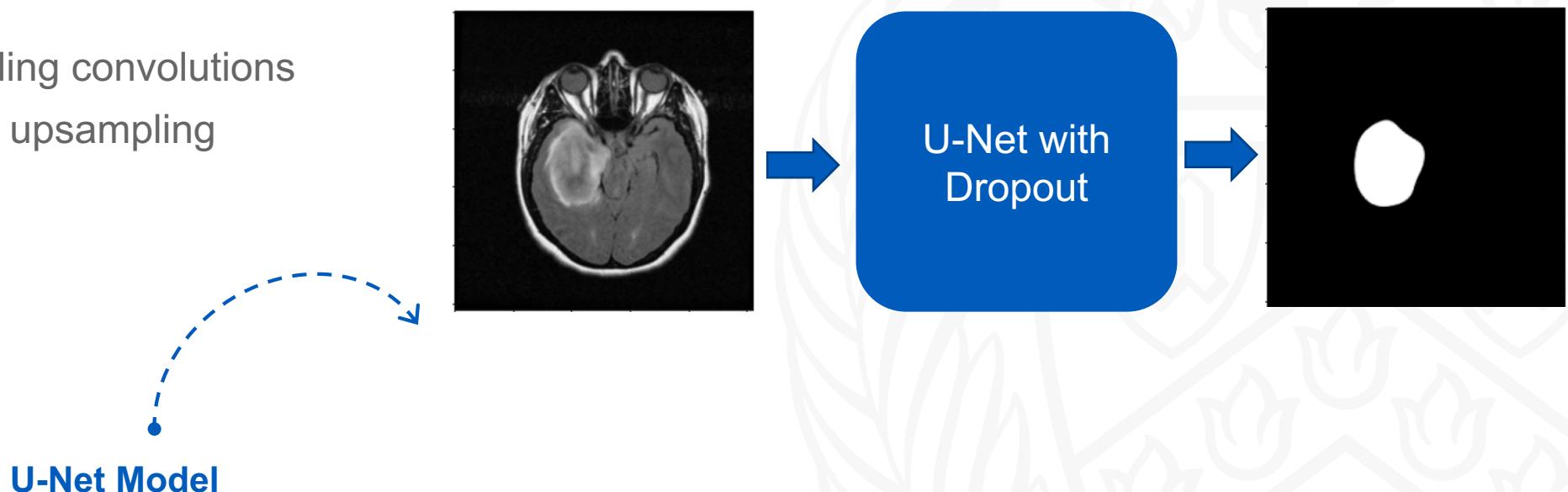
Objective

- Use **active learning** methodology to train a **convolutional neural network** for **semantic segmentation** of lesion areas in **medical images**.
- **Active Learning** - Auto-selection of useful instances to be labeled in order to achieve similar performance with few data



Architecture

- State-of-the-art **U-Net** model with **Dropout** for Semantic Segmentation
- 5 pairs of downsampling convolutions (3×3) and 4 pairs of upsampling convolutions (3×3)



Dataset

- “Skin Lesion Analysis Toward Melanoma Detection” dataset from Inter-national Skin Imaging Collaboration (ISIC)
- “Lower Grade Glioma Detection” dataset from The Cancer Imaging Archive (TCIA)

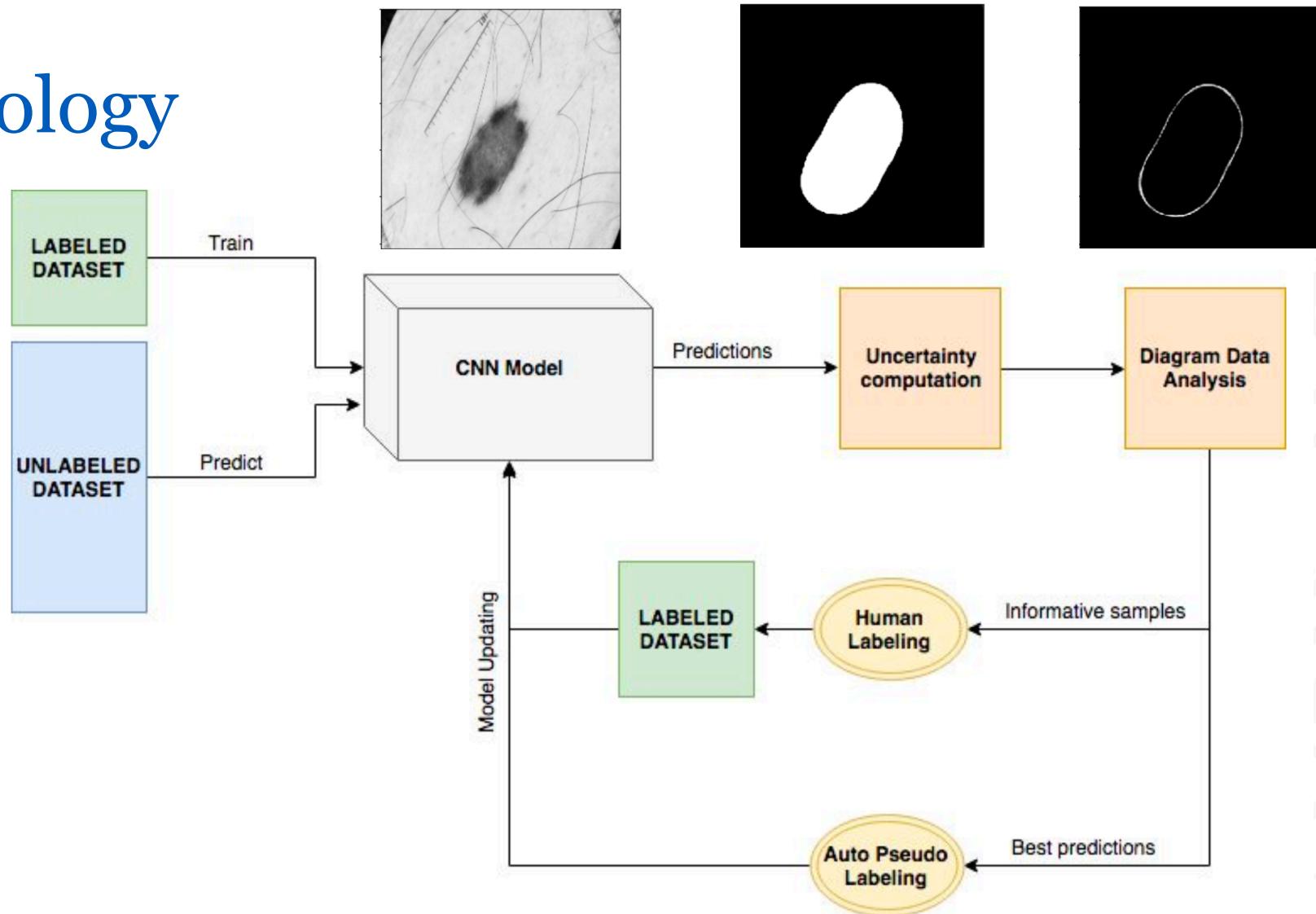
Data	Samples
Train	1600
Validation	400
Test	600

Initial Data	Samples
Labeled (D^L)	600
Unlabeled (D^U)	1000

Data	Samples
Train	878
Validation	220
Test	275

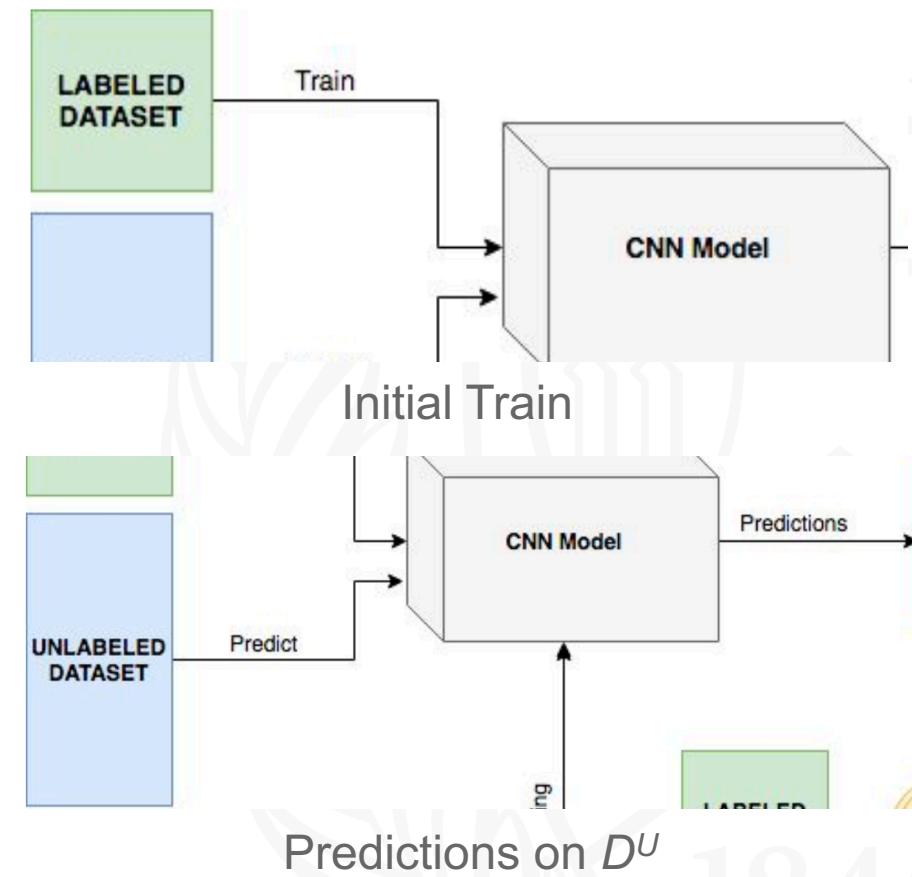
Initial Data	Samples
Labeled (D^L)	329
Unlabeled (D^U)	549

Methodology



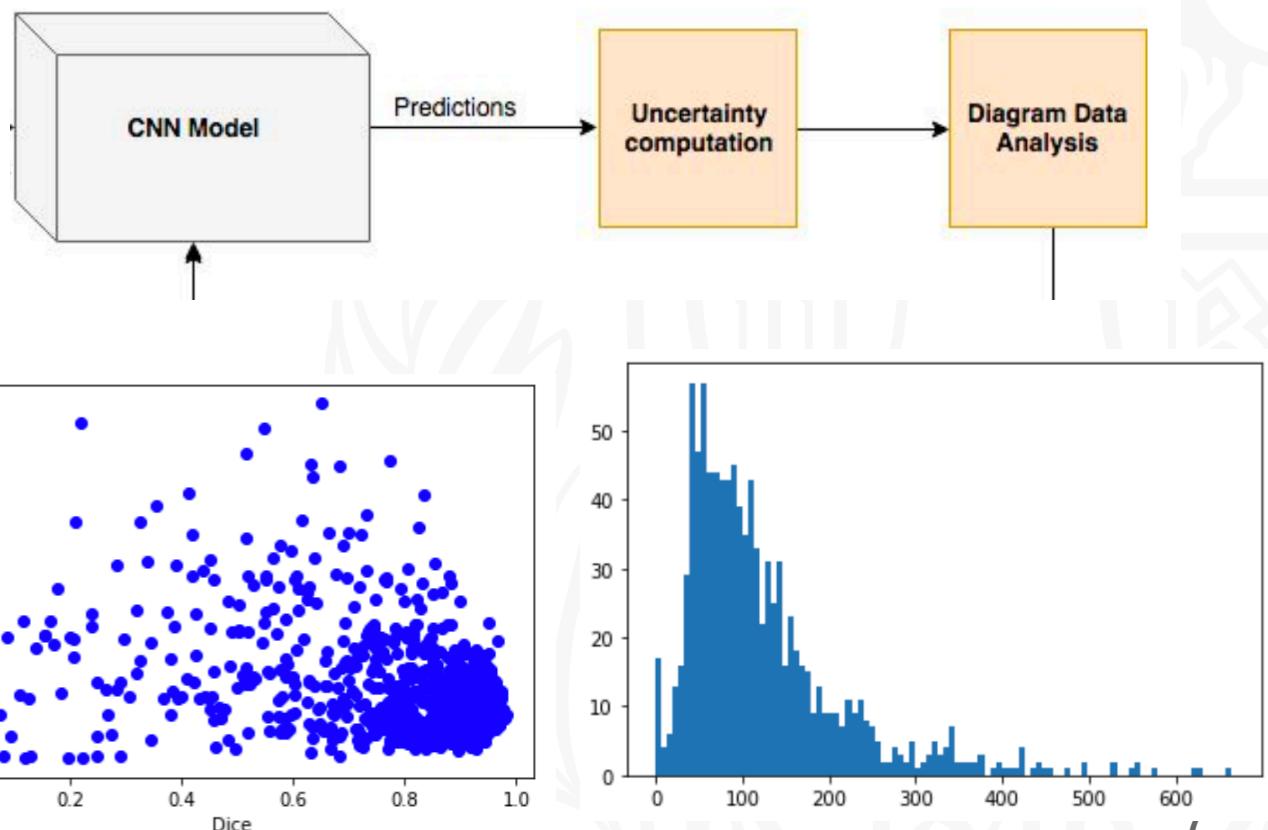
Methodology – Initial Training

- Initially, the U-Net is trained on limited labeled data (D^L).
- Predictions are made on Unlabeled Data (D^U) by the trained model.



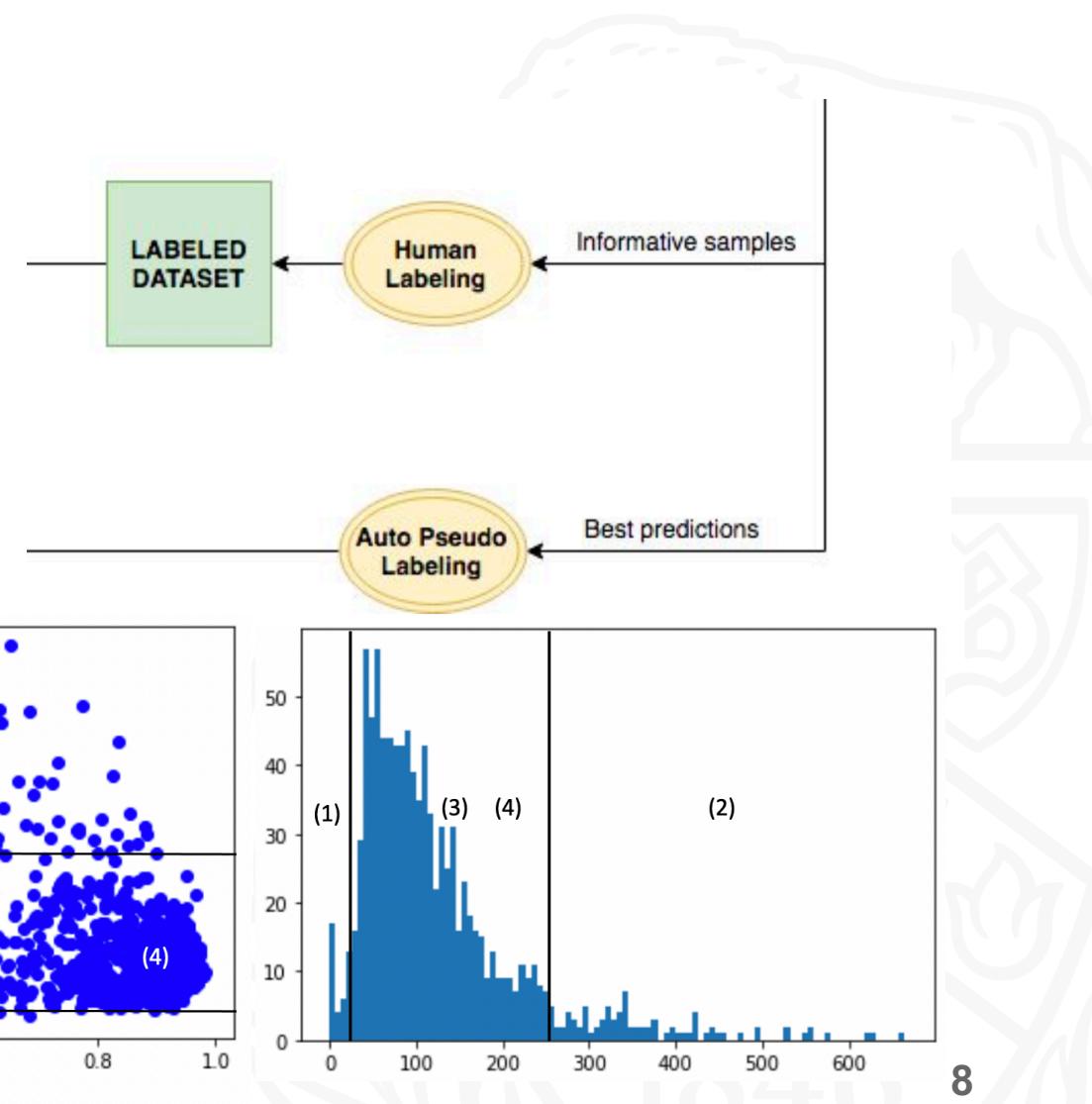
Methodology – Uncertainty

- In the Active Learning loop, uncertainty is calculated over t step predictions of D^U .
- Based on the Uncertainty score, a histogram is plotted.
- Analyze the histogram to select the samples.



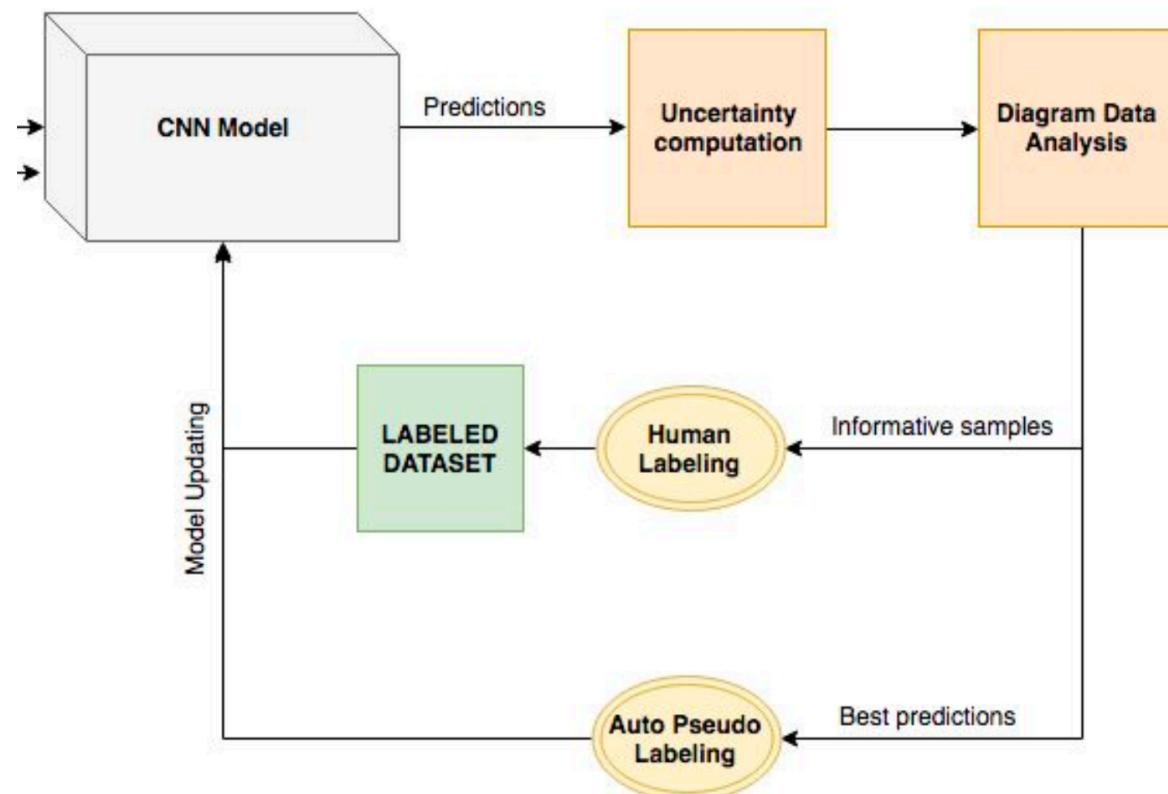
Methodology – Labelling

- 4 kinds of samples selected based on the histogram – 1. Undetected 2. Least Confident 3. Random 4. Most Confident.
- An Oracle (Ground Truth in our case) labels samples 1,2,3.
- Model, pseudo labels sample 4.



Methodology – Active Loop

- The model is trained again over the updated labeled data and weights are updated.
- Active Learning loop continues iteratively.



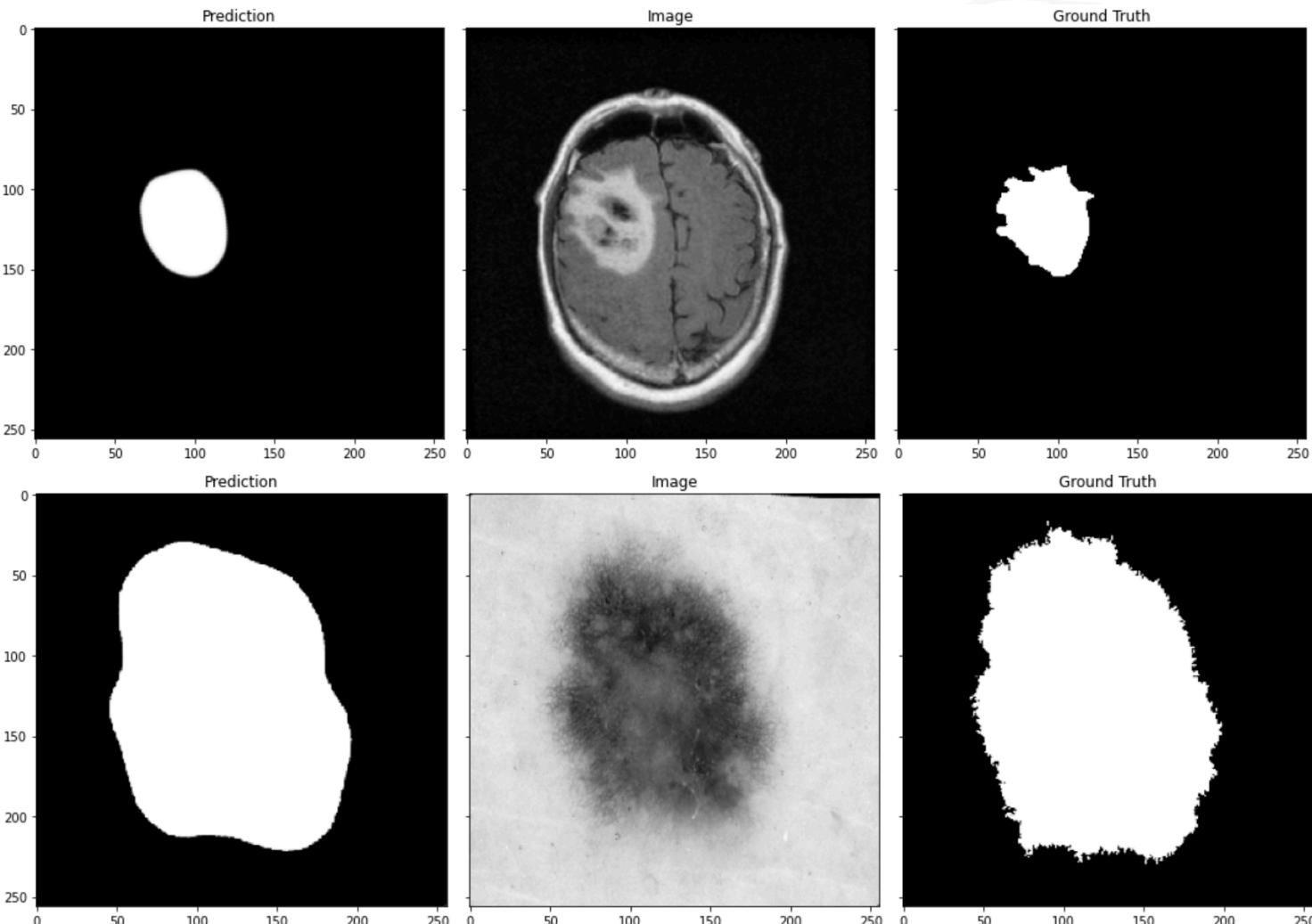
Results

Dataset	Dice
Skin Lesion	77
Brain MRI	58

Active Learning

Dataset	Dice
Skin Lesion	79
Brain MRI	59

Fully Labeled



THANK YOU

