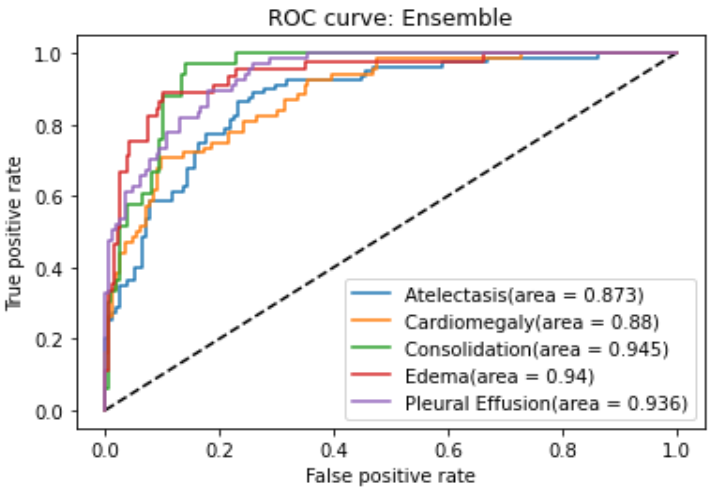
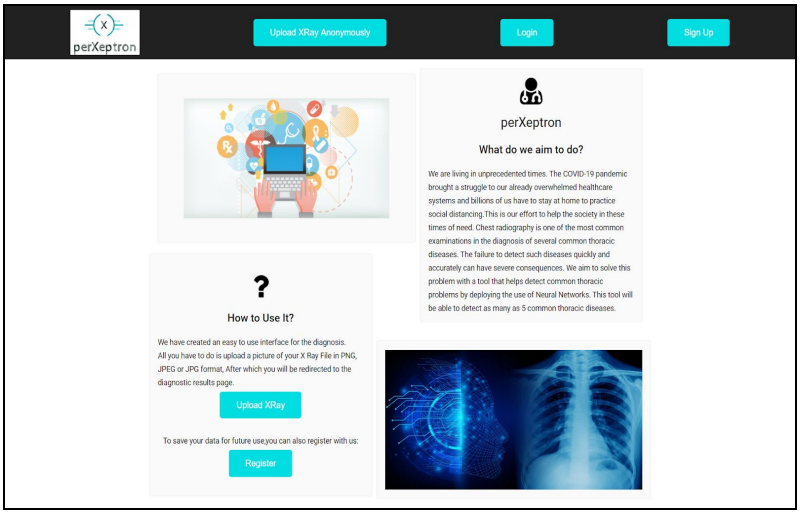
X-Ray Anomaly Detection using CNNs

Team PerXeptron (ITS20054)



Final AUC Scores of the Ensemble



Web App

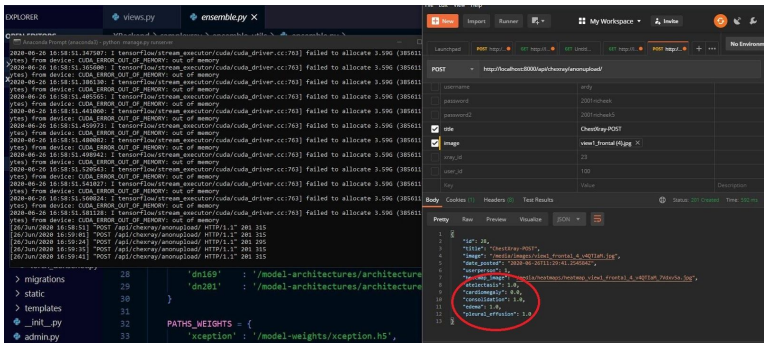
About

- The aim of this project is to **automate the process of examining Chest X-Rays (CXR)** to detect the presence of 5 diseases, namely Atelectasis, Cardiomegaly, Consolidation, Edema, and Pleural Effusion. Motivated by the prospect of contributing towards the already overwhelmed healthcare systems in today's world, we decided to use deep learning to build a **model ensemble** with the ability to predict the presence of the above 5 diseases.

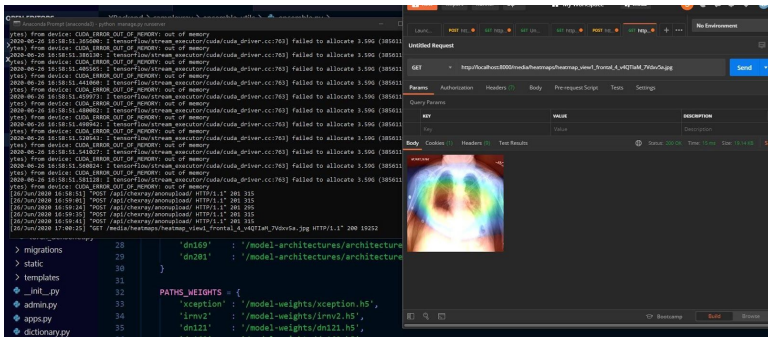
- To achieve this goal, we used transfer learning from 5 pre-trained (on the ImageNet dataset) CNNs, and fine-tuned these on the CheXpert dataset, compiled by the Stanford ML Group, a collection of diagnoses of 14 diseases (including the above 5) from more than 224,000 chest radiographs. We then built an ensemble with the 5 trained models, which was able to achieve an average **AUC score of 0.915**, a value **quite close** to the **state-of-the-art model** on this dataset, which achieves an average AUC score of 0.94.

- Finally, we designed a website, using **Angular 9** in the frontend and **Django REST Framework** in the backend, and an **Open API** for developers.

Link to main documentation : Team PerXeptron: Final Documentation



Open API



Reading Heat Map from the API Endpoint

Learnings/Key Takeaways/Experience

- **General:**
  - Fundamentals of Deep Learning and Computer Vision.
  - Fundamentals of Web development.
  - Experience of building deep learning models on large(~11GB) datasets with limited computational resources.
  - Continuous Integration and Deployment

- **Transfer Learning:**
  The fundamentals of transfer learning.
  Reference: Transfer learning from pre-trained models

- **Image Pre-processing**:
  Gained exposure to a few image pre-processing techniques:
  - **Histogram Equalization:** Increasing the global contrast of an image by "spreading out" the histogram of the intensity values (Histogram Equalization) & (Deep Learning for abnormality detection in Chest X-Ray images).
  - **Center Cropping:** An alternative to resizing images, can be used when most information is contained in the central region of the image.

- **Model Ensembling:**
  The process of combining (via a **weighted average**) the predictions from different models (In our case: Xception, Inception-ResNet-v2, DenseNet-121, DenseNet-169, DenseNet-201), and thus making the overall prediction more robust. The individual models have an AUC of about **88**, while ensembling increases it to **91.5**, the categorical accuracies of the individual models is about **45%**, while ensembling increases it to **51.7%**.

- **Authentication**
  This project utilises **DRF Token and Session Authentication** for authenticating client side hashes. So, we got to learn a lot about **session** and **local storage** and user retention to deal with passwords and sensitive information on the client side.