PROJECT ON

CLOUD COMPUTING

J-COMPONENT PROJECT FINAL REPORT

REVIEW – 3

ON

COVID DETECTION FROM X-RAY IMAGES USING AMAZON SAGEMAKER

UNDER THE GUIDANCE OF

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PROGRAMME

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SLOT

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1. ABSTRACT:

The effective management of the global epidemic now depends critically on the quick and accurate detection of COVID-19. A widely utilized and reasonably priced diagnostic method for finding COVID-19 is chest X-ray imaging.

Convolutional neural networks (CNNs), in particular, are used in the proposed method to automatically extract significant features from X-ray pictures and classify them as COVID-19 positive, COVID-19 negative, and maybe other lung-related disorders.

To provide a scalable and cloud-based solution for real-time inference, the model will be deployed toAmazon EC2 using Amazon Sage Maker.

2. INTRODUCTION:

The COVID-19 epidemic has had a severe impact on the global healthcare system. Rapid and accurate COVID-19 diagnosis is critical for limiting additional virus propagation and delivering prompt therapy to patients.

Chest X-ray imaging is a commonly available and low-cost diagnostic technique for detecting COVID-19. The use of artificial intelligence (AI) and machine learning (ML) techniques to analyses medical images for disease identification and diagnosis has shown considerable potential.

Amazon Sage Maker, a cloud-based platform for constructing, testing, and deploying machine learning models, provides an ideal environment for establishing a robust and scalable solution forCovid-19 detection from X-ray pictures in this Project.

This project intends to exploit the capabilities of deep learning and cloud computing by utilizing Amazon. The model will be deployed to Amazon EC2 using Amazon Sage Maker.

3. WHY SAGEMAKER?

On the Studio Lab free tier, you get a Tesla T4. On the Google Collab free tier, you get a TeslaP100 or Tesla K80. Studio offers a persistent environment.

You can choose to run a CPU-based environment for 12 hours or a GPU-based environment for 4 hours. This environment will keep running for that long unless you stop it via the console. Studio Lab is a good option for longer projects in data science or machine learning.

You will be using better hardware and working in a programming environment that you may customize.

4. LITERATURE SURVEY:

[1] TITLE: Automated detection of COVID-19 cases using deep neural networks with X-ray images

***AUTHOR*:** T. Ozturk et al.

PUBLISHED YEAR: 2020, ELSEVIER

DESCRIPTION:

The paper presents a new model for automatic COVID-19 detection using raw chest X-ray images. The proposed model aims to provide accurate diagnostics for binary classification (COVID vs. No-Findings) and multi-class classification (COVID vs. No-Findings vs. Pneumonia). The model achieved a classification accuracy of 98.08% for binary classes and 87.02% for multi-class cases. It can be used to assist radiologists in validating their initial screening and can also be employed via cloud for immediate patient screening.

PROPOSED METHODS:

The authors used the Dark Net model as a classifier for the you only look once (YOLO) real-time object detection system. They implemented 17 convolutional layers with different filtering on each layer. The model was trained using the Adam optimizer, cross-entropy loss function, and a learning rate of 3e-3. The training and validation were performed using a 5-fold cross-validation procedure.

[2] TITLE: CoroDet: A deep learning based classification for COVID-19 detection using chest X-ray images

AUTHOR: Emtiaz Hussain, Mahmudul Hasan, et al.

PUBLISHED YEAR: 2021, ELSEVIER

DESCRIPTION:

The paper discusses the development of a deep learning-based method called CoroDet for COVID-19 detection using chest X-ray images. The proposed method utilizes a 22-layer CNN architecture and achieves high accuracy for 2 class, 3 class, and 4 class classification. The paper also highlights the construction of a large X-ray image database for COVID-19 classification and presents experimental results and discussions on the performance of the proposed method.

PROPOSED METHODS:

The paper introduces the CoroDet method, which consists of a 22-layer CNN model for COVID-19 detection using chest X-ray and CT images. The model is evaluated based on various performance metrics such as accuracy, precision, recall, F1 score, specificity, sensitivity, and confusion matrix. The proposed method outperforms existing techniques in terms of accuracy and demonstrates its effectiveness for COVID-19 identification.

[3] TITLE: Exploring the effect of image enhancement techniques on COVID-19 detection using chest X-ray images

AUTHOR: Tawsifur Rahman, Amith Khandakar, et al.

PUBLISHED YEAR: 2021, ELSEVIER

DESCRIPTION:

This paper focuses on the exploration of different image enhancement techniques for the detection of COVID-19 using chest X-ray images. It highlights the importance of computer-aided diagnosis in the fast and reliable detection of COVID-19 to ease the burden on the healthcare system. The paper also introduces a large dataset (COVQU) consisting of 18,479 CXR images with normal, non-COVID, and COVID-19 cases, and proposes a modified U-Net model for lung segmentation.

PROPOSED METHODS:

The paper utilizes six different pre-trained Convolutional Neural Networks (CNNs) and a shallow CNN model for classification. It also investigates five different image enhancement techniques, including histogram equalization, contrast limited adaptive histogram equalization, image complement, gamma correction, and balance contrast enhancement technique. A modified version of the U-Net model is proposed for lung segmentation.

[4] TITLE: Automatic detection of coronavirus disease (COVID-19) using X-ray images and deep convolutional neural networks

AUTHOR: Ali Narin, Ceren Kaya, Ziynet Pamuk

PUBLISHED YEAR: 2021, SPRINGER NATURE.

DESCRIPTION:

The paper focuses on the automatic detection of COVID-19 using X-ray images and deep convolutional neural networks. It highlights the need for an alternative diagnosis option to prevent the spread of COVID-19 among people due to the limited availability of COVID-19 test kits in hospitals. The study proposes five pre-trained convolutional neural network-based models for the detection of coronavirus pneumonia-infected patients using chest X-ray radiographs. The performance results show that the pre-trained ResNet50 model provides the highest classification accuracy among the four models used.

PROPOSED METHODS:

The study proposes the use of five pre-trained convolutional neural network-based models, namely ResNet50, ResNet101, ResNet152, InceptionV3, and Inception-ResNetV2, for the detection of COVID-19 from chest X-ray images. Three different binary classifications with four classes (COVID-19, normal, viral pneumonia, and bacterial pneumonia) are implemented using five-fold cross-validation.

[5] TITLE: Application of deep learning techniques for detection of COVID-19 cases using chest X-ray images: A comprehensive study

AUTHOR: Soumya Ranjan Nayak, Deepak Ranjan Nayak, et al.

PUBLISHED YEAR: 2021, ELSEVIER.

DESCRIPTION:

The paper discusses the use of deep learning techniques for the detection of COVID-19 cases using chest X-ray images. It highlights the importance of an automated and early diagnosis system to reduce the diagnosis error and provide fast decisions. The study proposes a DL-assisted automated method using X-ray images for early diagnosis of COVID-19 infection.

PROPOSED METHODS:

The paper evaluates the effectiveness of eight pre-trained Convolutional Neural Network (CNN) models, such as Alex Net, VGG-16, Google Net, MobileNet-V2, etc., for the classification of COVID-19 infection cases from normal cases. The ResNet-34 model is found to outperform other networks with an accuracy of 98.33%.

[6] TITLE: Automatic Detection of COVID-19 Infection Using Chest X-Ray Images Through Transfer Learning

AUTHORS: Elene Firmeza Ohata, Gabriel Maia Bezerra, et al.

PUBLISHED YEAR: 2021, IEEE

DESCRIPTION:

The paper proposes an automatic detection method for COVID-19 infection based on chest X-ray images. The authors construct datasets consisting of X-ray images of patients diagnosed with coronavirus and healthy patients. They apply transfer learning using different convolutional neural network (CNN) architectures trained on ImageNet to extract features from the X-ray images. These features are then combined with machine learning methods such as k-Nearest Neighbor, Bayes, Random Forest, multilayer perceptron (MLP), and support vector machine (SVM) for classification. The results show high accuracy and F1-scores for detecting COVID-19 in X-ray images.

PROPOSED METHODS:

Transfer learning with convolutional neural networks (CNNs) trained on ImageNet, combined with machine learning methods such as k-Nearest Neighbor, Bayes, Random Forest, multilayer perceptron (MLP), and support vector machine (SVM).

[7] TITLE: Classification of COVID-19 from Chest X-ray images using Deep Convolutional Neural Network

AUTHOR: Sohaib Asif, Yi Wenhui, Hou Jin, Si Jinhai

PUBLISHED YEAR: 2020, IEEE.

DESCRIPTION:

The paper focuses on the automatic detection of COVID-19 pneumonia patients using digital chest X-ray images. It proposes the use of deep convolutional neural networks (DCNN) for accurate detection and classification. The study utilizes a dataset consisting of 864 COVID-19, 1345 viral pneumonia, and 1341 normal chest X-ray images. The proposed DCNN-based model, Inception V3 with transfer learning, achieves a classification accuracy of more than 98%.

PROPOSED METHODS:

The paper proposes the use of deep convolutional neural networks (DCNN) for the classification of COVID-19 from chest X-ray images. Specifically, the Inception V3 model with transfer learning is utilized. Transfer learning allows the model to leverage pre-trained weights and knowledge from a large dataset to improve performance on a smaller dataset.

[8] TITLE: Covid-19: automatic detection from X-ray images utilizing transfer learning with convolutional neural networks.

AUTHORS: Ioannis D. Apostolopoulos, Tzani A. Mpesiana

PUBLISHED YEAR: 2020, Australasian College of Physical Scientists And Engineers In Medicine

DESCRIPTION OF THE PAPER:

The paper focuses on the automatic detection of Covid-19 from X-ray images using transfer learning with convolutional neural networks. The study aims to evaluate the performance of state-of-the-art convolutional neural network architectures for medical image classification. The researchers utilized two datasets of X-ray images, one including confirmed Covid-19 cases, common bacterial pneumonia cases, and normal conditions, and the other including confirmed Covid-19 cases, bacterial and viral pneumonia cases, and normal conditions. The results suggest that deep learning with X-ray imaging can extract significant biomarkers related to Covid-19, achieving high accuracy, sensitivity, and specificity.

PROPOSED METHODS:

The paper utilizes transfer learning with convolutional neural networks for the automatic detection of Covid-19 from X-ray images. Transfer learning allows the detection of various abnormalities in small medical image datasets, yielding remarkable results. The researchers adopted state-of-the-art pre-trained convolutional neural networks and fine-tuned them using the available X-ray images. The performance of different CNN architectures, such as Mobile Net v2, was evaluated.

[9] TITLE: Problems of Deploying CNN Transfer Learning to Detect COVID-19 from Chest X-rays

AUTHOR: Taban Majeed, Rasber Rashid, Dashti Ali, and Aras Asaad

PUBLISHED YEAR: 2020, MEDRXIV.

DESCRIPTION:

The paper aims to investigate the applicability of convolutional neural networks (CNNs) for COVID-19 detection in chest X-ray images. It analyses the performance of 12 off-the-shelf CNN architectures and proposes a simple CNN architecture that outperforms other architectures when trained on a small dataset. The paper also highlights the challenges of using CNNs directly on chest X-ray images without pre-processing steps.

PROPOSED METHODS:

The paper uses transfer learning with 12 CNN architectures and a shallow CNN architecture trained from scratch. It also employs class activation maps (CAM) to visualize the regions on X-ray images used by CNNs for their predictions.

[10] TITLE: A new approach for computer-aided detection of coronavirus (COVID-19) from CT and X-ray images using machine learning methods

AUTHOR: Ahmet Saygılı

PUBLISHED YEAR: 2021, ELSEVIER.

DESCRIPTION:

The paper discusses a new approach for the computer-aided detection of COVID-19 from CT and X-ray images using machine learning methods. The study aims to support early diagnosis and treatment of the coronavirus epidemic. The proposed approach involves data set acquisition, pre-processing, feature extraction, dimension reduction, and classification stages. The results show high accuracy levels in detecting COVID-19 from both CT and X-ray images.

PROPOSED METHODS:

The proposed approach includes data set acquisition, pre-processing, feature extraction, dimension reduction, and classification stages. Machine learning and image processing methods are used to enable early diagnosis and treatment of COVID-19. The approach is applied to three different public COVID-19 data sets, achieving high accuracy levels in detecting COVID-19 from CT and X-ray images.

[11] TITLE: COVID-19 detection using deep learning models to exploit Social Mimic Optimization and structured chest X-ray images using fuzzy color and stacking approaches.

AUTHOR: Mesut Toğaçar, Burhan Ergen, Zafer Cömert.

PUBLISHED YEAR: 2020, ELSEVIER

DESCRIPTION:

The paper focuses on the detection of COVID-19 using deep learning models and structured chest X-ray images. The authors propose a method that combines the Fuzzy Color technique for pre-processing the data and the stacking technique for image structuring. The deep learning models MobileNetV2 and Squeeze Net are used to train the stacked dataset, and the feature sets obtained are processed using the Social Mimic optimization method. The proposed approach achieves an overall classification rate of 99.27% and shows potential for efficient COVID-19 detection.

PROPOSED METHODS:

The paper proposes the use of deep learning models (MobileNetV2 and Squeeze Net) to train a stacked dataset of chest X-ray images. The dataset is pre-processed using the Fuzzy Color technique and the images are structured using the stacking technique. The feature sets obtained from the models are then processed using the Social Mimic optimization method. The combined features are classified using Support Vector Machines (SVM) to detect COVID-19.

[12] TITLE: COVID-19 Screening on Chest X-ray Images Using Deep Learning based Anomaly Detection

AUTHOR: Jianpeng Zhang, Yutong Xie, Yi Li, Chunhua Shen, and Yong Xia

PUBLISHED YEAR: 2020, ARXIV

DESCRIPTION:

The paper focuses on developing a deep learning-based model for the screening of COVID-19 using chest X-ray images. The authors highlight the importance of chest X-ray imaging due to its wider availability and faster imaging time compared to CT scans. They propose a new deep anomaly detection model that can assist radiologists in analyzing chest X-ray images for efficient and reliable COVID-19 screening.

PROPOSED METHODS:

The proposed model consists of three components: a backbone network, a classification head, and an anomaly detection head. The backbone network extracts high-level features from the input chest X-ray image. The classification head generates a classification score, while the anomaly detection head generates an anomaly score. The model is trained using stochastic gradient descent (SGD) algorithm with data augmentation strategies.

[13] TITLE: COVID-CXNet: Detecting COVID-19 in frontal chest X-ray images using deep learning

AUTHORS: Arman Haghanifar, Mahdiyar Molahasani Majdabadi, Younhee Choi,et al.

PUBLISHED YEAR: 2022, SPRINGER

DESCRIPTION:

The paper focuses on detecting COVID-19 in frontal chest X-ray images using deep learning. The authors conducted research on efficiently detecting imaging features of COVID-19 viral pneumonia using deep convolutional neural networks. They collected numerous chest X-ray images from various sources and prepared one of the largest publicly accessible datasets. The proposed model, COVID-CXNet, is based on the well-known CheX Net model and is capable of detecting COVID-19 pneumonia based on relevant and meaningful features with precise localization.

PROPOSED METHODS:

The authors utilized deep convolutional neural networks, specifically the CheXNet model, for detecting COVID-19 in frontal chest X-ray images. They collected a large dataset of chest X-ray images from multiple sources and prepared it for training the model. The CheX Net model was fine-tuned on this dataset using the transfer learning paradigm to develop COVID-CXNet, which is capable of detecting COVID-19 pneumonia based on relevant and meaningful features.

[14] PAPER: Diagnosis and detection of infected tissue of COVID-19 patients based on lung x-ray image using convolutional neural network approaches.

AUTHOR: Shayan Hassantabar, Mohsen Ahmadi, Abbas Sharifi.

***PUBLISHED YEAR*:** 2020, ELSEVIER

DESCRIPTION:

The paper presents deep learning-based methods for the diagnosis and detection of COVID-19 in patients using lung x-ray images. Two algorithms, deep neural network (DNN) and convolutional neural network (CNN), are proposed for the classification and diagnosis of patients. The CNN architecture is also used for the segmentation of infected tissue in lung images. The results show high accuracy and sensitivity in detecting COVID-19 cases.

PROPOSED METHODS:

The paper proposes two deep learning-based methods, DNN and CNN, for the diagnosis and detection of COVID-19 in patients using lung x-ray images. The DNN method utilizes fractal features of the images, while the CNN method directly uses the lung images. The CNN architecture is also used for the segmentation of infected tissue in lung images.

[15] TITLE: Deep Learning-Based COVID-19 Detection Using CT and X-Ray Images: Current Analytics and Comparisons

AUTHOR: Amjad Rehman, Tanzila Saba, Usman Tariq, Noor Ayesha

PUBLISHED YEAR: 2021, IEEE.

DESCRIPTION:

The paper focuses on deep learning-based COVID-19 detection using CT and X-ray images. It provides an overview of the COVID-19 data and discusses the current resources and methodologies used in combating the pandemic. The paper aims to systematize the available data and help researchers and practitioners in building solutions for COVID-19.

PROPOSED METHODS:

The paper discusses various deep learning models and techniques used for COVID-19 detection, such as iCOVIDX-Net, CNN, fusion models, SqueezeNet, Q-deformed entropy algorithm, and GAN deep transfer learning. These methods utilize CT scans and X-ray images to accurately detect COVID-19 infections.

[16] TITLE: COVID-Net: a tailored deep convolutional neural network design for detection of COVID-19 cases from chest X-ray images

AUTHOR: Linda Wang, Zhong Qiu Lin, Alexander Wong

PUBLISHED YEAR: 2020, SCIENTIFIC REPORTS.

DESCRIPTION:

The paper introduces COVID-Net, a deep convolutional neural network design specifically tailored for the detection of COVID-19 cases from chest X-ray (CXR) images. It emphasizes the importance of effective screening of infected patients using radiology examination and presents COVID-Net as an open-source network design available to the general public. The paper also introduces COVIDx, an open access benchmark dataset comprising a large number of CXR images from COVID-19 positive cases.

PROPOSED METHODS:

The paper describes the use of a human-machine collaborative design strategy to create COVID-Net, combining human-driven network design prototyping with machine-driven design exploration. It introduces a novel deep neural network architecture that incorporates a lightweight projection-expansion-projection-extension (PEPX) design, enhancing representational capacity while reducing computational complexity. The paper also discusses the creation of the COVIDx dataset, which combines and modifies publicly available data repositories to provide a large dataset for training and evaluating COVID-Net.

[17] TITLE: COVID-19 Detection from Chest X-ray Images Using Feature Fusion and Deep Learning

AUTHOR: Nur-A-Alam, Mominul Ahsan, Md. Abdul Based, Julfikar Haider, Marcin Kowalski

PUBLISHED YEAR: 2021, SENSORS

DESCRIPTION:

The paper focuses on the detection of COVID-19 from chest X-ray images using feature fusion and deep learning techniques. It highlights the importance of early detection for reducing the death rate and presents a comprehensive study on the classification of chest X-ray images. The proposed method involves the fusion of features extracted by histogram-oriented gradient (HOG) and convolutional neural network (CNN), along with the application of modified anisotropic diffusion filtering and watershed segmentation technique for accurate diagnosis.

PROPOSED METHODS:

The paper proposes a novel fusion of features extracted by histogram-oriented gradient (HOG) and convolutional neural network (CNN) for COVID-19 detection from chest X-ray images. It also applies a modified anisotropic diffusion filtering (MADF) technique to eliminate multiplicative speckle noise and uses the watershed segmentation technique to identify fractured lung regions as evidence of COVID-19 attacked lungs.

[18] TITLE: Design of Accurate Classification of COVID-19 Disease in X-Ray Images Using Deep Learning Approach

AUTHOR: Joy Iong-Zong Chen

PUBLISHED YEAR: 2021, JOURNAL OF ISMAC

DESCRIPTION:

The paper focuses on the accurate classification of COVID-19 disease in X-ray images using a deep learning approach. It highlights the devastating influence of COVID-19 on global health and the need for timely and accurate monitoring and classification of healthy and infected individuals. The paper proposes a classification model based on deep learning and histogram-oriented gradients (HOG) feature extraction methodology. It aims to detect COVID-19 viral patterns in thoracic X-rays and provide reliable results for the classification of the disease.

PROPOSED METHODS:

The paper proposes the use of deep learning algorithms, specifically convolutional neural networks (CNN), for the accurate classification of COVID-19 disease in X-ray images. The proposed model leverages accurate classification based on medical images and utilizes edge-based neural networks for performance evaluation. The research work also includes the analysis of 10-fold cross-validation with confusion metrics to detect various lung infections caused by diseases such as Pneumonia corona virus-positive or negative.

[19] TITLE: Improving the performance of CNN to predict the likelihood of COVID-19 using chest X-ray images with pre-processing algorithms

AUTHORS: Morteza Heidari, Seyedehnafiseh Mirniaharikandehei, et al.

PUBLISHED YEAR: 2020, ELSEVIER

DESCRIPTION OF THE PAPER:

The paper presents a computer-aided diagnosis (CAD) scheme for detecting COVID-19 infected pneumonia using chest X-ray images. The authors propose a preprocessing algorithm that removes diaphragm regions, normalizes image contrast, and reduces image noise. They use a transfer learning-based convolutional neural network (CNN) model to classify the images into three classes: COVID-19 infected pneumonia, other community-acquired non-COVID-19 infected pneumonia, and normal (non-pneumonia) cases.

The study demonstrates that the proposed approach improves the performance and robustness of the CNN model in detecting COVID-19 cases.

PROPOSED METHODS:

The paper proposes a pre-processing algorithm that involves two steps: removing diaphragm regions and applying histogram equalization and a bilateral low-pass filter to the original image. The processed image, along with two filtered images, is used to create a pseudo color image. This pseudo color image is then fed into a transfer learning-based CNN model for classification.

[20] TITLE: SAM: Self-augmentation mechanism for COVID-19 detection using chest X-ray images

AUTHOR: Usman Muhammad, Md. Ziaul Hoque, et al.

PUBLISHED YEAR: 2022, ELSEVIER

DESCRIPTION:

The paper focuses on the detection of COVID-19 using chest X-ray images. It addresses the limitations of the current methods by proposing a self-augmentation mechanism (SAM) that generates augmented features in the feature space. The proposed approach combines a deep convolutional neural network (CNN), feature augmentation mechanism, and a bidirectional LSTM (BiLSTM) for accurate diagnosis of COVID-19.

PROPOSED METHODS:

The proposed method consists of three components: extraction of deep features, an augmentation-based learning module, and a BiLSTM based classification. The deep features are extracted using a CNN, and the augmentation mechanism generates low-dimensional augmented features. The BiLSTM is then used to classify the processed sequential information.

5. *SUMMARY ON LITERATURE SURVEY:*

REF.NO	*PROPOSED METHODS*	*PARAMETERS*	*CHALLENGES*
[1]	The authors used the Dark Net model as a classifier for the you only look once (YOLO) real-time object detection system. They implemented 17 convolutional layers with different filtering on each layer. The model was trained using the Adam optimizer, cross-entropy loss function, and a learning rate of 3e-3. The training and validation were performed using a 5-fold cross-validation procedure.	The deep learning model used in the study consists of 1,164,434 parameters.	One of the challenges faced in the study was the significant difference in the number of data samples in the COVID-19 class compared to the other two classes (Pneumonia and No-Findings). This led to a sharp increase and decrease in loss values during the training process. However, these fluctuations were gradually reduced as the model examined all X-ray images repeatedly during each epoch of training.
[2]	The paper introduces the CoroDet method, which consists of a 22-layer CNN model for COVID-19 detection using chest X-ray and CT images. The model is evaluated based on various performance metrics such as accuracy, precision, recall, F1 score, specificity, sensitivity, and confusion matrix. The proposed method outperforms existing techniques in terms of accuracy and demonstrates its effectiveness for COVID-19 identification.	The proposed CoroDet method utilizes a 22-layer CNN architecture with convolutional, max pooling, dense, and flatten layers. It also incorporates three activation functions, namely Sigmoid, ReLU, and Leaky ReLU. The model is trained using labeled data and pre-trained on the ImageNet dataset. The learning rate is set to 0.001, the batch size is 10, and the number of epochs is 50. The performance of the model is evaluated using a 5-fold cross-validation approach.	The paper acknowledges the challenges faced in COVID-19 detection, including the shortage of testing kits and the need for early detection to prevent viral spreading. The authors also highlight the limitations of their study, such as hardware limitations and the potential for further improvement by using larger image sets in the training stage.
[3]	The paper utilizes six different pre-trained Convolutional Neural Networks (CNNs) and a shallow CNN model for classification. It also investigates five different image enhancement techniques, including histogram equalization, contrast limited adaptive histogram equalization, image complement, gamma correction, and balance contrast enhancement technique. A modified version of the U-Net model is proposed for lung segmentation.	The paper evaluates the performance of the proposed methods based on accuracy, precision, recall, F1-score, and specificity. It also uses visualization techniques, such as Score-CAM, to confirm the findings of the deep networks.	One of the challenges addressed in the paper is the limited number of COVID-19 CXR images available for training and testing the CNN models. Another challenge is the investigation of the effect of image enhancement techniques on COVID-19 detection, which was not extensively studied in previous

[4]	The study proposes the use of five pre-trained convolutional neural network-based models, namely ResNet50, ResNet101, ResNet152, InceptionV3, and Inception-ResNetV2, for the detection of COVID-19 from chest X-ray images. Three different binary classifications with four classes (COVID-19, normal, viral pneumonia, and bacterial pneumonia) are implemented using five-fold cross-validation.	The performance of the proposed models is evaluated based on accuracy. The ResNet50 model achieves the highest classification performance with 96.1% accuracy for Dataset-1, 99.5% accuracy for Dataset-2, and 99.7% accuracy for Dataset-3.	The main challenge in the study is the limited availability of COVID-19 test kits in hospitals, which necessitates the development of an automatic detection system using X-ray images. Another challenge is the limited amount of data on COVID-19, which affects the training process. However, the study overcomes this challenge by increasing the number of data and utilizing deep transfer learning
[5]	The paper evaluates the effectiveness of eight pre-trained Convolutional Neural Network (CNN) models, such as AlexNet, VGG-16, GoogleNet, MobileNet-V2, etc., for the classification of COVID-19 infection cases from normal cases. The ResNet-34 model is found to outperform other networks with an accuracy of 98.33%.	The study uses chest X-ray images collected from two different sources, including the covid-chestxray-dataset and the ChestX-ray8 dataset. The dataset consists of 203 COVID-19 frontal-view chest X-ray images and an equal number of normal chest X-ray images. The training set contains 286 images, while the test set contains 120 images.	The paper mentions the limited and imbalanced nature of the publicly available datasets, which required multi-operation data augmentation and sample balancing techniques. The misclassification between normal and COVID-19 infection cases is also highlighted as a challenge due to similar imaging features.
[6]	Transfer learning with convolutional neural networks (CNNs) trained on ImageNet, combined with machine learning methods such as k-Nearest Neighbour, Bayes, Random Forest, multilayer perceptron (MLP), and support vector machine (SVM).	The paper uses two datasets, each consisting of 194 X-ray images of patients diagnosed with COVID-19 and 194 X-ray images of healthy patients. Different CNN architectures (Mobile Net, DenseNet201) are used as feature extractors, and various machine learning methods (k-Nearest Neighbour, Bayes, Random Forest, MLP, SVM) are used for classification.	One of the challenges mentioned in the paper is the limited availability of X-ray images of patients with COVID-19. To overcome this, the authors apply transfer learning to leverage the knowledge acquired by CNNs trained on ImageNet. Another challenge is the accurate classification of X-ray images as COVID-19 positive or negative, which is addressed by combining CNN features with different machine learning methods to achieve high accuracy and F1-scores.

[7]	The paper proposes the use of deep convolutional neural networks (DCNN) for the classification of COVID-19 from chest X-ray images. Specifically, the Inception V3 model with transfer learning is utilized. Transfer learning allows the model to leverage pre-trained weights and knowledge from a large dataset to improve performance on a smaller dataset.	The paper does not explicitly mention the specific parameters used in the proposed model. However, it states that the DCNN-based model, Inception V3 with transfer learning, achieves a classification accuracy of more than 98%. The training accuracy is reported as 97%, and the validation accuracy is reported as 93%.	The paper does not explicitly mention the challenges faced in the classification of COVID-19 from chest X-ray images. However, it highlights the importance of automated analysis systems to save valuable time for medical professionals. The paper also references other studies that have utilized deep learning techniques for COVID-19 pneumonia detection, indicating the ongoing research and challenges in this field.
[8]	The paper utilizes transfer learning with convolutional neural networks for the automatic detection of Covid-19 from X-ray images. Transfer learning allows the detection of various abnormalities in small medical image datasets, yielding remarkable results. The researchers adopted state-of-the-art pre-trained convolutional neural networks and fine-tuned them using the available X-ray images. The performance of different CNN architectures, such as MobileNet v2, was evaluated.	Parameters of the Paper: The paper evaluates the performance of different convolutional neural network architectures, including MobileNet v2, for the automatic detection of Covid-19 from X-ray images. The researchers fine-tuned the pre-trained CNNs using transfer learning and adjusted parameters such as the number of trainable layers and the classifier placed at the top of the CNN. The metrics used to evaluate the performance include accuracy, sensitivity, and specificity.	Problem Faced in the Paper: One of the main challenges faced in the paper is the limited availability of Covid-19 cases in the dataset. Due to the small size of the Covid-19 samples, transfer learning was preferred to train the deep convolutional neural networks. The researchers had to overcome the limitations of the data availability and utilize transfer learning to achieve accurate feature extraction and classification for the automatic detection of Covid-19 from X-ray images.
[9]	The paper uses transfer learning with 12 CNN architectures and a shallow CNN architecture trained from scratch. It also employs class activation maps (CAM) to visualize the regions on X-ray images used by CNNs for their predictions.	The paper does not mention specific parameters used in the CNN architectures or the dataset size.	The paper identifies several challenges in deploying CNN transfer learning for COVID-19 detection from chest X-rays. These challenges include the reliance on artifacts in the images, the use of regions/features outside the region of interest, and the need for cautious interpretation of CNN predictions without qualitative inspection by radiologists. The paper also highlights the importance of lung segmentation and the incorporation of clinical and cardiac features in future research.

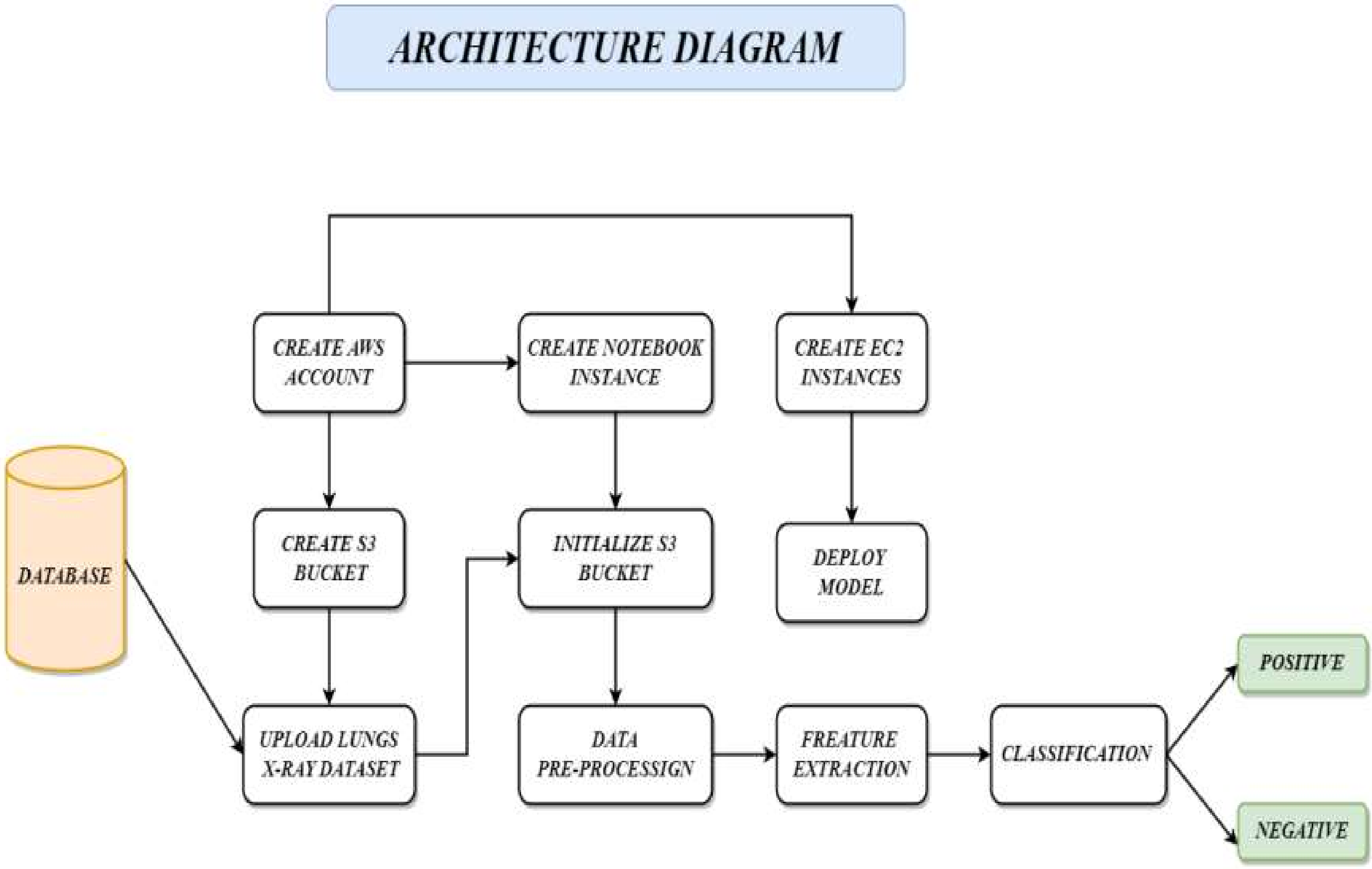
[10]	The proposed approach includes data set acquisition, pre-processing, feature extraction, dimension reduction, and classification stages. Machine learning and image processing methods are used to enable early diagnosis and treatment of COVID-19. The approach is applied to three different public COVID-19 data sets, achieving high accuracy levels in detecting COVID-19 from CT and X-ray images.	The proposed model achieves an accuracy of 89.41% for dataset-1 (CT), 99.02% for dataset-2 (X-ray), and 98.11% for dataset-3 (CT). In the X-ray data set, an accuracy of 85.96% is obtained for COVID-19 (+), COVID-19 (-), and those with Pneumonia but not COVID-19 classes. The study shows that COVID-19 can be detected with a high success rate in less than one minute using image processing and classical learning methods.	One of the challenges in detecting COVID-19 from CT and X-ray images is the similarity of disease findings to other lung infections, making it difficult for medical professionals to distinguish COVID-19. The study addresses this challenge by developing computer-aided diagnostic solutions using machine learning methods. Another challenge is the high false-negative rate and delays in test results of the Reverse Transcription Polymerase Chain Reaction (RT-PCR) test, which is currently used as a gold standard in detecting the virus.
[11]	The paper proposes the use of deep learning models (MobileNetV2 and Squeeze Net) to train a stacked dataset of chest X-ray images. The dataset is pre-processed using the Fuzzy Color technique and the images are structured using the stacking technique. The feature sets obtained from the models are then processed using the Social Mimic optimization method.	The overall classification rate achieved with the proposed approach is 99.27%. The SqueezeNet model achieves a classification rate of 97.81% for normal and pneumonia images, while the MobileNetV2 model achieves a classification rate of 98.54%. When the feature sets obtained from both models are combined, the overall classification rate increases to 99.27%.	One of the challenges mentioned in the paper is the limited availability of COVID-19 images for training and testing. Another challenge is dealing with low-resolution images, as the proposed approach may not achieve complete success in such cases. The resolution dimensions of the original and structured images must also be the same for the stacking technique to work effectively. Despite these challenges, the proposed approach achieves a high classification accuracy of 99.27%.
[12]	The proposed model consists of three components: a backbone network, a classification head, and an anomaly detection head. The backbone network extracts high-level features from the input chest X-ray image. The classification head generates a classification score. The model is trained using stochastic gradient descent (SGD) algorithm with data augmentation strategies.	Parameters: The model's performance is evaluated using 100 chest X-ray images of COVID-19 patients and 1431 chest X-ray images of non-COVID-19 pneumonia cases. The model achieved a sensitivity of 96.00% and specificity of 70.65% when evaluated on a dataset of 1531 X-ray images.	The model's performance is evaluated using 100 chest X-ray images of COVID-19 patients and 1431 chest X-ray images of non-COVID-19 pneumonia cases. The model achieved a sensitivity of 96.00% and specificity of 70.65% when evaluated on a dataset of 1531 X-ray images.

[13]	The authors utilized deep convolutional neural networks, specifically the CheXNet model, for detecting COVID-19 in frontal chest X-ray images. They collected a large dataset of chest X-ray images from multiple sources and prepared it for training the model. The CheXNet model was fine-tuned on this dataset using the transfer learning paradigm to develop COVID-CXNet, which is capable of detecting COVID-19 pneumonia based on relevant and meaningful features.	The COVID-CXNet model has 431 layers and approximately 7 million parameters. It is based on the DenseNet-121 architecture, which has shown better capabilities for this task compared to other architectures used in the literature.	One of the challenges mentioned in the paper is the lack of robustness in existing models, mainly due to the insufficient number of images available for training. The authors also highlight the challenges associated with using CT scans for COVID-19 diagnosis, such as the non-portability of CT scanners, higher radiation dose compared to X-rays, and the need for sanitizing equipment and imaging rooms between patients. They emphasize the advantages of using portable X-ray units, which are widely available and can be easily accessed in most primary hospitals.
[14]	The paper proposes two deep learning-based methods, DNN and CNN, for the diagnosis and detection of COVID-19 in patients using lung x-ray images. The DNN method utilizes fractal features of the images, while the CNN method directly uses the lung images. The CNN architecture is also used for the segmentation of infected tissue in lung images.	The parameters used in the CNN architecture include 11 layers with three convolutional layers. The input images are 256x256 grayscale CT scan images of COVID-19 patients' lungs, and the output layer includes the ground truth of the input images. The infected tissue is labeled by 255, while other points are shown with zero numbers.	The paper highlights the challenges in detecting the infected region of lung images using a brain-computer interface. It also mentions the need for deep learning methods to handle segmentation of regions with different colors. The lack of availability of large datasets and the complex nature of the testing mechanism for COVID-19 diagnosis are also mentioned as challenges addressed in the paper.
[15]	The paper discusses various deep learning models and techniques used for COVID-19 detection, such as iCOVIDX-Net, CNN, fusion models, SqueezeNet, Q-deformed entropy algorithm, and GAN deep transfer learning. These methods utilize CT scans and X-ray images to accurately detect COVID-19 infections.	Parameters: The paper mentions the use of AUC (Area Under Curve) as a common benchmarking dataset for evaluating the performance of COVID-19 detection models. It also discusses F1-scores as a measure of accuracy for specific models.	Challenges: The paper highlights the challenges faced in the growth of COVID-19 and the need for data scientists to predict possible issues. It emphasizes the lack of COVID-19 datasets, especially in X-ray chest images, and the need for more data to improve the precision of virus identification. Additionally, the paper mentions the challenges of managing healthcare resources, remote patient treatment, well-informed policies, handling uncertainty, and conducting acceptable clinical trials in the fight against COVID-19.

[16]	The paper describes the use of a human-machine collaborative design strategy to create COVID-Net, combining human-driven network design prototyping with machine-driven design exploration. It introduces a novel deep neural network architecture that incorporates a lightweight projection-expansion-projection-extension (PEPX) design, enhancing representational capacity while reducing computational complexity. The paper also discusses the creation of the COVIDx dataset, which combines and modifies publicly available data repositories to provide a large dataset for training and evaluating COVID-Net.	Parameters: The paper does not explicitly mention specific parameters used in COVID Net or the COVIDx dataset. However, it highlights the use of deep convolutional neural networks and the architecture design methodology behind COVID Net.	Challenges: The paper acknowledges that COVID Net and the COVIDx dataset are continuously evolving as new patient cases are added. It emphasizes the need for transparency and explainability in the decision-making process of COVID Net, aiming to provide clinicians with deeper insights into critical factors associated with COVID cases. The paper also mentions the importance of improving sensitivity and positive predictive value (PPV) to COVID-19 infections and suggests future directions for risk stratification and individualized care planning.
[17]	The paper proposes a novel fusion of features extracted by histogram-oriented gradient (HOG) and convolutional neural network (CNN) for COVID-19 detection from chest X-ray images. It also applies a modified anisotropic diffusion filtering (MADF) technique to eliminate multiplicative speckle noise and uses the watershed segmentation technique to identify fractured lung regions as evidence of COVID-19 attacked lungs.	The paper does not explicitly mention the specific parameters used in the proposed methods.	The paper highlights the challenges of data imbalance and the lack of necessary extracted features from chest X-ray images, which can affect the accuracy of the classification results. The proposed method aims to overcome these challenges by incorporating feature fusion and deep learning techniques.
[18]	The paper proposes the use of deep learning algorithms, specifically convolutional neural networks (CNN), for the accurate classification of COVID-19 disease in X-ray images. The proposed model leverages accurate classification based on medical images and utilizes edge-based neural networks for performance evaluation. The research work also includes the analysis of 10-fold cross-validation with confusion metrics to detect various lung infections caused by diseases such as Pneumonia corona virus-positive or negative.	The paper does not explicitly mention the specific parameters used in the proposed classification model. However, it mentions the use of COVID-19 thoracic X-rays and the histogram-oriented gradients (HOG) feature extraction methodology as inputs for the classification model.	The paper highlights the challenge of detecting viral patterns in COVID-19 thoracic X-rays using existing detection methods. It emphasizes the importance of developing accurate classification methods to address this challenge. Additionally, the paper mentions that the accuracy of tertiary classification with CNN may decrease when there is an increasing number of a class in the training network.

[19]	The paper proposes a preprocessing algorithm that involves two steps: removing diaphragm regions and applying histogram equalization and a bilateral low-pass filter to the original image. The processed image, along with two filtered images, is used to create a pseudo color image. This pseudo color image is then fed into a transfer learning-based CNN model for classification.	The study uses a publicly available dataset of 8474 chest X-ray images, which includes 415 COVID-19 infected pneumonia cases, 5179 other community-acquired non-COVID-19 infected pneumonia cases, and 2880 normal (non-pneumonia) cases. The dataset is randomly divided into training, validation, and testing subsets. The CNN model achieves an overall accuracy of 94.5% in classifying the images.	One of the challenges mentioned in the paper is the unbalanced nature of the dataset, with a small number of COVID-19 infected pneumonia cases. To address this, the authors apply a class weight technique during the training process and use a transfer learning approach with a well-trained VGG16 model. Another challenge is the need for image pre-processing and segmentation algorithms to remove irrelevant regions and enhance the performance and robustness of the deep learning models. The paper suggests that further research is needed to overcome these limitations.
[20]	The proposed method consists of three components: extraction of deep features, an augmentation-based learning module, and a BiLSTM based classification. The deep features are extracted using a CNN, and the augmentation mechanism generates low-dimensional augmented features. The BiLSTM is then used to classify the processed sequential information.	Parameters: The paper does not explicitly mention the specific parameters used in the proposed method.	Challenges: The paper highlights the challenges of limited representative X-ray images available in public benchmark datasets, which limits the performance of existing methods. The proposed self-augmentation mechanism aims to address this challenge by generating augmented features in the feature space.

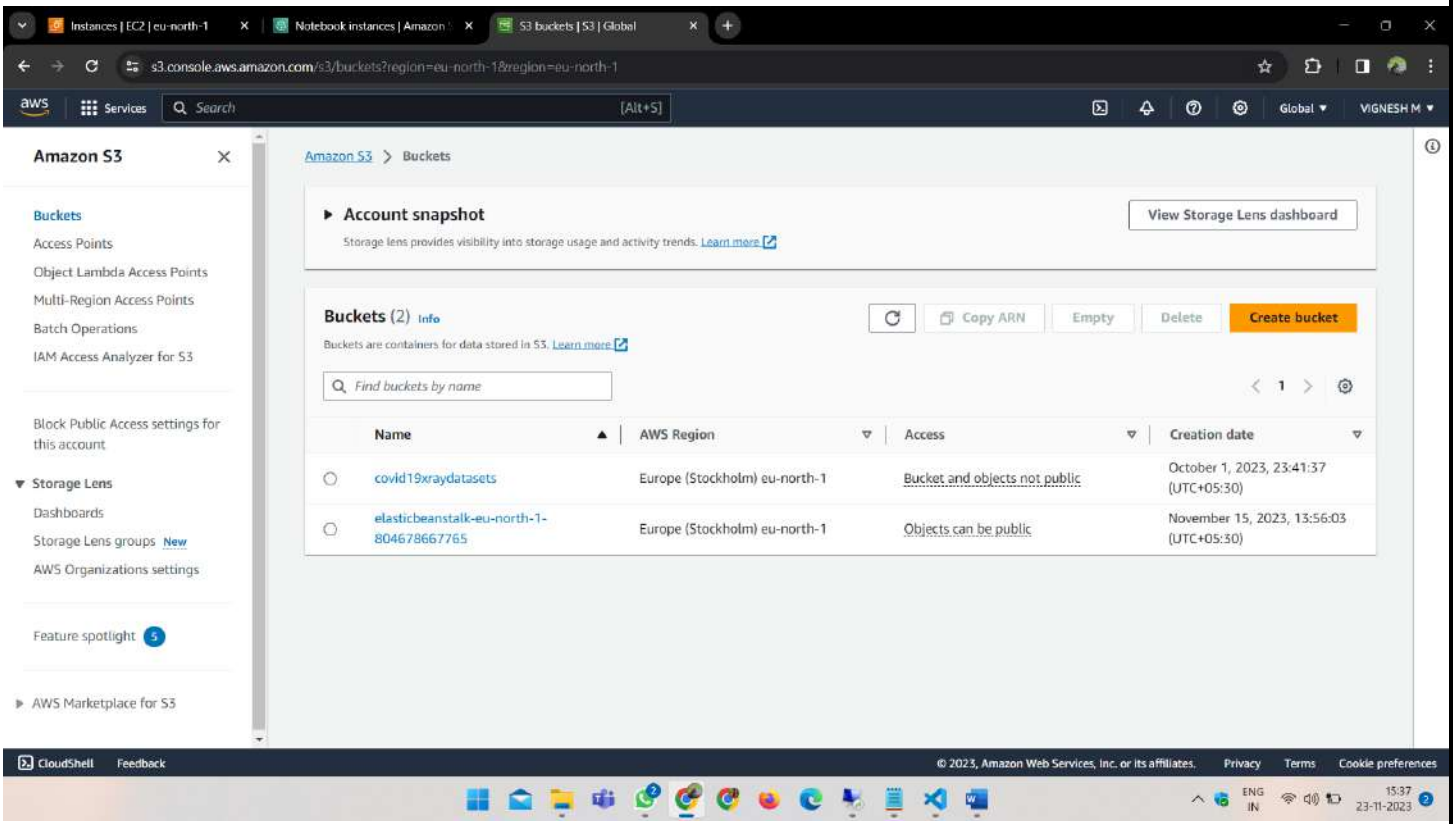
6. ARCHITECTURE DIAGRAM:

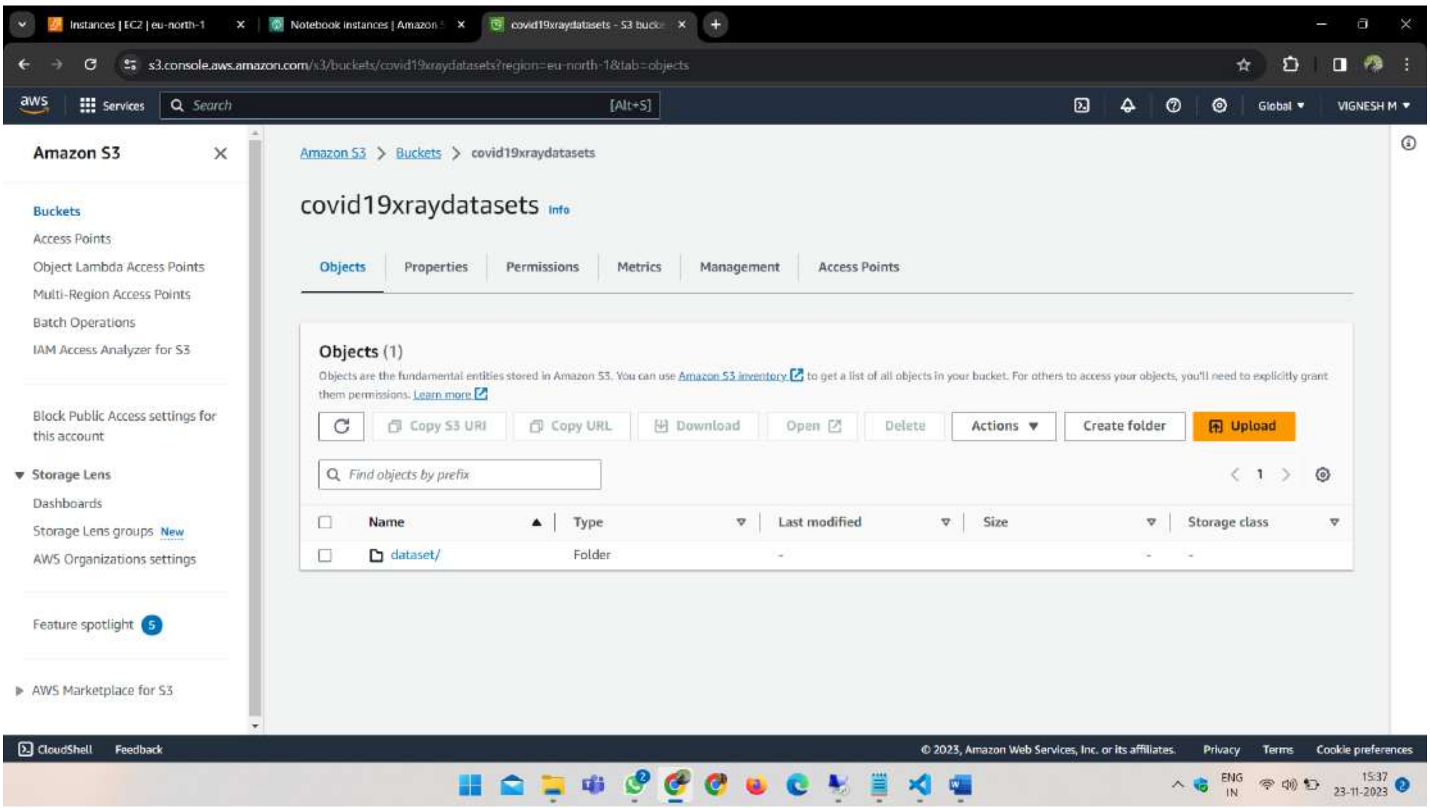


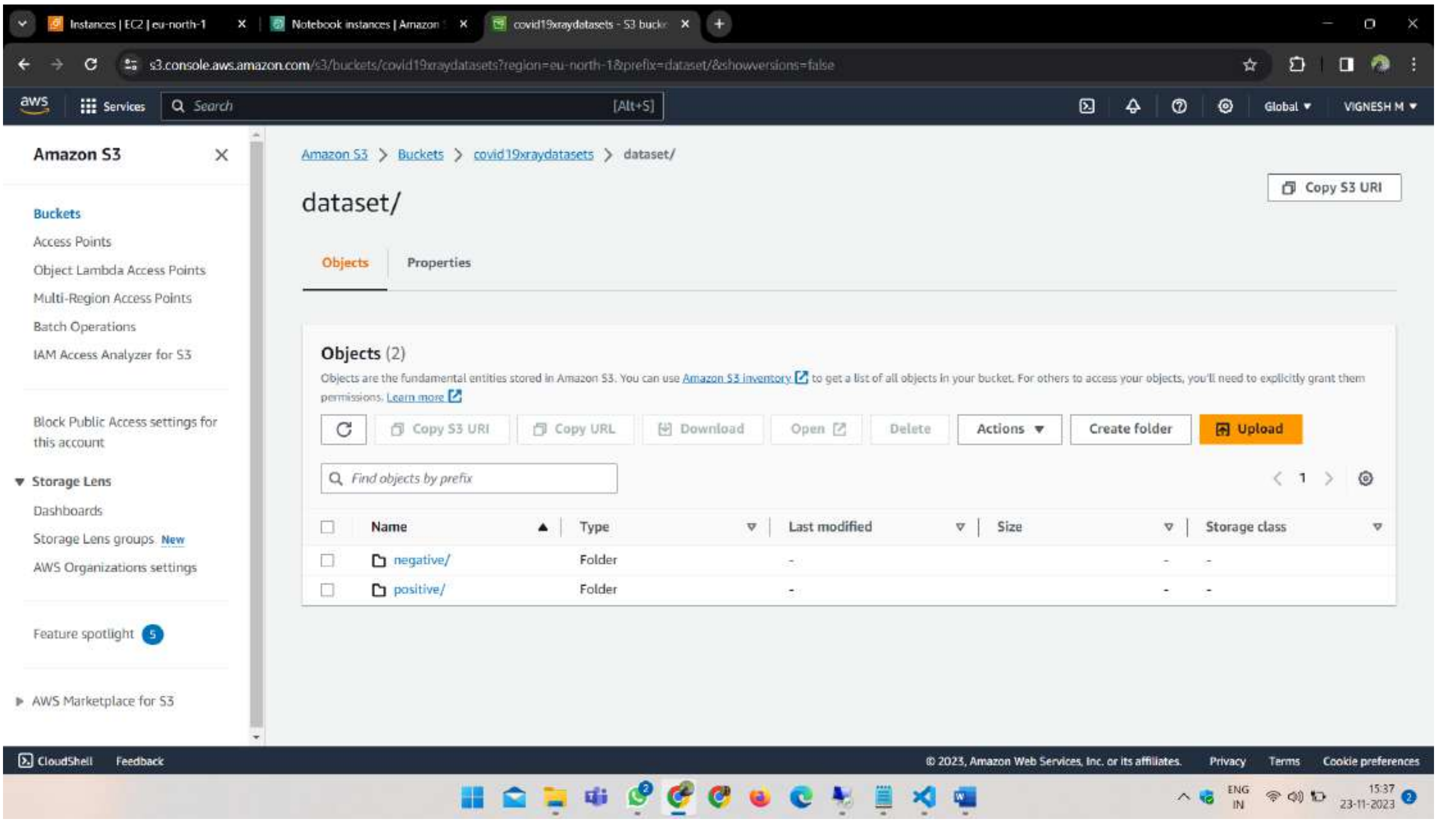
7. IMPLEMENTATION SCREENSHOTS:

7.1. DATASET STORED IN S3 BUCKET:

DATASET NAME: COVIDXRAYDATASETS:







Instances | EC2 | eu-north-1
Notebook instances | Amazon
covid19xraydatasets - S3 bucket
s3.console.aws.amazon.com/s3/buckets/covid19xraydatasets?region=eu-north-1&prefix=dataset/&showversions=false
Services
Search
[Alt+S]
Global
VIGNESH M
Amazon S3
Buckets
Access Points
Object Lambda Access Points
Multi-Region Access Points
Batch Operations
IAM Access Analyzer for S3
Block Public Access settings for this account
Storage Lens
Dashboards
Storage Lens groups New
AWS Organizations settings
Feature spotlight 5
AWS Marketplace for S3
Amazon S3 > Buckets > covid19xraydatasets > dataset/
dataset/
Copy S3 URI
Objects
Properties
Objects (2)
Objects are the fundamental entities stored in Amazon S3. You can use Amazon S3 inventory to get a list of all objects in your bucket. For others to access your objects, you'll need to explicitly grant them permissions. Learn more
Copy S3 URI
Copy URL
Download
Open
Delete
Actions
Create folder
Upload
Find objects by prefix
Name
Type
Last modified
Size
Storage class
negative/
Folder
positive/
Folder
CloudShell
Feedback
© 2023, Amazon Web Services, Inc. or its affiliates.
Privacy
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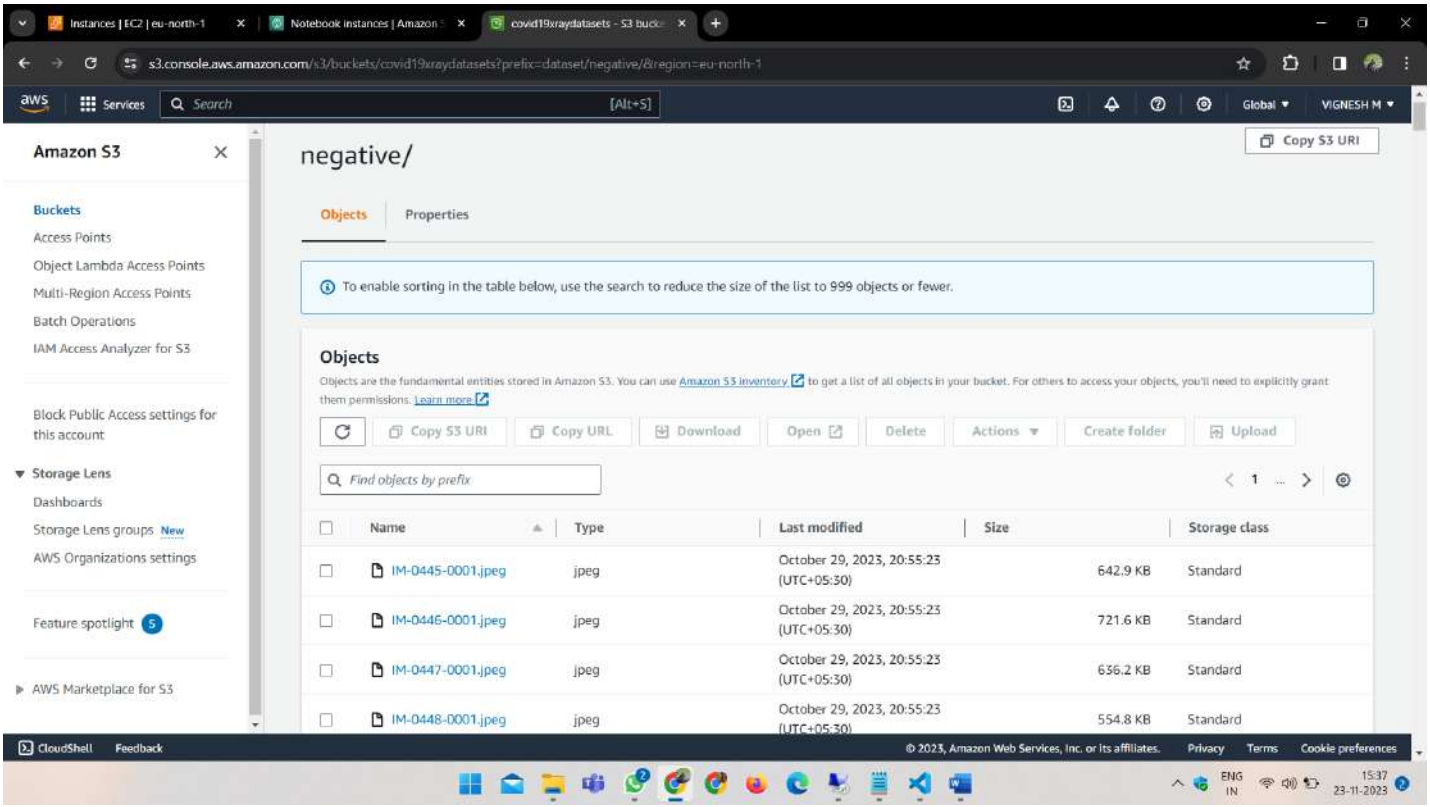

Instances | EC2 | eu-north-1
Notebook instances | Amazon
covid19xraydatasets - S3 bucket
s3.console.aws.amazon.com/s3/buckets/covid19xraydatasets?prefix=dataset/negative/&region=eu-north-1
Services
Search
[Alt+S]
Global
VIGNESH M
Amazon S3
Buckets
Access Points
Object Lambda Access Points
Multi-Region Access Points
Batch Operations
IAM Access Analyzer for S3
Block Public Access settings for this account
Storage Lens
Dashboards
Storage Lens groups New
AWS Organizations settings
Feature spotlight 5
AWS Marketplace for S3
negative/
Copy S3 URI
Objects
Properties
To enable sorting in the table below, use the search to reduce the size of the list to 999 objects or fewer.
Objects
Objects are the fundamental entities stored in Amazon S3. You can use Amazon S3 inventory to get a list of all objects in your bucket. For others to access your objects, you'll need to explicitly grant them permissions. Learn more
Copy S3 URI
Copy URL
Download
Open
Delete
Actions
Create folder
Upload
Find objects by prefix
Name
Type
Last modified
Size
Storage class
IM-0445-0001.jpeg
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October 29, 2023, 20:55:23 (UTC+05:30)
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CloudShell
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© 2023, Amazon Web Services, Inc. or its affiliates.
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Terms
Cookie preferences
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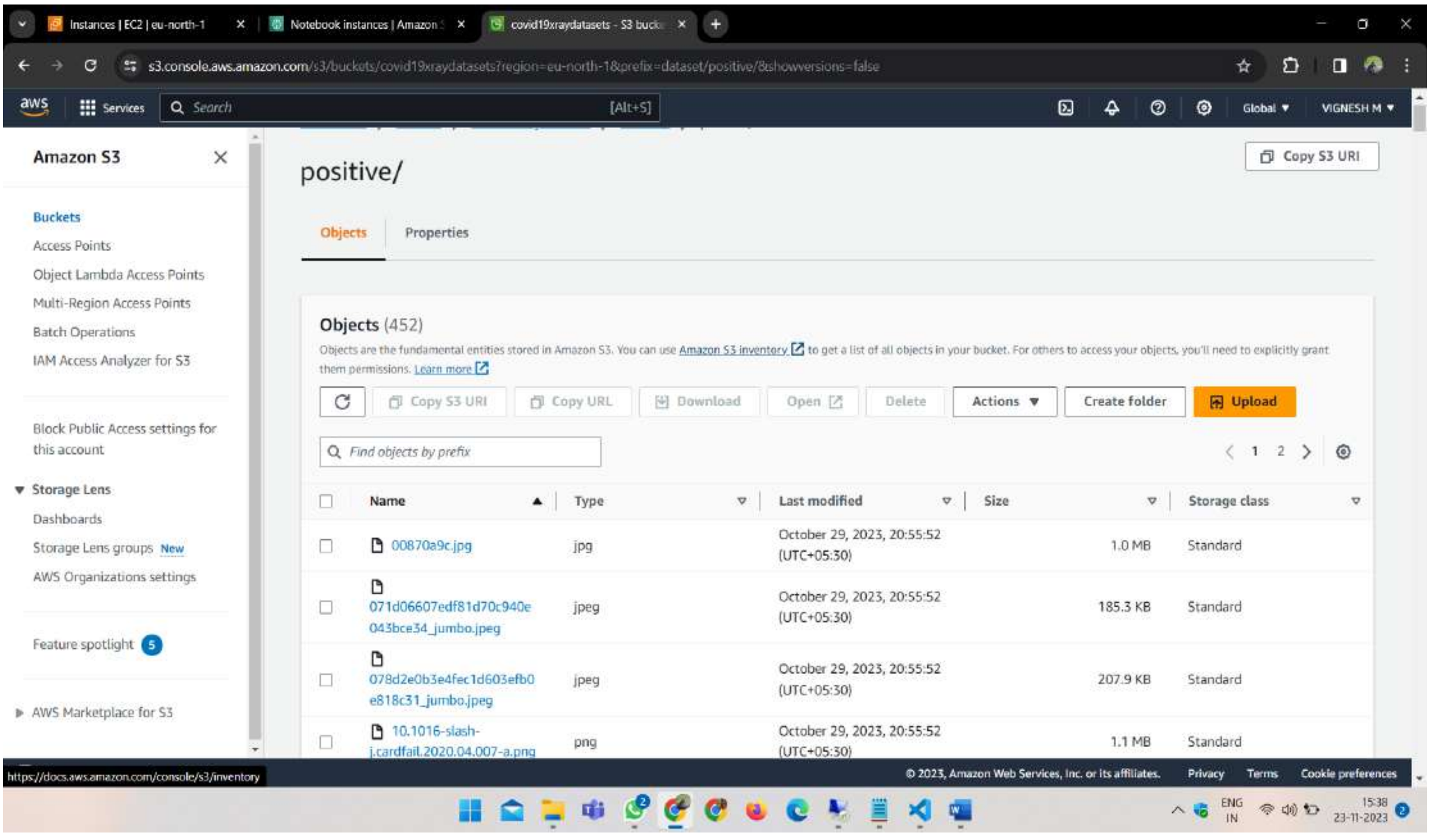
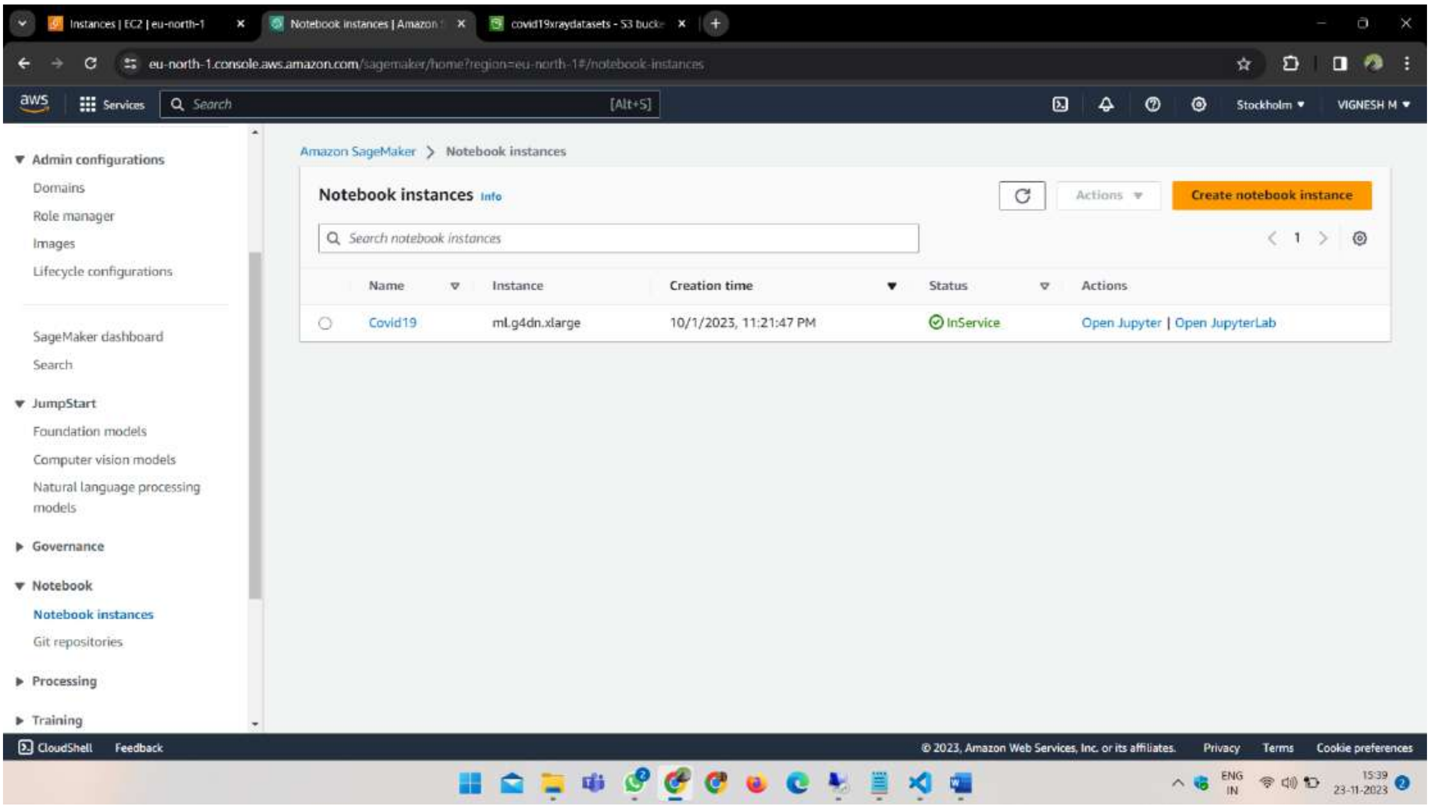
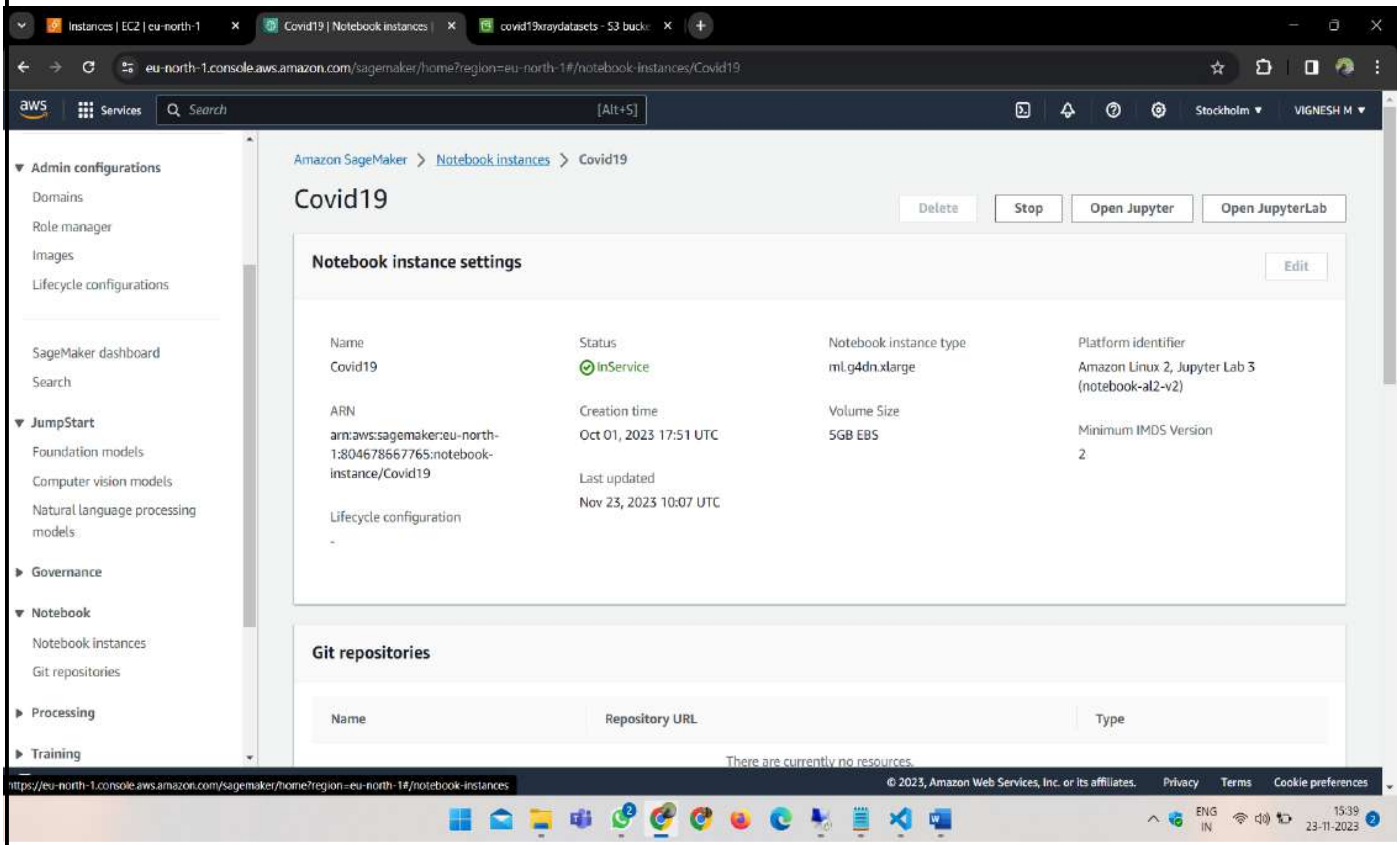


7.2. BUILD MODEL IN AMAZON SAGEMAKER:

CREATING JUPYTER NOTEBOOK INSTANCES IN SAGEMAKER:




Instances | EC2 | eu-north-1
Covid19 | Notebook instances
covid19xraydatasets - S3 bucke
eu-north-1.console.aws.amazon.com/sagemaker/home?region=eu-north-1#/notebook-instances/Covid19
Services
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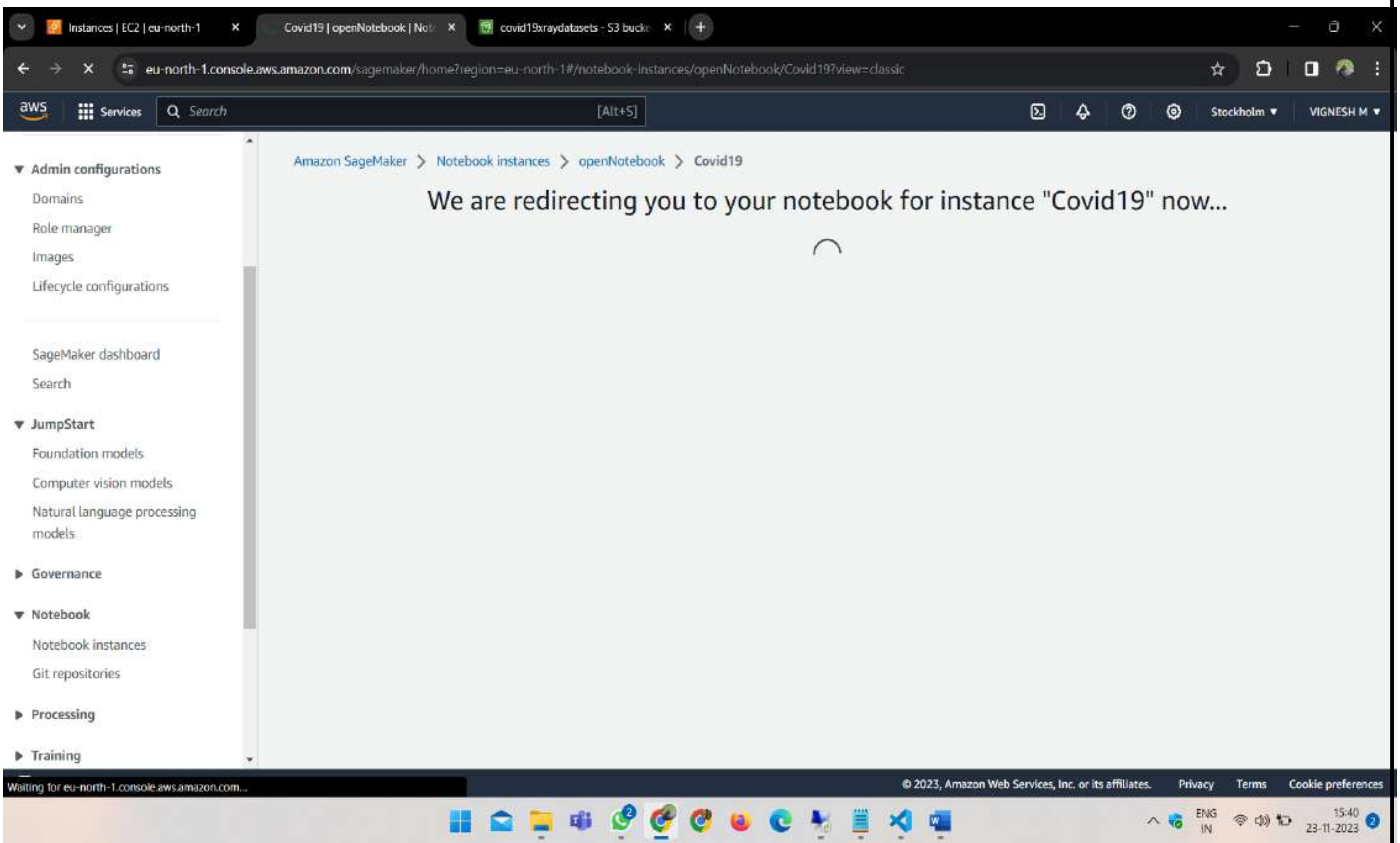
Role manager
Images
Lifecycle configurations
SageMaker dashboard
Search
JumpStart
Foundation models
Computer vision models
Natural language processing models
Governance
Notebook
Notebook instances
Git repositories
Processing
Training
Amazon SageMaker > Notebook instances > Covid19
Covid19
Delete
Stop
Open Jupyter
Open JupyterLab
Notebook instance settings
Edit
Name
Covid19
Status
InService
Notebook instance type
ml.g4dn.xlarge
Platform identifier
Amazon Linux 2, Jupyter Lab 3 (notebook-al2-v2)
ARN
arn:aws:sagemaker:eu-north-1:804678667765:notebook-instance/Covid19
Creation time
Oct 01, 2023 17:51 UTC
Volume Size
5GB EBS
Minimum IMDS Version
2
Last updated
Nov 23, 2023 10:07 UTC
Lifecycle configuration
-
Git repositories
Name
Repository URL
Type
There are currently no resources.
https://eu-north-1.console.aws.amazon.com/sagemaker/home?region=eu-north-1#/notebook-instances
© 2023, Amazon Web Services, Inc. or its affiliates.
Privacy
Terms
Cookie preferences
15:39
23-11-2023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Services
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Admin configurations
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Role manager
Images
Lifecycle configurations
SageMaker dashboard
Search
JumpStart
Foundation models
Computer vision models
Natural language processing models
Governance
Notebook
Notebook instances
Git repositories
Processing
Training
Amazon SageMaker > Notebook instances > openNotebook > Covid19
We are redirecting you to your notebook for instance "Covid19" now...
Waiting for eu-north-1.console.aws.amazon.com...
© 2023, Amazon Web Services, Inc. or its affiliates.
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Cookie preferences
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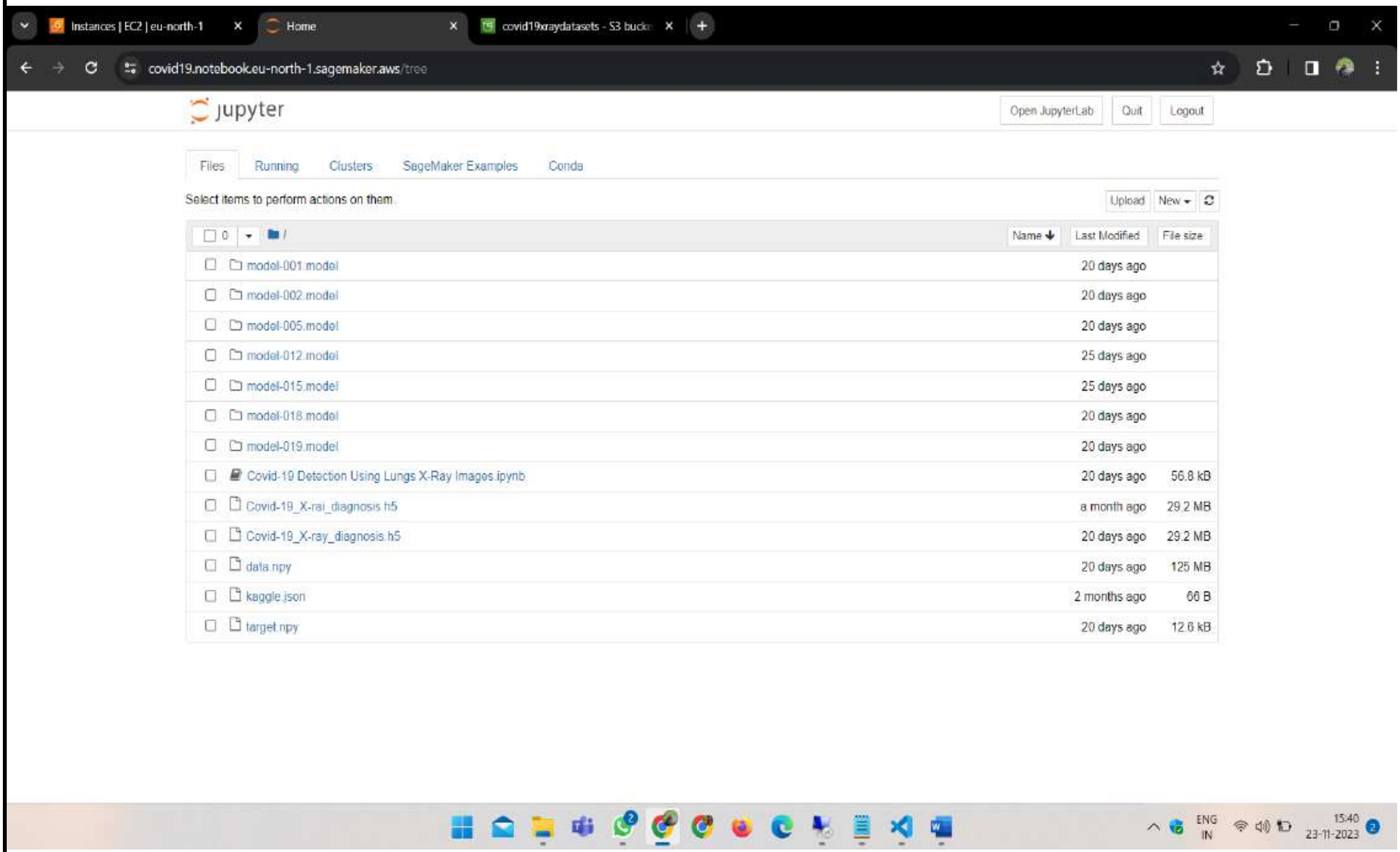
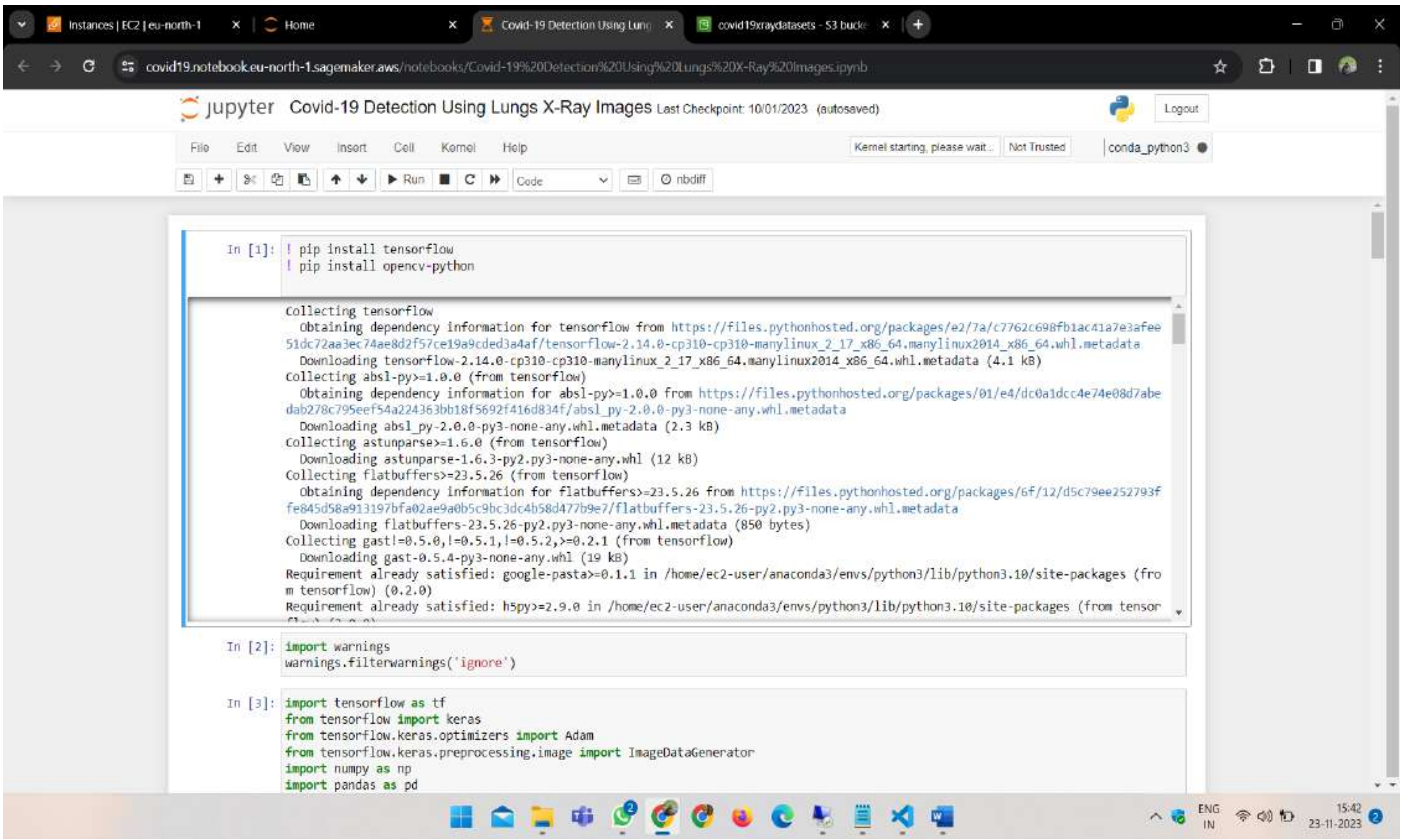
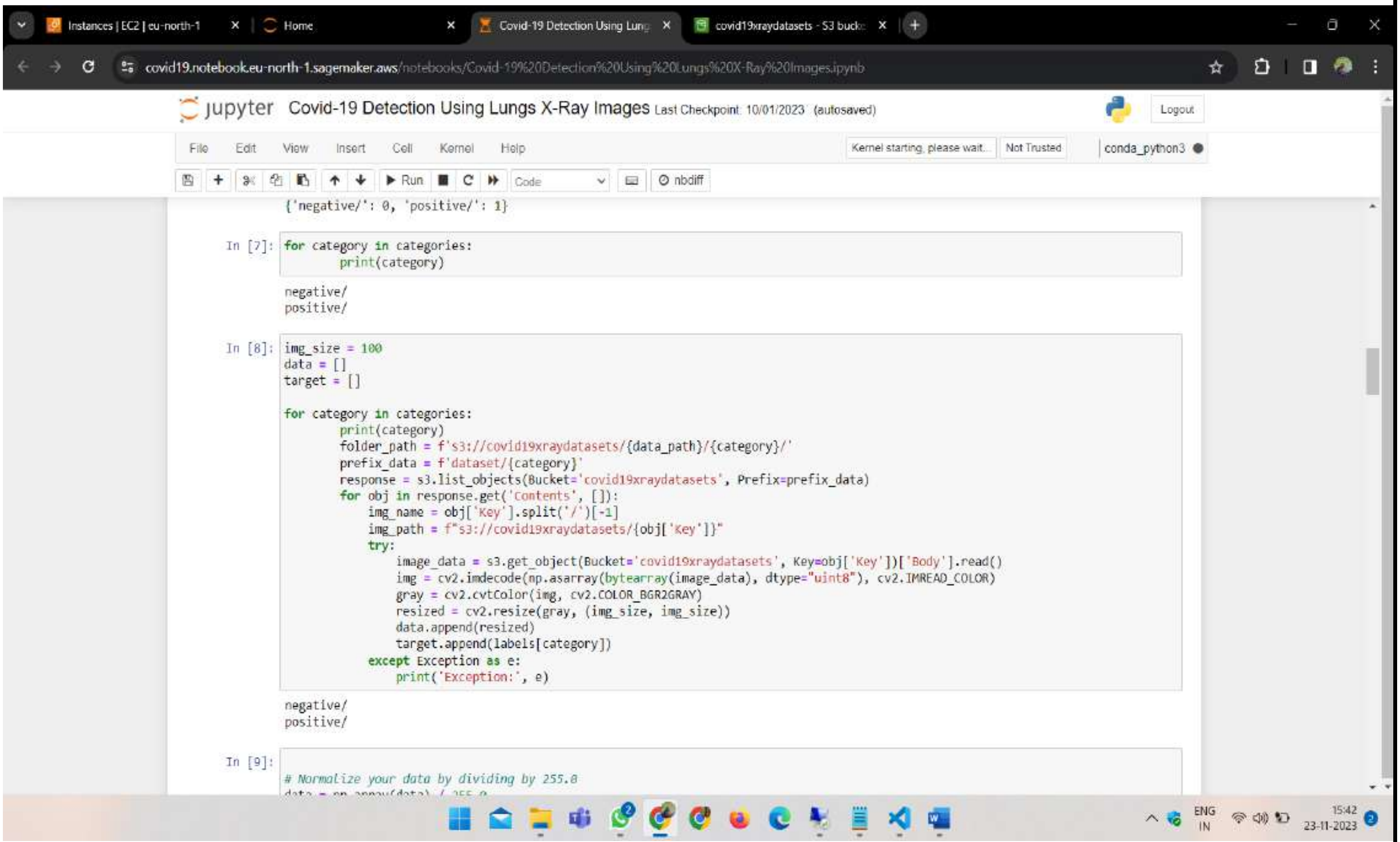
23-11-2023

JUPYTER NOTEBOOK IN SAGEMAKER:

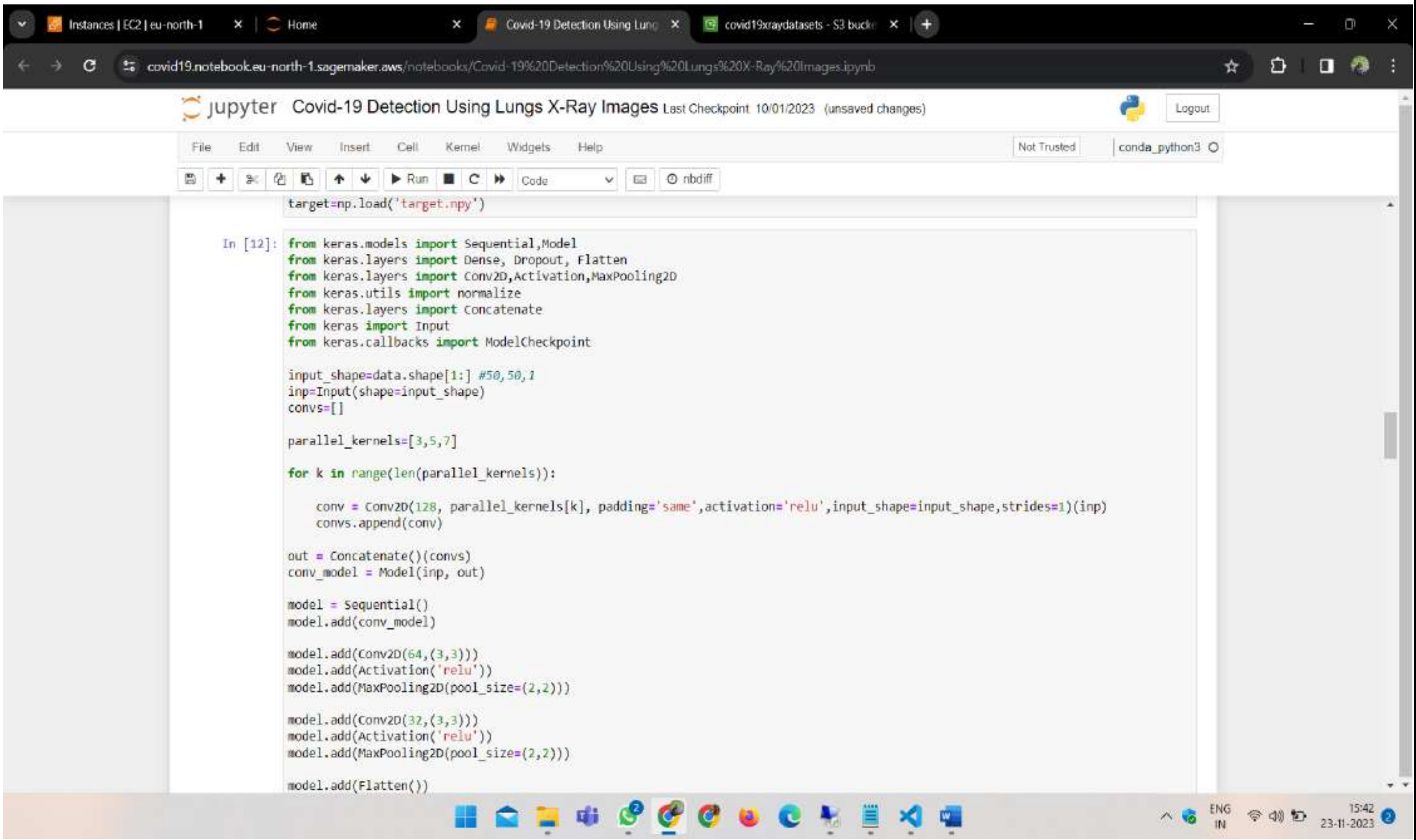




PREPROCESSING STEP:



BUILDING A CNN MODEL:

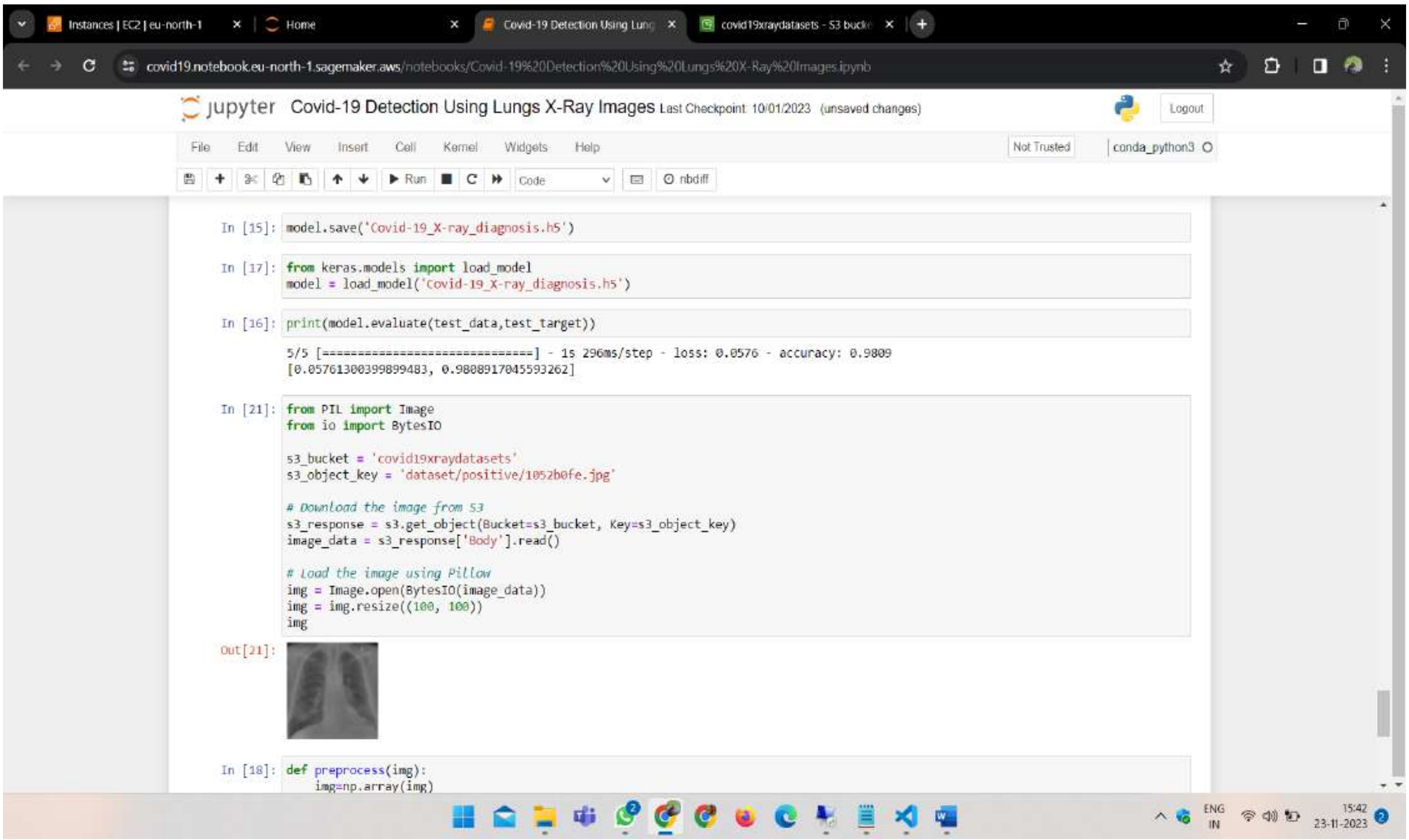


Covid-19 Detection Using Lungs X-Ray Images Last Checkpoint: 10/01/2023 (unsaved changes)

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 model (Functional)          (None, 100, 100, 384)     11008

 conv2d_3 (Conv2D)           (None, 98, 98, 64)        221248

 activation (Activation)     (None, 98, 98, 64)        0

 max_pooling2d (MaxPooling2  (None, 49, 49, 64)        0
 D)

 conv2d_4 (Conv2D)           (None, 47, 47, 32)        18464

 activation_1 (Activation)   (None, 47, 47, 32)        0

 max_pooling2d_1 (MaxPoolin  (None, 23, 23, 32)        0
 g2D)

 flatten (Flatten)           (None, 16928)             0

 dropout (Dropout)           (None, 16928)             0

 dense (Dense)               (None, 128)               2166912

 dropout_1 (Dropout)         (None, 128)               0

 dense_1 (Dense)             (None, 64)                8256

 dropout_2 (Dropout)         (None, 64)                0

 dense_2 (Dense)             (None, 2)                 130

=================================================================
Total params: 2426018 (9.25 MB)
```

Covid-19 Detection Using Lungs X-Ray Images Last Checkpoint: 10/01/2023 (unsaved changes)

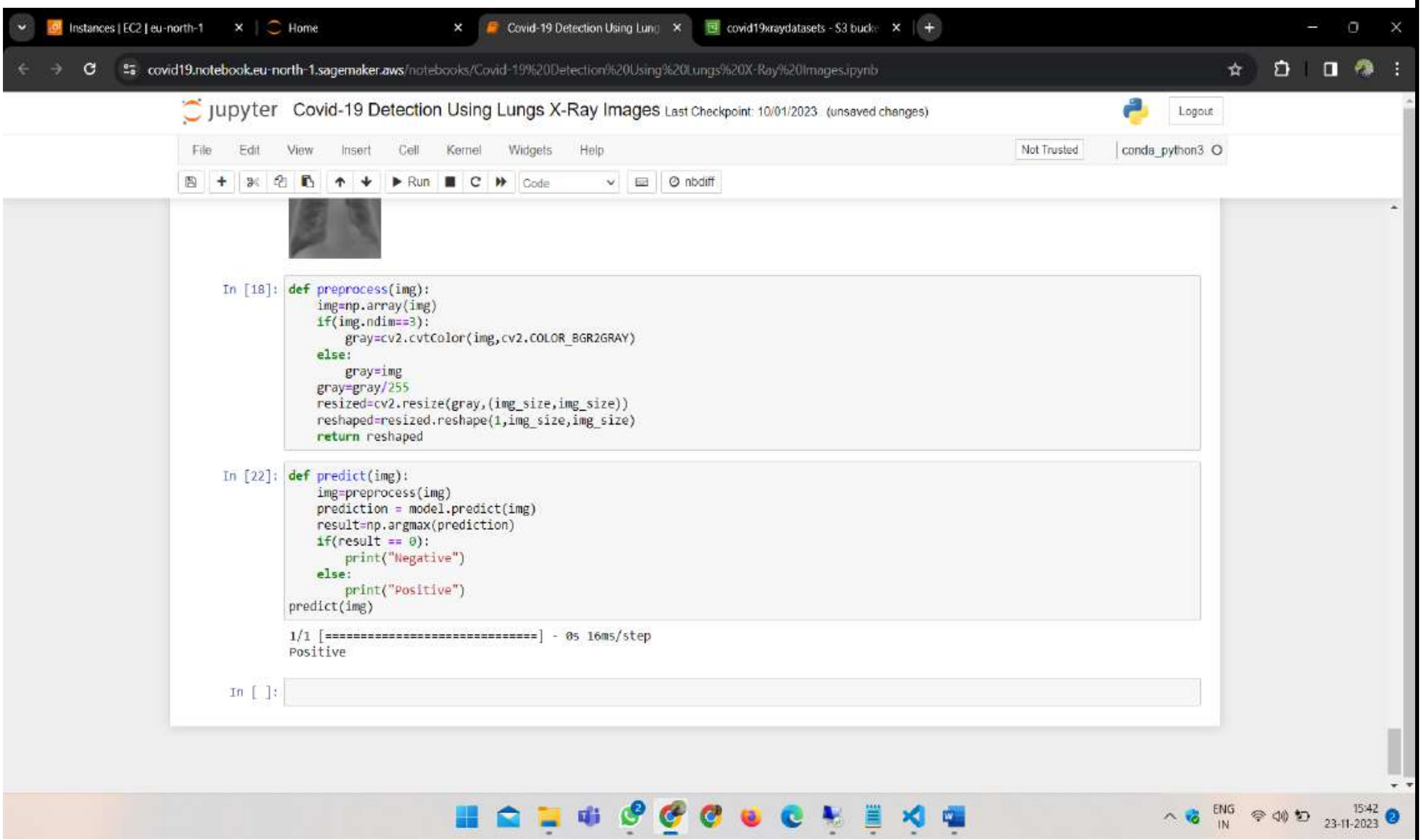
```
40/40 [==============================] - ETA: 0s - loss: 0.4483 - accuracy: 0.7874INFO:tensorflow:Assets written to: model-001.
model/assets
INFO:tensorflow:Assets written to: model-001.model/assets
40/40 [==============================] - 185s 212ms/step - loss: 0.4483 - accuracy: 0.7874 - val_loss: 0.1060 - val_accuracy:
0.9716
Epoch 2/20
40/40 [==============================] - ETA: 0s - loss: 0.1751 - accuracy: 0.9447INFO:tensorflow:Assets written to: model-002.
model/assets
INFO:tensorflow:Assets written to: model-002.model/assets
40/40 [==============================] - 5s 128ms/step - loss: 0.1751 - accuracy: 0.9447 - val_loss: 0.0624 - val_accuracy: 0.9
645
Epoch 3/20
40/40 [==============================] - 4s 96ms/step - loss: 0.1818 - accuracy: 0.9368 - val_loss: 0.0805 - val_accuracy: 0.97
16
Epoch 4/20
40/40 [==============================] - 4s 96ms/step - loss: 0.1191 - accuracy: 0.9652 - val_loss: 0.0676 - val_accuracy: 0.96
45
Epoch 5/20
40/40 [==============================] - ETA: 0s - loss: 0.0990 - accuracy: 0.9644INFO:tensorflow:Assets written to: model-005.
model/assets
INFO:tensorflow:Assets written to: model-005.model/assets
40/40 [==============================] - 5s 128ms/step - loss: 0.0990 - accuracy: 0.9644 - val_loss: 0.0561 - val_accuracy: 0.9
645
Epoch 6/20
40/40 [==============================] - 4s 96ms/step - loss: 0.0708 - accuracy: 0.9715 - val_loss: 0.0736 - val_accuracy: 0.95
74
Epoch 7/20
40/40 [==============================] - 4s 96ms/step - loss: 0.1636 - accuracy: 0.9573 - val_loss: 0.1227 - val_accuracy: 0.98
58
Epoch 8/20
40/40 [==============================] - 4s 96ms/step - loss: 0.1266 - accuracy: 0.9534 - val_loss: 0.0660 - val_accuracy: 0.97
```



Covid-19 Detection Using Lungs X-Ray Images Last Checkpoint: 10/01/2023 (unsaved changes)

```
In [15]: model.save('Covid-19_X-ray_diagnosis.h5')

In [17]: from keras.models import load_model
         model = load_model('Covid-19_X-ray_diagnosis.h5')

In [16]: print(model.evaluate(test_data,test_target))

5/5 [==============================] - 1s 296ms/step - loss: 0.0576 - accuracy: 0.9809
[0.05761300399899483, 0.9808917045593262]

In [21]: from PIL import Image
         from io import BytesIO

         s3_bucket = 'covid19xraydatasets'
         s3_object_key = 'dataset/positive/1052b0fe.jpg'

         # Download the image from S3
         s3_response = s3.get_object(Bucket=s3_bucket, Key=s3_object_key)
         image_data = s3_response['Body'].read()

         # Load the image using Pillow
         img = Image.open(BytesIO(image_data))
         img = img.resize((100, 100))
         img
Out[21]:

In [18]: def preprocess(img):
             img=np.array(img)
```

PREDICTING LUNGS X-RAY IMAGES:

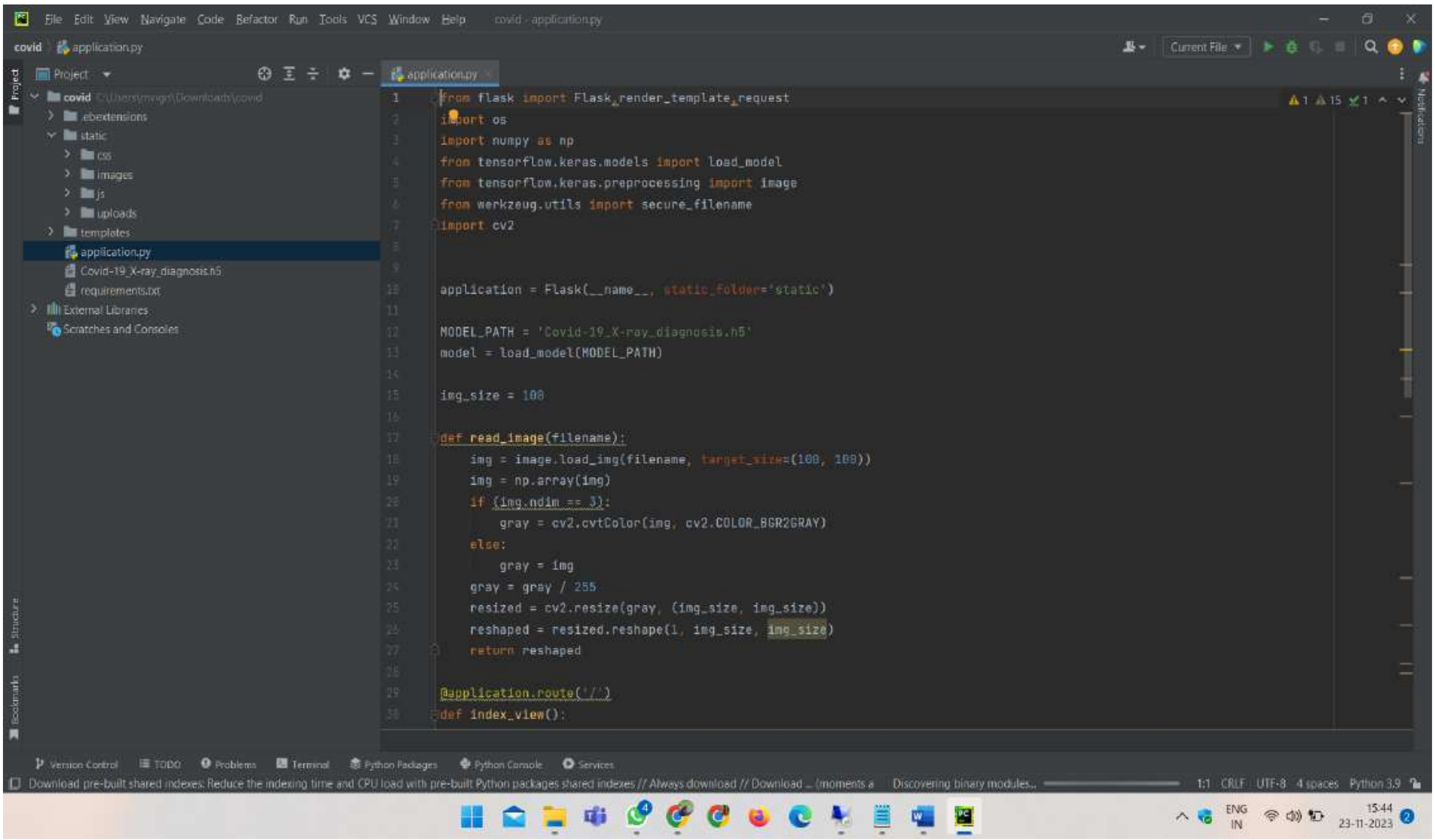


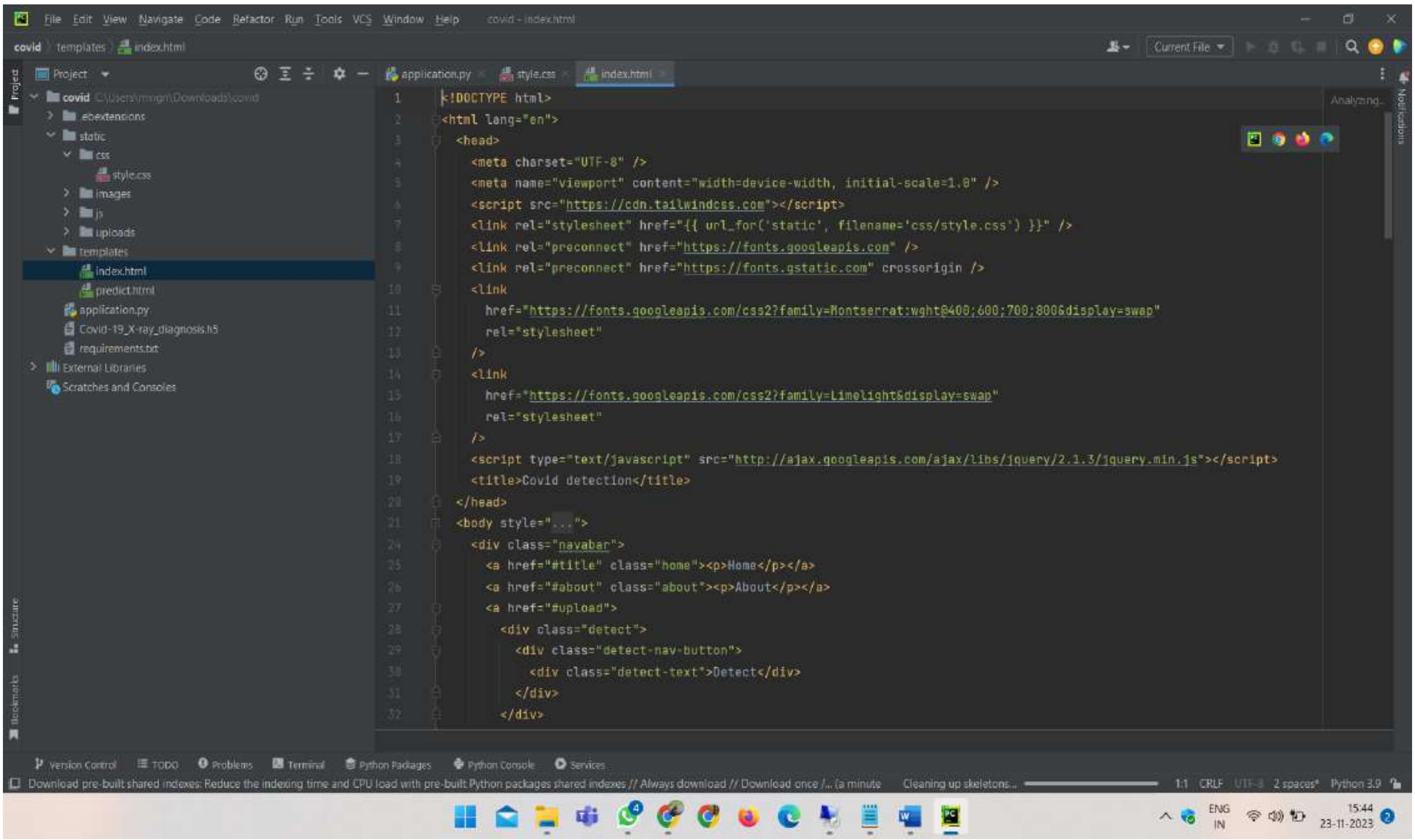
Covid-19 Detection Using Lungs X-Ray Images Last Checkpoint: 10/01/2023 (unsaved changes)

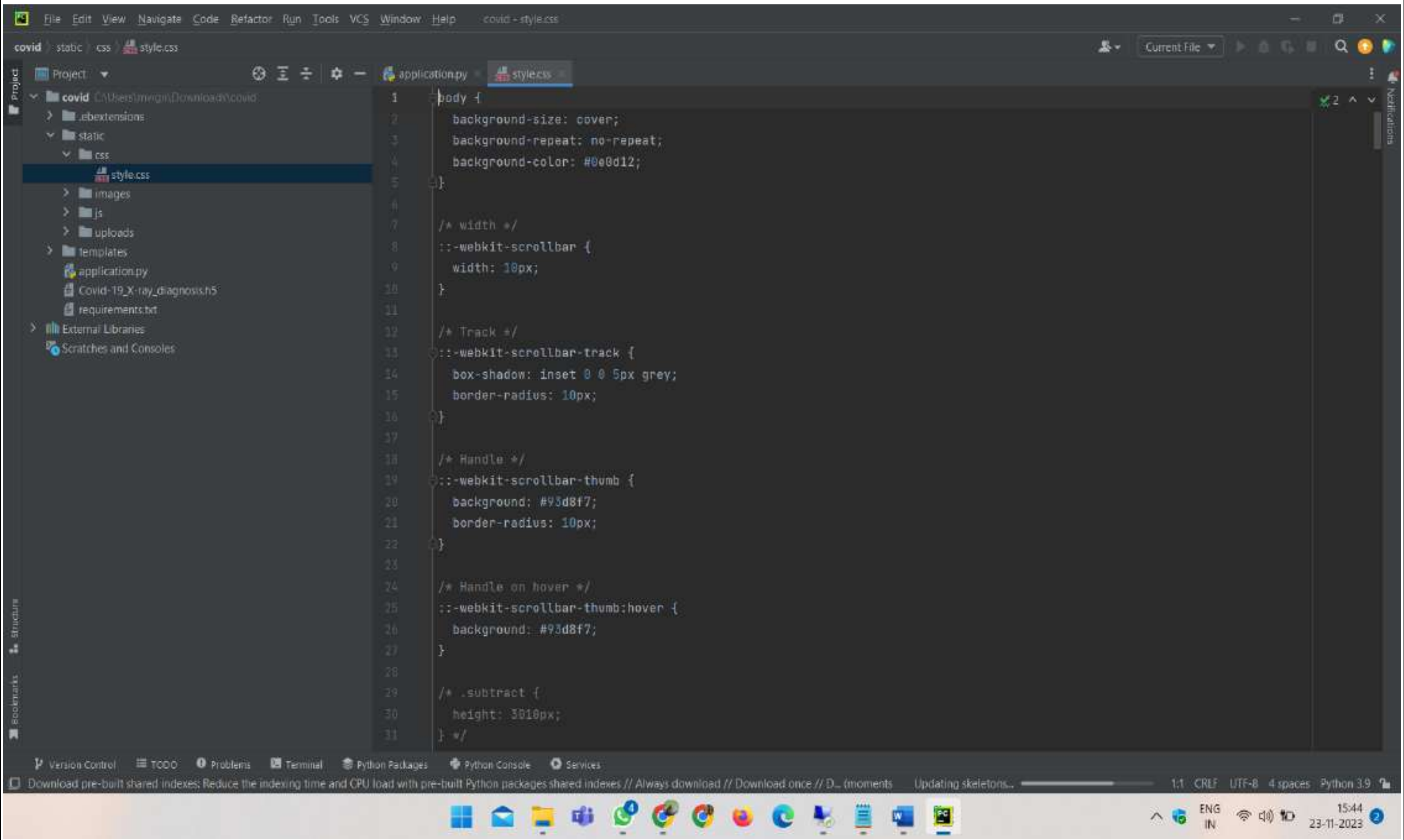
```
In [18]: def preprocess(img):
             img=np.array(img)
             if(img.ndim==3):
                 gray=cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)
             else:
                 gray=img
             gray=gray/255
             resized=cv2.resize(gray,(img_size,img_size))
             reshaped=resized.reshape(1,img_size,img_size)
             return reshaped

In [22]: def predict(img):
             img=preprocess(img)
             prediction = model.predict(img)
             result=np.argmax(prediction)
             if(result == 0):
                 print("Negative")
             else:
                 print("Positive")
         predict(img)

1/1 [==============================] - 0s 16ms/step
Positive

In [ ]:
```

7.3. BUILD A FLASK APPLICATION USING HTML, CSS:

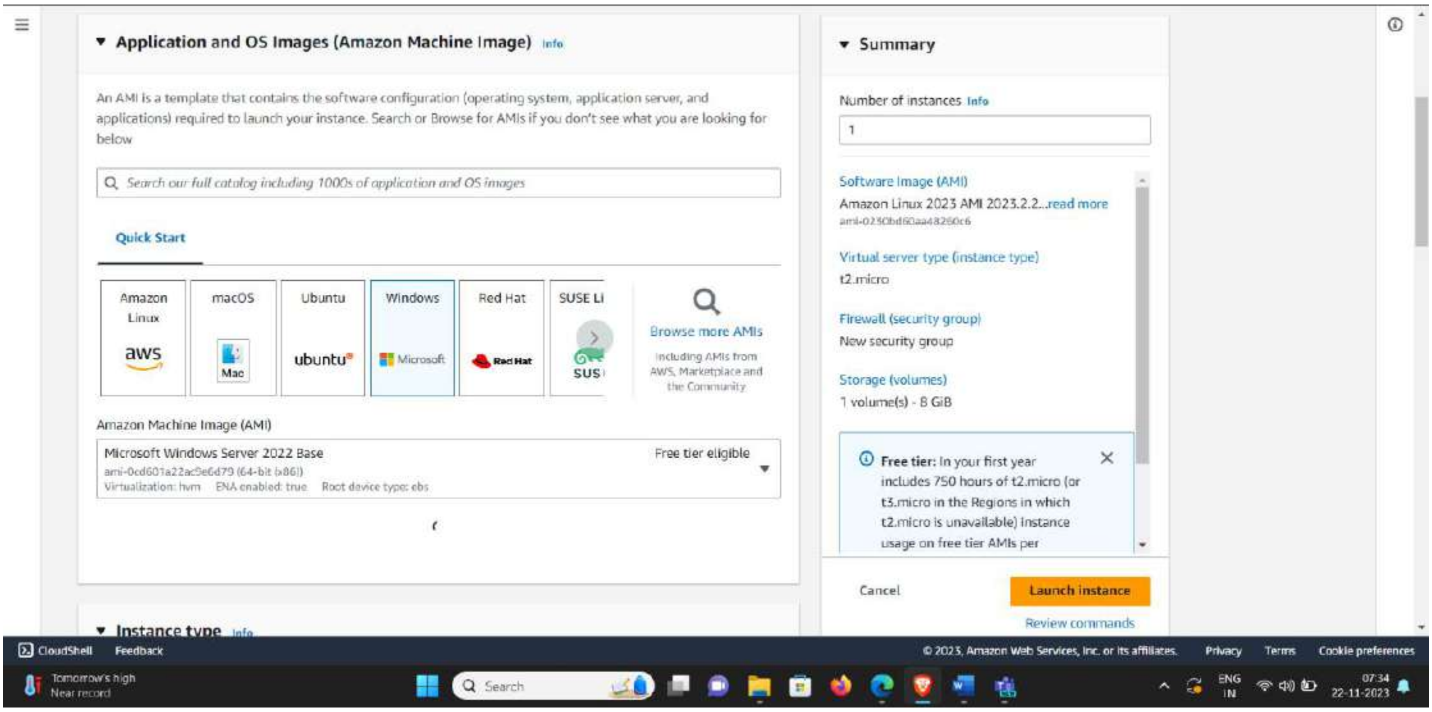
FLASK APPLICATION CODE:

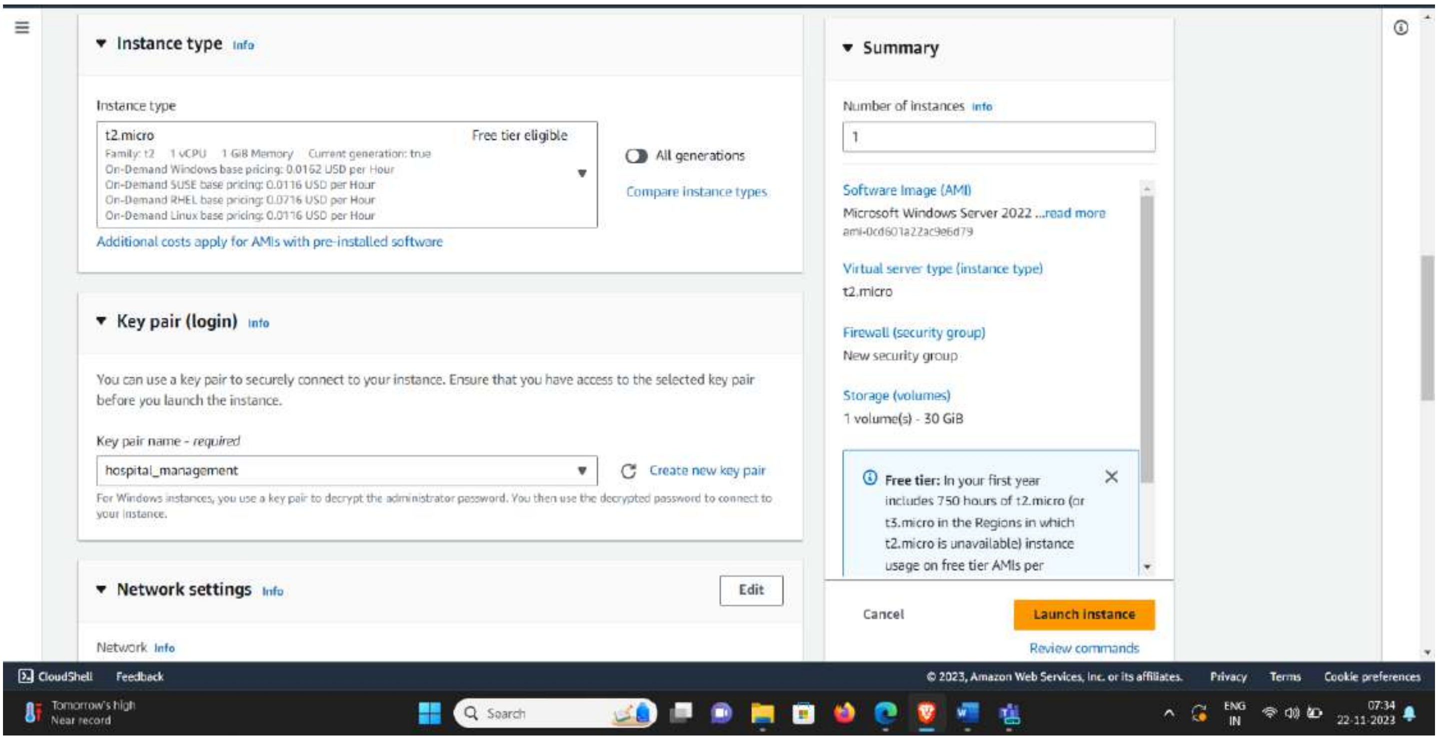


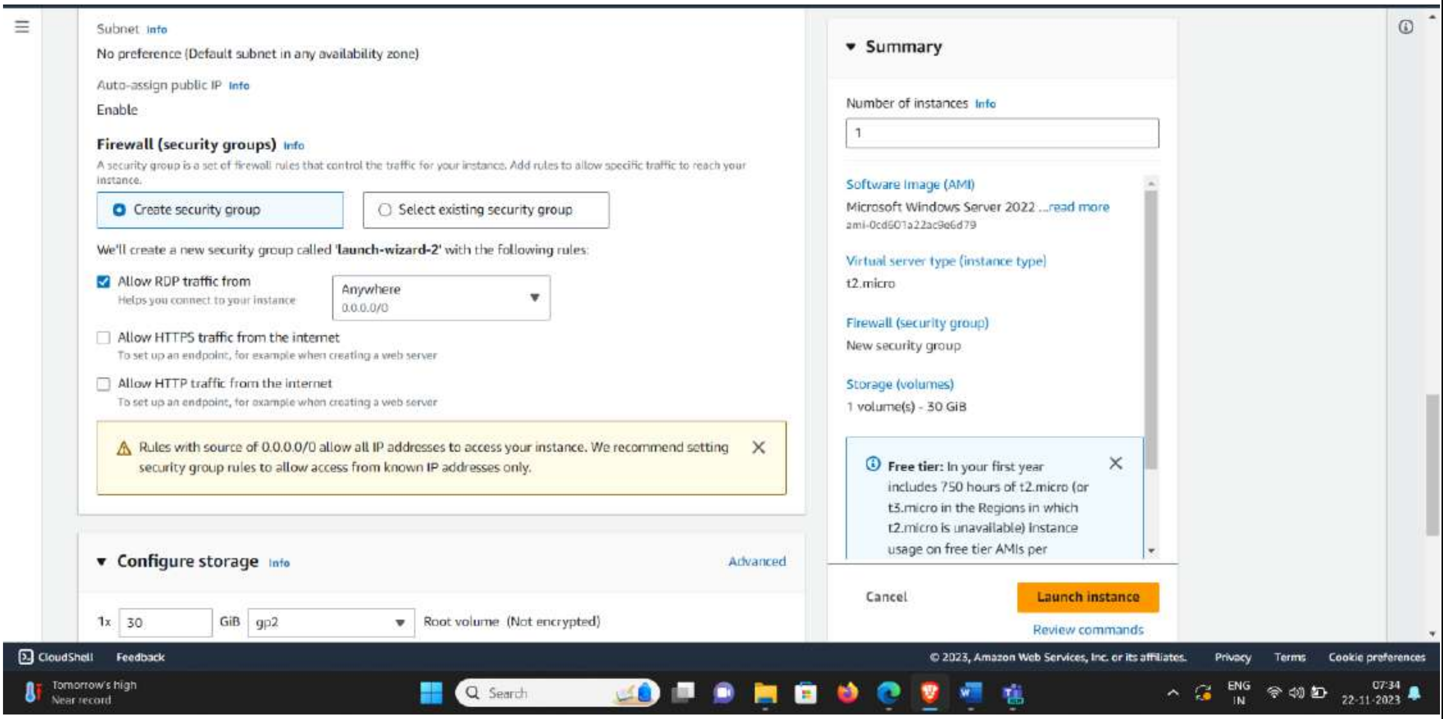


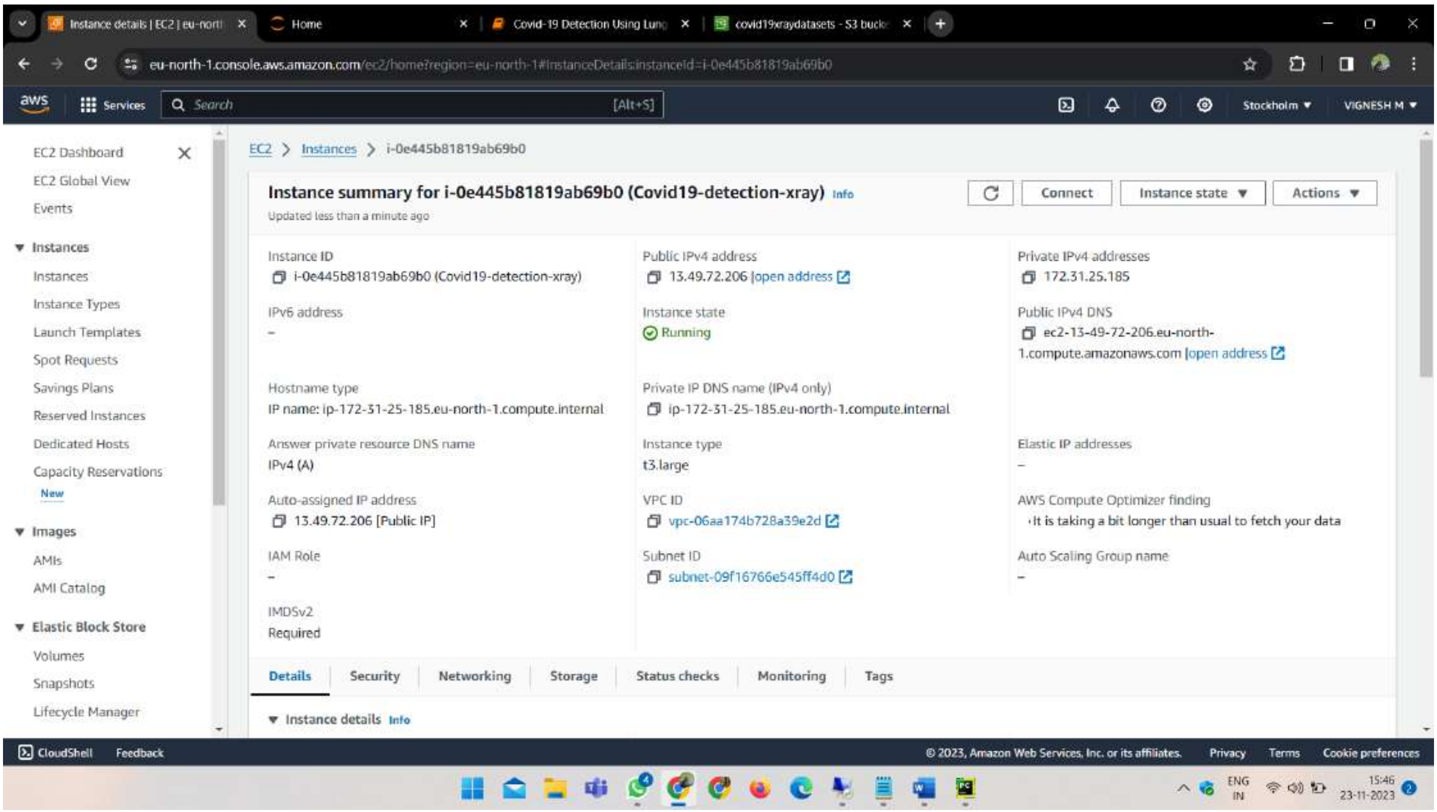


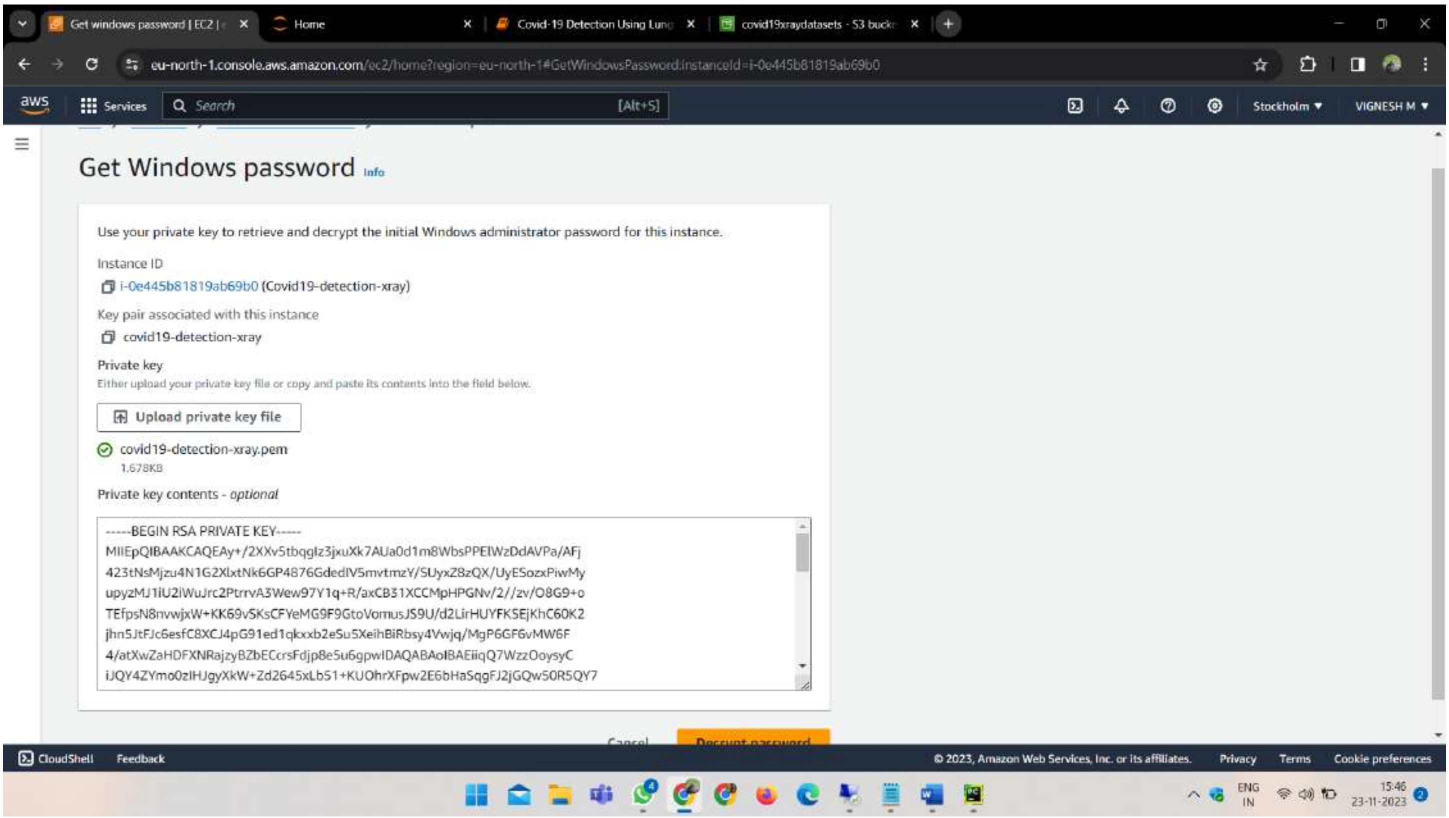
7.4. HOSTING OUR APPLICATION USING EC2 IN AWS:

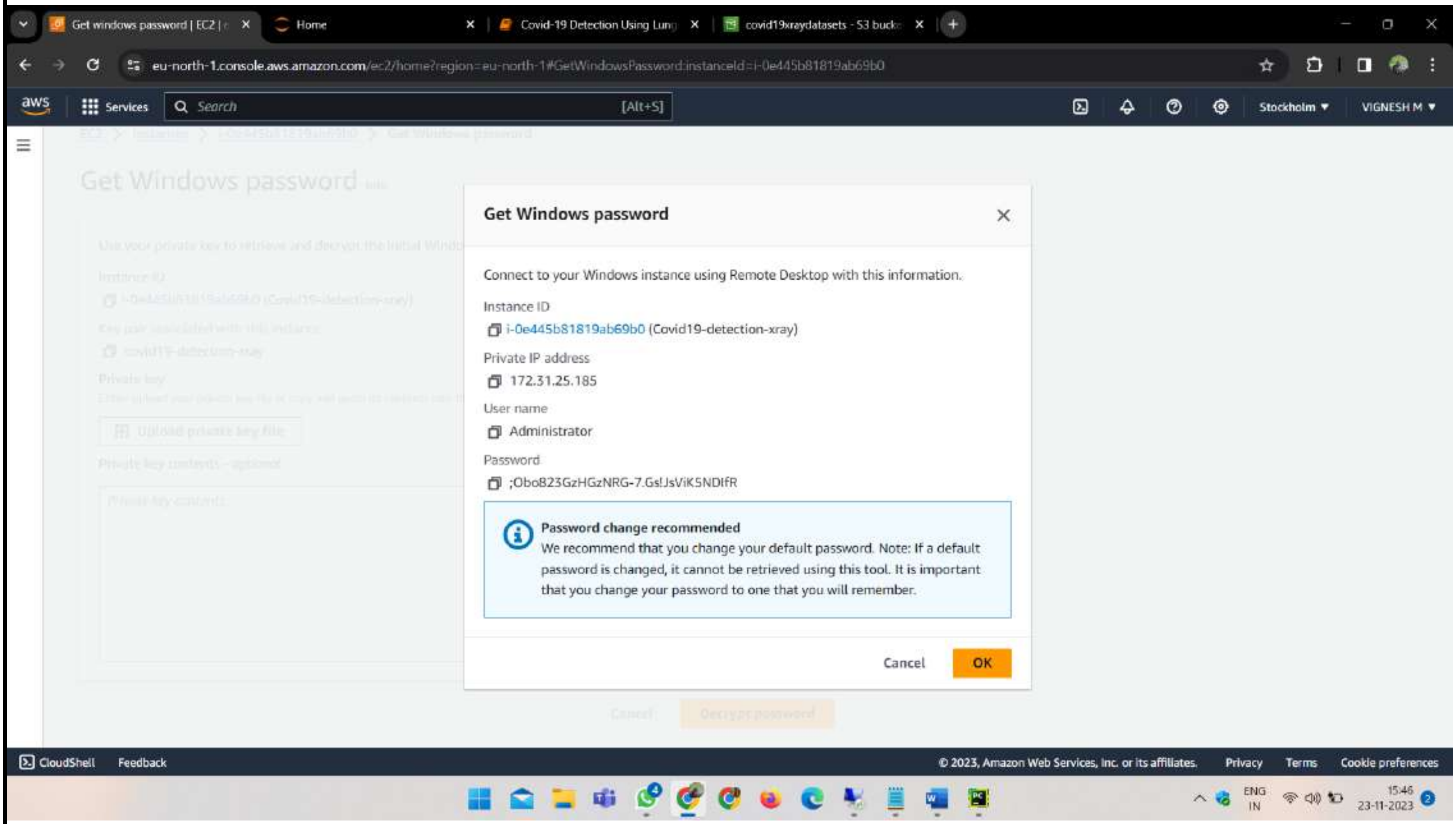



Instance type Info
Instance type
t2.micro
Free tier eligible
Family: t2 1 vCPU 1 GiB Memory Current generation: true
On-Demand Windows base pricing: 0.0162 USD per Hour
On-Demand SUSE base pricing: 0.0116 USD per Hour
On-Demand RHEL base pricing: 0.0716 USD per Hour
On-Demand Linux base pricing: 0.0116 USD per Hour
All generations
Compare instance types
Additional costs apply for AMIs with pre-installed software
Key pair (login) Info
You can use a key pair to securely connect to your instance. Ensure that you have access to the selected key pair before you launch the instance.
Key pair name - required
hospital_management
Create new key pair
For Windows instances, you use a key pair to decrypt the administrator password. You then use the decrypted password to connect to your instance.
Network settings Info
Edit
Network Info
Summary
Number of instances Info
1
Software Image (AMI)
Microsoft Windows Server 2022 ...read more
ami-0cd601a22ac9e6d79
Virtual server type (instance type)
t2.micro
Firewall (security group)
New security group
Storage (volumes)
1 volume(s) - 30 GiB
Free tier: In your first year includes 750 hours of t2.micro (or t3.micro in the Regions in which t2.micro is unavailable) instance usage on free tier AMIs per
Cancel
Launch instance
Review commands
CloudShell
Feedback
© 2023, Amazon Web Services, Inc. or its affiliates.
Privacy
Terms
Cookie preferences
Tomorrow's high
Near record
Search
ENG
IN
07:34
22-11-2023

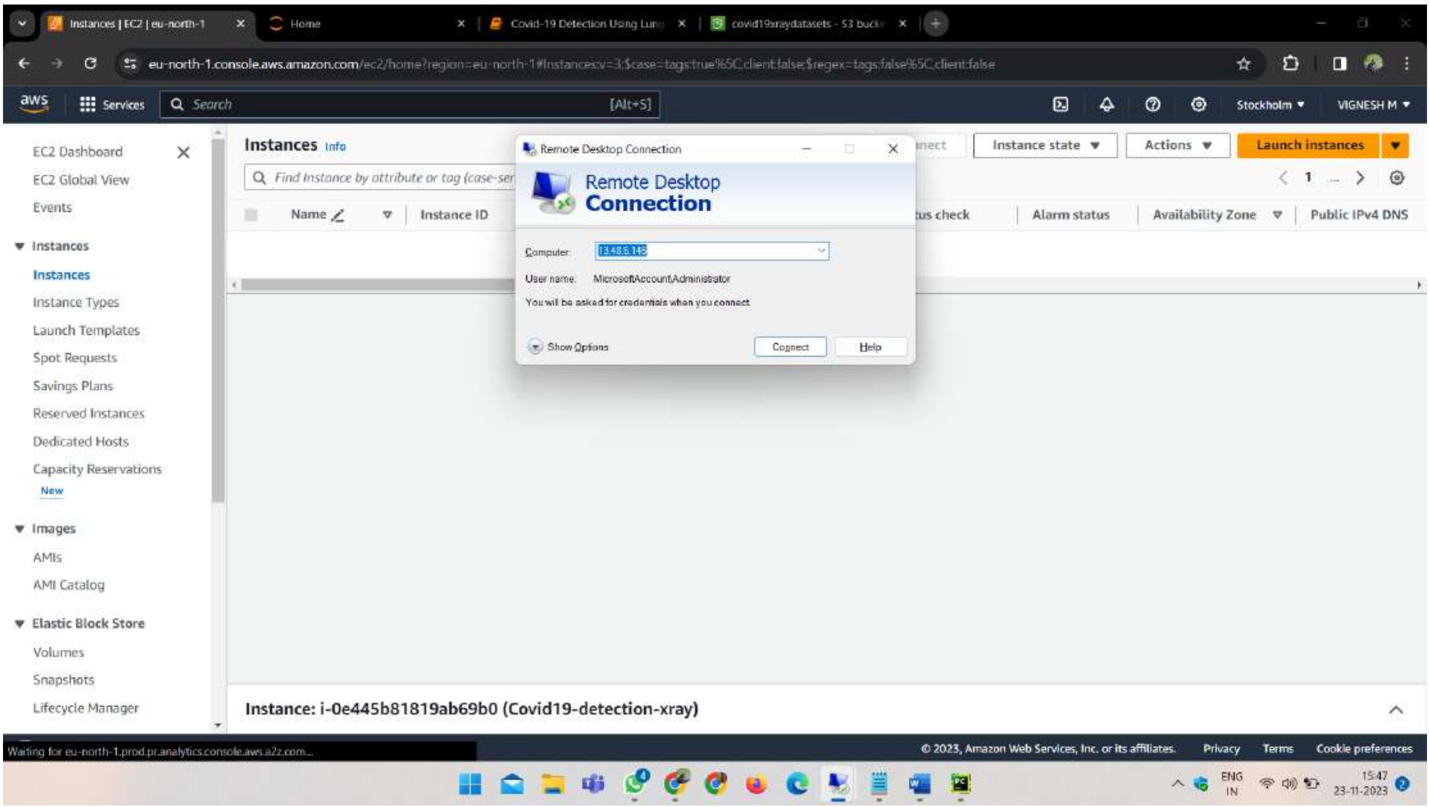

Subnet Info
No preference (Default subnet in any availability zone)
Auto-assign public IP Info
Enable
Firewall (security groups) Info
A security group is a set of firewall rules that control the traffic for your instance. Add rules to allow specific traffic to reach your instance.
Create security group
Select existing security group
We'll create a new security group called 'launch-wizard-2' with the following rules:
Allow RDP traffic from
Helps you connect to your instance
Anywhere
0.0.0.0/0
Allow HTTPS traffic from the internet
To set up an endpoint, for example when creating a web server
Allow HTTP traffic from the internet
To set up an endpoint, for example when creating a web server
Rules with source of 0.0.0.0/0 allow all IP addresses to access your instance. We recommend setting security group rules to allow access from known IP addresses only.
Configure storage Info
Advanced
1x
30
GiB
gp2
Root volume (Not encrypted)
Summary
Number of instances Info
1
Software Image (AMI)
Microsoft Windows Server 2022 ...read more
ami-0cd601a22ac9e6d79
Virtual server type (instance type)
t2.micro
Firewall (security group)
New security group
Storage (volumes)
1 volume(s) - 30 GiB
Free tier: In your first year includes 750 hours of t2.micro (or t3.micro in the Regions in which t2.micro is unavailable) instance usage on free tier AMIs per
Cancel
Launch instance
Review commands
CloudShell
Feedback
© 2023, Amazon Web Services, Inc. or its affiliates.
Privacy
Terms
Cookie preferences
Tomorrow's high
Near record
Search
ENG
IN
07:34
22-11-2023

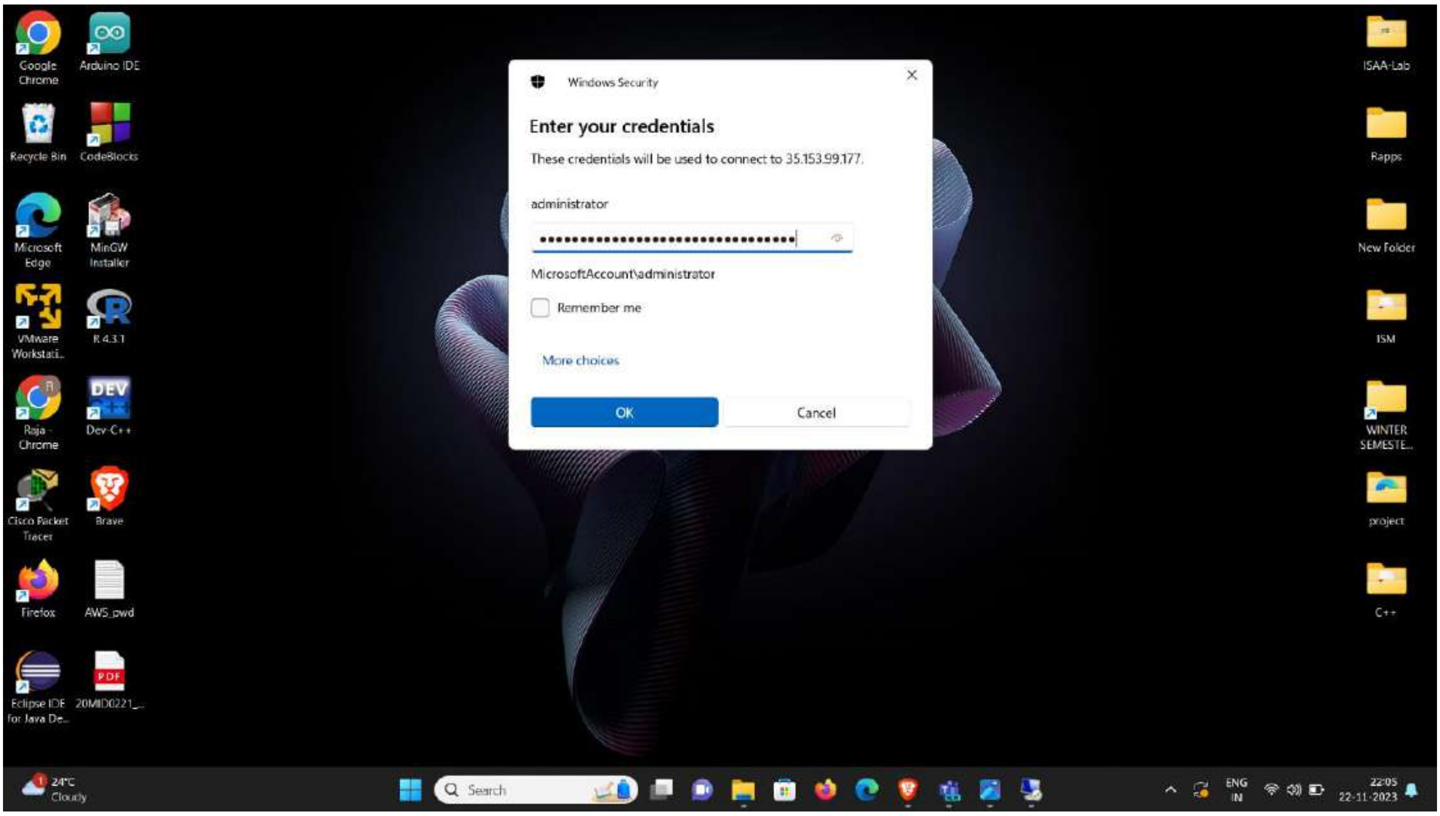

Instance details | EC2 | eu-north
Home
Covid-19 Detection Using Lung
covid19xraydatasets - S3 bucket
eu-north-1.console.aws.amazon.com/ec2/home?region=eu-north-1#InstanceDetails:instanceId=i-0e445b81819ab69b0
Services
Search
[Alt+S]
Stockholm
VIGNESH M
EC2 Dashboard
EC2 Global View
Events
Instances
Instances
Instance Types
Launch Templates
Spot Requests
Savings Plans
Reserved Instances
Dedicated Hosts
Capacity Reservations
New
Images
AMIs
AMI Catalog
Elastic Block Store
Volumes
Snapshots
Lifecycle Manager
EC2 > Instances > i-0e445b81819ab69b0
Instance summary for i-0e445b81819ab69b0 (Covid19-detection-xray) Info
Updated less than a minute ago
Connect
Instance state
Actions
Instance ID
i-0e445b81819ab69b0 (Covid19-detection-xray)
Public IPv4 address
13.49.72.206 |open address
Private IPv4 addresses
172.31.25.185
IPv6 address
–
Instance state
Running
Public IPv4 DNS
ec2-13-49-72-206.eu-north-1.compute.amazonaws.com |open address
Hostname type
IP name: ip-172-31-25-185.eu-north-1.compute.internal
Private IP DNS name (IPv4 only)
ip-172-31-25-185.eu-north-1.compute.internal
Answer private resource DNS name
IPv4 (A)
Instance type
t3.large
Elastic IP addresses
–
Auto-assigned IP address
13.49.72.206 [Public IP]
VPC ID
vpc-06aa174b728a39e2d
AWS Compute Optimizer finding
It is taking a bit longer than usual to fetch your data
IAM Role
–
Subnet ID
subnet-09f16766e545ff4d0
Auto Scaling Group name
–
IMDSv2
Required
Details
Security
Networking
Storage
Status checks
Monitoring
Tags
Instance details Info
CloudShell
Feedback
© 2023, Amazon Web Services, Inc. or its affiliates.
Privacy
Terms
Cookie preferences
ENG IN
15:46
23-11-2023

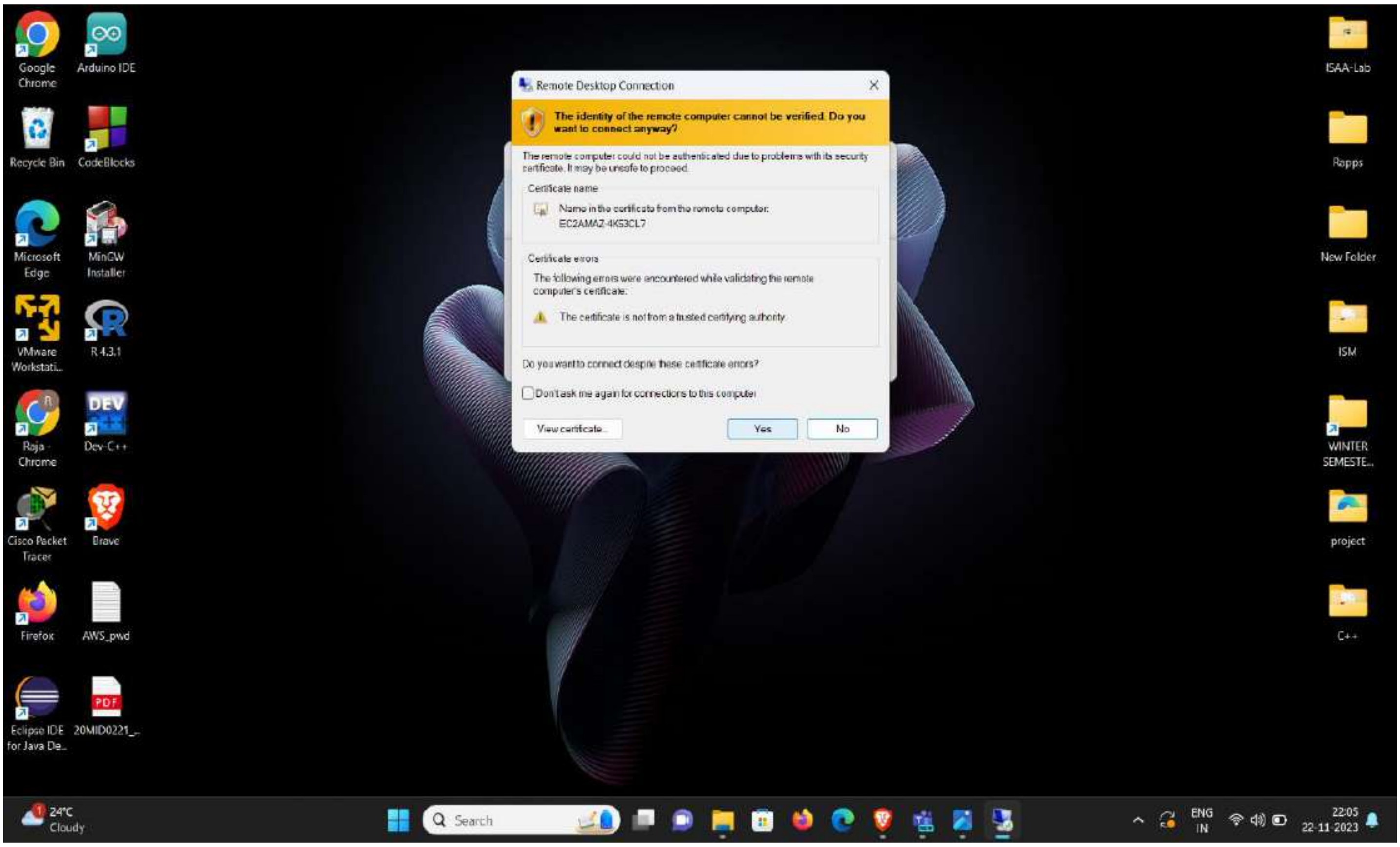

Get windows password | EC2 |
Home
Covid-19 Detection Using Lung
covid19xraydatasets - S3 bucket
eu-north-1.console.aws.amazon.com/ec2/home?region=eu-north-1#GetWindowsPassword:instanceId=i-0e445b81819ab69b0
Services
Search
[Alt+S]
Stockholm
VIGNESH M
Get Windows password Info
Use your private key to retrieve and decrypt the initial Windows administrator password for this instance.
Instance ID
i-0e445b81819ab69b0 (Covid19-detection-xray)
Key pair associated with this instance
covid19-detection-xray
Private key
Either upload your private key file or copy and paste its contents into the field below.
Upload private key file
covid19-detection-xray.pem
1.678KB
Private key contents - optional
-----BEGIN RSA PRIVATE KEY-----
MIIEpQIBAAKCAQEAy+/2XXv5tbqglz3jxuXk7AUa0d1m8WbsPPEIWzDdAVPa/AFj
423tNsMjzu4N1G2XlxtNk6GP4876GdedlV5mvtmzY/SUyxZ8zQX/UyESozxPiwMy
upyzMJ1iU2iWuJrc2PtrrvA3Wew97Y1q+R/axCB31XCCMpHPGNv/2//zv/O8G9+o
TEfpsN8nvwjxW+KK69v5KsCFYeMG9F9GtoVomusJS9U/d2LirHUYFKSEjKhC60K2
jhn5JtFJc6esfC8XCJ4pG91ed1qkxxb2eSu5XeihBiRbsy4Vwjq/MgP6GF6vMW6F
4/atXwZaHDFXNRajzyBZbECcrsFdjp8e5u6gpwIDAQABAoIBAEiiqQ7WzzOoysyC
iJQY4ZYmo0zlHJgyXkW+Zd2645xLb51+KUOhrXFpw2E6bHaSqgFJ2jGQw50R5QY7
Cancel
Decrypt password
CloudShell
Feedback
© 2023, Amazon Web Services, Inc. or its affiliates.
Privacy
Terms
Cookie preferences
ENG IN
15:46
23-11-2023



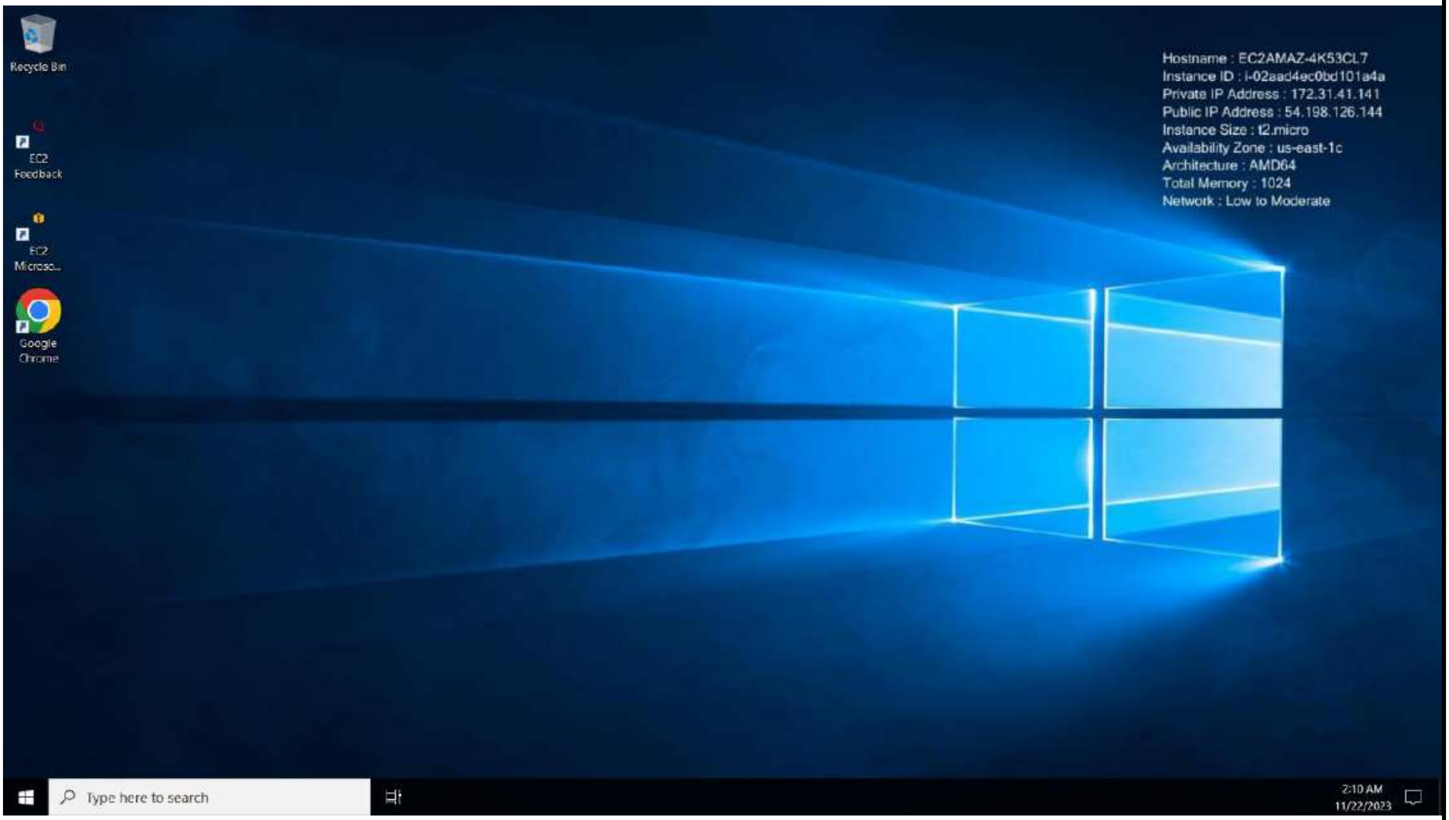
CONNECTING TO REMOTE DESKTOP:

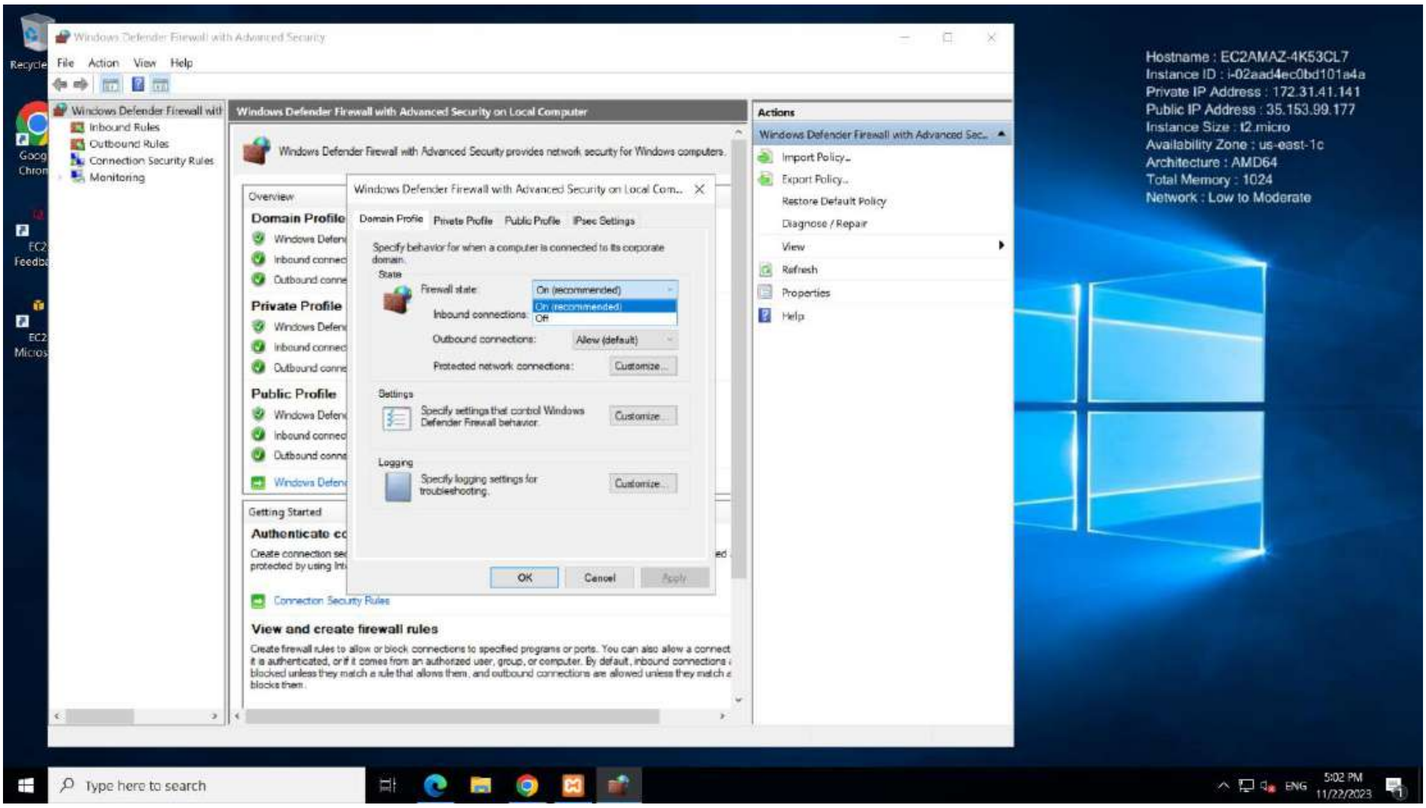


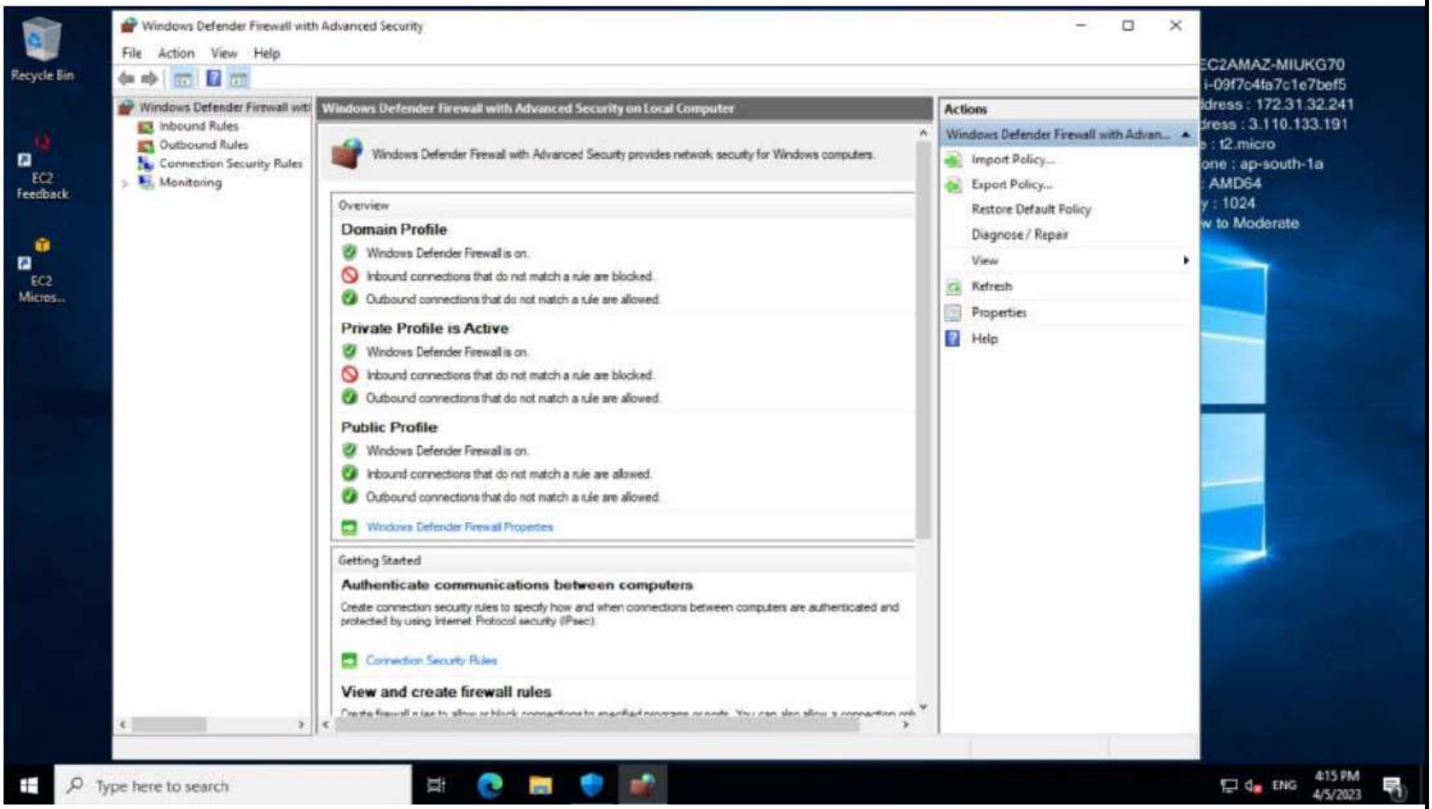

Windows Security
Enter your credentials
These credentials will be used to connect to 35.153.99.177.
administrator
MicrosoftAccount\administrator
Remember me
More choices
OK
Cancel
Google Chrome
Arduino IDE
Recycle Bin
CodeBlocks
Microsoft Edge
MinGW Installer
VMware Workstati...
R 4.3.1
Raja - Chrome
Dev-C++
Cisco Packet Tracer
Brave
Firefox
AWS_pwd
Eclipse IDE for Java De...
20MID0221_...
ISAA-Lab
Rapps
New Folder
ISM
WINTER SEMESTE...
project
C++
24°C Cloudy
Search
ENG IN
22:05 22-11-2023


Remote Desktop Connection
The identity of the remote computer cannot be verified. Do you want to connect anyway?
The remote computer could not be authenticated due to problems with its security certificate. It may be unsafe to proceed.
Certificate name
Name in the certificate from the remote computer:
EC2AMAZ-4KS3CL7
Certificate errors
The following errors were encountered while validating the remote computer's certificate:
The certificate is not from a trusted certifying authority.
Do you want to connect despite these certificate errors?
Don't ask me again for connections to this computer
View certificate...
Yes
No
Google Chrome
Arduino IDE
Recycle Bin
CodeBlocks
Microsoft Edge
MinGW Installer
VMware Workstati...
R 4.3.1
Raja - Chrome
Dev-C++
Cisco Packet Tracer
Brave
Firefox
AWS_pwd
Eclipse IDE for Java De...
20MID0221_...
ISAA-Lab
Rapps
New Folder
ISM
WINTER SEMESTE...
project
C++
24°C Cloudy
Search
ENG IN
22:05 22-11-2023

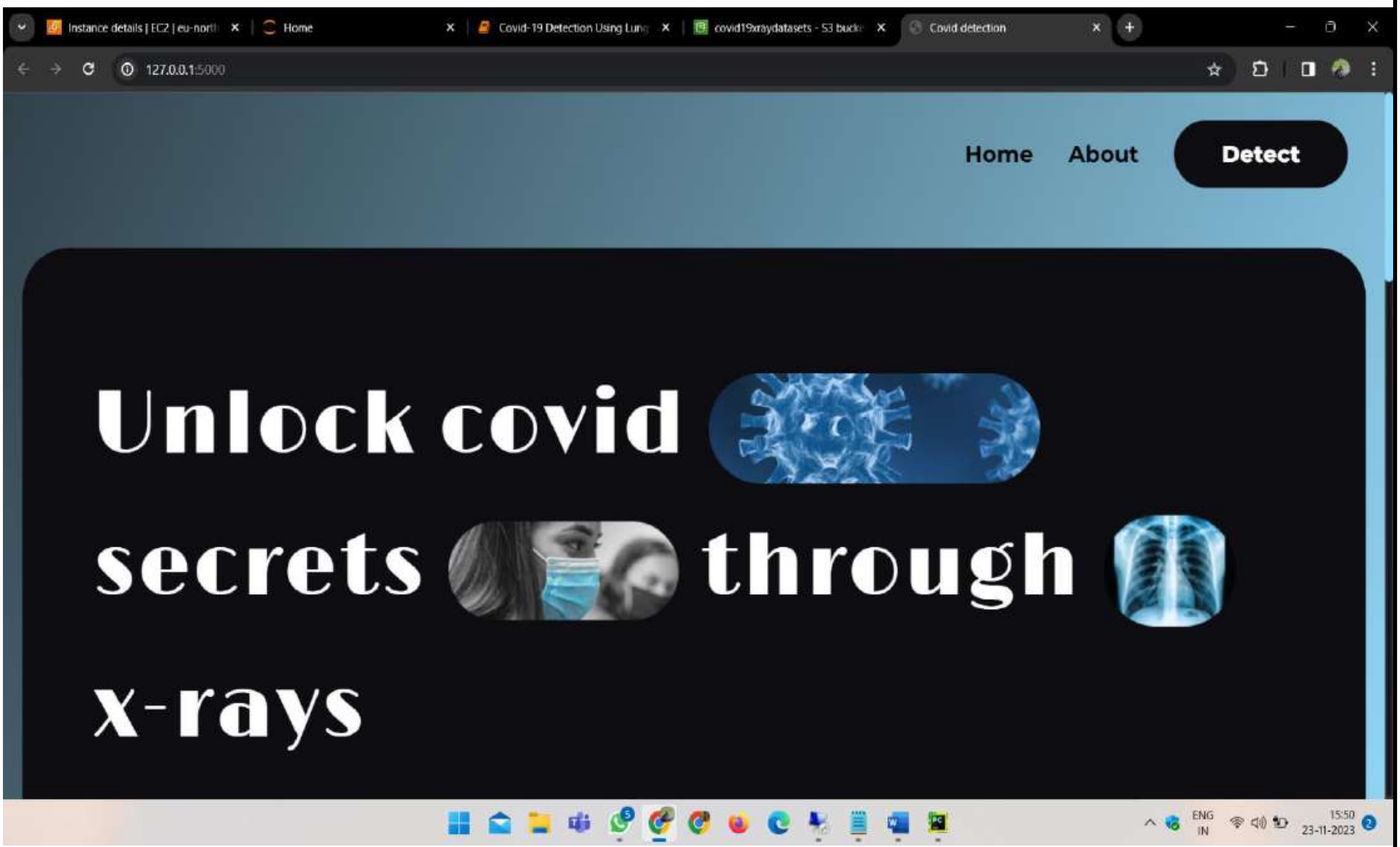
REMOTE DESKTOP OPENED:



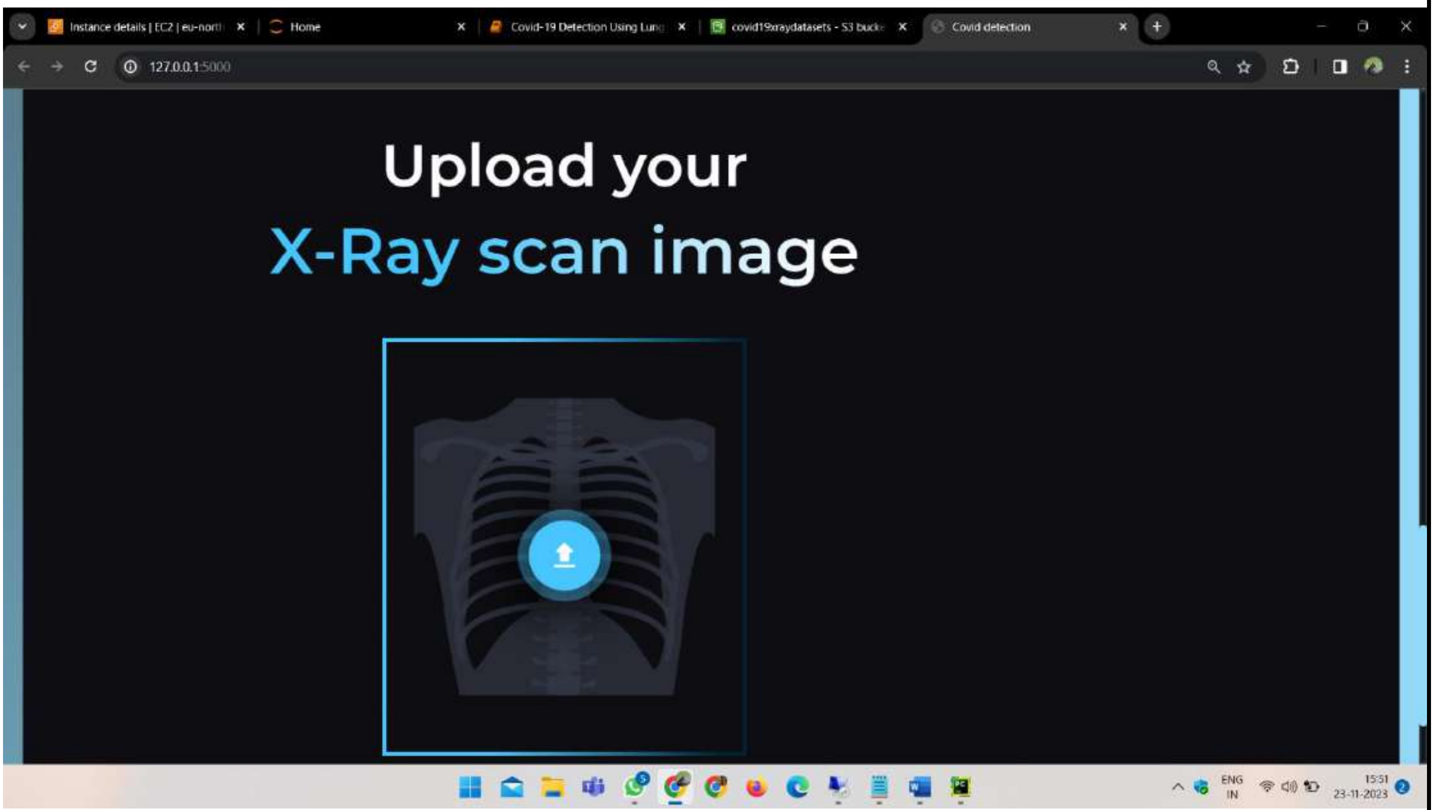




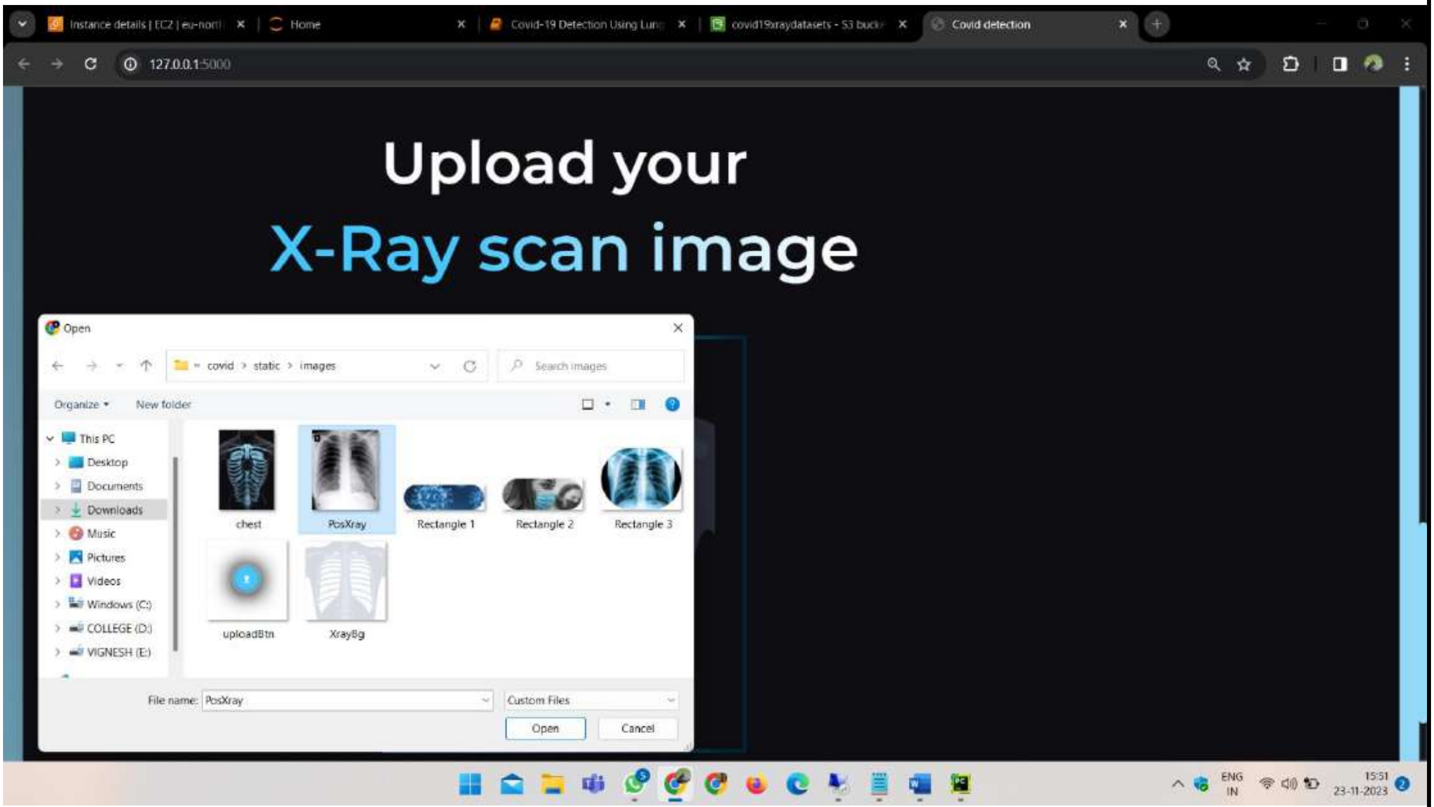
WEBSITE HOSTING IN AWS SERVER:

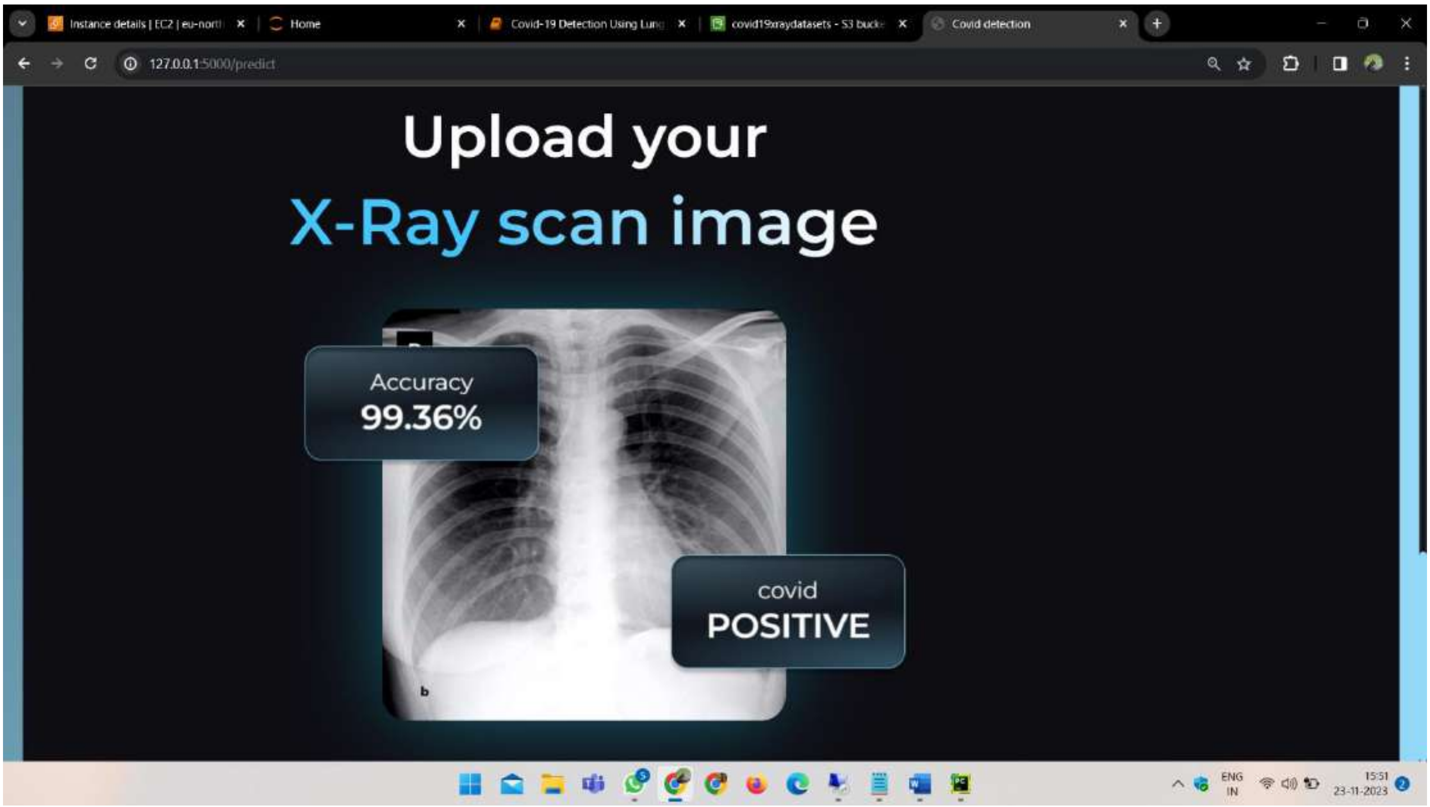


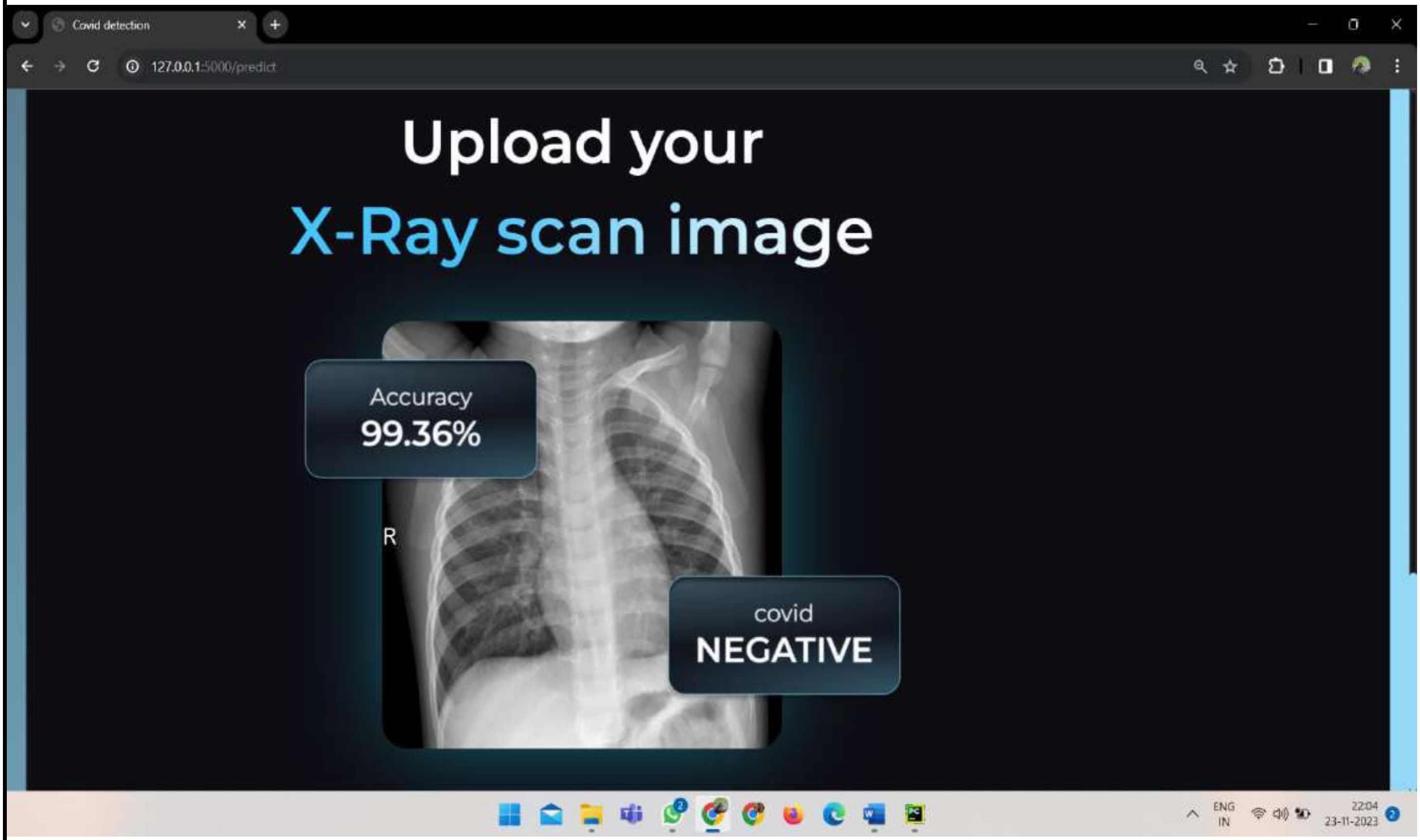

Instance details | EC2 | eu-north
Home
Covid-19 Detection Using Lung
covid19xraydatasets - S3 bucket
Covid detection
127.0.0.1:5000
Detect your condition
Detect →
Diagnose
COVID
By leveraging advanced deep learning algorithms
Detect the covid virus through X-ray images
ENG IN
15:51
23-11-2023


Instance details | EC2 | eu-north
Home
Covid-19 Detection Using Lung
covid19xraydatasets - S3 bucket
Covid detection
127.0.0.1:5000
Upload your
X-Ray scan image
ENG IN
15:51
23-11-2023

UPLOADING LUNGS XRAY IMAGES:







8. *RESULTS AND INFERENCES:*

Results indicate a highly promising outcome, with the COVID-19 detection model achieving an impressive accuracy of 99.36%. This underscores the effectiveness of utilizing Amazon Sage Maker for robust model training, AWS S3 for streamlined dataset storage, and Flask for seamless model deployment. The high accuracy suggests the potential for reliable identification of COVID-19 cases from X-ray images, showcasing the practicality of the developed solution.

Inferences drawn from this project include the viability of cloud-based services for machine learning applications in healthcare. The accuracy attained demonstrates the model's ability to make precise predictions, emphasizing its potential as a valuable tool in supporting medical professionals. Further validation through rigorous testing on diverse datasets and collaboration with healthcare experts would strengthen the model's credibility. Continuous monitoring and updates based on evolving medical knowledge and image acquisition technologies are essential to ensure the sustained effectiveness of the system.

9. CONCLUSION:

In conclusion, our COVID-19 detection project successfully leveraged advanced technologies and cloud services. Utilizing Amazon Sage Maker for model training, AWS S3 for efficient dataset storage, and Flask for seamless model deployment, we have created a robust system for detecting COVID-19 from X-ray images.

This integration of machine learning, cloud computing, and web development showcases the power of a holistic approach in addressing real-world challenges. As we navigate the ongoing pandemic, this project exemplifies the potential for technology to contribute meaningfully to healthcare solutions.

10. FUTURE WORK:

Future works for this project could involve enhancing the model's performance through more diverse datasets and fine-tuning. Exploring transfer learning techniques and staying updated on new X-ray imaging advancements can further improve accuracy.

Additionally, integrating real-time data feeds for continuous model training and considering multi-modal approaches, such as combining X-ray with other medical imaging data, could offer a more comprehensive diagnostic solution.

Enhancements to the deployment, such as incorporating user authentication and a user-friendly interface, would contribute to a more accessible and practical tool for healthcare professionals.

Ongoing collaboration with medical experts and adherence to evolving regulatory standards will be crucial for ensuring the model's clinical relevance and reliability in real-world settings.

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