

Seminar Automatic Question Answering Using IBM Watson



Project:

Medical Assistant(Chest X-ray Image Classifier)

By:

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Organization:

- **Project Objective**
- **Training of Classifier**
- **Creation of Chat bot**
- **Create Web Infrastructure**
- **Create Web based User Interface**
- **Fuse the classifier and Chat bot in User Interface**

Project Objective :

- ✓ **Use Chest X-ray Image**
- ✓ **Detect diseases**
- ✓ **Integrate multiple classifier kernel with a web framework**
- ✓ **Provide a web based user interface for easy and mobile access**
- ✓ **Use as an assistant tool for Doctors**

Training of Classifier

Training of Classifier

- ✓ **Data set selection**
- ✓ **Choosing Training Data**
- ✓ **Train Classifier**

Dataset selection:

✓ Reviewed Dataset

NIH Chest X-ray Dataset

Over 112,000 Chest X-ray images from more than 30,000 unique patients

National Institutes of Health Chest X-Ray Dataset · last updated 6 months ago

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[Data](#)
[Kernels](#)
[Discussion](#)
[Activity](#)
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Lung diseases data analysis

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Train Simple XRay CNN

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9 votes · 5 months ago

Discussion >

Patient Age / Follow-up Number

1 reply · a month ago

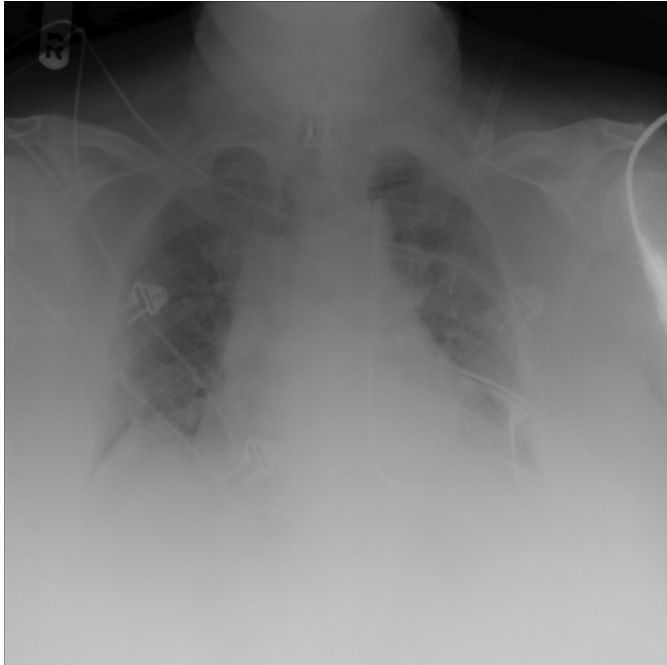
List of papers and posts

4 replies · a month ago

Source: <https://www.kaggle.com/nih-chest-xrays/data/version/1>

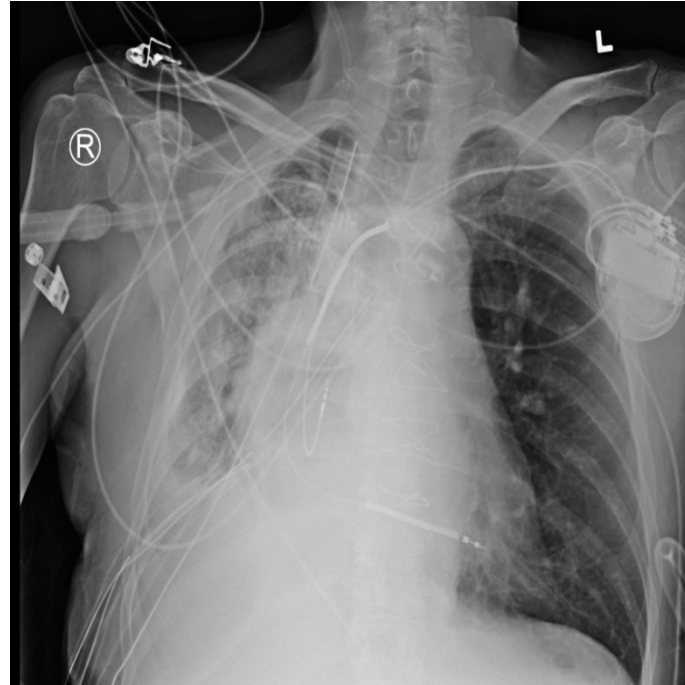
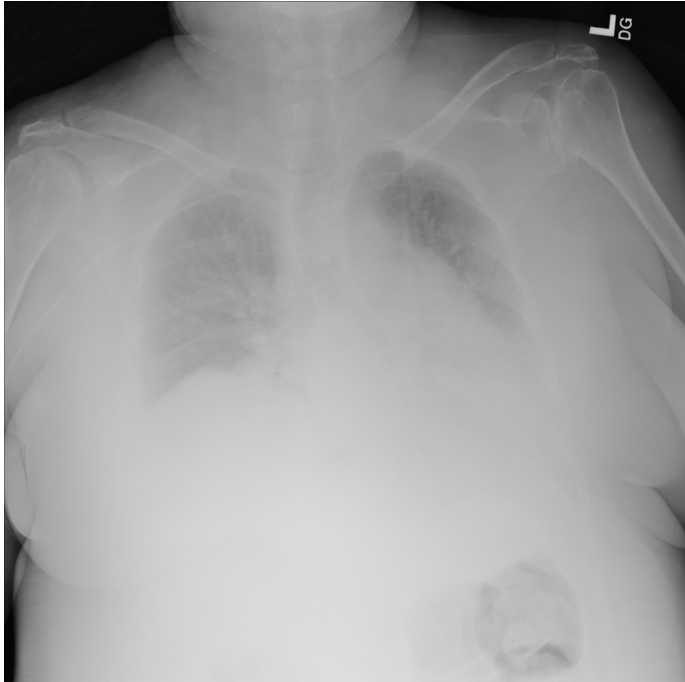
Choosing Training Data 1/5:

With huge data, comes huge Problem



Choosing Training Data 2/5:

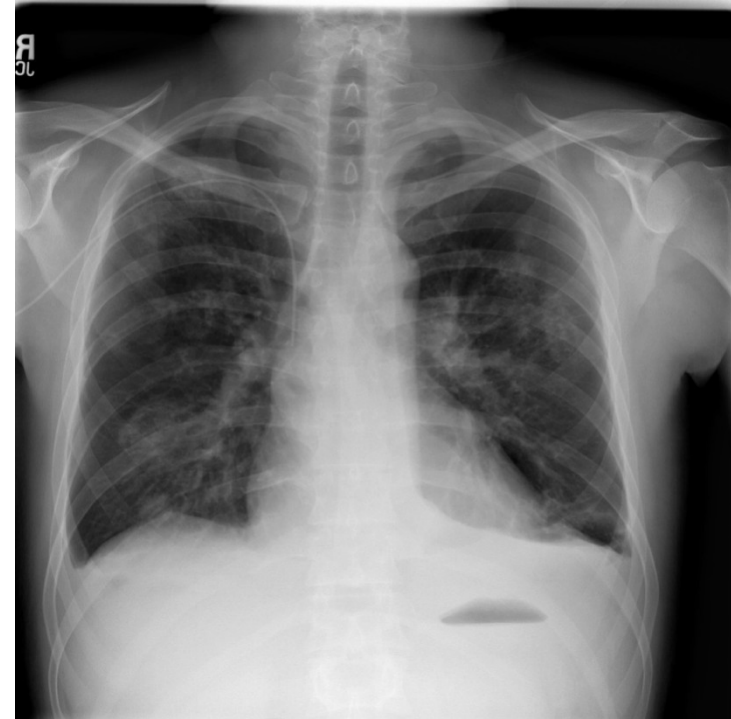
With huge data, comes huge problem



Choosing Training Data 3/5:

Hand picked images

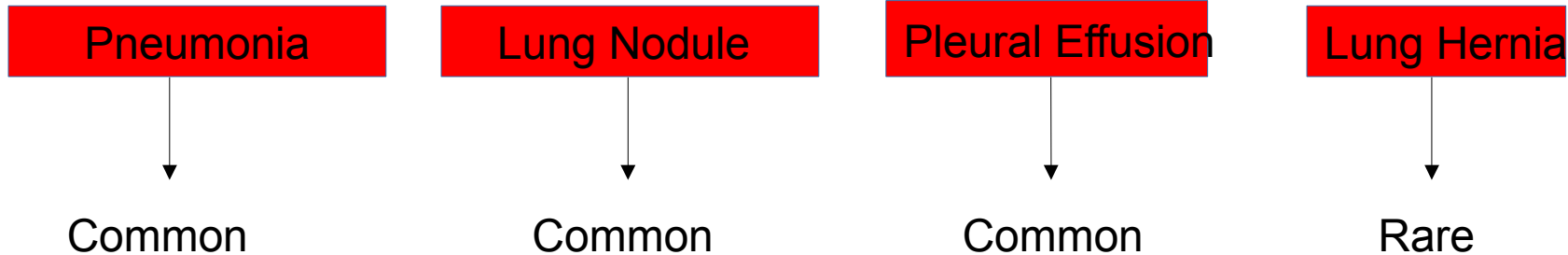
- **with better contrast**
- **Images having visually better feature**



Choosing Training Data 4/5:

- 112,000 images
- 14 classes

Selected diseases:



Classes:

Pneumonia

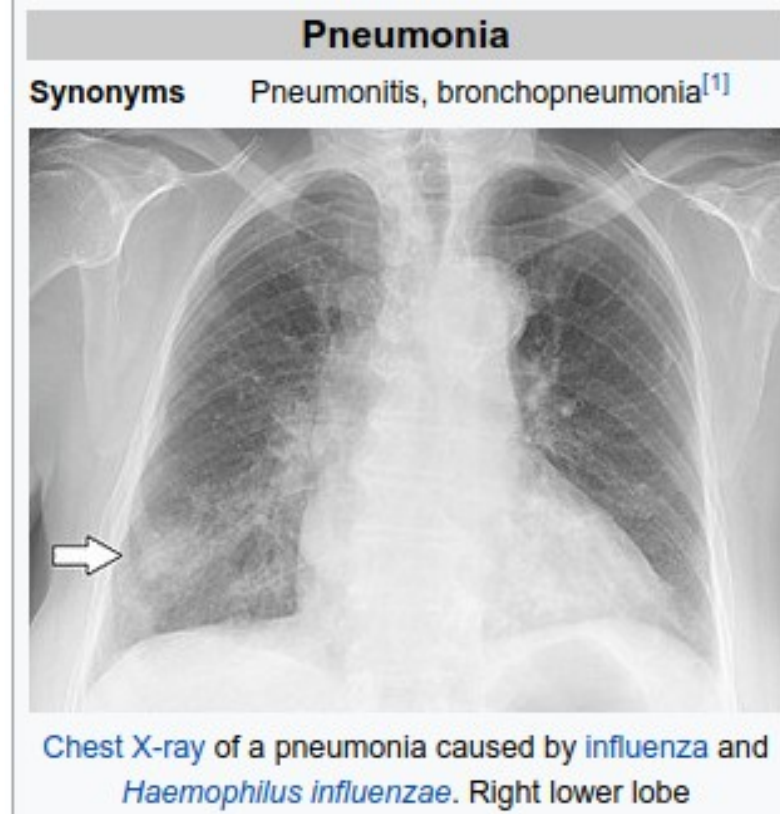


Image Source:
Wikipedia

Classes:

Lung Hernia

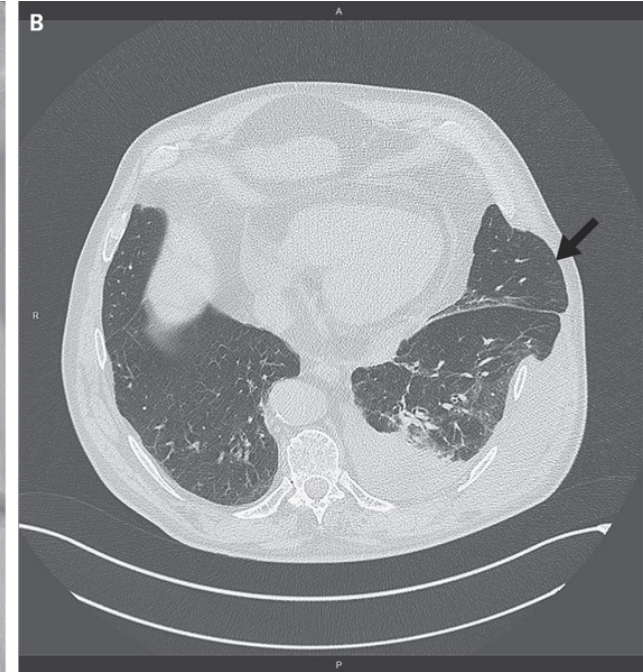
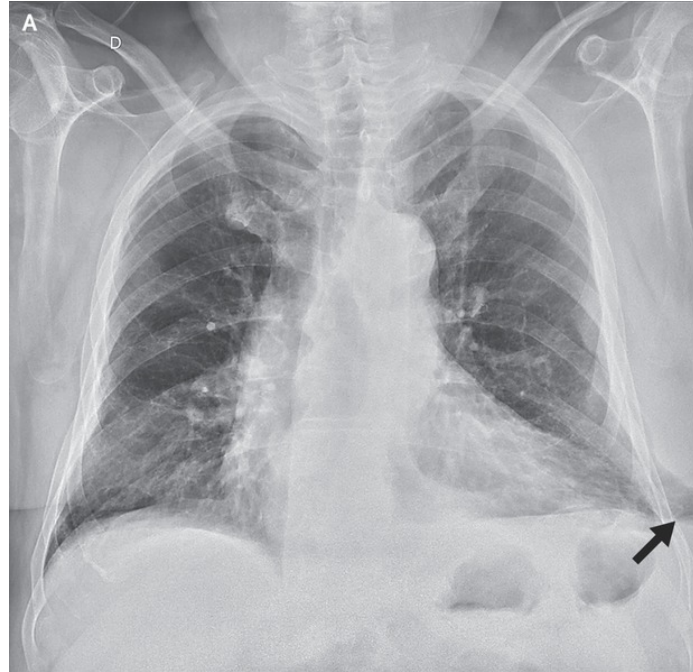


Image Source:
<https://www.urmc.rochester.edu/>

Classes:

Lung Nodule



Image Source: <https://www.med-ed.virginia.edu/>

Classes:

Pleural Effusion

Pleural Effusion

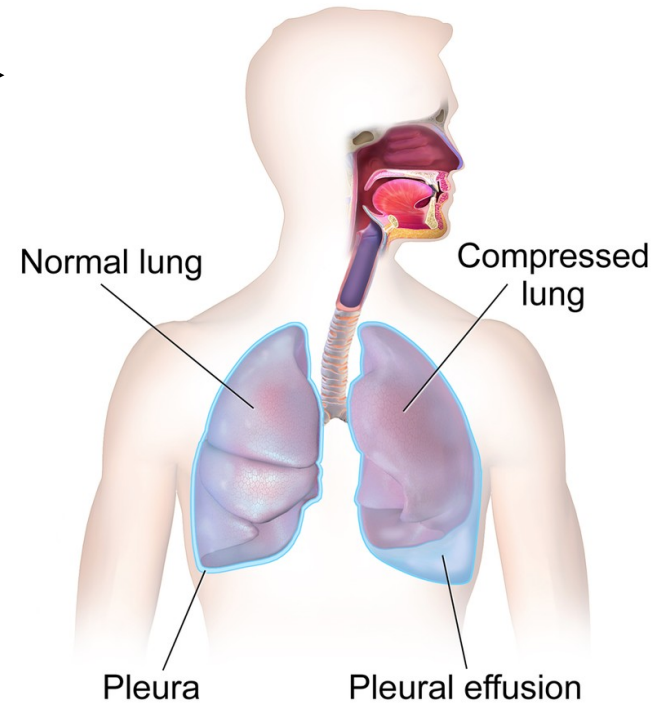


Image Source:

Wikipedia

Choosing Training Data 5/5:

Pneumonia	271
Nodule	200
Effusion	200
Hernia	200
Total=	871

Creation of Chat bot

Creation of Chatbot:

Watson /

 Assistant : ChestXrayChatBot

Location: United Kingdom Org: johar.k.sarker@fau.de Space: dev

Get started with the service.

Plan: free [Upgrade](#)

[Launch tool](#)

[Getting started tutorial](#) [API reference](#)

Credentials

[Show](#)  [Configure credentials](#)

```
{
  "url": "https://gateway.watsonplatform.net/assistant/api",
  "username": ".....",
  "password": "....."
}
```



Creation of Chat bot:

For each of the classes we have created :

- **Intent, Entity, dialogue**
- **Each entity has values:**
 - **definition, causes, symptoms, diagnosis and treatment**
- **Dialogue nodes contains dialogues for each of the classes along with greetings node**

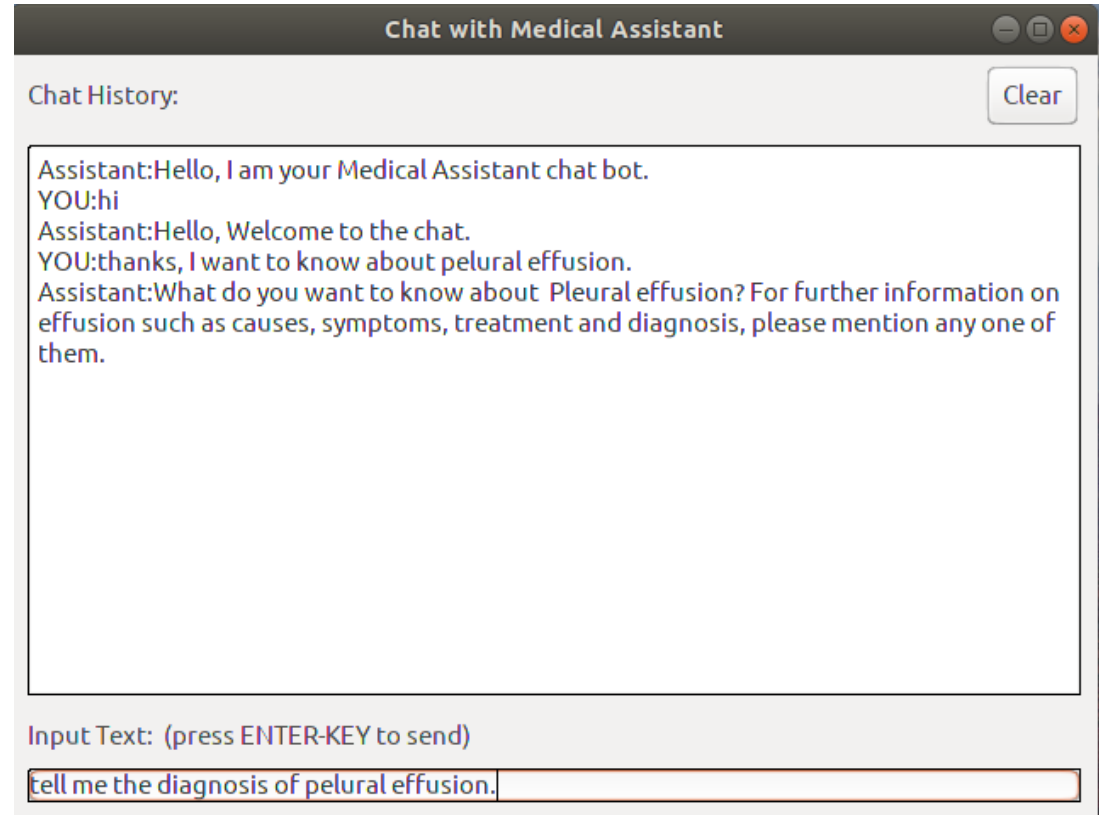
- **Creation of Chat bot:**
- **The chat bot interface is developed in Java**
- **We created a .jar file from the class and then executed anywhere we needed such as inside python or Java script**

```

WatsonChat.java
34
35 @SuppressWarnings("serial")
36 public class WatsonChat extends JFrame {
37
38     //-----
39     private static final String WATSON_CONVERSATION_USERNAME = "62ee3d3a-b3f8-4a01-b85b-97c0358b1dc7";
40     private static final String WATSON_CONVERSATION_PASSWORD = "za8u4Xld2Cqb";
41     private static final String WATSON_CONVERSATION_WORKSPACE_ID = "24e99336-59ef-4602-9cb8-c11fcbb1ae87";
42     //-----
43
44     private static final String WCS_CLIENT_ID = "user_id_johar";
45
46     private static final int WIDTH_PX = 640;
47     private static final int HEIGHT_PX = 480;
48
49     private final WcsClient mWatson = new WcsClient(
50         WATSON_CONVERSATION_USERNAME,
51         WATSON_CONVERSATION_PASSWORD,
52         WATSON_CONVERSATION_WORKSPACE_ID);
53
54     private final ExecutorService mExecutor = Executors.newSingleThreadExecutor();
55     private final StringBuilder mSb = new StringBuilder();
56
57     private final JTextArea mTextArea = new JTextArea();
58     private final JTextField mTextBox = new JTextField(""); //client text box
59

```

- **Creation of Chat bot:**
- **Chat bot in action**
- **We also used 3rd party Chatlio service for web integration**



Creating Web Application Infrastructure

For creating Web Application Infrastructure

Web Framework (Django)

Architecture Pattern (MTV)

configure for classifier integration

configure for server communication

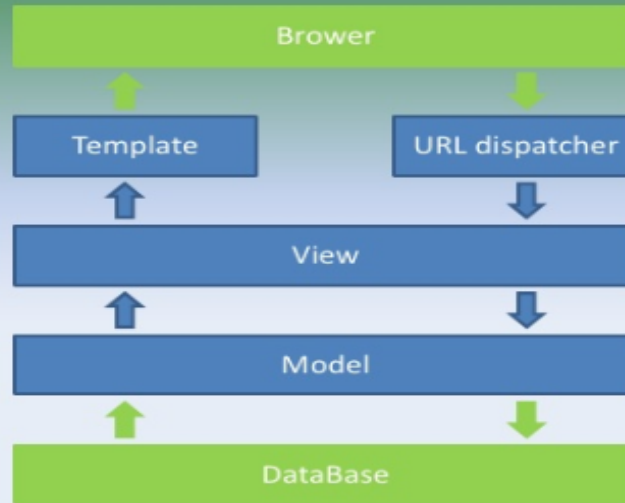
Web User Interface for user interaction

Django Web Framework

- ✓ A high-level Python Web framework
- ✓ Can be focused separately on:
 - business logic and presentation layer
 - Focus on automation
- ✓ Widely supported with many deployment options

Django Web Framework

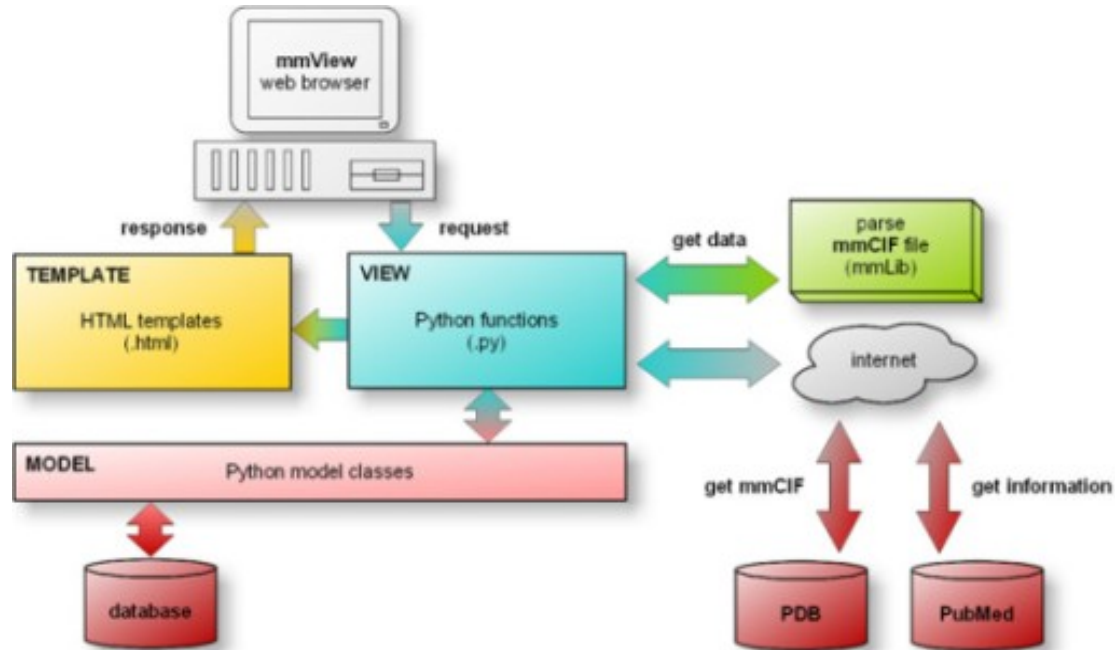
Architecture Diagram



MTV Architecture

- ✓ MTV stands for Model Template View
- ✓ Django Components
 - ✓ Model – Django ORM
 - ✓ Templates – Django Template Engine (HTML)
 - ✓ Views – Python function

MTV Architecture



Deploying Classifier kernel

- ✓ Put the classifier packages in the same folder with static folder
- ✓ Multiple classifier packages can be deployed
- ✓ Configure and Map static and Media directory in settings.py
- ✓ Create model files and folder to store image data
- ✓ Create interface file(*_upd.py) to interact with the classifier
- ✓ Create view files(tfExec.py) to handle request and response
- ✓ Map the view resource with the url pattern in urls.py

Web User Interface

- ✓ Create static pages using HTML
- ✓ HTML, CSS and other static resources in static folder
- ✓ The view generates the dynamic components
- ✓ User uploads the image through the UI
- ✓ Provide facilities for image cropping of selected image to discard unnecessary data for more accurate classification
- ✓ Map url pattern with static html as template view in urls.py

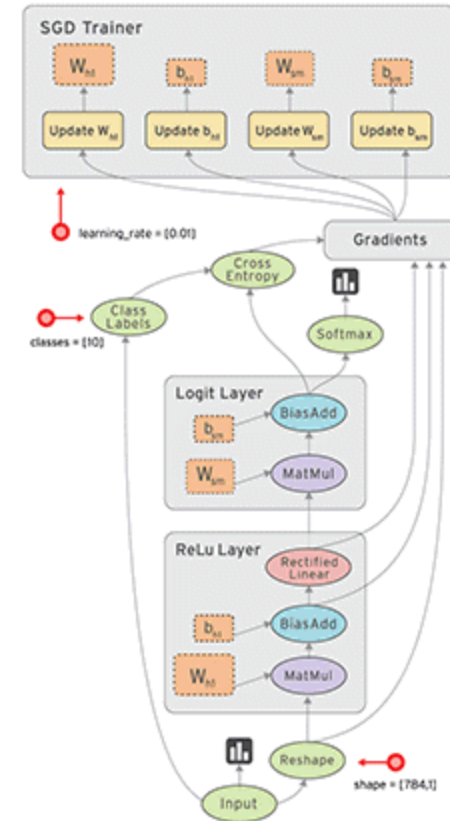
Technologies used

- ✓ **Python – For view and core logic**
- ✓ **HTML – For static view**
- ✓ **Jquery – For presentation layer logic**
- ✓ **Python Image Library(PIL) – For preprocessing of image**
- ✓ **Tensorflow library – For preparing image tensors for classifiers**
- ✓ **Used a plug-in ‘Chatlio’ for js based chatbot integration**

Classifiers : MobileNet Vs Inception

TensorFlow:

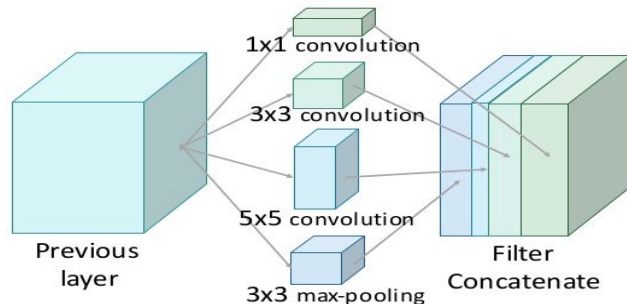
- an open source software library for numerical computation using dataflow graphs.
- Nodes in the graph represents mathematical operations, while graph edges represent multi-dimensional data arrays (aka tensors) communicated between them.
- The flexible architecture allows to deploy computation to one or more CPUs or GPUs in a desktop, server, or mobile device with a single API



Classifiers : Inception

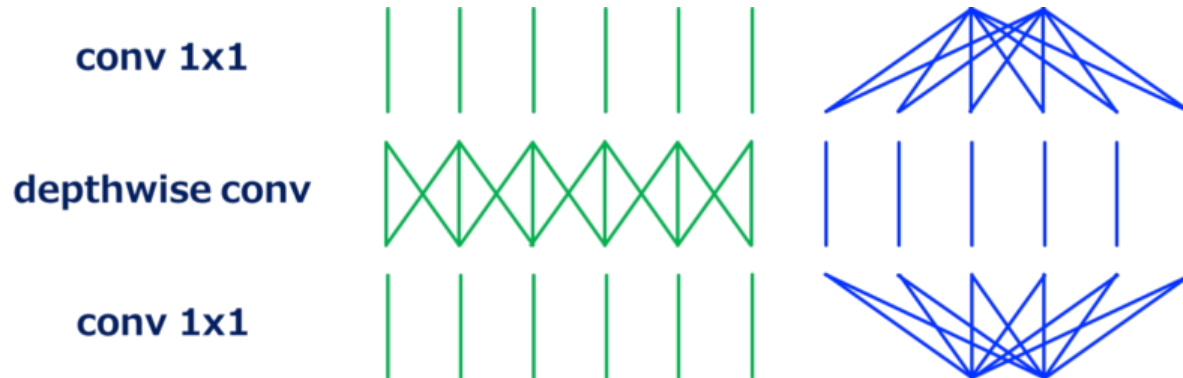
- ✓ A deep convolutional neural network architecture
- ✓ Hallmark of this architecture is the improved utilization of the computing resources inside the network
- ✓ This was achieved by a carefully crafted design that allows for increasing the depth and width of the network while keeping the computational budget constant.

Inception Module



Classifiers : Mobilenet

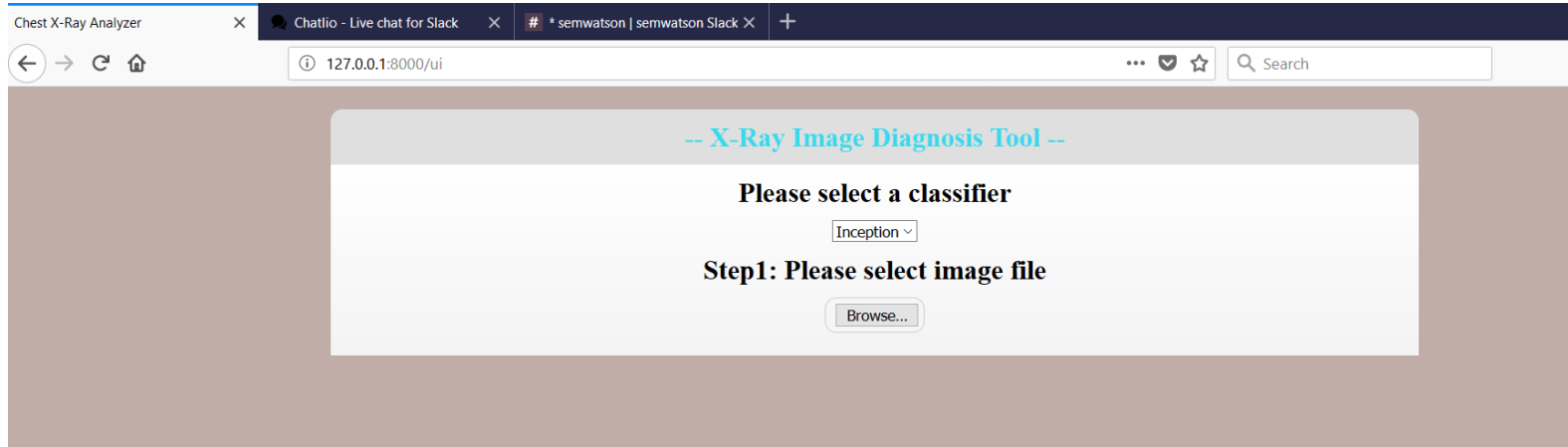
- ✓ MobileNet V2 is a family of neural network architecture
- ✓ Efficient on- device image classification and related tasks
- ✓ Originally published by Mark Sandler, Andrew Howard, Menglong Zhu, Andrey Zhmoginov, Liang-Chieh Chen: "Inverted Residuals and Linear Bottlenecks: Mobile Networks for Classification, Detection and Segmentation", 2018.



Which Model : Inception vs Mobilenet

- ✓ **Performance** of MobileNet model relative to Inception V3 is usually lower since MobileNet is optimized for speed whereas Inception aims for correctness.
- ✓ MobileNet has a much **lower model size** compared to Inception model
- ✓ MobileNet **training accuracy** can sometimes be better in case of reduced training sets
- ✓ MobileNet has **shorter prediction time** compared to Inception

Web User Interface: select file



Web User Interface: crop & upload for classification

The screenshot displays a web browser window with the following elements:

- Browser Tabs:** Chest X-Ray Analyzer, Chatlio - Live chat for Slack, # *semwatson | semwatson Slack
- Address Bar:** 127.0.0.1:8000/ui
- Page Title:** -- X-Ray Image Diagnosis Tool --
- Classifier Selection:** Please select a classifier (Inception)
- Step 1:** Please select image file (Browse...)
- Step 2:** Please select a crop region if necessary
- Image:** A chest X-ray image showing lung fields and the heart.
- File Metadata:** File size: 98.3 KB, Type: image/png, Image dimension: 339 x 395 (W x H)
- Buttons:** Upload, Performance Comparison

Web User Interface: using single classifier

127.0.0.1:8000/diagnose 70% Search

-- Diagnosis Details --

Top Results

Evaluation time (1-image): 1.549s

Classifier :	Inception
Classes	Probability
hernia	0.0038572787
nodule	0.8365465
pneumonia	0.14481099
effusion	0.0147851985

Diagnosis Bar Chart

Classification	Probability
hernia	0.0038572787
nodule	0.8365465
pneumonia	0.14481099
effusion	0.0147851985

Original Image

[Back to Home](#)

How can we help you?

Web User Interface: performance comparison

127.0.0.1:8000/performance

-- Performance Study --

Inception

Top Results

Evaluation time (1-image): 1.637s

Classes	Probability
hernia	0.013396523
nodule	0.2826635
penumonia	0.69608605
effusion	0.007853948

Diagnosis Bar Chart

Diagnosis of Image

Classification	Probability
hernia	0.013396523
nodule	0.2826635
penumonia	0.69608605
effusion	0.007853948

MobileNet

Top Results

Evaluation time (1-image): 0.665s

Classes	Probability
hernia	0.0011877783
nodule	6.5158565e-05
penumonia	0.998747
effusion	4.9464395e-12

Diagnosis Bar Chart

Diagnosis of Image

Classification	Probability
hernia	0.0011877783
nodule	6.5158565e-05
penumonia	0.998747
effusion	4.9464395e-12

[Back to Home](#)

How can we help you?

Future Work:

- Add more classes
- Add image pre-processing facility
- Improve GUI and Chat-bot
- Better classification model
- Add heat map

Thank You :)

Questions ?