

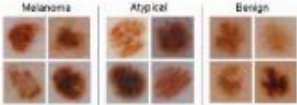
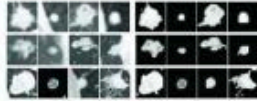

Medical Imaging

Medical Imaging

- IBM Visual Insights is a researcher tool to do rapid labeling and deep learning classification of medical images.
- VI runs on Intel x86 systems and IBM POWER8/9 Systems
- It is being used actively across multiple disciplines. We have several MVP use cases developed.
- See Medical Imaging Guide.

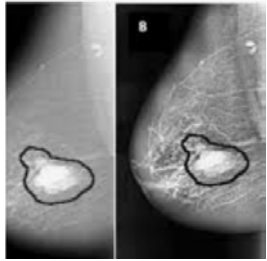
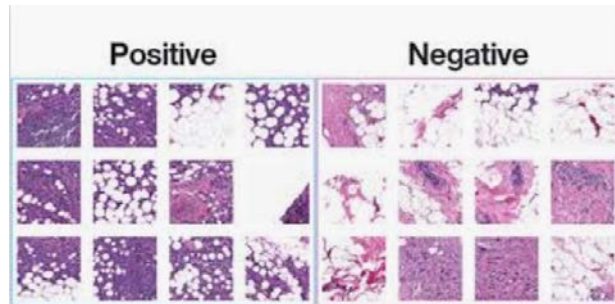
The IBM medical imaging solutions can provide speedup of image analysis to meet clinical, medical, or academic researchers' needs. (Fig 1).

Fig 1. Examples of medical imaging applications

	Dermatology	Diagnostic Radiology	Digital Pathology
Data Characteristics	Photos: RGB, 2D 	X-rays, CT scan, ultrasound, MRI 	High res digital slides, 2D, 3D 
Imaging Challenge	Identifying malignant mole with mobile phone images	Detecting lung nodules on 3D CT scans	Detecting and classifying blood cell subtypes in blood samples
Desired Outcomes	Prediction of malignancy in shorter time frame	Detection of lung cancer with higher accuracy	Diagnosis of blood-based diseases efficiently
Techniques also applicable to...	<ul style="list-style-type: none"> • Ophthalmology • Dentistry 	<ul style="list-style-type: none"> • Breast imaging • Cardiothoracic • Cardiovascular • Chest • Endovascular • Gastrointestinal • Genitourinary • Head and neck • Musculoskeletal • Neuroradiology • Nuclear • Radiation oncology • Dentistry 	<ul style="list-style-type: none"> • Chemical • Clinical • Cytopathology • Dermatopathology • Forensic • Genetic • Hematology • Immunopathology • Medical microbiology • Molecular • Neuropathology

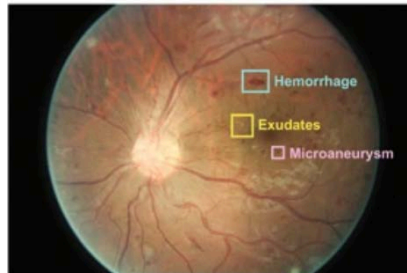
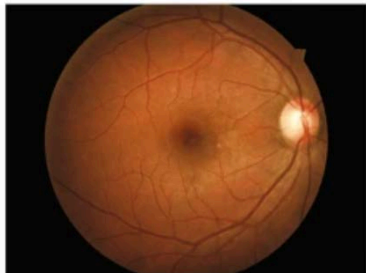
Visual Insights: “Point-and-Click” AI for Images & Video

Label Image or
Video Data



Patient without DR

Patient with DR



Auto-Train AI Model

← Training / NWPU-Breast Tumor (magnification 40×)_model

Browsing away from this page will not stop the training.
To delete or stop the training early, click the 'stop training' button.

Image classification
System Default (GoogLeNet)

1 MINUTE LEFT

Initialized
12/18/2019, 7:08:13 AM

Stop training

Training options

Max iteration 1
1500

Test iteration 1
100

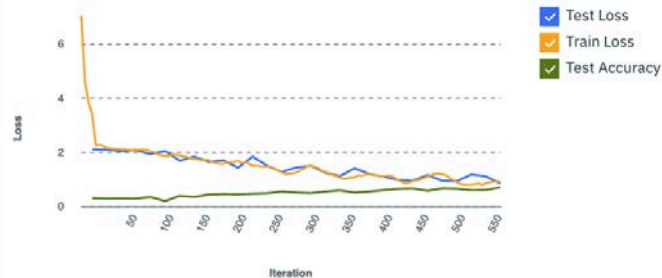
Test interval 1
20

Learning rate 1
0.001

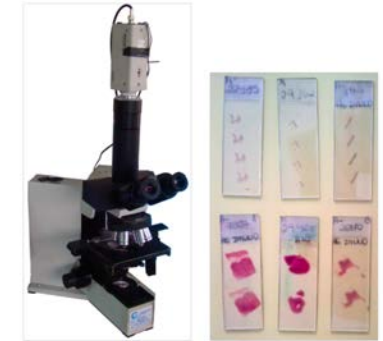
Weight decay 1
0.0005

Ratio 1
0.8

Loss VS Iteration




Package & Deploy
AI Model



Breast Cancer Classification


IBM PowerAI Vision

Welcome to IBM PowerAI Vision




Create Dataset

Start by adding images and video files to a data set.




Prepare Data

Label objects in images and video frames, then use auto labeling to finish adding labels to the whole data set; assign categories to images or videos, or label actions in videos.



Train Model

Select a few custom options to create your model.



Deploy Model

Deploy the trained model and receive an API link for an inference device.

[Get started](#)

IBM PowerAI Vision

Data Set / NWPU-Breast Tumor (magnification 40x)

Total files: 1,526 Matching files: 1,526 Selected files: 0

[Train model](#) [Augment data](#) [Auto label](#) [Export data set](#)

[Assign category](#) [Label objects](#) [Label actions](#) ☐ [Select](#) [Delete](#) [Refresh](#)

Drop files here

[Import files](#)

Filter categories

- ☐ Select all
- ☐ Unclassified (0)
- ☐ In-tubular_adenoma (135)
- ☐ In-tubular_carcinoma (146)
- ☐ In-mucinous_carcinoma (193)
- ☐ In-adenosis (114)
- ☐ In-ductal_carcinoma (458)
- ☐ In-fibroadenoma (241)
- ☐ In-papillary_carcinoma (136)
- ☐ In-phylloides_tumor (135)

[Add category](#)

Objects

Actions

Grid of 21 histology images showing various breast cancer types.

IBM PowerAI Vision

Trained Model / NWPU-Breast Tumor (magnification 40x)_model

Trained models are created from prepared data sets. This model can be evaluated, imported, and deployed for production for Graphics Processing Units (GPU).

[Deploy model](#) [Export model](#)

Image classification

Data set: NWPU-Breast Tumor (magnification 40x)

Created: 12/16/2019, 1:13:07 PM By: admin

System Default (GoogleNet)

Model hyperparameters

- Max iteration: 1500
- Test interval: 20
- Learning rate: 0.001
- Weight decay: 0.0005
- Test iteration: 100
- Learning rate: 0.001
- Ratio: 0.8

88% Accuracy

86% Precision

88% Recall

Loss VS Iteration

Category

Category	Precision	Recall
In-tubular_carcinoma (135 images)	0.895	0.837
In-fibroadenoma (241 images)	0.909	0.909
In-tubular_adenoma (135 images)	0.933	0.875
In-phylloides_tumor (135 images)	0.75	0.75
In-mucinous_carcinoma (193 images)	0.956	0.878

IBM PowerAI Vision

Deployed Model / NWPU-Breast Tumor (magnification 40x)_model

You can call the generated application programming interface (API) to run your deployed model. The API is unique to this model, and you cannot edit the API.

Image classification

System Default (GoogleNet)

Model: NWPU-Breast Tumor (magnification 40x)_model

Created: 12/16/2019, 1:14:07 PM By: admin

Model hyperparameters

- Max iteration: 1500
- Test interval: 20
- Learning rate: 0.001
- Weight decay: 0.0005
- Test iteration: 100
- Learning rate: 0.001
- Ratio: 0.8

88% Accuracy

Deployed model API endpoint

[api/dlapis/015e7247-f938-4378-a3df-439741cadcc6](#) [Copy](#)

API Reference

[GET](#) [POST](#)

Test Model

Drop image here

Confidence threshold: 0.1 [0.1-1.0]

External URL: [Upload](#)

Categories

- In-tubular_adenoma (135 images)
- In-mucinous_carcinoma (193 images)
- In-tubular_carcinoma (146 images)
- In-ductal_carcinoma (458 images)
- In-adenosis (114 images)
- In-fibroadenoma (241 images)
- In-papillary_carcinoma (136 images)
- In-phylloides_tumor (135 images)

IBM PowerAI Vision

Deployed Model / NWPU-Breast Tumor (magnification 40x)_model

You can call the generated application programming interface (API) to run your deployed model. The API is unique to this model, and you cannot edit the API.

Image classification

System Default (GoogleNet)

Model: NWPU-Breast Tumor (magnification 40x)_model

Created: 12/16/2019, 1:14:07 PM By: admin

Model hyperparameters

- Max iteration: 1500
- Test interval: 20
- Learning rate: 0.001
- Weight decay: 0.0005
- Test iteration: 100
- Learning rate: 0.001
- Ratio: 0.8

88% Accuracy

Deployed model API endpoint

[api/dlapis/015e7247-f938-4378-a3df-439741cadcc6](#) [Copy](#)

API Reference

[GET](#) [POST](#)

Test Model

Drop image here

Confidence threshold: 0.1 [0.1-1.0]

External URL: [Upload](#)

Categories

- In-tubular_adenoma (135 images)
- In-mucinous_carcinoma (193 images)
- In-tubular_carcinoma (146 images)
- In-ductal_carcinoma (458 images)
- In-adenosis (114 images)
- In-fibroadenoma (241 images)
- In-papillary_carcinoma (136 images)
- In-phylloides_tumor (135 images)

Results

Confidence threshold: 0.1 [0.1-1.0]

Category: In-papillary_carcinoma

Confidence: 0.98712

Normal opacity: 0.0 [0.0-1.0]

[Download heatmap](#)

Diabetic Retinopathy Detection



Use Case Description: Diabetic retinopathy (DR) is the leading cause of blindness. DR will grow from 126 million in 2010 to 191 million by 2030. Comprehensive and automated method of DR screening has long been recognized.

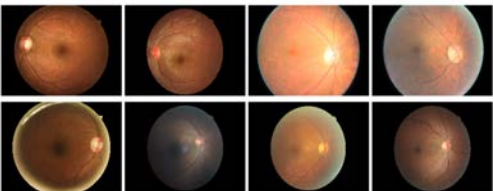
Solution: Create an automatic image classification solution to assist medical diagnosis and research etc.

Dataset: <https://www.kaggle.com/c/diabetic-retinopathy-detection>

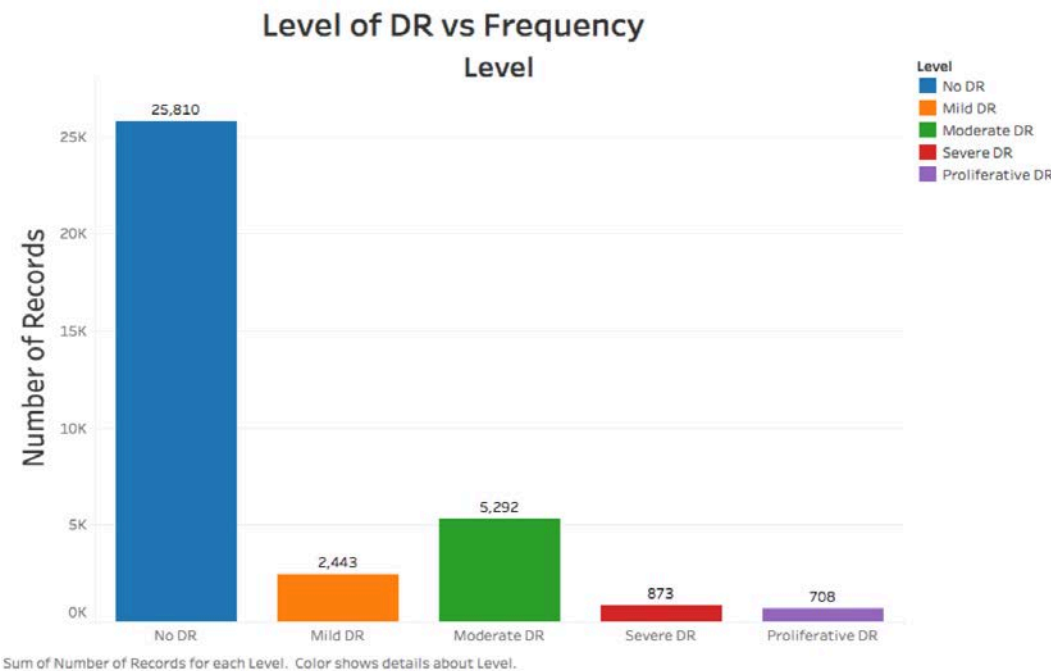
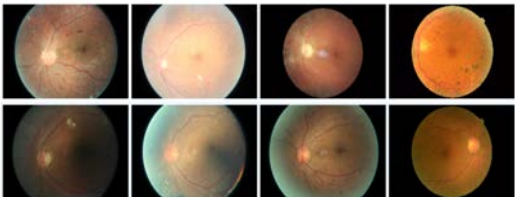
35,000 + images of various classes

- 0 - No DR
- 1 - Mild
- 2 - Moderate
- 3 - Severe
- 4 - Proliferative DR

Class 0



Class 4



Diabetic Retinopathy Detection

Step 1
Prepare Data

Step 2
Generate Dataset

Step 3
Data Augmentation

Step 4
Train Models

Step 5
Deploy Models

Step 6
Inferencing

Catalog large number of data files through **metadata** management. It is almost impossible to manage large number of files manually.

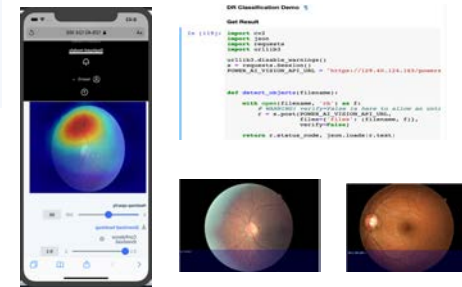
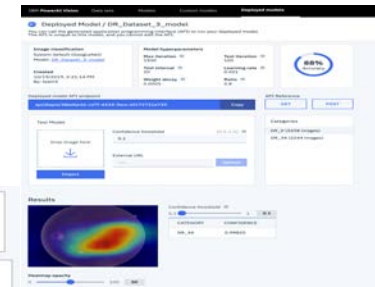
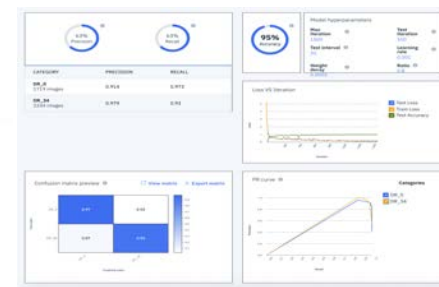
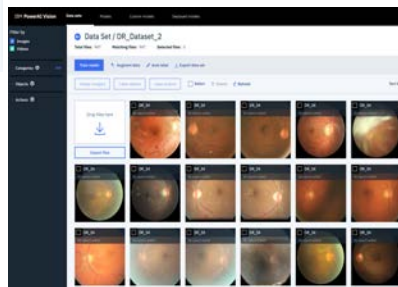
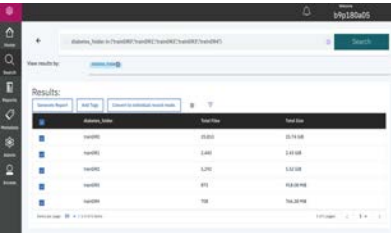
Automatically **select any dataset** and subset for multiple training iterations.

Create dataset with **balanced** categories to improve model accuracy. Simple UI to create new image data.

Automatic model training using **pre-trained model** and **GPU** to scale compute.

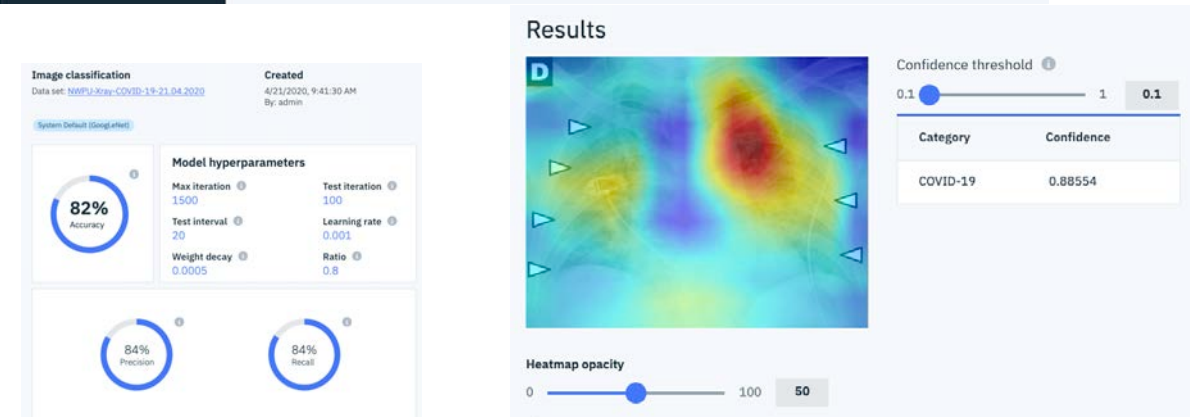
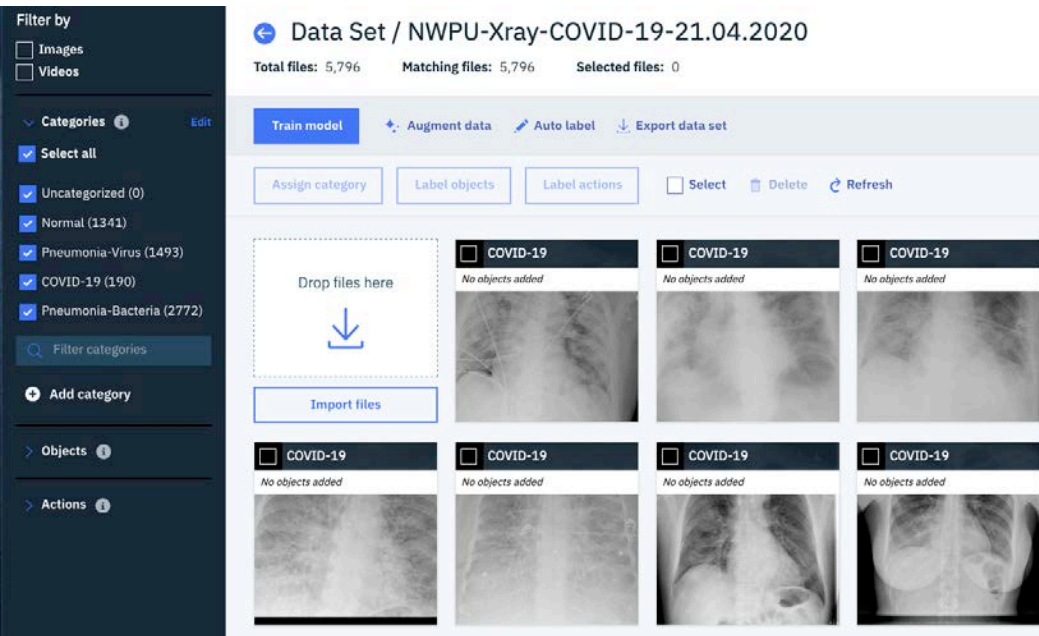
One click model API end-point deployment for any application.

Infuse AI with online (mobile/web app), batch, and real-time streaming process.



Scale up to Fight Covid-19

Covid-19 Research and Diagnosis



Training and Inferencing

patientid
offset
sex
age
finding
survival
intubated
intubation_present
went_icu
needed_supplemental_O2
extubated
temperature
pO2_saturation
leukocyte_count
neutrophil_count
lymphocyte_count
view
modality
date
location
folder
filename
doi
url
license
clinical_notes
other_notes

Covid-19 Research and Diagnosis

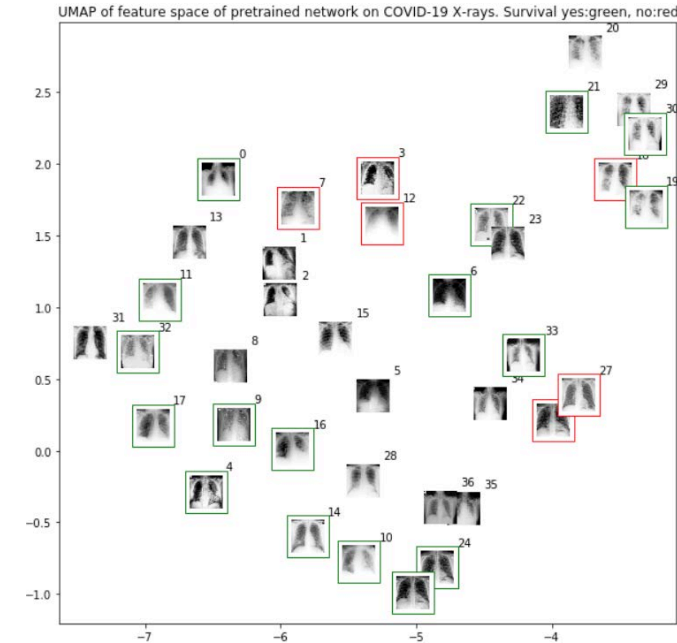
Answer Key Questions from Scientific Literature



- What is known about transmission, incubation, and environmental stability?
- What do we know about COVID-19 risk factors?
- What do we know about virus genetics, origin, and evolution?
- What has been published about medical care?

Source: [Kaggle](#)

Read COVID-19 X-ray or CT image



While PCR tests offer many advantages they are physical things that require shipping the test or the sample. X-ray machines can be plugged in to screen patients as long as they have electricity.

AI tools can help general practitioners to triage and treat patients. Companies are developing AI tools and deploying them at hospitals [Wired 2020](#).

Source: IEEE

Open Issues

- **AI Golden Age:** Big Data, Big Compute, Deep Learning
- **State-of-the-art** deep neural network architectures
 - Supervised pre-training/domain-specific fine-tuning
 - Unsupervised learning – GAN (Generative adversarial network)
 - Data + knowledge
- **Open medical datasets:** From ImageNet to ??
 - Data Labeling and Annotation
 - Data Privacy – Federated Learning
- **High Performance Computing** in FPGA, GPU, or CPU (x86 or P9)
 - Benchmarking – MLPerf – Medical Imaging
 - Model size reduction
 - Deployment on Edge Devices

Questions ?

Twitter: @a9zhang

Email the speaker: andrew.zhang@ibm.com

Call to Action

- Contact Ganesan or AICOC (aicoc@us.ibm.com) for guided lab exercises
 - Collaborate to share data and models for both DR and X-Ray lung Covid-19
 - Looking for PhD students with medical background to develop advanced research on IBM super-computers
 - Post slides on my twitter and Linkedin account
- *Twitter: @a9zhang*
 - *Email the speaker: andrew.zhang@ibm.com*

White House Announces New Partnership to Unleash U.S. Supercomputing Resources to Fight COVID-19

— HEALTHCARE | Issued on: March 23, 2020

STATEMENTS & RELEASES

Call to Action to the Tech Community on New Machine Readable COVID-19 Dataset

— HEALTHCARE | Issued on: March 16, 2020



r/COVIDProjects

References

1. [Rapid AI Development Cycle for the Coronavirus \(COVID-19\) Pandemic: Initial Results for Automated Detection & Patient Monitoring using Deep Learning CT Image Analysis](#)
2. [COVID-19 Screening on Chest X-ray Images Using Deep Learning based Anomaly Detection](#)
3. [Vendors debut AI X-ray system for COVID-19, give it away for free](#)
4. [How Does COVID-19 Appear in the Lungs?](#)
5. [COVID-19](#)

