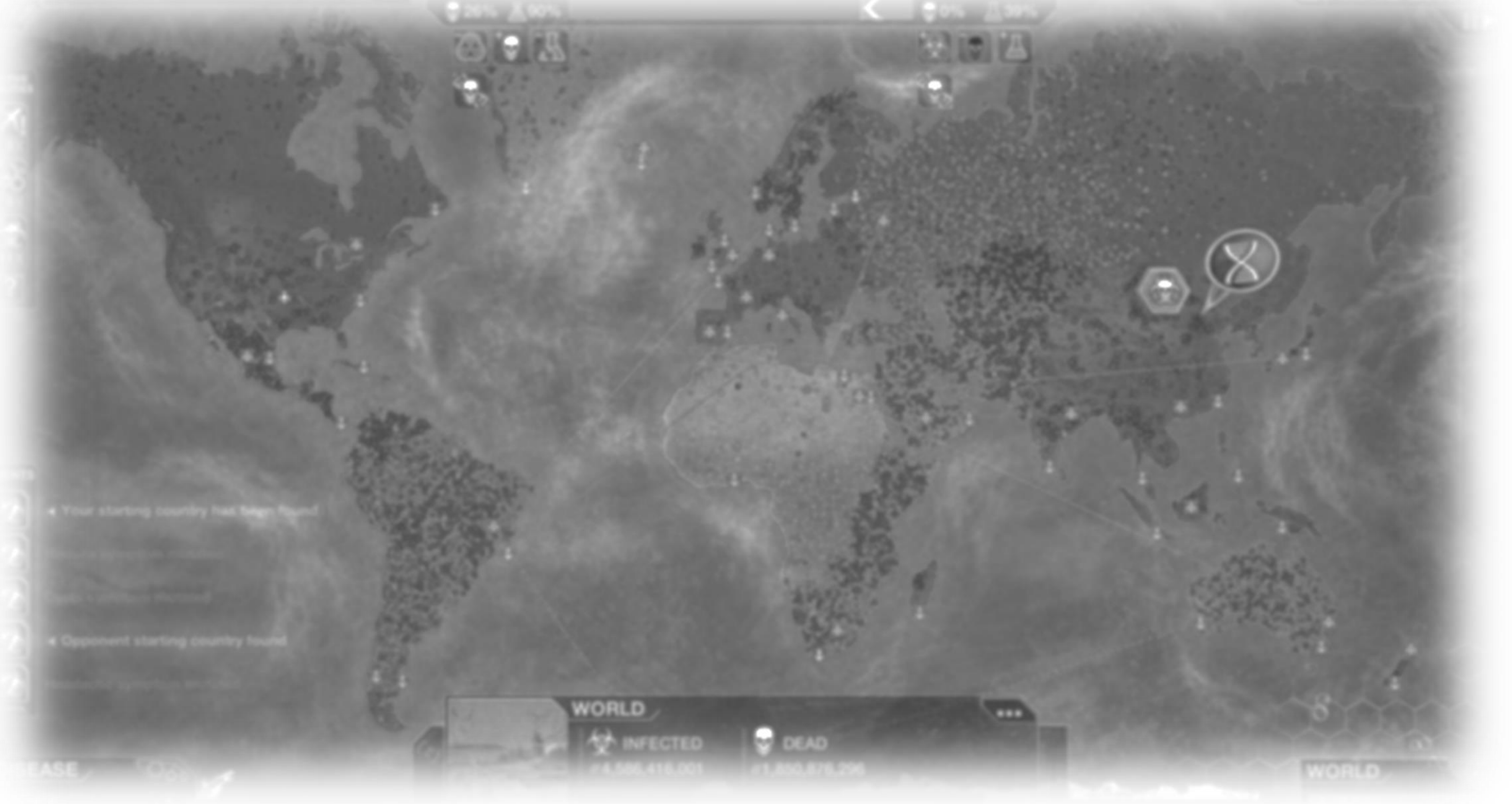

Your starting country has been found
Opponent starting country found
WORLD
INFECTED
DEAD
WORLD

Pneumonia Diagnosis using CNN

https://www.forbes.com/sites/mattperez/2020/02/27/china-removed-epidemic-themed-game-plague-inc-from-the-china-app-store

To be able to classify patients with Pneumonia through a Chest X-Ray:

using a CNN architecture

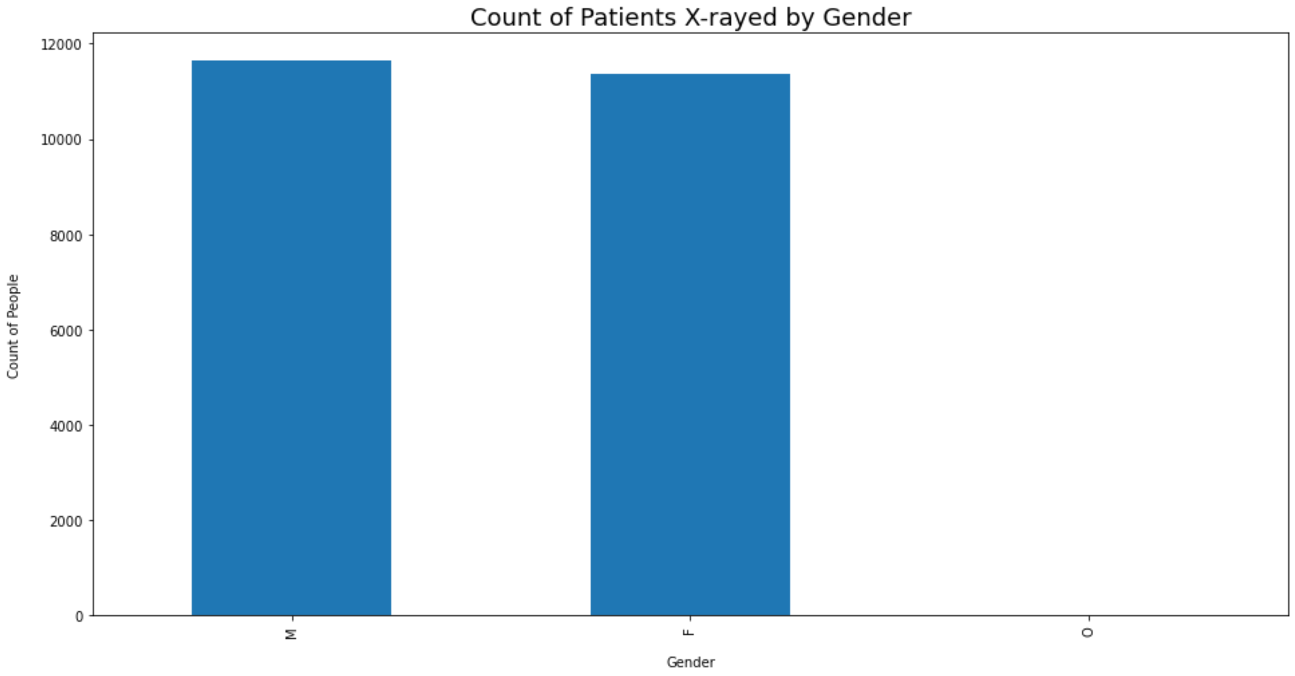
Problem Statement

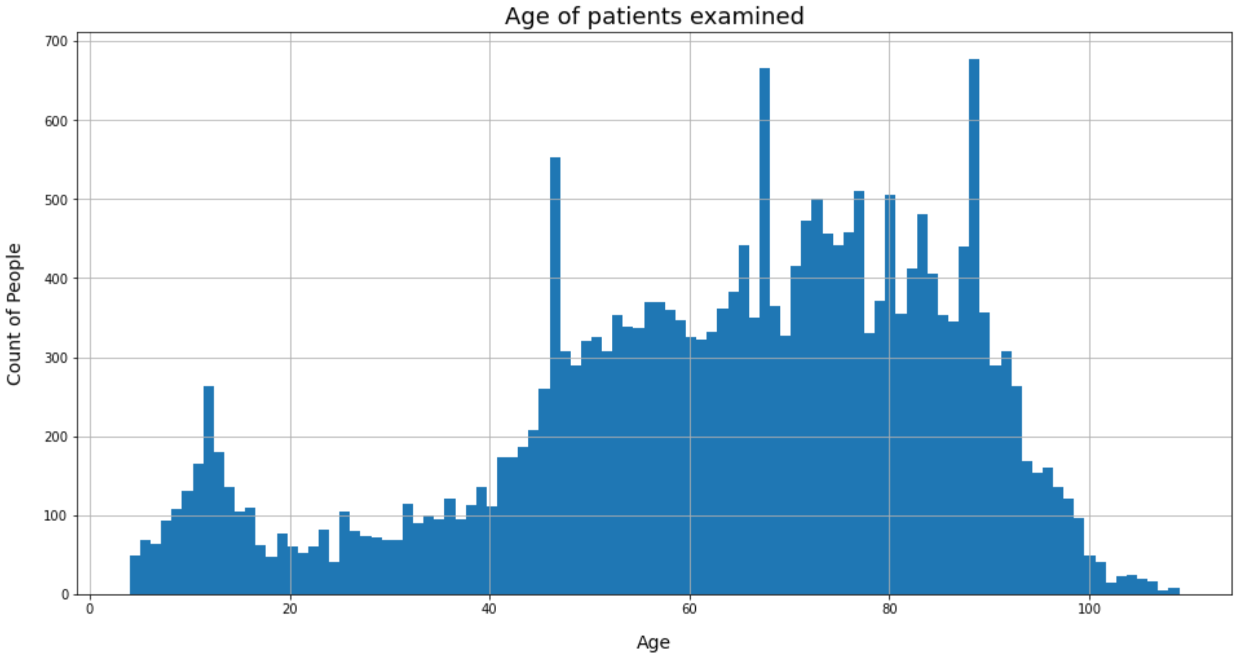
BIMCV
Medical Imaging Databank
of the Valencia Region

GENERALITAT
VALENCIANA

Fundació per al Foment de la
Investigació Sanitària i Biomèdica
de la Comunitat Valenciana

UNIÓN EUROPEA
Fondo Europeo de
Desarrollo Regional
Una manera de hacer Europa

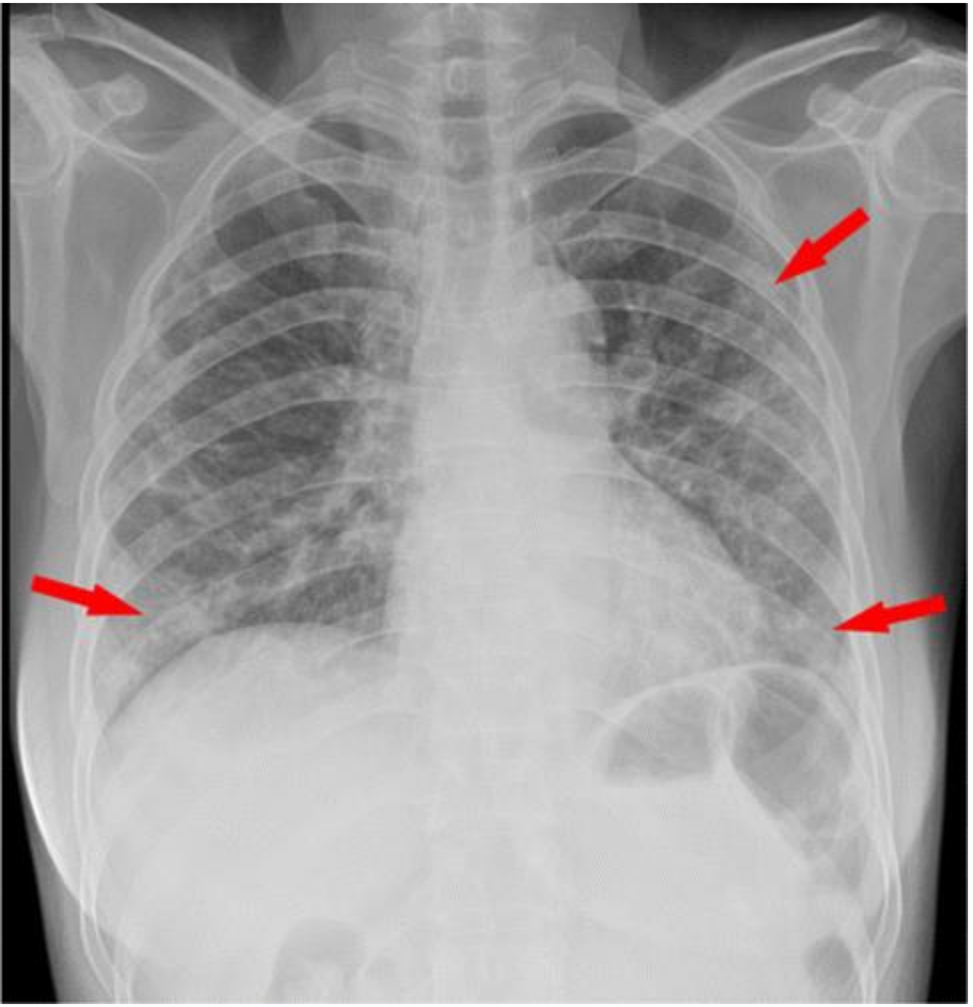

Count of Patients X-rayed by Gender


Age of patients examined

13114 patients
23024 X-Ray images
Mean Patient age:63

EDA on BIMCV-COVID-19 Dataset

Source: https://github.com/BIMCV-CSUSP/BIMCV-COVID-19



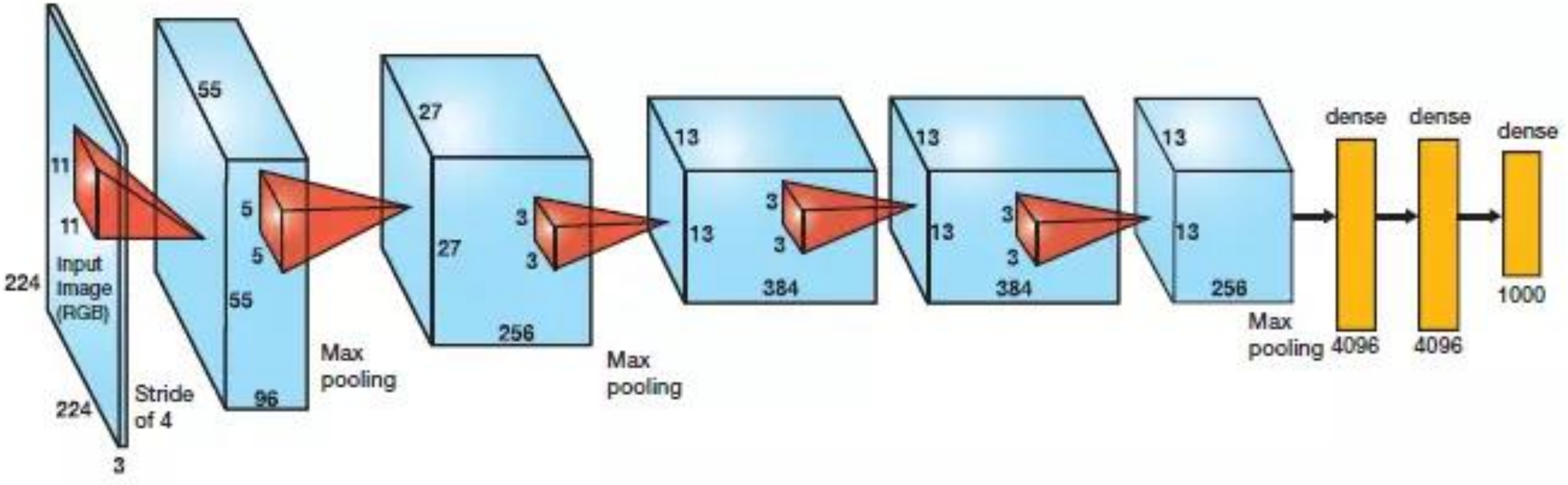
Resizing to 524 x 524

Rotation of Images

Dropping of blurry or otherwise invalid images

Pre-processing

https://cv-tricks.com/cnn/understand-resnet-alexnet-vgg-inception/



AlexNet’s novel features:

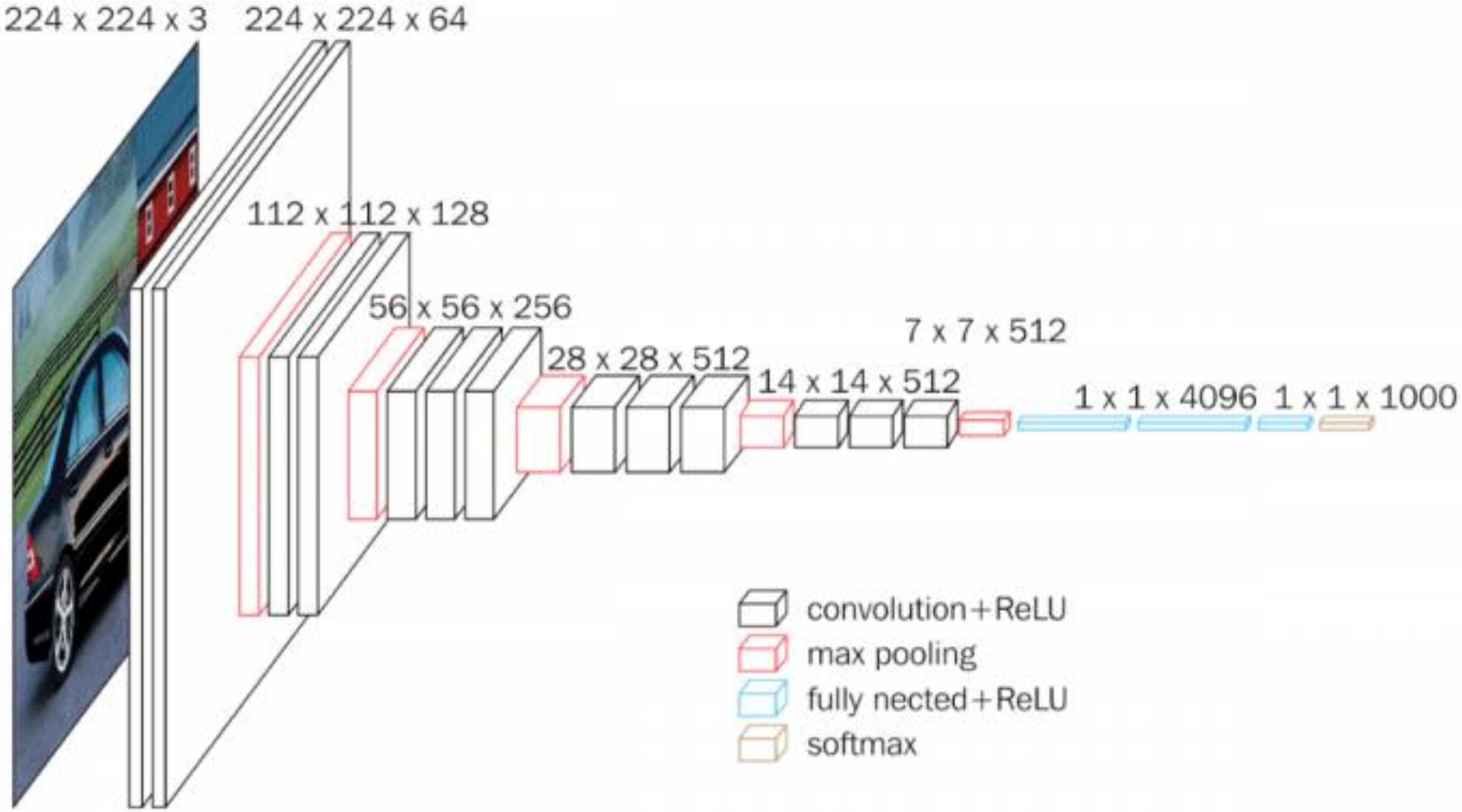
ReLu(Rectified Linear Unit)- counters vanishing gradient problem

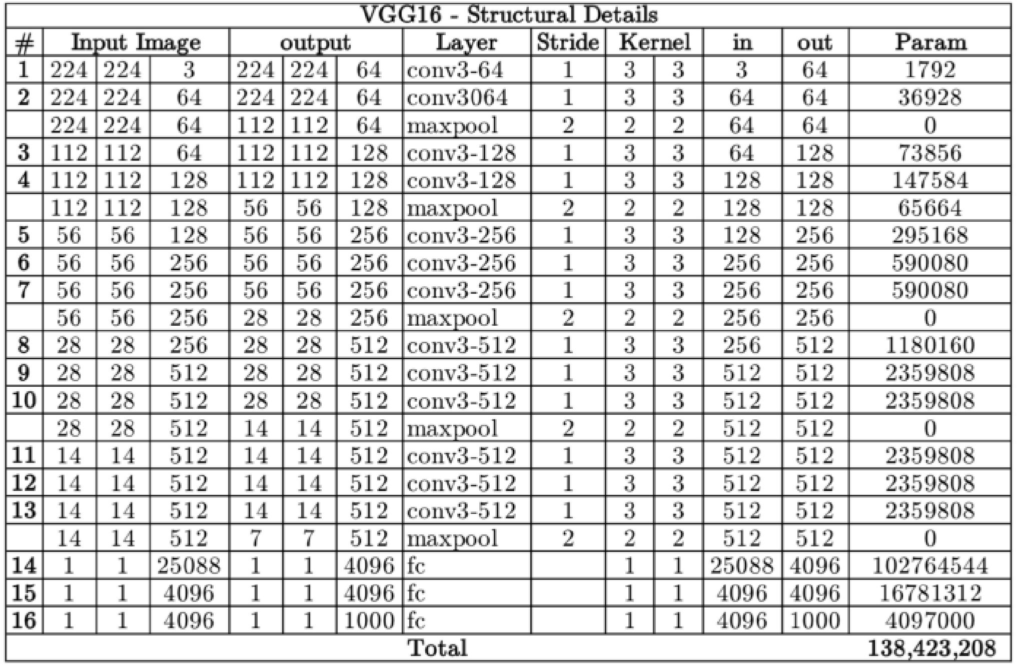
Dropout Layers introduced- counters overfitting

CNN Architectures

CNN –VGG16

https://www.pyimagesearch.com/2017/03/20/imagenet-vggnet-resnet-inception-xception-keras/





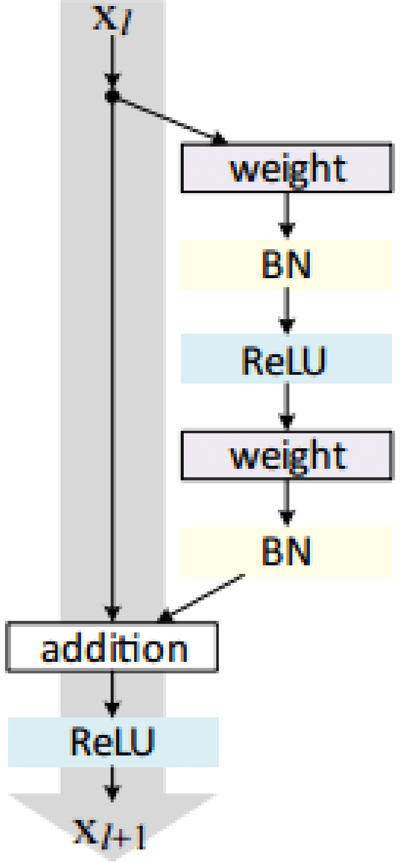
VGG16 - Structural Details													
#	Input Image			output			Layer	Stride	Kernel		in	out	Param
1	224	224	3	224	224	64	conv3-64	1	3	3	3	64	1792
2	224	224	64	224	224	64	conv3064	1	3	3	64	64	36928
	224	224	64	112	112	64	maxpool	2	2	2	64	64	0
3	112	112	64	112	112	128	conv3-128	1	3	3	64	128	73856
4	112	112	128	112	112	128	conv3-128	1	3	3	128	128	147584
	112	112	128	56	56	128	maxpool	2	2	2	128	128	65664
5	56	56	128	56	56	256	conv3-256	1	3	3	128	256	295168
6	56	56	256	56	56	256	conv3-256	1	3	3	256	256	590080
7	56	56	256	56	56	256	conv3-256	1	3	3	256	256	590080
	56	56	256	28	28	256	maxpool	2	2	2	256	256	0
8	28	28	256	28	28	512	conv3-512	1	3	3	256	512	1180160
9	28	28	512	28	28	512	conv3-512	1	3	3	512	512	2359808
10	28	28	512	28	28	512	conv3-512	1	3	3	512	512	2359808
	28	28	512	14	14	512	maxpool	2	2	2	512	512	0
11	14	14	512	14	14	512	conv3-512	1	3	3	512	512	2359808
12	14	14	512	14	14	512	conv3-512	1	3	3	512	512	2359808
13	14	14	512	14	14	512	conv3-512	1	3	3	512	512	2359808
	14	14	512	7	7	512	maxpool	2	2	2	512	512	0
14	1	1	25088	1	1	4096	fc		1	1	25088	4096	102764544
15	1	1	4096	1	1	4096	fc		1	1	4096	4096	16781312
16	1	1	4096	1	1	1000	fc		1	1	4096	1000	4097000
							Total						**138,423,208**

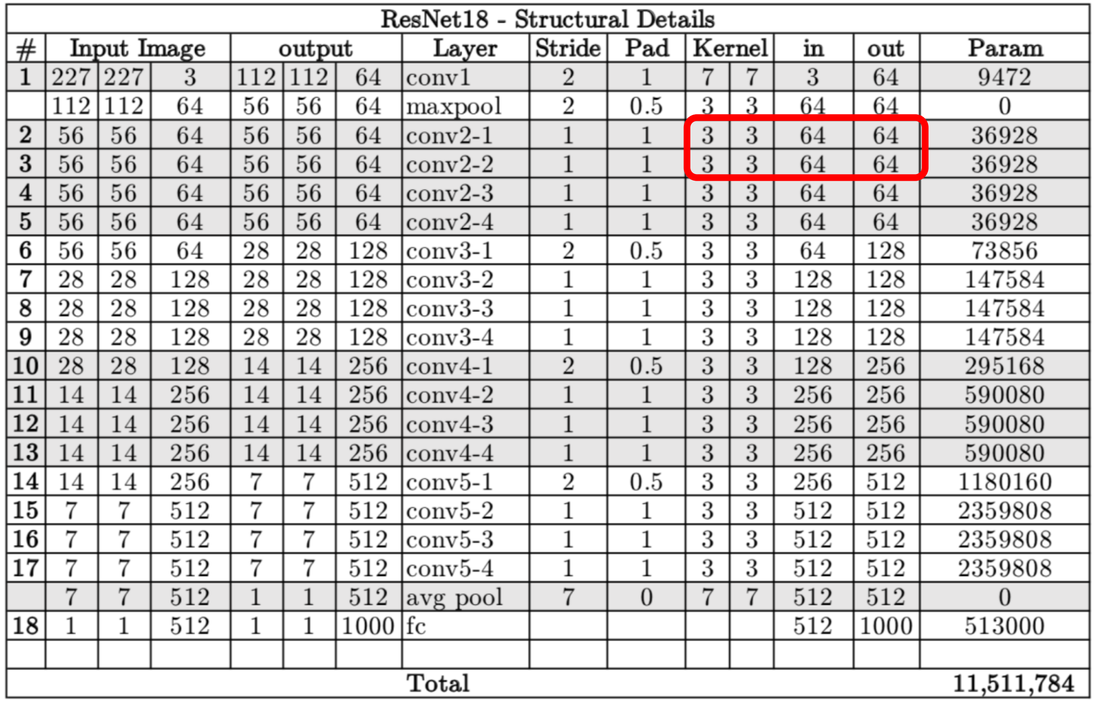
Replacing large kernel-sized filters with multiple 3X3 kernel-sized filters one after another.

ImageNet: pre-training

CNN – ResidualNet50

https://www.pyimagesearch.com/2017/03/20/imagenet-vggnet-resnet-inception-xception-keras/





ResNet18 - Structural Details

#	Input Image			output			Layer	Stride	Pad	Kernel		in	out	Param
1	227	227	3	112	112	64	conv1	2	1	7	7	3	64	9472
	112	112	64	56	56	64	maxpool	2	0.5	3	3	64	64	0
2	56	56	64	56	56	64	conv2-1	1	1	3	3	64	64	36928
3	56	56	64	56	56	64	conv2-2	1	1	3	3	64	64	36928
4	56	56	64	56	56	64	conv2-3	1	1	3	3	64	64	36928
5	56	56	64	56	56	64	conv2-4	1	1	3	3	64	64	36928
6	56	56	64	28	28	128	conv3-1	2	0.5	3	3	64	128	73856
7	28	28	128	28	28	128	conv3-2	1	1	3	3	128	128	147584
8	28	28	128	28	28	128	conv3-3	1	1	3	3	128	128	147584
9	28	28	128	28	28	128	conv3-4	1	1	3	3	128	128	147584
10	28	28	128	14	14	256	conv4-1	2	0.5	3	3	128	256	295168
11	14	14	256	14	14	256	conv4-2	1	1	3	3	256	256	590080
12	14	14	256	14	14	256	conv4-3	1	1	3	3	256	256	590080
13	14	14	256	14	14	256	conv4-4	1	1	3	3	256	256	590080
14	14	14	256	7	7	512	conv5-1	2	0.5	3	3	256	512	1180160
15	7	7	512	7	7	512	conv5-2	1	1	3	3	512	512	2359808
16	7	7	512	7	7	512	conv5-3	1	1	3	3	512	512	2359808
17	7	7	512	7	7	512	conv5-4	1	1	3	3	512	512	2359808
	7	7	512	1	1	512	avg pool	7	0	7	7	512	512	0
18	1	1	512	1	1	1000	fc					512	1000	513000
							Total							11,511,784

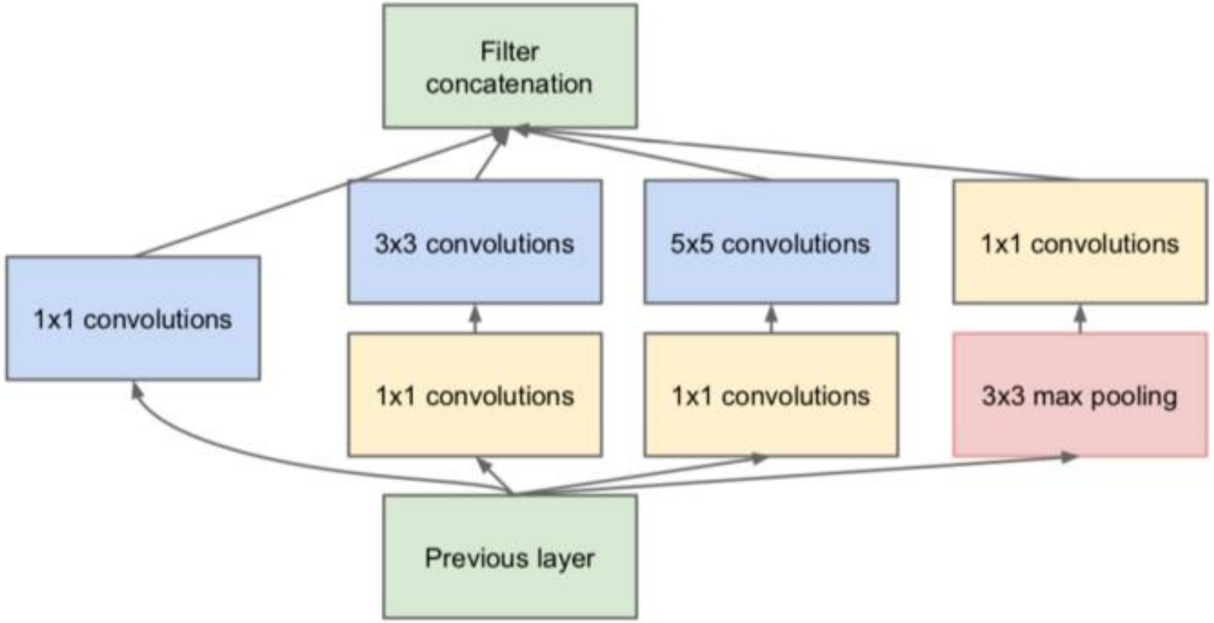
Identity Connections: shortcuts

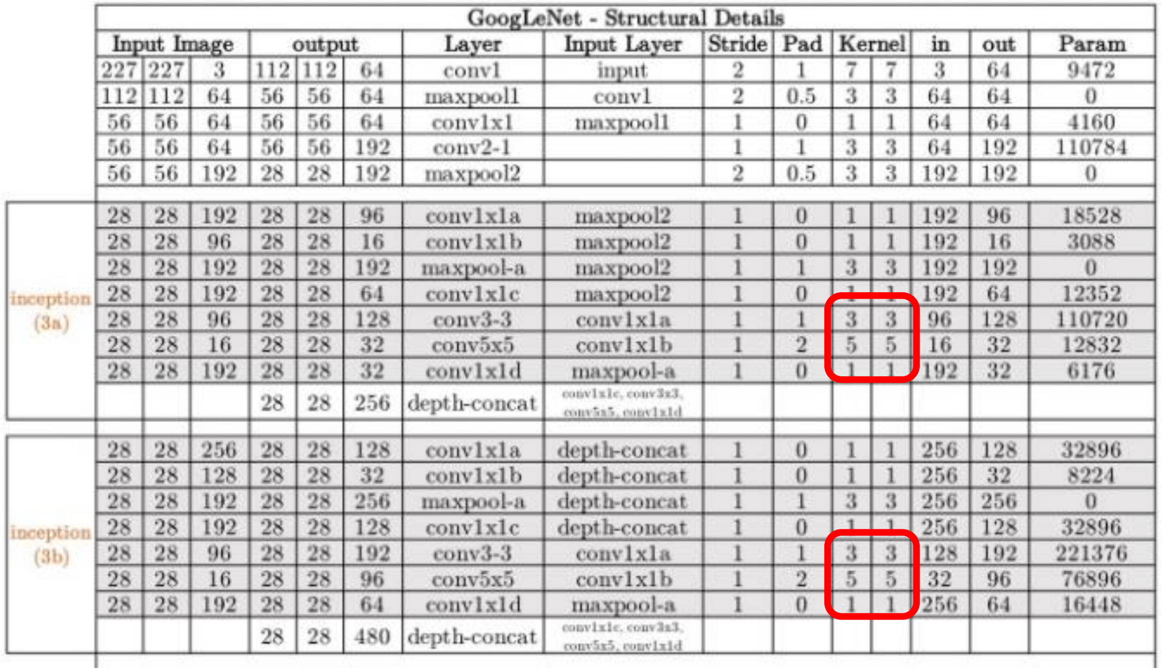
Retains many of the 3x3 layers

ImageNet: pre-training

CNN - InceptionNet

Source:https://towardsdatascience.com/the-w3h-of-alexnet-vggnet-resnet-and-inception-7baaaecccc96





GoogLeNet - Structural Details

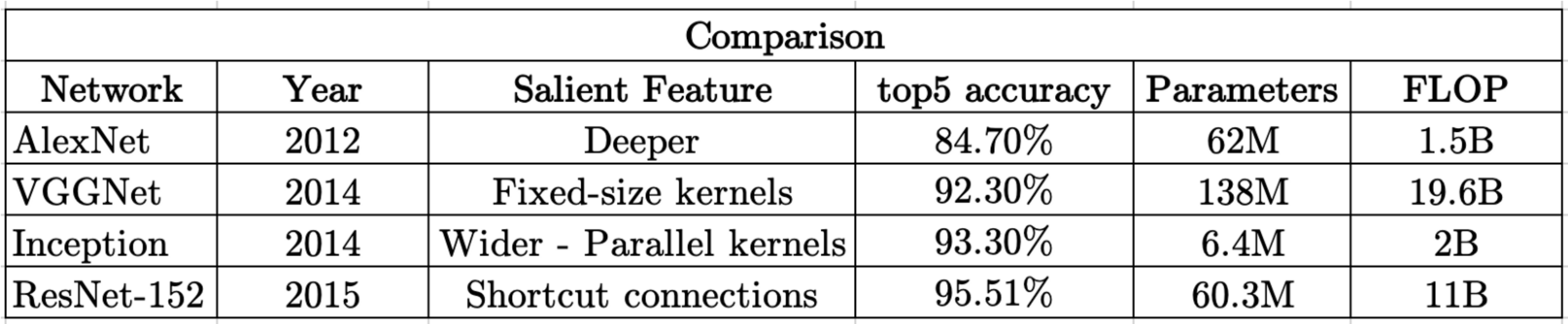
	Input Image			output			Layer	Input Layer	Stride	Pad	Kernel		in	out	Param
	227	227	3	112	112	64	conv1	input	2	1	7	7	3	64	9472
	112	112	64	56	56	64	maxpool1	conv1	2	0.5	3	3	64	64	0
	56	56	64	56	56	64	conv1x1	maxpool1	1	0	1	1	64	64	4160
	56	56	64	56	56	192	conv2-1		1	1	3	3	64	192	110784
	56	56	192	28	28	192	maxpool2		2	0.5	3	3	192	192	0
inception (3a)	28	28	192	28	28	96	conv1x1a	maxpool2	1	0	1	1	192	96	18528
	28	28	96	28	28	16	conv1x1b	maxpool2	1	0	1	1	192	16	3088
	28	28	192	28	28	192	maxpool-a	maxpool2	1	1	3	3	192	192	0
	28	28	192	28	28	64	conv1x1c	maxpool2	1	0	1	1	192	64	12352
	28	28	96	28	28	128	conv3-3	conv1x1a	1	1	3	3	96	128	110720
	28	28	16	28	28	32	conv5x5	conv1x1b	1	2	5	5	16	32	12832
	28	28	192	28	28	32	conv1x1d	maxpool-a	1	0	1	1	192	32	6176
				28	28	256	depth-concat	conv1x1c, conv3x3, conv5x5, conv1x1d							
inception (3b)	28	28	256	28	28	128	conv1x1a	depth-concat	1	0	1	1	256	128	32896
	28	28	128	28	28	32	conv1x1b	depth-concat	1	0	1	1	256	32	8224
	28	28	192	28	28	256	maxpool-a	depth-concat	1	1	3	3	256	256	0
	28	28	192	28	28	128	conv1x1c	depth-concat	1	0	1	1	256	128	32896
	28	28	96	28	28	192	conv3-3	conv1x1a	1	1	3	3	128	192	221376
	28	28	16	28	28	96	conv5x5	conv1x1b	1	2	5	5	32	96	76896
	28	28	192	28	28	64	conv1x1d	maxpool-a	1	0	1	1	256	64	16448
				28	28	480	depth-concat	conv1x1c, conv3x3, conv5x5, conv1x1d							

Simultaneous 3x3, 5x5, and 1x1 neural nets

Retains many of the 3x3 layers

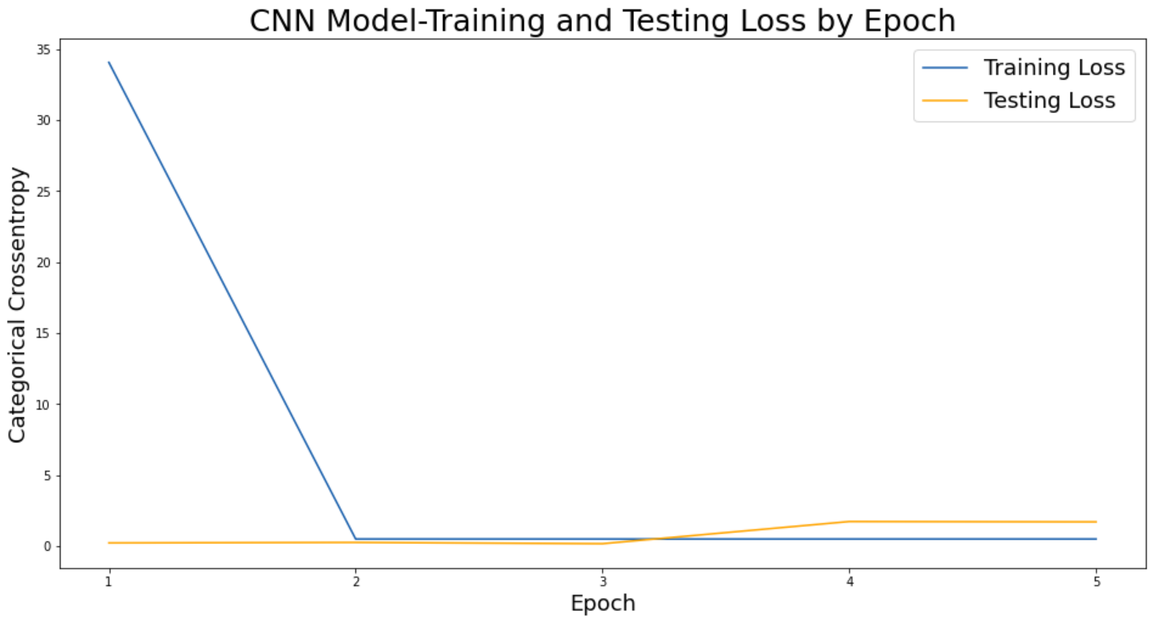
ImageNet: pre-training

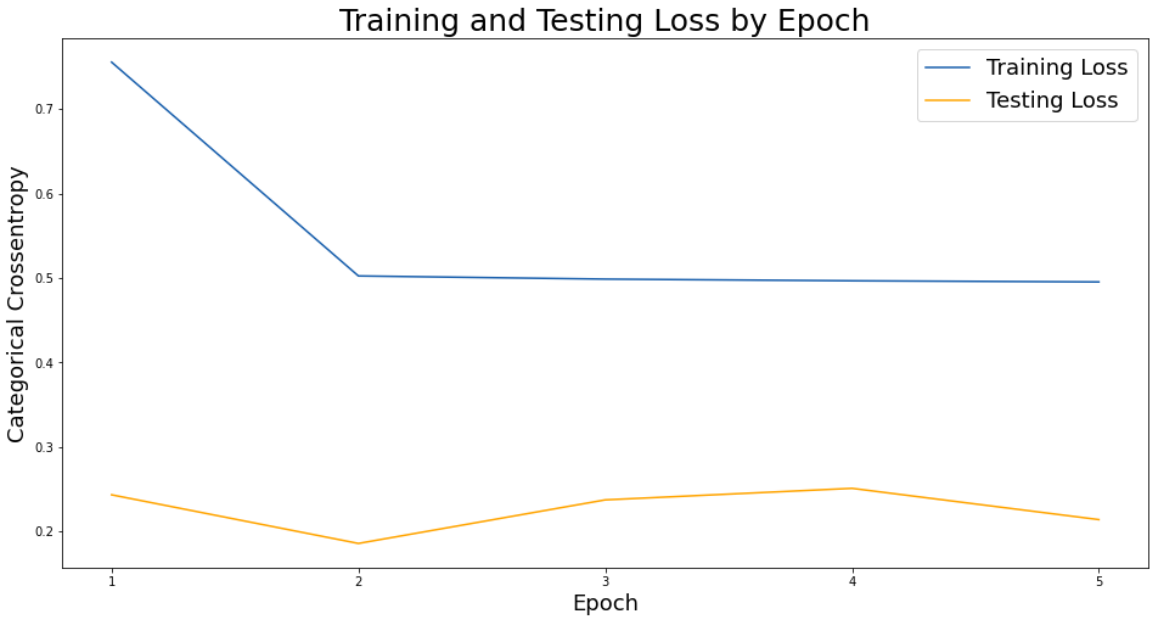
Source:https://towardsdatascience.com/the-w3h-of-alexnet-vggnet-resnet-and-inception-7baaaecccc96

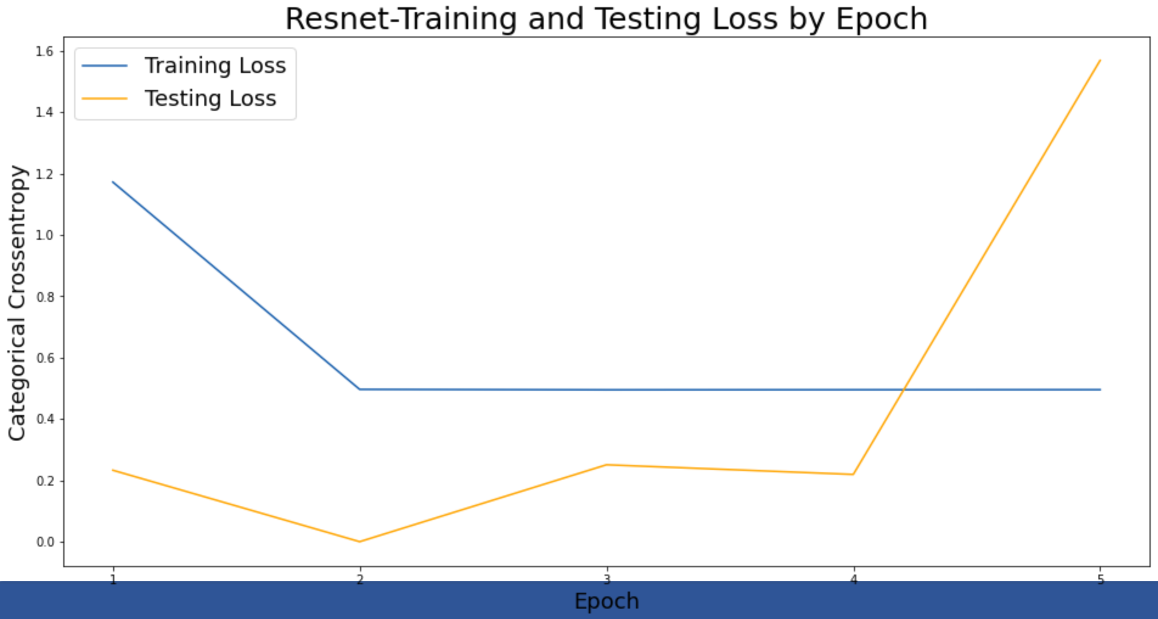


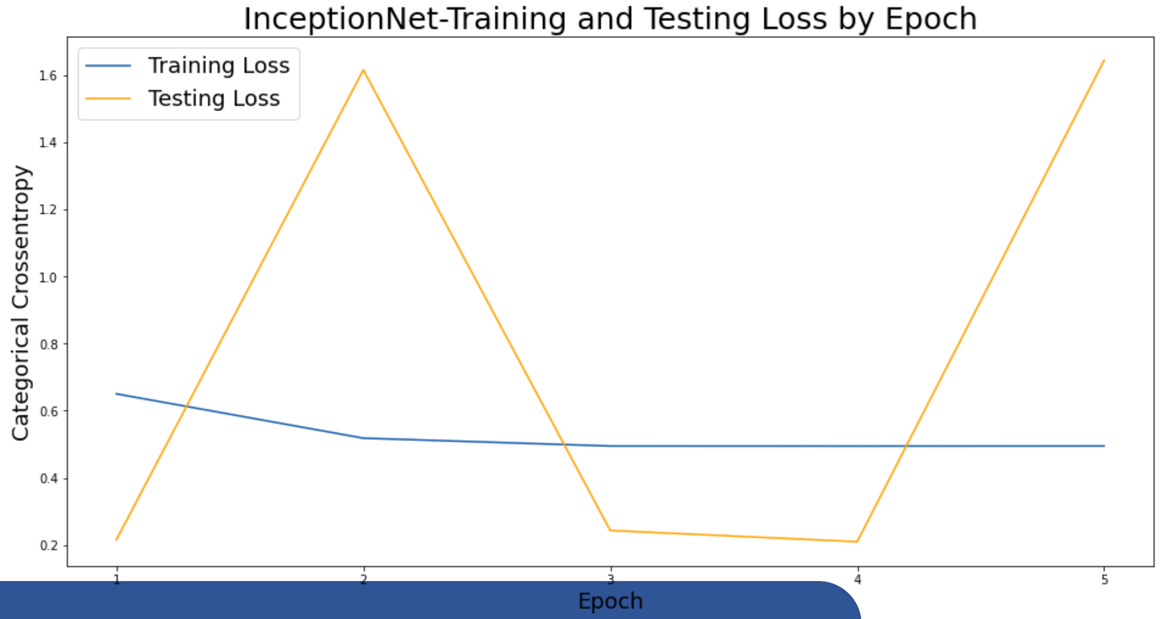
Comparison					
Network	Year	Salient Feature	top5 accuracy	Parameters	FLOP
AlexNet	2012	Deeper	84.70%	62M	1.5B
VGGNet	2014	Fixed-size kernels	92.30%	138M	19.6B
Inception	2014	Wider - Parallel kernels	93.30%	6.4M	2B
ResNet-152	2015	Shortcut connections	95.51%	60.3M	11B

Model Comparison



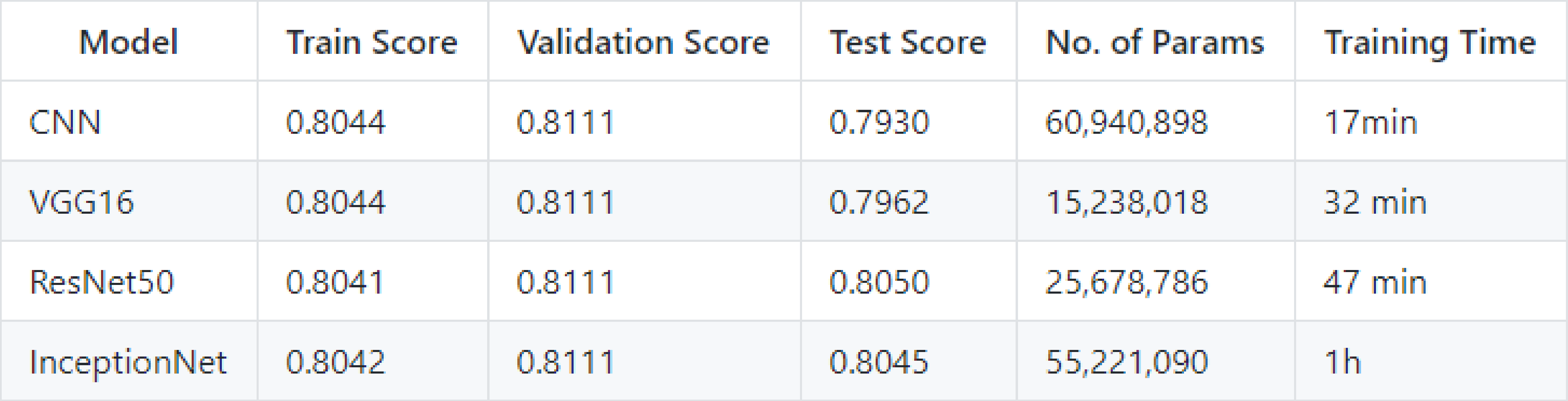






Model Comparison – COVID

Model Comparison – COVID



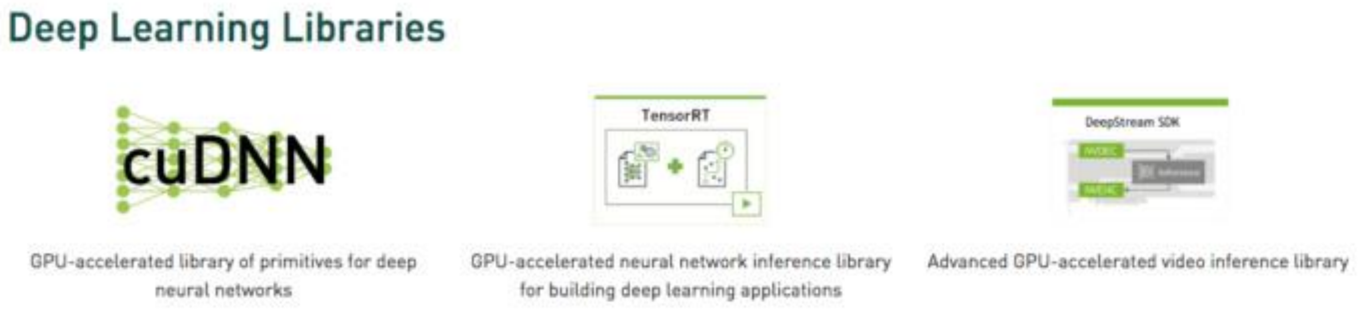
Model	Train Score	Validation Score	Test Score	No. of Params	Training Time
CNN	0.8044	0.8111	0.7930	60,940,898	17min
VGG16	0.8044	0.8111	0.7962	15,238,018	32 min
ResNet50	0.8041	0.8111	0.8050	25,678,786	47 min
InceptionNet	0.8042	0.8111	0.8045	55,221,090	1h

Question Time

CUDA

Chip: GP104
CUDA Cores: 2432
RAM: 8 GB GDDR5

Source: https://www.nvidia.com/en-sg/geforce/products/10series/geforce-gtx-1070-ti/



Deep Learning Libraries

GPU-accelerated library of primitives for deep neural networks

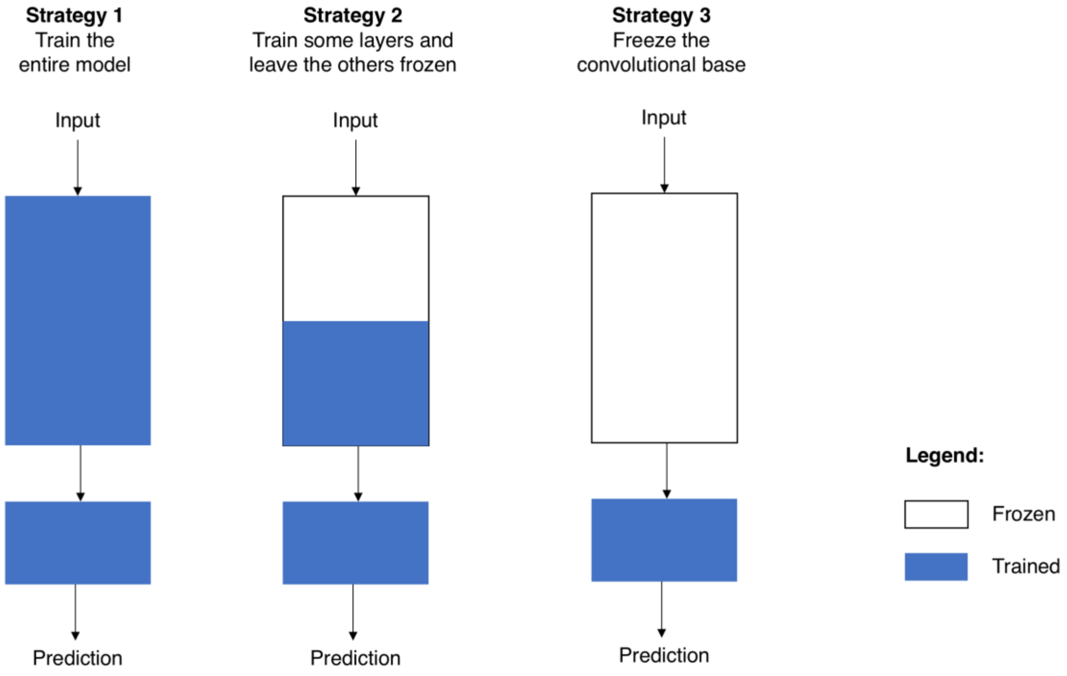
GPU-accelerated neural network inference library for building deep learning applications

Advanced GPU-accelerated video inference library

Other than TensorFlow, many other DL frameworks rely on CUDA for their GPU support:

Caffe2
CNTK
Databricks
H2O.ai
Keras
MXNet
PyTorch
Theano
Torch

Transfer Learning



- Select a pre-trained model
- Classify your problem according to the Size-Similarity Matrix
- Fine-tune your model

Source: https://towardsdatascience.com/transfer-learning-from-pre-trained-models-f2393f124751