Deep Learning Group Project

COVID-19 Detection based on Breathing Sounds

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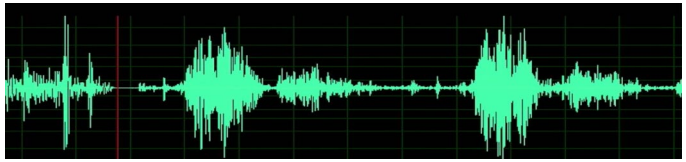
Problem Statement

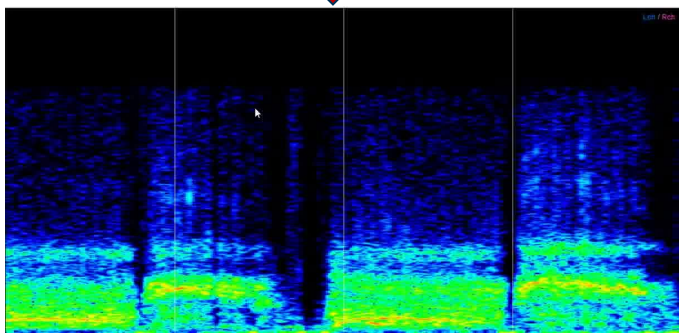
Can COVID-19 be detected based on breathing sounds using a neural network?

Approach

Does this belong to a covid19 or non-covid19 patient?

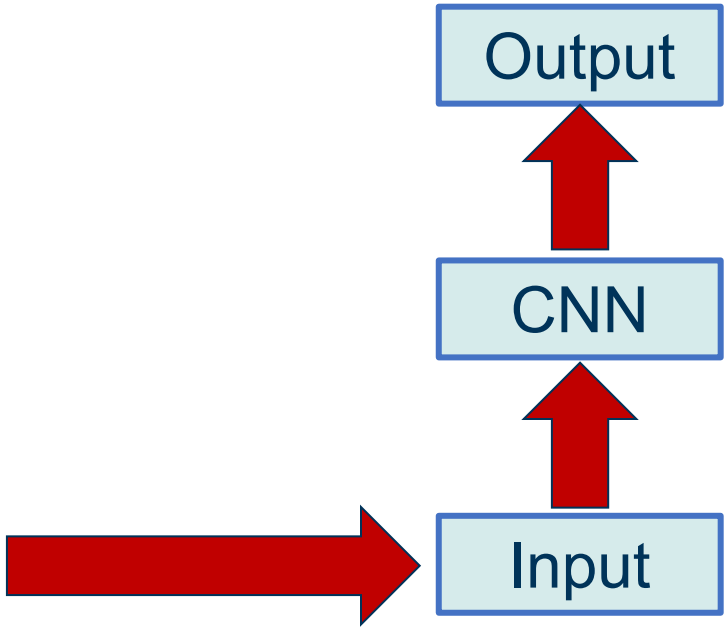


Audio sample of breathing sound



Spectogram of breathing sound

covid19 or non-covid19?



Our approach at a glance

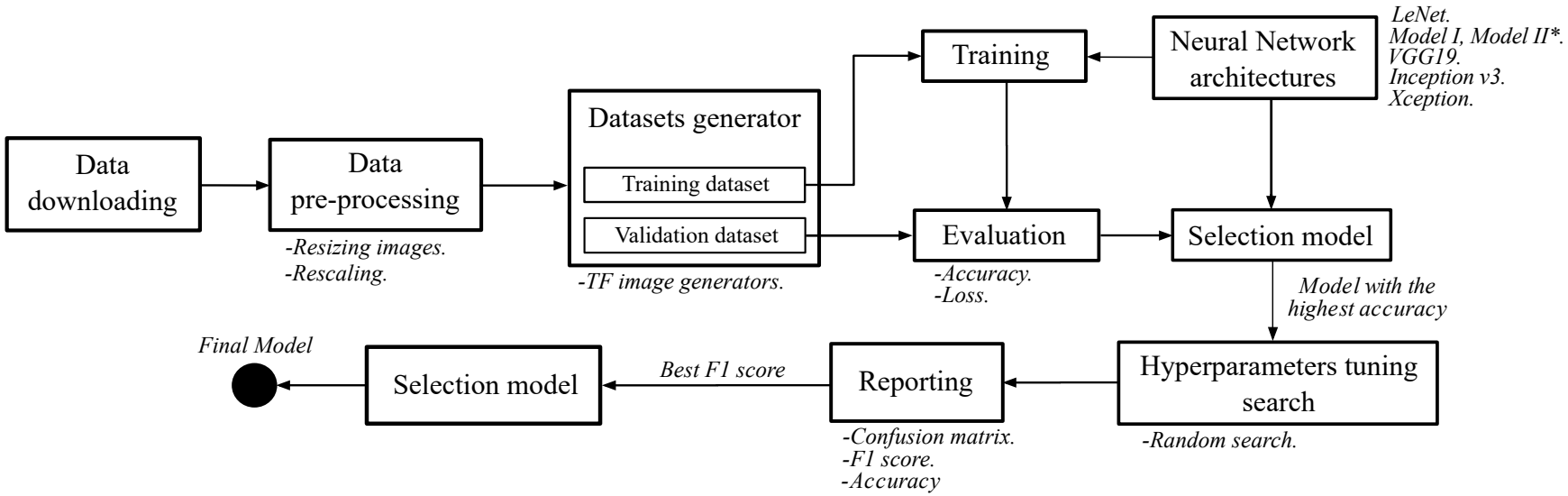


Fig 1. General view of the Pipeline applied for the Covid-19 detection project. *Proposed by authors of this document.

Neural network proposed by us

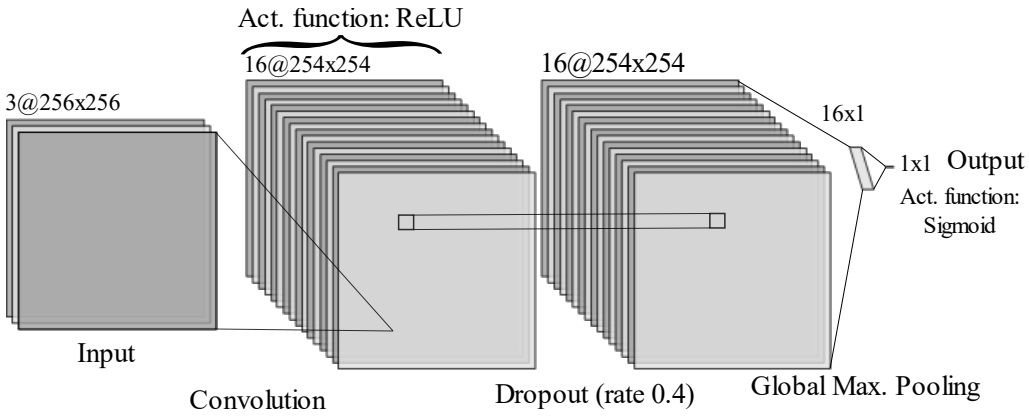


Fig 2. Architecture diagram for Model I.

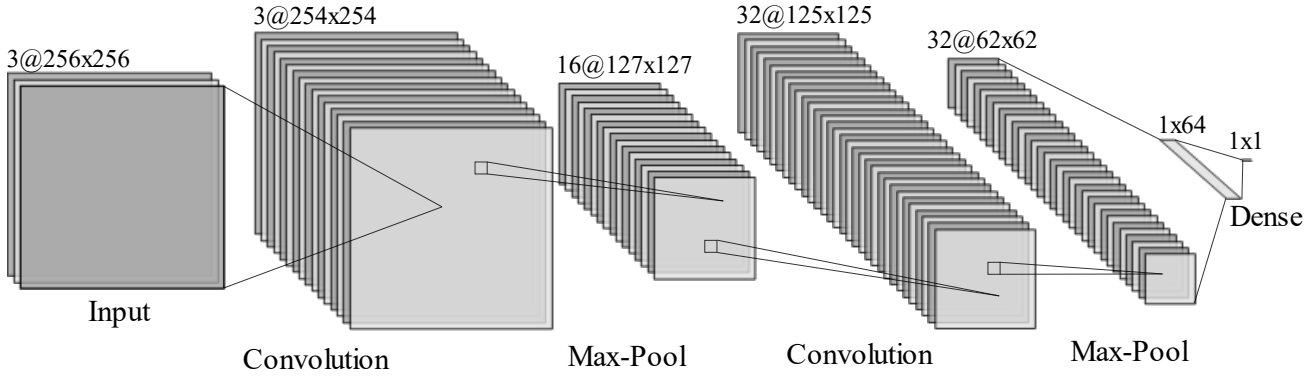


Fig 3. Architecture diagram for Model II.

Evaluation using learning curves

The ideal learning curves

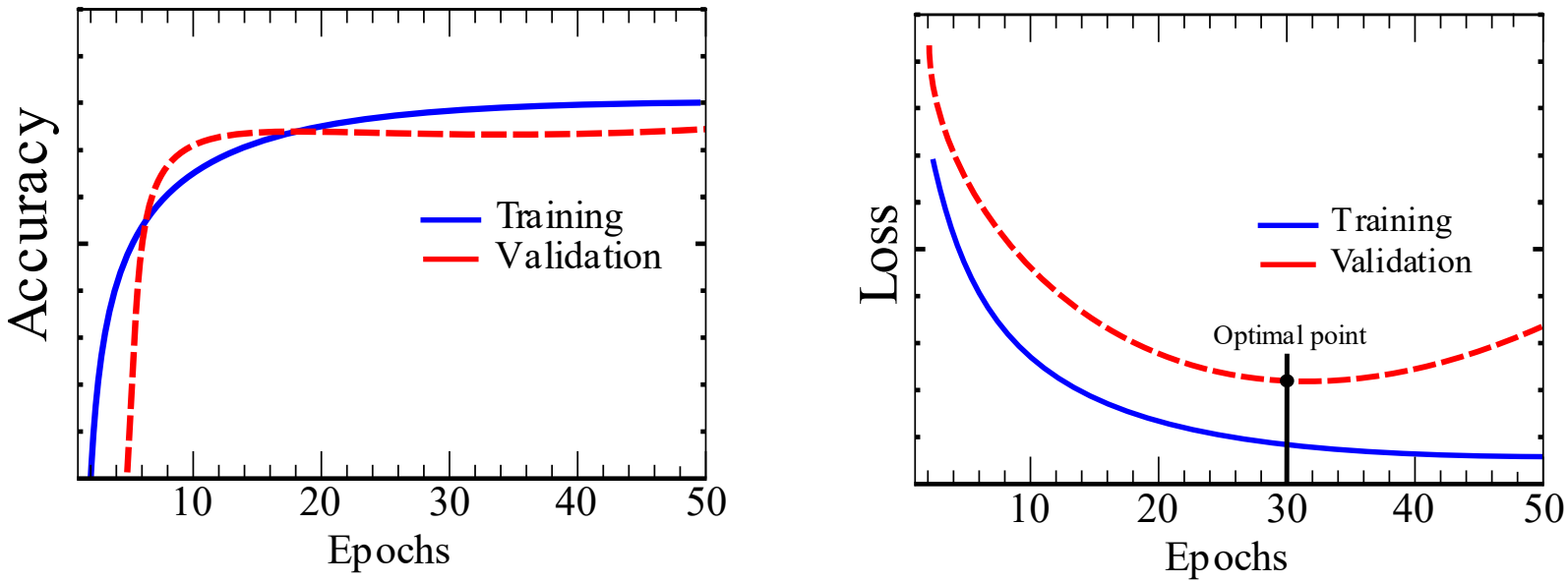


Fig 4. Ideal or expected Learning Curves in Machine Learning domain.

Results

Image size matters

TABLE I. NOMENCLATURE‘S EQUIVALENCE

Nomenclature	A1	A2	A3	A4	A5	A6	A7
Arch. Name	LeNet (orig.)	LeNet(mod.)	Model I	Model II	VGG19	Inception v3	Xception

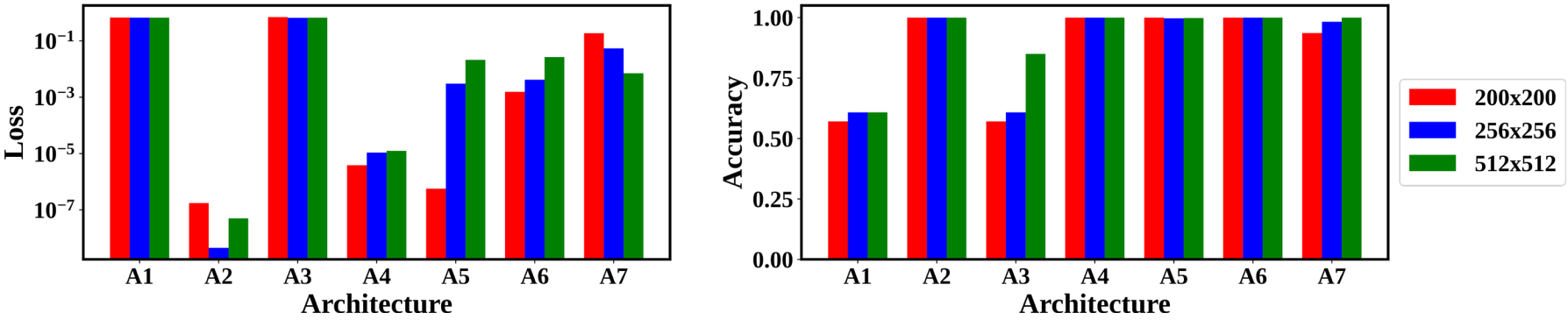


Fig 5. Loss and accuracy for models trained with images with different sizes.

Bigger images (512x512) tend to increase the accuracy in the trained models compared with small ones (200x200).

Results

Image size for training : 256x256

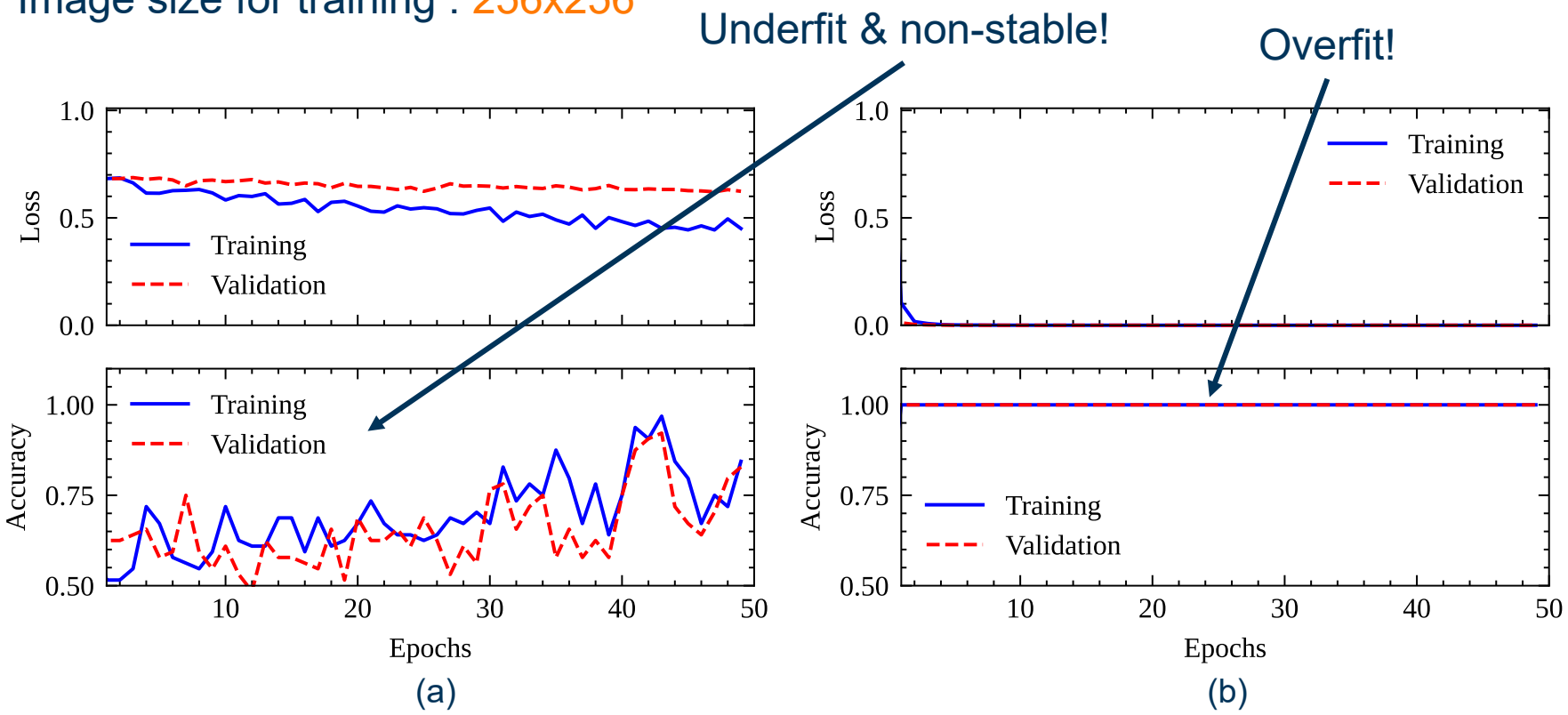


Fig 6. Learning curves for Model I (a) and Model II (b).

Results

Image size for training : 256x256

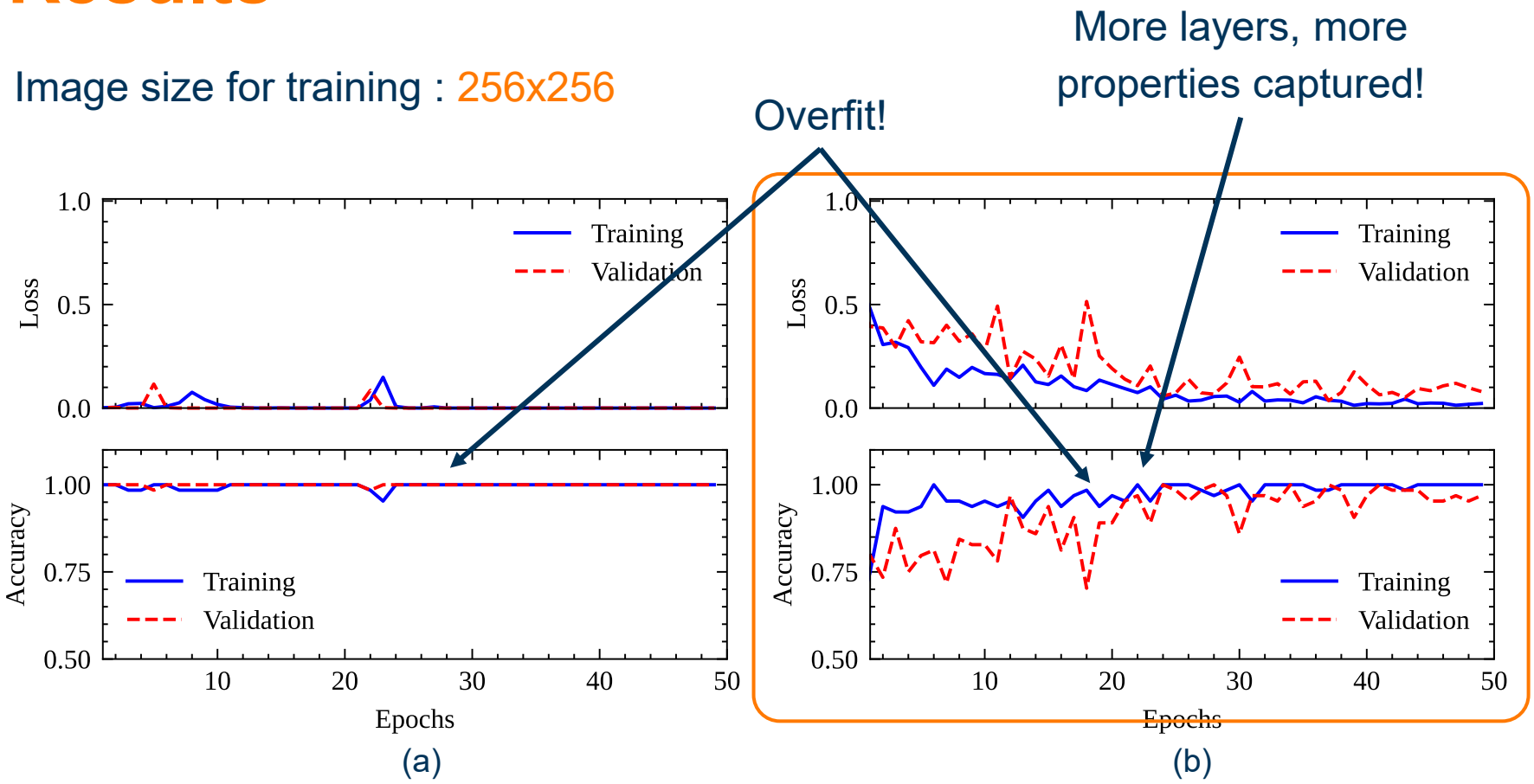
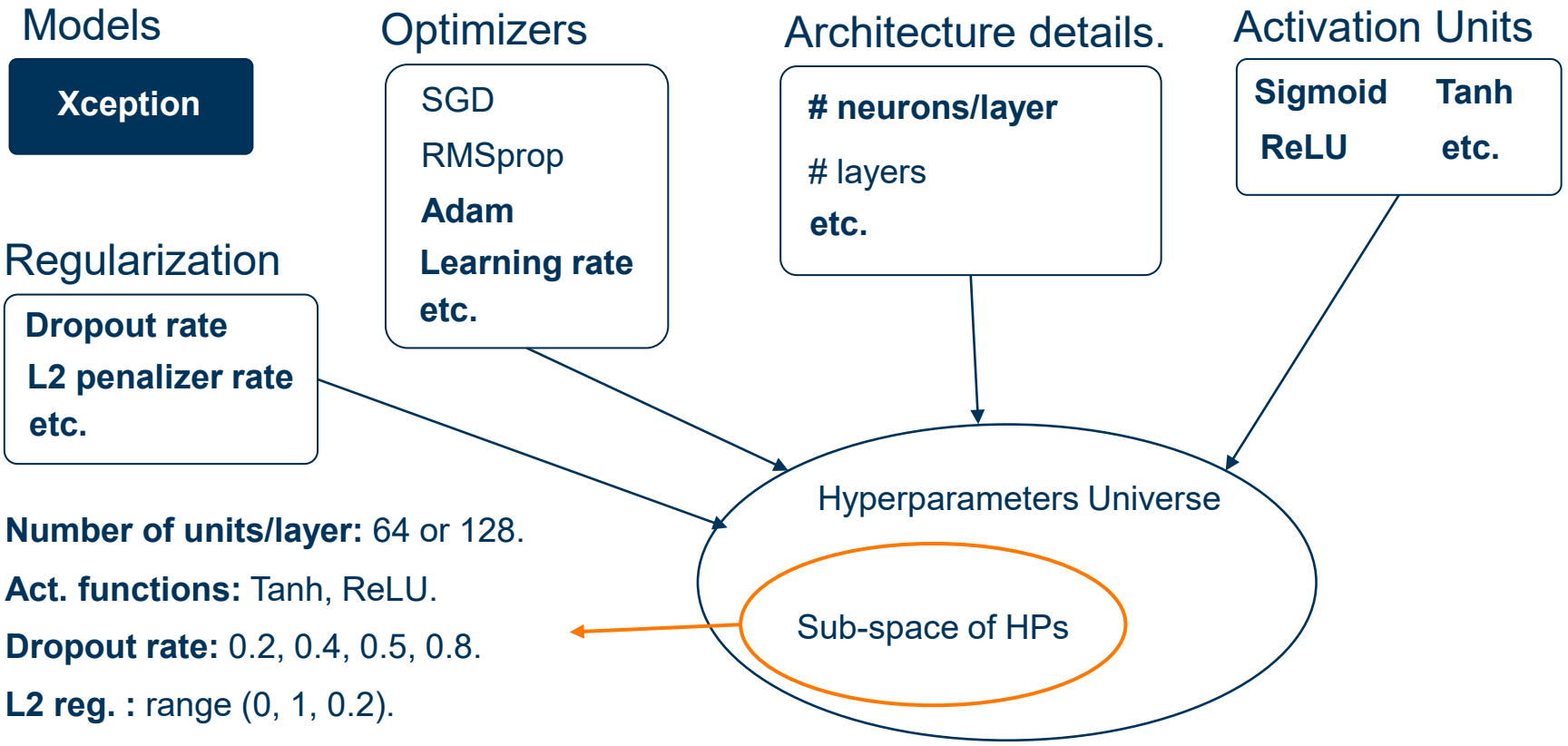


Fig 7. Learning curves for Inception v3 (a) and Xception (b) models.

Workspace for Tuning



Number of units/layer: 64 or 128.

Act. functions: Tanh, ReLU.

Dropout rate: 0.2, 0.4, 0.5, 0.8.

L2 reg. : range (0, 1, 0.2).

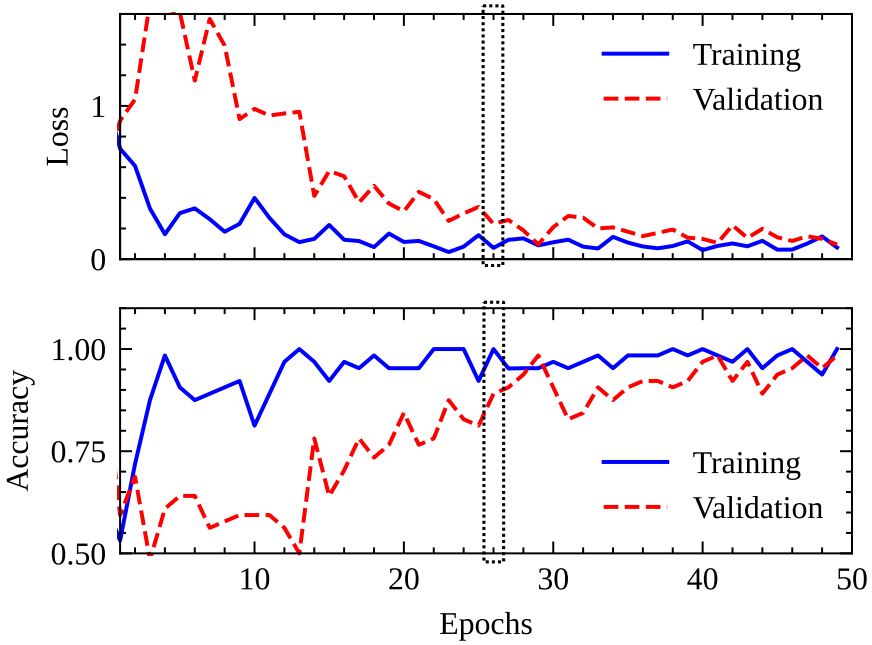
Learning rate. : with scheduler starting from 1e-3.

100 experiments, goal: to obtain the rank 10 with highest accuracies

Results

Unstable and low accurate at ~25 epochs

Stabilization after ~25 epochs



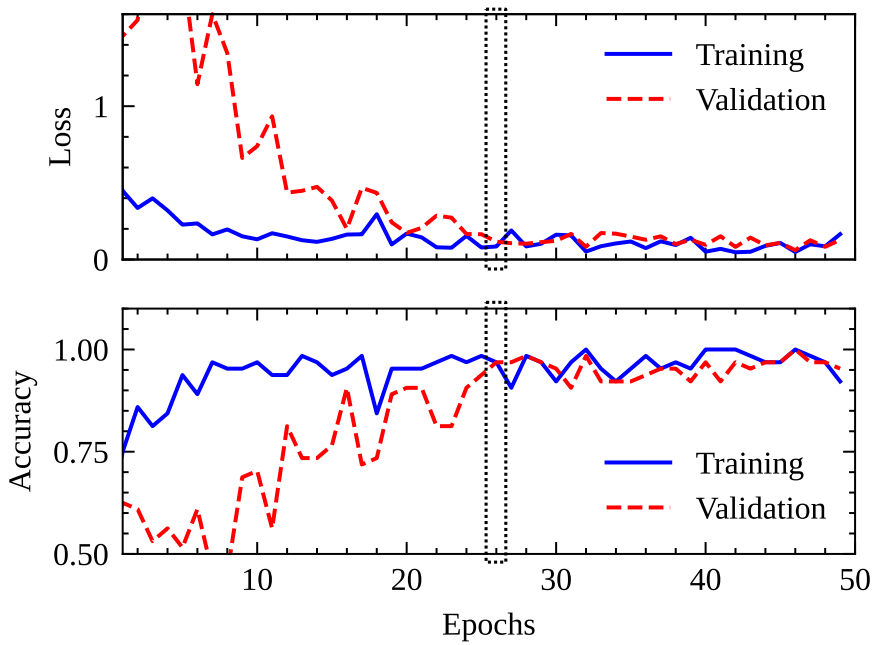


Fig 8. Learning curves for Xception model with different sets of hyperparameters. (a) Ranked 1st by keras-tuner (b) best model by manual inspection

Results

Ideal Confusion Matrix

		Actual Value	
		Non-Covid	Covid
Predicted Value	Non-Covid	*TN* 315	*FP* 0
	Covid	*FN* 0	*TP* 230

Real Confusion Matrix (best model)

		Actual Value	
		Non-Covid	Covid
Predicted Value	Non-Covid	*TN* 310	*FP* 1
	Covid	*FN* 14	*TP* 220

Achievement

Accuracy: 97.2%
F1-score : 97.0%
Precision: 99.54%
Recall: 94.01%

Previous works:
~ 75-80% (precision)

Thank you for your attention!

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