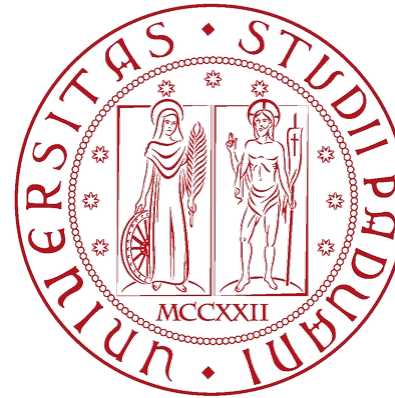


The importance of orientation in 3D object classification

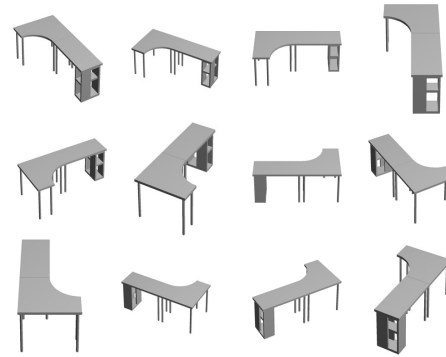
Neural Network and Deep Learning - A.A. 2022/2023



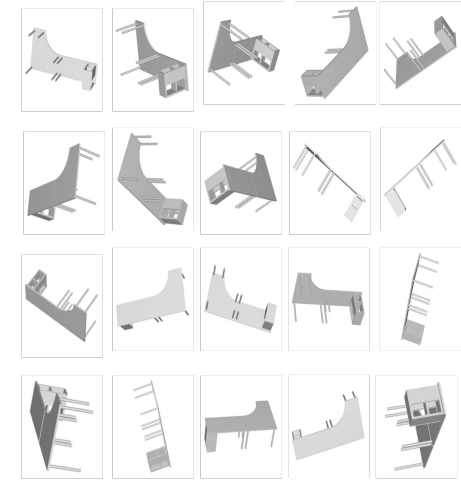
Peron Davide- 2082148
Vitetta Emanuele - 2082149

ModelNet

<https://modelnet.cs.princeton.edu>



(a)

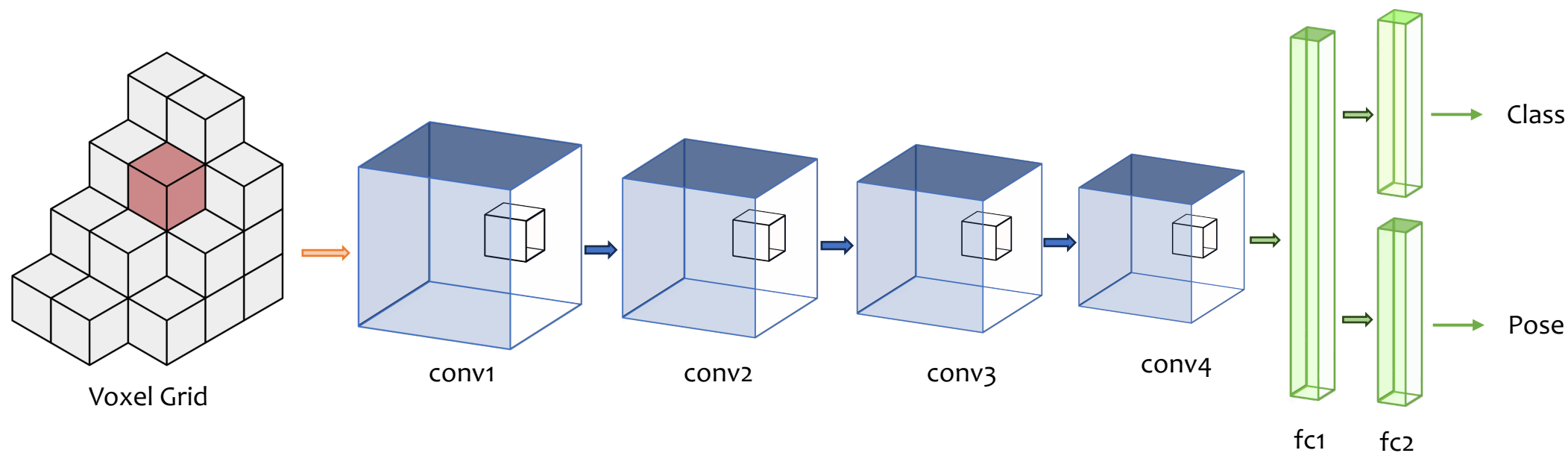


(b)

Dataset	Classes	Train Samples	Test samples
ModelNet10	10	3991	908
ModelNet40	40	9843	2468

ORION

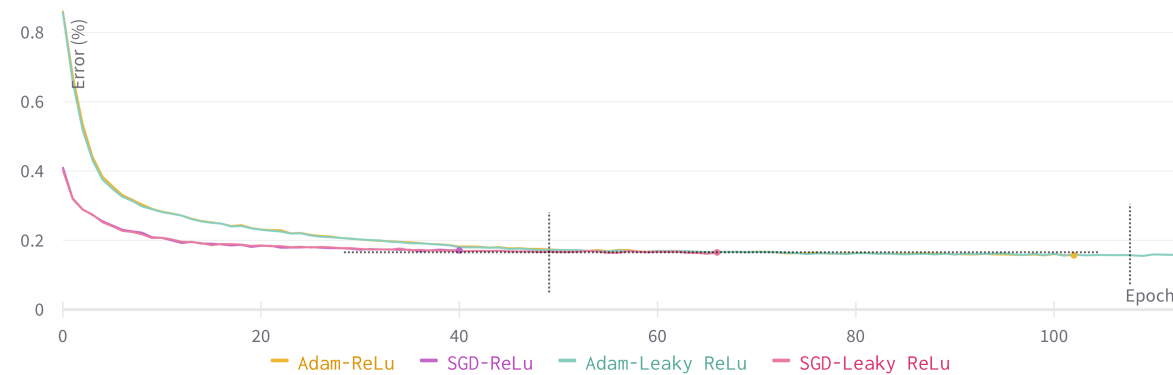
The structure is based on VoxNet. Here we can see the extended version of ORION.



Training

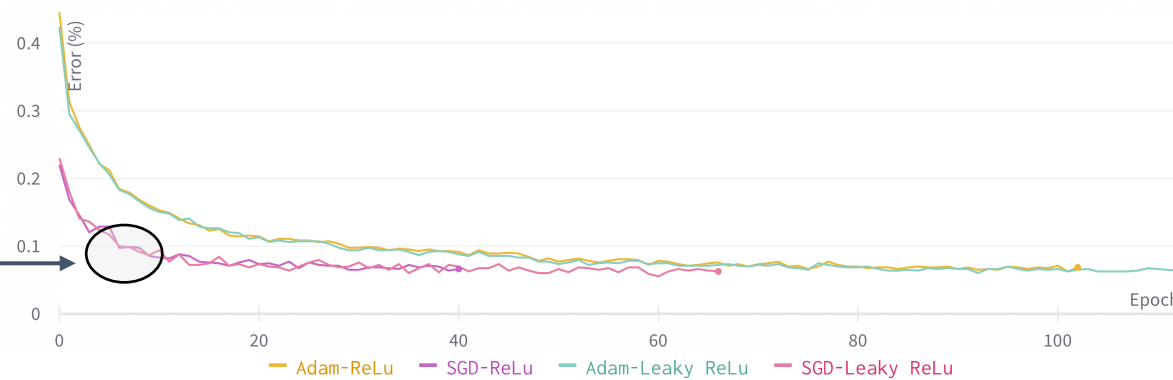
Some graphs showing the behaviors of both pose and class error depending on the weight optimizer and on the activation function.

Pose Validation Error



Convergence to similar values. SGD is faster.

Class Validation Error



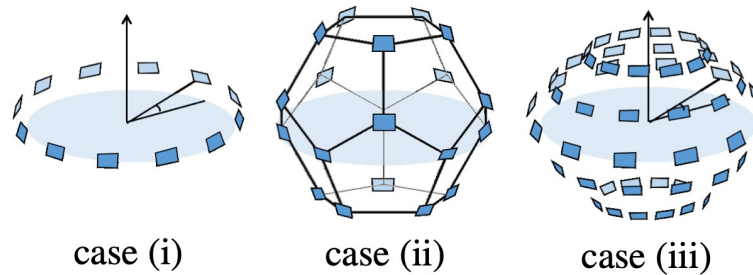
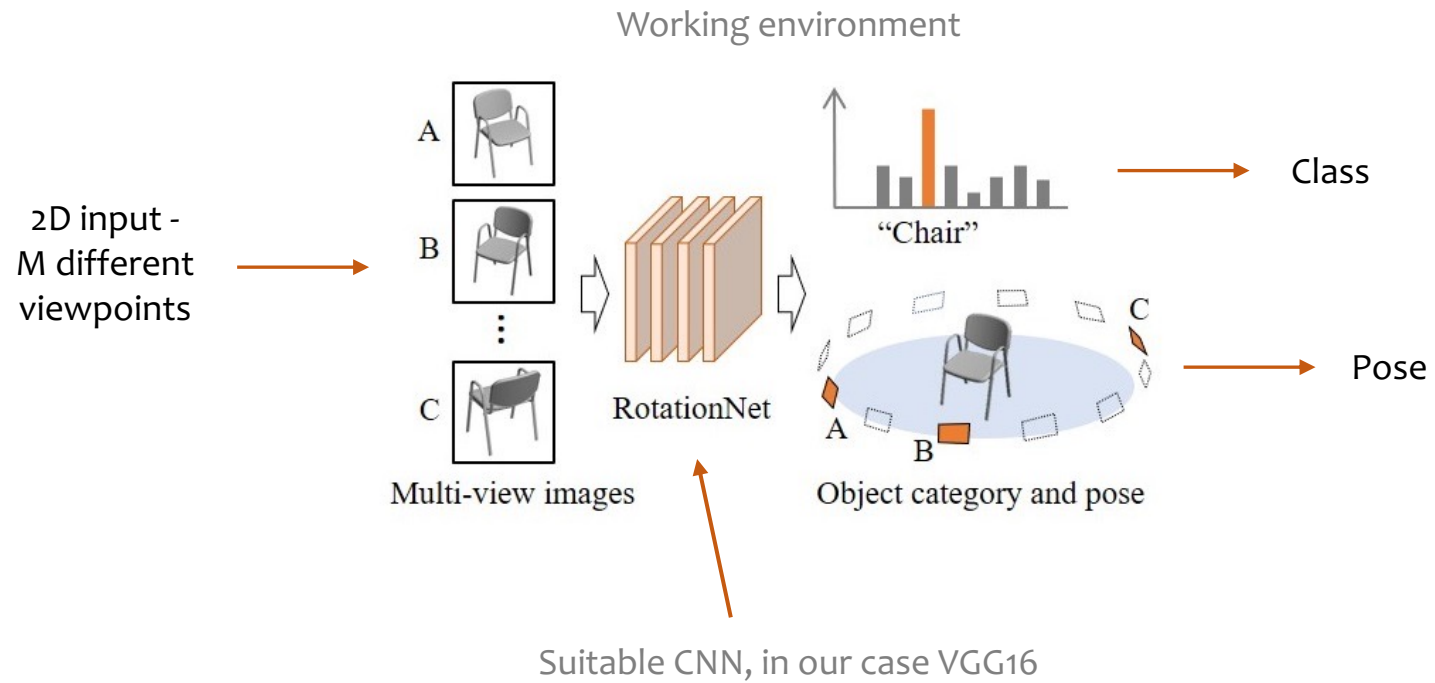
No relevant differences between ReLu and Leaky ReLu.

Results

Best results obtained using different training methods.
The highest value achieved is highlighted. Notice that not always more rotations corresponds to a higher accuracy.

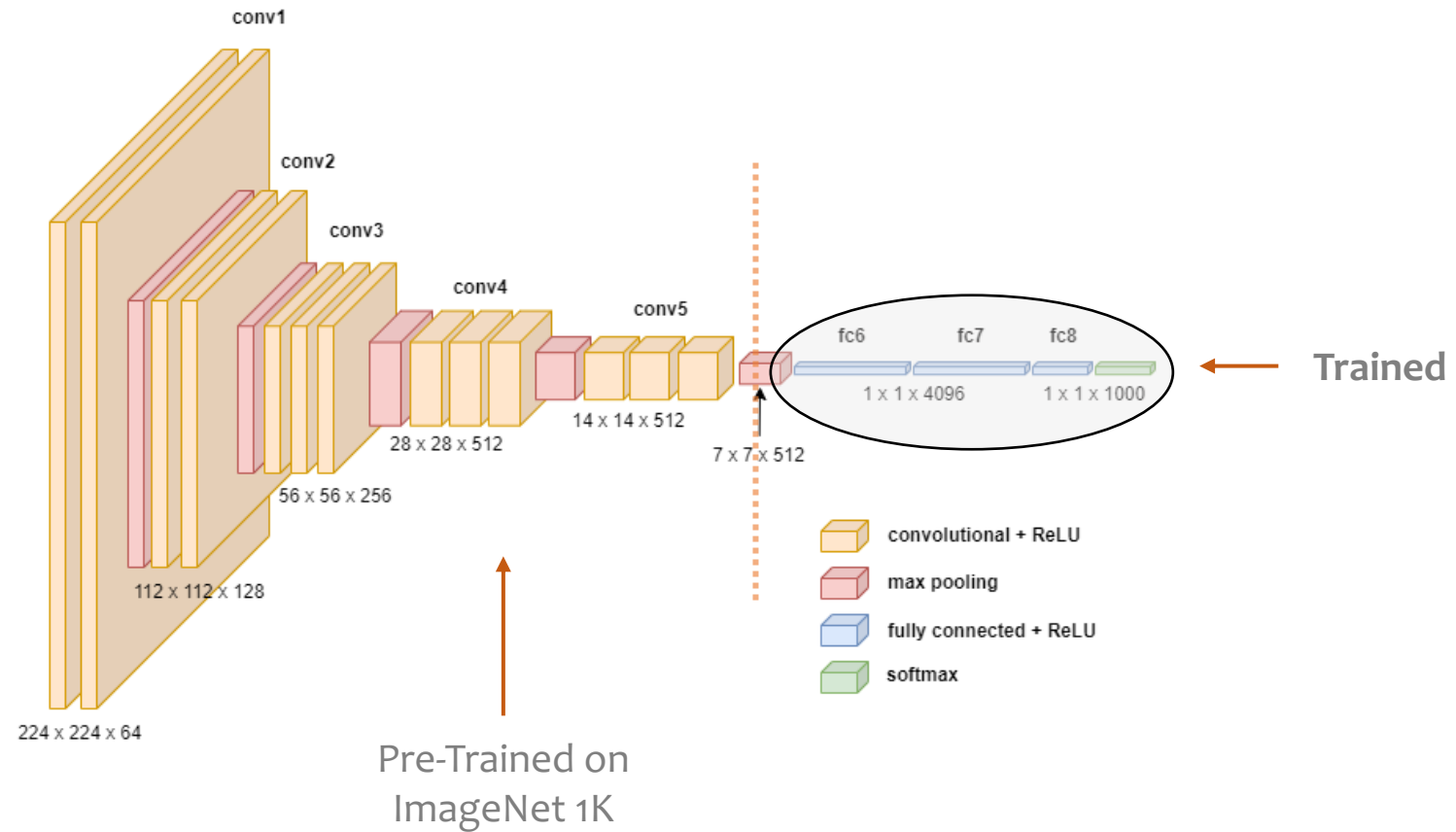
Data Aug.	Opt.	Act. func.	Accuracy Max (%)				Accuracy Avg. (%)			
			ModelNet10		ModelNet40		ModelNet10		ModelNet40	
			Class	Pose	Class	Pose	Class	Pose	Class	Pose
Az6	SGD	ReLu	93.6	85.6	88.0	84.9	93.4±0.07	85.3±0.11	87.6±0.18	84.1±0.27
Az6	SGD	Leaky ReLu	93.4	85.8	87.8	84.9	93.1±0.13	85.5±0.09	87.5±0.13	84.4±0.16
Az6	Adam	ReLu	93.5	86.5	87.5	85.1	92.7±0.20	86.0±0.16	87.3±0.08	84.7±0.13
Az6	Adam	Leaky ReLu	92.3	86.1	87.4	84.9	92.2±0.03	85.8±0.07	87.3±0.04	84.6±0.11
Az12	SGD	ReLu	93.5	84.5	87.6	84.2	93.4±0.04	84.0±0.17	87.2±0.16	83.5±0.19
Az12	SGD	Leaky ReLu	93.4	84.3	87.3	83.7	93.2±0.11	84.1±0.08	87.0±0.06	83.5±0.08
Az12	Adam	ReLu	92.9	85.3	86.7	84.3	92.4±0.15	84.8±0.15	86.4±0.13	84.0±0.11
Az12	Adam	Leaky ReLu	92.7	85.0	86.5	84.1	92.2±0.11	84.3±0.21	86.3±0.13	83.7±0.17
Az24	SGD	ReLu	93.6	83.5	87.7	84.2	93.4±0.06	83.0±0.21	87.4±0.11	83.9±0.09
Az24	SGD	Leaky ReLu	93.4	83.3	87.6	84.1	93.2±0.08	83.0±0.14	87.3±0.10	83.8±0.10
Az24	Adam	ReLu	92.7	84.1	87.3	84.5	92.4±0.09	83.7±0.11	87.0±0.08	84.1±0.11
Az24	Adam	Leaky ReLu	92.6	83.9	87.2	84.4	92.3±0.11	83.6±0.11	86.9±0.11	84.0±0.18

RotationNet



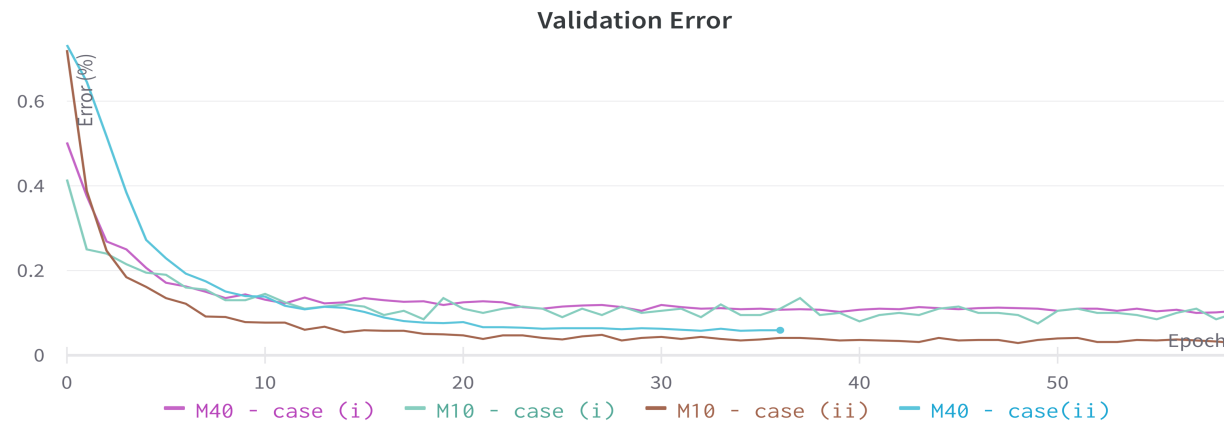
Different viewpoints used for training

NN structure – VGG16



Training

Some graphs showing the training loss and the validation error. The first value is used to do model selection, the second is the metric used to evaluate performances



Results

RotationNet is comparable with ORION in case (i), while in case (ii) its performances are outstanding.

Method	Data Aug.	Accuracy (%)	
		ModelNet10	ModelNet40
ORION	Az6	93.6	88.0
ORION	Az12	93.5	87.6
ORION	Az24	93.6	87.7
RotationNet	Case (i)	92.5	90.0
RotationNet	Case (ii)	96.8	93.7

Thanks everyone for your attention!