

CleanAI Analysis Report

Model Informations

The table below shows general information about the 'ResNet' model.

	Model name	Total params	Number of layers
Informations	ResNet	21797672	116

Coverage Values of Layers (For Only One Input)

The table below shows coverage values about the 'ResNet' model's all layers. The 'mean of layer' value shows the average of neurons in that layer. When calculating the number of covered neurons, this value is accepted as the threshold value for that layer. NOTE: The coverage value of a layer is the ratio of the number of covered neurons to the total number of neurons in that layer. The values in the table below, it was formed as a result of giving the 'n01440764_ILSVRC2012_val_00009111.JPEG' input in the data set to the model.

Layer Index	Activation Function	Number of Covered Neurons	Number of Total Neurons	Coverage Value	Mean of Layer
Layer 3	ReLU	343332	802816	42.77%	0.26
Layer 9	ReLU	91516	200704	45.60%	0.48
Layer 15	ReLU	86225	200704	42.96%	0.54
Layer 21	ReLU	85664	200704	42.68%	0.61
Layer 28	ReLU	38542	100352	38.41%	0.25
Layer 37	ReLU	37753	100352	37.62%	0.27
Layer 43	ReLU	37494	100352	37.36%	0.28
Layer 49	ReLU	37770	100352	37.64%	0.30
Layer 56	ReLU	18013	50176	35.90%	0.20
Layer 65	ReLU	17192	50176	34.26%	0.19
Layer 71	ReLU	17088	50176	34.06%	0.19
Layer 77	ReLU	16453	50176	32.79%	0.18
Layer 83	ReLU	15281	50176	30.45%	0.16
Layer 89	ReLU	13586	50176	27.08%	0.13
Layer 96	ReLU	6957	25088	27.73%	0.29
Layer 105	ReLU	7874	25088	31.39%	0.45
Layer 111	ReLU	8803	25088	35.09%	1.13
All model	-	879543	2182656	40.30%	

Coverage Values of Layers (For Multiple Inputs) 50 Inputs

The table below shows coverage values for multiple inputs about the 'ResNet' model. The values in the table below, it was formed as a result of giving the '50' inputs in the data set to the model.

Layer index	Number of covered neurons	Number of total neurons	Coverage value
All model	43559939	109132800	39.91%

Threshold Coverage Values of Layers (TH = 0.75)

The table below shows threshold coverage values about the 'ResNet' model's all layers. NOTE: The threshold coverage value of a layer is the ratio of the number of covered neurons (number of neurons greater than the threshold value) to the total number of neurons in that layer. The values in the table below, it was formed as a result of giving the 'n01440764_ILSVRC2012_val_00009111.JPEG' input in the data set to the model.

Layer index	Activation function	Number of covered neurons	Number of total neurons	Coverage value
Layer 3	ReLU	52840	802816	6.58%
Layer 9	ReLU	43234	200704	21.54%
Layer 15	ReLU	54118	200704	26.96%
Layer 21	ReLU	65657	200704	32.71%
Layer 28	ReLU	7901	100352	7.87%
Layer 37	ReLU	9651	100352	9.62%
Layer 43	ReLU	10487	100352	10.45%
Layer 49	ReLU	11799	100352	11.76%
Layer 56	ReLU	2691	50176	5.36%
Layer 65	ReLU	2516	50176	5.01%
Layer 71	ReLU	2628	50176	5.24%
Layer 77	ReLU	2605	50176	5.19%
Layer 83	ReLU	2382	50176	4.75%
Layer 89	ReLU	1859	50176	3.70%
Layer 96	ReLU	3801	25088	15.15%
Layer 105	ReLU	5434	25088	21.66%
Layer 111	ReLU	10939	25088	43.60%
All model	-	290542	2182656	13.31%

Sign Coverage and Value Coverage (TH = 0.75) Values of Model

The table below shows Sign Coverage and Value Coverage values of the 'ResNet' model. Sign Coverage: When given two different test inputs, it checks whether the signs of a specific neuron's value after the activation function are the same. If the signs are not the same, the counter is incremented. Value Coverage: When given two different test inputs, it checks whether the difference between the values of a specific neuron after the activation function is greater than the given threshold value. If the difference is greater than the threshold value, the counter is incremented. The values in the table below, it was formed as a result of giving the 'n01440764_ILSVRC2012_val_00009111.JPEG' and 'n01443537_ILSVRC2012_val_00000994.JPEG' input in the data set to the model.

Coverage Metric	Number of covered neurons	Number of total neurons	Coverage value
Sign Coverage	928468	2182656	42.54%
Value Coverage	209706	2182656	9.61%

Top-K Neuron Coverage (K = 3) Value of Model

The table below shows Top-K Neuron Coverage value of the 'ResNet' model. Top-K Neuron Coverage (TKNC) is a metric used to evaluate the activation patterns and coverage of neurons in a deep neural network (DNN). It measures the percentage of neurons that are activated for a given set of input samples. The idea behind TKNC is to assess how well a set of input samples can activate different neurons in the network. How is it calculated? TKNC travels through all layers on a model one by one and ranks the neuron values of each layer in order from largest to smallest. Then it takes k neurons in each layer and adds it to a list. It then creates a value called 'TKNC Sum', which represents the sum of neurons in this list. The 'Number of Selected Neurons' value shows how many neurons were selected on the whole model as a result of k neurons from each layer. The 'Mean of Top-K Neurons' value shows the ratio of the 'TKNC Sum' value to the 'Number of Selected Neurons' value. The values in the table below, it was formed as a result of giving the 'n01440764_ILSVRC2012_val_00009111.JPEG' input in the data set to the model.

Coverage Metric	TKNC Sum	Number of Selected Neurons	Mean of Top-K Neurons
Top-K Neuron Coverage	263.57	51	5.17

Neuron Boundary Coverage Value of Model (For 50 Inputs)

The table below shows Neuron Boundary Coverage value of the 'ResNet' model. Neuron Boundary Coverage (NBC) is a metric used to evaluate the coverage of decision boundaries in a deep neural network (DNN). It measures the percentage of decision boundaries in the network that have been activated or crossed by the input samples. How is it calculated? NBC receives a random set of inputs from the user, and as a result of these inputs, it determines the maximum and minimum interval value for each layer. Then, for the input data to be checked, it is checked whether each neuron belonging to each layer is within the maximum and minimum range of this layer. If it is within this range, the 'NBC Counter' value is increased by one. The values in the table below, it was formed as a result of giving the 'n01440764_ILSVRC2012_val_00009111.JPEG' input in the data set to the model.

Coverage Metric	NBC Counter	Number of Total Neurons	Neuron Boundary Coverage
Neuron Boundary Coverage	0	2182656	0.00%

Multisection Neuron Coverage Value of Model

The table below shows Multisection Neuron Coverage value of the 'ResNet' model. Multisection Neuron Coverage (MNC) specifically focuses on assessing the coverage of individual neurons within the model. The goal of MNC is to evaluate the degree to which the decisions made by individual neurons have been exercised by the test cases. It helps identify potential shortcomings in the model's behavior and reveal areas that may require further testing. It provides the user with the information of how many neurons are found according to the threshold value ranges given by the user. How is it calculated? The MNC receives threshold ranges from the user. Then, it evaluates all the neurons on the model and checks whether each neuron is within these threshold ranges. If the corresponding neuron is within this threshold value, it increases the 'MNC Counter' value found for the relevant range by one. The 'Multisection Neuron Coverage' value is the ratio of the 'MNC Counter' value to the number of all neurons on the model. The values in the table below, it was formed as a result of giving the 'n01440764_ILSVRC2012_val_00009111.JPEG' input in the data set to the model.

Threshold Intervals	MNC Counter	Number of Total Neurons	Multisection Neuron Coverage
0 - 0.1	843695	2182656	38.65%
0.1 - 0.2	192149	2182656	8.80%
0.2 - 0.3	212462	2182656	9.73%
0.3 - 0.4	199360	2182656	9.13%
0.4 - 0.5	160711	2182656	7.36%