

CleanAI Analysis Report

Model Informations

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

	Model name	Total params	Number of layers
Informations	ResNet	44549160	287

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\n01440764_14448.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	279493	802816	34.81%	0.21
Layer 13	ReLU	315930	802816	39.35%	0.11
Layer 24	ReLU	319913	802816	39.85%	0.13
Layer 32	ReLU	330093	802816	41.12%	0.14
Layer 41	ReLU	133644	401408	33.29%	0.10
Layer 52	ReLU	142944	401408	35.61%	0.11
Layer 60	ReLU	145133	401408	36.16%	0.12
Layer 68	ReLU	145004	401408	36.12%	0.12
Layer 77	ReLU	64360	200704	32.07%	0.10
Layer 88	ReLU	64982	200704	32.38%	0.11
Layer 96	ReLU	66401	200704	33.08%	0.12
Layer 104	ReLU	66214	200704	32.99%	0.12
Layer 112	ReLU	66051	200704	32.91%	0.12
Layer 120	ReLU	65571	200704	32.67%	0.12
Layer 128	ReLU	64709	200704	32.24%	0.11
Layer 136	ReLU	63419	200704	31.60%	0.11
Layer 144	ReLU	62178	200704	30.98%	0.11
Layer 152	ReLU	63242	200704	31.51%	0.11
Layer 160	ReLU	63169	200704	31.47%	0.11
Layer 168	ReLU	62185	200704	30.98%	0.11
Layer 176	ReLU	62111	200704	30.95%	0.11

Layer 184	ReLU	61283	200704	30.53%	0.11
Layer 192	ReLU	60965	200704	30.38%	0.11
Layer 200	ReLU	59515	200704	29.65%	0.11
Layer 208	ReLU	57320	200704	28.56%	0.10
Layer 216	ReLU	56052	200704	27.93%	0.10
Layer 224	ReLU	53037	200704	26.43%	0.09
Layer 232	ReLU	50328	200704	25.08%	0.08
Layer 240	ReLU	49197	200704	24.51%	0.07
Layer 248	ReLU	46664	200704	23.25%	0.07
Layer 256	ReLU	48186	200704	24.01%	0.06
Layer 265	ReLU	31753	100352	31.64%	0.20
Layer 276	ReLU	33549	100352	33.43%	0.31
Layer 284	ReLU	32353	100352	32.24%	0.45
All model	-	3286948	9734144	33.77%	

Coverage Values of Layers (For Multiple Inputs) 5 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 '5' inputs in the data set to the model.

Layer index	Number of covered neurons	Number of total neurons	Coverage value
All model	16613866	48670720	34.14%

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\n01440764_14448.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	54192	802816	6.75%
Layer 13	ReLU	2372	802816	0.30%
Layer 24	ReLU	2946	802816	0.37%
Layer 32	ReLU	3779	802816	0.47%
Layer 41	ReLU	1670	401408	0.42%
Layer 52	ReLU	1344	401408	0.33%

Layer 60	ReLU	1838	401408	0.46%
Layer 68	ReLU	2407	401408	0.60%
Layer 77	ReLU	1612	200704	0.80%
Layer 88	ReLU	1729	200704	0.86%
Layer 96	ReLU	1880	200704	0.94%
Layer 104	ReLU	2165	200704	1.08%
Layer 112	ReLU	2053	200704	1.02%
Layer 120	ReLU	2091	200704	1.04%
Layer 128	ReLU	2090	200704	1.04%
Layer 136	ReLU	2164	200704	1.08%
Layer 144	ReLU	2157	200704	1.07%
Layer 152	ReLU	2174	200704	1.08%
Layer 160	ReLU	2304	200704	1.15%
Layer 168	ReLU	2371	200704	1.18%
Layer 176	ReLU	2301	200704	1.15%
Layer 184	ReLU	2315	200704	1.15%
Layer 192	ReLU	2359	200704	1.18%
Layer 200	ReLU	2498	200704	1.24%
Layer 208	ReLU	2392	200704	1.19%
Layer 216	ReLU	2467	200704	1.23%
Layer 224	ReLU	2338	200704	1.16%
Layer 232	ReLU	2131	200704	1.06%
Layer 240	ReLU	2003	200704	1.00%
Layer 248	ReLU	1705	200704	0.85%
Layer 256	ReLU	1388	200704	0.69%
Layer 265	ReLU	7049	100352	7.02%
Layer 276	ReLU	13457	100352	13.41%
Layer 284	ReLU	21542	100352	21.47%
All model	-	161283	9734144	1.66%

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\n01440764_14448.JPEG' and 'n01440764\n01440764_5376.JPEG' input in the data set to the model.

Coverage Metric	Number of covered neurons	Number of total neurons	Coverage value
Sign Coverage	4939938	9734144	50.75%
Value Coverage	121397	9734144	1.25%

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\n01440764_14448.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	295.95	102	2.90

Neuron Boundary Coverage Value of Model (For 5 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\n01440764_14448.JPEG' input in the data set to the model.

Coverage Metric	NBC Counter	Number of Total Neurons	Neuron Boundary Coverage
Neuron Boundary Coverage	0	9734144	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\n01440764_14448.JPG' input in the data set to the model.

Threshold Intervals	MNC Counter	Number of Total Neurons	Multisection Neuron Coverage
0 - 0.1	6093693	9734144	62.60%
0.1 - 0.2	1354428	9734144	13.91%
0.2 - 0.3	962630	9734144	9.89%
0.3 - 0.4	553270	9734144	5.68%
0.4 - 0.5	304068	9734144	3.12%