

CleanAI Analysis Report

Model Informations

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

	Model name	Total params	Number of layers
Informations	ResNet	60192808	423

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_4979.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	293645	802816	36.58%	0.23
Layer 13	ReLU	325999	802816	40.61%	0.13
Layer 24	ReLU	331364	802816	41.28%	0.15
Layer 32	ReLU	338592	802816	42.18%	0.17
Layer 41	ReLU	138105	401408	34.41%	0.13
Layer 52	ReLU	143123	401408	35.66%	0.14
Layer 60	ReLU	148608	401408	37.02%	0.15
Layer 68	ReLU	151048	401408	37.63%	0.16
Layer 76	ReLU	149753	401408	37.31%	0.16
Layer 84	ReLU	150085	401408	37.39%	0.16
Layer 92	ReLU	150520	401408	37.50%	0.16
Layer 100	ReLU	149711	401408	37.30%	0.16
Layer 109	ReLU	62733	200704	31.26%	0.11
Layer 120	ReLU	64074	200704	31.92%	0.12
Layer 128	ReLU	64617	200704	32.20%	0.13
Layer 136	ReLU	65320	200704	32.55%	0.13
Layer 144	ReLU	65197	200704	32.48%	0.13
Layer 152	ReLU	64896	200704	32.33%	0.13
Layer 160	ReLU	64234	200704	32.00%	0.13
Layer 168	ReLU	64044	200704	31.91%	0.13
Layer 176	ReLU	63504	200704	31.64%	0.13

Layer 184	ReLU	63270	200704	31.52%	0.13
Layer 192	ReLU	63701	200704	31.74%	0.13
Layer 200	ReLU	64156	200704	31.97%	0.13
Layer 208	ReLU	63352	200704	31.56%	0.13
Layer 216	ReLU	62510	200704	31.15%	0.13
Layer 224	ReLU	61979	200704	30.88%	0.13
Layer 232	ReLU	62191	200704	30.99%	0.13
Layer 240	ReLU	62314	200704	31.05%	0.13
Layer 248	ReLU	62317	200704	31.05%	0.13
Layer 256	ReLU	61970	200704	30.88%	0.13
Layer 264	ReLU	61791	200704	30.79%	0.13
Layer 272	ReLU	60552	200704	30.17%	0.12
Layer 280	ReLU	60160	200704	29.97%	0.12
Layer 288	ReLU	59881	200704	29.84%	0.12
Layer 296	ReLU	59564	200704	29.68%	0.12
Layer 304	ReLU	59148	200704	29.47%	0.12
Layer 312	ReLU	59127	200704	29.46%	0.12
Layer 320	ReLU	58353	200704	29.07%	0.12
Layer 328	ReLU	57299	200704	28.55%	0.12
Layer 336	ReLU	56480	200704	28.14%	0.11
Layer 344	ReLU	56288	200704	28.05%	0.11
Layer 352	ReLU	55423	200704	27.61%	0.10
Layer 360	ReLU	54038	200704	26.92%	0.10
Layer 368	ReLU	53375	200704	26.59%	0.10
Layer 376	ReLU	51112	200704	25.47%	0.09
Layer 384	ReLU	50860	200704	25.34%	0.09
Layer 392	ReLU	50085	200704	24.95%	0.08
Layer 401	ReLU	29814	100352	29.71%	0.19
Layer 412	ReLU	31759	100352	31.65%	0.33
Layer 420	ReLU	30080	100352	29.97%	0.49
All model	-	4732121	13948928	33.92%	

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	23981993	69744640	34.39%

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_4979.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	59224	802816	7.38%
Layer 13	ReLU	4494	802816	0.56%
Layer 24	ReLU	5710	802816	0.71%
Layer 32	ReLU	7042	802816	0.88%
Layer 41	ReLU	5396	401408	1.34%
Layer 52	ReLU	4257	401408	1.06%
Layer 60	ReLU	4807	401408	1.20%
Layer 68	ReLU	5175	401408	1.29%
Layer 76	ReLU	6008	401408	1.50%
Layer 84	ReLU	6336	401408	1.58%
Layer 92	ReLU	7030	401408	1.75%
Layer 100	ReLU	7045	401408	1.76%
Layer 109	ReLU	2714	200704	1.35%
Layer 120	ReLU	3038	200704	1.51%
Layer 128	ReLU	3232	200704	1.61%
Layer 136	ReLU	3423	200704	1.71%
Layer 144	ReLU	3501	200704	1.74%
Layer 152	ReLU	3608	200704	1.80%
Layer 160	ReLU	3733	200704	1.86%
Layer 168	ReLU	3583	200704	1.79%
Layer 176	ReLU	3666	200704	1.83%
Layer 184	ReLU	3656	200704	1.82%
Layer 192	ReLU	3587	200704	1.79%
Layer 200	ReLU	3750	200704	1.87%

Layer 208	ReLU	3836	200704	1.91%
Layer 216	ReLU	3809	200704	1.90%
Layer 224	ReLU	3849	200704	1.92%
Layer 232	ReLU	3987	200704	1.99%
Layer 240	ReLU	4002	200704	1.99%
Layer 248	ReLU	4017	200704	2.00%
Layer 256	ReLU	4111	200704	2.05%
Layer 264	ReLU	4239	200704	2.11%
Layer 272	ReLU	4045	200704	2.02%
Layer 280	ReLU	4055	200704	2.02%
Layer 288	ReLU	4065	200704	2.03%
Layer 296	ReLU	4013	200704	2.00%
Layer 304	ReLU	4001	200704	1.99%
Layer 312	ReLU	4075	200704	2.03%
Layer 320	ReLU	4147	200704	2.07%
Layer 328	ReLU	4046	200704	2.02%
Layer 336	ReLU	3978	200704	1.98%
Layer 344	ReLU	3864	200704	1.93%
Layer 352	ReLU	3544	200704	1.77%
Layer 360	ReLU	3325	200704	1.66%
Layer 368	ReLU	3213	200704	1.60%
Layer 376	ReLU	2883	200704	1.44%
Layer 384	ReLU	2849	200704	1.42%
Layer 392	ReLU	2430	200704	1.21%
Layer 401	ReLU	6954	100352	6.93%
Layer 412	ReLU	14088	100352	14.04%
Layer 420	ReLU	21951	100352	21.87%
All model	-	297391	13948928	2.13%

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_4979.JPEG' and 'n01496331\n01496331_27720.JPEG' input in the data set to the model.

Coverage Metric	Number of covered neurons	Number of total neurons	Coverage value
Sign Coverage	6859048	13948928	49.17%
Value Coverage	296694	13948928	2.13%

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_4979.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	543.20	153	3.55

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_4979.JPEG' input in the data set to the model.

Coverage Metric	NBC Counter	Number of Total Neurons	Neuron Boundary Coverage
Neuron Boundary Coverage	15	13948928	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_4979.JPEG' input in the data set to the model.

Threshold Intervals	MNC Counter	Number of Total Neurons	Multisection Neuron Coverage
0 - 0.1	8324586	13948928	59.68%
0.1 - 0.2	1892972	13948928	13.57%
0.2 - 0.3	1387580	13948928	9.95%
0.3 - 0.4	896552	13948928	6.43%
0.4 - 0.5	547191	13948928	3.92%