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 'n01496331\n01496331_27985.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	273636	802816	34.08%	0.21
Layer 13	ReLU	331947	802816	41.35%	0.12
Layer 24	ReLU	334598	802816	41.68%	0.13
Layer 32	ReLU	342864	802816	42.71%	0.15
Layer 41	ReLU	134173	401408	33.43%	0.09
Layer 52	ReLU	145768	401408	36.31%	0.10
Layer 60	ReLU	146489	401408	36.49%	0.11
Layer 68	ReLU	147643	401408	36.78%	0.11
Layer 77	ReLU	61842	200704	30.81%	0.09
Layer 88	ReLU	62738	200704	31.26%	0.10
Layer 96	ReLU	64434	200704	32.10%	0.10
Layer 104	ReLU	64214	200704	31.99%	0.10
Layer 112	ReLU	64847	200704	32.31%	0.10
Layer 120	ReLU	64212	200704	31.99%	0.10
Layer 128	ReLU	63837	200704	31.81%	0.10
Layer 136	ReLU	62497	200704	31.14%	0.10
Layer 144	ReLU	60946	200704	30.37%	0.09
Layer 152	ReLU	63145	200704	31.46%	0.10
Layer 160	ReLU	63190	200704	31.48%	0.10
Layer 168	ReLU	61974	200704	30.88%	0.10
Layer 176	ReLU	63055	200704	31.42%	0.11

Layer 184	ReLU	62569	200704	31.17%	0.10
Layer 192	ReLU	62508	200704	31.14%	0.11
Layer 200	ReLU	61958	200704	30.87%	0.11
Layer 208	ReLU	60547	200704	30.17%	0.10
Layer 216	ReLU	58978	200704	29.39%	0.10
Layer 224	ReLU	55920	200704	27.86%	0.09
Layer 232	ReLU	53751	200704	26.78%	0.08
Layer 240	ReLU	52038	200704	25.93%	0.08
Layer 248	ReLU	50293	200704	25.06%	0.07
Layer 256	ReLU	52380	200704	26.10%	0.07
Layer 265	ReLU	28917	100352	28.82%	0.20
Layer 276	ReLU	31097	100352	30.99%	0.32
Layer 284	ReLU	30949	100352	30.84%	0.53
All model	-	3339954	9734144	34.31%	

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	165110517	486707200	33.92%

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 'n01496331\n01496331_27985.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	49844	802816	6.21%
Layer 13	ReLU	1663	802816	0.21%
Layer 24	ReLU	2121	802816	0.26%
Layer 32	ReLU	2622	802816	0.33%
Layer 41	ReLU	1159	401408	0.29%
Layer 52	ReLU	1188	401408	0.30%

Layer 60	ReLU	1347	401408	0.34%
Layer 68	ReLU	1521	401408	0.38%
Layer 77	ReLU	1168	200704	0.58%
Layer 88	ReLU	1286	200704	0.64%
Layer 96	ReLU	1232	200704	0.61%
Layer 104	ReLU	1326	200704	0.66%
Layer 112	ReLU	1323	200704	0.66%
Layer 120	ReLU	1359	200704	0.68%
Layer 128	ReLU	1373	200704	0.68%
Layer 136	ReLU	1360	200704	0.68%
Layer 144	ReLU	1435	200704	0.71%
Layer 152	ReLU	1503	200704	0.75%
Layer 160	ReLU	1600	200704	0.80%
Layer 168	ReLU	1693	200704	0.84%
Layer 176	ReLU	1661	200704	0.83%
Layer 184	ReLU	1740	200704	0.87%
Layer 192	ReLU	1837	200704	0.92%
Layer 200	ReLU	1843	200704	0.92%
Layer 208	ReLU	1834	200704	0.91%
Layer 216	ReLU	1904	200704	0.95%
Layer 224	ReLU	1839	200704	0.92%
Layer 232	ReLU	1758	200704	0.88%
Layer 240	ReLU	1708	200704	0.85%
Layer 248	ReLU	1538	200704	0.77%
Layer 256	ReLU	1376	200704	0.69%
Layer 265	ReLU	8372	100352	8.34%
Layer 276	ReLU	14044	100352	13.99%
Layer 284	ReLU	24191	100352	24.11%
All model	-	143768	9734144	1.48%

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 'n01496331\n01496331_27985.JPEG' and 'n01484850\n01484850_31115.JPEG' input in the data set to the model.

Coverage Metric	Number of covered neurons	Number of total neurons	Coverage value
Sign Coverage	4847096	9734144	49.79%
Value Coverage	154461	9734144	1.59%

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 'n01496331\n01496331_27985.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	321.34	102	3.15

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 'n01496331\n01496331_27985.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 'n01496331\n01496331_27985.JPEG' input in the data set to the model.

Threshold Intervals	MNC Counter	Number of Total Neurons	Multisection Neuron Coverage
0 - 0.1	6055275	9734144	62.21%
0.1 - 0.2	1432926	9734144	14.72%
0.2 - 0.3	1002970	9734144	10.30%
0.3 - 0.4	542162	9734144	5.57%
0.4 - 0.5	292071	9734144	3.00%