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 'n01496331\n01496331_9611.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	305901	802816	38.10%	0.28
Layer 9	ReLU	87665	200704	43.68%	0.49
Layer 15	ReLU	85955	200704	42.83%	0.56
Layer 21	ReLU	87689	200704	43.69%	0.64
Layer 28	ReLU	37166	100352	37.04%	0.25
Layer 37	ReLU	37074	100352	36.94%	0.26
Layer 43	ReLU	36901	100352	36.77%	0.26
Layer 49	ReLU	37613	100352	37.48%	0.28
Layer 56	ReLU	17898	50176	35.67%	0.19
Layer 65	ReLU	17435	50176	34.75%	0.18
Layer 71	ReLU	17067	50176	34.01%	0.19
Layer 77	ReLU	16311	50176	32.51%	0.17
Layer 83	ReLU	15348	50176	30.59%	0.15
Layer 89	ReLU	13428	50176	26.76%	0.12
Layer 96	ReLU	6955	25088	27.72%	0.33
Layer 105	ReLU	7608	25088	30.33%	0.50
Layer 111	ReLU	8291	25088	33.05%	0.94
All model	-	836305	2182656	38.32%	

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	43471071	109132800	39.83%

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_9611.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	74156	802816	9.24%
Layer 9	ReLU	46035	200704	22.94%
Layer 15	ReLU	59126	200704	29.46%
Layer 21	ReLU	74268	200704	37.00%
Layer 28	ReLU	8844	100352	8.81%
Layer 37	ReLU	8953	100352	8.92%
Layer 43	ReLU	9347	100352	9.31%
Layer 49	ReLU	10665	100352	10.63%
Layer 56	ReLU	2231	50176	4.45%
Layer 65	ReLU	2012	50176	4.01%
Layer 71	ReLU	2294	50176	4.57%
Layer 77	ReLU	2146	50176	4.28%
Layer 83	ReLU	2038	50176	4.06%
Layer 89	ReLU	1755	50176	3.50%
Layer 96	ReLU	4121	25088	16.43%
Layer 105	ReLU	5714	25088	22.78%
Layer 111	ReLU	9408	25088	37.50%
All model	-	323113	2182656	14.80%

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_9611.JPEG' and 'n01440764\n01440764_12021.JPEG' input in the data set to the model.

Coverage Metric	Number of covered neurons	Number of total neurons	Coverage value
Sign Coverage	956701	2182656	43.83%
Value Coverage	229188	2182656	10.50%

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_9611.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	279.03	51	5.47

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_9611.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 'n01496331\n01496331_9611.JPEG' input in the data set to the model.

Threshold Intervals	MNC Counter	Number of Total Neurons	Multisection Neuron Coverage
0 - 0.1	862778	2182656	39.53%
0.1 - 0.2	202107	2182656	9.26%
0.2 - 0.3	211663	2182656	9.70%
0.3 - 0.4	181540	2182656	8.32%
0.4 - 0.5	147809	2182656	6.77%