MACHINE LEARNING MODEL

COMPARISON BASED ON SOME METRICS

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I. PAPER IMPLEMENTATION

1. Comparison of Classification Algorithms for Detection of Phishing Websites

K-Nearest Neighbors: # of neighbors = 5, weights = uniform, algorithm = auto

Paper Accuracy: 94.81% --- Our Accuracy: 93.72%

Multilayer Perceptron: Hidden Layers = 30, max iterations = 3000

Paper Accuracy: 97.22% --- Our Accuracy: 95.41%

Multilayer Perceptron: Hidden Layers = 150, max iterations = 1000

Paper Accuracy: 90.28% --- Our Accuracy: 96.98%

Multilayer Perceptron: Hidden Layers = 100, max iterations = 1000

Paper Accuracy: 96.71% --- Our Accuracy: 97.04%

Random Forest: # of estimators = 7, max depth = 11, criteria = entropy

Paper Accuracy: 95.25% --- Our Accuracy: 95.17%

Random Forest: # of estimators = 7, max depth = 8, criteria = entropy

Paper Accuracy: 89.16% --- Our Accuracy: 95.38%

SVC: C = 1.0, kernel = linear

Paper Accuracy: 92.71% --- Our Accuracy: 92.67%

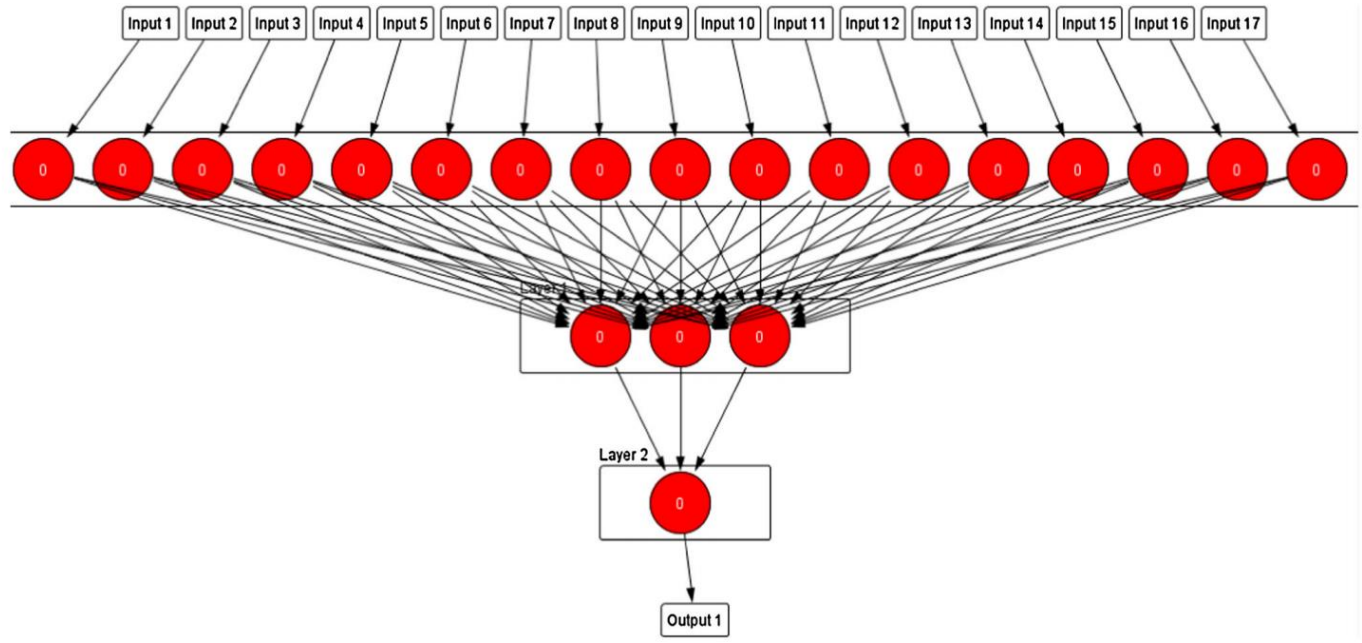
SVC: C = 1.0, kernel = polynomial, degree = 1

Paper Accuracy: 92.57% --- Our Accuracy: 92.58%

SVC: C = 1.0, kernel = polynomial, degree = 2

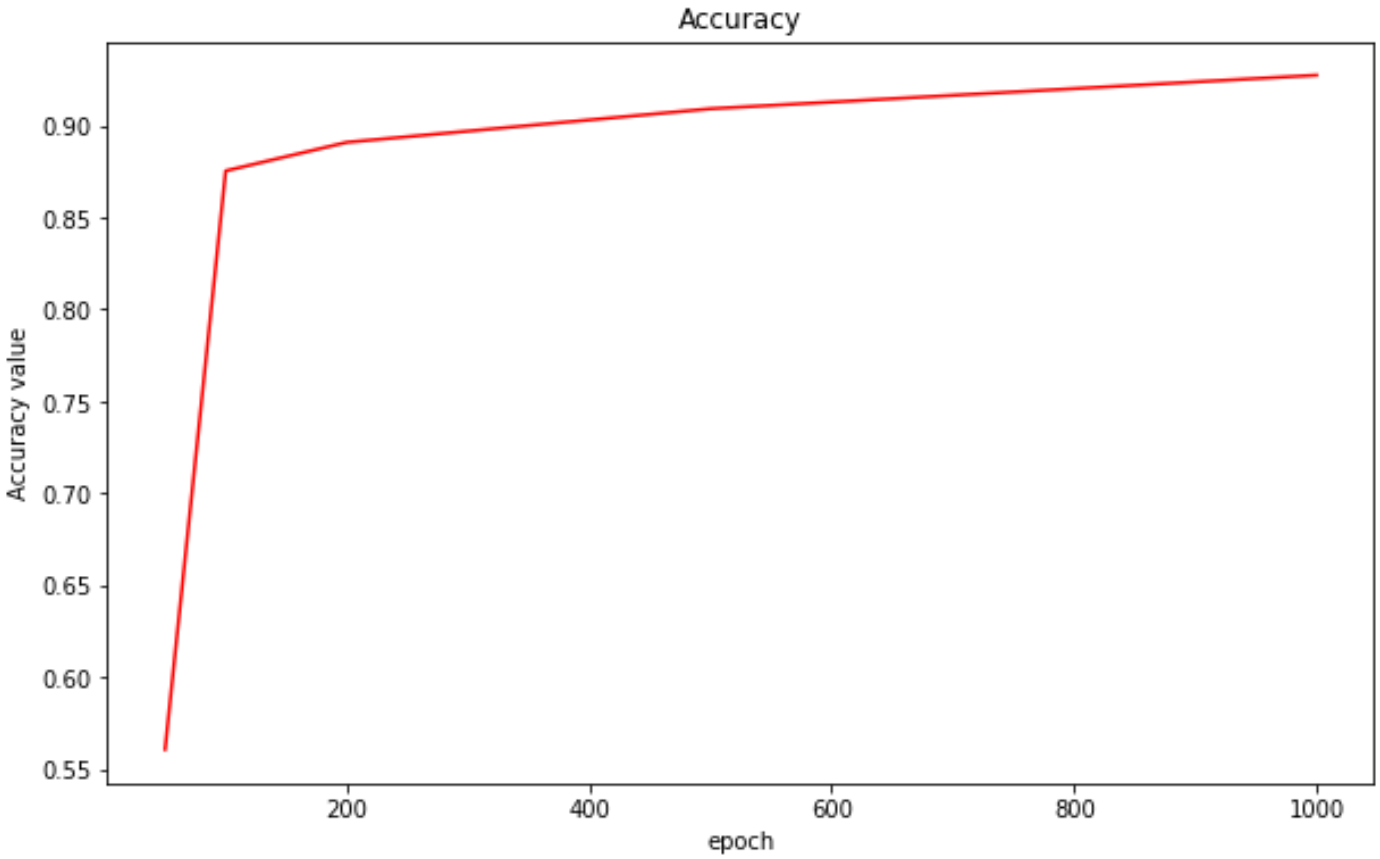
Paper Accuracy: 93.88% --- Our Accuracy 94.21%

2. Predicting phishing websites based on self-structuring neural network

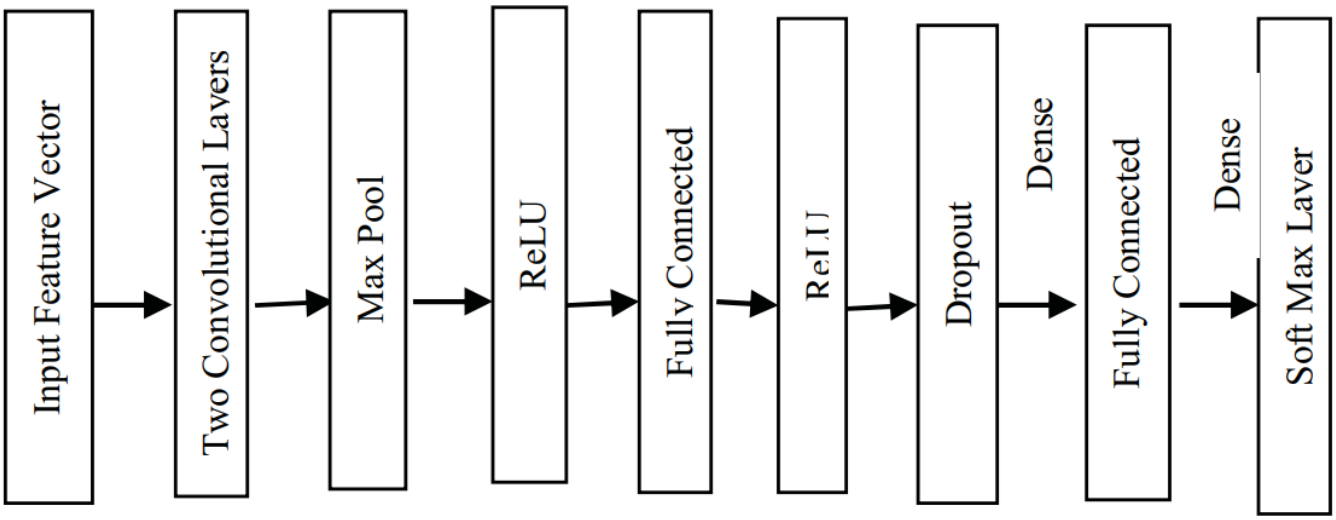


Features = having_IP_Address', 'URL_Length', 'having_At_Symbol', 'Prefix_Suffix', 'Abnormal_URL', 'SFH', 'HTTPS_token', 'Iframe', 'RightClick', 'popUpWidnow', 'having_Sub_Domain', 'Request_URL', 'URL_of_Anchor', 'Redirect', 'age_of_domain', 'DNSRecord', 'web_traffic', 'Result'

	Ours	Papers
Epoch: 50	**56.09%**	**91.32%**
Epoch: 100	**87.52%**	**92.33%**
Epoch: 200	**89.07%**	**93.07%**
Epoch: 500	**90.90%**	**93.45%**
Epoch: 1000	**92.72%**	**94.07%**



3. Automated Prediction of Phishing Websites Using Deep Convolutional Neural Network



Accuracy of Paper: 99.3%

Accuracy that we found: 55.43%

4. Phishing Website Detection Using Effective Classifiers and Feature Selection Techniques

Category	Feature Name	Value
Address bar	Having IP Address	1,0
	Having long url	1,0,-1
	Uses ShortningService	0,1
	Having '@' Symbol	0,1
	Double slash redirecting	0,1
	Having Prefix Suffix	-1,0,1
	Having Sub Domain	-1,0,1
	SSLfinal State	-1,1,0
	Domain registration Length	0,1,-1
	Favicon	0,1
	Is standard Port	0,1
	Uses HTTPS token	0,1
Abnormality	Request URL	1,-1
	Abnormal URL anchor	-1,0,1
	Links in tags	1,-1,0
	SFH	-1,1
	Submitting to email	1,-1
	Abnormal URL	1,0
HTML-JavaScript	Redirect	0,1
	on mouseover	0,1
	RightClick	1,-1
	popUpWindow	-1,1
	Iframe	0,1
Domain	Age of domain	-1,0,1
	on DNS Record	1,0
	Web traffic	-1,0,1
	Page Rank	-1,0,1
	Google Index	0,1
	Links pointing to page	1,0,-1
	Statistical report	1,0

PERFORMANCE OF CLASSIFIERS FOR ADDRESS BAR BASED FEATURES ONLY

Naive Bayes: 89.59% Paper: 89.95%

Decision Tree: 90.32% Paper: 90.19%

PERFORMANCE OF CLASSIFIERS FOR ABNORMAL BASED FEATURES ONLY

Naive Bayes: 72.20% Paper: 88.45%

Decision Tree: 87.63% Paper: 89.05%

PERFORMANCE OF CLASSIFIERS FOR JAVASCRIPT and HTML BASED FEATURES ONLY

Naive Bayes: 56.01% Paper: 54.12%

Decision Tree: 57.43% Paper: 58.02%

PERFORMANCE OF CLASSIFIERS FOR DOMAIN BAR BASED FEATURES ONLY

Naive Bayes: 69.88% Paper: 80.35%

Decision Tree: 72.74% Paper: 81.55%

Voting Classifier

Models used:

Support Vector Machine, K-Nearest Neighbors, BNaive Bayes, Random Forest, Decision Tree

Accuracy = 96.89

II. DEEP LEARNING WITH TENSORFLOW

Optimizers = 'sgd', 'rmsprop', 'adam', 'adadelta', 'adagrad', 'adamax', 'nadam', 'ftrl'

Loss = 'binary_crossentropy', 'categorical_crossentropy', 'hinge', 'squared_hinge', 'huber'

Activation = 'softplus', 'softsign', 'selu', 'elu', 'exponential', 'tanh', 'sigmoid', 'relu'

A. Results of the Deep Network:

```
Flatten(input_shape = (17,)
Dense(32, kernel_regularizer=l2(0.0001), activation='sigmoid')
Dense(64, activation='sigmoid')
Dense(32,activation='sigmoid')
Dense(1,activation='sigmoid')
loss='binary_crossentropy', optimizer='sgd', metrics=['accuracy'], epochs = 1000
```

Accuracy = 92.82%

Categorical Features:

```
Flatten(input_shape = (17,2)
Dense(32, kernel_regularizer=l2(0.0001), activation='sigmoid')
Dense(64, activation='sigmoid')
Dense(32,activation='sigmoid')
Dense(1,activation='sigmoid')
loss='binary_crossentropy', optimizer='sgd', metrics=['accuracy'], epochs = 1000
```

Accuracy = 72.02%

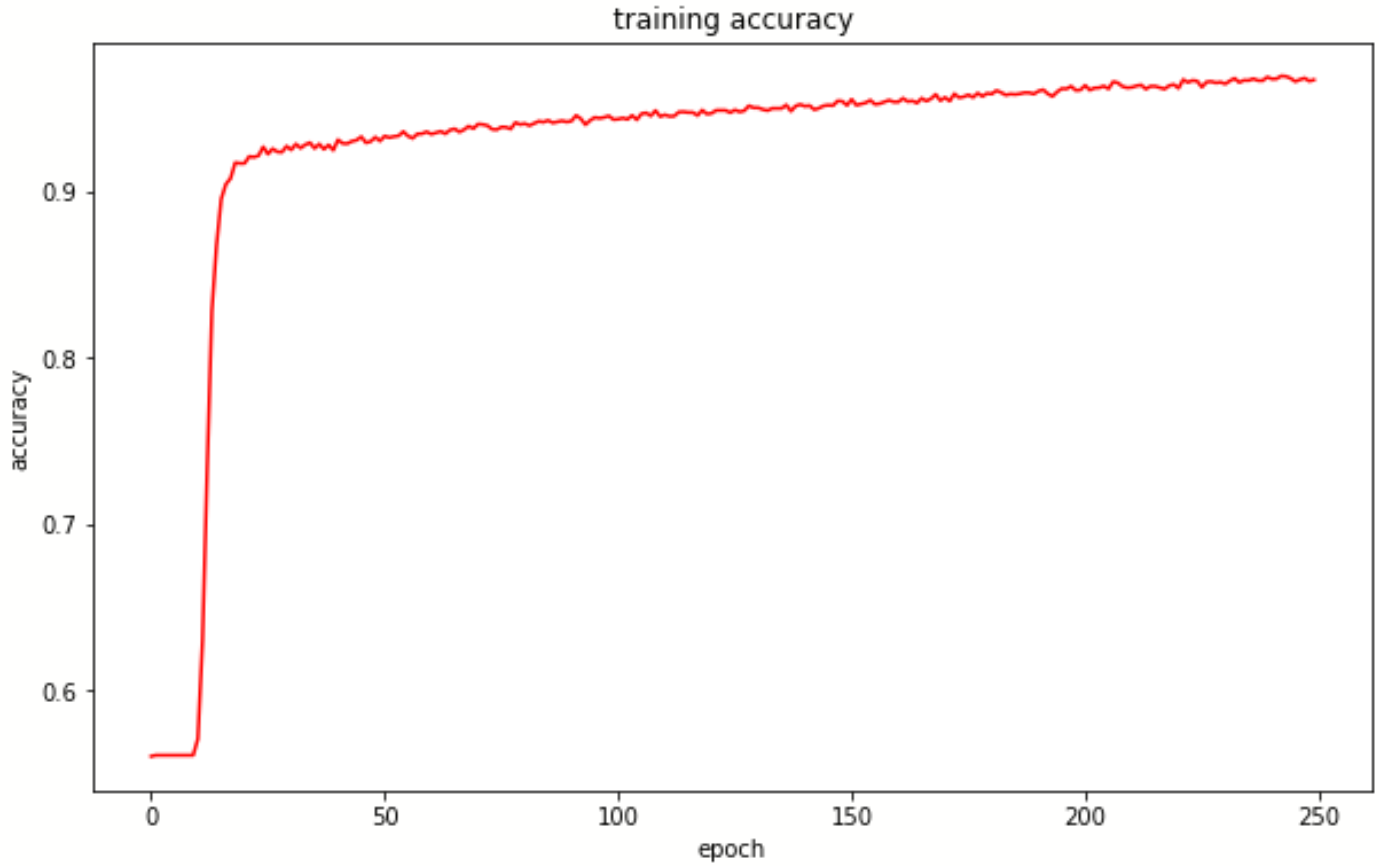
B. Recurrent Neural Networks:

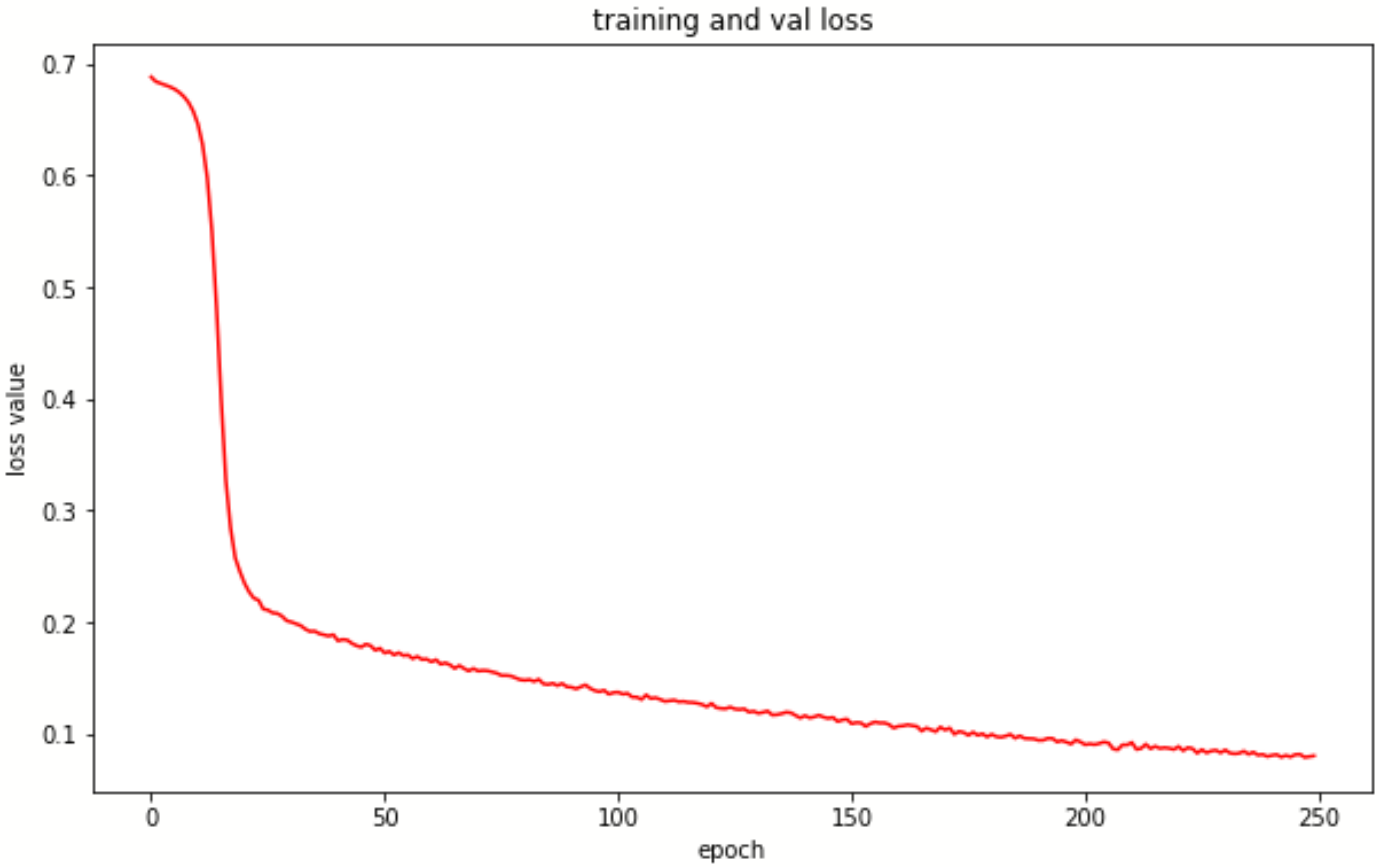
Model 1:

```
keras.layers.LSTM(128, activation='relu',return_sequences=True, input_shape=(1,30))
keras.layers.Dropout(0.2)
keras.layers.LSTM(256, activation='relu')
keras.layers.Dropout(0.2)
keras.layers.Dense(250,activation='relu')
keras.layers.Dense(1,activation='sigmoid')
```

Accuracy = 97.17%

```
loss='binary_crossentropy', optimizer='sgd', metrics=['accuracy']
Epoch Number = 250
```


training accuracy
accuracy
0.9
0.8
0.7
0.6
0
50
100
150
200
250
epoch

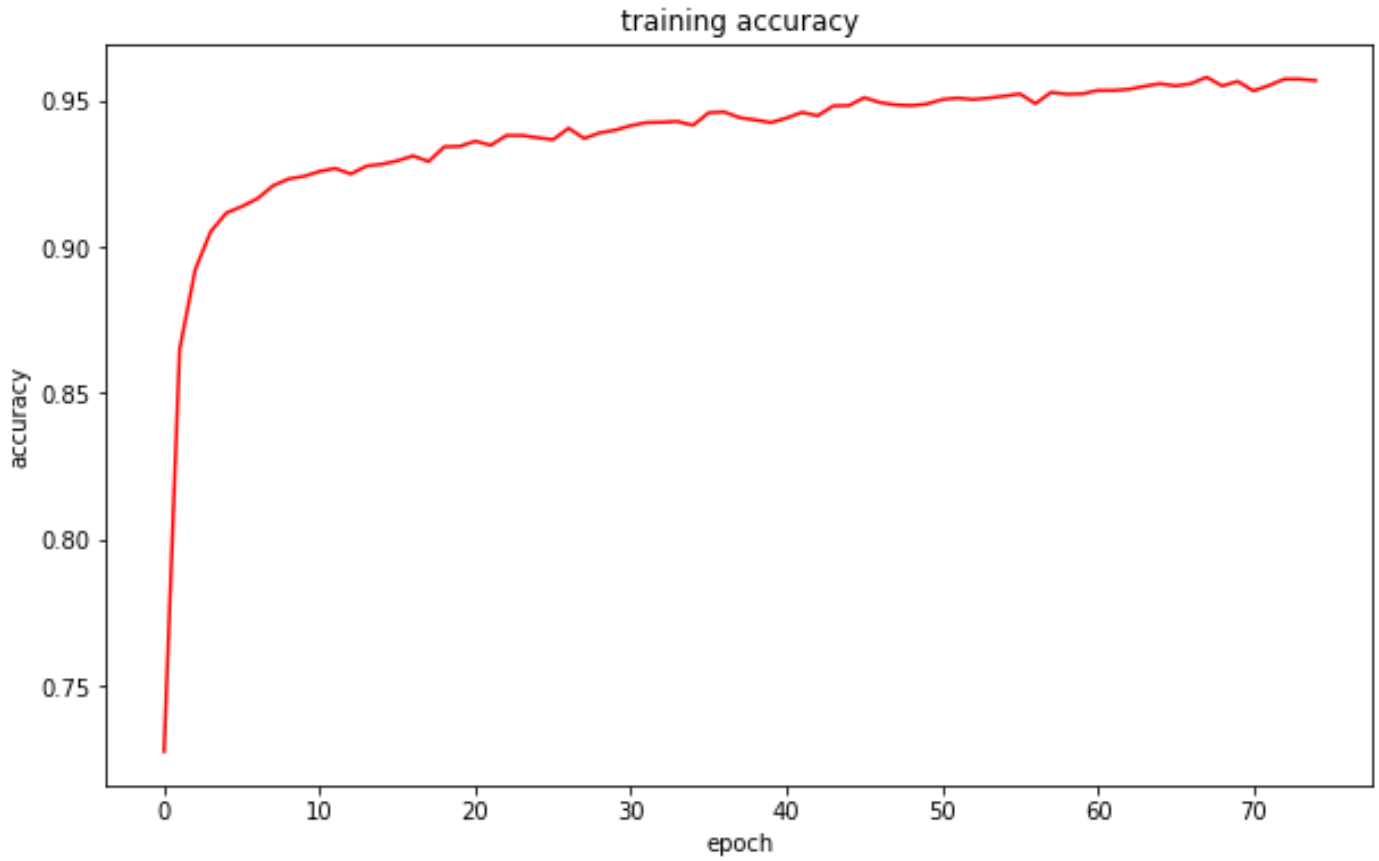

training and val loss
loss value
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
100
150
200
250
epoch

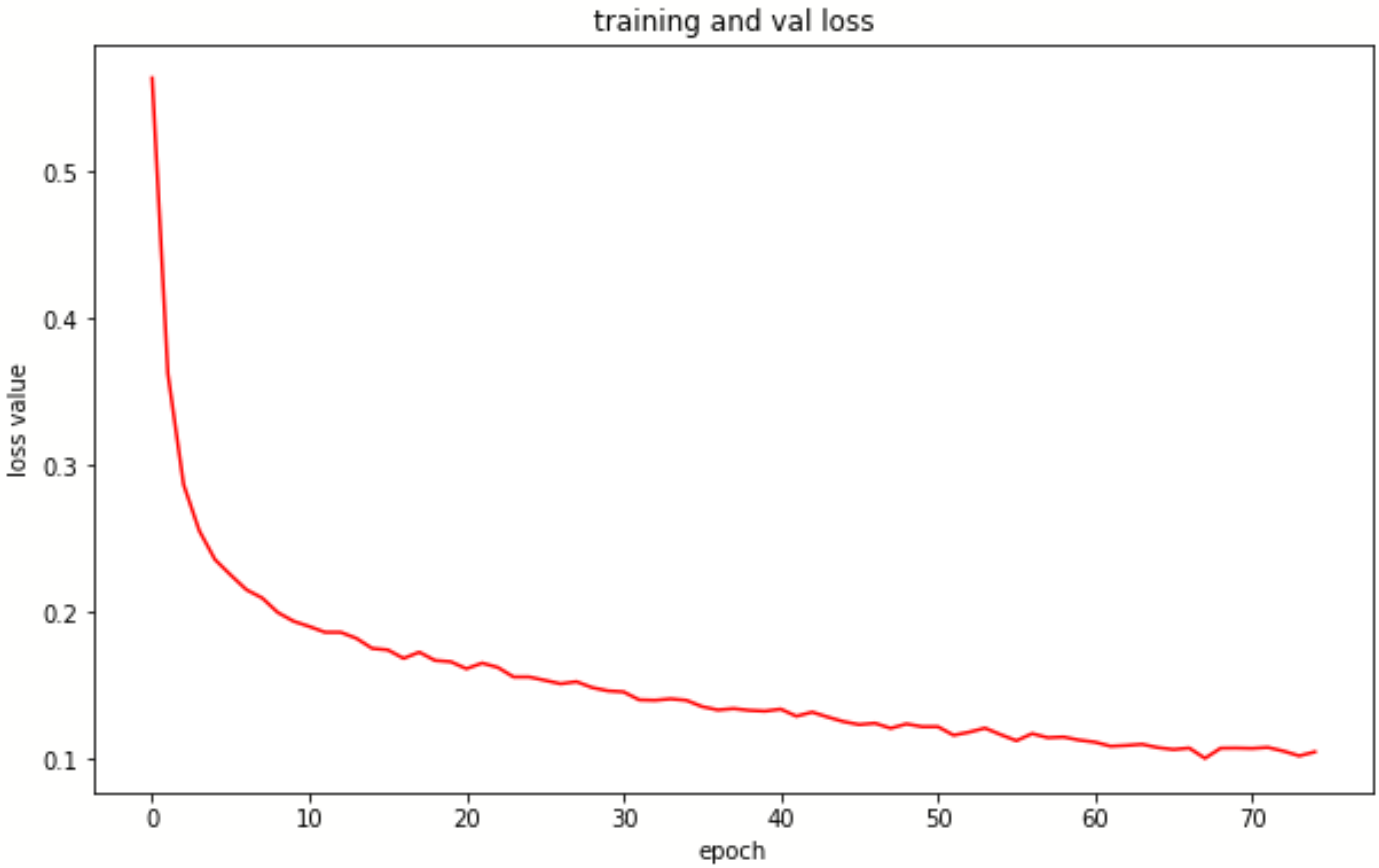
Model 2:

```
keras.layers.SimpleRNN(64, activation='relu',return_sequences=True, input_shape=(1,30))
keras.layers.Dropout(0.2)
keras.layers. SimpleRNN (128, activation='relu')
keras.layers.Dropout(0.2)
keras.layers.Dense(128,activation='relu')
keras.layers.Dense(128,activation='relu')
keras.layers.Dense(1,activation='sigmoid')
loss='binary_crossentropy', optimizer='sgd', metrics=['accuracy']
```

Accuracy = 96.54%

Epoch Number = 75





Model 3:

keras.layers.GRU(64, activation='relu',return_sequences=True, input_shape=(1,30))

keras.layers.Dropout(0.2)

keras.layers. SimpleRNN (128, activation='relu')

keras.layers.Dropout(0.2)

keras.layers.Dense(128,activation='relu')

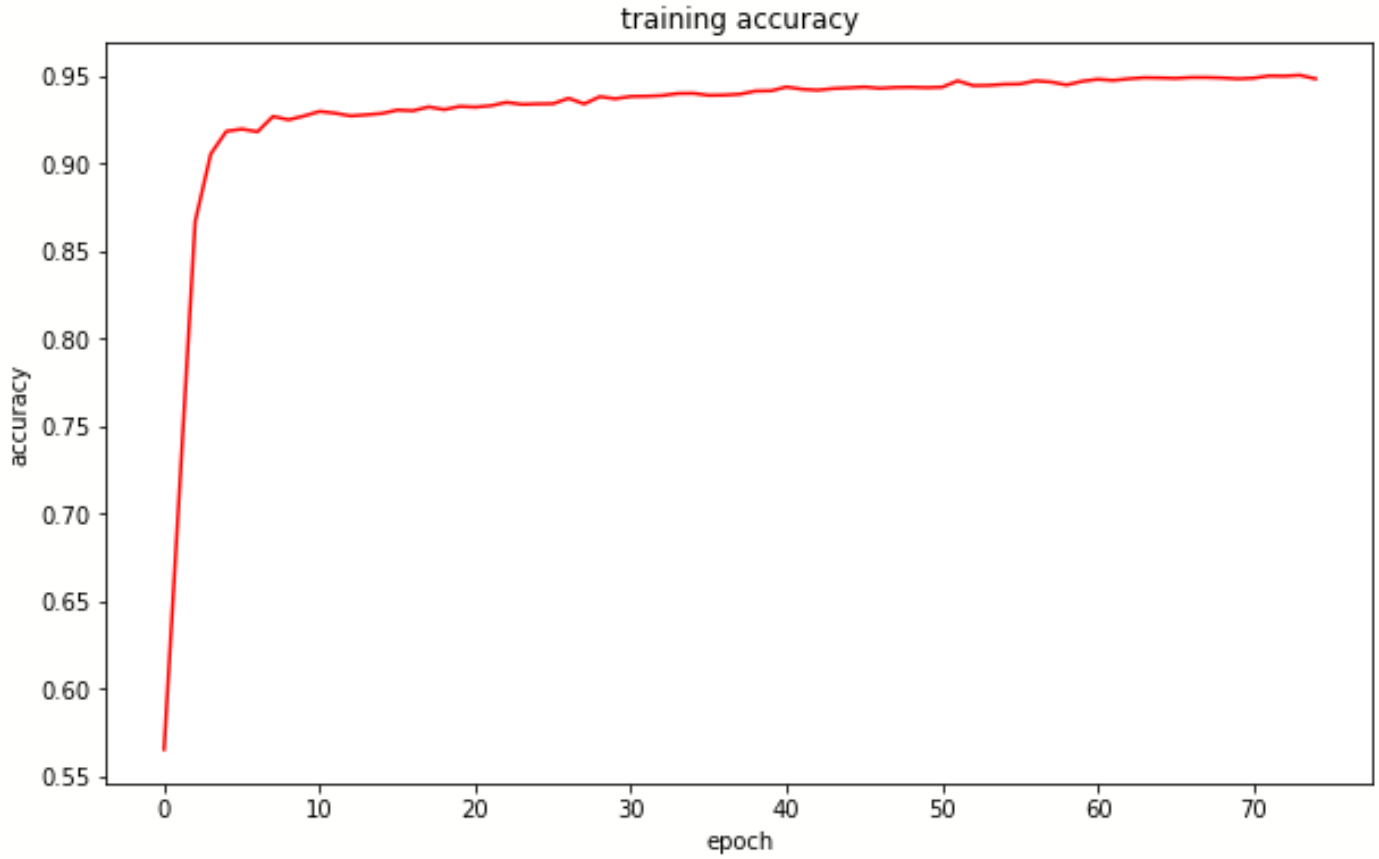
keras.layers.Dense(128,activation='relu')

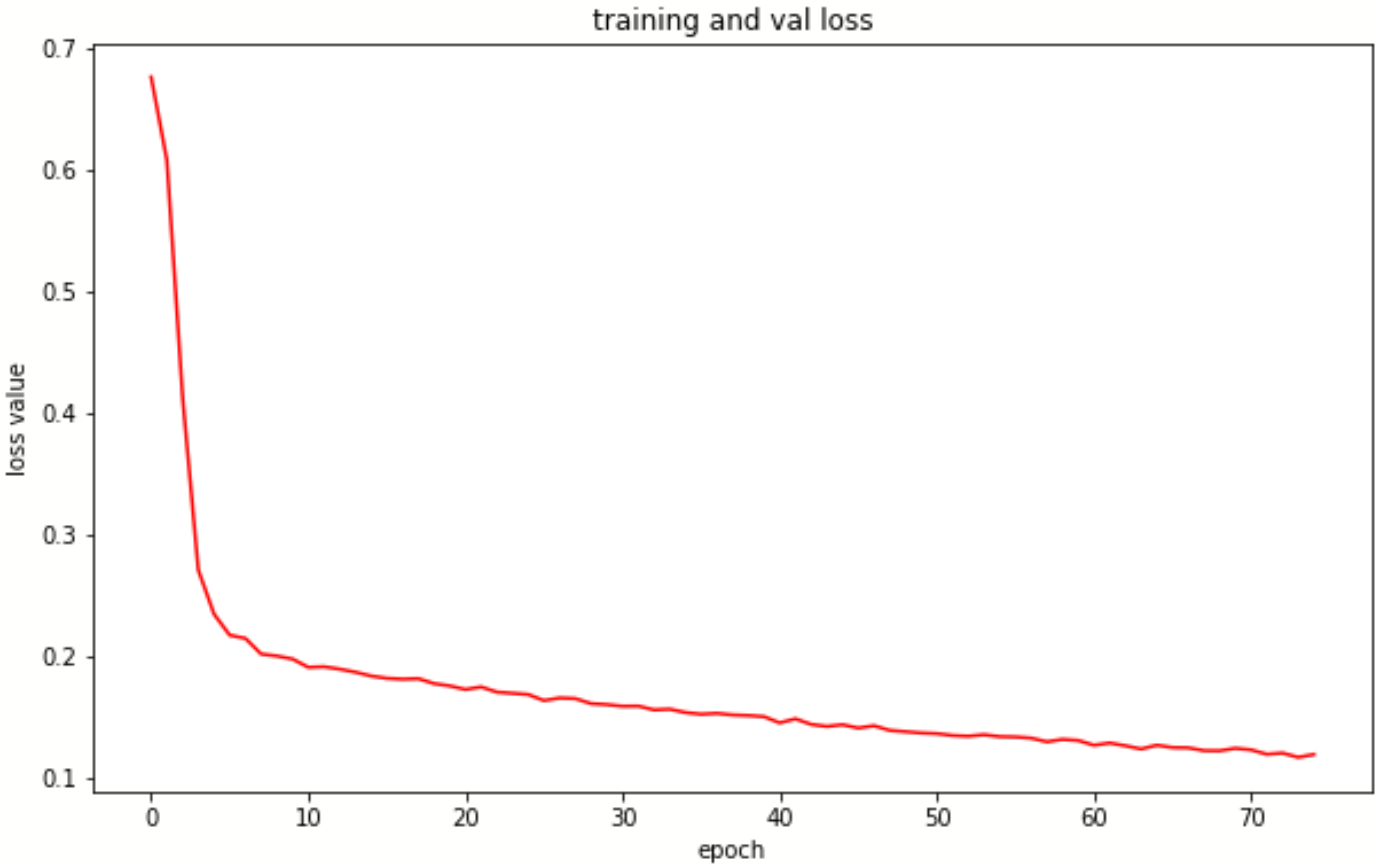
keras.layers.Dense(1,activation='sigmoid')

loss='binary_crossentropy', optimizer='sgd', metrics=['accuracy']

Accuracy = 95.11%

Epoch Number = 75


training accuracy
accuracy
epoch
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0
10
20
30
40
50
60
70


training and val loss
loss value
epoch
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10
20
30
40
50
60
70