DATA 630 – DATA MINING

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Assignment 4 -Neural Networks

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Introduction

The goals for Assignment four are to select a database that will be used for the Supervised Classification of Neural Net (NN) Analysis algorithms in RStudio and develop a model that can accurately predict the target class from independent variables using R and RStudio. Neural Networks were first created by neurophysiologist Warren McCulloch and mathematician Walter Pitts in 1943 by modeling a simple neural network using electrical circuits (Neural Nets, ND). Neural Networks have become a very popular statistical model because they are very flexible and can be used to model a lot of different problems (Adler, 2012).

The data selected for this assignment and the database was on Phishing. Phishing is a term used to describe a process where a "targeted individual is contacted by email or telephone from an individual posing as a legitimate organization". Their goal is to pull out sensitive information from an unsuspecting individual such as banking information, credit card details and passwords. Approximately 156 million phishing emails are sent globally every day that appear to come from legitimate resources (Canada, ND). Individuals are tricked into giving out personal information which can damage their financial or credit history (Phishing.org, ND). A recent article by The Cybersecurity Source states that the annual cost of Phishing is around 3.1 million dollars per year for the average company (Paul. 2017). The average cost of Phishing was around 500 million dollars per year for the United States alone (Phishing.org, ND).

The UCI Machine Learning website talks about how the previous Phishing Datasets had unreliable training datasets to be used for analysis. The current dataset has more reliable training data that the NN package can build a model from the training data through supervised learning on multi-layered perceptrons in RStudio. The NN model will be used to predict the accuracy from 30 input variables on the dependent Phishing variable in this dataset.

Analysis Methods

The Phishing Website database will be used for the NN algorithms and was obtained from the recommended datasets for Assignment four. The data set was in column delineated form (CSV) and was imported into **RStudio** for data preparation and analysis. Figure 1A (Appendix) has the R commands and the list of the variables found in the dataset. Please note that all figures that end in an "**A**" will be in the Appendix and all others will be found in this document. The data set contains 31 variables with total of 11, 055 data points (Figure 1A). All 31 variables from this data set were integers and a summary of these attributes can be seen in Table 1. All the variables were scaled from a value of -1 to 1 except for **Redirect** which was only a binary value that had 0 or 1 in this dataset. The independent variables are the first 30 entries listed in Table 1 and the dependent variable will be the **Result** and is the last variable in this table.

The Phishing data set was transferred into **RStudio** for analysis and the standard **str(), summary() and dim() functions** were completed to look at the variables in the dataset (Figure 1A and 2A). A few important data prepressing steps discussed in lecture and videos talks about the importance of missing variables and the scaling of attributes. NN algorithms are a very robust system, but if the database is highly skewed the model can have problems predicting factors leading to rare outcomes (Ennett et al., 2001). The **summary**() and **apply** () command shows this dataset had no missing variables (Figure 2A and 4A). The second important data preprocessing step for NN is the scale of the variables which can affect the weights of the analysis. All the variables had ranges between -1 and 1 as stated previously. The summary and brief definition of these attributes can be seen in Table 1.

Table 1: List of all 31 variables assigned to this study.

Name of Variable	Brief Description	Type
having_IP_Address	IP address used as an alternative domain name	Integer_IND
URL_Length	Length of URL Address to hide information	Integer_IND
Shortining_Service	Is the URL address considerably small in length	Integer_IND
having_At_Symbol	Using @ Symbol leads browser to ignore everything preceding the "@"Symbol	Integer_IND
double_slash_redirecting	The double slash redirects user to another site	Integer_IND
Prefix_Suffix	The "- "sign is rarely used in the legitimate sites	Integer_IND
having_Sub_Domain	If sub domain is greater than one its Suspicious	Integer_IND
SSLfinal_State	Is the Issuer trusted and age of Certificate	Integer_IND
Domain_registeration_length	Domains generally live for short periods of time	Integer_IND
Favicon	Graphic (icon) image from a specific website	Integer_IND
port	Port # of the preferred status for Phishing sites	Integer_IND
HTTPS_token	Addition of HTTP token domains to trick users	Integer_IND
Request_URL	Are external objects loaded from another site	Integer_IND
URL_of_Anchor	Checks the Anchor or tag from website	Integer_IND
Links_in_tags	deciphers legitimate verses suspicious tags	Integer_IND
SFH	Checks the Server From Handler contents	Integer_IND
Submitting_to_email	Is personal email redirected redirected from site	Integer_IND
Abnormal_URL	Is Host Name included or not in URL	Integer_IND
Redirect	How many times are websites forwarded	Integer_IND
on_mouseover	Does the onMouseOver change or not	Integer_IND
RightClick	Phishers will disable the right click on mouse	Integer_IND
popUpWidnow	Is there a popup winder for personal info	Integer_IND
Iframe	Is iframe tag being used or not	Integer_IND
age_of_domain	Is the domain older than six months or not	Integer_IND
DNSRecord	The domain name serve not recognized	Integer_IND
web_traffic	Counts web traffic. If > 100,000 then good	Integer_IND
Page_Rank	A value placed on website and Phishers have low values (0 to 0.2)	Integer_IND
Google_Index	Is the site found on Google search engine	Integer_IND
Links_pointing_to_page	Counting number of links to the website	Integer_IND
Statistical_report	Reporting agencies like PhishTank and StopBadware that will generate reports	Integer_IND
Result	This is the dependent variable and 0 means no Phishing and 1 means Phishing.	Integer_DEP

Note 1: A brief description of these attributes are listed in Table 1. A complete listing of these variables can be found in Phishing Website features by Rami et al. (ND). Retrieved from: http://archive.ics.uci.edu/ml/machine-learning-databases/00327/.

The Phishing data set has no missing values and was scaled correctly for this model. The standard data preparation procedures were initiated and all 31 variables were loaded into a

keep.vars file which can easily be modified as needed for analysis. One of the drawbacks in using the NN algorithms in R is the independent variables need to be manually loaded into the program and then the dependent variable has to be named **(target.name**). The previous **Ctree** or **Apriori Rules** models would load the independent variables if the dependent variable was defined with the addition of the tilde. The **keep.vars** list was then called to make sure all the variables were in this list and zero variables were in the do not keep list. The **set.seed(32)** was used to randomize the data set and then 70% of the data was used as the training data to build the model and 30% of the data was used to test the models accuracy. These R commands can be seen in Figure 5A to 7A. A **my.formula** file was created that contained the dependent variable and the training data set and this was inserted into the NN model (**nn**). The model had two hidden layers and a **linear.output** set to FALSE. The output from this model gave a wonderful warning message about algorithms not converging in one of one repetitions (Figure 8A). The model was rerun a couple of times and this message continued popping up. The 30 variables were then subdivided into three sets to see if one of the variables was causing the problem and this message appeared for the first set of the ten attributes. The message from Cross Validation discusses the error message and said the models needs more time to converge and the **stepmax** or threshold functions can be adjusted to give the model more time (Cross Validated, ND) (Figure 8A). The **stepmax** function was increased from 1000 to $100e^5$ times and this gave the model enough time to converge. The NN model was run in RStudio and the output from the following commands are listed below and the output can be found in Figures 9A to 17A.

The models will have the following commands run in RStudio unless stated otherwise in this report. The commands will be listed and briefly described based on class notes and Gunther and Fritsch article in the R Journal (2010). The **names()** command was used to display the NN

properties and **nn$call()** command displays the model created for this algorithm. The **model$list** command shows the dependent and independent variables in the output and the **nn$response** command shows the actual dataset for the dependent or Result variable in this model. The **nn$covariate** command was used to show the input values for all 31 variables. The **nn$weights** and **nn$startingweigths** commands were used to display the generalized and starting weights of the NN for each replication. The **nn$result.matrix** command were used to show the summary of the number of training steps with their errors and weights. The **nn$net.result[[1][1:10]** command in R will show the first 10 predicted probabilities for the first occurrences. The commands were organized in R to minimize output space for the Appendix section of this report.

The final two steps for the NN model is visualization of the model and the efficiency of the model. The **plot()** command was used to show the models input, hidden layers and output and this can be seen in Figure 15A. The model evaluation or performance is determined by the confusion matrix that shows how many true positives and negatives predicted by the training and testing models compared to the false positives and negatives that were predicted incorrectly. The model accuracy was predicted and can be seen in Figure 17A. These commands will be the standard operating procedure for all subsequent models unless stated otherwise (Class Notes).

The first NN model was imitated in RStudio and the output can be seen in Figures 5A to 17A. Model efficiency was less than 50% for both the testing and training data sets and another two models were initiated using the same commands except the hidden layer's neural nodes were increased for these models. The second model or **nn2** had a total of one hidden layer with 10 neural nodes and this can be seen in Figure 18A. The third model or **nn3** had a total of two hidden layers with 10 neural nodes each and this can be seen in Figure 29A. The second model had the highest efficiency results and a total of 30 plots were generated using **gwplot()** and this

plots the generalized weights for each covariate. These plots can be seen in figures 38A to 45B in the Appendix. This will show the distribution of the generalized weights to visualize the effects it had on the dependent variable.

The **"rprop+"** algorithm is the default setting and was used for the first three models. These models changed the number of hidden layers and nodes from 2, to 10 and then 10, 10 to increase the accuracy rate of the model. The remaining two models changed the "**rprop+"** algorithm to "**rprop-"** and this used the 10 neural nodes for the one hidden layer of the model. The last model used the "backprop" algorithm and only had two neural nodes for one hidden layer of the model. The results from these models can be found in Figures 46A to 60A in the Appendix.

Results

A total of three models (**nn, nn2** and **nn3**) were initiated to test the default algorithm for the supervised learning in the NN. The Results for all three models can be seen in Figures 9A to 37A in the Appendix. The NN model describes the relationship between the dependent variable "**Results**" and all 30 independent variables discussed in Table 1. The response variables were mostly binary with a -1 or 1 response or trinary with a 1-, 0 and 1 response. The training steps needed for the **nn** model was 482,732 steps and this number declined to 22, 605 for the **nn2** model and 17,829 steps for the **nn3** model (Figure 13A, 24A and 34A). The training process stopped when the default threshold was smaller than 0.01 for these models. The weights for the **nn** model ranged from a value of 0.3024 from the second hidden layer node and -209.4777 for the output node weights. The weights for the nn2 model ranged from -45.608 to 64.497 gong

from the first hidden layer to the output or result. The weights for nn3 model range from -55.768 to 629.635 for this algorithm.

The **plot()** function was used for the Evaluation of the models and the output can be seen in Figures 13A, 26A and 35A. The weight from the hidden layers can be seen in the **nn$result.matrix** and the plot for the input nodes, hidden(s) nodes and output node. The graph becomes hard to read as the hidden layers and neural nodes increase in number. The intercepts for the activation function for the **nn** model ranged from 115.343 to -125.685 for all intercepts. The intercepts for the **nn2** and **nn3** model can be seen in the plots generated for these models.

The confusion matrix was calculated in RStudio for all three models and the output from this function can be seen in Figure 17A, 28 and 37A and the list of the results can be seen in Table 2. The model with the highest predicted accuracy for both the Training and Testing data

Table 2.

Data Set Used	Predicted Accuracy		
	nn model	nn2 model	nn3 model
Training Data	49.73%	53.1%	52.31%
Testing Data	49.86%	52.03%	51.79%

was from the second model or **nn2.** The predicted accuracy was slightly higher for the Training set at 53.1% and 52.03% for the Testing Date set. The other models were only a few percentage points away from this model and this is a 3% better than chance in determining the Result dependent variable for this model.

The **"rprop**-"model was run in RStudio and the results can be found in Figures 46A to 55A. This model had two hidden layers with 10 neural nodes each and the learningrate was increased to 0.5 instead of the default of 0.01. The confusion matrix results were not as good as the **nn2** model and was completed in a total of 11, 816 steps. The Training Data set had a success rate of 52.63% and the Testing Data set was only at 51.69% for this model (Figure 55A). The

last NN model used to try and increase the prediction accuracy for both training sets was nn6_bp. The default was changed to "backprop" and the original model had 10 hidden nodes but it would not converge so it was changed to one hidden layer with two neural nodes. The results from this analysis can be found in Figures 55A to 57A. The confusion matrix generated the lowest prediction accuracy for this models and was lower than the original or **nn** model and was completed in a total of 368,399 steps. The Training Data accuracy was at 49.31% and the Testing Data accuracy was at 49.05%. The entire list of commands was not run for this model but the code can be found in the R Index.

Interpretation of the Results

The major goal for this assignment was to be able to accurately predict the Phishing outcome from the test data that was built from 30 independent variables. The NN Supervised Learning Algorithm was used for these non-linear attributes. The first three models used the "**rpart**" algorithm. This is a resilient backed propagation and the model was changed several times to have a different number of hidden layers and neural nodes to determine if this affected the accuracy of the model generated from the confusion matrix. The **nn** model had one hidden layer with two neural nodes and converged in 482, 732 steps with a test prediction accuracy of 49.86%. When the neural nodes for only one hidden layer was increased to 10, the number of steps for the result matrix decreased to 22, 605 and the test prediction accuracy increased to 52.03%. When the hidden layer increased to two and both layers had 10 neural nodes the number of steps to completion dropped to 17, 829 but the test prediction rates were only slightly higher than the first model in this exercise.

The **nn2** model is currently the best model and has a slight advantage in predicting the Result outcome for Phishing when compared to flipping a coin. The next set of steps were to change the algorithm in the models. The **nn5** used the "rpart-"algorithm, had two hidden layers with a total of 10 neural nodes each and the learningrate was increased from 0.01 to 0.50. The number of steps was at 11, 816, but the predicted accuracy for the Test Data was still lower than the **nn2** model in this study. The last model used to try and increase the prediction accuracy was the "backprop" algorithm and can be seen in the nn6_bp model. The hidden layer was set to two and the learningrate was set to default or 0.01. This model had a total of 368,399 steps and the prediction results for the Test Data was 49.05% and is the lowest percentage for this study.

The NN models look impressive on paper with the graphs showing the input, hidden and output layer and all the nodes connected by their weights (except the input layer). The literature discusses how robust these models are and analysts can run a linear or categorical data set with the models. The learning thresholds can be manipulated and the number of hidden layers, neural nodes can be adjusted to balance the model and obtain optimal prediction capabilities. The results from these models only changed by a total of 5.05% points for both the Training and Testing Data set. The second or **nn2** model was the most accurate but the other models were very similar in their output for this dataset.

The article from Research Gate discusses "over specialization" of the data and this is when the training data set used to create the model has too many layers and does not come up with a generalized solution but a specific one instead. This works well for the training data set, but not the testing data set (Research Gate, ND). The article suggests using one third of the data for the training set and one third for the testing set and one third for the cross validation set. The author says that if the error does not go down on the training set (too few hidden layers) or

overspecialize then you have created the best model. This could be one area that can be explored more in the future to optimize or validate the current results from this study.

Finally, the plots of generalized weights were calculated and these can be found in Figures 38A to 45B in the Appendix as discussed in Gunther and Fritsch's article (2010). The covariate of weights for the generalized distribution of the covariate for age suggests this had no limited effect on the dependent variable (from the article). All generalized weights were plotted to see if these variables had similar results and the first Figure is copied below in Figure 1 and the key to the variables is in Figure 1B. John Cook talks about when the models increase in size the errors will also increase and by adding more variables, hidden layers or neural nodes may not always be the best answer to increasing model efficiency. A total of 30 graphs were generated and there seems to be no clear attribute that can be removed as shown in the article to increase the efficiency of the model. A few bloggers mentioned removing a subset of variables to see how the accuracy of the model responds to different data sets.

Figure 1

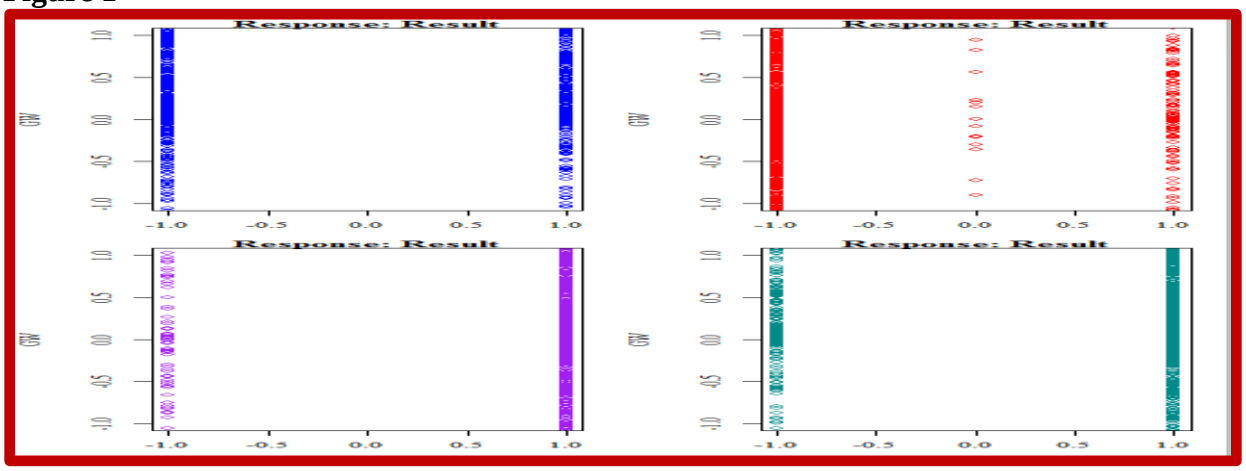

Figure 1B

```
> gwplot(nn2, selected.covariate = "having_IP_Address",
+          min = -1, max = 1, col="blue")
> gwplot(nn2, selected.covariate = "URL_Length",
+          min = -1, max = 1, col="red")
> gwplot(nn2, selected.covariate = "Shortining_Service",
+          min = -1, max = 1, col="purple")
> gwplot(nn2, selected.covariate = "having_At_Symbol",
+          min = -1, max = 1, col="dark cyan")
```

Experimental Limitations & Conclusions

The Neural Network Supervised learning can be described as an oxymoron in some respects. The literature discusses how robust and widely used these models are, assuming the data has been preprocessed correctly (Adler, 2012). The data should not contain missing variables and the scale or range of the values for each attribute should be similar in range when compared to the other variables. The most efficient scale are binary values such as 0 or 1. The lecture notes, articles and literature also describe these models as a black box that can be complicated and hard to understand. The article from KDnuggets (ND) discusses some of the major issues with the Neural Networks. The first issue is these models are quite complicated and when the number of hidden layers and neural nodes increase, so does the complexity of the model. John Cook also said that as we increase these hidden layers and neural nodes so does the error weights generated for these interactions between the nodes in the model. Another problem with NN is overfitting the data and the article discusses how there is a balance between overfitting the model and model complexity. The more complex the model is, the greater chance it will have of overfitting the data. The article discusses two ways of combating overfitting the model and these are regularization (L1 and L2) and Dropout. The regularization equation was taken from the article and is the "$Error+\lambda f(\theta)$, where $f(\theta)$ grows larger as the components of θ grow larger and λ is the regularization strength (a hyper-parameter for the learning algorithm)" (KDnuggets, ND). The article says these neurons will only use a small subset of the important inputs which makes them more resistant to noise in the system. The Dropout method will only keep a neuron active with some probability p (hyperparmeter) or setting it to zero during the training session. This will efficiently combine neural networks exponentially and minimize overfitting (KDnuggets).

The exercise in NN using the Phishing Data proved to be very challenging when trying to optimize the models. The so called NN "black box" and complexity of the neural nodes makes it more difficult to understand when compared to the CTREE models that were run for Assignment Three. The **nn2** model with one hidden layer and 10 neural nodes was the best model in predicting Phishing results for this study with a predicted Testing Accuracy of 52%.

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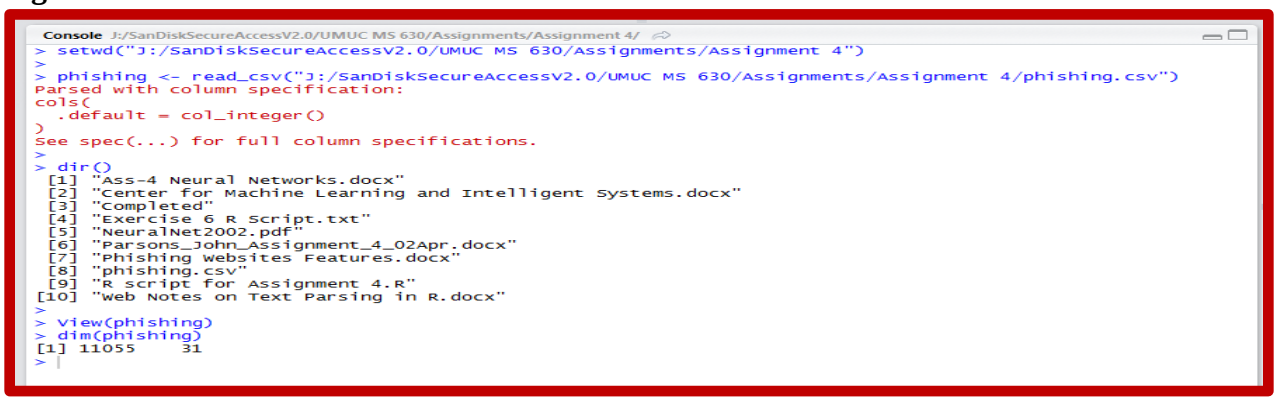
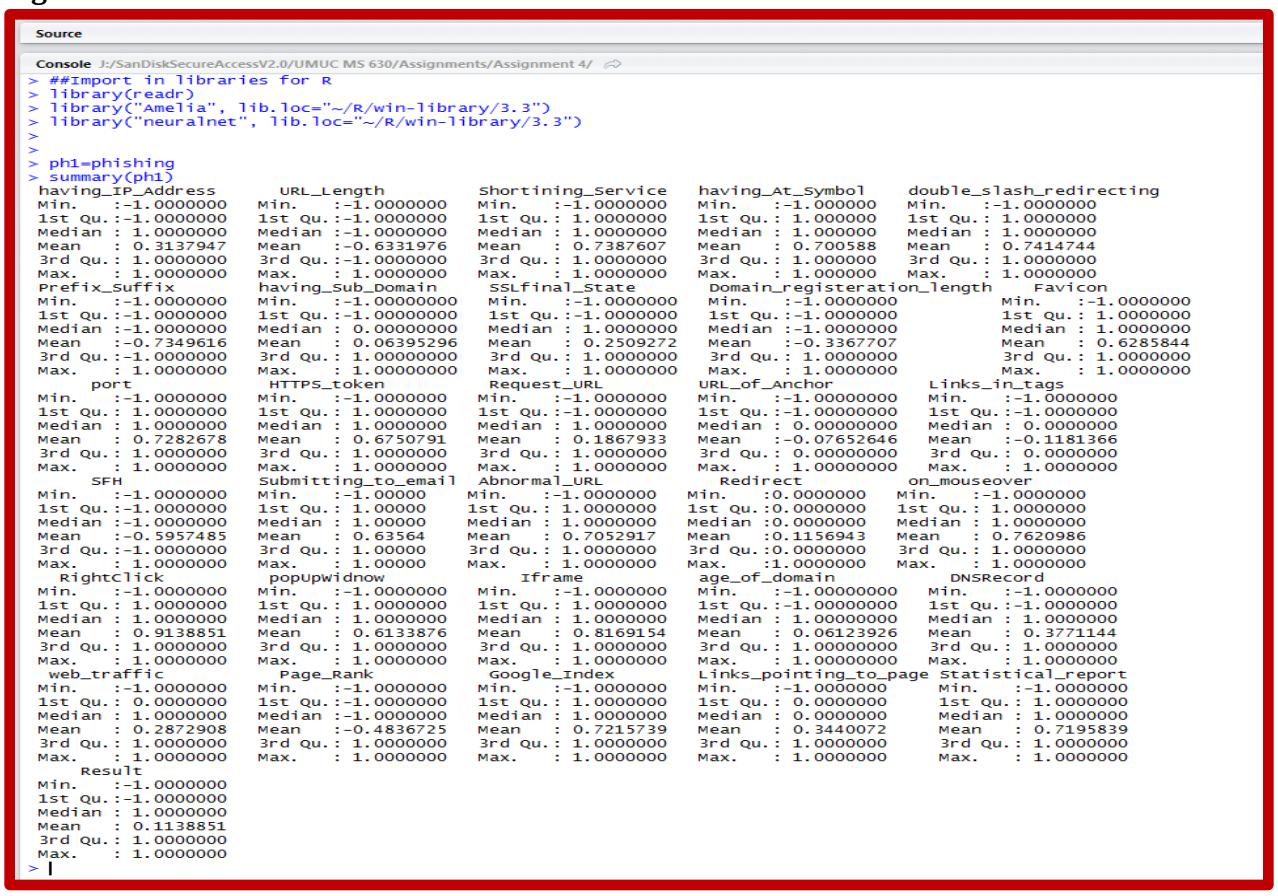
APPENDIX

Figure 1A:



```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> setwd("J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4")
>
> phishing <- read_csv("J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/phishing.csv")
Parsed with column specification:
cols(
  .default = col_integer()
)
See spec(...) for full column specifications.
>
> dir()
 [1] "Ass-4 Neural Networks.docx"
 [2] "Center for Machine Learning and Intelligent Systems.docx"
 [3] "Completed"
 [4] "Exercise 6 R Script.txt"
 [5] "NeuralNet2002.pdf"
 [6] "Parsons_John_Assignment_4_02Apr.docx"
 [7] "Phishing Websites Features.docx"
 [8] "phishing.csv"
 [9] "R script for Assignment 4.R"
[10] "Web Notes on Text Parsing in R.docx"
>
> View(phishing)
> dim(phishing)
[1] 11055    31
>
```

Figure 2A:



```
Source
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> ##Import in libraries for R
> library(readr)
> library("Amelia", lib.loc="~/R/win-library/3.3")
> library("neuralnet", lib.loc="~/R/win-library/3.3")
>
>
> ph1=phishing
> summary(ph1)
 having_IP_Address      URL_Length        Shortining_Service  having_At_Symbol    double_slash_redirecting
 Min.   :-1.0000000   Min.   :-1.0000000   Min.   :-1.0000000   Min.   :-1.000000   Min.   :-1.0000000
 1st Qu.:-1.0000000   1st Qu.:-1.0000000   1st Qu.: 1.0000000   1st Qu.: 1.000000   1st Qu.: 1.0000000
 Median : 1.0000000   Median :-1.0000000   Median : 1.0000000   Median : 1.000000   Median : 1.0000000
 Mean   : 0.3137947   Mean   :-0.6331976   Mean   : 0.7387607   Mean   : 0.700588   Mean   : 0.7414744
 3rd Qu.: 1.0000000   3rd Qu.:-1.0000000   3rd Qu.: 1.0000000   3rd Qu.: 1.000000   3rd Qu.: 1.0000000
 Max.   : 1.0000000   Max.   : 1.0000000   Max.   : 1.0000000   Max.   : 1.000000   Max.   : 1.0000000
 Prefix_Suffix      having_Sub_Domain     SSLfinal_State     Domain_registeration_length    Favicon
 Min.   :-1.0000000   Min.   :-1.00000000   Min.   :-1.0000000   Min.   :-1.0000000           Min.   :-1.0000000
 1st Qu.:-1.0000000   1st Qu.:-1.00000000   1st Qu.:-1.0000000   1st Qu.:-1.0000000           1st Qu.: 1.0000000
 Median :-1.0000000   Median : 0.00000000   Median : 1.0000000   Median :-1.0000000           Median : 1.0000000
 Mean   :-0.7349616   Mean   : 0.06395296   Mean   : 0.2509272   Mean   :-0.3367707           Mean   : 0.6285844
 3rd Qu.:-1.0000000   3rd Qu.: 1.00000000   3rd Qu.: 1.0000000   3rd Qu.: 1.0000000           3rd Qu.: 1.0000000
 Max.   : 1.0000000   Max.   : 1.00000000   Max.   : 1.0000000   Max.   : 1.0000000           Max.   : 1.0000000
      port          HTTPS_token         Request_URL         URL_of_Anchor        Links_in_tags
 Min.   :-1.0000000   Min.   :-1.0000000   Min.   :-1.0000000   Min.   :-1.00000000   Min.   :-1.0000000
 1st Qu.: 1.0000000   1st Qu.: 1.0000000   1st Qu.:-1.0000000   1st Qu.:-1.00000000   1st Qu.:-1.0000000
 Median : 1.0000000   Median : 1.0000000   Median : 1.0000000   Median : 0.00000000   Median : 0.0000000
 Mean   : 0.7282678   Mean   : 0.6750791   Mean   : 0.1867933   Mean   :-0.07652646   Mean   :-0.1181366
 3rd Qu.: 1.0000000   3rd Qu.: 1.0000000   3rd Qu.: 1.0000000   3rd Qu.: 0.00000000   3rd Qu.: 0.0000000
 Max.   : 1.0000000   Max.   : 1.0000000   Max.   : 1.0000000   Max.   : 1.00000000   Max.   : 1.0000000
      SFH          Submitting_to_email  Abnormal_URL          Redirect          on_mouseover
 Min.   :-1.0000000   Min.   :-1.00000   Min.   :-1.0000000   Min.   :0.0000000   Min.   :-1.0000000
 1st Qu.:-1.0000000   1st Qu.: 1.00000   1st Qu.: 1.0000000   1st Qu.:0.0000000   1st Qu.: 1.0000000
 Median :-1.0000000   Median : 1.00000   Median : 1.0000000   Median :0.0000000   Median : 1.0000000
 Mean   :-0.5957485   Mean   : 0.63564   Mean   : 0.7052917   Mean   :0.1156943   Mean   : 0.7620986
 3rd Qu.:-1.0000000   3rd Qu.: 1.00000   3rd Qu.: 1.0000000   3rd Qu.:0.0000000   3rd Qu.: 1.0000000
 Max.   : 1.0000000   Max.   : 1.00000   Max.   : 1.0000000   Max.   :1.0000000   Max.   : 1.0000000
   RightClick          popUpWidnow            Iframe          age_of_domain          DNSRecord
 Min.   :-1.0000000   Min.   :-1.0000000   Min.   :-1.0000000   Min.   :-1.00000000   Min.   :-1.0000000
 1st Qu.: 1.0000000   1st Qu.: 1.0000000   1st Qu.: 1.0000000   1st Qu.:-1.00000000   1st Qu.:-1.0000000
 Median : 1.0000000   Median : 1.0000000   Median : 1.0000000   Median : 1.00000000   Median : 1.0000000
 Mean   : 0.9138851   Mean   : 0.6133876   Mean   : 0.8169154   Mean   : 0.06123926   Mean   : 0.3771144
 3rd Qu.: 1.0000000   3rd Qu.: 1.0000000   3rd Qu.: 1.0000000   3rd Qu.: 1.00000000   3rd Qu.: 1.0000000
 Max.   : 1.0000000   Max.   : 1.0000000   Max.   : 1.0000000   Max.   : 1.00000000   Max.   : 1.0000000
  web_traffic          Page_Rank         Google_Index       Links_pointing_to_page Statistical_report
 Min.   :-1.0000000   Min.   :-1.0000000   Min.   :-1.0000000   Min.   :-1.0000000   Min.   :-1.0000000
 1st Qu.: 0.0000000   1st Qu.:-1.0000000   1st Qu.: 1.0000000   1st Qu.: 0.0000000   1st Qu.: 1.0000000
 Median : 1.0000000   Median :-1.0000000   Median : 1.0000000   Median : 0.0000000   Median : 1.0000000
 Mean   : 0.2872908   Mean   :-0.4836725   Mean   : 0.7215739   Mean   : 0.3440072   Mean   : 0.7195839
 3rd Qu.: 1.0000000   3rd Qu.: 1.0000000   3rd Qu.: 1.0000000   3rd Qu.: 1.0000000   3rd Qu.: 1.0000000
 Max.   : 1.0000000   Max.   : 1.0000000   Max.   : 1.0000000   Max.   : 1.0000000   Max.   : 1.0000000
     Result
 Min.   :-1.0000000
 1st Qu.:-1.0000000
 Median : 1.0000000
 Mean   : 0.1138851
 3rd Qu.: 1.0000000
 Max.   : 1.0000000
>
```

Figure 3A:

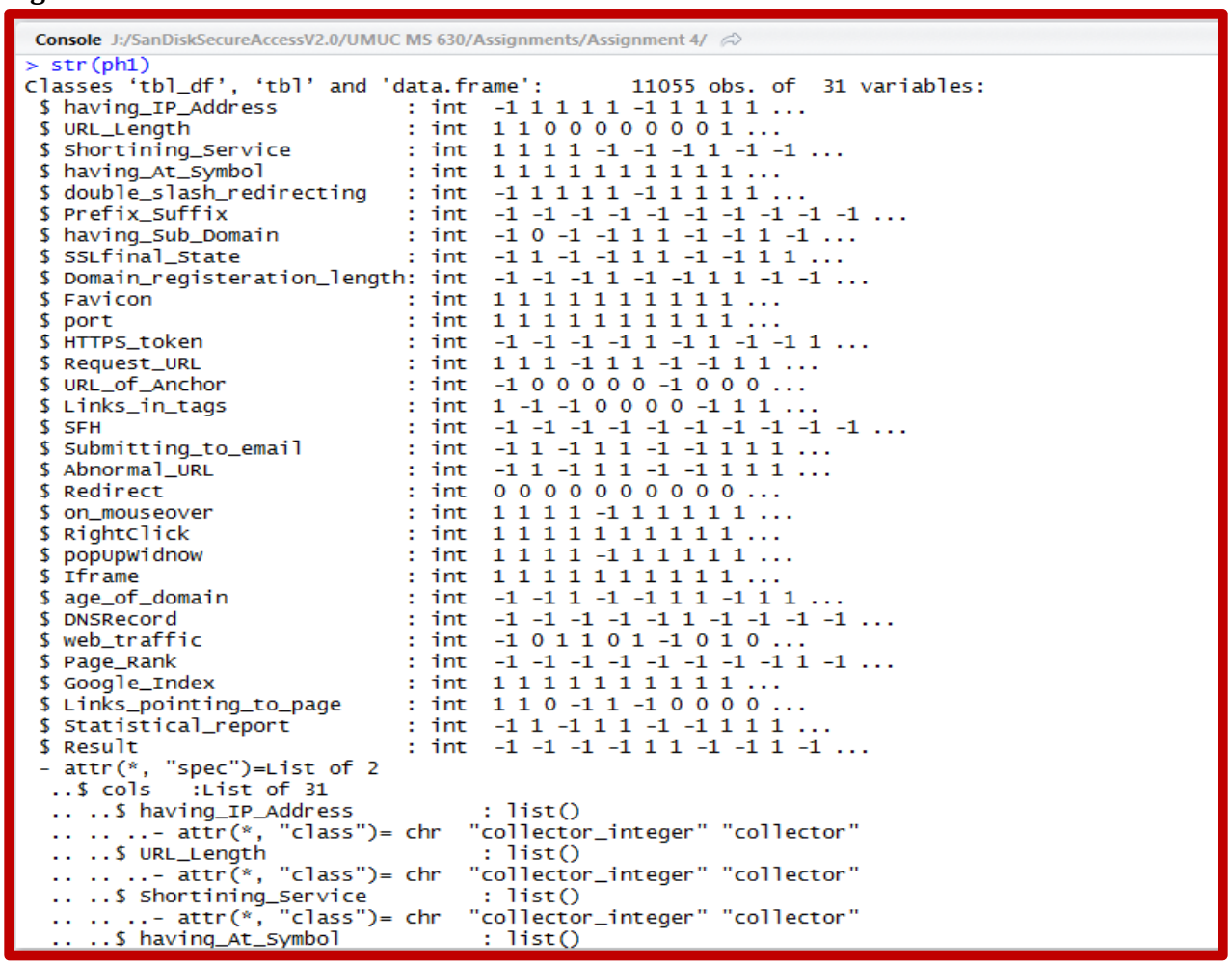
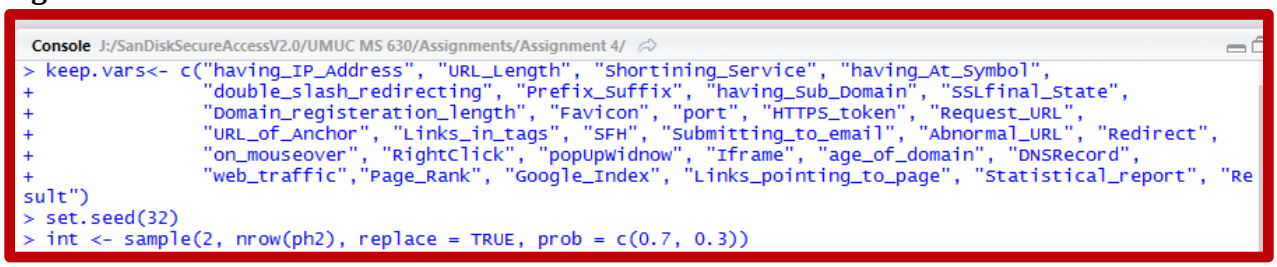


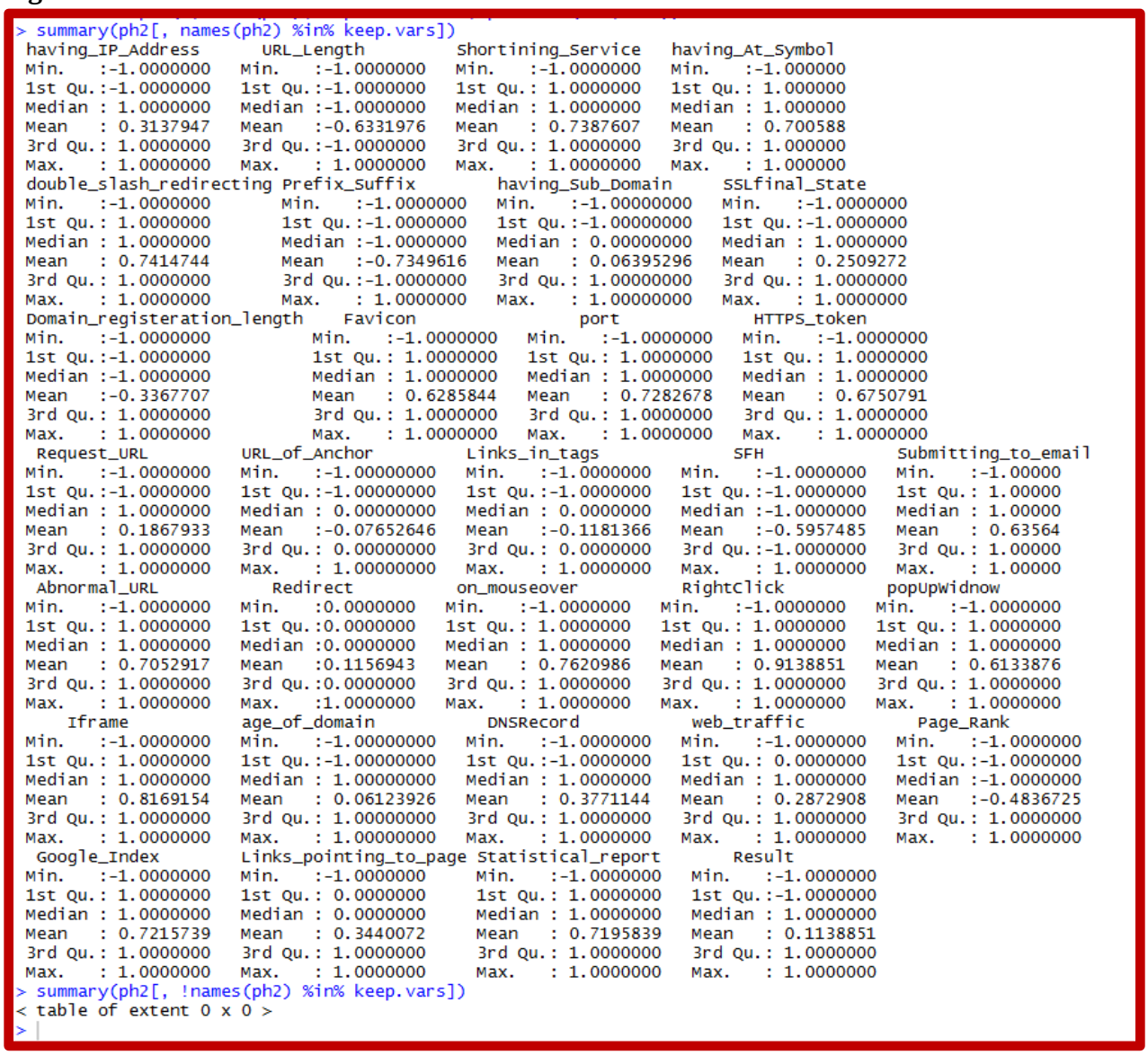
Figure 4A

Figure 5A



```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> keep.vars<- c("having_IP_Address", "URL_Length", "Shortining_Service", "having_At_Symbol",
+               "double_slash_redirecting", "Prefix_Suffix", "having_Sub_Domain", "SSLfinal_State",
+               "Domain_registeration_length", "Favicon", "port", "HTTPS_token", "Request_URL",
+               "URL_of_Anchor", "Links_in_tags", "SFH", "Submitting_to_email", "Abnormal_URL", "Redirect",
+               "on_mouseover", "RightClick", "popUpWidnow", "Iframe", "age_of_domain", "DNSRecord",
+               "web_traffic","Page_Rank", "Google_Index", "Links_pointing_to_page", "Statistical_report", "Re
sult")
> set.seed(32)
> int <- sample(2, nrow(ph2), replace = TRUE, prob = c(0.7, 0.3))
```

Figure 6A



```
> summary(ph2[, names(ph2) %in% keep.vars])
 having_IP_Address      URL_Length         Shortining_Service   having_At_Symbol
 Min.   :-1.0000000   Min.   :-1.0000000   Min.   :-1.0000000   Min.   :-1.000000
 1st Qu.:-1.0000000   1st Qu.:-1.0000000   1st Qu.: 1.0000000   1st Qu.: 1.000000
 Median : 1.0000000   Median :-1.0000000   Median : 1.0000000   Median : 1.000000
 Mean   : 0.3137947   Mean   :-0.6331976   Mean   : 0.7387607   Mean   : 0.700588
 3rd Qu.: 1.0000000   3rd Qu.:-1.0000000   3rd Qu.: 1.0000000   3rd Qu.: 1.000000
 Max.   : 1.0000000   Max.   : 1.0000000   Max.   : 1.0000000   Max.   : 1.000000
 double_slash_redirecting Prefix_Suffix       having_Sub_Domain     SSLfinal_State
 Min.   :-1.0000000       Min.   :-1.0000000   Min.   :-1.00000000   Min.   :-1.0000000
 1st Qu.: 1.0000000       1st Qu.:-1.0000000   1st Qu.:-1.00000000   1st Qu.:-1.0000000
 Median : 1.0000000       Median :-1.0000000   Median : 0.00000000   Median : 1.0000000
 Mean   : 0.7414744       Mean   :-0.7349616   Mean   : 0.06395296   Mean   : 0.2509272
 3rd Qu.: 1.0000000       3rd Qu.:-1.0000000   3rd Qu.: 1.00000000   3rd Qu.: 1.0000000
 Max.   : 1.0000000       Max.   : 1.0000000   Max.   : 1.00000000   Max.   : 1.0000000
 Domain_registeration_length    Favicon              port            HTTPS_token
 Min.   :-1.0000000          Min.   :-1.0000000   Min.   :-1.0000000   Min.   :-1.0000000
 1st Qu.:-1.0000000          1st Qu.: 1.0000000   1st Qu.: 1.0000000   1st Qu.: 1.0000000
 Median :-1.0000000          Median : 1.0000000   Median : 1.0000000   Median : 1.0000000
 Mean   :-0.3367707          Mean   : 0.6285844   Mean   : 0.7282678   Mean   : 0.6750791
 3rd Qu.: 1.0000000          3rd Qu.: 1.0000000   3rd Qu.: 1.0000000   3rd Qu.: 1.0000000
 Max.   : 1.0000000          Max.   : 1.0000000   Max.   : 1.0000000   Max.   : 1.0000000
  Request_URL         URL_of_Anchor         Links_in_tags              SFH             Submitting_to_email
 Min.   :-1.0000000   Min.   :-1.00000000   Min.   :-1.0000000   Min.   :-1.0000000   Min.   :-1.00000
 1st Qu.:-1.0000000   1st Qu.:-1.00000000   1st Qu.:-1.0000000   1st Qu.:-1.0000000   1st Qu.: 1.00000
 Median : 1.0000000   Median : 0.00000000   Median : 0.0000000   Median :-1.0000000   Median : 1.00000
 Mean   : 0.1867933   Mean   :-0.07652646   Mean   :-0.1181366   Mean   :-0.5957485   Mean   : 0.63564
 3rd Qu.: 1.0000000   3rd Qu.: 0.00000000   3rd Qu.: 0.0000000   3rd Qu.:-1.0000000   3rd Qu.: 1.00000
 Max.   : 1.0000000   Max.   : 1.00000000   Max.   : 1.0000000   Max.   : 1.0000000   Max.   : 1.00000
  Abnormal_URL           Redirect          on_mouseover          RightClick          popUpWidnow
 Min.   :-1.0000000   Min.   :0.0000000   Min.   :-1.0000000   Min.   :-1.0000000   Min.   :-1.0000000
 1st Qu.: 1.0000000   1st Qu.:0.0000000   1st Qu.: 1.0000000   1st Qu.: 1.0000000   1st Qu.: 1.0000000
 Median : 1.0000000   Median :0.0000000   Median : 1.0000000   Median : 1.0000000   Median : 1.0000000
 Mean   : 0.7052917   Mean   :0.1156943   Mean   : 0.7620986   Mean   : 0.9138851   Mean   : 0.6133876
 3rd Qu.: 1.0000000   3rd Qu.:0.0000000   3rd Qu.: 1.0000000   3rd Qu.: 1.0000000   3rd Qu.: 1.0000000
 Max.   : 1.0000000   Max.   :1.0000000   Max.   : 1.0000000   Max.   : 1.0000000   Max.   : 1.0000000
     Iframe           age_of_domain          DNSRecord          web_traffic          Page_Rank
 Min.   :-1.0000000   Min.   :-1.00000000   Min.   :-1.0000000   Min.   :-1.0000000   Min.   :-1.0000000
 1st Qu.: 1.0000000   1st Qu.:-1.00000000   1st Qu.:-1.0000000   1st Qu.: 0.0000000   1st Qu.:-1.0000000
 Median : 1.0000000   Median : 1.00000000   Median : 1.0000000   Median : 1.0000000   Median :-1.0000000
 Mean   : 0.8169154   Mean   : 0.06123926   Mean   : 0.3771144   Mean   : 0.2872908   Mean   :-0.4836725
 3rd Qu.: 1.0000000   3rd Qu.: 1.00000000   3rd Qu.: 1.0000000   3rd Qu.: 1.0000000   3rd Qu.: 1.0000000
 Max.   : 1.0000000   Max.   : 1.00000000   Max.   : 1.0000000   Max.   : 1.0000000   Max.   : 1.0000000
  Google_Index       Links_pointing_to_page Statistical_report       Result
 Min.   :-1.0000000   Min.   :-1.0000000     Min.   :-1.0000000   Min.   :-1.0000000
 1st Qu.: 1.0000000   1st Qu.: 0.0000000     1st Qu.: 1.0000000   1st Qu.:-1.0000000
 Median : 1.0000000   Median : 0.0000000     Median : 1.0000000   Median : 1.0000000
 Mean   : 0.7215739   Mean   : 0.3440072     Mean   : 0.7195839   Mean   : 0.1138851
 3rd Qu.: 1.0000000   3rd Qu.: 1.0000000     3rd Qu.: 1.0000000   3rd Qu.: 1.0000000
 Max.   : 1.0000000   Max.   : 1.0000000     Max.   : 1.0000000   Max.   : 1.0000000
> summary(ph2[, !names(ph2) %in% keep.vars])
< table of extent 0 x 0 >
>
```

Figure 7A

```
>
> train <- ph2[int == 1, names(ph2) %in% keep.vars]
> test <- ph2[int == 2, names(ph2) %in% keep.vars]
>
> target.name<- "Result"
>
> my.formula <- as.formula(paste("Result ~ ",
+                                paste(names(train)[!names(train) %in% target.name], collapse = ' + ')))
>
```

Figure 8A

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> nn <- neuralnet(my.formula, data = train, hidden = c(2), linear.output = FALSE, stepmax = 1e5)
Warning message:
algorithm did not converge in 1 of 1 repetition(s) within the stepmax
>
```

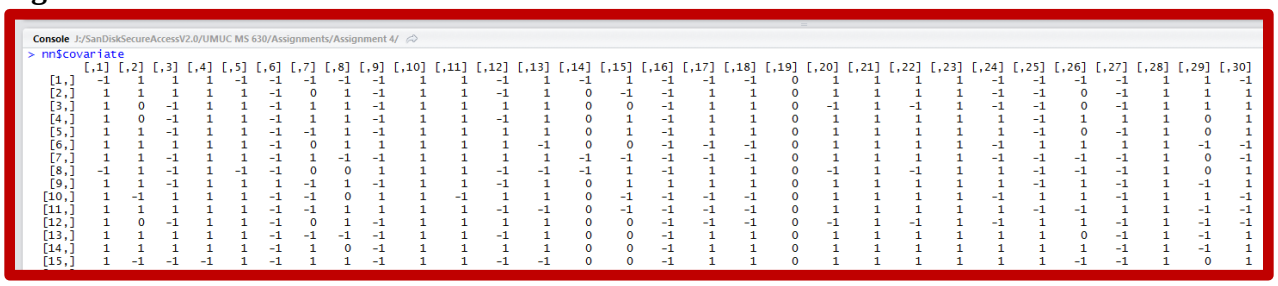
Figure 9A

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> nn <- neuralnet(my.formula, data = train, hidden = c(2), linear.output = FALSE, stepmax = 100e5)
> names(nn)
 [1] "call"                "response"            "covariate"           "model.list"
 [5] "err.fct"             "act.fct"             "linear.output"       "data"
 [9] "net.result"          "weights"             "startweights"        "generalized.weights"
[13] "result.matrix"
>
> nn$call
neuralnet(formula = my.formula, data = train, hidden = c(2),
    stepmax = 10000000, linear.output = FALSE)
> nn$model.list
$response
[1] "Result"

$variables
 [1] "having_IP_Address"          "URL_Length"                 "Shortining_Service"
 [4] "having_At_Symbol"           "double_slash_redirecting"   "Prefix_Suffix"
 [7] "having_Sub_Domain"          "SSLfinal_State"             "Domain_registeration_length"
[10] "Favicon"                    "port"                       "HTTPS_token"
[13] "Request_URL"                "URL_of_Anchor"              "Links_in_tags"
[16] "SFH"                        "Submitting_to_email"        "Abnormal_URL"
[19] "Redirect"                   "on_mouseover"               "RightClick"
[22] "popUpWidnow"                "Iframe"                     "age_of_domain"
[25] "DNSRecord"                  "web_traffic"                "Page_Rank"
[28] "Google_Index"               "Links_pointing_to_page"     "Statistical_report"

>
```

Figure 10A: "nn$response"

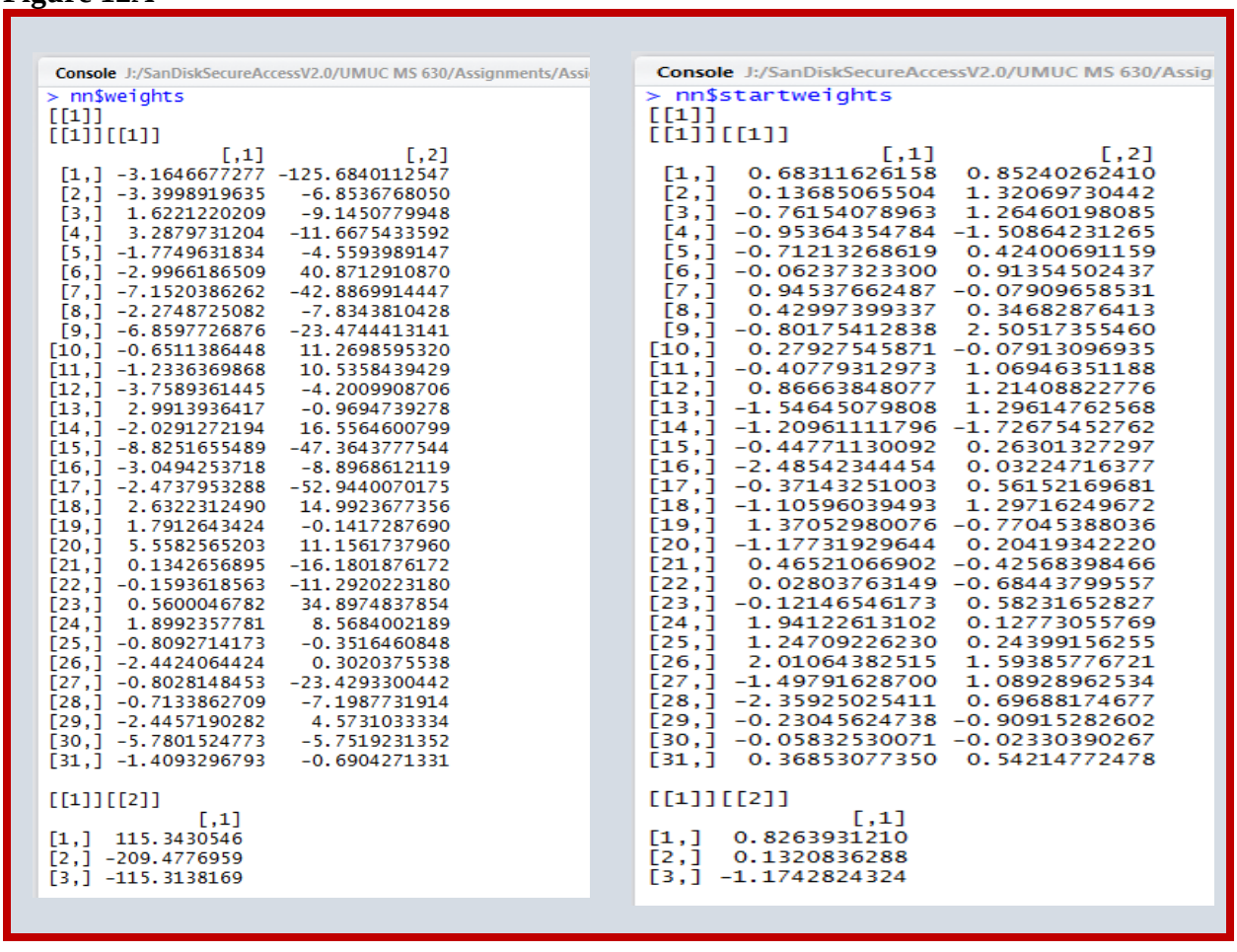
```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
2          -1
3           1
4           1
5          -1
6           1
7          -1
8          -1
9           1
10         -1
11          1
12          1
13          1
```

Figure 11A



```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> nn$covariate
      [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10] [,11] [,12] [,13] [,14] [,15] [,16] [,17] [,18] [,19] [,20] [,21] [,22] [,23] [,24] [,25] [,26] [,27] [,28] [,29] [,30]
 [1,]   -1    1    1    1   -1   -1   -1   -1   -1    1    1   -1    1   -1    1   -1   -1   -1    0    1    1    1    1   -1   -1   -1   -1    1    1   -1
 [2,]    1    1    1    1    1   -1    0    1   -1    1    1   -1    1    0   -1   -1    1    1    0    1    1    1    1   -1   -1    0   -1    1    1
 [3,]    1    0   -1    1    1   -1    1    1   -1    1    1    1    1    0    0   -1    1    1    0   -1    1   -1    1   -1   -1    0   -1    1    1
 [4,]    1    0   -1    1    1   -1    1    1   -1    1    1   -1    1    0    1   -1    1    1    0    1    1    1    1    1   -1    1    1    1    0    1
 [5,]    1    1   -1    1    1   -1   -1    1   -1    1    1    1    1    0    1   -1    1    1    0    1    1    1    1    1   -1    0   -1    1    0    1
 [6,]    1    1    1    1    1   -1    0    1    1    1    1    1   -1    0    0   -1   -1   -1    0    1    1    1    1   -1    1    1    1   -1   -1
 [7,]    1    1   -1    1    1   -1    1   -1   -1    1    1    1    1   -1   -1   -1   -1   -1    0    1    1    1    1   -1   -1   -1   -1    1    0   -1
 [8,]   -1    1   -1    1   -1   -1    0    0    1    1    1   -1   -1   -1    1   -1    1    1    0   -1    1   -1    1    1   -1   -1   -1    1    0    1
 [9,]    1    1   -1    1    1    1   -1    1   -1    1    1   -1    1    0    1    1    1    1    0    1    1    1    1   -1    1    1   -1    1   -1    1
[10,]    1   -1    1    1    1   -1   -1    0    1    1   -1    1    1    0   -1   -1   -1   -1    0    1    1    1    1   -1    1    1   -1    1    1   -1
[11,]    1    1    1    1    1   -1   -1    1    1    1    1   -1   -1    0   -1   -1   -1   -1    0    1    1    1    1   -1   -1    1    1   -1   -1    1
[12,]    1    0   -1    1    1   -1    0    1   -1    1    1    1    1    0    0   -1   -1   -1    0   -1    1   -1    1   -1    1    1   -1    1   -1   -1
[13,]    1    1    1    1    1   -1   -1   -1   -1    1    1   -1    1    0    0   -1    1    1    0    1    1    1    1    1    1    0   -1    1   -1    1
[14,]    1    1    1    1    1   -1    1    0   -1    1    1    1    1    0    0   -1    1    1    0    1    1    1    1    1    1    1   -1    1   -1    1
[15,]    1   -1   -1   -1    1   -1    1    1   -1    1    1   -1   -1    0    0   -1    1    1    0    1    1    1    1    1    1   -1   -1    1    0    1
```

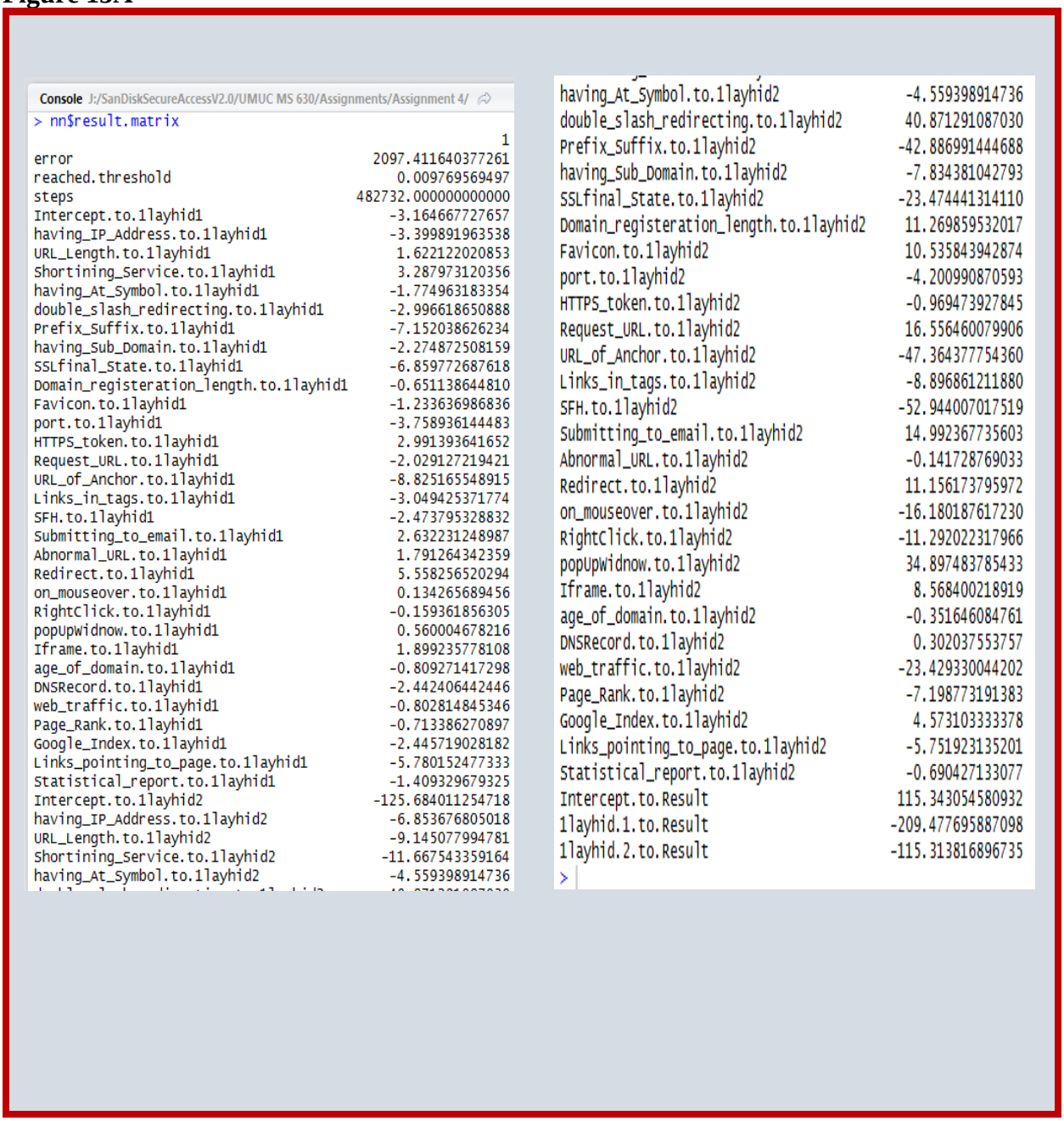
Figure 12A



```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assi
> nn$weights
[[1]]
[[1]][[1]]
                [,1]             [,2]
 [1,] -3.1646677277 -125.6840112547
 [2,] -3.3998919635   -6.8536768050
 [3,]  1.6221220209   -9.1450779948
 [4,]  3.2879731204  -11.6675433592
 [5,] -1.7749631834   -4.5593989147
 [6,] -2.9966186509   40.8712910870
 [7,] -7.1520386262  -42.8869914447
 [8,] -2.2748725082   -7.8343810428
 [9,] -6.8597726876  -23.4744413141
[10,] -0.6511386448   11.2698595320
[11,] -1.2336369868   10.5358439429
[12,] -3.7589361445   -4.2009908706
[13,]  2.9913936417   -0.9694739278
[14,] -2.0291272194   16.5564600799
[15,] -8.8251655489  -47.3643777544
[16,] -3.0494253718   -8.8968612119
[17,] -2.4737953288  -52.9440070175
[18,]  2.6322312490   14.9923677356
[19,]  1.7912643424   -0.1417287690
[20,]  5.5582565203   11.1561737960
[21,]  0.1342656895  -16.1801876172
[22,] -0.1593618563  -11.2920223180
[23,]  0.5600046782   34.8974837854
[24,]  1.8992357781    8.5684002189
[25,] -0.8092714173   -0.3516460848
[26,] -2.4424064424    0.3020375538
[27,] -0.8028148453  -23.4293300442
[28,] -0.7133862709   -7.1987731914
[29,] -2.4457190282    4.5731033334
[30,] -5.7801524773   -5.7519231352
[31,] -1.4093296793   -0.6904271331

[[1]][[2]]
               [,1]
[1,]  115.3430546
[2,] -209.4776959
[3,] -115.3138169
```

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assig
> nn$startweights
[[1]]
[[1]][[1]]
                [,1]             [,2]
 [1,]  0.68311626158  0.85240262410
 [2,]  0.13685065504  1.32069730442
 [3,] -0.76154078963  1.26460198085
 [4,] -0.95364354784 -1.50864231265
 [5,] -0.71213268619  0.42400691159
 [6,] -0.06237323300  0.91354502437
 [7,]  0.94537662487 -0.07909658531
 [8,]  0.42997399337  0.34682876413
 [9,] -0.80175412838  2.50517355460
[10,]  0.27927545871 -0.07913096935
[11,] -0.40779312973  1.06946351188
[12,]  0.86663848077  1.21408822776
[13,] -1.54645079808  1.29614762568
[14,] -1.20961111796 -1.72675452762
[15,] -0.44771130092  0.26301327297
[16,] -2.48542344454  0.03224716377
[17,] -0.37143251003  0.56152169681
[18,] -1.10596039493  1.29716249672
[19,]  1.37052980076 -0.77045388036
[20,] -1.17731929644  0.20419342220
[21,]  0.46521066902 -0.42568398466
[22,]  0.02803763149 -0.68443799557
[23,] -0.12146546173  0.58231652827
[24,]  1.94122613102  0.12773055769
[25,]  1.24709226230  0.24399156255
[26,]  2.01064382515  1.59385776721
[27,] -1.49791628700  1.08928962534
[28,] -2.35925025411  0.69688174677
[29,] -0.23045624738 -0.90915282602
[30,] -0.05832530071 -0.02330390267
[31,]  0.36853077350  0.54214772478

[[1]][[2]]
               [,1]
[1,]  0.8263931210
[2,]  0.1320836288
[3,] -1.1742824324
```

Figure 13A



Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/

```
> nn$result.matrix
                                                  1
error                                  2097.411640377261
reached.threshold                         0.009769569497
steps                                482732.000000000000
Intercept.to.1layhid1                     -3.164667727657
having_IP_Address.to.1layhid1             -3.399891963538
URL_Length.to.1layhid1                     1.622122020853
Shortining_Service.to.1layhid1             3.287973120356
having_At_Symbol.to.1layhid1              -1.774963183354
double_slash_redirecting.to.1layhid1      -2.996618650888
Prefix_Suffix.to.1layhid1                 -7.152038626234
having_Sub_Domain.to.1layhid1             -2.274872508159
SSLfinal_State.to.1layhid1                -6.859772687618
Domain_registeration_length.to.1layhid1   -0.651138644810
Favicon.to.1layhid1                       -1.233636986836
port.to.1layhid1                          -3.758936144483
HTTPS_token.to.1layhid1                    2.991393641652
Request_URL.to.1layhid1                   -2.029127219421
URL_of_Anchor.to.1layhid1                 -8.825165548915
Links_in_tags.to.1layhid1                 -3.049425371774
SFH.to.1layhid1                           -2.473795328832
Submitting_to_email.to.1layhid1            2.632231248987
Abnormal_URL.to.1layhid1                   1.791264342359
Redirect.to.1layhid1                       5.558256520294
on_mouseover.to.1layhid1                   0.134265689456
RightClick.to.1layhid1                    -0.159361856305
popUpWidnow.to.1layhid1                    0.560004678216
Iframe.to.1layhid1                         1.899235778108
age_of_domain.to.1layhid1                 -0.809271417298
DNSRecord.to.1layhid1                     -2.442406442446
web_traffic.to.1layhid1                   -0.802814845346
Page_Rank.to.1layhid1                     -0.713386270897
Google_Index.to.1layhid1                  -2.445719028182
Links_pointing_to_page.to.1layhid1        -5.780152477333
Statistical_report.to.1layhid1            -1.409329679325
Intercept.to.1layhid2                   -125.684011254718
having_IP_Address.to.1layhid2             -6.853676805018
URL_Length.to.1layhid2                    -9.145077994781
Shortining_Service.to.1layhid2           -11.667543359164
having_At_Symbol.to.1layhid2              -4.559398914736
double_slash_redirecting.to.1layhid2      40.871291087030
Prefix_Suffix.to.1layhid2                 -42.886991444688
having_Sub_Domain.to.1layhid2             -7.834381042793
SSLfinal_State.to.1layhid2                -23.474441314110
Domain_registeration_length.to.1layhid2   11.269859532017
Favicon.to.1layhid2                       10.535843942874
port.to.1layhid2                          -4.200990870593
HTTPS_token.to.1layhid2                   -0.969473927845
Request_URL.to.1layhid2                   16.556460079906
URL_of_Anchor.to.1layhid2                 -47.364377754360
Links_in_tags.to.1layhid2                 -8.896861211880
SFH.to.1layhid2                           -52.944007017519
Submitting_to_email.to.1layhid2           14.992367735603
Abnormal_URL.to.1layhid2                  -0.141728769033
Redirect.to.1layhid2                      11.156173795972
on_mouseover.to.1layhid2                  -16.180187617230
RightClick.to.1layhid2                    -11.292022317966
popUpWidnow.to.1layhid2                   34.897483785433
Iframe.to.1layhid2                         8.568400218919
age_of_domain.to.1layhid2                 -0.351646084761
DNSRecord.to.1layhid2                      0.302037553757
web_traffic.to.1layhid2                   -23.429330044202
Page_Rank.to.1layhid2                     -7.198773191383
Google_Index.to.1layhid2                   4.573103333378
Links_pointing_to_page.to.1layhid2        -5.751923135201
Statistical_report.to.1layhid2            -0.690427133077
Intercept.to.Result                      115.343054580932
1layhid.1.to.Result                     -209.477695887098
1layhid.2.to.Result                     -115.313816896735
>
```

Figure 14A

```
Console  J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> nn$net.result[[1]][1:10]
 [1] 0.0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000001090668167
 [2] 0.4993609169527263302867936545226257294416427612304687500000000000000000000000000000000000000000000000
 [3] 1.0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
 [4] 1.0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
 [5] 0.5011040193125870789714326747343875467777252197265625000000000000000000000000000000000000000000000000
 [6] 1.0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
 [7] 0.0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000001093107247
 [8] 0.0000000000000000000000000000000000000000000000000000000000000000000000000000000000007495184680229211
 [9] 1.0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
[10] 0.0000000338990160991925574152788813719894278619904071092605590820312500000000000000000000000000000000
>
```

Figure 15A

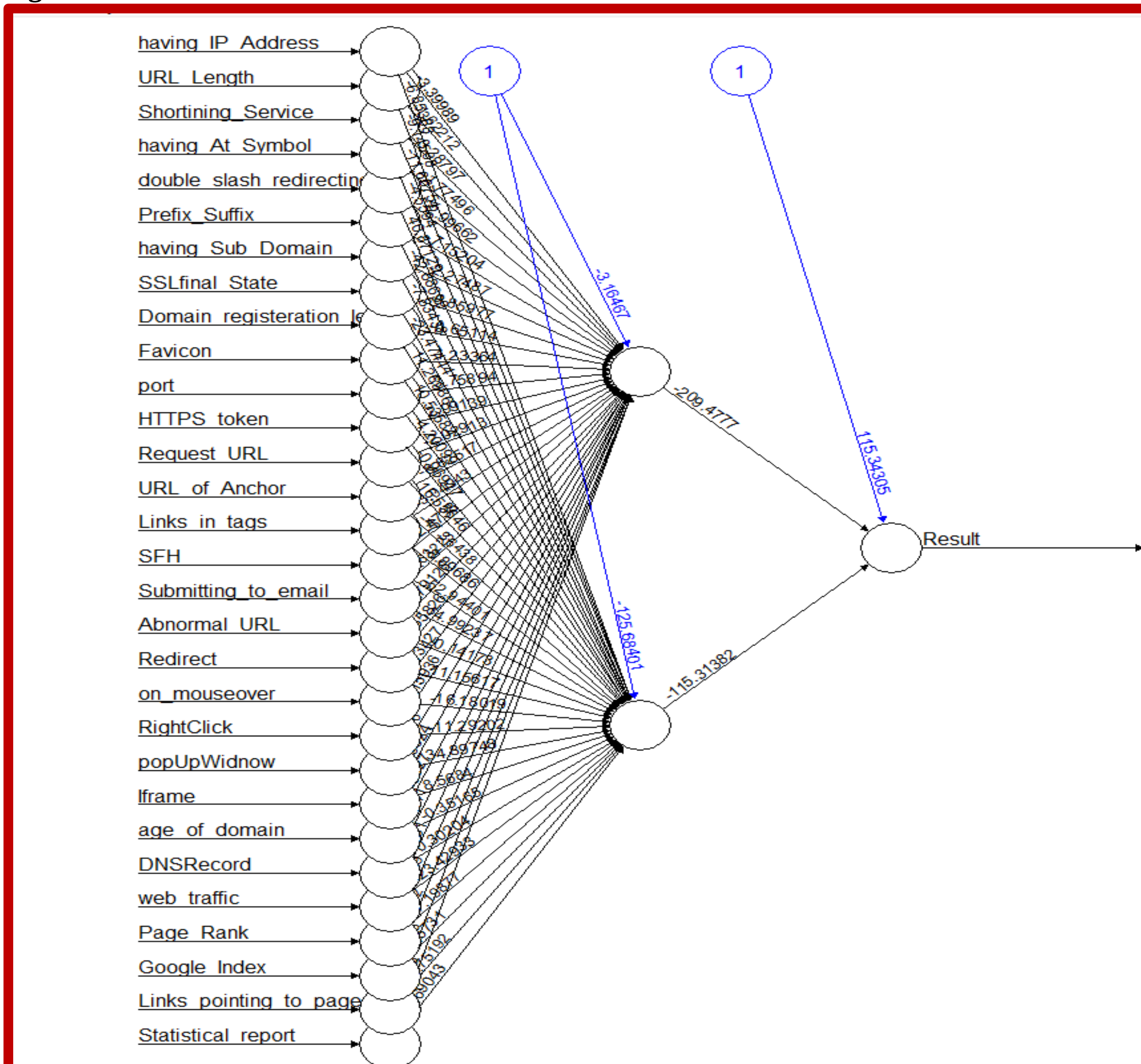


Figure 16A

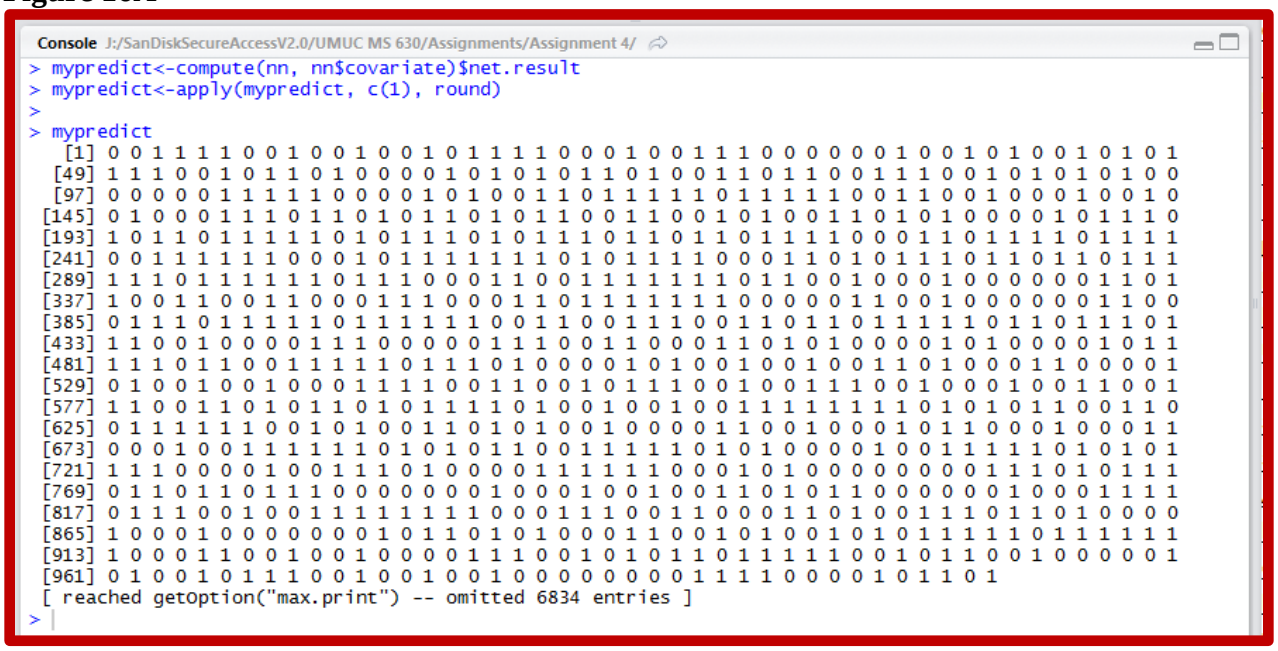


Figure 17A

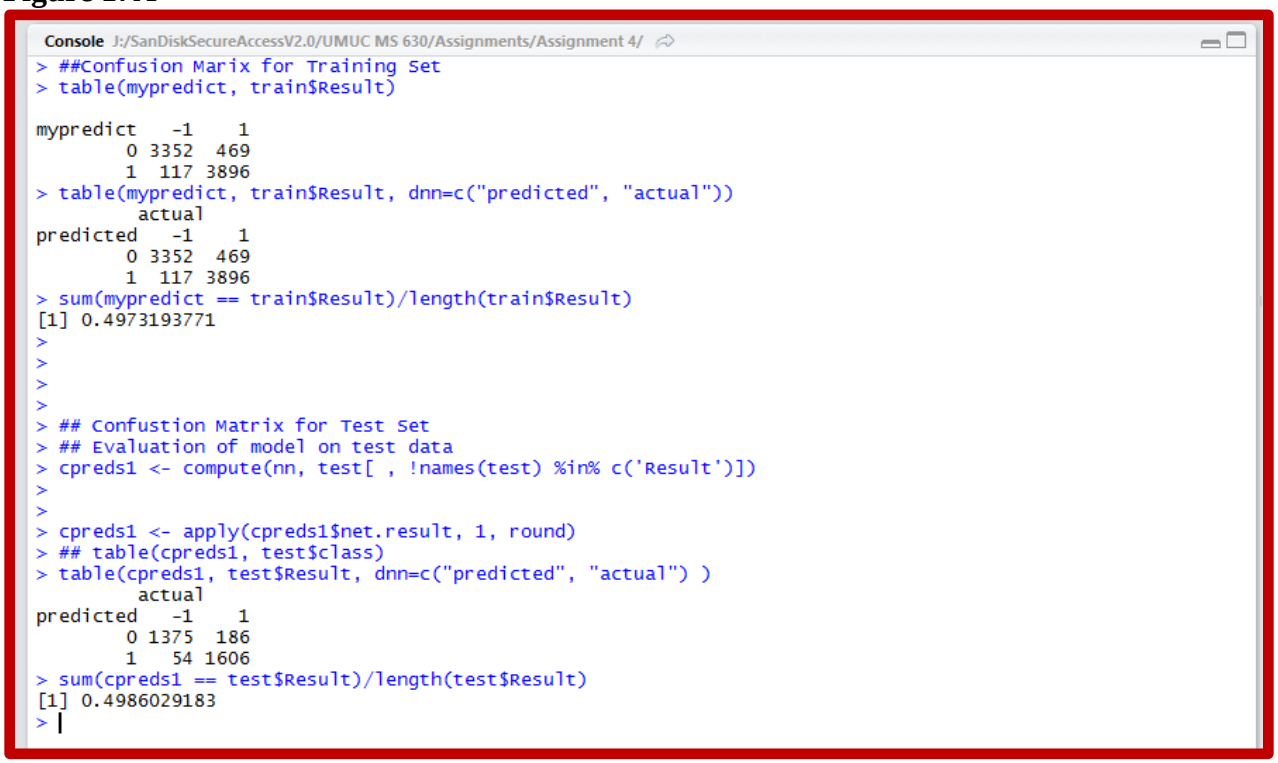


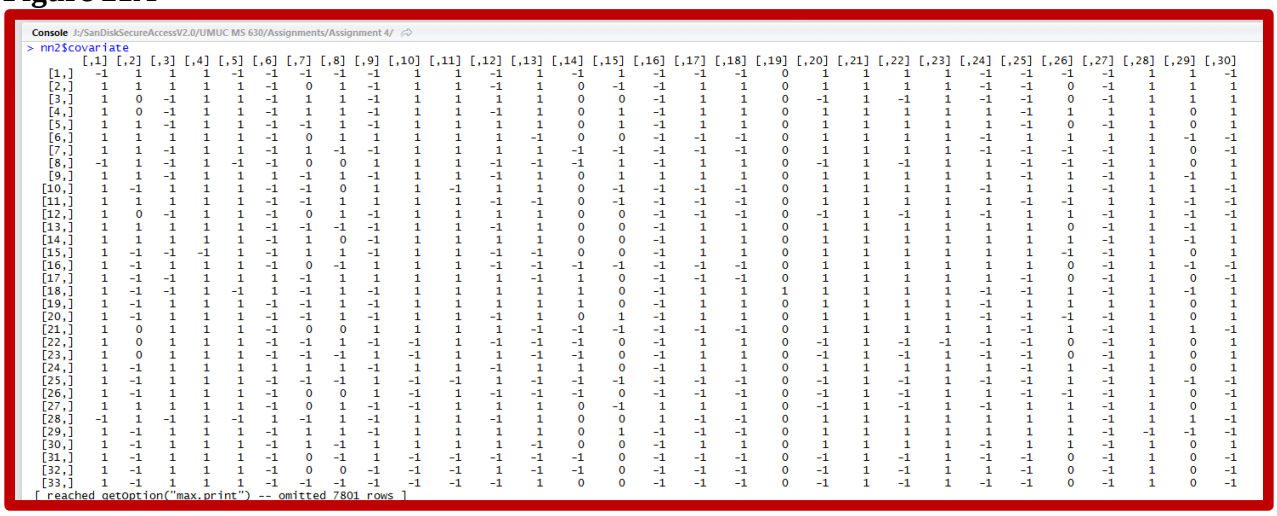
Figure 18A

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> nn2 <- neuralnet(my.formula, data = train, hidden = c(10), linear.output = FALSE, stepmax = 100e5)
> names(nn2)
 [1] "call"
 [2] "response"
 [3] "covariate"
 [4] "model.list"
 [5] "err.fct"
 [6] "act.fct"
 [7] "linear.output"
 [8] "data"
 [9] "net.result"
[10] "weights"
[11] "startweights"
[12] "generalized.weights"
[13] "result.matrix"
> nn2$call
neuralnet(formula = my.formula, data = train, hidden = c(10),
    stepmax = 10000000, linear.output = FALSE)
> nn2$model.list
$response
[1] "Result"

$variables
 [1] "having_IP_Address"
 [2] "URL_Length"
 [3] "Shortining_Service"
 [4] "having_At_Symbol"
 [5] "double_slash_redirecting"
 [6] "Prefix_Suffix"
 [7] "having_Sub_Domain"
 [8] "SSLfinal_State"
 [9] "Domain_registeration_length"
[10] "Favicon"
[11] "port"
[12] "HTTPS_token"
[13] "Request_URL"
[14] "URL_of_Anchor"
[15] "Links_in_tags"
[16] "SFH"
[17] "Submitting_to_email"
[18] "Abnormal_URL"
[19] "Redirect"
[20] "on_mouseover"
[21] "RightClick"
[22] "popUpWidnow"
[23] "Iframe"
[24] "age_of_domain"
[25] "DNSRecord"
[26] "web_traffic"
[27] "Page_Rank"
[28] "Google_Index"
[29] "Links_pointing_to_page"
[30] "Statistical_report"

>
```

Figure 20A: "nn2$response

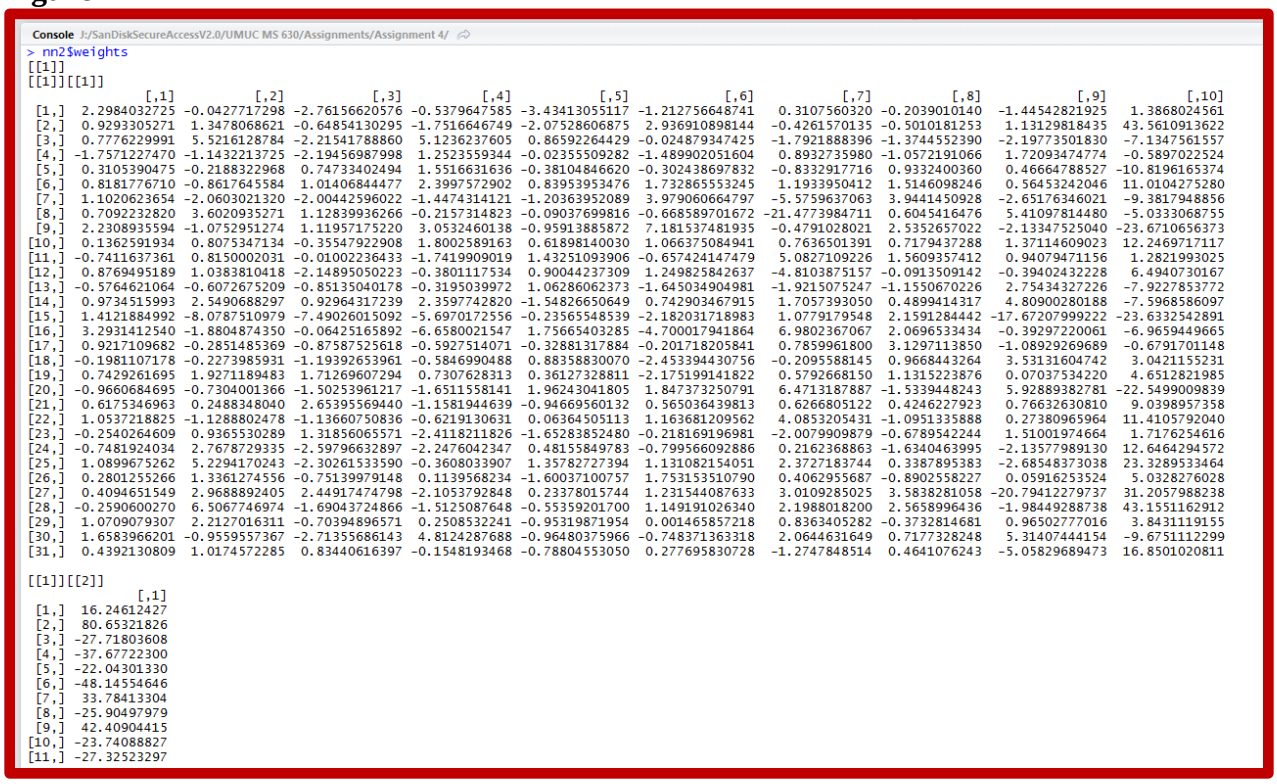
```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
2         -1
3          1
4          1
5         -1
6          1
7         -1
8         -1
9          1
10        -1
11         1
12         1
13         1
14         1
15         1
```

Figure 21A



```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> nn2$covariate
      [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10] [,11] [,12] [,13] [,14] [,15] [,16] [,17] [,18] [,19] [,20] [,21] [,22] [,23] [,24] [,25] [,26] [,27] [,28] [,29] [,30]
 [1,]   -1    1    1    1   -1   -1   -1   -1   -1     1     1    -1     1    -1     1    -1    -1    -1     0     1     1     1     1    -1    -1    -1    -1     1     1    -1
 [2,]    1    1    1    1    1   -1    0    1   -1     1     1    -1     1     0    -1    -1     1     1     0     1     1     1     1    -1    -1     0    -1     1     1     1
 [3,]    1    0   -1    1    1    1   -1    1    1    -1     1     1     1     1     0     0    -1     1     1     0    -1     1    -1     1    -1    -1     0    -1     1     1     1
 [4,]    1    0   -1    1    1    1   -1    1    1    -1     1     1    -1     1     0     1    -1     1     1     0     1     1     1     1     1    -1     1     1     1     0     1
 [5,]    1    1   -1    1    1    1   -1   -1    1    -1     1     1     1     1     0     1    -1     1     1     0     1     1     1     1     1    -1     0    -1     1     0     1
 [6,]    1    1    1    1    1    1   -1    0    1     1     1     1     1    -1     0     0    -1    -1    -1     0     1     1     1     1    -1     1     1     1     1    -1    -1
 [7,]    1    1   -1    1    1    1   -1    1   -1    -1     1     1     1     1    -1    -1    -1    -1    -1     0     1     1     1     1    -1    -1    -1    -1     1     0    -1
 [8,]   -1    1   -1    1   -1   -1    0    0    1     1     1     1    -1    -1    -1     1    -1     1     1     0    -1     1    -1     1     1    -1    -1    -1     1     0     1
 [9,]    1    1   -1    1    1    1    1   -1    1    -1     1     1    -1     1     0     1     1     1     1     0     1     1     1     1     1    -1     1    -1     1    -1     1
[10,]    1   -1    1    1    1   -1   -1    0    1     1    -1     1     1     0    -1    -1    -1    -1     0     1     1     1     1    -1     1     1    -1     1     1    -1
[11,]    1    1    1    1    1   -1   -1    1    1     1     1    -1    -1     0    -1    -1    -1    -1     0     1     1     1     1    -1    -1     1     1    -1     1    -1
[12,]    1    0   -1    1    1   -1    0    1   -1     1     1     1     1     0     0    -1    -1    -1     0    -1     1    -1     1    -1     1     1    -1     1    -1    -1
[13,]    1    1    1    1    1   -1   -1   -1   -1     1     1    -1     1     0     0    -1     1     1     0     1     1     1     1     1     1     0    -1     1    -1     1
[14,]    1    1    1    1    1   -1    1    0   -1     1     1     1     1     0     0    -1     1     1     0     1     1     1     1     1     1     1    -1     1    -1     1
[15,]    1   -1   -1   -1    1   -1    1    1   -1     1     1    -1    -1     0     0    -1     1     1     0     1     1     1     1     1     1    -1    -1     1     0     1
[16,]    1   -1    1    1    1   -1    0   -1    1     1     1    -1    -1    -1    -1    -1     0     1     1     0     1     1     1     1     1     1     0    -1     1    -1    -1
[17,]    1   -1   -1    1    1    1   -1    1    1     1     1     1    -1     1     0    -1    -1    -1     0     1     1     1     1     1    -1     0    -1     1     0    -1
[18,]    1   -1   -1    1   -1    1   -1    1   -1     1     1     1     1     1     0    -1     1     1     1     1     1     1     1    -1    -1     1    -1     1    -1     1
[19,]    1   -1    1    1    1   -1   -1    1   -1     1     1     1     1     1     0    -1     1     1     0     1     1     1     1    -1     1     1     1     1     0     1
[20,]    1   -1    1    1    1   -1   -1    1    1     1     1    -1     1     0     1    -1     1     1     0     1     1     1     1    -1    -1     1     1     1     0     1
[21,]    1    0    1    1    1   -1    0    0    1     1     1     1    -1    -1    -1    -1    -1    -1     0     1     1     1     1     1    -1     1    -1     1     1    -1
[22,]    1    0    1    1    1   -1   -1    1   -1     1     1    -1    -1     0    -1     1     1     0     1     1    -1    -1    -1     0    -1     1     0     1     0     1
[23,]    1    0    1    1    1   -1   -1   -1    1    -1     1     1    -1    -1     0    -1     1     1     0    -1     1    -1     1    -1    -1     0    -1     1     0     1
[24,]    1   -1    1    1    1    1    1    1   -1     1     1    -1     1     1     0    -1     1     1     0     1     1     1     1     1    -1     1    -1     1     0     1
[25,]    1   -1    1    1    1   -1   -1   -1    1    -1    -1     1    -1    -1    -1     1    -1    -1    -1     0    -1     1    -1     1    -1     1    -1     1    -1    -1
[26,]    1   -1    1    1    1   -1    0    0    1    -1     1    -1    -1    -1     0    -1    -1    -1    -1     0    -1     1    -1     1    -1     1    -1     1     0    -1
[27,]    1    1    1    1    1   -1    0    1   -1    -1     1     1     1     1     0    -1     1     1     1     0    -1     1    -1     1     1    -1     1     0     1
[28,]   -1    1   -1    1   -1    1   -1    1   -1     1     1    -1     1     0     0     1    -1    -1     0     1     1     1     1     1     1    -1     1     1    -1
[29,]    1   -1    1    1    1   -1    1   -1    1     1     1     1     1     0     1    -1    -1    -1     0     1     1     1     1     1     1    -1    -1    -1    -1
[30,]    1   -1    1    1    1   -1    1   -1    1     1     1     1    -1     0     0    -1     1     1     0     1     1     1     1    -1     1     1    -1     1     0     1
[31,]    1   -1    1    1    1   -1    0   -1    1    -1    -1    -1    -1     0    -1    -1    -1     0    -1     1    -1     1    -1    -1     0    -1     1     0    -1     0    -1
[32,]    1   -1    1    1    1   -1    0    0   -1    -1    -1     1    -1    -1     0    -1    -1    -1     0    -1     1    -1     1     1    -1     0    -1     1     0    -1
[33,]    1   -1    1    1    1   -1   -1   -1   -1    -1    -1    -1     1     0     0    -1    -1    -1     0    -1     1    -1     1    -1    -1     0    -1     1     0    -1
[ reached getOption("max.print") -- omitted 7801 rows ]
```

Figure 22A



```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> nn2$weights
[[1]]
[[1]][[1]]
              [,1]          [,2]          [,3]          [,4]          [,5]          [,6]          [,7]          [,8]          [,9]          [,10]
 [1,]  2.2984032725 -0.0427717298 -2.76156620576 -0.5379647585 -3.43413055117 -1.212756648741  0.3107560320 -0.2039010140 -1.44542821925  1.3868024561
 [2,]  0.9293305271  1.3478068621 -0.64854130295 -1.7516646749 -2.07528606875  2.936910898144 -0.4261570135 -0.5010181253  1.13129818435 43.5610913622
 [3,]  0.7776229991  5.5216128784 -2.21541788860  5.1236237605  0.86592264429 -0.024879347425 -1.7921888396 -1.3744552390 -2.19773501830 -7.1347561557
 [4,] -1.7571227470 -1.1432213725 -2.19456987998  1.2523559344 -0.02355509282 -1.489902051604  0.8932735980 -1.0572191066  1.72093474774 -0.5897022524
 [5,]  0.3105390475 -0.2188322968  0.74733402494  1.5516631636 -0.38104846620 -0.302438697832 -0.8332917716  0.9332400360  0.46664788527 -10.8196165374
 [6,]  0.8181776710 -0.8617645584  1.01406844477  2.3997572902  0.83953953476  1.732865553245  1.1933950412  1.5146098246  0.56453242046  11.0104275280
 [7,]  1.1020623654 -2.0603021320 -2.00442596022 -1.4474314121 -1.20363952089  3.979060664797 -5.5759637063  3.9441450928 -2.65176346021 -9.3817948856
 [8,]  0.7092232820  3.6020935271  1.12839936266 -0.2157314823 -0.09037699816 -0.668589701672 -21.4773984711  0.6045416476  5.41097814480 -5.0333068755
 [9,]  2.2308935594 -1.0752951274  1.11957175220  3.0532460138 -0.95913885872  7.181537481935 -0.4791028021  2.5352657022 -2.13347525040 -23.6710656373
[10,]  0.1362591934  0.8075347134 -0.35547922908  1.8002589163  0.61898140030  1.066375084941  0.7636501391  0.7179437288  1.37114609023  12.2469717117
[11,] -0.7411637361  0.8150002031 -0.01002236433 -1.7419909019  1.43251093906 -0.657424147479  5.0827109226  1.5609357412  0.94079471156  1.2821993025
[12,]  0.8769495189  1.0383810418 -2.14895050223 -0.3801117534  0.90044237309  1.249825842637 -4.8103875157 -0.0913509142 -0.39402432228  6.4940730167
[13,] -0.5764621064 -0.6072675209 -0.85135040178 -0.3195039972  1.06286062373 -1.645034904981 -1.9215075247 -1.1550670226  2.75434327226 -7.9227853772
[14,]  0.9734515993  2.5490688297  0.92964317239  2.3597742820 -1.54826650649  0.742903467915  1.7057393050  0.4899414317  4.80900280188 -7.5968586097
[15,]  1.4121884992 -8.0787510979 -7.49026015092 -5.6970172556 -0.23565548539 -2.182031718983  1.0779179548  2.1591284442 -17.67207999222 -23.6332542891
[16,]  3.2931412540 -1.8804874350 -0.06425165892 -6.6580021547  1.75665403285 -4.700017941864  6.9802367067  2.0696533434 -0.39297220061  -6.9659449665
[17,]  0.9217109682 -0.2851485369 -0.87587525618 -0.5927514071 -0.32881317884 -0.201718205841  0.7859961800  3.1297113850 -1.08929269689  -0.6791701148
[18,] -0.1981107178 -0.2273985931 -1.19392653961 -0.5846990488  0.88358830070 -2.453394430756 -0.2095588145  0.9668443264  3.53131604742  3.0421155231
[19,]  0.7429261695  1.9271189483  1.71269607294  0.7307628313  0.36127328811 -2.175199141822  0.5792668150  1.1315223876  0.07037534220  4.6512821985
[20,] -0.9660684695 -0.7304001366 -1.50253961217 -1.6511558141  1.96243041805  1.847373250791  6.4713187887 -1.5339448243  5.92889382781 -22.5499009839
[21,]  0.6175346963  0.2488348040  2.65395569440 -1.1581944639 -0.94669560132  0.565036439813  0.6266805122  0.4246227923  0.76632630810  9.0398957358
[22,]  1.0537218825 -1.1288802478 -1.13660750836 -0.6219130631  0.06364505113  1.163681209562  4.0853205431 -1.0951335888  0.27380965964 11.4105792040
[23,] -0.2540264609  0.9365530289  1.31856065571 -2.4118211826 -1.65283852480 -0.218169196981 -2.0079909879 -0.6789542244  1.51001974664  1.7176254616
[24,] -0.7481924034  2.7678729335 -2.59796632897 -2.2476042347  0.48155849783 -0.799566092886  0.2162368863 -1.6340463995 -2.13577989130 12.6464294572
[25,]  1.0899675262  5.2294170243 -2.30261533590 -0.3608033907  1.35782727394  1.131082154051  2.3727183744  0.3387895383 -2.68548373038 23.3289533464
[26,]  0.2801255266  1.3361274556 -0.75139979148  0.1139568234 -1.60037100757  1.753153510790  0.4062955687 -0.8902558227  0.05916253524  5.0328276028
[27,]  0.4094651549  2.9688892405  2.44917474798 -2.1053792848  0.23378015744  1.231544087633  3.0109285025  3.5838281058 -20.79412279737 31.2057988238
[28,] -0.2590600270  6.5067746974 -1.69043724866 -1.5125087648 -0.55359201700  1.149191026340  2.1988018200  2.5658996436 -1.98449288738 43.1551162912
[29,]  1.0709079307  2.2127016311 -0.70394896571  0.2508532241 -0.95319871954  0.001465857218  0.8363405282 -0.3732814681  0.96502777016  3.8431119155
[30,]  1.6583966201 -0.9559557367 -2.71355686143  4.8124287688 -0.96480375966 -0.748371363318  2.0644631649  0.7177328248  5.31407444154 -9.6751112299
[31,]  0.4392130809  1.0174572285  0.83440616397 -0.1548193468 -0.78804553050  0.277695830728 -1.2747848514  0.4641076243 -5.05829689473 16.8501020811

[[1]][[2]]
             [,1]
 [1,]  16.24612427
 [2,]  80.65321826
 [3,] -27.71803608
 [4,] -37.67722300
 [5,] -22.04301330
 [6,] -48.14554646
 [7,]  33.78413304
 [8,] -25.90497979
 [9,]  42.40904415
[10,] -23.74088827
[11,] -27.32523297
```

Figure 23A

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> nn2$startweights
[[1]]
[[1]][[1]]
              [,1]          [,2]          [,3]          [,4]          [,5]          [,6]          [,7]          [,8]          [,9]          [,10]
 [1,]  0.13855941792  0.008302558064 -2.1605747097 -0.54188786264 -0.997915070099 -1.44021869964 -0.33939985992 -0.25188379213 -0.92381830338  1.03166522810
 [2,] -0.05674993734  1.017322977499  0.1937902268 -0.78529536189 -0.849314552499  0.94609765256 -0.42006369816 -0.36487446143  0.21624674945  0.85079367539
 [3,]  0.42685836325  1.598367625856 -1.0785498456  0.22079150818 -0.768274199460  0.92511523293  0.93648630448 -0.10409173203  1.08338470112 -1.33368292651
 [4,] -1.48288075055 -1.009995553296 -0.6560226241  0.77953372680  0.016332938065 -1.63482836826  0.56739443178 -1.43001074526  1.77358334864  1.36068528587
 [5,] -0.85614242027 -0.711316389980  1.9306036727  0.44045040403  0.951140453634  0.15600062919  0.41768654074  0.84131332037  0.85050844083  0.69921258165
 [6,]  0.83124980413  0.025907767186 -0.1170980433  0.97426266613  0.377491644168  1.06961404005 -1.01307240200  0.93336848369  0.34886623433 -0.50957437151
 [7,]  0.03546392374 -1.036729185046 -0.5677656703  0.53259953841  0.607610230625  1.86040805820 -0.58575550215  0.47520478013  0.57611786887 -0.35435441807
 [8,] -0.09930781420 -0.056357930607 -0.4815013618  0.31614717782  0.399142778013 -0.55063110545 -2.60086178484 -0.43131715148 -0.85483478548 -0.02755493451
 [9,]  0.63924155349  0.434725582448  0.9272827499  1.67508631590  0.065696086304  1.58306648452  0.89345826998  0.57136009520  0.51432793582  0.44751752998
[10,]  0.45164291174  0.789413047065 -1.4349673714 -0.06036335797 -0.076059776121  0.09275235540 -0.09987314885  1.17919357394 -0.13738942531  1.24148735736
[11,] -0.23322572004  0.530397782701 -0.3314415731 -0.92044846358  1.799937178341 -0.37105993049 -1.79361164398  1.35092359207  0.03431328948 -0.68743052462
[12,]  0.55790975269  0.350062582669 -1.6623594433 -0.17006249450  1.492480579622 -0.30232387815 -1.46567286656 -0.20167640299 -0.04201383614 -0.10986340222
[13,] -0.62610775516  0.568570858636 -0.4830895583 -0.38512393726  0.263109611521  0.30770406819 -2.45793883133 -0.67693706415 -0.32494761956 -0.47999357750
[14,]  1.48063746326  1.326754237895  2.1580177114  1.96008925160 -0.513716304327  0.03449071815 -0.87378505056 -0.67732089432  0.95993673268 -1.55543206932
[15,]  0.27959113634  0.122866458579 -1.5268991325  0.31295658180 -0.748925478682 -0.98005519034 -0.23807968363  0.52286483599 -0.58391829378  0.43020689806
[16,]  1.95755858399 -1.610485348899  0.2124065115 -1.13896038790  0.684908738991 -1.54450089672 -1.17441239480  1.17203885523  0.69545041304  1.57174571786
[17,] -0.55490714189 -0.773459753072 -0.7981623301 -0.37039530968  0.665684421401 -0.13161412198 -0.16967683109  0.34486877780  0.23680864774 -1.00446527975
[18,] -0.19271896172 -1.403810490761  0.9379656179 -0.34749206706  0.155952112147  0.65686765844 -0.11154708948  0.78894928689  1.36012084264  1.08922820976
[19,]  0.83448767677  2.037620641566 -0.1682588519 -0.36674879851 -0.947139441368 -0.19563542485  1.83672798469  1.31019843756 -0.27275389681  0.07478125680
[20,] -0.68718458811 -0.329825924656 -0.9320019882 -0.71539085442 -0.952514955130 -1.97629298617  0.49768264019  0.50423718890  0.68641691415 -0.97919963139
[21,]  0.58018578259 -0.024673867659  2.0249154587 -0.59230704051 -1.557527697296 -0.45261338033 -0.82414701431  0.16450832460  0.78617500093  1.39935202184
[22,]  1.23791360927 -1.059299372050 -1.2971666590 -0.62411107776  0.065714816261  1.31490501831  2.25464678287 -1.14533902150 -0.32252776651  0.07552812621
[23,]  0.56917930623 -0.366862255019  0.1036678669 -0.02856648484 -1.240776849629  0.81283263789 -0.99036696806 -1.27362485231 -0.04598144049 -0.56892603805
[24,] -0.60775884179  2.037094586459 -1.8662041355 -0.51182206976  0.195213820150 -1.21395103633  0.51844287420 -1.64333069532 -1.13662116681 -0.99250658699
[25,] -0.67429971009 -0.474049180822  0.5337579471  0.69950008343 -0.004515326026 -0.94435944882  0.93136902380  0.57321819316  0.40411209004  0.23956101407
[26,] -0.98564992484 -0.156349538638  0.5063566391 -1.35857520899  1.034628208166 -0.40656174918  0.83664233609  0.47996918369 -0.93691938589 -0.32612352068
[27,]  0.73969198231 -1.509997897168  0.8286313430 -1.99026536245 -0.777962083599 -0.21131215535 -0.16236059295  1.93888230636 -0.04523502153  1.21240293115
[28,]  0.79814565828 -0.002749022197  1.1295886456 -0.32404653045 -0.915363111732  1.22538126033  1.27770440481  2.29028155483 -0.16655510700  0.38204970028
[29,]  0.68452371726  0.153069714109 -0.7441619115  1.12961212169 -2.228366698030 -0.29776732103 -0.17399338566  0.01474905164  0.86519546609  0.65703199901
[30,]  0.09451286865 -0.101606709390 -1.9081773109  0.26541265196  0.969847800809 -1.63484501730  1.66478832626  1.33507695695  1.11308575403 -0.77217724948
[31,]  1.32716374006  0.719879893394  1.2293127960 -0.03657342443 -0.770458528682 -0.04364255114  0.22084771411 -0.24611606705 -1.30832995141 -0.34355271738

[[1]][[2]]
             [,1]
 [1,] -0.1092722964
 [2,]  3.1456198039
 [3,] -0.7426876718
 [4,] -1.1001065940
 [5,] -0.1544732275
 [6,] -0.1985506346
 [7,]  0.3034672287
 [8,] -0.9997436393
 [9,]  1.4844352806
[10,] -0.0731949143
[11,] -0.9105292808
```

Figure 24A

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> nn2$result.matrix
                                                  1
error                                    1889.344659576555
reached.threshold                           0.009793856667
steps                                   22605.000000000000
Intercept.to.1layhid1                       2.298403272487
having_IP_Address.to.1layhid1               0.929330527121
URL_Length.to.1layhid1                      0.777622999103
Shortining_Service.to.1layhid1             -1.757122747037
having_At_Symbol.to.1layhid1                0.310539047454
double_slash_redirecting.to.1layhid1        0.818177670990
Prefix_Suffix.to.1layhid1                   1.102062365399
having_Sub_Domain.to.1layhid1               0.709223281978
SSLfinal_State.to.1layhid1                  2.230893559393
Domain_registeration_length.to.1layhid1     0.136259193414
Favicon.to.1layhid1                        -0.741163736099
port.to.1layhid1                            0.876949518900
HTTPS_token.to.1layhid1                    -0.576462106444
Request_URL.to.1layhid1                     0.973451599306
URL_of_Anchor.to.1layhid1                   1.412188499186
Links_in_tags.to.1layhid1                   3.293141254029
SFH.to.1layhid1                             0.921710968209
Submitting_to_email.to.1layhid1            -0.198110717829
Abnormal_URL.to.1layhid1                    0.742926169487
Redirect.to.1layhid1                       -0.966068469520
on_mouseover.to.1layhid1                    0.617534696314
RightClick.to.1layhid1                      1.053721882530
popUpWidnow.to.1layhid1                    -0.254026460889
Iframe.to.1layhid1                         -0.748192403415
age_of_domain.to.1layhid1                   1.089967526164
DNSRecord.to.1layhid1                       0.280125526635
web_traffic.to.1layhid1                     0.409465154899
Page_Rank.to.1layhid1                      -0.259060027021
Google_Index.to.1layhid1                    1.070907930733
Links_pointing_to_page.to.1layhid1          1.658396620133
Statistical_report.to.1layhid1              0.439213080854
Intercept.to.1layhid2                      -0.042771729805
having_IP_Address.to.1layhid2               1.347806862055
URL_Length.to.1layhid2                      5.521612878403
Shortining_Service.to.1layhid2             -1.143221372499
having_At_Symbol.to.1layhid2               -0.218832296759
double_slash_redirecting.to.1layhid2       -0.861764558435
```

```
Domain_registeration_length.to.1layhid10   12.246971711651
Favicon.to.1layhid10                        1.282199302536
port.to.1layhid10                           6.494073016687
HTTPS_token.to.1layhid10                   -7.922785377238
Request_URL.to.1layhid10                   -7.596858609658
URL_of_Anchor.to.1layhid10                -23.633254289130
Links_in_tags.to.1layhid10                 -6.965944966487
SFH.to.1layhid10                           -0.679170114831
Submitting_to_email.to.1layhid10            3.042115523065
Abnormal_URL.to.1layhid10                   4.651282198536
Redirect.to.1layhid10                     -22.549900983882
on_mouseover.to.1layhid10                   9.039895735801
RightClick.to.1layhid10                    11.410579204022
popUpWidnow.to.1layhid10                    1.717625461625
Iframe.to.1layhid10                        12.646429457183
age_of_domain.to.1layhid10                 23.328953346430
DNSRecord.to.1layhid10                      5.032827602849
web_traffic.to.1layhid10                   31.205798823848
Page_Rank.to.1layhid10                     43.155116291197
Google_Index.to.1layhid10                   3.843111915527
Links_pointing_to_page.to.1layhid10        -9.675111229914
Statistical_report.to.1layhid10            16.850102081060
Intercept.to.Result                        16.246124271378
1layhid.1.to.Result                        80.653218255051
1layhid.2.to.Result                       -27.718036081496
1layhid.3.to.Result                       -37.677223001278
1layhid.4.to.Result                       -22.043013297657
1layhid.5.to.Result                       -48.145546458888
1layhid.6.to.Result                        33.784133044933
1layhid.7.to.Result                       -25.904979792009
1layhid.8.to.Result                        42.409044146149
1layhid.9.to.Result                       -23.740888266085
1layhid.10.to.Result                      -27.325232974364
>
```

Figure 25A

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> nn2$net.result[[1]][1:10]
 [1] 0.000000000000000000000000234688365677271040593 2
 [2] 0.000049674472694580044367790305770427039533388
 [3] 0.999998626259818612638241575041320174932479858
 [4] 1.000000000000000000000000000000000000000000000
 [5] 0.000000000000000012767101912728433055557730746
 [6] 0.999999991698986789856462564785033464431762 70
 [7] 0.000000000000000000000000000000000150710651452
 [8] 0.000000000000000000000004218947965629036866031 7
 [9] 1.000000000000000000000000000000000000000000000
[10] 0.000000000000000000000000000000000004482960093
>
```

Figure 26A

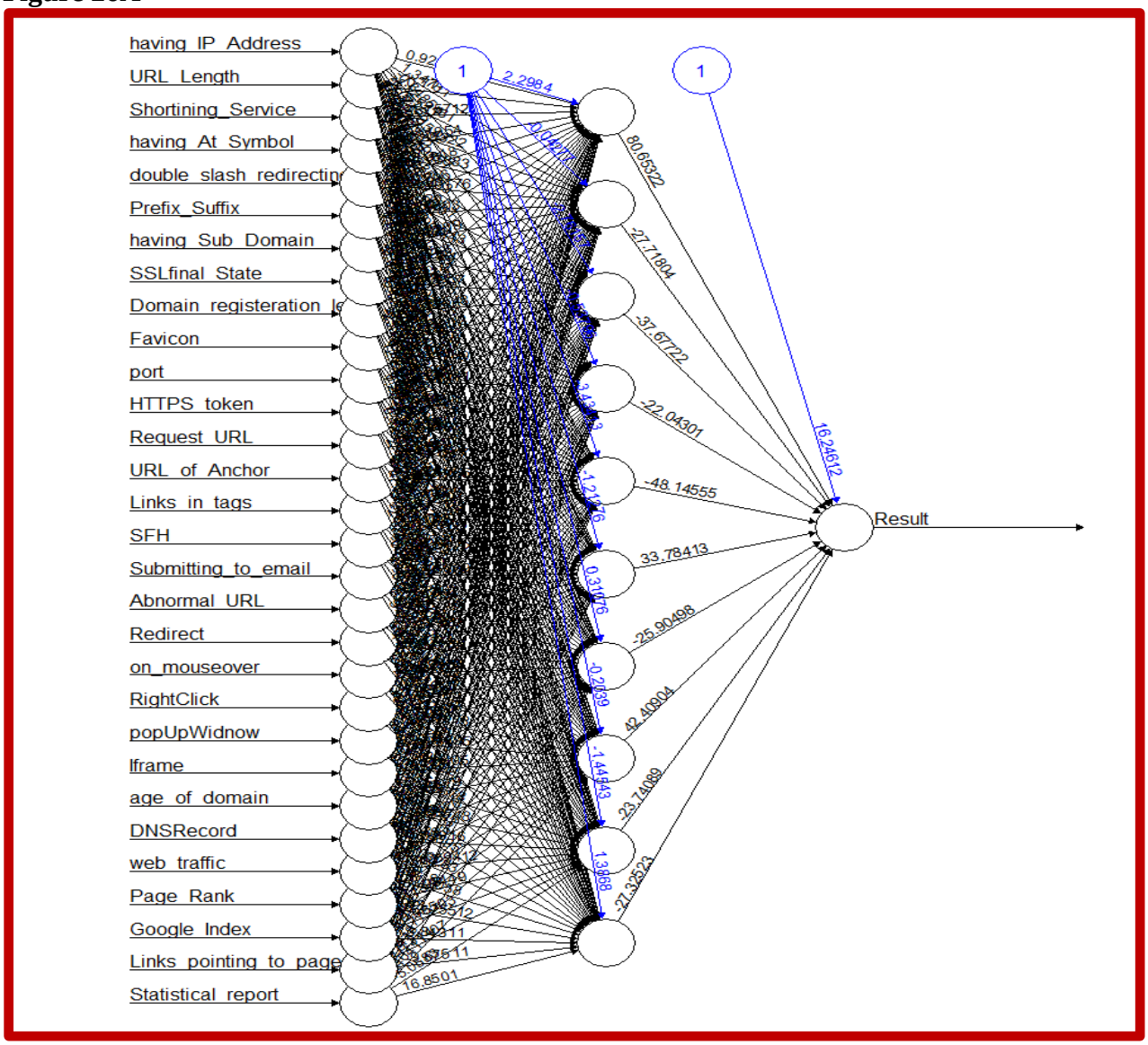


Figure 27A

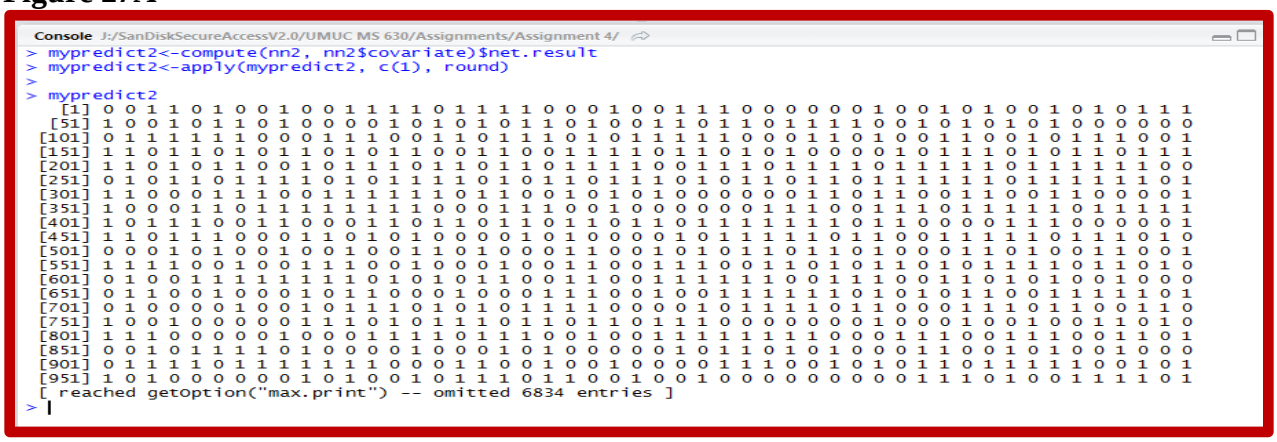


Figure 28A

Figure 29A

Figure 30

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> nn3$covariate
      [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10] [,11] [,12] [,13] [,14] [,15] [,16] [,17] [,18] [,19] [,20] [,21] [,22] [,23] [,24] [,25] [,26] [,27] [,28] [,29] [,30]
 [1,]   -1    1    1    1   -1   -1   -1   -1   -1     1     1    -1     1    -1     1    -1    -1    -1     0     1     1     1     1    -1    -1    -1    -1     1     1    -1
 [2,]    1    1    1    1    1   -1    0    1   -1     1     1    -1     1     0    -1    -1     1     1     0     1     1     1     1    -1    -1     0    -1     1     1     1
 [3,]    1    0   -1    1    1   -1    1    1   -1     1     1     1     1     0     0    -1     1     1     0    -1     1    -1     1    -1    -1     0    -1     1     1     1
 [4,]    1    0   -1    1    1   -1    1    1   -1     1     1    -1     1     0     1    -1     1     1     0     1     1     1     1     1    -1     1     1     1     0     1
 [5,]    1    1   -1    1    1   -1   -1    1   -1     1     1     1     1     0     1    -1     1     1     0     1     1     1     1     1    -1     0    -1     1     0     1
 [6,]    1    1    1    1    1   -1    0    1    1     1     1     1    -1     0     0    -1    -1    -1     0     1     1     1     1    -1     1     1     1     1    -1    -1
 [7,]    1    1   -1    1    1   -1    1   -1   -1     1     1     1     1    -1    -1    -1    -1    -1     0     1     1     1     1    -1    -1    -1    -1     1     0    -1
 [8,]   -1    1   -1    1   -1   -1    0    0    1     1     1    -1    -1    -1     1    -1     1     1     0    -1     1    -1     1     1    -1    -1    -1     1     0     1
 [9,]    1    1   -1    1    1    1   -1    1   -1     1     1    -1     1     0     1     1     1     1     0     1     1     1     1     1    -1     1    -1     1    -1     1
[10,]    1   -1    1    1    1   -1   -1    0    1     1    -1     1     1     0    -1    -1    -1    -1     0     1     1     1     1    -1     1     1    -1     1     1    -1
[11,]    1    1    1    1    1   -1   -1    1    1     1     1    -1    -1     0    -1    -1    -1    -1     0     1     1     1     1     1    -1    -1     1     1    -1    -1
[12,]    1    0   -1    1    1   -1    0    1   -1     1     1     1     1     0     0    -1    -1    -1     0    -1     1    -1     1    -1     1     1    -1     1    -1    -1
[13,]    1    1    1    1    1   -1   -1   -1   -1     1     1    -1     1     0     0    -1     1     1     0     1     1     1     1     1     1     0    -1     1    -1     1
[14,]    1    1    1    1    1   -1    1    0   -1     1     1     1     1     0     0    -1     1     1     0     1     1     1     1     1     1     1    -1     1    -1     1
[15,]    1   -1   -1   -1    1   -1    1    1   -1     1     1    -1    -1     0     0    -1     1     1     0     1     1     1     1     1     1    -1    -1     1     0     1
[16,]    1   -1    1    1    1   -1    0   -1    1     1     1    -1    -1    -1    -1    -1    -1    -1     0     1     1     1     1     1     1     0    -1     1    -1    -1
[17,]    1   -1   -1    1    1    1   -1    1    1     1     1     1    -1     1     0    -1    -1    -1     0     1     1     1     1     1    -1     0    -1     1     0    -1
[18,]    1   -1   -1    1   -1    1   -1    1   -1     1     1     1     1     1     0    -1     1     1     1     1     1     1     1    -1    -1     1    -1     1    -1     1
[19,]    1   -1    1    1    1   -1   -1    1   -1     1     1     1     1     1     0    -1     1     1     0     1     1     1     1    -1     1     1     1     1     0     1
[20,]    1   -1    1    1    1   -1   -1    1   -1     1     1    -1     1     0     1    -1     1     1     0     1     1     1     1    -1    -1    -1    -1     1     0     1
[21,]    1    0    1    1    1   -1    0    0    1     1     1     1    -1    -1    -1    -1    -1    -1     0     1     1     1     1     1    -1     1    -1     1     1    -1
[22,]    1    0    1    1    1   -1   -1    1   -1    -1     1    -1    -1    -1     0    -1     1     1     0    -1     1    -1    -1    -1    -1     0    -1     1     0     1
[23,]    1    0    1    1    1   -1   -1   -1    1    -1     1     1    -1    -1     0    -1     1     1     0    -1     1    -1     1    -1    -1     0    -1     1     0     1
[24,]    1   -1    1    1    1    1    1    1   -1     1     1    -1     1     1     0    -1     1     1     0     1     1     1     1     1    -1     1    -1     1     0     1
[25,]    1   -1    1    1    1   -1   -1   -1    1    -1    -1     1    -1    -1    -1    -1    -1    -1     0    -1     1    -1     1    -1    -1     1    -1     1    -1    -1
[26,]    1   -1    1    1    1   -1    0    0    1    -1     1    -1    -1    -1     0    -1    -1    -1     0    -1     1    -1     1     1    -1    -1    -1     1     0    -1
[27,]    1    1    1    1    1   -1    0    1   -1    -1     1     1     1     0    -1     1     1     1     0    -1     1    -1     1    -1     1     1    -1     1     0     1
[28,]   -1    1   -1    1   -1    1   -1    1   -1     1     1    -1     1     0     0     1    -1    -1     0     1     1     1     1     1     1     1    -1     1     1    -1
[29,]    1   -1    1    1    1   -1    1    1   -1     1     1     1     1     0     1    -1    -1    -1     0     1     1     1     1     1     1     1    -1    -1    -1    -1
[30,]    1   -1    1    1    1   -1    1   -1    1     1     1     1    -1     0     0    -1     1     1     0     1     1     1     1    -1     1     1    -1     1     0     1
[31,]    1   -1    1    1    1   -1    0   -1    1    -1    -1    -1    -1    -1     0    -1    -1    -1     0    -1     1    -1     1    -1    -1     0    -1     1     0    -1
[32,]    1   -1    1    1    1   -1    0    0   -1    -1    -1     1    -1    -1     0    -1    -1    -1     0    -1     1    -1     1     1    -1     0    -1     1     0    -1
[33,]    1   -1    1    1    1   -1   -1   -1   -1    -1    -1    -1     1     0     0    -1    -1    -1     0    -1     1    -1     1    -1    -1     0    -1     1     0    -1
 [ reached getOption("max.print") -- omitted 7801 rows ]
```

Figure 31: “nn3$weights”

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
               [,1]            [,2]          [,3]          [,4]          [,5]          [,6]          [,7]           [,8]          [,9]          [,10]
 [1,]   0.23076743581 -0.029192611397  0.53256117490 -0.06981182129 -3.9276737616 -1.25505796432  0.89910848830   2.3601625869  0.0254904839  0.98888177459
 [2,]   2.22004974835  0.892506482118 -0.86234789548 -2.74071787461 -1.3260037085  0.98352315210 -2.10499247957  -1.2096659573 -0.4004534594  0.92969624200
 [3,]   0.17693491041  0.271331887443  0.08391284471 -1.67435477166 -0.7464211603  0.76051164729  0.09858050782   0.8394002946  1.9977241709 -0.23919781196
 [4,]   0.31788260529  0.072347203312  0.48771464951 -0.64084132999  0.7014499356  0.85617355161  1.01046033099   1.8076707359  0.3857814538  0.24765936160
 [5,]   0.59486030682  0.555756749834 -0.19555760160 -0.42838494911 -1.3044422140 -0.65641309690  0.14739574745   1.3405455100  0.9268470317 -0.77804164759
 [6,]  -0.16120129456 -1.931452387242  0.71829797133  0.53286006482  1.3543996179 -0.78629724207 -1.49798871296   5.3932469931  0.7827022710 -0.31034119477
 [7,]  -2.24925079266  2.091216771046 -2.03107744118 -1.34620469450 -2.3191041955 -0.50866407934 -0.49947082946   1.6045265096 -0.8018735435  4.81878890252
 [8,]  -2.05359454540  0.555442665208  0.78382021659 -2.35811595406 -1.1925850961  2.34917620405  0.79422758030  -0.5742609023 -0.7155604257  8.33313643753
 [9,]  -0.25820779870  0.678218822874 -2.88284028689 -0.74680084061 -4.7390771858 -5.73363666229  4.93476861843   5.0632272290  0.6372138683  0.12113303869
[10,]   0.17814256368  1.102514435045  0.05665223869  0.64490622418  1.3507675965 -0.34012774318 -0.96522330092   0.5032859165 -0.8373941366 -0.72939595363
[11,]  -0.38574748254  0.529149032184 -0.48112987550 -0.73870285223 -0.5127363440  0.71937967995 -0.57042408598  -3.0226537039 -0.5723371494 -0.73216112484
[12,]   1.53466350991 -0.282573345037 -0.70573855409 -2.52789185305  0.3571976644  1.71650209752 -0.28669112241   5.3481756734 -0.9124530850 -0.55534367716
[13,]   0.09566143226  1.850170940057 -0.21767337262 -0.08009262580 -0.3605914376  0.06209555851 -0.77774472924  -3.2864901172  1.5119599484 -1.41107762372
[14,]  -0.73464330068  0.612458185125 -0.04713152205  0.16330706220 -0.6909249205  1.39396838239 -1.44365379116   1.1948892404 -0.4667597781  2.47935647187
[15,]  -6.08741508155  4.262211384982 -3.61645661621 -3.03290259296 -2.9677025254 -0.95263414894 -1.85474441918  22.5712780548 -1.5298259047  6.20495753173
[16,]   0.64991285367  1.238651046269 -1.43891797868 -0.77678305884 -4.6784557150  1.02384537889 -0.73737521295 -13.6331342379 -3.4118590320  2.15748479882
[17,]   0.93162045818 -1.212840081511 -2.16164225046 -0.12300165305 -1.7161634810 -1.09308005685  2.32393370310   3.1487695928 -3.0068878235  2.26172707285
[18,]  -0.65021742926 -0.568205529628 -3.40212667396  1.52651014651 -1.2529831376  0.16198252039 -4.38579201900  -3.2438923981  1.1957997847  1.21217638810
[19,]  -1.12314063848  0.006612990013  1.12649217845 -0.44322299811  0.3479961051  1.73475252607  0.38909088450   1.4404781357  1.1728576134  0.19603287741
[20,]  -4.89372696045  2.753898651842  1.81332278153  5.05634972174  4.3495094330 -0.57447122550 -0.41584425575   2.8855358045  3.7778242182 -0.68697279928
[21,]   0.55565704080  0.472248179745 -0.07034737073 -0.05572557389  1.8273241228  0.07370307895 -1.63509268709   3.7034271310 -1.0783067537  2.13354452053
[22,]   1.16787741782  0.354080686809  1.25685303140 -0.38255073087 -0.3557480094 -0.74351554027 -0.68521546789  -0.4092828442 -0.1547899708 -0.66204374693
[23,]   0.36391444427 -0.751187180942  1.72444114906  0.38585610984 -0.1406408376  0.02215843347 -3.56349057025   2.4847435554 -1.5987989113 -0.58095581883
[24,]   0.39984078968 -0.139991426872 -0.09213518657  0.57371796980 -0.8166992256  0.73001128655 -1.59704106733   1.7833217041  0.8863447986  0.04388026936
[25,]  -5.32525559552  0.058735704912  0.25324334660 -2.24354811369 -0.6231687648  0.16219756794  1.53551385703   0.2170709368  3.9638290004 -1.82641773152
[26,]  -2.94484794026  1.637701234490 -0.07128136606  0.48781777102  0.9674226828  0.67762142213  0.74708686787   0.2677854287 -0.4902495321  0.05425769621
[27,] -11.16766659902  0.477009313304 -1.99880207621 -1.16483750849 -1.5088074395 -0.15028605417 -10.89435157443   1.2320189133  0.3345150021  3.74850202776
[28,]   1.87557870666  1.303188301789  0.01905707874  0.02846873993 -0.4340190270 -0.23476209165 -0.38353722745   2.0219538822  1.4517395293  1.71907816101
[29,]   1.92790650777  2.757653691764  0.13355059866  2.14407895681 -2.7948878624 -0.06331541190  4.13234963554   2.0637890437  0.6971649103  0.73558703300
[30,]  -3.54970630124  0.940053148875 -6.39423399266 -1.28712670805 -0.1658714628  1.78903519297 -3.00925194966   6.1139240719  0.9244616557  0.25167682075
[31,]  -0.35305825699 -0.880763458032  0.35112889039 -0.16347065323 -2.3724683640 -0.08829659927 -1.89632180288  -1.9261171576 -1.2927367663 -0.34876717978

[[1]][[2]]
              [,1]          [,2]          [,3]          [,4]          [,5]           [,6]          [,7]          [,8]           [,9]         [,10]
 [1,]  -0.5958040063 -0.49997090366  0.43120733749  0.02330072643  1.6090804934   2.82798251399  0.3197229310 -0.8085607576    0.2073342922 -0.2839151469
 [2,]  -2.3368979174  0.79993665397  0.03700874465  9.32914876497 -1.2730314752  -0.42726833545  1.3500817057 -0.5808118253    0.4164217291  0.4508865344
 [3,]  -1.5458426732 -1.40540640798 -0.80721703339  0.46950400235  0.1256445572   0.61465727829 -0.4425476877  2.1406896205    1.5901909602 -2.1691926922
 [4,]   3.0013571757  1.85618365088 -1.43999803685  2.31111045914 -1.1388269028  -0.93625770008  0.2602279455 -0.1252373199   15.0333594711 -0.1973882594
 [5,]   0.3865115399  1.40570225281 -2.05715380490 -1.19872043854  0.3808146674  -0.58534911560  0.9026472717 -1.4038186323   -6.5760868882  0.8752433374
 [6,]  14.2534967223 -0.06435742324 -0.86140780744  7.95297435118 -6.0120638172 -10.41732558379  0.1879245612 -9.9426931467   22.4939842141  1.2257598601
 [7,]   0.4651000874  2.05802880249 -0.89530702704  2.72229244459 -1.3698707377  -3.28641320629  1.8238258075 -2.2752131767   12.0062603354  1.6305930910
 [8,] -14.9172317188 -2.67674252729  2.09382046788 -6.75584115530 -0.0448496186  10.08683510089 -1.7272167104  1.6377016685  -39.2795944277 -0.9880177512
 [9,]  -1.3365026434 -0.56077029479  1.82385462877 -2.37073043017  0.4640873198   0.12556566375 -1.5696190948  1.6736005585   -2.9895767259 -1.8504667636
[10,]   3.1509252666 -0.69867448038 -0.47496998201  0.37863363875 -1.6761994587  -0.75394945031 -0.1551683339 -0.4856289993    0.6819012426  1.9973362090
[11,]  -1.2066642763 -1.63674231298  2.45443238883 -3.54883173251  1.1809197686   0.08315685765 -1.3712282060  4.8318503794  -11.4220769295 -0.2630698436

[[1]][[3]]
              [,1]
 [1,]   0.9812366058
 [2,]  -4.6545767150
 [3,] -15.0796358470
 [4,]  57.2820865586
 [5,]  -3.2399601196
 [6,]  37.8317855422
 [7,]   4.9022417209
 [8,]  -2.3253956051
 [9,]   5.4464334509
[10,]  -5.8063738636
[11,] -85.3319433219
```

Figure 32A: "nn3$startweights"

Figure 33A

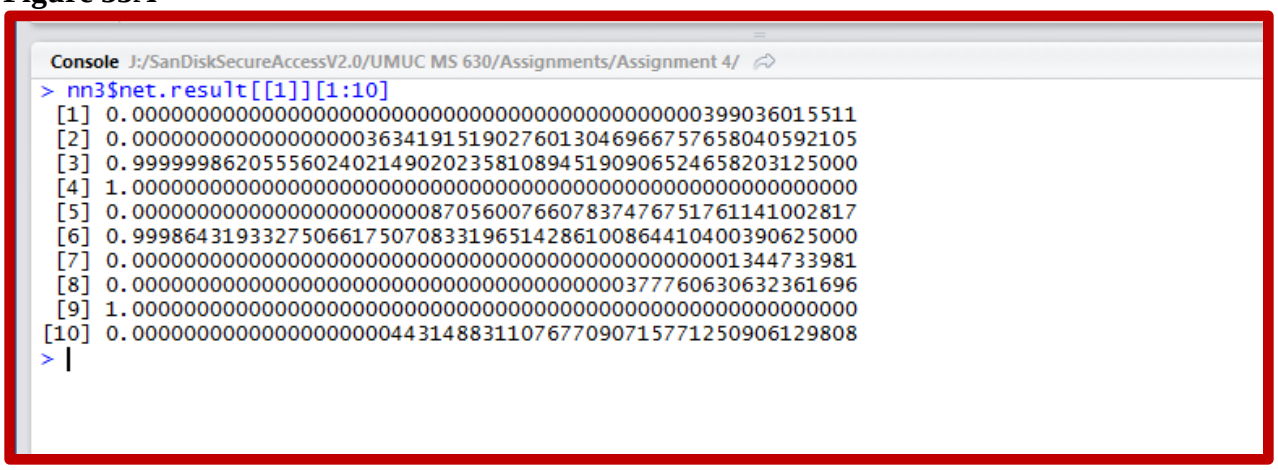
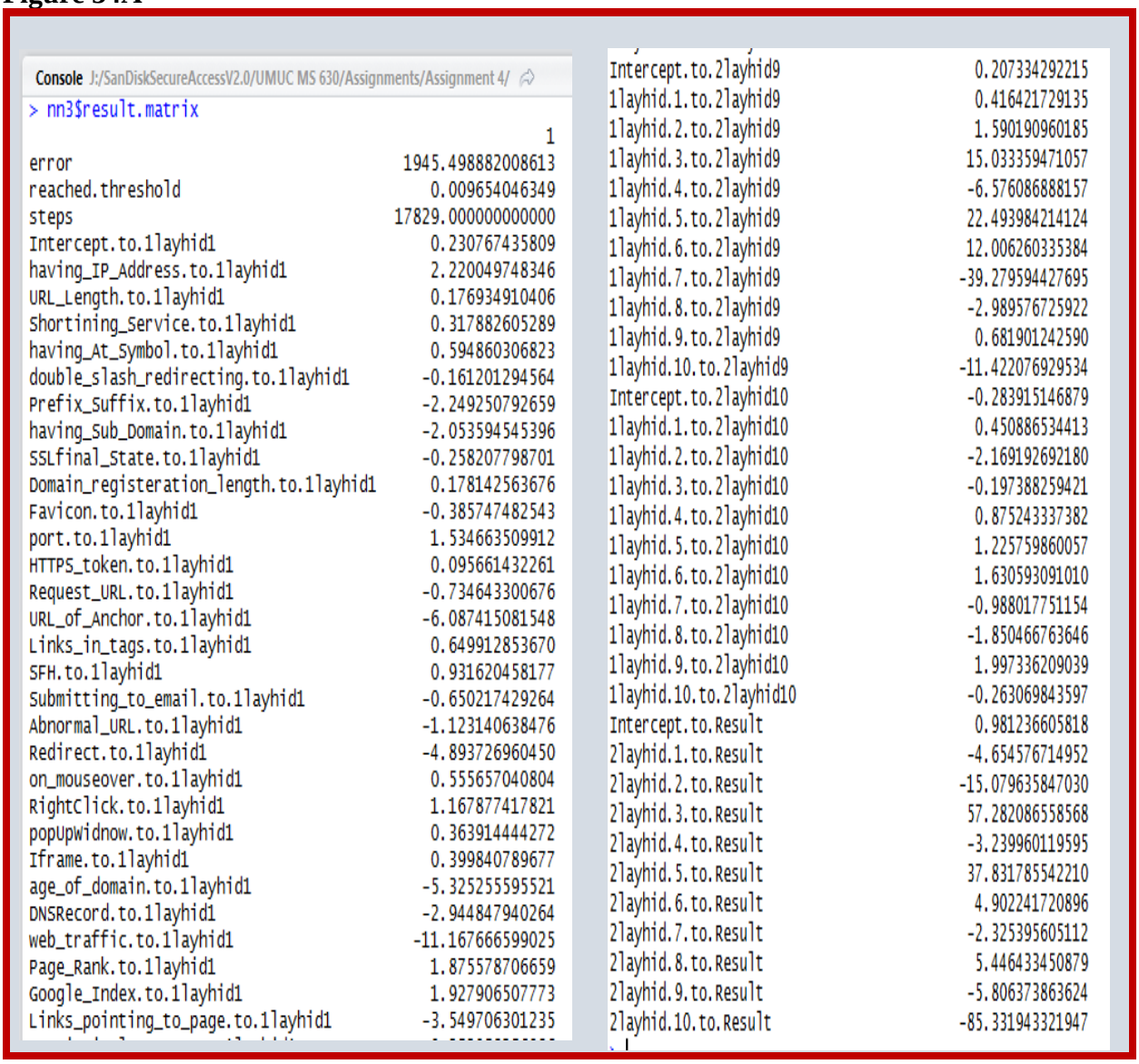


Figure 34A



Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/

```
> nn3$result.matrix
                                                  1
error                                1945.498882008613
reached.threshold                       0.009654046349
steps                               17829.000000000000
Intercept.to.1layhid1                   0.230767435809
having_IP_Address.to.1layhid1           2.220049748346
URL_Length.to.1layhid1                  0.176934910406
Shortining_Service.to.1layhid1          0.317882605289
having_At_Symbol.to.1layhid1            0.594860306823
double_slash_redirecting.to.1layhid1   -0.161201294564
Prefix_Suffix.to.1layhid1              -2.249250792659
having_Sub_Domain.to.1layhid1          -2.053594545396
SSLfinal_State.to.1layhid1             -0.258207798701
Domain_registeration_length.to.1layhid1 0.178142563676
Favicon.to.1layhid1                    -0.385747482543
port.to.1layhid1                        1.534663509912
HTTPS_token.to.1layhid1                 0.095661432261
Request_URL.to.1layhid1                -0.734643300676
URL_of_Anchor.to.1layhid1              -6.087415081548
Links_in_tags.to.1layhid1               0.649912853670
SFH.to.1layhid1                         0.931620458177
Submitting_to_email.to.1layhid1        -0.650217429264
Abnormal_URL.to.1layhid1               -1.123140638476
Redirect.to.1layhid1                   -4.893726960450
on_mouseover.to.1layhid1                0.555657040804
RightClick.to.1layhid1                  1.167877417821
popUpWidnow.to.1layhid1                 0.363914444272
Iframe.to.1layhid1                      0.399840789677
age_of_domain.to.1layhid1              -5.325255595521
DNSRecord.to.1layhid1                  -2.944847940264
web_traffic.to.1layhid1               -11.167666599025
Page_Rank.to.1layhid1                   1.875578706659
Google_Index.to.1layhid1                1.927906507773
Links_pointing_to_page.to.1layhid1     -3.549706301235
Intercept.to.2layhid9                   0.207334292215
1layhid.1.to.2layhid9                   0.416421729135
1layhid.2.to.2layhid9                   1.590190960185
1layhid.3.to.2layhid9                  15.033359471057
1layhid.4.to.2layhid9                  -6.576086888157
1layhid.5.to.2layhid9                  22.493984214124
1layhid.6.to.2layhid9                  12.006260335384
1layhid.7.to.2layhid9                 -39.279594427695
1layhid.8.to.2layhid9                  -2.989576725922
1layhid.9.to.2layhid9                   0.681901242590
1layhid.10.to.2layhid9                -11.422076929534
Intercept.to.2layhid10                 -0.283915146879
1layhid.1.to.2layhid10                  0.450886534413
1layhid.2.to.2layhid10                 -2.169192692180
1layhid.3.to.2layhid10                 -0.197388259421
1layhid.4.to.2layhid10                  0.875243337382
1layhid.5.to.2layhid10                  1.225759860057
1layhid.6.to.2layhid10                  1.630593091010
1layhid.7.to.2layhid10                 -0.988017751154
1layhid.8.to.2layhid10                 -1.850466763646
1layhid.9.to.2layhid10                  1.997336209039
1layhid.10.to.2layhid10                -0.263069843597
Intercept.to.Result                     0.981236605818
2layhid.1.to.Result                    -4.654576714952
2layhid.2.to.Result                   -15.079635847030
2layhid.3.to.Result                    57.282086558568
2layhid.4.to.Result                    -3.239960119595
2layhid.5.to.Result                    37.831785542210
2layhid.6.to.Result                     4.902241720896
2layhid.7.to.Result                    -2.325395605112
2layhid.8.to.Result                     5.446433450879
2layhid.9.to.Result                    -5.806373863624
2layhid.10.to.Result                  -85.331943321947
```

Figure 35A

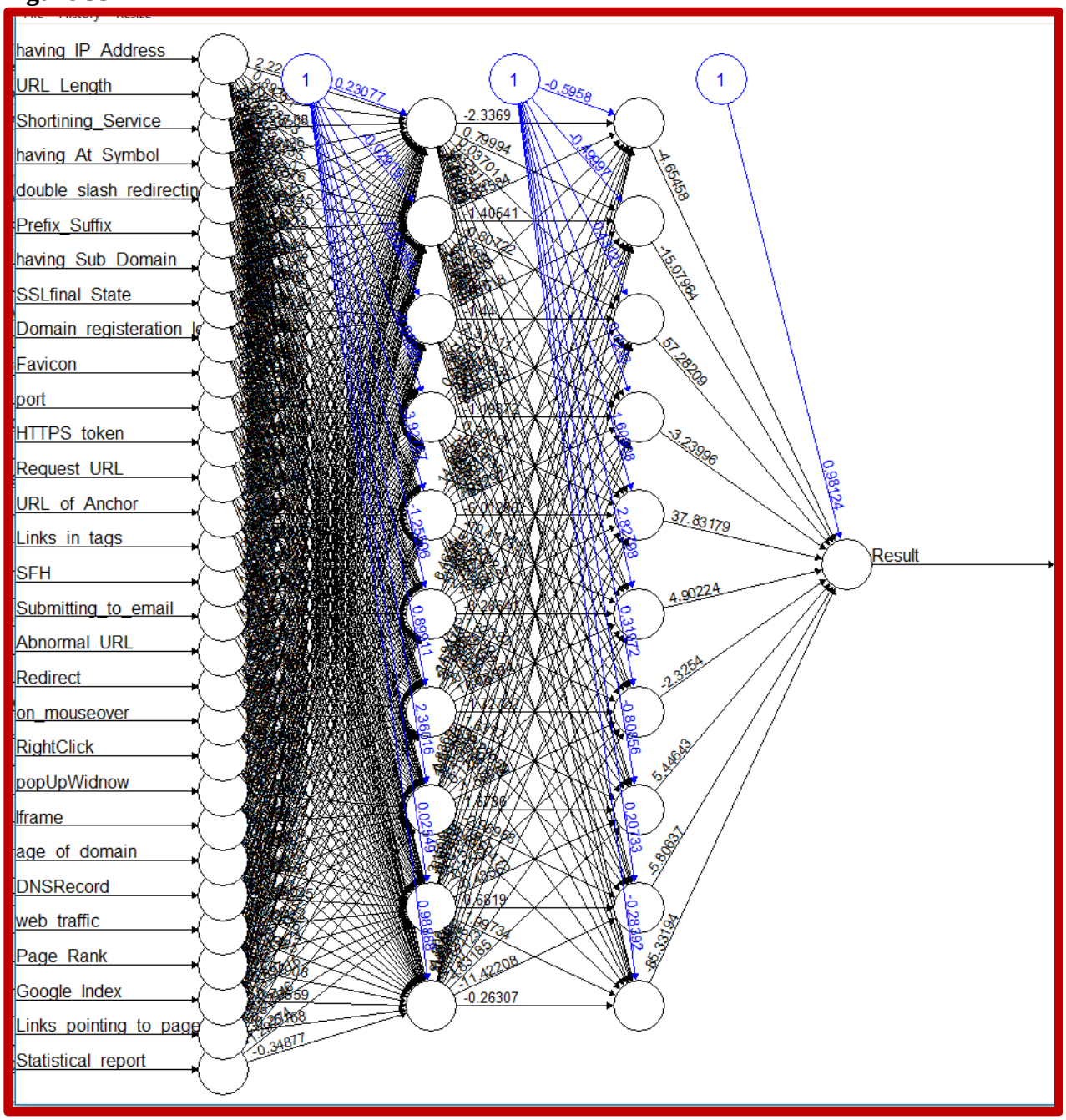

having_IP_Address
URL_Length
Shortining_Service
having_At_Symbol
double_slash_redirecting
Prefix_Suffix
having_Sub_Domain
SSLfinal_State
Domain_registeration_le
Favicon
port
HTTPS_token
Request_URL
URL_of_Anchor
Links_in_tags
SFH
Submitting_to_email
Abnormal_URL
Redirect
on_mouseover
RightClick
popUpWidnow
Iframe
age_of_domain
DNSRecord
web_traffic
Page_Rank
Google_Index
Links_pointing_to_page
Statistical_report
1
0.23077
-0.5958
-2.3369
-1.40641
-11.42208
-0.26307
-0.34877
-4.65458
-15.07964
57.28209
-3.23996
37.83179
4.90224
-2.3254
5.44643
-5.80637
-85.33194
0.98124
Result

Figure 36A

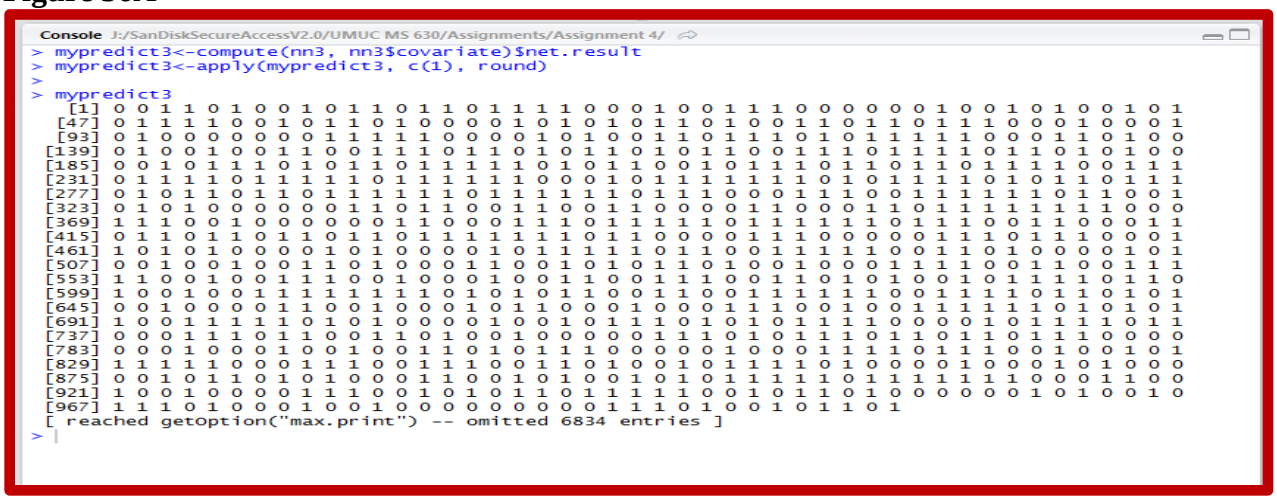


Figure 37A

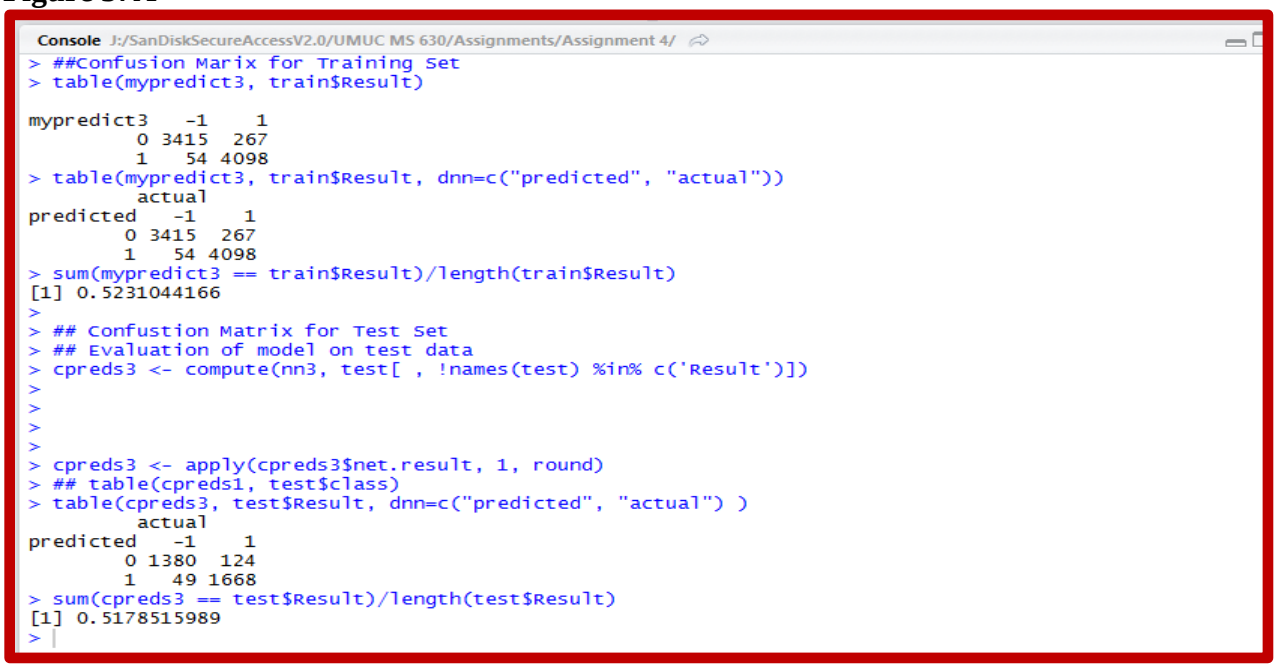


Figure 38A

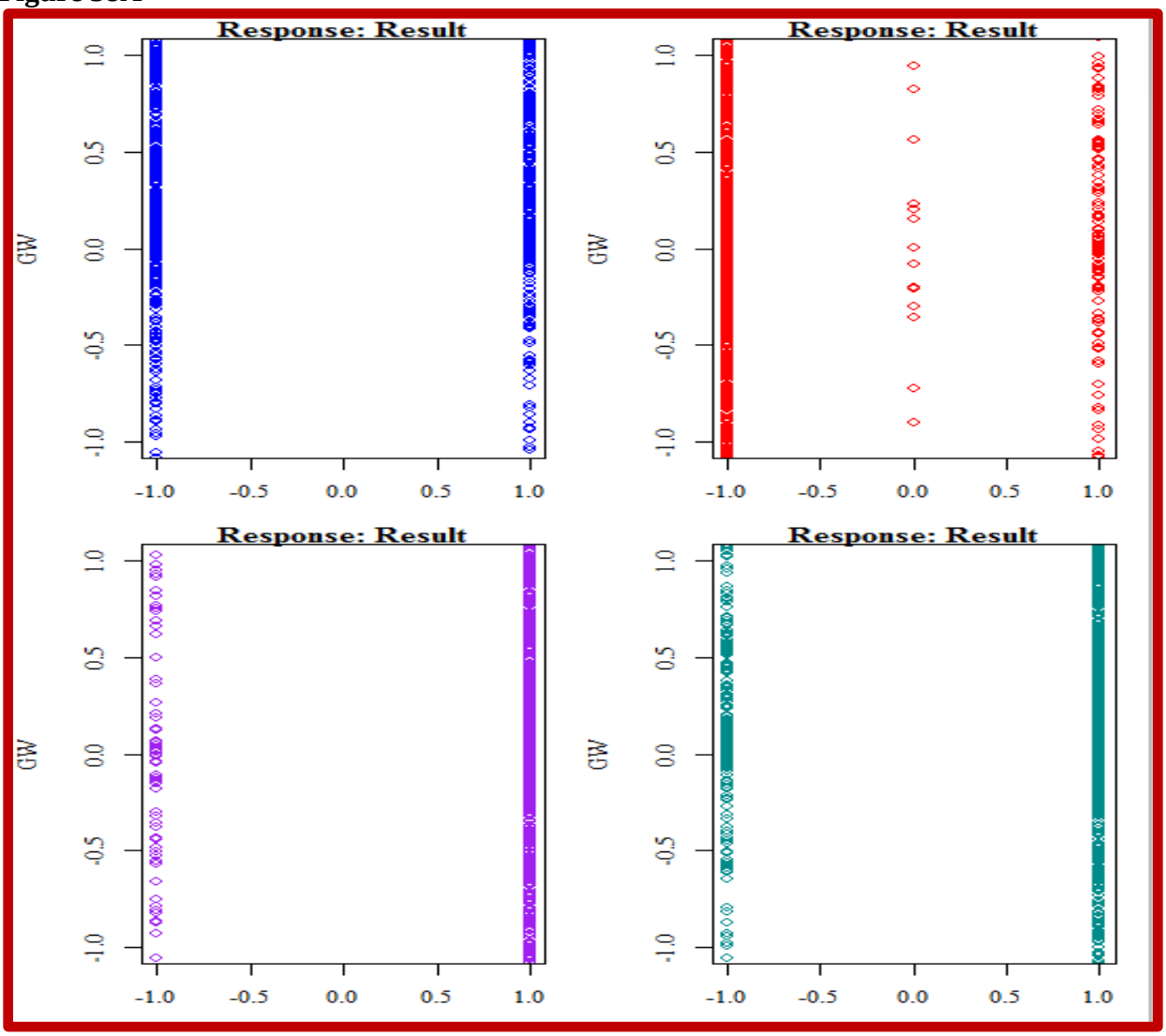


Figure 38B

```
> gwplot(nn2, selected.covariate = "having_IP_Address",
+          min = -1, max = 1, col="blue")
> gwplot(nn2, selected.covariate = "URL_Length",
+          min = -1, max = 1, col="red")
> gwplot(nn2, selected.covariate = "Shortining_Service",
+          min = -1, max = 1, col="purple")
> gwplot(nn2, selected.covariate = "having_At_Symbol",
+          min = -1, max = 1, col="dark cyan")
```

Figure 39A

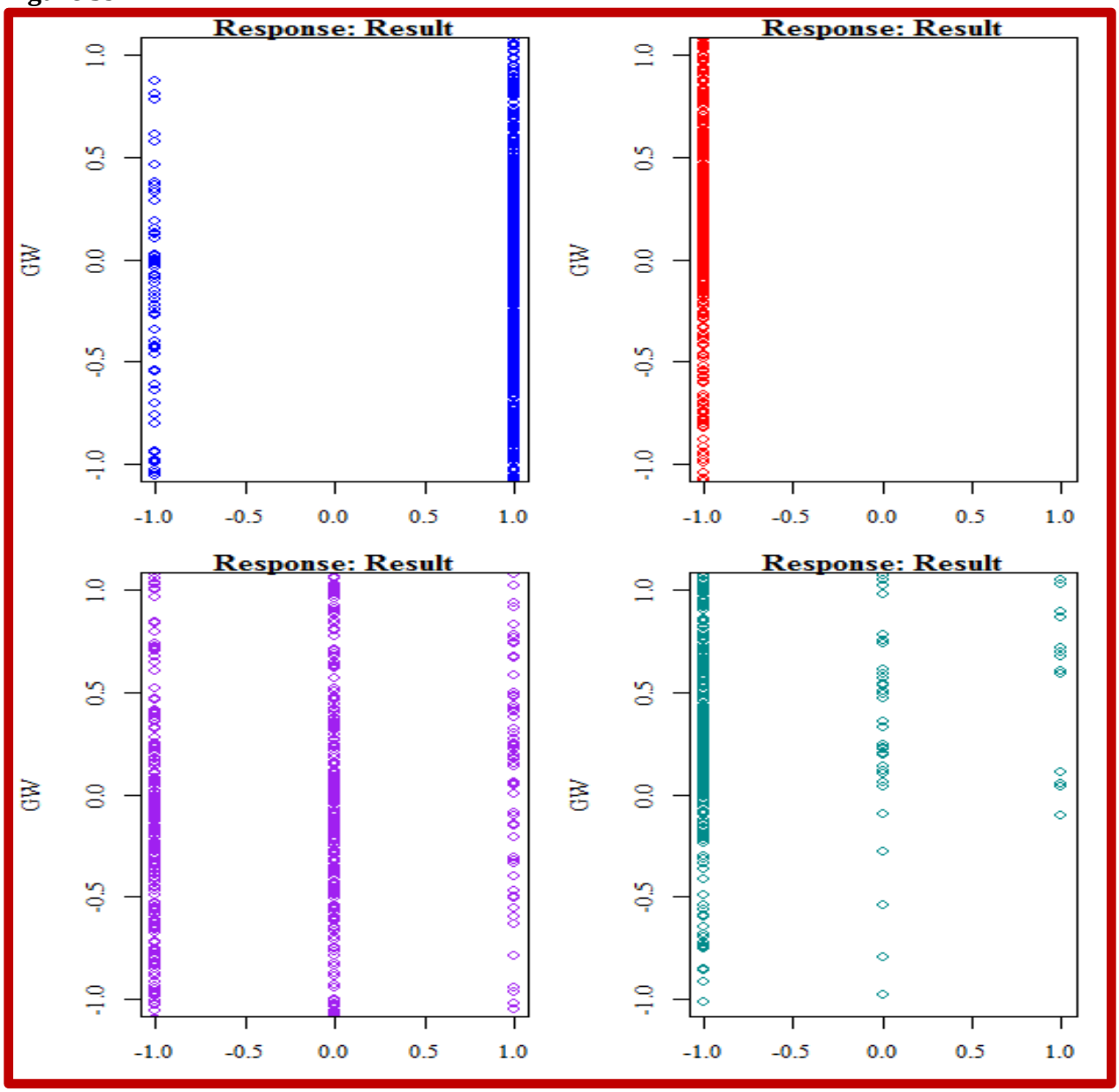


Figure 39B

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> par(mfrow=c(2,2))
> gwplot(nn2, selected.covariate = "double_slash_redirecting",
+        min = -1, max = 1, col="blue")
> gwplot(nn2, selected.covariate = "Prefix_Suffix",
+        min = -1, max = 1, col="red")
> gwplot(nn2, selected.covariate = "having_Sub_Domain",
+        min = -1, max = 1, col="purple")
> gwplot(nn2, selected.covariate = "SSLfinal_State",
+        min = -1, max = 1, col="dark cyan")
>
```

Figure 40A

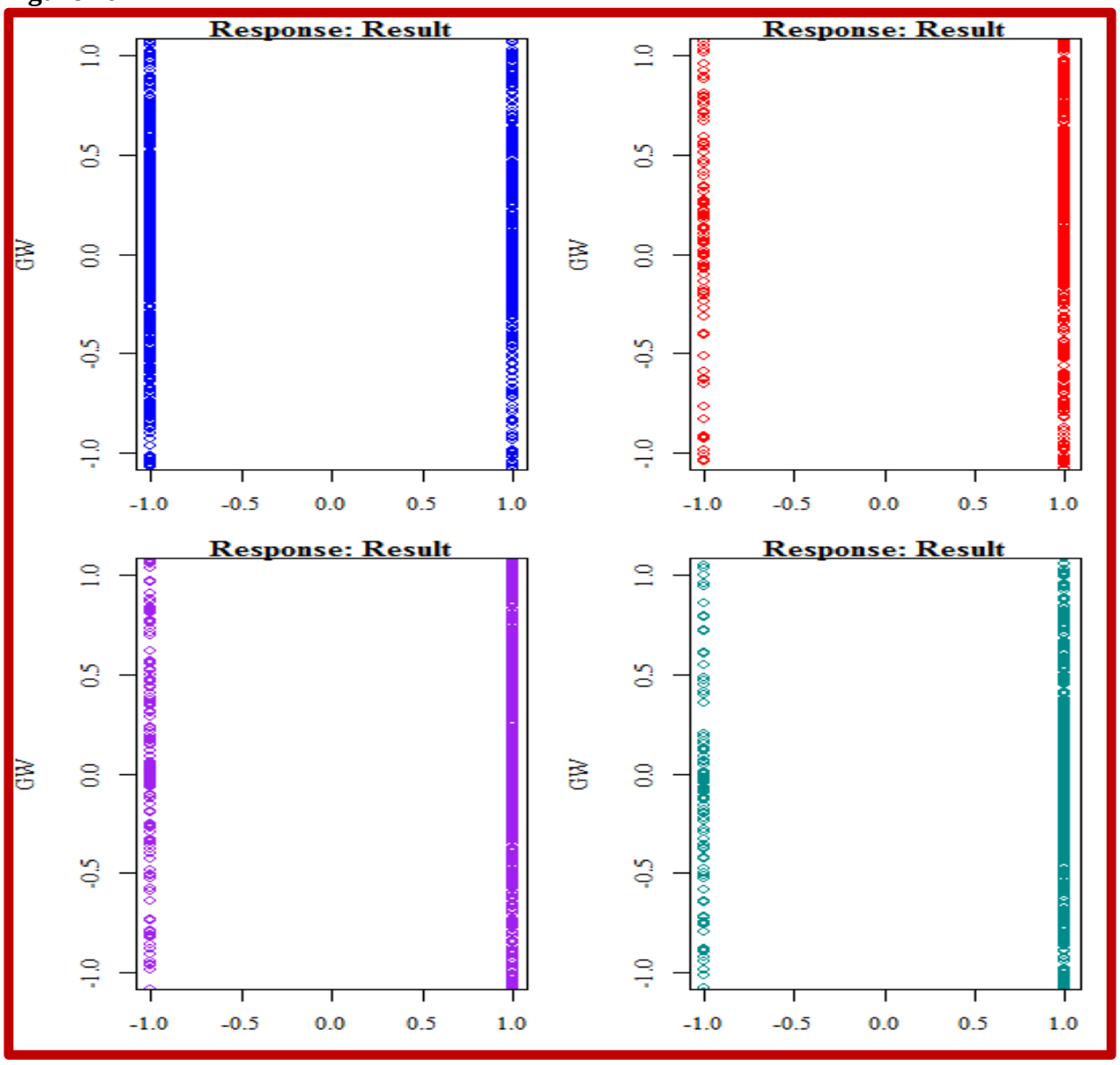


Figure 40B

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> par(mfrow=c(2,2))
> gwplot(nn2, selected.covariate = "Domain_registeration_length",
+        min = -1, max = 1, col="blue")
> gwplot(nn2, selected.covariate = "Favicon",
+        min = -1, max = 1, col="red")
> gwplot(nn2, selected.covariate = "port",
+        min = -1, max = 1, col="purple")
> gwplot(nn2, selected.covariate = "HTTPS_token",
+        min = -1, max = 1, col="dark cyan")
>
```

Figure 41A

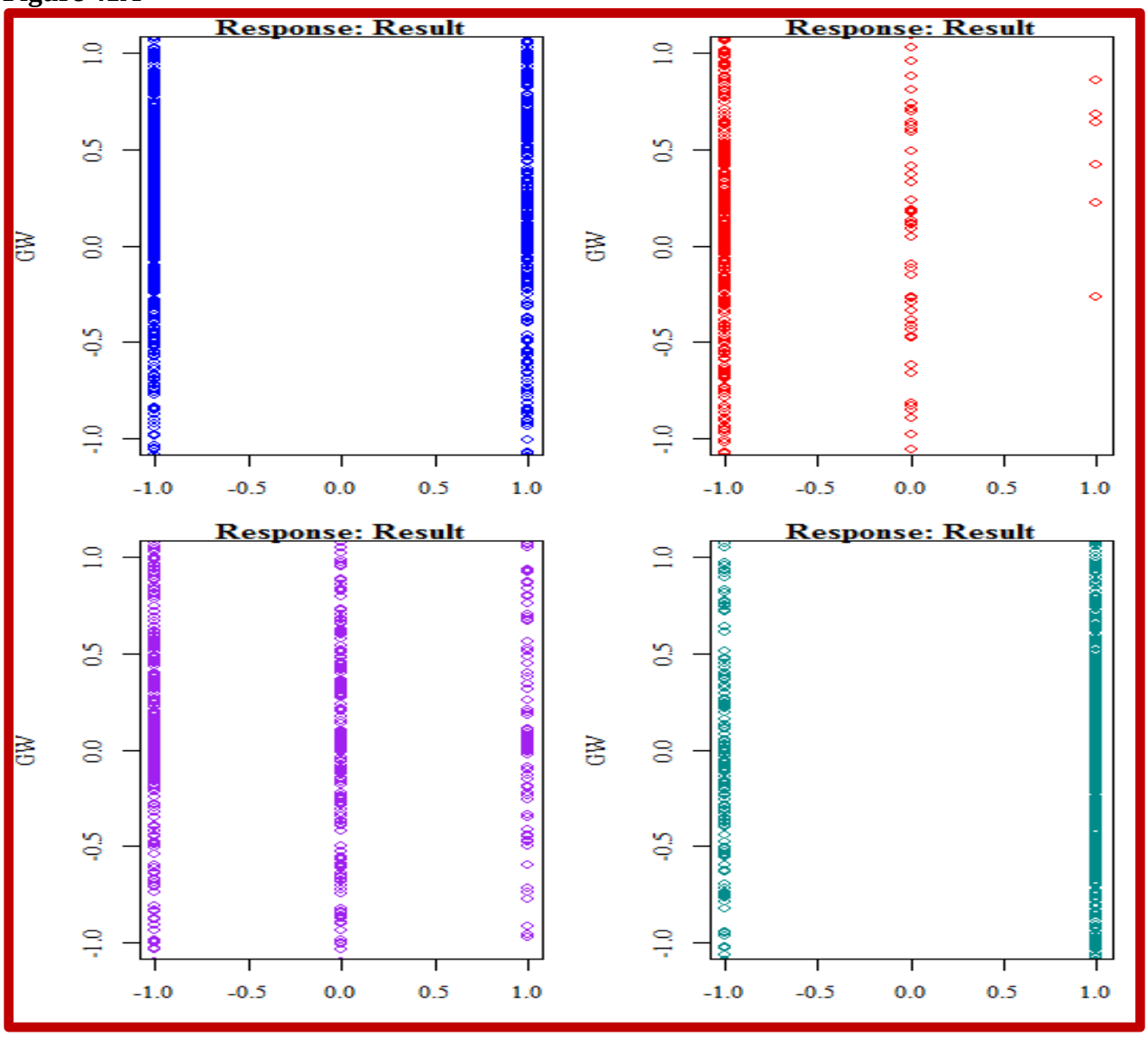


Figure 41B

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> par(mfrow=c(2,2))
> gwplot(nn2, selected.covariate = "Request_URL",
+        min = -1, max = 1, col="blue")
> gwplot(nn2, selected.covariate = "URL_of_Anchor",
+        min = -1, max = 1, col="red")
> gwplot(nn2, selected.covariate = "Links_in_tags",
+        min = -1, max = 1, col="purple")
> gwplot(nn2, selected.covariate = "Submitting_to_email",
+        min = -1, max = 1, col="dark cyan")
>
```

Figure 42A

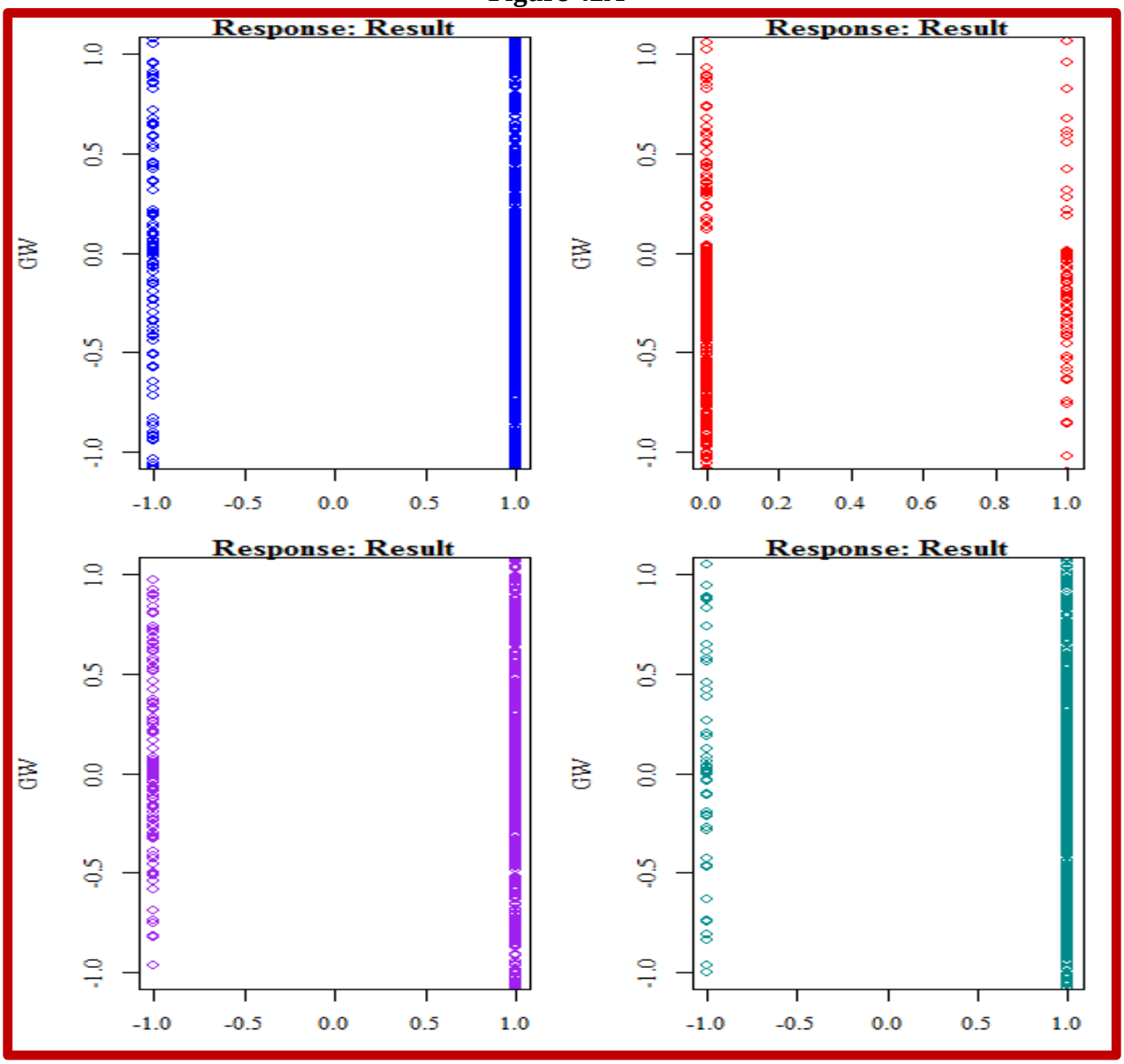


Figure 42B

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> par(mfrow=c(2,2))
> gwplot(nn2, selected.covariate = "Abnormal_URL",
+        min = -1, max = 1, col="blue")
> gwplot(nn2, selected.covariate = "Redirect",
+        min = -1, max = 1, col="red")
> gwplot(nn2, selected.covariate = "on_mouseover",
+        min = -1, max = 1, col="purple")
> gwplot(nn2, selected.covariate = "RightClick",
+        min = -1, max = 1, col="dark cyan")
>
```

Figure 43A

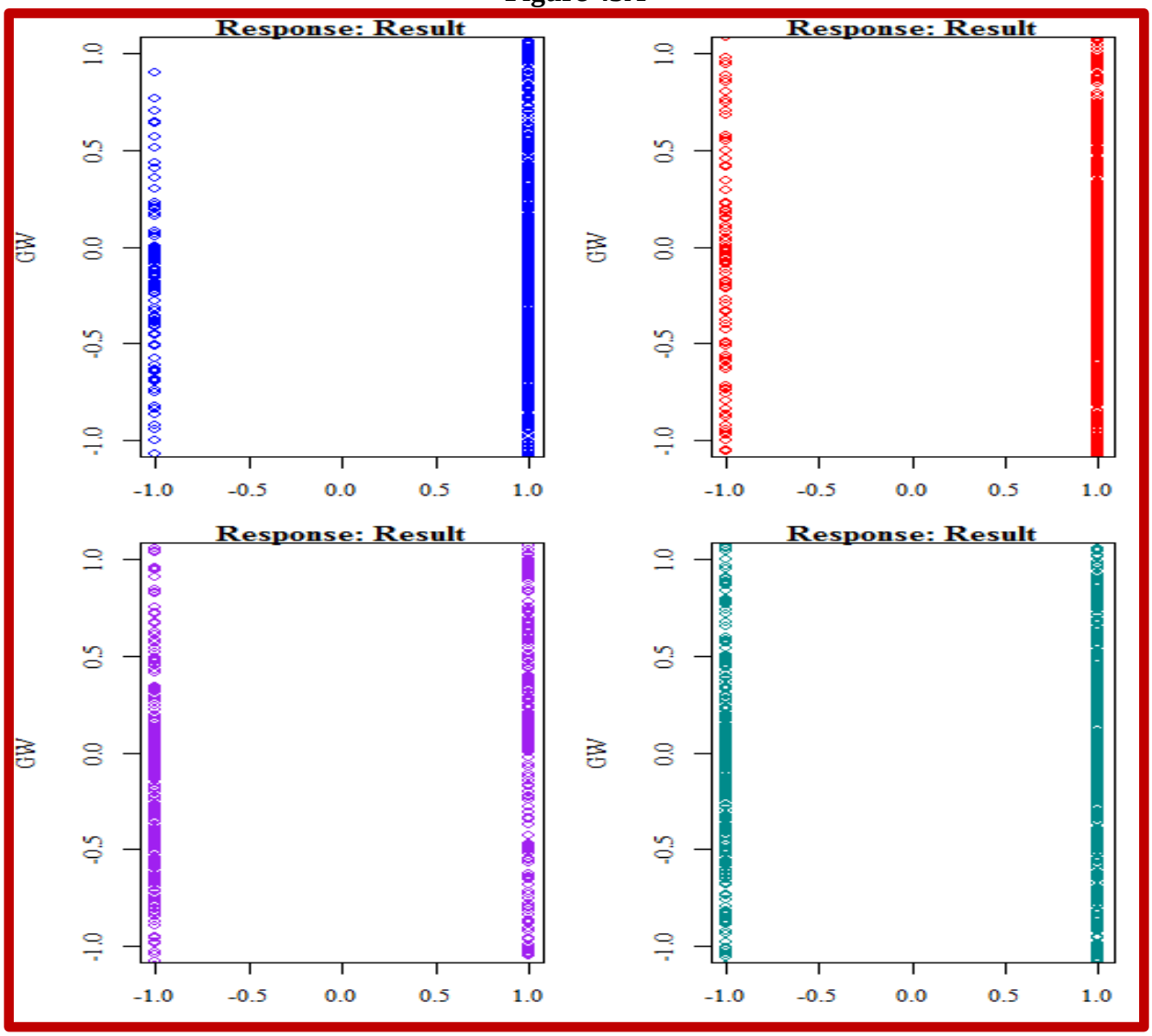


Figure 43B

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> par(mfrow=c(2,2))
> gwplot(nn2, selected.covariate = "popUpWidnow",
+         min = -1, max = 1, col="blue")
> gwplot(nn2, selected.covariate = "Iframe",
+         min = -1, max = 1, col="red")
> gwplot(nn2, selected.covariate = "age_of_domain",
+         min = -1, max = 1, col="purple")
> gwplot(nn2, selected.covariate = "DNSRecord",
+         min = -1, max = 1, col="dark cyan")
>
```

Figure 44A

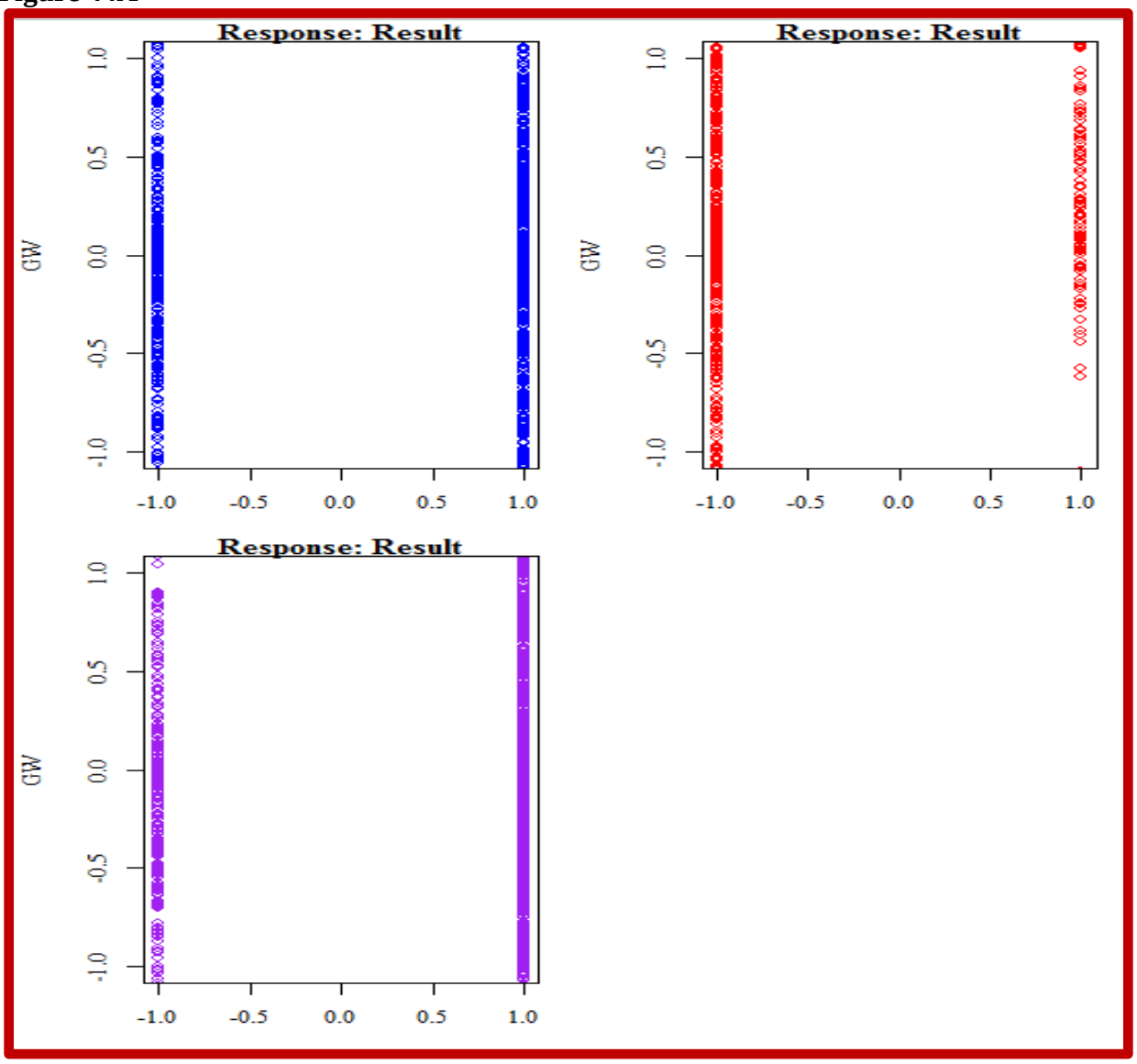


Figure 44B

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> par(mfrow=c(2,2))
> gwplot(nn2, selected.covariate = "DNSRecord",
+        min = -1, max = 1, col="blue")
> gwplot(nn2, selected.covariate = "Page_Rank",
+        min = -1, max = 1, col="red")
> gwplot(nn2, selected.covariate = "Google_Index",
+        min = -1, max = 1, col="purple")
>
```

Figure 45A

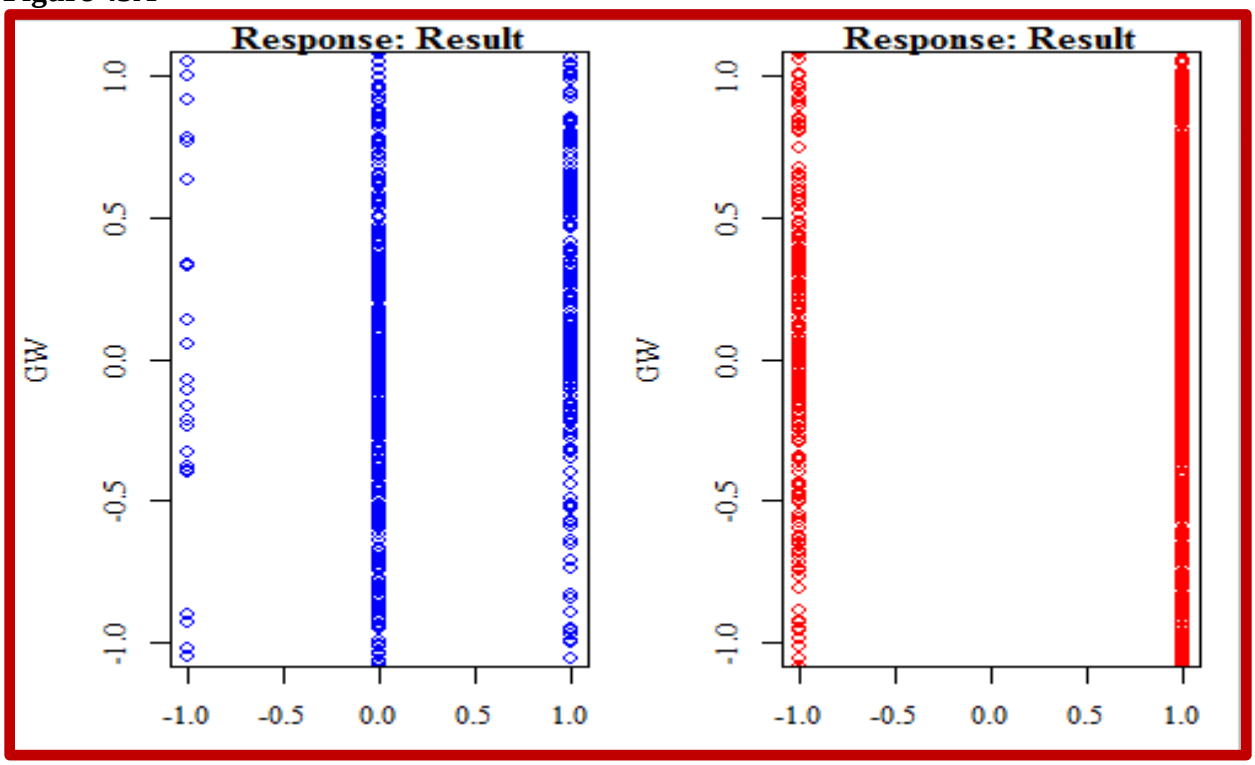


Figure 45B

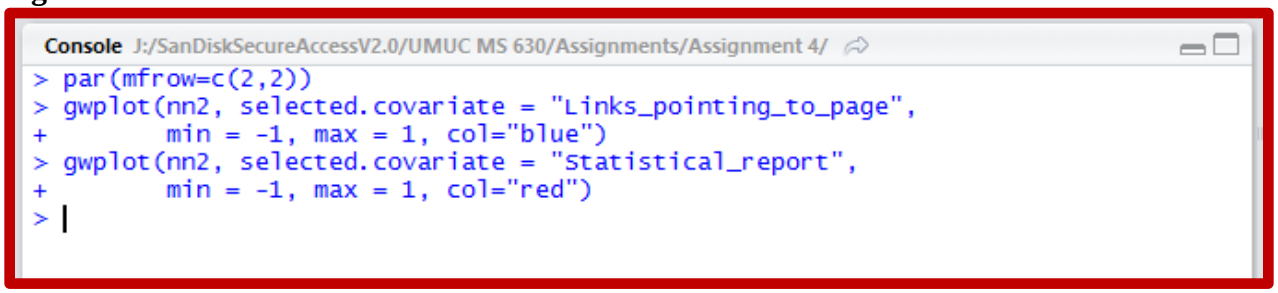
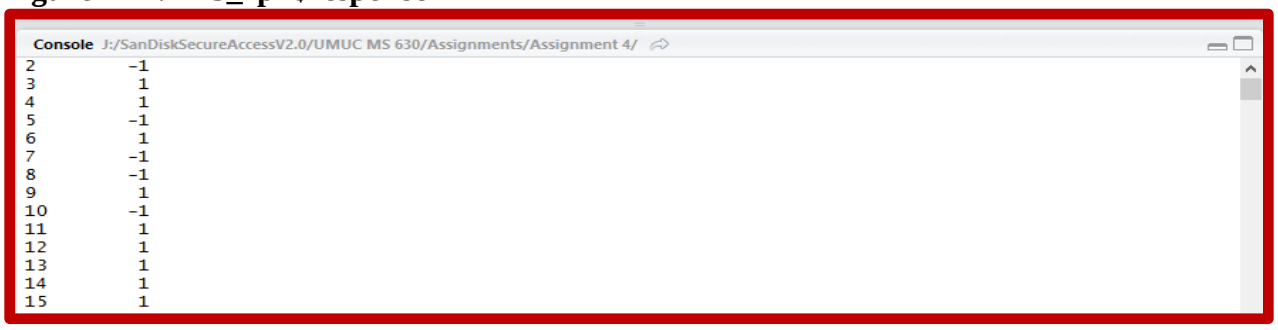


Figure 46A

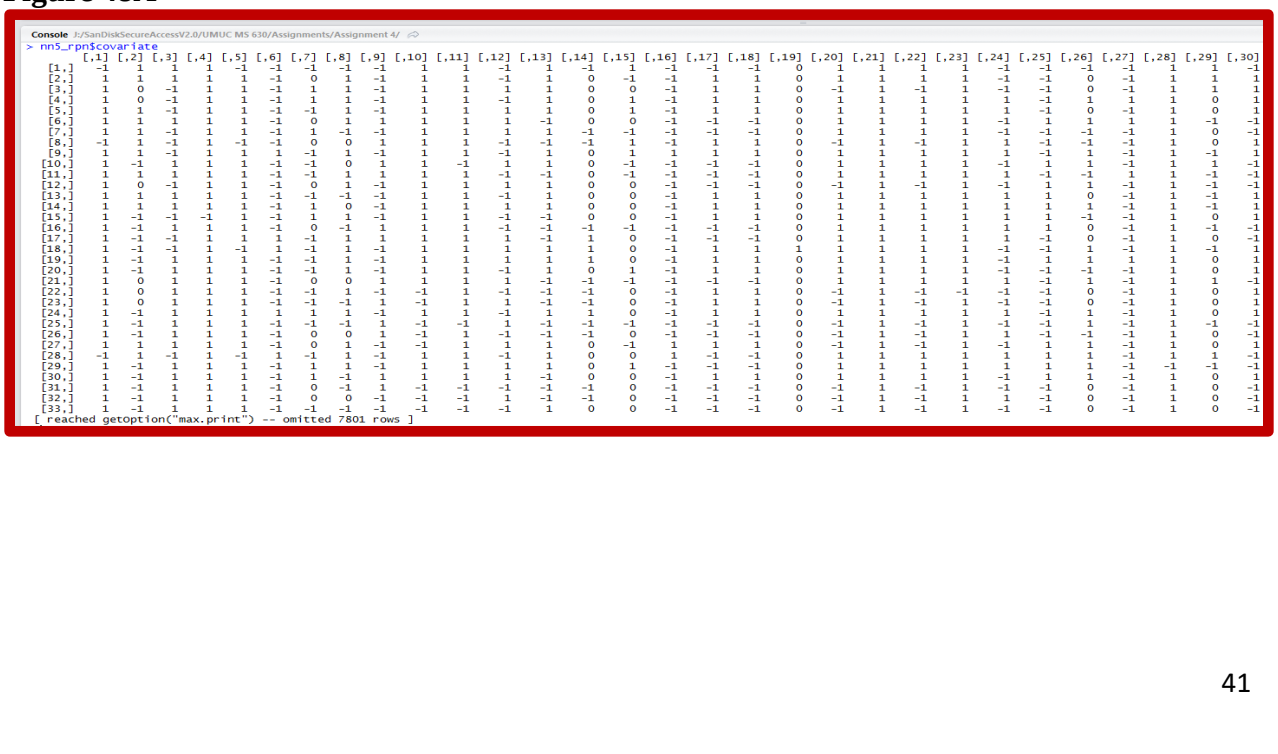
```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> nn5_rpn <- neuralnet(my.formula, data = train, hidden = c(10, 10),
+                      learningrate = 0.50,
+                      algorithm = "rprop-",
+                      linear.output = FALSE,
+                      stepmax = 100e5)
>
> names(nn5_rpn)
 [1] "call"                 "response"             "covariate"
 [4] "model.list"           "err.fct"              "act.fct"
 [7] "linear.output"        "data"                 "net.result"
[10] "weights"              "startweights"         "generalized.weights"
[13] "result.matrix"
> nn5_rpn$model.list
$response
[1] "Result"

$variables
 [1] "having_IP_Address"             "URL_Length"
 [3] "Shortining_Service"            "having_At_Symbol"
 [5] "double_slash_redirecting"      "Prefix_Suffix"
 [7] "having_Sub_Domain"             "SSLfinal_State"
 [9] "Domain_registeration_length"   "Favicon"
[11] "port"                          "HTTPS_token"
[13] "Request_URL"                   "URL_of_Anchor"
[15] "Links_in_tags"                 "SFH"
[17] "Submitting_to_email"           "Abnormal_URL"
[19] "Redirect"                      "on_mouseover"
[21] "RightClick"                    "popUpWidnow"
[23] "Iframe"                        "age_of_domain"
[25] "DNSRecord"                     "web_traffic"
[27] "Page_Rank"                     "Google_Index"
[29] "Links_pointing_to_page"        "Statistical_report"

>
```

Figure 47A: nn5_rpn$response



```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
2         -1
3          1
4          1
5         -1
6          1
7         -1
8         -1
9          1
10        -1
11         1
12         1
13         1
14         1
15         1
```

Figure 48A



```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> nn5_rpn$covariate
      [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10] [,11] [,12] [,13] [,14] [,15] [,16] [,17] [,18] [,19] [,20] [,21] [,22] [,23] [,24] [,25] [,26] [,27] [,28] [,29] [,30]
 [1,]   -1    1    1    1   -1   -1   -1   -1   -1    1    1   -1    1   -1    1   -1   -1   -1    0    1    1    1    1   -1   -1   -1   -1    1    1   -1
 [2,]    1    1    1    1    1   -1    0    1   -1    1    1   -1    1    0   -1   -1    1    1    0    1    1    1    1   -1   -1    0   -1    1    1    1
 [3,]    1    0   -1    1    1   -1    1    1   -1    1    1    1    1    0    0   -1    1    1    0   -1    1   -1    1   -1   -1    0   -1    1    1    1
 [4,]    1    0   -1    1    1   -1    1    1   -1    1    1   -1    1    0    1   -1    1    1    0    1    1    1    1    1   -1    1    1    1    0    1
 [5,]    1    1   -1    1    1   -1   -1    1   -1    1    1    1    1    0    1   -1    1    1    0    1    1    1    1    1   -1    0   -1    1    0    1
 [6,]    1    1    1    1    1   -1    0    1    1    1    1    1   -1    0    0   -1   -1   -1    0    1    1    1    1   -1    1    1    1    1   -1   -1
 [7,]    1    1   -1    1    1   -1    1   -1   -1    1    1    1    1   -1   -1   -1   -1   -1    0    1    1    1    1   -1   -1   -1    1    0    1   -1
 [8,]   -1    1   -1    1   -1   -1    0    0    1    1    1   -1   -1   -1    1   -1    1    1    0   -1    1   -1    1    1   -1   -1   -1    1    0    1
 [9,]    1    1   -1    1    1    1   -1    1   -1    1    1   -1    1    0    1    1    1    1    0    1    1    1    1    1   -1    1   -1    1   -1    1
[10,]    1   -1    1    1    1   -1   -1    0    1    1   -1    1    1    0   -1   -1   -1   -1    0    1    1    1    1   -1    1    1   -1    1    1   -1
[11,]    1    1    1    1    1   -1   -1    1    1    1    1   -1   -1    0   -1   -1   -1   -1    0    1    1    1    1   -1    1    1   -1    1   -1   -1
[12,]    1    0   -1    1    1   -1    0    1   -1    1    1    1    1    0    0   -1   -1   -1    0   -1    1   -1    1   -1   -1    1   -1    1   -1   -1
[13,]    1    1    1    1    1   -1   -1   -1   -1    1    1   -1    1    0    0   -1    1    1    0    1    1    1    1    1    1    0   -1    1   -1    1
[14,]    1    1    1    1    1   -1    1    0   -1    1    1    1   -1    0    0   -1    1    1    0    1    1    1    1    1    1    1   -1    1   -1    1
[15,]    1   -1   -1   -1    1   -1    1    1   -1    1    1   -1   -1    0    0   -1    1    1    0    1    1    1    1    1    1   -1   -1    1    0    1
[16,]    1   -1    1    1    1   -1    0   -1    1    1    1   -1   -1   -1   -1   -1   -1   -1    0    1    1    1    1    1    1    0   -1    1   -1   -1
[17,]    1   -1   -1    1    1    1   -1    1    1    1    1   -1    1    0   -1   -1   -1   -1    0    1    1    1    1    1   -1    0   -1    1    0   -1
[18,]    1   -1   -1    1   -1    1   -1    1   -1    1    1    1    1    1    0   -1    1    1    1    1    1    1    1   -1   -1    1   -1    1   -1    1
[19,]    1   -1    1    1    1   -1   -1    1   -1    1    1    1    1    1    0   -1    1    1    0    1    1    1    1   -1    1    1   -1    1    0    1
[20,]    1   -1    1    1    1   -1   -1    1    1    1   -1    1    1    0    1   -1    1    1    0    1    1    1    1   -1   -1   -1   -1    1    0    1
[21,]    1    0    1    1    1   -1    0    0    1    1    1    1   -1   -1   -1   -1   -1   -1    0    1    1    1    1    1   -1    1   -1    1    1   -1
[22,]    1    0    1    1    1   -1   -1    1   -1    1   -1   -1   -1   -1    0   -1    1    1    0   -1    1   -1   -1   -1   -1    0   -1    1    0    1
[23,]    1    0    1    1    1   -1   -1   -1    1   -1    1    1   -1   -1    0   -1    1    1    0   -1    1   -1    1   -1   -1    0   -1    1    0    1
[24,]    1   -1    1    1    1    1    1    0   -1    1    1   -1    1    1    0   -1    1    1    0    1    1    1    1   -1    1    1   -1    1    0    1
[25,]    1   -1    1    1    1   -1   -1   -1    1   -1   -1    1   -1   -1   -1   -1   -1   -1    0   -1    1   -1    1   -1   -1    1   -1    1   -1   -1
[26,]    1   -1    1    1    1   -1    0    0    1   -1    1   -1   -1   -1    0   -1   -1   -1    0   -1    1   -1    1    1   -1   -1   -1    1    0   -1
[27,]    1    1    1    1    1   -1    0    1   -1   -1    1    1    1    0   -1    1    1    1    0   -1    1   -1    1   -1    1    1   -1    1    0    1
[28,]   -1    1   -1    1   -1    1   -1    1   -1    1    1   -1    1    0    0    1   -1   -1    0    1    1    1    1    1    1    1   -1    1    1   -1
[29,]    1   -1    1    1    1   -1    1    1   -1    1    1    1    1    0    1   -1   -1   -1    0    1    1    1    1    1    1   -1   -1   -1   -1    1
[30,]    1   -1    1    1    1   -1    1   -1    1    1    1    1   -1    0    0   -1    1    1    0    1    1    1    1   -1    1    1   -1    1    0    1
[31,]    1   -1    1    1    1   -1    0   -1    1   -1   -1   -1   -1   -1    0   -1   -1   -1    0   -1    1   -1    1   -1   -1    0   -1    1    0   -1
[32,]    1   -1    1    1    1   -1    0    0   -1   -1   -1    1   -1   -1    0   -1   -1   -1    0   -1    1   -1    1   -1   -1    0   -1    1    0   -1
[33,]    1   -1    1    1    1   -1   -1   -1   -1   -1   -1    1    0    0   -1   -1   -1    0   -1    1   -1    1   -1   -1    0   -1    1    0   -1
[ reached getOption("max.print") -- omitted 7801 rows ]
```

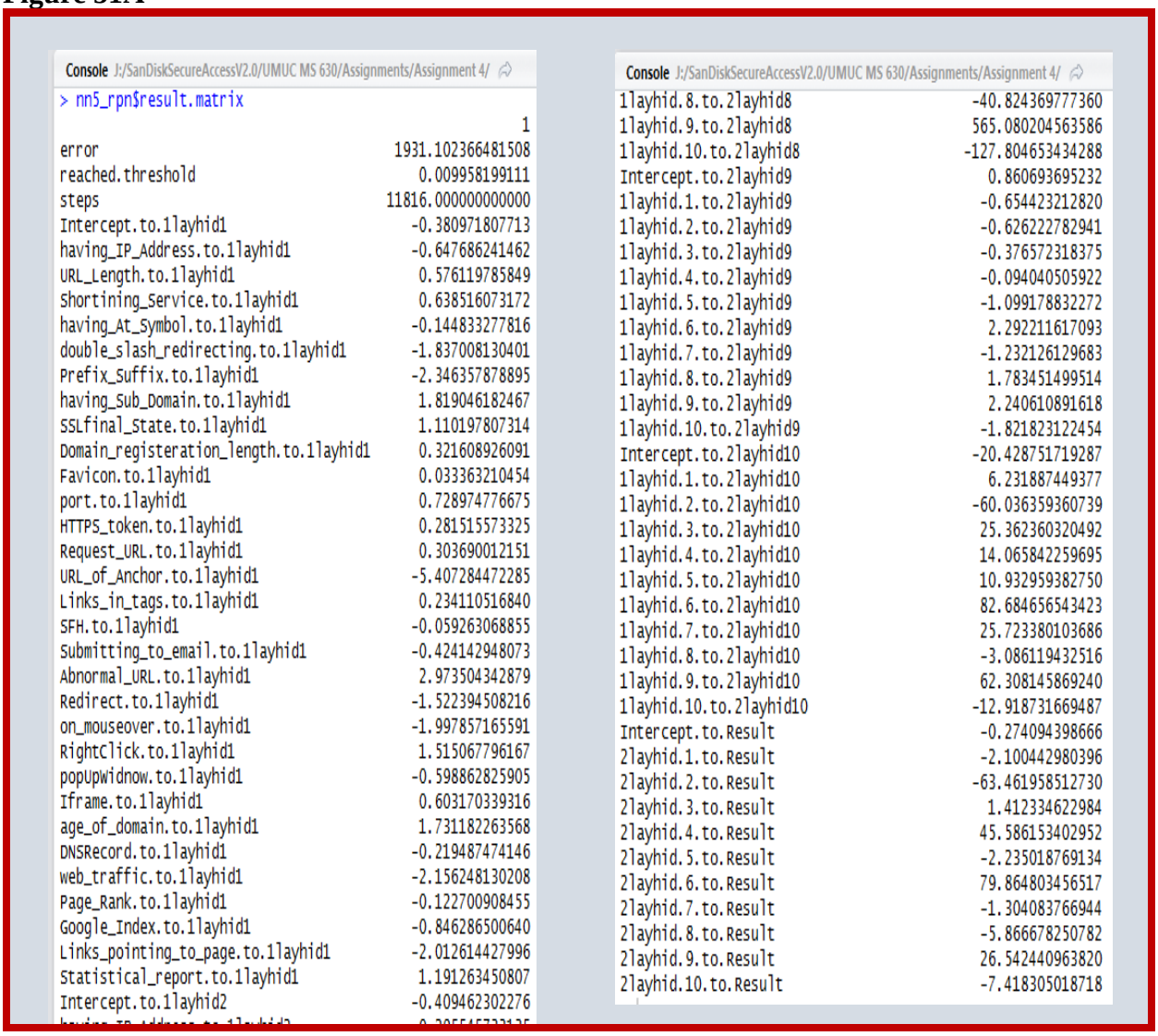
Figure 49A

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> nn5_rpn$weights
[[1]]
[[1]][[1]]
             [,1]           [,2]          [,3]          [,4]          [,5]          [,6]          [,7]           [,8]          [,9]         [,10]
 [1,] -0.38097180771 -0.409462302276  0.79707533611  0.04423655241 -0.70715784395 -0.50073780053 -0.37820786732  0.85308425119 -1.5341865423  1.06957680153
 [2,] -0.64768624146 -0.295545733135  0.03259325967 -1.46681496674 -0.90514027258  0.42722745891 -0.90046822872  0.07935857195 -0.9623100953 -1.29644072571
 [3,]  0.57611978585  0.515028521357  2.74909100559 -0.22595813294  0.50159941571  0.53612553750  0.15551363513  0.77052879033 -1.3140951753 -2.55220869977
 [4,]  0.63851607317 -0.009407197163  0.96884399112  1.25796791432  1.02850197077  0.10381718218  0.47051563222 -0.71969299039 -0.7015689838 -2.19341842682
 [5,] -0.14483327782 -0.910621078242  0.06042306909 -0.65589688520 -0.70011726790  0.56902340330 -0.11557106010 -1.08537498010  0.5880625610  0.33234217143
 [6,] -1.83700813040 -2.074501600862 -1.61063786180  1.34946595316 -0.97252410066  0.77022329561  0.82047287003  1.27360333083 -0.6299246210 -0.73305504817
 [7,] -2.34635787890 -2.053629745012 -1.76742605306 -6.30564386462 -0.59713026648  0.83692389707 -2.86208775161  0.10978241245  0.9366655217 -3.66503865075
 [8,]  1.81904618247 -0.854029429827 -2.86912680202 -3.51115622750 -2.20520016232  2.57184337509  1.58462924739  0.58185370609  0.5157001443 -1.13868926099
 [9,]  1.11019780731 -6.171401290384 -2.49316718270  1.87545194080  1.66399046241  2.63321211315 -2.74406409604  1.03154426478  1.7995785100 -0.60579609220
[10,]  0.32160892609  2.379765428665  1.47727225396  0.49508161483 -1.54977466047  0.01398116894  0.33553453305  0.60452843568 -0.8141501384 -1.40975023556
[11,]  0.03336321045  0.403823426775  0.55936594675 -1.21759459701 -0.42096954934 -0.22617291996  1.92174598048  1.20129601452  0.7872810346 -0.02077563821
[12,]  0.72897477667 -1.166733427329 -1.04281373229  1.24576605109  0.59492891881  0.35779999765 -0.10781574292  1.05099732238  0.1399806651  1.20070746652
[13,]  0.28151557333  1.873019519207  0.19348171038  0.08384173485 -0.19858235969 -1.32810574362 -0.34028363487  0.88529565594 -1.0465640521  1.56824442575
[14,]  0.30369001215 -0.866177834280 -0.74307738907 -1.84611175874  0.33634457549 -0.11707647627  0.61301851316  0.43726940938  0.8213929630 -0.76604482241
[15,] -5.40728447228 -0.966139413222 -1.32608498675 -4.88097133738 -4.28405494751  0.85741559139  0.78568296487 12.65378780798  0.4533474587  1.99188391371
[16,]  0.23411051684 -3.597233363285 -4.78852999404  0.39714144308  1.76378679010 -0.01728054243  0.23602574468  2.17108673944  0.8694081040 -0.96604267996
[17,] -0.05926306885 -2.965935202193 -2.29007777223 -2.33722167468 -0.97468723256  0.88134957921 -0.09727223078 -1.27906042284  2.8594954431 -1.02996699340
[18,] -0.42414294807 -2.499559093635 -1.24333851318 -0.92490151163  1.25194246027 -2.12106411186 -0.89168797708 -0.14599024232 -1.4890088392 -0.05109072035
[19,]  2.97350434288  1.298153088434 -2.67329411550 -0.22576744272 -0.43060209599 -0.23641622963 -0.03833133766 -0.34386042826 -0.2268551352  0.34373350122
[20,] -1.52239450822 -1.936173079695  4.46073283569 -3.57082426244 58.58063746326 -1.40605122404 -0.67753385723  1.58001240556  1.4034093105  6.10123697932
[21,] -1.99785716559  1.148071256712 -1.43029299933  2.45977946272  0.52571589612  0.82767151170 -1.33984865284  0.39781840612 -2.3394950476 -0.36013178290
[22,]  1.51506779617 -4.745895261668  1.29673561627 -1.14179491197  2.07675537054 -0.92843222770  0.03994916891 -0.80893734007  0.5943874930 -1.51211755007
[23,] -0.59886282591  2.722867156160 -1.09624810990 -0.36259756734  0.68306523781 -0.63012349237  0.31326004388 -0.40185795579  0.1954762942  0.46516186733
[24,]  0.60317033932 -1.260395564089  0.39251564941 -0.95997069690  0.16800286922 -0.91877921216  0.84029624574  0.12989185412  0.6299581734  0.72824463390
[25,]  1.73118226357  1.171636256152 -1.38637357085 -2.30239607400  0.93631913828  0.74954330155 -0.79991884947  1.42994668909 -2.4695608634  0.65947505557
[26,] -0.21948747415  1.430192748011 -1.13038056137  3.62936335168 -1.66285204958 -0.14061990152 -1.34104329059  0.26255181603 -0.8576098769 -1.17390664036
[27,] -2.15624813021  0.117170592198 -0.03149465375 -6.10193041068  4.81380762454  0.99049424041  1.37993564914  0.39667844120 -0.1283219094 -8.58687450952
[28,] -0.12270090845  1.114471158449  2.54484313458 -4.40882913972  1.87545243039  0.77461531759 -1.03222841613 -0.24933407197 -1.3601408221 -1.44791526354
[29,] -0.84628650064 -1.442271938291  1.23700412029 -0.19491858542 -1.30892639236  0.70802971991  0.58652518003  0.12636071752 -0.3406604068 -0.81307043094
[30,] -2.01261442800  2.680305954534 -1.15796868312 -9.42890947691 -0.09875377428 -0.43815432143 -2.32523069879  0.34303393069 -0.2056096209  0.69388806087
[31,]  1.19126345081 -2.131425257687 -2.43256008785 -0.06143714127 -0.65409543795  0.15329731535  0.58326470540  0.53579948438  0.5623677872 -0.76825588101

[[1]][[2]]
            [,1]          [,2]          [,3]          [,4]          [,5]          [,6]          [,7]          [,8]          [,9]         [,10]
 [1,] -0.3765691898 -0.5856725553 -0.1470641262  1.0589275836 -0.7681370765  1.1761757229 -5.8962203824  -23.990980424  0.86069369523 -20.428751719
 [2,]  0.9209778050  1.4661039732 -0.9862174207 -0.8254346423  1.4622623149 -0.5341583530 -6.2601294092   63.609623103 -0.65442321282   6.231887449
 [3,]  7.4173620246  2.6587371652 -1.8446328867 -1.4617287662  6.9359239246 -1.7934308058  9.2205480549 -349.158509510 -0.62622278294 -60.036359361
 [4,]  4.5764483546  2.1606285629 -3.2415389582 -0.3845215252  5.3873815540 -0.6678207474 -3.2313838877 -312.672752578 -0.37657231838  25.362360320
 [5,] -1.2749480942  0.3789775506 -0.8065246078 -0.6142112211 -0.3221982333 -1.4098776189  1.3155664249   -2.210297177 -0.09404050592  14.065842260
 [6,]  0.4098176686 -0.3211351866 -0.1185851607 -0.3844905625 -0.4858617861 -2.1285491723 20.6879077512   38.274657859 -1.09917883227  10.932959383
 [7,] -1.0850304992 -3.2498768676  0.5637162177  1.4703037383  0.4039539953  1.6249987213  7.9938985602  222.711254638  2.29221161709  82.684656543
 [8,]  0.8629737541  1.7600219946 -0.6885365526 -2.3138720310  1.6582072446 -0.8480087541  0.9347311118  555.886579779 -1.23212612968  25.723380104
 [9,] -0.6847853007 -2.3354613995  2.3845972338  1.8558949128 -0.6492030211  2.6154149452 -2.3989533532  -40.824369777  1.78345149951  -3.086119433
[10,] -4.6718184205  0.1693301247  8.7487212766  1.9865862196  5.5954644018  3.0501848922 -7.0213121648  565.080204564  2.24061089162  62.308145869
[11,]  2.1440487155  1.5799528436 -0.5429029498 -0.5389913077 -0.5737895857 -1.1013123893  2.1450665338 -127.804653434 -1.82182312245 -12.918731669

[[1]][[3]]
             [,1]
 [1,]  -0.2740943987
 [2,]  -2.1004429804
 [3,] -63.4619585127
 [4,]   1.4123346230
 [5,]  45.5861534030
 [6,]  -2.2350187691
 [7,]  79.8648034565
 [8,]  -1.3040837669
```

Figure 50A

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> nn5_rpn$startweights
[[1]]
[[1]][[1]]
             [,1]           [,2]           [,3]           [,4]           [,5]            [,6]            [,7]           [,8]            [,9]          [,10]
 [1,] -0.01706975989  0.60265580980  0.87073200841 -0.23045624738 -0.90915282602 -0.985649924837 -0.156349538638  0.50635663914 -1.358575208987  1.03462820817
 [2,] -0.09838048503 -1.21637373751  0.86502426729 -0.05832530071 -0.02330390267  0.739691982313 -1.509997897168  0.82863134297 -1.990265362446 -0.77796208360
 [3,]  0.29909164895 -1.10782136041  1.38184512543  0.36853077350  0.54214772478  0.798145658275 -0.002749022197  1.12958864561 -0.324046530449 -0.91536311173
 [4,] -0.44492154821 -0.38468625545  0.68311626158  0.85240262410  0.82639312102  0.684523717265  0.153069714109 -0.74416191146  1.129612121686 -2.22836669803
 [5,]  0.22631992652  0.32515980702  0.13685065504  1.32069730442  0.13208362884  0.094512868653 -0.101606709390 -1.90817731094  0.265412651958  0.96984780081
 [6,] -1.71365748319  0.24831635839 -0.76154078963  1.26460198085 -1.17428243242  1.327163740056  0.719879893394  1.22931279600 -0.036573424428 -0.77045852868
 [7,] -0.97557096490  0.03777244681 -0.95364354784 -1.50864231265  0.13855941792  0.008302558064 -2.160574709706 -0.54188786264 -0.997915070099 -1.44021869964
 [8,] -0.26025213418 -0.16831017383 -0.71213268619  0.42400691159 -0.05674993734  1.017322977499  0.193790226764 -0.78529536189 -0.849314552499  0.94609765256
 [9,]  1.65344650330 -1.17206986429 -0.06237323300  0.91354502437  0.42685836325  1.598367625856 -1.078549845622  0.22079150818 -0.768274199460  0.92511523293
[10,]  0.37793984089  0.33748331464  0.94537662487 -0.07909658531 -1.48288075055 -1.009995553296 -0.656022624097  0.77953372680  0.016332938065 -1.63482836826
[11,]  0.24050113029 -0.05980052127  0.42997399337  0.34682876413 -0.85614242027 -0.711316389980  1.930603672735  0.44045040403  0.951140453634  0.15600062919
[12,]  0.93872478725 -0.37217563890 -0.80175412838  2.50517355460  0.83124980413  0.025907767186 -0.117098043294  0.97426266613  0.377491644168  1.06961404005
[13,]  0.99165348075  1.28219439998  0.27927545871 -0.07913096935  0.03546392374 -1.036729185046 -0.567765670309  0.53259953841  0.607610230625  1.86040805820
[14,]  0.33600169168 -1.63115410386 -0.40779312973  1.06946351188 -0.09930781420 -0.056357930607 -0.481501361841  0.31614717782  0.399142778013 -0.55063110545
[15,] -1.96754281037  1.02793926648  0.86663848077  1.21408822776  0.63924155349  0.434725582448  0.927282749917  1.67508631590  0.065696086304  1.58306648452
[16,]  0.92981284205 -2.46084011755 -1.54645079808  1.29614762568  0.45164291174  0.789413047065 -1.434967371405 -0.06036335797 -0.076059776121  0.09275235540
[17,]  0.72563956241 -1.17076528211 -1.20961111796 -1.72675452762 -0.23322572004  0.530397782701 -0.331441573074 -0.92044846358  1.799937178341 -0.37105993049
[18,] -0.81684443533 -1.88126988587 -0.44771130092  0.26301327297  0.55790975269  0.350062582669 -1.662359443305 -0.17006249450  1.492480579622 -0.30232387815
[19,]  1.95475005086  0.15654622376 -2.48542344454  0.03224716377 -0.62610775516  0.568570858636 -0.483089558290 -0.38512393726  0.263109611521  0.30770406819
[20,] -0.24728237287 -0.32646689721 -0.37143251003  0.56152169681  1.48063746326  1.326754237895  2.158017711376  1.96008925160 -0.513716304327  0.03449071815
[21,] -1.68572208205  1.43027482928 -1.10596039493  1.29716249672  0.27959113634  0.122866458579 -1.526899132532  0.31295658180 -0.748925478682 -0.98005519034
[22,]  1.79508953543 -1.12218559864  1.37052980076 -0.77045388036  1.95755858399 -1.610485348899  0.212406511513 -1.13896038790  0.684908738991 -1.54450089672
[23,] -0.61986174325  1.06695110493 -1.17731929644  0.20419342220 -0.55490714189 -0.773459753072 -0.798162330073 -0.37039530968  0.665684421401 -0.13161412198
[24,]  0.77322435827 -0.12421736715  0.46521066902 -0.42568398466 -0.19271896172 -1.403810490761  0.937965617927 -0.34749206706  0.155952112147  0.65686765844
[25,]  2.43978315928 -0.11287045078  0.02803763149 -0.68443799557  0.83448767677  2.037620641566 -0.168258851892 -0.36674879851 -0.947139441368 -0.19563542485
[26,]  0.39308318500 -0.14221935605 -0.12146546173  0.58231652827 -0.68718458811 -0.329825924656 -0.932001988246 -0.71539085442 -0.952514955130 -1.97629298617
[27,]  0.27575239949 -0.86247469543  1.94122613102  0.12773055769  0.58018578259 -0.024673867659  2.024915458684 -0.59230704051 -1.557527697296 -0.45261338033
[28,] -0.46071834685 -0.51779718246  1.24709226230  0.24399156255  1.23791360927 -1.059299372050 -1.297166658995 -0.62411107776  0.065714816261  1.31490501831
[29,]  0.08440229557  0.58926541277  2.01064382515  1.59385776721  0.56917930623 -0.366862255019  0.103667866899 -0.02856648484 -1.240776849629  0.81283263789
[30,] -1.25689783726  2.11131725677 -1.49791628700  1.08928962534 -0.60775884179  2.037094586459 -1.866204135456 -0.51182206976  0.195213820150 -1.21395103633
[31,]  1.36046752698 -1.11641113107 -2.35925025411  0.69688174677 -0.67429971009 -0.474049180822  0.533757947063  0.69950008343 -0.004515326026 -0.94435944882

[[1]][[2]]
             [,1]           [,2]          [,3]          [,4]          [,5]           [,6]          [,7]           [,8]           [,9]          [,10]
 [1,] -0.40656174918 -1.01307240200 -0.1696768311  1.2777044048 -0.4313171515  1.31019843756  1.3350769569 -0.13738942531  0.78617500093  1.03166522810
 [2,] -0.21131215535 -0.58575550215 -0.1115470895 -0.1739933857  0.5713600952  0.50423718890 -0.2461160670  0.03431328948 -0.32252776651  0.85079367539
 [3,]  1.22538126033 -2.60086178484  1.8367279847  1.6647883263  1.1791935739  0.16450832460 -0.9238183034 -0.04201383614 -0.04598144049 -1.33368292651
 [4,] -0.29776732103  0.89345826998  0.4976826402  0.2208477141  1.3509235921 -1.14533902150  0.2162467495 -0.32494761956 -1.13662116681  1.36068528587
 [5,] -1.63484501730 -0.09987314885 -0.8241470143 -0.2518837921 -0.2016764030 -1.27362485231  1.0833847011  0.95993673268  0.40411209004  0.69921258165
 [6,] -0.04364255114 -1.79361164398  2.2546467829 -0.3648744614 -0.6769370642 -1.64333069532  1.7735833486 -0.58391829378 -0.93691938589 -0.50957437151
 [7,] -0.33939985992 -1.46567286656 -0.9903669681 -0.1040917320 -0.6773208943  0.57321819316  0.8505084408  0.69545041304 -0.04523502153 -0.35435441807
 [8,] -0.42006369816 -2.45793883133  0.5184428742 -1.4300107453  0.5228648360  0.47996918369  0.3488662343  0.23680864774 -0.16655510700 -0.02755493451
 [9,]  0.93648630448 -0.87378505056  0.9313690238  0.8413133204  1.1720388552  1.93888230636  0.5761178689  1.36012084264  0.86519546609  0.44751752998
[10,]  0.56739443178 -0.23807968363  0.8366423361  0.9333684837  0.3448687778  2.29028155483 -0.8548347855 -0.27275389681  1.11308575403  1.24148735736
[11,]  0.41768654074 -1.17441239480 -0.1623605929  0.4752047801  0.7889492869  0.01474905164  0.5143279358  0.68641691415 -1.30832995141 -0.68743052462

[[1]][[3]]
             [,1]
 [1,] -0.10986340222
 [2,] -0.47999357750
 [3,] -1.55543206932
 [4,]  0.43020689806
 [5,]  1.57174571786
 [6,] -1.00446527975
 [7,]  1.08922820976
 [8,]  0.07478125680
```

Figure 51A



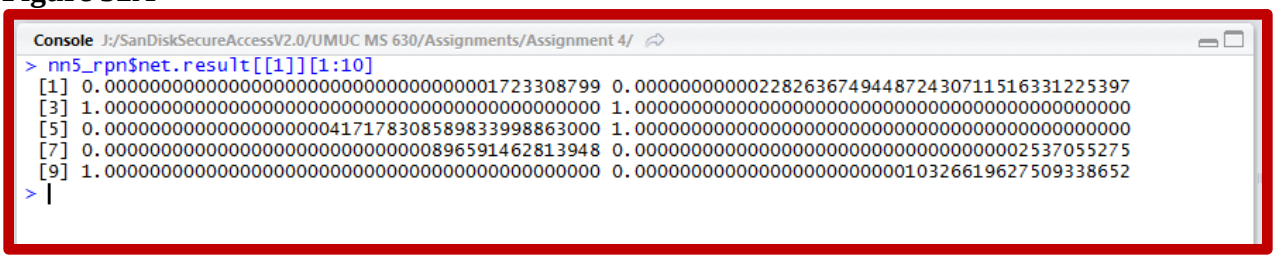
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/

```
> nn5_rpn$result.matrix
                                                                1
error                                          1931.102366481508
reached.threshold                                 0.009958199111
steps                                         11816.000000000000
Intercept.to.1layhid1                            -0.380971807713
having_IP_Address.to.1layhid1                    -0.647686241462
URL_Length.to.1layhid1                            0.576119785849
Shortining_Service.to.1layhid1                    0.638516073172
having_At_Symbol.to.1layhid1                     -0.144833277816
double_slash_redirecting.to.1layhid1             -1.837008130401
Prefix_Suffix.to.1layhid1                        -2.346357878895
having_Sub_Domain.to.1layhid1                     1.819046182467
SSLfinal_State.to.1layhid1                        1.110197807314
Domain_registeration_length.to.1layhid1           0.321608926091
Favicon.to.1layhid1                               0.033363210454
port.to.1layhid1                                  0.728974776675
HTTPS_token.to.1layhid1                           0.281515573325
Request_URL.to.1layhid1                           0.303690012151
URL_of_Anchor.to.1layhid1                        -5.407284472285
Links_in_tags.to.1layhid1                         0.234110516840
SFH.to.1layhid1                                  -0.059263068855
Submitting_to_email.to.1layhid1                  -0.424142948073
Abnormal_URL.to.1layhid1                          2.973504342879
Redirect.to.1layhid1                             -1.522394508216
on_mouseover.to.1layhid1                         -1.997857165591
RightClick.to.1layhid1                            1.515067796167
popUpWidnow.to.1layhid1                          -0.598862825905
Iframe.to.1layhid1                                0.603170339316
age_of_domain.to.1layhid1                         1.731182263568
DNSRecord.to.1layhid1                            -0.219487474146
web_traffic.to.1layhid1                          -2.156248130208
Page_Rank.to.1layhid1                            -0.122700908455
Google_Index.to.1layhid1                         -0.846286500640
Links_pointing_to_page.to.1layhid1               -2.012614427996
Statistical_report.to.1layhid1                    1.191263450807
Intercept.to.1layhid2                            -0.409462302276
```

Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/

```
1layhid.8.to.2layhid8                            -40.824369777360
1layhid.9.to.2layhid8                            565.080204563586
1layhid.10.to.2layhid8                          -127.804653434288
Intercept.to.2layhid9                             0.860693695232
1layhid.1.to.2layhid9                            -0.654423212820
1layhid.2.to.2layhid9                            -0.626222782941
1layhid.3.to.2layhid9                            -0.376572318375
1layhid.4.to.2layhid9                            -0.094040505922
1layhid.5.to.2layhid9                            -1.099178832272
1layhid.6.to.2layhid9                             2.292211617093
1layhid.7.to.2layhid9                            -1.232126129683
1layhid.8.to.2layhid9                             1.783451499514
1layhid.9.to.2layhid9                             2.240610891618
1layhid.10.to.2layhid9                           -1.821823122454
Intercept.to.2layhid10                          -20.428751719287
1layhid.1.to.2layhid10                            6.231887449377
1layhid.2.to.2layhid10                          -60.036359360739
1layhid.3.to.2layhid10                           25.362360320492
1layhid.4.to.2layhid10                           14.065842259695
1layhid.5.to.2layhid10                           10.932959382750
1layhid.6.to.2layhid10                           82.684656543423
1layhid.7.to.2layhid10                           25.723380103686
1layhid.8.to.2layhid10                           -3.086119432516
1layhid.9.to.2layhid10                           62.308145869240
1layhid.10.to.2layhid10                         -12.918731669487
Intercept.to.Result                              -0.274094398666
2layhid.1.to.Result                              -2.100442980396
2layhid.2.to.Result                             -63.461958512730
2layhid.3.to.Result                               1.412334622984
2layhid.4.to.Result                              45.586153402952
2layhid.5.to.Result                              -2.235018769134
2layhid.6.to.Result                              79.864803456517
2layhid.7.to.Result                              -1.304083766944
2layhid.8.to.Result                              -5.866678250782
2layhid.9.to.Result                              26.542440963820
2layhid.10.to.Result                             -7.418305018718
```

Figure 52A



Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/

```
> nn5_rpn$net.result[[1]][1:10]
 [1] 0.00000000000000000000000000000000001723308799 0.00000000000228263674944872430711516331225397
 [3] 1.00000000000000000000000000000000000000000000 1.00000000000000000000000000000000000000000000
 [5] 0.00000000000000000000417178308589833998863000 1.00000000000000000000000000000000000000000000
 [7] 0.00000000000000000000000000000000896591462813948 0.00000000000000000000000000000000002537055275
 [9] 1.00000000000000000000000000000000000000000000 0.00000000000000000000000010326619627509338652
>
```

Figure 53A

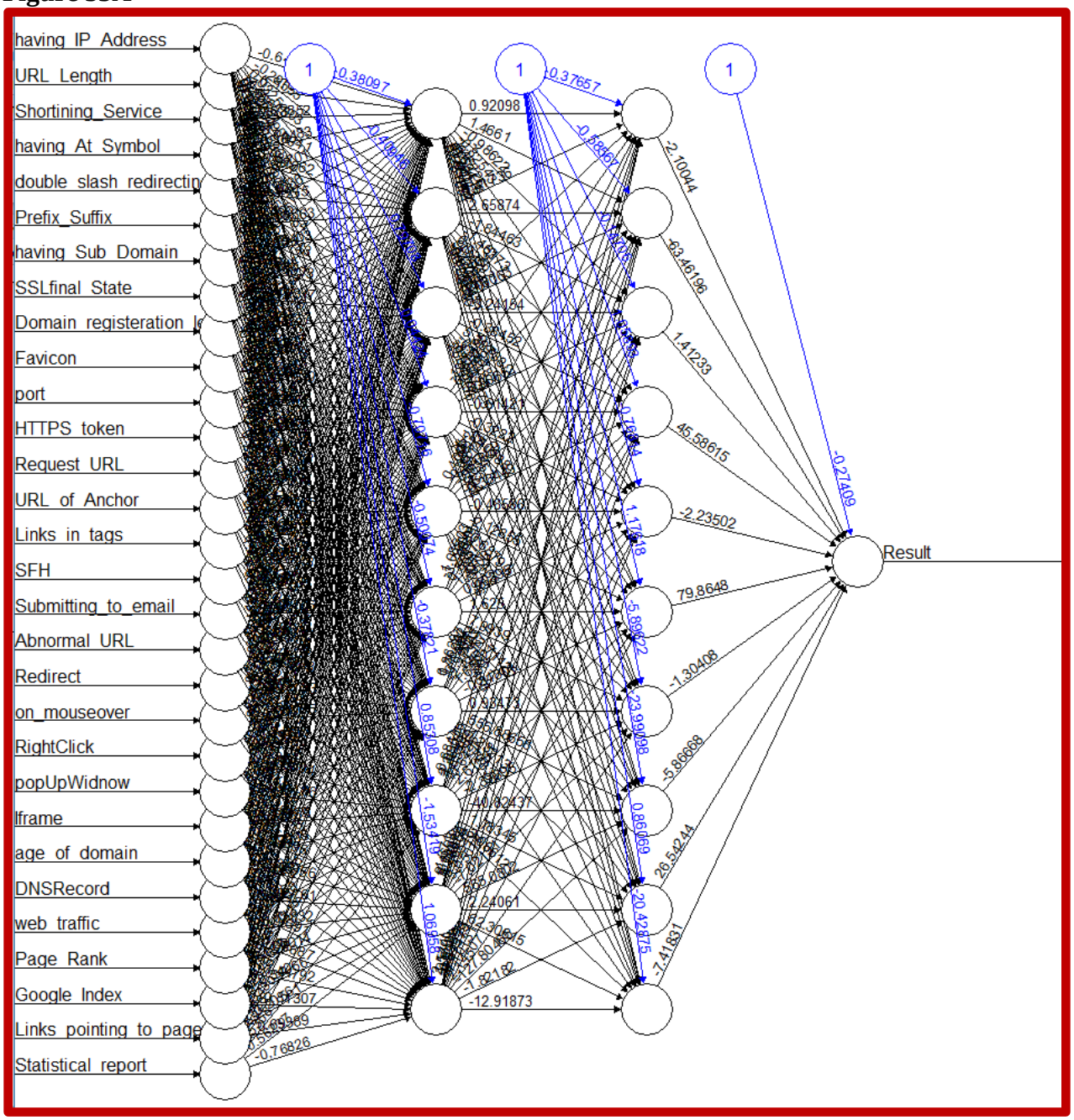

having_IP_Address
URL_Length
Shortining_Service
having_At_Symbol
double_slash_redirecting
Prefix_Suffix
having_Sub_Domain
SSLfinal_State
Domain_registeration_le
Favicon
port
HTTPS_token
Request_URL
URL_of_Anchor
Links_in_tags
SFH
Submitting_to_email
Abnormal_URL
Redirect
on_mouseover
RightClick
popUpWidnow
Iframe
age_of_domain
DNSRecord
web_traffic
Page_Rank
Google_Index
Links_pointing_to_page
Statistical_report
1
1
1
0.38097
0.37657
-0.27409
Result

Figure 54A

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> mypredict5<-compute(nn5_rpn, nn5_rpn$covariate)$net.result
> mypredict5<-apply(mypredict5, c(1), round)
>
> mypredict5
   [1] 0 0 1 1 0 1 0 0 1 0 0 1 0 1 1 0 1 1 1 1 0 0 0 1 0 0 1 1 1 0 0 0 0 0 0 1 0 0 1 0 1 0 0 1 0 1
  [47] 0 1 1 1 1 1 0 0 1 0 1 1 0 1 0 0 0 0 1 0 1 0 1 0 1 1 0 1 0 0 1 1 0 1 1 0 1 1 1 1 1 0 0 1 0 1 0 1
  [93] 0 1 0 0 0 0 0 0 0 0 1 1 1 1 1 0 0 0 0 1 0 1 0 0 1 1 0 1 1 1 0 1 0 1 1 1 1 1 0 0 0 1 1 0 1 0 0
 [139] 0 1 0 0 1 0 1 1 1 0 0 1 1 1 0 1 1 0 1 0 1 1 0 1 0 1 1 0 0 1 1 0 0 1 1 1 1 0 1 1 0 1 0 1 0 0
 [185] 0 0 1 0 1 1 1 0 1 0 1 1 0 1 1 1 1 1 1 0 1 0 1 1 0 0 1 0 1 1 1 0 1 1 0 1 1 0 1 1 1 1 0 0 1 1 1
 [231] 0 1 1 1 1 1 0 1 1 1 1 1 0 1 1 1 1 1 1 1 0 0 0 1 0 1 1 1 1 1 1 1 1 0 1 0 1 1 1 1 0 0 0 1 1 0 1 1 1
 [277] 0 1 0 1 1 0 1 1 0 1 1 1 1 1 1 1 0 1 1 1 1 1 1 1 0 1 1 1 0 0 0 1 1 1 0 0 1 1 1 1 1 1 1 0 1 1 0 0 1
 [323] 0 1 0 1 0 0 0 0 0 0 1 1 0 1 1 0 0 1 1 0 0 1 1 0 1 0 0 1 1 1 0 0 1 1 0 1 1 1 1 1 1 1 1 0 0 0
 [369] 1 1 1 0 0 1 0 0 0 0 0 0 0 1 1 0 0 0 0 1 1 1 1 0 1 1 1 1 1 1 0 1 1 1 1 1 1 0 1 1 1 0 0 1 1 0 0 0 1 1
 [415] 0 1 1 1 1 1 1 1 1 0 1 1 0 1 1 1 1 1 1 1 0 1 1 0 0 0 0 1 1 1 0 0 0 0 0 0 1 1 1 0 1 1 1 0 0 0 1
 [461] 1 0 1 0 1 0 0 0 0 1 0 1 0 0 0 0 1 0 1 1 1 1 1 1 0 1 1 0 0 1 1 1 1 1 1 0 1 1 1 0 1 0 0 0 0 1 0 1
 [507] 0 0 1 0 0 1 0 0 1 1 0 1 0 0 0 0 1 1 0 0 1 0 1 0 1 1 0 1 0 0 1 0 0 0 1 1 1 1 0 0 1 1 0 0 1 1 1
 [553] 1 1 0 0 1 0 0 1 1 1 0 0 1 0 0 0 1 0 0 1 1 0 0 1 0 1 0 0 1 1 0 1 0 1 0 0 1 0 1 1 1 1 0 1 1 0
 [599] 1 0 0 1 0 0 1 1 1 1 1 1 1 1 0 1 0 1 0 1 1 0 0 1 1 0 0 1 1 1 1 1 1 1 0 0 1 0 1 1 0 1 1 0 1 0 1
 [645] 0 0 1 0 0 0 0 1 1 0 0 1 0 0 0 1 0 1 1 0 0 0 1 0 0 0 1 1 1 0 0 1 0 0 1 1 1 1 1 1 0 1 0 1 0 1
 [691] 1 0 0 1 1 1 1 1 0 1 0 1 0 0 0 0 1 0 0 1 1 1 1 1 0 1 0 1 0 1 1 1 1 1 0 0 0 0 1 0 1 1 1 1 0 1 1
 [737] 0 0 0 1 1 1 0 1 1 0 0 1 1 0 1 0 0 1 0 0 0 0 0 0 1 1 1 0 1 0 1 1 1 0 1 1 0 1 1 0 1 1 1 0 0 0 0
 [783] 0 0 0 1 0 0 0 1 0 0 1 0 0 1 1 0 1 0 1 1 1 0 0 0 0 0 1 0 0 0 1 1 1 1 0 1 1 1 0 0 1 0 0 1 1 1
 [829] 1 1 1 1 1 0 0 0 1 1 1 0 0 1 1 1 0 0 1 1 0 1 0 0 1 0 1 1 1 1 0 1 0 0 0 0 1 0 0 0 1 0 1 0 0 0
 [875] 0 0 1 0 1 1 0 1 0 1 0 0 0 1 1 0 0 1 0 1 0 0 1 0 1 0 1 1 0 1 1 0 1 1 1 1 1 1 1 0 0 0 1 1 0 0
 [921] 1 0 0 1 0 0 0 0 0 1 1 1 0 0 1 0 1 0 1 1 0 1 1 1 1 1 1 0 0 1 0 1 1 0 1 0 0 0 0 0 0 1 0 1 0 0 1 0
 [967] 1 1 1 0 1 1 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 1 1 1 0 1 0 0 1 0 1 1 0 1
 [ reached getOption("max.print") -- omitted 6834 entries ]
>
> ##Confusion Marix for Training Set
> table(mypredict5, train$Result)

mypredict5   -1    1
         0 3416  242
         1   53 4123
> table(mypredict5, train$Result, dnn=c("predicted", "actual"))
         actual
predicted   -1    1
        0 3416  242
        1   53 4123
> sum(mypredict5 == train$Result)/length(train$Result)
[1] 0.5262956344
> ## Confustion Matrix for Test Set
> ## Evaluation of model on test data
> cpreds5 <- compute(nn5_rpn, test[ , !names(test) %in% c('Result')])
>
>
> cpreds5 <- apply(cpreds5$net.result, 1, round)
> ## table(cpreds5, test$class)
> table(cpreds5, test$Result, dnn=c("predicted", "actual") )
         actual
predicted   -1    1
        0 1383  127
        1   46 1665
> sum(cpreds5 == test$Result)/length(test$Result)
[1] 0.5169202111
>
```

Figure 55A

```
Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> nn6_bp <- neuralnet(my.formula, data = train, hidden = 2,
+                     learningrate = 0.01,
+                     algorithm = "sag",
+                     linear.output = FALSE,
+                     stepmax = 100e5)

> nn6_bp <- neuralnet(my.formula, data = train, hidden = 2,
+                     learningrate = 0.01,
+                     algorithm = "backprop",
+                     linear.output = FALSE,
+                     stepmax = 100e5)
> names(nn6_bp)
 [1] "call"                "response"            "covariate"
 [4] "model.list"          "err.fct"             "act.fct"
 [7] "linear.output"       "data"                "net.result"
[10] "weights"             "startweights"        "generalized.weights"
[13] "result.matrix"
> nn6_bp$call
neuralnet(formula = my.formula, data = train, hidden = 2, stepmax = 10000000,
    learningrate = 0.01, algorithm = "backprop", linear.output = FALSE)
> nn6_bp$model.list
$response
[1] "Result"

$variables
 [1] "having_IP_Address"           "URL_Length"
 [3] "Shortining_Service"          "having_At_Symbol"
 [5] "double_slash_redirecting"    "Prefix_Suffix"
 [7] "having_Sub_Domain"           "SSLfinal_State"
 [9] "Domain_registeration_length" "Favicon"
[11] "port"                        "HTTPS_token"
[13] "Request_URL"                 "URL_of_Anchor"
[15] "Links_in_tags"               "SFH"
[17] "Submitting_to_email"         "Abnormal_URL"
[19] "Redirect"                    "on_mouseover"
[21] "RightClick"                  "popUpWidnow"
[23] "Iframe"                      "age_of_domain"
[25] "DNSRecord"                   "web_traffic"
[27] "Page_Rank"                   "Google_Index"
[29] "Links_pointing_to_page"      "Statistical_report"
```

Figure 56A

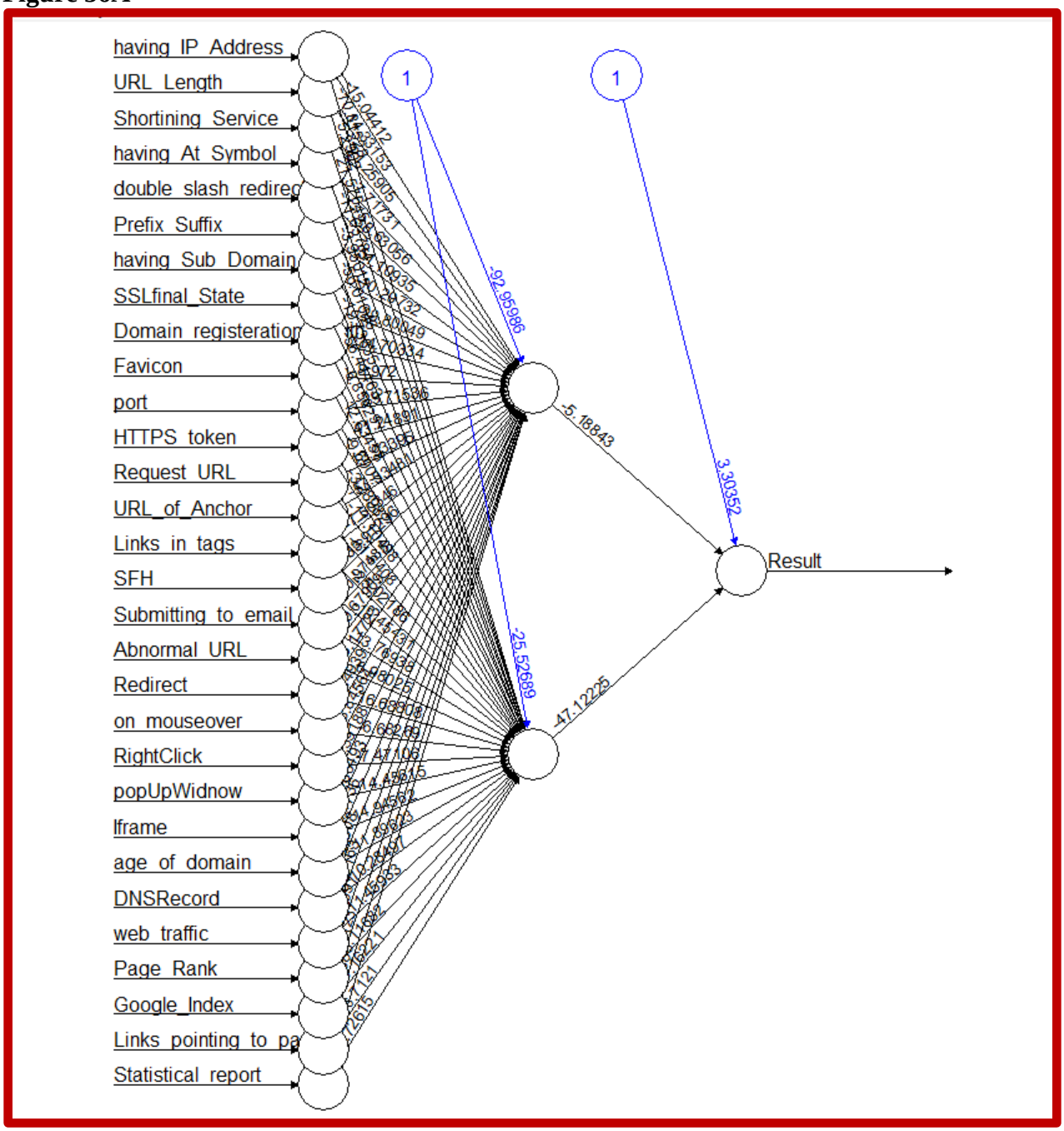
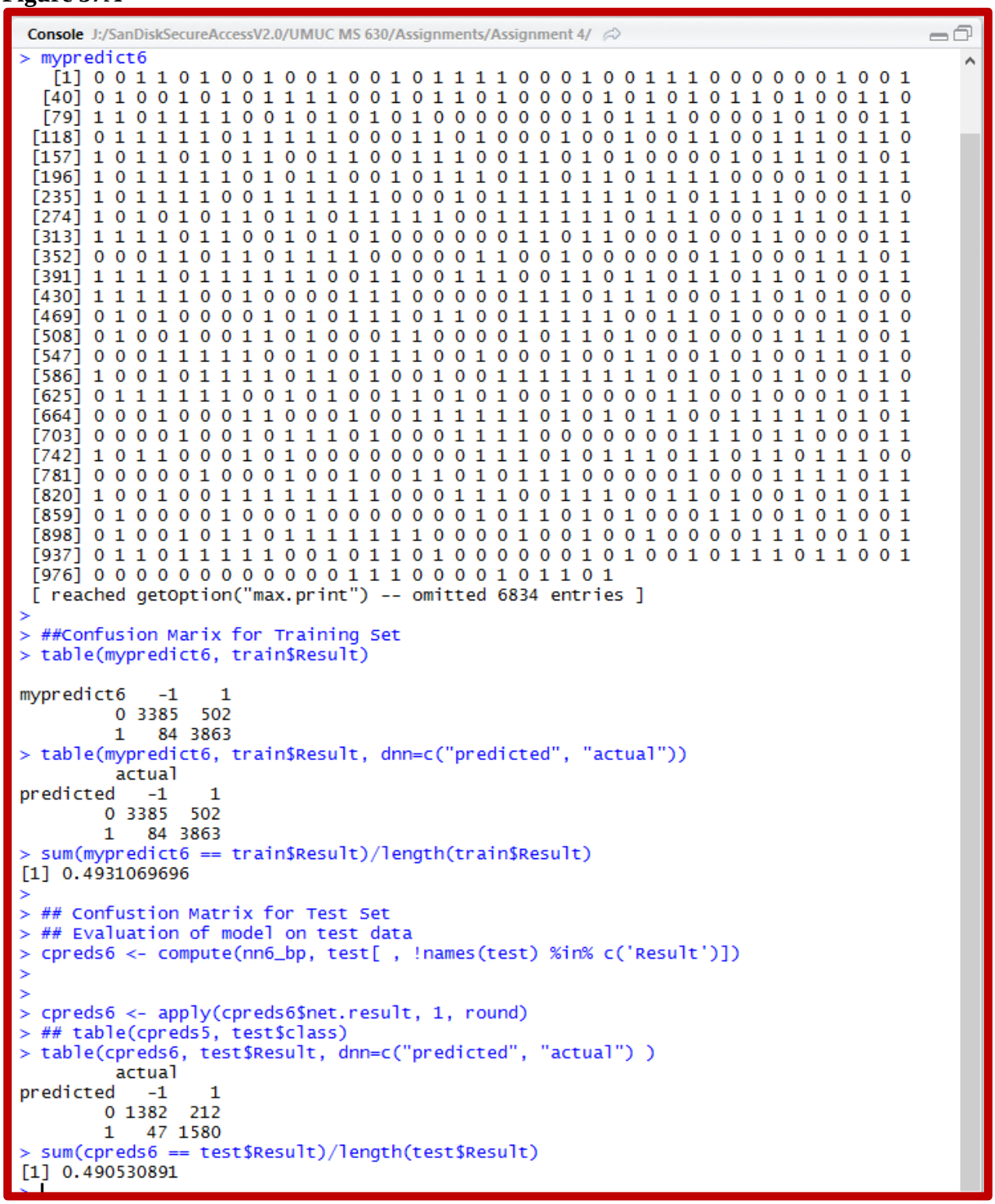

having IP Address
URL Length
Shortining Service
having At Symbol
double slash redirec
Prefix Suffix
having Sub Domain
SSLfinal_State
Domain registeration
Favicon
port
HTTPS token
Request URL
URL_of_Anchor
Links in tags
SFH
Submitting to email
Abnormal URL
Redirect
on mouseover
RightClick
popUpWidnow
Iframe
age of domain
DNSRecord
web traffic
Page Rank
Google_Index
Links pointing to pa
Statistical report
1
1
-92.95986
-25.52689
-5.18843
47.12225
3.30352
Result

Figure 57A


Console J:/SanDiskSecureAccessV2.0/UMUC MS 630/Assignments/Assignment 4/
> mypredict6
[1] 0 0 1 1 0 1 0 0 1 0 0 1 0 0 1 0 1 1 1 1 0 0 0 1 0 0 1 1 1 0 0 0 0 0 0 1 0 0 1
[40] 0 1 0 0 1 0 1 0 1 1 1 1 0 0 1 0 1 1 0 1 0 0 0 0 1 0 1 0 1 0 1 1 0 1 0 0 1 1 0
[79] 1 1 0 1 1 1 1 1 0 0 1 0 1 0 1 0 1 0 0 0 0 0 0 0 1 0 1 1 1 0 0 0 0 1 0 1 0 0 1 1
[118] 0 1 1 1 1 1 1 0 1 1 1 1 1 1 0 0 0 1 1 0 1 0 0 0 1 0 0 1 0 0 1 1 0 0 1 1 1 0 1 1 0
[157] 1 0 1 1 0 1 0 1 1 1 0 0 1 1 0 0 1 1 1 0 0 1 1 0 1 0 1 0 0 0 0 0 1 0 1 1 1 0 1 0 1
[196] 1 0 1 1 1 1 1 1 0 1 0 1 1 0 0 1 0 1 1 1 0 1 1 0 1 1 0 1 1 1 1 1 0 0 0 0 1 0 1 1 1
[235] 1 0 1 1 1 1 1 0 0 1 1 1 1 1 1 0 0 0 1 0 1 1 1 1 1 1 1 0 1 0 1 1 1 1 1 0 0 0 1 1 0
[274] 1 0 1 0 1 0 1 1 0 1 1 0 1 1 1 1 1 1 0 0 1 1 1 1 1 1 1 0 1 1 1 0 0 0 1 1 1 0 1 1 1
[313] 1 1 1 1 0 1 1 0 0 1 0 1 0 1 0 0 0 0 0 0 1 1 0 1 1 0 0 0 1 0 0 1 1 0 0 0 0 0 1 1
[352] 0 0 0 1 1 0 1 1 0 1 1 1 1 0 0 0 0 0 1 1 0 0 1 0 0 0 0 0 0 1 1 0 0 0 1 1 1 0 1
[391] 1 1 1 1 0 1 1 1 1 1 1 0 0 1 1 0 0 1 1 1 0 0 1 1 0 1 1 0 1 1 0 1 1 0 1 0 0 1 1
[430] 1 1 1 1 1 0 0 1 0 0 0 0 1 1 1 0 0 0 0 0 1 1 1 0 1 1 1 0 0 0 1 1 0 1 0 1 0 0 0
[469] 0 1 0 1 0 0 0 0 1 0 1 0 1 1 1 0 1 1 0 0 1 1 1 1 1 1 0 0 1 1 0 1 0 0 0 0 1 0 1 0
[508] 0 1 0 0 1 0 0 1 1 0 1 0 0 0 1 1 0 0 0 0 1 0 1 1 0 1 0 0 1 0 0 0 1 1 1 1 0 0 1
[547] 0 0 0 1 1 1 1 1 1 0 0 1 0 0 1 1 1 0 0 1 0 0 0 1 0 0 1 1 0 0 1 0 1 0 0 1 1 0 1 0
[586] 1 0 0 1 0 1 1 1 1 1 0 1 1 0 1 0 0 1 0 0 1 1 1 1 1 1 1 1 0 1 0 1 0 1 1 0 0 1 1 0
[625] 0 1 1 1 1 1 1 1 0 0 1 0 1 0 0 1 1 0 1 0 1 0 0 1 0 0 0 0 0 1 1 0 0 1 0 0 0 1 0 1 1
[664] 0 0 0 1 0 0 0 0 1 1 0 0 0 0 1 0 0 1 1 1 1 1 1 1 0 1 0 1 0 1 1 0 0 1 1 1 1 1 0 1 0 1
[703] 0 0 0 0 0 1 0 0 1 0 1 1 1 0 1 0 0 0 1 1 1 1 1 0 0 0 0 0 0 0 0 1 1 1 0 1 1 0 0 0 1 1
[742] 1 0 1 1 0 0 0 1 0 1 0 0 0 0 0 0 0 0 1 1 1 0 1 0 1 1 1 0 1 1 0 1 1 0 1 1 1 0 0
[781] 0 0 0 0 0 0 1 0 0 0 1 0 0 1 0 0 1 1 0 1 0 1 1 1 0 0 0 0 0 1 0 0 0 1 1 1 1 0 1 1
[820] 1 0 0 1 0 0 1 1 1 1 1 1 1 1 0 0 0 1 1 1 0 0 1 1 1 0 0 1 1 0 1 0 0 1 0 1 0 1 1
[859] 0 1 0 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 1 0 1 1 0 1 0 1 0 0 0 1 1 0 0 1 0 1 0 0 1
[898] 0 1 0 0 1 0 1 1 0 1 1 1 1 1 1 1 0 0 0 0 1 0 0 1 0 0 1 0 0 0 0 1 1 1 0 0 1 0 1
[937] 0 1 1 0 1 1 1 1 1 0 0 1 0 1 1 0 1 0 0 0 0 0 0 1 0 1 0 0 1 0 1 1 1 0 1 1 0 0 1
[976] 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 1 0 1 1 0 1
[reached getOption("max.print") -- omitted 6834 entries]
>
> ##Confusion Marix for Training Set
> table(mypredict6, train$Result)
mypredict6 -1 1
0 3385 502
1 84 3863
> table(mypredict6, train$Result, dnn=c("predicted", "actual"))
actual
predicted -1 1
0 3385 502
1 84 3863
> sum(mypredict6 == train$Result)/length(train$Result)
[1] 0.4931069696
>
> ## Confustion Matrix for Test Set
> ## Evaluation of model on test data
> cpreds6 <- compute(nn6_bp, test[, !names(test) %in% c('Result')])
>
>
> cpreds6 <- apply(cpreds6$net.result, 1, round)
> ## table(cpreds5, test$class)
> table(cpreds6, test$Result, dnn=c("predicted", "actual"))
actual
predicted -1 1
0 1382 212
1 47 1580
> sum(cpreds6 == test$Result)/length(test$Result)
[1] 0.490530891