

Learning outcomes:

After solving these exercises, you should be able to understand the following:

1. Applying Neural Networks on multiple data sets
2. Importance of Standardizing data
3. Visualizing and interpreting the results

Today's activities**Activity1**

1. Importing "UniversalBank.csv" file's data into R dataframe using read.csv function.
`bank_Data = read.csv(file="UniversalBank.csv", header=TRUE, sep=",")`
2. Understand the structure the summary of the data using str and summary R commands
3. Convert all the variables to appropriate type
 - To numeric using as.numeric()
 - To categorical using as.factor()
 - To ordinal using as.factor() with ordered argument set to TRUE or using as.ordered()
4. Using subset remove 'ID' and 'ZIP.Code' columns from the data
5. R neuralnet library takes only numeric attributes as input
 - Convert all categorical and ordinal attributes to numeric using appropriate technique. Hint: dummies
 - E.g. convert "Education" categorical attribute to numeric using dummy function in dummies R library
 - Drop actual Education attribute from original data set
 - Add created dummy Education variables to original data set
6. Separate Target Variable and Independent Variables.
 - In this case "Personal.Loan" is a target variable and all others are independent variable.
7. Standardization the independent variables using decostand function in vegan R library
Note: To standardize the data using 'Range' method
8. Prepare train and test data in 60:40 ratio
9. See data distribution in response variable in both Train and Test data:
10. Load neuralnet R library and build a Neural Network having 1 hidden layer with 2 nodes
`nn = neuralnet(Personal.Loan ~
Age+Experience+Income+Family+CCAvg+Mortgage+
Securities.Account+CD.Account+Online+CreditCard+`

```
Education1+Education2+Education3,  
data=train_Data, hidden=2)
```

11. See covariate and result variables of neuralnet model

```
out <- cbind(nn$covariate, nn$net.result[[1]])
```

12. Remove rownames and set column names

```
dimnames(out) = list(NULL,  
  c("Age", "Experience", "Income", "Family", "CCAvg", "Mortgage",  
    "Securities.Account", "CD.Account", "Online", "CreditCard",  
    "Education1", "Education2", "Education3", "nn_Output"))
```

13. To view top records in the data set

14. Plot the neural network

```
plot(nn)
```

15. Compute confusion matrix and calculate recall on Train Data

```
predicted = factor(ifelse(nn$net.result[[1]] > 0.5, 1, 0))  
conf_Matrix = table(train_Data$Personal.Loan, predicted)
```

16. Remove target attribute from Test Data

17. Predict

```
nn_predict <- compute(nn, covariate= test_Data_No_Target)
```

18. View the predicted values

19. Compute confusion matrix and calculate recall for Test Data

```
predicted = factor(ifelse(nn_predict$net.result > 0.5, 1, 0))  
conf_Matrix<-table(test_Data$Personal.Loan, predicted)
```

Activity2

- Objective:
 - Build multi-class classification neural network model, that takes features as input and predicts the alphabet id
- Data:
 - all_features.txt"
 - Has data that is collected from the image of Hindi alphabet.
 - Class/Target attribute is the alphabet id
 - In the given data set Target variable in the first column
 - Other 72 attributes are features collected from the image of that alphabet
 - Each row has details about one alphabet