



Customer Churn Analytics using Microsoft R Open

Malaysia R User Group Meet Up
16th February 2017
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<https://github.com/kuanhoong/churn-r>

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Agenda

- Introduction
- Customer Churn Analytics
- Machine Learning Framework
- Microsoft R Open and Visual Studio
- Model Performance Comparison
- Demo

Malaysia R User Group (MyRUG)

- The Malaysia R User Group (MyRUG) was formed on June 2016.
- It is a diverse group that come together to discuss anything related to the R programming language.
- The main aim of MyRUG is to provide members ranging from beginners to R professionals and experts to share and learn about R programming and gain competency as well as share new ideas or knowledge.

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Kuala Lumpur,
Malaysia

Founded Jun 5, 2016

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The R User Group Malaysia is a diverse group that come together to discuss anything related to the R programming language.



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Malaysia R User Group

MyRUG



Introduction

- **Customer churn** can be defined simply as the rate at which a company is losing its customers
- Imagine the business as a bucket with holes, the water flowing from the top is the growth rate, while the holes at the bottom is **churn**
- While a certain level of churn is unavoidable, it is important to keep it under control, as high churn rate can potentially kill your business







Data Scientists Quick Apply

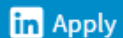
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Kuala Lumpur, Malaysia

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Job description

We are looking for data science and analytics candidates with the following experience:


- Experts in Python, SQL and R.
- Experienced in working with large data sets with the aim of developing predictive models.
- Have carried statistical modeling, analytics modeling, customer segmentation and profiling, social network analysis and customer insights.
- Have contributed to the marketing campaign strategically and tactically through the use of various models (descriptive, predictive, optimisation).
- Knowledge of Hadoop and Spark would be beneficial.



Data Scientist Quick Apply

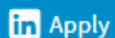
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Job description

Responsibilities

- Designs experiments, test hypotheses, and build models.
- Build, maintain, and improve on multiple real-time decision systems.
- Leads discovery processes with stakeholders to identify the business requirements and the expected outcomes.
- Works with and alongside business analysts by suggesting other products of interest to the client.
- Models and frames business scenarios that are meaningful and which impact on critical business processes and/or decisions.
- Identifies what data is available and relevant, including internal and external data sources, leveraging new data collection processes such as smart meters and geo-location information or social media.
- Collaborates with subject matter experts to select the relevant sources of information.
- Makes strategic recommendations on data collection, integration and retention requirements incorporating business requirements and knowledge of best practices.

digi

Data Scientist, BIRS
Digi Telecommunications Sdn Bhd

Job Description

JOB SUMMARY

This individual will be the expert modeler in the data science and modeling team and have deep knowledge of machine learning, data mining and statistical analyses.

KEY RESPONSIBILITIES

- Hands on building models utilizing the various analytical techniques.
- Engage regularly with the campaign mgt team to come up with new and innovative campaigns.
- Develop predictive models (e.g. Churn Prediction model, Next Best offer model, Market Basket analysis) to leverage existing information assets for optimal Marketing activity.
- Develop descriptive models (e.g. behavioural segmentation, lifetime value model, social network analysis) to enhance customer insights.
- Develop optimization models (e.g. network optimization, campaign optimization) to enhance return on investment.
- Capitalize opportunities for revenue enhancement through targeted campaigns by development of:
 - Behavioral analytics, measurement and modelling
 - Customer and Audience segmentation, clustering and profiling
 - Geo/demographic attribution and segmentation

Churn analytics

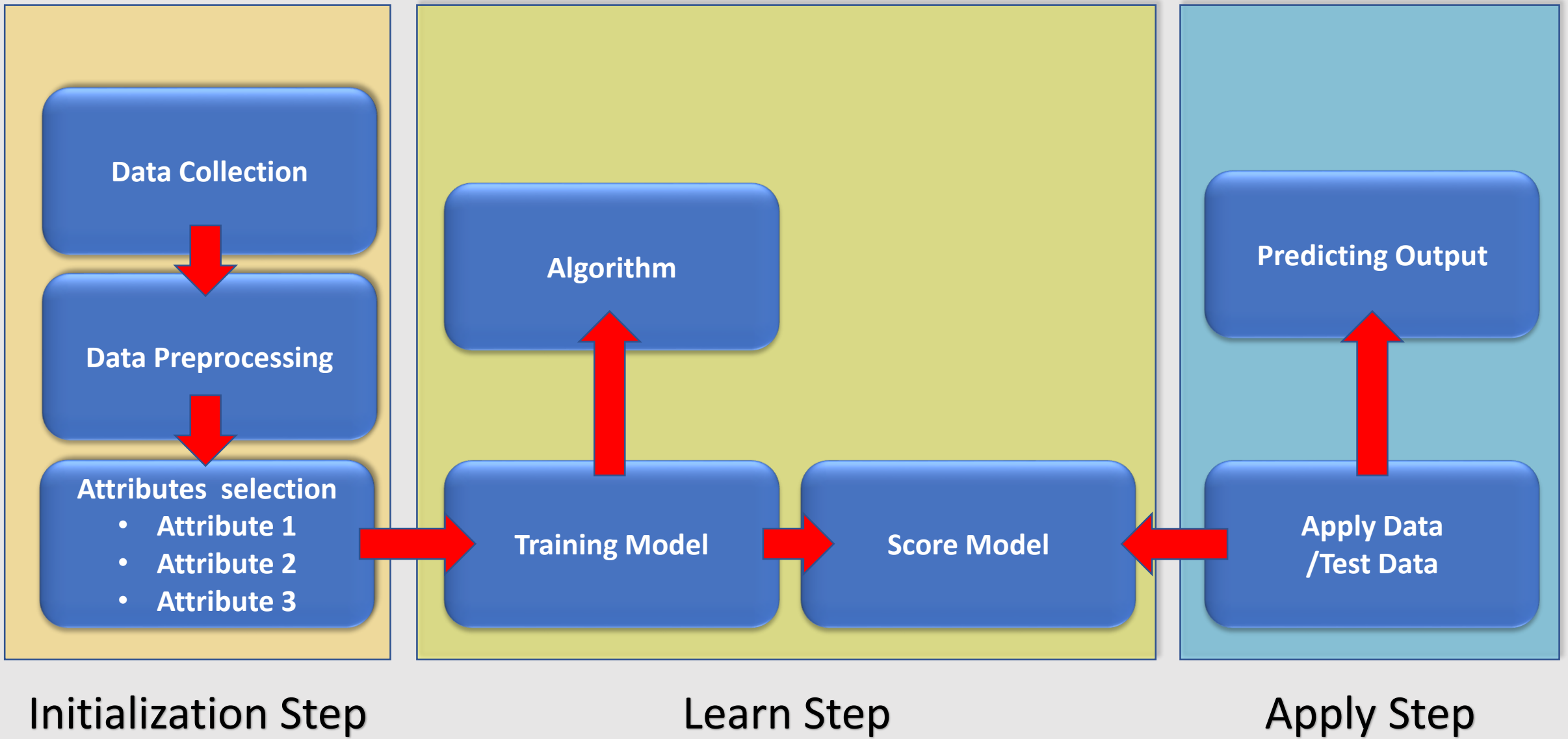
- Predicting who will switch mobile operator

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U |
|----|-----------|--------|------------|---------|----------|--------|-----------|------------|------------|------------|------------|------------|------------|------------|------------|----------|-----------|------------|-----------|-----------|-------|
| 1 | customerI | gender | SeniorCiti | Partner | Dependen | tenure | PhoneServ | MultipleLi | InternetSe | OnlineSec | OnlineBac | DevicePro | TechSupp | Streaming | Streaming | Contract | Paperless | PaymentM | MonthlyCl | TotalChar | Churn |
| 2 | 7590-VHV | Female | 0 | Yes | No | 1 | No | No phone | DSL | No | Yes | No | No | No | No | Month-to | Yes | Electronic | 29.85 | 29.85 | No |
| 3 | 5575-GNV | Male | 0 | No | No | 34 | Yes | No | DSL | Yes | No | Yes | No | No | No | One year | No | Mailed ch | 56.95 | 1889.5 | No |
| 4 | 3668-QPY | Male | 0 | No | No | 2 | Yes | No | DSL | Yes | Yes | No | No | No | No | Month-to | Yes | Mailed ch | 53.85 | 108.15 | Yes |
| 5 | 7795-CFO | Male | 0 | No | No | 45 | No | No phone | DSL | Yes | No | Yes | Yes | No | No | One year | No | Bank trans | 42.3 | 1840.75 | No |
| 6 | 9237-HQI | Female | 0 | No | No | 2 | Yes | No | Fiber opti | No | No | No | No | No | No | Month-to | Yes | Electronic | 70.7 | 151.65 | Yes |
| 7 | 9305-CDSI | Female | 0 | No | No | 8 | Yes | Yes | Fiber opti | No | No | Yes | No | Yes | Yes | Month-to | Yes | Electronic | 99.65 | 820.5 | Yes |
| 8 | 1452-KIOV | Male | 0 | No | Yes | 22 | Yes | Yes | Fiber opti | No | Yes | No | No | Yes | No | Month-to | Yes | Credit car | 89.1 | 1949.4 | No |
| 9 | 6713-OKC | Female | 0 | No | No | 10 | No | No phone | DSL | Yes | No | No | No | No | No | Month-to | No | Mailed ch | 29.75 | 301.9 | No |
| 10 | 7892-POC | Female | 0 | Yes | No | 28 | Yes | Yes | Fiber opti | No | No | Yes | Yes | Yes | Yes | Month-to | Yes | Electronic | 104.8 | 3046.05 | Yes |
| 11 | 6388-TAB | Male | 0 | No | Yes | 62 | Yes | No | DSL | Yes | Yes | No | No | No | No | One year | No | Bank trans | 56.15 | 3487.95 | No |
| 12 | 9763-GRSI | Male | 0 | Yes | Yes | 13 | Yes | No | DSL | Yes | No | No | No | No | No | Month-to | Yes | Mailed ch | 49.95 | 587.45 | No |
| 13 | 7469-LKBC | Male | 0 | No | No | 16 | Yes | No | No | No interne | No interne | No interne | No interne | No interne | No interne | Two year | No | Credit car | 18.95 | 326.8 | No |
| 14 | 8091-TTV | Male | 0 | Yes | No | 58 | Yes | Yes | Fiber opti | No | No | Yes | No | Yes | Yes | One year | No | Credit car | 100.35 | 5681.1 | No |
| 15 | 0280-XJGE | Male | 0 | No | No | 49 | Yes | Yes | Fiber opti | No | Yes | Yes | No | Yes | Yes | Month-to | Yes | Bank trans | 103.7 | 5036.3 | Yes |
| 16 | 5129-JLPI | Male | 0 | No | No | 25 | Yes | No | Fiber opti | Yes | No | Yes | Yes | Yes | Yes | Month-to | Yes | Electronic | 105.5 | 2686.05 | No |
| 17 | 3655-SNQ | Female | 0 | Yes | Yes | 69 | Yes | Yes | Fiber opti | Yes | Yes | Yes | Yes | Yes | Yes | Two year | No | Credit car | 113.25 | 7895.15 | No |
| 18 | 8191-XWS | Female | 0 | No | No | 52 | Yes | No | No | No interne | No interne | No interne | No interne | No interne | No interne | One year | No | Mailed ch | 20.65 | 1022.95 | No |
| 19 | 9959-WOI | Male | 0 | No | Yes | 71 | Yes | Yes | Fiber opti | Yes | No | Yes | No | Yes | Yes | Two year | No | Bank trans | 106.7 | 7382.25 | No |
| 20 | 4190-MFL | Female | 0 | Yes | Yes | 10 | Yes | No | DSL | No | No | Yes | Yes | No | No | Month-to | No | Credit car | 55.2 | 528.35 | Yes |

Customer churn - who do customers change operators?

- The top 3 reasons why subscribers change providers:
 - They want a new handset
 - They believe they pay too much for calls/data
 - Providers do not offer additional loyalty benefits

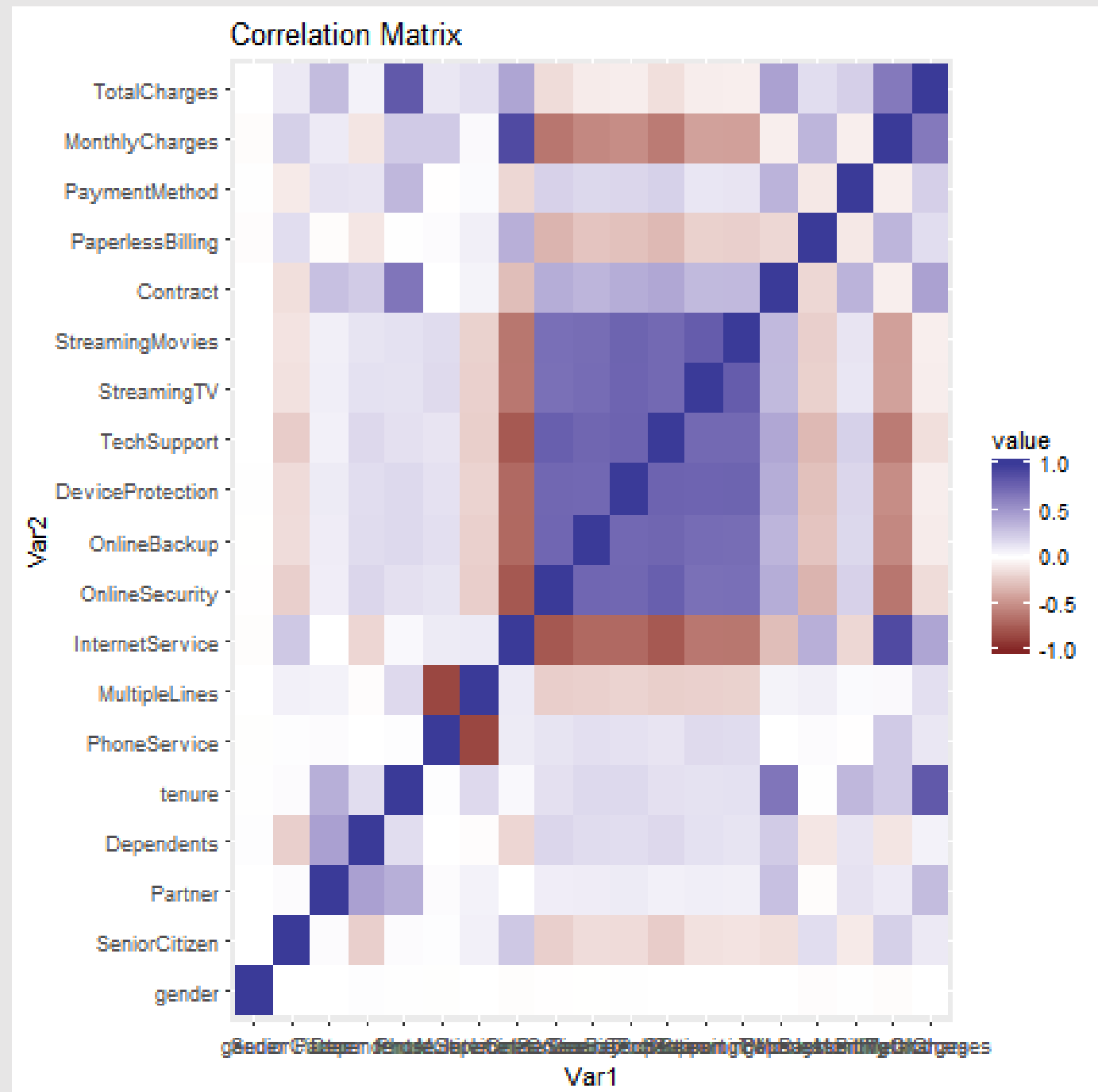




Machine Learning Framework

Correlation Matrix

- **correlation matrix**, which is used to investigate the dependence between multiple variables at the same time.



Microsoft R Open

- [Microsoft R Open](#), formerly known as Revolution R Open (RRO), is the enhanced distribution of R from Microsoft Corporation.
- It is a complete open source platform for statistical analysis and data science.

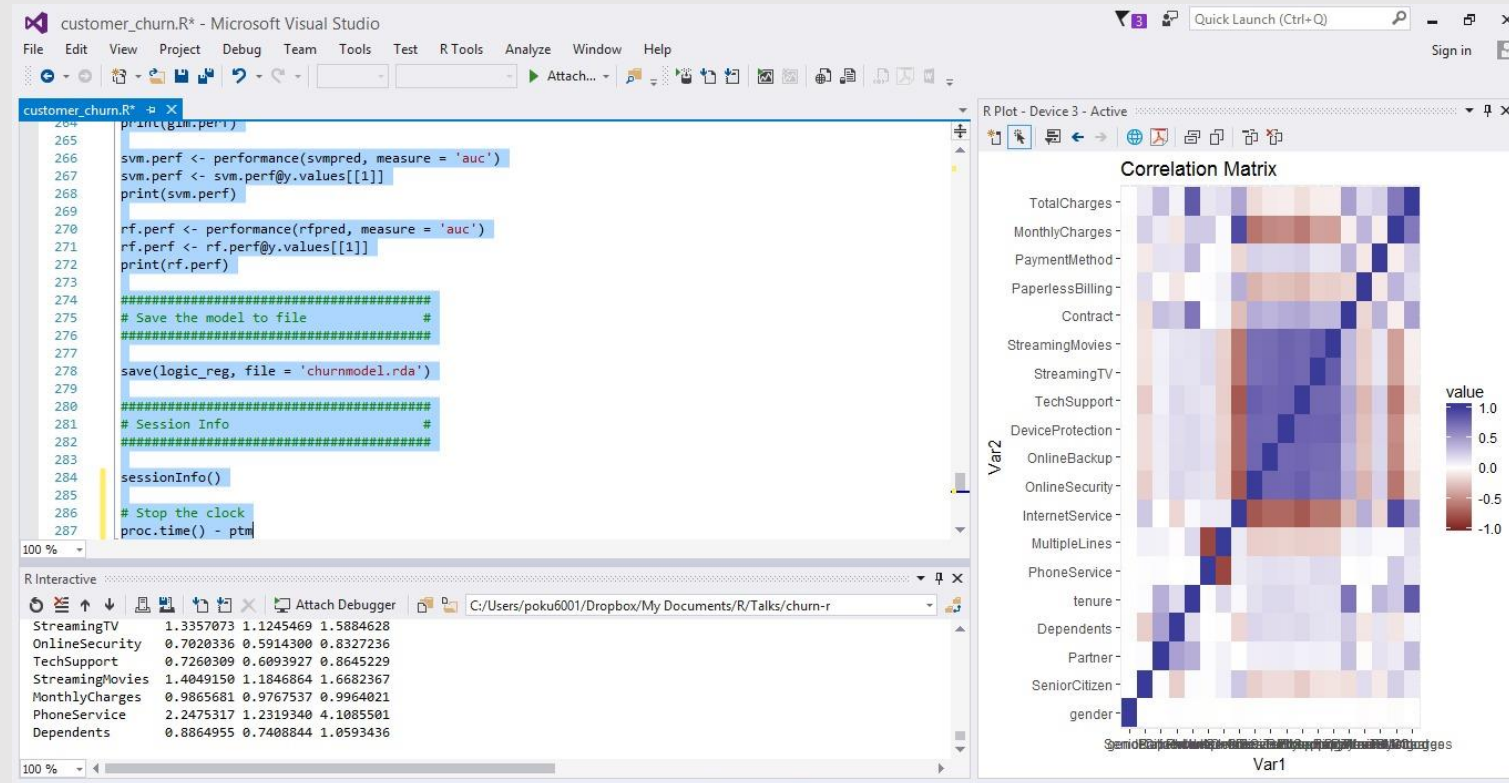
Key enhancement

- Multi-threaded math libraries that brings multi-threaded computations to R.
- A high-performance default CRAN repository that provide a consistent and static set of packages to all Microsoft R Open users.
- The checkpoint package that make it easy to share R code and replicate results using specific R package versions.



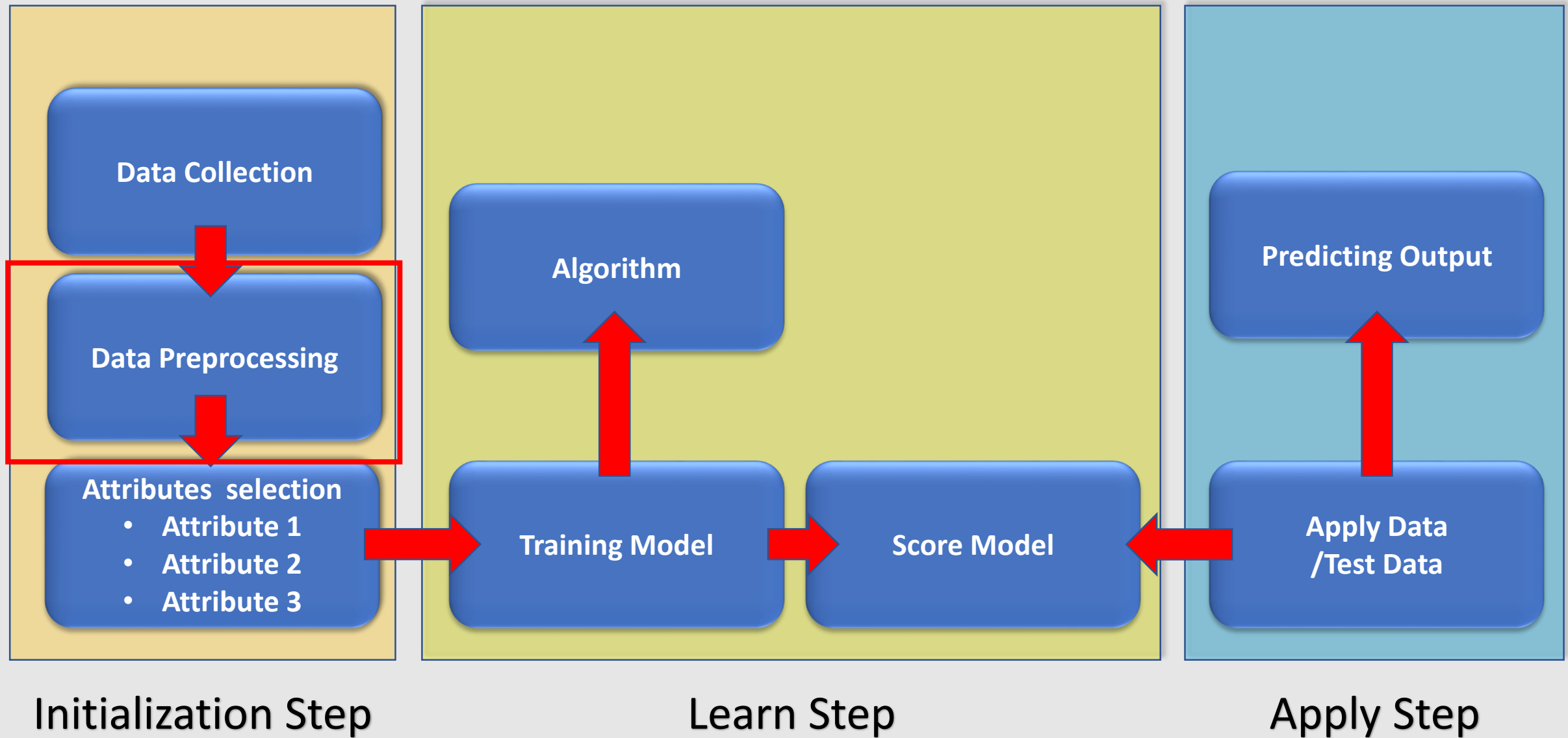
R Tools for Visual Studio

- Turn Visual Studio into a powerful R development environment
- [Download R Tools for Visual Studio](#)



R Tools for Visual Studio

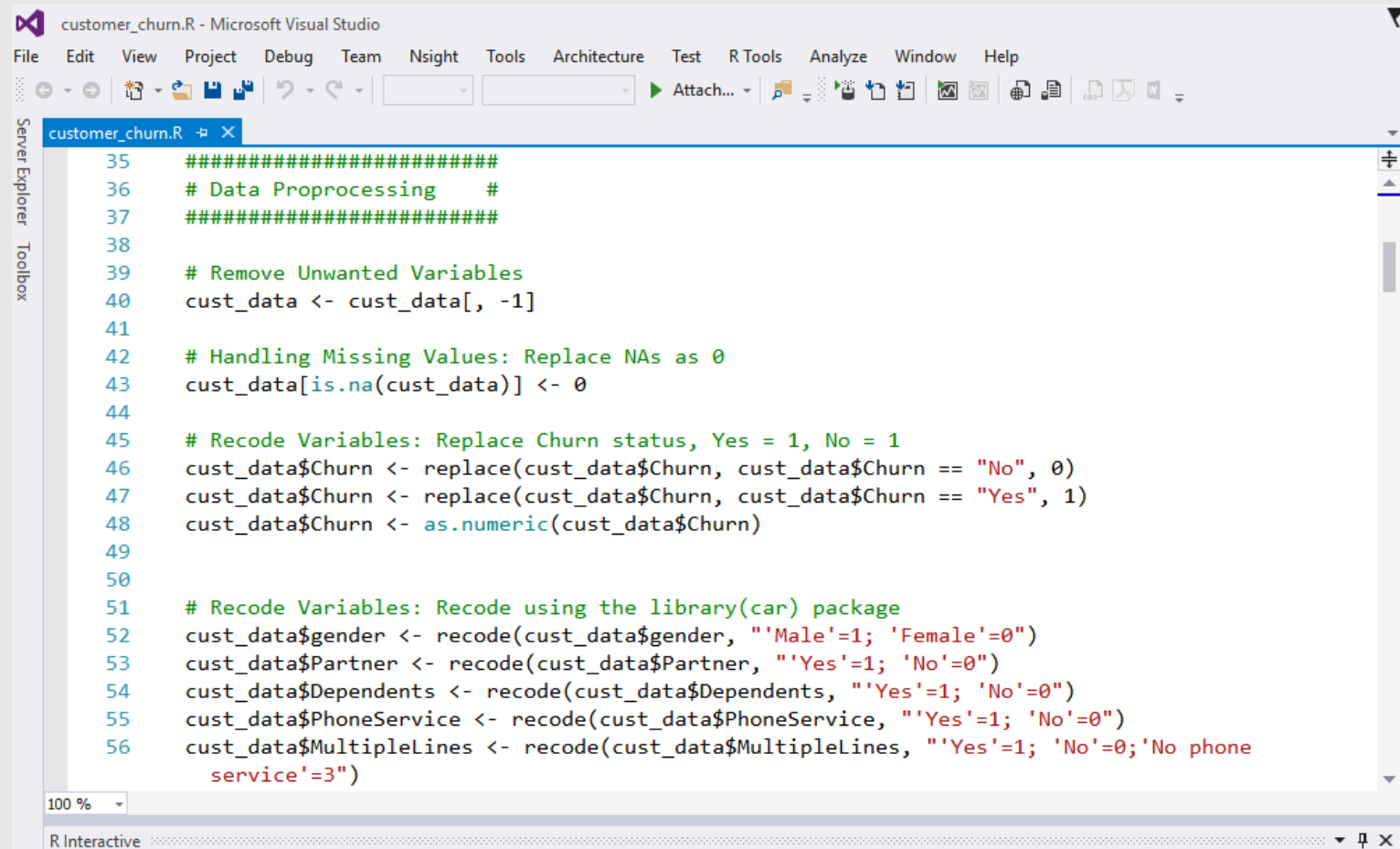
- Visual Studio IDE
- Intellisense
- Enhanced multi-threaded math libs, cluster scale computing, and a high performance CRAN repo with checkpoint capabilities.
- Learn more about R Tools from here:
<https://microsoft.github.io/RTVS-docs/>



Machine Learning Framework

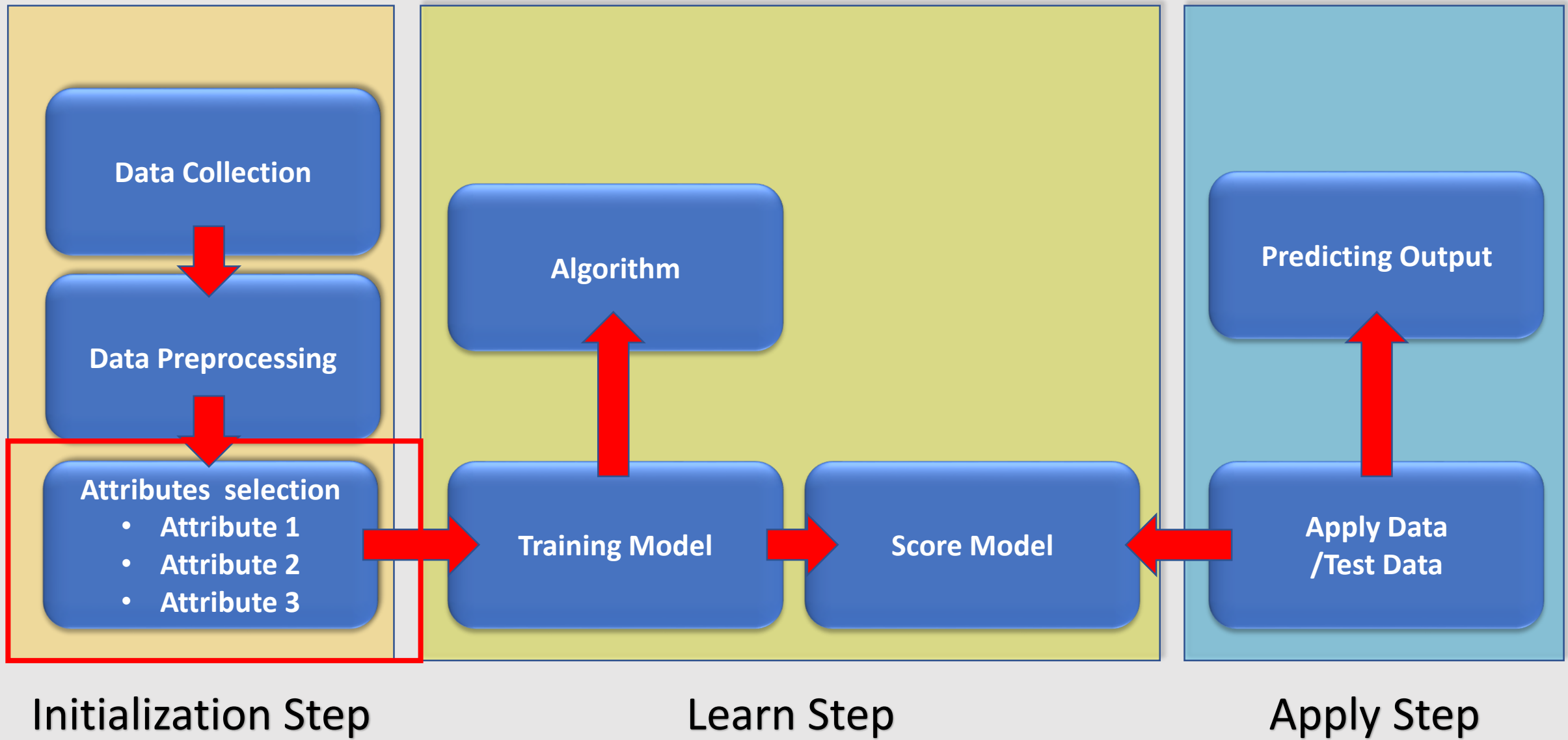
Data Preprocessing

- Assign missing values as zero
- Detect outliers
- Remove unwanted variables
- Recode variables
- Convert categorical variables



The screenshot shows the Microsoft Visual Studio interface with a file named 'customer_churn.R'. The code is written in R and focuses on data preprocessing. It includes comments for each step: removing unwanted variables, handling missing values, and recoding categorical variables. The 'car' package is used for recoding. The code is as follows:

```
35 #####
36 # Data Preprocessing #
37 #####
38
39 # Remove Unwanted Variables
40 cust_data <- cust_data[, -1]
41
42 # Handling Missing Values: Replace NAs as 0
43 cust_data[is.na(cust_data)] <- 0
44
45 # Recode Variables: Replace Churn status, Yes = 1, No = 0
46 cust_data$Churn <- replace(cust_data$Churn, cust_data$Churn == "No", 0)
47 cust_data$Churn <- replace(cust_data$Churn, cust_data$Churn == "Yes", 1)
48 cust_data$Churn <- as.numeric(cust_data$Churn)
49
50
51 # Recode Variables: Recode using the library(car) package
52 cust_data$gender <- recode(cust_data$gender, "'Male'=1; 'Female'=0")
53 cust_data$Partner <- recode(cust_data$Partner, "'Yes'=1; 'No'=0")
54 cust_data$Dependents <- recode(cust_data$Dependents, "'Yes'=1; 'No'=0")
55 cust_data$PhoneService <- recode(cust_data$PhoneService, "'Yes'=1; 'No'=0")
56 cust_data$MultipleLines <- recode(cust_data$MultipleLines, "'Yes'=1; 'No'=0; 'No phone
  service'=3")
```

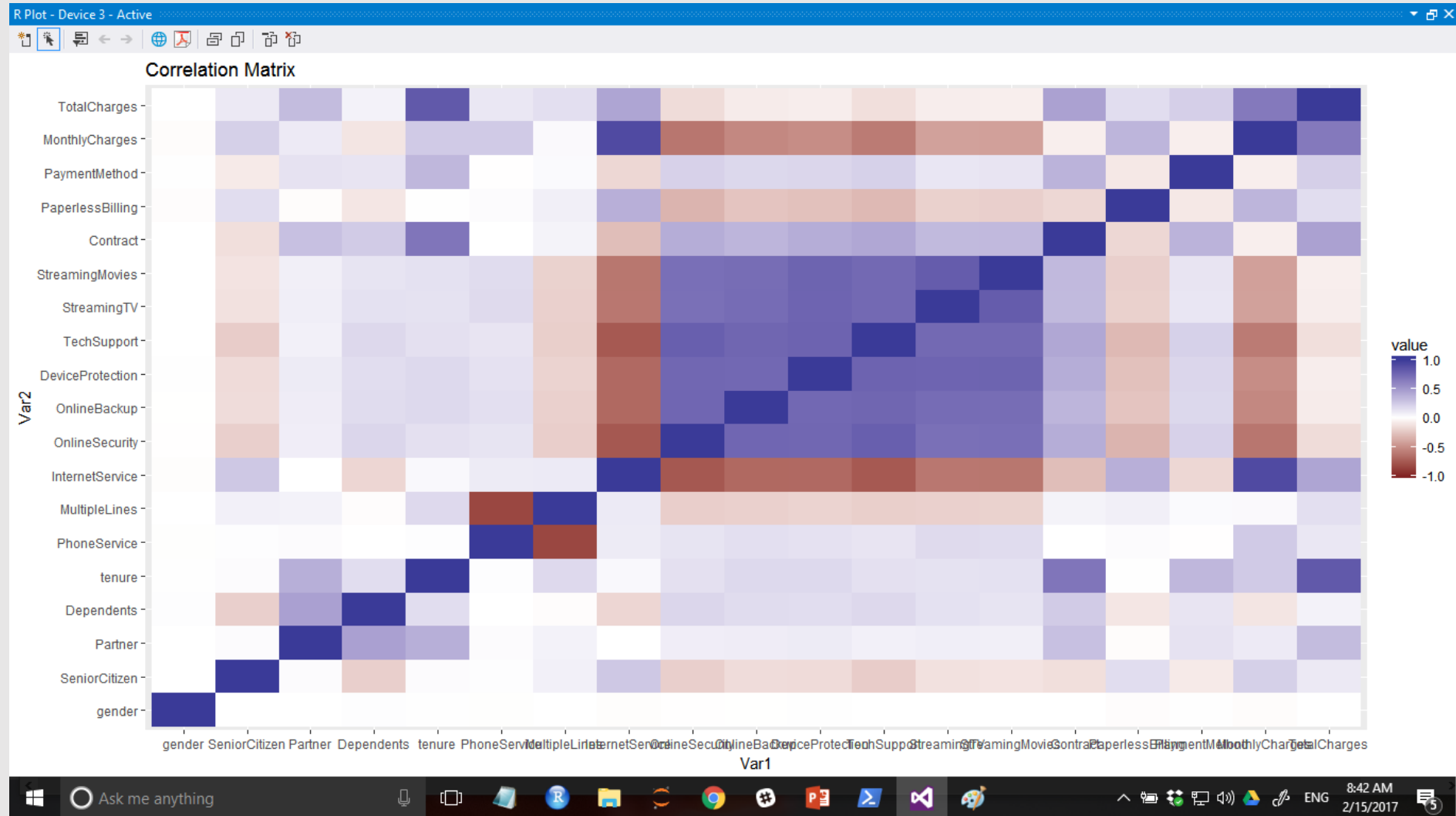


Machine Learning Framework

Features selection

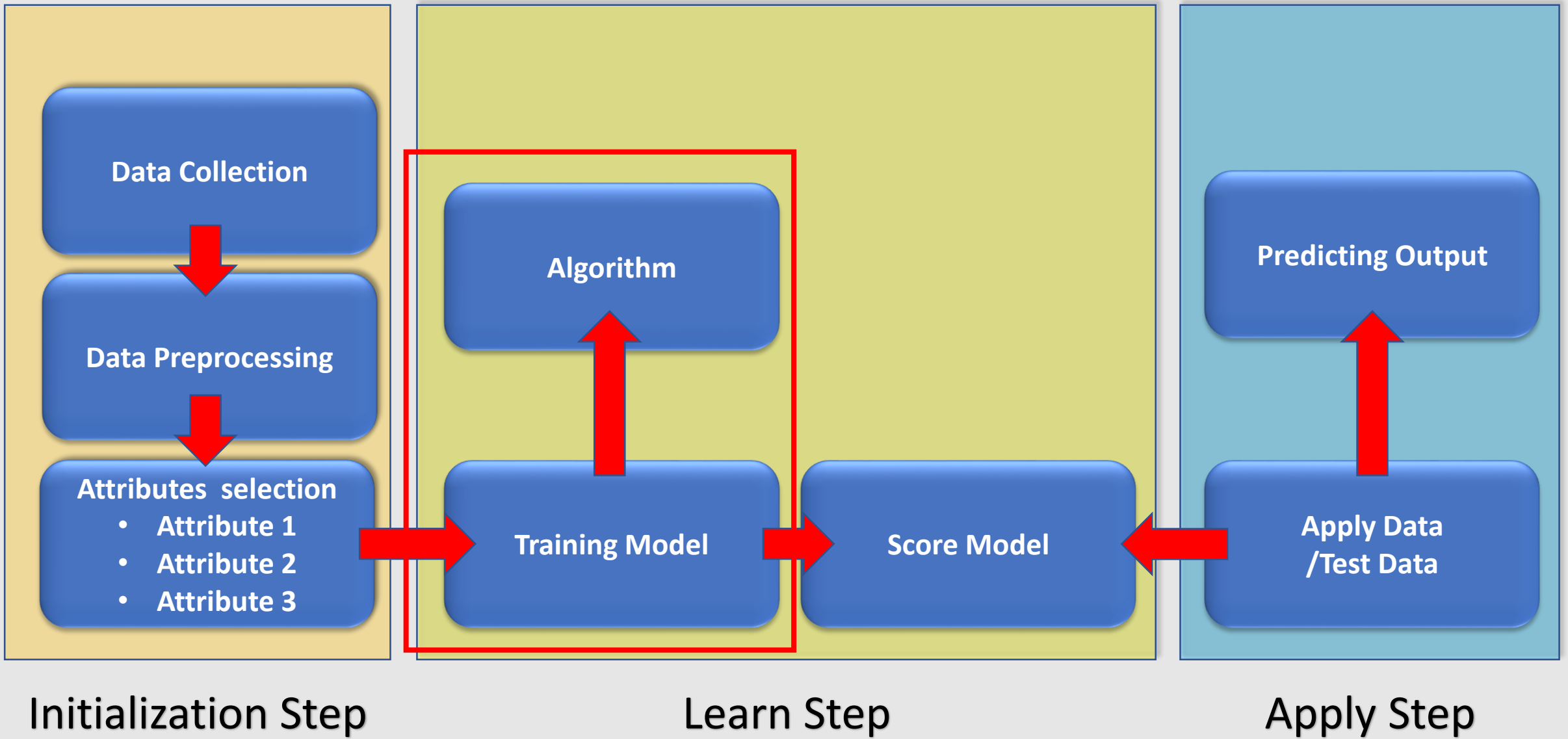
- The process of selecting a subset of relevant features (variables, predictors) for use in model construction.
- Feature selection techniques are used for three reasons:
 - simplification of models to make them easier to interpret by researchers/users,
 - shorter training times,
 - enhanced generalization by reducing overfitting

Correlation Matrix



Models Performance Comparison

- Logistic Regression
 - is a regression model where the dependent variable (DV) is categorical.
- Support Vector Machine
 - SVM is a supervised learning model with associated learning algorithms that analyze data used for classification and regression analysis.
- RandomForest
 - is an ensemble learning method for classification, regression and other tasks, that operate by constructing a multitude of decision trees at training time and outputting the class that is the mode of the classes (classification) or mean prediction (regression) of the individual trees.

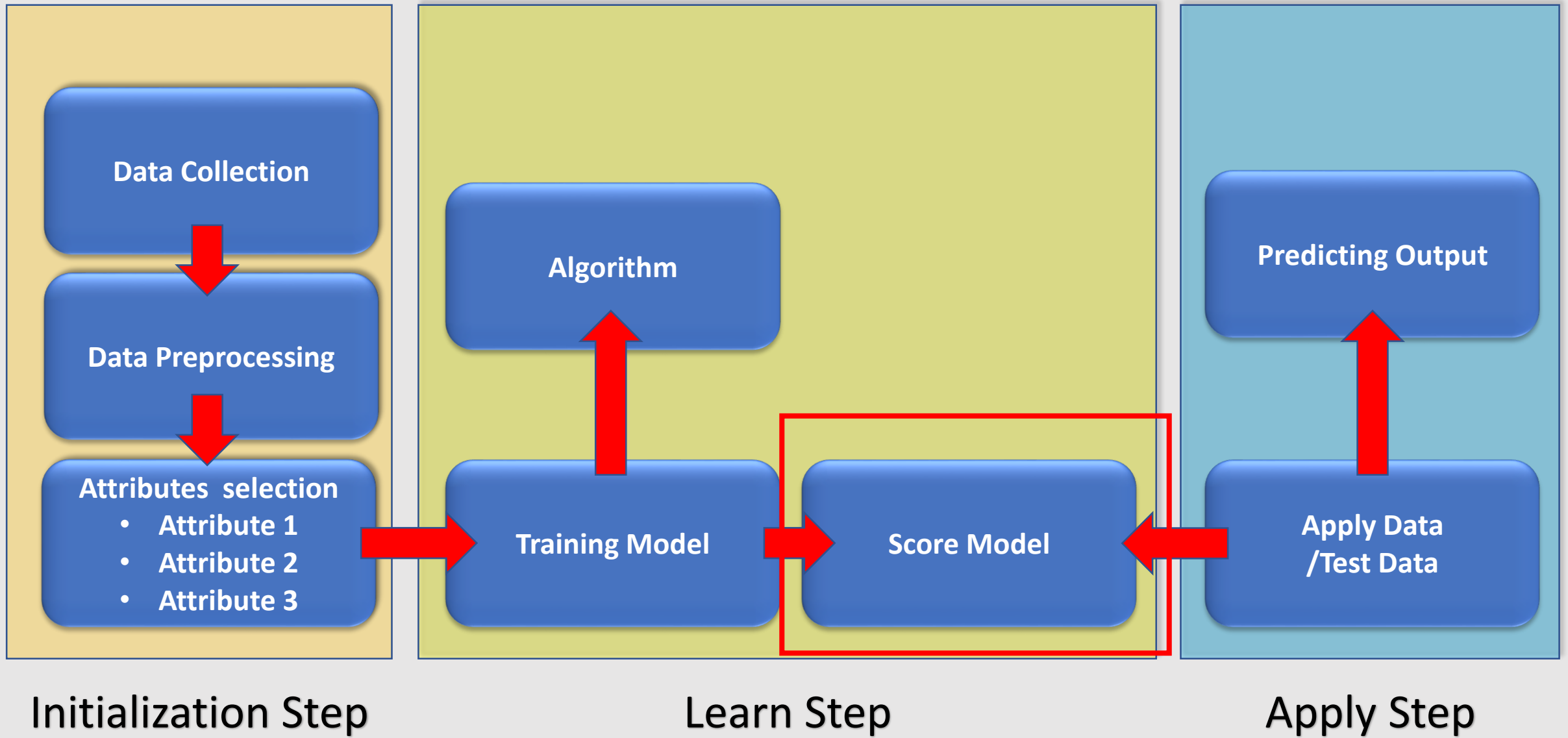


Machine Learning Framework

Training Model and Algorithm

- Split the data set into 80:20 using library(caret)
- Apply the algorithms: GLM, SVM and RF

```
customer_churn.R* X
87
88 #####
89 # Model Building #
90 #####
91
92 # For training and testing purpose,
93 # split the data to 80-20
94
95 library(caret)
96 set.seed(1234)
97 intrain <- createDataPartition(y = cust_data$Churn, p = 0.8, list = FALSE, times = 1)
98 training <- cust_data[intrain,]
99 testing <- cust_data[- intrain,]
100
101 #####
102 # Model 1: Logistic Regression Model #
103 #####
104
105 # Select the features to be used based on forward selection procedure
106 # Akaike information criterion (AIC = 2k - 2 log L) as the choice of
107 # metric. Lower AIC indicates better model
108
109 fullMod = glm(Churn ~ ., data = training, family = binomial)
110 summary(fullMod)
111 intMod <- glm(Churn ~ 1, data = training, family = binomial)
112 summary(intMod)
113 fwdSelection = stepAIC(intMod, scope = list(lower = formula(intMod), upper = formula(fullMod)),
```



Machine Learning Framework

Score Model

- **Confusion Matrix:** a table that is often used to describe the performance of a classification model (or "classifier") on a set of test data for which the true values are known.
 - **true positives (TP):** These are cases in which we predicted yes (they have the disease), and they do have the disease.
 - **true negatives (TN):** We predicted no, and they don't have the disease.
 - **false positives (FP):** We predicted yes, but they don't actually have the disease. (Also known as a "Type I error.")
 - **false negatives (FN):** We predicted no, but they actually do have the disease. (Also known as a "Type II error.")

Confusion Matrix: Generalized Linear Model (glm)

| n=1407 | Predicted: NO | Predicted: YES | |
|----------------|---------------------|---------------------|------|
| Actual: NO | TN = 919 (0.653) | FP = 115 (0.082) | 1034 |
| Actual: YES | FN = 167 (0.119) | TP = 206 (0.146) | 373 |
| | 1086 | 321 | |

Accuracy : 84.5%

Confusion Matrix: Support Vector Machine (SVM)

| n=1407 | Predicted: NO | Predicted: YES | |
|----------------|--------------------|--------------------|------|
| Actual: NO | TN= 929 (0.660) | FP= 105 (0.075) | 1034 |
| Actual: YES | FN= 183 (0.130) | TP= 190 (0.135) | 373 |
| | 1112 | 295 | |

Accuracy : 70.4%

Confusion Matrix: RandomForest

| n=1407 | Predicted: NO | Predicted: YES | |
|----------------|--------------------|--------------------|------|
| Actual: NO | TN= 939 (0.667) | FP= 95 (0.068) | 1034 |
| Actual: YES | FN= 181 (0.129) | TP= 192 (0.136) | 373 |
| | 1120 | 287 | |

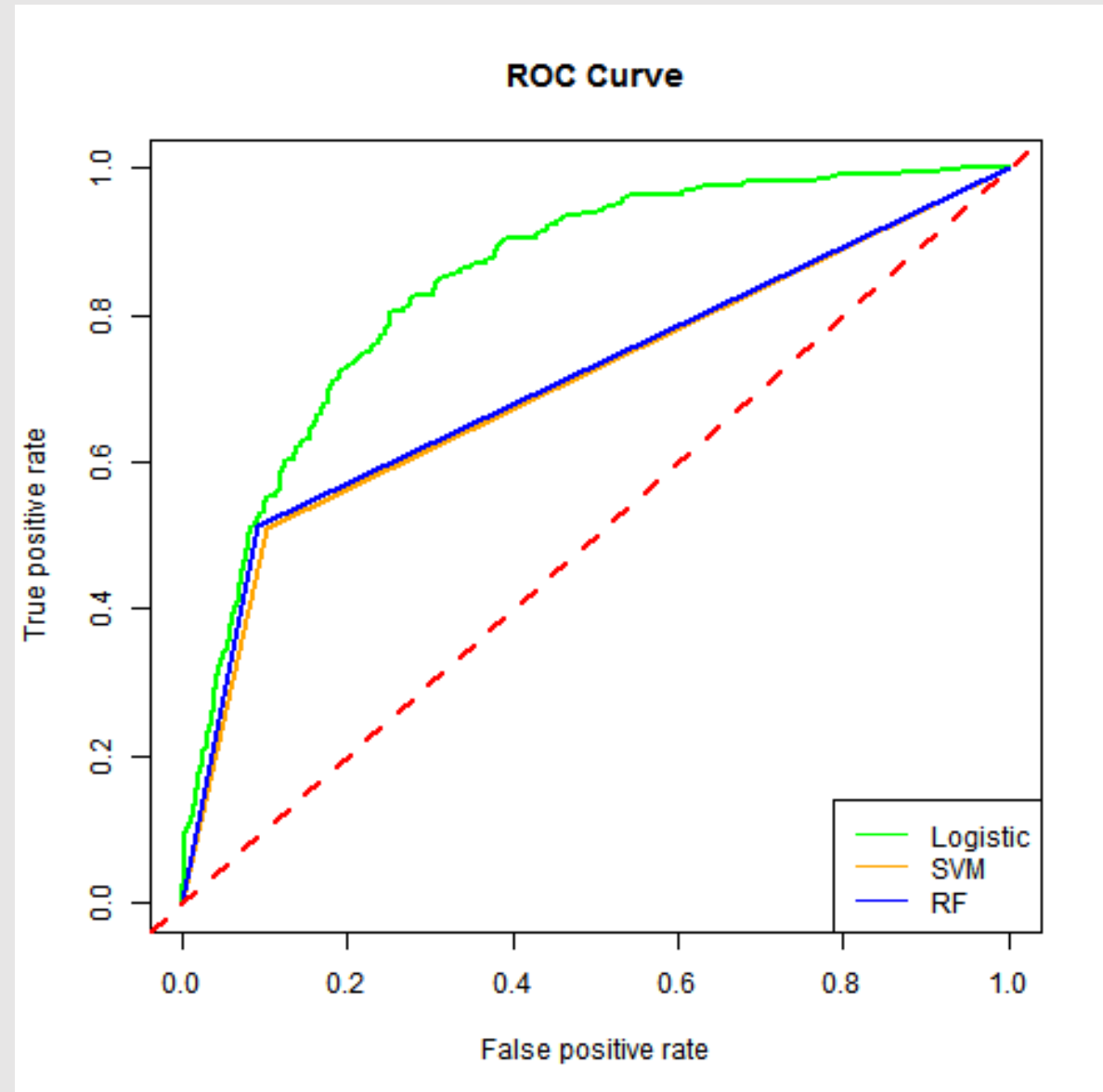
Accuracy : 71.1 %

Receiver Operating Characteristic (ROC) curve

- ROC curve is a graphical plot that illustrates the performance of a binary classifier system as its discrimination threshold is varied. The curve is created by plotting the true positive rate (TPR) against the false positive rate (FPR) at various threshold settings.

Models comparison

- ROC illustrates the performance of a binary classifier system as its discrimination threshold is varied.



Microsoft R Open vs R

```
[17] parallel_3.3.1      SparseM_1.74      RGtk2_2.20.31     stringr_1.1.0
[25] grid_3.3.1          nnet_7.3-12       survival_2.40-1    gdata_2.1.1
[33] scales_0.4.1         codetools_0.2-14  ModelMetrics_1.1.0 MASS_7.3-45
[41] labeling_0.3         quantreg_5.29     KernSmooth_2.23-15 stringi_1.1.2
>
> # Stop the clock
> proc.time() - ptm
  user system elapsed
750.81    4.59   758.04
> |
```

R

```
loaded via a namespace (and not attached):
 [1] Rcpp_0.12.9      nloptr_1.0.4      plyr_1.8.4        class_7.3
 [9] partykit_1.1-1   lme4_1.1-12       tibble_1.2         nlme_3.1-152
[17] parallel_3.3.2   SparseM_1.74      RGtk2_2.20.31     stringr_1.1.0
[25] stats4_3.3.2     grid_3.3.2        nnet_7.3-12       survival_2.40-1
[33] magrittr_1.5      scales_0.4.1       codetools_0.2-15  ModelMetrics_1.1.0
[41] colorspace_1.3-2 labeling_0.3        quantreg_5.29     KernSmooth_2.23-15
>
> # Stop the clock
> proc.time() - ptm
  user system elapsed
759.04    5.31   750.22
> |
```

Microsoft R Open

100 %

R Interactive

Attach Debugger C:/Users/poku6001/Dropbox/My Documents/R/talks/chum-r/

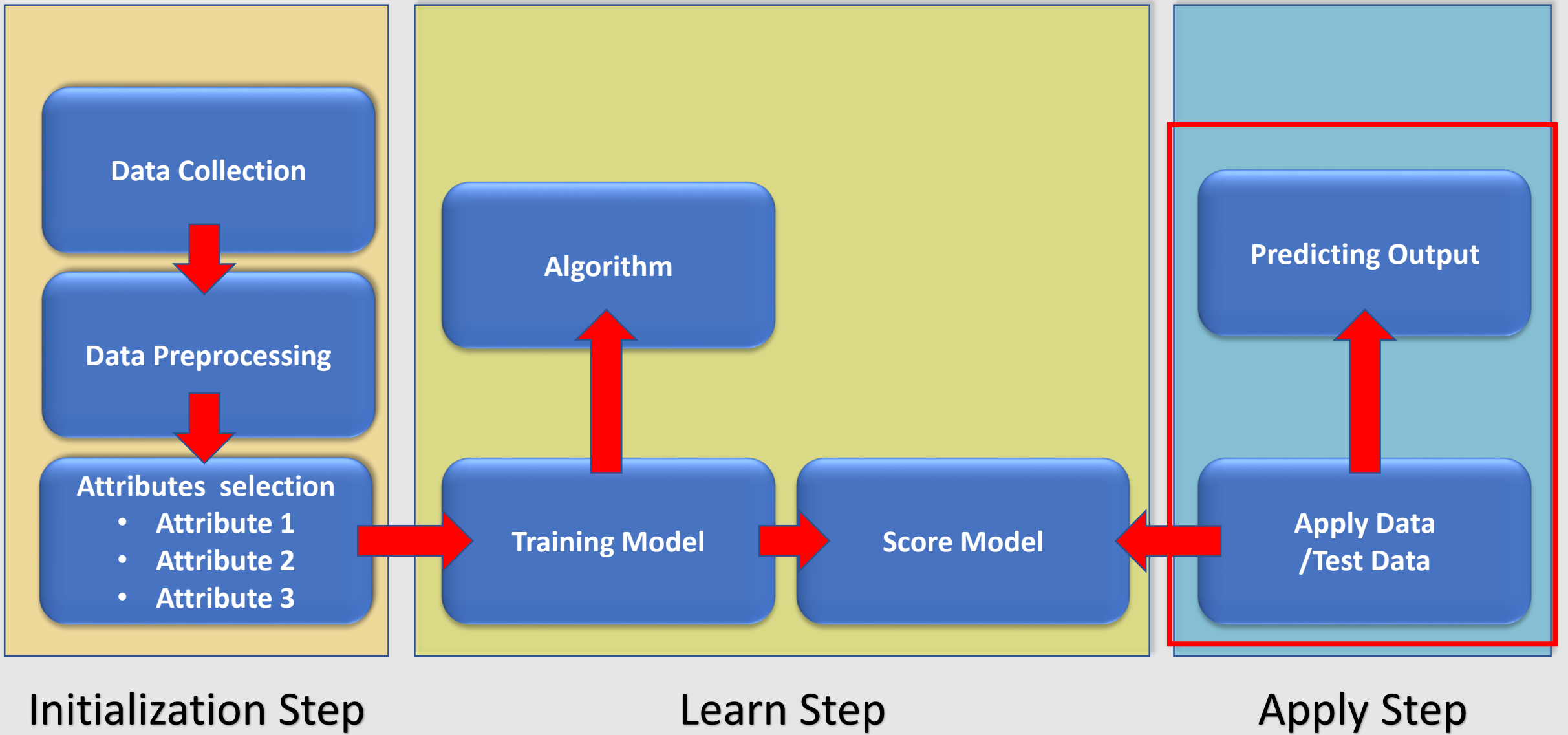
```
[19] RGtk2_2.20.31      stringr_1.1.0      caTools_1.17.1     gtools_3.5.0
[25] rtvs_1.0.0.0       stats4_3.3.2       grid_3.3.2         nnet_7.3-12
[31] minqa_1.2.4        Formula_1.2-1      reshape2_1.4.2     magrittr_1.5
[37] ModelMetrics_1.1.0 MASS_7.3-45         splines_3.3.2      assertthat_0.1
[43] labeling_0.3        quantreg_5.29      KernSmooth_2.23-15 stringi_1.1.2
  user system elapsed
769.02    3.16   770.47
> |
```

VS 2015

Console C:/Users/poku6001/Dropbox/My Documents/R/talks/chum-r/

```
[37] MASS_7.3-45         splines_3.3.2      assertthat_0.1     pkr
[41] colorspace_1.3-2    labeling_0.3        quantreg_5.29      Kern
[45] stringi_1.1.2       lazyeval_0.2.0     munsell_0.4.3
>
> # Stop the clock
> proc.time() - ptm
  user system elapsed
783.30    3.22   783.80
> |
```

RStudio



Machine Learning Framework

Predict test data

- Based on the training model, select the best model to be used for test data prediction

```
load_model.R  X customer_churn.R*
44 #####
45 # load model #
46 #####
47 load('churnmodel.rda')
48
49 #logic_reg <- glm(Churn ~ Contract
50 #               + InternetService
51 #               + tenure
52 #               + PaperlessBilling
53 #               + TotalCharges
54 #               + MultipleLines
55 #               + PaymentMethod
56 #               + SeniorCitizen
57 #               + StreamingTV
58 #               + OnlineSecurity
59 #               + TechSupport
60 #               + StreamingMovies
61 #               + MonthlyCharges
62 #               + PhoneService
63 #               + Dependents
64
65 #for glm, requires to select the same variables used in training
66 cust_data1 <- cust_data1[,c
67   ("Contract", "InternetService", "tenure", "PaperlessBilling", "TotalCharges", "MultipleLines", "PaymentMethod", "SeniorCitizen", "StreamingTV", "OnlineSecurity", "TechSupport", "StreamingMovies", "MonthlyCharges", "PhoneService", "Dependents", "Churn")]
67
```

Thanks!

Questions?



@kuanhoong



<https://www.linkedin.com/in/kuanhoong>



kuanhoong@gmail.com

DEMO