# Commonly used Machine Learning Algorithms (with Python and R Codes)



Home

Sunil Ray — September 9, 2017

Algorithm Business Analytics Classification Clustering Intermediate Listicle Machine Learning Python R Regression Structured Data Supervised Unsupervised

## Overview

- Major focus on commonly used machine learning algorithms
- Algorithms covered- Linear regression, logistic regression, Naive Bayes, kNN, Random forest, etc.
- Learn both theory and implementation of these algorithms in R and python

## Introduction

> Google's self-driving cars and robots get a lot of press, but the company's real future is in machine learning, the technology that enables computers to get smarter and more personal.
>
> – Eric Schmidt (Google Chairman)

We are probably living in the most defining period of human history. The period when computing moved from large mainframes to PCs to the cloud. But what makes it defining is not what has happened, but what is coming our way in years to come.

What makes this period exciting and enthralling for someone like me is the democratization of the various tools and techniques, which followed the boost in computing. Welcome to the world of data science!

Today, as a data scientist, I can build data-crunching machines with complex algorithms for a few dollars per hour. But reaching here wasn't easy! I had my dark days and nights.

*Are you a beginner looking for a place to start your data science journey? Presenting a list of comprehensive courses, full of knowledge and data science learning, curated just for you to learn data science (using Python) from scratch:*

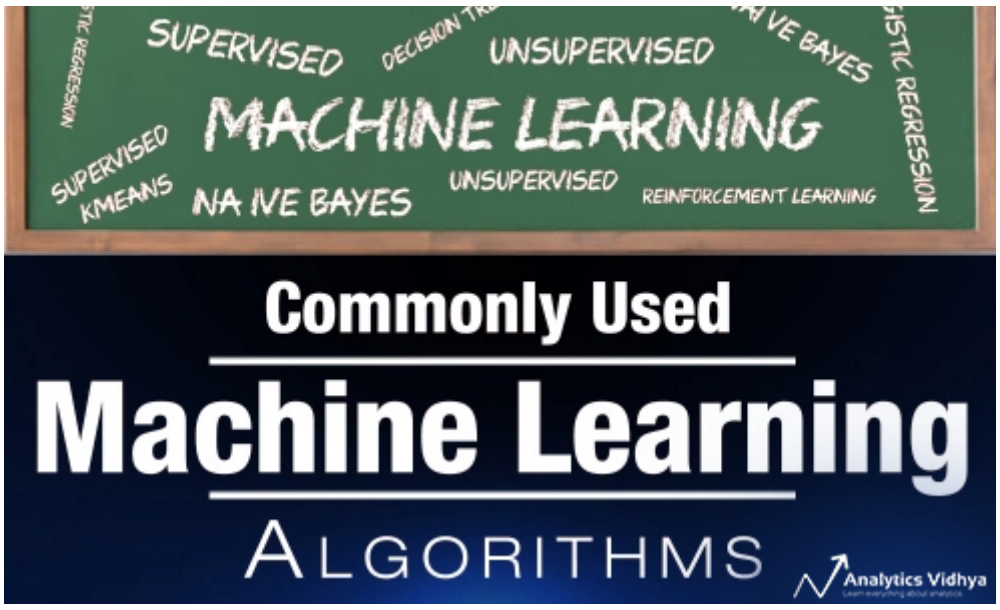
- Machine Learning Certification Course for Beginners
- *Introduction to Data Science*
- Certified AI & ML Blackbelt+ Program

## Who can benefit the most from this guide?

### What I am giving out today is probably the most valuable guide, I have ever created.

The idea behind creating this guide is to simplify the journey of aspiring data scientists and machine learning enthusiasts across the world. Through this guide, I will enable you to work on machine learning problems and gain from experience. **I am providing a high-level understanding of various machine learning algorithms along with R & Python codes to run them. These should be sufficient to get your hands dirty. You can also check out our Machine Learning Course.**

# Commonly used Machine Learning Algorithms (with Python and R Codes)




Essentials of machine learning algorithms with implementation in R and Python

I have deliberately skipped the statistics behind these techniques, as you don't need to understand them at the start. So, if you are looking for a statistical understanding of these algorithms, you should look elsewhere. But, if you are looking to equip yourself to start building a machine learning project, you are in for a treat.

## Broadly, there are 3 types of Machine Learning Algorithms

### 1. Supervised Learning

**How it works:** This algorithm consist of a target / outcome variable (or dependent variable) which is to be predicted from a given set of predictors (independent variables). Using these set of variables, we generate a function that map inputs to desired outputs. The training process continues until the model achieves a desired level of accuracy on the training data. Examples of Supervised Learning: Regression, Decision Tree, Random Forest, KNN, Logistic Regression etc.

### 2. Unsupervised Learning

**How it works:** In this algorithm, we do not have any target or outcome variable to predict / estimate. It is used for clustering population in different groups, which is widely used for segmenting customers in different groups for specific intervention. Examples of Unsupervised Learning: Apriori algorithm, K-means.

### 3. Reinforcement Learning:

**How it works:** Using this algorithm, the machine is trained to make specific decisions. It works this way: the machine is exposed to an environment where it trains itself continually using trial and error. This machine learns from past experience and tries to capture the best possible knowledge to make accurate business decisions. Example of Reinforcement Learning: Markov Decision Process

## List of Common Machine Learning Algorithms

Here is the list of commonly used machine learning algorithms. These algorithms can be applied to almost any data problem:

1. Linear Regression
2. Logistic Regression

**Commonly used Machine Learning Algorithms (with Python and R Codes)**

7. K-Means
8. Random Forest
9. Dimensionality Reduction Algorithms
10. Gradient Boosting algorithms
    1. GBM
    2. XGBoost
    3. LightGBM
    4. CatBoost

# 1. Linear Regression

It is used to estimate real values (cost of houses, number of calls, total sales etc.) based on continuous variable(s). Here, we establish relationship between independent and dependent variables by fitting a best line. This best fit line is known as regression line and represented by a linear equation Y= a *X + b.

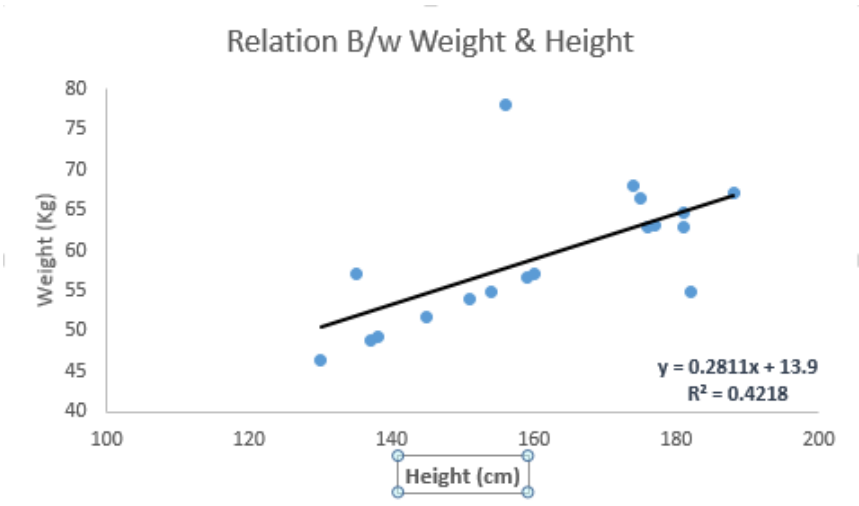
The best way to understand linear regression is to relive this experience of childhood. Let us say, you ask a child in fifth grade to arrange people in his class by increasing order of weight, without asking them their weights! What do you think the child will do? He / she would likely look (visually analyze) at the height and build of people and arrange them using a combination of these visible parameters. This is linear regression in real life! The child has actually figured out that height and build would be correlated to the weight by a relationship, which looks like the equation above.

In this equation:

- Y – Dependent Variable
- a – Slope
- X – Independent variable
- b – Intercept

These coefficients a and b are derived based on minimizing the sum of squared difference of distance between data points and regression line.

Look at the below example. Here we have identified the best fit line having linear equation **y=0.2811x+13.9**. Now using this equation, we can find the weight, knowing the height of a person.




Linear Regression is mainly of two types: Simple Linear Regression and Multiple Linear Regression. Simple Linear Regression is characterized by one independent variable. And, Multiple Linear Regression(as the name suggests) is characterized by multiple (more than 1) independent variables. While finding the best fit line, you can fit a polynomial or curvilinear regression. And these are known as polynomial or curvilinear regression.

Here's a coding window to try out your hand and build your own linear regression model in Python:

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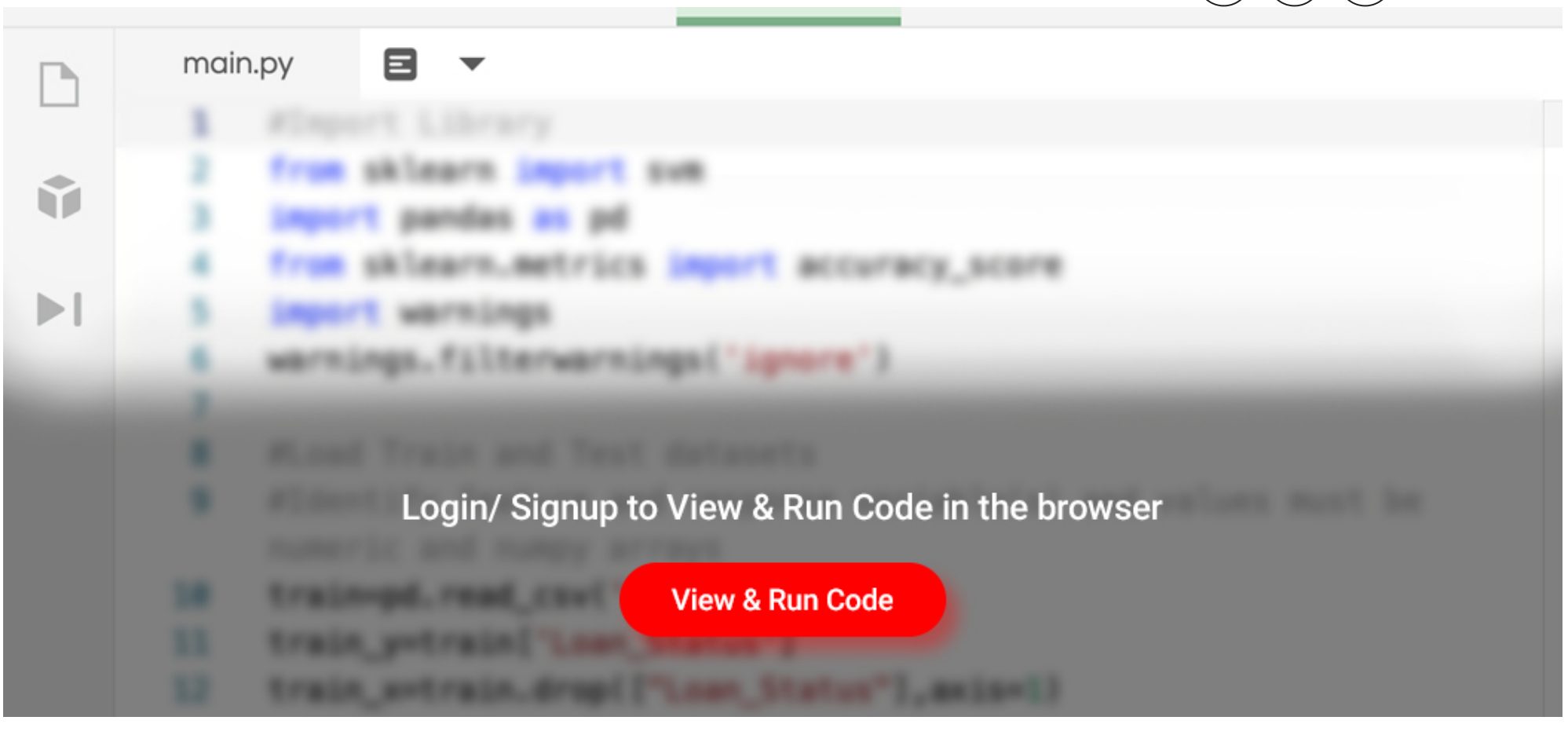


**R Code**

```
#Load Train and Test datasets
#Identify feature and response variable(s) and values must be numeric and numpy arrays
x_train <- input_variables_values_training_datasets
y_train <- target_variables_values_training_datasets
x_test <- input_variables_values_test_datasets
x <- cbind(x_train,y_train)
# Train the model using the training sets and check score
linear <- lm(y_train ~ ., data = x)
summary(linear)
#Predict Output
predicted= predict(linear,x_test)
```

## 2. Logistic Regression

Don’t get confused by its name! It is a classification not a regression algorithm. It is used to estimate discrete values ( Binary values like 0/1, yes/no, true/false ) based on given set of independent variable(s). In simple words, it predicts the probability of occurrence of an event by fitting data to a logit function. Hence, it is also known as **logit regression**. Since, it predicts the probability, its output values lies between 0 and 1 (as expected).

Again, let us try and understand this through a simple example.

Let’s say your friend gives you a puzzle to solve. There are only 2 outcome scenarios – either you solve it or you don’t. Now imagine, that you are being given wide range of puzzles / quizzes in an attempt to understand which subjects you are good at. The outcome to this study would be something like this – if you are given a trignometry based tenth grade problem, you are 70% likely to solve it. On the other hand, if it is grade fifth history question, the probability of getting an answer is only 30%. This is what Logistic Regression provides you.

Coming to the math, the log odds of the outcome is modeled as a linear combination of the predictor variables.

```
odds= p/ (1-p) = probability of event occurrence / probability of not event occurrence
ln(odds) = ln(p/(1-p))
```

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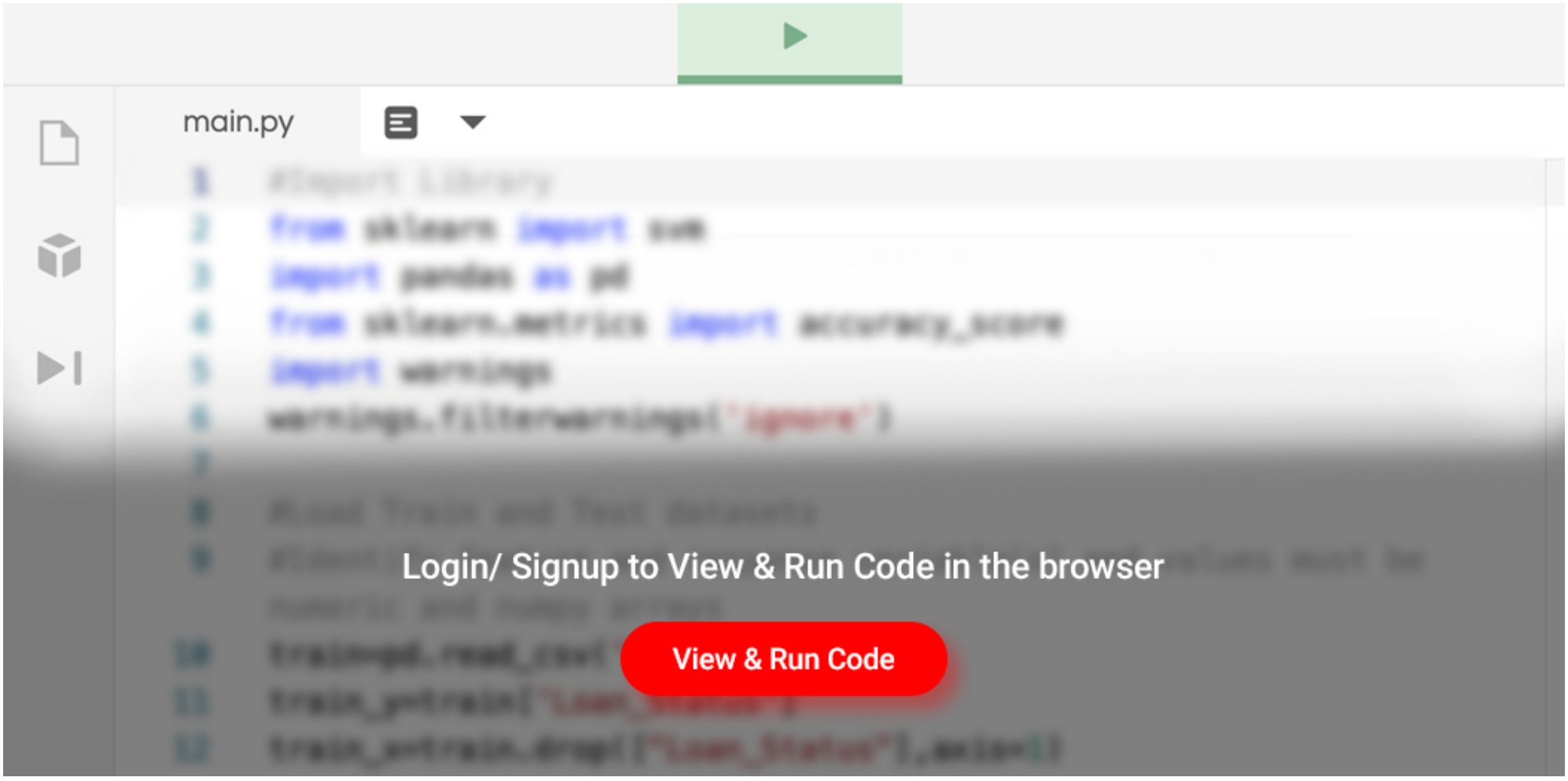
observing the sample values rather than that minimize the sum of squared errors (like in ordinary regression).

Now, you may ask, why take a log? For the sake of simplicity, let's just say that this is one of the best mathematical way to replicate a step function. I can go in more details, but that will beat the purpose of this article.

Build your own logistic regression model in Python here and check the accuracy:




**R Code**

```
x <- cbind(x_train,y_train)
# Train the model using the training sets and check score
logistic <- glm(y_train ~ ., data = x,family='binomial')
summary(logistic)
#Predict Output
predicted= predict(logistic,x_test)
```

## Furthermore..

There are many different steps that could be tried in order to improve the model:

- including interaction terms
- removing features
- regularization techniques

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This is one of my favorite algorithm and I use it quite frequently. It is a type of supervised learning algorithm that is mostly used for classification problems. Surprisingly, it works for both categorical and continuous dependent variables. In this algorithm, we split the population into two or more homogeneous sets. This is done based on most significant attributes/ independent variables to make as distinct groups as possible. For more details, you can read: Decision Tree Simplified.

source: statsexchange

In the image above, you can see that population is classified into four different groups based on multiple attributes to identify 'if they will play or not'. To split the population into different heterogeneous groups, it uses various techniques like Gini, Information Gain, Chi-square, entropy.

The best way to understand how decision tree works, is to play Jezzball – a classic game from Microsoft (image below). Essentially, you have a room with moving walls and you need to create walls such that maximum area gets cleared off with out the balls.

So, every time you split the room with a wall, you are trying to create 2 different populations with in the same room. Decision trees work in very similar fashion by dividing a population in as different groups as possible.

*More*: Simplified Version of Decision Tree Algorithms

Let's get our hands dirty and code our own decision tree in Python!

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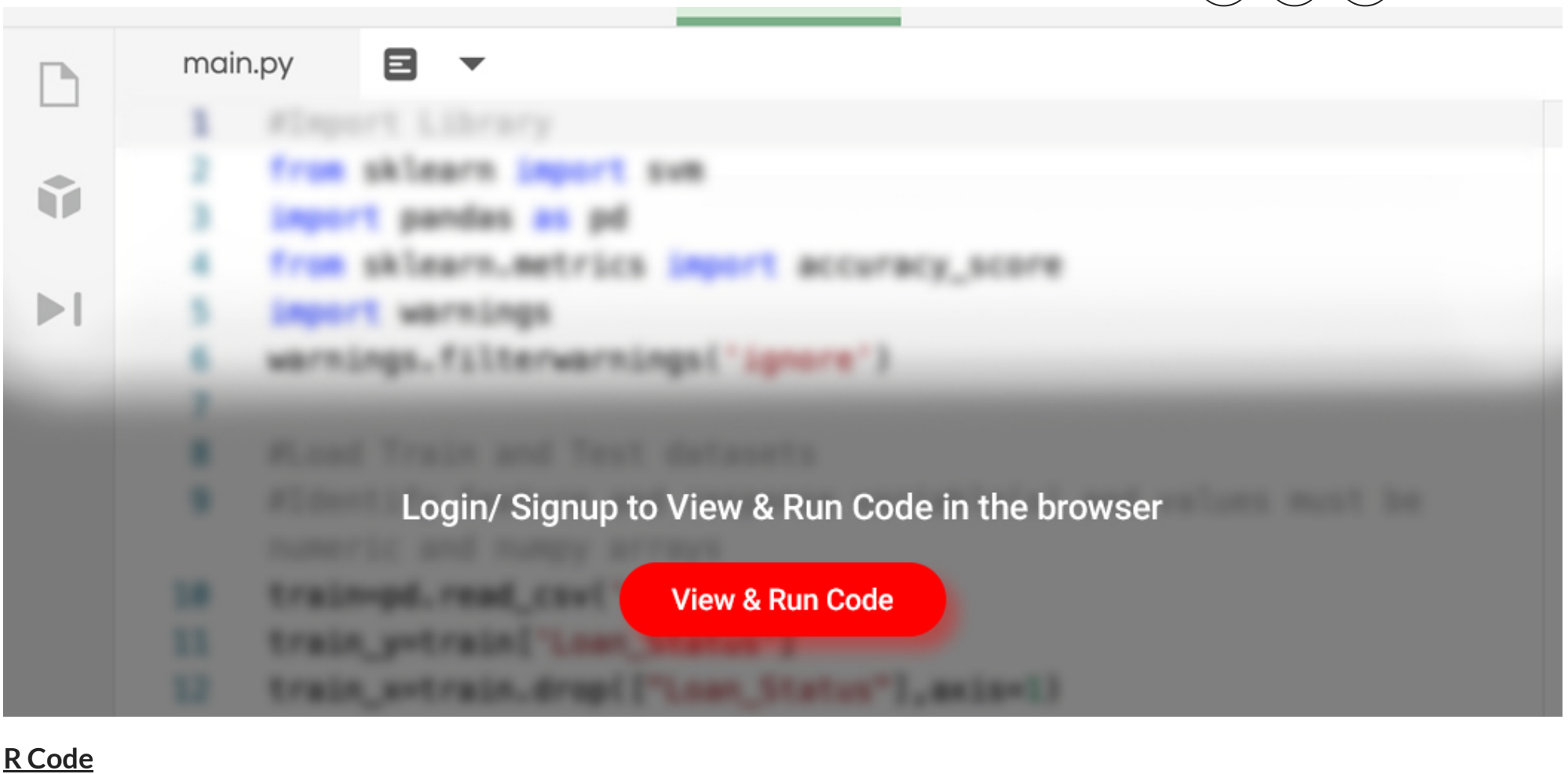


**R Code**

```
library(rpart)
x <- cbind(x_train,y_train)
# grow tree
fit <- rpart(y_train ~ ., data = x,method="class")
summary(fit)
#Predict Output
predicted= predict(fit,x_test)
```

## 4. SVM (Support Vector Machine)

It is a classification method. In this algorithm, we plot each data item as a point in n-dimensional space (where n is number of features you have) with the value of each feature being the value of a particular coordinate.

For example, if we only had two features like Height and Hair length of an individual, we'd first plot these two variables in two dimensional space where each point has two co-ordinates (these co-ordinates are known as **Support Vectors**)

Now, we will find some *line* that splits the data between the two differently classified groups of data. This will be the line such that the distances from the closest point in each of the two groups will be farthest away.

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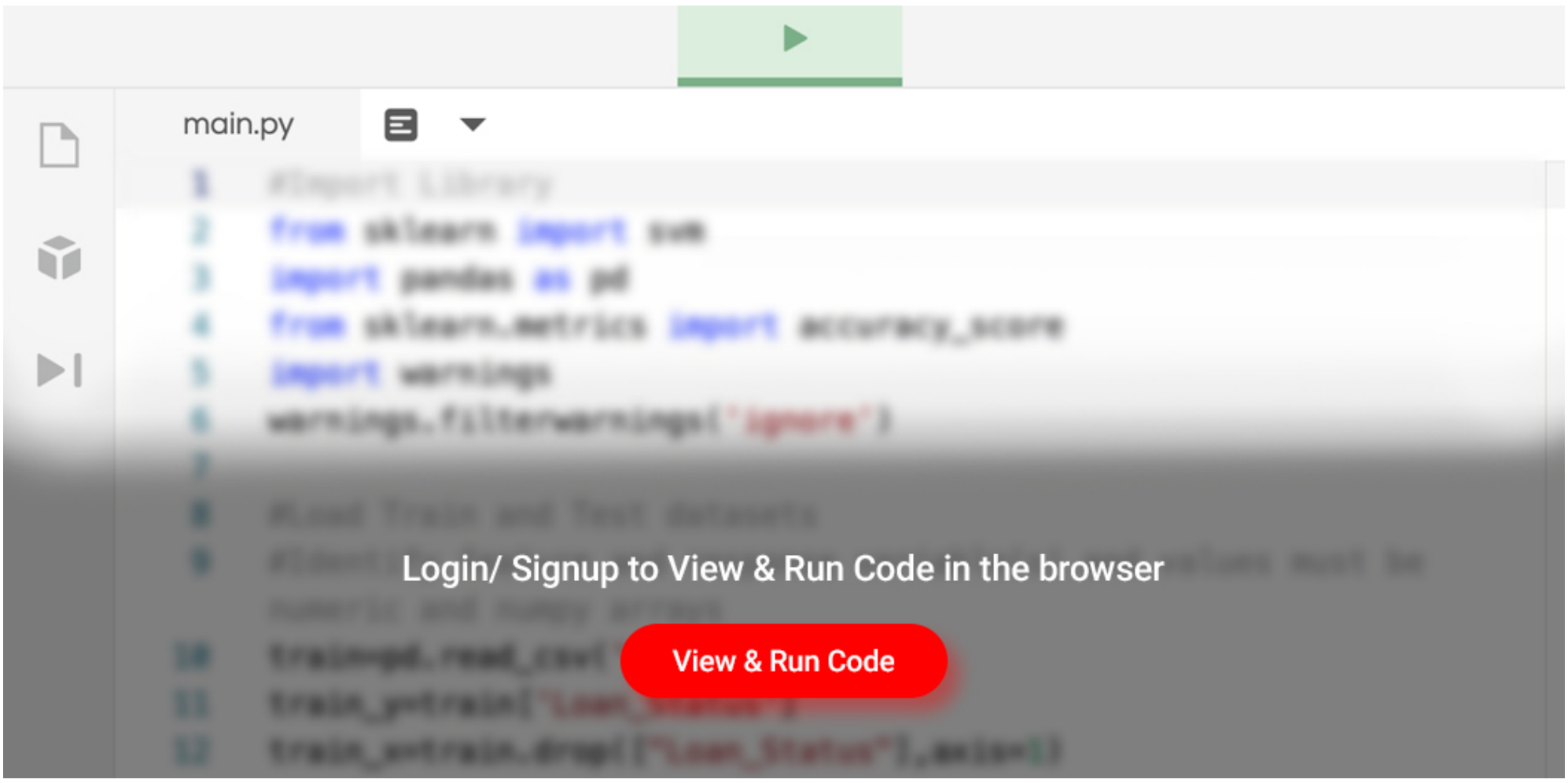
In the example shown above, the line which splits the data into two differently classified groups is the *black* line, since the two closest points are the farthest apart from the line. This line is our classifier. Then, depending on where the testing data lands on either side of the line, that's what class we can classify the new data as.

More: Simplified Version of Support Vector Machine

**Think of this algorithm as playing JezzBall in n-dimensional space. The tweaks in the game are:**

- You can draw lines/planes at any angles (rather than just horizontal or vertical as in the classic game)
- The objective of the game is to segregate balls of different colors in different rooms.
- And the balls are not moving.

Try your hand and design an SVM model in Python through this coding window:




**R Code**

```
library(e1071)
x <- cbind(x_train,y_train)
# Fitting model
fit <-svm(y_train ~ ., data = x)
summary(fit)
#Predict Output
predicted= predict(fit,x_test)
```

# 5. Naive Bayes

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terms, a Naive Bayes classifier assumes that the presence of a particular feature in a class is unrelated to the presence of any other feature. For example, a fruit may be considered to be an apple if it is red, round, and about 3 inches in diameter. Even if these features depend on each other or upon the existence of the other features, a naive Bayes classifier would consider all of these properties to independently contribute to the probability that this fruit is an apple.

Naive Bayesian model is easy to build and particularly useful for very large data sets. Along with simplicity, Naive Bayes is known to outperform even highly sophisticated classification methods.

Bayes theorem provides a way of calculating posterior probability P(c|x) from P(c), P(x) and P(x|c). Look at the equation below:

Here,

- *P*(*c*|*x*) is the posterior probability of *class* (*target*) given *predictor* (*attribute*).
- *P*(*c*) is the prior probability of *class*.
- *P*(*x*|*c*) is the likelihood which is the probability of *predictor* given *class*.
- *P*(*x*) is the prior probability of *predictor*.

**Example:** Let's understand it using an example. Below I have a training data set of weather and corresponding target variable 'Play'. Now, we need to classify whether players will play or not based on weather condition. Let's follow the below steps to perform it.

Step 1: Convert the data set to frequency table

Step 2: Create Likelihood table by finding the probabilities like Overcast probability = 0.29 and probability of playing is 0.64.

Step 3: Now, use Naive Bayesian equation to calculate the posterior probability for each class. The class with the highest posterior probability is the outcome of prediction.

**Problem:** Players will pay if weather is sunny, is this statement is correct?

We can solve it using above discussed method, so P(Yes | Sunny) = P( Sunny | Yes) * P(Yes) / P (Sunny)

Here we have P (Sunny |Yes) = 3/9 = 0.33, P(Sunny) = 5/14 = 0.36, P( Yes)= 9/14 = 0.64

Now, P (Yes | Sunny) = 0.33 * 0.64 / 0.36 = 0.60, which has higher probability.

Naive Bayes uses a similar method to predict the probability of different class based on various attributes. This algorithm is

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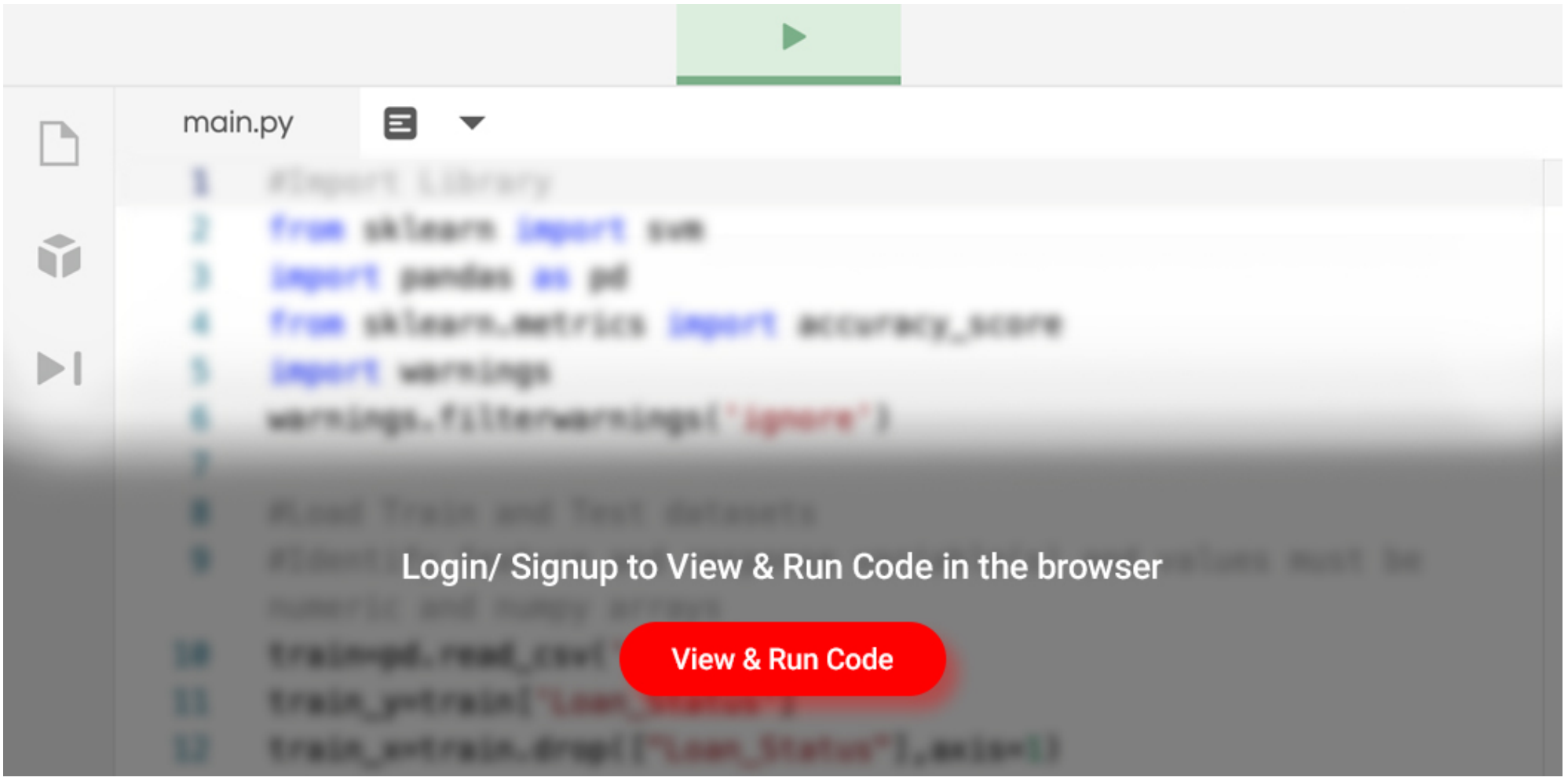


**R Code**

```
library(e1071)
x <- cbind(x_train,y_train)
# Fitting model
fit <-naiveBayes(y_train ~ ., data = x)
summary(fit)
#Predict Output
predicted= predict(fit,x_test)
```

# 6. kNN (k- Nearest Neighbors)

It can be used for both classification and regression problems. However, it is more widely used in classification problems in the industry. K nearest neighbors is a simple algorithm that stores all available cases and classifies new cases by a majority vote of its k neighbors. The case being assigned to the class is most common amongst its K nearest neighbors measured by a distance function.

These distance functions can be Euclidean, Manhattan, Minkowski and Hamming distance. First three functions are used for continuous function and fourth one (Hamming) for categorical variables. If K = 1, then the case is simply assigned to the class of its nearest neighbor. At times, choosing K turns out to be a challenge while performing kNN modeling.

More: Introduction to k-nearest neighbors : Simplified.

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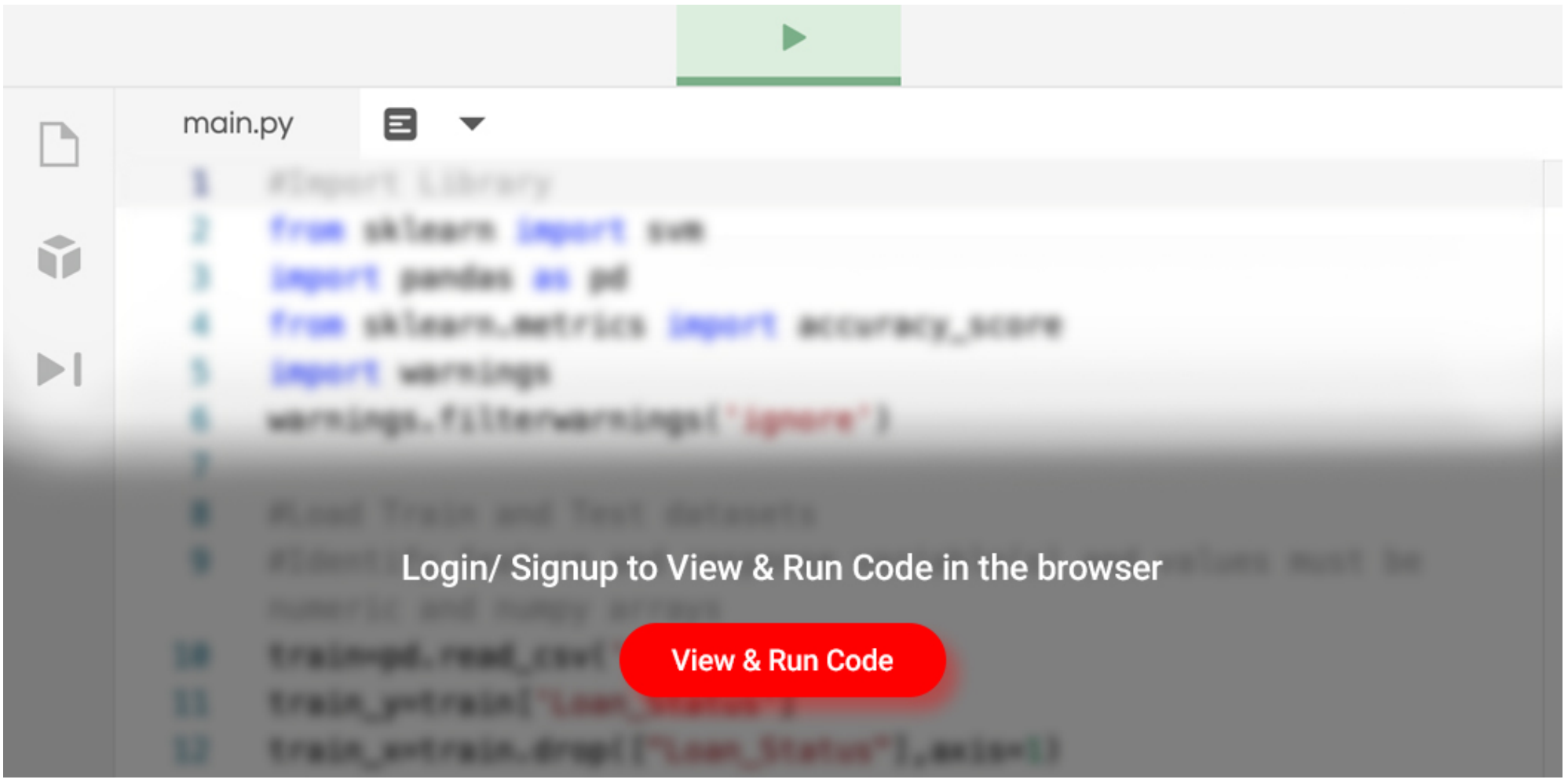
- KNN is computationally expensive
- Variables should be normalized else higher range variables can bias it
- Works on pre-processing stage more before going for kNN like an outlier, noise removal

Python Code




**R Code**

```
library(knn)
x <- cbind(x_train,y_train)
# Fitting model
fit <-knn(y_train ~ ., data = x,k=5)
summary(fit)
#Predict Output
predicted= predict(fit,x_test)
```

# 7. K-Means

It is a type of unsupervised algorithm which solves the clustering problem. Its procedure follows a simple and easy way to classify a given data set through a certain number of clusters (assume k clusters). Data points inside a cluster are homogeneous and heterogeneous to peer groups.

Remember figuring out shapes from ink blots? k means is somewhat similar this activity. You look at the shape and spread to decipher how many different clusters / population are present!

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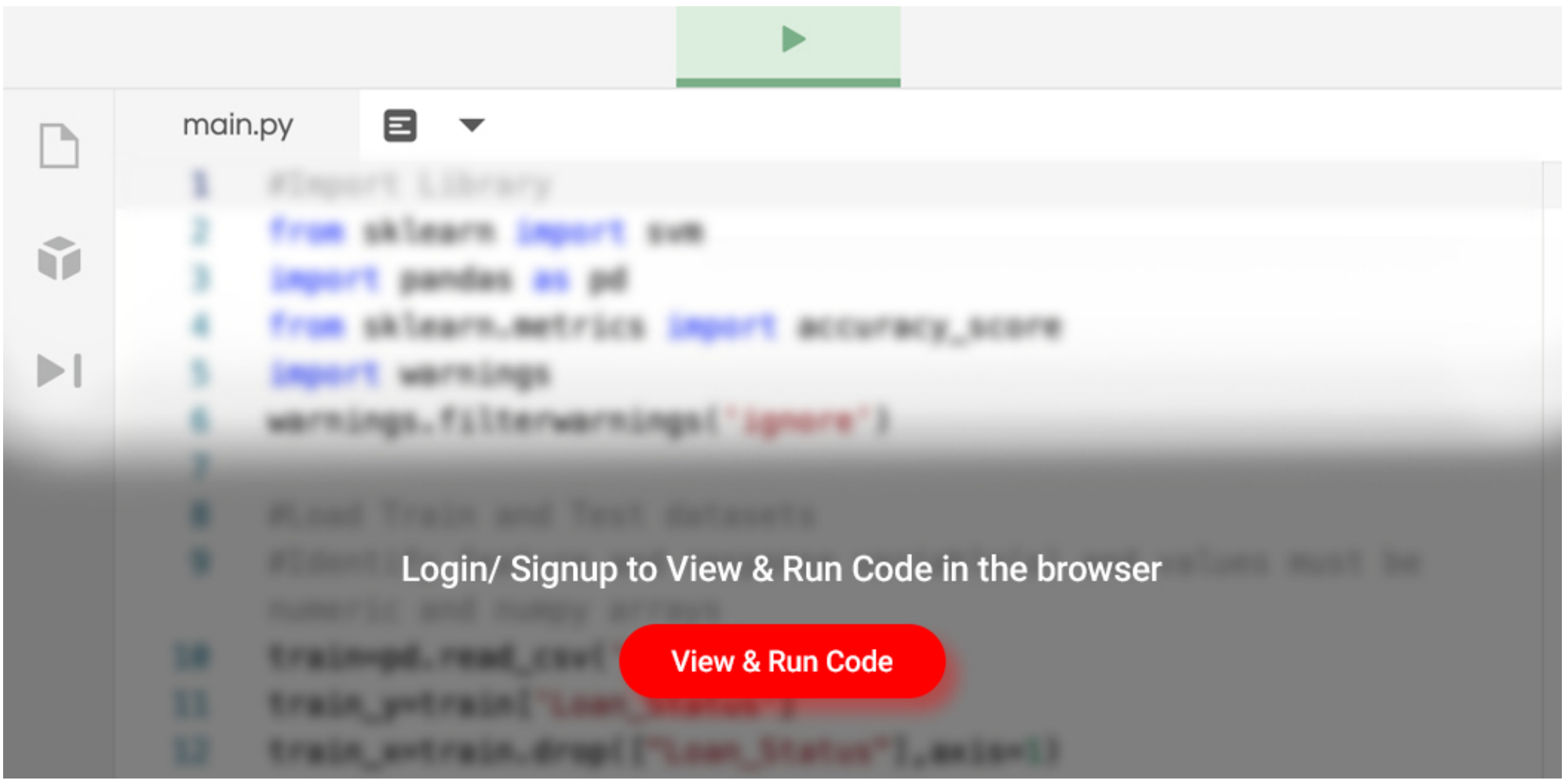
1. K-means picks k number of points for each cluster known as centroids.
2. Each data point forms a cluster with the closest centroids i.e. k clusters.
3. Finds the centroid of each cluster based on existing cluster members. Here we have new centroids.
4. As we have new centroids, repeat step 2 and 3. Find the closest distance for each data point from new centroids and get associated with new k-clusters. Repeat this process until convergence occurs i.e. centroids does not change.

**How to determine value of K:**

In K-means, we have clusters and each cluster has its own centroid. Sum of square of difference between centroid and the data points within a cluster constitutes within sum of square value for that cluster. Also, when the sum of square values for all the clusters are added, it becomes total within sum of square value for the cluster solution.

We know that as the number of cluster increases, this value keeps on decreasing but if you plot the result you may see that the sum of squared distance decreases sharply up to some value of k, and then much more slowly after that. Here, we can find the optimum number of cluster.

Python Code




**R Code**

```
library(cluster)
fit <- kmeans(X, 3) # 5 cluster solution
```

## Commonly used Machine Learning Algorithms (with Python and R Codes)

known as “Forest”). To classify a new object based on attributes, each tree gives a classification and we say the tree “votes” for that class. The forest chooses the classification having the most votes (over all the trees in the forest).

Each tree is planted & grown as follows:

1. If the number of cases in the training set is N, then sample of N cases is taken at random but *with replacement*. This sample will be the training set for growing the tree.
2. If there are M input variables, a number m<<M is specified such that at each node, m variables are selected at random out of the M and the best split on these m is used to split the node. The value of m is held constant during the forest growing.
3. Each tree is grown to the largest extent possible. There is no pruning.

For more details on this algorithm, comparing with decision tree and tuning model parameters, I would suggest you to read these articles:

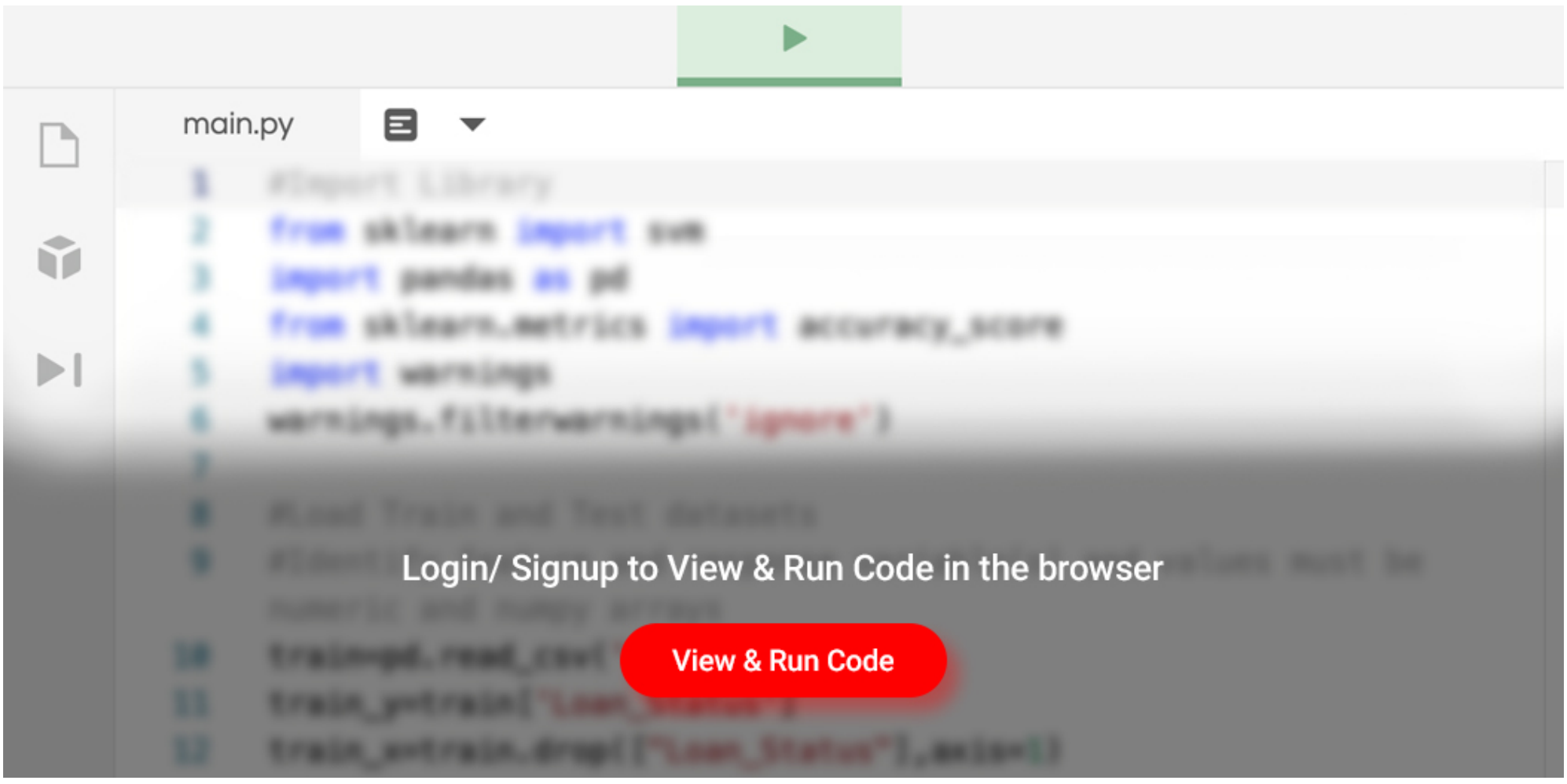
1. Introduction to Random forest – Simplified

2. Comparing a CART model to Random Forest (Part 1)

3. Comparing a Random Forest to a CART model (Part 2)

4. Tuning the parameters of your Random Forest model

**Python Code:**




**R Code**

```
library(randomForest)
x <- cbind(x_train,y_train)
# Fitting model
fit <- randomForest(Species ~ ., x,ntree=500)
summary(fit)
#Predict Output
predicted= predict(fit,x_test)
```

## Commonly used Machine Learning Algorithms (with Python and R Codes)

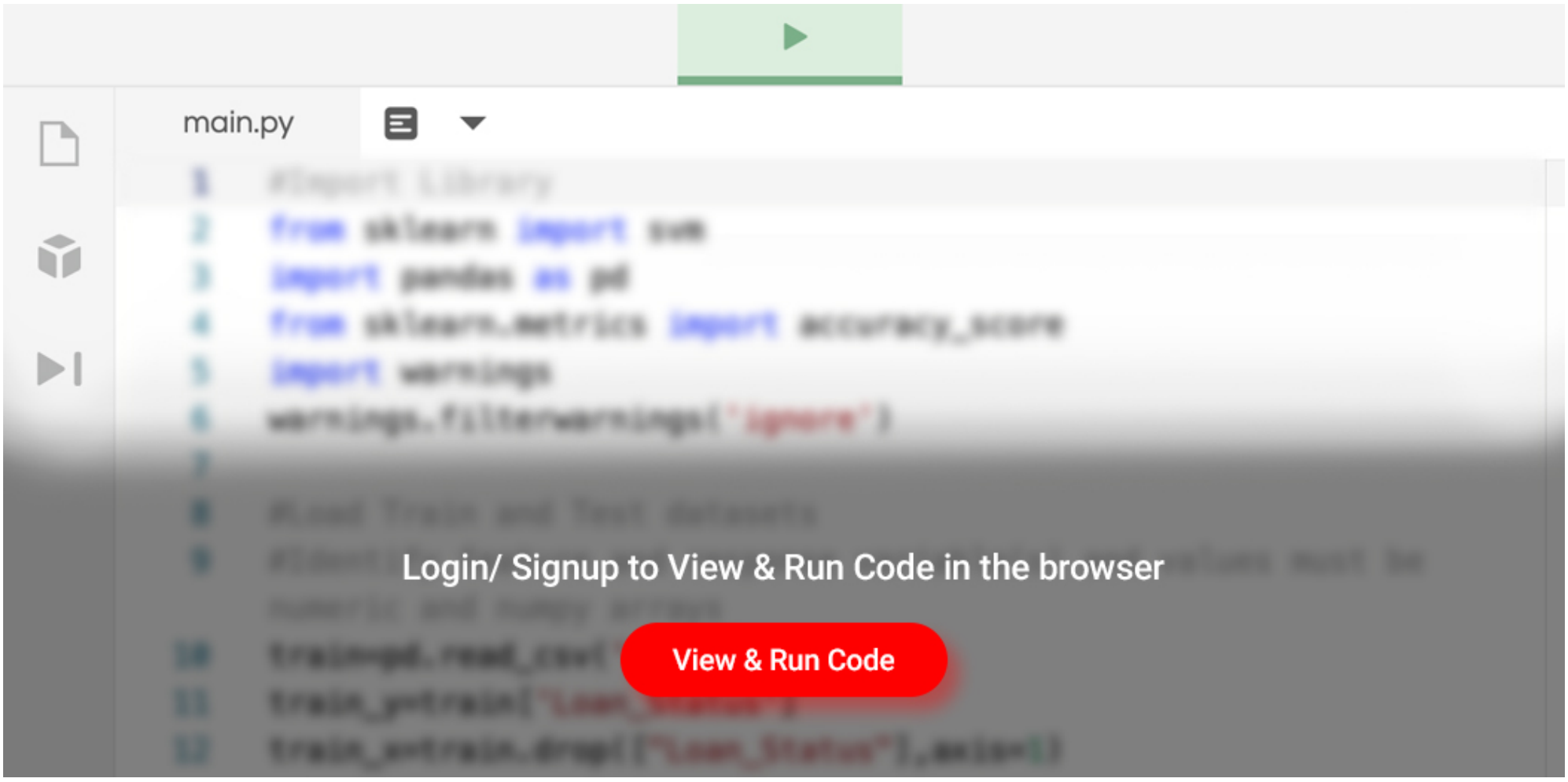
Government Agencies/ Research organisations are not only coming with new sources but also they are capturing data in great detail.

For example: E-commerce companies are capturing more details about customer like their demographics, web crawling history, what they like or dislike, purchase history, feedback and many others to give them personalized attention more than your nearest grocery shopkeeper.

As a data scientist, the data we are offered also consist of many features, this sounds good for building good robust model but there is a challenge. How'd you identify highly significant variable(s) out 1000 or 2000? In such cases, dimensionality reduction algorithm helps us along with various other algorithms like Decision Tree, Random Forest, PCA, Factor Analysis, Identify based on correlation matrix, missing value ratio and others.

To know more about this algorithms, you can read "Beginners Guide To Learn Dimension Reduction Techniques".

### Python Code




### R Code

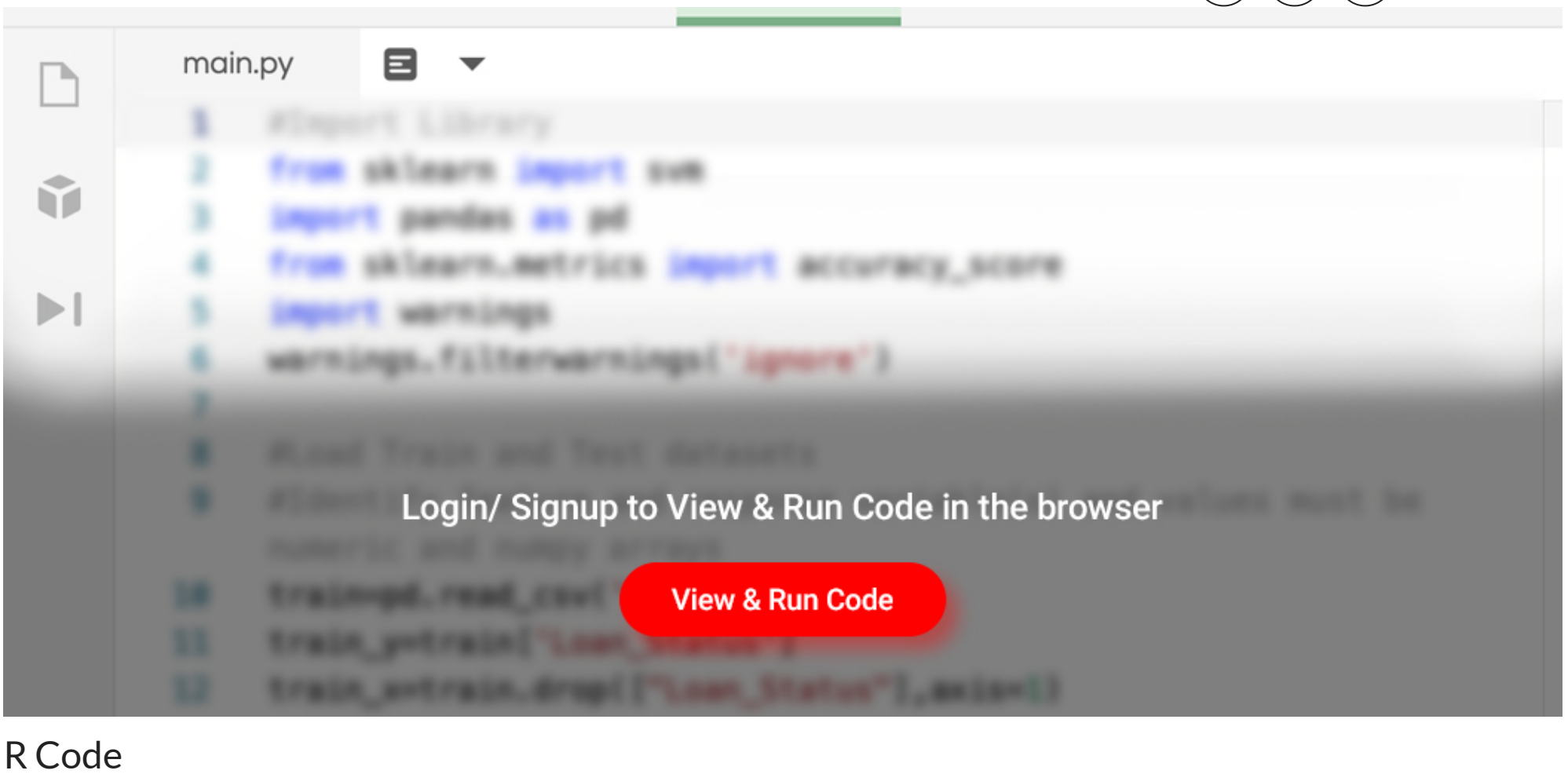
```
library(stats)
pca <- princomp(train, cor = TRUE)
train_reduced  <- predict(pca,train)
test_reduced  <- predict(pca,test)
```

## 10. Gradient Boosting Algorithms

### 10.1. GBM

GBM is a boosting algorithm used when we deal with plenty of data to make a prediction with high prediction power. Boosting is actually an ensemble of learning algorithms which combines the prediction of several base estimators in order to improve robustness over a single estimator. It combines multiple weak or average predictors to a build strong predictor. These boosting algorithms always work well in data science competitions like Kaggle, AV Hackathon, CrowdAnalytix.

# Commonly used Machine Learning Algorithms (with Python and R Codes)




## R Code

```
library(caret)
x <- cbind(x_train,y_train)
# Fitting model
fitControl <- trainControl( method = "repeatedcv", number = 4, repeats = 4)
fit <- train(y ~ ., data = x, method = "gbm", trControl = fitControl,verbose = FALSE)
predicted= predict(fit,x_test,type= "prob")[,2]
```

GradientBoostingClassifier and Random Forest are two different boosting tree classifier and often people ask about the difference between these two algorithms.

## 10.2. XGBoost

Another classic gradient boosting algorithm that's known to be the decisive choice between winning and losing in some Kaggle competitions.

The XGBoost has an immensely high predictive power which makes it the best choice for accuracy in events as it possesses both linear model and the tree learning algorithm, making the algorithm almost 10x faster than existing gradient booster techniques.

The support includes various objective functions, including regression, classification and ranking.

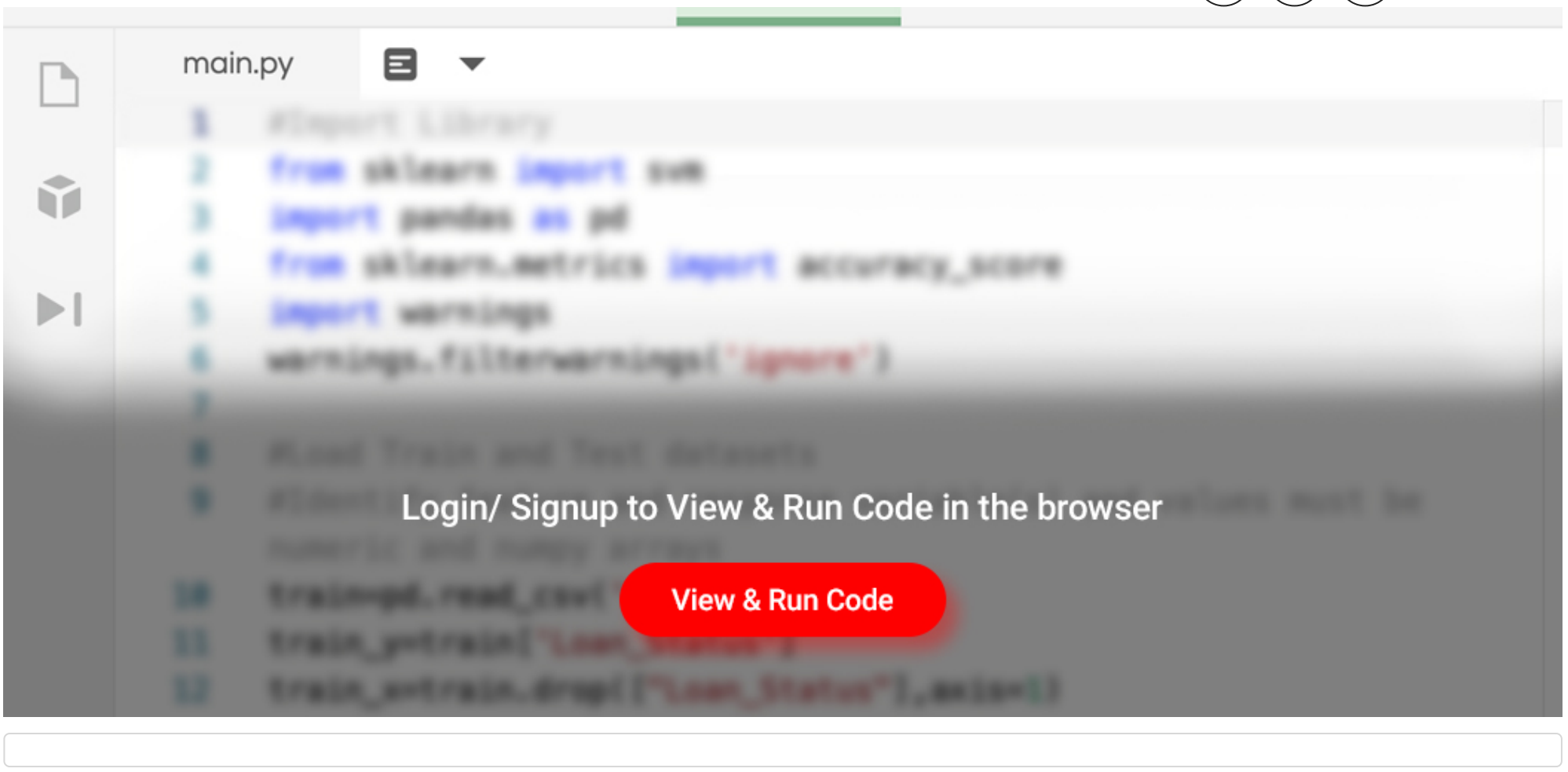
One of the most interesting things about the XGBoost is that it is also called a regularized boosting technique. This helps to reduce overfit modelling and has a massive support for a range of languages such as Scala, Java, R, Python, Julia and C++.

Supports distributed and widespread training on many machines that encompass GCE, AWS, Azure and Yarn clusters. XGBoost can also be integrated with Spark, Flink and other cloud dataflow systems with a built in cross validation at each iteration of the boosting process.

To learn more about XGBoost and parameter tuning, visit https://www.analyticsvidhya.com/blog/2016/03/complete-guide-parameter-tuning-xgboost-with-codes-python/.

**Python Code:**

## Commonly used Machine Learning Algorithms (with Python and R Codes)




R Code:

```
require(caret)

x <- cbind(x_train,y_train)

# Fitting model

TrainControl <- trainControl( method = "repeatedcv", number = 10, repeats = 4)

model<- train(y ~ ., data = x, method = "xgbLinear", trControl = TrainControl,verbose = FALSE)

OR

model<- train(y ~ ., data = x, method = "xgbTree", trControl = TrainControl,verbose = FALSE)

predicted <- predict(model, x_test)
```

## 10.3. LightGBM

LightGBM is a gradient boosting framework that uses tree based learning algorithms. It is designed to be distributed and efficient with the following advantages:

- Faster training speed and higher efficiency
- Lower memory usage
- Better accuracy
- Parallel and GPU learning supported
- Capable of handling large-scale data

The framework is a fast and high-performance gradient boosting one based on decision tree algorithms, used for ranking, classification and many other machine learning tasks. It was developed under the Distributed Machine Learning Toolkit Project of Microsoft.

Since the LightGBM is based on decision tree algorithms, it splits the tree leaf wise with the best fit whereas other boosting

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Also, it is surprisingly very fast, hence the word 'Light'.

Refer to the article to know more about LightGBM: https://www.analyticsvidhya.com/blog/2017/06/which-algorithm-takes-the-crown-light-gbm-vs-xgboost/

Python Code:

```
data = np.random.rand(500, 10) # 500 entities, each contains 10 features
label = np.random.randint(2, size=500) # binary target

train_data = lgb.Dataset(data, label=label)
test_data = train_data.create_valid('test.svm')

param = {'num_leaves':31, 'num_trees':100, 'objective':'binary'}
param['metric'] = 'auc'

num_round = 10
bst = lgb.train(param, train_data, num_round, valid_sets=[test_data])

bst.save_model('model.txt')

# 7 entities, each contains 10 features
data = np.random.rand(7, 10)
ypred = bst.predict(data)
```

R Code:

```
library(RLightGBM)
data(example.binary)
#Parameters

num_iterations <- 100
config <- list(objective = "binary",  metric="binary_logloss,auc", learning_rate = 0.1, num_leaves = 63,
tree_learner = "serial", feature_fraction = 0.8, bagging_freq = 5, bagging_fraction = 0.8, min_data_in_leaf =
50, min_sum_hessian_in_leaf = 5.0)

#Create data handle and booster
handle.data <- lgbm.data.create(x)

lgbm.data.setField(handle.data, "label", y)

handle.booster <- lgbm.booster.create(handle.data, lapply(config, as.character))

#Train for num_iterations iterations and eval every 5 steps

lgbm.booster.train(handle.booster, num_iterations, 5)

#Predict
pred <- lgbm.booster.predict(handle.booster, x.test)

#Test accuracy
sum(y.test == (y.pred > 0.5)) / length(y.test)

#Save model (can be loaded again via lgbm.booster.load(filename))
lgbm.booster.save(handle.booster, filename = "/tmp/model.txt")
```

## Commonly used Machine Learning Algorithms (with Python and R Codes)

```
require(RLightGBM)
data(iris)

model <-caretModel.LGBM()

fit <- train(Species ~ ., data = iris, method=model, verbosity = 0)
print(fit)
y.pred <- predict(fit, iris[,1:4])

library(Matrix)
model.sparse <- caretModel.LGBM.sparse()

#Generate a sparse matrix
mat <- Matrix(as.matrix(iris[,1:4]), sparse = T)
fit <- train(data.frame(idx = 1:nrow(iris)), iris$Species, method = model.sparse, matrix = mat, verbosity = 0)
print(fit)
```

# 10.4. Catboost

CatBoost is a recently open-sourced machine learning algorithm from Yandex. It can easily integrate with deep learning frameworks like Google's TensorFlow and Apple's Core ML.

The best part about CatBoost is that it does not require extensive data training like other ML models, and can work on a variety of data formats; not undermining how robust it can be.

Make sure you handle missing data well before you proceed with the implementation.

Catboost can automatically deal with categorical variables without showing the type conversion error, which helps you to focus on tuning your model better rather than sorting out trivial errors.

Learn more about Catboost from this article: https://www.analyticsvidhya.com/blog/2017/08/catboost-automated-categorical-data/

Python Code:

## Commonly used Machine Learning Algorithms (with Python and R Codes)

```
import numpy as np

from catboost import CatBoostRegressor

#Read training and testing files
train = pd.read_csv("train.csv")
test = pd.read_csv("test.csv")

#Imputing missing values for both train and test
train.fillna(-999, inplace=True)
test.fillna(-999,inplace=True)

#Creating a training set for modeling and validation set to check model performance
X = train.drop(['Item_Outlet_Sales'], axis=1)
y = train.Item_Outlet_Sales

from sklearn.model_selection import train_test_split

X_train, X_validation, y_train, y_validation = train_test_split(X, y, train_size=0.7, random_state=1234)
categorical_features_indices = np.where(X.dtypes != np.float)[0]

#importing library and building model
from catboost import CatBoostRegressormodel=CatBoostRegressor(iterations=50, depth=3, learning_rate=0.1,
loss_function='RMSE')

model.fit(X_train, y_train,cat_features=categorical_features_indices,eval_set=(X_validation,
y_validation),plot=True)

submission = pd.DataFrame()

submission['Item_Identifier'] = test['Item_Identifier']
submission['Outlet_Identifier'] = test['Outlet_Identifier']
submission['Item_Outlet_Sales'] = model.predict(test)
```

R Code:

## Commonly used Machine Learning Algorithms (with Python and R Codes)

```
require(titanic)

require(caret)

require(catboost)

tt <- titanic::titanic_train[complete.cases(titanic::titanic_train),]

data <- as.data.frame(as.matrix(tt), stringsAsFactors = TRUE)

drop_columns = c("PassengerId", "Survived", "Name", "Ticket", "Cabin")

x <- data[,!(names(data) %in% drop_columns)]y <- data[,c("Survived")]

fit_control <- trainControl(method = "cv", number = 4,classProbs = TRUE)

grid <- expand.grid(depth = c(4, 6, 8),learning_rate = 0.1,iterations = 100, l2_leaf_reg = 1e-3,
rsm = 0.95, border_count = 64)

report <- train(x, as.factor(make.names(y)),method = catboost.caret,verbose = TRUE, preProc = NULL,tuneGrid =
grid, trControl = fit_control)

print(report)

importance <- varImp(report, scale = FALSE)

print(importance)
```

# Projects

Now, its time to take the plunge and actually play with some other real datasets. So are you ready to take on the challenge?

Accelerate your data science journey with the following Practice Problems:

| | | |
|---|---|---|
| | Practice Problem: Food Demand Forecasting Challenge | Predict the demand of meals for a meal delivery company |
| | Practice Problem: HR Analytics Challenge | Identify the employees most likely to get promoted |
| | Practice Problem: Predict Number of Upvotes | Predict number of upvotes on a query asked at an online question & answer platform |

article and providing the codes in R and Python is to get you started right away. If you are keen to master machine learning, start right away. Take up problems, develop a physical understanding of the process, apply these codes and see the fun!

Did you find this article useful ? Share your views and opinions in the comments section below.

If you like what you just read & want to continue your analytics learning, subscribe to our emails, follow us on twitter or like our facebook page.

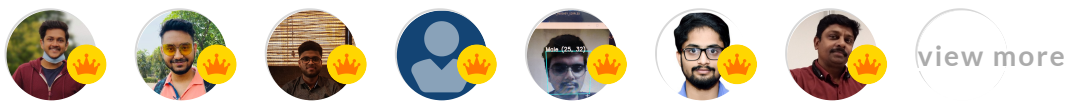
C4.5 cart catboost data science decision tree GBM K-Means KNN LightGBM linear regression live coding logistic regression machine learning Naive Bayes Neural network random forest Reinforcement Supervised Learning SVM Unsupervised XGBoost

## About the Author

Sunil Ray

I am a Business Analytics and Intelligence professional with deep experience in the Indian Insurance industry. I have worked for various multi-national Insurance companies in last 7 years.

## Our Top Authors

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Exclusive Interview with Pankaj Kulshreshtha, CEO, Scienaptic Systems

## 76 thoughts on "Commonly used Machine Learning Algorithms (with Python and R Codes)"

Kuber says:

**August 10, 2015 at 11:59 pm**

Awesowe compilation!! Thank you.

Reply

Karthikeyan says:

# Commonly used Machine Learning Algorithms (with Python and R Codes)

Hemanth says:
**August 11, 2015 at 4:50 am**

Straight, Informative and effective!! Thank you

Reply

---

venugopal says:
**August 11, 2015 at 6:05 am**

Good Summary airticle

Reply

---

Dr Venugopala Rao says:
**August 11, 2015 at 6:27 am**

Super Compilation...

Reply

---

Kishor Basyal says:
**August 11, 2015 at 7:30 am**

Wonderful! Really helpful

Reply

---

Brian Thomas says:
**August 11, 2015 at 9:24 am**

Very nicely done! Thanks for this.

Reply

---

Tesfaye says:
**August 11, 2015 at 10:30 am**

Thank you! Well presented article.

Reply

---

Tesfaye says:
**August 11, 2015 at 10:31 am**

Thank you! Well presented.

Reply

---

Huzefa says:
**August 11, 2015 at 3:53 pm**

Hello, Superb information in just one blog. Can anyone help me to run the codes in R what should be replaced with "~" symbol in codes? Help is appreciated

Reply

---

Huzefa says:
**August 11, 2015 at 3:54 pm**

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Reply

---

Sudipta Basak says:
**August 12, 2015 at 3:35 am**

Enjoyed the simplicity. Thanks for the effort.

Reply

---

Im_utm says:
**August 12, 2015 at 2:37 pm**

Great Article... Helps a lot, as naive in Machine Learning.

# Commonly used Machine Learning Algorithms (with Python and R Codes)

Reply

Dalila says:
**August 14, 2015 at 1:35 pm**

Very good summary. Thank! One simple point. The reason for taking the log(p/(1-p)) in Logistic Regression is to make the equation linear, I.e., easy to solve.

Reply

Statis says:
**August 19, 2015 at 12:14 am**

Nice summary! @Huzefa: you shouldn't replace the "~" in the R code, it basically means "as a function of". You can also keep the "." right after, it stands for "all other variables in the dataset provided". If you want to be explicit, you can write y ~ x1 + x2 + ... where x1, x2 .. are the names of the columns of your data.frame or data.table. Further note on formula specification: by default R adds an intercept, so that y ~ x is equivalent to y ~ 1 + x, you can remove it via y ~ 0 + x. Interactions are specified with either * (which also adds the two variables) or : (which only adds the interaction term). y ~ x1 * x2 is equivalent to y ~ x1 + x2 + x1 : x2. Hope this helps!

Reply

Sunil Ray says:
**August 21, 2015 at 5:21 am**

Thanks Dalila... :)

Reply

Chris says:
**August 26, 2015 at 1:01 am**

You did a Wonderful job! This is really helpful. Thanks!

Reply

Glenn Nelson says:
**September 10, 2015 at 7:48 pm**

I took the Stanford-Coursera ML class, but have not used it, and I found this to be an incredibly useful summary. I appreciate the real-world analogues, such as your mention of Jezzball. And showing the brief code snips is terrific.

Reply

Shankar Pandala says:
**September 15, 2015 at 12:09 pm**

This is very easy and helpful than any other courses I have completed. simple. clear. To the point.

Reply

markpratley says:
**September 26, 2015 at 9:29 am**

You Sir are a gentleman and a scholar!

Reply

whystatistics says:
**September 29, 2015 at 10:25 am**

Hi Sunil, This is really superb tutorial along with good examples and codes which is surely much helpful. Just, can you add Neural Network here in simple terms with example and code.

Reply

Sayan Putatunda says:
**November 01, 2015 at 7:00 am**

Errata:- fit <- kmeans(X, 3) # 5 cluster solution It`s a 3 cluster solution.

Reply

Baha says:
**November 27, 2015 at 1:13 pm**

# Commonly used Machine Learning Algorithms (with Python and R Codes)

This is a great resource overall and surely the product of a lot of work. Just a note as I go through this, your comment on Logistic Regression not actually being regression is in fact wrong. It maps outputs to a continuous variable bound between 0 and 1 that we regard as probability. it makes classification easy but that is still an extra step that requires the choice of a threshold which is not the main aim of Logistic Regression. As a matter of fact it falls under the umbrella of Generalized Libear Models as the glm R package hints it in your code example. I thought this was interesting to note so as not to forget that logistic regression output is richer than 0 or 1. Thanks for the great article overall.

Reply

Ashish Yelkar says:
**January 06, 2016 at 6:28 am**

Very Nice.!!

Reply

Bansari Shah says:
**January 14, 2016 at 6:27 am**

Thank you.. reallu helpful article

Reply

ayushgg92 says:
**January 22, 2016 at 9:54 am**

I wanted to know if I can use rattle instead of writing the R code explicitly

Reply

Debasis says:
**January 22, 2016 at 10:35 am**

Thank you. Very nice and useful article..

Reply

Debashis says:
**February 16, 2016 at 8:19 am**

This is such a wonderful article.

Reply

Anthony says:
**February 16, 2016 at 8:39 am**

Informative and easy to follow. I've recently started following several pages like this one and this is the best material ive seen yet.

Reply

Akhil says:
**February 17, 2016 at 3:55 am**

One of the best content ever read regarding algorithms.

Reply

Swathi says:
**February 17, 2016 at 12:02 pm**

Thank you so much for this article

Reply

Nícolas Robles says:
**February 18, 2016 at 5:51 am**

Cool stuff! I just can't get the necessary libraries...

Reply

wizzerd says:
**February 26, 2016 at 12:09 pm**

# Commonly used Machine Learning Algorithms (with Python and R Codes)

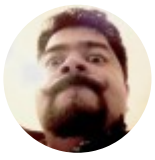
Good Article.

Reply

Pansy says:
**March 08, 2016 at 3:04 pm**

I have to thank you for this informative summary. Really useful!

Reply



J says:
**March 10, 2016 at 8:54 pm**

Somewhat irresponsible article since it does not mention any measure of performance and only gives cooking recipes without understanding what algorithm does what and the stats behind it. Cooking recipes like these are the ones that place people in Drew Conway's danger zone (https://www.quora.com/In-the-data-science-venn-diagram-why-is-the-common-region-of-Hacking-Skills-and-Substantive-Expertise-considered-as-danger-zone), thus making programmers the worst data analysts (let alone scientists, that requires another mindset completely). I highly recommend anyone wishing to enter into this brave new world not to jump into statistical learning without proper statistical background. Otherwise you could end up like Google, Target, Telefonica, or Google (again) and become a poster boy for "The Big Flops of Big Data".

Reply

Robin White says:
**March 15, 2016 at 11:38 pm**

Great article. It really summarize some of the most important topics on machine learning. But as asked above I would like to present thedevmasters.com as a company with a really good course to learn more depth about machine learning with great professors and a sense of community that is always helping itself to continue learning even after the course ends.

Reply

salman ahmed says:
**March 19, 2016 at 8:29 am**

awesome , recommended this article to all my friends

Reply

Borun Chowdhury says:
**April 21, 2016 at 8:13 am**

Very succinct description of some important algorithms. Thanks. I'd like to point out a mistake in the SVM section. You say "where each point has two co-ordinates (these co-ordinates are known as Support Vectors)". This is not correct, the coordinates are just features. Its the points lying on the margin that are called the 'support vectors'. These are the points that 'support' the margin i.e. define it (as opposed to a weighted average of all points for instance.)

Reply

Borun Chowdhury says:
**April 21, 2016 at 8:48 am**

That's not the reason for taking the log. The underlying assumption in logistic regression is that the probability is governed by a step function whose argument is linear in the attributes. First of all the assumption of linearity or otherwise introduces bias. However, logistic regression being a parametric model some bias is inevitable. The reason to choose a linear relationship is not because its easy to solve but because a higher order polynomial introduces higher bias and one would not like to do so without good reason. Now coming to the choice of log, it is just a convention. Basically, once we have decided to go with a linear model, in the case of one attribute we model the probability by p(x) = f( ax+b) such that p(-infinity)=0 and p(infinity)=0. It so happens that this is satisfied by p(x) = exp(ax+b)/ (1 + exp(ax+b)) which can be re-written as log(p(x)/(1-p(x)) = a x+ b While I am at it, it may be useful to talk about another point. One should ask is why we don't use least square method. The reason is that a yes/no choice is a Bernoulli random variable and thus we estimate the probability according to maximum likelihood wrt Bernoulli process. For linear regression the assumption is that the residuals around the 'true' function are distributed according to a normal distribution and the maximum likelihood estimate for a normal distribution amounts to the least square method. So deep down linear regression and logistic regression both use maximum likelihood estimates. Its just that they are max likelihoods according to different distributions.

Reply

# Commonly used Machine Learning Algorithms (with Python and R Codes)

Payal gour says:
**June 11, 2016 at 5:52 am**

Thank you very much, A Very useful and excellent compilation.

Reply

nd says:
**June 17, 2016 at 7:39 am**

Very good information interms of initial knowledge Note one warning, many methods can be fitted into a particular problem, but result might not be what you wish. Hence you must always compare models, understand residuals profile and how prediction really predicts. In that sense, analysis of data is never ending. In R, use summary, plot and check for assumptions validity .

Reply

Dung Dinh says:
**June 17, 2016 at 10:24 am**

The amazing article. I'm new in data analysis. It's very useful and easy to understand. Thanks,

Reply

George says:
**June 17, 2016 at 1:34 pm**

Do you have a better article?Please share...

Reply

sabarikannan says:
**June 30, 2016 at 5:35 am**

This is really good article, also if you would have explain about Anomaly dection algorithm that will really helpful for everyone to know , what and where to apply in machine learning....

Reply

ankita srivastava says:
**July 05, 2016 at 8:07 am**

a very very helpful tutorial. Thanks a lot you guys.

Reply

Haiyan says:
**July 07, 2016 at 7:41 am**

The amazing article

Reply

Namala Santosh Kumar says:
**July 15, 2016 at 2:33 am**

Analytics Vidhya - I am loving it

Reply

Mohammed Abdul Kaleem says:
**July 16, 2016 at 8:21 am**

Good article. thank you for explaining with python.

Reply

Jacques Gouimenou says:
**August 14, 2016 at 1:57 pm**

very useful compilation. Thanks!

Reply

Baseer says:

# Commonly used Machine Learning Algorithms (with Python and R Codes)

**August 24, 2016 at 4:59 pm**

great

Reply

Ali Kazim says:
**August 28, 2016 at 11:41 pm**

Very useful and informative. Thanks for sharing it.

Reply

JS says:
**September 03, 2016 at 7:42 pm**

Superb!

Reply

Denis says:
**September 04, 2016 at 10:53 am**

great summary, Thank you

Reply

sanjiv says:
**September 08, 2016 at 4:29 am**

Great article. It would have become even better if you had some test data with each code snippet. Add metrics and hyper parameter tunning for each of these models

Reply

Faizan says:
**September 13, 2016 at 9:17 am**

Thanks for the "jezzball" example. You made my day!

Reply

Satya Swarup Dani says:
**September 27, 2016 at 10:41 am**

Nicely complied. Every explanation is crystal clear and very easy to digest. Thanks for sharing knowledge.

Reply

Emerson Moizes says:
**October 05, 2016 at 10:58 am**

Perfect! It's exactly what I was looking for! Thanks for the explanation and thanks for sharing your knowledge with us!

Reply

Valery says:
**October 11, 2016 at 8:16 am**

Very useful summary. Thank you.

Reply

Malini Ramamurthy says:
**October 14, 2016 at 5:53 am**

Very informative article. For a person new to machine learning, this article gives a good starting point.

Reply

Shubham says:
**October 21, 2016 at 7:23 pm**

Good article. thank you for explaining with python.

Reply

# Commonly used Machine Learning Algorithms (with Python and R Codes)

ramesh says:
**October 23, 2016 at 12:35 pm**

Hi Friends, i'm new person to these machine learning algorithms. i have some questions.? 1) we have so many ML algorithms. but how can we choose the algorithms which one is suitable for my data set? 2) How does these algorithms works.? 3) why only these particular algorithms.? why not others.?

Reply

AshuthoshGowda says:
**October 29, 2016 at 12:06 am**

"~" is used to select the variables that you'll be using for a particular model. "label~." - Uses all your Attributes "label~Att1 + Att2," - Uses only Att1 and Att2 to create the model

Reply

Indra says:
**November 03, 2016 at 11:55 pm**

Nice Article.. Thanks for your effort

Reply

RAVI RATHORE says:
**November 08, 2016 at 1:44 pm**

hello I have to implement machine learning algorithms in python so could you help me in this. any body provide me the proper code for any algorithm.

Reply

Raghav says:
**November 10, 2016 at 8:09 pm**

All programe has error named Error in model.frame.default(formula = as.list(y_train) ~ ., data = x, : invalid type (list) for variable 'as.list(y_train)' What is that ?

Reply

Gaurav says:
**December 08, 2016 at 1:54 pm**

I think that "y_train" is data frame and it cannot be converted directly to list with "as.list" command. Try this instead y_train <- as.list(as.data.frame(t(y_train))) See if this works for you.

Reply

Suman says:
**December 09, 2016 at 6:43 am**

Very nice summary! Can you tell how to get machine learning problems for practice?

Reply

YB says:
**December 26, 2016 at 2:46 pm**

Do you have R codes based on caret?

Reply

NSS says:
**January 03, 2017 at 6:20 am**

Analytics Vidhya has some practice datasets. Check Analytics Vidhya hackathon. Also UCI machine learning repository is a phenomenal place. Google it and enjoy.

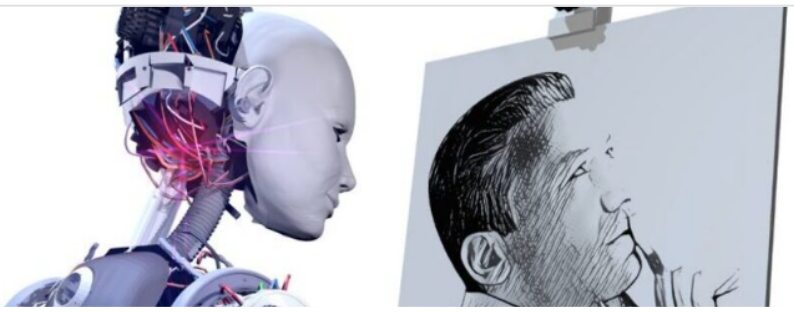
Reply

NSS says:
**January 03, 2017 at 6:21 am**

Yes

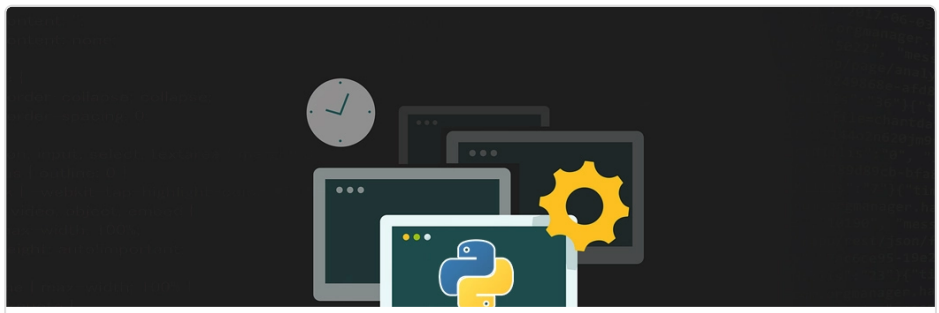
# Commonly used Machine Learning Algorithms (with Python and R Codes)

## Top Resources



An Introduction to Synthetic Image Generation from Text Data

Suvojit Hore - JAN 28, 2022

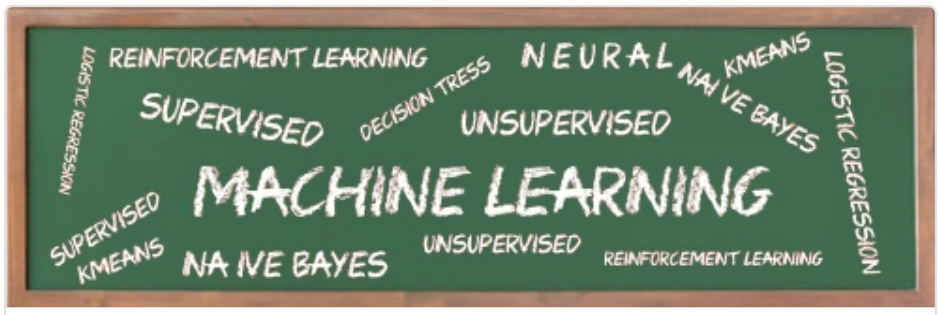


Python Tutorial: Working with CSV file for Data Science

Harika Bonthu - AUG 21, 2021


3 Interesting Python Projects With Code for Beginners!

Gaurav Sharma - JUL 18, 2021




Commonly used Machine Learning Algorithms (with Python and R Codes)

Sunil Ray - SEP 09, 2017