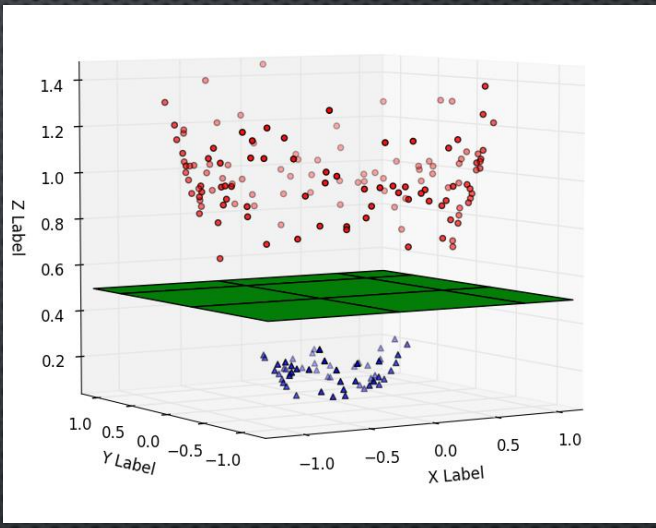
# VEHICLE DETECTION USING MACHINE LEARNING




# VEHICLE – NON VEHICLE CLASSIFIER

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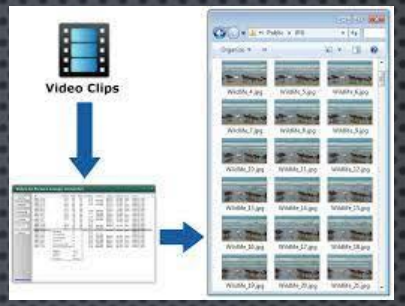
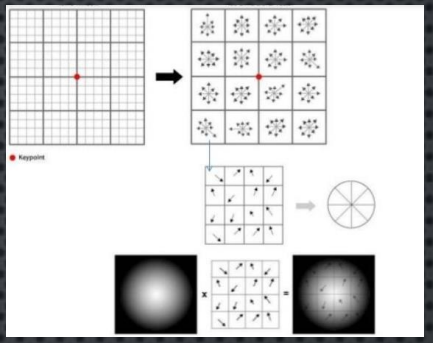
**Input**

ATV front vision

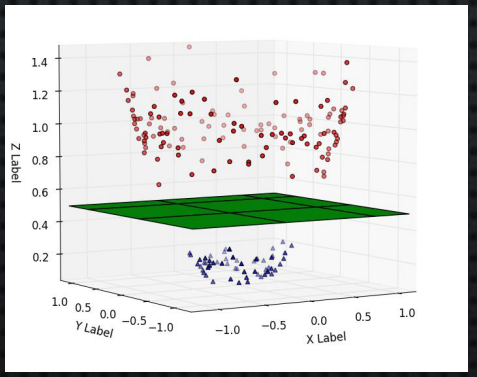
RGB camera




Split video into image frames



Feature extraction




Machine learning model

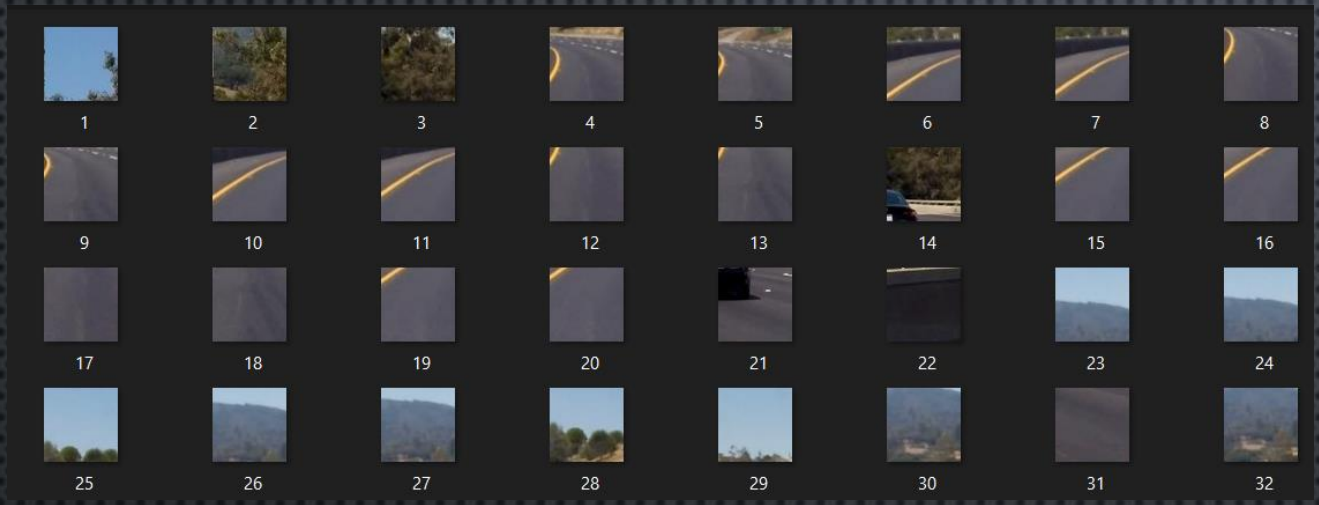
Add bounding boxes

**Output**

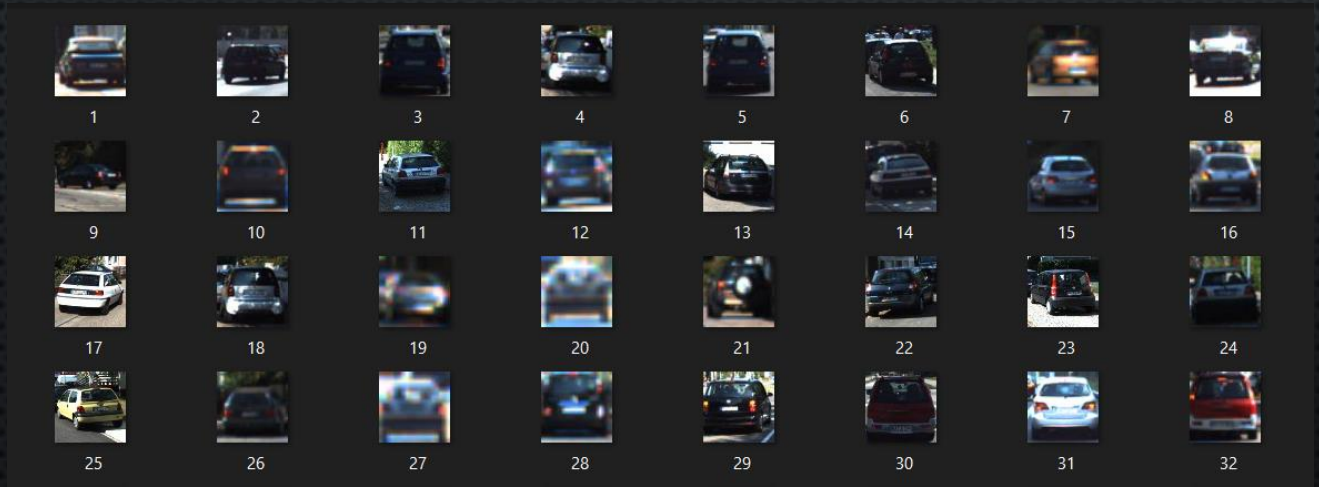
Number of vehicles
Vehicle speed
Moving direction

# DATA SET

Vehicle images (5600)



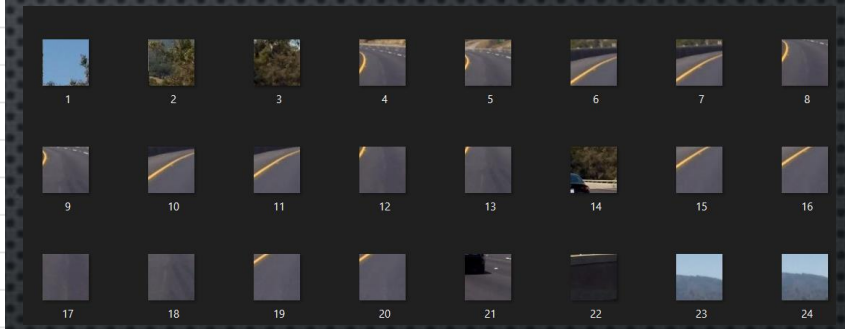

No - Vehicle images (5850)

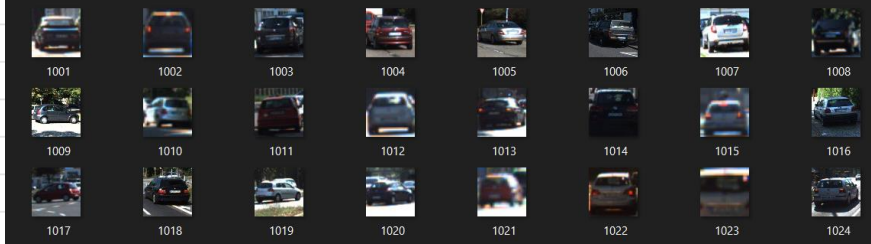


# CLEAN AND ORGANIZE DATA

- 1-1000 -> Non - vehicle mages
- 1001-2000 -> Vehicle images

| | old name | new nar | extension | " | ren | space | "old name" | "new name" | Syntax |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 1.png | 1 | .png | " | ren | | "1.png" | "1.png" | ren "1.png" "1.png" |
| 3 | 10.png | 2 | .png | " | ren | | "10.png" | "2.png" | ren "10.png" "2.png" |
| 4 | 100.png | 3 | .png | " | ren | | "100.png" | "3.png" | ren "100.png" "3.png" |
| 5 | 1000.png | 4 | .png | " | ren | | "1000.png" | "4.png" | ren "1000.png" "4.png" |
| 6 | 1001.png | 5 | .png | " | ren | | "1001.png" | "5.png" | ren "1001.png" "5.png" |
| 7 | 1002.png | 6 | .png | " | ren | | "1002.png" | "6.png" | ren "1002.png" "6.png" |
| 8 | 1003.png | 7 | .png | " | ren | | "1003.png" | "7.png" | ren "1003.png" "7.png" |
| 9 | 1004.png | 8 | .png | " | ren | | "1004.png" | "8.png" | ren "1004.png" "8.png" |
| 10 | 1005.png | 9 | .png | " | ren | | "1005.png" | "9.png" | ren "1005.png" "9.png" |
| 11 | 1006.png | 10 | .png | " | ren | | "1006.png" | "10.png" | ren "1006.png" "10.png" |
| 12 | 1007.png | 11 | .png | " | ren | | "1007.png" | "11.png" | ren "1007.png" "11.png" |
| 13 | 1008.png | 12 | .png | " | ren | | "1008.png" | "12.png" | ren "1008.png" "12.png" |
| 14 | 1009.png | 13 | .png | " | ren | | "1009.png" | "13.png" | ren "1009.png" "13.png" |
| 15 | 101.png | 14 | .png | " | ren | | "101.png" | "14.png" | ren "101.png" "14.png" |
| 16 | 1010.png | 15 | .png | " | ren | | "1010.png" | "15.png" | ren "1010.png" "15.png" |
| 17 | 1011.png | 16 | .png | " | ren | | "1011.png" | "16.png" | ren "1011.png" "16.png" |
| 18 | 1012.png | 17 | .png | " | ren | | "1012.png" | "17.png" | ren "1012.png" "17.png" |
| 19 | 1013.png | 18 | .png | " | ren | | "1013.png" | "18.png" | ren "1013.png" "18.png" |
| 20 | 1014.png | 19 | .png | " | ren | | "1014.png" | "19.png" | ren "1014.png" "19.png" |
| 21 | 1015.png | 20 | .png | " | ren | | "1015.png" | "20.png" | ren "1015.png" "20.png" |
| 22 | 1016.png | 21 | .png | " | ren | | "1016.png" | "21.png" | ren "1016.png" "21.png" |
| 23 | 1017.png | 22 | .png | " | ren | | "1017.png" | "22.png" | ren "1017.png" "22.png" |
| 24 | 1018.png | 23 | .png | " | ren | | "1018.png" | "23.png" | ren "1018.png" "23.png" |
| 25 | 1019.png | 24 | .png | " | ren | | "1019.png" | "24.png" | ren "1019.png" "24.png" |
| 26 | 102.png | 25 | .png | " | ren | | "102.png" | "25.png" | ren "102.png" "25.png" |
| 27 | 1020.png | 26 | .png | " | ren | | "1020.png" | "26.png" | ren "1020.png" "26.png" |
| 28 | 1021.png | 27 | .png | " | ren | | "1021.png" | "27.png" | ren "1021.png" "27.png" |



# FEATURE EXTRACTION

- Local Binary pattern

```
lbpB1 = extractLBPFeatures(y,'Upright',false); %local binary pattern feature extraction
lb1=sum(lbpB1);% get the summation
```

- Grey Level Co-occurrence matrices
  - Contrast
  - Homogeneity
  - Energy
  - Correlaton

```
glcm=graycomatrix(y,'Offset',[2,0;0,2]);    %Gray-Level Co-Occurrence Matrix
st1=graycoprops(glcm,{'contrast','homogeneity'});
st2=graycoprops(glcm,{'correlation','energy'});

f1=st1.Contrast;
f2=st1.Homogeneity;
f3=st2.Correlation;
f4=st2.Energy;
```

- Edges

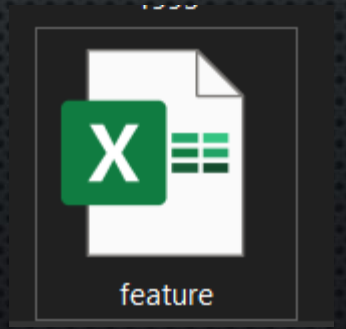
```
w=edge(y,'canny',0.2);
sum_value=0;
[r c]=size(w);
for a=1:r
     for j=1:c
        sum_value=sum_value+w(a,j);
     end
end
 ls=sum_value/(r*c);
```

# FEATURE EXTRACTION

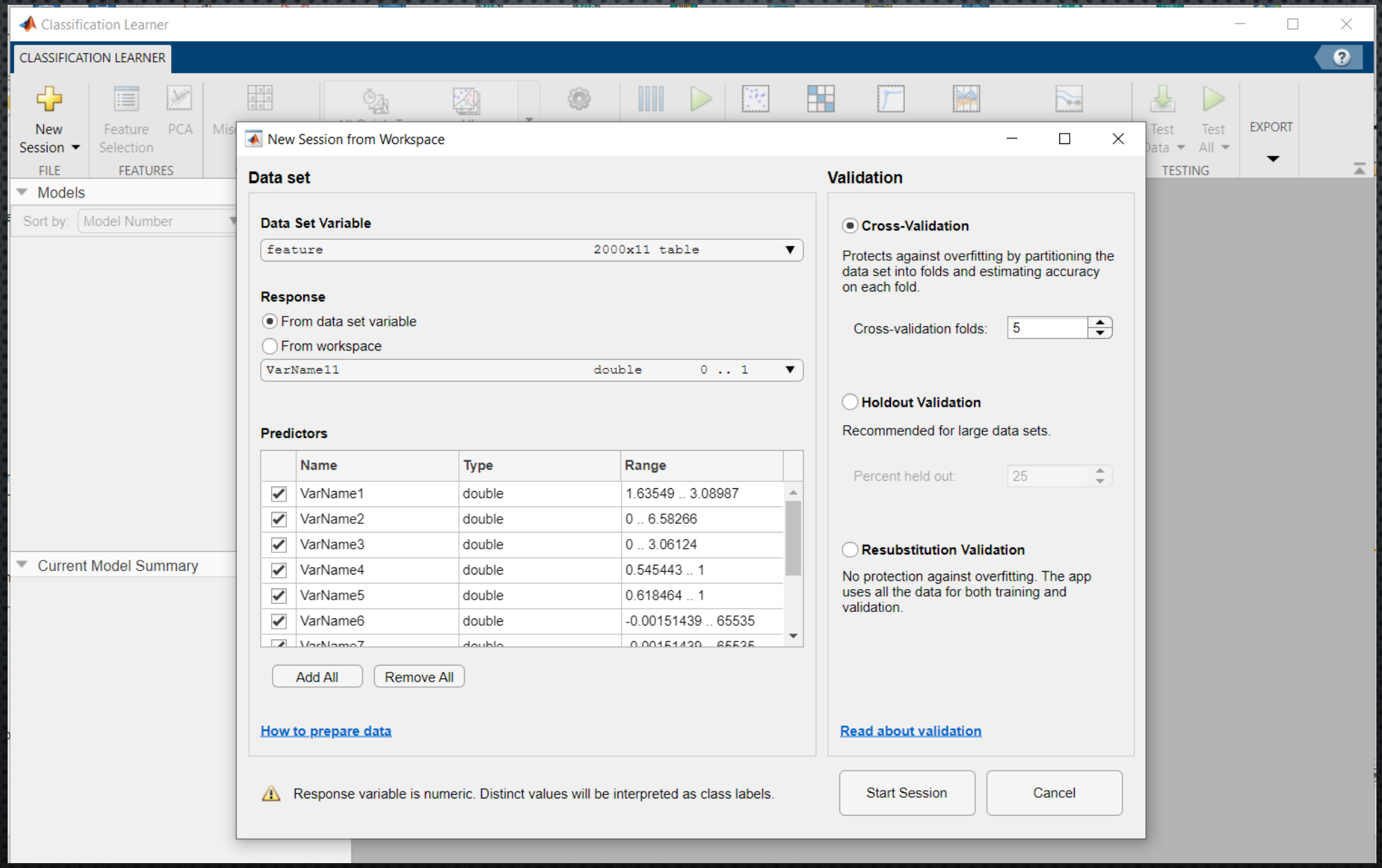
| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | LBP | Contrast | Contrast | Homogen | Homogen | Correlaion | Correlaion | Energy | Energy | Edge | Class |
| 2 | 2.219281 | 0.147681 | 0.180444 | 0.950248 | 0.94756 | 0.768843 | 0.7111 | 0.751961 | 0.749208 | 0.037354 | 0 |
| 3 | 3.055713 | 0.488659 | 0.46623 | 0.796182 | 0.805423 | 0.461415 | 0.476598 | 0.20226 | 0.210425 | 0.202393 | 0 |
| 4 | 2.812963 | 0.447833 | 0.452873 | 0.815629 | 0.829225 | 0.703751 | 0.697625 | 0.240009 | 0.250835 | 0.213135 | 0 |
| 5 | 2.823334 | 0.352823 | 0.297379 | 0.87416 | 0.913029 | 0.755833 | 0.793567 | 0.387333 | 0.4115 | 0.067383 | 0 |
| 6 | 2.815849 | 0.295111 | 0.231351 | 0.87962 | 0.920208 | 0.749144 | 0.795965 | 0.340535 | 0.37721 | 0.074463 | 0 |
| 7 | 2.513921 | 0.521925 | 0.243448 | 0.856876 | 0.911143 | 0.717852 | 0.865215 | 0.213117 | 0.258232 | 0.098633 | 0 |
| 8 | 2.590623 | 0.515121 | 0.234627 | 0.860152 | 0.915554 | 0.717894 | 0.868195 | 0.219477 | 0.268605 | 0.087646 | 0 |
| 9 | 2.846844 | 0.16381 | 0.225302 | 0.942456 | 0.948059 | 0.751418 | 0.642115 | 0.728257 | 0.742801 | 0.022949 | 0 |
| 10 | 2.880917 | 0.163558 | 0.170111 | 0.936996 | 0.950491 | 0.732467 | 0.707522 | 0.61573 | 0.628631 | 0.022217 | 0 |
| 11 | 2.731257 | 0.40877 | 0.171623 | 0.899257 | 0.939726 | 0.73541 | 0.889019 | 0.320166 | 0.3493 | 0.057373 | 0 |
| 12 | 2.769493 | 0.402218 | 0.174899 | 0.900181 | 0.938424 | 0.707226 | 0.873099 | 0.366751 | 0.393768 | 0.056396 | 0 |
| 13 | 2.831221 | 0.041835 | 0.090222 | 0.986475 | 0.982913 | 0.872235 | 0.709442 | 0.932286 | 0.929858 | 0.006592 | 0 |
| 14 | 2.907834 | 0.03629 | 0.054688 | 0.985551 | 0.984984 | 0.820775 | 0.714259 | 0.920407 | 0.916562 | 0.003174 | 0 |
| 15 | 2.798544 | 1.40877 | 0.404738 | 0.786307 | 0.869173 | 0.660974 | 0.901023 | 0.174214 | 0.201724 | 0.065186 | 0 |
| 16 | 2.791121 | 0.265373 | 0.146169 | 0.941049 | 0.952453 | 0.733653 | 0.852689 | 0.612818 | 0.61491 | 0.030029 | 0 |
| 17 | 2.785692 | 0.241179 | 0.136089 | 0.946615 | 0.956149 | 0.734741 | 0.850046 | 0.67218 | 0.672109 | 0.025391 | 0 |
| 18 | 2.817261 | 0.000504 | 0.000756 | 0.999748 | 0.999622 | 0.577205 | 7.3E-15 | 0.998489 | 0.998489 | 0.141357 | 0 |
| 19 | 2.924291 | 0.000504 | 0.000504 | 0.999748 | 0.999748 | 65535 | 65535 | 0.998992 | 0.998992 | 0.196777 | 0 |
| 20 | 2.767761 | 0.1187 | 0.068548 | 0.974462 | 0.979503 | 0.753848 | 0.860388 | 0.869836 | 0.87045 | 0.01123 | 0 |
| 21 | 2.777608 | 0.084173 | 0.051411 | 0.980406 | 0.983703 | 0.76078 | 0.858037 | 0.906903 | 0.907397 | 0.006836 | 0 |
| 22 | 2.658864 | 0.189768 | 0.084677 | 0.964226 | 0.978259 | 0.861587 | 0.938246 | 0.607703 | 0.628077 | 0.034912 | 0 |
| 23 | 2.582178 | 0.488155 | 0.097026 | 0.902986 | 0.957678 | 0.524588 | 0.920085 | 0.353706 | 0.413851 | 0.013184 | 0 |
| 24 | 2.716504 | 0.142389 | 0.047127 | 0.948631 | 0.976436 | 0.937802 | 0.978791 | 0.394684 | 0.424029 | 0.015869 | 0 |
| 25 | 2.693951 | 0.155998 | 0.060484 | 0.93981 | 0.969758 | 0.934628 | 0.973911 | 0.383154 | 0.406609 | 0.019531 | 0 |
| 26 | 2.572208 | 0.180192 | 0.12752 | 0.948253 | 0.958501 | 0.94623 | 0.958677 | 0.656325 | 0.652089 | 0.023926 | 0 |
| 27 | 2.675743 | 0.197833 | 0.087198 | 0.920909 | 0.956401 | 0.920373 | 0.964182 | 0.328025 | 0.347342 | 0.047119 | 0 |
| 28 | 2.658997 | 0.207409 | 0.10131 | 0.914441 | 0.949681 | 0.909364 | 0.955127 | 0.332028 | 0.350891 | 0.05542 | 0 |

Sheet1

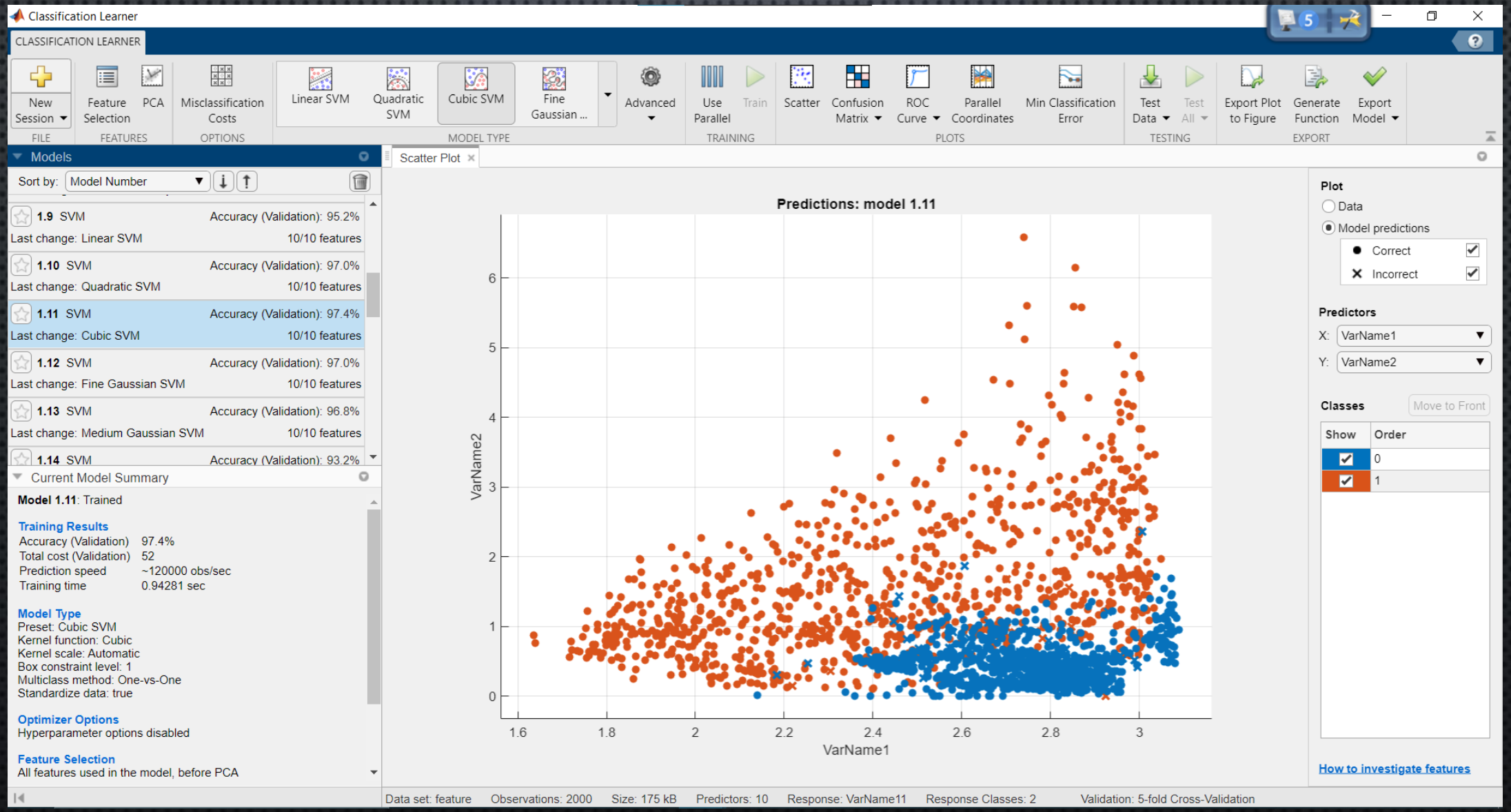
```
if i<=1000
    CL = 0;
end

if i>1000
    CL = 1;
end
Fr=horzcat([lb1,f1,f2,f3,f4,ls,CL]);

df=[df;Fr];
ex=xlswrite('feature.xlsx',df)
```



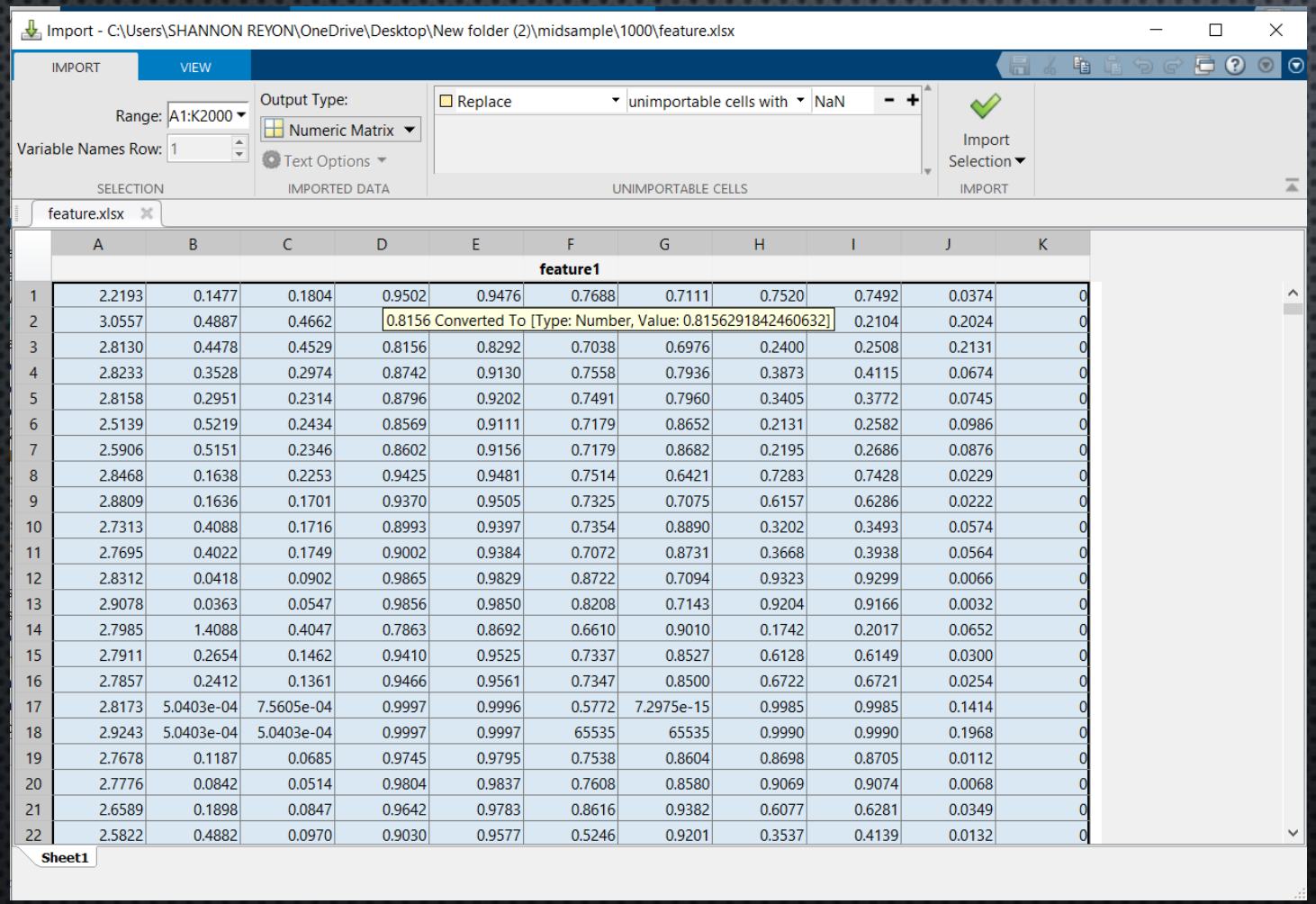
# ANALYZE FEATURES



# ANALYZE FEATURES AND SELECT A MODEL

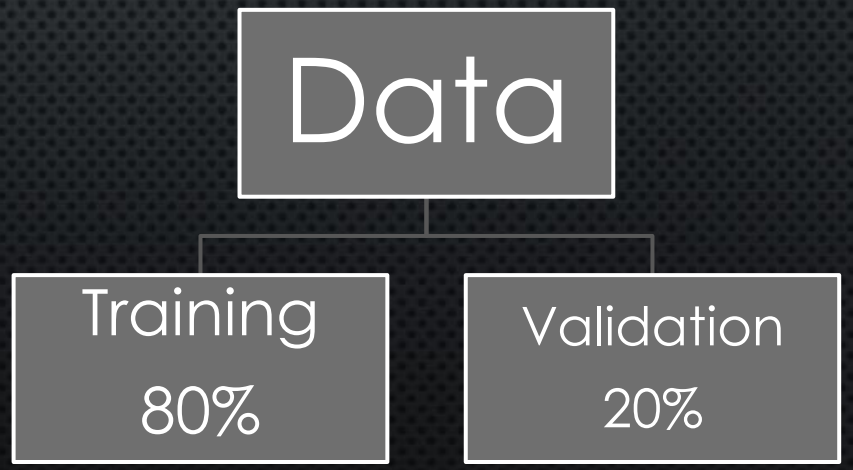


# IMPORT AND SPLIT DATA INTO TRAINING AND VALIDATION

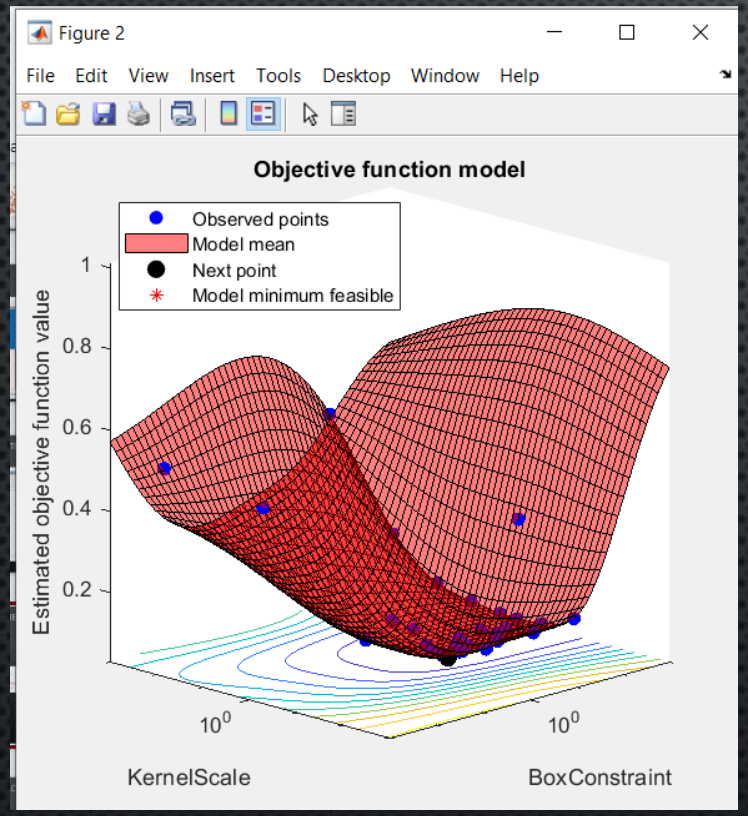



| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | feature1 | | | | | | | | | | |
| 1 | 2.2193 | 0.1477 | 0.1804 | 0.9502 | 0.9476 | 0.7688 | 0.7111 | 0.7520 | 0.7492 | 0.0374 | 0 |
| 2 | 3.0557 | 0.4887 | 0.4662 | 0.8156 | 0.8292 | 0.7038 | 0.6976 | 0.2400 | 0.2104 | 0.2024 | 0 |
| 3 | 2.8130 | 0.4478 | 0.4529 | 0.8742 | 0.9130 | 0.7558 | 0.7936 | 0.3873 | 0.2508 | 0.2131 | 0 |
| 4 | 2.8233 | 0.3528 | 0.2974 | 0.8796 | 0.9202 | 0.7491 | 0.7960 | 0.3405 | 0.4115 | 0.0674 | 0 |
| 5 | 2.8158 | 0.2951 | 0.2314 | 0.8569 | 0.9111 | 0.7179 | 0.8652 | 0.2131 | 0.3772 | 0.0745 | 0 |
| 6 | 2.5139 | 0.5219 | 0.2434 | 0.8602 | 0.9156 | 0.7179 | 0.8682 | 0.2195 | 0.2582 | 0.0986 | 0 |
| 7 | 2.5906 | 0.5151 | 0.2346 | 0.9425 | 0.9481 | 0.7514 | 0.6421 | 0.7283 | 0.2686 | 0.0876 | 0 |
| 8 | 2.8468 | 0.1638 | 0.2253 | 0.9370 | 0.9505 | 0.7325 | 0.7075 | 0.6157 | 0.7428 | 0.0229 | 0 |
| 9 | 2.8809 | 0.1636 | 0.1701 | 0.8993 | 0.9397 | 0.7354 | 0.8890 | 0.3202 | 0.6286 | 0.0222 | 0 |
| 10 | 2.7313 | 0.4088 | 0.1716 | 0.9002 | 0.9384 | 0.7072 | 0.8731 | 0.3668 | 0.3493 | 0.0574 | 0 |
| 11 | 2.7695 | 0.4022 | 0.1749 | 0.9865 | 0.9829 | 0.8722 | 0.7094 | 0.9323 | 0.3938 | 0.0564 | 0 |
| 12 | 2.8312 | 0.0418 | 0.0902 | 0.9856 | 0.9850 | 0.8208 | 0.7143 | 0.9204 | 0.9299 | 0.0066 | 0 |
| 13 | 2.9078 | 0.0363 | 0.0547 | 0.7863 | 0.8692 | 0.6610 | 0.9010 | 0.1742 | 0.9166 | 0.0032 | 0 |
| 14 | 2.7985 | 1.4088 | 0.4047 | 0.9410 | 0.9525 | 0.7337 | 0.8527 | 0.6128 | 0.2017 | 0.0652 | 0 |
| 15 | 2.7911 | 0.2654 | 0.1462 | 0.9466 | 0.9561 | 0.7347 | 0.8500 | 0.6722 | 0.6149 | 0.0300 | 0 |
| 16 | 2.7857 | 0.2412 | 0.1361 | 0.9997 | 0.9996 | 0.5772 | 7.2975e-15 | 0.9985 | 0.6721 | 0.0254 | 0 |
| 17 | 2.8173 | 5.0403e-04 | 7.5605e-04 | 0.9997 | 0.9997 | 65535 | 65535 | 0.9990 | 0.9985 | 0.1414 | 0 |
| 18 | 2.9243 | 5.0403e-04 | 5.0403e-04 | 0.9745 | 0.9795 | 0.7538 | 0.8604 | 0.8698 | 0.9990 | 0.1968 | 0 |
| 19 | 2.7678 | 0.1187 | 0.0685 | 0.9804 | 0.9837 | 0.7608 | 0.8580 | 0.9069 | 0.8705 | 0.0112 | 0 |
| 20 | 2.7776 | 0.0842 | 0.0514 | 0.9642 | 0.9783 | 0.8616 | 0.9382 | 0.6077 | 0.9074 | 0.0068 | 0 |
| 21 | 2.6589 | 0.1898 | 0.0847 | 0.9030 | 0.9577 | 0.5246 | 0.9201 | 0.3537 | 0.6281 | 0.0349 | 0 |
| 22 | 2.5822 | 0.4882 | 0.0970 | | | | | | 0.4139 | 0.0132 | 0 |

```
%% Prepare the dataset

x = feature(:, 1:10);
y = feature(:,11);

rand = randperm(2000);

xtr = x(rand(1:1600), :);
ytr = y(rand(1:1600), :);

xt = x(rand(1601:end), :);
yt = y(rand(1601:end), :);
```



# TRAINING THE MODEL

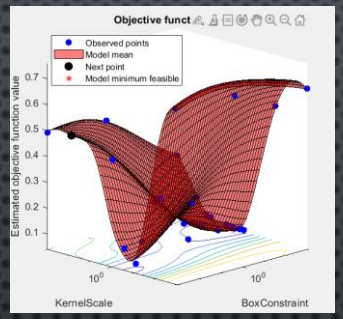



```
%% Training the model
model = fitcsvm(xtr, ytr, 'KernelFunction', 'rbf', ...
    'OptimizeHyperparameters', 'auto', ...
    'HyperparameterOptimizationOptions', struct('AcquisitionFunctionName', ...
    'expected-improvement-plus', 'ShowPlots', true));
```

# TESTING THE ACCURACY OF THE MODEL WITH DIFFERENT KERNEL FUNCTIONS

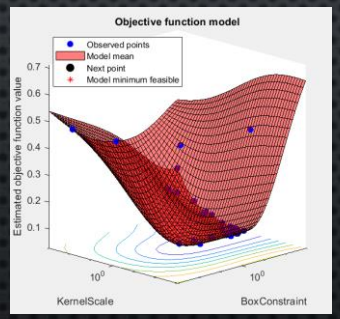
```
%% Test accuracy of the model
result = predict(model, xt);
accuracy = sum(result == yt)/length(yt)*100;
sp = sprintf("Test Accuracy = %.2f", accuracy);
disp(sp);
```

```
Estimated objective function value = 0.043332
Estimated function evaluation time = 23.1651

Test Accuracy = 96.00
fx >>
```



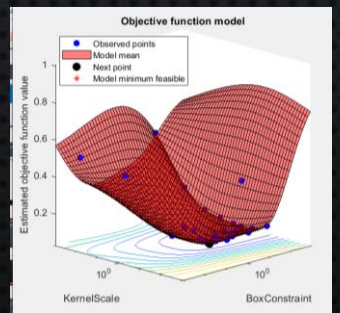

Linear – 96%

```
Estimated objective function value = 0.023349
Estimated function evaluation time = 0.23624

Test Accuracy = 97.00
fx >>
```




Gaussian – 97%

```
Estimated objective function value = 0.031029
Estimated function evaluation time = 0.27086

Test Accuracy = 97.75
fx >>
```




rbf - Radial Basis Function – 97.75%

# TEST THE MODEL USING NEW DATA

```
%% Test
cd ..
%%%%%%%%%%%get test image %%%%%%%%%%
    [f,p]=uigetfile('*.*');
    test=imread(strcat(p,f));
   %%%%%%%texture features test image%%%%%%%%
   B = imresize(test,[64 64]);
   y=rgb2gray(B);
   lbpB1 = extractLBPFeatures(y,'Upright',false);
   lb1=sum(lbpB1);
   glcm=graycomatrix(y,'Offset',[2,0;0,2]);   %Gray-Level Co-Occurrence Matrix
   st1=graycoprops(glcm,{'contrast','homogeneity'});
   st2=graycoprops(glcm,{'correlation','energy'});

   f1=st1.Contrast;
   f2=st1.Homogeneity;
   f3=st2.Correlation;
   f4=st2.Energy;

   w=edge(y,'canny',0.2);
   sum_value=0;
   [r c]=size(w);
   for a=1:r
        for j=1:c
           sum_value=sum_value+w(a,j);
        end
   end
    ls=sum_value/(r*c);

   Testftr=horzcat([lb1,f1,f2,f3,f4,ls]);
   TestSet=Testftr;

   result2 = predict(model, TestSet);
   if result2 == 1
       msgbox('Vehicle')
   elseif result2 == 0
       msgbox('no Vehicle')
   else
       msgbox('None')
   end
```