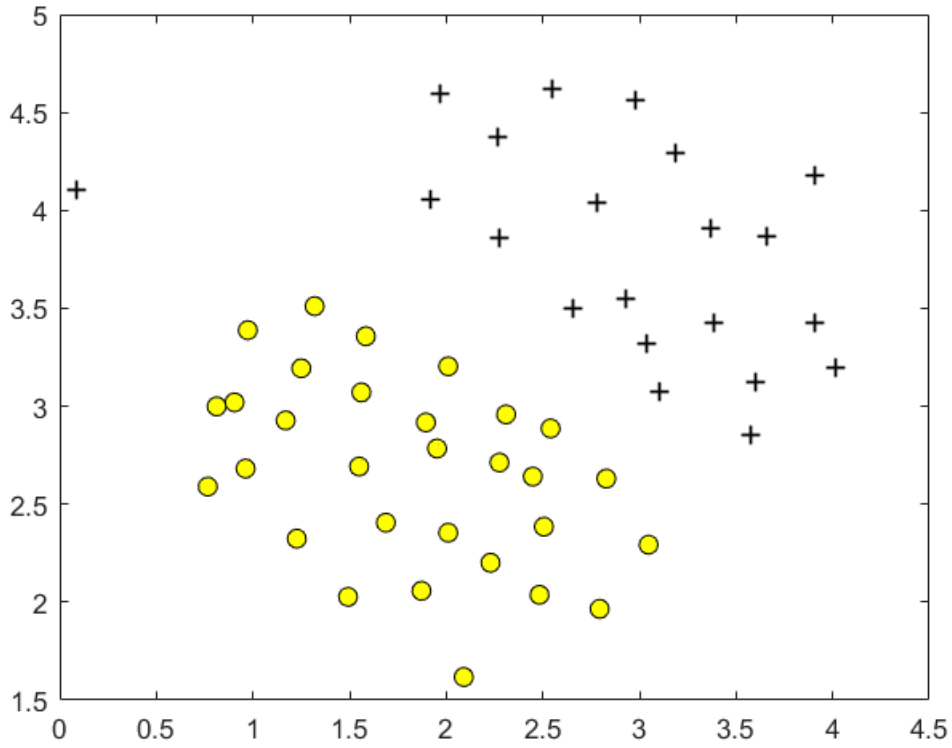
1. Загрузите данные **ex5data1.mat** из файла.

```
load('ex6data1.mat');
```

2. Постройте график для загруженного набора данных: по осям - переменные X1, X2, а точки, принадлежащие различным классам должны быть обозначены различными маркерами.

```
plotData(X, y);
```



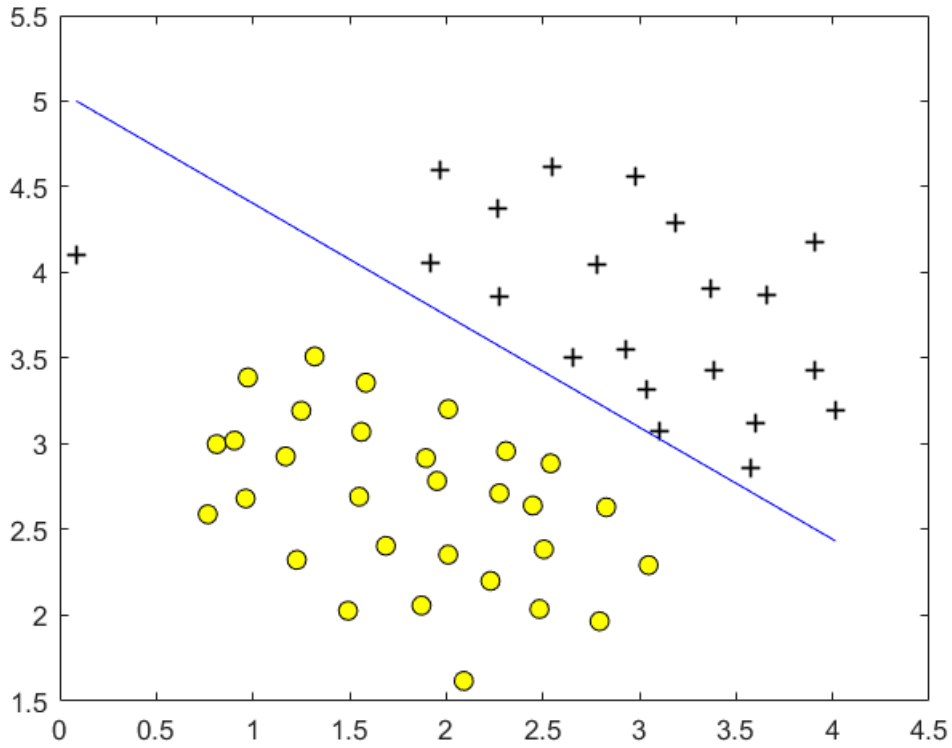
3. Обучите классификатор с помощью библиотечной реализации SVM с линейным ядром на данном наборе.

4. Постройте разделяющую прямую для классификаторов с различными параметрами C = 1, C = 100 (совместно с графиком из пункта 2). Объясните различия в полученных прямых?

```
C = 1;
model = svmTrain(X, y, C, @linearKernel, 1e-3, 20);
```

```
Training ..................................................................... Done!
```

```
visualizeBoundaryLinear(X, y, model);
```




```
C = 100;
model = svmTrain(X, y, C, @linearKernel, 1e-3, 20);
```

```
Training ...........................................................................
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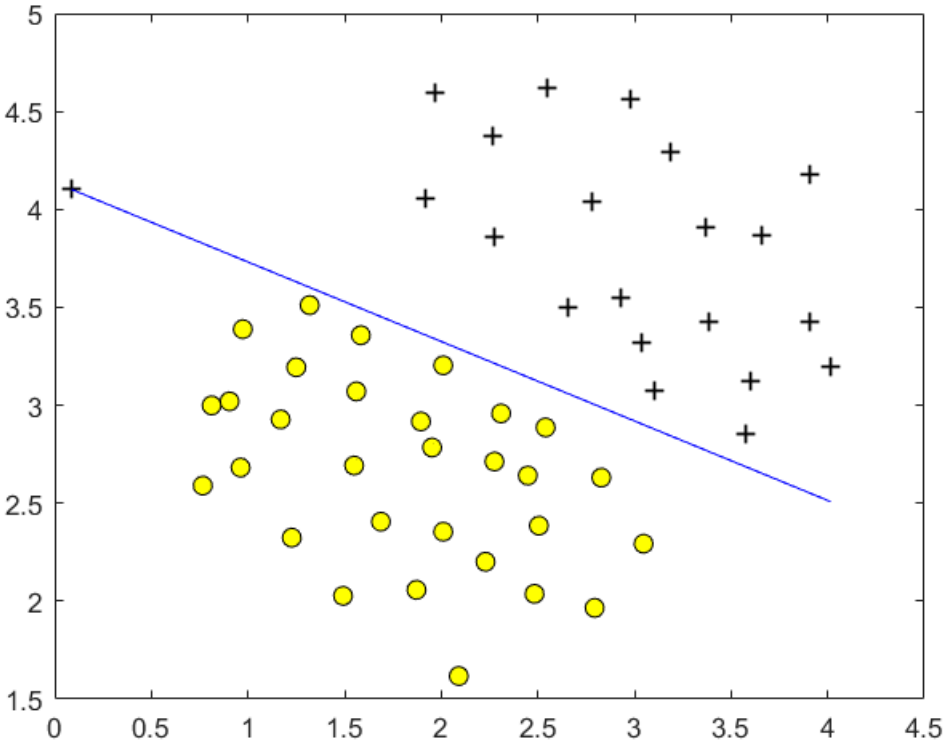
..................................... Done!
```

```
visualizeBoundaryLinear(X, y, model);
```



При большем C линия разделила все примеры, менее чувствительна к примерам не похожим на общий тренд. При меньшем C линия более похожая на естественную.

5. Реализуйте функцию вычисления Гауссового ядра для алгоритма SVM.

```
function sim = gaussianKernel(x1, x2, sigma)

x1 = x1(:); x2 = x2(:);
sim = 0;
sim = exp(-sum((x1-x2).^2)/(2*sigma^2));
end
```

6. Загрузите данные **ex5data2.mat** из файла.

```
load('ex6data2.mat');
```

7. Обработайте данные с помощью функции Гауссового ядра.

8. Обучите классификатор SVM.

9. Визуализируйте данные вместе с разделяющей кривой (аналогично пункту 4).

```
C = 1; sigma = 0.1;
model= svmTrain(X, y, C, @(x1, x2) gaussianKernel(x1, x2, sigma));
```

```
Training ..........................................................................
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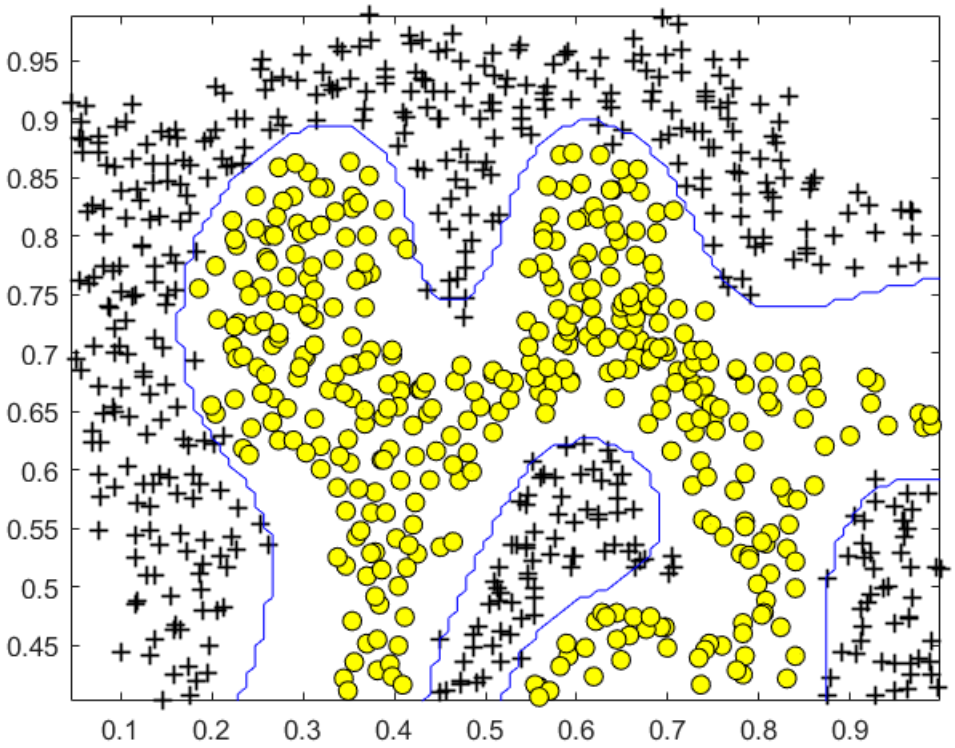
..........................................................................
. Done!
```

```
visualizeBoundary(X, y, model);
```



10. Загрузите данные **ex5data3.mat** из файла.

```
load('ex6data3.mat');
```

11. Вычислите параметры классификатора SVM на обучающей выборке, а также подберите параметры C и σ2 на валидационной выборке.

12. Визуализируйте данные вместе с разделяющей кривой (аналогично пункту 4).

```
% Try different SVM Parameters here
[C, sigma] = dataset3Params(X, y, Xval, yval)
```

```
Training ......... Done!


Training ..................................... Done!
```

```
Training ..... Done!

Training ..... Done!

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```
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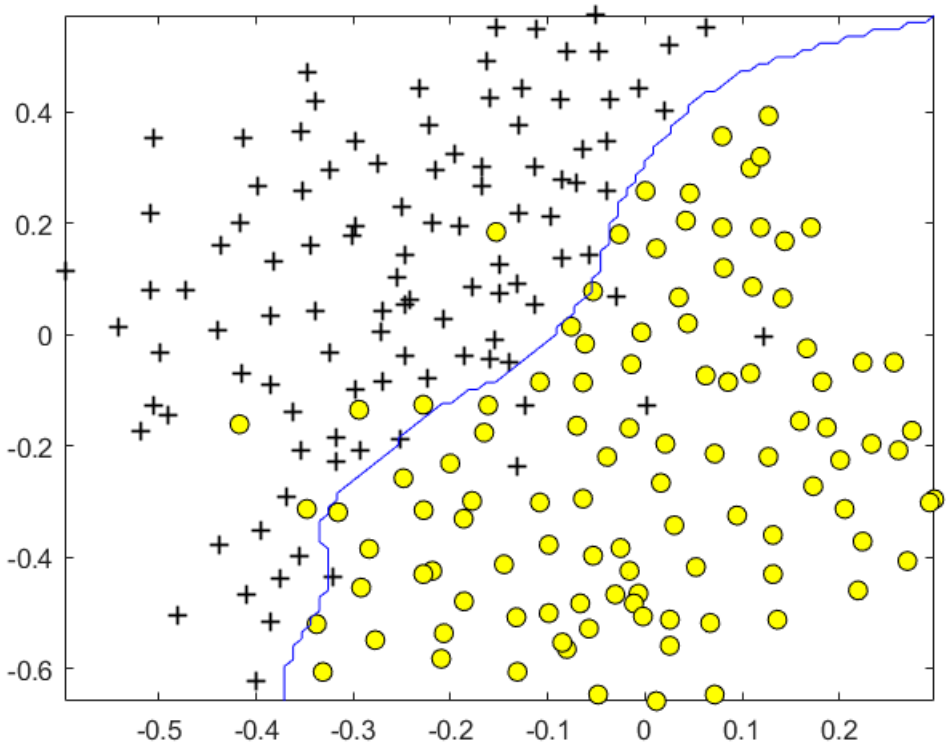
Training ............................................... Done!


Training ..................................... Done!
C = 1
sigma = 0.1000
```

```
% Train the SVM
model = svmTrain(X, y, C, @(x1, x2)gaussianKernel(x1, x2, sigma));
```

```
Training ..........................................................................
..........................................................................
..........................................................................
.............................. Done!
```

```
visualizeBoundary(X, y, model);
```



13. Загрузите данные **spamTrain.mat** из файла.

```
load('spamTrain.mat');
```

14. Обучите классификатор SVM.

```
C = 0.1;
model = svmTrain(X, y, C, @linearKernel);
```

```
Training ..........................................................................
..........................................................................
..........................................................................
..................................... Done!
```

```
p = svmPredict(model, X);
fprintf('Training Accuracy: %f\n', mean(double(p == y)) * 100);
```

```
Training Accuracy: 99.825000
```

15. Загрузите данные **spamTest.mat** из файла.

```
load('spamTest.mat');
```

```
Xtest = 1000×1899
     0     0     0     0     0     0     0     0     0     0     0     0 ···
     0     0     0     0     1     0     0     0     0     0     0     0
     0     0     0     0     0     0     0     0     0     0     0     0
     0     0     0     0     0     0     1     0     0     1     0     0     0
     0     0     0     0     0     0     0     0     0     0     0     0     0
     0     0     0     0     0     0     0     0     0     0     0     0     0
     0     0     0     0     0     0     0     0     1     0     0     0     1
     0     0     0     0     0     0     0     0     0     0     0     0     0
     0     0     0     0     0     0     0     0     0     0     0     0     0
     0     0     0     0     0     0     0     0     0     0     0     0     0
     ⋮
```

```
p = svmPredict(model, Xtest);
fprintf('Test Accuracy: %f\n', mean(double(p == ytest)) * 100);
```

```
Test Accuracy: 98.900000
```

```
[C, sigma] = dataset3Params(X, y, Xval, yval)
```

```
Undefined function or variable 'Xval'.
```

17. Реализуйте функцию предобработки текста письма.

18. Загрузите коды слов из словаря **vocab.txt**.

19. Реализуйте функцию замены слов в тексте письма после предобработки на их соответствующие коды.

```
function word_indices = processEmail(email_contents)

vocabList = getVocabList();

word_indices = [];

email_contents = lower(email_contents);

email_contents = regexprep(email_contents, '<[^<>]+>', ' ');

email_contents = regexprep(email_contents, '[0-9]+', 'number');

email_contents = regexprep(email_contents, ...
'(http|https)://[^\s]*', 'httpaddr');

email_contents = regexprep(email_contents, '[^\s]+@[^\s]+', 'emailaddr');

email_contents = regexprep(email_contents, '[$]+', 'dollar');

fprintf('\n==== Processed Email ====\n\n');

l = 0;

while ~isempty(email_contents)
```

```
[str, email_contents] = ...
strtok(email_contents, ...
[' @$/#.-:&*+=[]?!(){},''">_<;%' char(10) char(13)]);
str = regexprep(str, '[^a-zA-Z0-9]', '');
try str = porterStemmer(strtrim(str));
catch str = ''; continue;
end;
if length(str) < 1
continue;
end
idx = strmatch(str, vocabList, 'exact');
if ~isempty(idx)
word_indices = [word_indices; idx];
end
if (l + length(str) + 1) > 78
fprintf('\n');
l = 0;
end
fprintf('%s ', str);
l = l + length(str) + 1;

end
fprintf('\n\n=========================\n');

end
```

20. Реализуйте функцию преобразования текста письма в вектор признаков (в таком же формате как в файлах **spamTrain.mat** и **spamTest.mat**).

```
function x = emailFeatures(word_indices)
n = 1899;

x = zeros(n, 1);

x(word_indices) = 1;

end
```

```
test = emailFeatures(processEmail(readFile('emailSample1.txt')))
```

```
==== Processed Email ====

do you want to make dollarnumb or more per week if you ar a motiv and qualifi
individu i will person demonstr to you a system that will make you dollarnumb
number per week or more thi is not mlm call our number hour pre record number
to get the detail number number number i need peopl who want to make seriou
monei make the call and get the fact invest number minut in yourself now
number number number look forward to your call and i will introduc you to
peopl like yourself who ar current make dollarnumb number plu per week number
number number numberljgvnumb numberleannumberlrmsnumb
numberwxhonumberqiytnumb numberrjuvnumberhqcfnumb numbereidbnumberdmtvlnumb

=========================
test = 1899×1
     0
```

```
0
0
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0
0
0
0
0
0
⋮
```

```
p = svmPredict(model, test)
```

```
p = 1
```