Machine Learning Assignment6 Report

Implementation & Results

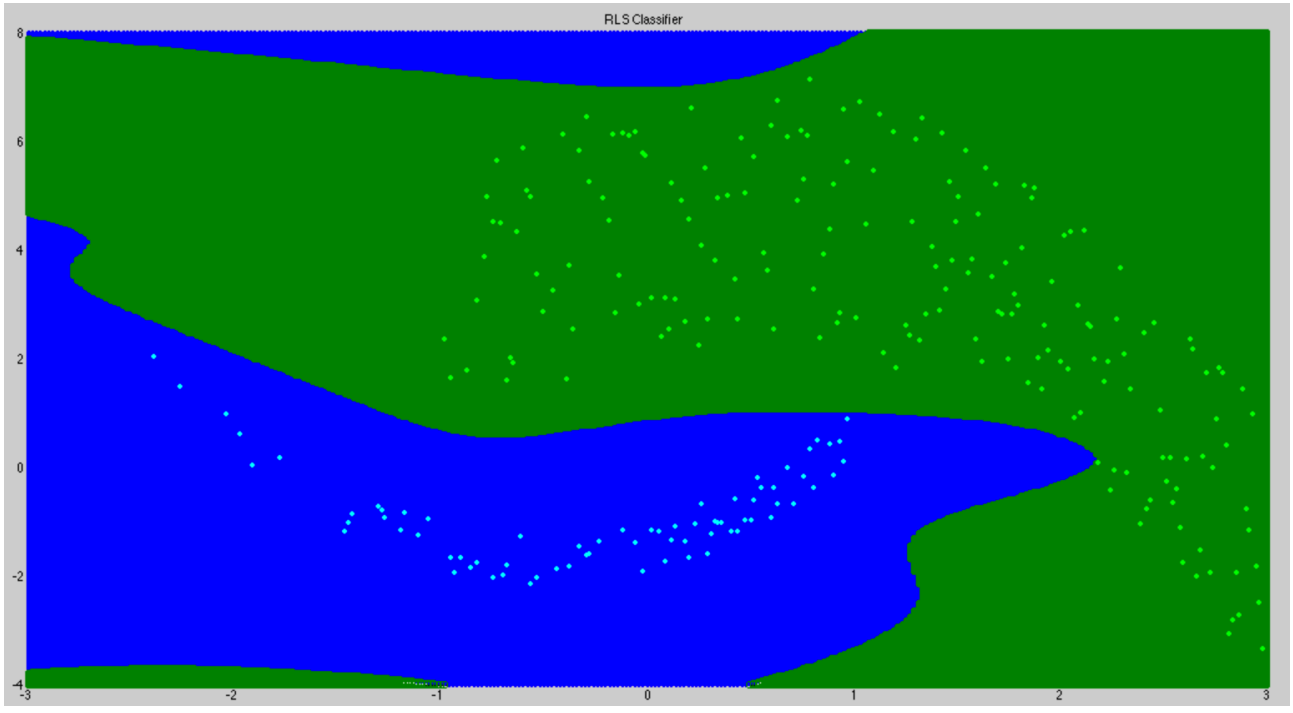
1. RLS Classifier

According to the solution of problem 2(a), we obtain α by the following:

$$\alpha = (K + \lambda I)^{-1} r$$

with λ=3 and σ=1 for Gaussian kernel

```
methods (Static)
    function RLSClassifierObj = train(X,y)
        sizeX = size(X,1);
        lambda = 3;
        sigma = 1;
        K = model.classify.RLSClassifier.rbf_kernel(X,X,sigma);
        alpha = inv(K+lambda*eye(sizeX))*y;
        RLSClassifierObj = model.classify.RLSClassifier(alpha, sigma, X);
    end

    function kval = rbf_kernel(u,v,n)
        kval = exp(-(1/(2*n^2))*(repmat(sqrt(sum(u.^2,2).^2),1,size(v,1))...
        -2*(u*v')+repmat(sqrt(sum(v.^2,2)'.^2),size(u,1),1)));
    end
end
```



The dark green area is classified -1, and the blue area is classified 1.

The light green points are the instances classified -1, and the cyan points are 1.

The error is 0.

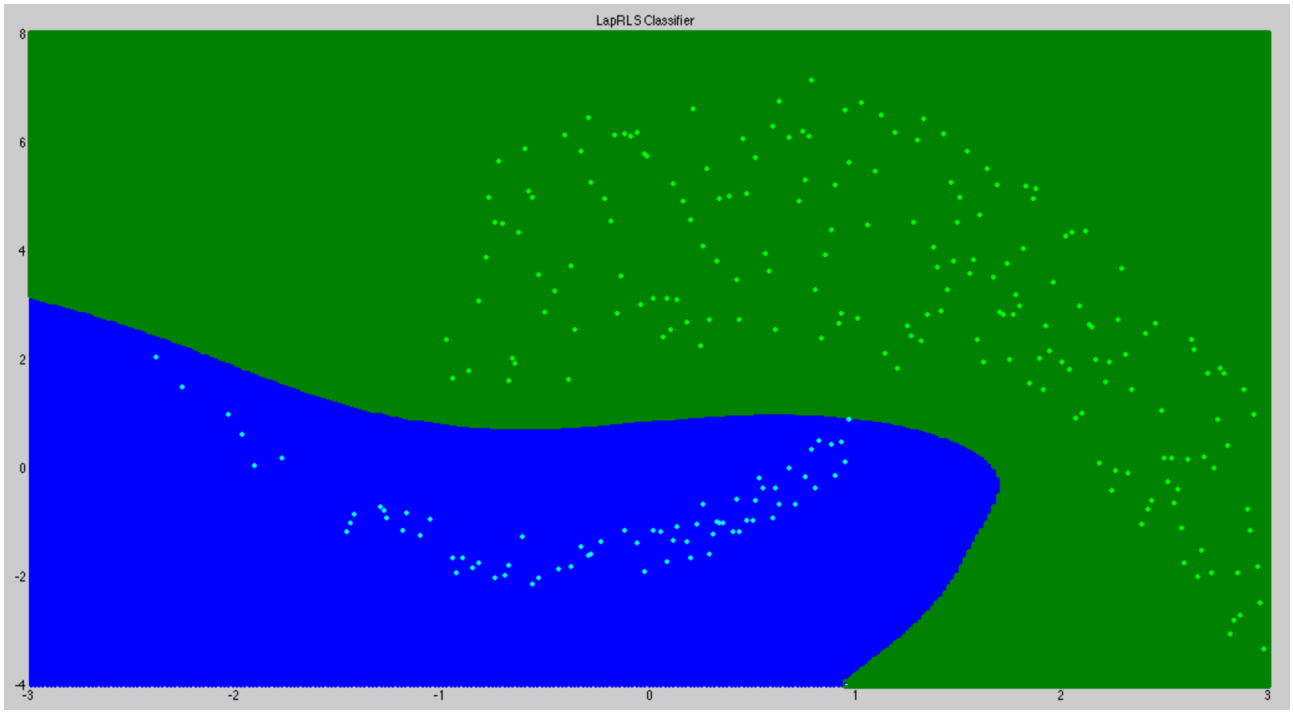
2. LapRLS Classifier

According to the solution of problem 2(b), we obtain α by the following:

$$\alpha = (JK + \mu LK + \lambda I)^{-1} J^{\top} r$$

with λ=3 and σ=1 for Gaussian kernel, and μ=0.1.

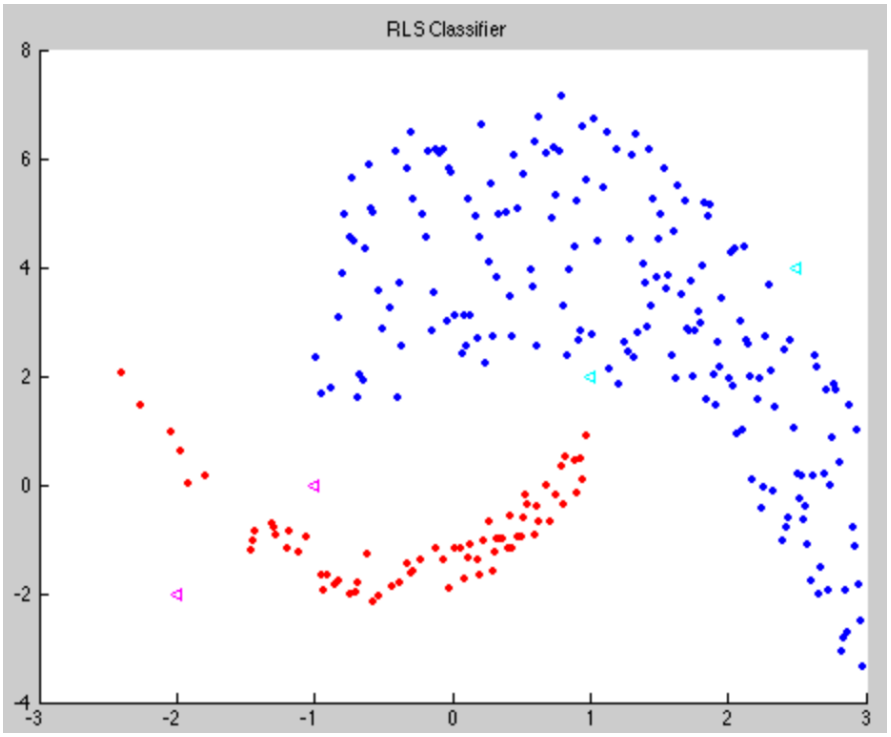
```
methods (Static)
    function LapRLSClassifierObj = train(X,y)
        sizeX = size(X,1);
        s1 = pdist(X(:,1));
        s2 = pdist(X(:,2));
        S = squareform(s1)+squareform(s2);
        sigma = 1;
        S = exp(-(S.^2/sigma^2));
        D = diag(sum(S));
        L = D-S;
        J = diag(y~=0);
        K = model.classify.LapRLSClassifier.rbf_kernel(X,X,sigma);
        lambda = 3;
        mu = 0.1;
        alpha = inv(J*K+mu*L*K+lambda*eye(sizeX))*J*y;
        LapRLSClassifierObj = model.classify.LapRLSClassifier(alpha, sigma, X);
    end

    function kval = rbf_kernel(u,v,n)
        kval = exp(-(1/(2*n^2))*(repmat(sqrt(sum(u.^2,2).^2),1,size(v,1))...
        -2*(u*v')+repmat(sqrt(sum(v.^2,2)'.^2),size(u,1),1)));
    end
end
```



The boundaries are smoother than RLS

The error can also reach 0.

3. Prediction of additional unlabeled instances:



The cyan and magenta triangles are the results of unlabeled instances.