Beibei du

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beibei:pp4 dubeibei$ python perceptron.py
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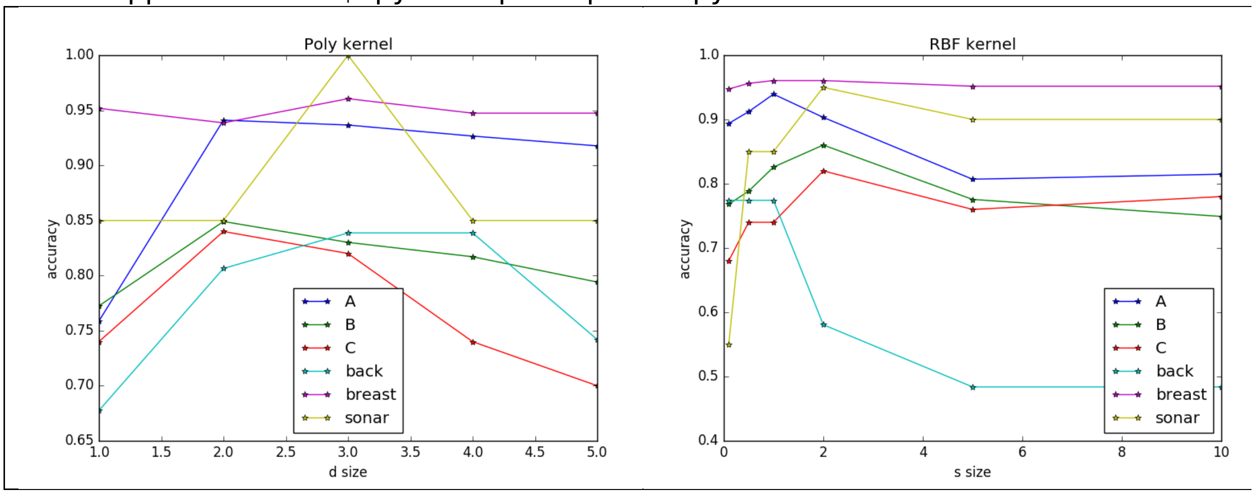

	A	B	C	back	breast	sonar	
primal	0.758620	0.772421	0.74	0.67742	0.95175	0.85	
RBF							
S = 0.1	0.8937709	0.7682105	0.68	0.77419	0.94737	0.55	
S = 0.5	0.9121246	0.7884210	0.74	0.77419	0.95614	0.85	
S = 1	0.9393770	0.8258947	0.74	0.77419	0.96053	0.85	
S = 2	0.9032258	0.8602105	0.82	0.58065	0.96053	0.95	
S = 5	0.8070078	0.7755789	0.76	0.48387	0.95175	0.9	
S = 10	0.8147942	0.7490526	0.78	0.48387	0.95175	0.9	
Poly							
d = 1	0.758620	0.772421	0.74	0.67742	0.95175	0.85	
d = 2	0.941046	0.849053	0.84	0.80645	0.93859	0.85	
d = 3	0.936596	0.830105	0.82	0.83871	0.96053	1.0	
d = 4	0.926585	0.817053	0.74	0.83871	0.94737	0.85	
d = 5	0.917686	0.794105	0.7	0.74194	0.94737	0.85	

Q: Are the primal and dual version of algorithms with linear kernel indeed identical? How do the answers to these questions vary across the datasets?
A: Yes, they are identical.
When d = 1, poly and primal have same accuracy for all datasets.

Q: How does the kernel parameter affect the results for the polynomial and RBF kernels? How do the answers to these questions vary across the datasets?
A:
For polynomial kernels, we can see that when d = 2 or d = 3, it performs better than others, which has highest accuracy.
For RBF kernels, dataset A, back and breast, when s = 1, it has highest accuracy; dataset A, B, C, breast and sonar, when s = 2, it has highest accuracy.
For both kernels, increase of kernel parameter, accuracy first increase and decrease or keep at some value.

Code perceptron.py

```
import numpy as np
import sys
import math
import matplotlib.pyplot as plt

# Read arff file
def read_file(filename):
	tr = []
	with open(filename, 'r') as f:
		for line in f:
			if line[0].isdigit() or line[0] == '-':
				feature = line.strip()
				feature = feature.split(',')
				tr.append(feature)
	tr = np.array(tr)
	tr = tr.astype(float)
	return tr

# add feature
def add_feature(t):
	result = []
	for data in t:
		data = data.tolist()
		label = data[-1]
		data[-1] = 1
		data.append(label)
		result.append(data)
	result = np.array(result)
	return result

# calculate kernel
def calculate_kernel(data_1, data_2, kernel_name, s, d):
	if kernel_name == 'RBF':
		dif = np.subtract(data_1, data_2)
		kernel = np.exp((-1) * sum(map(lambda x: x*x, dif)) / (2 *
np.power(s, 2)))
		return kernel
	if kernel_name == 'Poly':
		return np.power((np.dot(data_1, data_2) + 1), d)

# calculate tau
def calculate_tau_primal(tr):
	N = len(tr)
	s = 0.0
	for data in tr:
		s += np.sqrt(sum(map(lambda x: x*x, data[:-1])))
	A = s / float(N)
```

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    return 0.1 * A

def calculate_tau_kernel(tr, kernel_name, s, d):
    N = len(tr)
    temp_s = 0.0
    for data in tr:
        kernel =  calculate_kernel(data[:-2], data[:-2],
kernel_name, s, d)
        temp_s += np.sqrt(kernel)
    A = temp_s / float(N)
    return 0.1 * A

# primal perceptron
def primal_perceptron(tr, w, tau):
    for i in range(50):
        for tr_data in tr:
            y = tr_data[-1]
            if y * np.dot(w, tr_data[:-1]) < tau:
                w = w + np.dot(y, tr_data[:-1])
    return w

def calculate_sum(x_i, tr, alpha, kernel_name, s, d):
    n = 0
    N = len(tr)
    su = 0.0
    while n < N:
        kernel = calculate_kernel(x_i, tr[n][0:-2], kernel_name, s,
d)
        su += alpha[n] * tr[n][-1] * kernel
        n += 1
    return su

# kernel perceptron
def kernel_perceptron(tr, alpha, tau, kernel_name, s, d):
    N = len(tr)
    for it in range(50):
        i = 0
        while i < N:
            su = calculate_sum(tr[i][0:-2], tr, alpha,
kernel_name, s, d)
            if tr[i][-1] * su < tau:
                alpha[i] += 1
            i += 1
    return alpha


# classify using sign function
def sign(n):
    if n >= 0:
        return 1
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    else:
        return -1

# calculate accuracy
# w also represent alpha
def calculate_accuracy(te, tr, w, algo, s, d):
    N = len(te)
    if algo == 'primal':
        accu = 0
        for data in te:
            label = data[-1]
            O = sign(np.dot(w, data[:-1]))
            if O == label:
                accu += 1

        return accu / float(N)
    else:
        accu = 0
        i = 0
        while i < N:
            num = calculate_sum(te[i][0:-2], tr, w, algo, s, d)
            O = sign(num)
            if O == te[i][-1]:
                accu += 1
            i += 1
        return accu / float(N)


def main():
    train_file = ['ATrain.arff.txt', 'BTrain.arff.txt',
'CTrain.arff.txt', 'backTrain.arff.txt', 'breastTrain.arff.txt',
'sonarTrain.arff.txt']
    test_file = ['ATest.arff.txt', 'BTest.arff.txt',
'CTest.arff.txt', 'backTest.arff.txt', 'breastTest.arff.txt',
'sonarTest.arff.txt']

    file_RBF_acc = []
    file_Poly_acc = []
    s = [0.1, 0.5, 1, 2, 5, 10]
    d = [1,2,3,4,5]
    for t in range(6):
        tr = read_file(train_file[t])
        te = read_file(test_file[t])
        # add feature to train data for primal perceptron
        tr = add_feature(tr)
        te = add_feature(te)

        # primal perceptron with Margin
        # calcuate tau
        tau = calculate_tau_primal(tr)
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        # initialize w = 0
        k = len(tr[0]) - 1
        w = [0] * k
        w = primal_perceptron(tr, w, tau)

        # test accuracy
        accuracy = calculate_accuracy(te, tr, w, 'primal', 0, 0)
        print "%s primal perceptron accuracy:" %train_file[t]
        print accuracy

        # kernel perceptron with Margin
        N = len(tr)
        k = len(tr[0]) - 2
        alpha_RBF = []
        alpha_Poly = []
        accuracy_RBF = []
        accuracy_Poly = []
        for i in s:
             tau = calculate_tau_kernel(tr, 'RBF', i, 1)
             # initialize alpha to zero
             alpha = [0] * N
             alpha = kernel_perceptron(tr, alpha, tau, 'RBF', i, 1)
             accu = calculate_accuracy(te, tr, alpha, 'RBF', i, 1)
             alpha_RBF.append(alpha)
             accuracy_RBF.append(accu)
        file_RBF_acc.append(accuracy_RBF)

        for i in d:
             tau = calculate_tau_kernel(tr, 'Poly', 1, i)
             alpha = [0] * N
             alpha = kernel_perceptron(tr, alpha, tau, 'Poly', 1,
i)

             alpha_Poly.append(alpha)
             accu = calculate_accuracy(te, tr, alpha, 'Poly', 1, i)
             accuracy_Poly.append(accu)
        file_Poly_acc.append(accuracy_Poly)
        print "RBF kernel accuracy"
        print accuracy_RBF
        print "Poly kernel accuracy"
        print accuracy_Poly


    # plot figure
    plt.figure(1)
    plt.plot(s, file_RBF_acc[0], marker = '*', label = 'A')
    plt.plot(s, file_RBF_acc[1], marker = '*', label = 'B')
    plt.plot(s, file_RBF_acc[2], marker = '*', label = 'C')
    plt.plot(s, file_RBF_acc[3], marker = '*', label = 'back')
    plt.plot(s, file_RBF_acc[4], marker = '*', label = 'breast')
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    plt.plot(s, file_RBF_acc[5], marker = '*', label = 'sonar')
    plt.title('RBF kernel')
    plt.xlabel('s size')
    plt.ylabel('accuracy')
    plt.legend(loc = 0)
    plt.savefig("RBF.png")
    plt.clf()

    plt.figure(2)
    plt.plot(d, file_Poly_acc[0], marker = '*', label = 'A')
    plt.plot(d, file_Poly_acc[1], marker = '*', label = 'B')
    plt.plot(d, file_Poly_acc[2], marker = '*', label = 'C')
    plt.plot(d, file_Poly_acc[3], marker = '*', label = 'back')
    plt.plot(d, file_Poly_acc[4], marker = '*', label = 'breast')
    plt.plot(d, file_Poly_acc[5], marker = '*', label = 'sonar')
    plt.title('Poly kernel')
    plt.xlabel('d size')
    plt.ylabel('accuracy')
    plt.legend(loc = 0)
    plt.savefig("Poly.png")
    plt.clf()

main()
```

```
test.py

import numpy as np
import sys
import math

# Read arff file
def read_file(filename):
    tr = []
    with open(filename, 'r') as f:
        for line in f:
            if line[0].isdigit() or line[0] == '-':
                feature = line.strip()
                feature = feature.split(',')
                tr.append(feature)
    tr = np.array(tr)
    tr = tr.astype(float)
    return tr

# add feature
def add_feature(t):
    result = []
    for data in t:
```

```
            data = data.tolist()
            label = data[-1]
            data[-1] = 1
            data.append(label)
            result.append(data)
        result = np.array(result)
        return result

# calculate kernel
def calculate_kernel(data_1, data_2, kernel_name, s, d):
        if kernel_name == 'RBF':
            dif = np.subtract(data_1, data_2)
            kernel = np.exp((-1) * sum(map(lambda x: x*x, dif)) / (2 *
np.power(s, 2)))
            return kernel
        if kernel_name == 'Poly':
            return np.power((np.dot(data_1, data_2) + 1), d)

# calculate tau
def calculate_tau_primal(tr):
        N = len(tr)
        s = 0.0
        for data in tr:
            s += np.sqrt(sum(map(lambda x: x*x, data[:-1])))
        A = s / float(N)
        return 0.1 * A

def calculate_tau_kernel(tr, kernel_name, s, d):
        N = len(tr)
        temp_s = 0.0
        for data in tr:
            kernel =  calculate_kernel(data[:-2], data[:-2],
kernel_name, s, d)
            temp_s += np.sqrt(kernel)
        A = temp_s / float(N)
        return 0.1 * A

# primal perceptron
def primal_perceptron(tr, w, tau):
        for i in range(50):
            for tr_data in tr:
                y = tr_data[-1]
                if y * np.dot(w, tr_data[:-1]) < tau:
                    w = w + np.dot(y, tr_data[:-1])
        return w

def calculate_sum(x_i, tr, alpha, kernel_name, s, d):
        n = 0
        N = len(tr)
        su = 0.0
```

```
    while n < N:
        kernel = calculate_kernel(x_i, tr[n][0:-2], kernel_name, s,
d)
        su += alpha[n] * tr[n][-1] * kernel
        n += 1
    return su

# kernel perceptron
def kernel_perceptron(tr, alpha, tau, kernel_name, s, d):
    N = len(tr)
    for it in range(50):
        i = 0
        while i < N:
            su = calculate_sum(tr[i][0:-2], tr, alpha,
kernel_name, s, d)
            if tr[i][-1] * su < tau:
                alpha[i] += 1
            i += 1
    return alpha


# classify using sign function
def sign(n):
    if n >= 0:
        return 1
    else:
        return -1

# calculate accuracy
# w also represent alpha
def calculate_accuracy(te, tr, w, algo, s, d):
    N = len(te)
    if algo == 'primal':
        accu = 0
        for data in te:
            label = data[-1]
            O = sign(np.dot(w, data[:-1]))
            if O == label:
                accu += 1
        return accu / float(N)
    else:
        accu = 0
        i = 0
        while i < N:
            num = calculate_sum(te[i][0:-2], tr, w, algo, s, d)
            O = sign(num)
            if O == te[i][-1]:
                accu += 1
            i += 1
        return accu / float(N)
```

```
def main():
    train_file = ['additionalTraining.arff']
    test_file = ['additionalTest.arff']
    s = [0.1, 0.5, 1, 2, 5, 10]
    d = [1,2,3,4,5]
    for t in range(6):
        result = []
        tr = read_file(train_file[t])
        te = read_file(test_file[t])
        # add feature to train data for primal perceptron
        tr = add_feature(tr)
        te = add_feature(te)

        # primal perceptron with Margin
        # calcuate tau
        tau = calculate_tau_primal(tr)
        # initialize w = 0
        k = len(tr[0]) - 1
        w = [0] * k
        w = primal_perceptron(tr, w, tau)

        # test accuracy
        accuracy = calculate_accuracy(te, tr, w, 'primal', 0, 0)
        result.append(accuracy)

        # kernel perceptron with Margin
        N = len(tr)
        k = len(tr[0]) - 2
        alpha_RBF = []
        alpha_Poly = []
        for i in s:
            tau = calculate_tau_kernel(tr, 'RBF', i, 1)
            # initialize alpha to zero
            alpha = [0] * N
            alpha = kernel_perceptron(tr, alpha, tau, 'RBF', i, 1)
            accu = calculate_accuracy(te, tr, alpha, 'RBF', i, 1)
            alpha_RBF.append(alpha)
            result.append(accu)


        for i in d:
            tau = calculate_tau_kernel(tr, 'Poly', 1, i)
            alpha = [0] * N
            alpha = kernel_perceptron(tr, alpha, tau, 'Poly', 1,
i)
            alpha_Poly.append(alpha)
            accu = calculate_accuracy(te, tr, alpha, 'Poly', 1, i)
            result.append(accu)
```

```
            print "accuracy"
            print result[0], result[1], result[2], result[3],
result[4], result[5], result[6], result[7], result[8], result[9],
result[10], result[11]



main()
```