
```

clc
clear

w1 = [ 1 7 ; 6 3 ; 7 8 ; 8 9 ; 4 5 ; 7 5];
w2 = [ 3 4 ; 4 3 ; 2 4 ; 7 1 ; 1 3 ; 4 2];

x=[ 1 1 7 ; 1 6 3; 1 7 8 ; 1 8 9 ; 1 4 5 ; 1 7 5 ; ...
    -1 -3 -4 ; -1 -4 -3 ; -1 -2 -4 ; -1 -7 -1; -1 -1 -3 ; -1 -4 -2];

[m,d]=size(x);
theta=zeros([d ,1]); %zeros initialization of weight vectors

% part a
figure;
plot(w1(:,1)+i*w1(:,2), 'or', 'MarkerSize',10);
hold on;
plot(w2(:,1)+i*w2(:,2), 'xb', 'MarkerSize',10);

t1=single_sample_perceptron(x,theta);
t2=single_sample_perceptron_margin(x,theta,0.5);
t3=single_sample_perceptron_relaxation_margin(x,theta,0.5);
t4=LMS(x,theta,0.3);

plot([0,t1(2)]+[0,i*t1(3)], '--vg');
plot([0,t2(2)]+[0,i*t2(3)], '--<y');
plot([0,t3(2)]+[0,i*t3(3)], '--^b');
plot([0,t4(2)]+[0,i*t4(3)], '-->m');
legend('w1', 'w2', 'single-sample-perceptron', ...
    'single-sample-perceptron-margin', ...
    'single-sample-perceptron-margin-relaxation', 'LMS');

hold off

% part b
theta_set = [ t1' ; t2' ; t3' ; t4'; ...
    %optimal directions
    0 1 0; 0 1 1 ; 0 0 1; 0 -1 1 ; ...
    0 -1 0 ; 0 -1 -1 ; 0 0 -1 ; 0 -1 1 ; ...
    %different directions in 2d space
    0 100 0; 0 100 100 ; 0 0 100; 0 -100 100 ; ...
    0 -100 0 ; 0 -100 -100 ; 0 0 -100 ; 0 -100 100 ; ... ...
    %different directions in 2d space with multipliers
    0 -10 1000 ; 0 100 50 ; ...
    % some random numbers
    10 1 1 ; 100 1 1 ; -10 1 1 ; -100 1 1];
    % changing bias
time=zeros(4,length(theta_set));
b=0.3; % margin
for i=1:length(theta_set)
    tic;
    single_sample_perceptron(x,theta_set(i,:));
    time(1,i)=toc;

```

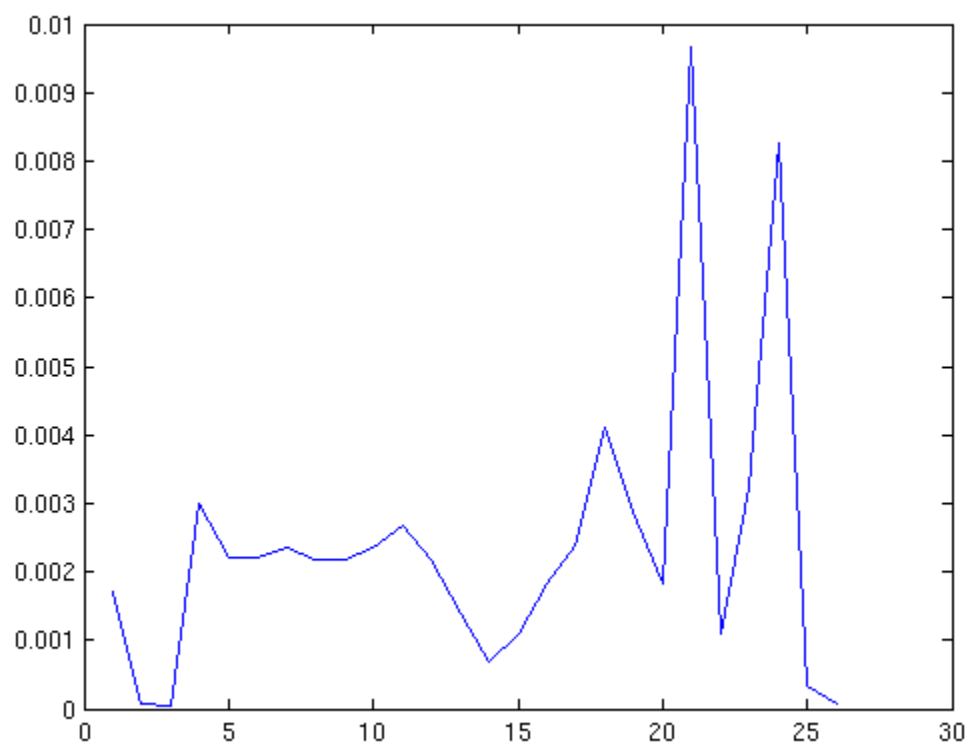
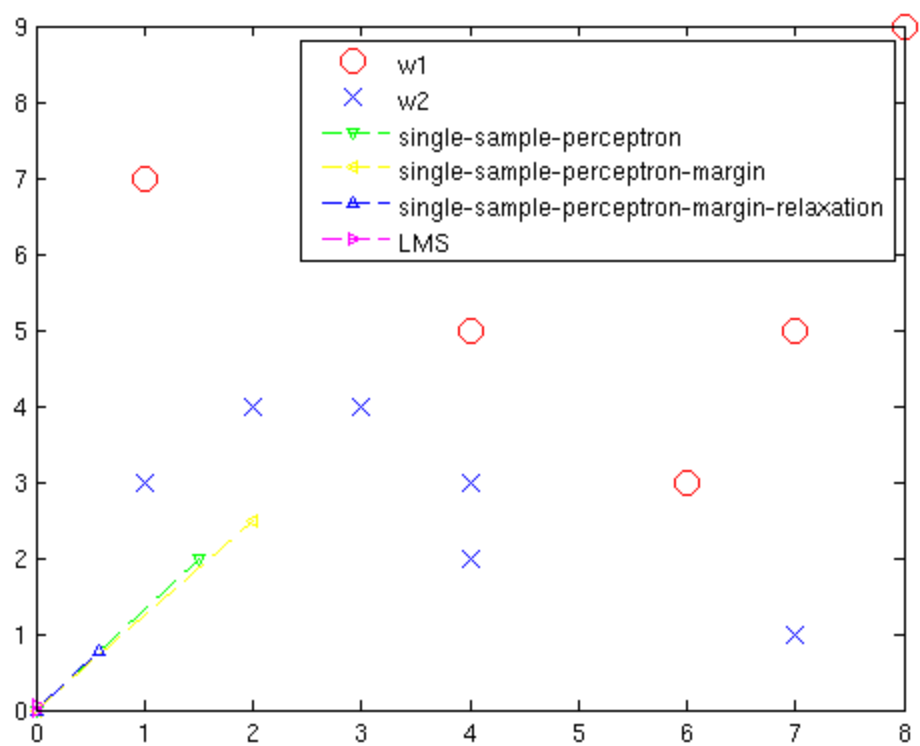
```

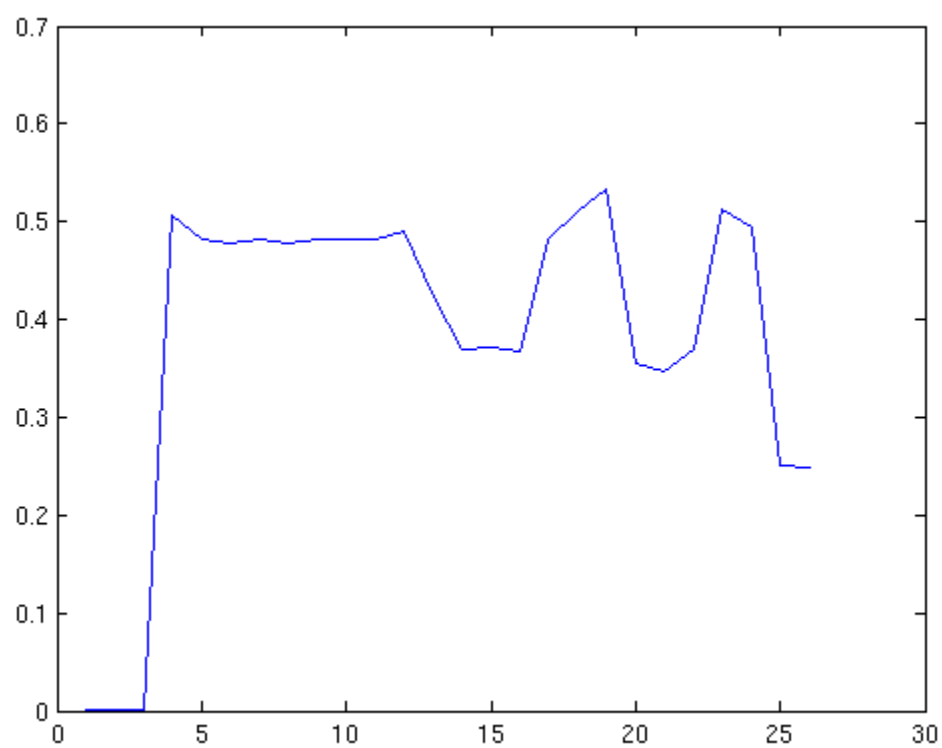
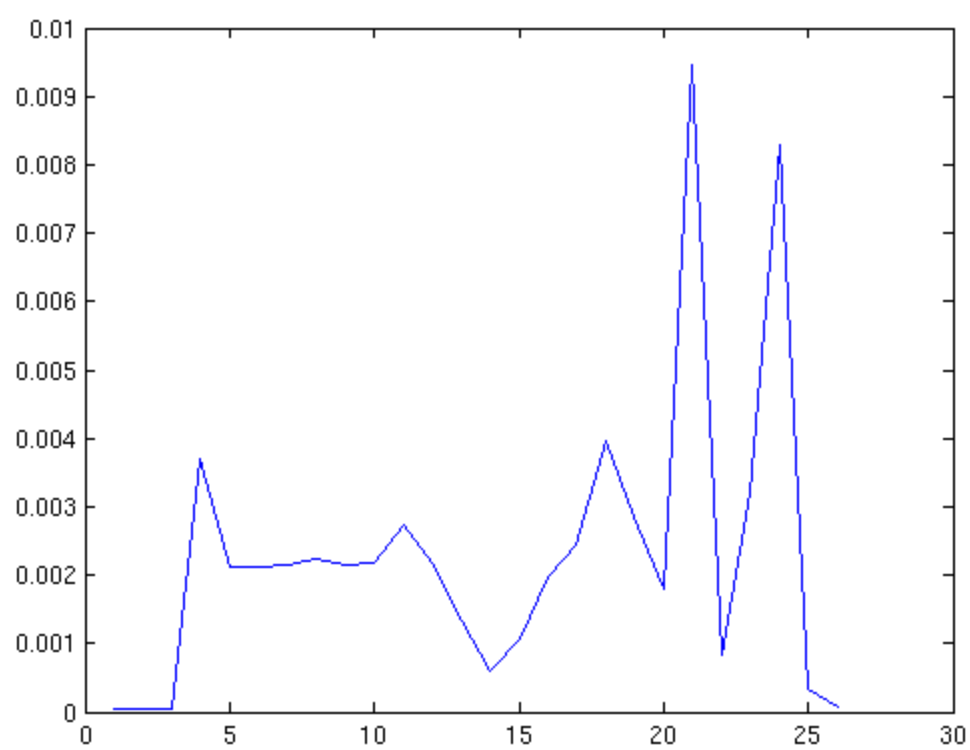
end
for i=1:length(theta_set)
    tic;
    single_sample_perceptron_margin(x,theta_set(i,:)','b);
    time(2,i)=toc;
end
for i=1:length(theta_set)
    tic;
    single_sample_perceptron_relaxation_margin(x,theta_set(i,:)','b);
    time(3,i)=toc;
end
for i=1:length(theta_set)
    tic;
    LMS(x,theta_set(i,:)','b);
    time(4,i)=toc;
end
for i=1:4
    figure;
    plot(time(i,:));
end

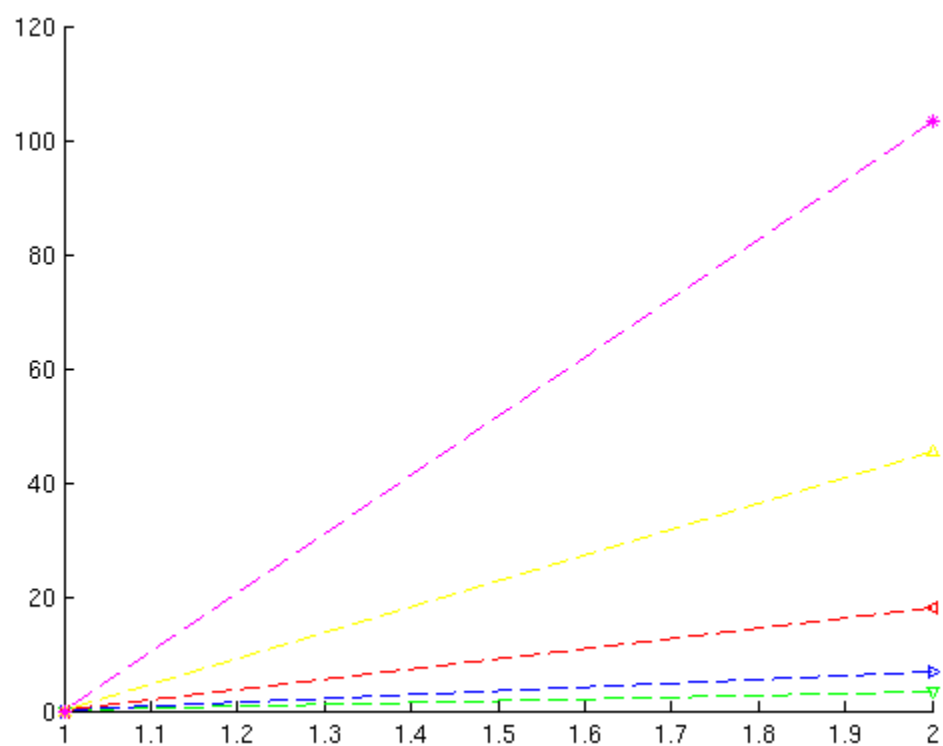
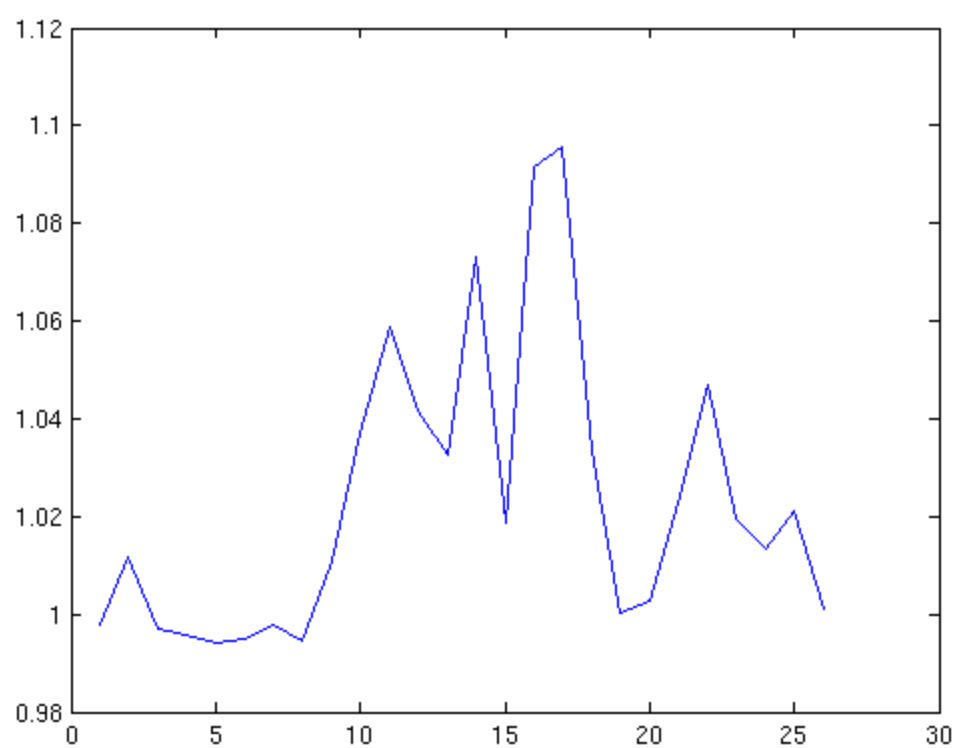
%part c
b=[0.1 0.5 1 5 10];
temp = ['--vg'; '-->b'; '--<r'; '--^y'; '--*m'];
time=zeros(2,length(b));
figure;
hold on;
for i=1:length(b)
    tic;
    t1=single_sample_perceptron_margin(x,theta,b(i));
    time(1,i)=toc;
    plot([0,t1(2)]+[0,i*t1(3)],temp(i,:));
end
hold off;
figure;
hold on;
for i=1:length(b)
    tic;
    t2=single_sample_perceptron_relaxation_margin(x,theta,b(i));
    time(2,i)=toc;
    plot([0,t2(2)]+[0,i*t2(3)],temp(i,:));
end
hold off;

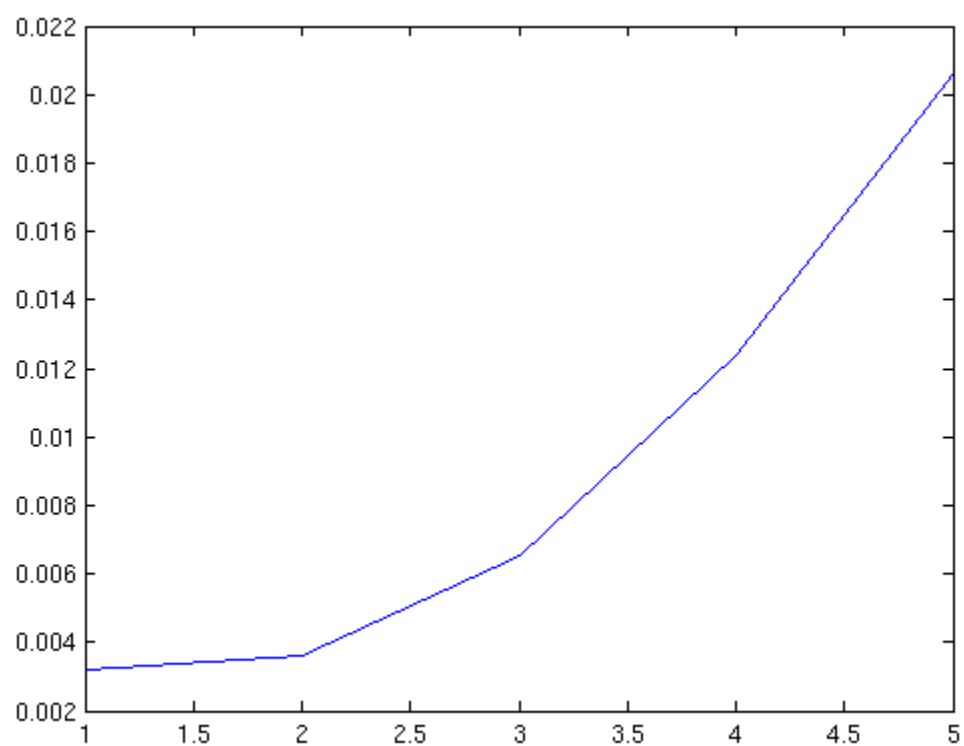
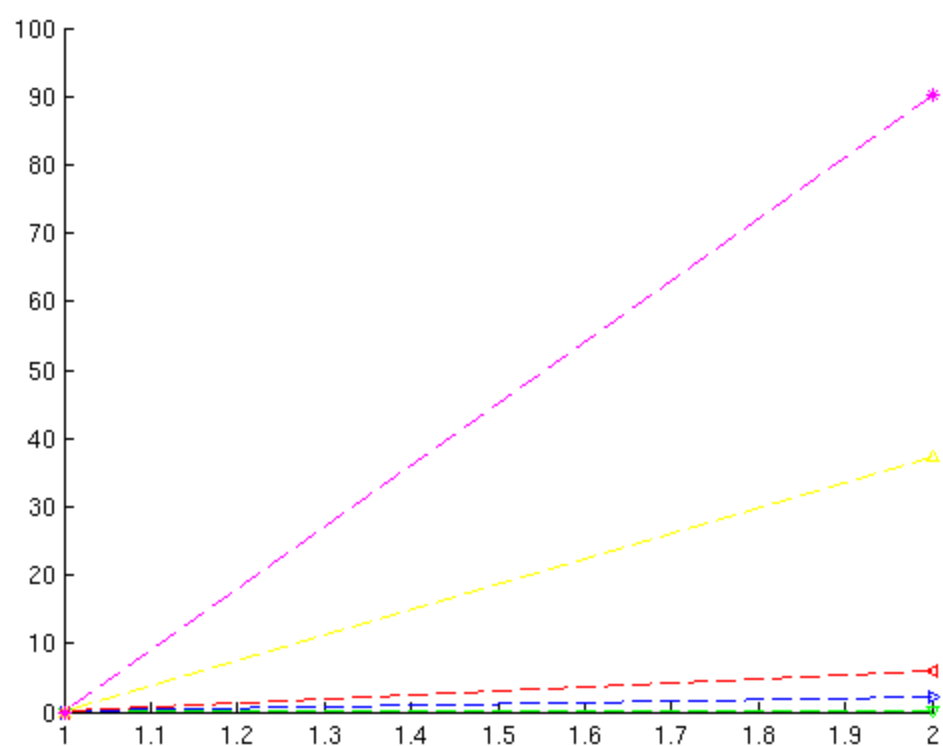
for i=1:2
    figure;
    plot(time(i,:));
end

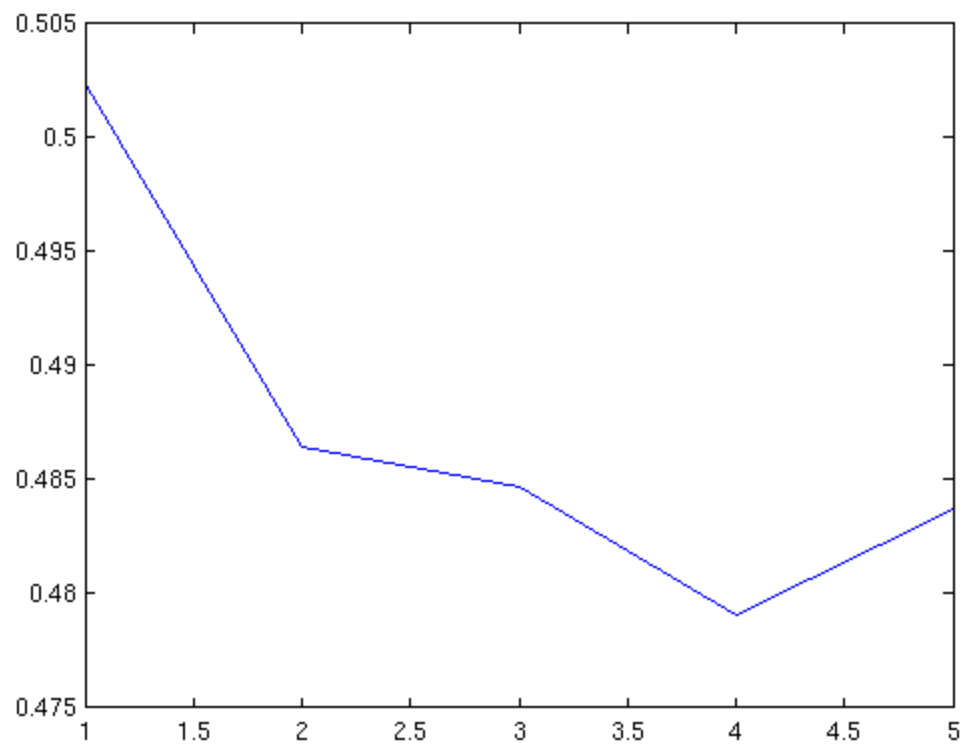
```











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