



THE UNIVERSITY OF TEXAS
AT AUSTIN

EE381V LARGE SCALE OPTIMIZATION

Problem Set 1

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Chapter 1

Matlab and Computational Assignment

Appendix A

Codes Printout

A.1 Orthogonal Matching Pursuit

A.1.1 OMP Routine

```

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Orthogonal matching Pursuit
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

function Iset = omp (X, y, SPARSITY)

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% INITIALIZATION
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
[target_feat_dot_prod, target_feat_idx] = max(X' * y);
Iset = [target_feat_idx];

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% AUGMENTATION
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
residual = y;
for iter = 1:(SPARSITY-1),
    % perpendicular complement of y to X.i
    phi = X(:, Iset);
    P = phi * inv(phi'*phi) * phi';
    I = eye(size(P));
    residual = (I - P) * residual;
    % elect new atom and add to selected atom set
    [target_feat_dot_prod, target_feat_idx] = max(X' * residual);
    % NOTE that new feature(atom) will not pre-exist in Iset
    % This is theoretically guaranteed by orthogonal projection
    Iset = [Iset, target_feat_idx];
end
end

```

A.1.2 Regression Script

```

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Invoke CVX least square regression after OMP
%% feature selection
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

SPARSITY = 5; % SPARSITY parameter for OMP

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Small-scale dataset
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
tic
Iset1 = omp(X1, y1, SPARSITY);
subX1 = X1(:, Iset1);
cvx_begin
    variable sub_b1(SPARSITY);
    minimize( norm(subX1 * sub_b1 - y1) )
cvx_end
toc

Iset1
RegressionError1 = norm(subX1*sub_b1 - y1)
TestingError1 = norm(X1test(:,Iset1)*sub_b1 - y1test)

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Medium-scale dataset
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
tic
Iset2 = omp(X2, y2, SPARSITY);
subX2 = X2(:, Iset2);
cvx_begin
    variable sub_b2(SPARSITY);
    minimize( norm(subX2 * sub_b2 - y2) )
cvx_end
toc

Iset2
RegressionError2 = norm(subX2*sub_b2 - y2)
TestingError2 = norm(X2test(:,Iset2)*sub_b2 - y2test)

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% Large-scale dataset
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
tic
Iset3 = omp(X3, y3, SPARSITY);
subX3 = X3(:, Iset3);
cvx_begin
    variable sub_b3(SPARSITY);
    minimize( norm(subX3 * sub_b3 - y3) )
cvx_end
toc

Iset3
RegressionError3 = norm(subX3*sub_b3 - y3)
TestingError3 = norm(X3test(:,Iset3)*sub_b3 - y3test)

```