function out = HW11Prog(A,B)

% A = [1,2,-1,3;0,4,1,2;-2,1,1,0;0,1,3,1];

% B = [1,2,0,1;3,1,2,0]';

n = length(A);

m = size(B,2);

C = zeros(n,n\*m);

for index = 0:n-1

C(:,index\*m+1:(index+1)\*m) = A^(index)\*B;

end

Ctemp = []; indexR = 0; index = 1; mutemp = zeros(n,1);

%Get 1st N linearly independent columns

while indexR < n && index <=size(C,2)

R = rank([Ctemp,C(:,index)]);

if R > indexR

Ctemp = [Ctemp C(:,index)];

mutemp(indexR+1) = mod(index,m)+m\*(mod(index,m)==0);

indexR = indexR+1;

end

index = index+1;

end

if rank(Ctemp)<n

print('System is not controllable.');

return

end

%Rearrange so that terms with same b are together

Cbar = zeros(n);

mu = zeros(1,m);

index=1;

for muI = 1:m

temp = find(mutemp==muI);

mu(muI) = length(temp);

if ~isempty(temp)

Cbar(:,sum(mu(1:muI-1))+1:sum(mu(1:muI-1))+mu(muI)) = Ctemp(:,temp);

index=index+1;

end

end

clear Ctemp;

CbarInv = eye(n)/(Cbar);

muIn = find(mu);

%Get P matrix

P = zeros(n);

for muI = 1:length(muIn)

index = sum(mu(1:(muI-1)));

P(index+1,:) = CbarInv(index+mu(muI),:);

for inde = 1:mu(muIn(muI))-1

P(index+inde+1,:) = P(index+1,:)\*A^inde;

end

end

%Define Control Forms of A, B, and output

Ac = P\*A/(P);

Bc = P\*B;

out = [Ac,Bc,P];