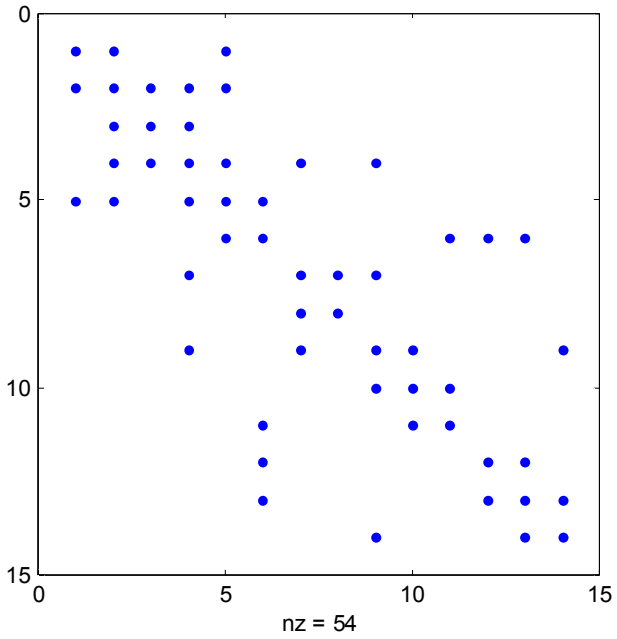
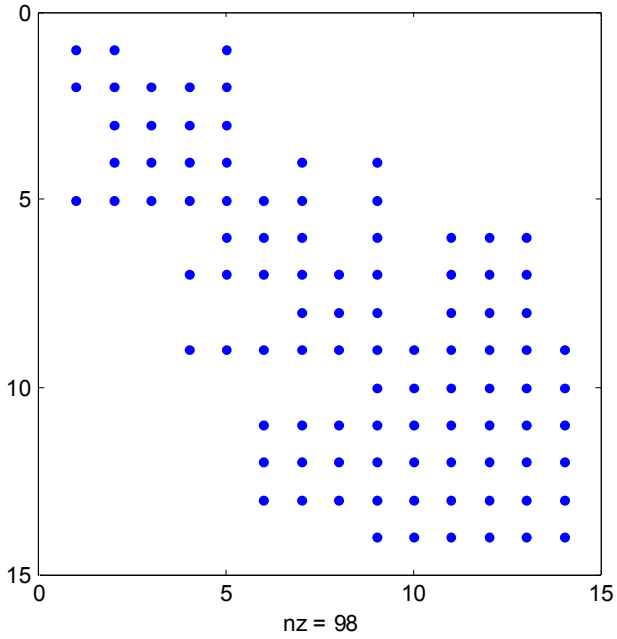
HW2 Optimal Ordering Solution
See Matlab program and data file on last pages.
numlines = 20
numbus = 14
numterms_original = 54

Sparsity pattern for original bus order: (NOTE nz = number of non zeros)

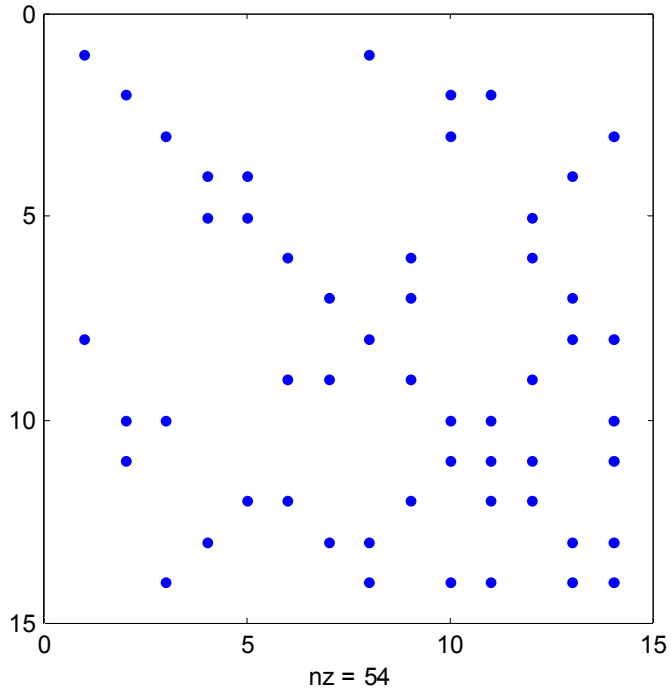


Result of LDU on original bus order, non zeros = 98

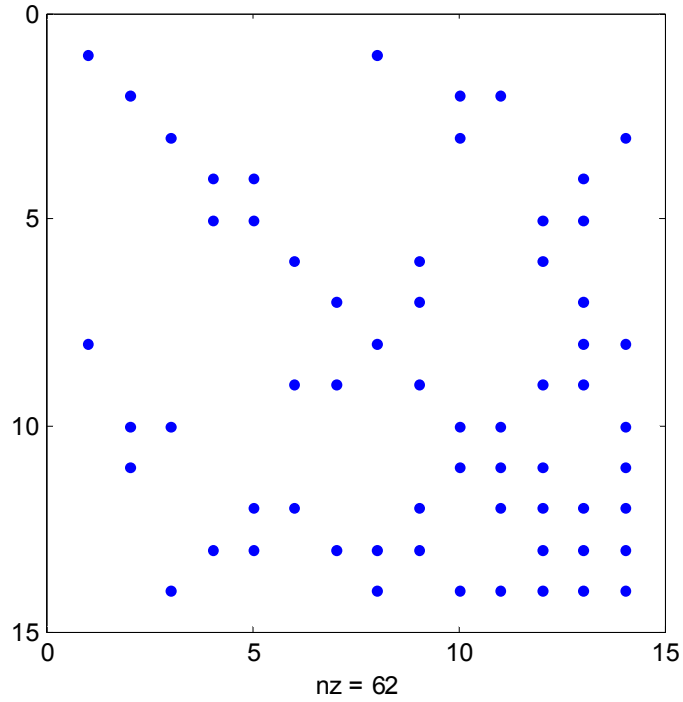


Simple permutation of the rows in the order of least number of terms first, still 54 terms, order is

8 1 3 10 11 12 14 7 13 2 5 6 9 4

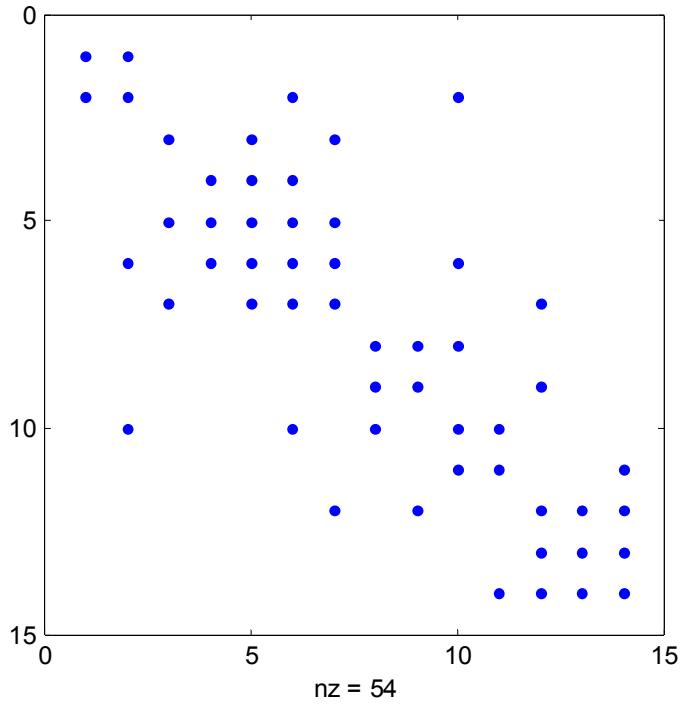


After LDU, number of non zero terms is 62

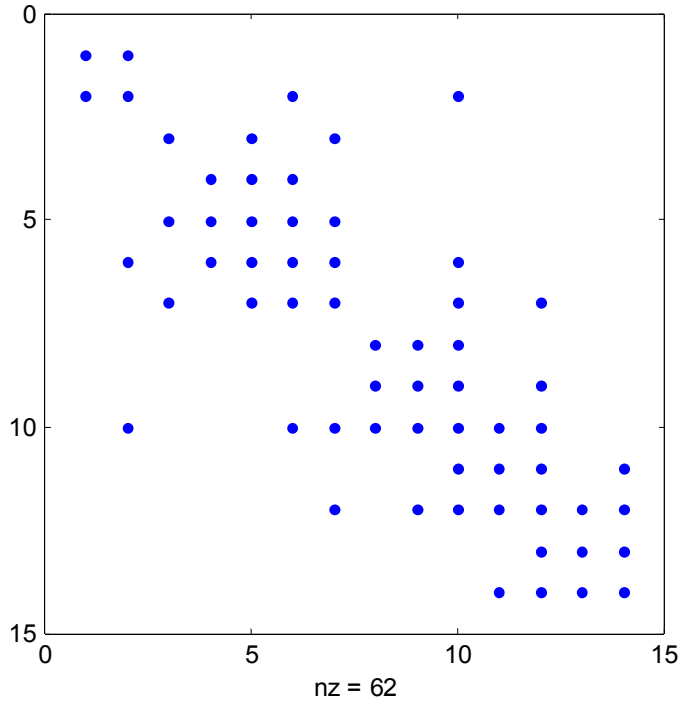


Minimum degree, Tinney Scheme 2 ordering

8 7 1 3 2 4 5 10 11 9 14 6 12 13



After LDU



Thus it turns out that on this matrix, just ordering by number of non zeros in a row or col give the same number of non zeros in the LDU factorization.

```
Optimal Ordering Program

clear
clc

% Input Data File
[file,pathname] = uigetfile('Y*.m','Select Data File');
if (pathname == 0),
    error('You Must Select A Valid Data File')
end
S=file;          % Name of the File that we need to read
% Open Data File
% Strip off .m
file = file(1:(length(file)-2));
eval(file);
%*************************************************************

[ numlines, numvar ] = size( Ymatrix);

numbus = 0;
for i = 1:numlines
    if  Ymatrix(i,1) > numbus
        numbus =  Ymatrix(i,1);
    end
    if  Ymatrix(i,2) > numbus
        numbus =  Ymatrix(i,2);
    end
end
numlines
numbus

% Build Y Matrix
Y = zeros(numbus, numbus);
for i = 1:numlines
    frombus =  Ymatrix(i,1);
    tobus =  Ymatrix(i,2);
    Y(frombus,tobus) = -1;
    Y(tobus,frombus) = -1;
end

for i = 1:numbus
    Y(i,i) = -sum(Y(i,:));
end

%analyze original matrix bus ordering
numterms_original = nnz(Y)
display(' ')
display('------------------- Original bus order ')
display(' ')
title('Original bus order')
spy(Y)
display('hit Enter to see next plot')
pause
numterms_afterLU = nnz(lu(Y))
spy(lu(Y))
display(' hit Enter to see next plot')
```

```
pause


%analyze column count bus ordering
display(' ')
display(' Permutation for Column Count Order')
display(' ')
r = colperm(Y)
numterms_original = nnz(Y(r,r))
spy(Y(r,r))
display(' hit Enter to see next plot')
pause
numterms_afterLU = nnz(lu(Y(r,r)))
spy(lu(Y(r,r)))
display(' hit Enter to see next plot')
pause

%analyze minimum degree (Tinney Scheme 2) bus ordering
display(' ')
display(' Permutation for Min Degree Order')
display(' ')
r = symamd(Y)
numterms_original = nnz(Y(r,r))
spy(Y(r,r))
display(' hit Enter to see next plot')
pause
numterms_afterLU = nnz(lu(Y(r,r)))
spy(lu(Y(r,r)))
```

Note: This code was written by a student who took the course in 2007. Students should note the use of the Matlab subroutines: nnz, spy, colperm, lu, and symamd

Y14bus.m data file which is read into the program.

```
Ymatrix = [
    1      2
    1      5
    2      3
    2      4
    2      5
    3      4
    4      5
    4      7
    4      9
    5      6
    6     11
    6     12
    6     13
    7      8
    7      9
    9     10
    9     14
   10     11
   12     13
   13     14 ];
```