Article

Matlab algorithm to generate adjacency matrix from connection pairs that nodes are represented by strings

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Abstract
It is harder to generate an adjacency matrix from connection (i.e., link) pairs that nodes are represented by strings than by numerical ID numbers. In present article, we developed a Matlab algorithm to generate adjacency matrix from connection pairs in which nodes are represented by strings. Full codes and executable program of the algorithm were given.

Keywords Matlab algorithm; connection pairs; connection weights; adjacency matrix; transformation.

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1 Introduction

Adjacency matrices are widely used in many algorithms of graph theory and network science (Zhang, 2015, 2016a-k, 2017a-d, 2018; Zhang and Li, 2016; Zhang and Feng, 2017). On the other hand, we have usually collected connection pairs, in which nodes are always represented by strings (names, abbreviations, ABC codes, etc.). Nevertheless, it is much harder to generate an adjacency matrix from connection (i.e., link) pairs that nodes are represented by strings than by numerical ID numbers. In this article, I present a Matlab algorithm to generate adjacency matrix from connection pairs in which nodes are represented by strings. Full codes and executable program of the algorithm are given also.

2 Method

Suppose there are *num* connection pairs, which are recorded in a space separated text file as, for example

$$\begin{matrix} v_1 & v_9 \\ v_1 & v_{20} \\ v_3 & v_5 \\ \cdots \end{matrix} \quad (1)$$

or

v_1 v_5 w_1
v_1 v_2 w_2
v_2 v_9 w_3
…

(2)

where v_i are nodes represented by strings and w_i are connection weights (numerical values), i=1,2,…. We want to find the series of unique nodes in (1) or (2):

$$v_1, v_2, \ldots, v_m \qquad (3)$$

where m is the total number of unique nodes, and transform (1) to an adjacency matrix $d=(d_{ij})_{m\times m}$. d_{ij}=1, if two nodes v_i and v_j are adjacent (connected), and d_{ij}=0, if v_i and v_j are not adjacent; i, j=1,2,…, m; or transform (2) to an adjacency matrix $d=(d_{ij})_{m\times m}$. $d_{ij}=w_{ij}$, if two nodes v_i and v_j are adjacent (connected), and d_{ij}=0, if v_i and v_j are not adjacent; i, j=1,2,…, m. Or for the situation (2), if a threshold for the connection weight, h>0, is given, we have d_{ij}=1 if $w_{ij}\geq h$ and, v_i and v_j are adjacent (connected), and d_{ij}=0 if $w_{ij}<h$ or v_i and v_j are not adjacent; i, j=1,2,…, m.

The IDs of rows and columns of the resultant adjacency matrix correspond to the natural IDs of unique nodes in the resultant series of unique nodes.

According to the above principle, the full Matlab algorithm, used in Matlab environment, is developed as the following.

```
[newdel,OK]=listdlg('liststring',{'Node-Node Data','Node-Node-Weight Data'},'listsize',[300
100],'OkString','OK','CancelString','Cancel','promptstring','Two Columns or Three Columns Data?','selectionmode','single');
if (newdel==2)
[choice,OK]=listdlg('liststring',{'Generate Weight Matrix','Generate 0-1 Adjacency Matrix'},'listsize',[300
100],'OkString','OK','CancelString','Cancel','promptstring','Two Columns or Three Columns Data?','selectionmode','single');
if (choice==2)
threshold=input('Input the threshold of the weight to produce 0 or 1 (=1 if >=weight, and =0 if <weight): ');
end
end
if (newdel==2)
strr=input('Input the text file name of node-node-weight matrix w (w=(wij)num×3): ','s');
[w(:,1) w(:,2) w(:,3)]=textread(strr,'%s%s%s');
elseif (newdel==1)
strr=input('Input the text file name of node-node matrix w (w=(wij)num×2): ','s');
[w(:,1) w(:,2)]=textread(strr,'%s%s');
end
num=length(w(:,1));
[st,m]=uniqNodes(w);
mm=0;
for i=1:num
for k=1:m
if (isequal(w{i,1},st{k})==1)
```

```
wid(i,1)=k;
end
if (isequal(w{i,2},st{k})==1)
wid(i,2)=k;
end
end
if (newdel==2)
wid(i,3)=str2num(w{i,3});
end
end
d=zeros(m,m);
for k=1:num
if (newdel==1) d(wid(k,1),wid(k,2))=1; d(wid(k,2),wid(k,1))=1;
elseif ((choice==1) && (newdel==2)) d(wid(k,1),wid(k,2))=wid(k,3); d(wid(k,2),wid(k,1))=wid(k,3);
elseif ((choice==2) && (newdel==2)) d(wid(k,1),wid(k,2))=wid(k,3)>threshold; d(wid(k,2),wid(k,1))=wid(k,3)>threshold;
end
end
fprintf('Matrix of Interactions\n');
d
fprintf(['Names of nodes from ID 1 to ' num2str(m) ':\n']);
st

function [st,m]=uniqNodes(w)
num=length(w(:,1));
w2=[w(:,1);w(:,2)];
m=1;
st{1}=w2{1};
for i=2:2*num
s=0;
for j=1:m
if isequal(w2{i},st{j})==0
s=s+1;
end
end
if (s==m)
m=m+1;
st{m}=w2{i};
end
end
```

The executable GUI software (see supplementary material) of the algorithm above is partly indicated in Fig. 1.

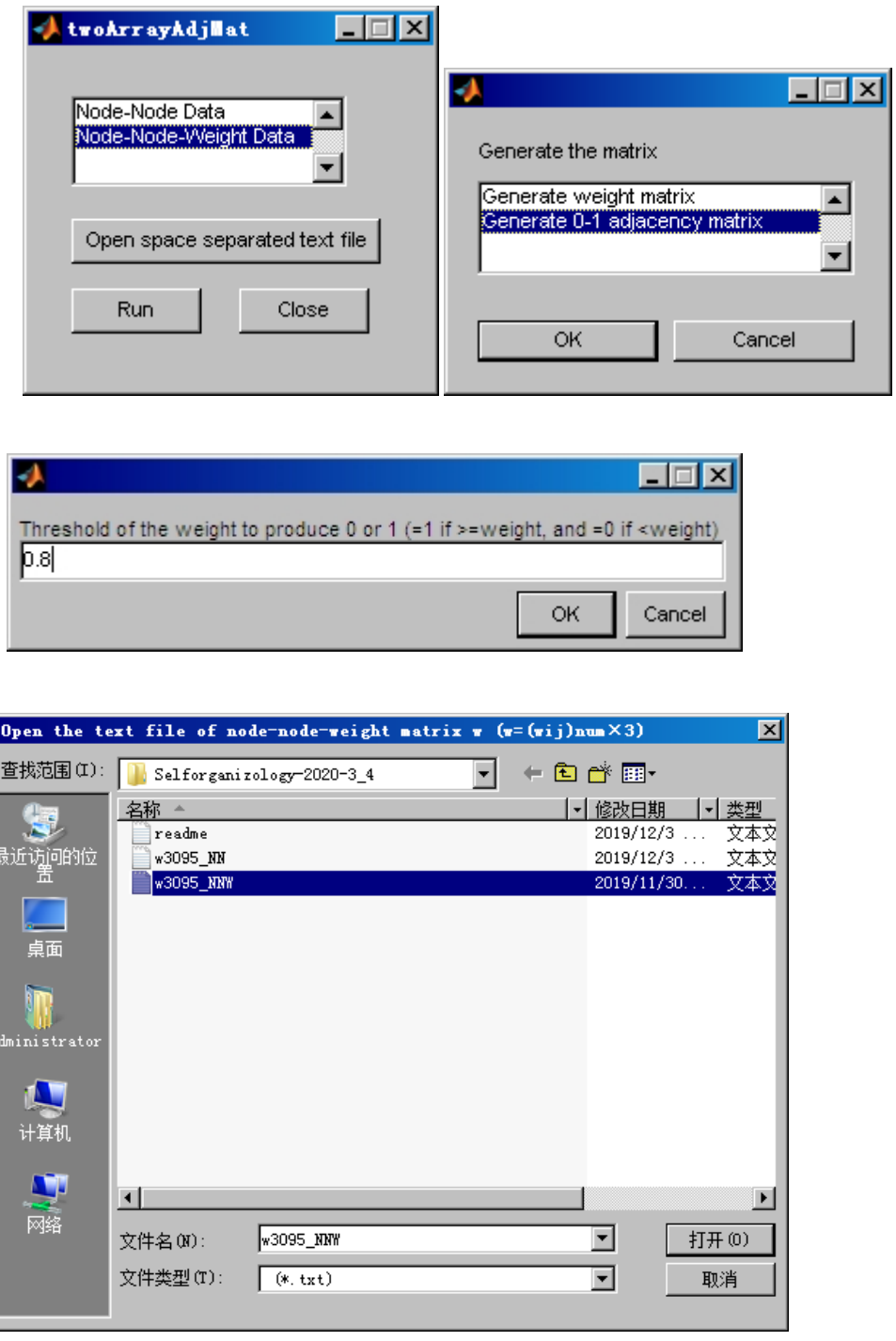


Fig. 1 The executable GUI software of the algorithm.

3 Application Example

There is a dataset for connection pairs with connection weights, as indicated in Fig. 2.

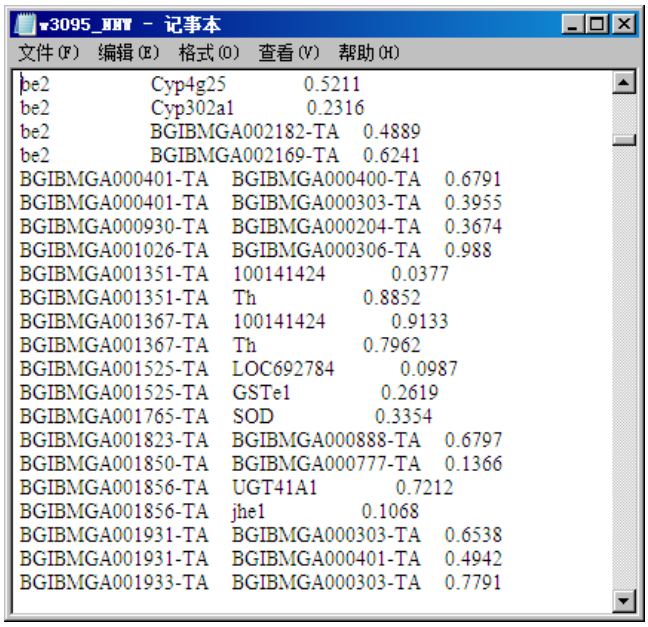
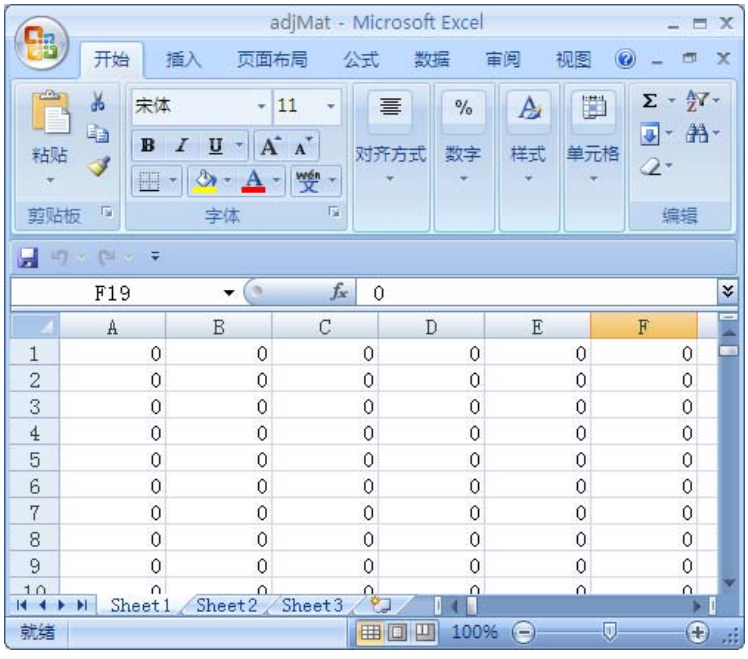
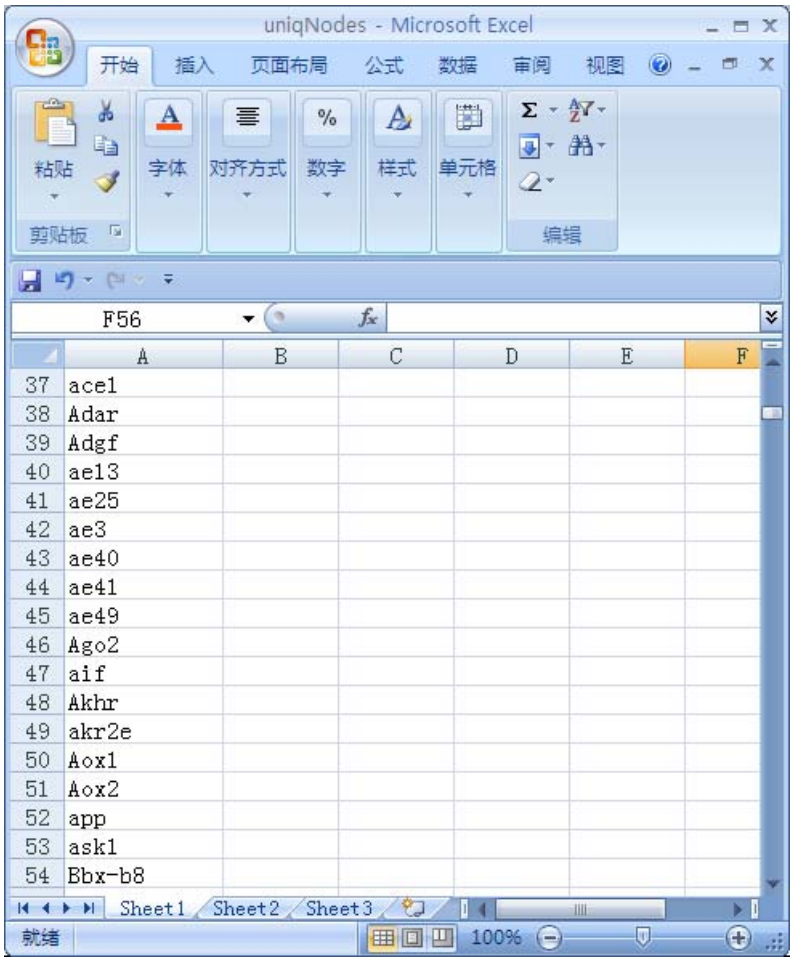


Fig. 2 An example dataset for connection pairs with connection weights. The dataset is stored in a space separated text file.

In the software interface, choose Node-Node-Weight Data and a dialog appears. In the dialog. choose generate 0-1 adjacency matrix and an input dialog appears for inputting the threshold *h*, for example, 0.8 is entered. The data file is loaded by open the space separated text file dialog. Finally, run the software (Fig. 1) and the two sets of results (adjacency matrix and unique node series) can be saved in to two specified excel files (Fig. 3a and 3b).



(3a)



(3b)

Fig. 3 Two sets of results, adjacency matrix (3a), and unique node series (3b).

4 Disscusion

It is obvious that the algorithm is applicable to datasets that nodes are represented by both strings and numerical ID numbers.

If the dataset is stored in an excel file. Users can save the file as a space separated text file (.prn), and open the ".prn" text file and re-save it as the text file (.txt) that can be used in the algorithm.

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