

Article

A Matlab software for visualizing user-interface interactive networks

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Abstract

Based on the previous web tool, I developed a Matlab software, netVisual, for generating a HTML file from which the user-interface interactive network can be visualized in the web browsers. In the network, the user can mouse-press any node to drag the network, to examine network topology, and to evaluate node centrality, etc. It can be freely used and run on popular web browsers as Chrome, etc. Both netVisual and demonstration data files are given.

Keywords network; visualization; Matlab; software.

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1 Introduction

The research areas in network biology include network construction, network analysis, network simulation and network control of biological networks (Kuang and Zhang, 2011; Huang and Zhang, 2012; Li and Zhang, 2013; Jiang et al., 2015; Zhang et al., 2014; Zhang, 2011, 2012b-c, 2016a-b, 2018; Zhang and Li, 2016; Qi et al., 2018; Zhang and Zhang, 2019; Xin and Zhang, 2020, 2021; Zhang, 2021b; Yang and Zhang, 2022).

As a basis, network visualization is an important area also (Narad et al., 2017). Various visualization software and tools have been developed and used (Zhang, 2007; Zhang, 2012a-b; Li and Zhang, 2013; Zhang and Zhang, 2019; Xin and Zhang, 2020, 2021; Yang and Zhang, 2022). In an earlier study, I presented a simple Java tools for visualizing networks (Zhang, 2007). Thereafter, I developed the more effective Java software for visualizing interactive networks (Zhang, 2012a). However, the data must be loaded with ODBC database in the Java application. In a recent study, I presented a web tool (<http://www.iaees.org/publications/software/netJa/netGen.htm>) for visualizing user-interface interactive networks (Zhang, 2021a). The tool is powerful but, it is not able to handle the networks with more than thousands of nodes and links due to the length limitation of browser's url, and the generated HTML page of the network is harder to be saved. For these reasons, in present study I developed a Matlab software for generating a HTML file from which the user-interface interactive network can be visualized in the web browsers.

2 Software and Data

2.1 Software and runtime environment

The Matlab software, netVisual, was developed based on the previous web tool (<http://www.iaees.org/publications/software/netJa/netGen.htm>; Zhang, 2021). The following are Matlab codes of the software:

```
function netVisual
%Copyright Zhang WJ, 2023
clear
[lang,OK]=listdlg('liststring',{'Directed network','Undirected network'},'listsize',[200
80],'OkString','OK','CancelString','Cancel','promptstring','Network type','selectionmode','single');
if (lang==1) arrows=1;
elseif (lang==2) arrows=0;
end
[lang,OK]=listdlg('liststring',{'Times New Roman','Sans Serif','Arial'},'listsize',[200
80],'OkString','OK','CancelString','Cancel','promptstring','Interactive node name visibility','selectionmode','single');
if (lang==1) fontFamily='Times New Roman';
elseif (lang==2) fontFamily='Sans Serif';
elseif (lang==3) fontFamily='Arial';
end
[lang,OK]=listdlg('liststring',{'True','False'},'listsize',[200 80],'OkString','OK','CancelString','Cancel','promptstring','Interactive
node name visibility','selectionmode','single');
if (lang==1) opacityNoHover=1;
elseif (lang==2) opacityNoHover=0;
end
answer=inputdlg({'Network size (e.g., 30)','Link length (e.g., 50)','Node name size (e.g., 15)','Interactive opacity for links and
node names (e.g., 100)'},'',1,{' ',' ',' '});
charge=-str2double(answer(1));
linkDistance=str2double(answer(2));
fontSize=str2double(answer(3));
opacity=str2double(answer(4));
[filename,pathname,filterindex]=uigetfile({'*.xls'},'Open the file of nodes');
nodesfile=fullfile(pathname,filename);
[filename,pathname,filterindex]=uigetfile({'*.xls'},'Open the file of links');
linksfile=fullfile(pathname,filename);
qans=questdlg('In the nodes file, the 1st column are node IDs (1,2,...), the 2nd column are node names, and the 3rd column are
node group IDs. In the links file, the 1st and 2nd columns are node IDs of source nodes and target nodes for links, the 3rd column
are link widths (e.g., 10), and the 4th column are link colors (e.g., 666).','Confirm or Abort','Confirm','Abort','Confirm');
if strcmp(qans,'Abort') quit; end
[temp1,temp2,nodesdata]=xlsread(nodesfile);
n=size(nodesdata,1);
linksdata=xlsread(linksfile);
l=size(linksdata,1);
name=";group=";
for i=1:n
```

```

if (i==1)
name=strcat("",nodesdata{i,2});
group=strcat(num2str(nodesdata{i,3}));
elseif (i>1)
name=strcat(name,"",nodesdata{i,2});
group=strcat(group,',',num2str(nodesdata{i,3}));
end
if (i==n) name=strcat(name,""); end
end
source="";target="";linkwidth="";colour="";
for i=1:l
if (i==1)
source=strcat(num2str(linksdata(i,1)-1));
target=strcat(num2str(linksdata(i,2)-1));
linkwidth=strcat(num2str(linksdata(i,3)));
colour=strcat("#",num2str(linksdata(i,4)));
elseif (i>1)
source=strcat(source,',',num2str(linksdata(i,1)-1));
target=strcat(target,',',num2str(linksdata(i,2)-1));
linkwidth=strcat(linkwidth,',',num2str(linksdata(i,3)));
colour=strcat(colour,"",num2str(linksdata(i,4)));
end
if (i==l) colour=strcat(colour,""); end
end
[filename,pathname]=uiputfile('*.htm','Sava network as');
file=fullfile(pathname,filename);
fid=fopen(file,'w','n','UTF-8');
printStr="";
printStr=strcat(printStr,'<html style="width: 100%%; height: 100%%;"><head><meta charset="utf-8">');
printStr=strcat(printStr,'<title>User-Interface Interactive Network</title>');
printStr=strcat(printStr,'<script type="text/javascript"
src="http://www.iaees.org/publications/software/netJa/netJsrc1.js"></script><script type="text/javascript"
src="http://www.iaees.org/publications/software/netJa/netJsrc2.js"></script><script type="text/javascript"
src="http://www.iaees.org/publications/software/netJa/netJsrc3.js"></script></head><body style="margin: 0px; padding: 10px;
overflow: hidden; width: 100%%; height: 100%%; background-color: white;">');
printStr=strcat(printStr,'<font face="Times New Roman" size="1" color="cyan">User manual: Zhang WJ. 2024. A Matlab
software for visualizing user-interface interactive networks. Network Biology, 14(1): 13-19</font>');
printStr=strcat(printStr,'<div id="htmlwidget_container" style="position: absolute; top: 10px; right: 10px; bottom: 10px; left:
10px;"><div id="htmlwidget-50742ce3f4548458b168" style="width: 100%%; height: 100%%;" class="forceNetwork
html-widget"></div></div>');
printStr=strcat(printStr,'<font face="Times New Roman" size="3"><script type="application/json"
data-for="htmlwidget-50742ce3f4548458b168">');
printStr=strcat(printStr,'{"x":{"links":{"source":["source,'],"target":["target,],"value":["linkwidth,],"colour":["colour,]}}');
printStr=strcat(printStr,'"nodes":{"name":["name,],"group":["group,]}}');
printStr=strcat(printStr,'"options":{"colourScale":"d3.scaleOrdinal(d3.schemeCategory20);","NodeID":{"name","Group":"group

```

```

", "arrows":',num2str(arrows),', "fontSize":',num2str(fontSize),', "fontFamily":',fontFamily,', "linkDistance":',num2str(linkDistance),', "linkWidth":',function(d) { return
Math.sqrt(d.value)}, "charge":',num2str(charge),', "opacity":',num2str(opacity),', "opacityNoHover":',num2str(opacityNoHover),'}
}, "evals": [], "jsHooks": []});
printStr=strcat(printStr,'</script><script type="application/htmlwidget-sizing"
data-for="htmlwidget-50742ce3f4548458b168">{"viewer":{"width":450,"height":350,"padding":10,"fill":true},"browser":{"width":960,"height":500,"padding":10,"fill":true}}</script></font></body></html>');
fprintf(fid,printStr);
web(file,'-browser');
fclose all;

```

netVisual was compiled into an executable software, netVisual.exe. First, the user must have installed the MATLAB software in the computer. Then, double-click netVisual.exe to run the software.

2.2 Data

The data for visualizing a network are stored in two excel files. In the nodes file, the 1st column are node IDs (1, 2, ...), the 2nd column are node names, and the 3rd column are node group IDs. In the links file, the 1st and 2nd columns are node IDs of source nodes and target nodes for links, the 3rd column are link widths (e.g., 10), and the 4th column are link colors (e.g., 666).

The software and demo data files are included in the package: [http://www.iaees.org/publications/journals/nb/articles/2024-14\(1\)/e-suppl/Zhang-Supplementary-Material2.rar](http://www.iaees.org/publications/journals/nb/articles/2024-14(1)/e-suppl/Zhang-Supplementary-Material2.rar)

3 Demonstration

The network data for TNF signaling pathway are used (Huang and Zhang, 2012; Li and Zhang, 2013), which are stored in two excel files (TNFnodes.xls, TNFlinks.xls), as shown in Fig. 1.

E32				K33				
	A	B	C		A	B	C	D
1	1	TRADD	1	1	1	8	10	666
2	2	SODD	1	2	1	12	10	666
3	3	TRAF2	1	3	1	16	10	666
4	4	FADD	1	4	2	1	10	666
5	5	RIP	1	5	2	8	10	666
6	6	RAIDD	1	6	3	12	10	666
7	7	Caspase 3	1	7	3	16	10	666
8	8	Caspase 8	1	8	4	8	10	666
9	9	Caspase 6	1	9	5	10	10	666
10	10	Caspase2	1	10	5	12	10	666
11	11	Caspase 7	1	11	5	16	10	666
12	12	Caspase 1	1	12	6	10	10	666
13	13	BID	1	13	8	13	10	666
14	14	Caspase 9	1	14	10	7	10	666
15	15	tBID	1	15	10	9	10	666
16	16	MEKIKs-P-NIK-P	1	16	10	11	10	666
17	17	CytoC	1	17	12	7	10	666
18	18	IKKs-P	1	18	12	9	10	666
19	19	CytoC-Caspase 9-APAF1	1	19	12	11	10	666
20	20	p38-P	1	20	13	15	10	666
21	21	(NF-kB)-IκBs	1	21	14	7	10	666
22	22	ATFs	1	22	14	9	10	666
23	23	NF-kB	1	23	14	11	10	666
24	24	ERKs-P	1	24	16	18	10	666
25	25	Elk1	1	25	16	20	10	666
26	26	Ceramides	1	26	16	24	10	666
27	27	JNK1-P	1	27	17	19	10	666
28	28	JNKK1-P	1	28	18	21	10	666
29	29	TAK1	1	29	19	14	10	666
30	30	(c-Jun)-(c-Fos)	1	30	20	22	10	666
31	31	Gene Expression	1	31	21	23	10	666
32	32		1	32	22	31	10	666

Fig. 1 The network data for TNF signaling pathway. Left: TNFnodes.xls; Right: TNFlinks.xls.

Run the software netGen.exe, make some choices, input some parametrical values, and load the data file above (Fig. 2), a HTML file for the interactive network can be generated. The HTML file can be loaded in a suitable web browser as chrome, and we can drag the nodes in the network to exhibit a better layout of the network (Fig. 3).

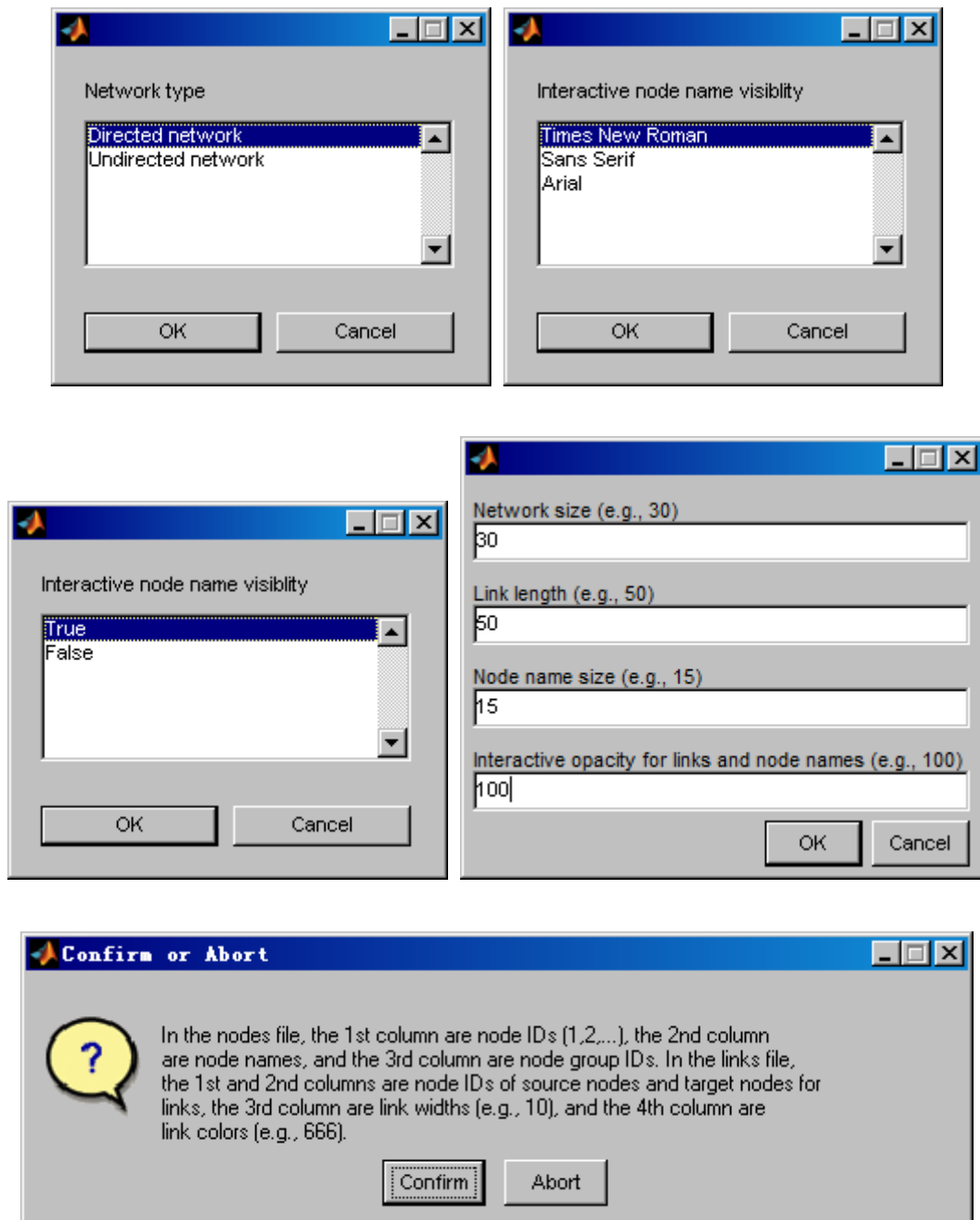


Fig. 2 Several windows of the software, netVisual.

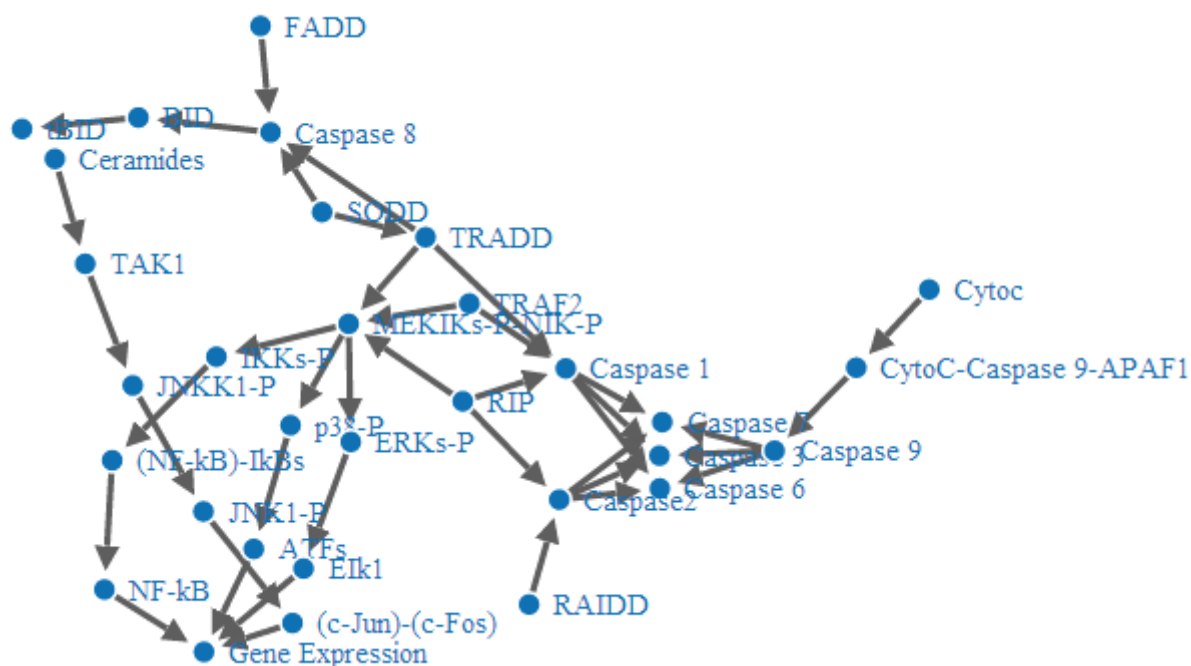


Fig. 3 The user-interface interactive network for TNF signaling pathway, generated by the software, netVisual.

Compared to the previous online web version (Zhang, 2021a), netVisual permits limitless nodes and links, and it will directly generate the HTML file for the network. The HTML file can be used anywhere with internet and web browsers.

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