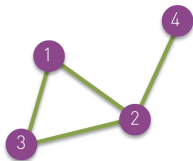# network *representations*

introduction to *network science in Python* (*NetPy*)

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14th Dec 2021

network *representations*

undirected graph

$$\begin{bmatrix} 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix}$$
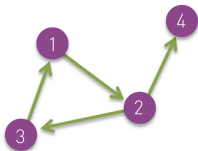
adjacency matrix

1: [2, 3]
2: [1, 3, 4]
3: [1, 2]
4: [2]

adjacency list

{1, 2}
{1, 3}
{2, 3}
{2, 4}

edge list

directed graph

$$\begin{bmatrix} 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix}$$

adjacency matrix

[3] :1: [2]
[1] :2: [3, 4]
[2] :3: [1]
[2] :4: [ ]

adjacency list

(1, 2)
(2, 3)
(2, 4)
(3, 1)

edge list

---

*adjacency list can also be implemented with maps or trees & edge list cannot represent isolated nodes

network *structures*

— *adjacency matrix* for elegant *analytical derivations*

  most derivations based on matrix representation[†]

— *adjacency list* for efficient *algorithms implementation*

  ideal complexity since most algorithms require incidence[†]

— *edge list* for efficient *network storing/manipulation*

  easy editing since each edge stored only once

[†]some derivations can also be based on adjacency list & some algorithms require edge list

network *formats*
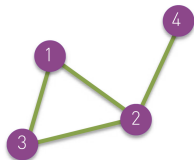
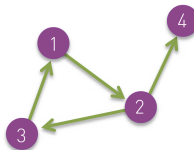*undirected* graph

edge list

```
# undirect
1 2
1 3
2 3
2 4
```

```
*vertices 4
1 "1"
2 "2"
3 "3"
4 "4"
*edges
1 2
1 3
2 3
2 4
```

Pajek format

```
# undirect
# 0 "1"
# 1 "2"
# 2 "3"
# 3 "4"
#
0 1
0 2
1 2
1 3
```

LNA format

directed graph

edge list

```
# directed
1 2
2 3
2 4
3 1
```

```
*vertices 4
1 "1"
2 "2"
3 "3"
4 "4"
*arcs
1 2
2 3
2 4
3 1
```

```
# directed
# 0 "1"
# 1 "2"
# 2 "3"
# 3 "4"
#
0 1
1 2
1 3
2 0
```

§ad-hoc edge list and Pajek format most popular & other formats include GML, GraphML and JSON

network *data*

— easily obtained from *online sources*

— already present in many *standard datasets*

— *personal web pages* of network researchers

— popular *network repositories/collections*

     – network catalogue and repository [Netzschleuder]

     – Colorado Index of Complex Networks [ICON]

     – Stanford Network Analysis Project [SNAP]

     – Koblenz Network Collection [KONECT]

     – Open Graph Benchmark [OGB]

     – Network Repository [NetRepo]

     – Pajek datasets [Pajek]