Effective Programming Practices for Economists

Background

A Primer on Graphs

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Graph definition

A graph G is a pair (N,E) of sets, where N are nodes and E are edges:

$$G = (N, E)$$

Edges are

- sets of two nodes (undirected graphs)
- pairs of nodes (directed graphs)

Chain (undirected)

```
х3
N = \{x_0, x_1, x_2, x_3\}
E=\{
                                                (x_2)
        \{x_0,x_1\},
         \{x_1,x_2\},
        \{x_2,x_3\}
                                                x_0
```

Chain (undirected)

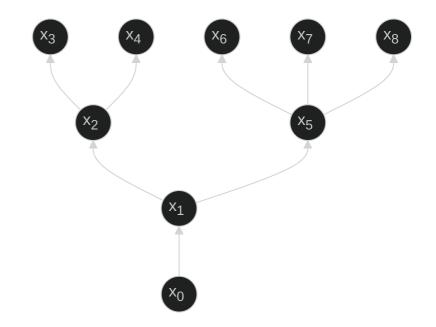
```
х3
N = \{x_0, x_1, x_2, x_3\}
E=\{
                                                (x_2)
        \{x_1,x_0\},
         \{x_1,x_2\},
        \{x_2,x_3\}
                                                x_0
```

Chain (directed)

```
N = \{x_0, x_1, x_2, x_3\}
E= \{
                                                   (x<sub>2</sub>
         (x_0,x_1),
         (x_1,x_2),
         (x_2,x_3)
                                                   x_0
```

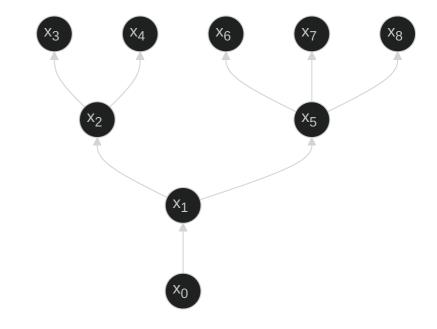
Tree (undirected)

```
egin{aligned} N = & \{x_0, x_1, \dots, x_8\} \ E = & \{x_0, x_1\}, \{x_1, x_2\}, \{x_2, x_3\}, \ & \{x_2, x_4\}, \{x_1, x_5\}, \{x_5, x_6\}, \ & \{x_5, x_7\}, \{x_5, x_8\} \ & \} \end{aligned}
```



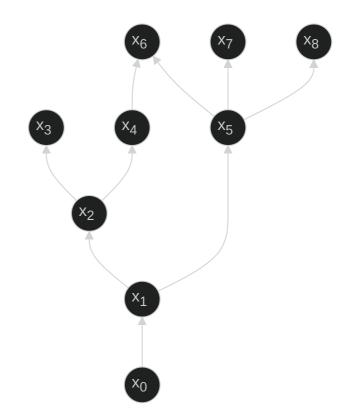
Tree (directed, "arborescence")

```
egin{aligned} N = & \{x_0, x_1, \dots, x_8\} \ E = & \{ & (x_0, x_1), (x_1, x_2), (x_2, x_3), \ & (x_2, x_4), (x_1, x_5), (x_5, x_6), \ & (x_5, x_7), (x_5, x_8) \ & \} \end{aligned}
```



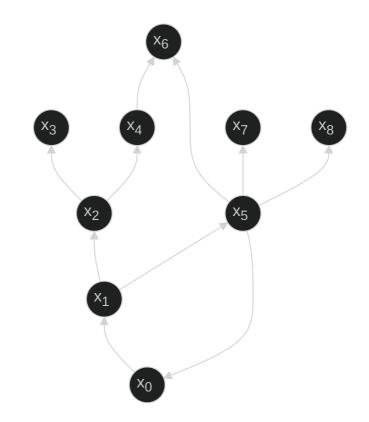
Directed Acyclic Graph (DAG)

```
egin{aligned} N = & \{x_0, x_1, \dots, x_8\} \ E = & \{ & (x_0, x_1), (x_1, x_2), (x_2, x_3), \ & (x_2, x_4), (x_1, x_5), (x_5, x_6), \ & (x_5, x_7), (x_5, x_8), (x_4, x_6) \ & \} \end{aligned}
```



Directed Acyclic Graph

```
N = \{x_0, x_1, \dots, x_8\}
E = \{
         (x_0, x_1), (x_1, x_2), (x_2, x_3),
         (x_2, x_4), (x_1, x_5), (x_5, x_6),
          (x_5, x_7), (x_5, x_8), (x_4, x_6),
         (x_5,x_0)
```



Graph Use Cases

- The file system
- Git
- Reproducible research
- Causal theory
- Behavioural economics
- **-** ...