STDISCM: Graphs

Graphs (Directed Graphs)

G=(V, E) – Graph

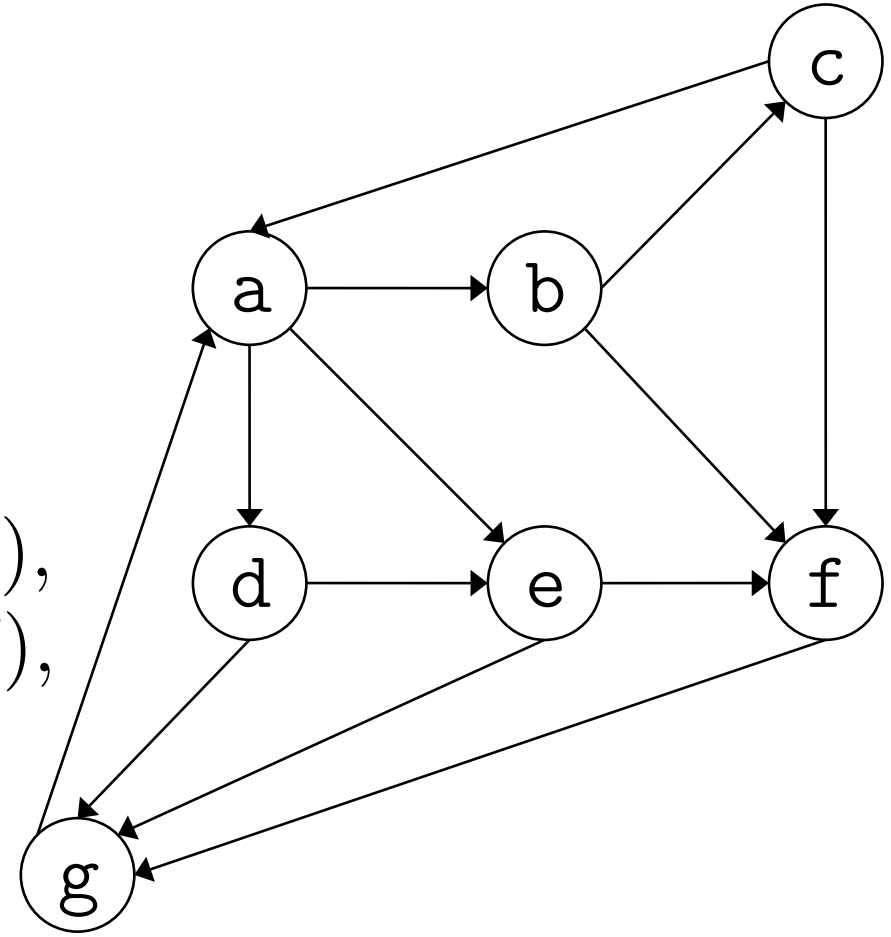
V – Set of Vertices (or Nodes)

E – Set of Edges (or Arrows)

Example:

V = {a, b, c, d, e, f, g}

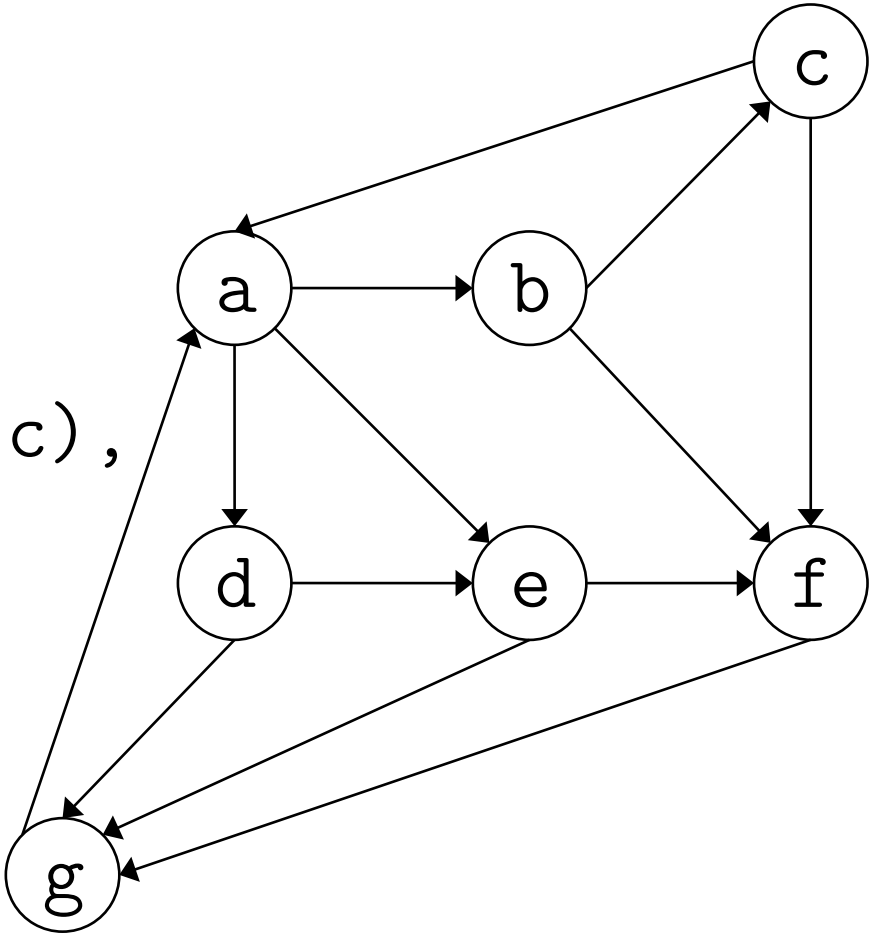
E = {(a,b), (a,d), (a,e),(b,c), (b,f),
(c,a), (c,f), (d,g), (d,e), (e,f),
(e,g), (f,g), (g,a) }



Graph Representation: Node List + Edge List

G=(V, E) – Graph
V – Set of Vertices (or Nodes)
E – Set of Edges (or Arrows)

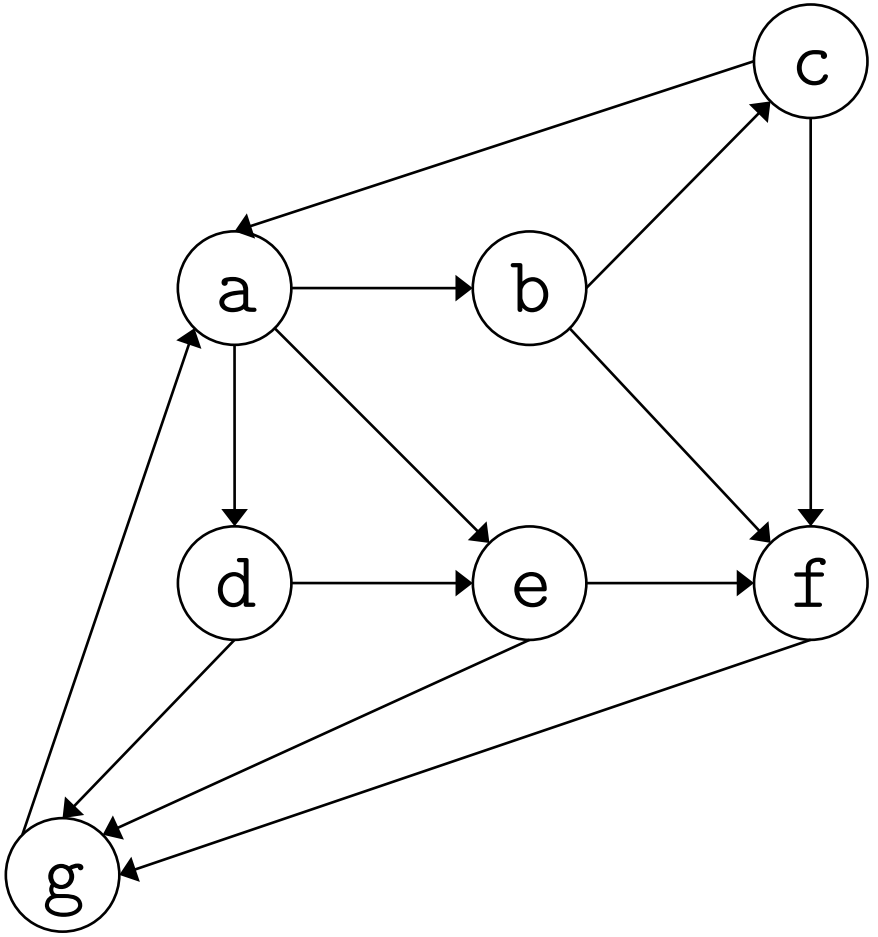
```
Example:
V = [a, b, c, d, e, f, g]
E = [(a,b), (a,d), (a,e),(b,c),
(b,f), (c,a), (c,f), (d,g),
(d,e), (e,f),(e,g), (f,g),
(g,a) ]
```



Graph Representation: Adjacency List

G=(V, E) – Graph
V – Set of Vertices (or Nodes)
E – Set of Edges (or Arrows)

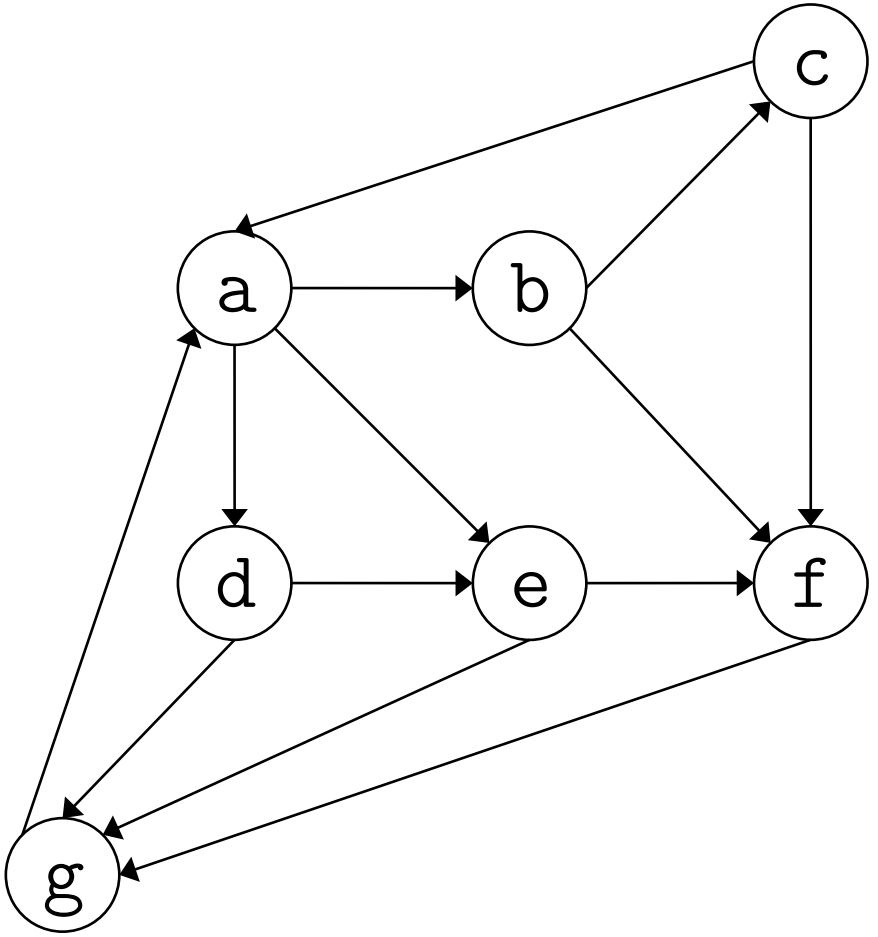
```
Example:
AdjList = [
a: [b,d,e],
b: [c,f],
c: [a,f],
d: [e,g],
e: [f,g],
f: [g],
g: [a]
]
```



Graph Representation: Adjacency Matrix

G=(V, E) – Graph
V – Set of Vertices (or Nodes)
E – Set of Edges (or Arrows)

```
Example:
AdjMatrix =
[  a b c d e f g
a [0,1,0,1,1,0,0],
b [0,0,1,0,0,1,0],
c [1,0,0,0,0,1,0],
d [0,0,0,0,1,0,1],
e [0,0,0,0,0,1,1],
f [0,0,0,0,0,0,1],
g [1,0,0,0,0,0,0]
]
```

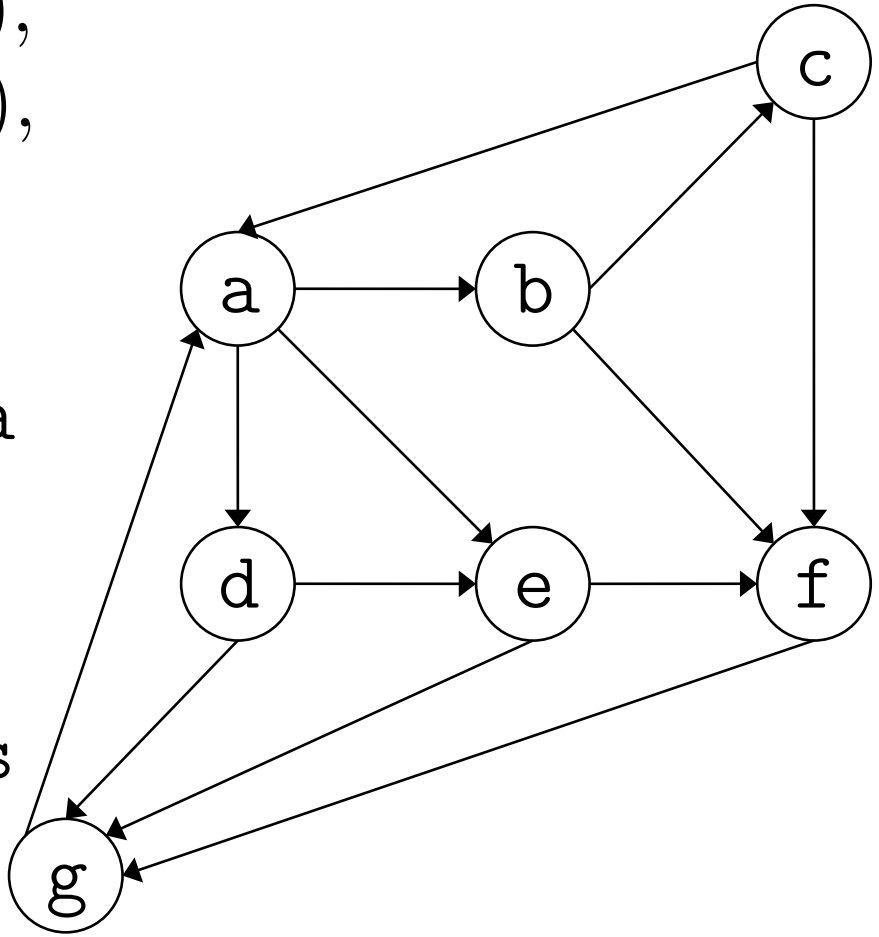


Our Format or Syntax for Defining a Graph (1/3)

Example:

V = {a, b, c, d, e, f, g}

E = {(a,b), (a,d), (a,e),(b,c), (b,f),
(c,a), (c,f), (d,g), (d,e), (e,f),
(e,g), (f,g), (g,a) }



Graph File Format:

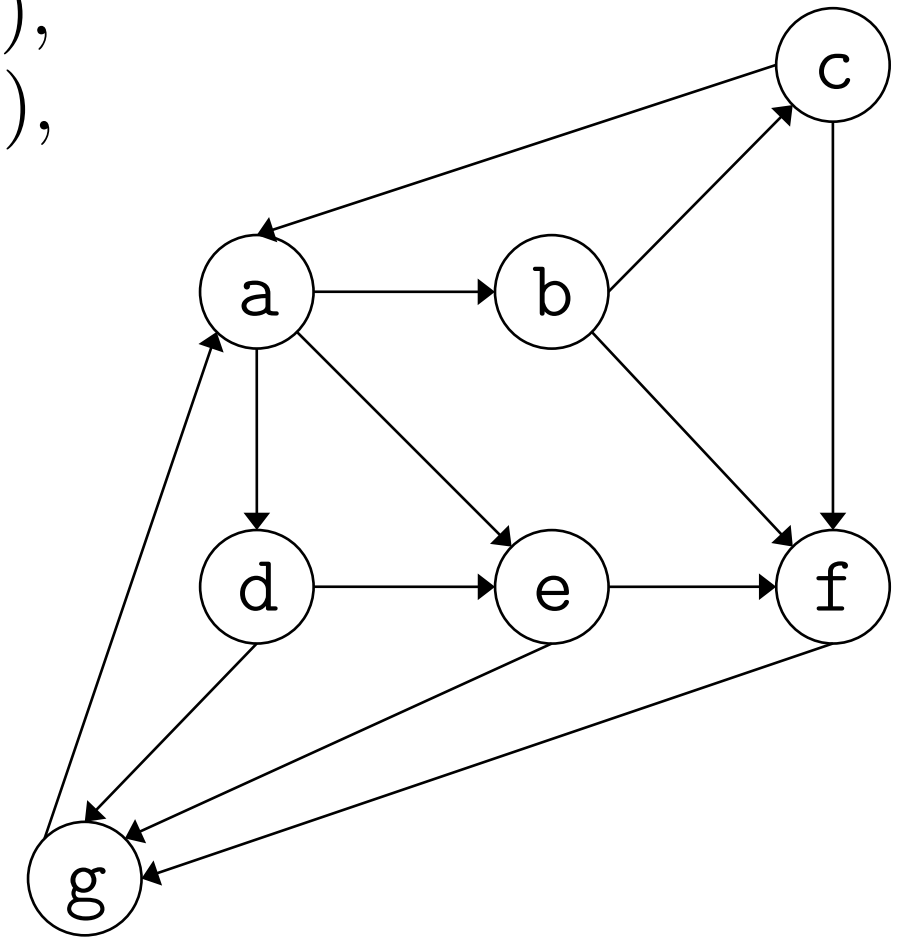
1. Each line defines either a node or an edge.
2. Lines that start with the '*' character is a node. The string that follows is the node label.
3. Lines that start with the '-' character is an edge. The two strings that follow are source and target nodes.

Our Format or Syntax for Defining a Graph (2/3)

Example:

V = {a, b, c, d, e, f, g}

E = {(a,b), (a,d), (a,e),(b,c), (b,f),
(c,a), (c,f), (d,g), (d,e), (e,f),
(e,g), (f,g), (g,a) }



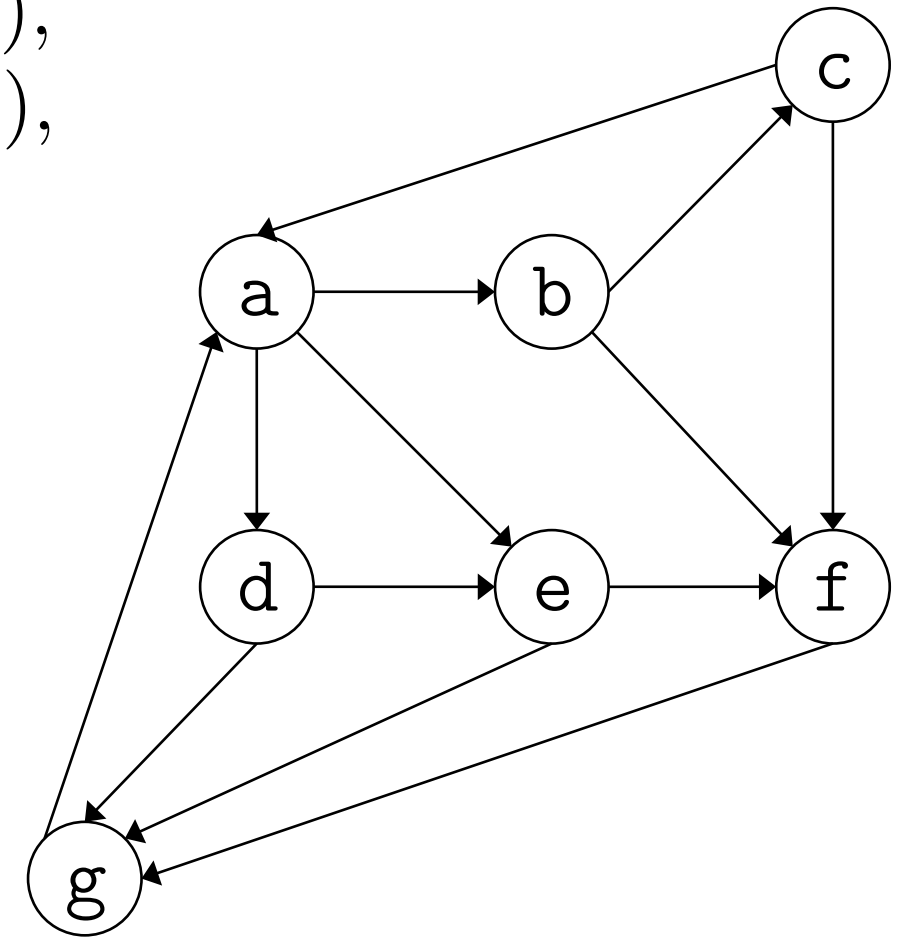

```
Graph File:
* a
* b
* c
* d
* e
* f
* g
- a b
- a d
- a e
```

Our Format or Syntax for Defining a Graph (3/3)

Example:

V = {a, b, c, d, e, f, g}

E = {(a,b), (a,d), (a,e),(b,c), (b,f),
(c,a), (c,f), (d,g), (d,e), (e,f),
(e,g), (f,g), (g,a) }



Graph File (continued):

```
- b c
- b f
- c a
- c f
- d e
- d g
- e f
- e g
- f g
- g a
```

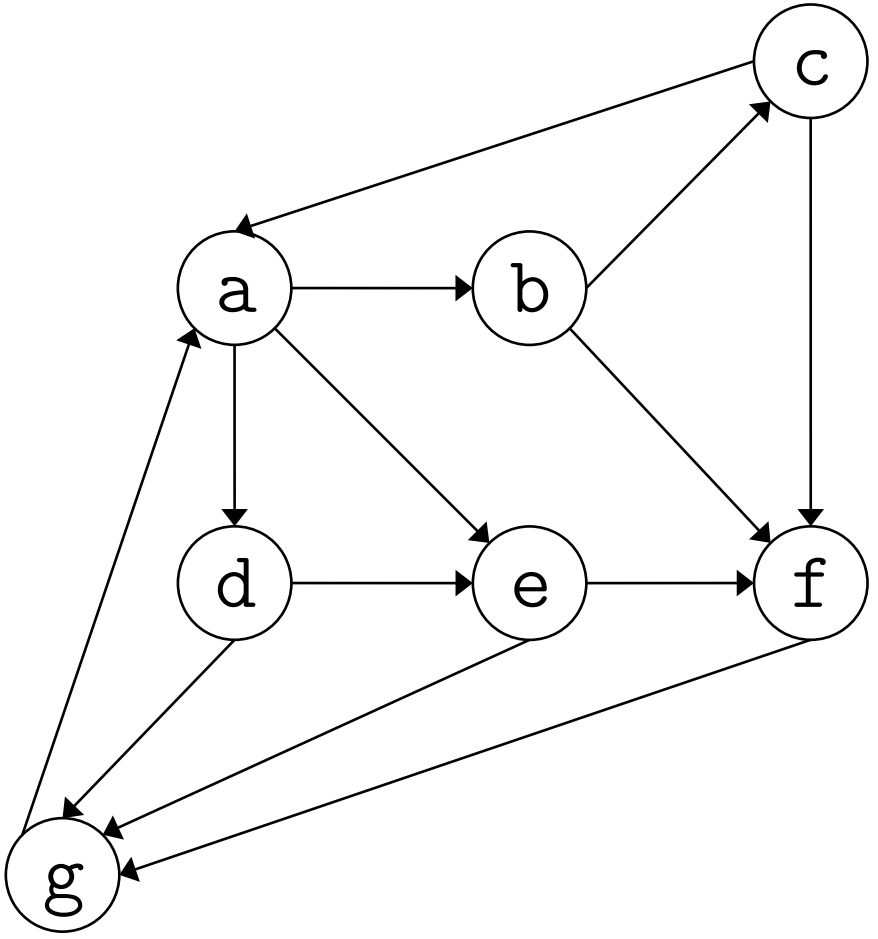
Structures in Graphs: Path (no loops)

Paths: a $\rightarrow$ g

a $\rightarrow$ b $\rightarrow$ c $\rightarrow$ f $\rightarrow$ g
a $\rightarrow$ b $\rightarrow$ f $\rightarrow$ g

a $\rightarrow$ d $\rightarrow$ e $\rightarrow$ f $\rightarrow$ g
a $\rightarrow$ d $\rightarrow$ e $\rightarrow$ g
a $\rightarrow$ d $\rightarrow$ g

a $\rightarrow$ e $\rightarrow$ f $\rightarrow$ g
a $\rightarrow$ e $\rightarrow$ g



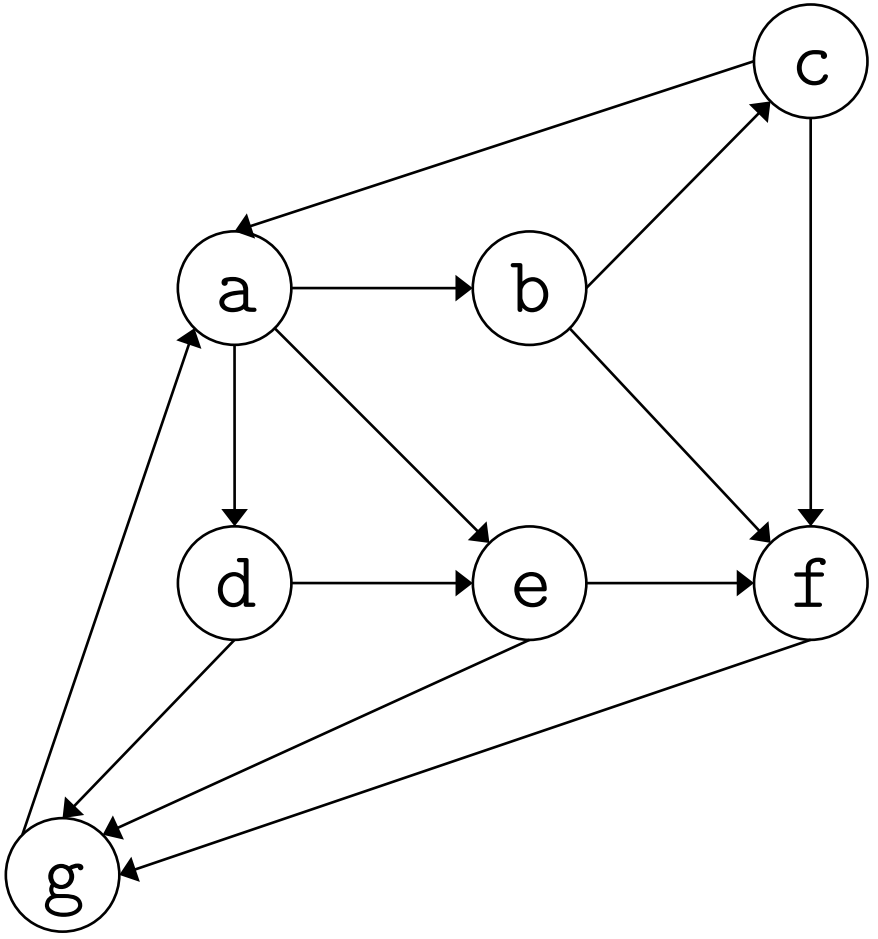
Structures in Graphs: Loops

Loop: a $\rightarrow$ a

a $\rightarrow$ b $\rightarrow$ c $\rightarrow$ a
a $\rightarrow$ b $\rightarrow$ c $\rightarrow$ f $\rightarrow$ g $\rightarrow$ a
a $\rightarrow$ b $\rightarrow$ f $\rightarrow$ g $\rightarrow$ a

a $\rightarrow$ d $\rightarrow$ e $\rightarrow$ f $\rightarrow$ g $\rightarrow$ a
a $\rightarrow$ d $\rightarrow$ e $\rightarrow$ g $\rightarrow$ a
a $\rightarrow$ d $\rightarrow$ g $\rightarrow$ a

a $\rightarrow$ e $\rightarrow$ f $\rightarrow$ g $\rightarrow$ a
a $\rightarrow$ e $\rightarrow$ g $\rightarrow$ a



Structures in Graphs: Clique

4-clique:
{a,b,d,e}

3-cliques:
{a,b,c}
{a,b,e}
{a,b,d}
{a,d,e}
{a,d,g}
{b,c,f}
{b,e,f}
{d,e,g}
{e,f,g}