

DFS starting from f

Obs. If there is a path from  $s$  to  $t$  in  $G$ , then DFS on  $G$  starting from  $s$  will find a path from  $s$  to  $t$ .

# DFS

- Bottom-up analysis of graphs  
ex. Computing optimal  
Strategies for games.
- Path-finding in graphs.

$dfs(G, s)$

$visited[v] \leftarrow \text{false}$  for all  $v \in V(G)$

$stack \leftarrow \{s\}$

while  $stack \neq \emptyset$

$v \leftarrow \text{pop } stack$

if  $visited[v]$  is false

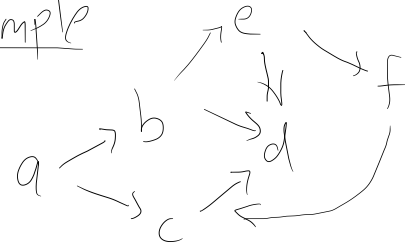
$visited[v] \leftarrow \text{true}$

for each  $v \rightarrow u$  in  $G$

if  $visited[u]$  is false

push  $u$  into  $stack$

Example



$dfs(G, a)$

Push a

Visit a

Push c

Push b

Visit b

Push c

Push d

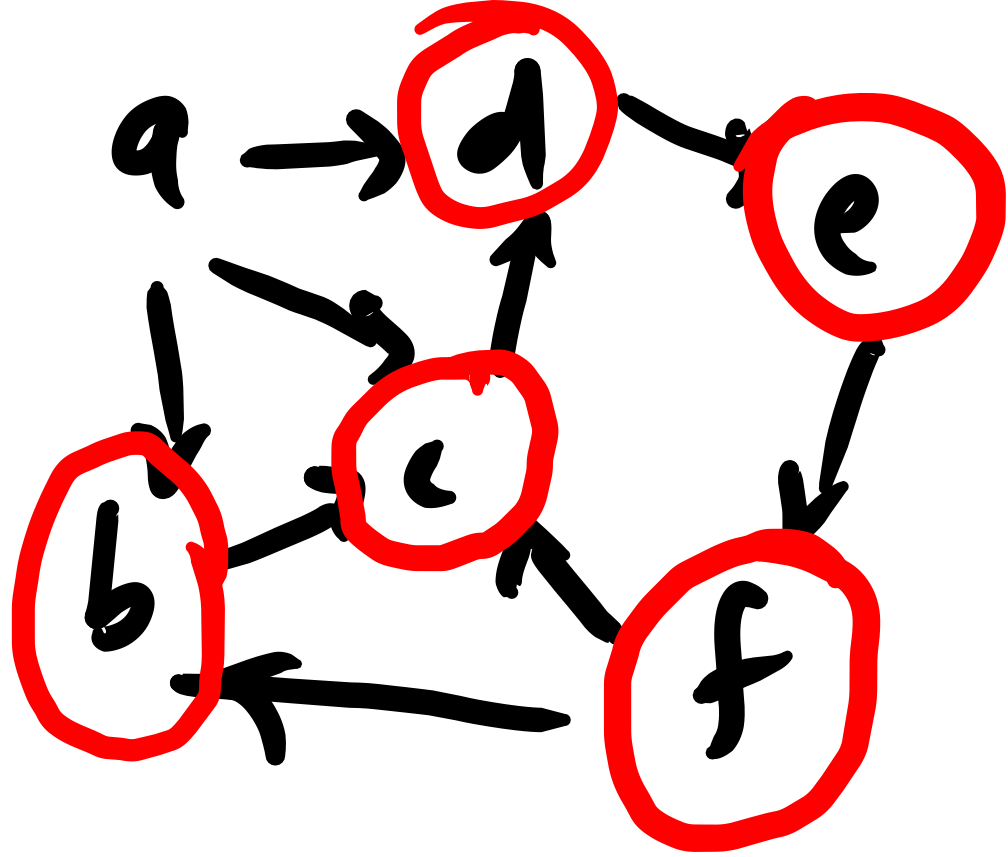
Visit d

Visit e

Push f

Visit f





dfs (G, t)

Stack

Sudoku

Path finding

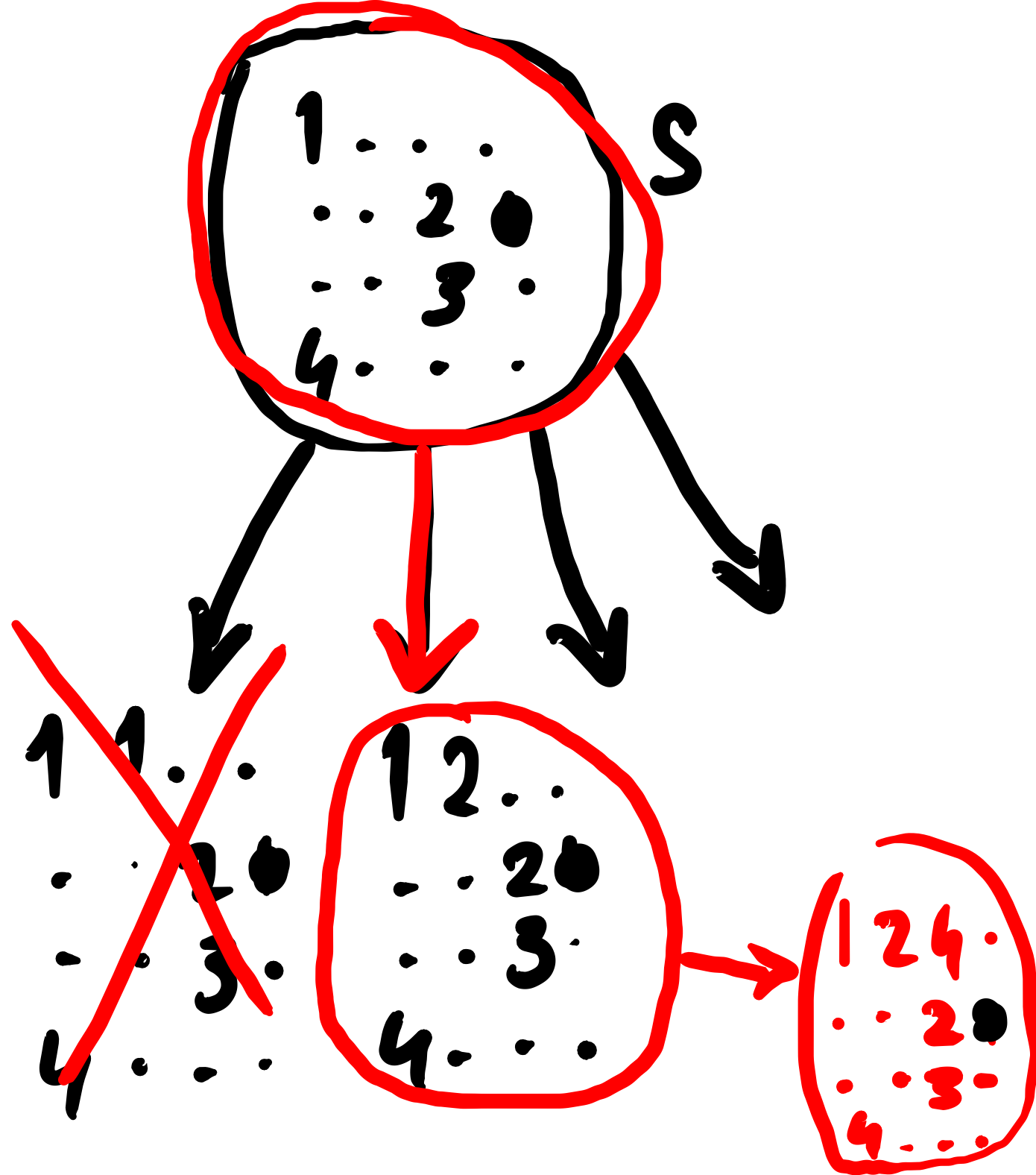
$(G, s, t)$

Find a path in  
 $G$  from  $s$  to  $t$ .

What is  $G, s, t$  for Sudoku?

$t$

1	2	4	3
3	4	2	1
2	1	3	4
4	3	1	2



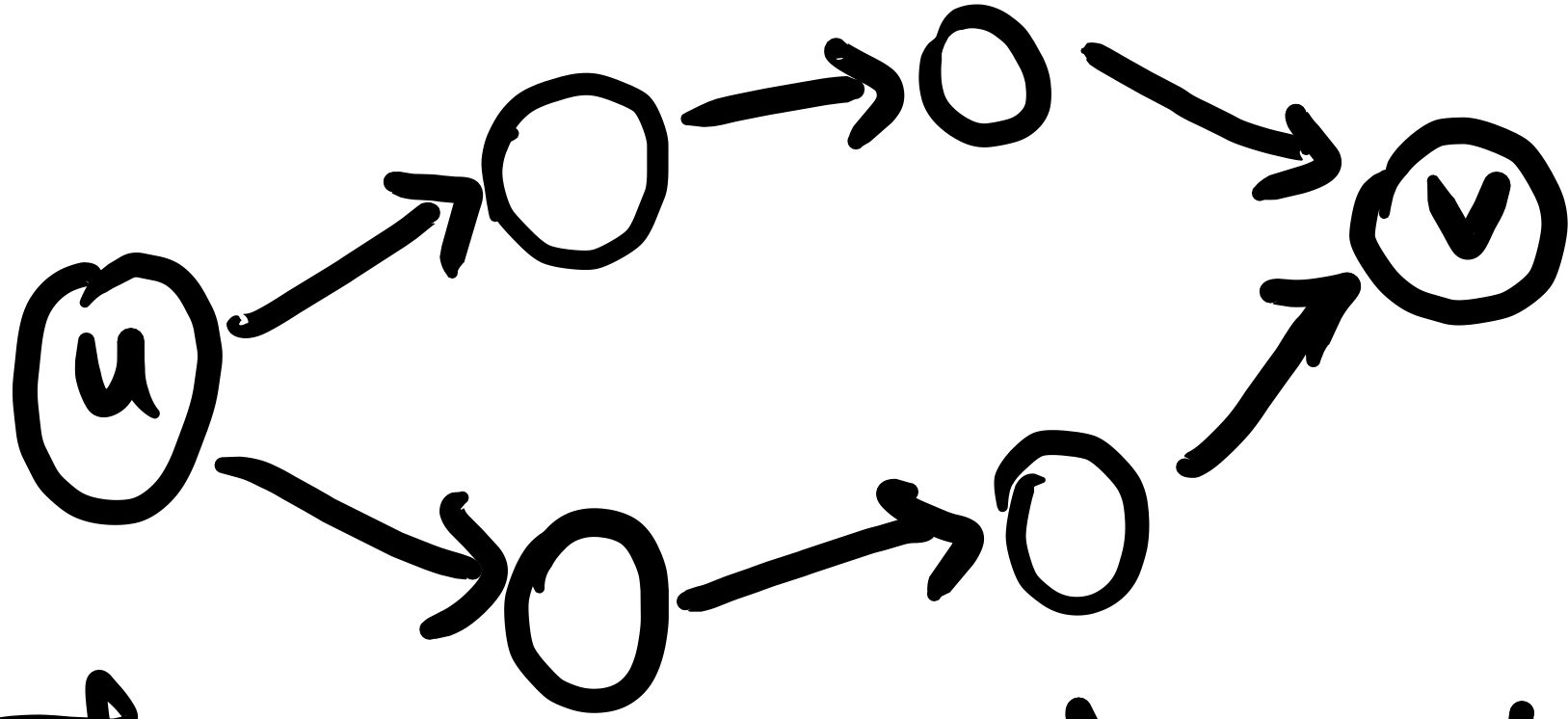
## Neighbors of $v$

Take topmost, leftmost empty cell

Fill all possible values on that cell.



In + + + graph



There are vertices  $u$  and  $v$   
s.t there are multiple Paths from  $u$  to  $v$ .

In Sudoku graph  
if there is a path from  $s \rightsquigarrow v$   
then this path is unique.  
(Hw. Prove!)

A hand-drawn 9x9 grid representing a 3x3 matrix of 3x3 submatrices. The grid is divided into three vertical sections of three columns each. The columns are indexed 0 to 8 at the top, and the rows are indexed 0 to 8 on the left. Arrows point to the first row and first column.