

# Overview Basics and Eulerian Graphs

515: Graph, nodes and edges

516: Königsberg

517: Special Paths

518: Cycle vs. Eulerian Cyc

519: Eulerian Tour?

524: Subgraph

525: Peterson Graph

526: Proof Eulerian Tour

527: Hierholzers Algorithm

528: Bipartite Graph

529: Traveling Salesman Pro

530: Complete Graphs

531:  $p$  can not be extended

534: Tree

653: Every vertex has an even

654: In forests:  $n = m + p$

655: Delete until acyclic

667: Searching a big tree

668: Spanning tree

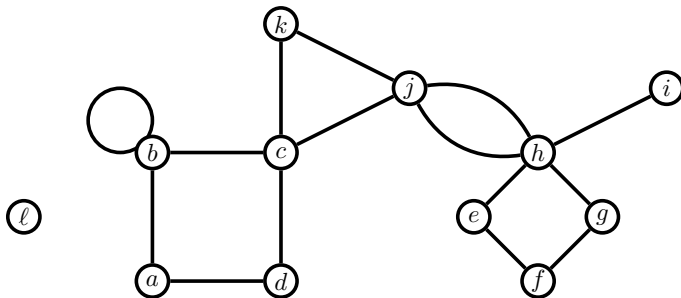
669: Properties of BFS and

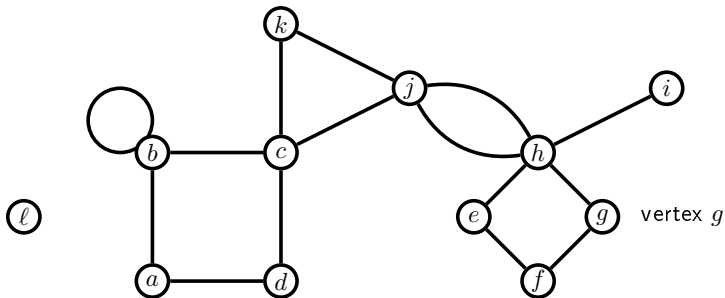
670:  $w$  is smallest common

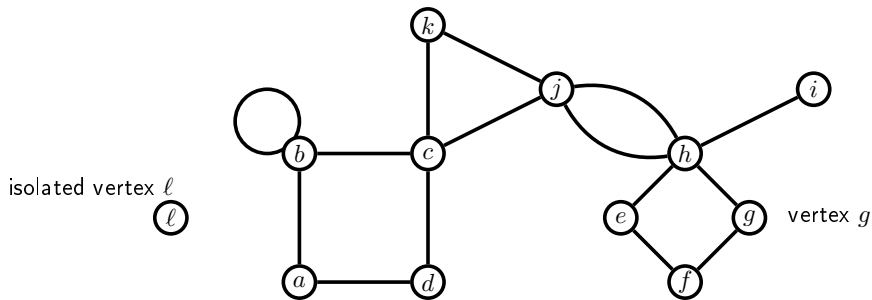
671:  $(u, v)$  cannot be connected

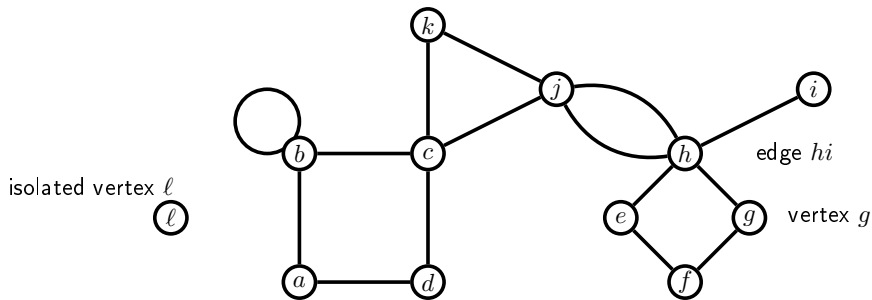
672: Generic graph search

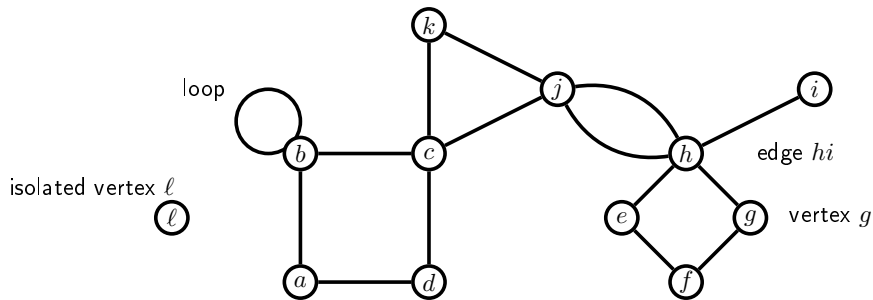
673: BFS and DFS

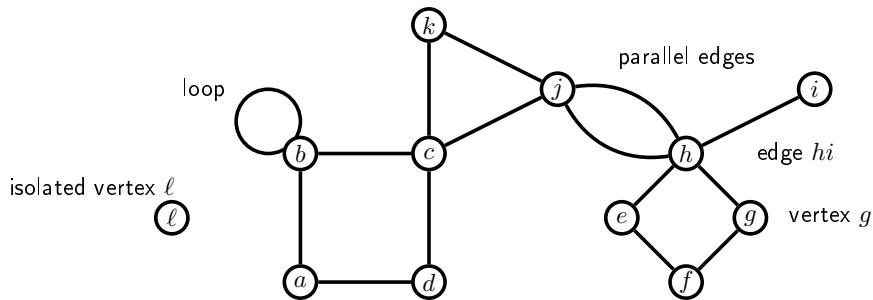


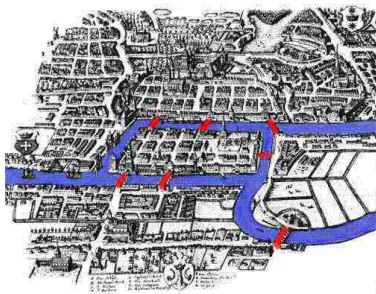




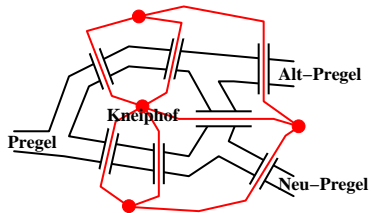
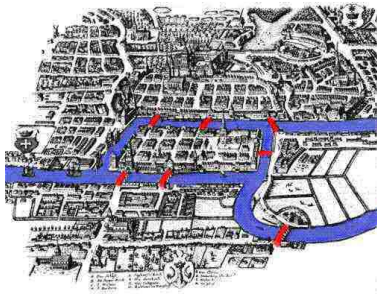


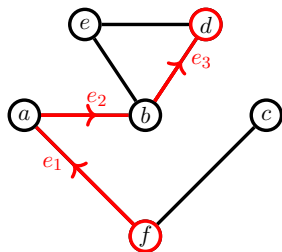




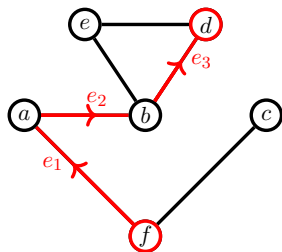




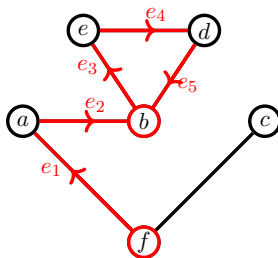




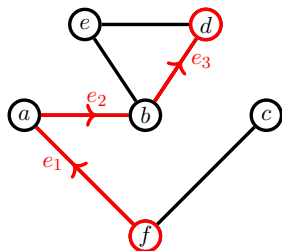
elementary  $(f, d)$ -path



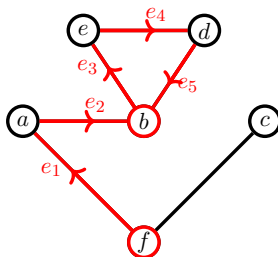
elementary  $(f, d)$ -path



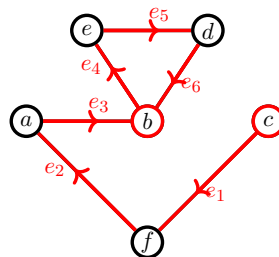
simple  $(f, b)$ -path



elementary  $(f, d)$ -path



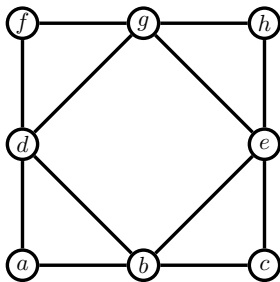
simple  $(f, b)$ -path



Eulerian path

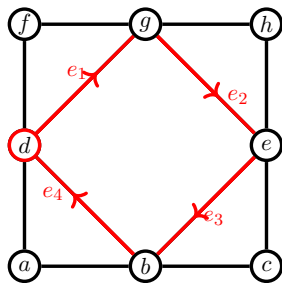
# Cycle vs. Eulerian Cycle

Nr. 518



# Cycle vs. Eulerian Cycle

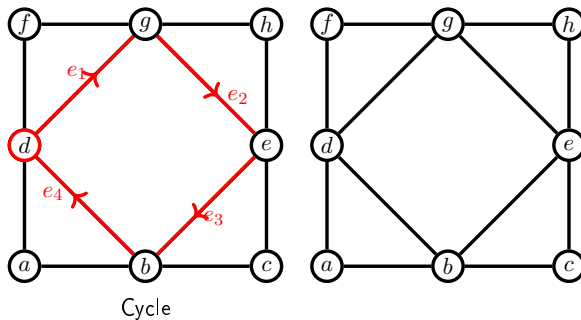
Nr. 518



Cycle

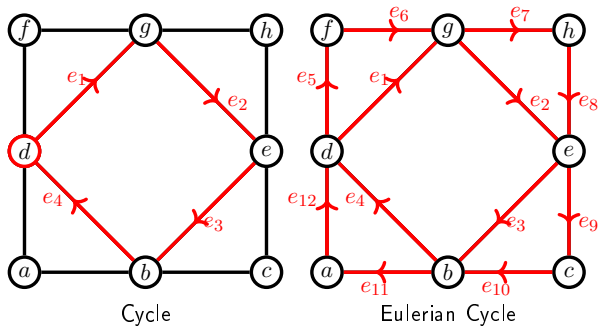
# Cycle vs. Eulerian Cycle

Nr. 518



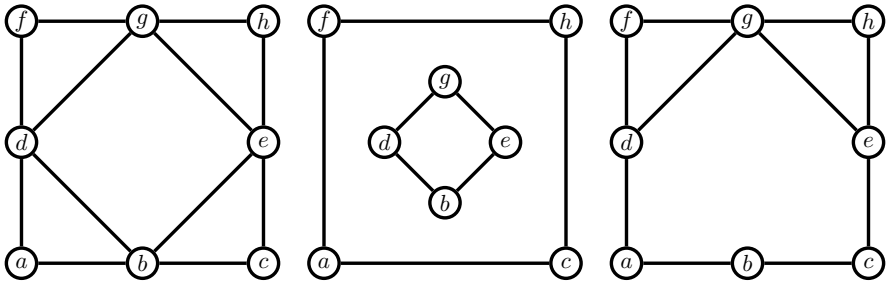
# Cycle vs. Eulerian Cycle

Nr. 518

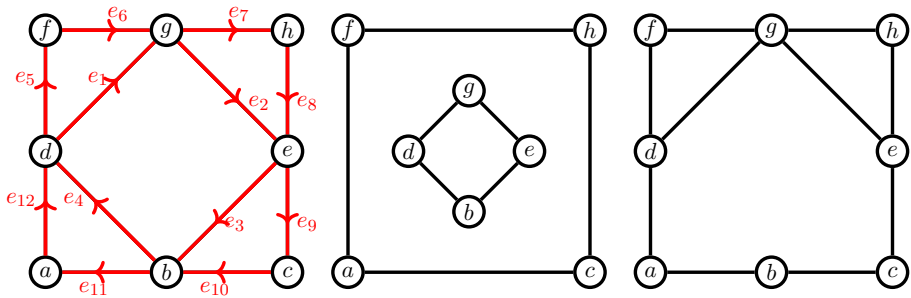




# Eulerian Tour?

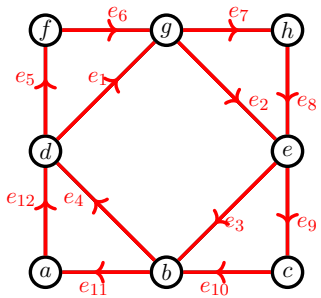


# Eulerian Tour?

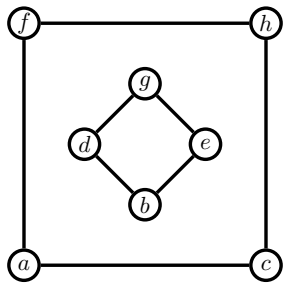


Eulerian Tour

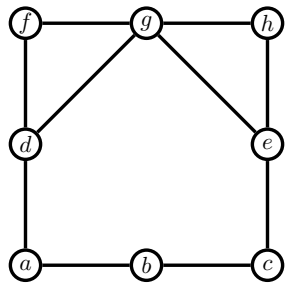
# Eulerian Tour?

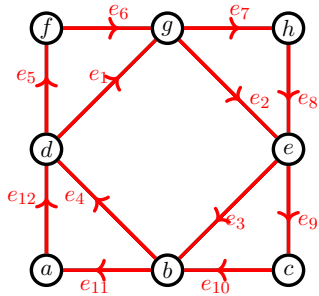


Eulerian Tour

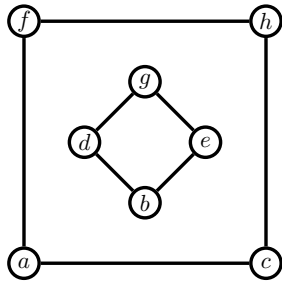


no Eulerian Tour

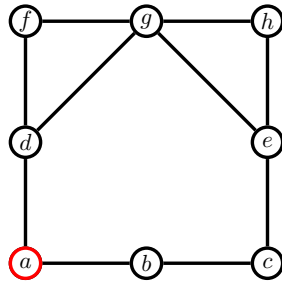




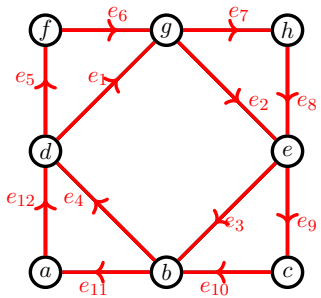
Eulerian Tour



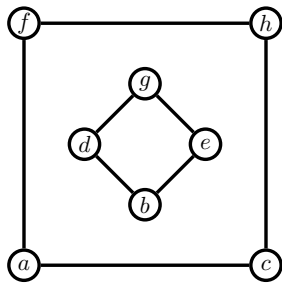
no Eulerian Tour



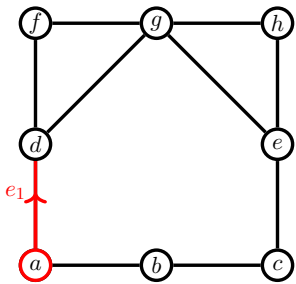
# Eulerian Tour?

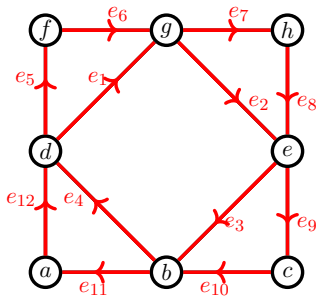


Eulerian Tour

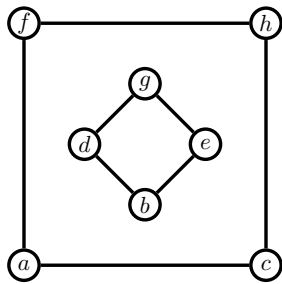


no Eulerian Tour

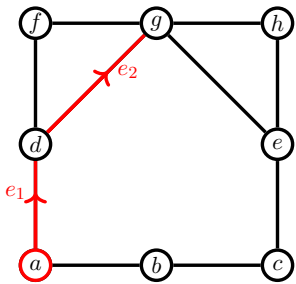




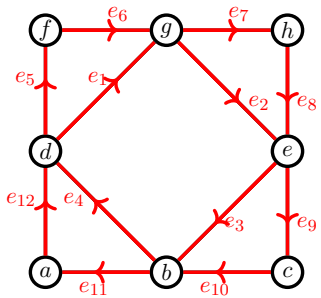
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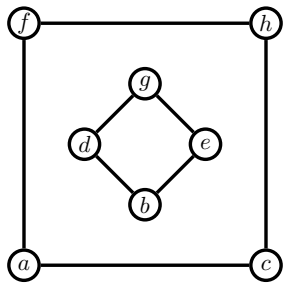
no Eulerian Tour



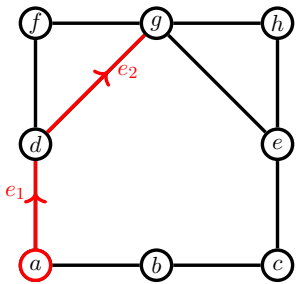
# Eulerian Tour?



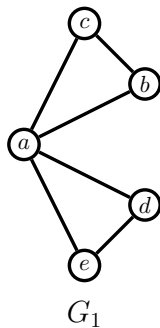
Eulerian Tour



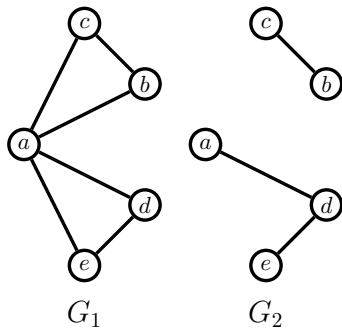
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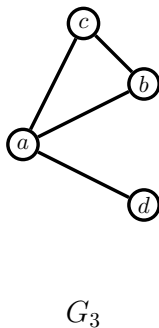
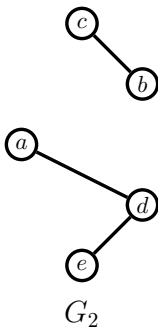
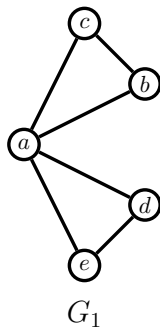


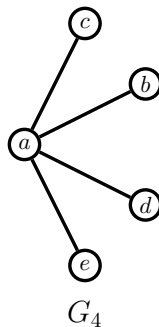
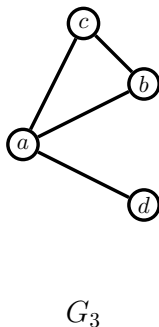
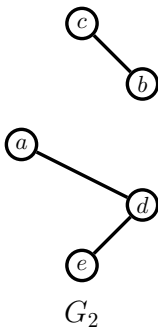
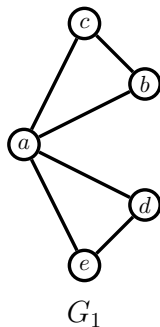
no Eulerian Tour





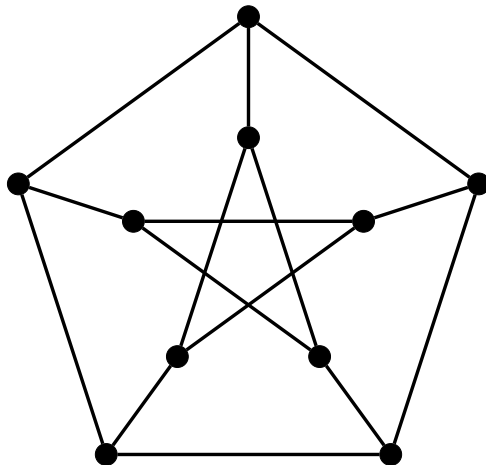


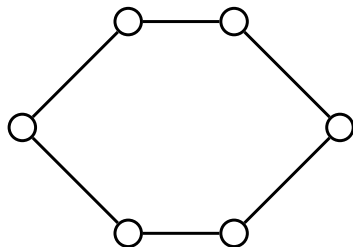




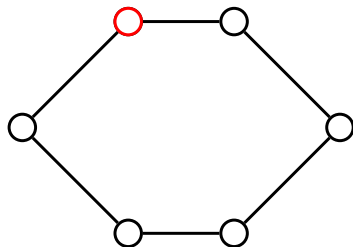
# Peterson Graph

Nr. 525

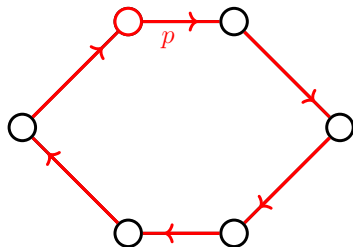




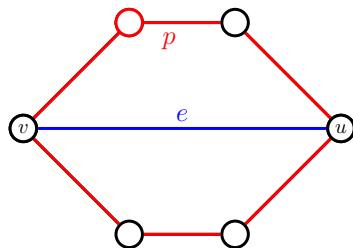
Case 2.1



Case 2.1

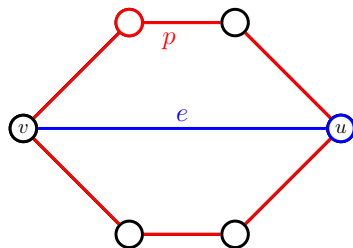


Case 2.1

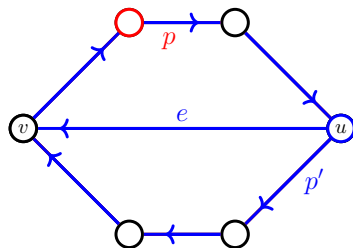


Case 2.1

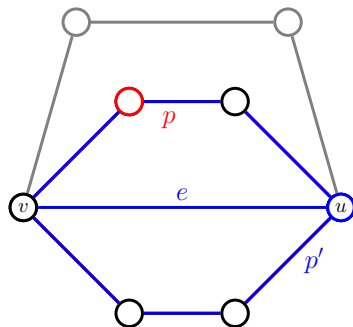




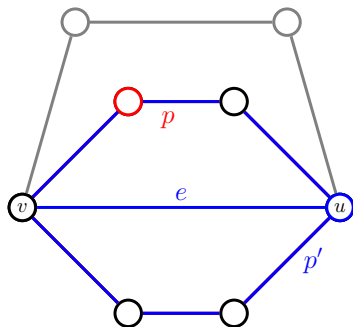
Case 2.1



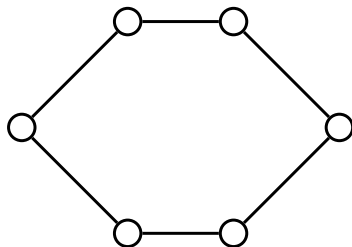
Case 2.1



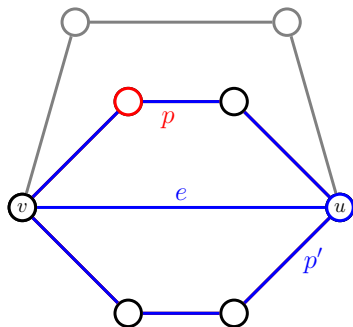
Case 2.1



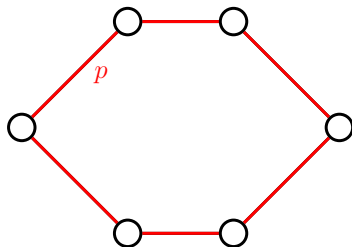
Case 2.1



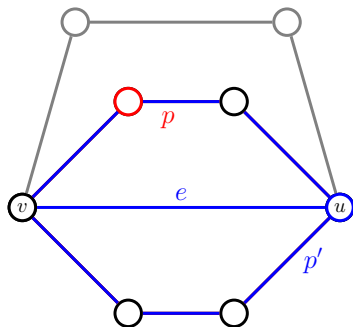
Case 2.2



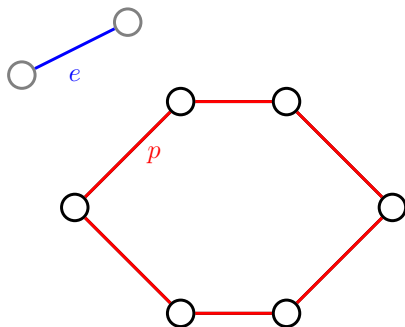
Case 2.1



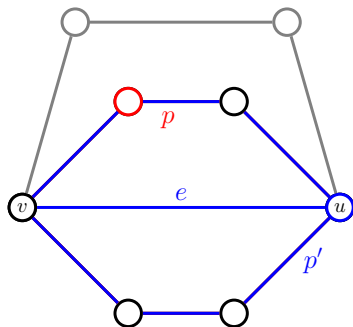
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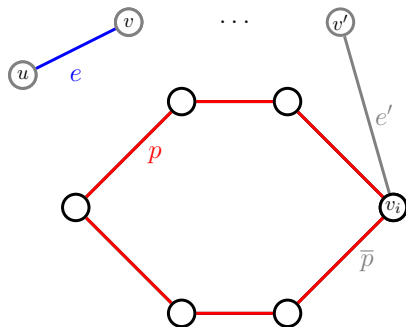
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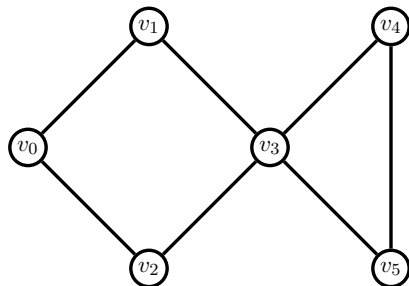
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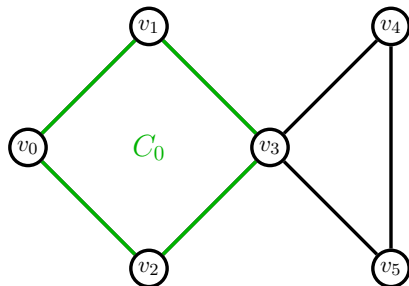
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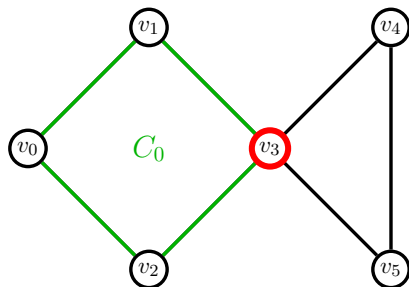


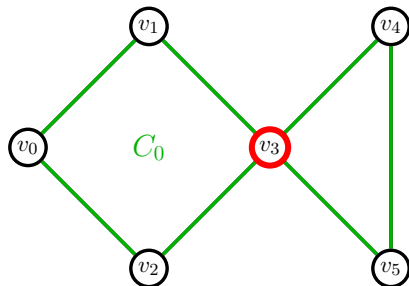
Case 2.2

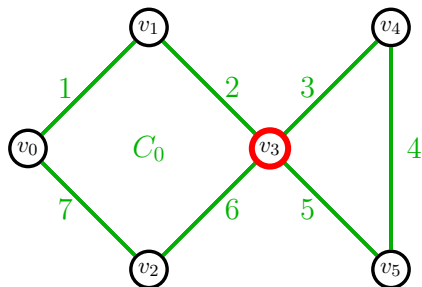






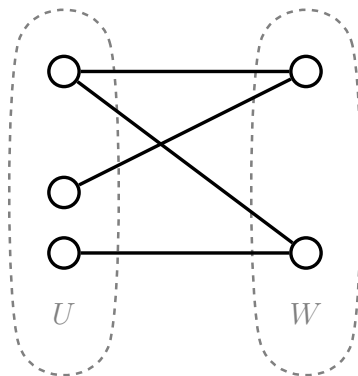






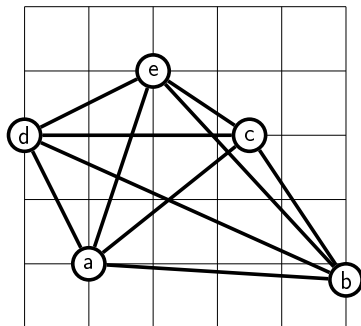
# Bipartite Graph

Nr. 528



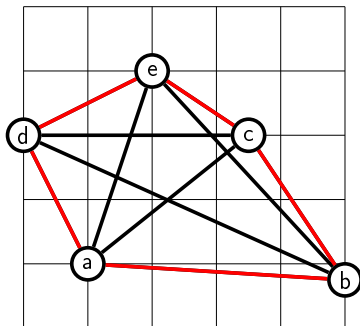
# Traveling Salesman Problem

Nr. 529



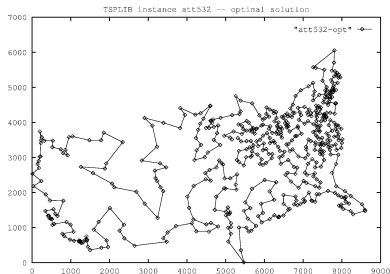
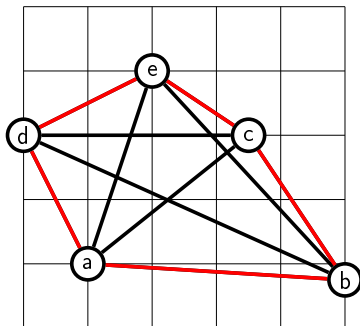
# Traveling Salesman Problem

Nr. 529



# Traveling Salesman Problem

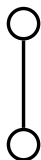
Nr. 529



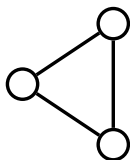




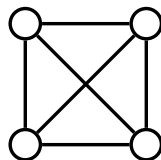
$K_1$



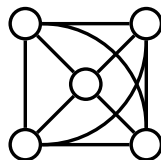
$K_2$



$K_3$



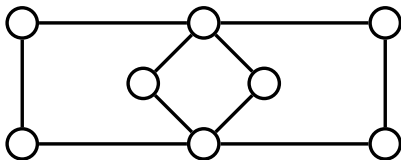
$K_4$



$K_5$

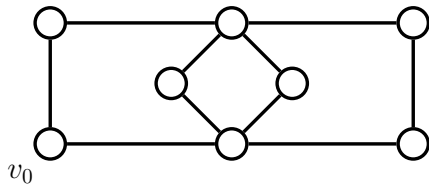
$p$  can not be extended

Nr. 531



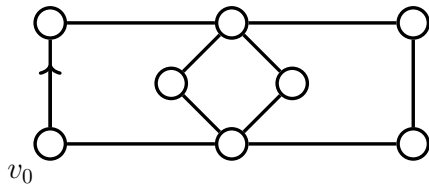
$p$  can not be extended

Nr. 531



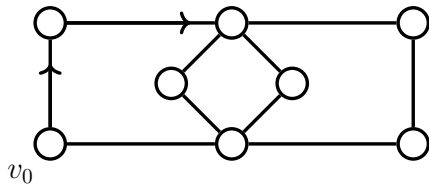
$p$  can not be extended

Nr. 531



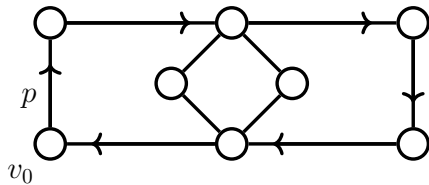
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Nr. 531



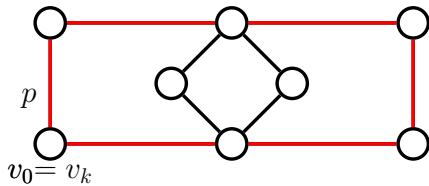
$p$  can not be extended

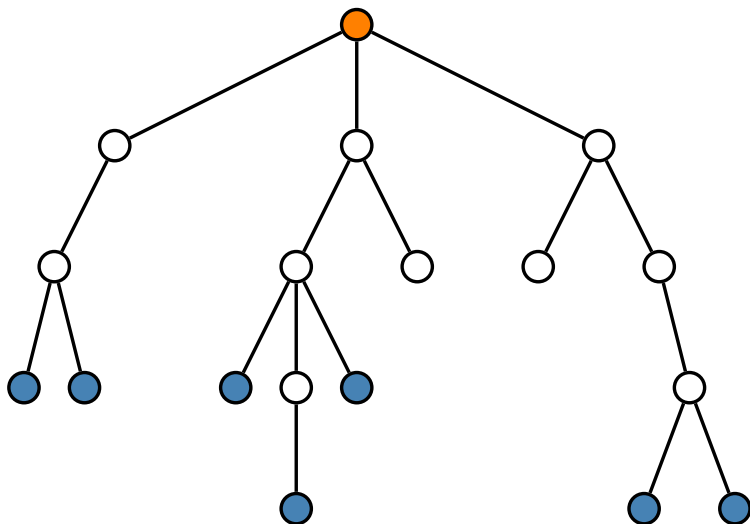
Nr. 531



$p$  can not be extended

Nr. 531







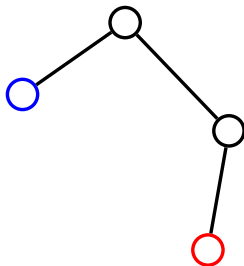
Every vertex has an even degree

Nr. 653



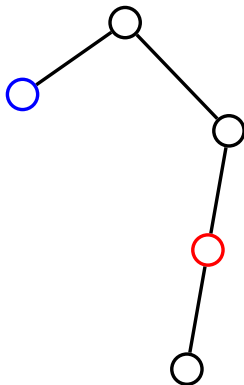
Every vertex has an even degree

Nr. 653



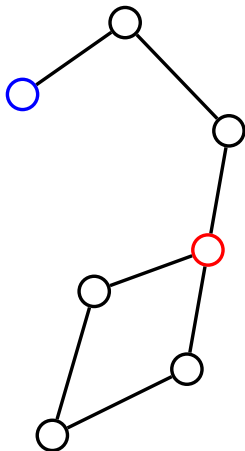
Every vertex has an even degree

Nr. 653



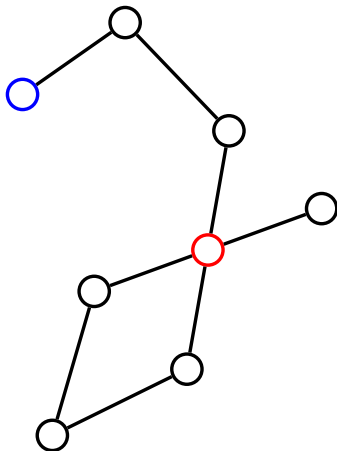
Every vertex has an even degree

Nr. 653



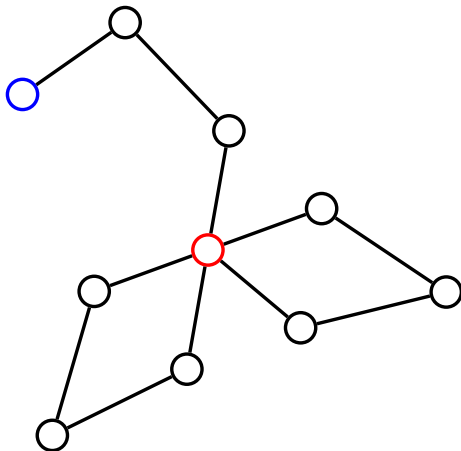
Every vertex has an even degree

Nr. 653



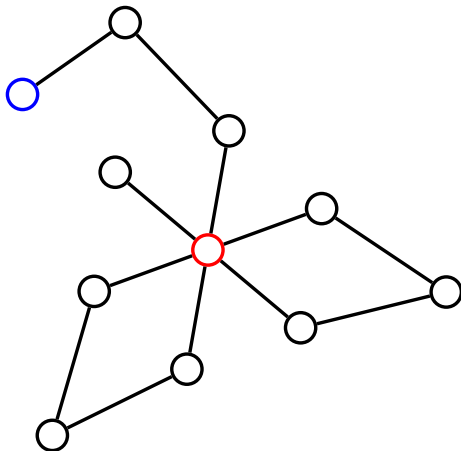
Every vertex has an even degree

Nr. 653



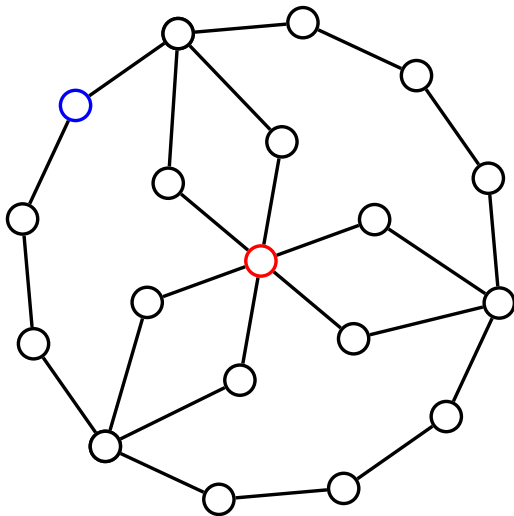
Every vertex has an even degree

Nr. 653



Every vertex has an even degree

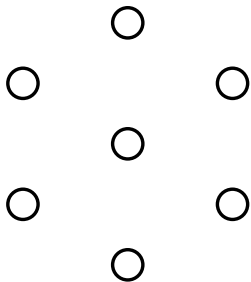
Nr. 653





In forttests:  $n = m + p$

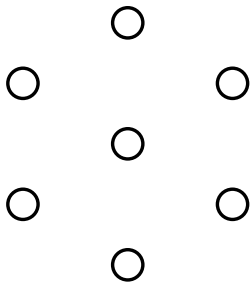
Nr. 654



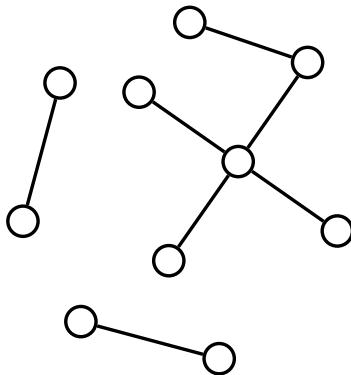
$m = 0$

In forttests:  $n = m + p$

Nr. 654



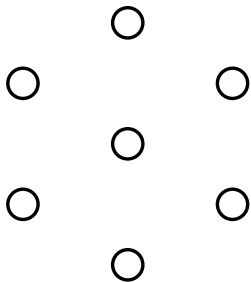
$m = 0$



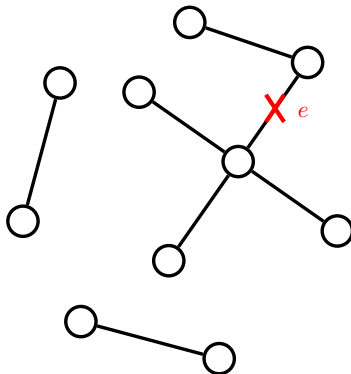
$G$

In forests:  $n = m + p$

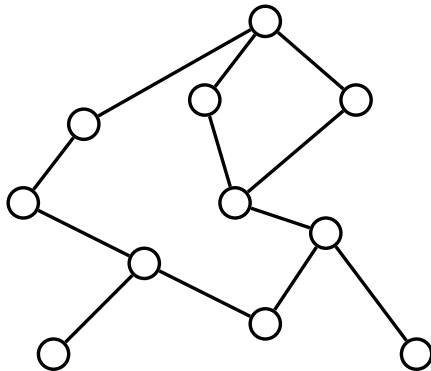
Nr. 654



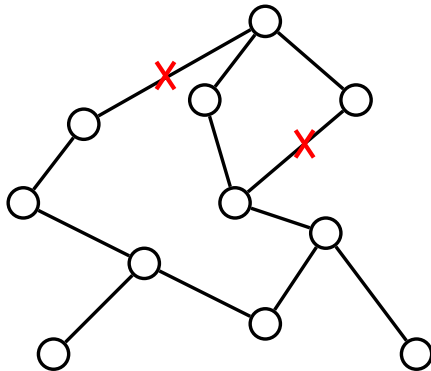
$$m = 0$$



$$G - e = G'$$



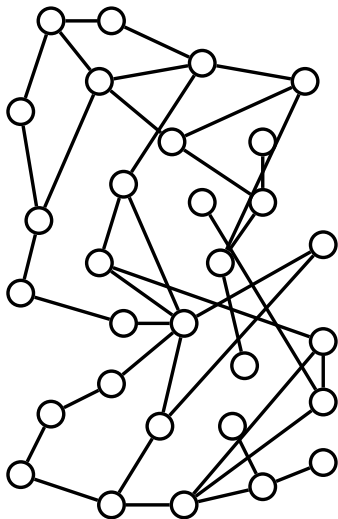
$G$

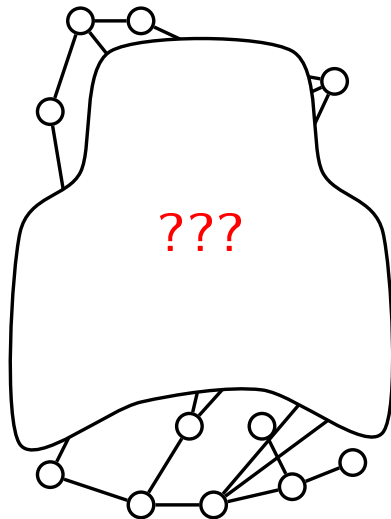
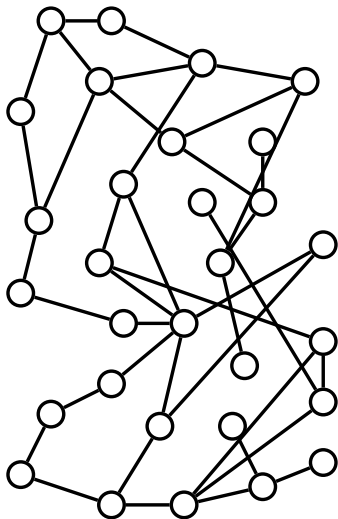


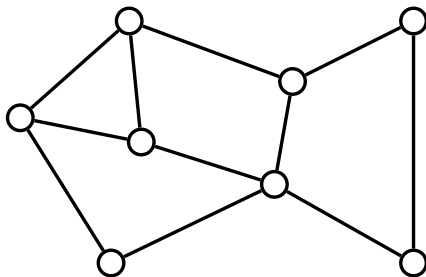
$G$   $G'$

## Searching a big tree

Nr. 667



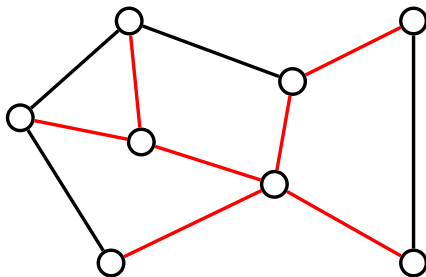


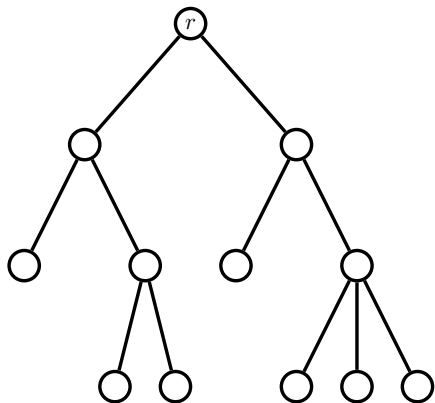




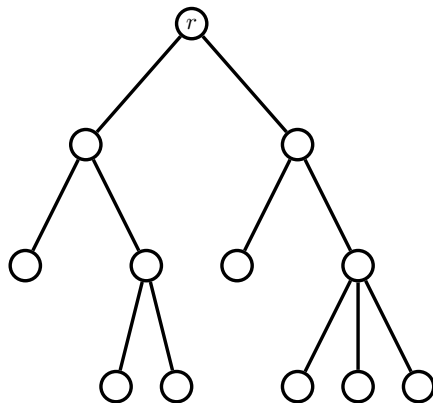
# Spanning tree

Nr. 668



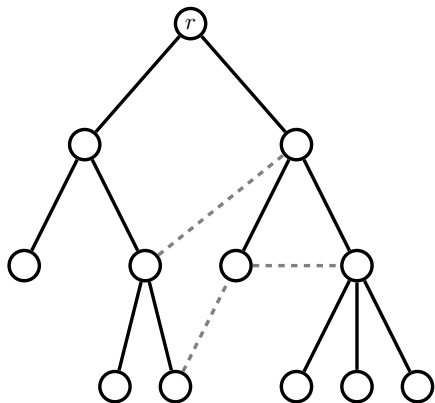


BFS

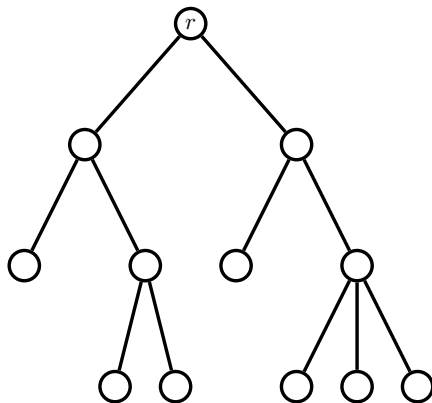


DFS

-- non-tree

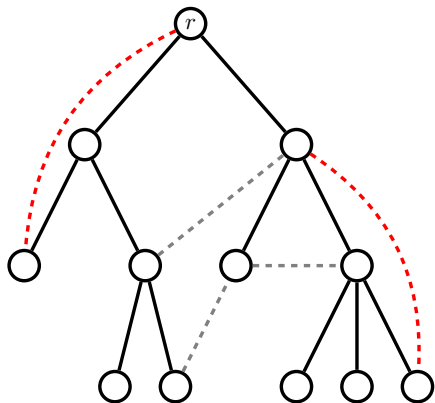


BFS

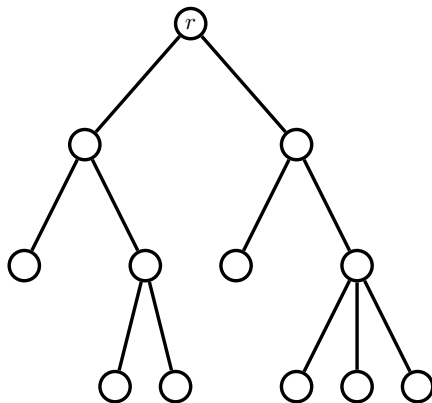


DFS

-- non-tree  
- - forbidden

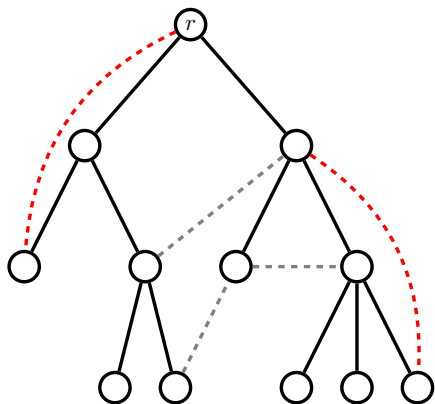


BFS

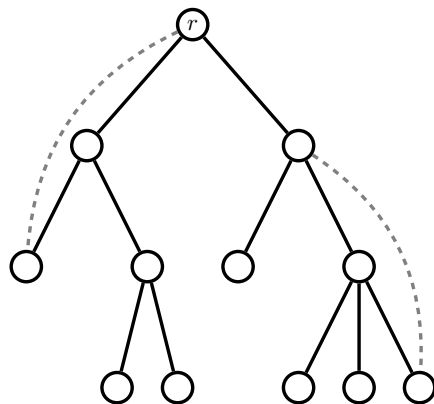


DFS

-- non-tree  
-- forbidden

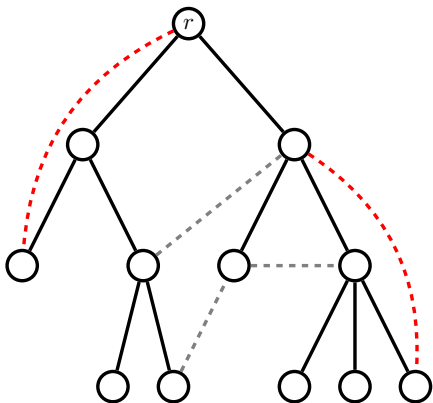


BFS

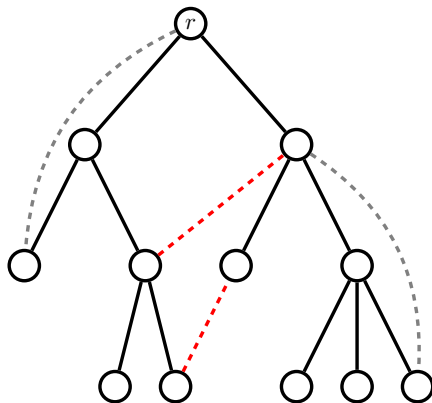


DFS

-- non-tree  
-- forbidden



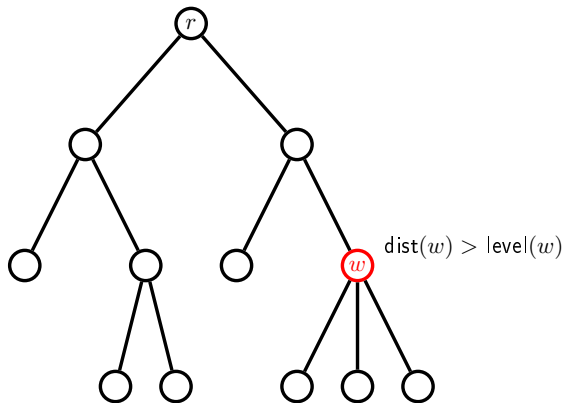
BFS



DFS

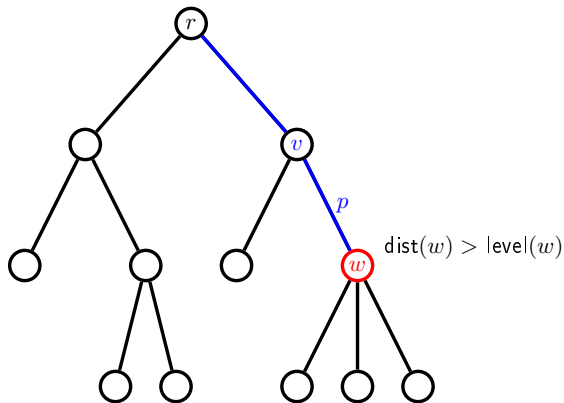
$w$  is smallest criminal

Nr. 670



$w$  is smallest criminal

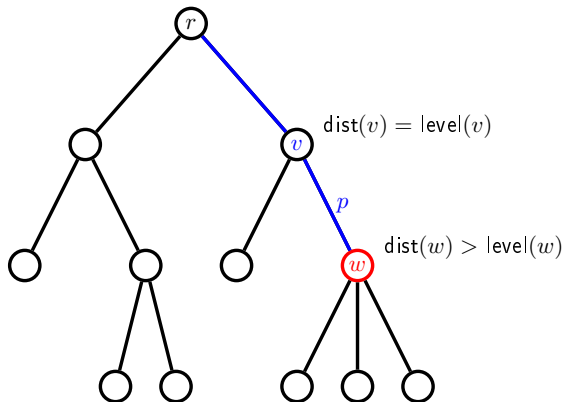
Nr. 670





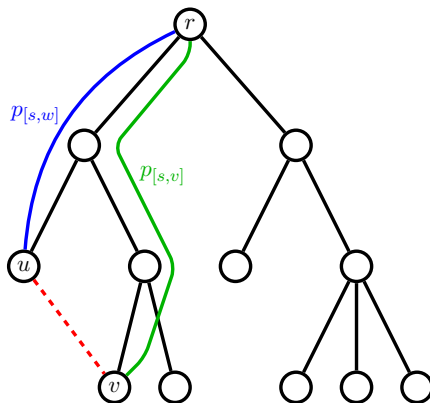
$w$  is smallest criminal

Nr. 670



$(u, v)$  cannot be connected

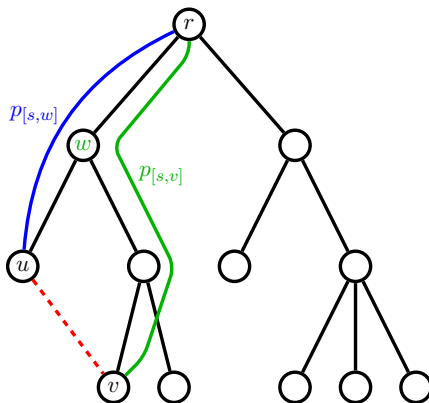
Nr. 671



DFS

$(u, v)$  cannot be connected

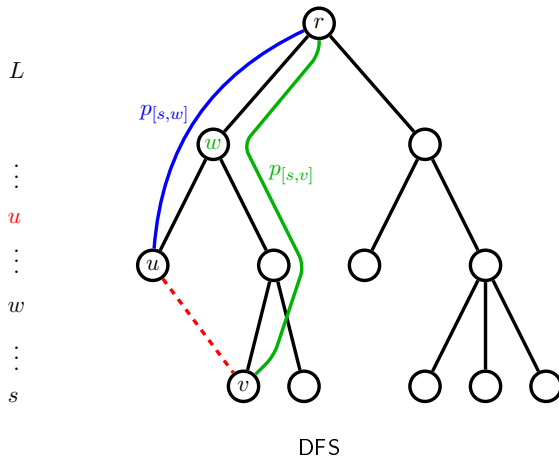
Nr. 671

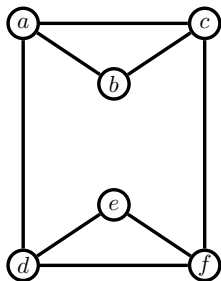


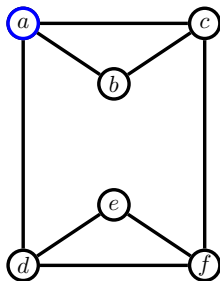
DFS

$(u, v)$  cannot be connected

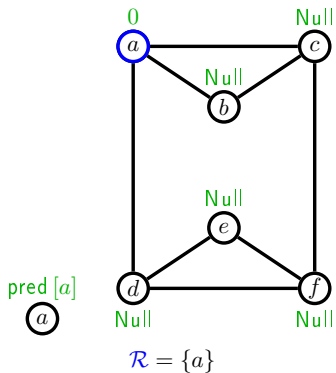
Nr. 671

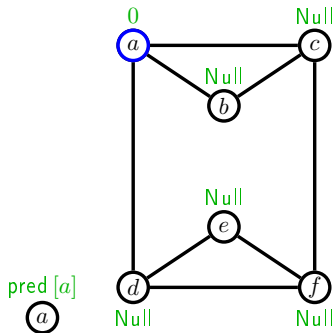






$$\mathcal{R} = \{a\}$$

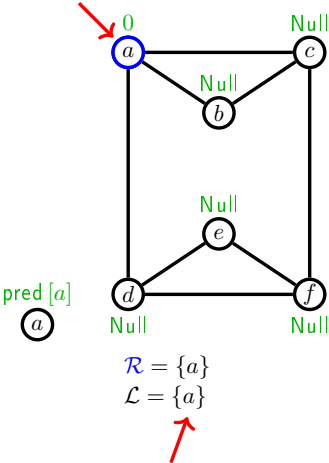


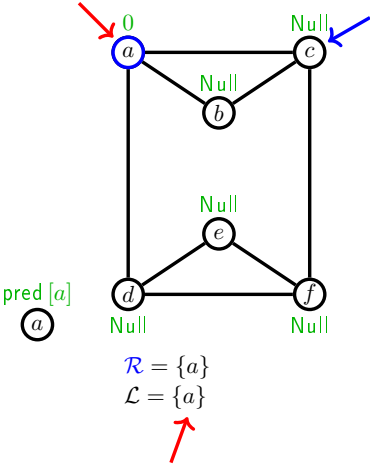


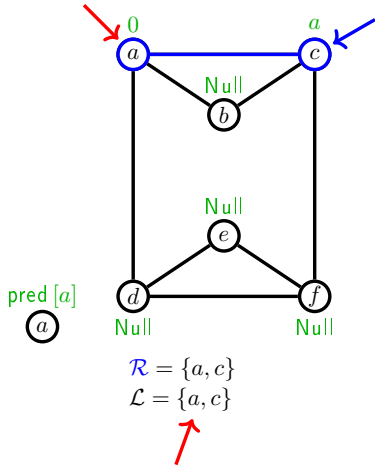
$$\mathcal{R} = \{a\}$$

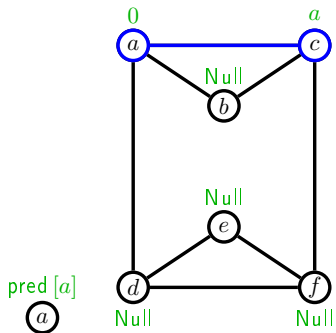
$$\mathcal{L} = \{a\}$$





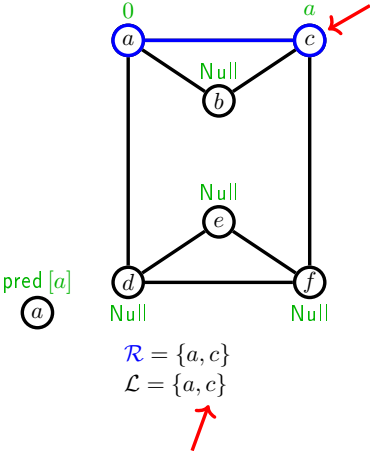


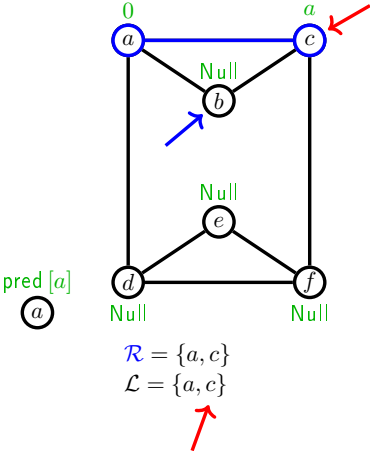


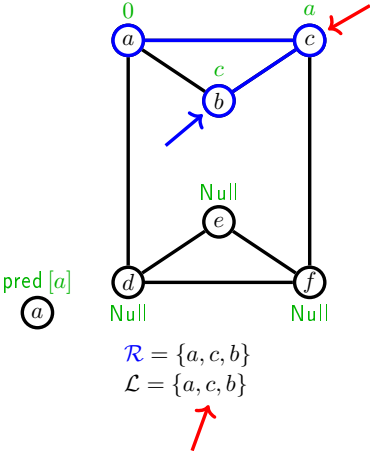


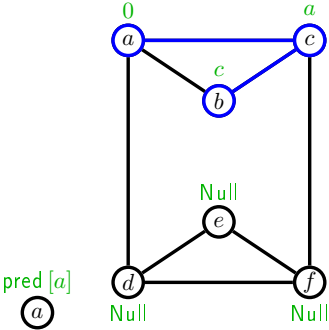
$$\mathcal{R} = \{a, c\}$$

$$\mathcal{L} = \{a, c\}$$



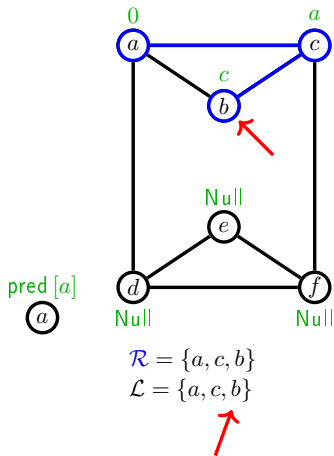


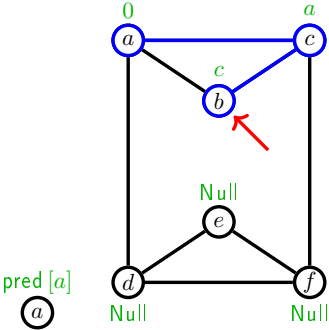




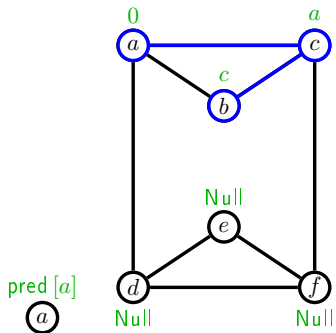
$$\mathcal{R} = \{a, c, b\}$$
$$\mathcal{L} = \{a, c, b\}$$





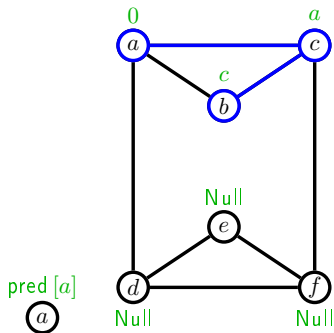


$$\mathcal{R} = \{a, c, b\}$$
$$\mathcal{L} = \{a, c\}$$



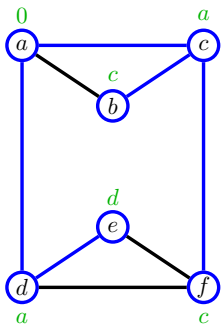
$$\mathcal{R} = \{a, c, b\}$$

$$\mathcal{L} = \{a, c\}$$

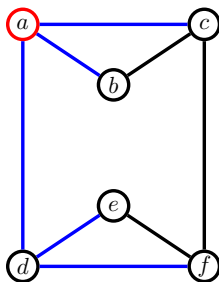


$$\mathcal{R} = \{a, c, b\}$$
$$\mathcal{L} = \{a, c\}$$

...

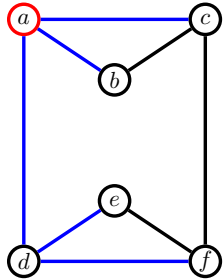


$$\mathcal{R} = \{a, c, b, f, d, e\}$$
$$\mathcal{L} = \emptyset$$



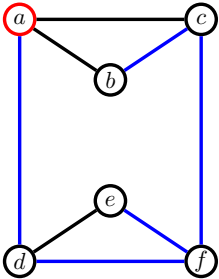
○ starting node  
— tree edges

BFS



BFS

○ starting node  
— tree edges



DFS