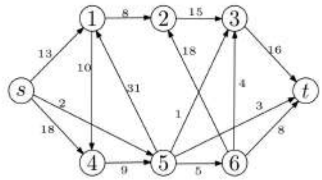
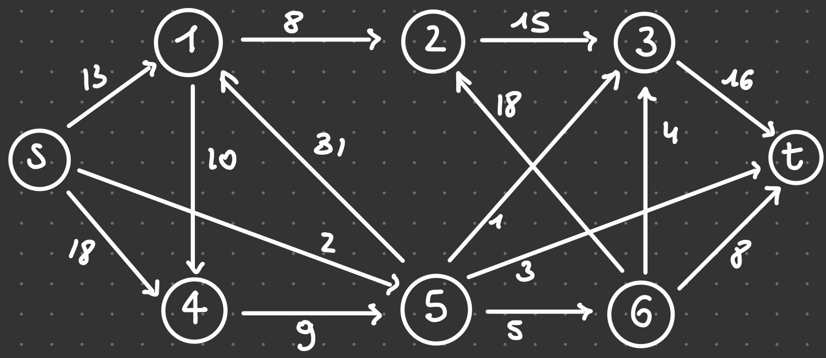
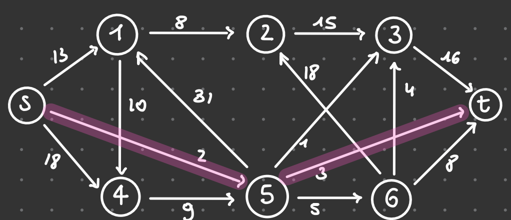
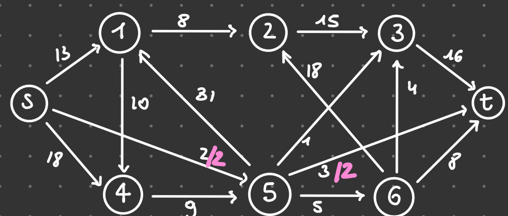
Esercizio 2.22. Si risolva il seguente problema MF con tramite l'algoritmo di Edmonds-Karp, determinando anche un taglio di capacità minima.

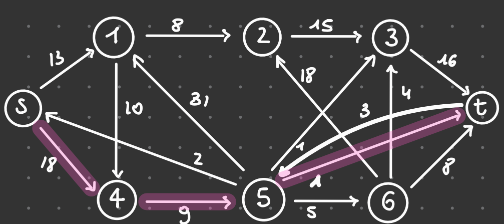


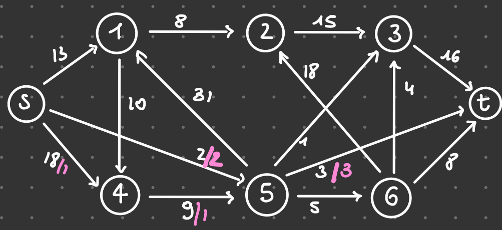




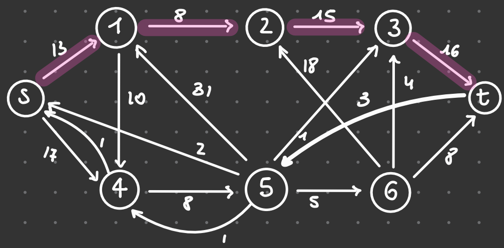


$\min\{2, 3\} = 2$

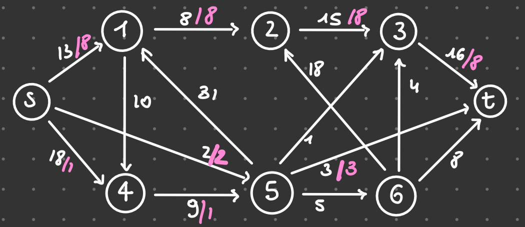


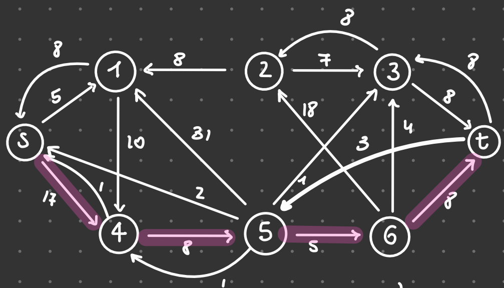


$\min\{18, 9, 1\} = 1$

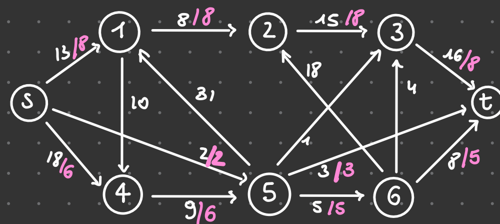


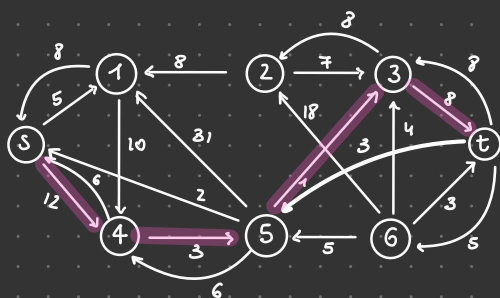
$\min\{13, 8, 15, 16\} = 8$



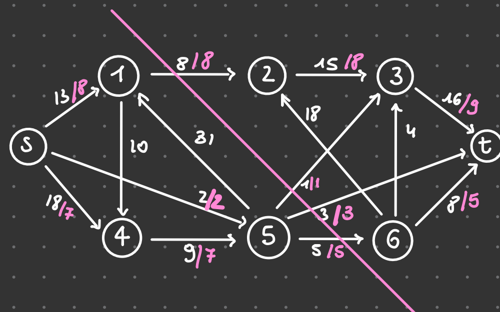


$\min\{17, 8, 5, 8\} = 5$

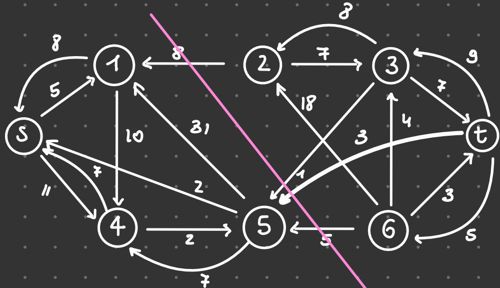




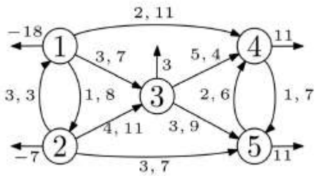
$\min\{12, 3, 1, 8\} = 1$

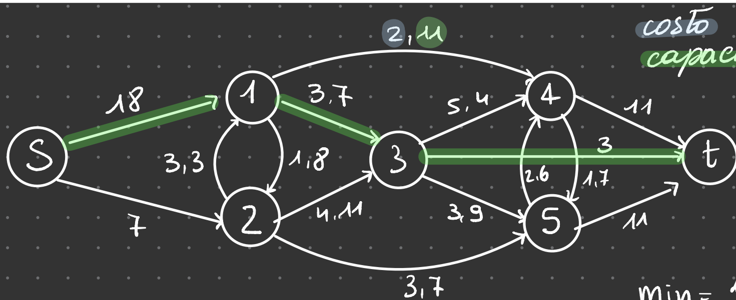


max Flow - Min - Cut



Esercizio 2.23. Si risolva il seguente problema MCF tramite l'algoritmo di cancellazione dei cicli.



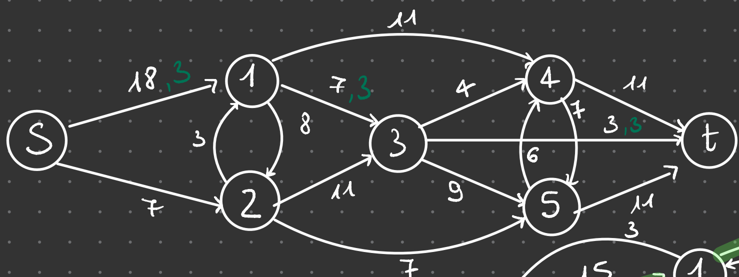


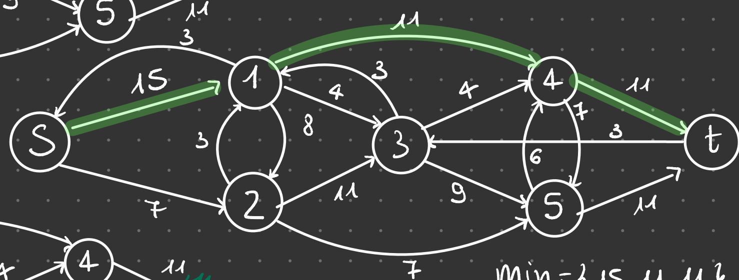
costo
capacità

Edmonds Karp

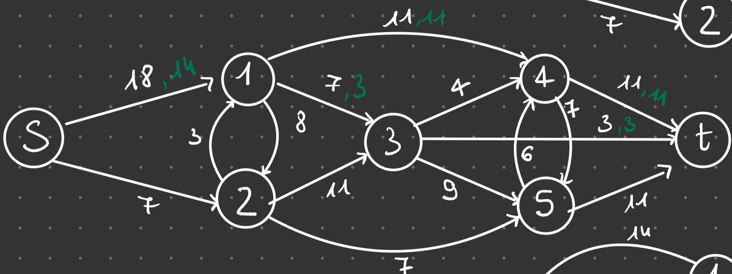
cammini aumentanti di lunghezza minima che va da s a t

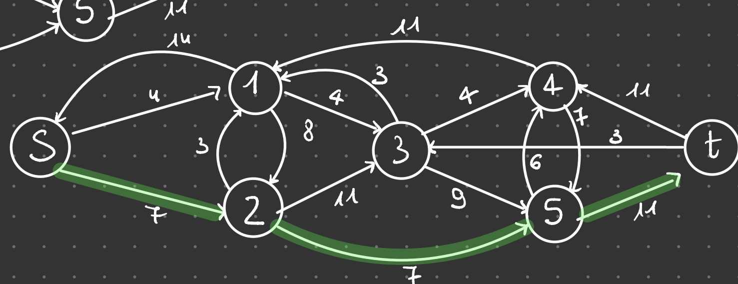
$\min = \{18, 7, 3\} = 3$



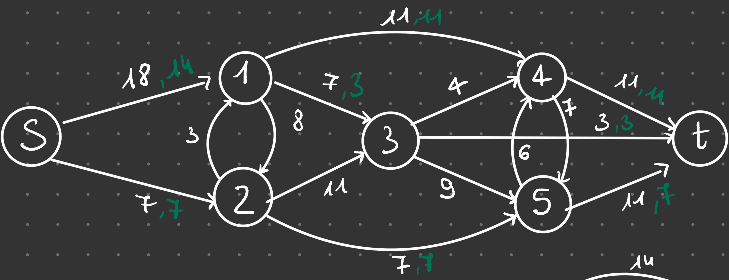


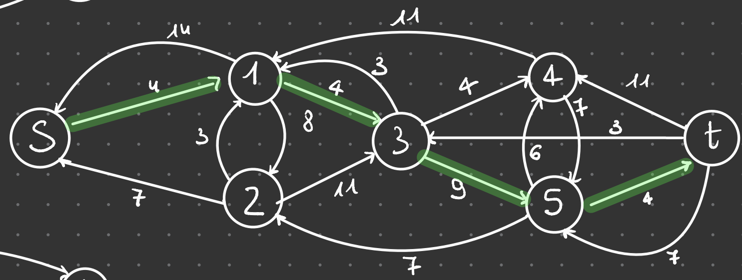
$\min = \{15, 11, 11\} = 11$



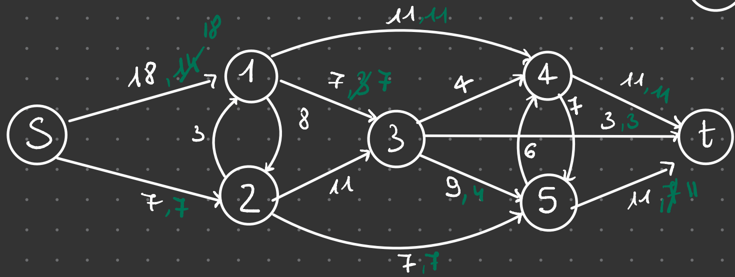


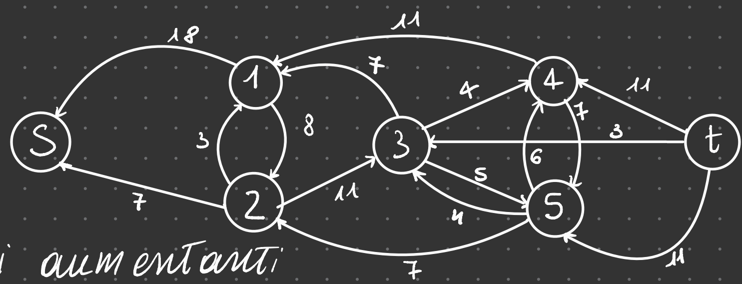
$\min = \{7, 7, 11\} = 7$





min = { 4, 9 } = 4

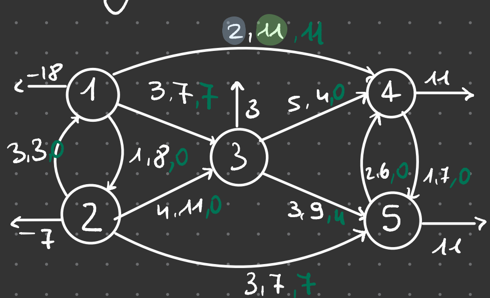




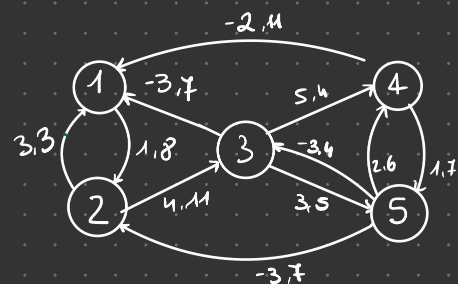
∄ cammini minimi aumentanti

↓

flusso massimo → flusso ammissibile

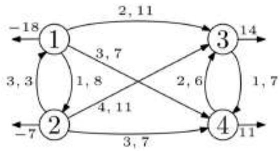


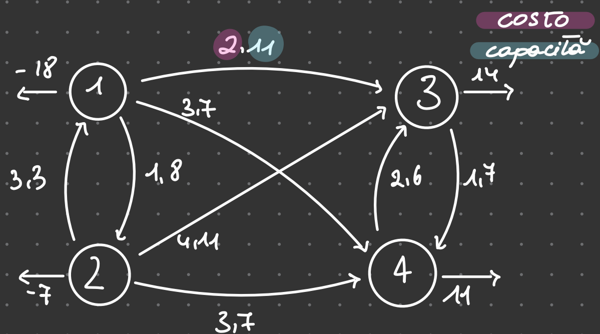
Uso l'algoritmo di cancellazione dei cicli negativi

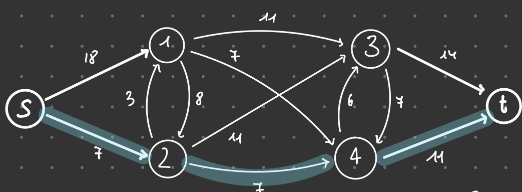


non ci sono cicli di costo negativi

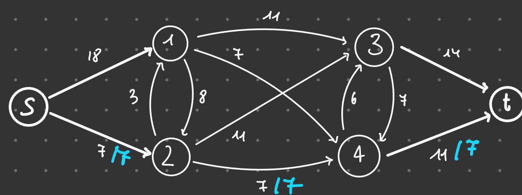
Esercizio 2.24. Si risolva il seguente problema MCF tramite l'algoritmo di cancellazione dei cicli.

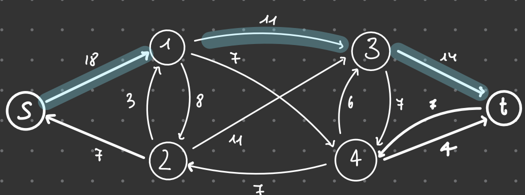




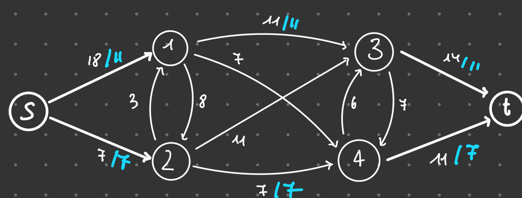


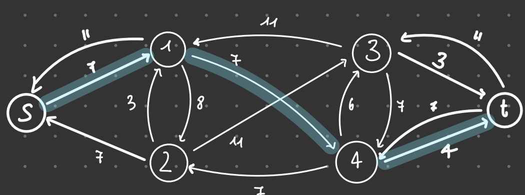
min{7, 7, 11} = 7



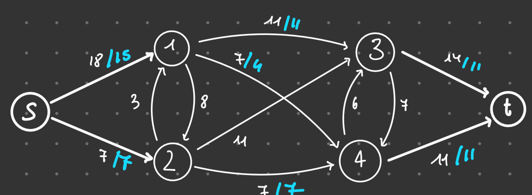


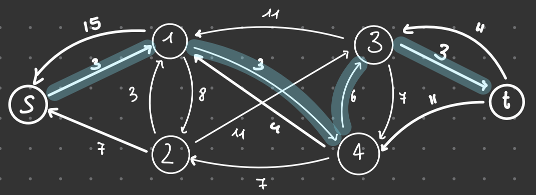
min{18, 11, 14} = 4

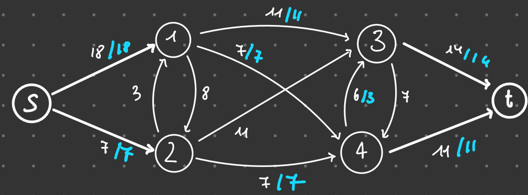




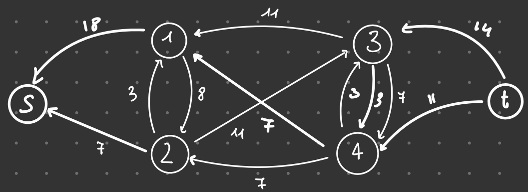
min{7, 7, 4} = 4







$\min\{3, 6\} = 3$



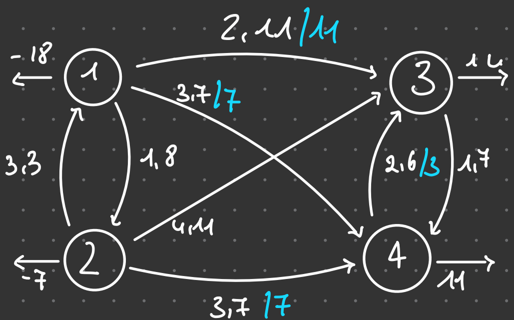
∄ cammini minimi

FLUSSO MASSIMO

Controllo che il flusso massimo sia ammissibile

↓

controllo se i nodi sono bilanciati



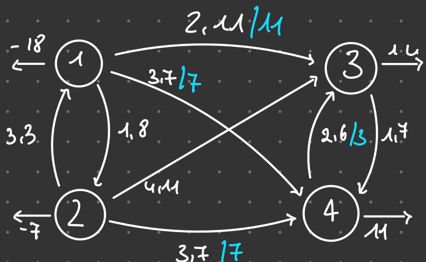
$n1 \rightarrow 18 - 18 = 0$

$n2 \rightarrow 7 - 7 = 0$

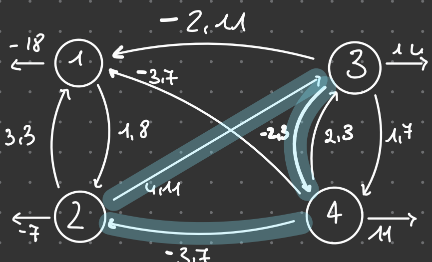
$n3 \rightarrow 11 + 3 - 14 = 0$

$n4 \rightarrow 7 + 7 - 3 - 11 = 0$

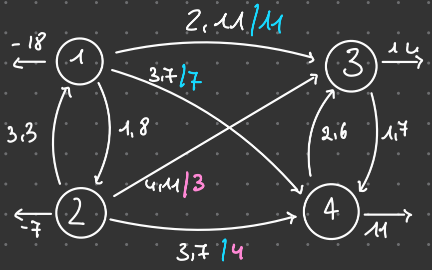
Procedo con l'algoritmo di cancellazione dei cicli

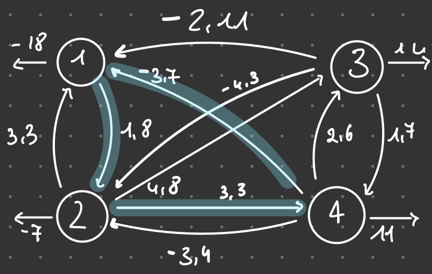


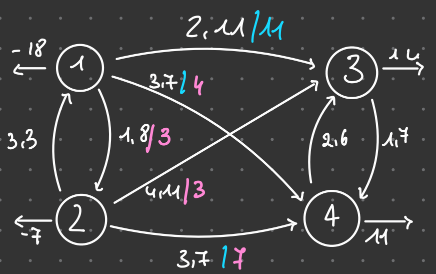
CERCO CICLI DI COSTO NEGATIVO

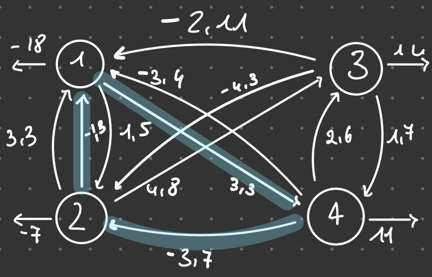


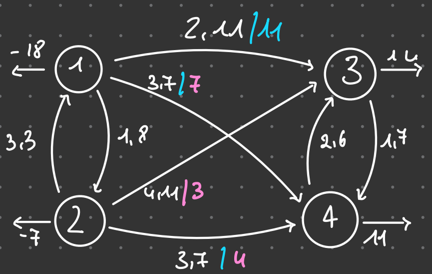
$\min\{7, 11, 3\} = 3$

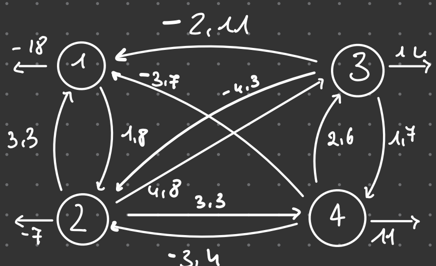








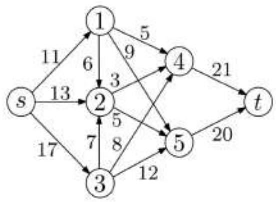


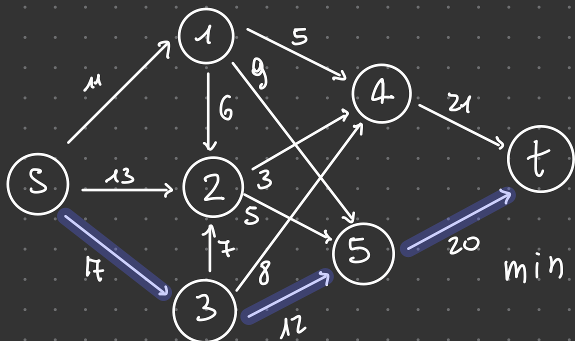


∄ cicli di costo negativo

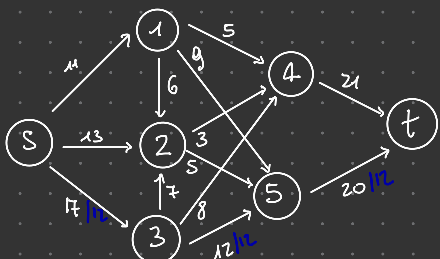
2.2.6 Temi d'esame 2018

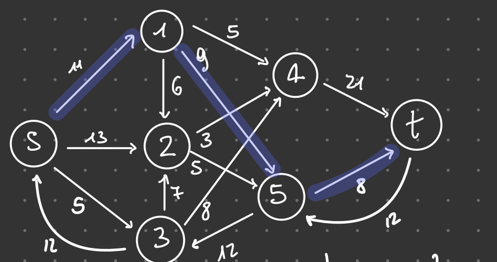
Esercizio 2.25. Si risolva il seguente problema di flusso massimo tramite l'algoritmo di Edmonds e Karp. Si determini inoltre un taglio di capacità minima.



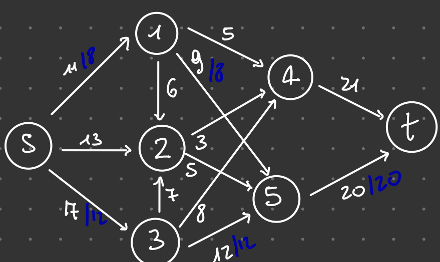


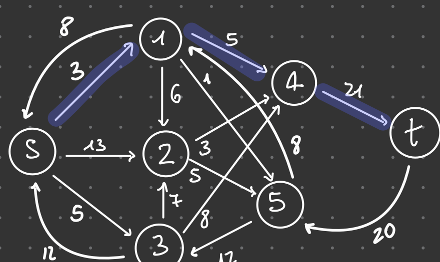
$\min\{17, 12, 20\} = 12$



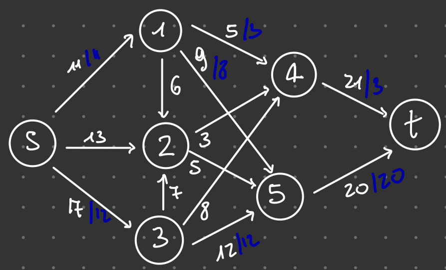


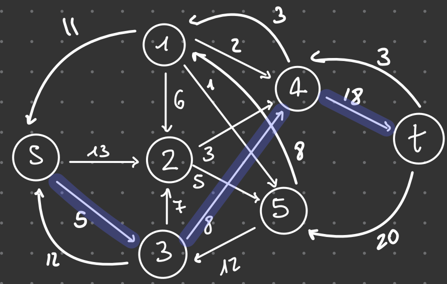
$\min\{11, 9, 8\} = 8$



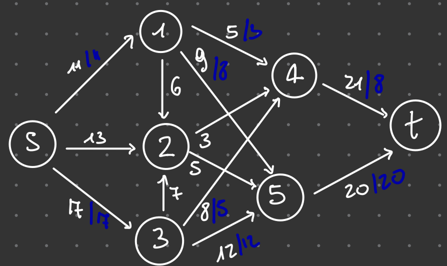


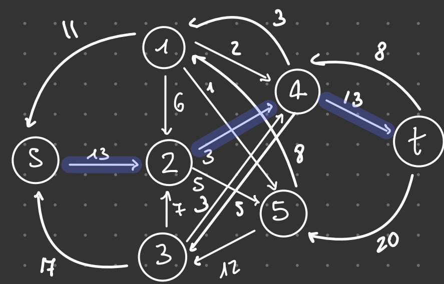
$\min\{3, 5, 21\} = 3$



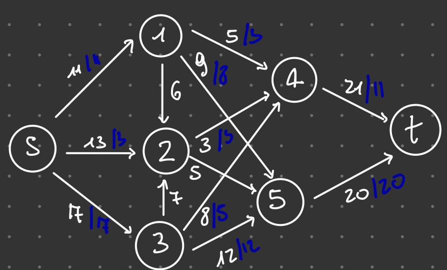


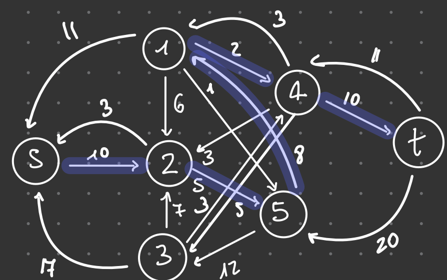
$\min\{5,8,18\}=5$



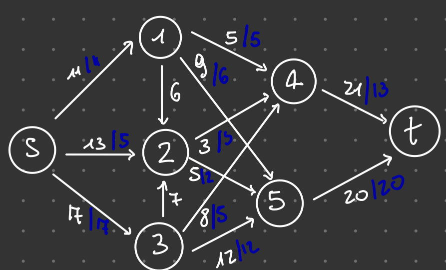


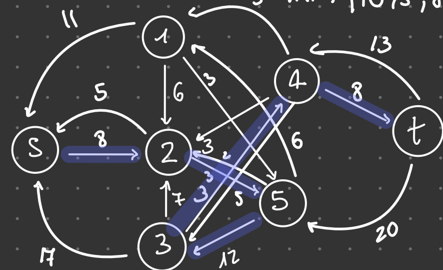
$\min\{13,3,13\}=3$



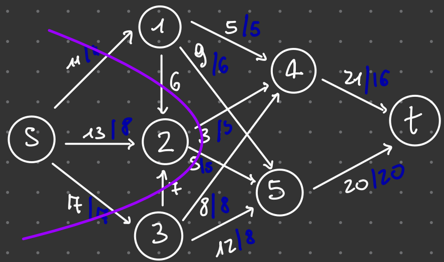


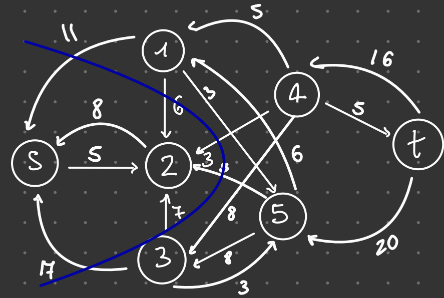
s $\min\{10,5,8,2,10\}=2$



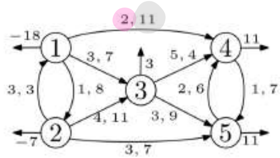


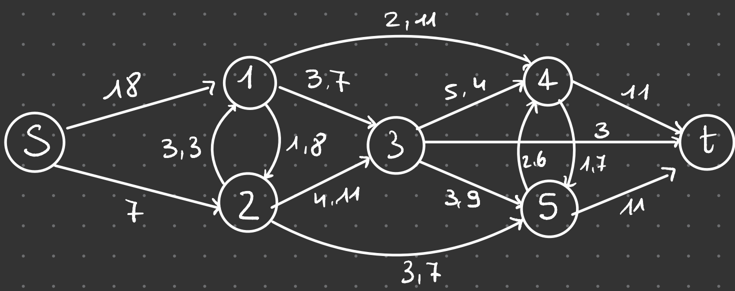
$\min\{8,3,12,3,8\}=3$

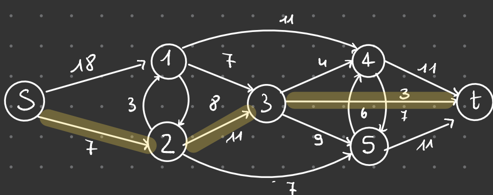




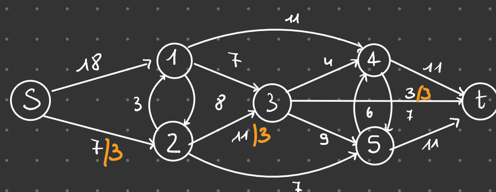
Esercizio 2.27. Si risolva il seguente problema di flusso di costo minimo tramite l'algoritmo basato sulla cancellazione di cicli. Ogni arco (i, j) è etichettato con la coppia c_{ij}, u_{ij} dove c_{ij} è il costo e u_{ij} è la capacità.

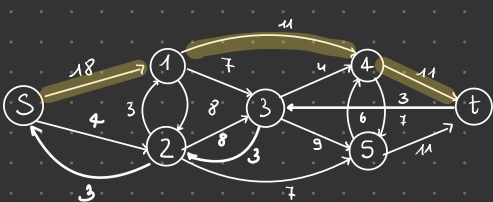




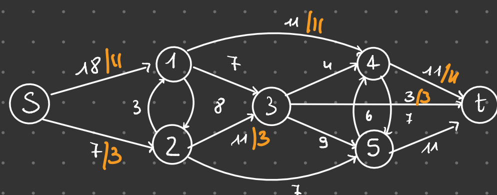


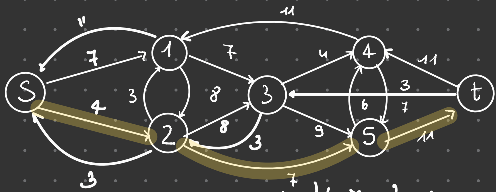
min{7, 11, 3} = 3

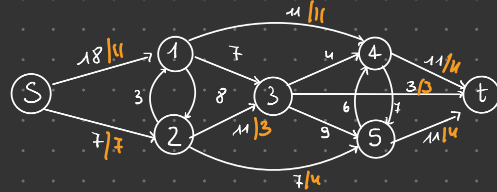




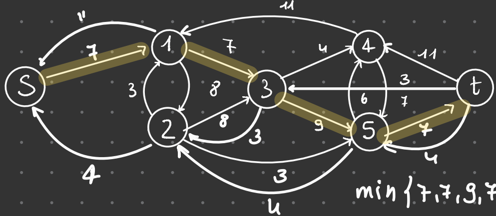
min{18, 11, 11} = 11

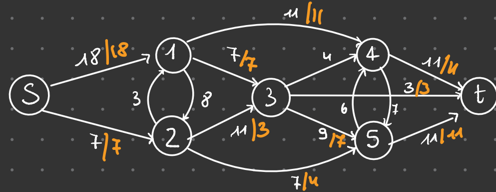




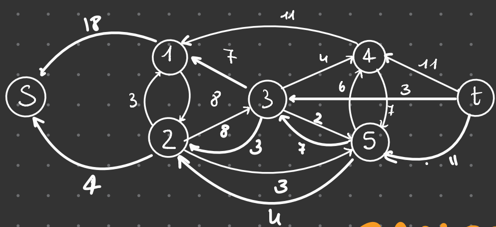


min{4,7,11} = 4

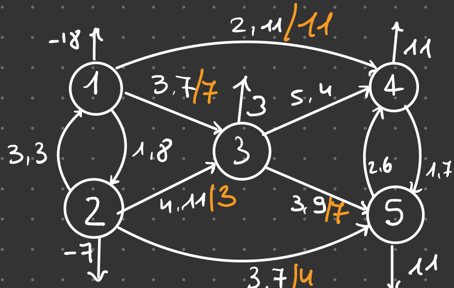


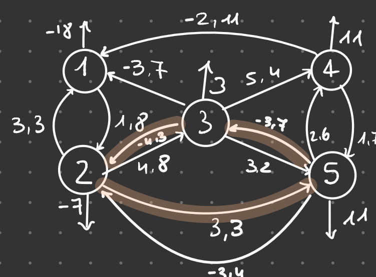


min{7,7,9,7} = 7

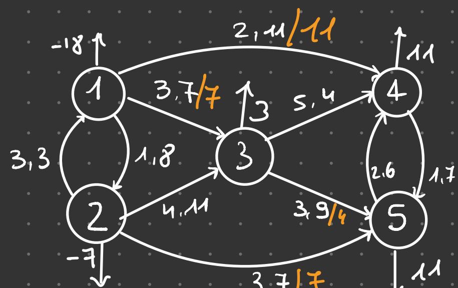


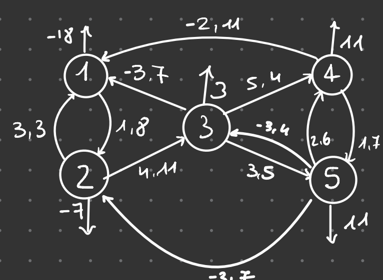
CANCELLAZIONE DEI CICLI



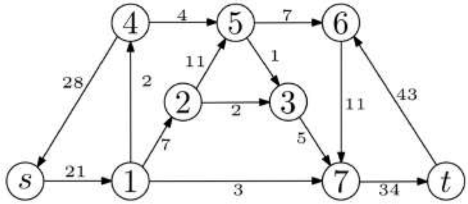


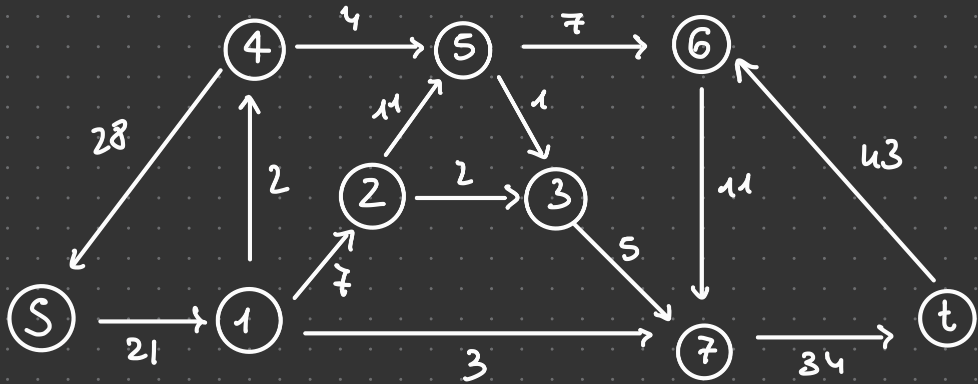
min{3,7,7}

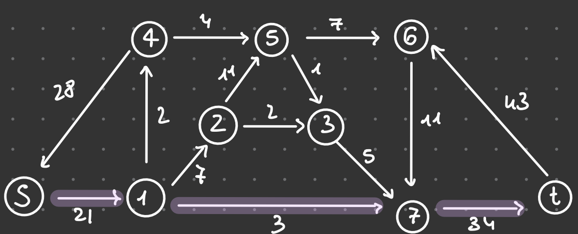


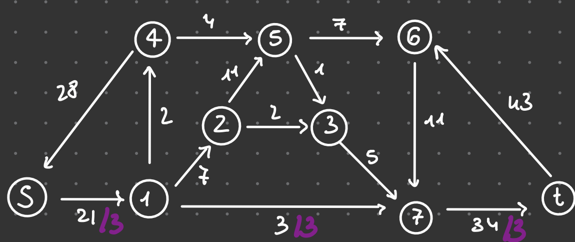


Esercizio 2.28. Si risolva il seguente problema di flusso massimo tramite l'algoritmo di Edmonds e Karp. Si determini altresì un taglio di capacità minima.

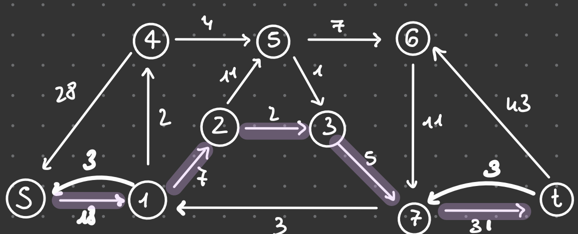


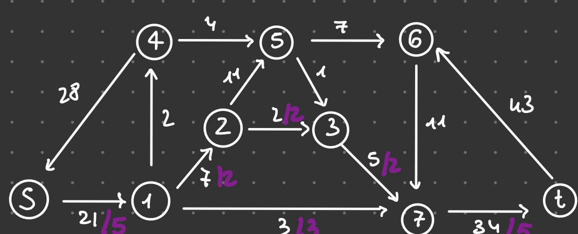




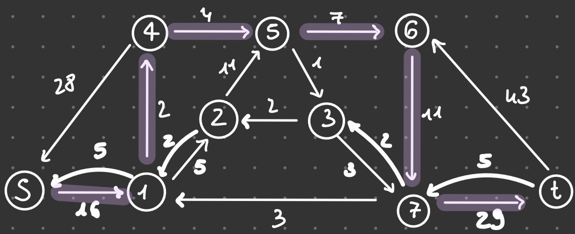


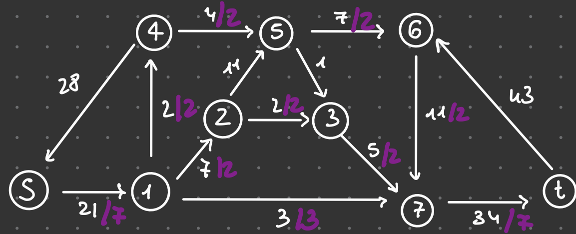
$\min\{21, 3, 34\} = 3$





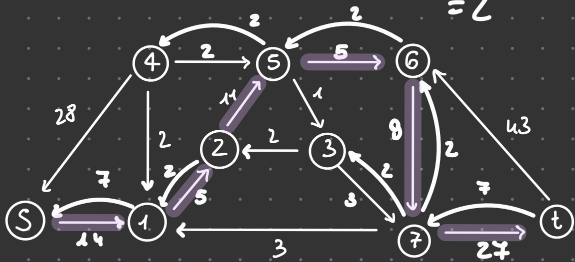
$\min\{18, 7, 2, 5, 31\}$
$= 2$

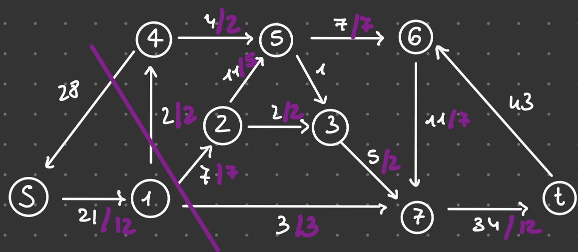




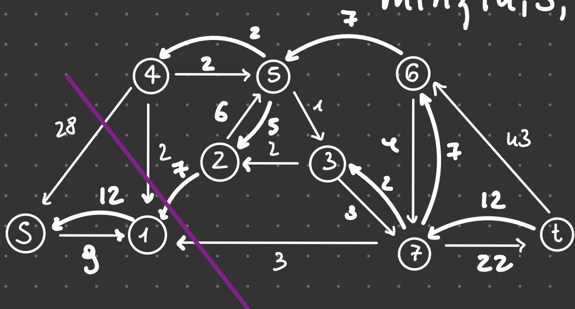
min{16, 2, 4, 7, 11, 29}

= 2

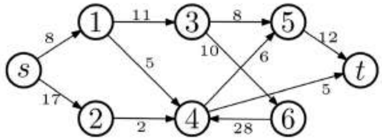


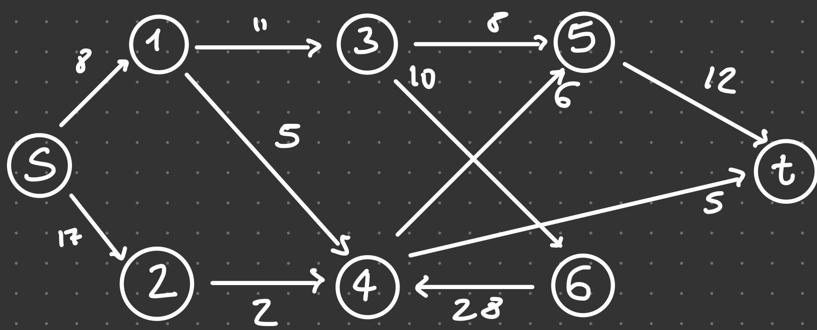


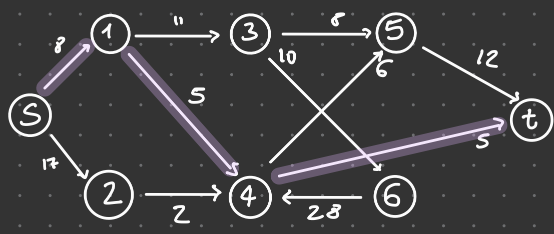
min{14, 5, 11, 5, 9, 27} = 5

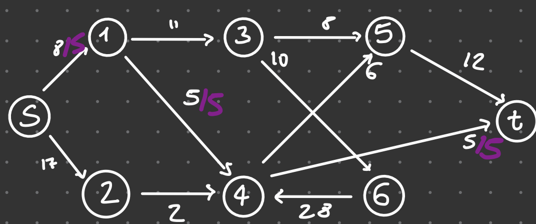


Esercizio 2.30. Si risolva il seguente problema di massimo flusso tramite l'algoritmo di Edmonds e Karp. Si determini altresì un taglio di capacità minima.

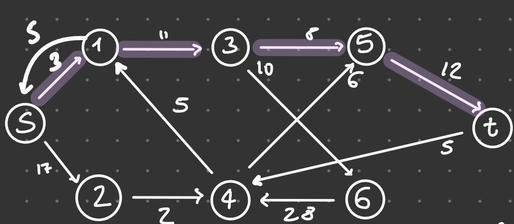


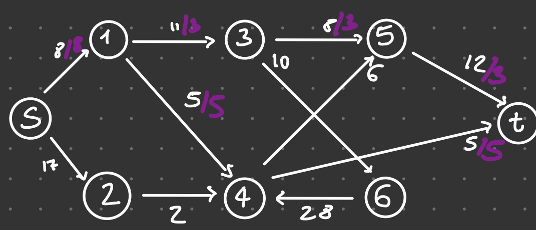




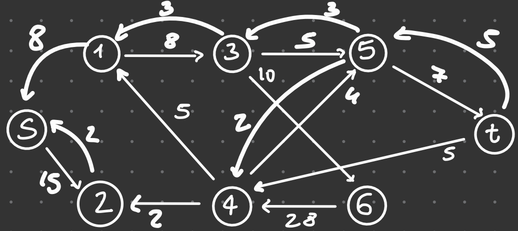


$\min\{8,5,5\} = 5$





$\min\{3,11,8,12\} = 3$



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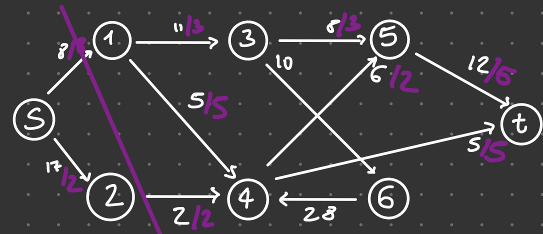

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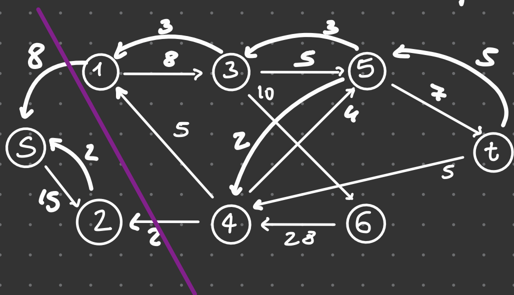
$$\min\{17, 2, 6, 9\} = 2$$



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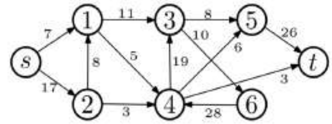
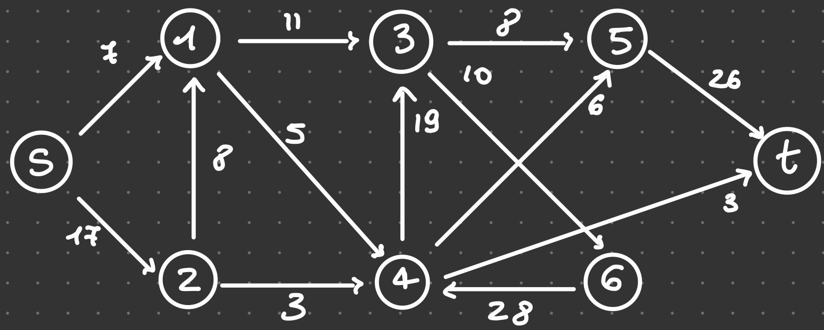
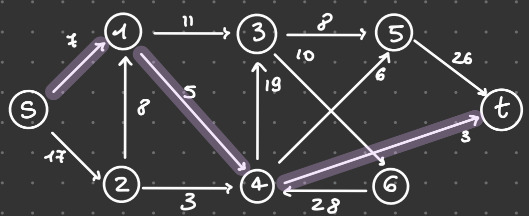
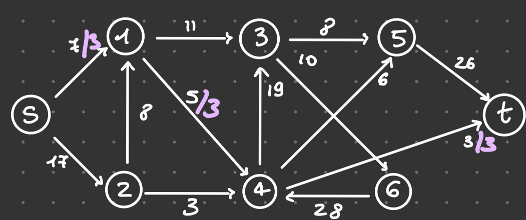
2.2.7 Temi d'esame 2019

Esercizio 2.31. Si risolva il seguente problema di flusso massimo tramite l'algoritmo di Edmonds e Karp. Si determini inoltre un taglio di capacità minima.

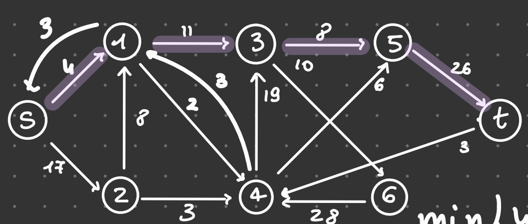


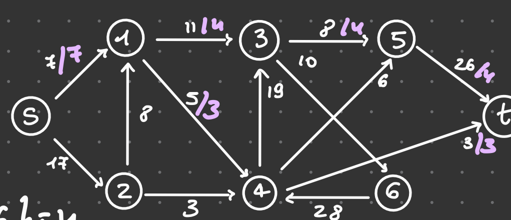




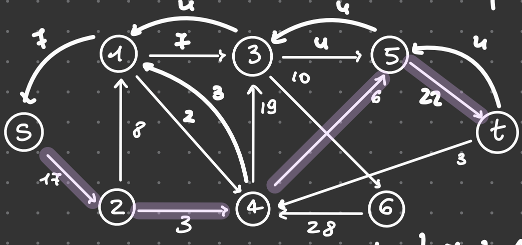


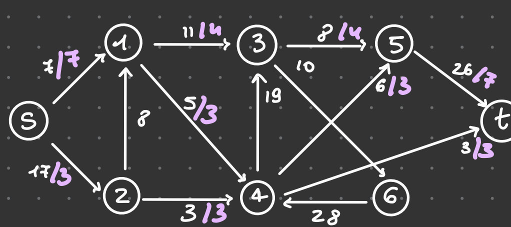
$\min\{7,5,3\}=3$



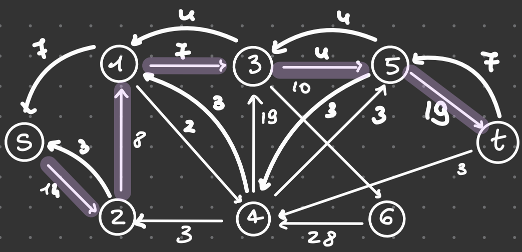


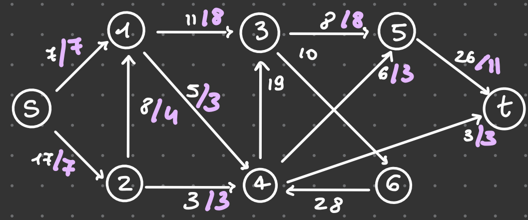
$\min\{4,11,8,26\}=4$



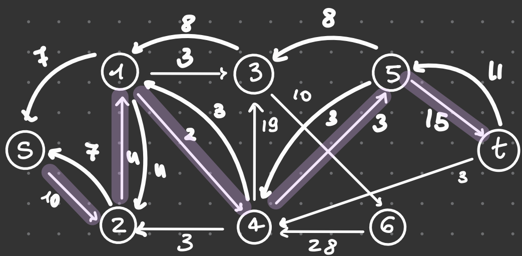


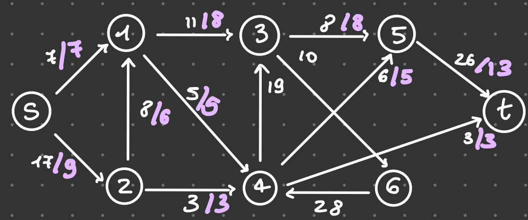
$\min\{17,3,6,22\}=3$



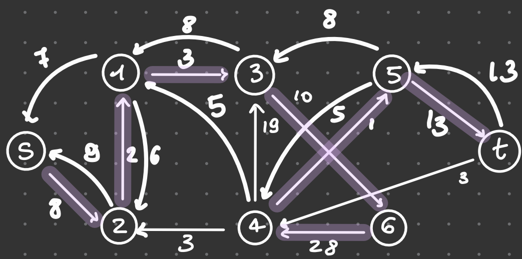


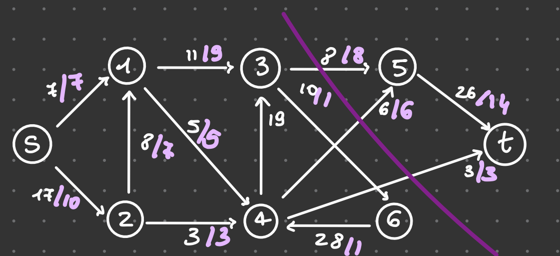
min{14, 8, 7, 4, 19} = 4



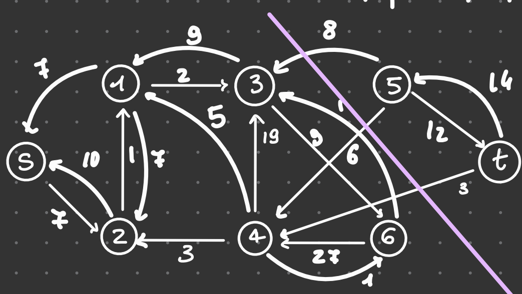


min{10, 4, 2, 3, 15} = 2

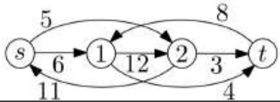




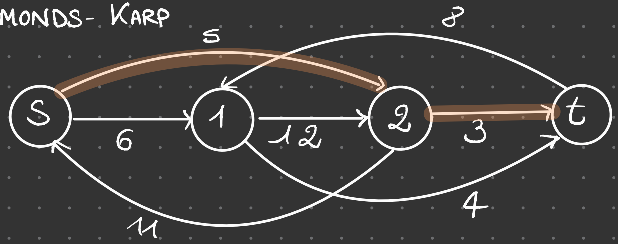
min{8, 2, 3, 10, 28, 1, 13} = 1



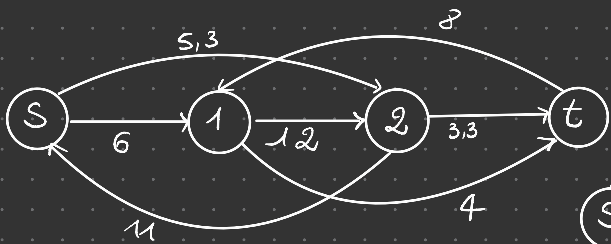
Esercizio 2.33. Si risolva il seguente problema di flusso massimo tramite l'algoritmo di Edmonds e Karp. Si determini altresì un taglio di capacità minima.

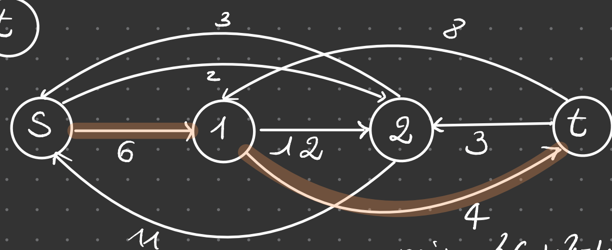


EDMONDS- KARP

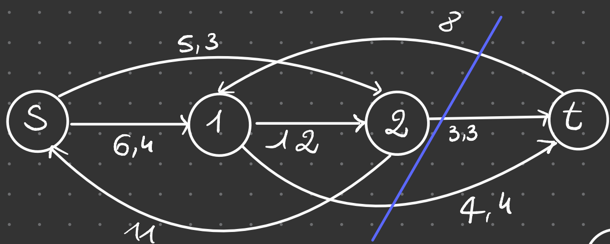


min = {5,3}
=3

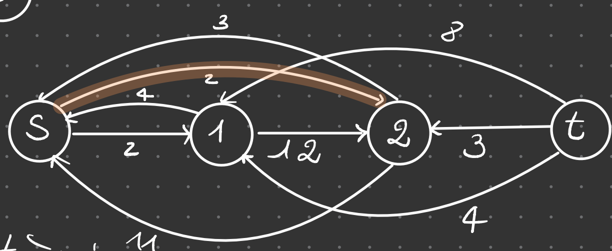




min ={6,4}=4



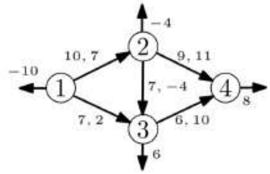
22

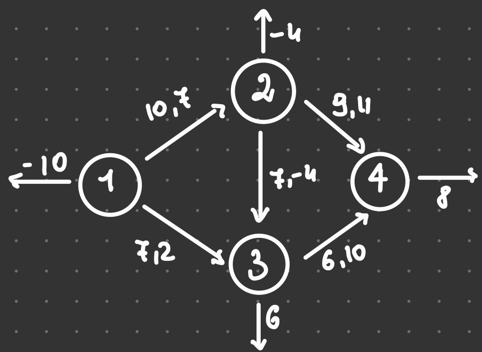


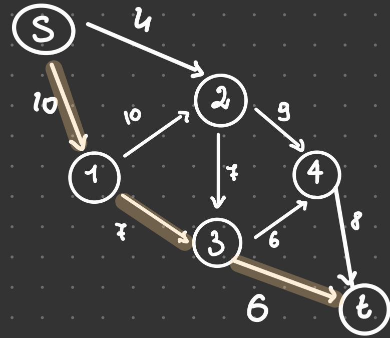
7 7

Flusso massimo = capacità minima

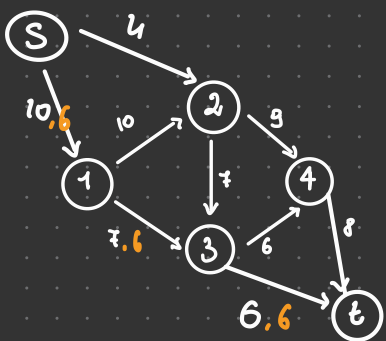
Esercizio 2.34. Si risolva il seguente problema di flusso di costo minimo tramite l'algoritmo di cancellazione di cicli:

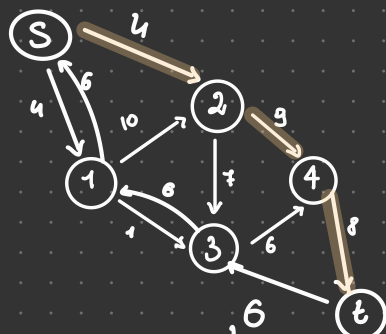




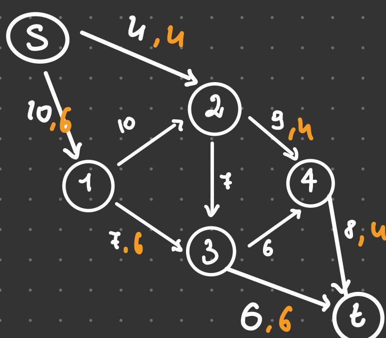


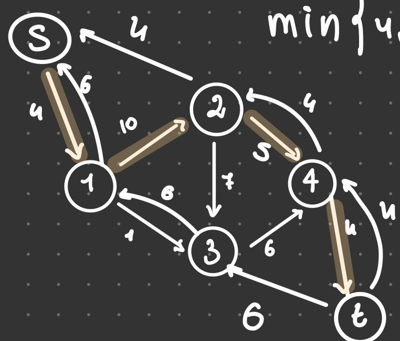
$\min\{10, 7, 6\} = 6$



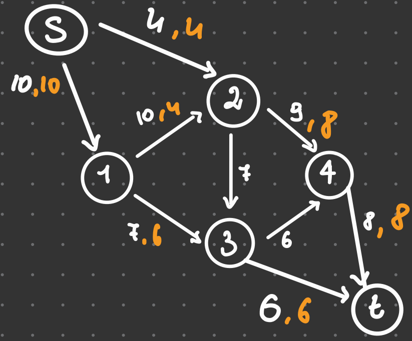


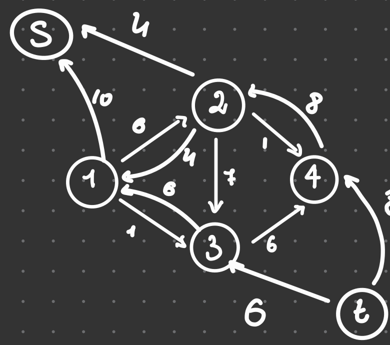
$\min\{4, 9, 8\} = 4$

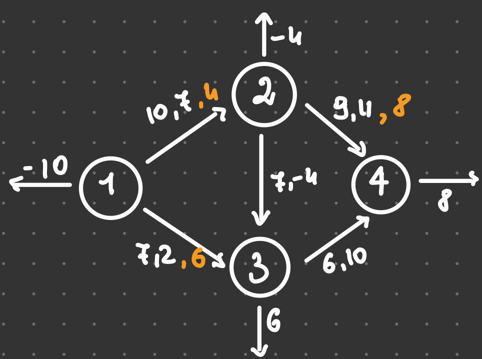




$\min\{4, 10, 5, 4\} = 4$





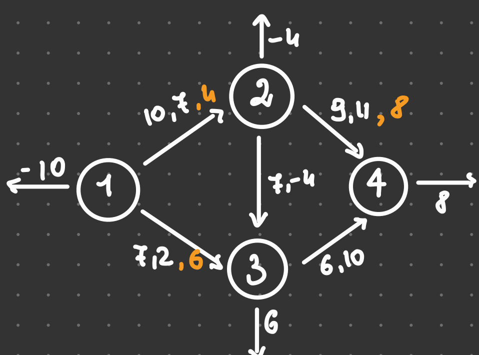


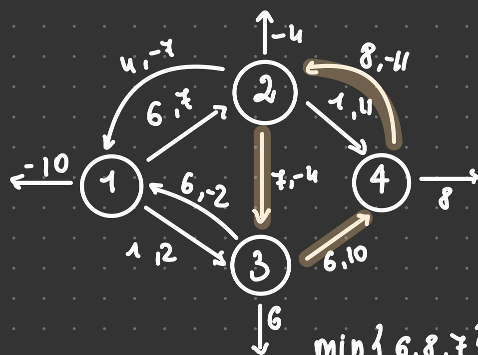
controllo se il flusso massimo
è ammissibile

Sbilanciamento

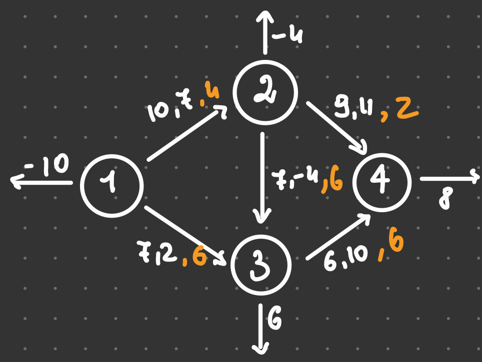
n 1 → 10 - 4 - 6 = 0
n 2 → 4 + 4 - 8 = 0
n 3 → 6 - 6 = 0
n 4 → 8 - 8 = 0

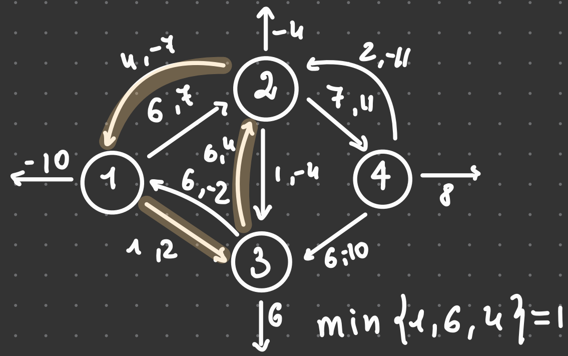
Procedo con l'algoritmo di cancellazione dei cicli

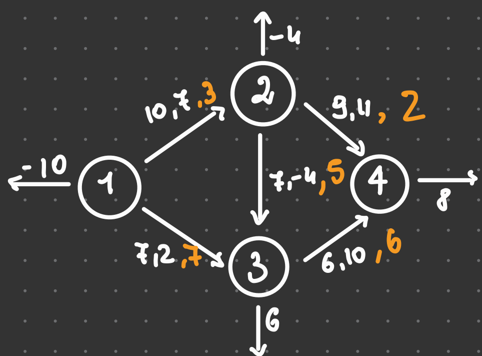


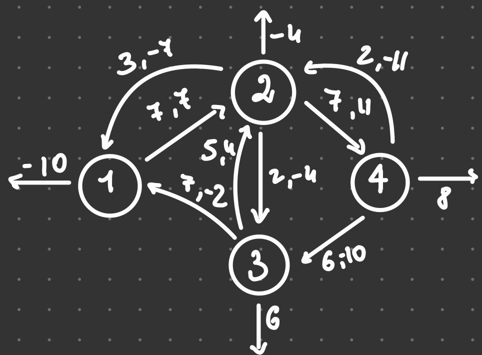


min{6,8,7}=6



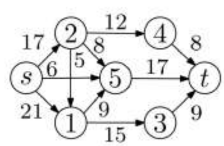


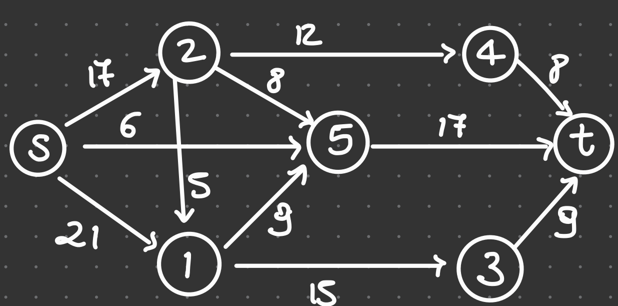




∄ cicli di costo negativo

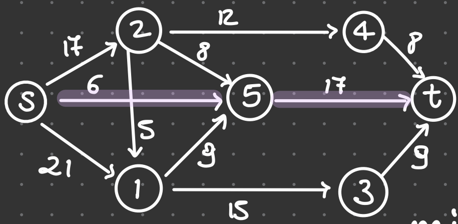
Esercizio 2.36. Si risolva il seguente problema di flusso massimo tramite l'algoritmo di Edmonds e Karp:

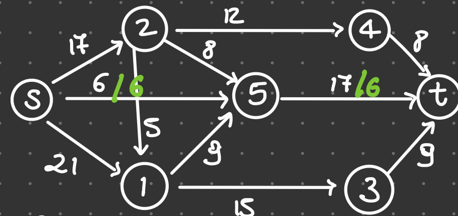




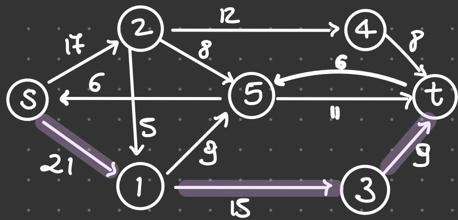
Ed-Karp

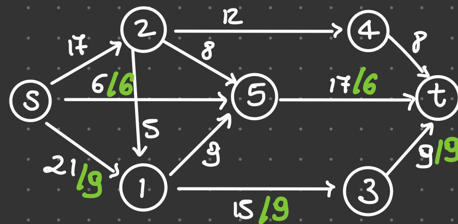
cammino minimo da S a t



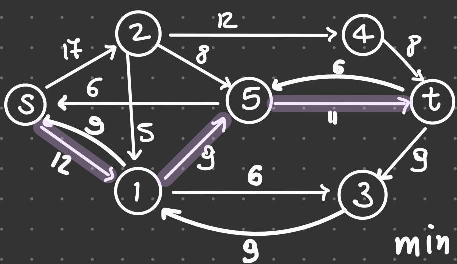


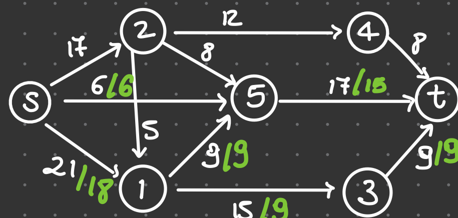
$\min\{6, 17\} = 6$



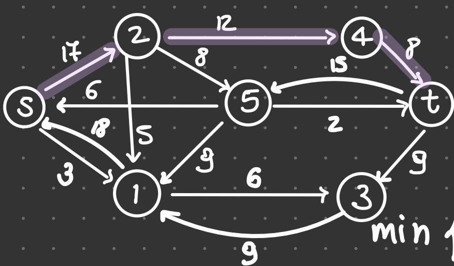


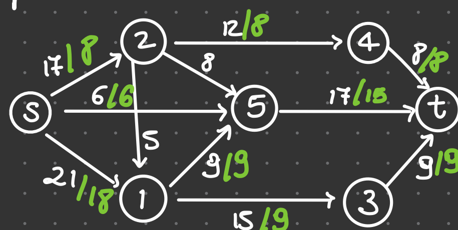
$\min\{21, 15, 9\} = 9$



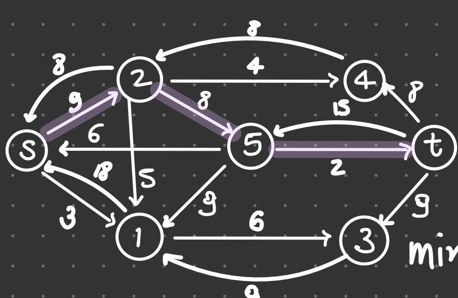


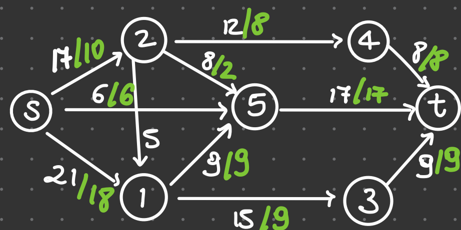
$\min\{12, 9, 11\} = 9$



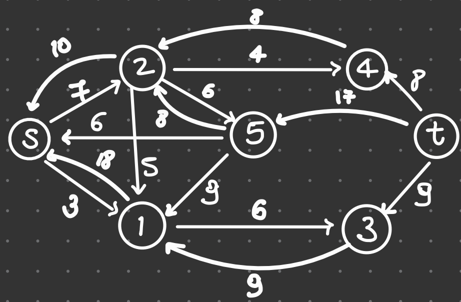


$\min\{17, 12, 8\} = 8$





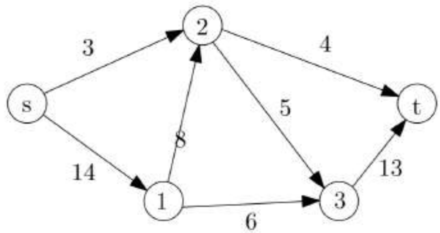
$\min\{9, 8, 2\} = 2$

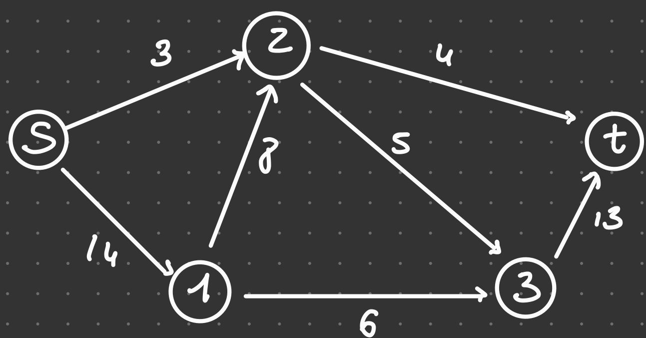


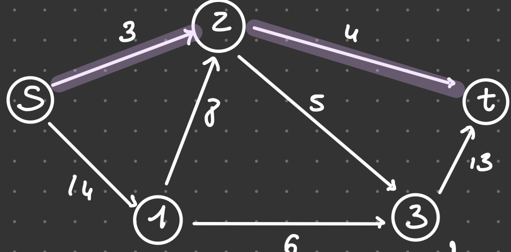
$\nexists$ cammini minimi da s a t.

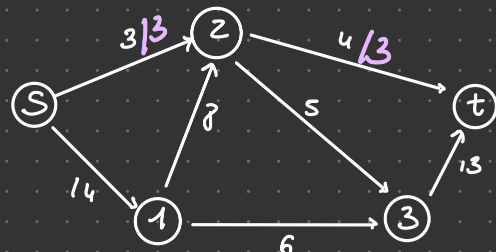
2.2.8 Temi d'esame 2020

Esercizio 2.37. Si risolva il seguente problema di flusso massimo tramite l'algoritmo di Edmonds-Karp e si indichi un taglio di capacità minima. [MF = 15]

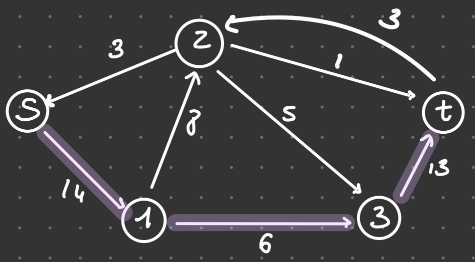


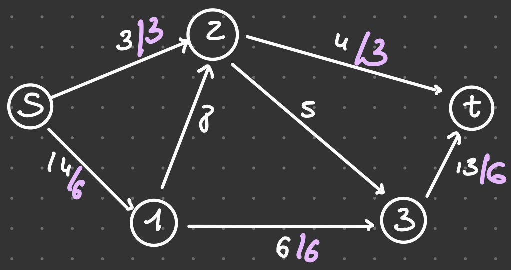




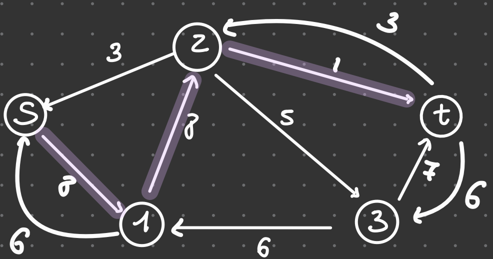


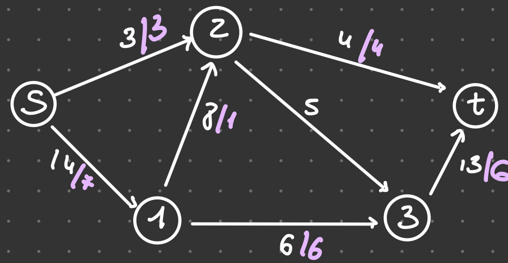
$\min\{3,4\}=3$



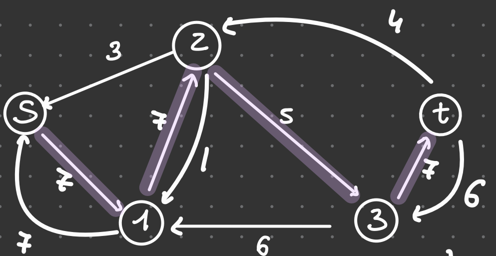


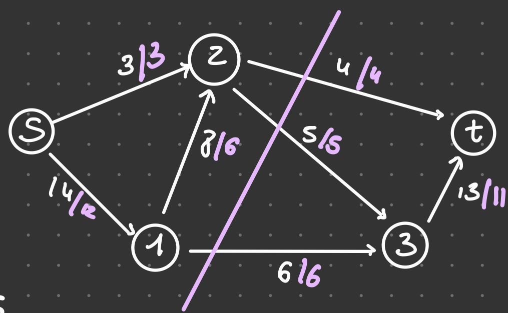
$\min\{14, 6, 13\} = 6$



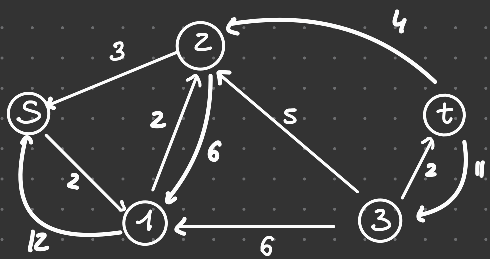


$\min\{8, 8, 1\} = 1$





$\min\{7, 5\} = 5$



$\nexists$ cammini minimi da s a t.

ACCOPPIAMENTO

MASSIMA CARDINALITÀ

Simili ai problemi di Flusso Massimo

(E-K)

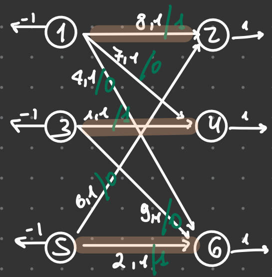
- capacità = 1

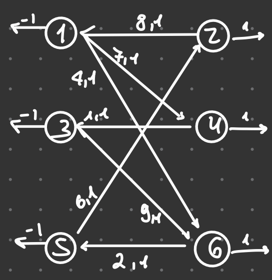
COSTO MINIMO

Simili ai problemi di MCF.

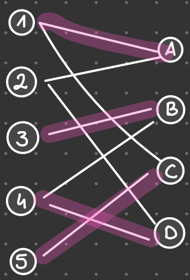
CANCELLAZIONE DI CICLI
- costi diversi
- capacità = 1

OPPURE CAMMINIMI MINIMI SUCCESSIVI

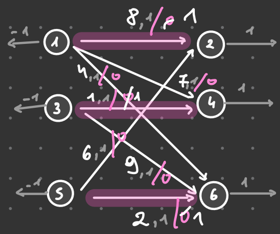




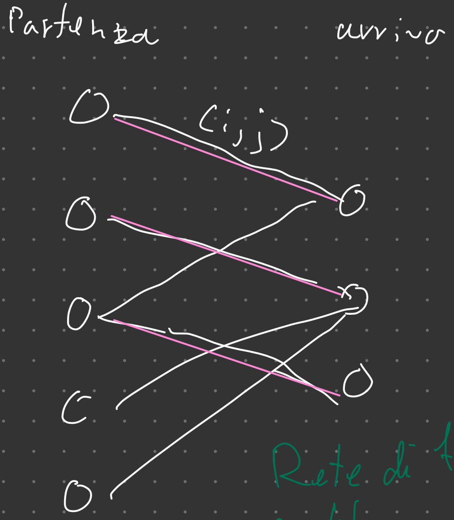
MASSIMA CARDINALITÀ



COSTO MINIMO



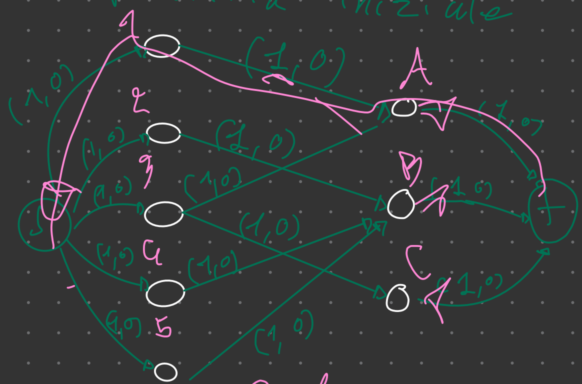
+	-
1	2
3	4
5	6



max numero di nodi a cui arriviamo

$$\forall i \in N_p \quad \sum_{j \in N_a} x_{ij} \le 1$$

Rete di flusso associata al problema iniziale



S - 1 - A - t

S - 2 - B - t

S - 3 - C - t

Grafo residuo