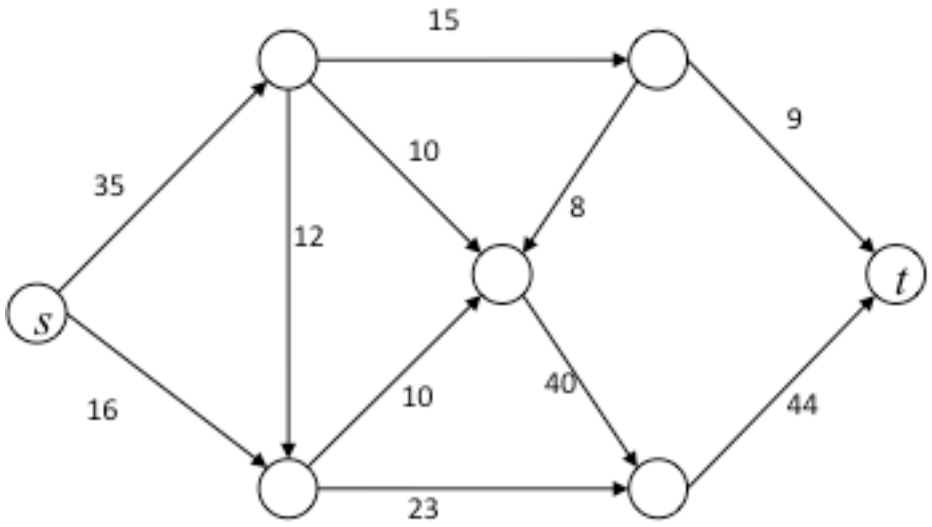
Network Design [Network Flows]
Prova parziale 22 marzo 2015

Cognome _____
Nome _____

Question 1
Given a directed graph $G=(N,A)$ and two nodes s and t, propose an algorithm to find the maximum number of node disjoint s-t paths.

Question 2
A group of p families goes out to dinner together. The restaurant has q tables and each table has seating capacity b_1, .., b_j. Describe a model to find a seating arrangement (if any) such that no two members of the same family seat at the same table.

Exercise 1
Find the maximum flow and the minimum cut on the following graph:



Exercise 2
Given the following matrix:

9.15	1.35	3.98	4.16
3.58	7.14	2.32	10.53
6.32	9.31	8.67	4.75

Let

$$r_i = \sum_{j=1}^{4} a_{ij}, \text{ for } i \in 1, \ldots, 3$$

$$c_j = \sum_{i=1}^{3} a_{ij}, \text{ for } j \in 1, \ldots, 4$$

Round each element a_{ij}, $r_{i\,SEP\,SEP}$ and $c_{j\,SEP\,SEP}$ **up** or **down** to integer so that the sum of the rounded elements in each row (column) equals row (column) sum.

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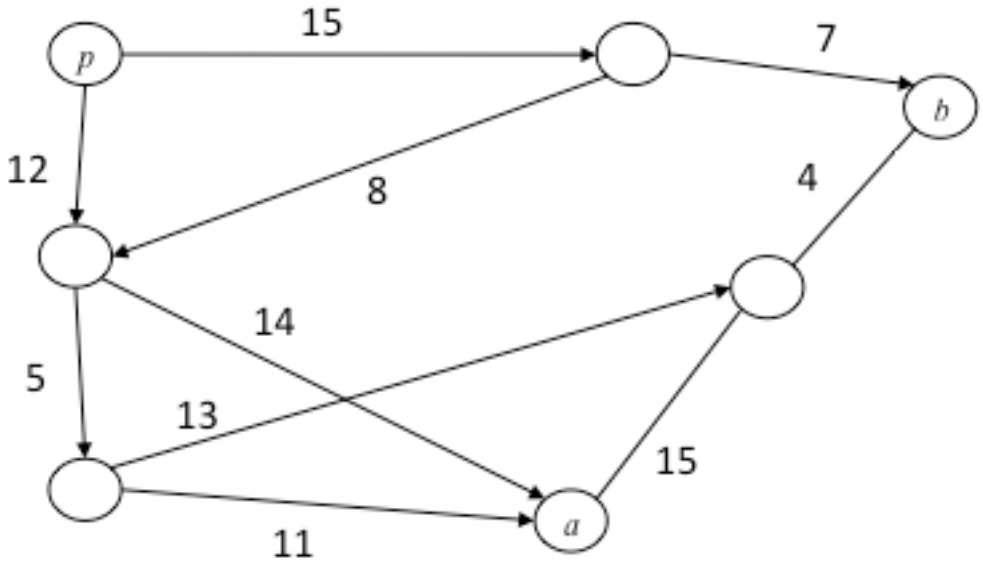
Exercise 3

The following graph $G=(N,A)$ represents a logistic distribution network. Node p is a manufacturing plant, origin of the goods and nodes a and b represent warehouses.

1. Evaluate the maximum quantity of goods that can be shipped from the plant to the warehouses
2. Suggest a method to increase goods shipping at warehouse b by at least 10% while keeping unchanged the quantity of goods shipped at the warehouse a.



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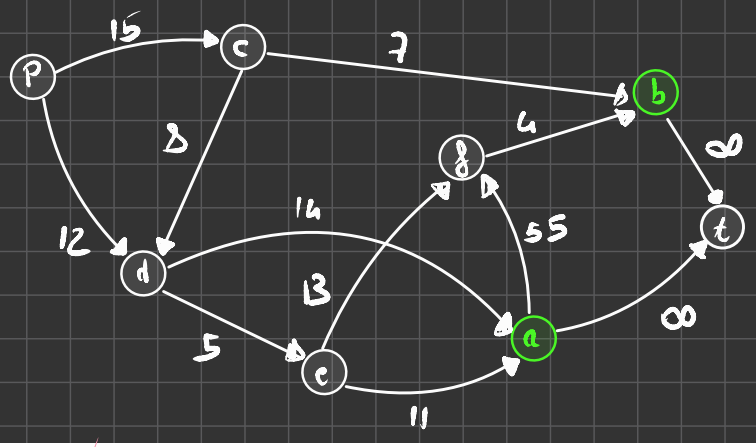
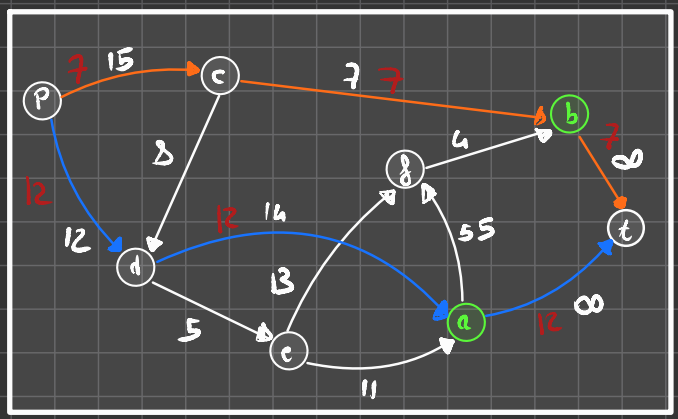
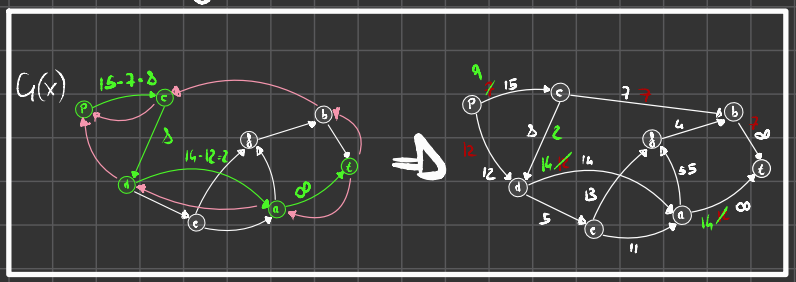


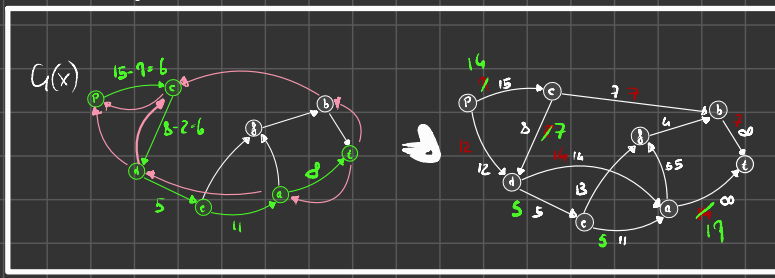
1. Evaluate the maximum quantity of goods that can be shipped from the plant to the warehouses

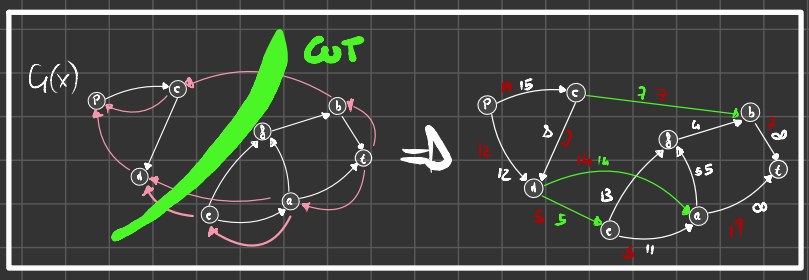
- INIZIALIZZ A FEAS. Flow: Prendiamo un (p,t)-PATH a caso per ogni arco entrante in t, e settiamo il flow sul path pari alla minima capacity degli archi che lo compongono



- F&F Algo per trovare il max-flow



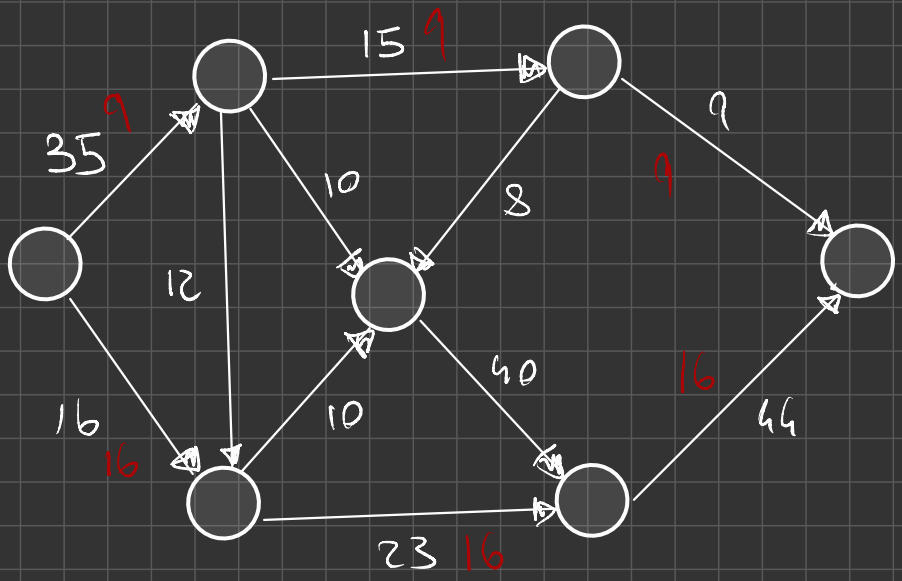


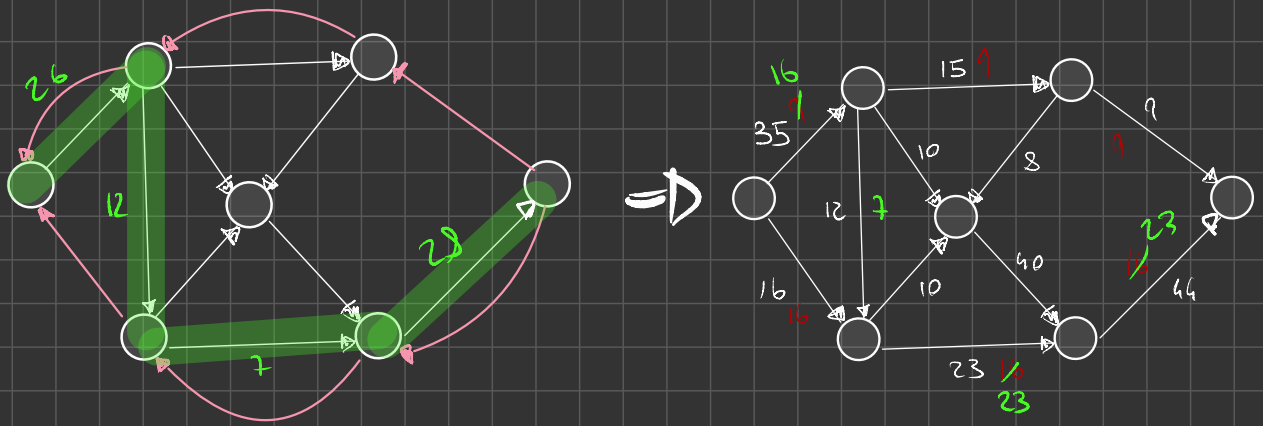


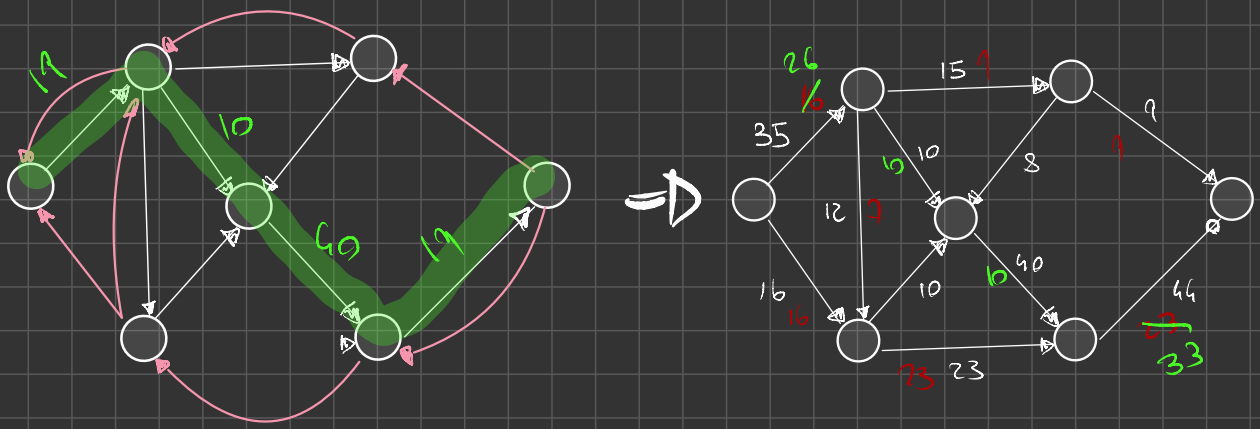
⇒ Il valore del flow equivale alla capacity del cut ⇒ $\phi_x(P) = u(\delta(R)) = 7 + 14 + 5 = 26$

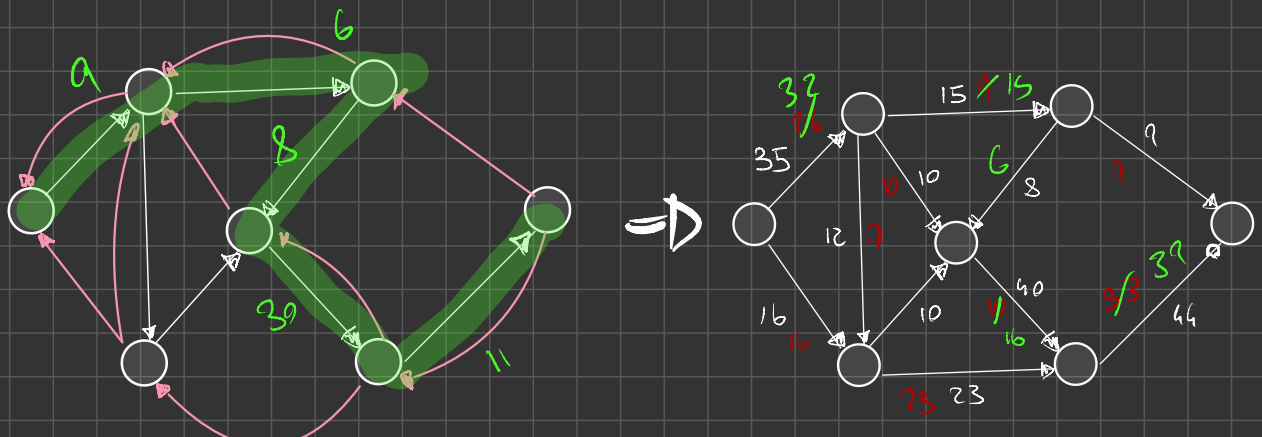
Exercise 1

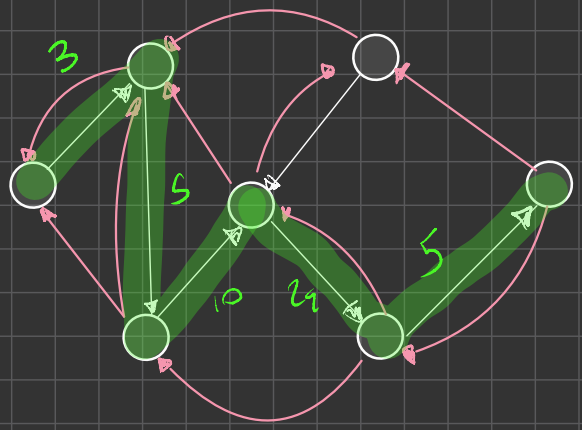
Find the maximum flow and the minimum cut on the following graph:

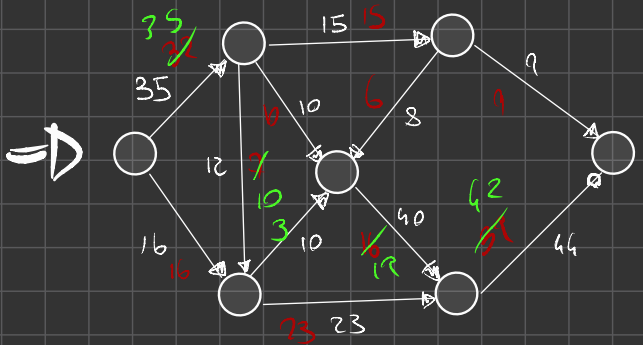


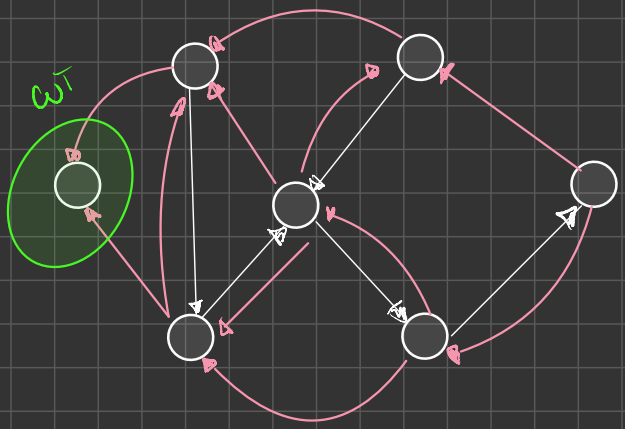


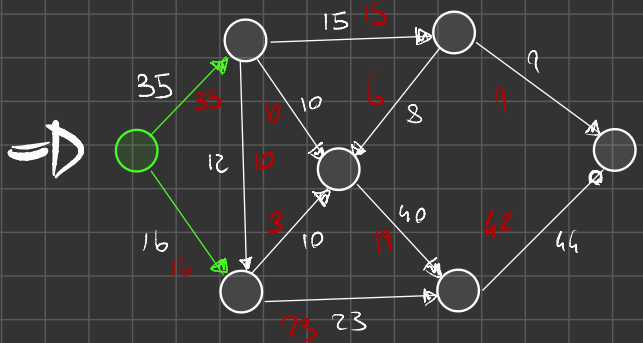












$\Rightarrow 35 + 16 = \delta_x(s) = \mu(\delta(R)) = 35 + 16$

Question 2

A group of p families goes out to dinner together. The restaurant has q tables and each table has seating capacity b_1, .., b_j. Describe a model to find a seating arrangement (if any) such that no two members of the same family seat at the same table.

P = # FAMIGLIE, $\{a_1 \dots a_p\} \mid a_i$ = # COMPONENTI FAMIGLIA i

q = # TAVOLI, $\{b_1 \dots b_q\} \mid b_j$ = # POSTI TAVOLO j