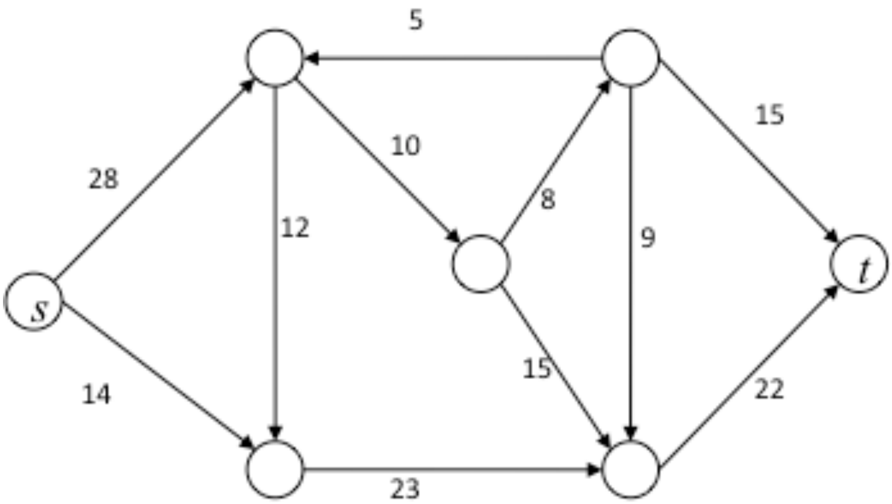
Network Design [Network Flows]
Prova parziale 22 marzo 2015

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 (s,t)-flow and the minimum (s,t)-cut on the following graph:



Exercise 2
Given the following matrix:

$$\begin{vmatrix} 6.21 & 4.33 & 7.12 & 5.21 \\ 7.28 & 9.13 & 1.45 & 11.23 \\ 4.32 & 7.23 & 6.47 & 5.67 \end{vmatrix}$$

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 and c_j **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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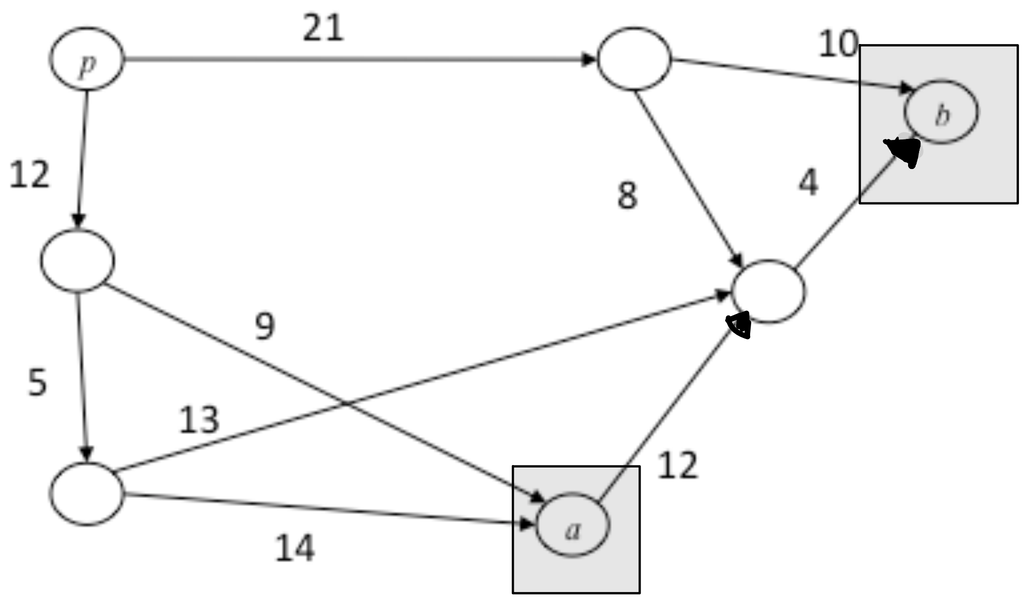
Exercise 3
The following graph G=(N,A) represents a logistic distribution network. Node p is a manufacturing plant, origin of the goods and nodes a and b represent warehouses.

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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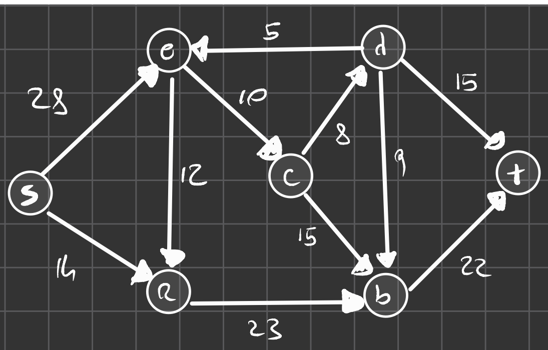
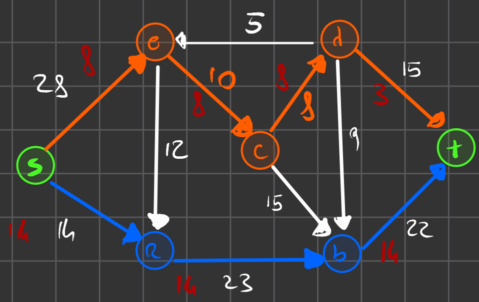
#ES 1

Exercise 1

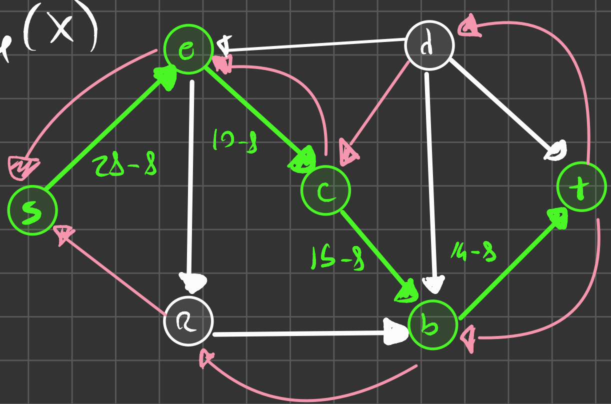
Find the maximum (*s*,*t*)-flow and the minimum (*s*,*t*)-cut on the following graph:

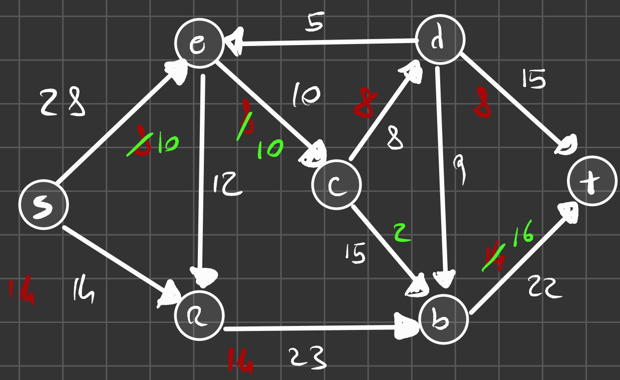


• INIT. FLOW

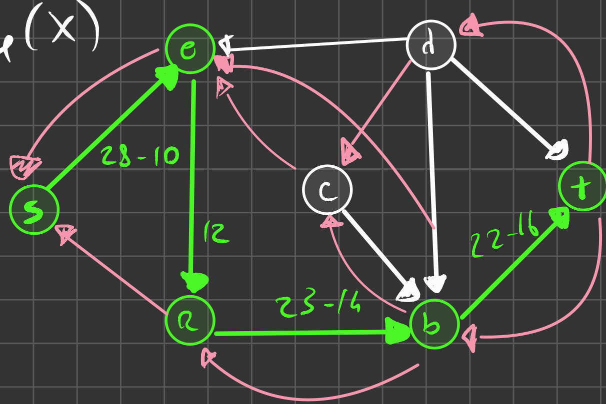


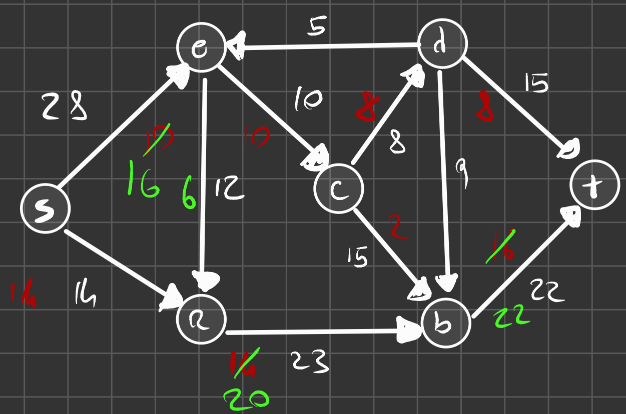
G(x)

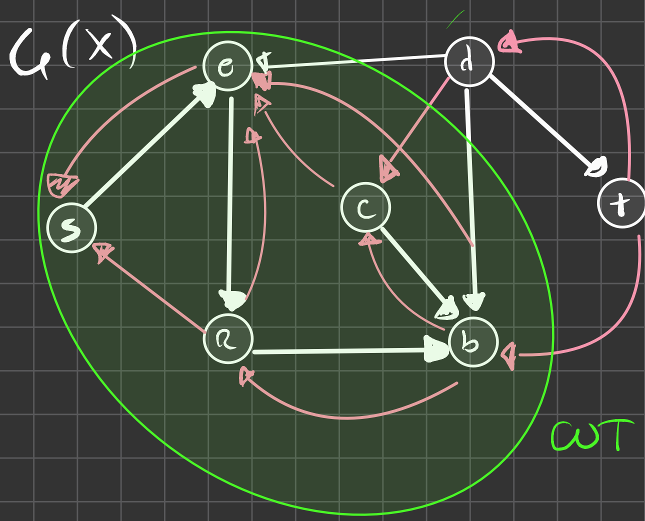




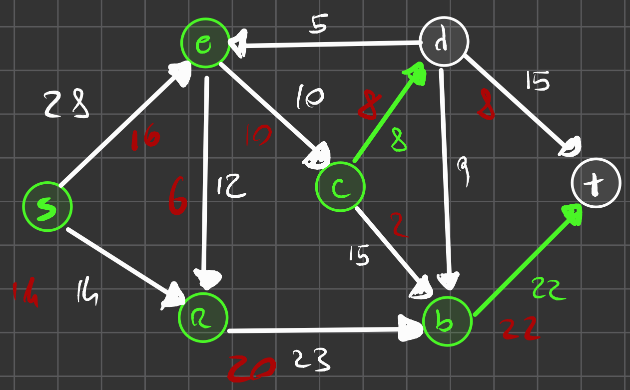
G(x)







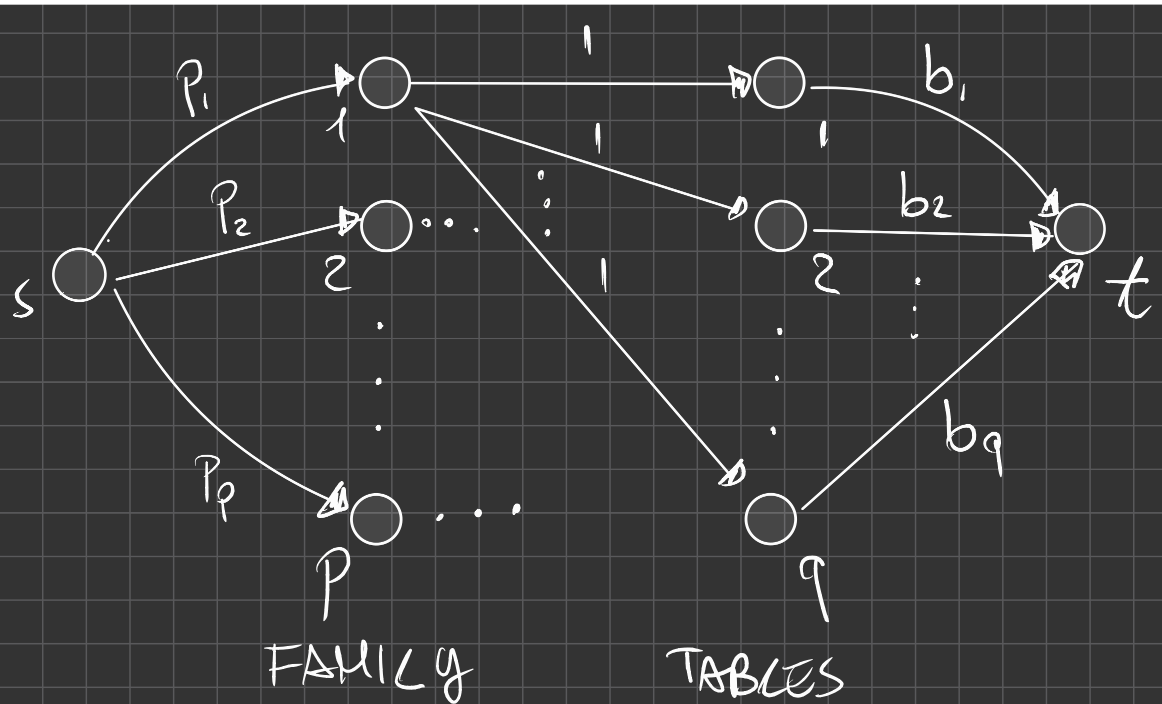
$\Rightarrow$



$$\delta_x(s) = 14 + 16 = u(\delta(R)) = 22+8 = 30$$

#Q2

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.



$\{P_1, \ldots, P_p\} \rightarrow P_i = |\text{componenti famiglia } i|$

$\{b_1, \ldots, b_q\} \rightarrow b_i = |\text{posti tavolo } i|$